

Industrial Hygiene Survey (IHS 89-7)
Riverside A/C Pipe Plant
March 29 and 30, 1989

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To	Mail Code	From	Mail Code	Ext.
Jim Burke	260	Janis Woodson	1125/4	

Subject	Date
Industrial Hygiene Survey Report IHS 89-7	6/1/89

cc: L. Todd - 260
J. McGinley - 1125/2B

Attached is the Industrial Hygiene Survey Report for the six month follow-up survey conducted March 29 and 30, 1989. Please respond to the recommendations listed on Page 2 of the report in 60 days. If you have any questions or if I can be of assistance please contact me.

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Industrial Hygiene Survey
Riverside A/C Pipe Plant
March 29 and 30 1989

An Industrial Hygiene Survey was conducted at the Riverside A/C Pipe Plant by Janis Woodson of Corporate Health and Safety on March 29 and 30, 1989.

This survey was conducted to supplement the ongoing in-plant Asbestos exposure surveillance program and to conduct a six month follow-up to the October 1988 survey.

This report is an employee exposure record as defined in Corporate Procedure GEC03.02 and OSHA Standard 29CFR1910.20 and must be retained for thirty years. Upon request, this record must be made available to those Federal officials, employee designees or employees as provided for in Corporate Procedure AD011[illegible], Paragraphs 7 and 8.

Appendix I of this report documents the air sampling methodologies, the analysis techniques and the current standards used in evaluating the data. The field and in-house laboratory notes on this survey are on file in Corporate Health and Safety. Appendix II contains the manufacturing production schedule for the survey.

SUMMARY

Twenty-two samples were taken during this survey ranging from less than detectable to 0.39 f/cc. The six TWA's taken on the Coupling Cut-Off, Crusher and Rework Operators ranged from 0.04 to 0.15 f/cc, with all being within the OSHA PEL of 0.2 f/cc.

Recommendations:

Outstanding Past Recommendations: NONE

Current Recommendations:

IHS 89-7 1. Inform employees of their sample results by posting them on the employee's bulletin board.

IHS 89-7 2. The coupling cut off dumpster be emptied on a more routine basis to prevent the employee from hand stacking the coupling end rings.

IHS 89-7 3. Until the coupling cut off dumpster problem is rectified, HEPA respirators should be required for all employees entering the dumpster room, and a sign to this effect should be posted outside the room.

IHS 89-7 4. The traveling ventilation hood on the left end of the large rework saw needs to be adjusted/aligned for a better fit to enclose the end of the pipe as it is being cut.

IHS 89-7 5. Remove the required respiratory protection signs posted at the Large and Small Rework saws.

IHS 89-7 6. Efforts be made to reduce dispersion of dust when feeding the coupling end rings into the crusher, i.e., placing the material in the crusher chute instead of throwing them.

IHS 89-7 7. A respirator storage box be built and installed in a convenient place, for each of the crusher operators respirators.

DISCUSSION

This survey was conducted as a six-month follow-up to the October 1988 survey. Three job positions were of primary interest during this survey, the Coupling Cut-Off, Rework Saw and Crusher Operators. The results of the samples taken during this survey are presented in Table I. Table II shows a comparison of the samples taken during this survey with those taken since August 1986.

These three jobs have been found to have variable sample results depending on the person working at the job; their individual work practices and work speed; and equipment speed and downtime. Special attention was given to each of the jobs during this survey to more fully characterize exposures during different aspects of each job.

Coupling Cut Off Operator

Each time the coupling cut off operator entered the dumpster room the sample cassette was changed, likewise when he entered the hood the sample was again changed. The samples indicated the highest exposure occurs in the dumpster room when the employee stacks the coupling rings in the dumpster (Sample =001D1 0.99 f/cc and =002E1 0.28 f/cc).

These two samples were only worn during the periods in the dumpster room (as noted in the remarks column) which were 10 and 13 minute samples respectively. An engineering environmental sample taken in the dumpster room on the tool cart, while the coupling cut off was in operation resulted in 0.01 f/cc (Sample =003A1). This sample indicates that the stacking of the coupling rings is the major source of exposure.

Exposures during tool set up at the cut off blades (Sample =002C1) and inside the hood (Sample =002D1) resulted in 0.02 f/cc and 0.06 f/cc, which are in the range of sample results for normal operations.

To reduce the exposures in the dumpster room, I recommend that the dumpster be emptied more often so that the material doesn't build up and therefore doesn't need stacking. I originally suggested that the finishing forklift empty the hopper on a routine bases, however L. Todd felt the forklift was already over utilized. Perhaps the Crusher operator could be alerted when the dumpster needs to be emptied and could then take the filled hopper directly to be autoclaved/crushed.

During these samples D. Cooley wore a plastic apron but no gloves. He also wore a full face HEPA respirator for all entries into the dumpster room and hood.

If the routine procedure of stacking the coupling rings in the dumpster continues, employees involved in this task should be required to wear a HEPA respirator and a sign to this effect should be posted on the outside of the dumpster room.

Rework Saw Operators

Samples were taken on the rework saw operators during first and second shift while the operators were working on both the Large and small rework saws.

Clauson and Meier are the main operators on the rework saws. Listed in Table III are the results of each person's samples on each saw from August 1986 to present. It's interesting to note that Meier continually has the lower sample results. His average is 0.04 f/cc vs Clauson's 0.11 f/cc, which is in fact above the action level. In observing Meier's work practices he is continually cleaning each pipe inside and out after each cut with his hand as well as the vacuum.

Both employees wear plastic aprons, Meier sometimes wears gloves. Clauson wears gloves all the time and because they tend to wear out so often, he wraps them with masking tape to make them last longer. Perhaps a more heavy duty glove would last longer. In Appendix III I have xeroxed a few examples of heavy duty gloves I have seen advertised that may suit your purpose.

On the large rework saw I observed that the traveling hood on the left end of the pipe does not align as originally designed for a complete seal. I recommend this ventilation hood be adjusted/aligned for a better fit, to enclose the end of the pipe as it is being cut.

Required respirator signs are posted at both the Small and Large rework saws. Presently respirators are not required at either machine, for this reason the signs should be completely removed. OSHA will cite in cases such as this were required respiratory protection is posted but not being utilized by the employees.

Crusher Operator

Samples taken on the Crusher Operator ranged from 0.02 to 0.26 f/cc. His two day TWA's both exceeded the 0.1 f/cc action level. The exposures vary considerably throughout the day, but the highest exposures seem to occur when handling coupling end rings. Each sample and

work procedure is described below:

0.08	small coupling end rings
0.19	24" coupling end rings
0.14	4' scrap pipe
0.12	random pieces
0.15	TWA

0.06	miscellaneous tasks, not crushing
0.02	emptied coupling hopper
0.26	1 tray small coupling end rings
0.12	emptied hoppers
0.19	TWA

While crushing, D. Galvin wears leather gloves and a 1/2 face HEPA respirator. Observing the employee at work I noted most of the coupling end pieces are thrown from the autoclave hopper into the crusher chute. The dust generation is visually apparent. It is a plus that the crusher system is located outside, however, there is still an increased exposure to the operator during the crusher feeding operation.

The best possible recommendation would be to directly empty the dumpsters into the crusher to eliminate the employee handling step, which could be very costly. Therefore, I recommend efforts be made to reduce the dispersion of dust by placing the coupling end rings in the chute instead of throwing them.

Just prior to this survey the Crusher Operator was issued a full face respirator in addition to the 1/2 mask he wears normally. This respirator is for entry into the crusher system enclosures. At the time of this survey, he was storing it in a plastic bag near the crusher. For the convenience of the operator as well as to insure the respirator is properly stored and easily accessible, I recommend a storage box be built and installed near the crusher controls for each of the operator's personal respirator.

INDUSTRIAL HYGIENE SURVEY - [illegible]
RIVERSIDE A C PIPE PLANT
MARCH 28-31, 1989
TABLE I - ASBESTOS EXPOSURES

NO. SP	POSITION AREA NAME SOC SEC NO	ANALYSIS DATE SHIFT DEPT LINE	TIME	MIN	RESULT	TWA	REMARKS
[illegible]	COUPLING CUT OFF DOOLEY, DENNIS 334-30-3938	ASBESTOS 890329 1ST	[illegible]	[illegible]	[illegible] F/CC	.	OSHA PEL = [illegible] F/CC
[illegible]	COUPLING CUT OFF DOOLEY, DENNIS 334-30-3938	ASBESTOS 890329 1ST	[illegible]	[illegible]	[illegible] F/CC	.	OSHA PEL = [illegible] F/CC
[illegible]	COUPLING CUT OFF DOOLEY, DENNIS 334-30-3938	ASBESTOS 890329 1ST	11:43- 15:22	219	[illegible] F/CC	.	OSHA PEL = 0.2 F/CC MACHINE DOWN [illegible] FOR CHAIN REPAIR - [illegible] EMPLOYEE PUT ON APRON [illegible] CLEANUP
[illegible]	COUPLING CUT OFF DOOLEY, DENNIS 334-30-3938	ASBESTOS 890329 1ST	[illegible]	10	[illegible] F/CC	[illegible]	OSHA PEL = 0.2 F/CC [illegible] ENTERED DUMPSTER ROOM - FULL FACE HEPA RESP
[illegible]	COUPLING CUT OFF DOOLEY, DENNIS 334-30-3938	ASBESTOS 890330 1ST	7:03- 10:48	225	0.00 F/CC	.	OSHA PEL = 0.2 F/CC **0.00482 f/cc**
[illegible]	COUPLING CUT OFF DOOLEY, DENNIS 334-30-3938	ASBESTOS 890330 1ST	[illegible] 12:37	[illegible]	[illegible] F/CC	.	OSHA PEL = 0.2 F/CC
[illegible]	COUPLING CUT OFF DOOLEY, DENNIS 334-30-3938	ASBESTOS 890330 1ST	[illegible]	[illegible]	[illegible] F/CC	.	OSHA PEL = 0.2 F/CC [illegible] - COUPLING CUT OFF [illegible]
[illegible]	COUPLING CUT OFF DOOLEY, DENNIS 334-30-3938	ASBESTOS 890330 1ST	[illegible]	[illegible]	[illegible] F/CC	.	OSHA PEL = 0.2 F/CC [illegible] FULL FACE HEPA [illegible]

INDUSTRIAL MISSILE SUPPLY - [illegible]
[illegible] SERVICE AND PARTS MANUAL
MARCH 28-31, 1989
TABLE 1 - MISSILE [illegible]

NO. OF	POSITION/AREA NAME SSN SEC NAME	SERIAL NO. DATE SHIFT DEPT LINE	TIME	YDS	REEL	TAG	E XP S
11881	COUPLING CUT OFF DOUGLAS, DONNIE 554-31-3439	48888703 SHP830 1ST 1:13	1:14- 1:13	13	.33	F 22	, +	1954 SL = .13 F 22 7159-81 + 7154-7157 .13(.1.13) .7154+ .155 8.77133 1.71 1.489759 9021 .158 FILL RATE 489. 1959 PARTS
12984	COUPLING CUT OFF AREA - ENGINEERING	48888703 SHP834 1ST .0:35	9:45- .0:35	50	1.71	F 22	,	1954 REL = .13 F 22 PUMP SETTING IN TEMPERED POINT IN TOOL JUST DURING MACHINE OPER - 8:45 8740-82 COUPLING FINISH .1954-1959+
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20:391	COUPLING CUT OFF AREA - ENGINEERING	48888703 SHP830 1ST	11:15- 11:35	30	,	,		SAMPLE DID - FILTER USED TWICE
20:441	SMALL REWORK SAW OPERATOR MEIER, STEVE 568-06-4985	48888703 SHP828 1ST	8:54- 15:35	391	1.26	F/22	1.16	0948 REL = .13 F 22
20:541	LARGE REWORK SAW OPERATOR MEIER, STEVE 568-06-4985	48888703 SHP830 1ST	7:15- 10:46	213	,	,		SAMPLE DID - FILTER USED TWICE
-----				----------				----------
11:51	LARGE REWORK SAW OPERATOR MEIER, STEVE 568-06-4985	48888703 SHP830 1ST	10:48- 11:35	47	,	,		SAMPLE DID - USED OFF P.M
-----				----------				----------
12:51	LARGE REWORK SAW OPERATOR MEIER, STEVE 568-06-4985	48888703 SHP [illegible] 1ST	11:17- 1:453	153	1.14	F 22		0948 REL = .13 F 22 SAMPLE AT OF 22 IN SMALL REWORK SAW
1 :54.	LARGE REWORK SAW OPERATOR [illegible] 554-78-4311	48888703 SHP834 1 0	5:45- 5 :45	221	.7	F 22	,	1945 REL = .13 F 22
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INDUSTRIAL HYGIENE SURVEY - DRAFT
RIVERSIDE A/C PIPE PLANT
MARCH 28-31, 1989
TABLE I - ASBESTOS EXPOSURES

ID NR	POSITION AREA / NAME / SOC SEC NBR	ANALYSIS / DATE SHIFT / DEPT LINE	TIME	VOL	RESULT	TWA	REMARKS
[illegible]SB1	LARGE [illegible] SAW OPERATOR / [illegible] / [illegible]	ASBESTOS / 890328 2ND	13:5[illegible]- 15:[illegible]	179	0.0[illegible] F/CC	0.0[illegible]	OSHA PEL = 0.2 F/CC
[illegible]TA1	CRUSHER OPERATOR / GALVIN, DENNIS / 560-48-6590	ASBESTOS / 890330 1ST	7:10- 8:3[illegible]	80	0.08 F/CC		OSHA PEL = 0.2 F/CC / CRUSHED COUPLING END PIECES FROM HOPPER - EMPLOYEE WORE 1/2 FACE HEPA RESPIRATOR
[illegible]TB1	CRUSHER OPERATOR / GALVIN, DENNIS / 560-48-6590	ASBESTOS / 890330 1ST	8:30- 11:50	330	0.19 F/CC	.	OSHA PEL = 0.2 F/CC / CRUSHED 8A COUPLING END PIECES FROM HOPPER USING FORK TRUCK & CPLNG ENDS & SCRAP PIPE MIXED - WORE 1/2 FACE
[illegible]TC1	CRUSHER OPERATOR / GALVIN, DENNIS / 560-48-6590	ASBESTOS / 890330 1ST	11:50- 14:02	132	0.14 F/CC	.	OSHA PEL = 0.2 F/CC / CRUSHED SCRAP PIPE 4' LENGTHS - EMPLOYEE WORE 1/2 FACE HEPA RESPIRATOR
[illegible]TD1	CRUSHER OPERATOR / GALVIN, DENNIS / 560-48-6590	ASBESTOS / 890330 1ST	14:12- 15:15	73	0.18 F/CC	0.15	OSHA PEL = 0.2 F/CC / CRUSHED RANDOMS 8:08-8:10 - WEARS LEATHER GLOVES - EMPLOYEE WORE 1/2 FACE HEPA RESPIRATOR
[illegible]SA1	CRUSHER OPERATOR / GALVIN, DENNIS / 560-48-6590	ASBESTOS / 890329 1ST	7:14- 7:54	[illegible]	0.0[illegible] F/CC	.	OSHA PEL = 0.2 F/CC / SLOW MORNING - EMPTYING HOPPERS AND [illegible]
[illegible]SB1	CRUSHER OPERATOR / GALVIN, DENNIS / 560-48-6590	ASBESTOS / 890329 1ST	7:54- [illegible]	279	0.0[illegible] F/CC	.	OSHA PEL = 0.2 F/CC / EMPTYING COUPLING HOPPER
[illegible]SC1	CRUSHER OPERATOR / GALVIN, DENNIS / 560-48-6590	ASBESTOS / 890329 1ST	12:03- [illegible]	[illegible]	0.0[illegible] F/CC	.	OSHA PEL = 0.2 F/CC / CRUSHED SMALL COUPLING ENDS - 1 TRAY LOAD - WORE 1/2 FACE HEPA RESPIRATOR

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table II
Riverside A/C Pipe Plant
Asbestos Sample Results (8-hour TWA's - f/cc)
August, 1986 through March, 1989

	8/86	12/86	3/87	8/87	2/88	4/88	8/88	10/88	3/89
1/4 Lathe Oper.	.31	.23	.26	.02	.07		.01	.02	
							.01	.02	
Cplg C/O Oper.	1.6	.27	.05	.10		.05	.04	.10	.07
			.05	.07			.01		.04
			.22	.04			.07		
							.07		
Wet Tester	.06	.41		*	.21	.03	.01		
	.03						.01		
							.01		
Crusher Oper.	.16	.31	.10	.10		.01	.01	.28	.15
				.09			.07		.09
				.07					
Saw Operator	.12			.03	.42	.01	.01	.03	.06
	.11						.09		.04
							.13		.10
Fittings Oper.	.12			<Dt	.04		<Dt	.01	
Fittings Insp.	.15			.09	.04		.02		
				.02			.03		

* Samples taken on employees working at this machine, during this survey, were not representative of normal operations due to mechanical problems.

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Riverside A/C Pipe Plant (IHS 89-7)
March 29 and 30, 1989

Table III

Rework Saw Exposure Sample Results
by Operator

	Clauson	Meier
Large Rework Saw	0.07 (8/89) 0.15 (8/89)	0.04 (8/89)
Small Rework Saw	0.04 (8/88) 0.17 (8/88) 0.03 (8/88)	0.06 (8/88) 0.02 (10/88) 0.04 (10/88) 0.05 (10/88) 0.02 (8/88) 0.02 (8/88)
Both Rework Saws	0.09 (8/88) 0.18 (8/88) 0.14 (8/86) 0.09 (8/86)	0.01 (4/88)* 0.01 (4/88)* 0.35 (2/88)*+ 0.50 (2/88)*+ 0.01 (8/87) 0.06 (8/87) 0.15 (8/86) 0.07 (8/86)
Averages:	0.11 (N=9)	0.04 (N=13)+

Notes: * Samples taken by the plant.
+ Unusually high sample results and are not representative of normal operations. These two samples are not included in the average.

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Riverside A/C Pipe Plant (IHS 89-7)
March 29 and 30, 1989

APPENDIX I

Sampling and Analytical Methods and Current Standards

It is our standard procedure in taking personal exposure samples, to inform each employee of the purpose of the sample and what they should and should not do to invalidate the results.

Specific do's and don'ts are: To go about their work as normal, not to remove the sampler, disconnect the tubing or filter holder, or purposely contaminate the sampling tube or filter.

We request they inform us of any loss of integrity of the sample such as sampling tube or cassette accidentally coming off, dropping or otherwise subjecting the devices to unnecessary impacts. We strongly encourage plant management to similarly inform the employees when conducting their sampling programs.

We request that each employee be informed of exposure results in this survey as outlined in the corporate procedure. Employees whose asbestos and noise exposures exceed the PEL and the action level respectively, must be informed accordingly to OSHA regulation.

We suggest that a copy of the attached tables be posted on the employees bulletin board. Also, a Fiber Notification Form (FEN) must be completed as outlined in the Health Maintenance Manual, Asbestos Unit Program Section VII, for each employee sampled for asbestos. Alternately, the employees, including those in similar positions to those measured, can be informed personally.

Asbestos (19 B and C)

The sampling and analysis was conducted following the current OSHA Standard 29CFR1910.1001, Appendix A CRM (Mandatory).

Personal samples were obtained open faced on a 25mm 0.8 micron mixed cellulose ester Millipore filter with a 50mm extension cowl. DuPont Alpha I, P4000 and P2500 air sampling pumps were calibrated before and after each sampling day to approximately 1 liter per minute. In most cases, a series of two, three or four different filter samples were obtained for the person, to

establish an 8-hour time-weighted average (TWA) concentration.

The analysis was conducted by NATLSCO Labs, Long Grove, Illinois. The counts were made following the A counting rules as described in the Standard, Appendix A.

The current Standard calls for a personal exposure limit of 0.2 fibers, longer than 5 microns per cubic centimeter of air (f/cc), an action limit of 0.1 f/cc and an excursion limit (EL) of 1 f/cc for 30 minutes.

Riverside A/C Pipe Plant (IHS 89-7)
March 29 and 30, 1989

APPENDIX II

Manufacturing Production Schedule
March 29 and 30 1989

March 29th 1st Shift

Coupling Cut-Off:	16" 150 512 pcs. Down: 1 hr. 45 min.
Rework Saws:	8" 150 Randoms 26 pcs. 8" 150 1/4 135 pcs. 24 FT 70 Randoms 4 pcs. 12 FT 35 1/4 35 pcs. Down: 1 hour

March 29th 2nd Shift

Rework Saws:	8" 150 1/4 39 pcs. 16" 200 cplgs. 60 pcs. 24" FT 60 Randoms 4 pcs. Down: 45 min.

March 30th 1st Shift

Coupling Cut-Off:	16" 150 416 pcs. 24" FT 60 15 pcs. Down: 3 hr. 15 min.
Rework Saws:	24" FT 70 Randoms 12 pcs. 24" FT 70 1/2 13 pcs. 16" 200 cplgs. 20 pcs. 8" 150 1/4 MEC's 61 pcs. Down: 45 min.



HAND PROTECTION

Edmont HEAVY DUTY INDUSTRIAL WORK GLOVES



A NBR Coated HYCRON® Abrasion Resistant Gloves. Nitrile coating protects hands from rough, abrasive materials, cuts, snags, punctures, grease, and oil. Soft jersey lining with seams away from working area prevents hand irritation and premature wear. Superior dry grip. Curved, predexed fingers and wing thumb provide working ease. Uses: handling of castings, cores, fabricated metal, and building materials such as concrete block, brick, tile, and lumber. Available in knit wrist and safety cuff styles. Men's and women's sizes. Blue color. Edmont brand.

B GOLDEN GRAB-IT II® Premium Rubber Coated Crinkle-Finish Gloves. Natural rubber, premium grade coating provides excellent cut resistance and long service life. Crinkle finish for safer handling. Soft knit jersey lining provides comfort and flexibility. Uses: handling sharp edged materials such as glass, scrap and sheet metals, and abrasive materials such as concrete block, tile, and lumber. Yellow color. Edmont brand.

C Raised Finished Winter MONKEY GRIP™ Gloves. Raised surface provides excellent wet and dry grip. Vinyl coating resists chemicals and abrasion, protects the nonwoven lining from wetness, keeps warmth and dryness inside. Uses: construction, cold storage, wintertime transportation, and handling applications. Orange color. Edmont brand.

Fig.	Size	Mfr's. Model	Stock No.	Per Pair List	Per Pair Each	Lots 12	Lots 72	Shpg. Wt.
A	Men's Lg.	05809	4T487†	$4.18	$3.88	$3.49	$3.22	0.4
	Women's	05699	4T488†	4.18	3.80	3.49	3.22	0.3
	Men's Lg.	08099	4T489	4.95	4.50	4.11	3.81	0.3
B	Men's	16584	4T415	4.02	3.65	3.31	3.09	0.5
C	Men's	04880	4T416	8.11	7.51	6.88	6.35	0.5

(†) Knit Wrist Style.

GLOVES

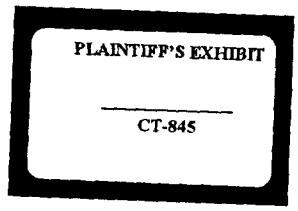
Stainless Steel Mesh Safety Glove Makes Dangerous Handling Duties Safer.



Linked stainless steel rings, individually welded for strength, allow easy movement. Cleaning or sanitizing glove won't weaken protection. Ideal for cutting operations and cleaning up broken glassware. Please specify size and right or left hand: (XS) (S) (M) (L) (XL).

EA-1770 Each glove/87.25

CTD007680



A-C

GENERAL

STANDARDS

MANUAL

A

June 5, 1970

BINDER 1 OF 2

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GENERAL STANDARDS MANUAL

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CTD015487

June 5, 1970

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CTD015488

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION:		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
SUPERSEDES:		DATE OF ISSUE: 8/1/76

DESCRIPTION:

DISTRIBUTION LIST

Vice President - National Sales
General Marketing Manager - A/C Products
Director of Manufacturing - A/C
District Sales Managers (8)
Manager of Sales Engineering
Manager of Industrial Engineering
Manager of Standard Specifications
Purchasing Agent - A/C
Traffic Manager
Controller
Claims Manager
Plant Managers - A/C (5)
Plant Quality Control Engineers (5)
Plant Industrial Engineers (5)
Plant Shipping Supervisors (5)
Plant Customer Service Managers (5)
Atlas Asbestos Company

CTD015489

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

CONFIDENTIAL DOCUMENT - NOT TO BE DISTRIBUTED TO UNAUTHORIZED PERSONNEL

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: General Standards Manual - Distribution List

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
4	Section B	2

SUPERSEDES:	DATE OF ISSUE:
September 10, 1969	June 5, 1970

DESCRIPTION: Distribution List

	Mandrel List (Sec. G-G.S.M.)	Prod. Performance Info. (Sec. H-G.S.M.)	Std. Product Samples (Sec. I-G.S.M.)	Inspection Standards (Sec. J-G.S.M.)	Plant Capabilities (Sec. K-G.S.M.)	Std. Packaging Methods (Sec. L-G.S.M.)	Std. Production Rates (Sec. M-G.S.M.)	Shipping Weights (Sec. N-G.S.M.)	Standard In Process Spec. (Sec. O-G.S.M.)
Q/C and Standards Mgr.	1	1	1	1	1	1	1	1	1
V. P. Marketing	1	1	1	1	1	1		1	
General Sales Mgr.	1	1	1	1	1	1		1	
General Mkt. Mgr.	1	1	1	1	1	1		1	
Asst. to V. P. Mkt.	1	1	1	1	1	1		1	
Field Mdse. Mgr.		1	1	1	1			1	
Sales Engr. Mgr.	1	5	5	5	5	5		5	
Service Mgr.		1	1	1	1	1		1	
District Sales Mgr.		1 (7)	1 (7)		1 (7)	1 (7)		1 (7)	
Industrial Sales Mgr.	1	1	1		1	1		1	
Planning Mgr.	1	1	1		1	1	1	1	
Purchasing Agent									
Traffic Manager						1		1	
V. P. of Mfg. and Engr.	1	1	1	1	1	1	1	1	1
Chief Engr.	1								1
Industrial Engr. Mgr.	1			1	1	1	1	1	1
Tech. Materials Lab.									
Divn. Controller	1			1	1	1	1		1
Plant Q/C Engineer	*1 (5)	*1 (5)	1 (6)	1 (6)	*1 (5)	1 (6)		1 (6)	1 (6)
(a) Plant Mgr.	*1 (5)	*1 (5)	1 (6)	1 (6)	*1 (5)	1 (6)	1 (6)	1 (6)	1 (6)
(b) Plant Gen. Foreman	*1 (5)			1 (6)					1 (6)
(c) Plant Finishing			*1 (5)	*1 (5)		1 (6)	1 (6)		1 (6)
(d) Plant Sales Service			1 (6)		*1 (5)	1 (6)		1 (6)	
(e) Plant Industrial Engr.	*1 (5)					1 (6)	1 (6)	1 (6)	1 (6)
(f) Plant Purch. Agent									
(g) Plant Inspection			1 (6)	1 (6)					
(h) Plant Shipping						1 (6)		1 (6)	
(i) Plant Traffic								*1 (5)	
(j) Plant Planning	*1 (5)				*1 (5)				
G. Barge (Atlas Asbestos)						2			

Number in parentheses denotes number of plants or sales districts.
*Excepting Plant 54. G.S.M. = General Standards Manual.
Note: All documents to plants will be sent to Q/C Engineers who will be responsible for their distribution, except those issued by Industrial Engineering. The plant Industrial Engineer will be responsible for the distribution of the documents issued by Industrial Engineering, either Central or Plant.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
R. J. Crowley Jr.						

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: General Standards Manual - Distribution List

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
4	Section B	1

SUPERSEDES:	DATE OF ISSUE:
May 7, 1969	June 5, 1970

DESCRIPTION:

Distribution List

	Standard Product Specification	Standard Formulations and Yields	Standard Purchasing Specification	Std. Control Procedures (Sec. A-G.S.M.)	Distribution List (Sec. B-G.S.M.)	Div. Nomen. and Definitions (Sec. C-G.S.M.)	Gen. Prod. Spec. Data (Sec. D-G.S.M.)	External Prod. Spec. (Sec. E-G.S.M.)	Std. Test Methods (Sec. F-G.S.M.)
Q/C and Standards Mgr.	3	3	3	3	3	3	3	3	3
V. P. Marketing	1		1	1	1	1	1	1	
General Sales Mgr.	1		1	1		1	1	1	
General Mkt. Mgr.	1		1	1		1	1	1	
Asst. to V. P. Mkt.	1		1	1	1	1	1	1	1
Field Mdse. Mgr.	1					1	1	1	
Sales Engr. Mgr.	5	1	1	1	1	1	5	5	1
Service Mgr.	1			1		1	1	1	1
District Sales Mgr.	1 (7)					1 (7)	1 (7)	1 (7)	
Industrial Sales Mgr.	1					1	1	1	
Planning Mgr.	1	1	1	1	1	1	1	1	
Purchasing Agent			10						10
Traffic Mgr.									
V. P. of Mfg. and Engr.	1	1	1	1	1	1	1	1	
Chief Engr.	1						1	1	
Industrial Engr. Mgr.	1	1		1	1	1	1	1	
Tech. Materials Lab.			1			1			1
Divn. Controller	1	1	1	1		1	1	1	
Plant Q/C Engineer	1 (6)	*1 (5)	1 (6)	1 (6)	1 (6)	1 (6)	1 (6)	1 (6)	1 (6)
(a) Plant Mgr.	1 (6)	*1 (5)	1 (6)	1 (6)	1 (6)	1 (6)	1 (6)	1 (6)	
(b) Plant Gen. Foreman	1 (6)	*1 (5)					1 (6)		
(c) Plant Finishing	*1 (5)						*1 (5)		
(d) Plant Sales Service	1 (6)		1 (6)				1 (6)	1 (6)	
(e) Plant Industrial Engr.		*1 (5)		1 (6)		1 (6)	1 (6)		
(f) Plant Purch. Agent			1 (6)						
(g) Plant Inspection	1 (6)						1 (6)	1 (6)	
(h) Plant Shipping									
(i) Plant Traffic									
(j) Plant Planning									
G. Barge (Altas Asbestos)	2		1	1	1	1	1	1	1

Number in parentheses denotes number of plants or sales districts.
*Excepting Plant 54. G.S.M. = General Standards Manual.
Note: All documents to plants will be sent to Q/C Engineers who will be responsible for their distribution, except those issued by Industrial Engineering. The plant Industrial Engineer will be responsible for the distribution of the documents issued by Industrial Engineering, either Central or Plant.

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C

FORM 0922

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: General Standards Manual
Divisional Nomenclature and Definitions

T.C.O. REF. NO.	SPECIFICATION NO.	PAGE NO.
1	Section C	1

SUPERSEDES:

DATE OF ISSUE: December 9, 1968

DESCRIPTION:

Divisional Nomenclature and Definitions

MANUFACTURED STANDARD PRODUCTS

The following categories of standard products have been devised to characterize the status of products for all elements of the division requiring a standard definition. While every effort should be made to place each manufactured item into one of the categories, a strict interpretation need not be followed if it interferes with effective and rapidly changing manufacturing conditions. It is also recognized that certain items may be carried under a particular category at one plant and another category at a second plant.

Standard Product Specifications may show Class X, Y, and Z items.

Class X Item

An item always in stock. It has a reorder point and a maximum for inventory purposes.

Example: 6" Class 150 pre-belled.

Class Y Item

An item intermediate to Class X and Class Z. If not in inventory it is not produced. When an order is received an overrun is permitted for servicing subsequent orders.

Example: TBIC coupling blanks for 4" Class 100.

Class Z Item

An item not carried in inventory. These are made to order only.

Example: 24" x 24" x 24" Sewer Tee.

NSPI

(Non-Standard Product Inquiry) A product for which there is no current issue of a Standard Product Specification for its manufacture. These items are not carried in inventory and are made to order only.

CTD015492

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TECHNICAL SPECIFICATIONS

FORM 0922

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAIN

SPECIFICATIONS CLASSIFICATION: General Standards Manual Divisional Nomenclature and Definitions		
T.C.O. REF. NO.: 1	SPECIFICATION NO.: Section C	PAGE NO.: 2
SUPERSEDES:		DATE OF ISSUE: December 9, 1966

DESCRIPTION:

Divisional Nomenclature and Definitions

Division Categories of Manufactured Standard Products

	Class X	Class Y	Class Z	NOPE
Capable of Being Manufactured	X	X	X	
Capability to Mfg. Unknown				X
High Repetitive Sale	X			
Discontinuous Sale		X	X	
Market Unknown				X
Authorized Inventory	X			
Overrun Inventory Only		X		
No Inventory			X	X
Dimensioned Drawings	X	X	X	
No Dimensioned Drawings				X
Mfg. Costs Developed, Routinely	X	X	X	
No Mfg. Costs Developed				X
May Be Shown in Sales Lit.	X	X	X	
Cannot Be Shown In Sales Lit.				X

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

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SPECIFICATIONS CLASSIFICATION: General Standards Manual Divisional Nomenclature and Definitions		
T.C.O. REF. NO. 2	SPECIFICATION NO: Section C	PAGE NO.: 3
SUPERSEDES: December 9, 1968		DATE OF ISSUE: APR 28 1972

DESCRIPTION:

Divisional Nomenclature and Definitions

Standard Density

The average "bone dry" density of unmachined, B, C, and D positions of autoclaved stock, reported in pounds per cubic inch. Standard density determinations are accomplished through the water displacement method outlined in CPC Standard Test Method TM-5.

Standard B.O.D.

The average of three barrel outside diameter measurements based on the circumference and taken on unmachined B, C, and D positions of autoclaved stock, reported in inches.

Measurement positions are:

A - Machined smallest outside diameter of pipe at drive end of wet machine.

B - Six inches from drive end.

C - Center of pipe.

D - Six inches from end opposite drive end.

E - Machined smallest outside diameter of pipe, opposite drive end.

Manufacturing Weight (Autoclaved Rough Stock)

$$\text{Mfg. Wt., Lbs./Ft.} = \left[(\text{Cross Sectional Area in sq. in.}) \times (\text{std. density in p.c.i.}) \times (12 \text{ in./ft.}) \times (\text{free moisture factor})\right] \times (\text{crown factor})$$

$$= \left[\left(\frac{\pi}{4}\right) \times (\text{B.O.D.}^2 - \text{I.D.}^2) \times (\text{density}) \times (12) \times (1.07)\right] \times (1.01)^*$$

* For extruded A/C pipe, the factor of (1.01) is omitted.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: General Chemical Manual
Divisional Nomenclature and Definitions

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	Section C	4

SUPERSEDES:

DATE OF ISSUE: December 9, 1968

DESCRIPTION:

Divisional Nomenclature and Definitions

Finished or Shipping Weight (Autoclaved Product)

Pipe

Finished Wt., Lbs./Ft. =

$$\text{Mfg. wt., lbs./ft.} - \frac{\text{Vol. removed,* in}^3 \times \text{std. den., pci} \times 1.07}{13 \text{ Ft.}}$$

*From 13 foot length of pipe.

Coupling

Finished Wt., Lbs./Unit =

Std. den., pci x 1.07 (Blank vol., $in.^3$ - vol. removed, in^3)

Other A/C Items

Finished Wt., Lbs./Unit = Final vol., in^3 x std. den., pci x 1.07

Net Machine Tonnage Rate

Roll-up time = time from start to stop of anvil roll, in secs.

Net roll-up time = roll-up time plus mandrel change time, in secs.

$$\text{Std. Pieces/hr.} = \frac{60 \text{ Min./Hr.}}{\text{Min./Piece (Based on net roll-up time)}}$$

$$\text{Cost Std. Tons/Hr.} = \frac{\text{Std. Pieces/Hr.} \times \text{Mfg. Cost Wt., Lbs./Ft.} \times 13.25 \text{ Ft./Piece}}{2000 \text{ Lbs./Ton}}$$

$$\text{Production Tons/Hr.} = \frac{\text{Actual Pieces/Hr.} \times \text{Mfg. Cost Wt., Lbs./Ft.} \times 13.25 \text{ Ft. Piece}}{2000 \text{ Lbs./Ton}}$$

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TECHNICAL SPECIFICATIONS

FORM [illegible]

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: General Standards Manual
Divisional Nomenclature and Definitions

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.
1	Section C	5

SUPERSEDES: | DATE OF ISSUE: December 9, 1963

DESCRIPTION:

Divisional Nomenclature and Definitions

Wet Machine Yield

Std. Wet Machine Yield, % = Given as 107%. It is based on the raw materials required and increased by approximately 12 per cent to account for inclusion of water. In general, water will react with cement in the ratio of 50 parts of cement to 20 parts of water.

Reported Wet Mach. Yield, % =

$$\frac{\text{Pieces Mfd. x 13.25 ft./piece x std. mfg. wt., lbs./ft.}}{\text{Raw Materials used, lbs. ("As Received" Wt.)}} \times 100$$

Standard Quality Yield

Pipe (Std., REG. F.M., etc.)

$$\text{Std. Quality Yield, \%} = \frac{\text{Ft. useable mat'l.}}{\text{Ft. useable mat'l. + Ft. rejected}} \times 100$$

Coupling (And Accessories After Conversion From Stock)

$$\text{Std. Quality Yield, \%} = \frac{\text{No. Pieces Entering System} - \text{No. Pieces Rejected}}{\text{No. Pieces Entering System}} \times 100$$

Agreement Weights - Shipping weights, agreed to by transportation agencies and CPC plants, arrived at by periodic weighing of arbitrary units of finished A/C products.

Machined Diameters - Specified diameters, both inside and outside, are based on direct diameter measurements and not on averages as calculated from circumferences.

Thickness - Shall be the direct measurement between outside and inside surfaces and not based on inside and outside diameters as calculated from circumferences.

Ovality - Ovality is the degree a tubular product diameter varies in roundness from a true circle. Ovality is the difference between the maximum and minimum diameters expressed in inches.

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TECHNICAL SPECIFICATIONS

CERTAINTEED PRODUCTS CORPORATION PIPE DIVISION	SPECIFICATIONS CLASSIFICATION: General Standards Manual Divisional Nomenclature and Definitions		
	T.C.O. REF. NO.: 1	SPECIFICATION NO.: Section C	PAGE NO.: 6
	SUPERSEDES:		DATE OF ISSUE: December 9, 1968

DESCRIPTION:

Divisional Nomenclature and Definitions

Stretch — Stretch is the average increase in the inside diameter of a tubular product. For couplings and accessory stock, it is the difference between the cured stock inside diameter and the steel mandrel outside diameter. For pipe, it is the difference between the autoclaved stock inside diameter and the steel mandrel outside diameter. In every case, it is expressed in inches.

Relative Strength — The relative reinforcing value of a fiber compared to the Standard C&G/3 rated at 100. The relative strength of a blend is calculated from the relative strength of the individual fibers as follows:

$$\text{Relative Strength} = \frac{\text{Wt. Fiber}_1\text{, Lbs.} \times \text{R.S.}_1 + \text{Wt. Fiber}_2\text{, Lbs.} \times \text{R.S.}_2 + \ldots}{\text{Wt. Fiber}_1\text{, Lbs.} + \text{Wt. Fiber}_2\text{, Lbs.} + \ldots\ldots}$$

Effectiveness of Furnish - A reinforcing efficiency index of a furnish calculated as follows:

Effectiveness of Furnish = % Fiber x R.S. (Blend) + 5* x % A/C Fines

* A value of 5 has been assigned as the relative strength of A/C fines.

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D

TECHNICAL CHANGE ORDER

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

APPLICABLE TO:

A/C General Standards Manual Section D

DATE OF ISSUE:	T.C.O. NO.:	PAGE NO.
AUG 2 1 1979	2	1

DESCRIPTION:

General Product Specification Data

Purpose:

Addition of handling label instructions applicable to all asbestos-cement pipe, 1/4 - length and above.

Addition of permissable dimension allowances.

Change Sales Instruction Bulletin code number.

Changes in trademark paragraph to now include 15" and 21" as Fluid-Tite products.

Correct 4" pipe size leakage allowance at 125 psi.

Effective Date:

Date of issue. Labels to be supplied to all plants by approximately mid-July.

Trial at Plant #258:

The Ambler plant started to put labels on one in four pipe on 4/20/79 and presently, they are affixing labels to all A/C pipe, 1/4 length and above.

Disposition of Superseded Pages:

Destroy all pages in Section D of the General Standards Manual and add the attached pages.

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TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: General Standards Manual		
T.C.O. REF. NO. 2	SPECIFICATION NO: Section D	PAGE NO.: 1
SUPERSEDES: June 4, 1968	DATE OF ISSUE: AUG 21 1979	

DESCRIPTION:

General Product Specification Data

SCOPE

This particular section of the General Standards Manual has been developed to contain those elements of Standard Product Specifications that are common to more than one product line.

COMPOSITION

Asbestos cement pipe, couplings and fittings shall be composed of an intimate mixture of Portland cement, asbestos fiber and silica and the mixture shall be free from organic additives with or without the addition of curing agents. The material shall be formed under pressure and cured to meet the physical and chemical requirements of each Standard Product Specification. Certain fittings permit the use of a special adhesive for the purpose of permanently joining components.

TRADEMARK

FLUID-TITE is a registered trademark for all A/C pipe, couplings and fittings and for rubber rings. CERTA-SPACER band is also a registered trademark.

TEST METHODS

Physical

Hydrostatic Proof Test

Hydrostatic strength tests are conducted in accordance with the latest issue of ASTM C-500. Products under test shall show no signs of leaking, weeping or cracking.

FLEXURAL STRENGTH

Flexural Strength tests are conducted in accordance with the latest issue of ASTM C-500. Pipe lengths under test shall support, without evidence of cracks or other stress induced defects, loads specified by Standard Product Specifications. The test span shall be 12 feet for

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FLS						

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standard pipe lengths of 13 feet and 9 feet for standard lengths of 10 feet. Random pipe in lengths from 8 feet through 12 feet, 6 inches, shall be converted from 13 feet stock having previously passed the flexural requirements.

CRUSHING STRENGTH

Crushing strength tests are conducted in accordance with the latest issue of ASTM C-500. Failure of the test specimen to withstand 75 per cent of the required load shall be cause for rejection of the lot the specimen represents. Where the specimen withstands over 75 per cent, but less than 100 per cent of the required load, one sample shall be cut from each of two additional pipes of the same size and class, representing the lot. Failure of one of these additional specimens to meet the required load shall be cause for rejection of the lot.

CHEMICAL

The uncombined calcium hydroxide present in A/C pipe, couplings and fittings shall be tested in accordance with the procedure outlined in the latest issue of ASTM C-500. The percentage found in CertainTeed products is sufficiently low to allow them to meet the most rigid requirement of any external specification.

GENERAL REQUIREMENTS

Pipe Lengths

Standard lengths are 13 feet. Random lengths are 7 feet to 12 feet 6 inches in increments of 6 inches. Short lengths for use in making connections to valves, fittings and structures and for making closures are fractional lengths of a standard 13 foot length and are identified as any one of the following:

Machined End Only	Fully Machined
1/8 MEO (19.5")	
1/4 MEO (39")	1/4 FM (39")
1/2 MEO (78")	1/2 FM (78")

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
General Standards Manual		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	Section D	3
SUPERSEDES:		DATE OF ISSUE:
June 4, 1968		AUG 21 1979

DESCRIPTION:

General Product Specification Data

LUBRICANT

Lubricant for use in all plant prebelling operations and special hydrostatic test situations shall conform to the requirements of A/C Standard Purchasing Specification 505. Lubricant for use in field assembly work shall conform to the requirements of A/C Standard Purchasing Specification 504. Sufficient field lubricant shall be supplied for joining pipe ends to couplings or fittings in accordance with the lubricant table shown in individual Standard Product Specifications.

CERTA-SPACER band APPLICATION

Where CERTA-SPACER bands are applied, they shall be flat and located adjacent to the first machined shoulder all around.

MARKING

Stamping and stenciling inks shall conform to the requirements of A/C Standard Purchasing Specification No. 502. Unless otherwise directed, all numerals and letters used in marking the products shall be at least 5/8 inch high. Refer to the Industrial Engineering Master list of stamp sketches for detailed stamp design information.

INSTALLATION INSTRUCTIONS

Sales Instruction Bulletin Code No. 40-21-03H on the installation of FLUID-TITE Asbestos Cement Pipe and Couplings shall be attached to the packing lists and pipe delivery report on each shipment of the order. The Sales Bulletin shall not be supplied where couplings are not part of the product line.

FINISH

Each FLUID-TITE asbestos cement pressure pipe shall be free of dents or tears on the inside surface that result in a variation in diameter of more than 0.187 inch from the diameter of the adjacent unaffected portions of the surface. Each pipe shall be properly machined on each end so as to facilitate joining the pipe

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FTS	MRS					

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sections without damaging or displacing the gasket. The machined ends of the pipe shall be free from damage, flaking or chips that extend back more than 1/2 inch or extend around the perimeter more than 1/2 inch at one location. The subject pipe shall be acceptable in appearance; the outside surfaces shall be free of loose skin laminations, but may be made acceptable by reworking, rasping or sanding.

Each coupling shall show complete machining and be free of delaminations on the inside surfaces and no delaminations shall be visible at the ends. The machining shall be smooth and free of chips and accumulation of machining dust. Circumferential and axial gouges or grooves on the machined area, except in the ring grooves, shall not have a depth greater than 1/32 inch and width greater than 1/16 inch. The ring grooves shall be smooth and free of imperfections and/or foreign materials that impair assembly, use or serviceability.

Refer to individual inspection standards for finishing details.

STRAIGHTNESS

No pipe shall have a variance from straightness, measured as an outside middle ordinate of more than 0.625 inch for 13 feet lengths or more than a proportionate amount for shorter lengths.

Handling Label:

Pictured below is a reproduction of the handling label which shall be put on all A/C pipe, 1/4 - length and above.

The labels shall be pressure-sensitive and water-resistant, therefore, it is recommended that they be attached on the finishing line at a location between the flex tester and the hydro-tester. They are to be placed on one end only (could be either end since pipe is alternately belled).

Those lengths (1/4 - lengths or above) which are used in the fabrication of fittings (i.e. wyes or tees) shall not have labels on them since no field cutting is necessary.

CAUTION: Always use recommended work practices. Do not use abrasive disc saws. When cutting, machining and tapping, refer to Recommended Work Practice Guide furnished by manufacturer to your employer.

CUIDADO: Observar siempre las prácticas recomendadas. No usar cierras circulares abrasivas. Al hacer los trabajos de cortado y taladrado consultar el manual de prácticas recomendadas (Recommended Work Practice Guide) preparada por el fabricante y disponible en el taller.

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: General Standard Manual

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	Section D	5

SUPERSEDES: June 4, 1968

DATE OF ISSUE: AUG 21 1979

DESCRIPTION: General Product Specification Data

PERMISSABLE VARIATIONS IN DIMENSIONS

OUT-OF-ROUND

The inside diameter total out-of-round tolerance at the ends of each length of pipe of a distance equal to one-half of the coupling length shall be as shown in the table below for sewer pipe.

Out-of-Round Tolerances

Size, Inches	Allowable Variation, Inches
4 to 10, incl.	1/8
12 to 20, incl.	3/16
21 and 24	1/4

AVERAGE INSIDE DIAMETERS

The average diameter may be less than the nominal by not more than those listed in the table below.

Pipe	Size, Inches	Allowable Variation, Inches
Pressure	4 to 24	5% of nominal I.D.
Sewer	4 to 6	1/4"
	8 to 24	1/4" or 1½% of nominal I.D. whichever is greater

Note: All measurements taken 3" in from end.

LEAKAGE ALLOWANCE (Non-Pressure Pipe)

For pipe products relying on a combined "coupling-rubber gasket" seal for maintaining fluid flow within the pipeline, the standard leakage allowance shall be a maximum of 10 gallons/inch diameter/mile/day when the pipe is running full under no pressure.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

General Product Specification Data

LEAKAGE ALLOWANCE (Pressure Pipe)

For pipe products relying on a combined "coupling-rubber gasket" seal for maintaining fluid flow within the pipeline, the standard leakage allowance shall conform to the following quantities when tested in accordance with AWWA C-603 of latest issue.

LEAKAGE ALLOWANCE

GALLONS OF WATER PER 100 COUPLINGS PER HOUR

	TEST PRESSURE AT LOWEST POINT IN LINE, PSI						
Pipe Size, In.	50	75	100	125	150	200	225
3	0.54	0.65	0.76	0.85	0.92	1.06	1.13
4	0.71	0.87	1.00	1.12	1.23	1.42	1.51
5	0.89	1.08	1.25	1.34	--	-	-
6	1.06	1.29	1.51	1.68	1.84	2.12	2.25
8	1.42	1.72	2.00	2.24	2.45	2.84	3.00
10	1.77	2.15	2.50	2.79	3.07	3.54	3.75
12	2.12	2.58	3.00	3.35	3.68	4.24	4.52
14	2.48	3.01	3.50	3.91	4.28	4.96	5.26
15	2.66	3.23	3.75	4.19	4.59	5.32	5.63
16	2.83	3.44	4.01	4.47	4.89	5.68	6.00
18	3.18	3.87	4.52	5.02	5.52	6.37	6.75
20	3.54	4.30	5.00	5.58	6.12	7.08	7.51
21	3.72	4.52	5.25	5.86	6.43	7.40	7.89
24	4.24	5.16	6.00	6.69	7.34	8.50	9.01

Note: 1. The data are based on 150 psi and represent a leakage of approximately 30 gallons per day per mile of pipe per inch of pipe diameter for pipe in 13 feet lengths.

2. Leakage allowances for pipe sizes 3, 5, 15 and 21 inch are interpolations from the AWWA C-603 requirements.

CertainTeed	Date	To	Location and mail code
	February 20, 1978	(See Below)	
Subject		From	Location and mail code
ASTM & AWWA STANDARDS FOR A/C PIPE		R. Korobij/rc	VF P&PG #8

L. C. Ambler - VF P&PG #2B
J. Baker - VF P&PG #2B
F. T. Duffy - VF P&PG #2B
J. P. McGinley - VF P&PG #2B
N. Sutterer - VF P&PG #2B

Attached, please find copies of the following most recent ASTM and AWWA Standards for A/C Pipe:

ASTM C 296-76	Asbestos-Cement Pressure Pipe
ASTM C 428-77a	Asbestos-Cement Nonpressure Sewer Pipe
ASTM C 500-~~77~~ 79	Standard Methods of Testing Asbestos-Cement Pipe
ASTM C 644-77	Asbestos-Cement Nonpressure Small Diameter Sewer Pipe.
ASTM C 663-76	Asbestos-Cement Storm Drain Pipe
ASTM C 668-76	Asbestos-Cement Transmission Pipe
ASTM D 1869-66	Rubber Rings for Asbestos-Cement Pipe
AWWA C 400-~~77~~ 80	Asbestos-Cement Distribution Pipe, 4 in. through 16 in., for Water and other Liquids
AWWA C 401-77	The Selection of Asbestos-Cement Distribution Pipe, 4 in. through 16 in., for Water and Other Liquids
AWWA C 402-77	Asbestos-Cement Transmission Pipe, 18 in. through 42 in., for Water and Other Liquids
403-78	
AWWA C 603-~~65~~ 78	Installation of Asbestos-Cement Water Pipe

Even though you may have some or all of these specifications in your possession, they may not be the most recent; for this reason, I am sending them to you.

Also, in the loose form, you will find the Specs. easy to carry around in your briefcase, always ready as a reference or as an available copy to give to a customer.

As Always, additional copies are available upon request.

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ASTM

Designation: C 296 – 81

Standard Specification for ASBESTOS-CEMENT PRESSURE PIPE[1]

This Standard is issued under the fixed designation C 296, the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

This specification has been approved for use by agencies of the Department of Defense and for listing in the DoD Index of Specifications and Standards.

1. Scope

1.1 This specification covers asbestos-cement pressure pipe for use in supply lines and distribution systems that carry water under pressure. The specification also covers asbestos-cement pressure pipe for use in sewer force mains which carry sewage under pressure.

2. Applicable Documents

2.1 *ASTM Standards:*

C 500 Testing Asbestos-Cement Pipe[2]

D 1869 Specification for Rubber Rings for Asbestos-Cement Pipe[3]

3. Classification

3.1 Asbestos-cement pipe furnished under this specification shall be manufactured in the pressure class designations of Classes 100, 150, and 200. The pressure class designations shall mean that the pipe is intended for water service at operating pressures corresponding to the class designation under the conditions of installation and operation encountered in many water distribution systems.

NOTE 1—The purchaser should determine for himself the proper class of pipe to be used under the installation and operating conditions that will exist on the project on which the pipe is to be used. For this purpose, reference can be made to AWWA H2, Standard Practice for the Selection of Asbestos-Cement Water Pipe

3.2 The types of pipe shall be known as Type I and Type II corresponding to the chemical requirements in Section 10 of this specification.

NOTE 2—To assist the purchaser in choosing the type of pipe most suitable for his use, guidelines for the definition of aggressiveness of water and of soil environments for selection of the proper type of asbestos-cement pipe are covered in Section 19 to 25 of Methods C 500.

4. Definitions

4.1 *pipe*—asbestos-cement pressure pipe as defined in Sections 1, 3, and 5.

4.2 *coupling*—a section for joining asbestos-cement pipe that, when properly installed with the proper accessories, develops a joint equivalent in strength and serviceability to the pipe sections.

4.3 *lot*—a lot as used herein for pipe 21 in. in diameter and smaller is defined as each 300 lengths of pipe or less, of identical class and size manufactured on each machine during a 24-h period. A lot as used herein for pipe larger than 21 in. in diameter is defined as each 300 lengths of pipe or less, of identical class and size manufactured on each machine during a period of consecutive working days not exceeding 7 days.

5. Manufacture

5.1 Asbestos-cement pressure pipe shall be composed of an intimate mixture of portland cement or portland blast-furnace slag

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[1] This specification is under the jurisdiction of ASTM Committee C-17 on Fiber-Cement Products.

Current edition approved Oct. 30, 1981. Published December 1981. Originally published as C 296 – 52. Last previous edition C 296 – 78.

[2] *Annual Book of ASTM Standards*, Part 16.

[3] *Annual Book of ASTM Standards*, Parts 16 and 38.

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cement and asbestos fiber with or without silica; or it shall be composed of portland-pozzolan cement and asbestos fiber. The mixture shall be free of organic additives. The material shall be of laminar construction formed under pressure to a homogeneous structure and cured to meet the physical and chemical requirements of this specification.

6. Rubber Rings

6.1 The rubber rings used to seal the joints of the asbestos-cement pipe shall conform to the requirements of the latest revision of Specification D 1869.

7. Hydrostatic Strength

7.1 Each standard, random or short length of pipe (Section 12) and each coupling sleeve, when manufactured from the same material as the pipe, shall be hydrostatically tested by the manufacturer prior to shipment and shall have sufficient strength to withstand the internal hydrostatic pressure prescribed in Table 1, when tested in accordance with Section 5 of Methods C 500.

7.2 From each lot which has passed the routine hydrostatic proof test, one length shall be selected by the inspector. Each selected length shall be hydrostatically tested in accordance with Section 5 of Method C 500 to a pressure of four times the rated working pressure for the class of pipe, maintaining such pressure for not less than 5 s. The pipe shall not fail under this pressure. Each pipe so tested shall be retested in accordance with 7.1 of this specification.

8. Flexural Strength

8.1 Each length of pipe in sizes 4, 6, and 8 in. (102, 152, and 203 mm) shall have sufficient flexural strength to withstand, without failure, the total load prescribed in Table 2, when tested in accordance with Section 8 of Methods C 500.

9. Crushing Strength

9.1 When specifically requested by the purchaser in his order, crushing tests shall be conducted before shipment at the purchaser's expense. A one-foot length of pipe for each lot cut from an unmachined portion of the pipe shall have sufficient strength to resist the minimum crushing load prescribed in Table 3, when tested in accordance with Section 11.1.1 of Methods C 500.

10. Chemical Requirements

10.1 When uncombined calcium hydroxide tests are requested, one sample shall be taken from each lot of pipe and tested in accordance with Sections 14 through 18 of Methods C 500 Sample to be tested may be taken from one of the specimens selected for the crushing test. The amount of uncombined calcium hydroxide shall not exceed 1.0 % for Type II pipe.

NOTE 3—There are no chemical requirements for Type I pipe.

11. Sampling

11.1 All pipe and couplings tested under this specification shall be in a normal air-dried condition.

12. Sizes and Dimensions

12.1 Couplings and coupling areas of pipe shall be machined or otherwise finished to such dimensions as will provide tight joints when assembled with proper accessories and put into service for which the pipe is intended.

12.2 Pipe shall be manufactured with nominal inside diameters of 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, and 36 in. (102, 152, 203, 254, 304, 356, 406, 457, 508, 610, 762, and 914 mm) in Classes 100, 150, and 200 as defined in Section 3. The average diameters of standard and random lengths may be less than the nominal by not more than 5.0 percent, when measured approximately 3 in. (76.2 mm) from the end.

12.3 The standard length shall be 13 ft ± 1 in. (3960 ± 25 mm). Alternative lengths shall be 10 ft ± 1 in. (3050 ± 25 mm) for 4 and 6-in (102 and 203-mm) pipe and 16 ft ± 1 in. (4880 ± 25 mm) for 14-in. (356-mm) and larger pipe. At least 85 percent of the total footage of pipe of any one class, type, and size, excluding short lengths, shall be furnished in standard lengths. The remaining 15 percent may be in random lengths of not less than 7 ft. (2.13 m). Short lengths, when specifically ordered, shall not exceed 6 ft. 9 in. (2.06 m).

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13. Workmanship and Finish

13.1 Machined ends of the pipe that receive coupling shall be free of dents and gouges ...at will affect the tightness of the joint.

13.2 Each pipe shall be free of bulges, dents, and tears in the inside surface that result in a variation in diameter of more than 1/16 in. (4.8 mm) from that obtained on adjacent unaffected portions of the surface.

13.3 Each length of pipe shall not vary in straightness by more than 0.05 in./ft (0.004 mm/m) of length when the variation is measured in accordance with Section 13 of Methods C 500.

14. Marking and Shipping

14.1 Each standard and random length of pipe shall be marked by the manufacturer with the trade name, nominal size, class, hydrostatic proof pressure, and date of manufacture. Each coupling sleeve, if made of the same material as the pipe, shall be marked by the manufacturer with the nominal size, class, and the letter "T" to indicate that it has been hydrostatically tested.

14.2 Pipe and couplings shall be prepared for commercial shipment so as to ensure acceptance by common or other carriers.

15. Inspection and Rejection

15.1 All material furnished under this specion shall conform to the requirements stated herein and shall be subjected to the factory inspection and tests prescribed in this specification. When requested by the purchaser in his order, the manufacturer shall notify the purchaser of the time that the inspection and testing will take place so that the purchaser may arrange for witnessing such tests and inspections at his own expense. Instead of such inspection, when requested, the manufacturer shall be prepared to certify that his product conforms to the requirements of this specification.

15.2 Each pipe and coupling shall be inspected by the manufacturer, before shipment, for compliance with the standards for dimensions, tolerances, and workmanship and finish (see also Section 11).

15.3 Failure of any specimen tested for crushing strength to withstand 75 percent of the load specified in Section 8 shall be cause for rejection of the lot from which the test specimen was taken. When any specimen tested for crushing strength withstands over 75 percent but under 100 percent of the load specified in Section 9, one specimen shall be cut from each of two additional pipes of the same lot. Failure of either of these additional specimens to meet the strength requirements of Section 9 shall be cause for rejection of the entire lot from which the original sample was taken.

15.4 If any pipe subjected to the hydrostatic test described in Section 5 of Methods C 500 fails to withstand the higher pressure specified in 7.2, two additional lengths of the same size and class shall be selected from the pipe manufactured during the same shift and shall be subjected to the higher hydrostatic test. The failure of one of these additional lengths to withstand the specified pressure shall be cause for rejection of the entire lot of that size and class manufactured during the same shift as the test lengths.

15.5 If the results of the uncombined calcium hydroxide test show that the sample failed to meet the specification requirements, two additional specimens shall be selected and sampled for test. The failure of one of these two additional samples to meet the specification requirements of Section 8 shall be cause for rejection of the lot.

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply when material is supplied under this specification for U.S. Government procurement.

S1. Packaging

S1.1 Unless otherwise specified in the contract, the material shall be packaged in accordance with the producer's standard practice which will be acceptable to the carrier at lowest rates. Containers and packing shall

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comply with Uniform Freight Classification Rules[4] or National Motor Freight Classification Rules.[5] Marking for shipment of such material shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

S2. Responsibility for Inspection

S2.1 Unless otherwise specified in the contract or purchase order, the producer is responsible for the testing of all material to assure compliance with the requirements specified herein. Except as otherwise specified in the contract or order, the producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to assure that material conforms to prescribed requirements.

[4] Available from the Uniform Classification Commission, Room 1106, 222 S. Riverside Plaza, Chicago, Ill. 60606

[5] Available from National Motor Freight Inc., 1616 P St. N W., Washington, D.C. 20036.

TABLE 1 Applied Hydrostatic Proof Pressures

Class	Applied Pressure, psi (MPa)
100	350 (2.4)
150	525 (3.6)
200	700 (4 8)

TABLE 2 Applied Flexural Proof Loads

Nominal size, in. (mm)	Total Applied Load, lbf (kN)		
	Class 100	Class 150	Class 200
4 (101.6)	1200 (5.3)	1470 (6.6)	1 870 (8.4)
6 (152.4)	2800 (12.5)	3700 (16.5)	4 900 (21.8)
8 (203.2)	5330 (25.9)	7600 (33.8)	10 130 (45.1)

TABLE 3 Minimum Crushing Loads

Nominal Size, in. (mm)	Crushing Strength per Lineal Foot, lbf (kN/m)		
	Class 100	Class 150	Class 200
4 (102)	4 100 (59.8)	5 400 (78.8)	8 700 (126.9)
6 (152)	4 000 (58.4)	5 400 (78.8)	9 000 (131.3)
8 (203)	4 000 (58.4)	5 500 (80.2)	9 300 (135.8)
10 (254)	4 400 (64.2)	7 000 (102.1)	11 000 (160.5)
12 (304)	5 200 (75.8)	7 600 (110.8)	11 800 (172.3)
14 (356)	5 200 (75.8)	8 600 (125.5)	13 500 (197.1)
16 (406)	5 800 (84.6)	9 200 (134 2)	15 400 (224 8)
18 (457)	6 500 (94.8)	10 100 (147.4)	17 400 (254 0)
20 (508)	7 100 (103.6)	10 900 (159 0)	19 400 (283 2)
24 (610)	8 100 (118.2)	12 700 (185.3)	22 600 (329.9)
30 (762)	9 700 (141.5)	15 900 (231.9)	28 400 (414.6)
36 (914)	11 200 (163.4)	19 600 (285.9)	33 800 (493.5)

APPENDIX

A1. ADDITIONAL INFORMATION

A1.1 It is suggested to the purchaser, without being made a part of this specification, that the purchaser may request inclusion of the following information in his order or agreement for purchase of the pipe:

A1.1.1 Any tests, in addition to those prescribed by this specification, as the special circumstances may require,

A1.1.2 The place or places where any additional tests are to be made,

A1.1.3 Description of the additional testing facilities,

A1.1.4 Who shall bear the expense of such additional tests,

A1.1.5 Whether such additional tests may be made by any sound sampling process or other method approved by the parties, and

A1.1.6 Such other matters as the parties may find desirable to include in their written agreement.

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa. 19103, which will schedule a further hearing regarding your comments. Failing satisfaction there, you may appeal to the ASTM Board of Directors.

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AMERICAN NATIONAL STANDARD ANSI/ASTM C 428 - 77a

AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for ASBESTOS-CEMENT NONPRESSURE SEWER PIPE[1]

This Standard is issued under the fixed designation C 428, the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

1. Scope

1.1 This specification covers asbestos-cement nonpressure sewer pipe for conveying sanitary sewage in gravity-flow systems.

NOTE 1—Rubber rings suitable for use with this pipe are covered in ASTM Specification D 1869, for Rubber Rings for Asbestos-Cement Pipe.[2]

2. Classification

2.1 Asbestos-cement pipe furnished under this specification shall be designated as Classes 1500, 2400, 3300, 4000, 5000, 6000, and 7000 based on the respective crushing strengths, and shall be furnished in the following sizes:

Class	Nominal Size, Diameter, in.
1500	8, 10, 12, 14, 15, 16
2400	8, 10, 12, 14, 15, 16, 18, 20, 21, 24
3300	8, 10, 12, 14, 15, 16, 18, 20, 21, 24, 27, 30
4000	10, 12, 14, 15, 16, 18, 20, 21, 24, 27, 30, 33, 36, 39, 42
5000	10, 12, 14, 15, 16, 18, 20, 21, 24, 27, 30, 33, 36, 39, 42
6000	36, 39, 42
7000	36, 39, 42

NOTE 2—Sizes 4, 5, and 6 in. diameters in classes 1500, 2400, and 3300 are covered by ASTM Specification C 644, Asbestos-Cement Nonpressure Small-Diameter Sewer Pipe.[2]

2.2 The types of pipe shall be known as Type I and Type II corresponding to the chemical requirements in Section 9 of this specification.

NOTE 3—To assist the purchaser in choosing the type of pipe most suitable for his use, guidelines for the definition of aggressiveness of water and of soil environments for selection of the proper type of asbestos-cement pipe are covered in Sections 19 to 25 of ASTM Methods C 500, Testing Asbestos-Cement Pipe.[2]

3. Definitions

3.1 *pipe*—asbestos cement nonpressure sewer pipe as defined in Sections 1, 2, and 4.

3.2 *coupling*—a section for joining asbestos-cement pipe that, when properly installed with the proper accessories, develops a joint equivalent in strength and serviceability to the pipe sections.

3.3 *fittings*—fittings such as wyes, tees, adaptors, etc., for use in laying asbestos-cement nonpressure sewer pipe as described in Section 4, made to such dimensions as will provide equivalent strength and tight joints when assembled with the pipe.

3.4 *purchaser*—the actual purchaser of the pipe or his authorized agents acting within the scope of the duties entrusted to them.

3.5 *Lot*:

3.5.1 A lot as used herein for pipe 21 in. (533 mm) in diameter and smaller is defined as each 300 lengths of pipe or less, of identical class and size manufactured on each machine during a 24-h period.

3.5.2 A lot as used herein for pipe larger than 21 in. (533 mm) in diameter is defined as each 300 lengths of pipe or less, of identical class and size manufactured on each machine

[1] This specification is under the jurisdiction of ASTM Committee C-17 on Asbestos-Cement Products.
Current edition approved Sept. 30, 1977. Published October 1977. Originally published as C 428 - 59 T. Last previous edition C 428 - 77.

[2] *Annual Book of ASTM Standards*, Part 16

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during a period of consecutive working days not exceeding 7 days.

4. Manufacture

4.1 Asbestos-cement sewer pipe shall be composed of an intimate mixture of portland cement or portland-blast furnace slag cement and asbestos fiber with or without silica; or portland-pozzolan cement and asbestos fiber; and the mixture shall be free of organic additives. The material shall be of laminar construction formed under pressure to a homogeneous structure and cured to meet the physical and chemical requirements of this specification.

5. Joint Tightness

5.1 The tests outlined in this section are considered to be one-time qualification tests to establish the adequacy of the manufacturer's joint design. Instead of requiring performance of these tests, the purchaser may require the manufacturer to certify that pipes and couplings equivalent in material and design have passed the tests enumerated in this section. At his own expense, however, the purchaser, by designation with his order, may require that assembled pipes and couplings pass the following performance tests without leakage:

5.1.1 *Straight Alignment*—A hydrostatic pressure test shall be made on an assembly of two sections of pipe, properly connected with a coupling in accordance with the joint design. An equivalent alternative may be a single pipe with a coupling on each end. The assembly shall be subjected to an internal hydrostatic pressure 10 psi (69 kPa) for 10 min. Any visible water leakage shall be considered a failure of the test requirements.

5.1.2 *Maximum Deflected Position*—Upon completion of the test for pipes in straight alignment in accordance with 5.1.1, deflect the test sections 5 deg for 12 in. (305 mm) and smaller diameters and 3 deg for 14 in. (356 mm) and larger diameters (with one half of the deflection being between each pipe and the coupling) and subject it to an internal hydrostatic pressure of 10 psi (69 kPa) for 10 min. Any visible water leakage shall be considered a failure of the test requirement.

5.2 Test one sample of at least one size unless some other arrangement is made with the purchaser by designation with his order. At the option of the purchaser, the sample of the pipes and couplings to be tested may be selected by him.

6. Flexural Strength

6.1 Each standard length of pipe in size 8 in. (203 mm) shall have sufficient flexural strength to withstand, without failure, the total load prescribed in Table 1, when tested in accordance with Section 8 of ASTM Methods C 500.

7. Crushing Strength

7.1 Crushing tests shall be conducted before shipment. A 1-ft (0.305-m) length of pipe cut from an unmachined portion of the pipe shall have the minimum crushing strength prescribed in Table 2, when tested in accordance with Section 11.1.1 of Methods C 500.

8. Couplings

8.1 The couplings, when assembled on pipe, shall be capable of withstanding simultaneously:

8.1.1 The minimum crushing strength in pounds-force per linear foot prescribed in Table 2, when tested in accordance with 11.1.1 of Methods C 500 and

8.1.2 The hydrostatic pressure test described in 5.1.1 of this specification.

9. Chemical Requirements

9.1 When tested in accordance with Sections 17 and 18 of Methods C 500, the amount of uncombined calcium hydroxide shall not exceed 1.0 percent for Type II pipe.

NOTE 4—There are no chemical requirements for Type I pipe.

10. Sampling

10.1 Test all material under this specification in a normal air-dried condition.

10.2 Each standard length of pipe in size 8 in. (203.2 mm) shall be tested in flexure by the manufacturer prior to shipment in accordance with Section 8 of Methods C 500.

10.3 For crushing tests, select one full length of pipe from each lot of each size, class, and type of pipe covered by the order. Cut one test specimen 12 in. (304.8 mm) long from the unmachined portion of the selected

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length of pipe.

10.4 When uncombined calcium hydroxide tests are requested (Section 9), take one sample from each lot of pipe. The sample to be tested may be taken from any one of the specimens selected for the crushing test.

11. Sizes and Dimensions

11.1 Couplings and coupling areas of pipe shall be machined or otherwise finished to such dimensions as will provide tight joints when assembled with proper accessories and put into service for which the pipe is intended.

11.2 The average diameter may be less than the nominal by not more than ¼ in. (6.4 mm) or 1½ percent, whichever is the greater.

11.3 The standard length of 8-in. (203-mm) diameter pipe may be 10 or 13 ft ± 1 in. (3.04 or 3.96 m ± 25.4 mm). The standard length of 10, 12, 14, 16, 18, 20, 24, 27, 30, 33, 36, 39, and 42-in. diameter pipe shall be 13 ft ± 1 in. (3.96 m ± 25.4 mm). At least 85 percent of the total footage of any one class, type, and size, excluding short lengths, shall be furnished in standard lengths. The remaining 15 percent may be in random lengths of not less than 7 ft (2.13 m). Short lengths specifically ordered for use in making rigid connection to manholes or other structures shall not exceed 6 ft 9 in. (2.06 m).

12. Workmanship and Finish

12.1 Machined ends of the pipe that receive the coupling shall be free of dents and gouges that will affect the tightness of the joint.

12.2 Each pipe shall be free of bulges, dents, and tears in the inside surface that result in a variation of more than 3/16 in. (4.8 mm) from that obtained on adjacent unaffected portions of the surface.

12.3 Each length of pipe shall not vary in straightness by more than 0.05 in./ft (4.17 mm/m) of length when the variation is measured in accordance with Section 13 of Methods C 500.

13. Marking and Shipping

13.1 Each standard and random length of pipe shall be marked by the manufacturer with the trade name, nominal size, class, and the date of manufacture. Each coupling sleeve shall be marked by the manufacturer with the nominal size and class for the pipe with which it shall be used.

13.2 Pipe and couplings shall be prepared for commercial shipment so as to ensure acceptance by common or other carriers.

14. Inspection and Rejection

14.1 All material furnished under this specification shall conform to the requirements stated herein and shall be subjected to the factory inspection and tests prescribed in this specification. When requested by the purchaser on his order, the manufacturer shall notify the purchaser of the time that the inspection and testing will take place so that the purchaser may arrange for witnessing such tests and inspections at his own expense. In lieu of such inspection, when requested, the manufacturer shall be prepared to certify that his product conforms to the requirements of this specification.

14.2 Each pipe and coupling shall be inspected by the manufacturer, before shipment, for compliance with the standards for dimensions, tolerances, and workmanship and finish (see Section 10).

14.3 Failure of any specimen tested for crushing strength to withstand 75 percent of the load specified in Section 7 shall be cause for rejection of the lot from which the test specimen was taken. When any specimen tested for crushing strength withstands over 75 percent but under 100 percent of the load specified in Section 7, one specimen shall be cut from each of two additional pipes of the same lot. Failure of either of these additional specimens to meet the strength requirements of Section 7 shall be cause for rejection of the entire lot from which the original sample was taken.

14.4 If the results of the uncombined calcium hydroxide test show the sample failed to meet the specification requirements, two additional specimens shall be selected and sampled for test. The failure of one of these two additional samples to meet the specification requirements of Section 9 shall be cause for rejection of the lot.

15. Field Performance and Acceptance

15.1 All field assembled joints for asbestos-cement nonpressure sewer pipe shall meet the requirements set forth in 15.5 for infiltration/exfiltration.

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15.2 Base measurements on a segment of sewer line between two consecutive manholes or other similar increment of distance, rather than taken from a single joint.

15.3 Before the sewer line is backfilled and tested, inspect the pipe line for proper bedding to assure uniform support of the pipe, and the absence of high points and irregularities which induce beam and shear loadings on the pipe.

15.4 Perform final acceptance testing on the sewer line after the final backfilling has been completed.

15.5 The infiltration/exfiltration of the installed pipe shall not exceed 0.079 gal/in. of internal pipe diameter per 100 ft of pipelines per hour (0.1177 litre/cm of internal pipe diameter per 30.5 m of pipelines per hour), where the maximum hydrostatic head at the center line of the pipe does not exceed 25 ft (7.63 m) (corresponds to 100 gal/in. of pipe diameter per mile per 24 h (149 litres/cm of pipe diameter per mile per 24 h.))

NOTE 5—Where infiltration/exfiltration tests are specified and the acceptance of a sewer line is dependent upon a satisfactory test, it should be recognized that leakage may occur at several locations beside the pipe joints. Manhole bases, walls, and connections to sewer lines must be tight. Fittings, including capped or plugged tees and wyes must be properly braced to prevent movement from thrust action, and, where used for vertical risers or sewer chimneys, proper support must be provided beneath the piping to withstand the greater transmitted earth and surface loads.

TABLE 1 Applied Flexural Proof Loads

Nominal Size, in.	Pipe Length, ft	Test Span, ft	Total Applied Load, lbf (kN)		
			Class 1500	Class 2400	Class 3300
8	10	9	2700 (12.0)	3000 (13.3)	3900 (17.3)
8	13	12	2025 (9.0)	2250 (10.0)	2925 (13.0)

TABLE 2 Minimum Crushing Load

Pipe Class	Crushing Strength, lbf/ft (kN/m)
1500	1500 (21.8)
2400	2400 (35.0)
3300	3300 (48.0)
4000	4000 (58.2)
5000	5000 (72.8)
6000	6000 (87.4)
7000	7000 (102.0)

APPENDIX

X1. SUPPLEMENTARY REQUIREMENTS

X1.1 It is suggested to the purchaser, without being made a part of this specification, that the purchaser may request inclusion of the following information in his order or agreement for purchase of the pipe:

X1.1.1 Any tests, in addition to those prescribed by this specification, as the special circumstances may require,

X1.1.2 The place or places where any additional tests are to be made,

X1.1.3 Description of the additional testing facilities,

X1.1.4 Who shall bear the expense of such additional tests,

X1.1.5 Whether such additional tests may be made by any sound sampling process or other method approved by the parties, and

X1.1.6 Such other matters as the parties may find desirable to include in their written agreement.

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CTD015513

Designation: C 460 – 72

American National Standard A130.1
American National Standards Institute

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Standard Definitions of Terms Relating to ASBESTOS-CEMENT AND RELATED PRODUCTS[1]

This Standard is issued under the fixed designation C 460; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

accessories—subordinate material such as fasteners, backer strips, closure strips, ridge and corner rolls, roofing starters and finishing pieces, couplings, gaskets, pipe fittings or other supplementary material necessary for the proper application of primary asbestos-cement products.

American Method—a method of application for roofing shingles, generally rectangular in shape, to provide double coverage with head lap and no side lap.

asbestos—a group of fibrous minerals which occur as small veins in the massive body of natural hydrous silicates of serpentine or amphibole and have heat-, fire-, and solvent-resistant properties.

asphalt felt, breather type—an underlayment sheet material saturated with asphalt for use with asbestos-cement products, which allows the transmission of water vapor.

backer strips—water-repellent strips of asphalt-coated felt applied behind each joint where the vertical edges of two shingles meet.

batten—a long narrow strip of asbestos-cement, either flat or corrugated, used to conceal the joints in butt joint application of flat or corrugated sheets.

bloom—see **efflorescence.**

caulking—a material ranging in physical characteristics from plastic to solid to preformed used to seal and waterproof joints and overlaps in structures, other assemblies or portions thereof where movement may occur.

cement, portland—a hydraulic cement produced by pulverizing clinker consisting essentially of hydraulic calcium silicates, and usually containing one or more of the forms of calcium sulfate as an interground addition.

cement, portland blast-furnace slag—essentially an intimately interground mixture of portland-cement clinker and granulated blast-furnace slag or an intimate and uniform blend of portland cement and fine granulated blast-furnace slag in which the amount of the slag constituent is within specified limits.

cement, portland-pozzolan—an intimate and uniform blend of portland cement or portland blast-furnace slag cement and fine pozzolan produced by intergrinding portland cement clinker and pozzolan, by blending portland cement or portland blast-furnace slag cement and finely divided pozzolan, or a combination of intergrinding and blending, in which the amount of the pozzolan constituent is within specified limits.

chemical resistance—in asbestos-cement products, the ability of the product to resist chemical attack, solution, decomposition, or other chemical changes when in contact with liquid, gaseous, or solid media normally encountered in its service environment.

closure strip—an asphalt or rubber preformed filler strip having the same shape and pitch as the asbestos-cement corrugated product and used to close openings in the corrugated sheets at window beads, eaves, lower

[1] These definitions are under the jurisdiction of ASTM Committee C-17 on Asbestos-Cement Products.

Current edition approved Sept. 29, 1972. Published December 1972. Originally published as C 460 - 60. Last previous edition C 460 - 71.

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edge of siding, and similar places.

color variation—the property of nonuniform color exhibited by asbestos-cement products before or after weathering.

corner rolls—half-round units of asbestos-cement used to trim and flash corners in asbestos-cement corrugated application.

corrugated—a term denoting an asbestos-cement sheet product having a design of alternating ridges and valleys manufactured according to a specified pitch.

coupling—a section for joining asbestos-cement pipe that, when properly installed with the proper accessories, develops a joint equivalent in strength and serviceability to the pipe sections.

crushing strength—a property of solid material that indicates its ability to withstand collapse from external, compressive loads.

curing agent—an additive incorporated in the furnish of asbestos-cement products resulting in increased chemical activity between the cementitious components with an increase or decrease in the rate of cure.

cure, normal cure—the method of setting or hardening asbestos-cement products wherein the portland cement is allowed to hydrate at atmospheric conditions of pressure, preferably under conditions to inhibit water loss.

deflection—the linear distance that a test specimen bends at the center from no load to stated load when loaded as a beam.

density—weight per unit volume, usually expressed in pounds per cubic inch, pounds per cubic foot, or grams per cubic centimeter.

Dutch or Scotch Method—a method of application for asbestos-cement roofing shingles which are rectangular in shape and lap at the top and one side to form either a square or rectangular pattern.

efflorescence (bloom)—a white powdery substance occurring on the surface of asbestos-cement products and caused by the migration of soluble salts, followed by precipitation and carbonation.

filler—an inert inorganic material used as an extender in the furnish of asbestos-cement which does not add to the cementitious value of the cement.

fittings—materials such as wyes, tees, elbows, adaptors, etc. used in the installation of asbestos-cement piping.

flat sheets, Type F (flexible)—an asbestos-cement flat sheet suitable for exterior and interior use, where a board having high strength and density, smoother surface, greater flexibility, and lower moisture absorption is desired.

flat sheets, Type U (utility)—an asbestos-cement flat sheet suitable for exterior and interior use, having sufficient strength for general utility and construction purposes, and where a board having maximum flexibility, highest density, smoother surface, and lower moisture absorption is not essential.

flexural strength—a property of solid material that indicates its ability to withstand a flexural or transverse load.

French or Hexagonal Method—a method of application for asbestos-cement roofing whereby the shingles have at least three corners clipped so that when they are laid with their diagonals perpendicular to the eave of the roof, they lap at the top and sides to form a hexagonal pattern.

granules—small ceramic or natural colored mineral pellets or grains applied to asbestos-cement to lend color to the surface.

headlap—the shortest distance between the lower edge of an overlapping shingle or sheet and the upper edge of the lapped unit in the second course below (see Fig. 1).

hip and ridge, finishing pieces—rectangular pieces of roofing shingles cut to a flair taper and applied with a side lap to conceal the joint of roofing shingles along the hips and ridge of a roof.

hydrostatic pressure—see **hydrostatic strength.**

hydrostatic strength—the property of a pipe, under specified conditions to withstand internal pressure of specified magnitude.

lap cement—the cementitious material used to seal the side and end laps of corrugated roofing.

lining—a coating or layer adhered to or in intimate contact with the interior surface and ends of asbestos-cement pipe and related couplings with said coating or layer being more chemically resistant than the pipe and related couplings.

louver blades—a shaped asbestos-cement product applied for ventilation in a building.

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physical stability—in asbestos-cement products, the ability of the product to maintain its physical dimensions and properties when in contact with liquid, gaseous, or solid media normally encountered in its service environment.

pigment—a water-insoluble coloring matter pulverized to a fine particle size and added to asbestos-cement products.

pipe—a tubular section of asbestos cement designed to convey liquids or gases, or both.

pitch—the distance from crest to crest of an asbestos-cement product of corrugated form.

purchaser—the actual buyer of asbestos-cement products, or his agent, acting within the scope of the duties authorized by the buyer.

ranch type—a type of asbestos-cement roofing, rectangular in shape, which is lapped at the top and one side.

ridge roll—a half-round section of asbestos-cement applied along the hips and ridge of a roof to conceal and waterproof the apex joint of the roofing material.

side lap—the shortest horizontal distance between the exposed side edge of a course of asbestos-cement roofing or siding material and the most proximate underlying area of roof deck or side wall not covered by the preceding adjacent course.

silica—a pulverized siliceous material used as a filler or part of the cementitious material.

slaters cement—a type of caulking compound, usually gray in color, and used to cover exposed bolt heads or at the side and end laps of corrugated roofing and in other places where water-resistant putty-like material is desired.

slope—the incline of a roof expressed as a ratio of the number of inches (or millimeters) of vertical rise per horizontal foot (or meter).

starters—lateral sections of roofing shingles, usually 3 in. (75 mm) wide, and applied beneath the first course of shingles with slight overhang at the eaves.

storm anchors—a corrosion-resistant metal fastener with a flat base and a shank which fastens the concealed lower corner of each shingle to the exposed edge of the adjacent shingle.

texture—a surface pattern as contrasted to a smooth finish.

toplap—the shortest distance between the lower edge of an overlapping shingle or sheet, and the upper edge of the lapped unit in the first course below (see Fig. 1).

underdrain—a type of asbestos-cement pipe having a multiplicity of perforations along its length, intended for use in surface or below-surface drainage.

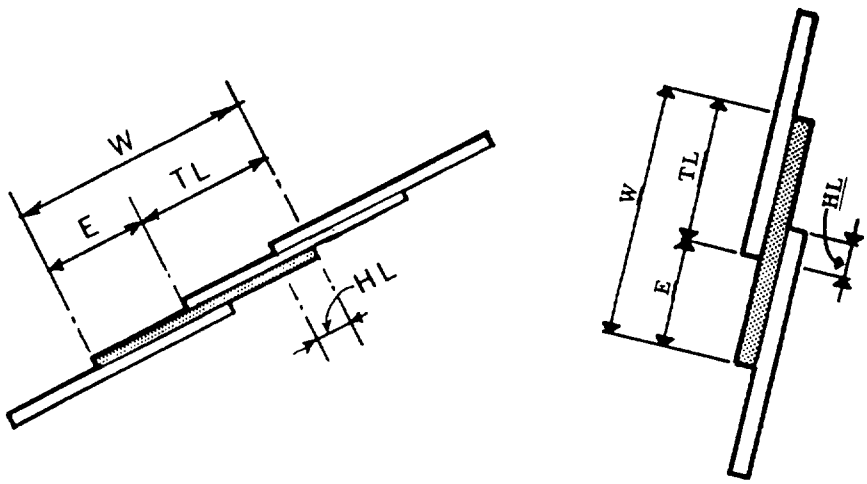
veneer—the decorative surface of an asbestos-cement shingle or sheet, usually pigmented or granuled for color.

warping—a change or deformation in the original contour of an asbestos-cement product.

water absorption—the increase in weight of a test specimen after immersion in water under specified conditions of time and temperature, expressed as a percentage of its dry weight.

water repellent substances—materials such as waxes, soaps, or silicones which render the surface of shingles more water repellent.

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Roofing Siding

Terminology

E—Exposure
TL—Toplap
HL—Head lap
W—Width for strip shingles or length for individual shingles

FIG. 1 Examples of Overlap.

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Standard Methods of Testing ASBESTOS-CEMENT PIPE[1]

This Standard is issued under the fixed designation C 500, the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval

1. Scope

1.1 These methods cover the testing of asbestos-cement pipe for hydrostatic strength, flexural strength, crushing strength, and uncombined calcium hydroxide, and are for use in connection with the individual specifications for asbestos-cement pipe.

1.2 The test methods appear in the following order:

	Sections
Hydrostatic Proof Test	3 to 5
Flexure Proof Test	6 to 8
Crushing Test	9 to 11
Straightness Test	12 to 13
Uncombined Calcium Hydroxide Test	14 to 18
Environmental Aggressiveness	19 to 25

2. Applicable Documents

2.1 *ASTM Standards:*

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[2]

HYDROSTATIC PROOF TEST

3. Significance

3.1 The hydrostatic proof test is performed to establish the fact that finished, shippable material has strength to withstand the internal bursting pressures stated in the specifications. The strength level required by the specifications assures that a minimum strength is maintained and that the pipe will not leak or weep in service and will accommodate the stresses simultaneously induced by internal pressure, earth loads, and surge pressures.

4. Description of Term

4.1 *Hydrostatic Strength*, as used in this method, refers to the ability of the pipe and coupling sleeve to withstand the forces resulting from internal pressure.

5. Procedure

5.1 Place the pipe, coupling, or pipe and coupling with factory-assembled joint, in a hydrostatic pressure testing machine with gaskets that seal the ends but exert no end pressure. Expel all air and apply the internal water pressure at a uniform rate of not less than 100 psi/s (689 kPa/s) to the specified pressure; maintain the pressure at this level for not less than 5 s. Couplings may instead be tested with a rubber bladder inside of the coupling.

FLEXURE PROOF TEST

6. Significance

6.1 The flexure proof test is a quality control test performed to establish the fact that finished, shippable material has sufficient strength to withstand the minimum applied loads stated in the specifications. These proof test loads provide adequate strengths to resist transverse bending loads normally encountered in field service when good bedding methods are employed by the installer.

7. Description of Term

7.1 *Flexural Strength*, as used in this method, refers to the ability of a standard pipe section to withstand external loads bearing on the pipe transversely to its longitudinal axis that induce bending in the section.

8. Procedure

8.1 Support the pipe in a flexure testing

[1] These methods are under the jurisdiction of ASTM Committee C-17 on Asbestos-Cement Products.

Current edition approved Dec. 28, 1979. Published February 1980. Originally published as C 500 – 63 T. Last previous edition C 500 – 79.

[2] *Annual Book of ASTM Standards*, Parts 13, 14, 15, 18, 26, 30, and 41.

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machine over a clear span of 9 ft (2.74 m). Unless otherwise specified, it shall be optional with pipe lengths in excess of 12½ ft (3.8 m) to test at 75 % of the specified loads on supports 12 ft (3.66 m) apart. Apply the load at a uniform rate of at least 250 lbf/s (1.1 kN/s) until it equals the proof load specified; maintain this load for at least 5 s. Distribute the load equally and apply at the third points of the clear span as indicated in Fig. 1.

8.2 Failure of the flexural proof test shall be considered to have taken place when a break occurs in the pipe as a result of the flexural load being applied to the pipe during the test prior to reaching the minimum flexural load, or while holding at the minimum flexural load, designated in the specification.

CRUSHING TEST

9. Significance

9.1 The crushing test establishes the fact that the pipe has sufficient strength to withstand the crushing loads stated in the specifications. The strength level required by the specifications assures minimum strengths that will satisfactorily withstand the magnitude of loads normally encountered in field service with a reasonable margin of safety.

10. Description of Term

10.1 *Crushing Strength*, as used in this method, refers to the ability of the pipe to withstand external loads that tend to collapse the pipe.

10.2 Failure of the crushing test shall be considered to have taken place when a break occurs in the pipe as a result of the crushing load being applied to the pipe during the test prior to reaching the minimum crushing load designated in the specifications.

11. Procedure

11.1 *Three-Edge-Bearing Method:*

11.1.1 *Wooden-Bearing Surfaces*—Test each specimen by the three-edge-bearing method as indicated in Fig. 2.

11.1.1.1 The lower bearing for the specimen consists of two strips with vertical sides, having their interior top corners rounded to a radius of approximately ½ in. (13 mm). The strips shall be of hardwood or metal; if metal, a piece of leather belting 3/16 in. (5 mm) in thickness shall be laid over them. They shall be straight and be fastened securely to the bearing block with their vertical interior sides parallel and spaced a distance apart as follows: for sizes up to and including 16 in. (400 mm), the space shall be 1 in. (25 mm); for sizes 18 through 27 in. (450 through 675 mm), the space shall be 2 in. (50 mm); for sizes 30 in. (750 mm) and above, the space shall be 3 in. (75 mm). Tolerances are −0, + ⅛ in. (−0, + 3 mm).

11.1.1.2 The upper bearing shall be a rigid wooden block, straight and true from end to end. The upper and lower bearing shall extend the full length of the outside of the specimen. Place the specimen symmetrically between the two bearings, and so place the center of application of the load that the vertical deformation at the two ends of the specimen will be equal.

11.1.2 *Rubber-Bearing Surfaces*—Test each specimen by the basic three-edge method indicated in Fig. 2 except that the bearing surfaces shall be rubber. The rubber shall be cut or formed from material having a durometer hardness between 45 and 60. The strips shall be of rectangular cross section having a width of 2 in. (50 mm) and a thickness of not less than 1 in. (25 mm) nor more than 1½ in. (38 mm).

11.1.2.1 Use two parallel strips on the bottom bearing spaced a distance apart of approximately 1 in. (25 mm)/ft of pipe diameter, but in no case less than 1 in. Lay the bottom strips on the 2-in. (50-mm) dimension and position on the bearing with wood or metal strips between them and adjacent to their outside edges, provided the thickness of these positioning strips does not exceed one half the thickness of the rubber-bearing strips.

11.1.2.2 Use the top-bearing edge with the 2-in. (50-mm) dimension of rubber in contact with the pipe. Position it on the upper bearing (see 11.1.1.2) by the use of wood or metal strips along its outside edges, provided the thickness of the positioning strips does not exceed one half the thickness of the rubber-bearing edge. The rubber-bearing strips may be attached to the bearings by adhesive, if desired, provided such method of attachment results in the strip remaining firmly fixed in position.

11.1.3 *Wood-Bearing Surfaces with Plas-*

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ter-of-Paris Fillets—Test each specimen by the basic three-edge method indicated in Fig. 2.

bearing surfaces shall not have a cross section smaller than 1 in. (25 mm) in either dimension. They shall be straight and securely fastened to the bearing block with their vertical interior sides parallel and spaced a distance apart of approximately 1 in./ft of internal pipe diameter, but in no case less than 1 in.

11.1.3.1 Before the pipe is placed on the bottom bearing, a fillet of plaster of paris thick enough to compensate for the inequalities of the pipe barrel shall be cast on and between the lower-bearing edges. The pipe shall be placed on the fillet while the plaster of paris is still workable, and prior to the time of initial set.

11.1.3.2 The upper-bearing edge shall be the same as that described in 11.1.1.2. A fillet of plaster of paris thick enough to compensate for the inequalities of the pipe barrel shall be cast along the length of the pipe crown. The upper bearing shall be brought in contact with the plaster of Paris while it is still workable and prior to initial set.

11.1.4 *Sand-Bearing Surfaces*—Test each specimen by the basic three-edge method indicated in Fig. 2 except that the wooden surfaces are replaced with sand-bearing surfaces. The sand-bearing edges should be made of heavy canvas duck or woven-cloth hose such as is commonly used for fire hose. They shall have a diameter not less than 2 in. (50 mm) nor more than $2^1/_2$ in. (63 mm) and shall be filled with tightly packed dry sand such as will pass a No. 6 (3.35-mm) sieve conforming to the requirements of Specification E 11. The ends of the bags shall be tightly stitched or fastened to prevent escape of the sand.

11.1.4.1 Use two parallel bags on the bottom bearing spaced a distance of approximately 1 in. (25 mm)/ft of pipe diameter, but in no case less than 1 in. Determine the spacing by measuring between the points of closest approach of the bags before loading. Use a positioning strip between the bags to secure alignment and spacing, provided it is withdrawn before the pipe is tested.

11.1.4.2 Place the top-bearing bag on the crown of the pipe so that its longitudinal center line parallels as nearly as possible the longitudinal axis of the specimen, and bring the top bearing into contact with it.

11.1.5 For all four test methods apply the load at a uniform rate of 2000 ± 500 lbf/min·linear ft (29.2 ± 7.3 kN/min·linear m).

NOTE 1—When the ultimate load exceeds 6000 lbf/linear ft (87.6 kN/linear m), the load may be applied at a rapid rate until 75 % of ultimate is reached. From then on apply the load at the rate of 2000 ± 500 lbf/min·linear ft (29.2 ± 7.3 kN/min·linear m).

11.1.6 Record the load.

11.2 *Sand-Bearing Method:*

11.2.1 When the sand-bearing method is used, carefully bed the specimen for its full length in sand, above and below, for one fourth of the circumference of the pipe measured on the middle line of the barrel. To facilitate placing of the specimen accurately in the sand, mark each end accurately into quarters of the circumference. The depth of the bedding above and below the pipe at the shallowest points shall be one half the mean radius of the barrel.

11.2.1.1 The sand shall be clean natural sand, or crushed hard rock, that will all pass a No. 4 (4.76-mm) sieve conforming to the requirements of Specifications E 11. The sand shall have a moisture content of not less than 5 percent at the time of test. The sand in the lower bearing shall be loose and uncompacted when a specimen is placed on it.

11.2.1.2 The frames of the bearings shall be made of timbers heavy enough to avoid appreciable bending from the side pressure of the sand. The interior surfaces of the frames shall be dressed. No part of the frames shall come in contact with the pipe during the test. A rigid top plate shall be made heavy enough to avoid appreciable bending. Attach a strip of cloth between the frame and the test specimen. Place the frame on the specimen and carefully bed the specimen for its full length in the cloth covered sand for one fourth of the circumference of the pipe. Level the upper surface of the sand in the top bearing with a straightedge and cover the entire frame with the rigid top plate. Apply the rigid top bearing plate used for the three-edge-bearing method to the top of that plate. Apply the load to the top-bearing plate at the center preferably through a spherical head.

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11.2.1.3 Apply the load at a uniform rate of 2000 ± 500 lbf/min·linear ft (29.2 ± 7.3 kN)/min·linear m) (Note 1).

11.3 *V-Shaped Bearing Method:*

11.3.1 Test each specimen by the V-shaped bearing method as indicated in Fig. 3.

11.3.2 The lower press-block consists of a V-shaped support having an included angle of 150 deg, made of metal or hardwood. Interpose strips of rubber of suitable width and length between the press-block and the test piece. The rubber strips shall be 0.6 in. (15 mm) thick and a hardness of 60 ± 5 Shore A durometer.

11.3.3 The flat upper press-block, made of the same material shall have a width of 8 in. (200 mm). Interpose a strip of rubber of suitable width and length between the press-block and the test piece. The rubber strip shall be 0.6 in. (15 mm) thick and a hardness of 60 ± 5 Shore A durometer.

11.3.4 Apply the load at a uniform rate so that failure will occur not less than 15 s and not more than 30 s.

STRAIGHTNESS TEST

12. Significance

12.1 The straightness test covers the measurement of the maximum deviation from straightness of a length of asbestos-cement pipe.

13. Procedure

13.1 Measure the maximum ordinate from the exterior surface of the pipe by placing a straightedge that exceeds the pipe length against the exterior surface and measuring the maximum distance from the exterior pipe surface to the straightedge.

UNCOMBINED CALCIUM HYDROXIDE TEST

14. Significance

14.1 This method covers the measurement of the amount of uncombined calcium hydroxide in asbestos-cement pipe to establish the fact that the pipe has the required chemical resistance. Criteria for suitability to environmental aggressiveness is given in Section 19.

15. Description of Term

15.1 *Uncombined Calcium Hydroxide*—The chemical resistance of the pipe is related to the uncombined calcium hydroxide determined when using this method.

16. Reagents

16.1 *Ammonium Acetate, Standard Solution (1 ml = 0.0066 g $Ca(OH)_2$)*—Dissolve 16.0 g dry crystalline ammonium acetate in 1 litre of absolute or anhydrous ethanol (Note 2). Standardize the solution against calcium oxide (CaO) in accordance with 17.3 and 17.4.

16.1.1 Calculate the calcium hydroxide ($Ca(OH)_2$) equivalent, in grams per millilitre, as follows:

$$Ca(OH)_2 \text{ equivalent, g/ml} = (A \times 1.32)/B$$

where:

A = grams of CaO used, and

B = millilitres of ammonium acetate required for the titration.

NOTE 2—Specially denatured alcohol conforming to Formula No. 30, 3a, or 2b of the U. S. Bureau of Internal Revenue, or alcohol consisting of 95 percent specially denatured alcohol conforming to Formula No. 3a plus 5 percent isopropanol may be substituted.

16.2 *Phenolphthalein Indicator Solution*—Dissolve 1.0 g of phenolphthalein in 100 ml of absolute ethanol (Note 2).

16.3 *Glycerol-Ethanol Solvent (1 + 2)*—Mix 1 volume of glycerol with 2 volumes anhydrous or absolute ethanol (Note 2). To each litre of this solution, add 2.0 ml of phenolphthalein indicator solution. Adjust the solvent to slightly basic with either dilute sodium hydroxide (NaOH) in absolute ethanol (Note 2) or standard ammonium acetate solution, depending on the original pH.

16.4 *Strontium Nitrate* ($Sr(NO_3)_2$).

17. Procedure

17.1 Prepare representative samples of pipe or sleeves and immediately sieve them through a No. 20 (850-μm) sieve. Place the material passing the sieve immediately into a weighing bottle and cover with its ground-glass top.

17.2 Place the bottle, with top removed, in a drying oven at 105 C (220 F) for 2 h, and then cool in a desiccator to room temperature.

17.3 Weigh out 1 ± 0.010 g of the dried sample from a pipe or sleeve to the nearest 0.001 g and place it in a dry 250-ml Erlenmeyer flask. Add a TFE-fluorocarbon encapsulated stirring bar, 60 ml of the glycerol ethanol solvent, and 2.0 g of $Sr(NO_3)_2$. At-

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tach the flask to a water-cooled condenser (with a standard-taper 24/40 glass joint) and place on a hot plate with a magnetic stirrer.

17.4 Boil the solution gently for 30 min with mild stirring. Then remove the flask and filter the mixture on a Büchner funnel under vacuum. Bring the filtrate to a boil and titrate with ammonium acetate solution to a colorless end point. Observe the end point by comparison with a similar mixture containing no phenolphthalein indicator.

18. Calculations

18.1 Calculate the percentage of uncombined $Ca(OH)_2$ in the sample as follows:

$$Ca(OH)_2, \text{ percent} = (AB/C) \times 100$$

where:

A = $Ca(OH)_2$ equivalent of ammonium acetate solution, in grams per millilitre,
B = millilitres of ammonium acetate required for titration of the solution, and
C = grams of sample used.

ENVIRONMENTAL AGGRESSIVENESS

19. Significance

19.1 The maximum limits of uncombined calcium hydroxide permitted by the specifications assure that the pipe will withstand the chemical action encountered in service.

20. Summary of Method

20.1 These sections intend to establish guidelines for the definition of aggressive water and soil environments for the selection of the proper type of asbestos-cement pipe. The aggressive environments caused by internal and external waters, external soil conditions, and (nonacid) soluble sulfate contents of waters and soils should be considered separately even though they may exist in combination.

21. Aggressiveness of Water Transported Through Asbestos-Cement Pipes

21.1 Aggressiveness of water is classified as follows:

Highly aggressive	$pH + \log(AH) < 10.0$
Moderately aggressive	$pH + \log(AH) = 10.0$ to 11.9
Nonaggressive	$pH + \log(AH) \geq 12.0$

where:

pH = index of acidity (or alkalinity) of the water, standard pH units,
A = total alkalinity, ppm as $CaCO_3$, and
H = calcium hardness, ppm as $CaCO_3$.

21.2 *Type of Asbestos-Cement Pipe for Use with Aggressive Waters*—The following table shows the type of pipe to be used with aggressive waters as described in 21.1:

Water	Pipe Recommended
Highly aggressive	[A]
Moderately aggressive	Type II
Nonaggressive	Types I and II

[A] The serviceability of pipe for such applications should be established by the purchaser in conjunction with the manufacturer.

NOTE 3—ASTM Type I and II asbestos-cement pipe may be used where the amount of uncombined calcium hydroxide is unspecified, but generally considered to exceed 1 %. ASTM Type II asbestos-cement pipe should be used where the amount of uncombined calcium hydroxide does not exceed 1.0 %.

22. Aggressiveness of Water External to Asbestos-Cement Pipe

22.1 The following table establishes guidelines for the use of asbestos-cement pipe in nonsulfate acidic soils based upon minimum pH factors alone. Asbestos-cement pipe may or may not perform satisfactorily in acid soil environments having pH values below those listed in this table. To determine the suitability of asbestos-cement pipe in soils having lower pH values, evaluate each situation individually, taking into consideration all aspects of the soil environment that affect its corrosiveness to asbestos-cement pipe:

Water Conditions Within Soil Environment	pH of Acidic Soils When Using Asbestos-Cement Pipe, min	
	Type I	Type II
Essentially quiescent	5.0	4.0
Mildly fluctuating	5.5	5.0
Rapidly moving or grossly cyclic	6.3	5.5

23. Aggressiveness of Nonacidic (pH ≥ 7.0) Soluble Sulfate in Water and Soils

23.1 The following table rates aggressiveness of nonacidic (pH ≥ 7.0) soluble sulfates in water and soils to asbestos-cement pipe:

Sulfate Aggressiveness	SO_4 in Water, ppm	SO_4 in Soil, ppm
Nonaggressive	150 and less	1000 and less
Mildly aggressive	150 to 1500	1000 to 2000
Moderately aggressive	1500 to 10 000	2000 to 20 000
Highly aggressive	10 000 and above	20 000 and above

23.2 The chemical resistance of asbestos-cement pipe to nonacidic acid (pH ≥ 7.0) soluble sulfates in water and soils is as follows:

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Type I pipe	will be attacked to various degrees by all but the nonaggressive levels of sulfate concentrations in waters and soils (see Note 3)[a]
Type II pipe	resistant to all levels of soluble sulfates

24. Aggressiveness of Acid (pH < 7.0) Soluble Sulfate Waters and Soils to Asbestos-Cement Pipe

24.1 Acid-sulfate soils and waters, whether the acid is inorganic or organic, must be evaluated independently of the criteria and guidelines set forth in Sections 22 and 23, taking into consideration soil permeability and other factors. For guidance, consult the manufacturer.

NOTE 4—This same criteria can be applied to appraise the corrosion resistance of other types of asbestos-cement products.

25. Limitations and References

25.1 Special consideration is recommended for services outside these guidelines.

25.2 These guidelines are based on exposures within the temperature range from 40 to 80°F (4 to 27°C). For pipe exposures to temperatures beyond these limits, consult the manufacturer.

[a] Guidelines for sulfate resistance of portland cement products were taken from the *Concrete Manual*, 8th Ed., Bureau of Reclamation, 1975. Sulfate resistance here applies to all soluble sulfates, regardless of the cation.

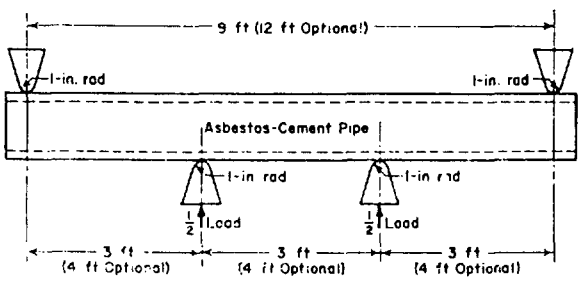


FIG. 1 Assembly for Flexure Strength Test.

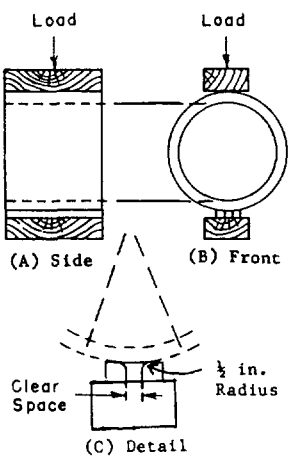


FIG. 2 Assembly for Crushing Strength Test.

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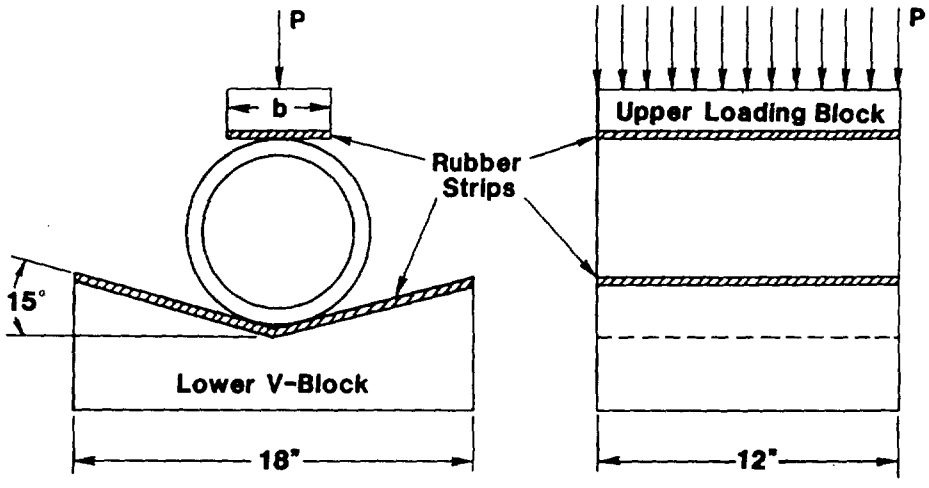


FIG. 3 Assembly for V-Shaped Crushing Strength Test

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, Pa. 19103, which will schedule a further hearing regarding your comments. Failing satisfaction there, you may appeal to the ASTM Board of Directors.

CTD015524

Designation: C 508 – 73

American National Standard A165.2
American National Standards Institute

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Standard Specification for ASBESTOS-CEMENT PERFORATED UNDERDRAIN PIPE[1]

This Standard is issued under the fixed designation C 508; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

1. Scope

1.1 This specification covers perforated asbestos-cement pipe intended for use in subsurface drainage of highways, airports, farms, foundations, and other similar drainage work.

2. Sizes and Types

2.1 Asbestos-cement perforated underdrain pipe furnished under this specification shall be known as "asbestos-cement perforated underdrain pipe." It shall be furnished in nominal inside diameters of 4, 6, 8, 10, and 12 in. The types of pipe shall be known as Type I, II, and III corresponding to the chemical requirements given in Section 8.

NOTE 1—To assist the purchaser in choosing the type of pipe most suitable for his use, the following descriptions of usage may be considered:

Type I—For use where moderately aggressive water and soil of moderate sulfate content are expected to come in contact with the pipe.

Type II—For use where highly aggressive water or water and soil of high sulfate content or both, are expected to come in contact with the pipe.

Type III—For use where contact with aggressive waters and sulfates are not expected.

3. Definitions

3.1 *pipe*—asbestos-cement perforated underdrain pipe as defined in Sections 1, 2, and 4.

3.2 *coupling*—a section for joining asbestos-cement pipe that, when properly installed with the proper accessories, develops a joint equivalent in strength and serviceability to the pipe sections.

3.3 *purchaser*—the actual purchaser of the pipe or his authorized agents acting within the scope of the duties entrusted to them.

4. Manufacture

4.1 Asbestos-cement perforated underdrain pipe shall be composed of an intimate mixture of portland cement or portland blast-furnace slag cement and asbestos fiber with or without silica; or it shall be composed of portland-pozzolan cement and asbestos fiber. The mixture shall be free of organic additives. The material shall be of laminar construction, formed under pressure to a homogeneous structure, and cured to meet the physical and chemical requirements of this specification.

5. Crushing Strength

5.1 Crushing tests shall be conducted before shipment. One foot lengths of pipe cut from unmachined portions of the pipe shall have the minimum crushing strength prescribed in Table 1 when tested in accordance with Methods C 500, Testing Asbestos-Cement Pipe, Section 10.1.1,[2] except that the sample shall contain four circumferential rows of holes with the first row 1½ in. (38.1 mm) from the end. The specimen shall be tested with the line of symmetry of the rows facing downward.

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[1] This specification is under the jurisdiction of ASTM Committee C-17 on Asbestos-Cement Products.

Current edition approved Sept. 27, 1973. Published November 1973. Originally published as C 508 – 63 T. Last previous edition C 508 – 70.

[2] *1974 Annual Book of ASTM Standards*, Part 16

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6. Couplings

6.1 Each standard, short, or random length of pipe shall be provided with a coupling means for the purpose of maintaining alignment and to ensure close joints.

7. Fittings

7.1 Asbestos-cement perforated underdrain pipe fittings shall be suitable in size, crushing strength, and design for the pipe with which they will be furnished.

8. Chemical Requirements

8.1 When tested in accordance with Sections 16 and 17 of Methods C 500, the amount of uncombined calcium hydroxide shall not exceed 3.0 percent for Type I or 1.0 percent for Type II pipe.

NOTE 2—There are no chemical requirements for Type III pipe.

9. Sampling

9.1 All material tested under this specification shall be in a normal processed condition.

9.2 For crushing tests, one full length of pipe shall be selected from each 1300 ft (396.2 m) or fraction thereof, of each size of pipe covered by the order.

9.3 When uncombined calcium hydroxide tests are requested (Section 8), one sample shall be taken from each lot of pipe. The sample to be tested may be taken from any one of the specimens selected for the crushing test.

10. Sizes and Dimensions

10.1 The nominal standard length for asbestos-cement perforated underchain pipe shall be either 10 or 13 ft (3.04 or 3.96 m). A maximum of 15 percent of the total footage of any one size and type for any order may be furnished, at the manufacturer's option, in pipe lengths shorter than specified nominal, but not shorter than 7 ft (2.13 m) these shall be termed random lengths.

10.2 A tolerance of ±1 in. (±25.4 mm) shall apply to nominal standard lengths, and ±6 in. (±152.4 mm) shall apply to random lengths. For billing purposes, random lengths shall be classified to 6-in. (152.4-mm) increments, allowing a tolerance of +4⅞ and −1 in. (+123.8 and −25.4 mm).

10.3 The average inside diameter of the pipe shall be not less than nominal by ¼ in. (6.4 mm) or 1½ percent, whichever greater.

11. Perforations

11.1 Perforations shall be circular holes, ¼ ± 1/16 in. (6.35 ± 1.59 mm) in diameter, arranged in rows parallel to the axis of the pipe. Perforations shall be approximately 3 in. (76.2 mm) center-to-center, along the rows. Rows shall be arranged in two equal groups on either side of the vertical center line of the pipe, and the total number of rows shall be as shown in Table 2. The lowermost rows of perforations in each group shall be separated by an arc of 90 deg and the uppermost rows of perforations in each group shall be separated by an arc of 160 deg. The spacing of rows between these limits shall be uniform. Holes may appear at the ends of short and random lengths.

12. Marking and Shipping

12.1 Each standard and random length of pipe shall be marked by the manufacturer with the trade name, nominal size, type, and the date of manufacture.

12.2 Pipe shall be prepared for commercial shipment so as to ensure acceptance by common or other carriers.

13. Inspection

13.1 All material furnished under this specification shall conform to the requirements stated herein and shall be subjected to the factory inspection and tests prescribed in this specification. When requested by the purchaser in his order, the manufacturer shall notify the purchaser of the time that the inspection and testing will take place so that the purchaser may arrange for witnessing such tests and inspections at his own expense. In lieu of such inspection, when requested, the manufacturer shall be prepared to certify that his product conforms to the requirements of this specification.

13.2 Each pipe shall be inspected by the manufacturer before shipment for compliance with the standards for dimensions, tolerances, workmanship, and finish (see Section 9).

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13.3 In the event of failure of the initial crushing sample to meet the load specified in Table 1, two additional samples shall be se-'ected. Failure of either of the additional amples shall be cause for rejection of the lot. In the event of rejection, the lot may be subdivided into rational subgroups and resampled.

13.4 If the results of the uncombined calcium hydroxide test show that the sample failed to meet the specification requirements, two additional specimens shall be selected and sampled for test. The failure of one of these two additional samples to meet the specification requirements of Section 8 shall be cause for rejection of the lot.

TABLE 1 Crushing Strength

Nominal Size, in.	Crushing Strength lbf/ft (N/m)
4	1000 (14 590)
6	1100 (16 049)
8	1300 (18 967)
10	1400 (20 444)
12	1500 (21 885)

TABLE 2 Perforations

Nominal Size, in.	Rows of Perforations
4	4
6	4
8	4
10	6
12	6

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CTD015527

Designation: C 541 - 75

American National Standard A165.6
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Standard Specification for LINININGS FOR ASBESTOS-CEMENT PIPE[1]

This Standard is issued under the fixed designation C 541; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

1. Scope

1.1 This specification covers requirements for plastic linings to be applied to asbestos-cement pipe, designed for special service in carrying corrosive fluids. This specification also covers methods of testing plastic lining material as well as sections of lined pipe. The requirements established by this specification shall serve as a guide in, but not the sole basis for, judging the suitability of the product for a particular service. The selection of the material should include consideration of performance in similar applications or testing under the intended service condition.

NOTE 1—To determine the suitability of the product for a particular service or corrosive fluid, refer to the manufacturer for specific recommendations.

2. Applicable Documents

2.1 *ASTM Standards:*

C 296 Specification of Asbestos-Cement Pressure Pipe[2]

C 428 Specification for Asbestos-Cement Nonpressure Sewer Pipe[2]

D 543 Test for Resistance of Plastics to Chemical Reagents[3]

3. Definitions

3.1 *pipe*—either asbestos-cement pressure pipe as described in Specification C 296, or asbestos-cement nonpressure sewer pipe as described in Specification C 428.

3.2 *coupling*—a section for joining asbestos-cement pipe that, when properly installed with the proper accessories, develops a joint equivalent in strength and serviceability to the pipe sections.

3.3 *purchaser*—the actual purchaser of the pipe or his agent acting within the scope of duties authorized by the purchaser.

3.4 *plastic lining*—a lining formed from thermoplastic or thermosetting polymer. The term "plastic coating" is synonymous with the term "plastic lining" with respect to composition.

4. Chemical Requirements

4.1 The plastic lining used shall be highly resistant to acids and alkalis, and shall be completely resistant to acids generated by the hydrogen sulfide corrosion cycle.

4.2 The plastic lining shall withstand a 5 weight % sulfuric acid solution and a 5 weight % sodium hydroxide solution, when tested in accordance with 9.1 and 9.2, without degradation or loss of its protective qualities.

4.3 The plastic lining material shall have a weight change not greater than 0.5 % after 7 days immersion and not greater than 0.9 % after 30 days immersion when tested with (*1*) distilled water, (*2*) a 10 weight % sulfuric acid solution, (*3*) a 5 weight % acetic acid solution, and (*4*) a 5 weight % sodium hydroxide solution when tested in accordance with 9.3.

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[1] This specification is under the jurisdiction of ASTM Committee C-17 on Asbestos-Cement Products.

Current edition approved Sept. 26, 1975. Published November 1975. Originally published as C 541 - 64 T. Last previous edition C 541 - 73.

[2] *Annual Book of ASTM Standards*, Part 16.

[3] *Annual Book of ASTM Standards*, Part 35.

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5. Adhesion Requirements

5.1 Thermosetting polymer linings and those thermoplastic linings that do not rely on mechanical means to hold them to the pipe wall shall have a strong permanent bond to the pipe wall. There shall be no sign of blisters, bubbles, peeling, or any other form of separation of the lining from the pipe wall when tested in accordance with Section 10.

6. Dimensions

6.1 Due to abrasion exposure and to provide a measurement as to continuity of the plastic-lined pipe, the thickness of the plastic lining shall be not less than 12 mils (0.012 in.) (0.305 mm) when measured in accordance with Section 11.

7. Workmanship and Finish

7.1 All lined pipe shall be free of runs, sags, blisters, or other imperfections that indicate unprotected areas, or areas where the lining thickness is less than the minimum specified in Section 6.

7.2 *Protection of Couplings and Machined Ends of Pipe*—Surfaces of the pipe ends and coupling areas exposed to corrosive conditions shall be protected with a plastic liner or plastic coating.

8. Inspection, Rejection, and Rehearing

8.1 Each pipe and coupling shall be inspected by the manufacturer, prior to shipment, for compliance with the standards for workmanship and finish. Inspection and testing of the materials by the purchaser shall be as agreed upon by the manufacturer and purchaser at the time of purchase. Instead of such inspection, when requested, the manufacturer shall be prepared to certify that his product conforms to the requirements of this specification.

8.2 If any specimen fails to meet the requirements of Sections 4, 5, or 6, two additional specimens shall be prepared from material manufactured during the same shift and shall be subjected to the test on which failure occurred. The failure of one of these additional specimens to meet the specification requirement shall be cause for rejection of the entire lot of that size and class manufactured during the same shift.

METHODS OF TEST

9. Chemical Resistance Tests

9.1 *Lined Test Specimens, Sulfuric Acid Test*—Fill a standpipe, made from a 1-ft (0.30-m) section of lined pipe plugged at the bottom with an inert material, to 2 in. (50.8 mm) from the top with a 5 weight % solution of sulfuric acid (H_2SO_4). Maintain these conditions for a period of 45 days at room temperature (approximately 75°F (23.9°C)). After 45 days, remove the acid, wash the specimen free of acid, allow to dry, and examine the dry surface of the lining. Any blister in the lining, formed during the test, which exceeds ⅛ in. (3.2 mm) in any dimension shall indicate failure of this test.

9.2 *Lined Test Specimens, Sodium Hydroxide Test*—Fill a standpipe, equivalent to that described in 9.1, to 2 in. (50.8 mm) from the top with a 5 weight % solution of sodium hydroxide (NaOH). Maintain these conditions for a period of 45 days at room temperature (approximately 75°F (23.9°C)). After 45 days, remove the solution and examine the lining. Any cracking, swelling, or other visible degradation shall constitute failure of this test.

9.3 *Lining Material*—Cast 1 by 3 by ⅛-in. (25.4 by 76.2 by 3.2-mm) specimens from the plastic lining material. Completely immerse the specimens in (*1*) distilled (or deionized) water, (*2*) a 10 weight % solution of sulfuric acid, (*3*) a 5 weight % solution of acetic acid, and (*4*) a 5 weight % solution of sodium hydroxide. Test in accordance with Section 7 of Method D 543 for periods of 7 and 30 days at room temperature (approximately 75°F (23.9°C)). Determine the initial and final weight of the specimens to ±0.0005 g and calculate the percentage weight change to the nearest 0.01 %.

10. Adhesion Tests

10.1 All three of the following tests require stave specimens measuring approximately 2 by 6 in. (50.8 by 152.4 mm).

10.1.1 *Four-Hour Boiling*—Immerse a 2 by 6-in. specimen in boiling distilled water for 4

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h. Remove and surface-dry the specimen before examination.

10.1.2 *Four-Day Hot*—Immerse a 2 by 6-in. specimen in distilled water maintained at 150°F (65°C) for 96 h. Remove and surface-dry the specimen before examination.

10.1.3 *Ninety-Day Immersion*—Immerse a 2 by 6-in. specimen in distilled water at room temperature (approximately 75°F) for 90 days. Remove and surface-dry the specimen before examination.

11. Dimensional Measurement

11.1 Carefully remove a section of the lining from the pipe by prying up the lining at the end of the pipe with a sharp tool such as a chisel. Scrape or sand away any cementitious material adhering to the back of the lining before measurement. Using a standard micrometer with a ¼-in. (6.4-mm) ball, measure the thickness at two locations located 90 deg from each other.

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AMERICAN NATIONAL STANDARD ANSI/ASTM C 644 - 77

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Standard Specification for ASBESTOS-CEMENT NONPRESSURE SMALL-DIAMETER SEWER PIPE[1]

This Standard is issued under the fixed designation C 644; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval

1. Scope

1.1 This specification covers asbestos-cement nonpressure sewer pipe for conveying sanitary sewage by gravity flow from point of occupancy to system of disposal.

NOTE 1—The values stated in U.S. customary units are to be regarded as the standard. The metric equivalents of U.S. customary units given in the standard may be approximate.

NOTE 2—Rubber rings suitable for use with this pipe are covered in ASTM Specification D 1869, for Rubber Rings for Asbestos-Cement Pipe.[2]

2. Classification

2.1 Asbestos-cement sewer pipe furnished under these specifications shall be designated as Class 1500, Class 2400, and Class 00, based on the respective crushing strengths, and furnished in 4, 5, and 6-in. (10.2, 12.7, and 15.2-cm) sizes.

2.2 The types of pipe shall be known as Type I and Type II corresponding to the chemical requirements given in Section 6 of this specification.

NOTE 3—To assist the purchaser in choosing the type of pipe most suitable for his use, guidelines for the definition of aggressiveness of water and of soil environments for selection of the proper type of asbestos-cement pipe are covered in Sections 19 to 25 ASTM Methods C 500, Testing Asbestos-Cement Pipe.[3]

3. Definitions

3.1 *pipe* — asbestos - cement nonpressure sewer pipe as defined in Sections 1, 2, and 5.

3.2 *coupling*—a coupling that is manufactured so that, when properly installed, lengths of pipe may be assembled and put into service for which they are intended.

3.3 *fittings*—wyes, tees, adaptors, etc., for use in laying asbestos-cement sewer pipe manufactured as described in Section 5 and made to such dimensions as will provide equivalent strength and tight joints when assembled with the pipe.

3.4 *purchaser*—the actual purchaser of the pipe or his authorized agents acting within the scope of the duties entrusted to them.

3.5 *lot*—those lengths of pipe of that size and class manufactured during the same shift.

4. Basis of Purchase

4.1 It is suggested to the purchaser, without being made a part of this specification, that the purchaser may request inclusion of the following information in his order or agreement for purchase of the pipe:

4.1.1 Any tests, in addition to those prescribed by this specification, as the special circumstances may require,

4.1.2 The place or places where any additional tests are to be made,

4.1.3 Description of the additional testing facilities,

4.1.4 Who shall bear the expense of such additional tests,

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[1] This specification is under the jurisdiction of ASTM Committee C-17 on Asbestos-Cement Products.
Current edition approved Sept. 30, 1977. Published November 1977. Originally published as C 644 - 69. Last previous edition C 644 - 76.

[2] *Annual Book of ASTM Standards*, Part 16

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4.1.5 Whether such additional tests may be made by any reliable sampling process or other method approved by the parties, and

4.1.6 Such other matters as the parties may find desirable to include in their written agreement.

5. Materials and Manufacture

5.1 Asbestos-cement sewer pipe shall be composed of an intimate mixture of portland cement or portland blast-furnace slag cement and asbestos fiber with or without silica, or portland-pozzolan cement and asbestos fiber. The mixture shall be free of organic additives. The material shall be of laminar construction formed under pressure to a homogeneous structure and cured to meet the physical and chemical requirements of this specification.

6. Chemical Requirements

6.1 When tested in accordance with Sections 17 and 18 of ASTM Methods C 500, the amount of uncombined calcium hydroxide shall not exceed 1.0 percent for Type II pipe.

NOTE 4—There are no chemical requirements for Type I pipe.

7. Dimensions and Permissible Variations

7.1 Couplings and coupling area of the pipe shall be machined or otherwise finished to such dimensions as will provide tight joints when assembled with proper accessories and put into service for which the pipe is intended.

7.2 The average diameter may be less than the nominal by not more than $\frac{1}{4}$ in. (0.63 cm).

7.3 The standard lengths may be 5, 6.5, 10, or 13 ft (1.52, 1.98, 3.05 or 3.96 m) ± 1 in. (2.5 cm). At least 85 percent of the total footage of any one class, type, and size, excluding short lengths, shall be furnished in standard lengths. The remaining 15 percent may be in random lengths of not less than 7 ft (2.13 m) when the standard length is 10 or 13 ft (3.05 or 3.96 m) and not less than 4 ft (1.22 m) when the standard length is 5 or 6.5 ft (1.52 or 1.98 m).

8. Workmanship

8.1 The ends of the pipe that receive the coupling shall be free of dents and gouges that will affect the tightness of the joint.

8.2 Each pipe shall be free of bulges, dents, and tears in the inside surface that result in a variation of more than $\frac{1}{16}$ in. (0.48 cm) from the adjacent unaffected portions of the surface.

8.3 Each length of pipe shall not vary in straightness by more than $\frac{1}{16}$ in./ft (5.2 mm/m) of length when the variation is measured in accordance with Section 13 of Methods C 500.

9. Sampling

9.1 For crushing tests, one full length of pipe shall be selected from each 500 lengths of 10 and 13-ft (3.05 and 3.96-m) lengths and each 1000 lengths of 5 and 6.5-ft (1.52 and 1.98-m) lengths of each size, class, and type of pipe covered by the order. One test specimen 12 in. (30.5 cm) long shall be cut from the unmachined portion of the selected length of pipe.

9.2 When uncombined calcium hydroxide tests are requested (Section 6), one sample shall be taken from each lot of pipe. The sample to be tested may be taken from any one of the specimens selected for the crushing test.

9.3 All material tested under this specification shall be in a normal air-dried condition.

10. Test Methods

10.1 *Joint Tightness:*

10.1.1 The tests outlined in this section are considered to be one-time qualification tests to establish the adequacy of the manufacturers joint design. Instead of requiring performance of these tests, the purchaser may require the manufacturer to certify that pipes and couplings equivalent in material and design have passed the tests enumerated in this section. At his own expense, however, the purchaser, by designation with his order, may require that assembled pipes and couplings pass the following performance tests without leakage:

10.1.1.1 *Straight Alignment*—Make hydrostatic pressure test on an assembly of two sections of pipe, properly connected with a coupling in accordance with the joint design. An equivalent alternative may be a single pipe with a coupling on each end. Subject the assembly to an internal hydrostatic pressure of 10 psi (69 kPa) for 10 min. Any visible water leakage shall be considered a failure of the test requirements.

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10.1.1.2 *Maximum Deflected Position*—Upon completion of the test for pipes in ight alignment in accordance with 10.1.1.1, ect the test sections 5 deg with one half of the deflection being between each pipe and the coupling and subject the test sections to an internal hydrostatic pressure of 10 psi (69 kPa) for 10 min. Any visible water leakage shall be considered a failure of the test requirements.

10.1.2 Test one sample of each size unless some other arrangement is made with the purchaser by designation with his order. At the option of the purchaser, the sample of the pipes and couplings to be tested may be selected by him.

10.2 *Flexural Strength:*

10.2.1 Each length of pipe shall have sufficient flexural strength to withstand, without failure, the total load prescribed in Table 1 when tested in accordance with Section 8 of Methods C 500.

10.3 *Crushing Strength:*

10.3.1 *Pipe*—Conduct crushing tests before shipment. One-foot (0.3 m) lengths of pipe cut from unmachined portions of the pipe shall have the minimum crushing strength prescribed in Table 2, when tested in accordance with Section 11.1.1 of Methods C 500.

10.3.2 *Couplings*—The couplings, when assembled on pipe, shall be capable of withding simultaneously:

10.3.2.1 The minimum crushing strength in pounds-force per linear foot prescribed in Table 2, when tested in accordance with 11.1.1 of Methods C 500, and

10.3.2.2 The hydrostatic pressure test described in 10.1.1.1 of this specification.

11. Inspection

11.1 All material furnished under this specification shall conform to the requirements stated herein and shall be subjected to the factory inspection and tests prescribed in this specification. When requested by the purchaser on his order, the manufacturer shall notify the purchaser of the time that the inspection and testing will take place so that the purchaser may arrange for witnessing such tests and inspections at his own expense. Instead of such inspection, when requested, the manufacturer shall be prepared to certify that his product conforms to the requirements of this specification.

11.2 Pipe and coupling shall be inspected by the manufacturer, before shipment, for compliance with the standards for dimensions, workmanship, and finish (see also Section 9).

12. Rejection

12.1 Failure of the specimens tested for crushing strength to withstand 75 percent of the load specified in 10.3 shall be cause for rejection of the entire lot represented by the test specimens. When the specimen tested for crushing strength withstands over 75 percent but under 100 percent of the load specified in 10.3, one specimen shall be cut from each of two additional pipes of the same size and class manufactured during the same shift. Failure of one of these additional specimens to meet the strength requirements of 10.3 shall be cause for rejection of the entire lot of that size and class manufactured during the same shift as the test specimen.

12.2 If the results of the uncombined calcium hydroxide test show the sample failed to meet the specification requirements, two additional specimens shall be selected and sampled for test. The failure of one of these two additional samples to meet the specification requirements of Section 6 shall be cause for rejection of the lot.

13. Marking and Shipping

13.1 Each standard and random length of pipe shall be marked by the manufacturer with the trade name, nominal size, class, and the date of manufacture. Each coupling sleeve shall be marked by the manufacturer with the nominal size and class for the pipe with which it shall be used.

13.2 Pipe and couplings shall be prepared for commercial shipment so as to ensure acceptance by common or other carriers.

14. Field Performance and Acceptance

14.1 All field-assembled joints for asbestos-cement nonpressure small diameter sewer pipe shall meet the requirements set forth in 14.5 for infiltration/exfiltration.

14.2 Measurements shall be based on a

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segment or segments of sewer line of asbestos-cement nonpressure small diameter sewer pipe installed separately or as a part of a sewer main system between two consecutive manholes or other similar increment of distance, rather than taken from a single joint.

14.3 Before the sewer line is backfilled and tested, all pipe shall be inspected for proper bedding to assure uniform support of the pipe, and the absence of high points and irregularities which induce beam and shear loadings on the pipe.

14.4 Final acceptance testing shall be performed on the sewer line(s) after the final backfilling has been completed.

14.5 The infiltration/exfiltration of the installed pipe shall not exceed 0.079 gal/in. of internal pipe diameter per 100 ft of pipelines/h (0.386 litre/cm of internal pipe diameter per 100 m of pipelines per hour), where the maximum hydrostatic head at the center line of the pipe does not exceed 25 ft (7.63 m) (corresponds to 100 gal/in. of pipe diameter per mile per 24 h (92.6 litres/cm of pipe diameter per 1000 m per 24 h).

TABLE 1 Applied Flexural Proof Loads

Nominal Size, in. (mm)	Total Applied Load, lbf (kN)
4 (100)	550 (2440)
5 (125)	950 (3780)
6 (150)	1500 (6680)

TABLE 2 Minimum Crushing Loads

Pipe Class	Crushing Strength, lbf/linear ft ((kN/m)
1500	1500 (21.8)
2400	2400 (35.0)
3300	3300 (48.0)

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Designation: C 663 – 76

American National Standard A165.7
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Standard Specification for ASBESTOS-CEMENT STORM DRAIN PIPE[1]

This Standard is issued under the fixed designation C 663; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

1. Scope

1.1 This specification covers asbestos-cement pipe intended for use in storm-water drainage of highways, airports, farms, foundations, and other similar drainage systems.

NOTE 1—The values stated in U.S. customary units are to be regarded as the standard. The metric equivalents of U.S. customary units may be approximate.

2. Applicable Documents

2.1 *ASTM Standards:*
C 500 Testing Asbestos-Cement Pipe.[2]

3. Classification

3.1 The types of pipe shall be known as Type I and Type II corresponding to the chemical requirements given in 10.1.

3.2 Asbestos-cement storm drain pipe furnished under this specification shall be designated as Class II, III, 2500D, IV, and V. The corresponding strength requirements are prescribed in Table 1. The D load is the crushing test load expressed in pounds-force per linear foot per foot of diameter. (The D_1 load is the crushing test load expressed in newtons per linear metre per metre of diameter.) The pipe shall be furnished in 4, 6, 8, 10, 12, 14, 15, 16, 18, 20, 21, 24, 27, 30, 33, 36, 39, and 42-in. sizes.

NOTE 2—To assist the purchaser in choosing the type of pipe most suitable for his use, guidelines for the definition of aggressiveness of water and of soil environments for selection of the proper type of asbestos-cement pipe are covered in Sections 19 to 25 of Methods C 500.

4. Definitions

4.1 *pipe*—asbestos-cement storm drain pipe as defined in Sections 1, 3, and 5.

4.2 *coupling*—a section for joining asbestos-cement storm drain that when properly installed develops sufficient tightness to prevent the surrounding soil from entering the drain.

4.3 *purchaser*—the actual purchaser of the pipe or his authorized agents, acting within the scope of the duties entrusted to them.

4.4 *lot*—A lot as used herein for pipe 21 in. in diameter and smaller is defined as each 300 lengths of pipe or less, of identical class and size manufactured on each machine during a 24-h period. A lot as used herein for pipe larger than 21 in. in diameter is defined as each 300 lengths of pipe or less, of identical class and size manufactured on each machine during a period of consecutive working days not exceeding 7 days.

5. Manufacture

5.1 Asbestos-cement storm drain pipe shall be composed of an intimate mixture of portland cement or portland blast-furnace slag cement and asbestos fiber with or without silica; or it shall be composed of portland-pozzolan cement and asbestos fiber. The mixture shall be free of organic additives. The material shall be of laminar construction formed under pressure to a homogeneous structure and cured to meet the physical and chemical requirements of this specification.

[1] This specification is under the jurisdiction of ASTM Committee C-17 on Asbestos-Cement Products.
Current edition approved May 28, 1976. Published July 1976. Originally published as C 663 – 70. Last previous edition C 663 – 73a.

[2] *Annual Book of ASTM Standards*, Part 16.

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6. Dimensions and Permissible Variations

6.1 The nominal length for asbestos-cement storm drain pipe shall be either 10 or 13 ft (3.05 or 3.96 m). A maximum of 15 percent of the total footage of any one size and type for any order may be furnished, at the manufacturer's option, in pipe lengths shorter than specified nominal, but not shorter than 7 ft (2.13 m); these shall be termed random lengths.

6.2 A tolerance of ±1 in. (25 mm) shall apply to nominal standard lengths. Random lengths shall be classified to 6-in. (152-mm) increments, allowing a tolerance of $+4^{7}/_{8}$ in. (124 mm) and −1 in.

6.3 The average inside diameter of the pipe may be less than the nominal size by not more than $^{1}/_{4}$ in. (6 mm) or $1^{1}/_{2}$ percent, whichever is greater.

7. Sampling

7.1 All material tested under this specification shall be in air-dried condition.

7.2 For crushing tests, select one full length of pipe from each lot of each size, class, and type of pipe covered by the order. Cut one test specimen 12 in. (305 mm) long from the unmachined portion of the selected length of pipe.

7.3 When uncombined calcium hydroxide tests are requested (10.1), take one sample from each lot of pipe and test in accordance with Sections 17 and 18 of Methods C 500. The sample to be tested may be taken from any one of the specimens selected for the crushing test.

8. Couplings

8.1 Each standard, short, or random length of pipe shall be provided with a coupling means for the purpose of maintaining alignment and to ensure close joints.

9. Fittings

9.1 Asbestos-cement storm drain pipe fittings shall be suitable in size, crushing strength, and design for the pipe with which they will be furnished.

10. Test Methods

10.1 *Chemical Requirements*—When tested in accordance with Sections 17 and 18 of Methods C 500, the amount of uncombined calcium hydroxide shall not exceed 1.0 percent for Type II pipe.

NOTE 3—There are no chemical requirements for Type I pipe.

10.2 *Crushing Strength*—Conduct crushing tests before shipment. One-foot (305-mm) lengths of pipe cut from unmachined portions of the pipe shall have the minimum crushing strength prescribed in Table 1 when tested in accordance with Section 11.1.1 of Methods C 500.

11. Inspection

11.1 All material furnished under this specification shall conform to the requirements stated herein and shall be subjected to the factory inspection and tests prescribed in this specification. When requested by the purchaser in his order (see Appendix X1), the manufacturer shall notify the purchaser of the time that the inspection and testing will take place so that the purchaser may arrange for witnessing such tests and inspections at his own expense. Instead of such inspection, when requested, the manufacturer shall be prepared to certify that his product conforms to the requirements of this specification.

11.2 Each pipe shall be inspected by the manufacturer before shipment for compliance with the standards for dimensions, tolerances, workmanship, and finish (see also Section 7).

12. Rejection

12.1 Failure of any specimen tested for crushing strength to withstand 75 percent of the load specified in 10.2 shall be cause for rejection of the lot from which the test specimen was taken. When any specimen tested for crushing strength withstands over 75 percent but under 100 percent of the load specified in 10.2, one specimen shall be cut from each of two additional pipes of the same lot. Failure of either of these additional specimens to meet the strength requirements of 10.2 shall be cause for rejection of the entire lot from which the original sample was taken.

12.2 If the results of the uncombined cal-

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cium hydroxide test show that the sample failed to meet the specification requirements, two additional specimens shall be selected and mpled for each test. The failure of one of nese two additional samples to meet the specification requirements of 10.1 shall be cause for rejection of the lot.

13. Marking and Shipping

13.1 Each standard and random length of pipe shall be marked by the manufacturer with the trade name, nominal size, class, and the date of manufacture.

13.2 Couplings and fittings shall be marked with the size and class.

13.3 Pipe, couplings, and fittings shall be prepared for commercial shipment so as to ensure acceptance by common or other carriers.

TABLE 1 Minimum Crushing Load

Pipe Class	Crushing Strength D Load, lbf/ft	Crushing Strength D_1 Load, kN/m
II	1500	21.9
III	2000	29.2
2500D	2500	36.5
IV	3000	43.8
V	3750	54.7

APPENDIX

X1. ADDITIONAL ORDERING INFORMATION

X1.1 It is suggested to the purchaser, without being made a part of this specification, that the purchaser may request inclusion of the following information in his order or agreement for purchase of the pipe:

X1.1.1 Any tests, in addition to those prescribed this specification, as the special circumstances y require,

X1.1.2 The place or places where any additional tests are to be made,

X1.1.3 Description of the additional testing facilities,

X1.1.4 Who shall bear the expense of such additional tests,

X1.1.5 Whether such additional tests may be made by any sound sampling process or other method approved by the parties, and

X1.1.6 Such other matters as the parties may find desirable to include in their written agreement.

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Designation: C 668 – 76

American National Standard A165.8-1974
Approved Dec. 23, 1974
By American National Standards Institute

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Standard Specification for ASBESTOS-CEMENT TRANSMISSION PIPE[1]

This Standard is issued under the fixed designation C 668; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

1. Scope

1.1 This specification covers asbestos-cement transmission pipe intended for use in transmission systems that carry fluids under pressure. A transmission system consists of pipe lines which convey fluids from their source to a point of distribution or discharge. The system is characterized by relatively steady flow and few appurtenances, thereby permitting reasonable hydraulic analysis, including surge analysis.

NOTE 1—The values stated in U.S. customary units are to be regarded as the standard. The metric equivalents of U.S. customary units may be approximate.

NOTE 2—This specification is issued for product standardization and purchasing purposes only, and does not include requirements for installation or the relationships between operating conditions and the strength characteristics of the various classifications pipe. The purchaser is cautioned that he must relate installation and operating conditions with the specified characteristics of the pipe.

2. Applicable Documents

2.1 *ASTM Standards:*

C 500 Testing Asbestos-Cement Pipe.[2]

D 1869 Specification for Rubber Rings for Asbestos-Cement Pipe.[2]

3. Classification

3.1 Asbestos-cement pipe furnished under this specification shall be manufactured in Classifications 30, 35, 40, 45, 50, 60, 70, 80, and 90. The classifications represent one tenth of the minimum hydrostatic strength.

3.2 The types of pipe shall be known as Type I and Type II corresponding to the chemical requirements in Section 7 of this specification.

NOTE 3—To assist the purchaser in choosing the type of pipe most suitable for his use, guidelines for the definition of aggressiveness of water and of soil environments for selection of the proper type of asbestos-cement pipe are covered in Sections 19 to 25 of Methods C 500.

4. Definitions

4.1 *pipe*—asbestos-cement transmission pipe as defined in Sections 1, 3, and 5.

4.2 *coupling*—a section for joining asbestos-cement pipe that, when properly installed with the proper accessories, develops a joint equivalent in strength and serviceability to the pipe sections.

4.3 *purchaser*—the actual purchaser of the pipe or his authorized agents acting within the scope of the duties entrusted to them.

4.4 *lot*—A lot as used herein for pipe 21 in. in diameter and smaller is defined as each 300 lengths of pipe or less, of identical class and size manufactured on each machine during a 24-h period. A lot as used herein for pipe larger than 21 in. in diameter is defined as each 300 lengths of pipe or less, of identical class and size manufactured on each machine during a period of consecutive working days not exceeding 7 days.

5. Manufacture

5.1 Asbestos-cement pipe furnished under this specification shall be composed of an intimate mixture of portland cement or portland blast-furnace slag cement and asbestos fiber

[1] This specification is under the jurisdiction of ASTM Committee C-17 on Asbestos-Cement Products.
Current edition approved May 28, 1976. Published July 1976. Originally published as C 668 – 70. Last previous edition C 668 – 73b.

[2] *Annual Book of ASTM Standards*, Part 16.

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with or without silica; or it shall be composed of portland-pozzolan cement and asbestos fiber. The mixture shall be free of organic additives. The material shall be of laminar construction formed under pressure to a homogeneous structure and cured to meet the physical and chemical requirements of this specification.

6. Rubber Rings

6.1 The rubber rings used to seal the joints of the asbestos-cement pipe shall conform to the requirements of the latest revision of Specification D 1869.

7. Chemical Requirements

7.1 When uncombined calcium hydroxide tests are requested, one sample shall be taken from each lot of pipe and tested in accordance with Sections 17 and 18 of Methods C 500. The sample to be tested may be taken from one of the specimens selected for the crushing test. The amount of uncombined calcium hydroxide shall not exceed 1.0 percent for Type II pipe.

NOTE 4—There are no chemical requirements for Type I pipe.

8. Hydrostatic Strength

8.1 Each standard, random, or short length of pipe (see Section 11) and each coupling sleeve, when manufactured from the same material as the pipe, shall be hydrostatically tested by the manufacturer prior to shipment and shall have sufficient strength to withstand the internal hydrostatic pressure prescribed in Table 1, when tested in accordance with Section 5 of Methods C 500.

8.2 From each lot of pipe which has passed the routine hydrostatic proof test, one length shall be selected by the inspector. A 12-in. (305-mm) or longer section of pipe cut from an unmachined portion of the selected length shall have the minimum hydrostatic strength designated in Table 2, when tested in accordance with Section 5 of Methods C 500, except that the pressure need not be held for 5 s.

9. Flexural Strength

9.1 Each length of pipe in sizes 6 and 8 in. nominal diameter having lengths 10 ft (3.05 m) or longer shall have sufficient flexural strength to withstand without failure the total load prescribed in Table 3 when tested in accordance with Section 8 of Methods C 500.

10. Crushing Strength

10.1 From each lot, one length shall be selected by the inspector. A 1-ft (305-mm) section of pipe cut from an unmachined portion of the selected length shall have the minimum crushing strength prescribed in Table 4 when tested in accordance with Section 11.1.1 of Methods C 500.

11. Dimensions and Permissible Variations

11.1 Couplings and coupling areas of pipe shall be machined or otherwise finished to such dimensions as will provide tight joints when assembled with the proper accessories and put into service for which the pipe is intended.

11.2 Pipe shall be manufactured with nominal inside diameters of 6, 8, 10, 12, 14, 15, 16, 18, 20, 21, 24, 27, 30, 33, 36, 39, and 42 in. in the classifications defined in 3.1, except 6-in. diameter pipe shall be of Classification 40 through 90 only. The average diameters of standard and random lengths may be less than the nominal inside diameter by not more than 5.0 percent, when measured approximately 3 in. (75 mm) from the end.

11.3 The standard length shall be 13 ft ± 1 in. (3.96 m ± 25 mm). Alternative standard lengths shall be 10 ft ± 1 in. (3.05 m ± 25 mm) for 6-in. pipe and 16 ft ± 1 in. (4.88 m ± 25 mm) for 14-in. and larger pipe. At least 85 percent of the total footage of pipe of any one classification, type, and size, excluding short lengths, shall be furnished in standard lengths. The remaining 15 percent may be in random lengths of not less than 7 ft (2.13 m). Short lengths, when specifically ordered, shall not exceed 6¾ ft (2.06 m).

12. Workmanship and Finish

12.1 Machined ends of the pipe that receive the coupling shall be free of dents and gouges that will affect the tightness of the joint.

12.2 Each pipe shall be free of bulges, dents, and tears in the inside surface that result in a variation in diameter of more than

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$^{3}/_{16}$ in. (5 mm) from that obtained on adjacent unaffected portions of the surface.

13. Sampling

13.1 All samples shall be in a normal air-dried condition when tests are initiated.

14. Inspection and Rejection

14.1 All material furnished under this specification shall conform to the requirements stated herein and shall be subjected to the factory inspection and tests prescribed in this specification. When requested by the purchaser in his order (see Appendix X1), the manufacturer shall notify the purchaser of the time that the inspection and testing will take place so that the purchaser may arrange for witnessing such tests and inspections at his own expense. Instead of such inspection, when requested, the manufacturer shall be prepared to certify that his product conforms to the requirements of this specification.

14.2 Pipe and couplings shall be inspected by the manufacturer, before shipment, for compliance with the standards for dimensions, and workmanship, and finish (See also Sections 7 to 10).

14.3 Failure of any specimen tested for crushing strength to withstand 75 percent of the load specified in Section 10 shall be cause for rejection of the lot from which the test specimen was taken. When any specimen tested for crushing strength withstands over 75 percent but under 100 percent of the load specified in Section 10, one specimen shall be cut from each of two additional pipes of the same lot. Failure of either of these additional specimens to meet the strength requirements of Section 10 shall be cause for rejection of the entire lot from which the original sample was taken.

14.4 If any pipe subjected to the hydrostatic strength test described in 8.2 fails to withstand the pressure specified, two additional lengths of the same size and classification shall be selected from the pipe manufactured during the same shift and shall be subjected to the specified pressure. The failure of one of these additional lengths to withstand the specified pressure shall be cause for rejection of the entire lot of that size and classification manufactured during the same shift as the test lengths.

14.5 If the results of the uncombined calcium hydroxide test shows that the sample failed to meet the specification requirements, two additional specimens shall be selected and sampled for test. The failure of one of these two additional samples to meet the specification requirements of Section 7 shall be cause for rejection of the lot.

15. Marking and Shipping

15.1 Each standard and random length of pipe shall be marked by the manufacturer with the trade name, nominal size, classification, and date of manufacture. The trade name shall include, but is not limited to, the manufacturer's name or trademark and the words "Transmission Pipe." Each coupling sleeve, if made of the same material as the pipe, shall be marked by the manufacturer with the nominal size, classification, and the letter "T" to indicate that it has been hydrostatically tested.

15.2 Pipe and couplings shall be prepared for commercial shipment so as to ensure acceptance by common or other carriers.

TABLE 1 Applied Hydrostatic Proof Pressures[A]

Pipe Classification	Pressure, min psi (MPa)
30	225 (1.55)
35	262 (1.81)
40	300 (2.07)
45	337 (2.32)
50	375 (2.58)
60	450 (3.10)
70	525 (3.62)
80	600 (4.13)
90	675 (4.65)

[A] The pressures and classifications indicated apply to all sizes.

TABLE 2 Minimum Hydrostatic Strength[A]

Pipe Classification	Pressure, psi (MPa)
30	300 (2.07)
35	350 (2.41)
40	400 (2.76)
45	450 (3.10)
50	500 (3.44)
60	600 (4.13)
70	700 (4.82)
80	800 (5.51)
90	900 (6.20)

[A] The pressures and classifications indicated apply to all sizes.

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TABLE 3 Minimum Applied Flexural Proof Loads, lbf (kN)

Nominal Size, in	Pipe Classification								
	30	35	40	45	50	60	70	80	90
6	...	...	2300 (10.23)	2500 (11.12)	2800 (12.45)	3200 (14.23)	3700 (16.46)	4000 (17.79)	4900 (21.80)
8	3700 (16.46)	4400 (19.57)	5100 (22.68)	5700 (25.35)	6400 (28.47)	6900 (30.69)	7600 (33.80)	8800 (39.14)	10100 (44.92)

TABLE 4 Minimum Crushing Strength, lbf/linear ft

Nominal Size, in.	Pipe Classification								
	30	35	40	45	50	60	70	80	90
6			2400	3200	4000	4700	5400	6700	9000
8	2000	2400	2800	3400	4000	4800	5500	7400	9300
10	2000	2500	3000	3500	4500	5500	7000	9000	11000
12	2000	2500	3000	4000	5200	6400	7800	10000	12200
14	2000	2500	3000	4000	5200	7000	8800	11000	13500
15	2300	2800	3300	4300	5500	7400	9300	12000	14500
16	2500	3000	3500	4500	5800	7500	9500	12400	15400
18	2500	3000	4000	5000	6500	8500	11000	14000	18000
20	2500	3500	4500	5500	7100	9500	12000	15000	20000
21	2500	3500	4500	5800	7300	9700	12500	16000	21000
24	2800	3800	5000	6200	8100	11000	15000	19000	24000
27	3500	4200	5500	7000	8800	12500	16500	20500	27000
30	3500	4500	6000	7500	9700	13500	18000	22500	30000
33	3500	5000	6500	8000	10500	14500	19500	24500	33000
36	4000	5000	7000	9000	11200	16000	21000	26000	36000
39	4200	5300	7500	9700	12000	17200	22500	28000	39000
42	4300	5700	8000	10500	13000	18500	24000	30000	42000

TABLE 4A Minimum Crushing Strength, N/linear m

Nominal Size, in.	Pipe Classification								
	30	35	40	45	50	60	70	80	90
6	...	..	35.0	46 7	58.4	68.6	78.8	97.8	131.3
8	29.2	35.0	40.9	49.6	58.4	70.1	80.3	108.0	135.7
10	29.2	36.5	43.8	51.1	65.7	80.3	102.2	131.3	160.5
12	29.2	36.5	43.8	58.4	75.9	93.4	113.8	145.9	178.0
14	29.2	36.5	43.8	58.4	75.9	102.2	128.4	160.5	197.0
15	33.6	40.9	48.2	62.8	80.3	108.0	135.7	175.1	211.6
16	36.5	43.8	51.1	65.7	84.7	109.5	138.6	181.0	224.7
18	36.5	43.8	58.4	73.0	94.9	124.0	160.5	204.3	262.7
20	36.5	51.1	65.7	80.3	103.6	138.6	175.1	218.9	291.9
21	36.5	51.1	65.7	84.6	106.5	141 6	182.4	233.5	306.5
24	40.9	55.5	73.0	90.5	118.2	160.5	218.9	277.3	350.3
27	51.1	61.3	80.3	102.2	128.4	182.4	240.8	299.2	394.0
30	51.1	65.7	87.6	109.5	141.6	197 0	262.7	328.4	437.8
33	51.1	73.0	94.9	116.8	153.2	211.6	284.6	357.6	481.6
36	58.4	73.0	102.2	131.3	163.5	233.5	306.5	379.4	525.4
39	61.3	77.3	109.5	141 6	175.1	251.0	328.4	408.6	569.2
42	62.8	83.2	116.8	153.2	189.7	270.0	350.3	437.8	612.9

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APPENDIX

X1. ADDITIONAL PURCHASE ORDER OPTIONS

X1.1 It is suggested to the purchaser, without being made a part of this specification, that the purchaser may request inclusion of the following information in his order or agreement for purchase of the pipe:

X1.1.1 Any tests, in addition to those prescribed by this specification, as the special circumstances may require,

X1.1.2 The place or places where any additional tests are to be made,

X1.1.3 Description of the additional testing facilities,

X1.1.4 Who shall bear the expense of such additional tests,

X1.1.5 Whether such additional tests may be made by any sound sampling process or other method approved by the parties, and

X1.1.6 Such other matters as the parties may find desirable to include in their written agreement.

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Designation: D 1869 – 66'

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Standard Specification for RUBBER RINGS FOR ASBESTOS-CEMENT PIPE[1]

This Standard is issued under the fixed designation D 1869, the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

'NOTE 1—Editorial changes, including metric equivalents, were made in May 1967.
NOTE 2—In 1.2, "natural and synthetic" was changed to "natural or synthetic" in November 1970.

1. Scope

1.1 This specification covers rubber rings used to seal the joints of asbestos-cement pipe conforming to ASTM Specifications C 296, for Asbestos-Cement Pressure Pipe[2] and C 428, for Asbestos-Cement Non-Pressure Sewer Pipe.[2]

1.2 A specification is given for (*1*) natural or synthetic rubber rings, or both, where resistance to oil or solvents is not required, and (*2*) synthetic rubber rings for services involving resistance to oil or solvents.

NOTE 1—The values stated in U.S. customary units are to be regarded as the standard. The metric equivalents of U.S. customary units may be approximate.

2. Composition and Manufacture

2.1 The ring shall consist of a properly vulcanized virgin rubber compound. Virgin rubber is defined as one containing no scrap, reclaim, or rubber substitutes.

2.2 If a joint is used in the manufacture of the ring, the strength of the joint shall be such that the ring will withstand the stretch test described in 7.8 with no visible separation or peeling.

3. Physical Requirements

3.1 Sample rings taken from the shipment shall conform to the requirements for physical properties prescribed in Table 1 when tested in accordance with the methods specified in Section 7.

4. Dimensions and Tolerances

4.1 The rings shall conform to the dimensions specified by the manufacturer of the pipe in which the rings are to be used, with a RMA Class 3 tolerance of ±0.25 up to 25 mm (±0.010 up to 1 in.) on all cross-section dimensions, and ±1 percent on all diametral dimensions, unless otherwise agreed upon by the pipe manufacturer and the ring supplier.

NOTE 2—The design and tolerances of asbestos-cement pipe are not sufficiently standardized to permit interchangeability of rings in many cases from pipe of one manufacturer to that of another.

5. Workmanship

5.1 The surface shall be smooth and free from pitting, cracks, blisters, air marks, and any other imperfection that would affect its behavior in service. The body shall be free from porosity and air pockets.

5.2 The flash thickness shall not exceed 0.4 mm (0.015 in.), nor the flash width 0.8 mm (0.03 in.) at any point in the ring.

5.3 Offset, or failure of the mold to register accurately, shall not exceed 0.4 mm (0.015 in.)

6. Sampling

6.1 A number of sample rings shall be drawn at random from each shipment of rings in accordance with Table 2.

6.2 These shall be stretched and examined as specified in 7.8. A sufficient additional number of rings shall be drawn at random for the tests specified in Table 1.

[1] This specification is under the jurisdiction of ASTM Committee D-11 on Rubber and Rubber-Like Materials. This standard is the direct responsibility of Subcommittee D-11.36 on Seals.

Current edition effective Sept. 20, 1966. Originally issued 1961. Replaces D 1869 - 63 T.

[2] *Annual Book of ASTM Standards*, Part 12.

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7. Methods of Test

7.1 *Tensile Strength, Elongation, and Stress at 300 percent Elongation*—ASTM Method D 412, Tension Testing of Vulcanized Rubber:[3]

7.1.1 Cut samples for tensile strength, elongation, and stress at 300 percent elongation tests from circumferential sections of the ring itself.

7.1.2 From these samples stamp dumbbell test specimens using a standard ASTM Type C dumbbell conforming to Fig. 1 of Method D 412.

7.1.3 The sections from which the dumbbells are cut may be prepared by sectioning a sample ring held rigidly in a jig, which in turn is mounted in a chuck of a machinist's lathe. A sharp, thin cutting knife should be mounted in the lathe holder and the cut made at a right angle to the jig face. The cutting site should be lubricated at all times by a jet of cool water.

7.1.4 These sections may be buffed lightly prior to cutting into dumbbell specimens in order to bring them to a uniform thickness for testing.

7.2 *Hardness:*

7.2.1 ASTM Method D 1415, Test for International Hardness of Vulcanized Rubbers,[3] shall be used as the referee method.

7.2.2 ASTM Method D 2240, Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer,[3] may be used for quality control.

7.2.3 Hardness readings for guidance purposes may be taken directly on the ring, recognizing that those may vary slightly from those taken on dumbbell specimens.

7.3 *Oven Aging: Tensile Strength, Elongation, and Hardness:*

7.3.1 ASTM Method D 573, Test for Accelerated Aging of Vulcanized Rubber by the Oven Method,[3] in conjunction with Methods D 412 and D 1415 or D 2240. Prepare test specimens in accordance with 7.1.

7.3.2 Age nonoil resistant specimens for 168 h at 70 ± 2 C.

7.3.3 Age oil-resistant specimens for 70 h at 100 ± 2 C.

7.4 *Water Aging: Volume and Appearance Change:*

7.4.1 Cut one specimen 50 ± 3 mm (2.0 ± 0.1 in.) long and not less than 13 mm^2 (0.2 $in.^2$) in cross section from each of three rings.

7.4.2 Totally immerse the specimens in t' siphon cup of an insulated 3-liter extractio. apparatus, and hold at a temperature of 100 ± 2 C for 20 consecutive days. Suspend the specimens at least 50 mm (2 in.) beneath the surface of the water in such a manner that they do not contact one another or the surface of the cup.

7.4.3 Immediately after removal from the boiling water, blot the specimens, weigh and calculate the volume increase in accordance with ASTM Method D 471, Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids.[3]

7.4.4 Average the values obtained for the three specimens.

7.5 *Compression Set:*

7.5.1 Method B of ASTM Methods D 395, Test for Compression Set of Vulcanized Rubber,[3] except cut three specimens from separate rings about 75 mm (3 in.) in length and the full cross-sectional area of the ring in a compression device 50 mm long.

7.5.1.1 Place the specimens in the compression device with the inside and outside circumference sides in contact with the compression plates.

7.5.1.2 If this is impractical because of the size or shape of the specimens, they may be placed in the compression device in a manne- that will give the most accurate values.

7.5.2 Make a reference measurement at any convenient point where the section is solid and compress the specimen 50 percent at the reference point, using spacers.

7.5.3 Oven age nonoil resistant specimens for 22 h at 70 ± 2 C.

7.5.4 Oven age oil-resistant specimens for 22 h at 100 ± 1 C.

7.6 *Low-Temperature Flexibility:*

7.6.1 ASTM Method D 746, Test for Brittleness Temperature of Plastics and Elastomers by Impact.[3]

7.6.2 Prepare test specimens in accordance with 7.1.2 through 7.1.5. The temperature of test shall be −25 ± 2 C.

---

[3] *Annual Book of ASTM Standards*, Part 28.

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7.7 *Oil Aging: Tensile Strength, Elongation, Hardness, and Volume Change:*

7.7.1 ASTM Method D 471, Test for ange in Properties of Elastomeric Vulcani-zates Resulting from Immersion in Liquids.[1]

7.7.2 Prepare test specimens for tensile strength, elongation, and hardness tests in accordance with 7.1.2 through 7.1.5.

7.7.3 Prepare specimens for the volume change test in accordance with 7.4.1.

7.7.4 Immerse the specimens in ASTM Oil No. 3 for 70 h at 100 ± 2 C.

7.8 *Stretch Test for Visual Examination:*

7.8.1 Stretch the rings until the circumference has increased 50 percent.

7.8.2 Inspect each ring visually for defects in accordance with 2.2 and 5.1.

7.8.3 The number of rings to be examined and the maximum number of defective rings for acceptance of the lot is shown in Table 2.

8. Markings and Color Coding

8.1 Each ring shall be marked with clearly legible letters, the size of which shall not exceed 6 mm ($^1/_4$ in.).

8.2 The markings shall include the ring manufacturer's name or symbol, the pipe manufacturer's name or symbol, the pipe size and pressure rating, and the year of manufacture.

8.3 Each oil-resistant synthetic rubber ring shall be marked with a color stripe, dot, or other identifying mark to distinguish this ring from the nonoil resistant type.

8.3.1 The shape and color of the mark shall be as specified by the manufacturer of the pipe in which the ring is to be used.

TABLE 1 Physical Requirements of Rubber Rings for Asbestos-Cement Pipe

Test	Type of Rubber Ring	
	Nonoil Resistant	Oil-Resistant
Original Properties.		
Tensile strength, min, kgf/cm² (psi)		
Average of three specimens	140 (2000)	105 (1500)
Lowest individual	125 (1800)	90 (1300)
Elongation, min, percent.		
Average of three specimens	350	325
Lowest individual	325	300
Hardness, durometer number[a]	nominal ± 5	nominal ± 5
Stress at 300 percent elongation, kgf/cm² (psi)		
Max	160 (2300)	160 (2300)
Min	85 (1200)	70 (1000)
Compression set, max, percent	16	25
Low-temperature flexibility	no cracks	no cracks
After Oven Aging:		
Tensile strength, average decrease, max, percent	15	20
Elongation, average decrease, max, percent	25	30
Hardness, average increase, max, points	7	15
After Water Aging:		
Volume change, max, percent	12	12
Appearance change	no surface degradation	no surface degradation
After Oil Aging:		
Tensile strength, average decrease, max, percent		35
Elongation, average decrease, max, percent		40
Hardness, average change, points		−10 to +2
Volume change, average, percent		−1 to +15

[a] Nominal hardness shall be from 50 to 60 as specified by the pipe manufacturer

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TABLE 2 Sampling Plan for Stretch Test for Visual Inspection

Number of Rings in Shipment	Number of Rings in Sample	Maximum Number of Defectives for Acceptance
Up to 800	75	4
801 to 3 200	150	8
3 201 to 8 000	225	11
8 001 to 22 000	300	14

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ANNEX

American Water Works Association

ANSI/AWWA C603-78

(Revision of
AWWA C603-65)

AWWA STANDARD

for

INSTALLATION OF ASBESTOS-CEMENT PRESSURE PIPE

AMERICAN NATIONAL STANDARD

First edition approved by AWWA Board of Directors Jan. 27, 1964.
This edition approved Jan. 28, 1978.

Approved by American National Standards Institute, Inc., Apr. 10, 1978.

AMERICAN WATER WORKS ASSOCIATION
6666 West Quincy Avenue, Denver, Colorado 80235

CTD015547

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J. L. WARDEN, *Vice-Chairman*
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* Alternate

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Foreword

This foreword is for information only and is not part of AWWA C603.

I. History of Standard

A new pipe material consisting of an intimate mixture of portland cement and asbestos fibers was introduced into the North American market in 1931 following several years of usage in other countries, particularly Italy.

In the ensuing years this type of pipe gained popularity, and in 1949 AWWA established a committee on standard specifications for asbestos–cement pipe under the chairmanship of S.M. Clarke of Greeley and Hanson, Chicago.

The committee developed a standard for asbestos–cement water pipe which was approved by the AWWA Board of Directors as *tentative* (AWWA C400–53T) May 15, 1953. In 1958 the committee was reactivated as Committee 8340D on Asbestos–Cement Pipe under the chairmanship of Roy H. Ritter, Whitman, Requardt and Associates, Baltimore.

The committee concluded that an installation guide was desirable to bring to the attention of users certain important requirements on the inspection, handling, installation, and field testing of asbestos–cement pressure pipe. In 1963 the committee submitted its final draft which received approval as *tentative* (AWWA C603–64T) Jan. 27, 1964. It was advanced to *standard* (AWWA C603–65) without revision Aug. 9, 1965.

In early 1968 the committee was reactivated as the Standards Committee on Asbestos–Cement Pressure Pipe to review and revise all AWWA standards on asbestos–cement pipe. The committee considered numerous recommendations for changes resulting in this current standard that has a completely revised format and takes into account various users' bedding methods.

II. Information Regarding Use of This Standard

If AWWA C603 is to be used in its published form, the engineer should prepare and include as part of the project specifications an addendum entitled, "Addendum to the Standard for Installation of Asbestos–Cement Pressure Pipe." Since the standard includes the various standard materials and methods that may be used, the engineer should select the materials and methods that apply to the project and, by reference to the sections in AWWA C603, indicate in the addendum those that are applicable or not. The engineer should include in the addendum information pertaining to subject matter referred to in certain sections of the standard that cannot therein be covered completely and made applicable to all projects. The engineer may also include in the addendum information that covers work and materials not included in the standard.

Although installation of pipe that is laid on earth mounds is included in this standard, caution should be exercised, particularly in small sizes, to ensure (1) that proper clearance is maintained between the pipe or coupling and the trench bottom, and (2) that after pipe placement, the earth beneath the entire length of the pipe including the coupling is properly placed beneath the pipe and is compacted to a uniform density.

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III. Major Revisions

The major changes from the 1965 standard made in this revision are:

1. A change in the title calling for "Installation of Asbestos–Cement *Pressure* Pipe" instead of *water* pipe. Therefore, this standard covers both asbestos–cement distribution pipe (AWWA C400) and asbestos–cement transmission pipe (AWWA C402).

2. A major change in format so as to follow "Procedures and Style for Preparation of AWWA Standards."

3. The inclusion of notes in paragraph 3.2.3, Preparation of Trench, to give further assistance in the installation of asbestos–cement pressure pipe.

4. A revision to the section, Pressure and Leakage Tests, to include both asbestos–cement distribution pipe (AWWA C400) and asbestos–cement transmission pipe (AWWA C402).

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American Water Works Association

AWWA C603–78

(Revision of
AWWA C603–65)

AWWA Standard for

Installation of Asbestos–Cement Pressure Pipe

Section 1—General

Sec. 1.1 Scope

This standard covers the installation of water pipelines of asbestos–cement pressure pipe with fittings and appurtenances of asbestos–cement, cast iron, other materials, or combinations of any of these. For specific projects, a thorough review of this standard is recommended for the purpose of supplementing it with provisions for special requirements not included herein. These requirements should be incorporated into the contract requirements.

Sec. 1.2 Definitions

Under this standard, the following definitions shall apply:

1.2.1 *Compacted backfill.* Job-excavated material or other such granular bedding material that is not frozen but is free from debris, organic matter, rocks, and stones, and which, in the opinion of the engineer, is suitable for backfilling. It shall be placed in not more than 6-in. layers and compacted to not less than 90 per cent standard density as defined in ASSHTO T-99.

1.2.2 *Drawings.* Drawings prepared by the owner to show the location and details for the construction of the pipeline and appurtenances.

1.2.3 *Supplementary specifications.* Supplementary specifications prepared by the owner to define which of the alternate materials and procedures provided in the standard apply and to provide for conditions, materials, and procedures not covered by this standard.

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Sec. 1.3 References

This standard references the following documents. They form a part of this standard to the extent specified herein. In any case of conflict, the requirements of this standard shall prevail.

AASHTO * T-99
—*Standard Method of Test for Moisture-Density Relationship for Soils*

ANSI A21.11
(AWWA C111)
—*American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings*

ASTM † B29
—*Specifications for Pig Lead*

AWWA C400
—*Standard for Asbestos–Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids*

AWWA C401
—*Standard Practice for Selection of Asbestos–Cement Distribution Pipe, 4 in. Through 16 in.*

AWWA C402
—*Standard for Asbestos–Cement Transmission Pipe, 18 in. Through 42 in., for Water and Other Liquids*

AWWA C403
—*Standard Practice for the Selection of Asbestos–Cement Transmission and Feeder Main Pipe, Sizes 18 in. Through 42 in.*

AWWA C601
—*Standard for Disinfecting Water Mains*

Section 2—Material Acceptance, Storage, and Handling

Sec. 2.1 Acceptance

At the time of delivery all material shall be examined for defects and damage, and any material that is defective or damaged shall be rejected and removed from the job site.

2.1.1 *Replacement of damaged pipe.* Material that is supplied by the owner and is rejected at the point of delivery because of defects or damage shall be replaced by the owner. Material that is supplied by the contractor and is rejected at the point of delivery because of defects or damage shall be replaced by the contractor. Material damaged subsequent to acceptance by the contractor shall be replaced by the contractor.

Sec. 2.2 Storage

Safe storage shall be provided for material until it has been incorporated into the completed project. The interior of all pipe, couplings, rings, fittings, and other accessories shall be kept free from dirt and other foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

* American Association of State Highway and Transportation Officials, 341 National Press Building, Washington, D.C. 20045.

† American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.

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Sec. 2.3 Handling

At all times material shall be handled with care to avoid damage. Whether moved by hand, skidways, or hoists, material shall not be dropped, bumped, or allowed to impact on itself.

2.3.1 *Rehandling.* All materials to be supplied by the owner shall be claimed at the locations designated in the supplementary specifications and hauled to and distributed at the site.

2.3.2 *Unloading at work site.* In distributing the material at the work site, it shall be unloaded adjacent to or near the location where it is to be installed.

Section 3—General and Detailed Work to be Performed

Sec. 3.1 Alignment and Grade

All pipe shall be laid to and maintained at the lines and grades required by the engineer. Fittings, valves, air vents, and hydrants shall be installed at the required locations with joints centered, spigots home, and valve and hydrant stems plumb. No deviation shall be made from the required line or grade without approval from the engineer or his representative.

Sec. 3.2 Excavation and Preparation of Trench

The trench shall be excavated to the required alignment and depth shown on the drawings, or as subsequently approved in writing by the engineer, and only so far in advance of pipelaying as permitted by the supplementary specifications.

3.2.1 *Excavation methods.* When necessary to prevent caving, trench excavations shall be sheeted and braced or sloped in accordance with applicable laws and ordinances. When sheeting and bracing are used, the trench width shall not be less than that specified in paragraph 3.2.2. As backfill is placed and sheeting is withdrawn, it shall be withdrawn in increments of not more than 1 ft, and the void left by the withdrawn sheeting shall be filled and compacted before withdrawing the next increment. All excavated material shall be piled in a manner that will not endanger the work or obstruct sidewalks and driveways. Gutters shall be kept clear or other provisions made for surface drainage.

3.2.2 *Trench width.* The trench width shall be ample to permit the pipe to be laid and jointed properly and the backfill to be placed and compacted as specified by the engineer. Trenches shall be of such extra width, when required, to permit the convenient placing of timber supports, sheeting and bracing, and the handling of specials.

3.2.3 *Trench preparation.* The trench shall be prepared for the direct placement of the pipe. This includes digging coupling holes in the trench bottom or bedding, or placing properly prepared mounds as specified by the engineer. (Illustrations of the various bedding conditions are in AWWA C401, "Standard Practice for the Selection of Asbestos-Cement Distribution Pipe, Sizes 4-in. Through 16-in.," and AWWA C403, "Standard Practice

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for the Selection of Asbestos–Cement Transmission and Feeder Main Pipe, Sizes 18-in. Through 42-in.")

3.2.4 *Excavation in poor soil and refilling to grade.* Any part of the trench excavated below grade shall be backfilled to grade with thoroughly compacted material approved by the engineer. When an unstable subgrade condition is encountered and, in the opinion of the engineer, it cannot support the pipe, an additional depth shall be excavated and refilled to pipe foundation grade with crushed stone or other suitable material as required by the engineer to achieve a satisfactory trench bottom.

3.2.5 *Pipe laid on trench bottom or bedding.* Before the pipe is lowered into the trench,

1. A coupling hole shall be excavated with sufficient length, width, and depth to permit assembly and provide a minimum clearance of 2 in. below the coupling, and

2. The pipe shall be provided with continuous support between coupling holes.

NOTE: Use of approved granular material for bedding is recommended as a preferred method of preparing the trench bottom for pipe installation.

3.2.6 *Pipe laid on earth mounds.* Pipe shall be laid on earth mounds of approved backfill material compacted firmly in place and of a size adequate to hold the pipe in alignment and to maintain a 2-in. minimum clearance from coupling to trench bottom. Each pipe shall be laid on two mounds with the center of each mound placed approximately one fifth of the pipe length from each end. The trench shall be excavated a minimum of 2 in. below the grade of the bottom of the outside diameter of the coupling, and high spots between couplings shall be leveled in order to maintain a minimum of 2 in. under the pipe barrel. The clearance between the trench bottom and the bottom of the coupling and pipe shall be properly backfilled utilizing material approved by the engineer. The material shall be compacted utilizing appropriate equipment to provide a firm and uniform bedding throughout the entire length of the pipe.

NOTE: Earth mounds have been used in some areas with success. However, if this method is to be used, particularly in small sizes, caution should be exercised to ensure (1) that proper clearance is maintained between the pipe or coupling and the trench bottom, and (2) that after pipe placement, the earth beneath the entire length of the pipe including the coupling is properly placed beneath the pipe and is compacted to a uniform density.

Sec. 3.3 Laying of Pipe

3.3.1 *Lowering of pipe and accessories into trench.* Pipe shall not be lowered into the trench until the pipe bed has been brought to grade. All pipe and accessories shall be inspected for defects. Dirt and other foreign matter shall be removed from the interior and the machined ends before lowering into the trench. Pipe and accessories shall be lowered carefully into the trench by hand or with suitable equipment in a manner that will prevent damage to pipe and fittings or injury to the installers. The sealing surfaces of all materials shall be kept clean during installation.

3.3.2 *Pipe joints.* The machined ends of pipe to be jointed, coupling grooves, and rubber rings shall be cleaned immediately before assembly, and assembly shall be made as recommended by the manufacturer. Care

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should be taken not to reverse the gasket when placed in the bell. Each pipe joint shall be sealed with a coupling consisting of an asbestos–cement sleeve and two rubber rings or an equivalent coupling or joint of equivalent strength and performance. The pipe joint shall not be deflected either vertically or horizontally beyond the limits recommended by the manufacturer.

3.3.2.1 When pipelaying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of trench water into the line.

3.3.2.2 Whenever water is excluded from the interior of the pipe, enough backfill shall be placed on the pipe to prevent floatation. Any pipe that has floated shall be removed from the trench and the bedding corrected to conform to paragraph 3.2.3. No pipe shall be laid when the weather is unsuitable for proper installation as determined by the engineer.

3.3.3 *Pipe cutting.* Pipe-cutting methods that produce a smooth, square cut end without damage to the pipe and that minimize or eliminate airborne particles shall be employed. Rotating blades, hand saws, or similar materials, when properly used, are acceptable. Abrasive disks are not recommended unless special precautions are taken.

3.3.4 *End preparation.* Whenever it is necessary to cut a length of pipe in the field, the end shall be prepared as follows:

3.3.4.1 The pipe end of random lengths shall be machined by commercially available field lathes designed for this purpose to ensure that the diameter, profile, and roundness meet the pipe manufacturer's specifications. The machined surface on which the compression ring seals shall be smooth and cylindrical to ensure joint integrity.

3.3.4.2 The pipe end of machined overall lengths shall be beveled in accordance with the pipe manufacturer's specifications.

3.3.5 *Length of pipe at fittings and rigid structures.* When rigid joints are formed by caulked materials or by bolts with rubber ring seals, such as at fittings, the length of 8-in. diameter and smaller pipe fitted into the bell of the fittings shall not exceed 3 ft 3 in. and the length of 10-in. diameter and larger pipe shall not exceed 6 ft 6 in. At least one flexible joint shall be used between two adjacent rigid joints. A coupling shall be cast in the wall of rigid structures at the point of entry of pipelines to provide flexibility at the wall. To provide additional flexibility, the pipe at the point of entry shall have a laying length of not more than 6 ft 6 in.

Sec. 3.4 Jointing of Pipe to Valves, Hydrants, and Fittings

3.4.1 *General.* Each valve, hydrant, or fitting connected to asbestos–cement pipe shall either be equipped with a bell of an inside diameter large enough to receive the pipe and caulking of at least ¼-in. thickness around the full circumference of the pipe, or shall have a profile that permits a seal to be made between the machined pipe and the bell of the fitting with a rubber ring.

3.4.1.1 Before valves, hydrants, or fittings are laid, all lumps, blisters, and excess coating shall be removed from the bell. The inside of the bell shall then be wire-brushed and both the inside of the bell and the spigot end of the pipe shall be wiped clean and dry. All surfaces to be jointed shall be kept clean until the joints are made.

3.4.2 *Push-on joints.* The push-on joint is a single rubber-gasket joint.

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It shall be assembled by positioning a continuous rubber ring gasket in the annular groove in the fitting bell and pulling the machined pipe end into the bell. A lubricant approved by the pipe manufacturer must be used. Care should be taken to ensure obtaining the correct size of gasket for the fitting bell for use with the correct size of asbestos–cement pipe. Cast-iron bell gaskets and asbestos–cement coupling gaskets are not interchangeable. An asbestos–cement coupling gasket shall not be used in a cast-iron fitting bell.

3.4.3 *Mechanical joint.* The mechanical joint is a bolted joint of the stuffing box type. In some sizes and classes, an adaptor is required between the asbestos–cement pipe and the mechanical joint. The joints shall conform to the current revision of ANSI A21.11 (AWWA C111), "Rubber-Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings," and shall be assembled as required in Appendix A, Notes on Installation of Mechanical Joints, of that standard.

3.4.4 *Poured joints.*

3.4.4.1 The yarning or packing material shall be as specified by the engineer. It shall consist of molded rubber rings. Asbestos rope or treated paper rope may be used only with the approval of the engineer when the space between the bell and spigot will not permit the use of a rubber ring.

3.4.4.2 The yarning material shall be placed around the spigot of the pipe and shall be of proper dimensions to center the spigot in the bell. When the spigot is shoved home, the yarning material shall be driven tightly against the inside base or hub of the bell with suitable yarning tools.

3.4.4.3 When a single strand of yarning material is used, it shall have an overlap at the top of not more than 2 in. When more than a single strand is required for a joint, each strand shall be cut to sufficient length so that the ends will meet without causing overlap. The ends of the strands shall meet on opposite sides of the pipe and not on the top or at the bottom. Successive strands of yarning material shall be driven home separately.

3.4.4.4 Lead-joint bells shall provide a jointing material space of not less than 2¼ in. for pipe of 20 in. diameter and smaller and 2½ in. for pipe 24–42 in. in diameter.

3.4.4.5 Lead for caulking purposes shall meet the current requirements of ASTM B29, "Standard Specifications for Pig Lead, in the Common Desilverized Grade."

Sec. 3.5 Setting of Hydrants, Valves, and Fittings

3.5.1 *General.* Hydrants, valves, and fittings shall be provided and installed as shown on the drawings or as specified in the supplementary specifications. They shall be inspected carefully and cleaned as required in paragraph 3.4.1.1 prior to lowering into the trench.

3.5.2 *Reaction or thrust backing.* A reaction or thrust backing shall be provided at each hydrant, valve, bend, and tee and at reducers or fittings where changes in pipe diameter occur. They shall be centered on the longitudinal axis and extended to solid undisturbed ground. Hydrants may be tied to the water main with rods. The size and shape of the thrust backing or the number and size of the tie rods shall be as shown on the drawings or as specified in the supplementary specifications.

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Sec. 3.6 Plugging of Dead Ends

Plugs shall be inserted into the bells of all dead-end fittings. Spigot ends of fittings and plain ends of pipe shall be capped. A reaction or thrust backing shall be provided at all dead ends of pipe that are capped or plugged. Capped or plugged outlets to fittings shall be tied to the fittings and shall be restrained according to the fitting manufacturer's recommendations.

Section 4—Pressure and Leakage Tests

Sec. 4.1 General

The field pressure and leakage tests should be conducted on each section as soon as possible after the following requirements have been met.

4.1.1 *Backfilling.* Backfill sufficient to prevent the lifting of the pipe shall be placed prior to filling with water and field testing. When local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be conducted after backfilling has been completed and before placement of permanent surface.

4.1.2 *Concrete curing time.* Before testing, or as specified by the engineer, at least 36 hr shall elapse after the last concrete thrust or reaction backing has been cast with high-early-strength cement, and at least seven days shall elapse after the last concrete thrust or reaction backing has been cast with standard cement.

Sec. 4.2 Test Pressure

Unless otherwise specified, the test pressure for distribution pipe (AWWA C400, sizes 4 in. through 16 in.) shall be double the operating pressure at the lowest elevation of the system or the class designation of the pipe plus 50 psi, whichever is less. The test pressure for transmission pipe (AWWA C402, sizes 18 in. through 42 in.) shall be the design pressure (operating pressure plus surge) times $1\frac{1}{2}$.

Sec. 4.3 Procedure

The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. The total time for the combined pressure and leakage tests for each section shall be a minimum of 2 hr unless otherwise specified. If separate tests are made, the pressure test shall be made first. The duration of the pressure test shall be a minimum of 1 hr. The duration of the leakage test shall be a minimum of 4 hr. The pressure of the leakage test may be reduced to 150 per cent of the maximum working pressure that will occur on that portion of the line or shall equal the test pressure (Sec. 4.2), whichever is less.

4.3.1 *Filling.* After the pipeline has been laid it shall be filled with water for a minimum of 24 hr before being subjected to the hydrostatic pressure test. Each section of the pipeline shall be filled slowly with water and all air expelled by means of taps at points of highest elevation.

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TABLE 1

*Allowable Leakage per 100 Couplings**

Pipe Diameter *in.*	Average Test Pressure at Lowest Point in Line—*psi*								
	50	75	100	125	150	175	200	225	250
	Leakage—*gal/hr*								
4	0.71	0.87	1.00	1.12	1.23	1.32	1.42	1.51	1.58
6	1.06	1.29	1.51	1.68	1.84	1.98	2.12	2.25	2.37
8	1.42	1.72	2.00	2.24	2.45	2.64	2.84	3.00	3.16
10	1.77	2.15	2.50	2.79	3.07	3.40	3.54	3.75	3.95
12	2.12	2.58	3.00	3.35	3.68	3.96	4.24	4.52	4.74
14	2.48	3.01	3.50	3.91	4.28	4.62	4.96	5.26	5.50
16	2.83	3.44	4.01	4.47	4.89	5.27	5.68	6.00	6.32
18	3.18	3.87	4.52	5.02	5.52	5.93	6.37	6.75	7.11
20	3.54	4.30	5.00	5.58	6.12	6.58	7.08	7.51	7.90
21	3.73	4.54	5.24	5.88	6.40	6.92	7.42	7.86	8.28
24	4.24	5.16	6.00	6.69	7.34	7.91	8.50	9.01	9.47
27	4.77	5.83	6.74	7.56	8.23	8.90	9.54	10.12	10.66
30	5.30	6.45	7.51	8.37	9.18	9.88	10.62	11.26	11.84
33	5.83	7.13	8.24	9.25	10.06	10.88	11.67	12.36	13.02
36	6.37	7.75	9.01	10.07	11.02	11.88	12.74	13.50	14.22
39	6.88	8.42	9.74	10.83	11.90	12.96	13.79	14.61	15.40
42	7.42	9.08	10.48	11.78	12.82	13.85	14.86	15.74	16.58

* The data are based on 150 psi and represent a leakage of approximately 30 gpd per mile of pipe per in. of pipe diameter for pipe in 13-ft lengths.

4.3.2 *Pressurization.* The specified test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the engineer. The test pressure shall be maintained for the specified time during which all exposed pipe, couplings, fittings, valves, and hydrants shall be examined carefully.

4.3.3 *Cracked or defective elements.* All cracked or defective elements shall be removed and replaced and the test repeated until all visible leakage has been stopped and the requirements of Sec. 4.4 have been met.

Sec. 4.4 Allowable Leakage

No pipe installation will be accepted if the leakage for the section of line that is tested is more than the rate of leakage specified in Table 1. In determining the number of couplings, consideration should be given to allow for the additional number of joints if the pipe is less than 13 ft. If the test leakage in any section is greater than permitted, the leakage shall be located, repaired, and the test performed until the leakage is within the permitted allowance.

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Section 5—Backfilling

Sec. 5.1 Backfill Procedure Before Tests

Backfill material approved by the engineer shall be free of any frozen lumps, rock that is 1½ in. or larger in size, and lumps of clay, large stones, boulders, or other unsuitable substances such as debris. The backfill shall be deposited in the trench up to the horizontal diameter of the pipeline in 6-in. thick compacted layers and shall be sufficiently damp to permit thorough compaction under and on each side of the pipe to provide support that is free from voids.

5.1.1 *Visual inspection not required.* If visual inspection during the hydrostatic tests is not required, then the pipe and joints shall be backfilled as specified previously and a cushion of material hand-placed over the pipe and joints to an average depth of 12 in. for all sizes of pipe.

5.1.2 *Visual inspection required.* If the joints are to be exposed during the test, additional backfill material shall be hand-placed between the joints in order to hold the line securely during the test. The average depth of material in this instance shall be 12 in. over the top of 8-in. diameter and smaller pipe, and 24 in. over larger pipe. In no case shall material with a diameter in excess of 1½ in. be placed in the trench in the first 12 in. above the pipe.

Sec. 5.2 Backfill Procedure After Tests

Upon completion of pressure and leakage tests, exposed couplings shall be covered and backfill hand-placed to a depth of 12 in. above the top of the pipe and couplings. The balance of backfill shall not contain stones that are more than 6 in. in their largest dimension, and the backfill mixture shall not be used for disposal of refuse. Trenches under pavements and sidewalks shall be backfilled to a compaction density of 90 per cent as determined by the American Association of State Highway and Transportation Officials Method T99 for compaction and density of soils. The balance of the backfill for other trenches and those trenches not in a right of way may be backfilled by machine without compaction unless otherwise specified in the supplementary specifications. Additional backfill material shall be supplied, if needed, to completely backfill the trenches or to fill depressions caused by subsequent settlement.

Section 6—Disinfection

Before the pipeline is placed into service, all new water systems, extensions to existing systems, valved sections of extension, replacements in the existing system, and any exposed section of the existing system shall be disinfected in accordance with AWWA C601, "Disinfection of Water Mains."

CTD015560

Department of Defense Acceptance Notice

This nongovernment document was adopted and approved for use by the Department of Defense (DoD) on 8 April 1982. The American Water Works Association has furnished the clearance required by existing regulations. Copies of the document are stocked by DoD Single Stock Point, Naval Publications and Forms Center, Philadelphia, PA 19120, for issue to DoD activities only. Contractors and industry groups must obtain copies from AWWA, 6666 West Quincy Ave., Denver, CO 80235.

Title of Document: Standard for Installation of Asbestos-Cement Pressure Pipe

Date of Specific Issue Adopted: January 28, 1978

Releasing Industry Group: American Water Works Association

Custodians: Army—ME
Navy—YD
Air Force—99

Military Coordinating Activity: Navy—YD

User Activity: Navy—MC

Project No. COND-0074

FSC COND

3P-2M-43603-5 82-LL

CTD015561

American Water Works Association

ANSI/AWWA C403–78
(First Edition)

AWWA STANDARD PRACTICE

for

THE SELECTION OF ASBESTOS–CEMENT TRANSMISSION AND FEEDER MAIN PIPE, SIZES 18 IN. THROUGH 42 IN.

AMERICAN NATIONAL STANDARD

Approved by AWWA Board of Directors Jan. 28, 1978.

Approved by American National Standards Institute, Inc., Jul. 17, 1978.

AMERICAN WATER WORKS ASSOCIATION
6666 West Quincy Avenue, Denver, Colorado 80235

CTD015562

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Foreword

This foreword is for information only and is not a part of AWWA C403

I. History of Standard

A new pipe material consisting of an intimate mixture of portland cement and asbestos fibers was introduced to the North American market in 1931 following several years of usage in other countries, particularly Italy.

In the ensuing years, this type of pipe gained popularity, and in 1949 AWWA established a committee on standard specifications for asbestos-cement pipe under the chairmanship of S. M. Clark of Greeley and Hanson, Chicago.

The committee developed a standard for asbestos-cement water pipe which was approved by the AWWA Board of Directors as tentative, AWWA C400-53T, May 15, 1953. In 1958, the committee was reactivated as Committee 8340D on Asbestos-Cement Pipe under the chairmanship of Roy H. Ritter, Whitman, Requardt and Assocs., Baltimore, to review several suggested changes and to recommend revisions to the standard. The committee produced a revised tentative standard adopted as AWWA C400-64T, Jan. 27, 1964. It was advanced to standard without revision Jul. 2, 1965 and designated as AWWA C400-65.

The committee concluded that an installation guide was desirable to bring to the attention of users certain important requirements on the inspection, handling, installation, and field testing of asbestos-cement pressure pipe. The committee submitted its final draft in 1963, and it received approval as tentative, AWWA C603-64T, Jan. 27, 1964. It was advanced to standard without revision Aug. 9, 1965 and designated as AWWA C603-65.

In early 1968, the committee was reactivated as the Standards Committee on Asbestos-Cement Pipe to review and revise all AWWA standards on asbestos-cement pipe. The committee produced a revised standard approved by the AWWA Board of Directors Jan. 31, 1972, designated as AWWA C400-72, "Standard for Asbestos-Cement Pressure Pipe for Water and Other Liquids."

AWWA C401-64, "Standard Practice for the Selection of Asbestos-Cement Water Pipe" (originally designated Handbook H2), was first approved by the AWWA Board of Directors Jan. 27, 1964. Although it covered pipe sizes up to and including 36 in., it was primarily intended for use with asbestos-cement pipe in smaller distribution sizes (4 through 16 in.).

In the winter of 1972-1973 the committee was reorganized and enlarged to include representatives of national organizations having an interest in the scope of the committee and wishing to participate in the work. The reorganized committee reaffirmed AWWA C400-72 without revision so that it could be presented to the American National Standards Institute for designation as an American National Standard.

In 1975 the committee produced a revised standard that was approved by the AWWA Board of Directors Jan. 26, 1975, and designated AWWA

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C400-75, "Standard for Asbestos-Cement Pressure Pipe, 4 in. Through 24 in., for Water and Other Liquids."

The asbestos-cement pipe manufacturers have developed a new series of large pipe classifications, designed to give greater freedom of selection to design engineers. This is of particular significance for large diameter pipeline projects where the savings in material cost can exceed the increased cost of more detailed design, better control of methods of installation, and provision of surge controls when justified.

To provide the user with a ready reference and specification for this type of pipe, known as transmission pipe, the committee produced and the AWWA Board of Directors approved AWWA C402-75, "Standard for Asbestos-Cement Transmission Pipe, 18 in. Through 42 in., for Water and Other Liquids."

The possibility of confusion between the two 1975 standards, AWWA C400 and C402, was carefully reviewed by the committee. The results were AWWA C402-77, which covers sizes 18 through 42 in., and AWWA C400-77, which covers sizes 4 through 16 in. There is now no overlap of sizes.

Consequently, it was desirable to revise AWWA C401-64 so that it would be directly compatible with AWWA C400-77, and to develop a new pipe selection standard to be directly compatible with AWWA C402-77. AWWA C401-77 and this new standard, AWWA C403, "Standard Practice for the Selection of Asbestos-Cement Transmission and Feeder Main Pipe, Sizes 18 in. Through 42 in.," are the result.

II. Discussion

The effect of water hammer generated by the opening and closing of fire hydrants can be of significant magnitude in small distribution pipe sizes, due to the high velocities generated by open hydrant flow conditions. Furthermore, it is difficult to accurately evaluate the magnitude of these surges; and, if calculated, control through the use of surge tanks or other devices is impractical. Rather than employ a rule-of-thumb allowance for surge based upon an assumed velocity change, to compensate for undetermined surge pressures AWWA C400-77 (covering sizes 4 through 16 in.) incorporates a large fixed safety factor for each asbestos-cement pressure class.

In large transmission and feeder main pipe sizes the effect of surge pressures generated by the opening and closing of fire hydrants connected to smaller diameter distribution pipelines is of significantly lower magnitude. For example, the surge pressure generated by hard closure of a hydrant connected to a 6-in. distribution line would be nine times greater than that which would occur in an 18-in. feeder main supplying a 6-in. distribution line.

Major surge pressures in large transmission or feeder main pipelines, caused by stopping and starting pumps and similar components, are more readily calculated. It also is more economically practical to control these surges by incorporating into the system design a variety of devices which will reduce anticipated surge pressures to lower levels. This standard is based on individually evaluating all stress loadings placed on a pipe and on applying adequate safety factors commensurate with a complete review of all design criteria.

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American Water Works Association

ANSI/AWWA C403-78
(First Edition)

AWWA Standard Practice for

The Selection of Asbestos-Cement Transmission and Feeder Main Pipe, Sizes 18 in. Through 42 in.

Section 1—General

Sec. 1.1 Scope

This standard has been prepared so that design engineers may quickly determine the correct strength classification of asbestos-cement transmission pipe to use under various combinations of internal pressure (static, operating, and surge) and external load (earth and superimposed live loads). Combined loading curves depicting the relationship between hydrostatic loading and external loading capabilities are included to expedite the selection of the correct pipe strength classification.

NOTE: Information to assist the engineer in selecting the most economical size of pipe is in the appendices. Appendix A contains a friction loss of head chart based on the Hazen and Williams formula. Appendix B is a detailed analysis of surge pressure factors. Appendix C includes tables to assist the engineer in determining the yearly power costs to overcome friction loss of head. The appendices are for information only and are not part of AWWA C403.

1.1.1 *Pipe classifications.* The pipe strength classifications of 30, 35, 40, 45, 50, 60, 70, 80, and 90 refer to the similarly numbered classifications specified in AWWA C402, "Standard for Asbestos-Cement Transmission Pipe, 18 In. Through 42 In., for Water and Other Liquids."

1.1.2 *Installation.* Detailed coverage of the installation of asbestos-cement pipe can be found in AWWA C603, "Standard for the Installation of Asbestos-Cement Pressure Pipe."

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Section 2—General Design

Sec. 2.1 Strength and Design Factors

The strength of asbestos-cement transmission pipe must be sufficient to withstand the combined forces of all types of internal pressures (static, operating, and surge) and external loadings (earth, live, and impact). Sound engineering practice also requires that adequate safety factors be applied to strength requirements to ensure performance under other than ideal or calculated loading conditions. The magnitude of these safety factors is inversely proportional to the confidence that the designer has in engineering estimates of actual operating conditions. Suggested safety factors based on experience are included under specific design factor subheadings.

2.1.1 *Bedding conditions.* The bedding conditions described in Fig. 1 have been selected as representative of typical installation conditions encountered in the field.

Descriptions of bedding conditions are as follows:

Class A—Gravel or sand base, backfill compacted. (Approximately 80% Standard Proctor, AASHTO T-99.)

Class B—Same as A, but backfill not compacted.

Class C—Pipe laid on earth mounds or pipe barrel on flat trench bottom with excavated coupling holes, backfill compacted. (Approximately 90% Standard Proctor, AASHTO T-9.)

Class D—Pipe barrel on flat trench bottom with excavated coupling holes, backfill not compacted.

Sec. 2.2 Combined Loading Theory

Tests of asbestos-cement pipe under various combinations of internal pressure and external crush load applied in three-edge bearing (see Sec. 2.3)

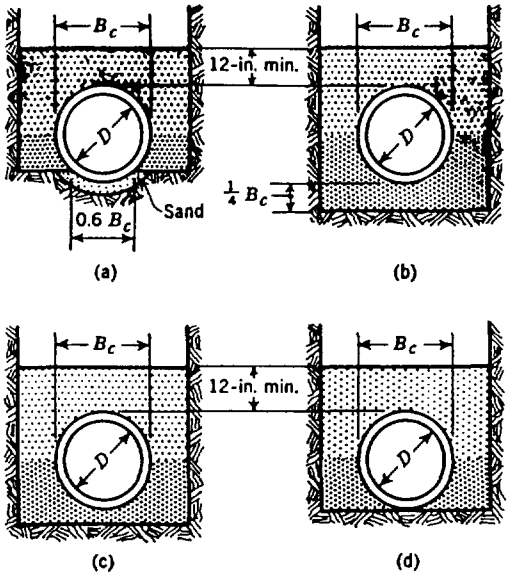


Fig. 1. Bedding Conditions

Class A bedding conditions are shown in (a) and (b). Class C conditions are shown in (c) and (d). In all four diagrams, the lightly shaded area represents approved backfill, not frozen and free from lumps, large stones, boulders, or other unsuitable substances. The heavily shaded areas represent approved backfill, carefully compacted in 4-in. layers.

In (a), a minimum of 2 in. of sand is placed in a shaped bottom under the pipe. In (b), the pipe is bedded in a gravel base. In (c), the pipe barrel rests on earth mounds and then the backfill between the earth mounds is compacted. In (d), the pipe barrel is resting on the flat bottom of the trench. Class B condition is the same as Class A, and Class D is the same as Class C except that the backfill is not compacted in B or D.

indicate that there is a relationship between the combined loads at the point of pipe fracture. This relationship can be represented by a parabolic curve as shown in Fig. 2. The equation for the load pressure parabolic curve, which is known as the Schlick formula, may be expressed as:

$$w_T = W\sqrt{\frac{P - p_T}{P}} \qquad \text{Eq 1}$$

in which,

P is the internal pressure, in pounds

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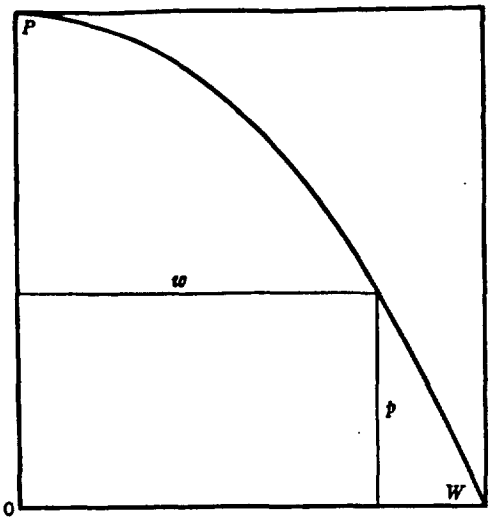


Fig. 2. Load Pressure Curve

P *represents the internal pressure;* W *the external load.*

per square inch, that will burst the pipe when no external load exists.

W is the external load, in pounds per lineal foot of pipe in the three-edge bearing test, that will crush the pipe when no internal pressure exists.

p_T is the internal pressure, in pounds per square inch which, in combination with some external load w_T applied in three-edge bearing, will fracture the pipe.

w_T is the external load, in pounds per lineal foot of pipe applied in three-edge bearing which, in combination with some internal pressure p_T, will fracture the pipe.

Sec. 2.3 Three-Edge Bearing Load

The combined loading curve shown in Fig. 2 is calculated on the basis of crush strengths determined by laboratory tests employing the three-edge bearing test method, which utilizes hardwood test blocks (Fig. 3). Because the field supporting strength of a pipe is influenced by the bedding conditions and by the lateral pressure acting against the sides of the pipe,

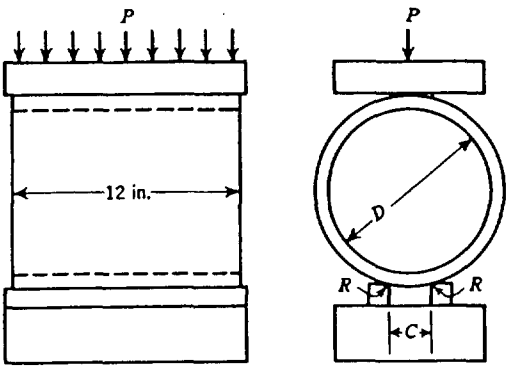


Fig. 3. Crushing Test Assembly

The diagram at the left shows a side view of the test assembly; that at the right, an end view. P *represents load;* R, *approximately 0.5 in.—the radius of the bearings;* D, *the nominal diameter of the pipe; and* C, *the clear space between supports.* C *should be approximately 1 in./ft of internal pipe diameter but in no case less than 1 in.*

it is necessary to apply a bedding load factor to the laboratory three-edge bearing loads to correlate them to the actual field loads. Since the external load equals the bedding factor times the three-edge bearing load, the bedding factor equals the external load divided by the three-edge bearing load. Table 1 shows bedding factors to be applied for each of the bedding conditions described in Fig. 1.

TABLE 1

Correlation of Bedding Conditions, Pipe Size, and Bedding Load Factors

Bedding Class	Pipe Size *in.*	Bedding Load Factor
A	18–20	1.8
	24–42	2.0
B	18–42	1.5
C	18–20	1.4
	24–42	1.5
D	18–42	1.1

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Section 3—External Loads

Sec. 3.1 Introduction

For the design of asbestos-cement transmission pipe external loads (w_T) are defined by the following equation:

$$w_T = \frac{w_E + w_S}{B.F.}(S.F.) \qquad \text{Eq 2}$$

in which,

w_T = the total external load in pounds per linear foot of pipe applied in three-edge bearing that, in combination with some internal pressure, p_T, will fracture the pipe.

w_E = the total earth load in pounds per linear foot of pipe to which the pipe is subjected. The magnitude of this load is a direct function of the burial conditions encountered or specified (trench, embankment, tunnel, etc.).

w_S = the total superimposed load, in pounds per linear foot of pipe, transmitted through the burial environment to the pipe by factors other than the earth loads. These loads can be static, dynamic, or a combination of both.

$B.F.$ = the bedding load factor, which is a load factor correlating three-edge bearing test loads to field loads associated with specific bedding conditions. (For a more explicit explanation see Sec. 2.3.)

$S.F.$ = the design safety factor specified by the design engineer. Safety factors are based on judgment, past experience, and sound engineering principles. For asbestos-cement transmission pipe, a design minimum safety factor of 1.5 is recommended for external loads.

Sec. 3.2 Earth Loads

Earth loads (w_E) to which pipe is subjected are a function of the soil density, pipe diameter, depth of cover, and construction techniques employed in laying the pipeline. They depend on the interplay between the weight of the prism of earth directly over the pipe, called the interior prism, and the frictional shearing forces, plus or minus, transferred to that interior prism by the adjacent outside prisms of earth. The magnitude of earth loads varies with the construction technique employed. There are two major construction techniques normally encountered: trench and embankment. Another technique, the tunnel condition, is not normally found, but nevertheless has unique design methods which make its inclusion in this discussion necessary. Fig. 4 shows these three construction techniques.

3.2.1 *Marston's equation.* For asbestos-cement transmission pipe design, earth loads are calculated by the general form of Marston's equation:

$$w_E = Cw_eB^2 \qquad \text{Eq 3}$$

in which,

w_E = the total earth load transmitted to the pipe in pounds per linear foot of pipe.

w_e = the soil density in pounds per cubic foot. Soil densities range in value from 100 to 135 lb/cu ft. In the absence of accurate soil density information, a value of 120 lb/cu ft is recommended for asbestos-cement transmission pipe design.

B = the trench width or pipe diameter measured in feet. The value chosen depends on the installation conditions employed in laying the pipe.

C = a coefficient that is dependent upon

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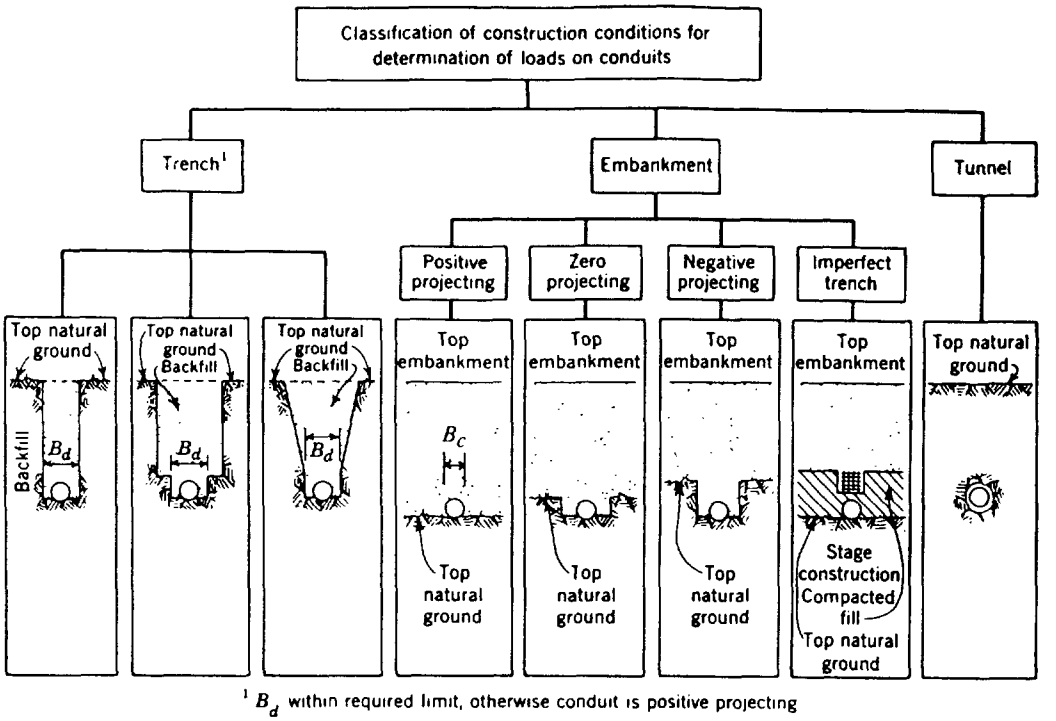


Fig. 4. Classification of Construction Techniques

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1. Ratio of the height of fill to the width of trench or pipe diameter.
2. Shearing forces between the interior and adjacent earth prisms.
3. Direction and amount of relative settlement between interior and adjacent earth prisms for embankment conditions.

The calculations used to find the value of the coefficient will depend on the installation conditions employed in laying the pipe.

Values for B and C must be determined to calculate earth loads by Eq. 3 for the trench, embankment, and tunnel construction techniques. The following subsections describe the different conditions and explain the methods for finding the values needed to use Marston's equation for soil loading.

3.2.2 *Trench condition.* A trench condition is defined as that in which the pipe is installed in a narrow trench, generally less than two to three diameters in width, cut in undisturbed ground and backfilled to the original ground surface, as illustrated in Fig. 4. For this condition, Eq 3 is rewritten as:

$$w_E = C_d w_e B_d^2 \qquad \text{Eq 4}$$

in which,

B_d = the trench width in feet, measured at the top of the pipe.

C_d = the load coefficient which is a function of the ratio H/B_d, where H is the height of the backfill in feet, measured to the top of the pipe, and B_d is the trench width as previously defined.

3.2.2.1 The values of C_d are obtained from Fig. 5, in which curves A, B, C, D, and E take into account the

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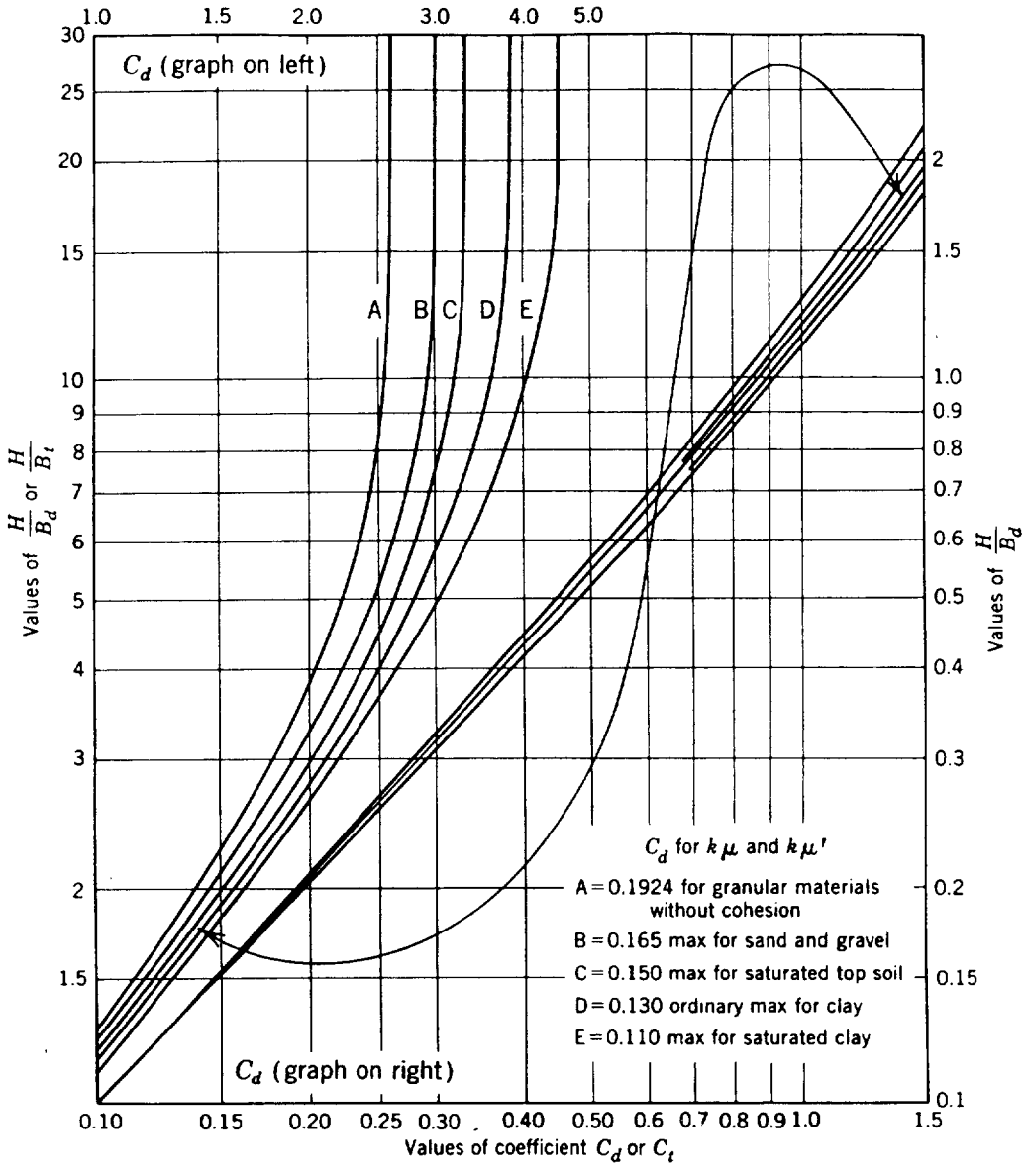


Fig. 5. Values of C_d for Trench Conditions

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friction coefficient between the backfill and the sides of the trench for the various soil compositions likely to be encountered. Curve *A* is for granular materials without cohesions. Curve *B* is for sand and gravel. Curve *C* is for saturated top soil. Curve *D* is for clay. Curve *E* is for saturated clay. Table 2 contains a series of earth load selection tables and is included as a convenience.

3.2.3 *Embankment condition.* An embankment condition is defined as either that condition where the pipe is installed in a trench that is wider than two to three pipe diameters and that is cut in undisturbed ground, or that condition where the pipe is

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TABLE 2

Earth Loads (lb/lineal ft)

NOTE: Values are for clay (part D of Fig. 9, $K\mu = K\mu' = 0.130$) with weight of earth taken as 120 lb/cu ft. Correction for other earth weights may be made by simple direct proportions. For corrections for other types of soils, refer to formulas in Sec. 3. **Boldface** figures indicate maximum earth load for depth of trench.

Pipe size 18 in. ID

Trench Cover *ft*	Trench Width—*ft*									Transition Width
	2.5	2.75	3.0	3.25	3.5	4.0	4.5	5.0	5.5	
2	**490**									2 ft 5 in.
2.5	640	**640**								2 ft 8 in.
3	810	835								2 ft 10 in.
4	1 000	1 110	**1 240**							3 ft 1 in.
5	1 200	1 320	1 450	**1 610**	1 640					3 ft 5 in.
6	1 350	1 520	1 700	1 865	2 050					3 ft 8 in.
7	1 500	1 690	1 900	2 090	2 300					3 ft 10 in.
8	1 600	1 850	2 100	2 320	2 525	**2 825**				4 ft 0 in.
9	1 725	2 000	2 250	2 510	2 750	3 230				4 ft 1 in.
10	1 850	2 120	2 400	2 725	2 950	3 550	3 635			4 ft 3 in.
12	2 050	2 360	2 675	3 020	3 300	4 000	4 440			4 ft 5 in.
14	2 200	2 570	2 900	3 280	3 600	4 400	5 220			4 ft 7 in.
16	2 300	2 720	3 100	3 515	3 900	4 800	5 640	6 040		4 ft 9 in.
18	2 400	2 840	3 275	3 720	4 150	5 100	6 040	6 830		5 ft 0 in.
20	2 500	3 000	3 400	3 995	4 350	5 350	6 400	7 450	**7 620**	5 ft 2 in.

Pipe size 20 in. ID

Trench Cover *ft*	Trench Width—*ft*									Transition Width
	2.75	3.0	3.25	3.5	3.75	4.0	4.5	5.0	5.5	
2	**545**									2 ft 8 in.
2.5	705									2 ft 10 in.
3	870	**890**								3 ft 0 in.
4	1 110	1 250	**1 330**							3 ft 4 in.
5	1 320	1 450	1 610	**1 750**	1 770					3 ft 8 in.
6	1 520	1 700	1 865	2 050	2 210	**2 220**				3 ft 11 in.
7	1 690	1 900	2 090	2 300	2 515	2 655				4 ft 1 in.
8	1 850	2 100	2 320	2 525	2 765	3 000	**3 095**			4 ft 3 in.
9	2 000	2 250	2 510	2 750	3 040	3 300	3 545			4 ft 5 in.
10	2 120	2 400	2 725	2 950	3 240	3 550	3 980			4 ft 6 in.
12	2 360	2 675	3 020	3 300	3 660	4 000	4 660	**4 810**		4 ft 10 in.
14	2 570	2 900	3 280	3 600	4 050	4 400	5 200	5 760		5 ft 1 in.
16	2 720	3 100	3 515	3 900	4 350	4 800	5 640	6 450	**6 640**	5 ft 2 in.
18	2 840	3 275	3 720	4 150	4 620	5 100	6 040	7 060	7 500	5 ft 4 in.
20	3 000	3 400	3 995	4 350	4 860	5 350	6 400	7 450	8 410	5 ft 7 in.

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TABLE 2—*Continued*

Pipe size 21 in. ID

Trench Cover *ft*	Trench Width—*ft*										Transition Width
	2.75	3.0	3.25	3.5	3.75	4.0	4.5	5.0	5.5	6.0	
2	570										2 ft 9 in.
2.5	745	730									2 ft 11 in.
3	870	915									3 ft 2 in.
4	1 110	1 250	1 330	1 380							3 ft 6 in.
5	1 320	1 450	1 610	1 750	1 860						3 ft 10 in.
6	1 520	1 700	1 865	2 050	2 210	2 325					4 ft 1 in.
7	1 690	1 900	2 090	2 300	2 515	2 700	2 795				4 ft 4 in.
8	1 850	2 100	2 320	2 525	2 765	3 000	3 260				4 ft 6 in.
9	2 000	2 250	2 510	2 750	3 040	3 300	3 725				4 ft 7 in.
10	2 120	2 400	2 725	2 950	3 240	3 550	4 140	4 210			4 ft 9 in.
12	2 360	2 675	3 020	3 300	3 660	4 000	4 660	5 160			5 ft 0 in.
14	2 570	2 900	3 280	3 600	4 050	4 400	5 200	6 000	6 100		5 ft 3 in.
16	2 720	3 100	3 515	3 900	4 350	4 800	5 540	6 450	7 020		5 ft 5 in.
18	2 840	3 275	3 720	4 150	4 620	5 100	6 040	7 050	7 950		5 ft 6 in.
20	3 000	3 400	3 995	4 350	4 860	5 350	6 400	7 450	8 460	8 920	5 ft 8 in.

Pipe size 24 in. ID

Trench Cover *ft*	Trench Width—*ft*										Transition Width
	3.0	3.25	3.5	3.75	4.0	4.5	5.0	5.5	6.0	6.5	
2	630										3 ft 1 in
2.5	805	810									3 ft 3 in.
3	955	1 010	1 010								3 ft 5 in
4	1 250	1 330	1 400	1 490							3 ft 9 in.
5	1 450	1 610	1 750	1 940	2 030						4 ft 1 in.
6	1 700	1 865	2 050	2 210	2 400	2 550					4 ft 5 in.
7	1 900	2 090	2 300	2 515	2 700	3 080					4 ft 8 in.
8	2 100	2 320	2 525	2 765	3 000	3 480	3 620				4 ft 10 in.
9	2 250	2 510	2 750	3 040	3 300	3 790	4 130				5 ft 0 in.
10	2 400	2 725	2 950	3 240	3 550	4 140	4 660	4 660			5 ft 2 in.
12	2 675	3 020	3 300	3 660	4 000	4 660	5 400	5 740			5 ft 5 in.
14	2 900	3 280	3 600	4 050	4 400	5 200	6 000	6 750	6 800		5 ft 8 in.
16	3 100	3 515	3 900	4 350	4 800	5 640	6 450	7 410	7 850		5 ft 11 in.
18	3 275	3 720	4 150	4 620	5 100	6 040	7 050	8 000	8 910		6 ft 1 in.
20	3 400	3 995	4 350	4 860	5 350	6 400	7 450	8 460	9 600	10 000	6 ft 2 in.

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TABLE 2—*Continued*

Pipe size 27 in. ID

Trench Cover *ft*	Trench Width—*ft*										Transition Width
	3.25	3.5	3.75	4.0	4.5	5.0	5.5	6.0	6.5	7.0	
2	**710**										3 ft 5 in.
2.5	895	**905**									3 ft 6 in.
3	1 040	1 095									3 ft 8 in.
4	1 330	1 400	**1 540**	**1 600**							4 ft 1 in.
5	1 610	1 750	1 940	2 050	**2 200**						4 ft 6 in.
6	1 865	2 050	2 210	2 400	2 785						4 ft 8 in.
7	2 090	2 300	2 515	2 700	3 110	**3 385**					5 ft 1 in.
8	2 320	2 525	2 765	3 000	3 480	3 900	**3 980**				5 ft 3 in.
9	2 510	2 750	3 040	3 300	3 790	4 300	4 590				5 ft 6 in.
10	2 725	2 950	3 240	3 550	4 140	4 700	5 190				5 ft 7 in.
12	3 020	3 300	3 660	4 000	4 660	5 400	6 060	**6 390**			6 ft 0 in.
14	3 280	3 600	4 050	4 400	5 200	6 000	6 750	7 550	**7 560**		6 ft 3 in.
16	3 515	3 900	4 350	4 800	5 640	6 450	7 410	8 300	8 800		6 ft 6 in.
18	3 720	4 150	4 620	5 100	6 040	7 050	8 000	9 000	9 960	**10 000**	6 ft 8 in.
20	3 995	4 350	4 860	5 350	6 400	7 450	8 460	9 600	10 890	11 180	6 ft 10 in.

Pipe size 30 in. ID

Trench Cover *ft*	Trench Width—*ft*									Transition Width
	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	
2	**755**									3 ft 7 in.
2.5	965									3 ft 10 in.
3	1 150	**1 185**								3 ft 11 in.
4	1 400	1 675	**1 680**							4 ft 5 in.
5	1 750	2 050	2 335	**2 340**						4 ft 8 in.
6	2 050	2 400	2 800	3 005						5 ft 0 in.
7	2 300	2 700	3 110	3 500	**3 665**					5 ft 5 in.
8	2 525	3 000	3 480	3 900	4 320					5 ft 7 in.
9	2 750	3 300	3 790	4 300	4 840	**4 980**				5 ft 10 in.
10	2 950	3 550	4 140	4 700	5 260	5 660				6 ft 1 in.
12	3 300	4 000	4 660	5 400	6 060	6 800	**6 990**			6 ft 5 in.
14	3 600	4 400	5 200	6 000	6 750	7 550	8 320	**8 320**		6 ft 9 in.
16	3 900	4 800	5 640	6 450	7 410	8 300	9 210	9 610		7 ft 0 in.
18	4 150	5 100	6 040	7 050	8 000	9 000	9 960	10 980	**10 980**	7 ft 3 in.
20	4 350	5 350	6 400	7 450	8 460	9 600	10 890	11 890	12 300	7 ft 5 in.

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TABLE 2—*Continued*

Pipe size 33 in. ID

Trench Cover *ft*	Trench Width—*ft*										Transition Width
	3.75	4.0	4 5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	
2	**810**										3 ft 10 in.
2 5	1 050	**1 060**									4 ft 1 in.
3	1 220	1 290									4 ft 3 in
4	1 540	1 675	**1 815**								4 ft 6 in.
5	1 940	2 050	2 335	**2 445**							5 ft 1 in
6	2 210	2 400	2 800	3 050	3 205						5 ft 5 in.
7	2 515	3 000	3 110	3 500	3 920	**3 925**					5 ft 8 in.
8	2 705	3 300	3 480	3 900	4 460	4 640					6 ft 1 in
9	3 040	3 550	3 790	4 300	4 840	5 400	**5 610**				6 ft 3 in.
10	3 240	4 000	4 140	4 700	5 260	5 900	6 070				6 ft 5 in.
12	3 660	4 400	4 660	5 400	6 060	6 800	7 450	**7 550**			6 ft 10 in.
14	4 050	4 800	5 200	6 000	6 750	7 550	8 350	9 030			7 ft 2 in.
16	4 350	5 100	5 640	6 450	7 410	8 300	**9 210**	**10 110**	**10 470**		7 ft 5 in.
18	4 620	5 350	6 040	7 050	8 000	9 000	9 960	11 060	12 120		7 ft 9 in.
20	4 860	5 575	6 400	7 450	8 460	9 600	10 890	11 890	13 020	**13 390**	7 ft 11 in.

Pipe size 36 in. ID

Trench Cover *ft*	Trench Width—*ft*										Transition Width
	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	
2	**920**	**925**									4 ft 3 in.
2.5	1 130	1 145									4 ft 4 in
3	1 325	1 550									4 ft 7 in.
4	1 675	1 950	**1 950**								4 ft 11 in.
5	2 050	2 335	2 555	**2 555**							5 ft 3 in.
6	2 400	2 800	3 050	3 340	**3 340**						5 ft 8 in.
7	2 700	3 110	3 500	3 920	4 160						6 ft 0 in.
8	3 000	3 480	3 900	4 460	4 900	**4 950**					6 ft 2 in.
9	3 300	3 790	4 300	4 840	5 400	5 760	**5 760**				6 ft 8 in.
10	3 550	4 140	4 700	5 260	5 900	6 430	6 540				6 ft 10 in
12	4 000	4 660	5 400	6 060	6 800	7 450	8 150	**8 150**			7 ft 4 in.
14	4 400	5 200	6 000	6 750	7 550	8 350	9 170	9 750	**9 750**		7 ft 8 in.
16	4 800	5 640	6 450	7 410	8 300	9 210	10 110	11 000	11 330		7 ft 11 in
18	5 100	6 040	7 050	8 000	9 000	9 960	11 060	12 150	12 900	**12 900**	8 ft 2 in.
20	5 350	6 400	7 450	8 460	9 600	10 890	11 890	13 020	14 140	14 510	8 ft 6 in.

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TABLE 2—*Continued*

Pipe size 39 in. ID

Trench Cover *ft*	Trench Width—*ft*										Transition Width
	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	
2	**990**										4 ft 5 in.
2.5	1 290										4 ft 7 in.
3	1 520	**1 580**									4 ft 9 in.
4	1 950	2 220	**2 340**								5 ft 2 in.
5	2 335	2 555	2 980								5 ft 6 in.
6	2 800	3 050	3 340	**3 680**							5 ft 10 in.
7	3 110	3 500	3 920	4 320	**4 500**						6 ft 3 in.
8	3 480	3 900	4 460	4 900	5 360						6 ft 7 in
9	3 790	4 300	4 840	5 400	5 760	**6 430**					6 ft 11 in.
10	4 140	4 700	5 260	5 900	6 430	7 170	**7 440**				7 ft 3 in.
12	4 660	5 400	6 060	6 800	7 450	8 150	8 980	9 310			7 ft 8 in.
14	5 200	6 000	6 750	7 550	8 350	9 170	9 750	11 090			8 ft 1 in.
16	5 640	6 450	7 410	8 300	9 210	10 110	11 000	11 980	**12 830**		8 ft 5 in.
18	6 040	7 050	8 000	9 000	9 960	11 060	12 150	12 900	14 330		8 ft 8 in.
20	6 400	7 450	8 460	9 600	10 890	11 890	13 021	14 140	15 260	**16 130**	8 ft 11 in.

Pipe size 42 in. ID

Trench Cover *ft*	Trench Width—*ft*										Transition Width
	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	
2	**1 060**										4 ft 8 in
2.5	1 390										4 ft 10 in.
3	1 700										5 ft 0 in.
4	2 220	**2 350**									5 ft 4 in.
5	2 555	3 080									5 ft 8 in.
6	3 050	3 340	**3 930**								6 ft 1 in.
7	3 500	3 920	4 320	**4 690**							6 ft 5 in.
8	3 900	4 460	4 900	5 600							6 ft 10 in.
9	4 300	4 840	5 400	5 760	**6 630**						7 ft 2 in.
10	4 700	5 260	5 900	6 430	7 170	**7 730**					7 ft 6 in.
12	5 400	6 060	6 800	7 450	8 150	8 980	**9 830**				8 ft 0 in.
14	6 000	6 750	7 550	8 350	9 170	9 750	10 940	**11 550**			8 ft 5 in.
16	6 450	7 410	8 300	9 210	10 110	11 000	11 980	13 580			8 ft 10 in.
18	7 050	8 000	9 000	9 960	11 060	12 150	12 900	14 390	**15 250**		9 ft 1 in.
20	7 450	8 460	9 600	10 880	11 890	13 020	14 140	15 260	16 430	**16 830**	9 ft 4 in.

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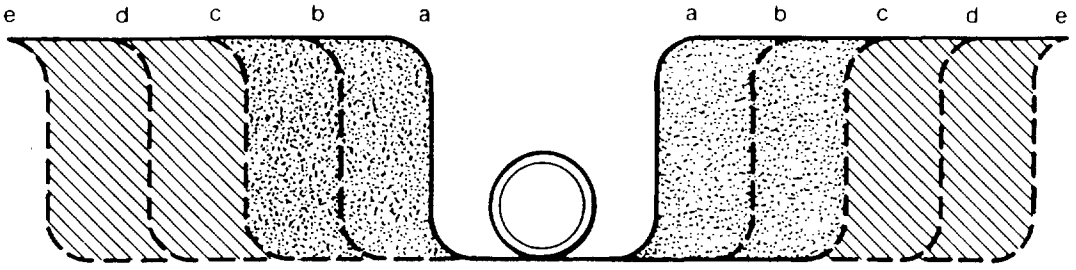


Fig. 6. Embankment Conditions

aa *and* bb *The trench width is less than the transition width; earth loads are computed by the trench equation (Eq 4).*
cc *The trench width is the transition width; earth loads are computed by either Eq 4 or Eq 5.*
dd *and* ee *The trench width is greater than the transition width; earth loads are computed by the positive projecting pipe embankment equation (Eq. 5). For a given depth of cover the earth loads resulting from trench widths* cc, dd, *and* ee *are equal.*

covered with fill above the original ground surface. Embankment conditions are further subdivided into positive and negative projecting pipe categories, depending on the location of the top of the pipe relative to the original undisturbed ground. A special case where compressible material is used as part of the backfill, called an imperfect trench, also is classified as an embankment condition. The various embankment conditions are illustrated in Fig. 6.

3.2.4 *Positive projecting pipe embankment condition.* A positive projecting pipe condition is defined as either that condition where the pipe is installed in a trench cut in undisturbed ground that is wider than two to three pipe diameters, or that condition where the top of the pipe is above the adjacent original ground surface and covered with fill above the original ground surface. For this condition, Eq 3 is rewritten as:

$$w_E = C_c w_e B_c^2 \qquad \text{Eq 5}$$

in which,

B_c = the pipe outside diameter in feet.

C_c = the load coefficient, which is a function of the ratio H/B_c, the projection ratio p, and the settlement ratio r_{sd}.

3.2.4.1 The values of C_c are obtained from Fig. 7. C_c also may be obtained from Eq 6 when the following conditions exist simultaneously:

1. The ratio H/B_c is greater than 1.3.
2. The product $p(r_{sd}) = 0.7$.

$$C_c = 1.892H/B_c - 0.96 \qquad \text{Eq 6}$$

3.2.4.2 The projection ratio p is defined as the ratio of the distance that the top of the pipe projects above the original ground surface to the pipe outside diameter. The recommended value for the settlement ratio r_{sd} is $+0.7$ for asbestos-cement transmission pipe design.

3.2.5 *Transition width.* It will be noted from the preceding discussion that under construction conditions where a trench is cut in undisturbed ground two methods of computing the earth load are available: (1) the trench condition, and (2) the positive projecting pipe embankment condition. The method chosen is de-

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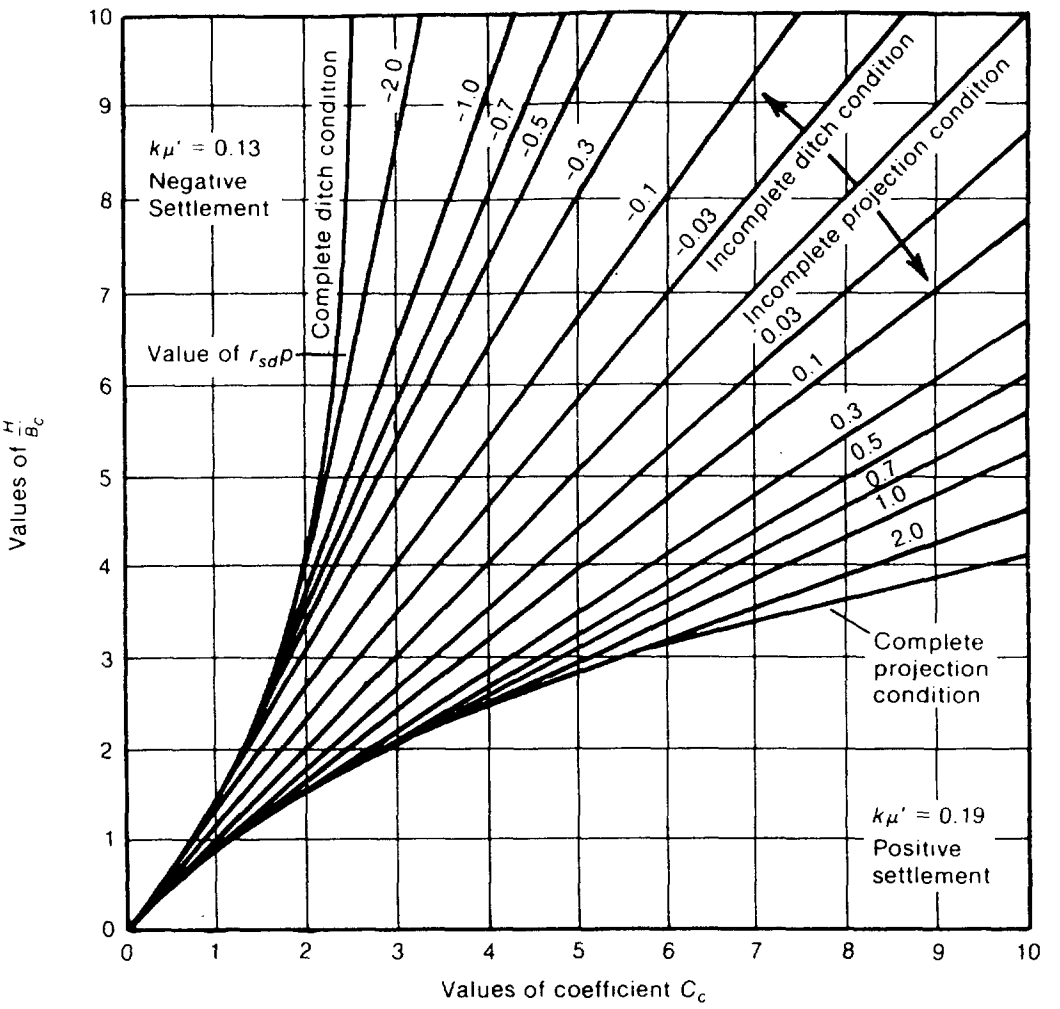


Fig. 7. Values of C_c for Positive Projecting Pipe

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pendent on the ratio of the trench width to the pipe diameter. As previously stated, when the trench width is less than two to three times the pipe diameter, earth loads are computed by the trench condition equation (Eq 4). The width of trench at which both methods of computation give equal loads is called the *transition width*. The earth load computed at the transition width is theoretically the maximum external earth load that can be transmitted to the pipe for any given depth of cover. For all trench widths greater than the transition width, earth loads are computed by the positive projecting pipe embankment condition equation (Eq 5). In this latter case and for a given depth of cover, the earth loads are equal to the load that results at the transition width and that is computed by the trench condition equation (Eq 4). [See Fig. 6.]

3.2.5.1 The transition width is determined from Fig. 8 by multiplying

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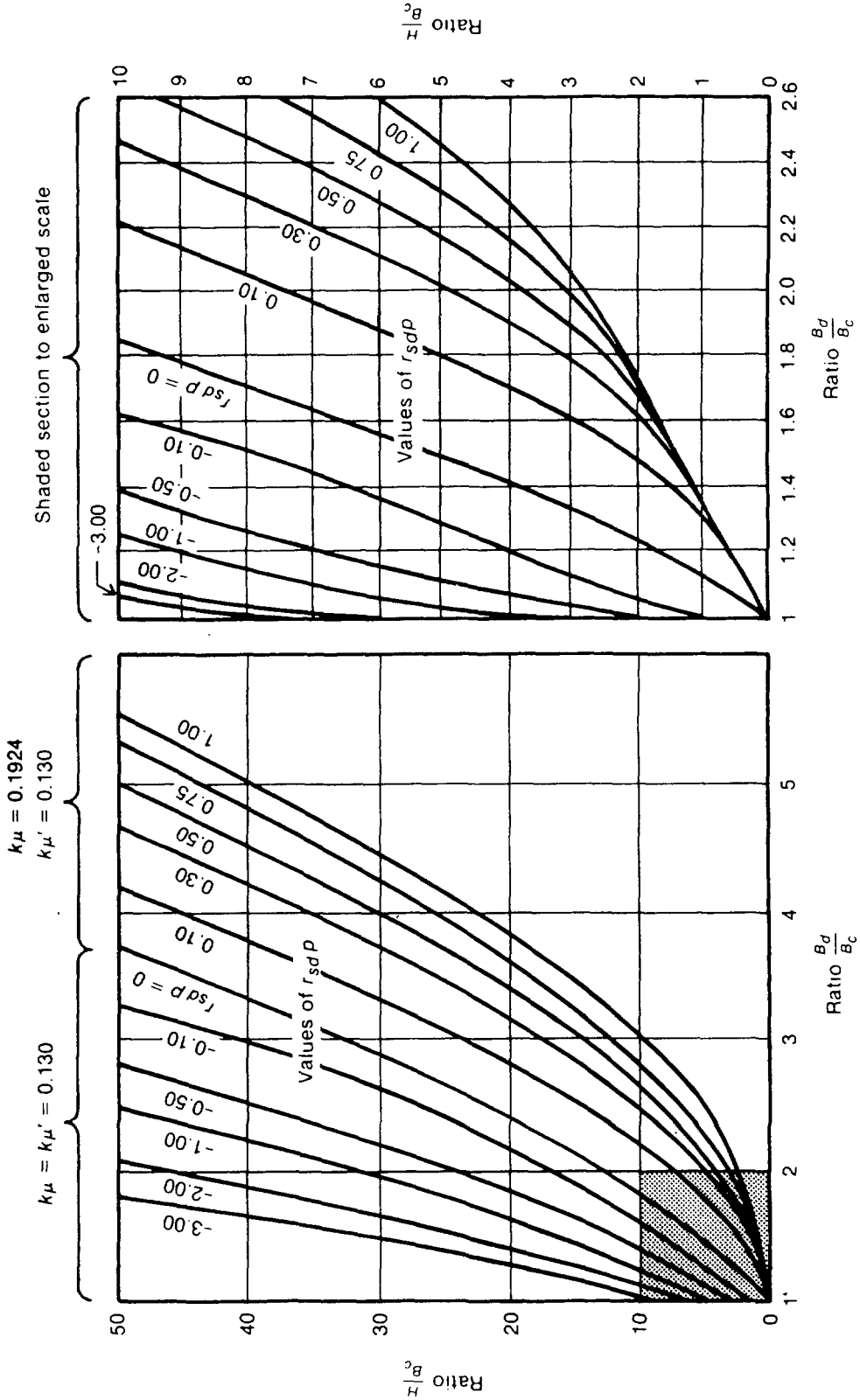


Fig. 8. Values of B_c/B_d at Which the Trench and Positive Projecting Pipe Equations Give Equal Loads

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the applicable ratio B_d/B_c by the applicable pipe outside diameter (B_c). The applicable ratio of trench width to pipe outside diameter (B_d/B_c) can be obtained from Fig. 8 for any given ratio of backfill height to pipe outside diameter (H/B_c).

3.2.6 *Negative projecting pipe embankment condition.* A negative projecting pipe condition is defined as that condition where the pipe is installed in a relatively shallow trench wherein the top of the pipe is at some elevation below the original ground surface. The trench is then backfilled and compacted, and embankment is constructed thereon to finished grade (Fig. 4). For this condition, Eq 3 is rewritten as

$$w_E = C_n w_e B_d^2 \qquad \text{Eq 7}$$

in which,

B_d = the trench width in feet, measured at the top of the pipe.

C_n = the load coefficient which is a function of the ratio H/B_d, the projection ratio p, and the settlement ratio r_{sd}.

3.2.6.1 The various values of C_n are obtained from Fig. 9. The projection ratio p is defined as the ratio of the vertical distance from the original ground surface down to the pipe top to the trench width, B_d. (See Fig. 10.) For asbestos–cement transmission pipe design the recommended value for the settlement ratio r_{sd} is zero.

3.2.6.2 When calculating earth loads under negative projecting pipe embankment conditions, consideration must be given to the transition width as defined in paragraph 3.2.5. For values of the ratio B_d/B_c less than those given in Fig. 8, the load on a pipe is determined from Eq 7 for negative projecting pipes. However, as the trench width increases and the ratio B_d/B_c becomes greater than that given in Fig. 8, the earth load should be determined from Eq 5 for positive projecting pipes. Adherence to the preceding rule will result in the most realistic earth loads for design purposes.

3.2.7 *Imperfect trench embankment condition.* The imperfect trench embankment condition occurs rather infrequently and is included for general information. The imperfect trench embankment condition refers to that construction technique wherein the pipe is first installed as a positive projecting pipe. A portion of the embankment is then built up to some elevation above the pipe top and thoroughly compacted as it is placed. A trench the same width as the pipe is then excavated directly over the pipe down to or near to its top and subsequently backfilled with loose compressible material. The remainder of the embankment is then built up to final elevation (Fig. 11). For this condition, Eq 3 is rewritten as

$$w_E = C_n w_e B_c^2 \qquad \text{Eq 8}$$

in which,

B_c = the pipe outside diameter in feet.

C_n = the load coefficient which is a function of the ratio H/B_c, the projection ratio p, and the settlement ratio r_{sd}.

3.2.7.1 The various values of C_n are obtained from Fig. 9. The projection ratio p is defined as the ratio of the vertical distance from the top of the excavated trench down to the pipe top to the pipe diameter (Fig. 11). For asbestos–cement transmission pipe design the recommended

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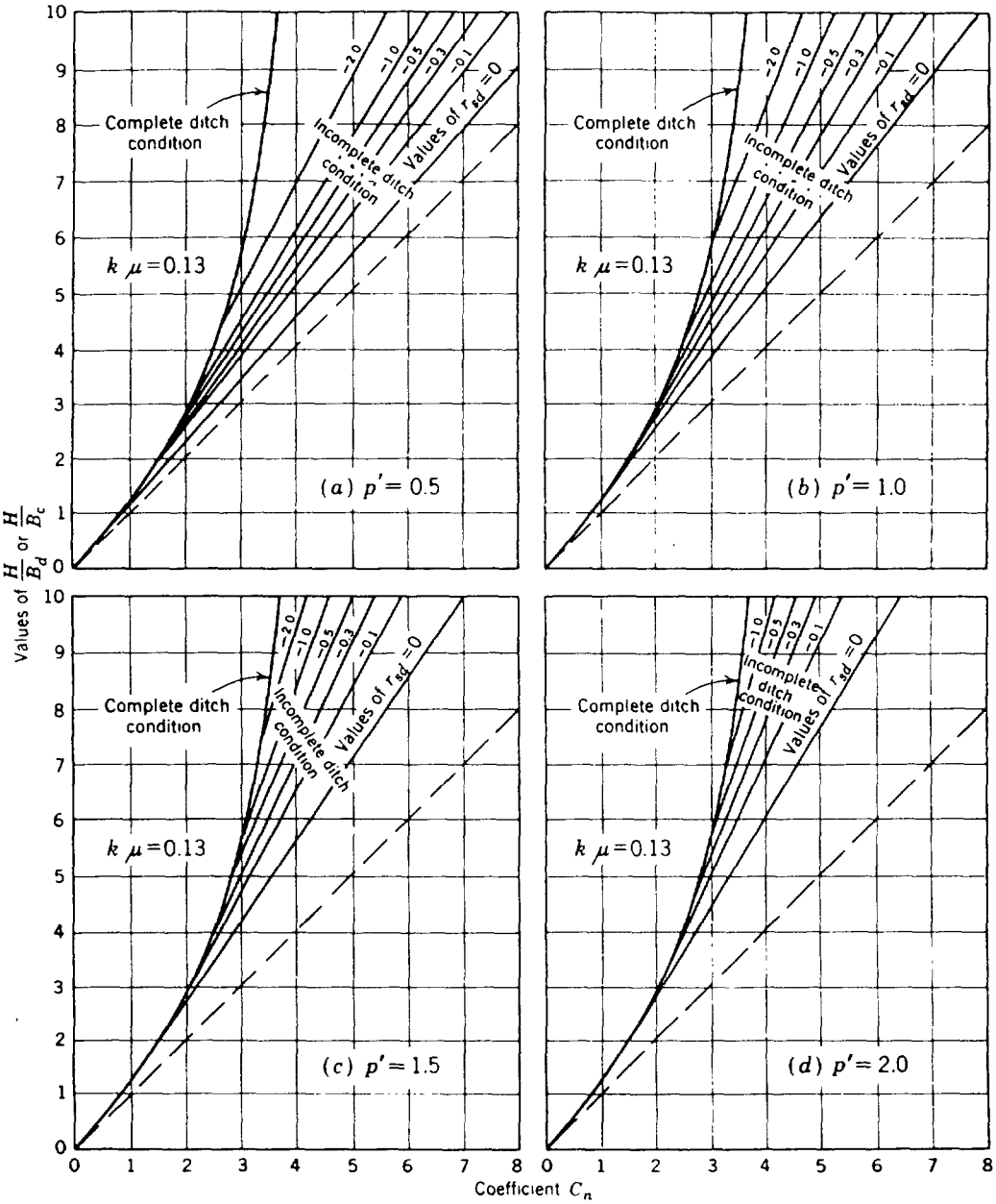


Fig. 9. Values of C_n for Negative Projecting Pipe and Imperfect Ditch Conditions

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value for the settlement ratio r_{sd} is equal to −0.3.

3.2.8 *Tunnel conditions.* There are two types of tunnel construction encountered in normal pipe laying operation.

3.2.8.1. The first type is the most frequently encountered and occurs when a sleeve of a larger diameter than the specified pipe is first jacked through an embankment. The pipe is then placed into the sleeve without

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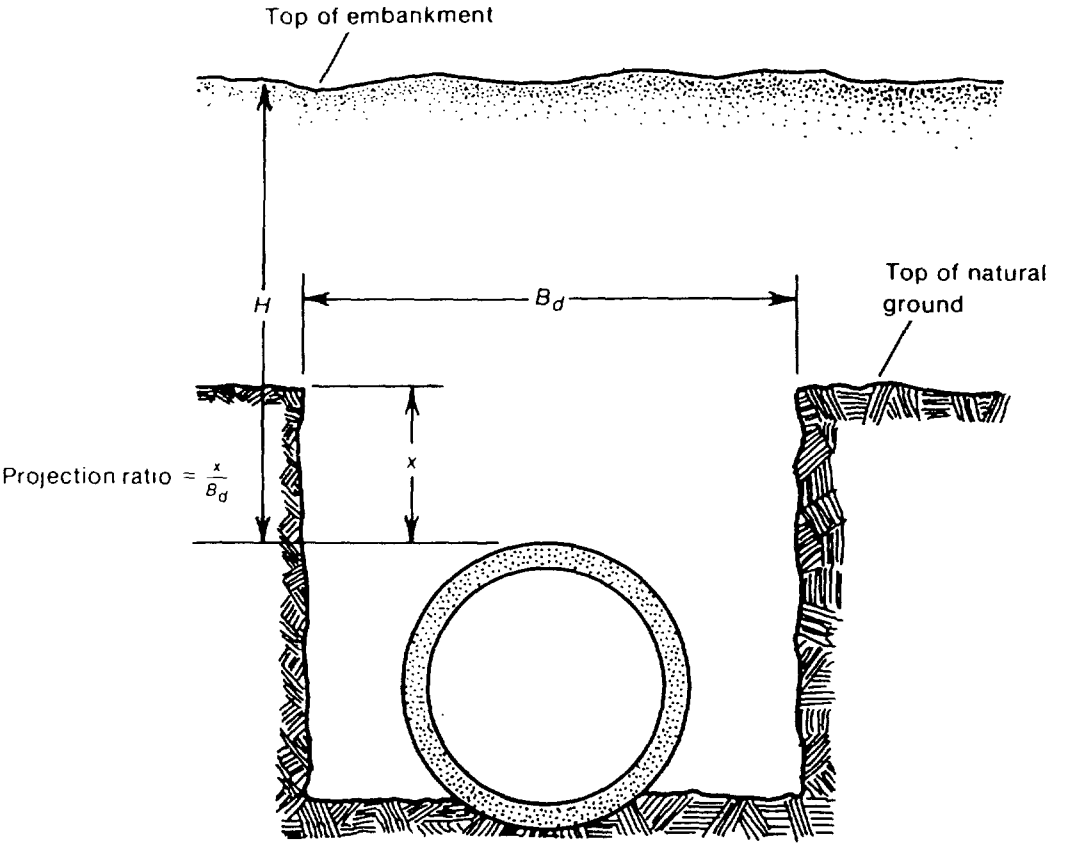


Fig. 10. Projection Ratio p for the Negative Projecting Pipe Embankment Condition

becoming an integral part of the tunnel construction. In this example the sleeve supports the entire earth load and the pipe contained therein is not subjected to crushing loads. When selecting the required pipe classification for this condition, only the internal pressure needs to be considered for design.

3.2.8.2. The second type of tunnel condition is rarely encountered in transmission work but is discussed here for completeness. It occurs when the pipe itself must carry the entire load. The area through which the pipeline must pass is bored and braced with the necessary supports. The pipe then is placed in the tunnel and the void between the pipe and tunnel braces is backfilled with compacted earth, grout, or concrete. Once this operation is completed, the earth load automatically transfers from the tunnel supports to the pipe itself. For this condition, Eq 3 is rewritten as

$$w_E = C_T B_T (w_e B_T - 2c) \qquad \text{Eq 9}$$

in which,

B_T = the maximum width of the tunnel excavation in feet.

c = the coefficient of cohesion in pounds per square foot.

C_T = the load coefficient which is a function of the coefficient of internal fraction for the material of the tunnel and of the ratio H/B_T, where H is the distance from the ground surface to the top of the tunnel in feet and B_T equals the width of the tunnel excavation in feet.

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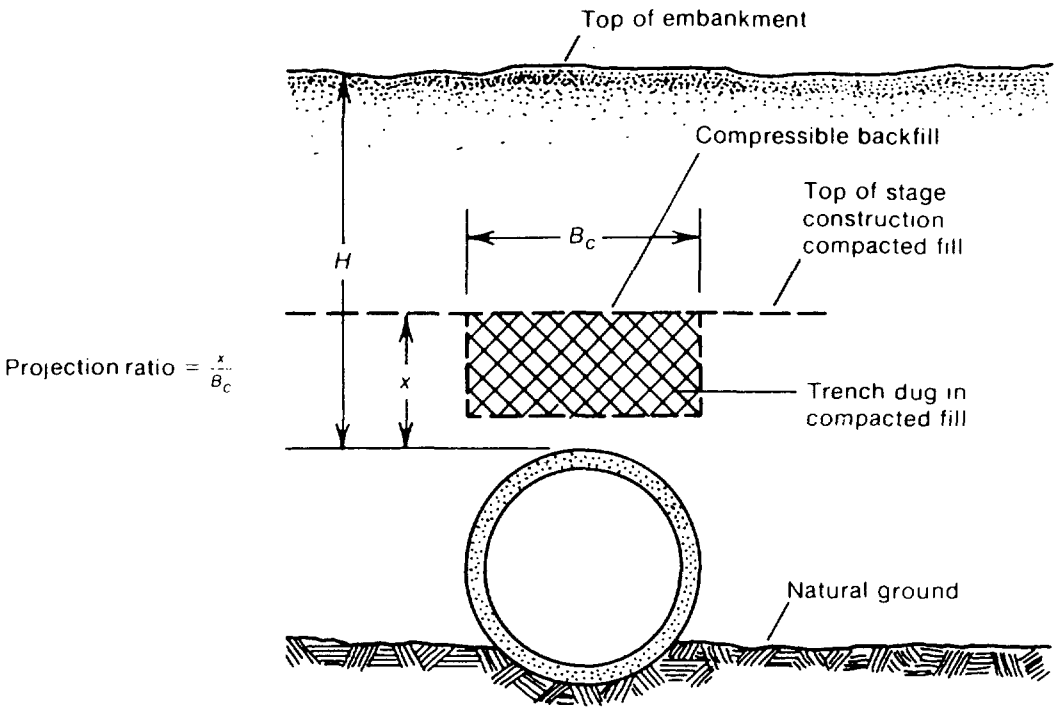


Fig. 11. Projection Ratio p for the Imperfect Trench Embankment Condition

3.2.8.3 Values of C_T for different types of soil are obtained from Fig. 12. If the value for the coefficient of cohesion is not available from laboratory tests, then the recommended safe design values in Table 3 are to be used.

TABLE 3

Recommended Safe Design Values of c *for Tunnel Conditions*

Material	Values of c
Clay, very soft	40
Clay, medium	250
Clay, hard	1000
Sand, loose dry	0
Sand, silty	100
Sand, dense	300
Top soil, saturated	100

3.2.8.4 When, in tunnel construction, the excavation becomes excessive, or when the void surrounding the pipe or tunnel lining is not carefully filled, or when the cohesion of the undisturbed material above the tunnel construction is destroyed by soil saturation or vibration, the earth load should be calculated by Eq 4 for trench conditions. Since it can be exceedingly difficult to either predict or assess whether the tunnel excavation is excessive, it is recommended that Eq 4 be used for most installations for safe asbestos–cement transmission pipe design.

3.2.8.5 It should be noted that the preceding discussion is based on the premise that the tunnel would be constructed in homogenenous soils that do not create unusual pressures and stresses. If the tunnel is constructed through materials that tend to squeeze or swell, such as some types of clay or shale, or through blocky and seamy rock, then methods other than tunnel construction must

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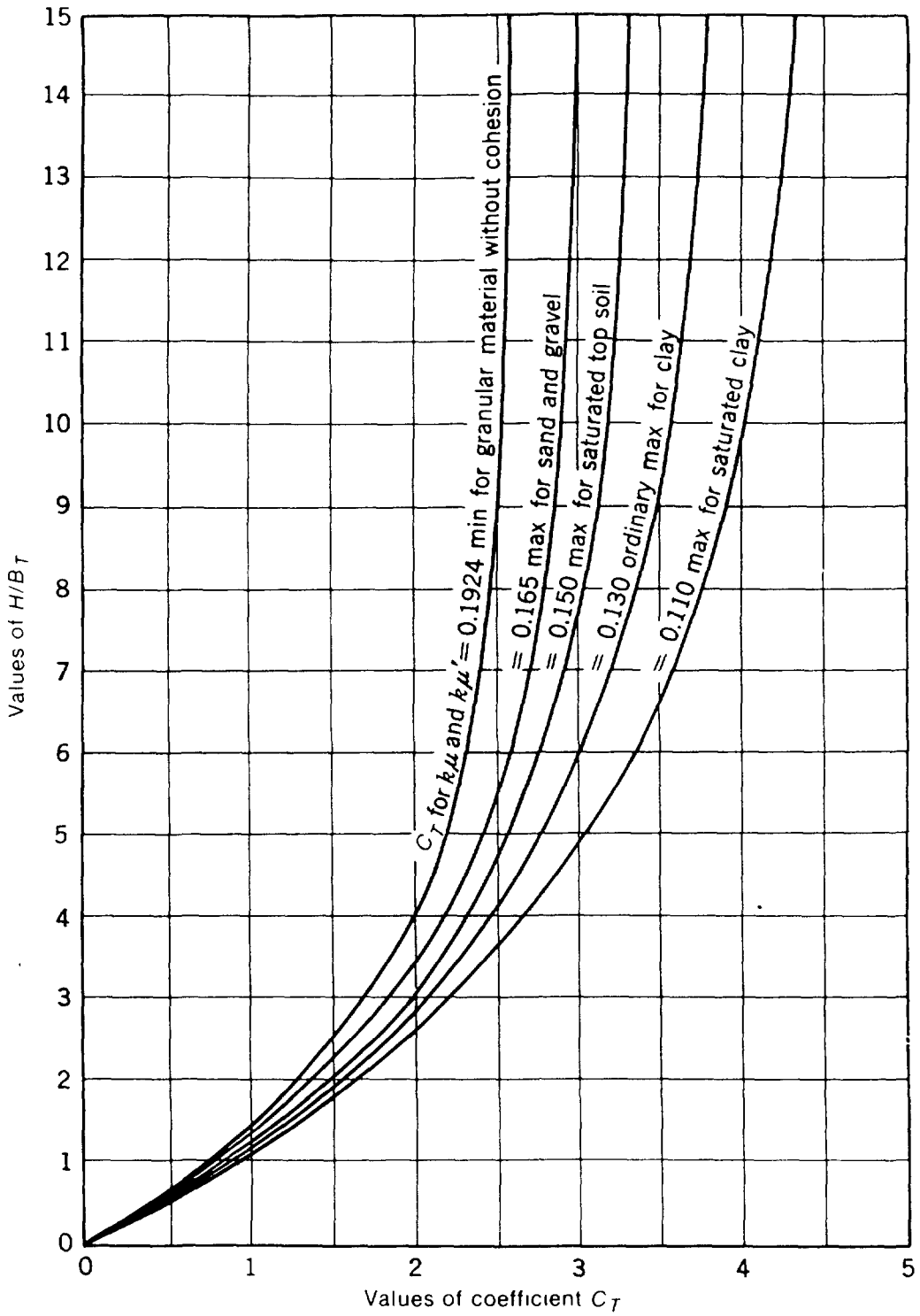
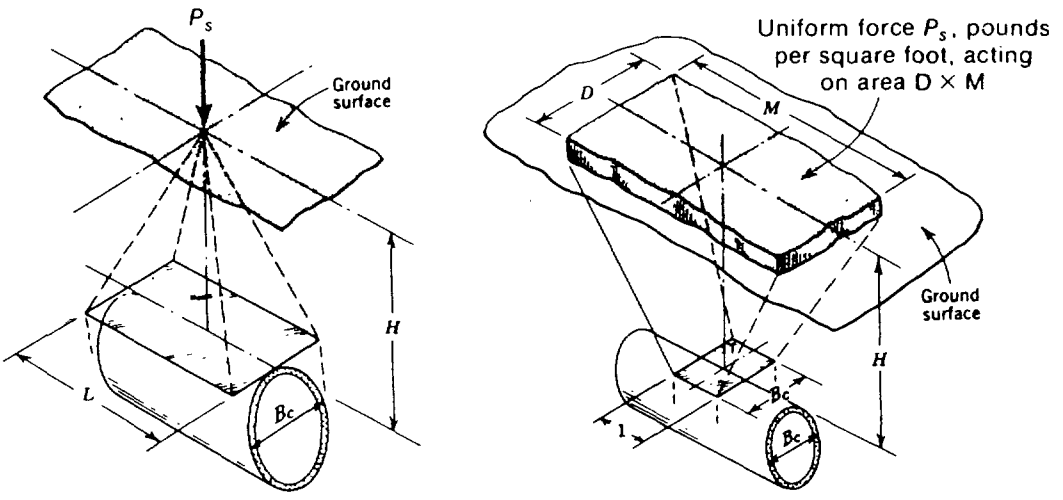


Fig. 12. Values of C_T for Tunnel Conditions

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Concentrated superimposed load, w_{S1}, vertically centered over pipe.

Distributed superimposed load, w_{S2}, vertically centered over pipe.

Fig. 13. Superimposed Loads

be utilized. The method of installation that is used is the responsibility of the engineer who is in charge of construction.

Sec. 3.3 Superimposed Loads

Superimposed loads w_S are external loads other than the normal earth loads transmitted to the pipe. There are two types of superimposed loads as illustrated in Fig. 13: (1) concentrated w_{S1}, and (2) distributed w_{S2}. Superimposed loads are frequently referred to as live loads.

3.3.1 *Concentrated loads.* A concentrated load is a load caused by a single force which may be either static or dynamic in nature. In normal pipe design, vehicular wheel loads are the most frequently encountered concentrated loads. The magnitude of the load produced by concentrated superimposed forces is determined by

$$w_{S1} = \frac{C_s P_s F}{L} \qquad \text{Eq 10}$$

in which

w_{S1} = the load on a pipe caused by a concentrated superimposed force in pounds per linear foot of pipe. (For convenience, concentrated superimposed loads resulting from a 16,000-lb wheel force are presented in Table 6.)

P_s = the concentrated force in pounds. The American Association of State Highway and Transportation Officials (AASHTO) design manual gives loads for various sizes and types of vehicles.

F = the impact factor. American Association of State Highway and Transportation Officials (AASHTO) vehicular wheel loads are shown in Table 4. Impact factors vary from one locale to another and values that are consistent with local, state, and federal specifications should be chosen.

L = the effective pipe length in feet. For pipe less than three feet, the actual length of the section should be used. For all other pipe lengths an effective length of three feet should be used.

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TABLE 4

Impact Factors

Depth of Cover *ft*	Impact Factor *F*
1.0–2.0	1.2
2.0—3.0	1.1
3.0 or greater	1.0

C_s = the load coefficient, which is a function of the depth of cover to the top of the pipe and the nominal inside diameter of the pipe. Values of C_s are obtained from Table 5.

3.3.2 *Distributed load.* A distributed load is a load caused by a uniform force distributed equally over a given area. The load may be either static or dynamic in nature. The magnitude of the load produced by distributed forces is determined by

$$w_{S2} = C_s P_s F\ B_c \qquad \text{Eq 11}$$

in which,

w_{S2} = the load on a pipe caused by distributed superimposed force in pounds per linear foot of pipe.

P_s = the intensity of the distributed force in pounds per square foot.

F = the impact factor as explained in paragraph 3.3.1.

B_c = the pipe diameter in feet.

C_s = the load coefficient, which is a function of the depth of cover to the top of the pipe and the nominal inside diameter of the pipe. Values of C_s are obtained from Table 5.

3.3.3. *Illustrative problem.* An 18-in. asbestos-cement transmission pipe is to be installed in a 3-ft wide trench under 8 ft of cover. The backfill is ordinary clay with a weight of 120 lb/cu ft. Determine the earth load on the pipe.

SOLUTION: The load must be computed two ways using the Marston equations for the trench condition and for the projecting pipe condition.

a. Trench condition Eq 4:

$$w_E = C_d w_e (B_d)^2$$

$$\frac{H}{B_d} = \frac{8}{3} = 2.7 \quad \text{(approximately 3)}$$

$$C_d = 1.9 \quad \left(\text{from Fig. 5 and } \frac{H}{B_d}\right)$$

$$w_E = (1.9)(120)(3)^2 = 2100 \text{ lb/ft}$$

TABLE 5

Values of Load Coefficients C_s *for Concentrated and Distributed Superimposed Loads Centered Vertically Over Conduit*

Pipe size, ID—*in.*	Depth of Cover *ft*										
	2	2½	3	4	5	6	8	10	12	16	20
18	0.391	0.289	0.221	0.136	0.092	0.066	0.038	0.025	0.017	0.010	0.006
20	0.422	0.316	0.241	0.150	0.102	0.073	0.042	0.027	0.019	0.011	0.007
21	0.436	0.327	0.251	0.157	0.107	0.077	0.044	0.029	0.020	0.012	0.007
24	0.478	0.362	0.280	0.177	0.120	0.087	0.050	0.033	0.022	0.013	0.008
27	0.510	0.392	0.306	0.195	0.133	0.096	0.056	0.037	0.025	0.014	0.008
30	0.543	0.423	0.332	0.213	0.147	0.106	0.062	0.041	0.029	0.016	0.010
33	0.563	0.446	0.353	0.230	0.159	0.115	0.067	0.045	0.032	0.018	0.011
36	0.590	0.470	0.375	0.248	0.171	0.124	0.073	0.049	0.035	0.020	0.012
39	0.615	0.502	0.404	0.272	0.191	0.140	0.083	0.054	0.041	0.026	0.015
42	0.619	0.516	0.422	0.286	0.202	0.147	0.089	0.063	0.043	0.030	0.017

NOTE: For convenience, concentrated superimposed loads resulting from a 16,000-lb wheel force are presented in Table 6.

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TABLE 6

w_{81}

Concentrated Superimposed (Wheel) Load on Asbestos-Cement Transmission Pipe
Single Wheel = 16,000 lb *(H-20 Wheel Load)*

Cover Over Top of Pipe *ft*	Pipe Diameter *in.*									
	18	20	21	24	27	30	33	36	39	42
2	2083*	2251	2364	2545	2720	2896	2992	3149	3280	3301
2½	1541	1682	1728	1939	2091	2256	2368	2510	2677	2752
3	1178	1286	1334	1494	1632	1723	1878	2000	2154	2250
4	725	800	837	944	1040	1136	1224	1321	1450	1525
5	490	544	570	640	710	784	845	912	1018	1077
6	352	389	410	464	512	566	611	662	747	784
8	203	224	234	267	299	330	357	390	443	475
10	133	144	154	176	197	219	240	261	288	336
12	91	100	105	117	133	155	170	187	219	229
16	53	59	64	69	75	85	96	107	139	160
20	32	37	40	43	45	53	60	63	80	91

* Values shown are in pounds per linear foot of pipe.
NOTE: Table is based on impact factor of one. If different impact is to be used, simply multiply value from table times desired impact factor.

b. Projecting pipe condition Eq 5:

$w_E = C_c w_c (B_c)^2$
B_c = 18 in. pipe OD = 1.7 ft
$C_c = 1.892(H/B_c) - 0.96$
$= 1.892(8/1.7) - 0.96 = 8$
$w_E = (8)(120)(1.7)^2 = 2800$ lb/ft

c. The engineer, knowing the job conditions and degree of inspection, should decide which load applies.

Section 4—Hydrostatic Pressure

Sec. 4.1 Introduction

For the design of asbestos-cement transmission pipe, the internal hydrostatic pressure p_T is defined by

$$p_T = (P_o + P_s)S.F. \qquad \text{Eq 12}$$

in which,

p_T = the total internal pressure in pounds per square inch which, in combination with some external load w_T applied in three-edge bearing, will fracture the pipe.

P_o = the static or operating pressure in pounds per square inch defined by the design criteria.

P_s = the surge pressure in pounds per square inch resulting from either water hammer or other incremental pressures over and above the normal operating pressure.

$S.F.$ = the design safety factor specified by the purchaser. Safety factors are based on judgment, past experiences, and sound engineering principles. For asbestos-cement trans-

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mission pipe design, a minimum safety factor of 2.0 is recommended.

For simplicity in design and selection of asbestos-cement transmission pipe, the internal pressure may be separated into two components: (1) operating pressure, and (2) water hammer or surge pressure. Each will be determined separately.

Sec. 4.2 Operating Pressure

The operating pressure P_o is that pressure which exists under normal or steady conditions of operation. The pressure may be induced by pumps, gravity (such as the head created by a reservoir or elevated water tank), or a combination of both pumps and gravity. Under a 100 percent gravity situation, the pressure in the line at a given point is somewhat higher when there is no flow and conditions are static. Under static conditions the pressure at a given point, measured in feet of head, is equal to the difference between the elevation of that point and the water surface level at the reservoir. Under flowing conditions the pressure at a given point is reduced by the amount of friction and other energy losses resulting from the flow of water from the reservoir to that point. The magnitude of this head loss may be found by using the Hazen and Williams chart in Appendix A. In piping systems that have long runs with relatively few fittings and accessories, the recommended value of C (coefficient of flow) is 140.

Sec. 4.3 Surge Pressure

Surge pressures P_s are of a transient nature and are caused by unsteady or changing conditions in the pipeline. The terms "water hammer," "surge," or "transient pressure" are often used interchangeably to refer to these pressures, which are of brief duration but often of considerable magnitude. A variety of conditions may cause surge pressures. These include a valve opening or closing, sudden movement of air in a line, or a pump starting or stopping. Transient pressures are often a controlling factor in the selection of pipe strength. For this reason, a pipe system should always be analyzed for surge pressure determinations and the results should be used in pipe selection.

4.3.1. *Surge control.* There are numerous methods for control of surge pressures in the line. Consideration should be given to use of these methods to limit pressures to an acceptable level. Economics plays a major role in this area. Various designs may have to be balanced, depending on the complexity of the system, to yield an economical and efficient design.

4.3.1.1 Appendix B presents a discussion of water hammer with emphasis on how it may be analyzed and controlled. Although the subject is discussed in some detail, and an illustrative problem is included that involves controlling surge pressure by timing a valve closure, the subject is too complex to be thoroughly covered in this standard. It is suggested that control of surge for any transmission system be discussed with surge control equipment manufacturers or consultants in this particular field. The effects of surge in a pipeline, however, should not be ignored, as neglect of this factor may result in severe damage to the system. Also, because of the number of variables involved in creating water hammer pressures, and because of the ability to regulate their magnitude with proper controls, it is

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not recommended that fixed water hammer allowances based on assumed velocity changes or some other single criterion be used for the larger diameter transmission and feeder main lines.

Section 5—Pipe Selection

Sec. 5.1 Combined Loading Curves

As discussed previously, it has been demonstrated satisfactorily by tests that asbestos-cement transmission pipe conforms generally to the Schlick formula for combined loading (Sec. 2.2). Numerous tests have established values for P, internal hydrostatic design pressure with no crush load applied, and for W, external crush design load with no internal pressure applied, for all diameters and strength classifications. These values represent the end points on the combined loading curves; the intermediate points on the curves are computed by use of the Schlick formula. (It should be noted that all values used for P and W represent a conservative interpretation of the test data.) On the curves, each intermediate point—w_T, p_T—represents a combination of crush loading and internal pressure that the pipe will withstand when the loads are applied simultaneously.

5.1.1 *Selection curves.* Selection curves in Fig. 14a–14j are presented for each size of pipe from 18 through 42 in. On the graph for each pipe diameter, a combined loading curve is drawn for each strength classification of that pipe size. The vertical axis represents the internal hydrostatic design pressure P, and the horizontal axis represents the external three-edge bearing crush design load W. Table 7 lists the values of P and W for the strength classifications of each pipe size. In Sec. 5.3, Use of Selection Charts for Economical Design, the method for pipe selection is outlined.

Sec. 5.2 Safety Factors

Safety factors are normally applied by the engineer to his computed design values of crush- and internal pressure that are to be resisted by the pipe in service. These factors protect against unforeseen loads that may be placed on the line at some time in the future, and against other contingencies such as improper construction. It is the engineer's prerogative to select which safety factors he feels should apply to a given system. Considerable field experience as well as extensive laboratory work has yielded a wealth of information on the behavior of asbestos-cement transmission pipe. For this reason, suggestions for minimum safety factors are made in Table 8. Note that, since the combined loading principle is applicable, the safety factors will be applied to both hydro and crush simultaneously. Note also that water hammer and live load, which are both transient load conditions, are considered as acting simultaneously for design purposes here. Since the likelihood of both occurring at the same time is minimal, an additional conservative element is introduced into the design.

Sec. 5.3 Use of Selection Charts for Economical Design

After all loads on the pipe have been computed (operating pressure, water

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TABLE 7

Design Internal Pressure and Design External Load† Intercepts for Use With Selection Curves for the Following Pipe Classifications*

Pipe Size *in.*	30	35	40	45	50	60	70	80	90
	*P** = 300	*P* = 350	*P* = 400	*P* = 450	*P* = 500	*P* = 600	*P* = 700	*P* = 800	*P* = 900
	W†	*W*	*W*	*W*	*W*	*W*	*W*	*W*	*W*
18	2 500	3 000	4 000	5 000	6 500	8 500	11 000	14 000	18 000
20	2 500	3 500	4 500	5 500	7 100	9 500	12 000	15 000	20 000
21	2 500	3 500	4 500	5 800	7 300	9 700	12 500	16 000	21 000
24	2 800	3 800	5 000	6 200	8 100	11 000	15 000	19 000	24 000
27	3 500	4 200	5 500	7 000	8 800	12 500	16 500	20 500	27 000
30	3 500	4 500	6 000	7 500	9 700	13 500	18 000	22 500	30 000
33	3 500	5 000	6 500	8 000	10 500	14 500	19 500	24 500	33 000
36	4 000	5 000	7 000	9 000	11 200	16 000	21 000	26 000	36 000
39	4 200	5 300	7 500	9 700	12 000	17 200	22 500	28 000	39 000
42	4 300	5 700	8 000	10 500	13 000	18 500	24 000	30 000	42 000

* *P*—*psi.*
† *W*—*lb/lin ft.*

hammer, earth load, and live load), the most economical strength of pipe to meet the service conditions should be selected. The applicable selection procedure using the suggested safety factors is:

1. Add operating pressure and water hammer, $P_o + P_s$ (Sec. 4).
2. Add earth load and live load, $w_E + w_S$ (Sec. 3).
3. Enter the combined loading graph for the appropriate pipe diameter. Plot the values from Steps 1 and 2 above as one point. When using the left-hand scales, be sure to multiply the *operating pressure plus water hammer* by the suggested safety factor of 2.0. When using the bottom scale, be sure to multiply the *earth load plus live load* by the suggested safety factor of 1.5, and then to divide it by the bedding factor (Sec. 2.3).
4. The point plotted will lie between the curves for two pipe strengths. Select the higher strength of the two. This represents the most economical selection consistent with engineering requirements.

TABLE 8

Minimum Safety Factors for Use With Asbestos-Cement Transmission Pipe Selection

Type of Load	Safety Factor	
	Hydro	Crush
Operating pressure plus water hammer, combined with earth load plus live load	2.0	1.5

Sec. 5.4 Illustrative Problem on Pipe Selection

A 24-in. asbestos-cement transmission line is to be installed in a 4-ft wide trench with 5 ft of cover. The operating pressure will be 100 psi. Surge pressures will be limited to a

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maximum of 50 psi. A 16,000-lb wheel load is to be assumed, with an impact factor = 1. Class C bedding will be used. Select the proper strength of pipe to be used with safety factors of 2.0 in hydro ($P_o + P_s$) and 1.5 in crush ($w_E + w_S$).

SOLUTION: Following instructions for use of selection charts with safety factors as described in Sec. 5.3 gives

1. $P_o + P_s = 100 + 50 = 150$ psi
2. $w_E + w_S = 2030 + 640$
   $= 2670$ lb/ft
3. $(P_o + P_s)(S.F.)$
   $= 150 \times 2.0 = 300$ psi
4. $\dfrac{(w_E + w_S)(S.F.)}{B.F.} = \dfrac{(2670)(1.5)}{1.5}$
   $= 2670$ lb/ft
5. Consult the combined loading chart for 24-in. pipe, using the left hand and bottom scales. Plot the two loads as a single point on the chart. The point falls between T-40 and T-45. Use T-45.

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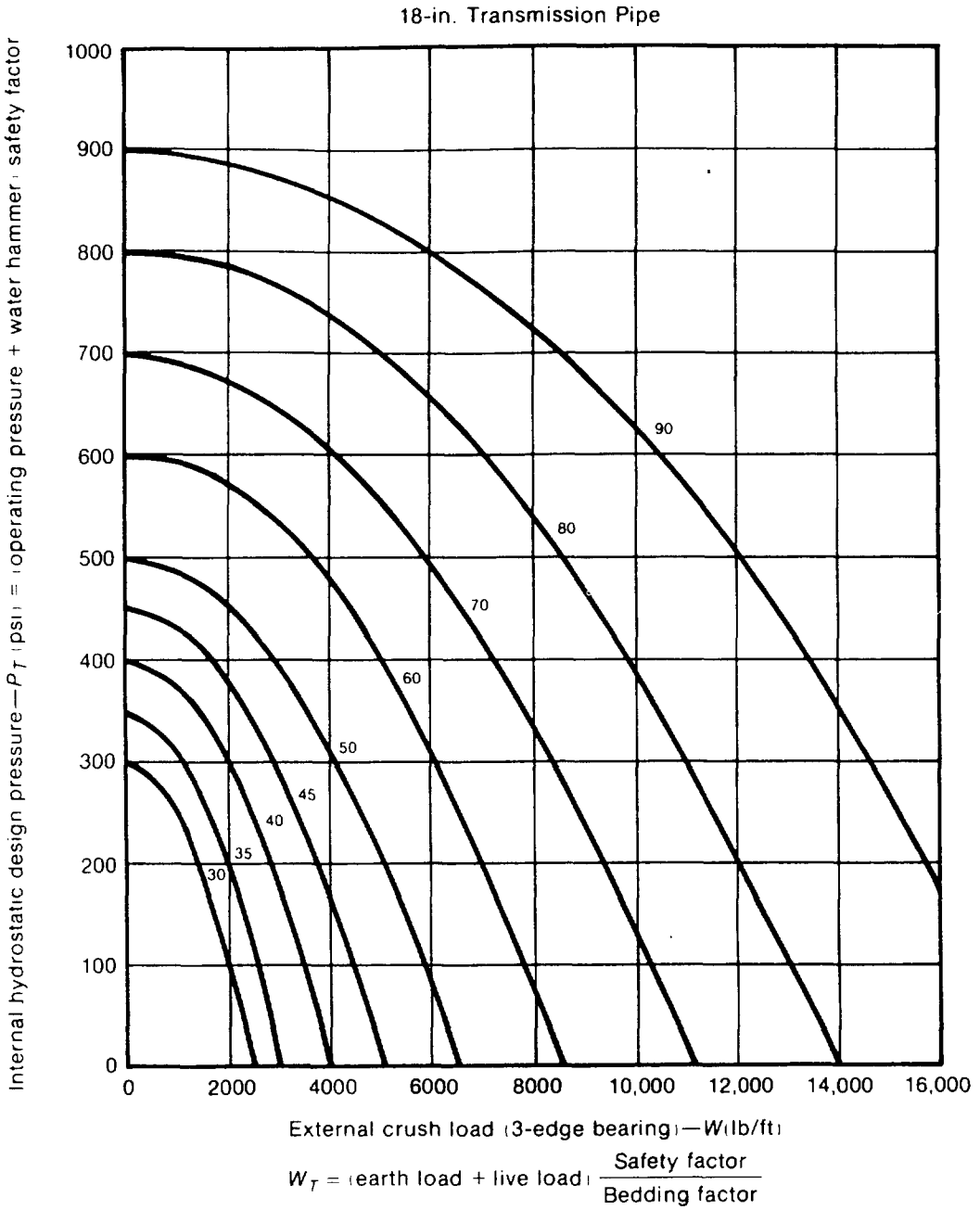


Fig. 14a. Combined Loading Curves for 18-in. Transmission Pipe

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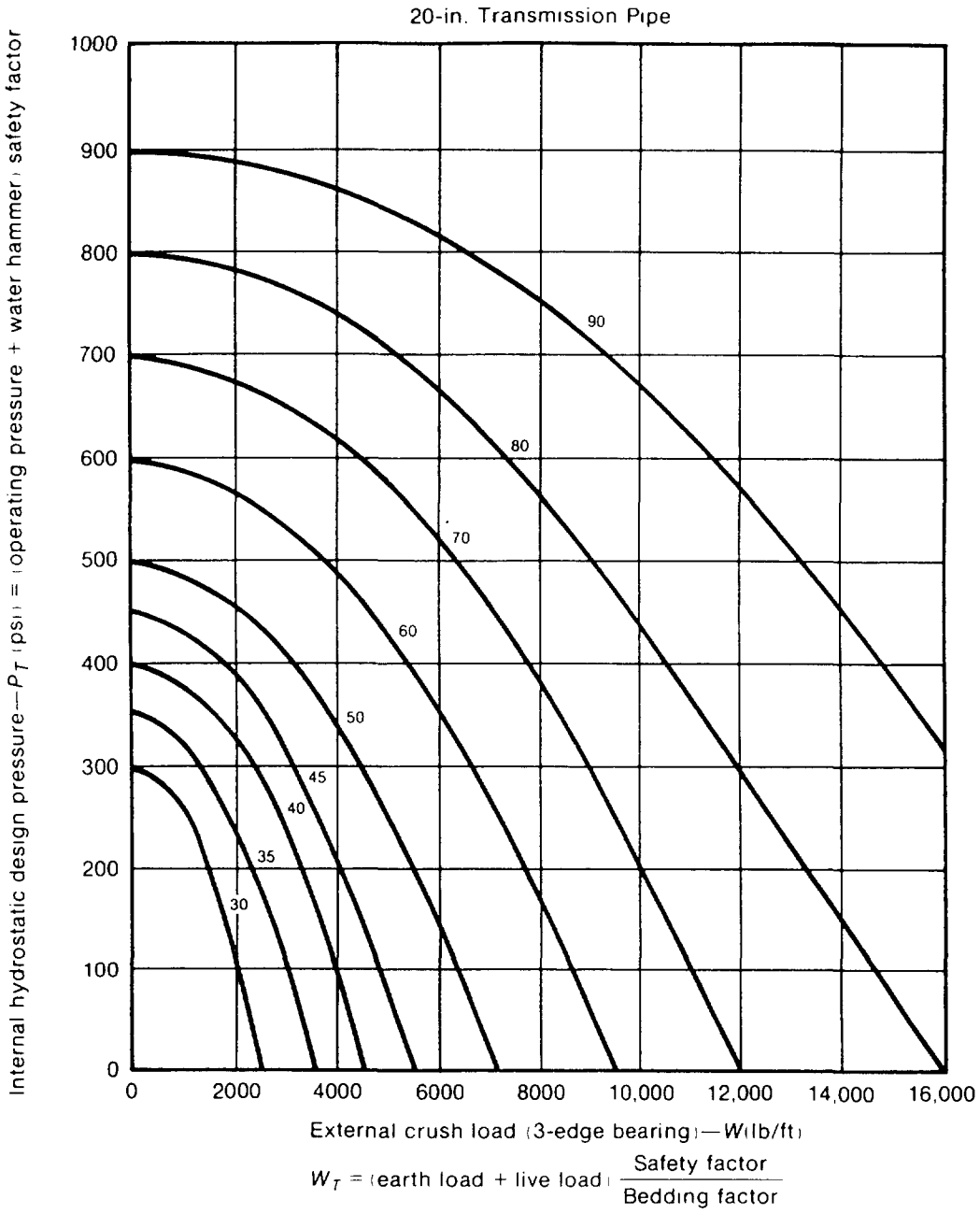


Fig. 14b. 20-in. Transmission Pipe

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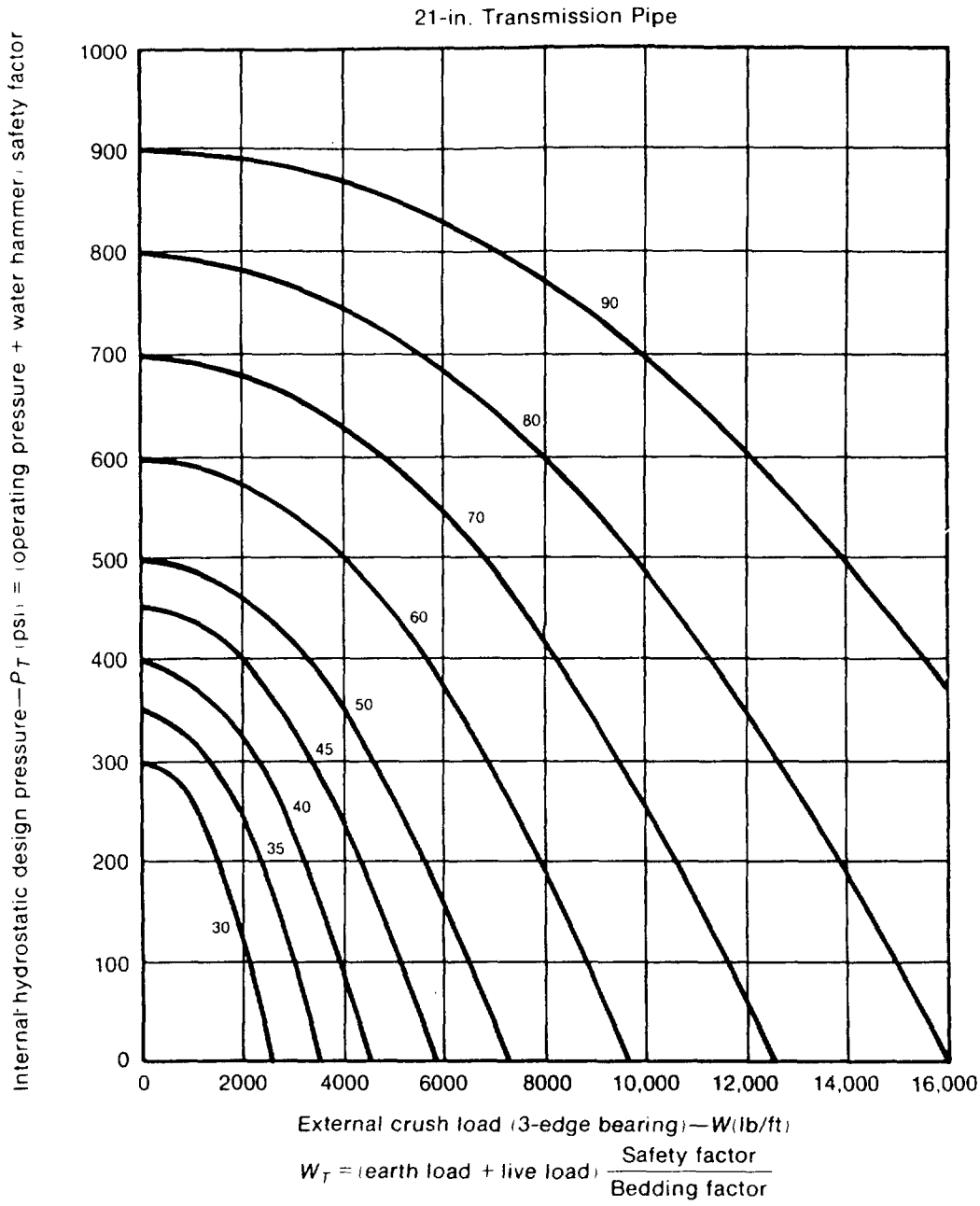


Fig. 14c. 21-in. Transmission Pipe

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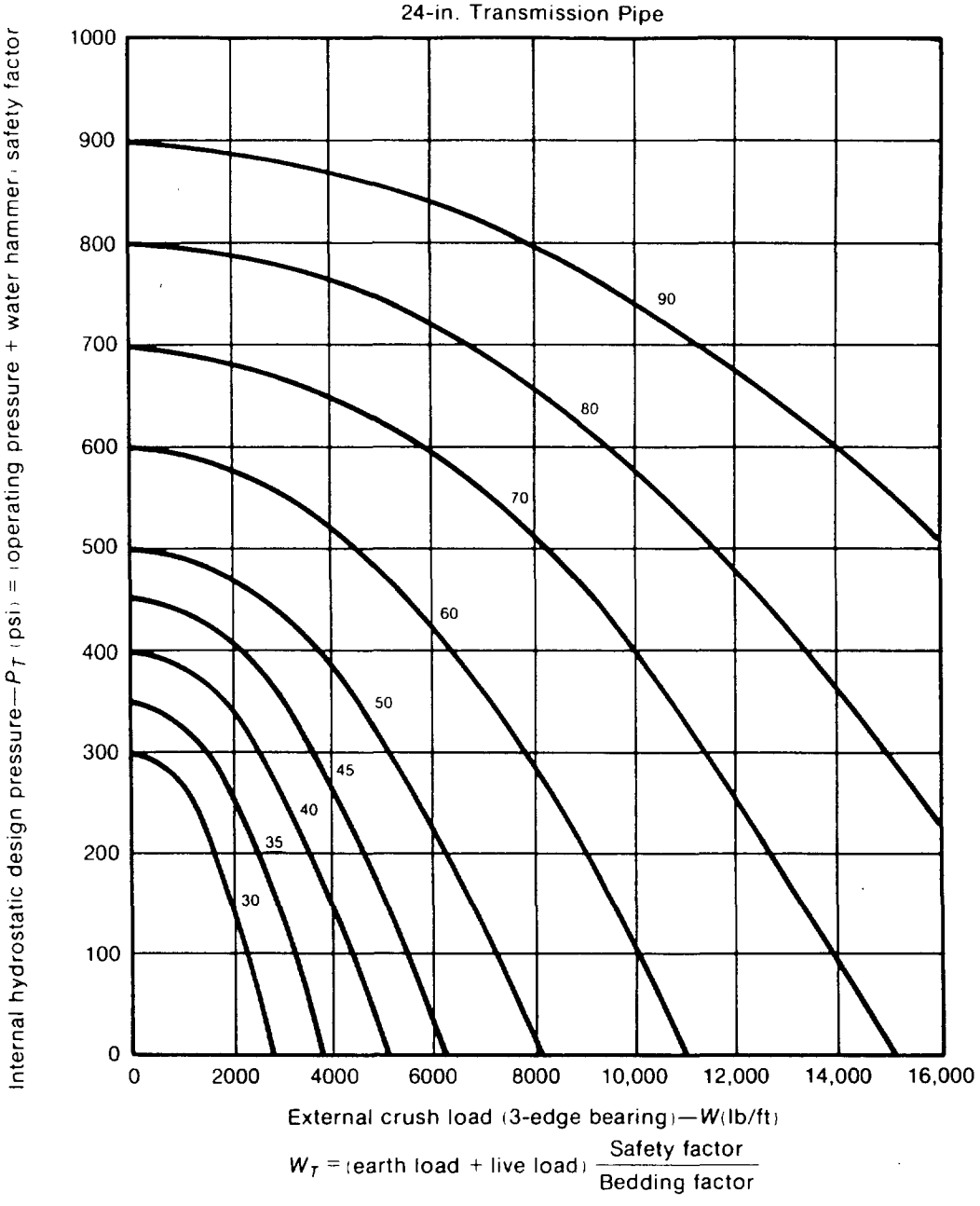


Fig. 14d. 24-in. Transmission Pipe

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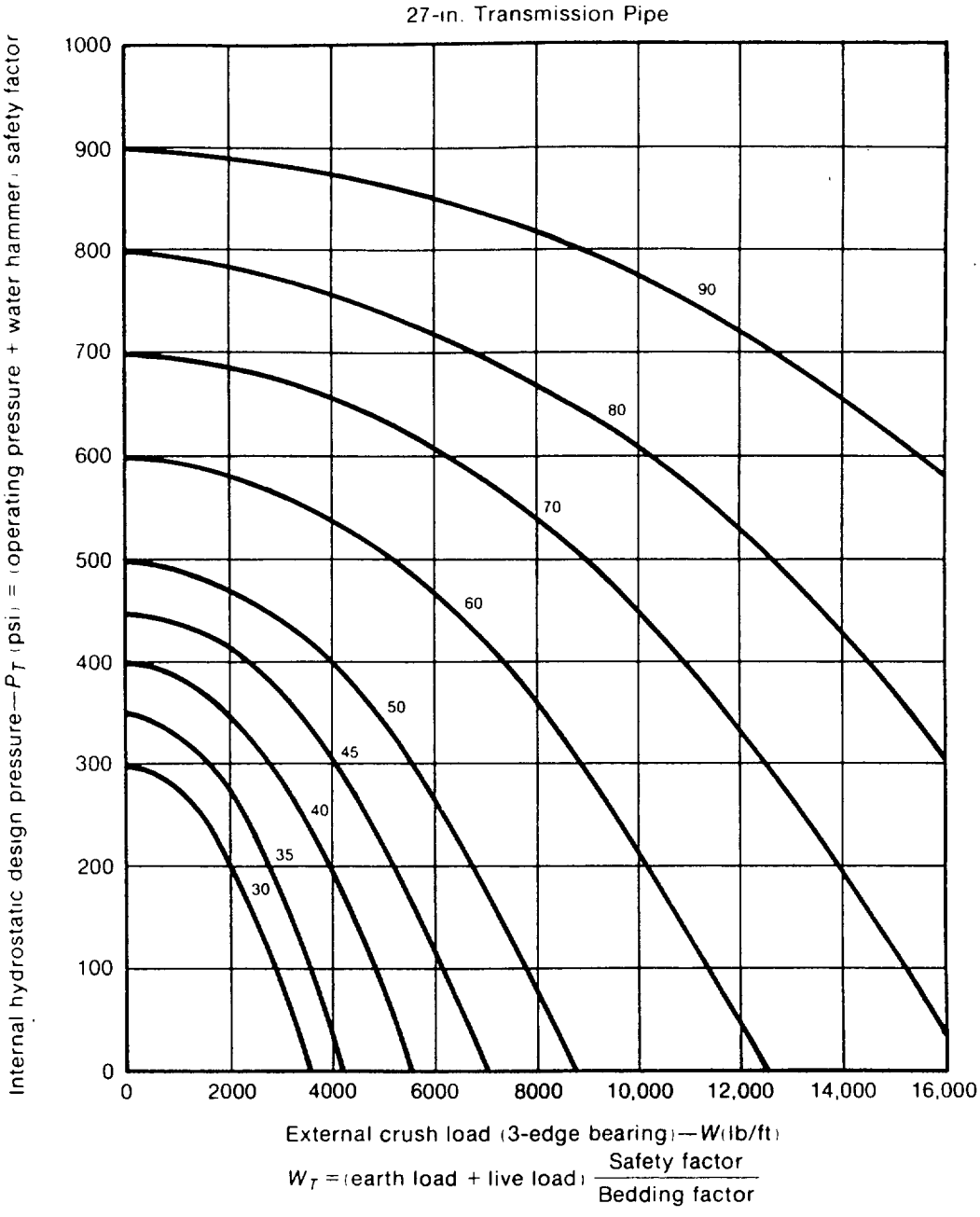


Fig. 14e. 27-in. Transmission Pipe

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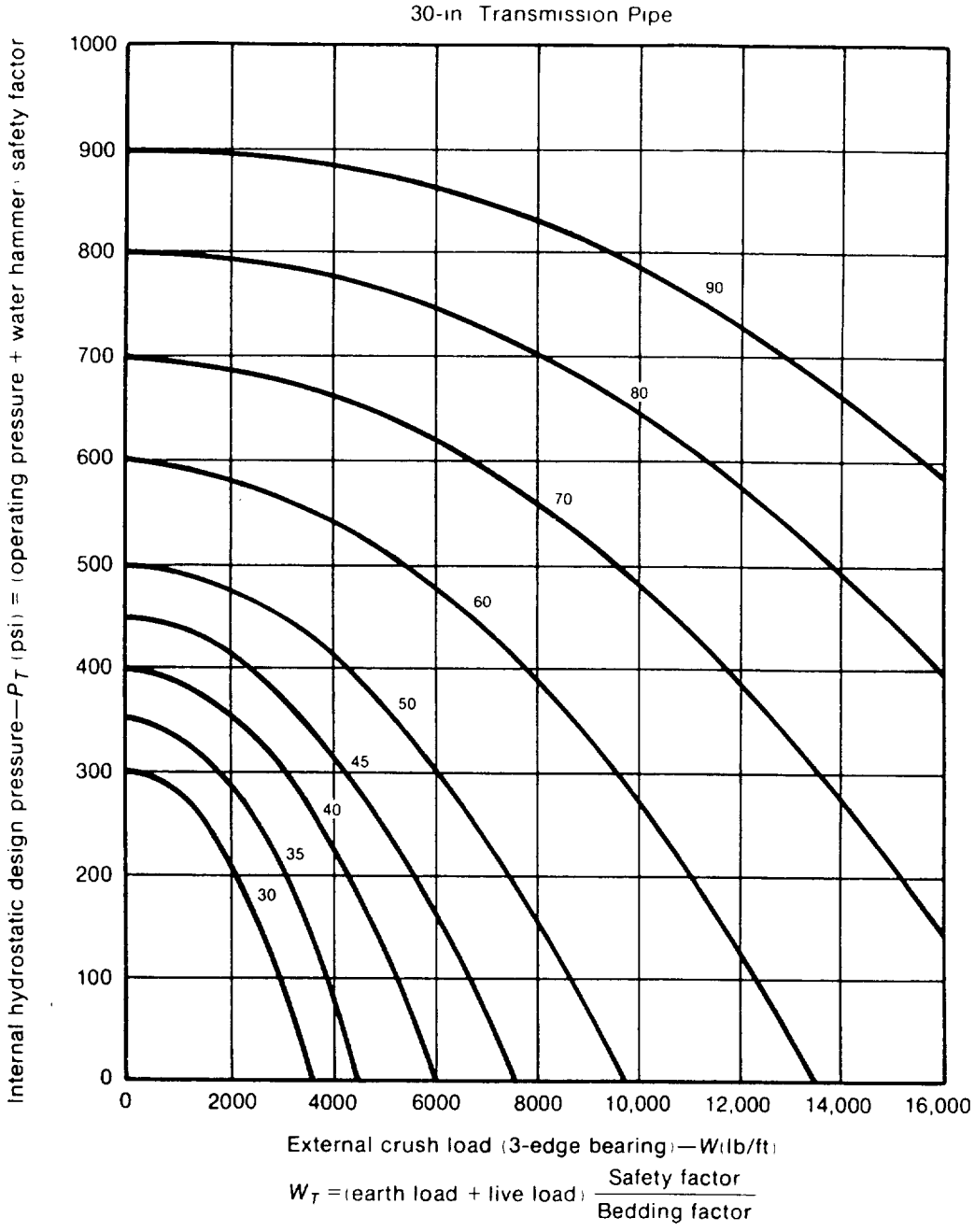


Fig. 14f. 30-in. Transmission Pipe

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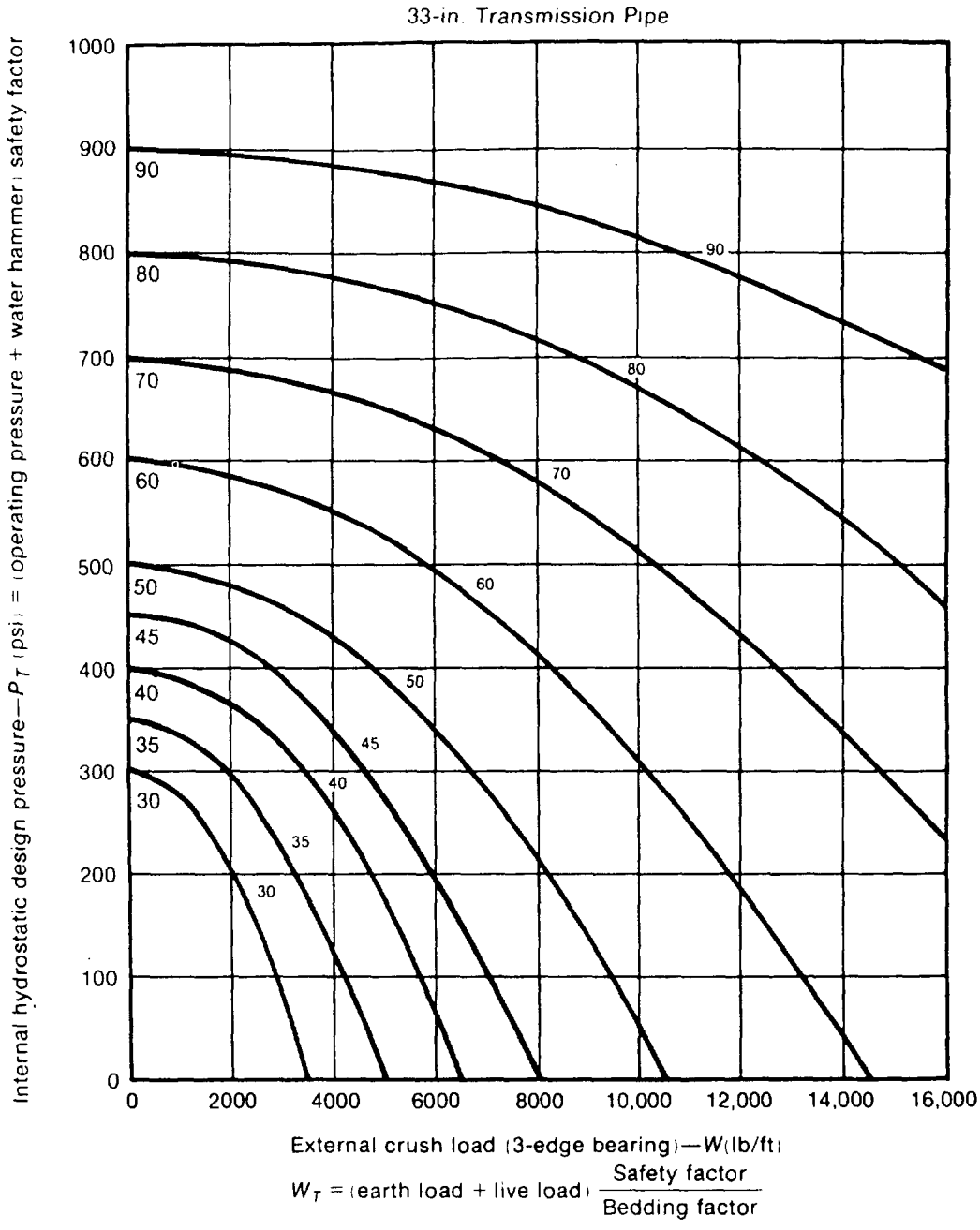


Fig. 14g. 33-in. Transmission Pipe

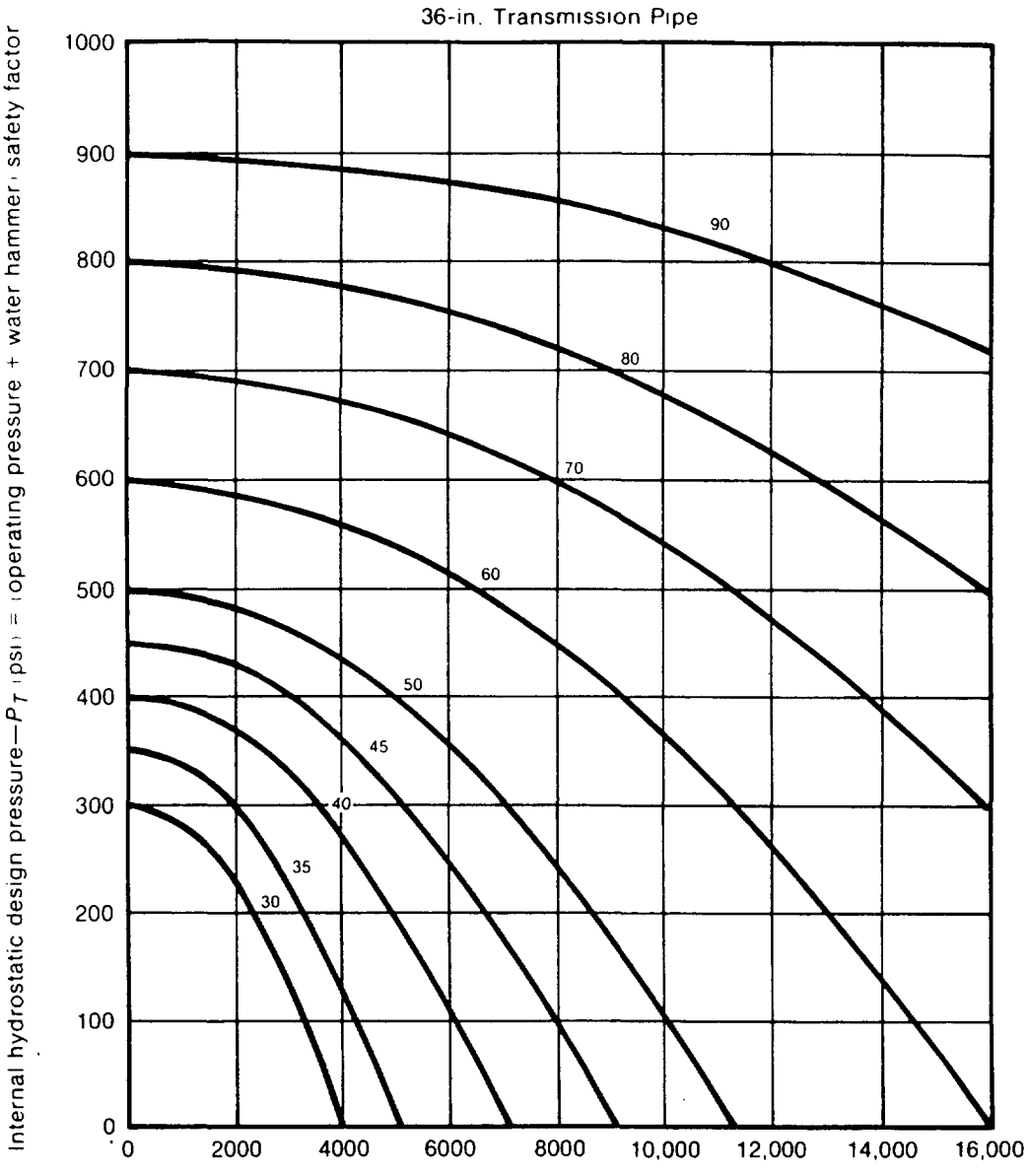


Fig. 14h. 36-in. Transmission Pipe

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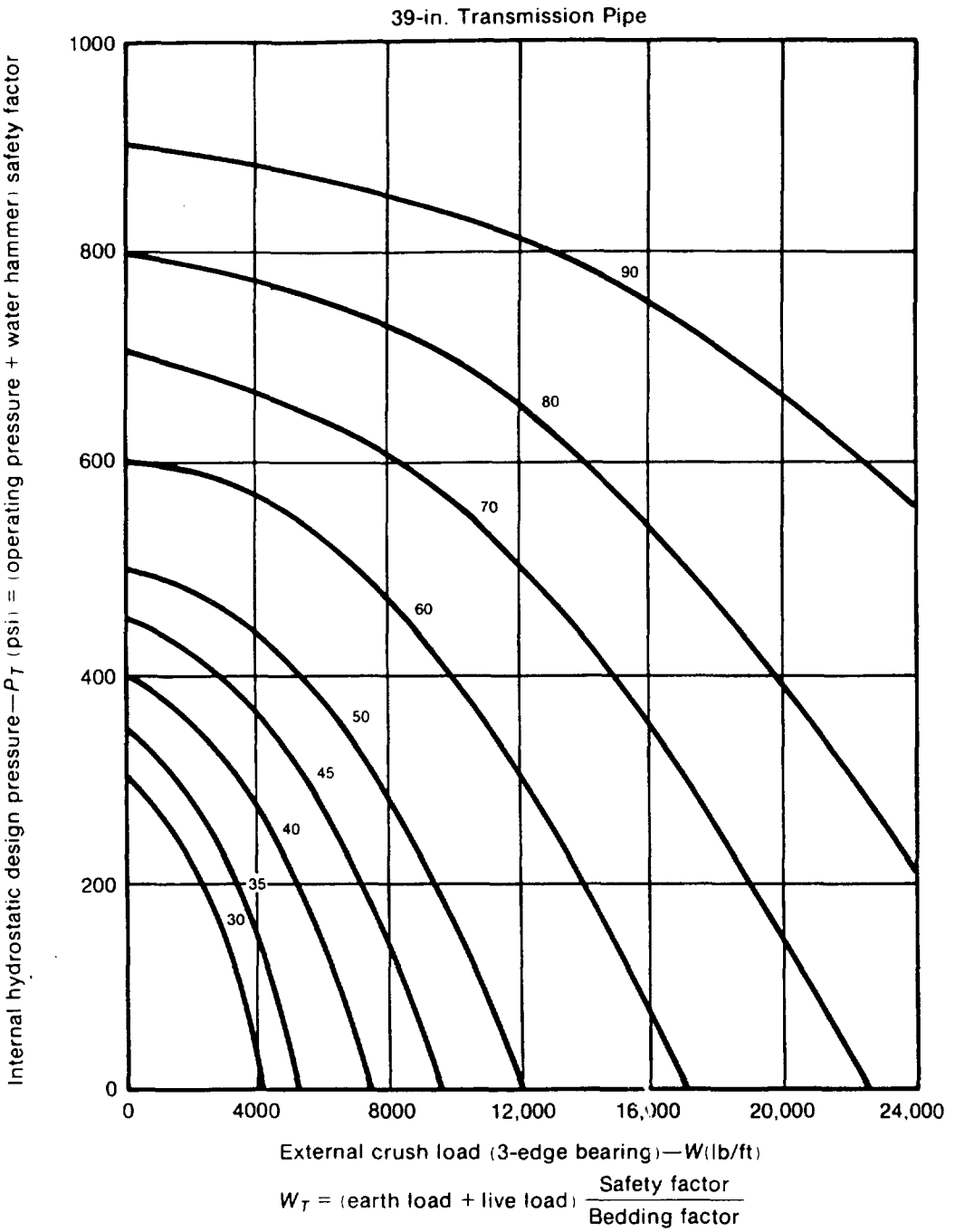


Fig. 14i. 39-in. Transmission Pipe

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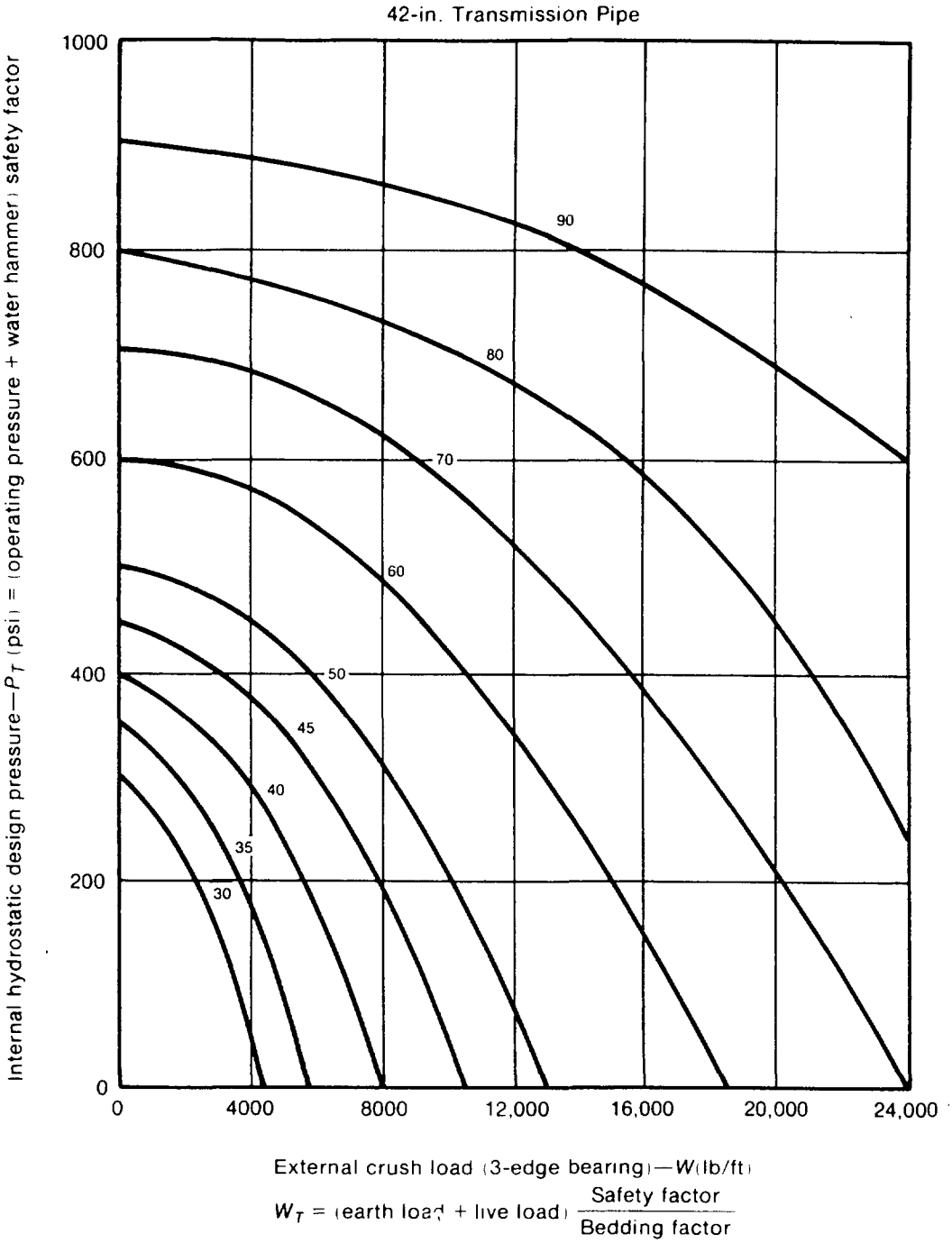


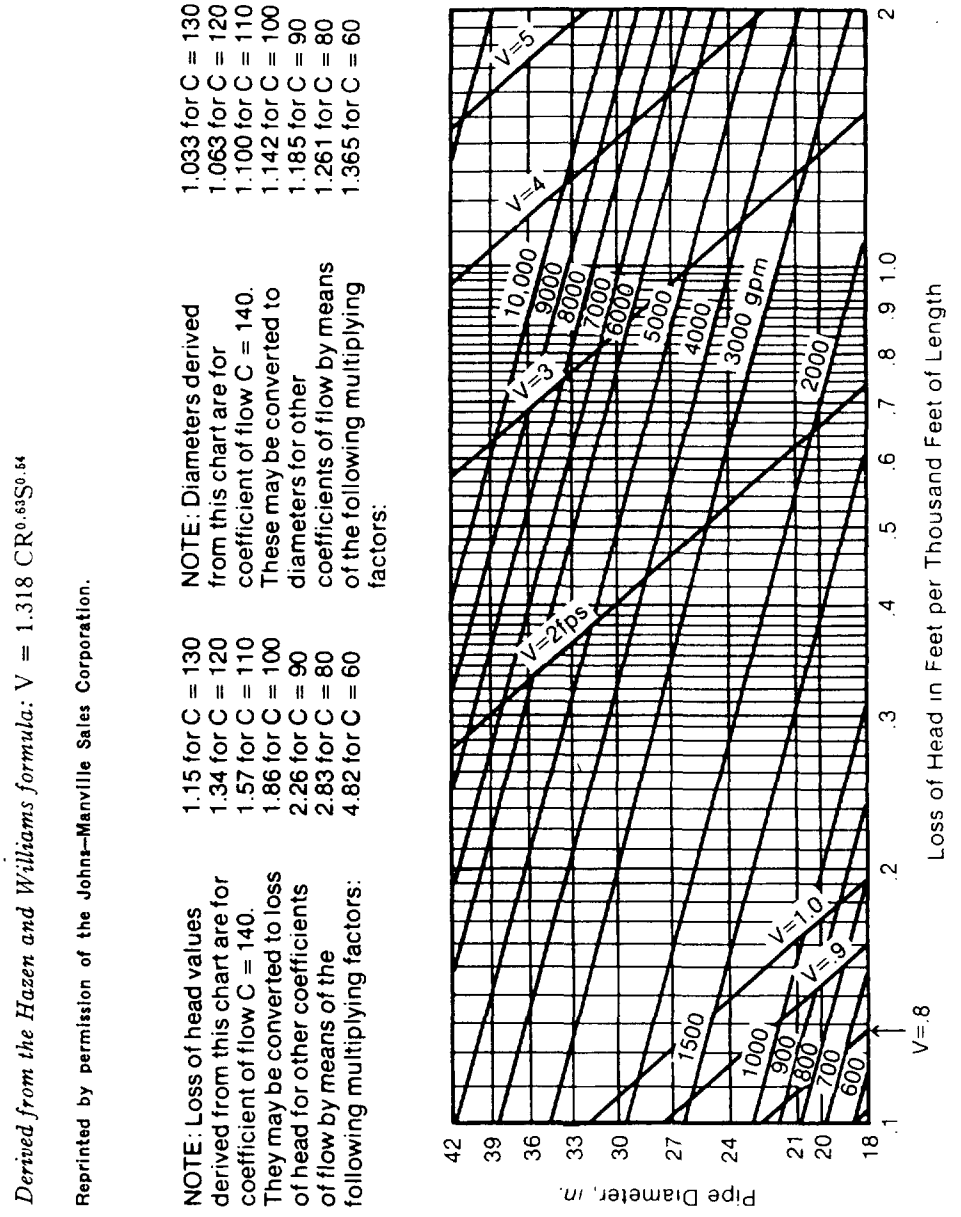
Fig. 14j—42-in. Transmission Pipe

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Appendix A

Friction Loss of Head Chart–Coefficient of Flow, C = 140

This appendix is for information only and is not a part of AWWA C403.



Derived from the Hazen and Williams formula: $V = 1.318\ CR^{0.63}S^{0.54}$

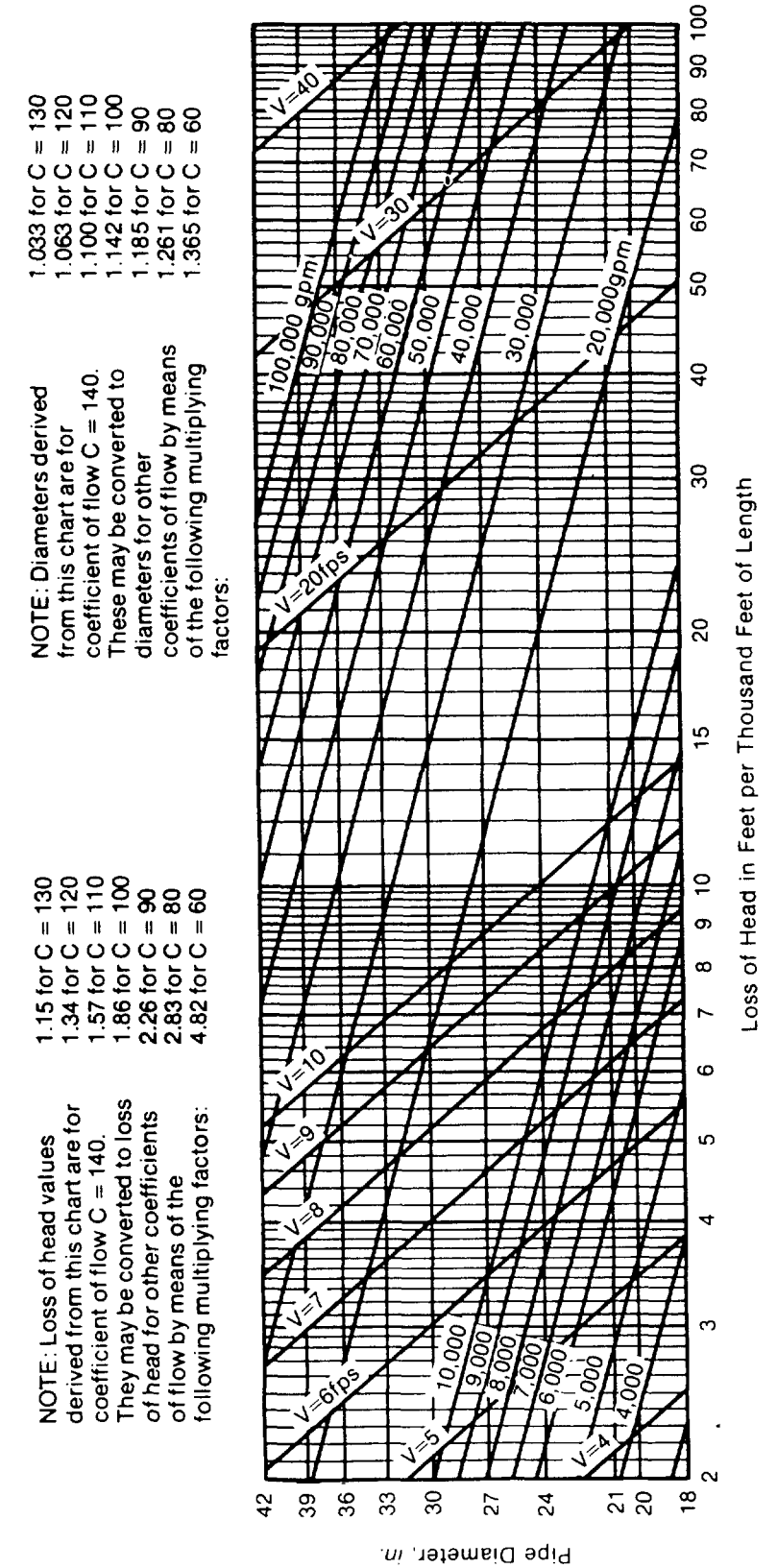
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NOTE: Loss of head values derived from this chart are for coefficient of flow C = 140. They may be converted to loss of head for other coefficients of flow by means of the following multiplying factors:

1.15 for C = 130	1.033 for C = 130
1.34 for C = 120	1.063 for C = 120
1.57 for C = 110	1.100 for C = 110
1.86 for C = 100	1.142 for C = 100
2.26 for C = 90	1.185 for C = 90
2.83 for C = 80	1.261 for C = 80
4.82 for C = 60	1.365 for C = 60

NOTE: Diameters derived from this chart are for coefficient of flow C = 140. These may be converted to diameters for other coefficients of flow by means of the following multiplying factors:

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Pipe Diameter, in.
Loss of Head in Feet per Thousand Feet of Length
V=40
V=30
V=20fps
V=10
V=9
V=8
V=7
V=6fps
V=5
V=4
100,000 gpm
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000gpm
10,000
9,000
8,000
7,000
6,000
5,000
4,000
NOTE: Loss of head values derived from this chart are for coefficient of flow C = 140. They may be converted to loss of head for other coefficients of flow by means of the following multiplying factors:
1.15 for C = 130
1.34 for C = 120
1.57 for C = 110
1.86 for C = 100
2.26 for C = 90
2.83 for C = 80
4.82 for C = 60
NOTE: Diameters derived from this chart are for coefficient of flow C = 140. These may be converted to diameters for other coefficients of flow by means of the following multiplying factors:
1.033 for C = 130
1.063 for C = 120
1.100 for C = 110
1.142 for C = 100
1.185 for C = 90
1.261 for C = 80
1.365 for C = 60

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Appendix B

Surge Pressure Analysis

This appendix is for information only and is not a part of AWWA C403.

B.1 Water Hammer or Surge

The slowing down or stopping of any moving mass requires a force or forces to counterbalance the kinetic energy that keeps the mass in motion. The faster a mass is decelerated and brought to a halt, the greater the force that is required.

B.1.1 *Forces involved.* It is somewhat of an oversimplification, but water hammer, or surge, can be defined in these terms: The shutting of a valve or the stopping of a pump causes a moving column of water in a pipeline to slow down and stop. The forces that bring about this deceleration are exerted radially on the moving water column by the pipeline walls. Conversely, the water exerts added pressure on the pipe, and the hoop stresses in the pipe walls thus increase over the normal operating pressure values. The faster the column of water is brought to a halt, the higher these stresses rise.

B.1.2 *Rate of velocity fluctuation.* The pipe wall stresses are thus developed by, and increase in direct proportion to, the internal pressure that builds up as the column of water decelerates. The slower the deceleration, the less the pressure builds up, and the less the pipe wall stresses increase. It is, therefore, of importance to the pipe designer to know how to control the rate of velocity fluctuation, since by controlling this rate he controls the magnitude of the pressure variations during the transitional periods. By such control he can keep the pipe wall stresses during surge to a predetermined value that will allow an economical installation.

B.1.3 *Wave motion.* Water, being liquid, will act in a fairly complex manner when undegoing acceleration or deceleration. Pressure waves are set up which move along the pipeline at a rate of 2500—4500 ft/sec, the rate depending on the pipe wall material. The waves will continue until they encounter a boundary condition, such as a reservoir, a closed valve, or a change in pipe diameter, at which point they will reflect back in the opposite direction. The wave motion will oscillate back and forth in the pipe until it is dampened out by the friction effects of the pipe walls.

B.1.4 *Causes.* The two major causes of water hammer or surge are

1. The closing or opening, fully or partially, of a valve in a pipeline system. The valve may be in the line for one of a number of purposes. It could be a gate valve, float valve, pressure reducing valve, or serve some other function.

2. The starting up or shutting down of a pump (switch or power failure). It can be seen that both of these occurrences cause changes in the velocity, and consequently in the quantity, of water flowing in the pipeline.

B.1.5. *Effects.* Ignoring the effects of surge in the pipeline can lead to difficulties after the line is in opera-

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tion. Surge can result in damaged equipment and seriously reduced capacity.

B.2 Water Hammer Analysis

The elastic wave theory for surge analysis has been empirically established to be correct by many experiments, the first of which were performed as early as 1890. Its application to pipeline problems will yield results which are accurate and which may be relied upon for adequate analysis.

B.2.1 *Wave velocity.* Water hammer pressures are a function of the maximum rate of change of flow. When a valve is closed or a pump stops, a pressure wave is propagated along a pipeline. The velocity of the wave is the same as the velocity of sound in water, modified by physical characteristics of the pipeline; it is given by the following equation:

$$a = \frac{4660}{\sqrt{1 + kd/Ee}} \qquad \text{Eq B1}$$

in which,

a = pressure wave velocity, in feet per second
k = modulus of compression of water, 300,000 psi
d = internal diameter of pipe, in inches
E = modulus of elasticity of asbestos–cement pipe, 3,400,000 psi
e = wall thickness, in inches
4660 = velocity of sound in water in feet per second

B. 2. 2. *Maximum pressure.* If the pressure wave is reflected back from a boundary condition, such as a reservoir, and returns to its initial position after the flow in the line is completely stopped, then maximum water hammer pressure for those conditions will result. Stopping of the flow may be effected by closing a valve or by a pump stoppage. The magnitude of that maximum pressure is given by

$$h = \frac{aV}{g} \qquad \text{Eq B2}$$

in which,

h = surge pressure, in feet of water
V = velocity of water in the pipeline during normal conditions, in feet per second
a = velocity of pressure wave, in ft/sec
g = acceleration due to gravity, 32.2 ft/sec^2

B.2.3 *Critical time.* The longest elapsed time before final flow stoppage that will still permit this maximum pressure to occur is called the critical time; it is simply the total length that the pressure wave travels in one cycle, divided by the velocity of the wave. It is given by the following equation:

$$U = \frac{2L}{a} \qquad \text{Eq B3}$$

in which,

U = the critical time, in seconds
L = distance within the pipeline that the pressure wave moves before it is reflected back by a boundary condition, in feet
a = velocity of the pressure wave in the line, in feet per second

B.3 Valve Closure

A valve in a water line may be of several different varieties, including gate, cone, and globe valves. When closing a valve, the area of the cross section of the pipeline that is progressively cut off is not generally proportional to the reduction in flow. In Fig. B1, Graph 1 presents a plot

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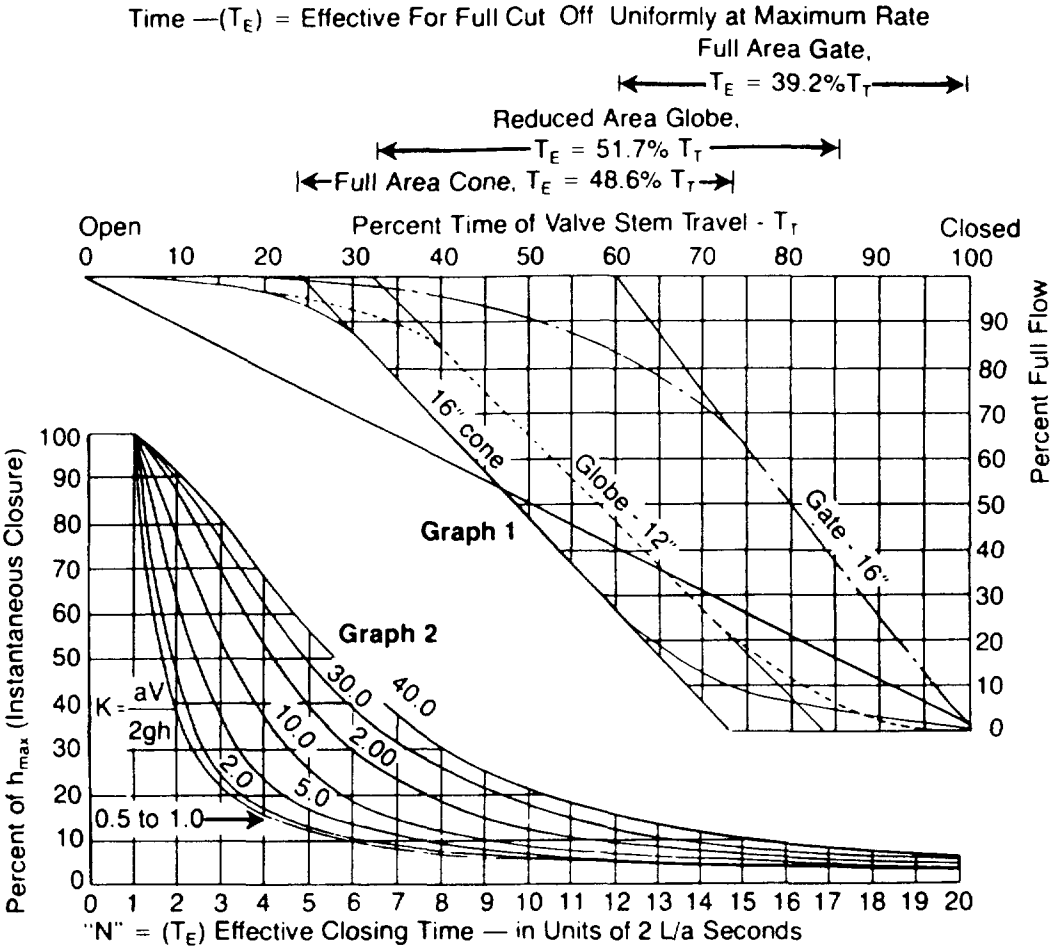


Fig. B1. Time (T_E) = Effective for Full Cut Off Uniformly at Maximum Rate

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of stem travel versus flow in the line for three types of valves. Note that the first 30–40 percent of stem travel has little effect on the flow in the pipeline.

B.3.1 *Effective time.* As stated previously, water hammer pressure is a function of the maximum rate of change of flow. Therefore, if tangents to the curves in Fig. B1 are drawn at the fastest rate of change (or steepest slope), the effective time of closure T_E is obtained. (See the curves in Fig. B1 with tangents plotted and values of T_E determined.) This effective time, T_E, is the time that is used in water hammer calculations. In most cases, it is about one half of the actual valve closing time. This indicates that if the critical time of a certain installed valve is calculated from Eq B3 and found to be x seconds, then the actual time for complete valve closure which will cause maximum pressure to occur will be approximately 2x seconds.

B.3.2 *Relation to surge control.* In the design of a water system one of the major considerations in the selection of a pipe is the design internal

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pressure that the pipe will be required to carry in service. The design internal pressure is the operating pressure plus the water hammer pressure. In order to keep the water hammer or surge pressures at a controlled level, calculations must be made to determine the valve closure times that will be required to stay within the design pressure level.

B.3.3 *Determining effective time.* Figure B1 presents a convenient three-step method for determining effective valve closure times for a given percentage of the maximum pressure (surge pressure when valve is closed in less than the critical time).

1. Determine the pipeline constant K given by

$$K = \frac{aV}{2gh_o} \qquad \text{Eq B4}$$

in which,

K = pipeline constant
a = velocity of the pressure wave in the line, in feet per second
V = velocity of water in the flow line under normal conditions, in feet per second
g = acceleration due to gravity, 32.2 ft/sec^2
h_o = operating pressure in the line under normal conditions, in feet of water

2. Determine the maximum head that might be developed from the surge by employing the formula $h_{max} = aV/g$.
3. Determine the percentage of h_{max} and find the corresponding effective closing time shown on the horizontal axis. This is given in units of $2L/a$, which represents the critical time for the pipeline. Note that the time determined is the *effective* closing time and the *actual* time of valve stem travel is about twice as long. The reason for this is that the first half of the closing of the valve has little effect on the stoppage of the flow. It is the closing of the final half of the valve stem travel which closes off the flow. The second half is the effective closing time. Therefore, two times the effective closing time is the actual time of the valve stem travel.

B.4 Pumped Systems

In relation to water hammer and surge, the most important elements in a system are pumps and valves. In a gravity system only valves have to be considered. Both pumps and valves must be considered in a pumped system.

B.3.1 *Complexity.* The surge analysis of a pumped system is more complex than in a 100 percent gravity system because

1. In a pumped system, the problem begins in the slowing down of the rising water column when the pump is shut off (because of power failure or otherwise). Consideration must be given to the time required for the pump to stop and for the flow to come to a halt. This involves the inertia of the motor and any flywheel in the assembly. Provisions normally should be made for slow opening and closing of pump control valves on pump systems. In a gravity system the hydraulic problem consists only of stopping the descending water column.
2. In a pumped system, the pipeline profile is usually irregular, with successive high and low points and with variable slopes. These conditions may give rise to water

column separation, causing severe surges and operational troubles. Surges from water column separation do not follow a standard pattern and they have been measured at many times the calculated values.

B.4.2 *Alternative layouts.* The design of a pumped system may involve the consideration of alternative layouts to keep surges and the consequent operational difficulties to a minimum. This work should be directed toward reducing the magnitude of surges and toward reducing the risk of water column separation that may be caused by the shutdown of a pump.

B.4.3 *Water column separation.* Water column separation can be serious due to the large magnitude of the surges developed when the water column rejoins. It can occur

1. At pump locations at the start of a steep main.
2. When the pressure at a high point falls below atmospheric and air enters the line through air valves that may be located at a high point.
3. When the pressure falls to below the vapor pressure of water.

B.4.4 *Entrapped air.* Water column separation can cause difficulties, not only because of the before-mentioned surges set up by the rejoining of the water column, but because of the difficulties in getting air out of the line on subsequent start-up, even with air valves. Entrapped air can cause flow fluctuations and can seriously reduce the capacity of the system.

B.5 Methods of Control

The two types of surge to be controlled are negative surge and positive surge. The type is determined, of course, by whether the surge pressures developed are below or above the normal static level.

B.5.1 *Negative surges.* Negative surges in themselves are usually not dangerous, except when they cause water column separation. If this occurs, extremely high positive surges result when the cavity closes, and this frequently causes serious problems. The control of both negative and positive surges should be given consideration.

B.5.2 *Surge control devices.* Limiting negative and positive surges is accomplished by several types of surge control devices, as follows:

1. Controlled valves. This is one of the most effective means for controlling positive surges. As explained previously, the rate of opening and closing of a valve can be calculated to allow an acceptable level of surge.
2. Flywheel on pump motor. In the event of a power outage the inertia of the flywheel will keep the pump running for a period of time, during which it will gradually slow to a stop. This means that the water column in the pipeline will also be brought to a gradual stop, thus reducing the risk of water column separation.
3. Standpipe. This is generally a tank with the surface of the water at atmospheric pressure. It is, therefore, only practical at low heads. At a pump stoppage and consequent reduced pressure, the reserve of water in the tank flows into the pipe and reduces the risk of water column separation. For positive surge control the tank

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provides an outlet for the built-up pressure in the system.

4. Air vessel or surge tank. This is an enclosed vessel containing air and water. It functions similarly to a standpipe, with water reentering the line during negative surge and leaving during positive surge. The major difference is that the air in the vessel is under pressure and much higher heads can be employed in the pipe system.
5. One-way surge tank. This is an adaptation of the surge tank. It contains a check valve that permits water to enter the line during negative surge, but will not permit water to leave during positive surge. It is, therefore, only for control of negative surges and is very effective.
6. Reservoir of water. This is similar to the one way surge tank, but provides some control of positive surge by permitting the slow entrance of water into the reservoir during a positive surge.
7. Suction pipe. This is a bypass around the pump from the suction side. It contains a check valve to prevent backflow into the reservoir. It effectively reduces negative pressure adjacent to the pump.
8. Surge relief valve. This is used for controlling positive and negative surges. The valve opens at a certain pressure and discharges water to relieve a surge; positive or negative. It must be carefully designed and controlled in order to be effective.
9. Nonreturn valve. This is a check, strategically placed in a line, that can bring a small measure of relief to positive pressure. However, unless properly placed, it can lead to higher rather than lower surge.
10. Reversal of pump. At pump stoppage the column of water reverses itself. If the pump will not run backwards to permit water to flow back through it, then positive surges will be developed by the sudden stopping of the backflowing column of water. The pump should be designed to run reversed without damage to itself. Design of pumps that can run reversed without damage is a significant problem. Other measures may have to be taken.

B.5.3 *Economic considerations.* From an economic standpoint it is usually worthwhile to properly evaluate the surge potential in a system under design. The cost of control devices may be balanced against the added strength of pipe, valves, and other equipment that will be needed if surges are not controlled, and the most advantageous conclusion reached. Manufacturers of surge control equipment or consultants in this field should be sought for advice in complex situations.

B.6 Surge Calculation Example

The following example problem illustrates the calculation that may be followed to determine valve closing time for the control of surge within prescribed limits.

A 24-in. gravity transmission line is to operate at a pressure of 100 psi. Velocity in the line is to be 5 ft/sec. A valve is to be included in the line at a distance of 5000 ft from the reservoir. If positive surge pressure

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is to be controlled within 50 psi, determine the minimum time for valve closure. Assume that the effective closing time is one half of the actual valve stem travel time. (E for asbestos-cement pipe = 3.4×10^6, wall thickness is 1.5 in., k for water = 3×10^5)

SOLUTION

1. Determine surge wave velocity

$$a = \frac{4660}{\sqrt{1 + \frac{kd}{Ee}}} = \frac{4660}{\sqrt{1 + \frac{3 \times 10^5 \times 24}{3.4 \times 10^6 \times 1.5}}} = 3000 \text{ ft/sec.}$$

2. Determine maximum surge pressure if the valve closes within the critical time

$$h = \frac{aV}{g} = \frac{3000 \times 5}{32.2} = 465 \text{ ft of water (200 psi)}$$

3. Determine the critical time

$$U = \frac{2L}{a} = \frac{2 \times 5000}{3000} = 3.33 \text{ sec}$$

4. Determine Constant K for use in Graph 2 (Fig. B1)

$$K = \frac{aV}{2gh_o} = \frac{3000 \times 5}{2 \times 32.2 \times 231} = 1.0$$

5. Determine percent of maximum surge pressure that should not be exceeded in the system.

$$\frac{50}{200} \times 100 = 25 \text{ percent}$$

6. Enter Graph 2 (Fig. B1) with percent of h_{max} (25 percent). Go horizontally to the curves where $K = 1.0$. Read the effective closing time along the horizontal axis. This value is 2.6 and is given in units of $2L/a$ seconds. The effective closing time in seconds would be $2L/a \times 2.6 = 3.33 \times 2.6 = 8.7$ sec. The actual valve stem travel time would be twice this amount, or 17.4 sec. This calculated time (17.4 sec.), therefore, represents the fastest allowable time the valve can be closed in order to keep the surge pressure below the desired control level of 50 psi.

B.7 Air in Pipelines

Air in pipelines can cause serious operational difficulties, including reduction in capacity because of reduced cross-sectional area, and fluctuation in flow caused by expanding and contracting air in the line. These fluctuations in flow cause sudden movements of the air from one location to another, followed by slugs of water, and this can cause serious surges.

B.7.1 *Entrance of air.* Air can enter a pipeline in many ways. It may enter at the intake. Entry may be caused by release of air from water due to temperature and pressure variation, or it may be caused by draining the line, or by draining parts of the line during normal shut-down. Negative surges may cause air to enter at air valves. Air should be prevented from entering the line in the first place. This is very important in order to reduce operational difficulties. Suggested solutions for control are as follows:

1. Intake. Correct design procedures, provide low water-level pump cut-off.
2. Release of air. Air is entrained in the water at intake and its release cannot be prevented. However, the quantities are not large and provisions for exhausting can be made by means of air valves. There are various types of air valves with different

functions, and the selection of the proper type and location for installation is essential.

3. Draining the line. Air cannot be prevented from entering the line on draining, of course. Large orifice air valves should be provided for exhausting the air during refilling. Draining and then refilling does not often occur; therefore, long filling times may be satisfactory.
4. Drainage during shut down. This can be a serious problem. Open standpipes can be provided for air entry and exhaust. Sweeping air out using high velocities is also a method.
5. Negative surges. The best way to prevent air from entering under these conditions is to design out the possibility of water column separation. Large volumes of air may be involved here and can cause serious problems. Any one of the negative surge control devices described in paragraph B.5.2 will normally be adequate.

B.7.2. *Recommendations to combat air entrapment.* Colorado State University has conducted studies to determine the effect of air entrapment in pipelines. The result of the studies proved that suddenly released entrapped air, under apparently static conditions, creates a situation similar to that of classic water hammer. Pressures are generated which may be on the order of fifteen times the pipeline test pressure. Any pipeline material is seriously affected by this rapid magnitude of load increase. Hydrostatic failure due to defective pipe may in all probability be traced to suddenly released entrapped air. The initial filling and testing of a pipeline is often the most critical period of its service life. Recommendations to combat air entrapment were made as follows:

1. Pipeline should be laid to grade wherever possible.
2. Automatic continual acting air release valves should be used at all high points.
3. Air should be bled from pipeline slowly.
4. Limit filling velocity in the pipeline to one foot per second or less.
5. Use $d/D = 1/10$ to $1/100$.
   d = diameter of air release valve
   D = pipe diameter

The results of this study, together with the recommendations, have been found to be most useful to contractors in performing pipeline tests. Such recommendations also have been found to be useful to engineers from the standpoint of designing pipelines to minimize air problems.

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Appendix C

Frictional Power Requirements

This appendix is for information only and is not a part of AWWA C700.

The chart shown in Fig. C1 permits rapid calculations of the yearly power costs to overcome friction loss of head. This chart is based on continuous pumping operation (24 hours per day and 365 days per year), a power cost of $0.01 per kwhr, and a motor–pump efficiency of 100 percent. For actual operating conditions and local power costs, appropriate factors must be applied to the values shown in the chart. By calculating power costs to overcome friction in two pipe sizes, or for two different types of pipe having different flow coefficients, an annual power cost savings can be determined. Economic justification for going to a larger pipe diameter with lower annual power costs can be determined by establishing the present worth of the annual savings using Table C1, which is based on the discounted cash flow method. If the present worth of the annual savings based on established interest rates exceeds the added costs for the installation of a different size or type of material, then economic justification exists for the added capital expenditure.

Nomograph values for Fig. C1 are based on the following:

Cost per 1000 ft of pipe per year—in dollars
Power cost—1¢ per kilowatt hour
Motor–pump efficiency (combined)—100 percent
Friction coefficient $C = 140$
Continuous operation

NOTE: Yearly power cost values derived in Fig. C1 are for coefficient of flow $C = 140$. They may be converted to yearly power cost values for other coefficients of flow by means of the following multiplying factors:

1.15 for $C = 130$
1.34 for $C = 120$
1.57 for $C = 110$
1.86 for $C = 100$
2.26 for $C = 90$
2.83 for $C = 80$
4.82 for $C = 60$

Diameters derived from Fig. C1 are for coefficient of flow $C = 140$. These may be converted to other diameters for other coefficients of flow by means of the following multiplying factors:

1.033 for $C = 130$
1.063 for $C = 120$
1.100 for $C = 110$
1.142 for $C = 100$
1.185 for $C = 90$
1.261 for $C = 80$
1.365 for $C = 60$

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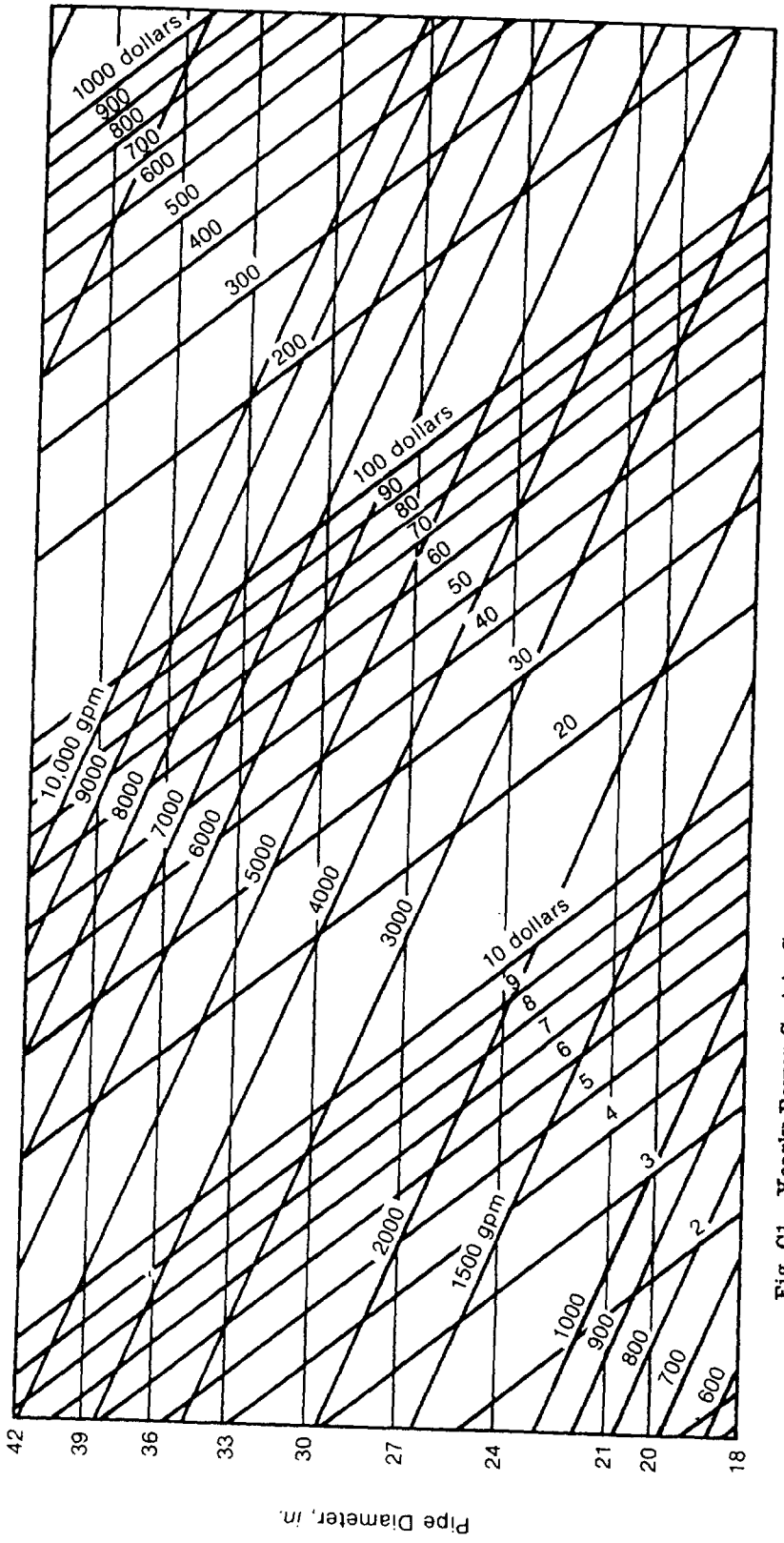


Fig. C1. Yearly Power Cost to Compensate for Friction Loss of Head * (*cont. on next page*)

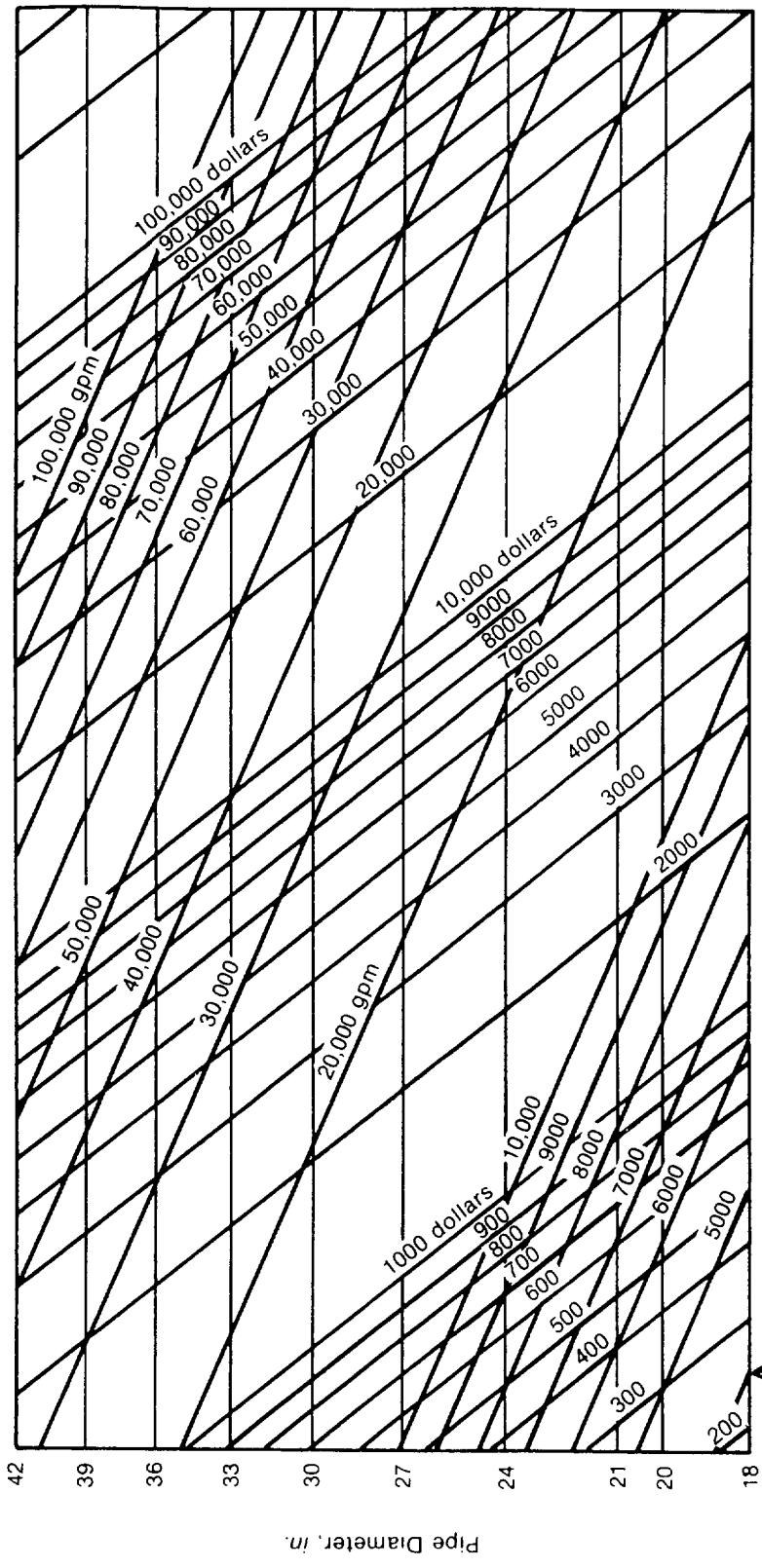


Fig. C1 (*cont.*)

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Table C1 *

Apply the following formula to Table C1, *Present Worth of an Income of $1.00 per Year for the Next* N *Years:*

$$\frac{(1 + r)^N - 1}{r(1 + r)^N}$$

where

r = rate of yield in percent
N = number of years from present

Example:

When using a 10 percent rate of yield, an income of $1.00 occurring each year for the next 5 years has a present worth of $3.791; for the next 7 years, $4.868; for the next 10 years, $6.145; etc.

The present worth (PW) of a regular pattern of savings in the future is found as follows:

Total years of operation—25
Amount of annual savings—$5000.00
PW factor at 10 percent—9.077
Total present worth (PW)—$45,385.00

When expenditure, cash income, and life are known, and income is the same each year, the PW factor can be computed by dividing expenditure by annual cash income. Yield can then be determined by looking for the factor on the line or known life in Table C1.

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TABLE C1

Present Worth of an Income of $1.00 per Year for the Next N Years

Years	.5%	1.0%	1.5%	2.0%	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%	Years
1	.995	.990	.985	.980	.976	.971	.966	.962	.957	.952	1
2	1.985	1.970	1.956	1.942	1.927	1.913	1.900	1.886	1.873	1.859	2
3	2.970	2.941	2.912	2.884	2.856	2.829	2.802	2.775	2.749	2.723	3
4	3.950	3.902	3.854	3.808	3.762	3.717	3.673	3.630	3.588	3.546	4
5	4.926	4.853	4.783	4.713	4.646	4.580	4.515	4.452	4.390	4.329	5
6	5.896	5.795	5.697	5.601	5.508	5.417	5.329	5.242	5.158	5.076	6
7	6.862	6.728	6.598	6.472	6.349	6.230	6.115	6.002	5.893	5.786	7
8	7.823	7.652	7.486	7.325	7.170	7.020	6.874	6.733	6.596	6.463	8
9	8.779	8.566	8.361	8.162	7.971	7.786	7.608	7.435	7.269	7.108	9
10	9.730	9.471	9.222	8.983	8.752	8.530	8.317	8.111	7.913	7.722	10
11	10.68	10.37	10.07	9.787	9.514	9.253	9.002	8.760	8.529	8.306	11
12	11.62	11.26	10.91	10.58	10.26	9.954	9.663	9.385	9.119	8.863	12
13	12.56	12.13	11.73	11.35	10.98	10.64	10.30	9.986	9.683	9.394	13
14	13.49	13.00	12.54	12.11	11.69	11.30	10.92	10.56	10.22	9.899	14
15	14.42	13.87	13.34	12.85	12.38	11.94	11.52	11.12	10.74	10.38	15
16	15.34	14.72	14.13	13.58	13.06	12.56	12.09	11.65	11.23	10.84	16
17	16.26	15.56	14.91	14.29	13.71	13.17	12.65	12.17	11.71	11.27	17
18	17.17	16.40	15.67	14.99	14.35	13.75	13.19	12.66	12.16	11.69	18
19	18.08	17.23	16.43	15.68	14.98	14.32	13.71	13.13	12.59	12.09	19
20	18.99	18.05	17.17	16.35	15.59	14.88	14.21	13.59	13.01	12.46	20
21	19.89	18.86	17.90	17.01	16.19	15.42	14.70	14.03	13.41	12.82	21
22	20.78	19.66	18.62	17.66	16.77	15.94	15.17	14.45	13.78	13.16	22
23	21.68	20.46	19.33	18.29	17.33	16.44	15.62	14.86	14.15	13.49	23
24	22.56	21.24	20.03	18.91	17.89	16.94	16.06	15.25	14.50	13.80	24
25	23.45	22.02	20.72	19.52	18.42	17.41	16.48	15.62	14.83	14.09	25
26	24.32	22.80	21.40	20.12	18.95	17.88	16.89	15.98	15.15	14.38	26
27	25.20	23.56	22.07	20.71	19.46	18.33	17.29	16.33	15.45	14.64	27
28	26.07	24.31	22.73	21.28	19.97	18.76	17.67	16.66	15.74	14.90	28
29	26.93	25.07	23.38	21.84	20.45	19.19	18.04	16.98	16.02	15.14	29
30	27.79	25.81	24.02	22.40	20.93	19.60	18.39	17.29	16.29	15.37	30
31	28.65	26.54	24.65	22.94	21.40	20.00	18.74	17.59	16.54	15.59	31
32	29.50	27.27	25.27	23.47	21.85	20.39	19.07	17.87	16.79	15.80	32
33	30.35	27.99	25.88	23.99	22.29	20.77	19.39	18.15	17.02	16.00	33
34	31.20	28.70	26.48	24.50	22.72	21.13	19.70	18.41	17.25	16.19	34
35	32.04	29.41	27.08	25.00	23.15	21.49	20.00	18.67	17.46	16.37	35
36	32.87	30.11	27.66	25.49	23.56	21.83	20.29	18.91	17.67	16.55	36
37	33.70	30.80	28.24	25.97	23.96	22.17	20.57	19.14	17.86	16.71	37
38	34.53	31.49	28.81	26.44	24.35	22.49	20.84	19.37	18.05	16.87	38
39	35.35	32.16	29.37	26.90	24.73	22.81	21.10	19.58	18.23	17.02	39
40	36.17	32.84	29.92	27.36	25.10	23.12	21.36	19.79	18.40	17.16	40
41	36.99	33.50	30.46	27.80	25.47	23.41	21.60	19.99	18.57	17.29	41
42	37.80	34.16	30.99	28.24	25.82	23.70	21.84	20.19	18.72	17.42	42
43	38.61	34.81	31.52	28.66	26.17	23.98	22.06	20.37	18.87	17.55	43
44	39.41	35.46	32.04	29.08	26.50	24.25	22.28	20.55	19.02	17.66	44
45	40.21	36.09	32.55	29.49	26.83	24.52	22.50	20.72	19.16	17.77	45
46	41.00	36.73	33.06	29.89	27.15	24.78	22.70	20.89	19.29	17.88	46
47	41.79	37.35	33.55	30.29	27.47	25.03	22.90	21.04	19.42	17.98	47
48	42.58	37.97	34.04	30.67	27.77	25.27	23.09	21.20	19.54	18.08	48
49	43.36	38.59	34.53	31.05	28.07	25.50	23.28	21.34	19.65	18.17	49
50	44.14	39.20	35.00	31.42	28.36	25.73	23.46	21.48	19.76	18.26	50

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TABLE C1

TABLE C1 (*continued*)

Years	5.5%	6.0%	6.5%	7.0%	7.5%	8.0%	8.5%	9.0%	9.5%	10.0%	Years
1	.948	.943	.939	.935	.930	.926	.922	.917	.913	.909	1
2	1.846	1.833	1.821	1.808	1.796	1.783	1.771	1.759	1.747	1.736	2
3	2.698	2.673	2.648	2.624	2.601	2.577	2.554	2.531	2.509	2.487	3
4	3.505	3.465	3.426	3.387	3.349	3.312	3.276	3.240	3.204	3.170	4
5	4.270	4.212	4.156	4.100	4.046	3.993	3.941	3.890	3.840	3.791	5
6	4.996	4.917	4.841	4.767	4.694	4.623	4.554	4.486	4.420	4.355	6
7	5.683	5.582	5.485	5.389	5.297	5.206	5.119	5.033	4.950	4.868	7
8	6.335	6.210	6.089	5.971	5.857	5.747	5.639	5.535	5.433	5.335	8
9	6.952	6.802	6.656	6.515	6.379	6.247	6.119	5.995	5.875	5.759	9
10	7.538	7.360	7.189	7.024	6.864	6.710	6.561	6.418	6.279	6.145	10
11	8.093	7.887	7.689	7.499	7.315	7.139	6.969	6.805	6.647	6.495	11
12	8.619	8.384	8.159	7.943	7.735	7.536	7.345	7.161	6.984	6.814	12
13	9.117	8.853	8.600	8.358	8.126	7.904	7.691	7.487	7.291	7.103	13
14	9.590	9.295	9.014	8.745	8.489	8.244	8.010	7.786	7.572	7.367	14
15	10.04	9.712	9.403	9.108	8.827	8.559	8.304	8.061	7.828	7.606	15
16	10.46	10.11	9.768	9.447	9.142	8.851	8.575	8.313	8.062	7.824	16
17	10.87	10.48	10.11	9.763	9.434	9.122	8.825	8.544	8.276	8.022	17
18	11.25	10.83	10.43	10.06	9.706	9.372	9.055	8.756	8.471	8.201	18
19	11.61	11.16	10.74	10.34	9.959	9.604	9.268	8.950	8.650	8.365	19
20	11.95	11.47	11.02	10.59	10.19	9.818	9.463	9.129	8.812	8.514	20
21	12.28	11.76	11.29	10.84	10.41	10.02	9.644	9.292	8.961	8.649	21
22	12.58	12.04	11.54	11.06	10.62	10.20	9.810	9.442	9.097	8.772	22
23	12.88	12.30	11.77	11.27	10.81	10.37	9.963	9.580	9.221	8.883	23
24	13.15	12.55	11.99	11.47	10.98	10.53	10.10	9.707	9.334	8.985	24
25	13.41	12.78	12.20	11.65	11.15	10.68	10.23	9.823	9.438	9.077	25
26	13.66	13.00	12.39	11.83	11.30	10.81	10.35	9.929	9.532	9.161	26
27	13.90	13.21	12.58	11.99	11.44	10.94	10.47	10.03	9.618	9.237	27
28	14.12	13.41	12.75	12.14	11.57	11.05	10.57	10.12	9.697	9.307	28
29	14.33	13.59	12.91	12.28	11.70	11.16	10.66	10.20	9.769	9.370	29
30	14.53	13.77	13.06	12.41	11.81	11.26	10.75	10.27	9.835	9.427	30
31	14.72	13.93	13.20	12.53	11.92	11.35	10.83	10.34	9.895	9.479	31
32	14.90	14.08	13.33	12.65	12.02	11.44	10.90	10.41	9.950	9.526	32
33	15.08	14.23	13.46	12.75	12.11	11.51	10.97	10.46	10.00	9.569	33
34	15.24	14.37	13.58	12.85	12.19	11.59	11.03	10.52	10.05	9.609	34
35	15.39	14.50	13.69	12.95	12.27	11.66	11.09	10.57	10.09	9.644	35
36	15.54	14.62	13.79	13.04	12.35	11.72	11.14	10.61	10.13	9.677	36
37	15.67	14.74	13.89	13.12	12.42	11.78	11.19	10.65	10.16	9.706	37
38	15.81	14.85	13.98	13.19	12.48	11.83	11.24	10.69	10.19	9.733	38
39	15.93	14.95	14.07	13.27	12.54	11.88	11.28	10.73	10.22	9.757	39
40	16.05	15.05	14.15	13.33	12.59	11.93	11.32	10.76	10.25	9.779	40
41	16.16	15.14	14.22	13.39	12.65	11.97	11.35	10.79	10.27	9.799	41
42	16.26	15.23	14.29	13.45	12.69	12.01	11.38	10.81	10.29	9.817	42
43	16.36	15.31	14.36	13.51	12.74	12.04	11.41	10.84	10.31	9.834	43
44	16.46	15.38	14.42	13.56	12.78	12.08	11.44	10.86	10.33	9.849	44
45	16.55	15.46	14.48	13.61	12.82	12.11	11.47	10.88	10.35	9.863	45
46	16.63	15.52	14.54	13.65	12.86	12.14	11.49	10.90	10.36	9.875	46
47	16.71	15.59	14.59	13.69	12.89	12.16	11.51	10.92	10.38	9.887	47
48	16.79	15.65	14.64	13.73	12.92	12.19	11.53	10.93	10.39	9.897	48
49	16.86	15.71	14.68	13.77	12.95	12.21	11.55	10.95	10.40	9.906	49
50	16.93	15.76	14.73	13.80	12.98	12.23	11.57	10.96	10.41	9.915	50

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TABLE C1 (*continued*)

Years	10.5%	11.0%	11.5%	12.0%	12.5%	13.0%	13.5%	14.0%	14.5%	15.0%	Years
1	.905	.901	.897	.893	.889	.885	.881	.877	.873	.870	1
2	1.724	1.713	1.701	1.690	1.679	1.668	1.657	1.647	1.636	1.626	2
3	2.465	2.444	2.423	2.402	2.381	2.361	2.341	2.322	2.302	2.283	3
4	3.136	3.102	3.070	3.037	3.006	2.974	2.944	2.914	2.884	2.855	4
5	3.743	3.696	3.650	3.605	3.561	3.517	3.475	3.433	3.392	3.352	5
6	4.292	4.231	4.170	4.111	4.054	3.998	3.943	3.889	3.836	3.784	6
7	4.789	4.712	4.637	4.564	4.492	4.423	4.355	4.288	4.224	4.160	7
8	5.239	5.146	5.056	4.968	4.882	4.799	4.718	4.639	4.562	4.487	8
9	5.646	5.537	5.431	5.328	5.228	5.132	5.038	4.946	4.858	4.772	9
10	6.015	5.889	5.768	5.650	5.536	5.426	5.320	5.216	5.116	5.019	10
11	6.348	6.207	6.070	5.938	5.810	5.687	5.568	5.453	5.341	5.234	11
12	6.650	6.492	6.341	6.194	6.053	5.918	5.787	5.660	5.538	5.421	12
13	6.923	6.750	6.583	6.424	6.270	6.122	5.979	5.842	5.710	5.583	13
14	7.170	6.982	6.801	6.628	6.462	6.302	6.149	6.002	5.861	5.724	14
15	7.394	7.191	6.997	6.811	6.633	6.462	6.299	6.142	5.992	5.847	15
16	7.596	7.379	7.172	6.974	6.785	6.604	6.431	6.265	6.106	5.954	16
17	7.779	7.549	7.329	7.120	6.920	6.729	6.547	6.373	6.206	6.047	17
18	7.945	7.702	7.470	7.250	7.040	6.840	6.649	6.467	6.294	6.128	18
19	8.095	7.839	7.596	7.366	7.147	6.938	6.739	6.550	6.370	6.198	19
20	8.231	7.963	7.710	7.469	7.241	7.025	6.819	6.623	6.437	6.259	20
21	8.354	8.075	7.811	7.562	7.326	7.102	6.889	6.687	6.495	6.312	21
22	8.465	8.176	7.903	7.645	7.401	7.170	6.951	6.743	6.546	6.359	22
23	8.566	8.266	7.984	7.718	7.467	7.230	7.005	6.792	6.590	6.399	23
24	8.657	8.348	8.058	7.784	7.526	7.283	7.053	6.835	6.629	6.434	24
25	8.739	8.422	8.124	7.843	7.579	7.330	7.095	6.873	6.663	6.464	25
26	8.814	8.488	8.183	7.896	7.626	7.372	7.132	6.906	6.693	6.491	26
27	8.881	8.548	8.236	7.943	7.667	7.409	7.165	6.935	6.718	6.514	27
28	8.942	8.602	8.283	7.984	7.704	7.441	7.194	6.961	6.741	6.534	28
29	8.997	8.650	8.326	8.022	7.737	7.470	7.219	6.983	6.761	6.551	29
30	9.047	8.694	8.364	8.055	7.766	7.496	7.242	7.003	6.778	6.566	30
31	9.093	8.733	8.398	8.085	7.792	7.518	7.261	7.020	6.793	6.579	31
32	9.134	8.769	8.429	8.112	7.815	7.538	7.279	7.035	6.806	6.591	32
33	9.171	8.801	8.456	8.135	7.836	7.556	7.294	7.048	6.817	6.600	33
34	9.204	8.829	8.481	8.157	7.854	7.572	7.307	7.060	6.827	6.609	34
35	9.235	8.855	8.503	8.176	7.870	7.586	7.319	7.070	6.836	6.617	35
36	9.262	8.879	8.523	8.192	7.885	7.598	7.330	7.079	6.844	6.623	36
37	9.287	8.900	8.541	8.208	7.898	7.609	7.339	7.087	6.851	6.629	37
38	9.309	8.919	8.557	8.221	7.909	7.618	7.347	7.094	6.856	6.634	38
39	9.330	8.936	8.571	8.233	7.919	7.627	7.354	7.100	6.861	6.638	39
40	9.348	8.951	8.584	8.244	7.928	7.634	7.361	7.105	6.866	6.642	40
41	9.365	8.965	8.595	8.253	7.936	7.641	7.366	7.110	6.870	6.645	41
42	9.380	8.977	8.606	8.262	7.943	7.647	7.371	7.114	6.873	6.648	42
43	9.394	8.989	8.615	8.270	7.949	7.652	7.375	7.117	6.876	6.650	43
44	9.406	8.999	8.623	8.276	7.955	7.657	7.379	7.120	6.879	6.652	44
45	9.417	9.008	8.631	8.283	7.960	7.661	7.383	7.123	6.881	6.654	45
46	9.427	9.016	8.637	8.288	7.965	7.664	7.386	7.126	6.883	6.656	46
47	9.437	9.024	8.643	8.293	7.968	7.668	7.388	7.128	6.885	6.657	47
48	9.445	9.030	8.649	8.297	7.972	7.671	7.390	7.130	6.886	6.659	48
49	9.452	9.036	8.654	8.301	7.975	7.673	7.392	7.131	6.887	6.660	49
50	9.459	9.042	8.658	8.304	7.978	7.675	7.394	7.133	6.889	6.661	50

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TABLE C1 (*continued*)

Years	15.5%	16.0%	16.5%	17.0%	17.5%	18.0%	18.5%	19.0%	19.5%	20.0%	Years
1	.866	.862	.858	.855	.851	.847	.844	.840	.837	.833	1
2	1.615	1.605	1.595	1.585	1.575	1.566	1.556	1.547	1.537	1.528	2
3	2.264	2.246	2.228	2.210	2.192	2.174	2.157	2.140	2.123	2.106	3
4	2.826	2.798	2.770	2.743	2.716	2.690	2.664	2.639	2.613	2.589	4
5	3.313	3.274	3.236	3.199	3.163	3.127	3.092	3.058	3.024	2.991	5
6	3.734	3.685	3.636	3.589	3.543	3.498	3.453	3.410	3.367	3.326	6
7	4.099	4.039	3.980	3.922	3.866	3.812	3.758	3.706	3.655	3.605	7
8	4.415	4.344	4.274	4.207	4.142	4.078	4.015	3.954	3.895	3.837	8
9	4.688	4.607	4.527	4.451	4.376	4.303	4.232	4.163	4.096	4.031	9
10	4.925	4.833	4.745	4.659	4.575	4.494	4.415	4.339	4.265	4.192	10
11	5.130	5.029	4.931	4.836	4.745	4.656	4.570	4.486	4.406	4.327	11
12	5.307	5.197	5.091	4.988	4.889	4.793	4.700	4.611	4.523	4.439	12
13	5.461	5.342	5.228	5.118	5.012	4.910	4.810	4.715	4.622	4.533	13
14	5.594	5.468	5.346	5.229	5.117	5.008	4.903	4.802	4.705	4.611	14
15	5.709	5.575	5.447	5.324	5.206	5.092	4.982	4.876	4.774	4.675	15
16	5.808	5.668	5.534	5.405	5.281	5.162	5.048	4.938	4.832	4.730	16
17	5.895	5.749	5.609	5.475	5.346	5.222	5.104	4.990	4.880	4.775	17
18	5.969	5.818	5.673	5.534	5.401	5.273	5.151	5.033	4.921	4.812	18
19	6.034	5.877	5.728	5.584	5.447	5.316	5.191	5.070	4.954	4.843	19
20	6.090	5.929	5.775	5.628	5.487	5.353	5.224	5.101	4.983	4.870	20
21	6.139	5.973	5.815	5.665	5.521	5.384	5.252	5.127	5.007	4.891	21
22	6.181	6.011	5.850	5.696	5.550	5.410	5.276	5.149	5.026	4.909	22
23	6.217	6.044	5.880	5.723	5.574	5.432	5.296	5.167	5.043	4.925	23
24	6.249	6.073	5.905	5.746	5.595	5.451	5.313	5.182	5.057	4.937	24
25	6.276	6.097	5.927	5.766	5.613	5.467	5.328	5.195	5.069	4.948	25
26	6.299	6.118	5.946	5.783	5.628	5.480	5.340	5.206	5.078	4.956	26
27	6.320	6.136	5.962	5.798	5.641	5.492	5.350	5.215	5.086	4.964	27
28	6.337	6.152	5.976	5.810	5.652	5.502	5.359	5.223	5.093	4.970	28
29	6.353	6.166	5.988	5.820	5.661	5.510	5.366	5.229	5.099	4.975	29
30	6.366	6.177	5.999	5.829	5.669	5.517	5.372	5.235	5.104	4.979	30
31	6.378	6.187	6.007	5.837	5.676	5.523	5.377	5.239	5.108	4.982	31
32	6.387	6.196	6.015	5.844	5.681	5.528	5.382	5.243	5.111	4.985	32
33	6.396	6.203	6.021	5.849	5.686	5.532	5.385	5.246	5.114	4.988	33
34	6.404	6.210	6.027	5.854	5.691	5.536	5.389	5.249	5.116	4.990	34
35	6.410	6.215	6.032	5.858	5.694	5.539	5.391	5.251	5.118	4.992	35
36	6.416	6.220	6.036	5.862	5.697	5.541	5.393	5.253	5.120	4.993	36
37	6.420	6.224	6.039	5.865	5.700	5.543	5.395	5.255	5.121	4.994	37
38	6.425	6.228	6.042	5.867	5.702	5.545	5.397	5.256	5.122	4.995	38
39	6.428	6.231	6.045	5.869	5.704	5.547	5.398	5.257	5.123	4.996	39
40	6.431	6.233	6.047	5.871	5.705	5.548	5.399	5.258	5.124	4.997	40
41	6.434	6.236	6.049	5.873	5.707	5.549	5.400	5.259	5.125	4.997	41
42	6.436	6.238	6.051	5.874	5.708	5.550	5.401	5.260	5.125	4.998	42
43	6.438	6.239	6.052	5.875	5.709	5.551	5.402	5.260	5.126	4.998	43
44	6.440	6.241	6.053	5.876	5.710	5.552	5.402	5.261	5.126	4.998	44
45	6.442	6.242	6.054	5.877	5.710	5.552	5.403	5.261	5.127	4.999	45
46	6.443	6.243	6.055	5.878	5.711	5.553	5.403	5.261	5.127	4.999	46
47	6.444	6.244	6.056	5.879	5.711	5.553	5.404	5.262	5.127	4.999	47
48	6.445	6.245	6.057	5.879	5.712	5.554	5.404	5.262	5.127	4.999	48
49	6.446	6.246	6.057	5.880	5.712	5.554	5.404	5.262	5.127	4.999	49
50	6.447	6.246	6.058	5.880	5.712	5.554	5.404	5.262	5.128	4.999	50

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TABLE C1 (*continued*)

Years	21%	22%	23%	24%	25%	26%	27%	28%	29%	30%	Years
1	.826	.820	.813	.806	.800	.794	.787	.781	.775	.769	1
2	1.509	1.492	1.474	1.457	1.440	1.424	1.407	1.392	1.376	1.361	2
3	2.074	2.042	2.011	1.981	1.952	1.923	1.896	1.868	1.842	1.816	3
4	2.540	2.494	2.448	2.404	2.362	2.320	2.280	2.241	2.203	2.166	4
5	2.926	2.864	2.803	2.745	2.689	2.635	2.583	2.532	2.483	2.436	5
6	3.245	3.167	3.092	3.020	2.951	2.885	2.821	2.759	2.700	2.643	6
7	3.508	3.416	3.327	3.242	3.161	3.083	3.009	2.937	2.868	2.802	7
8	3.726	3.619	3.518	3.421	3.329	3.241	3.156	3.076	2.999	2.925	8
9	3.905	3.786	3.673	3.566	3.463	3.366	3.273	3.184	3.100	3.019	9
10	4.054	3.923	3.799	3.682	3.571	3.465	3.364	3.269	3.178	3.092	10
11	4.177	4.035	3.902	3.776	3.656	3.543	3.437	3.335	3.239	3.147	11
12	4.278	4.127	3.985	3.851	3.725	3.606	3.493	3.387	3.286	3.190	12
13	4.362	4.203	4.053	3.912	3.780	3.656	3.538	3.427	3.322	3.223	13
14	4.432	4.265	4.108	3.962	3.824	3.695	3.573	3.459	3.351	3.249	14
15	4.489	4.315	4.153	4.001	3.859	3.726	3.601	3.483	3.373	3.268	15
16	4.536	4.357	4.189	4.033	3.887	3.751	3.623	3.503	3.390	3.283	16
17	4.576	4.391	4.219	4.059	3.910	3.771	3.640	3.518	3.403	3.295	17
18	4.608	4.419	4.243	4.080	3.928	3.786	3.654	3.529	3.413	3.304	18
19	4.635	4.442	4.263	4.097	3.942	3.799	3.664	3.539	3.421	3.311	19
20	4.657	4.460	4.279	4.110	3.954	3.808	3.673	3.546	3.427	3.316	20
21	4.675	4.476	4.292	4.121	3.963	3.816	3.679	3.551	3.432	3.320	21
22	4.690	4.488	4.302	4.130	3.970	3.822	3.684	3.556	3.436	3.323	22
23	4.703	4.499	4.311	4.137	3.976	3.827	3.689	3.559	3.438	3.325	23
24	4.713	4.507	4.318	4.143	3.981	3.831	3.692	3.562	3.441	3.327	24
25	4.721	4.514	4.323	4.147	3.985	3.834	3.694	3.564	3.442	3.329	25
26	4.728	4.520	4.328	4.151	3.988	3.837	3.696	3.566	3.444	3.330	26
27	4.734	4.524	4.332	4.154	3.990	3.839	3.698	3.567	3.445	3.331	27
28	4.739	4.528	4.335	4.157	3.992	3.840	3.699	3.568	3.446	3.331	28
29	4.743	4.531	4.337	4.159	3.994	3.841	3.700	3.569	3.446	3.332	29
30	4.746	4.534	4.339	4.160	3.995	3.842	3.701	3.569	3.447	3.332	30
31	4.749	4.536	4.341	4.161	3.996	3.843	3.701	3.570	3.447	3.332	31
32	4.751	4.538	4.342	4.162	3.997	3.844	3.702	3.570	3.447	3.333	32
33	4.753	4.539	4.343	4.163	3.997	3.844	3.702	3.570	3.448	3.333	33
34	4.755	4.540	4.344	4.164	3.998	3.845	3.703	3.571	3.448	3.333	34
35	4.756	4.541	4.345	4.164	3.998	3.845	3.703	3.571	3.448	3.333	35
36	4.757	4.542	4.345	4.165	3.999	3.845	3.703	3.571	3.448	3.333	36
37	4.758	4.543	4.346	4.165	3.999	3.845	3.703	3.571	3.448	3.333	37
38	4.759	4.543	4.346	4.165	3.999	3.846	3.703	3.571	3.448	3.333	38
39	4.759	4.544	4.346	4.166	3.999	3.846	3.703	3.571	3.448	3.333	39
40	4.760	4.544	4.347	4.166	3.999	3.846	3.703	3.571	3.448	3.333	40
41	4.760	4.544	4.347	4.166	4.000	3.846	3.703	3.571	3.448	3.333	41
42	4.760	4.544	4.347	4.166	4.000	3.846	3.704	3.571	3.448	3.333	42
43	4.761	4.545	4.347	4.166	4.000	3.846	3.704	3.571	3.448	3.333	43
44	4.761	4.545	4.347	4.166	4.000	3.846	3.704	3.571	3.448	3.333	44
45	4.761	4.545	4.347	4.166	4.000	3.846	3.704	3.571	3.448	3.333	45
46	4.761	4.545	4.348	4.166	4.000	3.846	3.704	3.571	3.448	3.333	46
47	4.761	4.545	4.348	4.166	4.000	3.846	3.704	3.571	3.448	3.333	47
48	4.761	4.545	4.348	4.167	4.000	3.846	3.704	3.571	3.448	3.333	48
49	4.761	4.545	4.348	4.167	4.000	3.846	3.704	3.571	3.448	3.333	49
50	4.762	4.545	4.348	4.167	4.000	3.846	3.704	3.571	3.448	3.333	50

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American Water Works Association

AWWA C402-77

(Revision of
C402-75)

AWWA STANDARD

for

ASBESTOS-CEMENT TRANSMISSION PIPE, 18 IN. THROUGH 42 IN., FOR WATER AND OTHER LIQUIDS

First approved by AWWA Board of Directors Jan. 26, 1975.
This edition approved Jan. 30, 1977.

AMERICAN WATER WORKS ASSOCIATION
6666 West Quincy Avenue, Denver, Colorado 80235

CTD015623

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*Alternate.

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Foreword

This foreword is for information only and is not a part of C402.

I—History of Standard

A new pipe material consisting of an intimate mixture of portland cement and asbestos fibers was introduced to the North American market in 1931 following a number of years of usage in other countries, particularly Italy.

In the ensuing years, this type of pipe gained popularity, and in 1949 AWWA established a committee on standard specifications for asbestos–cement pipe under the chairmanship of S. M. Clarke of Greeley and Hanson, Chicago.

The committee developed a standard for asbestos–cement water pipe, which was approved by the AWWA Board of Directors as a tentative standard, AWWA C400–53T, on May 15, 1953. In 1958, the committee was reactivated as Committee 8340D on Asbestos–Cement Pipe under the chairmanship of Roy H. Ritter, Whitman, Requardt and Assocs., Baltimore, to review several suggested changes and to recommend revisions to the standard. The committee produced a revised standard adopted by AWWA as C400–64T on Jan. 27, 1964. It was advanced to "standard" without revision on Jul. 2, 1965.

In early 1968, the committee was reactivated as the Standards Committee on Asbestos–Cement Pipe to review and revise all of the AWWA standards on asbestos–cement pipe. The committee produced a revised standard approved by the Board of Directors on Jan. 31, 1972, designated as "AWWA Standard for Asbestos–Cement Pressure Pipe for Water and Other Liquids, C400–72."

In the winter season of 1972–1973 the committee was reorganized and enlarged to include representation of national organizations having an interest in the scope of the committee and wishing to participate in the work. The reorganized committee reaffirmed C400–72 without revision so that it could be presented to the American National Standards Institute for designation as an American National Standard.

In 1975 the committee produced a revised standard approved by the AWWA Board of Directors Jan. 26, 1975, designated as AWWA C400–75, "Standard for Asbestos–Cement Pressure Pipe, 4 in. Through 24 in. for Water and Other Liquids." At the same time a new standard was produced by the committee and approved by the AWWA Board of Directors designated as AWWA C402–75, "Standard for Asbestos–Cement Transmission Pipe, 18 in. Through 42 in., for Water and Other Liquids."

The asbestos–cement pipe manufacturers had developed a new series of pipe classifications that was larger and designed to give greater freedom of selection to design engineers. This is of particular significance for large diameter pipeline projects where the savings in material cost can exceed the increased cost of more detailed design, better control of methods of installation, and provision of surge controls when justified.

The standard, AWWA C402–75, was developed to provide the user with a ready reference and specification for this type of pipe known as transmission pipe.

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The possibility of confusion between the two standards, C400 and C402, was carefully reviewed by the committee. The result is this edition of C402, which maintains the sizes covered from 18 in. through 42 in. C400 has been revised simultaneously and covers sizes 4 in. through 16 in. There is now no overlap in sizes.

II—Information Regarding Use of This Standard

II.A *General.* When ordering pipe covered by this standard, local installation and operating conditions should be considered to determine the classification and type of pipe to specify. Also, certain other items must be specified to describe completely the pipe required.

It is recommended that, for large diameter pipeline projects, the purchaser evaluate local installation and operating conditions, operating pressures and surge pressures, trench loads, and surface loads when determining the strength classification to be used.

A proposed AWWA C403, "Standard Practice for the Selection of Asbestos–Cement Transmission Pipe," is under consideration at the present time by the committee.

NOTE: The purchaser is referred to AWWA C401 (formerly AWWA H2), "Standard Practice for Selection of Asbestos–Cement Distribution Pipe," for guidance in designing transmission pipe to fit his installation and operating conditions. Attention is directed to the fact that selection curves and related data in the current edition of AWWA C401 are applicable to pipe covered by AWWA C400–77, "Asbestos–Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids," not to transmission pipe covered by this standard. The purchaser is advised to consult the manufacturer pending the issuance of the proposed AWWA C403.

The purchaser is referred to AWWA C603, "Installation of Asbestos–Cement Pressure Pipe," for guidance in the laying of the pipe.

II.B *Flexural load test.* Flexural load tests are not required (Sec. 2.2.1, 5.2.3). For large diameters, the wall thicknesses increase to a point at which the flexural strength is not a controlling factor, and therefore routine testing is not required.

II.C *Type of pipe.* The following criteria are presented for determining the type of pipe to be used under various soil and water conditions. Each condition should be considered separately even though each may exist in combination with others.

These criteria are based on exposures within the temperature range of 40–80F (5–28C). For pipe exposures to temperatures beyond these limits, consult the manufacturer.

The following criteria are referenced as:

1. Internal water (Table F.1).
2. External water (Table F.2).
3. Nonacid soluble sulfates—internal and external (Table F.3).
4. Acid soluble sulfates—internal and external.

II.C.1 *Internal water.* Aggressiveness of water transported through asbestos–cement pipes is related to the type–designation of asbestos–cement pipe suitable for such use in Table F.1. Aggressiveness of water is defined as follows:

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(a) Highly aggressive:

$$pH + \log (AH) < 10.0$$

(b) Moderately aggressive:

$$pH + \log (AH) = 10.0\text{–}11.9$$

(c) Nonaggressive:

$$pH + \log (AH) \geq 12.0$$

where

pH = Index of acidity (or alkalinity) of the water—standard pH units
A = Total alkalinity—ppm as $CaCO_3$
H = Calcium hardness—ppm as $CaCO_3$

It should be recognized that water that has a $pH + \log (AH)$ less than or equal to 10 is an extremely aggressive water and would be very corrosive to almost all materials found in a typical water system, including the plumbing in consumers' homes. Such waters should be treated to increase pH or hardness to protect the entire network of materials that make up the system. In the event such water treatment is not to be undertaken, the manufacturer of each item used in the water system should be consulted for recommendations regarding the use of his product in an extremely corrosive environment.

NOTE: The expression $pH + \log (AH)$ is a modification of the Langelier Index. It has been prepared so that the aggressiveness of the water may be determined easily. A reasonable comparison of the two would be as follows:

	$pH + \log (AH)$	Langelier Index
Highly aggressive water	<10.0	< − 2.0
Moderately aggressive water	10.0 to 11.9	−2.0 to −0.1
Nonaggressive water	≥12.0	≥0

TABLE F.1

Asbestos-Cement Pipe Type Recommended for Internal Water Aggressiveness

Internal Water Aggressiveness	Recommended Pipe Type*
Highly aggressive	†
Moderately aggressive	II
Nonaggressive	I and II

* Type I—no limit on uncombined calcium hydroxide; Type II—1.0 per cent or less uncombined calcium hydroxide.
† The serviceability of pipe for such applications should be established by the purchaser in conjunction with the manufacturer.

TABLE F.2

Aggressiveness of Nonsulfate Acidic Soils to Asbestos-Cement Pipe

Water Conditions Within the Soil Environment	Minimum pH of Acidic Soils When Using Asbestos-Cement Pipe	
	Type I	Type II
Essentially quiescent	5.0	4.0
Mildly fluctuating	5.5	5.0
Rapidly moving or grossly cyclic	6.3	5.5

II.C.2 *External water.* Aggressiveness of external water (water within the soil environment) in relation to asbestos–cement pipe as shown in Table F.2.

The guidelines for the use of asbestos–cement pipe in nonsulfate acidic soils are based upon minimum pH factors alone. Asbestos–cement pipe may or may not perform satisfactorily in acidic soil environments having pH values below those listed in Table F.2. To determine the suitability of asbestos–cement pipe in soils having lower pH values, each situation should be evaluated individually, taking into consideration all aspects of soil environment that affect asbestos–cement pipe corrosiveness.

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Sulfate Aggressiveness Classification	Water: Water Soluble Sulfates—*ppm* SO_4	Soil: Water Soluble Neutral Sulfates—*ppm* SO_4
Nonaggressive	150 and less	1000 and less
Mildly aggressive	150–1500	1000–2000
Moderately aggressive	1500–10 000	2000–20 000
Highly aggressive	10 000 and greater	20 000 and greater

II.C.3 *Nonacid soluble sulfates—internal and external.* Aggressiveness of nonacid (pH $\geq$ 7.0) soluble sulfates in water and soils is related to the type-designation of asbestos-cement pipe suitable for such use in Table F.3. Sulfate aggressiveness in water and soil can be classified as indicated above.

II.C.4 *Acid soluble sulfates—internal and external.* Aggressiveness of acid (pH < 7.0) soluble sulfate waters and soils to asbestos-cement pipe must be evaluated independently. Acid sulfate soils and waters, whether the acid is inorganic or organic, must be evaluated independently of the criteria and guidelines set forth in paragraphs II.C.2 and II.C.3 and must take into consideration soil permeability and other factors. For guidance, consult the manufacturer.

II.D *Supplementary specifications.* The following information summarizes the conditions and items that the purchaser should consider when preparing his supplementary specifications and lists the sections in the standard where they may be found.

1. The standard used; that is, AWWA C402-77.
2. Affidavit of compliance, if required (Sec. 1.3).
3. Type of pipe to be furnished (Sec. 2.3 and Foreword II.C).
4. Classification of pipe (Sec. 3.1).
5. Nominal inside diameter (Sec. 3.2).
6. Lineal feet to be furnished in standard and random lengths (Sec. 3.3).
7. Number, size, type, classification, lengths, and extent of machining of special short lengths (Sec. 3.3.3).
8. Whether inspection by the purchaser (Sec. 5.1) and special marking (Sec. 6.1.4) are required.

III—Major Revisions

Major changes to the 1975 standard made in this revision are:

1. A more detailed description of aggressive soil and water criteria has been added in the Foreword, Sec. II.

TABLE F.3

Asbestos-Cement Pipe Type-Designation Chemical Resistance to Nonacid (pH = 7.0) Soluble Sulfates in Water and Soils

Type Designation	Chemical Resistance to Nonacid Soluble Sulfates in Water and Soils
I*	Will be attacked in various degrees by all but the nonaggressive levels of sulfate concentrations in waters and soils.
II	Resistant to all levels of soluble sulfates.

* The guideline criteria for sulfate resistance of Type I pipe were taken from the *Concrete Manual*, 8th edition, Bureau of Reclamation, 1974. Sulfate resistance here applies to all soluble sulfates regardless of the cation.

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2. The lot definition of paragraph 1.2.3 has been revised to define more clearly the quantity of pipe manufactured by size versus time.
3. Paragraph 5.2.5 *Machines for Testing* defines the machines used in the various physical tests and also allows couplings to be hydrostatically tested with a rubber bladder inside the coupling at ten times the classification of the coupling.

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American Water Works Association

AWWA C402-77

(Revision of C402-75)

AWWA Standard for

Asbestos-Cement Transmission Pipe, 18 in. Through 42 in., for Water and Other Liquids

Section 1—General

Sec. 1.1—Scope

This standard covers nine pressure classifications of Type I and Type II asbestos-cement pipe, 18–42 in. in diameter, for water and other liquids, to be laid underground in public and private rights-of-way.

1.1.1 *Use.* Asbestos-cement transmission pipe is to be used in pipe systems having relatively predictable flows and few appurtenances, which permit reasonable hydraulic analyses, including those for surge pressures.

Sec. 1.2—Definitions

Under this standard, the following definitions shall apply:

1.2.1 *Inspection.* Inspection of the pipe and the tests by the inspector.

1.2.2 *Inspector.* The authorized representative of the purchaser, entrusted with the duty of inspecting pipe produced and tests performed under this standard.

1.2.3 *Lot.* A lot as used herein for pipe 20 in. in diameter and smaller is defined as all pipe of any one classification, type, and size manufactured on any one machine in 24 hr but not to exceed 300 lengths. A lot as used herein for pipe larger than 20 in. in diameter is defined as all pipe of any one classification, type, and size manufactured on any one machine during a period of consecutive working days not exceeding seven days but not to exceed 300 lengths.

1.2.4 *Manufacturer.* The person, firm, or corporation that manufactures the pipe.

1.2.5 *Purchaser.* The person, firm, corporation, or government agency entering into a contract or agreement to

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purchase pipe according to this standard.

Sec. 1.3—Affidavit of Compliance

The purchaser's supplemental specifications may require an affidavit of compliance from the manufacturer, whether factory inspection has been required or not, to the effect that the materials furnished under the purchaser's order comply with all applicable requirements of this standard.

Section 2—Materials

Sec. 2.1—Composition

Asbestos–cement pipe shall be composed of an intimate mixture of either: (1) portland cement or portland blast furnace slag cement and asbestos fiber with or without silica; or (2) portland pozzolana cement and asbestos fiber. Both (1) and (2) can be with or without the addition of curing agents. The pipe shall be formed under pressure and cured. The finished pipe shall be free from organic materials.

Sec. 2.2—Physical Requirements

2.2.1 *Flexural strength.* Because only improperly bedded and improperly installed small diameter pipe is susceptible to adverse flexural loading, there is no flexural requirement for large diameter pipes.

2.2.2 *Bursting strength.* Each length of pipe and each coupling sleeve shall have sufficient strength to withstand the design internal pressure indicated for its classification in Table 1 when subjected to the hydrostatic test procedure specified in this standard.

TABLE 1
Pipe Classification

Classification	Design Internal Pressure *psi*
30	300
35	350
40	400
45	450
50	500
60	600
70	700
80	800
90	900

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TABLE 2
*Design External Load**—lb/lineal ft

Pipe Size in.	Classification								
	30	35	40	45	50	60	70	80	90
18	2 500	3 000	4 000	5 000	6 500	8 500	11 000	14 000	18 000
20	2 500	3 500	4 500	5 500	7 100	9 500	12 000	15 000	20 000
21	2 500	3 500	4 500	5 800	7 300	9 700	12 500	16 000	21 000
24	2 800	3 800	5 000	6 200	8 100	11 000	15 000	19 000	24 000
27	3 500	4 200	5 500	7 000	8 800	12 500	16 500	20 500	27 000
30	3 500	4 500	6 000	7 500	9 700	13 500	18 000	22 500	30 000
33	3 500	5 000	6 500	8 000	10 500	14 500	19 500	24 500	33 000
36	4 000	5 000	7 000	9 000	11 200	16 000	21 000	26 000	36 000
39	4 200	5 300	7 500	9 700	12 000	17 200	22 500	28 000	39 000
42	4 300	5 700	8 000	10 500	13 000	18 500	24 000	30 000	42 000

* It is necessary to apply a load factor to the above three-edge bearing loads in order to correlate them to the field loads. (See AWWA Standard C403.)

2.2.3 *Crushing strength.* Each length of pipe shall have sufficient strength to support the design external load indicated for its classification in Table 2 when subjected to the crushing-test procedure specified in this standard.

Sec. 2.3—Chemical Requirements

Pipe shall be designated as either Type I or Type II according to its content of uncombined calcium hydroxide as determined by the test procedures in this standard for uncombined calcium hydroxide. The requirements for each type are

Type I—no limit on uncombined calcium hydroxide

Type II—1.0 per cent or less uncombined calcium hydroxide.

Section 3—Design

Sec. 3.1—Pipe Classifications

Pipe supplied under this standard shall be made in one or more of the classifications shown in Table 1. (The numerical value for each classification is equivalent to one tenth of the hydrostatic lot test pressure.)

Sec. 3.2—Pipe Diameters

Pipe shall be made with nominal inside diameters of 18, 20, 21, 24, 27, 30, 33, 36, 39, and 42 in. The average inside diameter of a standard or random pipe length shall not be less than the nominal diameter by more than 1.5 per cent.

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Sec. 3.3—Pipe Lengths

Pipe shall be produced in standard, random, and short lengths. At least 90 per cent of the total footage of pipe of any classification, type, and size, excluding short lengths, shall be furnished in standard lengths. The remaining 10 per cent may be in random lengths.

3.3.1 *Standard length* shall be 13 ft ± 1 in.

3.3.2 *Random lengths* shall be cut from standard lengths and shall be not less than 7 ft long.

3.3.3 *Short lengths* for making connections to valves, fittings, or structures, and for making closures shall be furnished as specified by the purchaser.

Sec. 3.4—Couplings

A coupling shall consist of an asbestos–cement sleeve of the same type and classification as the pipe and two rubber rings or a device that has equal or better bonding characteristics, strength, and serviceability as that of an asbestos–cement coupling. The manufacturer shall submit to the purchaser for approval, prior to manufacturing, specifications and drawings of alternate couplings.

TABLE 3
Wall Thickness Tolerances

Size of Pipe *in.*	Wall Thickness Tolerance *in.*
18	−0.12
20–24	−0.14
27–30	−0.17
33–36	−0.20
39–42	−0.23

3.4.1 *One coupling* of the same size and classification as the pipe shall be furnished with each standard and random length of pipe.

3.4.2 *Rubber rings* shall conform to the requirements of the latest edition of ASTM D1869, "Rubber Rings for Asbestos–Cement Pipe."

Sec. 3.5—Joints

Joints shall be capable of withstanding, without leakage, a hydrostatic pressure test as defined in Section 5.2.2.1.

Sec. 3.6—Wall Thickness

The wall thickness of the machined portion of any length of pipe shall not be less than the manufacturer's standard by the listed tolerance in Table 3.

Section 4—Workmanship and Finish

Sec. 4.1—Imperfections

4.1.1 *Interior surfaces.* The inside surface of each length of pipe shall be free from bulges, dents, and tears that result in a variation in diameter of more than 0.20 in. from the diameter of adjacent unaffected portions of the surface.

4.1.2 *Coupling areas.* The coupling areas of the barrel of each length of pipe shall be free from dents and gouges that could cause leakage from the joint.

4.1.3 *Exterior surfaces.* Flaking on the exterior surface and edge of machined ends shall not extend back by

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more than 0.500 in. from the end, have a depth of more than 0.125 in., and shall not extend around the perimeter for more than 0.500 in. at any one location.

4.1.4 *Straightness.* Each length of pipe shall not vary in straightness by more than 0.05 in./ft of length when the variation is measured as follows:

Measure the maximum ordinate from the exterior surface of the pipe by placing a straightedge that exceeds the pipe length against the exterior surface and measure the maximum distance from the exterior pipe surface to the straightedge.

Section 5—Inspection, Testing, and Rejection

Sec. 5.1—Inspection

5.1.1 *General.* Inspection by the purchaser shall not relieve the manufacturer of the responsibility to furnish material conforming in all respects to the requirements of this standard.

5.1.2 *Notification.* If inspection is specified under Sec. 5.1.4 by the purchaser, the manufacturer shall notify the purchaser, in advance, of the date, time, and place of testing of the pipe, so that the purchaser may be represented at the test.

5.1.3 *Access.* The inspector shall have free access to those parts of the manufacturer's plant that are involved in work performed under this standard. The manufacturer shall afford the inspector, without charge, all reasonable facilities for determining whether the pipe meets the requirements of this standard.

5.1.4 *Testing.* If inspection is specified by the purchaser, the purchaser at his option may witness any or all test phases. The pipe to be tested will have passed the routine inspection and testing of this specification. The number of tests to be conducted for hydrostatic bursting strength (lot test) and, when required, crushing strength shall be limited to one per each 300 standard lengths of each size, type, and classification of pipe on the order. If uncombined calcium hydroxide tests are required, the number of tests will be one for each size, type, and classification of pipe on the order. The purchaser or his authorized inspector may select the pipe to be tested. Retesting and rejection as shown in Sec. 5.3 shall apply.

Sec. 5.2—Physical Test Requirements

5.2.1 *Test specimens.* All pipes and couplings tested under this standard shall be in a normal, air-dried condition when tested.

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TABLE 4
Hydrostatic Tests

Classification	Proof Test *psi*	Lot Test *psi*
30	225	300
35	263	350
40	300	400
45	338	450
50	375	500
60	450	600
70	525	700
80	600	800
90	675	900

5.2.2 *Hydrostatic tests:*

5.2.2.1 Each standard, random, or short length of pipe and each coupling sleeve shall be tested under an internal hydrostatic pressure as shown for the routine proof test in Table 4. All air shall be expelled and the water pressure shall be increased to the test pressure at a uniform rate of not less than 100 psi/s. The test pressure shall be maintained for at least 5 s. Any pipe length or coupling sleeve that shows leakage, sweating, or other defects shall be rejected.

5.2.2.2 From each lot that has passed the hydrostatic proof test, a 1-ft, or longer length of pipe shall be cut from the unmachined portion of a pipe. The unmachined sample shall withstand the hydrostatic lot test shown in Table 4 when tested in the manner specified in paragraph 5.2.2.1 except that the test pressure need not be held for 5 s. If inspection by the purchaser has been specified, the length of pipe to be tested may be selected by the inspector. Each length of pipe so tested shall be retested in the manner and at the pressure specified in paragraph 5.2.2.1.

5.2.3 *Flexural testing.* No flexural testing is required.

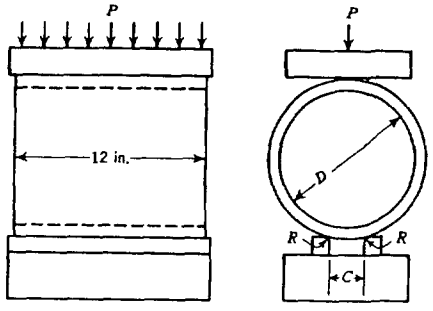


Fig. 1. Crushing Test Assembly

The diagram at the left shows a side view of the test assembly; that at the right, an end view. P *represents load;* R, *approximately 0.5 in.—the radius of the bearings;* D, *the nominal diameter of the pipe; and* C, *the clear space between supports.* C *should be approximately 1 in./ft of internal pipe diameter, but in no case less than 1 in.*

5.2.4 *Crushing tests.* On lots containing more than 100 lengths of each size and classification, one length from each 300 lengths or fraction thereof shall be tested for crushing strength. If inspection by the purchaser has been specified, the length of pipe to be tested may be selected by the inspector. From each selected length, one unmachined length of pipe 1 ft long shall be cut. This section shall be tested by the crushing-test method shown in Fig. 1. After 75 per cent of the specified load has been reached, the loading shall be applied at a uniform rate of approximately 2 000 lb/min. The test section shall not fail until the total load applied meets or exceeds the applicable value shown in Table 2.

5.2.4.1 For this test, the two lower bearings shall consist of two straight strips with vertical sides, each strip having its interior top edge rounded to a radius of approximately 0.5 in. The

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strips shall be of hardwood or metal; if metal, a piece of leather belting 3/16 in. in thickness shall be laid over them. The strips shall be securely fastened to a rigid block, with the interior vertical faces parallel and a distance apart of approximately 1 in./ft of internal pipe diameter, but in no case less than 1 in. The upper bearing shall be a rigid wooden block, straight and true from end to end. The upper and lower bearings shall extend the full length of the test section.

5.2.4.2 For those sizes and classifications where the specified crushing load exceeds 30 000 lb/linear ft, the test length may be less than 1 ft long. In those cases, the test load shall be such as to produce an equivalent specified loading per linear foot.

5.2.5 *Machines for testing.*

5.2.5.1 The machines used for the hydrostatic proof test shall have gaskets that seal the ends of the pipe, couplings, or pipe and coupling with factory-assembled joint, but exert no end pressure. Couplings also may be hydrostatically proof tested with a rubber bladder inside of the coupling and, if so tested, each coupling shall have sufficient strength to withstand a test pressure of ten times the classification of the coupling. The machine used for hydrostatic burst testing or lot test shall have gaskets that seal against the inside of the pipe at or near the ends of the test specimen without materially counteracting the hydrostatic test pressure.

5.2.5.2 The machine used for the crushing test shall be substantial and rigid throughout so that the distribution of the load will not be appreciably affected by the deformation or yielding of any part of the machine.

Sec. 5.3—Retests (Physical) and Rejection

5.3.1 *Crushing strength.* The failure of any specimen tested for crushing strength to support 75 per cent of the crushing load required in Table 2 shall be cause for rejection of the entire lot of that size and classification manufactured during the same shift as the test specimen. If any specimen tested for crushing strength supports more than 75 per cent but less than 100 per cent of the crushing load, two additional pipe sections of the same size and classification, manufactured during the same shift, shall be subjected to the crushing test. The additional lengths may be selected by the inspector, if inspection by the purchaser has been specified. The failure of one of these additional specimens to meet the full crushing strength requirement shall be cause for rejection of the entire lot of that size and classification manufactured during the same shift as the test specimen.

5.3.2 *Hydrostatic tests.* If any pipe subjected to the hydrostatic tests specified in Sec. 5.2.2.2 fails to withstand the pressure specified in Table 4, two additional lengths of the same size and classification, manufactured during the same shift, shall be subjected to the same hydrostatic test. The additional lengths may be selected by the inspector, if inspection by the purchaser has been specified. The failure of one of these additional lengths to withstand the specified pressure shall be cause for rejection of the entire lot of that size and classification manufactured during the same shift as the test lengths.

Sec. 5.4—Test for Uncombined Calcium Hydroxide

The manufacturer shall perform this test as often as necessary to ensure

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compliance with the requirements for uncombined calcium hydroxide in Type II pipe.

5.4.1 *Reagents.*

Phenolphthalein indicator. Dissolve 1.0 g of phenolphthalein in 100.0 ml of absolute ethanol.*

Glycerol-ethanol solvent. Prepare a solution consisting of glycerol and anhydrous or absolute ethanol,* 1:2 by volume. To each litre of this solution, add 2.0 ml phenolphthalein indicator. Adjust the solvent to slightly basic with either dilute NaOH in absolute ethanol* or standard ammonium acetate, depending upon the original pH.

Strontium nitrate [$Sr(NO_3)_2$].

Standard ammonium acetate solution. Dissolve 16.0 g dry crystalline ammonium acetate in 1 l of absolute, or anhydrous, ethanol.*

Standardize the ammonium acetate solution by titrating against pure CaO that has been freshly prepared by calcining pure calcium carbonate or calcium oxalate to constant weight in a platinum crucible at 1650–1830F (900–1 000C).

When the calcined CaO has cooled in a desiccator, perform the following operations in rapid succession. Grind it in an agate mortar. Then weigh out 0.05–0.06 g CaO into a clean, dry 250-ml Erlenmeyer flask and add 60 ml of the glycerol–ethanol solvent and 2.0 g of anhydrous strontium nitrate to the flask. Place a TFE encapsulated magnetic stirring bar into the flask and attach a reflux condenser. Adjust the heating rate and stirring speed to obtain a vigorous boiling and complete agitation. Titrate the hot solution with standardized ammonium acetate solution every 5 min. The endpoint is reached when no further color appears in the solution after 10 min of boiling. Titration is to be carried out only on a hot solution. Good titration procedure is evidenced by a change to pink color upon cooling.

5.4.2 *Procedure.*

Step 1. Brush representative pieces of the pipe free of dust and drill with a clean, sharp 0.25-in. carbide-tipped drill inward from the outer surface at a rate of penetration of approximately 1 ipm until the drill point emerges from the inside wall. Catch the drillings on a clean sheet of glazed paper. Use a soft brush to collect all drillings. Screen through a 20-mesh screen immediately, and place in a weighing bottle.

Step 2. Place the bottle with top removed into a drying oven at 217F (105C) for 2 hr and then cool to room temperature in a desiccator.

Step 3. Weigh out 1 ± 0.010 g of the dried sample to the nearest 0.001 g and place in a clean, dry 250-ml Erlenmeyer flask, to which a TFE-encapsulated stirring bar, 60 ml of the glycerol-ethanol solvent, and 2.0 g $Sr(NO_3)_2$ have been added. Attach the flask to a water-cooled condenser (with a standard 24/40 glass joint) and place on a hot plate with a magnetic stirrer. Boil the solution gently for 30 min, stirring slowly. Then, remove the flask and filter the mixture, under vacuum, through a Buchner funnel. Bring the filtrate to a boil and titrate to a colorless endpoint with the standardized ammonium acetate reagent. Determine the endpoint by comparing with a similar mixture containing no phenolphthalein indicator.

* Specially denatured alcohol No. 30, 3a, or 2b, of the US Bureau of Internal Revenue, or alcohol consisting of 95 per cent specially denatured alcohol No. 3a plus 5 per cent isopropanol, may be substituted.

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5.4.3 *Calculations:*

$$E = \frac{W\text{CaO} \times 1.32}{Va}$$

where

E = the weight in grams of $Ca(OH)_2$ per millilitre of standardized ammonium acetate solution

WCaO = the weight in grams of CaO in the standardized ammonium acetate solution

Va = the volume in millilitres of standardized ammonium acetate used in titration of the solution.

$$\text{Percentage uncombined } Ca(OH_2) = \frac{EV}{W} \times 100$$

where

V = the volume of standardized ammonium acetate solution required by the sample, in millilitres

W = the weight of the sample in grams.

Sec. 5.5—Test Records

The results of all tests shall be recorded and retained for one year, and shall be available to the purchaser at the place of manufacture.

Section 6—Marking and Delivery

Sec. 6.1—Marking

6.1.1 *Standard and random lengths.* Each standard or random length of pipe shall be clearly marked on the outside surface with the trade name, nominal inside diameter, classification, type, date, and shift of manufacture, and the word "Transmission."

6.1.2 *Short lengths.* Each short length of pipe shall be clearly marked on the outside surface with the nominal inside diameter, the classification, the letter T to indicate that it has been hydrostatically tested, and the word "Transmission."

6.1.3 *Couplings.* All component parts of each coupling shall be clearly marked for use with the pipe for which they are intended. Each coupling shall also be marked with the letter T to indicate that it has been hydrostatically tested.

6.1.4 *Special markings.* If factory inspection is made by the purchaser or his authorized inspector, each pipe and each coupling shall receive an additional special marking of no more than three letters, as specified by the purchaser.

Sec. 6.2—Preparation for Shipment

All pipe and couplings, unless otherwise specified, shall be prepared for standard commercial shipment.

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Department of Defense Acceptance Notice

This nongovernment document was adopted and approved for use by the Department of Defense (DoD) on 10 May 1982. The American Water Works Association has furnished the clearance required by existing regulations. Copies of the document are stocked by DoD Single Stock Point, Naval Publications and Forms Center, Philadelphia, PA 19120, for issue to DoD activities only. Contractors and industry groups must obtain copies from AWWA, 6666 West Quincy Ave., Denver, CO 80235.

Title of Document: AWWA Standard for Asbestos-Cement Transmission Pipe, 18 in. Through 42 in., for Water and Other Liquids

Date of Specific Issue Adopted: January 30, 1977

Releasing Industry Group: American Water Works Association

Custodians: Army—ME
Navy—YD
Air Force—99

Military Coordinating Activity: Navy—YD

User Activity: Navy—MC

Project No. 5630-0086

FSC 5630

4P-3 5M-43402-3/83-LL

CTD015640



American Water Works Association

ANSI/ AWWA C401-77

(Revision of
AWWA C401-64)

AWWA STANDARD PRACTICE

for

THE SELECTION OF ASBESTOS-CEMENT DISTRIBUTION PIPE, 4 IN. THROUGH 16 IN., FOR WATER AND OTHER LIQUIDS



First edition approved by AWWA Board of Directors Jan. 27, 1964.
This edition approved May 8, 1977.
Approved by American National Standards Institute, Inc., Jan. 17, 1978.

AMERICAN WATER WORKS ASSOCIATION
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CTD015641

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* Alternate

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Foreword

This foreword is for information only and is not a part of AWWA C401.

I. History of Standard

The information contained in this standard was first published as, "AWWA Handbook H2," with AWWA Board of Directors approval on Jan. 27, 1964. The designation was changed later to, "AWWA C401–64." Originally, it covered sizes 4–36 in. although the design was primarily based on service conditions generally related with smaller (4–16 in.) distribution sizes. In the smaller diameters the effect of water hammer generated by the opening and closing of fire hydrants can be of significant magnitude because of the high velocities generated by open hydrant flow conditions on small diameter lines in distribution systems. It is difficult to evaluate accurately the magnitude of surges, and if calculated, it would be impractical to attempt to control the surge by the use of surge tanks or other devices.

Rather than employ a rule-of-thumb surge allowance based upon an assumed velocity change, a large factor of safety is applied to the class pressure rating of the pipe to take into account the undetermined surges.

AWWA C403, "Standard Practice for the Selection of Asbestos–Cement Transmission and Feeder Main Pipe, 18 in. Through 42 in.," is a standard containing information similar to that contained herein but dealing with larger diameter pipes. In AWWA C403 the design is based on evaluation of all design conditions including surge pressures. Also, adequate factors of safety are applied to the combination of pressures to which the pipe line will be subjected.

The primary difference between AWWA C401 and AWWA C403 is one of differing methods for designing pipelines to account for surge pressures. In the small sizes where surges can be of great magnitude and are impractical to control, a large factor of safety is employed to compensate for the unknown. In the large sizes the design is based upon a more detailed evaluation of the magnitude of surge pressures, and a factor of safety based upon a more precise knowledge of actual operating conditions is employed.

II. Major Revisions

Major changes to the 1964 edition of this standard made in this revision are:

1. The title has been changed to indicate that the pipe is intended for use in distribution systems.

2. The size range has been changed to limit the maximum size covered by this standard to 16-in. diameter pipe.

3. Figure 2, Crushing Test Assembly, has been changed to show the C dimension to be approximately 1 in./ft of internal pipe diameter but in no case less than 1 in.

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American Water Works Association

AWWA C401-77

(Revision of
AWWA C401-64)

AWWA Standard Practice for

The Selection of Asbestos–Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids

Section 1—General

Sec. 1.1—Scope

This standard has been prepared so that design engineers can quickly determine the correct class of asbestos–cement pipe to use under various combinations of internal pressure and external loading. Curves are included to expedite the selection of the correct class of pipe. Detailed analyses of the various structural factors affecting pipe design and selection are treated under separate headings.

1.1.1 *Pressure classes.* Pipe pressure class designations of 100, 150, and 200 refer to the similarly numbered classes specified in AWWA C400, "Standard for Asbestos–Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids."

1.1.2 *Installation.* Detailed coverage of the installation of asbestos–cement pipe can be found in AWWA C603, "Standard for the Installation of Asbestos–Cement Pressure Pipe."

Sec. 1.2—References

This standard references the following documents. They form a part of this standard to the extent specified herein. In any case of conflict, the requirements of this standard shall prevail.

1. SCHLICK, W.J. Supporting Strengths for Cast-Iron Pipe for Water and Gas Service, *Iowa State Col. Eng. Sta. Bull.,* No. 146 (Jun. 1940).

2. ASCE. *Design and Construction of Sanitary and Storm Sewers,* Manual of Engineering Practice No. 37, Am. Soc. Civ. Engrs., New York (1967).

3. KERR, S.L. Practical Aspects of Water Hammer, *Jour. AWWA,* 40: 699 (Jun. 1948).

4. MARSTON, ANSON. The Theory of External Loads on Closed Conduits in the Light of Latest Experiments, *Iowa State Coll. Eng. Exp. Sta. Bull.,* No. 96 (1930).

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Section 2—Pipe Design and Selection

Sec. 2.1—Strength and Design Factors

The strength of asbestos-cement water pipe must be sufficient to withstand the combined forces of internal hydrostatic pressure and external loads. Furthermore, the conditions under which the pipe is installed will have a direct relationship to its ability to resist these forces. Therefore, satisfactory pipe performance in field service requires that the bedding* conditions, as well as the internal and external forces acting on the pipe, be taken into consideration when selecting a class of pipe for any given installation. Finally, sound engineering practice requires that adequate safety factors be applied to strength requirements to ensure performance under less than ideal conditions.

2.1.1 *Bedding conditions.* The bedding conditions described in Table 1 have been selected as representative of typical installation conditions encountered in the field. They are illustrated in Fig. A2 in the appendix.

TABLE 1

Typical Field Installation Conditions

Bedding Condition Class	Description
A	Gravel or sand base, backfill tamped
B	Same as A but backfill not tamped
C	Pipe laid on earth mounds or pipe barrel on flat trench bottom with excavated coupling holes, backfill tamped
D	Same as C but backfill not tamped

2.1.2 *Safety factors.* In the selection curves, a safety factor of 4.0 is applied to the operating pressure and a safety factor of 2.5 is applied to earth loads. Furthermore, pipe selected from the curves will have a safety factor of at least 2.5 for the operating pressure when combined with a safety factor of 2.5 for resisting an earth load consisting of the total equivalent earth load plus a 10 000-lb wheel load and impact load. Under impact loading conditions, the 2.5 safety factor for the operating pressure represents sound design practice, for it is unlikely that internal surge pressure would occur at the same instant as external impact.

Sec. 2.2—Combined-Loading Theory

Tests of asbestos-cement pipe under various combinations of internal pressure and external load applied in three-edge bearing (see Sec. 2.3) indicate that there is a relationship between the combined loads at the point of pipe fracture. This relationship can be represented by a parabolic curve as shown in Fig. 1. The equation for the load pressure parabolic curve shown in Fig. 1 may be expressed as:

$$w = W\sqrt{\frac{P - p}{P}} \qquad \text{Eq 1}$$

in which, P is the internal pressure, in pounds per square inch, that will burst the pipe when no external load exists; W is the external load, in pounds per lineal foot of pipe in the three-edge bearing test, that will crush the pipe when no internal pressure exists; p is the internal pressure, in pounds per square inch which, in combination with some external load w applied in three-

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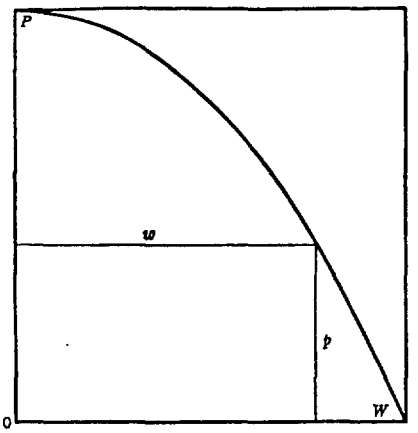


Fig. 1. Load Pressure Curve

P *represents the internal pressure;* W *the external load.*

edge bearing, will fracture the pipe; and w is the external load, in pounds per lineal foot of pipe applied in three-edge bearing which, in combination with some internal pressure p, will fracture the pipe.

Sec. 2.3—Three-Edge Bearing Load Factors

A convenient method of testing pipe for crushing strength W is the three-edge-bearing method of loading shown in Fig. 2. Because the field supporting strength of a conduit is influenced by the bedding conditions and the lateral pressure acting against the sides of the conduit, it is necessary to apply a load factor to the three-edge bearing loads in order to correlate them to the field loads. Since the external load equals the load factor times the three-edge bearing load, the load factor equals the external load divided by the three-edge bearing load. Table 2 shows load factors to be applied for each of the bedding conditions described in Table 1.

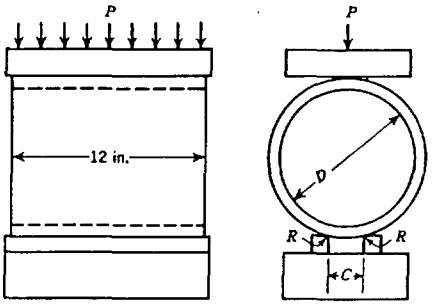


Fig. 2. Crushing Test Assembly

The diagram at the left shows a side view of the test assembly; that at the right, an end view. P *represents load;* R, *approximately 0.5 in.—the radius of the bearings;* D, *the nominal diameter of the pipe; and* C, *the clear space between supports.* C *should be approximately 1 in./ft of internal pipe diameter but in no case less than 1 in.*

TABLE 2

Correlation of Bedding Conditions, Pipe Size, and Load Factors

Bedding Class	Pipe Size in.	Load Factor
A	4–12	1.7
	14–16	1.8
B	4–16	1.5
C	4–12	1.3
	14–16	1.4
D	4–16	1.1

Sec. 2.4—Hydrostatic Pressures

The hydrostatic pressures to be considered in pipeline design are static operating pressure and surge pressure. The static pressure will be fixed by the particular field service condition. Ordinary surge pressure conditions are allowed for in this standard by applying a safety factor of at least 4.0 to internal pressure in combined loading.

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2.4.1 *Exceptional surge pressures.* When exceptional surge pressures are a necessary specific consideration in design, a conservative basis for surge allowance determination is the method proposed by S. Logan Kerr. His method considers the fundamental relations affecting water hammer, including velocity of flow in the pipeline, length of the pipeline, time of valve operation or interruption of flow, and the pressure wave velocity. Water hammer allowance is determined by the formulas of Eq 2 and 3.

$$h = 2.3p = \frac{aV}{g} \qquad \text{Eq 2}$$

in which,

h is the water hammer allowance, in feet; p is the water hammer allowance, in pounds per square inch; a is the velocity of the pressure wave, in feet per second; g is the acceleration due to gravity (32.2 fps/s); and V is the flow line velocity, in feet per second, cut off by the valve operation or other action in the critical time, or less.

$$a = \frac{4660}{\sqrt{1 + \frac{k}{E}\frac{d}{e}}} \qquad \text{Eq 3}$$

in which,

a is the pressure wave velocity in feet per second; k is the modulus of compression of water, in pounds per square inch (290 000–300 000 psi); E is the modulus of elasticity of asbestos–cement pipe, in pounds per square inch (3 400 000 psi); d is the internal diameter, in inches; and e is the wall thickness, in inches.

Sec. 2.5—External Loads

External-load determinations for underground conduit used in this standard are based on the data in Chapter 9 of the *Manual on Design and Construction of Sanitary and Storm Sewers* produced jointly by ASCE and WPCF. External loads on conduit are of two types: (1) those due to gravity earth loads and (2) those due to superimposed loads that may be static or moving.

2.5.1 *Gravity earth loads.* The magnitude of gravity earth loads may be computed by using the theory developed by Anson Marston which states, in general, that the load on a buried conduit is equal to the weight of a prism of earth (called the interior prism) directly over the conduit plus or minus the frictional shearing forces transferred to that prism by the adjacent prisms of earth. The magnitude and direction of these frictional forces are a function of the amount of relative settlement occurring between the interior and adjacent earth prisms. The general form of Marston's equation is

$$W = CwB^2 \qquad \text{Eq 4}$$

in which,

W is the vertical load, per lineal foot, acting on the conduit because of gravity earth loads; w is the weight of earth, in pounds per cubic foot; B is the trench or conduit width, depending on installation conditions; and C is the coefficient that includes the effect of:

1. The ratio of the height of the fill to the width of the trench or conduit,
2. the shearing forces between the interior and adjacent earth prisms,
3. the direction and amount of relative settlement between interior and adjacent earth prisms for embankment conditions, and
4. the rigidity of conduit support for embankment conditions.

2.5.1.1 Values for external loads may be determined by Marston's for-

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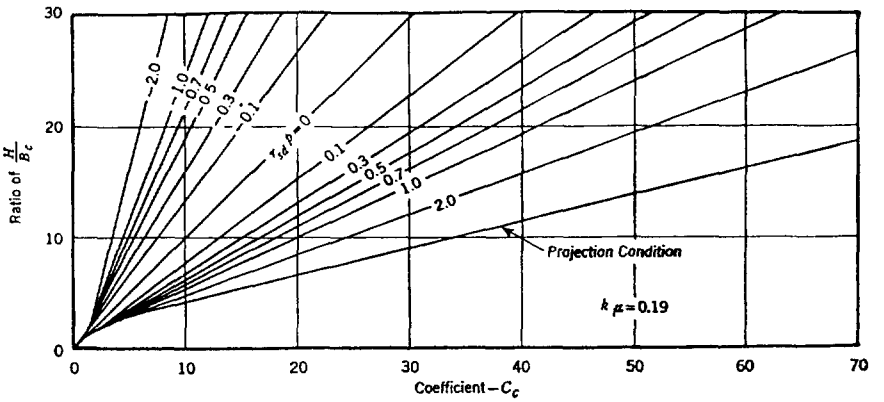


Fig. 3. Graph for Determining Load Coefficient Values

The graph shows a plot of load coefficient values C_c *against values obtained by dividing the height of the fill above the conduit by the outside width of the conduit* H/B_c.

mula as shown in Eq 5. Tables of external loads based on soil weight of 120 lb/cu ft are presented in Table A1 in the appendix.

$$W_c = C_c w (B_c)^2 \qquad \text{Eq 5}$$

in which,

W_c is the load on the conduit, in pounds per lineal foot; w is the unit weight of the soil, in pounds per cubic foot; B_c is the outside width of conduit, in feet; and C_c is the load coefficient.

In this formula load coefficient C_c is a function of H/B_c, p, r_{sd}, μ, and k. H is the height of the fill above the conduit, in feet. The projection ratio p is the ratio of the distance of the top of the conduit above the natural grade to the width of the conduit. r_{sd} is the settlement ratio, μ is the coefficient of internal friction of the backfill material, and k is the Rankins ratio of lateral pressure to vertical pressure.

2.5.1.2 Based on a Class C flat-bottomed, backfill-tamped trench, conservative values of $p = 1.0$, $r_{sd}p = 0.70$, and $k\mu = 0.192$ were used in the determination of external loads for the performance curves. C_c values may be determined from Fig. 3, which shows a plot of C_c against H/B_c ratios. For values of H/B_c greater than 1.3, when $r_{sd}p = 0.70$, the graph is linear and values may be determined by the empirical equation

$$C_c = 1.892 \frac{H}{B_c} - 0.96 \qquad \text{Eq 6}$$

2.5.1.3 Occasionally, a trench condition exists in which the width of the trench is less than two or three times the widths of the conduit. In such cases, Marston's trench condition formula may be used for determinations of the gravity loads.

$$W_d = C_d w (B_d)^2 \qquad \text{Eq 7}$$

in which,

W_d is the vertical load, in pounds per lineal foot; B_d is the width of the trench; w is the weight of the backfill soil in pounds per cubic foot, and C_d is a load coefficient. (See Fig. 4 for values of C_d.)

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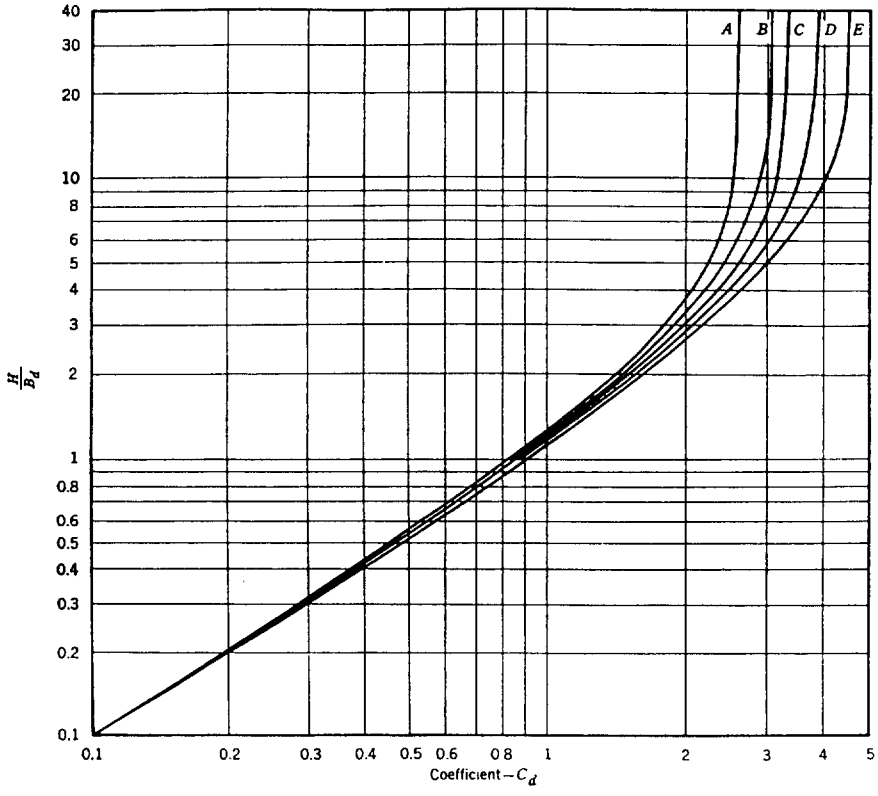


Fig. 4. Graph for Determining C_d Coefficients

Each of the above curves represent C_d *values for* $k\mu$ *and* $k\mu'$. A *represents 0.1924 for granular materials without cohesion;* B *is 0.165 maximum for sand and gravel;* C *is 0.150 maximum for saturated top soil;* D, *0.13 maximum for ordinary clay; and* E, *0.110 maximum for saturated clay. The symbol* μ', *is the coefficient of friction between the backfill material and the sides of the ditch.*

2.5.2 *Superimposed loads.* Where unusually heavy superimposed loads or impact loads are present, the solution of their magnitude may be computed for either a concentrated load (such as a truck load) or a distributed load condition. Normal truck and accompanying impact loads need not be considered when the depth of the cover is greater than 6 ft.

2.5.2.1 *Concentrated load.* The magnitude of a superimposed load produced by a concentrated load (see Fig. 5) is determined by use of the formula

$$W_{sc} = C_c \frac{PF}{L} \qquad \text{Eq 8}$$

in which,

W_{sc} is the load on the conduit, in pounds per lineal foot; P is the concentrated load, in pounds; F is the impact factor used to allow for the effects

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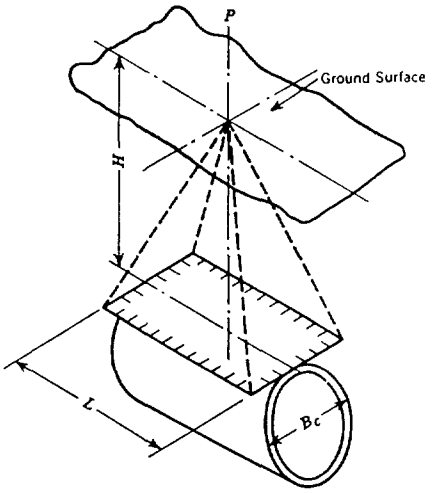


Fig. 5. Concentrated Superimposed Load

P ***represents the concentrated load;*** **H,** ***the height from the top of the conduit to the ground surface;*** B_c, ***the width of the conduit; and*** L, ***the length of the conduit.***

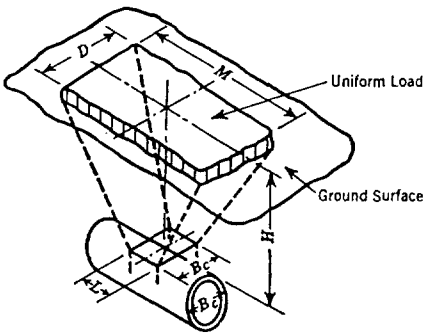


Fig. 6. Distributed Superimposed Load

D *and* M *are the width and length, in feet, respectively, of the area over which the distributed load acts. The uniform load is lbs per sq ft acting on area* D × M.

TABLE 3

Impact Factors Caused by Moving Vehicles

Type of Traffic	Impact Factor F
Highway	1.50
Railway	1.75
Airfield runways, taxiways, aprons, or hardstands	1.00 1.50

of dynamic loads due to moving vehicles (see Table 3); C_s is a load coefficient, a function of $B_c/2H$ and $L/2H$ (see Tables 4 and 5); B_c is the width of the conduit, in feet (OD of the pipe); H is the height from the top of the conduit to the ground surface, in feet; and L is the effective length of the conduit, in feet. L is 3 ft for conduits greater than or equal to 3 ft in length, but is the actual length for conduits less than 3 ft in length.

2.5.2.2. *Distributed load.* In the case of a distributed superimposed load, the formula may be written in the form of

$$W_{sd} = C_s p F B_c \qquad \text{Eq 9}$$

in which,

W_{sd} is the load on the conduit, in pounds per lineal foot (see Fig. 6); p is the intensity of distributed load, in pounds per square foot; F is the impact factor (see Table 3); B_c is the width of conduit, in feet; C_s is a load coefficient, a function of $D/2H$ and $M/2H$ (see Table 4); H is the height from the top of the conduit to the ground surface, in feet; and D and M are the width and length, respectively of the area over which the distributed load acts, in feet.

Sec. 2.6—Selection Curves

Research tests and the application of statistical analysis have shown that asbestos-cement pipe strength may be graphically illustrated by combined-loading parabolic curves. The com-

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TABLE 4

Values of Load Coefficients for Concentrated and Distributed Superimposed Loads Centered Vertically Over Conduit

$D/2H$ or $B_c/2H$	$\frac{M}{2H}$ or $\frac{L}{2H}$													
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.5	2.0	5.0
0.1	0.019	0.037	0.053	0.067	0.079	0.089	0.097	0.103	0.108	0.112	0.117	0.121	0.124	0.128
0.2	0.037	0.072	0.103	0.131	0.155	0.174	0.189	0.202	0.211	0.219	0.229	0.238	0.244	0.248
0.3	0.053	0.103	0.149	0.190	0.224	0.252	0.274	0.292	0.306	0.318	0.333	0.345	0.355	0.360
0.4	0.067	0.131	0.190	0.241	0.284	0.320	0.349	0.373	0.391	0.405	0.425	0.440	0.454	0.460
0.5	0.079	0.155	0.224	0.284	0.336	0.379	0.414	0.441	0.463	0.481	0.505	0.525	0.540	0.548
0.6	0.089	0.174	0.252	0.320	0.379	0.428	0.467	0.499	0.524	0.544	0.572	0.596	0.613	0.624
0.7	0.097	0.189	0.274	0.349	0.414	0.467	0.511	0.546	0.584	0.597	0.628	0.650	0.674	0.688
0.8	0.103	0.202	0.292	0.373	0.441	0.499	0.546	0.584	0.615	0.639	0.674	0.703	0.725	0.740
0.9	0.108	0.211	0.306	0.391	0.463	0.524	0.574	0.615	0.647	0.673	0.711	0.742	0.766	0.784
1.0	0.112	0.219	0.318	0.405	0.481	0.544	0.597	0.639	0.673	0.701	0.740	0.774	0.800	0.816
1.2	0.117	0.229	0.333	0.425	0.505	0.572	0.628	0.674	0.711	0.740	0.783	0.820	0.849	0.868
1.5	0.121	0.238	0.345	0.440	0.525	0.596	0.650	0.703	0.742	0.774	0.820	0.861	0.894	0.916
2.0	0.124	0.244	0.355	0.454	0.540	0.613	0.674	0.725	0.766	0.800	0.849	0.894	0.930	0.956

TABLE 5

Values of Load Coefficients C_c for Concentrated Superimposed Loads Centered Vertically Over Conduit

Pipe Size in.	Depth of Cover—ft										
	2	2.5	3	4	5	6	8	10	12	16	20
4	0.105	0.076	0.055	0.033	0.022	0.016	0.009	0.006	0.004	0.002	0.0015
6	0.147	0.106	0.078	0.046	0.031	0.023	0.013	0.008	0.006	0.003	0.002
8	0.191	0.137	0.102	0.061	0.041	0.029	0.017	0.010	0.008	0.004	0.003
10	0.237	0.174	0.129	0.078	0.052	0.037	0.022	0.013	0.009	0.006	0.0035
12	0.279	0.202	0.153	0.092	0.062	0.044	0.025	0.016	0.011	0.007	0.004
14	0.317	0.232	0.175	0.106	0.071	0.050	0.030	0.018	0.013	0.008	0.005
16	0.354	0.259	0.197	0.121	0.081	0.057	0.034	0.021	0.015	0.009	0.0055

bined-loading theory developed by the late W.J. Schlick is used as the basis for selection curves for asbestos–cement water pipe.

2.6.1 *Curve development.* The selection curves included in this standard were developed using the load-pressure formula, with the external load intercept being the external load as tabulated in Table 2 of AWWA C400–77, "Standard for Asbestos–Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids," and the design point on the parabolic curve being that condition existing at a 5-ft depth of cover with the trench width assumed as pipe ID plus 2 ft, a bedding condition of Class C and a soil weight of 120 lb/cu ft. The external loads were based on the positive projecting conduit analysis because this analysis produced the governing load on the pipe at the conditions previously set forth. The design point for each class of pipe is based on a safety factor of 4 times the pipe pressure class and 2.5 times the three-edge bearing equivalent of the trench load. Once the parabolic curve has been established through the external load inter-

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cept and the control point, the equivalent depth of cover scale is correlated for the various bedding conditions utilizing either the trench load condition or the positive-projecting conduit-load condition, whichever is the governing load condition.

2.6.2 *Curve use.* The curves may be used conveniently by entering them through the depth of cover and bedding condition scales. The scales are correlated to the three-edge bearing equivalents of the design external loads with a safety factor of 2.5. When there is an external loading condition different from that due only to depth of cover, or when conditions warrant a change in the safety factor, the equivalent external load should be determined and the selection curve entered at the proper value on the design external load scale. The field supporting strength listed for pipe so selected has been proved conservative during many years of performance under various field conditions.

2.6.2. *Example.* The application of the curves to design is shown in the following problem:

Required: A 6-in. pipe to operate at a pressure of 120 psi at 8 ft depth of cover. Bedding condition Class C, soil weight 120 lb/cu ft.

Solution: Enter the selection curve for 6-in. pipe at bedding condition Class C, 8 ft cover. The intersection of the 8-ft cover line with the 120 psi operating pressure line falls between pipe Classes 100 and 150. Use 6 in., Class 150.

The intersection of the 8-ft cover line with the Class 150 curve is at 135 psi operating pressure, or 550 psi design pressure. Therefore, the pressure safety factor equals $550/120 = 4.6$, with a safety factor of 2.5 for external load.

2.6.3 *Curves.* The selection curves for 4 in. through 16 in. asbestos-cement pipe are shown in Figs. 7 through 13 respectively.

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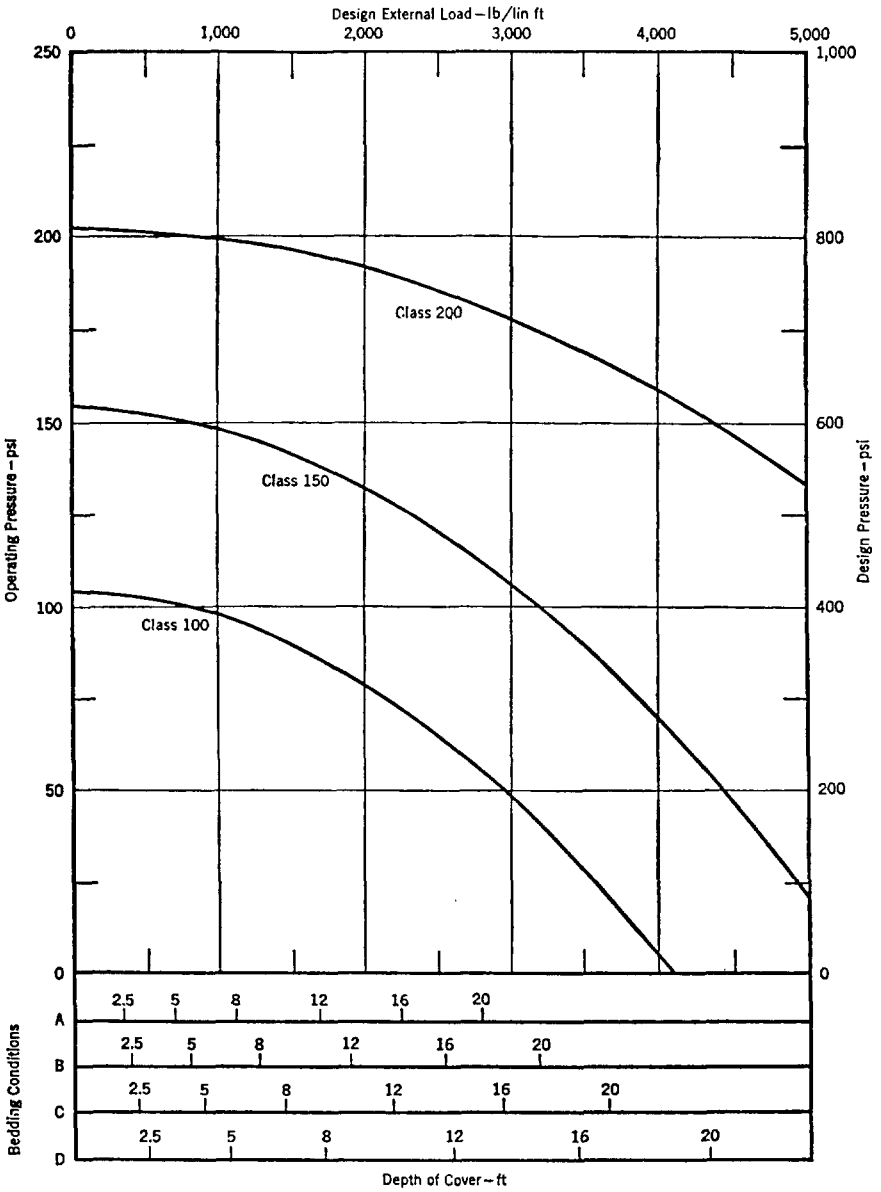


Fig. 7. Selection Curves for 4-in. Asbestos–Cement Pipe

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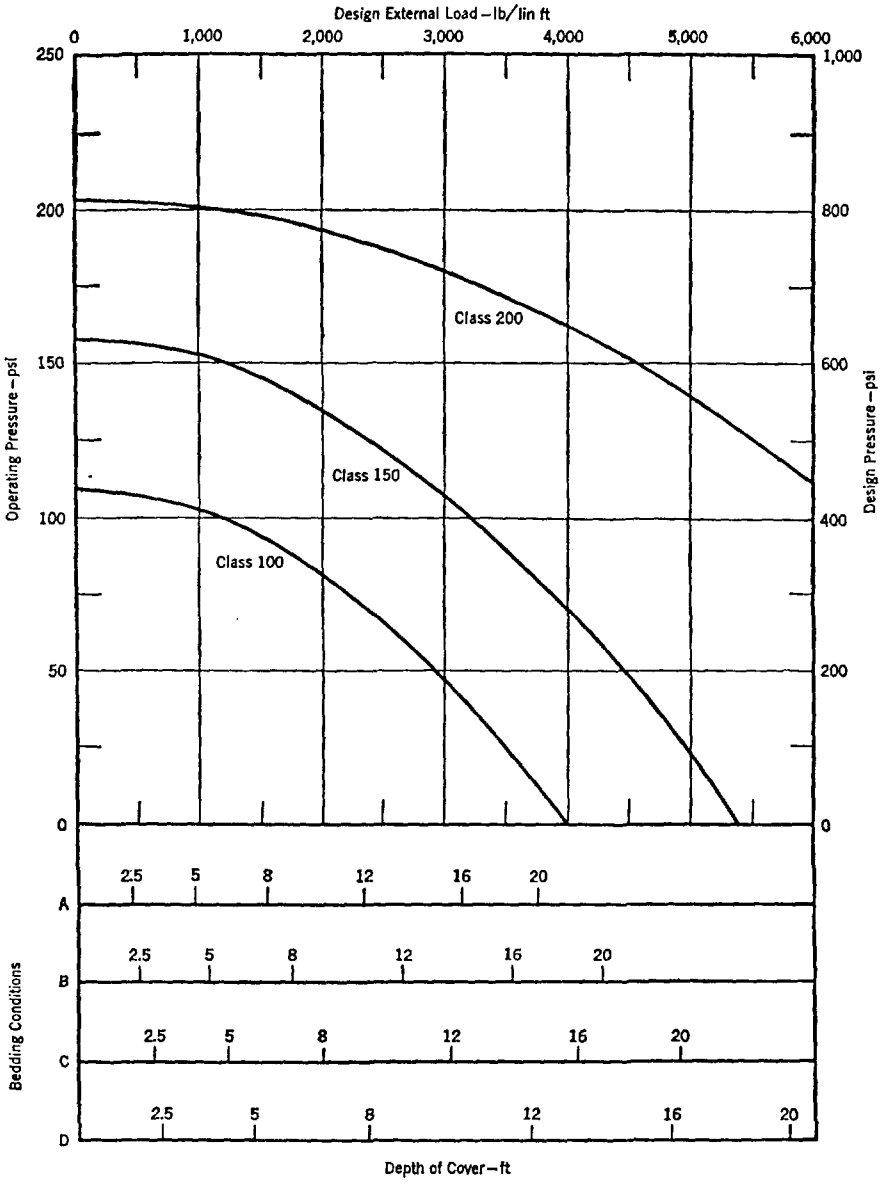


Fig. 8. Selection Curves for 6-in. Asbestos–Cement Pipe

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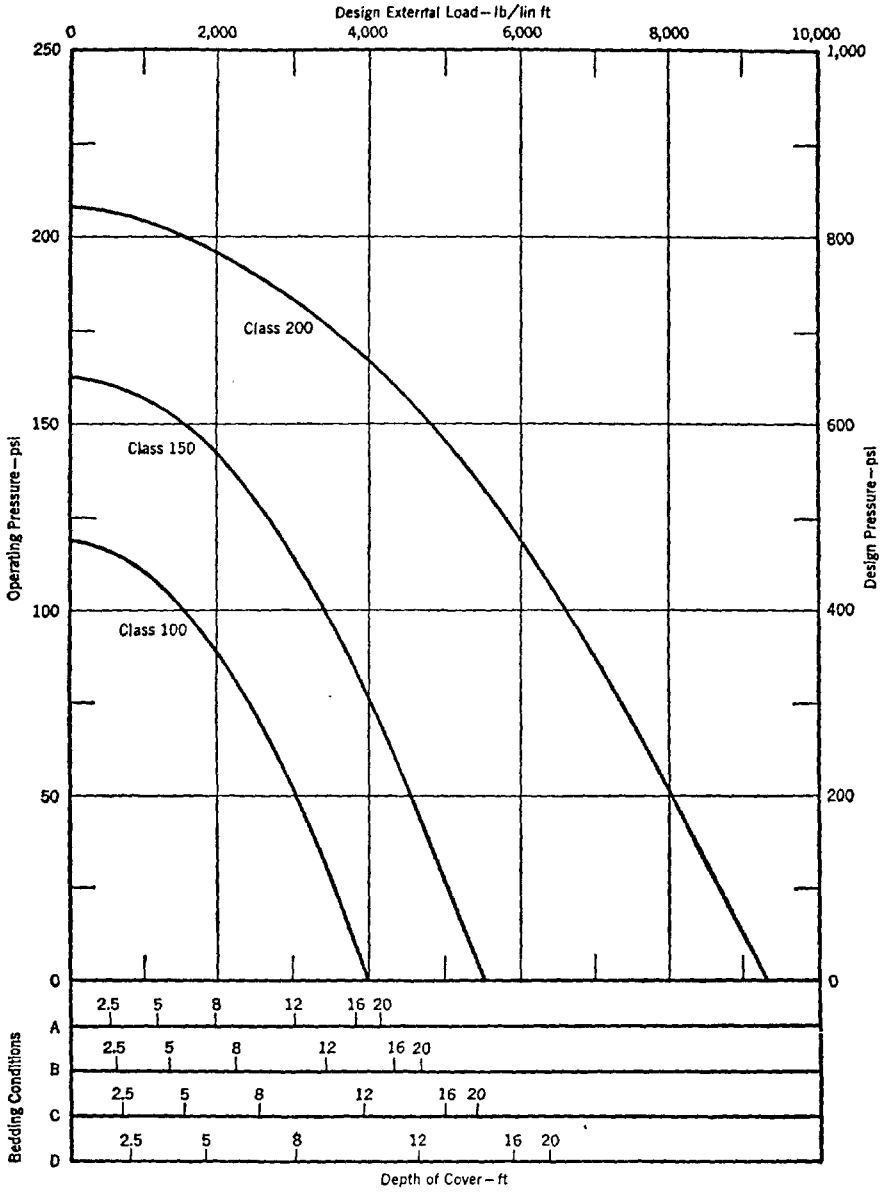


Fig. 9. Selection Curves for 8-in. Asbestos–Cement Pipe

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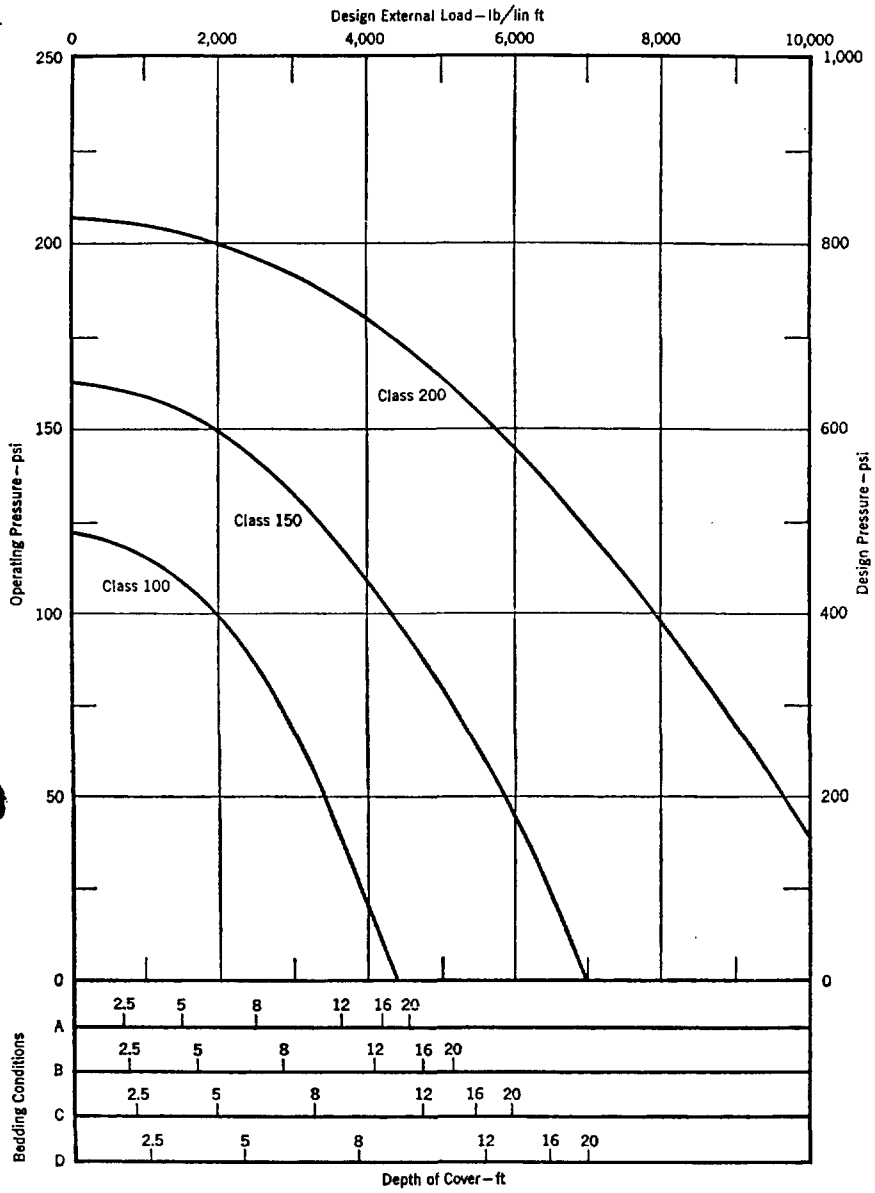


Fig. 10. Selection Curves for 10-in. Asbestos–Cement Pipe

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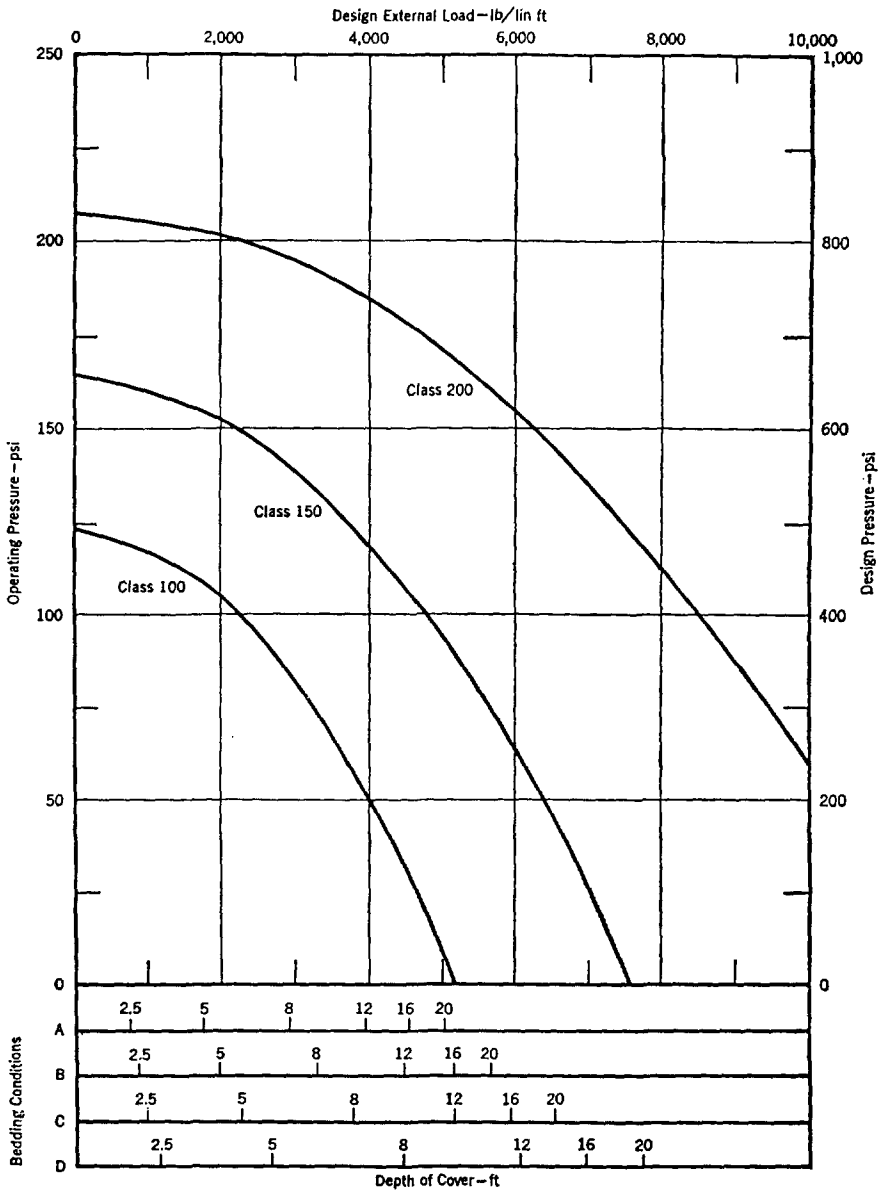


Fig. 11. Selection Curves for 12-in. Asbestos–Cement Pipe

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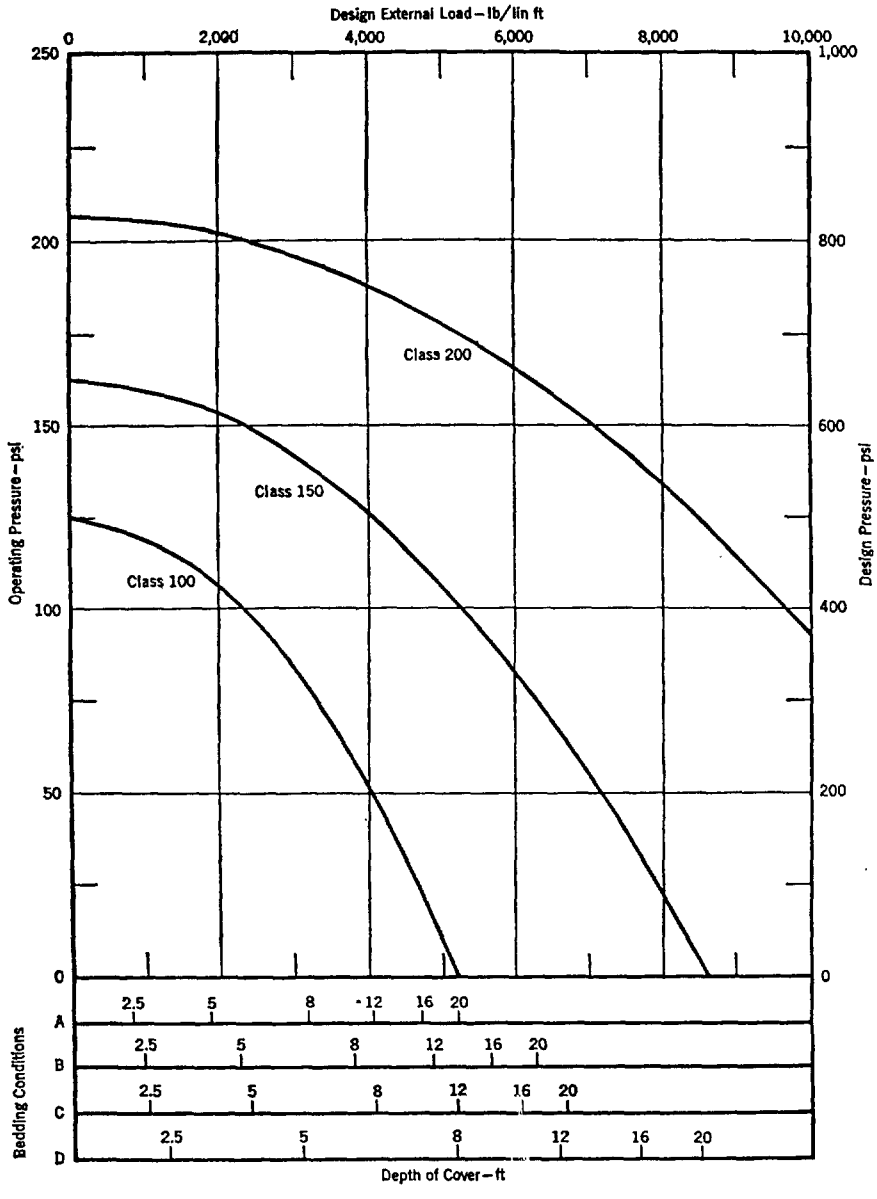


Fig. 12. Selection Curves for 14-in. Asbestos–Cement Pipe

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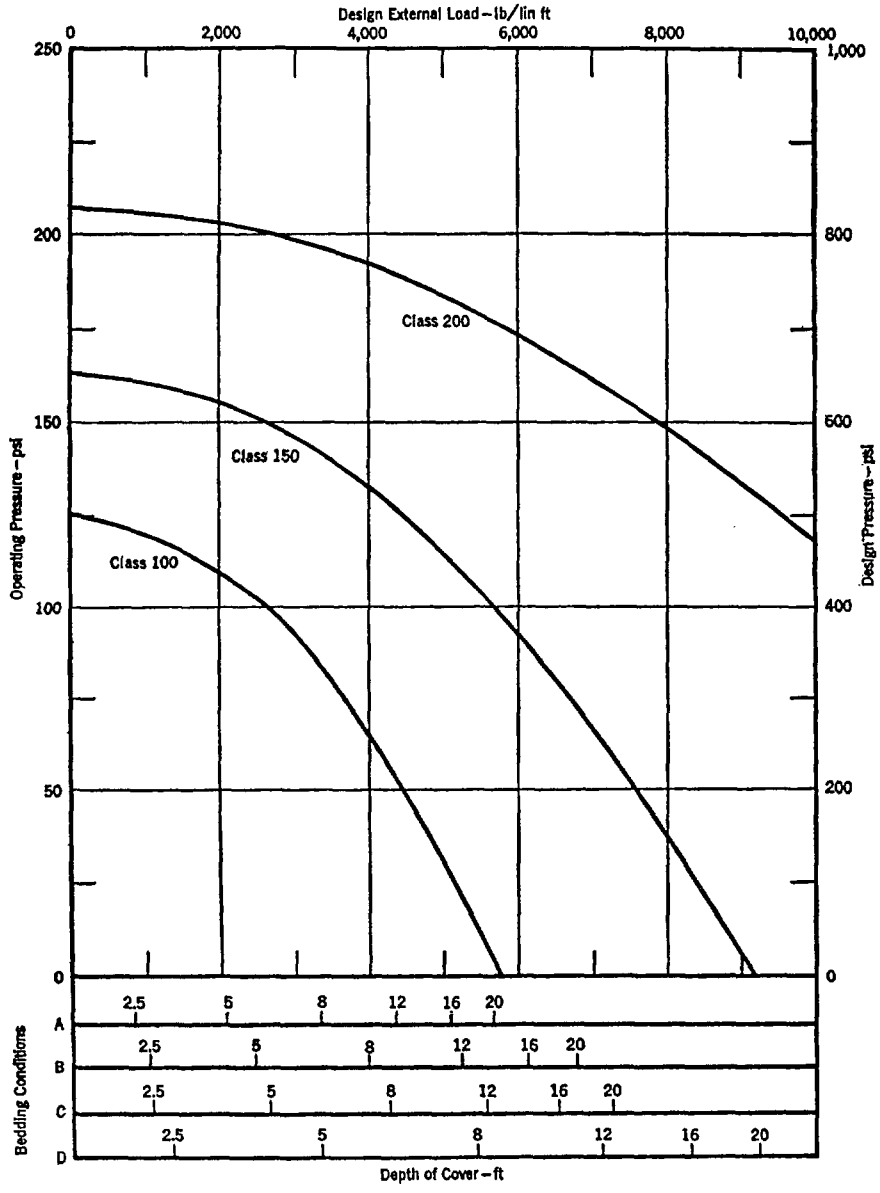


Fig. 13. Selection Curves for 16-in. Asbestos–Cement Pipe

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Appendix

This appendix is for information only and is not a part of AWWA C401.

A1. General

Data developed for the preparation of the selection curves are included in this appendix. Figures illustrating the various bedding conditions and the earth load conditions used in the preparation of the selection curves are included.

A2. Tables

In Table A2 of design internal pressure and design external load intercepts, the external loads are the crushing loads that the pipe must be able to support without failure as specified in AWWA C400. The tables of design earth load w for various field bedding conditions and depths of cover show the calculated loads for Class 150 pipe. For Class 100 pipe, similar calculated loads would be less than those shown in the tables, and for Class 200 pipe, the loads would be greater. The maximum variation would be less than 5 per cent.

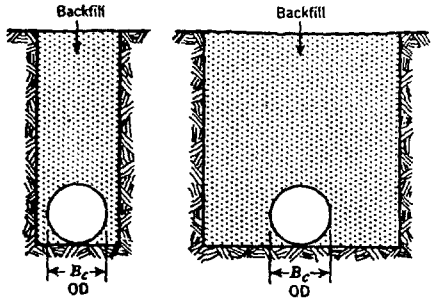


Fig. A1. Earth Load Conditions

The illustration on the left shows trench conduit conditions; that is, the trench width is less than two or three times B_c. *The illustration on the right shows a positive projecting conduit condition; that is, the trench width is greater than two or three times* B_c. *The shaded area represents backfill.*

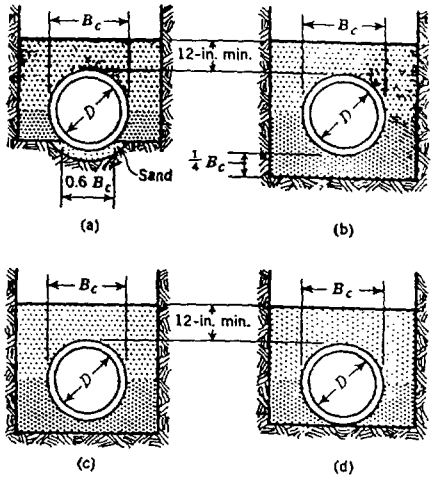


Fig. A2. Bedding Conditions Illustrated

Class A bedding conditions are shown in (a) and (b). Class C conditions are shown in (c) and (d). In all four diagrams, the lightly shaded area represents approved backfill, not frozen and free from lumps, large stones, boulders, or other unsuitable substances. The heavily shaded areas represent approved backfill, carefully compacted in 4-in. layers as specified by the engineer. In (a), a minimum of 2 in. of sand is placed in a shaped bottom under the pipe. In (b), the pipe is bedded in a gravel base. In (c), the pipe barrel rests on earth mounds and then the backfill between the earth mounds is compacted. In (d), the pipe barrel is resting on the flat bottom of the trench. Class B condition is the same as Class A, and Class D is the same as Class C except that the backfill is not tamped in B or D.

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TABLE A1

Determination of Design Earth Load w Applied in 3-Edge Bearing

	1	2	3	1	2	3	1	2	3
Pipe Size in.	External Load lb	Equivalent Three-Edge Bearing Load $\left(\frac{\text{Col. 1}}{\text{Load Factor}}\right)$	w Earth Load Applied in Three-Edge Bearing (Col. 2 × 2.5 Factor of Safety)	External Load lb	Equivalent Three-Edge Bearing Load $\left(\frac{\text{Col. 1}}{\text{Load Factor}}\right)$	w Earth Load Applied in Three-Edge Bearing (Col. 2 × 2.5 Factor of Safety)	External Load lb	Equivalent Three-Edge Bearing Load $\left(\frac{\text{Col. 1}}{\text{Load Factor}}\right)$	w Earth Load Applied in Three-Edge Bearing (Col. 2 × 2.5 Factor of Safety)
Class A Bedding Condition									
	2.5 ft of Cover			5 ft of Cover			8 ft of Cover		
4	219	129	323	458	269	673	744	438	1,095
6	297	175	438	634	373	933	1,041	612	1,530
8	371	218	545	814	479	1,198	1,344	790	1,975
10	450	264	660	1,012	595	1,488	1,688	993	2,483
12	507	298	745	1,174	691	1,728	1,975	1,162	2,905
14	559	311	778	1,336	742	1,855	2,267	1,259	3,148
16	604	335	838	1,484	825	2,063	2,398	1,332	3,330
	12 ft of Cover			16 ft of Cover			20 ft of Cover		
4	1,127	663	1,658	1,510	888	2,220	1,893	1,113	2,783
6	1,584	932	2,330	2,124	1,249	3,123	2,550	1,500	3,750
8	2,051	1,206	3,015	2,602	1,531	3,828	2,816	1,656	4,140
10	2,451	1,441	3,603	2,835	1,668	4,170	3,076	1,809	4,523
12	2,678	1,575	3,938	3,078	1,811	4,528	3,402	2,001	5,003
14	2,886	1,603	4,008	3,367	1,870	4,675	3,727	2,070	5,175
16	3,130	1,738	4,345	3,663	2,035	5,088	4,063	2,257	5,643
Class B Bedding Condition									
	2.5 ft of Cover			5 ft of Cover			8 ft of Cover		
4	219	146	365	458	305	763	744	496	1,240
6	297	198	495	634	423	1,058	1,041	694	1,735
8	371	248	620	814	542	1,355	1,344	896	2,240
10	450	300	750	1,012	674	1,685	1,688	1,126	2,815
12	507	338	845	1,174	783	1,958	1,975	1,317	3,293
14	559	373	933	1,336	890	2,225	2,267	1,512	3,780
16	604	402	1,005	1,484	989	2,473	2,398	1,598	3,995
	12 ft of Cover			16 ft of Cover			20 ft of Cover		
4	1,127	751	1,878	1,510	1,007	2,518	1,827	1,218	3,045
6	1,584	1,056	2,640	1,224	1,416	3,540	2,550	1,700	4,250
8	2,051	1,367	3,418	2,602	1,735	4,338	2,816	1,877	4,693
10	2,451	1,634	4,085	2,835	1,890	4,725	3,076	2,050	5,125
12	2,678	1,785	4,463	3,078	2,052	5,130	3,402	2,268	5,670
14	2,886	1,924	4,810	3,367	2,244	5,610	3,727	2,485	6,213
16	3,130	2,086	5,215	3,663	2,442	6,105	4,063	2,708	6,770

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TABLE A1—*Determination of Design Earth Load* w *Applied in 3-Edge Bearing (contd.)*

Pipe Size in.	1 External Load lb	2 Equivalent Three-Edge Bearing Load (Col. 1 / Load Factor)	3 w Earth Load Applied in Three-Edge Bearing (Col. 2 × 2.5 Factor of Safety)	1 External Load lb	2 Equivalent Three-Edge Bearing Load (Col. 1 / Load Factor)	3 w Earth Load Applied in Three-Edge Bearing (Col. 2 × 2.5 Factor of Safety)	1 External Load lb	2 Equivalent Three-Edge Bearing Load (Col. 1 / Load Factor)	3 w Earth Load Applied in Three-Edge Bearing (Col. 2 × 2.5 Factor of Safety)
Class C Bedding Condition									
	2.5 ft of Cover			5 ft of Cover			8 ft of Cover		
4	219	168	420	458	352	880	744	573	1,433
6	297	228	570	634	488	1,220	1,041	801	2,003
8	371	286	715	814	626	1,565	1,344	1,034	2,585
10	450	346	865	1,012	778	1,945	1,688	1,299	3,248
12	507	390	975	1,174	903	2,258	1,975	1,519	3,798
14	559	400	1,000	1,336	954	2,385	2,267	1,619	4,048
16	604	431	1,078	1,484	1,060	2,650	2,398	1,712	4,280
	12 ft of Cover			16 ft of Cover			20 ft of Cover		
4	1,127	867	2,168	1,510	1,161	2,903	1,893	1,456	3,640
6	1,584	1,219	3,048	2,124	1,634	4,085	2,550	1,961	4,903
8	2,051	1,578	3,945	2,602	2,002	5,005	2,816	2,166	5,415
10	2,451	1,885	4,713	2,835	2,181	5,453	3,076	2,366	5,915
12	2,678	2,060	5,150	3,078	2,368	5,920	3,402	2,617	6,543
14	2,886	2,061	5,153	3,367	2,405	6,013	3,727	2,662	6,655
16	3,130	2,235	5,588	3,663	2,616	6,540	4,063	2,902	7,255
Class D Bedding Condition									
	2.5 ft of Cover			5 ft of Cover			8 ft of Cover		
4	219	199	498	458	416	1,040	744	677	1,693
6	297	270	675	634	577	1,443	1,041	946	2,365
8	371	338	845	814	740	1,850	1,344	1,221	3,053
10	450	409	1,023	1,012	920	2,300	1,688	1,535	3,838
12	507	461	1,153	1,174	1,068	2,670	1,975	1,795	4,488
14	559	509	1,273	1,336	1,214	3,035	2,267	2,061	5,153
16	604	549	1,373	1,484	1,349	3,373	2,398	2,180	5,450
	12 ft of Cover			16 ft of Cover			20 ft of Cover		
4	1,127	1,025	2,563	1,510	1,373	3,433	1,893	1,721	4,303
6	1,584	1,440	3,600	2,124	1,931	4,828	2,550	2,318	5,795
8	2,051	1,864	4,660	2,602	2,366	5,915	2,816	2,560	6,400
10	2,451	2,228	5,570	2,835	2,578	6,445	3,076	2,796	6,990
12	2,678	2,434	6,085	3,078	2,798	6,995	3,402	3,093	7,733
14	2,886	2,623	6 558	3,367	3,061	7,653	3,727	3,388	8,470
16	3,130	2,845	7,113	3,663	3,330	8,325	4,063	3,693	9,233

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TABLE A2

Design Internal Pressure and Design Earth Load Intercepts for Use With Selection Curves

Pipe Size in.	Class 100		Class 150		Class 200	
	P psi	*W* lb/lin ft	*P* psi	*W* lb/lin ft	*P* psi	*W* lb/lin ft
4	417	4,100	616	5,400	809	8,700
6	441	4,000	632	5,400	815	9,000
8	472	4,000	653	5,500	824	9,300
10	490	4,400	650	7,000	826	11,000
12	490	5,200	658	7,600	830	11,800
14	500	5,200	650	8,600	826	13,500
16	500	5,800	654	9,200	825	15,400

7P-1M-43401-11/82-LL

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American Water Works Association

AWWA C400a-83
Addendum to
ANSI/AWWA C400-80

Standard for Asbestos-Cement Distribution Pipe, 4 in. Through 16 in. (100 mm Through 400 mm) NPS, for Water and Other Liquids

(Approved by AWWA Board of Directors Jan. 30, 1983 and by the American National Standards Institute, Inc., Nov. 11, 1982.)

In Sec. 5.2.4, Crushing Tests, in the twelfth line after the word "with," add the following: "the three edge bearing, V-block method of."

CTD015665



American Water Works Association

ANSI/AWWA C400-80
(Revision of AWWA C400-77)

AWWA STANDARD

for

ASBESTOS-CEMENT DISTRIBUTION PIPE, 4 IN. THROUGH 16 IN. (100 mm THROUGH 400 mm) NPS, FOR WATER AND OTHER LIQUIDS



First edition approved by AWWA Board of Directors May 15, 1953.
This edition approved Jun. 15, 1980.

Approved by American National Standards Institute, Inc., Feb. 19, 1981.

AMERICAN WATER WORKS ASSOCIATION
6666 West Quincy Avenue, Denver, Colorado 80235

CTD015666

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Foreword

This foreword is for information only and is not a part of AWWA C400.

I History of Standard

A new pipe material consisting of an intimate mixture of portland cement and asbestos fibers was introduced to the North American market in 1931 following several years of satisfactory usage in other countries, particularly Italy.

In the ensuing years this type of pipe gained popularity, and in 1949 AWWA established a committee on standard specifications for asbestos-cement pipe under the chairmanship of S. M. Clark of Greeley and Hansen, Chicago.

The committee developed a standard for asbestos-cement water pipe, which was approved by the AWWA Board of Directors as a tentative standard, AWWA C400-53T, May 15, 1953. In 1958 the committee was reactivated as Committee 8340D on Asbestos-Cement Pipe under the chairmanship of Roy H. Ritter of Whitman, Requardt and Associates, Baltimore, to review several suggested changes and to recommend revisions to the standard. The committee produced a revised tentative standard adopted by AWWA as C400-64T Jan. 27, 1964, which was advanced to standard without revision Jul. 2, 1965.

In 1968 the committee was reactivated as the Standards Committee on Asbestos-Cement Pipe to review and revise all AWWA standards on asbestos-cement pipe. The committee produced a revised standard approved by the Board of Directors Jan. 31, 1972 designated as AWWA C400-72, "Asbestos-Cement Pressure Pipe for Water and Other Liquids."

In 1972 and 1973 the committee was reorganized and enlarged to include representation of national organizations having an interest in the scope of the committee and wishing to participate in the work. The reorganized committee reaffirmed C400-72 without revision so that it could be presented to the American National Standards Institute for designation as an American National Standard.

In 1975 the committee produced a revised standard approved by the AWWA Board of Directors Jan. 26, 1975 designated as AWWA C400-75, "Asbestos-Cement Pressure Pipe, 4 in. Through 24 in., for Water and Other Liquids." At that same time a new standard was produced by the committee and approved by the AWWA Board of Directors and designated as AWWA C402-75, "Asbestos-Cement Transmission Pipe, 18 in. Through 42 in., for Water and Other Liquids."

The possibility of confusion between the two standards (C400 and C402) was carefully reviewed by the committee. The result was C400-77, which reduced the sizes covered from 4 in. through 24 in. to 4 in. through 16 in., eliminating any overlap between the standards.

In 1979 the committee again revised this standard to make reference to ASTM C500-77, "Testing Asbestos-Cement Pipe," and to include dimensional requirements for fittings in the Appendix.

II Information Regarding Use of This Standard

II.A *General.* When ordering pipe covered by this standard, local installation and operating conditions should be considered to determine the class and type of pipe to specify. Also, certain other items must be specified to describe completely the pipe required.

According to the conditions of installation and operation in many water distribution systems, the pipe may be used at operating pressures equal to the class

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designations. The purchaser should determine for himself from AWWA C401, "Standard Practice for the Selection of Asbestos Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids," the proper class of pipe to be used under the installation and operating conditions that will exist for the project on which the pipe is to be used.

The purchaser is referred to AWWA C603, "Installation of Asbestos Cement Pressure Pipe," for guidance in laying of the pipe.

II.B *Flexural load test.* The flexural load tests for pipe sizes, 4, 6, and 8 in. (Sec. 2.2.1 and 5.2.3) are intended only for use as a quality control test; not a simulated service test. Asbestos cement pipe will not be subjected to flexural stresses if properly installed with satisfactory bedding methods.

For diameters 10 in. and larger, the wall thickness increases to a point at which the flexural strength is not a controlling factor, and hence, routine testing is not required.

II.C *Type of pipe.* The following criteria are presented for determining the type of pipe to be used under various soil and water conditions. Each condition should be considered separately even though each may exist in combination with others. These criteria are based on exposures within the temperature range of 40–80° F (5–28° C). For exposure of pipe to temperatures beyond these limits, consult the manufacturer.

The following criteria are referenced as

1. Internal water (Table F.1).
2. External water (Table F.2).
3. Nonacid soluble sulfates—internal and external (Table F.3).
4. Acid soluble sulfates—internal and external.

II.C.1 *Internal water.* Aggressiveness of water transported through asbestos-cement pipe is related to the type of designation of asbestos-cement pipe

TABLE F.1

Asbestos-Cement Pipe Type Recommended for Internal Water Aggressiveness

Internal Water Aggressiveness	Recommended Pipe Type*
Highly aggressive	†
Moderately aggressive	II
Nonaggressive	I and II

* Type I—no limit on uncombined calcium hydroxide; Type II—per cent or less uncombined calcium hydroxide.

† The serviceability of pipe for such applications should be established by the purchaser in conjunction with the manufacturer.

TABLE F.2

Aggressiveness of Nonsulfate Acidic Soils to Asbestos-Cement Pipe

Water Conditions Within the Soil Environment	Minimum pH of Acidic Soils When Using Asbestos-Cement Pipe	
	Type I	Type II
Essentially quiescent	5.0	4.0
Mildly fluctuating	5.5	5.0
Rapidly moving or grossly cyclic	6.3	5.5

TABLE F.3

Asbestos-Cement Pipe Type Designation Chemical Resistance to Nonacid (pH = 7.0) Soluble Sulfates in Water and Soils

Type Designation	Chemical Resistance to Nonacid Soluble Sulfates in Water and Soils
I*	Will be attacked to various degrees by all but the nonaggressive levels of sulfate concentrations in waters and soils.
II	Resistant to all levels of soluble sulfates.

*The guideline criteria for sulfate resistance of Type I pipe were taken from the *Concrete Manual*, 8th edition, Bureau of Reclamation, 1974. Sulfate resistance here applies to all soluble sulfates regardless of the cation.

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suitable for such use in Table F.1. Aggressiveness of water is defined as follows.

a. Highly aggressive:
$pH + \log (AH) < 10.0$
b. Moderately aggressive:
$pH + \log (AH) = 10.0 \quad 11.9$
c. Nonaggressive:
$pH + \log (AH) \geq 12.0$

where

pH = Index of acidity (or alkalinity) of the water standard pH units.
A = Total alkalinity ppm (mg L) as $CaCO_3$.
H = Calcium hardness ppm (mg L) as $CaCO_3$.

It should be recognized that water that has a $pH + \log (AH)$ less than or equal to 10 is an extremely aggressive water and would be very corrosive to almost all materials found in a typical water system, including the plumbing in consumers' homes. Such waters should be treated to increase pH or hardness to protect the entire network of materials making up the system. If such water treatment is not undertaken, the manufacturer of each item used in the water system should be consulted for recommendations regarding the use of his product in an extremely corrosive environment.

NOTE: The expression $pH + \log (AH)$ is a modification of the Langelier Index. It has been prepared so that the aggressiveness of the water can be determined easily. A reasonable comparison of the two would be as indicated below.

	$pH + \log (AH)$	Langelier Index
Highly aggressive water	<10.0	< 2.0
Moderately aggressive water	10.0 11.9	2.0 to 0.1
Nonaggressive water	≥12.0	≥0

II.C.2 *External water.* Aggressiveness of external water (water within the soil environment) is related to asbestos cement pipe in Table F.2. The guidelines for the use of asbestos cement pipe in nonsulfate acidic soils are based upon minimum pH factors alone. Asbestos cement pipe may or may not perform satisfactorily in acidic soil environments that have pH values below those listed in Table F.2. To determine the suitability of asbestos cement pipe in soils having lower pH values, each situation should be evaluated individually and take into consideration all aspects of soil environment that affect asbestos cement pipe corrosiveness.

II.C.3 *Nonacid soluble sulfates internal and external.* Aggressiveness of nonacid (pH≥7.0) soluble sulfates in water and soils is related to the type designation of asbestos cement pipe suitable for such use in Table F.3. Sulfate aggressiveness in water and soil can be classified as indicated in Table F.4.

II.C.4 *Acid soluble sulfates internal and external.* Aggressiveness of acid (pH<7.0) soluble sulfate waters and soils to asbestos cement pipe must be evaluated independently.

Acid sulfate soils and waters, whether the acid is inorganic or organic, must be evaluated independently of the criteria and guidelines set forth in Sec. II.C.2 and II.C.3 and must take into consideration soil permeability and other factors. Consult the manufacturer for guidance.

II.D *Supplementary specifications.* The following information summarizes the conditions and items that the purchaser should consider when preparing his supplementary specifications. The section in the standard where they can be found is also listed.

1. The standard used; that is, AWWA C400.
2. Affidavit of compliance, if required (Sec. 1.3).
3. Type of pipe to be furnished (Sec. 2.3 and Foreword II.C).

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TABLE F.4

Sulfate Aggressiveness in Water and Soil

	Water	Soil
Sulfate Aggressiveness Classification	Water Soluble Sulfates *ppm* SO_4	Water Soluble Neutral Sulfates *ppm* SO_4
Nonaggressive	150 and less	1000 and less
Mildly aggressive	150–1500	1000–2000
Moderately aggressive	1500–10,000	2000–20,000
Highly aggressive	10,000 and greater	20,000 and greater

TABLE F.5

Metric Conversion Factors

To Convert From US Customary Units	To Metric Units
Inches (in.) × 25.40	= Millimetres (mm)
× 2.54	= Centimetres (cm)
× 0.0254	= Metres (m)
Feet (ft) × 304.8	= Millimetres (mm)
× 30.48	= Centimetres (cm)
× 0.3048	= Metres (m)
Pounds (lb) × 0.4536	= Kilograms (kg)
Pounds per square inch (psi) × 6.9	= Kilopascals (kPa)
Pounds per linear foot (lb/lin ft) × 1.488	= Kilograms per metre (kg/m)

4. Class of pipe (Sec. 3.1).
5. Nominal inside diameter (Sec. 3.2).
6. Lineal feet to be furnished in standard and random lengths (Sec. 3.3).
7. Number, size, type, class, lengths, and extent of machining of special short lengths (Sec. 3.3.3).
8. Whether inspection by the purchaser (Sec. 5.1) and special marking (Sec. 6.1.4) are required.

III Major Revisions

Major changes to the 1977 standard that were made in this revision are

1. Soft metric equivalents have been included.
2. Explanations of the test methods for hydrostatic, flexural and crushing requirements have been deleted and references have been made to ASTM C500, "Testing Asbestos-Cement Pipe."
3. A dimensional table of fittings for use with asbestos-cement pressure pipe has been added as Appendix A.

IV Metrication

The tables in this standard are stated in both US customary units and metric equivalents. Throughout the body of the standard, metric equivalents (rounded off) are set in parentheses next to the customary units. Metric conversion factors are listed in Table F.5.

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American Water Works Association

AWWA C400-80

(Revision of AWWA C400-77)

AWWA Standard for

Asbestos-Cement Distribution Pipe, 4 in. Through 16 in. (100 mm Through 400 mm) NPS, for Water and Other Liquids

Section 1—General

Sec. 1.1 Scope

This standard covers three pressure classes of Type I and Type II asbestos-cement pipe, 4-16 in. (100 mm to 400 mm) in diameter for water and other liquids intended to be laid underground in public and private rights-of-way.

1.1.1 *Use.* Asbestos-cement distribution pipe is to be used in pipe systems having relatively unpredictable flows and many appurtenances that do not permit reasonable hydraulic analyses, including that for surge pressure.

1.1.2 *Pressure classes.* The pressure class designations of class 100, class 150, and class 200 are the same as those used in AWWA C401 (formerly AWWA H2), "Standard Practice for the Selection of Asbestos-Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids."

Sec. 1.2 Definitions

The following definitions shall apply in this standard.

1.2.1 *Inspection.* Inspection of the pipe and the tests by the inspector.

1.2.2 *Inspector.* The authorized representative of the purchaser, entrusted with the duty of inspecting pipe produced and tests performed under this standard.

1.2.3 *Lot.* A lot as used herein is defined as all pipe of any one class, type, and size manufactured on any one machine in 24 hr but not to exceed 300 lengths.

1.2.4. *Manufacturer.* The person, firm, or corporation that manufactures the pipe.

1.2.5 *Operating pressure.* The maximum hydrostatic pressure to which the pipe will be subjected in normal operation after installation, exclusive of allowance for water hammer.

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1.2.6 *Purchaser.* The person, firm, corporation, or government agency entering into a contract or agreement to purchase pipe according to the provisions of this standard.

Sec. 1.3 Affidavit of Compliance

Whether factory inspection has been required or not, the purchaser's supplemental specifications may require an affidavit of compliance from the manufacturer that the material furnished under the purchaser's order comply with all applicable requirements of this standard.

Sec. 1.4 References

This standard references the following documents. They form a part of this standard to the extent specified herein. In any case of conflict, the requirements of this standard shall prevail.

AWWA C401, "Standard Practice for the Selection of Asbestos Cement Distribution Pipe, 4 in. Through 16 in., for Water and Other Liquids."

ASTM* C500, "Testing Asbestos Cement Pipe."

ASTM D1869, "Specification for Rubber Rings for Asbestos Cement Pipe."

*American Society for Testing and Materials
1916 Race St
Philadelphia, PA 19103

Section 2—Materials

Sec. 2.1 Composition

Asbestos-cement pipe shall be composed of an intimate mixture of either (1) portland cement or portland blast furnace slag cement and asbestos fiber with or without silica, or (2) portland pozzolana cement and asbestos fiber. Both (1) and (2) can be with or without the addition of curing agents. The pipe shall be formed under pressure and cured. The finished pipe shall be free from organic materials.

Sec. 2.2 Physical Requirements

2.2.1 *Flexural strength.* Each length of pipe 10 ft (3 m) or longer for pipe sizes 8 in. (200 mm) and less shall have the minimum flexural strength prescribed in Table 1 when tested in accordance with the Flexural Test Proof Method as required in the latest edition of ASTM C500, "Testing Asbestos-Cement Pipe."

2.2.2 *Bursting strength.* Each length of pipe and each coupling sleeve shall

TABLE 1
Flexural Test Loads
Total Applied Load—*lb* (*N*)

Nominal Diameter		Class 100		Class 150		Class 200	
in	(*mm*)	*lb*	(*N*)	*lb*	(*N*)	*lb*	(*N*)
4	(100)	1200	(5340)	1470	(6540)	1870	(8300)
6	(150)	2800	(12,500)	3700	(16,500)	4900	(21,800)
8	(200)	5330	(23,700)	7600	(33,800)	10,130	(45,100)

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TABLE 2

*Design Internal Pressure and Design External Load**

Nominal Pipe Size		Class 100				Class 150				Class 200			
		Internal Pressure		External Load		Internal Pressure		External Load		Internal Pressure		External Load	
in	*(mm)*	*psi*	*(k Pa)*	*lb/lin ft*	*(k N/m)*	*psi*	*(k Pa)*	*lb/lin ft*	*(k N/m)*	*psi*	*(k Pa)*	*lb/lin ft*	*(k N/m)*
4	(100)	417	(2900)	4100	(60)	616	(4200)	5400	(79)	809	(5600)	8700	(127)
6	(150)	441	(3000)	4000	(58)	632	(4400)	5400	(79)	815	(5600)	9000	(136)
8	(200)	472	(3300)	4000	(58)	653	(4500)	5500	(80)	824	(5700)	9300	(136)
10	(250)	490	(3400)	4400	(64)	650	(4500)	7000	(102)	826	(5700)	11,000	(161)
12	(300)	490	(3400)	5200	(76)	658	(4500)	7600	(111)	830	(5700)	11,800	(172)
14	(350)	500	(3400)	5200	(76)	650	(4500)	8600	(126)	826	(5700)	13,500	(197)
16	(400)	500	(3400)	5800	(85)	654	(4500)	9200	(134)	825	(5700)	15,400	(225)

*It is necessary to apply a load factor (see AWWA C401) to the three-edge bearing loads obtained in the crushing tests specified in Sec. 5.2.4 of this standard in order to correlate them to the field loads.

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have sufficient strength to withstand the design internal pressure indicated for its class in Table 2 when subjected to the hydrostatic test procedure specified in this standard.

2.2.3 *Crushing strength.* Each length of pipe shall have sufficient strength to support the design external load indicated for its class in Table 2 when subjected to the crushing test procedure specified in this standard.

Sec. 2.3 Chemical Requirements

Pipe shall be designated as either Type I or Type II according to its content of uncombined calcium hydroxide as determined by the test procedures in this standard for uncombined calcium hydroxide. The requirements for each pipe are:

Type I no limit on uncombined calcium hydroxide.

Type II—1 percent or less uncombined calcium hydroxide.

Section 3—Design

Sec. 3.1 Pipe Classes

Pipe supplied under this standard shall be made in one or more of the following classes: 100, 150, or 200.

Sec. 3.2 Pipe Diameters

Pipe shall be made with nominal inside diameters of 4, 6, 8, 10, 12, 14 and 16 in. (100, 150, 200, 250, 300, 350 and 400 mm, respectively). The average inside diameter of a standard or random pipe length shall not be less than the nominal diameter by more than 5 percent.

Sec. 3.3 Pipe Lengths

Pipe shall be produced in standard, random, and short lengths. At least 90 percent of the total footage (linear metres) of pipe of any class, type, size, excluding short lengths, shall be furnished in standard lengths. The remaining 10 percent may be in random lengths.

3.3.1 *Standard lengths.* Pipe is customarily furnished in standard lengths of 10 ft (3 m) or 13 ft (4 m) in 4, 6, and 8 in. (100, 150, and 200 mm, respectively) sizes, unless otherwise agreed upon at time of purchase. Sizes 10 in. (250 mm) and greater are customarily supplied in 13 ft (4 m) lengths, unless otherwise agreed upon at time of purchase. A maximum of 10 percent of each pipe size may be furnished in random lengths of not less than 7 ft (2 m). Short lengths for making connections to valves, fittings, or structures and for making closures shall be furnished as specified by the purchaser.

Sec. 3.4 Couplings

A coupling shall consist of an asbestos-cement sleeve of the same type and class as the pipe and two rubber rings or a device that has equal or better jointing characteristics, strength, and serviceability as that of an asbestos-cement coupling. The manufacturer shall submit specifications and drawings of alternate couplings to the purchaser for approval prior to manufacturing.

3.4.1 *Amount furnished.* One coupling of the same size and class as the pipe shall be furnished with each standard and random length of pipe.

3.4.2 *Rubber rings.* Rubber rings shall conform to the requirements of the latest edition of ASTM D1869, "Specification for Rubber Rings for Asbestos-Cement Pipe."

3.4.3 *Coupling areas.* Coupling areas

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for all lengths of pipe shall be properly machined at ends or over their entire length to serve their intended purpose, as specified by the purchaser.

Sec. 3.5 Joints

Joints shall be capable of withstanding, without leakage, a hydrostatic pressure test as defined in Sec. 5.2.2.1.

Sec. 3.6 Wall Thickness

The wall thickness of the machined portion of any length of pipe shall not be less than the manufacturer's standard by the tolerance listed in Table 3.

TABLE 3

Wall Thickness Tolerance

Nominal Pipe Size		Wall Thickness Tolerance	
in	(mm)	in	(mm)
4–12	(100-300)	0.06	(1.5)
14–16	(350-400)	0.12	(3.0)

Section 4—Workmanship and Finish

Sec. 4.1 Imperfections

4.1.1 *Interior surfaces.* The inside surface of each length of pipe shall be free from bulges, dents, and tears that could result in a variation in diameter of more than 0.20 in. (5 mm) from the diameter of adjacent unaffected portions of the surface.

4.1.2 *Exterior surfaces.* Flaking on the exterior surface and edge of machined ends shall not extend back by more than 0.500 in. (13 mm) from the end, have a depth of more than 0.125 in. (3 mm) or extend around the perimeter for more than 0.500 in. (13 mm) at any one location.

4.1.3 *Straightness.* Each length of pipe shall not vary in straightness by more than 0.05 in./ft (4 mm/m) of length when the variation is measured as follows:

Measure the maximum ordinate from the exterior surface of the pipe by placing a straightedge or line that exceeds the pipe length against the exterior surface and measure the maximum distance from the exterior pipe to the straightedge or line.

Section 5—Inspection, Testing, and Rejection

Sec. 5.1 Inspection

5.1.1 *General.* Inspection by the purchaser shall not relieve the manufacturer of the responsibility to furnish material conforming in all aspects to the requirements of this standard.

5.1.2 *Notification.* If inspection is specified by the purchaser under paragraph 5.1.4, the manufacturer shall notify the purchaser in advance of the date, time, and place of testing of the pipe so that the purchaser may be represented at the test.

5.1.3 *Access.* The inspector shall have free access to those parts of the manufacturer's plant that are involved in work performed under this standard. The manufacturer shall afford him, without charge, all reasonable facilities for determining whether the pipe meets the requirements of this standard.

5.1.4 *Testing.* If inspection is specified by the purchaser, he may, at his option, witness any or all test phases. The pipe to be tested shall have passed the routine inspection and testing of this specification. The number of tests to be conducted for flexural strength (4, 6, and 8 in., or 100, 150, and 200 mm respectively), hydrostatic proof ($3\frac{1}{2}$ times class), and, when required, crushing strength shall be limited to 1 per each 300 standard lengths of each size, type, and class of pipe on the order. If uncombined calcium hydroxide tests are required, the number of tests will be one for each size, type, and class of pipe on the order. The purchaser or his authorized inspector may select the pipe to be tested. Retesting and rejection stipulations as shown in Sec. 5.3 shall apply.

Sec. 5.2 Physical Test Requirements

5.2.1 *Test specimens.* All pipe and couplings tested under this standard shall be in a normal air-dried condition when tested.

5.2.2 *Hydrostatic tests.*

5.2.2.1 Each standard, random, or short length of pipe and each coupling sleeve shall be tested under an internal hydrostatic pressure as shown for the proof test in Table 4 in accordance with hydrostatic proof test requirements of the latest edition of ASTM C500, "Testing Asbestos-Cement Pipe." Any pipe length or coupling sleeve showing leakage, sweating, or other defects shall be rejected.

TABLE 4

Hydrostatic Tests

Class	Proof Test* psi	(k Pa)	Lot Test† psi	(k Pa)
100	350	(2400)	400	(2800)
150	525	(3600)	600	(4100)
200	700	(4800)	800	(5500)

*Every length per paragraph 5.2.2.1
†One per lot per paragraph 5.2.2.2

5.2.2.2 From each lot that has passed the hydrostatic proof test, one standard length shall be hydrostatically tested to the lot test in Table 4 for that class in the manner specified in paragraph 5.2.2.1. Each length of the pipe so tested shall be retested in the manner and at the pressure specified in paragraph 5.2.2.1.

5.2.3 *Flexure tests.* Each standard length of pipe and each random length of more than 9.5 ft (2.8 m) having a nominal diameter of 4, 6, or 8 in., (100, 150, and 200 mm respectively), shall be tested in flexure in accordance with the latest edition of ASTM C500, "Testing Asbestos Cement Pipe." Each pipe so tested shall support, without evidence of cracks or other defects, the applicable total load shown in Table 1.

5.2.4 *Crushing tests.* On lots containing more than 100 lengths of each size and class, one length from each 300 lengths or fraction thereof, shall be tested for crushing strength. If inspection by the purchaser has been specified, the length of pipe to be tested may be selected by the inspector. From each selected length, one unmachined section of pipe 1 ft (300 mm) long shall be cut. This section shall be tested for crushing strength in accordance with the latest edition of ASTM C500, "Testing Asbestos-Cement Pipe." The test section shall not fail until the total load applied meets or exceeds the applicable value shown in Table 2.

5.2.5 *Machines for testing.*

5.2.5.1 The machine used for the hydrostatic test shall have gaskets that seal the ends of the pipe, coupling, or pipe and coupling with factory assembled joint, but exert no end pressure. Couplings may be hydrostatically tested with a rubber bladder inside the couplings, and if so tested, each coupling shall have sufficient strength to withstand a test pressure of four times the class of the coupling.

5.2.5.2 The machines used for the flexure and crushing test shall be sub-

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stantial and rigid throughout so that the distribution of the load shall not be appreciably affected by the deformation or yielding of any part of the machine.

Sec. 5.3 Retests (Physical) and Rejection

5.3.1 *Crushing strength.* The failure of any specimen tested for crushing strength to support 75 percent of the crushing load required in Table 2 shall be cause for rejection of that portion of the lot of that size, type, and class manufactured during the same shift as the test specimen. If any specimen tested for crushing strength supports more than 75 percent but less than 100 percent of the crushing load, then two additional pipe sections of the same size, type, and class manufactured during the same shift shall be subjected to the same crushing test. The additional lengths may be selected by the inspector if inspection by the purchaser has been specified. The failure of one of these additional specimens to meet the full crushing strength requirement shall be cause for rejection of that portion of the lot of that size, type, and class manufactured during the same shift as the test specimen.

5.3.2 *Hydrostatic tests.* If any pipe subjected to the hydrostatic tests specified in Sec. 5.2.2.2 fails to withstand the specified pressure, then two additional lengths of the same size and class manufactured during the same shift shall be subjected to the same hydrostatic test. The failure of one of these additional lengths to withstand the specified pressure shall be cause for rejection of that portion of the lot of that size, type, and class manufactured during the same shift as the test lengths.

Sec. 5.4 Test for Uncombined Calcium Hydroxide

The manufacturer shall perform this test as often as necessary to ensure compliance with the requirements for uncombined calcium hydroxide in Type II pipe when tested in accordance with the latest edition of ASTM C500, "Testing Asbestos-Cement Pipe."

Sec. 5.5 Test Records

The results of all tests shall be recorded and retained for one year, and shall be available to the purchaser at the place of manufacture.

Section 6—Marking and Delivery

Sec. 6.1 Marking

6.1.1 *Standard and random lengths.* Each standard or random length of pipe shall be clearly marked on the outside surface with the trade name, nominal inside diameter, class, type, hydrostatic test pressure, and date and shift of manufacture.

6.1.2 *Short lengths.* Each short length of pipe shall be clearly marked on the outside surface with the nominal inside diameter, class, type, and the letter "T" to indicate that it has been hydrostatically tested.

6.1.3 *Couplings.* All component parts of each coupling shall be clearly marked for use with the pipe for which they are intended. Each coupling sleeve shall also be marked with the letter "T" to indicate that it has been hydrostatically tested.

6.1.4 *Special markings.* If factory

inspection is made by the purchaser or his authorized inspector, then each pipe and each coupling sleeve shall receive an additional special marking of no more than three letters, as specified by the purchaser.

Sec. 6.2 Preparation for Shipment

All pipe and couplings, unless otherwise specified, shall be prepared for standard commercial shipment.

Appendix A

Dimensional Table of Fittings Ends Designed for Use With Asbestos–Cement Pressure Pipe

This appendix is for information only and is not a part of AWWA C400.

In the figures and tables on the following page, the dimensions shown are for fittings to be used with asbestos-cement pipe having the end dimensions in Table A1. Dimensions for fittings for use with other asbestos-cement pipe end machining will be included should such design be established.

Fitting tolerances, where indicated, are required of the fittings manufacturer to establish proper control.

Rubber gaskets to be purchased from the pipe manufacturer.

Fittings shall be made of such materials as will provide service compatible with asbestos-cement pipe.

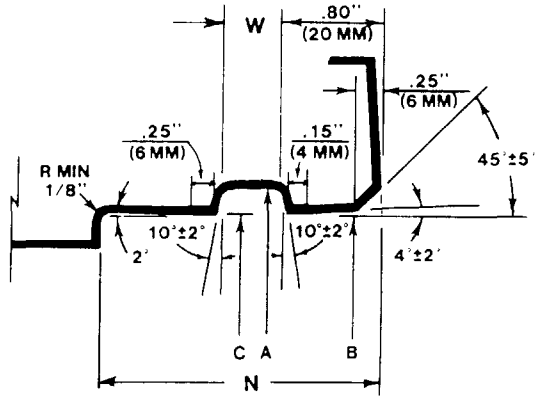
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TABLE A1

Pipe Size		Class 100				Class 150 200				All Classes			
in	(mm)	in	A (mm)	in	B (mm)	in	C (mm)	in	A (mm)	in	B (mm)	in	C (mm)	in	W (mm)	in	N (mm)
4	(100)	5.36	(136)	4.93	(125)	4.74	(120)	5.53	(140)	5.10	(130)	4 91	(125)	0.95	(24)	3 50	(89)
6	(150)	7 63	(194)	7.20	(183)	7.01	(178)	7.63	(194)	7.20	(183)	7.01	(178)	0 95	(24)	3 50	(89)
8	(200)	9 83	(250)	9.40	(239)	9.21	(234)	9.83	(250)	9.40	(239)	9.21	(234)	0 95	(24)	3 50	(89)
10	(250)	11 96	(304)	11.53	(293)	11.34	(288)	12.38	(314)	11.95	(304)	11 76	(299)	0 95	(24)	3 50	(89)
12	(300)	14.16	(360)	13 73	(349)	13.54	(344)	14.64	(372)	14.21	(361)	14.02	(356)	0 95	(24)	4.00	(102)
14	(350)	15.93	(405)	15.37	(390)	15.17	(385)	17.08	(434)	16.52	(420)	16.32	(414)	1.00	(25)	4.50	(114)
16	(400)	18 01	(457)	17 45	(443)	17.25	(438)	19 32	(491)	18.76	(476)	18.56	(471)	1.00	(25)	4.50	(114)

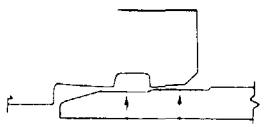
Note A, B & C tolerances are +.05 in (1.27mm)
-.04 in (1.02mm)

NOTE: All dimensions and tolerances are in inches, (millimetres).



Pipe Size		Class 100				Class 150 200			
in	(mm)	in	D_2 (mm)	in	D_3 (mm)	in	D_2 (mm)	in	D_3 (mm)
4	(100)	4.64	(118)	4.80	(122)	4.81	(122)	4.97	(126)
6	(150)	6 91	(176)	7 07	(180)	6.91	(176)	7.07	(180)
8	(200)	9.11	(231)	9.27	(236)	9.11	(231)	9.27	(235)
10	(250)	11.24	(286)	11.40	(290)	11.66	(296)	11.82	(300)
12	(300)	13.44	(341)	13 60	(345)	13.92	(354)	14.08	(358)
14	(350)	15.07	(383)	15 23	(387)	16 22	(412)	16 38	(416)
16	(400)	17 15	(436)	17 31	(440)	18.46	(469)	18.62	(473)

Note Consult pipe manufacturer for pipe tolerances.



D_2 D_3

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Department of Defense Acceptance Notice

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Title of Document: AWWA Standard for Asbestos-Cement Distribution Pipe, 4 in. Through 16 in. (100 mm Through 400 mm) NPS, for Water and Other Liquids

Date of Specific Issue Adopted: June 15, 1974

Releasing Industry Group: American Water Works Association

Custodians: Army—ME
Navy—YD
Air Force—99

Military Coordinating Activity: Navy—YD

User Activity: Navy—MC

Project No. 5630-0088

FSC 5630

4P—7 5M—43400—8/81—LL

CTD015683

UL

FORM P-6054

TECHNICAL CHANGE ORDER

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

APPLICABLE TO:

A/C General Standards Manual
Section E

DATE OF ISSUE:	T.C.O. NO.:	PAGE NO.:
MAY 28 1976	22	1

DESCRIPTION:

External Product Specification

PURPOSE:

To update UL's Standard for Asbestos-Cement Pipe and Couplings. The revisions as issued by UL add Tensile, Permanent Set, Hardness, and Accelerated Oxygen Pressure Aging tests to the Gaskets.

Our rings already meet all these tests.

EFFECTIVE DATE:

Date of issue.

DISPOSITION OF SUPERSEDED PAGES:

Destroy pages 1, 2, 5, and 6 dated April 30, 1973 and replace with the Attached pages.

CTD015684

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

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April 30, 1976

Revision pages for

STANDARD FOR
ASBESTOS-CEMENT PIPE AND COUPLINGS

UL 107, SECOND EDITION

Accompanying this sheet are revised and additional pages for the Second Edition of UL 107 dated April 30, 1973.

These new and revised requirements are now in effect.

The Underwriters Laboratories Inc. Bulletin on this subject dated January 15, 1976 proposed certain revisions for this Standard. As no adverse comments were received, the revisions were completed as proposed in the UL Bulletin.

With the inclusion of the accompanying material, the Standard consists of pages dated as shown in the following check list:

Page	Date
1	April 30, 1973
2	April 30, 1976
3, 4	April 30, 1973
5, 6	April 30, 1976
6A	April 30, 1976
7–10	April 30, 1973

Revised and/or additional pages may be issued from time to time.

CTD015685

APRIL 30, 1973

UL 107

STANDARD FOR ASBESTOS-CEMENT PIPE AND COUPLINGS

First Edition – September, 1967

SECOND EDITION

First Impression ..... April 30, 1973

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STANDARD FOR ASBESTOS-CEMENT PIPE AND COUPLINGS

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9. Ring Gaskets

9.1 Two sealing ring gaskets shall be provided with each coupling.

9.2 A ring gasket shall be made of a vulcanized natural rubber or a synthetic rubber compound and shall have uniform dimensions and be of such size, shape, and resiliency as to withstand ordinary wear and tear, compression stresses, and foreign matter carried by water. The material of which the ring gasket is made shall have the following properties:

Minimum tensile strength – 2000 psi (13.8 MPa).
Minimum ultimate elongation – 300 percent [1 to 4 inches (25.4 to 102 mm)].
Permanent set of 3/16 inch (4.8 mm) when 1 inch (25.4 mm) marks are stretched to 3 inches (76.2 mm), held for 2 minutes and measured 2 minutes after release.
After 96 hours in oxygen at a temperature of 70±1°C (158±3.4°F) and at a pressure of 300±10 psi (2070±69 kPa):

Minimum percent of original tensile strength – 60.
Minimum percent of original elongation – 60.

A hardness found to be consistent with the application and duty.

Paragraph 9.2 revised April 30, 1976

9.3 Spacer inserts need not comply with the requirements of paragraph 9.2 but, if otherwise interchangeable with the sealing ring gaskets, the insert is to be cut through at one point.

PERFORMANCE

10. General

10.1 Representative samples of each class and size of asbestos-cement pipe and couplings shall be subjected to the tests described. Samples of asbestos-cement sections cut from pipe or couplings, and of rubber gaskets, are required for tests.

11. Rubber Materials

11.1 Samples of sealing ring gaskets used in the various assemblies shall be subjected to the tests indicated in paragraph 9.2.

11.2 Test results shall comply with the minimum requirements specified in paragraph 9.2.

Paragraph 11.2 revised April 30, 1976

Tensile Strength
and Elongation Tests

11.3 Tensile strength and elongation are to be determined using the test methods and the type of power operated machine described in ASTM D412–68, ANSI J2.1–1969.

Paragraph 11.3 added April 30, 1976

11.4 The rate of travel of the power-actuated grip is to be 20±1 inches (508±25 mm) per minute.

Paragraph 11.4 added April 30, 1976

11.5 Die C, as described in ASTM D412–68, is to be used for cutting the specimens.

Paragraph 11.5 added April 30, 1976

11.6 Dumbbell specimens are to be die-cut and have a constricted portion 0.250 inch (6.4 mm) wide and 1.3 inches (33 mm) long. The enlarged ends are to be 1 inch (25.4 mm) wide, when possible.

Paragraph 11.6 added April 30, 1976

11.7 The constricted portion of the specimen is to be buffed to remove surface irregularities. The samples are to be buffed prior to cutting with the die.

Paragraph 11.7 added April 30, 1976

11.8 A power-driven buffing machine (grinding wheel) is used for buffing off irregularities in specimens. The abrasive wheel is to be No. 30–36 grit; and the diameter and rotary velocity of the wheel are to be such that it will have a peripheral speed of 4000±700 feet per minute [20.3±3.6 meters per second (m/s)]. The machine is to be provided with a slow feed in order that very little compound may be removed at one cut, thus avoiding overheating of the specimen.

Paragraph 11.8 added April 30, 1976

11.9 The cutting of the specimens may be facilitated by wetting the cutting edges of the die with water. The rubber is to rest on a smooth and slightly yielding surface which will not injure the cutting edges of the die. A piece of belting or light cardboard may be used for the purpose.

Paragraph 11.9 added April 30, 1976

Replaces page 5 dated April 30, 1973

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11.10 Three measurements for thickness are to be made in the constricted portion of the specimen using a dial micrometer graduated to 0.001 inch (0.02 mm) which exerts a load by means of an 85 gram (g) weight. This load is applied through a round, flat contact foot 0.25±0.01 inch (6.35±0.03 mm) in diameter, and amounts to a pressure of 3.8 psi (26.2 kPa) for this contact area. The minimum value obtained is to be used as the thickness of the specimen in calculating the tensile strength.

Paragraph 11.10 added April 30, 1976

11.11 Two bench marks 1 inch (25.4 mm) apart are to be stamped centrally on the constricted portion of each specimen.

Paragraph 11.11 added April 30, 1976

11.12 The elongation is to be measured by means of a scale or other device which is to be used in such a way as not to touch the specimen and is to be capable of indicating the elongation with an accuracy of 0.1 inch (2.5 mm).

Paragraph 11.12 added April 30, 1976

11.13 When a dumbbell test specimen breaks outside the bench marks, or if the result of either tensile strength or elongation is below the requirements, an additional specimen is to be tested, results of which are to be considered final. Results of tests of specimens which break in the curved portion just outside the bench marks may be accepted if within the minimum requirements.

Paragraph 11.13 added April 30, 1976

Permanent Set

11.14 The specimen for this test is to be prepared, and marks 1 inch (25.4 mm) apart are to be carefully placed on it, in the same manner described above for the specimens for the Tensile Strength Test.

Paragraph 11.14 added April 30, 1976

11.15 The specimen is to be placed in the jaws of the machine and stretched at a uniform rate of 20±1 inches (508±25 mm) per minute until an elongation of 200 percent is reached. The specimen is to be held in the stretched position for 2 minutes, then is to be released immediately, without being allowed to snap back. The specimen is then removed from the machine and placed on a surface having low thermal conductivity. At 2 minutes after release of tension, the distance between the gage marks is to be measured to the nearest 0.1 inch (2.5 mm) and recorded.

Paragraph 11.15 added April 30, 1976

Accelerated Oxygen Pressure Aging Test

11.16 Three specimens are to be prepared in the same manner as for tensile strength and elongation tests, except for the marks 1 inch (25.4 mm) apart, which are to be stamped on the specimens after the test exposure. The oxygen pressure exposure is to be conducted using the test procedures and the type of apparatus outlined in ASTM D572–73.

Paragraph 11.16 added April 30, 1976

11.17 Following the test exposure, the specimens are to be subjected to Tensile Strength and Elongation Tests as described above, and results are to be compared with results of the corresponding tests of specimens in the as-received condition.

Paragraph 11.17 added April 30, 1976

Hardness Tests

11.18 The Durometer hardness of ring gasket material is to be determined using the test methods and apparatus described in ASTM D2240–75, ANSI K65.63–1971.

Paragraph 11.18 added April 30, 1976

11.19 The test specimen(s) shall be cut from a sample ring gasket so as to be at least 6 mm (0.25 inch) in thickness unless it is known that identical results can be obtained from a thinner specimen. If it is not determined that thinner specimens will give valid results, thinner pieces may be plied together to provide a specimen of at least 6 mm (0.25 inch) thickness.

Paragraph 11.19 added April 30, 1976

11.20 The specimen(s) and the Durometer apparatus shall be conditioned at a temperature of 23±2°C (73.4±3.6°F) for at least 1 hour before testing.

Paragraph 11.20 added April 30, 1976

11.21 The average of five measurements made at different positions on the specimen shall be taken as the hardness of the ring gasket material. Each measurement shall be read at 1 second after application of the indenter.

Paragraph 11.21 added April 30, 1976

Replaces page 6 dated April 30, 1973

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12. Hydrostatic Strength

12.1 Asbestos-cement pipe and couplings shall be capable of withstanding, without rupture, an internal hydrostatic pressure of four times the rated working pressure for the minimum thickness of pipe for a period of 5 seconds. If the sample is thicker than the minimum thickness specified by the manufacturer, the required test pressure (P) shall be determined from the equation:

$$P = P_1 \left(\frac{d_1}{t_1} \frac{t_2}{d_2} \right)$$

where:

P_1 is the standard test pressure (four times rated working pressure),
t_1 is the minimum design thickness,
d_1 is the maximum design internal diameter,
t_2 is the minimum thickness at the fracture,
d_2 is the average inside diameter.

12.2 Representative samples of each class and size of pipe and couplings are to be arranged for testing under hydrostatic pressure. All air is to be expelled from the pipe or coupling and the internal water pressure is to be applied gradually until four times the rated pressure has been developed. This pressure is to be held for 5 seconds. The pressure is then to be increased until rupture occurs, and the data recorded.

13. Flexural Strength

13.1 Asbestos-cement pipe of sizes 3 to 8 inches (76.2 to 203.2 mm), and having a nominal length of 13 feet (approximately 3.9 m) or more shall, when supported on a 12 foot (3.65 m) span, be capable of supporting for 5 seconds the loads specified in Table 13.1 without cracking or developing other defects.

TABLE 13.1
FLEXURAL STRENGTH

Nominal Diameter		Proof Test Load (Total)					
		Class 100		Class 150		Class 200	
Inches	mm	Pounds	kg	Pounds	kg	Pounds	kg
3	76	560	255	660	300	760	345
4	102	900	409	1100	500	1400	635
6	152	2100	955	2800	1270	3700	1680
8	203	4000	1820	5700	2590	7600	3450

13.2 At least two samples of each class and size of pipe, 3 to 8 inches (76.2 to 203.2 mm), and in lengths of 13 feet (3.96 m) or longer are to be supported on wood or steel bearing blocks having rounded bearing surfaces 1 inch (25.4 mm) in diameter placed 12 feet (3.66 m) ± 1 inch (25.4 mm) apart. Loading of the pipe is to be applied at the two "third" points, 4 feet (1.22 m) from each support, through members having rounded contact surfaces.

13.3 The load is to be divided equally at the third points, applied at a uniform rate, and maintained for 5 seconds.

13.4 Pipe manufactured in lengths of less than 13 feet (3.96 m) but not less than 9-1/2 feet (2.90 m) shall, when supported on the maximum span for its length, be capable of supporting loads inversely proportional to those specified in Table 13.1. The proof test load shall be determined from the following equation:

$$P_2 = \frac{L_1 \quad P_1}{L_2}$$

where:

P_2 is the proof test load for the reduced length,
L_1 is the normal test span of 12 feet (3.65 m),
P_1 is the load specified in Table 13.1 for the normal test span,
L_2 is the new test span for the shorter length.

13.5 Lengths shorter than 9-1/2 feet (2.90 m) are not to be subjected to the flexural strength test.

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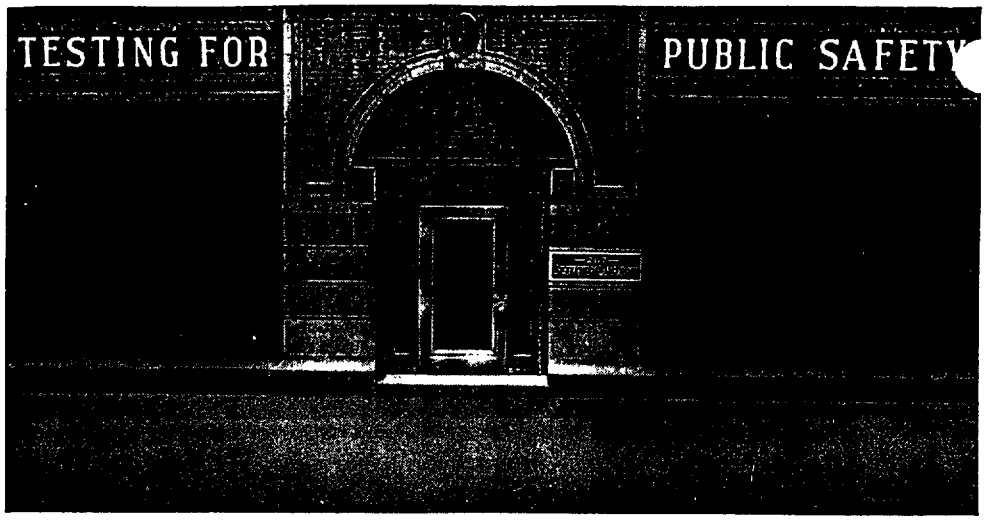
American Insurance Association

Standards for Safety

ASBESTOS-CEMENT PIPE AND COUPLINGS

UL 107-1967

CTD015691



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FIRST EDITION

First Impression ..... September, 1967

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STANDARD FOR ASBESTOS-CEMENT PIPE AND COUPLINGS

FOREWORD

1 This Standard represents the judgment of Underwriters' Laboratories, Inc. as to the basic requirements for the construction and performance of the products to be listed under this classification. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

2 The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued listing of the manufacturer's product under this classification. Underwriters' Laboratories, Inc., however, assumes no responsibility for the effect of such observance or nonobservance by the manufacturer upon the relations between the manufacturer and any other party or parties arising out of the sale or use of the product or otherwise.

3 A product which complies with these requirements will not necessarily be acceptable if, when examined and tested, it is found to have other features which impair the result contemplated by these requirements.

4 A product employing materials or having forms of construction differing from those detailed in these requirements may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be given recognition.

5 Many tests required by the Standards of Underwriters' Laboratories, Inc. are inherently hazardous. Underwriters' Laboratories, Inc. neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed, whether performed in whole or in part by the manufacturer, and whether or not any equipment, facility, or personnel for or in connection with the test is furnished by the manufacturer.

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REQUIREMENTS

SCOPE

6 These Requirements cover asbestos-cement pressure pipe, couplings, and gaskets for use in public and private water works and fire service systems and connections to such systems.

7 Pipe and couplings covered by these Requirements have nominal inside diameters of from 3 to 36 inches (approximately 75 to 900 mm).

8 Pipe and couplings covered by these Requirements are designated as Class 100, Class 150, and Class 200 for maximum working pressures of 100, 150, and 200 pounds per square inch (approximately 7, 10.5, and 14 kgf per sq cm), respectively.

9 Requirements for the installation and use of asbestos-cement pressure pipe and couplings are included in the Standards of the National Fire Protection Association for Outside Protection, NFPA No. 24.

CONSTRUCTION

Materials

10 Pipe and couplings shall be made of a mixture consisting of portland cement and asbestos fiber with or without the addition of curing agents; shall be free from organic substances; and shall be formed under pressure and thoroughly cured.

Pipe Diameters

11 The average inside diameter of a pipe section, in sizes up to and including 16 inches (400 mm), shall be not less than 95.0 percent of the nominal diameter as assigned by the manufacturer, nor less than 98.5 percent of the nominal diameter for larger sizes, when measured approximately 3 inches (75 mm) from each end of the pipe. The average is defined as the mean of four diameters measured 45 degrees apart.

Pipe Ends

12 End faces of a pipe section shall be cut square (90 degrees plus or minus 3 degrees) with respect to the axis.

13 Coupling areas shall be machined or otherwise rendered suitable for making a tight joint.

14 The design and machining of couplings and pipe ends shall be such that two lengths of pipe, machined to the maximum outside diameter permitted by the manufacturer's tolerances, are capable of being assembled with sealing ring gaskets and a coupling, which has been machined to the minimum inside diameter permitted by the manufacturer's tolerances, without damage to the sealing ring gaskets when following the installation instructions of the manufacturer.

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Straightness of Pipe

15 A pipe section shall not vary from straightness more than 5/8 inch (16 mm) for a nominal 13-foot (nominal 4-m) length, or more than a proportionate amount for a shorter or longer length.

16 Out-of-straightness is to be determined by placing a straight edge or tight string along the length of pipe and rotating the pipe in such a manner that the maximum concavity under the straight edge or string may be measured.

Couplings

17 A coupling and two sealing ring gaskets shall be furnished with each length of pipe. Each coupling shall be of the same composition, trade size, and class as the pipe. If a coupling is designed to use spacer-inserts, the spacers shall be furnished with the coupling.

18 End faces of a coupling shall be cut square (90 degrees plus or minus 3 degrees) with respect to the axis.

19 Each end of a coupling should be machined with an entrance bevel on the front shoulders. The bevel should be continuous around the entire circumference.

Imperfections

20 The interior surface of a pipe section shall be free from bulges, dents, and tears that result in a variation in inside diameter of more than 3/16 inch (4.8 mm) from the diameter of adjacent unaffected portions of the surface.

21 The exterior surface of a coupling shall have no dents, bruises, saw marks, or chips over 1/8 inch (3.2 mm) deep.

22 Saw kerf marks on an entrance face are permissible provided they do not affect the dimensional tolerances.

23 The interior surface of a pipe section shall be free from flaking which extends into the pipe more than 1 inch (25 mm) from an end. The maximum depth of flaking shall be not more than 1/8 inch (3.2 mm) and the maximum width of flaking shall be not more than 1 inch (25 mm).

24 An exterior, after machining, shall be free from flaking that extends more than 1/2 inch (13 mm) from the end of the pipe. The maximum depth of flaking shall be not more than 1/8 inch (3.2 mm) and the maximum width of flaking shall be not more than 1/2 inch (13 mm).

25 Axial dents, gouges, bruises, tool marks, or grooves in the gasket seating area of a pipe section or coupling shall not be deeper than 1/32 inch (0.8 mm).

26 Circumferential dents, gouges, bruises, tool marks, or grooves in a machined area shall not be wider than 1/4 inch (6.4 mm) nor deeper than 1/16 inch (1.6 mm).

27 A gasket-seating area of a pipe section or coupling is considered as that area which is, or could be, in contact with the sealing surfaces of the gasket in normal assemblies contemplated in the design of the joint.

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Ring Gaskets

28 Two sealing ring gaskets shall be provided with each coupling.

29 A ring gasket shall be made of a vulcanized natural rubber or a synthetic compound and shall have uniform dimensions and be of such size, shape, and resiliency as to withstand ordinary wear and tear, compression stresses, and foreign matter carried by water. A ring shall have the following properties:

Minimum tensile strength — 2000 pounds per square inch (141 kg per sq cm).

Minimum ultimate elongation — 300 percent (2 to 8 inches) (51 to 203 mm).

Maximum set of $\frac{3}{8}$ inch (9.5 mm) when 2-inch (51-mm) marks are stretched to 6 inches (153 mm), held for 2 minutes, and measured 2 minutes after release.

After 96 hours in oxygen at a temperature of 70 C $\pm$ 1 C and at a pressure of 300 $\pm$ 10 pounds per square inch (21.1 $\pm$ 0.7 kg per sq cm):

Minimum percent of original tensile strength — 60.

Minimum percent of original elongation — 60.

A hardness found to be consistent with the application and duty.

30 Spacer inserts need not comply with the requirements of paragraph 29 but, if otherwise interchangeable with the sealing ring gaskets, the insert is to be cut through at one point.

PERFORMANCE

General

31 Representative samples of each class and size of asbestos-cement pipe and couplings shall be subjected to the tests described in these Requirements. Samples of asbestos-cement sections cut from pipe or couplings, and of rubber gaskets, are required for tests.

Rubber Materials

32 Samples of sealing ring gaskets used in the various assemblies shall be subjected to the tests indicated in paragraph 29.

33 Test results shall comply with the minimum requirements specified in paragraph 29. The hardness test results, assuming the material is otherwise judged to be acceptable, shall provide the basis for follow-up tests on samples taken from future production.

Hydrostatic Strength

34 Asbestos-cement pipe and couplings shall be capable of withstanding, without rupture, an internal hydrostatic pressure of four times the rated working pressure for the minimum thickness of pipe for a period of 5 seconds. If the sample is thicker than the minimum thickness specified by

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the manufacturer, the required test pressure (P) shall be determined from the equation:

$$P = P_1 \left(\frac{d_1 \ t_2}{t_1 \ d_2} \right)$$

where:

P_1 is the standard test pressure (four times rated working pressure),
t_1 is the minimum design thickness,
d_1 is the maximum design internal diameter,
t_2 is the minimum thickness at the fracture,
d_2 is the average inside diameter.

35 Representative samples of each class and size of pipe and couplings are to be arranged for testing under hydrostatic pressure. All air is to be expelled from the pipe or coupling and the internal water pressure is to be applied gradually until four times the rated pressure has been developed. This pressure is to be held for 5 seconds. The pressure is then to be increased until rupture occurs, and the data recorded.

Flexural Strength

36 **Asbestos-cement pipe of sizes 3 to 8 inches (75 to 200 mm), inclusive, and having a nominal length of 13 feet (approximately 4 m) or more shall, when supported on a 12-foot (3.55-m) span, be capable of supporting for 5 seconds the loads specified in Table I without cracking or developing other defects.**

TABLE I
FLEXURAL STRENGTH

Nominal Diameter		Proof Test Load (Total)					
		Class 100		Class 150		Class 200	
Inches	Mm	Pounds	Kg	Pounds	Kg	Pounds	Kg
3	75	560	255	660	300	760	345
4	100	900	409	1100	500	1400	635
6	150	2100	955	2800	1270	3700	1680
8	200	4000	1820	5700	2590	7600	3450

37 At least two samples of each class and size of pipe, 3 to 8 inches (75 to 200 mm), inclusive, and in lengths of 13 feet (3.96 m) or longer are to be supported on wood or steel bearing blocks having rounded bearing surfaces 1 inch (25 mm) in diameter placed 12 feet (3.66 m) plus or minus 1 inch (25 mm) apart. Loading of the pipe is to be applied at the two "third" points, 4 feet (1.22 m) from each support, through members having rounded contact surfaces.

38 The load is to be divided equally at the third points, applied at a uniform rate, and maintained for 5 seconds.

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39 **Pipe manufactured in lengths of less than 13 feet (3.96 m) but not less than 9½ feet (2.90 m) shall, when supported on the maximum span for its length, be capable of supporting loads inversely proportional to those specified in Table I. The proof test load shall be determined from the following equation:**

$$P_2 = \frac{L_1 P_1}{L_2}$$

where:

P_2 is the proof test load for the reduced length,
L_1 is the normal test span of 12 feet (3.55 m),
P_1 is the load specified in Table I for the normal test span,
L_2 is the new test span for the shorter length.

40 Lengths shorter than 9½ feet (2.90 m) are not to be subjected to the flexural strength test.

Crushing Strength

41 **Asbestos-cement pipe shall have sufficient strength, when subjected to the three-edge bearing test as covered in paragraphs 42 through 44, to support the loads specified in Table II without cracking or developing other defects.**

TABLE II
CRUSHING STRENGTH

Nominal Diameter		Applied Load per Foot of Length					
		Class 100		Class 150		Class 200	
Inches	Mm	Pounds	Kg	Pounds	Kg	Pounds	Kg
4	100	4,100	1,850	5,400	2,450	8,700	3,950
6	150	4,000	1,810	5,400	2,450	9,000	4,080
8	200	4,000	1,810	5,500	2,500	9,300	4,210
10	250	4,400	2,000	7,000	3,180	11,000	4,990
12	300	5,200	2,360	7,600	3,450	11,800	5,350
14	350	5,200	2,360	8,600	3,900	13,500	6,120
16	400	5,800	2,630	9,200	4,170	15,400	6,990
18	450	6,500	2,950	10,100	4,580	17,400	7,890
20	500	7,100	3,220	10,900	4,940	19,400	8,800
24	600	8,100	3,680	12,700	5,760	22,600	10,300
30	760	9,700	4,400	15,900	7,210	28,400	12,900
36	900	11,200	5,080	19,600	8,890	33,800	15,300

42 At least two test specimens 12 inches (305 mm) long are to be cut from the unmachined section of each class of pipe of 4-inch (100-mm) size and larger. Each specimen is to be tested by a three-edge bearing method.

43 For this test, the two lower bearings are to consist of two straight wooden strips with vertical sides, each strip having its interior top edge rounded to a radius of approximately ½ inch (13 mm). The strips are to be securely fastened to a rigid block, with the interior faces parallel and

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a distance apart of not less than ½ inch (13 mm) nor more than 1 inch (25 mm) per foot (300 mm) of diameter of the pipe. The upper bearing is to be a rigid wooden block, straight and true from end to end. The upper and lower bearings are to extend the full length of the test specimen.

44 The load is to be applied at a uniform rate, and after 75 percent of the required proof test load is reached the load is to be applied at a uniform rate of 2000 pounds plus or minus 500 pounds per minute per lineal foot (300 kg ± 70 kg per minute per lineal meter).

Leakage

45 **Joints having maximum clearances and joints having minimum clearances between the pipe and coupling, as allowed by the manufacturer's tolerances, shall not leak when subjected to a hydrostatic pressure of two times the rated pressure.**

46 Pipe to be used in the initial test is to be representative of each class and size, and at least one joint is to have the pipe machined to the minimum outside diameters permitted by the manufacturer's tolerances, and the coupling of this joint is to be machined to the maximum inside diameters permitted by the manufacturer's tolerances. See paragraph 14. A test line is to be made up of at least five lengths of pipe with couplings and ring gaskets, and assembled in accordance with the manufacturer's installation instructions. At least two joints, including the maximum clearance joint, are to be deflected to the maximum recommended by the manufacturer. The ends of the test line are to be restrained to prevent longitudinal separation at the joints. Four single-joint tests may be conducted in lieu of the test line, in which each joint consists of two pieces of pipe and one coupling.

The test line is to be arranged for testing under hydrostatic pressure. All air is to be expelled from the system, and the water pressure is to be increased in 50-pound per square inch (3.5-kg per sq cm) increments until two times the rated pressure is attained. At each increment of pressure increase, observations are to be made of the stability of the joints. These observations are to include measurements of distortion at a joint, protrusion of gasket material, or other factors likely to affect the continued use of the pipe in service. During the test, the pressure is not to be increased to the next increment until the test line and connections have become stable, with no further movement of gasket material.

48 After the pressure has been increased to twice the rated pressure, the pressure is to be decreased to zero pounds per square inch, while observations are made for leakage. The pressure is then again to be slowly increased to twice the rated pressure while observations are made for leakage. This process may be repeated.

Assembly

49 **Joints made with minimum clearances between the pipe and coupling as allowed by the manufacturer's tolerances, shall be capable of being assembled without damage to gaskets, pipe, or coupling sections.**

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50 Representative samples of each class and size of pipe and couplings are to be machined as required. One pipe section is to be joined to each end of a coupling in accordance with the manufacturer's instructions, using a nonmineral base lubricant, or the equivalent, and normal installation tools such as pike bars, jack and chain, etc.

51 Cut or torn gasket materials, chipped or broken pipe and coupling sections, etc., are considered to be damaged within the meaning of these Requirements.

Service Connections (Corporation Stops)

52 **Asbestos-cement pipe with service connections shall be capable of withstanding for 5 seconds, without rupture, an internal hydrostatic pressure of not less than three times the rated working pressure of the pipe or coupling.**

53 At least two samples of each class and size of pipe are to be cut into two equal lengths. One length is to remain unaltered. The second length is to be prepared for attachment of the maximum size service connection intended for use with the product. If more than one type of service connection is to be tested, separate samples of pipe are to be prepared.

54 The service connection is to be attached to a sample following the manufacturer's installation instructions.

55 Both the unaltered section and the section provided with the service connection are to be subjected to the test for hydrostatic strength. See paragraph 35. The results of the tests on the unaltered section will be used for comparison with quarterly production tests. If the strength of the unaltered section is such that it is capable of withstanding more than 5 times the rated pressure, the manufacturer has the option of discarding the sample and testing other samples. See paragraphs 64 and 65.

MANUFACTURING AND PRODUCTION TESTS

General

56 **To assure compliance with these Requirements in production, the manufacturer shall conduct the necessary production control, inspection, and tests. The program shall include at least the following.**

Inspections

57 **Inspection of all pipe and couplings for flaws, cracks, bulges, dents, tears, etc.**

58 **Dimensional checks of diameters, lengths, thicknesses, etc. of pipe and couplings.**

59 **Dimensional checks of at least four ring gaskets from each lot of 500 or less, and at least six from each lot of more than 500.**

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Hydrostatic Tests

60 Each length of pipe and each coupling shall be hydrostatically tested at an internal pressure of three and one-half times rated pressure. Any pipe or coupling showing any leakage, sweating, or other defect shall be rejected.

61 This test is to be conducted by placing the test specimen in a hydrostatic-pressure testing machine with gaskets that seal the ends of the pipe or coupling. All air is to be expelled from the sample, and the internal water pressure is to be applied at a uniform rate of not less than 100 pounds per square inch per second (7 kg per sq cm per second) to the specified pressure and maintained at that pressure for not less than 5 seconds. Couplings may be tested using a bladder-type tester.

62 From each 300 couplings and standard lengths of pipe or portions thereof, of each size and class which have passed the three and one-half times rated pressure hydrostatic pressure test and the flexural test, one pipe length and one coupling shall be tested at a hydrostatic pressure of four times rated pressure, held for 5 seconds. The sample shall not rupture at this pressure.

63 If any pipe subjected to the hydrostatic test described in paragraph 62 fails to withstand the pressure specified, two additional lengths of the same size and class shall be selected from the pipe manufactured during the same shift and shall be subjected to this test. The failure of one of these additional lengths to withstand the specified pressure shall be cause for rejection of the entire lot of that size and class manufactured during the same shift as the test lengths.

64 A quarterly test shall be conducted on a sample of each size pipe in each pressure class recognized for use with service connections and which is in production during that quarter. This shall be done by (A) testing with service connections as is done in paragraph 52, or (B) testing in the manner described in paragraph 62, provided the test pressure is not less than 75 percent of the pressure obtained in tests conducted as described in paragraph 55 and is in no case less than four times the rated pressure.

65 If the test sample fails at a pressure below 75 percent of the rupture pressure determined in the initial tests conducted in accordance with paragraph 55, the tests required by paragraphs 52 through 55 are to be repeated in order to demonstrate the suitability of the pipe for use with service connections, if recognition for such use is to be continued.

66 The apparatus for conducting hydrostatic and rupture strength tests shall be equipped with a recording instrument such that the pressure to which each length of pipe or coupling was subjected will be automatically recorded. This test apparatus shall also be equipped with a time-delay relay switch or the equivalent arranged to automatically maintain the required hydrostatic pressure for the required test period of 5 seconds.

67 The manufacturer shall keep charts of the results of the hydrostatic and rupture strength tests. Each chart shall be marked to identify each test as to class, size, test pressure, date, and shift of manufacture.

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Flexural Tests

68 Each standard length of finished pipe in the 3-, 4-, 6-, and 8-inch (75-, 100-, 150-, and 200-mm) size shall be subjected to the test and requirements for flexural strength specified in paragraphs 36 to 39, inclusive, and Table I.

69 The apparatus for conducting flexural strength tests shall be equipped with a recording instrument such that the load to which each length of pipe was subjected will be automatically recorded. This test apparatus shall also be equipped with a time-delay relay switch or the equivalent arranged to automatically maintain the required hydrostatic pressure for the required test period of 5 seconds.

70 The manufacturer shall keep chart records of the test results. Each chart shall be marked to identify the particular tests as to class, size, date, and shift of manufacture.

Crushing Test

71 A three-edge bearing test shall be conducted once each month on one sample of each class of pipe of 4-inch (100-mm) size and larger manufactured during that month. The test shall be conducted as specified in paragraphs 41 to 44, inclusive, and Table II.

Hardness Tests

72 Hardness (durometer) tests shall be conducted on each lot of ring gaskets produced or purchased.

73 Four specimens are to be selected from each lot of 500 rings or less and six specimens are to be selected from each lot of more than 500 rings. They are to be conditioned for 4 hours at a temperature of 75 plus or minus 10 F (20 plus or minus 5 C) and then the hardness determined using either a Type A or a Type A2 Shore durometer. The durometer identification reading is to be taken 5 seconds after the pressure plate has made contact with the ring surface.

74 The hardness of the ring gaskets shall be uniform, with a maximum variation of plus or minus 5 from the identification reading established for the product. See paragraph 29.

75 If any of the sample rings are outside the limits, additional rings shall be selected at random from the same lot so as to make the total sampling 50 rings. If any one of the additional rings tested are outside the tolerances permitted, the lot shall be rejected.

MARKING

General

76 All required markings on pipe and couplings shall be of such size and applied in a manner to insure legibility. Letters and numerals used in the marking shall be not less than ½ inch (13 mm) in height.

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77 If a manufacturer produces pipe or couplings at more than one factory, each part shall have a distinctive marking, which may be in code, by which it may be identified as the product of a particular factory.

Pipe

78 Each length of pipe shall be marked on the outside surface with the following:

A. Manufacturer's name or trade name.

B. Size and class. Example: 6 IN.— CLASS 150 or 6 IN.—150.

C. Test pressure — 350, 525, or 700 pounds per square inch.

D. Date and shift of manufacture, except on special short lengths.

E. A marking to indicate the type of couplings with which it should be used if more than one type of coupling is supplied.

Couplings

79 Each coupling shall be marked on the outside surface with the following:

A. Manufacturer's name or trade name.

B. Size and class. Example: 6 IN.—CLASS 150 or 6 IN.—150.

C. Tested designation — the letter "T" to indicate that it has been pressure tested.

D. A marking to indicate the type of pipe with which it should be used if more than one type of coupling is supplied.

Ring Gaskets

80 The following information shall be molded into, or stamped on, each ring gasket in a manner to insure legibility:

A. Ring manufacturer's mark.

B. Size and class of pipe with which it is to be used.

C. Year of manufacture.

D. Material identification if more than one material is supplied. This identification may be in code.

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LABEL SERVICE

GENERAL

81 Asbestos-cement pipe and couplings are covered by the Label Service of Underwriters' Laboratories, Inc.

82 A Label Service Procedure consisting of a description of the product, together with instructions covering the examination and test program, if any, applicable to the product is furnished to the manufacturer and to the Laboratories' representative, and constitutes the basis for judging the product with respect to the applicable requirements.

83 The manufacturer is authorized to label (at the factory) such of his products as is found, by his own inspection, to comply with the requirements set forth in the Procedure. A Laboratories' representative makes periodic visits to the factory in which the product is manufactured and labeled as a countercheck of the manufacturer's inspection program. Should the examination or test by the Laboratories' representative disclose features not in compliance with the requirements, the manufacturer is required to correct such items or remove labels from the product.

84 **The manufacturer (1) shall not attach labels to a product that does not comply with the requirements of the Procedure, (2) shall not ship labels from one factory to another, and (3) shall not attach labels or furnish labels to anyone for attachment to a product outside of the factory in which Label Service on the product is authorized.**

85 The name "Underwriters' Laboratories, Inc." or any abbreviation, symbol, or other reference to the Laboratories shall not be used on or in connection with the product except as such name appears on the label for the product or in connection with the Label Service carton marker as outlined in the following paragraph. However, a listed component of the product may bear a properly authorized label or the Reexamination Service Marker, whichever is appropriate, when it appears in conjunction with all other markings required to be on the listed component.

86 The Laboratories is prepared to recognize the use of a marker of special design on cartons or packages containing labeled product to indicate that the contents are labeled. A manufacturer desiring to utilize this carton marker may obtain further information concerning its design and use from the Laboratories' offices at Chicago, Melville, or Santa Clara.

LABELS

87 Labels for asbestos-cement pipe incorporate the label Service Symbol

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together with the designation "Nonmetallic Pipe for Water Mains" and a number by means of which the Laboratories maintains a record of the

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manufacturer to whom the labels are released, the date of release, and the approximate date of use. It is recommended that, insofar as possible, manufacturers use the labels consecutively with respect to these numbers.

88 The labels are of the combination type only and, in addition to the label wording in the preceding paragraph, shall also bear the manufacturer's name or identification symbol and may include other name-plate data. Combination labels may be of any design and material which are acceptable to the manufacturer and to Underwriters' Laboratories, Inc. Orders for the manufacture of combination labels must be placed with the Laboratories and be accompanied by a remittance drawn payable to Underwriters' Laboratories, Inc. to cover the manufacturing cost. Following manufacture, the labels are stocked at the appropriate Label Center.

89 All labels are to be obtained only from Underwriters' Laboratories, Inc. Manufacturers may obtain labels by placing an order with the Laboratories for the number and type of labels desired. Each label order must be accompanied by a remittance drawn payable to Underwriters' Laboratories, Inc. to cover the applicable service charge.

90 Notwithstanding the payment of service charges or manufacturing costs, title to and control of all labels or portions thereof bearing the Label Service Symbol are vested in Underwriters' Laboratories, Inc. until the labels are attached to product complying with the Label Service requirements.

91 One label is to be applied by the manufacturer to each length of pipe (random or full). The label is to be so located as to be readily visible after it is attached to the pipe and a coupling is installed.

COST OF SERVICE

92 The cost of the Label Service is defrayed by service charges for use of labels. Underwriters' Laboratories, Inc. is established for service, not for profit. Accordingly, the service charges are adjusted from time to time, and subscribers to the service are notified of the current charge and all subsequent changes.

RESPONSIBILITY OF THE MANUFACTURER

93 The low cost at which the Label Service is operated necessitates the fullest measure of co-operation on the part of the manufacturer. The service is designed principally to act as a formal check on the supervision which the manufacturer exercises over his product. It is not designed to relieve the manufacturer of responsibility.

94 The manufacturer assumes full responsibility for the application of labels to that portion only of his output which is found, by his own inspection, to comply with the requirements for the product as set forth in the Label Service Procedure.

95 The manufacturer shall make arrangements for the Laboratories' inspector to have free access, during hours in which the factory is in operation, to the test room assigned for his use and to any portion of the

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premises where the product or components thereof are being fabricated, processed, finished, or stored. The inspector shall be permitted to examine and subject to prescribed tests, prior to shipment, any of the product, labeled or intended for labeling, and the manufacturer shall extend to him all necessary privileges and assistance.

96 The manufacturer shall provide at a convenient location the required test equipment and facilities for conducting all tests which are to be made at the factory and shall arrange that the equipment be available for the inspector's use when needed. It is strongly recommended that such equipment be, as far as possible, as specified in this Standard. If the manufacturer desires to provide special or additional equipment, its suitability will be investigated by the Laboratories. If it is found to be substantially the equivalent of the equipment specified in this Standard, its use will be permitted with the understanding that in event of question or disagreement as to the results obtained with such special equipment, additional tests may be conducted (at one of the Laboratories' testing stations, if necessary) with equipment as specified in this Standard, and the results of such additional tests shall be conclusive.

THE LABORATORIES' INSPECTOR

General

97 The inspector shall deal directly with the person (or persons) designated by the manufacturer. Upon entering the factory, the inspector shall go to the person designated and arrange for the selection, as specified in the Procedure, of representative samples of the product to be inspected. The inspector will avoid entering any portion of the factory where the necessities of his work do not require his presence.

98 The manufacturer's program of production, inspection, tests, and shipping will usually be well known to the inspector; and, if this program is effective, it may be regarded as largely assuring uniform compliance with the requirements of the Procedure. Hence, under normal conditions, the inspector's work will be that of counterchecking, as outlined herein, the products submitted by the manufacturer as suitable for labeling. If these conditions do not exist, the inspector will so inform the Superintendent of Follow-up Services, who will advise him of the special program to be followed.

99 Ordinarily, all details of the requirements shall be checked by the inspector at each inspection; but usually it will not be practical, nor should it be necessary, for the inspector to check each device in all particulars—for example, one device may be examined in certain details, another in others, etc.

100 If the product is found to have features which make it unacceptable for labeling, the inspector shall require that suitable corrections be made if it is to be labeled. The inspector shall check subsequent production carefully for recurrence of such features until conditions again appear to be normal.

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101 The inspector shall require that the manufacturer remove labels from all products which do not comply with requirements; except that in the event of disagreement between the manufacturer and the inspector as to whether the product is acceptable, the manufacturer may hold the labeled material at the factory, pending an appeal to and a decision from the Superintendent of Follow-up Services. Labels removed from rejected material shall be turned over to the inspector for destruction.

102 All failures to comply with the provisions of the Procedure shall be called immediately to the attention of the manufacturer and then confirmed in writing. For such confirmation, a form (Variation Notice) provided for the purpose shall be used, and a duplicate shall be attached to the inspection report when it is forwarded to the Chicago office.

103 The inspector shall not permit the attachment of labels to products not covered by the Label Service Procedure authorization, unless he has received special authorization from the Laboratories for such action.

Inspection Reports

104 A report shall be made out for each factory inspection and forwarded promptly to the Chicago office for review. The inspector shall indicate on the report form the results of the examination and tests made by him. A copy of the report will not be furnished to the manufacturer.

105 The report shall indicate clearly all features found, in the examination or test of the product, not in compliance with the requirements of the Procedure. Any action taken by the inspector shall be recorded in the report.

106 Under "General Remarks" the inspector may advise as to his general impression of conditions at the factory with respect to the manufacture and inspection of the listed product, and any other items of general interest. If criticisms are recorded, he should state briefly what suggestions or recommendations he may have for correcting the siuation, supplementing this by letter or telegram if necessary. The inspector shall advise briefly of improvements made in features criticized in this or previous reports, and of general improvements in workmanship, the arrangement and character of test apparatus, etc.

Special Instructions

General

107 **The production of pipe and couplings shall be observed by the inspector at each visit to be assured that the manufacturer maintains necessary production controls and conducts required inspections and tests.**

108 At each visit to the plant, the inspector shall conduct examinations to determine compliance with the descriptive and marking requirements. Manufacturer's "go" and "no-go" gauges may be used to determine dimensional conformity with the specified dimensions and tolerances. The inspector is to check at least three pipe sections, couplings, and ring gaskets of each size being labeled. The charts of the pressures applied in the production hydrostatic pressure and rupture tests, and of the loads applied

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in the flexure tests, shall be reviewed. In addition, the following tests are to be witnessed.

Hydrostatic Tests

109 The inspector is to observe that the manufacturer is conducting required hydrostatic and rupture tests on pipe and couplings and that the required test pressures are automatically (not under the control of the operator once the pressure has been impressed by him) impressed on each pipe and coupling for at least 5 seconds and are recorded on a chart recorder. The inspector is to witness two regular hydrostatic tests on pipe and couplings of two separate sizes being labeled as described under "Hydrostatic Tests." If only one size is available, four samples of this size shall be tested hydrostatically. The inspector should also witness, at six-month intervals, tests on one sample of the largest diameter of each class of pipe prepared for tests of service connections where such connections are recognized by the Laboratories. These tests are described in paragraph 64.

Flexural Tests

110 The inspector is to observe that the manufacturer is conducting the required flexural tests on each full length of 4-, 6-, and 8-inch size pipe during each inspection, that the load is automatically applied for at least 5 seconds, and that the loads are recorded on a chart recorder. He is to witness two tests on pipe of one size being labeled.

111 If pipe which is to be labeled is in production, the inspector shall witness the hydrostatic and flexural tests on the production pipe and assure that the pressure and load imposed are in accordance with those shown in the appropriate tables. If the pipe to be labeled has been previously tested by the manufacturer, and no labeled pipe is in production, then the samples described in paragraph 109 shall be selected and hydrostatic and flexural tests shall be conducted on these samples. If any of the tested samples fail, five additional samples of that size and class shall be selected and tested. Failure of any one of the additional samples shall be cause for rejection of the entire lot of that size. The manufacturer has the option of retesting the entire lot.

Crushing Test (Three-Edge Bearing Test)

112 The inspector shall check the manufacturer's records of tests conducted. Once during each quarter, he shall arrange to witness one test on each size of pipe labeled during that three-month period. He shall record the results on the inspection report.

Ring Gaskets

113 During each inspection, the inspector shall check the manufacturer's records of hardness (durometer). He shall arrange, once each quarter, to witness these tests on the samples from one lot of ring gaskets which have been tested and accepted by the manufacturer. If any failures are re-

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corded in these quarterly tests, additional samples shall be tested as directed in paragraph 75.

Stock Samples of Ring Gaskets

111 Upon receipt of an order from the Inspection Supervisor, the inspector shall select and send, as directed, three samples of ring gaskets (6- or 8-inch size) from each gasket supplier.

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UL 107

STANDA

ASBESTOS-CEMENT PIPES AND COUPLINGS

UNDERWRITERS' LABORATORIES, INC.®
TESTING FOR PUBLIC SAFETY

CTD015712

UL 107

First Edition – September, 1967

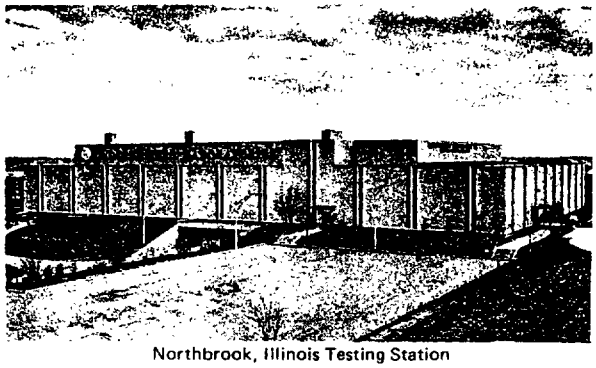
SECOND EDITION

First Impression ..... April 30, 1973

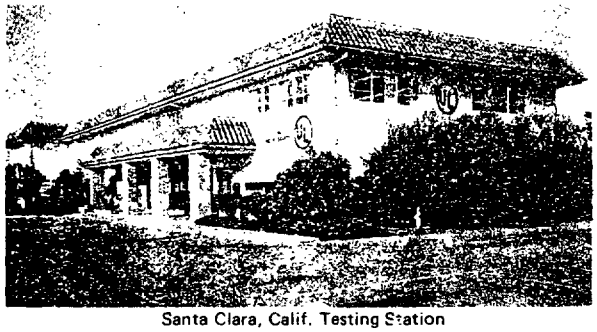
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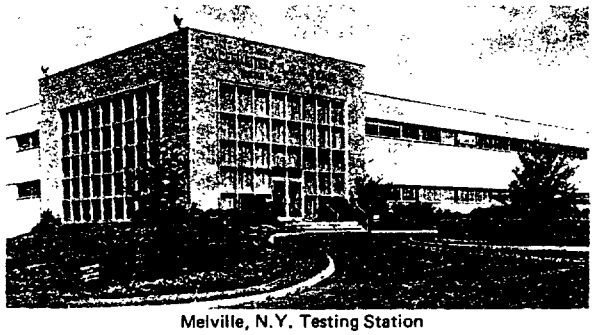
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UNDERWRITERS' LABORATORIES, INC.

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TESTING FOR PUBLIC SAFETY

Underwriters' Laboratories, Inc., founded in 1894, is chartered as a not-for-profit organization without capital stock, under the laws of the State of Delaware, to establish, maintain, and operate laboratories for the examination and testing of devices, systems and materials.

A complete description of the organization, purposes, and methods of Underwriters' Laboratories, Inc. is given in a separate pamphlet entitled "TESTING FOR PUBLIC SAFETY."

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Fire Resistance Index
Classified Products Index

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STANDARD FOR ASBESTOS-CEMENT PIPE AND COUPLINGS

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FOREWORD

A. This Standard represents the judgment of Underwriters' Laboratories, Inc., as to the basic requirements for the construction and performance of the products to be Listed under this category. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued Listing of the manufacturer's product. Underwriters' Laboratories, Inc., however, assumes no responsibility for the effect of such observance or nonobservance by the manufacturer upon the relations between the manufacturer and any other party or parties arising out of the sale or use of the product or otherwise.

C. A product which complies with these requirements will not necessarily be eligible for Listing if, when examined and tested, it is found to have other features which impair the result contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in these requirements may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be Listed.

E. Many tests required by the Standards of Underwriters' Laboratories, Inc., are inherently hazardous. Underwriters' Laboratories, Inc., neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed, whether performed in whole or in part by the manufacturer or the Laboratories, and whether or not any equipment, facility, or personnel for or in connection with the test is furnished by the manufacturer or the Laboratories.

GENERAL

1. Scope

1.1 These requirements cover asbestos-cement pressure pipe, couplings, and gaskets for use in public and private water works and fire service systems and connections to such systems.

1.2 Pipe and couplings covered by these requirements have nominal inside diameters of from 3 to 36 inches (76 to 914 mm).

1.3 Pipe and couplings covered by these requirements are designated as Class 100, Class 150, and Class 200 for maximum working pressures of 100, 150, and 200 pounds per square inch (psi) (0.69, 1.03, 1.38 MPa), respectively.

1.4 Requirements for the installation and use of asbestos-cement pressure pipe and couplings are included in the Standards of the National Fire Protection Association for Outside Protection, NFPA No. 24.

2. General

2.1 If a value for measurement as given in these requirements is followed by an equivalent value in other units, the first stated value is to be regarded as the requirement. A given equivalent value may only be approximate.

CONSTRUCTION

3. Materials

3.1 Pipe and couplings shall be made of a mixture consisting of portland cement and asbestos fiber with or without the addition of curing agents, shall be free from organic substances, and shall be formed under pressure and thoroughly cured.

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4. Pipe Diameters

4.1 The average inside diameter of a pipe section, in sizes up to and including 16 inches (406 mm), shall be not less than 95.0 percent of the nominal diameter as assigned by the manufacturer, nor less than 98.5 percent of the nominal diameter for larger sizes, when measured approximately 3 inches (76 mm) from each end of the pipe. The average is defined as the mean of four diameters measured 45 degrees apart.

5. Pipe Ends

5.1 End faces of a pipe section shall be cut square, 90 degrees ± 3 degrees, with respect to the axis.

5.2 Coupling areas shall be machined or otherwise rendered suitable for making a tight joint.

5.3 The design and machining of couplings and pipe ends shall be such that two lengths of pipe, machined to the maximum outside diameter permitted by the manufacturer's tolerances, are capable of being assembled with sealing ring gaskets and a coupling, which has been machined to the minimum inside diameter permitted by the manufacturer's tolerances, without damage to the sealing ring gaskets when following the installation instructions of the manufacturer.

6. Straightness of Pipe

6.1 A pipe section shall not vary from straightness more than 5/8 inch (15.9 mm) for a nominal 13 foot (nominal 3.9 m) length, or more than a proportionate amount for a shorter or longer length.

6.2 Out-of-straightness is to be determined by placing a straight edge or tight string along the length of pipe and rotating the pipe in such a manner that the maximum concavity under the straight edge or string may be measured.

7. Couplings

7.1 A coupling and two sealing ring gaskets shall be furnished with each length of pipe. Each coupling shall be of the same composition, trade size, and class as the pipe. If a coupling is designed to use spacer-inserts, the spacers shall be furnished with the coupling.

7.2 End faces of a coupling shall be cut square, 90 degrees ± 3 degrees, with respect to the axis.

7.3 Each end of a coupling should be machined with an entrance bevel on the front shoulders. The bevel should be continuous around the entire circumference.

8. Imperfections

8.1 The interior surface of a pipe section shall be free from bulges, dents, and tears that result in a variation in inside diameter of more than 3/16 inch (4.8 mm) from the diameter of adjacent unaffected portions of the surface.

8.2 The exterior surface of a coupling shall have no dents, bruises, saw marks, or chips over 1/8 inch (3.2 mm) deep.

8.3 Saw kerf marks on an entrance face are permissible provided they do not affect the dimensional tolerances.

8.4 The interior surface of a pipe section shall be free from flaking which extends into the pipe more than 1 inch (25 mm) from an end. The maximum depth of flaking shall be not more than 1/8 inch (3.2 mm) and the maximum width of flaking shall be not more than 1 inch (25 mm).

8.5 An exterior, after machining, shall be free from flaking that extends more than 1/2 inch (12.7 mm) from the end of the pipe. The maximum depth of flaking shall be not more than 1/8 inch (3.2 mm) and the maximum width of flaking shall be not more than 1/2 inch (12.7 mm).

8.6 Axial dents, gouges, bruises, tool marks, or grooves in the gasket seating area of a pipe section or coupling shall not be deeper than 1/32 inch (0.8 mm).

8.7 Circumferential dents, gouges, bruises, tool marks, or grooves in a machined area shall not be wider than 1/4 inch (6.4 mm) nor deeper than 1/16 inch (1.6 mm).

8.8 A gasket-seating area of a pipe section or coupling is considered as that area which is, or could be, in contact with the sealing surfaces of the gasket in normal assemblies contemplated in the design of the joint.

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9. Ring Gaskets

9.1 Two sealing ring gaskets shall be provided with each coupling.

9.2 A ring gasket shall be made of a vulcanized natural rubber or a synthetic compound and shall have uniform dimensions and be of such size, shape, and resiliency as to withstand ordinary wear and tear, compression stresses, and foreign matter carried by water. A ring shall have the following properties:

Minimum tensile strength – 2000 psi (13.8 MPa).

Minimum ultimate elongation – 300 percent (2 to 8 inches) (50.8 to 203.2 mm).

Maximum set of 3/8 inch (9.5 mm) when 2 inch (50.8 mm) marks are stretched to 6 inches (152.4 mm), held for 2 minutes, and measured 2 minutes after release.

After 96 hours in oxygen at a temperature of 70 ± 1°C (158 ± 3.4°F) and at a pressure of 300 ± 10 psi (2070 ± 69 kPa):

Minimum percent of original tensile strength – 60.

Minimum percent of original elongation – 60.

A hardness found to be consistent with the application and duty.

9.3 Spacer inserts need not comply with the requirements of paragraph 9.2 but, if otherwise interchangeable with the sealing ring gaskets, the insert is to be cut through at one point.

PERFORMANCE

10. General

10.1 Representative samples of each class and size of asbestos-cement pipe and couplings shall be subjected to the tests described. Samples of asbestos-cement sections cut from pipe or couplings, and of rubber gaskets, are required for tests.

11. Rubber Materials

11.1 Samples of sealing ring gaskets used in the various assemblies shall be subjected to the tests indicated in paragraph 9.2.

11.2 Test results shall comply with the minimum requirements specified in paragraph 9.2. The hardness test results, assuming the material is otherwise judged to be acceptable, shall provide the basis for follow-up tests on samples taken from future production.

12. Hydrostatic Strength

12.1 Asbestos-cement pipe and couplings shall be capable of withstanding, without rupture, an internal hydrostatic pressure of four times the rated working pressure for the minimum thickness of pipe for a period of 5 seconds. If the sample is thicker than the minimum thickness specified by the manufacturer, the required test pressure (P) shall be determined from the equation:

$$P = P_1 \left(\frac{d_1 \quad t_2}{t_1 \quad d_2} \right)$$

where:

P_1 is the standard test pressure (four times rated working pressure),

t_1 is the minimum design thickness,

d_1 is the maximum design internal diameter,

t_2 is the minimum thickness at the fracture,

d_2 is the average inside diameter.

12.2 Representative samples of each class and size of pipe and couplings are to be arranged for testing under hydrostatic pressure. All air is to be expelled from the pipe or coupling and the internal water pressure is to be applied gradually until four times the rated pressure has been developed. This pressure is to be held for 5 seconds. The pressure is then to be increased until rupture occurs, and the data recorded.

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13. Flexural Strength

13.1 Asbestos-cement pipe of sizes 3 to 8 inches (76.2 to 203.2 mm), and having a nominal length of 13 feet (approximately 3.9 m) or more shall, when supported on a 12 foot (3.65 m) span, be capable of supporting for 5 seconds the loads specified in Table 13.1 without cracking or developing other defects.

TABLE 13.1
FLEXURAL STRENGTH

Nominal Diameter		Proof Test Load (Total)					
		Class 100		Class 150		Class 200	
Inches	mm	Pounds	kg	Pounds	kg	Pounds	kg
3	76	560	255	660	300	760	345
4	102	900	409	1100	500	1400	635
6	152	2100	955	2800	1270	3700	1680
8	203	4000	1820	5700	2590	7600	3450

13.2 At least two samples of each class and size of pipe, 3 to 8 inches (76.2 to 203.2 mm), and in lengths of 13 feet (3.96 m) or longer are to be supported on wood or steel bearing blocks having rounded bearing surfaces 1 inch (25.4 mm) in diameter placed 12 feet (3.66 m) ± 1 inch (25.4 mm) apart. Loading of the pipe is to be applied at the two "third" points, 4 feet (1.22 m) from each support, through members having rounded contact surfaces.

13.3 The load is to be divided equally at the third points, applied at a uniform rate, and maintained for 5 seconds.

13.4 Pipe manufactured in lengths of less than 13 feet (3.96 m) but not less than 9-1/2 feet (2.90 m) shall, when supported on the maximum span for its length, be capable of supporting loads inversely proportional to those specified in Table 13.1. The proof test load shall be determined from the following equation:

$$P_2 = \frac{L_1 \quad P_1}{L_2}$$

where:

P_2 is the proof test load for the reduced length,
L_1 is the normal test span of 12 feet (3.65 m),
P_1 is the load specified in Table 13.1 for the normal test span,
L_2 is the new test span for the shorter length.

13.5 Lengths shorter than 9-1/2 feet (2.90 m) are not to be subjected to the flexural strength test.

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14. Crushing Strength

14.1 Asbestos-cement pipe shall have sufficient strength, when subjected to the three-edge bearing test as covered in paragraphs 14.2–14.4, to support the load specified in Table 14.1 without cracking or developing other defects.

14.2 At least two test specimens 12 inches (304.8 mm) long are to be cut from the unmachined section of each class of pipe of 4 inch (101.6 mm) size and larger. Each specimen is to be tested by a three-edge bearing method.

14.3 For this test, the two lower bearings are to consist of two straight wooden strips with vertical sides, each strip having its interior top edge rounded to a radius of approximately 1/2 inch (12.7 mm). The strips are to be securely fastened to a rigid block, with the interior faces parallel and a distance apart of not less than 1/2 inch (12.7 mm) nor more than 1 inch (25.4 mm) per foot (304.8 mm) of diameter of the pipe. The upper bearing is to be a rigid wooden block, straight and true from end to end. The upper and lower bearings are to extend the full length of the test specimen.

14.4 The load is to be applied at a uniform rate, and after 75 percent of the required proof test load is reached the load is to be applied at a uniform rate of 2000 pounds ± 500 pounds per minute per lineal foot (300 kg ± 70 kg per minute per lineal meter).

15. Leakage

15.1 Joints having maximum clearances and joints having minimum clearances between the pipe and coupling, as allowed by the manufacturer's tolerances, shall not leak when subjected to a hydrostatic pressure of two times the rated pressure.

15.2 Pipe to be used in the initial test is to be representative of each class and size, and at least one joint is to have the pipe machined to the minimum outside diameters permitted by the manufacturer's tolerances, and the coupling of this joint is to be machined to the maximum inside diameters permitted by the manufacturer's tolerances. See paragraph 5.3. A test line is to be made up of at least five lengths of pipe with couplings and ring gaskets, and assembled in accordance with the manufacturer's installation instructions. At least two joints, including the maximum clearance joint, are to be deflected to the maximum recommended by the manufacturer. The ends of the test line are to be restrained to prevent longitudinal separation at the joints. Four single-joint tests may be conducted in lieu of the test line, in which each joint consists of two pieces of pipe and one coupling.

TABLE 14.1
CRUSHING STRENGTH

Diameter		Applied Load per Foot of Length					
Nominal		Class 100		Class 150		Class 200	
Inches	mm	Pounds	kg	Pounds	kg	Pounds	kg
4	102	4,100	1,850	5,400	2,450	8,700	3,950
6	152	4,000	1,810	5,400	2,450	9,000	4,080
8	203	4,000	1,810	5,500	2,500	9,300	4,210
10	254	4,400	2,000	7,000	3,180	11,000	4,990
12	304	5,200	2,360	7,600	3,450	11,800	5,350
14	355	5,200	2,360	8,600	3,900	13,500	6,120
16	406	5,800	2,630	9,200	4,170	15,400	6,990
18	457	6,500	2,950	10,100	4,580	17,400	7,890
20	508	7,100	3,220	10,900	4,940	19,400	8,800
24	609	8,100	3,680	12,700	5,760	22,600	10,300
30	762	9,700	4,400	15,900	7,210	28,400	12,900
36	914	11,200	5,080	19,600	8,890	33,800	15,300

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15.3 The test line is to be arranged for testing under hydrostatic pressure. All air is to be expelled from the system, and the water pressure is to be increased in 50 psi (344.7 kPa) increments until two times the rated pressure is attained. At each increment of pressure increase, observations are to be made of the stability of the joints. These observations are to include measurements of distortion at a joint, protrusion of gasket material, or other factors likely to affect the continued use of the pipe in service. During the test, the pressure is not to be increased to the next increment until the test line and connections have become stable, with no further movement of gasket material.

15.4 After the pressure has been increased to twice the rated pressure, the pressure is to be decreased to 0 psi, while observations are made for leakage. The pressure is then again to be slowly increased to twice the rated pressure while observations are made for leakage. This process may be repeated.

16. Assembly

16.1 Joints made with minimum clearances between the pipe and coupling as allowed by the manufacturer's tolerances, shall be capable of being assembled without damage to gaskets, pipe, or coupling sections.

16.2 Representative samples of each class and size of pipe and couplings are to be machined as required. One pipe section is to be joined to each end of a coupling in accordance with the manufacturer's instructions, using a nonmineral base lubricant, or the equivalent, and normal installation tools such as pike bars, jack and chain, etc.

16.3 Cut or torn gasket materials, chipped or broken pipe and coupling sections, etc., are considered to be damaged.

17. Service Connections (Corporation Stops)

17.1 Asbestos-cement pipe with service connections shall be capable of withstanding for 5 seconds, without rupture, an internal hydrostatic pressure of not less than three times the rated working pressure of the pipe or coupling.

17.2 At least two samples of each class and size of pipe are to be cut into two equal lengths. One length is to remain unaltered. The second length is to be prepared for attachment of the maximum size service connection intended for use with the product. If more than one type of service connection is to be tested, separate samples of pipe are to be prepared.

17.3 The service connection is to be attached to a sample following the manufacturer's installation instructions.

17.4 Both the unaltered section and the section provided with the service connection are to be subjected to the test for hydrostatic strength. See paragraph 12.2. The results of the tests on the unaltered section will be used for comparison with quarterly production tests. If the strength of the unaltered section is such that it is capable of withstanding more than 5 times the rated pressure, the manufacturer has the option of discarding the sample and testing other samples. See paragraphs 20.5–20.6.

MANUFACTURING AND PRODUCTION TESTS

18. General

18.1 To assure compliance with these requirements in production, the manufacturer shall conduct the necessary production control, inspection, and tests. The program shall include at least the procedures specified in paragraphs 19.1–23.4.

19. Inspections

19.1 The following inspections and checks are to be conducted:

A. Inspection of all pipe and couplings for flaws, cracks, bulges, dents, tears, etc.

B. Dimensional checks of diameters, lengths, thicknesses, etc. of pipe and couplings.

C. Dimensional checks of at least four ring gaskets from each lot of 500 or less, and at least six from each lot of more than 500.

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20. Hydrostatic Tests

20.1 Each length of pipe and each coupling shall be hydrostatically tested at an internal pressure of three and one-half times rated pressure. Any pipe or coupling showing any leakage, sweating, or other defect shall be rejected.

20.2 This test is to be conducted by placing the test specimen in a hydrostatic-pressure testing machine with gaskets that seal the ends of the pipe or coupling. All air is to be expelled from the sample, and the internal water pressure is to be applied at a uniform rate of not less than 100 psi per second (689 kPa per second) to the specified pressure and maintained at that pressure for not less than 5 seconds. Couplings may be tested using a bladder-type tester.

20.3 From each 300 couplings and standard lengths of pipe or portions thereof, of each size and class which have passed the three and one-half times rated pressure hydrostatic pressure test and the flexural test, one pipe length and one coupling shall be tested at a hydrostatic pressure of four times rated pressure, held for 5 seconds. The sample shall not rupture at this pressure.

20.4 If any pipe subjected to the hydrostatic test described in paragraph 20.3 fails to withstand the pressure specified, two additional lengths of the same size and class shall be selected from the pipe manufactured during the same shift and shall be subjected to this test. The failure of one of these additional lengths to withstand the specified pressure shall be cause for rejection of the entire lot of that size and class manufactured during the same shift as the test length.

20.5 A quarterly test shall be conducted on a sample of each size pipe in each pressure class recognized for use with service connections and which is in production during that quarter. This shall be done by (1) testing with service connections as is done in paragraph 17.1, or (2) testing in the manner described in paragraph 20.3, provided the test pressure is not less than 75 percent of the pressure obtained in tests conducted as described in paragraph 17.4 and is in no case less than four times the rated pressure.

20.6 If the test sample fails at a pressure below 75 percent of the rupture pressure determined in the initial tests conducted in accordance with paragraph 17.4, the tests required by paragraphs 17.1–17.4 are to be repeated in order to demonstrate the suitability of the pipe for use with service connections, if recognition for such use is to be continued.

20.7 The apparatus for conducting hydrostatic and rupture strength tests shall be equipped with a recording instrument such that the pressure to which each length of pipe or coupling was subjected will be automatically recorded. This test apparatus shall also be equipped with a time-delay relay switch or the equivalent arranged to automatically maintain the required hydrostatic pressure for the required test period of 5 seconds.

20.8 The manufacturer shall keep charts of the results of the hydrostatic and rupture strength tests. Each chart shall be marked to identify each test as to class, size, test pressure, date, and shift of manufacture.

21. Flexural Tests

21.1 Each standard length of finished pipe in the 3, 4, 6, and 8 inch (76, 101, 152, and 203 mm) size shall be subjected to the test and requirements for flexural strength specified in paragraphs 13.1–13.4, and Table 13.1.

21.2 The apparatus for conducting flexural strength tests shall be equipped with a recording instrument such that the load to which each length of pipe was subjected will be automatically recorded. This test apparatus shall also be equipped with a time-delay relay switch or the equivalent arranged to automatically maintain the required hydrostatic pressure for the required test period of 5 seconds.

21.3 The manufacturer shall keep chart records of the test results. Each chart shall be marked to identify the particular tests as to class, size, date, and shift of manufacture.

22. Crushing Test

22.1 A three-edge bearing test shall be conducted once each month on one sample of each class of pipe of 4 inch (101 mm) size and larger manufactured during that month. The test shall be conducted as specified in paragraphs 14.1–14.4, and Table 14.1.

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23. Hardness Tests

23.1 Hardness (durometer) tests shall be conducted on each lot of ring gaskets produced or purchased.

23.2 Four specimens are to be selected from each lot of 500 rings or less and six specimens are to be selected from each lot of more than 500 rings. They are to be conditioned for 4 hours at a temperature of 75 ± 10°F (20 ± 5°C) and then the hardness determined using either a Type A or a Type A2 Shore durometer. The durometer identification reading is to be taken 5 seconds after the pressure plate has made contact with the ring surface.

23.3 The hardness of the ring gaskets shall be uniform, with a maximum variation of ± 5 from the identification reading established for the product. See paragraph 9.2.

23.4 If any of the sample rings are outside the limits, additional rings shall be selected at random from the same lot so as to make the total sampling 50 rings. If any one of the additional rings tested are outside the tolerances permitted, the lot shall be rejected.

MARKING

24. General

24.1 All required markings on pipe and couplings shall be of such size and applied in a manner to insure legibility. Letters and numerals used in the marking shall be not less than 1/2 inch (12.7 mm) in height.

24.2 If a manufacturer or vendor produces pipe or couplings at more than one factory, each part shall have a distinctive marking, or an identifying symbol to identify it as the product of a particular factory.

25. Pipe

25.1 Each length of pipe shall be marked on the outside surface with the following:

A. Manufacturer's or vendor's name or identifying symbol.

B. Size and class. Example: 6 IN. – Class 150 or 6 IN. – 150.

C. Test pressure – 350, 525, or 700 psi.

D. Date and shift of manufacture, except on special short lengths.

E. A marking to indicate the type of couplings with which it should be used if more than one type of coupling is supplied.

26. Couplings

26.1 Each coupling shall be marked on the outside surface with the following:

A. Manufacturer's or vendor's or identifying symbol.

B. Size and class. Example: 6 IN. – Class 150 or 6 IN. – 150.

C. Tested designation – the letter T to indicate that it has been pressure tested.

D. A marking to indicate the type of pipe with which it should be used if more than one type of coupling is supplied.

27. Ring Gaskets

27.1 The following information shall be molded into, or stamped on, each ring gasket in a manner to ensure legibility;

A. Ring manufacturer's or vendor's identifying symbol.

B. Size and class of pipe with which it is to be used.

C. Year of manufacture.

D. Material identification if more than one material is supplied. This identification may be in code.

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CTD015724

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FEDERAL

SS P 3310

FEDERAL SPECIFICATION

PIPE, SEWER, NONPRESSURE, ASBESTOS-CEMENT:

AND COUPLINGS AND FITTINGS

This Amendment which forms a part of Federal Specification SS-P-331D, dated November 3, 1972, was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal Agencies.

Page 4

3.1.3, line 2, delete "Synthetic rubber gaskets" and substitute "Synthetic or natural rubber gaskets as required (see 3.6),".

3.3.2, delete.

Page 6

3.5.2, delete and substitute:

3.5.2 Fittings. When specified (see 6.2), fittings such as but not limited to wyes, tees, and adapters shall be furnished. The fittings, when assembled with the pipe, shall withstand the crushing load specified for the class of pipe to which it is assembled. When tested as specified in 4.5.3, the assembled pipe and fittings shall withstand the crushing load for the applicable type, class, and size of pipe without permanent deformation or failure.

3.6, delete and substitute:

3.6 Sealing rings. Each length of pipe shall be provided with the necessary number of sealing rings. The rings shall be of the correct size and shape for the joints of pipe furnished and shall conform to ASTM D1869. Where resistance to oil or solvents is not required, rings may be either natural or synthetic rubber or both. Where resistance to oil or solvents is required, rings shall be of synthetic rubber (see 6.2).

FSC 5630

CTD015725

3.7, delete and substitute:

3.7 Flexural strength. Ten foot lengths of pipe, sizes 4 through 8 inch diameter inclusive, shall have sufficient flexural strength to withstand without failure the total load shown in table IV according to the class of pipe when tested in accordance with 4.5.2. Lengths of pipe over 10 feet, sizes 4 through 8 inch diameter inclusive, shall have sufficient flexural strength to withstand without failure 75 percent of the total load shown in table IV, according to the class of pipe, when tested in accordance with 4.5.2.

4.5.3, delete and substitute:

4.5.3 Crushing strength. The crushing strength of the pipe and couplings and fittings assembled to pipe shall be determined as specified in ASTM C500, crushing test. For assembled couplings and fittings the procedure may be modified to allow the application of the load to the coupling or fitting. When any specimen (pipe, assembled coupling, or assembled fitting, as applicable) withstands more than 75 percent but less than 100 percent of the load specified in table V, two additional specimens shall be tested. Inability of any specimen to withstand 75 percent of the crushing load specified in table V or inability of any additional specimens tested to withstand 100 percent of the crushing load specified in table V shall constitute failure of this test.

MILITARY INTEREST

Custodians:

Army - ME
Navy - YD
Air Force - 84

Preparing activity:

Army - ME

CIVIL AGENCY COORDINATING ACTIVITIES

Commerce - NBS
GSA - PCD, FSS
Forest Service - AFS

Project No. 5630-0035

U. S. GOVERNMENT PRINTING OFFICE : 1973 O - 546-576/2360

CTD015726

SS-P-331D
November 3, 1972
SUPERSEDING
Fed. Spec. SS-P-331C
June 28, 1967

FEDERAL SPECIFICATION

PIPE, SEWER, NONPRESSURE, ASBESTOS-CEMENT: AND COUPLINGS AND FITTINGS

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers asbestos-cement nonpressure sewer pipe and couplings and fittings (see 6.3).

1.2 Classification.

1.2.1 Types, classes, and sizes. The pipe shall be the following types and classes, and sizes shown in table I as specified (see 6.2 and 6.4).

Types:

I - Three percent maximum lime content.
II - One percent maximum lime content.
III - Unrestricted lime content.

Classes:

1500
2400
3300
4000
5000
6000
7000

FSC 5630

CTD015727

Sizes

TABLE I. Pipe sizes

Class	Nominal Size, Inside Diameter, in Inches																
	4	5	6	8	10	12	14	16	18	20	24	27	30	33	36	39	42
1500	X	X	X	X	X	X	X	X	-	-	-	-	-	-	-	-	-
2400	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-
3300	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-
4000	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X
5000	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X
6000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X
7000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	X	X

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein:

Federal Specifications:

NN-P-71 - Pallet, Materials Handling, Wood, Double Faced, Stringer Construction.
QQ-S-781 - Strapping, Steel, Flat and Seals.
PPP-B-601 - Boxes, Wood, Cleated-Plywood.
PPP-B-636 - Boxes, Shipping, Fiberboard.

Federal Standards:

Fed. Std. No. 123 - Marking for Domestic Shipment (Civil Agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.

CTD015728

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-130 - Identification Marking of US Military Property.
MIL-STD-147 - Palletized and Containerized Unit Loads, 40"x48" Pallets, Skids, Runners, or Pallet-Type Base.

(Copies of Military Specifications and Standards required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. **The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.**

American Society for Testing and Materials (ASTM) Standards:

C500 - Testing Asbestos-Cement Pipe.
D1869 - Rubber Rings for Asbestos-Cement Pipe.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

National Motor Freight Traffic Association, Inc., Agent:

National Motor Freight Classification.

(Application for copies should be addressed to the American Trucking Association, Inc., Tariff Order Section, 1616 P Street, N.W., Washington, DC 20036.)

CTD015729

Uniform Classification Committee, Agent:

Uniform Freight Classification.

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

3. REQUIREMENTS

3.1 Description.

3.1.1 Pipe. Asbestos-cement pipe shall conform to the chemical, mechanical, and physical properties specified herein.

3.1.2 Couplings. Couplings for asbestos-cement pipe consist of a sleeve and synthetic rubber gaskets and shall be as specified herein.

3.1.3 Fittings. Fittings, such as but not limited to, tees, reducers, adapters, and wyes shall be as specified herein. Synthetic rubber gaskets shall be furnished with each fitting.

3.2 First article (first produced item). The supplier shall furnish one or more of each type, class, and size of pipe and one or more of each coupling or fitting specified for the type, class, and size pipe specified for examination and testing within the time frame specified (see 6.2), to prove that his production methods and choice of design detail will produce pipe, couplings, and fittings that comply with the requirements of this specification. Examination and tests shall be as specified in section 4 and shall be subject to surveillance and approval by the Government (see 6.5).

3.3 Material. Material shall be as specified herein. Materials not specified shall be selected by the supplier and shall be subject to all provisions of this specification.

3.3.1 Sewer pipe. The sewer pipe shall be asbestos-cement composed of an intimate mixture of portland cement or portland-blast furnace slag cement and asbestos fiber, with or without silica, or portland-pozzolan cement and asbestos fiber. The asbestos-cement shall be free of organic additives. The material shall be formed under pressure and cured to meet the chemical, mechanical, and physical requirements of this specification.

3.3.2 Sealing rings. Sealing rings shall be synthetic rubber and shall conform to ASTM D1869.

CTD015730

3.3.3 Couplings and fittings. Couplings and fittings may be fabricated from asbestos-cement or other material which will provide the strength required for the type, class, and size of pipe specified.

3.4 Sewer pipe.

3.4.1 Length. Unless otherwise specified herein, sewer pipe of the type, class, and size specified shall be furnished in standard lengths as shown in table II. When specified (see 6.2), sewer pipe of the type, class, and size specified shall be furnished in short lengths as specified, except that short lengths of pipe shall not exceed 6 feet 6 inches. At least 85 percent of the total footage of any one type, class, and size of sewer pipe, except short lengths specified, shall be furnished in standard lengths. The remaining 15 percent may be in random lengths of not less than 7 feet when the standard length is 10 or 13 feet and no less than 4 feet when the standard length is 5 or 6.5 feet.

TABLE II. Standard pipe lengths

Pipe Diam. (Inches) Nominal	Standard Pipe Lengths			
	5	6.5	10	13
4 to 6 incl	X	X	X	X
8 and 10	-	-	X	X
12 to 42 incl	-	-	-	X

3.4.2 Tolerances.

3.4.2.1 Length. A tolerance of plus or minus 1 inch shall apply to all lengths of pipe.

3.4.2.2 Inside diameter. The average inside diameter of pipe may be less than the nominal diameter by not more than 0.25 inch or 1.5 percent, whichever is the greater.

3.4.2.3 Out-of-round. The inside diameter out-of-round tolerance at the ends of each length of pipe for a distance equal to one-half of the coupling length shall be as shown in table III.

TABLE III. Out-of-round tolerance

Size (inches)	Allowable Variation (inches)
4 to 10 incl.	1/8 (.125)
12 to 20 incl.	3/16 (.188)
24 to 42 incl.	1/4 (.250)

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3.4.2.4 Straightness. The straightness of sewer pipe 8 inches and greater in diameter and less than 8 inches in diameter shall not vary more than .05 inch per foot or .06 inch per foot respectively when measured in accordance with ASTM C500.

3.5 Couplings and fittings.

3.5.1 Couplings. Unless otherwise specified herein, one coupling shall be furnished with each length of pipe. When specified (see 6.2), couplings shall be furnished separately as specified. The coupling when assembled with the pipe shall be capable of withstanding the minimum crushing load as that specified for the class of pipe to which it is assembled. When tested as specified in 4.5.3 the assembled pipe and coupling shall withstand the crushing load for the type, class, and size pipe specified without permanent deformation or failure.

3.5.2 Fittings. When specified (see 6.2), fittings such as wyes, tees, and adapters shall be furnished. When tested as specified in 4.5.3 the fittings shall withstand the crushing load specified for the type and class of pipe for which the fittings are to be attached.

3.6 Sealing rings. The necessary number of sealing rings shall be furnished with each length of pipe. The rings shall be of correct size and shape for the joints of the pipe furnished, shall conform to ASTM D1869, and shall be non-oil resistant or oil resistant as specified (see 6.2).

3.7 Flexural strength. Each standard length of pipe 10 feet or longer from 4 to 8 inch diameter, inclusive, shall have sufficient flexural strength to withstand without failure the total load shown in table IV according to the class of pipe.

TABLE IV. Applied flexural proof loads

Pipe Size (Inches)	Total Applied Load (Pounds)		
	Class 1500	Class 2400	Class 3300
4	550	550	550
5	950	950	950
6	1500	1500	1500
8	2700	3000	3900

3.8 Crushing strength. The pipe shall withstand the total applied load shown in table V for that class of pipe without crushing or other damage.

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TABLE V. Minimum crushing loads

Pipe Class	Crushing Strength Per Foot Pounds
1500	1500
2400	2400
3300	3300
4000	4000
5000	5000
6000	6000
7000	7000

3.9 Uncombined calcium hydroxide. When tested as specified in 4.5.4 the amount of uncombined calcium hydroxide shall not exceed 3 percent for type I pipe or 1 percent for type II pipe. The amount of uncombined calcium hydroxide shall be unrestricted for type III pipe.

3.10 Identification marking. Each length of pipe and coupling shall be identified in accordance with MIL-STD-130. Each length of pipe shall be marked with the nominal size, type, class, name of supplier or his trademark, and date of manufacture. All parts of sleeve couplings except bolts and nuts if used, shall be marked with the supplier's identification, size, type, and class of pipe for which the parts are required.

3.11 Workmanship. The pipe shall be uniform in structure and of such homogeneous composition that the pipe may be cut, drilled or machined.

3.11.1 Coupling area. The coupling area of the pipes shall produce a leaktight joint when drawn together in the coupling with rubber rings or gaskets and subjected to an internal hydrostatic pressure of 10 psi. All surfaces of the joint upon which the rubber rings may bear shall be smooth, free from spalls, cracks, airholes, fractures and other defects that could affect the correct sealing of the joint.

3.11.2 Inside surface. Each pipe shall be free from bulges, dents, and tears on the inside surface which could result in a variation in diameter greater than 0.188 inch from that obtained on adjacent unaffected portions of the surface.

3.11.3 Ends. Machined ends of the pipe that receive the coupling shall be free from dents and gouges that could affect the tightness of the joint. The exterior edge of the pipe which extends into the coupling area shall be free from axial chips having a length greater than 0.50 inch, a width greater than 0.50 inch, or a depth greater than 0.125 inch. The interior edge shall be free from axial chips having a length greater than 1 inch, a width greater than 1 inch, or a depth greater than 0.125 inch.

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4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Classification of inspection. Inspection shall be classified as follows:

(a) First produced pipe, coupling, or fitting inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).
(c) Inspection of preparation for delivery (see 4.6).

4.3 First produced pipe, coupling, and fitting inspection.

4.3.1 Examination. The first produced pipe(s), coupling(s), and fitting(s) for each type, class, and size of pipe specified shall be examined for the defects marked X in columns 1, 2, or 3 of table VI, as applicable. Presence of one or more defects shall be cause for rejection.

4.3.2 Tests. The first produced pipe(s), coupling(s), and fitting(s) for each type, class, and size of pipe specified shall be subjected to the tests marked X in columns 1, 2, or 3 of table VII, as applicable. Failure of any test shall be cause for rejection.

4.4 Quality conformance inspection.

4.4.1 Lot size.

4.4.1.1 Pipe. For the purpose of inspection all pipe of the same type, class, and size presented for inspection at one time shall be considered a lot.

4.4.1.2 Couplings and fittings. For the purpose of inspection all couplings and fittings for the same type, class, and size pipe presented for inspection at one time shall be considered a lot.

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4.4.2 Sampling. Sampling for examination and test shall be in accordance with MIL-STD-105, inspection level S-2.

4.4.3 Examination. Samples selected in accordance with 4.4.2 shall be examined for the defects marked X in columns 4, 5, and 6 of table VI, as applicable. Presence of one or more defects shall be cause for rejection.

TABLE VI. Examination schedule

First Produced			Quality Conformance			Examination		Requirement Paragraph
Pipe	Coupling	Fitting	Pipe	Coupling	Fitting			
1	2	3	4	5	6	7		8
X	X	X	X	X	X	101.	Material not as specified.	3.3
X	-	-	X	-	-	102.	Length of pipe not as specified.	3.4.2.1
X	X	X	X	X	X	103.	Inside diameter not as specified.	3.4.2.2
X	X	X	X	X	X	104.	Inside diameter out of round.	3.4.2.3
X	-	-	X	-	-	105.	Straightness of pipe not as specified.	3.4.2.4
-	X	X	-	X	X	106.	Couplings or fittings not as specified.	3.5
-	X	X	-	X	X	107.	Sealing rings not as specified.	3.6
X	X	X	X	X	X	108.	Identification marking not as specified.	3.10
X	X	X	X	X	X	109.	Workmanship not as specified	3.11

4.4.4 Tests. Samples selected in accordance with 4.4.2 shall be subjected to the tests marked X in columns 4, 5, and 6 of table VII, as applicable. Failure of any test shall be cause for rejection.

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TABLE VII. Test schedule

First Produced			Quality Conformance			Test	Test Paragraph
Pipe	Couplings	Fittings	Pipe	Couplings	Fittings		
1	2	3	4	5	6	7	8
X	X	X	X	X	X	Test preparation.	4.5.1
X	-	-	X	-	-	Flexural Strength	4.5.2
X	X	X	X	X	X	Crushing Strength	4.5.3
X	1/	1/	X	1/	1/	Uncombined Calcium Hydroxide	4.5.4
X	X	X	X	X	X	Joint tightness	4.5.5

1/ When couplings and fittings are asbestos cement the uncombined calcium hydroxide test shall apply.

4.5 Tests.

4.5.1 Test preparation. All pipe, couplings, and fittings shall be in a normal air-dry condition. The apparatus used for the flexural and crushing tests shall be constructed so that the distribution of the load will not be affected appreciably by the deformation or yielding of any part of the apparatus.

4.5.2 Flexural strength. Flexural strength tests shall be performed in accordance with ASTM C500, sections 5, 6, and 7. Inability of the pipe to support the minimum load specified in table IV shall constitute failure of this test.

4.5.3 Crushing strength. The crushing strength of the pipe, couplings, and fittings shall be determined as specified in ASTM C500, sections 8, 9, and 10. Inability of the pipe, coupling, or fitting to withstand 75 percent of the minimum load specified in table V shall constitute failure of this test. When any specimen tested for crushing strength withstands over 75 percent but under 100 percent of the load specified in table V, one specimen shall be cut from each of two additional pipes, couplings, and fittings of the same lot and the test repeated. Failure of any of these additional specimens to withstand 100 percent of the load specified in table V shall constitute failure of this test.

CTD015736

4.5.4 Uncombined calcium hydroxide (free lime). The amount of uncombined calcium hydroxide in the pipe, coupling, and fitting shall be determined as specified in ASTM C500, sections 13, 14, 15, 16, and 17. If the lime content of the samples is in excess of that specified in 3.9 for the particular class pipe, two additional samples shall be selected and tested from pipe of the same lot and two from the couplings. Nonconformance of any of these additional samples to 3.9 shall constitute failure of this test.

4.5.5 Joint tightness. A hydrostatic pressure test shall be conducted on an assembly of two sections of pipe, correctly connected in a straight alinement with a coupling in accordance with the joint design. The assembly shall be subjected to an internal hydrostatic pressure of 10 psi for 10 minutes. Upon completion of this procedure, deflect the test assembly 5 degrees for 12 inch and smaller diameter pipe and 3 degrees for 14 inch and larger with one half the deflection being between each pipe and the coupling, and subject the assembly to an internal hydrostatic pressure of 10 psi for 10 minutes. If any leakage occurs in the test assembly in either the straight alinement or the deflected position, select three additional test assemblies from the same lot and test them in the straight alinement and deflected position as specified above. The occurance of leakage in any of the three additional sections in either position shall constitute failure of this test.

4.6 Inspection of preparation for delivery.

4.6.1 Quality conformance inspection of pack.

4.6.1.1 Unit of product. For the purpose of inspection, a completed pack prepared for shipment shall be considered a unit of product.

4.6.1.2 Sampling. Sampling for examination shall be in accordance with MIL-STD-105.

4.6.1.3 Examination. Samples selected in accordance with 4.5.1.2 shall be examined for the following defects. AQL shall be 2.5 percent defective.

110.	Materials and containers not as specified for level A or B.	Each incorrect material, or container shall constitute one defect.
111.	Bundled pipe contains various types, classes, and sizes for level A or B.	
112.	Bundled pipe not bundled and secured as specified for level A or B.	
113.	Couplings not attached to the pipe, not boxed or palletized as specified for level A or B.	

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114. Strapping not zinc coated for level A.
115. Palletized loads not in accordance with the referenced document and table for level A or B.
116. Sealing rings not packed as specified for level A or B.
117. Marking missing, illegible, incorrect or incomplete.

5. PREPARATION FOR DELIVERY

5.1 Packing. Packing shall be level A, B, or C as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Pipe. Pipe shall be shipped loose or in secured bundles. Bundles shall contain only pipe of the same type, class and size. Each bundle shall be secured with not less than three equally spaced straps. Strapping shall conform to QQ-S-781, type 1, class B, size 1-1/4 by 0.035 inches.

5.1.1.2 Couplings and fittings. Couplings and fittings for the same type and class and size pipe shall be packed together in a close-fitting box conforming to PPP-B-601, overseas type, style optional, or in palletized loads in accordance with table VIII. Couplings and fittings packed in boxes shall be immobilized within the box to prevent movement and damage and the gross weight shall not exceed the limitation of the box. Box closure shall be in accordance with the appendix to the box specification. Strapping shall be zinc coated. Couplings and fittings to be palletized shall be prepared as palletized loads in accordance with MIL-STD-147, using the most applicable load type. The pallets shall conform to NN-P-71, type I, II, III, or IV, size 2, group 2 or 3, except the pallet size shall be in accordance table VIII. Bonding of the couplings and fittings on the pallets shall conform to MIL-STD-147.

TABLE VIII. Palletized loads

Coupling size	Pallet size	Number couplings per pallet width	Number couplings per pallet length	Number couplings per layer	Number couplings high	Number couplings per pallet
1	2	3	4	5	6	7
(Inch)	(Inch)					
4	45.5 x 52	7	8	56	7	392
5	45.5 x 52	6	7	42	7	294
6	45.5 x 52	5	6	30	7	210
8	45.5 x 52	4	5	20	5	100
10	45.5 x 52	3	4	12	5	60
12	45.5 x 52	3	3	9	5	45

CTD015738

TABLE VIII. Palletized loads (con.)

1	2	3	4	5	6	7
14	45.5 x 52	2	3	6	4	24
16	45.5 x 60	2	3	6	4	24
18	45.5 x 45.5	2	2	4	4	16
20	45.5 x 45.5	1	2	2	4	8
24	45.5 x 45.5	1	1	1	4	4
27	45.5 x 45.5	1	1	1	3	3
30	45.5 x 45.5	1	1	1	3	3
33	45.5 x 45.5	1	1	1	3	3
36	45.5 x 45.5	1	1	1	3	3
39	45.5 x 45.5	1	1	1	3	3
42	45.5 x 45.5	1	1	1	3	3

5.1.1.3 Sealing rings. Sealing rings of like description shall be packed together in a close-fitting box conforming to PPP-B-601, overseas type, style optional, in quantities, not to exceed a gross weight of 200 pounds. Box closure shall be in accordance with the appendix to the box specification. Strapping shall be zinc coated.

5.1.2 Level B. Packing shall be as specified in 5.1.1 for level A except boxes for couplings shall be domestic type and strapping need not be zinc coated. Boxes for sealing rings shall conform to PPP-B-636, type CF, class weather resistant, variety and grade as applicable to the weight of the contents, style optional.

5.1.3 Level C. Pipe, couplings, and sealing rings shall be prepared for delivery in a manner to assure carrier acceptance and safe delivery to destination at lowest ratings in compliance with Uniform Freight Classification rules or National Motor Freight Classification rules.

5.2 Marking.

5.2.1 Civil agencies. Loose pipe, bundles, palletized unit loads, and shipping containers, shall be marked in accordance with FED. STD. No. 123.

5.2.2 Military agencies. Loose pipe, bundles, palletized unit loads, and shipping containers shall be marked in accordance with MIL-STD-129.

CTD015739

6. NOTES

6.1 Intended use. Pipes covered by this specification are intended for conveying sanitary sewage in gravity flow sewage systems. Type I pipe is intended for use where moderate aggressive water or soil of moderate sulfate content, or both, are expected to come in contact with the pipe. Type II pipe is intended for use where highly aggressive water or water and soil of high sulfate content are expected to come into contact with the pipe. When this pipe is to be used in areas having warm climates which tend to promote generation of hydrogen sulfide in sewage, such generation should be controlled in the design of the sewage system. In cases where the generation of hydrogen sulfide cannot be controlled by design, the use of asbestos-cement pipe with lining conforming to ASTM C541 should be considered. When this pipe is to be used in sewage systems servicing industries producing acid wastes, such wastes should receive an adequate degree of neutralization or dilution prior to discharge into the sewage system by means of an appropriately designed facility. Type III pipe is intended for use where contact with aggressive waters and sulfates are not expected.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in the procurement documents:

(a) Title, number, and date of this specification.
(b) Type, class, and size of pipe required (see 1.2.1).
(c) Time frame required for submission of first produced item(s) and number of items to be furnished (see 3.2).
(d) When short lengths of sewer pipe are required and length(s) required (see 3.4.1).
(e) When couplings are to be furnished separately (see 3.5.1).
(f) When fittings are required (see 3.5.2).
(g) Whether non-oil resistant or oil resistant sealing rings are required (see 3.6).
(h) Level of packing required (see 5.1).

6.3 The requirements of this specification are similar to ASTM C428, asbestos-cement nonpressure sewer pipe, and ASTM C644, asbestos-cement nonpressure small diameter sewer pipe.

6.4 Classification changes. Classification changes between this and the previous issue of this specification are:

Class 6000 and class 7000 - added.
Sizes 4, 5, 27, 33, 39, and 42 inch diameter - added.

CTD015740

6.5 First produced items(s). Any changes or deviations of production pipe and couplings from the approved first produced item(s) during production will be subject to the approval of the contracting officer. Approval of the first produced item(s) will not relieve the supplier of his obligation to furnish pipe and couplings conforming to this specification.

MILITARY INTEREST

Custodians:

Army - ME
Navy - YD
Air Force - 84

Preparing activity:

Army - ME

Civil Agency Coordinating Activities:

COMMERCE - NBS
GSA - PCD, FSS
FOREST SERVICE - AFS

Project No. 5630-0030

☆ U. S. GOVERNMENT PRINTING OFFICE : 1972 O - 514-174 (219)

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CTD015741

SS-P-340B
August 18, 1969
SUPERSEDING
Int. Fed. Spec. SS-P-00340A (DOT-PR)
October 11, 1968

FEDERAL SPECIFICATION

PIPE, ASBESTOS-CEMENT PERFORATED UNDERDRAIN

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers asbestos-cement perforated pipe, fittings, and couplings to be used as underdrains for subsurface drainage.

1.2 Classification.

1.2.1 Types. Pipe covered by this specification shall be of the following types, as specified (see 6.2).

Type I - For use where contact with moderately aggressive water or water and soil of moderate sulfate content are expected.
Type II - For use where contact with highly aggressive water or water and soil of high sulfate content are expected.
Type III - For use where contact with aggressive waters and sulfates are not expected.

1.2.2 Sizes and lengths. Perforated pipe covered by this specification shall be of the following nominal inside diameters and lengths, as specified (see 6.2).

Sizes: 4, 6, 8, 10, and 12 inches.
Lengths: 10 or 13 feet.

1.2.3 Fittings. Fittings shall be the same type as the pipe specified (see 6.2) and shall be of suitable size, strength, and design.

2. APPLICABLE DOCUMENTS

2.1 Specifications and standards. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

Federal Specifications:

PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner.
PPP-B-601 - Boxes, Wood, Cleated-Plywood.
PPP-C-650 - Crates, Wood, Open and Covered.

Federal Standard:

Fed. Std. No. 123 - Marking for Domestic Shipment (Civilian Agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, Wash.

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(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-130 - Identification Marking of U.S. Military Property.
MIL-STD-1186 - Cushioning, Anchoring, Bracing, Blocking, and Waterproofing, with Appropriate Test Methods.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Publications:

C500 - Testing Asbestos-Cement Pipe.
C508 - Specification for Asbestos-Cement Perforated Underdrain Pipe.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.)

Uniform Classification Committee:

Uniform Freight Classification.

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, 516 West Jackson Boulevard, Chicago, Illinois 60606.)

National Classification Board:

National Motor Freight Classification.

(Application for copies of rules should be addressed to the National Classification Board, 1616 P Street, N. W., Washington, D. C. 20036.)

3. REQUIREMENTS

3.1 Description. The pipe, couplings, and fittings shall be in accordance with ASTM C508 and as specified herein.

3.2 Couplings. Unless otherwise specified (see 6.2) each length of pipe or each fitting shall be furnished with a coupling.

3.3 Identification marking.

3.3.1 Civil agencies. Each length of pipe and fitting shall be marked with the manufacturer's name or trademark, the nominal size, date of manufacture, and the word "Underdrain".

3.3.2 Military agencies. Each length of pipe and fitting shall be marked in accordance with MIL-STD-130.

3.4 Workmanship. Asbestos-cement pipe and fittings shall be uniform in quality, have squared ends, ans shall be free from bulges, dents, and tears.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that suppliers and services conform to prescribed requirements.

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4.2 Classification of inspection. Inspection shall be classified as follows:

(a) Quality conformance inspection (see 4.3).
(b) Inspection of preparation for delivery (see 4.4).

4.3 Quality conformance inspection.

4.3.1 Unit of product. For the purpose of inspection, one pipe with coupling or fitting shall be considered a unit of product.

4.3.2 Sampling.

4.3.2.1 Examination. Sampling for examination shall be in accordance with MIL-STD-105.

4.3.2.2 Tests. Sampling for tests shall be in accordance with ASTM C508.

4.3.3 Examination. Samples selected in accordance with 4.3.2.1 shall be examined as follows for major defects. The Acceptable Quality Level (AQL) shall be 2.5 percent defective.

101. Dimensions not as specified.
102. Couplings or fittings not as specified.
103. Identification marking omitted, incorrect, or illegible.
104. Workmanship not as specified.

4.3.4 Tests. Samples selected in accordance with 4.3.2.2 shall be examined as specified in 4.4.2.

4.4 Inspection of preparation for delivery.

4.4.1 Examination. The pipe, couplings, and fittings shall be examined for the following defects.

105. Materials and containers not as specified for level A, B, or C. Each incorrect material or container shall be considered one defect.
106. Pipe of different types, sizes, or lengths packed together for level A or B.
107. Blocking, bracing, and anchoring not as specified for level A or B.
108. Couplings and fittings of different descriptions packed together for level A or B.
109. Strapping not zinc coated for level A.
110. Marking missing, illegible, incorrect, or incomplete for level A, B, or C.

4.4.2 Tests. The pipe, couplings, and fittings shall be tested as specified in ASTM C500 (see 3.1).

5. PREPARATION FOR DELIVERY

5.1 Packing. Packing shall be level A, B, or C as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Pipe. Pipe of like type, size, and length shall be packed together in a crate conforming to PPP-C-650, Type III, Style B, open. The pipe shall be blocked, braced, and anchored to the crate base in accordance with the appendix to the crate specification and in accordance with MIL-STD-1186. Closure and strapping of the crate shall be in accordance with the appendix to the crate specification.

5.1.1.2 Couplings and fittings. Couplings and fittings of like description shall be packed together in quantities not to exceed the weight limitations of the box, in a close fitting box conforming to PPP-B-621, class 2, style optional, or PPP-B-601, overseas type, style optional. The contents shall be blocked, braced, anchored, or cushioned as applicable to prevent free movement and damage. Closure shall be in accordance with the appendix to the applicable box specification. Strapping shall be zinc coated. The box containing the couplings and fittings shall be shipped separate from but at the same time as the crate containing the pipe.

5.1.2 Level B. Packing shall be as specified for level A except boxes for couplings and fittings shall be domestic type or class as applicable and strapping shall not be required to be zinc coated.

5.1.3 Level C. Pipe, couplings, and fittings shall be prepared for delivery in a manner to assure carrier acceptance and safe delivery to destination at lowest ratings in compliance with Uniform Freight Classification Rules or National Motor Freight Classification.

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5.2 Marking.

5.2.1 Civil agencies. Marking for shipment and storage shall be in accordance with Federal Standard No. 123.

5.2.2 Military agencies. Marking for shipment and storage shall be in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. Asbestos-cement underdrain pipe is intended for use in subsurface drainage of highways, airports, foundations, and other similar drainage work.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

(a) Title, number, and date of this specification.
(b) Type, size, and length of pipe required (see 1.2.1 and 1.2.2).
(c) Total linear footage of pipe required (see 6.3).
(d) Number, kind, and nominal size of fittings required (see 1.2.3).
(e) When couplings are not to be included (see 3.2).
(f) Size of lot, if different from the total of all pipe and accessories offered for delivery at the same time.
(g) Level of packing required (see 5.1).

6.3 Pipe normally shall be ordered by total linear footage only.

6.4 Perforations. Perforations are circular holes 1/4 inch in diameter, approximately 3 inches on center, arranged in rows parallel to the axis of the pipe. Rows are arranged in two equal groups on either side of the vertical center line of the pipe, and the total number of rows for sizes 4, 6, and 8 is 4; for sizes 10 and 12, there are 6 rows.

6.5 Similar specification. This specification is similar to American Association of State Highway Officials (AASHO) designation M 189.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1969 O - 395-524 (4147)

Order for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein. Price 10 cents each.

CTD015745

SS-P-351c
August 12, 1968
SUPERSEDING
Int. Fed. Spec. SS-P-00351b(GSA-FSS)
December 7, 1966 and
Fed. Spec. SS-P-351a
October 7, 1953

FEDERAL SPECIFICATION

PIPE AND COUPLINGS, ASBESTOS-CEMENT, PRESSURE

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers asbestos cement pressure pipe and couplings for conveying water, sewage, and other fluids under pressure.

1.2 Classification.

1.2.1 Types, classes, sizes, and lengths. Pipe shall be of the following types, classes, sizes and lengths, as specified (see 6.2):

Types:

Type I - Three percent maximum lime content.
Type II - One percent maximum lime content.
Type III - Unrestricted lime content.

Classes:

Class 100-Maximum operating pressure, psi.
Class 150-Maximum operating pressure, psi.
Class 200-Maximum operating pressure, psi.

Sizes:

Diameter, pipe size
4,6,8,10,12,14,16,18,20,24,30, and 36 inches.

Lengths:

13 feet, all pipe sizes.
10 feet, four and six-inch pipe sizes.

2. APPLICABLE DOCUMENTS

2.1 Specifications and standards. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

Federal Specifications:

PPP-B-585 - Boxes; Wood, Wirebound.
PPP-B-591 - Boxes; Fiberboard, Wood-Cleated.
PPP-B-601 - Boxes; Wood, Cleated-Plywood.
PPP-B-621 - Boxes; Wood, Nailed and Lock-Corner.

Federal Standard:

Fed. Std. No. 123 - Marking for Domestic Shipment (Civilian Agencies).

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(Activities outside the Federal Government may obtain copies of Federal Specification and Standards as outlined under General Information in the Index of Federal Specification and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Wash D.C., Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, Seattle, Wash.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specification and Standards from established distribution points in their agencies.)

Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-147 - Palletized Unit Loads (40" x 48" 4-Way Partial and 4-Way Pallets).

(Copies of specifications standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Publications:

C296 - Specification for Asbestos-Cement Pressure Pipe.
C500 - Methods of Testing Asbestos-Cement Pipe.
D1869 - Specification for Rubber Rings for Asbestos-Cement Pipe.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.)

Uniform Classification Committee:

Uniform Freight Classification Rules.

(Application for copies should be addressed to the Uniform Classification Committee, 202 Union Station, 516 W. Jackson Blvd., Chicago, Ill., 60606.)

National Classification Board:

National Motor Freight Classification Rules.

(Application for copies should be addressed to the National Classification Board, 1616 P Street N.W., Washington, D. C., 20036.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Pipe and couplings. Types I, II, and III pipe and couplings shall conform to ASTM C296 (see 4.4.1.1 and 4.4.1.2).

3.2 Elastomer coupling rings. Rings shall conform to ASTM D1869, and shall be non-oil resistant or oil resistant, as specified (see 4.4.2 and 6.2).

3.3 Pipe and accessories. Unless otherwise specified (see 6.2), a coupling and the necessary number of sealing rings shall be furnished with each length of pipe.

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3.4 Identification marking. Unless otherwise specified (see 6.2), each length of pipe shall be marked with the nominal size, class, name of the manufacturer or his trademark, and date of manufacture. All parts of sleeve couplings, except bolts and nuts if used, shall be marked with the manufacturer's identification, size, and class of pipe for which the parts are intended.

3.5 Workmanship. The pipe shall be uniform in structure and of such homogeneous composition that the pipe may be cut, drilled, and machined.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirments specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Sampling

4.2.1 Lot. Unless otherwise specified (see 6.2), a lot shall consist of all pipe and accessories offered for delivery at the same time.

4.2.2 Unit of product. For the purpose of quality conformance inspection, one pipe with sleeve coupling and rubber rings when so specified (see 3.3) shall be considered a unit of product.

4.2.3 Samples for visual and dimensional examination. Sampling shall be in accordance with MIL-STD-105, inspection level S-3.

4.2.4 Samples for test. Sampling of pipe and couplings shall be in accordance with ASTM C296. Sampling of rings shall be in accordance with ASTM D1869.

4.3 Examination

4.3.1 Visual and dimensional. Pipe and accessories shall be examined for the following major defects. The Acceptable Quality Level (AQL) shall be 2.5 percent defective.

101. Dimensions not as specified.
102. Coupling or joints not as specified.
103. Identification marking omitted, incorrect, or illegible.
104. Workmanship not as specified.

4.3.2 Inspection of preparation for delivery.

4.3.2.1 Quality conformance inspection of pack.

4.3.2.1.1 Unit of product. For the purpose of inspection, a completed pack prepared for shipment shall be considered a unit of product.

4.3.2.1.2 Sampling. Sampling for examination shall be in accordance with MIL-STD-105.

4.3.2.1.3 Examination. Samples selected in accordance with 4.2.3. shall be examined for the following minor defects. AQL shall be 2.5 percent defective.

105. Materials and containers not as specified for level A or B.
106. Each incorrect material or container shall be considered on defect.
107. Couplings not palletized as required for level A or B.
108. Strapping not zinc coated for level A.
109. Marking missing, illegible, incorrect, or incomplete.

4.4 Test methods.

4.4.1 Pipe and couplings.

4.4.1.1 Flexural, crushing, and hydrostatic strength. Conduct these tests in accordance with ASTM C500 (see 3.1).

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4.4.1.2 Uncombined calcium hydroxide (free lime). When specified (see 3.1 and 6.2), test for free lime in accordance with ASTM C500.

4.4.2 Rings. Test for non-oil resistant, and oil resistant rings in accordance with ASTM D1869 (see 3.2).

5. PREPARATION FOR DELIVERY

5.1 Packing. Packing shall be level A, B, or C, as specified (see 6.2).

5.1.1 Level A

5.1.1.1 Pipe. The pipe shall be prepared for delivery as loose pieces.

5.1.1.2 Couplings. Couplings shall be prepared as palletized loads. Unless otherwise specified (see 6.2), pallets shall conform to MIL-STD-147, load type XVII, except the size of pallets, the number of couplings, and the pallet applicable to the type of load which shall be in accordance with table I. Bonding of the couplings on pallets shall also conform to MIL-STD-147.

TABLE I. Palletized loads

Coupling size	Pallet size	Number couplings per pallet width	Number couplings per pallet length	Number couplings per layer	Number couplings high	Number couplings per pallet
Inch	Inch					
6	45.5 x 52	5	6	30	5	150
8	45.5 x 52	4	5	20	5	100
10	45.5 x 52	3	4	12	5	60
12	45.5 x 52	3	3	9	5	45
14	45.5 x 52	2	3	6	4	24
16	45.5 x 60	2	3	6	4	24
18	45.5 x 45.5	2	2	4	4	16
20	45.5 x 45.5	1	2	2	4	8
24	45.5 x 45.5	1	1	1	4	4
30	45.5 x 45.5	1	1	1	3	3
36	45.5 x 45.5	1	1	1	3	3

5.1.1.3 Gaskets and sealing rings. Gaskets and sealing rings of like size and description shall be packed in boxes conforming to PPP-B-621, class 2, style optional, PPP-B-601, overseas type, style optional; PPP-B-585, style optional, class 2, or PPP-B-591, overseas type, style optional. The boxes shall be close-fitting and shall be strapped in accordance with the appendix to the box specification. Strapping shall be zinc coated. The gross weight of each box shall not exceed 200 pounds.

5.1.2 Level B. Packing shall be as specified in 5.1.1 for level A, except boxes for gaskets and sealing rings shall be domestic class or type as applicable, and strapping need not be zinc coated.

5.1.3 Level C. The pipe, couplings, gaskets, and sealing rings shall be prepared for delivery to assure carrier acceptance and safe delivery to destination at lowest rating. Containers and packing shall comply with Uniform Freight Classification Rules or National Motor Freight Classification Rules.

5.2 Marking

5.2.1 Civil agencies. The loose pipe, palletized unit loads, and shipping containers shall be marked in accordance with Fed. Std. No. 123.

5.2.2 Military agencies. The loose pipe, palletized unit loads, and shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use.

6.1.1 Type I. For use where moderately aggressive water and soil of moderate sulfate content are expected to come in contact with the pipe.

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6.1.2 Type II. For use where highly aggressive water or water and soil of high sulfate content, or both, are expected to come in contact with the pipe.

6.1.3 Type III. For use where contact with aggressive waters and sulfates are not expected.

6.2 Ordering data. Purchasers should select the perferred options permitted herein and include the following information in procurement documents:

(a) Title, number, and date of this specification.
(b) Type, class, and size of pipe required (1.2 and 6.4).
(c) Whether coupling rings shall be oil - or non-oil-resistant (3.2).
(d) Accessories, if other than specified (3.3).
(e) Identification marking (see 3.4).
(f) Size of lot, if different from 4.2.1.
(g) Whether chemical analysis is required for types I and II (see 4.4.2.2).
(h) Selection of applicable level of packing required (see 5.1).
(i) When required, size of pallets and number of couplings per pallet (see 5.1.1.2).

6.3 Similar specification. American Water Works Association AWWA C400 for Asbestos-Cement Water Pipe contains requirements and tests similar to ASTM C296 and C500.

6.4 Selection of pipe classes. Refer to AWWA M2, Standard Practice for the Selection of Asbestos-Cement Water Pipe. Copies may be obtained from the American Water Works Association, 2 Park Avenue, New York, N. Y. 10016.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1968 O - 342-503 (3138)

Order for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein. Price 5 cents each.

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SOIL CONS.
SERVICE

SOIL CONSERVATION SERVICE

ENGINEERING STANDARD

IRRIGATION PIPELINE
Asbestos-Cement

Definition

A pipeline and appurtenances installed in an irrigation system.

Scope

This standard applies to buried asbestos-cement pipelines with rubber gasket joints.

Purpose

The conservation objectives of this pipeline practice are to prevent erosion or loss of water quality or damage to land, to make possible the proper management of irrigation water, and to reduce water conveyance losses.

Conditions Where Practice Applies

All pipelines shall be planned and located to serve as integral parts of an irrigation water distribution or conveyance system that has been designed to facilitate the conservation use of soil and water resources on a farm or group of farms.

All lands served by the pipelines shall be suitable for use as irrigated land.

Water supplies and irrigation deliveries to the area shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Design Criteria

Pressure

The maximum design working pressure shall be based on a safety factor of no less than 3.0 applied to the certified hydrostatic proof pressure as determined in accordance with Section 4, ASTM C 500. Hydrostatic test pressures for standard working pressure classification shall be as specified in Table 1.

For pipelines to be used principally for conveyance, where adequate hydraulic analysis of surge, water hammer or other pressure change is made on the basis of anticipated operating conditions, and where

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combined loading stresses are determined, a safety factor of 3.0 or less may be applied to the hydrostatic proof pressure to determine the maximum design working pressure.

The minimum acceptable working pressure classification shall be 15 p.s.i.

Pipelines may be designed either closed or open to the atmosphere.

External Load Limit

A safety factor of at least 1.50 shall be applied to the certified 3-edge bearing test in computing allowable heights of fill over the pipe. The earth loads shall be computed by the method outlined in Soil Conservation Service Technical Release No. 5.

Capacity

Design capacity shall be based on whichever of the following is greater:

1. The capacity shall be sufficient to deliver the volume of water needed to meet the peak consumptive use of the crop.

2. The capacity shall be sufficient to provide an adequate irrigation stream for all planned methods of irrigation.

Friction Loss

For design purposes, the pipeline friction loss shall be no less than that computed by the Hazen-Williams formula using a roughness coefficient, c, of 140.

Check Valves

Where detrimental backflow may occur, a check valve shall be installed between the pump discharge and the pipeline.

Pressure Relief, Vacuum Release, and Air Release Valves - Pipelines Closed to the Atmosphere

A pressure relief valve shall be installed at the pump location when excessive pressure can be developed by operating with all valves closed. Also, in closed systems where the line is protected from reversal of flow by a check valve and excessive surge pressures could be developed, a surge chamber or pressure relief valve shall be installed close to the check valve or the side away from the pump.

Pressure relief valves for all classes of asbestos cement pipe except Class 15 Irrigation Pipe shall be no smaller than 1/4-inch nominal size for each diameter inch of the pipeline, and shall be set at a maximum of 5 p.s.i. above the pressure rating of the pipe.

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Pressure relief valves for Class 15 Irrigation Pipe shall have a flow capacity of equal to the pipeline design flow rate with a pipeline pressure no greater than 50 percent higher than the permissible working head for the pipe. Such pressure relief valves shall be marked with the pressure at which the valve starts to open; and adjustable pressure relief valves shall be sealed or otherwise altered to prevent changing of the adjustment from that marked on the valve.

A pressure relief valve or surge chamber shall be installed at the end of the pipeline when needed to relieve surge.

Pressure relief valves do not function as air release valves and shall not be used as substitutes for air release valves or to perform the air release function of vents or valves.

Air release and vacuum release valves shall be placed at all summits in the pipeline, at the end of the line, and between the pump and check valve when needed to provide a positive means of air entrance or escape.

Air release and vacuum release valve outlets shall be at least 1-inch nominal diameter when specified for lines of 5- to 8-inch diameter, at least 2-inch outlets for lines of 10- to 16-inch diameter, at least 4-inch outlets for lines of 18- to 28-inch diameter, at least 6-inch outlets for lines of 30- to 36-inch diameter, and at least 8-inch outlets for lines of 38- to 48-inch diameter.

For pipelines larger than 16-inch diameter, 2-inch air release valves may be used in place of the sizes indicated above if they are supplemented with vacuum release valves that will provide vacuum release capacity equal to the sizes shown.

Stands and Vents - Lines Open to the Atmosphere

General.
Stands shall be placed at each inlet to the irrigation pipe system and at such other points as required. All stands shall serve as vents in addition to their other functions. All stands will be supported on a base adequate to support the stand and prevent movement or undue stress on the pipeline. All stands will comply with the following:

1. Avoid entrainment of air.

2. Allow 1 to 5 feet of freeboard.

3. Conform to ASTM C 76 or C 478 when concrete pipe greater than 24 inches in diameter is used for a stand.

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4. When cast in place, contain steel reinforcing on not more than 1-foot centers to provide steel areas equal to or greater than the least values specified for Class II (1500-D-Ultimate) pipe in ASTM C 76.

5. The tops of all stands shall be at least 4 feet above the ground surface, except that if visibility is not a factor, the top may be lower if covered or equipped with trash guards.

Pump stands.
Pump stands shall be one of the following types:

1. Concrete box stands with vertical sides, suitably reinforced.

2. Non-tapered stands of concrete pipe, suitably reinforced.

3. Non-tapered concrete pipe stands, capped and having a vent pipe of the height required to take care of hydraulic gradient plus freeboard.

4. Steel cylinder stands mortared to short concrete pipe riser.

The centerline of the pump discharge pipe shall have a minimum vertical offset from the centerline of the outlet pipe equal to the sum of the diameters of the inlet and outlet pipes. This may be through the side of the stand or over the top.

Construction shall be such as to insure that the vibration from the pump discharge pipe is not carried to the stand.

Velocities in stand.
Downward water velocities shall not exceed 2 feet per second. In no case shall such velocities exceed the average pipeline velocity.

If the size of a pump stand is decreased above the pump discharge pipe, the top vent portion shall be of such inside cross-sectional area that, if the entire flow of the pump were discharging through it, the average velocity will not exceed 10 feet per second.

Gate stands.
Gate stands shall:

1. Be constructed of concrete pipe or shall be cast-in-place concrete. Reinforcing requirements listed under Stand Requirements will apply.

2. Have dimensions sufficient to accommodate the gate or gates required.

3. Serve as vents.

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4. Be of such dimensions that gates are accessible for repair.

Float valve stands.
Float valve stands shall be of sufficient diameter to provide accessibility for maintenance and to dampen surge.

Sand traps.
Pump stands or gravity inlets serving as sand traps shall have a minimum inside diameter of 30 inches and shall be constructed so that the bottom is at least 24 inches below the invert of the outlet pipeline. Suitable provisions for cleaning sand traps shall be provided.

Vent requirements.
Vents must be designed into the system to provide for the removal of air and protection from surge. They shall:

1. Have a minimum freeboard of 1 foot above the hydraulic grade-line. The maximum height of the vent above the centerline of the pipeline must not exceed the maximum working head of the pipe.

2. Have a cross-sectional area at least one-half the cross-sectional area of the pipeline (both inside measurements) for a distance of at least 1 pipeline diameter up from the centerline of the pipeline. Above this elevation the vent may be reduced to 2 inches in diameter.

3. Be located:

   a. At the downstream end of each lateral.

   b. At summits in the line.

   c. At points where there are changes in grade in a downward direction of flow of more than 10 degrees.

   d. Immediately below the pump stand if the downward velocity in the stand exceeds 1 foot per second.

Draining and Flushing Requirements
Provisions shall be made for draining the pipeline completely where a hazard is imposed by freezing temperatures or drainage is specified for the job or recommended by the pipe manufacturer.

Where provisions for drainage are required, drainage outlets shall be located at all low places in the line. These outlets may drain into dry wells or to points of lower elevation. If drainage cannot be thus provided by gravity, provisions shall be made to empty the line by pumping.

A suitable valve shall be installed at the distal end of the line when flushing to remove sediment is required.

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Outlets

Appurtenances to deliver water from a pipe system to the land, a ditch, or any surface pipe system shall be known as outlets. Outlets shall have a capacity to deliver the required flow:

1. To the hydraulic gradeline of a pipe or ditch.

2. To a point at least 6 inches above the field surface.

3. To an individual sprinkler or lateral line at the design operating pressure of the sprinkler or lateral line as the case may be.

Thrust Control

Abrupt changes in pipeline grade, horizontal alignment, or reduction in size require an anchor or thrust blocks to absorb any axial thrust of the pipeline.

Where thrust blocks or anchors are used, they shall be constructed of concrete or soil cement with at least one part cement to 12 parts soil of sandy loam or coarser texture. Thrust blocks shall fill the space between the pipe and the undisturbed earth at the side of the trench on the outside of bends to the full height of the outside diameter of the pipe, shall have a minimum thickness of 6 inches and a length in feet perpendicular to the direction of thrust equal to:

$$(98\ HD\ Sin\ 1/2\ a)/B$$

Where:

H = maximum working head in feet

D = inside diameter of the pipe in feet

B = allowable passive pressure of the soil in pounds per square foot, and

a = deflection angle of the pipe bend.

Materials

All materials shall conform to the minimum requirements of this Standard under Engineering Specifications for Materials.

Installation Requirements

Placement

All pipe shall be placed deep enough below the land surface to protect it from hazards imposed by traffic crossings, farm operations, freezing temperatures, or soil cracking. Minimum cover shall be 2 feet except in soils subject to deep cracking for which minimum cover shall

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be 3 feet. For Class 15 Irrigation Pipe (15# I.P.) minimum cover shall be 2 1/2 feet and maximum cover shall be 4 feet.

Extra fill may be placed over the pipeline to provide the minimum depth of cover if the top width of fill is not less than 10 feet and the side slopes are not steeper than 6 to 1.

Where trenches are excavated in soils containing rock or other hard materials, where soils are subject to appreciable swelling and shrinking on wetting and drying, or where the trench bottom is unstable, the trenches shall be over-excavated and backfilled with selected materials as needed to provide a suitable base. If water is in the trench, that water shall be drained away, and laying the pipe postponed until a suitable base has been obtained.

The pipe trench shall be reasonably straight. The maximum deflection in any one coupling shall not exceed 5 degrees for pipe sizes up to 12 inches and 3 degrees for larger sizes. Short radius curves may be introduced into the alignment by using short sections of pipe and giving each coupling no more than the maximum allowable deflection.

Trench width for Class 15 Irrigation Pipe (15# I.P.) shall be no wider than the pipe diameter plus 18 inches.

Testing

Pipelines shall be tested for leaks by observing their normal operation any time after the contractor has installed all appurtenances on the pipeline and indicated the pipeline as ready for testing.

The line shall be inspected in its entirety while the maximum working pressure is maintained. All visible leaks shall be promptly repaired and the line re-tested.

It shall be demonstrated by testing that the pipeline will function properly at design capacity. At or below design capacity there shall be no objectionable surge or water hammer. Objectionable flow conditions shall include continuing unsteady delivery of water, damage to the pipeline, and detrimental discharge from control valves.

Certification and Guarantee

The pipe shall be certified by the manufacturer for compliance with this standard.

The installing contractor shall certify that his installation complies with the requirements of this standard. He shall furnish a written guarantee designed to protect the owner against defective workmanship and materials over a period of not less than 2 years, and shall name the source of the asbestos-cement pipe used.

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Plans and Specifications

Plans and specifications for Asbestos Cement Irrigation Pipelines shall be in keeping with the Standard and shall describe the requirements for application of the practice to achieve its intended purposes.

ENGINEERING SPECIFICATIONS FOR MATERIALS

Pipe and Couplings

Asbestos-cement irrigation pipe shall be composed of an intimate mixture of Portland Cement ASTM C150 or of Portland Blast Furnace Slag Cement ASTM C595 or of Portland-Pozzolan Cement ASTM C595, silica and asbestos fiber and shall be free from organic substances. The material shall be formed under pressure and thoroughly cured to produce pipe meeting the requirements of these specifications.

Coupling sleeves shall be made of asbestos-cement and shall be machined with rubber ring retaining grooves so that when the joint is assembled a water-tight seal is provided. Assembly of pipe and coupling shall provide necessary end separation.

The types of pipe shall be known as Types I, II, and III corresponding to the chemical requirements given.

Type I - for use including those sites where moderately aggressive water, and soil of moderate sulfate content are expected to come in contact with the pipe and when tested in accordance with Sections 14 and 15 of ASTM C500, the amount of uncombined calcium hydroxide shall not exceed 3.0 percent.

Type II - for general use including those sites where either moderately or highly aggressive water or water and soil of both moderate and high sulfate content are expected to come in contact with the pipe, and when tested in accordance with Sections 14 and 15 of ASTM C500, the uncombined calcium hydroxide shall not exceed 1.0 percent.

Type III - for use only on those sites where contact with aggressive waters and sulfates are not expected. There are no chemical requirements for Type III pipe.

Asbestos cement irrigation pipe (SCS 432-B, I.P.) shall be classified in accordance with its allowable maximum operating pressure: 15, 25, 75, 90 and 125. Asbestos cement pressure pipe (ASTM C296) shall be classified in accordance with its pressure class: 100, 150 and 200. Asbestos cement transmission pipe (ASTM C668) shall be in classifications representing numerically one-tenth of the minimum hydrostatic strength.

Each standard, random, or short length of pipe and coupling sleeve shall be hydrostatically tested by the manufacturer prior to shipment and shall have sufficient strength to withstand the internal hydrostatic pressure prescribed in Table I when tested in accordance with Section 4 of ASTM C500.

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Each length of pipe shall have sufficient flexural strength to withstand, without failure, the total load prescribed in Table 2a and 2b for the classes and sizes listed, when tested in accordance with Section 7, ASTM C500.

Asbestos-cement pipe shall have a minimum crushing strength as indicated in Tables 3a and 3b, when tested in accordance with the crushing test as specified in Section 10 of ASTM C500.

Each length of pipe shall be marked with the manufacturer's identification, pipe classification, Type of pipe (Type I, II or III corresponding to the chemical requirements) and date of manufacture.

Each coupling shall be marked with the manufacturer's identification, nominal size, and letter "T" to indicate that it has been hydrostatically tested.

Gaskets

The rubber ring gaskets required for proper assembly of pipe and coupling shall conform to the manufacturer's dimensions and tolerances. They shall equal or exceed the specifications for gaskets in ASTM D1869.

Accessories

The valves, asbestos-cement or metal fittings, etc., shall be of adequate capacity and suitable quality to withstand the design pressures and shall be installed in accordance with the manufacturer's recommendation to meet the service requirements of the pipeline.

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Table 1

Applied Hydrostatic Proof Pressure

Applicable Specification No.	Classification	Working Pressure p.s.i.	Applied Proof Pressure p.s.i.	Size Range ins.
SCS 432-B Irrigation Pipe	15# I.P. 1/	15	45	10-36
	25# I.P.	25	75	3-36
	75# I.P.	75	225	3-36
	90# I.P.	90	270	3-36
	125# I.P.	125	375	3-36
ASTM C 296	Class 100	100	350	3-36
	Class 150	150	525	3-36
	Class 200	200	700	3-36
ASTM C 668	Classification number is one tenth of minimum hydrostatic strength 2/	One fourth of minimum hydrostatic strength 2/	Three fourths of minimum hydrostatic strength 2/	6-42

1/ I.P. = Irrigation Pipe
2/ Minimum hydrostatic strength as defined in Section 7, C 668

Table 2a

Minimum Flexural Strength

(Total Applied Load, Lbs.)

Nominal Size	Working Pressure Classification						
	432-B Irrigation Pipe				ASTM C 296		
Inches	25#	75#	90#	125#	Class 100	Class 150	Class 200
3	300	500	-	750	755	853	915
4	600	1000	-	1300	1200	1460	1860
5	900	1500	-	2000	-	-	-
6	1300	2000	2000	3300	2800	3700	4900
8	2500	3700	4000	6000	5330	7600	10130

Note: Based on 9-foot span for all sizes - See ASTM C 500, Section 7

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Table 2b

Minimum Flexural Strength

(Total Applied Load in Lbs.)

Nominal Size ins.	Pipe Classification C 668								
	30	35	40	45	50	60	70	80	90
6	-	-	2300	2500	2800	3200	3700	4000	4900
8	3700	4400	5100	5700	6400	6900	7600	8800	10100

Note: Based on 10-foot span for both sizes - See Section 7, ASTM C 500

Table 3a

Minimum Crushing Strength

(Lbs. Per Lineal Foot)

Nominal Size	Working Pressure Classification							
	Irrigation Pipe					ASTM C 296		
Inches	15#	25#	75#	90#	125#	Class 100	Class 150	Class 200
3	-	1500	2300	-	4400	4600	6700	8800
4	-	1100	1900	-	4200	4100	5400	8700
5	-	1000	1650	-	4000	-	-	-
6	-	1000	1400	1600	3700	4000	5400	9000
8	-	1300	1650	2000	4000	4000	5500	9300
10	1200	1500	1900	2100	4300	4400	7000	11000
12	1200	1500	2200	2300	4600	5200	7600	11800
14	1200	1500	2600	-	5000	5200	8600	13500
16	1400	1500	2750	-	5400	5800	9200	15400
18	1500	1800	2900	-	5800	6500	10100	17400
20	1800	2000	3100	-	6400	7100	10900	19400
24	2000	2400	3500	-	7500	8100	12700	22600
30	2400	3000	4100	-	9000	9700	15900	28400
36	3000	3600	5000	-	10500	11200	19600	33800

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Table 3b

Minimum Crushing Strength

(Lbs. per Lineal Foot)

Nominal Size ins.	Pipe Classification C 668								
	30	35	40	45	50	60	70	80	90
6	-	-	2400	3200	4000	4700	5400	6700	9000
8	2000	2400	2800	3400	4000	4800	5500	7400	9300
10	2000	2500	3000	3500	4500	5500	7000	9000	11000
12	2000	2500	3000	4000	5200	6400	7800	10000	12200
14	2000	2500	3000	4000	5200	7000	8800	11000	13500
15	2300	2800	3300	4300	5500	7400	9300	12000	14500
16	2500	3000	3500	4500	5800	7500	9500	12400	15400
18	2500	3000	4000	5000	6500	8500	11000	14000	18000
20	2500	3500	4500	5500	7100	9500	12000	15000	20000
21	2500	3500	4500	5800	7300	9700	12500	16000	21000
24	2800	3800	5000	6200	8100	11000	15000	19000	24000
27	3500	4200	5500	7000	8800	12500	16500	20500	27000
30	3500	4500	6000	7500	9700	13500	18000	22500	30000
33	3500	5000	6500	8000	10500	14500	19500	24500	33000
36	4000	5000	7000	9000	11200	16000	21000	26000	36000
39	4200	5300	7500	9700	12000	17200	22500	28000	39000
42	4300	5700	8000	10500	13000	18500	24000	30000	42000

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IAPMO
PS-26-67C

INTERNATIONAL ASSOCIATION OF PLUMBING
AND MECHANICAL OFFICIALS

Asbestos Cement Building Sewer Pipe

PS-26-67-T

TENTATIVE -
This is a report of the IAPMO Standards Committee and is subject to ratification by the membership.

1. PURPOSE

1.1 The purpose of this standard is to establish a generally acceptable quality standard for asbestos cement building sewer pipe. Its purpose is also to serve as a guide for producers, distributors, designers, engineers, installers, inspectors, and users; to promote understanding regarding materials, manufacture, and installation; to form a basis for fair competition, and to provide for identifying building sewer pipes that conform to this standard.

The provisions of this standard are not intended to prevent the use of any alternate material or method of construction provided any such alternate meets the intent of this standard.

2. SCOPE

2.1 This standard covers dimensions, physical and chemical properties, design and tests together with other significant properties of constructions and finish, together with the methods of marking and identification.

2.2 The building sewer pipes covered by this standard are intended for use in conveying domestic sewage from house or building to the street sewer of private sewage disposal system and shall be installed in compliance with the Uniform Plumbing Code as published by the International Association of Plumbing and Mechanical Officials and IAPMO Standard IS 1-66.

3. GENERAL REQUIREMENTS

3.1 Pipe shall be manufactured with the nominal inside diameter of 4", 5", and 6". The average inside diameter may be not more than -1/4" or 1-1/2%, whichever is the greater.

3.2 The standard nominal length of 4", 5", and 6" building sewer pipe may be 10' or 13'_ 1". At least 85 percent (85%) of the total number of pipes of any one size excluding half lengths, shall be furnished in standard lengths. The remaining 15 percent (15%) or less may be in random lengths of not less than 7'.

3.2.1 Half lengths for use in making connections to fittings and structures shall not exceed 6' 6" except 15 percent (15%) may be furnished less than the 6' 6" but in no case less than 4'.

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F

FIBER TEST METHODS AND PROCEDURES

Two Sections: Test Methods to Evaluate Asbestos Fibers

Fiber Test Procedures

Test Methods (TM)

Appendix B - Test Methods used to Evaluate Asbestos Fibers

TM-6	- Fiber Sampling and Sample Preparation for Individual Test Specimen Selections
TM-7	- Relative Strength Test for Asbestos Fibers
TM-8	- T&N Drainage Test for Determination of Relative Filterability of Asbestos Fiber
TM-9	- Ridgen Air-Permeability Test for Determination of Asbestos Fiber Surface Area
TM-10	- Wet Volume Test
TM-11	- Clark Classifier Determination of Fiber Length, Fraction Distribution and Dust Content of Asbestos Fiber
TM-12	- T&N Classifier Determination of Distribution and -200 Mesh Dust Content of Asbestos Fiber
TM-13	- T&N Air Permeability Test for Surface Area of Asbestos Fiber

Fiber Test Procedures

C-5-72	- T&N Wet Classification
F-3-74	- Strength in Asbestos-Cement Products
	- Dust Content of Asbestos Fiber

Notes: Fiber TM's are a part of Test Methods (separate binder) which are a part of General Standards (additional separate binder). Each of the three binders is cross-referenced.

Fiber Test Procedures with numbers are a part of Chrysotile Asbestos Test Manual (large green binder from Bell).

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Section F

STANDARD TEST METHODS

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FILED: FIBER TEST METHODS + PROCEDURES BINDER

* Located in Asbestos Fiber Evaluation Manual
** To be prepared

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** To be prepared

FP-1

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UNCONFINED CALCIUM HYDROXIDE TEST

11/22/61
T.C. #601
3/18/60

mrs

CMuck

GENERAL:

The following test is intended to replace the alkalinity test in ASTM specifications for asbestos cement pipe.

REAGENTS:

A. Phenolphthalein Indicator - Dissolve 1.0 g. of phenolphthalein in 100 ml. of absolute ethanol.*

B. Glycerol (Ethanol Solvent) - Prepare a solution consisting of one part by volume of glycerol and two parts by volume of absolute ethanol*. The glycerol should conform to the requirements for glycerol of the Committee on Analytical Reagents of the American Chemical Society and shall assay at least 95.0%. Glycerol sold by the J. T. Baker Chemical Company as "Baker Analyzed" Reagent grade or any similar glycerol is satisfactory. To each liter of this solution add 2 ml. of the phenolphthalein indicator. The solvent should be slightly alkaline to the indicator. If the solvent is colorless, add a dilute solution of NaOH in absolute ethanol* until a slight pink color appears. If the initial color is pink, remove it with the standard ammonium acetate solution (Paragraph (c)) and add the NaOH solution until a slight pink color appears. Heat 60 ml. of the solvent to boiling. If the pink color persists, add one small drop of the standard solution of ammonium acetate (0.02 ml., equivalent to 0.0001 g. CaO), to the hot solvent. If the pink color does not disappear, the solvent contains too much alkali which should be reduced. The solvent if allowed to stand for a considerable length of time, may become slightly acid and should be checked and, if necessary, readjusted from time to time.

*Note: Absolute ethanol may be replaced with denatured alcohol No. 30, 3a, or 2b or alcohol consisting of 95 per cent specially denatured No. 3a plus five per cent isopropanol. Glycerol and ethanol are highly hygroscopic. Every effort should be made to avoid exposing them and other materials unnecessarily to water and Co_2 in air. Bottles with an outlet near the bottom or fitted with a syphon are convenient. They can be filled to the top and protected with tubes containing Ca SO_4 and ascarite. Condensers may also be fitted with such tubes at the top.

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pg 209 c

FF-1

11/22/61

T.C. #601
3/18/60

UNCOMBINED CALCIUM HYDROXIDE TEST

4.63

C. The ammonium acetate used shall also meet A. C. S. specifications and shall assay at least 98.0%. Ammonium acetate is also hygroscopic. Therefore, a quantity should be placed in a desiccator for a week before being used. Ammonium acetate sold by J. T. Baker Company as "Baker Analyzed" Reagent grade or any similar ammonium acetate is satisfactory. The ammonium acetate solution is prepared by dissolving 16.0 g. of the dry crystalline ammonium acetate in one liter of absolute or anhydrous ethanol*. Standardize the ammonium acetate solution by titrating against pure Calcium oxide, CaO, that is freshly prepared by calcining pure calcium carbonate or calcium oxalate in a platinum crucible with a platinum cover at 1652° to 1832°F. to constant weight. Any platinum container having a platinum cover and capable of holding about 0.1 g. or more of CaO is satisfactory. When the CaO has cooled in a desiccator, perform the following operations in quick succession:

50-60 mgm.

Grind it in a mortar, weigh out 0.05 to 0.06 g. into a dry 250 ml. Erlenmeyer flask having a 24/40 ground glass joint, and add 60 ml. of the glycerol-ethanol solvent and 2.0 g. of anhydrous strontium nitrate, $Sr(NO_3)_2$, and a teflon encapsulated stirring bar to the flask. Sometimes pure CaO will cake on the bottom of the flask, particularly if the glycerol is anhydrous. This trouble may be avoided by putting a few grams of clean, dry quartz sand in the flask before the introduction of CaO and solvent. Attach the flask to the water cooled condenser and continue the standardization of the ammonium acetate solution exactly as the procedure described for a sample of pipe drillings. Calculate the CaO equivalent of the ammonium acetate solution in grams per ml. by dividing the weight of CaO used by the volume of solution required. To change the CaO equivalent to $Ca(OH)_2$ equivalent (E), multiply the former by 1.32.

6.11

PROCEDURE:

Representative samples of the pipe or coupling shall be brushed free of dust and drilled with a clean, sharp 1/4 inch carbide tipped drill from the outer surface inwardly until the drill point emerges from the inside wall. Drilling is done on a clean sheet of glazed paper with a rate of penetration of approximately one inch per minute. Using a soft brush, all drillings are collected and immediately screened through a 20-mesh screen. The material passing through the screen is placed immediately into a weighing bottle and covered with

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ASTM

11/22/61

W.C. #601
3/13/60

mpb

CLBlack

UNCOMBINED CALCIUM HYDROXIDE TEST

a ground glass top. The bottle with top removed is placed in a drying oven at 105°C. for two hours and then cooled in a desiccator to room temperature. Weigh out 1.0 g. ±0.010 g. of the material and record weight to the nearest 0.001 g. Place the weighed sample into a dry 250 ml. Erlenmeyer flask with a ground glass 24/40 joint, add a Teflon encapsulated stirring bar, 60 ml. of the glycerol-ethanol solvent and 2.0 g. of anhydrous strontium nitrate, $Sr(NO_3)_2$, to the flask. Attach the flask to the water-cooled reflux condenser having a 24/40 ground glass joint and place on a hot plate magnetic stirrer with the hot plate setting such that the mixture boils gently and with the magnetic stirrer setting such that the solids are kept in suspension without splashing. Boil for 30 minutes, disconnect the reflux condenser from the flask, remove the flask from the hot plate and filter the solution under moderate vacuum which does not cause boiling and using a 250 ml. filter flask and a size (2) Buchner funnel. The filter paper must first be wet with the glycerol-ethanol solvent prior to filtration. Swirl the Erlenmeyer flask twice with a small amount of solvent and pour the wash over the retained solids. When no more liquid filters through, turn off the vacuum, disconnect the filter flask and place the filtrate into a clean, dry, 250 ml. Erlenmeyer flask. Wash the filter flask with a small amount of solvent and pour the wash into the filtrate. Replace the 250 ml. Erlenmeyer flask on the hot plate, replace the condenser, and bring to a boil. Disconnect the condenser, remove the flask from the hot plate and titrate. During the titration, no excess of ammonium acetate should be added at any time because an excess may react with calcium aluminates and silicates giving a high answer.

CALCULATION:

Calculate the percentage of uncombined $Ca(OH)_2$ to the nearest 0.1 as follows:

$$\text{Uncombined } Ca(OH)_2 \text{ per cent} = \frac{EV \times 100}{W}$$

where: E = $Ca(OH)_2$ equivalent of the ammonium acetate solution in grams per milliliter.
V = Milliliters of ammonium acetate solution required by sample.
W = Weight of sample (grams) to nearest 0.001.

Note: Allowable limit is ~~*~~ 1% uncombined calcium hydroxide.

1% E

UNCOMBINED CALCIUM HYDROXIDE TEST

11/22/61

T.C. #601
3/10/60

EQUIPMENT:

1 - Liebig condenser, drip tip, standard ground glass joint, male 24/40 joint, approximately 300 mm. in length.

6 - Erlenmeyer flask, standard ground glass joint, 24/40, 250 ml. capacity

1 - Hot plate - magnetic stirrer. (A Teflon encapsulated stirring bar, about one inch in length, is usually included. This must be purchased separately if not included.)

1 - Buret, capacity 10 ml. in 0.05 ml. subdivisions.

1 - Platinum crucible, 10 ml. capacity.

1 - Platinum crucible cover, 10 ml. size.

1 - Mecker burner

1 - 200 ml. I. D. desiccator

1 - Aspirator for water spigot to provide vacuum.

1 - 2 liter capacity bottle with drain at bottom for solvent.

1 - 100 ml. capacity bottle for phenolphthalein solution.

1 - 1 liter capacity bottle for ammonium acetate reagent.

1 - graduated cylinder, 10 ml.

1 - graduated cylinder, 250 ml.

3 ft. - 1/4" bore vacuum rubber tubing

5 ft. - 1/4" bore rubber tubing for condenser.

1 - lb. "Drierite".

x1 - lb. "Ascarite", 8-20 mesh

1 - lb. Ammonium acetate, reagent grade.

1 gal. Glycerine, reagent grade.

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UNCOMBINED CALCIUM HYDROXIDE TEST

17/12/61

T.C. 7601
3/18/60

1 - Buchner funnel, size 2

1 - Set balance weights, class P or better.

1 - Box of 100 Whatmann #42 filter papers, 70 mm. diameter.

1 - Tube of stopcock grease

1 - Burner support for triangle and crucible.

1 - Triangle, 1-1/2 inch to hold crucible.

1 - 250 ml. Erlenmeyer filtering flask, heavy wall glass.

6 - Weighing bottles, 15 x 50 mm.

2 - Drying tubes, 100 mm. in length

1 - Mortar and pestle, 100 mm. O. D.

1/4 lb. Strontium nitrate, reagent grade.

1/4 lb. Sodium hydroxide, reagent grade.

1/4 lb. Phenolphthalein, reagent grade.

1 - Support stand to hold buret and buret clamp.

1 - Buret clamp

1 - Pair crucible tongs

1 - ft. Tygon tubing 1/4" bore for solvent bottle draining.

1 - Hoffmann clamp for closing Tygon tubing on solvent bottle.

1 - Spatula

1 - Eye dropper

1 gal. ethyl alcohol, absolute, or No. 30, 3a, or 2b or alcohol consisting of 95% specially denatured alcohol No. 3a plus 5% isopropanol.

cork and rubber stoppers.

glazed paper, any paper with a smooth surface.

CTD015776

UNCOMBINED CALCIUM HYDROXIDE TEST

11/22/61

T.C. #601
5/18/60

CC: R&D Headquarters

Q/C Headquarters

Q/C Supervisors Plant 6
7
8
9

Chemical Research Manager

A/C Pipe Development Manager

CTD015777

XERO COPY

H4

Uncombined Calcium Hydroxide

Preparation of Solutions

1. Glyeerol Ethanol
   a. Mix one (1) part by volume Glycerol and two (2) parts by volume Ethanol , (Ethanol- J.T. Baker Alcohol #9400 3A) to each liter add 2 ml. of Phenolphthalein indicatior.
      1. Take a 1000 ml. graduate- clean with hydrochloric acid and rinse with distilled water.
      2. Add 300 ml. Glycerol and 600 ml. Ethanol.
      3. Add 2 ml. Indicatior
      4. Pour into a brown bottle and shake well.
2. Ammonium Acetate Solution
   a. Dissolve 16 grams dry crystaline ammonium acetate into 1000 ml. Ethanol.

Standardization of Ammonium Acetate Solution

When a new batch of ammonium acetate soln. is made up , it must be standardized.

Procedure:

1. Set up apparatus for-Uncombined Calcium Hydroxide Test.
2. Set up Bunsen Burner and stand with triangle.
3. Clean all flasks etc. with hydrochloric acid.
4. Fill platinum crucible a little less than 1/2 way with Calcium Carbonate.
5. Place crucible and Calcium Carbonate over flame and burn until the Calcium Carbonate reaches a constant weight. (2 1/2 - 3 hrs.)
6. When at a constant weight - cool in a desiccator to room temp.
7. Place sample in a mortar and grind it. Weigh out 0.05 to 0.06 grams and place into a 250 ml. flask.
8. Perform the routine test for Uncombined Calcium Hydroxide.

Calculations:

$$\text{CaO Equivalent of Ammonium Acetate} = \frac{\text{CaO used}}{\text{ml. of ammonium acetate used in titration}}$$

e.g. $\frac{0.06 \text{ grams CaO}}{7.80 \text{ ml. Ammo. Acetate}} = .0077$

Note:
1. The burning of Calcium Carbonate gives CaO
2. When titrating the soln. is purple to begin with; the end point is when the soln. turns clear.

R.J. Weiner
Q.C. Technician
10/3/66

CTD015778

KEASBEY & MATTISON CO.
AMBLER, PA.

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TEST METHOD

TEST METHOD NO.	A METHOD FOR EVALUATION OF "PORTLAND CEMENTS" FOR USE IN ASBESTOS CEMENT PRODUCTS			
NEW ISSUE DATE				
SUPERSEDING DATE	R&D MANAGER	Q.C. SUPERVISOR	GEN. MGR., RES. OR DEV.	Q.C. MANAGER

SCOPE:

This method of test covers certain characteristics of cement related to production machine operation and product quality. The method covers both freshly formed and cured asbestos cement sheets and is applicable to all existent processes and products.

A "Flow Chart" of the test procedure is given in the Procedure Appendix page 16.

I. APPARATUS:

A schematical layout of the entire equipment, as manufactured by Humboldt Manufacturing Company, Chicago 47, Illinois, with the exceptions of items A, B, C, and D is shown in Fig. 1. The numbers preceding the other items coincide with those given in Fig. 1.

A. Dry Mixing Cans - The mixing cans shall be ordinary 1/2 gallon friction top pails fitted with three one inch wide deflecting vanes which shall extend approximately the full length of the can and be soldered to the can. The vanes shall be equally spaced and shall be parallel to the axis of the cans.

B. Dry Mixing Equipment - This shall be a roll table, capable of holding 1/2 gallon cans and of rotating these cans at 90 ±20 rpm.

C. Wet Mixing Equipment - The mixer is the Cenco Variable Speed Electric Motor Stirrer with friction cone drive, adjusted to 600 rpm. at no load. The agitator used in connection with the power mixer shall be a three blade semi-finished and drilled bronze propeller, approximately 2-1/4 inch diameter, 4 inch pitch, left-handed.

D. Glass Graduate - A glass graduate of 1000 ml. capacity shall be used for measuring the mixing water.

1. Mixing Funnel - A cone shaped mixing funnel with a short stem at the bottom for discharge of the slurry. This opening of the stem shall be fitted with a rubber stopper during mixing.

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TEST METHOD NO. RM-1	A METHOD FOR EVALUATION OF "PORTLAND CEMENT" FOR USE IN ASBESTOS CEMENT PRODUCTS			
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2. Chute - The chute enables the slurry to flow from the mixing funnel into the filter box in an even flow. Its dimensions and positioning relative to funnel and filter box are shown in Fig. 2, (Standard Method for Evaluation of Portland Cement, dated August 1, 1960). Positioning of the chute, as specified, is of major importance as it affects the formation of the cake.

3. Filter Box - The filter box is used for the formation of the cake. It shall be made of No. 16 gauge galvanized sheet or equivalent. Its dimensions and specifications are given in Fig. 3, (Standard Method for Evaluation of Portland Cement, dated August 1, 1960). In constructing the box, the perforated plate must be aligned level to assure the formation of a cake of uniform thickness.

4. Suction Flask - A 2000 ml. suction flask shall be used between suction source and filter box to collect the filtrate. Vacuum type rubber tubings, with an inside diameter of 5/16 inch and three foot length, shall be used as connecting media. The connections between air aspirator, suction flask, and filter box shall be made as shown in Fig. 1; i.e. the side inlet of the suction flask shall be connected to the filter box, and the top inlet shall be connected to the vacuum source. The top inlet of the flask shall be 5/16 inch copper tubing inserted through the rubber stopper, and the sufficient length so that it extends one inch below the side opening of the flask. The flask is set on a stand with the lip of the flask approximately nine inches below the table level.

5. Manometer - A mercury manometer, minimum range 20 inches, and graduated in inches with 1/4 inch divisions, shall be connected into the system to indicate the vacuum.

6. Vacuum Source - An air activated aspirator shall be used for the source of the vacuum. The aspirator shall be connected, through a pressure reducing valve, to a compressed air line capable of delivering a constant volume of clean, dry air at a pressure

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of at least 50 psi. The aspirator may be adjusted by turning the upper, cone-tipped pipe, until readings are obtained as outlined in the Procedure Appendix, Section A.

7. Hand Tamper - The hand tamper shall be used to assure proper formation of the cake in the filter box. It is designed to fit snugly into the filter box. The hand tamper is fitted with a weight to bring its total weight to 25 pounds.

8. Pressing Tool - The pressing tool shall be used to maintain closure between the sides of the filter box and the edges of the cake so that proper vacuum can be maintained during the formation of the cake.

9. Stand for Cake Removal - This stand receives the cake after formation in the filter box.

10. Cake Support Table - This cake support table shall be used to handle the cake during weighing to per cent deformation.

11. Balance - The balance shall be used for all weighing. It shall have a capacity of at least 250 grams and be capable of weighing within one-tenth gram.

12. Press - The press shall be used for the required densification of the cake. It shall be a standard Carver Laboratory Press, provided with a gauge for 10,000 pounds total load (Carver Gauge Range 0-10,000 pounds). It shall be fitted with additional platens. In addition a mold is required. The press bed includes a series of perforated plates and screens in combination with Fisher Scientific Filter Paper No. 9-800. The correct assembly is shown in Fig. 1 with a change in the filter paper specification to read "two thicknesses of 5 by 10 inch (one 10 x 10 inch section

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folded) and four thicknesses of 5 by 10 inch (two 10 x 10 inch sections folded)". This press bed, placed under the mold containing the cake during pressing, retains the water removed from the cake during the pressing operation.

13. Sag Tester - The sag tester measures the sag or plasticity of the cake, i.e. the deviation from the horizontal under a given load. A releasable center support holds the test cake in place before the test is started. A Starrett Dial Gauge (No. 655-441), with all springs removed, is mounted centrally between the two anvils. The total dead weight of the micrometer stem and foot shall be 18.0 grams, and a 20.0 gram dead weight is placed at the top of the stem to affect the total weight of 38.0 grams. The sag tester shall be placed on a flat rigid plate positioned on a one-half inch thick rubber mat.

II. RAW MATERIALS & PROPORTIONING:

A. Asbestos Fiber - K&M Standard Prepared Fiber.

B. Silica Sample - Prepared by the N. J. Pulverizing Company, 205 West 34th Street, New York, N. Y. It shall contain not less than 90% SiO_2, and shall have a wash fineness so that 85% passes a 200 mesh screen.

C. Cement - Cement to be tested shall be stored in air-tight containers at room temperature.

D. Mixing Water - Distilled water, having a Ph within the range of 6.0 and 7.0 shall be used for all tests.

E. Proportioning - For autoclave cure, the dry mix shall consist of 20% fiber, 30% silica flour, and 50% cement. The total dry mix required for one cake shall be 155 grams.

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III. SAMPLE PREPARATION:

A. Preliminary Steps:

1. Dry Mixing - Since there is danger that some of the mix might be retained in the mixing can, a batch larger than necessary (160 grams) shall be mixed. The quantities of the ingredients required are: 9/30/60

31	Fiber	32 grams	20%
46.5	Silica	48 grams	30%
77.5	Cement	80 grams	50%
155	Total	160 grams	

Place these ingredients into the mixing can and rotate on the roll table for ten (10) minutes at 90 ±20 rpm. Upon completion of the mixing period, weigh out the required batch (for one cake) of 155 grams and discard excess. (Several mixes may be rotated at one time.)

2. Vacuum - Close manometer valve in vacuum system and adjust air pressure reducing valve to result in a vacuum of 16-1/4 inches of mercury.

3. Preparation of Filter Box - Connect empty 2000 ml. suction flask to vacuum source and filter box as shown in Figure 1. The suction flask shall be emptied prior to formation of each cake to assure the evacuation of a constant volume of air for each test. The No. 9-800 Filter Paper is cut to fit the filter box so that the paper crimp is perpendicular to the long dimension. A 3 by 8 metal template is most suitable for lining the paper. Dimensions are to be cut with paper shears.

Place the 3 by 8 inch filter paper into position by wetting it with water from a wash bottle and gradually lowering it into the final flat position on the filter plate. The filter paper placement and opening of the vacuum system valve is done just before releasing the wet slurry from the funnel to the chute, (approximately at the 9:30 time of the ten minute wet mix period.)

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4. Mixing Water - Since the temperature of the mixing water can affect the sag characteristic of a cement, tests shall be made at a constant temperature. To cover the range of typical machine operation of A/C pipe, an 80 to 95°F test shall be performed with a mixing water temperature of 80°F ±1° Fahrenheit.

B. Cake Formation:

1. Mixing - Pour 1000 ml. of distilled water into the mixing funnel, add the dry mix (155 grams) to the water, and then start the agitator and timing immediately. The time record is continuous from this point through the 19 minute cycle.

2. Mixing Time (0:00 to 10:00 min.) - The slurry shall be mixed for ten minutes at an agitator speed of 600 rpm.; at 9:00 to 9:30 minutes position and wet down the filter paper in the filter box. Check for zero reading of manometer at 3-1/2 inches of mercury.

3. Filtering Operation - (10:00 to 14:00 min.) - At the end of ten minutes, the funnel stopper shall be carefully removed by tilting it, as it is removed, in order to avoid opening the orifice completely any too suddenly. The slurry is discharged onto the chute and into the filter box. The chute shall then be wiped down with a rubber wiper or the straight edge of the pressing tool. Clumps of fiber retained by the propeller should be lifted from the funnel to the chute and wiped down to the filter box. The filter box is grasped by both hands and twisted back and forth on the table top several times. This serves the purpose of levelling off the slurry surface and is repeated as required. During removal of the water, the vacuum should be 16 to 16-1/4 inches of mercury.

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Just before the surface of the cake is free of water, indicated by the time when the glassy appearance is just about disappearing, the hand tamper (25 lb. weight) shall be lowered against the surface of the cake. Observing the mercury level, the time at which the first break in vacuum occurs is recorded as the filtering time, i.e. this observed time minus ten minutes. As soon as the vacuum starts to decrease, remove the hand tamper quickly from box, and dress edges of the cake with the dressing tool. This will maintain closure between the edges of the cake and the sides of the filter box. With proper manipulation of the dressing tool, a vacuum of between 13 and 13-1/2 inches of mercury should be maintained during the rest of the filtering cycle. (Hand tamper and dressing tool shall not be used to pound the cake, as they serve only the purpose of levelling the cake and of maintaining the vacuum.) At 13:55 minutes, the box shall be raised and tilted, removing water remaining in the lower part of the box. At 14:00 minutes the suction shall be broken by removing the rubber tubing from the vacuum connection.

4. Cake Removal (time 14:00 to 14:30) - The sag cake shall be removed from the filter box by inverting the box over the "stand for cake removal", and then blowing air by mouth into the suction fitting to release the cake. The box shall then be lifted and the cake remains on the stand. The filter paper adhering to the cake is peeled off and the cake transferred to the "cake support table" by placing the surface of the table against the cake and then inverting. This table is used for convenience in making weighings of the cake and table.

5. Weight After Filtering (time 14:30 to 15:00 minutes)- Cake and support shall be placed on the balances and the weight of the cake recorded as "weight after filtering".

6. Pressing Operation (time 15:00 to 16:05 minutes)- After obtaining the "weight after filtering", the cake shall be transferred to the mold resting on the press bed assembly. By holding table with cake

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firmly in hand, inverting it and allowing the other hand to lightly support the cake as it slides into the mold. Additional slight pressure from the table flat surface may be required to fit the cake into the mold. Place 3 by 8 inch filter paper on top of cake. Insert mold on bed assembly into the press, placing it on the lower platen centered below the plug of the upper platen. Use press lever bar to close press until pressure is indicated on the gauge. As the two platens are drawn together, the hooks of the ejection are coupled to the hooks of the mold. Pressure application shall be started at 15:50 minutes. At a uniform rate of loading, using three or four strokes of the lever, a dwelling pressure of 7680 pounds gauge (320 psi. on specimen) is reached at 16:00 minutes. The pressure is maintained until 16:05 minutes and then quickly released by means of the short "T" lever set in release position. As the pressure is released, the cake is ejected by raising the ejector arm, the cake dropping from the mold onto the press bed. Remove cake and press bed assembly from the press, peel off the filter paper, and place support table face down on the cake. Hold table, cake, and 20 mesh screen together, invert, and remove screen. The cake is now resting on the support table with screen impressions up.

7. Weight After Pressing (time 16:05 to 18:00 minutes)- Cake and support table shall again be weighed, and the weight of the cake recorded as "weight after pressing". Place sag platform (attached to sag tester) face down on cake and invert table, cake, and platform so that the sag platform screen impression is facing down.

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TEST METHOD NO. RM-7	A METHOD FOR EVALUATION OF "PORTLAND CEMENT" FOR USE IN ASBESTOS CEMENT PRODUCTS			
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IV. SAG TEST:

A. Adjustment of Sag Tester - With the dial micrometer set at zero reading, the sag platform bearing the cake shall be attached to the sag tester. The micrometer foot shall be raised and the cake centered under the foot by sliding the cake over from the platform. The cake comes to rest on the center support and the two anvils, (make certain that the center support is in locked position (up) before sliding cake onto the anvils). The screen impressions on the cake will be facing down. The micrometer foot shall be adjusted, and the initial reading of the micrometer recorded. This reading is the basis for the subsequent sag measurement and indicates the thickness (uncured) of the cake.

B. Sag Measurement (time 18:00 to 19:00 minutes) - At 18:00 minutes, the center support shall be released and the dial reading shall be taken at 19:00 minutes. The reading is subtracted from the initial reading and is the sag due to the weight of the cake, and the load applied by the foot and micrometer assembly.

C. Number of Test Specimens - In an evaluation, four cakes shall be prepared and tested.

V. CURING AND FLEXURAL STRENGTH TEST:

A. Curing of Sag Cakes - Upon completion of the sag measurement, each cake shall be removed from the sag tester and carefully straightened on a flat glass plate. Each cake, on a glass plate, shall be placed immediately in the humidity cabinet, maintained at 73°F ±3° Fahrenheit and at least 90 per cent relative humidity. Cakes may be stacked to a convenient height and the top cake covered with a glass plate.

Cakes of autoclave composition shall remain in the humidity cabinet from 16 to 24 hours. (The longer period of time would seem to be required only by cakes with very high water retention value. (This type, when precured for less than 23 hours in the humidity cabinet, blistered on autoclaving.) The cakes shall then be removed from the humidity cabinet and transferred to the

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autoclave. The glass plates are removed and the cakes uniformly supported on the tray shelf of the autoclave. They shall be cured for seven (7) hours at 115 psi. (line pressure) saturated steam pressure.

B. Operation of Autoclave - The steam line shall be purged of condensate. The autoclave shall be closed, tightened with a few bolts, and shall be preheated for ten (10) minutes, purging the condensate from the autoclave. The autoclave is opened, charged with the cakes, and bolted shut. The vent valve is left open until steam escape is indicated. The vent valve is then closed and the pressure raised at a uniform rate, over a 30 minute period, to the dwelling pressure of 115 psi. (line pressure). After seven (7) hours curing, pressure is released at a uniform rate over a period of 30 minutes. This provides an autoclave cycle within the limits of a normal workday period.

C. Drying - After removal from the autoclave, the cakes shall be positioned on a rack supporting the cakes apart, in a ventilated oven at a temperature of 212 to 220 degrees Fahrenheit. They are dried for 24 hours in a mechanical convection oven. Cakes autoclaved on a Friday may be dried over the weekend in a gravity convection oven. When removed from the oven, the cakes are transferred to a dessicator and cooled to room temperature. Test cakes removed from the oven Friday p.m. may be placed in the dessicator over the weekend. The dessicant (calcium chloride) should always be in good condition. The dry cakes removed from the dessicator shall be weighed and the dry weights recorded.

D. Flexural Strength - Determine the flexural strength of the dry cake. Position the cake on the transverse tester over a six inch span, screen impressions facing down, smooth face up. Record the breaking load in pounds. Measure the thickness at five points along one broken edge and record the average thickness for each cake.

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VI. RECORDS AND CALCULATIONS:

A. Records - Record the temperature of mix water, weight after filtering and after pressing, sag, and filtering time for each test. The filtering time is calculated by subtracting the wet mix time (10 minutes) from the observed time at the first break in vacuum during the filtration cycle. Report the average values for the four tests.

B. Calculations -

1. Water Retention - Calculate the per cent water retained after filtering and pressing as follows:

Water retention after filtering in per cent:

$$\frac{W_F - W_D}{W_D} \times 100$$

Water retention after pressing in per cent:

$$\frac{W_P - W_D}{W_D} \times 100$$

Where: W_F = Weight of cake after filtering
W_P = Weight of cake after pressing
W_D = Weight of dry mix (155 grams)

Report the average values for four tests.

2. Flexural Strength - Calculate the Modulus of Rupture for each cake as follows:

$$MR = 1.5 \times \frac{P.L}{b.h^2}$$

Where: MR = Modulus of Rupture in lbs./sq.in.
P = Breaking load in pounds
L = Span length in inches (6)
b = Width of cake at break in inches (3)
h = Average thickness at break in inches

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Using constant values for "L" and "b" the equation is simplified:

$$MR = \frac{3P}{h^2}$$

Report the average value for four tests.

3. Density -

$$D = \frac{W_D}{L \cdot b \cdot h} \times .0022$$

Where: D = Density in pounds per cubic inch
L = Length of cake in inches (8)
b = Width of cake in inches
h = Thickness of cake in inches
W_D = Weight of dry cake in grams

Using the constant values for "L" and "b", the equation is simplified:

$$D = \frac{W_D}{24h} \times .0022$$

(Grams x .0022 = pounds)

Report the average value for density and cake thickness for four tests.

PROCEDURE APPENDIX:

A. Air Aspirator -

1. Close vacuum valve on panel and set air pressure reducing valve (30-40 pounds air pressure) to result in vacuum of 16-1/4 inches of mercury. Top plug must be removed from mercury well of manometer otherwise erroneous readings will be obtained. When set, an empty 2000 ml. flask should be evacuated to 16 inches of mercury in 10-12 seconds. This shall be done by disconnecting the vacuum hose from the filter box and sealing the end of the hose with thumb, then

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opening vacuum valve, and timing period of return to 16 inches of mercury. A minimum time of eight seconds is admissible. More than twelve seconds evacuating time indicates probable clogging of the aspirator.

2. With vacuum set at 16-1/4 inches, connect filter flask and filter box to system. Open vacuum valve, place filter paper No. 9-800 in filter box and wet filter paper in the usual manner. The mercury column shall then reach its equilibrium at 3-1/2 inches which is considered as the zero reading. If this reading is off, the aspirator can be cleaned or adjusted.

B. Filter Box -

1. The perforated plate shall be kept clean. Occasional cleaning by means of a small drill #54 (0.055 inch diameter) will suffice.

2. The perforated plate of a new filter box is removable to facilitate occasional cleaning of the box. There may be cracks between plate and box sides in a new box, causing leaks in the vacuum system. These cracks should be permitted to fill up with asbestos cement mix so the perfected plate will be tightly sealed in the box. To accomplish this, several cakes should be formed and discarded. If this fails to seal in the plate, the plate may be cemented. The sealing procedure will have to be repeated each time the perforated plate is removed from the box.

C. Hand Tamper - To minimize clogging of the 14 mesh screen at the bottom of the hand tamper, the tamper should be soaked in a tray of water between tests. At the end of each day's use, dipping in dilute HCL (1:10) and rinsing with water will help to keep the mesh exposed.

D. Press - The faces of the two platens shall be substantially parallel and horizontal and one platen shall be free floating.

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E. Filter Paper No. 9-800 - The 3 by 8 inch size for the filter box shall be cut as exactly as possible with the paper crimp perpendicular to the eight inch length. Paper sizes for the mold, 3 by 8 inches, and the press bed, 10 by 10 inches, can be cut on a paper cutting table exact enough for use.

NOTE IN PROCEDURE:

Determination of time for weighted tamper in section is most critical. Too soon with insertion, results in considerable retention of solids by the tamper. Too late results in loss of constant vacuum level. The removal of the tamper, with the first break in vacuum and employment of the dressing tool, must be done quickly to avoid drastic vacuum drop.

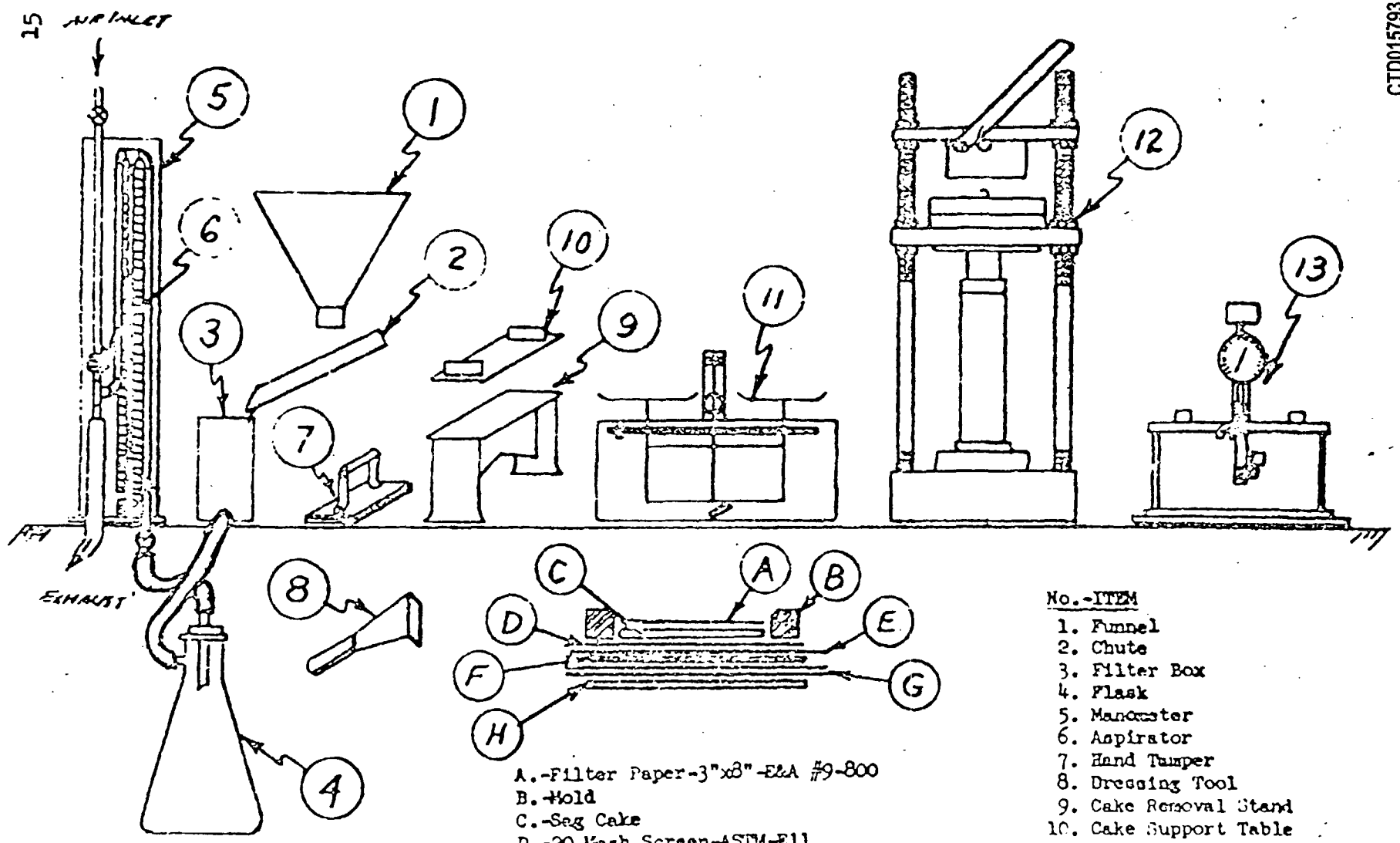
PRACTICE OF TEST TECHNIQUE:

Experience has indicated that an operator of the test will probably have to run a minimum of fifty tests in order to achieve the necessary familiarity and dexterity with the test routine.

When the test data does not vary beyond the following, he could consider he is performing the test properly: ±.05 inch from the average value for cements having a 329 in the range of .100 to .150 inch. The Modulus of Rupture should be within ±10 per cent of the average value of the test specimen. The average values of series of four tests should be reasonably reproducible.

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A.-Filter Paper-3"x8"-E&A #9-800
B.-Mold
C.-Seg Cake
D.-20 Mesh Screen-ASTM-E11
E.-2 thicknesses of Filter Paper(4"x9")
F.-Perforated Plate (1/4" Holes)
G.-4 thicknesses of Filter Paper(4" x9")
H.-Perforated Plate (1/2" Holes)

No.-ITEM

1. Funnel
2. Chute
3. Filter Box
4. Flask
5. Manometer
6. Aspirator
7. Hand Tamper
8. Dressing Tool
9. Cake Removal Stand
10. Cake Support Table
11. Balance
12. Carver Press & Mold
13. Seg Tester

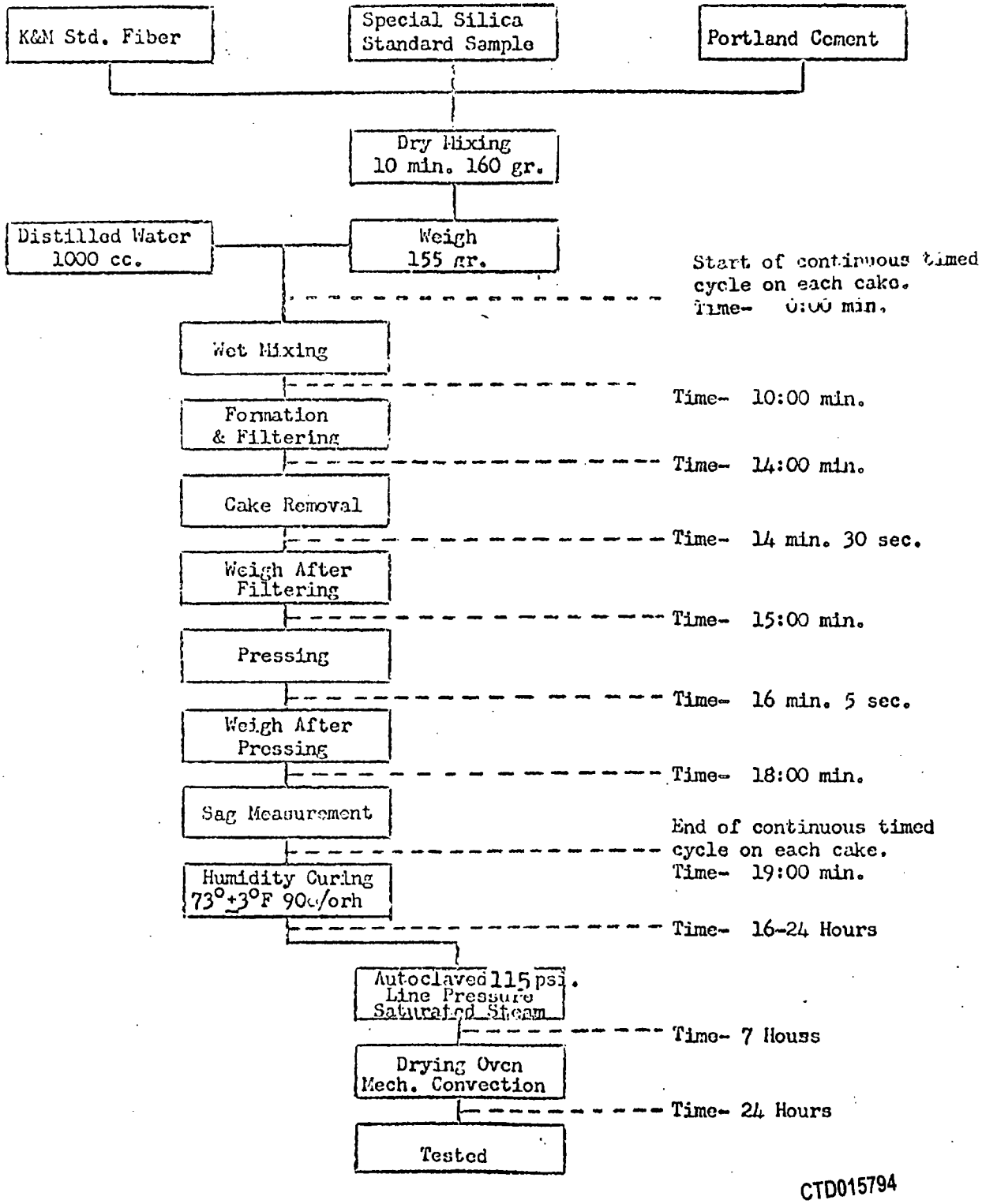
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FIG. 1 SAG TEST EQUIPMENT

FLOW CHART

K&M METHOD FOR EVALUATION

OF PORTLAND CEMENTS



CTD015794

DATE:

Composition of Mixture
_____ Fiber _____ %
_____ Silica _____ %
_____ Cement _____ %

Mixing Temperature _____ °F
Relative Humidity _____ %

Type of Water (Check)
Savall ( )
Distilled ( )

Serial No. _____
Operator _____

67.1

SPECIMEN NO.										
Filtering Time										
Weight After Filtering										
Weight After Pressing										
Sag Test:										
Reading Taken	Dial	Sag	Dial	Sag	Dial	Sag	Dial	Sag	Dial	Sag
At 0 Seconds										
At 1 Minute										
Mixing Water Temperature - °F.										
Weight After Filtering - GMS										
Water Retention After Filtering - %										
Weight After Pressing - GMS										
Water Retention After Pressing - %										

Curing Time _____ Hrs. in Humidity Cabinet

_____ Hrs. in Autoclave at _____ P.S.I.

Series No.	Specimen No.	Dry Weight Grams	Density Lbs./Cu.In.	Thickness d in.	Thickness d^2 in.^{2}	Breaking Load Lbs.	Mod. of Rupture Lbs/Sq.
	Avg.						

CTD015795

DATE
SUPPLIER
ROOM TEMP. OF
% RELATIVE HUMIDITY
NUMBER OF TESTS
AV. % WATER RETENTION AFTER FILTERING
AV. % WATER RETENTION AFTER PRESSING
SAG, INCHES
FILTERING TIME, SECS.
AV. DRY WEIGHT GRAMS
AV. DENSITY LBS./CU.IN.
THICKNESS, IN.
BREAKING LOAD, LBS.
MODULUS OF RUPTURE LBS./SQ.IN.

PERIOD:

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: Standard Test Methods		
T.C.O. REF. NO.: 1	SPECIFICATION NO.: TM - 3	PAGE NO.: 1
SUPERSEDES: May 22, 1964		DATE OF ISSUE: April 18, 1969

DESCRIPTION:

Method Of Test For Determination Of Fineness Of Portland Cement And Silica By Blaine Air Permeability Apparatus

A. Scope

1. This method of test covers the procedure for determining the fineness of Portland cement and silica in terms of specific surface expressed as total surface area in square centimeters per gram (cm^2/gram) of cement, by use of the Blaine air permeability apparatus.

   Note: The Blaine apparatus was originally designed for determining the fineness or surface area of Portland cement; however since it operates on the principle of porosity, it can be easily and accurately used to determine the surface area of silicas.

B. Apparatus

1. The Blaine air permeability apparatus consists essentially of a means of drawing a definite quantity of air through a prepared bed of cement or silica of definite porosity. The number and size of the pores in a prepared bed of definite porosity is a function of the size of the particles and determines the rate of air flow through the bed.

2. The Blaine apparatus shall consist of the following parts:

   a. Permeability Cell
   b. Disk (Perforated)
   c. Plunger
   d. Filter Paper
   e. Manometer
   f. Manometer liquid
   g. Timer

   All the individual parts of the Blaine apparatus shall be in accordance with the requirements as specified in ASTM C 204-55 "Standard Method of Test for Fineness of Portland Cement by Air Permeability Apparatus".

C. Calibration of Apparatus

1. The calibration of the Blaine apparatus shall be in accordance with the requirements as specified in ASTM C 204-55. The National Bureau of Standards No. 114 Standard Sample may be obtained from the U. S. Department of Commerce, National Bureau of Standards, Washington 25, D. C. (A charge of approximately $2.50 is made for each standard sample).

2. A method of checking to determine if the volume and weight of standard sample used is correct is:

$$P = \left(V - \frac{W}{3.15}\right) \frac{}{V}$$

   Where: P = Porosity (should be 0.500 ± 0.005)
   V = Volume of cement bed.
   W = Weight of standard cement sample.

D. Calculations

1. For Cement

$$S = \frac{Ss\ \sqrt{T}}{\sqrt{T_s}} \qquad (a)$$

$$S = \frac{Ss\ \sqrt{n_s\ T}}{\sqrt{T_s\ n}} \qquad (b)$$

For Silica

$$S = \frac{Ss\ Ps\ (1-e_s)\ \sqrt{e^3\ T}}{P\ (1-e)\ \sqrt{e^3_s}\ \sqrt{T_s}} \qquad (c)$$

$$S = \frac{Ss\ Ps\ (1-e_s)\ \sqrt{n_s}\ \sqrt{e^3}\ \sqrt{T}}{P\ (1-e)\ \sqrt{e^3_s}\ \sqrt{T_s}\ \sqrt{n}} \qquad (d)$$

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
J. C. Taylor						

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Where:

S = Specific surface in sq. cm. per gram of test sample.
Ss = Specific surface in sq. cm. per gram of standard sample used in calibration of the apparatus.
T = Time in seconds for measured manometer drop of test sample.
Ts = Time in seconds for measured manometer drop of standard sample used in calibration of the apparatus.
n = Viscosity of air in poises at the temperature of test of the test sample.
ns = Viscosity of air in poises at the temperature of test of the standard sample used in calibration of the apparatus.
e = Porosity of prepared bed of test sample.
es = Porosity of prepared bed of standard sample used in calibration of the apparatus.
P = Specific Gravity of test sample - 3.15 shall be used for Portland cement and 2.65 shall be used for silica.
Ps = Specific gravity of standard sample used in calibration of the apparatus - 3.15 is used.

Note: Values for V_n V_{e3} and V_T may be taken from the Tables I, II and III as shown in ASTM C 204-55.

i.e. In the Technical Service Materials Laboratory

The Volume is 1.824 cu. cm.

The Weight of the standard cement sample is 2.87 grams.

$$\frac{1.824 - \frac{2.87}{3.15}}{1.824} =$$

$$\frac{1.824 - 0.911}{1.824} =$$

$$\frac{0.913}{1.824} = 0.5005 \text{ Porosity}$$

2. When using the Blaine apparatus to determine the surface area of silica the weight of the sample must be adjusted due to the difference in the specific gravity of the silica so that the porosity remains the same. This can be calculated from the standard cement sample as follows:

$$\frac{2.65}{3.15} = \frac{S}{W}$$

Where: 2.65 is the Specific Gravity of Silica
3.15 is the Specific Gravity of Cement
S = Weight of Silica
W = Weight of Cement

i.e. At Technical Service:

$$\frac{2.65}{3.15} = \frac{S}{2.87}$$

S = 2.42 grams

3. The surface area may be checked by varying the porosity and substituting the values in the formula as shown in the tables in ASTM C 204-55. By varying the porosity from .495 to .505 the surface area should be within 300 cm^2/gm.

E. Test

The surface area of the material shall be determined on representative samples of the material using the same weight of sample as has been determined from the calibration of the apparatus using the standard sample. All silica must be oven dried for 24 hours at 210°F. ± 5°F. or to constant weight and allowed to cool at room temperature in a dessicator before making the surface area determinations. Cement shall be tested on the as-received basis. Five determinations shall be made on separate samples of each material. The average of these test results shall be recorded.

F. Sampling

When incoming shipments of cement and silica are sampled, each compartment of each truck and/or railroad car shall be sampled. The sample should be obtained from the material at least one foot below the top surface. The samples obtained from each compartment of the truck or railroad car shall be combined to form a composite sample. The composite sample shall be kept in an airtight container (polyethylene bag or jar will suffice). The container should be identified by Vendor and date. The composite sample should be a minimum of 5 pounds.

FORM P827 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 1
	SUPERSEDES:	DATE OF ISSUE: November 16, 19[illegible]
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

1.0 OBJECTIVE

The purpose of this Test Method Specification is to provide a standardized, accurate and feasible Quality Control operation for the density determination of pipe, couplings and A/C irregular pieces.

2.0 SCOPE

This test method is designed primarily for pipe and coupling density determinations. Pieces or chunks of A/C may be tested also. The A/C material tested must be in the after autoclaved state.

3.0 APPARATUS AND SUPPLIES REQUIRED

3.1 Weighing Balance

A balance that has a weighing range in grams which will allow the A/C piece to be weighed to the nearest 1/100 gram with an absolute accuracy of ±.1% of the true weight of the A/C piece. Note: an acceptable balance for the smaller pipe sizes is the #1969 OHAUS Triple Beam Balance with a set of #1969G extra weights. For large pipe sizes, an acceptable balance is the OHAUS Heavy Duty Solution Balance, Model 1119 (20 kilogram capacity, from OHAUS SCALE CORPORATION, 1050 Commerce Street, Union, New Jersey).

3.2 Water Tank

This may be metal or plastic and should be noncorrosive. The container must be big enough so that the A/C pieces will be completely submerged in the water and not touch the bottom or sides of container. Note: an acceptable tank design is shown in Figure 1. This tank is fabricated of corrosion resistant galvanized iron.

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[signature]	[signature]

CTD015799

3.3 Force Air Convection Oven

The oven should have a temperature control able to maintain 250° ± 10°F. temperature for any length of time. The volume of the oven should be 10 times the volume of the A/C pieces to be dried. An acceptable oven is the Hotpack Oven, Model 1203, 230 V., 4400 W., 35-260°C., Interior 24" W. x 20" D. x 30" H., Exterior 41" W. x 28" D. x 63" H. from Hotpack Corporation.

3.4 Mechanical Saw

The saw must be capable of cutting A/C pipe and coupling ring sections.

3.5 Clock

For timing oven piece drying and room draining time intervals.

3.6 Workroom

The room temperature should be controlled within a range of 75° ± 10°F.

4.0 PROCEDURE FOR TESTING

4.1 A typical schematic diagram of the density testing set up is given in Figure 2.

4.2 Place the rings in the drying oven with the rings preferably not touching or stacked on top of one another. If the rings must be stacked, use thin 1/16" thick (minimum) spacers to allow circulation between the pieces. Dry the rings for time intervals according to the following schedule. The spacers may be of any non-charable, chemically stable material.

FORM P927 1-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 3
	SUPERSEDES:	DATE OF ISSUE: November 16, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

1" Wide Ring

Thickness of Piece	Minimum Time	Maximum Time
0.00 to 0.49"	16 hours	24 hours
0.50 to 0.74"	20 hours	26 hours
0.75 to 0.99"	26 hours	32 hours
1.00 to 1.49"	34 hours	40 hours
1.50 and up	45 hours	55 hours

2" Wide Ring

Thickness of Piece	Minimum Time	Maximum Time
0.00 to 0.49"	26 hours	34 hours
0.50 to 0.74"	32 hours	38 hours
0.75 to 0.99"	35 hours	45 hours
1.00 to 1.24"	45 hours	60 hours
1.25 to 1.49"	60 hours	75 hours
1.50 to 1.99"	75 hours	95 hours
2.00 and up	95 hours	115 hours

Note: 1. If the above drying times for 1" wide rings cannot be adhered to, then follow the following less accurate time intervals:

0 to .99" thick rings - 26 hours.
1" and above thick rings - 42 hours.

2. For 2" wide ring, above schedule must be adhered to.

3. If 1" and 2" wide rings are included in one oven consignment, select rings of various thicknesses so that 1" wide maximum drying times overlap 2" wide minimum times.

4. If the rings are too large to handle conveniently, the ring may be cut in half and the densities determined for each half and the two values then averaged.

It is not permissible to cut a section from the ring and merely determine the density of the section.

5. The preferred ring thickness is 1" ± 3/16".

PREPARED BY:	APPROVED BY:

CTD015801

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 4
	SUPERSEDES:	DATE OF ISSUE: November 16, 196
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

4.3 Remove the pieces from the oven according to the recommended log time entry previously made and weigh the A/C pieces between 15 and 30 minutes after removal. Record these dry weights on the log sheet.

4.4 Place the rings in the water tank. The water temperature should be 75° ± 10°F. Temperature of the room should be 75° ± 10°F. also. The rings must be allowed to soak (completely submerged in the water) between 8 and not more than 20 hours. This includes either 1" or 2" wide rings of any wall thickness. If pieces or chunks of A/C material are to be tested, make certain the length is ten times the width of the piece regardless of the piece thickness.

4.5 Weigh the A/C pieces in the water soak. Do not remove the pieces from the water soak until the submerged weight has been obtained. The submerged weight is determined by taring the balance while the suspending wire and hook are dangling in the water (at a depth which will insure complete submersion of the piece when it is placed on the hook). Place the A/C piece on the hook, bring the balance to equilibrium, making certain the A/C pieces and the wire or hook are not touching the bottom or sides of the water tank and check to see that the A/C piece is completely submerged. Enter weight in log sheet. Specimen surface should be free of air bubbles.

4.6 Remove the A/C pieces from the water tank and shake vigorously four times to remove excess water. Support the A/C piece at an angle of 45° to 60° on a rack to obtain maximum and uniform surface exposure. Keep the A/C pieces away from excessive drafts and do not allow them to be in contact with any absorbent surface. Weigh the pieces after 5 minutes of draining on the rack, but not after more than 20 minutes. This is the saturated weight. Enter the weight in the log sheet.

PREPARED BY:	APPROVED BY:	
		CTD015802

FORM P317 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 5
	SUPERSEDES:	DATE OF ISSUE: November 16, 19[illegible]
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION: Water Displacement Density Test Method for A/C Products

5.0 PROCEDURE FOR CALCULATING DENSITY

Density is defined as $\frac{\text{weight of object}}{\text{volume of object}}$. If we measure volume in cubic inches, the density of A/C pipe is reported as pounds per cubic inch (p.c.i.) of A/C material. Because of tiny voids or pores in A/C material, (it is not a fused solid substance) the following calculations must be made to obtain the true density of A/C pipe.

a) $\frac{\text{Saturated Weight, Gms.}}{\text{Dry Weight, Gms.}}$ = Saturated Ratio

b) $\frac{\text{Submerged Weight, Gms.}}{\text{Dry Weight, Gms.}}$ = Submerged Ratio

$$\text{p.c.i.} = \frac{0.0362}{\text{Saturated Ratio} - \text{Submerged Ratio}}$$

In this equation $\frac{1}{\text{Saturated Ratio} - \text{Submerged Ratio}}$ = A/C Specific Gravity or $\frac{\text{grams}}{\text{cubic centimeter}}$ and the factor 0.0362 converts $\frac{\text{grams}}{\text{cubic centimeter}}$ to $\frac{\text{pounds}}{\text{cubic inch}}$.

Notes:
1. All data and calculations are to remain in the daily log sheets.
2. Particular effort should be made to periodically examine and calibrate the weighing balance used in this Test Method Procedure.
3. It must be emphasized that the balance must be capable of measuring the weight of the A/C rings with an accuracy of at least ± 0.1%.
4. This density Test Method is based on the following Certain-teed, Ambler R&D reports.

   A-6504 Density Determination, Phase I: Drying of Density Rings, W. R. Seipt, May 20, 1965.

   Assignment 0004-65, Density Determination Method, Phase II Report, W. R. Seipt, February 4, 1966.

PREPARED BY:	APPROVED BY:	
[signature]	[signature]	CTD015803

FORM P927 TR. 10-63

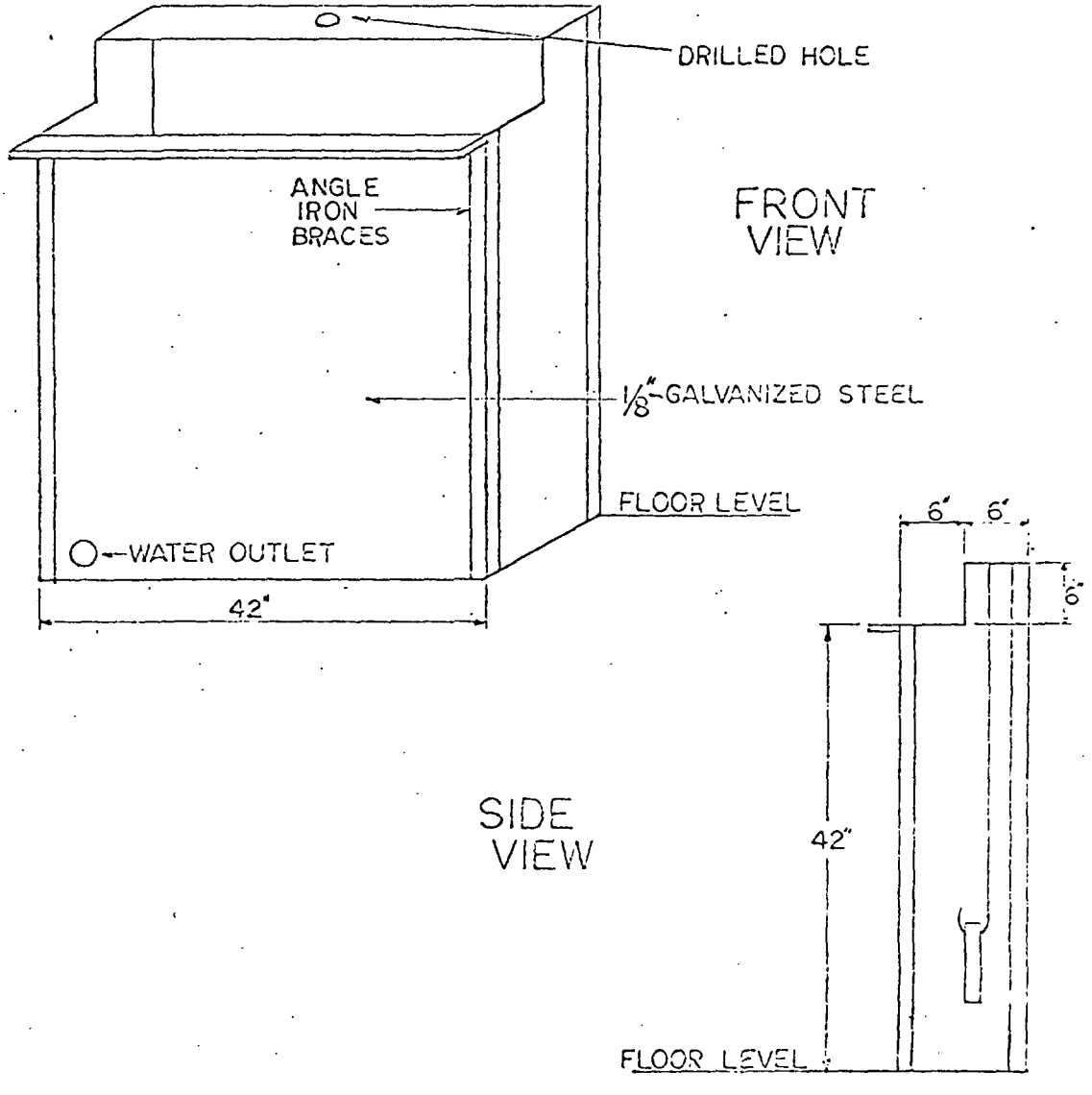
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 6
	SUPERSEDES:	DATE OF ISSUE: November 16, 19
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

FIGURE 1



WATER IMMERSION TANK

PREPARED BY:	APPROVED BY:

CTD015804

FORM F027 TM. 10-63

TECHNICAL SPECIFICATIONS

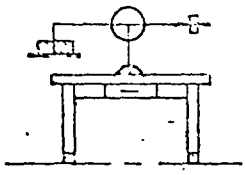
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 7
	SUPERSEDES:	DATE OF ISSUE: November 16, 19
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION.

Water Displacement Density Test Method for A/C Products

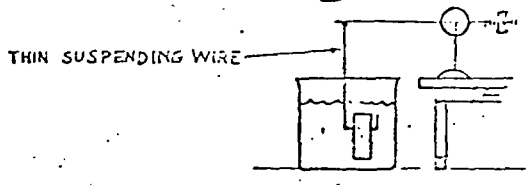
FIGURE 2

A.



Dry Weight Measurement of A/C Ring after coming from drying oven. (measure to nearest hundredth of gm.)

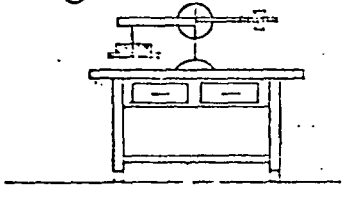
B.



Submerged Weight Measurement

1. Tare the thin suspending wire when submerged in the water in the tank.
2. Then add the A/C ring and measure its submerged weight.
3. Measure to nearest hundredth of a gm.
4. Make certain the wire, A/C ring and supporting pan are not touching the sides of the tank and that the ring is completely submerged.

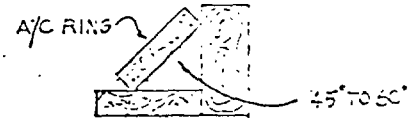
C



Wet Weight Measurement

1. Measure to the nearest hundredth of a gm. Do not weigh before 5 minutes or after 20 minutes of setting on the drain rack.

D DRAIN RACK



Allowable drain time of A/C ring is between 5 and 20 minutes.

PREPARED BY:	APPROVED BY:	CTD015805

TM-10

TECHNICAL CHANGE ORDER

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

APPLICABLE TO:
A/C General Standards Manual - Section F
A/C Standard Test Method TM-10

DATE OF ISSUE:	T.C.O. NO.:	PAGE NO.:
APR 2 6 1979	2	1

DESCRIPTION:

Wet Volume of Asbestos Fiber

Purpose:

To change the Wet Volume of Asbestos Fiber test method. The procedure was changed slightly and a paragraph was added to accomodate fiber blends with a wet volume over 950 ml's.

Ref: Letter B. Haigh to M. Streepy dated 3-27-79 Wet Volume of Asbestos Fiber A/C Standard Test Method TM-10.

Effective Date:

Date of issue.

Disposition of Superseded Pages:

Destroy pages 1 and 2 of A/C Standard Test Method TM-10 dated 3/20/79 and replace with the pages attached.

CTD015806

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
JBN						

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TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	TM-10	1
SUPERSEDES: March 20, 1979		DATE OF ISSUE: APR 2 6 1979

DESCRIPTION:

Wet Volume of Asbestos Fiber

1.0 Scope:

This procedure covers the evaluation of asbestos fibers in terms of the volume occupied when it is immersed in water. It is applicable to individual fibers, both in the as - received and prepared states, and to fiber blends.

2.0 Apparatus:

2.1 Graduated Cylinders - 1000 milliliter stoppered graduates (Catalog No. 3560-E45, supplied by Arthur H. Thomas Co., Vine Street at Third, P.O. Box 779, Philadelphia, PA. 19105).

2.2 Balance - Capable of weighing 100 grams; accurate to 0.1 grams.

2.3 Tweezers

2.4 Thermometer

2.5 Timer

3.0 Procedure:

3.1 Weigh out 15.0 grams of the fiber to be tested and transfer with the tweezers to a 1000 milliliter graduated cylinder.

3.2 Add tap water at 77° ± 5° F to the 1000 milliliter mark and insert the stopper.

3.3 Holding the stopper firmly in place with one hand while grasping the bottom of the cylinder with the other, invert the cylinder so that it is upside down and then return to the upright position. Repeat at a uniform rate such that there are 30 complete oscillations in one minute.

3.4 Allow the cylinder to stand for 10 minutes, then again invert 30 times over a one minute period.

CTD015807

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: A/C Standard Test Method		
T.C.O. REF. NO. 2	SPECIFICATION NO: TM-10	PAGE NO.: 2
SUPERSEDES: March 20, 1979	DATE OF ISSUE: APR 2 6 1979	

DESCRIPTION:

Wet Volume of Asbestos Fiber

3.5 Place the graduate on a vibration free table, start the timer and allow the fiber to settle undisturbed for a period of one hour. At the end of this time record the volume occupied by the fiber to the closest five milliliters. (If the top of the fiber column is uneven, an approximate average height should be used when reading the wet volume. Allowing the cylinder to stand is excess of one hour gives negligibly lower wet volume results.)

3.6 At least two runs shall be made in establishing the wet volume of a fiber sample. The runs shall be considered acceptable if they agree within five percent.

3.7 Report the average of two acceptable runs (to the closest five milliliters) as the wet volume of the fiber tested. This number shall be shown on the Quality Control Product Data, Form #0006, under "surface area" in brackets.

3.8 For highly opened fibers (those having a wet volume in excess of 950 milliliters), a 10.0 gram sample shall be used and the equivalent volume for 15.0 grams calculated as follows:

Wet Volume = (1.081) (volume using 10.0 grams) + 160

CTD015808

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 1
	SUPERSEDES:	DATE OF ISSUE: November 16, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

1.0 OBJECTIVE

The purpose of this Test Method Specification is to provide a standardized, accurate and feasible Quality Control operation for the density determination of pipe, couplings and A/C irregular pieces.

2.0 SCOPE

This test method is designed primarily for pipe and coupling density determinations. Pieces or chunks of A/C may be tested also. The A/C material tested must be in the after autoclaved state.

3.0 APPARATUS AND SUPPLIES REQUIRED

3.1 Weighing Balance

A balance that has a weighing range in grams which will allow the A/C piece to be weighed to the nearest 1/100 gram with an absolute accuracy of ±.1% of the true weight of the A/C piece. Note: an acceptable balance for the smaller pipe sizes is the #1969 OHAUS Triple Beam Balance with a set of #1969G extra weights. For large pipe sizes, an acceptable balance is the OHAUS Heavy Duty Solution Balance, Model 1119 (20 kilogram capacity, from OHAUS SCALE CORPORATION, 1050 Commerce Street, Union, New Jersey).

3.2 Water Tank

This may be metal or plastic and should be noncorrosive. The container must be big enough so that the A/C pieces will be completely submerged in the water and not touch the bottom or sides of container. Note: an acceptable tank design is shown in Figure 1. This tank is fabricated of corrosion resistant galvanized iron.

CTD015809

PREPARED BY:	APPROVED BY:

3.3 Force Air Convection Oven

The oven should have a temperature control able to maintain 250° ± 10°F. temperature for any length of time. The volume of the oven should be 10 times the volume of the A/C pieces to be dried. An acceptable oven is the Hotpack Oven, Model 1203, 230 V., 4400 W., 35-260°C., Interior 24" W. x 20" D. x 30" H., Exterior 41" W. x 28" D. x 63" H. from Hotpack Corporation.

3.4 Mechanical Saw

The saw must be capable of cutting A/C pipe and coupling ring sections.

3.5 Clock

For timing oven piece drying and room draining time intervals.

3.6 Workroom

The room temperature should be controlled within a range of 75° ± 10°F.

4.0 PROCEDURE FOR TESTING

4.1 A typical schematic diagram of the density testing set up is given in Figure 2.

4.2 Place the rings in the drying oven with the rings preferably not touching or stacked on top of one another. If the rings must be stacked, use thin 1/16" thick (minimum) spacers to allow circulation between the pieces. Dry the rings for time intervals according to the following schedule. The spacers may be of any non-charable, chemically stable material.

FORM [illegible]

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 3
	SUPERSEDES:	DATE OF ISSUE: November 16, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

1" Wide Ring

Thickness of Piece	Minimum Time	Maximum Time
0.00 to 0.49"	16 hours	24 hours
0.50 to 0.74"	20 hours	26 hours
0.75 to 0.99"	26 hours	32 hours
1.00 to 1.49"	34 hours	40 hours
1.50 and up	45 hours	55 hours

2" Wide Ring

Thickness of Piece	Minimum Time	Maximum Time
0.00 to 0.49"	26 hours	34 hours
0.50 to 0.74"	32 hours	38 hours
0.75 to 0.99"	35 hours	45 hours
1.00 to 1.24"	45 hours	60 hours
1.25 to 1.49"	60 hours	75 hours
1.50 to 1.99"	75 hours	95 hours
2.00 and up	95 hours	115 hours

Note: 1. If the above drying times for 1" wide rings cannot be adhered to, then follow the following less accurate time intervals:

0 to .99" thick rings - 26 hours.
1" and above thick rings - 42 hours.

2. For 2" wide ring, above schedule must be adhered to.

3. If 1" and 2" wide rings are included in one oven consignment, select rings of various thicknesses so that 1" wide maximum drying times overlap 2" wide minimum times.

4. If the rings are too large to handle conveniently, the ring may be cut in half and the densities determined for each half and the two values then averaged.

It is not permissible to cut a section from the ring and merely determine the density of the section.

5. The preferred ring thickness is 1" ± 3/16".

PREPARED BY:	APPROVED BY:
[signature]	[signature]

CTD015811

FORM P927 [illegible]

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 4
	SUPERSEDES:	DATE OF ISSUE: November 16, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

4.3 Remove the pieces from the oven according to the recommended log time entry previously made and weigh the A/C pieces between 15 and 30 minutes after removal. Record these dry weights on the log sheet.

4.4 Place the rings in the water tank. The water temperature should be 75° ± 10°F. Temperature of the room should be 75° ± 10°F. also. The rings must be allowed to soak (completely submerged in the water) between 8 and not more than 20 hours. This includes either 1" or 2" wide rings of any wall thickness. If pieces or chunks of A/C material are to be tested, make certain the length is ten times the width of the piece regardless of the piece thickness.

4.5 Weigh the A/C pieces in the water soak. Do not remove the pieces from the water soak until the submerged weight has been obtained. The submerged weight is determined by taring the balance while the suspending wire and hook are dangling in the water (at a depth which will insure complete submersion of the piece when it is placed on the hook). Place the A/C piece on the hook, bring the balance to equilibrium, making certain the A/C pieces and the wire or hook are not touching the bottom or sides of the water tank and check to see that the A/C piece is completely submerged. Enter weight in log sheet. Specimen surface should be free of air bubbles.

4.6 Remove the A/C pieces from the water tank and shake vigorously four times to remove excess water. Support the A/C piece at an angle of 45° to 60° on a rack to obtain maximum and uniform surface exposure. Keep the A/C pieces away from excessive drafts and do not allow them to be in contact with any absorbent surface. Weigh the pieces after 5 minutes of draining on the rack, but not after more than 20 minutes. This is the saturated weight. Enter the weight in the log sheet.

PREPARED BY:	APPROVED BY:	
[signature]	[signature]	CTD015812

FORM P927 (1-62)

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 5
	SUPERSEDES:	DATE OF ISSUE: November 16, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

5.0 PROCEDURE FOR CALCULATING DENSITY

Density is defined as $\frac{\text{weight of object}}{\text{volume of object}}$. If we measure volume in cubic inches, the density of A/C pipe is reported as pounds per cubic inch (p.c.i.) of A/C material. Because of tiny voids or pores in A/C material, (it is not a fused solid substance) the following calculations must be made to obtain the true density of A/C pipe.

a) $\frac{\text{Saturated Weight, Gms.}}{\text{Dry Weight, Gms.}}$ = Saturated Ratio

b) $\frac{\text{Submerged Weight, Gms.}}{\text{Dry Weight, Gms.}}$ = Submerged Ratio

$$\text{p.c.i.} = \frac{0.0362}{\text{Saturated Ratio} - \text{Submerged Ratio}}$$

In this equation $\frac{1}{\text{Saturated Ratio} - \text{Submerged Ratio}}$ = A/C Specific Gravity or $\frac{\text{grams}}{\text{cubic centimeter}}$ and the factor 0.0362 converts $\frac{\text{grams}}{\text{cubic centimeter}}$ to $\frac{\text{pounds}}{\text{cubic inch}}$.

Notes:
1. All data and calculations are to remain in the daily log sheets.
2. Particular effort should be made to periodically examine and calibrate the weighing balance used in this Test Method Procedure.
3. It must be emphasized that the balance must be capable of measuring the weight of the A/C rings with an accuracy of at least ± 0.1%.
4. This density Test Method is based on the following Certain-teed, Ambler R&D reports.

   A-6504 Density Determination, Phase I: Drying of Density Rings, W. R. Seipt, May 20, 1965.

   Assignment 0004-65, Density Determination Method, Phase II Report, W. R. Seipt, February 4, 1966.

PREPARED BY:	APPROVED BY:

CTD015813

FORM P927 REV. 10-64

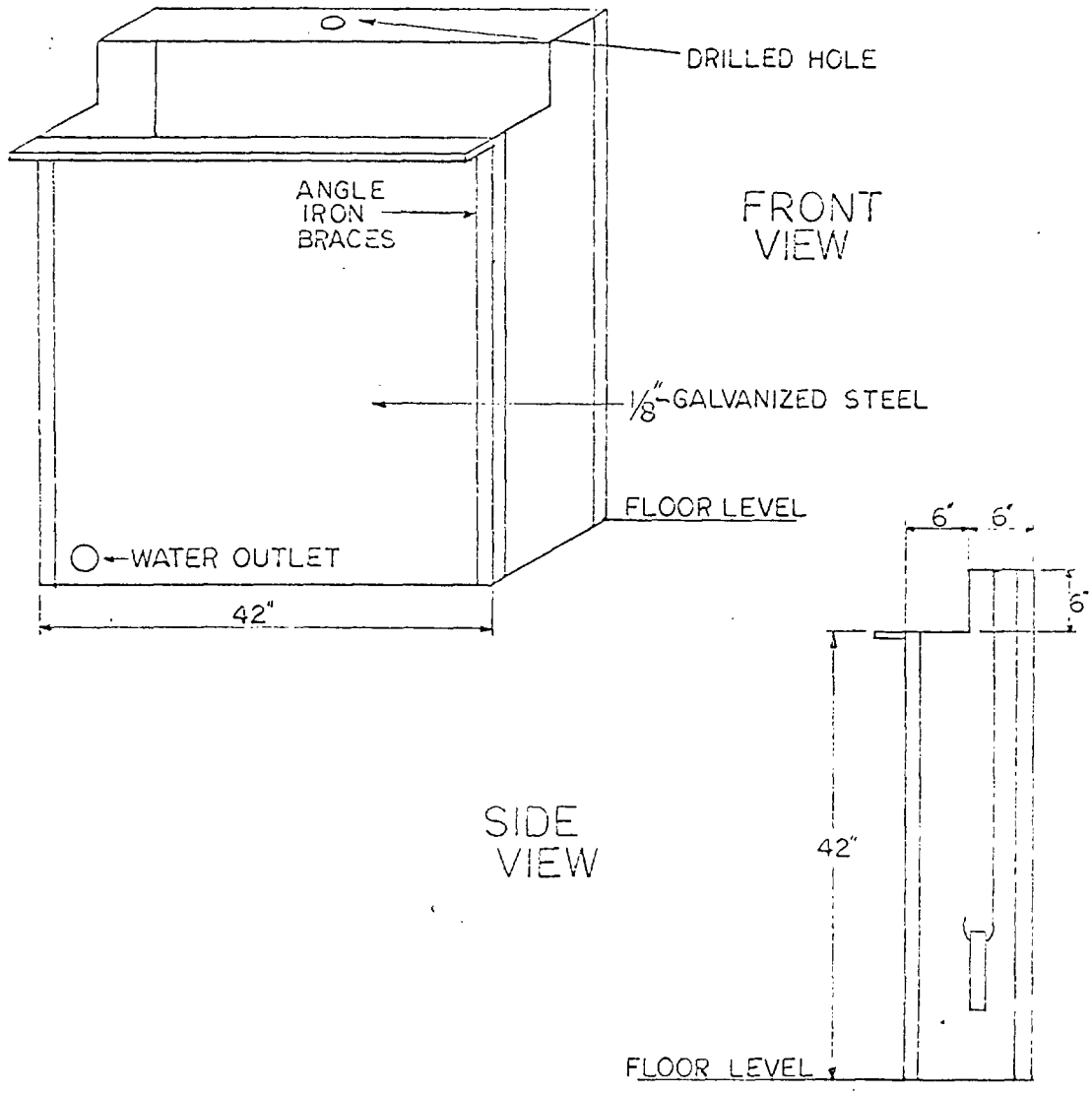
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 6
	SUPERSEDED:	DATE OF ISSUE: November 16, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

FIGURE 1



WATER IMMERSION TANK

PREPARED BY:	APPROVED BY:	
		CTD015814

FORM P027 TR 10-63

TECHNICAL SPECIFICATIONS

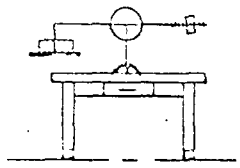
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-5	PAGE 7
	SUPERSEDED:	DATE OF ISSUE: November 16, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Methods	

DESCRIPTION:

Water Displacement Density Test Method for A/C Products

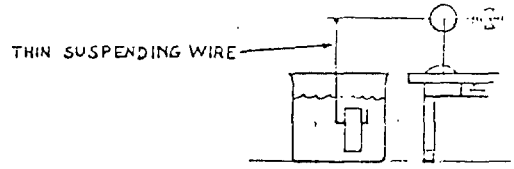
FIGURE 2

A.



Dry Weight Measurement of A/C Ring after coming from drying oven. (measure to nearest hundredth of gm.)

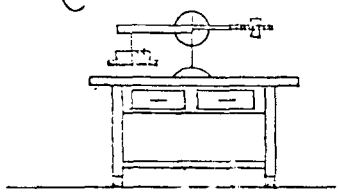
B.



Submerged Weight Measurement

1. Tare the thin suspending wire when submerged in the water in the tank.
2. Then add the A/C ring and measure its submerged weight.
3. Measure to nearest hundredth of a gm.
4. Make certain the wire, A/C ring and supporting pan are not touching the sides of the tank and that the ring is completely submerged.

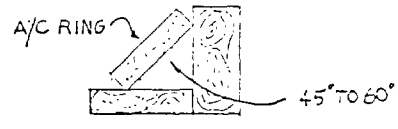
C



Wet Weight Measurement

1. Measure to the nearest hundredth of a gm. Do not weigh before 5 minutes or after 20 minutes of setting on the drain rack.

D DRAIN RACK



Allowable drain time of A/C ring is between 5 and 20 minutes.

PREPARED BY:	APPROVED BY:
11-16-67	

CTD015815

TM-14

FORM P927 8 62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-14	PAGE 1
	SUPERSEDES:	DATE OF ISSUE: February 7, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Ozone Resistance Test For Elastomeric Compounds

1.0 SCOPE

This method is an accelerated aging test for determining the resistance of vulcanized rubber to cracking when exposed to an atmosphere containing ozone.

2.0 REFERENCE

This test method is in accordance with ASTM D-1149, "Test For Ozone Cracking of Vulcanized Rubber."

3.0 PHYSICAL PROPERTY REQUIREMENTS

The physical property requirements for this test method can be found in the appropriate CPC Purchasing Specifications.

4.0 APPARATUS

1 Ozonator Unit, in accordance with ASTM D-1149

1 Graduated Cylinder, 100 ml.

1 Pipette, 1 ml.

1 Stopwatch

Non-Corrosive Wire, .008" in diameter or less

2 Bottles, 1 liter, amber; ground glass stoppers

1 ruler, 12 inch

1 mandrel, 2" diameter, 1 foot long, wood or aluminum

1 beaker, 50 ml.

PREPARED BY: mgs J.R. Giancaterino	APPROVED BY: J.C. Jackson

CTD015816

FORM P927 R-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-14	PAGE 2
	SUPERSEDES:	DATE OF ISSUE: February 7, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Ozone Resistance Test For Elastomeric Compounds

5.0 REAGENTS

Di Sodium Hydrogen Phosphate (Na_2HPO_4), .025 N

Potassium Di Hydrogen Phosphate (KH_2PO_4), .025 N

Potassium Iodide (KI)

Sodium Thiosulfate ($Na_2S_2O_3$), .02 and .002 M

Note: Sodium Thiosulfate when put into a solution should be stored at a concentration of .02 M in an amber, ground glass stoppered bottle. The solution should remain stable for two (2) months.

6.0 DETERMINATION OF SPECIMEN LENGTH

The specimen length will depend on its width and the degree of stretch desired. The inner width of the specimen is compressed, while the outer width is stretched. When mounted on a mandrel, the specimen shall be stretched 4 to 6 per cent. The length of the specimen is calculated as follows.

$$L = 8.78 + 2.07G + .05C$$

Where: L = desired length of a specimen stretched five (5) per cent, in inches.

G = width of ring, in inches.

C = circumference of mandrel and ½ width of ring or

$$C = (d + \tfrac{1}{2} G)\pi$$

Where: d = diameter of mandrel in inches.

PREPARED BY: M.A.S. F.R. Gonçalves	APPROVED BY: J.A. Jackson

CTD015817

FORM P927 R-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-14	PAGE 3
	SUPERSEDES:	DATE OF ISSUE: February 7, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Ozone Resistance Test For Elastomeric Compounds

7.0 MOUNTING SPECIMENS

7.1 Procedure

Mark each specimen 1¼" from the ends with crayon. Form the specimen into a loop by tying the two ends securely with a non-corrosive wire at the marks, as shown in Figure 1. Slip the complete loop over the mandrel.

8.0 SPECIMEN EXPOSURE

8.1 Procedure

After the specimens are mounted, allow them to rest for 48 hours at room temperature in a realtively ozone free atmosphere. Place the mandrel in the test chamber and seal securely. Set the temperature of the test chamber at 100° ± 2°F.

Turn on the vacuum pump and set the "flowmeter normal" to a reading of 24.5 (22,000 ccm) by regulating the vacuum pressure (Figure 2).

Turn on the main switch and turn the poly-way valve to "normal". This will permit full air flow to the vacuum chamber.

Set the potentiometer to the calibrated setting for fifty (50) parts per hundred million (pphm) ozone (see section 10). The specimens shall be exposed for 48 hours.

9.0 RATING OF EXPOSED SPECIMENS

When the exposure time is completed, examine the specimens while mounted on the mandrel with a two (2) power magnification. Evaluate the degree of cracking with the reference standards shown in ASTM D-1171, Figure 3.

PREPARED BY: mpb H.R. Gianattasio	APPROVED BY: J.C. Jackson

CTD015818

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TECHNICAL SPECIFICATIONS

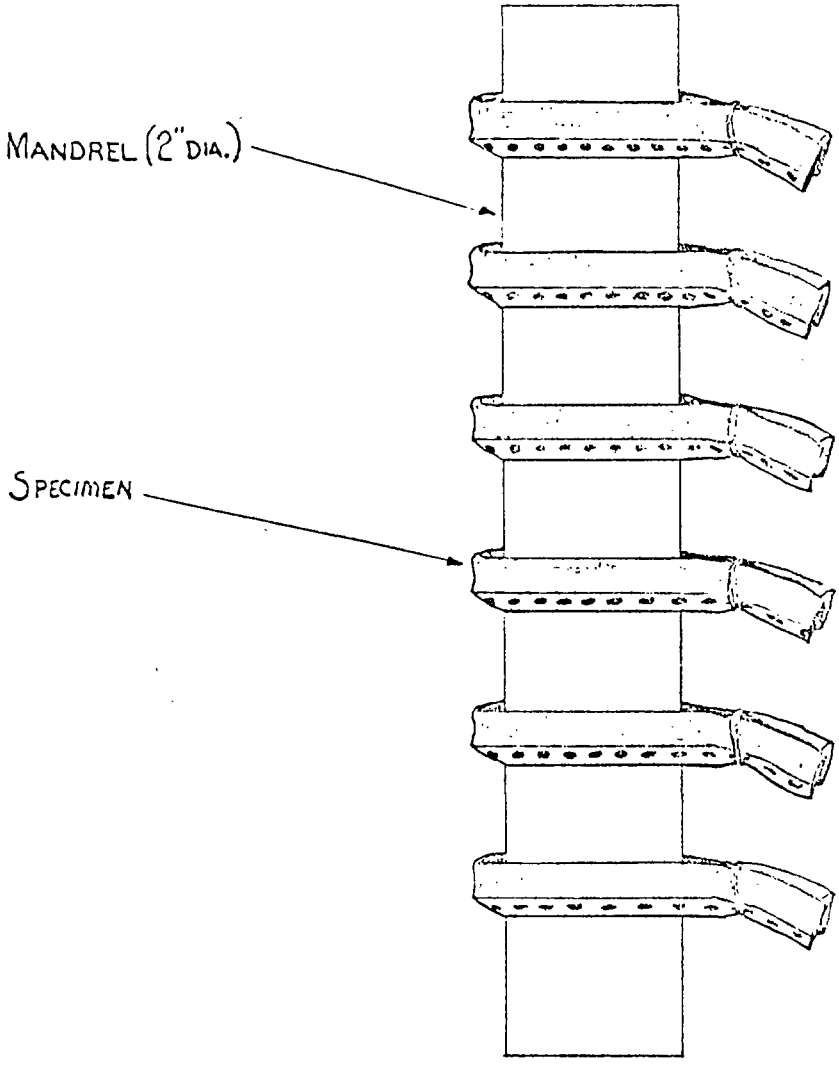
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-14	PAGE: 4
	SUPERSEDES:	DATE OF ISSUE: February 7, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Ozone Resistance Test For Elastomeric Compounds

FIGURE 1

MOUNTED SPECIMENS FOR OZONE TEST



PREPARED BY:	APPROVED BY:
mgs J. R. Giancaterino	J. C. Jackson

CTD015819

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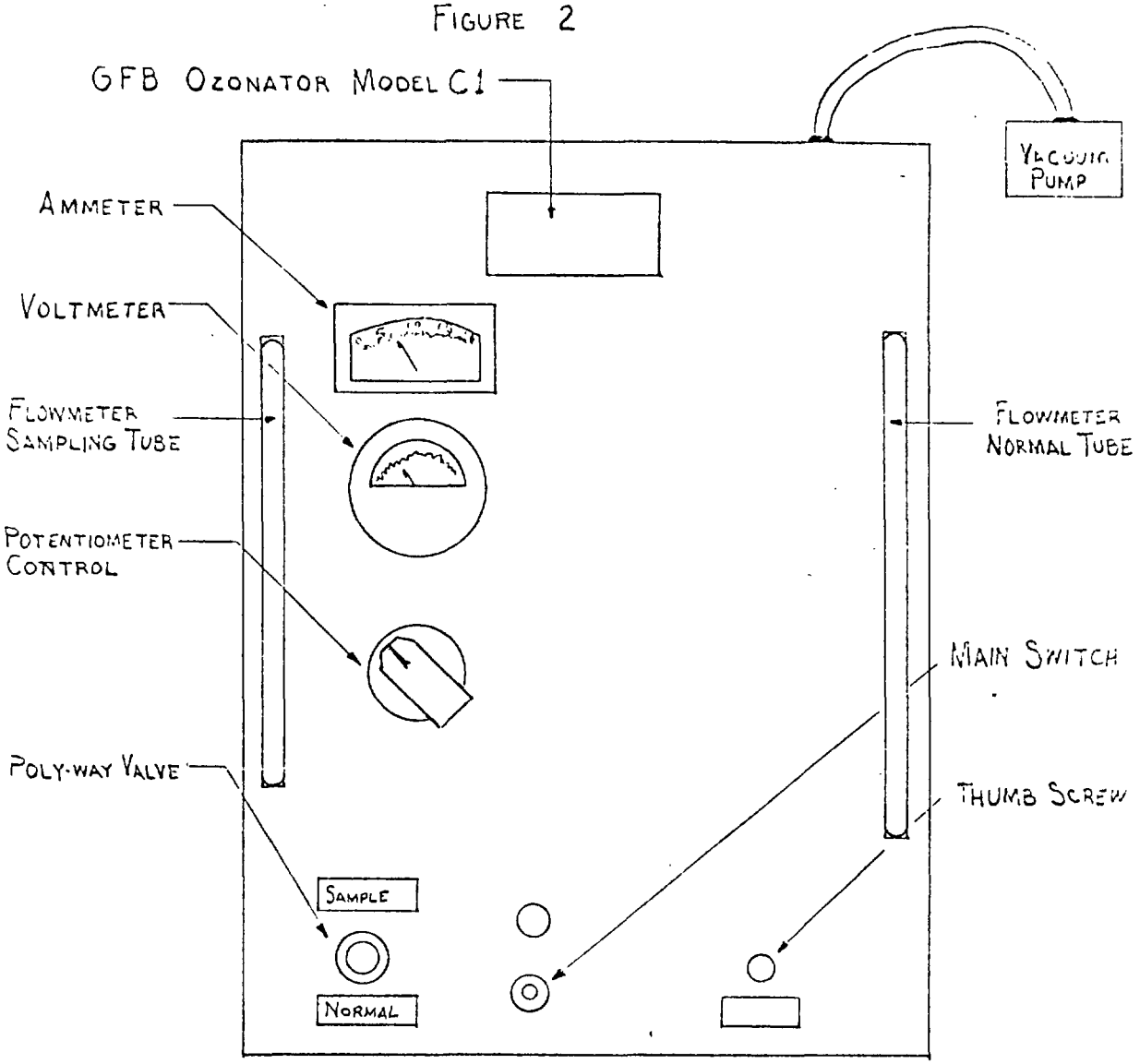
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-14	PAGE 5
	SUPERSEDES:	DATE OF ISSUE: February 7, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Ozone Resistance Test For Elastomeric Compounds

FIGURE 2



PREPARED BY: mps J R Giancaterino	APPROVED BY: J C Jackson

CTD015820

FORM P927 R-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-14	PAGE 6
	SUPERSEDES:	DATE OF ISSUE: February 7, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Ozone Resistance Test For Elastomeric Compounds

10.0 MEASURING OZONE CONCENTRATION

10.1 Procedure

The ozone concentration shall be checked before each test. This is done by absorbing the ozone with a buffered potassium iodide solution. The liberated iodine is then titrated with sodium thiosulfate. By recording the time it takes for the iodine to neutralize the thiosulfate, it can be calculated how much ozone was absorbed by the potassium iodide. This is done as follows.

Prepare a buffered potassium iodide solution by dissolving ten (10) grams of potassium iodide in 30 ml. of .025 N Na_2HPO_4 and 20 ml. of .025 N KH_2PO_4.

Note: The KI solution shall be discarded after each use.

Transfer the solution into the absorption bottle (Figure 3). Turn the poly-way valve to sampling and tighten the "reduce to sample" thumb screw until a reading of 12.0 (5500 ccm) is obtained. The "flowmeter normal" shall still read 24.5. If not, adjust.

Start with a potentiometer setting of 32. Draw ionized air through the absorption bottle until the ammeter reads approximately three (3) to four (4) amperes. Record the exact ampere reading and titrate the KI solution by pipeting one (1) ml. of .002 M $Na_2S_2O_3$ into the absorption bottle.

Record the time it takes the ammeter to return to its original reading.

11.0 CALCULATIONS

The ozone concentration shall be calculated as follows.

$$C = \frac{11.2 \cdot B \cdot M 10^8}{Ft}$$

Where: C = ozone concentration in pphm.
B = ml. of .0020 M $Na_2S_2O_3$.
M = molarity of $Na_2S_2O_3$.
F = flowrate of sampling in ccm.
t = time in minutes for ammeter to return to the original reading after titration.

PREPARED BY:	APPROVED BY:
J.R. Giancaterino	J.C. Jackson

CTD015821

FORM PSET TM 10-63

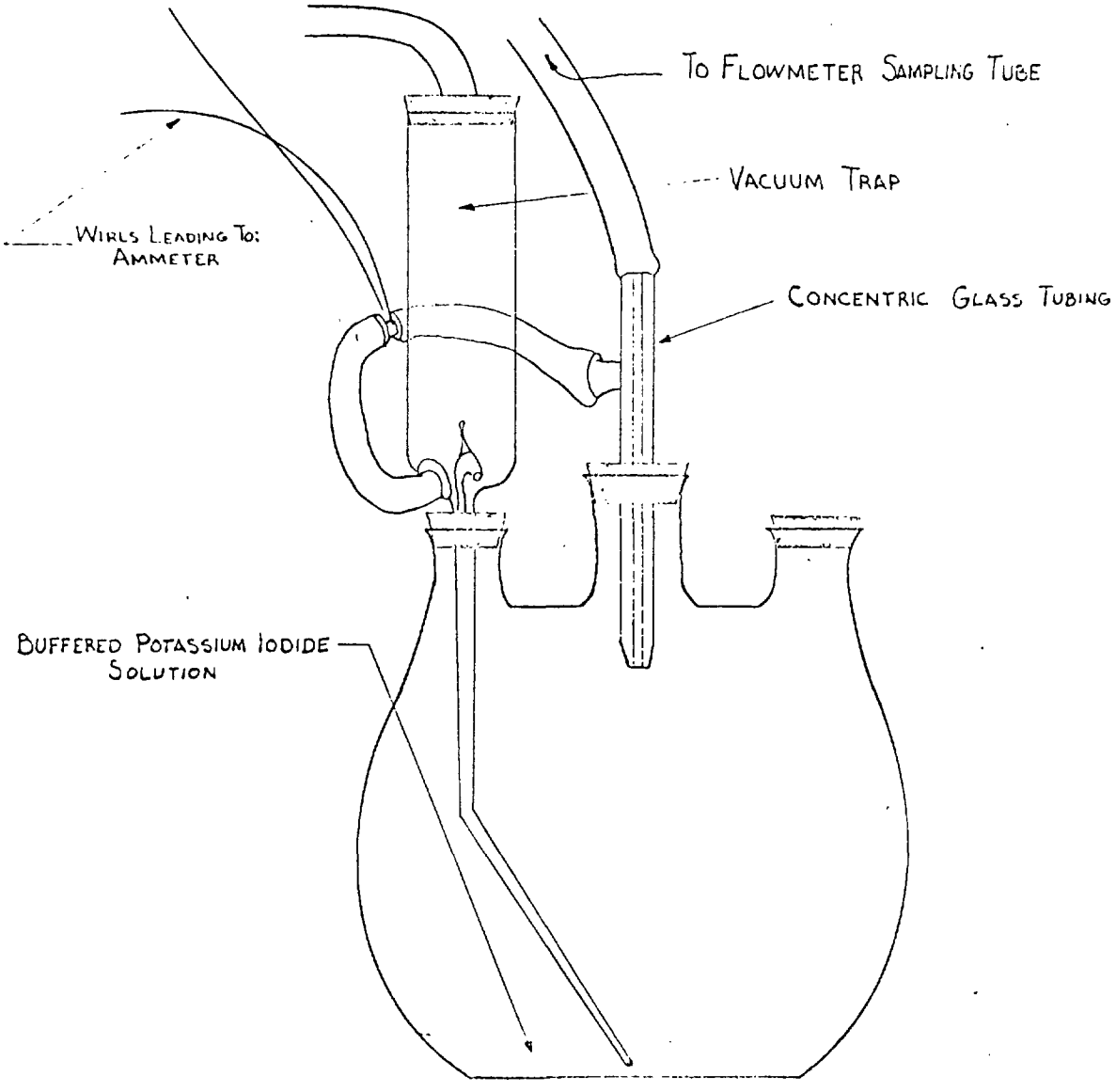
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-14	PAGE 7
	SUPERSEDES:	DATE OF ISSUE: February 7, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Ozone Resistance Test For Elastomeric Compounds

FIGURE 3
OZONE ABSORBING DEVICE (SPRAY JET)



PREPARED BY: J.R. Lianca Jr. MJS

APPROVED BY: J.C. Jackson

CTD015822

FORM P927 R 62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-14	PAGE 8
	SUPERSEDES:	DATE OF ISSUE: February 7, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	
DESCRIPTION: Ozone Resistance Test For Elastomeric Compounds		

Note: If C is less than 50 pphm, raise the potentiometer setting. If C is greater than 50 pphm, lower the potentiometer setting. Calibrations are to be repeated until C equals 50 pphm. Record the setting on which C equals 50 pphm. This setting should remain fairly constant within a reading of ± 2 digits on the potentiometer control.

12.0 APPROVED VENDORS FOR APPARATUS

The ozonator unit described in this test method is the GFB Ozonator model C-1 from G. F. Bush Co., Princeton, New Jersey. However, there are more modern ozonators which are now on the market that operate in a similar manner. Any ozonator unit which meets the requirements of ASTM D-1149 is a suitable unit.

PREPARED BY:	APPROVED BY:
J.R. Giancaterino	

CTD015823

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	TM-15	1
SUPERSEDES:		DATE OF ISSUE:
January 10, 1968		September 13, 1968

DESCRIPTION:

Low Temperature Flexibility Test for Elastomeric Materials

1.0 Scope

This test method describes a procedure for determining the resistance of elastomeric materials to cracking when exposed to low temperature.

2.0 Physical Property Requirements

The physical property requirements for this test method can be found in the appropriate CPC Standard Purchasing Specification.

3.0 Apparatus

Cutting Device - refer to CPC TM-19; section 5.1.

* Cold Chamber - temperature maintained at - 25° C ± 2° C.

4.0 Test Procedure

Prepare specimens from finished products four (4) to five (5) inches (10.16 to 12.70 cm.) long with a thickness of .100 ± .010 inches (.254 cm. ± .025 cm.). Place the specimens in the cold chamber at -25° ± 2° C for a minimum of 4 hours. Immediately check the specimens for cracking by flexing 180 degrees over a $\frac{1}{4}$ inch (.635 cm.) mandrel.

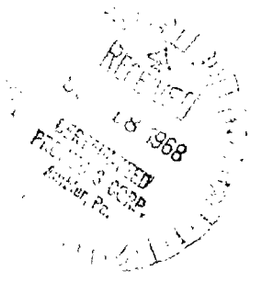
NOTE CERTA-SPACER bands shall be tested at a length of four (4) to five (5) inches (10.16 to 12.70 cm.) and with their original thickness.

5.0 Approved Vendor for Apparatus

* Any cold chamber may be used where the specimen does not come in direct contact with a liquid. A Wagner Cold Box, model 8860, Type RP is suitable.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
Brian Jeffrey		MBL				

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FORM PS27 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-16	PAGE 1
	SUPERSEDES:	DATE OF ISSUE: November 30, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Oil Immersion Test For Oil Resistant Elastomeric Compounds

1.0 SCOPE

The purpose of the test is to determine the comparative ability of elastomeric materials to withstand the effects of hot oil. It is based on changes in appearance, weight, volume, hardness, tensile strength, and elongation. The test is primarily used for oil resistant elastomeric compounds, but other elastomers can be tested to determine their comparative resistance to oil.

2.0 REFERENCE

This test method is in accordance with ASTM 471, "Change in Properties of Elastomeric Vulcanizates Resulting From Immersion in Liquids".

3.0 PHYSICAL PROPERTY REQUIREMENTS

The physical property requirements for oil resistant elastomeric compounds can be found in the appropriate CPC Purchasing Specifications.

4.0 APPARATUS

*1 - Hot Plate, 0-700° ± 5°F
5 - Erlenmeyer Flask, 500 ml, pyrex
5 - Neoprene Stoppers, size 7 (alternate - rubber stoppers wrapped in aluminum foil)
5 - Reflux Condensers, 700 mm in length
5 - Clamps and Stands
2 - Beakers, 100 and 1000 ml
**1 - Shore Durometer, Type A or A_2
***1 - Analytical Balance, 0-160 gm ± .003 gm
1 - Universal Tester, (refer to CPC TM-18)
Tygon Tubing
Non-Corrosive Wire, .008" in diameter or less
Alcohol, 95% ethanol or isopropanol
ASTM Oil No. 3

PREPARED BY:	APPROVED BY:
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CTD015826

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-16	PAGE 2
	SUPERSEDES:	DATE OF ISSUE: November 30, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Oil Immersion Test For Oil Resistant Elastomeric Compounds

5.0 DETERMINATION OF ORIGINAL APPEARANCE, WEIGHT, AND VOLUME

5.1 Procedure

Three specimens 2" ± 1/8" cut from separate finished rings shall be used. Check the appearance of each specimen which shall be free from cracks, tears, and pits. All flash and loose filings shall be removed. Identify each specimen.

Wrap one end of each specimen securely with a non-corrosive wire leaving a 12" excess of wire. Weigh and record each specimen with the wire to the nearest milligram. Neglect the weight of the wire.

To determine the volume, the specimen must be weighed in distilled water (75 ± 5°F). Tare the balance and attach the hanger to the weighing pan (Figure 1). If the specimen has holes, e.g. FLUID-TITE rings, douse it into a beaker of alcohol and quickly shake off the excess liquid. Immerse the specimen in distilled water and shake the air bubbles from the holes. Attach the specimen to the hanger and weigh to the nearest milligram.

6.0 DETERMINATION OF ORIGINAL HARDNESS, TENSILE STRENGTH, AND ELONGATION

6.1 Procedure

Prepare six dumbbell specimens from three separate finished rings. Two dumbbells are to be cut from each ring. Determine the tensile strength and elongation of one dumbbell specimen from each of the three rings (refer to CPC TM-18). Average the three values.

Determine the hardness on the three remaining dumbbell specimens (refer to CPC TM-19). Use these three specimens for the oil immersion tests.

PREPARED BY:	APPROVED BY:
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CTD015827

FORM P927 TN. 10-63

TECHNICAL SPECIFICATIONS

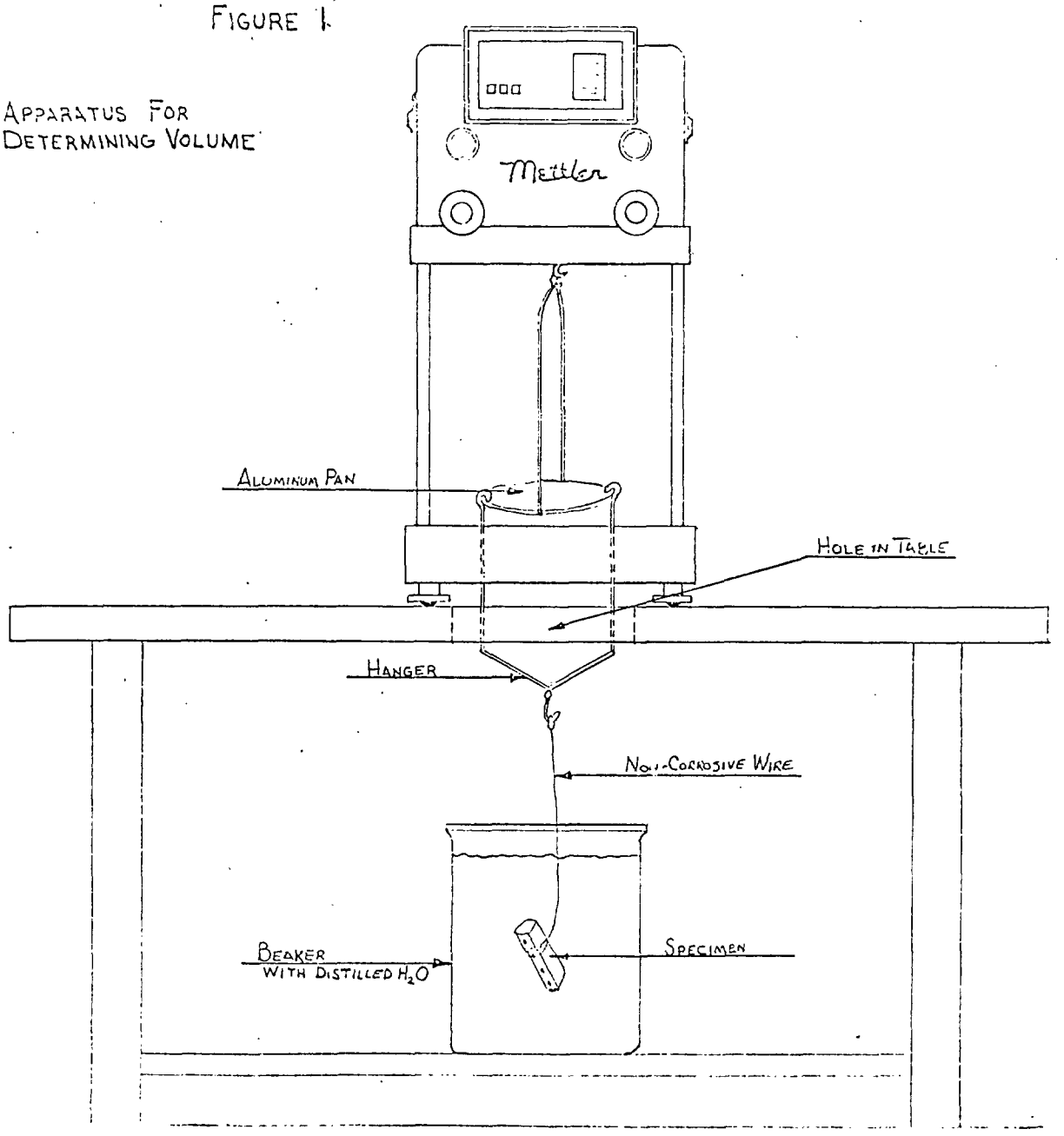
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-16	PAGE 3
	SUPERSEDES:	DATE OF ISSUE: November 30, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Oil Immersion Test For Oil Resistant Elastomeric Compounds

FIGURE 1.

APPARATUS FOR DETERMINING VOLUME



PREPARED BY:	APPROVED BY:	
F.R. Giancaterino 11-29	J.C. Jackson	CTD015828

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-16	PAGE 4
	SUPERSEDES:	DATE OF ISSUE: November 30, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Oil Immersion Test For Oil Resistant Elastomeric Compounds

7.0 SPECIMEN IMMERSION

7.1 Procedure

Totally immerse the specimens in a 500 ml Erlenmeyer flask, filled to one inch below the neck with ASTM Oil No. 3 (Figure 2). The loose end of the wire is squeezed between the stopper and inside neck of the flask. The specimens shall hang freely, two inches from the top of the oil. It is preferred that only one specimen be put in each flask. If necessary, two specimens of the same compound may be put in a flask. In the case of dumbbell specimens, three may be put in the same flask. The specimens shall not touch each other. The temperature of the oil shall be kept at 210 $\pm$ 2°F for seventy hours.

Note: New oil is to be used for each test.

8.0 DETERMINATION OF CHANGE IN THE PHYSICAL PROPERTIES

8.1 Procedure

After the specified exposure time has expired, remove the specimens from the immersion apparatus and blot the excess oil.

Immediately determine the physical properties as previously done in sections five (5) and six (6). Record these results with the originals and calculate the change.

9.0 CALCULATIONS

9.1 Calculate the change in hardness as follows. Change in hardness is expressed as points increased or decreased from the original hardness. Therefore,

$$\text{Change in hardness, points} = H_2 - H_1$$

where:

H_1 = initial hardness
H_2 = hardness after immersion

PREPARED BY:	APPROVED BY:
H.R. Lancaster mpf	J.C. Jackson

CTD015829

FORM P987 TR. 10-63

TECHNICAL SPECIFICATIONS

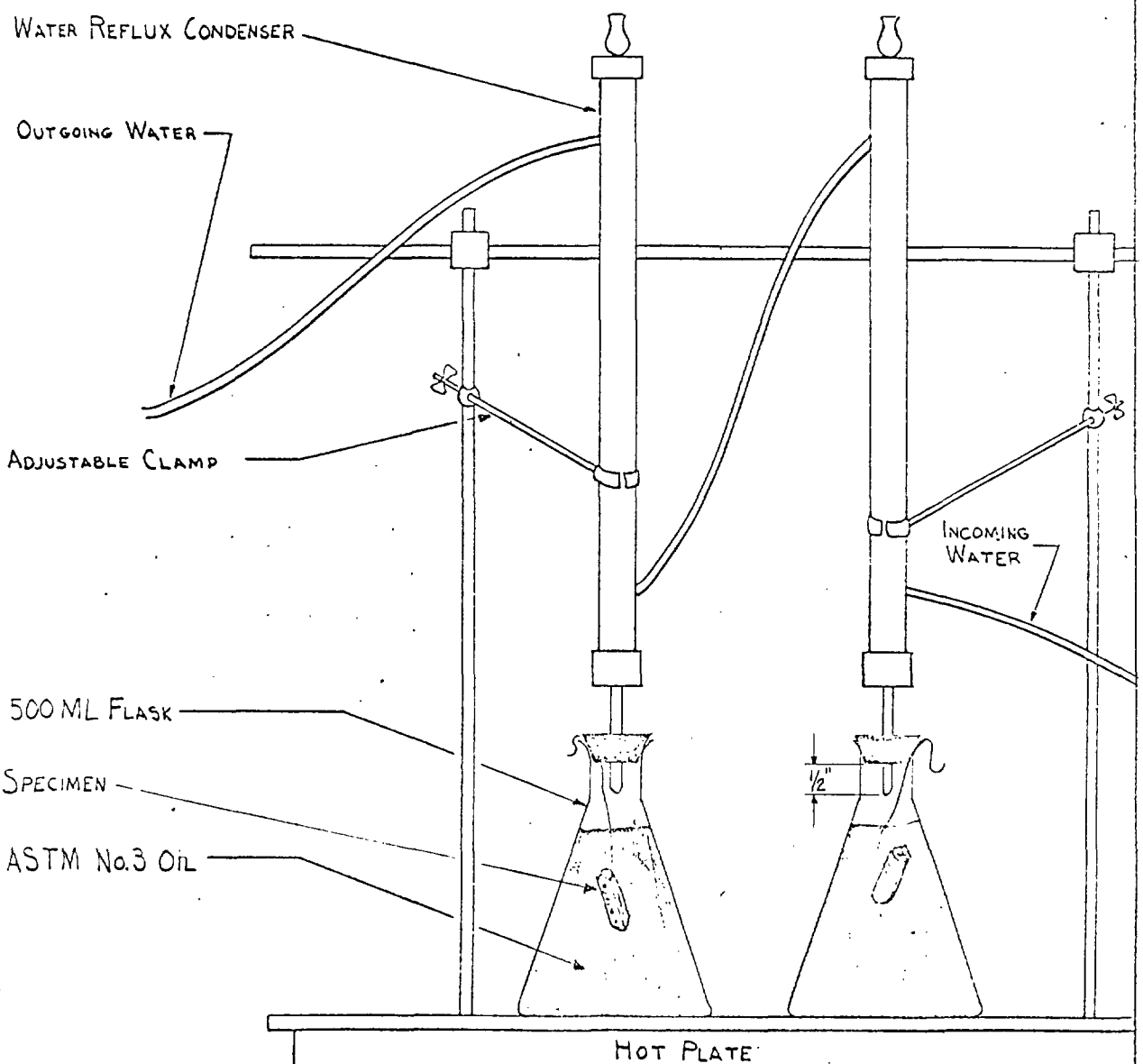
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-16	PAGE 5
	SUPERSEDES:	DATE OF ISSUE: November 30, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Oil Immersion Test For Oil Resistant Elastomeric Compounds

FIGURE 2

OIL IMMERSION APPARATUS



PREPARED BY: J.R. Francatorino

APPROVED BY: J. Jackson

CTD015830

9.2 Calculate the change in weight as follows.

$$\text{Change in weight, per cent} = \frac{(W_2 - W_1)}{W_1} \times 100$$

where:

W_1 = initial weight of specimen in grams
W_2 = weight of specimen in grams after immersion

9.3 Calculate the change in volume as follows.

$$\text{Change in volume, per cent} = \frac{(W_3 - W_4) - (W_1 - W_2)}{(W_1 - W_2)} \times 100$$

where:

W_1 = initial weight of specimen in air, in grams
W_2 = initial weight of specimen in water, in grams
W_3 = weight of specimen in air after immersion, in grams
W_4 = weight of specimen in water after immersion, in grams

9.4 Calculate the change in tensile strength and elongation as follows.

Change in tensile strength and/or elongation, per cent =

$$\frac{(P_2 - P_1)}{P_1} \times 100$$

where:

P_1 = initial tensile strength and/or elongation of specimen in pounds per square inch.
P_2 = tensile strength and/or elongation of specimen after immersion in pounds per square inch.

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-16	PAGE 7
	SUPERSEDES:	DATE OF ISSUE: November 30, 1967
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Oil Immersion Test For Oil Resistant Elastomeric Compounds

10.0 APPROVED VENDORS FOR TEST APPARATUS

*A suitable hot plate is the Thermo Plate Precision Type TP-4. It can be obtained from Matheson Scientific, catalog no. 61689. Any equivalent hot plate is satisfactory.

**The Shore Durometer, Type A or A_2, may be purchased from the Shore Instrument and Mfg. Co., Inc., 90-35 Van Wyck Expressway, Jamaica, N.Y.

***A suitable analytical balance is the Mettler Balance Model H-4 or equivalent.

PREPARED BY:	APPROVED BY:	
F.R. Giancaterino 11/29	J.C. Johnson	CTD015832

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-17	PAGE 1
	SUPERSEDES:	DATE OF ISSUE: January 10, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Water Immersion Test For Elastomeric Compounds

1.0 SCOPE

The purpose of this test is to determine the comparative ability of rubber or rubber-like materials to withstand the effect of water by examining the material for degradation, weight, and volume change.

2.0 REFERENCE

This test is in accordance with ASTM D-471, "Change in Properties of Elastomeric Vulcanizates Resulting From Immersion in Liquids."

3.0 PHYSICAL PROPERTY REQUIREMENTS

The physical property requirements for this test method can be found in the appropriate CPC Purchasing Specifications.

4.0 APPARATUS

1 - Hot Plate, 0-700°F, ±5°F.

3 - Extraction Apparatus, three (3) liter.

Non-Corrosive Wire, .008 inches in diameter or less.

1 - Analytical Balance, 0-160 grams ±.003 grams.

2 - Beakers, 100 and 1000 ml.

Tygon Tubing.

Alcohol, 95% ethanol or isopropanol.

Clamps and Stand (alternate apparatus).

3 - Reflux Condensers, 600 mm. (alternate apparatus).

3 - Erlenmeyer Flask, 3000 ml., pyrex (alternate apparatus).

PREPARED BY: T. R. Giancaterino	APPROVED BY: J. C. Jackson	CTD015833

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-17	PAGE 2
	SUPERSEDES:	DATE OF ISSUE: January 10, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Water Immersion Test For Elastomeric Compounds

5.0 DETERMINATION OF ORIGINAL APPEARANCE, WEIGHT, AND VOLUME

5.1 Procedure

Three (3) specimens 2" ± 1/8" cut from separate finished rings shall be used. Check the appearance of each specimen which shall be free from cracks, tears, and pits. All flash and loose filings shall be removed. Identify each specimen.

Wrap one end of each specimen securely with a non-corrosive wire, leaving a twelve (12) inch excess of wire. Weigh and record each specimen with the wire to the nearest milligram. Neglect the weight of the wire.

To determine the volume of the specimen, it must be weighed suspended in distilled water (75° ± 5°F). Attach the hanger to the weighing pan and tare the balance (Figure 1). If the specimen has holes, e.g. FLUID-TITE ring, submerge it in a beaker of alcohol and quickly shake off the excess liquid. Immerse the specimen in distilled water and shake the air bubbles from the holes. Attach the specimen to the hanger and weigh to the nearest milligram.

6.0 SPECIMEN IMMERSION

6.1 Procedure

Totally immerse the specimen in a three (3) liter extraction apparatus, which shall be filled to the bottom of the neck with distilled water (Figure 2 or 3). The specimen shall hang freely about four (4) inches below the surface of the water. If necessary, two (2) specimens of the same compound may be placed in a single apparatus provided that the two (2) specimens do not touch each other.

The temperature of the water should be kept at 210° ± 2°F for twenty (20) consecutive days. After the twenty (20) day period, remove the specimens from the apparatus and blot dry.

PREPARED BY: mps F.R. Giancaterino	APPROVED BY: J.C. Jackson

FORM PSTP TM 10-63

TECHNICAL SPECIFICATIONS

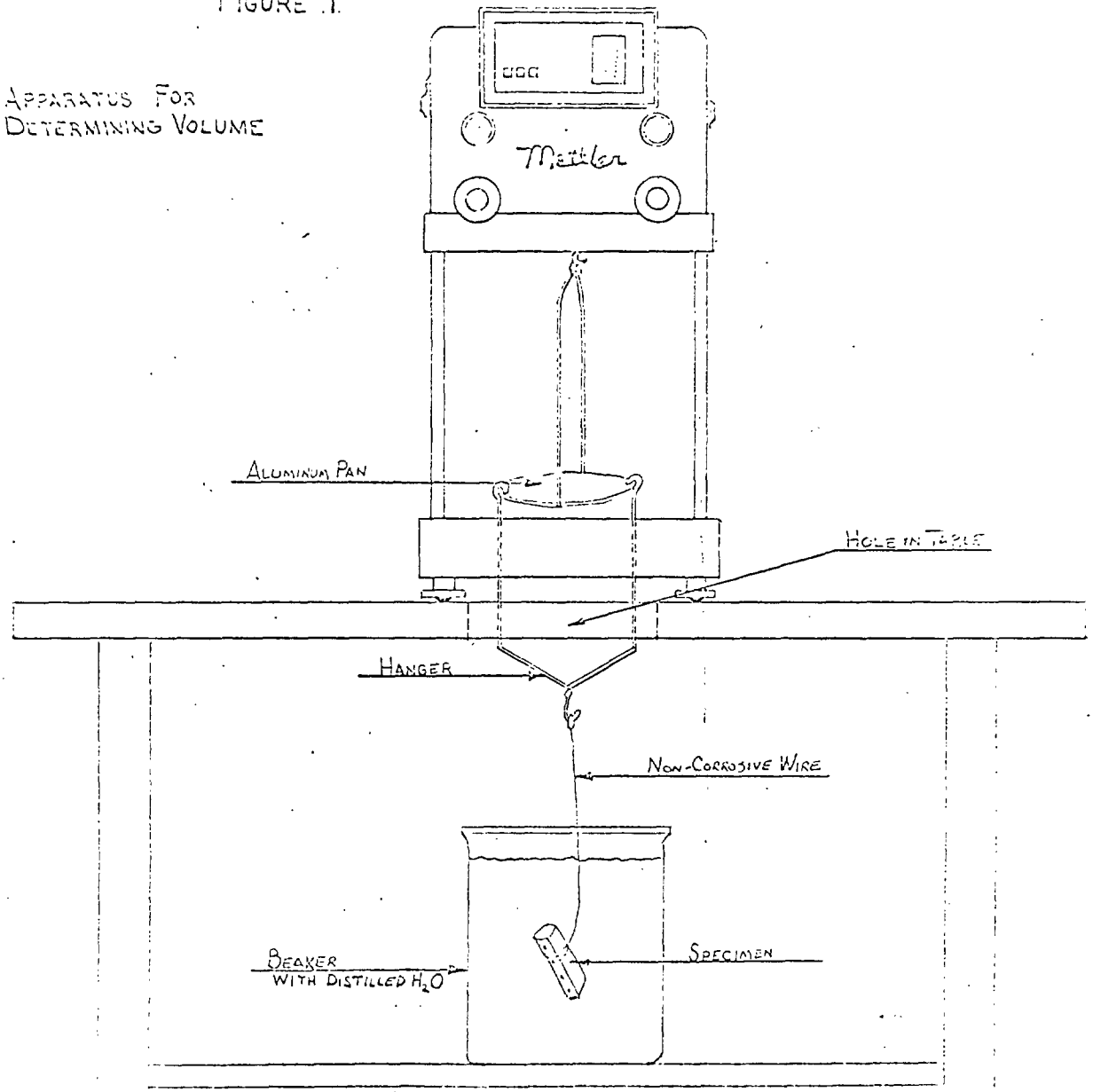
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-17	PAGE 3
	SUPERSEDES:	DATE OF ISSUE: January 10, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Water Immersion Test For Elastomeric Compounds

FIGURE 1.

APPARATUS FOR DETERMINING VOLUME



PREPARED BY: F.R. Giancatarino	APPROVED BY: F.C. Jacobsen	CTD015835

FORM PD27 TR. 10-63

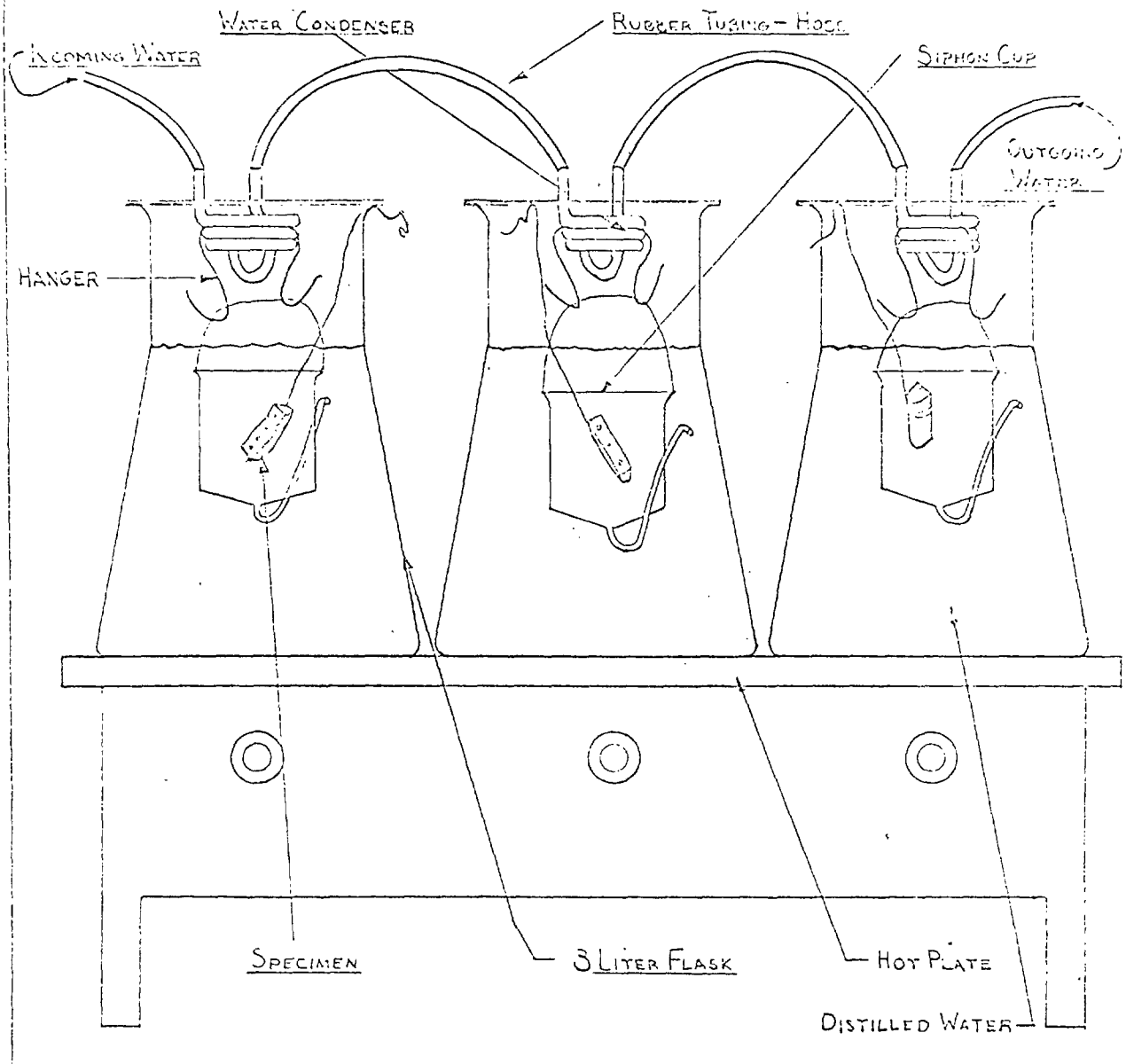
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-17	PAGE 4
	SUPERSEDES:	DATE OF ISSUE: January 10, 1963
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Water Immersion Test For Elastomeric Compounds

FIGURE 2
WATER IMMERSION APPARATUS



PREPARED BY: F. R. Francalancia 1963

APPROVED BY: J. C. Jackson

CTD015836

FORM PS27 TR. 10-63

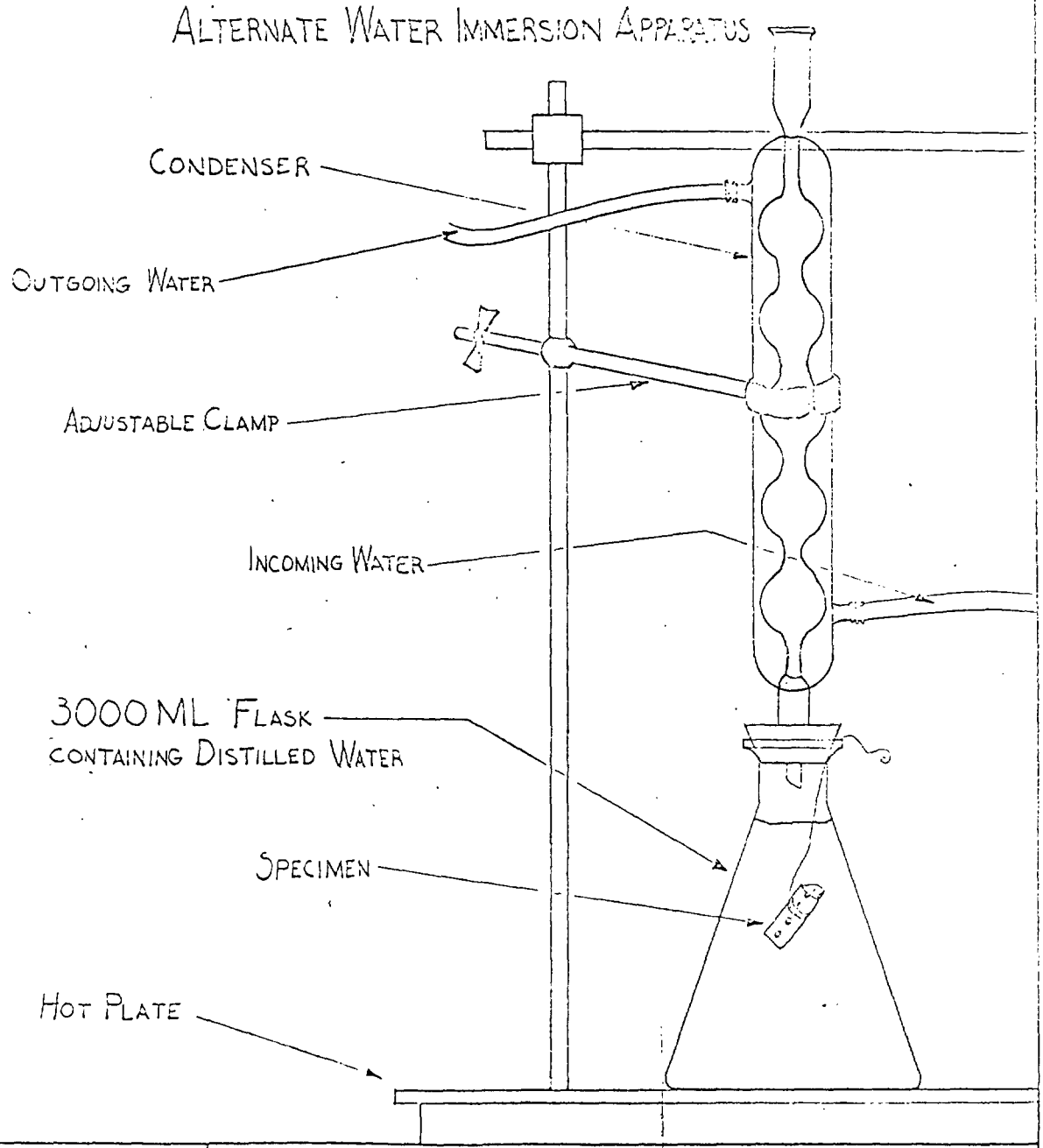
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-17	PAGE 5
	SUPERSEDES:	DATE OF ISSUE: January 10, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Water Immersion Test For Elastomeric Compounds

FIGURE 3

ALTERNATE WATER IMMERSION APPARATUS



PREPARED BY: J.R. Giancaterino

APPROVED BY: J.C. Jackson

CTD015837

FORM 0327 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-17	PAGE 6
	SUPERSEDES:	DATE OF ISSUE: January 10, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Water Immersion Test For Elastomeric Compounds

7.0 DETERMINATION OF CHANGE IN APPEARANCE, WEIGHT, AND VOLUME

7.1 Procedure

Check the appearance of the specimens to see if any cracks, tears, or pitting occurred during immersion.

Determine the weight and volume immediately as previously described in section 5.1 and record the results with the originals and calculate the per cent change.

8.0 CALCULATIONS

8.1 Calculate the change in weight as follows.

$$\text{Change in weight, per cent} = \frac{(W_2 - W_1)}{W_1} \times 100$$

Where: W_1 = initial weight of specimen in grams.

W_2 = weight of specimen in grams after immersion.

8.2 Calculate the change in volume as follows.

$$\text{Change in volume, per cent} = \frac{(W_3 - W_4) - (W_1 - W_2)}{(W_1 - W_2)} \times 100$$

Where: W_1 = initial weight of specimen in air, in grams.

W_2 = initial weight of specimen in water, in grams.

W_3 = weight of specimen in air after immersion, in grams.

W_4 = weight of specimen in water after immersion, in grams.

PREPARED BY: MWS H.R. Giancaterino	APPROVED BY: J.C. Jackson	CTD015838

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-17	PAGE 7
	SUPERSEDES:	DATE OF ISSUE: January 10, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Water Immersion Test For Elastomeric Compounds

9.0 APPROVED VENDORS FOR TEST APPARATUS

A suitable analytical balance is the Mettler Balance, model H-4 or equivalent.

Any hot plate within the test requirements for this method may be used. A suitable hot plate is the Thermo Plate Precision Type TP-4. It can be obtained from Matheson Scientific, catalog no. 61689.

The Erlenmeyer Flasks must be Pyrex Brand Glass and can be obtained from Fisher Scientific Co., catalog no. 10-040 or equivalent.

Condensers should be the Allihn type, made of Pyrex. They can be obtained from Fisher Scientific Co., catalog no. 7-732.

PREPARED BY: mjs J.R. Giancaterino	APPROVED BY: J.C. Jackson

CTD015839

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-18	PAGE 1
	SUPERSEDED:	DATE OF ISSUE: January 11, 1966
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Hardness Test For Elastomeric Materials

1.0 SCOPE

The method describes the procedure for determining the indentation hardness of materials ranging from soft vulcanized rubber to some rigid plastics by means of a durometer.

2.0 REFERENCE

This test method is in accordance with ASTM D-2240, "Test for Indentation of Rubber by Durometer".

3.0 PHYSICAL PROPERTY REQUIREMENTS

The physical property requirements for this test method can be found in the appropriate CPC Purchasing Specifications.

4.0 APPARATUS

*Shore Durometer, type A or A_2

**Aging Oven

5.0 ORIGINAL HARDNESS

5.1 Procedure

Condition the specimens and durometer at room temperature ($75^\circ \pm 5^\circ F$) for four (4) hours. The test is to be performed on a finished product. Lay the specimen on a flat smooth surface. If the specimen is a FLUID-TITE ring, place the face containing the holes down.

If a Type A durometer is used, apply the indentor point of the durometer to the specimen and press firmly (with a force of approximately 1000 grams) for five (5) seconds before taking a reading (Figure 1). When a Type A_2 durometer is used, place the specimen in a jig in which it will fit snugly (Figure 2). Place the arm of the durometer on the specimen and wait five (5) seconds before taking a reading.

Five readings are to be taken at random on each specimen and the median reading recorded.

PREPARED BY: T. R. Garcia-Marino	APPROVED BY:

CTD015840

TECHNICAL SPECIFICATIONS

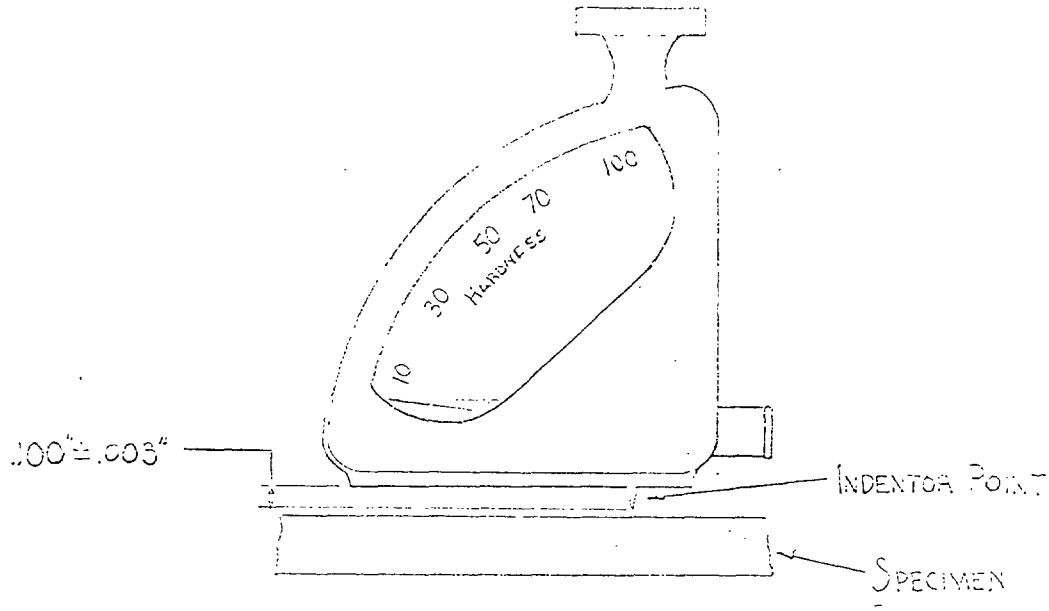
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-18	PAGE 2
	SUPERSEDES:	DATE OF ISSUE: January 31, 1963
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Hardness Test For Elastomeric Materials

FIGURE 1

SHORE DUROMETER TYPE A



PREPARED BY: J.R. Granca Jr.	APPROVED BY:

CTD015841

TECHNICAL SPECIFICATIONS

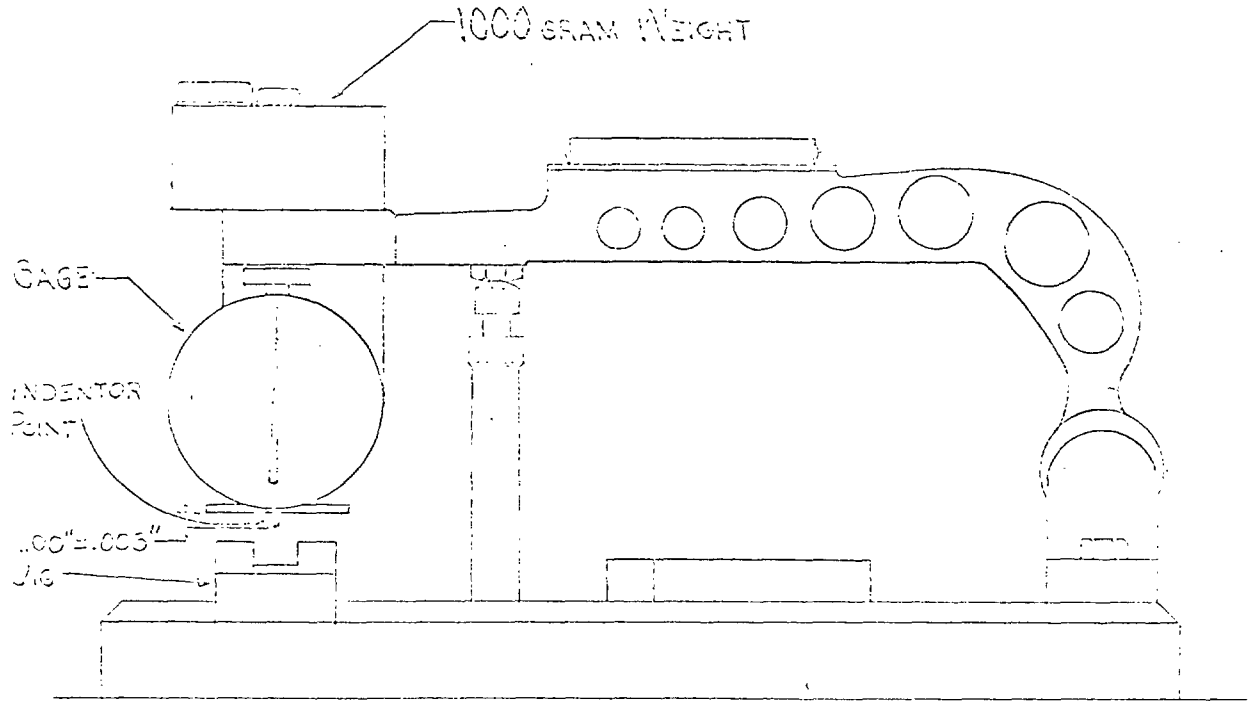
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-18	PAGE: 3
	SUPERSEDES:	DATE OF ISSUE: December 15, 1960
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Hardness Test For Elastomeric Materials

FIGURE 2

SHORE DUROMETER TYPE A_2



PREPARED BY:	APPROVED BY:	
F. R. Giancaterino		CTD015842

TECHNICAL SPECIFICATIONS

FOR

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATION CLASSIFICATION:		
Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	T M - 18	4
SUPERSEDES:		DATE OF ISSUE:
January 11, 1968		August 8, 1969

DESCRIPTION:

Hardness Test For Elastomeric Materials

6.0 AGED HARDNESS

6.1 Procedure

Place three (3) specimens on which the original hardness has been taken in an air circulating oven for 166 hours at $158^{\circ} \pm 1.8^{\circ}F$ for non-oil resistant rings or 70 hours at $212^{\circ} \pm 2^{\circ}F$ for oil resistant rings. Remove from oven; allow to cool for thirty (30) minutes. Determine the hardness and record with the original reading.

Note: For CERTA-SPACER bands, place in an air circulating oven for 166 hours at $212^{\circ} \pm 2^{\circ}F$.

7.0 CALCULATIONS

The difference between the original and aged hardness is expressed in points increased or decreased.

Change in hardness, points = $H_2 - H_1$

Where: H_1 = original hardness

H_2 = aged hardness

8.0 APPROVED VENDORS FOR TEST APPARATUS

*The Shore Durometer, type A or A_2 may be purchased from the Shore Instrument & Mfg. Co., Inc., 90-35 Van Wyck Expressway, Jamaica, New York.

**The oven shall be in accordance with Federal Test Method Standard No. 601, Method 7221 except that a recorder is optional. A Blue M, Hi Heat Utility Oven, number JA 1021 from Fisher Scientific or equivalent is suitable.

CTD015843

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
E R Dereham						

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TM-19

FORM [illegible]

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-19	PAGE 1
	SUPERCEDES:	DATE OF ISSUE [illegible] 1966
APPLICABLE TO	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Tensile Strength, Modulus, and Elongation For Elastomeric Materials

1.0 SCOPE

This method describes procedures for determining the effect of the application of a tension load to elastomeric materials. The procedures cover tests for tensile strength, modulus, and elongation. Determination of per cent change in tensile strength and elongation after oven aging is also described.

2.0 REFERENCE

This test method is in accordance with ASTM 412, "Tension Testing of Vulcanized Rubber".

3.0 PHYSICAL PROPERTY REQUIREMENTS

The physical property requirements for this test method can be found in the appropriate CPC Purchasing Specifications.

4.0 APPARATUS

*Dies, Type C

*Bench Marker

*Stamp Pad

*Thickness Gage

*Testing Machine

*Grips

Cutting Device

Air Circulating Oven

Spray Mist Coolant System

Aquarex Lubricant

*Details for these apparatus can be found in ASTM 412.

PREPARED BY:	APPROVED BY:
J. R. Grisamore	L. C. Jackson

CTD015844

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-19	PAGE 2
	SUPERSEDES: January 11, 1968	DATE OF ISSUE: September 13, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Tensile Strength, Modulus, and Elongation For Elastomeric Materials

5.0 TEST SPECIMENS

5.1 Cutting Specimens

Strips cut from rubber rings shall have a flat smooth surface and a thickness of 0.075 to 0.125 inches. They shall be of such a size as to permit the cutting of dumbbell specimens four (4) inches long and 5/8 inches wide. Any suitable method of cutting the specimen may be used provided it does not distort or change the properties of the specimen. One method is to cut the specimen strips from the rubber ring with a rotary bench saw. The specimen is placed in a jig held in place by a permanent magnetic chuck. A spray mist coolant system is used to lubricate the specimen. Aquarex lubricant is used in a 1000 to 1 ratio with water. The dumbbell specimens are stamped out of this strip with a Type C die. This is done either by a stamp press or with a mallet. If a stamp press is used, attach the die to the upper portion of the press. Place the strip of rubber from which the dumbbell is to be cut on a smooth, slightly yielding surface to prevent injury to the die. Place the specimen directly under the die and press the foot pedal. Nothing should be between the specimen and the die. The die should be examined at frequent intervals for nicks in the test portion. If there are nicks that can not be removed, the die shall be replaced.

5.2 Measuring Specimens

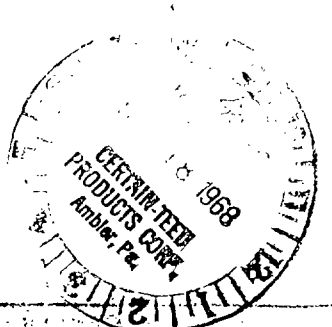
Measure the center and each end of the restricted section of the dumbbell specimen to the nearest .001 inch with the lowest of the three (3) measurements used as the thickness of the specimen. The width of the restricted section is equivalent to the width of the type C die (0.25 inches).

5.3 Marking Specimens

Dumbbell specimens are to be marked with a bench marker with a distance of one (1) inch between the knife edges. The specimen shall be under no tension and shall be marked at the center of the restricted section.

PREPARED BY: Brian Haffey	APPROVED BY: MRS

CTD015845


1968
CERTAIN-TEED
PRODUCTS CORP.
Ambler, Pa.

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION PIPE DIVISION	SPECIFICATIONS CLASSIFICATION: Standard Test Method		
	T.C.O. REF. NO.: 3	SPECIFICATION NO.: T M - 19	PAGE NO.: 3
	SUPERSEDES: January 11, 1968		DATE OF ISSUE: August 8, 1969

DESCRIPTION:

Tensile Strength, Modulus, and Elongation For Elastomeric Materials

6.0 DETERMINATION OF ORIGINAL TENSILE STRENGTH, MODULUS, AND ELONGATION

6.1 Procedure

Dumbbell specimens are to be conditioned for four (4) hours at room temperature ($75^{\circ} \pm 5^{\circ}F$). Place the specimen in the grips of the testing machine and adjust them symmetrically. Start the machine and note continuously the distance between the two bench marks. Record the force after the specimen has been elongated 300 per cent, i.e., when the one (1) inch center has been stretched to a total of four (4) inches. Continue running the machine until the specimen breaks. Record the force and the length between the bench marks at which the specimen broke. This is ultimate elongation and tensile strength.

Note: When testing CERTA-SPACER bands, dumbbells need not be used. A six (6) inch $\pm$ ¼ inch length cut from the band is required. Proceed as in section 6.1 except that the modulus is taken at 100 per cent instead of 300 per cent.

7.0 AGED TENSILE STRENGTH AND ELONGATION

7.1 Procedure

Oven age non-oil resistant dumbbell specimens in an aging oven at $158^{\circ} \pm 1.8^{\circ}F$ for 166 $\pm$ 1 hours and oil resistant dumbbell specimens at $212^{\circ} \pm 2^{\circ}F$ for 70 $\pm$ 1 hours. Allow the specimens to reach room temperature. Repeat the tensile strength and elongation determinations as in section 6.1 and calculate the per cent change from the original properties.

Note: For CERTA-SPACER bands, place in an air circulating oven for 166 hours at $212^{\circ} \pm 2^{\circ}F$.

8.0 CALCULATIONS

8.1 The cross sectional area of an unstretched dumbbell specimen shall be calculated as follows:

Cross Sectional Area = w x t = A in square inches of unstretched specimen

Where: w=width of restricted section in inches
t=thickness of restricted section in inches

CTD015847

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
E R Dereham						

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8.2 The tensile strength shall be calculated as follows.

$$\text{tensile strength, psi} = \frac{L}{A}$$

Where: L = breaking load in pounds
A = cross sectional area of unstretched specimen, in square inches.

8.3 The modulus shall be calculated as follows.

$$\text{modulus, psi} = \frac{S}{A}$$

Where: S = force at specific elongation, in pounds
A = cross sectional area of unstretched specimen, in square inches.

8.4 The elongation shall be calculated as follows.

$$\text{ultimate elongation, per cent} = \frac{(D - G)}{G} \times 100$$

Where: D = distance at break in inches
G = original distance in inches

8.5 Change in tensile strength and/or elongation shall be calculated as follows.

$$\text{change in tensile and/or elongation, per cent} = \frac{(P_1 - P_2)}{P_1} \times 100$$

Where: P_1 = initial tensile strength and/or elongation in psi
P_2 = tensile strength and/or elongation after oven aging in psi

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-19	PAGE 5
	SUPERSEDES:	DATE OF ISSUE: [illegible]
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Tensile Strength, Modulus, and Elongation For Elastomeric Materials

9.0 [illegible]

The oven shall be in accordance with Federal Test Method Standard No. 601, Method 7221 except a recorder is optional. A Blue M, HL Heat Binary, Oven, Model SW 1021 from Fisher Scientific or equivalent is suitable.

A Dillon TF or Scott universal tester equivalent are suitable testing machines.

The blade used on the rotary bench saw is model no. 2343-30 from Industrial Products Corporation, Bloomfield, New Jersey. Any equivalent blade that will facilitate the cutting of rubber is suitable.

PREPARED BY.	APPROVED BY.
J.R. Fiorentino	[signature]

CTD015849

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-20	PAGE 1
	SUPERSEDES:	DATE OF ISSUE: January 9, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Shrinkage Test For Elastomeric Compounds

1.0 SCOPE

The shrinkage test is a method of determining the relative shrinkage resistance of elastomeric compounds when placed in elevated temperatures after they have been immersed in water.

2.0 PHYSICAL PROPERTY REQUIREMENTS

The physical property requirements for this test method can be found in the appropriate CPC Purchasing Specifications.

3.0 APPARATUS

Air Circulating Oven *.
Lufkin Outside Diameter Tape (refer to CPC TM-22).
Pan, impervious to water.
Tank, equipped for running water (for alternate procedure).
Elevated drain extension (for alternate procedure).

4.0 SHRINKAGE DETERMINATION

4.1 Test Procedure

Condition finished rubber rings for at least four (4) hours at room temperature (75° ± 5°F.). Measure the outside diameter. The specimen shall then be submerged in tap water (75° ± 5°F.) for twenty (20) hours, removed and allowed to dry for four (4) hours at room temperature. Measure the outside diameter again. This procedure shall be repeated for seven (7) days using clean tap water each day. Specimens shall remain in the water over weekends. At the end of the seven (7) days, the specimens' outside diameter shall be measured in not less than four (4) hours nor more than eight (8) hours after removal from the water. Place the specimens in an air circulating oven at 70° ± 1°C. for 166 ± 1 hour. At the end of the aging period, remove the specimens and set aside from four (4) to eight (8) hours at room temperature before measuring the final outside diameter.

PREPARED BY:	APPROVED BY:	
Frank R Francalanci mgfs		CTD015850

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-20	PAGE 2
	SUPERSEDES:	DATE OF ISSUE: January 9, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	
DESCRIPTION: Shrinkage Test For Elastomeric Compounds		

4.2 Alternate Test Procedure

An alternate test method for shinkage can be used if there are several specimens to be tested at the same time or to eliminate the changing of water each day. Allow the specimens to lay completely submerged in running tap water for seven (7) days (Figure 1). If the specimen is a FLUID-TITE ring, shake the air bubbles from the holes and lay with the holes facing upwards. At the end of seven (7) days, remove the specimens from the water and allow to air dry for not less than four (4) hours nor more than eight (8) hours before measuring the outside diameter. Place in an air circulating oven and continue test for oven exposure as described above in Section 4.1.

5.0 CALCULATIONS

The change or shrinkage in the outside diameter shall be calculated as follows

$$\text{Shrinkage, per cent} = \frac{(D - E)}{D} \times 100$$

Where D = original outside diameter, inches.
E = final outside diameter, inches.

The shrinkage shall be recorded to the nearest 0.01% and shall be reported as the shrinkage for the specimens tested.

The per cent shrinkage shall be calculated both after water immersion and oven aging.

6.0 APPROVED VENDOR FOR TEST APPARATUS

* The oven shall be in accordance with Federal Test Method Standard No. 601, Method 7221 except that a recorder is optional. A Blue M, Hi Heat Utility Oven, No. JA 1021 from Fisher Scientific or equivalent is suitable.

PREPARED BY: Frank R. Francatorio	APPROVED BY:

CTD015851

FORM P927 TM. 10-63

TECHNICAL SPECIFICATIONS

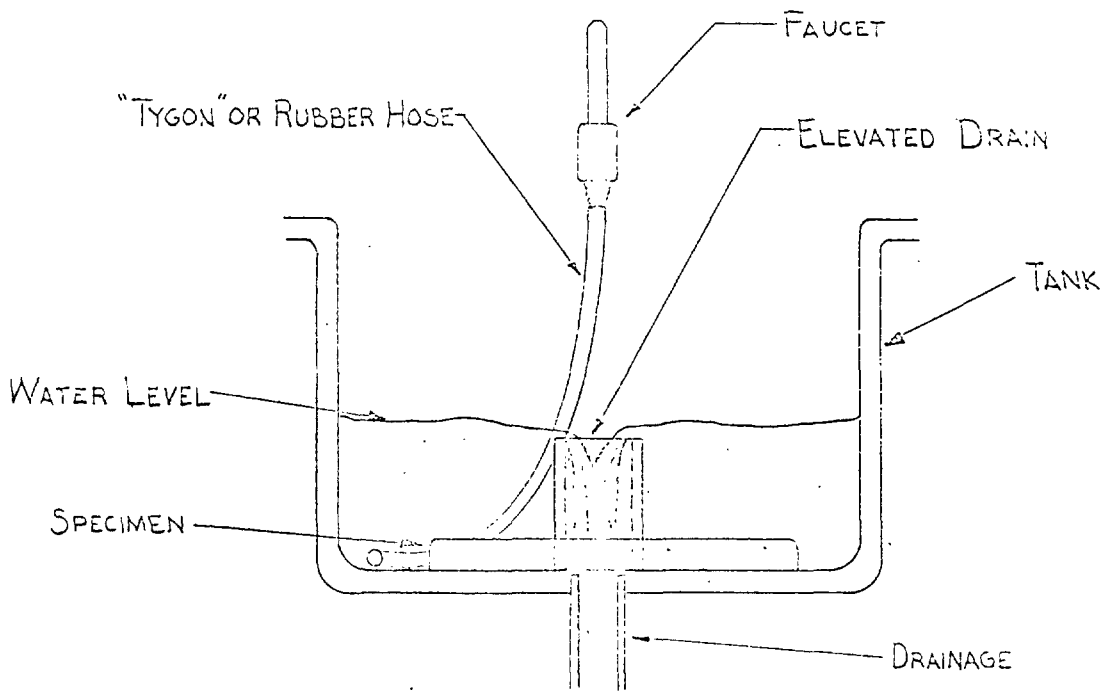
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-20	PAGE 3
	SUPERSEDES:	DATE OF ISSUE: January 9, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Shrinkage Test For Elastomeric Compounds

FIGURE 1

SHRINKAGE TEST
(ALTERNATE METHOD)



PREPARED BY: Frank R. Giancaterino mgs

APPROVED BY:

CTD015852

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-21	PAGE 1
	SUPERSEDES:	DATE OF ISSUE: January 9, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Compression Set Test for Elastomeric Compounds

1.0 SCOPE

Compression Set Tests are intended to measure the ability of elastomeric compounds to retain elastic properties during prolonged action of compressive stresses.

2.0 REFERENCE

This test method is in accordance with ASTM D-395, Method B, "Test for Compression Set of Rubber".

3.0 PHYSICAL PROPERTY REQUIREMENTS

The physical property requirements for this test method can be found in the appropriate CPC Purchasing Specifications.

4.0 APPARATUS

Compression Device, as shown in Figure 1.
Dial Micrometer, 0 - 1 inch, ± .001 inches.
Air Circulating Oven *

Note: The steel plate surface of the compression device must be ground to a maximum roughness of ten (10) microinches before chromium plated.

5.0 TEST PROCEDURE

Cut a specimen three (3) inches long from a finished product. Measure its height and mark the exact point of measurement. This measurement shall be taken with a dial micrometer to the nearest 0.001 inches. The ring shall lay flat on a smooth level surface (Figure 2). No height measurement shall be made in any area where the raised printing on the specimen will be under the presser foot. Allow the entire presser foot to fall on the specimen and take a direct reading from the dial gauge.

Place the specimen in the compression device (Figure 1). If necessary, two (2) specimens may be placed on the same plate at opposite ends. Compress the specimen to the required percentage by placing the correct size spacer between the plates; e.g., if

PREPARED BY: Frank R. Gonsalves	APPROVED BY:	CTD015853

FORM P027 TR. 10-63

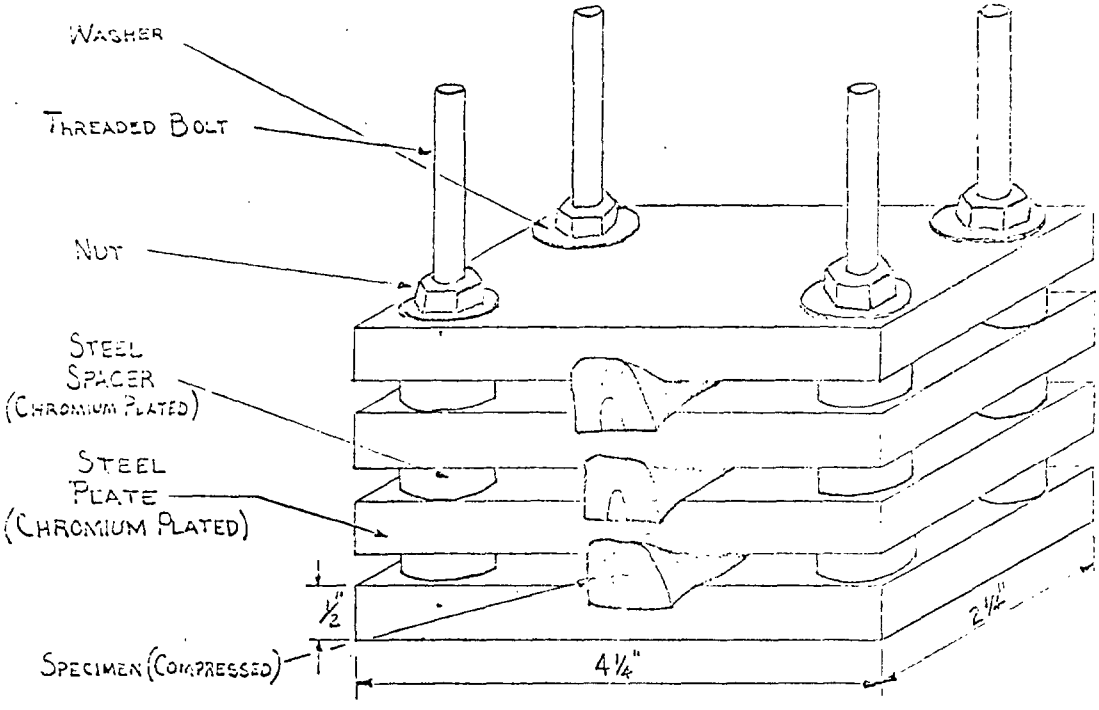
TECHNICAL SPECIFICATIONS

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APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Compression Set Test for Elastomeric Compounds

FIGURE 1



COMPRESSION SET APPARATUS

PREPARED BY: Frank R Francatorino

APPROVED BY:

CTD015854

a one (1) inch thick specimen is to be compressed fifty (50) per cent, a 0.5 inch spacer shall be used. Tighten the device with a wrench until secure. Oven age in an air circulating oven for 22 hours at a temperature of 70° ± 1°C. for non oil resistant specimens, or 100° ± 2°C. for oil resistant specimens. Remove the specimens from the device immediately upon removal from the oven and allow to cool for thirty (30) minutes. Measure the height of the specimen at the reference point.

Note: The plates are to be cleaned with acetone after each use.

6.0 CALCULATIONS

The compression set is calculated as per cent deflection.

$$\text{Compression Set, per cent} = \frac{(t_o - t_i)}{(t_o - t_s)} \times 100$$

Where: t_o = original height
t_i = height after compression release
t_s = height of spacers

7.0 REPORT

All deviations from the requirements of this test method shall be reported with the results.

8.0 APPROVED VENDORS FOR TEST APPARATUS

* The oven shall be in accordance with Federal Test Method Standards No. 601, Method 7221 except that the recording as optional. A Blue M, Hi Heat Utility Oven, Model JA 1021 or equivalent is suitable.

TECHNICAL SPECIFICATIONS

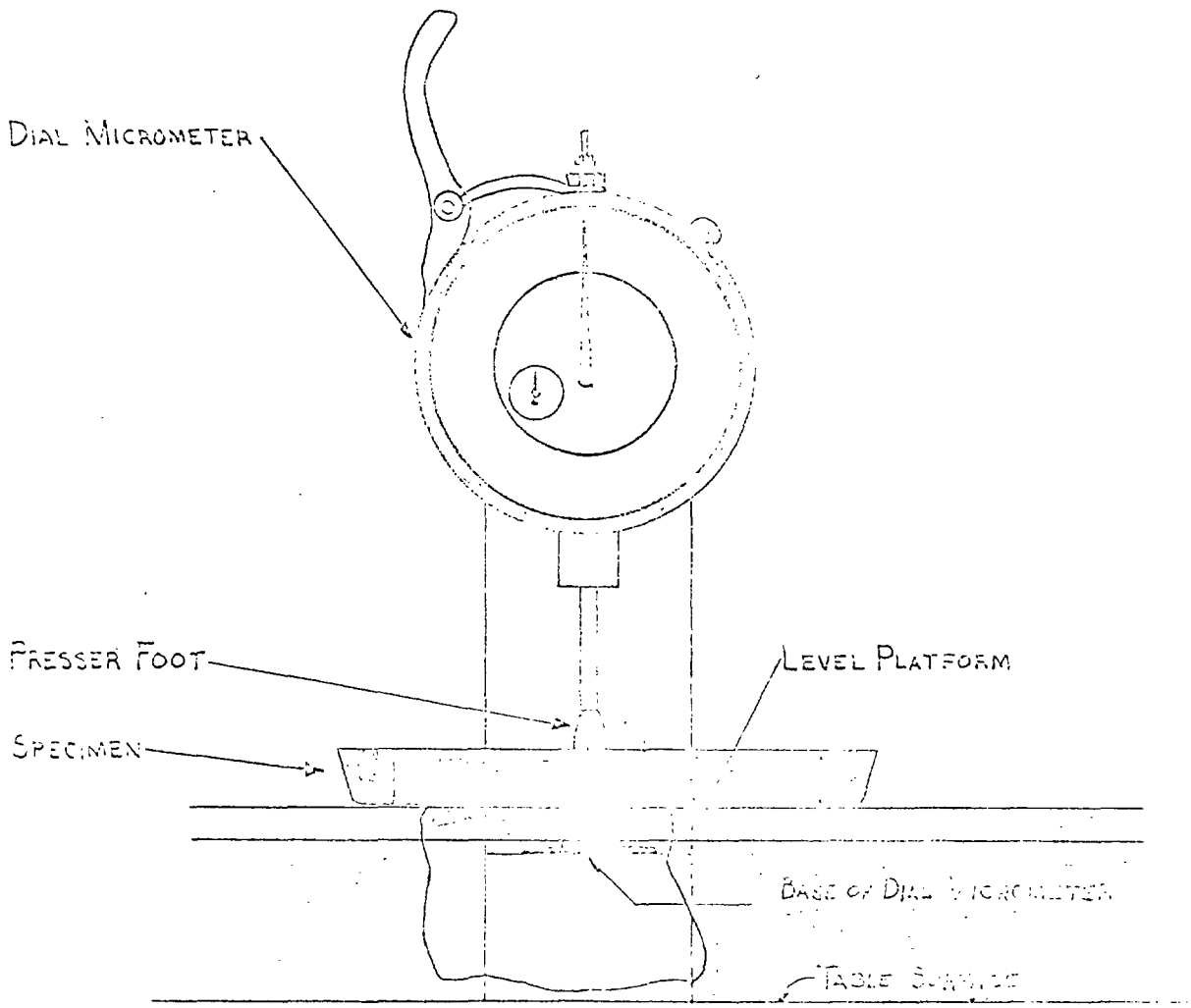
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-21	PAGE: 4
	SUPERSEDES:	DATE OF ISSUE: January 9, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Compression Set Test for Elastomeric Compounds

FIGURE 2

APPARATUS FOR HEIGHT MEASUREMENTS



PREPARED BY: Frank R. Gianotsos	APPROVED BY: J. C. Jackson	CTD015856

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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SUPERSEDES:	DATE OF ISSUE: SEP 28 1971	

DESCRIPTION:

Compression Set Test for CG Rubber Rings

1.0 Scope

Compression Set Tests are intended to measure the ability of elastomeric compounds to retain elastic properties during prolonged action of compressive stresses.

2.0 Reference

This test method is in accordance with ASTM D-395, method B- "Test for Compression Set of Rubber."

3.0 Physical Property Requirements

The physical property requirements for this test method can be found in P&PG Standard Purchasing Specification 503B.

4.0 Apparatus

Compression Device as shown in Figure 2.
Dial Micrometer, 0-1 inch ±.001 inches with weight 84 gms, ±2.8 gms.
Air Circulating Oven *

Note: The steel plate surface of the compression device must be ground to a maximum roughness of ten (10) microinches before chromium plated. (Stainless steel plates may also be used provided they are polished to a roughness not to exceed 10 microinches.)

5.0 Test Procedure

Cut two specimens .560" ±.010" through the cross-section of the ring. Each specimen shall contain only a single complete hole reasonably centered in the specimen (Figure 1). Measure their thickness at the point shown and mark the exact point of measurement. These measurements shall be taken with a dial micrometer to the nearest .001 inches. Place the specimens in the compression device with the cut sides on the plates. Compress the specimens to the required percentage by placing the correct size spacer (.28 inches) between the plates. Tighten the device with a wrench until secure against the spacers. Oven age in an air circulating

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

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oven for 22 hours at a temperature of 70°C ±1°C (158°F ±1.8°F) for non oil resistant specimens or 100°C ±2°C (212°F ±3.6°F) for oil resistant specimens. Remove the specimens from the device immediately upon removal from the oven. Allow the specimens to cool for thirty (30) minutes. Measure the height of the specimens at the reference points.

Note: The plates are to be cleaned with acetone after each use.

6.0 Calculations

Compression Set is calculated as per cent deflection.

$$\text{Compression set, per cent} = \frac{(t_o - t_1)}{(t_o - t_s)} \times 100$$

where t_o = original height.
t_1 = height after compression release.
t_s = height of spacer.

7.0 Report

All deviations from the requirements of this test method shall be reported with the results. The results, using this method of test, are higher than those of using the 3-inch strip. Care should be exercised until a correlation between the test methods is developed.

8.0 Referee Method

The 3-inch trimmed strip shall be used for referee testing. This test will usually be done at North Wales, Pa.

9.0 Approved Vendors for Test Apparatus

*The oven shall be in accordance with Federal Test Method Standard No. 601 Method 7221 except that the recording is optional. A Blue M Hi Heat Utility Oven, Model JA1021 or equivalent is suitable.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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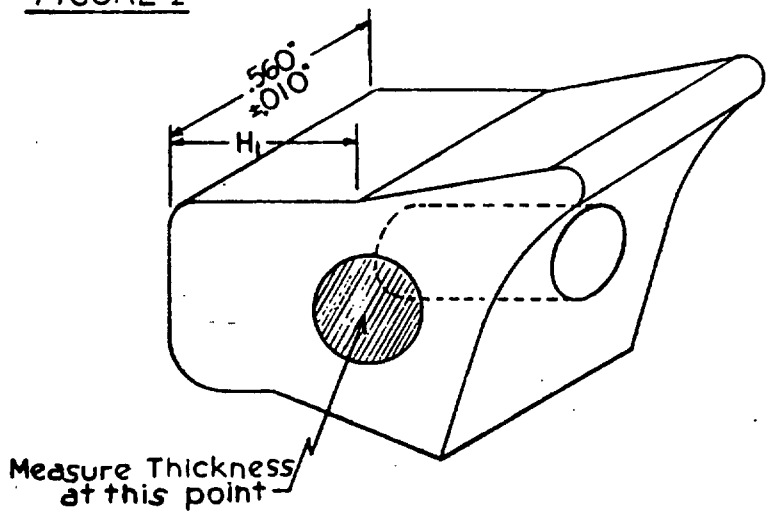
SUPERSEDES:

DATE OF ISSUE: SEP 28 1971

DESCRIPTION:

Compression Set Test for CG Rubber Rings

FIGURE 1



CTD015859

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

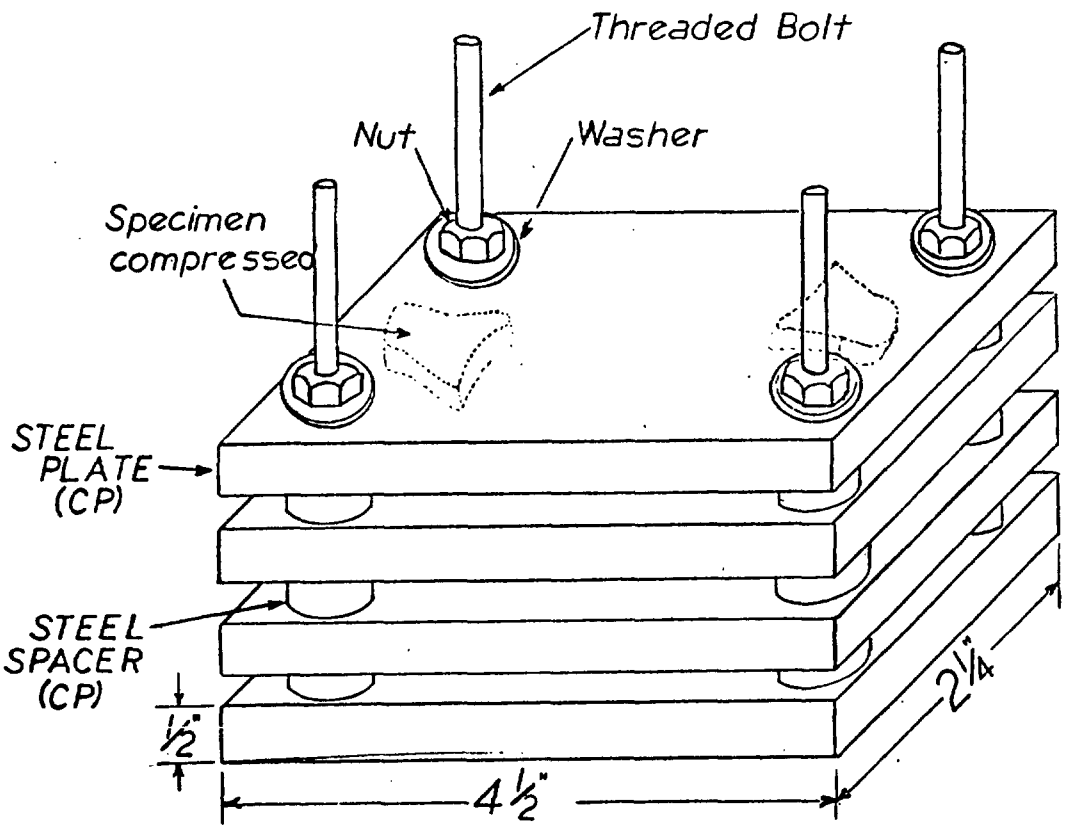
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SPECIFICATIONS CLASSIFICATION:		
Standard Test Method		
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SUPERSEDES:		DATE OF ISSUE: SEP 28 1971

DESCRIPTION:

Compression Set Test for CG Rubber Rings

FIGURE 2



CP = Chromium Plated

CTD015860

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
R. Crowell Jr.						

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-22	PAGE 1
	SUPERSEDES:	DATE OF ISSUE: January 9, 1968

APPLICABLE TO:	CLASSIFICATION: Standard Test Method

DESCRIPTION:

Mold Approval for Rubber Rings

1.0 SCOPE

The purpose of the mold approval is to assure that all rings produced from each cavity in a mold will be within the dimensional requirements of the CPC Purchasing Specifications. All mold approvals will be performed in the Materials Laboratory, Ambler, Pennsylvania.

2.0 DIMENSIONAL REQUIREMENTS

The dimensional requirements for this test can be found in the appropriate CPC Purchasing Specifications.

3.0 APPARATUS

Outside Diameter Tape, accurate to ± .005 inches.

Pocket Comparator, 20 mm linear scale lens, accurate to ± .0025 inches.
0-3/8 inches radial scale lens, accurate to ± 1/32 inches.

Micrometer Depth Gauge, accurate to ± .001 inches.

Hole Depth Go-No-Go Gauge, refer to Quality Control Drawing No. 10.

Hole Diameter Go-No-Go Gauge, refer to Quality Control Drawing No. 10.

4.0 DIMENSION

All dimensional measurements shall be made on rings that are conditioned at room temperature (75° ± 5°F.) for at least four (4) hours. Fifteen rings that are properly finished shall be checked from each cavity. Ten readings shall be taken at random on every ring for all dimensions unless otherwise stated. All readings are to be recorded and a distribution obtained.

4.1 HOLE DIMENSIONS

4.1.1 Hole Diameter

The diameter shall be taken with a pocket comparator to the nearest 0.1 mm (see Figure 1). The reading should be taken on the widest part of the hole using the lens with the 20 mm linear scale. Care

PREPARED BY:	APPROVED BY:	CTD015861

should be taken that the zero hash mark is lined exactly on the border of the hole edge. The remainder of the holes shall be checked with a diameter go-no-go gauge. In Figure 3, the gauge application for the hole diameter illustrates that the hole diameter of the first specimen is within tolerance, the second is too small and the third is too large.

4.1.2 Hole Depth

The measurement shall be taken with a depth gauge to the nearest .001 inches (Figure 2). Hold the gauge firmly on the ring and insert the indentor rod into the hole by turning the barrel clockwise. Continue turning until initial contact is made with the bottom of the hole. The depth of the remainder of holes shall be checked with a depth go-no-go gauge. In Figure 3, the gauge application for the hole depth illustrates that the hole depth of the first specimen is within tolerance, the second is too shallow and the third is too deep.

4.1.3 Number of Holes

Count the number of holes on the ring. The holes are counted by making a mark on the ring and counting until the mark is met again.

4.1.4 Position of Holes

The holes shall be equally spaced from one another and be the same distance from the inner edge of the ring. The distance between the holes and the distance from the holes to the inner edge of the ring shall be measured with a pocket comparator.

4.2 RING OUTSIDE DIAMETER

Measurement of the ring outside diameter is taken by direct reading with a flexible outside diameter tape to the nearest 0.005 inches. The tape shall be held snugly against the ring outside diameter, but shall not distort the ring.

4.3 WIDTH OF RING

The width measurement ("G" dimension) shall be taken with a pocket comparator to the nearest 0.1 mm (Figure 1) using the lens with the 20 mm linear scale. Care should be taken that the zero hash mark is lined up exactly on one edge of the ring.

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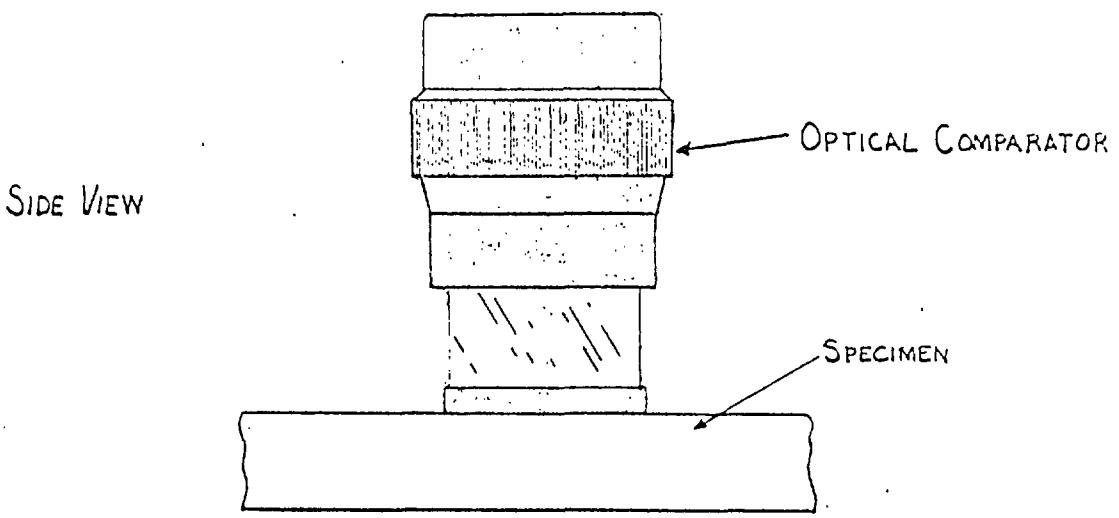
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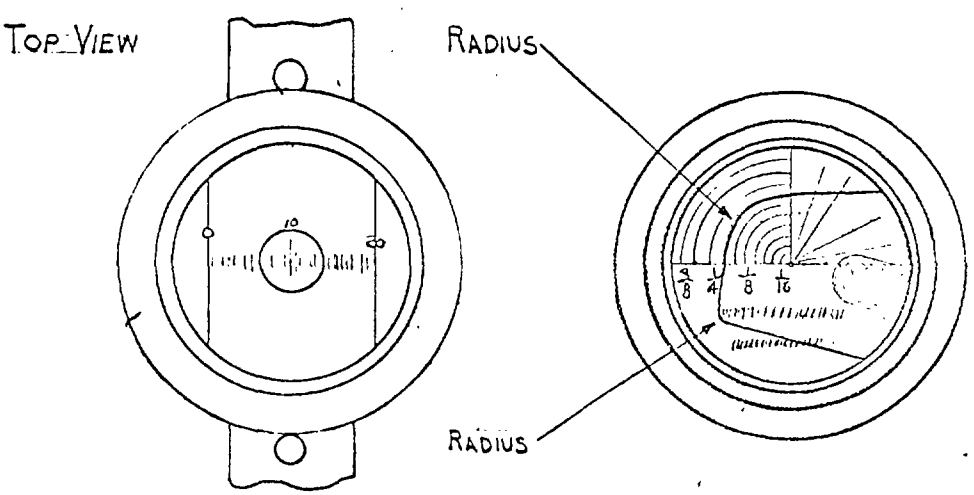
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APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Mold Approval for Rubber Rings

FIGURE 1





A. LINEAR DIMENSIONS

B. RADIAL DIMENSIONS

PREPARED BY: mkB Frank R. Giannotonio	APPROVED BY: J. C. Jackson

CTD015863

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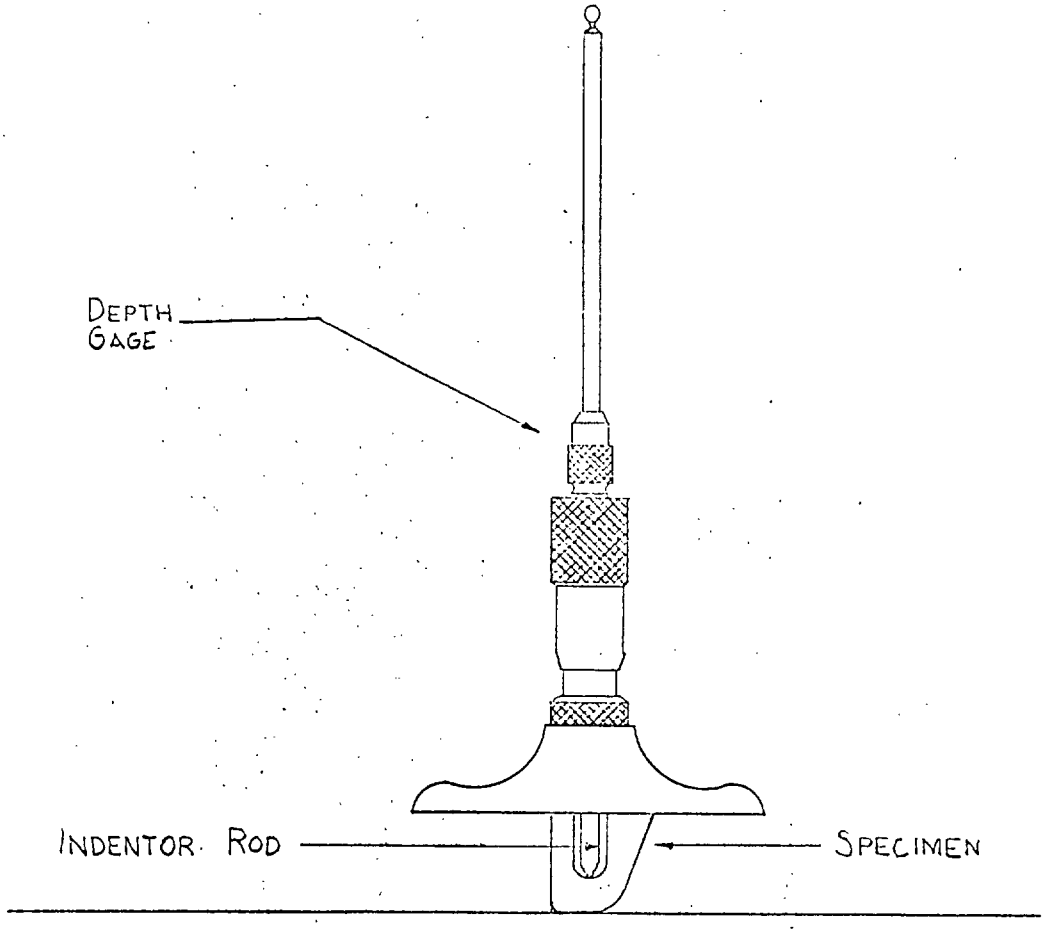
TECHNICAL SPECIFICATIONS

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	SUPERSEDES:	DATE OF ISSUE: January 9, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Mold Approval for Rubber Rings

FIGURE 2



PREPARED BY: Frank R Gimmestad

APPROVED BY:

CTD015864

FORM P627 TR. 10-63

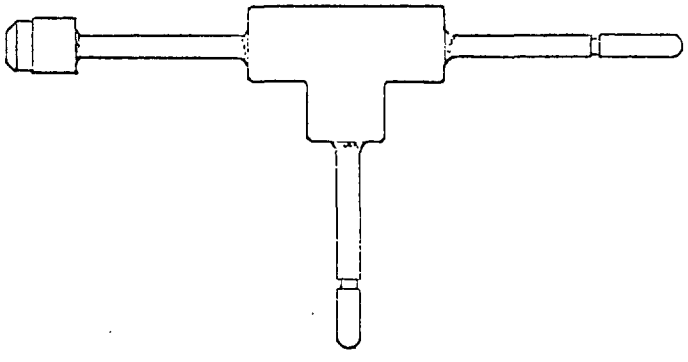
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-22	PAGE 5
	SUPERSEDED:	DATE OF ISSUE: January 9, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Mold Approval for Rubber Rings

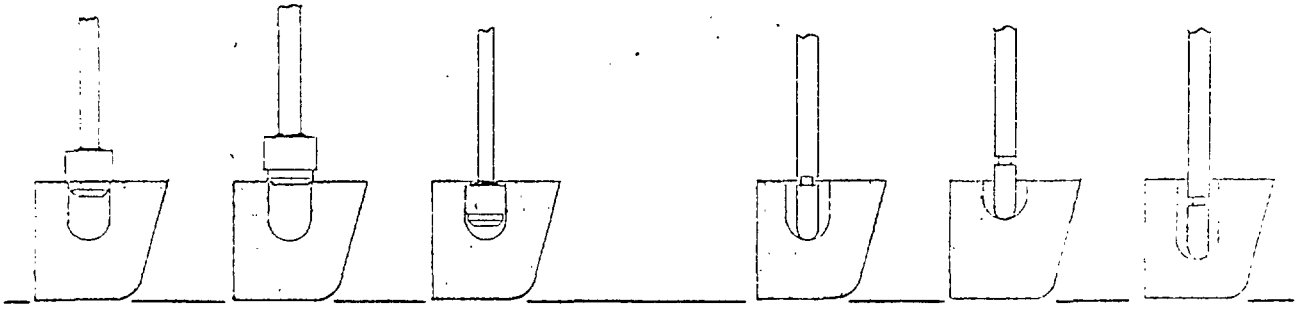
FIGURE 3
"Go" "No-Go" GAUGE



GAUGE APPLICATION

HOLE DIAMETER

HOLE DEPTH



PREPARED BY: Frank R. Giamotarino wpjs

APPROVED BY:

CTD015865

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-22	PAGE 6
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APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Mold Approval for Rubber Rings

4.4 HEIGHT OF RING

The measurement shall be taken with a dial micrometer to the nearest 0.001 inches. The ring shall lay on a flat surface with the holes facing upwards (Figure 4). No height measurement shall be made in any area where the raised printing on the ring will be under the presser foot. Allow the entire presser foot to fall on the ring and take a direct reading from the dial gauge.

4.5 RADIUS OF RING

Cut the ring into four (4) equal parts. Two radii of the ring shall be checked with an optical comparator. Move the lens along the radius until it lines evenly with the hash mark (Figure 1). If there is no hash mark on which the radius lines evenly, determine which two (2) hash marks it falls between and estimate the radii. Four reading per radii for each ring shall be taken.

5.0 IDENTIFICATION MARKINGS

Check the identification markings for accuracy, completeness, legibility and size. This part of the mold approval is a visual examination.

6.0 APPROVED VENDORS FOR APPARATUS

Outside Diameter Tape - Lufkin Model 146 PD tape from the Lufkin Rule Company in Saginaw, Michigan or equivalent.

Pocket Comparator - Peak Scale Magnifier 7X from Optical Apparatus Company, Ardmore, Pennsylvania or equivalent.

Micrometer Depth Gauge - Micrometer Depth Gauge No. 605 from Brown and Sharp Manufacturing Company, Providence, Rhode Island or equivalent.

Dial Micrometer - A Federal Dial Micrometer, Model No. 691B-28-R-2 from Federal Products, Providence, Rhode Island or equivalent.

PREPARED BY: Frank R. Giannattasio	APPROVED BY:

CTD015866

FORM PSCP TM 10-63

TECHNICAL SPECIFICATIONS

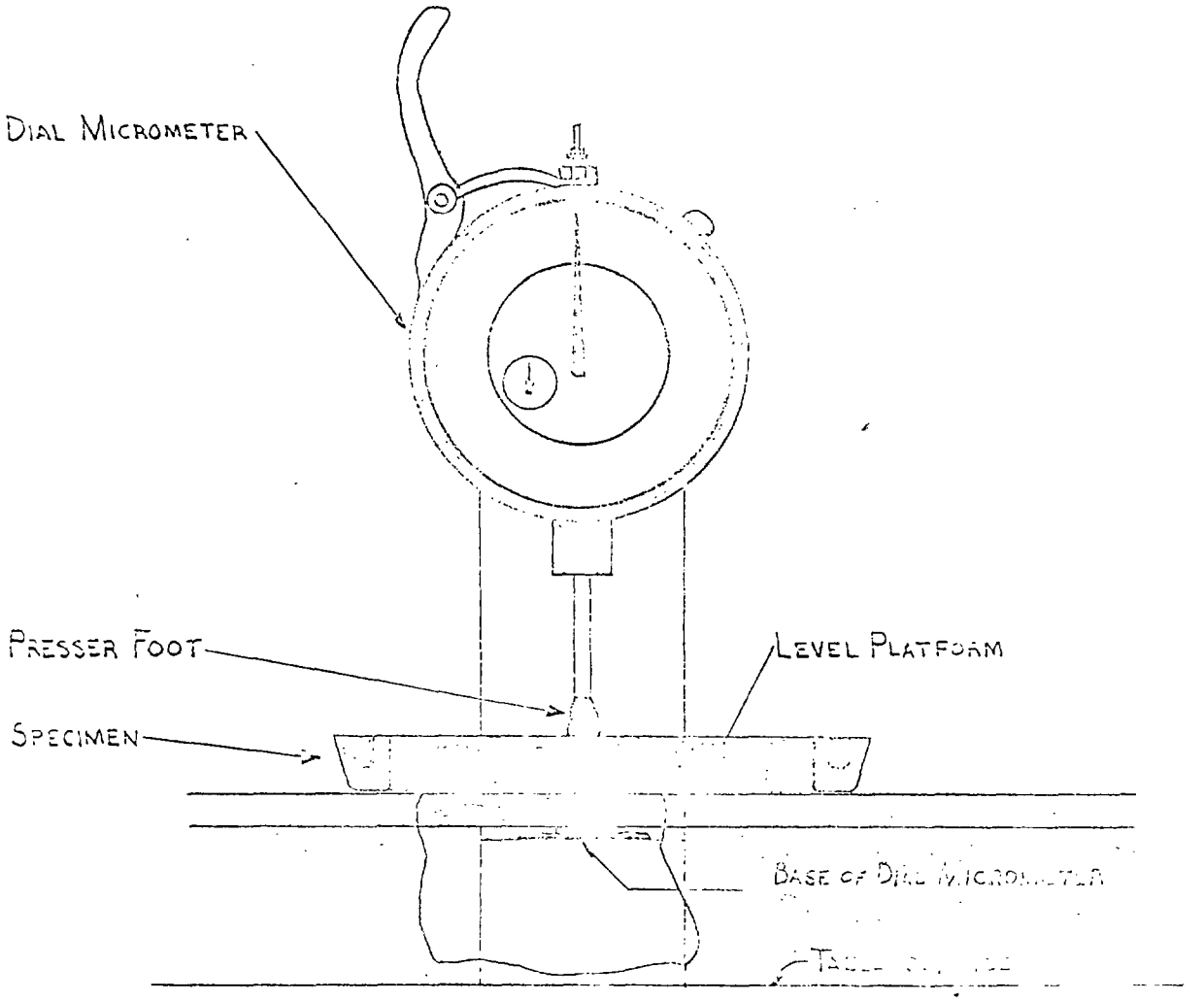
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-22	PAGE 7
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APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Mold Approval for Rubber Rings

FIGURE 4

APPARATUS FOR HEIGHT MEASUREMENTS



PREPARED BY: MPS Frank R Giannattasio

APPROVED BY: J C Jackson

CTD015867

FORM PS27

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAIN-TEED
gfb

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 1	SPECIFICATION NO.: TM22A	PAGE NO.: 1
SUPERSEDES:		DATE OF ISSUE: August 26, 1970

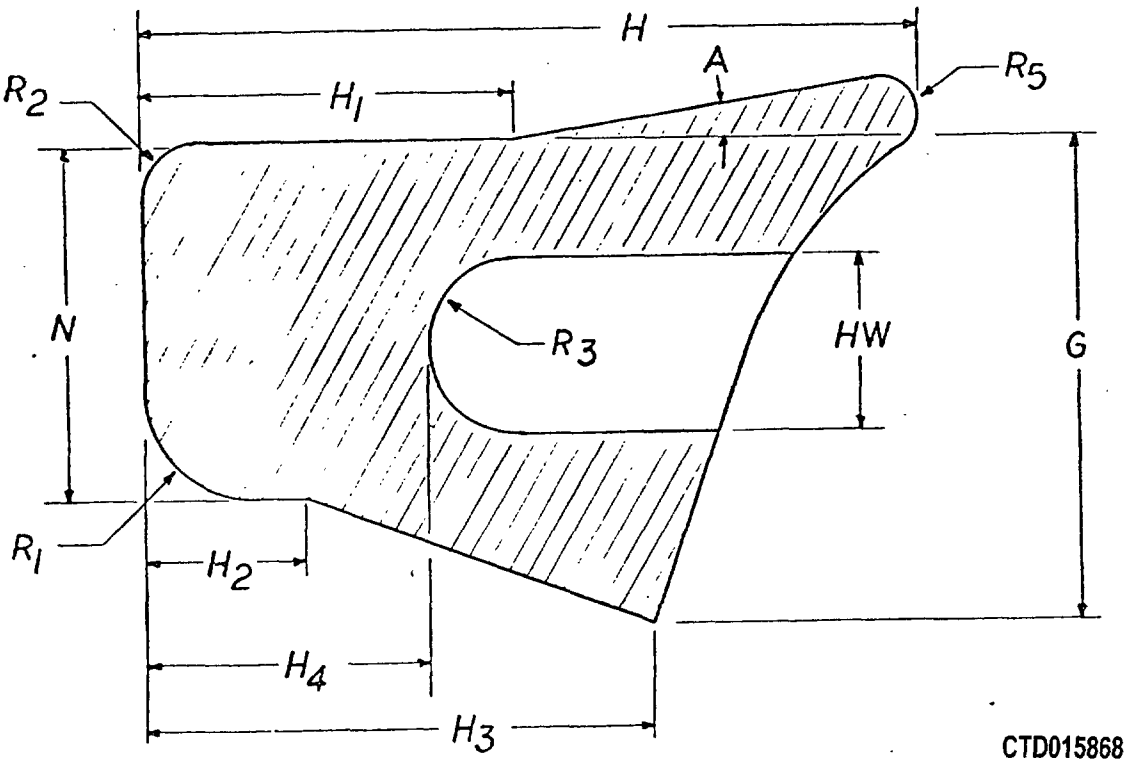
DESCRIPTION: Mold Approval Procedure CG Rubber Rings

SCOPE

The objective of this procedure is to state in detail the test methods employed in measuring CG (Common Groove) rings for mold approval. Mold approvals are to be done by the Materials Laboratory of CERTAIN-TEED Products Corporation (CPC), Piping and Plastics Division and approved by the Technical Service Manager - Materials.

Because of the configuration of the CG ring design several methods of measurements are used. Specific dimensions as well as equipment and methods are as follows:

1. Dimensions



PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
C.J. Brandfass	CDB	8-27-70				

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
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SUPERSEDES:		DATE OF ISSUE: August 26, 1970

DESCRIPTION:

Mold Approval Procedure CG Rubber Rings

Dimensions and Measuring Apparatus

Dimension		Ring Form	Measurement Apparatus
Outside Diameter	"O.D."	Ring	O.D. Tape
Number of Holes		Ring	Actual Count
Hole Width	"HW"	Ring	Optical Magnifier
Height	"H"	Ring	Dial Micrometer
Nose Depth	"H_4"	Ring	Dial Micrometer
Nose Width	"N"	Slice	Projection Comparator
Nose Side	"H_1"	Slice	Projection Comparator
Nose Side	"H_2"	Slice	Projection Comparator
Height Shortside	"H_3"	Slice	Projection Comparator
Width	"G"	Slice	Projection Comparator
Nose Radius	"R_1"	Slice	Projection Comparator
Nose Radius	"R_2"	Slice	Projection Comparator
Hole Radius	"R_3"	Slice	Projection Comparator
Tail Radius	"R_5"	Slice	Projection Comparator
Tail Angle	"A"	Slice	Projection Comparator

Dimensions

Ring dimensions and other requirements may be found in CPC Standard Purchasing Specification No. 503.

RING FORM

1. General

Rings to be checked for mold approval should be numbered, and placed individually on a level, smooth surface for a period sufficiently long for distortion to be relieved and flat laying circular form to be attained. No measurement should be made until the rubber has conditioned at 75°F ±5 for at least four (4) hours. All rings shall be inspected for nicks, cuts, excessive flash, and other imperfections as well as lettering content and positioning.

2. Samples

a. At least ten (10) rings shall be submitted for approval check of each cavity.
b. All rings submitted shall have the O.D. measured.
c. Four (4) of the ten (10) are to be randomly selected from each cavity submitted for approval, shall have the following test done:

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
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SUPERSEDES:		DATE OF ISSUE: August 26, 1970

DESCRIPTION:

Mold Approval Procedure CG Rubber Rings

1. All points for measurement shall begin at the hole nearest the vendor logo and be numbered in a clockwise direction.
2. One ring of the four selected in 2c above shall be taken and checked as follows.
   a. Shall have the "H_4" measured by dial micrometer at each hole around the ring.
   b. Shall have the "HW" dimension measured by optical magnifier at every tenth hole around the ring. The remaining holes will be checked by GO-NOGO gauge.
   c. Shall have the "H" dimension measured by dial micrometer at the same points as the "HW" dimension.
   d. Dimensions found faulty shall be checked on all rings from that cavity.
3. Each of the four selected rings before slicing shall have four points marked at right angles to each other. At these points, "H", "HW", and "H_4" will be actually measured before slicing.
   a. These four points are where slices are to be made.
      1. Slices - may be cut by using a razor blade knife or mechanical rubber slicer. The slice should be about one eighth (1/8") inch or less in thickness. Both sides of the cut should be reasonably square and at least one side should be flat. To make a satisfactory cut, the ring should be placed on the "H" dimension on a piece of soft wood and the cut started through the dip of the "G" dimension and finished up with the thin part of the "H" tail. Buffing of the slice with a moderately fine emery cloth to remove rough spots of the cut may be done. Also a fine buffing wheel may be used, if care is taken to prevent overheating the rubber. It is recommended that the cut be made through solid rubber, except one (1) slice from each ring will be through the center of a hole, so the "R_3" radius can be measured.

      Letter heights and thickness should be measured at least once as they appear on slices.
      a. Slices from the single selected ring will have all the dimensions measured by grid overlay. The other three rings sliced shall be checked by GO-NOGO overlay.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P.J. Read Jr.	C.E.W.	7.9.70				

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

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SUPERSEDES:		DATE OF ISSUE: August 26, 1970

DESCRIPTION:

Mold Approval Procedure CG Rubber Rings

APPARATUS FOR MEASURING

a. An Optical Comparator and associated measuring equipment should be sufficient to measure CG rings cross sections. CPC Piping and Plastics Division comparator has the following capabilities.
   1. A projection comparator with a 14½" diameter ground glass screen with "X" and "Y" axis cross-hairs; 10 x magnification with a measuring micrometer accurate to at least 0.001 inches and a circular stage.
   2. Machinist Grid overlay for comparator screen with 0.005 inch "X" and "Y" grid, 0.005 inch radii, and 1° angle graduations.
   3. "GO-NOGO" overlay for comparator for specific ring cross-section at 10 x magnification and 14½ inches in diameter.

b. Optical Magnifier 10x with lens scale 0.600 inches graduated in 0.005 inches.
c. Dial Micrometer with 0.001 inch scale and 0.250 inch flat foot, and interchangeable pointed foot 0.180 inches less O.D. and 1/16 inch diameter lip.
d. Steel O.D. Tape accurate to 0.005 inches.
e. Hole diameter "GO-NOGO gauge" (refer to QC-10).
f. Razor blade knife or Mechanical Rubber Slicer.

METHODS OF MEASURING

a. Outside Diameter "O.D." is measured by placing the ring nose down on a smooth flat surface. Then place O.D. tape (accurate to 0.005") snugly and evenly around the straight shoulder of the ring and read to the nearest 0.005 of an inch.

b. Hole Width "HW" is measured by using a 10x optical magnifier as described above. The hole should be centered in the field of the lens and a major lens graduation carefully aligned at the hole edge. The distance to the other hole edge is then read from the scale to the nearest 0.001 inch. Alternatively a "GO-NOGO" gauge may be used requiring magnifier checking only in defective holes.

c. Nose Depth "H_4" is determined by placing the ring on its nose holes up on a flat smooth surface. A dial micrometer with no weight and with a downwardly extending shaft of suitable diameter to allow for entry into the hole, at its lower end a point of 1/16 inch diameter is inserted and centered in the radius of the hole bottom. Because of the lettering on the nose it is proposed that several glass plates 0.020" thick with a small crack between two of them at the micrometer foot will nullify the lettering thickness, but still give adequate support on the bottom edges of the ring. The micrometer should be suitably zeroed on the glass surface and measurements taken from the dial to the nearest 0.001 of an inch.

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TECHNICAL SPECIFICATIONS

FORM P927

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM 22A	PAGE NO.: 5
SUPERSEDES:		DATE OF ISSUE: August 26, 1970

DESCRIPTION:

Mold Approval Procedure CG Rubber Rings

d. Height "H" dimension is taken with the ring placed nose down on a flat level surface. Because of the lettering thickness a glass plate arrangement (as described in (Nose Depth "H_4") should be used. An unweighted dial micrometer with a ¼ inch flat foot is used. The flat foot is placed gently on curvature of the tail at its highest point, read the dial to the nearest 0.001 of an inch.

e. "N", "H_1", "H_2", "H_3", "G", "R_1", "R_2", "R_3", "R_5", & "A"
All these dimensions are measured from a slice using a projection comparator.

In measuring slices of rubber rings, the slice is to be placed on the stage glass of the comparator, the projection light is activated and the slice image put in sharp focus on the aligned and calibrated ground glass screen. The slice is then manipulated to put it in alignment with the horizontal and vertical crosshairs on the ground glass screen. Final alignment is then obtained by micrometers.

Linear measurement may be done by a grid or "GO-NOGO" overlay, or micrometers. Radii measurements must be done with the grid or "GO-NOGO" overlay. Angular measurements may be done with protractor ring around the ground glass screen, grid overlay or "GO-NOGO" overlay.

The grid overlay must first be aligned with the ground glass screen crosshairs and the measurements can be read directly from the overlay with proper alignment. With a "GO-NOGO" overlay the image should be roughly aligned in the middle of the screen. The overlay is placed on the screen over the image and particular dimensions are determined as being in or out of the specifications represented by the overlay. The two basic alignment reference points for both types of overlays are the "N" and the "H_1" dimensions. With micrometer measurements the slice is precisely aligned as the grid overlay; however, the size of the dimension must be considered to make sure that sufficient scale is left on the micrometer to measure the desired dimension. The micrometers have a travel of one (1) inch and may be set at zero and still be manuevered for alignment one-half (½) inch by means of a black cap at the stage end of the micrometer. The micrometers are accurate to 0.0001 of an inch.

CTD015872

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION PIPE DIVISION	SPECIFICATIONS CLASSIFICATION: Standard Test Method		
	T.C.O. REF. NO.: 1	SPECIFICATION NO.: TM 22A	PAGE NO.: 6
	SUPERSEDES:		DATE OF ISSUE: August 26, 1970

DESCRIPTION:

Mold Approval Procedure CG Rubber Rings

PRECAUTIONARY NOTES FOR COMPARATOR (Piping and Plastics Div. only)

1. Do not attempt to operate without qualified instruction.
2. Once the ground glass screen has been aligned and the machine calibrated by the factory representative, do not remove except for long distance moving; otherwise realignment and recalibration will be needed.
3. The mirror should be adjusted by a factory representative.
4. Alignment of the grid overlay should be done prior to each usage.
5. Keep plastic cover on when machine is not in use, making sure light head is cool before replacing.
6. The stage glass, ground glass screen and magnifying lens may be cleaned with lens paper or alcohol and absorbent cotton. The alcohol cotton may be used on overlays. Avoid scratching.
7. Turn off the projection light when not measuring. Caution, these bulbs are expensive.

PIPING AND PLASTICS APPARATUS VENDORS

STEEL OUTSIDE DIAMETER TAPE
Lufkin Model 1446PD from Lufkin Rule Co. Saginaw, Michigan or equivalent.

PROJECTION COMPARATOR AND ACCESSORIES
Scherr-Tumico 14" Model from St. James, Minnesota or equivalent.

OPTICAL MAGNIFIER
10X Wide Field Microscope #31-29-11 from Bausch and Lomb, Rochester, N. Y. or equivalent.

DIAL MICROMETER
Federal Model 6913-28-R-2 from Federal Products, Providence, R. I. or equivalent.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
T.C.O. REF. NO.: 1	SPECIFICATION NO:	PAGE NO.: 1
SUPERSEDES:		DATE OF ISSUE: April 22, 1968

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

NOT TO BE DISTRIBUTED TO VENDORS

1.0 SCOPE

The purpose of an incoming rubber ring inspection is to assure that the rings received by the plants meet the requirements of CPC Purchasing Specifications. Rings are inspected for appearance, dimensions and certain physical properties (compression set and hardness) by the plant's quality control departments. Each month all Pipe Plants send to the Materials Laboratory representative samples of rubber rings which they are using during the month. Dimensional and all physical properties are tested in the Materials Laboratory.

The intention of this test method is to describe a procedure by which incoming rubber rings are to be tested in the plants and the Materials Laboratory (Ambler R&D).

2.0 GENERAL

Rubber rings shall be separated into the following categories:

2.1 FLUID-TITE Rings

2.1.1 A/C Pressure

2.1.2 A/C Sewer

2.1.3 PVC Pressure

2.2 Round Rubber Rings

2.2.1 Bureau of Reclamation

2.2.2 Adaptor O-Rings for CPC Sewer Fittings

2.2.3 Rubber O-Rings for Threaded Brass Inserts

2.2.4 Adaptor O-Rings for Irrigation Fittings

2.2.5 Rubber Rings for Building Sewer End Plug

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SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
T.C.O. REF. NO.: 1	SPECIFICATION NO:	PAGE NO.: 2
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DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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2.3 CERTA-SPACER bands

2.3.1 CERTA-SPACER bands for Pressure and Gravity Sewer

2.3.2 CERTA-SPACER bands for Bureau of Reclamation

2.4 Center Spacing Strips for CPC Building Sewer Couplings.

CTD015875

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SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
T.C.O. REF. NO.: 1	SPECIFICATION NO.:	PAGE NO.: 3
SUPERSEDES:		DATE OF ISSUE: April 22, 1968

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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3.0 FLUID-TITE Rings

3.1 Normal Inspection

3.1.1 Sampling

Sampling for normal inspection procedure shall be carried out according to the sampling plan in Table I which represents a 97.5 percent quality level. On each shipment a minimum of twenty five (25) percent of the cartons must be opened in order to obtain the sample. No more than two (2) rings shall be taken from a bundle of 25 rings and one (1) ring from a bundle of ten (10) rings.

Table I

No. of Rings In Shipment	Sample Number	Rings In Sample	Acceptable Defectives	Defectives Constituting Rejection Basis
2 - 150	One Only	5	0	1
151 - 500	1	13	0	2
	2	13	1	2
501 - 1200	1	20	0	3
	2	20	3	4
1201 - 3200	1	32	1	4
	2	32	4	5
3201 - 10,000	1	50	2	5
	2	50	6	7
10,001 - 35,000	1	80	3	7
	2	80	8	9

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SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
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DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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3.1.2 Resampling

In the event that the number of defectives on the initial sample falls between the limits set for acceptance or rejection, a second sample shall be taken in the size indicated. The number of defectives found in the first and second samples shall be accumulated. This total will determine acceptance or rejection of the lot. An additional twenty-five (25) per cent of the cartons must be opened in order to obtain the second sample, with the same restrictions on the number of rings being taken from each bundle of 25 or 10 rings as is present in the initial sample.

3.2 Tightened Inspection

Normal inspection shall be used unless two (2) out of five (5) consecutive lots have been rejected on original inspection. In this event the tightened inspection shall be employed. If any vendors have a serious defect present in their rings, Q.C. Headquarters may request tightened inspection at all plant locations. Sampling for tightened inspection procedures shall be carried out as specified in Table II.

When tightened inspection is in effect, normal inspection shall be instituted when five (5) consecutive lots have been considered acceptable on original inspection, or advised by Q.C. Headquarters. In the event that ten (10) consecutive lots (or as directed) remain on tightened inspection, inspection should be discontinued pending action to improve the quality of submitted material. Quality Control Headquarters is to be informed of all sampling under tightened inspection.

The sampling method, i.e. twenty-five (25) per cent of the boxes must be opened, also applies to tightened inspection.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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Table II

No. of Rings In Shipment	Sample Number	Rings In Sample	Acceptable Defectives	Defectives Constituting Rejection Basis
2 - 150	One Only	10	0	1
151 - 500	1	25	0	2
	2	25	1	2
501 - 1200	1	40	0	2
	2	40	1	3
1201 - 3200	1	64	1	4
	2	64	4	5
3201 - 10,000	1	100	2	5
	2	100	6	7
10,001 - 35,000	1	160	5	7
	2	160	8	9

3.3 Rejections

The following procedure shall be followed on all rejected shipments:

3.3.1 Quality Control Headquarters shall be notified, and samples representative of the defects present shall be forwarded to the Materials Manager who shall make the final decision of rejection or approval. These rings are an aid in discussing the rejection with the vendors.

3.3.2 Rejected shipments shall not be returned to the vendors without the approval of the Materials Manager.

3.3.3 The Headquarters Purchasing Department shall be notified. They will issue instructions on when and how a rejected shipment is to be returned.

3.4 Reference

3.4.1 Dimensional and physical property requirements can be found in the appropriate CPC Purchasing Specification.

3.4.2 Dimensional measurement techniques can be found in TM-22.

3.4.3 Hardness determination procedure can be found in TM-18.

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CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

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DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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3.4.4 Compression Set determination procedure can be found in TM-21

3.5 Ring Dimensions

Once a mold has been approved, all ring dimensions shall be measured in the plants.

Dimensional checks for Height, Width ("G" dimension), O.D. and Hole Dimensions shall be performed on ten rings or twenty-five (25) per cent of the rings in the sample, whichever is greater. These tests shall be performed before the rings are fifty (50) per cent elongated for visual inspection. The rings tested dimensionally should represent various mold cavities from which the rings were manufactured.

3.5.1 Hole Dimensions

The height and width of each hole shall be checked with a GO-NO-GO gauge. Should four or more holes be outside the specification limit, the ring shall be considered defective, the defect forming a part of the sample defect total. The number of holes shall be counted and be within specification limits.

3.5.2 Ring Outside Diameter

If the O.D. dimension is outside of specification limits the ring shall be considered defective, the defect forming a part of the sample defect total.

3.5.3 Height and Width of Ring

Height and Width measurements shall be measured at four points, 90 degrees apart. Should two or more points be outside the specification limit the ring shall be considered defective, the defect forming a part of the sample defect total.

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TECHNICAL SPECIFICATIONS

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PIPE DIVISION

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SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
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SUPERSEDES:		DATE OF ISSUE: April 22, 1968

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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3.6 Visual Examination

In the plants all rings in the sample shall be subjected to visual examination at a circumferential elongation of fifty (50) per cent in excess of the original circumference. The examination shall encompass the ring appearance, color stripe and identification marks. All such requirements can be found in the appropriate purchasing specification.

3.7 Physical Properties

Hardness and Compression Set test shall be performed in the plants.

3.7.1 Hardness

A sample of twenty-five (25) per cent of the original sample or ten (10) rings whichever is greater shall be employed in this test.

If more than 20% of the rings tested exceed the hardness limits of the appropriate Purchasing Specification by one to three points, the lot shall be re-sampled and a quantity of rings equal to 80% of the original sample tested for hardness. If more than 20% of the rings on the re-sample exceed the hardness limits by one to three points, the lot shall be rejected. If, on the first or second sampling, one ring exceeds the hardness limits by more than three points, the lot shall be rejected. If, on the first or second sampling, no more than 20% of the rings exceed the hardness limits by one to three points, the lot shall be accepted.

3.7.2 Compression Set

A compression set test shall be performed each month on either four or six inch rings from each vendor which were received during that month. If the results do not meet the requirements of CPC Purchasing Specifications the Materials Manager shall be notified of the defect and in turn notify the vendor.

3.8 Old Rings

CTD015880

All rings not used within three years of the date of manufacture shall be discarded, first obtaining permission from the Purchasing Department.

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FORM P027

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

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SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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3.9 Monthly Samples

Each month all pipe plants must send five (5) samples of each compound representative of the rings used during that month to the Materials Laboratory. The Materials Laboratory shall check the physical properties that are specified in the CPC Purchasing Specification. The test methods shall be performed in accordance with CPC Test Methods TM-14 through TM-22. If the test results do not meet CPC Purchasing Specifications the vendor shall be immediately notified by the Materials Manager.

4.0 Round Rubber Rings

4.1 Inspection - For Bureau of Reclamation Rings Only

The normal and tightened inspection procedures shall be performed in the same manner as for FLUID-TITE rings (refer to sections 3.1 and 3.2).

4.2 Inspection - For All Round Rubber Rings Except Bureau of Reclamation Rings

Sampling for normal inspection procedure (there is no tightened inspection) shall be carried out according to Table III which is based on a single sampling plan. On each shipment a minimum of twenty-five (25) per cent of the cartons of each size ring must be opened in order to obtain the sample.

Table III

No. of Rings of Each Size In Shipment	No. of Rings in Sample	Acceptable Defects	Defectives Constituting Rejection Basis
2 - 15	2	0	1
16 - 50	3	0	1
51 - 150	5	0	1
151 - 500	8	0	1
501 - 3200	13	1	2

CTD015881

4.3 Rejection - All Round Rubber Rings

The rejection procedure as for FLUID-TITE rings shall be followed, (refer to section 3.3).

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

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SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
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SUPERSEDES:		DATE OF ISSUE: April 22, 1968

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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4.4 Reference

4.4.1 Dimensional and physical property requirements can be found in the appropriate CPC Purchasing Specification.

4.4.2 Dimensional measurement techniques can be found in TM-29.

4.4.3 Hardness determination procedure can be found in TM-18.

4.4.4 Compression Set determination procedure can be found in TM-21.

4.5 Ring Dimension

Dimensional measurements for outside diameter, height and width shall be performed on ten (10) rings or twenty five (25) percent of the rings in the sample, whichever is greater for Bureau of Reclamation rings. All rings in the sample shall be checked for all other round rings.

These tests shall be performed before the rings are elongated fifty per cent for visual inspection (70% for Bureau of Reclamation rings).

4.5.1 Ring Outside Diameter

If the O.D. dimension is outside specification limits the ring shall be considered defective, the defect forming part of the sample total.

4.5.2 Height

The rings shall be measured at four points, 90 degrees apart. Should two or more points be outside the specification limits, the ring shall be considered defective, the defect forming a part of the sample defect total.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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CERTAIN-TEED

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DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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4.5.3 Width

For routine inspection, this measurement may be made using a machinist micrometer. In cases of dispute, the measurement must be taken as described in TM-29 using a pocket comparator.

The width measurement shall be taken at four points, 90 degrees apart. If two or more points are outside the specification limits the ring shall be considered defective, the defect forming a part of the sample defect total.

4.6 Visual Examination

In the plants, all rings in the sample shall be subjected to a visual examination at a circumferential elongation - fifty (50) per cent greater than the original circumference (70 per cent for Bureau of Reclamation rings). The examination shall encompass the ring appearance, markings and splice. All such requirements can be found in the appropriate purchasing specification.

4.7 Physical Properties

Refer to section 3.7

4.8 Old Rings

Refer to section 3.8

4.9 Monthly Samples

Samples of Bureau of Reclamation rings are to be sent monthly to the Materials Laboratory as described in section 3.9. All other round rubber rings are to be sent once every six months.

5.0 PVC CERTA-SPACER bands

5.1 SAMPLING

Refer to section 4.2

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TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
T.C.O. REF. NO. 1	SPECIFICATION NO:	PAGE NO.: 11
SUPERSEDES:		DATE OF ISSUE: April 22, 1968

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

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5.2 Rejection

Refer to section 3.3

5.3 Reference

5.3.1 Dimensional and physical requirements can be found in the appropriate CPC Purchasing Specification.

5.3.2 Hardness determination procedure can be found in TM-18.

5.4 Apparatus

Machinist Micrometer, accurate to ± .001". Steel Tape or Rule, accurate to ± .01". Shore Durometer, Type A or A_2.

5.5 Dimensions

Dimensional measurements for height, width and O.D. shall be made on all rings in the sample before they have been elongated fifty (50) per cent for visual inspection.

5.5.1 Outside Diameter

The outside diameter measurement shall be made by cutting the band at the splice and measuring the cut length. The outside diameter is then calculated by dividing this result by 22/7.

5.5.2 Thickness and Height

A machinist micrometer shall be used for this measurement. It is necessary that the PVC CERTA-SPACER band be measured at only one point. If the measurement is outside specification limits, four points shall be measured ninety degrees apart. If two or more points are outside the specification limits, the band shall be considered defective, the defect forming a part of the sample defect total.

CTD015884

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAIN-TEED

SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
T.C.O. REF. NO.: 1	SPECIFICATION NO:	PAGE NO.: 12
SUPERSEDES:		DATE OF ISSUE: April 22, 1968

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

NOT TO BE DISTRIBUTED TO VENDORS

5.6 Visual Examination

In the plants, all bands in the sample shall be subjected to visual examination at a circumferential elongation fifty (50) per cent greater than the original circumference. The bands appearance, splice and identification marks shall meet the requirements of the appropriate specification.

5.7 Physical Properties

The hardness test shall be conducted on all bands in the sample. If any band is more than three points beyond specification limits, all rings in the sample shall be tested, and if any similar reading is found, the lot shall be rejected.

5.8 Monthly Samples

Five CERTA-SPACER bands from each vendor shall be sent to the materials laboratory for the testing of their physical properties, according to the appropriate CPC Purchasing Specifications and test methods.

6.0 Center Spacing Strips

6.1 SAMPLING

Refer to section 4.2.

6.2 Reference

6.2.1 Dimensional and physical property requirements can be found in the appropriate CPC Purchasing Specification.

6.3 Apparatus

Steel Tape or Rule, accurate to ± .01 inches. Machinist Micrometer accurate to ± .001 inches, Shore Durometer, type A or A_2.

6.4 Dimension

Dimensional measurements shall be made on all spacing strips in the sample.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: Standard Test Method TM-23		
T.C.O. REF. NO. 1	SPECIFICATION NO:	PAGE NO.: 13
SUPERSEDES:		DATE OF ISSUE: April 22, 1968

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

NOT TO BE DISTRIBUTED TO VENDORS

6.4.1 Length

The length measurement shall be a direct reading by means of a steel tape or rule.

6.4.2 "A", "B", and "E" Dimensions

These dimensions shall be taken with a machinist micrometer. Refer to the appropriate purchasing specification for definition of these dimensions. Only one measurement is necessary for each of these dimensions. If the measurement is outside specification limits, four points shall be measured at random intervals. If two or more points are outside specification limits the spacing strip shall be considered defective, the defect forming part of the sample defect total.

6.5 Visual Examination

Visual examination shall be made on all samples. Their appearance and markings shall comply with the appropriate purchasing specification.

6.6 Monthly Samples

Samples are required to be sent to the Materials Laboratory once every six months.

6.7 Rejections

Refer to section 3.3.

CTD015886

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
		MPS				

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAINTEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-23A	1
SUPERSEDES:	DATE OF ISSUE:	OCT 28 1971

DESCRIPTION:

Incoming Rubber Ring Inspection (FLUID-TITE CG Rings)

NOT TO BE DISTRIBUTED TO VENDORS

1.0 SCOPE

The purpose of the incoming rubber ring inspection is to assure that CG rings received by the plants meet the requirements of CPC Std. Purchasing Specification 503-B. Rings are inspected for appearance, dimensions, and certain physical properties (compression set and hardness) by the Plant's Quality Control Department. Every six months, all Pipe Plants send to the Materials Laboratory samples of rubber rings which they are using during the month. Dimensional and all physical properties are tested in the Materials Laboratory.

This test method describes how incoming CG Rubber Rings are to be tested in the plants.

2.0 GENERAL

This test method is cross-referenced to TM-23, "Incoming Rubber Ring and Spacer Inspection". Use TM-23 (Para. 3.0 through Para. 3.9) except as indicated herein.

3.0 SPECIFICS

For Normal Inspection (Para. 3.1), tightened inspection (Para. 3.2), and rejections (Para. 3.3), see TM-23.

3.4 REFERENCE

3.4.1 Refer to the CPC Standard Purchasing Specification 503-B for the dimensional and physical property requirements.

3.4.2 Dimensional measurement techniques are as follows. (Note that rings must be at room temperature (75°F. ± 5°F.) for four hours before measurements are taken.

3.4.2.1 Outside Diameter

Use outside diameter tape accurate to ±.005". Place ring on flat surface, holes up. Avoid placing tape on angled portion of ring diameter.

3.4.2.2 Overall Height (H)

Place ring on flat surface with the nose face (identification information) up (See Figure 2). Use zero load on dial indicator and, with .03 radius tapered sensitive contact point, measure at four points (but not over the raised lettering). If more than one measurement is out of tolerance, the ring is discrepant.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
L C Kuyvenhoven						

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CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION
CERTAINTEED

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM-23A	PAGE NO.: 2
SUPERSEDES:		DATE OF ISSUE: OCT 28 1971

DESCRIPTION:

Incoming Rubber Ring Inspection (FLUID-TITE CG Rings)

NOT TO BE DISTRIBUTED TO VENDORS

3.4.2.3 Hole Width (HW)

Check width of each hole with a Go-No Go Gauge.

3.4.2.4 Under Hole Dimension (H4)

Use dial indicator gauge with zero load (see Figure 3) and .03 radius tapered contact points, (both on sensitive contact and reference contact). Do not measure over raised lettering on ring.

3.4.2.5 Nose Width (N)

Use same dial indicator gauge as for Overall Height (3.4.2.2). Drape the ring over a burette stand or equivalent (see Figure 4). Make certain that sensitive contact point and the slotted edge of the base of the gauge stand do not touch the angled portion of the ring inside or outside diameter.

3.5 SAMPLE SIZE RING DIMENSIONS

Dimensional checks shall be performed on ten rings or twenty-five (25) percent of the rings in the sample, whichever is greater. These tests shall be performed before the rings are fifty (50) percent elongated for visual inspection. The rings tested dimensionally should represent various mold cavities from which the rings were manufactured.

3.6 VISUAL EXAMINATION

In the plants all rings in the sample shall be subjected to visual examination at a circumferential elongation of fifty (50) percent in excess of the original circumference. The examination shall encompass the ring appearance, color stripe, and identification marks. All such requirements can be found in Std. Purchasing Specification 503-B.

3.7 PHYSICAL PROPERTIES

Hardness and Compression Set test shall be performed in the plants.

3.7.1 Hardness- See TM-23 Para. 3.7.1 - Use hand durometer.

3.7.2 Compression Set procedure can be found in Standard Test Method TM-21A. Notify Division Quality Control Manager if any material is found over the maximum allowable percentage.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
L C Kurpiewski						

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TECHNICAL CHANGE ORDER

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

APPLICABLE TO:

Standard Test Method
TM-23

DATE OF ISSUE:	T.C.O. NO.:	PAGE NO.:
November 11, 1980	2	1

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

Purpose:

To revise the existing statement on testing old rings already in plant inventories or received from vendors or other sources such as distributor stocks. This revision provides guidelines for accepting rings beyond an arbitrary time cut-off of three years.

Effective Date:

Date of Issue.

Disposition of Superseded Pages:

Destroy Page 7 of TM-23, dated April 22, 1968 and replace with the attached pages.

PREPARED BY: | APPROVED BY: | OTHERS

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CTD015889

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	TM-23	7
SUPERSEDES:		DATE OF ISSUE:
April 22, 1968		November 11, 1980

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

NOT TO BE DISTRIBUTED TO VENDORS

3.6 Visual Examination

In the plants, all rings in the sample shall be subjected to visual examination at a circumferential elongation of fifty (50) per cent in excess of the original circumference. The examination shall encompass the ring appearance, color stripe and identification marks. All such requirements can be found in the appropriate purchasing specification.

3.7 Physical Properties

Hardness and Compression Set test shall be performed in the plants.

3.7.1 Hardness

A sample of twenty-five (25) per cent of the original sample or ten (10) rings, whichever is greater, shall be employed in this test.

If more than 20% of the rings tested exceed the hardness limits of the appropriate Purchasing Specification by one to three points, the lot shall be re-sampled and a quantity of rings equal to 80% of the original sample tested for hardness. If more than 20% of the rings on the re-sample exceed the hardness limits by one to three points, the lot shall be rejected. If on the first or second sampling one ring exceeds the hardness limits by more than three points, the lot shall be rejected. If on the first or second sampling no more than 20% of the rings exceed the hardness limits by one to three points, the lot shall be accepted.

3.7.2 Compression Set

A compression set test shall be performed each month on either four or six inch rings from each vendor which were received during that month. If the results do not meet the requirements of CertainTeed Purchasing Specifications, the Quality Control Manager shall be notified of the defect and in turn notify the Purchasing Agent for ultimate action to be taken.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
M. R. Steele						

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	TM-23	7A
SUPERSEDES:		DATE OF ISSUE:
April 22, 1968		November 11, 1980

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

NOT TO BE DISTRIBUTED TO VENDORS

3.8 Routine Sampling, Testing and Inspection of Old Rings

3.8.1 Ring properties deteriorate with age to the point where reliability in use becomes questionable and a decision must be reached to retain or destroy them. As their effectiveness is influenced by the initial quality level, rate of change in properties, storage exposure conditions and end use, each case needs to be treated individually before a decision is rendered. Prior to carrying out the following steps, due consideration should be given to the merits of the venture. Is the time and cost really worth the effort?

3.8.2 Rings over three (3) years old are considered suspect and must be checked for re-admittance to the active inventory. Quarterly production dates are to be used as a point of reference. Each combination of size and class shall represent a lot.

3.8.3 Unless otherwise stated, the details of this program apply to our general purpose Elastomers:

NR - Natural Rubber
IR - Polyisoprene Rubber
SBR - Styrene Butadiene Rubber
NBR - Acrylonitrile Butadiene Rubber
EPDM - Ethylene Propylene Rubber (delete Ozone)

3.8.4 After three years:

3.8.4.1 From CertainTeed inventory

Sampling - Normal Inspection, Par. 3.1, TM-23
Inspection - Par. 3.6, TM-23
Dimensional Checks - Par. 3.5, TM-23
Testing - Hardness, Par. 3.7.1, TM-23
Compression Set - Par. 3.7.2, TM-23. Test all sizes

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
M. R.						

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	TM-23	7B
SUPERSEDES:		DATE OF ISSUE:
April 22, 1968		November 11, 1980

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

NOT TO BE DISTRIBUTED TO VENDORS

3.8.4.2 From other sources

Same as from CertainTeed inventory, except add:

Ozone - TM-14 by R&D
Stretch Recovery - TM-29 by R&D

3.8.5 After four years:

3.8.5.1 From CertainTeed inventory

Same as Par. 3.8.4.2

3.8.5.2 From other sources

Same as Par. 3.8.4.2

3.8.6 After five years:

3.8.6.1 From CertainTeed inventory

Same as Par. 3.8.4.2, plus water and dry heat shrinkage, TM-20 by R&D

3.8.6.2 From other sources

Same as Par. 3.8.6.1

3.8.7 Beyond five years

3.8.7.1 From CertainTeed inventory

Inspection and dimensional by the plant. Samples to be sent to R&D for all tests per compound requirement Spec. 506 except delete the following:

Assembly Effort
Low Temp. Flexibility
Oxygen Bomb

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
M. R. Stuckey						

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	TM-23	7C
SUPERSEDES:		DATE OF ISSUE:
April 22, 1968		November 11, 1980

DESCRIPTION:

Incoming Rubber Ring and Spacer Inspection

NOT TO BE DISTRIBUTED TO VENDORS

3.8.7.2 From other sources

Only rings from vendors to be considered and they must supply a complete test report as if mold and compound approvals were required.

3.8.8 Beyond eight years:

No rings will be accepted for use.

3.8.9 Non conforming lots shall be reported on "Report of Incoming Material Inspection", Form 02-08-0001 (P6075) 4/78 and forwarded to the Purchasing Agent and the Quality Control Manager. The Quality Control Manager shall decide on the disposition of the lot(s) based on the data and related factors.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
M. R.						

TECHNICAL SPECIFICATIONS

FORM P927

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

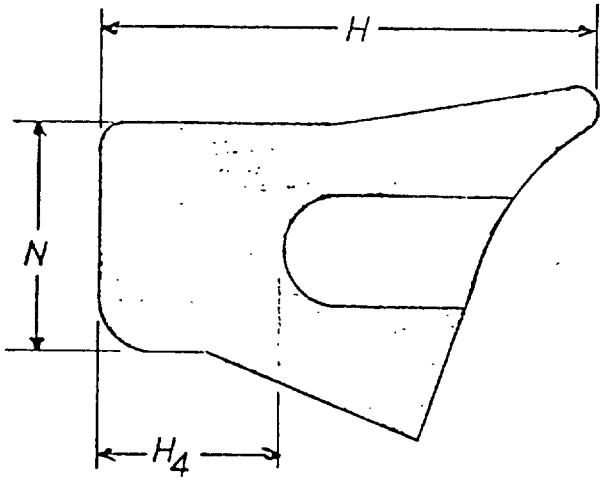
SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-23A	4
SUPERSEDES:		DATE OF ISSUE: OCT 28 1971

DESCRIPTION:

Incoming Rubber Ring Inspection (FLUID-TITE CG Rings)

NOT TO BE DISTRIBUTED TO VENDORS

FIGURE 1



Dimensions to be measured.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
L C Kurpuski						

CTD015894

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

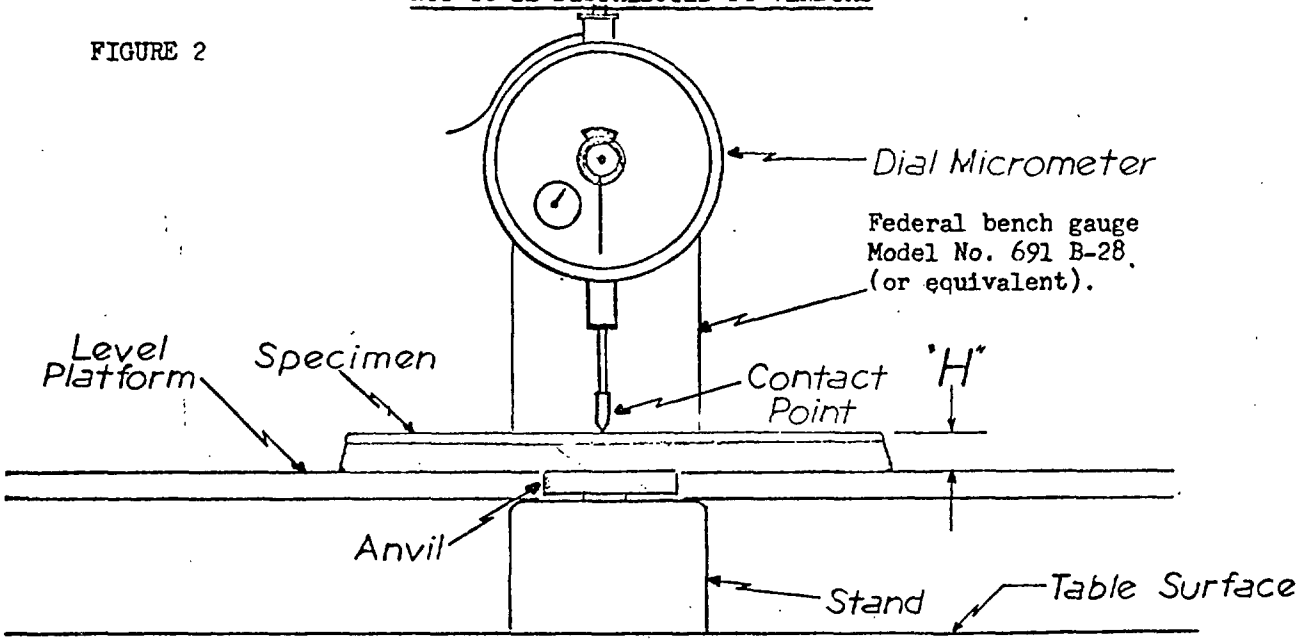
CERTAIN-TEED

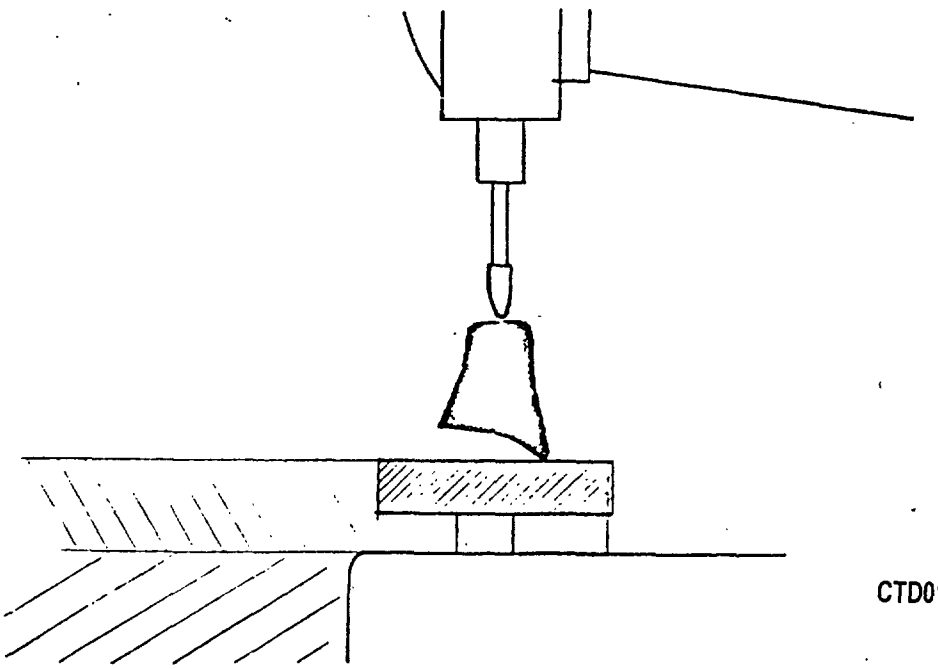
SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 1	SPECIFICATION NO.: TM-23A	PAGE NO.: 5
SUPERSEDES:		DATE OF ISSUE: OCT 28 1971

DESCRIPTION:

Incoming Rubber Ring Inspection (FLUID-TITE CG Rings)
NOT TO BE DISTRIBUTED TO VENDORS

FIGURE 2





CTD015895

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L C Kuykendall						

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

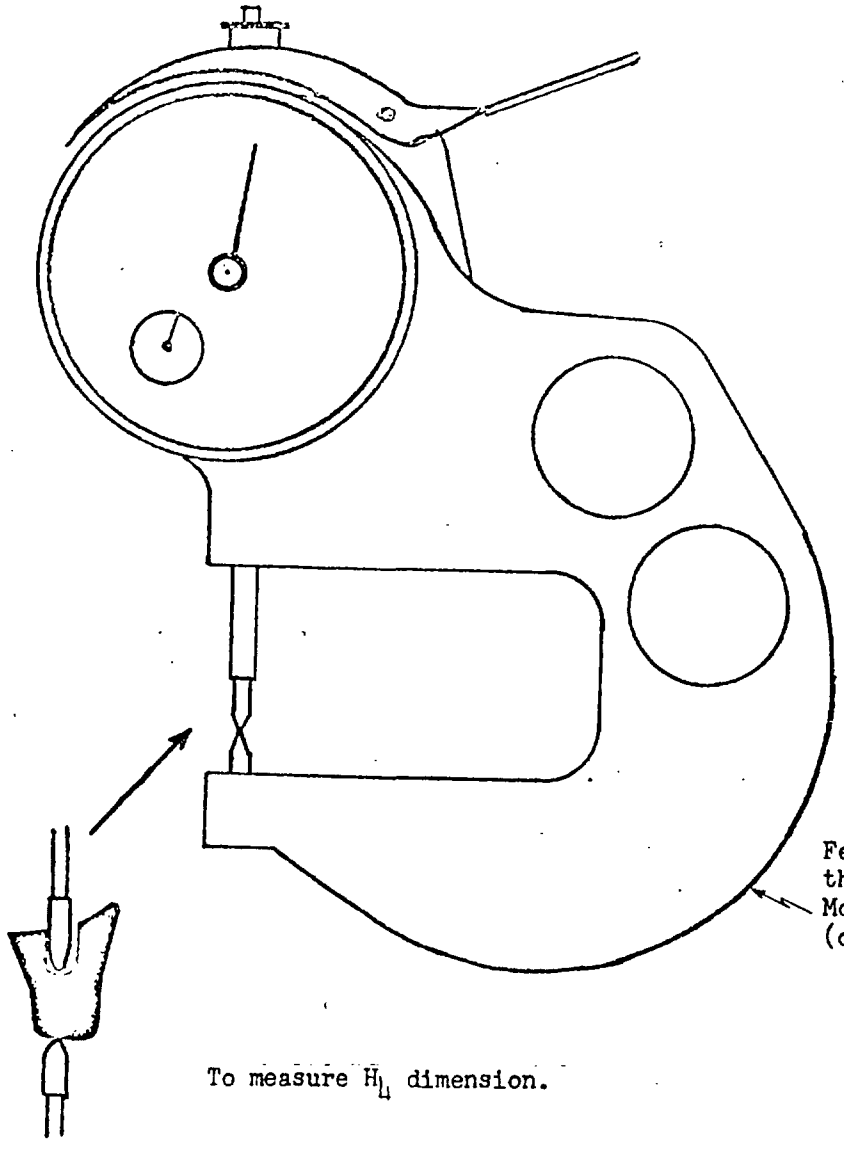
SPECIFICATIONS CLASSIFICATION:		
Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-23A	6
SUPERSEDES:		DATE OF ISSUE: OCT 28 1971

DESCRIPTION:

Incoming Rubber Ring Inspection (FLUID-TITE CG Rings)

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FIGURE 3



To measure H_4 dimension.

CTD015896

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L C Kurpanek						

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-23A	7

SUPERSEDES:

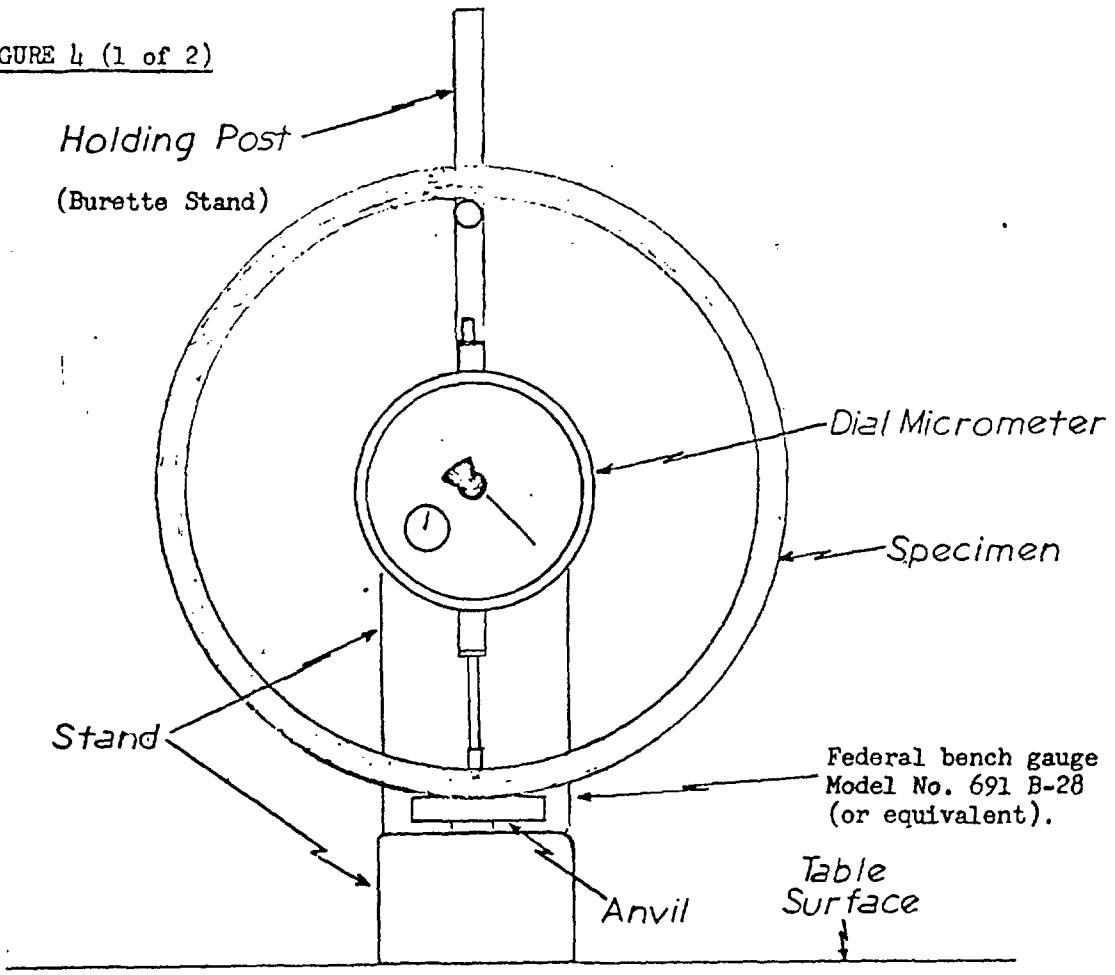
DATE OF ISSUE: OCT 28 1971

DESCRIPTION:

Incoming Rubber Ring Inspection (FLUID-TITE CG Rings)

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FIGURE 4 (1 of 2)



CTD015897

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
L C Kuypers	DJH					

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-23A	8

SUPERSEDES:

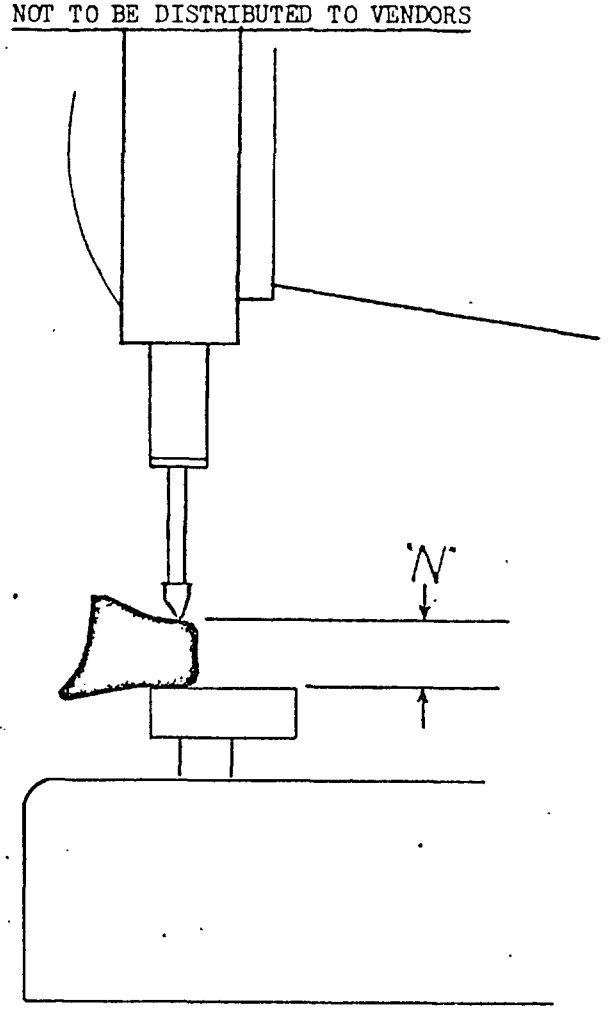
DATE OF ISSUE: OCT 28 1971

DESCRIPTION:

Incoming Rubber Ring Inspection (FLUID-TITE CG Rings)

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FIGURE 4 (2 of 2)



CTD015898

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
L C Kuyrend						

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION PIPE DIVISION	SPECIFICATIONS CLASSIFICATION: Standard Test Method		
	T.C.O. REF. NO. 2	SPECIFICATION NO: TM-24	PAGE NO.: 1
	SUPERSEDES: Jan. 15, 1968		DATE OF ISSUE: May 24, 1968

DESCRIPTION:

Fineness of Silica by Sieve Analysis

1.0 Scope

This method of test is for determining the fineness of silica by means of wet sieve analysis.

2.0 Physical Property Requirements

The physical property requirements for this test method can be found in the appropriate CPC Purchasing Specifications.

3.0 Apparatus

Sieves, U.S. Standard Sieve Series No. 200 and No. 325, 8 inches (203 mm.) diameter, 2 inches (53 mm.) high.

Oven, Gravity; 100-250°F ± 10°F (37.8-121.1°C ± 5.6°C)

Balance, 0-1000 grams ± .1 gram

Receiving Pan, 8 inches (203 mm.) diameter.

4.0 Procedure

Dry the silica to be tested for two (2) hours at a temperature of 210° ± 5°F (98.9° ± 2.8°C). Remove the silica from the oven, place in a dessicator for one (1) hour and let it cool. Weigh a 50 ± 1 gram sample of the dried silica on a clean tared paper and transfer into a clean No. 200 sieve. Fill the receiving pan with water and attach the sieve. While holding the sieve and pan in both hands, rotate with a gentle wrist motion until most of the fine material has passed through. Discard the water in the receiving pan and fill again with clean tap water. Repeat this procedure until the pan water is perfectly clean after the sieving. Repeat the test using a No. 325 sieve. Place the sieves with the residue in a gravity oven at 220° ± 10°F (104.4° ± 5.6°C) for two (2) hours to dry. Let the residue cool for 30 ± 5 minutes. Weigh the residue.

CTD015899

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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CTD015900

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION PIPE DIVISION	SPECIFICATIONS CLASSIFICATION: Standard Test Method		
	T.C.O. REF. NO.: 2	SPECIFICATION NO.: TM-24	PAGE NO.: 2
	SUPERSEDES: Jan. 15, 1963		DATE OF ISSUE: May 24, 1968

DESCRIPTION:

Fineness of Silica by Sieve Analysis

5.0 Calculations

Calculate the per cent silica that remained on the No. 200 or No. 325 sieve as follows.

$$F = \frac{R}{50} \times 100$$

Where: F = finess of silica expressed as a percentage of residue on the No. 200 or No. 325 sieve.

R = grams of residue on the No. 200 or No. 325 sieve.

6.0 Cleaning of Sieves

After each sieve analysis place the sieve under hot running water for two to three minutes, constantly moving the sieve around. Oven dry at 220° ± 10°F (104.4 + 5.6°C) for one (1) hour. After every ten (10) sieve analyses fill the receiving pan with dilute acetic acid and attach the sieve. Let it sit for ten (10) to fifteen (15) minutes. Run cold water over the sieve for two to three minutes after draining the acid. Dry in an oven at 220° ± 10°F (104.4° ± 5.6°C) for one (1) hour.

7.0 Approved Vendors for Test Apparatus

The sieves shall conform with the requirements of ASTM E11, "Sieves for Testing Purposes". Suitable sieves and receiving pan are made by W. S. Tyler Co. and can be purchased through scientific supply companies.

A suitable gravity oven is a Stabil-Therm Oven, Model No. OV-12C, from Blue M Electric Company and can be purchased through Fisher Scientific Company or equivalent.

CTD015901

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
Brian Haffney		MPS				

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CTD015902

KEASBEY & MATTISON CO.
AMBLER, PA.

PAGE NO. 1

TECHNICAL CONTROL ~~QUALITY CONTROL SPECIFICATION~~ MAKING PARTICULARS

NEW ISSUE DATE	GENERAL DESCRIPTION	NO.
1/15/51	RECEIVED MATERIAL CONTROL Part 5	600
SUPERSEDING DATE		PLANT NO. Plant #6 A/C Pipe

ASBESTOS CEMENT PIPE WASTE

GENERAL:

Asbestos Cement Fine Waste, as added to pipe products, serves a useful purpose in that it assists in reducing manufacturing costs and provides a means for practical disposition. In order to achieve optimum benefits from this waste, it is desirable that its particle size and particle size distribution be controlled.

This Control Specification has been initiated to show, within our present knowledge, the desired particle size distribution. Further, the Control Specification outlines the common test procedures to be employed.

A periodic testing program and correlation of results with finished product test data should be helpful in establishing the desired particle size limitations and the grinding procedures to be followed at Plant 6.

The requirements stated herein shall not be considered restrictive at this time; they are shown merely as target values.

USE:

To be used as a raw material in all A/C Pipe products within Plant 6.

SOURCE:

All types and classes of A/C Pipe or coupling millings within the plant. These sources contribute the material to be ground and then returned to the manufacturing line as reclaim.

SAMPLING:

Sampling shall be on a spot check basis as time and necessity permit. As a minimum, samples shall be taken prior to closing down the mill to replace plates and immediately after a plate change has been made. Quality Control shall take the sample at the collection bin. The sample shall be a composite of a group of sub samples. Every precaution shall be exercised to insure non-stratification of the sample.

AUTHORIZED BY W. Conrad Plant Manager DIRECTOR OF MFG. APPROVED BY Gen. Mgr. -- RCS. QUALITY CONTROL MGR.

ISSUED BY H. M. Heath R&D Mgr. or Q/C Supv. APPROVED BY E. C. Fiss Quality Control Manager PLANT MANAGER

FORM P-933-A

CTD015903

KEASBEY & MATTISON CO.
AMBLER, PA.

PAGE NO. 2

TECHNICAL CONTROL MAKING PARTICULARS

NEW ISSUE DATE	GENERAL DESCRIPTION	NO.
1/15/62	RECEIVED MATERIAL CONTROL Part 5	600
SUPERSEDING DATE		PLANT NO. Plant #6 A/C Pipe

TESTING:

Each sample shall be tested for moisture content and sieve analysis.

TEST METHODS:

a. Moisture - Thoroughly mix the sample and quarter. Accurately weigh approximately 125 grams plus or minus 0.01 grams. Dry to constant weight at 220 degrees Fahrenheit, plus or minus 20 degrees. Cool in a desiccator and weigh.

$$\% \text{ Moisture} = \frac{\text{Original Weight} - \text{Dry Weight}}{\text{Original Weight}} \times 100$$

b. Sieve Analysis - Weigh 100 grams, plus or minus 0.1 gram of the sample previously dried in the moisture test. Spread evenly over the top sieve in the series. Place the sieve assembly in the Ro-Tap machine and operate it for 15 minutes. Weigh each fraction separately to the nearest 0.1 gram and report the remaining on each sieve.

$$\% \text{ Remaining on Sieve} = \frac{\text{Wt. on Sieve}}{\text{Total Wt. of Sample}} \times 100$$

SPECIFICATIONS:

a. Moisture - None.

b. Sieve Analysis - Target Values.

Tyler Sieve Size	% Remaining On
10	0 max.
20	5 max.
35	10 min.
60	15 min.
80	20 min.
100	10 max.
Pan	40 max.

Pan value should be as low as possible.

ACTION: Periodic review of data to establish realistic control limits.

TEST RECORDS: Q. C. Form 4 attached.

CTD015904

AUTHORIZED BY Plant Manager DIRECTOR-MFG. APPROVED BY Gen. Mgr. --Res. or QUALITY CONTROL MGR.

ISSUED BY R&D Mgr. or Q/C Supv. APPROVED BY Quality Control Manager PLANT MANAGER

FORM P-833-A

MOISTURE & SCREEN ANALYSIS DATA SHEET

ASBESTOS CEMENT FINE WASTE

TEST DATE:_____

TYLER SIEVE SIZE	% REMAINING ON
10	
20	
35	
60	
80	
100	
Pan	

MOISTURE

Original Weight

Dry Weight

% Moisture

CTD015905

FORM CP27 11-61

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-25	PAGE: 1
	SUPERSEDES:	DATE OF ISSUE: January 24, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Determination of Available SiO_2 in Pulverized Silica

1.0 SCOPE

This test method covers the procedures for determining the per cent available SiO_2 in pulverized silica. In order to obtain the per cent available SiO_2 content of pulverized silica for reaction with cement during autoclaving, an analysis for total SiO_2, Al_2O_3, Na_2O and K_2O content must first be performed.

2.0 CHEMICAL PROPERTY REQUIREMENTS

Chemical property requirements for this test method can be found in the appropriate CPC Purchasing Specifications.

3.0 APPARATUS

The apparatus needed for this analysis are enumerated in ASTM C-114-61, "Chemical Analysis of Portland Cement", Sections 3 through 8.

4.0 DETERMINATION OF Al_2O_3, Na_2O, K_2O and total SiO_2

4.1 Procedure

Analysis for each of the mentioned oxides shall be accomplished in accordance with ASTM C-114-61, "Chemical Analysis of Portland Cement", Sections 3 through 12, 21 and 22, substituting silica for cement.

Other analytical methods, such as X-ray diffraction, which may be faster and possess similar accuracy, may be used when available.

5.0 DETERMINATION OF AVAILABLE SiO_2

5.1 Calculation

5.1.1 General

Based on the foregoing analysis, the various oxide and silicate combinations that are likely to be found as mineral impurities in silica are calculated. In these calculations it is normally considered that:

PREPARED BY: mfs F.R. Giancaterino	APPROVED BY: J.C. Jackson

CTD015906

a. K_2O and Na_2O are combined with the proper proportion of alumina and silica to form orthoclase feldspar ($K_2O \cdot Al_2O_3 \cdot 6SiO_2$) and albite feldspar ($Na_2O \cdot Al_2O_3 \cdot 6SiO_2$).

b. Any Al_2O_3 remaining is then combined with silica to form kaolinite ($Al_2O_3 \cdot 2SiO_3 \cdot 2H_2O$).

5.1.2 Method

The method of calculation can be best explained by the use of an example as follows:

a. Typical pulverized silica analysis where results are reported in per cent by weight are then divided by the molecular weight of the appropriate oxides to yield a value in molecular equivalents.

Oxide	Per Cent	÷ Oxide Molecular Weight	= Molecular Equivalent
SiO_2	97.35	60	1.6225
Al_2O_3	2.05	102	0.0201
K_2O	0.50	94	0.0053
Na_2O	0.10	62	0.0016

b. The molecular equivalent value just computed is placed in a columnar table under each oxide and then through appropriate subtractions are distributed to the different minerals according to the described mineral composition.

A table follows which shows stepwise subtractions and proportions the amount of each oxide which is required to form the related mineral. Oxide molecular equivalent subtractions for each mineral were dictated by the following oxides.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-25	PAGE: 3
	SUPERSEDES:	DATE OF ISSUE: January 24, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Determination of Available SiO_2 in Pulverized Silica

K_2O equivalent for orthoclase; plus equivalent Al_2O_3 and six times equivalent for SiO_2.

Na_2O equivalent for albite; plus equivalent Al_2O_3 and six times equivalent for SiO_2

Remaining Al_2O_3 equivalent for kaolinite; plus two times equivalent for SiO_2.

Remaining SiO_2 equivalent represents the free or "available SiO_2" molecular equivalent.

Oxide Molecular Equivalents

Mineral	K_2O	Na_2O	Al_2O_3	SiO_2
Molecular Equivalent	0.0053	0.0016	0.0201	1.6225
$K_2O \cdot Al_2O_3 \cdot 6SiO_2$ Orthoclase (0.0053)	-0.0053(1) / 0	0 / 0.0016	-0.0053(1) / 0.0148	-0.0318(6) / 1.5907
$Na_2O \cdot Al_2O_3 \cdot 6SiO_2$ Albite (0.0016)		-0.0016(1) / 0	-0.0016(1) / 0.0132	-0.0096(1) / 1.5811
$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$ Kaolinite (0.0132)			-0.0132(1) / 0	-0.0264(2) / 1.5547
SiO_2 Silica (1.5547)				-1.5547(1) / 0

c. The remaining SiO_2 molecular equivalent (1.5547) is then multiplied by the molecular weight of silica (60) to obtain the per cent "available SiO_2" (93.28%). Thus, although the chemical analysis showed 97.35 per cent SiO_2, the uncombined useful or "available SiO_2" was only 93.28 per cent. The balance of the total SiO_2 was tied up in the minerals orthoclase, albite and kaolinite.

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CTD015908

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-26	PAGE 1
	SUPERSEDES:	DATE OF ISSUE: February 1, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Particle Size Distribution of Pulverized Silica by the Andreason Sedimentation Pipette Method

1.0 SCOPE

This test method covers a procedure for determining the particle size distribution of pulverized silica by the Andreason Sedimentation Pipette Method and applies to silica used in the manufacture of asbestos cement pipe.

2.0 PURPOSE

The rate of filtration of water through the pulverized silica is related to its surface area and the particle size distribution. This is believed to be pertinent to the rate of water removal on the pipe machine.

3.0 APPARATUS

Andreason Sedimentation Pipette as described by Fisher Scientific Catalog No. 14-232. (Figure 1).

Analytical Balance - capable of weighing sixty (60) grams to the nearest 0.0001 gram.

Source of vacuum that can be regulated.

A Rubber Pipette Filler with Ball Valves - Fisher Scientific Catalog No. 13-681-50 is recommended.

Timer - capable of being read to the nearest 0.5 second and accurate to one per cent or less.

Drying Oven - standard gravity convection type capable of maintaining 230 ± 5°F.

Twelve 100 ml. beakers or crucibles of equivalent size.

Constant Temperature Bath capable of maintaining 78 ± 1°F.

Ringstand and Clamps.

French Curve (Keuffel & Esser Company #57-1685-60) is recommended for drawing log probability curve (Figure 3).

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mps	

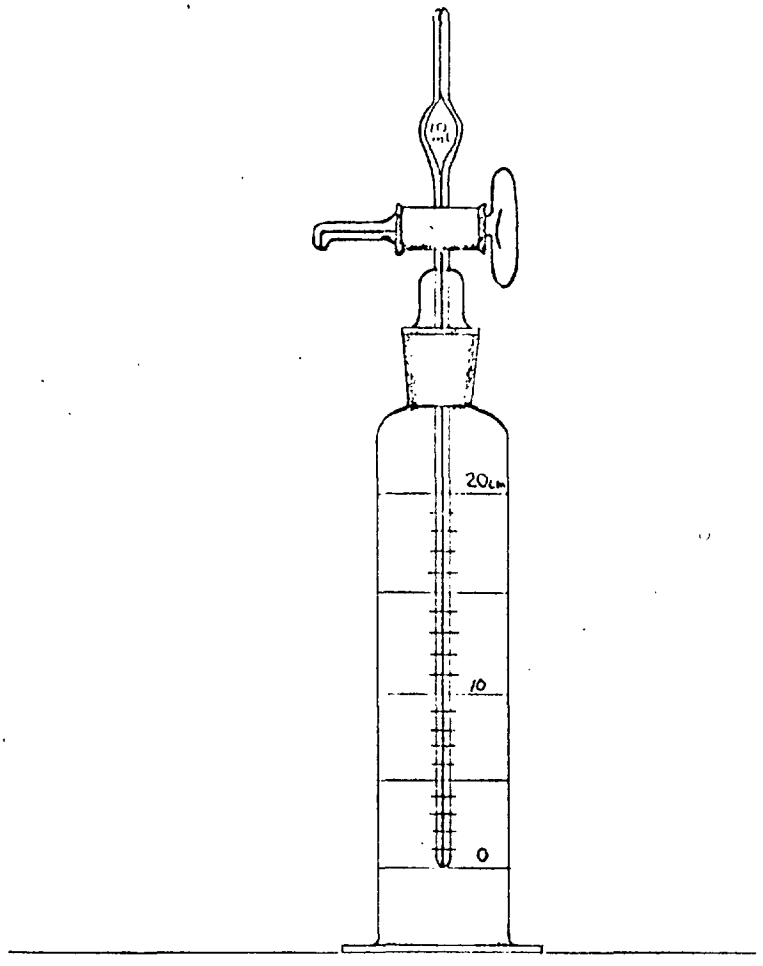
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-26	PAGE 2
	SUPERSEDES:	DATE OF ISSUE: February 1, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Particle Size Distribution of Pulverized Silica by the Andreason Sedimentation Pipette Method



ANDREASON SEDIMENTATION PIPET

FIGURE—1

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CTD015910

FORM P927 8-62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-26	PAGE 3
	SUPERSEDES:	DATE OF ISSUE: February 1, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION:

Particle Size Distribution of Pulverized Silica by the Andreason Sedimentation Pipette Method

4.0 PROCEDURE

Add distilled water to the Andreason cylinder up to the 10 cm. level. Weigh out 14.3000 grams of silica previously dried at 230°F. for a minimum of 12 hours. The per cent moisture must first be determined and the silica weight corrected if necessary. Transfer the weighed silica to the partially filled cylinder from Step 1 and add distilled water to the 19 cm. level. Insert the stopper carrying the pipette (re: attached instructions) close the stopcock, and while holding a finger over the small vent in the stopper, shake by inverting the vessel end over end at about 30 times per minute for 5 minutes. Then carefully add distilled water to the 20 cm. graduation mark on the cylinder. Allow to stand for 30 minutes and then repeat the shaking by inversion for 5 more minutes. Place the apparatus in a constant temperature bath at 78 ± 2°F. for 20 to 30 minutes. Remove and shake for two minutes by inverting as in Steps 4 and 5.

Start the timer at the exact time shaking ceases and replace the apparatus in the constant temperature bath.

Take the first sample immediately by drawing 10 ml. up into the pipette bulb with the rubber propipette (or other vacuum source) at a slow rate. A reasonable sampling period would be 20 seconds.

Drain the sample rapidly into a tared weighing vessel, dry in an oven at 230°F. for a minimum of twelve hours and weigh to nearest 0.0001 gram. Turn stopcock to the open position immediately after sampling. Withdraw later samples at various time intervals and all at the same rate (20 seconds total, starting 10 seconds prior to recorded sampling time). Record the time of each sample; dry and weigh as in Step 10. The height at which each sample is secured (average i.e. 19.4 to 19.0 = height of 19.2 cm.) is recorded along with the time.

PREPARED BY:	APPROVED BY:
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CTD015911

FORM PS27 8 65

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-26	PAGE 4
	SUPERSEDES:	DATE OF ISSUE: February 1, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Particle Size Distribution of Pulverized Silica by the Andreason Sedimentation Pipette Method

5.0 CALCULATIONS

5.1 The particle sizes are calculated from Stokes' Law according to the falling velocity of the particles. The diameter of the maximum size silica particles remaining in the distilled water suspension at 78°F. and height (h) after time (t) from the start of the test is given by the following equation:

$$d = \sqrt{\frac{307\ v\ h}{(D_1 - D_2)\ t}} = 12.79\sqrt{h/t}$$

Where: d = diameter of silica particles in microns
v = viscosity of water (0.88 centipoises @ 78°F.)
h = height in cm.
D_1 = density of silica (2.65 gm/cc.)
D_2 = density of water (0.997 gm/cc. @ 78°F.)
t = time in minutes

5.2 By using this equation, a sampling procedure can be predetermined for the particle size range desired so that a log probability plot of per cent of "particles finer than" versus "particle size" can be made and from this plot, a particle size distribution curve can be drawn. Refer to Figures 2 and 3. A typical sampling procedure is shown as follows:

Sample No.	Height (cm)	Time (min.)	Particle Diameter (microns)
0	20.0	start	-
1	19.6	2	40.0
2	19.2	5	25.1
3	18.8	8	19.6
4	18.4	15	14.2
5	14.0	25	9.6
6	10.0	50	5.7
7	7.0	90	3.6
8	4.0	180	1.9
9	2.4	240	1.3
10	2.0	300	1.05

PREPARED BY: mfd

APPROVED BY:

CTD015912

FORM PS:T 4 62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-26	PAGE 5
	SUPERSEDES:	DATE OF ISSUE: February 1, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Particle Size Distribution of Pulverized Silica by the Andreason Sedimentation Pipette Method

From the weight of the dried samples (Nos. 1-10), calculate their percentage by weight of the original sample in suspension (0.2600 gms/10 ml.). The original 14.3000 grams of silica was placed in 550 ml. distilled water suspension which means a 10 ml. sample of the suspension at actual time zero would be 0.2600 grams. The percentage calculated here refers to the "per cent finer than" and "particle size diameter" of the sample. Example: A .0313 gm. dried sample of No. 7 above would comprise $\frac{0.0313}{0.2600} \times 100 = 12.04\%$ or 12.04% of the particles in the original silica sample are finer than 3.6 microns.

5.3 Plot the results as a smooth curve on log probability paper (Keuffer and Esser Company # 46-8043 probability X 2 Log Cycles) with "particle size diameter" (1-100 microns)* as the abscissa and the "per cent finer than" as the ordinate. From this basic curve, determine the per cent by weight in each of the following particle size ranges and compare (In Figure 3) to the corresponding minimum and maximum per cent allowed within each range or fraction.

Fraction	Particle Size Range (Diameter in Microns)	Minimum to Maximum % Required For Each Range
1	Less Than 1	0 - 3
2	1 - 4	6 - 9
3	4 - 10	11 - 15
4	10 - 20	17 - 22
5	20 - 35	22 - 27
6	35 - 60	17 - 24
7	60 -100	8 - 13
8	Greater Than 100	2 - 6

* Since data is available only to 40 microns, the French Curve (See Apparatus Section) is used to extrapolate the curve in Figure 2 from the 40 micron through 100 micron particle size range.

Figure 3 which shows the maximum and minimum percentages permissible for a particular fraction (ordinates for a fraction are taken in the center of the fraction range) is based on Assignment Report 190, July 8, 1965, "Fineness Test Method and Tests on SiO_2".

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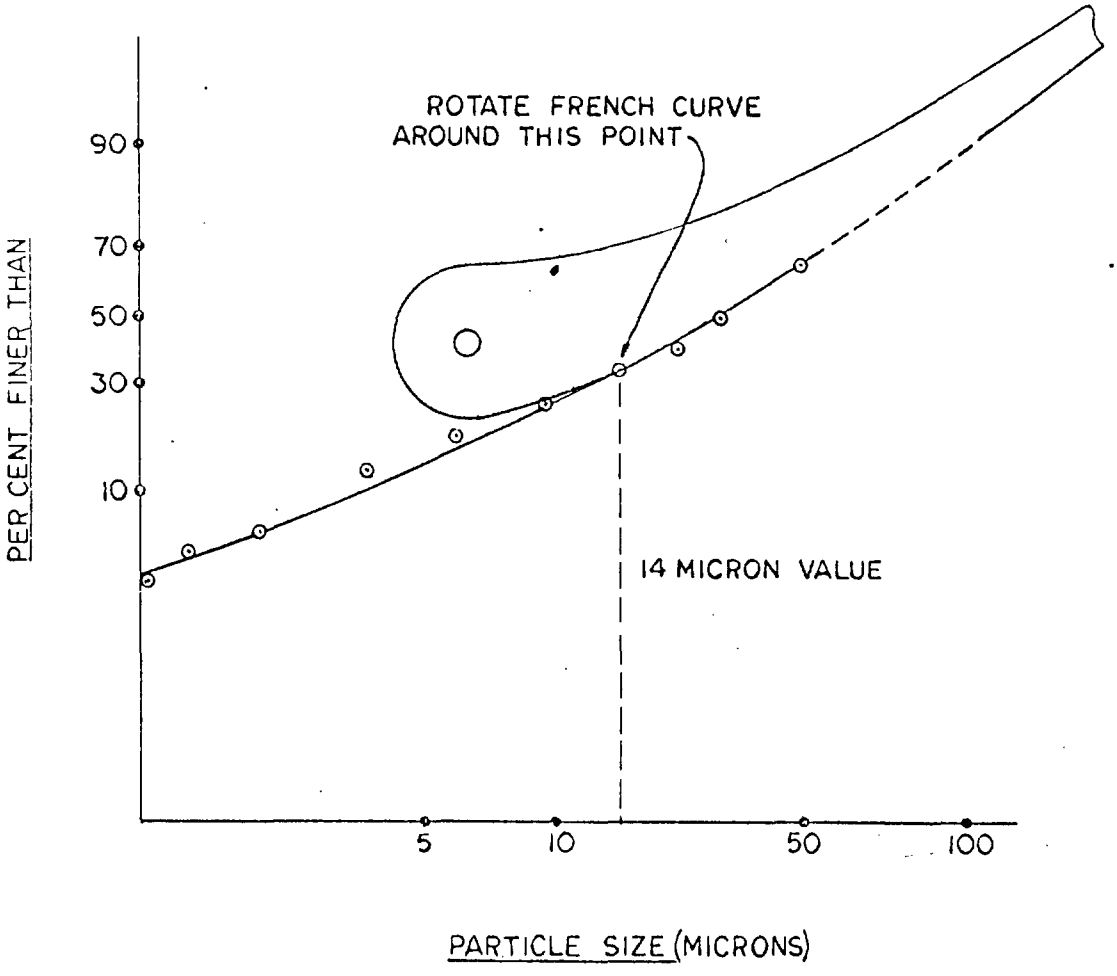
FORM P827 TR 10-63

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-26	PAGE 6
	SUPERSEDES:	DATE OF ISSUE: February 1, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	
DESCRIPTION: Particle Size Distribution of Pulverized Silica by the Andreason Sedimentation Pipette Method		

FIGURE-2

TYPICAL LOG PROBABILITY PLOT OF PARTICLE SIZE DISTRIBUTION OF SILICA



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FORM P027 TR 10 63

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: TM-26	PAGE 7
	SUPERSEDES:	DATE OF ISSUE: February 1, 1968
APPLICABLE TO:	CLASSIFICATION: Standard Test Method	

DESCRIPTION: Particle Size Distribution of Pulverized Silica by the Andreason Sedimentation Pipette Method

PARTICLE SIZE ANALYSIS DATA SHEET

FIGURE-3

Date _____

Sample Source _____

Blaine Surface Area $cm^2/gm.$ _____

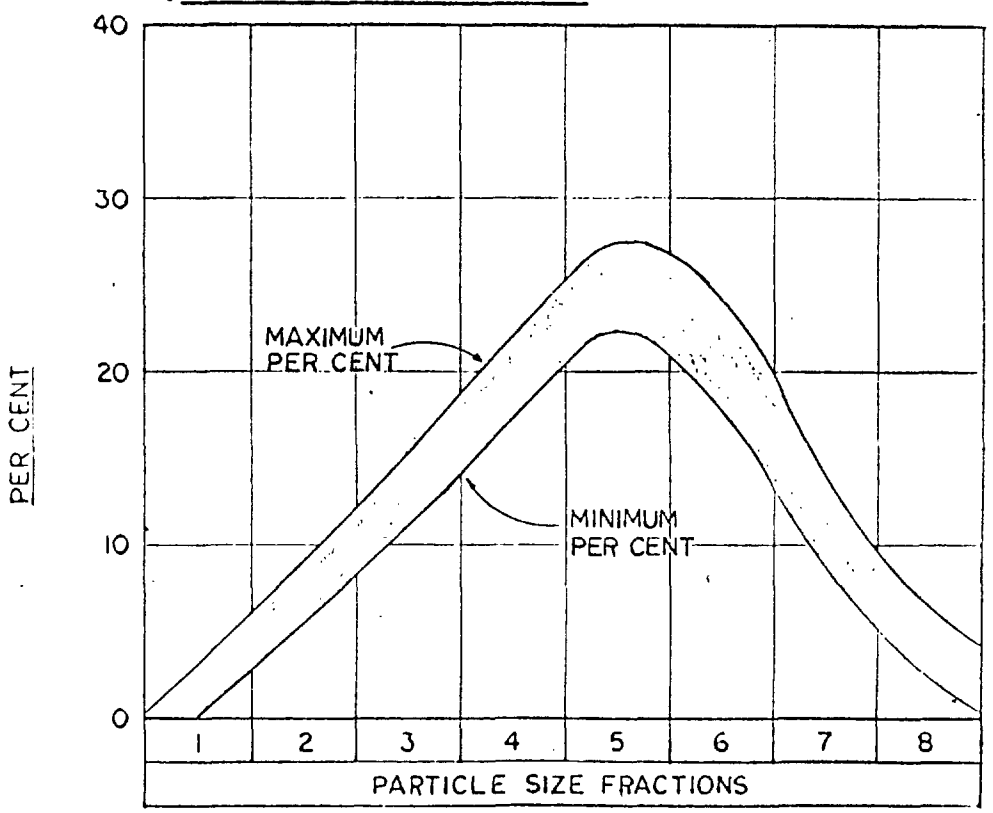
Filterability _____

Per Cent Moisture _____

Per Cent Loss on Ignition _____

Per Cent Purity _____

FRACTION	MICRON RANGE
1	< 1
2	1 - 4
3	4 - 10
4	10 - 20
5	20 - 35
6	35 - 60
7	60 - 100
8	> 100



PREPARED BY: mps

APPROVED BY:

CTD015915

ANDREASON SEDIMENTATION PIPET

Catalog No. 14-232

GENERAL DESCRIPTION

The Andreason Sedimentation Pipet is used for the determination of sub-sieve grain sizes according to Stokes' Law. Also from the data collected a characteristic curve for the material under study may be plotted to determine the percentage by weight of any grain size in the sample. The apparatus is not practical for separations by gravity below 0.5 micron because of the time required and because Stokes' Law becomes inoperative. The Andreason method is correct within 2-5%.

PROCEDURE

1. Weigh out sufficient sample so that on dilution in the sedimentation vessel to the 20 cm graduation mark (550 ml) the concentration would be about 1% by volume.

2. On a separate sample determine the moisture content to correct to the true powder weight.

3. Make up the suspension in the selected medium, using a technique which will give reproducible results with as high a degree of dispersion as possible.

4. Transfer the dispersed sample to the sedimentation vessel, and adjust the volume to the 20 cm mark with distilled water.

5. Insert the stopper carrying the pipet, and place the apparatus in a constant temperature bath for 15 to 30 minutes.

6. After the apparatus has come to the temperature of the bath, remove it, cover the small vent in the stopper with a finger, and shake the apparatus by hand for 2 minutes.

7. Note the exact time that shaking was stopped and replace the apparatus in the bath.



(continued on other side)

8. Take the first sample immediately by drawing 10 ml up into the pipet bulb with aspirator suction at a slow rate. A reasonable sampling time would be 20 seconds.

9. Drain the sample rapidly into a weighing vessel, dry and weigh. The weight of the first sample gives the initial powder weight.

10. Withdraw later samples at successive time intervals. Withdraw all samples at the same rate, and record the time at which the sample was taken.

11. Dry and weigh all samples.

CALCULATIONS

1. The grain sizes are calculated from Stokes' Law according to the falling velocity of the particles. Each sample drawn has a smaller size of grain than that corresponding to the falling velocity because all particles of large size will have fallen below the level of the pipet tip. Stokes' Law may be expressed as follows:

$$r = \sqrt{\frac{9\,hn}{2\,(D_1 - D_2)\,gt}}$$

Where r = radius of spherical particle (cm)
n = viscosity of suspending medium (poises)
h = distance between liquid surface and pipet tip when sample is drawn (cm).
D_1 = true specific gravity of particles
D_2 = true specific gravity of suspending medium
g = gravitation constant
t = time from start of test (sec.)

2. From the weight of the dried samples, calculate the percentages by weight of the original sample. IN SUSPENSION

3. Plot the results in a smooth curve with grain size as the abscissae and the percentage by weight as the ordinate. From this basic curve, the percentage by weight of any grain size in the sample may be obtained.

REPLACEMENT PARTS

Item	Part
Pipet	14-232A
Graduated Cylinder	14-232C

CTD015917

REFERENCES

Herdan, G., Small Particle Statistics, Elsevier Publishing Co., N.Y., 1953.

Loomis, George, A., Grain Size of Whiteware Clays, as Determined by the Andreason Pipet, Journal of the American Ceramic Society, 21, 393-399, 1938.

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION PIPE DIVISION	SPECIFICATIONS CLASSIFICATION: Standard Test Method		
	T.C.O. REF. NO.: 1	SPECIFICATION NO.: TM-28	PAGE NO.: 1
CERTAIN	SUPERSEDES:		DATE OF ISSUE: July 2, 1968

DESCRIPTION:

Dimensional Testing of Round Cross-Section Rubber Rings

1.0 Scope

The purpose of this test method is to provide standard means of measuring Round Cross-Section Rubber Rings on incoming inspection. The measurements to be described are, Outside Diameter, height and width. The height shall be considered the distance from the top of the ring to the bottom of the ring when the ring is lying on a flat surface. The width shall be considered as the distance from the I.D. of the ring to the O.D. of the ring. (Figure 2)

2.0 Dimensional Requirements

The dimensional requirements for this test can be found in the appropriate CPC Purchasing Specifications.

3.0 Apparatus

Outside Diameter tape accurate to ±.005 inches (.1270 mm).
Outside Diameter tape 8 feet Pi Tape accurate to ±.007 inches (.1773 mm).
Pocket Comparator 20 mm. linear scale lens, accurate to ±.1 mm.
Dial Micrometer accurate to ±.001 inches (.0254 mm).

4.0 Dimensions

All dimensional measurements shall be made on rings that are conditioned at room temperature (75° ±5°F) (23.9 ±2.8°C) for at least four (4) hours.

4.1 Ring Outside Diameter

Measurement of the ring outside diameter in all sizes up to and including twelve (12) inch shall be taken by direct reading with a flexible outside diameter tape to the nearest 0.005 inches (.1270 mm). Care should be exercised to make sure that the tape is on the maximum O.D. of the ring and should not be allowed to slide down. The tape shall be held snugly against the ring but shall not distort the ring.

In sizes fourteen (14) inches and up the outside diameter shall be measured using an eight (8) feet Pi tape. The measurement shall be by direct reading to the nearest .007 inch (.1778 mm). The same care shall be exercised in using this tape as was described in using the smaller O.D. tape.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAIN-TEED

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-28	2
SUPERSEDES:		DATE OF ISSUE: July 2, 1968

DESCRIPTION:

Dimensional Testing of Round Cross-Section Rubber Rings

4.2 Width of Ring.

The rings to be measured for width shall be cut into three sections and each cut end measured using a pocket comparator to the nearest 0.1 mm. using the lens with the 20 mm linear scale. Care should be taken that the zero hash mark is lined up exactly on one edge of the ring. See Figure I.

4.3 Height of Ring

The height of the ring may be measured in the same manner and at the same time as the width of the ring.

Another method of measuring the height of the ring is by use of a dial micrometer accurate to 0.001 inches (.0254 mm). The ring shall lie on a flat surface. Allow the entire presser foot to fall on the ring and take a direct reading from the dial gauge. Care should be exercised that the presser foot is placed on the top of the ring so that the maximum height is obtained. Four readings ninety (90) degrees apart shall be taken on each ring.

5.0 Approved Vendors for Apparatus

Outside Diameter Tape - Lufkin Model 146 PD tape from Lufkin Rule Company, Saginaw, Michigan,
Lufkin 8 feet Pi tape-Lufkin Rule Company, Saginaw, Michigan.
Pocket Comparator - Peak Scale Magnifier 7X, Optical Apparatus Company, Ardmore, Pennsylvania.
Dial Micrometer - Federal Dial Micrometer, Model No. 691B-28-R-2. Federal Products, Providence, Rhode Island or equivalent.

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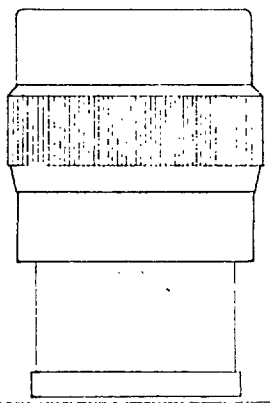
SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 1	SPECIFICATION NO.: TM-28	PAGE NO.: 3
SUPERSEDES:		DATE OF ISSUE: July 2, 1968

DESCRIPTION:

Dimensional Testing of Round Cross-Section Rubber Rings

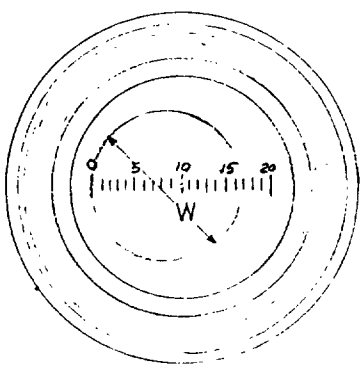
FIGURE-1

SIDE VIEW



OPTICAL COMPARATOR

TOP VIEW



CTD015920

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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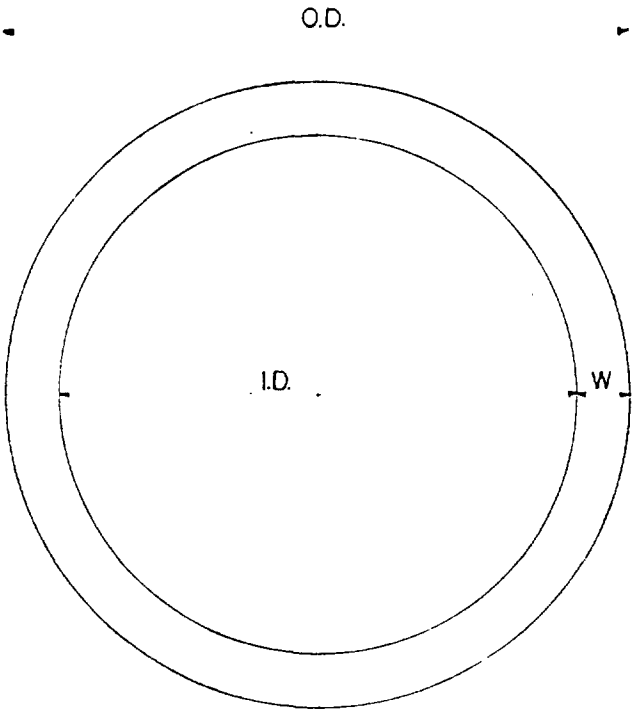
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-28	4
SUPERSEDES:		DATE OF ISSUE: July 2, 1968

DESCRIPTION:

Dimensional Testing of Round Cross-Section Rubber Rings

FIGURE-2



CTD015921

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-29	1
SUPERSEDES:	DATE OF ISSUE:	
	June 2, 1971	

DESCRIPTION:

Stretch Recovery Test For Elastomeric Compounds

1.0 Scope

The purpose of this test method is to establish a standard test method for determining the stretch recovery of elastomeric compounds.

2.0 Physical Requirements

The stretch recovery requirements can be found in the appropriate CERTAIN-TEED PRODUCTS CORPORATION, P&PG, Standard Purchasing Specification.

3.0 Apparatus

3.1 Rubber ring stretching device.

3.2 O.D. tape graduated in 0.01".

3.3 Yardstick graduated in 0.0625".

3.4 Stopwatch or timer.

4.0 Test Method

All tests are to be performed at 75°F. ± 5°F. on whole rings only.

4.1 Condition the rubber rings for 4 hours at 75°F. ± 5°F.

Note: The ring shall be relaxed and lying flat with the holes up for FT-CG and the holes down for FT-B. If at the end of 4 hours, the ring is not relaxed and lying flat, continue conditioning the ring until it is relaxed and lying flat.

4.2 Place the rubber ring on a flat smooth surface.

4.3 Measure the ring O.D. by using an O.D. tape to the nearest 0.005". Record this dimension as the original O.D.

4.4 Place the rubber ring on the stretching device and stretch the ring until the O.D. is 1.4 times the original O.D. See Table A for referee dimensions.

Note: The rubber ring shall be placed on the stretching device in such a manner that the face hole center lines are roughly parallel to the rotation axis of the pulley.

CTD015922

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TECHNICAL SPECIFICATIONS

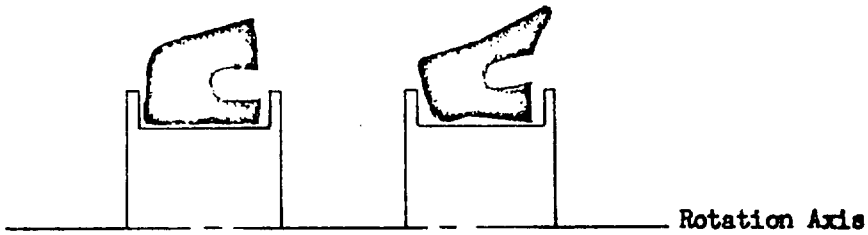
CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAIN-TEED

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 1	SPECIFICATION NO: TM-29	PAGE NO.: 2
SUPERSEDES:		DATE OF ISSUE: June 2, 1971

DESCRIPTION:

Stretch Recovery Test for Elastomeric Compounds



4.5 Leave the ring(s) on the stretching device for 24 hours, occasionally rotating the rings by hand.

4.6 At the end of 24 hours, Time (T) is 0 minutes.

4.6.1 At T = 0 release the tension on the stretching device and place the rubber ring on a sheet of plastic (the plastic being taped over a smooth flat surface).

Note: If two rubber rings are on the stretching device, do not release the tension but roll one ring off by bending the ring over the pulley edge and rolling off.

4.6.2 At T = 1 min. measure and record the O.D.

4.6.3 At T = 2 min. measure and record the O.D.

4.6.4 At T = 5 min. measure and record the O.D.

4.6.5 At T = 10 min. measure and record the O.D.

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4.6.6 At T = 15 min. measure and record the O.D.

Note: When the rubber ring is laid down on the plastic, the holes shall be face up for FT-CG and face down for FT-B.

4.6.7 After all measurements have been taken for the first rubber ring release the tension on the stretching device and repeat steps 4.6.1 to 4.6.6 for the second ring.

4.7 To find the stretch remaining after 1 min. subtract the original O.D. from the measured O.D. at 1 min., divide the result by the original O.D. and multiply by 100.

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method

T.C.C REF NO.	SPECIFICATION NO	PAGE NO
1	TM-29	3

SUPERSEDES:

DATE OF ISSUE: June 2, 1971

DESCRIPTION:

Stretch Recovery Test for Elastomeric Compounds

$$\text{Percent Stretch Remaining} = \frac{\text{Measured O.D.} - \text{Original O.D.}}{\text{Original O.D.}} \times 100$$

4.8 Do the same for 2 min., 5 min., 10 min., and 15 min.

TABLE A

Materials Laboratory Stretching Device — Pulley Center to Center Distance
40% Stretch for 24 hours

Type Ring	Size (In.)	Class	Based on Nom. Ring Dimensions Pulley Center to Center Distance (In.)
FLUID-TITE CG Pressure	6	All	10.375
	8	All	15.3125
	10	100	20.00
	10	150/200	20.875
	12	100	25.375
	12	150/200	25.875
	14	100	30.125
	14	150/200	30.375
FLUID-TITE B Pressure	4	All	5.3125
	6	All	10.375
	8	All	15.250
	10	100	19.1875
	10	150/200	20.9375
	12	100	24.875
	12	150/200	25.500
	14	100	27.750
	14	150/200	30.4375
FLUID-TITE B Sewer	4	1500 to 3300	5.1875
	5	1500 to 3300	7.500
	6	1500 to 3300	9.750
	6 CAS	1500 to 3300	9.500
	8	1500 to 3300	14.375
	10	1500 to 5000	19.3125
	12	1500 to 5000	23.750
	14	1500 to 5000	28.1875

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SPECIFICATIONS CLASSIFICATION: Standard Test Method

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-29	4

SUPERSEDES:

DATE OF ISSUE: June 2, 1971

DESCRIPTION:

Stretch Recovery Test for Elastomeric Compounds

Table A (Continued)

Type Ring	Size (In.)	Class	Pulley Center to Center Distance (In.)
Bur. of Rec. and Fluid Transmission	4	All	5.5625
	6	A/C 4-6	9.750
	6	A/C 9-20	10.250
	8	A/C 4-6	15.000
	8	A/C 9-20	15.000
	10	A/C 4-9	18.000
	10	A/C 13-20	20.6875
	12	A/C 4-9	23.625
	12	A/C 10	24.3125
	12	A/C 13-20	25.6875
	14	A/C 4-6	28.750
	14	A/C 9-10	29.1875
	14	A/C 13-20	30.875

Note: Decimals are equivalent to fractions expressed in 1/16's.

5.0 Approved Vendors of Test Apparatus

5.1 Rubber ring stretching device - P&PG Drawings Q.C. 8, 8A and 8B.

5.2 O.D. Tape - Lufkin Model No. 146.

5.3 Yardstick - Commercial with 0.0625"graduations.

5.4 Timer - Fisher 6-600 Interval Timer.

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TM-30

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF.- NO. 1	SPECIFICATION NO: TM 30	PAGE NO.: 1
SUPERSEDES:		DATE OF ISSUE: August 19, 1969

DESCRIPTION:

Free Moisture Content of Silica

1.0 Scope

The purpose of the test method is to determine the percentage of free moisture in pulverized silica.

2.0 Physical Property Requirements

Physical property requirements for this test method can be found in the appropriate CAP Division Standard Purchasing Specifications.

3.0 Apparatus

Tared glass weighing bottle
Oven - either convection or gravity
Balance, 0-100 grams $\pm$ 0.05 gram
Desiccator

4.0 Procedure

Transfer about 10 grams of a sample of "as received" pulverized silica into a clean, tared and previously dried glass weighing bottle. Weigh accurately. Heat and dry for a minimum of two hours to a constant weight at 220° F $\pm$ 10° F. Cool in a desiccator and weigh.

5.0 Calculations

The percentage of free moisture can be calculated using the following formula:

$$\% \text{ Free Moisture} = \frac{(\text{Wt. "as received"} - \text{Wt. dry})}{\text{Wt. "as received"}} \times 100$$

Two determinations shall be made on each sample with the average recorded.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION PIPE DIVISION	SPECIFICATIONS CLASSIFICATION: Standard Test Method		
	T.C.O. REF. NO.: 1	SPECIFICATION NO.: TM - 31	PAGE NO.: 1
	SUPERSEDES:		DATE OF ISSUE: August 8, 1969

DESCRIPTION:

Loss On Ignition

1.0 Scope

The purpose of this test method is to determine if volitile and/or organic impurities are present in the silica or cement.

2.0 Chemical Property Requirements

Chemical property requirements for this test method can be found in the appropriate CAP Division Standard Purchasing Specifications.

3.0 Apparatus

Porcelain cruicible with cover.
Muffle Furnace.
Balance, 0-100 grams ± 0.0005 gram.
Desiccator.

4.0 Procedure

Accurately weigh approximately one gram of a dried sample and transfer into a clean, tared and previously fired porcelain crucible fitted with a cover. Place crucible into a muffle furnace and maintain at 1900° F ± 50° F for one hour ± five minutes. Cool in a desiccator and weigh.

5.0 Calculations

The per cantage of weight loss due to ignition can be calculated using the following formula:

$$\% \text{ Loss on ignition} = \frac{(\text{Wt. dried sample} - \text{Wt. ignited sample})}{\text{Wt. dried sample}} \times 100$$

Two determinations shall be made on each sample and the average recorded.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM-32	PAGE NO.: 1
SUPERSEDES:		DATE OF ISSUE: June 26, 1970

DESCRIPTION:

Pot Life For Epoxy Resins & Hardeners

1.0 Scope

The purpose of this test method is to establish a standard method of determining pot life for epoxy resins and hardeners.

2.0 Physical and Chemical Requirements

The physical and chemical requirements for the epoxy materials and the minimum required pot life can be found in the appropriate CERTAIN-TEED PRODUCTS CORP. PIPING AND PLASTIC INDUSTRIES (PPI) Purchasing Specifications.

3.0 Apparatus

3.1 Tall 8 oz. paper cups suitable for hot liquids.
3.2 Wooden tongue depressors or suitable disposable stirring rods.
3.3 Timer with a maximum one minute intervals to two hours.
3.4 Trip balance accurate to 0.1 gram or equivalent.

4.0 Test Method

4.1 Epoxy Resin

4.1.1 Weigh out 200 grams of epoxy resin into a tall 8 oz. paper cup on the trip balance.
4.1.2 Weigh out the desired amount of standard hardener as specified in applicable PPI In Process Specification.
4.1.3 Start timer and immediately start stirring the hardener into the resin thoroughly with the wooden tongue depressor.
4.1.4 After thorough mixing (approximately 1 minute) allow the resin-hardener mix, with the tongue depressor left in the mix, to sit at 75°F ± 5°F until a skim begins to form on the surface. Stop the timer at this point and record the elapsed time in minutes which is considered the pot life of the mixture.
4.1.5 For new epoxy resins repeat the above steps three (3) times and take the average of the pot lives. In addition, at least one standard resin-hardener mix shall be done at the same time as a control check.

4.2 Hardeners

4.2.1 The same procedure for hardeners is followed as for epoxy resins except the standard epoxy resin specified in the PPI In Process Specification is used with the hardener to be tested.

4.3 Adhesives

4.3.1 Prepared epoxy adhesives supplied by vendors are generally a two component system. Determine from the sales literature, container instructions or from the vendor the proper weight or volume ratio to make approximately 225 grams of mix.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM-32	PAGE NO.: 2
SUPERSEDES:		DATE OF ISSUE: June 26, 1970

DESCRIPTION:

Pot Life For Epoxy Resins & Hardeners

4.3.2 Determine pot life by the procedure described in para. 4.1.

5.0 Approved Vendors of Test Apparatus

5.1 Tall 8 oz. cups for hot liquid - Lily No. 208 BG manufactured by Lily-Tulip Cup Corp. 122 E 42rd Street, New York, N. Y.

5.2 Timer - Fisher 6-660 Interval Timer.

5.3 Trip balance - O'Haus Scale Corp., Union, New Jersey 2610 gram max. capacity.

5.4 Standard Epoxy Resin - any approved epoxy resin vendor listed in PPI Standard Purchasing Specification 521.

5.5 Standard Epoxy Hardener - any approved epoxy hardener vendor listed in PPI Standard Purchasing Specification 521.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-34	1
SUPERSEDES:		DATE OF ISSUE: September 15, 1970

DESCRIPTION:

Density Test for Epoxy Components

1.0 Scope

The purpose of this test is to establish a standard test method for determining density of epoxy resins and hardeners.

2.0 Physical Requirements

The physical requirements for the epoxy resins and hardeners can be found in the appropriate CERTAIN-TEED PRODUCTS CORPORATION, PIPING AND PLASTIC INDUSTRIES (PPI) Purchasing Specifications.

3.0 Apparatus

3.1 Trip balance accurate to 0.1 grams or equivalent.

3.2 250 cc. graduated cylinder.

4.0 Test Method

All tests are to be performed at 25°C. ±2°C.

4.1 Place clean, dry, graduated cylinder on trip balance and determine the weight of the cylinder to the nearest 0.1 gram.

4.2 Record the weight of the clean, dry, cylinder.

4.3 Place exactly 100 cc. of either the epoxy resin or epoxy hardener in the graduated cylinder and weigh the combined system to the nearest 0.1 gram.

4.4 Record the weight of the graduated cylinder and epoxy sample.

4.5 Subtract the weight of the cylinder from the total weight.

4.6 Multiply the weight in grams by 0.08345 to get lbs. per U. S. gallon.

4.7 Three samples shall be weighed and the average weight taken as the sample weight.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-34	2
SUPERSEDES:		DATE OF ISSUE: September 15, 1970

DESCRIPTION:

Density Test for Epoxy Components

Density of epoxy sample = $(W_T - W_C)\ 0.08345$

Where W_T = Weight of clean, dry, cylinder and 100 cc. of epoxy resin or hardener.

W_C = Weight of clean, dry, cylinder.

8.345 lbs. per gal. = Conversion factor from Marks' Standard Handbook for Mechanical Engineers, 7th Edition, McGraw Hill Book Company, page 1-85.

0.08345 = 8.345 x .01 for 100 cc. sample.

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TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM-35	PAGE NO.: 1
SUPERSEDES:		DATE OF ISSUE: July 21, 1970

DESCRIPTION:

Standard Tests-FLUID-TITE Lubricant For Field Use

1.0 SCOPE

The purpose of this test method is to provide a standard means of determining color, odor, taste, shelf life and temperature effects for FLUID-TITE Lubricant for field use.

2.0 PHYSICAL REQUIREMENTS

The physical requirements can be found in the appropriate PPI Standard Purchasing Specification.

3.0 APPARATUS

3.1 Clear, sealable, waterproof, one liter containers.
3.2 Measuring containers.
3.3 Brookfield Viscosity Machine.
3.4 Oven capable of 120°F.
3.5 Freezer capable of 0°F.

4.0 TEST METHOD

4.1 Color, Odor, Taste
Prepare a solution with a concentration of ten (10) parts per million. This is done by dissolving exactly 1 gram of lubricant in a liter of distilled water. When fully dissolved, take 10cc of this solution and dilute to one liter with distilled water. Allow this solution to stand in a sealed container for 24 hours.

4.1.1 Color and Clarity - Visually.

4.1.2. Odor - Shake the solution vigorously for two minutes, remove cap. Compare odor with a blank sample (distilled water only) stored for 24 hours under the same conditions.

4.1.3 Taste - The solution shall be tested for taste in comparison with a blank sample stored for 24 hours under the same conditions.

4.2 Shelf Life
Leave Lubricant in a sealed container on shelf for 1 year, then perform all tests listed in this test method on the sample.

4.3 Temperature Effect

4.3.1 Place 100 gram sample in oven at 120°F for 24 hours. Then run Brookfield Viscosity using no.7 Spindle at 20 R.P.M.
4.3.2 Place 100 gram sample in freezer at 0°F for 24 hours. Then run Brookfield Viscosity using No. 7 Spindle at 20 R.P.M.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 1	SPECIFICATION NO: TM-36	PAGE NO.: 1
SUPERSEDES:	DATE OF ISSUE: July 23, 1970	

DESCRIPTION:

Standard Tests - FLUID-TITE Lubricant For In-Plant Use.

1.0 SCOPE

The purpose of this test method is to provide a standard means of determining color, odor, taste, shelf life, temperature effect and freeze-thaw for FLUID-TITE Lubricant for In-Plant Use.

2.0 PHYSICAL REQUIREMENTS

The physical requirements can be found in the appropriate PPI Standard Purchasing Specification.

3.0 APPARATUS

3.1 Clear, sealable, waterproof, one liter containers.
3.2 Measuring containers.
3.3 Brookfield Viscosity Machine.
3.4 Oven capable of 120°F.
3.5 Freezer capable of 0°F.

4.0 TEST METHODS

4.1 Color, Odor, Taste
Prepare a solution with a concentration of ten (10) parts per million. This is done by dissolving exactly 1 gram of lubricant in a liter of distilled water. When fully dissolved, take 10 cc of this solution and dilute to one liter with distilled water. Allow this solution to stand in a sealed container for 24 hours.

4.1.1 Color and Clarity - Visually.

4.1.2 Odor
Shake the solution vigorously for two minutes, remove cap. Compare odor with a blank sample (distilled water only) stored for 24 hours under the same conditions.

4.1.3 Taste
The solution shall be tested for taste in comparison with a blank sample stored for 24 hours under the same conditions.

4.2. Shelf Life
Leave lubricant in a sealed container on shelf for 1 year, then perform all testslisted in this test method on the sample.

4.3 Temperature Effect
4.3.1 Place 100 grams sample in oven at 120°F for 24 hours. Then run Brookfield Viscosity using No. 7 Spindle at 20 RPM.

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TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM-36	PAGE NO.: 2
SUPERSEDES:		DATE OF ISSUE: July 23, 1970

DESCRIPTION:

Standard Tests - FLUID-TITE Lubricant For In-Plant Use.

4.3.2 Place 100 grams sample in freezer at 0°F for 24 hours. Then run Brookfield Viscosity using No. 7 Spindle at 20 RPM.

4.4 Freeze-Thaw

Place a 50 gram sample in freezer at 0°F for 8 hours. Remove and allow sample to return to room temperature. Check viscosity. Repeat cycle two more times.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM-37	PAGE NO.: 1
SUPERSEDES:		DATE OF ISSUE: June 17, 1971

DESCRIPTION:

Chemical Resistance and Adhesive Strength of Epoxy Lining for A/C Pipe

1.0 SCOPE

The purpose of this test method is to establish a standard method for determining chemical resistance and adhesive strength of epoxy lining for A/C pipe.

2.0 PHYSICAL AND CHEMICAL REQUIREMENTS

The physical and chemical requirements for the epoxy lining can be found in the appropriate CERTAIN-TEED PRODUCTS CORP. PIPE AND PLASTIC GROUP (P&PG) Std. Purchasing Specification.

3.0 APPARATUS

3.1 Tall 8-oz. paper cups suitable for hot liquids.
3.2 Wooden tongue depressors or suitable disposable stirring rods.
3.3 Trip balance accurate to 0.1 gram or equivalent.
3.4 Analytical balance accurate to 0.0005 grams.
3.5 4-qt. wide mouth jars with phenolic screw tops.
3.6 2 - one liter beakers.
3.7 Distilled water.
3.8 3 pieces of 3" wide by 6" long A/C pipe staves.
3.9 ½" diameter steel or aluminum bar 2" long.
3.10 Teflon coated cookie pan.
3.11 Tension testing machine such as a Tinius-Olsen Tester.

4.0 PREPARATION OF SPECIMENS

4.1 Chemical Resistance Specimens

4.1.1 Using the 8-oz. paper cups and wooden tongue depressors, mix according to the following formula:

62.0 Epoxy Resin
30.8 15 Micron Min-U-Sil
7.2 TETA

by weight. Epoxy Resin and TETA to be in accordance with CERTAIN-TEED PRODUCTS CORP. P&PG Standard Purchasing Specification No. 539.

4.1.2 Take the teflon coated cookie pan and coat it with a thin layer of silicone grease. Pour the epoxy mixture into the pan and level off to a depth of 1/8".

4.1.2.1 The pan is put in a 200° F oven for 20 minutes.

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4.1.2.2 Remove the pan and strip the epoxy mixture from the pan in one piece while hot and place in a circulating oven for 1½ hours at 200° F.

4.1.2.3 Remove the epoxy from the oven, cool to room temperature and cut into 1" x 3" x 1/8" chips. Cut a total of 16 chips.

Note: Warming the epoxy mixture to about 100 - 110° F. before pouring and leveling helps pouring and leveling.

4.2 Adhesive Strength Specimens

4.2.1 Prepare the epoxy mixture in accordance with paragraph 4.1.1.

4.2.2 Apply the epoxy mixture to a clean dry A/C pipe stave 3" x 6" using a paint brush to a depth of 20 mils.

4.2.2.1 Allow the coating to air dry at 75° F until tack free and then cure in a circulating oven at 200° F for 1½ hours.

4.2.2.2 Cool the coated A/C and rough up the center of the coating with sandpaper.

4.2.2.3 Take the ½" dia. bar and apply a thin coat of the epoxy mixture to the face of the bar and the roughened surface of the coated A/C. Press together lightly and allow to air cure at 75° F for 16-24 hours. Then cure in circulating oven for 1½ hours at 200° F. Any excess epoxy ooze around the interface of ½" plug and coated A/C should be removed.

4.2.3 Prepare 3 specimens.

5.0 TEST METHOD FOR CHEMICAL RESISTANCE

5.1 Weigh the 16 dry specimens (Paragraph 4.1.2.3) to the nearest 0.0005 grams. Record the weight.

5.2 Place two specimens completely immersed in each of the following solutions. One of each solution shall be kept at 75° F ± 3° F for seven days and the other of each solution shall be kept at 75° F ± 3° F for 30 days. Use the wide mouth jars with top screwed on.

5.2.1 Distilled water.
5.2.2 10 percent (by weight) solution of sulfuric acid.
5.2.3 5 percent solution of acetic acid.
5.2.4 5 percent (by weight) solution of sodium hydroxide.

5.3 After the proper time has elapsed, remove the specimens from solution, blot dry the specimen and weigh the specimen to the nearest 0.0005 gram.

5.4 Determine the gain or loss of weight as follows:

$$\text{Gain or Loss of Weight} = \frac{W_2 - W_1}{W_1} \times 100\%$$

Where W_2 = Weight after immersion.

W_1 = Weight before immersion.

6.0 TEST METHOD FOR ADHESIVE STRENGTH

6.1 Place the specimens in distilled water, maintained at 150° F ± 3° F for 96 hours. Use one liter beakers.

6.2 After the proper time has elapsed, remove the specimen from the distilled water.

6.3 Place the specimen in the Tinius-Olsen Tester and test for tensile strength of the epoxy lining. Record the force necessary to break the epoxy lining.

6.4 Determine the tensile strength as follows:

$$\text{Tensile strength} = \frac{\text{Force required to break}}{\text{Square area of face of } \frac{1}{2}\text{" dia. bar}}$$

Square area of face of bar is equal to $\frac{3.14159(D)^2}{4} = .7854D^2$ where D = Dia. of bar.

7.0 APPROVED VENDORS OF TEST APPARATUS

7.1 Tall 8-oz. cups for hot liquid - Lily No.-208BG
Lily-Tulip Cup Corporation, 122 E. 42nd Street, New York, N.Y.

7.2 Trip Balance - O'Haus Scale Corporation, Union, New Jersey.
2160 gram max. capacity.

7.3 Analytical Balance - Mettler H_6.

7.4 Quart wide mouth jars with phenolic screw tops - any supplier.

7.5 One liter beakers - any supplier.

7.6 Wooden tongue depressors - any supplier.

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

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SPECIFICATIONS CLASSIFICATION: Standard Test Method

T C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.
1	TM-37	4

SUPERSEDES:

DATE OF ISSUE: June 17, 1971

DESCRIPTION:

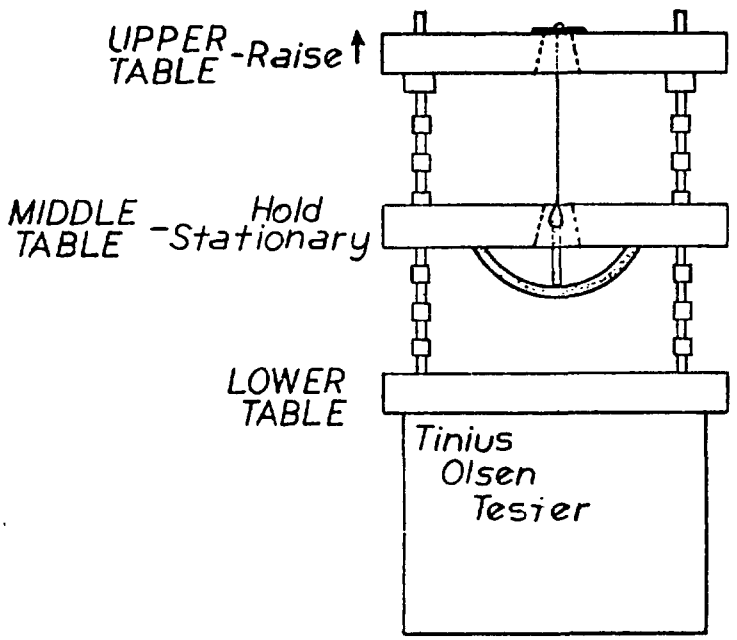
Chemical Resistance and Adhesive Strength of Epoxy Lining for A/C Pipe

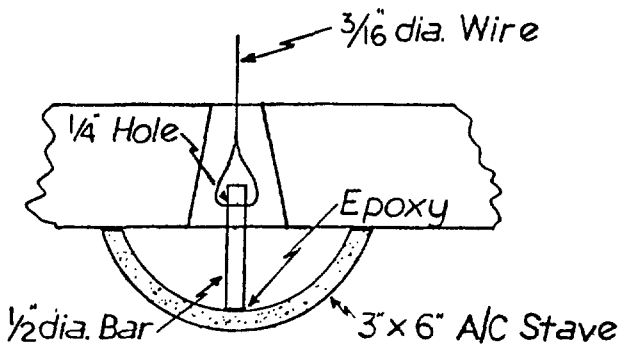
7.7 Distilled Water - any supplier.

7.8 Teflon coated cookie pan - any supplier.

7.9 Tension Tester - Tinius Olsen Tester.

Method for Determining
Tensile Strength of Epoxy Lining





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PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 1	SPECIFICATION NO: TM-38	PAGE NO.: 1
SUPERSEDES:		DATE OF ISSUE: JUN 12 1972

DESCRIPTION:

Assembly Effort Test Method Using "Cold Box"

1. Scope

The purpose of this test method is to initiate a standard procedure for measuring the force required to insert a lubricated pipe stem in a coupling and ring at low temperature to form an assembled joint.

2. Physical Requirements

Assembly effort requirements can be found in the appropriate CPC, P&PG Standard Purchasing Specifications for rubber rings.

3. Apparatus

3.1 Cold Box - A well insulated box with forced air circulation capable of temperature control from 0°F. to 80°F.

3.2 Equipped with the following: (Refer to Figure II for approximate location).

3.2.1 Air cylinder with reverse direction parts and air pressure source to 120 psi.

3.2.2 Throttle attached to air cylinder.

3.2.3 Regulator valve capable of reducing line pressure to operating levels of the test method.

3.2.4 Regulator gauge to measure line pressure of the regulator valve (3.2.3) must have at least half-pound increments.

3.2.5 Friction gauge to give a more precise reading than the regulator gauge (3.2.4) in one-eighth pound increments, up to 15 pounds.

3.2.6 Line pressure gauge to measure line pressure.

3.2.7 Air control valve - off/on.

3.2.8 Bypass valve - off/on switch to shut down system.

3.2.9 Operation valve - assemble/neutral/disassemble to regulate movement direction.

3.2.10 A suitable carriage to transport the pipe stem to the coupling propelled by the air cylinder (3.2.1); also equipped with adjustable devices to align the pipe stem and coupling.

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 1	SPECIFICATION NO: TM-38	PAGE NO.: 2
SUPERSEDES:	DATE OF ISSUE: JUN 12 1972	

DESCRIPTION:

Assembly Effort Test Method Using "Cold Box"

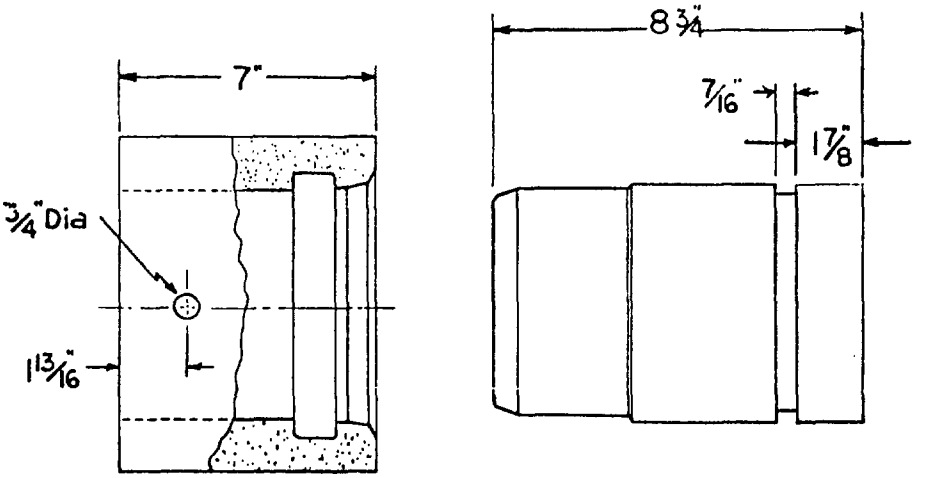
3.2.11 Thermometer, – 30°F. to 120°F., mercury or dial (inserted into the box).

3.2.12 Light and thermostat controlled heater to regulate temperature and view assembly. Switch is located on the outside of the box.

3.2.13 Window to view assembly.

3.3 Pipe Stem and Coupling

Figure I



3.4 Lubricant, per CPC, P&PG Standard Purchasing Specification No. 504.

3.5 Rubber Rings, per applicable CPC, P&PG Standard Purchasing Specifications.

3.6 O.D. tape accurate to 0.005".

4. Control Functions

4.1 Air control valve (3.2.7) turns on line pressure.

4.2 Regulator valve (3.2.3) controls line pressure.

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4.3 Regulator gauge (3.2.4) measures line air pressure.

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4.4 Friction gauge, (3.2.5), precise measuring of friction of carriage.

4.5 Line pressure gauge (3.2.6).

4.6 Bypass valve (3.2.8) to give quick disassembly by circumventing the regulator valve and throttle giving full line pressure.

4.7 Operation valve (3.2.9) to control carriage traverse direction, and bleed off air pressure.

5. Safety Notes

5.1 The air cylinder exerts considerable force and due care should be exercised before any movement of the carriage or application of air pressure.

Make sure all personnel are clear of the box interior and moving parts before applying pressure.

Shut off all control panel valves when interior of the box is being serviced and keep operation valve in neutral position.

Remove all tools and other material from the box which will interfere with the free movement of the carriage.

6. Calibration of Box Mechanism

6.1 A machined coupling and pipe stem (3.3) of nominal dimensions and rubber ring of specification tolerances are assembled on the Universal Tester at 75°F.±2°F. with a dial load rate of 75. The pounds of assembly are read from the large dial and recorded. Run a minimum of three (3) samples.

6.2 Similar size couplings, stems, and rings are run in the Cold Box at 75°F.±2°F. The friction and total air pressure for assembly is recorded and the total pounds for assembly effort calculated as shown in 8. Total pounds assembly effort should be within ± 20 pounds of the Universal Tester.

6.3 The same size, type of ring from the same vendor should be used in both test apparatus.

7. Procedure

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7.1 General

This test method employs air pressure applied to the stem which is in contact with the ring inside the coupling at the time of application of increasing pressure until an assembled joint has been accomplished.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-38	4
SUPERSEDES:	DATE OF ISSUE: JUN 12 1972	

DESCRIPTION:

Assembly Effort Test Method Using "Cold Box"

7.1.1 All tests shall be run at 10°F. ± 2°F. except Universal Tester calibration.

7.1.2 The test is based on nominal dimensions of stem, coupling, and rubber rings within specification tolerances.

7.1.2.1 Size is limited to 10" I.D. pipe joints as maximum size, six and eight inch joints are preferred.

7.1.2.2 For proper mounting in the Cold Box, special machining of the stems and coupling by the Experimental Shop is required(3.3).

7.1.3 Common Groove joints (CG) shall have only the O.D.$_1$ lubricated, FLUID-TITE Sewer, and Bureau of Reclamation joints shall have the O.D.$_1$, and the rings lubricated after insertion into the groove keeping lubricant out of the groove.

7.1.4 Unused stems should be used whenever possible. Used stems should be cleansed of lubricant after each assembly with cold water and a stiff brush, then thoroughly dried in an air circulating oven. Air drying may be used if oven is not available.

7.2 Preparation

7.2.1 To prepare apparatus for assembly a stem is inserted in the bracket of the carriage and the Centering Jaws tightened by turning the Tightening Wheel.

7.2.2 A matching coupling with a bar through the two holes in the coupling is placed in the bracket at the opposite end of the box. Small set screws in the bracket allow for adjustment to concentric centering rings as well as holding the coupling in place on the mounting plate.

7.2.3 All rings, stems, couplings, and lubricants to be tested shall be placed in the Cold Box (where space permits).

7.2.4 The refrigeration unit is then set at 10°F. and turned on simultaneously with the circulating fan.

7.2.5 All test samples are to be cooled for four (4) hours after the box is cooled to 10°F.

7.3 Assembly

7.3.1 To complete alignment the air control valve should be open full, the operation valve put in "Assemble" position and the regulator valve

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slowly opened until the carriage starts to move on the rails (usually about 2 pounds on the regulator gauge is sufficient). The stem then enters the ringless coupling to the full length of the $O.D._1$ length at which point the operation valve is shifted to "neutral". If discernible misalignment is noticed, adjust the coupling and/or stem, disassemble and repeat alignment.

7.3.2 Once alignment is accomplished the carriage is returned to disassemble at the end of the rails, the air control valve closed and regulator valve relieved. Final pressure is bled off by pumping the operation valve handle to "neutral" and back to "disassemble" several times until the regulator gauge reads zero.

7.3.3 The nose of the stem is then lubricated, the ring inserted and lubricated if required (7.1.3). The box is then closed and cooled to 10°F.

7.3.4 When the box has stabilized at 10°F., the air control valve is opened full, the operation valve placed in "assemble" and the regulator valve is slowly opened until the carriage just moves forward. RECORD the friction gauge pressure for final assembly effort calculation. This represents the friction of the carriage. At this pressure the stem is allowed to enter the coupling and is pushing against the rubber ring. Immediately increase the regulator valve pressure at a rate of about one pound per second until assembly is accomplished. RECORD the regulator gauge pressure at assembly to the nearest pound.

7.4 Disassembly

7.4.1 Once assembly is made and pressure recorded, shift the operation valve lever to "disassemble". If insufficient pressure, close the air control valve, relieve the regulator valve and open the bypass valve slowly until disassembly is accomplished. Finally, bleed off the remaining pressure to zero on the regulator gauge by pumping the operation valve handle to "neutral" and back to "disassemble" several times until zero reading appears.

After disassembly, insert new test pieces, align, lubricate, and cool to 10°F. and repeat assembly as desired.

8. Calculations

Assembly effort is calculated as pounds per circumferential inch of stem ($O.D._1$) as follows:

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1	TM-38	6
SUPERSEDES:		DATE OF ISSUE: JUN 12 1972

DESCRIPTION:

Assembly Effort Test Method Using "Cold Box"

Total Pounds for Assembly (Regulator gauge pressure at assembly-friction pressure)x ram force area in square inches (12.57 in.^{2})

$$\text{Assembly Effort} = \frac{\text{Total pounds for assembly}}{\text{Circumferential (O.D.}_1\text{) inches}} = \text{Lbs./circumferential inch stem O.D.}_1.$$

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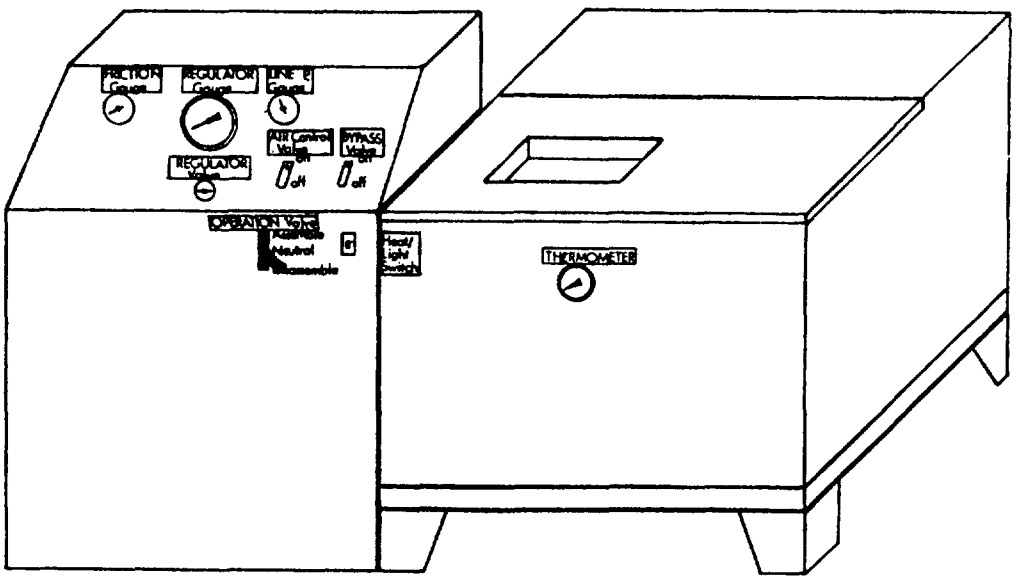
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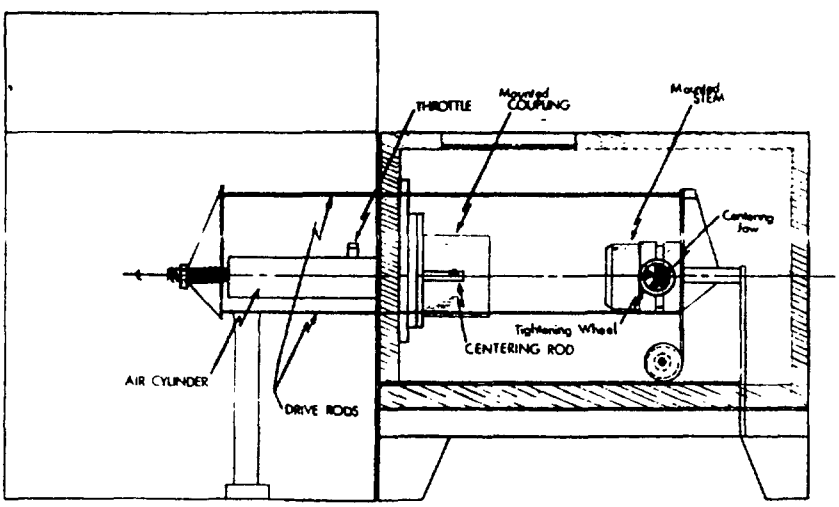
SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 1	SPECIFICATION NO: TM-38	PAGE NO.: 7
SUPERSEDES:		DATE OF ISSUE: JUN 12 1972

DESCRIPTION:

Assembly Effort Test Method Using "Cold Box"

FIGURE II





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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM-39	PAGE NO.: 1
SUPERSEDES:		DATE OF ISSUE: FEB - 7 1972

DESCRIPTION:

Tensile Testing of Storm Drain Coupling Material

1.0 SCOPE

The purpose of this test method is to establish a standard method of determining tensile strength of Storm Drain Coupling material and tensile strength of the weld of Storm Drain Coupling material.

2.0 PHYSICAL REQUIREMENTS

The physical requirements for the coupling material can be found in the appropriate CERTAIN-TEED PRODUCTS CORPORATION PIPE AND PLASTICS GROUP (P&PG) Purchasing Specifications. The required weld tensile strength can be found in the appropriate CERTAIN-TEED PRODUCTS CORPORATION P&PG In-process Inspection Standards.

3.0 APPARATUS

3.1 Tensile Tester Machines as per Dwg. TM-39-1,-2,-3,-4.
3.2 "C" Die as per ASTM D-412 for 0.120 inch & 0.150 inch thick material.
3.3 Type I Die 8 1/2" overall length as per ASTM D-412 for 0.180 inch and 0.210 inch thick material.
3.4 Steel Plate 12" X 12" X 1" and 1 piece of leather same size, 1/4" thick.
3.5 Crush Tester.
3.6 1" Bench Marker.
3.7 2" Bench Marker.

4.0 PREPARATION OF SPECIMENS

4.1 Welded Tensile Strength Specimens

4.1.1 Weld two pieces of coupling material per appropriate welding instructions.
4.1.2 Using the crush tester, proper die, steel plate and leather, cut the necessary number of specimens with the weld across the restricted portion of the specimen center as well as possible.

4.2 Non-Welded Tensile Strength Specimens

4.2.1 Using the crush tester, proper die, steel plate and leather, cut the necessary number of specimens.

4.3 Use white stencil ink and the proper bench marker (1" for 0.120 & 0.150, 2" for 0.180 & 0.210). Mark each specimen in the restricted area.

5.0 TEST METHOD

See Figure 1 for layout.

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5.1 Turn on the air.

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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 3	SPECIFICATION NO: TM-39	PAGE NO.: 2
SUPERSEDES: February 7, 1972	DATE OF ISSUE: MAY 30 1972	

DESCRIPTION:

Tensile Testing of Storm Drain Coupling Material

5.2 Open the center screw on the speed muffler all the way.

5.3 Pull the push button out - the jaws will come together.

5.4 For welded tensile strength specimens------

5.4.1 Measure the thickness of the specimen. See Figure 2.
5.4.2 Measure the width of the restricted area. See Figure 2.
5.4.3 Multiply the thickness in inches by the width in inches by 1350 PSI to get the necessary thrust in pounds.
5.4.4 Divide the thrust (in pounds) by the effective area (sq. inches) of the air cylinder. - See Table A.
5.4.5 Multiply by the correlation factor - See Table A - to get the pressure regulator PSI reading.
5.4.6 Set the pressure regulator at the proper PSI reading.
5.4.7 Open the jaws and insert the test specimen centered between and in the jaws.
5.4.8 Push the push button in.
5.4.9 Observe the separation of the jaws.
5.4.10 If the specimen does not break, the welded joint is satisfactory.
5.4.11 If the specimen breaks in the base material, the welded joint is satisfactory.
5.4.12 If the specimen breaks at the weld, reject the weld and all the couplings the weld represents.

5.5 For non-welded tensile strength specimens------

5.5.1 Measure the thickness of the specimen. See Figure 2.
5.5.2 Measure the width of the specimen. See Figure 2.
5.5.3 Multiply the thickness in inches by the width in inches by 1500 PSI to get the necessary thrust in pounds.
5.5.4 Divide the thrust (in pounds) by the effective area (sq. inches) of the air cylinder - See Table A.
5.5.5 Multiply by the correlation factor - See Table A - to get the pressure regulator PSI reading.
5.5.6 Set the pressure regulator at the proper PSI reading.
5.5.7 Open the jaws and insert the test specimen centered between and in the jaws.
5.5.8 Push the push button in.
5.5.9 Observe the separation of the jaws.
5.5.10 When the specimen breaks, measure the elongation.
5.5.10.1 If the elongation is 400% or greater, the specimen is satisfactory.
5.5.10.2 If the elongation is under 400%, reject the specimen.
5.5.11 If the specimen does not break, measure the elongation.
5.5.11.1 If the elongation is 400% or greater, pull the push button and start the next test.

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TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 2	SPECIFICATION NO: TM-39	PAGE NO.: 3
SUPERSEDES: February 7, 1972	DATE OF ISSUE: APR 21 1972	

DESCRIPTION:

Tensile Testing of Storm Drain Coupling Material

5.5.11.2 If the elongation is less than 400%, slowly increase the pressure regulator PSI setting until the jaws start separating. When the specimen breaks, measure the elongation; if over 400%, accept; if under 400%; reject.

TABLE A

Width of Restricted Area of Die	Thickness of Material	Air Cylinder Bore Size	Effective Area	Required PSI	Correlation Factor	Required Air Pressure PSI
.250	.120	1.50	1.46	1350	1.26	35
.250	.150	1.50	1.46	1350	1.20	42
.500	.180	2.00	2.835	1350	1.15	50 *
.500	.210	2.00	2.835	1350	1.20	60 *
.250	.120	1.50	1.46	1500	1.26	39
.250	.150	1.50	1.46	1500	1.20	46
.500	.180	2.00	2.835	1500	1.15	55 *
.500	.210	2.00	2.835	1500	1.20	67 *

* Use a Type I die.

6.0 APPROVED VENDORS

6.1 Tensile Tester Machines - P&PG Drawing TM-39-1,-2,-3,-4.
6.2 "C" Die - Any supplier in accordance with ASTM D-412.
6.3 Steel Plate - Any Supplier.
6.4 Crush Tester - Use the tester in the plant.
6.5 1" Bench Marker - Any supplier.
6.6 Type I Die 8 1/2" overall length - Any supplier in accordance with ASTM D-412.
6.7 2" Bench Marker - Any supplier.

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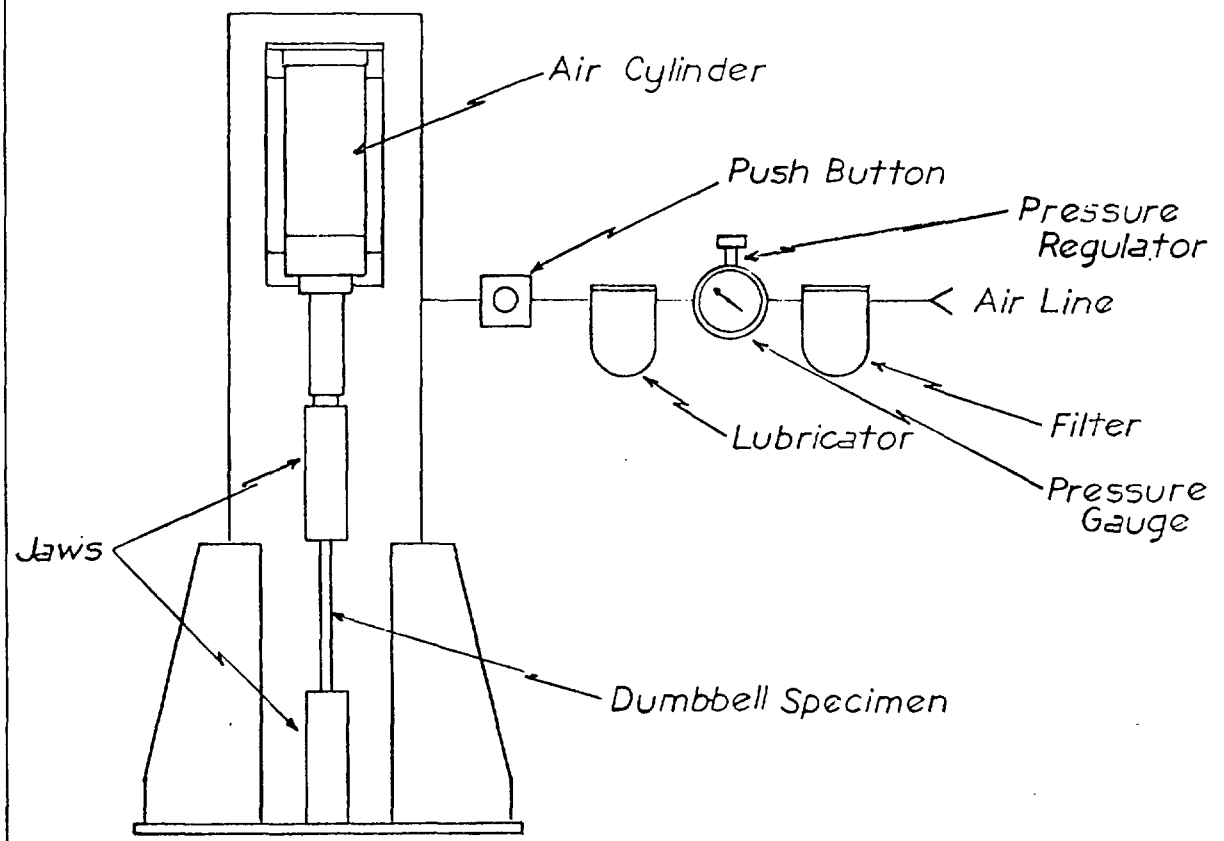
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.: 1	SPECIFICATION NO: TM-39	PAGE NO.: 4
SUPERSEDES:		DATE OF ISSUE: FEB - 7 1972

DESCRIPTION:

Tensile Testing of Storm Drain Coupling Material

FIGURE 1



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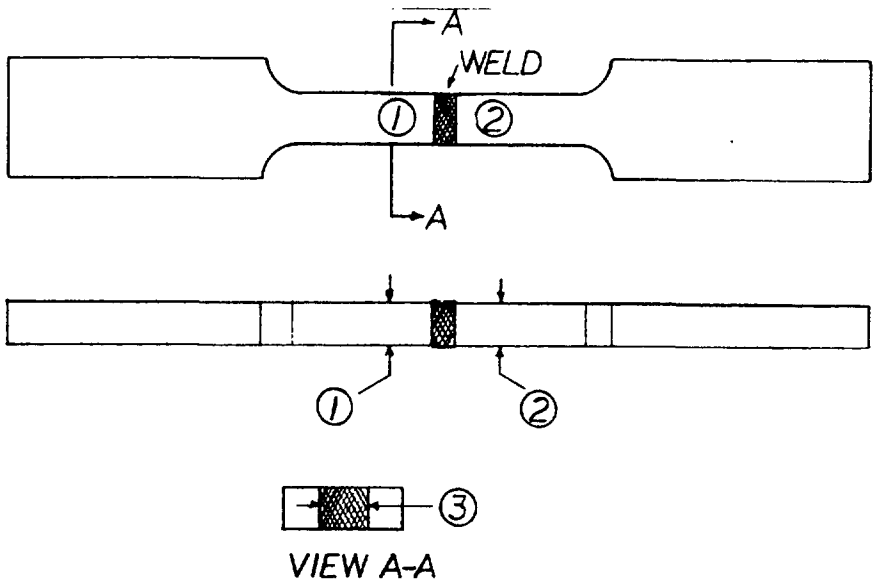
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
3	TM-39	5
SUPERSEDES:		DATE OF ISSUE: MAY 30 1972

DESCRIPTION:

Tensile Testing of Storm Drain Coupling Material

FIGURE 2



A. Measure the thickness at Point 1 - Just next to the weld.

B. Measure the thickness at Point 2 - Just next to the weld.

C. Take the average of the thickness.

D. Measure the width each side of the weld at Point 3 - halfway down.

E. Take the average of the widths.

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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM-40	PAGE NO. 1
SUPERSEDES:	DATE OF ISSUE: DEC 2 1971	

DESCRIPTION

· Sieve Analysis and Moisture Content of A/C Fines

1.0 SCOPE

The purpose of this test is to measure:

a) The percent moisture content of A/C fines*.

b) The relative particle size distribution.

2.0 REQUIREMENTS

The requirements for these characteristics can be found in the appropriate Standard In-Process Specification.

3.0 APPARATUS

3.0.1. A Ro-Tap, a device which vibrates a closed stack of sieves.

3.0.2. A set of Tyler Sieves in sizes 10, 20, 35, (60) 80, 100 and pan.

3.0.3. Micro-Wave Oven.

4.0 PROCEDURE

4.0.1. Obtain a sample of fines (about 120 grams) from your system, as close as possible to the point where the fines are mixed with the other ingredients. (Record on Form P-6038, "Cement, Fines and Silica Analysis".) Sample at approx. the same time of day as required.

4.0.2. Weigh sample and record value, place in Micro-Wave Oven and dry until no further weight loss is noted. Record original weight, dry weight and calculated percent moisture on Form P-6038.

4.0.3. From dried fines, take a 100 gram, plus or minus 1 gram, sample - record weight. Spread sample over top sieve screen in sieve series. Place lid on sieve assembly, clamp sieve assembly in Ro-Tap. Shake for 15 minutes.

4.0.4. Remove sieve assembly from Ro-Tap. Weigh each sieve and contents. Record weight of fines remaining on each sieve and pan to nearest 0.1 of a gram.

4.0.5. Calculate percent retained by each sieve, by pan and loss. Record percentages on Form P-6038.

*A/C fines are obtained from ground, rejected A/C pipe or coupling; also from A/C material removed during the machining operations.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-41	1
SUPERSEDES:	DATE OF ISSUE: APR 10 1972	

DESCRIPTION:

Sewer Pipe Flex Deflection Test

1.0 SCOPE

This test is designed to measure the deflection under flex load of 13 ft. long sewer pipe.

2.0 REQUIREMENTS

No requirements have been established as of this date.

3.0 APPARATUS

3.1 Flex Test Rig on Finishing Line.
3.2 Dial Indicator Gauges (3).
3.3 Dial Indicator Mounts or Stands (see Fig. 1).

4.0 PROCEDURE

4.1 Obtain a 13' sewer pipe that has been tested and has passed the 100% flex test requirement for its size and class, and place in test rig.

Note:

Size	Min. Flex Requirement, Lbs. Class		
	1500	2400	3300
6"	1125	1275	1575
8"	2025	2250	2925

4.2 Apply 1000 lb. load*, then reduce load to 100 lbs. Place dial indicators in position**.
4.3 Record dial indicator values as shown in example in Fig. 2.
4.4 Increase load (to 1100 lbs. on 6" pipe, to 1600 lbs. on 8" pipe) and record dial indicator values (Fig. 2).
4.5 Calculate average deflection in .xxx" per 1000 lb. load. (See example in Fig. 3).

* The Test Method is designed to be non-destructive of pipe, dial indicators, and personnel. But, wait 10 seconds before approaching pipe after any change in applied load.

** The dial indicators most prevalent at the plant are designed for inside diameter measurement and hence, the reading decreases as the sensitive contact of the indicator retracts.

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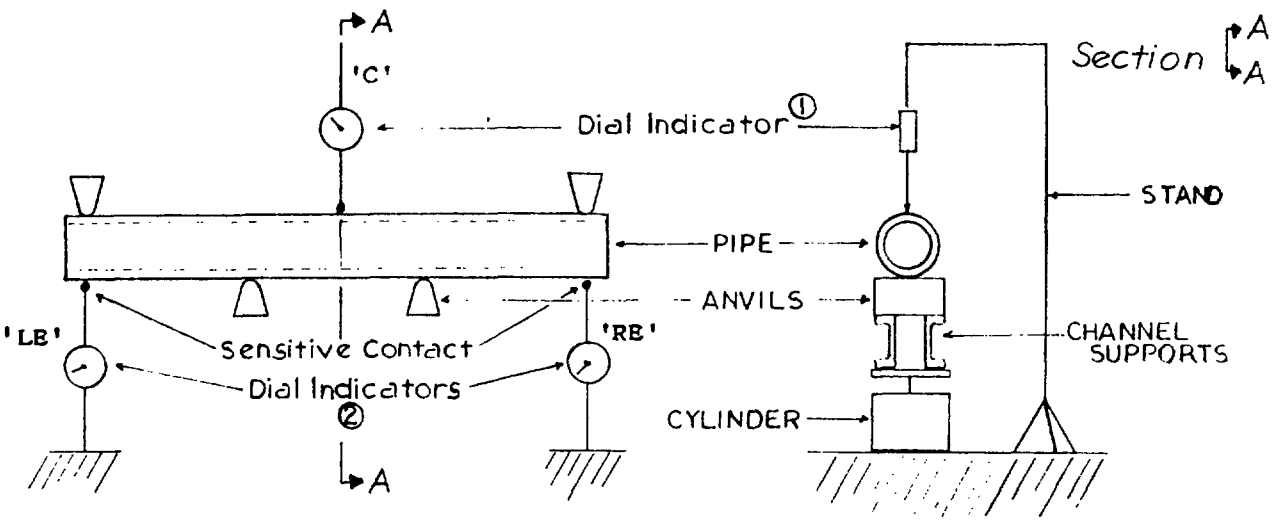
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SPECIFICATIONS CLASSIFICATION:		
Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
2	TM-41	2
SUPERSEDES:		DATE OF ISSUE:
April 10, 1972		APR 25 1972

DESCRIPTION:

Sewer Pipe Flex Deflection Test

Figure 1



① Mount center Dial Indicator to separate stand.
② Dial Indicators must be independent of Test Rig Superstructure.

Figure 2

Date 1 Mar. 72

Size/Class 8"- 2400

Load	Reading on Dial LE	C	RE
100 lb. load	.197	.300	.237
1600 (~~1100~~) lb.	.186	.109	.225
Deflection*	-.011	-.191	-.012
Deflection per 1000 lbs.**		0.135	

* The deflection of an indicator is "plus" when the sensitive dial indicator contact extends farther when going from an "at rest" condition, to an "under-load" condition. (Also, see bottom of Page 1 **.)

** See Fig. 3 for calculations to obtain this.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO. 1	SPECIFICATION NO: TM-41	PAGE NO.: 3
SUPERSEDES:		DATE OF ISSUE: APR 10 1972

DESCRIPTION:

Sewer Pipe Flex Deflection Test

Figure 3

$$\text{Deflection}^{***} = (1/k)\left[(-1/2)(\text{'LE' deflection} + \text{'RE' deflection}) - (\text{'C' deflection})\right]$$

where k = 1 for 1000 lb. load increment
= 1.5 for 1500 lb. load increment

Example (from Fig. 2)

$$\text{Deflection} = (1/1.5)\left[(-1/2)\times\left((-.011)+(-.012)\right) - (-.191)\right]$$
$$= (1/1.5)\left[(.0115) - (-.191)\right]$$
$$= 0.135 \text{ inches per 1000 lbs.}$$

***In inches per 1000 lb. load.

CTD015954

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
L C Kuypers						

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: Standard Test Method		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-42	1
SUPERSEDES:	DATE OF ISSUE: MAR 6 1973	

DESCRIPTION:

In-Plant Evaluation of Chemical Resistance of Epoxy Lined Pipe and Couplings

1. Scope

This test is designed to provide an accelerated in-plant method of evaluating the effectiveness of production applied epoxy lining in protecting asbestos-cement pipe and couplings from chemical attack.

2. Physical and Chemical Requirements

Performance requirements of the lining are those listed in ASTM C-541.

3. Equipment Required

a. Variable speed stirrer with chemical resistant propeller and shaft - A. H. Thomas 8585-C10 or equivalent (1 per joint).

b. Triple beam balance with 0.1 gm. sensitivity and 2600 gm. capacity - A. H. Thomas 1382-F15 or equivalent.

c. 1000 ml graduated pyrex cylinder.

d. 100 ml graduated pyrex cylinder.

e. Acid resistant plastic container 4" deep and of sufficient diameter to hold the test stem.

f. Aquarium heater 150 or 200 watt capacity with built-in heat control with 10" or 12" tube (1 per joint).

g. Mercury thermometer at least 150°F. capacity.

4. Materials Required

a. Hillsboro epoxy lining mix.

b. Triethylene-tetramine (TETA).

c. Concentrated H_2SO_4 C.P.

d. Distilled water.

e. 8 oz. hot liquid cups.

f. Polyethylene sheeting 3 mils or thicker.

CTD015955

g. Tongue depressors.

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h. Two 6"-8" long epoxy lined MEQ stems and one epoxy lined coupling (with 14" to 24" pipe only one stem and one coupling needed)

i. NR or NBR rings to fit couplings

5. Test Procedure

a. Examine lining of components for possible sources of attack before test is begun and mark on lining when found.

b. Prepare test joint.

1. Take one stem and roughen epoxy lining about 1/2" up from bore end. Wipe clean and place stem roughened end down on flat plastic sheeting large enough to cover end of bore completely.

2. At room temperature mix sufficient epoxy bore lining composition and TETA in 8 oz. paper cup (7 grams TETA per 100 gm. lining mixture) to a depth of 1/4". Pour the prepared epoxy mix into the stem base taking care to avoid soiling the pipe wall.

3. Allow the epoxy to cure at 70°F.-80°F. for one hour and add a second 1/4" of epoxy mixture to form a 1/2" plug. Note: If all the epoxy is added at once, the heat generated will cause the plug to crack and leak.

4. The plug is cured overnight at 70°F.-80°F. Check for cracks and patch if necessary.

5. Once the plug is secure, assemble joint from the lined components and rubber rings. Use lubricant.

c. Prepare sufficient 5% by weight sulfuric acid in distilled water to fill the joint to within two inches of the top. Premark fill line on the top stem lining. Caution: Add the acid to water slowly with mixing. Use clean polyethylene buckets for mixing. Cool to room temperature.

d. Place the assembled joint plug end down in a plastic container (leak precaution). Fill with acid to 2" mark in joint.

e. Take piece of polyethylene sheeting large enough to cover open end of stem and with enough extra to tie and seal around stem. Cut small holes to allow for mixer shaft, heater, and thermometer.

f. Position mixer and heater far enough apart to prevent breakage of heater tube. Insert mixer rod and heater tube through plastic and seal around sides with string or rubber bands. The heater tube must be set so that the test solution is at or above the water line marked on the heater. The heater control should be outside the plastic sheet.

g. Adjust heater until 120°F. ± 2°F. is maintained and set mixer dial so that a vortex is just visible in solution.

h. Check daily for temperature and mixer function.

6. Test Data

The joints shall be exposed to the test solution for 45 days or lesser time if failure occurs. Examination and recording of observations shall be made at least weekly. Special attention should be given to noses and ring grooves.

7. Report

At the completion of the test period, a written report shall be forwarded to the Manager, Quality Control and Standards including the following information:

a. Type and size of pipe and rings used.

b. Date of lining application to pipe and couplings.

c. Results of test - passes or fails ASTM C-541.

d. Observations made over test period, and if failure occurs, indicate exposure time when chemical attack began, components attacked, size of damaged areas, cause for damage and corrective action suggested or taken.

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Section F		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	TM-47	1
SUPERSEDES: November 22, 1961 - FP-1		DATE OF ISSUE: February 1, 1983

DESCRIPTION:

Uncombined Calcium Hydroxide Test

1. Apparatus Needed

1 - Liebig condenser, drip tip, 24/40 ground glass joint.
2 - Erlenmeyer flasks, 250 ml, 24/40 ground glass joint.
1 - Magnetic stirrer - hot plate.
2 - Teflon encapsulated stirring bar, about one inch in length.
1 - Pack of glass beads (to control boiling).
1 - Buret capacity 10 ml in 0.05 subdivisions.
1 - Bottle with drain at bottom for solvent - 2 liter capacity.
1 - Tygon tubing for condenser and solvent bottle draining, 1/4" bore.
1 - Vacuum source (Vacuum pump or aspirator for water spigot).
1 - Vacuum rubber tubing, 1/4" bore.
1 - Volumetric flask, 100 ml, with ground glass stopper.
1 - Volumetric flask, 1 liter, with ground glass stopper.
1 - Graduated cylinder, 100 ml capacity.
1 - Desiccator.
1 - Bunsen burner
1 - Platinum or porcelain crucible with cover.
1 - Burner support tripod.
1 - Triangle to hold crucible.
1 - Pair crucible tongs.
1 - Mortar and pestle.
1 - Support stand to hold buret clamp and buret.
1 - Buret clamp.
1 - Hoffman clamp to close tygon tubing on solvent bottle.
1 - Analytical balance with accuracy to nearest 0.001 grams.
1 - Box of glazed weighing paper.
1 - Spatula
1 - Weighing bottle with ground glass top.
1 - Eyedropper
1 - Drying tube, 100 mm in length.

CTD015958

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
J. P. Mugavero							

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DESCRIPTION:

Uncombined Calcium Hydroxide Test

I. Apparatus - (Cont'd.)

1 - Lb. "Ascarite" 8-20 mesh.

1 - Lb. "Drierite"

1 - Buchner funnel, 75 mm inside diameter.

1 - Box of 100 Whatman #40 filter papers, 70 mm diameter.

1 - Filter flask, 250 ml capacity, heavy wall glass.

Cork and rubber stoppers.

Reagents

1 - Lb. Ammonium Acetate, reagent grade.

1 - Gal. Ethyl alcohol, absolute, or No. 30, 3a, or 2b or alcohol consisting of 95% specially denatured alcohol No. 3a, plus 5% isopropanol.

1 - Gal. Glycerine, reagent grade.

1/4 Lb., Phenolphthalein, reagent grade.

1 - Lb. Sodium hydroxide; reagent grade.

1 - Lb. Strontium nitrate, reagent grade.

CTD015959

II. Preparation of Reagents

A. Phenolphthalein Indicator

1. Dissolve 1.0 gram of phenolphthalein in 100 ml of absolute ethanol.

B. Glycerol-Ethanol Solvent

1. Prepare a solution consisting of one part by volume of glycerol and two parts by volume of absolute ethanol.*

2. To each liter of this solution add 2 ml of the phenolphthalein indicator solution. The solvent should be slightly alkaline to the indicator. If the solvent is colorless, make up a solution of sodium hydroxide in absolute ethanol by dissolving a pellet or two (approximately 0.2 grams) of sodium hydroxide in 20cc of ethanol. Add this solution dropwise to the solvent just until a very slight pink color appears. If the initial color of the solvent is pink, remove it by adding dropwise the standard ammonium acetate solution (Part "C" Preparation of Reagents) until color disappears and then add the NaOH solution until a very slight pink color appears.

Note: Absolute ethanol may be replaced by denatured alcohol No. 30, 3a, or 2b or alcohol consisting of 95% specially denatured No. 2a plus 5% isopropanol. Glycerol and ethanol are highly hygroscopic. Every effort should be made to avoid exposing them unnecessarily to water and CO_2 in the air. Bottles with an outlet near the bottom or fitted with a siphon are convenient. They can be filled to the top and protected with drier tubes containing $CaSO_4$ and ascarite.

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Section F		
T.C.O. REF. NO.: 1	SPECIFICATION NO.: TM-47	PAGE NO.: 3
SUPERSEDES: November 22, 1961 - FP-1		DATE OF ISSUE: February 1, 1983

DESCRIPTION:

Uncombined Calcium Hydroxide Test

II. Preparation of Reagents - (Cont'd.)

B. Glycerol-Ethanol Solvent - (Cont'd.)

3. To check the integrity of the solvent, transfer 60 ml into a 250 ml Erlenmeyer flask and heat slowly on a hot plate to near boiling. If the pink color persists, add one drop of the standard ammonium acetate solution. If the pink color does not disappear, the solvent contains too much alkali and must be reduced with the ammonium acetate solution. The solvent, if allowed to stand for a considerable length of time may become slightly acid and should be checked and corrected if necessary.

C. Ammonium Acetate Titrating Solution

1. Ammonium Acetate is also hygroscopic. Therefore a quantity should be placed in a dessicator and allowed to dry out for a week prior to being used.

2. Dissolve 16.000 grams of the dry, crystalline ammonium acetate with absolute ethanol in a one liter volumetric and bring volume up to mark.

D. Calcium Oxide

1. Grind approximately 1 gram of CaO lumps into a powder with mortar and pestle.

2. Transfer into a platinum or porcelain crucible, cover and place over a bunsen burner flame for at least 20 minutes.

3. Transfer with a crucible tongs to a gravity oven preset to 105° C for about 10 min. (To gradually cool the crucible.)

4. Place in a desiccator and allow to return to room temperature.

Alternate Method - If no CaO is available it can be prepared fresh by calcining pure calcium carbonate or calcium oxalate.

1. Transfer approximately 1 to 2 grams of either calcium carbonate or calcium oxalate into a crucible and cover.

CTD015960

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DESCRIPTION:

Uncombined Calcium Hydroxide Test

II. Preparation of Reagents - (Cont'd.)

D. Calcium Oxide - (Cont'd.)

Alternate Method - (Cont'd.)

2. Place into a muffle furnace, raise the temperature to 900° - 1000° C and maintain for 2 hours.

3. Turn off and allow crucible to cool down to approximately 105° C before transferring to desiccator.

4. Grind any lumps into a powder with mortar and pestle.

III. Standardization of Ammonium Acetate Solution (1 ml = 0.0077 g $Ca(OH)_2$)*

1. Weigh out 0.050 to 0.060 g CaO on glazed weighing paper and transfer into a clean dry 250 ml Erlenmeyer flask having a 24/40 ground glass opening.

2. Add 2.0 g strontium nitrate. - $Sr(NO_3)_2$

3. Add 60 ml of the glycerol ethanol solvent washing down the sides of the flask.

4. Add a teflon encapsulated stirring bar and a few glass beads. (The glass beads will help loosen the CaO which may cake on the bottom and will also help in a controlled boil.)

5. Attach flask to a water cooled condenser and place on magnetic stirrer - hot plate and continue the standardization for the ammonium acetate solution exactly as the procedure described for a sample of pipe drillings.

Calculation of $Ca(OH)_2$ Equivalent "E" of the Ammonium Acetate Solution

Calculate the CaO equivalent "A" of the ammonium acetate solution in grams per milliliter by dividing the weight of CaO used "W" by, the volume of solution "V" required in the titration.

$$A = \frac{W}{V}$$

To change the CaO equivalent "A" to the $Ca(OH)_2$ equivalent "E", multiply the former by 1.32.

$$\left(\frac{\text{molecular Wt. of } Ca(OH)_2}{\text{molecular Wt. of CaO}} = \frac{74}{56} = 1.32 \right)$$

CTD015961

$$E = (A)(1.32)$$

*This number differs from the number given in the ASTM C-500 specification which we believe to be in error.

TECHNICAL SPECIFICATIONS

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CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Section F		
T.C.O. REF. NO.: 1	SPECIFICATION NO: TM-47	PAGE NO.: 5
SUPERSEDES: November 22, 1961 - FP-1		DATE OF ISSUE: February 1, 1983

DESCRIPTION:

Uncombined Calcium Hydroxide Test

IV. Preparation of Test Sample*

1. Representative samples of pipe or coupling shall be vacuumed free of dust, and placed on a clean sheet of glazed paper.
2. Drill, using a clean sharp 1/4" carbide tipped drill, from the outer surface inwardly at a rate of approximately one inch per minute.
3. Collect all drillings using a soft brush and immediately screen through a 20 mesh sieve.
4. Transfer the material passing through the sieve into a weighing bottle with a ground glass top.
5. Place bottle with the top removed into a drying oven of 105° C for at least 2 hours.
6. Transfer to a desiccator and cool to room temperature.

V. Uncombined Calcium Hydroxide Test Procedure

1. Weigh out 1.0 g ± 0.010 g of the sample material and record weight to the nearest 0.001 g.
2. Transfer sample into a clean dry 250 ml Erlenmeyer flask having a 24/40 ground glass opening.
3. Add 2.0 g strontium nitrate - $Sr(NO_3)_2$.
4. Add a teflon encapsulated stirring bar and several glass beads.
5. Add 60 ml of the glycerol-ethanol solvent washing down the sides of the flask.
6. Place on a magnetic stirrer - hot plate and attach a water-cooled reflux condenser having a ground glass 24/40 joint.

*When preparing asbestos cement samples by drilling proper safety precautions must be taken by wearing safety goggles and filter mask to avoid chips and inhalation of dust.

CTD015962

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
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DESCRIPTION:

Uncombined Calcium Hydroxide Test

V. Uncombined Calcium Hydroxide Test Procedure - (Cont'd.)

7. Raise the setting on the hot plate such that the mixture boils* gently and adjust the magnetic stirrer setting such that the solids are kept in suspension without splashing.

8. Boil for thirty minutes.

9. Remove flask from hot plate and condenser and filter the material under a moderate vacuum using a 250 ml filter flask and 75 mm (inside diameter) Buchner funnel. The filter paper must be wet with glycerol ethanol solvent prior to filtration.

10. Wash the Erlenmeyer flask twice with small amounts of the solvent and pour the wash over the retained solids.

11. When filtering is completed, turn off vacuum, disconnect the filter flask, remove Buchner funnel and pour filtrate into a clean dry 250 ml Erlenmeyer flask. Wash filter flask with small amount of the solvent and add to filtrate.

12. Add a clean stirring bar, return flask to hot plate and bring temperature to just below boiling while stirring.

13. Turn off hot plate, but leave magnetic stirrer on. Immediately titrate dropwise from the buret until the pink color completely disappears, using the standardized ammonium acetate solution.

14. Read buret to the nearest 0.01 ml and record result.

15. Run duplicate tests on each sample.

*Caution should be taken not to boil solvent too rapidly as ethyl alcohol is extremely volatile and may cause an explosion and fire. Face shield should be worn as a precaution.

VI. Calculation

Calculate the percentage of uncombined calcium hydroxide to the nearest 0.01 as follows:

$$\text{Uncombined } Ca(OH)_2 \text{ percent} = \frac{(E)(V)(100)}{W}$$

Where: E = $Ca(OH)_2$ equivalent of the ammonium acetate solution in grams per milliliter.

V = Milliliters of ammonium acetate solution required by sample.

W = Weight of sample (grams) to nearest 0.001

Note: Allowable limit is 1% uncombined calcium hydroxide.

FORM P827

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
49	Section N	4A-1

SUPERSEDES:	DATE OF ISSUE:
September 26, 1977	JUN 25 1979

DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Standard, Random, Short Lengths (MEO)
Shipping Wt., Lbs/ft. Unbelled

Pipe Size	Type or Class	Plant 56	57	58	59	60	
6"	25		X	X		X	8.1
		X					8.2
					X		8.6
8"	25		X	X	X	X	12.0
		X					12.1
10"	25			X		X	16.1
		X	X		X		17.6
12"	25	X		X	X	X	20.8
			X				23.0
14"	25		X	X	X	X	26.4
15"	25	X		X		X	28.9
16"	25		X	X	X	X	31.7
18"	25		X	X		X	38.4
					X		39.8
20"	25		X	X		X	44.1
21"	25		X				47.0
				X		X	48.1
24"	25			X		X	60.0

Pipe Size	Type or Class	Plant 56	57	58	59	60

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[signature]	[signature]		[signature]	[signature]		

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DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Standard, Random, Short Lengths (MEO)
Shipping Wt., Lbs./ft. Belled

Pipe Size	Type or Class	Plant 56	57	58	59	60	
6"	25		X	X		X	8.5
		X					8.6
					X		9.0
8"	25		X	X	X	X	12.8
		X					12.9
10"	25			X		X	17.0
		X	X		X		18.5
12"	25	X		X	X	X	22.1
			X				24.3
14"	25		X	X	X	X	28.3
15"	25	X		X		X	31.5
16"	25		X	X	X	X	34.3
18"	25		X	X		X	41.7
					X		43.1
20"	25		X	X		X	47.9
21"	25		X				51.3
				X		X	52.4
24"	25			X		X	65.2

Pipe Size	Type or Class	Plant 56	57	58	59	60

CTD013868

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
49	Section N	4A-3

SUPERSEDES:	DATE OF ISSUE:
September 26, 1977	JUN 25 1979

DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Standard Type 25 Coupling

Coupling Size, Inches	Shipping Weight Lbs/Unit
6	5.5
8	9.7
10	11.9
12	17.5
14	24.1
15	33.7
16	33.3
18	43.0
20	50.1
21	56.5
24	67.0

CTD013869

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Fully Machined Pipe (FM)
Shipping Weight, Lbs./Ft.

Pipe Size	Type or Class	Plant 56	57	58	59	60	
6"	25				X		6.1
		X	X	X		X	7.1
8"	25	X	X	X	X	X	8.5
10"	25	X	X	X	X	X	13.3
12"	25	X		X	X	X	15.7
			X				17.8
14"	25		X	X	X	X	19.9
15"	25					X	25.4
16"	25		X	X	X	X	27.6
18"	25		X	X		X	29.1
					X		30.5
20"	25		X	X			33.8
21"	25		X				36.1
				X		X	37.2
24"	25			X		X	47.5

Pipe Size	Type or Class	Plant 56	57	58	59	60

CTD013870

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
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SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.G. REF. NO.	SPECIFICATION NO:	PAGE NO.:
49	Section N	4A-5

SUPERSEDES:	DATE OF ISSUE:
September 26, 1977	JUN 25 1979

DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Type 25, 3" and 4" Direct Tap Couplings

Couplings Size, Inches	Shipping Weight Lbs./Unit
6	23.7
8	27.1
10	40.6
12	57.6
14	80.2
15	89.7
16	97.4
18	120.0
20	143.0
21	157.0
24	190.0

CTD013871

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
JBN	MKS					

Description:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Type 25, Threaded Brass Insert Couplings (TBIC)

Coupling Size Inches	Shipping Weight Lbs./Unit
6	8.3
8	15.1
10	20.8
12	31.1

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
49	Section N	4A-7

SUPERSEDES:	DATE OF ISSUE:
Sept 26, 1977	JUN 25 1979

DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

End Cap

Cap Size, Inches	Type	Shipping Wt. Lbs./Unit
6	25	5.4
8	25	9.3
10	25	12.2
12	25	17.3
14	25	22.9

CTD013873

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

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Description:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Type 25 Tapped Couplings With 2½" X 2" Hex. Bushing Shipping Weight, Lbs./Unit

Coupling Size Inches	15" Length
6	30.3
8	41.0
10	56.4
12	72.4
14	89.7
15	100.0
16	84.8
18	121.0
20	146.0
21	163.0
24	196.0

TECHNICAL SPECIFICATIONS

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CertainTeed Corporation
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SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights		
T.C.O. REF. NO. 49	SPECIFICATION NO: Section N	PAGE NO.: 4A-9
SUPERSEDES: Sept 26, 1977		DATE OF ISSUE: JUN 25 1979

DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Coupling Adaptor - Type 25 to Steel

Adaptor Size Inches	Shipping Weight Lbs./Unit
6x4	12.0
6x6	7.4
8x6	17.6
8x8	11.5
10x10	12.9
12x12	19.5

CTD013875

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

Description:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Coupling Reducer - Type 25

Reducer Size Inches	Shipping Weight Lbs./Unit
8 to 6	12.3
10 to 8	15.0
12 to 10	20.4
14 to 12	28.9
15 to 14	22.6
16 to 14	33.4
16 to 15	22.7
18 to 16	42.1
20 to 18	50.2
21 to 10	46.1
24 to 21	92.8

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights		
T.C.O. REF. NO.: 49	SPECIFICATION NO.: Section N	PAGE NO.: 4A-11
SUPERSEDES: Sept 26, 1977		DATE OF ISSUE: JUN 25 1979

DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Elbows - 45° and 90° Type 25
Shipping Wt. Lbs./Unit

Pipe Size, Inches	45°	90°
6	12.9	19.7
8	18.9	28.6
10	26.7	40.5
12	34.8	53.2
14	39.3	60.7
15	43.0	65.8
16	47.4	72.1
18	124.0	187.0
20	138.0	206.0
21	150.0	224.0
24	188.0	279.0

CTD013877

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Tee Fittings - Type 25
Shipping Wt. Lbs/Unit (Main Branch Coupling)

Size		Size		Size	
6x6x6	37.1	16x16x6	138.0	21x21x6	213.0
		8	141.0	8	215.0
8x8x6	52.8	10	144.0	10	219.0
8	54.3	12	149.0	12	223.0
		14	152.0	14	279.0
10x10x6	72.5	15	153.0	15	281.0
8	74.7	16	153.0	16	283.0
10	77.4			18	292.0
		18x18x6	173.0	20	296.0
12x12x6	95.2	8	175.0	21	296.0
8	97.3	10	179.0		
10	101.0	12	183.0	24x24x6	261.0
12	104.0	14	230.0	8	263.0
		15	232.0	10	267.0
14x14x6	112.0	16	234.0	12	271.0
8	114.0	18	240.0	14	340.0
10	118.0			15	342.0
12	122.0	20x20x6	194.0	16	344.0
14	123.0	8	196.0	18	353.0
		10	200.0	20	357.0
15x15x6	130.0	12	204.0	21	364.0
8	132.0	14	255.0	24	497.0
10	136.0	15	257.0		
12	140.0	16	259.0		
14	144.0	18	268.0		
15	143.0	20	268.0		

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights		
T.C.O. REF. NO. 49	SPECIFICATION NO: Section N	PAGE NO.: 4A-13
SUPERSEDES: Sept 26, 1977		DATE OF ISSUE: JUN 25 1979

DESCRIPTION:

AGRI-PERM Pipe for Agricultural Irrigation Systems

Alfalfa Tee Fittings
Shipping Wt. Lbs/Unit (Main Branch Coupling)

Size		Size	
8x8x8	131.0	14x14x8	237.0
		14x14x10	283.0
10x10x8'	168.0	14x14x12	324.0
10x10x10	212.0	14x14x14	359.0
12x12x8	203.0	16x16x8	281.0
12x12x10	249.0	16x16x10	327.0
12x12x12	286.0	16x16x12	368.0
		16x16x14	408.0
		16x16x16	449.0

CTD013879

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
ADV	mrb					

Description:

AGRI-PERM Pipe for Agricultural Irrigation Systems

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CTD013880

FORM P927 R 62

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: 9	PAGE 12
	SUPERSEDES:	DATE OF ISSUE: January 24, 1966
APPLICABLE TO: Plant No. 57	CLASSIFICATION: Inspection Standard	
DESCRIPTION: FLUID-TITE A/C Epoxy Sewer Pipe, Couplings and Accessories. Classes 1500, 2400, 3300, 4000 & 5000		

6.3 PIPE BORE LINING ATTRIBUTES

6.3.1 Lining Inspection

The lining shall be visually inspected in all pipe. The lining surface shall be visually smooth and uniform, free of holes, voids, blisters, holidays, runs, sags, cracks, uncoated areas or other defects so as to impair the protective function of the lining.

6.3.2 Pipe Surface Irregularities

Minor irregularities in the pipe surface shall be acceptable if they are continuously coated with resin.

6.3.3 Impressions and Dimples

Minor impressions and dimples in the lining shall be acceptable if there is no evidence of uncoated areas. However, a lining shall not be acceptable if there is an appearance of a pattern or groups. An arrangement of dimples in which there is a predictable distance or locus of points between individual dimples shall be considered a pattern. An arrangement of dimples in which there are more than three dimples per one (1) square foot of lining surface shall be considered a group.

6.3.4 Patches

A patched area will be considered acceptable if said area meets the requirements set forth in NSF-C7. A patch will blend with the adjacent lining and in general, be as unnoticeable as possible. A patch shall not have an area in square inches greater than one half the pipe diameter. Further, the number of patches shall not exceed one (1) per three (3) feet of pipe.

A pin hole, blister or any other void in the lining shall not be repaired with a patch. Said pipe may be acceptable if it is recoated and inspected for subsequent voids, etc.

PREPARED BY	APPROVED BY	
R C Hunter mpd		CTD013881

6.3.5 Lining Irregularities

A raised portion in the lining or bump shall be considered a blister, unless otherwise proven, and shall not be acceptable.

6.4 PIPE END LINING

6.4.1 Lining Inspection

All pipe ends shall be visually inspected and shall be smooth and free of ripples, dents, stray fibers, sharp protrusions, voids and uncoated areas. The ring sealing surface shall have no imperfections that would tend to cut or tear the ring nor shall it have any imperfection that would impair the sealing ability of the ring. The ring sealing O.D. surface shall be inspected by sliding the proper CERTA-SPACER back and forth over the sealing area looking towards a light source at the epoxy lining CERTA-SPACER interface. The end shall be considered acceptable if no "daylight" is seen under the CERTA-SPACER.

6.4.2 Pipe Bore Lining and Pipe End Lining Junction

The junction of the pipe bore lining and the end coating shall be smooth and continuous. If portions of this junction have broken out, said area will be acceptable if properly patched. The patched area shall have a thickness equal to the adjacent lining.

6.5 COUPLING LINING ATTRIBUTES

6.5.1 Lining Inspection

All couplings shall be visually inspected and shall be smooth and free of sharp edges. All coated surfaces shall be free of holes, cracks, uncoated areas, or other defects as to impair the protective function of the lining. All lined areas shall have a smooth surface. However, imperfections such as spiraling, which is present in the uncoated coupling, shall be acceptable.

6.5.2 Ring Groove Inspection

The ring groove shall have no runs or sags perpendicular to the wall of the ring groove. A run or sag parallel to the wall of the ring groove will be acceptable if the A dimensions of said area are within the tolerance stated in CPC Standard Specification No. 9.

6.5.3 Extraneous Lining

The B and F dimensions, as shown in CPC Standard Specification No. 9, Page 12, shall be free of lining material

6.6 FITTING STOCK LINING

Refer to attributes of pipe bore lining, Section 6.3.

6.7 DISPOSITION OF REJECTED MATERIAL

6.7.1 Pipe Bore Lining

Imperfection in the pipe bore lining may be repaired either by a patch or by recoating the pipe with the exception of rifling and runs and sags. However, if only a fraction of the pipe is rifled or contains runs or sags, this section may be removed and the remaining pipe section used for random lengths and fittings.

6.7.2 Pipe End Lining

Rejected pipe ends may be repaired by a suitable method or the ends may be removed and the remaining pipe machined for use as a random length or fitting stock.

6.7.3 Coupling Lining

Couplings rejected for voids, blisters, sharp protrusion or any other surface irregularity may be repaired by a suitable method.

Couplings rejected for runs and sags shall be scrapped.

6.7.4 Fitting Stock Lining

Refer to disposition of rejected pipe bore lining, Section 6.7.1.

7.0 SPECIAL LINING REQUIREMENTS

7.1 ADHESION

The lining shall have a permanent bond to the pipe wall. Proof of bond strength shall be established by:

7.1.1 A four hour immersion test in boiling distilled water as described in ASTM C-541.

7.1.2 A ninety-six hour hot (150°F.) distilled water immersion as detailed in ASTM C-541.

7.1.3 A bond tensile strength of at least 200 lbs. per square inch obtained by method of National Sanitation Foundation Criteria C-7.

7.1.4 Each of the above tests shall be performed on no less than twelve (12) specimens manufactured with one batch of resin. A batch will consist of the quantity of resin shipped by the resin vendor under the same batch or lot number. Test specimens shall be selected so as to distribute the tests over the life of the resin batch. Specimens shall be selected from a minimum of four (4) different runs with three specimens selected per run per test.

7.1.5 Specimens selected for the bond tensile test shall be forwarded to CPC Quality Control Manager for testing at CPC Research Center.

7.1.6 All test values shall be recorded as well as: the date of manufacture, pipe size and class, resin vendor, resin type (for example EPON 828V) resin

batch or lot number, lining nominal thickness, hardener vendor, type and batch or lot number.

7.2 ACID RESISTANCE

7.2.1 There shall be no evidence of blistering, cracking, swelling or other visual degradation of the lining when exposed to the acid tests as described in NSF-C7, Section 3.011. This test shall be performed on no less than three specimens per batch of resin. The specimens shall be selected from one of the first runs using a new batch of resin.

7.2.2 All results shall be recorded as well as the date of manufacture, pipe size and class, resin vendor, resin batch or lot number, lining nominal thickness, hardener vendor, type and batch or lot number.

7.3 ALKALI RESISTANCE

7.3.1 There shall be no evidence of blistering, cracking, swelling, or other visual degradation of the lining when exposed to the alkali test as described in NSF-C7, Section 3.012. This test shall be performed on no less than three specimens per batch of resin. The specimens shall be selected from one of the first runs using a new batch of resin.

7.3.2 All results shall be recorded as well as the date of manufacture, pipe size and class, resin vendor, resin batch or lot number, lining nominal thickness, hardener vendor, type and batch or lot number.

7.4 DISPOSITION OF REJECTED MATERIAL

7.4.1 Adhesion

If any of the nine (9) test specimens selected during a run fail the test to which it is subjected, all the pipe coated since the last valid test from the resin batch currently being used shall be subject to rejection. The Quality Control Manager shall be notified at once.

7.4.2 Acid Resistance

If any of the three test specimens per resin batch fail the acid resistance test, the remainder of that resin batch and the hardener currently in use will be held and shall not be used. A sample of that resin and hardener shall be sent to CPC Quality Control Manager for chemical resistance tests as cited in NSF-C7, Section 3.013.

The stock coated with the above resin shall be subject to rejection. The Quality Control Manager shall be notified immediately.

7.4.3 Alkali Resistance

Refer to disposition of rejected material acid resistance, Section 7.4.2.

8.0 RETURNED MATERIALS

All epoxy lined material that has been returned to a plant for any reason shall be inspected in accordance with Sections 1 through 6 of this Standard. Special attention shall be given to those areas susceptible to handling damage, such as pipe ends.

9.0 INTERPLANT TRANSFER

All epoxy lined material that has been transferred from one plant to another shall be reinspected by the receiving plant in accordance with Sections 1 through 6 of this Standard. Special attention should be given to those areas susceptible to handling damage, such as pipe ends.

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: 10	PAGE 1
	SUPERSEDES:	DATE OF ISSUE December 12, 1967

APPLICABLE TO:	CLASSIFICATION:
Plant No. 57	Inspection Standard

DESCRIPTION: FLUID-TITE A/C Epoxy Lined Pressure Pipe, Couplings and Accessories Classes 100, 150 and 200

1.0 GENERAL

The requirements of these standards are designed for an epoxy resin lining applied to A/C pressure pipe, couplings and accessories. Such lined pipe is primarily intended for use where unusual acidic conditions arise in A/C pipe due to the hydrogen sulfide cycle in force mains and for the transporting of corrosive industrial wastes containing dilute acid, alkali or salts. In addition, the lining presents a surface from which deposits such as those found in salt water disposal lines can be easily removed.

2.0 PRODUCT REFERENCE

Refer to Standard Product Specification No. 10 for FLUID-TITE A/C Epoxy Lined Pressure Pipe, Couplings and Accessories described in this specification.

3.0 CONFORMANCE

The epoxy lining shall conform to the standards set forth in ASTM Designation C-541 and National Sanitation Foundation Criteria C-7.

4.0 SPECIAL REQUIREMENTS

The pressure pipe and couplings used for lining shall conform to physical and chemical standards as set forth in CPC Standard Specification No. 1. Attention should be directed at the following areas:

4.1 PIPE

4.1.1 Straightness and Ovality

These properties are important to the lining process. A pipe which does not spin true around its long axis will not coat satisfactorily, therefore, the straightest, roundest pipe shall be used for lining.

CTD013887

PREPARED BY:	APPROVED BY:

4.1.2 Finish

This property is important to the appearance and integrity of a lined pipe. Defective pipe surfaces can undermine the epoxy-A/C bond causing lining failure and subsequent A/C deterioration. It is important to the appearance of a lined pipe that all pipe surfaces to be coated shall be as smooth as possible and free of stray fibers. Further, all pipe surfaces to be coated shall be free of grease, oil, lubricant or any other foreign material that would prohibit the lining from bonding to the A/C.

4.1.3 Physical Requirements

All lined pressure pipe must pass the physical test requirements as specified in Standard Specification No. 1 before entering the epoxy lining process. The process has no effect on the physical properties of the pipe (i.e. crush, flex, hydro).

4.2 COUPLINGS

4.2.1 Dimensions

Unlined pressure couplings intended for use in the lining process do not have the same dimensions as comparable standard couplings. The dimensions of unlined couplings intended for use in the lining process shall conform to CPC Standard Specification No. 10.

4.2.2 Finish

This property is important to the appearance and integrity of a lined coupling. Defective coupling surfaces can undermine the epoxy-A/C bond causing lining failure and subsequent A/C deterioration.

It is important to the appearance of a lined coupling that all coupling surfaces to be coated be as smooth as possible and free of stray fibers. Further, all coupling surfaces to be coated shall be free of grease, oil, lubricant or any other foreign material that would prohibit the lining from bonding to the A/C.

4.3 FITTING STOCK

Refer to special requirements for pipe, Section 4.1.

5.0 DIMENSIONS

5.1 PIPE BORE LINING

5.1.1 Lining Thickness Determination

The thickness of the epoxy lining shall be determined on no less than four (4) pipe sections per run. A run is defined as that period in which a specific product is manufactured, but shall not be longer than one shift. The lining thickness shall be determined on a section of pipe not less than one foot from the pipe end. Three readings will be made on each pipe section located 45° apart using a standard Federal Dial Gauge or an equivalent instrument accurate to 0.001". The lining thickness shall be determined by the following equation:

$$\text{Lining Thickness} = \frac{\text{Unlined I.D.} - \text{Lined I.D.}}{2}$$

The unlined I.D. readings must be made before the pipe is lined at predesignated points. The points may be designated by marking the B.O.D. The lined I.D. readings shall be made where the unlined I.D. readings were made.

5.1.2 Sampling For Lining Thickness Determination

Sampling shall be such that specimens are selected throughout the run (i.e. the first specimen at

the beginning of a run, the second specimen one quarter through the run, the third, one half, etc.).

5.1.3 Required Lining Thickness

The thickness of the epoxy lining shall not be less than 12 mils (0.012"). The average lining thickness shall not be less than the stated nominal thickness as specified in CPC Standard Specification No. 10.

5.1.4 Recording Lining Thickness

All lining thickness values shall be recorded as well as the date and approximate time of coating manufacture, pipe size and class and specified lining nominal thickness.

5.2 PIPE END LINING

5.2.1 Determination of Machined O.D.

The machined ring sealing dimension, $O.D._1$, shall be determined on all epoxy coated pipe ends and shall conform to the specifications set forth in CPC Standard Specification No. 10. The dimension shall be determined with a standard O.D. tape accurate to 0.001" or an equivalent gauge.

5.3 UNLINED COUPLINGS

5.3.1 Determination of Unlined Coupling Dimensions

Incoming unlined couplings shall have the dimensions as specified in CPC Standard Specification No. 10. The A dimension, ring groove diameter, shall be determined on 10 per cent of all incoming unlined couplings using a standard Federal Dial Gauge or an equivalent instrument accurate to 0.001".

CTD013890

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER 10	PAGE 5
	SUPERSEDES:	DATE OF ISSUE: December 12, 1967
APPLICABLE TO: Plant No. 57	CLASSIFICATION: Inspection Standard	
DESCRIPTION: FLUID-TITE A/C Epoxy Lined Pressure Pipe, Couplings and Accessories Classes 100, 150 and 200		

5.3.2 Sampling For Determination of Unlined Coupling Dimensions

Sampling shall be random.

5.4 COUPLING LINING

5.4.1 Determination of Lined Ring Groove Diameter

Epoxy lined couplings shall have the dimensions as specified in CPC Standard Specification No. 10. The A dimension shall be determined on all couplings using a standard Federal Dial Gauge or an equivalent instrument accurate to 0.001". Three measurements will be made on each coupling ring groove located 45° apart.

5.4.2 Determination of Lined Ring Groove Width

The G dimension will be determined on all couplings in which the lining covers both walls of the ring groove using a Go-No-Go Gauge as per CPC drawing QC-6.

5.5 FITTING STOCK LINING

Refer to dimension requirements for pipe bore lining, Section 5.1.

5.6 DISPOSITION OF REJECTED MATERIAL

5.6.1 Pipe Bore Lining

If upon testing, the lining thickness of any portion of a pipe section is below the required minimum or if the average lining thickness of the pipe section is below the nominal thickness, a correction must be made at the lining station immediately. All pipe coated prior to the test, but not past the last valid test, shall be rejected. This rejected material may be acceptable if it is properly recoated so that the lining is brought to the required thickness.

CTD013891

PREPARED BY:	APPROVED BY:

If upon testing, the lining thickness of any portion of a pipe section is above the maximum, or if the average lining thickness of the pipe section is above the specified nominal thickness, a correction should be made at the lining station. However, this material shall be acceptable.

5.6.2 Pipe End Lining

All lined pipe that is rejected for out of dimension pipe ends may be reclassified for fitting stock or random lengths. Also, the out of dimension ends may be reworked so that the ends meet the requirements set forth in CPC Standard Specification No. 10.

5.6.3 Unlined Couplings

If 20 per cent of the tested incoming unlined couplings are not within the dimensions stated in CPC Standard Specification No. 10, the entire lot shall be inspected. All rejected material shall be separated from the lot and returned to the plant of manufacture. The purpose of this inspection is to insure that standard couplings are not coated and the inspector should act accordingly.

5.6.4 Coupling Lining

An epoxy lined coupling that has been rejected because of an oversized A dimension may be recoated so as to bring the A dimension within the required tolerance.

A lined coupling that has been rejected because of one of the A dimensions being undersized may be used if the undersized side is not less than 0.010" below the required minimum and the undersized side is prebelled. The ring should then be checked for fishmouthing and displacement.

A lined coupling that has been rejected because of both of the A dimensions being undersized shall be scrapped.

Couplings rejected because of undersized G dimensions may be prebelled unless both G dimensions are undersized. In this case, the coupling shall be scrapped. If undersized G dimension couplings are prebelled, the ring must be checked for fishmouthing and displacement. Any coupling that has undersized G and A dimensions simultaneously shall be scrapped.

5.6.5 Fitting Stock Lining

Refer to disposition of rejected pipe bore lining, Section 5.6.1.

6.0 ATTRIBUTES

6.1 GENERAL

The lining surface shall be visually smooth and uniform, free of holes, voids, blisters, holidays, runs, sags, cracks, uncoated areas or any other defects that would impair the protective function of the lining. The lining shall be pleasing to the eye and shall have no areas that draw attention to a specific portion of the lining, excluding minor irregularities mentioned below. Generally, lining defects occur in limited portions of a pipe. It is the intent of this standard that only those pipe areas which contain the defects shall be considered unsatisfactory. It is therefore possible that these unsatisfactory areas may be removed or eliminated and the entire pipe length or some fraction of the pipe made acceptable.

6.2 DEFINITIONS

6.2.1 Recoated

A lined pipe that has been properly reprocessed shall be termed recoated.

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CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER 10	PAGE 8
	SUPERSEDES:	DATE OF ISSUE December 12, 1967
APPLICABLE TO: Plant No. 57	CLASSIFICATION: Inspection Standard	
DESCRIPTION: FLUID-TITE A/C Epoxy Lined Pressure Pipe, Couplings and Accessories Classes 100, 150 and 200		

6.6.2 Patch

Any area that has been recoated after the initial coating has gelled or set will be considered patched. A patch is usually applied by hand with an applicator such as a paint brush.

6.2.3 Pin Hole or Void

A void is a break in the lining, usually circular, that extends from lining surface to pipe surface and which exposes A/C. The walls of a void are of a height equal to the surrounding lining thickness.

6.2.4 Holiday or Dimple

A holiday, sometimes called a dimple, is a circular impression in the lining. The geometry of a holiday is such that the lining at the outer perimeter of the holiday has a thickness equal to the adjacent unaffected lining with a continuous decrease in lining thickness until a thin point is reached at the center of the holiday. Generally, it is shaped like an upright bowl.

6.2.5 Blister

A blister is a circular elevation in the lining. The geometry of a blister is such that the lining at the outer perimeter of the blister has a thickness equal to the adjacent unaffected lining with a continuous increase in lining thickness until a high point is reached at the center of the blister. The interior of a blister is hollow. The skin of a blister may or may not be pierced. Generally, a blister is shaped like an inverted bowl.

6.2.6 Uncoated Area

An uncoated area is any area which should be, but is not coated with resin.

PREPARED BY:	APPROVED BY:

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6.2.7 Bump

A bump is a circular elevation in the lining. The geometry of a bump is such that the lining at the outer perimeter of the bump has a thickness equal to the adjacent unaffected lining with a continuous increase in lining thickness until a high point is reached at the center of the bump. The interior of a bump is solid.

6.2.8 Run and Sag

A run or sag is the result of lining movement from one area onto another before the coating has set. The result is a excessively thick coating preceded by an excessively thin coating. The configuration of a run or sag may take various forms. The primary difference between a run and a sag is configuration. A sag will generally be a uniform excessively thick coating which usually encompasses large portions of the pipe. A run will generally be a non-uniform excessively thick coating which usually resembles fingers.

6.2.9 Slick

A slick is an area which is coated with little or no resin because of some contaminate on the pipe surface which has repelled the resin.

6.2.10 Orange Peel

An orange peel is a non-uniform lining surface which resembles the pebbled skin of an orange.

6.2.11 Ripple

A ripple occurs on the coated pipe ends. Further, a ripple usually runs circumferentially around the pipe end and there is normally more than one ripple per pipe end. Ripples appear as waves in the lining with any number of crests and troughs.

6.2.12 Spiraling

A spiraled pipe has the appearance of a rifled gun barrel. However, the effect is such that there is little or no variation in the lining thickness. Spiraling is a surface irregularity.

6.2.13 Rifling

A rifled pipe has the appearance of a rifled gun barrel. Unlike a spiralled pipe, the effect is such that there are variations in the lining thickness.

6.2.14 Spike or Sharp Protrusion

A spike or protrusion is stray material on the pipe surface which is coated with resin. It is usually in the form of a stray fiber protruding from the pipe surface which when coated with resin is extremely sharp.

6.2.15 Break-out

A break-out is a phenomenon that usually occurs when a lined pipe is improperly cut or sawed. Instead of the lining at the sawed edge being clean and smooth, it is ragged and sections of A/C are exposed.

6.2.16 Surface Scuff

A surface scuff is an area on the lining in which the surface of the lining has been rubbed or possibly filed resulting in a white discoloration of the lining. A surface scuff is restricted to the lining surface and will not expose A/C.

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FORM P927 TR. 10-63

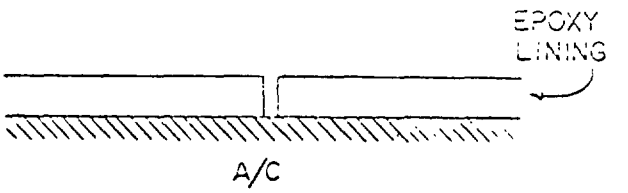
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: 10	PAGE 11
	SUPERSEDES:	DATE OF ISSUE: December 12, 1967

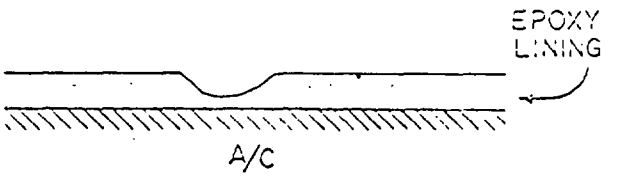
APPLICABLE TO:	CLASSIFICATION:
Plant No. 57	Inspection Standard

DESCRIPTION: FLUID-TITE A/C Epoxy Lined Pressure Pipe, Couplings and Accessories Classes 100, 150 and 200

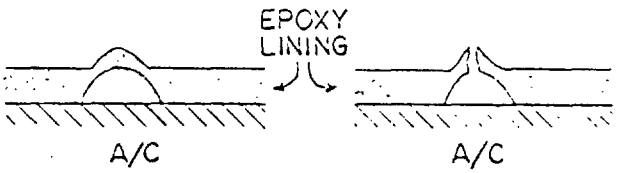
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PIN HOLE OR VOID



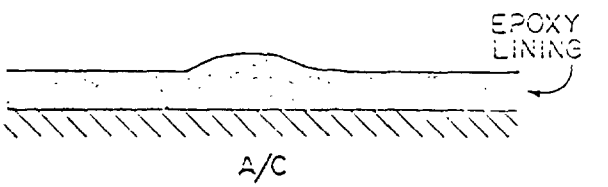
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HOLIDAY OR DIMPLE



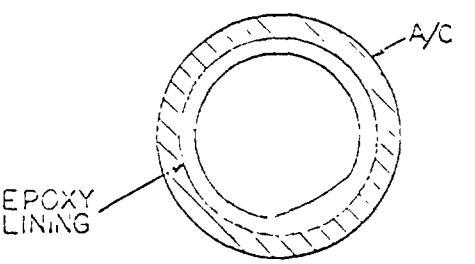
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BLISTER



REF PAR. 6-2-7
BUMP



REF PAR. 6-2-8
SAG



CTD013897

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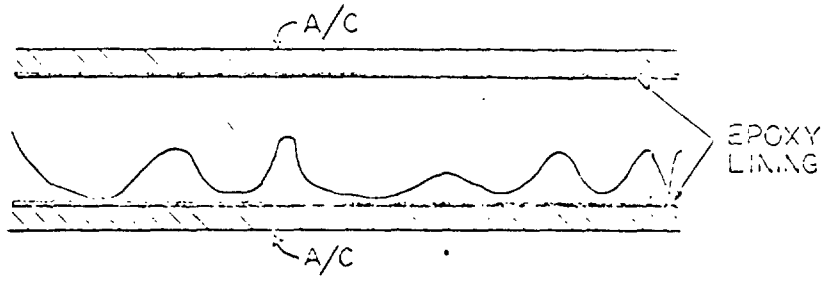
FORM 7037 TM 10-63

TECHNICAL SPECIFICATIONS

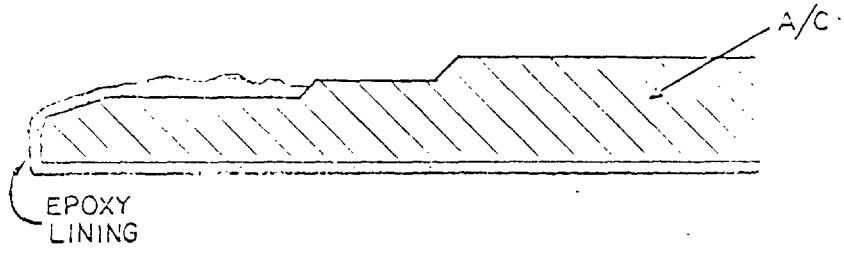
CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: 10	PAGE 12
	SUPERSEDES:	DATE OF ISSUE: December 12, 1963
APPLICABLE TO: Plant No. 57	CLASSIFICATION: Inspection Standard	

DESCRIPTION: FLUID-TITE A/C Epoxy Lined Pressure Pipe, Couplings and Accessories Classes 100, 150 and 200

REF. PAR. 6·2·8
RUN



REF. PAR. 6·2·11
RIPPLE



CTD013898

PREPARED BY:	APPROVED BY:

6.3 PIPE BORE LINING ATTRIBUTES

6.3.1 Lining Inspection

The lining shall be visually inspected in all pipe. The lining surface shall be visually smooth and uniform, free of holes, voids, blisters, holidays, runs, sags, cracks, uncoated areas or other defects so as to impair the protective function of the lining.

6.3.2 Pipe Surface Irregularities

Minor irregularities in the pipe surface shall be acceptable if they are continuously coated with resin.

6.3.3 Impressions and Dimples

Minor impressions and dimples in the lining shall be acceptable if there is no evidence of uncoated areas. However, a lining shall not be acceptable if there is an appearance of a pattern or groups. An arrangement of dimples in which there is a predictable distance or locus of points between individual dimples shall be considered a pattern. An arrangement of dimples in which there are more than three dimples per one (1) square foot of lining surface shall be considered a group.

6.3.4 Patches

A patched area will be considered acceptable if said area meets the requirements set forth in NSF-C7. A patch will blend with the adjacent lining and in general, be as unnoticeable as possible. A patch shall not have an area in square inches greater than one half the pipe diameter. Further, the number of patches shall not exceed one (1) per three (3) feet of pipe.

CTD013899

A pin hole, blister or any other void in the lining shall not be repaired with a patch. Said pipe may be acceptable if it is recoated and inspected for subsequent voids, etc.

6.3.5 Lining Irregularities

A raised portion in the lining or bump shall be considered a blister, unless otherwise proven, and shall not be acceptable.

6.4 PIPE END LINING

6.4.1 Lining Inspection

All pipe ends shall be visually inspected and shall be smooth and free of ripples, dents, stray fibers, sharp protusions, voids and uncoated areas. The ring sealing surface shall have no imperfections that would tend to cut or tear the ring nor shall it have any imperfection that would impair the sealing ability of the ring. The ring sealing $O.D._1$ surface shall be inspected by sliding the proper CERTA-SPACER back and forth over the sealing area looking towards a light source at the epoxy lining CERTA-SPACER interface. The end shall be considered acceptable if no "daylight" is seen under the CERTA-SPACER.

6.4.2 Pipe Bore Lining and Pipe End Lining Junction

The junction of the pipe bore lining and the end coating shall be smooth and continuous. If portions of this junction have broken out, said area will be acceptable if properly patched. The patched area shall have a thickness equal to the adjacent lining.

6.5 COUPLING LINING ATTRIBUTES

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6.5.1 Lining Inspection

All couplings shall be visually inspected and shall be smooth and free of sharp edges. All

coated surfaces shall be free of holes, cracks, uncoated areas, or other defects as to impair the protective function of the lining. All lined areas shall have a smooth surface. However, imperfections such as spiraling, which is present in the uncoated coupling, shall be acceptable.

6.5.2 Ring Groove Inspection

The ring groove shall have no runs or sags perpendicular to the wall of the ring groove. A run or sag parallel to the wall of the ring groove will be acceptable if the A dimensions of said area is within the tolerance stated in CPC Standard Specification No. 10.

6.5.3 Extraneous Lining

The B and F dimensions, as shown in CPC Standard Specification No. 10, Page 13, shall be free of lining material.

6.6 FITTING STOCK LINING

Refer to attributes of pipe bore lining, Section 6.3.

6.7 DISPOSITION OF REJECTED MATERIAL

6.7.1 Pipe Bore Lining

Imperfection in the pipe bore lining may be repaired either by a patch or by recoating the pipe with the exception of rifling and runs and sags. However, if only a fraction of the pipe is rifled or contains runs or sags, this section may be removed and the remaining pipe section used for random lengths or fittings.

CTD013901

6.7.2 Pipe End Lining

Rejected pipe ends may be repaired by a suitable method or the ends may be removed and the remaining pipe machined for use as a random length or fitting stock.

6.7.3 Coupling Lining

Couplings rejected for voids, blisters, sharp protusion or any other surface irregularity may be repaired by a suitable method.

Couplings rejected for runs and sags shall be scrapped.

6.7.4 Fitting Stock Lining

Refer to disposition of rejected pipe bore lining, Section 6.7.1.

7.0 SPECIAL LINING REQUIREMENTS

7.1 ADHESION

The lining shall have a permanent bond to the pipe wall. Proof of bond strength shall be established by:

7.1.1 A four hour immersion test in boiling distilled water as described in ASTM C-541.

7.1.2 A ninety-six hour hot (150°F.) distilled water immersion as detailed in ASTM C-541.

7.1.3 A bond tensile strength of at least 200 lbs. per square inch obtained by method of National Sanitation Foundation Criteria C-7.

CTD013902

7.1.4 Each of the above tests shall be performed on no less than twelve (12) specimens manufactured with one batch of resin. A batch will consist of the quantity of resin shipped by the resin vendor under the same batch or lot number. Test specimens shall be selected so as to distribute the tests over the life of the resin batch. Specimens shall be selected from a minimum of four (4) different runs with three specimens selected per run per test.

7.1.5 Specimens selected for the bond tensile test shall be forwarded to CPC Quality Control Manager for testing at CPC Research Center.

7.1.6 All test values shall be recorded as well as: the date of manufacture, pipe size and class, resin vendor, resin type (for example EPON 828V) resin batch or lot number, lining nominal thickness, hardener vendor, type and batch or lot number.

7.2 ACID RESISTANCE

7.2.1 There shall be no evidence of blistering, cracking, swelling or other visual degradation of the lining when exposed to the acid tests as described in NSF-C7, Section 3.011. This test shall be performed on no less than three specimens per batch of resin. The specimens shall be selected from one of the first runs using a new batch of resin.

7.2.2 All results shall be recorded as well as the date of manufacture, pipe size and class, resin vendor, resin batch or lot number, lining nominal thickness, hardener vendor, type and batch or lot number.

CTD013903

FORM P917 11-67

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION ASBESTOS CEMENT PIPE	NUMBER: 10	PAGE 18
	SUPERSEDES:	DATE OF ISSUE December 12, 1967
APPLICABLE TO: Plant No. 57	CLASSIFICATION: Inspection Standard	
DESCRIPTION: FLUID-TITE A/C Epoxy Lined Pressure Pipe, Couplings and Accessories Classes 100, 150 and 200		

7.3 ALKALI RESISTANCE

7.3.1 There shall be no evidence of blistering, cracking, swelling, or other visual degradation of the lining when exposed to the alkali test as described in NSF-C7, Section 3.012. This test shall be performed on no less than three specimens per batch of resin. The specimens shall be selected from one of the first runs using a new batch of resin.

7.3.2 All results shall be recorded as well as the date of manufacture, pipe size and class, resin vendor, resin batch or lot number, lining nominal thickness, hardener vendor, type and batch or lot number.

7.4 DISPOSITION OF REJECTED MATERIAL

7.4.1 Adhesion

If any of the nine (9) test specimens selected during a run fail the test to which it is subjected, all the pipe coated since the last valid test from the resin batch currently being used shall be subject to rejection. The Quality Control Manager shall be notified at once.

7.4.2 Acid Resistance

If any of the three test specimens per resin batch fail the acid resistance test, the remainder of that resin batch and the hardener currently in use will be held and shall not be used. A sample of that resin and hardener shall be sent to CPC Quality Control Manager for chemical resistance tests as cited in NSF-C7, Section 3.013.

The stock coated with the above resin shall be subject to rejection. The Quality Control Manager shall be notified immediately.

CTD013904

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7.4.3 Alkali Resistance

Refer to disposition of rejected material acid resistance, Section 7.4.2.

8.0 RETURNED MATERIALS

All epoxy lined material that has been returned to a plant for any reason shall be inspected in accordance with Sections 1 through 6 of this Standard. Special attention shall be given to those areas susceptible to handling damage, such as pipe ends.

9.0 INTERPLANT TRANSFER

All epoxy lined material that has been transferred from one plant to another shall be reinspected by the receiving plant in accordance with Sections 1 through 6 of this Standard. Special attention should be given to those areas susceptible to handling damage, such as pipe ends.

CTD013905

FORM P627

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: General Standards Manual
Inspection Standard No. 13

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	Section J	1

SUPERSEDES:

DATE OF ISSUE: FEB - 7 1972

DESCRIPTION:

Inspection Standard for Fabrication of Storm Drain Couplings

1.0 General

This inspection standard describes the inspection to be used for checking the inplant fabrication of storm drain couplings.

2.0 Sampling Plan

Sampling for normal inspection procedures shall be carried out on the sampling plan as shown in Table 1 for each width and thickness.

Table 1

No. of couplings in each Width and Thickness	Couplings In Sample	Acceptable Defectives	Defectives Constituting Rejects
2-15	2	0	1
16-50	3	0	1
51-150	5	0	1
151-500	8	0	1
501-3200	13	1	2

Each sample shall be conditioned for a minimum of four (4) hours at 70° ±5°F.

2.1 Cut Length

Samples shall be taken in accordance with Table 1 and measured for conformance with Standard Product Specification No. 13, pages 8, 9 cut length.

2.2 Coupling I.D.

Samples shall be taken in accordance with Table 1. The inspection shall be as follows:

2.2.1 Measure the thickness at four points, 90° apart, one inch in from the edge, using a micrometer. Record the average of these readings for the thickness.

CTD013906

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2.2.2 Measure the O.D. of coupling one inch in from the edge with a pi tape, accurate to .005".

2.2.3 Subtract from the measured O.D. two times the average thickness.

2.2.4 The calculated I.D. shall be within the limits specified in Table II of this in-process specification.

2.3 Tensile Strength of Coupling Weld

Samples shall be taken in accordance with Table 1. Note: Two pieces of coupling material 6" long shall be welded together for each sample using the proper welding procedure rather than destroying a coupling to get the sample. It is extremely important that the coupling welding procedure be followed exactly in order to get a representative sample.

2.3.1 Tensile strength shall be conducted as specified in Standard Test Method No. 39.

2.3.1.1 The minimum tensile strength shall be 1350 p.s.i. across the weld.

CTD013907

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: General Standards Manual
Inspection Standard No. 13

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
1	Section J	3

SUPERSEDES:

DATE OF ISSUE: FEB - 7 1972

DESCRIPTION:

Inspection Standard For Fabrication of Storm Drain Couplings

Table II

I.D. of Storm Drain Couplings

Size	Type	I.D."	Size	Type	I.D."
6"	1500 D	6.69	16"	1500 D	17.04
	2000 D	6.69		2000 D	17.04
	3000 D	6.69		3000 D	17.47
	3750 D	6.69		3750 D	17.72
8"	1500 D	8.73	18"	1500 D	19.06
	2000 D	8.73		2000 D	19.33
	3000 D	8.73		3000 D	19.77
	3750 D	8.73		3750 D	19.77
10"	1500 D	10.81	20"	1500 D	21.11
	2000 D	10.81		2000 D	21.41
	3000 D	10.81		3000 D	21.88
	3750 D	11.00		3750 D	21.88
12"	1500 D	12.85	21"	1500 D	22.15
	2000 D	12.85		2000 D	22.45
	3000 D	13.12		3000 D	22.91
	3750 D	13.26		3750 D	22.91
14"	1500 D	14.91	24"	1500 D	25.54
	2000 D	14.96		2000 D	25.76
	3000 D	15.22		3000 D	25.97
	3750 D	15.59		3750 D	25.97
15"	1500 D	16.00			
	2000 D	16.00			
	3000 D	16.43			
	3750 D	16.65			

Tolerance on I.D.
6", 8", 10" --- +.04" -.09"
12", 14" --- +.04" -.11"
15", 16", 18" ---+.04" -.19"
20", 21", 24" --- +.04" -.21"

Max. I.D. = Max. C.O.D. - 2X Min. T.
Min. I.D. = Min. C.O.D. - 2X Max. T.

CTD013908

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B W Haigh				WPS		WS

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A/C PLANTS CAPABILITIES

A/C PLANT CAPABILITIES

PRESSURE PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
3" - 100		X			X	X				X		X		X			X		X			X			X		X				X		X		X
150		X		X		X				X		X		X			X		X			X			X			X			X		X		X
200		X		X		X				X		X		X			X		X			X			X			X			X		X		X
4" - 100	X			X		X		X			X		X		X			X		X		X			X		X				X		X		X
150	X			X		X		X			X		X		X			X		X		X			X		X				X		X		X
200	X			X		X		X			X		X			X		X		X		X			X		X				X		X		X
6" - 100	X			X		X		X			X		X		X			X		X		X			X		X		X			X		X	
150	X			X		X		X			X		X		X			X		X		X			X		X		X			X		X	
200		X		X			X	X			X		X			X		X			X		X		X		X			X		X		X	
8" - 100		X		X		X		X			X		X		X			X		X		X			X		X		X			X		X	
150	X			X		X		X			X		X		X			X		X		X			X		X		X			X		X	
200			X	X		X			X		X		X			X		X				X			X		X			X		X		X	

Pipe & Plastics Group

CTD013910

A/C PLANT CAPABILITIES

PRESSURE PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
10" - 100		X		X		X			X		X		X		X			X		X			X		X		X	X			X		X	
150		X		X		X			X		X		X		X			X		X			X		X		X	X			X		X	
200		X		X		X			X		X		X				X	X		X			X		X		X		X		X		X	
12" - 100	X			X		X			X		X		X		X			X		X		X			X		X	X			X		X	
150	X			X		X		X			X		X		X			X		X		X			X		X	X			X		X	
200		X		X		X			X		X		X				X	X		X			X		X		X		X		X		X	
14" - 100			X		X		X		X		X		X			X		X		X			X		X		X		X		X		X	
150			X		X		X		X		X		X		X			X		X			X		X		X	X			X		X	
200			X		X		X		X		X		X			X		X		X			X		X		X		X		X		X	
16" - 100			X		X		X		X		X		X			X		X		X			X		X		X		X		X		X	
150			X		X		X		X		X		X		X			X		X		X			X		X	X			X		X	
200			X		X		X		X		X		X			X		X		X			X		X		X		X		X		X	

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CTD013911

A/C PLANT CAPABILITIES

PRESSURE PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
18" - 100			X		X		X		X		X		X	
150			X		X		X		X		X		X	
20" - 100			X		X		X		X		X		X	
150			X		X		X		X		X		X	
24" - 100			X		X		X			X		X		X
150			X		X		X			X		X		X

SIZE & CLASS	AMBLER							ST. LOUIS						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
18" - 100	X			X			X			X	X			X
150	X			X		X				X		X		X
20" - 100		X		X		X				X		X		X
150	X			X		X				X		X		X
24" - 100		X			X		X			X		X		X
150		X			X	X				X		X		X

SIZE & CLASS	RIVERSIDE					
	Pipe			Cplg		F.M.
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
18" - 100		X		X		X	
150	X			X		X	
20" - 100		X		X		X	
150		X		X		X	
24" - 100	X			X		X	
150	X			X		X	

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CTD013912

A/C PLANT CAPABILITIES

SEWER PIPE

August 1975

SIZE & CLASS	SANTA CLARA					HILLSBORO					AMBLER					ST. LOUIS					RIVERSIDE				
	Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NC CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
4" - 1500	X			X		X			X		X			X		X			X				X		X
2400	X			X		X			X		X			X		X			X				X		X
3300	X			X		X			X		X			X		X			X				X		X
5" - 1500		X		X				X	X			X		X		X			X				X		X
2400		X		X				X	X			X		X		X			X				X		X
3300		X		X				X	X			X		X		X			X				X		X
6" - 1500	X			X		X			X		X			X		X			X				X		X
2400	X			X		X			X		X			X		X			X				X		X
3300	X			X		X			X		X			X		X			X				X		X
8" - 1500	X			X		X			X		X			X		X			X		X			X	
2400	X			X		X			X		X			X		X			X		X			X	
3300	X			X		X			X		X			X		X			X		X			X	

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A/C PLANT CAPABILITIES

SEWER PIPE

August 1975

SIZE & CLASS	SANTA CLARA					HILLSBORO					AMBLER					ST. LOUIS					RIVERSIDE				
	Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
10" - 1500		X		X			X		X		X			X			X		X			X		X	
2400		X		X			X		X		X			X			X		X			X		X	
3300		X		X			X		X		X			X			X		X			X		X	
4000		X		X			X		X		X			X			X		X			X		X	
5000		X		X			X		X		X			X			X		X		X			X	
12" - 1500	X			X			X		X			X		X			X		X			X		X	
2400	X			X			X		X			X		X			X		X			X		X	
3300	X			X			X		X		X			X		X			X			X		X	
4000	X			X			X		X		X			X		X			X			X		X	
5000	X			X			X		X		X			X		X			X			X		X	

Pipe & Plastics Group

CTD013914

A/C PLANT CAPABILITIES

SEWER PIPE

August 1975

Size and Class	Santa Clara					Hillsboro					Ambler					St. Louis					Riverside				
	Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.	
	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability
14" - 1500			X		X		X		X			X		X			X		X			X		X	
2400			X		X		X		X			X		X			X		X			X		X	
3300			X		X		X		X			X		X			X		X			X		X	
4000			X		X		X		X			X		X			X		X			X		X	
5000			X		X		X		X			X		X			X		X			X		X	
15" - 1500			X		X			X	X		X			X				X	X			X		X	
2400			X		X			X	X		X			X				X	X			X		X	
3300			X		X			X	X		X			X				X	X			X		X	
4000			X		X			X	X		X			X				X	X			X		X	
5000			X		X			X	X		X			X				X	X			X		X	

CTD013915

Pipe & Plastics Group

A/C PLANT CAPABILITIES

SEWER PIPE

August 1975

SIZE AND CLASS	Santa Clara					Hillsboro					Ambler					St. Louis					Riverside				
	Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.	
	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability
16" - 1500			X		X		X		X			X		X		X			X			X		X	
2400			X		X		X		X			X		X		X			X			X		X	
3300			X		X		X		X		X			X		X			X			X		X	
4000			X		X		X		X		X			X		X			X			X		X	
5000			X		X		X		X		X			X		X			X			X		X	
18" - 2400			X		X		X		X		X			X			X		X			X		X	
3300			X		X		X		X		X			X			X		X			X		X	
4000			X		X		X		X		X			X			X		X			X		X	
5000			X		X		X		X		X			X			X		X		X			X	

CTD013916

Pipe & Plastics Group

A/C PLANT CAPABILITIES

SEWER PIPE

August 1975

SIZE AND CLASS	Santa Clara					Hillsboro					Ambler					St. Louis					Riverside				
	Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.		Pipe			Cplg.	
	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability	Capability	Limited Capability	No Capability	Capability	No Capability
20" - 2400			X		X		X		X			X		X				X		X		X		X	
3300			X		X		X		X			X		X				X		X		X		X	
4000			X		X		X		X			X		X				X		X		X		X	
5000			X		X		X		X			X		X				X		X		X		X	
21" - 2400			X		X			X	X			X		X				X		X		X		X	
3300			X		X			X	X		X			X				X		X		X		X	
4000			X		X			X	X		X			X				X		X		X		X	
5000			X		X			X	X		X			X				X		X	X			X	
24" - 2400			X		X			X		X	X			X				X		X		X		X	
3300			X		X			X		X	X			X				X		X		X		X	
4000			X		X			X		X	X			X				X		X	X			X	
5000			X		X			X		X	X			X				X		X	X			X	

Pipe & Plastics Group

CTD013917

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		vPipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
6" - 40	X			X		X		X			X		X				X				X	X			X		X				X		X		X
45	X			X		X		X			X		X				X		X		X	X			X		X				X		X		X
50	X			X		X		X			X		X			X		X		X		X			X		X				X		X		X
60	X			X		X		X			X		X			X		X		X		X			X		X				X		X		X
70	X			X		X		X			X		X			X		X		X		X			X		X				X		X		X
80		X		X		X		X			X		X				X	X		X		X			X		X				X		X		X
90		X		X		X		X			X		X				X	X			X	X			X		X				X		X		X

CTD013918

Pipe & Plastics Group

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F. M.		Pipe			Cplg		F. M.		Pipe			Cplg		F. M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
8" - 30	X			X		X		X			X		X			X			X	X		X			X		X			X		X		X	
35	X			X		X		X			X		X			X			X	X		X			X		X			X		X		X	
40	X			X		X		X			X		X			X			X	X		X			X		X			X		X		X	
45	X			X		X		X			X		X			X			X	X		X			X		X			X		X		X	
50	X			X		X		X			X		X			X		X		X		X			X		X			X		X		X	
60	X			X		X		X			X		X			X		X		X		X			X		X			X		X		X	
70	X			X		X		X			X		X			X		X		X		X			X		X			X		X		X	
80			X	X		X			X		X		X			X		X		X			X		X		X			X		X		X	
90			X	X		X			X		X		X			X		X		X			X		X		X			X		X		X	

CTD013919

Pipe & Plastics Group

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
10" - 30		X		X		X			X		X		X	
35		X		X		X			X		X		X	
40		X		X		X			X		X		X	
45		X		X		X			X		X		X	
50		X		X		X			X		X		X	
60	X			X		X			X		X		X	
70	X			X		X			X		X		X	
80		X		X		X			X		X		X	
90		X		X		X			X		X		X	

SIZE & CLASS	AMBLER							ST. LOUIS						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
10" - 30	X				X	X			X		X		X	
35	X				X	X			X		X		X	
40	X				X	X			X		X		X	
45	X			X		X			X		X		X	
50	X			X		X			X		X		X	
60	X			X		X			X		X		X	
70	X			X		X			X		X		X	
80			X	X		X			X		X		X	
90			X	X		X			X		X		X	

SIZE & CLASS	RIVERSIDE					
	Pipe			Cplg		F.M.
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
10" - 30		X		X		X	
35		X		X		X	
40		X		X		X	
45		X		X		X	
50		X		X		X	
60		X		X		X	
70		X		X		X	
80		X		X		X	
90		X		X		X	

Pipe & Plastics Group

CTD013920

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
12" - 30	X			X		X			X		X		X		X				X	X			X		X		X			X		X		X	
35	X			X		X			X		X		X		X				X	X		X			X		X			X		X		X	
40	X			X		X			X		X		X		X				X	X		X			X		X			X		X		X	
45	X			X		X			X		X		X		X			X		X		X			X		X			X		X		X	
50	X			X		X			X		X		X		X			X		X		X			X		X			X		X		X	
60	X			X		X		X			X		X		X			X		X		X			X		X			X		X		X	
70	X			X		X		X			X		X		X			X		X		X			X		X			X		X		X	
80		X		X		X			X		X		X				X	X		X		X			X		X			X		X		X	
90		X		X		X			X		X		X				X	X		X		X			X		X			X		X		X	

CTD013921

Pipe & Plastics Group

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
14" - 30			X		X		X		X		X		X			X		X		X			X		X		X			X		X		X	
35			X		X		X		X		X		X			X		X		X			X		X		X			X		X		X	
40			X		X		X		X		X		X				X	X		X			X		X		X		X			X		X	
45			X		X		X		X			X	X				X		X		X		X		X		X			X		X		X	
50			X		X		X		X			X	X				X		X		X		X		X		X			X		X		X	
60			X		X		X		X		X		X			X			X	X			X		X		X			X		X		X	
70			X		X		X		X		X		X			X		X		X			X		X		X			X		X		X	
80			X		X		X		X		X		X			X		X			X		X		X		X			X		X		X	
90			X		X		X		X		X		X			X		X		X			X		X		X			X		X		X	

CTD013922

Pipe & Plastics Group

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
15" - 30			X		X		X			X		X		X			X		X		X			X		X		X		X		X		X	
35			X		X		X			X		X		X			X		X		X			X		X		X		X		X		X	
40			X		X		X			X		X		X			X		X		X			X		X		X		X		X		X	
45			X		X		X			X		X		X			X		X		X			X		X		X			X		X		X
50			X		X		X			X		X		X			X		X		X			X		X		X			X		X		X
60			X		X		X			X		X		X			X		X		X			X		X		X			X		X		X
70			X		X		X			X		X		X			X		X		X			X		X		X			X		X		X
80			X		X		X			X		X		X			X		X		X			X		X		X	X			X		X	
90			X		X		X			X		X		X			X		X		X			X		X		X			X	λ		X	

CTD013923

Pipe & Plastics Group

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
16" - 30			X		X		X		X		X		X			X		X		X		X			X		X			X		X		X	
35			X		X		X		X		X		X			X		X		X		X			X		X			X		X		X	
40			X		X		X		X		X			X		X			X	X		X			X			X	X			X		X	
45			X		X		X		X			X	X				X		X		X		X			X		X			X		X	X	
50			X		X		X		X			X	X				X		X		X		X				X	X			X		X	X	
60			X		X		X		X		X		X		X			X		X		X				X	X		X			X		X	
70			X		X		X	X			X		X		X			X		X		X				X	X		X			X		X	
80			X		X		X		X		X			X		X		X		X			X			X		X			X		X		
90			X		X		X		X		X			X		X		X		.	X			X		X		X			X		X		

CTD013924

Pipe & Plastics Group

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NC CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
18" - 30			X		X		X		X		X		X				X		X		X			X		X		X		X		X		X	
35			X		X		X		X		X		X				X		X		X			X		X		X		X		X		X	
40			X		X		X		X		X		X		X				X	X				X		X		X		X		X		X	
45			X		X		X		X		X		X		X				X		X			X		X		X		X		X		X	
50			X		X		X		X		X		X		X				X		X			X		X		X		X		X		X	
60			X		X		X		X		X		X				X		X		X			X		X		X		X		X		X	
70			X		X		X		X		X		X		X				X		X			X		X		X	X			X		X	
80			X		X		X		X		X		X		X				X		X			X		X		X	X			X		X	
90			X		X		X			X		X		X			X		X		X			X		X		X	X			X		X	

CTD013925

[redacted] Pipe & Plastics Group

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
20" - 30			X		X		X		X		X		X	
35			X		X		X		X		X		X	
40			X		X		X		X		X		X	
45			X		X		X		X		X		X	
50			X		X		X		X		X		X	
60			X		X		X		X		X		X	
70			X		X		X			X		X		X
80			X		X		X			X		X		X
90			X		X		X			X		X		X

SIZE & CLASS	AMBLER							ST. LOUIS						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
20" - 30			X		X		X			X		X		X
35			X		X		X			X		X		X
40		X			X	X				X		X		X
45		X			X	X				X		X		X
50		X			X	X				X		X		X
60			X		X		X			X		X		X
70	X				X		X			X		X		X
80	X				X		X			X		X		X
90			X		X	X				X		X		X

SIZE & CLASS	RIVERSIDE						
	Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
20" - 30		X		X		X	
35		X		X		X	
40		X		X		X	
45		X		X		X	
50		X		X		X	
60		X		X		X	
70		X		X		X	
80	X			X		X	
90			X	X			X

CTD013926

Pipe & Plastics Group

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO							AMBLER							ST. LOUIS							RIVERSIDE						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
21" - 30			X		X		X			X		X		X			X		X					X		X			X			X		X	
35			X		X		X			X		X		X			X		X					X		X			X			X		X	
40			X		X		X			X		X		X			X		X					X		X			X			X	X	X	
45			X		X		X			X		X		X			X		X					X		X			X			X	X	X	
50			X		X		X			X		X		X			X		X					X		X			X			X		X	
60			X		X		X			X		X		X			X		X					X		X			X			X		X	
70			X		X		X			X		X		X			X		X					X		X				X		X			X
80			X		X		X			X		X		X			X		X					X		X				X		X			X

Pipe & Plastics Group

CTD013927

A/C PLANT CAPABILITIES

FLUID TRANSMISSION PIPE

August 1975

SIZE & CLASS	SANTA CLARA							HILLSBORO						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
24" - 30			X		X		X			X		X		X
35			X		X		X			X		X		X
40			X		X		X			X		X		X
45			X		X		X			X		X		X
50			X		X		X			X		X		X
60			X		X		X			X		X		X
70			X		X		X			X		X		X
80			X		X		X			X		X		X

SIZE & CLASS	AMBLER							ST. LOUIS						
	Pipe			Cplg		F.M.		Pipe			Cplg		F.M.	
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
24" - 30			X		X		X			X		X		X
35			X		X		X			X		X		X
40		X			X		X			X		X		X
45		X			X		X			X		X		X
50		X			X		X			X		X		X
60			X		X		X			X		X		X
70			X		X		X			X		X		X
80			X		X		X			X		X		X

SIZE & CLASS	RIVERSIDE					
	Pipe			Cplg		F.M.
	CAPABILITY	LIMITED CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY	CAPABILITY	NO CAPABILITY
24" - 30		X		X		X	
35		X		X		X	
40	X			X		X	
45	X			X		X	
50	X			X		X	
60	X			X		X	
70	X			X		X	
80	X			X		X	

Pipe & Plastics Group

CTD013928

CertainTeed

To	Mail Code	From	Mail Code	Ext.
See Below		G. A. Berkhimer	2125 2B	7974

Subject	Date
A/C Packaging Specifications	April 24, 1986

To:
Mr. L. Ambler - VF 2125 2B
Mr. J. L. Anderson - Hillsboro #257 (3)
Mr. R. Beavers - Mountain Region #267
Mr. J. A. Burke - Riverside #260 (3)
Mr. F. Duffy - Southwest Region #264
Mr. J. Himmelberger - Pacific Region #265
Mr. J. P. McGinley - VF 2125 2B
Mr. G. C. Olson - Eastern Region VF 2125 2B
Mr. C. Patti - VF 2125 2B
Mr. G. Stelian - VF 2125 2B
Mr. D. F. Young - VF 2125 2B

Attached are updated packaging specifications for A/C pipe and accessories.

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CTD013929

TECHNICAL CHANGE ORDER

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CertainTeed Corporation
Pipe and Plastics Group

APPLICABLE TO: Packaging Methods - A/C Plants

DATE OF ISSUE:	T.C.O. NO.:	PAGE NO.:
April 24, 1986		1

DESCRIPTION: Revision to General Packaging Methods

Purpose

To update packaging specifications for A/C pipe and accessories.

Instructions

Replace existing packaging specifications for A/C pipe with the attached.

CTD013930

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

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TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - HILLSBORO		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
	85-1	1
SUPERSEDES:		DATE OF ISSUE:
ALL PREVIOUS		APRIL 1, 1986

DESCRIPTION:

4" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - RAGGLE BOARDS					
4"	100	8	5	40	AC
	150	8	5	40	AC
	200	7	5	35	AC
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
4"	100	8	5	40	BD
	150	8	5	40	BD
	200	7	5	35	BD
4' WIDE-BELLED ONE END - OFFSET UNITS - RAGGLE BOARDS					
4"	100	7	5	35	AC
	150	7	5	35	AC
	200	6	5	30	AC
ACCESSORIES - 4' WIDE 1/2 and 1/4 MEO'S					
4"	100	8	5	40	BD
	150	8	5	40	AC
	200	7	5	35	BD

LUMBER:

A. Bearing Raggle Boards: 2 1/4" x 3" x 44"
B. Bearing Flat Boards: 3" x 3" x 47"
C. Separator Raggle Boards: 1 3/8" x 1 3/4" x 44"
D. Separator Flat Boards: 2" x 3" x 47"
E. Chocks: 1 3/4" x 1 3/4" x 2 3/4" Diagonal Cut

Steel Bands: 3/4" x .025" Painted, wax coated and positioned around unit at center and at Bearing Boards

CTD013931

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					GS		

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DESCRIPTION:

6" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - RAGGLE BOARDS					
6"	100	6	3	18	FG
	150	6	3	18	FG
	200	6	3	18	HI
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
6"	100	6	3	18	BDE
	150	6	3	18	BDE
	200	6	3	18	BDE
4' WIDE-BELLED ONE END - OFFSET UNITS - RAGGLE BOARDS					
6"	100	6	3	18	FG
	150	6	3	18	AC
	200	5	3	15	HIJK
ACCESSORIES - 4' WIDE - 1/2 and 1/4 MEO'S					
6"	100	6	4	24	AC
	150	6	4	24	AC
	200	6	4	24	AC

LUMBER:

A. Bearing Raggle Boards: 2 1/4" x 3" x 47"
B. Bearing Flat Boards: 3" x 3" x 47"
C. Separator Raggle Boards: 1 3/8" x 1 3/4" x 47"
D. Separator Flat Boards: 2" x 3" x 47"
E. Chocks: 1 3/4" x 1 3/4" x 2 3/4" Diagonal Cut
F. Bearing Raggle Boards: 2 1/4" x 3" x 44"
G. Separator Raggle Boards: 1 3/8" x 1 3/4" x 44"
H. Separator Raggle Boards: 1 3/8" x 2 1/2" x 39"
I. Bearing Raggle Boards: 2 1/4" x 3" x 39"
J. Separator Raggle Boards: 1 3/8" x 2 1/2" x 43"
K. Bearing Raggle Boards: 2 1/4" x 3" x 43"

Steel Bands: 3/4" x .025" Painted, wax coated and positioned around unit at center and at Bearing Boards.

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - HILLSBORO		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 3
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: APRIL 1, 1986

DESCRIPTION:

8" A/C PRESSURE PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - RAGGLE BOARDS					
8"	100	4	3	12	AC
	150	4	3	12	AC
	200	4	3	12	AC
TRUCK LOAD MAXIMIZING OPTION					
8"	100	4	2	8	AC
	150	4	2	8	AC
	200	4	2	8	AC
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
8"	100	4	3	12	BDE
	150	4	3	12	BDE
	200	4	3	12	BDE
TRUCK LOAD MAXIMIZING OPTION					
8"	100	4	2	8	BDE
	150	4	2	8	BDE
	200	4	2	8	BDE

LUMBER:

A. Bearing Raggle Boards: 2 1/2" x 3 1/2" x 38"
B. Bearing Flat Boards: 3" x 3" x 47"
C. Separator Raggle Boards: 2" x 2" x 38"
D. Separator Flat Boards: 2" x 3" x 47"
E. Chocks: 1 3/4" x 1 3/4" x 2 3/4" Diagonal Cut

Steel Bands: 3/4" x .025" Painted, wax coated and positioned around unit at center and at Bearing Boards

CTD013933

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					CJ		

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DESCRIPTION:

8" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ONE END - OFFSET UNITS - RAGGLE BOARDS					
8"	100	4	3	12	ABCD
	150	4	3	12	ABCD
	200	4	3	12	EFGH
TRUCK LOAD MAXIMIZING OPTION					
8"	100	4	2	8	ABCD
	150	4	2	8	ABCD
	200	4	2	8	EFGH
ACCESSORIES - 4' WIDE - 1/2 AND 1/4 MEO'S					
8"	100	4	3	12	CD
	150	4	3	12	CD
	200	4	3	12	CD

LUMBER:

A. Bearing Raggle Boards: 2 1/4" x 3" x 42"
B. Separator Raggle Boards: 1 3/8" x 2 1/2" x 42"
C. Bearing Raggle Boards: 2 1/4" x 3" x 38"
D. Separator Raggle Boards: 1 3/8" x 2 1/2" x 38"
E. Bearing Raggle Boards: 2 1/4" x 3" x 43"
F. Separator Raggle Boards: 1 3/4" x 2 1/2" x 43"
G. Bearing Raggle Boards: 2 1/4" x 3" x 40"
H. Separator Raggle Boards: 1 3/4" x 2" x 40"

Steel Bands: 3/4" x .025" Painted, wax coated and positioned around unit at center and at Bearing Boards.

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - HILLSBORO		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 5
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: APRIL 1, 1986

DESCRIPTION:

10" A/C PRESSURE PIPE ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - RAGGLE BOARDS					
10"	100	3	2	6	AD
	150	3	2	6	AD
	200	3	2	6	AD
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
10"	100	3	2	6	BE
	150	3	2	6	BE
	200	3	2	6	BE
4' WIDE-BELLED ONE END - OFFSET UNITS - RAGGLE BOARDS					
10"	100	3	2	6	CF HI
	150	3	2	6	CF HI
	200	3	2	6	CF HI
ACCESSORIES - 4' WIDE - 1/2 AND 1/4 MEO'S					
10"	100	3	2	6	HI
	150	3	2	6	HI
	200	3	2	6	HI

LUMBER:

A. Bearing Raggle Boards: 2 1/2" x 3 1/2" x 36"
B. Bearing Flat Boards: 3" x 3" x 47"
C. Bearing Raggle Boards: 2 1/2" x 3 1/2" x 38"
D. Separator Raggle Boards: 2" x 2" x 36"
E. Separator Flat Boards: 2" x 3" x 47"
F. Separator Raggle Boards: 2" x 2" x 38"
G. Chocks: 2 3/4" x 2 3/4" x 3 7/8" Diagonal Cut
H. Bearing Raggle Boards: 2 1/4" x 3" x 37"
I. Separator Raggle Boards: 2 1/4" x 3" x 37"

Steel Bands: 3/4" x .025" Painted, wax coated and positioned around unit at center and at Bearing Boards.

CTD013935

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					G.A.		

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DESCRIPTION:

12" A/C PRESSURE PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - RAGGLE BOARDS					
12"	100	3	2	6	AE
	150	3	2	6	AE
	200	3	2	6	AE
4' WIDE-BELLED ALTERNATE END - OFFSET UNITS - RAGGLE BOARDS					
12"	100	3	2	6	BFI
	150	3	2	6	BFI
	200	3	2	6	BFI
4' WIDE-BELLED ONE END - OFFSET UNITS - RAGGLE BOARDS					
12"	100	3	2	6	CG
	150	3	2	6	CG
	200	2	2	4	CG
8' WIDE-BELLED ALTERNATE ENDS - OFFSET UNITS - FLAT BOARDS					
12"	100	6	2	12	DHI
	150	6	2	12	DHI
	200	6	2	12	DHI

LUMBER:

A. Bearing Raggle Boards: 2 1/4" x 3" x 44"
B. Bearing Flat Boards: 3" x 3" x 47"
C. Bearing Raggle Boards: 2 1/2" x 3 1/2" x 46"
D. Bearing Flat Boards: 3" x 3" x 96"
E. Separator Raggle Boards: 2 1/4" x 3" x 44"
F. Separator Flat Boards: 2" x 3" x 47"
G. Separator Raggle Boards: 2" x 2" x 46"
H. Separator Flat Boards: 3" x 3" x 96"
I. Chocks: 2 3/4" x 2 3/4" x 3 7/8" Diagonal Cut

Steel Bands: 3/4" x .025" Painted, wax coated and positioned around unit at center and at Bearing Boards.

CTD013936

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - HILLSBORO		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 7
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: APRIL 1, 1986

DESCRIPTION:

12" A/C PRESSURE ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE 1/2 AND 1/4 MEO'S					
12"	100	3	2	6	AC
	150	3	2	6	AC
	200	3	2	6	AC
8' WIDE - 1/2 AND 1/4 MEO'S					
12"	100	6	2	12	BDE
	150	6	2	12	BDE
	200	6	2	12	BDE

LUMBER:

A. Bearing Raggle Boards: 2 1/4" x 3" x 44"
B. Bearing Flat Boards: 3" x 3" x 96"
C. Separator Raggle Boards: 2 1/4" x 3" x 44"
D. Separator Flat Boards: 3" x 3" x 96"
E. Chocks: 2 3/4" x 2 3/4" x 3 7/8"

Steel Bands: 3/4" x .025" Painted, wax coated and positioned around unit at center and at Bearing Boards

CTD013937

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					6J		

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DESCRIPTION:

14" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
14"	100	6	1	6	AB
	150	5	1	5	AB
	200	5	1	5	AB
ACCESSORIES - 8' WIDE - 1/2 AND 1/4 MEO'S					
14"	100	6	1	6	AB
	150	5	1	5	AB
	200	5	1	5	AB

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 94"
B. Chocks: 2 3/4" x 2 3/4" x 3 7/8" Diagonal Cut

Perforated Straps: 3/4" x .020" Painted, wax coated and positioned around unit at Bearing Boards

CTD013938

TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - HILLSBORO		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 9
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: APRIL 1, 1986

DESCRIPTION:

16" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
16"	100	5	1	5	AD
	150	5	1	5	AD
	200	5	1	5	AD
OPTIONAL-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
16"	100	3	1	3	BD
	150	3	1	3	BD
	200	3	1	3	BD
16"	100	2	1	2	CD
	150	2	1	2	CD
	200	2	1	2	CD
ACCESSORIES - 8' WIDE - 1/2 AND 1/4 MEO'S					
16"	100	4	1	4	AD
	150	4	1	4	AD
	200	4	1	4	AD

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 96"
B. Bearing Flat Boards: 3" x 3" x 58"
C. Bearing Flat Boards: 3" x 3" x 38"
D. Chocks: 2 3/4" x 2 3/4" x 3 7/8" Diagonal Cut

Perforated Straps: 3/4" x .020" Painted, wax coated and positioned around unit at Bearing Boards

CTD013939

PREPARED BY: G. A. BERKHIMER	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
					GT		

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DESCRIPTION:

18" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
18"	100	4	1	4	AB
	150	4	1	4	AB
ACCESSORIES - 8' WEDE - 1/2 AND 1/4 MEO'S					
18"	100	4	1	4	AB
	150	4	1	4	AB

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 96"
B. Chocks: 3 7/16" x 3 7/16" x 4 3/4"

Perforated Straps: 3/4" x .020" Painted, wax coated and positioned around unit at Bearing Boards

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - HILLSBORO		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 11
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: APRIL 1, 1986

DESCRIPTION:

20" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
20"	100	4	1	4	AB
	150	4	1	4	AB
ACCESSORIES - 8' WIDE - 1/2 AND 1/4 MEO'S					
20"	100	4	1	4	AB
	150	4	1	4	AB

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 96"
B. Chocks: 3 7/16" x 3 7/16" x 4 3/4"

Perforated Straps: 3/4" x .020" Painted, wax coated and positioned around unit at Bearing Boards

CTD013941

PREPARED BY	APPROVED BY	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER							

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:

DESCRIPTION:

CTD013942

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
	85-1	1
SUPERSEDES:		DATE OF ISSUE:
ALL PREVIOUS		NOVEMBER 1, 1985

DESCRIPTION:

6" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ONE END - OFFSET UNITS - RAGGLE BOARDS					
6"	100	6	5	30	AC
	150	6	5	30	AC
	200	6	5	30	AC
8' WIDE-BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
6"	100	11	4	44	BDE
	150	11	4	44	BDE
	200	11	4	44	BDE
ACCESSORIES - 4' WIDE - 1/2 AND 1/4 MEO'S					
6"	100	6	5	30	AC
	150	6	5	30	AC
	200	6	5	30	AC

LUMBER:

A. Bearing Raggle Boards: 2 1/2" x 3 1/2" x 47"
B. Bearing Flat Boards: 3" x 4" x 95"
C. Separator Raggle Boards: 2 1/2" x 3 1/2" x 47"
D. Separator Flat Boards: 2" x 4" x 95"
E. Chocks: 3 1/2" x 3 1/2"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and first Separator Boards

CTD013943

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					6J		

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DESCRIPTION:

8" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ONE END - OFFSET UNITS - RAGGLE BOARDS					
8"	100	4	4	16	AC
	150	4	4	16	AC
	200	4	4	16	AC
8' WIDE-BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
8"	100	9	3	27	BDE
	150	9	3	27	BDE
	200	8	3	24	BDE
ACCESSORIES - 4' WIDE - 1/2 AND 1/4 MEO'S					
8"	100	5	4	20	AC
	150	5	4	20	AC
	200	5	4	20	AC

LUMBER:

A. Bearing Raggle Boards: 2 1/2" x 3 1/2" x 47"
B. Bearing Flat Boards: 3" x 4" x 95"
C. Separator Raggle Boards: 2 1/2" x 3 1/2" x 47"
D. Separator Flat Boards: 2" x 4" x 95"
E. Chocks: 3 1/2" x 3 1/2"

Steen Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and first Separator Boards

CTD013944

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - RIVERSIDE

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
	85-1	3

SUPERSEDES:	DATE OF ISSUE:
ALL PREVIOUS	NOVEMBER 1, 1985

DESCRIPTION:

10" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ONE END - OFFSET UNITS - RAGGLE BOARDS					
10"	100	3	3	9	AD
	150	3	3	9	AD
	200	3	3	9	AD
8' WEDE-BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
10"	100	7	3	21	BEI
	150	7	3	21	BEI
	200	6	3	18	BGI
ACCESSORIES - 4' WIDE - 1/2 AND 1/4 MEO'S					
10"	100	4	3	12	CHI
	150	4	3	12	CHI
	200	4	3	12	CHI

LUMBER:

A. Bearing Raggle Boards: 2 1/2" x 3 1/2" x 36"
B. Bearing Flat Boards: 3" x 4" x 95"
C. Bearing Flat Boards: 3" x 4" x 48"
D. Separator Raggle Boards: 2" x 2" x 36"
E. Separator Flat Boards: 2" x 4" x 95"
F. Separator Raggle Boards: 2 1/2" x 3 1/2" x 36"
G. Separator Flat Boards: 3" x 4" x 95"
H. Separator Flat Boards: 2" x 4" x 48"
E. Chocks: 3 1/2" x 3 1/2"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: Zinc coated, on bearing boards and first Separator Boards

CTD013945

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E	Q.C.	OTHERS
G. A. BERKHIMER					6/		

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DESCRIPTION:

12" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER PIPE	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ONE END - OFFSET UNITS - RAGGLE BOARDS					
12"	100	3	3	9	AD
	150	3	3	9	AD
	200	3	3	9	AE
8' WIDE- BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
12"	100	6	2	12	BFI
	150	6	2	12	BGI
	200	6	2	12	BGI
ACCESSORIES - 4' WIDE - 1/2 AND 1/4 MEO'S					
12"	100	3	3	9	CHI
	150	3	3	9	CHI
	200	3	3	9	CHI

LUMBER:

A. Bearing Raggle Boards: 2 1/2" x 3 1/2" x 44"
B. Bearing Flat Boards: 3" x 4" x 95"
C. Bearing Flat Boards: 3" x 4" x 43"
D. Separator Raggle Boards: 2" x 2" x 44"
E. Separator Raggle Boards: 2 1/2" x 3 1/2" x 44"
F. Separator Flat Boards: 2" x 4" x 95"
G. Separator Flat Boards: 3" x 4" x 95"
H. Separator Flat Boards: 2" x 4" x 43"
I. Chocks: 3 1/2" x 3 1/2"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - RIVERSIDE

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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SUPERSEDES:	DATE OF ISSUE:
ALL PREVIOUS	NOVEMBER 1, 1985

DESCRIPTION:

14" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
14"	100	5	2	10	ACD
	150	5	2	10	ABD
	200	5	2	10	ABD
ACCESSORIES - 8' WIDE - 1/2 AND 1/4 MEO'S					
14"	100	5	2	10	ACD
	150	5	2	10	ACD
	200	5	2	10	ACD

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 3" x 4" x 95"
C. Separator Flat Boards: 2" x 4" x 95"
D. Chocks: 3 1/2" x 3 1/2"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and Separator Boards

CTD013947

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					6:1		

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DESCRIPTION:

16" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
16"	100	5	2	10	ACD
	150	5	2	10	ABD
	200	5	2	10	ABD
ACCESSORIES - 8' WIDE - 1/2 AND 1/4 MEO'S					
16"	100	5	2	10	ACD
	150	5	2	10	ACD
	200	5	2	10	ACD

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 3" x 4" x 95"
C. Separator Flat Boards: 2" x 4" x 95"
D. Chocks: 3 1/2" x 3 1/2"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and Separator Boards

CTD013948

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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SUPERSEDES:		DATE OF ISSUE:
ALL PREVIOUS		NOVEMBER 1, 1985

DESCRIPTION:

18" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
18"	100	4	2	8	ABC
	150	4	2	8	ABC
ACCESSORIES - 8' WIDE - 1/2 AND 1/4 MEO'S					
18"	100	4	2	8	ABC
	150	4	2	8	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 3" x 4" x 95"
C. Chocks: 3 1/2" x 3 1/2"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and Separator Boards

CTD013949

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER							

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	8

DESCRIPTION:

20" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
20"	100	3	2	6	ABC
	150	3	2	6	ABC
ACCESSORIES - 8' WIDE - 1/2 AND 1/4 MEO'S					
20"	100	4	2	8	ABC
	150	4	2	8	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 3" x 4" x 95"
C. Chocks: 3 1/2" x 3 1/2"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and Separator Boards

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 9
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: NOVEMBER 1, 1985

DESCRIPTION:

24" A/C PRESSURE PIPE AND ACCESSORIES

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
24"	100	3	2	6	ABC
	150	3	1	3	AC
ACCESSORIES - 8' WIDE - 1/2 AND 1/4 MEO'S					
24"	100	3	2	6	ABC
	150	3	2	6	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 3" x 4" x 95"
C. Chocks: 3 1/2" x 3 1/2"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and first Separator Boards

CTD013951

PREPARED BY	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER							

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	10

DESCRIPTION:

6" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
6"	ALL	6	5	30	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 47"
B. Separator Flat Boards: 2" x 4" x 47"
C. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and First Separator Boards

CTD013952

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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DESCRIPTION:

8" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
8"	ALL	4	4	16	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 43"
B. Separator Flat Boards: 2" x 4" x 43"
C. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and first Separator Boards

CTD013953

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER							

02-10-0023 4/80

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	12

DESCRIPTION:

10" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
10"	ALL	4	3	12	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 47"
B. Separator Flat Boards: 2" x 4" x 47"
C. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and first Separator Boards

CTD013954

TECHNICAL SPECIFICATIONS

CertainTeed

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Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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ALL PREVIOUS		NOVEMBER 1, 1985

DESCRIPTION:

12" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE-BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
12"	ALL	3	3	9	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 43"
B. Separator Flat Boards: 2" x 4" x 43"
C. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and first Separator Boards

CTD013955

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E	Q.C.	OTHERS
G. A. BERKHIMER					6-1		

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	14

DESCRIPTION:

14" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
14"	ALL	5	2	10	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and first Separator Boards

CTD013956

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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SUPERSEDES:		DATE OF ISSUE:
ALL PREVIOUS		NOVEMBER 1, 1985

DESCRIPTION:

15" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE-BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
15"	ALL	5	2	10	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc cated, on Bearing Boards and first Separator Boards

CTD013957

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					G.J		

02-10-0023 4/80

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
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DESCRIPTION:

16" A/C Sewer PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
16"	ALL	5	2	10	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013958

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.
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SUPERSEDES:		DATE OF ISSUE:
ALL PREVIOUS		NOVEMBER 1, 1985

DESCRIPTION:

18" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
18"	ALL	5	2	10	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013959

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					(-/		

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	18

DESCRIPTION:

20" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
20"	ALL	4	2	8	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

TECHNICAL SPECIFICATIONS

CertainTeed

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Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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SUPERSEDES:		DATE OF ISSUE:
ALL PREVIOUS		NOVEMBER 1, 1985

DESCRIPTION:

21" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
21"	ALL	3	2	6	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013961

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER							

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
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DESCRIPTION:

24" A/C SEWER PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNAT END - OFFSET UNITS - FLAT BOARDS					
24"	ALL	3	2	6	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separated Boards

TECHNICAL SPECIFICATIONS

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CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 21
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: NOVEMBER 1, 1985

DESCRIPTION:

6" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - UNBELLED - FLAT BOARDS					
6"	ALL	6	5	30	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 47 1/2"
B. Separator Flat Boards: 2" x 4" x 47 1/2"
C. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013963

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					(c)		

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	22

DESCRIPTION:

8" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - UNBELLED - FLAT BOARDS					
8"	ALL	4	4	16	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 43"
B. Separator Flat Boards: 2" x 4" x 43"
C. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated, on Bearing Boards and first Separator Boards

CTD013964

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 23
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: NOVEMBER 1, 1985

DESCRIPTION:

10" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - UNBELLED - FLAT BOARDS					
10"	ALL	4	3	12	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 47"
B. Separator Flat Boards: 2" x 4" x 47 1/2"
C. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013965

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER							

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	24

DESCRIPTION:

12" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - UNBELLED - FLAT BOARDS					
12"	ALL	3	3	9	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 43"
B. Separator Flat Boards: 2" x 4" x 43"
C. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013966

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 25
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: NOVEMBER 1, 1985

DESCRIPTION:

14" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - UNBELLED - FLAT BOARDS					
14"	ALL	5	2	10	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 94"
B. Separator Flat Boards: 2" x 3" x 94"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013967

PREPARED BY	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER							

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DESCRIPTION:

15" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - UNBELLED - FLAT BOARDS					
15"	2000 D	3	2	6	ABC
	2500 D	3	2	6	ABC
8' WIDE - UNBELLED - FLAT BOARDS					
15"	ALL	5	2	10	DEC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 47 1/2"
B. Separator Flat Boards: 2" x 4" x 47 1/2"
C. Chocks: 3" x 3"
D. Bearing Flat Boards: 3" x 3" x 94"
E. Separator Flat Boards: 2" x 3" x 94"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 27
SUPERSEDES: ALL PREVIOUS	DATE OF ISSUE: NOVEMBER 1, 1985	

DESCRIPTION:

16" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - UNBELLED - FLAT BOARDS					
16"	ALL	5	2	10	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 94"
B. Separator Flat Boards: 2" x 3" x 94"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013969

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					6-5		

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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	28

DESCRIPTION:

18" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - UNBELLED - FLAT BOARDS					
18"	ALL	4	2	8	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 94"
B. Separator Flat Boards: 2" x 3" x 94"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 29
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: NOVEMBER 1, 1985

DESCRIPTION:

20" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - UNBELLED - FLAT BOARDS					
20"	ALL	4	2	8	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 94"
B. Separator Flat Boards: 2" x 3" x 94"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separated Boards

CTD013971

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	30

DESCRIPTION:

21" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - UNBELLED - FLAT BOARDS					
21"	ALL	4	2	8	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 94"
B. Separator Flat Boards: 2" x 3" x 94"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013972

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

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T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 31
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DESCRIPTION:

24" A/C STORM DRAIN PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - UNBELLED - FLAT BOARDS					
24"	ALL	3	2	6	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 3" x 94"
B. Separator Flat Boards: 2" x 3" x 94"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013973

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER					(C)		

02-10-0023 4/80

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DESCRIPTION:

6" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
6"	ALL	6	5	30	ACE
8' WIDE - BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
6"	ALL	4	4	16	BDE

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 47"
B. Bearing Flat Boards: 3" x 4" x 95"
C. Separator Flat Boards: 2" x 4" x 47"
D. Separator Flat Boards: 2" x 4" x 95"
E. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

TECHNICAL SPECIFICATIONS

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Pipe and Plastics Group

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PACKAGING METHODS - RIVERSIDE		
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DESCRIPTION:

8" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
8"	ALL	4	4	16	ACE
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
8"	ALL	9	3	27	BDE

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 43"
B. Bearing Flat Boards: 3" x 4" x 95"
C. Separator Flat Boards: 2" x 4" x 43"
D. Separator Flat Boards: 2" x 4" x 95"
E. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013975

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
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DESCRIPTION:

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PACKAGING METHODS - RIVERSIDE		
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ALL PREVIOUS		NOVEMBER 1, 1985

DESCRIPTION:

10" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
10"	30-50	4	3	12	ADG
	60-90	3	3	9	BEG
8' WIDE - BELLED ONE END - OFFSET UNITS - FLAT BOARDS					
10"	30-70	7	3	21	CFG
	80-90	6	3	18	CFG

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 47"
B. Bearing Flat Boards: 3" x 4" x 43"
C. Bearing Flat Boards: 3" x 4" x 95"
D. Separator Flat Boards: 2" x 4" x 47"
E. Separator Flat Boards: 2" x 4" x 43"
F. Separator Flat Boards: 2" x 4" x 95"
G. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

CTD013977

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G. A. BERKHIMER							

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DESCRIPTION:

12" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
12"	ALL	3	3	9	ACE
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
12"	ALL	6	2	12	BDE

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 43"
B. Bearing Flat Boards: 3" x 4" x 95"
C. Separator Flat Boards: 2" x 4" x 43"
D. Separator Flat Boards: 2" x 4" x 95"
E. Chocks: 3" x 3"

Steel Bands: 3/4" x .025" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and first Separator Boards

TECHNICAL SPECIFICATIONS

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PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
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SUPERSEDES:		DATE OF ISSUE:
ALL PREVIOUS		NOVEMBER 1, 1985

DESCRIPTION:

14" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
14"	ALL	5	2	10	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .020" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and Separator Boards

CTD013979

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER							

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DESCRIPTION:

15" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
15"	30-50	5	2	10	ABC
	60-90	5	1	5	AC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and Separator Boards

TECHNICAL SPECIFICATIONS

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T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 38
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: NOVEMBER 1, 1985

DESCRIPTION:

16" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
16"	30-60	5	2	10	ABC
	70-90	5	1	5	AC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and Separator Boards

CTD013981

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E	Q.C.	OTHERS
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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:
NOVEMBER 1, 1985	85-1	39

DESCRIPTION:

18" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
18"	30-35	5	2	10	ABC
	40-90	4	2	8	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and Separator Boards

CTD013982

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 40
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: NOVEMBER 1, 1985

DESCRIPTION:

20" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
20"	ALL	4	2	8	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and Separator Boards

CTD013983

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
G. A. BERKHIMER							

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DESCRIPTION:

21" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
21"	ALL	3	2	6	ABC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and Separator Boards

TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: PACKAGING METHOD - RIVERSIDE		
T.C.O. REF. NO.	SPECIFICATION NO: 85-1	PAGE NO.: 42
SUPERSEDES: ALL PREVIOUS		DATE OF ISSUE: NOVEMBER 1, 1985

DESCRIPTION:

24" A/C FLUID TRANSMISSION PIPE

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS - FLAT BOARDS					
24"	30-60	3	2	6	ABC
	70-90	3	1	3	AC

LUMBER:

A. Bearing Flat Boards: 3" x 4" x 95"
B. Separator Flat Boards: 2" x 4" x 95"
C. Chocks: 3" x 3"

Steel Bands: 1 1/4" x .031" One positioned around center of unit

Perforated Straps: 3/4" x .020" Zinc coated on Bearing Boards and Separator Boards

CTD013985

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
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DATE OF ISSUE:	SPECIFICATION NO:	PAGE NO.:

DESCRIPTION:

CTD013986

FORM P927

TECHNICAL SPECIFICATIONS

A-C

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
27	General Sec. L	1-1-1
SUPERSEDES:		DATE OF ISSUE:
1-3-73		APR 18 1975

DESCRIPTION:

STANDARD LENGTH A/C PIPE PART I - TABLE OF CONTENTS

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PART XVB	BUREAU OF RECLAMATION/ FLUID TRANSMISSION	2-15B-1

CTD013987

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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GENERAL

TECHNICAL SPECIFICATIONS

FORM P827

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING INSTRUCTIONS - ALL PLANTS

T.C.O REF. NO.	SPECIFICATION NO:	PAGE NO.:
23	GENERAL SEC. L	1 of 1

SUPERSEDES:	DATE OF ISSUE:
11-1-71	SEP 2 4 1973

DESCRIPTION:

PART II - PACKAGING INFORMATION - *13 FOOT LENGTHS

A - IDENTIFICATION CHART

PIPE	SIZE	4' Units: UNBELLED	4' Units: UNBELLED CANNON BALL	4' Units: BELLED ONE END	4' Units: ALTERNATE BELLED	8' Units: UNBELLED	8' Units: BELLED ONE END	8' Units: ALTERNATE BELLED
Pressure	3" - 4"	x	x	x				x
	6" - 10"			x			x	
	12"			x				x
	14" - 24"							x
Pressure Common Groove	6" - 10"			x			x	
	12"			x				x
	14" - 16"							x
Sewer	4" - 6"	x	x					
	8" - 10"			x			x	
Common Groove	12"			x				x
	14" - 24"							x
Irrigation								
	3" - 5"	x	x					
Type 25/75/90 only	6" - 10"			x			x	
	12"			x				x
	14" - 24"							x
Type 125 Class 100/150/200	3" - 4"	x	x	x				x
	6" - 10"			x			x	
	12"			x				x
	14" - 24"							x
Irrigation Common Groove								
Type 25/75/90 only	6" - 10"			x			x	
	12"			x				x
	14" - 16"							x

CTD013988

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

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CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO. 23	SPECIFICATION NO: GENERAL SEC. L	PAGE NO. 1-2-2
SUPERSEDES: 1-3-73	DATE OF ISSUE: SEP 2 4 1973	

DESCRIPTION:

PART II - PACKAGING INFORMATION

A - IDENTIFICATION CHART		4' UNITS				8' UNITS				
DESCRIPTION		Unbelled	Unbelled Cannon Ball	Belled One End	Alternate Belled	Unbelled	Belled One End	Alternate Belled	Unbelled Cannon Ball	
TYPE	SIZE									
13 FOOT LENGTHS										
Irrigation CG Type 125 Class 100/150/200	6" - 10"				x		x			
	12"				x			x		
	14" - 16"							x		
Bureau of Reclamation/ Fluid Transmission Class 30-90	6" - 10"				x		x			
	12"				x		x	x		
	14" - 24"						x	x		
Storm Drain	6" - 24"					x				
***MEO QUARTER LENGTHS**										
Pressure	4"		x							
	18" - 24"					x				
Pressure CG	6" - 8"		x							
	10" - 12"	x								
	14" - 16"					x				
Sewer CG	8"		x							
	10" - 12"	x								
	14" - 24"					x				
***MEO HALF LENGTHS**										
Pressure	4"		x							
	18" - 24"					x				
Pressure CG	6" - 8"		x							
	10" - 12"	x								
	14" - 16"					x				
Sewer CG	8"		x							
	10" - 12"	x				x			x	
	14" - 24"					x				

* Denotes Change

CTD013989

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

FORM P927

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF NO. 23	SPECIFICATION NO: GENERAL SEC. L	PAGE NO. 1-2
SUPERSEDES: 11-1-71	DATE OF ISSUE: SEP 24 1973	

DESCRIPTION:

PART II PACKAGING INFORMATION

B PARAMETERS OF CALCULATIONS:

1. Fork Lift Truck
   a. Maximum Lifting *3,650 lbs. (4' Unit)
   b. Maximum Lifting *7,300 lbs. (8' Unit)

2. Width of Unit:
   a. 8 Foot Unit.
      (1) 94 inches.
   b. 4 Foot Unit.
      (1) 47 inches.

3. Board Sizes:
   a. Bearing Board.
      (1) 3" x 3" x 94" (8' Unit)
      (2) 3" x 3" x 47" (4' Unit)
   b. Separator Boards.
      (1) 2" x 4" x 94" (8' Unit)
      (2) 1" x 4" x 94" (8' Unit)
      (3) 2" x 4" x 47" (4' Unit)
      (4) 1" x 4" x 47" (4' Unit)
   c. The 84" Bearing and Separator Boards can be used at all locations for pipe size 14" and 16" , provided the size package has been test shipped.

C. RECOMMENDED LUMBER, BANDS AND FASTENERS:

1. Lumber used in unit construction must allow clearance between layers so that couplings do not touch verticall .
   a. Separator Boards. (Hardwood-rough cut)
      (1) 1" x 4" For unbelled units 3" thru 6"
      (2) 1" x 4" For all units 3" thru 5"

CTD013990

* Denotes Change

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

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(3) 2" x 4" For all units 6" thru 24" pipe

b. Bearing Boards (Hardwood-rough cut)

(1) 3" x 3" For all units 3" thru 24" pipe

*c. Chocks: (Length 3")

(1) 1 3/4" x 1 3/4" x 2 3/4" (2x2) 3" thru 8" pipe

(2) 2 3/4" x 2 3/4" x 3 7/8" (3x3) DIAGONAL CUT - 3" thru 15" pipe

(3) 3 5/8" x 3 5/8" x 5 1/2" (4x4) DIAGONAL CUT - 16" thru 24" pipe

d. Steel Strap:

(1) 1/2" x .020"

(2) PERFORATED AND ZINC COATED

e. Steel Bands: (4' units only)

(1) 3/4" x .020

(2) COATED WITH WAX AND PAINTED BLACK

f. Nails:

(1) 6d - 2" long

g. Staples:

(1) 2" - Coated

D. COUPLING & ACCESSORIES CARTONS:

DESCRIPTION	CARTON SPECIFICATION
SIZE-Inside dim.	$17\frac{1}{2}$" x $16\frac{1}{4}$" x $15\frac{1}{2}$"
TEST BURSTING	200# 84 LBS/1000 SQ. FT.
WEIGHT, GROSS	65 LBS. MAX.
SIZE LIMIT	75"
CONSTRUCTION	SINGLE WALL CORRUGATED REGULAR SLOTTED
WATER PROOFING	WAX IMPREGNATED

CTD013991

*Denotes Change

FORM P927

TECHNICAL SPECIFICATIONS

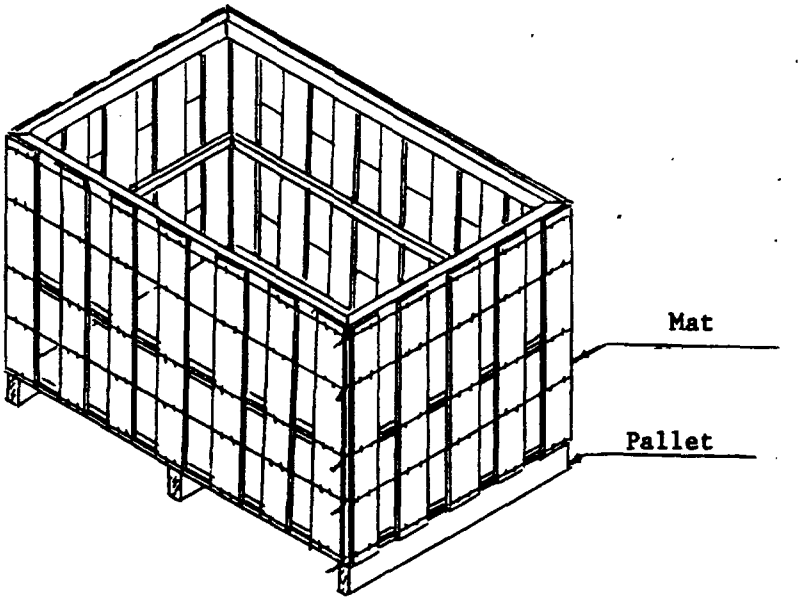
CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.: 29	SPECIFICATION NO: General Section L	PAGE NO.: 1-2-5
SUPERSEDES: New		DATE OF ISSUE: NOV 12 1975

DESCRIPTION:

Part II - Packaging Information



E. Coupling & Accessory Wire Bound Shipping Crates

1. Crates used in shipping of couplings and fittings as an alternative method to the use of trailer pig pens.

2. Crates used in yard storage for fast moving items. Stacking limit- 4 crates high.

3. Inside dimensions:

   48" x 40" x 30" H, does not include 4" Pallet

4. Constructed of resawn hardwood and assembled with 5-13 gauge wires around perimeter.

5. Weight per crates = 65 lbs.

CTD013992

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P.H. Foulds						

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O REF NO.	SPECIFICATION NO:	PAGE NO.
20	GENERAL SEC. L	1-3-1
SUPERSEDES: 11-1-71	DATE OF ISSUE: JUN 7 1973	

DESCRIPTION:

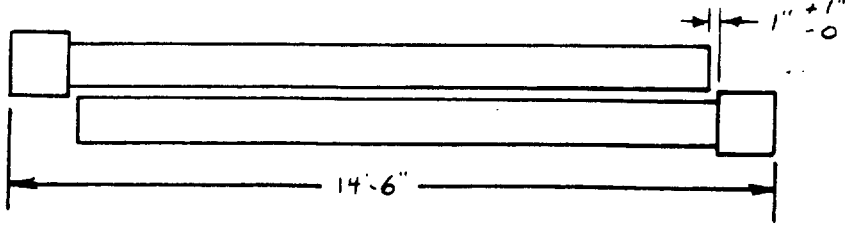
PART III - UNIT CONSTRUCTION DETAILS

A. CONSTRUCTION OF UNIT - 4 AND 8 FOOT UNITS:

1. Belled alternated end, belled one-end offset, and unbelled (Regular or Cannon-Balled) Units.
   a. One bearing board on bottom and separator board between each regular or cannon balled layer, each end.
   b. Locate boards 38" from each end of pipe.
   c. Staple or nail standard chocks 3" x 3" diagonal cut, to each end of bearing boards. Staple or nail chocks to each end, top and bottom of separator boards. Chocks must be tight against pipe.
   d. Multiple layers - nail 4 steel straps ½" x .020" to ends of bearing boards and then to next separator boards, one nail per end. Do not nail strap to top of bearing board or chock.
      (1) Single Layer - wrap strap over unit, nail two steel straps ½" x .020" to both ends of bearing board, one nail per end.
   e. Place steel strap around unit at center of 4 foot units only.

B. BUILDING OF UNIT:

1. Belled alternate end and belled one end offset units.
   a. Position two bearing boards, staple or nail chocks to one end, two nails or two staples per chock, one to each flat.
   b. Roll Pipe on Boards.
      (1) Belled alternate end-offset unit.
         (a) Alternating pre-belled ends.
      (2) Belled one end unit.
         (b) Belled same ends.
   * c. Offset Pipe
      (1) Belled alternate end, and belled one end offset units.
         (a) Unbelled and pre-belled ends shall be positioned a minimum of 1", and no more than 2", from the pre-belled coupling end.
      (2) The maximum length of any offset units shall not exceed 14'6".



PREPARED BY	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

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CTD013993

d. Staple or nail chock to other end of bearing board tight against pipe, two nails or two staples per chock, two to outside of flats.

e. Position two separator boards, nail chocks to one end, top and bottom, two nails or two staples per chock, one to each flat.

f. Position lower chock to other end, turn board 180°, nail lower chock, one nail or one staple.

g. Nail strap to each end of bearing board and to next separator board - (1) nail partially driven.

h. Roll pipe - refer to Part III - B-BUILDING OF UNIT, Sec. b

i. Stagger layers of pre-belled ends both vertically and horizontally.

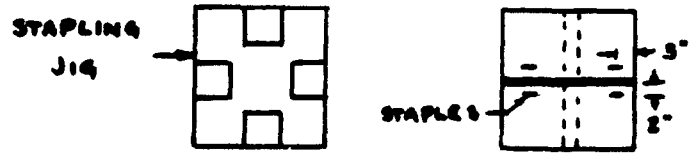
j. Staple or nail chock on the other end of separator board tight against pipe, two nails, one flat.

2. Unbelled Units:

a. Same as Part III-B-BUILDING OF UNIT.
b. With exception to Cannon-Balled units.
c. Disregard steps c. and i.

C. ASSEMBLING OF ACCESSORIES CARTON:

1. Unfold carton.
2. Fold two shorter flaps.
3. Fold remaining two flaps, so that edge butt each other.
4. Place carton over table with area to be stapled over cutouts. (interchangeable)
5. Fasten with four staples as indicated.



6. Remove from table, and place on floor with open flaps upward.
7. Place items in cartons as specified, and mark carton.
8. Close top flaps and staple as described in steps 2,3, and 5.

TECHNICAL SPECIFICATIONS

FORM P927

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO: General Section L	PAGE NO.: 1-3-3
SUPERSEDES: New		DATE OF ISSUE: NOV 12 1975

DESCRIPTION:

Part III - Unit Construction Details

D. Assembling of Wire Bound Shipping Crates:

1. Open one piece mat with beveled cleats to inside.
2. Place mat around pallet joining at one corner.
3. Join two wires at corner of crate. (5 locations)
4. Twist all wires with hand tool until tight.
5. Drive one staple per side into pallet, if desired.

CTD013995

PREPARED BY: P.H. Foulds	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO:
15	GENERAL SEC. L	1-4-1

SUPERSEDES:	DATE OF ISSUE:
11-1-71	JAN 3 1972

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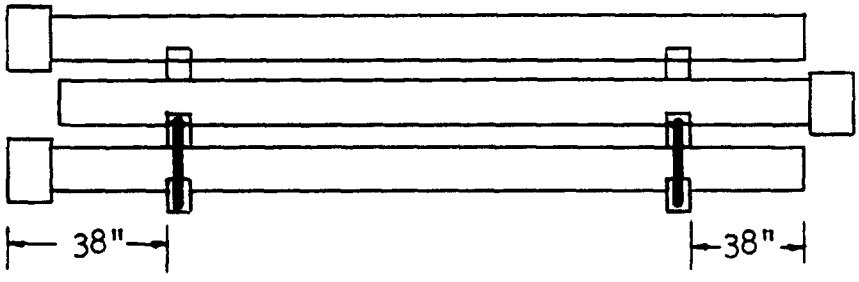
PART IV - UNIT DESCRIPTION

A. 8 FOOT UNITS:

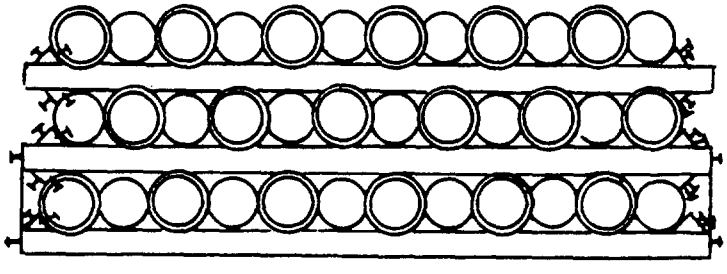
*1. Pressure, Sewer, Irrigation, Bureau of Reclamation/ Fluid Transmission Pipe.

a. Belled alternate ends - offset units.

(1) See PART II - A thru C - for applicable construction material.



SIDE VIEW



END VIEW

T - Nail or Staple

CTD013996

*Denotes Change

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. FOULDS 7-65						

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TECHNICAL SPECIFICATIONS

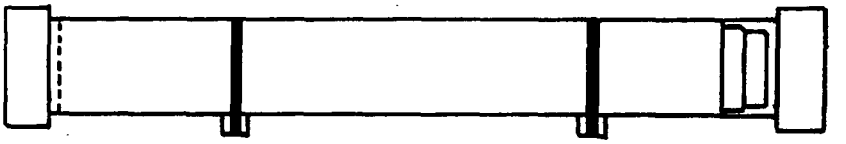
CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
27	General Sec. L	1-4-2
SUPERSEDES:		DATE OF ISSUE:
11-1-71		APR 18 1975

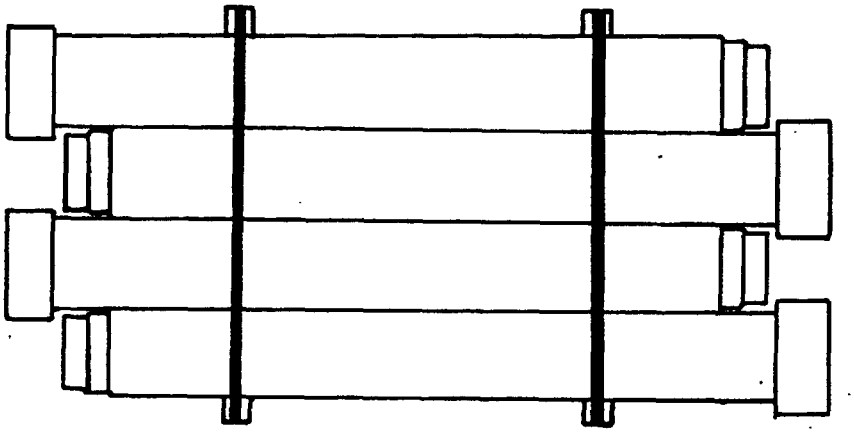
DESCRIPTION:

PART IV - UNIT DESCRIPTION

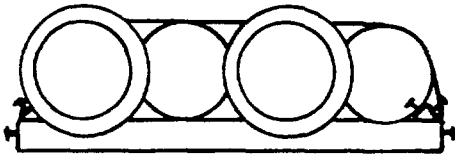
(b) SINGLE LAYER - ALTERNATELY BELLED



SIDE VIEW



TOP VIEW



END VIEW

CTD013997

T - NAIL OR STAPLE

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. Foulds PF						

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PIPE DIVISION

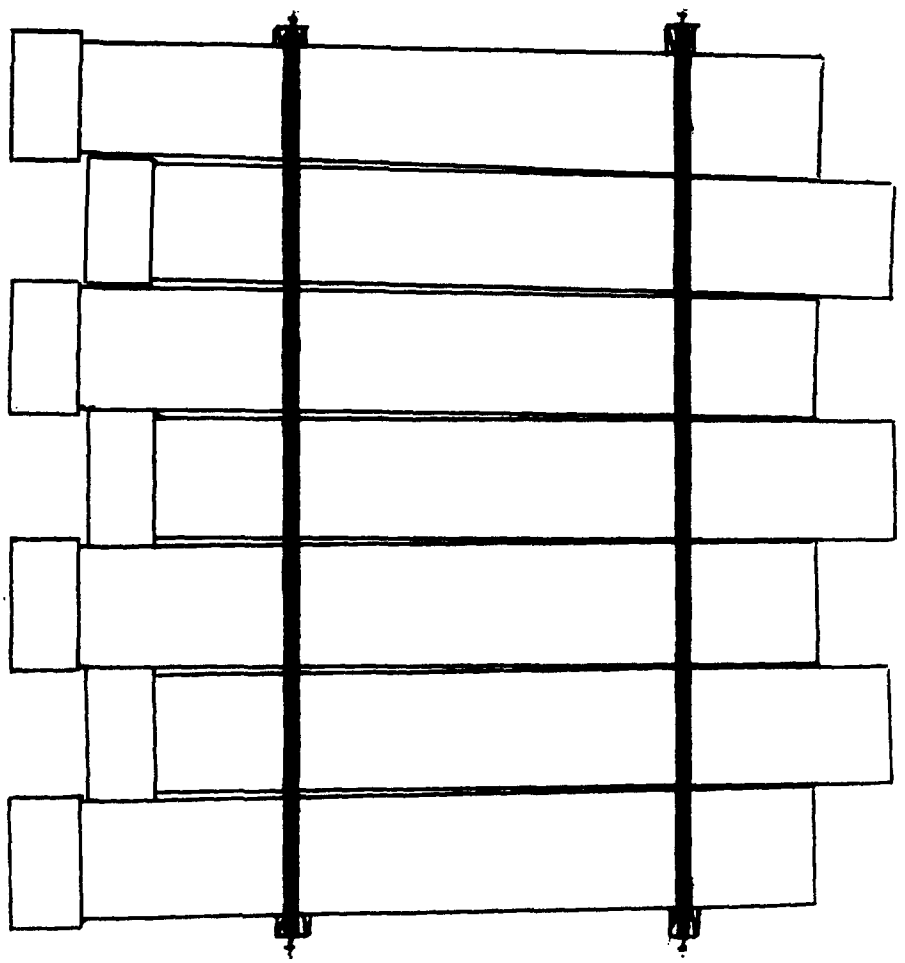
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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	1-4-3
SUPERSEDES:		DATE OF ISSUE:
4-28-70		11-1-71

DESCRIPTION:

PART IV - UNIT DESCRIPTION

b. Belled one end - Offset units.

(1) See Part II A Thru C for applicable Construction Material.



TOP VIEW

CTD013998

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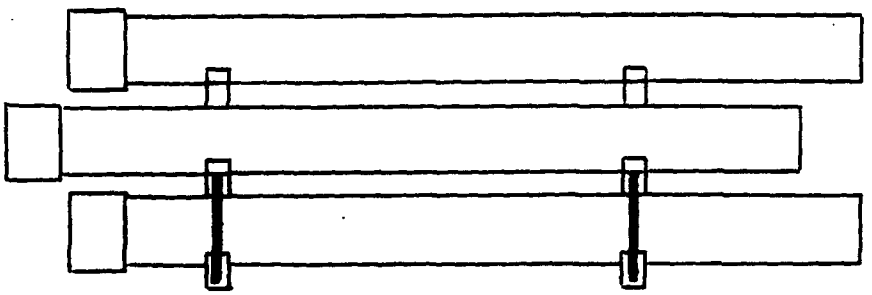
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

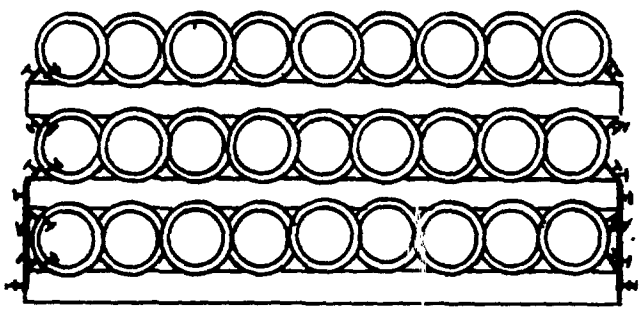
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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	1-4-4
SUPERSEDES:		DATE OF ISSUE:
4-28-70		11-1-71

DESCRIPTION:

PART IV - UNIT DESCRIPTION



SIDE VIEW



END VIEW

T - NAIL OR STAPLE

CTD013999

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

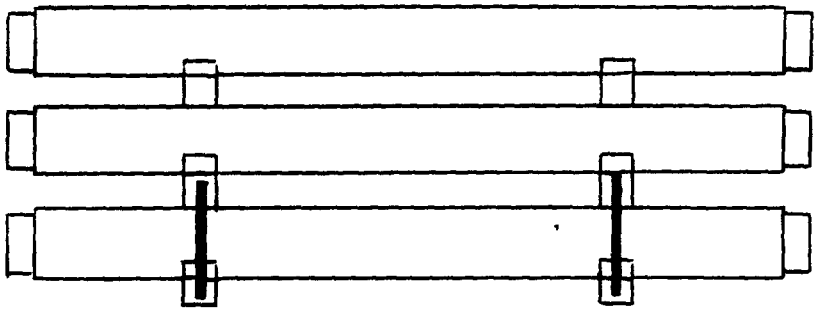
SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	GENERAL SEC. L	1-4-5
SUPERSEDES:		DATE OF ISSUE:
4-28-70		11-1-71

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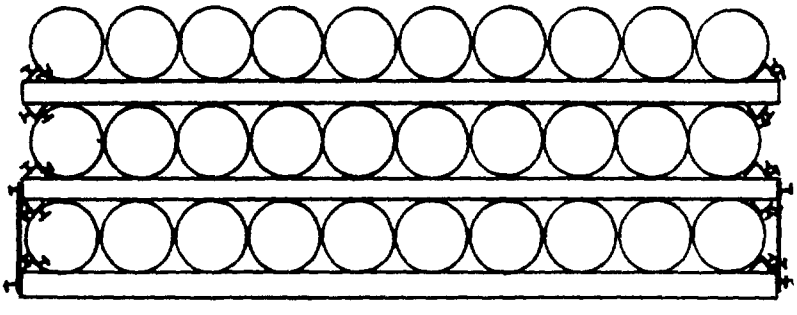
PART IV - UNIT DESCRIPTION

c. Unbelled Unit:

(1) See Part II A Thru C for applicable Construction Material.



SIDE VIEW



END VIEW

T - NAIL OR STAPLE

CTD014000

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T.C.O. REF. NO. 15	SPECIFICATION NO: GENERAL SEC. L	PAGE NO.: 1-4-6
SUPERSEDES: 11-1-71		DATE OF ISSUE: JAN 3 1973

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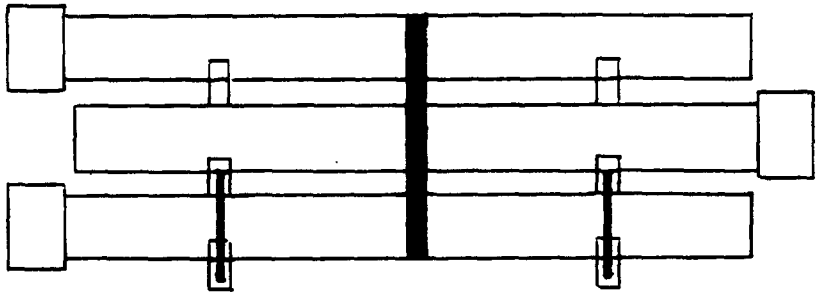
PART IV - UNIT DESCRIPTION

B. 4 FOOT UNITS:

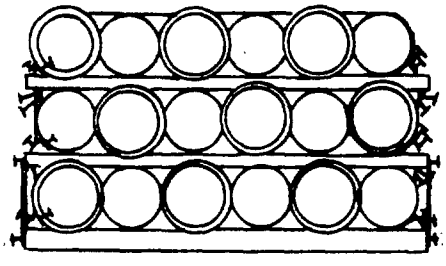
*1. Pressure, Sewer, Irrigation and BUREAU OF RECLAMATION/FLUID TRANSMISSION pipe.

a. Belled alternate ends offset units.

(1) See Part II A through C for applicable Construction Material.



SIDE VIEW



END VIEW

T - Nail or Staple

CTD014001

*Denotes Change.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. FOULDS						

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CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

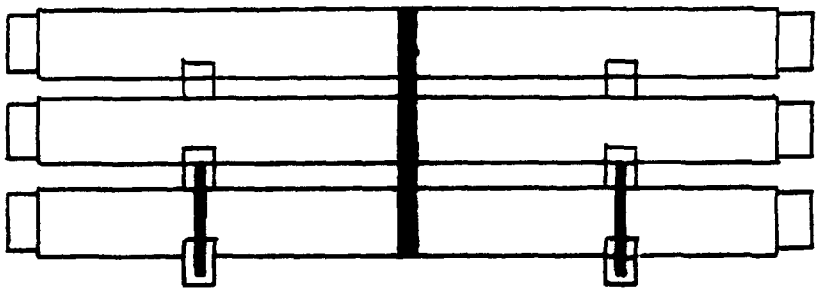
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PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	1-4-7
SUPERSEDES:		DATE OF ISSUE:
4-28-70		11-1-71

DESCRIPTION:

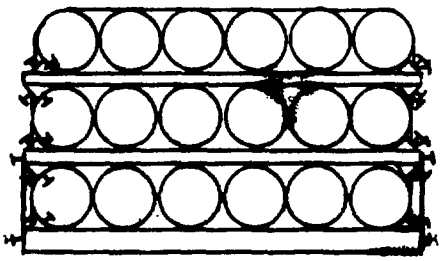
PART IV - UNIT DESCRIPTION

b. Unbelled Unit: (Regular)

(1) See Part II A Thru C for Applicable Material.



SIDE VIEW



END VIEW

T - NAIL OR STAPLE

CTD014002

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PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	1-4-8
SUPERSEDES:		DATE OF ISSUE: 11-1-71

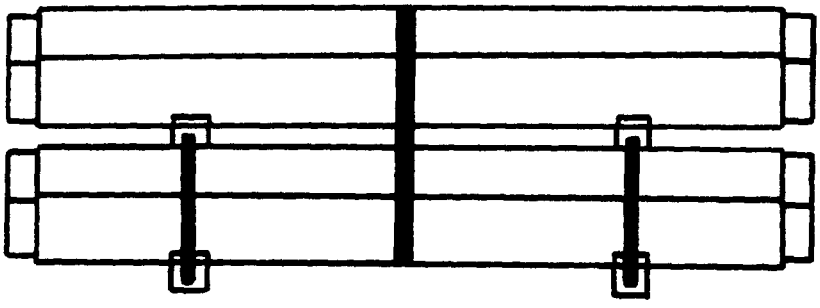
DESCRIPTION:

PART IV - UNIT DESCRIPTION

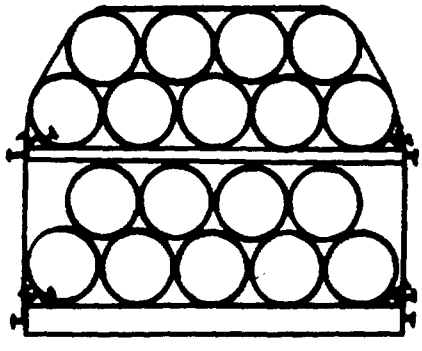
C. UNBELLED UNIT: (Cannon Balled)

(1) See Part II A thru C for Applicable material

(2) 4" thru 6" Pressure and Sewer pipe only.



SIDE VIEW



END VIEW

CTD014003

T- Nail or Staple

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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CERTAIN-TEED PRODUCTS CORPORATION
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SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
23	GENERAL SEC. L.	1-5-1
SUPERSEDES:		DATE OF ISSUE:
5-8-73		SEP 24 1973

DESCRIPTION:

PART V - UNIT LOADING

LOADING OF TRUCK:

* 1. Two steel straps shall be placed around each stack of pipe to increase the stability of the load. These straps are to be placed as close to separator boards as possible.

2. Two chains or two cables are required per stack and are to be placed as close to the boards as possible.

3. Chains or cables must be padded at all points where it comes into contact with the pipe under pressure.

   Specific materials now in use are used felts and used tire sections. If any similar protecting materials are used in the future, they shall be approved by this office.

* 4. Each stack of pipe must have protective material, and/or used felts between the stacks. This is to eliminate the possibility of damaging pipe during transit.

5. All units of pipe closest to front end of trailer shall be tarped for protection against exhaust fumes. Tarp shall be located on front portion of unit covering all pipe and coupling ends exposed to exhaust fumes.

6. The load must be properly secured with the approval of the Shipping Foreman before leaving the plant.

7. Belled one end units shall be loaded with belled ends positioned towards cab of truck.

CTD014004

* Denotes Change

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

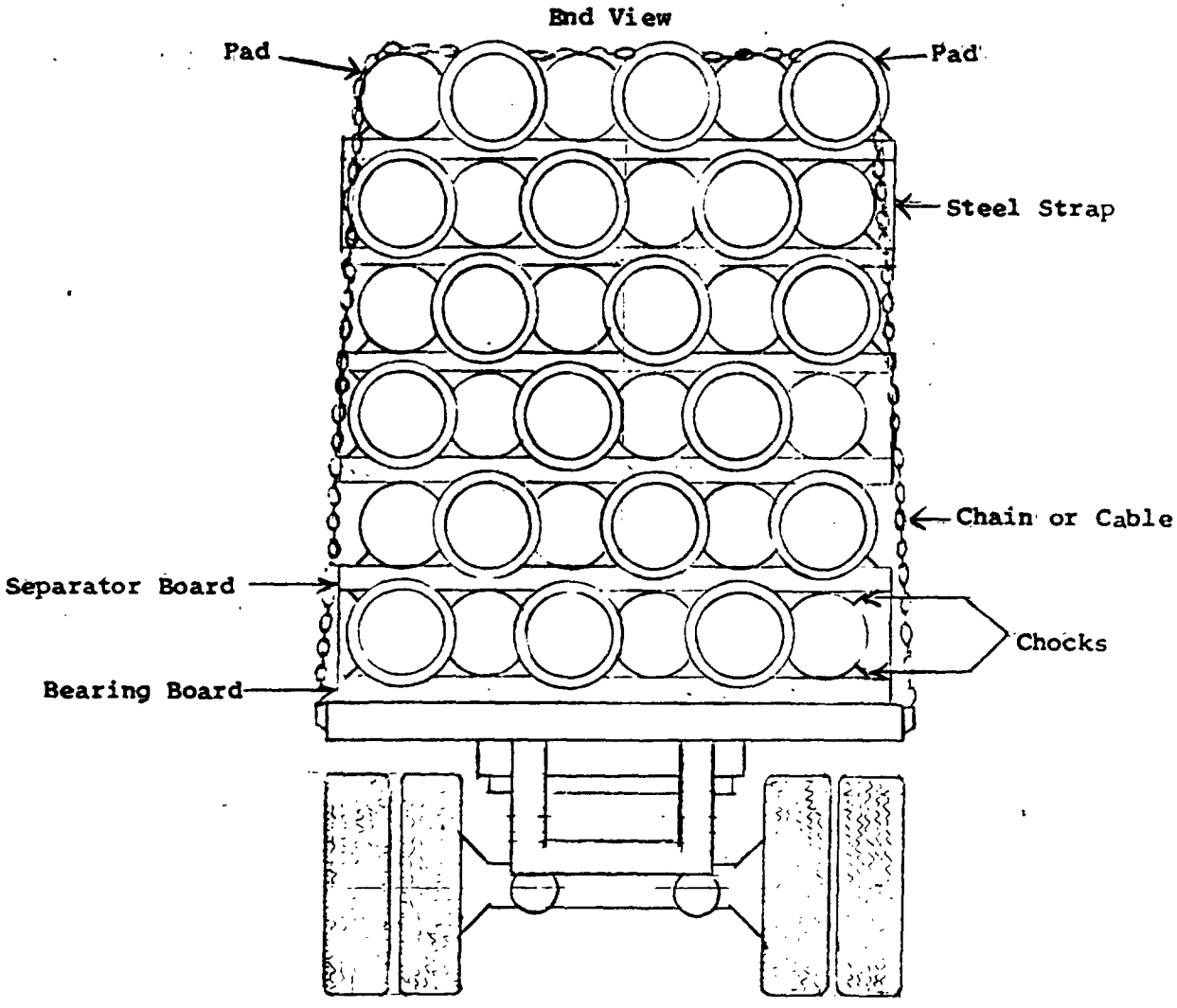
SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	GENERAL SEC. L	1-5-2
SUPERSEDES:		DATE OF ISSUE:
5-7-69		4-28-70

DESCRIPTION:

PART V UNIT LOADING

TRUCKLOAD BELLED ALTERNATE END UNITS

EXAMPLE



CTD014005

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P. Foulds						

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ACTION MEMO	Subject ☐ See attached

☐ For Your APPROVAL ☐ For Your COMMENT ☐ Advise COMPLETION Date ☐ CONTACT Me About This ☐ Per ☐ Our ☐ Your CONVERSATION ☐ For DISCUSSION ☐ Prepare ESTIMATE ☐ For Your FILE ☐ For FOLLOW-UP Record ☐ Please HANDLE ☐ For Your INFORMATION ☐ INVESTIGATE And Report ☐ READ ☐ Destroy ☐ Return ☐ Per Your REQUEST ☐ Advise STATUS	TO G. STELLAN FROM P. H FOULDS DATE 8-11-78 RETURN BY FORWARD TO

☒ RECOMMENDED CHANGES TO SPECIFICATIONS

CTD014006

Paul
please take care of item # 4 65

July 26, 1978 | See Below | See Below

Bureau of Reclamation (B/R) Problems | J. P. McGinley - ap | VF P&PG-2B #2125

To: Mr. J. F. Baker - VF P&PG-2B #2125
Mr. G. Stelian - VF P&PG-2B #2125
Mr. M. R. Streepy - BB P&PG #2126

The following will serve as minutes of the meeting held in my office this morning.

Jay Baker reviewed the following problems that the B/R was having with A-C pipe in an effort to see what corrective action we could propose.

(1) Elimination of Stab Belling

The B/R intends to forbid stab belling of pipe in the field and Jay feels that this restriction will most probably be extended to include the manufacturing plants. In view of this impending situation, it was agreed that manufacturing should explore the feasibility of converting our present in-plant stab-belling operation to hydraulic belling.

Jay agreed not to commit us to hydraulic belling unless he had no other choice and then he would attempt to get as much lead time as possible from the B/R.

(2) Hydraulic Testing of Pre-belled Pipe

We hydraulically test all couplings before they are assembled with the pipe and I asked Jay to resist all attempts to have us hydraulically test the pre-belled assembly. This requirement, if we had to comply with it, would reduce our production rates through Finishing by as much as 40%. I also feel that testing the pre-belled assembly can cause serious stresses in the coupling due to the deflection that often takes place between the coupling and pipe during the hydraulic test operation.

(3) Alternate Belling

Our present Packaging Specifications call for alternate-end belling. However, in practice, we ship most pipe fan-belled due to the requests from the contractor. I feel that the shipment of fan-belled pipe is the major cause of the cracked coupling problems that are being encountered by the B/R. It was agreed that the B/R would have to forbid the shipment of fan-belled pipe in order to effectively stop this practice.

(continued)

AUG - 4 1978

Bureau of Reclamation (B/R) Problems

(4) Flex Break Problems

A review of some of the pipe failures on B/R jobs indicates that flex failures could be caused during shipment to the job due to the placement of the hold-down chains on the trailer bed. In order to eliminate this as a possible cause, Gabe Stelian will revise our loading specifications so that the hold-down chains are placed within 12" of the bearing boards. If it is necessary for a particular load of pipe to place the hold-down chains in the middle of that load of pipe, then the plant will be required to install a third bearing board for that particular load of pipe.

If there are any areas that I have omitted or have stated incorrectly, I would appreciate your comments.

TECHNICAL SPECIFICATIONS

FORM P927

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

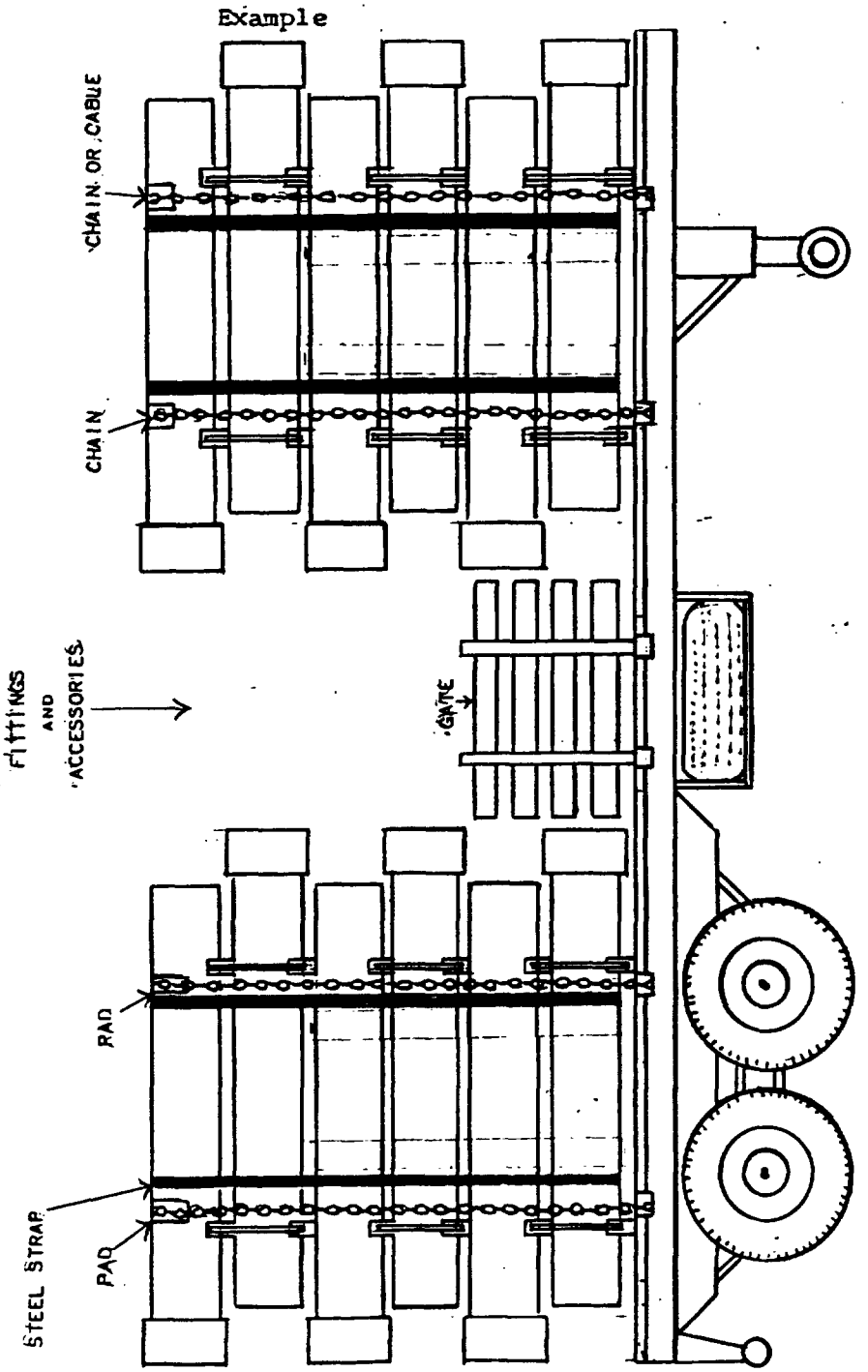
SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
23	GENERAL SEC. L	1-5-3
SUPERSEDES:		DATE OF ISSUE:
4-28-70		SEP 2 4 1973

DESCRIPTION:

PART V UNIT LOADING

TRUCKLOAD BELLED ALTERNATE END UNITS

Example



NOTE: Straps, chains and cables are to be placed as close to boards as possible, NOT TO EXCEED 12" ON EITHER SIDE, OF IF POSITIONED AT CENTER OF STACK, ADDITIONAL SEPARATION ON BOARDS WILL BE REQUIRED BETWEEN EACH LAYER OF STACK BOARDS SO THAT

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

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CTD014009

TECHNICAL SPECIFICATIONS

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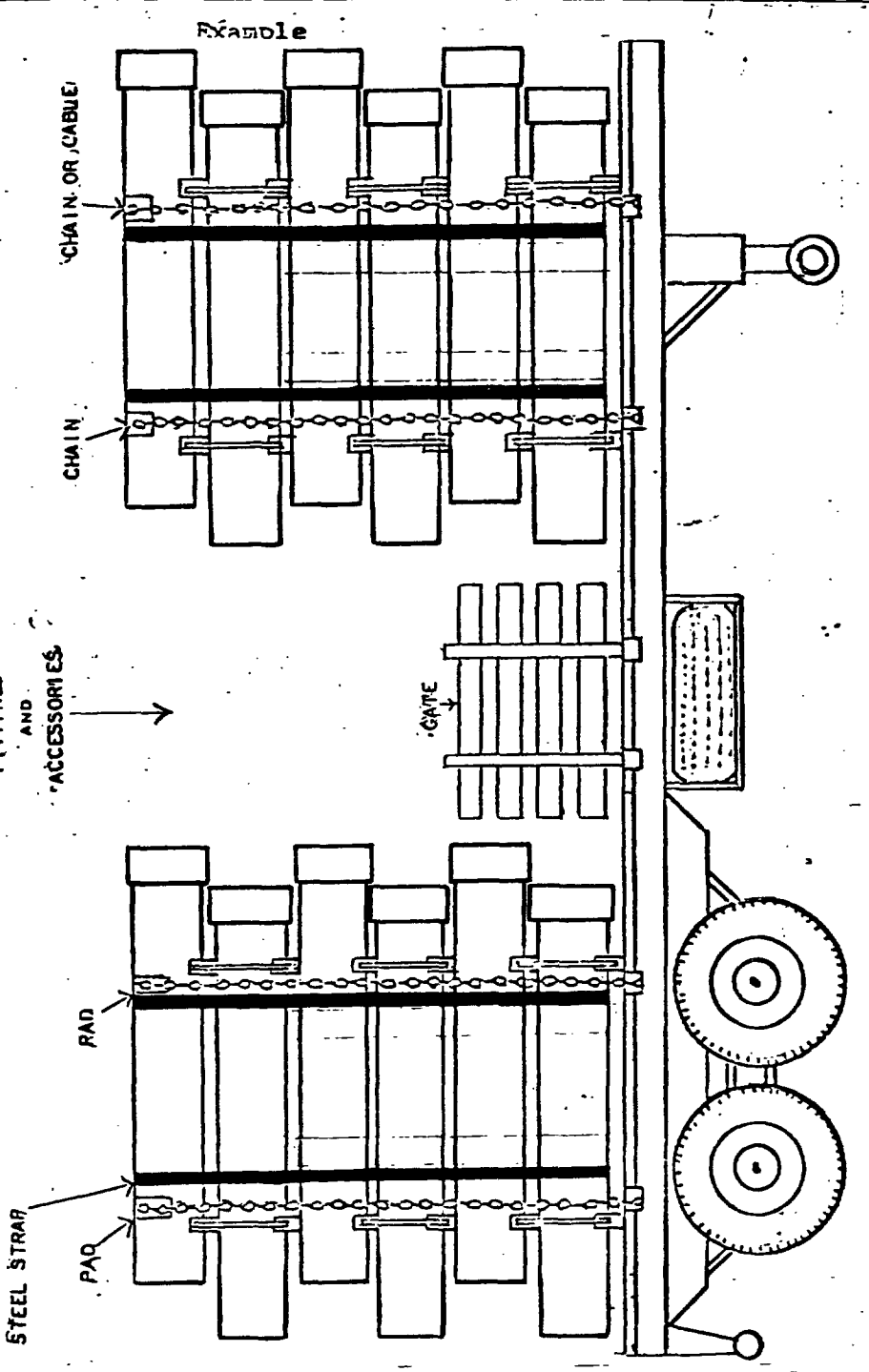
CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
23	GENERAL SEC. L	1-5-4
SUPERSEDES:		DATE OF ISSUE:
1-15-72		SEP 2 4 1973

DESCRIPTION:

PART V UNIT LOADING

TRUCKLOAD BELLED ONE END UNITS



NOTE: Straps, chains and cables are to be placed as close to boards as possible, not to exceed 12" on either side, or if positioned at center of stack, additional separation on bearing boards will be required between each layer of stack bearings

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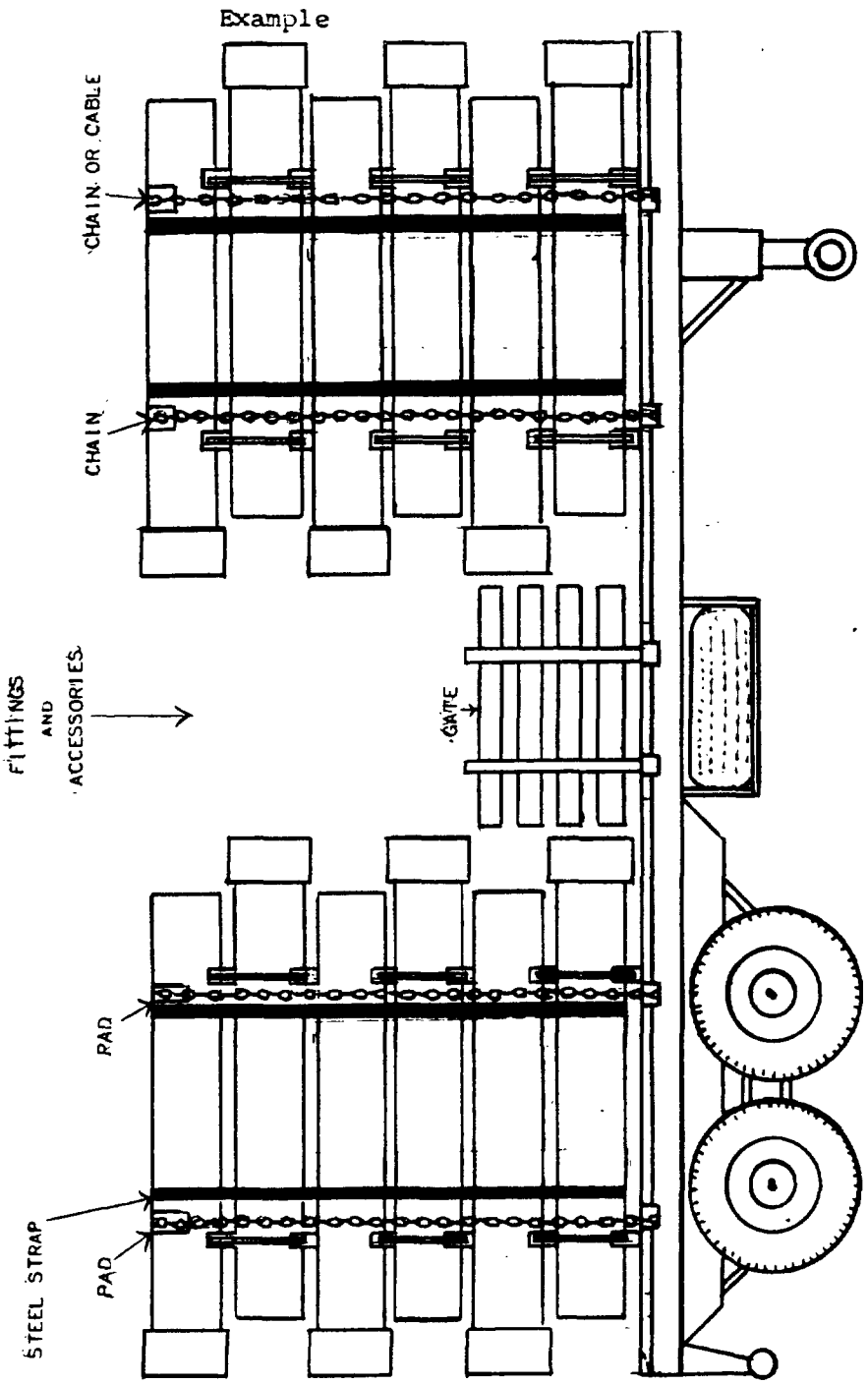
SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T C O REF NO.	SPECIFICATION NO:	PAGE NO
23	GENERAL SEC. L	1-5-3
SUPERSEDES: 4-28-70		DATE OF ISSUE: SEP 2 4 1973

DESCRIPTION:

PART V UNIT LOADING

TRUCKLOAD BELLED ALTERNATE END UNITS

Example



NOTE: Straps, chains and cables are to be placed as close to boards as possible.

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FORM P927

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T.C.O. REF. NO	SPECIFICATION NO:	PAGE NO:
23	GENERAL SEC. L	1-5-4

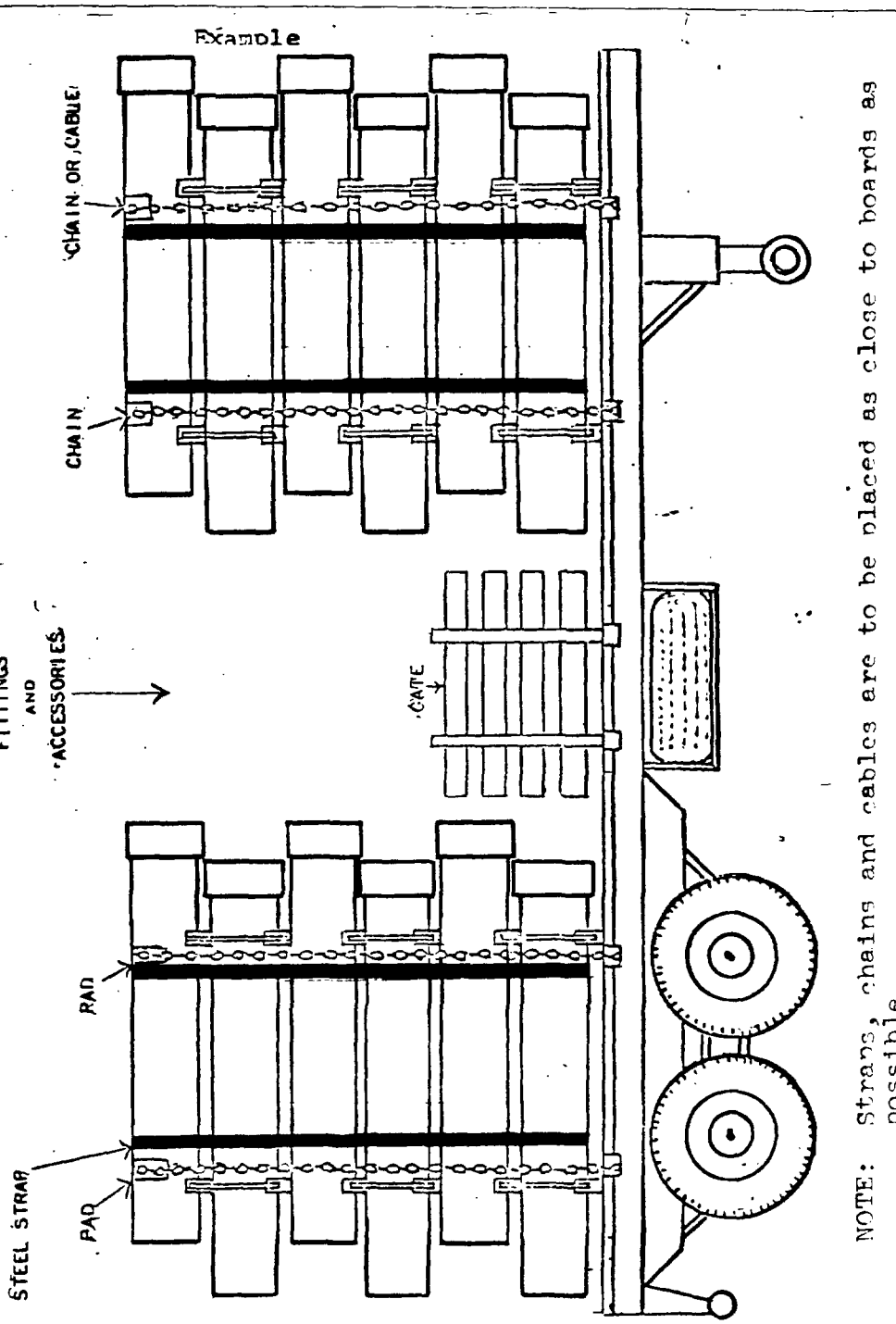
SUPERSEDES:	DATE OF ISSUE:
1-15-72	SEP 2 4 1973

DESCRIPTION:

PART V UNIT LOADING

TRUCKLOAD BELLED ONE END UNITS

Example



NOTE: Straps, chains and cables are to be placed as close to boards as possible.

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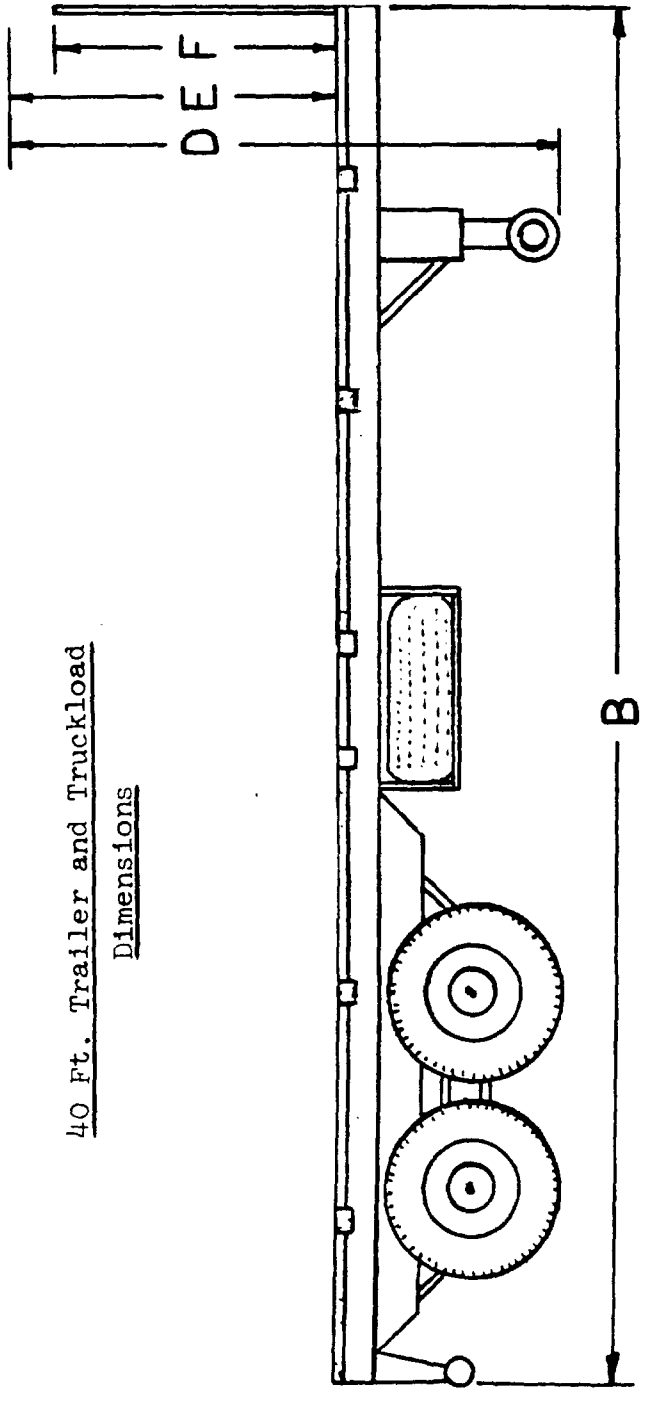
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

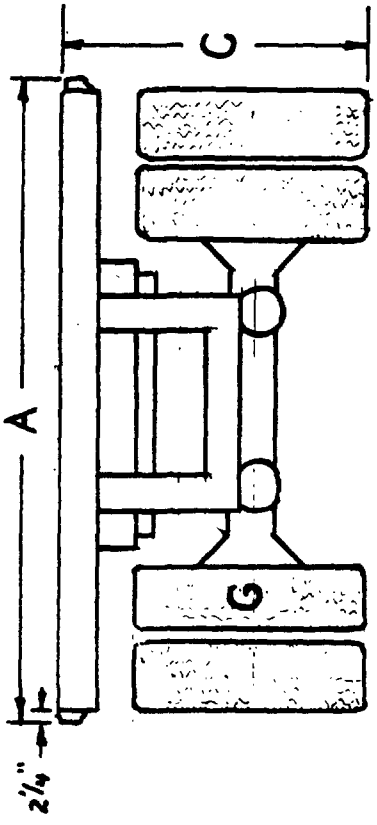
SPECIFICATIONS CLASSIFICATION:		
Packaging Methods -- All Plants		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO
15	General Sec L.	1-5-5
SUPERSEDES:		DATE OF ISSUE:
New		12-1-72

DESCRIPTION:

PART V - UNIT LOADING



40 Ft. Trailer and Truckload Dimensions



CTD014013

A - Trailer Width - 94.5"
B - Trailer Length- 39'10"
C - Trailer Height- 55"
D - Height, incl. Load - 162"
E - Load Height - 107"
F - Head Board Height - 48"
G - Tire Size - - 10.00 x 20

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	GENERAL SEC. L	1-6-1
SUPERSEDES:		DATE OF ISSUE:
5-7-69		4-28-70

DESCRIPTION:

PART VI - EXPORT PACKAGING

A. CONSTRUCTION OF UNITS - PIPE:

1. The pipe shall be unitized unbelled in 4 foot units either cannon ball or straight layers.
2. One Bearing Board on bottom and Separator Boards between layers, each end.
3. Locate Boards 38" from each end of pipe.
4. Nail standard chock, 3" x 3" diagonal cut, to each end of Bearing Boards. Nail chocks to each end, top and bottom of Separator Boards. Chocks must be tight against pipe.
5. Multiple Layers - Nail 4 steel straps ½" x .020 to ends of Bearing Boards and top sides of first separators, 1 nail per board.
6. Saw the excess length of the Bearing and Separator Boards which extend from the chocks to reduce the volume of the unit.
7. Band the entire unit with 3 girth straps of 1¼" x .031 steel strapping.

B. BUILDING OF UNIT:

1. Position 2 Bearing Boards, nail chocks to one end, 2 nails per chock, one to each flat.
2. Roll pipe on Boards - straight layer or Cannon Ball (2 layer).
3. Nail chock to other end of Bearing Board, tight against pipe, 2 nails per chock, two to outside flat.
4. Position 2 Separator Boards, nail chocks to one end top and bottom, 2 nails per chock, one to each flat.
5. Position Lower chock to other end, turn board 180°, nail Lower chock, 1 nail.

CTD014014

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6. Nail (1) strap (1) to each end of Bearing Board and top side of Separator, (1) nail partially driven.

7. Roll Pipe, See B.

8. Nail chock on the other end of the Separator Board tight against pipe, 2 nails, one flat.

C. CONSTRUCTION OF CRATES - Couplings and One-Quarter Lengths 3" - 24"

1. The crate shall be constructed of 1" x 6" hardwood lumber with approximate interior dimensions of 78" L. x 46"W x 42" H.

2. Frame ends with 2 x 4" hardwood lumber.

3. Space the boards 1½" apart.

4. Skid the crate to permit 2 way entry by a Fork Lift Truck.

5. Final dimensions will be dependent upon individual export orders and tailored and insure the security of the crate contents.

6. Place 1" x 4" or 1" x 6" boards on top from side to side and (1) board diagonally from corner to corner after the crate has been packed.

D. PACKAGING OF CRATE:

1. Position the specified quantity of the product in the crate.

2. Whenever possible, insert smaller pieces into larger pieces to keep volume requirements at a minimum.

3. The net weight of the crate should not exceed 5,500 lbs.

4. Band the crate with (3) 1¼" x .031 girth steel strapping around the sides and (3) straps around the ends.

CTD014015

FORM P927

TECHNICAL SPECIFICATIONS

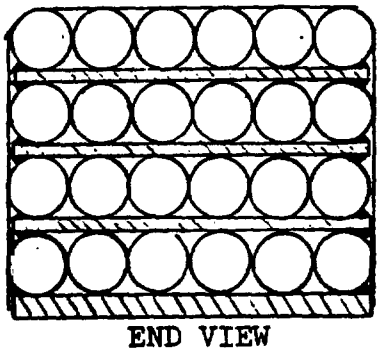
CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	GENERAL SEC. L	1-6-3
SUPERSEDES:		DATE OF ISSUE:
5-7-69		4-28-70

DESCRIPTION:

PART VI - EXPORT PACKAGING

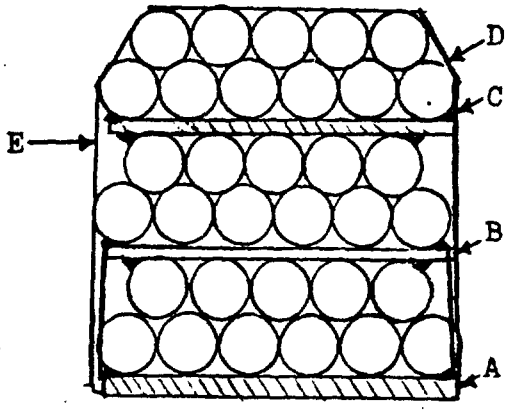
STRAIGHT STACKING



END VIEW

A. BEARING BOARDS
B. SEPARATOR "
C. CHOCKS
D. STEEL STRAP $1\frac{1}{4}$ x .031
E. STEEL STRAP $\frac{1}{2}$ x .020 - PERFORATED AND COATED

CANNONBALL STACKING



END VIEW

CTD014016

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. Foulds						

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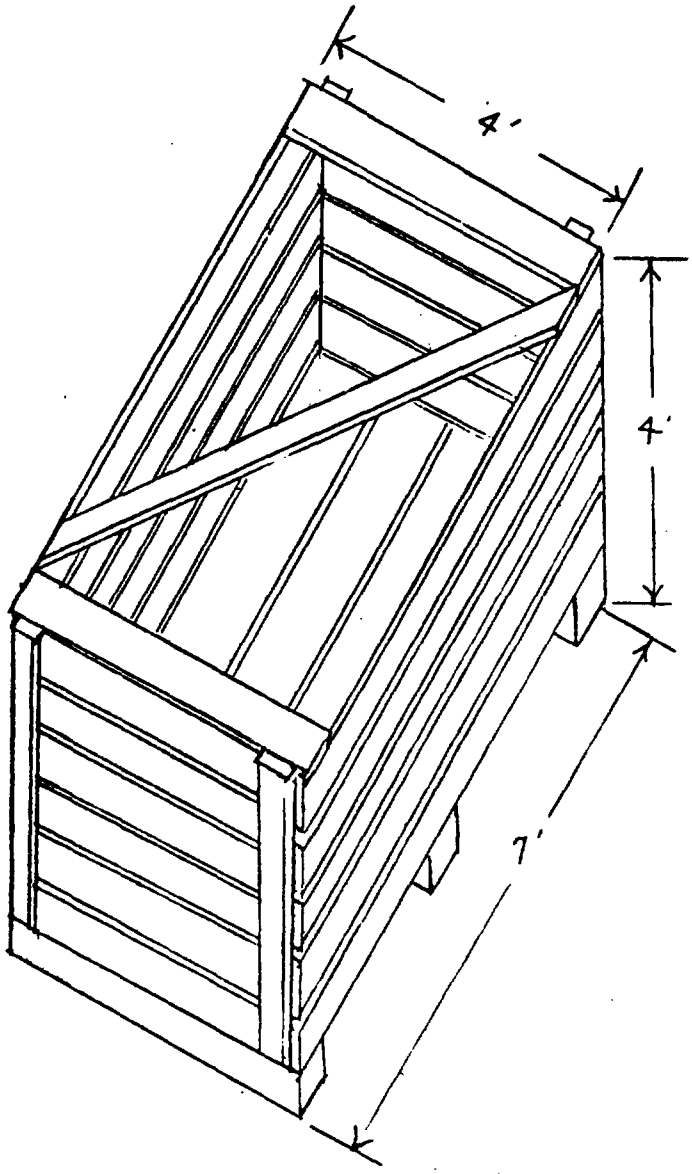
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PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	GENERAL SEC.L	1-6-4
SUPERSEDES:		DATE OF ISSUE:
5-7-69		4-28-70

DESCRIPTION:

PART VI - EXPORT PACKAGING

EXPORT CRATE FOR PIPE



CTD014017

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FORM P927

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PIPE DIVISION

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	GENERAL SEC. L	1-6-5
SUPERSEDES:		DATE OF ISSUE:
5-7-69		4-28-70

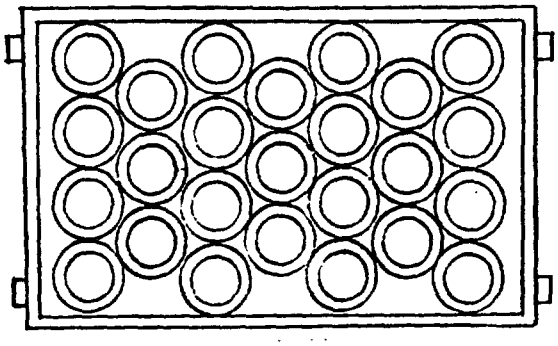
DESCRIPTION:

PART VI - EXPORT PACKAGING

EXPORT CRATE FOR COUPLINGS

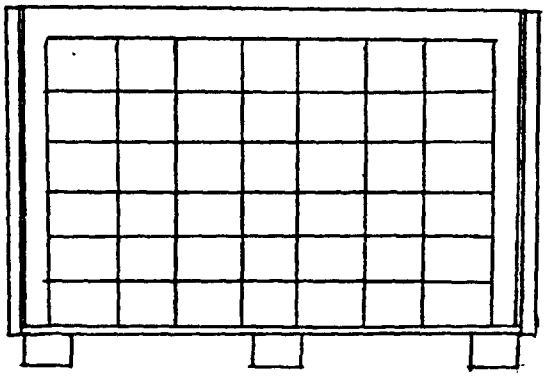
Top View

(Top Boards Removed)



Front View

(Front Boards Removed)



CTD014018

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO. ~~35~~	SPECIFICATION NO: GENERAL SEC. L.	PAGE NO.: 1-6B-1
SUPERSEDES: NEW		DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

GENERAL

1. SCOPE

1.1 This specification covers all export orders released by MKSAC. The specification may not cover all phases of the order, but the best export packaging method shall be practiced. Please do not deviate without approval from Division Packaging Engineer.

2. MATERIAL AND WORKMANSHIP

2.1 Material - Material used for packaging shall be recognized brands and grades, and shall conform to the best standards in the area in which products are shipped.

2.2 Workmanship - Workmanship shall be in accordance with best commercial practice and with the requirements of the applicable specification.

3. GENERAL PACKAGING REQUIREMENTS - A/C PIPE

3.1 Building of Export Unbelled Pipe Units

Item	Number of Pieces	Description
1.	Plywood Deck 1 per unit	3/8" thick, CDX grade, refer to page 1-6A-6-8 for approximate dimensions. Deck to be nailed or stapled to bearing boards with 12 staples or nails.
2.	Bearing Boards 2 per unit	3" x 3" mixed hardwoods refer to page 1-6A-6-8 for length dimensions. The boards shall be positioned no less than 32" from unit end.

CTD014019

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

TECHNICAL SPECIFICATIONS

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~91~~	GENERAL SEC. L.	1-6B-2

SUPERSEDES:	DATE OF ISSUE:
NEW	NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

Item	Number of Pieces	Description
3.	Chocks 2 per Bearing Board 4 per Separator Board	Triangular wood chock blocks driven securely against pipe, with each securely fastened to wood dunnage. Approximate Sizes Small- 1 3/4" x 1 3/4" x 2 3/4" (4"-8") Medium- 2 3/4" x 2 3/4" x 3 7/7" (10"-14") Large- 3 5/8" x 3 5/8" x 5 1/2" (16"-24") 2 staples or nails per chock.
4.	Separator Boards (Quantity required dependent on number of rows)	2" x 4" hardwoods, refer to page for length dimensions. All units of two or more rows must have separators vertically aligned above bearing boards.
5.	Staples	Signode or equal 1 3/8" x 3/4" steel - to be applied at board ends, where possible.
6.	Steel Strap 7 per unit	Signode or equal 1 1/4" x .031" Magnus steel strap. 2 per unit around bearing boards, deck, and first layer of pipe. 2 per unit around all dunnage. 3 per unit around pipe, installed after longintudinal protector straps.
7.	Nails or Staples	8d common nails or 2" steel staples, resin coated. 2 per chock.

CTD014020

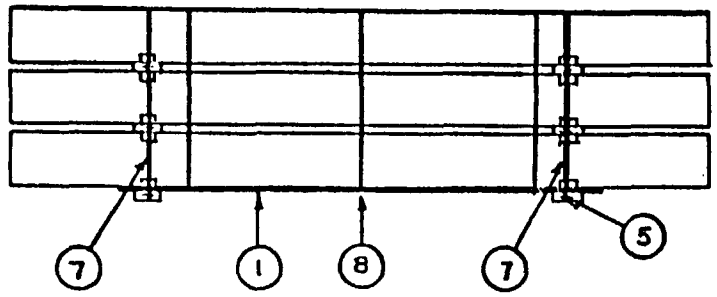
PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds PF						

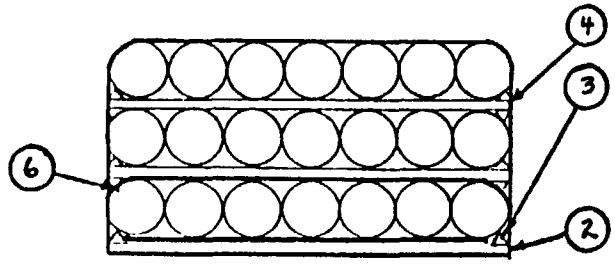
CertainTeed

UNBELLED A/C PIPE

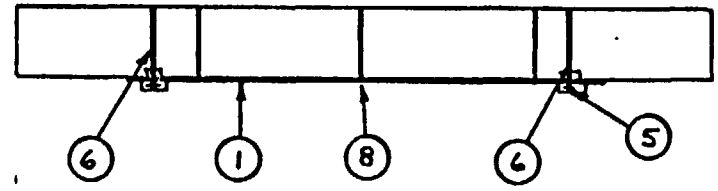
90 INCH EXPORT PACKAGE

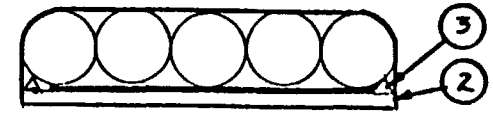
MULTI - LAYER





SINGLE LAYER





(1) FLYWOOD DECK
UNIT BOTTOM SUPPORT - 3/8" THICK, CDX GRADE LENGTH 8'-0" WIDTH DEPENDANT ON UNIT WIDTH-
ONE (1) PER UNIT, NAILED OR STAPLED TO BEARING BOARDS

(2) BEARING BOARDS
3"X3" HARDWOOD, LENGTH NOT TO EXCEED UNIT WIDTH
TWO (2) PER UNIT

(3) CHOCKS
CHOICE OF THREE (3) SIZES OF CHOCKS TO ASSURE BOARD LENGTHS NOT TO EXCEED TOTAL UNIT WIDTH
TWO (2) STAPLES OR NAILS PER CHOCK
FOUR (4) CHOCKS PER SEPARATOR BOARD
TWO (2) CHOCKS PER BEARING BOARD

(4) SEPARATOR BOARDS
2"X4" HARDWOOD, LENGTH NOT TO EXCEED UNIT WIDTH
TWO (2) PER PIPE LAYER

(5) STAPLE
1 3/8"X3/4" STEEL
ONE (1) PER BOARD END

STEEL STRAP
-1 1/4"X.031
(6) TWO (2) PER UNIT AROUND DUNNAGE AND FIRST LAYER
(7) TWO (2) PER UNIT AROUND ALL DUNNAGE
(8) THREE (3) PER UNIT AROUND PIPE

MKSAC APPROVAL

DRAWN BY - P.H.F.
APPROVED
DATE 9-20-78

CTD014021

1-68-3

TECHNICAL SPECIFICATIONS

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Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO. ~~31~~	SPECIFICATION NO: GENERAL SEC. L.	PAGE NO.: 1-6B-4
SUPERSEDES: NEW		DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

3.2 Building of End Protection For Unbelled A/C Export Pipe Units

Item	Number of Pieces	Description
1.	Face Boards 2 per unit	3/8" plywood, CDX grade refer to page 1-6A-6-8 for dimensions.
2.	Edge Boards 2 Horiz. Boards/unit 2 Vert. Boards/unit	1" x 8" softwood group 2. Refer to page 1-6A-6-8 for dimensions
3.	Corner Protectors 8 per multi-layer 4 per single layer	Signode or equal, #7 steel ribbed edge protector 2" x 2 3/4" x .030 applied over corners of end protectors, and under the 1 1/4" steel longitudinal straps.
4.	Staple 16 per multi-layer 8 per single layer	Signode or equal 1 3/8" x 3/4" steel over 1 1/4" steel strap and thru the corner protectors (holes provided)
5.	Longitudinal Strap 2 per mulit-layer 1 per single layer	Signode or equal 1 1/4" x .031 magnus strap. Refer to drawing for location and page 1-6A-9-11 for length dimensions. Strap to be positioned over protectors, face boards, and securely tensioned and stapled.
6.	Protector Straps 2 per unit	Signode or equal 1 1/4" x .031 Magnus steel strap. Refer to drawing and page 1-6A-9-11 for length dimensions. Strap to be positioned over edge boards and on the pipe rough B.O.D. securely tensioned and sealed.
7.	Nails	6d common nails or 2" steel staple resin coated, located approximately 6" apart when fastening edge boards to protector face boards.

CTD014022

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P. H. Foulds						

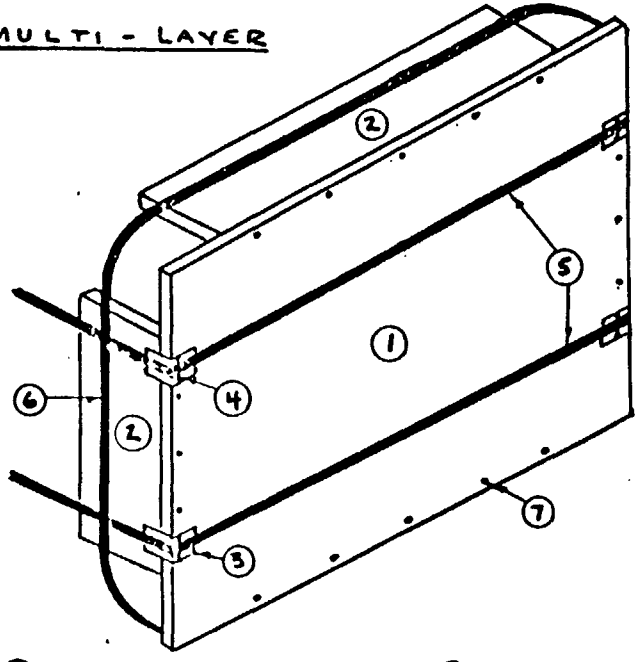
CertainTeed

UNBELLED A/C PIPE

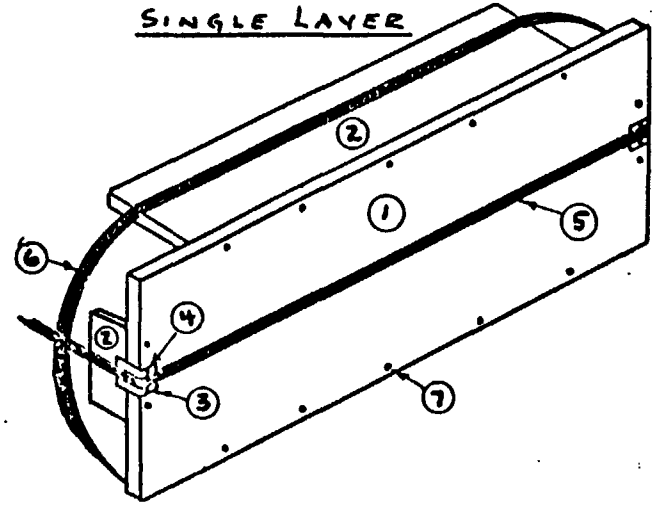
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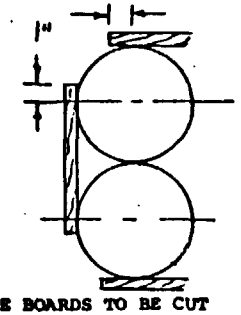
END PROTECTION ALL UNITS

MULTI - LAYER



SINGLE LAYER





EDGE BOARDS TO BE CUT 1" BEYOND MIDPOINT OF PIPE

1. FACE BOARDS
   - 3/8" PLYWOOD, CDX GRADE
   - TWO (2) PER UNIT

2. EDGE BOARDS
   - 1" x 8" YELLOW PINE
   - FOUR (4) PER MULTI-LAYER
   - FOUR (4) PER SINGLE LAYER

3. CORNER PROTECTORS
   - #7 RIBBED EDGE
   - WHERE INDICATED

4. STAPLE (BAND)
   - 1-3/8" x 3/4" STEEL
   - WHERE INDICATED

5. HORIZONTAL STRAPS
   - 1-1/4" x .031 STEEL
   - TWO (2) PER MULTI-LAYER
   - ONE (1) PER SINGLE LAYER

6. PROTECTOR STRAPS
   - 1-1/4 x .031 STEEL
   - TWO (2) PER UNIT

7. NAILS
   - 6 PENNY

NOTE:
EDGE AND FACE BOARD DIMENSIONS DETERMINED BY UNIT SIZE.

MKSAC APPROVAL:

DRAWN BY P.H.F.

APPROVED BY

DATE 9-19-78

CTD014023

1-6B-5

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
81	GENERAL SEC. L.	1-6B-6

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION: PART VI - EXPORT PACKAGING TYPE III
LUMBER DIMENSIONS

SIZE & CLASS	3 x 3 BEARING 2 x 4 SEPARATOR BD. LEN., IN.	CHOCK SIZE	DECK BOARD WIDTH, IN.(1)	END PANNEL ± 1/2"			
				PLYWOOD		EDGE BD.	
				W	HT	HORIZ.	VERT.
4 - 150	87	Small	81	88	37	79	28
6 - 150	88	Small	82	90	37	82	29
8 - 150	85	Small	80	88	33	78	23
10 - 150	85	Medium	78	87	42	73	28
12 - 150	85	Medium	77	89	33	72	17
14 - 150	83	Medium	74	86	38	67	19
16 - 150	75	Large	64	79	43	57	21
18 - 150	85	Large	72	89	25	65	8
20 - 150	71	Large	57	75	27	48	8
24 - 150	85	Large	67	89	32	58	8
4 - 200	89	Small	84	90	31	82	22
6 - 200	83	Small	78	86	30	75	19
8 - 200	86	Small	81	89	35	77	22
10 - 200	84	Medium	70	87	28	73	15
12 - 200	85	Medium	77	89	32	72	17
14 - 200	83	Medium	74	86	38	67	19
16 - 200	75	Large	64	79	43	57	21
(1) Length	is 96"						

CTD014024

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~31~~	GENERAL SEC. L.	1-6B-7

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION: PART VI - EXPORT PACKAGING TYPE III

LUMBER DIMENSIONS

SIZE & CLASS	3 x 3 BEARING 2 x 4 SEPARATOR BD. LEN., IN.	CHOCK SIZE	DECK BOARD WIDTH, IN. (1)	END PANNEL ± 1/2"			
				PLYWOOD		EDGE BD.	
				W	HT	HORIZ.	VERT.
4-15-2400	89	Small	82	89	42	80	33
5-15-2400	89	Small	82	89	48	80	39
6-15-2400	87	Small	81	90	46	79	36
8-15-2400	82	Small	78	86	45	74	33
10-15-2400	80	Medium	73	82	40	68	26
12-15-2400	80	Medium	73	83	46	68	31
14-15-2400	77	Medium	70	81	70	63	52
15-15-2400	82	Medium	74	86	74	67	55
16-15-2400	88	Large	78	91	40	71	20
18 - 2400	79	Large	67	82	66	60	43
20 - 2400	87	Large	75	91	72	66	48
21 - 2400	68	Large	56	72	75	47	50
24 - 2400	78	Large	62	81	84	53	56
4 - 3300	89	Small	85	91	29	82	21
5 - 3300	90	Small	84	92	42	82	32
6 - 3300	89	Small	85	92	38	81	27
8 - 3300	84	Small	89	87	45	76	34
10 - 3300	81	Medium	74	83	41	69	27
12 - 3300	81	Medium	74	85	47	69	31
14 - 3300	78	Medium	70	81	70	63	52
15 - 3300	83	Medium	75	87	38	68	19
16 - 3300	88	Large	75	92	40	72	20
18 - 3300	80	Large	68	83	66	61	44
20 - 3300	88	Large	76	94	72	67	48
21 - 3300	69	Large	56	73	76	47	50
24 - 3300	79	Large	62	82	57	53	29

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P. H. Foulds PF						

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~21~~	GENERAL SEC. L.	1-6B-8

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION: PART VI - EXPORT PACKAGING TYPE III

LUMBER DIMENSIONS

SIZE & CLASS	3 x 3 BEARING 2 x 4 SEPARATOR BD. LEN., IN.	CHOCK SIZE	DECK BOARD WIDTH, IN.	END PANNEL ± 1/2"			
				PLYWOOD		EDGE BD.	
				W	HT	HORIZ.	VERT.
10-4-5000	83	Medium	76	84	41	71	27
12-4-5000	83	Medium	75	85	47	70	32
14-4-5000	80	Medium	72	82	36	65	18
15-4-5000	85	Medium	76	87	38	69	20
16-4-5000	90	Large	80	93	40	73	21
18 - 4000	80	Large	68	83	66	61	44
5000	81	Large	68	84	45	62	23
20-4-5000	90	Large	77	92	49	68	25
21 - 4000	70	Large	57	73	76	48	51
5000	71	Large	57	74	52	49	26
24-4-5000	81	Large	63	81	57	54	29
(1) Length	is 96"						

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~~31~~	GENERAL SEC. L.	1-6B-9

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION: PART VI - EXPORT PACKAGING TYPE III

STRAPPING DIMENSIONS

SIZE & CLASS	STRAP AROUND BOARDS		UNIT STRAP (3)	END PROTECTION STRAPS (2)	HORIZONTAL PROTECTION STRAPS (2)
	FIRST LAYER (2)	ENTIRE UNIT (2)			
4 - 150	16	21	21	21	42
6 - 150	17	22	22	22	42
8 - 150	17	21	21	21	42
10 - 150	17	22	22	22	42
12 - 150	17	20	20	20	42
14 - 150	17	21	21	21	41
16 - 150	16	20	20	20	40
18 - 150	14	-	15	15	42
20 - 150	12	-	13	13	40
24 - 150	14	-	15	15	42
4 - 200	15	20	20	30	42
6 - 200	16	19	19	19	41
8 - 200	17	21	21	21	42
10 - 200	17	20	20	20	42
12 - 200	17	20	20	20	42
14 - 200	17	21	21	21	41
16 - 200	16	20	20	20	40

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~94~~	GENERAL SEC. L.	1-6B-10

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION: PART VI - EXPORT PACKAGING TYPE III

STRAPPING DIMENSIONS

SIZE & CLASS	STRAP AROUND BOARDS		UNIT STRAP (3)	END PROTECTION STRAPS (2)	HORIZONTAL PROTECTION STRAPS (2)
	FIRST LAYER (2)	ENTIRE UNIT (2)			
4-15-2400	16	22	22	22	42
5-15-2400	16	22	22	22	42
6-15-2400	17	23	23	23	42
8-15-2400	16	21	21	21	42
10-15-2400	16	21	21	21	42
12-15-2400	18	23	23	23	42
14-15-2400	16	24	24	24	42
15-15-2400	17	26	26	26	42
16-15-2400	18	21	21	21	42
18 - 2400	17	24	24	24	42
20 - 2400	18	26	26	26	42
21 - 2400	15	23	23	23	39
24 - 2400	17	26	26	26	42
4 - 3300	16	19	19	19	42
5 - 3300	16	22	22	22	42
6 - 3300	17	22	22	22	42
8 - 3300	16	21	21	21	42
10 - 3300	16	21	21	21	42
12 - 3300	18	23	23	23	41
14 - 3300	16	24	24	24	41
15 - 3300	17	23	23	23	41
16 - 3300	18	21	21	21	42
18 - 3300	17	24	24	24	42
20 - 3300	18	26	26	26	41
21 - 3300	15	23	23	23	39
24 - 3300	17	22	22	22	42

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~31~~	GENERAL SEC. L.	1-6B-11

SUPERSEDES: NEW

DATE OF ISSUE: NOV 15 1978

DESCRIPTION: PART VI - EXPORT PACKAGING TYPE III

STRAPPING DIMENSIONS

SIZE & CLASS	STRAP AROUND BOARDS		UNIT STRAP (3)	END PROTECTION STRAPS (2)	HORIZONTAL PROTECTION STRAPS (2)
	FIRST LAYER (2)	ENTIRE UNIT (2)			
10-4-5000	16	21	21	21	41
12-4-5000	18	23	23	23	41
14-4-5000	16	19	19	19	41
15-4-5000	17	23	23	23	42
16-4-5000	18	21	21	21	43
18 - 4000	17	24	24	24	42
5000	17	21	21	21	42
20-4-5000	18	23	23	23	43
21 - 4000	15	23	23	23	39
5000	11	21	21	21	39
24-4-5000	17	22	22	22	42

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SUPERSEDES: NEW		DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

4. GENERAL PACKAGING REQUIREMENTS - COUPLINGS AND FITTINGS

4.1 Assembling and Packaging Pre-Fabricated Export Crate

Item	Number of Pieces	Description
1.	Side 2 per crate	Soft wood, Group 2 Framing Nom. 2" x 4" Cleats Nom. 1" x 6" Diagonals Nom. 1" x 6"
2.	End 2 per crate	Soft wood, Group 2 Framing Nom. 2" x 4" Cleats Nom. 1" x 6" Diagonals Nom 1" x 6"
3.	Top 1 per crate	Soft wood, Group 2 Cleats nom. 1" x 6" Diagonals Nom.1" x 6"
4.	Pallet 1 per crate	Runners to be 4" x 4" hardwood, and deck boards to be 2" x 6" soft wood, Group 2
5.	Nails or Staples	8d common nails, or 2" steel staples, resin coated. All parts to be securely nailed to assure a stable crate.
6.	Strap 3 per crate	Signode or equal 1 1/4" x .031 Magnus steel, strap positioned over the 2nd and 6th vertical side boards, and around the crate horizontally. Strap shall be securely tensioned, and stapled along crate length
7.	Separator Sheets (Quantity required dependant on number of rows)	Double wall corrugated sheet placed between each layer of couplings and fittings approximate size 44" x 92"

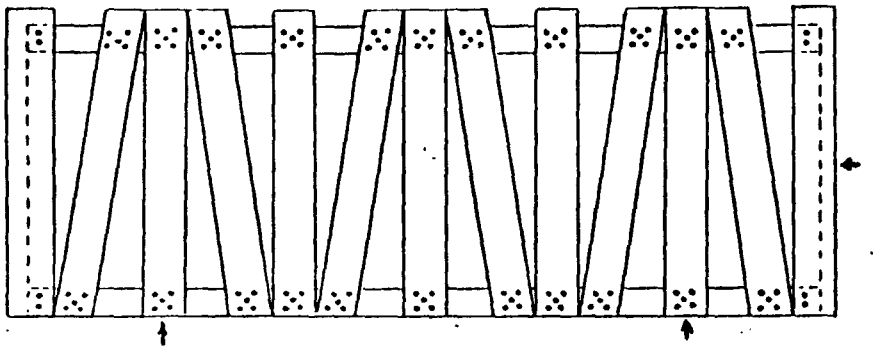
CTD014030

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COUPLING AND FITTINGS

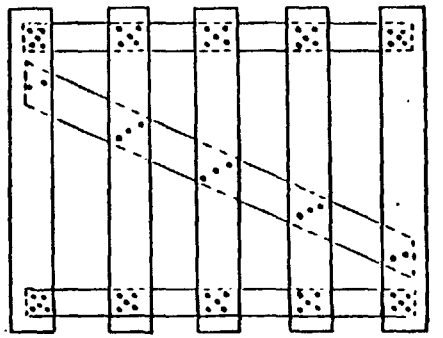
PREFABRICATED EXPORT CRATE

SIDE

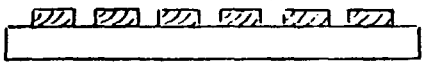


1½" STRAP LOCATIONS

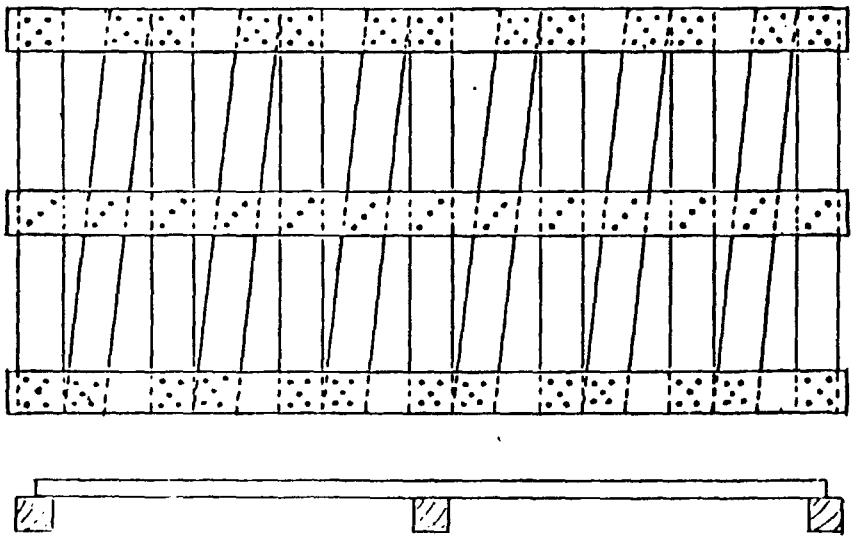
END



PALLET



TOP



DIMENSIONS
INSIDE 92"x44x36H
OUTSIDE 97"x49"x43H

CAPACITY - 4000 LBS

CUBE - 118 FT^3

SPECIFICATION
RUNNERS - 4"x4"
DECK - NOM 2"x6"
FRAMING - NOM 2"x4"
CLEATS - NOM 1"x6"
DIAGONALS - NOM 1"x6"

MKSAC APPROVAL - [illegible]

DRAWN BY - [illegible]
APPROVED BY [illegible]
DATE - 10-2-78

No Scale

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CTD014031

1-6B-13

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SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

5. A/C PIPE UNIT CONFIGURATION

5.1 Pressure Pipe

Pipe Size	Class	Pipe/Layer	Layers/Unit	Pipe/Unit	Std. Wt/Unit	Cube/Unit	Comm. Code
3	150	21	5	105	7140	226	42030-A
	200	20	5	100	7800	224	43030-A
4	100	17	5	85	7480	270	41040-A
	150	16	5	80	7680	258	42040-A
	200	16	4	64	7168	229	43040-A
6	100	12	4	48	6720	280	41060-A
	150	12	4	48	7200	277	42040-A
	200	11	3	33	6336	204	43060-A
8	100	9	4	36	7200	340	41080-A
	150	9	3	27	6102	255	42080-A
	200	9	3	27	7587	266	43080-A
10	100	7	3	21	6153	298	41100-A
	150	7	3	21	7749	317	42100-A
	200	7	2	14	6048	293	43100-A
12	100	6	3	18	7326	347	41120-A
	150	6	2	12	6048	247	42120-A
	200	6	2	12	7068	247	43120-A
14	100	5	3	15	7125	371	41140-A
	150	5	2	10	6340	283	42140-A
	200	5	2	10	7710	287	43140-A
16	100	5	2	10	6240	320	41160-A
	150	4	2	8	6680	286	42160-A
	200	4	2	8	8072	287	43160-A
18	100	4	2	8	6176	343	41180-A
	150	4	1	4	4300	185	42180-A

CTD014032

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

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NEW	NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

Pipe Size	Class	Pipe / Layer	Layers / Unit	Pipe / Unit	Std. Wt / Unit	Cube / Unit	Comm. Code
20	100	4	1	4	3640	213	41200-A
	150	3	1	3	3978	174	42200-A
24	100	3	1	3	3900	199	41240-A
	150	3	1	3	5655	255	42240-A

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SUPERSEDES:	DATE OF ISSUE:
NEW	NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

5.2 Sewer Pipe

Pipe Size	Class	Pipe / Layer	Layers / Unit	Pipe / Unit	Std. Wt / Unit	Cube / Unit	Comm. Code
4	1500	17	6	102	6936	289	61040-A
	2400	17	6	102	7344	300	62040-A
	3300	17	4	68	5644	210	63040-A
5	1500	14	6	84	7224	343	61050-A
	2400	14	6	84	7728	348	62050-A
	3300	14	5	70	7980	311	63050-A
6	1500	12	5	60	6420	324	61050-A
	2400	12	5	60	7320	336	62060-A
	3300	12	4	48	6624	283	63060-A
8	1500	9	4	36	5328	313	61080-A
	2400	9	4	36	5652	313	62080-A
	3300	9	4	36	6660	328	63080-A
10	1500	7	3	21	4788	283	61100-A
	2400	7	3	21	4788	283	62100-A
	3300	7	3	21	5439	287	63100-A
	4000	7	3	21	6006	298	64100-A
	5000	7	3	21	6531	302	65100-A
12	1500	6	3	18	5382	327	61120-A
	2400	6	3	18	5382	327	62120-A
	3300	6	3	18	6246	339	63120-A
	4000	6	3	18	6570	343	64120-A
	5000	6	3	18	7200	347	65120-A
14	1500	5	4	20	6740	497	61140-A
	2400	5	4	20	6740	497	62140-A
	3300	5	4	20	7640	503	63140-A
	4000	5	2	10	4190	258	64140-A
	5000	5	2	10	4690	269	65140-A
15	1500	5	4	20	7360	559	61150-A
	2400	5	4	20	7360	559	62150-A
	3300	5	2	10	4210	287	63150-A
	4000	5	2	10	4650	298	64150-A
	5000	5	2	10	5250	301	65150-A

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	L.E.	OTHERS
P. H. Foulds						

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SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

Pipe Size	Class	Pipe / Layer	Layers / Unit	Pipe / Unit	Std. Wt / Unit	Cube / Unit	Comm. Code
16	1500	5	2	10	4100	320	61160-A
	2400	5	2	10	4100	320	62160-A
	3300	5	2	10	4630	320	63160-A
	4000	5	2	10	5030	323	64160-A
	5000	5	2	10	5730	335	65160-A
18	2400	4	3	12	6396	474	62180-A
	3300	4	3	12	7176	487	63180-A
	4000	4	3	12	7956	487	64180-A
	5000	4	2	8	5848	339	65180-A
20	2400	4	3	12	7104	569	62200-A
	3300	4	3	12	8040	584	63200-A
	4000	4	2	8	5992	396	64200-A
	5000	4	2	8	6648	409	65200-A
21	2400	3	3	9	5796	463	62210-A
	3300	3	3	9	6750	476	63210-A
	4000	3	3	9	7632	490	64210-A
	5000	3	2	6	5946	335	65210-A
24	2400	3	3	9	7218	595	62240-A
	3300	3	2	6	5624	409	63240-A
	4000	3	2	6	6036	416	64240-A
	5000	3	2	6	6672	422	65240-A

CTD014035

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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SUPERSEDES:	DATE OF ISSUE:
NEW	NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

5.3 FT & Agri-Perm Pipe (Classes 30-90 Have Identical Dimensions-FT Code Used)

Pipe Class	Class	Pipe / Layer	Layer / Unit	Pipe / Unit	Std. Wt / Unit	Cube / Unit	Comm. Code
6	25	12	5	60	6720	324	54060-A
	40	12	5	60	7560	340	AC060-A
	45	12	5	60	7560	340	AD060-A
	50	12	4	48	6720	280	AE060-A
	60	12	4	48	7200	227	AF060-A
	70	12	4	48	7200	227	AG060-A
	80	12	3	36	6876	221	AH060-A
	90	12	3	36	6876	221	AI060-A
8	25	9	4	36	5652	320	54080-A
	30	9	4	36	6048	324	AA080-A
	35	9	4	36	6804	328	AB080-A
	40	9	4	36	6804	328	AC080-A
	45	9	4	36	7308	332	AD080-A
	50	9	4	36	7524	332	AE080-A
	60	9	3	27	6102	255	AF080-A
	70	9	3	27	6102	255	AG080-A
	80	9	3	27	7587	266	AH080-A
	90	9	2	18	5508	181	AI080-A
10	25	7	3	21	4809	283	54100-A
	30	7	3	21	4809	283	AA100-A
	35	7	3	21	4935	283	AB100-A
	40	7	3	21	5397	287	AC100-A
	45	7	3	21	6258	298	AD100-A
	50	7	3	21	6363	298	AE100-A
	60	7	3	21	8001	317	AF100-A
	70	7	2	14	5390	216	AG100-A
	80	7	2	14	6118	216	AH100-A
	90	7	2	14	7294	232	AI100-A
12	25	6	3	18	5382	327	54120-A
	30	6	3	18	5382	327	AA120-A
	35	6	3	18	5508	327	AB120-A
	40	6	3	18	5922	331	AC120-A
	45	6	3	18	7326	347	AD120-A
	50	6	3	18	7560	354	AE120-A
	60	6	2	12	6228	266	AF120-A
	70	6	2	12	6708	269	AG120-A
	80	6	2	12	7224	266	AH120-A
	90	6	1	6	4104	144	AI120-A

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	ENG.	OTHERS
P.H. Foulds						

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Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~at~~	GENERAL SEC. L	1-6B-19

SUPERSEDES:	DATE OF ISSUE:
NEW	NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

Pipe Size	Class	Pipe / Layer	Layer / Unit	Pipe / Unit	Std. Wt / Unit	Cube / Unit	Comm. Code
14	25	5	3	15	5145	371	54140-A
	30	5	3	15	5265	371	AA140-A
	35	5	3	15	5475	383	AB140-A
	40	5	3	15	5475	383	AC140-A
	45	5	3	15	6870	395	AD140-A
	50	5	3	15	7200	400	AE140-A
	60	5	2	10	6580	287	AF140-A
	70	5	2	10	7870	287	AG140-A
	80	5	2	10	7870	287	AH140-A
	90	5	1	5	4490	154	AG140-A
15	25	5	2	10	3760	283	54150-A
	30	5	2	10	4420	290	AA150-A
	35	5	2	10	4900	301	AB150-A
	40	5	2	10	4900	301	AC150-A
	45	5	2	10	5640	305	AD150-A
	50	5	2	10	6500	316	AE150-A
	60	5	2	10	7880	332	AF150-A
	70	5	1	5	4425	170	AG150-A
	80	4	2	8	7840	282	AH150-A
	90	4	1	4	4304	141	AI150-A
16	25	5	3	10	4120	320	54160-A
	30	5	2	10	4550	320	AA160-A
	35	5	2	10	5580	335	AB160-A
	40	5	2	10	5580	335	AC160-A
	45	5	2	10	5930	339	AD160-A
	50	4	2	8	5208	279	AE160-A
	60	4	2	8	6552	293	AF160-A
	70	4	2	8	7408	301	AG160-A
	80	4	1	4	4292	152	AH160-A
	90	4	1	4	4942	163	AG160-A
18	25	4	2	8	4136	312	54180-A
	30	4	2	8	4296	316	AA180-A
	35	4	2	8	4296	316	AB180-A
	40	4	2	8	5952	339	AC180-A
	45	4	2	8	5952	339	AD180-A
	50	4	2	8	6576	343	AE180-A
	60	4	2	8	7824	359	AF180-A
	70	4	1	4	4684	195	AG180-A
	80	4	1	4	5304	200	AH180-A
	90	4	1	4	6396	215	AI180-A

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~94~~	GENERAL SEC. L.	1-6B-20

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

Pipe Size	Class	Pipe / Layer	Layer / Unit	Pipe / Unit	Std. Wt / Unit	Cube / Unit	Comm. Code
20	20	4	2	8	4582	379	54200-A
	30	4	2	8	5064	387	AA200-A
	35	4	2	9	5064	387	AB200-A
	40	4	2	8	7080	409	AC200-A
	45	4	2	8	7080	409	AD200-A
	50	4	2	8	7448	413	AE200-A
	60	3	2	6	7230	331	AF200-A
	70	3	2	6	8034	335	AG200-A
	80	3	1	3	4914	179	AH200-A
	90	3	1	3	5967	193	AI200-A
21	25	3	2	6	3750	315	54210-A
	30	3	2	6	4116	320	AA210-A
	35	3	2	6	4116	320	AB210-A
	40	3	2	6	6192	342	AC210-A
	45	3	2	6	6192	342	AD210-A
	50	3	2	6	6468	347	AE210-A
	60	3	2	6	7956	362	AF210-A
	70	3	1	3	4797	193	AG210-A
	80	3	1	3	5499	203	AH210-A
24	25	3	2	6	4680	404	54240-A
	30	3	2	6	5364	409	AA240-A
	35	3	2	6	5364	409	AB240-A
	40	3	2	6	7362	434	AC240-A
	45	3	2	6	7362	434	AD240-A
	50	3	1	3	4251	224	AE240-A
	60	3	1	3	5265	237	AF240-A
	70	3	1	3	6162	250	AG240-A
	80	3	1	3	7020	256	AH240-A

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~91~~	GENERAL SEC. L.	1-6B-21

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

6. COUPLINGS CRATE CONTENTS

6.1 Pressure Couplings

Cpls Size	Class	Cpls/Layer	Layers/Crate	Cpls/Crate	Crate Std. Wt.	Comm. Code
4	100	98	5	490	2744	12040
	150	79	5	390	2730	13040
	200	78	5	390	3159	14040
6	100	50	5	250	1775	12060
	150	50	5	250	2375	13060
	200	45	5	225	3038	14060
8	100	32	5	160	1728	12080
	150	27	5	135	2039	13080
	200	21	5	105	2216	14080
10	100	17	5	85	1420	12100
	150	17	5	85	2040	13100
	200	17	5	85	2788	14100
12	100	11	4	44	1030	12120
	150	11	4	44	1672	13120
	200	11	4	44	2266	14120
14	100	10	4	40	1432	12140
	150	8	4	32	1853	13140
	200	8	4	32	2288	14140
16	100	7	4	28	1193	12160
	150	7	4	28	1963	13160
	200	7	4	28	2531	14160
18	100	8	3	24	1342	12180
	150	8	3	24	2203	13180
20	100	6	3	18	1345	12200
	150	6	3	18	1980	13200
24	100	3	3	9	893	12240
	150	3	3	9	1422	13240

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
94	GENERAL SEC. L.	1-6B-22

SUPERSEDES: NEW

DATE OF ISSUE: NOV 15 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

6.2 Sewer Coupling

Cpls Size	Class	Cpls / Layer	Layers / Crate	Cpls / Crate	Crate Std. Wt.	Comm. Code
4	1500	105	7	735	2279	16041
	2400	105	7	735	2279	16042
	3300	105	7	735	2426	16043
5	1500	78	7	546	2184	16051
	2400	78	7	546	2184	16052
	3300	78	7	546	2348	16053
6	1500	55	7	385	1887	16061
	2400	55	7	385	2002	16062
	3300	55	7	385	2002	16063
8	1500	32	6	192	1747	16081
	2400	32	6	192	1747	16082
	3300	32	6	192	1862	16083
10	1500	21	5	105	1460	16101
	2400	21	5	105	1460	16102
	3300	21	5	105	1460	16103
	4000	21	5	105	1701	16104
	5000	21	5	105	1701	16105
12	1500	17	5	85	1522	16121
	2400	17	5	85	1522	16122
	3300	17	5	85	1522	16123
	4000	17	5	85	1743	16124
	5000	17	5	85	1743	16125
14	1500	10	5	50	1150	16141
	2400	10	5	50	1150	16142
	3300	10	5	50	1150	16143
	4000	10	5	50	1365	16144
	5000	10	5	50	1365	16145
15	1500	10	5	50	1565	16151
	2400	10	5	50	1565	16152
	3300	10	5	50	1565	16153
	4000	10	5	50	1875	16154
	5000	10	5	50	1875	16155

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
52	GENERAL SEC. L.	1-6B-23

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

Cpls Size	Class	Cpls / Layer	Layers / Crate	Cpls / Crate	Crate Std. Wt.	Comm. Code
16	1500	8	5	40	1084	16161
	2400	8	5	40	1084	16162
	3300	8	5	40	1084	16163
	4000	8	5	40	1300	16164
	5000	8	5	40	1300	16165
18	2400	8	4	32	1194	16182
	3300	8	4	32	1194	16183
	4000	8	4	32	1478	16184
	5000	8	4	32	1478	16185
20	2400	5	4	20	872	16202
	3300	5	4	20	872	16203
	4000	5	4	20	1016	16204
	5000	5	4	20	1016	16205
21	2400	5	3	15	891	16212
	3300	5	3	15	891	16213
	4000	5	3	15	1011	16214
	5000	5	3	15	1011	16215
24	2400	5	4	20	1134	16242
	3300	5	4	20	1134	16243
	4000	5	4	20	1372	16244
	5000	5	4	20	1372	16245

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~31~~	GENERAL SEC. L.	1-6B-24

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

6.3 FT & Agri-Perm Couplings

Cpls Size	Class	Cpls/Layer	Layers/Crate	Cpls/Crate	Crate Std. Wt.	Comm. Code
6	25	63	5	315	2835	06060
	40	55	5	275	2805	AR060
	45	55	5	275	2805	AS060
	50	50	5	250	2850	AT060
	60	50	5	250	3050	AV060
	70	50	5	250	3050	AV060
	80	34	5	170	2669	AW060
	90	34	5	170	2669	AX060
8	25	32	5	160	2064	06080
	30	32	5	160	2192	AP080
	35	32	5	160	2448	AQ080
	40	32	5	160	2448	AR080
	45	32	5	160	2640	AS080
	50	32	5	160	2720	AT080
	60	32	5	160	2976	AV080
	70	32	5	160	2976	AV080
	80	26	5	130	3016	AW080
	90	26	5	130	3263	AX080
10	25	21	5	105	1943	06100
	30	21	5	105	1943	AP100
	35	21	5	105	2106	AQ100
	40	21	5	105	2195	AR100
	45	21	5	105	2541	AS100
	50	21	5	105	2583	AT100
	60	21	5	105	2799	AU100
	70	18	5	90	2826	AV100
	80	17	5	85	3069	AW100
	90	17	5	85	3621	AX100
12	25	18	4	72	1750	06120
	30	18	4	72	1750	AP120
	35	18	4	72	1807	AQ120
	40	18	4	72	1807	AR120
	45	17	4	68	2251	AS120
	50	15	4	60	2058	AT120
	60	15	4	60	2568	AU120
	70	14	4	56	2582	AV120
	80	14	4	56	2817	AW120
	90	14	4	56	3170	AX120

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
9A	GENERAL SEC. L.	1-6B-25

SUPERSEDES:	DATE OF ISSUE:
NEW	NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

Cpls Size	Class	Cpls / Layer	Layers / Crate	Cpls / Crate	Crate Std. Wt.	Comm. Code
14	25	15	4	60	1698	06140
	20	14	4	56	1669	AP140
	35	14	4	56	1730	AQ140
	40	14	4	56	1730	AR140
	45	10	4	40	1520	AS140
	50	9	4	36	1451	AT140
	60	9	4	36	1984	AU140
	70	9	4	36	2362	AV140
	80	9	4	36	2376	AW140
	90	8	4	32	2416	AX140
15	25	10	4	40	1260	06150
	30	10	4	40	1464	AP150
	35	10	4	40	1612	AQ150
	40	10	4	40	1628	AR150
	45	9	4	36	1688	AS150
	50	9	4	36	1940	AT150
	60	8	4	32	2099	AU150
	70	8	4	32	2365	AV150
	80	7	4	28	2316	AW150
	90	7	4	28	2548	AX150
16	25	9	4	36	1235	06160
	30	9	4	36	1354	AP160
	35	9	4	36	1663	AQ160
	40	9	4	36	1663	AR160
	45	8	4	32	1568	AS160
	50	8	4	32	1725	AT160
	60	7	4	28	1915	AU160
	70	7	4	28	2156	AV160
	80	7	4	28	2506	AW160
	90	7	4	28	2884	AX160
18	25	8	3	24	1034	06180
	30	8	3	24	1073	AP180
	35	8	3	24	1082	AQ180
	40	7	3	21	1300	AR180
	45	7	3	21	1315	AS180
	50	6	3	18	1238	AT180
	60	6	3	18	1490	AU180
	70	6	3	18	1791	AV180
	80	6	3	18	2036	AW180
	90	5	3	15	2025	AX180

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~31~~	GENERAL SEC. L.	1-6B-26

SUPERSEDES:	DATE OF ISSUE:
NEW	NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

Cpls Size	Class	Cpls / Layer	Layers / Crate	Cpls / Crate	Crate Std. Wt.	Comm. Code
20	25	6	3	18	862	06200
	30	6	3	18	949	AP200
	35	6	3	18	956	AQ200
	40	6	3	18	1327	AR200
	45	6	3	18	1343	AS200
	50	6	3	18	1411	AT200
	60	6	3	18	1836	AU200
	70	6	3	18	2052	AV200
	80	6	3	18	2520	AW200
	90	4	3	12	2016	AX200
21	25	6	3	18	943	06210
	30	6	3	18	1033	AP210
	35	6	3	18	1039	AQ210
	40	6	3	18	1550	AR210
	45	6	3	18	1557	AS210
	50	6	3	18	1625	AT210
	60	6	3	18	2016	AU210
	70	4	3	12	1620	AV210
	80	4	3	12	1860	AW210
24	25	6	3	18	1174	06240
	30	6	3	18	1336	AP240
	35	6	3	18	1345	AQ240
	40	4	3	12	1224	AR240
	45	4	3	12	1236	AS240
	50	4	3	12	1416	AT240
	60	4	3	12	1764	AU240
	70	3	3	9	1566	AV240
	80	3	3	9	782	AW240

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P. H. Foulds						

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
34	GENERAL SEC. L.	1-6B-27

SUPERSEDES: NEW

DATE OF ISSUE: NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

7. A/c FITTINGS CRATE CONTENTS

7.1 Sewer Fittings (Fast Moving Items)

SIZE & DESCRIPTION	FTG PER CRATE	WEIGHT PER CRATE
4X4X4 Tee	42	420
5X5X4 Tee	39	546
5X5X5 Tee	39	546
6X6X4 Tee	36	612
6X6X5 Tee	36	648
6X6X6 Tee	36	648
4X4X4 WYE	30	390
5X5X4 WYE	24	432
5X5X5 WYE	22	374
6X6X4 WYE	26	598
6X6X5 WYE	24	600
6X6X6 WYE	24	600
8X8X4 Tee	21	1008
8X8X5 Tee	21	1029
8X8X6 Tee	21	1050
8X8X8 Tee	21	1092
8X8X4 WYE	21	1050
8X8X5 WYE	21	1071
8X8X6 WYE	21	1134
8X8X8 WYE	21	1239
11¼° Elbow	324	2592
22½° Elbow	324	2592
30° Elbow	324	2592
45° Elbow	300	2400
90° Elbow	174	2088
11¼° Elbow	212	2120
22½° Elbow	212	2120
30° Elbow	212	2120
45° Elbow	192	1920
90° Elbow	129	2064

CTD014045

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	L.E.	OTHERS
P. H. Foulds						

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T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
~~31~~	GENERAL SEC. L.	1-6B-28

SUPERSEDES:	DATE OF ISSUE:
NEW	NOV 13 1978

DESCRIPTION:

PART VI - EXPORT PACKAGING TYPE III

SIZE & DESCRIPTION	FTG PER CRATE	WEIGHT PER CRATE
$11\frac{1}{4}^{o}$ Elbow	152	1824
$22\frac{1}{2}^{o}$ Elbow	152	1824
30° Elbow	152	1824
45° Elbow	136	1632
90° Elbow	90	1710

7.2 Shipping Container Quantity for Slow Moving Items:

Consolidation of items, physical characteristics, weight, size limitations, and other restrictions and considerations shall dictate shipping container content quantities.

CTD014046

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES		OTHERS
P. H. Foulds						

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	1-7-1
SUPERSEDES: 12-16-69		DATE OF ISSUE: 11-1-71

DESCRIPTION:
Department of Water and Power - City of Los Angeles
4" Thru 12" Pressure Pipe Belled One End Offset 4' Wide Units

I. CONSTRUCTION OF UNIT

A. Two Bearing Boards on the bottom and Separators between layers. The boards shall be equal in length, but no longer than the width of the row of pipe plus the width of the Chock.

B. Locate the boards 39" on each side of the center of the unit.

C. Nail Chocks 3" x 3" diagonal cut as long as board width to each end of Bearing Boards. Nail Chocks to each end top and bottom, of Separator Boards. Chocks must be tight against pipe.

D. Nail 4 steel straps $\frac{1}{2}$" x .020" to the ends of the Bearing Boards and the ends of the first Separator Boards.

E. Place two $1\frac{1}{4}$" x .023" steel bands around the unit and secure with crimping seals. Locate the two bands directly on the side of the dunnage toward the Belled end.

F. The overall length of the unit 14'3".

CTD014047

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FORM P927

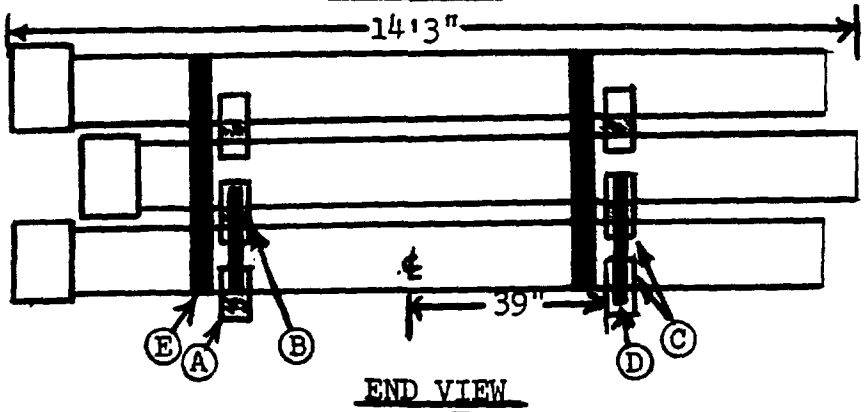
TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

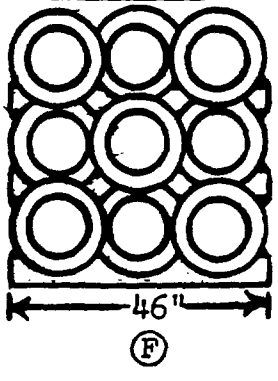
SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	1-7-2
SUPERSEDES:		DATE OF ISSUE:
12-19-69		11-1-71

DESCRIPTION:
Department of Water and Power - City of Los Angeles
4" Thru 12" Pressure Pipe Belled one End Offset 4' Wide Units

12"-150 Pressure Pipe
Example
Side View



END VIEW



A - Bearing Boards	3" x 4" rough cut
B - Separator Boards	2" x 4" rough cut
C - Chocks	3" x 3" diagonal cut
D - Steel Strap	¾" x .020" perforated and wax coated
E - Steel Bands	1¼" x .023" wax coated and painted
F - Width of Unit	

SIZE	WIDTH
4"	45"
6-8"	42"
10-12"	46"

CTD014048

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. Foulds	C.S.					

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FITTINGS

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.: 10	SPECIFICATION NO.: GENERAL SEC. L	PAGE NO.: 1-8-1
SUPERSEDES:		DATE OF ISSUE: 11-1-71

DESCRIPTION: 8" and 10" Sewer Pipe
4' Wide Belled Alternate End - Off Set Unit
Tee and Wye Fittings

I. CONSTRUCTION OF UNIT:

A. Bearing Boards on Bottom and Separator Boards between layers.
B. Fittings positioned so that branch rests on boards.
C. Three (3) Bands placed around unit adjacent to boards.
D. Bands stapled to end of boards.

II. BUILDING OF UNIT:

A. Position three (3) bearing boards on unitizing fixture.
B. Place first fitting on bearing boards with branch positioned toward center. Place second fitting, alternating pre belled ends, position branch against trunk of first fitting.
C. Position third and fourth fitting as described above.
D. Position three (3) separator boards on top of first row of fittings.
E. Follow steps B and C for the remaining layers.
F. Feed three (3) bands thru unitizing fixture and around unit.
G. Position bands adjacent to end of boards.
H. Secure center band of unit first, then the two outer bands.
I. Staple all bands to ends of separator and bearing boards.

CTD014049

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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FORM P827

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

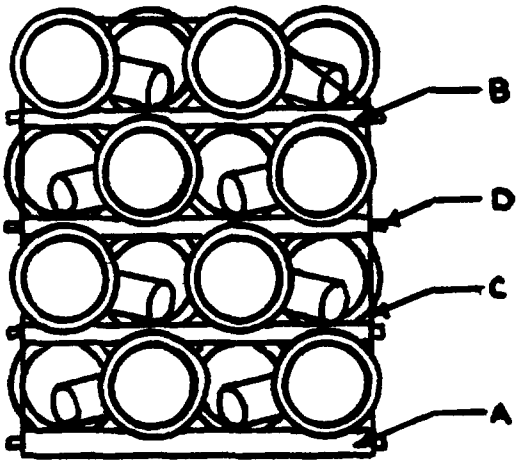
SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	1-8-2
SUPERSEDES:		DATE OF ISSUE: 11-1-71

DESCRIPTION:

8" and 10" Sewer Pipe
4' Wide, Belled Alternate End - Offset Unit
~~TEE AND WYE FITTINGS~~

8 x 8 x 6 Wye
Example

END VIEW



A. Bearing Boards; Rough Cut
B. Separator Boards; Rough Cut
C. Steel Bands; 3/4" x .020" Painted and Waxed
D. Staples; 3/4" x 7/8" - 12 Gauge Steel

CTD014050

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

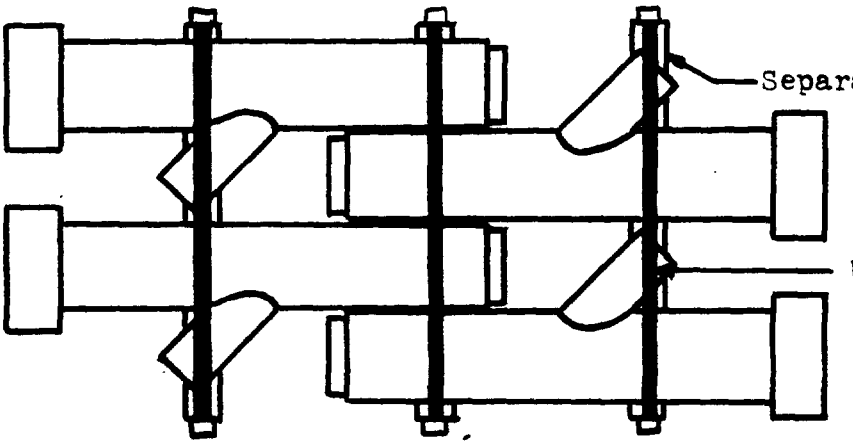
SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS -ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	1-8-3
SUPERSEDES:		DATE OF ISSUE:
		11-1-71

DESCRIPTION:

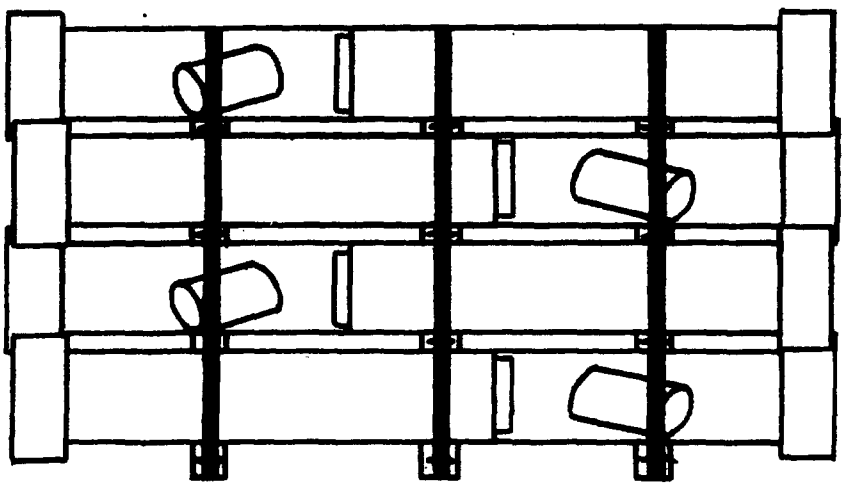
8" and 10" Sewer Pipe
4' Wide, Belled Alternate End - Offset Unit
TEE AND WYE FITTINGS

8 x 8 x 6 Wye
Example

TOP VIEW



SIDE VIEW



CTD014051

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. Foulds						

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO
30	1 Sec. L	2-1-1

SUPERSEDES:	DATE OF ISSUE:
1/15/72	JUL 2 8 1976

DESCRIPTION:

A/C PRESSURE PIPE
8' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

Size	Class	Pipe Per Layer	Layers Per Unit	Pipe Per Unit	Lumber
3"	100	23	4	92	ABD
	150	22	4	88	ABD
	200	21	4	84	ABD
4"	100	18	4	72	ABD
	150	17	4	68	ABD
	200	17	3	51	ABD
18"	100	4	2	8	ACF
	150	4	1	4	AF
20"	100	4	1	4	AF
	150	3	1	3	AF
24"	100	3	1	3	AF
	150	3	1	3	AF

LUMBER

A - Bearing Boards - 3" x 3" x 94" Rough Cut
B - Separator Boards - 1" x 4" x 94" Rough Cut
C - Separator Boards - 2" x 4" x 94" Rough Cut
D - Chocks - 1-3/4" x 1-3/4" x 2-3/4" Diagonal Cut
F - Chocks - 3-5/8" x 3-5/8" x 5-1/8" Diagonal Cut
Steel Straps - 1/2" x .020" Perforated and Zinc-coated

CTD014052

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

PHF:ap 7/22/76

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FORM P-6084

TECHNICAL CHANGE ORDER

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

APPLICABLE TO:
A-C
PACKAGING METHODS - ALL PLANTS

DATE OF ISSUE:	T.C.O. NO.:	PAGE NO.:
JUL 28 1976	30	1

DESCRIPTION:

PACKAGING METHODS FOR 6" THRU 12" PRESSURE PIPE, 4' UNITS

PURPOSE

1. To specify the use of raggle boards for 6" thru 12" Class 150 Pressure Pipe, belled alternate end, 4' units.

2. To delete 6" thru 16" Packaging Methods from Specification No. 1.

Instructions:

1. The attached Pages 2-1-1 and 2-1-3 supersede those formerly issed 1/15/72.

2. Please remove Page 2-1-2 and discard.

3. Please insert new Specification 2-3A-3A in its applicable section.

CTD014053

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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PHF:ad 7/22/76

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.
30	1 Sec. L	2-1-3

SUPERSEDES:	DATE OF ISSUE:
1/15/72	JUL 2 8 1976

DESCRIPTION:

A/C PRESSURE PIPE
4' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

Size	Class	Pipe Per Layer	Layers Per Unit	Pipe Per Unit	Lumber
3"	100	11	5	55	ABD
	150	10	5	50	ABD
	200	10	4	40	ABD
4"	100	8	5	40	ABD
	150	8	4	32	ABD
	200	8	3	24	ABD

Lumber

A - Bearing Boards - 3" x 3" x 47" Rough Cut
B - Separator Boards - 1" x 4" x 47" Rough Cut
D - Chocks - 1-3/4" x 1-3/4" x 2-3/4" Diagonal Cut
Steel Straps - 1/2" x .020" Perforated and Zinc-coated
Steel Bands - 3/4" x .020" Painted, Wax-coated and Positioned around Unit at Center

CTD014054

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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PHF:ap 7/22/76

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TECHNICAL SPECIFICATIONS

FORM P927

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	1 SEC. L	2-1-4

SUPERSEDES:	DATE OF ISSUE:
5-7-69	4-28-70

DESCRIPTION:

3" THRU 24" A/C PRESSURE PIPE
4' WIDE - EXPORT UNITS - STRAIGHT STACK UNBELLED

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	FT. PER UNIT	VOLUME PER UNIT	LUMBER
3"	100	10	6	60	780	136.9	AB
	150	10	6	60	780	138.9	AB
	200	10	6	60	780	143.1	AB
4"	100	8	6	48	624	148.7	AB
	150	8	6	48	624	156.1	AB
	200	7	5	35	455	127.9	AB
6"	100	6	5	30	390	176.4	AB
	150	6	5	30	390	184.4	AB
	200	6	4	24	312	149.2	AB
8"	100	4	4	16	208	160.5	AB
	150	4	4	16	208	169.8	AB
	200	4	4	16	208	178.6	AB
10"	100	4	3	12	156	176.8	AB
	150	3	3	9	117	190.6	AB
	200	3	3	9	117	144.1	AB
12"	100	3	3	9	117	177.4	AB
	150	3	3	9	117	190.6	AB
	200	3	3	9	117	190.6	AB
14"	100	3	2	6	78	146.0	AB
	150	2	2	4	52	112.1	AB
	200	2	2	4	52	112.1	AB
16"	100	2	2	4	52	136.9	AB
	150	2	2	4	52	142.8	AB
	200	2	2	4	52	142.8	AB
18"	100	2	2	4	52	166.4	AB
	150	2	2	4	52	183.1	AB
20"	100	2	2	4	52	203.0	AB
	150	2	1	2	26	113.3	A
24"	100	1	1	1	13	75.5	A
	150	1	1	1	13	80.1	A

LUMBER

A - BEARING BOARDS 3" x 3" x 48" ROUGH CUT
B - SEPARATOR BOARDS 1" x 4" x 48" ROUGH CUT

CTD014055

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. Foulds						

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	1 SEC. L	2-1-5

SUPERSEDES:	DATE OF ISSUE:
5-7-69	4-28-70

DESCRIPTION:

3" THRU 6" A/C PRESSURE PIPE
4' WIDE - EXPORT UNITS - CANNON BALL STACKING - UNBELLED

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	FT. PER UNIT	VOLUME PER UNIT	LUMBER
3"	100	10/9	4	76	988	141.0	AB
	150	10/9	4	76	988	143.0	AB
	200	10/9	4	76	988	148.2	AB
4"	100	8/7	4	60	780	176.5	AB
	150	8/7	4	60	780	184.9	AB
	200	7/6	3	39	507	137.8	AB
6"	100	6/5	3	33	429	187.6	AB
	150	6/5	3	33	429	196.3	AB
	200	6/5	3	33	429	201.0	AB

LUMBER

A - BEARING BOARDS 3" x 3" x 48" ROUGH CUT
B - SEPARATOR BOARDS 1" x 4" x 48" ROUGH CUT

CTD014056

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	1 SEC. L	2-1-6

SUPERSEDES:	DATE OF ISSUE:
5-7-69	4-28-70

DESCRIPTION:

3" THRU 24" A/C PRESSURE COUPLINGS
EXPORT - 78" x 46" x 42" CRATE

SIZE	CLASS	COUPLINGS PER LAYER	LAYERS PER CRATE	COUPLINGS PER CRATE
3"	100	120	6	720
	150	112	6	672
	200	112	6	672
4"	100	84	6	504
	150	84	6	504
	200	66	6	396
6"	100	45	6	270
	150	40	6	240
	200	40	6	240
8"	100	28	6	168
	150	28	6	168
	200	24	6	144
10"	100	18	6	108
	150	15	6	90
	200	15	6	90
12"	100	15	6	90
	150	8	6	48
	200	8	6	48
14"	100	8	6	48
	150	8	6	48
	200	6	6	36
16"	100	6	6	36
	150	6	6	36
	200	6	6	36
18"	100	3	3	9
	150	3	3	9
20"	100	3	3	9
	150	2	3	6
24"	100	2	3	6
	150	2	3	6

CRATE SHOULD BE TAILORED TO FIT ORDER REQUIREMENTS.

CTD014057

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	1 Sec. L	2-1-7
SUPERSEDES:	DATE OF ISSUE:	
4-28-70	11 1 71	

DESCRIPTION:

3" and 4" A/C PRESSURE PIPE
4' WIDE - UNBELLED

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
3"	100	11	5	55	ABD
	150	10	5	50	ABD
	200	10	4	40	ABD
4"	100	8	5	40	ABD
	150	8	5	40	ABD
	200	8	4	32	ABD

LUMBER

A - BEARING BOARDS - 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS - 1" x 4" x 47" ROUGH CUT
D - CHOCKS - 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)
STEEL BANDS - 3/4" x .020" COATED(WAX) & PAINTED
- ONE PER UNIT AT CENTER

CTD014058

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	1 Sec. L	2-1-8

SUPERSEDES:

DATE OF ISSUE: 11-1-[illegible]1

DESCRIPTION:

3" and 4" A/C PRESSURE PIPE
4' - WIDE - UNBELLED (CANNON BALLED)

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
3"	100	11/10	3	63	ABD
	150	10/9	2	38	ABD
	200	10/9	2	38	ABD
4"	100	8/7	3	45	ABD
	150	8/7	2	30	ABD
	200	8/7	2	30	ABD

LUMBER

A - BEARING BOARDS - 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS- 1" x 4" x 47" ROUGH CUT
D - CHOCKS - 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)
STEEL BANDS - 3/4" x .020" COATED (WAX) & PAINTED
- ONE PER UNIT AT CENTER

CTD014059

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	2 1-0
SUPERSEDES:		DATE OF ISSUE:
12-19-69		11-1-71

DESCRIPTION: Department of Water and Power - City of Los Angeles
4" Thru 12" PRESSURE PIPE BELLED ONE END OFFSET 4' WIDE UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4"	100	7	5	35	ABCEGH
	150	7	5	35	ABCEGH
	200	7	5	35	ABCEGH
6"	100	5	5	25	ABCDGH
	150	5	5	25	ABCDGH
	200	5	5	25	ABCDGH
8"	100	4	4	16	ABCDGH
	150	4	4	16	ABCDGH
	200	4	4	16	ABCDGH
10"	100	3	3	9	ABCFGH
	150	3	3	9	ABCFGH
	200	3	3	9	ABCFGH
12"	100	3	3	9	ABCFGH
	150	3	3	9	ABCFGH
	200	3	3	9	ABCFGH

LUMBER

A. Bearing Boards - 3" x 4" Rough cut
B. Separator Boards - 2" x 4" Rough cut
C. Chocks - 3" x 3" Diagonal cut

LENGTH OF BOARDS

D. 42"
E. 45"
F. 46"
G. Steel straps ½" x .020" Perforated and zinc coated
H. Steel strapping 1¼".x .023" and seals

CTD014060

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.
23	1 SEC. L	2-1-10
SUPERSEDES:		DATE OF ISSUE:
NEW		SEP 2 4 1973

DESCRIPTION:
4" and 18" through 24" - A/C Pressure Pipe
MEO Quarter Lengths - Unbelled

4-FOOT UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4"	100-150 200	7/8	2	30	BCE

Steel bands - 3/4" x .020 painted, wax coated and positioned around unit at center.

8-FOOT UNITS

18"	100-150	4	2	8	ADF
20"	100-150	3	2	6	ADF
24"	100-150	3	2	6	ADF

A - Bearing Boards - 3" x 3" x 94" - Rough Cut
B - Bearing Boards - 3" x 3" x 47" - Rough Cut
C - Separator Boards - 1" x 4" x 47" - Rough Cut
D - Separator Boards - 2" x 4" x 94" - Rough Cut
E - Chocks - 1 3/4"x 1 3/4" x 2 3/4" - Diagonal Cut
F - Chocks - 3 5/8" x 3 5/8" x 5 1/8" - Diagonal Cut

Steel Straps - ½" x .020" - Perforated and Zinc Coated

CTD014061

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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SEWER PIPE

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
23	1 SEC. L.	2-1-11
SUPERSEDES:		DATE OF ISSUE:
NEW		SEP 2 4 1973

DESCRIPTION:

4" and 18" through 24" - A/C Pressure Pipe
MEO Half Lengths - Unbelled

4-FOOT UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4"	100-150 200	7/8	2	30	BCD

Steel Bands - 3/4" x .020 painted, wax coated, and positioned around unit at center.

8-FOOT UNITS

18"	100-150	4	1	4	AF
20"	100-150	3	1	3	AF
24"	100-150	3	1	3	AF

A - Bearing Boards - 3" x 3" x 94" - Rough Cut
B - Bearing Boards - 3" x 3" x 47" - Rough Cut
C - Separator Boards - 1" x 4" x 47" - Rough Cut
D - Chocks - 1 3/4" x 1 3/4" x 2 3/4" - Diagonal Cut
E - Chocks - 3 5/8" x 3 5/8" x 5 1/8" - Diagonal Cut

Steel Straps - ½" x .020" - Perforated and Zinc Coated

CTD014062

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	2 Sec. L	2-2-1
SUPERSEDES:		DATE OF ISSUE:
11-11-70		11-1-71

DESCRIPTION:

12" - 24" A/C SEWER PIPE
8' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
12"	1500	7	3	21	ACE
	2400	7	3	21	ACE
	① 3300	7	3	21	ACE
	4000	6	3	18	ACE
	5000	6	3	18	ACE
14"	1500	6	3	18	ACE
	2400	6	3	18	ACE
	3300	6	3	18	ACE
	4000	6	2	12	ACE
	5000	5	2	10	ACE
15"	1500	5	3	15	ACE
	2400	5	3	15	ACE
	3300	5	3	15	ACE
	4000	5	3	15	ACE
	5000	5	2	10	ACE
16"	1500	5	3	15	ACE
	2400	5	3	15	ACE
	3300	5	2	10	ACE
	4000	5	2	10	ACE
	5000	5	2	10	ACE
18"	2400	4	3	12	ACE
	3300	4	3	12	ACE
	4000	4	2	8	ACE
	5000	4	2	8	ACE
20"	2400	4	2	8	ACE
	3300	4	2	8	ACE
	4000	4	2	8	ACE
	5000	4	2	8	ACE
21"	2400	4	2	8	ACE
	3300	4	2	8	ACE
	4000	4	2	8	ACE
	5000	3	2	6	ACE

① Riverside Plant has been successfully shipping 21/unit. Weight is over 7250 approved by W. R. Krause 5-1-72.

(Continued on next page)

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. Foulds	G.S.					

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	2 Sec. L	2-2-2

SUPERSEDES:	DATE OF ISSUE:
4-28-70	11-1-71

DESCRIPTION:

8" - 24" A/C SEWER PIPE
8' WIDE BELLED ALTERNATE END - OFFSET UNIT

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
24"	2400	3	2	6	ACF
	3300	3	2	6	ACF
	4000	3	2	6	ACF
	5000	3	2	6	ACF

LUMBER

A - BEARING BOARDS - 3" x 3" x 94" ROUGH CUT
C - SEPARATOR BOARDS - 2" x 4" x 94" ROUGH CUT
E - CHOCKS - 2 3/4 x 2 3/4 x 3 7/8 DIAGONAL CUT
F - CHOCKS - 3 5/8 x 3 5/8 x 5 1/8 DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)

CTD014064

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P. Foulds PF						

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PACKAGING METHODS

18"-24" A/C SEWER PIPE (CLASS 6000-7000)

8' WIDE BELLED ALTERNATE END-OFFSET UNIT

SIZE	CLASS	PIPE/LAYER	LAYERS/UNIT	PIPE/UNIT	LBS/FT.
18"	6000	4	2	8	64.6
	7000	4	2	8	69.7
20"	6000	4	1	4	75.0
	7000	4	1	4	81.2
21"	6000	3	2	6	80.5
	7000	3	2	6	86.9
24"	6000	3	1	3	98.0
	7000	3	1	3	106.0

3/25/81

CTD014065

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	2 Sec. L	2-2-3
SUPERSEDES:		DATE OF ISSUE:
4-28-70		11-1-71

DESCRIPTION:

8" - 10" A/C SEWER PIPE

8' WIDE - BELLED ONE END - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8"	1500	9	5	45	ACD
	2400	9	4	36	ACD
	3300	9	4	36	ACD
10"	1500	7	4	28	ACE
	2400	7	4	28	ACE
	3300	7	4	28	ACE
	4000	7	3	21	ACE
	5000	7	3	21	ACE

LUMBER

A - BEARING BOARDS - 3" x 3" x 94" ROUGH CUT
C - SEPARATOR BOARDS - 2" x 4" x 94" ROUGH CUT
D - CHOCKS- 1 3/4" x 1 3/4" x 2 3/4"DIAGONAL CUT
E - CHOCKS- 2 3/4" x 2 3/4" x 3 7/8"DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)

CTD014066

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	2 Sec. L	2-2-4
SUPERSEDES:		DATE OF ISSUE:
4-28-70		11-1-71

DESCRIPTION:

4" - 6" A/C SEWER PIPE
4' WIDE - UNBELLED

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4"	1500	9	6	54	ABD
	2400	9	5	45	ABD
	3300	8	5	40	ABD
5"	1500	7	6	42	ABD
	2400	7	5	35	ABD
	3300	7	4	28	ABD
6"	1500	6	5	30	ABD
	2400	6	5	30	ABD
	3300	6	4	24	ABD

LUMBER

A - BEARING BOARDS - 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS - 1" x 4" x 47" ROUGH CUT
D - CHOCKS - 1 3/4" x 1 3/4" x 2 3/4 DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)
STEEL BANDS - 3/4" x .020" COATED (WAX) & PAINTED
- ONE PER UNIT AT CENTER

CTD014067

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	2 Sec. L	2-2-4A

SUPERSEDES:

DATE OF ISSUE: 11-1-71

DESCRIPTION: 4" - 6" A/C SEWER PIPE
4' - WIDE - UNBELLED (CANNON BALLED)

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4"	1500	9/8	3	51	ABD
	2400	9/8	3	51	ABD
	3300	8/7	3	45	ABD
5"	1500	7/6	3	39	ABD
	2400	7/6	3	39	ABD
	3300	7/6	2	26	ABD
6"	1500	6/5	3	33	ABD
	2400	6/5	2	22	ABD
	3300	6/5	2	22	ABD

LUMBER

A - BEARING BOARDS - 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS - 1" x 4" x 47" ROUGH CUT
D - CHOCKS - 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)
STEEL BANDS - 3/4" x .020" COATED(WAX) & PAINTED
- ONE PER UNIT AT CENTER

CTD014068

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	2 Sec. L	2-2-5

SUPERSEDES:	DATE OF ISSUE:
4-28-70	11-1-71

DESCRIPTION:

8" - 12" A/C SEWER PIPE

4' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8"	1500	5	4	20	ACD
	2400	5	4	20	ACD
	3300	5	3	15	ACD
10"	1500	4	3	12	ACE
	2400	4	3	12	ACE
	3300	4	3	12	ACE
	4000	4	3	12	ACE
	5000	4	2	8	ACE
12"	1500	3	3	9	ACE
	2400	3	3	9	ACE
	3300	3	3	9	ACE
	4000	3	3	9	ACE
	5000	3	3	9	ACE

LUMBER

A - BEARING BOARDS - 3" x 3" x 47" ROUGH CUT
C - SEPARATOR BOARDS- 2" x 4" x 47" ROUGH CUT
D - CHOCKS - 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS - 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)
STEEL BANDS - 3/4" x .020 COATED(WAX) & PAINTED
- ONE PER UNIT AT CENTER

CTD014069

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
22	2 SEC. L	2-2-5A

SUPERSEDES: 5-8-73

DATE OF ISSUE: JUL 11 1973

DESCRIPTION:

8" A/C SEWER PIPE
4' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PER UNIT	LUMBER
8"	1500	5	3	15	ABD
	2400	5	3	15	ABD
	3300	5	3	15	ABD

LUMBER

A - Bearing Boards - 3" x 3" x 47" Rough Cut

B - Separator Boards - 1 3/4" x 1 3/4" x 47 Raggle Cut

D - Chocks - 1 3/4" x 1 3/4" x 2 3/4" Diagonal Cut

Steel Straps - ½" x .020" Perforated and Coated zinc

Steel Bands - 3/4" x .020" Coated (Wax) and Painted

- One per unit at center

CTD014070

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	1 SEC. L	2-2-6

SUPERSEDES:	DATE OF ISSUE:
5-7-69	4-28-70

DESCRIPTION:

6" THRU 24" A/C SEWER PIPE
4' WIDE - EXPORT UNITS - STRAIGHT STACKING - UNBELLED

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	FT. PER UNIT	VOLUME PER UNIT	LUMBER
6"	1500	6	5	30	390	163.4	AB
	2400	6	5	30	390	163.4	AB
	3300	6	5	30	390	168.6	AB
8"	1500	5	4	20	260	186.5	AB
	2400	5	4	20	260	186.5	AB
	3300	4	4	16	208	158.0	AB
10"	1500	4	3	12	156	164.3	AB
	2400	4	3	12	156	167.5	AB
	3300	4	3	12	156	172.8	AB
	4000	4	3	12	156	176.0	AB
	5000	4	3	12	156	176.0	AB
12"	1500	3	3	9	117	166.6	AB
	2400	3	3	9	117	168.6	AB
	3300	3	3	9	117	173.6	AB
	4000	3	3	9	117	176.1	AB
	5000	3	3	9	117	176.1	AB
14"	1500	3	2	6	78	143.4	AB
	2400	3	2	6	78	143.4	AB
	3300	3	2	6	78	148.7	AB
	4000	3	2	6	78	151.8	AB
	5000	3	2	6	78	151.8	AB
16"	1500	2	2	4	52	121.6	AB
	2400	2	2	4	52	121.6	AB
	3300	2	2	4	52	125.3	AB
	4000	2	2	4	52	127.6	AB
	5000	2	2	4	52	127.6	AB
18"	2400	2	2	4	52	154.3	AB
	3300	2	2	4	52	157.6	AB
	4000	2	2	4	52	160.6	AB
	5000	2	2	4	52	160.6	AB
20"	2400	2	3	4	52	187.1	AB
	3300	2	2	4	52	190.9	AB
	4000	2	2	4	52	194.3	AB
	5000	2	2	4	52	194.3	AB

CTD014071

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	1 SEC. L	2-2-7

SUPERSEDES:	DATE OF ISSUE:
5-7-69	4-28-70

DESCRIPTION:

6" THRU 24" A/C SEWER PIPE
4' WIDE - EXPORT UNITS - STRAIGHT STACKING - UNBELLED

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	FT. PER UNIT	VOLUME PER UNIT	LUMBER
24"	2400	1	1	1	13	67.4	A
	3300	1	1	1	13	68.6	A
	4000	1	1	1	13	69.8	A
	5000	1	1	1	13	71.2	A

LUMBER

A - BEARING BOARD 3" x 3" x 48" ROUGH CUT
B - SEPARATOR BOARD 1" x 4" x 48" ROUGH CUT

CTD014072

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	2 SEC. L	2-2-8
SUPERSEDES:		DATE OF ISSUE:
5-7-69		4-28-70

DESCRIPTION:

6" A/C SEWER PIPE
4' WIDE - EXPORT UNITS - CANNON BALL STACKING - UNBELLED

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	FT. PER UNIT	VOLUME PER UNIT	LUMBER
6"	1500	6/5	3	33	429	172.4	AB
	2400	6/5	3	33	429	172.4	AB
	3300	6/5	3	33	429	172.4	AB

LUMBER

A - BEARING BOARDS 3" x 3" x 48" ROUGH CUT
B - BEARING BOARDS 1" x 4" x 48" ROUGH CUT

CTD014073

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
6	2	2-2-9
SUPERSEDES:		DATE OF ISSUE:
5-7-69		4-28-70

DESCRIPTION:

6" THRU 24" A/C SEWER COUPLINGS
EXPORT 78" x 46" x 42" CRATE

SIZE	CLASS	COUPLINGS PER LAYER	LAYERS PER CRATE	COUPLINGS PER CRATE
6"	1500	45	7	315
	2400	45	7	315
	3300	45	7	315
8"	1500	28	7	196
	2400	28	7	196
	3300	28	7	196
10"	1500	18	6	108
	2400	18	6	108
	3300	18	6	108
	4000	18	6	108
	5000	18	6	108
12"	1500	15	6	90
	2400	15	6	90
	3300	15	6	90
	4000	15	6	90
	5000	15	6	90
14"	1500	8	6	48
	2400	8	6	48
	3300	8	6	48
	4000	8	6	48
	5000	8	6	48
16"	1500	8	6	48
	2400	8	6	48
	3300	6	6	36
	4000	6	6	36
	5000	6	6	36
18"	2400	6	5	30
	3300	6	5	30
	4000	6	5	30
	5000	6	5	30
20"	2400	3	5	15
	3300	3	5	15
	5000	3	5	15
24"	2400	2	5	10
	3300	2	5	10
	4000	2	5	10
	5000	2	5	10

CRATE SHOULD BE TAILORED TO FIT ORDER REQUIREMENTS.

CTD014074

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.: 23	SPECIFICATION NO.: 2 SEC. L.	PAGE NO.: 2-2-10
SUPERSEDES: NEW	DATE OF ISSUE: SEP 2 4 1973	

DESCRIPTION:

8" through 24" - A/C Sewer Pipe CG
Unbelled

4-FOOT UNITS
MEO QUARTER LENGTHS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8"	15-3300	4/5	3	27	BDF
10"	15-5000	4	4	16	BDF
12"	15-5000	3	3	9	BDF

Steel Bands - 3/4" x .020 painted, wax coated and positioned around unit at center.

8-FOOT UNITS
MEO QUARTER & HALF LENGTHS

14"	15-4000	6	3	18	ACF
	5000	5	3	15	ACF
15"	15-5000	5	3	15	ACF
16"	15-5000	5	2	10	ACG
18"	24-5000	4	2	8	ACG
20"	24-5000	4	2	8	ACG
21"	24-5000	4	2	8	ACG
24"	24-5000	3	2	6	ACG

A - Bearing Boards - 3" x 3" x 94" - Rough Cut
B - Bearing Boards - 3" x 3" x 47" - Rough Cut
C - Separator Boards - 2" x 4" x 94" - Rough Cut
D - Separator Boards - 2" x 4" x 47" - Rough Cut
E - Chocks - 1 3/4" x 1 3/4" x 2 3/4" - Diagonal Cut
F - Chocks - 2 3/4" x 2 3/4" x 3 7/8" - Diagonal Cut
G - Chocks - 3 5/8" x 3 5/8" x 5 1/8" - Diagonal Cut

Steel Straps - ½" x .020" Perforated and Zinc Coated.

CTD014075

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
23	2 SEC. L.	2-2-11
SUPERSEDES:		DATE OF ISSUE:
NEW		SEP 2 4 1973

DESCRIPTION:
8" through 12" - A/C Sewer CG Pipe
Unbelled

4 FOOT UNITS
MEO HALF LENGTHS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8"	15-3300	4/5	3	27	BDE
10"	15-5000	4	4	16	BDF
12"	15-5000	3	3	9	BDF

Steel Bands - 3/4" x .020" painted, wax coated and positioned around unit at center.

8 FOOT UNITS
MEO HALF LENGTHS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
8"	15-3300	8/9	2	34	ACE
10"	15-5000	8	3	24	ACF
12"	15-3300	7	3	21	ACF
	4000-5000	6	3	18	ACF

A - Bearing Boards - 3" x 3" x 94" - Rough Cut
B - Bearing Boards - 3" x 3" x 47" - Rough Cut
C - Separator Boards - 2" x 4" x 94" - Rough Cut
D - Separator Boards - 2" x 4" x 47" - Rough Cut
E - Chocks - 1 3/4" x 1 3/4" x 2 3/4" - Diagonal Cut
F - Chocks - 2 3/4" x 2 3/4" x 3 7/8" - Diagonal Cut

Steel Straps - ½" x .020" Perforated and Zinc Coated.

CTD014076

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

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PIPE, COUPLING, ETC.

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	3 SEC. L	2-3-1
SUPERSEDES:		DATE OF ISSUE:
5-1-70		11-1-71

DESCRIPTION:

PART III — SMALL DIAMETER SEWER PIPE, COUPLING & ACCESSORIES PACKAGING - 4 FOOT UNIT (CANNON BALL METHOD)

SIZE	CLASS	DESCRIPTION	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4"	1500	Half Length	9/8	3	51	ABD
	2400	MEO 1'-2'-3' 5'-10'	9/8	3	51	ABD
4"	1500	FM 1'	9/8	3	51	ABD
4"	3300	Half Length	8/7	3	45	ABD
		MEO 1'-2'-3' 5'-10'	8/7	3	45	ABD
5"	1500	Half Length	7/6	3	39	ABD
		MEO 1'-2'-3' 5'-10'	7/6	3	39	ABD
		FM 1'	7/6	3	39	ABD
5"	2400	Half Length	7/6	3	39	ABD
		MEO 1'-2'-3' 5'-10'	7/6	3	39	ABD
5"	3300	Half Length	7/6	3	39	ABD
		MEO 1'-2'-3' 5'-10'	7/6	3	39	ABD
6"	1500	Half Length	6/5	3	33	ABD
		MEO 1'-2'-3' 5'-10'	6/5	3	33	ABD
		FM 1'	6/5	3	33	ABD
6"	2400	Half Length	6/5	3	33	ABD
		MEO 1'-2'-3' 5'-10'	6/5	3	33	ABD
		FM 1'	6/5	3	33	ABD
6"	3300	Half Length	6/5	3	33	ABD
		MEO 1'-2'-3' 5'-10'	6/5	3	33	ABD
		FM 1'	6/5	3	33	ABD

LUMBER

A - BEARING BOARDS - 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS - 1" x 4" x 47" ROUGH CUT
D - CHOCKS - 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT

CTD014077

(Continued on next page)

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. Foulds						

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	3 SEC. L	2-3-2
SUPERSEDES:		DATE OF ISSUE:
5-1-70		11-1-71

DESCRIPTION:

SMALL DIAMETER SEWER PIPE, COUPLING & ACCESSORIES
PACKAGING - 4 FOOT UNIT (CANNON BALL METHOD)

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)

STEEL BANDS - 3/4" x .020 COATED (WAX) & PAINTED

- ONE BAND PER UNIT AT CENTER

CTD014078

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. Foulds PF						

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.D. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	3 SEC. L	2-3-3

SUPERSEDES:	DATE OF ISSUE:
5-1-70	11-1-71

DESCRIPTION: SMALL DIAMETER SEWER PIPE, COUPLING & ACCESSORIES
PART III PACKAGING - 8 FOOT UNIT (CANNON BALL STACKING METHOD)

SIZE	CLASS	DESCRIPTION	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
4"	1500-2400	Half Lengths	18/17	3	105	ABD
		MEO 1'-2'3'	18/17	3	105	ABD
4"	1500	FM 1'	18/17	3	105	ABD
4"	3300	Half Lengths	18/17	3	105	ABD
		MEO 1'-2'-3'	18/17	3	105	ABD
5"	1500	Half Lengths	15/14	3	87	ABD
		MEO 1'-2'-3'	15/14	3	87	ABD
5"	1500	FM 1'	15/14	3	87	ABD
5"	2400-3300	Half Lengths	15/14	3	87	ABD
		MEO 1'-2'-3'	14/13	3	81	ABD
6"	1500	Half Lengths	13/12	3	75	ABD
		MEO 1'-2'-3'	13/12	3	75	ABD
6"	1500	FM 1'	13/12	3	75	ABD
6"	2400	Half Lengths	13/12	3	75	ABD
		MEO 1'-2'-3'	13/12	3	75	ABD
6"	3300	Half Lengths	12/11	3	69	ABD
		MEO 1'-2'-3'	12/11	3	69	ABD

LUMBER

A - BEARING BOARDS 3" x 3" x 94" ROUGH CUT
B - SEPARATOR BOARDS 1" x 4" x 94" ROUGH CUT
D - CHOCKS 1 3/4"x1 3/4"x2 3/4" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)

CTD014079

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	3 SEC. L	2-3-4
SUPERSEDES:		DATE OF ISSUE:
5/1/70		2-1-72

DESCRIPTION:

PART III — **SMALL DIAMETER SEWER PIPE, COUPLINGS, & ACCESSORIES PACKAGING**

CARTON SIZE - 17½" x 16¼"x 15½" High

SIZE	CLASS	DESCRIPTION	PIECES PER CARTON	WEIGHT PER PIECE	WEIGHT PER CARTON
4"	15-2400	COUPLING	18	2.9	52
4"	3300	COUPLING	18	3.0	54
5"	15-2400	COUPLING	14	3.6	50
	3300	COUPLING	14	3.9	55
6"	15-2400	COUPLING	9	4.5	41
	3300	COUPLING	9	4.8	43

SIZE	DESCRIPTION	PIECES PER CARTON	WEIGHT PER PIECE	WEIGHT PER CARTON
4"	SLEEVE	10	4.0	40
5"	ADAPTOR	8	5.1	41
6"		6	6.7	40
4"	ADAPTOR	10	5.5	55
5"	BELL & SPIGOT	8	6.6	53
6"		6	8.3	50
2 x 4	INCREASOR ADAPTOR	18	4.5	81
3 x 4	CI TO SEW	18	2.8	50
4 x 5		12	3.7	54
4 x 6		8	7.6	61
4"	DUPLEX ADAPTOR	12	5.0	60
5"	CLAY SPIGOT TO	9	6.0	54
6"	A/C - M.E.	6	7.7	46
4"	DUPLEX ADAPTOR	12	5.2	62
6"	COUPLING (CONC-FT)	6	8.9	53
4"	DUPLEX ADAPTOR	10	4.7	47
5"	COUPLING CI TO S	8	5.7	46
6"		6	7.4	44

CTD014080

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.
13	3 SEC. L	2-3-5

SUPERSEDES: 5-1-70

DATE OF ISSUE: JUL 17 1972

DESCRIPTION:

SMALL DIAMETER SEWER

PART III PIPE, COUPLINGS, & ACCESSORIES PACKAGING

SIZE	DESCRIPTION	PIECES PER CARTON	WEIGHT PER PIECE	WEIGHT PER CARTON
4-5	INCREASOR ADAPTOR	10	3.0	30
4-6	FT - FT	8	5.7	46
5-6		6	6.8	41
4"	COUPLING END PLUG	36	.6	22
5"		20	1.7	34
6"		16	1.9	30
4"	END CAP	36	1.9	68
5"		24	2.5	60
6"		12	4.6	55
4"	COUPLING ADAPTOR	20	2.6	52
5"	BS - FT	12	3.4	41
6"		9	4.2	38
4"	PIPE ADAPTOR	27	1.5	41
5"	BS - FT	18	1.9	34
6"		12	2.2	26
4-4	ME. CONVERTER	15	3.3	50
5-5	CS TO FT	12	4.3	52
6-6		9	5.3	48
4"	CONVERTER NIPPLE	18	2.8	50
5"	CS - FT	8	3.4	28
6"		8	4.1	32
4 x 4	CI SLEEVE ADAPTOR	8	5.4	43
5 x 5	CI - A/C	8	5.6	45
6 x 6	CI - C.S.	6	6.9	41
4"	SEWER TEE NIPPLE	10	2.8	28
5"		8	3.2	26
6"		7	3.7	26
* 4"	PLASTIC END PLUGS ①	12	.8	10
5"		12	1.0	12
6"		12	1.2	14

① To be shipped in vendor's carton.

(*) Denotes change.

CTD014081

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P. Foulds						

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF NO.	SPECIFICATION NO:	PAGE NO.
13	3 SEC. L	2-3-6

SUPERSEDES:	DATE OF ISSUE:
11-1-71	JUL 17 1972

DESCRIPTION:

SMALL DIAMETER SEWER

PART III PIPE, COUPLINGS, & ACCESSORIES PACKAGING

SIZE	DESCRIPTION	(*)PIECES PER CARTON	WEIGHT PER PIECE	(*)WEIGHT PER CARTON
5 x 4	45° WYE	3	16.1	48
6 x 4		2	21.1	42
6 x 5		2	21.1	42
4 x 4		4	11.1	44
5 x 5		3	15.8	47
6 x 6		2	21.2	42
6 x 4	60° WYE	2	22.4	45
6 x 5		2	23.8	48
6 x 6		2	25.4	51
5 x 4	TEE	3	16.8	50
6 x 4		3	18.0	54
6 x 5		3	19.2	58
4 x 4		4	13.5	54
5 x 5		3	18.0	54
6 x 6		2	20.6	41
	ELBOWS			
4"	11¼°	8	7.2	58
	22½°	7	7.2	50
	30°	6	7.2	43
	45°	7	7.2	50
	90°	4	11.0	44
5"	11¼°-22½°-30°-45°	4	9.5	38
	90°	3	14.6	44
6"	11¼°-22½°-30°	4	11.5	46
	45°	3	11.5	35
	90°	2	17.7	35

(*) Denotes change.

NOTE: 45° Double Wye's to be Shipped Unpackaged.

CTD014082

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	GENERAL SEC. L	2-3-7

SUPERSEDES:

DATE OF ISSUE: 11/1/71

DESCRIPTION: 8" and 10" SEWER PIPE
4' WIDE BELLED ALTERNATE END. OFF SET UNIT
TEE AND WYE FITTINGS

DESCRIPTION	FITTINGS PER LAYER	LAYERS PER UNIT	FITTINGS PER UNIT	WT. LBS. PER UNIT	LUMBER
8 x 8 x 4	4	4	16	736	AC
8 x 8 x 5	4	4	16	816	AC
8 x 8 x 6	4	4	16	848	AC
8 x 8 x 8	4	4	16	880	AC
10 x 10 x 4	4	3	12	900	BD
10 x 10 x 5	4	3	12	912	BD
10 x 10 x 6	4	3	12	936	BD
10 x 10 x 8	4	3	12	996	BD
10 x 10 x 10	4	3	12	1092	BD

LUMBER

A. Bearing Boards 3" x 3" x 40" ROUGH CUT
B. Bearing Boards 3" x 3" x 47" ROUGH CUT
C. Separator Boards 1" x 4" x 40" ROUGH CUT
D. Separator Boards 1" x 4" x 47" ROUGH CUT
STEEL BANDS - 3/4" x .020" COATED (WAX) & PAINTED

CTD014083

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:
PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.
	3 Section L	2-3-8

SUPERSEDES:	DATE OF ISSUE:
New	NOV 12 1975

DESCRIPTION:

Small Diameter Sewer
Part III Pipe, Couplings, & Accessories Packaging

Wirebound Crate Size - 48" x 40" x 30" H

Size	Class	Description	Pieces Per Crate	Weight Per Piece (lbs)	Weight (1) Per Crate(lbs)
4"	3300	Coupling	294	3.5	1094
5"	3300	Coupling	190	4.5	920
6"	3300	Coupling	150	5.4	875
4"	All Classes	30°Elbow	96	7.2	756
4"	All Classes	45°Elbow	96	7.2	756
6"	All Classes	30°Elbow	48	11.5	617

(1) Weight of crate included in Total weight.

CTD014084

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	3 A SEC. L	2-3A-1

SUPERSEDES:	DATE OF ISSUE:
	1-15-72

DESCRIPTION: 12" - 16" A/C PRESSURE PIPE, COMMON GROOVE
8' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
12"	100	6	2	12	ACE
	150	6	2	12	ACE
	200	6	2	12	ACE
14"	100	6	2	12	ACE
	150	5	2	10	ACE
	200	5	1	5	AE
16"	100	5	2	10	ACF
	150	4	2	8	ACF
	200	4	1	4	AF

LUMBER

A - BEARING BOARDS 3" x 3" x 94" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 94" ROUGH CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT
F - CHOCKS 3 5/8" x 3 5/8" x 5 1/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

CTD014085

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	1 SEC. L	2-3A-2

SUPERSEDES:

DATE OF ISSUE: 1-15-72

DESCRIPTION: 6" - 10" A/C PRESSURE PIPE, COMMON GROOVE
8' WIDE - BELLED ONE END - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
6"	100	11	4	44	ACD
	150	11	4	44	ACD
	200	11	3	33	ACD
8"	100	9	3	27	ACD
	150	9	3	27	ACD
	200	8	3	24	ACD
10"	100	7	3	21	ACE
	150	7	2	14	ACE
	200	6	2	12	ACE

LUMBER

A - BEARING BOARDS 3" x 3" x 94" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 94" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

CTD014086

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FORM P927

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO. 10	SPECIFICATION NO: 1 SEC. L	PAGE NO.: 2-3A-3
SUPERSEDES:		DATE OF ISSUE: 1-15-72

DESCRIPTION: 6" - 12" A/C PRESSURE PIPE, COMMON GROOVE
4' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
6"	100	6	4	24	ACD
	150	6	4	24	ACD
	200	6	3	18	ACD
8"	100	5	3	15	ACD
	150	5	3	15	ACD
	200	4	3	12	ACD
10"	100	4	3	12	ACE
	150	3	3	9	ACE
	200	3	2	6	ACE
12"	100	3	2	6	ACE
	150	3	2	6	ACE
	200	3	2	6	ACE

LUMBER

A - BEARING BOARDS 3" x 3" x 47" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 47" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

STEEL BANDS - 3/4" x .020" PAINTED, WAX COATED, AND POSITIONED AROUND UNIT AT CENTER

CTD014087

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
30	3A Sec. L	2-3A-3A

SUPERSEDES:	DATE OF ISSUE:
New —	JUL 2 8 1976

DESCRIPTION:

6" - 12" A/C PRESSURE PIPE, COMMON GROOVE
4' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

Raggle Board Option

Size	Class	Pipe Per Layer	Layers Per Unit	Pipe Per Unit	Lumber
6"	150	6	3	18	AE
8"	150	4	3	12	BF
10"	150	3	3	9	CG
12"	150	3	2	6	DH

LUMBER

A - Bearing Boards - 2-1/2" x 3-1/2" x 44" Raggle Cut (one side)
B - Bearing Boards - 2-1/2" x 3-1/2" x 38" Raggle Cut (one side)
C - Bearing Boards - 2-1/2" x 3-1/2" x 36" Raggle Cut (one side)
D - Bearing Boards - 2-1/2" x 3-1/2" x 43" Raggle Cut (one side)
E - Separator Boards - 2" x 2" x 44" Raggle Cut (two sides)
F - Separator Boards - 2" x 2" x 38" Raggle Cut (two sides)
G - Separator Boards - 2" x 2" x 36" Raggle Cut (two sides)
H - Separator Boards - 2" x 2" x 43" Raggle Cut (two sides)
Steel Straps - 1/2" x .020" Perforated and Zinc-coated
Steel Bands - 3/4" x .020" Painted and Wax-coated
One Per Unit at Center

CTD014088

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PHF:ap 7/22/76

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
23	3A SEC. L.	2-3A-4
SUPERSEDES:		DATE OF ISSUE:
NEW		SEP 2 4 1973

DESCRIPTION:

6" through 16" - A/C Pressure Pipe - Common Groove
MEO Quarter Lengths - Unbelled

4 FOOT UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
6"	100-150 200	5/6	2	22	BCF
8"	100-150 200	4/5	2	18	BDF
10"	100-150 200	3	3	9	BDG
12"	100-150 200	3	2	6	BDG

Steel Bands - 3/4" x .020" painted, wax coated and positioned around unit at center.

8 FOOT UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
14"	100-150 200	5	2	10	AEG
16"	100-150 200	4	2	8	AEH

A - Bearing Boards - 3" x 3" x 94" - Rough Cut
B - Bearing Boards - 3" x 3" x 47" - Rough Cut
C - Separator Boards - 1" x 4" x 47" - Rough Cut
D - Separator Boards - 2" x 4" x 47" - Rough Cut
E - Separator Boards - 2" x 4" x 94" - Rough Cut
F - Chocks - 1 3/4" x 1 3/4" x 2 3/4" - Diagonal Cut
G - Chocks - 2 3/4" x 2 3/4"x 3 7/8" - Diagonal Cut
H - Chocks - 3 5/8" x 3 5/8" x 5 1/8" - Diagonal Cut

Steel Straps - ½" x .020" - Perforated and Zinc Coated.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO. 23	SPECIFICATION NO: 3A SEC. L.	PAGE NO. 2-3A-5
SUPERSEDES: NEW		DATE OF ISSUE: SEP 2 4 1973

DESCRIPTION:

6" through 16" - A/C Pressure Pipe, Common Groove
MEO Half Lengths - Unbelled

4 FOOT UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
6"	100-150-200	5/6	2	22	BCF
8"	100-150-200	4/5	2	18	BDF
10"	100-150-200	3	3	9	BDG
12"	100-150-200	3	2	6	BDG

Steel Bands - 3/4" x .020" painted, wax coated, and positioned around unit at center.

8 FOOT UNITS

14"	100-150-200	5	2	10	AEG
16"	100-150-200	4	2	8	AEH

A - Bearing Boards - 3" x 3" x 94" - Rough Cut
B - Bearing Boards - 3" x 3" x 47" - Rough Cut
C - Separator Boards - 1" x 4" x 47" - Rough Cut
D - Separator Boards - 2" x 4" x 47" - Rough Cut
E - Separator Boards - 2" x 4" x 94" - Rough Cut
F - Chocks - 1 3/4" x 1 3/4" x 2 3/4" - Diagonal Cut
G - Chocks - 2 3/4" x 2 3/4" x 3 7/8" - Diagonal Cut
H - Chocks - 3 5/8" x 3 5/8" x 5 1/8" - Diagonal Cut

Steel Straps - ½" x .020" - Perforated and Zinc Coated.

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. Foulds						

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IRRIGATION PIPE

FORM P827

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.: 10	SPECIFICATION NO: 4 Sec. L	PAGE NO.: 2-4-1
SUPERSEDES: 4/28/70	DATE OF ISSUE: 11-1-71	

DESCRIPTION:

3" Thru 5" A/C IRRIGATION PIPE
4' WIDE - UNBELLED

SIZE	TYPE	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
3"	25	11	5	55	ABD
	75	11	5	55	ABD
4"	25	9	5	45	ABD
	75	8	5	40	ABD
5"	25	7	6	42	ABD
	75	7	6	42	ABD

LUMBER

A - BEARING BOARDS 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS 1" x 4" x 47" ROUGH CUT
D - CHOCKS 1 3/4 x 1 3/4" x 2 3/4" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)

STEEL BANDS - 3/4" x .020" COATED (WAX) & PAINTED

- ONE PER UNIT AT CENTER

CTD014091

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	2 SEC. L	2-4-1A

SUPERSEDES:	DATE OF ISSUE:
	11-1-71

DESCRIPTION:

3" THRU 5" - A/C IRRIGATION PIPE
4' WIDE - UNBELLED (CANNON-BALLED)

SIZE	TYPE	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
3"	25	11/10	3	63	ABD
	75	11/10	3	63	ABD
4"	25	9/8	3	51	ABD
	75	8/7	3	45	ABD
5"	25	7/6	3	39	ABD
	75	7/6	3	39	ABD

LUMBER

A - BEARING BOARDS 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS 1" x 4" x 47" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)
STEEL BANDS - 3/4" x .020" COATED (WAX) & PAINTED

- ONE PER UNIT AT CENTER

CTD014092

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.: 10	SPECIFICATION NO: 4 SEC. L	PAGE NO.: 2-4-2
SUPERSEDES: 4-28-70		DATE OF ISSUE: 11/1/71

DESCRIPTION:

3" AND 4" A/C IRRIGATION PIPE
4' WIDE - UNBELLED

SIZE	TYPE	CLASS	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
3"	125		11	5	55	ABD
		100	11	5	55	ABD
		150	10	5	50	ABD
		200	10	4	40	ABD
4"	125		8	5	40	ABD
		100	8	5	40	ABD
		150	8	4	32	ABD
		200	8	4	32	ABD

LUMBER

A - BEARING BOARDS 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS 1" x 4" x 47" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)

STEEL BANDS - 3/4" x .020" COATED (WAX) & PAINTED

- ONE PER UNIT AT CENTER

CTD014093

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	2 SEC. L	2-4-2A

SUPERSEDES:

DATE OF ISSUE: 11-1-71

DESCRIPTION:

3" and 4" A/C IRRIGATION PIPE
4' WIDE - UNBELLED (CANNON BALLED)

SIZE	TYPE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
3"	125		11/10	3	63	ABD
		100	11/10	3	63	ABD
		150	10/9	2	38	ABD
		200	10/9	2	38	ABD
4"	125		8/7	3	45	ABD
		100	8/7	3	45	ABD
		150	8/7	2	30	ABD
		200	8/7	2	30	ABD

LUMBER

A - BEARING BOARDS - 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS - 1" x 4" x 47" ROUGH CUT
D - CHOCKS - 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020 PERFORATED AND COATED (ZINC)
STEEL BANDS - 3/4" x .020 COATED (WAX) & PAINTED
- ONE PER UNIT AT CENTER

CTD014094

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4 SEC. L	2-4-3

SUPERSEDES:	DATE OF ISSUE:
4-28-70	1-15-72

DESCRIPTION:

6" - 12" A/C IRRIGATION PIPE
4' WIDE - BELLED ALTERNATE END - OFFSET UNITS

SIZE	TYPE	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
6"	25	6	6	36	ACD
	75	6	5	30	ACD
	90	6	5	30	ACD
8"	25	5	5	25	ACD
	75	5	4	20	ACD
	90	5	4	20	ACD
10"	25	4	4	16	ACE
	75	4	4	16	ACE
	90	4	4	16	ACE
12"	25	3	4	12	ACE
	75	3	4	12	ACE
	90	3	4	12	ACE

LUMBER

A - BEARINB BOARDS 3" x 3" x 47" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 47" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED
STEEL BANDS - 3/4" x .020" PAINTED, WAX COATED AND POSITIONED AROUND UNIT AT CENTER

CTD014095

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.: 10	SPECIFICATION NO: 4 SEC. L	PAGE NO.: 2-4-4
SUPERSEDES: 4-28-70		DATE OF ISSUE: 1-15-72

DESCRIPTION: 3" - 12" A/C IRRIGATION PIPE
4' WIDE - BELLED ALTERNATE END - OFFSET UNITS

SIZE	TYPE	CLASS	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
3"	125		11	5	55	ABD
		100	11	5	55	ABD
		150	10	5	50	ABD
		200	10	5	50	ABD
4"	125		8	5	40	ABD
		100	8	5	40	ABD
		150	8	4	32	ABD
		200	8	4	32	ABD
6"	125		6	4	24	ACD
		100	6	4	24	ACD
		150	6	4	24	ACD
		200	6	3	18	ACD
8"	125		5	3	15	ACD
		100	5	3	15	ACD
		150	4	3	12	ACD
		200	4	3	12	ACD
10"	125		4	3	12	ACE
		100	4	3	12	ACE
		150	3	3	9	ACE
		200	3	3	9	ACE
12"	125		3	3	9	ACE
		100	3	3	9	ACE
		150	3	2	6	ACE
		200	3	2	6	ACE

LUMBER

A - BEARING BOARDS 3" x 3" x 47" ROUGH CUT
B - SEPARATOR BOARDS 1" x 4" x 47" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 47" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED
STEEL BANDS - 3/4" x .020" PAINTED, WAX COATED, AND POSITIONED AROUND UNIT AT CENTER

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4 SEC. L	2-4-5

SUPERSEDES:	DATE OF ISSUE:
4-28-70	1-15-72

DESCRIPTION:

12" - 24" A/C IRRIGATION PIPE
8' WIDE _ BELLED ALTERNATE END - OFFSET UNITS

SIZE	TYPE	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
12"	25	7	3	21	ACE
	75	7	3	21	ACE
	90	7	3	21	ACE
14"	25	6	3	18	ACE
	75	6	3	18	ACE
15"	25	5	3	15	ACE
	75	5	2	10	ACE
16"	25	5	3	15	ACF
	75	5	2	10	ACF
18"	25	4	3	12	ACF
	75	4	3	12	ACF
20"	25	4	3	12	ACF
	75	4	2	8	ACF
21"	25	4	2	8	ACF
	75	4	2	8	ACF
24"	25	3	2	6	ACF
	75	3	2	6	ACF

LUMBER

A - BEARING BOARDS 3" x 3" x 94" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 94" ROUGH CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT
F - CHOCKS 3 5/8" x 3 5/8" x 5 1/8" DIAGONAL CUT
STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

CTD014097

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4 SEC. L	2-4-6

SUPERSEDES:	DATE OF ISSUE:
4-28-70	1-15-72

DESCRIPTION: 3" - 4" AND 12" - 24" A/C IRRIGATION PIPE
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS

SIZE	TYPE	CLASS	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
3"	125		23	4	92	ABD
		100	23	4	92	ABD
		150	22	4	88	ABD
		200	21	4	84	ABD
4"	125		18	4	72	ABD
		100	18	4	72	ABD
		150	17	4	68	ABD
		200	17	3	51	ABD
12"	125		6	3	18	ACE
		100	6	2	12	ACE
		150	6	2	12	ACE
		200	6	2	12	ACE
14"	125		6	2	12	ACE
		100	6	2	12	ACE
		150	5	2	10	ACE
		200	5	1	5	AE
15"	125		5	2	10	ACE
		100	5	2	10	ACE
		150	5	1	5	AE
		200	5	1	5	AE
16"	125		5	2	10	ACF
		100	5	2	10	ACF
		150	4	2	8	ACF
		200	4	1	4	AF
18"	125		4	2	8	ACF
		100	4	2	8	ACF
		150	4	1	4	AF
20"	125		4	2	8	ACF
		100	4	1	4	AF
		150	3	1	3	AF
21"	125		3	2	6	ACF
		100	3	2	6	ACF
		150	3	1	3	AF

(Continued on next page)

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4 SEC. L	2-4-7
SUPERSEDES:		DATE OF ISSUE:
4-28-70		1-15-72

DESCRIPTION:

3" - 4" AND 12" - 24" A/C IRRIGATION PIPE
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS

SIZE	TYPE	CLASS	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
24"	125		3	1	3	AF
		100	3	1	3	AF
		150	3	1	3	AF

LUMBER

A - BEARING BOARDS 3" x 3" x 94" ROUGH CUT
B - SEPARATOR BOARDS 1" x 4" x 94" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 94" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT
F - CHOCKS 3 5/8" x 3 5/8" x 5 1/8" DIAGONAL CUT

STEEL STRAPS 1/2" x .020" PERFORATED AND ZINC COATED

CTD014099

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4 SEC. L	2-4-8

SUPERSEDES:	DATE OF ISSUE:
4-28-70	1-15-72

DESCRIPTION:

6" - 10" A/C IRRIGATION PIPE
8' WIDE - BELLED ONE END - OFFSET UNITS

SIZE	TYPE	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
6"	25	12	6	72	ACD
	75	12	5	60	ACD
	90	12	5	60	ACD
8"	25	9	5	45	ACD
	75	9	5	45	ACD
	90	9	5	45	ACD
10"	25	7	4	28	ACE
	75	7	4	28	ACE
	90	7	4	28	ACE

LUMBER

A - BEARING BOARDS 3" x 3" x 94" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 94" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

CTD014100

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4 SEC. L	2-4-9

SUPERSEDES:	DATE OF ISSUE:
4-28-70	1-15-72

DESCRIPTION:

6" - 10" A/C IRRIGATION PIPE
8' WIDE - BELLED ONE END - OFFSET UNITS

SIZE	TYPE	CLASS	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
6"	125		11	4	44	ACD
		100	11	5	55	ACD
		150	11	4	44	ACD
		200	11	3	33	ACD
8"	125		9	4	36	ACD
		100	9	4	36	ACD
		150	9	3	27	ACD
		200	8	3	24	ACD
10"	125		7	3	21	ACE
		100	7	3	21	ACE
		150	6	3	18	ACE
		200	6	2	12	ACE

LUMBER

A - BEARING BOARDS		3" x 3" x 94"	ROUGH CUT
C - SEPARATOR BOARDS		2" x 4" x 94"	ROUGH CUT
D - CHOCKS	1 3/4" x 1 3/4"	x 2 3/4"	DIAGONAL CUT
E - CHOCKS	2 3/4" x 2 3/4"	x 3 7/8"	DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

CTD014101

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4 A SEC. L	2-4A-1

SUPERSEDES:	DATE OF ISSUE:
	1-15-72

DESCRIPTION:

6" - 12" A/C IRRIGATION PIPE, COMMON GROOVE
4' WIDE - BELLED ALTERNATE END - OFFSET UNITS

SIZE	TYPE	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
6"	25	6	6	36	ACD
	75	6	5	30	ACD
	90	6	5	30	ACD
8"	25	5	5	25	ACD
	75	5	4	20	ACD
	90	5	4	20	ACD
10"	25	4	4	16	ACE
	75	4	4	16	ACE
	90	4	4	16	ACE
12"	25	3	4	12	ACE
	75	3	4	12	ACE
	90	3	4	12	ACE

LUMBER

A - BEARING BOARDS — 3" x 3" x 47" ROUGH CUT
C - SEPARATOR BOARDS — 2" x 4" x 47" ROUGH CUT
D - CHOCKS — 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS — 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

STEEL BANDS - 3/4" x .020" PAINTED, WAX COATED, AND POSITIONED AROUND UNIT AT CENTER

CTD014102

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4A SEC. L	2-4A-2

SUPERSEDES:

DATE OF ISSUE: 1-15-72

DESCRIPTION:

6" - 12" A/C IRRIGATION PIPE, COMMON GROOVE 4' WIDE - BELLED ALTERNATE END - OFFSET UNITS

SIZE	TYPE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
6"	125		6	4	24	ACD
		100	6	4	24	ACD
		150	6	4	24	ACD
		200	6	3	18	ACD
8"	125		5	3	15	ACD
		100	5	3	15	ACD
		150	5	3	15	ACD
		200	4	3	12	ACD
10"	125		4	3	12	ACE
		100	4	3	12	ACE
		150	3	3	9	ACE
		200	3	3	9	ACE
12"	125		3	3	9	ACE
		100	3	3	9	ACE
		150	3	2	6	ACE
		200	3	2	6	ACE

LUMBER

A - BEARING BOARDS 3" x 3" x 47" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 47" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

STEEL BANDS - 3/4" x .020" PAINTED, WAX COATED, AND POSITIONED AROUND UNIT AT CENTER

CTD014103

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4A SEC. L	2-4A-3

SUPERSEDES:	DATE OF ISSUE:
	1-15-72

DESCRIPTION:

12" - 16" A/C IRRIGATION PIPE, COMMON GROOVE
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS

SIZE	TYPE	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
12"	25	7	3	21	ACE
	75	7	3	21	ACE
	90	7	3	21	ACE
14"	25	6	3	18	ACE
	75	6	3	18	ACE
15"	25	5	3	15	ACE
	75	5	3	15	ACE
16"	25	5	3	15	ACF
	75	5	2	10	ACF

LUMBER

A - BEARING BOARDS 3" x 3" x 94" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 94" ROUGH CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT
F - CHOCKS 3 5/8" x 3 5/8" x 5 1/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

CTD014104

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION:		
PACKAGING METHODS - ALL PLANTS		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4A SEC. L	2-4A-4
SUPERSEDES:		DATE OF ISSUE:
		1-15-72

DESCRIPTION:

12" - 16" A/C IRRIGATION PIPE, COMMON GROOVE
8' WIDE - BELLED ALTERNATE END - OFFSET UNITS

SIZE	TYPE	CLASS	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
12"	125		6	2	12	ACE
		100	6	2	12	ACE
		150	6	2	12	ACE
		200	6	1	6	ACE
14"	125		6	2	12	ACE
		100	6	2	12	ACE
		150	5	2	10	ACE
		200	5	1	5	AE
15"	125		5	2	10	ACE
		100	5	2	10	ACE
		150	5	1	5	AE
		200	5	1	5	AE
16"	125		5	2	10	ACF
		100	5	2	10	ACF
		150	4	2	8	ACF
		200	4	1	4	AF

LUMBER

A - BEARING BOARDS		3" x 3" x 94"	ROUGH CUT
C - SEPARATOR BOARDS		2" x 4" x 94"	ROUGH CUT
E - CHOCKS	2 3/4" x 2 3/4"	x 3 7/8"	DIAGONAL CUT
F - CHOCKS	3 5/8" x 3 5/8"	x 5 1/8"	DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

CTD014105

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4A SEC. L	2-4A-5

SUPERSEDES:

DATE OF ISSUE: 1-15-72

DESCRIPTION: 6" - 10" A/C IRRIGATION PIPE, COMMON GROOVE
8' WIDE - BELLED ONE END - OFFSET UNITS

SIZE	TYPE	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
6"	25	12	6	72	ACD
	75	12	5	60	ACD
	90	12	5	60	ACD
8"	25	9	5	45	ACD
	75	9	5	45	ACD
	90	9	5	45	ACD
10"	25	7	5	35	ACE
	75	7	5	35	ACE
	90	7	5	35	ACE

LUMBER

A - BEARING BOARDS 3" x 3" x 94" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 94" ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	4A SEC. L	2-4A-6

SUPERSEDES:

DATE OF ISSUE: 1-15-72

DESCRIPTION:

6" - 10" A/C IRRIGATION PIPE, COMMON GROOVE
8' WIDE - BELLED ONE END - OFFSET UNITS

SIZE	TYPE	CLASS	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
6"	125		11	4	44	ACD
		100	11	4	44	ACD
		150	11	4	44	ACD
		200	11	3	33	ACD
8"	125		9	4	36	ACD
		100	9	4	36	ACD
		150	9	3	27	ACD
		200	8	3	24	ACD
10"	125		7	3	21	ACE
		100	7	3	21	ACE
		150	7	2	14	ACE
		200	6	2	12	ACE

LUMBER

A - BEARING BOARDS	3" x 3" x 94"	ROUGH CUT
C - SEPARATOR BOARDS	2" x 4" x 94"	ROUGH CUT
D - CHOCKS	1 3/4" x 1 3/4" x 2 3/4"	DIAGONAL CUT
E - CHOCKS	2 3/4" x 2 3/4" x 3 7/8"	DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND ZINC COATED

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STORM DRAIN

FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
10	3A SEC. L.	2-13-1

SUPERSEDES:

DATE OF ISSUE: 11/1/71

DESCRIPTION:

6" THRU 24" A/C STORM DRAIN PIPE
8' WIDE - UNBELLED (RIVERSIDE & SANTA CLARA)

SIZE	"D" CLASS	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
6"	All	13	4	52	ABD
8"	All	10	4	40	ACD
10"	15-2000	8	4	32	ACE
	3000	8	3	24	ACE
	3750	8	3	24	ACE
12"	15-2000	7	3	21	ACE
	3000	7	3	21	ACE
	3750	6	3	18	ACE
14"	1500	6	3	18	ACE
	2000	6	3	18	ACE
	3000	6	2	12	ACE
	3750	5	2	10	ACE
15"	15-2000	5	3	15	ACE
	30-3750	5	2	10	ACE
16"	1500	5	3	15	ACF
	2000	5	3	15	ACF
	3000	5	2	10	ACF
	3750	5	2	10	ACF
18"	1500	4	3	12	ACF
	2000	4	3	12	ACF
	3000	4	2	8	ACF
	3750	4	2	8	ACF
20"	1500	4	2	8	ACF
	2000	4	2	8	ACF
	3000	4	2	8	ACF
	3750	4	1	4	AF
21"	1500	4	2	8	ACF
	2000	4	2	8	ACF
	3000	3	2	6	ACF
	3750	3	2	6	ACF

(Continued on next page)

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS		
T.C.O. REP. NO.: 10	SPECIFICATION NO.: 3A SEC. L	PAGE NO.: 2-13-2
SUPERSEDES:	DATE OF ISSUE: 11/1/71	

DESCRIPTION:

6" THRU 24" A/C STORM DRAIN PIPE
8' WIDE - UNBELLED (RIVERSIDE & SANTA CLARA)

SIZE	"D" CLASS	PIPE PER LAYER	LAYER PER UNIT	PIPE PER UNIT	LUMBER
24"	1500	3	2	6	ACF
	2000	3	2	6	ACF
	3000	3	1	3	AF
	3750	3	1	3	AF

LUMBER

A - BEARING BOARDS - 3" x 3" x 94" ROUGH CUT
B - SEPARATOR BOARDS 1" x 4" x 94" ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 94" ROUGH CUT
D - CHOCKS - 1 3/4" x 1 3/4" x 2 3/4" DIAGONAL CUT
E - CHOCKS - 2 3/4" x 2 3/4" x 3 7/8" DIAGONAL CUT
F - CHOCKS - 3 5/8" x 3 5/8" x 5 1/8" DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" PERFORATED AND COATED (ZINC)

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
15	15B SEC. L	2-15B-1

SUPERSEDES:	DATE OF ISSUE:
11-1-71	JAN 3 1973

DESCRIPTION: 12" - 24" A/C BUREAU OF RECLAMATION/FLUID TRANSMISSION
8' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
12"	30	7	3	21	ACE
	35	7	3	21	ACE
	40	7	3	21	ACE
	45	6	2	12	ACE
	50	6	2	12	ACE
	60	6	2	12	ACE
	70	6	2	12	ACE
	80	6	1	6	AE
	90	6	1	6	AE
14"	30	6	3	18	ACE
	35	6	2	12	ACE
	40	6	2	12	ACE
	45	5	3	15	ACE
	50	5	2	10	ACE
	60	5	2	10	ACE
	70	5	1	5	AE
	80	5	1	5	AE
	90	5	1	5	AE
15"	30	5	3	15	ACE
	35	5	2	10	ACE
	40	5	2	10	ACE
	45	5	2	10	ACE
	50	5	2	10	ACE
	60	5	1	5	AE
	70	5	1	5	AE
	*80	5	1	5	AE
	*90	5	1	5	AE
16"	30	5	2	10	ACF
	35	5	2	10	ACF
	40	5	2	10	ACF
	45	5	2	10	ACF
	50	5	2	10	ACF
	*60	5	1	5	ACF
	70	4	1	4	AF
	80	4	1	4	AF
	90	4	1	4	AF

CTD014110

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REP. NO.	SPECIFICATION NO:	PAGE NO
15	15B SEC. L	2-15B-2

SUPERSEDES:	DATE OF ISSUE:
NEW	JAN 3 1977

DESCRIPTION: 12" - 24" A/C BUREAU OF RECLAMATION/FLUID TRANSMISSION
8' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
18"	30	4	3	12	ACF
	35	4	3	12	ACF
	40	4	2	8	ACF
	45	4	2	8	ACF
	50	4	2	8	ACF
	60	4	1	4	AF
	70	4	1	4	AF
	80	4	1	4	AF
	90	4	1	4	AF
20"	30	4	2	8	ACF
	35	4	2	8	ACF
	40	4	1	4	AF
	45	4	1.	4	AF
	50	4	1	4	AF
	60	3	1	3	AF
	70	3	1	3	AF
	80	3	1	3	AF
	90	3	1	3	BF
21"	30	4	2	8	ACF
	35	4	2	8	ACF
	40	3	2	6	ACF
	45	3	2	6	ACF
	50	3	2	6	ACF
	60	3	1	3	AF
	70	3	1	3	AF
	80	3	1	3	AF

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
15	15B SEC. L	2-15B-3

SUPERSEDES: NEW

DATE OF ISSUE: JAN 3 1973

DESCRIPTION: 12" - 24" A/C BUREAU OF RECLAMATION/FLUID TRANSMISSION
8' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
24"	30	3	2	6	ACF
	35	3	2	6	ACF
	40	3	1	3	AF
	45	3	1	3	AF
	50	3	1	3	AF
	60	3	1	3	AF
	70	3	1	3	AF
	80	2	1	2	BF

LUMBER:

A - Bearing Boards 3" x 3" x 94" - ROUGH CUT
B - Bearing Boards 3" x 4" x 94" - ROUGH CUT
C - Separator Boards 2" x 4" x 94" - ROUGH CUT
E - Chocks - 2 3/4" x 2 3/4" x 3 7/8" - DIAGONAL CUT
F - Chocks - 3 5/8" x 3 5/8" x 5 1/8" - DIAGONAL CUT

CTD014112

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
15	15B SEC. L	2-15B-4

SUPERSEDES: 11-1-71

DATE OF ISSUE: JAN 3 19[illegible]

DESCRIPTION: 6" - 24" A/C BUREAU OF RECLAMATION/FLUID TRANSMISSION
8' WIDE - BELLED ONE END - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
6"	*40	12	4	48	ACD
	*45	12	4	48	ACD
	50	11	4	44	ACD
	60	11	4	44	ACD
	70	11	4	44	ACD
	80	11	3	33	ACD
	90	11	3	33	ACD
8"	30	9	4	36	ACD
	35	9	4	36	ACD
	40	9	4	36	ACD
	45	9	3	27	ACD
	50	9	3	27	ACD
	60	9	3	27	ACD
	70	9	3	27	ACD
	80	8	3	24	ACD
	*90	7	3	21	ACD
10"	30	7	4	28	ACE
	35	7	4	28	ACE
	*40	7	3	21	ACE
	45	7	3	21	ACE
	50	7	3	21	ACE
	60	7	2	14	ACE
	70	7	2	14	ACE
	80	6	2	12	ACE
	90	6	2	12	ACE

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
15	15B SEC. L	2-15B-5

SUPERSEDES:	DATE OF ISSUE:
NEW	JAN 3 1972

DESCRIPTION:

6" - 24" A/C BUREAU OF RECLAMATION/FLUID TRANSMISSION
8' WIDE - BELLED ONE END - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
12"	30	6	4	24	ACE
	35	6	3	18	ACE
	40	6	3	18	ACE
	45	6	2	12	ACE
	50	6	2	12	ACE
	60	6	2	12	ACE
	70	5	2	10	ACE
	80	5	2	10	ACE
	90	5	2	10	ACE
14"	30	5	3	15	ACE
	35	5	3	15	ACE
	40	5	2	10	ACE
	45	5	3	15	ACE
	50	5	2	10	ACE
	60	5	2	10	ACE
	70	5	1	5	AE
	80	5	1	5	AE
	90	4	1	4	AE
15"	30	5	3	15	ACE
	35	5	2	10	ACE
	40	5	2	10	ACE
	45	5	2	10	ACE
	50	5	2	10	ACE
	60	4	2	8	ACE
	70	4	1	4	AE
	80	4	1	4	AE
	90	4	1	4	AE
16"	30	5	2	10	ACF
	35	5	2	10	ACF
	40	5	2	10	ACF
	45	4	2	8	ACF
	50	4	2	8	ACF
	60	4	2	8	ACF
	70	4	1	4	AF
	80	4	1	4	AF
	90	4	1	4	AF

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.
15	15B SEC. L	2-15B-6

SUPERSEDES:	DATE OF ISSUE:
NEW	JAN 3 [illegible]

DESCRIPTION: 6" - 24" A/C BUREAU OF RECLAMATION/FLUID TRANSMISSION
8' WIDE - BELLED ONE END - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
18"	30	4	3	12	ACF
	35	4	3	12	ACF
	40	4	2	8	ACF
	45	4	2	8	ACF
	50	4	2	8	ACF
	60	4	1	4	AF
	70	3	1	3	AF
	80	3	1	3	AF
	90	3	1	3	AF
20"	30	4	2	8	ACF
	35	4	2	8	ACF
	40	3	2	6	ACF
	45	3	2	6	ACF
	50	3	2	6	ACF
	60	3	1	3	AF
	70	3	1	3	AF
	80	3	1	3	AF
	90	3	1	3	BF
21"	30	3	3	9	ACF
	35	3	3	9	ACF
	40	3	2	6	ACF
	45	3	2	6	ACF
	50	3	2	6	ACF
	60	3	1	3	AF
	70	3	1	3	AF
	80	3	1	3	AF

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
15	15B SEC. L	2-15B-7

SUPERSEDES:	DATE OF ISSUE:
NEW	JAN 3 [illegible]

DESCRIPTION: 6" - 24" A/C BUREAU OF RECLAMATION/FLUID TRANSMISSION
8" WIDE - BELLED ONE END - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
24"	30	3	2	6	ACF
	35	3	2	6	ACF
	40	3	1	3	AF
	45	3	1	3	AF
	50	3	1	3	AF
	60	3	1	3	AF
	70	2	1	2	AF
	80	2	1	2	BF

LUMBER:

A - Bearing Boards 3" x 3" x 94" - ROUGH CUT
B - Bearing Boards 3" x 4" x 94" - ROUGH CUT
C - Separator Boards 2" x 4" x 94" - ROUGH CUT
D - Chocks 1 3/4" x 1 3/4" x 2 3/4"- DIAGONAL CUT
E - Chocks 2 3/4" x 2 3/4" x 3 7/8"- DIAGONAL CUT
F - Chocks 3 5/8" x 3 5/8" x 5 1/8"- DIAGONAL CUT

STEEL STRAPS - 1/2" x .020 - PERFORATED AND ZINC COATED

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO
15	15B SEC. L	2-15B-8

SUPERSEDES:	DATE OF ISSUE:
11-1-71	JAN 3 1972

DESCRIPTION: 6" - 24" A/C BUREAU OF RECLAMATION/FLUID TRANSMISSION
4' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
6"	40	6	4	24	ACD
	45	6	4	24	ACD
	50	6	4	24	ACD
	*60	6	3	18	ACD
	*70	6	3	18	ACD
	80	6	3	18	ACD
	90	6	3	18	ACD
8"	30	5	4	20	ACD
	35	5	3	15	ACD
	40	5	3	15	ACD
	45	5	3	15	ACD
	50	5	3	15	ACD
	60	5	3	15	ACD
	70	5	3	15	ACD
	80	4	3	12	ACD
	*90	4	2	8	ACD
10"	30	4	4	16	ACE
	*35	4	3	12	ACE
	40	4	3	12	ACE
	45	4	3	12	ACE
	*50	3	3	9	ACE
	60	3	3	9	ACE
	70	3	3	9	ACE
	80	3	2	6	ACE
	90	3	2	6	ACE

CTD014117

*Denotes Change.

(Cont. on next page)

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TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

SPECIFICATIONS CLASSIFICATION: PACKAGING METHODS - ALL PLANTS

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
15	15B SEC. L	2-15B-9

SUPERSEDES:	DATE OF ISSUE:
11-1-72	JAN 3 1973

DESCRIPTION:

6" - 24" A/C BUREAU OF RECLAMATION/FLUID TRANSMISSION
4' WIDE - BELLED ALTERNATE ENDS - OFFSET UNITS

SIZE	CLASS	PIPE PER LAYER	LAYERS PER UNIT	PIPE PER UNIT	LUMBER
12"	30	3	4	12	ACE
	35	3	3	9	ACE
	40	3	3	9	ACE
	45	3	2	6	ACE
	50	3	2	6	ACE
	60	3	2	6	ACE
	70	3	2	6	ACE
	80	3	1	3	AE
	90	3	1	3	AE

LUMBER

A - BEARING BOARDS 3" x 3" x 47" - ROUGH CUT
C - SEPARATOR BOARDS 2" x 4" x 47" - ROUGH CUT
D - CHOCKS 1 3/4" x 1 3/4" x 2 3/4" - DIAGONAL CUT
E - CHOCKS 2 3/4" x 2 3/4" x 3 7/8" - DIAGONAL CUT

STEEL STRAPS - 1/2" x .020" - PERFORATED AND COATED (ZINC)
STEEL BANDS - 3/4" x .020" - COATED (WAX) AND PAINTED
- ONE PER UNIT AT CENTER

CTD014118

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
P. H. FOULDS						

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M

N

TECHNICAL CHANGE ORDER

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

APPLICABLE TO:
A/C General Standards Manual
Section N (Shipping Weights)

DATE OF ISSUE:	T.C.O. NO.:	PAGE NO.
September 1, 1982	55	1

DESCRIPTION:
A/C Bureau of Reclamation/Fluid Transmission
Pipe, Couplings and Accessories

Purpose: 1. To publish the shipping weights of the products revised by the most recent design review and published under date of February 1, 1982 in Standard Product Spec. 15B. Basic items included in the design change were:

a) 19 Pipe dimensions

b) 9 FM dimensions

c) 1 PAD dimensions

These in turn affected elbows and existing tees.

2. All of the above corresponding shipping weights have been revised accordingly.

3. Random checks of the non-affected tee weights disclosed errors requiring recalculation of all tee weights.

Effective Date:

Date of Issue.

Disposition of Superseded Pages:

Destroy pages	15B-1/15B-2	September 26, 1977
	15B-3/15B-4	"
	15B-5/15B-6	"
	15B-7/15B-8	"
	15B-9/15B-10	"
	15B-17/15B-18	"
	15B-25/15B-26	"
	15B-27/15B-28	"

Replace with pages attached.

CTD014119

RECEIVED AUG 31 1982

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
M. R. Stuckey			RH	J.R.A.		

0-10-80-11 (P6054) 12/76 CONFIDENTIAL DOCUMENT - NOT TO BE DISTRIBUTED TO UNAUTHORIZED PERSONNEL

TECHNICAL SPECIFICATIONS

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Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
46	Section N	1-1

SUPERSEDES:	DATE OF ISSUE:
See TCO #46	SEP 26 1977

DESCRIPTION:
Fluid - Tite A/C Pressure Pipe, Couplings, and Accessories.
Classes 100, 150, and 200.

Standard Pipe Shipping Wt. Lbs./Ft.

Pipe Size	Type or Class	Plant SB	SZ	SS	SE	SD	
3"	100				X		4.7
		X					4.4
	150				X		5.2
		X					4.9
	200				X		6.0
		X					5.7
4"	100	X	X			X	6.8
				X	X		6.4
	150	X	X			X	7.4
				X	X		7.1
	200	X	X	X	X	X	8.6

Prebelled Pipe Shipping Wt. Lbs./Ft.

Pipe Size	Type or Class	Plant SB	SZ	SS	SE	SD	
3"	100				X		5.0
		X					4.7
	150				X		5.6
		X					5.3
	200				X		6.4
		X					6.1
4"	100	X	X			X	7.2
				X	X		6.8
	150	X	X			X	7.9
				X	X		7.6
	200	X	X	X	X	X	9.2

CTD014120

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DESCRIPTION:
Fluid - Tite A/C Pressure Pipe, Couplings, and Accessories
Classes 100, 150, and 200

Standard Coupling

Coupling Size Inches	Class	Shipping Weight Lbs./Pc.
3"	100	4.0
	150	4.8
	200	5.6
4"	100	5.3
	150	6.6
	200	7.6

Fully Machined Pipe (FM) Shipping Wt., Lbs./Ft.

FM Size, In.	Class	
3"	100	3.5
	150	4.4
	200	4.4
4"	100	4.5
	150	5.6
	200	7.0

TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REP. NO.	SPECIFICATION NO:	PAGE NO.:
54	Section N	1-3

SUPERSEDES: September 26, 1977

DATE OF ISSUE: DEC 3 1981

DESCRIPTION:

Fluid-Tite A/C Pressure Pipe, Couplings and Accessories
Classes 100, 150 and 20

Threaded Brass Insert Couplings (TBIC)
Single or Double Outlet
Shipping Wt., Lbs./Unit

Coupling Size Inches	Class	
3	100	7.5
	150	9.1
	200	10.0
4	100	8.1
	150	9.9
	200	13.6

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PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
M. R. Stanley			Bolt	J.R.A.		

DESCRIPTION:

Fluid-Tite A/C Pressure Pipe, Couplings and Accessories
Classes 100, 150 and 200

Coupling Adaptor, A/C to Steel (CAS) or Plastic (CAP)
Shipping Wt., Lbs./Unit

A/C Size Inches	Steel or Plastic Size, Inches	Class 100	Class 150	Class 200
3	3	4.2	5.3	6.0
4	4	5.5	7.1	8.1

Coupling Reducer, FLUID-TITE to FLUID-TITE
Shipping Wt., Lbs./Unit

Coupling Size Inches	Class 100	Class 150	Class 200
4 to 3	3.4	3.6	3.9
6 to 4	9.5	8.9	9.5

Pipe Adaptors
Shipping Wt., Lbs./Unit

Pipe Size, Inches	PAD-2	Class 150	Class 200	PAD-5
3	5.0	5.3	5.3	4.6
4	6.6	---	---	6.2

TECHNICAL SPECIFICATIONS

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Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
52	Section N	2-1

SUPERSEDES: April 9, 1979

DATE OF ISSUE: MAY 20 1980

DESCRIPTION:

FLUID-TITE A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 - Sections A & B

Standard Pipe - Shipping Weight (lbs./ft.)

Pipe Size	Type or Class	Plant 56	57	58	60
4"	1500	5.2	5.2	4.8	5.2
	2400	5.5	5.5	5.2	5.5
	3300	6.4	6.4	6.1	6.4
5"	1500	6.6	6.6	6.6	6.6
	2400	7.1	7.1	7.1	7.1
	3300	8.8	8.8	8.8	8.8
6"	1500	7.8	7.7	7.7	7.7
	2400	9.0	8.8	8.8	8.8
	3300	10.6	10.4	10.4	10.4
8"	1500	11.4	11.4	11.4	11.4
	2400	12.1	12.1	12.1	12.1
	3300	14.2	14.2	14.2	14.2
10"	1500	17.5	17.5	16.1	16.1
	2400	17.5	17.5	16.1	16.1
	3300	19.9	19.9	18.4	18.4
	4000	22.0	22.0	20.6	20.6
	5000	23.9	23.9	22.4	22.4
12"	1500	20.8	23.0	20.8	20.8
	2400	20.8	23.0	20.8	20.8
	3300	24.6	26.7	24.6	24.6
	4000	25.9	28.1	25.9	25.9
	5000	28.6	30.8	28.6	28.6
14"	1500		25.9	25.9	25.9
	2400		25.9	25.9	25.9
	3300		29.4	29.4	29.4
	4000		32.2	32.2	32.2
	5000		36.1	36.1	36.1

CTD014124

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
FLS						

DESCRIPTION:

FLUID-TITE A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 - Sections A & B

Standard Pipe - Shipping Weight (lbs./ft.)

Pipe Size	Type or Class	Plant 56	57	58	60
15"	1500			28.3	28.3
	2400			28.3	28.3
	3300			32.5	32.5
	4000			35.9	35.9
	5000			40.5	40.5
16"	1500		31.5	31.5	31.5
	2400		31.5	31.5	31.5
	3300		35.6	35.6	35.6
	4000		38.7	38.7	38.7
	5000		44.0	44.0	44.0
18"	2400		39.6	39.6	39.6
	3300		44.6	44.6	44.6
	4000		49.6	49.6	49.6
	5000		54.8	54.8	54.8
	6000		60.5	60.5	60.5
	7000		65.6	65.6	65.6
20"	2400		45.5	45.5	45.5
	3300		51.5	51.5	51.5
	4000		57.6	57.6	57.6
	5000		63.9	63.9	63.9
	6000		70.2	70.2	70.2
	7000		76.4	76.4	76.4
21"	2400			49.5	49.5
	3300			55.2	55.2
	4000			62.2	62.2
	5000			68.8	68.8
	6000			75.4	75.4
	7000			81.8	81.8
24"	2400			61.7	61.7
	3300			69.5	69.5
	4000			77.4	77.4
	5000			85.5	85.5
	6000			91.8	91.8
	7000			99.7	99.7

TECHNICAL SPECIFICATIONS

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CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
52	Section N	2-3

SUPERSEDES: April 9, 1979

DATE OF ISSUE: MAY 20 1980

DESCRIPTION:

FLUID-TITE A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 - Sections A & B

Prebelled Pipe (Pipe/Cplg./Ring) - Shipping Weight (lbs./ft.)

Pipe Size	Type or Class	Plant 56	57	58	60
8"	1500	12.1	12.1	12.1	12.1
	2400	12.8	12.8	12.8	12.8
	3300	14.9	14.9	14.9	14.9
10"	1500	18.6	18.6	17.2	17.2
	2400	18.6	18.6	17.2	17.2
	3300	21.0	21.0	19.5	19.5
	4000	23.2	23.2	21.8	21.8
	5000	25.1	25.1	23.6	23.6
12"	1500	22.2	24.4	22.2	22.2
	2400	22.2	24.4	22.2	22.2
	3300	26.0	28.1	26.0	26.0
	4000	27.5	29.7	27.5	27.5
	5000	30.2	32.4	30.2	30.2
14"	1500		27.7	27.7	27.7
	2400		27.7	27.7	27.7
	3300		31.2	31.2	31.2
	4000		34.3	34.3	34.3
	5000		38.2	38.2	38.2
15"	1500	30.3		30.3	30.3
	2400	30.3		30.3	30.3
	3300	34.5		34.5	34.5
	4000	38.3		38.3	38.3
	5000	42.9		42.9	42.9
16"	1500		33.6	33.6	33.6
	2400		33.6	33.6	33.6
	3300		37.7	37.7	37.7
	4000		41.2	41.2	41.2
	5000		46.5	46.5	46.5
18"	2400		42.5	42.5	42.5
	3300		47.5	47.5	47.5
	4000		53.2	53.2	53.2
	5000		58.4	58.4	58.4
	6000		64.6	64.6	64.6
	7000		69.7	69.7	69.7

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
FLS	mps		GBH			

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DESCRIPTION:

FLUID-TITE A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 - Sections A & B

Prebelled Pipe (Pipe/Cplg./Ring) - Shipping Weight (lbs./ft.)

Pipe Size	Type or Class	Plant 56	57	58	60
20"	2400		48.9	48.9	48.9
	3300		54.9	54.9	54.9
	4000		61.5	61.5	61.5
	5000		67.8	67.8	67.8
	6000		75.0	75.0	75.0
	7000		81.2	81.2	81.2
21"	2400			53.1	53.1
	3300			58.8	58.8
	4000			66.3	66.3
	5000			72.9	72.9
	6000			80.5	80.5
	7000			86.9	86.9
24"	2400			66.1	66.1
	3300			73.9	73.9
	4000			82.7	82.7
	5000			90.8	90.8
	6000			98.0	98.0
	7000			106.0	106.0

TECHNICAL SPECIFICATIONS

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Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights

T.C.O. REP. NO.	SPECIFICATION NO:	PAGE NO.:
52	Section N	2-5

SUPERSEDES:	DATE OF ISSUE:
April 9, 1979	MAY 20 1980

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3000, 4000, 5000, 6000 and 7000 Sections A and B

Standard Coupling
Shipping Weight, Lbs./Unit

Coupling Size, Inches	Class		Coupling Size, Inches	Class	
4	1500	3.1	15	1500	25.5
	2400	3.1		2400	25.5
	3300	3.3		3300	25.5
				4000	30.6
5	1500	4.0		5000	30.6
	2400	4.0			
	3300	4.3	16	1500	27.2
				2400	27.2
6	1500	4.9		3300	27.2
	2400	4.9		4000	32.8
	3300	5.2		5000	32.8
8	1500	9.1	18	2400	37.3
	2400	9.1		3300	37.3
	3300	9.7		4000	46.2
				5000	46.2
10	1500	13.9		6000	53.8
	2400	13.9		7000	53.8
	3300	13.9			
	4000	16.2	20	2400	43.6
	5000	16.2		3300	43.6
				4000	50.8
12	1500	17.9		5000	50.8
	2400	17.9		6000	62.1
	3300	17.9		7000	62.1
	4000	20.5			
	5000	20.5	21	2400	47.2
				3300	47.2
14	1500	23.1		4000	53.9
	2400	23.1		5000	53.9
	3300	23.1		6000	66.3
	4000	27.5		7000	66.3
	5000	27.5			
			24	2400	56.7
				3300	56.7
				4000	68.6
				5000	68.6
				6000	80.4
				7000	80.4

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
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Sleeve Adaptor (A/C Rough Barrel to Cast Iron)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	60
4	3.8	3.8	3.8	3.8
5	4.7	4.7	4.7	4.7
6	6.3	6.3	6.3	6.3

Sleeve Adaptor (2400) (A/C Rough Barrel to Clay)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	60
4	4.4	4.4	4.4	4.4
6	6.0	6.0	6.0	

Adaptor Bell & Spigot (A/C to A/C) (A/C to SWCI) (A/C to XHCI)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	60
4	6.1	6.1	6.0	6.1
5	7.8	8.2	7.8	
6	9.7	9.6	9.6	9.6

TECHNICAL SPECIFICATIONS

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Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
48	Section N	2-7

SUPERSEDES: February 11, 1977

DATE OF ISSUE: APR 9 1979

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section A

Increaser Adaptor (Cast Iron to Sewer)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
2x4	5.0			5.0	
3x4	3.2	3.2	3.2	3.2	
4x5	4.3	4.3	4.3	4.3	
4x6	8.3	8.3	8.3	8.3	

Duplex Adaptor (Clay Spigot to A/C M.E.)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
4	5.5	5.5	5.5	5.5	5.5
5	6.5	6.5	6.5	6.5	
6	8.3	8.3	8.3	8.4	8.3

Increaser Adaptor (Cast Iron to Sewer)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
2x4	5.0			5.0	
3x4	3.2	3.2	3.2	3.2	
4x5	4.3	4.3	4.3	4.3	
4x6	8.3	8.3	8.3	8.3	

CTD014130

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

DESCRIPTION:

FLUID-TITE A/C Sewer Pipe, Couplings, and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section A

Duplex Adaptor Coupling (Clay Spigot to A/C M.E.)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
4	5.5	5.5	5.5	5.5	5.5
5	6.5	6.5	6.5	6.5	
6	8.3	8.3	8.3	8.4	8.3

Duplex Adaptor Coupling (Concrete to F.T. Sewer)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
4	5.6	5.6	5.6	5.6	
6	9.6		9.6	9.6	

Duplex Adaptor Coupling (Cast Iron to Sewer)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
4	5.1	5.1	5.1	5.1	
5		6.3	6.4	6.3	6.3
6	8.2		8.2	8.2	

Increaser Adaptor (A/C Sewer to A/C Sewer)
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
4 to 5	4.2	4.2	4.2	4.2	4.3
4 to 6	8.5	8.5	8.5	8.5	8.6
5 to 6	5.2		5.2	5.2	

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights		
T.C.O. REF. NO. 48	SPECIFICATION NO: Section N	PAGE NO.: 2-9
SUPERSEDES: May 16, 1977	DATE OF ISSUE: APR 9 1979	

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section A

Coupling End Plug
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
4	2.0	2.0	1.9	1.9	2.0
5	2.7		2.7	2.7	
6	3.4	3.3	3.3	3.5	3.3

End Cap
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
4	2.4	2.4	2.4	2.4	2.4
5	3.1		3.1	3.1	
6	3.9	3.9	3.9	3.9	3.9

CTD014132

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
JBN	MRS		DKJ			

Sewer Tee Nipple for Field Cut Mains
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
4	3.1	3.1	3.0	3.0	3.1
5	3.7		3.7	3.7	
6	4.3	4.2	4.2	4.5	4.2

45° Wye Fitting
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
5x4	18.4		18.1	18.1	
6x4	23.3	23.6	23.4	23.3	23.6
6x5	24.3		24.6	24.6	
4x4	13.0	13.0	12.8	13.0	13.2
5x5	16.9		16.9	16.9	
6x6	25.0	25.3	25.3	25.6	25.3

Alternate 45° Wye Fitting
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	60
6x4	28.6	28.2
6x6	41.2	40.6

TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
42	Section N	2-11

SUPERSEDES:	DATE OF ISSUE:
February 11, 1977	APR 9 1979

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section A

45° Double Wye Fitting
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
5x4	22.1		21.6	21.6	
6x4	27.0	27.4	26.8	26.8	27.4
6x5	29.0		29.4	29.4	
4x4	16.0	16.0	15.6	15.8	16.3
5x5	21.0		21.0	21.0	
6x6	30.5	30.6	30.6	31.4	30.6

Alternate 45° Double Wye Fitting
Shipping Weight, Lbs./Unit

Pipe Size Inches	56	60
6x4	31.7	31.2
6x6	46.0	45.2

CTD014134

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

60° Wye Fitting
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
6x4			22.7	22.7	
6x5			24.1	24.1	
6x6			25.4	25.7	

Tee Fitting
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	59	60
5x4	13.8		13.6	13.6	
6x4	17.6	17.6	17.4	17.4	17.6
6x5	17.5		17.8	17.8	
4x4	10.0	10.0	9.8	9.9	10.1
5x5	14.0		14.0	14.0	
6x6	17.8	18.0	18.0	18.2	18.0

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights		
T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
48	Section N	2-13
SUPERSEDES: February 11, 1977		DATE OF ISSUE: APR 9 1979

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section A

Alternate Tee Fitting
Shipping Weight, Lbs./Unit

Pipe Size Inches	56	60
6x4	27.4	26.9
6x6	37.8	37.2

Elbows 11¼°, 22½°, 30°, 45°, and 90°
Shipping Weight, Lbs./Unit

Pipe Size, Inches	11¼°, 22½°, 30°, 45°					90°				
	56	57	58	59	60	56	57	58	59	60
4	7.7	7.7	7.7	7.8	7.8	11.7	11.7	11.7	12.0	12.0
5	10.1		10.1	10.1		15.5		15.5	15.5	
6	12.1	12.3	12.3	12.3	12.3	18.5	18.8	18.8	18.8	18.8

CTD014136

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section B

Manhole Stub
Shipping Weight, Lbs./Unit

Pipe Size, Inches	Class	56	57	58	59	60
6	1500	15.3	15.0	15.0	16.1	15.0
	2400	17.4	17.0	17.0	18.1	17.0
	3300	20.3	20.0	20.0	21.1	20.0
8	1500	22.3	22.3	22.3	22.3	22.3
	2400	23.5	23.5	23.5	23.5	23.5
	3300	27.3	27.3	27.3	27.3	27.3
10	1500	34.3	34.3	31.5	34.3	31.5
	2400	34.3	34.3	31.5	34.3	31.5
	3300	38.4	38.4	35.5	38.4	35.5
	4000	42.1	42.1	39.3	42.1	39.3
	5000	45.5	45.5	42.5	45.5	42.5
12	1500	40.6	45.0	40.6	40.6	40.6
	2400	40.6	45.0	40.6	40.6	40.6
	3300	47.3	51.6	47.3	47.3	47.3
	4000	49.6	54.0	49.6	49.6	49.6
	5000	54.4	58.8	54.4	54.4	54.4
14	1500	50.5	50.5	50.5	50.5	50.5
	2400	50.5	50.5	50.5	50.5	50.5
	3300	56.7	56.7	56.7	56.7	56.7
	4000	61.6	61.6	61.6	61.6	61.6
	5000	68.4	68.4	68.4	68.4	68.4
15	1500	55.3		55.3		55.3
	2400	55.3		55.3		55.3
	3300	62.6		62.6		62.6
	4000	68.5		68.5		68.5
	5000	76.5		76.5		76.5
16	1500	61.6	61.6	61.6	61.6	61.6
	2400	61.6	61.6	61.6	61.6	61.6
	3300	68.6	68.6	68.6	68.6	68.6
	4000	74.1	74.1	74.1	74.1	74.1
	5000	83.4	83.4	83.4	83.4	83.4
18	2400		76.7	76.7	79.5	76.7
	3300		85.2	85.2	88.2	85.2
	4000		93.7	93.7	96.6	93.7
	5000		103.0	103.0	106.0	103.0
	6000		112.0	112.0	115.0	112.0
	7000		121.0	121.0	124.0	121.0
20	2400		88.2	88.2		88.2
	3300		97.7	97.7		97.7
	4000		109.0	109.9		109.0
	5000		120.0	120.0		120.0
	6000		131.0	131.0		131.0
	7000		141.0	141.0		141.0

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
52	Section N	2-15

SUPERSEDES: October 19, 1979

DATE OF ISSUE: MAY 20 1980

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section B

Manhole Stub (Cont)
Shipping Weight, Lbs/Unit

Pipe, Size, Inches	Class	56	57	58	60
21	2400			95.9	95.9
	3300			106.0	106.0
	4000			118.0	118.0
	5000			129.0	129.0
	6000			140.0	140.0
	7000			151.0	151.0
24	2400			120.0	120.0
	3300			133.0	133.0
	4000			147.0	147.0
	5000			161.0	160.0
	6000			171.0	171.0
	7000			185.0	185.0

Drop Manhole Section
Shipping Weight, Lbs./Unit

Pipe Size, Inches	56	57	58	60
6	21.5	21.5	21.5	21.5
8	33.9	33.9	33.9	33.9
10	55.9	55.9	55.9	55.9
12	77.7	77.7	77.7	77.7
14		86.4	86.4	86.4
15		105.0	105.0	105.0
16		111.0	111.0	111.0

End Cap
Shipping Weight, Lbs./Unit

Pipe Size, Inches	Class	56	57	58	60
8	2400	8.4	8.4		
	Heavy	8.8	8.8		
10	2400	13.0	13.0	13.0	13.0
	Heavy	13.0	13.0	13.0	13.0
	Ex-heavy	14.6	14.6	14.6	14.6

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
FJS			JDH			

02-10-0023 (P927) 12/76 CONFIDENTIAL DOCUMENT - NOT TO BE DISTRIBUTED TO UNAUTHORIZED PERSONNEL

DESCRIPTION:

FLUID-TITE A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 - Section B

Pipe Size, Inches	Class	56	57	58	60
12	2400	17.0	17.1	17.0	17.0
	Heavy	17.0	17.1	17.0	17.0
	Ex-Heavy	18.8	18.9	18.8	18.8
14	2400		25.1	25.1	25.1
	Heavy		25.1	25.1	25.1
	Ex-Heavy		28.1	25.1	28.1
15	2400		28.0	28.0	28.0
	Heavy		28.0	28.0	28.0
	Ex-Heavy		31.5	31.5	31.5
16	2400		30.5	30.5	30.5
	Heavy		30.5	30.5	30.5
	Ex-Heavy		34.3	34.3	34.3
18	2400		43.0	43.0	43.0
	Heavy		43.0	43.0	43.0
	Ex-Heavy		49.6	49.6	49.6
	6000/7000		55.3	55.3	55.3
20	2400		50.9	50.9	50.9
	Heavy		50.9	50.9	50.9
	Ex-Heavy		56.2	56.2	56.2
	6000/7000		64.8	64.8	64.8
21	2400		56.7	56.7	56.7
	Heavy		56.7	56.7	56.7
	Ex-Heavy		61.3	61.3	61.3
	6000/7000		70.0	70.0	70.0
24	2400			68.2	68.2
	Heavy			68.2	68.2
	Ex-Heavy			77.0	77.0
	6000/7000			86.6	86.6

TECHNICAL SPECIFICATIONS

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Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
52	Section N	2-17

SUPERSEDES:	DATE OF ISSUE:
October 19, 1979	MAY 20 1980

DESCRIPTION:

FLUID-TITE A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 - Section B

Increaser A/C to A/C

Size" A/C to A/C	Class	Shipping Weight, Lbs/Unit Plants 56	57	58	60
6 to 8	Ex. Heavy	14.0	13.9	13.9	13.9
8 to 10	Ex. Heavy	19.9	19.9	19.9	19.9
10 to 12	Ex. Heavy	27.0	27.0	26.5	26.5
12 to 14	Ex. Heavy	34.0	34.8	34.0	34.0
12 to 15	Ex. Heavy	48.5	49.3	48.5	48.5
14 to 15	Ex. Heavy		30.9	30.9	30.9
14 to 16	Ex. Heavy		42.6	42.6	42.6
15 to 16	Ex. Heavy		34.0	34.0	34.0
15 to 18	Ex. Heavy		68.3	68.3	68.3
	6000/7000		72.0	72.0	72.0
16 to 18	Ex. Heavy		53.0	53.0	53.0
	6000/7000		56.7	56.7	56.7
18 to 20	Ex. Heavy		62.5	62.5	62.5
	6000/7000		67.3	67.3	67.3
18 to 21	Ex. Heavy		86.5	86.5	86.5
	6000/7000		91.5	91.5	91.5
20 to 21	Ex. Heavy		55.4	55.4	55.4
	6000/7000		61.4	61.4	61.4
21 to 24	Ex. Heavy		102.0	102.0	102.0

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
FJS						

02-10-0023 (P927) 12/76 CONFIDENTIAL DOCUMENT - NOT TO BE DISTRIBUTED TO UNAUTHORIZED PERSONNEL

DESCRIPTION:

FLUID-TITE A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 - Section B

11¼°, 22½°, 30° and 45° Elbows - Shipping Weights (lbs./unit)

Pipe Size	Type or Class	Plants			
		56	57	58	60
8"	2400	18.1	18.1	18.1	18.1
	Heavy	20.5	20.5	20.5	20.5
10"	2400	26.5	26.5	24.2	24.2
	Heavy	28.9	28.9	26.6	26.6
	Ex. Heavy	33.1	33.1	30.8	30.8
12"	2400	31.4	35.0	31.4	31.4
	Heavy	35.4	38.9	35.4	35.4
	Ex. Heavy	39.6	43.1	39.6	39.6
14"	2400		39.0	39.0	39.0
	Heavy		42.4	42.4	42.4
	Ex. Heavy		49.0	49.0	49.0
15"	2400	42.7		42.7	42.7
	Heavy	46.8		46.8	46.8
	Ex. Heavy	54.6		54.6	54.6
16"	2400		47.5	47.5	47.5
	Heavy		51.4	51.4	51.4
	Ex. Heavy		59.7	59.7	59.7
18"	2400		123.2	123.2	123.2
	Heavy		136.3	136.3	136.3
	Ex. Heavy		163.1	163.1	163.1
	6000/7000		191.0	191.0	191.0
20"	2400		141.9	141.9	141.9
	Heavy		157.7	157.7	157.7
	Ex. Heavy		190.1	190.1	190.1
	6000/7000		222.0	222.0	222.0
21"	2400			154.0	154.0
	Heavy			169.1	169.1
	Ex. Heavy			204.5	204.5
	6000/7000			238.5	238.5
24"	2400			193.2	193.2
	Heavy			213.7	213.7
	Ex. Heavy			255.8	255.8
	6000/7000			292.4	292.4

TECHNICAL SPECIFICATIONS

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CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
52	Section N	2-19

SUPERSEDES:	DATE OF ISSUE:
April 9, 1979	MAY 20 1980

DESCRIPTION:

FLUID-TITE A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 - Section B

90° Elbows - Shipping Weights (lbs./unit)

Pipe Size	Type or Class	Plants 56	57	58	60
8"	2400	27.8	27.8	27.8	27.8
	Heavy	31.9	31.9	31.9	31.9
10"	2400	40.5	40.5	37.1	37.1
	Heavy	44.9	44.9	41.4	41.4
	Ex. Heavy	52.4	52.4	48.9	48.9
12"	2400	48.1	53.4	48.1	48.1
	Heavy	55.1	60.4	55.1	55.1
	Ex. Heavy	62.7	68.0	62.7	62.7
14"	2400		59.6	59.6	59.6
	Heavy		66.1	66.1	66.1
	Ex. Heavy		78.2	78.2	78.2
15"	2400	64.7		64.7	64.7
	Heavy	72.2		72.2	72.2
	Ex. Heavy	86.5		86.5	86.5
16"	2400		72.0	72.0	72.0
	Heavy		79.2	79.2	79.2
	Ex. Heavy		94.4	94.4	94.4
18"	2400		185.1	185.1	185.1
	Heavy		206.3	206.3	206.3
	Ex. Heavy		249.8	249.8	249.8
	6000/7000		295.0	295.0	295.0
20"	2400		212.0	212.0	212.0
	Heavy		237.5	237.5	237.5
	Ex. Heavy		290.0	290.0	290.0
	6000/7000		342.0	342.0	342.0
21"	2400			230.0	230.0
	Heavy			254.7	254.7
	Ex. Heavy			311.9	311.9
	6000/7000			367.1	367.1
24"	2400			286.7	286.7
	Heavy			319.7	319.7
	Ex. Heavy			387.4	387.4
	6000/7000			446.7	446.7

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
FJS			ABN			

02-10-0023 (P927) 12/76 CONFIDENTIAL DOCUMENT - NOT TO BE DISTRIBUTED TO UNAUTHORIZED PERSONNEL

45° Wye Fittings - Class 3400 - Main Probelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches		Pipe Size, Inches	
8x8x4	50.0	16x16x4	129.0	21x21x4	204.0
5	50.7	5	130.0	5	204.0
6	53.5	6	132.0	6	207.0
8	58.9	8	136.0	8	210.0
		10	142.0	10	216.0
10x10x4	72.1	12	147.0	12	221.0
5	72.8	14	155.0	14	283.0
6	75.6	15	162.0	15	290.0
8	79.3	16	176.0	16	292.0
10	88.8			18	310.0
		18x18x4	168.0	20	322.0
12x12x4	93.5	5	168.0	21	343.0
5	94.2	6	171.0		
6	96.9	8	174.0	24x24x4	252.0
8	100.0	10	181.0	5	253.0
10	107.0	12	185.0	6	256.0
12	117.0	14	238.0	8	259.0
		15	245.0	10	265.0
14x14x4	107.0	16	248.0	12	269.0
5	108.0	18	277.0	14	344.0
6	111.0			15	351.0
8	114.0	20x20x4	188.0	16	353.0
10	121.0	5	189.0	18	370.0
12	126.0	6	191.0	20	384.0
14	139.0	8	195.0	21	391.0
		10	201.0	24	570.0
15x15x4	117.0	12	205.0		
5	118.0	14	263.0		
6	121.0	15	270.0		
8	124.0	16	273.0		
10	131.0	18	290.0		
12	135.0	20	316.0		
14	144.0				
15	155.0				

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standard Manual-Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
49	Section N	2-21

SUPERSEDES: April 9, 1979

DATE OF ISSUE: JUN 25 1979

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section B

45° Wye Fittings - Class - Heavy - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches		Pipe Size, Inches	
8x8x4	56.5	16x16x4	140.0	21x21x4	219.0
5	57.2	5	140.0	5	219.0
6	60.0	6	143.0	6	222.0
8	65.4	8	147.0	8	225.0
		10	155.0	10	233.0
10x10x4	78.0	12	161.0	12	238.0
5	79.0	14	170.0	14	307.0
6	82.0	15	178.0	15	315.0
8	85.0	16	192.0	16	317.0
10	97.0			18	336.0
		18x18x4	181.0	20	352.0
12x12x4	104.0	5	181.0	21	373.0
5	104.0	6	184.0		
6	107.0	8	187.0	24x24x4	273.0
8	110.0	10	195.0	5	273.0
10	119.0	12	200.0	6	276.0
12	130.0	14	260.0	8	279.0
		15	268.0	10	286.0
14x14x4	121.0	16	270.0	12	291.0
5	122.0	18	302.0	14	376.0
6	124.0			15	384.0
8	128.0	20x20x4	204.0	16	386.0
10	136.0	5	204.0	18	404.0
12	142.0	6	207.0	20	420.0
14	156.0	8	210.0	21	430.0
		10	218.0	24	629.0
15x15x4	129.0	12	223.0		
5	130.0	14	289.0		
6	133.0	15	296.0		
8	136.0	16	299.0		
10	144.0	18	317.0		
12	150.0	20	347.0		
14	159.0				
15	172.0				

CTD014144

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

45° Wye Fittings - Class-Extra Heavy - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches		Pipe Size, Inches	
		16x16x4	168.0	21x21x4	274.0
		5	168.0	5	275.0
		6	171.0	6	277.0
		8	174.0	8	279.0
		10	184.0	10	290.0
10x10x4	91.5	12	190.0	12	294.0
5	92.1	14	202.0	14	382.0
6	94.7	15	212.0	15	391.0
8	98.1	16	229.0	16	393.0
10	113.0			18	414.0
		18x18x4	216.0	20	434.0
12x12x4	117.0	5	217.0	21	450.0
5	118.0	6	219.0		
6	120.0	8	222.0	24x24x4	327.0
8	124.0	10	233.0	5	327.0
10	135.0	12	237.0	6	329.0
12	147.0	14	312.0	8	332.0
		15	322.0	10	342.0
14x14x4	143.0	16	324.0	12	346.0
5	144.0	18	362.0	14	453.0
6	146.0			15	463.0
8	149.0	20x20x4	243.0	16	465.0
10	161.0	5	244.0	18	485.0
12	166.0	6	246.0	20	505.0
14	185.0	8	249.0	21	524.0
		10	259.0	24	763.0
15x15x4	156.0	12	264.0		
5	156.0	14	347.0		
6	159.0	15	357.0		
8	162.0	16	359.0		
10	173.0	18	380.0		
12	178.0	20	418.0		
14	190.0				
15	208.0				

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standard Manual-Shipping Weights		
T.C.O. REF. NO. 48	SPECIFICATION NO: Section N	PAGE NO.: 2-23
SUPERSEDES: February 11, 1977	DATE OF ISSUE: APR 9 1979	

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section B

45° Fittings - Class 6000/7000 - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches	
18x18x4	247.0	21x21x4	307.0
5	248.0	5	307.0
6	250.0	6	310.0
8	253.0	8	312.0
10	264.0	10	322.0
12	268.0	12	327.0
14	354.0	14	430.0
15	364.0	15	439.0
16	366.0	16	441.0
18	416.0	18	461.0
		20	482.0
20x20x4	287.0	21	530.0
5	287.0		
6	290.0	24x24x4	375.0
8	292.0	5	375.0
10	303.0	6	378.0
12	308.0	8	380.0
14	405.0	10	390.0
15	415.0	12	395.0
16	417.0	14	518.0
18	438.0	15	528.0
20	494.0	16	529.0
		18	550.0
		20	570.0
		21	589.0
		24	882.0

CTD014146

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

DESCRIPTION:
FLUID-TITE A/C Sewer Pipe, Couplings, and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section B

60° Wye Fittings - Class - 2400 - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches		Pipe Size, Inches	
8x8x4	50.0	16x16x4	129.0	21x21x4	204.0
5	50.5	5	129.0	5	204.0
6	51.2	6	130.0	6	205.0
8	55.0	8	132.0	8	207.0
		10	135.0	10	209.0
10x10x4	72.1	12	141.0	12	215.0
5	72.5	14	144.0	14	272.0
6	73.2	15	152.0	15	280.0
8	75.6	16	159.0	16	279.0
10	82.6			18	288.0
		18x18x4	168.0	20	291.0
12x12x4	93.5	5	168.0	21	320.0
5	93.9	6	169.0		
6	94.5	8	171.0	24x24x4	252.0
8	96.8	10	173.0	5	253.0
10	99.9	12	179.0	6	253.0
12	110.0	14	227.0	8	255.0
		15	235.0	10	258.0
14x14x4	107.0	16	234.0	12	263.0
5	108.0	18	255.0	14	333.0
6	108.0			15	341.0
8	111.0	20x20x4	188.0	16	340.0
10	114.0	5	188.0	18	349.0
12	119.0	6	189.0	20	352.0
14	128.0	8	191.0	21	367.0
		10	194.0	24	531.0
15x15x4	117.0	12	199.0		
5	118.0	14	252.0		
6	118.0	15	260.0		
8	120.0	16	259.0		
10	123.0	18	269.0		
12	129.0	20	289.0		
14	133.0				
15	145.0				

CTD014147

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standard Manual-Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
49	Section N	2-25

SUPERSEDES: April 9, 1979

DATE OF ISSUE: JUN 25 1979

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section B

60° Wye Fittings - Class - Heavy - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches		Pipe Size, Inches	
8x8x4	56.5	16x16x4	140.0	21x21x4	219.0
5	57.0	5	140.0	5	219.0
6	57.7	6	141.0	6	220.0
8	61.5	8	143.0	8	221.0
		10	147.0	10	225.0
10x10x4	78.4	12	154.0	12	231.0
5	78.7	14	157.0	14	295.0
6	79.4	15	166.0	15	303.0
8	81.6	16	173.0	16	302.0
10	90.1			18	312.0
		18x18x4	181.0	20	315.0
12x12x4	104.0	5	181.0	21	347.0
5	104.0	6	181.0		
6	105.0	8	183.0	24x24x4	273.0
8	107.0	10	187.0	5	273.0
10	111.0	12	193.0	6	273.0
12	122.0	14	247.0	8	275.0
		15	256.0	10	278.0
14x14x4	121.0	16	255.0	12	284.0
5	121.0	18	277.0	14	364.0
6	122.0			15	372.0
8	124.0	20x20x4	204.0	16	371.0
10	128.0	5	408.0	18	380.0
12	135.0	6	204.0	20	383.0
14	136.0	8	206.0	21	403.0
		10	210.0	24	586.0
15x15x4	129.0	12	216.0		
5	130.0	14	276.0		
6	130.0	15	285.0		
8	132.0	16	283.0		
10	136.0	18	294.0		
12	143.0	20	317.0		
14	146.0				
15	161.0				

CTD014148

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
JBN						

60° Wye Fittings - Class - Extra Heavy - Main Prebelled

Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches		Pipe Size, Inches	
		16x16x4	167.0	21x21x4	274.0
		5	168.0	5	274.0
		6	168.0	6	275.0
		8	170.0	8	276.0
		10	175.0	10	280.0
10x10x4	91.5	12	181.0	12	286.0
5	91.8	14	187.0	14	366.0
6	92.4	15	198.0	15	377.0
8	94.4	16	207.0	16	375.0
10	105.0			18	385.0
		18x18x4	216.0	20	389.0
12x12x4	117.0	5	216.0	21	416.0
5	118.0	6	217.0		
6	118.0	8	218.0	24x24x4	327.0
8	120.0	10	223.0	5	327.0
10	125.0	12	229.0	6	327.0
12	138.0	14	297.0	8	328.0
		15	308.0	10	332.0
14x14x4	143.0	16	306.0	12	338.0
5	143.0	18	332.0	14	438.0
6	144.0			15	448.0
8	146.0	20x20x4	243.0	16	446.0
10	151.0	5	244.0	18	456.0
12	158.0	6	244.0	20	460.0
14	170.0	8	245.0	21	488.0
		10	250.0	24	709.0
15x15x4	156.0	12	264.0		
5	156.0	14	332.0		
6	156.0	15	343.0		
8	158.0	16	341.0		
10	163.0	18	351.0		
12	170.0	20	380.0		
14	185.0				
15	194.0				

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standard Manual-Shipping Weights		
T.C.O. REF. NO. 48	SPECIFICATION NO: Section N	PAGE NO.: 2-27
SUPERSEDES: February 11, 1979	DATE OF ISSUE: APR 9 1979	

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section B

60° Fittings - Class 6000/7000 - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches	
18x18x4	247.0	21x21x4	307.0
5	247.0	5	307.0
6	248.0	6	307.0
8	249.0	8	309.0
10	254.0	10	313.0
12	260.0	12	319.0
14	339.0	14	415.0
15	350.0	15	425.0
16	348.0	16	423.0
18	381.0	18	433.0
		20	437.0
20x20x4	287.0	21	492.0
5	287.0		
6	287.0	24x24x4	375.0
8	289.0	5	375.0
10	293.0	6	375.0
12	300.0	8	377.0
14	390.0	10	381.0
15	401.0	12	387.0
16	398.0	14	503.0
18	409.0	15	513.0
20	450.0	16	511.0
		18	521.0
		20	525.0
		21	553.0
		24	821.0

CTD014150

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

Tee Fittings - Class - 2400 - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches		Pipe Size, Inches	
8x8x4	48.3	16x16x4	128.0	21x21x4	203.0
5	48.5	5	128.0	5	204.0
6	50.0	6	129.0	6	204.0
8	51.9	8	130.0	8	206.0
		10	132.0	10	208.0
10x10x4	70.5	12	133.0	12	211.0
5	70.6	14	133.0	14	266.
6	72.3	15	133.0	15	266.0
8	73.0	16	142.0	16	268.0
10	77.2			18	273.0
		18x18x4	166.0	20	273.0
12x12x4	91.8	5	166.0	21	289.0
5	91.9	6	168.0		
6	93.6	8	168.0	24x24x4	251.0
8	94.2	10	170.0	5	251.0
10	96.1	12	172.0	6	252.0
12	101.0	14	217.0	8	253.0
		15	216.0	10	255.0
14x14x4	106.0	16	218.0	12	256.0
5	106.0	18	232.0	14	323.0
6	107.0			15	323.0
8	108.0	20x20x4	187.0	16	323.0
10	110.0	5	187.0	18	327.0
12	112.0	6	188.0	20	327.0
14	117.0	8	189.0	21	327.0
		10	191.0	24	486.0
15x15x4	117.0	12	192.0		
5	117.0	14	242.0		
6	118.0	15	242.0		
8	119.0	16	243.0		
10	122.0	18	247.0		
12	125.0	20	260.0		
14	126.0				
15	132.0				

CTD014151

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standard Manual-Shipping Weights

T.C.D. REF. NO.	SPECIFICATION NO:	PAGE NO.:
49	Section N	2-29

SUPERSEDES: April 9, 1979

DATE OF ISSUE: JUN 25 1979

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section B

Tee Fittings - Class - Heavy - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size Inches		Pipe Size, Inches	
8x8x4	54.9	16x16x4	138.0	21x21x4	219.0
5	55.0	5	138.0	5	219.0
6	56.5	6	140.0	6	219.0
8	56.6	8	140.0	8	221.0
		10	143.0	10	223.0
10x10x4	76.8	12	145.0	12	227.0
5	76.9	14	145.0	14	288.0
6	78.5	15	144.0	15	288.0
8	79.0	16	153.0	16	289.0
10	84.0			18	294.0
		18x18x4	179.0	20	294.0
12x12x4	102.0	5	179.0	21	312.0
5	102.0	6	181.0		
6	104.0	8	181.0	24x24x4	272.0
8	104.0	10	184.0	5	271.0
10	106.0	12	185.0	6	273.0
12	112.0	14	235.0	8	273.0
		15	235.0	10	275.0
14x14x4	115.0	16	236.0	12	277.0
5	115.0	18	252.0	14	352.0
6	117.0			15	352.0
8	117.0	20x20x4	202.0	16	352.0
10	120.0	5	202.0	18	356.0
12	122.0	6	204.0	20	355.0
14	128.0	8	204.0	21	356.0
		10	206.0	24	535.0
15x15x4	129.0	12	208.0		
5	129.0	14	264.0		
6	130.0	15	264.0		
8	131.0	16	265.0		
10	134.0	18	269.0		
12	138.0	20	284.0		
14	138.0				
15	151.0				

CTD014152

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
JBN	mrb			JRA		

Tee Fittings - Class Extra-Heavy - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches		Pipe Size, Inches		Pipe Size, Inches	
		16x16x4	166.0	21x21x4	274.0
		5	166.0	5	274.0
		6	167.0	6	274.0
		8	167.0	8	275.0
		10	170.0	10	279.0
10x10x4	89.9	12	171.0	12	281.0
5	89.9	14	171.0	14	358.0
6	91.4	15	171.0	15	359.0
8	91.8	16	182.0	16	359.0
10	97.7			18	364.0
		18x18x4	215.0	20	364.0
12x12x4	116.0	5	215.0	21	374.0
5	116.0	6	216.0		
6	117.0	8	216.0	24x24x4	325.0
8	117.0	10	219.0	5	325.0
10	120.0	12	220.0	6	326.0
12	126.0	14	282.0	8	326.0
		15	281.0	10	329.0
14x14x4	138.0	16	283.0	12	330.0
5	138.0	18	301.0	14	423.0
6	139.0			15	423.0
8	139.0	20x20x4	242.0	16	423.0
10	142.0	5	242.0	18	427.0
12	144.0	6	243.0	20	426.0
14	151.0	8	243.0	21	426.0
		10	246.0	24	646.0
15x15x4	155.0	12	247.0		
5	155.0	14	317.0		
6	156.0	15	317.0		
8	157.0	16	318.0		
10	161.0	18	322.0		
12	164.0	20	339.0		
14	166.0				
15	176.0				

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standard Manual-Shipping Weights		
T.C.O. REF. NO. 49	SPECIFICATION NO: Section N	PAGE NO.: 2-31
SUPERSEDES: April 9, 1979	DATE OF ISSUE: JUN 25 1979	

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe, Couplings and Accessories
Classes 1500, 2400, 3300, 4000, 5000, 6000 and 7000 Section B

Tee Fittings - Class 6000/7000 - Main Prebelled
Shipping Weight, Lbs./Unit

Pipe Size, Inches	
18x18x4	246.0
5	246.0
6	247.0
8	247.0
10	249.0
12	251.0
14	324.0
15	323.0
16	324.0
18	346.0
20x20x4	285.0
5	285.0
6	287.0
8	286.0
10	289.0
12	290.0
14	375.0
15	375.0
16	376.0
18	380.0
20	402.0

Pipe Size, Inches	
21x21x4	307.0
5	307.0
6	307.0
8	308.0
10	311.0
12	314.0
14	406.0
15	407.0
16	408.0
18	412.0
20	412.0
21	442.0
24x24x4	374.0
5	374.0
6	375.0
8	375.0
10	377.0
12	378.0
14	488.0
15	488.0
16	488.0
18	492.0
20	490.0
21	491.0
24	748.0

CTD014154

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
JBN	mpl			JQA.		

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2A

FORM P-6054

TECHNICAL CHANGE ORDER

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

APPLICABLE TO:

A/C General Standards Manual
Section N

DATE OF ISSUE:	T.C.O. NO.:	PAGE NO.:
FEB 11 1977	43	1

DESCRIPTION:

P&PG, A/C Sewer, Fluid-Tite CG-S (Section B)

PURPOSE:

To remove shipping weights for common groove sewer pipe. We were only manufacturing 15" and 21" and now these are incorporated into Spec #2's weights.

EFFECTIVE DATE:

Date of issue.

DISPOSITION OF SUPERSEDED PAGES:

Destroy 2A-7 through 2A-23 all dated September 7, 1973 in Section N of your General Standards Manual. No pages are to be put in their place.

CTD014156

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

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FORM P-6054

TECHNICAL CHANGE ORDER

CERTAIN-TEED PRODUCTS CORPORATION
PIPE DIVISION

CERTAINTEED

APPLICABLE TO:

A/C General Standards Manual

DATE OF ISSUE:	T.C.O. NO.:	PAGE NO.:
FEB 11 1977	44	1

DESCRIPTION:

Fluid-Tite A/C Sewer Pipe - Hi Flex

PURPOSE:

To revise Fluid-Tite Hi-Flex Sewer weights based on the recent spec revision.

EFFECTIVE DATE:

Date of issue.

DISPOSITION OF SUPERSEDED PAGES:

Destroy page 2B-1 dated June 9, 1975 of Section N and replace with the page attached.

CTD014157

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
JBH	JF K					

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FORM P927

TECHNICAL SPECIFICATIONS

CERTAIN-TEED PRODUCTS CORPORATION
PIPE & PLASTICS GROUP

SPECIFICATIONS CLASSIFICATION: General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
44	Section N	2B-1

SUPERSEDES:	DATE OF ISSUE:
June 9, 1975	FEB 11 1977

DESCRIPTION:

FLUID-TITE A/C Sewer Pipe - Hi Flex

Standard Pipe - Shipping Weight Lbs./Ft.

Pipe Size	Type or Class	Plant 56	57	58	59	60	
8"	2400			X			12.1
	3300			X			14.2

Prebelled Pipe - Shipping Weight Lbs./Ft. (Pipe/Coupling/Ring)

8"	2400			X			12.8
	3300			X			14.9

CTD014158

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
JBH						

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
48	Section N	3A-1

SUPERSEDES:	DATE OF ISSUE:
May 2, 1978	APR 9 1979

DESCRIPTION:

Fluid - Tite A/C Pressure Pipe, Couplings, and Accessories
Classes 100, 150, 200 - Common Groove.

Standard Pipe
Shipping Wt. Lbs./Ft. Unbelled

Pipe Size	Type or Class	Plant 56	57	58	59	60	
4"	100			X	X		6.4
		X	X			X	6.8
	150			X	X		7.0
		X	X			X	7.4
	200	X	X	X	X	X	8.6
6"	100		X	X		X	10.3
		X					10.4
					X		10.8
	150	X	X	X	X	X	11.5
	200	X	X	X	X	X	14.7
8"	100		X	X	X	X	15.3
		X					15.4
	150	X	X	X	X	X	17.4
	200	X	X[1]	X	X	X	21.6
10"	100			X		X	21.0
		X	X		X		22.5
	150			X		X	27.0
		X	X		X		28.4
	200	X	X	X	X	X	33.2
12"	100	X		X	X	X	29.1
			X				31.3
	150	X		X	X	X	36.6
			X				38.8
	200	X	X	X	X	X	45.3
14"	100		X	X		X	33.8
					X		36.5

Pipe Size	Type or Class	Plant 56	57	58	59	60	
14"	150		X	X	X	X	48.8
	200		X	X		X	56.6
					X		59.3
16"	100		X	X		X	43.8
					X		48.0
	150		X	X		X	60.9
					X		64.2
	200		X	X		X	73.4
					X		77.6
18"	100		X	X		X	58.0
					X		59.4
	150		X	X		X	82.7
20"	100		X	X		X	70.0
	150		X	X		X	102.0
24"	100			X		X	100.0
	150			X		X	145.0

CTD014159

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

DESCRIPTION:

Fluid - Tite A/C Pressure Pipe, Couplings, and Accessories
Classes 100, 150, 200 - Common Groove

Standard Pipe
Shipping Wt. Lbs./Ft. Belled

Pipe Size	Type or Class	Plant 56	57	58	59	60	
4"	100			X	X		6.8
		X	X			X	7.2
	150			X	X		7.5
		X	X			X	7.9
	200	X	X	X	X	X	9.2
6"	100		X	X		X	10.8
		X					10.9
					X		11.3
	150	X	X	X	X	X	12.2
	200	X	X	X	X	X	15.8
8"	100		X	X	X	X	16.1
		X					16.2
	150	X	X	X	X	X	18.6
	200	X	X	X	X	X	23.2
10"	100			X		X	22.3
		X	X		X		23.8
	150			X		X	28.8
		X	X		X		30.2
	200	X	X	X	X	X	35.7
12"	100	X		X	X	X	30.9
			X				33.1
	150	X		X	X	X	39.5
			X				41.7
	200	X	X	X	X	X	49.3
14"	100				X		39.3
			X	X		X	36.6

Pipe Size	Type or Class	Plant 56	57	58	59	60	
14"	150		X	X	X	X	53.3
	200		X	X		X	62.1
					X		64.8
16"	100		X	X		X	47.1
					X		51.3
	150		X	X		X	66.3
					X		69.6
	200		X	X		X	80.4
					X		84.6
18"	100		X	X		X	62.3
	150		X	X		X	89.8
20"	100		X	X		X	75.7
	150		X	X		X	110.0
24"	100			X		X	108.0
	150			X		X	162.0

CTD014160

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
47	Section N	3A-3

SUPERSEDES:	DATE OF ISSUE:
September 26, 1977	MAY 2 1978

DESCRIPTION:

Fluid - Tite A/C Pressure Pipe, Couplings, and Accessories.
Classes 100, 150, 200 - Common Groove

Standard Coupling

Coupling Size, Inches	Class	Shipping Weight Lbs./Unit
4	100	5.6
	150	7.0
	200	8.1
6	100	7.1
	150	9.5
	200	13.5
8	100	10.8
	150	15.1
	200	21.1
10	100	16.7
	150	24.0
	200	32.8
12	100	23.4
	150	38.0
	200	51.5
14	100	35.8
	150	57.9
	200	71.5
16	100	42.6
	150	70.1
	200	90.4
18	100	55.9
	150	91.8
20	100	74.7
	150	110.0
24	100	99.2
	150	158.0

CTD014161

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

DESCRIPTION:

Fluid - Tite A/C Pressure Pipe, Couplings, and Accessories
Classes 100, 150, 200 - Common Groove

Fully Machined Pipe (FM)
Shipping Wt. Lbs./Ft.

Pipe Size	Type or Class	Plant 56	57	58	59	60	
4"	100	X	X	X	X	X	4.5
	150	X	X	X	X	X	5.6
	200	X	X	X	X	X	7.0
6"	100	X	X	X	X	X	9.0
	150	X	X	X	X	X	10.0
	200	X	X	X	X	X	12.6
8"	100	X	X	X	X	X	14.1
	150	X	X	X	X	X	16.5
	200	X	X	X	X	X	17.5
10"	100	X	X	X	X	X	22.3
	150	X	X	X	X	X	24.3
	200	X	X	X	X	X	28.4
12"	100	X	X	X	X	X	31.6
	150	X	X	X		X	33.7
					X		40.0
	200	X	X	X	X	X	40.0
14"	100		X		X		31.9
				X		X	34.1
	150		X		X	X	47.0
				X			49.6
	200		X		X		54.9
				X		X	57.1
16"	100		X			X	40.9
				X			43.8
					X		54.3
	150		X	X	X	X	57.2
	200		X			X	70.7
				X			73.6
					X		84.0
18"	100		X			X	60.6

Pipe Size	Type or Class	Plant 56	57	58	59	60	
	150		X	X		X	72.7
20"	100		X	X		X	66.0
	150		X	X		X	90.2
24"	100					X	98.5
	150			X		X	131.0

CTD014162

TECHNICAL SPECIFICATIONS

CertainTeed

CertainTeed Corporation
Pipe and Plastics Group

SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
51	Section N	3A-5

SUPERSEDES:	DATE OF ISSUE:
September 26, 1977	November 29, 1979

DESCRIPTION:

Fluid-Tite A/C Pressure Pipe, Couplings and Accessories
Classes 100, 150 and 200 - Common Groove

Threaded Brass Insert Coupling (TBIC)
Single or Double Outlet

Coupling Size, Inches	Class	Shipping Weight Lbs./Unit
4"	100	8.2
	150	10.1
	200	14.1
6"	100	11.7
	150	15.8
	200	23.9
8"	100	18.6
	150	25.5
	200	38.7
10"	100	24.3
	150	38.1
	200	50.4
12"	100	36.2
	150	60.1
	200	77.9

Special Application Threaded Brass Insert Coupling (TBIC)

Single and Double Outlet

Coupling Size, Inches	Class	Shipping Weight lbs./unit
10	150	77.1
12	150	110.0

CTD014163

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
FJS						

DESCRIPTION:
Fluid - Tite A/C Pressure Pipe, Couplings, and Accessories
Classes 100, 150, and 200 - Common Groove

Threaded Brass Insert Pipe Adaptor (TBIPA)
Single or Double Outlet

Pipe Size, Inches	Class	Shipping Weight Lbs./Unit
14"	100	115.0
	150	159.0
	200	211.0
16"	100	150.0
	150	214.0
	200	277.0
18"	100	208.0
	150	272.0
20"	100	252.0
	150	334.0
24"	100	354.0
	150	476.0

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SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
53	Section N	3A-7

SUPERSEDES:	DATE OF ISSUE:
September 26, 1977	DEC 3 1981

DESCRIPTION:

Fluid-Tite A/C Pressure Pipe, Couplings and Accessories
Classes 100, 150 and 200 - Common Groove

Coupling Adaptor to Steel or Plastic - 6" through 12"
Shipping Wt. Lbs./Unit

A/C Pipe Size, Inches	Steel or Plastic Size, Inches	Class 100	Class 150	Class 200
4	4	5.9	7.6	8.7
6	6	8.1	10.4	14.3
8	8	12.7	16.9	22.7
10	10	19.1	28.3	36.8
12	12	27.7	45.2	58.3

CTD014165

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	Q.C.	OTHERS
M.R. Stuebe				J.R.A.			

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DESCRIPTION:

Fluid-Tite A/C Pressure Pipe, Couplings and Accessories
Classes 100, 150 and 200 - Common Groove

2" NPT Threaded Brass Insert Coupling

Shipping Wt. Lbs./Unit

Coupling Size, Inches	Class 100	Class 150	Class 200
6	18.3	24.6	35.3
8	28.0	39.9	56.2
10	36.8	63.2	91.1
12	55.3	95.0	139.7
14	71.6	136.7	---
16	93.1	170.4	---
18	132.8	---	---
20	164.0	---	---
24	234.9	---	---

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SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual - Shipping Weights

T.C.O. REF. NO.	SPECIFICATION NO:	PAGE NO.:
51	Section N	3A-9

SUPERSEDES:	DATE OF ISSUE:
September 26, 1977	November 29, 1979

DESCRIPTION: Fluid-Tite A/C Pressure Pipe, Couplings and Accessories
Classes 100, 150, and 200 - Common Groove

Coupling Reducer, Fluid-Tite CG to Fluid-Tite CG

Shipping Weight (lbs./unit)

Reducer Size, Inches	Class 100	Class 150	Class 200
6 to 4	9.5	9.0	9.0
8 to 6	13.1	13.1	13.2
10 to 8	16.4	19.7	20.3
12 to 10	21.6	23.5	33.6
14 to 12	22.1	33.0	48.2
16 to 14	33.4	53.3	65.1
18 to 16	53.5	70.8	----
20 to 18	56.7	90.3	----
24 to 20	122.4	133.6	----

CTD014167

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS
FJ						

DESCRIPTION:

Fluid - Tite A/C Pressure Pipe, Couplings, and Accessories
Classes 100, 150, and 200 - Common Groove

Special Closure Sections
Shipping Wt. Lbs./Ft.

Pipe Size, Inches	Class	Plant 56	Plant 57	Plant 58	Plant 59	Plant 60
4	100	6.6	6.6	6.3	6.3	6.6
	150	7.3	7.3	6.9	6.9	7.3
	200	8.4	8.4	8.4	8.4	8.4
6	100	10.3	10.1	10.1	10.6	10.1
	150	11.3	11.3	11.3	11.3	11.3
	200	14.5	14.5	14.5	14.5	14.5
8	100	15.3	15.2	15.2	15.2	15.2
	150	17.2	17.2	17.2	17.2	17.2
	200	21.3	21.3	21.3	21.3	21.3
10	100	22.1	22.1	20.7	22.1	20.7
	150	28.1	28.1	26.7	28.1	26.7
	200	32.8	32.8	32.8	32.8	32.8
12	100	28.6	30.8	28.6	28.6	28.6
	150	36.3	38.5	36.3	36.3	36.3
	200	44.9	44.9	44.9	44.9	44.9
14	100	—	36.0	36.0	33.3	36.0
	150	—	48.8	48.8	48.8	48.8
	200	—	59.3	59.3	56.6	59.3
16	100	—	43.1	43.1	47.3	43.1
	150	—	60.5	60.5	63.8	60.5
	200	—	72.8	72.8	77.0	72.8
18	100	—	57.0	57.0	58.4	57.0
	150	—	82.0	82.0	—	82.0
20	100	—	68.9	68.9	—	68.9
	150	—	101.0	101.0	—	101.0
24	100	—	—	98.6	—	98.6
	150	—	—	144.0	—	144.0

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TECHNICAL SPECIFICATIONS

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SPECIFICATIONS CLASSIFICATION: A/C General Standards Manual-Shipping Weights		
T.C.O. REF. NO.: 49	SPECIFICATION NO: Section N	PAGE NO.: 3A-11
SUPERSEDES: September 26, 1977	DATE OF ISSUE: JUN 2 5 1979	

DESCRIPTION:

Fluid - Tite A/C Pressure Pipe, Couplings, and Accessories
Classes 100, 150, and 200 - Common Groove

Pipe Adaptors (PAD's 2, 3, 5)
Shipping Wt. Lbs./Unit

Pipe Size, Inches	Pad 2	Pad 3	Pad 5
4	6.7	FM	6.3
6	FM	FM	FM
8	21.4	21.4	FM
10	35.7	39.8	31.4
12	45.3	50.9	44.4
14	58.3	80.2	70.6
16	74.8	103.0	90.9
18	91.7	136.0	116.0
20	122.0	187.0	130.0
24	164.0	266.0	194.0

CTD014169

PREPARED BY:	APPROVED BY:	R & D	MFG.	SALES	I.E.	OTHERS

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