

PLAINTIFF'S EXHIBIT

CT-319



FLUID-TITE®

**ASBESTOS-CEMENT
HIGH HEAD
IRRIGATION PIPE
SPECIFICATIONS**

CTD031091

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STANDARD SPECIFICATIONS
CERTAIN-TEED ASBESTOS-CEMENT FLUID-TITE[®] HIGH HEAD IRRIGATION PIPE

SECTION 1 - GENERAL

Sec. 1.1 Scope - This specification designates the requirements for Certain-teed FLUID-TITE Asbestos-Cement, High Head Irrigation pipe manufactured for use in irrigation supply lines and distribution systems which carry water under pressure.

Sec. 1.2 Conformance -

Certain-teed Irrigation Pipe, as manufactured to meet these specifications, meets the requirements of the U. S. Dept. of Agriculture, Soil Conservation Service Specification Guide 432 for Asbestos Cement Pipe.

SECTION 2 - GENERAL REQUIREMENTS

Sec. 2.1 Sizes - Pipe shall be manufactured with nominal inside diameters of 3", 4", 6", 8", 10", 12", 14", 15" and 16" in classes 100, 150 and 200 psi; 18", 20", 21" and 24" in classes 100 and 150 psi.

Sec. 2.2 Types - Pipe shall be manufactured in three classes, for working pressures of 100, 150 and 200 psi designated as Class 100 Irrigation, Class 150 Irrigation and Class 200 Irrigation respectively.

Sec. 2.3 Lengths -

2.3.1 The standard nominal length of High Head Irrigation Pipe shall be 13 feet in all classes and sizes. At least 90% of the total footage of any class and size, excluding short lengths, shall be of this length with a plus zero or minus 1 inch tolerance. The remaining 10% or less may be in random lengths of not less than 7 feet with a tolerance of plus or minus 1 inch.

2.3.2 Short Lengths - Short lengths for use in making connections to valves, fittings, and structures, and for making closures shall not exceed 6 feet 6 inches. Standard lengths are $\frac{1}{2}$ lengths (6' 6" $\pm$ 1") machined ends only (M.E.O.) and $\frac{1}{4}$ lengths (3' 3" $\pm$ 1") fully machined (FM). Short lengths (includes), when not specified on the order, may be furnished as a maximum at factory option as follows:

In sizes 3" through 12", 1% of total footage in $\frac{1}{4}$ F.M. with one coupling for every two pieces and 1% in $\frac{1}{2}$ M.E.O. with one coupling for each piece.

In sizes 14" through 24", $\frac{1}{2}\%$ of the total footage in $\frac{1}{4}$ F.M. with one coupling for every two pieces and $\frac{1}{2}\%$ in $\frac{1}{2}$ M.E.O. with one coupling for each piece except that includes will be supplied in sizes 18" through 24" only on customer request at time of order.

$\frac{1}{2}$ F.M. with one coupling per piece may be substituted for $\frac{1}{4}$ F.M. in sizes 8" through 16" on an equal percentage basis upon request.

Sec. 2.4 Couplings –

Couplings shall be of the FLUID-TITE design, unless otherwise specified. They shall provide tight joints when subjected to the same hydrostatic test as designated for the pipe. One coupling of the same manufacture as the pipe shall be furnished with each standard and random length of pipe. It shall consist of an asbestos-cement sleeve and two rubber gaskets suitable for use with the particular size and class of pipe with which it is supplied.

- 2.4.1 CERTA-SPACER Band –** Each end of a standard, random and M.E.O. pipe shall include a factory installed CERTA-SPACER to provide positive end separation without employing the sealing gasket for this function.

Sec. 2.5 Materials –

- 2.5.1 Pipe and Couplings –** Asbestos-Cement Pressure Pipe and Couplings shall be composed of an intimate mixture of portland cement, asbestos fiber and silica, and shall be free from organic additives. The material shall be formed under pressure and cured by autoclave process to meet the physical and chemical requirements of the specification.

- 2.5.2 Rubber Gaskets –** Rubber Gaskets shall consist of a vulcanized rubber compound as specified by the manufacturer.

- 2.5.3 CERTA-SPACER Band –** CERTA-SPACER Band shall consist of a special yielding synthetic compound as specified by the manufacturer.

SECTION 3 – DETAIL REQUIREMENTS

Sec. 3.1 Pipe –

- 3.1.1 Description –** Asbestos-Cement Pressure Pipe shall be made to the manufacturer's standard dimensions and tolerances. The pipe shall be machined on each end to properly receive the coupling and gasket.

- 3.1.2 Hydrostatic Test –** Each standard, random, or short length of pipe and each coupling for the corresponding pipe shall have sufficient strength to hold an internal hydrostatic test for each class of pipe equal to three and one half times the working pressure of the pipe as shown in the following table, when tested as described in Section 4.2.1.

<u>TYPE OF PIPE</u>	<u>TEST PRESSURE</u>
Class 100 Irrigation	350 PSI
Class 150 Irrigation	525 PSI
Class 200 Irrigation	700 PSI

- 3.1.3 **Flexural Strength** – Each standard length of pipe in sizes 3", 4", 6" and 8" shall have sufficient beam strength to withstand without failure the total applied load specified below when tested as described in Section 4.2.2. The following values are based on tests across a 12 foot span.

TOTAL APPLIED LOAD – LBS.

Nominal Diameter Inches	Total Applied Load – Lbs.		
	CLASS 100 IRRIGATION	CLASS 150 IRRIGATION	CLASS 200 IRRIGATION
3	565	625	685
4	900	1100	1400
6	2100	2800	3700
8	4000	5700	7600

- 3.1.4 **Crushing Strength** – Each pipe when tested shall have sufficient strength, when submitted to the ASTM three-edge bearing test as specified in Section 4.2.3, to support not less than the loads indicated in the following tabulation:

MINIMUM CRUSHING STRENGTH

Nominal Diameter Inches	Total Applied Load – Lbs.		
	CLASS 100 IRRIGATION	CLASS 150 IRRIGATION	CLASS 200 IRRIGATION
3	4600	6700	8800
4	4100	5400	8700
6	4000	5400	9000
8	4000	5500	9300
10	4400	7000	11000
12	5200	7600	11800
14	5200	8600	13500
15	5600	9000	14500
16	5800	9200	15400
18	6500	10100	–
20	7100	10900	–
21	7600	11300	–
24	8100	12700	–

- 3.1.5 **Workmanship** –

3.1.5.1 **Inside Surface** – Each pipe shall be free from bulges, dents, and tears on the inside surface which result in a variation in diameter greater than 3/16 from that obtained on adjacent unaffected portions of the surface.

3.1.5.2 **Ends** – Machined ends of the pipe that receive the coupling shall be free from dents and gouges that will affect the tightness of the joint.

3.1.5.3 Straightness – Each pipe shall not vary from straightness more than 5/8 inch measured as an outside mid-ordinate, in lengths of 13 feet.

3.1.5.4 Dimensions – The average inside diameter of standard and random lengths shall not be less than the nominal by more than 5.0 per cent for sizes through 16 in. and 1.5 per cent for sizes 18 in. and larger.

Sec. 3.2 Couplings – Asbestos-Cement Couplings shall be machined on the inside surface so that the gaskets are retained in the proper position to make a tight seal.

Sec. 3.3 Rubber Gaskets – The Rubber gaskets shall conform to the manufacturers standards.

Sec. 3.4 Chemical Requirements – The Uncombined Calcium Hydroxide in Asbestos-Cement pipe and couplings shall not be greater than one per cent when tested in accordance with Section 4.2.4.

SECTION 4 – INSPECTION TESTS AND REJECTIONS

Sec. 4.1 General – All material furnished under specifications shall be inspected and tested in accordance with these specifications. All material shall be in a normal processed condition prior to test for conformance to the requirements stated in previous sections. When requested on his order, the purchaser may witness inspection and test procedures at his own expense. In lieu of this witnessing, he may request the manufacturer to submit a certificate certifying the product meets the requirements of these specifications. To insure the purchaser that all pipe purchased under these specifications conforms to the standards herein required and for the convenience of the purchaser or his representative, all tests must be conducted in the Continental U. S.

Sec. 4.2 Methods of Testing –

4.2.1 Hydrostatic Proof Test

4.2.1.1. a Description of Term – Hydrostatic strength, as used in these specifications, refers to the ability of each pipe and coupling to withstand the bursting forces resulting from internal pressures.

4.2.1.1.b Significance of Test – The hydrostatic proof test is mandatory for each piece of pipe and coupling sleeve prior to shipment. It is performed to establish the fact that finished, shippable material has strength to withstand the internal bursting pressures stated in these specifications. The strength level required by these specifications assures minimum strengths that are three and one half times maximum recommended operating pressures in field service and that accommodate the stresses simultaneously induced by internal pressure, earth loads, and surge pressures.

4.2.1.1.c **Procedure** – Each pipe regardless of length, each asbestos-cement coupling and adaptor shall be tested under a hydrostatic pressure of three and one half times the working pressure for the type of pipe. The water pressure shall be applied gradually and maintained at the specified test level for 5 seconds. Any pipe or coupling showing any defect shall be rejected. The machine used for the hydrostatic tests shall have gaskets which seal the ends of the pipe without materially counter-acting the hydrostatic test pressure.

4.2.1.1.d **Sampling Method** – From each 300 lengths of pipe, or fraction thereof, of each size and class, which have passed the routine hydrostatic and flexural tests, one length shall be selected by the inspector. Each selected length shall be hydrostatically tested to a pressure of four times the rated working pressure for the class of pipe, such pressure to be maintained for at least 5 seconds. The pipe shall not fail under this pressure. Each pipe so tested shall be retested in the manner specified in paragraph 4.2.1.1.c.

4.2.2 **Flexure Proof Test** –

4.2.2.1.a **Description of Term** – Flexural strength, as used in these specifications, refers to the ability of a standard pipe section to withstand external loads bearing on the pipe transversely to its long axis that induce bending in the section.

4.2.2.1.b **Significance of Test** – Each standard 13 foot length of 3", 4", 6" and 8" pipe, of all classes, shall be tested in flexure. It is performed to establish the fact that finished, shippable material has inherent strength to withstand the external loads specified in Section 3.1.3. The strength level required by these specifications assures resistance with a reasonable margin of safety to transverse bending loads normally encountered in field service.

4.2.2.1.c **Procedure** – The test shall be conducted by supporting the pipe in a flexural testing machine with supports 12 feet apart. The load shall be applied at a uniform rate until it equals the tests loads specified in Section 3.1.3. The total load shall be divided equally and applied at the third points of the clear span at a uniform loading of at least 250 pounds per second.

4.2.3 **Crushing Test** –

4.2.3.1.a **Description of Term** – Crushing strength, as used in these specifications, refers to the ability of the pipe to withstand external loads that tend to collapse the pipe.

4.2.3.1.b Significance of Test – From each 300 lengths of pipe, or fraction thereof, of each size and class when specifically requested by the purchaser on his order, one length shall be selected by the inspector for a three-edge bearing test before shipment. From each selected length, there shall be cut one unmachined section of pipe one foot long. This section shall be tested by the ASTM three-edge bearing method and shall not fail until the total applied load exceeds the applicable value shown in Section 3.1.4.

4.2.3.1.c Procedure – For this test, the two lower bearings shall 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. The strips shall be securely fastened to a rigid block, with the interior vertical faces parallel and clear space distance of 1/2 inch for pipe 12 inches and under and 1 inch for pipe 14 through 24 inches. The upper bearing shall be a rigid wooden block, at least 6 inches in cross section straight and true from end to end. The upper and lower bearings shall extend the full length of the test section. The rate of loading shall be 2,000 pounds per minute per lineal foot, with a tolerance of plus or minus 500 pounds per minute per lineal foot.

4.2.4. Uncombined Calcium Hydroxide Test –

4.2.4.1.a Description of Term – The Uncombined Calcium Hydroxide characteristics covered by these specifications refers to the chemical stability of the pipe.

4.2.4.1.b Significance of Test – The Uncombined Calcium Hydroxide Test establishes the fact that Asbestos-Cement pipe has chemical stability. The stability level required by these specifications assures that the material has maximum chemical stability and will satisfactorily resist, with a reasonable factor of safety, the chemical action normally encountered in field service.

4.2.4.1.c Certification of Test – The manufacturer shall conduct periodic controlled Uncombined Calcium Hydroxide tests. Upon request, certifications shall be issued to the customer that the pipe and couplings will conform to the requirements of maximum Uncombined Calcium Hydroxide permitted in Section 3.4.

4.2.4.1.d Reagents -

(a) Phenolphthalein Indicator - Dissolve 1.0 g of phenolphthalein in 100:0 ml. of absolute ethanol. *

(b) Glycerol - Ethanol Solvent - Prepare a solution consisting of glycerol and anhydrous or absolute ethanol, *1:2 by volume. To each liter of this solution 2.0 ml. of the indicator is added. Adjust the solvent to slightly basic with either dilute NaOH in absolute ethanol* or standard ammonium acetate depending on the original pH.

(c) Standard Ammonium Acetate Solution - (1 ml. - 0.005 g CaO). Dissolve 16.0 g. dry crystalline ammonium acetate in one liter of absolute or anhydrous ethanol. * The solution is standardized by following the analytical Procedure except that 0.05 - 0.06 g of pure ground CaO is substituted for the 1 g sample.

* Note: Specially denatured alcohol No. 30, 3a or 2b or alcohol consisting of 95% specially denatured alcohol No. 3a plus 5% isopropanol may be substituted.

4.2.4.1.e Procedure - Representative samples of pipe or sleeves shall be prepared and immediately screened through a 20 mesh screen. Place the material passing through the screen immediately into a weighing bottle and cover with its ground-glass top. Place the bottle with top removed, in a drying oven at 105° C. for two hr., and then cool in a desiccator to room temperature. Weigh out 1 g. ± 0.010 g. of the dried sample from a pipe or sleeve to the nearest 0.001 g. and place it into a dry 250 ml. Erlenmeyer flask, to which a teflon encapsulated stirring bar, 60 ml. of the glycerol-ethanol solvent and 2.0 g. Sr. (NO₃) are added. Attach the flask to a water-cooled condenser (with a standard 24/40 glass joint), and place on a hot plate-magnetic stirrer. Boil the solution gently for 30 minutes with mild stirring. Then remove the flask and filter the mixture on a Buchner funnel under vacuum. Bring the filtrate to a boil and titrate with the standardized ammonium acetate reagent to a colorless endpoint. The endpoint is observed by comparison with a similar mixture containing no phenolphthalein indicator. No excess ammonium acetate should be added at any time because an excess may react with calcium silicates and aluminates.

4.2.4.1.f Calculations -

(a) Standardization of Ammonium Acetate Solution

$$E = \frac{W(\text{CaO}) \times 1.32}{V_a}$$

Where E = weight of $\text{Ca}(\text{OH})_2$ in g/ ml. of ammonium acetate solution.

$W(\text{CaO})$ = weight of CaO in grams.

V_a = volume of ammonium acetate in ml.

(b) Percentage of Uncombined $\text{Ca}(\text{OH})_2$

$$\% \text{Ca}(\text{OH})_2 = \frac{EV}{W} \times 100$$

Where V = volume of ammonium acetate solution required by sample in ml.

W = weight of sample in grams.

Sec. 4.3 Rejection -

4.3.1 Hydrostatic - If any pipe subjected to the higher hydrostatic test fails to withstand the specified pressure required in Section 3.1.2, two additional lengths of the same size and class of pipe 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.

4.3.2 Crushing - Failure of the specimen tested for crushing strength to attain 75 per cent of the crushing load required in Section 3.1.4, shall be cause for rejection of the entire lot of that size and class 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 required in Section 3.1.4., one specimen shall be cut from each of two additional pipes of the same size and class manufactured during the same shift and shall be subjected to the crushing test. Failure of one of these additional specimens to meet the crushing strength requirements shall be cause for rejection of the entire lot of that size and class manufactured during the same shift as the test specimen.

SECTION 5 - MARKING

Section 5.1 Pipe - Each standard, random and short length of pipe shall be clearly marked on the outside surface with the trade name, pipe size, class designation, date of manufacture and test pressure or maximum working pressure.

Sec. 5.2 Coupling - Each coupling shall be clearly marked with the trade name, class and size of pipe for which it is intended to be used, and the letter "T" to indicate that it has been tested.

Sec. 5.3 Gaskets - Each rubber gasket shall be marked with the manufacturers identification, the size and year of manufacture.

Sec. 5.4 Additional Marking - When factory inspection is made by the purchaser, each pipe and each coupling may receive an additional special marking of no more than three letters, as required by the purchaser.

SECTION 6 - PREPARATION FOR SHIPMENT

Sec. 6.1 General - All pipe, couplings and gaskets shall, unless otherwise specified, be prepared for standard commercial shipment, so as to insure acceptance by common or other carriers.

SECTION 7 - SUPPLEMENTARY DETAILS TO BE PROVIDED BY PURCHASER

Sec. 7.1 General - When purchasing Pressure Pipe under these specifications, it will be necessary for the purchaser to make specific statements for each lot of pipe.

Sec. 7.2 Size - The purchaser shall state the pipe size or sizes required.

Sec. 7.3 Types - The purchaser shall state the class or classes of pipe required.

Sec. 7.4 Standard Lengths - The purchaser shall state the total footage of 13 ft. lengths required.

Sec. 7.5 Short Lengths - The purchaser shall state the total footage of 6 ft. 6 inch and 3 ft. 3 inch lengths required.

Sec. 7.6 Inspection & Tests -

7.6.1 Crushing Tests - The purchaser shall state on his order when crushing tests are required.

7.6.2 Uncombined Calcium Hydroxide Tests - The purchaser shall state on his order when the Uncombined Calcium Hydroxide Test is required.

7.6.3 Certificate of Tests – The purchaser shall state on his order when a certificate of tests in lieu of inspection is required.

Sec. 7.7 Definitions – Under these specifications the following definitions will apply:

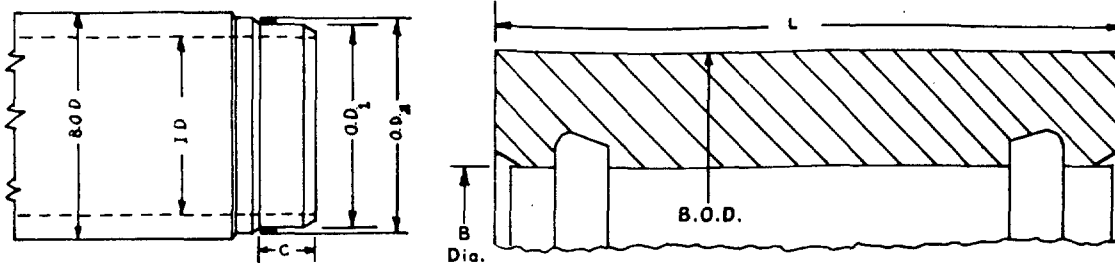
7.7.1 Purchaser: The person, firm, corporation or governmental sub-division entering into a contract or agreement to purchase pipe according to these specifications.

7.7.2 Manufacturer: The person, firm or corporation who manufactures the pipe.

7.7.3 Inspector: The representative of the purchaser, properly authorized and limited by the duties entrusted to him.

7.7.4 Working Pressure: The maximum hydrostatic pressure to which the pipe will be subjected after installation, exclusive of allowance for water hammer.

DIMENSIONS & TOLERANCES **ASBESTOS-CEMENT FLUID-TITE®** **HIGH HEAD IRRIGATION PIPE & COUPLINGS**



TOLERANCES

PIPE OD₁ & OD₂
 3" - 16" ± 0.020"
 18" - 24" ± 0.030"

COUPLING ID (B)
 3" - 16" ± .025"
 18" - 24" ± .040"

PIPE						COUPLINGS		
PIPE SIZE	B.O.D. INCHES	I.D. INCHES	O.D. 1 INCHES	O.D. 2 INCHES	C ±1/16 INCHES	B (I.D.) INCHES	L +.25 - .00	B.O.D.
CLASS 100 IRRIGATION								
3	4.06	3.00	3.74	3.90	2.60	3.85	6.25	5.35
4	5.08	4.00	4.64	4.80	2.90	4.75	6.50	6.47
6	7.16	6.00	6.91	7.07	2.90	7.02	6.50	8.76
8	9.36	8.00	9.11	9.27	3.40	9.23	7.50	11.40
10	11.51	10.00	11.14	11.30	3.40	11.26	7.50	13.51
12	13.82	12.00	13.32	13.48	3.50	13.44	7.75	15.96
14	15.36	13.60	15.07	15.23	4.00	15.20	9.00	17.86
15	17.02	15.00	16.68	16.95	4.31	16.79	9.00	19.45
16	17.48	15.50	17.15	17.31	4.00	17.28	9.00	20.11
18	20.64	18.00	19.90	20.06	4.88	20.08	11.10	23.40
20	22.94	20.00	22.12	22.28	4.88	22.30	11.10	25.82
21	24.00	21.00	23.28	23.55	5.27	23.41	11.10	26.65
24	27.46	24.00	26.48	26.64	4.88	26.66	11.10	30.60
CLASS 150 IRRIGATION								
3	4.09	3.00	3.84	4.00	2.60	3.95	6.25	5.55
4	5.12	4.00	4.81	4.97	2.90	4.92	6.50	6.66
6	7.16	5.85	6.91	7.07	2.90	7.02	6.50	8.96
8	9.52	7.85	9.11	9.27	3.40	9.23	7.50	11.46
10	12.01	10.00	11.66	11.82	3.40	11.78	7.50	14.61
12	14.25	12.00	13.92	14.08	3.50	14.04	7.75	17.13
14	16.47	14.00	16.22	16.38	4.00	16.36	9.00	19.80
15	17.90	15.00	17.28	17.55	4.31	17.39	9.00	21.00
16	18.78	16.00	18.46	18.62	4.00	18.60	9.00	22.28
18	21.32	18.00	20.94	21.10	4.88	21.12	11.10	25.33
20	23.66	20.00	23.28	23.44	4.88	23.46	11.10	27.97
21	24.94	21.00	24.38	24.65	5.27	24.51	11.10	29.22
24	28.34	24.00	27.96	28.12	4.88	28.14	11.10	33.44
CLASS 200 IRRIGATION								
3	4.17	3.00	3.84	4.00	2.60	3.95	6.25	5.75
4	5.34	3.95	4.81	4.97	2.90	4.92	6.50	6.94
6	7.46	5.70	6.91	7.07	2.90	7.02	6.50	9.24
8	9.67	7.60	9.11	9.27	3.40	9.23	7.50	11.70
10	12.10	9.60	11.66	11.82	3.40	11.78	7.50	14.85
12	14.30	11.47	13.92	14.08	3.50	14.04	7.75	17.67
14	16.84	13.60	16.22	16.38	4.00	16.36	9.00	20.67
15	18.47	14.55	17.82	18.09	4.31	17.93	9.00	22.54
16	19.20	15.50	18.46	18.62	4.00	18.60	9.00	23.41

All above dimensions are subject to manufacturing tolerances. The 15" and 21" coupling is of different design than shown.

DISTRICT OFFICES

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CLEVELAND PIPE DISTRICT

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DENVER PIPE DISTRICT

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Denver, Colorado 80206
Area Code 303 Telephone: 388-5751

HOUSTON PIPE DISTRICT

Texas Gas Building Suite 275
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PHILADELPHIA PIPE DISTRICT

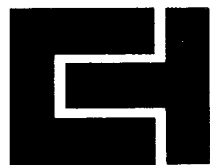
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CERTAINTEED

PIPE DIVISION

CTD031103

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