

Houston Office
August 25, 1960

C. W. Beam - Baton Rouge

Cast Iron Pipe
Sales Propaganda

Thank you very kindly for the attachment to your memo of August 22.

I had not seen this particular effort on the part of our competition but it represents nothing particularly new. It does, however, contain some outright misrepresentation and generally twists the facts, as one would expect, in a manner intended to make the reader believe that thin walled cast iron pipe represents progress.

I will not attempt in this letter to provide you with all of the details but will discuss the matter on our next personal visit. It is sufficient for the moment to state that, when the original ASA Specification A21.1 was published in 1939, these specifications clearly recognized that pipe could be made with a thinner wall than that recommended as minimum by the responsible committee. Without attempting to quote the specifications verbatim, the committee simply stated that the possibilities of breakage in handling and other hazards were such that the thicknesses developed on the basis of using 18/40 iron were the minimum practicable for normal usage.

W. H. Waring

WHW/plg

cc: W. P. Richardson - New Orleans
File

MEMO

Location Baton Rouge

Date 8-22-60

To H. N. Harris Office Houston

Subject Cast Iron Sales Aid?

If by chance you haven't seen attached, I thought you might find it interesting.

WHY FILE THIS!

Signed Wally Jr

Form 3-2B PRINTED IN U.S.A.

P

JGR -
For your
files
EHO
2/16

TO: Water Works Engineers

Re: Specifications for underground water pipes

There has been some ambiguity and resulting confusion in regard to the various specifications and materials governing underground water distribution pipes. The history of these specifications is enlightening.

The American Standards Association Committee A21, formed in 1926 made an extensive study of the requirements that an underground pressure pipe must meet to assure that it will do the job for which it was intended. The ASA, under the sponsorship of the American Gas Association, the American Society for Testing Materials, The American Water Works Association and the New England Water Works Association, studied the factors influencing the design of pipes, evaluating the best available knowledge of ground stresses and experience with pressure pipes. Participating in this work were representatives of sponsors, producers and consulting engineers. The result of this comprehensive, scientific study was the development of a formula which recognized in pipe design such factors as trench loads, water hammer, internal pressure and safety factors. The formula is as follows:

$$w = \frac{W}{\sqrt{P}} \quad \sqrt{P - p}$$

$$(a) \quad W = \frac{t^2 R}{.0795\ (d + t)}$$

$$(b) \quad P = \frac{2tS}{d}$$

t - Thickness of pipe in inches
S - Bursting Tensile in lb. per sq. in.
d - Internal diameter of pipe in inches
R - Modulus of Rupture in lb. per sq. in.
p - Internal Water pressure in lb. per sq. in.
w - Load (earth & traffic) in lb. per linear foot of pipe.
W - Crushing load in lbs per linear foot of pipe.

In 1939, when the formula was published, centrifugal pipe casting foundries were able to consistantly attain a metal strength of 18,000 psi bursting tensile and a 40,000 psi Modulus or Rupture. Therefore, the necessary tables for various sizes of pipe, trench conditions and depths of cover were begun to be compiled on this basis. In 1953 these tables

were published and the ASA specifications formally adopted. In the meantime however, technical advances in the cast iron pipe industry enabled pipes to be cast consistantly with a 21,000 psi Bursting Tensile Strength and a 45,000 psi Modulus of Rupture. This increase in strength was accomplished without changing the chemical composition of the metal which has given cast iron pipe its' long record of service. Cast iron pipe manufactured using 21/45 iron must then be recalculated in accordance with the formula developed by the ASA to ascertain the wall thickness required. Thicknesses for pipes laid in a flat bottom trench and under 5 feet of cover for 150 psi water working pressure are as follows:

Pipe Sizes	Wall Thickness
4"	.32"
6"	*.32"
8"	.35"
10"	.38"
12"	.41"

*Minimum recommended thickness for shipping and handling is .35"

These thicknesses are manufactured and marketed under Specification ASA 21.1. It should be noted that the pipes with a thicker wall will have an even greater safety factor than those set up by the ASA and will give better service where in later years unforeseen stresses occur.

Using a minimum Bursting Tensile Strength of 3,400 psi and a Modulus of Rupture of 7,600 psi (Note 1) for Cement Asbestos, the thicknesses calculated for 150 psi are as follows:

Pipe Size	ASA Calculated Wall Thickness	C.A. Class 200 Wall Thickness	C. A. Class 150 Wall Thickness
4"	.48"	.51"	.51"
6"	.68"	.685"	.61"
8"	.87"	.835"	.71"
10"	1.11"	1.095"	.91"
12"	1.28"	1.260"	1.04"

To meet the minimum strength requirements of underground water pipes as calculated by the ASA formula, Class 200 Cement- Asbestos comes fairly close to these requirements. The thicknesses listed under the columns labeled Class 200 and Class 150 are manufactured and marketed under A.W.W.A. Specifications C400-53T. Because these specifications follow the manufacturer's standards, the introduction to AWWA Specifications for Cement-Asbestos pipe contains the following statements: "AWWA specifications for Asbestos-Cement pipe are based upon the best known experience and are intended for use under normal conditions. They are not designed for unqualified use under all conditions, and the advisability of their use for any installation must be subjected to review by the engineer responsible. The use of the terms "Class 100", "Class 150" and "Class 200" applied to asbestos-cement pipe produced under these specifications is not intended to imply that the material, when initially installed, is the engineering equivalent of cast iron pipe bearing the same designation."

In May 1954 the National Bureau of Standards published the results of thirteen years of testing the "Effect of exposure to soils on the properties of Asbestos-Cement pipe." The results show that, in general, for the first five years of exposure, the exposed pipe absorbed less water than unexposed pipe; however, after that period of time, the pipe, in general, absorbed more water as the time increased. The graphs show that the strength of the pipe decreases with the percentage of water absorbed. It is noted that saturation with water reduces the strength of Asbestos-Cement pipe from 10 to 20%. Consequently, all bursting pressures or tensile strengths of test made on unsaturated asbestos-cement pipe must be reduced by 10 to 20% for comparison with actual working conditions. Unfortunately these test were concluded by the National Bureau of Standards after only thirteen years of testing.

At the same velocity of flow the volume delivered by two pipe of different sizes is proportional to the squares of their diameters. With the same head, however, the velocity is less in the smaller pipe and the volume delivered varies about as the square root of the fifth power of the diameter. Inside diameters of both cast iron and asbestos-cement pipes as as follows:

Nominal Pipe Size	Cement-Asbestos Class 200	Cast Iron Class 150 w/half-thickness cement lining (1/16")
4"	3.95"	3.975"
6"	5.70"	6.015"
8"	7.60"	8.105"
10"	9.63"	10.095"
12"	11.56"	12.115"

Note: C = 130 to 140 for both pipes.

Developed, this gives Cast Iron Pipe with half-thickness cement lining more capacity as follows:

4" Half-thickness cement lined cast iron pipe delivers more water than asbestos-cement pipe.	1.6%
6" ditto	14.4% more
8" ditto	16.6% more
10" ditto	12.3% more
12" ditto	11.1% more

In light of the foregoing facts, it appears that Cast Iron Pipe, Class 150 has only a slight advantage over Cement-Asbestos Class 200 from a structural standpoint, therefore, the engineer must evaluate the proven long life, additional carrying capacity, tapping characteristics and reliability of cast iron pipe with the lower first cost of material for cement-asbestos pipe to determine which material he should specify for his client.

Yours very truly,

Cecil M. Forbes
926 North 3rd Street
Jacksonville Beach, Florida

CMF/sh

NOTE 1: These values were taken from actual test as reported to the Cast Iron Pipe Research Association by the Southern Research Institute.

A. Final Report to Cast Iron Pipe Research Association on Comparative Testing of Cast Iron Pressure Pipe and Asbestos-Cement Pressure Pipe. Project 444, Report 1.

B. American Water Works Association Specifications C400-53T.

C. American Standards Association Manual for the Computation of strength and thickness of Cast Iron Pipe. ASA 21.1, 1939.

D. "Effect of Exposure to Soils on the Properties of Asbestos Cement Pipe", by Melvin Romanoff and Irving A. Denison - Corrosion Section, Metallurgy Division, National Bureau of Standards Washington, D.C.

E. Review of Paper "D" Enclosure".

SPECIFICATION FOR CEMENT-ASBESTOS PIPE

Cement-Asbestos Pipe shall be manufactured in accordance with Federal Specification SS-P-351a, Class 200, with Ringtite or equal joints. Fittings shall be Mechanical Joint Cast Iron, Class 250.

Approved strength equivalent of Class 150 Cast Iron

In clay soils, pipe shall be enveloped in a minimum of four inches of tamped sand. In such instances trench bottom must be dug at least 4" deeper than grade and then brought back to grade with tamped sand. In unstable soils, it will be necessary to dig deeper and refill with selected materials of gravel or crushed stone until pipe grade is reached. When spreading refill soil on the trench bottom, a 2" minimum clearance shall be left beneath the coupling and thoroughly tamped for coupling support.

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All fittings shall be suitably anchored with a thrust-block of 1:2:5 concrete. In soft soils, each coupling shall be similarly anchored for side thrust. All Valves shall be similarly anchored with a ½" steel rod looped over each hub of the valve and securely embedded in the concrete thrust block.

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Service connections shall be made with a Clow F4339 Double Strap Service Clamp equipped with a rubber outlet gasket. Before placing the clamp, file the surface of the pipe and provide a clean hard surface for the clamp.

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Cement Asbestos Pipe shall have a minimum of 4'-0" cover over the top of the pipe. Stub roots exposed by trenching that are within one foot of pipe in place shall be coated with hot bituminous tar or other suitable growth inhibitant.

TESTING:

Dry Cement Asbestos Pipe will absorb some water, so the line shall be filled with water at least 24 hours before the leakage tests begin. Pipe shall be purged of air and then tested to 200 psi for 24 hours. Leakage shall not exceed 75 U.S. Gallons per 24 hours per mile of pipe per inch diameter.

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NOTES