Johns-Manville

Internal Correspondence

To: L. J. Ciancia - 2S

Date: June 19, 1975

From: S. M. Quint - R&D

Copies: See Below

Subject: 10 and 12 IN. PERMASTRAN, CAST IRON O.D.

The calculated amounts of glass and resin were based on long term 50 year glass stress and cross checked by calculations based on quick burst minimums.

The following assumptions were made:

1. Long term glass hoop MR = 160,000 psi @ 50 yr.
2. 4:1 safety factor
3. Glass density = 0.09172 lb/in^3
4. Cured epoxy density = 0.03205 lb/in^3
5. Wind angle 80-81 degrees
6. Overwrap is 60% glass, 40% resin (includes gel)

Before going into the C.I. O.D. design, the present IPS 10 in. and 12 in. product was examined. The plant quick burst on both products has consistently been 1800 psig with little variation. This indicates that too much glass has been designed into the product since minimum burst is 1500 psig.

An analysis shows the following for 12 in.:

Present 12 in. IPS O.D. PERMASTRAN

glass weight = 32.2 lb over 248.5 in. length
glass volume = 351.068 in.^{3}

$$\text{glass } t = \frac{351.068}{(248.5)\ (12.613)\ (\pi)} = .036 \text{ in.}$$

$$\text{at 1800 psig Q.B., glass } S = \frac{1800\ (12.690 - .036)}{(2)\ (.036)} = 316{,}350 \text{ psi}$$

(12.690 = finished pipe O.D. minus gel cost)

at 1600 psig Q.B., the glass t needed is calculated by

$$316{,}350 = \frac{1600\ (12.690 - t)}{2t} \qquad t = .032 \text{ in.}$$

$$W = (248.5)\ (.032)\ (12.613)\ (\pi)\ (.09172) = 28.9 \text{ lb glass}$$

(12.613 = core O.D. plus glass t)

Fabricator info

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MTC 010482

Therefore, for a quick burst of 1600 psig on the present product we should be using 28.9 lb glass instead of 32.2 lb.

The same calculation for 10 in. IPS shows we should be using 20.6 lb instead of 23.2 lb.

Cross checking on thicknesses shows that for the present 12 in. IPS product we have:

t glass = 0.036 in.
t epoxy = 0.068 in. (40 wt %, includes gel coat)
total t = 0.104

Therefore, core O.D. should be 12.750 - (2) (0.104) = 12.54 which checks since actual core is 12.535 and allows 0.004 in. for the coating (or .008 in. on O.D.)

Now for the 10 in. and 12 in. C.I. O.D. First calculations show that for a wind angle of 80-81 degrees, the band width for 10 in. pipe must be increased from 5.5 in. to 6.0 in. and for 12 in. pipe wind angle must be increased from 6.5 in. to 7.0 in. This is a machine gear change which production and/or engineering must perform. However, this increase in band width may actually allow the 10 in. and 12 in. C.I. products to be wrapped faster than the IPS pipe since more glass can be applied per revolution.

A. Based on long term hoop the calculations are:

160,000 x 0.25 = 40,000 (hydro design stress)

1. 10 in. C.I. O.D. pipe, 200 psig rating

figuring glass t $40{,}000 = \frac{200\ (11.100 - t)}{2t}$; t = .028

2. 12 in. C.I. O.D., pipe 200 psig rating

figuring glass t $40{,}000 = \frac{200\ (13{,}300 - t)}{2t}$; t = .033

B. Based on quick burst 1500 psig minimum and using 1600 psig for calculations.

1. 10 in. C.I. O.D. pipe

glass S @ 1800 psig for IPS product = 316,800 psig

glass t for 1600 psig burst $316{,}800 = \frac{1600\ (11.040 - t)}{2t}$; t = .028

2. 12 in. C.I. O.D. pipe

$$316{,}350 = \frac{1600\ (13.140 - t)}{2t};\ t = .033$$

Note that the glass t for each size for both long term and quick burst checks out closely.

Figuring the glass weights and epoxy t and weights shows:

	10 in.	12 in.
spigot glass, lb/section	22.1	31.0
spigot glass, lb/ft	1.07	1.50
glass t, in.	0.028	0.033
spigot epoxy, lb/section	14.7	2.07
spigot epoxy, lb/ft	0.71	1.00
epoxy t, in.	0.053	0.063
core O.D., in.	10.930*	13.000*
core t, in.	0.185	0.225

(Note: 0.008 in. core O.D. allowance for 0.004 in. of coating thickness)

The core O.D. and t were calculated by R. Bishop to result in a minimum finished product F/ΔY of 40. Core weights are 79.5 lb for 10 in. and 114.9 lb for 12 in..

The bell end may or may not need a gear change and Entec should be consulted on this as to maintaining the helix bell wind angle which engineering specified on the winder (60-70 degrees?) for 10 and 12 in. IPS. The bell glass and resin weights would be:

	10 in.	12 in.
glass weight (lb/section)	1.7	2.5
resin weight (lb/section)	1.1	1.7

The finished product weights for a 20 ft laying length should be approximately:

10 in.	115 lb
12 in.	165 lb

I have deliberately gone into more detail than normal to try to give all involved a better feel for PERMASTRAN design. Also, I wanted to clarify why the C.I. O.D. products will use less glass and resin than the present IPS products.

S. M. Quint

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