



In 2007, Tata & Howard began extracting one foot long cast iron water main samples ranging in diameter from six to twelve inches as part of a cleaning and cement lining water main rehabilitation project for the South Central Connecticut Regional Water Authority (SCCRWA). Since then, Tata & Howard has evaluated a significant number of cast iron water main samples for several water distribution systems throughout Massachusetts and Connecticut, typically during a rehabilitation project, water main failure, or water main replacement project.

CONDITION ASSESSMENT OF CAST IRON WATER MAIN SAMPLES

All sections of removed water main are evaluated using several criteria:

1. Pipe Class Estimation Based on Remaining Wall Thickness

Nominal Diameter (in.)	Thickness Class	Thickness (in.)	Outside Diameter (in.)
6	A	0.44	6.90
	B	0.48	7.10
	C	0.51	7.10
	D	0.55	7.10
8	A	0.46	9.05
	B	0.51	9.05
	C	0.56	9.30
	D	0.60	9.30
12	A	0.54	13.20
	B	0.62	13.20
	C	0.68	13.50
	D	0.75	13.50

2. Pipe Crushing - ANSI A21.6-13 Yields Break Load of Sample



Pipe Sample Being Load Tested

3. Remaining Factor of Safety Estimation

- A. Calculate break load of the class of pipe the sample is estimated to be, which includes a 2.5 factor of safety:

$$\text{Break Load} = \frac{\text{rupture modulus} \times \text{wall thickness}^2}{0.0795 \times (\text{diameter} + \text{wall thickness})}$$

- B. Compare the calculated break load to the break load measured by pipe crushing

Utilizing this methodology, Tata & Howard concluded that old pipe is not necessarily weak pipe — 6-inch Class C pipe from 1892 actually had a higher remaining factor of safety than the same class of pipe from 1923, 1925, and 1928 — and that the factor of safety limit for rehabilitation is 1.75. In addition, making the decision to rehab or replace in field during a cement cleaning and lining project allows the utility to spend capital efficiently.

4. Visual Inspection

Pipe samples from the SCCRWA



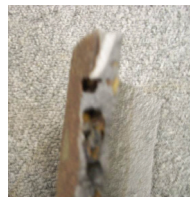
External Corrosion



Internal Corrosion



Wall Perforation



Air Inclusions



Stamps



Wall Thickness

FIELD REPLACEMENT OR REHABILITATION DECISION MAKING

1. Approval or Rejection for Rehabilitation is Based on the Following Factors:

Pipe Class / Wall Thickness



The pipe at left was rejected for rehab because of its thin, weak wall.

Extent of Corrosion



Excessive corrosion excluded the pipe at left from rehab.

Presence of Existing Liner



Although the pipe at left lacks excessive corrosion, it was rejected for rehab because of its existing liner.

2. Field Pressure Testing

- Prior to Cleaning
- After Cleaning
- After Lining



All rejected pipe is scheduled for replacement.