FIBERGLASS MANHOLES
PERFORMANCE TESTING IN COMPLIANCE WITH ASTM D 3753, STANDARD SPECIFICATIONS (42", 48" INTERNAL DIAMETER)

Summary

Separate tests were conducted on 42" cylinder internal diameter and 48" cylinder internal diameter Containment Solutions (CSI) Fiberglass Manholes, each with a cone reducer of 22-1/2" internal diameter. Test samples used were actual pieces of manhole or samples manufactured in a manner consistent in every way with the manhole component construction. While Contain-ment Solutions attempts to manufacture fiberglass manholes uniformly, properties of individual manholes may vary somewhat from those measured in these tests, but should always meet or exceed ASTM D 3753 standards.

Results were as follows:

- All workmanship requirements were met without any repair.
- Dimensions of the manholes were as follows:
  - Cylinder internal diameter - 42", 48"
  - Cylinder length - 3'
  - Cone opening diameter - 22.5"
- The manhole met all loading requirements with no leakage or other evidence of damage before or after load testing.
- The manhole cylinders met all stiffness requirements of the specification.
- Chemical resistance requirements were exceeded by the constructions used in both the cone and the cylinder of the manhole.
- Material Properties have been established for the construction of the manhole cylinder.

TESTING REQUIREMENTS

Load Rated Test:

- Method of test explained in ASTM D 3753, section 8.4.1.1 for concentric manholes. (See Figure 1) The finished manhole (minimum 36 inch cylinder length) is loaded vertically with cover and supporting ring installed. Load is applied eccentrically in 2,000 lb. increments with close visual inspection at each increment and deflection measurement. Deflection in this testing is measured with low intensity lasers, to a 24,000 lb. load. The load is increased to 40,000 lb. and the complete manhole shall not leak, crack or suffer other damage (see Table 1 for results).

Cylinder Stiffness:

- The cylindrical portion of the manhole is to be tested in accordance with ASTM Method D 2412. The specification stiffness requirements are included in the test table of this report (see Table 1).

Soundness:

- In order to determine soundness, an air or water test is to be applied to the manhole test sample. While holding the pressure between 3-5 psi, the entire manhole must be inspected for leaks (see Table 1).

FIGURE 1

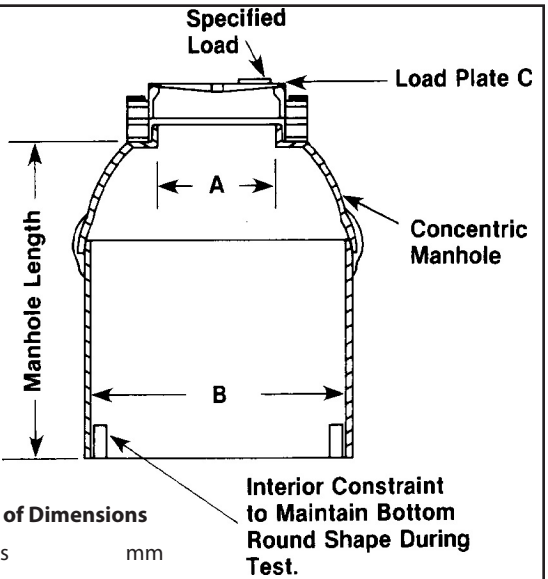


Table of Dimensions

	inches	mm
A	21 (min.)	533 (min.)
B	42 (min.)	1067 (min.)
C	6 x 6 x 1/2	152 x 152 x 12.7

TABLE 1

Test Results - Load, Stiffness & Soundness

Depth	ASTM Requirement	42" Diameter	48" Diameter
Load Rating			
Maximum Deflection at 24,000 lbs. (inches)	0.25	0.156	0.20
Visual Damage at 40,000 lbf.	None	None	None
Cylinder Stiffness (psi)			
6'	0.72	6.25	1.38
12'	1.26	6.25	1.38
20'	2.01	6.25	6.15
25'	3.02	6.25	6.15
35'	5.24	6.25	6.15
Soundness			
Leakage at 5 psi	None	None	None

Chemical Resistance per ASTM C 581:

- Flexural strength, flexural modulus and barcol hardness are plotted versus time on log-log coordinates. The line defined by these points is extrapolated to 100,000 hours. The minimum extrapolated retention allowed for any of these properties is 50%. Test samples used are actual pieces of manhole or samples manufactured in a manner consistent in every way with the manhole component construction.

Sulfuric acid was used to simulate sewage in this testing because it is the most aggressive material found in sanitary sewers. This sulfuric acid is produced by the action of certain bacteria on hydrogen sulfide in the absence of air. The details of the phenomena have been report by the EPA and numerous others (see Table 2 and Chart 1).

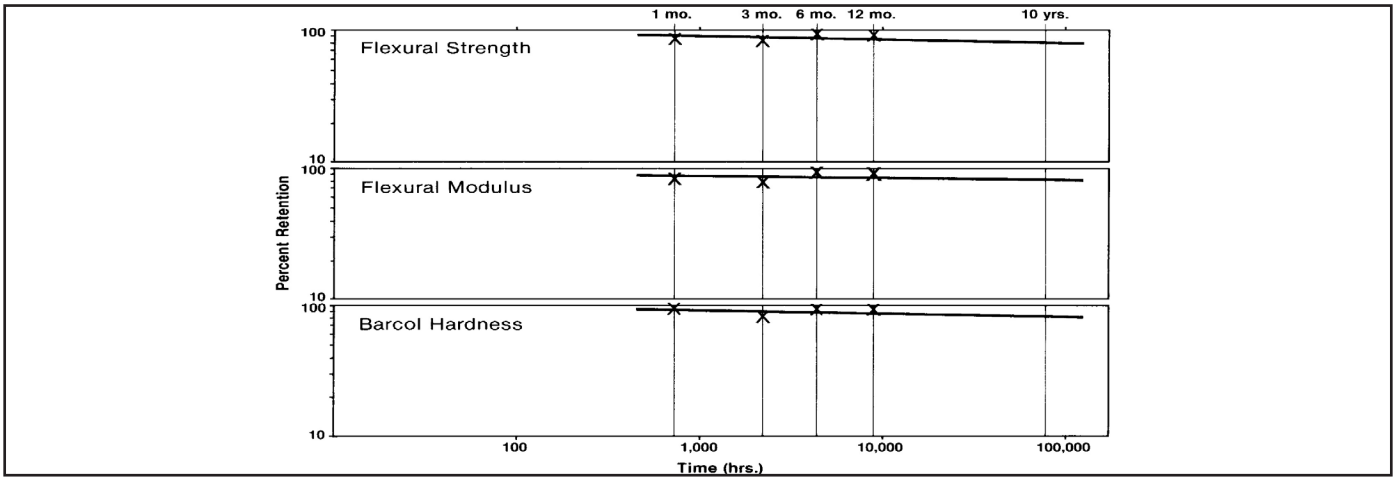
TABLE 2

Test Results - Chemical Resistance

(Extrapolated Values at 100,000 Hours)

	Cone (% Retention)				**Cylinder** (% Retention)			
	pH4	**pH10**	**Sat'd NaCL**	**20% H_2SO_4**	**pH4**	**pH10**	**Sat'd NaCL**	**20% H_2SO_4**
Flexural Strength	80	72	94	80	85	100	100	80
Flexural Modulus	96	88	98	92	80	60	82	82
Barcol Hardness	80	92	84	90	80	70	100	82

CHART 1



Material Properties:

Tests are made on actual pieces of manholes or samples manufactured consistent in al respects with the construction of the manholes. Tests are to be as follows: (see Table 3 for results)

- Material composition per ASTM D 2584
- Compressive Strength per ASTM D 695
- Flexural Strength and Modulus per ASTM D 790
- Barcol Hardness per ASTM D 2583
- Thickness

TABLE 3

Test Results - Nominal Material Properties

	42", 48" Cone	**42", 48" Cylinder**
Material Composition		
Resin (wt %)	60	42
Glass (wt %)	15	14
Sand (wt %)	25	44
Compressive Properties		
Strength (10^3 psi)	*	18.90
Modulus (10^6 psi)	*	1.40
Barcol Hardness		
	40-50	40-50

	42", 48" Cone	**42", 48" Cylinder**
Flexural Properties		
Hoop Strength (10^3 psi)	15.400	22.500
Hoop Modulus (10^6 psi)	0.820	1.050
Axial Strength (10^3 psi)	17.200	14.300
Axial Modulus (10^6 psi)	0.905	0.096
Thickness		
	To accommodate structural loads, thickness ranges from .300 to .550	0.284

* Compressive property test methods require flat specimen; therefore, no cone results are available.