

Long Term Monitoring of Acrylic Bonds Immersed in Ultra Pure Water

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1. Proposal:

It is proposed to place flexural test specimens of bonded acrylic in a test tank containing water which approximates the chemistry and temperature of the water in the SNO detector. 10 specimens will be removed every six months and tested according to the ASTM D 790-86 procedure in order to ascertain any change in the bond strength due to the ultra pure water environment of the SNO acrylic vessel.

2. Test Specimens:

Material for the test specimens were prepared as part of the qualification procedure for the bonding adhesive LUC 6751. Tensile strengths were recorded for each batch of test specimens by Davis Earle at the Chalk River Laboratory.

The test specimens will be prepared according to ASTM D 790-86. Each specimen shall be given a unique identification number scribed on the end of the specimen which will allow it to be correlated with the original Chalk River test batch. This identification number also specifies the orientation of the specimen in the long term test rig and the flexural test machine.

A total of 200 specimens are required in order to provide 20 specimens per year for the 10 year design life of the acrylic vessel. The dimensions of the test specimens are given in figure 1.

3. Test Conditions:

The test conditions are described in the proposal "Test Tanks for the Sudbury Neutrino Observatory", N. Jelly and J. Lyon, October 5 1995. The test specimens are placed in a polypropylene tank of 965mm internal diameter, filled to a depth of 700mm with water returning from the SNO cavity. The exchange rate of the water will be approximately 1 volume per day at an anticipated temperature of 12°C. The pH and conductivity of the water will be constantly monitored. The test tanks are hermetically sealed and provided with a nitrogen cover gas at above ambient pressure.

4. Test Apparatus:

The test specimens will be subjected to a constant bending force by applying a 4 point loading according to ASTM D 790-86 figure 2B. The load is chosen such that the tensile stress experienced by each test specimen is approximately 300 psi.

The equal loading of each test specimen will be achieved by the technique proposed by Phil Cumyn, Monenco Engineering, January 28 1992. This technique involves stacking the test specimens like cord wood separated by the loading noses called for in ASTM D 790-86 and is shown in figure 2.

All components of the test rig are fabricated from stainless steel and acrylic. An effective load in water of 28.4 Kg is provided by 5 stainless steel plates, this results in a tensile stress of 300 psi in the test specimens. The load noses consist of 9.5 mm (3/8") diameter stainless steel tubes. Since the test procedure calls for 10 specimens to be tested at a time, the specimens are stacked in layers of 10 specimens per layer, allowing a whole layer to be removed at a time. The 200 specimens are arranged in the water tank in 2 stacks as shown in figure 2

5. Test Procedure:

As soon as water of the appropriate purity is available to fill the tank the specimens shall be placed in the tank in the manner shown in figure 3. The test specimens shall be stacked in a random order such that removing a layer from a stack represents a random sampling of bond adhesive used in the construction of the acrylic vessel. To fix the orientation of the test specimen in the rig (direction of flexure) the identification marks must be the correct way up.

The QC check list located on the top of the test tank should be completed noting the date and time of immersion/loading of the specimens.

After an appropriate time, not to exceed 6 months, a layer consisting of 10 specimens are removed from the test apparatus and stored in a sealed container of pure water until ready to be tested. The QC check list is filled in noting the time of removal and identification of the test specimens.

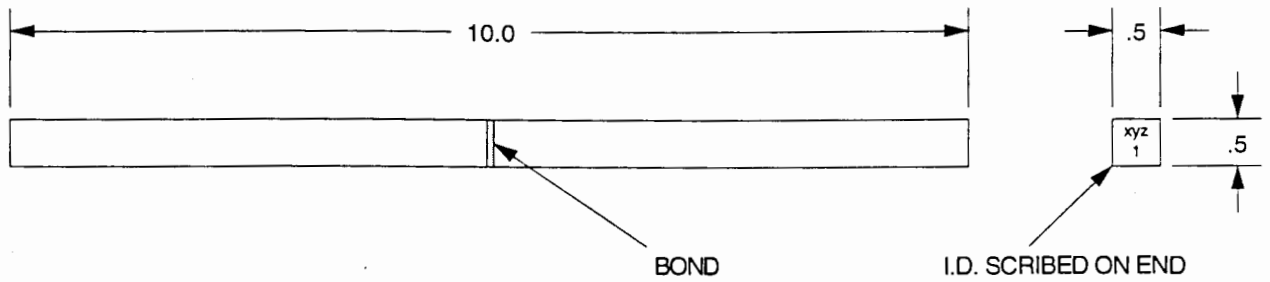
The test specimens are removed from the container immediately prior to being inserted in the flexural test machine. Prior to testing the specimen is examined for any unusual features and any observation noted in the QC check list. The specimen is then tested to failure according to ASTM D-790 procedure using Test Method II (four point loading at the 1/4 points), procedure A. To fix the orientation of the test specimen in the test machine (direction of flexure) the identification marks must be the correct way up (i.e. the same orientation as in the long term test rig).

The rate of cross head motion shall be 5.3 (0.21) mm(in)/min as recommended in table 3 of the procedure. For each specimen the flexural strength (modulus of rupture) shall be recorded.

The results of the set of 10 test specimens shall be presented for consideration to the engineer responsible for the vessel.

FIGURE 1: LONG TERM FLEXURAL TEST SPECIMEN

DIMENSIONS: INCHES



FOUR POINT LOADING AT 1/4 POINTS

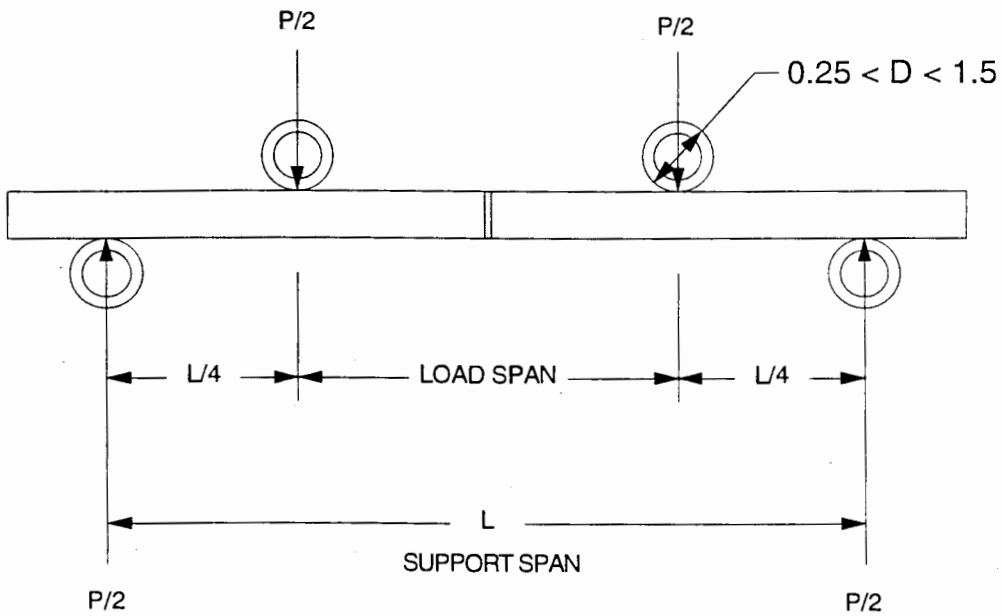
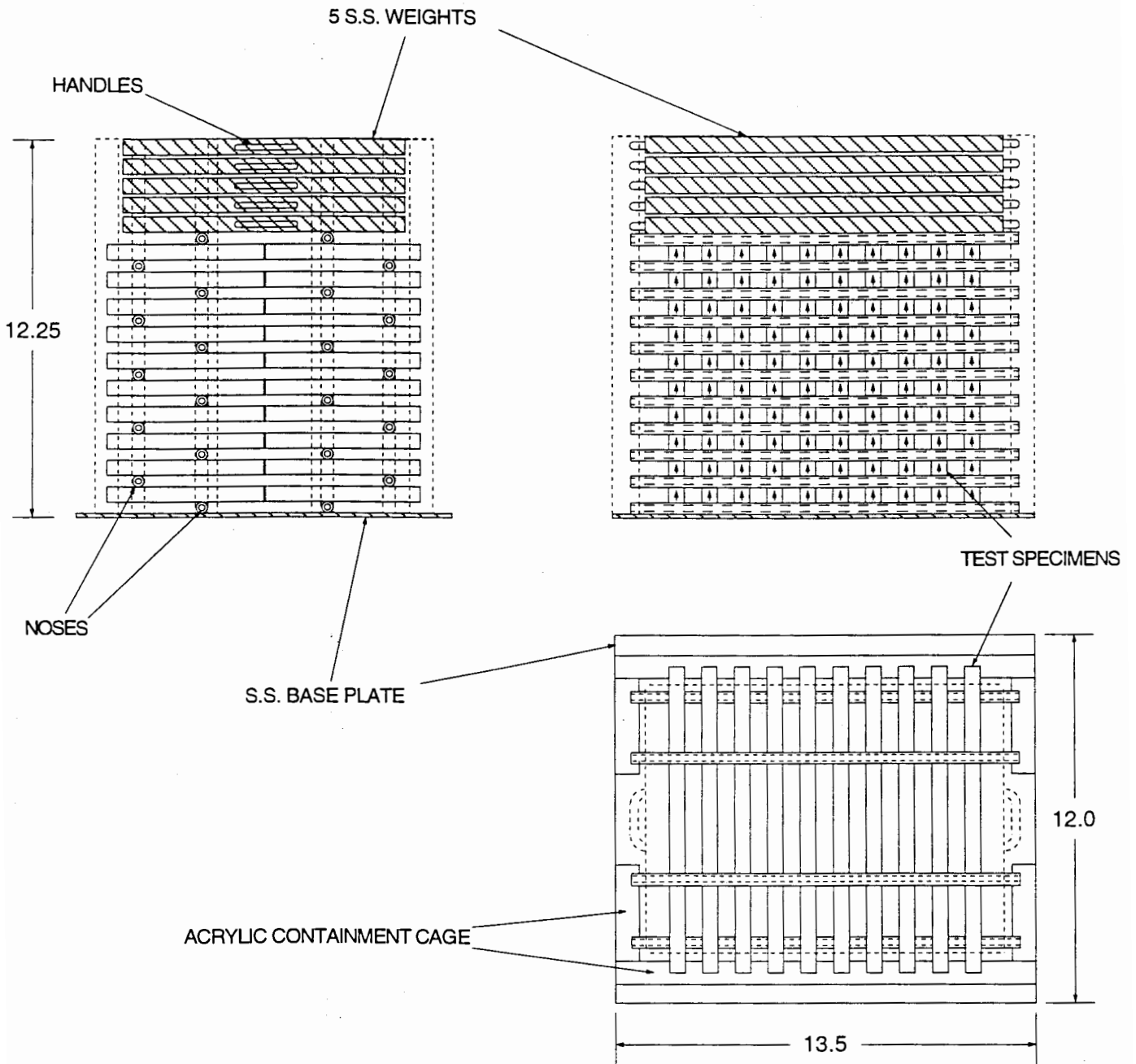


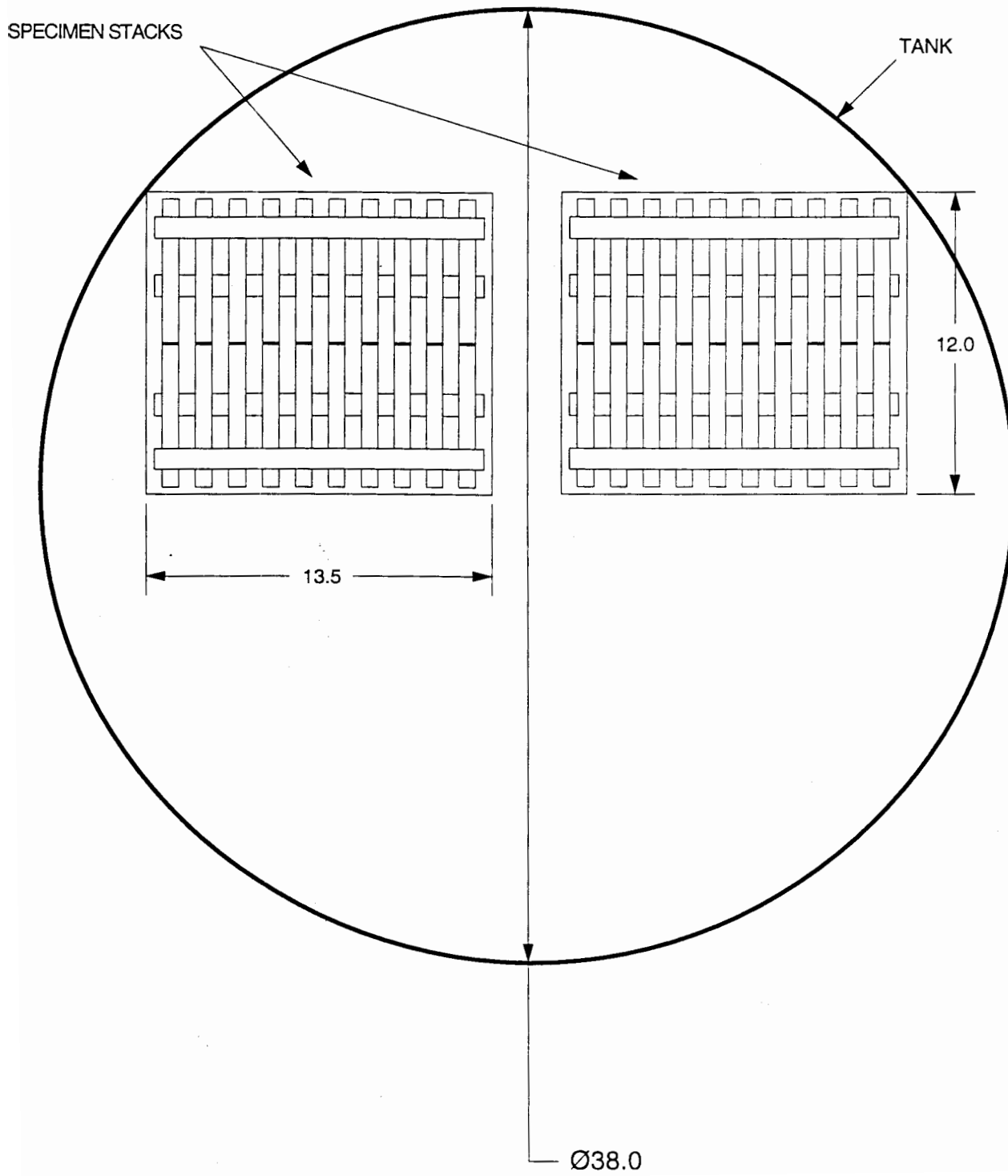
FIGURE 2: LONGTERM ACRYLIC TEST ASSEMBLY

SIDE VIEWS (CONTAINMENT SHOWN DASHED)



PLAN VIEW (WEIGHTS SHOWN DASHED)

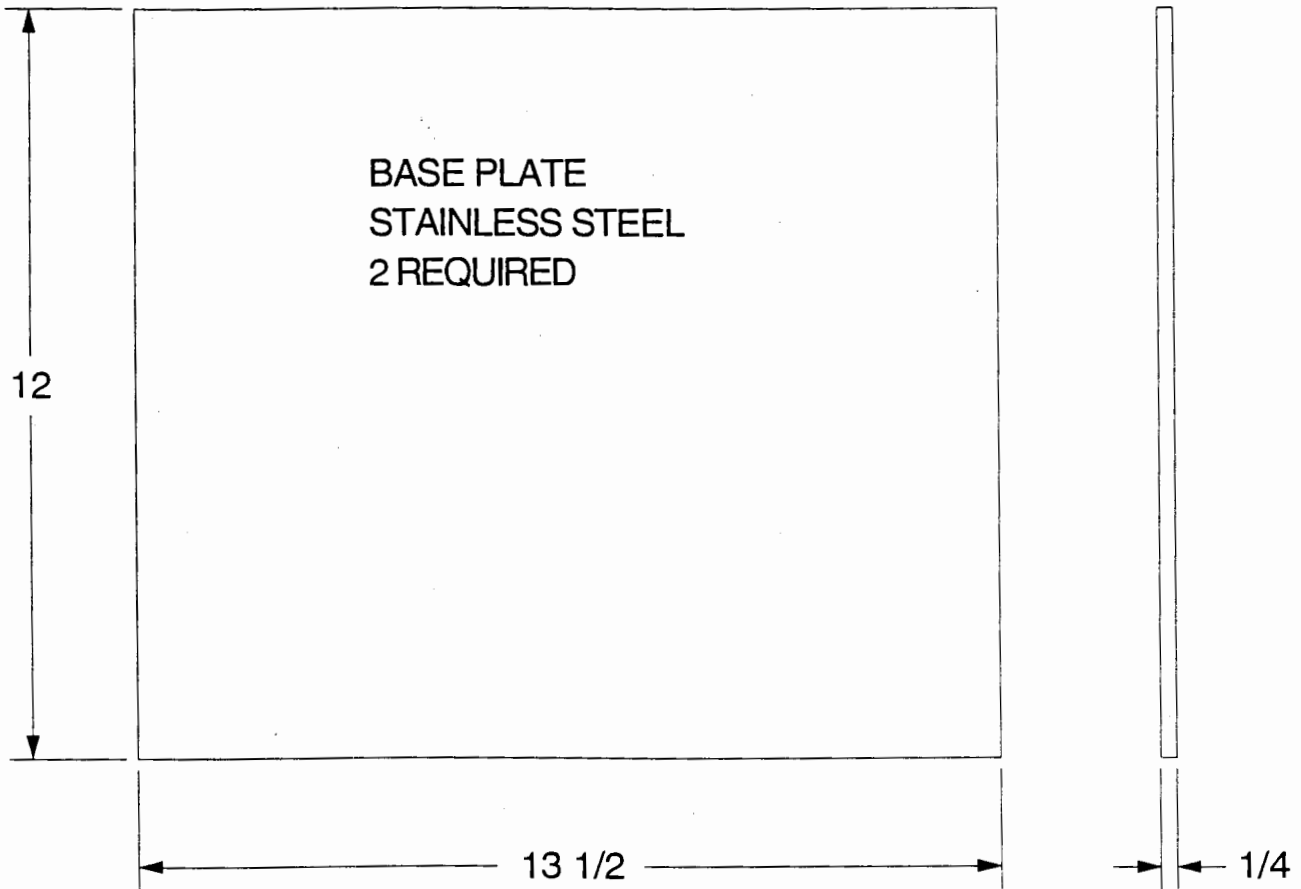
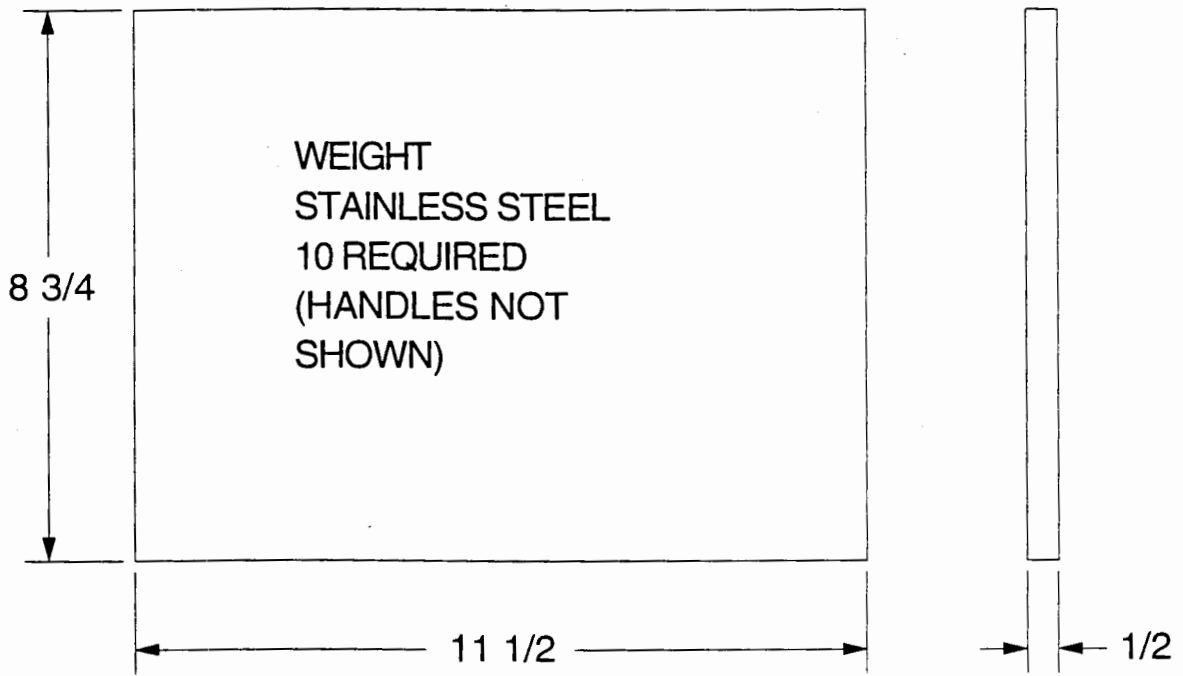
FIGURE 3: LOCATION OF TEST SPECIMENS IN TANK



TEST RIG MATERIALS LIST:

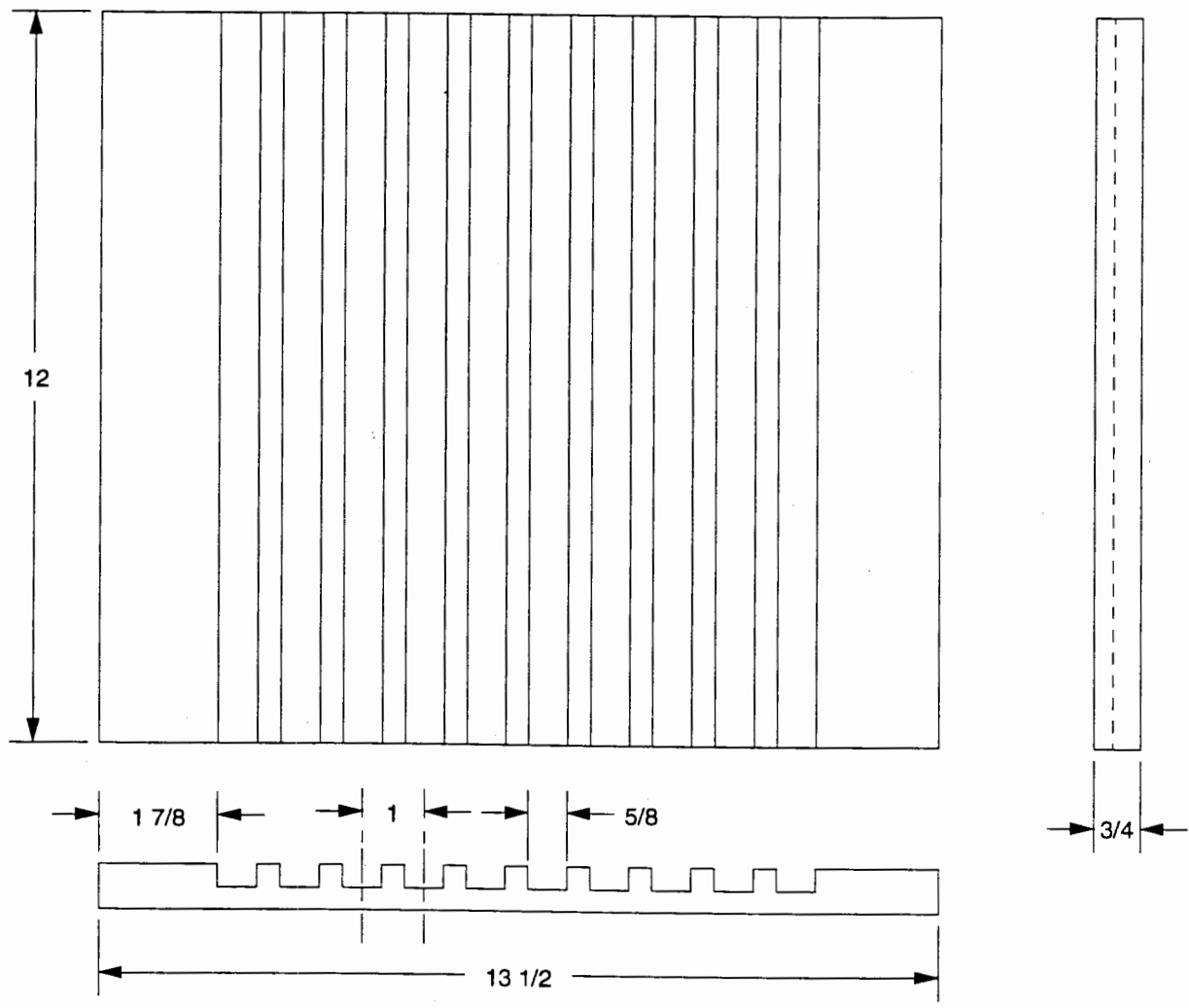
- 1) Base Plate:
Stainless Steel
2 required
13.5 x 12.0 x 0.25
- 2) Acrylic Containment Cage (Sides):
Acrylic Plate
4 required
12.0 x 13.5 x 0.75
- 3) Acrylic Containment Cage (Front/Back)
Acrylic Plate
8 required
12.0 x 3.125 x 0.75
- 4) Noses
Stainless Steel Tube
22 required
12.688 x 0.375OD, 0.125 wall
- 5) Weights
Stainless Steel Plate
10 required
11.5 x 8.75 x 0.5

LONGTERM TEST ASSEMBLY - COMPONENTS



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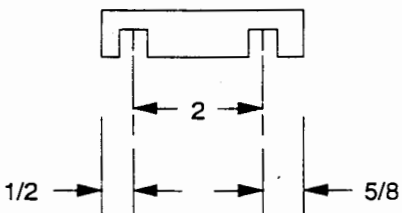
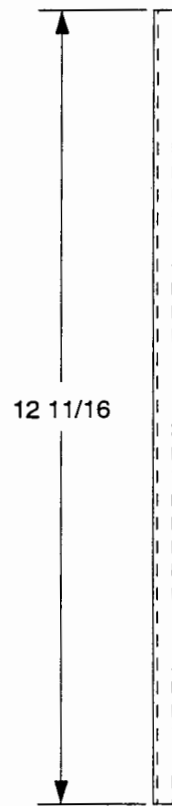
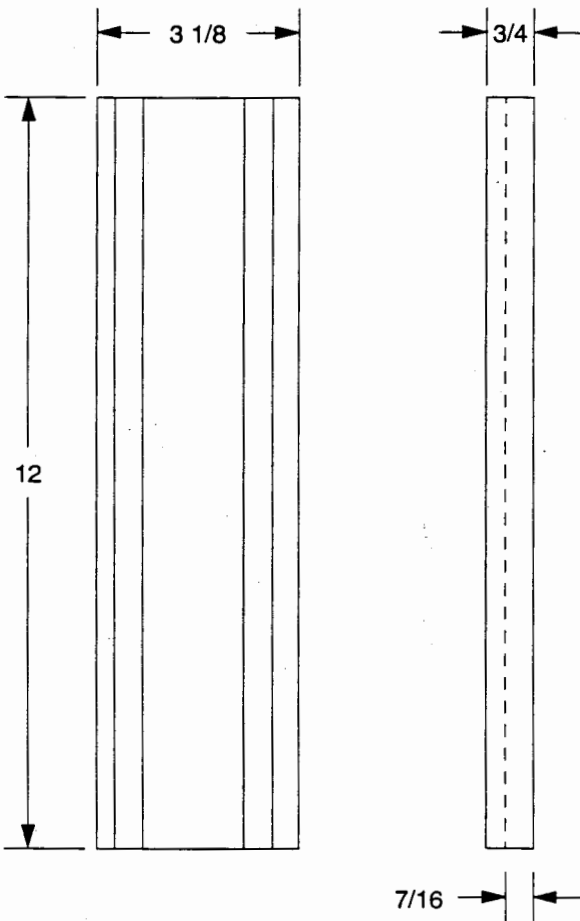
CONTAINMENT CAGE
ACRYLIC
4 REQUIRED



LONGTERM TEST ASSEMBLY - COMPONENTS

CONTAINMENT CAGE
ACRYLIC
8 REQUIRED

NOSES
STAINLESS STEEL
22 REQUIRED



3/8 OD, 1/8 WALL, S.S. TUBE