

**DEPARTMENT OF TRANSPORTATION**  
**ENGINEERING SERVICE CENTER**  
 Transportation Laboratory  
 5900 Folsom Boulevard  
 Sacramento, California 95819-4612



## METHOD FOR TESTING THERMOPLASTIC TRAFFIC LINE MATERIAL

**CAUTION:** Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read “**SAFETY AND HEALTH**” in Part 15 of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

### SCOPE

This test method is divided into the following parts:

1. Sample Preparation
2. Melting Procedure
3. Binder Content
4. Glass Bead Content and Grading
5. Specific Gravity
6. Ring and Ball Softening Point
7. Tensile Bond Strength
8. Viscosity
9. Impact Resistance
10. Yellow Color in Yellow Thermoplastic
11. Yellowness Index and Daylight Luminous Reflectance in White Thermoplastic
12. Hardness
13. Ultraviolet Light and Condensate Exposure

14. Abrasion Test

15. Safety and Health

### PART 1. SAMPLE PREPARATION

Sample preparation for granular type with meltable bag and premelted block form material.

#### A. APPARATUS

1. Scale, 45-kg capacity, capable of weighing to 0.05 kg
2. Top-loading balance, at least 200-g capacity, capable of weighing to 0.01 g
3. Sample splitter with 50-mm wide slots and top hopper to hold a 22.5-kg bag of thermoplastic

#### B. PROCEDURE

1. Determine the weight of bag plus the thermoplastic material.
2. Empty the contents of the bag into the splitter box. Mix the material and break up all large lumps.
3. Weigh the empty bag.

- Split the sample with the splitter to yield a 6000-g sample of the granular thermoplastic.
- Calculate the weight of bag material to be added to the granular thermoplastic using the following ratio:

$$\frac{\text{Weight of Bag + Thermo- plastic (g)}}{\text{Weight of bag (g)}} = \frac{\text{Weight of Sample (g)}}{X \text{ (g)}}$$

where x = weight of bag to be added to the granular thermoplastic sample.

- Weigh out the calculated amount of material and cut it up into small pieces. Mix this material into the previously weighed sample of granular thermoplastic.
- In the yellow thermoplastic, the lead chromate may be packaged separately in a sealed plastic bag within the original 22.5-kg bag. Remove the lead chromate bag and determine the net weight of the lead chromate. Calculate the amount of lead chromate to be added to the thermoplastic using the following ratio:

$$\frac{\text{Weight of Bag + Thermo- plastic (g)}}{\text{Net Weight of Lead Chromate(g)}} = \frac{\text{Weight of Thermo- plastic Sample (g)}}{X \text{ (g)}}$$

where x = weight of lead chromate to be added to the thermoplastic sample.

The sample is now ready for test.

Sample preparation, granular type with paper bag or nonmeltable plastic bag:

Empty the contents of the bag into the splitter box, mix and split as outlined above and prepare a 6000-g sample with no bag.

Sample preparation, block type:

Break up plastic block into small pieces to yield a sample of 6000 g.

## PART 2. MELTING PROCEDURE

### A. APPARATUS

- Stainless steel 4000-mL beaker, 150-mm diameter by 230-mm high, Vollrath No. 84 000 or equivalent.

Alternatively, a disposable heating vessel can be made using a 165-mm diameter by 190-mm high unlined metal 3.78-L paint can. This item is available from Paramount Can Co., 2085 Burroughs Avenue, San Leandro, CA 94577.

This can will fit into the Glas-Col Model 100DDH098BC heating mantle. A gasket made from crumpled aluminum foil can be used to seal the gap between the can and mantle to reduce the amount of heat escaping from this gap.

- Glas-Col heating mantle, Model TM 620 or equivalent (for use with 4000-mL stainless steel beaker listed above).
- Temperature indicator-controller, Omega Engineering Model 4001 JF or equivalent.
- Thermocouple, iron constantan, Omega Engineering No. T36-ICSS-116G-12 with 1.6-mm 304SS sheath or equivalent.
- An air-powered variable speed mixer, Lightnin Model 30 with two Lightnin A310 stainless steel impellers is required. The top impeller should have a 63.5-mm diameter, and the bottom should have a 96.5-mm diameter. The two impellers are mounted on a 305-mm long by 7.95-mm diameter shaft. The top impeller should be about 95 mm above the bottom impeller. See Figure 1 (Detail A).

Another air-powered variable speed mixer that has been found to be satisfactory is the Cole Parmer Model #04685-00 stirrer. This mixer can be fitted with a 9.5-mm Jacobs drill chuck (Cole Parmer Model #H-04423-00) to hold the stirrer shaft.

Most of this equipment can be obtained from Cole Parmer Instrument Co., Chicago, Illinois 60648, Telephone 1-800-323-4340.

6. Aluminum lid to cover top of stainless steel 4000-mL beaker with slot to clear the air motor agitator shaft and thermocouple.
7. Stainless steel ladles with pouring spout, 30 and 60-mL capacity.
8. Tachometer to measure shaft speed of mixer.
9. Copper or SS tubing, approximately 3.2-mm inside diameter and 250-mm long.

## B. PROCEDURE

1. Set up apparatus as shown in Figure 1. Wire the Glas-Col mantle power cord to the temperature indicator-controller according to manufacturer's instructions. Mount the controller-indicator in a panel which can be wall mounted to keep the unit away from heat, dirt, and vibration. When unit is ready for operation, make a test melt in order to set the proportional band and other adjustments to give a controlled temperature of  $218 \pm 1^\circ\text{C}$ .
2. Charge about one-half of prepared 6000-g sample into the Vollrath stainless steel beaker and place beaker into Glas-Col mantle and attach the stirring shaft and thermocouple. Turn on power to the TM 620 mantle and controller. Note time of startup. As the thermoplastic melts down, add the remainder of the 6000-g sample. Start the variable speed air agitator when plastic has softened sufficiently to mix. Continue mixing and heating until the temperature of the melt reaches  $218 \pm 1^\circ\text{C}$  and the melt is homogeneous. This should take about one hour from startup.
3. At this time, using the 60-mL stainless steel ladle, remove enough of the hot

melt to fill a 150-mm diameter paint can lid. This sample is allowed to cool and will be used for the glass bead and binder tests. At this point, samples are also cast for the ring and ball and specific gravity tests.

4. Set the speed of the mixer shaft at 85 rad/s with a suitable tachometer. Continue stirring and heating at  $218 \pm 1^\circ\text{C}$  for a total time of 4 h from start of meltdown or as otherwise stated in specification. Keep the aluminum cover over the Vollrath beaker during the extended heating period.
5. At the end of the extended heating period, samples for bond, viscosity, impact, reflectance, color, UV exposure, abrasion, and hardness are taken. The samples are taken while stirring and heating. After samples are taken, turn off agitator and power to Glas-Col mantle and controller, remove Vollrath beaker from Glas-Col mantle and pour out hot melt into suitable cardboard box or other container for discard. Scrape out Vollrath beaker with a spatula while still hot —CAUTION— wear gloves. When cool, clean the residue in the Vollrath beaker with toluene or other suitable solvent.

If a disposable can was used as a container for melting the thermoplastic, then the molten material should be allowed to cool before removing the can from the heating mantle and disposing of it. Remove the agitator shaft before allowing the thermoplastic to cool.

## PART 3. BINDER CONTENT

### A. APPARATUS

1. Porcelain crucible, 40-mL capacity
2. Diagonal cutter
3. Analytical balance
4. Desiccator

5. Muffle furnace capable of maintaining 450°C

#### B. PROCEDURE

1. With diagonal cutters, cut the cooled sample on the can lid from initial meltdown into small pieces.
2. Weigh the porcelain crucible and fill it with about 20 g of thermoplastic.
3. Determine the exact weight of thermoplastic and crucible.
4. Place the crucible in the muffle furnace and set controls for 450°C. Heat for 3 h, remove crucible, cool in desiccator, and weigh crucible.
5. Calculation:

$$\% \text{ Binder} = \frac{A - B}{A - C} \times 100$$

Where:

A = Mass of the crucible and thermoplastic

B = Mass of the crucible and ash

C = Mass of the crucible

6. Save the crucible and ash for the glass bead determination.

### PART 4. GLASS BEAD CONTENT AND GRADING

#### A. APPARATUS

1. Beakers, 600 and 400-mL capacities
2. Hot plate - stirrer
3. Teflon-coated stirring bar
4. Toluene and acetone or other suitable solvents
5. Air-circulation oven at 100°C.

6. Balance, 200-g capacity or greater
7. Concentrated hydrochloric acid - reagent grade
8. A standard 150-µm sieve
9. Diagonal cutters

#### B. PROCEDURE

1. For the glass-bead content only - no grading analysis.
  - a. Weigh the 400-mL beaker to the nearest 0.01 g.
  - b. Place the crucible and ash from the binder determination into the bottom of beaker.
  - c. Add concentrated HCl until effervescence ceases.
  - d. Wash out the crucible into the beaker and remove the clean crucible.
  - e. Dilute the sample with hot water to 300 mL. Let the sample settle for about 15 min.
  - f. Carefully decant all insoluble material making sure the beads remain on the bottom of the beaker.
  - g. Wash and decant about 3 or 4 more times or until only the beads remain in the beaker and the supernatant liquid is clear.
  - h. Wash the beads once with acetone, let settle and decant. After the acetone has evaporated, place the beaker in an oven at 100°C until the beads are dry.
  - i. Remove the beaker from the oven, cool the beaker, and determine weight of beads in the 400-mL beaker.

j. Calculation:

$$\% \text{ Beads} = \frac{\text{Weight of Beads}}{A - C} \times 100$$

For A and C, refer to Part 3, Binder Content, Item B5.

k. Examine the beads under a 20 power microscope. If an acid insoluble material other than the beads is present, screen all the bead sample on a standard 150- $\mu\text{m}$  sieve. If the insoluble material is larger than the 150- $\mu\text{m}$  sieve, then the sample is failed. If the insolubles pass the 150- $\mu\text{m}$  sieve, then collect and weigh the contents. Subtract the weight of the insolubles from the glass bead weight and correct the percentage of glass beads reported.

2. For glass bead grading analysis:

- a. With the diagonal cutters, cut the cooled sample on the can lid from the initial meltdown into small pieces.
- b. Weigh the 600-mL beaker and fill it with about 100 g of the thermoplastic sample.
- c. Determine the exact weight of the thermoplastic.
- d. Add about 400 mL of toluene or other suitable solvent and place stirring bar in beaker.
- e. Heat and stir for 1 h; do not boil the toluene. Keep the temperature about 65°C by adjusting the hot plate controls.
- f. Remove beaker from hot plate, let settle for about 15 min, then decant the insolubles.
- g. Repeat the solvent extraction, settle, and decant operations.

h. Wash and decant residue two times with about 200 mL of acetone.

i. Add about 100 mL of water and, with stirring, carefully add concentrated HCl to the residue until all reaction has ceased. Remove stirring bar.

j. Dilute to about 500 mL with hot water, let it settle 15 min. Carefully decant the insolubles making sure the beads remain on the bottom.

k. Repeat the water dilution, settle, and decant operations until the supernatant liquid is clear.

l. Wash the beads with about 200 mL of acetone, settle, and decant. After the acetone has evaporated, dry the beaker in a 100°C oven. Cool and weigh.

m. Calculation:

$$\% \text{ Beads} = \frac{\text{Weight of the Beads}}{\text{Weight of the Sample}} \times 100$$

n. Examine the beads under the microscope, as done in Part 4, Section B.1.k above, and separate the insolubles, if necessary.

o. Run a sieve analysis on the beads using the appropriate sieves, depending on the requirements of the thermoplastic specification. Report % passing through each sieve size.

## PART 5. SPECIFIC GRAVITY

### A. APPARATUS

1. Vacuum oven capable of maintaining 60°C and a vacuum of 101 kPa
2. Analytical balance
3. Glass beaker, 600-mL capacity

4. Metal stand for beaker to clear weighing pan.
5. Aluminum disposable weighing dish, 65-mm wide and 17.5-mm deep. This item is available from Fisher Scientific, Catalog No. 8-732-5C or equal.
6. Fine wire about 150-mm long.
7. A steel rod with the following dimensions; 70-mm diameter and 80-mm length can be used as a heat source to keep the specific gravity sample molten while it is being deaerated. Preheat this rod to 218°C in an oven for 1 h prior to use.

## B. PROCEDURE

1. From the initial meltdown, cast a sample about 5 mm in depth from the Vollrath beaker into the bottom of the aluminum dish.
2. Immediately place the dish on top of the hot steel rod and place them both into the vacuum oven. Start the vacuum pump.
3. Sample should rise under vacuum. Control the air bleed valve to keep sample from overflowing dish.
4. Continue adjusting air bleed, and when vacuum reaches about 101 kPa and puffing has subsided, stop vacuum pump and remove dish from oven.
5. When cool, strip off aluminum, trim sides to remove uneven edges. Bore a small hole near one edge of the sample to accommodate the fine wire.
6. Weigh the sample in air.
7. Place beaker stand over balance pan and make sure it does not touch balance pan.
8. Position the 600-mL beaker full of distilled water on the beaker stand so that it does not touch the balance arms.

9. Suspend the sample by the fine wire and attach other end of wire to the top of the balance arm. Sample should not touch sides of beaker and should be completely immersed in the water.
10. Record the sample weight in the water.

Calculation:

$$\text{Specific Gravity} = \frac{A}{A - W}$$

Where A = Weight in air  
W = Weight in water

## PART 6. RING AND BALL SOFTENING POINT

### A. APPARATUS

ASTM Designation: E 28, Ring and Ball Apparatus.

### B. PROCEDURE

From the initial meltdown, cast a sample into the Ring and Ball ring, allow to cool, and run the test according to ASTM Designation: E 28.

**NOTE:** Tests on Parts 7 through 14 are done at the termination of the 4-h heating and stirring period.

## PART 7. TENSILE BOND STRENGTH

### A. APPARATUS

1. Concrete bricks 180 by 90 by 50 mm, made from the following formula:

7.9 kg of portland cement

3.5 kg of free water

17 kg of aggregate, saturated surface-dry.

17 kg of sand, saturated surface-dry.

Use commercial quality PCC aggregate, with a maximum size of 9.5 mm.

2. Steel screed box with 3.2-mm opening as shown in Figure 2.
3. Steel die for cutting 50.8-mm diameter sample as shown in Figure 3.
4. Steel blade spatula with wooden handle and an approximately 76-mm wide blade.
5. A round solid aluminum bar, 50.8-mm diameter and 44.5-mm high is required. The bar is drilled and tapped to receive a hook for connection to the dynamometer or testing press. The bonding surface shall be sandblasted prior to use.
6. A suitable testing machine or dynamometer shall have a capacity of 8900 N, or greater, to pull the thermoplastic sample in tension. The sample should be tested at a separation rate of 5.1 mm/min.
7. An oven is required to maintain  $218 \pm 1^\circ\text{C}$ .

## B. PROCEDURE

1. Condition the screed box in the  $218^\circ\text{C}$  oven about 30 min before test.
2. Sandblast the 180 by 90-mm face of a concrete brick.
3. Remove the screed box from oven and place on one end of the concrete brick.
4. With the 60-mL stainless steel ladle, remove a sample from the hot melt and quickly pour into the screed box and draw down a 3.2-mm film lengthwise down the middle of the brick.
5. Immediately place the 50.8-mm die in the middle of the thermoplastic film and hold firmly with one hand while scraping off the hot plastic with the steel spatula from the surface of the brick. Be sure to remove all plastic cleanly from the edges of the die. Lightly sand the surface of the resulting

thermoplastic patty with 240 grit sandpaper to form a better bonding surface.

6. Bond the 50.8-mm aluminum bar to the surface of the 50.8-mm diameter patty with epoxy adhesive. Be careful not to get the epoxy on the concrete brick. Wipe off any excess adhesive.
7. Let the epoxy cure overnight.
8. Using a suitable holding jig, thread a hook into the threaded aluminum bar which has been bonded to the thermoplastic specimen. Pull the thermoplastic from the brick using a testing machine or dynamometer operated at a separation rate of 5.1 mm/min. Record the load at break in MPa.

Calculation:

$$\text{Tensile Bond Strength, in MPa} = \frac{\text{Load, in N}}{2026}$$

## PART 8. VISCOSITY

### A. APPARATUS

1. Brookfield digital viscometer, Model RVTD
2. Brookfield Thermosel and Model 64 temperature controller and accessories
3. Stainless steel SC4-27 spindle
4. Horizontal strip chart recorder, Linear 1200, Model 1202
5. An oven maintained at  $218 \pm 1^\circ\text{C}$

### B. PROCEDURE

1. Approximately 30 min before testing, turn on Thermosel unit and set the temperature at  $218^\circ\text{C}$ . Place the SC4-27 spindle and stainless steel sample chamber in the oven at  $218 \pm 1^\circ\text{C}$ .

2. Check the Thermosel for the correct temperature. Remove the SC4-27 spindle from the oven and attach it to the coupling link on the viscometer.
3. Remove the sample chamber from the oven and place it in the sample holder.
4. With the 30-mL stainless ladle, sample the hot melt from the Vollrath beaker and carefully fill the sample chamber to  $\frac{1}{2}$  volume.
5. With the extracting tool, position the sample chamber in the Thermosel well and carefully rotate the chamber until it drops and locks into place.
6. Lower the spindle into the sample chamber and make alignments according to manufacturer's instructions.
7. Place the insulating cap on the sample chamber. Turn on the viscometer at 2.1 rad/s, turn on the strip recorder.
8. Initial readings are always high. When the digital readout has stabilized, note the reading and convert the readout to Pa • s. The Linear chart recorder makes a permanent record of the viscosity. The recorder readily shows the point where the viscosity readout has stabilized. If a recorder is not used, then the digital readout must be watched until stable.

Viscosity Calculation:

(for the SC4-27 spindle rotating at 2.1 rad/s)

$$\text{Viscosity (Pa.s)} = \frac{\text{viscometer reading} \times 1.25}{10}$$

9. Raise the viscometer, cover the well with a lid to prevent hot plastic from dripping into Thermosel well. Remove and clean spindle.
10. Using the extracting tool, remove sample chamber from Thermosel well and pour out hot plastic. Soak the sample

chamber in toluene or other suitable solvent and clean with a brush.

## PART 9. IMPACT RESISTANCE

### A. APPARATUS

1. Suitable falling ball apparatus as described in ASTM Designation: D 2794. Use male indenter, 15.9 mm, with no female die. Use a 907-g mass.
2. Steel screed box, as used in Bond Strength, Part 7, Apparatus.

### B. PROCEDURE

1. Draw down a 3.2 mm thick film on concrete brick, as described in Part 7, Procedure. Let it cool overnight.
2. Place a concrete brick with the thermoplastic film face up on the impact base, positioning the brick so that the impactor will hit the plastic sample in the middle.
3. Raise the 907-g mass to a height of 0.635 m, unless otherwise is required in the specifications.
4. Release the mass to impact on the sample.
5. Observe the impact area for any cracks or loss of bond. Do not run more than one impact test on each brick.
6. Report pass or fail.

## PART 10. YELLOW COLOR IN YELLOW THERMOPLASTIC

### A. APPARATUS

1. Hunter Color Difference Meter, 0.785 rad illumination; 0 rad viewing or equivalent.
2. CIE chromaticity charts for yellow with wavelengths from 580 to 584 nm.

3. Aluminum disposable weighing dish, 63-mm wide and 17.5-mm deep. This item is available from Fisher Scientific, Catalog No. 8-732-5C or equivalent.

#### B. PROCEDURE

1. With the 60-mL ladle, fill the aluminum dish with the hot thermoplastic from the Vollrath beaker.
2. Allow the dish to cool and strip the aluminum from the sample.
3. Determine the Y, x, and y values on the Hunter meter, as outlined in California Test 660.
4. Plot the x and y values on the chromaticity chart and determine if the yellow color lies within specification limits. The brightness, Y, should also be within specification limits.
5. Save the sample for the Hardness Determination, Part 12.

#### PART 11. YELLOWNESS INDEX AND DAYLIGHT LUMINOUS REFLECTANCE IN WHITE THERMOPLASTIC

##### A. APPARATUS

1. Photovolt Reflection Meter, Model 670, with search unit provided with Tristimulus filters; amber, blue, and green or equivalent.
2. An aluminum disposable weighing dish, 63-mm wide and 17.5-mm deep. This item is available from Fisher Scientific, Catalog No. 8-732-5C or equivalent.

##### B. PROCEDURE

1. With the 60-mL ladle, fill the aluminum dish with the hot thermoplastic from the Vollrath beaker.
2. Allow the dish to cool and strip the aluminum from the sample.

3. Calibrate the Photovolt Meter according to the manufacturer's instructions and measure the reflectance of the sample using the amber, blue, and green Tristimulus filters.

4. Save the sample for the Hardness Test, Part 12.

Calculation:

$$\text{Yellowness Index} = \frac{\text{Amber-Blue}}{\text{Green}} \times 100$$

Daylight Luminous Reflectance = Reflectance with the green filter.

#### PART 12. HARDNESS

##### A. APPARATUS

1. Shore Durometer Hardness Tester, Type A-2, with attached lead weights so that total weight of unit is 2000 g
2. Incubator oven with glass inner door, capable of maintaining  $46.1 \pm 1^\circ\text{C}$
3. Stopwatch
4. Mold release

##### B. PROCEDURE

1. Use the sample from Part 10 or Part 11.
2. Place the sample on a metal 1-L can lid previously coated with mold release to prevent sticking and place it in the  $46.1 \pm 1^\circ\text{C}$  oven for 3 h.
3. At the same time, place the durometer in the oven.
4. After 3 h, place the durometer on top of the sample, immediately start the stopwatch, and close the inner glass door.
5. After 15 s contact, read the durometer, open the inner glass door, turn the sample over, and repeat the durometer reading.

6. Report the average of readings made on the top and bottom of the sample.

### **PART 13. ULTRAVIOLET LIGHT AND CONDENSATE EXPOSURE**

#### **A. APPARATUS**

1. Accelerated Weathering Tester, as described in ASTM Designation: G 53
2. Aluminum panels 150 by 75 mm
3. 50-mm wide duct tape
4. Steel screed box, as described in Part 7, Apparatus
5. Oven capable of maintaining  $218 \pm 1^\circ\text{C}$
6. Photovolt meter, as described in Part 11, Apparatus
7. Hunter Color Difference Meter, as described in Part X, Apparatus
8. Masking tape, 13-mm wide

#### **B. PROCEDURE**

1. Approximately 30 min prior to testing, place the screed box in the  $218 \pm 1^\circ\text{C}$  oven.
2. Tape the 75 by 150-mm aluminum panel to the bench surface with masking tape to hold the panel firmly to the bench.
3. Remove the screed box from the oven and position at right angles to the 150-mm length of the aluminum panel and in the middle of the panel.
4. With the 30-mL ladle, remove a sample from the Vollrath beaker and quickly draw down the sample across the aluminum panel.
5. While hot, trim off the excess plastic from the edges of the aluminum panel.
6. When cool, wrap the top and bottom edges of the plastic sample with duct tape to keep the sample in position on the

aluminum panel. Lap the edges of the plastic, no more than 6 mm, with the duct tape.

7. For the white thermoplastic, measure the yellowness index as described in Part 11.
8. For the yellow thermoplastic, measure the Y, x, and y values, as described in Part 10.
9. Expose the sample for 300 h in the accelerated weathering tester. Set the timer on the tester for 4 h UV exposure at  $60^\circ\text{C}$ , and 4 h condensate exposure at  $40^\circ\text{C}$ . Type FS-40 (UV-B) bulbs are used at an irradiance level of  $0.47 \text{ W/m}^2/\text{nm}$  at 310 nm, as measured at the sample surface during the UV cycle.
10. Remove samples from accelerated weathering tester and for the white sample, determine the yellowness index. For the yellow sample, determine Y, x, and y values.
11. Report the yellowness index and chromaticity values.

### **PART 14. ABRASION TEST**

#### **A. APPARATUS**

1. A blasting cabinet shall be constructed from 20-mm plywood and lined with steel sheeting. Inside dimensions are 305 by 305 by 305 mm with blasting nozzle, glass bead container, air pressure regulator, and filter. The bottom of the unit shall have a removable drawer to catch the expended glass beads. The thermoplastic sample is held in position by metal clips and positioned as shown in the diagrams. The top of the unit shall have a hinged window to permit viewing, placing, and removal of the sample. This apparatus is shown in Figures 4 and 5.
2. Glass beads: a collection of beads passing the 710- $\mu\text{m}$  sieve and retained on the 600- $\mu\text{m}$  sieve

3. Steel sample mold, 115 by 13 by 115 mm , as shown in Figure 6
4. Steel baseplate, 125 mm by 125 mm by 3.2 mm, as shown in Figure 6
5. Mold release
6. Balance, a 500 g or greater capacity capable of weighing items to 0.01 g
7. Clean, dry air supply to 275 kPa
8. A vacuum cleaner to exhaust bead and dust particles
9. When the bead container is empty, close the air valve, turn off the vacuum cleaner and remove the sample.
10. Brush off any loose dust from the sample and reweigh the sample, noting the weight loss.
11. Place the sample back in the blasting cabinet and rotate it approximately 1.6 rad from the original position so that a fresh corner may be blasted.
12. Repeat the blasting and weighing process until all four corners have been blasted.

## B. PROCEDURE

1. Spray the steel sample mold with the release agent and place concentrically on the 125 by 125-mm steel baseplate.
2. With the 60-mL ladle, remove enough hot thermoplastic from the Vollrath beaker to fill the sample mold.
3. When cool, loosen the mold screws and remove the mold.
4. Weigh the baseplate and thermoplastic.
5. Weigh 400 g of the glass beads and fill the bead container in the blasting cabinet.
6. Position the thermoplastic sample as shown in the diagram so that the blaster hits one corner of the sample. Use the spring clips to keep the sample in place.
7. Close the hinged window, turn on the air supply, set the regulator at 150 kPa, observe level of beads in glass bead container to see if they are flowing into the blast nozzle. Check the air pressure frequently to be sure the regulator remains at 150 kPa.
8. Turn on the vacuum cleaner, if available. The vacuum cleaner is not required, but helps keep the surrounding area much cleaner.
13. Average the weight loss of the four corners. The maximum deviation among the four corners should be 0.5 g.
14. Do not blast down to the base metal on the baseplate. If the sample blasts through before bead supply is exhausted, blast enough of one corner so that base metal does not show through, then stop blasting, remove sample, and rotate approximately 1.6 rad to expose a fresh surface and continue blasting until beads have been used.

## PART 15. SAFETY AND HEALTH

This method may involve the use of toxic chemicals as well as high temperatures. Review the Material Safety Data Sheet before handling a product to be tested.

When splitting out granular thermoplastic materials, always wear an approved respirator as well as gloves and labcoat. Practice good hygiene by washing hands and face after handling the dry thermoplastic and before eating, drinking or smoking.

Due to the high temperatures of the molten thermoplastic, full eye/face protection and suitable insulated gloves are mandatory when handling the molten material. Arms should be fully covered by sleeves or gloves. If thermoplastic burns do occur, immediately flush the affected area with cold water. Be

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aware of the location of safety showers and cold water taps near the testing area.

Melting and pouring of thermoplastic should be done in an exhaust hood or other well ventilated area.

Prior to handling, testing or disposing of any sample, testers are required to read the Caltrans Laboratory Safety Manual. This manual contains information on; general

safety principles, standard operating procedures, protective apparel, disposal of materials and how to handle spills, accidents, emergencies, etc. Users of this method do so at their own risk.

**REFERENCES:**

ASTM Designations: E 11, G 53, D 2794,  
E 28, E 1347 and E 313.  
California Test 660

**End of Test (California Test 423 contains 18 pages)**

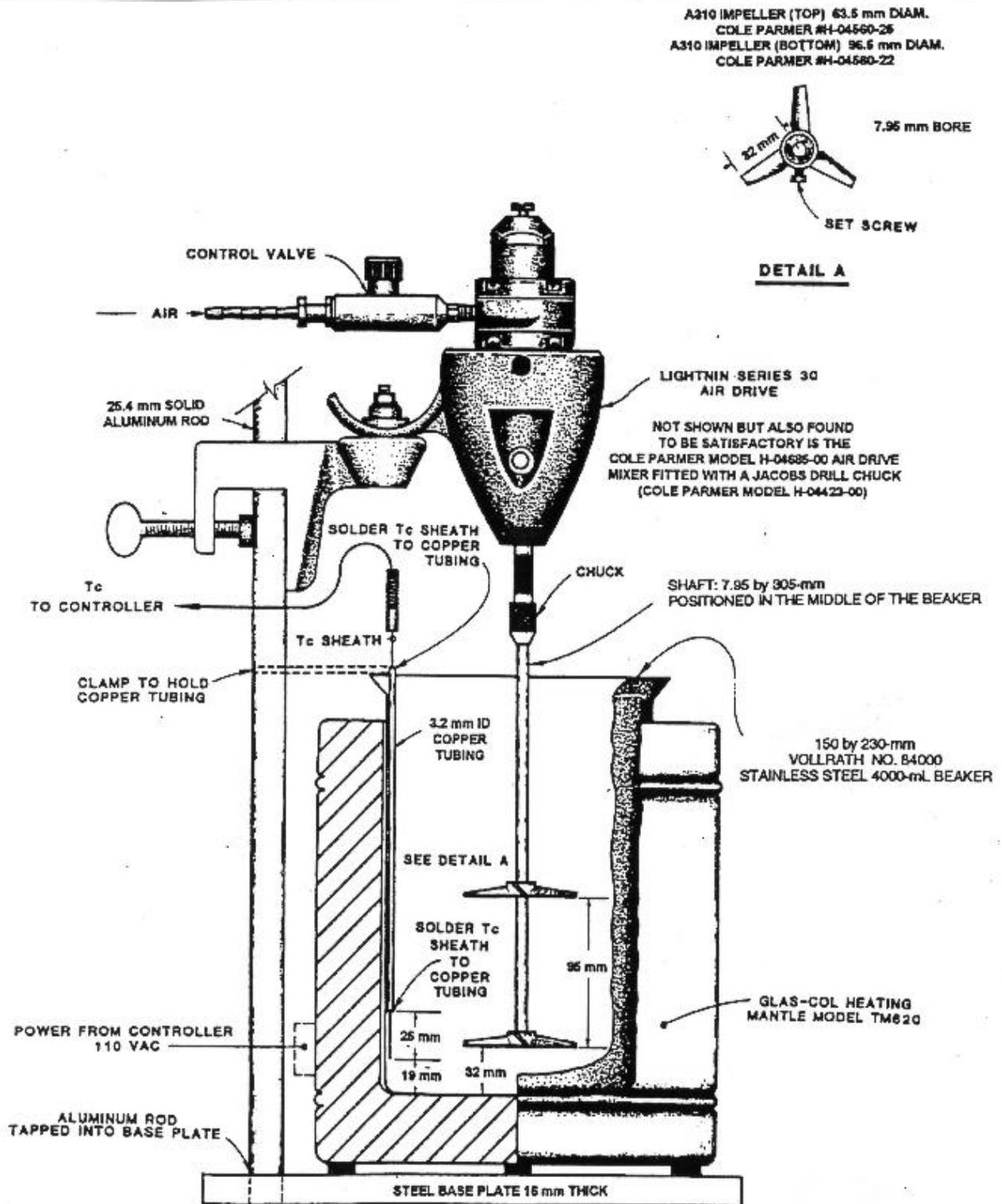


FIGURE 1 - THERMOPLASTIC MELTER APPARATUS

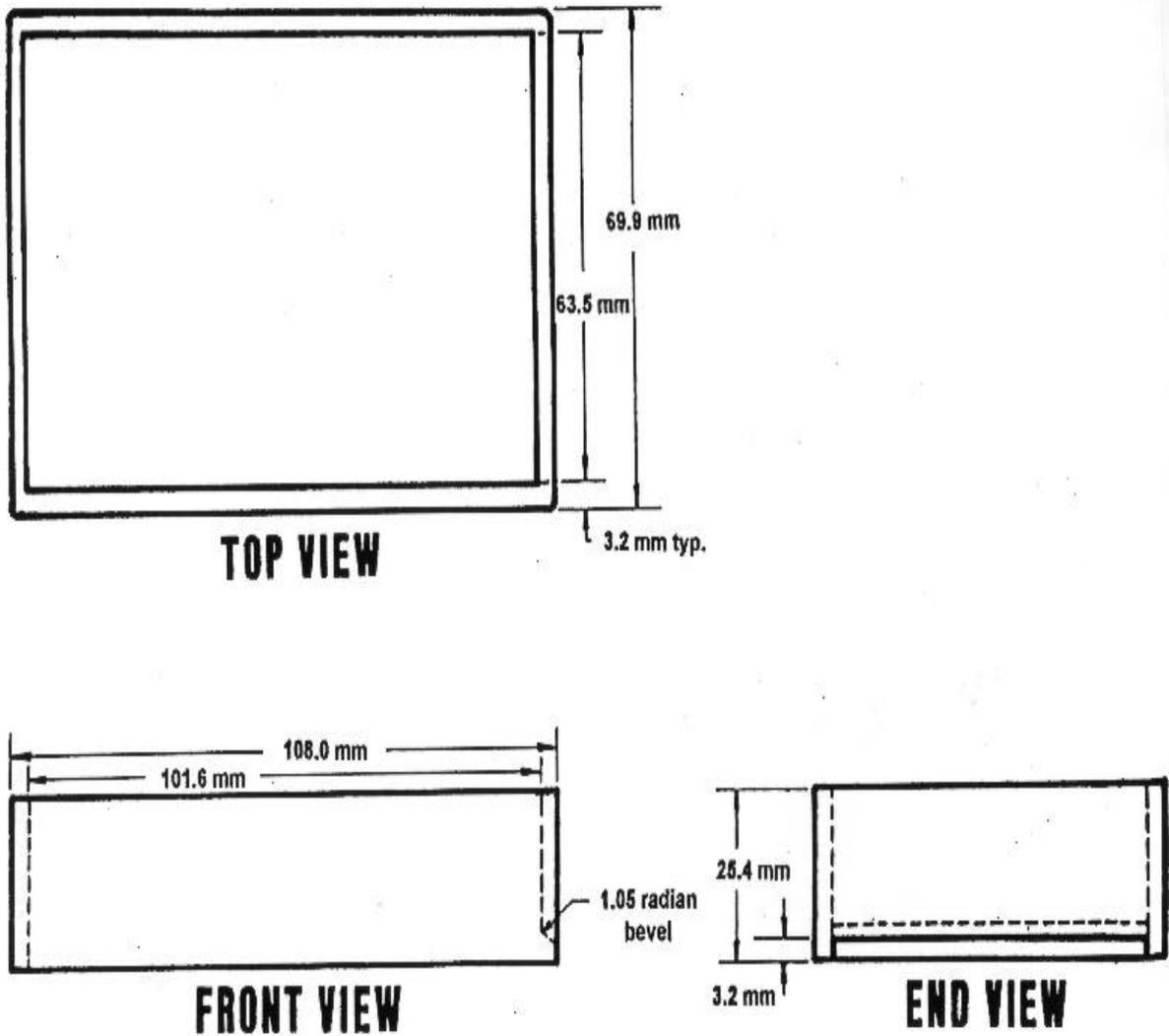


FIGURE 2 - SCREED BOX

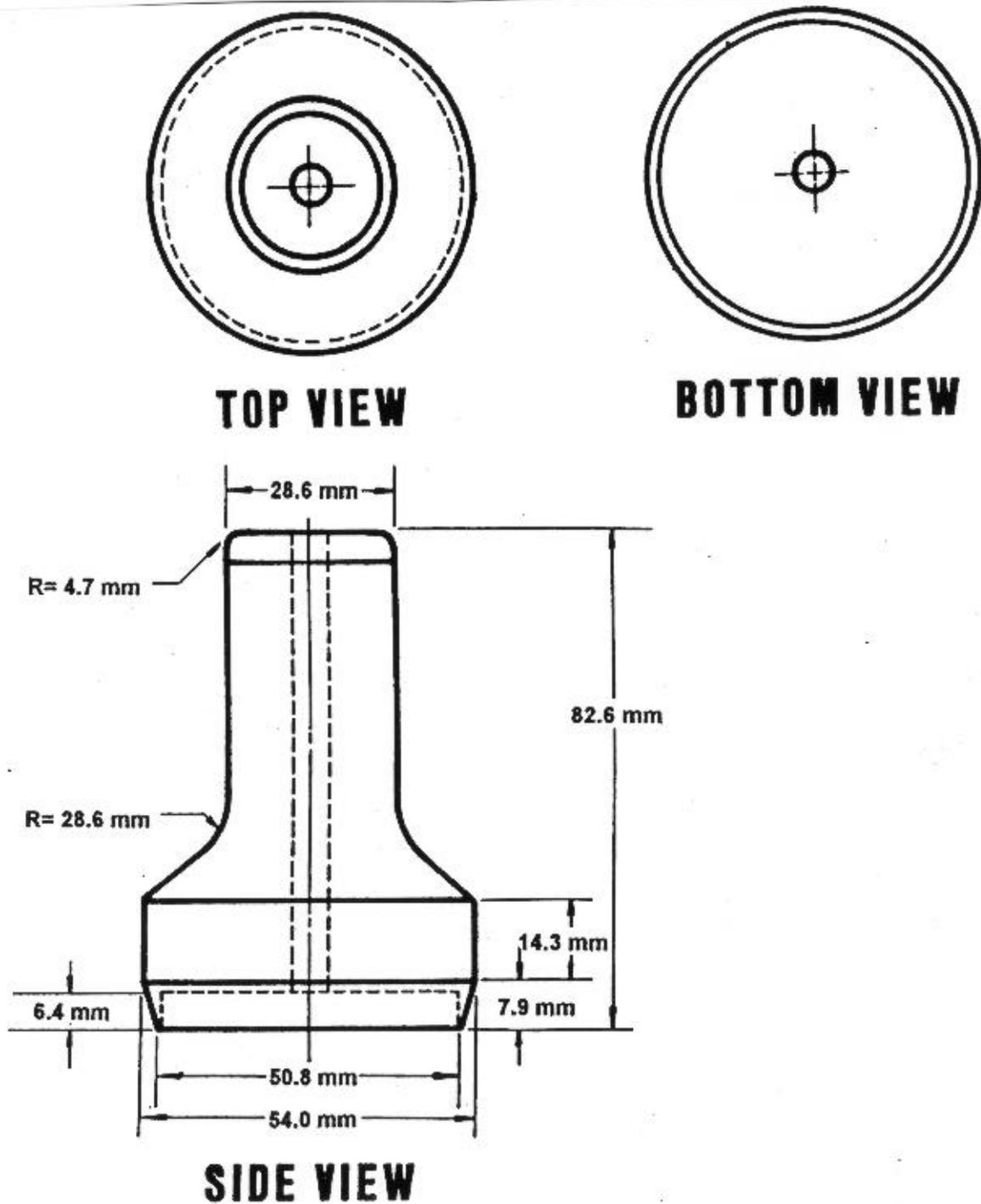


FIGURE 3 - 50.8-mm DIE

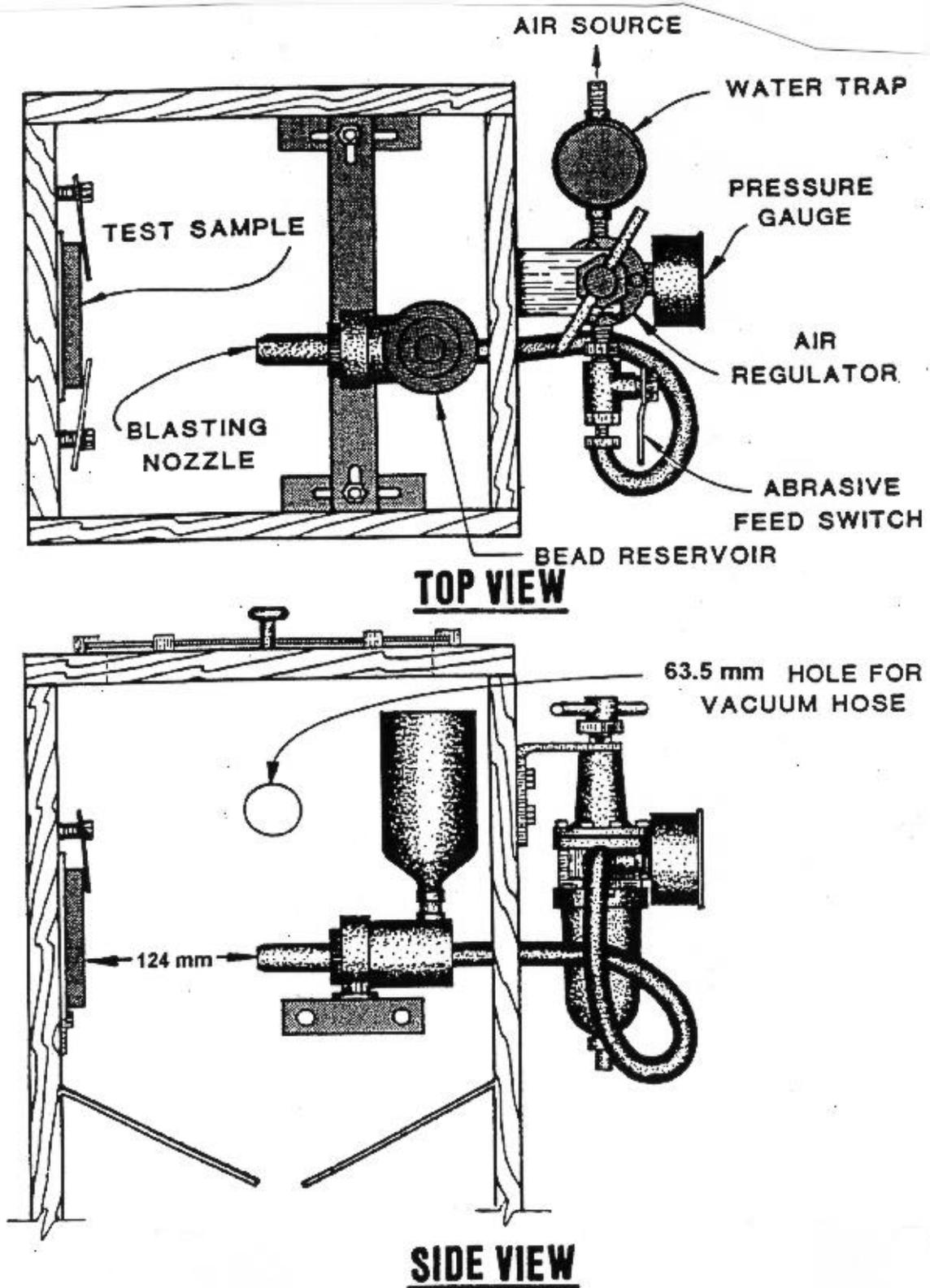


FIGURE 4 - GLASS BEAD ABRASION APPARATUS (SIDE AND TOP VIEWS)

Some small hardware has been omitted .

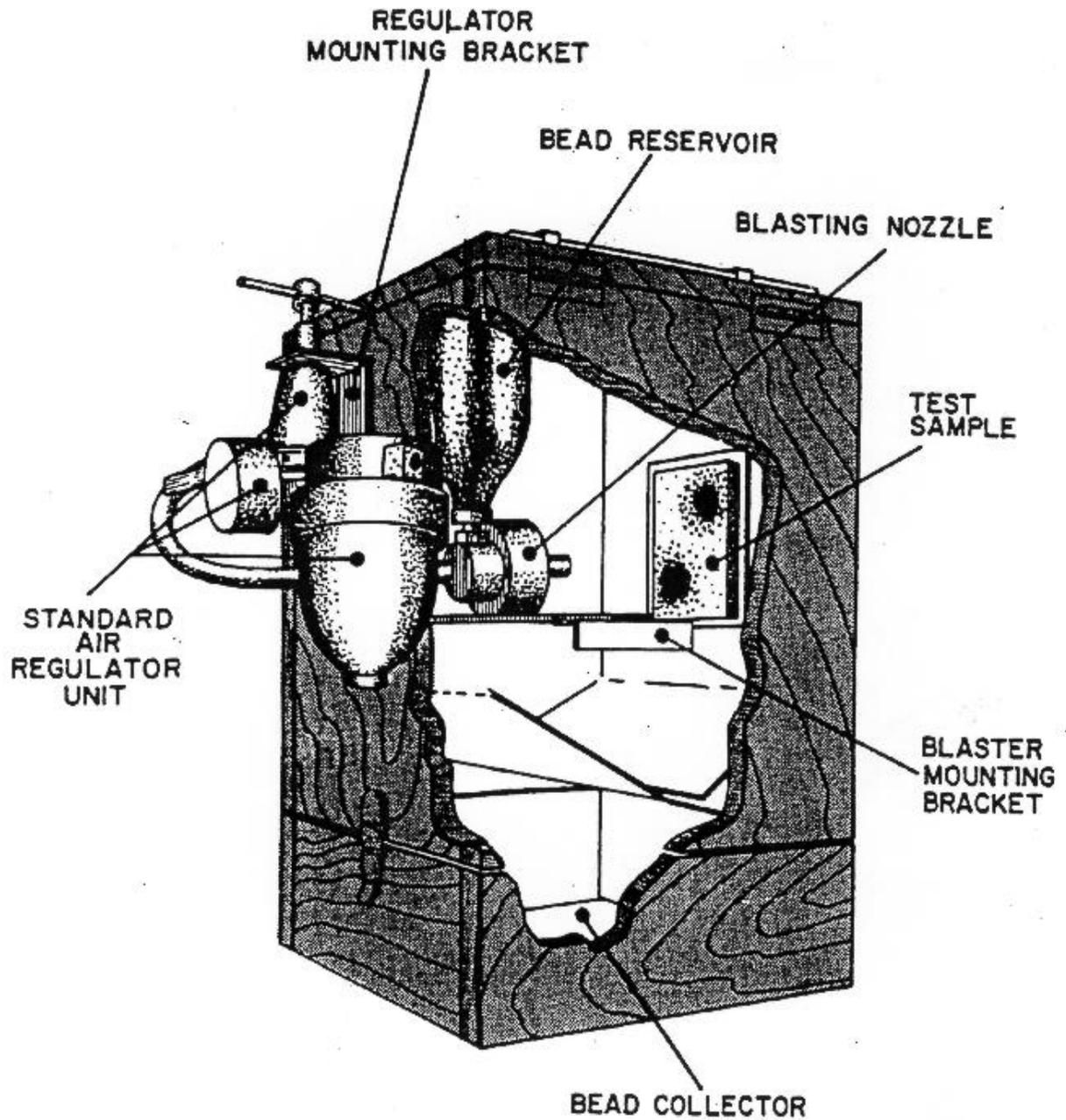


FIGURE 5 - GLASS BEAD ABRASION APPARATUS

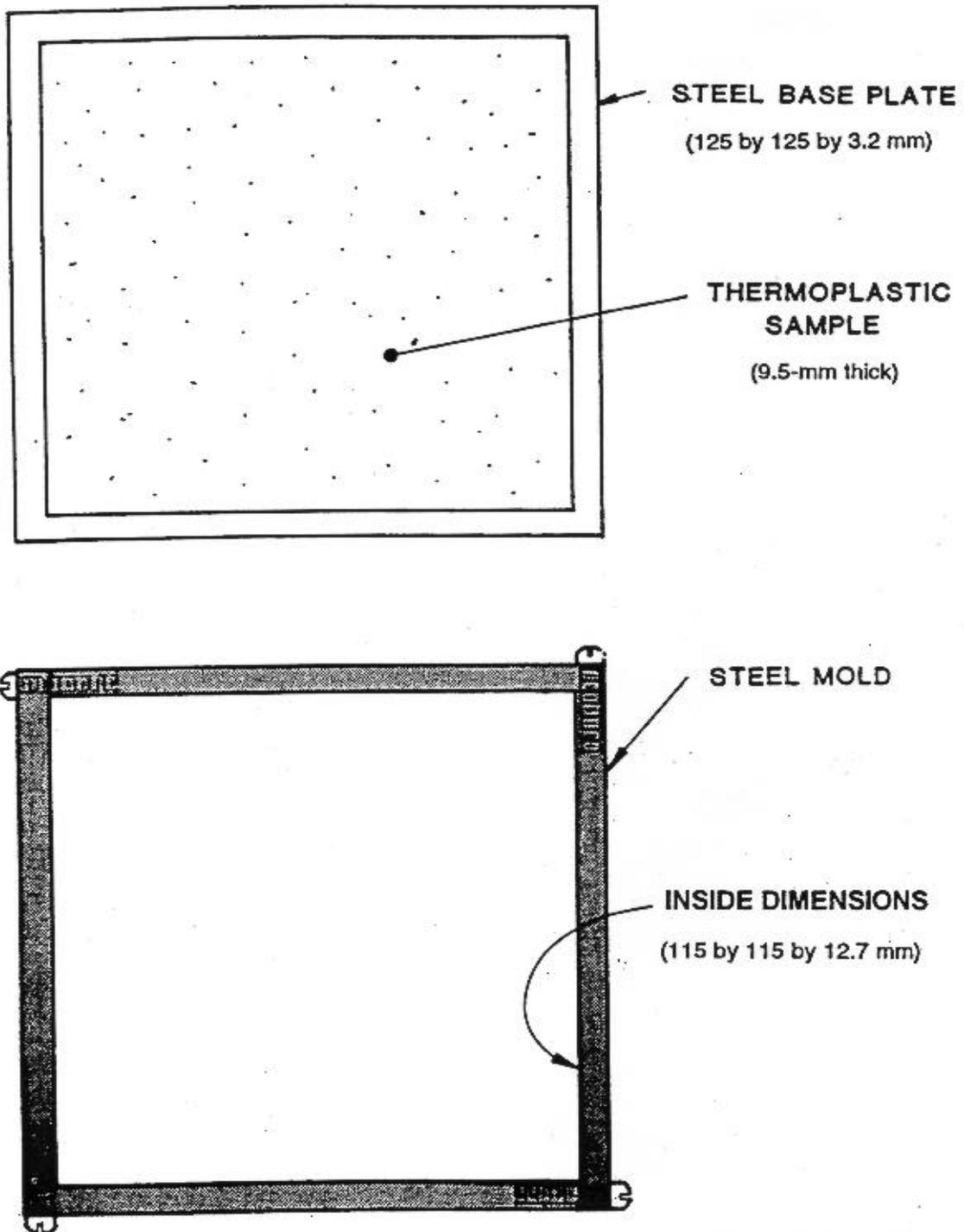


FIGURE 6 - ABRASION TEST SAMPLE DETAILS