Cast-A-Form

CAST-A-FORM 9600, 9601 and 9602 - INSTRUCTIONS FOR USE

CAST-A-FORM MOLDS**:**

Molds for **CAST-A-FORM 9600** and **9601**:

Short Runs:	(9600 only) Use Surface Coat with Laminating Resin and tooling grade only glass cloth.
Medium Runs:	Use Surface Coat with Laminating Resin and tooling grade glass cloth.
Long Runs:	Use Aluminum Castings.

Molds for **CAST-A-FORM 9602**

Short Runs:	Use Surface Coat with Laminating Resin and tooling grade glass cloth.
Medium to Long Runs:	Use Aluminum Castings.

Technical data and instructions for the epoxy mold materials appropriate to your application are available upon request.

For the best quality mandrels, the mold should be designed in such a way that it has uniform wall thickness (refer to the discussion in CASTING MOLD DETAILS). Whenever possible, the pouring gate should open into the largest cavity of the mold.

The sections of a mold should be assembled and clamped in place for storage immediately after use to prevent warpage.

MELTING PROCEDURES:

Select the appropriate type of **CAST-A-FORM** so that it corresponds to the cure temperature that will be used on the finished part.

Place the selected **CAST-A-FORM** material in a melting pot equipped with a thermostat and agitator. Use slow continuous agitation at 20 to 30 RPM. Set the thermostat for the appropriate melting temperature (see "Physical Properties"). Stir material continuously to avoid hot spots.

Never break through a solid surface crust because molten **CAST-A-FORM** (under pressure) may spurt up. After becoming liquid, **CAST-A-FORM** is a fair heat transfer material and will heat or cool about as evenly as water.

DO NOT heat **CAST-A-FORM** materials more than 150°F above their recommended "Melting or Pouring" temperature. Overheating will increase viscosity, shorten mold life and may produce harmful vapors. Overheating will also cause some slight foaming of the melt and, if poured in this state, will result in a weaker porous mandrel.

At the melting temperature, the viscosity of liquid **CAST-A-FORM 9602** is not noticeably changed when contaminated with water. **CAST-A-FORM 9600 and 9601** will thicken or will not melt at all when overly contaminated with water.

CAST-A-FORM 9602 should be heated at the melting temperature for several hours with a ventilation system set up to capture and remove the vapor from any absorbed water before casting. Water cannot be driven from **CAST-A-FORM 9600 and 9601** by heat. However if **CAST-A-FORM 9600 and 9601** have good, pourable viscosities, the water contamination is nil and they can be poured immediately.

CAUTION: ALWAYS WEAR HEAVY GLOVES, FACE AND EYE PROTECTION AND A LONG SLEEVE SHOPCOAT WHEN WORKING WITH MOLTEN **CAST-A-FORM**.

BASIC CASTING PROCEDURE:

NOTE: Suggested variations on this procedure for certain applications are described in later sections of this bulletin.

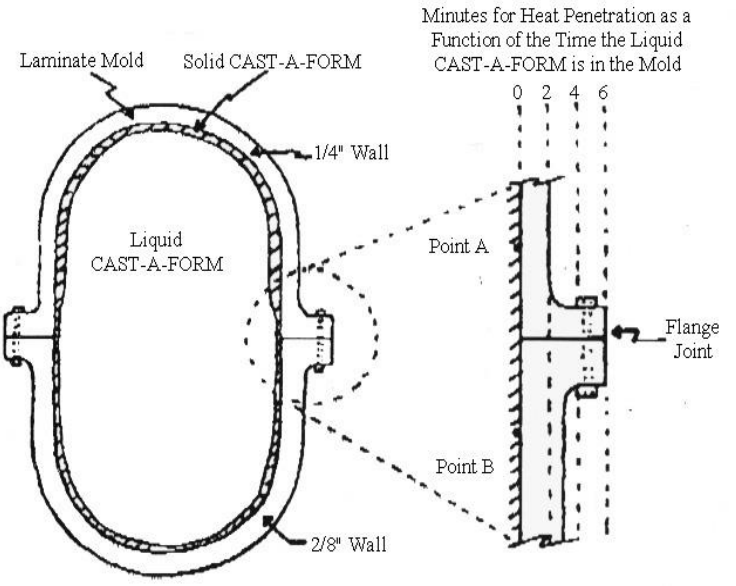
1. While stirring, adjust liquid **CAST-A-FORM** to specified pour temperature.
2. Stabilize the mold to be used at the recommended "Mold Pre-Heat" temperature.
3. Pour the liquid **CAST-A-FORM** in the mold fairly rapidly until it is full. No parting agent is necessary.
4. If a hollow mandrel is desired, pour the liquid **CAST-A-FORM** out of the mold as soon as the outside material begins to harden (within three to five minutes after filling).
5. Allow the mold to cool down to near the stabilizing temperature of Step 2.
6. Open the mold. If the shell or mandrel wall is thick enough, remove the mandrel.
7. If the mandrel wall is too thin leave it in the mold and repeat Steps 2-6.

CASTING MOLD DETAILS

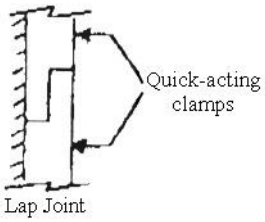
A graphic illustration of the importance of uniform mold wall thickness is shown on the following page. When the mold is filled with hot liquid **CAST-A-FORM**,

heat builds up at the inner mold surface and finally penetrates to the outside surface where it is dissipated into the air. The temperature of the inside surface of the mold reaches a maximum in two minutes in places where the mold thickness is the same as at Point A in the illustration.

However, heat continues to build up at the inside surface of the mold where the wall is thicker, such as at Point B. In these areas, heat is not dissipated until after three minutes have passed. The inside surface temperature at the joint area is even hotter since heat is not dissipated here until after six minutes have passed. Thus **CAST-A-FORM** solidifies slower at the thicker mold section, resulting in a thinner mandrel wall section.



If the flange type joint should create a problem, one solution is to build the mold with lap joints fastened by quick closing clamps as indicated here. In places where the mold cannot be uniform in wall thickness, such as in throat areas, metal inserts can be used to bleed off the heat and enable **CAST-A-FORM** to build up in thickness uniformly with the rest of the mandrel.



In arriving at the best procedure for complex configurations, the first mandrels cast should be broken and checked against the mold. If thick mandrel wall sections fit against thin mold wall sections and vice versa (thickness variations are opposite between mandrel and mold), the pour temperature and /or cycle time may be wrong and should be reduced to eliminate this problem. Reducing the mold temperature will also help, but pour lines may appear due to sudden cooling of the **CAST-A-FORM.**

In order to get consistent and predictable results, the mold temperature, pouring temperature, and cycle time must all be closely controlled. **CAST-A FORM** should be poured evenly into the mold, which is held at such an angle as to allow air to escape easily. If it is poured too rapidly, air may be trapped inside. If it is poured too slowly, there will be pour lines in the surface due to irregular cooling.

Certain irregular shaped mandrels with long, thin extensions may warp if removed from the mold too fast (while the mandrel is "green"). These mandrels should be left in the mold as long as possible, but not so long as to allow cracking due to thermal contraction of the surrounding mold, to set in.

To minimize thermal contraction (shrinkage) in large diameter (5” or more) mandrels, the mandrel wall can be built-up in layers by a slushing procedure. Repeat Steps 3,4, and 5 of the BASIC CASTING PROCEDURE until the desired wall thickness is obtained.

After removing them from the mold, hot **CAST-A-FORM 9602** mandrels should be slowly cooled in a warm, dry, stress-relieving oven to prevent cracking. The other **CAST-A-FORM** mandrels can be cooled at room temperature if placed on a non-conductive surface. The part fabrication may then commence in the normal way. If handling of the mandrel is necessary, gloves should be worn.

SPECIFIC APPLICATIONS:

A few of the more widely used procedures are mentioned here, but **CAST-A-FORM** can be adapted to a multitude of purposes:

MANDRELS FOR DUCTS

Both **CAST-A-FORM 9600** AND **9601** are used extensively for the manufacture of reinforced fiberglass ducts. Shrink-tape or vacuum bag pressure may be used as needed. Complicated mandrels can easily be washed out and result in great saving in labor.

FILAMENT WINDING MANDRELS

CAST-A-FORM 9602 is used for its strength at elevated temperatures and its casting advantages. During development, **CAST-A-FORM 9601** can be used with R.T. epoxy molds which allows low-cost rework toward completion of design and size. A predetermined charge of **CAST-A-FORM**, calculated from the surface area and thickness requirements for the mandrel, is poured into the

preheated mold (high temp. epoxy or aluminum). The mold is then rotated slowly on a gimble to distribute the melt uniformly over the mold surface.

The mandrel is removed from the mold and slowly cooled to the handling temperature over a period of 5 to 8 hours. Some cases require that oversize holes be cast in the mandrel so thermal contraction will allow it to clamp down around a metal shaft without cracking.

Difficulties may occur with certain types of rubber liners that exude or "sweat" at elevated temperatures. If these liners are used, the mandrel should be coated with an impervious film to prevent exuded liquid from lowering the heat resistance and affecting the other physical properties of the mandrel.

MANDREL REMOVAL:

After curing the part, one of the following methods may be used to remove the **CAST-A-FORM**.

a. WASH OUT-Place cooled, finished part in a container of hot water, under hot running tap water, or insert a steam jet inside the mandrel.
b. MELT OUT- Place the finished part on end over a suitable collecting container in a non-recirculating oven heated to the melting temperature of the **CAST-A-FORM**.
c. BREAK OUT- Use ordinary manual methods.

In the latter two methods, the **CAST-A-FORM** may be returned to the melter if not contaminated during use. CAUTION: When reusing MELT-OUT AND BREAK-OUT be sure to avoid moisture contamination and absorption, and always maintain at least 50% new powdered **CAST-A-FORM** in the melter.

HANDLING PRECAUTIONS:

FOR INDUSTRIAL USE ONLY. KEEP OUT OF REACH OF CHILDREN.

CAST-A-FORM contains inorganic nitrates, nitrites and oxides. Eye contact with **CAST-A-FORM** powder causes severe irritation and a chemical burn.

CAST-A-FORM is a moderate irritant to all mucous membranes. Avoid breathing dust. If ingested, powdered **CAST-A-FORM** causes burns to any surface contacted.

In the molten state, **CAST-A-FORM** causes severe burns when contacting the skin. As with any hot, molten material, severe damage to the eyes occurs if in contact.

CAST-A-FORM powder is drying to the skin. Skin contact should be avoided.

PROCESSING PRECAUTIONS:

Do not allow any acid to contact **CAST-A-FORM** in any form. Toxic gases will evolve.

Do not store **CAST-A-FORM** near ammonium or chlorate compounds or combustible materials. While not flammable, **CAST-A-FORM** supplies oxygen to fires. **CAST-A-FORM** can act as a strong oxidizer.

Do not use **CAST-A-FORM** in melting pots or tanks which formerly contained cyanide compounds.

Do not allow **CAST-A-FORM** to contact magnesium. Together they may result in explosive conditions.

Do not heat **CAST-A-FORM** above 150°F higher than the recommended "Melt and Pour Temperature". Explosive decomposition may occur at 1100 - 1200°F. Local over-heating of **CAST-A-FORM** or direct flame impingement on melting pot is dangerous.

Do not add other material to **CAST-A-FORM** -explosive and toxic vapor mixtures may result.

Do not attempt to melt **CAST-A-FORM** after it has become contaminated with water or other material.

Use only water as the wash-away liquid. Do not pour water into molten **CAST-A-FORM-** copious amounts of steam will result.

PHYSICAL PROPERTIES

Specific Volume (solid cast, $In.^3$ /lb.)	13.0-13.4
Decomposition Temperature (°F)	Approximately 1,200
Specific Heat (BTU/lb. °F)	0.33 to 0.37
Latent Heat of Fusion (BTU/lb.)	35 (average)
Heat Conductivity	Approximately equal to water

THERMAL CONTRACTION- "SHRINKAGE"

The thermal expansion and contraction of **CAST-A-FORM** may be compensated for in the mold if necessary. Example with **CAST-A-FORM 9600**:

1. Subtract the part cure temperature from the **CAST-A-FORM 9600** melting temperature. 306°F - 250°F = 56°F
2. Multiply this figure by the coefficient of linear thermal expansion for the type of **CAST-A-FORM** used and also by the part dimensions (such as 10" length) 56°F times 2.4×10^{-5} times 10" - 0.014 inch.
3. Often this figure is small enough to disregard. In this case it is less than 0.002" per inch of length.

GUIDE TO COMPUTING MOLD DIMENSIONS FOR THE PRODUCTION OF **CAST-A-FORM** MANDRELS.

The data presented here shows the dimensional changes needed in designing molds for **CAST-A-FORM** mandrels where close tolerances are necessary. These figures were obtained by application of the coefficient of linear thermal expansion for **CAST-A-FORM**. They must be considered as a guide only and do not take into account such factors as:

1. The thermal expansion of the mold, which will vary due to differences in mold construction (material used, wall thickness, mold backing, configuration, etc.)
2. Differences in the length of time molten **CAST-A-FORM** remains in the mold before pouring back into the melter (net expansions of the mold and mandrel are affected).
3. Part shrinkage (usually insignificant).
4. Reuse of **CAST-A-FORM** material (contamination will increase the thermal contraction).

The thermal expansion of the mold above its original dimensions may partially compensate for the thermal contraction of **CAST-A-FORM** and result in slightly larger mandrels. In fact, this mold expansion could be made to work for the user. That is, changes in the preheat temperature of the mold, within practical limits, would allow the user to make minor changes in the mandrel size. This may allow for greater accuracy of the finished part made from the mandrel.

	CAST-A-FORM Pour temp.	Mandrel Contraction When Cooled to 75°F	Part Cure Temp	Mandrel Expansion 75°F to Part Cure Temp	FACTOR* Added to Mold Pattern to 75°F
9600	306-333°F	0.0065 in./in.	250°F 225 200 75	0.005 in./in. 0.004 0.0035 0.000	0.0015 in./in. 0.0025 0.003 0.0065
9601	326-420°F	0.0095 in./in.	325°F 300 275 250 225 200 75	0.0075 in./in. 0.0065 0.006 0.005 0.0045 0.004 0.000	0.002 in./in. 0.003 0.0035 0.0045 0.005 0.0055 0.0095
9602	441-550°F	0.011 in./in.	450°F 425 400 375 350 325 300 75	0.009 in./in. 0.0085 0.008 0.0075 0.0065 0.006 0.0055 0.000	0.002 in./in. 0.0025 0.003 0.0035 0.0045 0.005 0.0055 0.011

* A factor is a dimensional difference, reported to the nearest 0.0005 inches, resulting from the thermal contraction of **CAST-A-FORM** alone. For extremely close tolerances, mold thermal expansion characteristics and configuration variables should be considered.

NOTE: All of the above data is applicable to virgin **CAST-A-FORM** only.

Endurance Technologies, Inc. is not a patternmaker. We have experience only in the compounding of resins, not in the actual manufacture of the tools or patterns. Each part is different. The user should run tests to assure the suitability of the system for use in a particular application. The test data and results set forth herein are based on laboratory work and do not necessarily indicate the results that the buyer or user will attain.

Endurance Technologies, Inc. makes no warranty expressed or implied, including warranties of merchantability or fitness for a particular use. Under no circumstances will Endurance Technologies, Inc. be liable for incidental, consequential or other damages, alleged negligence, breach of warranty, strict liability, tort or any other legal theory arising out of the use or handling of this product.

Revised October 2015