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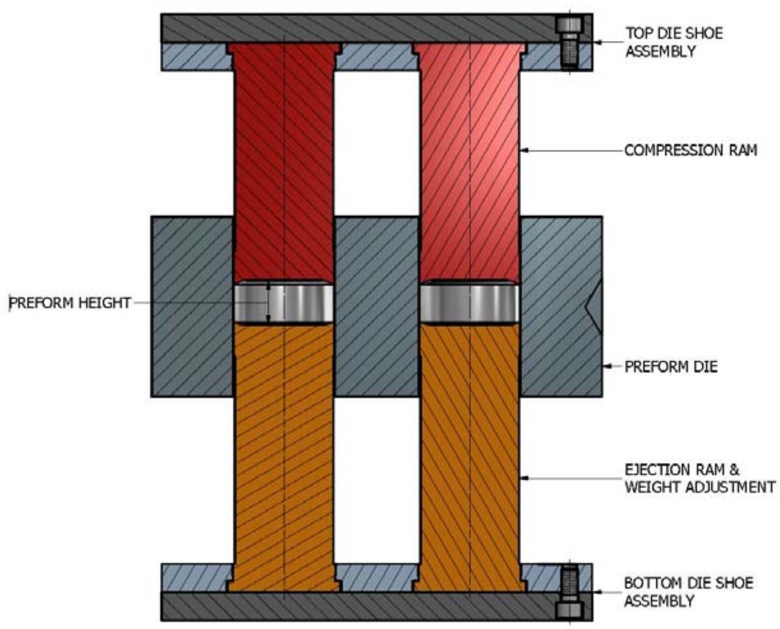
Preforming & Preheating

When compression or transfer molding thermoset molding materials, the preferred method of material handling and molding utilizes **preforms**. A preform is loose powder that has been compressed into the shape of a tablet and is the correct weight for the part to be molded. The reasons for using preforms are ease of handling and consistent material charge weights. Preforms can then be heated in a high frequency preheater (**R**adio **F**requency Preheaters) to a state of flux and loaded into the cavities of a compression mold or the pot of a transfer mold. Preheated preforms allow the molder to run a significantly shorter cycle, have a better surface finish and better properties than can be achieved when using cold powder for the same part.

A preform is made (see drawing below) by loading a specified amount of molding compound into the material chamber between two opposing rams. (Note: Prior to preforming, the material should be stored at room temperature for 24 to 48 hours.) The material is compressed between the rams or punches with a force of approximately 10,000 psi (68.9 MPa). The resulting preform should have a typical surface hardness, as measured with a Shore "D" hardness tester, of 55 to 65. It is important to note that there is typically no heat used in the preforming of the material.



Vertical Preform Die Set Shown

Preform Punch Design

The design of the preformer rams or punches is fairly simple.

- There should be a clearance of 0.002" (0.05 mm) per 1" (25mm) of diameter between the preform die and the punch.

- The tight clearance should be maintained for a distance of ½" (12.7 mm) from the face of the preform punch. Then it can be relieved by 0.010" to 0.020 (0.25 mm to 0.50 mm).

- A cup shaped design to the punch face helps compress the outside diameter of the preforms and reduce the likelihood of the preforms being chipped or broken during handling. (See below)

- The steel used in the punches and the sleeves should have good strength and high wear resistance properties. A-2 steel has been used for preform punches and H-13 steel can be used for preform sleeves.

- Chrome plating of the punches and sleeves typically is done after running the preform die set for a short period of time

PREFORMING TROUBLE SHOOTING

Preforming Problem	Probable Cause	Possible Solutions
Preforms are difficult to eject from the preform die without being damaged or the preformer is having difficulty ejecting the preforms from the preform die.	Because of prolonged use, the preform die has worn and the inside diameter at the ejection ram is significantly larger than the inside diameter of the open end of the die. As a result, upon ejection, the large diameter preforms are being forced through a smaller diameter opening. This results in the preforms breaking or making the preformer work harder to eject the preforms from the die.	The solution is to sleeve the inside diameter of the preform die. The sleeve can be made from A-2, H-13. At the same time the punches should be checked to determine their condition and if they also need to be replaced.
Weak preforms that crumble and fall apart during normal handling.	1. Lack of packing pressure.	Increase the packing pressure until the preforms have a Shore “D” hardness of 55 to 65.
	2. The clearance between the preform punch and the die is too tight. This traps air with the material during the compaction of the preform.	Increase the clearance between the punch and the die to be 0.002" (0.05 mm) per 1" 25mm of preform diameter.
	3. Insufficient dwell time or too rapid a preforming speed.	Increase the dwell time on hydraulic preform press or slow the speed of mechanical preform machines.
	4. Insufficient amount of fines.	Work with the material supplier to produce a material granulation that will preform satisfactorily.

NOTE: Preforms are normally made in advance. They should always be stored in a sealed container until needed for molding. If possible, that container should also have a sealable plastic liner, which will help prevent the preforms from gaining or losing moisture.

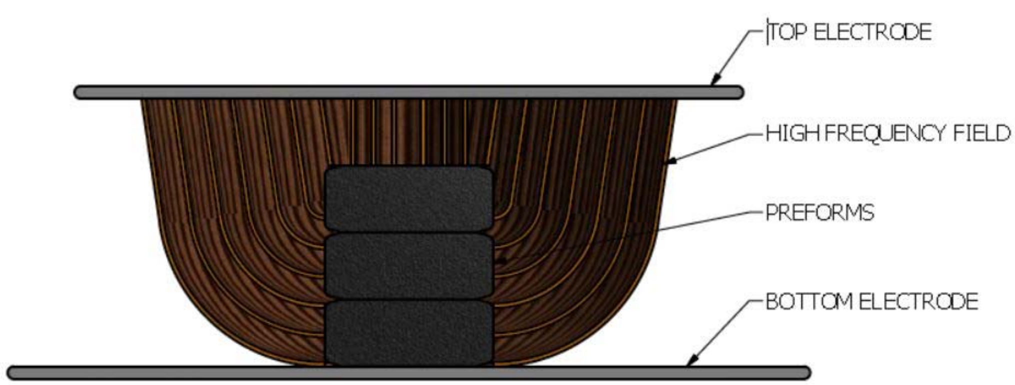
Preheating

Preheating the compound prior to charging the mold results in a number of benefits. One is the material will reach molding temperature sooner, which reduces the cycle time. Another benefit is the heated material is more fluid than cold powder and will allow easier flow into difficult to fill areas of the mold. Preheating also allows some moisture and gas to dissipate before the material is placed into the mold.

The methods of preheating thermoset materials have evolved through the years, from placing the material in a heated oven to the present method of using **RF** preheaters. In this method, preforms are placed between the two electrodes of the preheater and when the electrodes are energized, they produce a high-frequency field that causes the molecules in the material to vibrate rapidly. This vibration generates friction between the molecules, which produces heat. With all the molecules in the material vibrating, the material heats very quickly. The temperature of the preform should always be checked before the first part is molded using a calibrated pyrometer and needle probe.

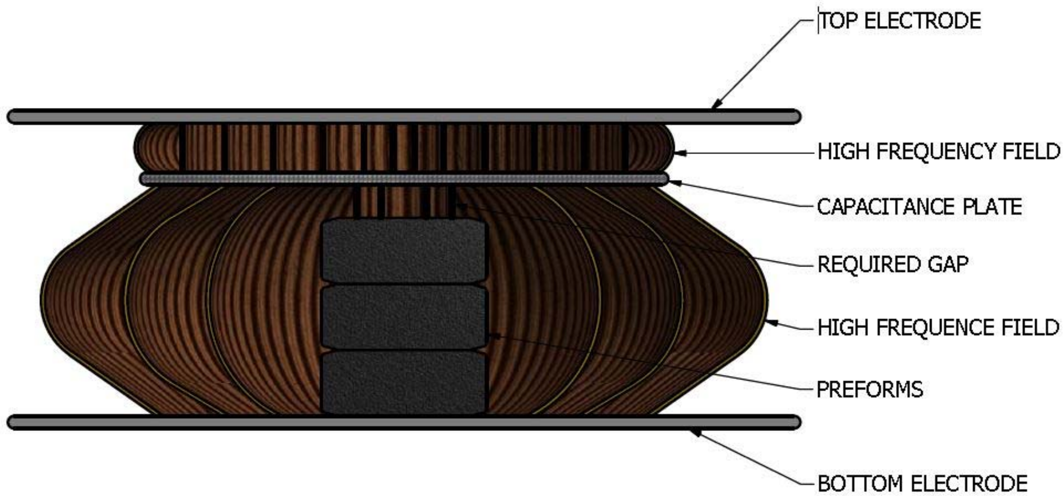
There are three ways of loading preforms into the preheater. The preforms can be laid flat, laid flat and stacked or they can be stood on edge between the rollers of a rotisserie device. If the preforms are laid flat or laid flat and stacked (see drawing below), a temperature difference of as much as 30°F (17°C) can occur between the top and bottom of the preform or stack of preforms.

Preforms Stacked Flat Without a Capacitance Plate



For this reason, it is usually necessary to place an aluminum capacitance plate on top of the preform or preforms. This plate straightens and concentrates the lines of the high frequency field and helps to produce uniformly heated preforms. The plate should be 3.2 mm (⅛") thick and fully radiused on all edges. It should be slightly larger than the total area covered by the preforms. (See below.)

Preforms Stacked Flat With Capacitance Plate



If the preforms are stood on edge between the rollers of a rotisserie device that is mounted over the bottom electrode, they are continuously rotated through the high frequency field. This rotation allows the high frequency field to be evenly dispersed through the preforms and produces the most uniformly heated preforms.

Regardless of which way the preforms are loaded into the preheater, when possible there should be an air gap between preforms or stacks of preforms, to allow a more uniform preheat. Also, during preheating, the preforms will swell. Therefore, make sure there is at least a ¼" (6.4 mm) gap between the top electrode and the top of the preforms or capacitance plate.

Cleanliness with regards to the electrode plates, the capacitance plate, the rotisserie rollers, and the air filters is very important. If the plates are covered with an excessive buildup of residue, the output efficiency will be affected and there is a greater likelihood of arcing. The rotisserie rollers can become jammed if they become covered with material or residue. The air filters help keep the RF Tube clean and cool. They should be cleaned at least weekly or more often if operating in a very dusty environment. They should also be replaced on a regular basis, to ensure maximum airflow to the RF Tube. If the RF Tube is not kept cool and clean, it can short out and they are very expensive to replace.

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