

# ***Equipment Specific Safety Training***

## **Vacuum Former (DARC 225)**

Safety / Training subjects:

- **Ventilation:** Two fans
- **Power Switch:** Always turn the machine off when finished using
- Heating Elements Map & Temp Control switches
- **Materials:** Which materials can and cannot be run through the vacuum former: ABS, Acrylic Plexi, Co-Polyester, Polystyrene, Polycarbonate, Polyethelene, PVC (Gary's Plastics – SC)
- **Process:**
  - o **Clamping:** The clamp frame needs to be sufficiently powerful enough to handle the thickest material likely to be formed on the machine – up to 6mm with our single heater models and up to 10mm with the twin heater machines. If an automated process is used the operation of the moving parts must be guarded and interlocked to avoid accidental damage. In addition a safety guard ( in the form of a fabricated guard or light curtain) must be provided to protect the machine operator at all times.
  - o **Timer System:**
  - o **Heating:** Heaters are generally infra-red elements mounted within an aluminium reflector plate. In order to obtain the best vacuum forming results, using any material, it is essential that the sheet is heated uniformly over its entire surface area and throughout its thickness. In order to achieve this it is necessary to have a series of zones which are controlled by energy regulators. Ceramics do have some disadvantage in that their high thermal mass makes them slow to warm up (approx 15 minutes) and slow in their response time when adjustments are made. More sophisticated quartz heaters are available which have less thermal mass enabling more rapid response time. Pyrometers enable accurate heat temperature control by sensing the melting temperature of the sheet and interacting with the operating process control. A cooling jacket is required for the pyrometer. Precise temperature readout is also available with a computer controlled system working in unison with the pyrometer(s). The megapoint system was devised by Formech for the accurate heating of large areas, using a standard PC and a minimum of exterior electronics. The heating control system is an extension of the process controller, allowing rapid visual interpretation of the heater zoning. Temperatures are controlled precisely using thyristor modules. Full feedback is available to allow zones to be banked up or down by percentage amounts. Twin heaters are also recommended when forming thicker materials as they assist in providing more uniform heat penetration and faster cycle times. Twin quartz heaters as used in the Formech FDH model are advisable when forming high temperature materials with critical forming temperatures. By close control of areas of heat intensity, heat losses around the edges caused by convection air currents and absorption from clamp areas can be fully compensated for and consistent results achieved on a continuous basis. Cost savings can also be considerable if quartz heaters are specified as there is an adjustable percentage power drop when the heaters are in the rear position during the forming process.

o **Pre-Stretch Bubble:** Once the plastic has reached its forming temperature or 'plastic' state it can be prestretched to ensure even wall thickness when the vacuum is applied. Pre-stretch is an invaluable feature when forming deep draw parts with minimum draft angles and high mould surface detail. The method of controlling the bubble height should be such that consistent results are obtainable. Vacuum, air pressure and optional aids such as a plug assist are then used to assist in moulding the heated, stretched plastic.

o **Vacuum:** Once the material is suitably pre-stretched a vacuum can be applied to assist in forming the sheet. A dry vane vacuum pump is used to draw the air trapped between the sheet and the mould. The vacuum pump should be capable of maintaining a differential pressure of approx 27" mercury. With larger machines a vacuum reservoir is used in conjunction with a high volume capacity vacuum pump. This enables a two stage vacuum to be applied ensuring rapid moulding of the heated sheet (before the sheet temperature drops below its ideal forming temperature).

o **Cooling & Release:** Once formed the plastic must be allowed to cool before being released. If released too soon then deformation of the moulding will result in a reject part. To speed up the cooling cycle high speed fans are fitted and activated once the part is formed. A spray mist option is also available whereby nozzles are attached to the fans and a fine mist of chilled water is directed onto the sheet. This, in conjunction with the fans can speed up the cooling cycle by up to 30%. Mould temperature control units are also available which regulate the temperature within the mould ensuring accurate and consistent cooling times when cooling crystalline and crystallising polymers such as PP, HDPE and PET. Once cooled sufficiently the sheet can be released by a reverse pressure activated through the vacuum system. The part is then stripped from the mould and transferred to the trimming station. See the relevant section for further details on trimming and finishing.

**Clean Up:** Clean up machine and sweep around.