

The main disadvantage with this method is that the press only applies pressure in one direction, and hence, it is difficult to make complex-shaped (e.g., beads, closed corners) parts or parts with legs that approach vertical. Since the temperature of the die set need not be cycled with each part, rapid forming times of between 10 minutes and 2 hours are achievable with press forming.

Thermocouples

A thermocouple (TC) is a thermoelectric device used to accurately measure temperatures. It may be connected to a simple temperature reading device, or connected to a hot bonder, oven, or other type of controller that regulates the amount of heat. TCs consist of a wire with two leads of dissimilar metals that are joined at one end. Heating the joint produces an electric current, which is converted to a temperature reading with a TC monitor. Select the type of wire (J or K) and the type of connector that are compatible with the local temperature monitoring equipment (hot bonder, oven, autoclave, etc.). TC wire is available with different types of insulation; check the manufacturer's product data sheets to ensure the insulation withstands the highest cure temperature. Teflon-insulated wire is generally good for 390 °F and lower cures; Kapton-insulated wire should be used for higher temperatures.

Thermocouple Placement

Thermocouple placement is the key in obtaining proper cure temperatures throughout the repair. In general, the thermocouples used for temperature control should be placed as close as possible to the repair material without causing it to become embedded in the repair or producing indentations in the repair. They should also be placed in strategic hot or cold locations to ensure the materials are adequately cured but not exposed to excessively high temperatures that could degrade the material structural properties. The thermocouples should be placed as close as practical to the area that needs to be monitored. The following steps should be taken when using thermocouples:

- Never use fewer than three thermocouples to monitor a heating cycle.
- If bonding a precured patch, place the thermocouple near the center of the patch.
- A control thermocouple may be centered over a low-temperature (200 °F or lower) co-cured patch as long as it is placed on top of a thin metallic sheet to prevent a thermocouple indentation onto the patch. This may allow for a more accurate control of the patch temperature.
- The thermocouples installed around the perimeter of the repair patch should be placed approximately 0.5-inch away from the edge of the adhesive line.

- Place flash tape below and above the thermocouple tips to protect them from resin flash and to protect the control unit from electrical shorts.
- Do not place the thermocouple under the vacuum port as the pressure may damage the lead and cause erroneous readings to occur.
- Do not place thermocouple wires adjacent to or crossing the heat blanket power cord to prevent erroneous temperature readings caused by magnetic flux lines.
- Do not place any control thermocouple beyond the heat blanket's two-inch overlap of the repair to prevent the controller from trying to compensate for the lower temperature.
- Always leave slack in the thermocouple wire under the vacuum bag to prevent the thermocouple from being pulled away from the area to be monitored as vacuum is applied.

Thermal Survey of Repair Area

In order to achieve maximum structural bonded composite repair, it is essential to cure these materials within the recommended temperature range. Failure to cure at the correct temperatures can produce weak patches and/or bonding surfaces and can result in a repair failure during service. A thermal survey should be performed prior to installing the repair to ensure proper and uniform temperatures can be achieved. The thermal survey determines the heating and insulation requirements, as well as TC locations for the repair area. The thermal survey is especially useful for determining the methods of heating (hot air modules, heat lamps, heat blanket method and monitoring requirements in cases where heat sinks (substructure for instance) exist in the repair area). It should be performed for all types of heating methods to preclude insufficient, excessive, or uneven heating of the repair area.

Temperature Variations in Repair Zone

Thermal variations in the repair area occur for many reasons. Primary among these are material type, material thickness, and underlying structure in the repair zone. For these reasons, it is important to know the structural composition of the area to be repaired. Substructure existing in the repair zone conducts heat away from the repair area, resulting in a cold spot directly above the structure. Thin skins heat quickly and can easily be overheated. Thick skin sections absorb heat slowly and take longer to reach soak temperature. The thermal survey identifies these problem areas and allows the technician to develop the heat and insulation setup required for even heating of the repair area.