These recommendations along with the Technology Manual, Safety Data Sheet and Technical Data Sheet should be followed by all potential users of RTM6 and RTM6-2.

All users should make their own assessment of the application of these recommendations and products to their particular equipment, process and end use. Full scale trials using the equipment which is intended to be used should be undertaken before using the products for commercial production.

HexFlow® epoxy resin systems are suitable for most direct processes because of their low viscosity when heated to the process temperature. It is this low viscosity that allows the reinforcement to be impregnated. Heating the resin also introduces risks associated with the thermal stability of reactive resins which could lead to an uncontrolled exotherm if not properly managed. However, the resin can be processed safely by following the safety & processing guidelines outlined in this document.
RTM6 & RTM6-2 are formulated epoxy resins that have the potential to exotherm when heated for an extended period of time. Processing of RTM6 & RTM6-2 can be conducted safely by controlling the temperature and time of heating and incorporating the following guidelines, into an in-house risk assessment of the injection or infusion process.

**RTM6 & RTM6-2 - General Recommendations for Safe Handling and Contingency for Emergency Planning**

**Procedures:**

- A formal written risk assessment must be completed specifically for RTM6 and RTM6-2 use with the mixing and injection equipment and heating medium to be used. To ensure complete assessment of the process, cleaning procedures should also be risk assessed.

- Full process documents must be in place, including emergency plans and instructions.

- Operators must be fully trained in the emergency and operating procedures, and use of equipment.

- The equipment should be manned during the whole operation, including loading the resin, injection, decanting any excess resin, and cleaning.

- It is important for regular preventative maintenance to be conducted to ensure temperature controls, alarms etc. are working efficiently.

**Emergency Procedures:**

- A contingency plan must be in place to remove hot resin from the mixing vessel or injection pot in case the stirring fails or temperature increases. Typically, the emergency procedure will include the following elements:

  - An alarm that alerts the operator that the mixing element or stirrer has stopped or the temperature has risen above the maximum set point.

  - In the case of over-heating or stirrer failure, procedures should be established whereby the hot resin can be quickly removed from the mixer/injection pot into shallow metallic trays, to enable rapid cooling. To expedite this process, the metallic trays can be placed on a pallet and taken outside to air cool the resin.

  - During emergency decanting there is a risk of splash back from hot, low viscosity resin - this can be avoided by the operator wearing suitable personal protective equipment, such as full face visor with cover to the neck and long gauntlet gloves.

  - The personal protective equipment and emergency equipment must be available and easily accessible in the area, in readiness for use in an emergency situation.
**Equipment and Process Design:**

- An alarm needs to be part of the temperature measurement and control to prevent an unsafe temperature being reached for the following equipment:
  - Oven used for preheating RTM6/RTM6-2
  - Heated lid drum pump
  - Mixing vessel for RTM6-2
  - Injection pot

- Mixing vessel and injection pot must be stirred constantly and no hot points are permitted.

- If possible, the lid of the mixing vessel should not be clamped down but held down using vacuum only. If the mixing head must be clamped, then the comments made for emergency decanting, under Emergency Procedures, are critical.

- Pressure relief venting should be incorporated in the design of the injection pot.

**Operator Exposure to Chemicals:**

- RTM6/RTM6-2 contains resins which can cause skin sensitisation by either direct contact with the resin or via fumes from hot material.

**Personal Protective Equipment**

- Long sleeve overalls, either natural rubber or nitrile gloves, and safety glasses, should be worn when handling resin and conducting cleaning procedures.

**Engineering Controls**

- When the resin is heated above ambient temperature, during processing and cleaning procedures, local exhaust ventilation should be used to avoid operator contact with vapours.

- For degassing operations, vacuum pumps should be vented outside, away from the work area.

- Measures need to be taken to avoid contact with processing vapours during curing.

**RTM6**

Typical processing steps:

1. **Step 1**
   - Preconditioning at RT
   - Preheating cans in an oven

2. **Step 2**
   - Transfer to resin pot for injection
Step 1 – Preconditioning and Preheating

RTM6 previously stored at -18°C will require preconditioning at room temperature for 24 hours prior to the preheating step as detailed below.

RTM6 is supplied in 10 & 25kg cans, which require preheating in an oven to reduce the viscosity and enable transfer to the resin pot in preparation for injection. Critical control parameters to be considered are oven temperature and duration in the oven. An oven temperature of 60-80°C is considered adequate to reduce the viscosity sufficiently to allow easy transfer from can to resin pot. The duration in the oven will depend on can size and oven design.

Step 2 – Transferring and holding in resin pot prior to injection/infusion

To reduce the severity of potential exotherm, Hexcel strongly recommends limiting the resin injection pot size up to 50kg. In cases where more than 50kg of resin is required, multiple 50kg resin pots in parallel should be used. Alternatively, a system where a 50kg resin pot is refilled by pumping extra resin from separate drums of RTM6 can be used. This reduces the exotherm risk associated with holding large quantities of resin at elevated temperatures for long periods of time. The resin pot design should incorporate a stirring device to ensure unified heat transfer and no potential for hot spots to form.

Tabulated below are maximum working times that should not be exceeded. A resin pot temperature of 70-80°C is recommended. This will give sufficiently low viscosity for injection/infusion combined with a long safe working time.

The Maximum Working Time has been developed based on thermal stability data generated by empirical and predictive analytical techniques. It should be noted that the Maximum Working Time includes all processing steps where RTM6 is heated, including preheating prior to transfer to the resin pot and holding time in the resin pot. The guideline information has been generated on the basis of using RTM6 that has not been heated previously. As the resin has a thermal memory, repeat cooling and heating will reduce the time to exotherm and hence compromise the safe working time. Therefore, if it is planned to use resin that has been heated previously, this previous heating (temperature and time) must be taken into account. Total heating operations must not exceed the Maximum Working Time.

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<th>Temperature (°C)</th>
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RTM-6-2

Typical processing steps:

**Step 1 - Preconditioning and Preheating**

RTM-6-2 components previously stored at +5°C or below will require preconditioning at room temperature for 48 hours prior to the preheating step as detailed below.

RTM-6-2 Part A (27 kg) and Part B (18 kg) require preheating in an oven, to reduce the viscosity and enable transfer to holding tanks or mixing vessel for the mixing and degassing process step. An oven temperature of 60 ± 5°C for Part A and 85 ± 5°C for Part B, for up to 24 hours, is considered adequate to reduce the viscosity sufficiently to allow easy transfer.

**Step 2 - Mixing and Degassing**

Part A & B of RTM-6-2 are required to be mixed and degassed.

For the option of tanks to hold Part A and B separately, followed by degassing, holding tank temperatures of 60 ± 5°C for Part A and 85 ± 5°C for Part B, for up to 24 hours, should be adhered to.

For the option of using batch mixing in a vessel, followed by degassing, a mixing time of 30 minutes at a maximum temperature of 80°C should be adequate to provide a homogenous mix. Hexcel strongly recommends limiting the mixing volume to up to 50kg.

**Step 3 - Transferring and holding RTM-6-2 in resin pot prior to injection/infusion**

To reduce the severity of potential exotherm, Hexcel strongly recommends limiting the resin injection pot size up to 50kg. In cases where more than 50kg of resin is required, multiple 50kg resin pots in parallel should be used. Alternatively, a system where a 50kg resin pot is refilled by pumping extra resin from separate supply of RTM-6-2 can be used. This reduces the exotherm risk associated with holding large quantities of resin at elevated temperatures for long periods of time. The resin pot design should incorporate a stirring device to ensure unified heat transfer and no potential for hot spots to form.
Tabulated below are maximum working times that should not be exceeded. A resin pot temperature of 70-80°C is recommended. This will give sufficiently low viscosity for injection/infusion combined with a long safe working time.

The Maximum Working Time has been developed based on thermal stability data generated by empirical and predictive analytical techniques\(^1\). It should be noted that the Maximum Working Time includes all processing steps where RTM6-2, as a mixed one component system, is heated, including mixing duration in the mixing vessel and degassing. The guideline information has been generated on the basis of using RTM6-2, as a mixed one component system, that has not been heated previously. As the resin has a thermal memory, repeat cooling and heating will reduce the time to exotherm and hence compromise the safe working time. Therefore, if it is planned to use resin that has been heated previously, this previous heating (temperature and time) must be taken into account. Total heating operations must not exceed the Maximum Working Time.

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Users are also strongly advised to follow the Technology Manual, Safety Data Sheet and Technical Data Sheet for these products. Documents are available from the Hexcel website and Hexcel Technical Support who will also be happy to discuss any issues you may have.

All information has been prepared with reasonable skill and care but is given without acceptance of liability. All users should make their own assessment of the suitability of the products for their equipment and process and the purpose required.

\(^1\)Predictive thermal stability data were generated from dynamic scanning calorimetric data using AKTS Thermokinetics software.

Thermal stability measurements were made by adiabatic dewar and accelerated rate calorimetry (ARC) tests.
Notes
Important
All information is believed to be accurate but is given without acceptance of liability. Users should make their own
evaluation of the suitability of any product for the purposes required. All sales are made subject to our standard terms
of sale which include limitations on liability and other important terms.

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