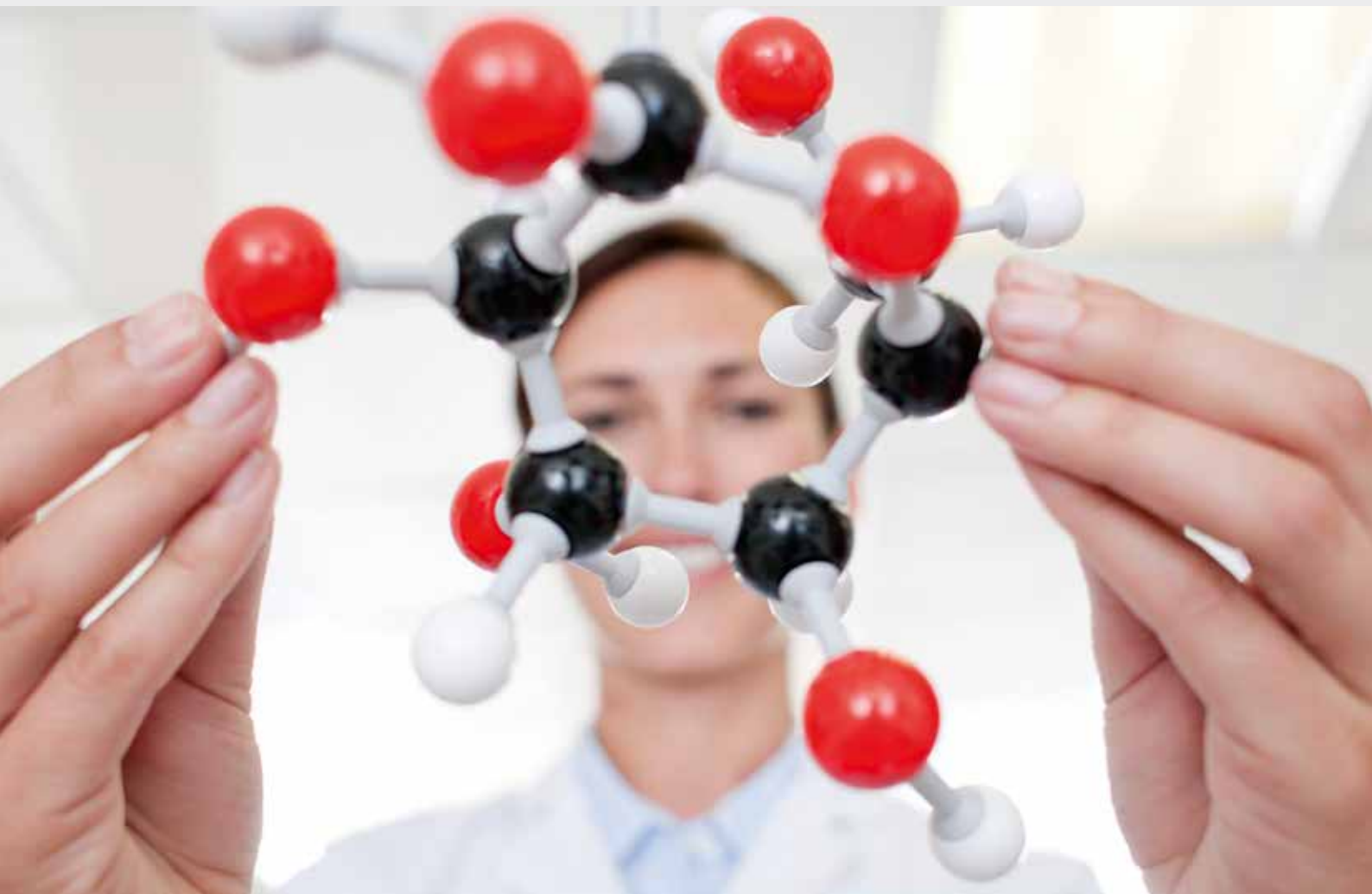


LOCTITE[®]



Process Guide

LOCTITE Benzoxazine Liquid Resin Systems Vacuum Cure Process Bulletin



Excellence is our Passion

LOCTITE Benzoxazine Liquid Resin Systems VaRTM Process Bulletin

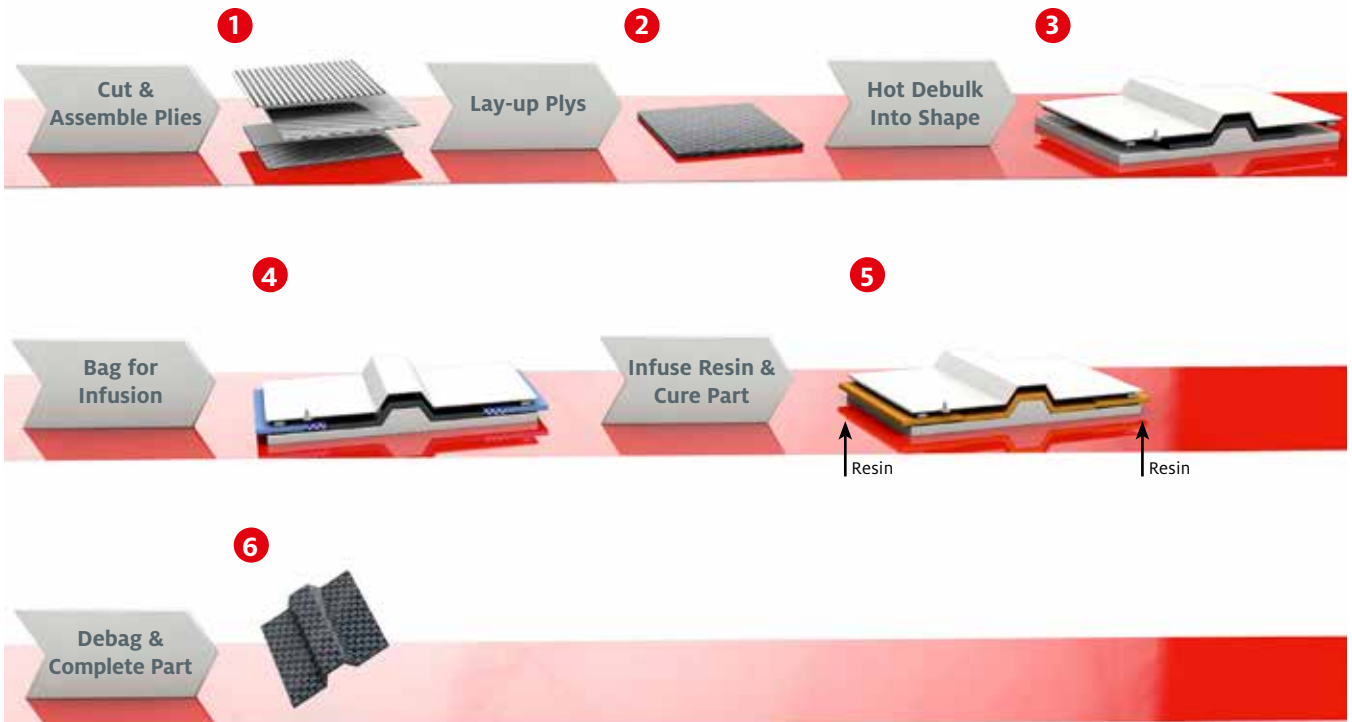
Description of Infusion Resin

LOCTITE Benzoxazine resins are one component, benzoxazine-based resin systems which can be stored for over 6 months at room temperature (25°C/77°F). Loctite Benzoxazine resins have high service temperature, good retention of properties in hot/wet conditions and low flammability. They are intended for use in Resin Transfer Molding (RTM) and Vacuum infusion and cure processes. Loctite Benzoxazine resins coupled with secondary toughening solutions provide high intrinsic toughness resulting in increased impact resistance and damage tolerance.

Features and Benefits

- › One-part system - no mixing is required
- › Room temperature stability - no refrigerated storage or shipping is required, can be air shipped
- › Broad processing window - suitable for large parts and intricate shapes
- › Viscosity stability - long injection window for large parts

Typical Process Flow



Standard Process Parameters

Resin Form at RT:	One-Part Liquid / Semi-solid
Chemistry:	Benzoxazine Based
Package Configuration:	1 or 5 gallon container
Typical Injection:	
Resin Pre-heating (optional):	70-110°C (158-230°F) for up to 30 min
Resin / Tooling Temperature ¹ at Infusion:	110 ± 10 °C (230 ± 18 °F)
Vacuum Requirements:	≥ 690 mm (27 in) Hg
Typical Cure:	
Ramp Rate ² :	0.5 – 5°C/min (1 to 10 °F/min)
Standard Cure and Post-cure ³ :	120 min at 185 °C (365 °F) Only LOCTITE® BZ 9130 AERO requires free-standing post-cure (oven) for 60min at 232 °C (450 °F)

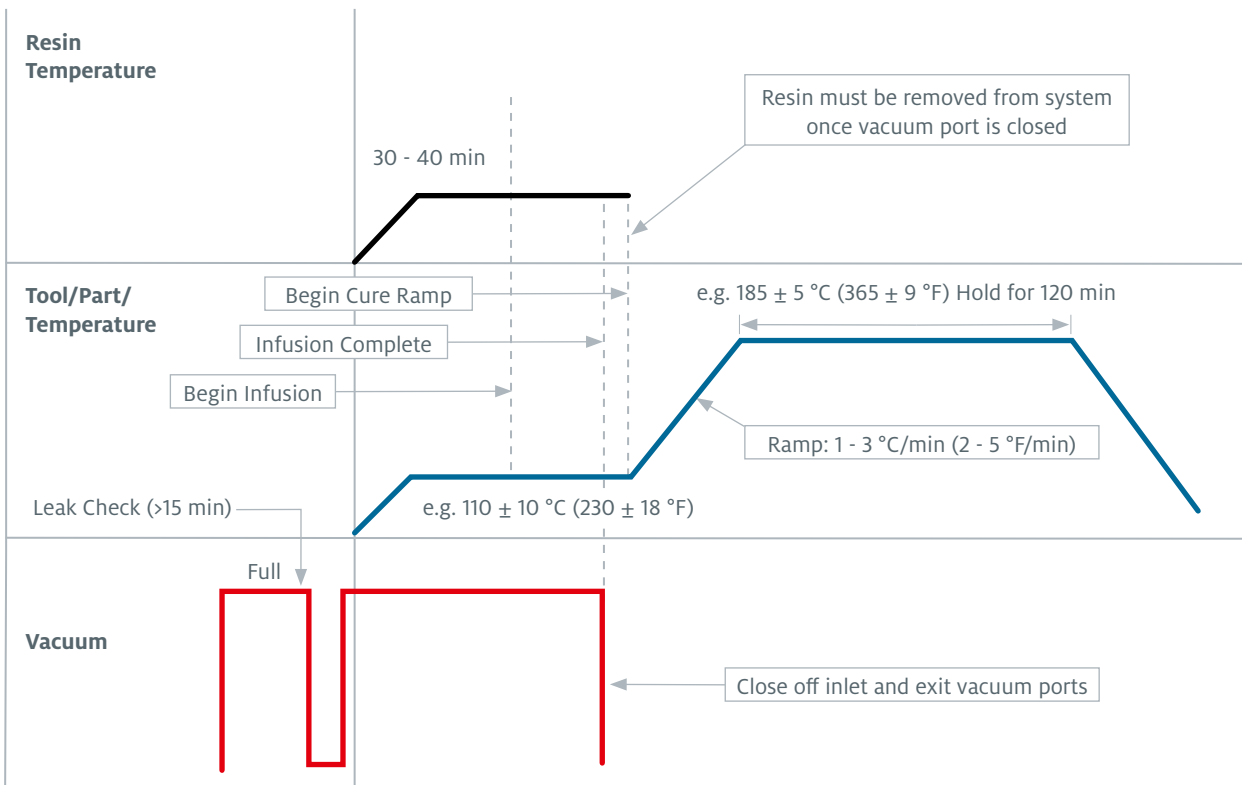
¹ Depending on required infusion time, infusion temperature may go as high as:

- 140°C (284°F) for LOCTITE BZ 9130 AERO
- 120°C (248°F) for all other systems

² Due to the low exotherm potential of Benzoxazines, ramp rates as high as 5°C/min (10°F/min) may be utilized.

³ Post cure step can be straight up post-cure temperature in the bagged assembly, or a free-standing oven post-cure.

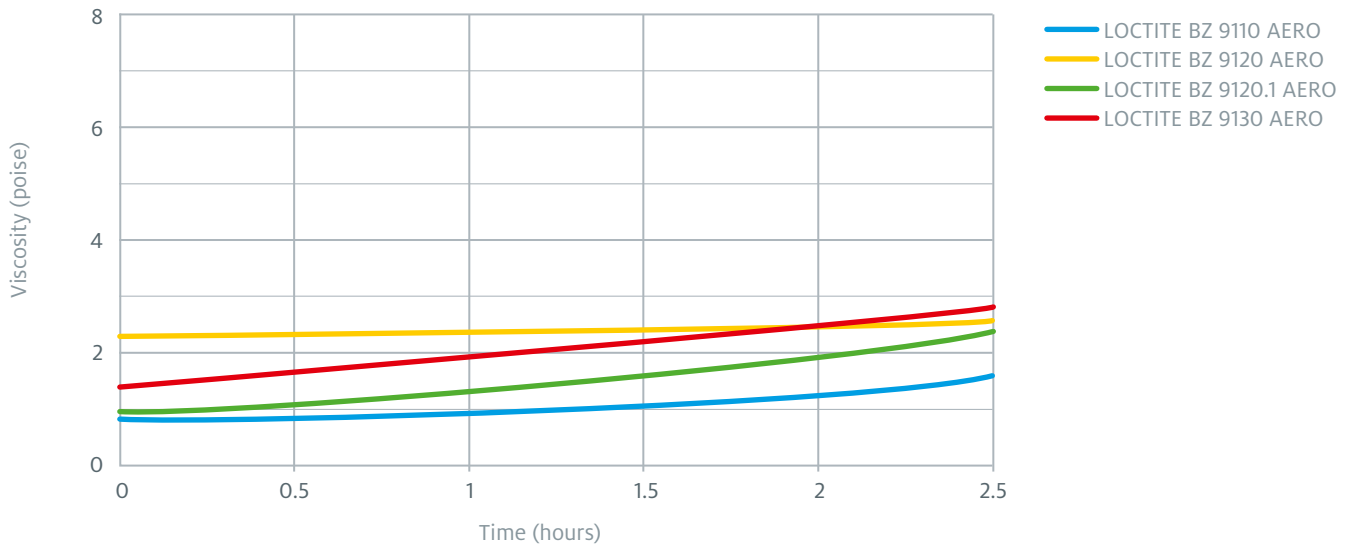
Expanded Cure Schedule for LOCTITE Benzoxazine Vacuum Infusion and Cure Single-Bag Processing



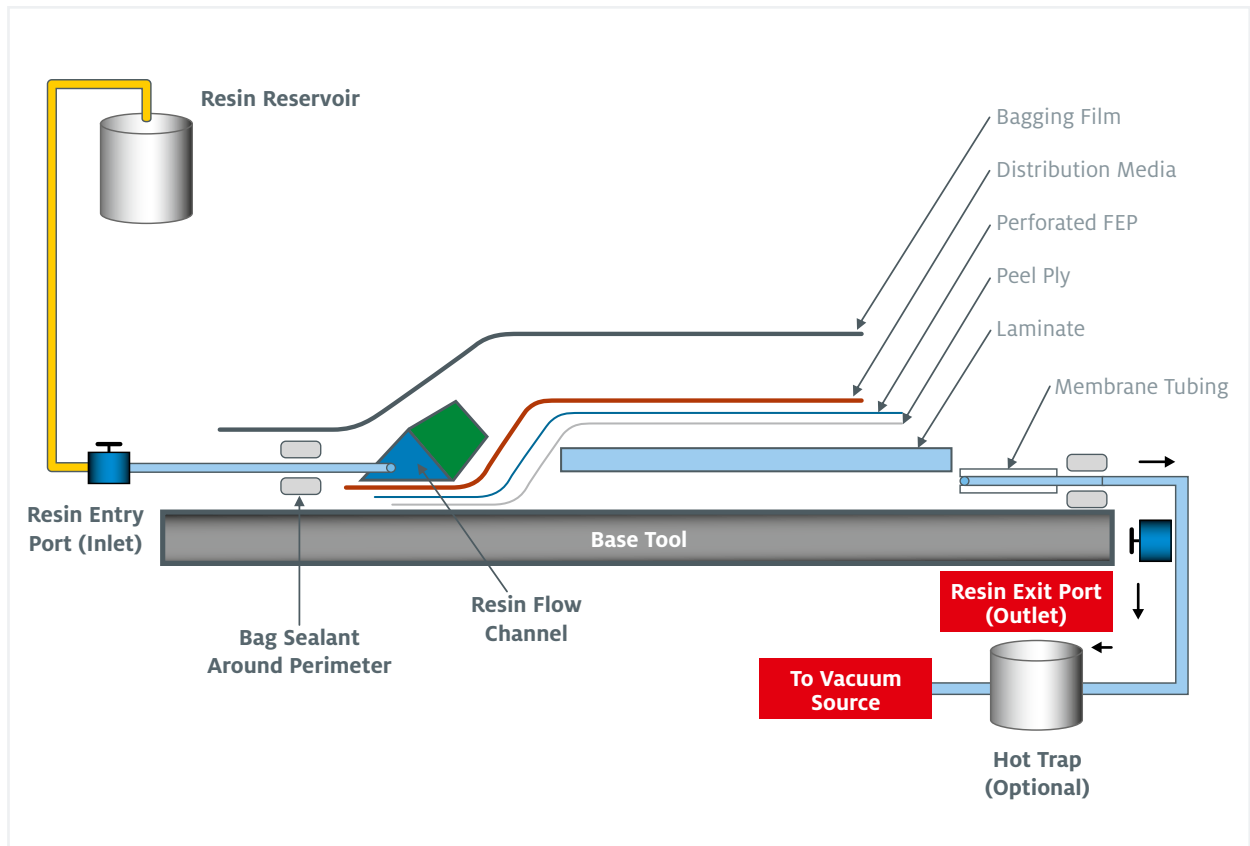
- LOCTITE BZ 9130 AERO requires a free-standing post-cure for 60 minutes at 232°C (450°F) to achieve maximum service temperature

Supplemental Resin Properties

Isothermal Viscosity of BZ Resins at 110°C (230°F) for 3 hours (Process Window)



Typical Bag Assembly Schematic:



Standard Lay-up Procedure:

1. Clean debris off tool and apply LOCTITE Frekote® mold release
2. Outline the work area on the tool with sealant tape (provide enough spacing for part)
3. Place pre-cut reinforcement on tool within the tape
4. (Optional) Tape down corners of fiber to prevent movement
5. Cut oversized pieces of peel ply, perforated FEP and distribution media:
 - The materials should be at least 25 mm (1 inch) longer along the y-axis, both top and bottom, to completely cover the ply assembly / preform.
 - The materials should be at least 50 mm (2 inches) longer along the x-axes, both sides, to go under the channel bar on the inlet side and the membrane tubing on the outlet side.
6. Place the pieces in the following order on top of the fiber
 - Peel ply (1st)
 - Perforated FEP (next)
 - Distribution media (last)
7. (Optional) Tape down the corners
8. Prep the inlet and outlet by tightening the compression fittings on the tubing
9. Place channel bar on left side of part (not on top of part, but no more than 25 mm (1 inch) away)
 - Slide the inlet tubing within the bar
 - (Optional) Secure the bar by taping it down
 - Apply sealant tape to secure tubing on the sealant border
10. Take the membrane tubing and carefully seal one end with sealant tape
 - Secure the seal by wrapping in Teflon release tape
11. Place membrane tubing on the right side of part (not on top of part, but no more than 25 mm (1 inch) away)
 - Slide the outlet tubing inside the membrane tubing
12. Apply sealant tape to secure plastic tubing on the sealant border

Typical Cure Steps Based on Above Cycle

The following steps are provided to help define the process parameters of the above cure schematic. This information is provided as an example of a typical cure cycle. Please note that the recommended steps and variables may be changed depending on tooling, equipment, and part geometry.

13. Assemble laminate/preform per drawing or specification instructions.
14. Vacuum debulk preform as required (heat may be applied, up to 110 °C (230 °F), to aid in compaction and consolidation).
15. Assemble Tool. Tooling surfaces should be released with a suitable mold release (LOCTITE Frekote 700NC is recommended). In addition, an optional layer of adhesive-backed Teflon coated release film may be applied to primary surfaces of the tool. Do not use the mold release on bag sealant.
16. Bag assembly per the bagging schematic shown above.
17. Preheat resin at 70-80 °C (158 -176 °F) for 30 min.
18. Conduct a bag vacuum leak check on each vacuum bag as required. Vacuum bag system(s) should maintain vacuum integrity over a 15 minute period; typically less than 25mm (1 inch) Hg / min is acceptable.
19. Transfer neat resin into reservoir.
20. Place tooling in the oven (or curing chamber) at 110 ± 10°C (230 ± 18 °F) heat inlet lines to this temperature as well) for 30 min and connect the outlet to vacuum. Also, place resin in the oven for the last 10-20 minutes (after the tooling is placed at the specified temperature).
21. Hook up inlet lines to resin source (infusion starts) – a resin trap (recommended) may be installed between the exit port and the vacuum source. Ensure inlet line is secured and always submerged below the resin level in reservoir.
22. Monitor flow of resin, vacuum can be regulated to control flow front. Resin flow rate will depend on applied vacuum, intended fiber volumes, process temperatures (resulting resin viscosity), part geometry and flow media.
23. Continue to pull vacuum until a continuous stream of resin, free of air pockets, is observed at the exit port (or visible through a glass caul plate if used) – this is an indication that the resin infusion process is complete.

24. Once an adequate quantity of resin is drawn through the exit (typically 15 minutes after resin is observed in exit lines for small parts), disconnect the inlet port.
25. Disconnect the vacuum and/or resin reservoir line at the outlet. Remove resin from oven to avoid exotherm.
26. Ramp tool temperature to cure temperature (see materials and Curing) – ramp rates should not exceed 3°C (5.4 °F) per min.
27. Once the mold reaches the recommended cure temperature, begin hold for the recommended time period (see Cure Schedule on Page 3).
28. After recommended cure time is reached, cure is complete, cool part to room temperature. The recommended cooling time is 90 min to 32 °C (90°F).
29. Carefully remove bagging from tooling and trim as necessary.
30. Process is complete

Recommended Material List

Items	Grade	Supplier
Bagging film	Pink-Ipplon(NA1350227) Vacuum Bag	Airtech
Breather	7781 Glass 120	National Aerospace
Peel Ply	Dry Peel Ply - B	Airtech
Distribution Media	Infusion Flow N1000	Richmond Aircraft Product
Resin Vent Ply	NA100-3/38 (non-perf) Armalon Teflon Coated	Airtech
Bag Sealant	GS213-Airtech Sealant	Airtech
Membrane tubing	MTI hose	German Advanced Composites
Flow Channel	Silicon Robber line OF313	Airtech
Tubing	Teflon Tube	McMaster

General:

As with most resin systems, use this product with adequate ventilation. Do not get in eyes or on skin. Avoid breathing the vapors. Use proper PPE when handling resin, including gloves and safety glasses. Wash thoroughly with soap and water after handling. Empty containers retain product residue and vapors, so obey all precautions when handling empty containers.

CAUTION! LOCTITE Benzoxazine. This material may cause eye and skin irritation or allergic skin reaction.

Before using this product, read the Material Safety Data Sheet carefully.

Users should review the Material Safety Data Sheet (MSDS) and product label for the material to determine possible health hazards, appropriate engineering controls and any precautions to be observed in using the material. Copies of the MSDS and label are available upon request.

The data contained herein are intended as reference only. Please contact Henkel Technical Support Group for assistance and recommendation on specifications these products.

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