

Flexible Heater Insulation

Introduction:

The use of thin, flexible silicone rubber/fiberglass fabric composite materials is the standard for high temperature heaters. Arlon manufactures a full line of UL recognized reversion resistant silicone rubber/fiberglass fabric composites for use as insulation for flexible heaters. Arlon's silicone rubber composites operate reliably and offer long life in both wire wound and etched foil heater applications.



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Features:

- UL Recognized, see File E 54153.
- Broad temperature range: to 450°F continuous operation (intermittent to 600°F); maintains properties to -70°F (resists thermal shock, allows quick heat up even in cold conditions).
- Dielectric strength: 400 to 600 volts per mil; resists corona, arc-tracking damage; excellent dielectric fatigue resistance.
- Ozone, weather, chemical resistance: silicone chemistry resists oxidation embrittlement, permits use in hostile environments; resists most harsh weather environments.
- Flame retardant, non-toxic: UL-94 HB and V0 rated options, resists burning; low smoke generating silicones contain no sulfur or nitrogen to emit toxic fumes common to PVC and organic rubber insulation materials.
- Bondable: can be bonded using primers to wire or metal foil elements, as well as to aluminum backers; compatible with silicone pressure sensitive adhesives for bond-in-place systems and silicone RTV adhesives for various field application requirements.
- Ease of fabrication: permits manufacture of heaters to conform to complex geometries; uncured rubber acts as its own adhesive.
- Foil laminate: I51576R015 available with pre-bonded Alloy 600 foil for etched circuit heater fabrication, please inquire about other foils.

Technical Specifications:

■ Construction

1. Fiberglass fabric reinforcement standard in 0.0055" (Style 1681 glass), 0.008" (Style 7628 glass) and 0.018" (Style 162 glass) with other styles and thicknesses available for special requirements.
2. Unsupported rubber available for patching leads, burying heavy wire, bonding to metal plates, etc., on a heavy polyethylene carrier in rubber thicknesses from 0.015" to 0.060". Also available in bulk.
3. Calendered rubber thickness from 0.002" to 0.100" in standard configurations.
Construction options include:
 - a. Uncured rubber on one side of the fabric.
 - b. Uncured rubber on both sides.

- c. Fully cured rubber on one side and uncured rubber on the second side.
 - d. Fully cured rubber on one side with uncured rubber over the cured layer.
4. Polyethylene film liner is supplied on all uncured rubber surfaces to protect rubber from dirt, contamination, and blocking.

■ Tolerances/Putups

1. Thickness typically is held $\pm 10\%$ of target.
2. Standard widths are 38" untrimmed (36" usable) with some fabrics and constructions available in 50" width (48" usable). Stock rolls can be slit to selected widths. The minimum standard slit width is $1" \pm 1/16"$.

Process and Handling Recommendations:

■ Wire Wound Heaters:

1. Rubber thickness should be selected to permit encapsulation of wire without damage to glass supporting fabric.
2. Resistance wire must be degreased to remove excess drawing lubricants or oils.
3. Wire should be primed with a silane-type primer system such as Dow ⁽¹⁾ S-2260. Use of excessive primer will weaken bonding. The primer supplier will provide dilution and application recommendations.
4. Primed metal should air cure for 30 min. near 50% relative humidity before applying silicone rubber.
5. Wire may be laid-up on the uncured rubber. In most cases the tack of the rubber will prevent the wire from moving.
6. Place cap material over the exposed wire and press in place to encapsulate the wire.
7. Vulcanization may be done in an autoclave (vacuum bag) or a platen press at 212°F-350°F for 5-15 minutes. The ideal cure cycle depends on the tooling, the silicone compound, and the heater construction. 30-50 psi pressure results in the best cure, although 14.7 psi usually yields acceptable results.
8. Post-curing is recommended in an air circulating oven to maximize insulation resistance values and remove residues from the catalysts. For thin heaters (to 0.050" overall) 2 hrs. @ 400°F is adequate. For thicker heaters, 4 hrs. @ 400°F is recommended.

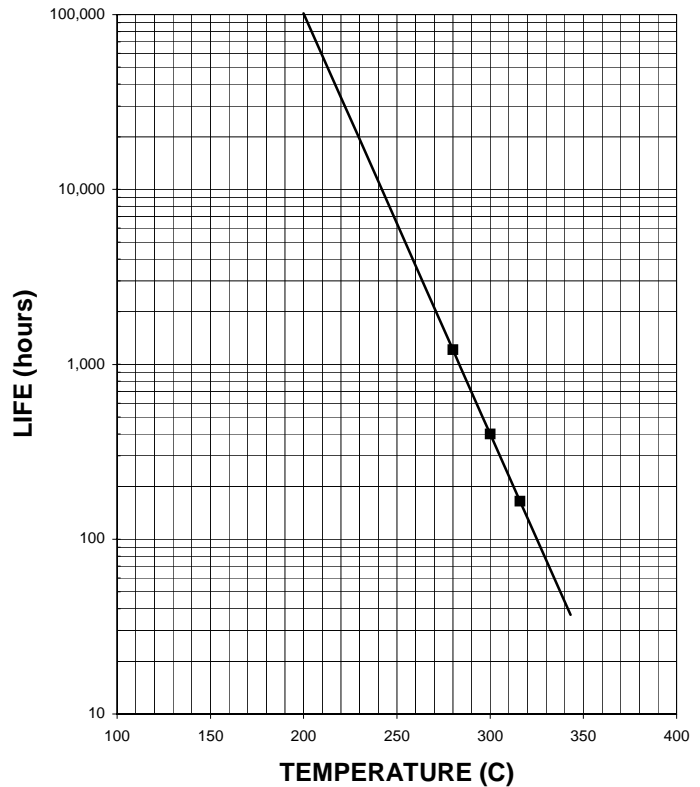
(1) Dow Corning Corp., Midland, MI

Note: If too many heaters are cured under a vacuum blanket at one time, a white powdery residue may appear which can be removed with a small amount of solvent on a soft rag.

■ **Foil Clad Heaters (Etched Foil)**

1. Foil-clad/etched foil heaters can be made with thinner constructions because less rubber is required to encapsulate the foil than the wire.
2. Foils must be degreased and cleaned to remove oils or rolling lubricants. Although not required, a light abrasive treatment to roughen the surface may improve the bond.
3. Prime the foil as outlined for wire priming. Do not overprime. Allow 30 min. near 50% relative humidity to allow primer to bond.
4. Lay the foil on the rubber (primed surface to the uncured rubber layer) and laminate under 30-50 psi pressure, 212-350°F for 5-15 minutes. The ideal cure cycle depends on the tooling, the silicone compound, and the heater construction.
5. Silk screen or print the heater circuit onto the foil-silicone laminate.
6. A ferric chloride etch is normally used to remove the excess foil. This should be followed by a rinse to remove ferric hydroxides and other residues. Incomplete rinsing can cause bonding issues.
7. Cover the exposed heater circuit with an uncured silicone sheet and cure under 30-50 psi pressure, 212-350°F for 5-15 minutes. The ideal cure cycle depends on the tooling, the silicone compound, and the heater construction.
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Typical Heat Aging Properties



Typical Physical Properties:

Flame Retardance:

UL-94	Flame class	HB and V0 rated options
FTMS 191A	Flame and glow	25 seconds, max.
(Method 5903)	Char length	3 inches, max.

Dielectric Strength:

ASTM D-149	Breakdown	500 volts per mil (typical)
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Tensile Strength:

ASTM D-1458	Break strength	70 lb/in (0.0055" glass)
		120 lb/in (0.008" glass)
		200 lb/in (0.018" glass)

Peel (Bond) Strength (Rubber to Rubber):

ASTM D-624	Bond strength	6-10 lb/in (typical)
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Storage:

We recommend that our flexible heater insulation products be stored in a controlled area held at 75°F ± 5°F. We also recommend that the material be used as soon as possible to avoid potential difficulties with removal of release liners.

Shelf Life:

Six months from date of manufacture at 75°F.

FLEXIBLE HEATER PRODUCT EXAMPLES

Arlon Product #	Product construction			Notes
	Side 1	Woven Glass	Side 2	
31140R020	0.020" (uncured)	-	-	Unsupported silicone rubber on release carrier available in 0.001"-0.010" thickness
51140R015	0.007" (uncured)	0.008"	-	Style 7628 fiberglass available in 0.012-0.040" total thickness
55140R025	0.007" (uncured)	0.018"	-	Style 162 fiberglass available in 0.025-0.040" total thickness
51141R015	0.0035" (uncured)	0.008"	0.0035" (uncured)	Style 7628 fiberglass available in 0.012-0.040" total thickness
51146R015	0.003" (cured)	0.008"	0.005" (uncured)	Style 7628 fiberglass available in 0.12-0.27" total thickness
55146R028	0.003" (cured)	0.018"	0.007" (uncured)	Style 162 fiberglass available in 0.025-0.065" total thickness
55149R028	0.003" (cured) + 0.007" (uncured)	0.018"	-	Uncured rubber over cured rubber on Style 162 glass available in 0.028-0.055" total thickness

Many more options are available; please contact us to discuss your specific requirements.

PRODUCT CONSTRUCTION OPTIONS

	0	1	2	3	4	5	6	7	8	9
SIDE 1	Uncured	Uncured	Cured	Cured	Semi-cured	Semi-cured	Cured	Semi-cured	Special	Uncured on top of cured
SIDE 2	None	Uncured	None	Cured	None	Semi-cured	Uncured	Uncured	Special	None

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