LHS® FILL AND FLOW THERMAL MANAGEMENT MATERIALS

INFORMATION SHEET | DATE: NOV. 2020 | ISSUE: REV.7

LHS® thermal management materials provide energy absorption, heat storage and heat dissipation characteristics for passive thermal control. LHS® thermal management materials provide homogenous and lower pack/cell temperatures leading to longer cell life and lower overall energy and replacement costs.

LHS® F&F is specifically designed to fill enclosed and small cavity systems by completely flowing around, encompassing and contacting all fully enclosed cell and pack surfaces.

LHS® F&F MATERIALS - TYPICAL PROPERTIES

LHS Product	LHS® F&F-91	LHS® F&F-92	LHS® F&F-93
Phase Transition Temperature (PTT):	49–51 °C	53–57 °C	59–63 °C
Latent Heat:	200–220 kJ/kg	200–220 kJ/kg	210–230 kJ/kg
Specific Gravity @ 22 °C:	0.8	0.8	0.8
Viscosity above PTT (cps)	25–100	25–100	25–100
Operating Temp. Range:	–10–120 °C	–10–120 °C	–10–120 °C
Volume Resistivity:	4.5 x10^{13} Ωcm	4.5 x10^{13} Ωcm	4.5 x10^{13} Ωcm
Dielectric Constant:	3.05	3.05	3.05
Dielectric Strength:**	35.63 MV/m	35.63 MV/m	35.63 MV/m
RoHS Compliance:	Compliant	Compliant	Compliant
Avg. Specific Heat Capacity, Cp – Below PTT*	1.90 J/g·°C	1.90 J/g·°C	1.90 J/g·°C
Avg. Specific Heat Capacity, Cp– Above PTT*	2.45 J/g·°C	2.45 J/g·°C	2.45 J/g·°C
Avg. Thermal Conductivity, – Below PTT*	0.35 W/m·K	0.35 W/m·K	0.35 W/m·K
Avg. Thermal Conductivity, – Above PTT*	0.25 W/m·K	0.25 W/m·K	0.25 W/m·K

*Similar to most solid and liquid materials, the specific heat capacity and thermal conductivity have insignificant change above and below the transition temperature.
**Tested at 3 mm thickness

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Storage: Store in cool, dry place away from direct sunlight. Storage is preferably between 0-40°C. Best if used within 12 months.

Prototype Processing: F&F materials are supplied as solids and must be heated to their full liquid state before use. Small amounts of F&F materials can be heated in a glass or metal beaker. This is best carried out either in an oven or on a hot plate at 10-20°C above its transition temperature, but the temperature should not exceed about 85°C.

It is recommended, but not critical, that the enclosure or pack to be filled be preheated to 30-45°C. This allows the material to completely fill and flow into all cavities and crevices before cooling and solidifying. If pack or enclosure is to cool, the F&F material can quickly solidify, blocking areas and preventing homogenous and complete encasement. It is also possible to lean or slant the pack to aid in complete void filling.

Enclosure or Pack filling: The most suitable method is to completely melt the material at 10-20°C above its transition temperature in one of the preferred material containers mentioned. If material is supplied in drums or pails, it can be melted and used directly from these containers but should not be used for long term storage.

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Large Scale Storage and Processing: The most suitable material for warehouse or commercial storage is either bags, pails or drums as supplied. Bulk storage tanks can be used and preferred materials are stainless steel, pure aluminum, rubber, polyethylene, polypropylene or polyethylene-lined containers and storage tanks made from glass-fiber-reinforced polyester (GRP). The tank should be ventilated by means of a silica gel dryer. Conventional steel tanks are of limited suitability because after prolonged storage the product may become discolored owing to traces of iron.

The long-term storage temperature should not exceed 70°C, and it is advisable to thoroughly mix the contents of the storage container. This mixing can be accomplished by mixing blade, pump circulation, or bubbling dry nitrogen through the material.

Band heaters and electrical immersion heaters are not suitable for heating due to the high thermal stress and localized hot spots which lead to overheating and degradation.

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Dispensing and Filling Equipment: Production dispensing procedures and equipment are generally designed to a company's specific needs and production operations. Dispensing equipment can be as simple as a temperature-controlled heating blanket around a drum with a hand-controlled dispensing valve or as expansive as jacketed tanks with metered pumps and computer controlled dispensing valves.

Examples of suitable commercial production equipment are general hot melt dispensing machines supplied by companies such as Graco, Nordson, Valco Melton, or various industry distributors.

Compatibility: It is recommended that compatibility testing be undertaken with all pack components to insure long term stability. Thermocycling, as opposed to static soak, is recommended due to varying conductivities and heating rates which can effect the solubility and thermal stresses on materials and parts.

Generally, most engineering polymers such nylons, polycarbonates, polyetheramides, PBT, etc. will be acceptable materials. Glass filled materials should be specifically evaluated due to glass fiber wicking (fibers act as wicks to material interior) and interactions with fiber sizing.

Note: *LHS® thermal management materials are developmental products that are furnished for R&D purposes only. The information contained herein is merely preliminary data due to continued development. Further information, including data changes, may occur as testing, process optimization, and formulation changes occur and development proceeds. The user/purchaser agrees that: use is undertaken at the users sole risk, that the material is furnished "as-is, with all faults", without any warranty or guarantee: and that Latent Heat Solutions LLC., shall not be liable for any damages, of whatever nature, arising out of the user's / purchaser's receipt and/or use of this material. Commercialization and continued supply are not assured.*

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