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TECHNICAL DATA SHEET (TDS)

GPO-3

PRODUCT IDENTIFICATION

- **Product Name:** GPO-3
- **Material Type:** Glass Mat Reinforced Polyester (GRP) Composite
- **Details:**
  - **Company:** MISCO Australia
  - **Address:** 89-91 Licola Crescent, Dandenong South, VIC 3175
  - **Telephone Number:** 03 9706 5185
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- **TDS Number:** MISCO – TDS - 011
- **TDS Date:** 01/12/2024
- TDS Version: 1.0

PRODUCT DESCRIPTION

GPO-3 is a rigid, flame-retardant glass-reinforced polyester composite produced by impregnating a chopped glass-fibre mat with unsaturated polyester resin and hot-pressing under heat and pressure.

This process results in a dimensionally stable, high-strength electrical insulation material that maintains exceptional mechanical performance, dielectric strength, and arc resistance under conditions of high voltage, heat, and humidity.

GPO-3 offers low smoke and toxicity, excellent machinability, and long-term dimensional reliability, making it the preferred choice for switchboard barriers, busbar supports, transformer frames, and electrical structural insulation.

NEMA GRADE

NEMA Grade: GPO-3

CLASS

Class F (155 °C)

Designed for continuous operation up to 155 °C, GPO-3 maintains mechanical strength, dielectric integrity, and dimensional stability under thermal stress.
Short-term peaks up to 180 °C are acceptable without loss of insulation performance.

Classification Reference:

- IEC 60085 – Electrical Insulation Systems (Thermal Classification)
- NEMA LI-1 – GPO-3 (Glass Mat Reinforced Polyester)
- MIL-I-24768/17 – Type GPO-3

MILITARY SPECIFICATIONS AND TYPE

Military Specification: MIL-I-24768/17
Type Designation: GPO-3 – Glass Mat Reinforced Thermoset Polyester

Description:
This military specification covers thermosetting glass mat reinforced polyester sheets, rods, and shapes used for electrical insulation and structural applications.
Type GPO-3 under MIL-I-24768/17 is recognised for:

- High arc and track resistance
- Excellent dielectric strength
- Flame retardancy (UL 94 V-0)
- Mechanical and dimensional stability under heat and moisture

It meets the stringent requirements for defence, aerospace, and electrical equipment where durability, electrical insulation, and fire safety are critical.

KEY PROPERTIES

- **High Mechanical Strength:**
  Excellent tensile, flexural, and compressive performance suitable for structural and support components.
- **Superior Electrical Insulation:**
  High dielectric strength and insulation resistance, maintaining stability under high voltage and humidity.
- **Outstanding Arc and Track Resistance:**
  Excellent performance in environments prone to electrical arcing or tracking.
- **Flame Retardant:**
  UL 94 V-0 rated, self-extinguishing with low smoke and toxicity emissions.
- **Dimensional Stability:**
  Retains shape and strength under heat, load, and moisture exposure.
- **Thermal Endurance:**
  Rated Class F (155 °C) for continuous service temperature.
- **Chemical Resistance:**
  Resistant to oils, acids, alkalis, and common industrial solvents.
- **Machinability:**
  Easily CNC machined, drilled, or cut with minimal tool wear using carbide or PCD tooling.
- **Low Moisture Absorption:**
  Ensures electrical reliability and stability in humid or outdoor environments.
- **Environmentally Compliant:**
  Halogen-free, asbestos-free, RoHS 3 and REACH compliant.
- **Stable Dielectric Properties:**
  Minimal degradation in electrical performance at elevated temperatures.
- **Long-Term Durability:**
  Excellent ageing characteristics and resistance to thermal cycling.
- **Versatile Form Availability:**
  Supplied in sheets, rods, and custom-machined parts to customer specification.

APPLICATIONS

- **Switchboard Construction:**
  Barriers, phase separators, mounting panels, and arc chutes.
- **Busbar Systems:**
  Supports, cleats, and spacers providing electrical isolation and rigidity.
- **Transformers:**
  End frames, coil supports, and insulation panels.

- **Motors and Generators:**
  Slot wedges, terminal boards, and insulating components.
- **Power Distribution Equipment:**
  Control panels, switchgear partitions, and load centre assemblies.
- **Industrial Equipment:**
  Structural insulation for machinery, drives, and electrical enclosures.
- **Renewable Energy Systems:**
  Insulation for inverters, converters, and solar or wind installations.
- **Defence and Aerospace:**
  Electrical panels and non-conductive structural supports requiring flame retardancy and traceability.
- **Rail and Transport:**
  Electrically insulated panels and brackets for traction systems and control assemblies.
- **General Fabrication:**
  Machined parts, spacers, and custom profiles where high dielectric and mechanical strength are required.

INDUSTRIES SERVED

- Switchboard Builders
- Transformer Manufacturers
- Motor Rewinders and Repairers
- Electrical and Electronics
- Power Generation and Distribution
- Renewable Energy (Solar, Wind, Hydro)
- Industrial Machinery and Automation
- Construction and Infrastructure
- Rail and Transport Systems
- Automotive and Heavy Vehicle
- Oil, Gas, and Energy Sector
- Defence and Aerospace Manufacturing
- OEM and Custom Fabrication Workshops

SPECIFICATIONS

Property	Details
Product Form	Sheets, rods, and custom-machined parts
Standard Colours	MISCO Red / Natural White
Sheet Size	1220 × 2440 mm (standard) – custom sizes available
Thickness Range	1.6 mm to 60 mm (others available on request)
Rod Diameter Range	10 mm to 150 mm
Thermal Class	Class F (155 °C)
NEMA Grade	GPO-3
MIL Specification	MIL-I-24768/17 Type GPO-3
IEC Standard	IEC 60893-3-5 (EPGC203)
UL File Number	E180362
Flame Rating	UL 94 V-0
Density	1.85 – 1.90 g/cm³
Halogen / Asbestos Content	Halogen-free, Asbestos-free
Compliance	RoHS 3 / REACH / AS 61439 (Switchgear)

TOLERANCES ON SHEET THICKNESS

Nominal Thickness (mm)	Tolerance (± mm)
1.6 – 3.0	± 0.15
>3.0 – 6.0	± 0.20
>6.0 – 12.0	± 0.25
>12.0 – 25.0	± 0.30
>25.0 – 40.0	± 0.40
>40.0 – 60.0	± 0.50

MECHANICAL PROPERTIES

Property	Typical Value (Unit)	Test Method / Standard
Flexural Strength	180 - 200 MPa	ASTM D790
Compressive Strength (Flatwise)	250 - 300 MPa	ASTM D695
Compressive Modulus	12 -15 GPa	ASTM D695
Tensile Strength	120 -150 MPa	ASTM D638
Tensile Modulus	10 - 12 GPa	ASTM D638
Shear Strength	30 - 35 MPa	ASTM D732
Impact Strength (Charpy, Unnotched)	20 - 25 kJ/m^2	ASTM D256
Impact Strength (Izod, Notched)	8 - 12 kJ/m^2	ASTM D256
Elongation at Break	1.2 - 1.8 %	ASTM D638
Elastic Modulus	10 - 12 GPa	ASTM D790
Poisson's Ratio	0.25 - 0.30	ASTM E132
Density	1.85 - 1.90 g/cm^3	ASTM D792
Water Absorption (24 hrs @ 23°C)	≤ 0.25 %	ASTM D570
Hardness (Rockwell M)	100 - 110 M Scale	ASTM D785
Machinability Index	Excellent - Comparable to Phenolic Composites	MISCO Standard
Creep Resistance (at 23 °C / 7 MPa)	< 0.15 % strain after 1000 hrs	ASTM D2990
Bond Strength (Laminate Integrity)	> 1.0 N/mm	IEC 60893

Notes:

- Properties based on average of multiple test samples in standard atmospheric conditions.
- Actual results may vary with material thickness, processing temperature, and resin batch.
- MISCO Australia recommends CNC machining with carbide or PCD tooling for consistent dimensional results.

ELECTRICAL PROPERTIES

Property	Typical Value (Unit)	Test Method / Standard
Dielectric Strength (3 mm)	12 - 16 kV/mm	ASTM D149
Dielectric Strength (6 mm)	10 - 12 kV/mm	ASTM D149
Volume Resistivity	1×10^{13} Ω·cm	ASTM D257
Surface Resistivity	1×10^{12} Ω	ASTM D257
Dielectric Constant (at 1 MHz)	4.8 - 5.2	ASTM D150
Dissipation Factor (at 1 MHz)	0.015 - 0.025	ASTM D150
Arc Resistance	180 - 200 sec	ASTM D495
Comparative Tracking Index (CTI)	≥ 600 V	IEC 60112
Insulation Resistance (After Immersion)	> 10^{11} Ω	ASTM D257
Electric Strength After Humidity Exposure	≥ 80% retention	ASTM D149 (Wet Condition)
Breakdown Voltage (6 mm)	60 - 70 kV	ASTM D149

Notes:

- Excellent dielectric performance even under humid or elevated temperature environments.
- High arc and tracking resistance make GPO-3 suitable for switchgear, busbar supports, and transformer insulation systems.
- Electrical values are typical and may vary slightly with thickness and humidity.

THERMAL PROPERTIES

Property	Typical Value (Unit)	Test Method / Standard
Thermal Class	Class F (155 °C)	IEC 60085 / NEMA LI-1
Maximum Continuous Operating Temperature	155 °C	IEC 60085
Short-Term Temperature Limit	180 °C	MISCO Standard
Heat Deflection Temperature (1.8 MPa)	220 – 240 °C	ASTM D648
Thermal Conductivity	0.30 – 0.35 W/m·K	ASTM E1530
Specific Heat Capacity	1.1 – 1.3 kJ/kg·K	ASTM E1269
Coefficient of Thermal Expansion (Parallel)	18 – 22 × 10^{-6} /°C	ASTM E831
Coefficient of Thermal Expansion (Perpendicular)	35 – 45 × 10^{-6} /°C	ASTM E831
Thermal Diffusivity	0.18 – 0.22 mm^2/s	ASTM E1461
Thermal Ageing Retention (1000 h @ 155 °C)	≥ 85 % mechanical strength retained	IEC 60085
Flammability Rating	UL 94 V-0 (Self-Extinguishing)	UL 94
Smoke Density (Flaming / Non-Flaming)	≤ 75 / ≤ 35 (ASTM E662)	ASTM E662
Oxygen Index (LOI)	≥ 30 %	ASTM D2863
Glass Transition Temperature (Tg)	180 – 190 °C	ASTM E1640

Notes:

- GPO-3 maintains dimensional stability, dielectric strength, and flame resistance across a wide temperature range.
- The low thermal conductivity aids insulation efficiency in high-voltage systems.
- Suitable for continuous electrical service up to 155 °C, with temporary exposure up to 180 °C without degradation.

CHEMICAL RESISTANCE

Chemical Group	Resistance	Comments / Notes
Dilute Acids (e.g., H_2SO_4, HCl)	Good	Resistant to mild concentrations; prolonged exposure to strong acids may cause surface dulling.
Strong Acids (e.g., Nitric, Concentrated Sulphuric)	Poor	Not recommended for continuous exposure; may attack the resin matrix.
Alkalis (e.g., NaOH, KOH)	Fair to Good	Stable in low concentrations; high alkalinity can cause surface erosion.
Alcohols (e.g., Ethanol, Isopropanol)	Excellent	No significant effect at ambient temperature.
Hydrocarbons (e.g., Mineral Oils, Diesel)	Excellent	Chemically stable; ideal for transformer oil and lubricant contact.
Aromatic Solvents (e.g., Toluene, Xylene)	Moderate	Prolonged exposure may soften the resin surface.
Ketones (e.g., Acetone, MEK)	Poor	Causes swelling and potential surface cracking.
Esters and Ethers	Fair	Limited resistance; short-term contact only.
Halogenated Solvents (e.g., Trichloroethylene)	Poor	Attacks resin structure — avoid use.
Water (Cold / Hot)	Excellent	Minimal absorption and negligible loss of mechanical or dielectric properties.
Salt Solutions / Seawater	Excellent	Suitable for marine and high-humidity environments.
Oils and Greases	Excellent	No effect; stable in transformer and lubricating oils.
Oxidising Agents	Moderate	May cause slight surface oxidation over time.

Summary:
GPO-3 demonstrates excellent resistance to oils, alcohols, and water, with good performance in dilute acids and alkalis. It should be protected from prolonged exposure to strong acids, chlorinated solvents, and ketones to preserve surface finish and dielectric integrity.

Recommendation:
For harsh or chemical-rich environments, MISCO Australia recommends periodic inspection of exposed surfaces and protective coatings for extended service life.

PROCESSING AND MACHINING CONSIDERATIONS

Processing and Machining Considerations

- Machinability: GPO-3 machines cleanly using standard CNC mills, routers, and saws. It offers smooth edge finishes with minimal tool wear.
- Tooling: Use carbide or PCD-tipped cutters for best results. High-speed steel tools may dull quickly due to glass content.
- Cutting Parameters: Moderate spindle speeds with light to medium feed rates minimise heat and resin burn.
- Coolant: Use air blast or light mist coolant to reduce dust and control cutting temperature. Avoid water flood systems where moisture absorption is a concern.
- Drilling: Use slow feed, high speed, and sharp brad-point or diamond-coated drills to prevent delamination.
- Sawing: Employ carbide-tipped circular saws with fine teeth; feed steadily to prevent chipping.
- Fixturing: Clamp firmly on a stable, vibration-free surface. Backing boards help reduce breakout on through-cuts.
- Dust Extraction: Always use local exhaust or vacuum extraction during machining. Glass dust is abrasive and should not be inhaled.
- Edge Finishing: Edges can be sanded or chamfered; deburr lightly to avoid micro-cracking.
- Pre-conditioning: Store and machine materials at stable workshop temperature (20–25 °C) for dimensional accuracy.
- Post-Machining: Blow off residue and inspect edges for fibre exposure before installation.

SHEET HANDLING BEFORE MACHINING

Proper handling of GPO-3 sheets before fabrication is critical to maintain flatness, dimensional stability, and surface integrity. The following guidelines should be followed in all production environments.

Storage Conditions

- Store sheets flat and fully supported on a level surface.
- Keep in a clean, dry area away from direct sunlight, heat sources, and moisture.

- Maintain ambient conditions of 20–25 °C and 40–60 % relative humidity.
- Avoid stacking heavy items on top of sheets to prevent warping or compression marks.
- Use separator sheets (kraft paper or polyethylene film) between panels to prevent surface abrasion.

Pre-Conditioning

- Allow sheets to stabilise to workshop temperature and humidity for at least 24 hours before machining.
- This prevents internal stress release or size variation during cutting.
- For thick or large-format panels, extend conditioning time as needed.

Inspection and Preparation

- Visually inspect for cracks, delamination, or contamination prior to loading.
- Wipe surfaces clean using a dry or slightly damp lint-free cloth — avoid solvents.
- Verify sheet grade, thickness, and colour match the production specification.

Handling Practices

- Always lift sheets vertically with two people or use vacuum lifting devices.
- Avoid dragging edges across hard surfaces; use protective spacers when stacking.
- Support sheets evenly during transport or placement on CNC beds.

Safety Precautions

- Wear gloves, long sleeves, and safety glasses to prevent irritation from glass fibres.
- Use mechanical assistance or lifting aids for large sheets to prevent bending or impact damage.

Summary

Correct storage, conditioning, and handling of GPO-3 sheets ensure consistent machining accuracy, stable tolerances, and long-term material reliability.

ENVIRONMENTAL COMPLIANCE

Regulation / Standard	Status	Description
RoHS 3 (Directive 2015/863/EU)	**Compliant**	Free from restricted hazardous substances including lead, mercury, cadmium, hexavalent chromium, PBB, and PBDE.
REACH (EC No. 1907/2006)	**Compliant**	No Substances of Very High Concern (SVHC) above threshold levels.
Halogen Content	**Halogen-Free**	Does not contain chlorine, bromine, or fluorine-based compounds.
Asbestos Content	**Asbestos-Free**	Contains no asbestos or mineral fibres classified as carcinogenic.
Formaldehyde Emissions	**Nil**	Phenol-free resin formulation – compliant with low-VOC manufacturing standards.
Ozone-Depleting Substances (ODS)	**None**	Manufactured without CFCs, HCFCs, halons, or other ozone-depleting agents.
WEEE Directive (2012/19/EU)	**Compliant**	Suitable for recycling and recovery under the Waste Electrical and Electronic Equipment framework.
ISO 14001 Alignment	**Meets Intent**	Manufactured under environmental management practices consistent with ISO 14001 principles.
End-of-Life Disposal	**Non-Hazardous Waste**	Can be disposed of in accordance with local industrial waste regulations.
Carbon Footprint	**Low**	Produced via compression moulding with minimal energy and waste generation.

Summary:
GPO-3 is an environmentally responsible insulation composite, meeting RoHS, REACH, and halogen-free standards.

It contains no asbestos, heavy metals, or ozone-depleting chemicals, supporting sustainable manufacturing and responsible disposal.

MISCO Australia ensures all GPO-3 materials are sourced and processed in accordance with Australian environmental, health, and safety regulations, and supports full traceability via Certificates of Conformance (CoC) and Material Declarations upon request**.**

SUSTAINABILITY AND ENVIRONMENTAL IMPACT

Sustainability and Environmental Impact

Overview:
GPO-3 is engineered for long service life, low environmental impact, and full regulatory compliance, aligning with MISCO Australia's commitment to responsible sourcing and sustainable manufacturing. Its durability and electrical performance extend equipment lifespan, reducing replacement frequency and waste generation.

Material Sustainability

- **Long Lifecycle:** Exceptional thermal and mechanical stability allows decades of service in switchboards, transformers, and power systems.
- **Recyclable Components:** GPO-3 can be repurposed for secondary insulation uses or ground for filler in composite recycling streams.
- **Reduced Resource Consumption:** Compression moulding processes minimise resin waste and scrap generation.
- **Non-Toxic Composition:** Free from halogens, asbestos, heavy metals, and formaldehyde.

Manufacturing and Energy Efficiency

- **Low-Emission Production:** Manufactured using controlled moulding cycles with minimal VOC release.
- **Energy Efficient Process:** Hot-press curing achieves high yield per cycle with reduced energy input compared to continuous laminating processes.
- **Waste Management:** Offcuts and rejected parts are collected for recycling or energy recovery in accordance with local EPA guidelines.

Environmental Impact

- **Halogen-Free and Asbestos-Free:** Prevents the release of harmful gases during cutting, processing, or disposal.
- **Chemically Stable:** Resistant to leaching, degradation, or release of hazardous substances in landfill conditions.
- **Non-Corrosive and Non-Contaminating:** Safe for use in enclosed electrical equipment and near environmentally sensitive installations.
- **Reduced Carbon Impact:** Local machining and fabrication by MISCO Australia reduce transport-related emissions and support domestic manufacturing sustainability.

End-of-Life and Disposal

- Classified as non-hazardous industrial waste under Australian regulations.

- Can be mechanically recycled, co-processed for energy recovery, or disposed of in industrial landfill where permitted.
- No special handling required beyond standard composite waste protocols.

MISCO Australia Environmental Commitment

MISCO Australia operates under environmental management principles aligned with ISO 14001, promoting waste reduction, energy efficiency, and sustainable supply chain practices. Each batch of GPO-3 is traceable to source and accompanied by a Certificate of Conformance (CoC) confirming compliance with RoHS 3, REACH, and WHS environmental safety standards.

Summary:
GPO-3 supports sustainable engineering through durability, compliance, and recyclability. By using environmentally responsible composites like GPO-3, MISCO Australia contributes to safer, longer-lasting, and more sustainable electrical infrastructure across Australia's industrial and energy sectors.

SAFETY INFORMATION

GPO-3 is a solid, inert thermoset composite and is not hazardous in its finished form. Health risks arise primarily from dust produced during cutting, machining, or sanding.

Health Hazards

- Dust may irritate the eyes, skin, and respiratory system.
- Prolonged exposure without protection may cause temporary coughing or itching.
- Material is non-toxic, non-carcinogenic, and contains no asbestos or halogens.

Personal Protective Equipment (PPE)

- Eye Protection: Safety glasses or face shield.
- Respiratory: P2 dust mask or respirator when machining.
- Skin Protection: Gloves and long sleeves to prevent irritation.
- Hearing Protection: Recommended during power tool operation.

Safe Work Practices

- Use dust extraction or local exhaust ventilation at all machining points.
- Keep dust levels below Safe Work Australia exposure limits (<10 mg/m^3 total dust).
- Clean using vacuum or damp cloths – never use compressed air.
- Maintain a tidy, ventilated workspace.

Fire Safety

- Rated UL 94 V-0, self-extinguishing.
- Combustion may release carbon monoxide and carbon dioxide.
- Use water fog, CO_2, or dry chemical to extinguish.

First Aid

- Inhalation: Move to fresh air; seek attention if irritation continues.
- Skin Contact: Wash with soap and water.
- Eye Contact: Rinse with water for 15 minutes; seek medical advice if needed.
- Ingestion: Rinse mouth; medical advice if symptoms persist.

Storage and Disposal

- Store flat in a cool, dry place away from sunlight and ignition sources.
- Dispose of as non-hazardous industrial waste through approved facilities.

Regulatory Compliance

- GHS Classification: Not hazardous.
- Transport: Not regulated (ADG Code).
- WHS / ISO 45001: Conforms to Australian workplace safety standards.

Summary:
GPO-3 is a safe, flame-retardant insulation material when handled properly.
Use PPE, dust extraction, and safe machining practices to ensure a clean and compliant work environment.

Refer to Safety Data Sheet (SDS) for full details before handling.

WARRANTY

MISCO Australia Pty Ltd warrants that all GPO-3 products supplied are free from manufacturing defects in material and workmanship at the time of delivery.

This warranty applies under the following conditions:

- The material is used, stored, and processed in accordance with MISCO Australia's technical data, handling, and safety guidelines.
- The product has not been altered, machined, or modified in a manner inconsistent with the intended use.

- The material has not been subjected to misuse, neglect, accident, or improper installation.

Warranty Period:
Twelve (12) months from the date of delivery unless otherwise specified in a formal supply agreement.

Remedy:
MISCO Australia's liability under this warranty is limited, at its discretion, to the replacement of the product or refund of the original purchase price.
No claim shall exceed the invoice value of the material supplied.

DISCLAIMER

*The information provided in this data sheet is intended as a general guide for the use and handling of material. It is based on current knowledge, testing, and is believed to be accurate and reliable as of the date of publication. However, **MISCO Australia** makes no warranties, express or implied, regarding the material's performance, suitability, or fitness for any specific application.*

Users are responsible for determining the material's suitability for their intended purpose, including conducting independent tests and evaluations, as necessary. MISCO Australia does not accept any liability for any loss, damage, or injury resulting from the use of this information, the products described, or reliance on the provided recommendations.

Specifications are subject to change without notice as part of MISCO Australia's ongoing product improvement initiatives.

Always refer to the latest version of this data sheet before proceeding with critical applications.

All sales are subject to MISCO Australia's standard terms and conditions of sale.

Revision	Date Issued	Prepared / Reviewed By	Description of Change	Approved By
1.0	01/12/2024	MISCO Australia	Initial release of Safety Data Sheet	Director, MISCO Australia

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End of Technical Data Sheet.