



TECHNICAL DATA SHEET (TDS)

TYPE X SWITCHPANEL

PRODUCT IDENTIFICATION

- **Product Name:** Type X Switchpanel
- **Material Type:** Paper-Reinforced Phenolic Composite (Thermoset)
- **Details:**
 - **Company:** MISCO Australia
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- **TDS Number:** MISCO – TDS - 001
- **TDS Date:** 01/12/2024
- **TDS Version:** 1

PRODUCT DESCRIPTION

Type X Switchpanel is a paper-based phenolic composite engineered for use as an electrical insulating and structural material in switchboards, transformers, and general electrical equipment. It is manufactured under heat and pressure from high-grade cellulose paper impregnated with phenolic resin, forming a dense, rigid, and dimensionally stable panel with outstanding dielectric performance and mechanical strength.

The material provides excellent electrical insulation, low moisture absorption, and resistance to tracking, arcing, and heat — making it a reliable and economical choice for low- to medium-voltage assemblies. Type X Switchpanel machines cleanly, holds tight tolerances, and maintains surface integrity during fabrication, ensuring accuracy in CNC-cut components and drilled or tapped parts.

It is the industry-proven standard for busbar barriers, backplates, control panels, and insulation partitions, where consistent performance, cost efficiency, and machinability are equally critical.

NEMA GRADE

NEMA: Type X (Paper-Base Phenolic)

Standard Reference: NEMA LI-1 – Industrial Laminated Thermosetting Products

CLASS

Thermal Class: Class B (130 °C)

Insulation Class (Electrical): Class E – B, suitable for continuous operation up to 130 °C

Material Group: Phenolic Resin – Paper Reinforced (Thermoset Composite)

Flame Rating: UL 94 HB (Self-Extinguishing)

Application Range: Low- to Medium-Voltage Insulation Systems

MILITARY SPECIFICATIONS AND TYPE

Specification: MIL-I-24768 – Insulating Materials, Thermosetting, Laminated, Sheet, Rod, and Tube

Material Type: MIL-I-24768/12 – Type PFB (Phenolic Resin, Paper Base)

Equivalent Commercial Grade: NEMA X / IEC PFCP201

Description: Paper-reinforced phenolic laminate with excellent dielectric strength and moderate mechanical strength, designed for switchgear, control panels, and electrical insulation structures.

Conformance: Manufactured and tested in accordance with MIL-I-24768 performance requirements for electrical and mechanical properties.

KEY PROPERTIES

- **High Dielectric Strength** – Reliable electrical insulation for low- and medium-voltage systems.
- **Dimensional Stability** – Maintains shape and flatness under load and temperature.
- **Mechanical Strength** – Strong, rigid, and impact-resistant paper-based composite.
- **Arc and Track Resistance** – Withstands electrical discharge and surface tracking.
- **Thermal Endurance** – Rated to Class B (130 °C) for continuous service.
- **Machinability** – Excellent performance in CNC routing, drilling, and tapping.
- **Flame Retardant** – Self-extinguishing phenolic resin system (UL 94 HB).
- **Low Moisture Absorption** – Stable electrical and mechanical performance in humid environments.
- **Chemical Resistance** – Resistant to oils, coolants, and cleaning solvents.
- **Economical** – Cost-effective solution for insulating and structural switchboard components.

- **Uniform Surface Finish** – Provides clean edges and smooth surfaces ideal for painted or labelled panels.
- **Non-Halogenated & Asbestos-Free** – Environmentally safer insulation material.

APPLICATIONS

- Switchboard panels, partitions, and barriers
- Busbar supports, covers, and backing boards.
- Control panel boards and front plates.
- Terminal boards, spacers, and insulating blocks
- Transformer and motor insulation barriers
- Electrical and mechanical mounting plates
- Protective shrouds, guards, and structural insulation components
- Arc shields and phase separators in low- and medium-voltage assemblies.
- Custom-machined parts for electrical and industrial systems

INDUSTRIES SERVED

- **Switchboard Builders** – Insulating panels, barriers, and busbar supports.
- **Transformer Manufacturers** – Structural insulation and component fabrication
- **Motor Rewinds and Repairs** – Electrical insulation and mounting components
- **Electrical and Electronics** – Control panels, terminal boards, and support plates
- **Industrial Machinery** – Custom insulation and non-conductive machine parts
- **Construction and Infrastructure** – Electrical distribution and enclosure systems
- **Power Generation and Renewable Energy** – Low-voltage isolation and control equipment
- **Rail and Transport** – Electrical barrier panels and switchgear insulation
- **Defence and Aerospace** – Electrical isolation materials for compliant systems.
- **Oil, Gas, and Energy** – Non-conductive structural supports and switchgear insulation.

SPECIFICATIONS

Property	Details
Product Form	Sheets, rods, and machined components
Standard Colours	Black / Grey
Sheet Sizes	1220 × 2440 mm (standard) — custom sizes available on request
Thickness Range	1.6 mm to 50 mm (other thicknesses available on request)

Manufactured To	NEMA LI-1 Type X IEC 60893-3-4 PFCP201 MIL-I-24768/12 (Type PFB)
Flame Rating	UL 94 HB (Self-Extinguishing)
Compliance	RoHS 3 and REACH Compliant Asbestos-Free / Halogen-Free Environmentally Safe – Non-Toxic
Finish	Smooth matte finish suitable for painting, printing, or engraving
Density	1.35 – 1.45 g/cm ³
Thermal Class	Class B (130 °C)

TOLERANCES ON SHEET THICKNESS

Nominal Thickness (mm)	Thickness Tolerance (± mm)	Typical Flatness (mm/m)
1.6 – 3.0	±0.20	≤ 1.5
3.1 – 6.0	±0.25	≤ 1.5
6.1 – 12.0	±0.30	≤ 1.5
12.1 – 25.0	±0.40	≤ 2.0
25.1 – 40.0	±0.50	≤ 2.0
40.1 – 50.0	±0.70	≤ 2.5

Notes:

- Tolerances apply to standard sheets in as-supplied condition.
- Machined components may require additional allowance depending on finish and dimensional accuracy.
- Flatness values measured at 23 °C and 50 % RH after conditioning.

MECHANICAL PROPERTIES

Property	Unit	Typical Value	Test Method / Standard
Density	g/cm ³	1.35 – 1.45	ASTM D792
Tensile Strength (Cross Grain)	MPa	90 – 110	ASTM D638 / IEC 60893
Compressive Strength (Flatwise)	MPa	250 – 300	ASTM D695
Flexural Strength	MPa	150 – 200	ASTM D790
Modulus of Elasticity (Flexural)	GPa	9.0 – 10.5	ASTM D790
Impact Strength (Charpy, Unnotched)	kJ/m ²	5 – 7	ISO 179
Shear Strength	MPa	20 – 25	ASTM D732
Hardness (Rockwell M)	–	90 – 100	ASTM D785
Poisson's Ratio	–	0.30	Typical
Water Absorption (24 hr @ 23 °C)	%	0.7 – 1.2	ASTM D570
Bond Strength (Interlaminar Shear)	MPa	12 – 15	ASTM D2344
Compressive Modulus	GPa	10 – 11	ASTM D695
Edgewise Compressive Strength	MPa	220 – 250	IEC 60893-2
Elastic Recovery (after 24h @ 23°C)	%	≥ 97	Internal Test
Coefficient of Friction (Dry vs Steel)	–	0.35 – 0.40	ASTM D1894
Machinability Rating	–	Excellent (Carbide / PCD tooling recommended)	MISCO Standard

Notes:

- Mechanical properties are determined on conditioned 3–6 mm sheet specimens.
- Type X maintains rigidity and dimensional stability under both compressive and bending loads.
- High mechanical integrity and consistent surface hardness make it ideal for precision machined electrical components.
- When CNC machining, steady fixturing and moderate feed rates prevent edge chipping and ensure smooth finish.
- Machining dust is fine and should be controlled using local extraction and appropriate PPE.

ELECTRICAL PROPERTIES

Property	Unit	Typical Value	Test Method / Standard
Dielectric Strength (Perpendicular @ 3 mm)	kV/mm	10 – 12	ASTM D149 / IEC 60243-1
Dielectric Strength (Parallel to Laminate)	kV	18 – 22	ASTM D149
Insulation Resistance (After 24 h @ 90 % RH)	Ω	1×10^{10}	ASTM D257
Volume Resistivity	$\Omega \cdot \text{cm}$	1×10^{12}	ASTM D257
Surface Resistivity	Ω	1×10^{12}	ASTM D257
Arc Resistance	Sec	100 – 120	ASTM D495
Comparative Tracking Index (CTI)	V	300 – 400	IEC 60112
Dielectric Constant (1 MHz)	–	4.5 – 5.0	ASTM D150
Dissipation Factor (1 MHz)	–	0.020 – 0.030	ASTM D150
Insulation Class	–	Class B (130 °C)	IEC 60085
Breakdown Voltage (3 mm sample)	kV	30 – 36	ASTM D149

Notes:

- Values are typical for 3 mm thickness, tested at 23 °C and 50 % relative humidity.
- Type X retains stable dielectric properties under humidity, heat, and electrical load.
- The material provides reliable insulation performance for low- to medium-voltage switchgear and control panels.

THERMAL PROPERTIES

Property	Unit	Typical Value	Test Method / Standard
Thermal Class	°C	Class B (130 °C)	IEC 60085
Maximum Continuous Operating Temperature	°C	130	ASTM D794
Short-Term Temperature Limit	°C	160	Typical
Heat Distortion Temperature (HDT @ 1.8 MPa)	°C	160	ASTM D648
Coefficient of Thermal Expansion (Linear)	1/K × 10 ⁻⁵	2.0 – 2.5	ASTM E831
Thermal Conductivity	W/m·K	0.30	ASTM E1530
Specific Heat Capacity	J/kg·K	1,000	Typical
Flammability Rating	–	UL 94 HB (Self-Extinguishing)	UL 94
Oxygen Index (LOI)	%	25 – 28	ASTM D2863
Thermal Stability (Weight Loss @ 150 °C, 24 h)	%	≤ 1.0	Internal Test
Glass Transition Temperature (Tg)	°C	160 – 175	DSC (ASTM D3418)
Thermal Ageing (168 h @ 130 °C)	–	No delamination or cracking	IEC 60216
Thermal Endurance Index (TEI)	°C	135	IEC 60216-1
Smoke Emission (when exposed to flame)	–	Low / Non-toxic	Internal Test
Shrinkage After Heating (150 °C, 24 h)	%	< 0.2	ASTM D955
Dimensional Stability (RT → 120 °C)	mm/m	≤ 1.0	MISCO Standard

Notes:

- Type X Switchpanel maintains dimensional stability and mechanical strength at elevated temperatures typical of switchboard and transformer environments.
- Material performance is stable across Class B thermal systems (130 °C continuous operation).
- Not recommended for sustained service above 160 °C.

CHEMICAL RESISTANCE

Chemical / Substance	Resistance Level	Observation / Notes
Mineral Oils	Excellent	No swelling or degradation; stable under transformer and hydraulic oils.
Synthetic Lubricants	Good	Minimal surface change after prolonged exposure.
Alcohols (Methanol, Ethanol)	Good	Slight softening possible under long-term immersion.
Petroleum Solvents (Kerosene, Diesel)	Good	Minor surface dulling; dimensional stability retained.
Aliphatic Hydrocarbons	Excellent	Chemically stable; no visible effect.
Aromatic Hydrocarbons (Toluene, Xylene)	Fair	Slight swelling; not recommended for continuous exposure.
Dilute Acids (Sulphuric, Hydrochloric <10%)	Good	Minimal change; occasional surface discolouration.
Concentrated Acids (> 10%)	Poor	Surface attack and strength reduction over time.
Alkalis (NaOH, KOH)	Fair	Limited resistance; surface etching over extended contact.
Saline Solutions	Excellent	No degradation; ideal for humid or marine-adjacent environments.
Ammonia Solutions	Fair	Slight softening possible; short-term exposure acceptable.
Water (Cold, Room Temp)	Excellent	Negligible absorption or warping.
Steam (100 °C)	Moderate	Gradual loss of mechanical strength over long exposure.
Refrigerants (R134a, R22)	Excellent	Chemically stable under operational conditions.
Cleaning Agents / Detergents	Excellent	No effect under normal maintenance exposure.

- Type X Switchpanel demonstrates strong resistance to oils, greases, coolants, and most cleaning chemicals used in switchboard and transformer environments.
- It remains chemically stable in industrial atmospheres, with only limited attack from concentrated acids, alkalis, and aromatic solvents.
- The phenolic resin system is non-reactive and self-extinguishing, ensuring electrical safety even after surface contamination.
- Long-term immersion in corrosive fluids is not recommended, clean with mild solvents or neutral detergents only.

PROCESSING AND MACHINING CONSIDERATIONS

Type X Switchpanel machines cleanly and predictably using standard woodworking or composite machining equipment. Its dense, paper-based phenolic structure allows accurate cutting, drilling, and routing without fibre pull-out or resin chipping when proper tooling and feeds are used.

General Machining Guidance

- Tooling: Use tungsten carbide (K10–K20) or polycrystalline diamond (PCD) cutting tools for extended life and clean finish.
- Tool Geometry: Positive rake angles (10–15°) with fine cutting edges reduce surface tearing.
- Feed & Speed: Moderate feed rates and spindle speeds prevent overheating. Avoid tool dwell or excessive pressure at breakout points.
- Coolants: Typically machined dry. Compressed air or vacuum extraction is preferred over liquid coolants to avoid surface staining.
- Surface Finish: Produces smooth, matte surfaces suitable for painting, screen-printing, or engraving.

Drilling and Tapping

- Use sharp HSS or carbide drills; back up the exit side to avoid chipping.
- Maintain consistent chip evacuation; withdraw drills periodically on deep holes.
- Threads can be tapped cleanly; lubricate lightly with paraffin or cutting wax for best results.

Sawing and Cutting

- Panel saws or CNC routers with triple-chip or straight-flute cutters are recommended.
- Maintain a firm hold-down or vacuum table to avoid vibration.
- Pre-scoring on CNC routers improves surface edge definition.

Milling and Routing

- Use solid carbide end mills for small-diameter cuts and high edge precision.
- Light climb milling passes minimise delamination.
- Maintain consistent toolpath overlap to prevent edge heat marks.

Dust Extraction and Safety

- Phenolic machining produces fine dust that may irritate eyes, skin, and lungs.
- Always use local exhaust extraction (LEV) and PPE including respirator, gloves, and safety glasses.
- Maintain a clean work area; do not blow dust with compressed air.

Post-Processing

- Deburr edges with fine abrasive or scotch-brite pad.
- Parts may be painted or printed directly; ensure surface is clean and free of oil or residue.
- Thermal forming is not recommended — Type X is a fully cured thermoset material.

SHEET HANDLING BEFORE MACHINING

Proper handling and conditioning of Type X Switchpanel prior to machining are essential to ensure dimensional stability and consistent finish quality.

Storage Conditions

- Store sheets flat and fully supported on a dry, level surface to prevent warping or bowing.
- Keep material in a clean, enclosed, and dry environment, ideally at 23 ± 2 °C and 50 \pm 5 % relative humidity.
- Avoid exposure to direct sunlight, heat sources, or moisture, as these can cause slight dimensional movement.
- Do not lean large sheets vertically against walls for extended periods.

Acclimatisation

- Allow sheets to acclimatise in the workshop environment for a minimum of 24 hours prior to machining, or longer if stored in cooler or humid conditions.
- This ensures equilibrium moisture content and prevents post-machining dimensional drift.

Preparation

- Inspect each sheet for damage, surface contamination, or delamination prior to cutting.
- Remove any protective film or packaging immediately before machining.
- Wipe surfaces free of dust or oil with a clean, dry cloth.
- Mark out components using soft pencil or non-permanent marker only — avoid sharp scribes.

Handling and Safety

- Always lift sheets by two persons or use mechanical assistance for thicker panels to prevent edge damage.
- Use protective gloves to avoid skin irritation from resin dust or sharp edges.
- Keep sheet edges protected during storage and transport to prevent corner chipping.

ENVIRONMENTAL COMPLIANCE

Compliance Category	Status / Details
RoHS 3 (Directive 2015/863/EU)	Compliant — free from lead, cadmium, mercury, hexavalent chromium, PBB, and PBDE.
REACH (EC 1907/2006)	Compliant — no Substances of Very High Concern (SVHC) present above threshold limits.
Asbestos Content	None — completely asbestos-free.
Halogen Content	None — halogen-free resin system.
Ozone-Depleting Substances	None detected; compliant with Montreal Protocol.
Persistent Organic Pollutants (POP Regulation EU 2019/1021)	Compliant — no restricted persistent organic pollutants.
Heavy Metals (Lead, Cadmium, Mercury, Chromium VI)	Below analytical detection limits.
Volatile Organic Compounds (VOC)	Low-VOC; phenolic resin fully cured and non-emissive under normal conditions.
Recyclability	Non-recyclable thermoset; can be mechanically repurposed or used in energy recovery processes.
Waste Classification	Non-hazardous solid waste under EPA guidelines.
Environmental Impact	Stable, non-toxic, non-leaching material suitable for landfill disposal under local regulations.

- Type X Switchpanel is a non-hazardous, halogen-free, and environmentally stable insulating material.
- Fully compliant with RoHS 3, REACH, and global environmental standards relevant to industrial electrical products.
- Its cured phenolic system produces no volatile emissions or leachable contaminants, supporting safe use in switchboards, transformers, and enclosed electrical assemblies.

SUSTAINABILITY AND ENVIRONMENTAL IMPACT

Material Composition and Lifecycle

- Type X Switchpanel is a fully cured thermoset composite made from phenolic resin and cellulose paper reinforcement, both derived from responsibly managed sources.
- The phenolic resin system provides long-term stability and minimal material degradation, resulting in an extended service life and reduced replacement frequency in industrial applications.
- Manufacture is conducted under controlled conditions to ensure low emissions, minimal waste generation, and compliance with RoHS and REACH directives.

Resource Efficiency

- Production involves efficient resin impregnation and hot-pressing, minimising offcuts and reject material.
- Offcuts and machining residues are inert and can be safely disposed of as non-hazardous industrial waste.
- Material longevity contributes to lower lifecycle energy consumption compared to reprocessed or short-life insulating materials.

Recycling and Disposal

- As a cured thermoset, Type X cannot be melted or reformed; however, it can be:
 - Mechanically repurposed as filler or reinforcement in composite manufacturing.
 - Used in energy recovery processes through controlled incineration, generating recoverable heat energy.
- Waste material should be disposed of in accordance with local EPA and state environmental regulations.

Environmental Stability

- Type X is chemically inert, non-leaching, and does not emit volatile organic compounds (VOCs) in service.
- It does not contribute to soil or groundwater contamination and is suitable for landfill under non-hazardous waste classifications.
- The material's long operational lifespan reduces total environmental impact over product use cycles.

Sustainability Summary

- Long-lasting, stable, and environmentally responsible composite material.
- No halogens, asbestos, or toxic additives.
- Minimal maintenance and low disposal impact.
- Aligned with MISCO Australia's commitment to sustainable manufacturing and responsible material management.

SAFETY INFORMATION

General Overview

Type X Switchpanel is a fully cured thermoset composite that is non-toxic, non-flammable, and stable under normal handling and storage conditions. The material does not release harmful emissions during use and is safe when used as intended in electrical and mechanical insulation applications.

Handling Precautions

- Avoid generating or inhaling dust during cutting, drilling, or machining. Fine dust may cause temporary respiratory, skin, or eye irritation.
- Always use local exhaust ventilation (LEV) or dust extraction systems at machining stations.
- Wear appropriate Personal Protective Equipment (PPE):
 - Safety glasses or face shield.
 - Cut-resistant gloves.
 - P2 or N95 respirator during machining.
 - Protective clothing to prevent dust contact with skin.

Exposure Route	Recommended Action
Inhalation	Move to fresh air. Seek medical attention if irritation persists.
Skin Contact	Wash with soap and water. Use moisturiser to relieve dryness.
Eye Contact	Rinse cautiously with clean water for several minutes. Seek medical advice if irritation continues.
Ingestion	Unlikely under normal use. Rinse mouth and seek medical attention if symptoms occur.

Fire and Thermal Decomposition

- Material is self-extinguishing (UL 94 HB) and will not sustain combustion once the ignition source is removed.
- In a fire, decomposition may produce carbon monoxide, carbon dioxide, and phenolic vapours.
- Use CO₂, dry chemical, or foam extinguishers. Avoid direct water spray on molten resin residues.
- Firefighters should wear self-contained breathing apparatus (SCBA) and full protective gear.

Stability and Reactivity

- Stable under recommended storage and operating conditions.
- Avoid prolonged exposure to open flame or temperatures exceeding 160 °C.
- Incompatible with strong oxidising acids and alkalis.

Disposal and Environmental Safety

- Offcuts and machining dust are non-hazardous solid waste.
- Dispose of through general industrial waste streams or via energy recovery where permitted.
- Avoid uncontrolled burning or dumping.

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

WARRANTY

MISCO Australia warrants that Type X Switchpanel is manufactured to meet the company's published specifications and undergoes quality inspection prior to dispatch. The product is guaranteed to be free from defects in material and workmanship at the time of delivery.

This warranty is limited to the replacement or credit of goods proven defective due to manufacturing fault, provided that:

- The material has been stored, handled, and processed in accordance with MISCO Australia's recommendations.
- The defect is reported within a reasonable period from delivery.
- The material has not been subjected to misuse, modification, improper installation, or mechanical damage after supply.

No warranty is expressed or implied for performance in a specific application, as suitability must be determined by the user through evaluation under actual service conditions. MISCO Australia assumes no responsibility for loss, damage, or consequential costs arising from use of the material beyond the scope of this warranty.

All products are supplied in accordance with MISCO Australia's **Standard Terms and Conditions of Sale**, available on request or via www.misco.net.au

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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	January 2025	MISCO Australia	Initial release of Safety Data Sheet for Type X Switchpanel.	Director, MISCO Australia

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End of Technical Data Sheet.