BentleyHarris®
Protection Products

Innovative
Technology Solutions

FEDERAL MOGUL
Systems Protection

About Systems Protection

Federal-Mogul Systems Protection (FMSP) is the world's foremost supplier of protective sleeving and shielding solutions for wires, hoses, and mechanical assemblies. Major industries served include automotive, aerospace and defense, as well as a host of industrial segments. With sales, manufacturing, and innovation centers located in the Americas, Europe and Asia, FMSP delivers the broadest, most innovative product portfolio to both original equipment and tier suppliers. FMSP is the proud manufacturer of Bentley-Harris® protection products.

About Federal-Mogul

Headquartered in Southfield, Michigan, Federal-Mogul Corporation is a leading global supplier of powertrain and safety technologies, serving the world's foremost original equipment manufacturers of automotive, light commercial, heavy-duty, agricultural, marine, rail, off-road and industrial vehicles, as well as the worldwide aftermarket. With locations in 35 countries, the company's leading technology and innovation, lean manufacturing expertise, as well as marketing and distribution deliver world-class products, brands and services.

Our Mission

To be recognized by our customers, on a worldwide basis, as the pre-eminent supplier of protection products, by providing excellent product value, outstanding customer service and innovative product solutions.

FEDERAL MOGUL Systems Protection

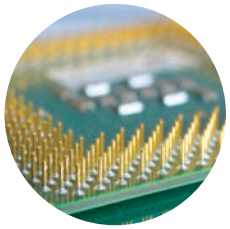
BentleyHarris® Protection Products

About Innovative Technology Solutions

Innovative Technology Solutions (ITS) offers a comprehensive line of bundling and component protection solutions. Our wide range of products include sleeving and shielding to protect against abrasion, radiant and convective heat, and electromagnetic interference.

ITS, a division of Federal-Mogul Systems Protection, is focused on serving customers in a variety of transportation and industrial markets, including:

Commercial Vehicle



Electronics

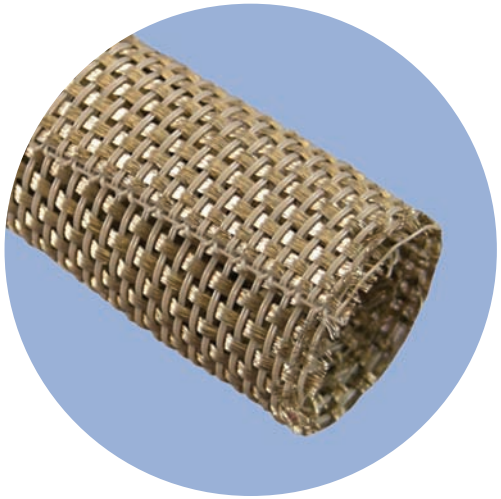
Marine

Offshore Oil Drilling

Railway

With excellent products, strong technical services, and global manufacturing and distribution, ITS is the supplier of choice for component protection.

Sensor/Connector Protection



EMI Protection

Leading Edge Solutions

Federal-Mogul Systems Protection is committed to the continual development of innovative solutions that meet your ever changing needs. From concept to commercialization, we focus on the advancement of engineering technologies from our state-of-the-art research, development and testing facilities located worldwide. Our specific areas of concentration include:

- Abrasion & Damage Protection
- Acoustic Noise Generation & Propagation
- Heat Generation & Absorption
- Materials Engineering
- Electromagnetic Shielding

Our experienced technical teams are focused on new technology exploration as well as new product development. With innovation facilities in North America, Europe and Asia, we are fully staffed to ensure quick and appropriate customer response.

And with certifications including ISO/TS 16949:2002 for Quality Management Systems, and ISO 14001:2004 for Environmental Management with conformity for Occupational Health & Safety, you'll always be assured of the quality and reliability of our products.

ISO

RoHS COMPLIANT

UL

Exceptional Capabilities

The ITS Group is committed to providing customers with extensive technical support related to their application requirements. We offer extensive qualification reports on our components though our world-class technology centers. Utilizing state-of-the art test equipment, we are able to simulate real-life conditions that allow you to evaluate our product performance for your specific application. Testing capabilities provide evaluation of the following:

- **Acoustical:** sound dampening and absorption effect of a product
- **EMI:** ability of a component to dissipate or shield from electromagnetic interference
- **Environmental:** product performance in terms of anticipated environmental conditions, including flammability, smoke density, durability, fogging, stone impingements, and humidity
- **Mechanical:** abrasion resistance, tensile strength, and impact effect on a product under various stress conditions
- **Thermal:** insulating ability of a product to protect or contain heat from an external or internal heat source

Our ability to simulate customer specific scenarios on-site, utilize predictive modeling and conduct extensive testing enables us to quickly respond and deliver the highest level of protection for your applications. Our technical teams are at your disposal to define and conduct the tests most appropriate to your component needs.

Abrasion / Mechanical Protection

	Product	Description	Temperature	Flammability	Halogen Free	Aerospace Grade*	UL Recognized	Construction	Available Sizes
ELECTRONICS	 **Expando® PT Plus**	Highly expandable braid (1:3) with strong mechanical protection; treated to prevent end-fray; available in a variety of colors for identification	-70°C to +125°C (-94°F to +257°F)				✓	**Material:** Polyester **Colors:** Natural, Black, Yellow, Blue, Gray, Orange	3 to 64 mm (1/8" to 2-1/2")
	 **Expando® FR Plus**	Highly expandable braid (1:3) with strong mechanical protection and outstanding flame resistance; treated to prevent end-fray	-70°C to +125°C (-94°F to +257°F)	UL 1441 VW-1 FAR Part 25			✓	**Material:** Flame-retardant polyester **Colors:** Black with white tracer; White with black tracer	3 to 64 mm (1/8" to 2-1/2")
	 **ROUNDIT® 2000**	Self-wrapping sleeve with strong mechanical protection; quick and easy installation on cables	-70°C to +125°C (-94°F to +257°F)	FMVSS-302 Test Method D45 1333 Self-extinguishing Type B			✓	**Material:** Polyester **Color:** Black	5 to 45 mm (3/16" to 1-3/4")
	 **Expando® QT / TCP S**	Highly expandable braid (1:3) with a combination of mono and multifilaments, offering both noise suppression and mechanical protection	-50°C to +150°C (-58°F to +302°F)	FMVSS-302 Test Method D45 1333 Self extinguishing Type B				**Material:** Polyester **Color:** Black	3 to 32 mm (1/8" to 1-1/4")
HEAVY DUTY / INDUSTRIAL	 **Expando® DM**	Expandable braid (1:2) with high mechanical protection; ideal protection from cut-through	-70°C to +125°C (-94°F to +257°F)				✓	**Material:** Nylon and polyester **Color:** Black	3 to 51mm (1/8" to 2")
	 **ProGard®**	Tubular woven sleeve with outstanding mechanical protection; ideal for hydraulic hose protection	-20°C to +125°C (-4°F to +257°F)					**Material:** Nylon **Color:** Black	19 to 70 mm (3/4" to 2-3/4")
RAILWAY	 **ROUNDIT® 2000 FR**	Self-wrapping sleeve with good mechanical protection; soft to the cable structure	-50°C to +125°C (-58°F to +257°F)	NF 16 101 - 16102 : I3 F2 DB DIN 5510 § 2 & 54837 : S4,SR2,ST2; ASTM E 662 - ASTM E 162	✓			**Material:** Flame-retardant polyester **Color:** Black	5 to 50 mm (3/16" to 2")
	 **ROUNDIT® 2000 V0**	Self-wrapping sleeve with high mechanical protection; ideal flame resistance with low toxicity and smoke emission	-50°C to +125°C (-58°F to +257°F)	NF 16101 - 16102: I2 F1; DB DIN 5510 § 2 & 54837: S4,SR2, ST2; UNI; ASTM E 662 - ASTM E 162; Raw material UL 94 V0	✓			**Material:** UL 94 V0 Rated Polyester **Color:** Black	5 to 50 mm (3/16" to 2")
	 **Expando® TCP V0**	Expandable braid (1:2) with strong mechanical protection; with low toxicity and smoke emission	-50°C to +150°C (-58°F to +302°F)	NF 16101 - 16102: I2 F2; DB DIN 5510 § 2 & 54837: S4,SR2, ST2; UNI; ASTM E 662 - ASTM E 162; Raw material UL 94 V0	✓			**Material:** UL 94 V0 Rated Polyester **Colors:** Black with gray tracer; Gray with a black tracer	3 to 50 mm (3/16" to 2")
SPECIALTY HIGH TEMPERATURE	 **Expando® HR Plus**	Highly expandable braid (1:3) with good mechanical protection and outstanding chemical resistance; treated to prevent end-fray	-70°C to +150°C (-94°F to +302°F)	UL 1441 VW-1 FAR Part 25		✓	✓	**Material:** Halar **Color:** Black with a white tracer; White with a black tracer	3 to 64 mm (1/8" to 2-1/2")
	 **ROUNDIT® PPS**	Self-wrapping sleeve with good mechanical protection; ideal for mechanical protection of shielding metal in swamp areas	-60°C to +175°C (-76°F to +347°F)	FAR Part 25	✓	✓		**Material:** PPS **Color:** Black	5 to 38 mm (3/16" to 1-1/2")
	 **Expando® 686 DM**	Expandable braid (1:2) with outstanding mechanical protection; ideal solution for high temperature mechanical performance	-70°C to +200°C (-94°F to +392°F)	UL 1441 VW-1 FAR Part 25	✓	✓		**Material:** PEEK & PPS **Color:** Black, Natural	3 to 64 mm (1/8" to 2-1/2")
	 **Expando® HTNS-L/HO**	Expandable braid (1:2) with strong mechanical protection; oil and water repellent treated sleeve with the additional benefit of being soft to the cable structure	-60°C to +240°C (-76°F to +464°F)	FAR Part 25	✓	✓		**Material:** Nomex® **Color:** Camouflage green, ivory	2 to 30 mm (5/64" to 1-3/16")
	 **ROUNDIT® 2000 NX / NX HT**	Self-wrapping sleeve with high mechanical protection; ideal solution for high temperature mechanical performance	-60°C to +260°C (-76°F to +500°F)	FAR Part 25	✓	✓		**Material:** Nomex® and PPS or PEEK **Color:** Camouflage green, Orange, Red	5 to 40 mm (3/16" to 1-5/8")

Nomex is a registered trademark of DuPont

** meets highly stringent requirements of aerospace/defense industry*

Thermal Management

	Product	Description	Temperature	Type of Heat Protection	Halogen Free	Aerospace Grade*	Construction	Available Sizes
HEAVY DUTY / INDUSTRIAL	 **Industrial FyreJacket® / Thermotubix**	Silicone-coated sleeve with good resistance to high temperatures; provides excellent protection against high temperatures, fire, and molten splashes	-54°C to +260°C (-65°F to +500°F)	Convective			**Material:** Fiberglass and silicone **Color:** Reddish-brown	8 to 101 mm (5/16" to 4")
	 **ThermoJacket® R / S**	Braided sleeve with excellent resistance to high temperatures; used as a long-term heat protection; extremely expandable (TJ-R) or delivered without anti-fray impregnation (TJ-S)	up to +550°C (up to +1022°F)	Convective		✓	**Material:** Fiberglass **Color:** Natural	6 to 102 mm (1/4" to 4")
	 **ThermoJacket® C**	Nextel braided sleeve with outstanding resistance to high temperatures; used as a long-term heat protection	up to +1200°C (up to +2200°F)	Convective			**Material:** Nextel® 312 **Color:** Natural	5 to 64 mm (1/4" to 2-1/2")
RAILWAY	 **GES 40 / 100**	Coated braided sleeve with dielectric resistance to 4kV or 10kV provides effective grounding of metal braid; resistant to salt and other harsh environments	-60°C to +220°C (-76°F to +428°F)	Conductive	✓		**Material:** Silicone rubber and fiberglass **Color:** Reddish-brown	0.5 to 32 mm (1/32" to 1-1/4")
	 **Aerospace FyreJacket® / Thermotubix**	Silicone-coated sleeve with outstanding fire protection up to +1100°C; provides excellent protection against high temperatures, fire, and molten splashes	-54°C to +260°C (-65°F to +500°F)	Conductive	✓	✓	**Material:** Fiberglass and silicone **Color:** Reddish-brown, black, aluminum	8 to 101 mm (5/16" to 4")
	 **FyreTape® / Thermobande**	Silicone-coated tape with good fire protection; easy to install on big pipes; may be used to replace or compliment Thermotubix	-54°C to +260°C (-65°F to +500°F)	Conductive	✓		**Material:** Fiberglass and silicone **Color:** Reddish- brown, aluminum	25 to 152 mm (1" to 6")
SPECIALTY HIGH TEMPERATURE	 **ROUNDIT® Therm A**	Self-wrappable sleeve with 3 layers for high fire protection up to +1100°C; excellent cut-through and abrasion resistance	-60°C to +260°C (-76°F to +500°C)	Flame-resistant	✓	✓	**Material:** Nomex® and PEEK with panox and silica **Color:** Olive green	10 to 32 mm (3/8" to 1-1/4")
	 **ROUNDIT® Therm B**	Self-wrappable sleeve with 2 layers with outstanding fire protection; excellent cut-through and abrasion resistance	-60°C to +260°C (-76°F to +500°C)	Fire-proof	✓	✓	**Material:** Nomex® and PEEK with fiberglass and silicone **Color:** Olive green	10 to 32 mm (3/8" to 1-1/4")
	 **Thermocord®**	Flexible rope with good resistance to high temperatures; provides complete isolation of air exchange	up to +550°C (up to +1022°F)	Conductive			**Material:** Fiberglass **Color:** White, Gray (adhesive version)	5 to 40 mm (1/4" to 1-5/8")
	 **PyroSeal**	Stainless steel knitted tube with good resistance to high temperatures; provide complete isolation to oven doors	up to +550°C (up to +1022°F)	Conductive			**Material:** Stainless steel and fiberglass **Color:** Gray or black	Customized part
	 **TST / TSX**	Silica braided sleeve with outstanding resistance to high temperatures; used for long-term heat protection in extreme environments	-60°C to +1100°C (-76°F to +2012°F)	Conductive	✓	✓	**Material:** Silica **Color:** Natural	0.5 to 35 mm (1/32" to 1-13/32")
OFFROAD	 **Therm-L-Wrap™**	Self-wrappable sleeve with an adhesive closure offers excellent radiant heat protection; provides component protection in high temperature areas	-40°C to +200°C (-40°F to +392°F)	Radiant			**Material:** Aluminum with fiberglass **Color:** Aluminum	10 to 25 mm (3/8" to 1")
	 **ReflectSleeve® / Therm-L-Lite®**	Tubular sleeve with excellent radiant heat protection; provides component protection in high temperature areas	-50°C to +220°C (-58°F to +428°F)	Radiant			**Material:** Aluminum with fiberglass **Color:** Aluminum	10 to 51 mm (3/8" to 2")
	 **Convoshield®**	Corrugated sleeve with good resistance to high temperatures; provides component protection in high temperature areas	-40°C to +175°C (-40°F to +347°F)	Radiant			**Material:** Nylon **Color:** Aluminum	6 to 25 mm (1/4" to 1")
	 **ThermoJacket® E**	Knitted sleeve with excellent resistance to high temperatures; good thermal containment performance	up to +650°C (up to +1202°F)	Convective			**Material:** Basalt **Color:** Brown	51 to 140 mm (2" to 5-1/2")
	 **ThermoJacket® D**	Knitted sleeve with excellent resistance to high temperatures; outstanding thermal containment performance	up to +1000°C (up to +1832°F)	Convective			**Material:** Silica and fiberglass **Color:** White	19 to 127 mm (3/4" to 5")
	 **ThermoJacket® M**	Wrappable sleeve with excellent resistance to high temperatures; outstanding thermal containment performance	up to +1000°C (up to +1832°F)	Convective			**Material:** Stainless steel and silica **Color:** Gray	51 to 140 mm (2" to 5-1/2")

Nomex is a registered trademark of DuPont • Nextel is a registered trademark of 3M Corporation.
** meets highly stringent requirements of aerospace/defense industry*

Electromagnetic Shielding

	Product	Description	Temperature	Flammability	Halogen Free	Aerospace Grade*	Metal	Construction	Available Sizes
HEAVY DUTY / INDUSTRIAL	**ROUNDIT® 2000 S EMI**	Tough self-wrapping solution; flexible and easy to install offering a combination of EMI shielding and abrasion resistance in corrosive environments	-50°C to +125°C (-58°F to +257°F)				316L Stainless steel	**Material:** 316L fine stainless steel combined with polyester **Color:** Black with ivory tracer for size identification	5 to 25 mm (3/16" to 1")
RAILWAY	**ROUNDIT® V0 EMI**	Self-wrapping metal solution; flexible and easy to install providing high performance EMI shielding	-50°C to +150°C (-58°F to +257°F)	NF 16101 16102: I4-F1 DIN5510 54837 SR2, ST2 Raw Material UL94 V0	✓		Tin-plated copper	**Material:** Tin-plated copper according to ASTM B-33 & EN13 602 combined with UL94 V0 rated flame retardant polyester monofilament **Color:** Light gray	8 to 45 mm (5/16" to 1-3/4")
SPECIALTY HIGH TEMPERATURE	**ROUNDIT® 2000 NX EMI**	Self-wrapping multi-layer solution providing mechanical protection and very high performance EMI shielding; can also be delivered with an inner layer of PTFE for protection of the cables against abrasion from the metal layer	-55°C to +200°C (-65°F to + 392°F)	FAR 25 § 853 A & B	✓	✓	Nickel-plated copper C27	**Material:** Nickel-plated copper C27 according to ASTM B-355 combined with Nomex® multifilaments and PPS monofilaments. Also available with inner layer of PTFE tape. **Color:** Olive green	6 to 38 mm (1/4" to 1-1/2")
	ROUNDIT® EMI FMJ	Self-wrapping metal solution with 95% optical coverage; flexible and easy to install providing very high performance EMI shielding	-60°C to +200°C (-76°F to +392°F)	FAR 25 § 853 A & B	✓	✓	Nickel-plated copper C4	**Material:** Nickel-plated copper C4 according To ASTM B-355 combined with PPS monofilament **Color:** Light gray	8 to 38 mm (5/16" to 1-1/2")

EMI Highlights

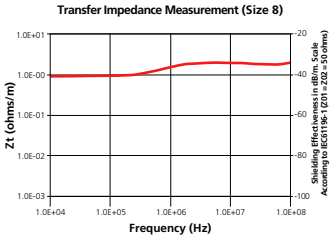
Electromagnetic Interference (EMI) can cause adverse effects on electronic components and equipment leading to operational malfunctions. Proper shielding and grounding of electromagnetic sensitive components can effectively eliminate this occurrence. Our EMI shielding products, constructed from materials including nickel-plated copper, tin-plated copper and stainless steel, Nomex®, PPS and polyester, provide excellent shielding properties with the added benefit of abrasion or thermal protection.

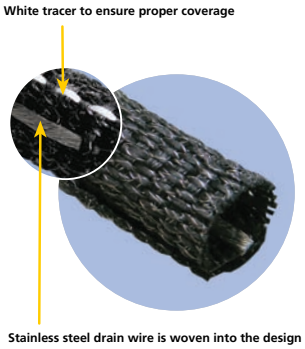
Services Provided to the Customer

Mock-up Service: We offer a unique service that provides you with the most appropriate solution in terms of shielding efficiency and installation. Using your harness, our engineers analyze your shielding needs. We define the specific products, accessories and related grounding solutions for your application as well as provide an installation guide to ensure the best solution to your EMI challenges.

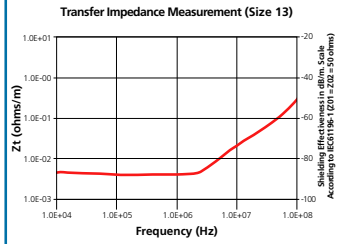
Customized Test Reporting: Our state-of-the-art test laboratory is available to evaluate your current or future wire harness shielding solutions. A detailed test report can be generated for your different harnessing and protection scenarios, allowing you to benchmark various application concepts. Working together, we can help fine-tune the appropriate solution to meet your needs.

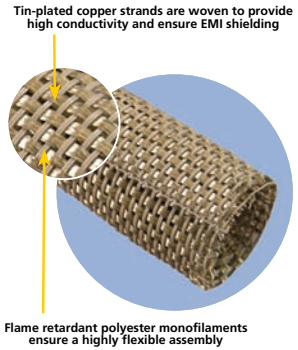
ROUNDIT® 2000 S EMI



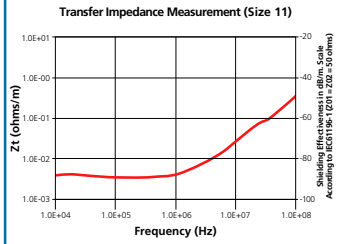


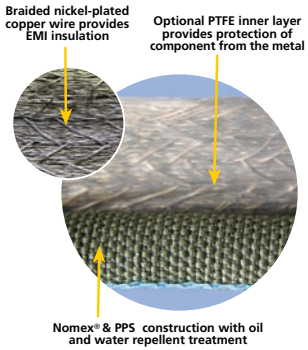
ROUNDIT® V0 EMI



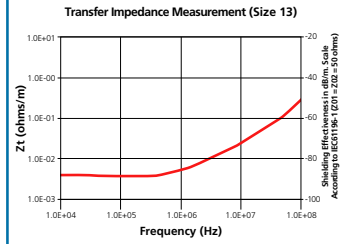


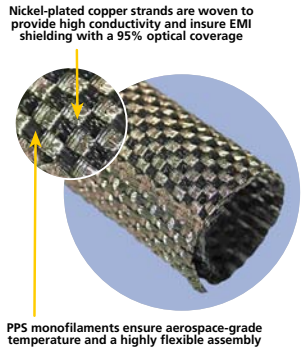
ROUNDIT® 2000 NX EMI





ROUNDIT® EMI FMJ





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Custom Shielding

Product Family	Description	Temperature	Type of Shielding	Construction	Available Sizes
QuietShield®	Noise suppression materials providing strong acoustical insulation *(under development)*		Acoustic	Various material blends and configurations available including eco-friendly version	Roll goods and die-cut pieces
ReflectShield® / Therm-L-Gard™	Custom multi-layer composite heat shielding system designed to provide excellent protection for components that must survive in high temperature areas; may include secondary processes and attachments to best meet application	Survives extended exposure to 538°C (1000°F) at 25 mm above radiant heat source; actual heat resistant properties are application specific	Thermal	Application specific; may include fiberglass fabric, aluminum foil laminate, pressure sensitive adhesive, non-woven materials	Custom parts may be slit to width and length, or die cut into complex geometric shapes

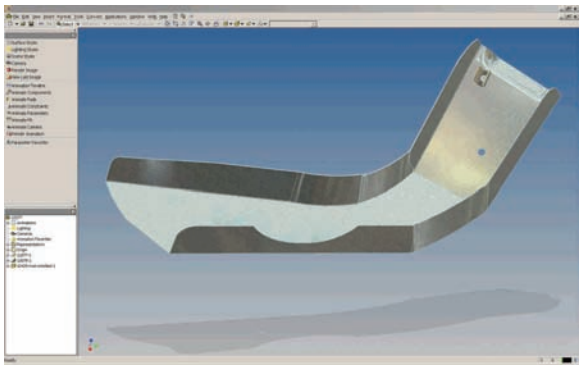
Shielding Highlights

The shielding family of products offer a custom solution to challenging thermal and NVH (Noise, Vibration and Harshness) environments. Engineers and product development specialists work with you to address your specific application needs. This innovative approach to thermal and acoustic management address the following needs:

Right material selection: A variety of material combinations may be considered to provide the right level of shielding efficiencies. For ReflectShield, this may include woven fiberglass substrate, non-woven material or closed-cell foam with an aluminum foil laminate. Such material combinations ensure outstanding ability to dissipate surface temperature. For QuietShield, a full range of material blends and configurations delivers the right acoustic solution along with potential weight savings to meet your critical needs.

Innovative design: Our design capabilities allow us to accommodate a variety of geometric shapes that are needed to provide appropriate shielding. Use of pressure sensitive adhesives may be used for the product to be adhered directly to component. Alternatively, mechanical attachment can also be integrated into the design and may include snaps and clips.

Cost-effective: Our unique approach to part design allows for a cost-effective solution to your shielding needs. For example, our ReflectShield approach allows for the reduction of tooling costs and lead times compared to traditional rigid heat shields.

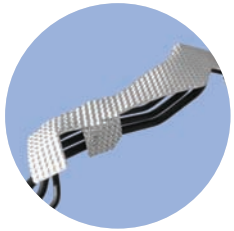
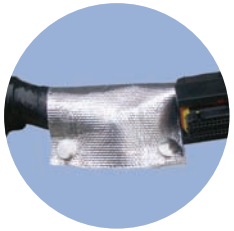


Your Partner in Development

Thanks to our expertise in CATIA® and SolidWorks®, our trained engineers, can directly open and integrate your drawings into our design system. We can provide detailed simulation of the integrated protection component, thus helping you visualize real-life installation. This collaborative approach saves you time and resources.

ReflectShield Applications

Applications include engine components, wire harnesses and fuel lines, in a variety of market segments including marine, rail, heavy-duty and industrial transportation.


QuietShield Applications

This product helps eliminate noise in such areas as engine covers, wheel arches, headliners, door panels and trunk liners.

QuietShield® GRN
AN EARTH-FRIENDLY SOLUTION



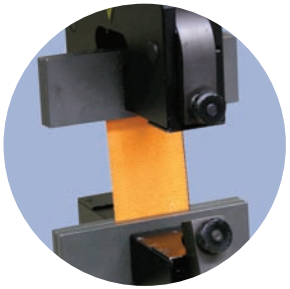
Advanced Technology Expertise

The ITS Group serves as a valuable resource and partner to its customers by providing advanced technology expertise to meet customer needs for today and tomorrow. Our engineering competencies include:

- **Chemical engineering:** coating formulation and compounding
- **Materials engineering:** Flame retardancy, water and fluid resistance, electromagnetic compatibility, conductive materials, mechanical performance (abrasion resistance, cut-through resistance, friction-reduction) and adhesive technology
- **Mechanical engineering:** development of both equipment and processes for coating, forming, embossing, lamination and converting
- **Textile engineering:** fibers, yarns, knitting, braiding, weaving, non-woven

In addition, we offer a broad range of advanced engineering tools designed to further assist our product development efforts, including:

- Computational Fluid Dynamics (CFD)
- Computer Aided Design (CAD)
- Failure mode and effects analysis (DFMEA and PFMEA)
- Finite element analysis (FFA)
- Geometric Dimensioning and Tolerancing (GD&T)
- Rapid prototyping
- Thermal, EMI and Acoustic simulation



We continue to invest in new technology exploration to ensure that we remain on the cutting edge of solution development.

Your Innovative Technology Solution

Let the ITS group of Federal-Mogul Systems Protection help solve your component protection issues. Contact us today to learn more about our industry specific solutions.

www.federalmogul.com/sp

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