



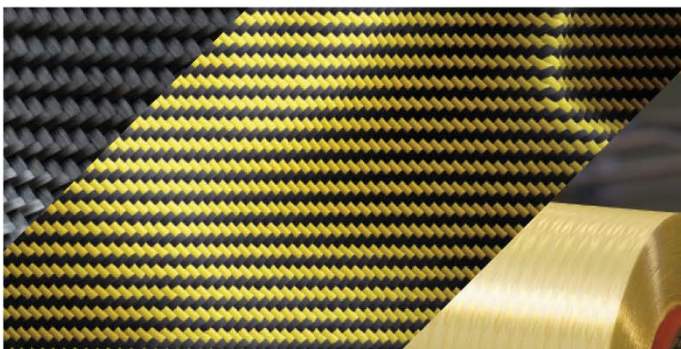
From cryogenic temperature (-269°C) to ultra-high temperature ($+1500^{\circ}\text{C}$)

Heat & Electrical insulation + Non-combustible



Rigid insulation : Insulating board and precision machining

Heat insulation board / Electrical insulation board / CFRP / High-performance plastics



Flexible Fiber insulation : Non-combustible fiber

*Non-combustible fiber / Fire suppression pad for EV & battery
/ Removable heating jacket*



ePTFE · Clean cable

Clean cable POD / FLAT cable / ePTFE tape

Founded in 2009, Incorporated in 2015

Manufacturer of Textiles, Plastics, Composite Materials, and Advanced Materials

Heat & Electrical insulation / Non-combustible / ePTFE

BIZ 1

SUECO[®]TEX

Non-combustible fiber, high strength fiber, super fiber, fire suppression fabric, etc.

BIZ 2

Machining Service

Fiber composites panels, insulation board, electrical insulation board, CFRP

BIZ 3

SUECO[®]FLEX

ePTFE · Clean Cable

Non-combustible fiber

- Up to 1500°C Ultra-high temperature non-combustible fiber
- High-strength, high-performance special fibers
- Protective cover jacket for human, robots, and equipment.
- Fire suppression fabric for EV battery and other applications
- Specialized functional fabrics for electrically conductive, heating, shielding, etc.
- Removable heating jackets and materials for semiconductor and chemical processing
- Sensor cable for use in cryogenic temperatures
- Electric erosion preventing device
- High voltage explosion proof strap



Insulation board·Precision Machining

- Ultra-high temperature, high strength insulation board
- Electrical insulation board
- Fiber composites such as CFRP
- Ultra-precision machining of jigs and parts
- CNC, MCT, ROUTER, POLISHING
- Insulators and jigs for EV battery manufacturing
- Insulator for semiconductor process
- Heat and Electrical Insulation in Cryogenic temp (liquid hydrogen, nuclear fusion)
- Space launch vehicle, aircraft insulation



ePTFE ·Clean Cable

- ePTFE membrane film
- ePTFE hybrid film
- ePTFE Clean POD, FLAT Cable
- ePTFE Gasket Seal Tape
- ePTFE Vent
- Wire Insulation Tape



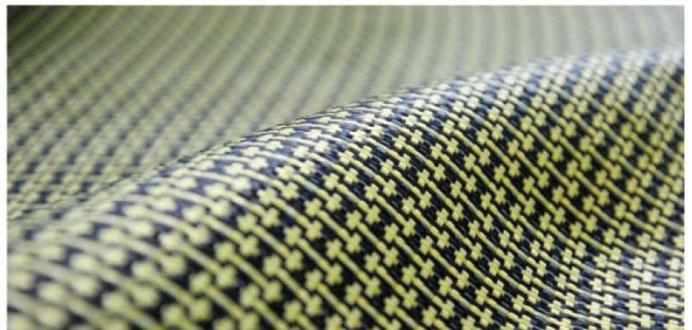
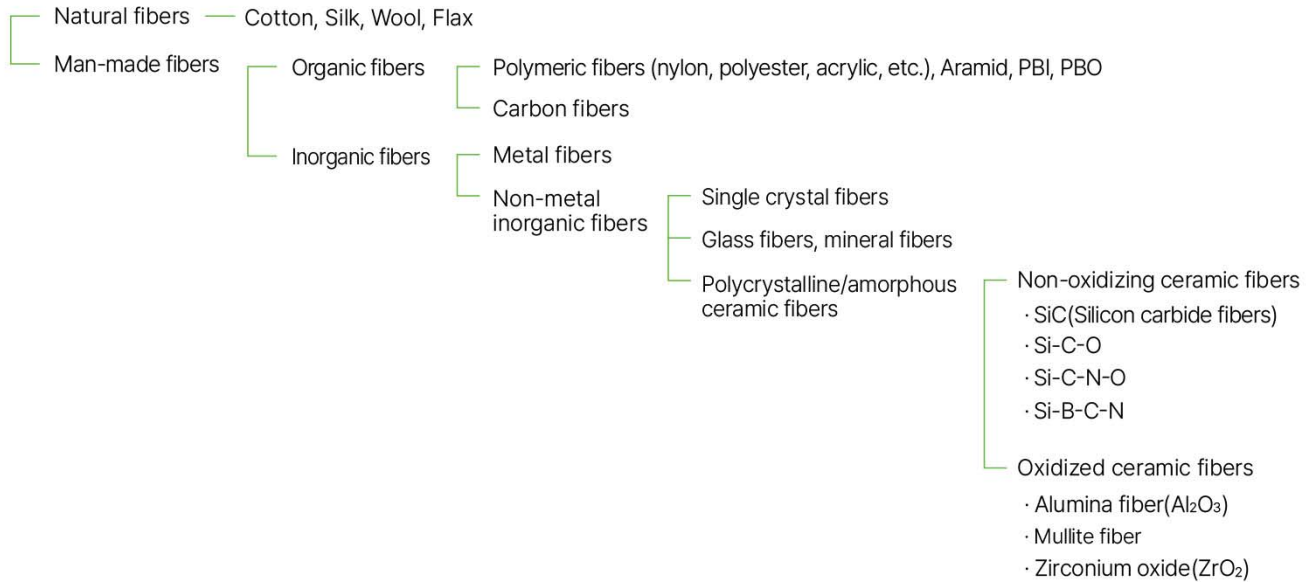
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Sueco Tex is a brand name of an industrial textile material with various properties such as lightweight, reinforcement, super heat resistance, and thermal insulation.

Sueco Advanced Materials provides a comprehensive, customized service that considers not only temperature, strength, and wear in the usage environment but also machinability, compatibility, and convenience from material selection to finished products.

Fiber classification



04 SUECO[®]TEX[®] High performance fiber types

Yarn type

- Para aramid Kevlar[®] Technora[®]
Twaron[®] Heracron[®]
- Meta aramid Nomex[®]
- PPS
- Phenolic
- LCP Vectran[®]
- Polyimide
- PBI
- POD(Polyoxadiazole)
- PTFE
- PEEK
- PBO Zylon[®]
- Oxypan Para aramid hybrid (5:5, 7:3, 8:3)
- Glass(E-glass, BC-glass, S-glass)
- Basalt
- Silica : SiO₂ 95~99%
- Metal (SUS304, SUS316L, FeCrAl)
- Carbon
- Quartz
- Alumina
- Ceramic, SiC
- Silver plated Nylon
- UHMW PE
- High strength PP
- Flax
- PLA

Product type

- ✓ Short Fiber(38mm, 51mm)
- ✓ Chopped Fiber(1mm~10mm), Millde Fiber
- ✓ Long Fiber(Filament Yarn)
- ✓ Woven (1000-3000mm wide, plain/twill/satin weave)
- ✓ Multiaxial fabric, 3D fabric
- ✓ Knitted fabrics
- ✓ Non-woven
- ✓ Webbing (narrow band)
- ✓ Rope/strip (braided)
- ✓ Sewing threads, hybrid-yarns, conductive yarns, heating yarns
- ✓ Sizing, coating, and laminating of polymer resins (Coating/laminating processes for synthetic rubber, fluororubber, silicone, Teflon, PET, and aluminum, as well as metal deposition processing.)

Applications

- Heating vests
- Sling bars for high heat/heavy loads
- Heat resistant buffer fabrics for glass manufacturing and post-processing
- Heat-reflective heat resistant fabrics for metal melting operations
- Flame-retardant and non-flammable fabrics for railroads, vehicles, and aircraft
- Fabrics for high-strength, lightweight composites
- Resin, cement reinforcement fiber
- Seismic reinforcement (fabric or composites)
- Non-flammable and insulating PAD for EV-Battery
- EV Motor electrical corrosion preventing ring
- Explosion-proof bands for high-voltage cables
- Fabric for fire extinguishing, chemical protective clothing
- Protective fabrics for fire, evacuation
- Anti-stab, bulletproof fabrics and jackets
- Cut-resistant yarns & fabrics
- Sheets & fabrics for electromagnetic interference (EMI) and radiation shielding
- Protective covers & jackets for (welding)robot
- Yarns & fabrics for smart suits
- Yarns & fabrics for electrostatic control (ESD)
- Highly efficient fabric planar heating elements



Handbook of tensile properties of textile and technical fibers Technical datasheets ; Kozey et al., 1995

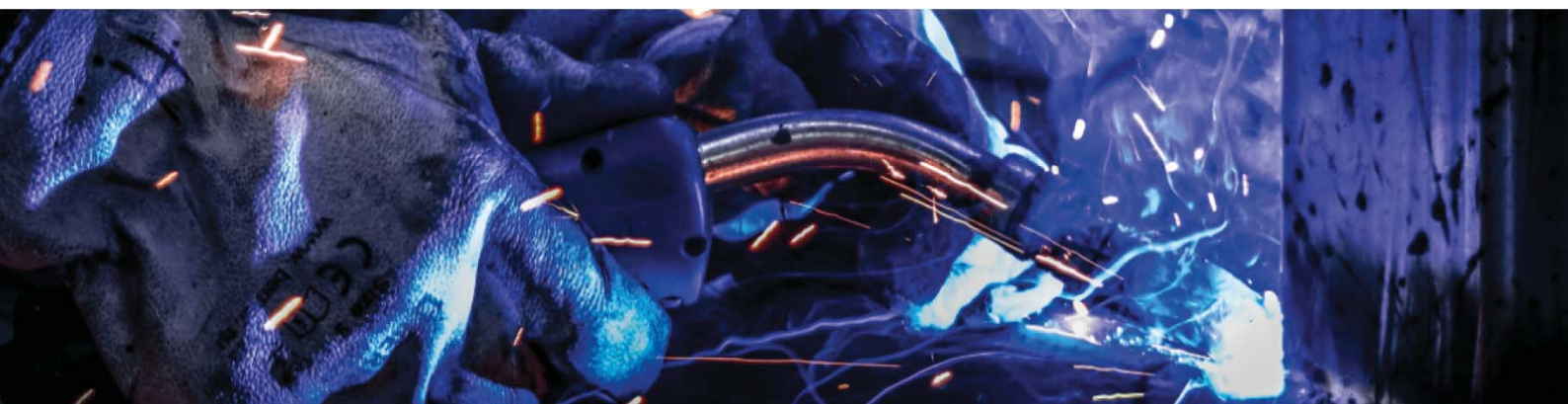
Fiber/Trademark	Company	Density(g/cm ³)	Tensile modulus(Gpa)	Tensile strength(Gpa)	Elongation at break (%)
Kevlar 29	DuPont	1.44	71	2.9	3.6
Kevlar 49	DuPont	1.44	112	3	2.4
Kevlar 149	DuPont	1.45	143	2.3	1.3
Nomex	DuPont	1.38	11.6	0.59	28
Twaron	Teijin Aramid	1.44	70	3.2	3.3
Twron Hm	Teijin Aramid	1.45	103	2.8	2.5
Technora	Teijin Aramid	1.39	73	3.4	4.6
Teijinconex	Teijin Aramid	1.38	7.9~9.7	0.61~0.67	40
Teijinconex HT	Teijin Aramid	1.38	11.6~12.2	0.73~0.85	2.5~3.5
Armos	Ltd Lirsot	1.43	150~160	4.5~5.5	1.43
SVM	ASRIPE	1.43	135~150	4.0~4.5	3.0~3.5
Terlon	ASRIPE	1.46	130~160	2.5~3.5	2.5~3
PBI	PBI Perf.Products	1.4	5.6	0.4	30
PBZT - PBT		1.58		2.6~3.9	1.5~3.5
Zylon AS(PBO)	Toyobo	1.54	180	5.8	3.5
Zylon HM(PBO)	Toyobo	1.56	270	5.8	2.5
M5(PIPD)	Magellan	1.7	330	5.5	1.5
Vectran NT/Vectran M	Kuraray	1.4	52	1.1	2
Vectran HT/Vectran HS	Kuraray	1.41	75	3.2	3.3
Vectran UM	Kuraray	1.4	103	3	n.a.
Nylon(polyamide)	DuPont	1.14	5.5	1	18.3
Dacron(ployester)	DuPont	1.38	13.8	1.1	14.5
Spectra 900(UhmwPE)	Honeywell	0.97	70	2.4	4
Spectra 1000(UhmwPE)	Honeywell	0.97	105	3.1	2.5
E-glass		2.55	72	1.5~3.0	1.8
S-glass		2.5	87	3.5	4
S2-glass	AGY	2.49	86	4	5.4
Carbon		1.8~2.0	140~820	1.4~7.0	0.4~2.1
Steel		7.86	210	0.34~2.8	>1.0

* The data described in this document is provided for informational purposes only, data values are not guaranteed or warranted.

Handbook of technical textile, High performance and high temperature resistant fibers

Fiber/Trademark	LOI	Service temperature (Max)	Decomposition temperature (or melting point)
Meta aramid	29	220	400
Para aramid	25~28	250	430
POD	30	250	500
PBI	41	250	450
PBO	68	275~315	650
Oxidized PAN fiber	45~55		
PEEK	42	250	345
PPS	34	200	285
PTFE	95	250	327
Phenolic	30~34	150	350
Melamine	32	190	450
Polyimide	38	250	450
UHMW PE		120	150
Technora	25		500
PAN carbon	55	400	600
LCP vectran	28	220	350
Polyester	22		260

* The data described in this document is provided for informational purposes only, data values are not guaranteed or warranted.



Outer/Inner Cover Fabric

200~250°C

- Meta Aramid(Nomex[®]) White
- Para Aramid(Kevlar[®]) Yellow, POD

250~300°C

- Silicone coated glass : Silver Grey, White, Green, Yellow
- Teflon-coated glass : Grey, Bright yellow, White
- Teflon laminated glass brown Black, Blue, Green
- High-density teflon fabric (100% teflon) Bright White 280, 420, 580(With Membrane)
- ePTFE Sheet (0.3, 0.5, 1.0t) Bright White 1500×1500, 1500×4500
- Tear resistant teflon film Grey, White & Other Colors Thickness 0.08, 0.13, 0.23, 0.30mm
- Oxypan(70%) Para Aramid(30%) Hybrid, Sage Green

300~350°C

- PBO Zylon Golden Brown

400~600°C

- Carbon 300~400°C
- Fiberglass(E-glass) Bright White 400~450°C
- Basalt, Dark Brown 500~600°C

900°C

- Pure silica Bright White 0.3t, 0.6t, 1.4t
- Wear-resistant anti-loosening coated silica Brown 0.6t, 1.4t

1100°C

- High-purity silica Bright White
- Quartz Bright White

1200°C

- Alumina Bright White
- SiC Fiber, Black
- Ceramic



Insulation

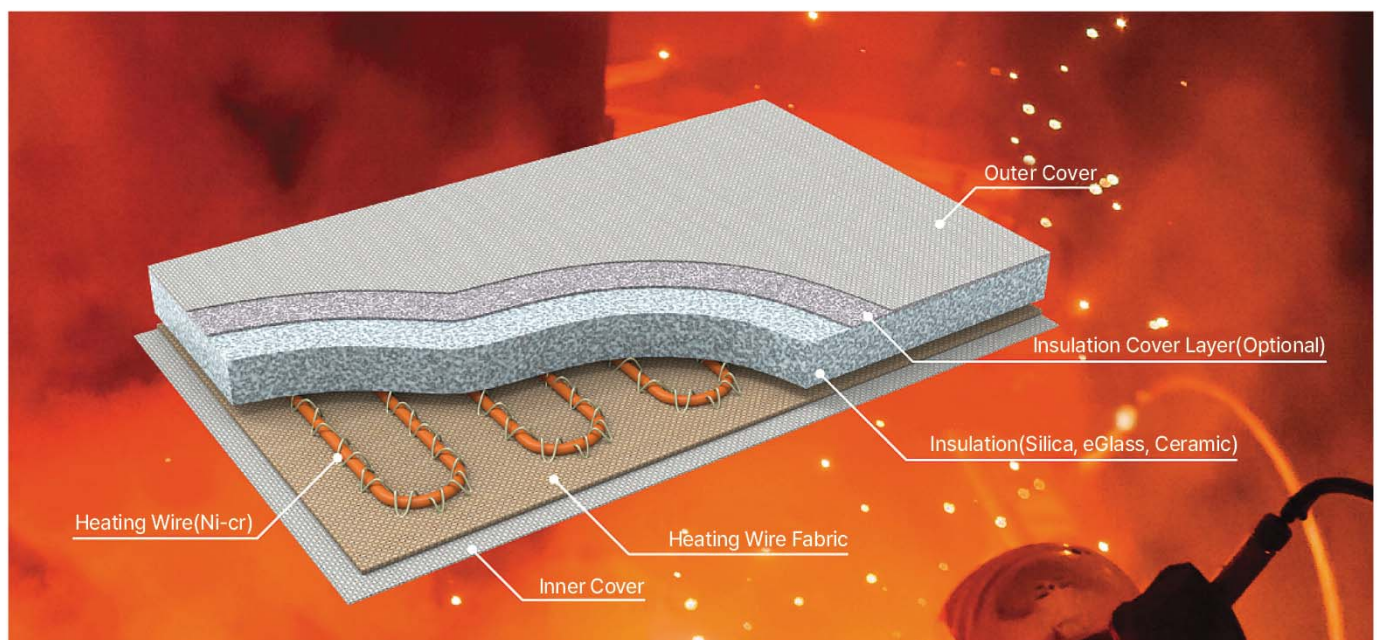
- ✓ Needle punching mat
- ✓ 220°C Meta Aramid
- ✓ 250°C Para Aramid, Polyimide, PTFE, POD
- ✓ 450°C Glass (120~200kg/m³), Panox
- ✓ 900°C Silica (120~200kg/m³)
- ✓ 1200°C Ceramic
- ✓ Sponge, foam : Melamine, Polyimide
- ✓ Other : Aerogel Mat, MLI

Fasteners & others

- ✓ Flame retardant nylon, polyester Hook and Loop
- ✓ 200~250 Nomex, PPS Hook and Loop
- ✓ SUS hook and loop for ultra-high temperatures(400~800)
- ✓ Micro heating wire SUS 4, 5, 7, 9, 14, 27 ohm(Ω)
- ✓ Webbing, rope, tube PET, Nylon, Glass, Kevlar, Silica, Alumina, Basalt, Quartz

Sewing thread

- ✓ 220°C Meta Aramid (various colors)
- ✓ 250°C Para Aramid (Yellow, Black), Teflon (White & Other color)
- ✓ 450°C Teflon coated fiberglass (Grey, Brown), fiberglass (White)
- ✓ 250~700°C SUS inserted para aramid
- ✓ 900°C Silica
- ✓ 1200°C alumina, quartz



combustible fire blanket that helps to extinguish fires quickly and prevent them from spreading in buildings, facilities, vehicles, and other areas, minimizing damage. As the number of EVs (Electric Vehicles) and ESS (Energy Storage Systems) rapidly increases, the risk of fires caused by battery thermal runaway is also growing.

In the case of EV (Electric Vehicle) battery fires, it is difficult to fully extinguish the fire with just one method, such as a fire blanket, smothering blanket, or other firefighting tools. Therefore, utilizing all available methods through step-by-step collaboration is essential.

Sueco offers a variety of solutions to maximize the functionality you need and minimize risk.

Materials

Uncoated or low-coated fiberglass/silica fabric

- It is very soft and highly flexible, allowing it to quickly wrap around the fire, providing excellent oxygen-blocking capability.
- It is difficult to sew, and it can easily tear or get damaged during use
- If there is no physical damage, reuse rate is high.

Silicone-coated fiberglass/silica fabrics

- Compared to raw fabric, it has lower flexibility and oxygen-blocking capability, but its durability during production, storage, and use is very high.
- When exposed to fire, the coated silicone hardens and stiffens, but retains its fire barrier properties.



Eco-friendly flame retardant resin-coated silica fabric

- It is a hard-coated type used for firewalls or roll screens that need to maintain their shape, and when exposed to fire, the resin carbonizes, turning it into a flexible fabric.(Ministry of Land, Infrastructure, and Transport test report)

Sewing thread

- PTFE coated Glass sewing thread, Metal sewing thread

Bar, Button, Hook Clip

- Steel, Stainless steel

Fire and heat resistant performance

- 1300°C torch 30 min test



* a video of +30 min TSET

- 1000°C chamber 1 hour test, a video of endurance

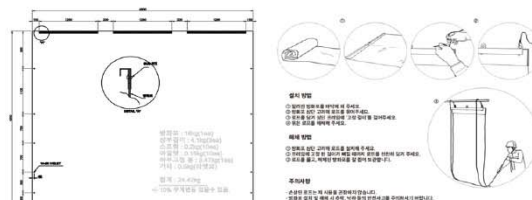


1300 degree 30 min flame test report

fire suppression pad/fire safety curtain/ fire shutter

A fire barrier installed and used to prevent the spread of fire and evacuation in the event of a fire.

- Material** Glass fabric, Silica fabric, Silicone coated glass/silica fabric, PU coated glass/silica fabric
- Size** customized, can be made in extra-large sizes of 10 meters or more
- Production example** rack top mounted fire barrier

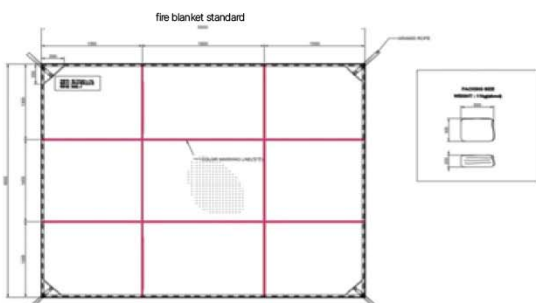


Fire blanket

A fabric used to cover equipment, parts, vehicles/EVs, batteries, etc., to block air and either extinguish the fire or prevent its spread

- Material** Flexible polymer coated silica fabric, Glass/silica fabric
- Size** Customized
- Production example** Fire cover for standard battery packs

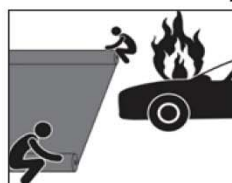
- Portable and storage cases** Designed and manufactured as custom orders, such as bags or installation boxes, depending on the installation and carrying method
- How to Use**



How to use a fire cover

Emergency use in case of fire

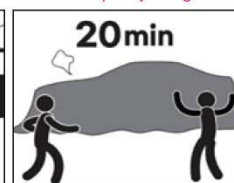
* Leave it until the fire is completely extinguished.



1. Unfold the smothering blanket from the front or rear center of the vehicle.



2. Hold both sides of the blanket and sweep it over the entire vehicle, covering it completely.



3. Ensure the blanket is tightly sealed against the ground to prevent any air from reaching the vehicle.

08 SUECOTEX® High performance textile applications

Robot & Human Jacket



Human and robot jackets are customized to fit the shapes and range of motion and protect the robot bodies, cables, and components from friction, heat, and water.

Applications : automotive welding, furnace work, nuclear work, clean room

- ✓ Para Aramid Fabric
- ✓ Silver Silicone Coated Para Aramid Fabric
- ✓ Silicone Coated Para Aramid Knit
- ✓ Aluminized E-glass
- ✓ Technora Fabric
- ✓ TPU, Silicone
- ✓ Oxypan para Hybrid Fabric(Coated)
- ✓ Zylon Fabric
- ✓ Aluminized Para Aramid

Alumina fiber SUECOTEX®

Characteristics

- ✓ High melting point and stable use at ultra-high temperatures (over 1200°C, up to 1600°C)
- ✓ Retains rigidity at high temperatures
- ✓ High elasticity
- ✓ Corrosion resistance
- ✓ Electrical insulation
- ✓ Low moisture absorption
- ✓ Low thermal conductivity
- ✓ Low shrinkage at high temperatures

Applications

- ✓ High-temperature furnace linings
- ✓ Oilstone abrasive tools
- ✓ High-temperature insulating curtains
- ✓ High-temperature sintering gaskets
- ✓ Molten alloy filters
- ✓ Roller sleeves for tempered glass production lines
- ✓ Fire resistance, insulation, and thermal insulation for thermocouple wires, cables, and electrical wires
- ✓ Insulating sealing rings for semiconductor crystal growth furnaces (discs and shaft rings)
- ✓ Fireproof materials for generator and aerospace engine combustion chambers
- ✓ Electrical insulators and thermal insulators for particulate filter systems in fuel engines
- ✓ EV battery fire run-away block
- ✓ Thermal insulation and thermal runaway delay/prevention for electric vehicle batteries

1600°C Alumina Fiber



Alumina standard products

Long fiber	Chemical Composition F72(72% Al ₂ O ₃ + 28% SiO ₂ , 7~14um) C85(85+15,10~12um) M99(Al ₂ O ₃ 99,12~14um)
Short fiber	Fibers for Needled nonwoven fabrics, Chopped fibers
Woven Fabric	Plain / Satin / Double Twill Fabric Weight 170~1000 g/m ² , Width 0.8~1.5 m, Roll Length 25 m, 50 m/roll
Non woven Mat	Needled nonwoven fabrics, thickness 8/10/12.5/25/50mm, Density 96/128/150K/m ³ , width 610mm, length 3.6/7.2/12m
Paper	Electrospun, all inorganic, 1200°C(max 1500~1600°C), thickness 0.4~1mm, weight 50~150g/m ²
Sewing thread	400 tex, OD 0.45/0.54/0.6mm, 180TPM, 23/42/62N
Woven tape	Plain/satin width 15~100mm, length 20m 50m/roll
Rope	OD 0.3~3mm braided rope
Braided sleeve	OD 1.5~80mm(1.4/4/10/15/20/35/50/60mm) length 25m 50m 100m/roll

* Various shapes can be produced according to customer requirements.

SUECOTEX® Smart & Others



Custom Flexible Ducts and Bellows

- ✓ Smart yarn, elastic band & yarn for electrical signal transmission
- ✓ Stainless steel yarn for heating
- ✓ EV Motor electrical erosion protecting ring
- ✓ Custom High-Performance Flexible Duct Hose (Heat resistant, Chemical resistant)
- ✓ Cryogenic precision sensor cable
- ✓ UL Vo Duct & LM Bellows Fabric(OTEGO)
- ✓ Copper, Aluminum, Steel Hybrid Yarn
- ✓ Silver-plated nylon yarn
- ✓ Pure Silver

°C Brand	N Kassei	DT	KP	DP	Others
	High-temperature epoxy glass (G11) can reach 140°C/180°C, while Bakelite and normal epoxy glass (G10) can reach 100~120°C (caution)				
200				AN, ANG, DN, DNB	
200			4000RD	S4K, WD20	
250				SD25	G30 - ZT PI-Glass G-Etronax PI
280			280WH	AS	
300	Besthermo F NL-IG, NL-IGL T-mold MS112 Nikko Pallet, Thermo B 200		310BL		
350	Teijin Aramid			DG	
400	Lossna Board, NL-IGL-12				
500	KALHON-L			SG	Hemisul15, Hemisul20
600		DT 600M	KP 600M	DT 600M	
700		700		700M	
800		800M		800M	
1000		1000			LUMIBOARD, NEOARK
1100		1100	1100	1100	
1200					
Cryogenic temperature					G10CR, C11CR Pressed Wood

* Hemisul, Lumiboard, Neoark is Trade mark of NICHIAS * Available in board, rod, tube, and pipe as standard

Nema laminate classification table

* Nema laminated board, an electrical insulation material, is often used as an insulation material.

Laminated board	Resin	Reinforcements	Prosperities
X	Phenol	Paper	Mechanical parts, weak to moisture, not used as insulation
XP			Mechanical parts, Hot Punch, weaker than X but stronger to moisture
XPC			For mechanical parts, Cold Punch, lower flexural strength than XP
XX			General purpose, for insulation, not as strong as X, but slightly better for moisture
XXP			General purpose, Hot Punch, better electrical properties than XX
XXX			Excellent electrical insulation, creep resistance
XXXP			Electrical insulation class Hot Punch
XXXPC			Electrical insulation class Cold Punch
ES1	Nameplate		White melamine core + black surface (and other colors)
ES2			Phenolic paper core + white surface
ES3			Black melamine core + white surface (and other colors)
C	Phenol	Cotton fabric	For mechanical parts
CE	Phenol	Canvas	
CEF	Phenol		
L	Phenol	Linen fabric	
LE	Phenol		
G3	Phenol	Fiberglass fabric	Good general purpose, heat resistant impact strength
G5	Melamine		Excellent insulation and arc resistance, abrasion resistant, flame retardant, marine insulated components
G7	Silicone		Excellent insulation and arc resistance, good physical properties, heat resistance
G9	Melamine (water-resistant)		Higher insulation than G5 in moisture environment, otherwise similar to G5
G10	Epoxy		Very good mechanical strength [epoxy glass], can be used at cryogenic temperatures
G11	Epoxy (heat-resistant)		The operating temperature (140°C/180°C) is higher than G10 and other properties are similar to G10
G20	Polyimide		Highest service temperature and insulation performance
N-1	Phenol	Nylon fabric	Insulator for wet environments requiring impact strength
FR1	Phenol	Paper	Flame retardant, XP mechanical parts, Hot Punch
FR2	Phenol		Flame retardant, XXXPC insulation, Cold Punch
FR3	Epoxy		Flame retardant V1, insulation, flexural strength, better than XXXPC
FR4	Epoxy	Fiberglass fabric	Flame retardant V0, similar properties to G10
FR5	Epoxy (modified)		Flame retardant V0, similar properties to G11
FR6	Polyester		fiberglass mat
CEM1			Fiberglass fabric surface + core flame retardant epoxy impregnated cellulose paper
CEM3			Fiberglass cloth surface + core epoxy-impregnated fiberglass mat, braided, similar to FR4
GPO1	Polyester	fiberglass mat	Colored boards GPO3 (pink or red) in white, brown, pink, etc.
GPO2	Polyester	fiberglass mat	
GPO3	Polyester	fiberglass mat	

Temperature-specific recommended insulation board

	°C Recommended insulation board
Cryogenic	G10CR, G11CR Epoxy glass, Bakelite
100	Bakelite, Epoxy glass(G10) * Caution when using
140	G11
180	G11(HT)
220	4000RD
250	DP-SD25 ZT PI-Glass
280	KP280WH, DP-AS
300	Besthermo F 310BL
400	Lossna Board, NL-IGL-12
500	Hemisul20 KALHON-L
600	DT600M
800	DT800M
1100	1100

* Recommended mainly for fiber/resin laminates, excluding plastics, the above operating temperatures are for reference for material selection, and caution is required for specific applications.

10 SUECO Precision machining of insulation boards and materials

Engineered plastic parts machining

MC nylon, TP601(Oilon), TP610, MP5000, PE, PP, Acetal, PVC, PMMA, PC, PTFE, PEEK, ULTEM, Polyimide, PBI Celazole, ESD plastic, Medical, Semiconductor, OLED, Chemical, Aerospace, Energy and Battery industries

Molding and processing of composite materials

Molding and processing of high strength and lightweight composites, RTM, Infusion, Hot press, Filament winding, Pultrusion, Autoclave, Carbon (CFRP), Glass fiber (GFRP), Aramid (AFRP)

Electrical insulation molding and machining

G10 Epoxy glass, FR4, G11, G10CR, G11CR, GP03, G5, G7, G9, G30 Mica, Ceramic, Silicone glass, Bakelite

Precision machining of insulation board

We provide total services for energy saving, including selection and processing of insulation materials, insulation boards, heating jackets, insulation covers, etc.

Ultra-precision grinding

Ultra-precision grinding and high-precision flatness (parallelism) processing of insulation boards, epoxy G10, and other materials.



Applications

- Semiconductor manufacturing process insulation
- Induction furnace insulation
- Tire molding equipment insulation
- Insulation materials for rubber and plastic injection, compression, and extrusion molding machines.
- Defense insulation for launch vehicles, aircraft, etc.
- Cryogenic insulation
 - LNG, LPG, LH2 (liquefied hydrogen) storage devices
 - Nuclear fusion devices, MRI, Cryo pump
- EV, secondary battery manufacturing process
 - Lamination process
 - Sealing processes
 - Firing and drying processes
 - Jigs for manufacturing processes
 - Fire protection for cell module packs (Mica, non-combustible PAD)
- Fuel cell separator frame
- Wafer molding
- Precision PCB, CPU molding



- Spindle nut for train screen doors
- 400°C insulation washers
- Graphite (Fuel Cell) Stack Bipolar Plate



SuecoFLEX is a hybrid film used in clean cables and flat cables (ePTFE flat cable), where two types of films, such as Teflon (ePTFE) and urethane, are bonded and combined.

It has properties such as flexibility, smoothness, and cleanliness, and is made for easy bonding processing.

- ✓ Colors : bright white and gray (various colors available)
- ✓ Dimensions : thickness(0.25, 0.35, 0.45) width (up to 200mm), length (up to 200m)
- ✓ Backing material : urethane, THV, etc.

SUECOFLEX® Cable

Upper film	Material	ePTFE
Top film	Thickness	0.1~0.125mm
	Denstiy	0.7~1.0 g/cc
	Tensile strength	4,000~5,000 N/cm ²
	Elongation	20~30%
Backing film	Material	Polyurethane
Total Thickness(PU25/PU35/PU45)		0.25.0.35.45mm

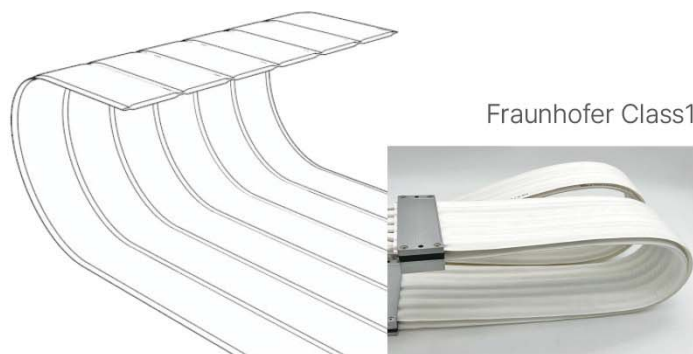
* The above is the basic property and may be changed depending on the application.

Clean Cable POD SUECOFLEX®

Cable pods are products that make it easy to create desired cable bundles (cable assemblies) by inserting the required cables into holes (pods), as well as facilitate cable runs in dynamic installations. It is manufactured by multiple bonding of ePTFE hybrid film (SuecoFLEX).

It is manufactured and supplied with different widths and numbers of holes (POD) according to customer requirements.

The maximum width is 200mm, and we can supply up to 100m, but we recommend the 50m standard product for ease of handling.



*This is a hybrid film which is consist of two layers ; ePTFE and other polymer film like PU and THV.

- ✓ Colors : White, grey
- ✓ Product code : SuecoFlex 1Pod~6Pod

Standard type

No. of Pod	Pod Width **	Total Width
1 POD	20.5mm	25.1mm
2 POD		47.9mm
3 POD		70.7mm
4 POD		93.5mm
5 POD		116.3mm
6 POD		139.1mm

**Width can be changed to the customer's needs.

One-pod type

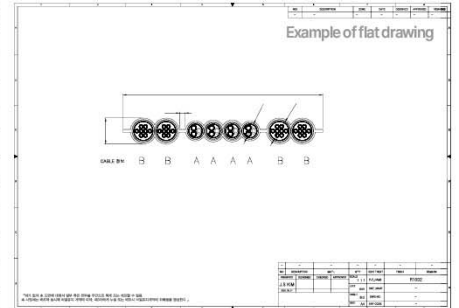
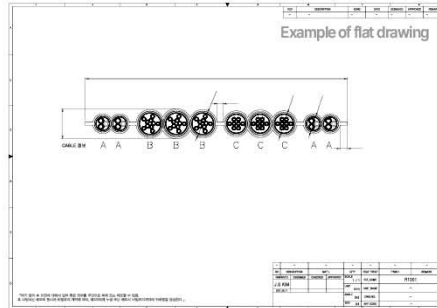
No. of Pod	Pod Width **	Total Width
1 POD	30mm	34.6mm
	40mm	44.6mm
	62mm	66.6mm
	83mm	87.6mm
	105mm	109.6mm
	125mm	129.6mm

**Other specs are available

12 SUECOFLEX® FLAT Cable



We can design and supply flat cables according to customer requirements, and we also offer production and supply based on provided flat cable drawings and cables. We specialize in small batch, high-mix production.



SUECOFLEX® Jacket



This jacket is made from SuecoFLEX, an ePTFE hybrid film, and uses various fastening methods such as buttons and zippers to wrap and protect cables, chains, and cable carriers in the drive unit, or to prevent dust generation.

It is used to wrap the drive units of cleanroom equipment, cables and bodies of robots, or as a protective cover for clean cables that have reached the end of their replacement cycle.

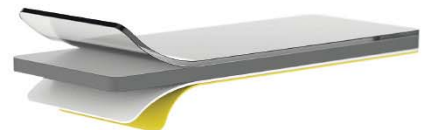


SUECOFLEX® PAD

Cushion Pad

This is a shock-absorbing pad designed to prevent cable damage and minimize friction caused by repeated contact with the floor during the movement of cable carriers or clean cable systems.

The top layer is made of (ePTFE, UHMW PE, PTFE) film, and the bottom layer consists of a cushioning sheet (PU, silicone, EPDM, etc.). The cushioning sheet is coated with adhesive on one side, and it is supplied in a roll film format, making it easy to use on-site as needed.



Aid Patch

This is a patch designed to cover and repair partial damage caused by negligence during the operation of ePTFE clean cables (cable pods, flat cables), thereby extending the lifespan of the equipment depending on the extent of the damage.





Electrical insulation and wrapping tapes

Wrapping tape to wrap pipes in clean environments such as clean rooms, or to protect exposed parts.

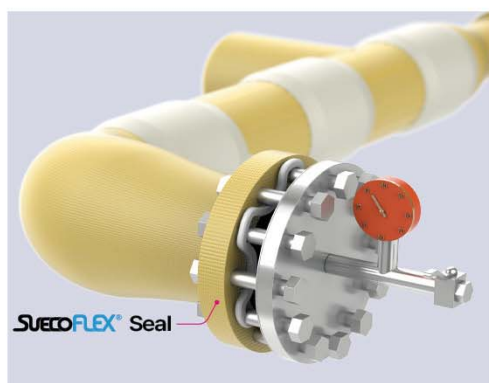
It has high insulating properties and is used as an insulating material for wires and conductors, such as coaxial cables, high-performance insulated cables, heating wires, etc.

※ Customization is available.

- ✓ Thickness : 0.05mm~3mm
- ✓ Width : 2mm~200mm
- ✓ Density : 0.4~1.2 g/cc
- ✓ Standard gasket wrapping tape : 0.7g/cc, 0.3t × 35mmw × 30m

SUECOFLEX® Gasket & Seal

Utilizing the flexibility, heat resistance, chemical resistance, and sealing properties of ePTFE, this general-purpose seal is used in applications requiring high-temperature and high-pressure sealing, such as flange piping. It is available in various thicknesses and widths, and can be cut to fit the required area.

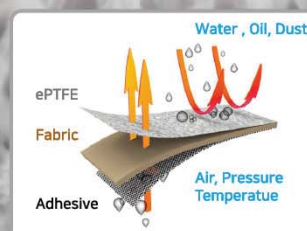
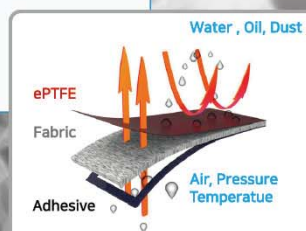
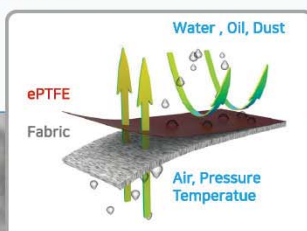


Vent **SUECOFLEX®**

The membrane structure of ePTFE prevents the ingress of liquids and dust, while allowing ventilation to regulate sudden pressure/temperature changes to protect contents and equipment. It is often used alone or in combination with fabrics or nonwovens, and is also available as patches in a variety of shapes with one-sided adhesive backing.

Applications

- Automotive : sensors, motors, headlights, powertrain, etc.
- Electrical and electronic components : protection of externally installed electronic devices such as mobile communication devices, solar panels, etc.
- Packaging containers : ventilation of packaging containers for chemical, paints, food, and pharmaceuticals
- Sensor ventilation : control of sudden temperature and pressure changes, protection of precision instrument sensors
- Exterior lighting : adapt to and protect against environmental changes such as temperature, moisture, and ultraviolet light
- Medical devices
- Testing and Lab instruments, etc.



14 SUECOFLEX® ePTFE Yarn · Fabric

When PTFE is heated and stretched in one direction to its maximum extent, it becomes a high-strength, flexible ePTFE. By using this process to create yarns and fabrics of various thicknesses, you can obtain fibers (fabrics) with the advantages of PTFE, which can be applied in various fields.

Product Type

- ✓ Yarn (200~1500d yarn)
- ✓ Fabrics(woven fabric, plain / twil, 280g / 440g / 580g)
- ✓ Narrow wide fabrics and ropes
- ✓ Sewing thread 1200d
- ✓ Knitted fabrics
- ✓ Zipper

Product properties

- ✓ Highest chemical and weather(UV) resistance
- ✓ Wide range of service temperatures (from cryogenic temperature to 260°C)
- ✓ Low coefficient of friction
- ✓ Cleanliness
- ✓ Water repellency

Applications

- Cryogenic temperature, high temperature, chemical resistant, weather resistant, sewing threads
- Clean removable heating jacket shell (high density fabric)
- Heat resistant, chemical resistant filter base fabric/scrim (mesh, low density fabric)
- Chemical liquid filters

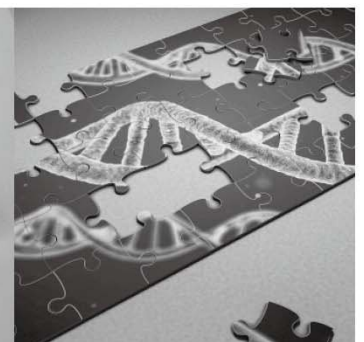
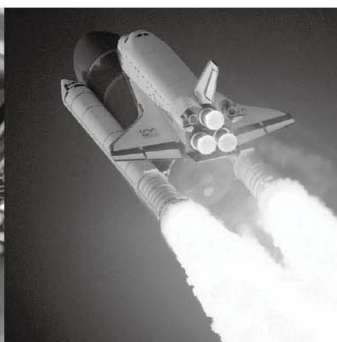
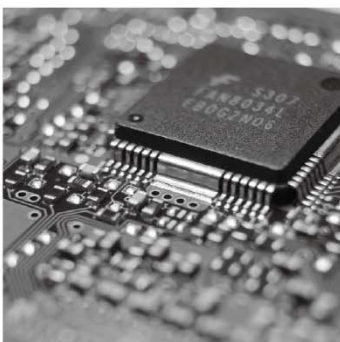


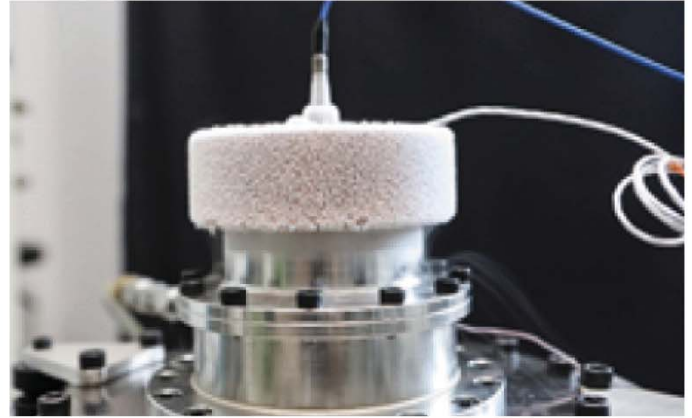
Medi SUECOFLEX®

ePTFE is widely used in medical applications due to its non-toxicity, flexibility, pore properties, and biocompatibility. Different levels of approvals and permits are required depending on the intended use.

Applications

- Suture
- Stent
- Implantable block
- Artificial skin and artificial blood vessels
- Chemical liquid filters





In cryogenic (ultra-low temperature) environments below minus 150°C, polymers lose much of their mobility, becoming inflexible and brittle (easily broken by small impacts). As a result, polymer resins and composites that can be used in these environments are becoming increasingly important with the expansion of polar transportation, aerospace, hydrogen fuel cells, and ultra-precise devices.

Sueco offers a full range of services from material selection to finished product processing to enable industries to operate in any environment.

Cryogenic environment

- ✓ Energy : Natural gas (LNG) transportation and storage, nuclear fusion facilities, liquefied hydrogen tank
- ✓ Semiconductor and other industries : industrial gas, vacuum deposition, ion implantation accelerator, sputtering, cryopump
- ✓ Medical device : MRI, X-ray detector
- ✓ Aerospace : Liquid fuel tank of a space launch vehicle, space environment structures
- ✓ Transportation : hydrogen energy, Maglev train
- ✓ Precision measuring instruments : NMR, SMES
- ✓ Telecommunications : superconducting cables, superconducting filters, superconducting computing (quantum computer)

Typical problems with polymeric materials in cryogenic environments

- ✓ Seal performance breakdown leading to frostbite, suffocation of operators, and equipment explosion
- ✓ Performance failure of the component due to the difference in the coefficient of thermal expansion between it and the corresponding metal material



Boiling point of various liquids (liquefaction temperature of gases)

Fluid	Boiling Point	Expansion Ratio
LNG	-162°C(-260°F) 111K	600 ×
Argon	-186°C(-302.8°F) 87K	860 ×
Helium	-269°C(-452.2°F) 4K	780 ×
Hydrogen	-253°C(-423.4°F) 20K	865 ×
Nitrogen	-196°C(-320.8°F) 77K	710 ×
Oxygen	-183°C(-297.4°F) 90K	875 ×

* The above service temperatures are based on the manufacturer's and application's indicated temperatures, but are not guaranteed and should be verified and applied in the individual application environment.

** Developed as a substitute for PCTFE, which is not easy to purchase standard rods/boards, and solves the problem of fluoroplastic supply.

*** Cotton cloth phenolic laminated board

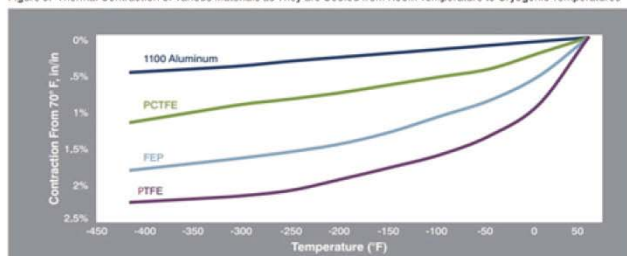
**** Laminated vacuum-pressed wood / main material : beech wood

Materials that can be used at cryogenic temperatures

	Type	Operating temperature(°C)*
Resin	PTFE	-250~+260
	PCTFE	-269~+150
	UHMW PE	-260~+70
	Polyimide	-250~+250
	Victrex CT200**	-196~+200
Laminated board	G10CR, G11CR	-270~+140(+180)
	Phenolic cotton***	-210~+100
	Durolight	-196~+200
	G30, PIGC	-250~+250
	Lignostone cryogenic****	-196~+90
MLI(multilayer insulation)film		-273~+500
Fiber glass blanket		-268~+232

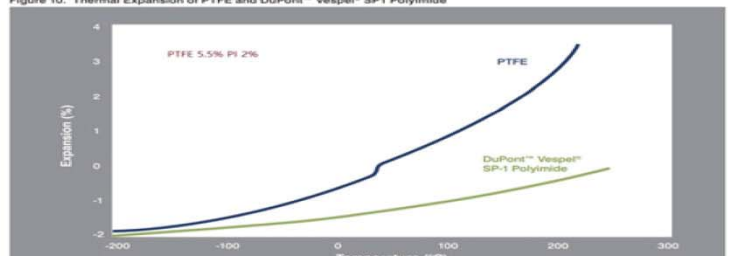
Reference properties

Figure 9. Thermal Contraction of Various Materials as They are Cooled from Room Temperature to Cryogenic Temperatures



Source: Mowers, R., (1969)

Figure 10. Thermal Expansion of PTFE and DuPont™ Vespel™ SP1 Polyimide



Source: Koriv, R., (1956), and McDonald, P. & Rao, M., (1987)



Characteristics

Heat resistant

- Retains shape up to 500 degrees
- Continuous service temperature of approximately 300 degrees

Electrical properties

- Excellent electrical insulation properties
- Prevention of static electricity available

Machinability

- Excellent machinability with dimensional stability
- Customized product manufacturing

Wear resistance

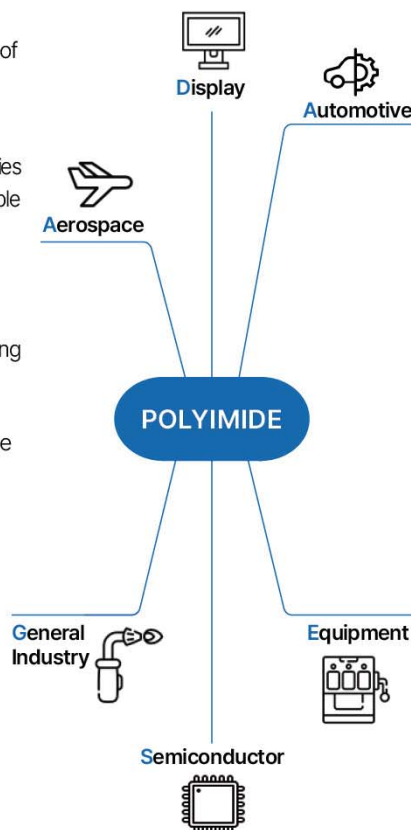
- Maintains wear resistance at the level of metals/ceramics
- Maintains shape in extreme environments

Chemical resistance

- Maintains chemical resistance to organic solvents
- Lubrication resistance at high temperatures and high abrasion

Low outgassing

- No harmful gas leakage even at high temperatures



Polyimide molded parts have been attracting attention as they possess the highest levels of heat resistance, friction resistance, abrasion resistance, electrical insulation, mechanical properties, radiation resistance, and chemical resistance among engineering plastics.

Polyimide molded parts are used as key mechanical components in various environments such as vacuum, electrical and electronics, chemical, automotive, aerospace, and military equipment, and they also exhibit excellent machinability.

Leomid

Leomid is an extremely heat-resistant material that can maintain its mechanical properties at high temperatures of around 300°C for continuous use and 480°C for short periods of time. Even in extreme environments, it has excellent friction resistance and high marginal PV, allowing many metal and ceramic parts to be replaced.

Leomid is able to offer new solutions to customers in the market based on its highly superior properties compared to competing products.



Leomid-PN

Features

- High heat resistance and dimensional stability
- Excellent storage stability

Application

- Compound filler
- For diamond tools
- Heat resistant fibers, etc.



Leomid-MD

Features

- Various shapes, compression molded products
- Applied to large demand volume

Application

- Thrust Plug, Thrust Plate, Brake Pad, Blank, Tube, etc.
- Plug/Plate, Blank, Brake Pad, Tube, etc.



Leomid-MP

Features

- Semi-finished products that can be secondarily processed
- Applied to fields requiring precision machining

Application

- Roller, Guide Pin, Support Pin, Vacuum Pad, etc.

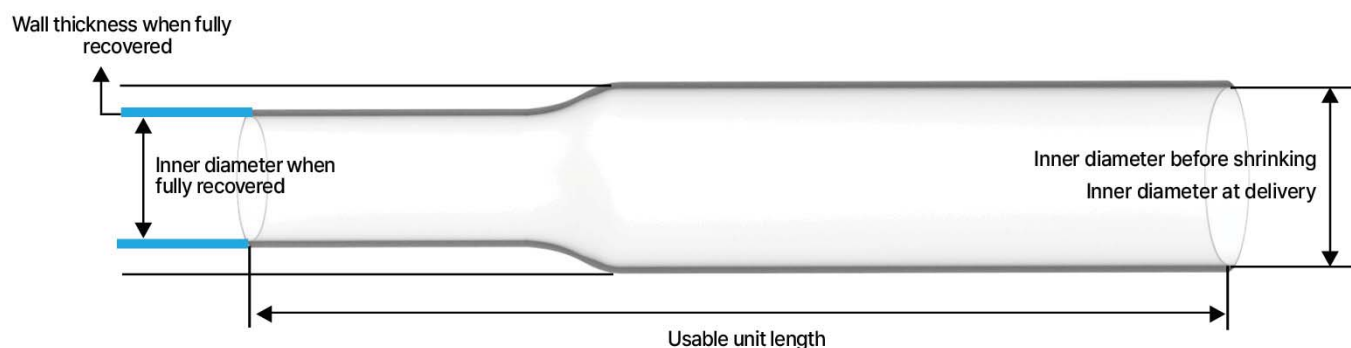
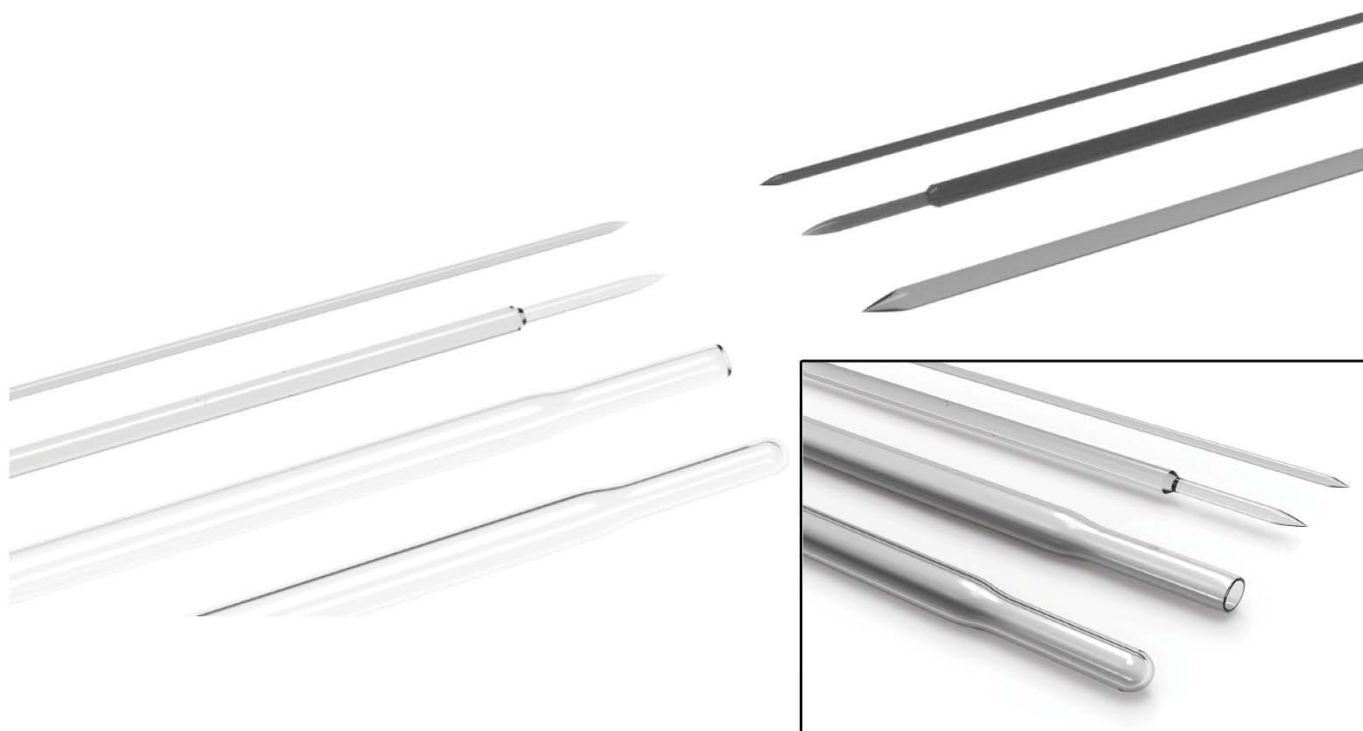
Polyimide molded parts are manufactured by compressing polyimide powder under high temperature and high pressure for an extended period of time. Each molded part is manufactured according to its characteristics, such as heat resistance, wear resistance, and ease of machining. We collaborate with our customers to analyze the intended application and then produce and supply molded parts that meet the specific requirements. Additionally, various fillers are added to the molded parts, enhancing the properties of the original polyimide molded products. This results in products with more distinctly reinforced characteristics tailored to specific applications. This can be **customized according to the customer's needs** and is an item that can create high added value.

Technical Data sheet	Grades		Advanced Engineering Plastic	
	Type of Resin		Polyimide	
	Property	Unit	Value	
	Mechanical Properties			
	Tensile Strength	23°C	MPa	85.5
		250°C	MPa	43
	Elongation		%	6.8
		23°C	MPa	108
	Flexural Strength	250°C	MPa	62
		23°C	MPa	150
Compressive Strength	250°C	MPa	70	
	Compressive Modulus	23°C	MPa	2401
Thermal Properties				
Heat Deflection Temperature		℃	>360	
Coefficient of Thermal Expansion		um/m/℃	54	
Thermal Conductivity		W/m*℃	0.35	
Etc. (Other Properties)				
Density		g/cm^3	1.42	
Water Absorption		%	0.15	
Maximum Size				
Board	65T × 320 × 320 mm			
Rod	60Φ × 320 mmL			



The above data should be used as an example of average quality properties for a reference, and should be verified and applied upon the individual user's responsibility on a case-by-case basis.

* Sueco does not guarantee the accuracy or completeness of any information contained herein for unknow application, So these data should be used as a reference



Teflon heat shrinkable tube

Teflon heat shrinkable tube's properties (summary) comparison

	FEP	PFA	PTFE
Shrink temp	>120°C	>150°C	>330°C
Shrink ratio	>1:1.35(1:1.6 possible)	>1:1.3	1:2, 1:4(1:6 or higher possible)
Shelf life	Infinite (permanent)	Infinite (permanent)	Infinite (permanent)
Storage temp	<40°C(Capable of shrinking at room temperature)	See FEP (Capable of shrinking at room temperature)	<100°C
Color	Transparent	Slightly less transparent than FEP	Milky Translucent
Toxicity	Completely non-toxic	Completely non-toxic	Completely non-toxic
Working temp	-200°C~+200°C	-200°C~+250°C	-200°C~+260°C
Length change	0~+15%	0~+15%	±12%
UV resistance	Completely unaffected	Completely unaffected	Completely unaffected
Flammability	UL V0	UL V0	UL V0
Water absorption	≤0.01%	≤0.03%	≤0.01%
Radiation resistance	1 megarad		0.3 megarad
Hardness	D55~56	D55~60	D50~65
Melting temp	280°C	320°C	330°C self-welding impossible
Coefficient of friction	0.02	0.02	0.04



Teflon heat shrinkable Tubes' standards FEP · PTFE · (PFA available)

(unit:mm)				(unit:mm)				(unit:mm)				(unit:mm)				(unit:mm)							
FEP heat shrinkable tube (Standard)				FEP heat shrinkable tube (Light)				PTFE heat shrinkable tube (Shrinking ratio 4:1)				PTFE heat shrinkable tube (Shrinking ratio 2:1)				Large diameter roll cover (FEP)							
PartNo.	Before shrinking	After shrinking	Wall thickness	PartNo.	Before shrinking	After shrinking	Wall thickness	Part No.	Before shrinking	After shrinking	Wall thickness	Part No.	Before shrinking	After shrinking	Wall thickness	PartNo.	Before shrinking	After shrinking	Wall thickness				
FS 2	2.7	2	0.2	FS 3.8L	5.1	3.8	0.25	T 20	1.98	0.64	0.22	HT 30T	0.86	0.38	0.2	L 16	21	16	0.5				
FS 27	3.6	3		FS 5.5L	7.4	5.5		T 32	3.18	0.94	0.25	HT 28T	0.97	0.46		L 19	25	19					
FS 36	4.8	3.6		FS 7.5L	40.2	7.5		T 48	4.75	1.27	0.3	HT 26T	1.17	0.56		L 23	27	23					
FS 46	6.2	4.6		FS 9.5L	12.8	9.5		T 64	6.35	1.6		HT 24T	1.27	0.64		L 27	34	27					
FS 6	8	6	FS 13L	18	13	T 80		7.92	2	HT 22T		1.4	0.8	L 32		41	32						
FS 7	9.5	7	FS 16L	22	16	T 95		9.52	2.44	HT 20T		1.52	0.97	L 40		50	40						
FS 9	12	9	FS 19L	27	19	T 111		11.13	2.85	HT 18T		1.93	1.17	L 46		60	46						
FS 10	13.5	10	FS 23L	31	23	T 125		12.7	3.66	HT 16T		2.35	1.45	L 56		67	56						
FS 11	15	11	FS 27L	36	27	T 143		14.27	3.94	HT 14T		3.05	1.82	L 65		81	65						
FS 13	17	13	FS 32L	44	32	T 158		15.88	4.52	HT 12T		3.81	2.26	L 80		91	80						
FS 16	21	16	FS 39L	53	39	T 175		17.45	5.03	HT 10T	4.85	2.8	L 100	116		95							
FS 19	25	19	0.5	FS 46L	62	46		T 190	19.05	5.7	0.38	HT 8T	6.1	3.55		L 125	148	113					
FS 23	31	23		(unit:mm)				T 222	22.23	6.2		HT 6T	7.67	4.4		L 150	175	130					
FS 27	36	27		FEP heat shrinkable tube (Heavy)				T 254	25.4	7.06		HT 4T	9.4	5.45		L 175	180	150					
FS 32	43	32		PartNo.	Before shrinking	After shrinking	Wall thickness	T 317	31.75	8.82		HT 2T	10.9	6.9		L 200	203	177					
FS 40	54	40		FS 37H	50	37	1.5	T 381	38	10.2		HT 0T	11.95	8.56		L 225	241	204					
FS 46	62	46		FS 49H	66	49		(unit:mm)				Large diameter roll cover (FEP)				L 250	266	242					
FS 56	76	56		FS 61H	82	61		FEP heat shrinkable tube (Standard)				Large diameter roll cover (FEP)				L 300	315	266					
FS 65	81	65		FS 74H	100	74		FEP heat shrinkable tube (Light)				Large diameter roll cover (FEP)				L 350	350	315					
FS 80	96	80		FS 96	13	96		FEP heat shrinkable tube (Heavy)				Large diameter roll cover (FEP)											
FS 115	115	95		FEP heat shrinkable tube (Standard)				FEP heat shrinkable tube (Light)				Large diameter roll cover (FEP)											
FS 113	150	113		0.7	FEP heat shrinkable tube (Heavy)				FEP heat shrinkable tube (Light)				Large diameter roll cover (FEP)										

※ Non-standard products
can be produced

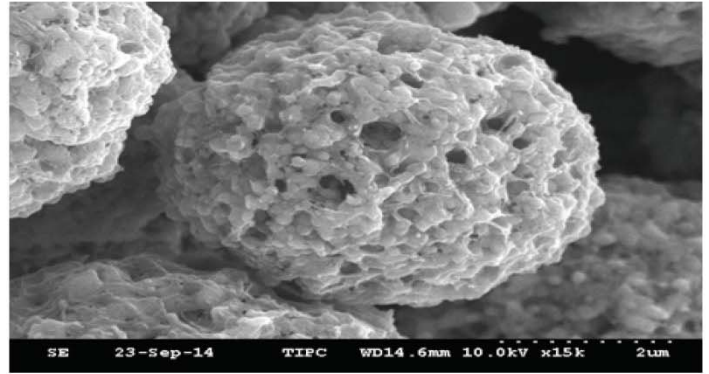
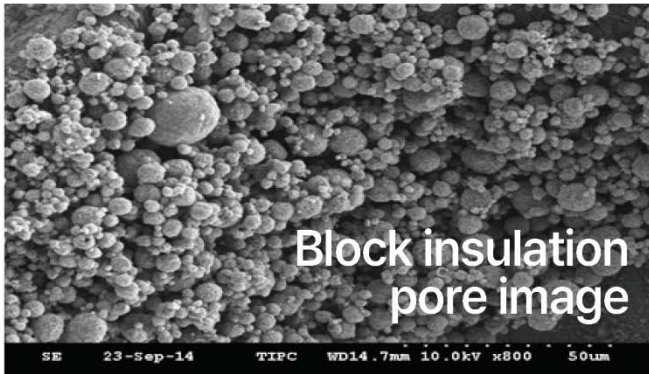
* Non-standard products
can be produced

Teflon tube standard dimension PFA · PTFE · FEP Tube(mm)

Type A standard thickness						Type B thin thickness						Type C lowest thickness					
Size	Min ID	ID	Max ID	OD	Wall	Size	Min ID	ID	Max ID	OD	Wall	Size	Min ID	ID	Max ID	OD	Wall
AWG 32	0.21	0.26	0.31	0.51	0.13	AWG 32	0.21	0.26	0.31	0.51	0.13	AWG 30	0.26	0.31	0.39	0.61	0.16
AWG 30	0.26	0.31	0.39	0.77	0.23	AWG 30	0.26	0.31	0.39	0.77	0.23	AWG 28	0.34	0.39	0.46	0.69	0.16
AWG 28	0.34	0.39	0.46	0.84	0.23	AWG 28	0.34	0.39	0.46	0.84	0.23	AWG 26	0.41	0.46	0.54	0.77	0.16
AWG 26	0.41	0.46	0.54	0.92	0.23	AWG 26	0.41	0.46	0.54	0.92	0.23	AWG 24	0.51	0.56	0.67	0.87	0.16
AWG 24	0.51	0.56	0.67	1.17	0.31	AWG 24	0.51	0.56	0.67	1.07	0.26	AWG 23	0.59	0.67	0.74	0.97	0.16
AWG 23	0.59	0.67	0.74	1.31	0.31	AWG 23	0.59	0.67	0.74	1.17	0.26	AWG 22	0.64	0.72	0.82	1.02	0.16
AWG 22	0.64	0.72	0.82	1.33	0.31	AWG 22	0.64	0.72	0.82	1.22	0.26	AWG 21	0.74	0.82	0.89	1.12	0.16
AWG 21	0.74	0.82	0.89	1.43	0.31	AWG 21	0.74	0.82	0.89	1.33	0.26	AWG 20	0.82	0.87	0.97	1.17	0.16
AWG 20	0.82	0.87	0.97	1.68	0.41	AWG 20	0.82	0.87	0.97	1.48	0.31	AWG 19	0.92	0.97	1.07	1.27	0.16
AWG 19	0.92	0.97	1.07	1.78	0.41	AWG 19	0.92	0.97	1.07	1.58	0.31	AWG 18	1.02	1.07	1.17	1.38	0.16
AWG 18	1.02	1.07	1.17	1.88	0.41	AWG 18	1.02	1.07	1.17	1.68	0.31	AWG 17	1.15	1.20	1.33	1.50	0.16
AWG 17	1.15	1.20	1.33	2.01	0.41	AWG 17	1.15	1.20	1.33	1.81	0.31	AWG 16	1.30	1.35	1.48	1.66	0.16
AWG 16	1.30	1.35	1.48	2.16	0.41	AWG 16	1.30	1.35	1.48	1.96	0.31	AWG 15	1.45	1.50	1.66	1.81	0.16
AWG 15	1.45	1.50	1.66	2.32	0.41	AWG 15	1.45	1.50	1.66	2.11	0.31	AWG 14	1.63	1.68	1.83	2.09	0.21
AWG 14	1.63	1.68	1.83	2.49	0.41	AWG 14	1.63	1.68	1.83	2.29	0.31	AWG 13	1.83	1.88	2.06	2.34	0.21
AWG 13	1.83	1.88	2.06	2.75	0.41	AWG 13	1.83	1.88	2.06	2.54	0.31	AWG 12	2.06	2.16	2.32	2.57	0.21
AWG 12	2.06	2.16	2.32	2.98	0.41	AWG 12	2.06	2.16	2.32	2.77	0.31	AWG 11	2.32	2.42	2.57	2.82	0.21
AWG 11	2.32	2.42	2.57	3.23	0.41	AWG 11	2.32	2.42	2.57	3.03	0.31	AWG 10	2.60	2.70	2.85	3.10	0.21
AWG 10	2.60	2.70	2.85	3.51	0.41	AWG 10	2.60	2.70	2.85	3.31	0.31	AWG 9	2.90	3.00	3.15	3.31	0.21
AWG 9	2.90	3.00	3.15	4.02	0.51	AWG 9	2.90	3.00	3.15	3.76	0.39	AWG 8	3.28	3.38	3.54	3.79	0.21
AWG 8	3.28	3.38	3.54	4.40	0.51	AWG 8	3.28	3.38	3.54	4.15	0.39	AWG 7	3.66	3.76	3.94	4.17	0.21
AWG 7	3.66	3.76	3.94	4.78	0.51	AWG 7	3.66	3.76	3.94	4.53	0.39	AWG 6	4.12	4.22	4.42	4.73	0.26
AWG 6	4.12	4.22	4.42	5.24	0.51	AWG 6	4.12	4.22	4.42	4.98	0.39	AWG 5	4.63	4.73	4.96	5.24	0.26
AWG 5	4.63	4.73	4.96	5.75	0.51	AWG 5	4.63	4.73	4.96	5.49	0.39	AWG 4	5.19	5.29	5.54	5.80	0.26
AWG 4	5.19	5.29	5.54	6.30	0.51	AWG 4	5.19	5.29	5.54	6.05	0.39	AWG 3	5.82	5.95	6.20	6.46	0.26
AWG 3	5.82	5.95	6.20	6.96	0.51	AWG 3	5.82	5.95	6.20	6.71	0.39	AWG 2	6.56	6.69	6.94	7.22	0.26
AWG 2	6.56	6.69	6.94	7.70	0.51	AWG 2	6.56	6.69	6.94	7.45	0.39	AWG 1	7.35	7.47	7.75	7.98	0.26
AWG 1	7.35	7.47	7.75	8.49	0.51	AWG 1	7.35	7.47	7.75	8.23	0.39	AWG 0	8.26	8.39	8.69	9.00	0.31
AWG 0	8.26	8.39	8.69	9.40	0.51	AWG 0	8.26	8.39	8.69	9.15	0.39						

Heat shrinkable tube standard dimension for UV lamp protection

UV lamp T-fluorescent lamp diameter	
Standard	Diameter(mm)
T2	6.35
T3	9.53
T4	12.70
T5	15.88
T8	25.40
T10	31.75
T12	38.10

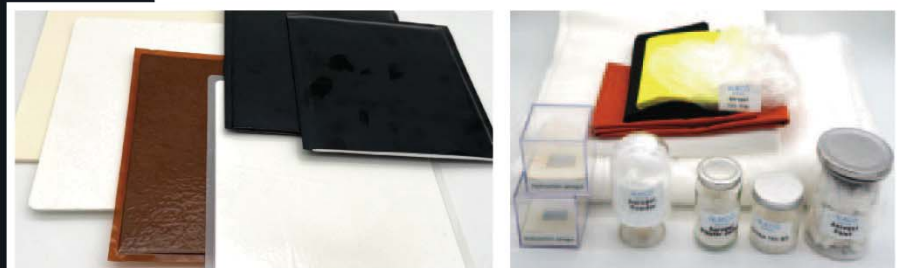


Hong Hitech holds **patented manufacturing technology for high-performance Aerogels** and produces a variety of application products. Sueco advanced material introduces and supplies Hong Hitech's products through the development and technical support of application products.



Aerogel's Properties

- ✓ The lightest solid 30 g/m³
- ✓ The lowest thermal conductivity 0.013 W/mK
- ✓ The maximum air porosity 90~99.8%
- ✓ The highest specific surface area 600~2000m²/g
- ✓ The lowest sound propagation velocity 70m/s
- ✓ The lowest dielectric constant <1.003



Standard Products & Applications

· Silica Aerogel powder

Using high-performance aerogel materials to provide easy application in new fields. Hydrophilic/Hydrophobic, 3kg/Pack, 100g small package sales

· EV battery cell

Stable use of ternary lithium-ion batteries, stabilization of battery life in winter, delay of thermal runaway due to abnormal high temperatures

· Insulation Mat

Large pipe insulation for petrochemical and chemical manufacturing lines, equipment and pipe insulation for power plants, CUI prevention insulation, energy-saving insulation

· Insulation Paint

Replaces traditional insulation mats, architectural insulation

· Electrical insulation film

Improves insulation performance of insulation tape used for wires

· Metal with Aerogel

When added to metals in small quantities with unique technology, it can improve strength, reduce the quantity of material to use, increase productivity, and increase stability while maintaining the inherent properties of the metal (Copper, Aluminum, and other expensive metals).

· Other applications

Insulation fibers, construction insulation panel, heat-resistant bricks for blast furnace, PCM, PU insulation foam



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