



HILTEX

Semi Products

ALF THE ULTIMATE SOLUTION

HILTEX ALF

Hiltex continuous alumina-silica fiber





INTRODUCTION

HILTEX Continuous Alumina Fiber “HILTEX ALF” was jointly developed with HILTEX. It is based on the strong combination of dry spinning technology and extensive experience in fibrous refractory manufacturing technology.

HILTEX ALF is a alumina-silica fiber that is composed of Al_2O_3 (alumina) and SiO_2 (silica), that are commonly known as representatives of stable metal oxide materials. No other ingredients are included in HILTEX ALF but alumina and silica.

HILTEX ALF are polycrystalline filaments whose crystal type is gamma alumina and amorphous silica. HILTEX ALF has accomplished excellent flexibility and strength standard without B_2O_3 (Boron) because of the fine filament diameter, which is offered in 7-10 micron diameter.

HILTEX ALF yarn is made up of thousands of continuous and strong filaments that gives it excellent flexibility and allows it to be readily transformed into various textile forms such as woven fabrics, braided sleeves, tapes, ropes and sewing threads without the aid of any other organic fibers or metal fibers.

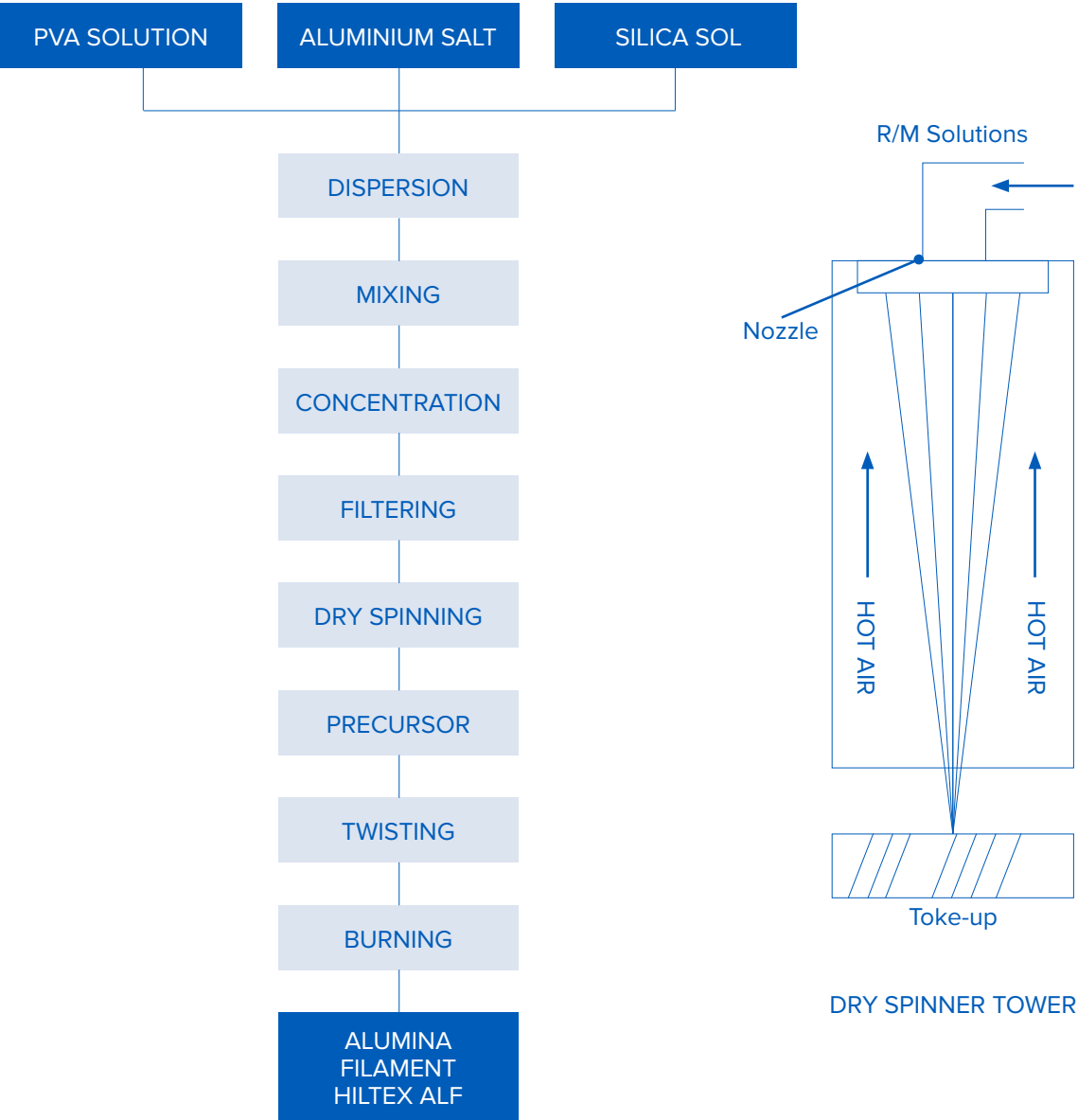
HILTEX ALF offers good chemical resistance, thermal shock resistance and electrical insulation properties. At present, there is growing interest in HILTEX ALF for use in a wide range of applications, in high temperature environment.

We also have several types of fabrics, sleeves and yarns with 2% boron which can be used for applications approaching 1395°C , this called out FB3 type.

MANUFACTURING PROCESS

HILTEX ALF is produced by burning of precursor, made by special dry spinning technology. It is prepared by a mixture of aluminium salt solution, silica sol and PVA(poly-vinyl-alcohol).

Fig.1 Production Process of HILTEX ALF



FIBER SELECTION GUIDE

HILTEX ALF continuous Alumina-Silica fiber is classified into four types with different ratio of Alumina and Silica.

Briefly, hardness of the fiber and the max temperature for continuous use goes up as ratio of alumina increases.

HILTEX ALF G2 Type – Alumina/Silica ratio 60/40%

HILTEX ALF G2 type has excellent flexibility and softness due to containing 40% of Silica. HILTEX ALF G2 type can continuously resist temperatures up to 1200°C.

HILTEX ALF F2 Type – Alumina/Silica ratio 72/28%

HILTEX ALF F2 type is the most common type of HILTEX ALF. Most of our products are made by using HILTEX ALF F2 yarn.

This type of yarn can continuously resist temperatures up to 1250°C.

HILTEX ALF E3 Type – Alumina/Silica ratio 80/20%

This type can continuously resist the temperatures up to 1300°C.

HILTEX ALF FB3 Type – Alumina/Silica/Boron ratio 70/28/2%

HILTEX ALF FB3 type has the best thermal resistance and hardness among all type of HILTEX ALF. HILTEX ALF FB3 type contains 2% boron.

This type can continuously resist the temperatures up to 1395°C.

CHARACTERISTICS

1. Excellent thermal resistance.
(HILTEX ALF retains strength and flexibility after exposure in high temperature environment.)
2. Great flexibility for the making of textiles.
3. Superior thermal insulation properties.
4. High tensile strength and modulus.
5. Superior electrical insulation properties.
6. Resists corrosion.
7. Does not absorb moisture.

TYPICAL APPLICATIONS

1. Thermal insulation rings (disks and collars) for diffusion furnaces used in the semi-conductor manufacturing process.
2. Furnace linings.
3. Heat-Shielding curtains.
4. Thermal insulation seals and packing materials.
5. Thermal insulation coverings for thermocouple cables and wires.
6. Roller covering for tempered glass plate manufacturing.
7. Filters for molten alumina or other metals.
8. Spacers for heat treatment of metal or other materials.
9. Abrasives for plastic whetstones.
10. Insulators around generator and aircraft/rocket engines.
11. Catalyst carries.
12. Electrical and thermal insulators for diesel particulate filter(DPF) systems.
13. And many other applications.



SIZING, HEAT CLEANING

All types of HILTEX ALF are produced using organic sizing (polyurethane).

This organic sizing gives HILTEX ALF products, stability during the process of weaving, braiding and so on.

However organic sizing generate some smoke during usage first time at high temperature.

For some applications this is a unwanted effect. In these cases we recommend to remove the seizing prior before usage by heat cleaning:

Atmosphere Active condition (oxidation)

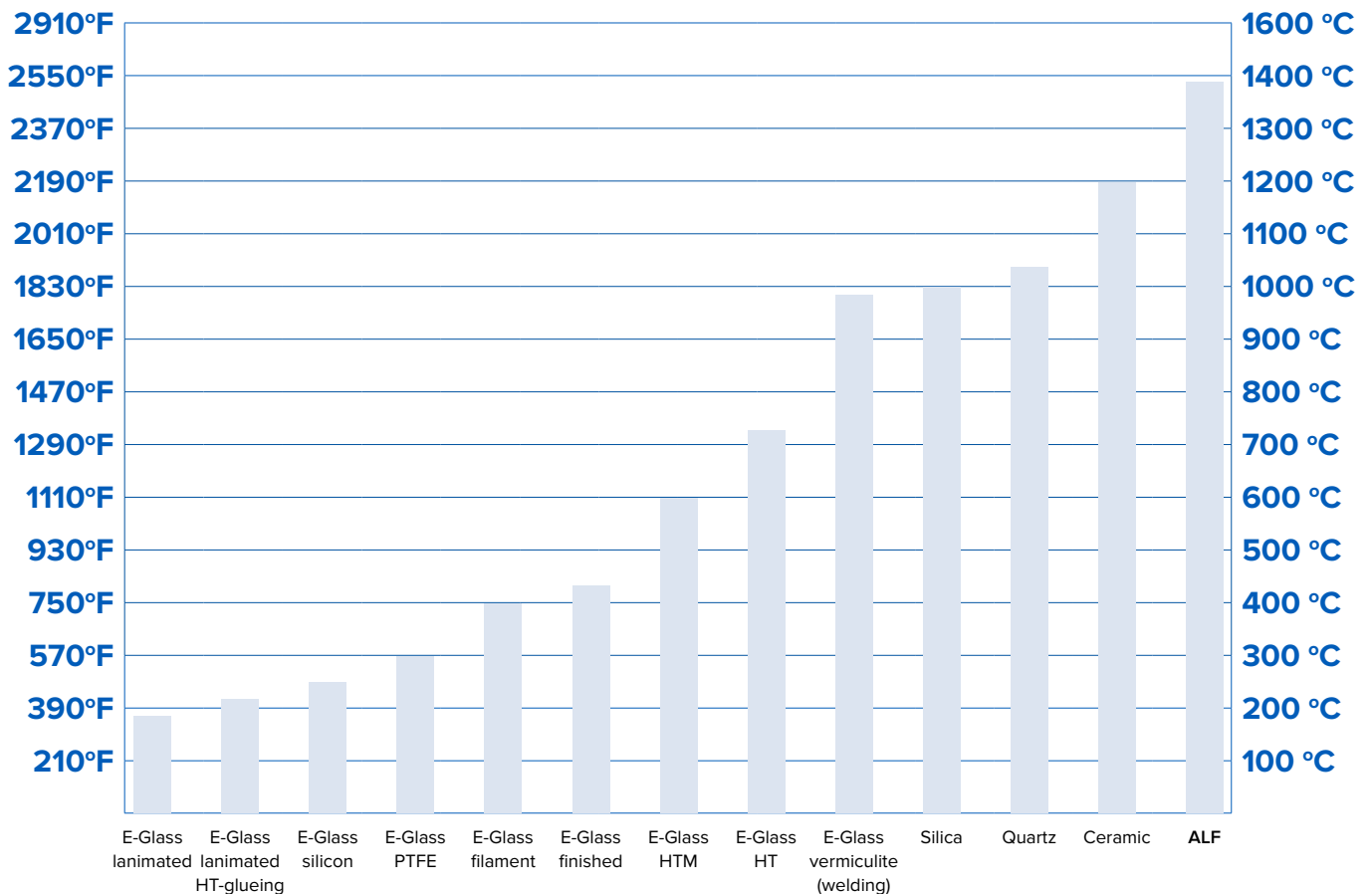
Temperature 850°C × 2hr

Equipment Recommended is to use equipment that has exhaust ventilation like an exhaust enclosure or hood.

Heat cleaning, to remove the organic sizing generates thermal decomposition products. Carbon monoxide is the predominant decomposition products. Recommended is to control carbon monoxide concentrations to the ACGIH Threshold Limit Value of 25ppm(8hr TWA), also other decomposition products should also be adequately controlled.

Thermal behaviour of Hiltex products

The graphic display provides an overview of which Hiltex fabrics are suited to each temperature range.



THE SUPPLEMENTARY EXPLANATION IN TERMS OF TECHNICAL INFORMATION

The crystal phases of HILTEX ALF is comprised are fine size of crystals, which are a mixture of alumina and amorphous SiO_2 . This combination gives HILTEX ALF flexibility and perfect tensile strength. At the case of exposure to more than 1200°C , the crystal phases initiate to change into unstable phases, such as α -alumina, θ -alumina and mullite. In addition, the size of the crystals is growing at exposure of even higher temperatures. This phenomena causes decrease in flexibility and the tensile strength of HILTEX ALF. For instance, the strength retention of HILTEX ALF is approximately 50% after 24hrs at 1200°C .

In actual cases HILTEX ALF can be used over 1200°C giving HILTEX ALF still enough tensile strength and flexibility for usage in many applications, despite the changing of the crystal phase and growing size of the crystal.

The maximum temperature we recommend, is based on our various experiences of the usage of HILTEX ALF.

Shrinkage

Regarding “shrinkage”, HILTEX ALF shrinks approximately 2% after being exposed at 1300°C for 24hrs as a result of transition of crystal type or phase from γ -Alumina and amorphous SiO_2 to Mullite.

Weight loss

There is no weight loss, except binder that vaporizes due to exposure to high temperature. This is different from products that contain boron.

Cold atmosphere

Additionally, HILTEX ALF is not affected in the atmosphere of extreme low temperatures like liquid nitrogen (-196°C).

Chemical resistance

(1). Acid

Usually, HILTEX ALF has a good resistance against Strong Acid even in at high temperature atmospheres, except phosphoric acid. HILTEX ALF can be used in conditions including acid gas such as Hydrochloric acid, Sulfuric acid and Nitric acid without any problems.

(2). Alkali

Commonly known strong alkali like Sodium hydroxide and Potassium hydroxide, which have a corrosive effect on HILTEX ALF. Ammonia is an exception as there is no reaction.



HILTEX ALF TYPICAL PROPERTY

Typical property of Hiltex ALF

Yarn type	G2	F2	E3	FB3
Max use temperature °C	1,200	1,250	1,300	1,400
Filament diameter micron (Φ)	7	7	10	10
Density g/cm ³	2,8	2,9	3,0	3,0
Tensile strength MPa	1,900	1,800	1,700	1,750
Tensile modulus GPa	180	190	200	190
Chemical composition %	Al ₂ O ₃ 60 SiO ₂ 40	Al ₂ O ₃ 72 SiO ₂ 28	Al ₂ O ₃ 80 SiO ₂ 20	Al ₂ O ₃ 70 SiO ₂ 28 B ₂ O ₃ 2
Melting point °C	>1,800	>1,850	>1,900	>1,850

PRODUCTS LIST OF HILTEX ALF WOVEN FABRIC

F2 Type

Type name	Weave	Width mm	Yarn Tex	Thickness mm	Thread count		Weight g/m ²	Breaking Load N/cm
					Warp	Weft		
3030-P-F2	Plain	1000	33	0.10	30	30	80	135
2525-P-F2	Plain	1000	67	0.21	25	25	135	270
0909-P-F2	Plain (Mesh)	1000	200	0.41	09	09	145	230
2626-P-F2	Plain	1000	133	0.31	26	26	280	580
5537-S-F2	Satin	1.000	67	0,25	55	37	265	620
3025-T-F2	Twill	1000	200	0.55	30	25	440	940
1111-P-F2	Plain (Mesh)	1000	620	0.87	11	11	550	820
2220-S-F2	Satin	1000	400	0.97	22	20	670	860
4018-D-F2	Double twill	1000	400	1.35	40	18	940	1350

E3 Type

Type name	Weave	Width mm	Yarn Tex	Thickness mm	Thread count		Weight g/m ²	Breaking Load N/cm
					Warp	Weft		
3025-T-E3	Twill	1000	200	0.55	30	25	440	580

FB3 Type

Type name	Weave	Width mm	Yarn Tex	Thickness mm	Thread count		Weight g/m ²	Breaking Load N/cm
					Warp	Weft		
3025-T-FB3	Twill	1000	220	0.55	30	25	480	510
2220-S-FB3	Satin	1000	440	0.97	22	20	740	470
4018-D-FB3	Double twill	1000	440	1.35	40	18	1050	900

PRODUCTS LIST OF HILTEX ALF WOVEN TAPE

F2 Type

Type name	Weave	Width mm	Thickness mm	Weight g/m	Breaking Load N/cm
TP-25S	Twill	25	0.53	11	500
TP-25D	Twill	25	1.87	37	2500
TP-50S(T)	Twill	50	0.53	22	500
TP-50S(P)	Plain	50	0.45	22	500
TP-70S	Twill	70	0,53	30	500
TP-100S	Twill	100	0,53	43	500

PRODUCTS LIST OF HILTEX ALF SEWING YARN

F2 Type

Type	Tex	Twist(T/m)	Quantity (g/bobbin)	Length (m/ Kg)	O.D.*(m-mφ)	Note
CT-2560D	330	180	350	1.060	0,5	Machine
CT-5120D	610	180	350	573	0,8	Machine
T-5760D	620	125	400	645	1,0	Hand

PRODUCTS LIST OF HILTEX ALF BRAIDED SLEEVE

F2 Type

Type name	Inside diameter mm	Yarn Tex	Weight g/m	Picks
SV-1-XP	0.3	33	0.7	16
SV-1-SP	0.5	67	1.3	16
SV-1	1	133	2.4	16
SV-2	2	200	3.7	16
SV-3	3	200	8.3	16
SV-6	6	200	12	24
SV-10	10	200	20	40
SV-12	12	200	24	48
SV-16	16	200	38	64
SV-20	20	200	44	84
SV-25	25	200	70	84
SV-32	32	200	108	64
SV-40	40	200	90	96

The sleeve types mentioned above have been used in general for applications such as covering material, thermocouple cable and heat resistance electric cable.

G2 Type

Type name	Inside diameter mm	Yarn Tex	Weight g/m	Picks
SV-50	50	200	124	96
SV-58	58	133	116	128
SV-60	60	200	182	96
SV-63	63	133	108	128
SV-70	70	400	218	96
SV-85	85	400	333	96
SV-95	95	400	390	96

The sleeve types mentioned above have been used in general for tempered glass manufacturing.

THE THERMAL CONDUCTIVITY OF HILTEX ALF FABRIC

1. Sample F2

Woven fabric 3025-T

Type name	Weave	Yarn Tex	Thread count		Weight g/ m ²	Thickness mm
			Warp	Weft		
3025-T-F2	Twill	200	30	25	440	0,55

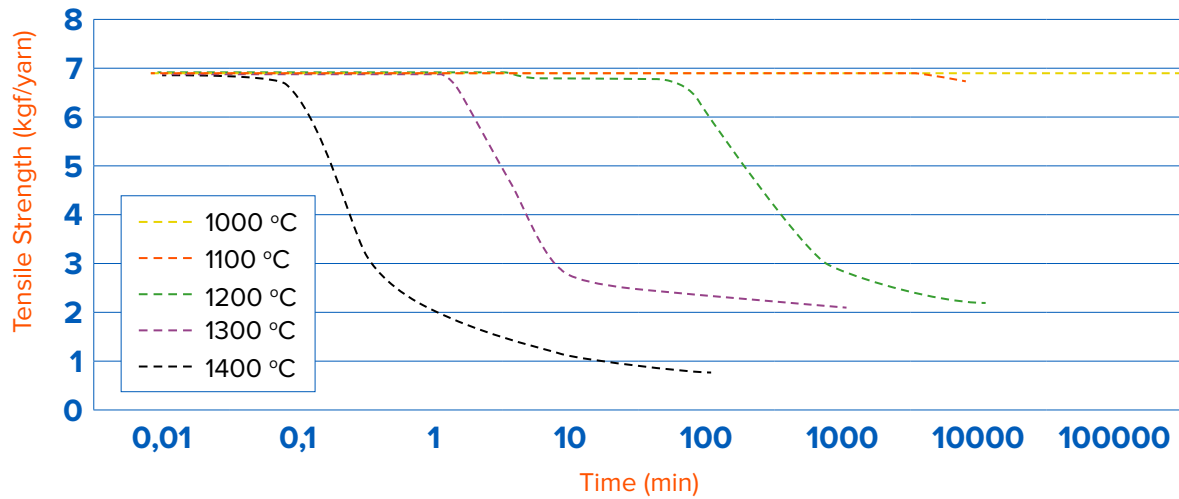
1.1. The thermal conductivity of ALF

Temperature °C	Thermal conductivity (kcal/m hr °C)
200	0.10
400	0.13
600	0.16
800	0.19
1,000	0.21

STRENGTH AT TEMPERATURE

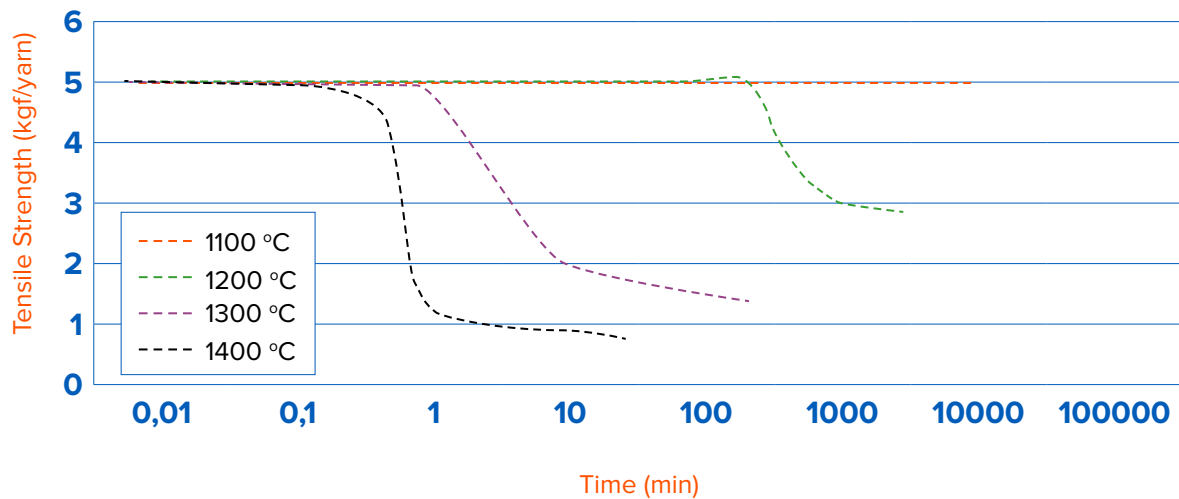
F2 Type

Changing of tensile strength of HILTEX ALF at temperature and time



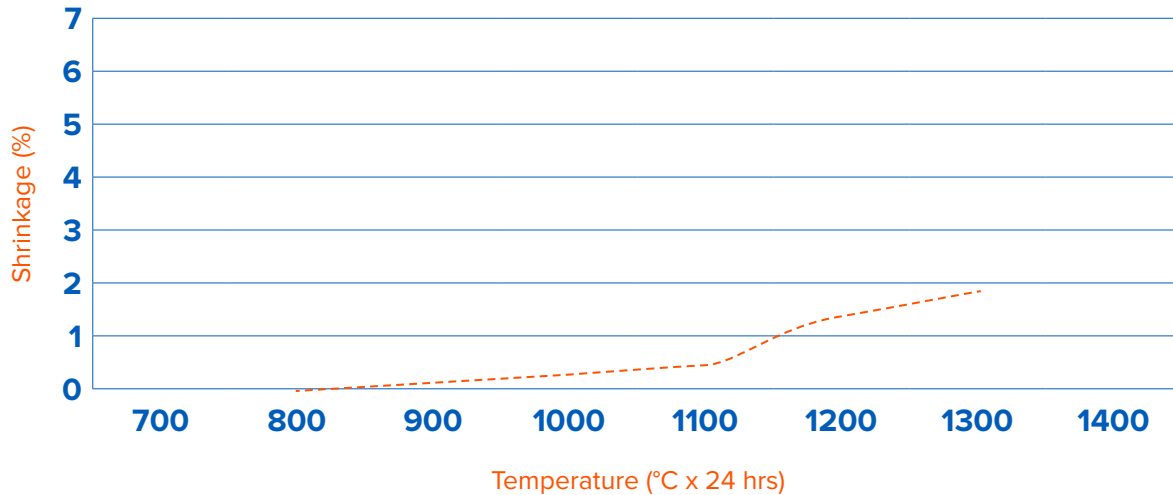
E3 Type

Changing of tensile strength at keeping temperature



THE SHRINKAGE OF HILTEX ALF F2 TYPE

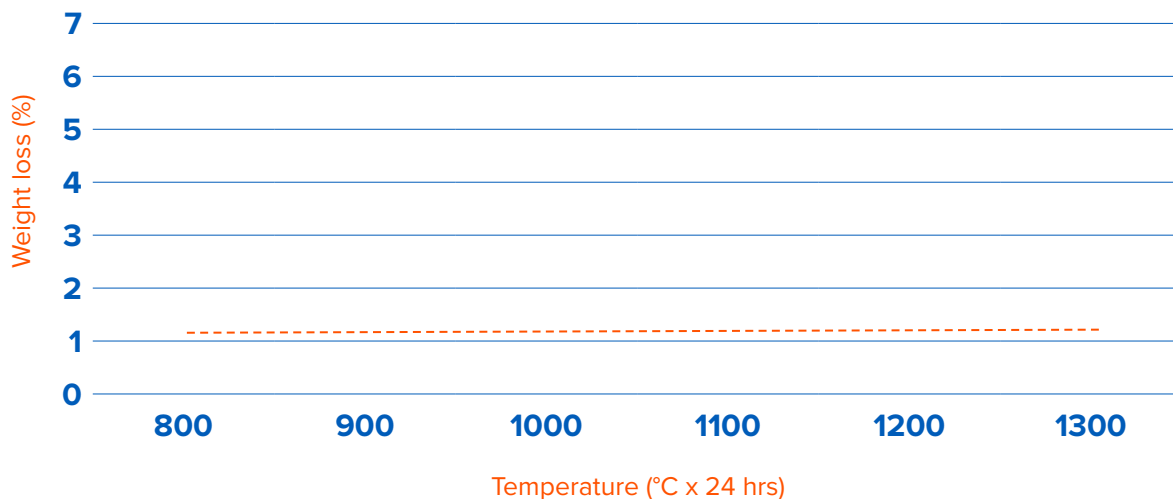
%Shrinkage vs Temperature (24 hours)



THE WEIGHT LOSS AT HIGH TEMPERATURE

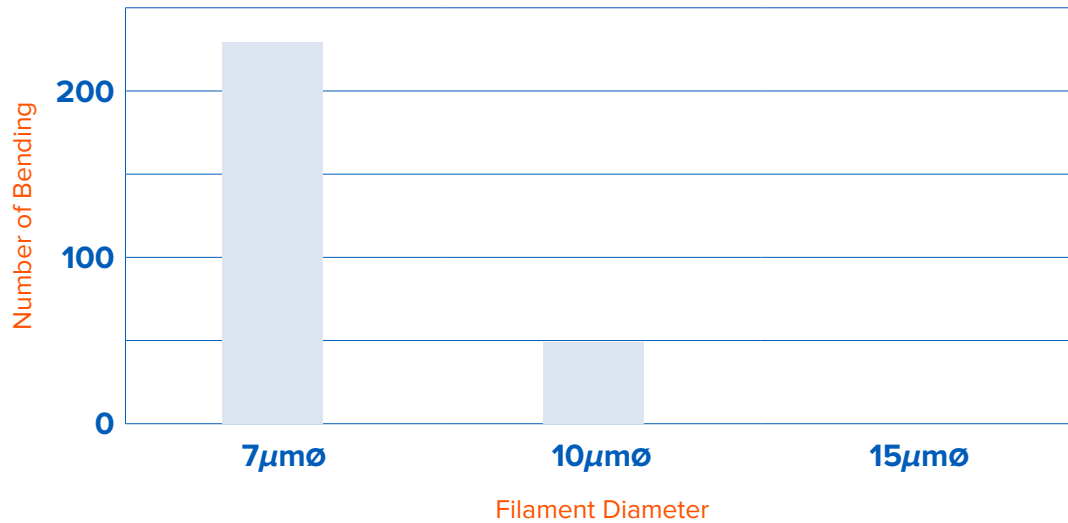
Following graph shows the weight loss at high temperature of HILTEX ALF

The weight loss at high teperature



THE BENDING RESISTANCE

Bending resistance comparison of filament diameter



THE STRENGTH RETENTION AFTER TREATED AT EXTREME COLD ATMOSPHERE

(The temperature of Liquid Nitrogen -196°C)

Table 1.

The strength retention and outside appearance after treated in liquid nitrogen

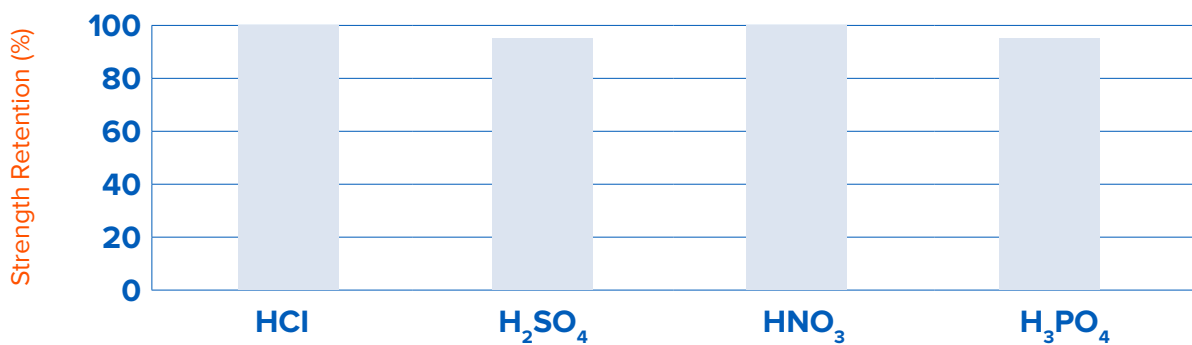
Sample	Time in liquid Nitrogen (-196°C)	Strength retention (%)	Outside appearance
S-1920D(7)	RT	100	-
F2 type	10 min	100	unchanged
	1 hr	100	unchanged
	10hr	100	unchanged
	24 hr	100	unchanged

CHEMICAL RESISTANCE (ACID) OF HILTEX ALF F2 TYPE

Strong Acid (Room Temperature)

Strength Retention vs Strong Acid

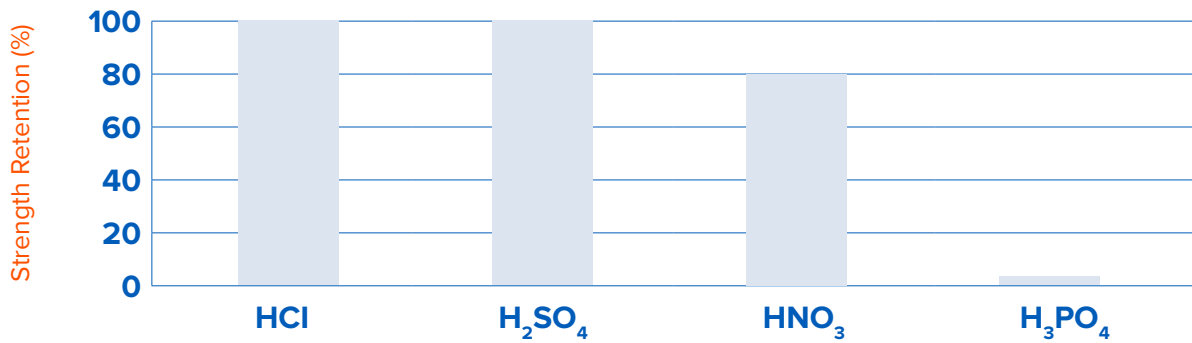
Soak ALF in 10% solution for 24hrs



Strong Acid (After exposed at 800 ×10min)

Strength Retention vs Strong Acid

Soak ALF 300°C x 10 min

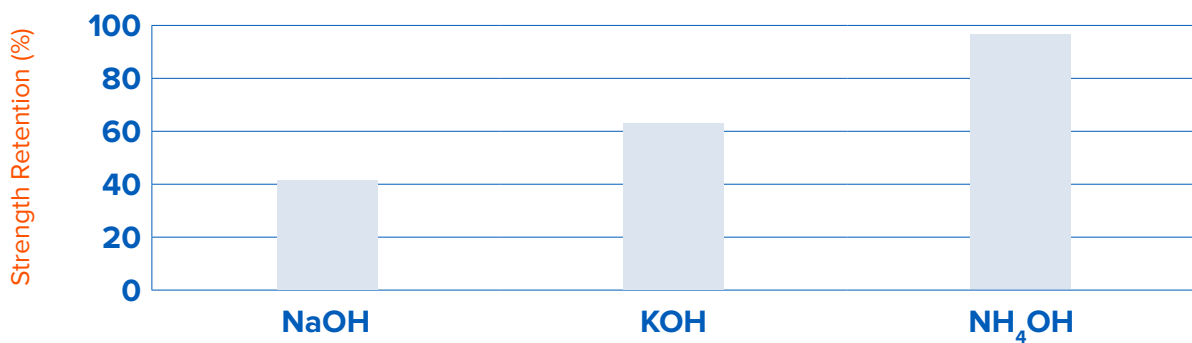


CHEMICAL RESISTANCE (ALKALI) OF HILTEX ALF F2 TYPE

1. Alkali(Room temperature)

Strength Retention vs Alkali

SOAK ALF in solutions of 10% for 24hrs



2. Alkali (After exposed at 800 °C x 10min)

Strength Retention vs Alkali

After exposed at 800°C x 10min



ELECTRICAL PROPERTIES OF HILTEX ALF

1. Sample Woven fabric F2 Type

Type name	Weave	Yarn Tex	Thread count per inch		Weight g/ m ²	Thickness mm
			Warp	Weft		
3025-T-F2	Twill	200	30	25	440	0,55

1. Sample Woven fabric F2 Type

Temperature (oC)	Volume resistivity (Ωcm)	Dielectric constant	Dielectric loss tangent	Dielectric breakdown voltage (KV/mm)
Room temperature	3.60×10 ¹⁴	1.635	0.00202	3.3
100	2.58×10 ¹⁵	1.669	0.00407	–
200	1.51×10 ¹³	1.800	0.02004	2.8
600	3.50×10 ⁹	–	–	1.9
1,000	9.05×10 ⁸	–	–	1.5

THE ELECTRIC NON-CONDUCTANCE OF HILTEX ALF AT HIGH TEMPERATURE

1. Sample (Woven fabric)

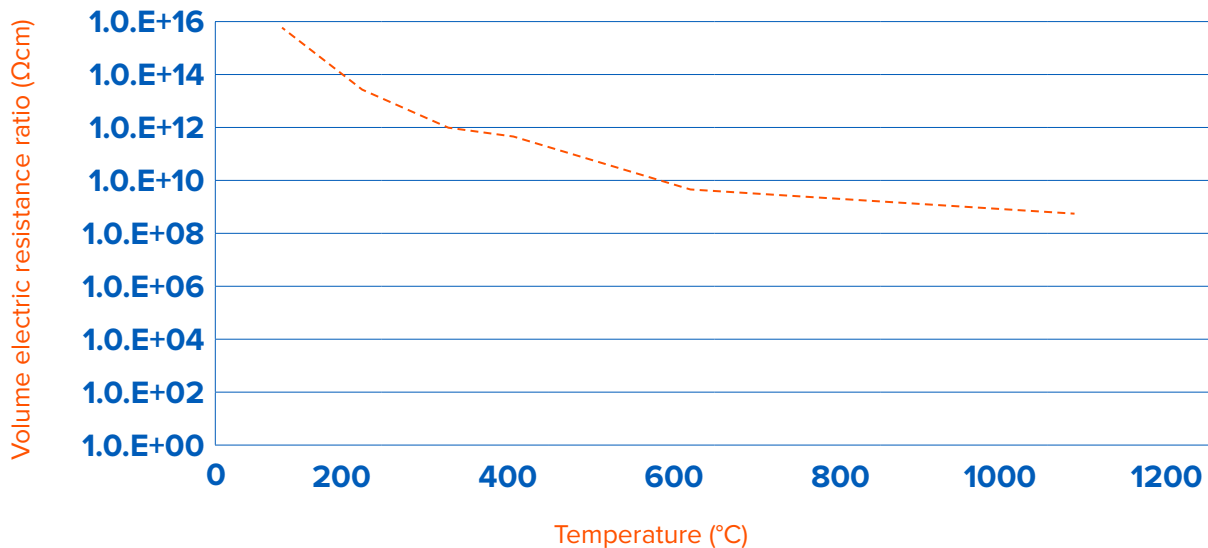
Type name	Weave	Yarn Tex	Thread count per inch		Weight g/m ²	Thickness mm
			Warp	Weft		
3025-T-F2	Twill	200	30	25	440	0,55

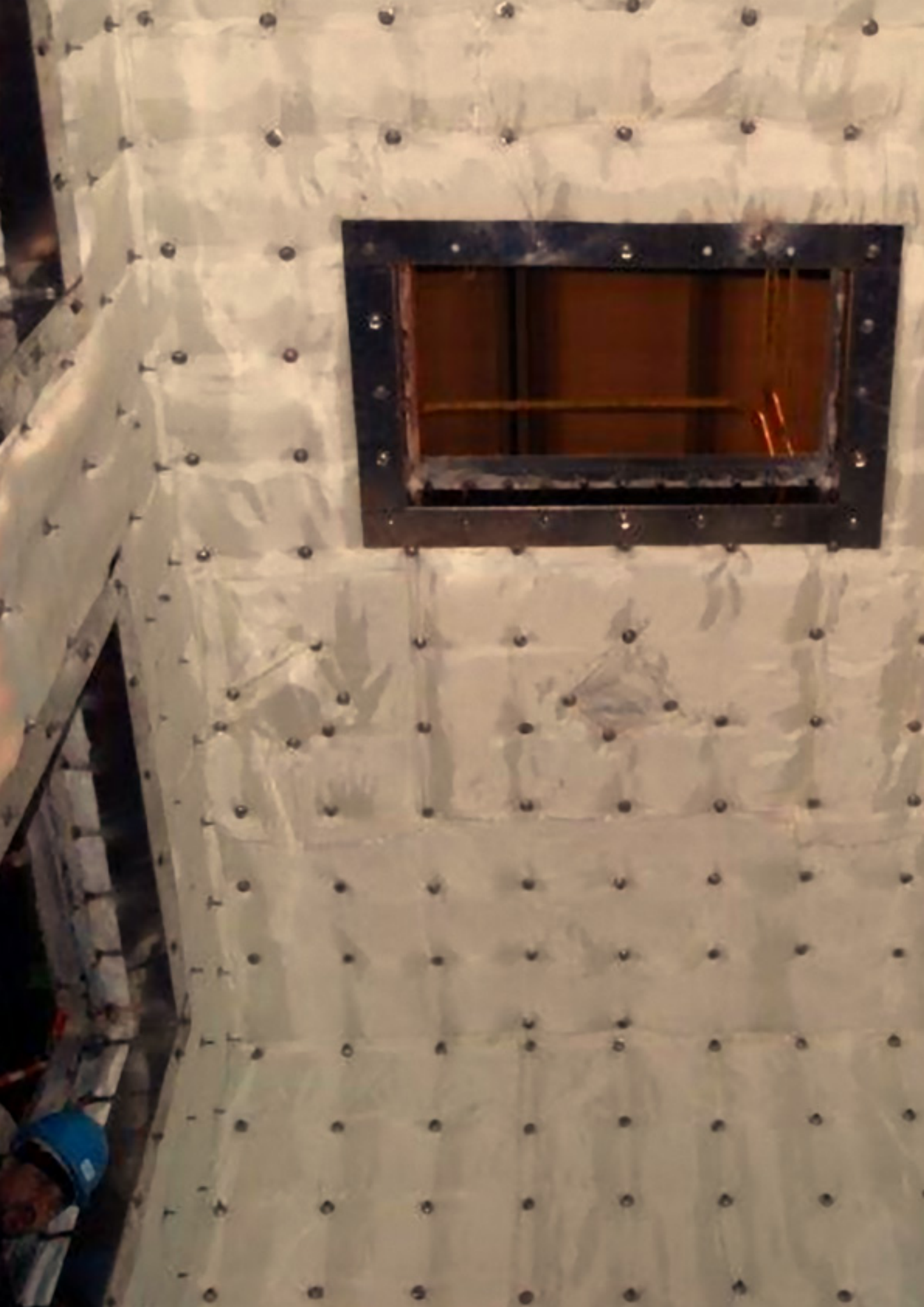
2. The measuring method

The following data is measured in accordance with "JIS K 6911".

3. Result

%Shrinkage vs Temperature (24 hours)







HEALTH & SAFETY BULLETIN

HILTEX ALF

Introduction

HILTEX ALF Ceramic Fibers are refractory alumina-silica fibers with diameters 7-10 microns. They are produced in continuous lengths.

HILTEX ALF Ceramic Fibers are coated with organic sizing which help to textile processing. HILTEX ALF Ceramic Fibers does not indicate significant health risks under most condition of use.

Under certain conditions, however, HILTEX ALF Ceramic Fibers may cause health effects if not handled properly. The following information is available in Material Safety Data Sheets (MSDS).

Fiber and Dust Inhalation

Although HILTEX ALF is classified as ceramic fibers, they are manufactured in continuous lengths and have diameters (7-10microns) which are not considered to be respirable by humans. Since they are not considered to be respirable, inhalation exposure to HILTEX ALF fibers is not expected to pose a carcinogenic risk to humans. They may, however, cause mechanical irritation of the nose and throat.

In certain operations, HILTEX ALF Ceramic Fibers may break to form a dust, particularly if the sizing has been removed or the fibers have been exposed to high temperatures.

There is currently no specific OSHA Permissible Exposure Limit(PEL) or ACGIH Threshold Limit Value(TLV) for refractory ceramic fibers. The Refractory Ceramic Fiber Coalition (RCFC) has suggested an exposure limit of 0.5 fibers/cc for those fibers <3microns in diameter. The RCFC suggested exposure limit is an organizational number rather than a regulatory number. However, since HILTEX ALF Ceramic fibers are non respirable (fiber diameter of >3 microns), they are not covered by this suggested limit.

Instead, HILTEX ALF Ceramic Fibers are covered by the OSHAPELs for “particulates not otherwise regulated” of 15mg/M³ as total particulate and 5mg/M³ as respirable

particulate. In addition, these fibers are covered by the ACGIH TLVs for “particulates not otherwise classified” of 10mg/M³ as inhalable(total) particulate and 3mg/M³ as respirable particulate. Both values are 8-hour time-weighted averages. We recommend the ACGH TLVs. The EU directive 97/69/EC of December 5, 1997 is the European legal base for classification, packaging and labeling of certain man-made vitreous fibers.

Laboratory studies have shown that certain man-made vitreous fibers have carcinogenic effects. Due to the fact that HILTEX ALF Ceramic Fibers do not meet the critical geometric dimensions for respirable fibers (note R in 97/96/EC).

HILTEX ALF does not have to be classified as dangerous substances according to this directive. Furthermore, HILTEX ALF ceramic fiber diameter 7-10 microns puts them outside the World Health Organization (WHO) definition of respirable. Fibers are defined as respirable by WHO convention if the length is greater than 5 microns and the diameter ratio greater than 3:1. Local exhaust ventilation and/or use of NIOSH approved dust mist respirators is recommended for operations where fibers or dust may become airborne. If nose or throat irritation occurs, move to fresh air.

Eye and Skin Contact

HILTEX ALF Ceramic Fibers can cause mechanical irritation of the eyes and skin similar to that caused by fiberglass. Safety glasses or goggles, gloves and long sleeved clothing with tight fitting cuffs are recommended to minimize eye and skin contact. Contaminated clothing should be laundered each day.

If eye irritation occurs, flush eyes with water. If skin irritation occurs, wash the affected area with soap and water and change to fresh clothing.

Heat Cleaning / Treatment

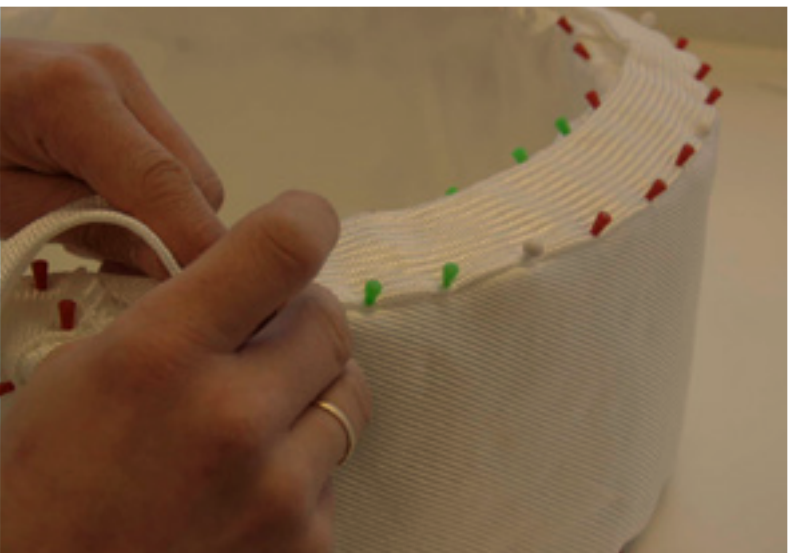
HILTEX ALF Ceramic Fibers are coated with organic sizing which are removed at high temperature. HILTEX ALF Ceramic Fibers generate thermal decomposition products which may be hazardous if inhaled at concentrations exceeding their recommended exposure limits. Carbon monoxide is the predominant decomposition product. Trace amounts of nitrogen oxides and hydrogen cyanide may

also be generated. By controlling carbon monoxide concentrations to the ACGIH Threshold Limit Value of 25 ppm(8hr TWA), other decomposition products should also be adequately controlled. Control of carbon monoxide levels may be most effectively achieved through the use of exhaust ventilation, for example an exhaust enclosure or hood.

The ventilation system should provide a minimum capture velocity of 150ft/min(45.72m/min) and should not be subject to disturbances produced by cross drafts.

After Service Considerations

Analyses of HILTEX ALF Ceramic Fibers, either as manufactured or after use, has shown that neither free silica nor the cristobalite form of silica is present. The silica in the fibers is present in a stable mixture of alumina and silica





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