



## **Schunk – Innovative Insulation Materials**

# Thermal Insulation at High Temperatures

## Carbon and Graphite Felt

As a manufacturer of graphite felt for insulation in high-temperature applications, Schunk Kohlenstoff-technik offers a broad range of services and proven know-how.

Schunk graphite felt offers excellent insulation properties due to its low thermal conductivity and high emissivity compared to other high-temperature materials.

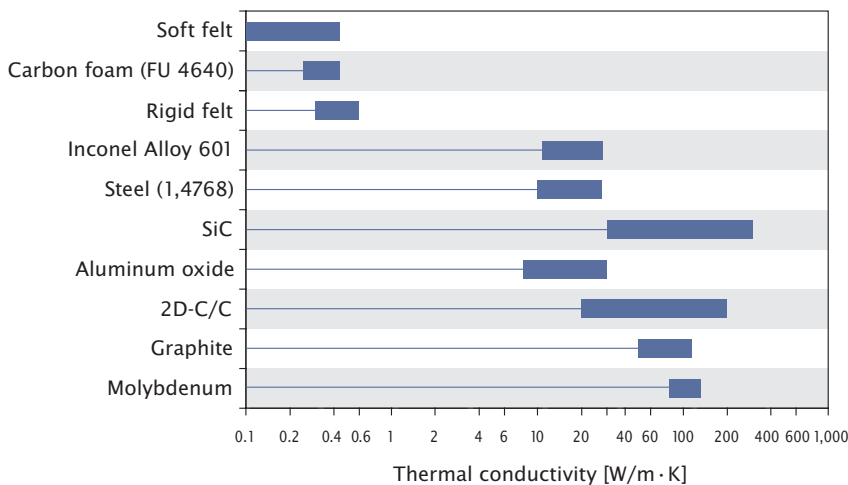
## Advantages

- High temperature resistance
- High stability
- Easy processability
- Custom-made shapes and special sizes possible
- High purity



Graphite soft felt

## High-Temperature Materials



Graphite felts can be used under vacuum or protective gas at temperatures of up to 2,800°C.

Schunk insulation materials provide excellent resistance to chemical attack and a prolonged lifespan due to their high purity.

The usable lifetime can be further increased through purification and special coating.



Graphite soft felt



## Carbon and Graphite Soft Felt

Graphite soft felt is characterized by high flexibility and ease of processing. This property allows for the fabrication of even complicated shapes for insulation in almost any plant construction.

Through die cutting, special shapes in higher quantities can be produced, as well.

Soft felt can be stabilized and made into self-supporting structures through Chemical Vapor Infiltration, CVI, with carbon.

Due to their high purity, Schunk insulation materials stand out for excellent thermal properties and increased lifetime.

### Properties

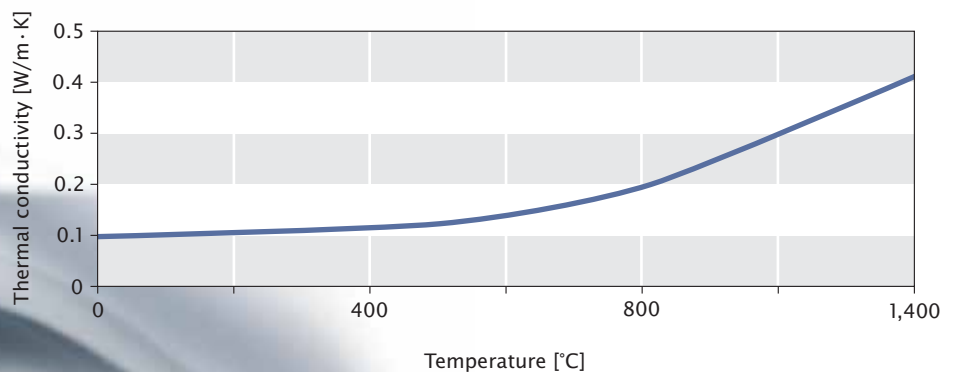
- Low thermal conductivity
- High temperature resistance
- Does not take static electric charge
- Low heat capacity
- High purity
- Excellent homogeneity

### Schunk – Material Data

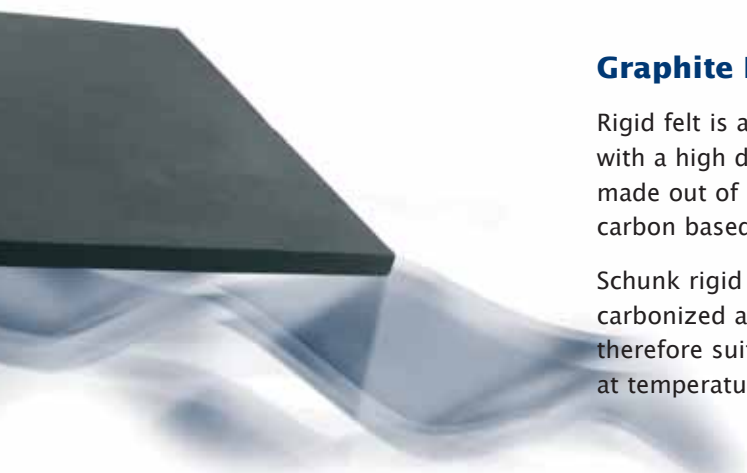
Material grade		Thickness/mm	Width/mm	Ash/ppm
Carbon felt	KF1	5	1,200	<3,000
	KF2	10	1,200	<3,000
Graphite felt	GF1	5	1,200	<300
	GF2	10	1,200	<300
Purified Graphite felt	PF1	5	1,200	<30
	PF2	10	1,200	<30

*Different sizes are available on request.*

### Thermal Conductivity of Graphite Felt (GF2)



# System Solutions for the Future



Rigid felt plate

## Graphite Rigid Felt

Rigid felt is an insulation material with a high dimensional stability, made out of graphite fibers and a carbon based binding material.

Schunk rigid felt FU 2914 is carbonized and graphitized and therefore suitable for applications at temperatures up to 2,800 °C.

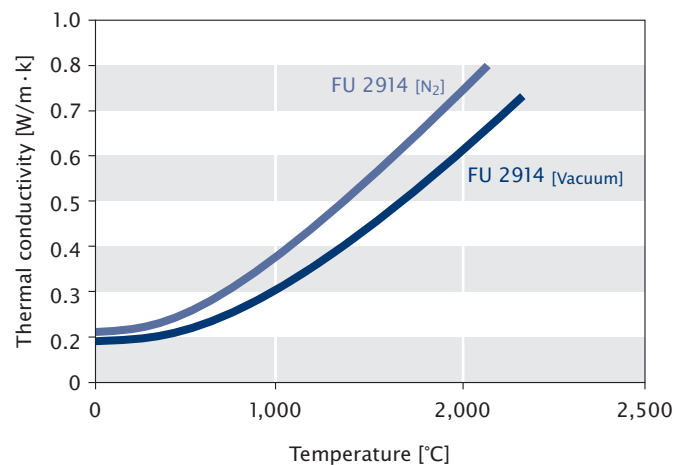
This material is mainly used to fabricate self-supporting tiles, concave cylinders and customized shapes.

A main application area is the furnace construction industry.

## Typical Usage

- Insulation for vacuum furnaces
- Insulation for inert gas furnaces

## Thermal Conductivity – FU 2914



## Advantages

- Low thermal conductivity
- Low heat capacity
- High temperature resistance
- High dimensional stability
- Low adsorption of gases and vapours
- Excellent resistance to chemical attack



Standard rigid felt plates with graphite foil protection on one side

Material grade	Thickness/mm	Width/mm	Length/mm
FU 2914	20	1,000	1,500
	30	1,000	1,500
	40	1,000	1,500

Please order our data sheet for more information.

## Graphite Felt – Refinement

We offer a wide range of refinement options for our insulation materials.

Through the use of special graphite or carbon fibre foil, it is possible to reduce the release of potentially corrosive materials and/or gases into the furnace. Such gas diffusion barriers are often laminated onto the felt.

## OxaTherm® – Production Process

Our special OxaTherm® materials are made out of graphitized soft felts and stabilized through vapour infiltration with pyrolytic carbon (pyrocarbon, PyC). Additionally, components can be protected against chemical attack by infiltration with silicon carbide (SiC).

Customized demands can be met during the fabrication process as we control the complete production chain from the raw material to the finished component in our plants.



OxaTherm®-Insulation tube

## Standard Size – Graphite Foil

Grade	Thickness /mm	Width /mm
FU 2913	0.35	500
		1,000
	0.50	500
		1,000
	0.75	500
		1,000
	0.80	500
		1,000
	1.00	500
		1,000
	1.50	500
		1,000

## Advantages

- Extremely long lifetime
- Different layer thicknesses possible [µm]
- Good chemical resistance
- High temperature resistance
- Oxidation protected through PyC- and/or SiC-layer

## Main Application Temperature – OxaTherm®

Material	Grade	Temperature [°C]	Atmosphere
OxaTherm®	C	2,800	Vacuum
	SiC	1,600	Vacuum

OxaTherm® can also be used for critical components where a reaction with hydrogen (Methanization) or silicon oxide is likely to happen.



Carbon U-Nails



We recommend our graphite cord or U-Nails to attach the foil materials to the graphite felt.



Soft felt insulation tube rigidized by C/C- and graphite foil

Grade	Ash/ppm	Diameter /mm
KK1	3,000	2
GK1	<100	2

# Special Insulation Systems

## Carbon Foam

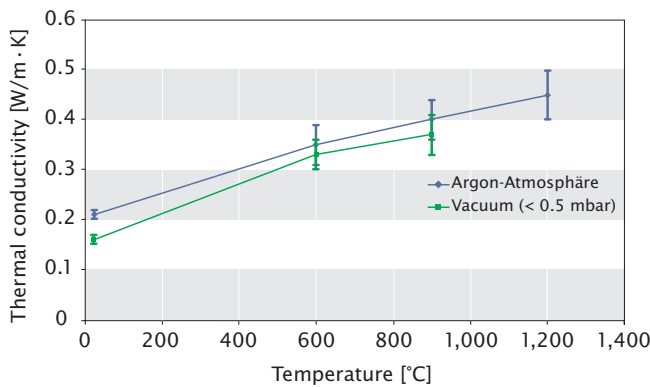
Besides felts, carbon foams can also be used for insulation. Like felt, carbon foam offers high temperature resistance up to approx. 2,800 °C and excellent stability against thermal shock.

Low thermal conductivity, high mechanical stability and a rather closed porous structure (compared to that of carbon felt) make foam a natural choice for special high-temperature applications.

## Advantages

- Isotropic mechanical and thermal attributes
  - No release of fiber and reduced release of particles
  - Low gas permeability
  - Spherical pore geometry (50 – 300 µm)
  - Components can be coated with pyrocarbon
  - High purity (Impurity level of approx. 100 ppm)
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- Dimensions  
1,000 mm x 1,000 mm x 30 mm or 40 mm  
1,000 mm x 500 mm x 20 mm, 30 mm or 40 mm
  - Special sizes and treatments are available on request

### Thermal Conductivity FU 4640



Due to their high purity and precise processability, carbon foams are suitable for use in semiconductor manufacturing.

Material Properties*		FU 4640
Bulk density	[g/cm <sup>3</sup> ]	0.15
Porosity	[%]	85
Flexural strength	[MPa]	2.5
Elongation at rupture	[%]	0.5
Young's modulus (dyn.)	[GPa]	0.6
Compressive strength	[MPa]	5
Coefficient of thermal expansion (20 - 1,000 °C)	[10 <sup>-6</sup> /K]	3.5
Thermal conductivity	[W/mK]	0.25
Specific electrical resistance	[µΩm]	1,050
Ash	[µg/g]	100

\* The given data are not binding but are typical values based on our experiences. It should be taken into consideration that a spread of results can arise due to material and production variations.



Carbon foam segment



*Graphite soft felt plate  
laminated with graphite foil*

As carbon foam is self-supporting and mechanically and dimensionally stable, three-dimensional structures can be made out of blocks and be used for insulation without reinforcement or fixation.

Water jet cutting is suitable for cutting components out of flat boards. Single elements can be combined to form larger insulation components by sleep-fit or adhesive joints.

The oxidation resistance of carbon foam can be improved through coating and/or infiltration with pyrocarbon.

## **Felt Processing**

Schunk Kohlenstofftechnik uses most modern equipment suitable for high volume production. We are therefore able to produce felt insulations in larger dimensions ( $\text{\O} 2,000 \times 1,200 \text{ mm}$ ) to meet specific customer needs.

Mechanical processing of self-supporting components such as tiles, cylinders and other insulation parts is performed by sawing, drilling, cutting and milling.



**We will be pleased  
to help you!**

We are happy to share information  
with you about any of our

- Graphite soft felts,
- Graphite hard felts,
- Graphite foils,
- Carbon foams.

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