

Thermiculite 866® is a high temperature sealing material designed for solid oxide fuel cell applications. It is based upon the mineral vermiculite and contains no organic binder or any other organic component.

The traditional method of exfoliation is thermal and in this thermally exfoliated form vermiculite is well known as a thermal insulation, a packaging material and used in many other applications. Another method of exfoliation is chemical exfoliation.

This produces a dispersion of individual platelets which are separated from each other. These platelets are highly flexible and conform to the surfaces of other particles to bind them together. This binding action allows a sheet material to be manufactured without any organic binding agents being present, thus Thermiculite® 866 consists just of the chemically exfoliated vermiculite and a second filler material.

The second filler material is a very familiar mineral, talc, also known as steatite or soapstone. Like mica and vermiculite, steatite is also a naturally occurring, high temperature stable, sheet silicate mineral but it is characterized in that it is very soft. The combination of the chemically exfoliated vermiculite with steatite results in a material that retains all the chemical and thermal durability but which is very soft and conformable.

The softness of the material and the platelet alignment result in a material which compresses under very low load to produce a compacted material that offers a very tortuous, passage stopping, path to any gas trying to permeate through it in the plane of the sheet or perpendicular to that plane. This means that the material has superb sealing characteristics combined with peerless thermal stability.

A gasket must first create a seal and must then maintain that seal for the required lifetime. Thermiculite® 866 is excellent in both of these respects.

It is soft and highly conformable and therefore creation of both macro and micro sealing is readily achieved. Also, maintaining the seal is not a problem as it contains no organic components that would result in relaxation or creep and, in a connection stressed by bolts, lead to loss of surface load on the gasket.

Until Thermiculite® 866 has been raised to 570°C or more for the first time it has poor water resistance so care should be taken to ensure that in areas where condensed water is likely to be present that no part of the gasket that is not compressed protrudes into the area where that water is likely to be present.

Waranty exclusion

In view of the variety of different installation and operation conditions as well as application and process engineering options, the information given in this datasheet can only provide approximate guidance and cannot be used as basis for warranty claims

Approvals / Compliance

BAM for Oxygen approved.

Availability

Thermiculite® 866 is available as either cut gaskets or in sheet form. Thermiculite® 866 is made at a width of 450mm and can be supplied in lengths of up to 1000mm.

A popular sheet size is 450mm x 350mm.

Thermiculite® 866 is supplied at a density of 1.9 gm/cm³ and thicknesses on 0.3, 0.5, 0.7 and 1.0mm are routinely stocked with intermediate thicknesses being available on special request.

Thermiculite® 866 can be easily cut into complex shape gaskets by the traditional gasket cutting techniques but laser and water jet cutting methods should not be used.

Typical Physical Properties

Figure 1 shows the compression characteristics of Thermiculite® 866 of the standard thicknesses.

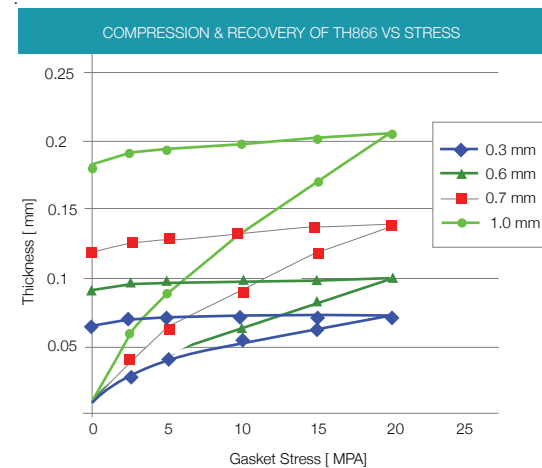


figure 1

Figure 2 demonstrates the creep resistance of Thermiculite® 866 at ambient and elevated temperature. The temperature of 450°C being a test equipment limitation, not a material limitation.

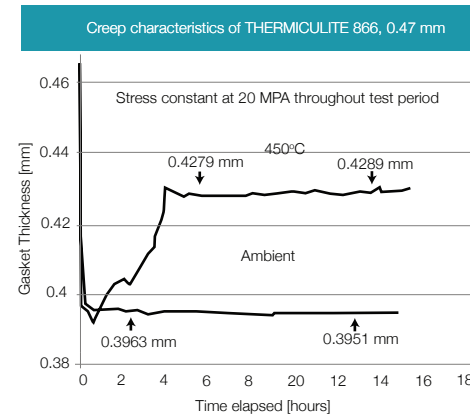


figure 2

Figure 3 compares the sealing performance of Thermiculite® 866 and mica and clearly demonstrates, even at ambient temperature, the superiority of Thermiculite® 866. At an elevated temperature the difference would be higher.

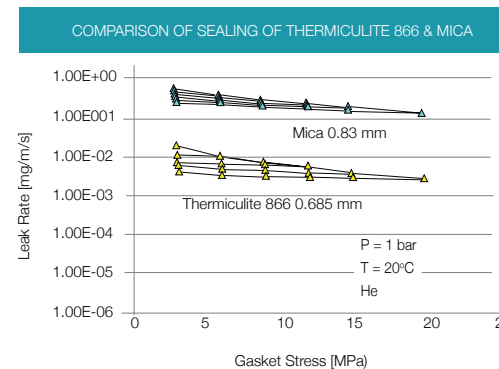
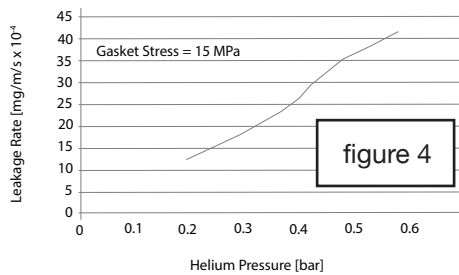


figure 3

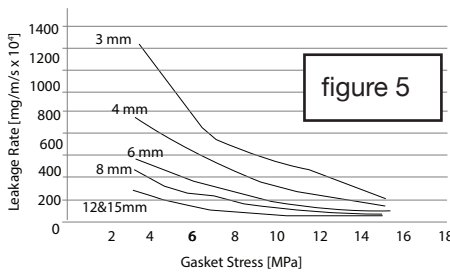
Figure 4 shows how the sealing of Thermiculite® 866 improves as the pressure to be sealed reduces.

The influence of the internal pressure on the leakage rate of Thermiculite 866



Figures 5 and 6 show further how the sealing of Thermiculite® 866 is influenced by the gas pressure to be sealed and on the landwidth of the gasket, the land width is half the difference between the compressed external and internal dimensions of the gasket.

The effect of land-width on the leakage rate helium pressure = 1 bar



The effect of land-width on the leakage rate helium pressure = 0,3 bar

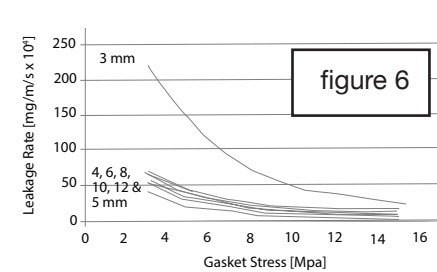
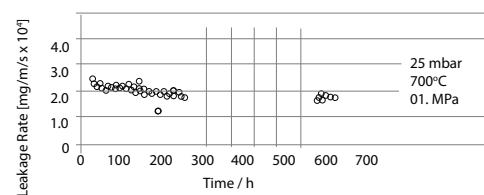


Figure 7 shows the robustness of the sealing of Thermiculite® 866 against thermal cycling. In this figure the sealing after the five thermal cycles, shown as red lines, remains as expected from the data obtained before the thermal cycles.

The robustness against thermal cycling and sealing performance of thermiculite 866



Electrical insulating resistance of Thermiculite® 866 determined by IE 167 (BS 2782: Part 2: 1992)

	[Megohms]	
	As Received	After 50 °C for 24 hours
0.5mm	0.33	7.5
0.7mm	0.50	7.5

The specific heat capacity of Thermiculite® 866

	[J / g / K]
0.5mm	0.949
0.7mm	0.950

The thermal conductivity of Thermiculite® 866 determined by ISO 8301 (DIN 52612 & ASTM C518)

	[W / m / K]
0.7mm	0.19

Best Sealing Practice

To obtain the best performance from a sealing material the following considerations apply just as much to an SOFC as to an industrial pipeline gasket:

- Minimize the gasket area as far as possible taking into consideration the minimum landwidth requirement for gasket handling and sealing
- Maximize the compressive load available
- Use studs of the appropriate metal and stress to a high percentage of yield
- Minimize load loss by making the studs as compliant as possible by using the minimum stud diameter suitable and by using extension collars or constant load washers such as Belleville washers
- Tighten the studs in a cross pattern manner
- Tighten the studs using either controlled torque or hydraulic tensioners
- With torque tensioning use a reliable lubricant having a known friction factor
- Unless the gasket is compensating for connection defects, always use the minimum practical thickness
- The surfaces to be sealed should preferably have ground rather than a turned finish but they should certainly be free from transverse machining marks or scratches.

An appropriate surface finish is N6, Ra 0.8µm, CLA 32µ" / Rz 3.20µm, 126µ" or better.