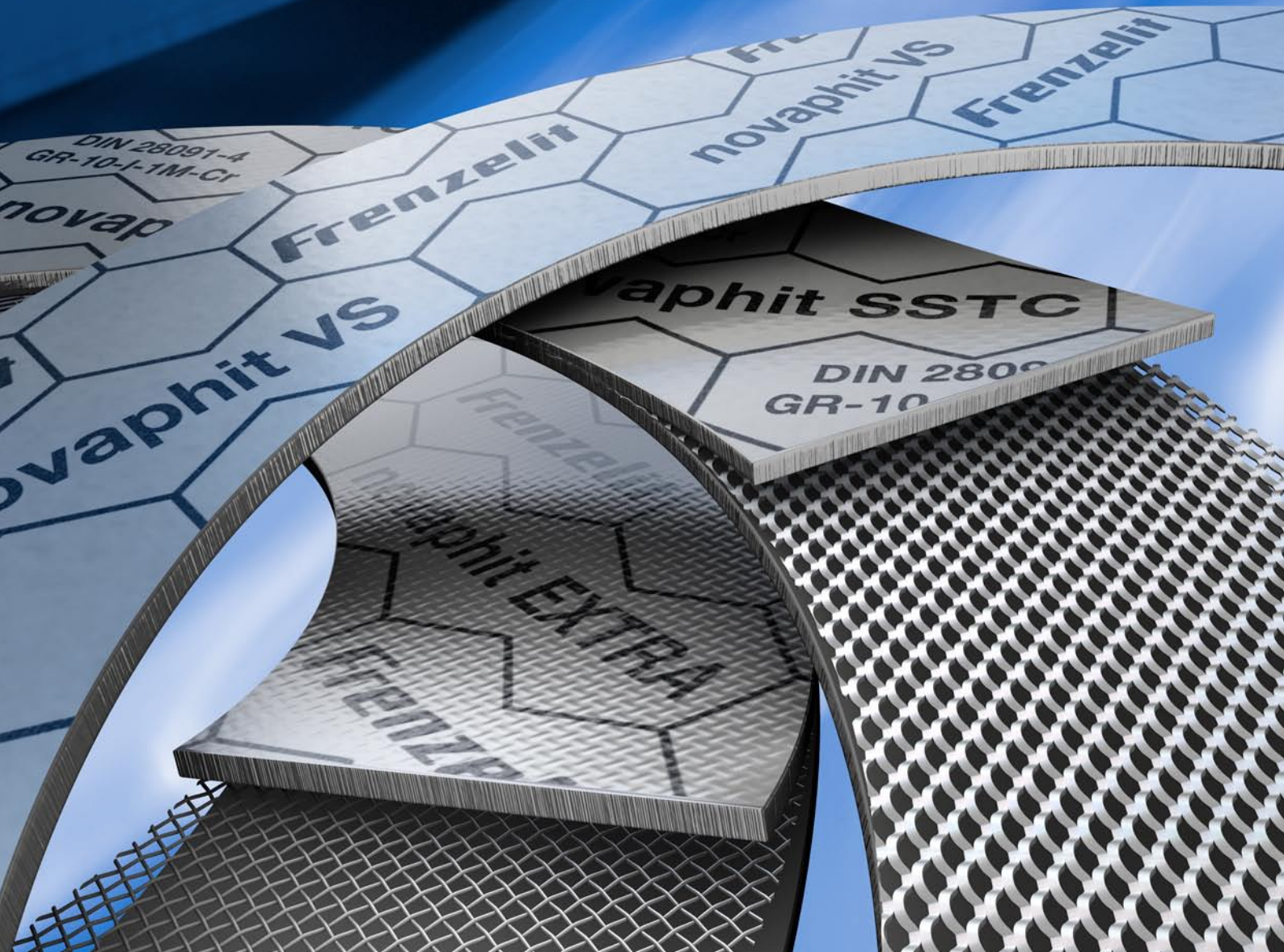




novaphit® – high-pressure gasket material
made from expanded graphite
for maximum safety requirements.



GASKETS

TECHNICAL TEXTILES

EXPANSION JOINTS

INSULATION

NEW MATERIALS



creating
hightech
solutions

Why using graphite as gasket material?

Following the substitution of asbestos, no technically reliable solutions were available initially for gasket applications in higher temperature ranges. Rubber-bonded gasket materials have a natural maximum temperature limit. There was a particular need for better solutions for media that are hot, dangerous and have creep properties, such as steam or heat transfer oils. This was the reason for the tremendous success of gaskets made from expanded graphite.

Properties of novaphit® gaskets made from expanded graphite

- Suitable for temperatures between -200 °C and 550 °C
- Insensitive to changing loads
- Maximum adaptability to flange unevenness
- High flexibility when sealing surfaces are unfavourable/faulty
- Practically no hot creep
- Universal chemical resistance
- Maximum sealing performance in the flange
- Use possible at internal pressure levels of up to 250 bar

Consistent product quality thanks to process control system

Frenzelit is involved throughout the manufacturing process for the novaphit® product family, from obtainment of the graphite raw material to the finished gasket. All the parameters that affect quality are monitored via a process control system. This guarantees consistent maintenance of the highest product quality. Reliable production processes lead to reliable sealing in the user's operations and thus to just as reliable processes at his plant.

Sealing system design

Frenzelit produces the data needed to calculate the design parameters for gasket applications in its own laboratory. A large number of different tests that are relevant to gasket materials are carried out in-house on an ongoing basis. The tests range from media resistance tests to mechanical/thermal tests and determination of sealing parameters on state-of-the-art AMTEC test rigs. Both the quality assurance department and the development department take frequent advantage of these laboratory services. Customer-specific tests are made as well, in order to ensure that the user's assignment is carried out as well as possible.



The production process from the mine to the finished product



Graphite ore from the mine

High-quality graphite gaskets made from high-quality graphite

novaphit® gaskets made from expanded pure graphite are suitable for high chemical, thermal and mechanical stresses. They do their job reliably even when there are extreme fluctuations in conditions. novaphit® gaskets do not contain any bonding agents, incidentally.

There can be substantial differences in the quality of expanded graphite. An explanation is given below of how expanded graphite is made and what criteria need to be met as quality features.

Where does graphite come from?

Graphite is obtained in both open-cast and underground mines. The choice of the mine already decides the subsequent quality level. The grinding and cleaning operations that follow are just as important.

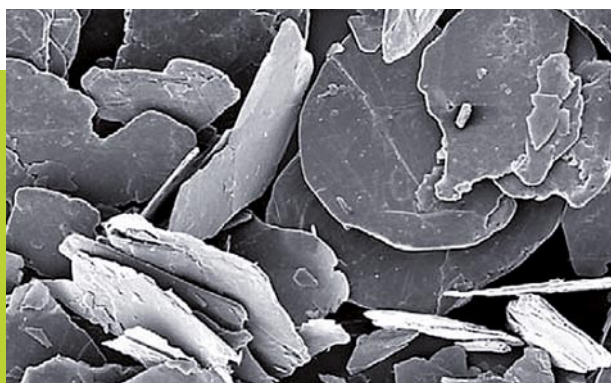
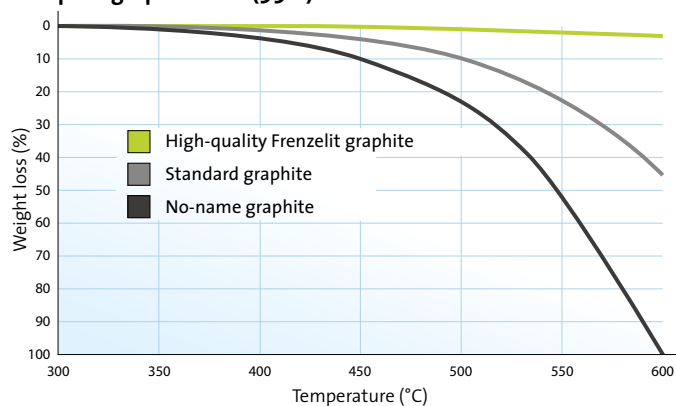
What happens in the expanding process?

The ground basic graphite is expanded in a thermal process, in which the volume of the graphite is increased many times over. A flexible and soft graphite film is produced from a "brittle" graphite powder.

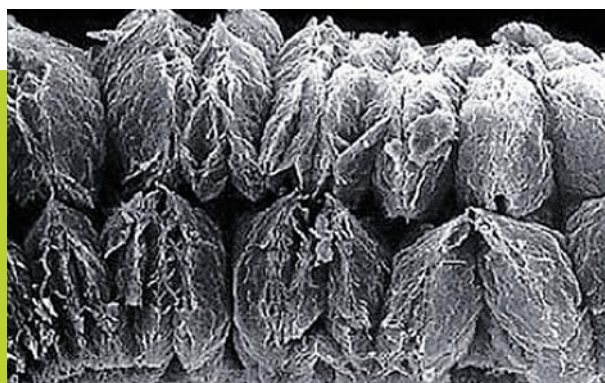
Oxidation resistance is the most important quality feature of graphite gaskets

The efficiency of the graphite is defined essentially by its oxidation resistance. The common assumption that graphite quality is determined solely by a specific degree of purity is not correct. On the contrary: it is essential to determine the oxidation properties of the graphite exactly, because even graphite films of the highest purity level may not be resistant enough to oxidation. Thanks to careful selection of the basic graphite and 100% incoming goods checks of this and other properties, only high-quality graphite is used in the novaphit® SSTC/SSTC^{TRD 401}, novaphit® EXTRA and novaphit® VS production process.

Weight loss as an indication of the oxidation resistance of pure graphite film (99%)



Flake graphite Source: Graphit Kropfmühl AG



Expanded graphite Source: Graphit Kropfmühl AG

Material profile of novaphit® SSTC

Advantages of the expanded metal insert used

Gasket material made from expanded graphite (purity level 99%) with internal impregnation and an acid-resistant expanded metal insert made from chrome-nickel steel (material no. 1.4404 / AISI 316L).

Expanded metal made from acid-resistant stainless steel

Corrosion- and acid-resistant material (AISI 316L).

Thickness of the expanded metal insert used

Stretching the stainless steel film used (original thickness 0.15 mm) leads to a three-dimensional structure with a projected height of about 0.4 mm, as a result of which chambering of the gasket core is achieved.

Geometry of the stainless steel insert

- Better exploitation of the surface pressure available to compact the graphite, because no “crowns” need to be levelled. Installation of the gasket is completed faster.
- No undercutting in the insert material. The graphite film encloses the insert completely.
- Optimised surface pressure distribution by comparison with other insert concepts. This is demonstrated impressively by the self-contained lines of higher surface pressure (see the Fuji Film photo of novaphit® SSTC with expanded metal).
- Favourable grid geometry (diamond dimension = 3.0 mm) makes it possible to produce gaskets with very narrow widths reliably.
- Easy cuttability. Handling benefits in manual and in-house finishing.
- Considerably lower risk of layer separation when bending occurs. Even in such a case, the graphite film is pressed around the insert again completely when pressure is

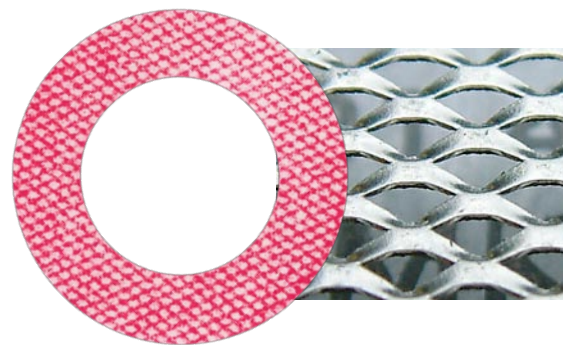
applied to the gasket during installation in the flange, i.e. greater tolerance when mistakes are made in installation.

- Repeated bending of the insert is irreversible because of strain hardening, i.e. the insert recovers and is actively involved in the sealing operation! This guarantees greater security in the gasket connection, particularly at higher surface pressure levels.
- Another advantage of novaphit® SSTC in direct comparison with smooth metal inserts is its open insert design principle. This means that not merely the outer graphite layer but rather that a considerably thicker layer is available to compensate for flange damage.

Fuji Film photos

Sensitivity: medium
Gasket thickness: 2.0 mm
Surface pressure: 30 N/mm²

Frenzelit graphite gasket novaphit® SSTC with expanded metal

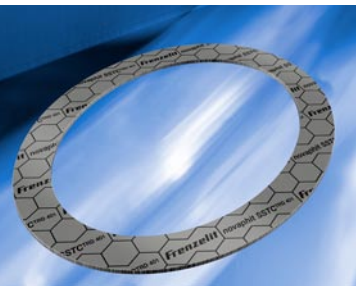


Graphite gasket with tanged metal



Graphite gasket with smooth metal





novaphit® SSTC^{TRD 401}

The TÜV-certified solution for oval closure lid gaskets.

This gasket, which is based on the classic novaphit® SSTC material, has become the widely used standard product for oval gaskets that require

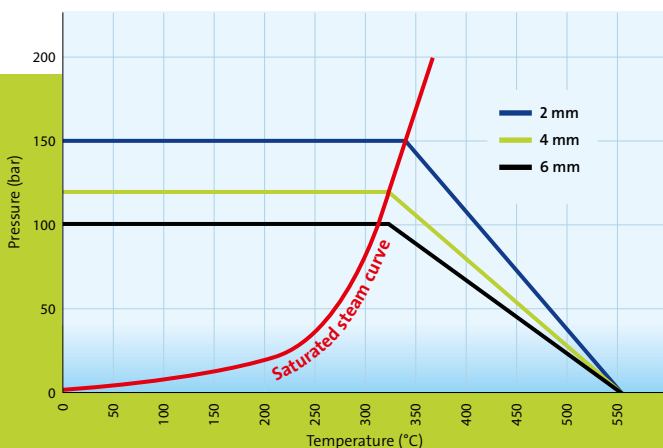
official approval since TÜV testing was introduced in connection with TRD 401.

novaphit® SSTC^{TRD 401} satisfies the requirements made in the highest testing category D (250 °C/40 bar) specified in TRD 401 without any difficulty. It can, however, also be used when the application parameters are more demanding than this (see the application recommendation below). Oval gaskets 2, 4 or 6 mm thick are produced from the basic material, which is 2 mm thick, by certified manufacturers. This means that all the different applications are covered - from delivery of a new boiler to a steam generator that has already been in operation for a long time.

Thanks to a sufficiently thick graphite layer and the positive properties of the expanded metal insert, novaphit® SSTC^{TRD 401} is unusually adaptable to sealing surface unevenness. Optimum advantage is taken of the low bolting forces required in the closure lid area due to the design parameters to shape the graphite.

novaphit® SSTC^{TRD 401} also has all the properties of novaphit® SSTC and can therefore be recommended for any other steam generation application too.

Application recommendation for novaphit® SSTC^{TRD 401}



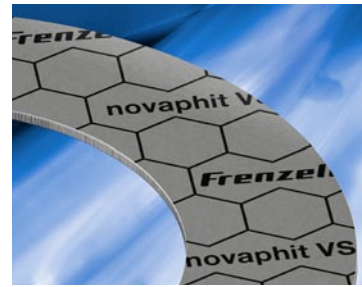
novaphit® EXTRA

novaphit® EXTRA, high-quality pure graphite (purity level at least 99 %) reinforced with a woven stainless steel insert made from 1.4301. No compromises on the quality of the graphite make application temperatures of up to 550 °C possible - even under fluctuating conditions. Combination with a wire mesh insert leads to an economic solution with a better performance than gaskets reinforced with tanged metal.



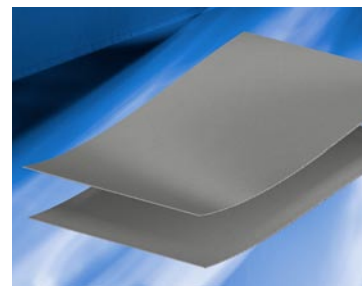
novaphit® VS

novaphit® VS, high-quality pure graphite (purity level at least 99 %) without a reinforcement insert, is used when stainless steel inserts are not an option for technical reasons. The material is already compacted moderately in advance to optimise the handling properties. Thin gasket thicknesses and very narrow gasket widths can in particular be achieved without any difficulty with novaphit® VS.



novaphit® M

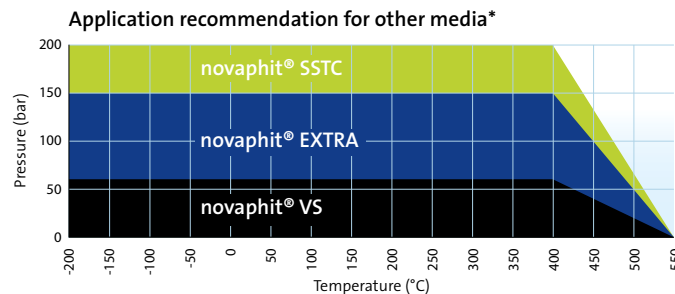
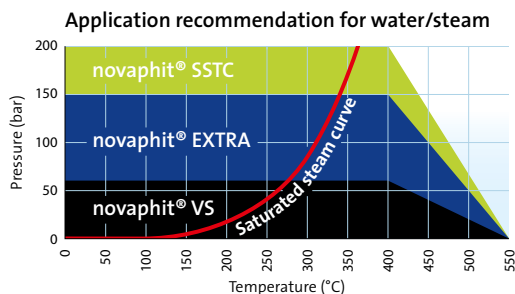
novaphit® M is the graphite film made from high-quality pure graphite (purity level at least 99 %) with a gross density of about 1.0 g/cm³. novaphit® M is used for such purposes as a layer for grooved gaskets.



Technical information

Application recommendations, depending on the pressure and temperature

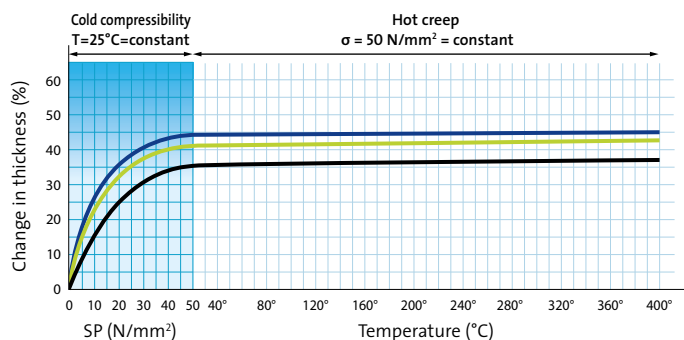
The application recommendations for different temperature and pressure levels in the graphs apply to a gasket thickness of 2.0 mm and with smooth flanges. Higher limits are possible when thinner gaskets are being used!



* Example for the most common other media. Precise data for individual cases can be found in the Frenzeli novaDISC program or you can contact our application engineering specialists.

Compression set - Temp-Test

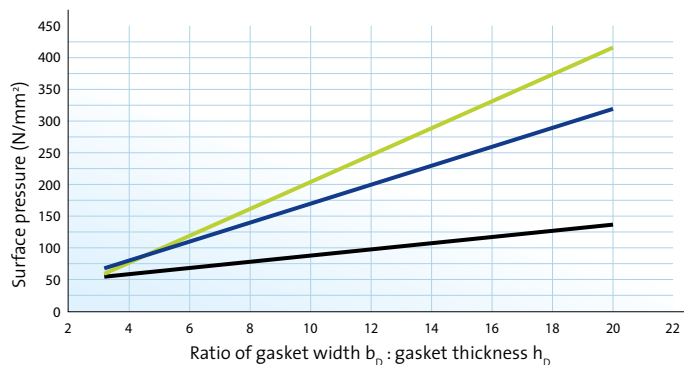
up to 50 N/mm² and 400 °C



- novaphit® SSTC / novaphit® SSTC^{TRD 401}
- novaphit® EXTRA
- novaphit® VS

Maximum surface pressure

after installation, with smooth sealing faces*



* The maximum surface pressure can be increased by a factor of approximately 1.5 in the case of tongue and groove flanges.

Warranty exclusion

In view of the variety of different installation and operating conditions and application and process engineering options, the information given in this prospectus can only provide approximate guidance. There is as a result no basis for warranty claims.

Material data

| General information | | | novaphit® SSTC/SSTC ^{TRD 401} | novaphit® EXTRA | novaphit® VS |
|---|--|--|--|---|---|
| Bonding agent | | | Without | Without | Without |
| Approvals | | DVGW Firesafe (DIN EN ISO 10497, API607, BS6755) BAM (O ₂ : 200 °C / 130 bar, including liquid O ₂) Germanischer Lloyd (GL) TRD 401 (oval boiler closure gasket) ROSENERGOATOM RMRS (Russian Maritime Register of Shipping) GOSPROMNADZOR ROSTECHNADZOR | ✓ ✓ ✓ ✓ only SSTC ^{TRD 401} ✓ - ✓ ✓ | - - - ✓ - - ✓ ✓ ✓ | - - ✓ - - ✓ - ✓ ✓ |
| Identification colour | | graphite | • | • | • |
| Printed | | black | • | • | • |
| Dimensional and thickness tolerances | | according to DIN 28 091-1 | • | • | • |
| Physical parameters | Test standard | Unit | Value Modal value (typical value) | | |
| Sample thickness 2.0 mm | | | | | |
| Designation | DIN 28 091-4 | | GR-10-I-1M-Cr | GR-10-I-1M-Cr | GR-10-O-O-O |
| Purity level / graphite | | | 99 % | 99 % | 99 % |
| Density | DIN 28 090-2 | [g/cm ³] | 1.35 | 1.20 | 1.20 |
| Tensile strength | longitudinal DIN 52 910 traverse DIN 52 910 | [N/mm ²] [N/mm ²] | 17 8 | 8 7 | 6 5 |
| Residual stress $\sigma_{dE/16}$ | at 300 °C DIN 52 913 | [N/mm ²] | ≥ 45 | ≥ 45 | ≥ 46 |
| Compressibility | ASTM F 36 J | [%] | 40 | 40 | 34 |
| Recovery | ASTM F 36 J | [%] | 15 | 10 | 18 |
| Cold compressibility ϵ_{KSW} | DIN 28 090-2 | [%] | 39 | 40 | 35 |
| Cold recovery ϵ_{KRW} | DIN 28 090-2 | [%] | 4.0 | 4.0 | 5.0 |
| Hot creep $\epsilon_{WSW/300}$ | DIN 28 090-2 | [%] | 2.0 | 2.5 | 1.0 |
| Hot recovery $\epsilon_{WRW/300}$ | DIN 28 090-2 | [%] | 3.5 | 3.0 | 4.0 |
| Specific leakage rate | DIN 3535-6 | [mg/(s·m)] | ≤ 0.100 | ≤ 0.250 | ≤ 0.100 |
| Specific leakage rate $\lambda_{2,0}$ | DIN 28 090-2 | [mg/(s·m)] | ≤ 0.100 | ≤ 0.250 | ≤ 0.100 |
| Chloride content (total) | DIN 28 090-2 | [ppm] | ≤ 50 | ≤ 50 | ≤ 50 |
| Chloride content (water-soluble) | FZT PV-001-133 | [ppm] | ≤ 20 | ≤ 20 | ≤ 20 |
| Total fluoride and chloride | | [ppm] | ≤ 100 | ≤ 100 | ≤ 100 |
| Product data | | | | | |
| Dimensions | | [mm] | 1000 x 1000 1500 x 1500 2000 x 1000 | 1500 x 1500 | 1000 x 1000 1500 x 1500 |
| Thicknesses | | [mm] | 1.0 / 1.5 / 2.0 / 3.0 | 1.0 / 1.5 / 2.0 / 3.0 | 0.5 / 0.75 / 1.0 / 1.5 / 2.0 |
| Further dimensions and thicknesses are available on request (doubling is possible). | | | | | |

Do you have any questions about your application?

The gasket information service will help you:

gaskets@frenzelit.de

Good for people and the environment.

Frenzelit has obtained certification that the company complies with the requirements of ISO 9001, ISO/TS 16949 and ISO 14001. This means complete transparency in all areas and therefore gives our customers a high degree of security.

Quality management

ISO 9001

ISO/TS 16949

Environmental management

ISO 14001

Installation instructions

- Clean the surfaces that being sealed and remove traces of old gaskets without damaging the flange surface.
- Check the flange surfaces for parallelity and unevenness; make adjustments if necessary.
- Before installing them, check gaskets that have been stored in dry conditions for cracks, surface damage, dimensional accuracy and - in the case of gaskets with bolt holes - congruence of the bolting pattern with the flange.
- Do not use any sealing agents! Fit gaskets dry and grease-free!
- Check the condition of the bolts before fitting them and use new bolts if necessary.
- Install the gaskets consistently and carefully by hand first. (Important note: never tighten the first bolt too securely!).
- Tighten the bolts with a suitable tool. Apply the specified torque diagonally in several stages.

The novaphit® product family

| | Professional Technology | Emission Control |
|-------------------|--|---|
| Multilayer | | novaphit® MST |
| 1 insert | novaphit® SSTC novaphit® SSTC ^{TRD 401} novaphit® EXTRA | novaphit® SSTC ^{TA-L} |
| Without an insert | novaphit® VS | |
| Film | novaphit® M High-purity graphite film (purity level > 99%), e.g. as a soft layer for grooved gaskets for maximum sealing performance (a data leaflet is available on request) | novaphit® XC Internally impregnated, high-purity graphite film (purity level > 99%), e.g. as a soft layer for grooved gaskets for maximum sealing performance (a data leaflet is available on request) |

GASKETS

TECHNICAL TEXTILES

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NEW MATERIALS

Frenzelit Werke GmbH
P.O. Box 11 40 · 95456 Bad Berneck · Germany
Phone: +49 9273 72-0 · Fax: +49 9273 72-221
info@frenzelit.de · www.frenzelit.com



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