Official German General building approval:

MM1018

The liquid shim! 100% form and force-locking gap compensation for steel and bridge construction
Approval number: Z-3.82-2042

Valid from: 15. January 2018
Valid to: 15. January 2023

Subject of approval:
Metall Polymer „MM1018 P“ and „MM1018 FL“

The subject of approval mentioned above is herewith generally approved in the field of construction. This allgemeine bauaufsichtliche Zulassung ("national technical approval") comprises ten pages and one annex.
I GENERAL PROVISIONS

1 With the allgemeine bauaufsichtliche Zulassung ("national technical approval") the fitness for use and the applicability of the subject of approval according to the Landesbauordnungen ("Building Regulations of the Land") has been verified.

2 If, in the allgemeine bauaufsichtliche Zulassung ("national technical approval") requirements are made concerning the special expertise and experience of persons entrusted with the manufacture of construction products and types of construction according to the relevant regulations of the Land following section 17, sub-section 5 Musterbauordnung ("Model Building Code"), it is to be noted that this expertise and experience can also be proven by equivalent verifications from other Member States of the European Union. If necessary, this also applies to verifications presented within the framework of the Agreement on the European Economic Area (EEA) or other bilateral agreements.

3 The allgemeine bauaufsichtliche Zulassung ("national technical approval") does not replace the permits, approvals and certificates prescribed by law for carrying out building projects.

4 The allgemeine bauaufsichtliche Zulassung ("national technical approval") will be granted without prejudice to the rights of third parties, in particular private property rights.

5 Notwithstanding further regulations in the "Specific Provisions" manufacturers and distributors of the subject of approval shall make copies of the allgemeine bauaufsichtliche Zulassung ("national technical approval") available to the user and point out that the allgemeine bauaufsichtliche Zulassung ("national technical approval") has to be available at the place of use. Upon request copies of the allgemeine bauaufsichtliche Zulassung ("national technical approval") shall be placed at the disposal of the authorities involved.

6 The allgemeine bauaufsichtliche Zulassung ("national technical approval") may be reproduced in full only. Publication in the form of extracts requires the consent of Deutsches Institut für Bautechnik. Texts and drawings of advertising brochures may not be in contradiction to the allgemeine bauaufsichtliche Zulassung ("national technical approval"). Translations of the allgemeine bauaufsichtliche Zulassung ("national technical approval") have to contain the note "Translation of the German original, not checked by Deutsches Institut für Bautechnik".

7 The allgemeine bauaufsichtliche Zulassung ("national technical approval") is granted until revoked. The provisions of the allgemeine bauaufsichtliche Zulassung ("national technical approval") can subsequently be supplemented and amended in particular, if this is required by new technical findings.
II  SPECIFIC PROVISIONS

1  Subject of approval and field of application

1.1  This general national technical approval applies to the production and utilization of metal polymer "MM1018". Metal polymer "MM1018" is a filler containing, 2-component reaction resin system (epoxy resin) in pasty ("MM1018P") or liquid ("MM1018FL") consistency.

1.2  Uses of metal polymer "MM1018" comprise the full surface and flush compensation or filling of gaps and uneven areas between metal elements, such as header panels, bridge bearings, crane tracks and railway tracks as well as steel structure components.

1.3  Metal polymer "MM1018" is suitable for applications involving crevices of 0.25 to 10 mm. It is recommended to use insertion sheet metal made of steel for crevices exceeding 10 mm, in order to reduce the width of such crevices to less than 10 mm.

2  Provisions for the construction product

2.1  Properties and composition

2.1.1  General information

Metal polymer "MM1018" is a filler containing, 2-component reaction resin system (epoxy resin). Its composition is archived with the Deutsches Institut für Bautechnik. The material indices or compositions not included in this approval notice for metal polymers "MM1018P" and "MM1018FL" must be in compliance with the information archived with the Deutsches Institut für Bautechnik.

2.1.2  Infrared spectroscopy (IR)

The infrared spectrograms for the resin and hardener components have to be in compliance with the infrared spectrograms archived with the Deutsches Institut für Bautechnik. The spectroscopy procedure is described in Annex 1, A.1.

2.1.3  Thermo gravimetric analysis

The thermo gravimetric diagrams for the resin and hardener components must be in compliance with the diagrams archived with the Deutsches Institut für Bautechnik. The analytical process is described in Annex 1, A.2.

2.1.4  Original material indices / kernel size distribution

The original material indices are summarized in the following table or have been archived with the Deutsches Institut für Bautechnik.

<table>
<thead>
<tr>
<th>Index</th>
<th>&quot;MM1018P&quot;</th>
<th>&quot;MM1018FL&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density of the resin component</td>
<td>2.986 g/dm³ ±5 %</td>
<td>3.002 g/dm³ ±5 %</td>
</tr>
<tr>
<td>Density of the hardener component</td>
<td>1.998 g/dm³ ±5 %</td>
<td>0.997 g/dm³ ±1 %</td>
</tr>
<tr>
<td>Filler material content</td>
<td>79 M.-% ±5 M.-%</td>
<td>77 M.-% ±5 M.-%</td>
</tr>
</tbody>
</table>

The kernel size distribution of the filler material, recorded using laser granulometrics, must be in compliance with the kernel size distribution archived with the Deutsches Institut für Bautechnik.
2.1.5 Viscosity
The viscosity of metal polymer "MM1018P" is 600 Pa·s ±15 % and the viscosity of metal polymer "MM1018FL" 11,000 mPa·s ±15 %. The analytical process determining the viscosity is described in Annex 1, A.3.

2.1.6 Pot life
The pot life (temperature increased by 15 °C; measured in compliance with DIN EN ISO 9514) of metal polymer "MM1018P" at 21 °C is 20 min ±20 %. The pot life (temperature increased by 15 °C; measured in compliance with DIN EN ISO 9514) of metal polymer of metal polymer "MM1018FL" at 21 °C is 89 min ±20 %.

2.1.7 Glass transfer temperature
The glass temperature determined in compliance with DIN EN 12614 at the age of 7 days post storage at a temperature of 21 °C/60 % relative humidity of metal polymer "MM1018P" or metal polymer "MM1018FL" must be at least 60 °C.

2.1.8 Pressure resistance
2.1.8.1 At the age of 7 (28) days metal polymer "MM1018" demonstrates the following typical pressure resistance ratings based on the table below.

<table>
<thead>
<tr>
<th>Test element</th>
<th>Storage</th>
<th>Pressure resistance in N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;MM1018P&quot;</td>
<td>&quot;MM1018FL&quot;</td>
</tr>
<tr>
<td>Standing prism*</td>
<td>35 x 35 x 140 mm³</td>
<td>7 d</td>
</tr>
<tr>
<td></td>
<td>Temp. 21/60</td>
<td>28 d Temp. 21/60</td>
</tr>
<tr>
<td>Thin disks**</td>
<td>100 x 100 x 10 mm³</td>
<td>7 d</td>
</tr>
<tr>
<td>Standing prism*</td>
<td>35 x 35 x 140 mm³</td>
<td>6 d temp. 21/60 + 1 d at 50 °C</td>
</tr>
<tr>
<td>Thin disks**</td>
<td>100 x 100 x 10 mm³</td>
<td></td>
</tr>
</tbody>
</table>

*: Tested in compliance with DIN EN 12190,
**: Procedure see Annex 1, A.4

2.1.8.2 Metal polymer "MM1018" does have a relative pressure resistance development that is contingent on the storage temperature, tested in compliance with DIN EN 12190 on prisms 35 x 35 x 140 mm³ equivalent to the values in the table below.

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1. DIN EN ISO 9514:2005-07 Paints and varnishes - Determination of the pot life of multicomponent coating systems - Preparation and conditioning of samples and guidelines for testing (ISO 9514:2005); German version EN ISO 9514:2005
2. DIN EN ISO 9514:2005-07 Paints and varnishes - Determination of the pot life of multicomponent coating systems - Preparation and conditioning of samples and guidelines for testing (ISO 9514:2005); German version EN ISO 9514:2005
3. DIN EN 12614:2005-01 Products and systems for the protection and repair of concrete structures - Test methods - Determination of glass transition temperatures of polymers; German version EN 12614:2004
### Table

<table>
<thead>
<tr>
<th>Age when tested</th>
<th>Relative pressure resistance (ref. to 7 days at 21 °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;MM1018P&quot;</td>
</tr>
<tr>
<td>5 °C</td>
<td>88 %</td>
</tr>
<tr>
<td>21 °C</td>
<td>79 %</td>
</tr>
<tr>
<td>30 °C</td>
<td>89 %</td>
</tr>
<tr>
<td>5 °C</td>
<td>80 %</td>
</tr>
<tr>
<td>21 °C</td>
<td>82 %</td>
</tr>
<tr>
<td>30 °C</td>
<td>100 %</td>
</tr>
<tr>
<td>5 °C</td>
<td>91 %</td>
</tr>
<tr>
<td>21 °C</td>
<td>111 %</td>
</tr>
<tr>
<td>30 °C</td>
<td>105 %</td>
</tr>
<tr>
<td>7 d</td>
<td>100 %</td>
</tr>
<tr>
<td>28 d</td>
<td>105 %</td>
</tr>
</tbody>
</table>

2.1.8.3 Metal polymer "MM1018P" has to have a minimum pressure resistance of 70 N/mm² at age 7 days when tested on prisms 35 x 35 x 140 mm³ after storage at a temperature of 21 °C/60 % relative humidity.

Metal polymer "MM1018FL" has to have a minimum pressure resistance of 85 N/mm² at age 7 days when tested on prisms 35 x 35 x 140 mm³ after storage at a temperature of 21 °C/60 % relative humidity.

### Elasticity module

2.1.9 Elasticity module

At age 7 days, metal polymer "MM1018", tested in compliance with DIN EN 13412, Process 2, on prisms 35 x 35 x 140 mm³ (load level 1/3 of the 7 day pressure resistance) demonstrates an elasticity module corresponding with the table below.

<table>
<thead>
<tr>
<th>Storage</th>
<th>Elasticity module in N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&quot;MM1018P&quot;</td>
</tr>
<tr>
<td>7 d temp. 21/60</td>
<td>10,000</td>
</tr>
<tr>
<td>6 d temp. 21/60 + 1 d at 50 °C</td>
<td>7,000</td>
</tr>
</tbody>
</table>

2.1.10 Creepage

After 182 days of consistent application of pressure applied at the age of 7 days, metal polymer "MM1018P" (load level 25% of the 7 d pressure resistance), tested in compliance with DIN EN 13584⁶ and verified on prisms 35 x 35 x 140 mm³, does have a creepage coefficient \( \psi_{182,7 d} = (\varepsilon_{ges} - \varepsilon_{el}) / \varepsilon_{el} \) of 2.9.

Using a prism with the same cross sectional dimensions, with which 9 layers of "MM1018P" of 10 mm thickness each were placed between 1 mm thick steel panels, an \( \psi_{182,7 d} \) of 2.1 was measured.

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After 182 days of consistent application of pressure applied at the age of 7 days, metal polymer "MM1018FL" tested in compliance with DIN EN 13584 on prisms 35 x 35 x 140 mm³ (load level 25 % of the 7d pressure resistance) had a creepage coefficient ϕ_{182,7d} = (ε_{ges} - ε_{als} - ε_{als}) / ε_{als} of 1.6.

Using a prism with the same cross sectional dimensions, with which 9 layers of "MM1018P" of 10 mm thickness each were placed between 1 mm thick steel panels, an ϕ_{182,7d} of 1.1 was measured.

2.1.11 Heat expansion coefficient

The heat expansion coefficient at the age of 7 days measured on prisms 35 x 35 x 140 mm³ is:

<table>
<thead>
<tr>
<th>Temperature range</th>
<th>&quot;MM1018P&quot;</th>
<th>&quot;MM1018FL&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20 to 20 °C</td>
<td>24 · 10⁻⁶ 1/K</td>
<td>24 · 10⁻⁶ 1/K</td>
</tr>
<tr>
<td>20 to 60 °C</td>
<td>54 · 10⁻⁶ 1/K</td>
<td>44 · 10⁻⁶ 1/K</td>
</tr>
</tbody>
</table>

2.2 Production, packaging, transport, storage and marking

2.2.1 Production

Metal polymer "MM1018" is being manufactured with the components archived in accordance with Section 2.1.1 at the Mönchengladbach plant of DIAMANT Metallplastik GmbH.

The applicant is required to maintain records of when metal polymer "MM1018" has been manufactured and shipped.

2.2.2 Storage and transport

2.2.2.1 At the manufacturing plant, metal polymer "MM1018" must be stored in appropriate containers, which are labeled with the following information in a highly visible manner:

- Metal polymer "MM1018P" or "MM1018FL"
- In accordance with the general national approval no. Z-3.82-2042

2.2.2.2 Metal polymer "MM1018" is shipped in ready-to-use packaging sizes. The product must be stored in its original, unopened containers in a dry, cool place, where it is protected from frost (temperature range 5 °C to 20 °C). Higher temperatures will reduce the shelf life of the product, which is otherwise 2 years. The product must be protected against direct exposure to the sun.

2.2.3 Marking

2.2.3.1 General

The packaging and delivery note of the construction product shall be marked by the manufacturer with the conformity mark (U-mark) according to the Überestimmungszeichen-Verordnung der Länder ('Regulations on the conformity mark of the states of the Federal Republic of Germany'). The marking may only be carried out if the requirements according to Section 2.3 "Überestimmungsnachweis" ('Verification of conformity') have been met.

2.2.3.2 Labeling on packaging units

Packaging units of metal polymer "MM1018" must be labeled in a highly visible, legible and permanent manner, with the following information placed inside a frame for further emphasis:

- Product name and description of the construction material: MM1018P or "MM1018FL"
- Type: "Component A" or "Component B"
- Manufacturing plant: DIAMANT Metallplastik GmbH, Mönchengladbach
Conformity code with approval no.: Z-3.82-2042

Manufacturing date and batch number: ..........

Approved for use through: ..........

Target filling volume in kg: ..........

2.2.3.3 Delivery notes

Delivery notes will have to include the following information:

Construction material name and description: "MM1018P" or "MM1018FL"

Approval no.: Z-3.82-2042

Batch number*: ..........

Delivery volume (mass): ..........

2.3 Übereinstimmungsnachweis (Verification of conformity)

2.3.1 General

Each manufacturing plant shall confirm that the construction product complies with the provisions of this "Allgemeine bauaufsichtliche Zulassung" by means of a certificate of conformity based on the factory production control and a regular external surveillance, including initial testing of the construction product in accordance with the following provisions.

The manufacturer of the construction product shall organise a recognised certification body and a recognised inspection body to issue a certificate of conformity and for the external surveillance, including product testing that has to be carried out.

The manufacturer shall state by marking the products with the conformity mark (U-mark) with reference to the intended use, that the certificate of conformity is issued.

The certification body shall send a copy of the issued certificate of conformity to Deutsches Institut für Bautechnik.

2.3.2 Factory production control

Each manufacturing plant shall set up and carry out a factory production control. Factory production control is a continuous surveillance of production by the manufacturer who thus ensures that the manufactured construction product is in conformity with the provisions of this "Allgemeine bauaufsichtliche Zulassung".

The factory production control shall enclose at least the following provisions:

- Description and checking of the original material and the components (inbound goods inspection) for each batch:
  - Density and epoxy equivalence of the resin component, density and amine value of the hardening component, kernel size distribution of the filler components with company issued certificate "2.2" or inspection certificate "3.1" pursuant to DIN EN 10204,
  - Density and viscosity of the original material,
  - Analysis of the Shore-D hardness and pot life* of the resin with a reference hardener or the hardener with a reference resin

* The batch number does not have to be in conformity with the delivery note if the construction material is not delivered directly to its place of use, but for instance through construction material retailers.

7 DIN EN 10204:2005-01 Metallic products - Types of inspection documents; German version EN 10204:2004

8 The pot life is determined on the basis of 100 g of material. The time until the material has physically hardened is tracked. The pot life has been reached as soon as the viscosity of the material changes noticeably.
- Checks and verifications that have to be performed during the production process
- Verification and tests which are carried out at the finished construction product:
  - Color of the resin component and of the hardener component, every batch
  - Density of the resin component and hardener component, every batch
  - Dispersion\(^9\) of the resin component and the hardener component, every batch
  - Viscosity of the resin component and the hardener component, every batch
  - Color of the blend of the resin component and the hardener component, every batch,
  - Viscosity of the blend immediately after mixing at a temperature of 21/60, every 10\(^{th}\)
    resin and hardener batch
  - Pot life according to DIN EN ISO 9514\(^4\) at 21 °C, every 10\(^{th}\) resin and hardener batch
  and
  - Pressure resistance after 7 days at a temperature of 21/60, every 10\(^{th}\) resin and
    hardener batch.

The results of factory production control shall be recorded and evaluated. The records shall
include at least the following information:
- Designation of the construction product respectively the raw material and its components
- Type of control or test
- Date of manufacture and test of the construction product respectively of the raw material
  or components
- Results of control and tests and, if applicable, a comparison with requirements
- A signature of the person responsible for factory production control.

The records shall be deposited for at least five years and presented to the recognised
external surveillance body. On request, they shall be submitted to Deutsches Institut für
Bautechnik and to the zuständige oberste Bauaufsichtsbehörde (responsible building
authority).

If the test results are unsatisfactory, the manufacturer shall immediately take the action
necessary to eliminate the deficiency. Construction products which do not meet
requirements shall be treated in such a way that confusion with conforming products is
excluded. Once the deficiency has been eliminated, the original test shall be repeated
immediately, provided that this is technically possible and also required to verify the
elimination of the deficiency.

2.3.3 External surveillance

In each production plant, external surveillance shall be carried out regularly, but at least
twice a year, to check the factory production control.

During external surveillance, initial testing of the construction product shall be carried out
and random samples taken. Sampling and testing are to be done by the recognized
surveillance body.

In conjunction with third party monitoring, the following properties have to verified or the
following tests have to be performed at least once a year:
- Density of the resin and hardener component,
- Thermo gravimetric analysis of resin and hardener,
- Filler content,
- Viscosity of the blend immediately after mixing at 21 °C,
- Glass transfer temperature,

\(^9\) To test dispersion, a material sample is taken from the mixer and placed on a rubber disk. Placing same on a flat
spatula provides conclusions as to whether the powder conglomerates have been dispersed completely. As a result
of this test, a consistent material film with uniform coloring will be generated.
The results of certification and external surveillance shall be retained for at least five years. On request, they shall be submitted to Deutsches Institut für Bautechnik and the responsible building authority by the certification body respectively by the surveillance body.

3 Provisions for design

3.1 Metal polymer "MM1018" is suitable for applications involving crevices of 0.25 to 10 mm. It is recommended to use insertion sheet metal made of steel for crevices exceeding 10 mm, in order to reduce the width of such crevices to less than 10 mm.

3.2 Metal polymer "MM1018" may be used at a temperature range of 5 °C to 40 °C, whereby the following criteria must be met:
- Material temperature 5 °C to 30 °C
- Component temperature 5 °C to 40 °C

3.3 The usage temperature range of the hardened metal polymer is -20 °C to 50 °C.

3.4 The elasticity module of hardened metal polymer may be presumed at temperatures of up to 50 °C at a rate of 7 kN/mm².

3.5 The pressure resistance of the hardened metal polymer at temperatures of up to 50 °C on thin disks (100 x 100 x 10 mm²) is 90 N/mm² minimum for "MM1018P" and 120 N/mm² for "MM1018FL".

3.6 Any loads that are not primarily resting loads must be applied only after the metal polymer is completely hardened.

4 Provisions for installation

4.1 The performance of the application by trained professionals is recommended. Compliance with the technical data sheet is mandatory.

4.2 Metal polymer "MM1018" is suitable for applications involving crevices of 0.25 to 10 mm. It is recommended to use insertion sheet metal made of steel for crevices exceeding 10 mm, in order to reduce the width of such crevices to less than 10 mm.

4.3 Metal polymer "MM1018" may be used at a temperature range of 5 °C to 40 °C, whereby the following criteria must be met:
- Material temperature 5 °C to 30 °C
- Component temperature 5 °C to 40 °C

4.4 A complete unit of hardener component B must be mixed with a complete unit of resin component A. The splitting of the components into smaller portions is not permitted.

4.5 The metal polymer will have to be mixed in the original packing units with an electrical mixer in compliance with the instructions in the technical data sheet.

4.6 As the temperature rises, the product unit processing time declines. The following table provides the approximate values indicating how quickly the material has to be processed once it has been mixed.
Any loads that are not primarily resting loads must be applied only after the metal polymer is completely hardened.
The properties specified in Section 2.1 were determined through the following procedures:

A.1 Infrared spectroscopy

The infrared spectroscopy was conducted in compliance with DIN EN 1767:1999\(^{A1}\) using a Fourier transformation infrared spectrometer. Filler containing components were extracted with hexane. The IR spectrum was obtained on the capillary between a film generated between potassium bromide disks, if necessary after the hexane had evaporated. In each case, 500 scans were performed. The solution was 4 cm\(^{-1}\).

A.2 Thermal gravimetric analysis

The thermo gravimetric analysis was conducted in compliance with DIN EN ISO 11358:1997\(^{A2}\) using an original sample weight of 44.84 mg (resin component "MM 1018 P") or 51.22 mg (resin component "MM 1018 FL") or 62.13 mg (hardener component "MM 1018 P") or 31.13 mg (hardener component "MM 1018 FL") in an argon atmosphere with an open crucible and a heating rate of 10 cal/min and a thermal scale precision level of: 0.1 μg. The TGA curves are based on sliding average values across an 8-second period.

A.3 Viscosity

The dynamic viscosity was determined in compliance with DIN EN ISO 3219:1994\(^{A3}\) using a cylinder rotation viscosity meter combined with the disk-disk system at 21 and 30 °C. The viscosity meter was started up about 2 minutes after the mixing process was complete, using the following settings: consistent increase of the shear rate from 0 to 1.1 l/s (21 °C, "MM 1018 P") or 25 l/s (21 °C, "MM 1018 FL") or 4.0 l/s (30 °C, "MM 1018 P") or 124 l/s (30 °C, "MM 1018 FL") in 180 s.

A.4 Pressure resistance on thin disks

The specimen were processed by pressing together the mixed material between two glass disks coated with a releasing compound until the thickness had been compressed to 10 mm. They were cut to a size of 100 x 100 mm\(^2\) when they were three days old. During the pressure test, which was conducted in a path controlled manner with a piston advancing speed of approx. 1 mm/min at (21±2) °C and (60±10) % relative humidity, the specimen were positioned between 5 cm thick hardened steel disks, dimensions 100 x 100 mm\(^2\), whose surfaces had been smoothed. The tests using the 50 °C samples were completed about 6 min. after removal from the heating cabinet.

\(^{A1}\) DIN EN 1767:1999-09 Products and systems for the protection and repair of concrete structures - Test methods - Infrared analysis; German version EN 1767:1999


\(^{A3}\) DIN EN ISO 3219:1994-10 Plastics - Polymers/resins in the liquid state or as emulsions or dispersions - Determination of viscosity using a rotational viscometer with defined shear rate (ISO 3219:1993); German version EN ISO 3219:1994

Metal polymer "MM1018P" and "MM1018FL"

Procedures used to determine the indices

Annex 1
The liquid shim!
Time and cost-optimized gap compensation between pressure-loaded metal elements, bridge bearings, head plates and floodgates

- Without mechanical processing
- General building approval
- Corrosion resistant
- 100% form and force-locking
- Versatile
- Extremely pressure resistant
- Seawater resistant
References
Pontal do Paraná-PR-BRAZIL, February 4th, 2017

Reference:
Application Diamant MM1018 liquid shimplate

Dear Ladies and Gentlemen,

with this letter we confirm the successful application of Diamant MM1018 liquid shimplate between foundation and bearing on ships and offshore platforms as gap-compensating-solution.

With the approved product, Diamant MM1018 liquid shimplate, we were able to level and balance small irregular surface-imperfection about 2-15mm without machining and time delay. In comparison to machined shimplates we had relevant advantages regarding time efficiency. Further on we were able to react spontaneously to any kind of gap-geometry.

Best regards,

Mark Hummel
Consórcio Technip-Techint - P-76
REFERENCE

About the application of MM1018 by the DIAMANT company for the water- and shipping office in Nuremberg

Your products MM1018- liquid and MM1018- pasty were successfully examined by the water- and shipping office Nuremberg in the field of the Rhine-Danube-Canal 2008 at the lock gates in Bamberg, Leerstetten, Eckersmühlen and Hilpoltstein.

By the use of MM1018, gaps and unevenesses up till 10 mm between the new installed hard-support box outs and the worn hard-supports (storage area for the water retaining aft gates) have been filled. After approx. 24 hours the material has been cured.

The work was performed under the supervision of qualified personnel from the DIAMANT company.

The application of yours MM1018, with its property to fill gaps and carry high loads, finally enabled the water and shipping office the box outs of the worn hard-support. Thereby the required evenness of the elements from +/- 1 mm over the length of 12 metres length could be realized without any machining. Compared with alternative options, this variant spared the office approx. 10 workdays in the 24 hours-operation.

We can hereby confirm a 3-year flaw less condition of your product. The application of MM1018 is planned for more comparable operating ranges.

27.03.2012
(date)

[official representative]

Wasser- u. Schifffahrtsamt
Marientorgraben 1
90402 NÜRNBERG

(official seal)
CERTIFICATE OF

DESIGN ASSESSMENT

This is to certify that a representative of this Bureau did, at the request of

DIAMANT METALLPLASTIC GMBH

assess design plans and data for the below listed product. This assessment is a representation by the Bureau as to the

degree of compliance the design exhibits with applicable sections of the Rules. This assessment does not waive unit
certification or classification procedures required by ABS Rules for products to be installed in ABS classed vessels or

facilities. This certificate, by itself, does not reflect that the product is Type Approved. The scope and limitations of

this assessment are detailed on the pages attached to this certificate.

Product: Metal-Hard Composites
Model: Metal polymer DIAMANT MM1018P and DIAMANT MM1018FL

This Product Design Assessment (PDA) Certificate 16-HG1509022-1-PDA, dated 07 Jun/2016 remains valid until 06 Jun/2021 or until the

Rules or specifications used in the assessment are revised (whichever occurs first).

This PDA is intended for a product to be installed on an ABS classed vessel, MODU or facility which is in existence or under contract for

construction on the date of the ABS Rules or specifications used to evaluate the Product.

Use of the Product on an ABS classed vessel, MODU or facility which is contracted after the validity date of the ABS Rules and specifications

used to evaluate the Product, will require re-evaluation of the PDA.

Use of the Product for non ABS classed vessels, MODUs or facilities is to be to an agreement between the manufacturer and intended client.

AMERICAN BUREAU OF SHIPPING

Efstratios Maliatsos
Engineer/Consultant
„With our „liquid shim“ MM1018, you can compensate gaps and imperfections on spot, without mechanical work. That saves time and costs.“
Technical data
**Product description**

MM1018 FL is a metal polymer for the 100% form- and force-locking gap compensation for tolerance inaccuracies and unevenness between metal elements, head plates, bridge bearings, crane and rail guides as well as steel components. For gaps of > 10 mm, it is recommended to insert steel shim plates in order to reduce the gap width to less than 10 mm.

**Characteristics**

- Very high compressive strength
- Corrosion and weathering resistant
- Injection for almost any gap situation, no casting
- General building authority approval
- Seawater resistant

**Chemical resistance**

- Oil
- Petrol
- Coolant

**Package sizes**

- 0.5 kg
- 1.0 kg
- 1.5 kg
- 4.5 kg
Special sizes on request

MM1018 FL is supplied in ready-to-use package sizes. The product consists of two components. Both components must be thoroughly mixed with each other. To avoid mixing errors, a portioning of the components into smaller quantities is expressly discouraged.

**Storage/Shelf life**

Store in the original unopened container in a dry, cool and frost-free location (5°C - + 20°C). Shelf life 2 years. Protect from direct sunlight. Higher temperatures reduce the shelf life.

---

**Technical specifications**

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Test procedure</th>
<th>Formula symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application (gap size)</td>
<td>-</td>
<td>d</td>
<td>0 – 140 mm</td>
</tr>
<tr>
<td>Friction</td>
<td>-</td>
<td>µ</td>
<td>&gt; 0.5</td>
</tr>
<tr>
<td>E-Modulus [N/mm²]</td>
<td>DIN EN 13412-2006</td>
<td>E</td>
<td>10,000</td>
</tr>
<tr>
<td>Compressive strength [N/ mm²]</td>
<td>DIN EN 12190-1998</td>
<td>f_c</td>
<td>161</td>
</tr>
<tr>
<td>Shrinkage [mm/m]</td>
<td>DIN EN 12617-4:2002</td>
<td>ε</td>
<td>0.35</td>
</tr>
<tr>
<td>Viscosity [mPas]</td>
<td>DIN EN ISO 3219-1994</td>
<td>ν</td>
<td>16.900</td>
</tr>
<tr>
<td>Creep coefficient</td>
<td>DIN EN ISO 13584-2003-11</td>
<td>Φ</td>
<td>1.1</td>
</tr>
<tr>
<td>Thermal expansion coeff. [1/K]</td>
<td>-</td>
<td>ΔT (-20°C - 60°C)</td>
<td>2E - 05</td>
</tr>
<tr>
<td>Density [g/cm³]</td>
<td>-</td>
<td></td>
<td>2.66</td>
</tr>
<tr>
<td>Pot life [min]</td>
<td>DIN EN ISO 9514</td>
<td>T_15,k</td>
<td>89 ± 20%</td>
</tr>
<tr>
<td>Shore-D hardness</td>
<td>DIN ES ISO 868</td>
<td>-</td>
<td>89</td>
</tr>
</tbody>
</table>

**Consumption calculation**

The base area (A in cm²) and the mean gap dimension (d in cm) are required as a basis for calculation of the material consumption.

In this calculation, a material surplus of 20% is taken into account to compensate for tolerances as well as application-oriented additional consumption.

\[
M \ (\text{in g}) = A \ \text{cm}^2 \cdot d \ \text{cm} \cdot 1.2 \cdot 2.6 \ \text{g/cm}^3
\]

Indication: 1 m² contactsurface with 1 mm gap

\[
M = 10,000 \text{cm}^2 \cdot 0.1 \text{cm} \cdot 1.2 \cdot 2.6 \text{g/cm}^3 = 3120 \text{g} = 3.12 \text{kg}
\]

**Important instructions**

Please refer to the safety data sheet.
**Processing Parameters**

The processing time (pot life) of the material starts as soon as the two components A and B are combined. The pot life and hardening time are dependent on the material quantity (volume) and the temperature. The following table provides pot life values for a 1 kg pack relevant to practical applications:

<table>
<thead>
<tr>
<th>Temperature [°C]</th>
<th>Pot life [Min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>110</td>
</tr>
<tr>
<td>20</td>
<td>55</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Measured with 1 kg of product in the original container

For larger containers, the pot life may be reduced due to a higher reaction temperature. The compressive strength depends on the temperature, the curing time and the material dimension. The following table gives approximate values for a gap of 10 mm.

<table>
<thead>
<tr>
<th>Temperature [°C]</th>
<th>Compressive strength [N/mm²]</th>
<th>Time until compressive strength is attained</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>-</td>
<td>24 hours</td>
</tr>
<tr>
<td>5</td>
<td>138</td>
<td>7 days</td>
</tr>
<tr>
<td>21</td>
<td>156</td>
<td>24 hours</td>
</tr>
<tr>
<td>21</td>
<td>161</td>
<td>7 days</td>
</tr>
<tr>
<td>30</td>
<td>166</td>
<td>24 hours</td>
</tr>
<tr>
<td>30</td>
<td>182</td>
<td>7 days</td>
</tr>
</tbody>
</table>

Compressive strength relative to the ambient temperature

The material curing can be accelerated by heating. The maximum permissible temperature for accelerated curing is 65°C. The required curing temperature is 5°C. At lower temperatures it is recommended to preheat the material.

**Fatigue strength**

The pressure threshold strength of MM1018 FL is shown in the following Smith diagram:

<table>
<thead>
<tr>
<th>Medium stress N/mm²</th>
<th>Amplitude in N/mm²</th>
<th>Achieved cycle number</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>24</td>
<td>10,000,000</td>
</tr>
<tr>
<td>50</td>
<td>24</td>
<td>10,000,000</td>
</tr>
<tr>
<td>60</td>
<td>21</td>
<td>10,000,000</td>
</tr>
</tbody>
</table>

Maximum achieved amplitude per medium stress

---

**Work preparation**

Contact surfaces, which are covered with MM1018 FL, must be cleaned of dirt and loose particles, if possible using deoiled compressed air. The Diamant Cleaner #1417 is recommended. The cleaner must be applied to a lint-free cloth with which the contact surface is then cleaned. Existing screws must be protected by PU screw protection to avoid later sticking of the threads with MM1018 L. If the contact surfaces have to be separated again at a later point in time, it will be necessary to pre-treat it with a separator. It is recommended to use Diamant seperator #1354. The seperator must be applied generously on the contact surface where adhesion is to be avoided.

*For further information see the seperator technical data sheet.*

**Mixing process**

For the mixing of MM1018 FL, the entire package of component B is added to the container with component A. Mix thoroughly with a hand-held drill and the Diamant mixing propeller (# 0789) (max. 250 rpm for approx. 2 minutes). Scrape off material adhering to the wall of the container with a spatula and add to the mixture. Mix again thoroughly.
**Application description**

The application of MM1018 FL can be carried out by pouring or injecting. In both cases it is necessary that the gap is completely sealed to prevent MM1018 from flowing out of the gap. The use of MM1018 SEAL #2108 is recommended for the gap seal. Information on material and processing can be found in the technical data sheet MM1018 SEAL #2108.

**Casting**

The blended MM1018 FL can be used for gap compensation by pouring it into a gap. Before pouring, add the mixed MM1018 into a clean container. From this container, the material can be poured directly into the cavity. Ensure adequate venting as well as air bubble-free potting.

**Inject**

MM1018 FL can be injected into a sealed gap. Precondition for injection are appropriate injection and venting openings as a function of the gap dimension or hollow space. The injection is carried out via a flexible plastic hose (Prod # 1579) using shut-off valves (Prod # 1577) which are connected via R1/4” screw connections (# 1578) at the inlet and outlet points. An approx. 150 mm long plastic hose, a shut-off valve and a further piece of hose designed for the connection of the injection cartridge and / or for venting must be fitted via suitable hose clips (Prod # 1576).

![Diagram of injection port](Image)

1) Example of an injection port

After opening the shut-off valve, the injection can begin. Pressing should be carried out with a constant pressure. It is absolutely necessary to ensure that no air bubbles are pressed through the hose into the gap! To change or refill the cartridges, the shut-off valve is closed to prevent a flow back of the material that is already injected. The free end of the tube is fixed for the cartridge change so that no material can leak. The injection is terminated as soon as the material emerges from the upper ventilation opening. The shut-off valve must be closed before removing the cartridge. Material that flows back from the injection hose can be caught, for example, with a cloth and disposed of appropriately in domestic waste.

After 24 hours of curing, the injection and venting connections can be removed and disposed in domestic waste.

MM1018 FL is mixed according to the processing regulations. The finished product is then transferred to a blanket cartridge (Prod # 1573 - 320ml) in a very thin stream, avoiding air bubbles. The cartridge will be closed after filling with a cartridge piston and slowly rotated to allow the liquid MM1018 to flow from the tip to the piston, causing the trapped air in the cartridge to rise to the cartridge tip. This procedure is especially necessary for a bubble-free injection! The cartridge can now be opened at the top with a knife and the tip can be screwed. It is recommended to shorten the tip of the cartridge slightly so that it has an inside diameter of approx. 8 mm. This reduces the resistance during injection and facilitates the injection. The cartridge tip is now placed manually onto the free tube end.
Instructions
1.) Clean with Diamant Cleaner
2.) Install screw protection
3.) Insert injection and venting connections and prepare
4.) Completely seal around the circumference with MM1018 SEAL
5.) Curing of MM1018 SEAL
6.) Injection with Diamant MM1018 FL
7.) Curing of MM1018 FL
8.) Remove and clean the injection and venting connections

Pictures 2 and 3 show typical applications for injection applications. For design and application notes, please contact our technicians.

3) Grouting of a bridge bearing

Disposal
Unused residual material from the cans can be disposed of normally (EAKV 170203) when mixed in the correct mixture ratio and completely cured. Unmixed material must be disposed as chemical waste (EAKV 080111). When the Diamant service team is booked, we dispose of the waste.

Qualification and Service
It is recommended that the application be carried out by trained DIAMANT technicians.

In order to guarantee optimum quality and faultfree application, we offer the following services:
• Product Training
• Construction site supervising
• Complete execution of works by our experienced application technicians

Further information can be found in the service data sheet

MM1018 FL #1866

The technical data cited here has been obtained under laboratory conditions and verified on the day of product manufacture through quality assurance processes. This information is subject to change, even without prior notice. The customer is responsible for verifying the current status of the data and should inquire with DIAMANT in this regard prior to ordering the material. Application, use and processing of the product takes place outside of our control and therefore exclusively under the responsibility of the purchaser. However, if a question of liability should arise, it shall be limited - in relation to all damages - to the value of the goods supplied by us and used by you. We guarantee the faultless quality of our products according to the provisions of our general terms and conditions of sales and deliveries. All technical specifications vary depending on loads and application conditions. We are able to issue substantiated application data in individual cases on request.
MM1018 P - putty
Product #1436

Product description
MM1018 L is a metal polymer for the 100% form- and force-locking gap compensation for tolerance inaccuracies and unevenness between metal elements, head plates, bridge bearings, crane and rail guides as well as steel components. For gaps of > 10 mm, it is recommended to insert steel shim plates in order to reduce the gap width to less than 10 mm.

Characteristics
• Very high compressive strength
• Corrosion and weather resistant
• Injection for almost any gap situation, no casting
• General building authority approval
• Seawater resistant

Chemical resistance
• Oil
• Petrol
• Coolant

Package sizes
0.5 kg  
1.0 kg  
1.5 kg  
4.5 kg  
Special sizes on request

MM1018 P is supplied in ready-to-use package sizes. The product consists of two components. Both components must be thoroughly mixed with each other. To avoid mixing errors, a portioning of the components into smaller quantities is expressly discouraged.

Storage / shelf life
Store in the original unopened container in a dry, cool and frost-free location (5°C - + 20°C). Shelf life 2 years. Protect from direct sunlight. Higher temperatures reduce the shelf life.

Technical specifications

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Test method</th>
<th>Symbols</th>
<th>Value 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application (gap size)</td>
<td>-</td>
<td>d</td>
<td>0 – 140 mm</td>
</tr>
<tr>
<td>Friction</td>
<td>-</td>
<td>μ</td>
<td>&gt;0.5</td>
</tr>
<tr>
<td>E-modulus [N/mm²]</td>
<td>DIN EN 13412:2006</td>
<td>E</td>
<td>10,000</td>
</tr>
<tr>
<td>Compressive strength [N/mm²]</td>
<td>DIN EN 12190:1998</td>
<td>f&lt;sub&gt;c&lt;/sub&gt;</td>
<td>110</td>
</tr>
<tr>
<td>Shrinkage [mm/m]</td>
<td>DIN EN 12617-4:2002</td>
<td>ε</td>
<td>0.84</td>
</tr>
<tr>
<td>Viscosity [mPas]</td>
<td>DIN EN ISO 3219:1994</td>
<td>ν</td>
<td>600</td>
</tr>
<tr>
<td>Creep coefficient</td>
<td>DIN EN ISO 13584:2003-11</td>
<td>Φ&lt;sub&gt;18,171&lt;/sub&gt;</td>
<td>2.1</td>
</tr>
<tr>
<td>Thermal Expansion Coefficient [1/K]</td>
<td>-</td>
<td>α&lt;sub&gt;r&lt;/sub&gt; (-20°C - 60°C)</td>
<td>2.5E-05</td>
</tr>
<tr>
<td>Density [g/cm³]</td>
<td>-</td>
<td>-</td>
<td>2.66</td>
</tr>
<tr>
<td>Pot life [min]</td>
<td>DIN EN ISO 9514</td>
<td>t&lt;sub&gt;15,k&lt;/sub&gt;</td>
<td>20 ± 20%</td>
</tr>
<tr>
<td>Shore D hardness</td>
<td>DIN IS ISO 868</td>
<td>-</td>
<td>89</td>
</tr>
</tbody>
</table>

Consumption calculation
The base area (A in cm²) and the mean gap dimension (d in cm) are required as a basis for calculation of the material consumption.

In this calculation, a material surplus of 20% is taken into account to compensate for tolerances as well as application-oriented additional consumption.

\[ M \text{ (in g)} = A \text{ cm}^2 \times d \text{ cm} \times 1.2 \times 2.6 \text{ g/cm}^3 \]

Indication: 1m² contactsurface with 1mm gap
\[ M = 10.000\text{cm}^2 \times 0.1\text{cm} \times 1.2 \times 2.6\text{g/cm}^2 = 3120\text{g} = 3,12\text{kg} \]

Important instructions
Please refer to the safety data sheet.
Processing parameters

The processing time (pot life) of the material starts as soon as the two components A and B are combined. The pot life and hardening time are dependent on the material quantity (volume) and the temperature. The following table provides pot life values for a 1 kg pack relevant to practical applications:

<table>
<thead>
<tr>
<th>Temperature [°C]</th>
<th>Pot life [Min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>60</td>
</tr>
<tr>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>30</td>
<td>10</td>
</tr>
</tbody>
</table>

Measured with 1 kg of product in the original container

For larger containers, the pot life may be reduced due to a higher reaction temperature. The compressive strength depends on the temperature, the curing time and the material dimension. The following table gives approximate values for a gap of 10 mm.

<table>
<thead>
<tr>
<th>Temperature [°C]</th>
<th>Compressive strength [N/mm²]</th>
<th>Time until compressive strength is attained</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>-</td>
<td>24 hours</td>
</tr>
<tr>
<td>5</td>
<td>106</td>
<td>7 days</td>
</tr>
<tr>
<td>21</td>
<td>88</td>
<td>24 hours</td>
</tr>
<tr>
<td>21</td>
<td>110</td>
<td>7 days</td>
</tr>
<tr>
<td>30</td>
<td>90</td>
<td>24 hours</td>
</tr>
<tr>
<td>30</td>
<td>122</td>
<td>7 days</td>
</tr>
</tbody>
</table>

Compressive strength relative to the ambient temperature

The material curing can be accelerated by heating. The maximum permissible temperature for accelerated curing is 65°C. The required curing temperature is 5°C. At lower temperatures it is recommended to preheat the components.

Work preparation

Contact surfaces that are to be coated with MM1018 P, must be cleaned of dirt and loose particles, if possible using deoiled compressed air. The Diamant Cleaner #1417 is recommended. The cleaner must be applied to a lint-free cloth with which the contact surface is then cleaned. Existing screws must be protected by PU screw protection to avoid later sticking of the threads with MM1018 P. If the contact surfaces have to be separated again at a later point in time, it is necessary to use a separator in advance. It is recommended to use Diamant separator #1354. The separator must be applied generously on the contact surface where adhesion is to be avoided.

For further information see the Technical Data Sheet separator.

Mixing process

For the mixing of MM1018 P, the entire package of component B is added to the container with component A. Mix thoroughly with a hand-held drill and the Diamant mixing propeller (# 0789) (max. 250 rpm for approx. 2 minutes). Scrape off material adhering to the wall of the container with a spatula and add to the mixture. Mix again thoroughly.

Application description

MM1018 P is applied to the contact surface in an X-shape. Examples of a square or rectangular contact surface are illustrated in Figures 1 and 2. It is important to note that the highest material lift is applied at the center of the contact surface (see the red line in Figure 1) so that the MM1018 P can be distributed paste-like, air bubble-free and over the entire surface when the contact surfaces are joined together. After joining the contact surfaces the MM1018 P will be distributed over the entire surface out to the edges. Excess material, which has been pressed out at the sides of the contact surfaces, should be removed before curing, if possible.
Instructions
1.) Clean with Diamant Cleaner
2.) Install screw protection
3.) If necessary apply Diamant seperator
4.) Mix the material
5.) Apply the calculated amount of material
6.) Join contacts
7.) Remove excess material from the joints by using a spatula
8.) Curing of MM1018 P

Figure 1 and 2 show a typical applications for MM1018 P.
For design and application notes, please contact our technicians.

Figure 1

Figure 2

Disposal
Unused residual material from the cans can be disposed of normally (EAKV 170203) when mixed in the correct mixture ratio and completely cured. Unmixed material must be disposed as chemical waste (EAKV 080111). When the Diamant service team is booked, we dispose of the waste.

Qualification and Service
It is recommended that the application be carried out by trained DIAMANT technicians.

In order to guarantee optimum quality and faultfree application, we offer the following services:
- Product Training
- Construction site supervising
- Complete execution of works by our experienced application technicians

Further information can be found in the service data sheet

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**MM1018 P #1436**

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www.diamant-polymer.de

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**Technical data sheet**

**MM1018 SEAL - Solid Epoxy Adhesive Link**

**Product #2108**

**Product description**
MM1018 SEAL is a metal polymer for pressure-tight joint sealing between two metal parts. MM1018 SEAL is used in conjunction with MM1018 injection applications in order to seal cavities and is fully compatible with MM1018 liquid.

**Characteristics**
- High compressive strength
- Corrosion and weather resistant
- Dimensionally stable
- Curing approx. 2-3h at 20°C ambient temperature

**Chemical resistance**
- Oil
- Petrol
- coolant and environmental influences

**Package size**
300 g double cartridge (resin + hardener)

**Technical specifications**

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density [g/cm³]</td>
<td>1.7</td>
</tr>
<tr>
<td>Mixing ratio by volume</td>
<td>A:B = 2:1</td>
</tr>
</tbody>
</table>

**Storage / Shelf life**
Store in the original, unopened container, dry, cool and frost-free (5°C - + 20°C). Shelf life 2 years. Protect from direct sunlight. Higher temperatures reduce the shelf life.

**Consumption calculation**
For joint sealing, the following approximation values can be used for quantity calculation:

<table>
<thead>
<tr>
<th>Joint height [mm]</th>
<th>Material consumption [g/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>150</td>
</tr>
<tr>
<td>10</td>
<td>300</td>
</tr>
</tbody>
</table>

In order to ensure sufficient pressure tightness, MM1018 SEAL should be pressed into the gap at least 10 mm.

**Important instructions**
Please note the safety data sheet.

**Processing parameters**
The processing time (pot life) of the material begins as soon as the two components A and B are mixed together in the mixing spiral. The used material must be processed within 15 minutes. The strength of the material is essentially influenced by the component temperature of the adjacent components. At a temperature of 20°C, the material is usually sufficiently solid after 3 hours to start the injection. We recommend a strength test with a pointed object such as: a screwdriver to ensure that the material is thoroughly cured.

Contact surfaces, which are in contact with MM1018 SEAL, must be cleaned of dirt and loose particles using compressed air. The elimination of existing corrosion on the contact surfaces is not required for the function of MM1018, however, in view of the durability of the bonding surfaces recommended. To ensure good adhesion of MM1018 Seal, the adhesive surfaces must be degreased with DIAMANT Cleaner # 1417.
Disposal
MM1018 SEAL is supplied in double cartridges and can be reused during the specified storage period. After the expiration date, unused residual material can be disposed of normally (EAKV 170203).

Qualification and Service
It is recommended that the application be carried out by trained DIAMANT technicians.

In order to guarantee optimum quality and faultfree application, we offer the following services:
- Product Training
- Construction site supervising
- Complete execution of works by our experienced application technicians

Further information can be found in the service data sheet

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- Installation by excellently trained DIAMANT specialists
- Guarantee of professional product processing
- Problem solving on site
- Detailed documentation of the performed work
- Quality assurance of the assembly work by means of checks and acceptance protocol
- Fair billing according to effort and consumption

Contact us:

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