

High-quality connections **for PV modules**



**OTTO
CHEMIE**

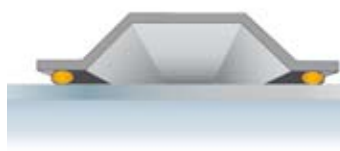
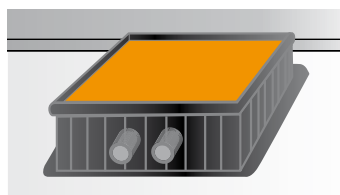
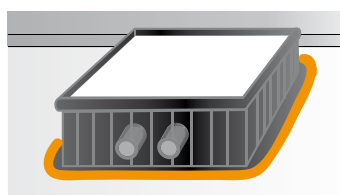
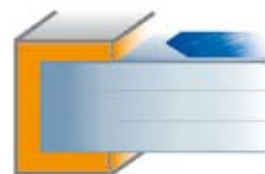
Sealants • Adhesives

Long lasting Quality for long-term Investments

It takes many years for a photovoltaic system to prove profitable investment. Only if the acquisition costs can be re-covered by saving energy is the decision to acquire a solar system justified. Therefore, top quality is needed, right down to the last detail.

Survival of the fittest silicones: The adhesives and sealants required for photovoltaic modules are exposed to extreme conditions. They have to withstand and compensate alternating fluctuations of up to 100 °C between hot and cold, endure and remain impervious to damage, mechanical deformation and moisture.

As individual as your requirements: OTTO has been supplying global leaders in the photovoltaic industry with customised silicone adhesives and sealants for more than a decade. We are perfectly equipped to adapt the properties of our products specifically to meet your requirements. You benefit from our knowledge and experience gained from over 40 years of research and development, production and industrial processing of special silicones. We support you all the way from prototype testing to serial application in production.



Bonding of **Module Frames**

4

Bonding of **Corner Connections**

6

Bonding of **Junction Boxes**

8

Potting of **Junction Boxes**

10

Bonding of **Back-Rails**

12

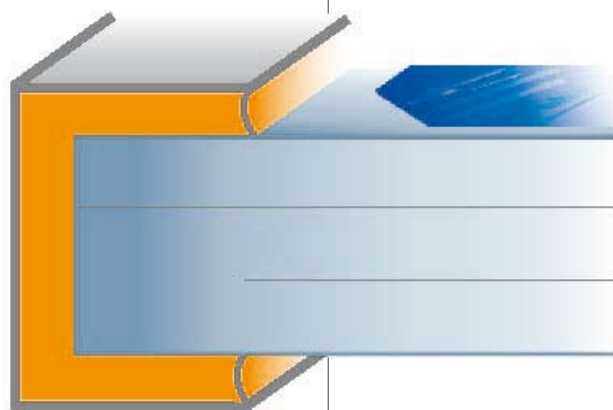
Packing Units

14

Bonding of Module Frames

Photovoltaic modules are permanently exposed to harsh environmental conditions. Sun light (UV rays), temperature changes, snow, frost, rain, humidity and wind loads are constantly affecting the materials used.

As a result selection of perfect products to fit these conditions is a crucial and determining factor for module makers.



The OTTO solution.

Laminated solar-cell units need high-performance adhesives to suit demanding requirements of the finished products whether on roof-tops or in solar-parks. OTTO's range of products has been developed accordingly and has proven its reliability for many years already.

The key-characteristics of the OTTO products are defined by several „Musts“:

- Fail-safe long-term connection of components and substrates
- Stabilization of modules and increased stiffness of elements
- Perimeter edge-protection
- Compensation of different thermal properties of materials
- Moisture protection



| | Novasil® S 49 | Novasil® S 56 | Novasil® SP 5737 |
|----------------------|--|---|--|
| CURE SYSTEM | Two-part alkoxy silicone | One-part oxime silicone | One-part alkoxy silicone |
| MIXING RATIO | 10 : 1 | Ready to use | Ready to use |
| KEY PROPERTIES | Resistance to Temperature | Damp-Heat | Optimized viscosity |
| PROCESS ADAPTABILITY | Tailor made cure leads to optimized production output | Allows manual as well automated application | Allows manual as well automated application |
| UL APPROVAL | UL 94 HB RTI 105° C | UL 94 HB RTI 105° C | UL 94 HB RTI 105° C |
| COLOUR RANGE | Customized colours on demand (except for transparent) even for small batch sizes | Customized colours on demand (except for transparent) | Customized colours on demand (including transparent) |

Bonding of Corner Connections

Even though not a major issue for most PV module makers, a perfect corner connection is both secure and optically appealing.

Trusting in a perfectly bonded and sealed module as part of their marketing and sales concept some manufacturers offer this little extra to their customers.

This simple and efficient while costwise almost imperceptible solution offers:

- increased moisture protection in corner sections
- additional stabilization against mechanical forces
- easy insertion of internal corner angles due to lubricating properties of agent



The OTTO solution.

Looking not only at the huge demand of basic requirements on bonding and sealing materials, OTTO has been also focussing on the very tiny details of module manufacturing processes worldwide for many years.

In order to offer our customers ways and means to distinguish their finished products from others, OTTO provides supplementary tailor made solutions for securing corner connections.



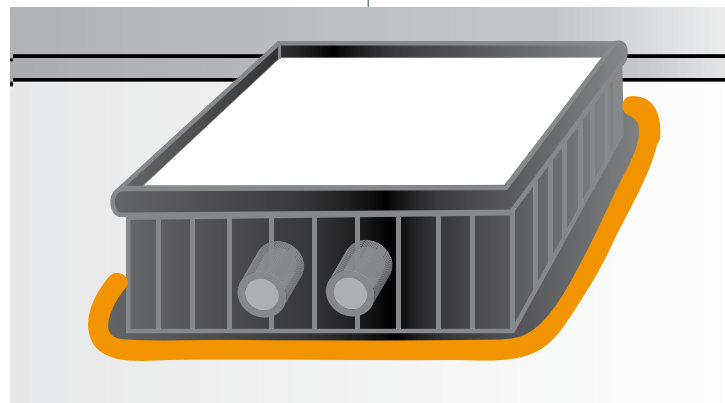
| | Novasil® S 13 | OTTOCOLL® P 520 |
|----------------------|--|---|
| CURE SYSTEM | One-part alkoxy silicone | Two-part polyurethane |
| MIXING RATIO | Ready to use | 1 : 1 |
| KEY PROPERTIES | Optimized viscosity Transparency supports module aesthetics | Extreme mechanical strength |
| PROCESS ADAPTABILITY | Allows manual as well as automatized application | Tailor made cure leads to optimized production output |
| UL APPROVAL | UL 94 HB RTI 105 °C | — |

Bonding of Junction Boxes

Out of experience one of the crucial parts of ready-to-use modules is defined by the spot where transformed sunlight becomes electrical energy which needs to be transferred off the modules to external points such as cables and inverters.

Usually junction-boxes are the places to combine string-wires with clamps, diodes resp. transmitting cables.

Because of that fact well-known suppliers of J-boxes are highly attentive to the way their boxes are connected to backsheets resp. glass. That is why they regard bonding by means of silicones superior to other methods.



The OTTO solution.

The use of OTTO's silicone-based adhesives leads to a permanently reliable bonding interface between J-box and backsheets resp. glass.

Due to extensive research efforts formulations are not just taken off the rack but truly designed, re-designed resp. altered according to specific requirements of components, their raw materials and process peripherals.



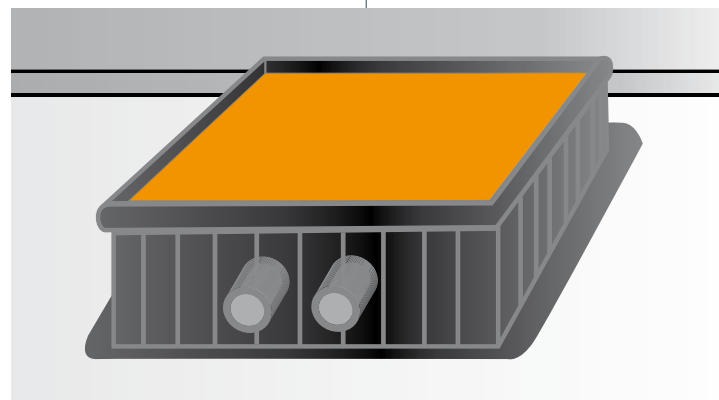
| | Novasil® S 49 | Novasil® S 56 | Novasil® SP 5737 |
|----------------------|--|---|--|
| CURE SYSTEM | Two-part alkoxy silicone | One-part oxime silicone | One-part alkoxy silicone |
| MIXING RATIO | 10 : 1 | Ready to use | Ready to use |
| KEY PROPERTIES | Fully compatible with OTTO potting agents Tested and approved for many J-Box types and backsheets | | |
| PROCESS ADAPTABILITY | Tailor made cure leads to optimized production output | Allows manual as well as automated application | Allows manual as well as automated application |
| UL APPROVAL | UL 94 HB RTI 105 °C | UL 94 HB RTI 105 °C | UL 94 HB RTI 105 °C |
| COLOUR RANGE | Customized colours on demand (except for transparent) even for small batch sizes | Customized colours on demand (except for transparent) | Customized colours on demand (including transparent) |

Potting of Junction Boxes

Electrical contacts and connections inside J-boxes rely on design resp. tightness of the box itself.

Open areas between laminated package and J-box may not only serve as exit for string-wires but also as entry-point for humidity. Leakage might lead to short circuits resp. failure of module or – in worst of cases – to destruction of the unit.

Moisture protection combined with flame resistance and di-electric properties of encapsulant therefore is a supporting means of longterm failsafe operation of J-boxes.



The OTTO solution.

Development of OTTO's silicone-based potting agents / encapsulants took place over years and is mainly influenced by true and practical experience reported by module makers, J-box manufacturers and electrical interactions.

Superior elasticity of pottant results in low modulus reducing mechanical stress to the J-box interior.

Perfect adaption of fluid-properties to highly sophisticated and partially complicated shapes of state-of-the-art J-boxes allow bubble-free filling.



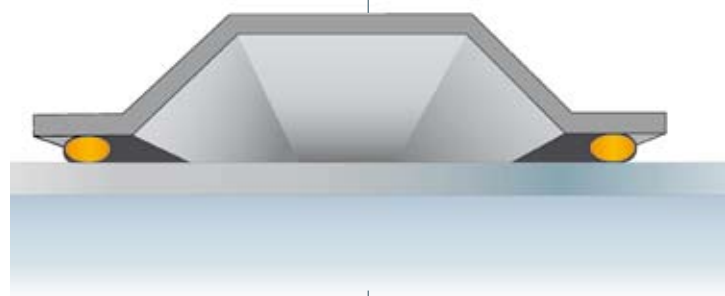
| | Novasil® S 650 | Novasil® SP 5170 |
|----------------------|---|---|
| CURE SYSTEM | Two-part alkoxy silicone | Two-part alkoxy silicone |
| MIXING RATIO | 10 : 1 | 4 : 1 |
| KEY PROPERTIES | Customized viscosity Transparent colour Fast curing | Low viscosity Damp-Heat resistance |
| PROCESS ADAPTABILITY | Cure adaption for every kind of application possible | Multi-usable for various types of J-boxes |
| UL APPROVAL | requested / pending | UL 94 HB RTI 105 °C HWI: 3 / HAI: 0 |

Bonding of Back-Rails

Traditional modules and their fastening racks resp. fixation systems recently have been amended by additional profiles at the panel's reverse side as soon as it comes to frameless constructions.

To ease and facilitate installation of finished panels module makers are improving their fastening system by bonding supporting rails to their modules at the back-end of the production line.

Thus corrosion can be avoided as silicone-based adhesives may serve as sole fastening mechanism and take over changing loads from temperature, wind, rain, sand, ice and snow even under worst conditions.



The OTTO solution.

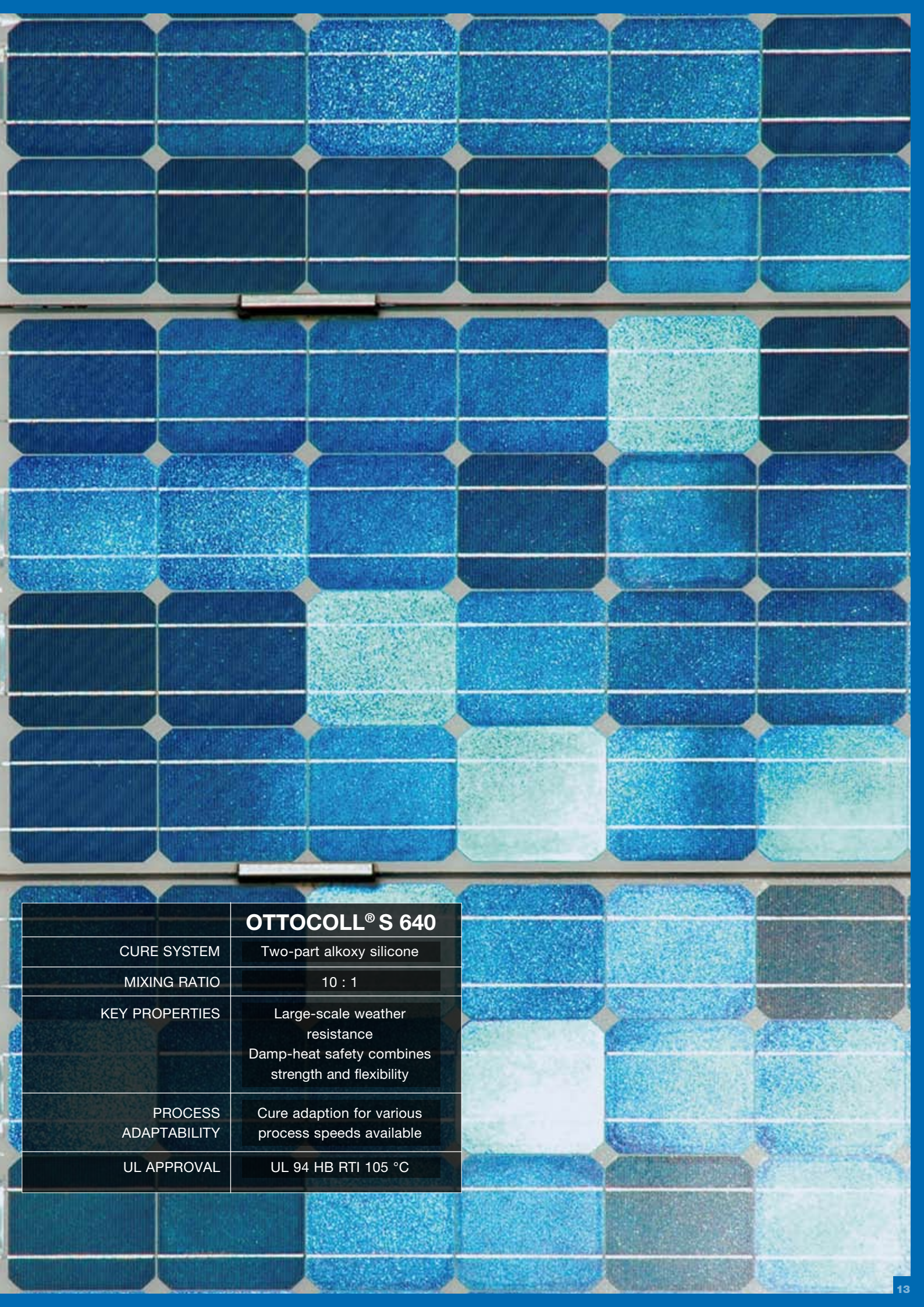
As one of Europe's leading compounders, OTTO is determined to develop products based on real experience from several decades of extensive practice in the field of silicones.

Products which are initiated by OTTO's R+D division in cooperation with trusted customers seem new to the public, but have passed an intense phase of pre-testing prior to launch.

Development of especially designed back-rail attachment adhesives for manufacturers of standardized as well as oversized modules considers permanently changing loads and repeatedly harsh climate influences.

Looking at the back-rail attachment, a combination of fast reacting two-part silicones with the know-how from mixing & dosing equipment manufacturers was the result.

We proudly present the youngest member of a product family going back four decades from today.



OTTOCOLL® S 640



| | |
|----------------------|--|
| CURE SYSTEM | Two-part alkoxy silicone |
| MIXING RATIO | 10 : 1 |
| KEY PROPERTIES | Large-scale weather resistance Damp-heat safety combines strength and flexibility |
| PROCESS ADAPTABILITY | Cure adaption for various process speeds available |
| UL APPROVAL | UL 94 HB RTI 105 °C |

Ready to Use

The Premium products by OTTO are available in a variety of useful sizes and shapes of trading units.

To permit fast use in production, two-component adhesives are available in pre-configured mixing units for immediate use.

The following table will give you an initial overview. If you have any questions or special wishes, we would be delighted to advise you.

| | 20 l Plastic pail | 60 l Metal pail |
|----------------|---|---|
| Outer diameter | | |
| Inner diameter | 282 mm +/- 1,5 mm | 355 mm |
| Length | | |
| Height | 367 mm +/- 2 mm | 656 mm |
| Width | | |
| |  |  |
| Remarks | For automized application | |

| 200 l Metal drum | 310 ml Plastic cartridge | 400 ml Aluminium sachet | 580 ml Aluminium sachet | 330 ml Side-by-side cartridge (mixing ratio 10:1) | 2 x 190 ml Side-by-side cartridge (mixing ratio 1:1) | 2 x 310 ml Side-by-side cartridge (mixing ratio 1:1) |
|--|---|---|---|--|---|---|
| | 50 mm | 48 mm | 48 mm | | | |
| 571,5 mm +/- 1,5 mm | | | | | | |
| | 215 mm | 220 mm | 320 mm | 247,7 mm | 170,0 mm | 240,0 mm |
| 887 mm +/- 3 mm | | | | | | |
| | | | | 70,0 x 51,0 mm | 90,8 x 50,4 mm | 90,8 x 50,4 mm |
|  |  |  |  |  |  |  |
| | For manual application of one-part materials | | | For two-part silicones in testing and / or pre-series phase | For OTTOCOLL® P 520 | |



Sealants • Adhesives