GENERAL INFORMATION

Product Description:
Two component, hand or spray applied, high temperature coating, suitable for continuous immersion in aqueous/hydrocarbon systems up to 320°F/160°C. Also suitable for steaming out up to 410°F/210°C. Exhibits excellent corrosion resistance at elevated temperatures and is resistant to a wide range of chemicals.

Application Areas:
When mixed and applied as detailed in the Belzona Instructions for Use (IFU), the system is ideally suited for application to the following:

- Absorbers
- Boiler Feed Water Systems
- Condensate Tanks
- Condensers
- De-aerators
- Evaporators
- Heat Exchangers
- Hot Water Vessels
- LP & HP Knock-Out Drums
- Pipework
- Scrubbers
- Separators
- Slug Catchers
- Storage Tanks

APPLICATION INFORMATION

Application Methods
Brush
Applicator
Spray

Application Temperature
Application should occur in the following ambient temperature range: 50°F/10°C to 104°F/40°C

Coverage Rate
Belzona 1593 shall be applied in two coats to give a minimum thickness of 20 mils (500 microns).

At a thickness of 20 mils/500 μm, the theoretical coverage rate will be 1.10 m²/kg.

Cure Time
Cure times will vary depending on the ambient conditions; consult the Belzona IFU for specific details.

Mixed Properties
Colour: Light Green or Light Grey
Density: 1.81 g/cm³
Gel Time (BS 5350-B5): 70–110 minutes (68°F/20°C)
Sag Resistance (BS 5350-B9): >30 mils / >750 μm
60° Specular Gloss (ASTM D2457): 60–70 Gloss Units
VOC content (ASTM D2369 / EPA ref. 24): 0.62% / 11.14 g/L

Mix Ratio (base : solidifier) 11 : 1 (parts by weight)

Overcoat Window
Overcoat times will vary depending on the ambient conditions; consult the Belzona IFU for specific details.
At 68°F/20°C, the maximum overcoat time will typically be 24 hours.

Working Life
The working life will vary according to the temperature. At 68°F/20°C, the usable life of mixed material will typically be 45 minutes; consult the Belzona IFU for specific details.

The above application information serves as introductory guide only. For full application details including the recommended application procedure/technique, refer to the Belzona IFU which is enclosed with each packaged product.
PRODUCT SPECIFICATION SHEET
BELZONA 1593
FN10151

ABRASION

Taber
Dry sliding abrasion resistance, when determined in accordance with ASTM D4060 using CS17 wheels, will typically result in:
17.4 mm³ loss per 1000 cycles
(212°F/100°C cure & 68°F/20°C test)
Wet sliding abrasion resistance, when determined in accordance with ASTM D4060 using H10 wheels, will typically result in:
1042 mm³ loss per 1000 cycles
(212°F/100°C cure & 68°F/20°C test)

ADHESION

Cleavage Adhesion
The Cleavage Strength when applied to grit blasted mild steel, as determined in accordance with ASTM D1062, will typically be:
1830 pli / 320 N/mm (68°F/20°C cure & test)
980 pli / 172 N/mm (212°F/100°C cure & 68°F/20°C test)
770 pli / 134 N/mm (320°F/160°C cure & 68°F/20°C test)
760 pli / 132 N/mm (212°F/100°C cure & test)
400 pli / 70 N/mm (320°F/160°C cure & test)

Pull Off Adhesion
The PosiTest Dolly Pull Off Strength on 10mm thick grit blasted mild steel, as determined in accordance with ASTM D4541 and ISO 4624, will typically be:
4350 psi / 30.0 MPa (68°F/20°C cure)
3430 psi / 23.7 MPa (212°F/100°C cure)
2770 psi / 19.1 MPa (284°F/140°C cure)
2290 psi / 15.8 MPa (320°F/160°C cure)

Tensile Shear Adhesion
The Tensile Shear Adhesion on grit blasted mild steel, as determined in accordance with ASTM D1002, will typically be:
2900 psi / 20.0 MPa (68°F/20°C cure & test)
2110 psi / 14.6 MPa (212°F/100°C cure & 68°F/20°C test)
2400 psi / 16.6 MPa (320°F/160°C cure & 68°F/20°C test)
1530 psi / 10.6 MPa (212°F/100°C cure & test)
1790 psi / 12.3 MPa (320°F/160°C cure & test)

CHEMICAL ANALYSIS

The mixed Belzona 1593 has been independently analysed for halogens, heavy metals, and other corrosion-causing impurities in accordance with ASTM E165, ASTM D4327 and ASTM E1479. Typical results are displayed as follows:

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Total Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoride</td>
<td>68</td>
</tr>
<tr>
<td>Chloride</td>
<td>300</td>
</tr>
<tr>
<td>Bromide</td>
<td>ND (&lt;10)</td>
</tr>
<tr>
<td>Sulphur</td>
<td>57</td>
</tr>
<tr>
<td>Nitrite</td>
<td>ND (&lt;7)</td>
</tr>
<tr>
<td>Nitrate</td>
<td>7</td>
</tr>
<tr>
<td>Zinc</td>
<td>5.4</td>
</tr>
<tr>
<td>Antimony, Arsenic, Bismuth, Cadmium, Lead, Tin, Silver, Mercury, Gallium and Indium</td>
<td>ND (&lt;5.0)</td>
</tr>
</tbody>
</table>

CHEMICAL RESISTANCE

When tested in accordance with ISO 2812 and ISO 4628, the coating demonstrates excellent resistance to a wide range of chemicals. For full details, see the Belzona 1593 Chemical Resistance Chart

COMPRESSIVE PROPERTIES

When determined in accordance with ASTM D695, typical values will be:

Compressive Yield Strength
8280 psi / 57.1 MPa (68°F/20°C cure & test)
11460 psi / 79.0 MPa (212°F/100°C cure & 68°F/20°C test)
13200 psi / 91.0 MPa (320°F/160°C cure & 68°F/20°C test)
5510 psi / 38.0 MPa (212°F/100°C cure & test)
5010 psi / 34.6 MPa (320°F/160°C cure & test)

Compressive Modulus
1.81x10⁶ psi / 12500 MPa (68°F/20°C cure & test)
1.66x10⁶ psi / 1140 MPa (212°F/100°C cure & 68°F/20°C test)
1.68x10⁶ psi / 1170 MPa (320°F/160°C cure & 68°F/20°C test)
1.20x10³ psi / 830 MPa (212°F/100°C cure & test)
0.99x10³ psi / 680 MPa (320°F/160°C cure & test)

CORROSION PROTECTION

Cathodic Disbondment
When tested in accordance with ASTM G42 at 194°F/90°C, the average disbondment radius will typically be: 0.209 in/5.3 mm

Salt Spray
When tested in accordance with ASTM B117, the coating will show no signs of failure after 1000 hours continuous exposure.
**PRODUCT SPECIFICATION SHEET**

**BELZONA 1593**

**FN10151**

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**ELECTRICAL PROPERTIES**

When tested in accordance with ASTM D149, method A, with voltage rise of 2kV/s, typical value will be:

Dielectric strength 27.5 kV/mm

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**ELONGATION & TENSILE PROPERTIES**

When determined in accordance with ASTM D638, typical values will be:

**Tensile Strength**

<table>
<thead>
<tr>
<th>Value</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2750 psi / 19.0 MPa</td>
<td>(68°F/20°C cure &amp; test)</td>
</tr>
<tr>
<td>2610 psi / 18.0 MPa</td>
<td>(212°F/100°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>2570 psi / 17.7 MPa</td>
<td>(320°F/160°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>2070 psi / 14.3 MPa</td>
<td>(212°F/100°C cure &amp; test)</td>
</tr>
<tr>
<td>1620 psi / 11.2 MPa</td>
<td>(320°F/160°C cure &amp; test)</td>
</tr>
</tbody>
</table>

**Elongation**

<table>
<thead>
<tr>
<th>Value</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.27 %</td>
<td>(68°F/20°C cure &amp; test)</td>
</tr>
<tr>
<td>0.29 %</td>
<td>(212°F/100°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>0.30 %</td>
<td>(320°F/160°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>0.31 %</td>
<td>(212°F/100°C cure &amp; test)</td>
</tr>
</tbody>
</table>

**Young's Modulus**

<table>
<thead>
<tr>
<th>Value</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.30x10⁵ psi / 6410 MPa</td>
<td>(68°F/20°C cure &amp; test)</td>
</tr>
<tr>
<td>8.68x10⁵ psi / 5980 MPa</td>
<td>(212°F/100°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>9.26x10⁵ psi / 6380 MPa</td>
<td>(320°F/160°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>6.27x10⁵ psi / 4320 MPa</td>
<td>(212°F/100°C cure &amp; test)</td>
</tr>
<tr>
<td>2.40x10⁵ psi / 1650 MPa</td>
<td>(320°F/160°C cure &amp; test)</td>
</tr>
</tbody>
</table>

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**EXPLOSIVE DECOMPRESSSION**

When tested in accordance with NACE TM0185 using a seawater/crude oil test fluid over-pressured with 10% carbon dioxide/90% methane, the coating exhibits no breakdown after a 21 day immersion period at 248°F/120°C and 70 bar pressure followed by rapid decompression over 15 minutes.

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**FLEXURAL PROPERTIES**

When determined in accordance with ASTM D790, typical values will be:

**Flexural Strength**

<table>
<thead>
<tr>
<th>Value</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>7500 psi / 51.7 MPa</td>
<td>(68°F/20°C cure &amp; test)</td>
</tr>
<tr>
<td>7810 psi / 53.8 MPa</td>
<td>(212°F/100°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>6880 psi / 47.4 MPa</td>
<td>(320°F/160°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>4600 psi / 31.7 MPa</td>
<td>(212°F/100°C cure &amp; test)</td>
</tr>
<tr>
<td>4660 psi / 32.1 MPa</td>
<td>(320°F/160°C cure &amp; test)</td>
</tr>
</tbody>
</table>

**Flexural Modulus**

<table>
<thead>
<tr>
<th>Value</th>
<th>Typical Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.99x10⁵ psi / 6200 MPa</td>
<td>(68°F/20°C cure &amp; test)</td>
</tr>
<tr>
<td>8.42x10⁵ psi / 5810 MPa</td>
<td>(212°F/100°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>9.15x10⁵ psi / 6310 MPa</td>
<td>(320°F/160°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>5.19x10⁵ psi / 3580 MPa</td>
<td>(212°F/100°C cure &amp; test)</td>
</tr>
<tr>
<td>4.31x10⁵ psi / 2970 MPa</td>
<td>(320°F/160°C cure &amp; test)</td>
</tr>
</tbody>
</table>

---

**HARDNESS**

The Shore D and Barcol hardness, when determined in accordance with ASTM D2240 and ASTM D2583, will typically be:

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shore D</td>
<td>88</td>
</tr>
<tr>
<td>Barcol</td>
<td>87</td>
</tr>
</tbody>
</table>

---

**HEAT RESISTANCE**

**Heat Distortion & Glass Transition Temperature (HDT & Tgü)**

The HDT and Tgü, when determined in accordance with ASTM D648 and ISO 11357-2 respectively, following a 7 day cure period, will typically be:

<table>
<thead>
<tr>
<th>Cure Temperature</th>
<th>HDT</th>
<th>Tgü</th>
</tr>
</thead>
<tbody>
<tr>
<td>68°F/20°C</td>
<td>120°F</td>
<td>127°F</td>
</tr>
<tr>
<td>212°F/100°C</td>
<td>334°F</td>
<td>291°F</td>
</tr>
<tr>
<td>284°F/140°C</td>
<td>448°F</td>
<td>347°F</td>
</tr>
<tr>
<td>320°F/160°C</td>
<td>453°F</td>
<td>383°F</td>
</tr>
</tbody>
</table>

**Atlas Cell Cold Wall Immersion Test**

When tested in accordance with NACE TM0174 procedure A, the coating will exhibit no blistering or rusting (ASTM D714 rating 10; ASTM D610 rating 10) after 6 months immersion in water at 320°F (160°C).

**Electrochemical Impedance Spectroscopy (EIS)**

The EIS results (log(ωZ’)) determined in accordance with ISO 16773 following Atlas cell testing at 320°F/160°C will typically:

a) Unexposed: 11.0 &omega;cm²
b) Liquid Phase: 10.8 &omega;cm²
c) Vapor Phase: 10.5 &omega;cm²

**Immersion Resistance**

Suitable for service at temperatures up to 320°F (160°C) but refer to chemical resistance data for chemical contact limitations.

**Steam-out Resistance**

Once fully cured the coating exhibited no blistering, cracking or delamination after 96 hours exposure to pressurized steam at 410°F (210°C).

In addition, the coating was independently tested for 5-week pressurized steam exposure at 365°F (185°C) and deemed a pass when assessed to the requirements of ASTM D 1654.

**Dry Heat Resistance**

The indicated degradation temperature in air based on Differential Scanning Calorimetry (DSC) operated in accordance with ISO11357 is typically 428°F (220°C).
## IMPACT RESISTANCE

**Izod Pendulum**
Izod impact strength, when determined in accordance with ASTM D256, will typically be:

<table>
<thead>
<tr>
<th>Reverse</th>
<th>4.9 KJ/m²</th>
<th>(68°F/20°C cure &amp; test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notched</td>
<td>3.2 KJ/m²</td>
<td>(212°F/100°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td></td>
<td>3.0 KJ/m²</td>
<td>(320°F/160°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td>Un-notched</td>
<td>5.7 KJ/m²</td>
<td>(68°F/20°C cure &amp; test)</td>
</tr>
<tr>
<td></td>
<td>5.3 KJ/m²</td>
<td>(212°F/100°C cure &amp; 68°F/20°C test)</td>
</tr>
<tr>
<td></td>
<td>3.8 KJ/m²</td>
<td>(320°F/160°C cure &amp; 68°F/20°C test)</td>
</tr>
</tbody>
</table>

## THERMAL PROPERTIES

**Thermal cycling**
When tested in accordance with NACE TM0304 the coating exhibited no cracking after 252 cycles between +140°F and -22°F (+60°C and -30°C).

**Low Temperature Thermal Shock**
Coated steel panels will exhibit no blistering, cracking or delamination after multiple cycles of rapid cooling from 212°F (100°C) to -76°F (-60°C).

**Thermal Conductivity**
Thermal conductivity over a range of temperatures has been determined:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>25°C</th>
<th>100°C</th>
<th>200°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal conductivity (W/m.K)</td>
<td>0.6258</td>
<td>0.6773</td>
<td>0.6710</td>
</tr>
</tbody>
</table>

**Specific Heat Capacity**
Using DSC in accordance with ASTM E1269 the Specific heat capacity has been determined over a range of temperatures:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>25°C</th>
<th>100°C</th>
<th>200°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific heat capacity (J/g.K)</td>
<td>1108</td>
<td>1299</td>
<td>1412</td>
</tr>
</tbody>
</table>

## THICK FILM CRACKING RESISTANCE

When tested in accordance with NACE TM0104 no cracking was experienced when applied at three times recommended thickness and exposed for 12 weeks in sea water at 104°F (40°C).

## SHELF LIFE

Separate base and solidifier components shall have a shelf life of 3 years from date of manufacture when stored in their original unopened containers between 32°F (0°C) and 86°F (30°C).
Belzona products are manufactured under an ISO 9001 Registered Quality Management System

**WARRANTY**

This product will meet the performance claims stated herein when material is stored and used as instructed in the Belzona Information For Use leaflet. Belzona ensures that all its products are carefully manufactured to ensure the highest quality possible and are tested strictly in accordance with universally recognized standards (ASTM, ANSI, BS, DIN, ISO, etc.). Since Belzona has no control over the use of the product described herein, no warranty for any application can be given.

**AVAILABILITY AND COST**

*Belzona 1593* is available from a network of Belzona Distributors throughout the world for prompt delivery to the application site. For information, consult the Belzona Distributor in your area.

**HEALTH AND SAFETY**

Prior to using this material, please consult the relevant Safety Data Sheets.

**MANUFACTURER / SUPPLIER**

Belzona Polymers Ltd.  
Claro Road, Harrogate,  
HG1 4DS, UK  

Belzona Inc.  
14300 NW 50th Ave,  
Miami Lakes, FL, 33014, USA

**TECHNICAL SERVICE**

Complete technical assistance is available and includes fully trained Technical Consultants, technical service personnel and fully staffed research, development and quality control laboratories.