

PRODUCT SPECIFICATION SHEET

BELZONA 1593

FN10151



GENERAL INFORMATION

Product Description:

Two component, hand 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 482°F (250°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 | - Evaporators | - Scrubbers |
| - Boiler Feed Water Systems | - Heat Exchangers | - Separators |
| - Condensate Tanks | - Hot Water Vessels | - Slug Catchers |
| - Condensers | - LP & HP Knock-Out Drums | - Storage Tanks |
| - De-aerators | - Pipework | |

APPLICATION INFORMATION

Application Methods

Brush
Applicator

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/cm ³
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.

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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

Total Concentration

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:

Analyte	Total Concentration (ppm)
Fluoride	68
Chloride	300
Bromide	ND (<10)
Sulphur	57
Nitrite	ND (<7)
Nitrate	7
Zinc	5.4
Antimony, Arsenic, Bismuth, Cadmium, Lead, Tin, Silver, Mercury, Gallium and Indium	ND (<5.0)

ND : Not Detected

Leachable Concentration

The mixed **Belzona 1593** has been independently analysed for leachable concentrations of fluoride, chloride, bromide, sulphur and for nitrite and nitrate determination. The coating was exposed to a one-hour boiling leach in accordance with ASTM D4327-17. Typical results are displayed as follows:

Analyte	Leachable Concentration (ppm)	
	Ambient Cured	Post-Cured
Fluoride	<1	<1
Chloride	1	2
Bromide	ND (<2)	ND (<2)
Sulphur	3	3
Nitrite	4	ND (<8)
Nitrate	13	13

ND : Not Detected

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

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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

1.81x10 ⁵ psi / 1250 MPa	(68°F/20°C cure & test)
1.66x10 ⁵ psi / 1140 MPa	(212°F/100°C cure & 68°F/20°C test)
1.68x10 ⁵ psi / 1170 MPa	(320°F/160°C cure & 68°F/20°C test)
1.20x10 ⁵ psi / 830 MPa	(212°F/100°C cure & test)
0.99x10 ⁵ 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.

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

ELONGATION & TENSILE PROPERTIES

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

Tensile Strength

4,518 psi / 31.15 MPa	(68°F/20°C cure & test)
3,990 psi / 27.51 MPa	(212°F/100°C cure & 68°F/20°C test)
4,827 psi / 33.28 MPa	(320°F/160°C cure & 68°F/20°C test)
3,442 psi / 23.73 MPa	(212°F/100°C cure & test)
2,174 psi / 14.99 MPa	(320°F/160°C cure & test)

Elongation

0.43 %	(68°F/20°C cure & test)
0.44 %	(212°F/100°C cure & 68°F/20°C test)
0.52 %	(320°F/160°C cure & 68°F/20°C test)
0.59 %	(212°F/100°C cure & test)

Young's Modulus

1.12x10 ⁶ psi / 7,747 MPa	(68°F/20°C cure & test)
1.07x10 ⁶ psi / 7,400 MPa	(212°F/100°C cure & 68°F/20°C test)
1.06x10 ⁶ psi / 7,294 MPa	(320°F/160°C cure & 68°F/20°C test)
6.83x10 ⁵ psi / 4,709 MPa	(212°F/100°C cure & test)
2.06x10 ⁵ psi / 1,417 MPa	(320°F/160°C cure & test)

EXPLOSIVE DECOMPRESSION

No coating breakdown was exhibited upon inspecting after the following testing:

Explosive Decompression (NACE TM0185)		
	Test 1	Test 2
Test duration	21 days	21 days
Temperature	158°F (70°C)	248°F (120°C)
Pressure	3,000 psi (207 bar)	1,015 psi (70 bar)
Gas Phase	200 ppm H ₂ S, 1% CO ₂ , balance CH ₄	10% CO ₂ , 90% CH ₄
Hydrocarbon Phase	1:1 (toluene: kerosene)	Crude Oil
Aqueous Phase	Saltwater (ASTM D1141)	Saltwater (ASTM D1141)
Decompression Rate	58 psi/min (4 bar/min)	68 psi/min (4.7 bar/min)

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FLEXURAL PROPERTIES

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

Flexural Strength

7500 psi / 51.7 MPa	(68°F/20°C cure & test)
7810 psi / 53.8 MPa	(212°F/100°C cure & 68°F/20°C test)
6880 psi / 47.4 MPa	(320°F/160°C cure & 68°F/20°C test)
4600 psi / 31.7 MPa	(212°F/100°C cure & test)
4660 psi / 32.1 MPa	(320°F/160°C cure & test)

Flexural Modulus

8.99x10 ⁵ psi / 6200 MPa	(68°F/20°C cure & test)
8.42x10 ⁵ psi / 5810 MPa	(212°F/100°C cure & 68°F/20°C test)
9.15x10 ⁵ psi / 6310 MPa	(320°F/160°C cure & 68°F/20°C test)
5.19x10 ⁵ psi / 3580 MPa	(212°F/100°C cure & test)
4.31x10 ⁵ psi / 2970 MPa	(320°F/160°C cure & test)

HARDNESS

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

	68°F/20°C cure	212°F/100°C cure	320°F/160°C cure
Shore D	88	89	91
Barcol 934-1	37	50	55
Barcol 935	87	88	90

HEAT RESISTANCE

Heat Distortion & Glass Transition Temperature (HDT & T_g)

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

Cure temperature	HDT	T _g
68°F/20°C	120°F/49°C	127°F/53°C
212°F/100°C	334°F/168°C	291°F/144°C
284°F/140°C	448°F/231°C	347°F/175°C
320°F/160°C	453°F/234°C	383°F/195°C

Atlas Cell Cold Wall Immersion Test

When tested in accordance with NACE TM 0174 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 (log₁₀|Z|_{0.1Hz}) determined in accordance with ISO 16773 following Atlas cell testing at 320°F/160°C will be typically:

a) Unexposed:	11.0 Ω.cm ²
b) Liquid Phase:	10.8 Ω.cm ²
c) Vapor Phase:	10.5 Ω.cm ²

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 482°F (250°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:

Reverse		
Notched:	4.9 KJ/m ²	(68°F/20°C cure & test)
	3.2 KJ/m ²	(212°F/100°C cure & 68°F/20°C test)
	3.0 KJ/m ²	(320°F/160°C cure & 68°F/20°C test)
Un-notched:	5.7 KJ/m ²	(68°F/20°C cure & test)
	5.3 KJ/m ²	(212°F/100°C cure & 68°F/20°C test)
	3.8 KJ/m ²	(320°F/160°C cure & 68°F/20°C test)

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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 41°F (5°C) and 86°F (30°C).

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.

Temperature	25°C	100°C	200°C
Thermal conductivity (W/m.K)	0.6258	0.6773	0.6710

Specific Heat Capacity

Using DSC in accordance with ASTM E1269 the Specific heat capacity has been determined over a range of temperatures.

Temperature	25°C	100°C	200°C
Specific heat capacity (J/g.K)	1108	1299	1412

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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.

MANUFACTURER / SUPPLIER

Belzona Limited,
Claro Road, Harrogate,
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HEALTH AND SAFETY

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

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.

The technical data contained herein is based on the results of long term tests carried out in our laboratories and to the best of our knowledge is true and accurate on the date of publication. It is however subject to change without prior notice and the user should contact Belzona to verify the technical data is correct before specifying or ordering. No guarantee of accuracy is given or implied. We assume no responsibility for rates of coverage, performance or injury resulting from use. Liability, if any, is limited to the replacement of products. No other warranty or guarantee of any kind is made by Belzona, express or implied, whether statutory, by operation of law or otherwise, including merchantability or fitness for a particular purpose.

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