



DEPARTMENT OF THE ARMY  
U.S. ARMY CHEMICAL MATERIALS ACTIVITY  
PUEBLO CHEMICAL DEPOT, BUILDING 1  
45825 HIGHWAY 96 EAST  
PUEBLO, COLORADO 81006-9330

Colorado Department of Public Health and Environment  
Hazardous Materials and Waste Management Division  
Attention: Mr. Kevin Mackey  
4300 Cherry Creek Drive South  
Denver, Colorado 80246-1530

Chron20-00458

RE: PCAPP Permit Modification No. 290, Repair of Manways on 30-day Hydrolysate Storage Tanks, submittal

Dear Mr. Mackey:

The Permittees at Pueblo Chemical Agent-Destruction Pilot Plant (PCAPP) are submitting the enclosed Class 2 Permit Modification Request No. 290, Repair of Manways on 30-day Hydrolysate Storage Tanks, to the PCAPP Resource Conservation and Recovery Act (RCRA) Research, Development and Demonstration (RD&D) Permit, No. CO-04-07-01-01. This request requires prior Colorado Department of Public Health and Environment (CDPHE) approval. The modification proposes to include in the permit an optional repair method for the manways on the 30-Day Hydrolysate Storage Tanks.


In accordance with the CDPHE public notice of draft PCAPP RD&D permit renewal issued on September 8, 2017, PCAPP requests that this permit modification amend the draft PCAPP RD&D permit renewal application submitted to CDPHE on June 7, 2017.

For all technical matters, please contact Mr. Michael Saupe, Bechtel Pueblo Team Environmental Manager, at (719) 549-5455. For all matters related to the request, please contact Mr. Patrick Sullivan with the Assembled Chemical Weapons Alternatives staff at (719) 549-4523.

Sincerely,

 27 FEB 2020

Michael W. Cobb\*      Date  
Colonel, U.S. Army  
Commanding

 2/27/2020

K.E. Harrawood \*      Date  
Project Manager, Bechtel National, Inc.  
Bechtel Pueblo Team Project Manager

 20200227

Walton W. Levi \*      Date  
PCAPP Site Project Manager  
Pueblo Chemical Agent-Destruction Pilot Plant

Enclosure

CC:

Ms. Gail Wallingford-Ingo, Pueblo County Planning/Development, 229 West 12th Street,  
Pueblo, CO 81003-2810

Mr. Jesse Newland, US EPA Region 8, 1595 Wynkoop Street, Denver, CO 80202-1129

Mr. Walton W. Levi, PCAPP, 45825 Highway 96 East, Pueblo, CO 81006-9330

PCAPP Document Control Center, 45825 Highway 96 East, Pueblo, CO 81006-9330

Mr. Chris Pulskamp, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo, CO  
81006-9330

Mr. Trevor Klotz, Sentinel 650 South Cherry Street, Ste 1140, Denver, CO 80246

\*In accordance with 6 CCR 1007-3 Sections 100.12 and 100.42(k), I certify under penalty of law that, except as specifically noted, this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person(s) who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

## PCAPP Permit Modification Request

**Permit Number:** CO-04-07-01-01

**Permit Modification Request Title:** Repair of Manways on 30-day Hydrolysate Storage Tanks (Permit Modification 290)

**Classification:** Class 2 Permit Modification Request

### Description of Changes:

This permit modification request proposes to include in the permit an optional repair method for the manways on the 30-day Hydrolysate Storage Tanks. Although this method is only currently intended for a leaking manway on tank MT-B04-0301, the proposed changes are structured such that this method could be applied to any of the manways on any of the three 30-Day Hydrolysate Storage Tanks should this be desired in the future.

The proposed method uses a multi-purpose epoxy-based material manufactured by Belzona®. The Belzona® seal will encapsulate the mating surface of the cover flange and the nozzle flange and cover the perimeter of the back face of the nozzle flange (including the bolt materials). This would provide a fully covered area from the front of the cover to the back of the nozzle flange and encase the entirety of the manway, sealing any potential weep path from the mating surface of the cover flange or bolt holes.

Based on discussions with the manufacturer's technical representative, a combination of Belzona® products have been selected to seal and encapsulate a manway. After surface preparation and using a cleaner/degreaser to remove contaminants from the manway surfaces, a paste (Belzona® 1212) covers the suspect area, adheres to the surface, and seals that area to prevent further leaks. For the remaining areas (i.e., areas where an active leak is not suspected), as well as the entirety of the encapsulation, Belzona® 1111 is used. Lastly, Belzona® 1321 is applied in two coats over the entirety of the encapsulated area to ensure a good seal and the flange mating area is wrapped with a reinforcing cloth. The specification sheets for these three Belzona® products are provided in Enclosure 3.

The barrier material that will be in contact with the hydrolysate stored in this system is Belzona® 1212. Hydrolysate is mostly water with Thiodiglycol (TDG), sodium chloride (NaCl), and sodium sulfate (Na<sub>2</sub>SO<sub>4</sub>) salts making up the remainder. Before exiting the APB, sodium hydroxide (NaOH) is added to the hydrolysate to ensure a pH of 10 or greater. The Belzona® 1212 chemical resistance chart (ref: Enclosure 4) rates Belzona® 1212 "excellent" for use in contact with water, NaOH, NaCl, and Na<sub>2</sub>SO<sub>4</sub>. The excellent rating means Belzona 1212 showed "no significant deterioration/barrier properties retained for greater than 52 weeks, suitable for all applications including long term immersion." Although Belzona® 1212 was not tested by the manufacturer against TDG, it was tested against glycol and alcohols with similar molecular structure to TDG and was rated excellent.

Should entry into a tank by way of a manway repaired by the Belzona® seal be required (e.g., solids cleanout, visual inspection), the Belzona® material can be easily removed via grinding.

**Justification for Changes:**

Currently, when a manway associated with the 30-Day Hydrolysate Storage Tanks exhibits evidence of leaking, such as gasket weeping (through a bolt hole), it is designated as unavailable for filling and drained so that repairs (e.g., replacement of manway gaskets) can be subsequently performed. The Belzona® seal described herein can be applied without draining the tank and would therefore allow repair to be performed quickly to minimize the amount of time such a tank would be unavailable for filling.

Sealing the manway with the Belzona® products will fully contain any potential weep or leak path while providing a mechanically and chemically sound encapsulation of the nozzle. The Belzona® seal is chemically compatible as described above and provides a high mechanical strength. Consultation with the manufacturer's application engineer confirms that this seal is capable of maintaining its integrity under the range of head pressures that the tank experiences.

**Justification for Classification:**

Per 6 CCR 1007-3 Part 100.63 Appendix I (Item G.2), this permit modification is classified as a Class 2 modification (i.e., a modification of a tank unit without increasing the capacity of the unit).

**Enclosures:**

- Enclosure 1: Permit Change Page – List of Permit Modifications
- Enclosure 2: Permit Change Page – Part III: Storage and Treatment in Tanks and Miscellaneous Units, Page III-20
- Enclosure 3: Specification Sheets for Belzona® Products
- Enclosure 4: Belzona® 1212 Chemical Resistance Chart

## **Enclosure 1**

Permit Change Page – List of Permit Modifications

Modification #289 – Effective Date: February 13, 2020

Class 1 modification titled, “Relocate Drained Munitions Weigh Station (DMWS) Scale,” relocates the Munitions Treatment Unit (MTU) Drained Munitions Weigh Station (DMWS) scale to the top of each MTU at the existing mortar baseplate chutes. The munition cradle for each MTU is reconfigured to support vertical munition orientation placement by the robot.

[Modification #290 – Effective Date: XXXX, 2020](#)

[Class 2 modification titled “Repair of Manways on 30-day Hydrolysate Storage Tanks.” The request addresses the use of a multi-purpose epoxy-based seal manufactured by Belzona® \(or a Division-approved alternative\) for the repair of manways on these tanks.](#)

**Enclosure 2**

Permit Change Page –

Part III: Storage and Treatment in Tanks and Miscellaneous Units, Page III-20

- III.F.2.e. Potential deterioration of the tanks shall be monitored using a corrosion surveillance program. The requirements specified in the Corrosion Monitoring Plan for Resource Conservation and Recovery Act (RCRA) Tank Systems (24852-RD-30G-000-V0001) shall be followed for these tanks.
- III.F.2.f. If any tank's thickness is below the required tank safe design value (a value to be established per the Corrosion Monitoring Plan for Resource Conservation and Recovery Act (RCRA) Tank Systems (24852-RD-30G-000-V0001), the tank shall be considered unfit for use, and removed from service immediately, in accordance with Condition III.E of this Permit.
- III.F.2.g. If a tank system or component is found to be unfit for use as a result of the integrity assessment or any inspection, the Permittees shall comply with Condition III.G of this Permit and notify the Department, in accordance with Condition III.I of this Permit.

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Leaking manways may be repaired by a multi-purpose epoxy-based seal manufactured by Belzona® or by a Division-approved alternative. The Belzona® seal will encapsulate the mating surface of the cover flange and the nozzle flange and cover the perimeter of the back face of the nozzle flange (including the bolt materials). This seal may be installed on non-leaking manways as a preventative measure at the discretion of the Permittee.

- III.F.2.h. Ancillary Piping Associated with the 30-day Hydrolysate Storage Tanks (except piping for the truck loading station): The piping shall conform to the materials and dimensions detailed in permit drawings 24852-RD-M6-B04-M0016 through M0018. The above-ground ancillary piping will consist of carbon steel, welded, piping with a 1/8" corrosion allowance. The piping shall be inspected daily in accordance with the Inspection Plan, Attachment K of the Permit and will be insulated with a minimum of 1" thick mineral fiber in accordance with ASTM C 547, Type 1. The insulation will be non-absorptive and moisture proof.

For hydrolysate piping located outside of the APB and the 30-day Hydrolysate Tank secondary containment area, H<sub>2</sub>Oblvious™ leak detection devices, or a Division approved equal, shall be installed for each weld on the horizontal pipe runs and at the bottom of each vertical pipe run. The leak detection devices shall be installed in the insulation joints closest to each piping weld at a minimum frequency of one (1) leak detection device per 20 feet of horizontal piping or at the bottom of each vertical pipe run.



**Enclosure 3**

Specification Sheets for Belzona® Products

# PRODUCT SPECIFICATION SHEET

## BELZONA 1212

FN10174



### GENERAL INFORMATION

#### Product Description:

Two component, fast curing, surface tolerant repair paste used as an emergency repair and rebuild system for machinery and equipment. Ideal for use as a high strength structural bonding adhesive or for the creation of irregular load bearing shims.

#### Application Areas:

When mixed and applied as detailed in the Belzona Instructions for Use (IFU), the system is ideally suited for application to damp and oil contaminated surfaces. In addition, the material can be applied underwater.

### APPLICATION INFORMATION

#### Application Methods

Plastic applicator and spatula

#### Application Temperature

Application should ideally occur in the following ambient temperature range: 41°F/5°C to 104°F/40°C

#### Volume Capacity

The volume capacity of mixed material is 12.9 in<sup>3</sup> / 212 cm<sup>3</sup> per 450g unit.

#### Cure Time

Cure times will vary depending on the ambient conditions. At 68°F/20°C, and a thickness of 0.25 in / 6 mm, mechanical loading is possible after 90 minutes. Consult the Belzona IFU for specific details.

#### 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 9 minutes, consult the Belzona IFU for specific details

#### Base Component

Color: Black  
Form: Paste  
Density: 1.93 g/cm<sup>3</sup>  
Gel Strength (QH paddle): 127 g/cm

#### Solidifier Component

Color: Light Grey  
Form: Paste  
Density: 2.32 g/cm<sup>3</sup>  
Gel Strength (QH paddle): 182 g/cm

#### Mixed Properties

Mixing Ratio by Weight (Base : Solidifier) 5 : 6  
Mixing Ratio by Volume (Base : Solidifier) 1 : 1  
Color: Grey  
Mixed Form: Paste  
Mixed Density: 2.12 g/cm<sup>3</sup>  
Slump Resistance: >0.5 in / >12.7 mm  
VOC (ASTM D2369): 0.06 % / 1.29 g/L

*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 1212

FN10174



ABRASION	
<b>Taber</b> When determined in accordance with ASTM D4060 the sliding Taber abrasion resistance will be:	
<b>Dry</b> (CS17 Wheels) 54 mm <sup>3</sup> loss per 1000 cycles	(7 day cure at 68°F/20°C)
<b>Wet</b> (H10 Wheels) 1061 mm <sup>3</sup> loss per 1000 cycles	(7 day cure at 68°F/20°C)

ADHESION		
<b>Cleavage Adhesion</b> The Cleavage Adhesion on mild steel substrates, as determined in accordance with ASTM D1062, following a 7 day cure at 68°F/20°C, will typically be:		
	<b>Cleavage Adhesion</b>	<b>Failure Mode</b>
Grit Blasted (SSPC-SP10) (ISO 8501-1 Sa2.5)	1680 pli / 295 N/mm	Cohesive
Ground (SSPC-SP11) (ISO 8501-1 St3)	1620 pli / 285 N/mm	Cohesive
<b>Pull Off Adhesion</b> The PosiTest Dolly Pull Off Strength on 10mm thick mild steel, as determined in accordance with ASTM D4541 and ISO 4624, following a 7 day cure at 68°F/20°C, will typically be:		
<b>Grit Blasted (SSPC-SP10) (ISO 8501-1 Sa2.5)</b>	<b>Pull Off Adhesion</b>	
Clean & Dry	4220 psi / 29.1 MPa	
Transformer Oil	4635 psi / 32.0 MPa	
Wet	4665 psi / 32.2 MPa	
Underwater	1925 psi / 13.3 MPa	
<b>Ground (SSPC-SP11) (ISO 8501-1 St3)</b>	<b>Pull Off Adhesion</b>	
Clean & Dry	4365 psi / 30.1 MPa	
Transformer Oil	4105 psi / 28.3 MPa	
Diesel	4430 psi / 30.6 MPa	
Gearbox Oil	1880 psi / 13.0 MPa	
Crude Oil	2670 psi / 18.4 MPa	
Hydraulic Oil	3585 psi / 24.7 MPa	
Fully Synthetic Motor Oil	3260 psi / 22.5 MPa	
Wet	4100 psi / 28.3 MPa	
Underwater	2500 psi / 17.2 MPa	

ADHESION		
<b>Pull Off Adhesion</b> The PosiTest Dolly Pull Off Strength on Lead sheet, 6 mm glass and 10 mm thick glass reinforced epoxy (G.R.E), as determined in accordance with ASTM D4541 and ISO 4624, following a 7 day cure at 68°F/20°C, will typically be:		
<b>Substrate</b>	<b>Surface Preparation</b>	<b>Pull Off Adhesion</b>
Lead	Roughing brush	1500 psi / 10.3 MPa
Glass	Solvent clean	1005 psi / 6.9 MPa *
Glass Reinforced Epoxy (G.R.E)	Frost blast	1580 psi / 10.9 MPa **
	Ground	1500 psi / 10.4 MPa **
*Cohesive failure of glass substrate **Cohesive failure of G.R.E substrate		
<b>Tensile Shear Adhesion</b> The Tensile Shear Adhesion on mild steel substrates, as determined in accordance with ASTM D1002, following a 7 day cure at 68°F/20°C, will typically be:		
<b>Substrate</b>	<b>Grit Blasted (SSPC-SP10) (ISO 8501-1 Sa2.5)</b>	<b>Ground (SSPC-SP11) (ISO 8501-1 St3)</b>
Clean & Dry	2615 psi / 18.0 MPa	2575 psi / 17.8 MPa
Transformer Oil	2920 psi / 20.1 MPa	2615 psi / 18.0 MPa
Wet	2170 psi / 15.0 MPa	1970 psi / 13.6 MPa
Underwater	2000 psi / 13.8 MPa	1915 psi / 13.2 MPa
The Tensile Shear Adhesion on various metal substrates, as determined in accordance with ASTM D1002, following a 7 day cure at 68°F/20°C, will typically be:		
<b>Substrate</b>	<b>Grit Blasted (SSPC-SP10) (ISO 8501-1 Sa2.5)</b>	<b>Ground (SSPC-SP11) (ISO 8501-1 St3)</b>
Aluminum	1400 psi / 9.7 MPa	1440 psi / 9.9 MPa
Brass	2235 psi / 14.8 MPa	1450 psi / 9.4 MPa
Copper	1855 psi / 12.8 MPa	1825 psi / 12.6 MPa
Stainless Steel	2540 psi / 16.5 MPa	1665 psi / 10.5 MPa
Lead		270 psi / 1.9 MPa **
**Preparation with a roughing brush and Tensile failure of Lead		

# PRODUCT SPECIFICATION SHEET

## BELZONA 1212

FN10174



### CHEMICAL ANALYSIS

The mixed **Belzona 1212** has been independently analyzed 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	110
Chloride	552
Bromide	ND (<10)
Sulfur	157
Nitrite	ND (<7)
Nitrate	5
Zinc	11.5
Antimony	19.1
Tin	5.7
Arsenic, Bismuth, Cadmium, Lead, Silver, Mercury, Gallium and Indium	ND (<5.0)

ND : Not Detected

### MECHANICAL PROPERTIES

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

<b>Compressive Strength (Maximum)</b>	
10935 psi / 75.4 MPa	(24 hour cure at 68°F/20°C)
12375 psi / 85.4 MPa	(7 day cure at 68°F/20°C)
14070 psi / 97.0 MPa	(24 hour post cure at 194°F/90°C)
15230 psi / 105.0 MPa	(7 day post cure at 194°F/90°C)
<b>Compressive Strength (Yield)</b>	
8590 psi / 59.2 MPa	(24 hour cure at 68°F/20°C)
10010 psi / 69.0 MPa	(7 day cure at 68°F/20°C)
10405 psi / 71.8 MPa	(24 hour post cure at 194°F/90°C)
10955 psi / 75.5 MPa	(7 day post cure at 194°F/90°C)
<b>Compressive Modulus</b>	
1.61 x 10 <sup>5</sup> psi / 1113 MPa	(24 hour cure at 68°F/20°C)
1.73 x 10 <sup>5</sup> psi / 1192 MPa	(7 day cure at 68°F/20°C)
1.78 x 10 <sup>5</sup> psi / 1229 MPa	(24 hour post cure at 194°F/90°C)
1.69 x 10 <sup>5</sup> psi / 1165 MPa	(7 day post cure at 194°F/90°C)

### CORROSION RESISTANCE

#### Salt Spray

When tested in accordance with ASTM B117, the material shows no visible signs of corrosion after 12 months continuous exposure.

### ELONGATION & TENSILE PROPERTIES

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

<b>Tensile Strength (Maximum)</b>	
3625 psi / 25.0 MPa	(24 hour cure at 68°F/20°C)
3905 psi / 26.9 MPa	(7 day cure at 68°F/20°C)
5085 psi / 35.1 MPa	(7 day post cure at 194°F/90°C)
<b>Tensile Strength (Yield)</b>	
1825 psi / 12.6 MPa	(24 hour cure at 68°F/20°C)
2495 psi / 17.2 MPa	(7 day cure at 68°F/20°C)
3175 psi / 21.9 MPa	(7 day post cure at 194°F/90°C)
<b>Elongation</b>	
0.67 %	(24 hour cure at 68°F/20°C)
0.60 %	(7 day cure at 68°F/20°C)
0.76 %	(7 day post cure at 194°F/90°C)
<b>Young's Modulus</b>	
7.48 x 10 <sup>5</sup> psi / 5156 MPa	(24 hour cure at 68°F/20°C)
7.25 x 10 <sup>5</sup> psi / 5003 MPa	(7 day cure at 68°F/20°C)
7.45 x 10 <sup>5</sup> psi / 5135 MPa	(7 day post cure at 194°F/90°C)

### MECHANICAL PROPERTIES

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

<b>Flexural Strength (Maximum)</b>	
8905 psi / 61.4 MPa	(24 hour cure at 68°F/20°C)
9790 psi / 67.5 MPa	(7 day cure at 68°F/20°C)
11215 psi / 83.0 MPa	(7 day post cure at 194°F/90°C)
<b>Flexural Strength (Yield)</b>	
5160 psi / 35.6 MPa	(24 hour cure at 68°F/20°C)
6285 psi / 43.4 MPa	(7 day cure at 68°F/20°C)
7375 psi / 50.9 MPa	(7 day post cure at 194°F/90°C)
<b>Flexural Modulus</b>	
6.69 x 10 <sup>5</sup> psi / 4612 MPa	(24 hour cure at 68°F/20°C)
7.41 x 10 <sup>5</sup> psi / 5109 MPa	(7 day cure at 68°F/20°C)
7.97 x 10 <sup>5</sup> psi / 5469 MPa	(7 day post cure at 194°F/90°C)

### HARDNESS

The Shore D and Barcol hardness, when determined in accordance with ASTM D2240 and ASTM D2583 (Model No 935) respectively, will typically be:

	Shore D	Barcol
24 hour cure at 68°F/20°C	82	81
7 day cure at 68°F/20°C	84	82
7 day post cure at 194°F/90°C	86	83

# PRODUCT SPECIFICATION SHEET

## BELZONA 1212

FN10174



**HEAT RESISTANCE**

**Heat Distortion (HDT)**  
The HDT when determined in accordance with ASTM D648, will typically be:

Cure	HDT
24hrs at 68°F/20°C	111°F/44°C
7 days at 68°F/20°C	120°F/49°C
24 hour post cure at 194°F/90°C	147°F/64°C
7 day post cure at 194°F/90°C	153°F/67°C

**Dry Heat Resistance**  
The indicated degradation temperature in air based on Differential Scanning Calorimetry (DSC) operated in accordance with ISO11357 is typically 392°F (200°C)  
For many applications the product is suitable down to -40°F (-40°C).

**수도용**

**KC**  
Listed in Barrier Materials as epoxy resin-based waterproof and anticorrosion material, which has passed full test of sanitation and safety.

Separate base and solidifier components shall have a shelf life of 5 years from date of manufacture when stored in their original unopened containers between 32°F (0°C) and 86°F (30°C).

**IMPACT**

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

Notched:	4.17 KJ/m <sup>2</sup>	(7 day cure at 68°F/20°C)
	4.76 KJ/m <sup>2</sup>	(7 day post cure at 194°F/90°C)
Un-notched:	5.07 KJ/m <sup>2</sup>	(7 day cure at 68°F/20°C)
	5.07 KJ/m <sup>2</sup>	(7 day post cure at 194°F/90°C)

# PRODUCT SPECIFICATION SHEET

## BELZONA 1212

FN10174



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.

**Belzona 1212** will be 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.

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

Belzona Inc.  
14300 NW 60<sup>th</sup> Ave,  
Miami Lakes, FL, 33014, USA

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

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.

Nothing in the foregoing statement shall exclude or limit any liability of Belzona to the extent such liability cannot by law be excluded or limited.

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*Belzona products are  
manufactured under an  
ISO 9001 Registered  
Quality Management System*



# PRODUCT SPECIFICATION SHEET

## BELZONA 1111

FN10132



### GENERAL INFORMATION

**Product Description:**

A two component paste grade system for repairing and rebuilding machinery and equipment. Based on a silicon steel alloy blended with high molecular weight reactive polymers and oligomers. When cured, the material is durable yet fully machinable. Also used as a high strength structural adhesive for bonding or for creation of irregular load bearing shims with good electrical insulation characteristics. For use in Original Equipment Manufacture or repair situations.

**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:

- Shafts
- Keyways
- Pipes
- Hydraulic rams
- Engine blocks
- Tanks
- Bearing housings
- Casings
- Flange faces

### APPLICATION INFORMATION

**Working Life**

Will vary according to temperature. At 77°F (25°C) the usable life of mixed material is 15 minutes.

**Cure Time**

Cure times will vary depending on the ambient conditions and will be reduced for thicker sections and extended for thinner applications. Consult the Belzona IFU for specific details.

**Volume Capacity**

24.3 in<sup>3</sup> (398 cm<sup>3</sup>)/kg.

**Base Component**

Appearance	Paste
Color	Dark gray
Gel strength at 77°F (25°C)	>150 g/cm HF
Density	2.70 - 2.90 g/cm <sup>3</sup>

**Solidifier Component**

Appearance	Paste
Color	Light gray
Gel strength at 77°F (25°C)	40 - 150 g/cm QV
Density	1.64 - 1.70 g/cm <sup>3</sup>

**Mixed Properties**

Mixing Ratio by Weight (Base : Solidifier)	5 : 1
Mixing Ratio by Volume (Base : Solidifier)	3 : 1
Mixed Form	Paste
Peak Exotherm Temperature	203 - 232°F (95 - 111°C)
Time to Peak Exotherm	33 - 41 mins.
Slump Resistance	nil at 0.5 inch (1.27 cm)
Mixed Density	2.41-2.61 g/cm <sup>3</sup>

*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 1111

FN10132



### ABRASION

#### Taber

The Taber abrasion resistance determined in accordance with ASTM D4060 with 1 kg load is typically:

H10 Wheels (Wet)	852 mm <sup>3</sup> loss per 1000 cycles
CS17 Wheels (Dry)	24 mm <sup>3</sup> loss per 1000 cycles

### ADHESION

#### Tensile Shear

When tested in accordance with ASTM D1002, using degreased strips, grit blasted to a 3-4 mil profile, typical values will be:

Mild steel	2,790 psi (19.2 MPa)
Brass	1,650 psi (11.4 MPa)
Copper	2,060 psi (14.2 MPa)
Stainless steel	2,960 psi (20.4 MPa)
Aluminium	1,950 psi (13.4 MPa)

#### Tensile fatigue

The Tensile fatigue in accordance with ASTM D3166 at ambient temperature and 653 psi (4.5 MPa) applied static tensile stress is >1,000,000 cycles

#### Pull Off Adhesion

When tested in accordance with ASTM D 4541/ ISO 4624, the pull off strength from grit blasted steel will be typically:

3240 psi (22.3 MPa)	68°F (20°C) cure
2980 psi (20.5 MPa)	212°F (100°C) cure

#### Cleavage strength

When tested in accordance with ASTM D 1062, the cleavage strength to grit blasted steel will be typically:

1199 pli	68°F (20°C) cure
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### CHEMICAL ANALYSES

The mixed **Belzona 1111** has been independently analyzed 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	224
Chloride	398
Bromide	ND (<12)
Sulfur	1019
Nitrite	ND (<6)
Nitrate	4
Zinc	3.4
Antimony, Arsenic, Bismuth, Cadmium, Lead, Tin, Silver, Mercury, Gallium and Indium	ND (<3.0)

ND : Not Detected

### CHEMICAL RESISTANCE

Once fully cured, the material will demonstrate excellent resistance to most commonly found inorganic acids and alkalis at concentrations up to 20%. The material is also resistant to hydro-carbons, mineral oils, lubricating oils and many other commonly found chemicals.

\* For a more detailed description of chemical resistance properties, refer to relevant Chemical Resistance chart.

### COMPRESSIVE PROPERTIES

When determined in accordance with ASTM D695 (1.0in/25.4mm thick test pieces), typical values will be:

	Cure temperature
<b>Compressive Strength (Maximum)</b>	
12525 psi (86.4 MPa)	68°F (20°C)
16645 psi (114.8 MPa)	212°F (100°C)
<b>Compressive Strength (Yield)</b>	
9620 psi (66.3 MPa)	68°F (20°C)
10955 psi (75.6 MPa)	212°F (100°C)
<b>Compressive Modulus</b>	
1.77 x 10 <sup>5</sup> psi (1217 MPa)	68°F (20°C)
1.75 x 10 <sup>5</sup> psi (1205 MPa)	212°F (100°C)

When determined using a modified version of ASTM D695, at thickness more representative of in service application, typical values will be:

Thickness	Compressive Strength (Yield)	Cure Temperature
0.24 in (6.0 mm)	13095 psi (90.3 MPa)	68°F (20°C)
	16450 psi (113.4 MPa)	212°F (100°C)
0.12 in (3.0 mm)	14855 psi (102.5 MPa)	68°F (20°C)
	18980 psi (130.9 MPa)	212°F (100°C)

Bonded to grit blasted mild steel (single side)

Thickness	Compressive Strength (Yield)	Cure Temperature
0.12 in (3.0 mm)	19910 psi (137.3 MPa)	68°F (20°C)
	23840 psi (164.4 MPa)	212°F (100°C)

### CORROSION PROTECTION

#### Corrosion Resistance

Will show no visible signs of corrosion after 5,000 hours exposure in the ASTM B117 salt spray cabinet.



# PRODUCT SPECIFICATION SHEET

## BELZONA 1111

FN10132



### ELECTRICAL PROPERTIES

**Dielectric Constant (Relative Permittivity)**

Tested to ASTM D150 is typically 8.0 when tested at 1V & 10 kHz.

**Dielectric Strength**

Tested to ASTM D149 is typically 2.2 kV/mm when tested at 2000V/s.

**Dissipation Factor (Tan Delta/Dielectric Loss)**

Tested to ASTM D150 is typically 0.09 when tested at 1V & 10 kHz.

**Surface Resistivity**

Tested to ASTM D257 is typically  $2.28 \times 10^{10}$  Mohm when tested at 500V for 1 minute.

**Volume Resistivity**

Tested to ASTM D257 is typically  $2.6 \times 10^9$  Mohm mm when tested at 500V for 1 minute.

### ELONGATION & TENSILE PROPERTIES

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

<b>Tensile Strength</b>	<b>Cure temperature</b>
4975 psi / 34.3 MPa	68°F (20°C)
6686 psi / 46.1 MPa	212°F (100°C)
<b>Elongation</b>	
0.49 %	68°F (20°C)
0.58 %	212°F (100°C)
<b>Young's Modulus</b>	
$12.6 \times 10^5$ psi / 8681 MPa	68°F (20°C)
$12.3 \times 10^5$ psi / 8468 MPa	212°F (100°C)

### Mechanical Properties

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

<b>Flexural Strength</b>	<b>Cure temperature</b>
9,140 psi (63.0 MPa)	68°F (20°C)
11,820 psi (81.5 MPa)	212°F (100°C)
<b>Flexural Modulus</b>	<b>Cure temperature</b>
$10.44 \times 10^5$ psi (7199 MPa)	68°F (20°C)
$10.15 \times 10^5$ psi (6995 MPa)	212°F (100°C)

### FOOD CONTACT

**Incidental Food Contact (USDA)**

USDA compliant as an Incidental food contact surface

**Direct Food Contact (FDA)**

Meets extraction requirements as set out in 21 CFR 175.300 (paragraph c) for a broad range of food types in Conditions of Use D, E and F (paragraph d). Please contact Belzona for more comprehensive data.

### HARDNESS

**Shore D**

When determined in accordance with ASTM D2240, typical value will be:  
84

**Barcol**

When determined in accordance with ASTM D2583, using Model No.935, typical values will be:

	<b>Cure temperature</b>
85	68°F (20°C)
92	212°F (100°C)

### HEAT RESISTANCE

**Heat Distortion Temperature (HDT)**

Tested to ASTM D648 (264 psi fiber stress), typical values obtained will be:

	<b>Cure temperature</b>
127°F (53°C)	68°F (20°C)
195°F (91°C)	212°F (100°C)

**Dry Heat Resistance**

The indicated degradation temperature in air based on Differential Scanning Calorimetry (DSC) operated in accordance with ISO11357 is typically 392°F (200°C). For many applications the product is suitable down to -40°F (-40°C).

### IMPACT RESISTANCE

**Impact Strength**

The impact strength (reverse notched) when tested to ASTM D256 is typically:

	<b>Cure temperature</b>
0.69 ft.lb./in., 37 J/m	68°F (20°C)
0.73 ft.lb./in., 39 J/m	212°F (100°C)

# PRODUCT SPECIFICATION SHEET

## BELZONA 1111

FN10132



### POTABLE WATER FITTINGS

#### KC

Listed in Barrier Materials as epoxy resin-based waterproof and anticorrosion material, which has passed full test of sanitation and safety.



#### WRAS

Listed in the UK Water Fittings Directory under "Materials which have passed full tests of effect on water quality".



#### NSF/ANSI 61

Tested and certified by WQA against NSF/ANSI 61. For product use restrictions visit [www.wqa.org](http://www.wqa.org)



### SHelf LIFE

Separate base and solidifier components shall have a shelf life of 5 years from date of manufacture when stored in their original unopened containers between 32°F (0°C) and 86°F (30°C).

### INTERNATIONAL RECOGNITION

The material has received recognition from organizations worldwide including:

- AMERICAN BUREAU OF SHIPPING
- U.S.D.A.
- RUSSIAN REGISTER OF SHIPPING
- KOREAN REGISTER OF SHIPPING
- CHINA CLASSIFICATION SOCIETY
- LLOYDS REGISTER
- UK WRAS
- BUREAU VERITAS
- NSF/ANSI 61
- KOREAN WATER AND WASTEWATER WORKS ASSOCIATION

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.

**Belzona 1111** 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.

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

Belzona Inc.  
14300 NW 60th Ave,  
Miami Lakes, FL, 33014, USA

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

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.

*Belzona products are manufactured under an ISO 9001 Registered Quality Management System*

Nothing in the foregoing statement shall exclude or limit any liability of Belzona to the extent such liability cannot by law be excluded or limited.

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# PRODUCT SPECIFICATION SHEET

## BELZONA 1321

FN10026



### GENERAL INFORMATION

**Product Description:**

A two component coating system designed to operate under continuous immersion at operating temperatures up to 140°F (60°C). Exhibits excellent erosion-corrosion resistance. Resistant to a broad range of aqueous solutions, hydrocarbons and process chemicals. Also used as a high strength structural adhesive for bonding or for creation of irregular load bearing shims with good electrical insulation characteristics. For use in Original Equipment Manufacture or repair situations.

**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:

- Centrifugal and turbine pumps
  - Propellers
  - Pipe elbows
- = Heat exchangers, water box ends, division bars and tube sheets
- Butterfly and gate valves
  - Kort nozzles
  - T-pieces

### APPLICATION INFORMATION

**Working Life**

Will vary according to temperature. At 77°F (25°C) the usable life of mixed material is 30 minutes.

**Cure Time**

Allow to solidify for the times shown in the Belzona IFU before subjecting it to the conditions indicated.

**Volume Capacity**

25.7 cu. in. (422 cm<sup>3</sup>)/kg.

**Coverage rate**

**Belzona 1321** should be applied as a two coat system at a recommended average thickness of 15 mil (375 μm) per coat.

At the minimum recommended two coat system thickness of 24 mil (600 μm), the theoretical coverage rate will be 7.6 ft<sup>2</sup> (0.71m<sup>2</sup>)/kg.

**Base Component**

Appearance	Paste
Color	Gray
Density	2.60 - 2.80 g/cm <sup>3</sup>

**Solidifier Component**

Appearance	Liquid
Color	Blue or Violet
Density	1.03 - 1.09 g/cm <sup>3</sup>

**Mixed Properties**

Mixing Ratio by Weight (Base : Solidifier)	11 : 1
Mixing Ratio by Volume (Base : Solidifier)	4 : 1
Mixed Form	Liquid
Peak Exotherm Temperature	158 - 185°F (70 - 85°C)
Time to Peak Exotherm	53 - 63 mins.
Sag Resistance	nil at 25 mil (625 microns)
Mixed Density	2.32 - 2.42 g/cm <sup>3</sup>
VOC content (ASTM D2369 / EPA ref. 24)	0.74% / 17.6 g/L

*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 1321

FN10026



### ABRASION

#### Taber

The Taber abrasion resistance determined in accordance with ASTM D4060 with 1 kg load is typically:

H10 Wheels (Wet)	178 mm <sup>3</sup> loss per 1000 cycles
CS17 Wheels (Dry)	14 mm <sup>3</sup> loss per 1000 cycles

### ADHESION

#### Tensile Shear

When tested in accordance with ASTM D1002, using degreased strips, grit blasted to a 3-4 mil profile, typical values will be:

Mild steel	2,710 psi (18.68 MPa)
Copper	3,050 psi (21.03 MPa)
Stainless steel	3,180 psi (21.92 MPa)
Aluminium	2,090 psi (14.41 MPa)

#### Tensile Fatigue

The Tensile fatigue in accordance with ASTM D3166 at ambient temperature and 595 psi (41 MPa) applied static tensile stress is >1,000,000 cycles

#### Pull Off Adhesion

When tested in accordance with ASTM D 4541/ ISO 4624, the pull off strength from grit blasted steel will be typically:

6330 psi (43.64 MPa)	68°F (20°C) cure
6290 psi (43.37 MPa)	212°F (100°C) cure

#### Cleavage strength

When tested in accordance with ASTM D 1062, the cleavage strength to grit blasted steel will be typically:

1634 pli	68°F (20°C) cure
----------	------------------

### CHEMICAL RESISTANCE

Once fully cured, the material will demonstrate excellent resistance to most commonly found inorganic acids and alkalis at concentrations up to 20%.

The material is also resistant to hydro-carbons, mineral oils, lubricating oils and many other commonly found chemicals.

\* For a more detailed description of chemical resistance properties, refer to relevant Chemical Resistance chart.

### COMPRESSIVE PROPERTIES

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

<b>Compressive Strength</b> 12,500 psi (86.18 MPa)	68°F (20°C) cure
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### CORROSION PROTECTION

#### Corrosion Resistance

Once fully cured, will show no visible signs of corrosion after 5,000 hours exposure in the ASTM B117 salt spray cabinet.

### ELONGATION & TENSILE PROPERTIES

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

<b>Elongation</b> 0.5%	68°F (20°C) cure
<b>Tensile Strength</b> 3703 psi (25.54 MPa)	68°F (20°C) cure
<b>Young's Modulus:</b> 7.76x10 <sup>5</sup> psi (5352 MPa)	68°F (20°C) cure

### FLEXURAL PROPERTIES

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

<b>Flexural Strength</b> 9,400 psi (64.81 MPa)	68°F (20°C) cure
<b>Flexural Modulus</b> 7.70 x 10 <sup>5</sup> psi (5309 MPa)	68°F (20°C) cure

### HARDNESS

#### Shore D

When determined in accordance with ASTM D2240, typical values will be:

84	68°F (20°C) cure
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#### Barcol

When determined in accordance with ASTM D2583, will typically be:

87	68°F (20°C) cure
92	212°F (100°C) cure

# PRODUCT SPECIFICATION SHEET

## BELZONA 1321

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### HEAT RESISTANCE

#### Heat Distortion Temperature (HDT)

Tested to ASTM D648 (264 psi fiber stress), typical values obtained will be:

118°F (48°C)	68°F (20°C) cure
189°F (87°C)	212°F (100°C) cure

#### 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).

For many applications the product is suitable down to -40°F (-40°C).

#### Wet Heat Resistance

Designed to operate under continuous immersion at operating temperatures up to 140°F (60°C). Suitable for steaming out up to 410°F (210°C).

### IMPACT RESISTANCE

#### Impact Strength

The impact strength (reverse notched) when tested to ASTM D256 is typically:

43 J/m or 2.77 kJ/m <sup>2</sup>	68°F (20°C) cure
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### SHELF LIFE

Separate base and solidifier components shall have a shelf life of 5 years from date of manufacture when stored in their original unopened containers between 32°F (0°C) and 86°F (30°C).

### APPROVALS/ADEPTANCES

The material has received recognition from organizations worldwide including:

- U.S.D.A.
- ABS
- BUREAU VERITAS
- LLOYDS REGISTER
- NATO
- YORK INTERNATIONAL
- UK WRAS

# PRODUCT SPECIFICATION SHEET

## BELZONA 1321

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### Product Guarantee

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

**Belzona 1321** 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.

Belzona Polymerics Ltd  
Claro Road, Harrogate,  
HG1 4DS, UK

Belzona Inc.  
14300 NW 60<sup>th</sup> Ave,  
Miami Lakes, FL, 33014, USA

### Warnings

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

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.

Nothing in the foregoing statement shall exclude or limit any liability of Belzona to the extent such liability cannot by law be excluded or limited.

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*Belzona products are  
manufactured under an  
ISO 9001 Registered  
Quality Management System*



**Enclosure 4**

Belzona® 1212 Chemical Resistance Chart

# CHEMICAL RESISTANCE OF BELZONA® 1212

FN 10174



	Chemical name (Synonym)	Chemical formula (CAS number)	Concentration	20 °C 68 °F	Other
Inorganic Acids	Hydrochloric acid	HCl (647-01-0)	10%	<b>P</b>	-
			5%	<b>M</b>	-
			1%	<b>M</b>	-
	Nitric acid	HNO <sub>3</sub> (7697-37-2)	10%	<b>P</b>	-
			5%	<b>M</b>	-
	Phosphoric acid (orthophosphoric acid)	H <sub>3</sub> PO <sub>4</sub> (7664-38-2)	10%	<b>P</b>	-
5%			<b>P</b>	-	
Sulfuric acid	H <sub>2</sub> SO <sub>4</sub> (7664-93-9)	10%	<b>P</b>	-	
		5%	<b>P</b>	-	
		1%	<b>M</b>	-	
Organic Acids	Acetic acid (ethanoic acid)	CH <sub>3</sub> COOH (64-19-7)	5%	<b>P</b>	-
	Formic acid (methanoic acid)	HCOOH (64-18-6)	1%	<b>P</b>	-
	Phenol (hydroxybenzene)	C <sub>6</sub> H <sub>5</sub> OH (108-95-2)	-	<b>P</b>	-
Alcohols, Aldehydes and Ketones	Acetone	(CH <sub>3</sub> ) <sub>2</sub> CO (67-64-1)	-	<b>M</b>	-
	Amyl alcohol (1-Pentanol)	C <sub>5</sub> H <sub>11</sub> OH (71-41-0)	-	<b>Ex</b>	-
	n-Butanol (butyl alcohol)	C <sub>4</sub> H <sub>9</sub> OH (71-36-3)	-	<b>Ex</b>	-
	Ethanol (ethyl alcohol)	CH <sub>3</sub> CH <sub>2</sub> OH (64-17-5)	-	<b>Ex</b>	-
	Ethylene glycol (ethan-1,2-diol, monoethylene glycol, MEG)	(CH <sub>2</sub> OH) <sub>2</sub> (107-21-1)	-	<b>Ex</b>	-
	Glycerol (glycerine, propane-1,2,3-triol)	HOCH <sub>2</sub> CH(OH)CH <sub>2</sub> OH (56-81-5)	-	<b>Ex</b>	-
	Isopropyl alcohol (IPA) (isopropanol, propan-2-ol)	CH <sub>3</sub> CH(OH)CH <sub>3</sub> (67-63-0)	-	<b>Ex</b>	-
	Methanol (methyl alcohol)	CH <sub>3</sub> OH (67-56-1)	-	<b>M</b>	-
	Methyl ethyl ketone (MEK, butanone)	CH <sub>3</sub> C(O)CH <sub>2</sub> CH <sub>3</sub> (78-93-3)	-	<b>M</b>	-
	Propan-1-ol (Propyl alcohol)	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH (71-23-8)	-	<b>Ex</b>	-

<b>Excellent</b>	<b>Ex</b>	no significant deterioration / barrier properties retained for greater than 52 weeks <i>suitable for all applications including long term immersion</i>
<b>Good</b>	<b>G</b>	no significant deterioration / barrier properties retained for 12 - 52 weeks <i>suitable for short-term immersion and general chemical contact</i>
<b>Moderate</b>	<b>M</b>	no significant deterioration / barrier properties retained for 1 - 12 weeks <i>suitable for applications involving short term chemical contact e.g. spillage, splashing or secondary containment</i>
<b>Poor</b>	<b>P</b>	significant deterioration / loss of barrier properties after 1 week or less <i>not suitable for any application</i>
<b>Ex</b>		<b>Bold text highlights real life data obtained via chemical resistance testing</b>
<b>Ex</b>		Normal font indicates that the resistance has been predicted based upon partial test data and/or similar reagents



# CHEMICAL RESISTANCE OF BELZONA® 1212

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	Chemical name (Synonym)	Chemical formula (CAS number)	Concentration	20 °C 68 °F	Other
Alkalis/Bases	Ammonia	NH <sub>3</sub> (7664-41-7)	25%	Ex	-
	Barium hydroxide	Ba(OH) <sub>2</sub> (17194-00-2)	-	Ex	-
	Calcium hydroxide (lime water)	Ca(OH) <sub>2</sub> (1305-62-0)	-	Ex	-
	Magnesium hydroxide (milk of magnesia)	Mg(OH) <sub>2</sub> (1309-42-8)	-	Ex	-
	Potassium hydroxide (caustic potash)	KOH (1310-58-3)	40% 20%	Ex Ex	-
	Sodium hydroxide (caustic soda)	NaOH (1310-73-2)	50% 40% 20% 10%	Ex Ex Ex Ex	-
Amines and Amides	Diethanolamine (DEA) (2,2'-iminodiethanol)	HN(CH <sub>2</sub> CH <sub>2</sub> OH) <sub>2</sub> (111-42-2)	-	Ex	-
	Diethylene glycolamine (DGA) (2-(2-aminoethoxy) ethanol)	H <sub>2</sub> NCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>2</sub> OH (929-06-6)	-	M	-
	N-Methyl diethanolamine (MDEA)	CH <sub>3</sub> N(CH <sub>2</sub> CH <sub>2</sub> OH) <sub>2</sub> 105-59-9	-	G	-
	Monoethanolamine (MEA) (2-aminoethanol)	H <sub>2</sub> NCH <sub>2</sub> CH <sub>2</sub> OH (141-43-5)	-	M	-
	Sulfanol solution (50% diisopropanolamine, 25% tetramethylene sulfone, 25% water)	N/A	-	G	-
Gases	Carbon dioxide (dry)	CO <sub>2</sub> (124-38-9)	-	Ex	-
	Carbon monoxide	CO (630-08-0)	-	Ex	-
	Hydrogen	H <sub>2</sub> (1333-74-0)	-	Ex	-
	Nitrogen	N <sub>2</sub> (7727-37-9)	-	Ex	-
Halocarbons	Carbon tetrachloride	CCl <sub>4</sub> (56-23-5)	-	P	-
	Chlorobenzene (benzene chloride, phenyl chloride)	C <sub>6</sub> H <sub>5</sub> Cl (108-90-7)	-	P	-
	Chloroform (trichloromethane)	HCCL <sub>3</sub> (67-66-3)	-	P	-
	Dichloromethane (DCM) (methylene chloride)	CH <sub>2</sub> Cl <sub>2</sub> (75-09-2)	-	P	-

Excellent	Ex	no significant deterioration / barrier properties retained for greater than 52 weeks <i>suitable for all applications including long term immersion</i>
Good	G	no significant deterioration / barrier properties retained for 12 - 52 weeks <i>suitable for short-term immersion and general chemical contact</i>
Moderate	M	no significant deterioration / barrier properties retained for 1 - 12 weeks <i>suitable for applications involving short term chemical contact e.g. spillage, splashing or secondary containment</i>
Poor	P	significant deterioration / loss of barrier properties after 1 week or less <i>not suitable for any application</i>
Ex		<b>Bold text highlights real life data obtained via chemical resistance testing</b>
Ex		Normal font indicates that the resistance has been predicted based upon partial test data and/or similar reagents

# CHEMICAL RESISTANCE OF BELZONA® 1212

FN 10174



	Chemical name (Synonym)	Chemical formula (CAS number)	Concentration	20 °C 68 °F	Other
Hydrocarbons	Aviation fuel (AVCAT, AVGAS, AVTAG, AVTUR)	N/A	-	Ex	-
	Crude oil	N/A	-	Ex	-
	Gasoline (petrol)	N/A (8032-32-4)	-	Ex	-
	Heptane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> (142-82-7)	-	Ex	-
	Hexane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> (110-54-3)	-	Ex	-
	Kerosene	N/A (8008-20-6)	-	Ex	-
	Mineral Spirits / White Spirits (Turpentine, Stoddards Solvent)	N/A (8052-41-3)	-	Ex	-
	Paraffin wax	N/A (8002-74-2)	-	Ex	-
	Petrolatum (Petroleum jelly)	N/A (8009-03-8)	-	Ex	-
	Toluene (methylbenzene, phenylmethane, toluol)	C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub> (108-88-3)	-	Ex	-
	Xylene (dimethyl benzene, xylol)	C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> ) <sub>2</sub> (95-47-6/108-38-3/106-42-3/1330-20-7)	-	Ex	-
	Miscellaneous	Brake fluid	N/A	-	Ex
Emulsion paint		N/A	-	Ex	-
Fertilizer solutions		N/A	-	Ex	-
Grease		N/A	-	Ex	-
Ink (water based)		N/A	-	Ex	-
Mercury		Hg (7439-97-6)	-	Ex	-
Silicone oil		N/A	-	Ex	-
Starch		N/A	-	Ex	-
Water <i>Deionised, Fresh, Mineral, Sea</i>		H <sub>2</sub> O (7732-18-5)	-	Ex	-
Water/Oil Mixtures		N/A	-	Ex	-
Wax emulsions		N/A	-	Ex	-

Excellent	Ex	no significant deterioration / barrier properties retained for greater than 52 weeks <i>suitable for all applications including long term immersion</i>
Good	G	no significant deterioration / barrier properties retained for 12 - 52 weeks <i>suitable for short-term immersion and general chemical contact</i>
Moderate	M	no significant deterioration / barrier properties retained for 1 - 12 weeks <i>suitable for applications involving short term chemical contact e.g. spillage, splashing or secondary containment</i>
Poor	P	significant deterioration / loss of barrier properties after 1 week or less <i>not suitable for any application</i>
Ex		<b>Bold text highlights real life data obtained via chemical resistance testing</b>
Ex		Normal font indicates that the resistance has been predicted based upon partial test data and/or similar reagents

# CHEMICAL RESISTANCE OF BELZONA® 1212

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	Chemical name (Synonym)	Chemical formula (CAS number)	Concentration	20 °C 68 °F	Other
Oils - Mineral	Bunker oil	N/A	-	Ex	-
	Diesel oil	N/A	-	Ex	-
	Fuel oil	N/A	-	Ex	-
	Hydraulic oil	N/A	-	Ex	-
	Lube oil	N/A	-	Ex	-
	Petroleum oil	N/A	-	Ex	-
	Transformer oil	N/A	-	Ex	-
Oils – Vegetable/Animal	Castor oil	N/A	-	Ex	-
	Coconut oil	N/A	-	Ex	-
	Cod liver oil	N/A	-	Ex	-
	Corn oil	N/A	-	Ex	-
	Cottonseed oil	N/A	-	Ex	-
	Lard oil	N/A	-	Ex	-
	Linseed oil	N/A	-	Ex	-
	Olive oil	N/A	-	Ex	-
	Palm oil	N/A	-	Ex	-
	Pine oil	N/A	-	Ex	-
	Soybean oil	N/A	-	Ex	-
	Tall oil	N/A	-	Ex	-
	Tung oil	N/A	-	Ex	-

Excellent	Ex	no significant deterioration / barrier properties retained for greater than 52 weeks <i>suitable for all applications including long term immersion</i>
Good	G	no significant deterioration / barrier properties retained for 12 - 52 weeks <i>suitable for short-term immersion and general chemical contact</i>
Moderate	M	no significant deterioration / barrier properties retained for 1 - 12 weeks <i>suitable for applications involving short term chemical contact e.g. spillage, splashing or secondary containment</i>
Fail	F	significant deterioration / loss of barrier properties after 1 week or less <i>not suitable for any application</i>
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	Chemical name (Synonym)	Chemical formula (CAS number)	Concentration	20 °C 68°F	Other
Salts	Aluminium chloride	AlCl <sub>3</sub> (7446-70-0)	-	Ex	-
	Aluminium sulfate	Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> (10043-01-3)	-	E	-
	Ammonium bicarbonate	(NH <sub>4</sub> )HCO <sub>3</sub> (1066-33-7)	-	E	-
	Ammonium carbonate	(NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub> (506-87-6)	-	E	-
	Ammonium chloride	NH <sub>4</sub> Cl (12125-02-9)	-	E	-
	Ammonium phosphate	(NH <sub>4</sub> ) <sub>3</sub> PO <sub>4</sub> (10361-65-6)	-	E	-
	Ammonium nitrate	NH <sub>4</sub> NO <sub>3</sub> (6484-52-2)	-	E	-
	Ammonium sulfate	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> (7783-20-2)	-	G	-
	Barium carbonate	BaCO <sub>3</sub> (513-77-9)	-	E	-
	Barium chloride	BaCl <sub>2</sub> (10361-37-2)	-	E	-
	Barium sulfate	BaSO <sub>4</sub> (7727-43-7)	-	E	-
	Calcium carbonate	CaCO <sub>3</sub> (471-34-1)	-	E	-
	Calcium chloride	CaCl <sub>2</sub> (10043-52-4)	-	E	-
	Calcium hypochlorite	Ca(ClO) <sub>2</sub> (7778-54-3)	10%	M	-
	Calcium sulfate	CaSO <sub>4</sub> (7778-18-9)	-	E	-
	Copper acetate	Cu(CH <sub>3</sub> COO) <sub>2</sub> (142-71-2)	-	E	-
	Copper chloride	CuCl <sub>2</sub> (7447-39-4)	-	E	-
	Copper nitrate	Cu(NO <sub>3</sub> ) <sub>2</sub> (3251-23-8)	-	E	-
	Copper sulfate	CuSO <sub>4</sub> (7758-98-7)	-	E	-
	Ferric chloride	FeCl <sub>3</sub> (7705-08-0)	-	M	-
Ferrous chloride	FeCl <sub>2</sub> (7758-94-3)	-	M	-	

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Moderate	M	no significant deterioration / barrier properties retained for 1 - 12 weeks <i>suitable for applications involving short term chemical contact e.g. spillage, splashing or secondary containment</i>
Poor	P	significant deterioration / loss of barrier properties after 1 week or less <i>not suitable for any application</i>
Ex		<b>Bold text highlights real life data obtained via chemical resistance testing</b>
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	Chemical name (Synonym)	Chemical formula (CAS number)	Concentration	20 °C 68°F	Other
Salts	Ferric sulfate	Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> (10028-22-5)	-	M	-
	Ferrous sulfate	FeSO <sub>4</sub> (7720-78-7)	-	M	-
	Lead acetate	Pb(CH <sub>3</sub> COO) <sub>2</sub> (301-04-2)	-	Ex	-
	Magnesium chloride	MgCl <sub>2</sub> (7786-30-3)	-	G	-
	Magnesium sulfate (Epsom salt)	MgSO <sub>4</sub> (7487-88-9)	-	G	-
	Nickel chloride	NiCl <sub>2</sub> (7718-54-9)	-	G	-
	Potassium bromide	KBr (7758-02-3)	-	G	-
	Potassium chlorate	KClO <sub>3</sub> (3811-04-9)	-	G	-
	Potassium chloride	KCl (7447-40-7)	-	G	-
	Potassium cyanide	KCN (151-50-8)	-	G	-
	Potassium ferrocyanide	K <sub>4</sub> [Fe(CN) <sub>6</sub> ] (13943-58-3)	-	G	-
	Potassium iodide	KI (7681-11-0)	-	G	-
	Potassium nitrate	KNO <sub>3</sub> (7757-79-1)	-	G	-
	Potassium permanganate	KMnO <sub>4</sub> (7722-64-7)	-	G	-
	Potassium sulfate	K <sub>2</sub> SO <sub>4</sub> (7778-80-5)	-	G	-
	Silver nitrate	AgNO <sub>3</sub> (7761-88-8)	-	G	-
	Sodium acetate	CH <sub>3</sub> COONa (127-09-3)	-	G	-
	Sodium borate (borax)	Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> (1303-96-4)	-	G	-
	Sodium bromide	NaBr (7647-15-6)	-	G	-
	Sodium chlorate	NaClO <sub>3</sub> (7775-09-9)	-	G	-
Sodium chloride	NaCl (7647-14-5)	-	G	-	
Sodium chromate	Na <sub>2</sub> CrO <sub>4</sub> (7775-11-3)	-	G	-	

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	Chemical name (Synonym)	Chemical formula (CAS number)	Concentration	20 °C 68°F	Other
Salts	Sodium cyanide	NaCN (143-33-9)	-	Ex	-
	Sodium fluoride	NaF (7681-49-4)	-	Ex	-
	Sodium hypochlorite (bleach)	NaClO (7681-52-9)	12%	M	-
	Sodium nitrate	NaNO <sub>3</sub> (7631-99-4)	-	Ex	-
	Sodium phosphate (dibasic)	Na <sub>2</sub> HPO <sub>4</sub> (7558-79-4)	-	Ex	-
	Sodium phosphate (tribasic)	Na <sub>3</sub> PO <sub>4</sub> (7601-54-9)	-	Ex	-
	Sodium silicate	Na <sub>2</sub> SiO <sub>3</sub> (6834-92-0)	-	Ex	-
	Sodium sulfate	Na <sub>2</sub> SO <sub>4</sub> (7757-82-6)	-	Ex	-
	Sodium sulfide	Na <sub>2</sub> S (1313-82-2)	-	Ex	-
	Stannous chloride (tin chloride)	SnCl <sub>2</sub> (7772-99-8)	-	Ex	-
	Zinc chloride	ZnCl <sub>2</sub> (7646-85-7)	-	Ex	-
	Zinc sulfate	ZnSO <sub>4</sub> (7733-02-0)	-	Ex	-

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