Base Load Power Hub (BLPH)

PAINTING PROCEDURE

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F.R.I. SRL

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Revision / Change Log

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

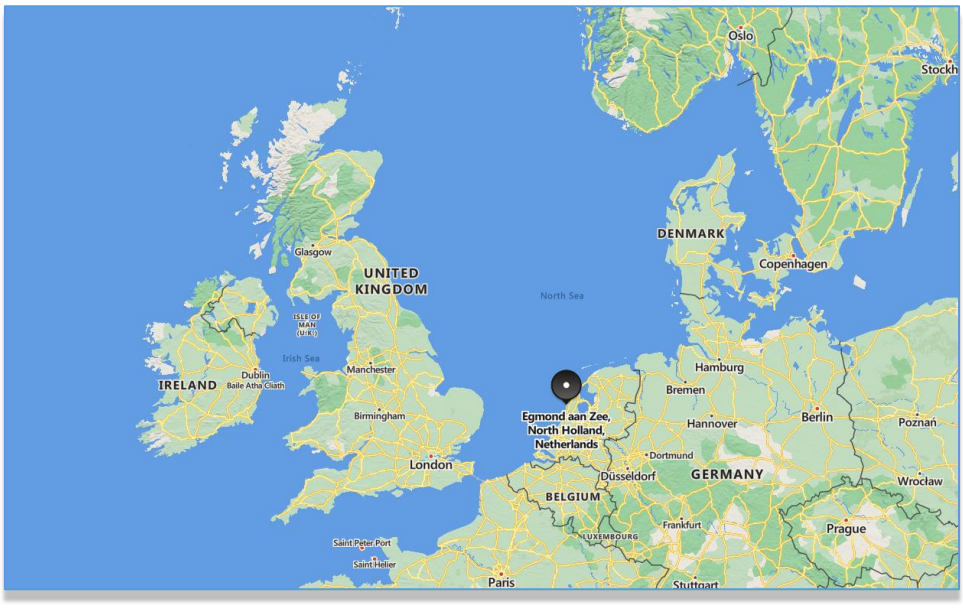


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

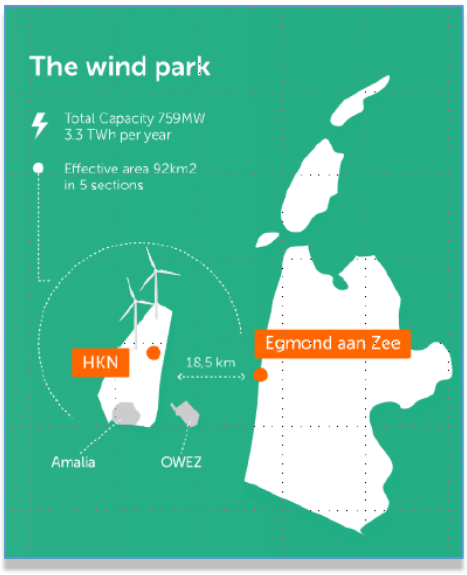


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

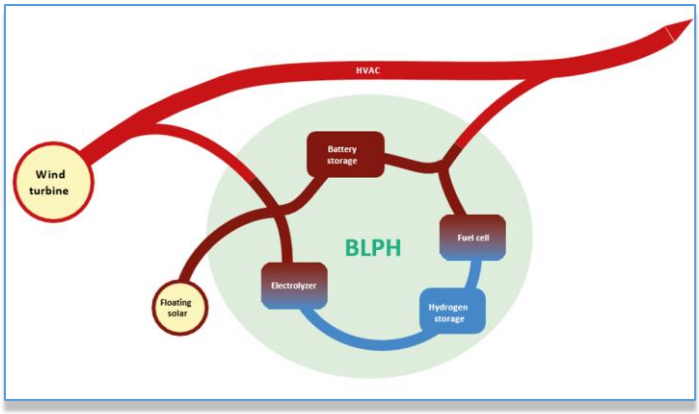


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

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2 DOCUMENT SCOPE

The document's scope is to define the index of final record book.

2.1 REFERENCES

Doc. No.	Description
123A90-DDL-PP-SP-70000	Piping Material Classes
123A90-DDL-PP-DS-70003	Manual Valve Data Sheets
Appendix 1 extracted from doc. 123A90-DDL-PP-LIS-70002	Gate, Globe & Check Valves MTO
123A90-DDL-PP-SP-70030	TSS - Manual Valves & Strainers
123A90-DDL-MAT-SP-60006 Rev.00	Coating and painting specification
1724000799-QC-ITP-00002_00	Inspection and test plan
NORSOK M-501 Ed 6: 2012	Surface Preparation and protective coating
ISO 8501-3:2008	Preparation of Steel Substrates before Application of Coatings and Related Products – Visual Assessment of Surface Cleanliness – Part 3: Preparation Grades of Welds, Cut Edges and Other Areas with Surface Imperfections
ISO 8501-1:2012	Preparation of Steel Substrates before Application of Coatings and Related Products – Visual Assessment of Surface Cleanliness – Part 1: Rust Grades and Preparation Grades of Uncoated Steel Substrates and of Steel Substrates after Removal of Previous Coatings
ISO 11124-1-4:2018	Preparation of Steel Substrates before Application of Paints and Related Products – Parts 1-4, Specifications for Metallic BlastCleaning Abrasives
ISO 11126-1-10:2017	Preparation of Steel Substrates before Application of Paints and Related Products – Parts 1-10, Specifications for Non-Metallic Cleaning Abrasives

ISO 8502-3:2017	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressuresensitive tape met
ISO 8502-9:2020	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 9: Field method for the conductometric determination of water-soluble salts
ASTM D4752:2020	Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub
ISO 29601:2011	Paints and varnishes – Corrosion protection by protective paint systems – Assessment of porosity in a dry film
ISO 19840:2012	Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces
ISO 4624 :2016	Paints and varnishes – Pull-off test for adhesion
ASTM D7393:2016	Standard Practice for Indicating Oil in Abrasives
ASTM D4940:2020	Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blast Cleaning Abrasives

Table 1 - Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project

Table 2 - Definitions and Abbreviations

3 PAINTING PROCEDURE

3.1 PURPOSE

This procedure is applicable only for FRI job F240106.

3.2 COATING SYSTEMS

POS	QUANTITY	DATASHEET	PIPING CLASS	CUSTOMER CODE	PAINTINGS	COLOR
10	1	HS01B02RF	01CS	VDA0NN16000100	9	RAL 9002
30	1	NT01B02RF	01CS	VDE0NN02580100	1	RAL 9002
40	2	CH01C02RFH	01HSS	VDRNNN02460100	6A	RAL 9002
60	1	CH01B02RF	01CS	VDRNNN02580100	1	RAL 9002
70	1	CH01B02RF	01CS	VDRNNN02591H00	1	RAL 9002
80	6	CH03C02RFH	03HSS	VDRNNN02620100	6A	RAL 9002

Table 3 – Coating systems for each item

Handwheels, levers and gearboxes shall be with system 6A complete with RAL 9005.

Coating system 1 shall be prequalified by paint manufacturer in accordance with NORSOK M-501.

3.3 APPROVED PAINT MANUFACTURERS

Paint products have to be chosen from one of the following paint manufacturers:

- JOTUN Paints;
- PPG/AMERON;
- HEMPEL Paints;
- CARBOLINE Paints.

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3.4 PAINTING CYCLES PRODUCTS AND THICKNESSES

COATING SYSTEM	PRODUCTS	DFT	TDFT	MATERIAL	SURFACE PREPARATION
9	Epoxyphenolic (Hempadur 85671)	150	300	CS	Sa 2 1/2
		150			
1	Zinc-rich epoxy (Avantguard 750)	60	280	CS	Sa 2 1/2
	Epoxy-polyamide (Hempaprime multi 500)	160			
	Acrylic polyurethane (Hempathane HS 55610)	60			
6A	Epoxy-primer (Hempadur 15570)	50	225	SS	Sa 2 1/2
	Epoxy-polyamide (Hempaprime multi 500)	100			
	Acrylic polyurethane (Hempathane HS 55610)	75			

Table 4 – Product for each cycle

3.5 APPLICATION EQUIPMENT

Equipment shall follow coating manufacturer TDS.

3.6 SAFETY INSTRUCTIONS

Appropriate ventilation is needed during application in small places and during curing time. This product contains solvents that mixed with air can create explosive mixtures if there are flames, sparks or electrostatics charges.

Protective glasses and clothes must be used.

Adequate protection equipment of the respiratory tract must be used.

3.7 CYCLE

3.7.1 Abrasives and surface preparation

The surface shall be cleaned from dust, oil and grease according to SSPC-SP1.

In general, all surfaces shall be finished in accordance with ISO 8501-3 and preparation grade P3, which implies that all edges, including cut-outs, rat holes and welds shall be generally rounded to a radius of at least 2 mm.

On carbon steel surfaces, metallic abrasives comply with ISO 11124-1-4.

On stainless steels and duplex substrates, only non-metallic abrasives in compliance with ISO

11126-1-10 shall be used.

Whether the abrasives are recycled tests in accordance with ASTM D7393 and ASTM D4940 shall be done.

All steel shall be cleaned for the removal of weld flux, oils, grease and salt prior to blasting in accordance

with ISO 12944-4.

The compressed air supply for abrasive blasting shall comply with ASTM D4285. It shall be clean and dry, free from water and oil.

Surface profile shall be Medium G (ISO 8503-1) with a roughness between 50 and 75 μm measured according to ISO 8503-5. Surface profile of S.S. material shall be fine G with a roughness between 25 - 55 micron.

Apply the paint within 4 hours as possible after surface preparation to prevent any contamination.

Do not leave blasted steel uncoated overnight. Spot reblast steel if needed.

3.7.2 Working conditions

Paint can be applied to steel only if the relative humidity is lower than 85% and the temperature is higher than 3°C above the ambient dew point.

Surface and air temperature shall be above the paint manufacturer recommendations (according to paint datasheet).

3.7.3 Application Procedure

For each coat, a stripe coat shall be applied by brush to all welds, corners, behind angles, edges of beams etc. and areas not fully reachable by spray in order to obtain the specified coverage and thickness.

Each coat shall be applied uniformly over the entire surface. Skips, runs, sags and drips shall be avoided. Each coat shall be free from pinholes, blisters and holidays.
Contamination of painted surfaces between coats shall be avoided. For other indications regarding application refer to coating manufacturer TDS.

3.8 INSPECTION AND TESTING

Test Type	Method	Frequency	Acceptance criteria	Consequence
Environmental conditions	Ambient and steel temperature.	Before start of each shift + minimum twice per shift.	In accordance with specified requirements	No blasting or coating

	Relative humidity. Dew point.			
Visual examination	Visual for sharp edges weld spatter slivers, rust grade, etc. ISO 8501-3	100 % of all surfaces	No defects, see specified requirements. Where defects are noted on pressure retaining equipment such as pipework, these items shall be quarantined and the CONTRACTOR advised prior to repair.	Defects to be repaired
Compressed air quality	ASTM D4285 Blotter test	Before Each shift	No oil or water drops	Rectify air supply
Blast media control	ASTM D7393 Check of any oil content	Spot check	No oil	Replace blast media
	ASTM D4940:15 (2020) Check the presence of any salt	Spot check	150 µS/cm	Replace blast media
Cleanliness	a) ISO 8501-1 b) ISO 8502-3 (Dust contamination)	a) 100 % visual of all surfaces b) Spot checks	a) The required blast standard shall be minimum SA 2.5 for all coating systems. b) Maximum quantity and size rating 2	a) Reblasting b) Recleaning and retesting until acceptable
Salt test	The ISO 8502-9 method shall be used.	Tests shall be carried out on each fabricated item.	Maximum conductivity corresponding to 20 mg/m2 NaCl	Repeated washing with potable water and retesting until acceptable
Roughness	Comparator, stylus instrument (preferred) or testex tape (see ISO 8503). Surface profile comparators in accordance with ISO 8501-2 may be used but only as an inspection tool to	Each component or once per 10 m^2	As specified	Reblasting

	supplement DFT measurements.			
Curing test (for Zn silicate).	ASTM D4752	Each component or once per 100 m2	Rating 4 to 5	Allow to cure
Visual examination of coating	Visual to determine curing, contamination, solvent retention, pinholes/popping, sagging and surface defects	100% of all coating shall be holiday tested and pinholes repaired.	According to specified requirements	Repair of defects
Holiday detection	ISO 29601 Voltage, see table 1	As per coating system specification	No holidays	Repair and retesting.
Film thickness	ISO 19840 Calibration on a smooth surface. Measurement of DFT readings on non magnetic (e.g. DSS) surfaces shall be subject to agreement with COMPANY. Supplier shall select suitable instrument and demonstrate accuracy of readings (against precision foils and against test plate and micrometer).	ISO 19840	ISO 19840, and coating system datasheet	Repair, additional coats or recoating as appropriate
Adhesion	ISO 4624. For adhesion testing, only hydraulic type 'pull-off' testing devices shall be used.	An adhesion test shall be performed on each item during production with separate tests panels	Absolute minimum value is 5 MPa.	Coating to be rejected

		sprayed at the same time as the primary item.		

Table 5 – Tests and checks

3.9 PAINT PARAMETERS APPLICATION DATA

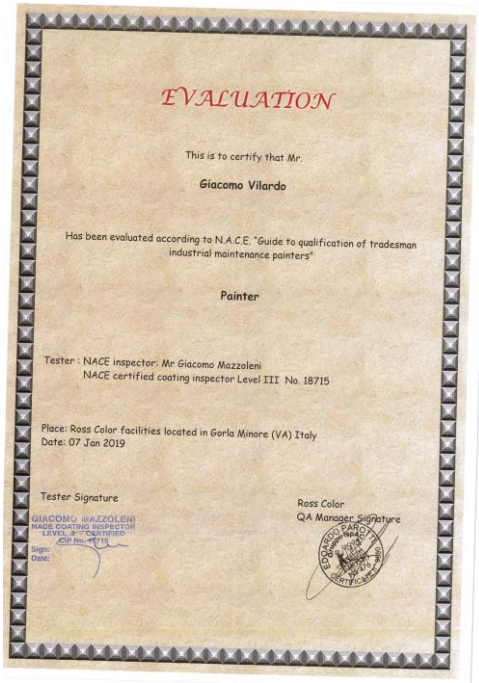
Refer to single PDS for application limits.

3.10 ACTIONS IN CASE OF NON-CONFORMITIES

Usually, no NC Report is issued for this activity since any not perfect painted area can be touched up.

3.11 PERSONNEL QUALIFICATIONS





EVALUATION

This is to certify that Mr.

Giacomo Vilardo

Has been evaluated according to N.A.C.E. "Guide to qualification of tradesman industrial maintenance painters"

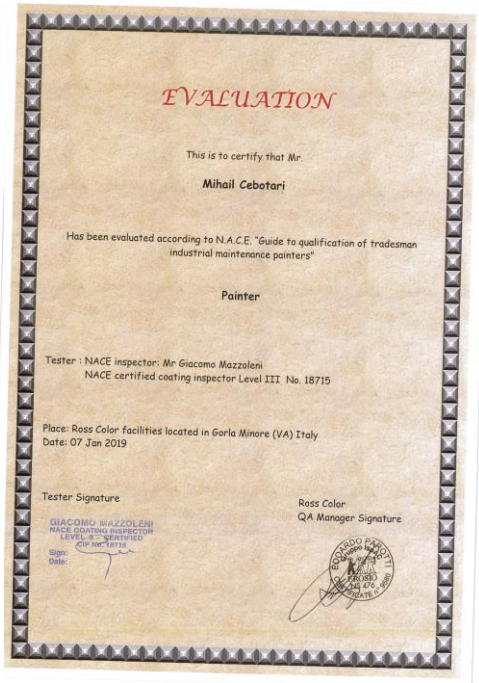
Painter

Tester : NACE inspector: Mr Giacomo Mazzoleni
NACE certified coating inspector Level III No. 18715

Place: Ross Color facilities located in Gorla Minore (VA) Italy
Date: 07 Jan 2019

Tester Signature

Ross Color
QA Manager Signature



EVALUATION

This is to certify that Mr.

Mihail Cebotari

Has been evaluated according to N.A.C.E. "Guide to qualification of tradesman industrial maintenance painters"

Painter

Tester : NACE inspector: Mr Giacomo Mazzoleni
NACE certified coating inspector Level III No. 18715

Place: Ross Color facilities located in Gorla Minore (VA) Italy
Date: 07 Jan 2019

Tester Signature

Ross Color
QA Manager Signature

Frosio Level 3:



CERTIFICATE

FROSIO Certified Surface Treatment

INSPECTOR LEVEL III

Given name Surname
Edoardo Parotti

Certificate no
9580

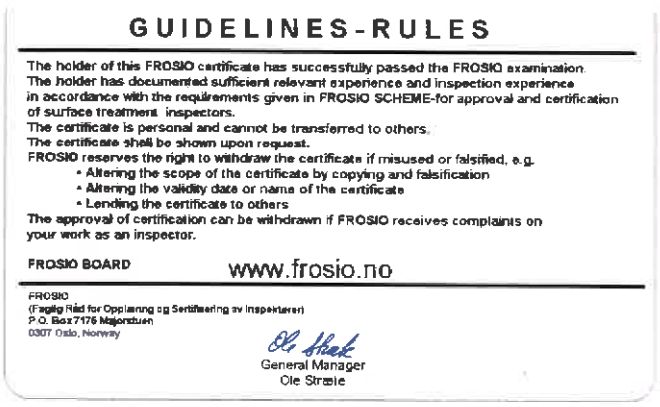
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Valid from
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Date of expiry
30 DEC 2025

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Ole Strøle

3.12 APPENDIX 1 - PRE-QUALIFICATION SYSTEM 1





Pre - qualification Report

Testing in accordance with NORSOK M-501 - Edition 6
System 1

1st Hempadur AvantGuard 750
2nd Hempaprime Multi 500 Winter
3rd Hempathane Speed-Dry 55250

Customer:
Hempel A/S

Norner project number:
2215294

Report number:
NO17402

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5. Test Results Page 6
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Attachments
- Photo – Cyclic Ageing – Cyclic ageing – Figure 1
- Photo – Cyclic Ageing – Cyclic ageing – Overcoating – Figure 2

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1. Introduction

Norner AS was instructed to carry out testing in accordance to Norsok M-501 - Edition 6 - System 1, at the request of:

Hempel A/S
Lundtoftegårdsvej 91
Kgs. Lyngby
DK-2800
Denmark

Norner AS has tested the samples supplied by Hempel A/S in accordance with Norsok M-501 - Edition 6 - system 1 – Carbon steel with maximum operating temperature < 120°C.

Testing was carried out between dates 01.11.2016 and 25.04.2017

Coating system

- 1st coat Hempadur AvantGuard 750 @ 60 µm DFT
- 2nd coat Hempaprime Multi 500 Winter @ 160 µm DFT
- 3rd coat Hempathane Speed-Dry 55250 @ 60 µm DFT

Customer reference: ID 16-0701-1 System 4

2. Summary

Test	Specification	Result
Cyclic Ageing	ISO 20340	Pass

Tested coating system is in accordance with requirements given in Norsok M-501-Edidtion 6 system 1 – Carbon steel with maximum operating temperature < 120°C.

Date: 26.06.2017

.....
Roger Didrichsen
Senior Engineer

.....
Henning Baann
Laboratory manager

Report no.: NO17402
Author: Roger Didrichsen
Client: Hempel

Issue date: 26.06.2017
Issue no.: 1

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3. Application

3.1. Substrate and Surface Preparation

Hot-rolled mild steel, abrasive-blasted with iron grit to a cleanliness degree equivalent to Sa 2½ (ISO 8501-1). The surface roughness was randomly checked according ISO 8503-4. Rz was found to be in the range 50-84 µm.
Panel size 75x150x5 mm, hot-rolled mild steel, Rust grade A (ISO 8501-1).
Salt level was measured in accordance to ISO 8502-6 and found to be below 20 mg/m^2.

3.2. Paint application

Paint application was carried out by conventional airless spray with a diaphragm pump WAGNER SF31.

The surface control and application was witnessed by a Norner representative.

Table 1 Application condition – 3rd party verification

Ambient Temperature [°C]	23.1
Relative Humidity [%]	60
Steel Temperature [°C]	23.4

Table 2 Substrate control - 3rd party verification

Method	Value	Equipment ID
Surface Prep: Sa 2 1/2 ISO 8501-1:2007	Sa 2½	G17 Sharp Angular Grit
Blast Profile [µm]:	77	Positector RTR
Salt Level [mg/m^2] ISO 8502-6	13	EC Tester 11+

3.3. Coating System

Table 3 Coating system

Product	Type	Name	Shade	Batch no.
Hempadur AvantGuard 750, 1736G	Base	1736U	19840	045100270
	Curing Agent	97043	00000	046020043
Hempaprime Multi 500 Winter, 45953	Base	45959	50630	PDK1505328F0075B002
	Curing Agent	95093	00000	PDK1505328F0076B002
Hempathane Speed-Dry 55250	Base	55259	11150	045080765
	Curing Agent	97050	00000	046060963

3.4. DFT measurements

The dry film thickness was measured according with ISO 19840. Thickness was measured using an Elcometer 355 Coating Thickness Gauge.

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Table 4 – DFT measurements – 1st Coat

Panel No.	Coat	Required NDFT	Dry Film Thickness (µm)				
			Lowest	Highest	Mean	Std. Dev.	No. readings
361	1736G	60	55	67	62	4	6
362	1736G	60	48	69	55	8	6
363	1736G	60	47	62	55	6	6
364	1736G	60	43	54	48	4	6
365	1736G	60	45	65	55	8	6
366	1736G	60	43	58	51	7	6

Table 5 – DFT measurements – 2nd Coat

Panel No.	Coat	Required NDFT	Dry Film Thickness (µm)				
			Lowest	Highest	Mean	Std. Dev.	No. readings
361	45953	220	208	229	220	7	6
362	45953	220	193	217	207	10	6
363	45953	220	186	210	202	10	6
364	45953	220	183	204	194	8	6
365	45953	220	189	215	202	9	6
366	45953	220	186	209	199	9	6

Table 6 – DFT measurments – 3rd Coat

Panel No.	Coat	Required NDFT	Dry Film Thickness (µm)				
			Lowest	Highest	Mean	Std. Dev.	No. readings
361	55250	280	262	306	285	14	6
362	55250	280	258	292	278	12	6
363	55250	280	256	285	271	11	6
364	55250	280	261	274	265	5	6
365	55250	280	266	288	275	9	6
366	55250	280	258	280	272	8	6

4. Test program

Table 7 Test program

Test	Applicable standard
Dry film thickness	ISO 19840
Adhesion test	ISO 4624
Cyclic Ageing	ISO 20340
Blistering	ISO 4628-2
Rusting	ISO 4628-3
Cracking	ISO 4628-4

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5. Test results

Table 8 Summary of results

Test parameter	Panel no.	Corrosion from scribe (mm)		Blistering Density (size)		Rusting (Ri)		Cracking Density (size)		Adhesion (Mpa)		Result
		Req.	Res.	Req.	Res.	Req.	Res.	Req.	Res.	Req.	Res.	
Cyclic Ageing	364	≤3	3.0	0(0)	0(0)	0	0	0(0)	0(0)	≥5	10.4	Pass
	365	≤3	2.6	0(0)	0(0)	0	0	0(0)	0(0)	≥5	10.9	Pass
	366	≤3	3.4	0(0)	0(0)	0	0	0(0)	0(0)	≥5	13.0	Fail
	364 Overcoated									≥5	12.6	Pass
Reference	364									≥5	11.7	Pass

Table 9 Adhesion Results

Test Parameter	Panel no	Result (MPa)		Type of fracture
Reference	363	15.2	11.7	100%D
		11.4		20%CD 80%D
		8.6		20%CD 80%D
Cyclic Ageing	364	11.4	10.4	30%CD 70%D
		11.7		30%CD 70%D
		8.0		10%B 30%CD 60%D
	365	12.7	10.9	50%B 20%CD 30%D
		8.9		50%B 20%CD 30%D
		11.1		40%B 20%CD 40%D
	366	13.6	13.0	50%B 20%CD 30%D
		11.0		20%B 30%CD 50%D
		14.5		60%B 20%CD 20%D
	364 Overcoated	14.4	12.6	30%B 20%D 50%EY
		10.9		60%B 20%CD 20%D

Table 10 Corrosion results

Test parameter	Panel no.	Corrosion from scribe line (mm)									Average (mm)	Corrosion from scribe (mm)
Cyclic Ageing	364	8.4	6.6	9.1	7.8	5.5	4.6	11.7	12.2	6.3	8.0	3.0
	365	5.1	9.0	5.6	7.6	5.1	8.6	6.3	10.2	7.8	7.3	2.6
	366	11.0	8.2	7.2	7.4	5.5	10.9	7.2	11.7	9.4	8.8	3.4

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6. General test information

6.1. Cyclic ageing

Scribe line, 2 x 50 mm was made mechanically on each sample.

The cyclic ageing was performed in accordance with ISO 20340:

- 72 hours UV / Condense exposure in accordance with ISO11507
- 72 hours salt spray in accordance with ISO 9227
- 24 hours exposure to low temperature (-20°C ± 2)

Panels size: 75 mm x 150 mm x 5 mm

Total exposure: 4200 hours (25 cycles).

6.2. Adhesion test

Adhesion before and after ageing has been tested in accordance with ISO 4624.

Visual assessment of the fracture surface has been performed as follows:

- A is cohesive failure of substrate
- A/B is adhesive failure between substrate and first coat
- B is cohesive failure of first coat
- B/C is adhesive failure between first and second coats
- *n* is cohesive failure of the *n*th coat of a multicoat system
- *n/m* is adhesive failure between *n*th coat and the *m*th coat of a multicoat system
- -/Y is adhesive failure between final coat and adhesive
- Y is cohesive failure of adhesive
- Y/Z is adhesive failure between adhesive and dolly

6.3. General

Three test panels were used for all exposure tests. Evaluation of adhesion was done after two weeks of conditioning.
Only one of three test panels shall be allowed not to completely comply with specified requirements.

6.4. Requirements

Visual assessment requirements

- ISO 4628-2 Blistering 0 (S0)
- ISO 4628-3 Rusting Ri 0
- ISO 4628-4 Cracking 0 (S0)
- ISO 4628-5 Flaking 0 (S0)

Adhesion in accordance with ISO 4624

- Minimum adhesion value of 5 MPa and maximum reduction of 50% of original measured value.

Corrosion from scribe line

- Corrosion from scribe shall be less or equal to 3.0 mm for coating systems with zinc based primer. or less than or equal to 8.0 mm for coating systems with non-zinc based primer.
- No adhesive failure between the substrate and the first coat unless the pull-off value is 5 MPa or more.

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7. Attachment

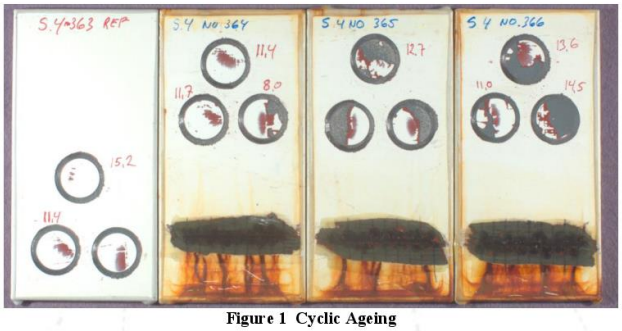


Figure 1 Cyclic Ageing



Figure 2 Overcoated panel

Report no.: NO17402
Author: Roger Didrichsen
Client: Hempel

Issue date: 26.06.2017
Issue no.: 1

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Date: May 2020
Ref. MAES

Technical Statement

INTERCHANGEABILITY OF TOPCOATS

In anticorrosive paint systems the primary function of topcoats is to provide a desired finish while the primer and the mid coat are the deciding factors in the protective properties of the paint system and the level of anti-corrosion protection it can offer. For this reason Hempel finds it correct to consider a certain interchangeability between topcoats, provided that they represent the same proportion part of the anticorrosive paint system.

Hempel A/S has decided to apply a principle of interchangeability also expressed in the NORSOK Standard M501, where in section 10 on Qualification Requirements is stated that topcoats in approved and similarly build systems can be freely changed between systems with no impact on the anti-corrosive performance and without requirement for further testing and revised approvals.

Hempel has tested a series of topcoats that fulfil these prerequisites and meet the test requirements found in ISO 12944-6:2018 and ISO 12944-9:2018, thus, the topcoats can be considered interchangeable in regards to the anticorrosive properties of the paint systems - with the precondition that the paint system remains at the original total nominal dry film thickness and that the nominal dry film thickness of the alternative topcoats are within 30 microns of each other.

At present Hempel considers the following list of topcoats to be interchangeable, subject to agreement with the client:

- Hempathane HS 55610
- Hempathane HS 55613
- Hempathane HS 5561B
- Hempathane 55750
- Hempathane 55250
- Hempathane 55210
- Hempathane 55213
- Hempathane 55214
- Hempathane 55930
- Hempel's polyenamel 55102
- Hempel's Pro Acrylic 55883
- Hempaxane Light 55030

The ISO 12944-6 and ISO12944-9 test schemes are anti-corrosive tests. Interchangeability of topcoats provides additional flexibility for combining the best anti-corrosive solution with the required weathering resistance, gloss level and other desired topcoat properties to provide an optimal solution on cost and performance.

Marta Esparrica on behalf of Niels Lund Jensen (Subject Matter Experts Department Manager, BTE, Group R&D)



Marta Esparrica
Group R&D – Global RD Services
Business Technical Expertise
HEMPEL A/S

3.13 APPENDIX 2 - PRODUCT DATASHEET

Product Data Sheet

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Hempadur 85671

Film thickness

Specification range	Low	Recommended	High
Dry film thickness	90 micron [3.5 mils]	100 micron [3.9 mils]	175 micron [6.9 mils]
Wet film thickness	130 micron [5 mils]	150 micron [6 mils]	250 micron [9 mils]
Theoretical spreading rate	7.5 m²/L [310 sq ft/US gal]	6.8 m²/L [280 sq ft/US gal]	3.9 m²/L [160 sq ft/US gal]

Product may be specified in another film thickness than indicated depending on purpose and area of use. This will alter spreading rate, drying and curing time and overcoating interval. For best performance, avoid excessive film thickness.

Application conditions
- Temperature of product must be above 15°C [59°F] during application.
- To avoid condensation, apply on a clean and dry surface with a temperature that is at least 3°C [5°F] above the dew point.
- Surface temperature must be above 10°C [50°F] during application and curing.

Relative Humidity:
- Relative humidity must be below 80% during curing.
- Relative humidity must be below 80% during application.

Drying and overcoating

Product compatibility
- Previous coat: None or according to Hempel's specification.
- Subsequent coat: None or according to Hempel's specification.

Drying time

Surface temperature		10°C [50°F]	20°C [68°F]	30°C [86°F]	40°C [104°F]
Touch dry	hours	6	2	1½	1
Surface dry	hours	6	3	1½	1
Hard dry	hours	11	6½	3	1½
Fully cured	days	13	7	5	3

Determined for dry film thickness 100 micron [3.9 mils] at standard conditions, see Hempel's Explanatory Notes for details.

Overcoating

Hempel's specification supersedes any guidelines indicated in the overcoating table

Quality name		10°C [50°F]	20°C [68°F]	30°C [86°F]	40°C [104°F]
Atmospheric severe					
Hempadur 85671	Min	25 h	16 h	8 h	5 h
	Max	47 d	21 d	10 d	6½ d
Immersion					
Hempadur 85671	Min	25 h	16 h	8 h	5 h
	Max	47 d	21 d	10 d	6½ d

Overcoating times are indicative for products of the same generic chemistry. Consult Hempel's specification for more information.

Drying conditions
- To obtain the drying time stated, it is important to maintain sufficient ventilation during application, drying and curing.

Overcoating details
- If the maximum overcoating interval is exceeded, roughening of the surface is necessary to ensure intercoat adhesion.
- The surface must be dry and clean prior to application.

Other remarks
- Epoxy coats have an inherent tendency of chalking in outdoor exposure. This does not affect the performance of the coating.
- Hempel's Specification supersedes any recommendations given in the Product Data Sheets.

Issued by Hempel A/S - January 2024
3/4

Product Data Sheet

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Hempadur 85671

Reference dry film thickness
100 micron [3.9 mils]

Aluminium shade / code
Aluminium grey 19000

Gloss
Please consult Hempel's Guideline on aluminium pigmented coatings.

Volume solids
67 ± 2%

Specific gravity
1.7 kg/L [14 lb/US gal]

Reference dry film thickness
100 micron [3.9 mils]

Surface preparation

Cleanliness
- Remove oil, grease and other contaminants by suitable detergent cleaning.
- Remove salts, detergents and other contaminants by high pressure fresh water cleaning.
- Concrete: According to Hempel's Specification.

New build:
- Abrasive blasting to min. Sa 2½ (ISO 8501-1) / SP 10 (SSPC).
- Stainless steel, aluminium and other non ferric metals and alloys: use non-metallic blast media (corundum, garnet, etc.).
- Remove dust, blast media and loose materials.

Maintenance and Repair
- Spot abrasive blasting to min. PSa 2½ (ISO 8501-2) / SP 10 (SSPC).
- Water jetting to Wa 2½ (ISO 8501-4).
- Flash rust degree of maximum FR M (ISO 8501-4).
- Stainless steel, aluminium and other non ferric metals and alloys: use non-metallic blast media (corundum, garnet, etc.).
- Remove dust, blast media and loose materials.

Roughness
- Surface profile Medium (G) (ISO 8503-2).

Consult Hempel's separate Surface Preparation Guidelines for more details.

Application

Mixing ratio
Base 85675 : Curing Agent 97371
(8.8 : 1.2 by volume)

Stir well before use.

Thinner
Hempel's Thinner 08450
Hempel's Thinner 08630

Cleaner
Hempel's Tool Cleaner 99610

Pot life

Product temperature	15°C [59°F]	20°C [68°F]	30°C [86°F]
Induction time	20 min	15 min	5 min
Pot life	3½ hours	3 hours	1 hour

Application method

Tool	Thinning max vol.	Application parameters
Airless spray	10%	Nozzle pressure: 200 bar [2900 psi] Nozzle orifice: 0.017-0.021"
Brush	10%	Not Applicable.

If brush or roller application is used, more coats will be necessary to achieve the specified dry film thickness. As tank lining, brush and roller application must only be limited to stripe coating and touch up areas or minor repairs. Spray data are indicative and subject to adjustment. Pressure is for a material temperature of 20°C [68°F].

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Product Data Sheet

Hempadur 85671

Product characteristics

Description
Hempadur 85671 is an amine adduct cured, phenolic epoxy (novolac) coating with very good adhesion and excellent chemical and high temperature resistance.

Recommended use
Lining: As interior lining in tanks, pipelines, railcars, etc. for hot water, brine, crude oil, vegetable oils and other chemicals as per the Chemical protection guide (only valid for shades 11150 & 50900).

Subsea equipment: As corrosion protection for hot subsea equipment and structures according to NORSOK system 7C.

Service temperature:
- From -196°C [-321°F] up to 205°C [401°F] for dry or dry/wet exposure.
- Maximum, in water (no temperature gradient): 95°C [203°F].
- Other liquids: Please contact Hempel.
- Please consult the Chemical protection guide at hempel.com.

Certificates / Approvals
- Complies with US FDA and EU food regulations for contact with liquid and dry foodstuff. Consult Hempel for details.
- Meets requirements to NORSOK M-501 when used as part of a predefined paint system. Edition 6, System 3C, 3D, 3E, 3F, 7C.
- Tested and assessed according to Aramco SAES-H-101. APCS 2A, 2B, 2C.

Product safety

Flash point 26°C [79°F]

VOC content mixed product

Legislation	Value
EU	317 g/L [2.65 lb/US gal]
US (coatings)	317 g/L [2.65 lb/US gal]
US (regulatory)	317 g/L [2.65 lb/US gal]
China	317 g/L [2.65 lb/US gal]

According to specific legislation, see details in the Explanatory Notes available at Hempel website, hempel.com or at your local Hempel website. VOC values may vary with shade, please consult the Safety Data Sheet, section 9.

Handling
Handle with care. Before and during use, observe safety labels on packaging and paint containers and follow all local and national safety regulations. Always consult Hempel's Safety Data Sheet for this product along with the Product Data Sheet.

For professional use only.

Product data

Product code
85671

Product components
Base 85675
Curing Agent 97371

Standard shade* / code
Light grey 11150 **

Gloss
Flat

Volume solids
68 ± 2%

Specific gravity
1.7 kg/L [14 lb/US gal]

* Other shades are available, please contact your local Hempel representative.
** Slight discolouration may occur. This does not affect the performance of the coating.

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Product Data Sheet

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Hempadur 85671

Storage

Shelf life

Ambient temperature	25°C [77°F]
Base	12 months
Curing Agent	12 months

Shelf life from date of production, when stored in original, unopened containers. Thereafter, the product quality must be re-inspected. Storage at elevated temperatures may reduce shelf life. For advice, please consult Hempel.

Storage conditions

- Product must be stored according to local legislation, at maximum 40°C [104°F], without direct sunlight and protected from rain and snow.

Carbon Footprint

Dry film thickness	1 µm	1 mil
GWP (Global Warming Potential)	9.1 g CO_2e/m^2	0.047 lb CO_2e/ft^2

The carbon footprint is for 1 square meter / square foot of surface area with a dry film thickness of 1 micron / mil.

The scope includes raw materials, in-bound transport to the Hempel factory, Hempel manufacturing processes, and any Volatile Organic Compounds emitted during and after the application of the product.

It is calculated based on the standard shade defined in this PDS. Values may vary with shade.

Additional documents

Additional information is available at the Hempel website https://www.hempel.com/service-and-support/technical-guidelines or at your local Hempel website:

- Explanatory Notes for Product Data Sheet.
- Application methods.
- Substrates.
- Surface Preparation.
- Application Instruction for this product.
- Repair & maintenance.
- Inspection & quality control.
- Tank linings.
- For further information see Hempel's Technical Guidelines.

This Product Data Sheet ("**PDS**") relates to the supplied product ("**Product**") and is subject to updating from time-to-time. Accordingly, the buyer/applicator should have regard to the PDS supplied together with the relevant batch of the Product (and not an earlier version). In addition to the PDS, the buyer/applicator may receive some or all of the following specifications, statements and/or guidelines as listed below or as are available from the Hempel website under 'Products' at www.hempel.com (the "**Additional documents**"):

No.	Document description	Location/comments
1.	Technical Statement	One-off specific advice provided on request for specific projects
2.	Specification	Only issued for specific projects
3.	PDS	This document
4.	Explanatory Notes to the PDS	Available at www.hempel.com and contain relevant information about the Product testing parameters
5.	Application Instruction	Where available, at www.hempel.com
6.	Generic technical guidelines (e.g. on application and surface preparation)	Where available, at www.hempel.com

In the event of a conflict of information between the PDS and the Additional documents, the order of priority of information shall be in the order as set out above. In such event you should also contact your representative at Hempel for clarification. Furthermore, the buyer/applicator must have full regard to the relevant Safety Data Sheet provided with each Product and which can also be downloaded from www.hempel.com.

Hempel shall not be liable for defects where the application of the Product has not been made fully in accordance with the recommendations and requirements set out in the relevant PDS and the Additional Documents. The information and terms of this disclaimer apply to this PDS, the Additional documents and any other documents supplied by Hempel in respect of the Product. In addition, the Product is supplied and all technical assistance is given subject to Hempel's General Conditions of Sale, Delivery and Service, unless otherwise expressly agreed in writing.

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Product Data Sheet

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Hempadur Avantguard 750

Product characteristics

Description
Hempadur Avantguard 750 is an activated, zinc-rich epoxy primer in compliance with the requirements of Level 2, type II in SSPC Paint-20, 2019 and ISO 12944 Part 5, 2018. The product is in full compliance with ASTM D520 type II and EU Directive 2004/42/EC, the Paints Directive on the limitation of volatile organic compounds: subcategory j.

Recommended use
Hempadur Avantguard 750 is recommended as a versatile primer for long-term protection of steel in severely corrosive environments including offshore.

Service temperature:
- Maximum, dry exposure only: 160°C [320°F].

Certificates / Approvals
- Meets requirements to NORSOK M-501 when used as part of a predefined paint system. Edition 6, system no. 1.
- Complies with the European Fire Standard EN 13501-1, reaction to fire classification, when used as part of a predefined paint system. B-s1, d0.

Features
- Reduces the effect of corrosion and provides excellent galvanic protection.
- Fast drying primer with short minimum overcoating intervals.
- Excellent mechanical strength, also in cyclic temperatures, with improved tolerance to high film thickness through high flexibility and self-healing effect.
- Superior tolerance to high relative humidity during application.
- Cures down to -10°C [14°F].

Product safety

Flash point 25°C [77°F]

VOC content mixed product

Legislation	Value	5% thinning, by volume	Limit value, phase II (2010)[a]
EU	330 g/L [2.75 lb/US gal]	356	500
US (coatings)	330 g/L [2.75 lb/US gal]		
US (regulatory)	330 g/L [2.75 lb/US gal]		
China	330 g/L [2.75 lb/US gal]		

VOC values may vary with shade, please consult the Safety Data Sheet, section 9. According to specific legislation, see details in the Explanatory Notes available at Hempel website, hempel.com or at your local Hempel website.
[a]EU Directive 2004/42/CE.

Handling
Handle with care. Before and during use, observe safety labels on packaging and paint containers and follow all local and national safety regulations. Always consult Hempel's Safety Data Sheet for this product along with the Product Data Sheet.

For professional use only.

Product data

Product code
1736G

Product components
Base 1736U
Curing Agent 97043

Standard shade / code
Grey 19840

Gloss
Flat

Volume solids
65 ± 2%

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Product Data Sheet

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Hempadur Avantguard 750

Specific gravity
2.3 kg/L [19 lb/US gal]

Reference dry film thickness
60 micron [2.4 mils]

Surface preparation

Cleanliness
- Remove oil, grease and other contaminants by suitable detergent cleaning.
- Remove salts, detergents and other contaminants by high pressure fresh water cleaning.

New build:
- Abrasive blasting to min. Sa 2½ (ISO 8501-1) / SP 10 (SSPC).
- Remove dust, blast media and loose materials.

Roughness
- Surface profile Medium (G) (ISO 8503-2).

Consult Hempel's separate Surface Preparation Guidelines for more details.

Application

Mixing ratio
Base 1736U : Curing Agent 97043
(8.5 : 1.5 by volume)

Products containing floating or settling particles/pigments need to be continuosly stirred during application. This is especially important in case of heavy thinning.

Thinner
Above 20°C [68°F] Hempel's Thinner 08450
Below 20°C [68°F] Hempel's Thinner 08510

Cleaner
Hempel's Tool Cleaner 99610

Pot life

Product temperature	0°C [32°F]	20°C [68°F]	40°C [104°F]
Pot life	5 hours	4 hours	1½ hours

Application method

Tool	Thinning max vol.	Application parameters
Airless spray	5%	Nozzle pressure: 220 bar [3200 psi] Nozzle orifice: 0.017-0.021"

If brush or roller application is used, more coats will be necessary to achieve the specified dry film thickness. Spray data are indicative and subject to adjustment. Pressure is for a material temperature of 20°C [68°F].

Film thickness

Specification range	Low	High	Recommended
Dry film thickness	40 micron [1.6 mils]	100 micron [3.9 mils]	60 micron [2.4 mils]
Wet film thickness	60 micron [2.5 mils]	150 micron [6 mils]	90 micron [3.5 mils]
Theoretical spreading rate	16 m²/L [650 sq ft/US gal]	6.5 m²/L [260 sq ft/US gal]	11 m²/L [450 sq ft/US gal]

Overthickness should be closely controlled and never locally exceed 200 micron [7.9 mils] DFT. On irregular surfaces it is recommended to employ special care in avoiding over application.

Application conditions
- Temperature of product must be above 15°C [59°F] during application.
- To avoid condensation, apply on a clean and dry surface with a temperature that is at least 3°C [5°F] above the dew point.
- Surface temperature must be above -10°C [14°F] during application and curing.
- Surface temperature must be below 40°C [104°F] during application and curing.

Relative Humidity:
- Relative humidity must be below 95% during curing.
- Relative humidity must be below 95% during application.

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Product Data Sheet

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Hempadur Avantguard 750

Drying and overcoating

Product compatibility
- Previous coat: None.
- Subsequent coat: According to Hempel's Specification.

Drying time

Surface temperature		-10°C [14°F]	0°C [32°F]	20°C [68°F]	40°C [104°F]
Touch dry	min	50	30	10	5
Hard dry	hours	4½	3	1½	½

Determined for dry film thickness 60 micron [2.4 mils] at standard conditions, see Hempel's Explanatory Notes for details.

Overcoating

Hempel's specification supersedes any guidelines indicated in the overcoating table

Quality name		-10°C [14°F]	0°C [32°F]	20°C [68°F]	40°C [104°F]
Atmospheric medium					
Hempaprime Multi 500	Min	3 h	90 min	45 min	25 min
	Max	Ext*	Ext	Ext	Ext
Hempathane HS 55610	Min	3 h	90 min	45 min	25 min
	Max	56 d	42 d	14 d	3½ d
Atmospheric severe					
Hempaprime Multi 500	Min	3 h	90 min	45 min	25 min
	Max	90 d	90 d	30 d	7 d
Hempathane HS 55610	Min	3 h	90 min	45 min	25 min
	Max	20 d	15 d	5 d	28 h

Overcoating times are indicative for products of the same generic chemistry. Consult Hempel's specification for more information.

Drying conditions
- To obtain the drying time stated, it is important to maintain sufficient ventilation during application, drying and curing.

Overcoating details
- If the maximum overcoating interval is exceeded, roughening of the surface is necessary to ensure intercoat adhesion.
- Remove zinc salts or other contamination before overcoating.
- The surface must be dry and clean prior to application.

Other remarks
- Hempel's Specification supersedes any recommendations given in the Product Data Sheets.

Storage

Shelf life

Ambient temperature	25°C [77°F]	35°C [95°F]
Base	12 months	9 months
Curing Agent	36 months	24 months

Shelf life from date of production, when stored in original, unopened containers. Thereafter, the product quality must be re-inspected. Always check the best before date or expiry date on the label.

Storage conditions
- Product must be stored according to local legislation, at maximum 40°C [104°F], without direct sunlight and protected from rain and snow.

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Product Data Sheet

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Hempadur Avantguard 750

Additional documents

Additional information is available at the Hempel website hempel.com or at your local Hempel website:

- Explanatory Notes explaining the fields in this Product Data Sheet.
- Surface Preparation Guidelines.
- Application Guidelines for different application methods.
- General Application Guidelines

This Product Data Sheet ("**PDS**") relates to the supplied product ("**Product**") and is subject to updating from time-to-time. Accordingly, the buyer/applicator should have regard to the PDS supplied together with the relevant batch of the Product (and not an earlier version). In addition to the PDS, the buyer/applicator may receive some or all of the following specifications, statements and/or guidelines as listed below or as are available from the Hempel website under 'Products' at www.hempel.com (the "**Additional documents**"):

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Product Data Sheet

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Hempaprime Multi 500

Product characteristics

Description
Hempaprime Multi 500 is a fast drying, high solids epoxy paint. It provides hard wearing and long lasting barrier protection in coating systems for severe corrosive environments. The product meets the requirements of ISO 12944 Part 5, 2019 when used as part of a predefined paint system.

Recommended use
Hempaprime Multi 500 is recommended as a high-build, intermediate coat in high performance coating systems where fast handling and short overcoating times are required. Due to its fast drying - up to twice as fast as comparable products - the product is excellent for projects where fast throughput is key. The product can also be used as a self-priming, surface tolerant coat and a finishing coat in heavy-duty coating systems. Suited for application down to 10°C [50°F]. The product is available in several MIO shades such as 18021 and 18061; both with 80% MIO content. The volume solids % for MIO shades is 82 ± 2.

Service temperature:
- Maximum, dry exposure only: 120°C [248°F].

Certificates / Approvals
- Meets requirements to ISO 12944 when used as part of a predefined paint system. Part 6, Im2; Part 9, CX.
- Meets requirements to NORSOK M-501 when used as part of a predefined paint system. Edition no. 6, System 1.

Features
- Fast overcoating.
- Crack resistant in high film thickness.
- Low VOC.
- Ready to use - optimised application properties.
- Surface tolerant.

Product safety

Flash point 25°C [77°F]

VOC content mixed product

Legislation	Value
EU	196 g/L [1.64 lb/US gal]
US (coatings)	196 g/L [1.64 lb/US gal]
US (regulatory)	196 g/L [1.64 lb/US gal]
China	196 g/L [1.64 lb/US gal]

According to specific legislation, see details in the Explanatory Notes available at Hempel website, hempel.com or at your local Hempel website. VOC values may vary with shade, please consult the Safety Data Sheet, section 9.

Handling
Handle with care. Before and during use, observe safety labels on packaging and paint containers and follow all local and national safety regulations. Always consult Hempel's Safety Data Sheet for this product along with the Product Data Sheet.

For professional use only.

Product data

Product code
45950

Product components
Base 45959
Curing Agent 95090

Standard shade* / code
Brownish red 50630 **

Gloss
Semi-gloss

* Wide range of colours is available via Hempel's Multi-Tint® system.
** Slight discolouration may occur. This does not affect the performance of the coating.

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Product Data Sheet

HEMPEL
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Hempaprime Multi 500

Volume solids
85 ± 2%

Specific gravity
1.4 kg/L [12 lb/US gal]

Reference dry film thickness
150 micron [5.9 mils]

Aluminium shade / code
Aluminium grey 19002

Gloss
Please consult Hempel's Guideline on aluminium pigmented coatings.

Volume solids
78 ± 2%

Specific gravity
1.3 kg/L [11 lb/US gal]

Reference dry film thickness
150 micron [5.9 mils]

Surface preparation

Cleanliness
- Remove oil, grease and other contaminants by suitable detergent cleaning.
- Remove salts, detergents and other contaminants by high pressure fresh water cleaning.

New build:
- Abrasive blasting to min. Sa 2½ (ISO 8501-1) / SP 10 (SSPC).
- Stainless steel, aluminium and other non ferric metals and alloys: use non-metallic blast media (corundum, garnet, etc.). Sweep blasting to a uniform dense sharp profile, without blank spots.
- Remove dust, blast media and loose materials.

Maintenance and Repair
- Spot abrasive blasting to min. PSa 2 (ISO 8501-2) / SP 6 (SSPC).
- Minor areas may be hand or power tool cleaned instead of abrasive blasting.
- Water jetting to min. Wa 2 (ISO 8501-4).
- Flash rust degree of maximum FR M (ISO 8501-4).
- Stainless steel, aluminium and other non ferric metals and alloys: use non-metallic blast media (corundum, garnet, etc.). Sweep blasting to a uniform dense sharp profile, without blank spots.
- Feather edges to sound surrounding coating.
- Remove dust, blast media and loose materials.

Roughness
- Surface profile Medium (G) (ISO 8503-2).

Consult Hempel's separate Surface Preparation Guidelines for more details.

Application

Mixing ratio
Base 45959 : Curing Agent 95090
(4 : 1 by volume)

Stir well before use.

Thinner
Hempel's Thinner 08450

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Product Data Sheet

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Hempaprime Multi 500

Cleaner
Hempel's Tool Cleaner 99610
Hempel's Thinner 08450

Pot life

Product temperature	10°C [50°F]	20°C [68°F]	30°C [86°F]
Pot life	2½ hours	1 hour	¾ hours

Application method

Tool	Thinning max vol.	Application parameters
Airless spray	5%	Nozzle pressure: 225 bar [3300 psi] Nozzle orifice: 0.019-0.023"
Brush/Roller	5%	Not Applicable.

Spray data are indicative and subject to adjustment. Pressure is for a material temperature of 20°C [68°F].

Film thickness

Specification range	Low	High	Recommended
Dry film thickness	100 micron [3.9 mils]	250 micron [10 mils]	150 micron [5.9 mils]
Wet film thickness	120 micron [5 mils]	300 micron [12 mils]	175 micron [7 mils]
Theoretical spreading rate	8.5 m²/L [350 sq ft/US gal]	3.4 m²/L [140 sq ft/US gal]	5.6 m²/L [230 sq ft/US gal]

Product may be specified in another film thickness than indicated depending on purpose and area of use. This will alter spreading rate, drying and curing time and overcoating interval. For best performance, avoid excessive film thickness.

Application conditions
- Optimal paint temperature for proper mixing, pumping and spraying is: 20°C [68°F].
- To avoid condensation, apply on a clean and dry surface with a temperature that is at least 3°C [5°F] above the dew point.
- Surface temperature must be above 10°C [50°F] during application and curing.

Relative Humidity:
- Relative humidity must be below 85% during application.
- Relative humidity must be below 85% during curing.

Application remarks
- Product requires heavy duty spray equipment; spray hoses shall be as short as possible.

Drying and overcoating

Product compatibility
- Previous coat: None or according to Hempel's specification.
- Subsequent coat: None or according to Hempel's specification. Recommended products are: Hempadur, Hempaprime, Hempathane

Drying time

Surface temperature		10°C [50°F]	20°C [68°F]	30°C [86°F]	40°C [104°F]
Touch dry	hours	2½	1	⅔	⅓
Surface dry	hours	5½	2½	1	½
Hard dry	hours	8	3½	1½	¾

Determined for dry film thickness 150 micron [5.9 mils] at standard conditions, see Hempel's Explanatory Notes for details.

Overcoating

Hempel's specification supersedes any guidelines indicated in the overcoating table

Quality name		10°C [50°F]	20°C [68°F]	30°C [86°F]	40°C [104°F]
Atmospheric medium					
Hempaprime Multi 500	Min	7 h	3 h	2 h	90 min
	Max	Ext*	Ext	Ext	Ext
Hempathane HS 55610	Min	7 h	3 h	2 h	90 min
	Max	Ext*	Ext	Ext	Ext

Overcoating times are indicative for products of the same generic chemistry. Consult Hempel's specification for more information.

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Hempaprime Multi 500

Drying conditions
- To obtain the drying time stated, it is important to maintain sufficient ventilation during application, drying and curing.
- According to Hempel's Specification.

Overcoating details
- If the maximum overcoating interval is exceeded, roughening of the surface is necessary to ensure intercoat adhesion.
- The surface must be dry and clean prior to application.

Other remarks
- Epoxy coats have an inherent tendency of chalking in outdoor exposure. This does not affect the performance of the coating.
- Hempel's Specification supersedes any recommendations given in the Product Data Sheets.

Storage

Shelf life

Ambient temperature	25°C [77°F]
Base	24 months
Curing Agent	24 months

Shelf life from date of production, when stored in original, unopened containers. Thereafter, the product quality must be re-inspected. Storage at elevated temperatures may reduce shelf life. For advice, please consult Hempel.

Storage conditions
- Product must be stored according to local legislation, at maximum 40°C [104°F], without direct sunlight and protected from rain and snow.

Carbon Footprint

Dry film thickness	1 µm	1 mil
GWP (Global Warming Potential)	5.5 g CO_2e/m^2	0.028 lb CO_2e/ft^2

The carbon footprint is for 1 square meter / square foot of surface area with a dry film thickness of 1 micron / mil.

The scope includes raw materials, in-bound transport to the Hempel factory, Hempel manufacturing processes, and any Volatile Organic Compounds emitted during and after the application of the product.

It is calculated based on the standard shade defined in this PDS. Values may vary with shade.

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Hempaprime Multi 500

Additional documents

Additional information is available at the Hempel website
https://www.hempel.com/service-and-support/technical-guidelines
or at your local Hempel website:

- Explanatory Notes for Product Data Sheet.
- Application methods.
- Substrates.
- Surface Preparation.
- Application Instruction for this product.
- Repair & maintenance.
- Inspection & quality control.

This Product Data Sheet ("**PDS**") relates to the supplied product ("**Product**") and is subject to updating from time-to-time. Accordingly, the buyer/applicator should have regard to the PDS supplied together with the relevant batch of the Product (and not an earlier version). In addition to the PDS, the buyer/applicator may receive some or all of the following specifications, statements and/or guidelines as listed below or as are available from the Hempel website under 'Products' at www.hempel.com (the "**Additional documents**"):

No.	Document description	Location/comments
1.	Technical Statement	One-off specific advice provided on request for specific projects
2.	Specification	Only issued for specific projects
3.	PDS	This document
4.	Explanatory Notes to the PDS	Available at www.hempel.com and contain relevant information about the Product testing parameters
5.	Application Instruction	Where available, at www.hempel.com
6.	Generic technical guidelines (e.g. on application and surface preparation)	Where available, at www.hempel.com

In the event of a conflict of information between the PDS and the Additional documents, the order of priority of information shall be in the order as set out above. In such event you should also contact your representative at Hempel for clarification. Furthermore, the buyer/applicator must have full regard to the relevant Safety Data Sheet provided with each Product and which can also be downloaded from www.hempel.com.

Hempel shall not be liable for defects where the application of the Product has not been made fully in accordance with the recommendations and requirements set out in the relevant PDS and the Additional Documents. The information and terms of this disclaimer apply to this PDS, the Additional documents and any other documents supplied by Hempel in respect of the Product. In addition, the Product is supplied and all technical assistance is given subject to Hempel's General Conditions of Sale, Delivery and Service, unless otherwise expressly agreed in writing.

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Product Data Sheet

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Hempathane HS 55610

Product characteristics

Description
Hempathane HS 55610 is a glossy polyurethane topcoat, cured with aliphatic isocyanate. The product has good gloss and colour retention and contains zinc phosphate.
Complies with EU Directive 2004/42/EC, The Paints Directive on the limitation of volatile organic compounds: subcategory j.

Recommended use
Hempathane HS 55610 is recommended as VOC compliant, high-build finishing coat for protection of structural steel in severely corrosive environment. The product may be specified as a one coat "direct to metal" system in environments classified as C2 and C3. It may also be applied directly on galvanised steel.

Service temperature:
- Maximum, dry exposure only: 120°C [248°F].

Certificates / Approvals
- EC-type examined as a low flame spread material when used as part of a predefined paint system. Please refer to "Declaration of Conformity" on hempel.com for further details.
- The following shades are formulated with special electrical conductive pigments that makes it possible to design paint systems that meet the requirements in ISO 80079-36:2016 Explosive atmospheres (ATEX): 95000

Features
- For severely corrosive atmospheric environment.
- Direct-to-metal in C2 and C3 environments.
- Glossy with good gloss and colour retention.
- High volume solids and VOC-compliant.
- The minimum temperature for curing is -10°C [14°F].

Product safety

Flash point 31°C [88°F]

VOC content mixed product

Legislation	Value	5% thinning, by volume	Limit value, phase II (2010)[a]
EU	343 g/L [2.86 lb/US gal]	366 g/L [3.05 lb/US gal]	500 g/L [4.17 lb/US gal]
US (coatings)	320 g/L [2.67 lb/US gal]	-	-
US (regulatory)	343 g/L [2.86 lb/US gal]		
China	343 g/L [2.86 lb/US gal]		
Hong Kong	320 g/L [2.67 lb/US gal]		

According to specific legislation, see details in the Explanatory Notes available at Hempel website, hempel.com or at your local Hempel website. VOC values may vary with shade, please consult the Safety Data Sheet, section 9. [a]EU Directive 2004/42/CE. According to EPA Method 24.

Handling
Handle with care. Before and during use, observe safety labels on packaging and paint containers and follow all local and national safety regulations. Always consult Hempel's Safety Data Sheet for this product along with the Product Data Sheet.

For professional use only.

Product data

Product code
55610

Product components
Base 55619
Curing Agent 97050

Standard shade* / code
White 10000 **

Gloss
Glossy

* Wide range of colours is available via Hempel's Multi-Tint® system.
** Colour stability may be affected by exposure to harsh chemical and/or high temperatures.

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Product Data Sheet

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Hempathane HS 55610

Volume solids
67 ± 2%

Specific gravity
1.4 kg/L [12 lb/US gal]

Reference dry film thickness
80 micron [3.1 mils]

Aluminium shade / code
Aluminium grey 19002

Gloss
Please consult Hempel's Guideline on aluminium pigmented coatings.

Volume solids
58 ± 2%

Specific gravity
1.1 kg/L [10 lb/US gal]

Reference dry film thickness
80 micron [3.1 mils]

Surface preparation

Cleanliness
- Remove oil, grease and other contaminants by suitable detergent cleaning.
- Remove salts, detergents and other contaminants by high pressure fresh water cleaning.

New build:
- Abrasive blasting to min. Sa 2½ (ISO 8501-1) / SP 10 (SSPC).
- Remove dust, blast media and loose materials.

Maintenance and Repair
- Abrasive blasting to min. Sa 2 (ISO 8501-1) / SP 6 (SSPC).
- Minor areas may be hand or power tool cleaned instead of abrasive blasting.
- Water jetting to Wa 2½ (ISO 8501-4).
- Flash rust degree of maximum FR M (ISO 8501-4).
- Remove dust, blast media and loose materials.

Roughness
- Surface profile Medium (S) (ISO 8503-2).

Consult Hempel's separate Surface Preparation Guidelines for more details.

Application

Mixing ratio
Base 55619 : Curing Agent 97050
(7 : 1 by volume)

Stir well before use.

Thinner
Hempel's Thinner 08080

Cleaner
Hempel's Thinner 08080

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Product Data Sheet

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Hempathane HS 55610

Pot life

Product temperature	10°C [50°F]	20°C [68°F]	30°C [86°F]
Pot life	3½ hours	2 hours	1 hour

Application method

Tool	Thinning max vol.	Application parameters
Airless spray	5%	Nozzle pressure: 175 bar [2500 psi] Nozzle orifice: 0.017-0.021"

If brush or roller application is used, more coats will be necessary to achieve the specified dry film thickness. Never thin more than allowed according to local environmental legislation. Spray data are indicative and subject to adjustment. Pressure is for a material temperature of 20°C [68°F].

Film thickness

Specification range	Low	High	Recommended
Dry film thickness	50 micron [2.0 mils]	125 micron [4.9 mils]	80 micron [3.1 mils]
Wet film thickness	75 micron [3 mils]	190 micron [7 mils]	120 micron [5 mils]
Theoretical spreading rate	13 m²/L [530 sq ft/US gal]	5.3 m²/L [220 sq ft/US gal]	8.3 m²/L [340 sq ft/US gal]

For best performance, avoid excessive film thickness.

Application conditions
- To avoid condensation, apply on a clean and dry surface with a temperature that is at least 3°C [5°F] above the dew point.
- Surface temperature must be above -10°C [14°F] during application and curing.
- Beware of ice on the surface at low temperatures.
- The film formation may be adversely affected by light rain, high humidity and/or condensation during application and the following interval after application: "8 hours, 20°C/68°F".
- Optimal spraying properties are obtained at paint temperatures of 15-30°C [59-86°F]. Beyond these temperatures additional thinning may be necessary.

Relative Humidity:
- Relative humidity must be below 85% during curing.
- Relative humidity must be below 85% during application.

Drying and overcoating

Product compatibility
- Previous coat: According to Hempel's Specification. Recommended products are: Hempaprime Multi 500 45950/3, Hempadur Quattro series, Hempadur Avantguard series.
- Subsequent coat: None.

Drying time

Surface temperature		10°C [50°F]	20°C [68°F]	30°C [86°F]
Touch dry	min	120	90	60
Surface dry	hours	11	3½	2
Hard dry	hours	12	5	3
Fully cured	days	-	7	-

Determined for dry film thickness 80 micron [3.1 mils] at standard conditions, see Hempel's Explanatory Notes for details.

Overcoating

Hempel's specification supersedes any guidelines indicated in the overcoating table

Quality name		-10°C [14°F]	10°C [50°F]	20°C [68°F]	30°C [86°F]
Atmospheric medium					
Hempathane HS 55610	Min	30 h	9 h	6 h	3 h
	Max	Ext*	Ext	Ext	Ext

Overcoating times are indicative for products of the same generic chemistry. Consult Hempel's specification for more information.

Drying conditions
- To obtain the drying time stated, it is important to maintain sufficient ventilation during application, drying and curing.
- Condensation on the freshly applied coating should be avoided.

Overcoating details
- The surface must be dry and clean prior to application.

Other remarks
- Hempel's Specification supersedes any recommendations given in the Product Data Sheets.

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Product Data Sheet

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Hempathane HS 55610

Storage

Shelf life

Ambient temperature	25°C [77°F]
Base	36 months
Curing Agent	24 months

Shelf life from date of production, when stored in original, unopened containers. Thereafter, the product quality must be re-inspected. Storage at elevated temperatures may reduce shelf life. For advice, please consult Hempel.

Storage conditions

- Product must be stored according to local legislation, at maximum 40°C [104°F], without direct sunlight and protected from rain and snow.
- The curing agent is sensitive to moisture. Store in a dry place and keep the can tightly closed until use.

Carbon Footprint

Dry film thickness	1 µm	1 mil
GWP (Global Warming Potential)	8.7 g CO_2e/m^2	0.045 lb CO_2e/ft^2

The carbon footprint is for 1 square meter / square foot of surface area with a dry film thickness of 1 micron / mil.

The scope includes raw materials, in-bound transport to the Hempel factory, Hempel manufacturing processes, and any Volatile Organic Compounds emitted during and after the application of the product.

It is calculated based on the standard shade defined in this PDS. Values may vary with shade.

Additional documents

Additional information is available at the Hempel website https://www.hempel.com/service-and-support/technical-guidelines or at your local Hempel website:

- Explanatory Notes for Product Data Sheet.
- Application methods.
- Surface Preparation.
- Application Instruction for this product.
- Aluminium pigmented topcoats.

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3.	PDS	This document
4.	Explanatory Notes to the PDS	Available at www.hempel.com and contain relevant information about the Product testing parameters
5.	Application Instruction	Where available, at www.hempel.com
6.	Generic technical guidelines (e.g. on application and surface preparation)	Where available, at www.hempel.com

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Hempel shall not be liable for defects where the application of the Product has not been made fully in accordance with the recommendations and requirements set out in the relevant PDS and the Additional Documents. The information and terms of this disclaimer apply to this PDS, the Additional documents and any other documents supplied by Hempel in respect of the Product. In addition, the Product is supplied and all technical assistance is given subject to Hempel's General Conditions of Sale, Delivery and Service, unless otherwise expressly agreed in writing.

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Product Data Sheet

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Hempadur 15570

Product characteristics

Description
Hempadur 15570 is a two component, polyamide-adduct cured epoxy paint, which cures to a strong and highly corrosion resistant coating, at temperatures down to -10°C/14°F. The Micaceous Iron Oxide pigmented reddish grey 12430 shade is also well suited for application under humid conditions, on damp steel surfaces, and may be applied on moist surfaces. The greyish yellow 21780 and the grey 11320 shades contains zinc phosphate.
Complies with EU Directive 2004/42/EC, The Paints Directive on the limitation of volatile organic compounds: subcategory j.

Recommended use
As a maintenance and repair primer, intermediate, and/or finishing coat in Hempadur systems in severely corrosive environment. As a finishing coat where a cosmetic appearance is of less importance.
As a low temperature curing epoxy primer, intermediate, and/or finishing coat in paint systems according to specification. Well suited as a (blast) primer in epoxy systems.
Mist coat on Galvosil.

Service temperature:
- Maximum, dry exposure only: 140°C [284°F].

Certificates / Approvals
- EC-type examined as a low flame spread material when used as part of a predefined paint system. Please refer to "Declaration of Conformity" on hempel.com for further details.
- Reaction to fire tested (as part of a coating system with approved primer and topcoat) according to EN13501-1 B-s1, d0.

Product safety

Flash point 25°C [77°F]

VOC content mixed product

Legislation	Value	15% thinning, by volume	Limit value, phase II (2010)[a]
EU	412 g/L [3.44 lb/US gal]	478 g/L [3.99 lb/US gal]	500 g/L [4.17 lb/US gal]
US (coatings)	412 g/L [3.44 lb/US gal]	-	-
US (regulatory)	412 g/L [3.44 lb/US gal]	-	-
China	412 g/L [3.44 lb/US gal]	-	-

According to specific legislation, see details in the Explanatory Notes available at Hempel website, hempel.com or at your local Hempel website. VOC values may vary with shade, please consult the Safety Data Sheet, section 9. [a]EU Directive 2004/42/CE.

Handling
Handle with care. Before and during use, observe safety labels on packaging and paint containers and follow all local and national safety regulations. Always consult Hempel's Safety Data Sheet for this product along with the Product Data Sheet.

For professional use only.

Product data

Product code
15570

Product components
Base 15579
Curing Agent 95570

Standard shade* / code
Brownish red 50630

Gloss
Flat

* Other shades are available, please contact your local Hempel representative.

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Hempadur 15570

Volume solids
54 ± 2%

Specific gravity
1.3 kg/L [11 lb/US gal]

Reference dry film thickness
100 micron [4.0 mils]

Micaceous iron oxide (MIO) shade / code
Metallic grey 12430

Gloss
Flat

Volume solids
54 ± 2%

Specific gravity
1.4 kg/L [12 lb/US gal]

Reference dry film thickness
100 micron [4.0 mils]

Surface preparation

Cleanliness
- Remove oil, grease and other contaminants by suitable detergent cleaning.
- Remove salts, detergents and other contaminants by high pressure fresh water cleaning.
- All damage of shopprimer and contamination from storage and fabrication should be thoroughly mechanically/chemically cleaned prior to final painting.

New build:
- Abrasive blasting to min. Sa 2½ (ISO 8501-1) / SP 10 (SSPC).
- Stainless steel, aluminium and other non ferric metals and alloys: use non-metallic blast media (corundum, garnet, etc.). Sweep blasting to a uniform dense sharp profile, without blank spots.
- Remove dust, blast media and loose materials.

Maintenance and Repair
- Abrasive blasting to min. Sa 2 (ISO 8501-1) / SP 6 (SSPC).
- Water jetting to min. Wa 2 (ISO 8501-4).
- Flash rust degree of maximum FR M (ISO 8501-4).
- Minor areas can be cleaned by power tool to St 3 provided the surface is roughened and not polished.
- Stainless steel, aluminium and other non ferric metals and alloys: use non-metallic blast media (corundum, garnet, etc.). Sweep blasting to a uniform dense sharp profile, without blank spots.
- Remove dust, blast media and loose materials.

Roughness
- Surface profile Medium (G) (ISO 8503-2).

Consult Hempel's separate Surface Preparation Guidelines for more details.

Application

Mixing ratio
Base 15579 : Curing Agent 95570
(3 : 1 by volume)

Stir well before use.

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Product Data Sheet

Hempadur 15570

Thinner
Hempel's Thinner 08450

Cleaner
Hempel's Tool Cleaner 99610

Pot life

Product temperature	20°C [68°F]
Pot life	2 hours

Application method

Tool	Thinning max vol.	Application parameters
Airless spray	5%	Nozzle pressure: 175 bar [2500 psi] Nozzle orifice: 0.019-0.021"
Air spray	15%	Not Applicable.
Brush	5%	Not Applicable.

If brush or roller application is used, more coats will be necessary to achieve the specified dry film thickness. Spray data are indicative and subject to adjustment. Pressure is for a material temperature of 20°C [68°F].

Film thickness

Specification range	Low	High	Recommended
Dry film thickness	50 micron [2.0 mils]	125 micron [5.0 mils]	100 micron [4.0 mils]
Wet film thickness	90 micron [3.6 mils]	230 micron [9.2 mils]	190 micron [7.6 mils]
Theoretical spreading rate	11 m²/L [448 sq ft/US gal]	4.3 m²/L [175 sq ft/US gal]	5.4 m²/L [220 sq ft/US gal]

For best performance, avoid excessive film thickness. Product may be specified in another film thickness than indicated depending on purpose and area of use. This will alter spreading rate, drying and curing time and overcoating interval.

Application conditions
- To avoid condensation, apply on a clean and dry surface with a temperature that is at least 3°C [5°F] above the dew point.
- Surface temperature must be above -10°C [14°F] during application and curing.
- Beware of ice on the surface at low temperatures.
- Temperature of product must be above 15°C [59°F] during application.

Relative Humidity:
- Relative humidity must be below 85% during application.
- Relative humidity must be below 85% during curing.

Application remarks
- Metallised surfaces should be overcoated before exposure to open air conditions.
- Flash-coat technique is recommended when overcoating porous substrates.

Drying and overcoating

Product compatibility
- Previous coat: None or according to Hempel's specification.
- Subsequent coat: According to Hempel's Specification. Recommended products are: Hempadur, Hempathane, Hempatex

Drying time

Surface temperature		20°C [68°F]
Touch dry	min	60
Hard dry	hours	5
Fully cured	days	7

Determined for dry film thickness 100 micron [4.0 mils] at standard conditions, see Hempel's Explanatory Notes for details.

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Hempadur 15570

Overcoating

Hempel's specification supersedes any guidelines indicated in the overcoating table

Quality name		0°C [32°F]	10°C [50°F]	20°C [68°F]	30°C [86°F]
Atmospheric medium					
Hempadur 15570	Min	18 h	8 h	4 h	3 h
	Max	Ext	Ext	Ext	Ext
Hempathane HS 55610	Min	18 h	8 h	4 h	3 h
	Max	Ext	Ext	Ext	Ext
Hempatex Enamel 56360	Min	9 h	4 h	2 h	90 min
	Max	36 h	16 h	8 h	6 h
Immersion					
Hempadur 15570	Min	36 h	16 h	8 h	6 h
	Max	Ext	Ext	Ext	Ext

Overcoating times are indicative for products of the same generic chemistry. Consult Hempel's specification for more information.

Drying conditions

- To obtain the drying time stated, it is important to maintain sufficient ventilation during application, drying and curing.

Overcoating details

- If the maximum overcoating interval is exceeded, roughening of the surface is necessary to ensure intercoat adhesion.
- The surface must be clean before overcoating.

Other remarks

- Epoxy coats have an inherent tendency of chalking in outdoor exposure. This does not affect the performance of the coating.
- Hempel's Specification supersedes any recommendations given in the Product Data Sheets.

Storage

Shelf life

Ambient temperature	25°C [77°F]
Base	36 months
Curing Agent	36 months

Shelf life from date of production, when stored in original, unopened containers. Thereafter, the product quality must be re-inspected. Storage at elevated temperatures may reduce shelf life. For advice, please consult Hempel.

Storage conditions

- Product must be stored according to local legislation, at maximum 40°C [104°F], without direct sunlight and protected from rain and snow.

Carbon Footprint

Dry film thickness	1 µm	1 mil
GWP (Global Warming Potential)	9.1 g CO_2e/m^2	0.047 lb CO_2e/ft^2

The carbon footprint is for 1 square meter / square foot of surface area with a dry film thickness of 1 micron / mil.

The scope includes raw materials, in-bound transport to the Hempel factory, Hempel manufacturing processes, and any Volatile Organic Compounds emitted during and after the application of the product.

It is calculated based on the standard shade defined in this PDS. Values may vary with shade.

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Product Data Sheet

HEMPEL
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Hempadur 15570

Additional documents

Additional information is available at the Hempel website
https://www.hempel.com/service-and-support/technical-guidelines
or at your local Hempel website:

- Explanatory Notes for Product Data Sheet.
- Application methods.
- General Application Guidelines

This Product Data Sheet ("**PDS**") relates to the supplied product ("**Product**") and is subject to updating from time-to-time. Accordingly, the buyer/applicator should have regard to the PDS supplied together with the relevant batch of the Product (and not an earlier version). In addition to the PDS, the buyer/applicator may receive some or all of the following specifications, statements and/or guidelines as listed below or as are available from the Hempel website under 'Products' at www.hempel.com (the "**Additional documents**"):

No.	Document description	Location/comments
1.	Technical Statement	One-off specific advice provided on request for specific projects
2.	Specification	Only issued for specific projects
3.	PDS	This document
4.	Explanatory Notes to the PDS	Available at www.hempel.com and contain relevant information about the Product testing parameters
5.	Application Instruction	Where available, at www.hempel.com
6.	Generic technical guidelines (e.g. on application and surface preparation)	Where available, at www.hempel.com

In the event of a conflict of information between the PDS and the Additional documents, the order of priority of information shall be in the order as set out above. In such event you should also contact your representative at Hempel for clarification. Furthermore, the buyer/applicator must have full regard to the relevant Safety Data Sheet provided with each Product and which can also be downloaded from www.hempel.com.

Hempel shall not be liable for defects where the application of the Product has not been made fully in accordance with the recommendations and requirements set out in the relevant PDS and the Additional Documents. The information and terms of this disclaimer apply to this PDS, the Additional documents and any other documents supplied by Hempel in respect of the Product. In addition, the Product is supplied and all technical assistance is given subject to Hempel's General Conditions of Sale, Delivery and Service, unless otherwise expressly agreed in writing.

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