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# Hempel NORSOK coating systems

NORSOK M-501 edition
5/6 system guide

# Hempel NORSOK coating systems

## NORSOK M-501 approved systems from Hempel

Hempel is a world leader in the supply of marine and protective coatings to a wide variety of industry segments, including:

- Oil and Gas Upstream
- Oil and Gas Downstream
- Petrochemical
- Civil Infrastructure
- Power
- Marine
- Transport

Our global capabilities allow us to supply our tailored coating solutions anywhere in the world, helping you protect your investment from corrosion. With 28 factories globally and operations in over 80 countries, wherever your next project takes you, you're never far from Hempel.

However, we recognise that our technologically advanced product ranges make up only half the story. Our people make the difference. With a global network of experienced personnel and trained coating advisors to help you deliver your project on time and to specification, Hempel's technical service is second to none.

We recognise that choosing a coatings' supplier is often a tough choice. We are here to make that choice easier.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email protective@hempel.com.

## What is NORSOK M-501?

The NORSOK standards are a series of standards developed by the Norwegian petroleum industry. The purpose of these industry standards is to replace the individual oil company specifications and to add value, reduce cost and lead time and to remove unnecessary activities in offshore field developments and operation.

NORSOK M-501 mandates a series of systems based on generic coating type and minimum scheme thicknesses. In addition, for some systems, testing requirements are also necessary for pre-qualification to this standard. A full list of the systems within NORSOK can be found in the Frequently Asked Questions guide.

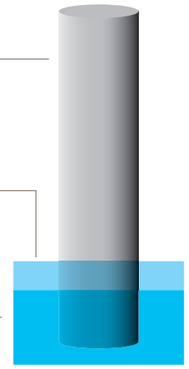
Each of the published system sheets provide examples of Hempel-recommended schemes, corresponding to the different systems within NORSOK M-501. Where a system requires pre-qualification, this is clearly stated and Hempel systems listed will have been subjected to all of the necessary pre-qualification testing. Where pre-qualification isn't mandatory, a series of recommended schemes are listed. This document covers only those systems appropriate to edition 5 and/or 6 of the NORSOK M-501 standard.

## Exposure conditions

**Atmosphere C5M**
- Cyclic testing (ISO 20340:2009)
- Three-coat, zinc-rich system requires ≤ 3 mm scribe creep

**Splash/tidal zone C5M + IM2**
- Cyclic testing
- Cathodic Protection (CP)
- Water immersion

**Immersed IM2**
- Cathodic Protection (CP)
- Water immersion



NORSOK M-501 coating systems

# System 1

Structural steel and exteriors of equipment, vessels piping and valves (uninsulated)

## System 1: Operating temperature below 120°C/248°F

**Pre-qualification is required**

### Zinc silicate

| Product | DFT (µm) |
|---|---|
| Hempel's Galvosil 15700 | 60 |
| Hempaprime Multi 500[2] | Mist coat |
| Hempaprime Multi 500[2] | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempel's Galvosil 15680 | 60 |
| Hempaprime Multi 500[2] | Mist coat |
| Hempaprime Multi 500[2] | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempel's Galvosil 15700 | 60 |
| Hempadur Quattro XO 17870 | Mist coat |
| Hempadur Quattro XO 17870 | 160 |
| Hempel's Pro Acrylic 55883 | 60 |
| **Total** | **280** |

Note 1: An optional mist coat (tie-coat) may be specified to avoid popping. Typically, 25 µm of the specified epoxy (diluted, mist coat technique) can be used. Contact your Hempel representative for further details. This note applies to all of the above systems.

Note 2: Both summer and winter versions of Hempaprime Multi 500 are pre-qualified.

### Zinc epoxy

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 750 | 60 |
| Hempaprime Multi 500[2] | 160 |
| Hempel's Pro Acrylic 55883 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 750 | 60 |
| Hempaprime Multi 500 Winter | 160 |
| Hempathane Speed-Dry Topcoat 250 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 750 | 60 |
| Hempaprime Multi 500 Summer | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 770 | 60 |
| Hempaprime Multi 500 Winter | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 770 | 60 |
| Hempaprime Multi 500 Summer | 160 |
| Hempathane Speed-Dry Topcoat 250 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 750 | 60 |
| Hempadur 4774D | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 750 | 60 |
| Hempadur Quattro XO 17870 | 160 |
| Hempel's Pro Acrylic 55883 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 750 | 60 |
| Hempadur 47300 | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 770 | 60 |
| Hempadur Quattro XO 17870 | 160 |
| Hempel's Pro Acrylic 55883 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 770 | 60 |
| Hempadur 4774D | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 770 | 60 |
| Hempadur 47300 | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 860 | 60 |
| Hempaprime Multi 500[2] | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 860 | 60 |
| Hempadur Quattro XO 17870 | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 860 | 60 |
| Hempadur Quattro XO 17820 | 160 |
| Hempathane HS 55610 | 60 |
| **Total** | **280** |

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email protective@hempel.com

Note 1: Subject to owner approval, a pre-qualified topcoat may be substituted for another topcoat if the topcoat thickness and the intermediates remain the same. The topcoat listed is the one tested. Commonly used topcoats, which may be substituted include:
- Hempaxane Light 55030
- Hempathane HS 55610
- Hempathane 55210
- Hempel's Pro Acrylic 55883
- Hempathane Speed-Dry Topcoat 250

This note applies to all of the above systems.

Note 2: Both summer and winter versions of Hempaprime Multi 500 are pre-qualified.

Note 3: Avantguard® is a registered trademark of Hempel A/S.

NORSOK M-501 coating systems

# System 2

Areas with operating temperatures above 120°C/248°F and/or areas under insulation etc.

## System 2A: Consists of 200 µm thermally sprayed aluminium or alloys of aluminium top coated with the following systems.

**Pre-qualification is not required**

| Product | DFT (µm) |
|---|---|
| Hempadur 15570 (diluted) [1] | 25 |
| **Total** | **25** |

| Product | DFT (µm) |
|---|---|
| Hempadur Sealer 05990 [1] | 25 |
| **Total** | **25** |

| Product | DFT (µm) |
|---|---|
| Hempel's Silicone Aluminium 56914/3 [1] (diluted) | 25 |
| **Total** | **25** |

| Product | DFT (µm) |
|---|---|
| Hempadur 85671 [2] | 150 |
| Hempadur 85671 | 150 |
| **Total** | **300** |

Note 1: Sealer for thermally sprayed aluminium. Service temperature below 120°C/248°F.

Note 2: Alternative to thermally sprayed aluminium for insulated surfaces at service temperatures below 120°C/248°F.

## System 2B: Consists of 100 µm thermally sprayed zinc or alloys of zinc top coated with the following systems.

**Pre-qualification is required (for intermediate and topcoat as per System 1, see Note 2)**

| Product | DFT (µm) |
|---|---|
| Optional tie-coat | 25 [1] |
| Hempaprime Multi 500[3] | 125 |
| Hempathane HS 55610 | 75 |
| **Total** | **225** |

| Product | DFT (µm) |
|---|---|
| Optional tie-coat | 25 [1] |
| Hempaprime Multi 500[3] | 125 |
| Hempel's Pro Acrylic 55883 | 75 |
| **Total** | **225** |

| Product | DFT (µm) |
|---|---|
| Optional tie-coat | 25 [1] |
| Hempadur 4774D | 125 |
| Hempathane HS 55610 | 75 |
| **Total** | **225** |

Note 1: An optional tie-coat (mist coat) may be specified to avoid popping. Typically, 25 µm Hempadur 15590 (diluted) or 25 µm of the specified epoxy (diluted, mist coat technique) can be used. Contact your Hempel representative for further details. This note applies to all of the above systems.

Note 2: Topcoats which have been pre-qualified in System 1 may also be used for System 2B. Commonly used topcoats, which may be substituted for those listed, include:
- Hempaxane Light 55030
- Hempathane 55210
- Hempathane Speed-Dry Topcoat 250

This note applies to all of the above systems.

Note 3: Both summer and winter versions of Hempaprime Multi 500 are pre-qualified

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email protective@hempel.com

NORSOK M-501 coating systems

# System 3

## Internal surface of carbon steel vessels

### System 3A: Potable water tanks

**Pre-qualification is not required**

| Product | DFT (µm) |
|---|---|
| Hempadur 35560 WRAS 35°C, NSF | 300 |
| Hempadur 35560 | 300 |
| **Total** | **600** |

| Product | DFT (µm) |
|---|---|
| Hempadur 35600 WRAS 60°C | 300 |
| Hempadur 35600 | 300 |
| **Total** | **600** |

| Product | DFT (µm) |
|---|---|
| Hempadur Multi-Strength 35530 WRAS 23°C, NSF | 300 |
| Hempadur Multi-Strength 35530 | 300 |
| **Total** | **600** |

WRAS 23°C = Water Regulations Advisory Scheme, UK (Approved for potable water up to 23°C/73°F).
WRAS 35°C = Water Regulations Advisory Scheme, UK (Approved for potable water up to 35°C/95°F).
WRAS 60°C = Water Regulations Advisory Scheme, UK (Approved for potable water up to 60°C/140°F).
NSF = NSF International

Note 1: Potable water requirements generally come under the regulatory guidance of the country where the facility will be installed. The above are an example of approvals these products hold but are not exhaustive. Consult your Hempel representative for further guidance.

### System 3B: Ballast tanks

**Pre-qualification is required[2]**

| Product | DFT (µm) |
|---|---|
| Shopprimer | 20 |
| Hempadur Quattro XO 17720 | 160 |
| Hempadur Quattro XO 17720 | 160 |
| **Total** | **340** |

| Product | DFT (µm) |
|---|---|
| Shopprimer | 20 |
| Hempadur Quattro XO 17870 | 160 |
| Hempadur Quattro XO 17870 | 160 |
| **Total** | **340** |

| Product | DFT (µm) |
|---|---|
| Shopprimer | 20 |
| Hempadur Quattro XO 17820 | 160 |
| Hempadur Quattro XO 17820 | 160 |
| **Total** | **340** |

| Product | DFT (µm) |
|---|---|
| Shopprimer | 20 |
| Hempadur BT 35750 | 160 |
| Hempadur BT 35750 | 160 |
| **Total** | **340** |

Note 1: Various optional shop primers are approved - contact Hempel for details. This note applies to all of the coating systems listed in System 3B.

Note 2: Coating system 3B for ballast water tanks approved to IMO MSC.215 (82) shall be considered as qualified. This note applies to all of the above systems in System 3B, which comply to IMO resolution MSC.215 (82).

Note 3: Care should be taken to avoid excessive temperature gradients from adjacent storage areas. For temperature gradients above 15°C contact Hempel technical support. This note applies to all of the above systems in System 3B.



### System 3C: Tanks for stabilised crude, diesel and condensate

**Pre-qualification is not required**

| Product | DFT (µm) |
|---|---|
| Quattro XO 17720[1] | 160 |
| Quattro XO 17720[1] | 160 |
| **Total** | **320** |

| Product | DFT (µm) |
|---|---|
| Quattro XO 17820[1] | 160 |
| Quattro XO 17820[1] | 160 |
| **Total** | **320** |

| Product | DFT (µm) |
|---|---|
| Quattro XO 17870[1] | 160 |
| Quattro XO 17870[1] | 160 |
| **Total** | **320** |

| Product | DFT (µm) |
|---|---|
| Hempadur 15600[2] | 160 |
| Hempadur 15600 | 160 |
| **Total** | **320** |

| Product | DFT (µm) |
|---|---|
| Hempadur 85671[3] | 150 |
| Hempadur 85671 | 150 |
| **Total** | **300** |

| Product | DFT (µm) |
|---|---|
| Hempadur 85671[4] | 100 |
| Hempadur 85671 | 100 |
| Hempadur 85671 | 100 |
| **Total** | **300** |

| Product | DFT (µm) |
|---|---|
| Hempaline Defend 400[2] | 300 |
| Hempaline Defend 400 | 300 |
| **Total** | **600** |

| Product | DFT (µm) |
|---|---|
| Hempaline Defend 630[4] | 300 |
| Hempaline Defend 630 | 300 |
| **Total** | **600** |

Note 1: Content of aromates should be less than 15%. Maximum service temperature is 40°C/104°F. Loading and offloading up to 85°C/185°F.

Note 2: Maximum service temperature is 60°C/140°F. Loading and offloading up to 85°C/185°F.

Note 3: Maximum service temperature is 60°C/140°F.

Note 4: Maximum service temperature is 90°C/140°F.

Note 5: Care should be taken to avoid excessive temperature gradients from adjacent storage areas. For temperature gradients above 15°C contact Hempel technical support. This note applies to all of the above systems in System 3C.

Note 6: Approved to IMO Resolution MSC.288 (87):2010 - Annex II test procedures for coating qualification for cargo oil tanks of crude oil tankers. This note applies to all of the coating systems listed in System 3C.

## System 3D, 3E and 3F: Process vessels

**Pre-qualification is not required**

System 3D: Process vessels < 3 bar, < 75°C/167°F
System 3E: Process vessels < 70 bar, < 80°C/176°F
System 3F: Process vessels < 30 bar, < 130°C/266°F

| Product | DFT (µm) |
|---|---|
| Hempadur 85671 | 100 |
| Hempadur 85671 | 100 |
| Hempadur 85671 | 100 |
| **Total** | **300** |

| Product | DFT (µm) |
|---|---|
| Hempaline Defend 630 | 300 |
| Hempaline Defend 630 | 300 |
| **Total** | **600** |

Note 1: Suitability is subject to confirmation of actual operating conditions. This note applies to all systems in System 3D, 3E and 3F.

Note 2: For service temperatures up to 60°C/140°F.

| Product | DFT (µm) |
|---|---|
| Hempadur 85671 [2] | 150 |
| Hempadur 85671 | 150 |
| **Total** | **300** |

## System 3G: Vessels for storage of methanol, MEG etc

**Pre-qualification is not required**

| Product | DFT (µm) |
|---|---|
| Hempel's Galvosil 15700 | 100 |
| **Total** | **100** |

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email protective@hempel.com





# System 4

## Walkways, escape routes and lay down areas

## System 4: Decks

**Pre-qualification is required**

| Product | DFT (µm) |
|---|---|
| Hempadur Spray-Guard 35493 | 3000 |
| **Total** | **3000** |

| Product | DFT (µm) |
|---|---|
| Hempadur Spray-Guard 35493 | 1500 |
| Hempadur Spray-Guard 35493 | 1500 |
| **Total** | **3000** |

| Product | DFT (µm) |
|---|---|
| Hempadur 15590 | 20[1] |
| Hempadur Spray-Guard 35493 | 3000 |
| **Total** | **3020*** |

*According to ISO 19840

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email protective@hempel.com

Note 1: The use of Hempadur 15590 is optional.

Note 2: The coating schemes for System 4 relate to walkways, escape routes and laydown areas. Coating schemes pre-qualified according to NORSOK M-501
System 1 may be used for other deck areas with the addition of a non-skid aggregate (Hempel 67500). Hempel's Anti-slint 67500 may be added to the systems to provide non-slip properties. This note applies to all of the above systems.

# System 6

## Other metals when painting is required

## System 6A: Stainless steel and aluminium

**Pre-qualification is not required**

| Product | DFT (µm) |
|---|---|
| Hempadur 15570 or 15590 | 50 |
| Hempaprime Multi 500 | 100 |
| Hempel's Pro Acrylic 55883 [2] | 75 |
| **Total** | **225** |

Sweep blasting

## System 6B: Hot dip galvanized steel

**Pre-qualification is not required**

| Product | DFT (µm) |
|---|---|
| Hempadur 15553 | 50 |
| Hempaprime Multi 500 | 100 |
| Hempel's Pro Acrylic 55883 [2] | 75 |
| **Total** | **225** |

No sweep blasting

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email protective@hempel.com

## System 6C: Insulated stainless steel piping and vessels at temperatures < 150°C

**Pre-qualification is not required**

| Product | DFT (µm) |
|---|---|
| Hempadur 85671 | 125 |
| Hempadur 85671 | 125 |
| **Total** | **250** |

Sweep blasting

Note 1: As pre-qualification is not required additional systems may also be recommended. Contact your Hempel representative for further details. This note applies to all of the above systems.

Note 2: Topcoats which have been pre-qualified in System 1 may also be used for Systems 6A and 6B. Commonly used topcoats, which may be substituted for those listed, include:
- Hempaxane Light 55030
- Hempathane HS 55610
- Hempathane 55210
- Hempathane Speed-Dry Topcoat 250





# System 7

## Submerged carbon and stainless steel including the splash zone

## System 7A: Carbon and stainless steel in the splash zone

**Pre-qualification is required**

| Product | DFT (µm) |
|---|---|
| Hempadur 35560 | 300 |
| Hempadur 35560 | 300 |
| **Total** | **600** |

| Product | DFT (µm) |
|---|---|
| Hempadur Multi-Strength 35620 | 300 |
| Hempadur Multi-Strength 35620 | 300 |
| **Total** | **600** |

| Product | DFT (µm) |
|---|---|
| Hempadur Multi-Strength 45703 | 300 |
| Hempadur Multi-Strength 45753 | 300 |
| Hempathane HS 55610 | 60 |
| **Total** | **660** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 770 | 60 |
| Hempadur 35560 | 240 |
| Hempadur 35560 | 240 |
| Hempathane HS 55610 | 60 |
| **Total** | **600** |

| Product | DFT (µm) |
|---|---|
| Hempadur Multi-Strength 35620 | 275 |
| Hempadur Multi-Strength 35620 | 275 |
| Hempathane HS 55610 | 60 |
| **Total** | **610** |

| Product | DFT (µm) |
|---|---|
| Hempadur Multi-Strength 35460 | 300 |
| Hempadur Multi-Strength 35460 | 300 |
| **Total** | **600** |

| Product | DFT (µm) |
|---|---|
| Hempadur 15590 | 50 |
| Hempadur Multi-Strength 35460 | 300 |
| Hempadur Multi-Strength 35460 | 300 |
| **Total** | **650** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 770 | 60 |
| Hempadur Multi-Strength 35620 | 240 |
| Hempadur Multi-Strength 35620 | 240 |
| Hempathane HS 55610 | 60 |
| **Total** | **600** |

| Product | DFT (µm) |
|---|---|
| Hempadur 15590 | 20[1] |
| Hempadur Spray-Guard 35493 | 3000 |
| **Total** | **3020** |

Note 1: According to ISO 19840
Note 2: Avantguard® is a registered trademark of Hempel A/S

## System 7A: Carbon and stainless steel in the splash zone continued

**Pre-qualification is required**

| Product | DFT (µm) |
|---|---|
| Hempadur Multi-Strength 35840 | 300 |
| Hempadur Multi-Strength 35840 | 300 |
| **Total** | **600** |

| Product | DFT (µm) |
|---|---|
| Hempadur Multi-Strength 35842 | 750 |
| Hempadur Multi-Strength 35842 | 750 |
| **Total** | **1500** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 770 | 60 |
| Hempadur Multi-Strength 45753 | 240 |
| Hempadur Multi-Strength 45753 | 240 |
| Hempathane HS 55610 | 60 |
| **Total** | **600** |

## System 7B: Submerged carbon and stainless steel ≤ 50°C/122°F

**Pre-qualification is required**

| Product | DFT (µm) |
|---|---|
| Hempadur Multi-Strength 45703 | 175 |
| Hempadur Multi-Strength 45753 | 175 |
| **Total** | **350** |

| Product | DFT (µm) |
|---|---|
| Hempadur 15590 | 50 |
| Hempadur Multi-Strength 35840 | 300 |
| **Total** | **350** |

| Product | DFT (µm) |
|---|---|
| Hempadur Quattro XO 17720 [1] | 175 |
| Hempadur Quattro XO 17720 | 175 |
| **Total** | **350** |

Note 1: Only prequalified in aluminium shades.

Note 2: Systems approved for System 7A shall also meet the requirements for System 7B if applied at the film thickness for which System 7A approval was granted.

## System 7C: Submerged carbon and stainless steel > 50°C/122°F

**Pre-qualification is required**

| Product | DFT (µm) |
|---|---|
| Hempadur 85671 [1] | 125 |
| Hempadur 85671 | 125 |
| Hempadur 85671 | 100 |
| **Total** | **350** |

Note 1: Pre-qualified for steel temperature up to 150°C/300°F.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email protective@hempel.com





# System 8

## Structural carbon steel

Structural carbon with an operating temperature of 80°C/176°F in internal, fully dry and well ventilated areas.

**Pre-qualification is not required**

| Product | DFT (µm) |
|---|---|
| Hempel's Galvosil 15700 | 60 |
| Hempadur 15570 (diluted 20 percent) | 25 |
| **Total** | **85** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 860 | 60 |
| Hempadur 15570 (diluted 20 percent) | 25 |
| **Total** | **85** |

| Product | DFT (µm) |
|---|---|
| Hempaprime Multi 500 | 150 |
| **Total** | **150** |

| Product | DFT (µm) |
|---|---|
| Hempadur Avantguard 750 | 60 |
| Hempadur 15570 (diluted 20 percent) | 25 |
| **Total** | **85** |

Note 1: May be topcoated as required. Commonly used topcoats include:
- Hempaxane Light 55030
- Hempathane HS 55610
- Hempathane 55210
- Hempel's Pro Acrylic 55883
- Hempathane Speed-Dry Topcoat 250

This note applies to all of the above systems.

Note 2: As pre-qualification is not required additional systems may also be recommended. Contact your Hempel representative for further details.

Note 3: Avantguard® is a registered trademark of Hempel A/S.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email protective@hempel.com

# System 9

## Valves

### Bulk supplied carbon steel valves with operating temperatures up to 150°C/302°F.

**Pre-qualification is not required**

| Product | DFT (µm) |
|---|---|
| Hempadur 85671 | 150 |
| Hempadur 85671 | 150 |
| **Total** | **300** |

| Product | DFT (µm) |
|---|---|
| Versiline CUI 56990 | 200 |
| Versiline CUI 56990 | 200 |
| **Total** | **400** |

Note 1: For temperatures above 150°C thermally sprayed aluminium shall be used. This note applies to all of the above systems.

Note 2: An alternative system if agreed with the purchaser may be 1 x 75 µm zinc ethyl silicate and an epoxy tie-coat in accordance with System 1. Final coating shall then be done after insulation. Hempel recommend that this is used for uninsulated items only.

Note 3: Versiline® is a registered trademark of Hempel A/S.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email protective@hempel.com



NORSOK M-501 coating systems

# Hempel NORSOK coating systems

**System 1 (pre-qualified)**
Carbon steel with operating temperature below 120°C/248°F
- Structural steel
- Exteriors of equipment, vessels, piping and valves (not insulated)

**System 2**
Areas with operating temperatures above 120°C/248°F and/or areas under insulation etc

**System 3A-3G (System 3B pre-qualified)**
Internal surface of carbon steel vessels

**System 4 (pre-qualified)**
Walkways, escape routes and lay down areas

**System 5A (pre-qualified)**
Passive fire protection

**System 5B (pre-qualified)**
Cement-based fire protection

**System 6A**
Uninsulated stainless steel when painting is required.
Aluminium when painting is required

**System 6B**
Hot-dipped, galvanised steel when painting is required

**System 6C**
Insulated stainless steel piping and vessels at temperatures < 150°C/302°F

**System 7A (pre-qualified)**
Carbon and stainless steel in the splash zone

**System 7B (pre-qualified)**
Submerged carbon and stainless steel ≤ 50°C/122°F

**System 7C (pre-qualified)**
Submerged carbon and stainless steel > 50°C/122°F

**System 8**
Structural carbon steel with an operating temperature of <80°C/176°F in internal, fully dry and well ventilated areas

**System 9**
Bulk supplied carbon steel valves with operating temperatures up to 150°C/302°F

Note: DFT = dry film thickness





**What is NORSOK M-501?**

NORSOK M-501 is a standard document developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. It is intended to replace oil company specifications for offshore installations where possible.

**Do all systems need to be tested to comply with NORSOK?**

No, not all of the sections of NORSOK require testing, referred to as pre-qualification. The main sections which require pre-qualification are System 1, System 3B, System 4, System 5A/5B and System 7A/B/C.

For the remaining systems it is permitted to offer any coating schemes provided they meet the generic requirements and minimum DFT's listed for that system. In the case of Systems 2B, 6A and 6B it is required that certain parts of the proposed coating scheme have already been pre-qualified according to other systems.

**What type of testing is required?**

NORSOK is not a test method. It is a standard document which lists different test methods and acceptable values for various offshore uses and environments. The type of pre-qualification testing which is required depends upon the system the coating scheme is being proposed for. Many of the pre-qualification requirements are currently based around ISO 20340:2009 with additional supplementary testing being required in some cases.

**Is there some type of listing when a system is approved?**

Systems are not approved by NORSOK, manufacturers simply claim whether they are in compliance with the standard or not. The primary means of evidence of compliance is via a mandatory third party laboratory report which will clearly state whether the coating scheme tested is compliant with the standard or not. Many coating manufacturers keep lists of their compliant systems either in print or on their internet sites. This may or may not be their complete listings.

**What about coating schemes that have been tested according to previous revisions of the standard?**

NORSOK allows coating schemes that have been tested to previous revisions provided several rules have been followed.

For full guidance on whether specific previous testing is compatible with the current standard then please contact your local Hempel representative.

**Can pre-qualification be carried out by the coating supplier?**

No, pre-qualification must be carried out at an independent test laboratory. Suppliers can of course test in house to the same standard and this is often done prior to submitting a coating scheme for external testing to gauge the likelihood of success.

**How long does testing take?**

Many of the exposure periods in the NORSOK standard require 4200 hours test exposure (6 months approximately). When preparation of test panels, supplementary testing, post-exposure inspection and report writing is taken into consideration testing may exceed 9 months. There is no way to accelerate this timeframe and it should be considered when asking for new schemes to be pre-qualified.

**What is the connection between NORSOK systems and those systems mentioned in ISO 12944:2018 Part 9?**

Whilst currently NORSOK Edition 6 continues to reference ISO 20340 and as such has no direct correlation with the new ISO 12944:2018 Part 9 standard, the fact that they use the same test parameters should mean that comparisons could be made.

However the results of any testing to the new ISO 12944:2018 Part 9 standard should be reviewed against the acceptance criteria for the current edition of Norsok M-501.

NORSOK M-501 coating systems

# System 1

I have been told that the topcoat can be changed in systems that have been pre-qualified. Is that correct?

Yes it is correct. However, there are certain rules that must be considered. Firstly, you can only swap the topcoat, provided that the intermediate coat remains the same. Secondly, the DFT of the alternate topcoat should be the same as that of the approved one.

Some companies claim to have non zinc schemes that are approved to NORSOK System 1. How come?

Schemes based around non-zinc primers may be pre-qualified according to NORSOK System 1 under certain conditions. Note 6 to System 1 states that specialised systems without zinc can be used if there is a minimum of two coats with total dry film thickness in excess of 1,000 microns, the system has passed the aging test demonstrating corrosion creep of < 8 mm, and successful prior field experience can be documented.

What about using a shop primer? Is this permitted?

Use of a 15 µm zinc ethyl silicate shop primer as an integrated part of coating System 1, 3B, 4, 5, 7 or 8 is covered by some strict guidance. Firstly one coating system (System 1, System 3B or System 7) shall be tested with and without the shop primer. If this testing is successful then the shop primer may be used in conjunction with any coating system that has been pre-qualified, whether that pre-qualification included a shop primer or not.

However for System 4 and System 5 the whole system including shop primer must be pre-qualified.

Can I use any zinc rich primer for System 1?

Whilst System 1 does not distinguish between the various type of zinc rich primer it does state that they must meet the requirements of ISO 12944-5. Both zinc epoxy and zinc silicate types are accepted. Minimum 80% Zn-dust in dry film.

What about the use of tie coats? Do they need to be pre-qualified for System 1?

The use of tie coats relates to zinc rich primer systems. NORSOK guidance is not 100% clear on this issue but states “This tie-coat/sealer shall either be of a thickness below 50 µm or pre-qualified as a part of the coating system” implying that provided it is below 50 microns pre-qualification is not required. Hempel tries to avoid any doubt and usually pre-qualifies systems with a tie coat, at least for zinc silicates.

Once pre-qualified all coating schemes are considered equal. Is this correct?

No. NORSOK suggests that for external surfaces those schemes with a chalking rating of 1 or better should be shown preference. Of course operators can also express preference based upon the test results. Generally but not always, for System 1 they will use the corrosion creep as a means of determining performance.

Is there any situation where I can pre-qualify a non zinc coating for System 1?

Yes. Schemes based around non-zinc primers are permitted to be pre-qualified according to NORSOK System 1 for particularly exposed areas but only under certain conditions. Note 6 to System 1 states that specialised systems without zinc can be used if there is a minimum of two coats with total dry film thickness in excess of 1,000 microns, the system has passed the aging test demonstrating corrosion creep of < 8 mm, and successful prior field experience can be documented.

## System 2

System 2 is not about paints? Is that correct?

System 2, although primarily dealing with thermally sprayed metals is also one of the systems considering corrosion under insulation which is an important topic in the offshore oil and gas industry. It provides some guidance on where paint systems can be used in this area. It also covers the guidelines for sealing of thermally sprayed metals an important component in their success.

As pre-qualification is not required can any coating be used?

For further guidance on which schemes are suited consult the Hempel NORSOK M501 system sheet or your local Hempel representative. Note also that for System 2B the intermediate and topcoat should also have been pre-qualified as per System 1 though not necessarily at the same thickness.

## System 3A

NORSOK is a Norwegian developed standard so do I need Norwegian potable water approval?

No, potable water requirements generally come under the regulatory guidance of the country where the facility will be installed. Consult the owner for further clarification.

## System 3B

Hempel has a lot of systems approved for 3B. Have they all been tested according to NORSOK?

Pre-qualification to System 3B may also be carried out by testing to IMO MSC.215 (82). As this is a standard requirement for many marine vessels, Hempel has a significant number of systems listed. Note that IMO also lists an alternate testing method. Coatings submitted via the alternate route cannot be considered as pre-qualified for NORSOK M-501 System 3B.

## System 3C

Does the same apply for cargo oil tanks? Can I use IMO testing to pre-qualify for System 3C?

System 3C does not require pre-qualification so there is no specific requirement although increasingly it is common that owners will prefer accreditation to IMO MSC 288 (87) : 2010. Note the difference in coverage areas between IMO and NORSOK in relation to tank tops.





## System 3D, 3E and 3F

Systems 3D, 3E and 3F don't require pre-qualification. What types of coatings can be used?

These systems are often used for process equipment operating at elevated temperature and pressure. As the conditions in these types of vessels can vary from field to field it is essential that you fully understand the operating conditions that you are dealing with. Contact your local Hempel representative for further information.

## System 4

Do I have to coat whole deck areas in the thick film systems described in System 4?

No, the coating schemes described for System 4 relate to walkways, escape routes and laydown areas. Coating schemes that have been pre-qualified according to System 1 can be used for remaining deck areas.

## System 5A

Can Hempel topcoats be used for System 5A?

Yes, Hempel topcoats may be offered for System 5. Prior to application of the topcoat a tie coat must be utilised for the system. Top coating should be in accordance with the passive fire protection manufacturers recommendations. As NORSOK pre-qualified schemes are typically tested without topcoat the choice of an alternate topcoat does not typically affect NORSOK pre-qualification.

## System 5B

Are the rules any different for System 5B?

No not really. Primers shall be tie coated and all coating products used shall be in accordance with the passive fire protection manufacturers' guidance.

## System 6

Can any coatings used for carbon steel also be used on stainless steel?

No, stainless steel has specific requirements. In particular coatings containing zinc or certain impurities (such as Chlorides) shall not be used on stainless steel under any circumstances. Stainless steel shall be blasted with chloride free non-metallic abrasive.

Ok, apart from zinc containing coatings is there anything else that applies here?

Yes. Only topcoats that have already been pre-qualified as per System 1 shall be used for System 6A and 6B.





## System 7

System 7 is a single system that requires to be pre-qualified, correct?

No. System 7 is actually made up of three discrete systems, 7A, 7B and 7C the pre-qualification requirements for which are different. System 7A relates to the splash zone, whereas System 7B relates to submerged areas at temperatures less than 50 °C. System 7C relates to submerged areas at operating temperatures > 50 °C and is often used to pre-qualify coating systems for sub-sea pipework and process equipment.

How different are the pre-qualification requirements?

In short all of the systems require immersion and cathodic disbondment testing which is the basic requirement of System 7B. In addition to this, System 7A also requires the same aging resistance testing used in System 1 to take into account changing conditions in the splash zone. System 7C uses immersion and cathodic disbondment, however the cathodic disbondment testing is carried out at higher temperatures.

Are systems pre-qualified for System 7A also pre-qualified for System 7B?

Yes but only at the total dry film thickness for which pre-qualification for System 7A was carried out. Minimum DFT requirements are different and 7A systems are generally not competitive for 7B although they fulfil all requirements.

The system describes use on carbon steel and stainless steel. Which substrate is pre-qualification carried out on?

In short, pre-qualification is usually carried out on carbon steel but the resulting pre-qualification is subsequently valid for both, remembering that coatings containing zinc (and certain other impurities) shall not be used on stainless steel under any circumstances. Stainless steel shall be blasted with chloride free non-metallic abrasive.

What temperature do I carry out my elevated temperature cathodic disbondment at for System 7C?

The choice of temperature is up to the supplier pre-qualifying their product, however once tested the pre-qualification is only valid for temperatures up to that temperature which was tested. Note that to qualify for temperatures > 100 °C requires the electrolyte to be pressurised and requires very specialist test equipment.

## System 8

System 8 is also for structural carbon steel, how does it differ from System 1?

System 8 is for structural carbon steel for temperatures < 80 °C that is in a dry and fully ventilated area. Because of this it allows non-zinc systems to be used. However, the system should not be used on surfaces where water condensation may occur.

But what if it has to be transported/stored outside before going into service?

If this is the case then coating System 1 shall be utilised.

# System 9

System 9 describes bulk supplied valves. What does this mean exactly?

Bulk valves are valves that are supplied against certain performance requirements but where their exact usage may not be known at the time of ordering. As a result of this it may sometimes be difficult to identify what coating system is required.

That sounds problematic, how does NORSOK control this?

NORSOK controls this in a number of ways. Firstly it restricts the temperature range for this category to less than < 150 °C. Secondly it limits the metal type to carbon steel. Finally it requires that where the service conditions are known at the time of ordering then the applicable NORSOK coating system must be selected.

Are epoxy phenolics the only systems that can be used?

No. NORSOK allows for an alternative system including Zinc Silicate and an epoxy tie coat prior to final coating after installation. The epoxy tie coat must be in accordance with System 1. Hempel does not recommend the use of zinc based systems beneath thermal insulation.

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# General comments:

These questions and answers are based upon NORSOK M-501 Edition 6, February 2012 and are not necessarily applicable to earlier revisions.

These comments are intended for guidance only. In some cases the wording of the standard may be open to individual interpretation. For further clarification consult Hempel business support.

It is recommended that this document is read in conjunction with the standard document itself.

The standard document is available at https://www.standard.no/en/sectors/energi-og-klima/petroleum/norsok-standard-categories/m-material/m-5014/



NORSOK M-501 coating systems

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**About Hempel**
As a world-leading supplier of trusted coating solutions, Hempel is a global company with strong values, working with customers in the protective, marine, decorative, container and yacht industries. Hempel factories, R&D centres and stock points are established in every region.

Across the globe, Hempel's coatings protect surfaces, structures and equipment. They extend asset lifetimes, reduce maintenance costs and make homes and workplaces safer and more colourful. Hempel was founded in Copenhagen, Denmark in 1915. It is proudly owned by the Hempel Foundation, which ensures a solid economic base for the Hempel Group and supports cultural, social, humanitarian and scientific purposes around the world.

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