SUBSEA APPLICATION AND REPAIR GUIDELINES FOR PHENGUARD™

PPG SUBSEA SYSTEM APPLICATION GUIDELINES FOR PHENGUARD

The following table lists the approved subsea system for NORSOK M501 Rev.6 System 7C:

Table 1: NORSOK M501 Rev.6 System 7C Approved System		
Coat	**Product**	**DFT**
First	PHENGUARD 930	100 µm (4 mils)
Second	PHENGUARD 935	125 µm (5 mils)
Third	PHENGUARD 930, PHENGUARD 940 or PHENGUARD SUBSEA 780	125 µm (5 mils)

PHENGUARD SUBSEA 780 (formerly SIGMALINE 780) was specifically designed as an alternate topcoat for color options for subsea applications. PHENGUARD SUBSEA 780 colors include a gold yellow, bright yellow, and orange (the listed colors are approximations of RAL 1004, RAL 1018, and 2004 respectively).

The PHENGUARD system was originally developed as a chemically resistant tank coating and the standard product data sheet reflects the application requirements for when PHENGUARD is used as a tank coating.

The subsea system using PHENGUARD has been tested to NORSOK M501 Rev.6 System 7C and has an extensive track record in the subsea market. Application conditions for subsea equipment are greatly different to those of a tank coating. Subsea applications conditions are much better in terms of ventilation, curing temperature and solvent release. Therefore, the PHENGUARD subsea system for in-shop application can be used with reduced overcoating times.

The curing and overcoating tables below are applicable for when PHENGUARD is used for subsea applications.

For your convenience, PPG has developed a curing table for the complete subsea system based on the total measured DFTs.

Table 2: Curing time (*) for the total measured DFT				
Substrate Temp	**350 µm (14 mils)**	**400 µm (16 mils)**	**450 µm (18 mils)**	**525 µm (21 mils)**
10°C (50°F)	6 days	6 days	7 days	8 days
15°C (59°F)	5 days	5 days	6 days	7 days
20°C (68°F)	3.5 days	3.5 days	4 days	5 days
30°C (86°F)	2.5 days	2.5 days	3 days	4 days
40°C (104°F)	1.5 days	1.5 days	1.5 days	2 days

(*) denotes ready for insulation using a non-aggressive adhesive

The specified minimum total dry film thickness is 350 µm (14 mils) the maximum average DFT is 525 µm (21 mils) and locally the maximum DFT should not exceed 600 µm (24 mils).

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The subsea system has the following overcoating intervals per coat:

Table 3: Overcoating time per coat measured DFT			
Substrate Temp	**100 µm (4 mils)**	**125 µm (5 mils)**	**150 µm (6 mils)**
10°C (50°F)	36 hours	48 hours	60 hours
15°C (59°F)	32 hours	40 hours	48 hours
20°C (68°F)	24 hours	30 hours	30 hours
30°C (86°F)	16 hours	24 hours	24 hours
40°C (104°F)	12 hours	20 hours	20 hours

Pull off adhesion curing times

In general, coating systems need to be fully cured (21 days) to exhibit their full adhesion characteristic. However, it is recognized that this practice can have an impact on process idle time for OEM applications. Therefore, PPG has modified the recommendation. Table 2 illustrates the minimum recommended cure time before conducting pull-off adhesion testing.

If the minimum pull-off value required is not achieved (5 MPa according to NORSOK M-501) after the above times, then the system should be left to further cure for two additional days in well ventilated conditions at a minimum of 20°C (68°F) before repeating the adhesion test.

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PPG SUBSEA SYSTEM REPAIR GUIDELINES FOR PHENGUARD

The following repair guidelines are applicable for PHENGUARD and PHENGUARD SUBSEA 780 systems with a maximum area of 100 cm^2 (15 in^2). For larger repair areas, re-blasting is required with application of the complete subsea system.

Nature of Damaged Coatings

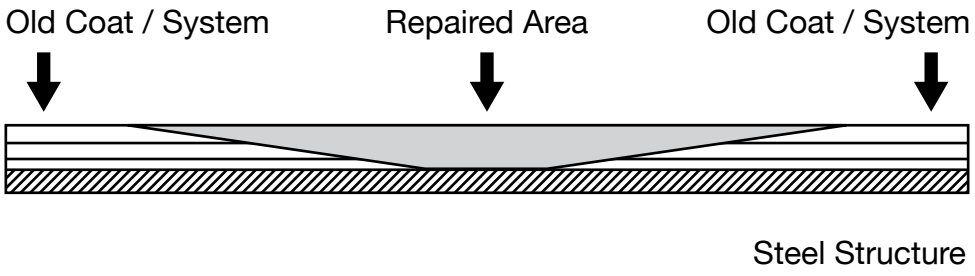
1) Damage to topcoat or down to the intermediate coat

- Remove any loose and flaking coating to a firm sound edge
- Thoroughly clean and degrease area to be repaired
- Feather back existing sound coating abraded area to be coated and surrounding area (5 cm / 1.97 in) if necessary (depends on time since application of previous coat and whether the maximum overcoating time has passed)
- Ensure surface to be coated is dry and free from any contamination immediately prior to coating (including any dust from abrading)
- Re-apply topcoat at specified DFT overlapping existing system by about 5 cm (1.97 in)

2) Damage down to substrate (bare metal)

- Remove any loose and flaking coating to a firm sound edge
- Thoroughly clean and degrease area to be repaired
- Feather back existing intact coating

Drawing - feathered spot coating repair



a) Undamaged bare metal – if the original specified standard of cleanliness and profile is undamaged

- Ensure surface to be coated is dry and free from any contamination immediately prior to coating (including any dust from abrading)
- Re apply damaged primer, intermediate and topcoats at specified DFT overlapping as existing intact system by about 5 cm (1.97 in)

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b) Damaged bare metal – if surface is corroded, damaged or original specified standard of cleanliness and profile does not exist

- For small areas – mechanically prepare to achieve ISO 8501: St3 standard of cleanliness with original specified profile. Take care not to over polish
- For large areas – re blast area to original specified standard of cleanliness and profile
- Re apply damaged primer, intermediate and topcoats at specified DFT overlapping existing intact system by about 5 cm (1.97 in)
- For areas where new work has taken place, for example welding; then the area should re blasted to original standard

Note: The preferred surface preparation of bare metal is to re-blast. We accept that in some circumstances this may not be practical. If the area has small mechanical damage; then St3 standard is acceptable; however, if there are several scattered small areas adjacent to one another, it may be quicker and more cost effective to re blast that area.

OVERCOATING AND CURING SCHEDULE FOR REPAIR COATINGS

The overcoating and curing times on the respective product datasheets should be followed.

With the PHENGUARD subsea system it is acceptable to use the following overcoating table for small repair areas:

Table 4: Overcoating time for Repair Work

Substrate Temperature	Minimum	Maximum
10°C (50°F)	28 hours	28 days
15°C (59°F)	20 hours	25 days
20°C (68°F)	14 hours	21 days
30°C (86°F)	6 hours	14 days
40°C (104°F)	4 hours	7 days

Note: For repair areas defined as less than 100 cm^2 (15 in^2) the minimum overcoating time in the table above will be slightly shorter compared to full application because of better control of DFT and less solvent emission from the coating.

Temperatures

If elevated temperatures are to be used on the repair areas to decrease overcoating and curing times the following points should be noted:

- The product datasheets give a range of temperatures showing overcoating and curing times for the products. It is acceptable to use elevated temperatures in line with the product datasheet overcoating times and curing times. Exceptions to this must be authorized by the PPG.
- It is recommended that a minimum flash off time of 1 hour is allowed between coating application and elevating the temperature.

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