

# TANKBOTTOM MAINTENANCE

## working procedure

4139

a twelve page issue

September 2005  
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This working procedure is a guideline for best tank maintenance practice.

### 1. BEFORE STARTING THE PAINTING JOB

The tank should be delivered in such a condition that it can be adequately coated before starting the painting job. Conditions to be fulfilled are gas free and cleanliness.

#### 1.1 Gas free

The tank should be delivered in a gas free condition according to the prevailing laws and regulations.

#### 1.2 Cleanliness

A Approx. 2 meters adjacent to the area to be coated should be free from all contamination such as: Sludge, water, fat, oil, grease etc.

In case of a floating roof tank also the underside of the roof should be cleaned and/or sweep blasted to remove loose corrosion products and other contamination.

To keep the substrate clean and to avoid contamination from the upper part of the tank it is recommended to seal off the area by means of a tent or to use the internal floating roof as a cover. For protection against rain water the gap between floating roof seal and tank shell shall be water proofed.

#### 1.3 Condition of the substrate to be treated

Prior to the blasting operation the substrate should be checked for oil and other contaminations according to 2.4.1.

The result of this inspection will determine the pretreatment procedure.

- Heavily scaled surfaces are to be de-scaled by pneumatic tools and/or hammers prior to grit blasting.
- All sharp edges should be broken or ground-off to approximately 3.0 millimeters (0.12 inch) radius as minimum.
- All welding spatter and slag to be removed.
- All corner cut-outs to be cleaned from all weld and burn slag.
- Any undercuts/blowholes to welds requiring re-welding have to be repaired prior to grit blasting.
- All plate laminations should be ground off with a grinding machine.
- All welding and burning in a tank or adjacent areas of tank should be completed prior to grit blasting.
- All welding lugs, brackets, etc. to be removed. After removal, such areas are to be ground to provide a smooth surface, as well as any other areas of damage which may have occurred during erection.



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- Weld seams, if necessary, to be ground so as to eliminate sharp profiles.
- Repairs of pits where the loss of steel is extensive may be carried out by means of welding or glueing steel plates. In this case prevailing regulations should be respected.

### 1.4 Additional requirements

Enough access holes should be available to carry out the different activities and to install proper ventilation equipment.

Local regulations have to be followed

### 1.5 Acceptance

Acceptance of the conditions of the tank should be agreed between the tank owner and the various parties involved.

If the condition is not in accordance to the required standard, the tank owner should carry out additional work.

## 2. BLASTING AND COATING SPECIFICATION

### 2.1 Lighting

Adequate lighting is to be provided to enable the work to be carried out and should be in accordance with the safety regulations of the plant.

### 2.2 Ventilation

- Adequate ventilation is to be maintained at all times during blasting and until the coating job is completed and cured in accordance with manufacturer's application instructions (see also information sheet 1434 and product datasheet).
- Ventilation shall be of sufficient capacity and if necessary dehumidified to prevent condensation at the substrate.

### 2.3 Compressed air

All compressed air sources shall have properly sized and designed oil and moisture separators, attached and functional, to allow air at the nozzle, either for blast cleaning, blow-off or painting, to be oil-free, and moisture-free. They shall have sufficient pressure/capacity to accomplish the associated work efficiently and effectively.

Compressors for blast cleaning shall supply a minimum of 9 m<sup>3</sup>/min (300 cfm) per blast nozzle at 7 atm. (100 psi) pressure at the nozzle. This should be fed via an efficient water trap into a reservoir placed as close as possible to the tanks being blasted and coated.

The blotter test shall be performed at the start of each blasting shift and at least every four hours during the blasting operation by the Contractor to ensure that the compressed air is free of oil and moisture. The blotter test shall be performed in accordance with the procedure outlined in ASTM D4285. For contaminated air sources, the oil and moisture separators shall be drained and the air retested.



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### 2.4 Surface preparation

#### 2.4.1 Substrate cleanliness prior to grit blasting

Depending on the presence of residual oil, grease and other contaminations the substrate should be cleaned by means of:

Steam cleaning to remove oil, grease, or high pressure water cleaning (with detergents) to remove oil, grease and other contaminations, which is described in ISO 8504.

Note: If high pressure water cleaning with detergents has been used rinsing with fresh water shall be carried out to remove residues of detergents and other residual water soluble materials.

#### 2.4.2 Moisture control and ventilation (during grit blasting and coating)

The contractor shall provide sufficient ventilation, heating or cooling, and dehumidification equipment so that at all stages during the contract i.e. grit blasting, paint application and curing, the conditions in the tank are maintained in accordance with the following:

- The tank must be kept in a condensation free condition.
- The substrate temperature shall be at least 3 °C above the dew point as recommended in the respective product datasheet.
- During grit blasting and application of the system it is recommended that the relative humidity must be below 80 % (quality of blasting standard will be maintained for longer periods when humidity is lower than 50 %).
- During application and curing of the coating system, the tank must be maintained in a well-ventilated, condensation free condition, in accordance with product datasheet.
- All ventilation ducting must be arranged to give maximum efficiency and a slight over pressure in the tank has to be maintained.
- Rain shelters must be erected in way of tank entrance and any other openings to prevent ingress of rain, dust and other contaminants.
- In cold conditions it may be necessary to partially insulate the outside of the tank to keep the minimum required steel temperature according to product datasheet. This depending on outside temperature, capacity of dehumidifier/heater, and the structural design of the tanks (see also information sheet 1433 and 1434).



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### 2.4.3 Scaffolding/staging

- If staging is required it should be constructed in such a way that maximum safe access to all surfaces is obtained. Special care is to be taken to ensure that staging boards and staging pole ends do not mask areas to be treated. It is recommended that the distance between staging and substrate should be to a minimum of 30 centimeters (12 inch) and a maximum of approximately 60 cm (24 inch). All contact between scaffolding poles and steel surfaces is to be point contact only i.e. spade ends to be fitted.
- All staging must be capable of being cleaned satisfactorily.
- Tubular staging poles must be plugged or capped prior to grit blasting, and remain plugged until coated areas are accepted.
- All staging should be according local rules and regulation.

### 2.4.4 Grit blasting

- Blast grade shall be carried out in accordance with coating specification (ISO 8501-2).
- The type of grit used for blast cleaning should meet the following requirements, which is also described in ISO 11124 and ISO 11126.
  - Fresh, preferably mineral grit shall be used for all grit blasting operations.
  - Mineral abrasives such as corundum, aluminum silicate slag, or any slag mixtures which are suitable for removing rust, scale, old paint or shop primer from steel by blast cleaning and giving a satisfactory anchor pattern shall be used. This specification covers only those abrasives commonly known as utility grades.

If recycled grit has been used, care should be taken regarding that contamination, such as oil, grease, water soluble salts etc, is within specification.
  - The abrasive material may be any material meeting the requirements of this specification. It shall be composed of clean, sound, hard particles free from foreign substances such as dirt, oil, grease, toxic substances, organic matter and water soluble salts. The abrasive supplier shall certify that any product to be delivered conform to all requirements stated herein.
  - The pH can be determined by using 100 gram of a representative abrasive sample which is crushed using a mortar and pestle. Approximately 50 grams of the crushed sample is added to 200 ml de-ionized water. The pH of this slurry is then determined through the use of an electronic pH meter with an accuracy of  $\pm 0.01$  pH unit. A slurry mixture prepared in this way shall not have a pH below 6.20.
  - The amount of water soluble salts of the abrasive should be determined (ISO 11127-6) by mixing it with de-ionized water, in the proportion 1:2, e.g. 50 cm<sup>3</sup> abrasive to 100 cm<sup>3</sup> water (maximum conductivity 1  $\mu$ S/cm). The mixture is shaken for 5 minutes, allowed to settle for at least 1 hour and then shaken again for 5 minutes. Some of the water is decanted, the temperature is recorded and the conductivity measured by a conductivity gauge.



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If the conductivity gauge does not have any temperature compensation adjustment, the conductivity should be converted to 20°C or measurement should be carried out at this temperature. If the conductivity exceeds 300 µS/cm) the abrasive is rejected.

- The moisture content of the abrasive should be determined (ISO 11125-7) by weighting approximately 200 grams of abrasive to the nearest 0.1 g in a tarred weighing dish and dried at 105 to 110°C for 3 hours or more until successive weightings after additional 1 hour heating periods show a weight change of not more than 0.1%. The percentage of moisture is calculated as follows:

$$\text{Percentage moisture} = \frac{\text{original weight} - \text{final weight}}{\text{original weight of sample}} \times 100$$

- The moisture content for material delivered in bags or in bulk shall not exceed 0.5% by weight.
  - The abrasive shall not be contaminated with oil and grease. 10 cm<sup>3</sup> abrasive is shaken with 10 cm<sup>3</sup> methylene chloride or dry cleaning spirit for about 5 minutes. 5 drops of the solvent are applied to a clean glass plate. After complete evaporation of the solvent the glass plate is exposed to ultraviolet light in total darkness. If there is blue fluorescence the abrasive is rejected.
  - The individual abrasive grains shall be angular in shape.
  - The abrasive material shall produce a prescribed blasting profile R<sub>z</sub> value (varying between 50-100 µm)
- Only experienced and skilled grit-blasters are to be employed on this work.
  - Before main grit blasting is started it recommended to pre-blast a number of test areas for determination of soluble salts. The test area should comply with the blast standard and inspection shall be carried out. This includes also the blasting profile, and removal of grit adhering to steel surfaces. The total allowable soluble salts level of chlorides equivalents on the surface shall be maximum 60 mg/m<sup>2</sup>, which corresponds to a conductivity of 12 µS/cm. The assessment of salts level shall be carried out in accordance with ISO 8502-6 (Bresle Test Method) or ISO 8502-9. If assessment shows too high values additional cleaning shall be carried out.
  - After blast cleaning the surface should be free from all mill scale, rust, grease, paint marks and other foreign matters and should comply with the required standard.
  - Care is to be taken to ensure that the areas on the bottom covered by scaffolding support tubes are taken into the blasting schedule.



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### 2.5 Surface cleaning: after blasting

- Immediately after the blast cleaning is finished all grit, dirt and dust is to be removed from the area to be coated and from staging above the blasted area.
- Scaffolding and tank fittings shall be cleaned and free from spent abrasive.
- Final cleaning should be carried out by means of powerful vacuum cleaners to provide dust free and clean surface suitable for coating. Particular attention should be given to removal of grit and dust from pitted areas and welds.
- After completion the cleaning operation, inspection of the blast standard shall be carried out. This includes also the blasting profile, and removal of grit adhering to steel surfaces. A soluble salt test will be conducted at this stage. A soluble salt test will be conducted at this stage. The total allowable soluble salts level of chloride equivalents on the surface shall be maximum 60 mg/m<sup>2</sup>, which corresponds to a conductivity of 12 μS/cm. The assessment of salts level shall be carried out in accordance with ISO 8502-6 (Bresle Test Method) or ISO 8502-9.

Measured	Amount of chloride equivalent
12 μS/cm	60 mg/m <sup>2</sup>
16 μS/cm	80 mg/m <sup>2</sup>
20 μS/cm	100 mg/m <sup>2</sup>
24 μS/cm	120 mg/m <sup>2</sup>
28 μS/cm	140 mg/m <sup>2</sup>

- The cleanliness of the blasted steel shall be checked in accordance with the visual ISO standard 8501-1 or equivalent, such as SSPC-SP10.
- If oil and grease contamination is expected, a test can be conducted only on suspected places. Oil and grease on the surface can be determined by using a test area 25 cm<sup>2</sup> is washed with 10 ml methylisobutyl keton (MIBK). 5 drops of the washing are applied to a clean glass plate. After complete evaporation of the solvent the glass plate is exposed to ultra-violet light in total darkness. If there is a blue fluorescence, the surface was contaminated by oil and grease.  
The MIBK shall checked itself and be taken on a glass plate as blank reference.
- The profile of the blast cleaned steel shall be checked with visual comparators or with mechanical devices (ISO 8503-2). The surface profile should comply with the value mentioned in the product datasheet.
- All plate laminations should be grounded off with a grinding machine.

### 2.6 De-humidification

It is our recommendation that de-humidifiers are employed to maintain conditions as in sections 2.4.2 and 2.4.4.



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### 2.7 Preparation and application of the coating

#### 2.7.1 General

All coating manufacturer's specific recommendations and instructions on pot life, thinners, directions for thinning, recommended spray guns, tips, nozzles, painter safety and any other specific provisions for application of the coating system are to be considered as a specific part of this specification and have to be followed accordingly. For the detailed recommendations and instructions reference is made to the product datasheets and application instructions on the system sheet.

#### 2.7.2 Guidelines for aged tanks

Before the application of the coating system some issues can arise like the use of a holding primer, pit repair, floating roof storage tanks and uneven bottom plates. If reinforcement is used either by chopped fiber or glass mat to rehabilitate the tank bottom it is vital to use compatible glass fibers and glass mats. In paragraph 2.7.7 a list of recommended glass fibers and glass mats is summarized.

#### 2.7.3 Holding Primer

In large tanks the blast standard can be safeguarded by use of a holding primer. This is especially valid for blasting which is carried out in tanks where relative humidity and substrate temperature cannot be sufficiently controlled.

The intended use of a holding primer is the temporary protection of freshly blasted steel during the application of tank linings.

Priming may facilitate a final inspection for tracing previously undetected steel imperfections such as residual corrosion pits, weld blowholes, burrs and weld spatter. A fully compatible holding primer will maintain the optimum performance of the applied tank lining.

#### 2.7.4 Pit repair

In general when corrosion pits occur these are concentrated at the bottom area of the tank. The shell sides are coated only for the first 0.3 to 1.5 meter and remaining of the shell is left uncoated, because these areas are less in contact with water.

If corrosion pitting has deeply penetrated into the steel adequate repair is required to prevent further progress of the corrosion process which may eventually lead to perforation of the tank bottom and subsequent leakage of the tank load. If the pitting has led to perforation of the steel, repair measures should be taken.



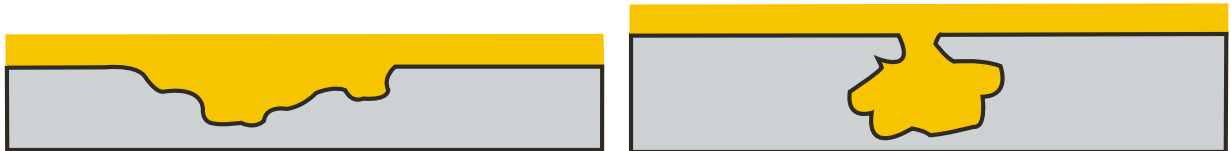
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The following generic types of pitting that are recognized on the tank bottom can be repaired as following.



*Shallow or open pitting (easy to fill)*

*Deep pitting (difficult to fill)*

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Pits can be repaired in different ways:

1. Repair of pits where the loss of steel is extensive and difficult to fill may be carried out by means of welding steel plates. In this case the prevailing regulations should be respected.
2. In case of pitting, Sigmaguard CSF 650 or Sigma Novaguard 840 can be used as a sprayable pit filler. The products are self caulking and high build over critical areas. The coating gradually penetrates the pitting and after 5 to 10 minutes depending on conditions (temperature, kind of pitting) the surface can be scraped of by excess material by use of a squeegee technique.

Around pitted areas in general, very severe corrosion attack of steel occurs.

It may be necessary to smoothen some extreme roughness by means of grinding but in general the application of a tanklining system in high dft will embed this roughness and provides adequate corrosion protection.

### 2.7.5 Floating roof

Doubler plates below the floating roof leg can be glued to the tank bottom with Sigmaguard CSF 650 or Sigma Novaguard 840. This eliminates hot work in the tank during maintenance.

The procedure of glueing is as following:

- Roof leg is lifted from tank bottom.
- Area of doubler plates is blasted to ISO SA2½.
- Sigmaguard CSF 650 or Sigma Novaguard 840, depending on applied coating in the tank, is applied onto the blasted area, film thickness approximately 2000 to 3000 microns.
- Pre-blasted and pre-primed doubler plate is placed into the wet coating.
- Roof leg is lowered onto the doubler plate.
- Excess of coating at the doubler plate edge to be leveled flush with rubber spatula.





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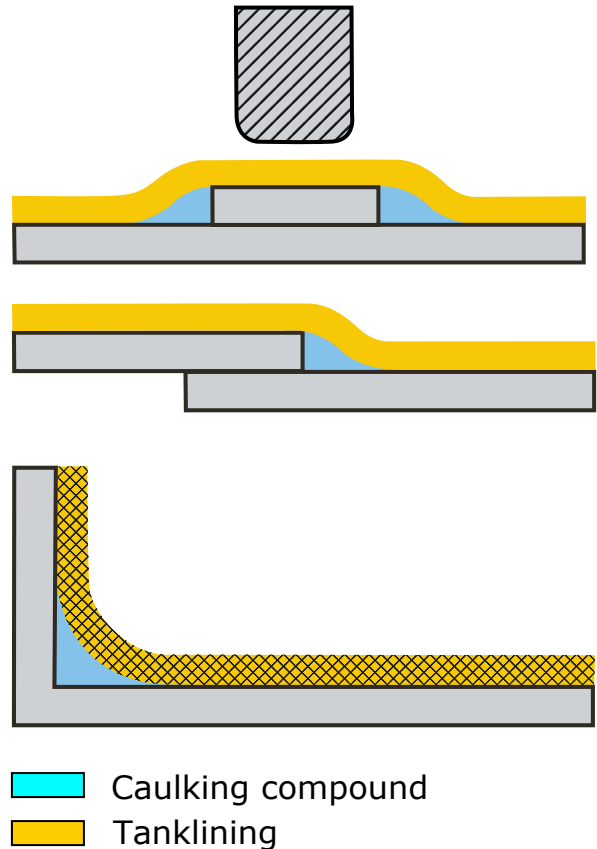
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2.7.6 Uneven tank bottom areas

In some situations for uneven areas of the tank bottom or with the application of glass mats a caulking compound is required. The caulking compound can be applied to all weld seams, lap joints, shell joints or other surface projections to provide a smooth surface transition. It is of importance that the surface provided by the caulking compound is regular and even.

For reinforced systems like chopped fiber or glass mat applications this becomes even more important. Without the use of a caulking compound it would be more difficult to apply glass mat or chopped fiber applications on the shell/bottom joint area.



2.7.7 Recommended chopped fibers and glass mats

There is a variety of glass fibers that might be used for chopped fiber applications; however, it is important that the glass fiber is suitable for use in epoxy resins. A range of glass fibers have been tested in Sigmaguard CSF 650 and Sigma Novaguard 840 and the recommended glass fiber for chopped fiber applications are listed in table below.

Supplier	Contact details	Fiber
PPG	<a href="http://www.ppg.com/fgs_main/reinforcements_products.htm">www.ppg.com/fgs_main/reinforcements_products.htm</a> Product datasheet and contact details per area	PPG 6428/2400 TEX
	<a href="http://www.ppg.com/fgs_main/reinforcements_products.htm">www.ppg.com/fgs_main/reinforcements_products.htm</a> Product datasheet and contact details per area	PPG 6313/2400 TEX
Saint Gobain Vetrotex	<a href="http://www.vetrotexeurope.com/products/">www.vetrotexeurope.com/products/</a> Product datasheet and contact details per area	P207
Euroresins Benelux B.V.	Meemortel 47 6021 AD Budel The Netherlands Tel: +31 (0495) 584910 <a href="http://www.euroresins.com">www.euroresins.com</a>	EC11/2400 TEX 819, article code 25831

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For glass mat application the same requirements are applicable as for glass fibers. The following glass mats have been tested and approved.

Supplier	Contact details	Glass mat
Saint Gobain Vetrotex	<a href="http://www.vetrotexeurope.com/products/">www.vetrotexeurope.com/products/</a> Product datasheet and contact details per area	M113
	<a href="http://www.vetrotexeurope.com/products/">www.vetrotexeurope.com/products/</a> Product datasheet and contact details per area	M123
PPG	<a href="http://www.ppg.com/fgs_main/reinforcements_products.htm">www.ppg.com/fgs_main/reinforcements_products.htm</a> Product datasheet and contact details per area	Mat 79
	<a href="http://www.ppg.com/fgs_main/reinforcements_products.htm">www.ppg.com/fgs_main/reinforcements_products.htm</a> Product datasheet and contact details per area	Mat 92

### 2.7.8 Preparation of the coating application

- All painted surfaces shall be kept clean and dry till completion of the coating job.
- To prevent condensation during application and drying of the coating, the surface temperature must be at least 3 °C (5 °F) above the dew point.
- During application, each coat of the coating system should be checked for the correct wet film thickness by means of a suitable wet film thickness gauge.

### 2.7.9 Application of the coating

- The selected tanklining system, to be applied directly to blasted steel, by airless spray, at the specified/recommended dft and in accordance with the product datasheet. After sufficient drying time as recommended in the product datasheet, a stripe coat should be applied to all sharp edges, rough/manual weld seams, back of the bars and other structural members, edges of cut outs, plate edges etc. After proper drying time the subsequent full coat will be applied at the specified/recommended dft.
- Coating defects due to excessive thickness, inadequate mixing or poor application should be avoided. Each coat of the system must be inspected including the stripe coat. The applied coatings have to be in accordance with the specified standards and requirements as stated in the system and product datasheets.
- Each coat of the system must be a closed film and free from over-spray, sags, curtains, holidays, grit and dirt inclusion. Any such defects are to be repaired prior to the application of the next coat of the system, and within the over-coating limits of the coating. Any dust caused by the repair of defects is to be removed from the tank by vacuum cleaning.
- Overspray shall be kept to an absolute minimum, consistent with good painting workmanship practices. All unavoidable overspray shall be repaired.
- Dry film thickness shall be determined with a non destructive dry film thickness gauge.



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Measuring dry film thickness:

- Because of low initial hardness (e.g. solvent free epoxy) the dft cannot be measured within a few days due to the penetration of the measuring device into the paint film.
- If so the dft should be measured using a calibration foil of known thickness placed in between the coating and the measuring device.
- The time interval between application of the various coats of the system must be held in strict accordance with the latest system sheet and/or product datasheets.
- All paint materials shall be stored inside a safe storage space at temperatures between 10-30 °C. Solvent free coatings shall be stored in a climatically controlled environment at temperatures between 20-25 °C at least 24 hours prior to use. This to assist the contractor in mixing and application of material.
- During all inspections of the coating on the bottom area all personnel should wear soft foot wear.

#### **2.7.10 Holiday detection (only for >500 µm dft systems)**

Holidays including pinholes are not acceptable. It is recommended that the electrically non-conductive tank coating system is inspected for holidays in accordance with NACE RP 0188-99 using a high voltage pore testing device (DIN 55670), only for >500 µm dft coatings. The test should be carried out on the coating after 50 % of the full cure time (see product datasheet). An indication of the voltage to be used is 500 Volt/100 microns. Any defects detected shall be repaired in accordance with this specification.

#### **2.8 Dismantling and removal of scaffolding**

- Scaffolding will be dismantled only after upper areas have been fully coated and accepted.
- During dismantling of the scaffolding, care should be taken to avoid damage to the freshly applied coating system.
- Any areas damaged during dismantling, must be prepared and brought up to required standard and dry film thickness, in accordance with this specification, system sheet and/or product datasheets.



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### 2.9 Remedial touching up of paint film in tank bottom and coating of the ventilation doors

After re-installing any fittings, ventilation doors, and strums in the tank, the contractor will carry out any remedial work to damage that may occur in connection with such reinstallation. Care should be taken to avoid damage to coated surfaces. Soft footwear shall be used at all times.

Surface shall be prepared to ST3 according to ISO 8501-1 power tool clean to bare metal finish. Equipment, which polishes the steel, will not be approved. After a clean, feathered surface is prepared, care should be taken to remove all debris from and around the area by vacuum or other such devices. The system will be repaired by application of the primer and the topcoat at the specified DFT. Proper curing between all coats must be strictly enforced.

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