

## Internal Painting of ADF Bulk Military Fuel Storage Tanks

### Introduction

1. This guidance outlines the criteria for the internal surface finishing and anti-corrosion coating of steel tanks used for storing aviation and marine fuels.

Aviation fuels comprise:

- a. NATO CODE F-34 AVTUR/FSII - Turbine Aviation Fuel that meets DEF(AUST)5240;
- b. NATO CODE F-44 AVCAT/FSII - Turbine Aviation Fuel that meets DEF(AUST)5240; and
- c. NATO CODE F-18 - Aviation Gasoline that meets DEFSTAN91-90.

Marine fuels comprise:

- a. NATO CODE F-76 - Naval Fuel Distillate that meets DEF(AUST)206F Amd 3; and
- b. AS3570 – Automotive Diesel Fuel.

The coating systems shall have an expected service life of 10 years or more. The quality of materials and workmanship is of prime importance to achieve this purpose.

2. This guidance is applicable to the internal painting of both new and existing, bulk fuel storage steel tanks. It is not applicable to austenitic stainless steel tanks that normally do not require internal painting. When the provision of new fuel storage tank(s) is part of the scope of a project, cost benefit analysis, including life cycle costing, should be carried out to detail the material requirements of the tank(s). The analysis should consider whether steel tank with internal painting or stainless steel tank will be the most suitable choice.

### Safety Requirements

3. Painting precautions shall comply with all safety requirements specified by Defence, relevant Australian Standards and statutory regulations. These shall include, but not be limited to:

- a. ABR 6107;
- b. DI(AF)AAP 7002.012-2;
- c. DOHSMAN;
- d. SAFETYMAN;
- e. AS1627.1 & AS1627.4;
- f. AS1940;
- g. AS/NZS2312;
- h. AS2865;
- i. AS3750.13 & AS3750.14; and
- j. AS3894.1, AS3894.2, AS3894.3 & AS/NZS3894.8.

### Standards

4. All the relevant Australian and International Standards, Defence Standards and Instructions, Statutory Regulations, Rules of Regulatory Authorities and Codes of Practices that are referred to in this guidance shall be of the current edition including amendments.

5. All surface preparation, abrasive blasting, application of coating and rectification work on damaged surfaces shall be carried out in accordance with the relevant specifications and standards and the requirements of the paint manufacturer. Standards deemed to be relevant shall include, but not be limited to:

- a. AS1580;
- b. AS2310;
- c. AS/NZS2312; and
- d. AS3750.13 & AS3750.14.

### Painting Contractor

6. Painting Contractor (hereafter named as the Contractor) shall have proven performance and proficiency in applying aviation and/or maritime (dependant on tank usage) fuel tank coating of epoxy materials. In selecting a painting Contractor, preference should be given to one who has been certified by the Painting Contractor Certification Program (PCCP)



13. **Oil, Grease and Dirt Removal.** All oil, grease and dirt shall be removed from the surfaces by a suitable cleaning solution or agent that complies with AS 1627.1 prior to blasting. Potable water, that shall be free of impurities, may be used for rinsing operations if required.

14. **Sharp Edges.** All weld slag, spatter, pinnacles and sharp edges shall be removed by chipping and grinding. All sharp edges shall be ground to a radius of not less than 3mm.

15. **Protection.** During blasting, treated surfaces, adjacent areas previously painted and tank fittings shall be protected from damage. The Contractor shall be responsible for protecting all rotating equipment, instrument panels, machinery, valve stems and glands from damage cause by abrasives. In particular, valve stems and glands, open pipe ends, ENRAF or other gauging systems, floating suction components and machinery components shall be firmly sealed off to prevent ingress of abrasives. After blasting, all dust and abrasives shall be removed from pockets and corners using clean compressed air or vacuum devices, and employing protective barriers where necessary. All abrasive materials shall be removed from the surfaces prior to application of paint.

## Paint Application

16. **Extent of Painting.** All steel surfaces shall be painted with an appropriate system listed in Clause 38. Items that shall be painted include but are not limited to:

- a. internal surfaces of fuel tanks including connected flanges and pipework; and
- b. valve bodies.

17. **Paint Application.** Paint shall only be applied when the conditions within the tank and the condition of the surfaces to be painted comply with those specified by the paint manufacturer and this guidance, and are compatible with the achievement of the performance of the surface coating required by this guidance. This requirement is particularly significant in tropical areas and, if necessary, the painting work shall be arranged in an appropriate work program or provide whatever equipment is necessary to monitor and achieve these conditions. Paint shall be applied:

- a. in accordance with the specification of the paint manufacturer (the specification shall include reference to all relevant factors covered by AS/NZS2312 Section 8, 'Painting and Paint Application Method');
- b. strictly in accordance with the limit of tank surface temperature and relative humidity as stipulated in the paint manufacturer's written specification;
- c. within the pot life of the paint. (Taking into account that most manufacturers specify pot life as a period of time at 25°C. Due allowance must be made for the consequent reduction in pot life caused by temperatures above 25°C. The Contractor should also be aware that mixed materials in spray pots and spray lines exposed to the sun can suffer a very short pot life.);
- d. with regard to the ambient temperatures, relative humidities and other relevant conditions; and
- e. in accordance with the minimum and maximum dry film thickness specified in Annex A or recommended by the painting manufacturer, whichever is more stringent.

18. **Coating Materials.** Coating materials shall be rejected if it shows signs of curdling, gassing, levering, gelling or contamination. Batches of coating materials shall only be prepared in quantities sufficient for each work period. Prior to being used, coating materials shall be stirred or agitated as specified by the manufacturer until the ingredients are completely mixed. Under no circumstances shall the pot life of mixed coating be extended by adding thinners.

19. **Tank Surfaces.** The tank surfaces to be painted shall be free of grease, dust, condensation, and visible rusting or discoloration, after blast cleaning and at time of painting application.

20. **Application Method.** Airless spray is the preferred method of application. Each coat shall be applied uniformly and completely over the entire tank surface. All oversprays, spills, runs and/or sags shall be brushed out immediately or the paint shall be removed and the surface re-sprayed. Before spraying the first coat, all areas such as corners, edges, welds, small brackets, bolts, nuts and interstices shall be pre-painted by brush with a stripe coat to ensure that these areas have the nominal dry-film thickness as stated in Clause 38.

21. **Primer.** Primer is not normally required. A hold primer is called for only when the first coat cannot be applied on the same day as blasting. The primer shall be compatible with the coating system and recommended by the paint manufacturer.

22. **First Coat.** The first coat of paint shall be applied to the prepared surface to give the nominal dry film thickness as required in Clause 38. The coating shall be applied as soon as possible after blast cleaning, dust settlement, and removal of debris and dust; and before any visual rusting ("flash rusting") has occurred. The final blast cleaned surface should not remain unpainted for a period exceeding four hours. In any case, coating shall be applied on the same day as blasting. The Contractor shall allow the coating to cure for a minimum of 16 hours and a maximum of 48 hours in a fully ventilated environment before applying subsequent coats. The ambient temperatures shall be above 13°C and relative humidities below 85% for an epoxy painting system, or shall be as specified by the paint manufacturer, whichever is more stringent. The maximum ambient temperatures shall not exceed 45°C or the temperature recommended by the paint manufacturer, whichever is more stringent.

This operation shall proceed until the whole area to be painted has received its first coat. The colour of this coat shall be other than white unless otherwise stated.

23. **Successive Coat(s).** Clean whole surface free from dust and deposits using suitable non-contaminating method. Allow the surface to dry completely. Apply one or more coats as required in Clause 38 by airless spray to the whole surface to give the nominal dry film thickness as required in Clause 38 for the total lining. The finish obtained shall be smooth, and even and free from runs, sags, wrinkles, cracks, pinholes, brush or roller marks and any other defects and shall possess the correct degree of gloss units ( $^3$  20 GU) in accordance with AS/NZS3894.8. The colour of the topcoat shall be white unless otherwise stated. Inter-coat adhesion may be weaker as the time between the application of coats of paint increases. When re-coating, compliance with the manufacturer's instructions shall be followed to ensure good adhesion.

24. **Ventilation.** Adequate forced ventilation shall be provided continually during coating application and curing. If required by the paint manufacturer, forced ventilation should be filtered.

25. **Protection.** All equipment, name plates, sight and level glasses, valve screws and moving parts of machinery shall be masked prior to application of any protective coating. These parts shall be cleaned on completion of the work. During painting, any previously painted adjacent areas shall be protected from over-spray and tank fittings from damage. The Contractor shall take all possible precautions to prevent mist from being carried by wind and deposited on equipment or vehicles. The reasonable costs of removing paint particles from and/or repainting of affect vehicles or equipment as required shall be borne by the Contractor.

## Special Requirements

26. **Ladders.** Internal Ladders shall be painted where ladders' materials, such as ferrous materials (other than austenitic stainless steels), are not compatible with fuel. Where practicable, the top of each rung should have non-skid surface after painting.

27. **Handling New Tanks.** Extreme cares shall be taken in handling new tanks to prevent the entry into tanks of foreign matters, and damage to seams, internal and external paintings, fittings or shape. All tanks shall be examined on receipt from the manufacturer at site to ensure that they are sound in all aspects. The installation contractor shall be responsible for any damage during transport, handling, offloading or installation of the tanks.

## Curing, Inspection and Testing

28. **Curing.** Allow the finish coat to cure in accordance with the timing, temperature and relative humidity required by the paint manufacturer. The ambient temperatures shall be above 13°C and relative humidities below 85% for an epoxy painting system, or shall be as specified by the paint manufacturer, whichever is more stringent. The maximum ambient temperatures shall not exceed 45°C or the temperature recommended by the paint manufacturer, whichever is more stringent. Newly painted surfaces shall undergo a minimum curing period of seven days after application of the last coat. The period may require extension to meet the paint manufacturer's instructions. This curing time shall precede inspection and tests required in this guidance.

29. **Inspection and Testing.** Following the specified curing time, the coating shall be inspected and tested. Before and after inspection and testing, the Contractor shall ensure that the interior of the tank is clean, dry, and free from contaminants. The Contractor shall be responsible for ensuring requirements of this guidance are met. The following inspection and testing shall be carried out:

- a. **Visual Inspection (100% of final coating).** The finished coating shall be free from runs, sags, cissing, cratering, disbonding, wrinkling, cracks, inclusions and other defects. It shall possess the correct degree of gloss, and shall be smooth and evenly textured without dry spray.
- b. **Film Thickness Measurement (each coat).** The dry film thickness shall be measured in accordance with AS3894.3 using a minimum of 30 points per tank for measurement. In the case of small sections, three points per square metre or part thereof shall be measured. No single spot measurement shall be less than 90% of the minimum dry film thickness specified. No single spot measurement shall be more than 150% of the maximum dry film thickness. If the coating does not meet the thickness requirement, the surface shall be re-painted and the dry film thickness re-measured.
- c. **Wet Sponge Testing (100% testing of final coating).** The tank lining shall be pinhole tested by the low voltage wet sponge method. The testing method shall be in accordance with ASTM D5162 and AS3894.2. The wet sponge test can be used for testing tank lining up to 500m m based on ASTM D5162. The wet sponge test may be replaced by high voltage test in accordance with ASTM D5162 and AS3894.1 when the total lining thickness exceeds 500m m. (High voltage testing is not permitted unless cleared as safe as detailed below.) Before testing, a specialist consultant shall conduct a risk assessment to certify that the testing method will not cause hazards such as fire or explosion in the specific fuel installation. Adequate safety procedures shall be recommended and implemented to prevent hazards. Where pinholes occur, the surface shall be abraded, re-painted and re-tested.

- d. **Rub-Testing (test a representative sample for curing time of final coating).** The coating shall be fully cured before carrying out the rub-testing. The degree of curing time is to be checked by the determination of the resistance of the coating to Methyl Ethyl Ketone (MEK). After rubbing the coating for one minute with a rag soaked in MEK, the coating shall not be softened (test by scraping with a fingernail) and the rag shall not show any of the lining colour. Where coating softening occurs or the rag shows lining colour, the coating shall be abraded, re-painted and re-tested.
- e. **Adhesion Test.** Adhesion shall be tested by coating steel test panels conforming to AS/NZS1580.104.1 under the same conditions as the main work. After curing, the test panels shall be tested in accordance with the parallel cut method of AS1580.408.2. Adhesion is unsatisfactory if there is removal of any coating from the substrate or other coatings. Alternatively, tests shall be carried out on the actual coated surfaces (at least 1 test per tank). All test areas in a tank shall be repaired in accordance with the paint manufacturer's recommendations. If any area fails, the tank coating, including the test patches, shall be abraded, re-painted and re-tested.

30. **Pre-commissioning.** Prior to a tank being accepted into service, the interior of the tank shall be fresh water washed (no surfactants/detergents are to be used), dried and left free from foreign objects and in all other respects, fit to receive fuel. If the tank is to be used for storage of aviation fuels, the tank coating shall be soaked with the intended aviation fuel for at least fourteen days. For the purpose of this test, the tank shall be filled with the aviation fuel to cover the newly painted surfaces as far as practicable. Samples of delivered fuel shall be taken and held on site before the test. After the test, tank and reference samples are to be drawn and tested in accordance with DEF(AUST)206E Annex B (including the BOCLE testing for presence of the lubricity improver additive). Where the soak testing fails, the problem shall be determined and fixed, and the tank shall be re-tested.

31. **Inspection of Works.** The Contractor shall provide an experienced aviation and/or marine (where applicable) coating inspector capable of providing an adequate level of supervision, undertaking the necessary quality checks and carrying out all necessary testing. The Superintendent shall have an experienced coating inspector to witness throughout the coating application and testing, and to carry out regular inspection. The requirements and practices for the inspector shall comply with AS/NZS2312 Section 11, 'Inspection and Testing'. At minimum, the Superintendent's inspector shall be invited to inspect the works at the following stages:

- a. after initial whip blast;
- b. after the final abrasive blast and before the application of the first coat of paint; and
- c. during all inspection and testing as required in Clause 29.

At any time, Defence reserves the right to nominate hold points beyond which the surface preparation and coating application operations shall not proceed until the work has been passed as acceptable. This in no ways removes the prime responsibility for the Contractor to ensure compliance with the requirements of this guidance.

32. **Coating Defects.** Any coating that fails the tests for cure, adhesion or both shall be blasted off to bare metal, re-painted, re-inspected and re-tested. Coating defects shall be repaired to the satisfaction of the witnessing inspector and Defence.

33. The Contractor shall provide and maintain at the site of works, a copy of all the referenced standards, the paint manufacturer's application instructions and the Contractor's project quality plan and ITP for the duration of the works.

## Materials

34. The paint used shall be an aviation or maritime (dependant on tank usage) fuel tank coating of epoxy materials currently approved by Defence in this guidance.

35. All paint, thinners, cleaning solutions or agents, and the like that are to be used for a tank or tank group should be of the same manufacturer where practicable. The Contractor shall ensure all materials are compatible.

36. All paint and associated materials shall be brought onto the site, stored and prepared in a proper manner so that the paint and associated materials are always at high quality as specified by the manufacturer. All paint and associated materials shall be stored and paint preparation shall take place in a weather-proof and sheltered area. Paint shall not be used after six months from the date of manufacture or if the quality has deteriorated. The painting Contractor shall advise Defence, prior to commencement of work, of any special requirements or precautions for the storage and preparation of the paint and associated materials at the site of works.

37. All equipment, whether associated with spray, brush or roller application, shall be suitable for the intended purpose and be properly maintained (in first class condition) if not new. The equipment shall be approved by the paint manufacturer and thoroughly cleaned before use.

## Approved Painting Systems

38. Current Defence approved painting systems are contained in Annex A. These systems shall be used in painting a new bulk fuel tank and in rectification works that require repainting a whole existing fuel tank. Where minor rectification such as

touch painting is required for an existing fuel tank, the original painting system should be used in order to ensure compatibility. The painting system shall be applied in accordance with the intent of this guideline and the manufacturer's written specification and recommendations.

## **Painting Systems Approval**

39. Defence has reviewed Specification APAS-0212 'Aviation fuel storage tank coating' prepared by Australian Paint Approval Scheme (APAS). Proposal has been made to amend the Specification in order to satisfy Defence requirements. When the Specification has been amended by APAS and accepted by Defence, Defence may approve other painting systems in accordance with the following conditions:

- a. the manufacturer of the proposed painting system shall test the system, at the manufacturer's own cost in accordance with the Specification, in a NATA certified laboratory; and
- b. the test results are deemed acceptable by Defence.

## **Maintenance Recording**

40. On completion of the surface treatment, Defence will annotate the appropriate maintenance log with the following information:

- a. date when tank repaired or coated;
- b. surface finishing scheme applied; and
- c. details of the Contractor.

41. In addition, the Contractor shall provide an engraved, stainless steel tag showing the completion date of the paint/repaint and affix the tag on the outside of the tank, near the hatch by a non-destructive method (e.g. attachment by silicon compound). Lettering shall be a minimum of 50mm high.

**Sponsors:** JFLA and ETS

## Internal Painting of ADF Bulk Military Fuel Storage Tanks - Annex A

The current Defence approved painting systems are:

Painting system	Fuel
<ul style="list-style-type: none"> <li>● Jotun Jotacote 418(A) - One unthinned stripe coat; and</li> <li>● International Interline 850.</li> </ul>	NATO CODE F-34 AVTUR/FSII - Turbine Aviation Fuel that meets DEF(AUST)5240B
<ul style="list-style-type: none"> <li>● Jotun Jotacote 418 - One unthinned stripe coat; and</li> <li>● International Interline 850</li> </ul>	NATO CODE F-44 AVCAT/FSII - Turbine Aviation Fuel that meets DEF(AUST)5207A
<ul style="list-style-type: none"> <li>● Jotun Jotacote - Two coats of (150 ± 25 µm DFT)(B) per coat</li> </ul>	NATO CODE F-18 - Aviation Gasoline that meets DEF (AUST)5215.
To Be Advised	NATO CODE F-76 - Naval Fuel Distillate that meets DEF(AUST)5213 Amd 3
To Be Advised	AS3570 - Automotive Diesel Fuel

### Notes:

- A. The approved painting systems are selected with reference to the recommendations in the report *RAAF Aviation Fuel Storage Tanks - Testing of Epoxy Coatings* dated September 1996 by Scientific Services Laboratory.
- B. Nominal thickness - 150 µm, minimum thickness - 125 µm, maximum thickness - 175 µm. Thickness is based on the recommendations from MPD AMRL DSTO.

**Internal Painting of ADF Bulk Military Fuel Storage Tanks - Annex B  
Record of Amendment**

Amendment	Item	Topic affected	Amended by	Date
1	1	Annex A-  Remove the painting system for fuel type NATO CODE F-44 AVCAT/FSII, NATO CODE F-76 - Naval Fuel Distillate and AS3570 – Automotive Diesel Fuel.  Add "To be confirmed."	ETS	30/5/01
1	2	Annex A – Delete Note C.	ETS	30/5/01
2	1	Clause 806 – Inspection periods of tank coating specified.	ETS	31/10/01
2	2	Clause 808. – Modification to improve quality assurance and add reference to AS 3894.1	ETS	31/10/01
2	3	Clause 817 e. – Add the requirements for minimum and maximum dry film thickness.	ETS	31/10/01
2	4	Clause 829 c. – Add the requirements for high voltage test.	ETS	31/10/01
2	5	Clause 831 – Modification to improve quality assurance in inspection.	ETS	31/10/01

Amendment	Item	Topic affected	Amended by	Date
2	6	Annex A – Delete "Dulux Epoxy Bildcote" from the approval list, as the painting system is no longer manufactured.	ETS	31/10/01
2	7	Clause 803 j. and References – Add AS 3894.1	ETS	31/10/01

## Internal Painting of ADF Bulk Military Fuel Storage Tanks - References

1. ABR 6107 - *Marine fuels and Lubricants Handbook Field Edition*
2. AS/NZS1580 Series – *Paints and Related Materials - Methods of Test*
3. AS/NZS1580.104.1 – *Paints and Related Materials - Methods of Test - Recommended Materials for Test Panels*
4. AS1580.408.2 – *Paints and Related Materials – Method of Test Method 408.2: Adhesion – Knife Test*
5. AS1627.1 - *Metal Finishing - Preparation and Pre-treatment of Surfaces-Cleaning using Liquid Solutions and Alkaline Solutions*
6. AS1627.4 - *Metal Finishing - Preparation and Pre-treatment of Surfaces-Abrasive Blast Cleaning*
7. AS1940 - *The Storage and Handling of Flammable and Combustible Liquids*
8. AS/NZS2310 – *Glossary of Paint and Painting Terms*
9. AS/NZS2312 - *Guide to the Protection of Iron and Steel against Exterior Atmospheric Corrosion*
10. AS2865 - Australian Standard and Worksafe Australia National Standard *Safe Working in a Confined Space*  
<http://www.worksafe.gov.au>
11. AS3570 – *Automotive Diesel Fuel*
12. AS/NZS3750.13 – *Paints for steel structures – Epoxy Primer (two-pack)*
13. AS/NZS3750.14 – *Paints for steel structures – High-build Epoxy (two-pack)*
14. AS3894.1 – *Site Testing of Protective Coatings Method 1: Non-conductive coatings – Continuity Testing – High Voltage 'Brush' Method*
15. AS3894.2 – *Site Testing of Protective Coatings Method 2: Non-conductive coatings – Continuity Testing – Wet Sponge Method*
16. AS3894.3 – *Site Testing of Protective Coatings Method 3: Determination of Dry Film Thickness*
17. AS/NZS3894.5 – *Site Testing of Protective Coatings Method 5: Determination of Surface Profile*
18. AS/NZS3894.8 – *Site Testing of Protective Coatings Method 8: Visual Determination of Gloss*
19. AS3894.10 – *Site Testing of Protective Coatings: Inspection Report - Daily*
20. AS3894.12 – *Site Testing of Protective Coatings: Inspection Report - Coating*
21. AS/NZS ISO 9001:2000 - *Quality Management Systems - Requirements*
22. ASTM D1562 – *Standard Practice of Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates*
23. DEF(AUST)206E – *Handbook of Liquid Fuels, Lubricants and Allied Products*
24. DEF(AUST)5207A – *Turbine Fuel, Aviation (High Flashpoint Type)* DEF(AUST)5213 Amd 3 – *Fuel, Naval, Distillate*
25. DEF(AUST)5215 – *Gasoline, Aviation*
26. DEF(AUST)5240B – *Turbine Fuel, Aviation (Kerosene Type Plus FSII)*
27. DI(AF)AAP 7002.012-2 - *Fuels and Lubricants Handbook Instructions*
28. DOHSMAN *Defence Occupational Health and Safety Manual*
29. SAFETYMAN *Defence Safety Manual (Currently in Draft only)*