



Technical Guideline

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B-MT

Surface Coating for Mild Steel Cryostat Vacuum Vessels

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1. Scope

- 1) This document defines requirements on coatings for corrosion protection of atmosphere related surface at cryostat vacuum vessels and its components, made from mild steel in applications like
 - magnet cryostats,
 - cryogenic supply systems,
 - cryogenic transport systems,
 - cryogenic current lead boxes,
 - auxiliary cryogenic systems within FAIR accelerators.
- 2) This document is NOT related to
 - any stainless steel components,
 - any coating applied for operation in vacuum,
 - any components not being dedicated cryostat components (e.g. support feet, support frames, vacuum gauges, feedthroughs, etc.).
- 3) This document is NOT related to any other purpose as afore mentioned.

2. Definitions

- 1) A *cryostat* in terms of this document is a technical system enclosing another technical system to be operated at temperatures far below room temperature (e.g. 4.5K).
- 2) A *cryostat vacuum vessel* in terms of this document is the outermost shell of a cryostat, keeping the insulation vacuum of the cryostat.
- 3) A *cryostat vacuum vessel component* in terms of this document is any attached part; removable or unremovable; and not belonging to any other system then the cryostat vacuum vessel it self.

3. Codes and Standards

- 1) ISO 12944 [2] defines the general requirements on protective paint systems for corrosion protection of steel structures.

- 2) ISO 2409 [1] defines the requirements, execution and evaluation methods for a cross-cut test on varnishes.

4. Identification of surfaces for corrosion protection

- 1) In case of mild steel being used for production of vacuum vessels or vacuum vessel components, their atmosphere related surfaces must be corrosion protected as long as not indicated as exceptional within a technical drawing (see chapter 7).
- 2) The following surfaces must not be varnished or contaminated with varnish:
 - insulation vacuum related surfaces
 - stainless steel surfaces
 - vacuum sealing surfaces
 - gasket grooves
 - reference surfaces
 - joint surfaces for connection to adjacent components
- 3) Any surface being indicated within a technical drawing especially as uncoated or otherwise surface treated must not be varnished or contaminated with varnish.

5. Requirements on corrosion protection coatings

- 1) A description of corrosion protection for steel structures is provided by [2].
- 2) Any coating for corrosion protection of cryostat vacuum vessels and components must at least consist of
 - a suitable primer fit for the dedicated substrate – varnish combination,
 - a coloured varnish (see chapter 6).
- 3) Surfaces to be coated must be appropriately pre-treated, fit for the particular coating systems.
- 4) The coating must be applied uniformly in thickness. No blisters, varnish tears or wrinkles are allowed.
- 5) For approval of the coatings adhesion to the substrate, cross –cut tests (as defined by [1]) must be applied on 5 dedicated samples for each material combination of substrate and coating system. The results of the cross-cut tests (as defined by [1])
 - must be of the mark 0 for at least 4 out of 5 samples,
 - must not exceed a mark 1 for the 5th sample.
- 6) Coatings applied to a surface, must withstand a sudden cool down to 220 K without flaking from the surface. For approval of the adhesion after sudden cool down, the following requirements must be fulfilled:
 - 5 out of 5 samples must not show any flaking without a cross-cut being applied,
 - at least 3 out of 5 cross-cut samples must reach the mark 1 or better,
 - The further two samples must not exceed a mark 2 after sudden cool down and warming up again.

- 7) For cool down, the samples must be doused with LN₂ from their uncoated back-side until a temperature of ≤ 220 K is reached at the coated side.
- 8) For comparability, samples must be treated by the same processes with the same process parameters (pre – treatment, coating, etc.) as the objects to be coated.

6. Colour selection

- 1) As long as not defined within a dedicated specification document, the colour selection for the coloured varnish must be agreed with the contracting entity in writing.

7. Indications in technical drawings

- 1) Surfaces which unconditionally need corrosion protection must be marked as such.
- 2) For components which must be corrosion protected and the application of- or contamination with varnish damages the functionality of any special surface or area, such areas must be indicated as "No varnishing" within the corresponding technical drawing.

8. References

- [1] ISO 2409; Paints and varnishes - Cross-cut test; International Organization for Standardization, Beuth Verlag GmbH, Berlin, Germany, 2007
- [2] ISO 12944 et seq.; Paints and varnishes - Corrosion protection of steel structures by protective paint systems; International Organization for Standardization, Beuth Verlag GmbH, Berlin, Germany, 1998 - 2008