
	Manufacturing, testing and supply of vacuum vessels for HNB3 (Beam Line Vessel and Beam Source Vessel) and DNB <i>Annexure 8: Passivation and Pickling</i>	INDUS Ref No II-1NUL4QI- v1_0
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1. Scope

This annexure specifies typical procedures and processes to be used when materials used for DNB Vessel and HNB3 Vessel (assembly / sub-components) need to be passivated.

It is intended that the suppliers using such processes should follow the guidance in this annexure to achieve the requirements of the ITER Vacuum Handbook. However, the supplier is at liberty to utilise other techniques not described in this annexure provided that the components supplied comply with the requirements of the overall technical specification and the ITER Vacuum Handbook.

2. Reference documents

ITER Vacuum Handbook: [Appendix_14_Passivation_and_Pickling_2F457S_v1_2](#)

The following standard procedures may also be used as supplementary guidelines:

- EN 2516:1997 – Passivation of corrosion resistant steels and decontamination of nickel base alloys
- ASTM A380 – Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems
- ASTM A967 – Specification for Chemical Passivation Treatments for Stainless Steel Parts

3. General Comments

Pickling is most frequently used to remove heavy scale from steels. Pickling is rarely specified for vacuum components, normally only for those to be used in rough vacuum, since the process attacks the metal surface and the oxide layer, tending to leave residues which are difficult to remove.


Heavy scale on steel is best avoided by specifying that the plate produced in a rolling mill or a hot-forged blank is stripped with an air knife while still hot.

Light scale on steel may be removed with a wire brush.

Pickling often leaves the surface in an etched state with a matt finish, which may or may not be desirable.

Dimensional stability cannot be guaranteed during the pickling process, so it should normally be carried out on the material before manufacture.

If a vessel assembly is pickled, then final machining of vacuum sealing surfaces must be left until after the pickling/passivation process.

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Pickling and passivation must always be followed immediately by an appropriate cleaning process (Annexure 7: Cleaning and cleanliness)

Pickling should always be followed by passivation. This is best carried out chemically, although native oxide layers can reform on exposure to atmosphere.

It should be noted that thermal outgassing from surfaces which have been pickled/passivated may well be greater than that from a native metal surface and may require additional baking to achieve the outgassing requirements of the ITER Vacuum Handbook.

The Supplier shall propose a pickling procedure of the weld bead by paste or gel in accordance with the RCC-MR Code.

4. Pickling and Passivation of Steels.

Steel manufacturers/suppliers will often have their own preferred method of pickling/passivation and may be unwilling to use any other method. Expert advice from both a metallurgical and vacuum point of view shall be sought in this case. The vacuum person in this case will be the ITER Vacuum RO.


In no case, however, shall the use of glue in the pickling solution be permitted.

Note that the chemicals used in these processes are hazardous and all appropriate safety procedures must be followed

Table below lists some of the acceptable pickling solutions for steels.

Material	Solution	Concentration	Temperature (°C)	Comment
				visually removed
	Hydrochloric acid (SG 1.19)	10-20% solution	50-80	visually removed
Stainless steel	Nitric acid (SG 1.4)	200gl ⁻¹	55-65	Until Scale visually removed
	Hydrofluoric acid (52%)	40gl ⁻¹		
	Sulphuric acid (SG 1.84)	60gl ⁻¹	Room	As above
	Hydrofluoric acid (52%)	60gl ⁻¹		
	Chromic acid - 60	60gl ⁻¹		
	Hydrochloric acid (SG 1.19)	250gl ⁻¹	60-70	Bright Finish
	Nitric acid (SG 1.4)	22gl ⁻¹		

- Gross contamination is removed by washing the material in a jet of hot (80oC)

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water.

- The material is allowed to dry.
- The material is thoroughly degreased using one of the methods specified in **Annexure 7: Cleaning and cleanliness**
- The pickling baths should be checked visually to ensure that there are no visible signs of contamination, e.g. oils or greases floating on the surface.
- Ideally, clean pickling solutions in clean baths should be used.
- The material is lowered into the pickling solution for the specified time or until the process is complete.
- The material is washed in a jet of hot (80°C) water.
- The surface of the material is then passivated by lowering into a bath of dilute nitric or citric acid.
- The material is washed in a jet of hot (80°C) water and allowed to dry.

Note that there are alternative methods of pickling and passivation using spray and gel techniques. The use of such techniques is not prohibited but should only be used following acceptance of the proposal by the ITER Vacuum RO.