Contents

1. Scope

This annexure covers the dimensional inspection requirements for DNB Vacuum Vessel. This relates to the dimensions to be measured on the actual component at various during the fabrication and after completion of manufacturing.

2. References

- ISO 5458:1998: Geometrical Product Specifications (GPS)–Geometrical Tolerancing - Positional Tolerancing
- ISO 2768:1989: Tolerance for Linear and angular dimensions without individual tolerance indication
- ISO 13920:1996: General tolerance for welded construction
- ITER_Dimensional_Metrology_Handbook_46FN9B_v2_1

3. Requirements

3.1 Pre-requisites

Contractor shall establish shop floor documentation for dimensional inspection for each stage. Elements relating to dimensional control shall include:

- Reference standards
- Manufacturing drawings and CAD models
- Design change procedures
- Document control
- Measurement procedure
- Instrument calibrations and test procedures
- Non-conformity procedure

3.2 General Requirements

- The geometrical shape and tolerances shall be measured according to a testing protocol following the ITER_Dimensional_Metrology_Handbook_46FN9B_v2_1.

IO shall also witness the geometrical measurements (Hold Point).

The IO and the DA and Supplier shall agree about the Hold Points at the critical steps of the measurements during the MRR.

- All metrological and alignment operation shall be performed in accordance with the ITER Dimensional Metrology Handbook ITER_Dimensional_Metrology_Handbook_46FN9B_v2_1.

The DNB Vessel and HNB3 Vessel are considered as an Alignment & Metrology (A&M) class 1 component. The paragraph 6.4- Mandatory Requirements Procurement (MRP) for A&M Class 1 activities of applies to the DNB Vessel and HNB3 Vessel. All MRPs from MRP2 to MRP13 shall be respected.

At every important stage of the manufacturing each assembly is to be dimensionally inspected. Results are to be compared with the Approved Manufacturing Drawings that will be produced at MRR". If necessary, remedial action is to be proposed.

The dimensional inspections shall be reported in the MIP / in form of back-up report of MIP.

Dimensional Control Plan (DCP):

A Dimensional Control Plan (DCP) shall be prepared and provided (according to 6.4 of ITER_Dimensional_Metrology_Handbook_46FN9B_v2_1 during the MMR and approved by ITER-India and IO. The DCP shall include an implementation plan defining all the quality related activities as per [MRP3] in paragraph 6.4 of ITER_Dimensional_Metrology_Handbook_46FN9B_v2_1.

The equipment selected by the Contractor shall fit for the requirements of the measurement process. The selection process shall consider areas such as measurement uncertainty, speed of data acquisition, measurement geometry, local environmental conditions etc.

Measurement uncertainty shall be calculated for all reported measurements, at a confidence level of +/- 2σ. As a general rule, the uncertainty value shall not exceed 10% of the tolerance applicable to the feature being measured.

Dimensional check for the individual components and the completed equipment shall be carried out at a constant temperature as per the approved procedure and shall meet the requirements specified in the approved drawing.

All the dimensions given in the drawing are at 20 Deg C. Measurement carried out at any other temperature shall be corrected to 20 Deg C before comparing with dimensions in the drawing. Value of co-efficient of thermal expansion at various temperatures can be obtained from purchaser during manufacturing.

Dimensional measurements shall be taken with respect to co-ordinate system define in tolerance drawings. These dimensions shall also include key dimensions to be measured at room temperature (20^{o} C) or corrected to this temperature. The correction factor at that temperature may be mutually agreed upon.

During measurement bidder shall ensure that components are in free condition without any restraints. If supports are taken, it shall be ensured that it does not impact final dimensions.

The Bidder shall prepare dimensional measurement procedure which includes details of measurement process (i.e. measurement instruments, methodology and software etc.) for individual parts and assemblies.

In order to monitor deformation (if required) during the manufacturing process, reference points on the component shall be periodically measured. The location and frequency of measurements shall be mutually agreed.

All the dimensions mentioned in the approved manufacturing drawing shall be measured. The measurement interval on the straight section at the time of stage inspection shall be limited to 50mm, typically. For smaller sub-assemblies / sub-components, this values shall be mutually agreed. Curvature portion shall be check using appropriate templates, with prior agreement with ITER-India and IO.

3.3 Frequency and stages of Inspection

Dimensional Inspection shall be carried out at all required stages starting from part, sub-assembly and final assembly stage to satisfy the tolerance requirements specified in Annexure 14: Engineering Drawings.

ITER-India and IO shall witness the dimensional inspections in accordance with relevant MIP/IP.

3.3 Measuring Instruments and calibration

All equipment used for dimensional measurement shall be in accordance with relevant EN ISO standard. Each instrument shall have calibration certificates (released by independent accredited laboratory) at the time of use with a required validity.

3.4. Dimensional measurement as a part of Final acceptance

Dimensional control shall be carried out on:

- Vessel main body at atmospheric pressure, without Lid, without flanges bolted on and without anything installed on that is not represented on the vessel drawings.
- Top Lid, at atmospheric pressure, without any flanges bolted on and without anything installed on that is not represented on the Top Lid drawings.

- Instrumentation Feedthrough Boxes, at atmospheric pressure without any flanges bolted on and without anything installed on that is not represented on the feedthrough drawings.
- In addition, the coordinates of the reference points shall be measured.

Dimensional control for factory acceptance shall be carried out in a controlled environment with a maximum temperature variation of ± 2˚C as per [MRP9] of ITER_Dimensional_Metrology_Handbook_46FN9B_v2_1.

Overall assembly dimensions of DNB Vessel and HNB3 Vessel shall be measured at interval of max 200mm for straight portion. Curvature portion shall be checked using appropriate templates, with prior agreement with ITER-India and IO. Each of the curved portion or profiled configurations shall be measured with the standard / customized templets, with the accuracy better than the desired tolerance. Such templets shall be proposed to ITER-India and IO for approval.

Bidder may propose other equivalent method suitable for measurement of above criteria.

Bidder has to provide a proposal to affix fiducials on DNB Vessel and HNB3 Vessel and the same is subject to mutual agreement among bidder, ITER-India and IO.

During final dimensional inspection, environmental conditions having vibration, unstable ground, noise and dust, direct sunlight on component/measuring instrument and fast variation in temperature etc. shall be avoided.

A Metrology and Tolerances Final Report shall be provided by the Bidder to ITER-India and IO for approval at the end of the Metrology

3.5. Acceptance:

The dimensions of DNB Vessel and HNB3 Vessel shall be within the tolerance specified in Annexure 14: Engineering Drawings. The Bidder shall produce “as-built” drawings to demonstrate the compliance with the design. Additionally, Interface dimensions if any identified by IO shall also be recorded. Any discrepancies shall be subjected to non-conformance report and its corrective actions.

3.6. Dimensional Measurement Report:

The measurement data shall be presented in the Metrology report which is part of the EMR. This report shall comply with the requirements [MRP13] of ITER_Dimensional_Metrology_Handbook_46FN9B_v2_1.

All inspection reports shall include following information as minimum and shall be in format acceptable to ITER-India.

- Identification of the company responsible for dimensional control when subcontracted.
- Identification of measuring instruments with date of calibration and validity.
- Identification of components/parts examined including fabrication process (forging, rolling, welding etc.)
- Dimensional inspection procedure along with revision details
- Sketches and drawings if required to represent dimensional measurement
- Surface preparation (method, cleaning, grinding, machining etc.)
- Material grade and thickness of part
- Drawing no. along with revision details
- Date of examination
- Name of operator along with signed and date
- Non-Conformity Report if any
- Meteorological data (temperature, etc.)
- Interpretation of result (Acceptance/Non Acceptance)

ITER-India does not prescribe to use any software for performing and recording the measurement. However, it is critical to ensure that measurement data can be easily transferred between parties. This data may be required to verify the measurement processes, address non-conformance/deviations issues. In addition, these data shall be used to construct a configuration model representing the true geometry of the as-built DNB Vessel and HNB3 Vessel.

3.7 Roughness measurement

The control of the surface condition or roughness shall be carried out following RMC7200 requirements [1].

The finishing of the surfaces shall be as identified in the manufacturing drawing validated at the MRR.

4. Documentation

The Bidder shall submit dimensional Inspection procedure to ITER-India for approval before start of any dimension inspection activity.

The Bidder shall submit dimensional Inspection report to ITER-India for approval during manufacturing, as per MIP requirements.

In case of corrective measures (such as machining, welding or plastic deformation etc.) required to comply with the drawing requirements, proposal of such shall be covered in NCR report and shall be submitted to ITER-India IO for approval.