

Type of document	Tender Document
IDM number (If required)	---
References	---
Current Document phase	Signed
Current Document Version	v1.3
Version date	25-03-2019
Access control	Restricted

Title	Design, Fabrication and Supply of Torus Cryo Pump Housing (TCPH) with Bellows and Other Loose items
Sub-title	MANDATORY APPENDIX : II-TCPH-APB3_07_LEAK TESTING

Author	ITER-India
Contributors	ITER-India

Distribution list	Public tender
-------------------	---------------

Written by	Reviewed by	Approved by
ITER-India	ITER-India	ITER-India


ITER-India, Institute for Plasma Research

Block A, Sangath Skyz, Bhat-Motera Road, Koteswar,

Ahmedabad 380005, Gujarat, India


<http://www.iter-india.org>



	Mandatory Appendix Appendix-II-TCPH-APB3_07 Leak Testing	INDUS Ref. No. R34VABP
---	---	------------------------------

CONTENTS

1. SCOPE	3
2. REFERENCE CODES AND STANDARDS	3
3. REQUIREMENTS.....	3
3.1. Pre-requisites:.....	3
3.2. Location and Frequency of Test:.....	3
3.3. Leak Testing Methods:.....	3
3.3.1. Local Helium Leak testing (Individual welds leak test):	3
3.3.2. Global Helium Leak testing with welded bellows (Equipment and assemblies leak test).....	4
3.3.3. Leak testing of Bellows	5
3.4. Acceptance Criteria	5
3.5. Rectification of Leak.....	6
3.6. Reporting:.....	6
3.7. Documentation and Responsibility:	6

	Mandatory Appendix Appendix-II-TCPH-APB3_07 Leak Testing	INDUS Ref. No. R34VABP
---	---	------------------------------

1. SCOPE

This mandatory appendix specifies leak testing requirements for TCPH.

2. REFERENCE CODES AND STANDARDS

- ITER Vacuum Handbook V2.3 (RDB3_07)
- ITER Vacuum Handbook Appendix_12 Guide Lines to Leak testing (RDB3_07)
- EN13185: 2001 Leak Testing (Tracer Gas Method)
- ASME Sec-V, Article 10, Edition 2013

3. REQUIREMENTS

3.1. Pre-requisites:

All components or welds subject to leak tests shall be cleaned in accordance with II-TCPH-APB3_03 prior to commencement of leak test.

Leak testing shall only be performed after approval of leak testing procedure from I-I and IO. The procedure shall be specified with methodologies of test including description of test with configuration sketches and diagrams, calibration of equipment etc.

Additional accessories like Jigs, seals and temporary closures plates etc. required to perform final site leak testing at site shall be supplied by Bidder along with methodology of fitting and removal.

3.2. Location and Frequency of Test:

Local leak testing shall be carried out by bidder for all welded joints forming a vacuum boundary.

Global leak testing shall be performed by bidder after completion of final assembly of TCPH with bellows in welded condition.

3.3. Leak Testing Methods:


3.3.1. Local Helium Leak testing (Individual welds leak test):

Leak testing of welds shall be carried out by probe leak testing (i.e. isolating a section of weld (on the vacuum side only)) in a temporary isolation hood (or suction sup) which is evacuated to at least 3 Pa with a leak detector in series.

Helium shall be introduced on the atmospheric pressure side of the weld (within another isolation hood or otherwise) and the leak rate determined.

The time and date and the value of the reference leak before and after the test and the response time shall be noted.

A mass spectrometer leak detector shall be used. The leak detection assembly may integrate a cold trap if necessary to reduce as much as possible the background water.

	Mandatory Appendix Appendix-II-TCPH-APB3_07 Leak Testing	INDUS Ref. No. R34VABP
---	---	------------------------------

The calibrated leak shall have a value as close as possible of the acceptance leak rate. Sensitivity of the leak detection unit shall be 10 times better than the acceptance leak rate.

A minimum period of observation shall be proposed in the procedure developed by the Bidder and approved by I-I and IO (at least 2 times greater than the response time).

All single leaks larger than $10^{-9} \text{ Pa.m}^3\text{s}^{-1}$ shall be measured, located, recorded and reported to I-I and IO.

Leak testing procedure and system calibration shall be in line with requirement specified in ITER Vacuum Handbook Appendix-12 and EN13185.

Parameters related to local leak tests for individual welds shall be as specified below:

Test temperature	20 °C (~ Ambient temperature)
Tracer Gas medium	Helium (Concentration > 50%)
Max. Vacuum side Pressure	< 3 Pa
Acceptance Criteria	As per Clause 3.4
Calibrated Leak	$\sim 10^{-9} \text{ Pa.m}^3/\text{s}$

3.3.2. Global Helium Leak testing with welded bellows (Equipment and assemblies leak test)

Global leak testing shall be used for a closed assembly or components required to test as a final assembly leak testing. Bellow leak testing shall be conducted separately as per clause 3.3.3 of this specification.


Closed assembly shall be pressurized using Helium gas or evacuated to the vacuum pressure of 3 Pa using appropriate vacuum pump.

In case of Inner cylinder assembly, it shall be filled with helium gas and pressurized by closing both the ends closed by temporary blank.

In case of outer shell evacuated, outer shell assembly shall be covered with polythene bag from outer surface. Helium gas is now than filled to measure the leak rate of outer shell vacuum boundary.

Vacuum side portion shall be connected with MSLD to measure the leak rate of an assembly.

The leak detection assembly sometimes may integrate a cold trap if necessary to reduce as much as possible the background water. The reference leak shall have a value as

	Mandatory Appendix Appendix-II-TCPH-APB3_07 Leak Testing	INDUS Ref. No. R34VABP
---	---	------------------------------

close as possible of the acceptance leak rate. Sensitivity of the leak detection unit shall be 10 times better than the acceptance leak rate.

A minimum period of observation shall be proposed in the procedure (at least 5 times greater than the response time).

In case of leakage rate exceeds the specified acceptance, the leak shall be located and measured with appropriate local leak test method.

Leak testing conditions for closed assemblies shall be as specified below :

Test temperature	20 °C (~ Ambient temperature)
External/Internal tracer Gas medium	Helium (Concentration > 50%)
Max. Vacuum side Pressure (Inner Cylinder and outer box)	< 3 Pa
Acceptance Criteria	As per Clause 3.4
Calibrated Leak	$\sim 10^{-9} \text{ Pa.m}^3/\text{s}$

3.3.3. Leak testing of Bellows


The leak testing for double bellows shall be conducted by appropriate bracing and accomplished by evacuating the interspace with a leak detector in series. An atmosphere of helium (with a helium concentration >50%) shall surround the bellows in a temporary enclosure.

The leak testing of single walled bellows shall be conducted by closing with a temporary blank and appropriate bracing (to avoid structural collapse from buckling in the bellows). The created volume will be evacuated with a leak detector in series. An atmosphere of helium (concentration >50%) shall surround the bellows in a temporary enclosure.

3.4. Acceptance Criteria

The acceptable helium leak rate:

TCPH individual component or individual welds Joint leak (VQC1 components)	$2.69 \times 10^{-9} \text{ Pa.m}^3/\text{s}$
TCPH Global leak test with welded bellows	$2.69 \times 10^{-8} \text{ Pa.m}^3/\text{s}$

	Mandatory Appendix Appendix-II-TCPH-APB3_07 Leak Testing	INDUS Ref. No. R34VABP
---	---	------------------------------

Acceptance of above mentioned criteria is subject to successful completion of following conditions:

- Leak detector has been correctly calibrated and its calibration value is within the limits of the standard leak rate value, taking into account the ambient temperature and the age of the item
- Test has been performed and evaluated by ASNT Level II qualified personnel in accordance with requirement specified in SNT-TC-1A as per ASME Section V.
- Reading from the leak detector has not increased in value above the measure background to more than the specification leak rate over the entire duration of the global leak test
- Location and magnitude of all identified leaks shall be recorded. All practical efforts shall be made, after agreement with the I-I, to reduce any leak quantified during the manufacturing phase to a level lower than the limit of detection of the leak detection method used

3.5. Rectification of Leak

In case of leak rate not meeting specified acceptance criteria (except simple tightening of bolts or gasket replacement), the respective location shall be identified. Bidder shall prepare rectification plan and submit to I-I for approval before conducting any rectification process.

3.6. Reporting:

Test details in report of Helium leak testing shall be as per details specified in T- 1091 of ASME Sec-V.

3.7. Documentation and Responsibility:

Bidder shall develop leak testing procedure and submit to I-I and IO for approval. The leak test procedure shall contain a schematic of the leak testing setup including a detailed list of the components used, (vacuum pumps, valves, vacuum line dimensions, leak detector type, position of the calibrated leak in the test setup, etc.

Bidder shall implement the approved procedure for final leak testing at factory.

I-I and IO shall witness the factory leak testing during final acceptance.

The final acceptance leak testing at ITER site is IO responsibility. Additionally, IO reserves the right to conduct acceptance leak tests at any stage of the manufacturing process (Local/Global or both) with prior agreement with Bidder and I-I