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TECHNICAL ANNEX B2 Vacuum Vessel Gravity Support

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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

TECHNICAL ANNEX B2

Vacuum Vessel Gravity Support

Abstract

This document is prepared based on the Annex B of the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes technical specification for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document which describes the overall technical requirements.

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1.0	2014. 08. 05	First issue for the Call for Tender
1.1	2014. 08. 12	Minor changes in sentence according to IO comments
1.2	2016. 01. 19	Changes in reviewer and approver for re-tendering. Materials of Bolt plates have been changed to INCONEL 718 and Delivery dates of VVGS are updated. Applicable reference document list has been updated.

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1. SUBJECT

1.1. Description of the Procurement

The Vacuum Vessel Gravity Support (hereinafter VVGS) supply is included in the Procurement Arrangement (hereinafter PA) for the VV equatorial and lower ports between IO and KODA. This Technical Specification of ITER VVGS Procurement, designated as Technical Annex B2, is part of the VVGS contract document package between KODA and supplier.

This Technical Annex B2 is in compliance with the Korea Domestic Agency (hereinafter KODA) Quality Assurance Templates.

All technical details, scope of supply, time schedule, codes and standards, and acceptance requirements are specified in the present specification.

The VVGS PA is a build to print PA.

1.2. Function of the Procurement

VVGS provides support to the ITER Vacuum Vessel.

2. SCOPE OF THE SUPPLY

The supplier shall produce a total 9 sets of VVGS and prepare to deliver them to the IO.

2.1. Hardware items supply

The scope of the basic supply comprises the production and delivery of the VVGS, as described in the following tables. The Delivery Date includes the transportation to final destinations. The Site Acceptance Tests of each component at the IO is not included in the Delivery Date.

The supplier shall contribute the equipment, or materials, or components listed in the following Table Annex B2: 2.1-1.

No.	Part Title ¹⁾	Material	Q'ty ¹⁾	Remarks
1	LOWER_BLOCK	316L(N)-IG	9	
2	UPPER_BLOCK	316L(N)-IG	9	
3	PRIMARY_HINGE_BLOCK	Steel 660	9	
4	SECONDARY_HINGE_BLOCK	316L(N)-IG	9	
5	UPPER_DOWEL	Steel 660	9	Need to be coated in MoS ₂ ²⁾
6	LOWER_DOWEL	Steel 660	9	Need to be coated in MoS ₂ ²⁾
7	JACK_SCREW	304	9(1)	

8	SECONDARY_HINGE_CLAMP_LEFT	304	9(1)	
9	SECONDARY_HINGE_CLAMP_RIGHT	304	9(1)	
10	SECONDARY_HINGE_LOWER_CLAMP_LEFT	304	9(1)	
11	SECONDARY_HINGE_LOWER_CLAMP_RIGHT	304	9(1)	
12	LOWER_PRIMARY_ANTIF_WASHER_LEFT_1	Al-bronze	9(1)	
13	LOWER_PRIMARY_ANTIF_WASHER_LEFT_2	Al-bronze	9(1)	
14	LOWER_PRIMARY_ANTIF_WASHER_LEFT_3	Al-bronze	9(1)	
15	LOWER_PRIMARY_ANTIF_WASHER_LEFT_4	Al-bronze	9(1)	
16	LOWER_PRIMARY_ANTIF_WASHER_RIGHT_1	Al-bronze	9(1)	
17	LOWER_PRIMARY_ANTIF_WASHER_RIGHT_2	Al-bronze	9(1)	
18	LOWER_PRIMARY_ANTIF_WASHER_RIGHT_3	Al-bronze	9(1)	
19	LOWER_PRIMARY_ANTIF_WASHER_RIGHT_4	Al-bronze	9(1)	
20	UPPER_ANTIFRICTION_WASHER_LEFT_1	Al-bronze	9(1)	
21	UPPER_ANTIFRICTION_WASHER_LEFT_2	Al-bronze	9(1)	
22	UPPER_ANTIFRICTION_WASHER_LEFT_3	Al-bronze	9(1)	
23	UPPER_ANTIFRICTION_WASHER_LEFT_4	Al-bronze	9(1)	
24	UPPER_ANTIFRICTION_WASHER_RIGHT_1	Al-bronze	9(1)	
25	UPPER_ANTIFRICTION_WASHER_RIGHT_2	Al-bronze	9(1)	
26	UPPER_ANTIFRICTION_WASHER_RIGHT_3	Al-bronze	9(1)	
27	UPPER_ANTIFRICTION_WASHER_RIGHT_4	Al-bronze	9(1)	
28	STUD_M42x700	304	18(2)	
29	LOWER_TOROIDAL_SHIMS_LEFT	304	9(1)	
30	LOWER_TOROIDAL_SHIMS_RIGHT	304	9(1)	
31	BOTTOM_SHIM_LEFT	304	9(1)	
32	BOTTOM_SHIM_RIGHT	304	9(1)	
33	LOWER_TOROIDAL_WEDGE	304	9(1)	
34	BOTTOM_PAD	304	9(1)	
35	UPPER_INS_PLATE_BACK_BLOCKER_LEFT	Polyimide	9(1)	Includes bolt sheaths and plate insulation ³⁾
36	UPPER_INS_PLATE_BACK_BLOCKER_RIGHT	Polyimide	9(1)	Includes bolt sheaths and plate insulation ³⁾
37	UPPER_INS_PLATE_BACK	Polyimide	9(1)	Includes bolt sheaths and plate insulation ³⁾
38	UPPER_INS_PLATE_BACK_CHAMFER	Polyimide	9(1)	Includes bolt sheaths and plate insulation ³⁾
39	UPPER_INS_PLATE_CHAMFER_LEFT	Polyimide	9(1)	Includes bolt sheaths and plate insulation ³⁾
40	UPPER_INS_PLATE_CHAMFER_RIGHT	Polyimide	9(1)	Includes bolt sheaths and plate insulation ³⁾
41	UPPER_INS_PLATE_LEFT	Polyimide	9(1)	Includes bolt sheaths and plate insulation ³⁾
42	UPPER_INS_PLATE_MIDDLE	Polyimide	9(1)	Includes bolt sheaths and plate insulation ³⁾
43	UPPER_INS_PLATE_RIGHT	Polyimide	9(1)	Includes bolt sheaths and plate insulation ³⁾
44	RADIAL_WEDGE_LEFT	304	9(1)	

45	RADIAL_WEDGE_RIGHT	304	9(1)	
46	UPPER_RADIAL_SHIM_LEFT	304	9(1)	
47	UPPER_RADIAL_SHIM_RIGHT	304	9(1)	
48	BOLT_PLATE_4_LEFT	INCONEL 718	9(1)	
49	BOLT_PLATE_4_LEFT	INCONEL 718	9(1)	
50	BOLT_PLATE_3_LEFT	INCONEL 718	9(1)	
51	BOLT_PLATE_3_RIGHT	INCONEL 718	9(1)	
52	RADIAL_SHIM_LEFT	304	9(1)	
53	RADIAL_SHIM_RIGHT	304	9(1)	
54	SECONDARY_ANTIF_WASHER_LEFT	Al-bronze	9(1)	
55	SECONDARY_ANTIF_WASHER_RIGHT	Al-bronze	9(1)	
56	BOLT_PLATE_2_LEFT	INCONEL 718	9(1)	
57	BOLT_PLATE_2_RIGHT	INCONEL 718	9(1)	
58	UPPER_INSULATING_PLATE_BELOW	Polyimide	36(4)	
59	BOLT_PLATE_1	INCONEL 718	36(4)	
60	UPPER_INSULATING_TUBE_BACK	Polyimide	54(5)	
61	UPPER_INSULATING_TUBE_FRONT	Polyimide	54(5)	
62	UPPER_BLOCK_SLEEVE_LEFT_1	Al-bronze	9(1)	
63	UPPER_BLOCK_SLEEVE_LEFT_2	Al-bronze	9(1)	
64	UPPER_BLOCK_SLEEVE_MIDDLE	Al-bronze	9(1)	
65	UPPER_BLOCK_SLEEVE_RIGHT_1	Al-bronze	9(1)	
66	UPPER_BLOCK_SLEEVE_RIGHT_2	Al-bronze	9(1)	
67	UPPER_HINGE_SLEEVE_LEFT_1	Al-bronze	9(1)	
68	UPPER_HINGE_SLEEVE_LEFT_2	Al-bronze	9(1)	
69	UPPER_HINGE_SLEEVE_RIGHT_1	Al-bronze	9(1)	
70	UPPER_HINGE_SLEEVE_RIGHT_2	Al-bronze	9(1)	
71	LOWER_RADIAL_WEDGE_SHIM_LEFT	304	9(1)	
72	LOWER_RADIAL_WEDGE_SHIM_RIGHT	304	9(1)	
73	LOWER_BLOCK_SLEEVE_LEFT_1	Al-bronze	9(1)	
74	LOWER_BLOCK_SLEEVE_LEFT_2	Al-bronze	9(1)	
75	LOWER_BLOCK_SLEEVE_MIDDLE	Al-bronze	9(1)	
76	LOWER_BLOCK_SLEEVE_RIGHT_1	Al-bronze	9(1)	
77	LOWER_BLOCK_SLEEVE_RIGHT_2	Al-bronze	9(1)	
78	LOWER_HINGE_SLEEVE_LEFT1	Al-bronze	9(1)	
79	LOWER_HINGE_SLEEVE_LEFT2	Al-bronze	9(1)	
80	LOWER_HINGE_SLEEVE_RIGHT1	Al-bronze	9(1)	
81	LOWER_HINGE_SLEEVE_RIGHT2	Al-bronze	9(1)	
82	UPPER_SHIM_LEFT	304	9(1)	
83	UPPER_SHIM_RIGHT	304	9(1)	

84	UPPER_SPACER_LEFT	Al-bronze	9(1)	
85	UPPER_SPACER_RIGHT	Al-bronze	9(1)	
86	UPPER_TOROIDAL_SHIMS_LEFT	304	9(1)	
87	UPPER_TOROIDAL_SHIMS_RIGHT	304	9(1)	
88	CYLINDER_HEAD_SCREW_ISO_4762_M30X110	304	18(2)	
89	CYLINDER_HEAD_SCREW_ISO_4762_M36X100	304	18(2)	
90	CYLINDER_HEAD_SCREW_ISO_4762_M48X150	304	36(4)	
91	CYLINDER_HEAD_SCREW_ISO_4762_M48X200	304	36(4)	
92	CYLINDER_HEAD_SCREW_ISO_4762_M48X280	304	36(4)	
93	CYLINDER_HEAD_SCREW_ISO_4762_M36X140	304	72(7)	
94	HEXAGON_NUT_ISO_4032_M42	304	72(7)	

Note 1 : Part title and Quantity are based on 3D Model (DET-02447)

Note 2* : Dowels shall be coated in MoS2 to reduce friction

Note 3* : Includes bolt sheaths and plate insulation

Note 4 : part quantities in parenthesis are 10% extra quantities for spares and shall be delivered to IO

Note 5 : all shims are machined by the IO after surveying the interface components

Table Annex B2: 2.1-1 List of Items manufactured and delivered by the supplier.

Items	Date	Remark
VVGS #06, #05, #04	21 Jun. 2019	SAT of each component at the IO is not included
VVGS #03, #02, #01	17 Jan. 2020	SAT of each component at the IO is not included
VVGS #09, #08, #07	31 Jul. 2020	SAT of each component at the IO is not included

Table Annex B2: 2.1-2: Delivery Schedule of VVGS at the IO site

2.2. Basic supply non-hardware items

The supplier provides a set of non-hardware items described in section 12 and in the mandatory appendices listed in Table Annex B2: 13.1 of this document.

3. TECHNICAL INTERFACES

The technical interfaces are defined in the mandatory appendix APB2_10.

4. TECHNICAL REQUIREMENTS

The scope of the basic supply includes the procurement and delivery of all the items listed in Section 2.1 and 2.2 and comprises all the following activities:

- all necessary provisions to guarantee high manufacturing quality
- structural verification analysis, complying with the requirements of APB2_07

- the supply must take into account the regulatory checks (design, manufacturing including materials and Non Destructive Testing (NDT)) by the Agreed Notified Body (ANB) which is selected and paid by IO.
- manufacturing method and design complying with the requirements of APB2_01
- NDE procedure for bolts APB2_03 and APB2_09
- jigs and fixtures for transportation including concept design, manufacturing drawings and analysis report according to APB2_06 and APB2_07. Note that these jigs are not defined in this specification but are required according to the needs of restraints for the control of excessive displacement during transportation.
- detailed design and manufacturing drawings, complying with the requirements of APB2_02
- procurement of materials specified according to the material specifications in APB2_09
- all aspects of manufacturing and inspection including cutting, marking, cleaning complying with the requirements of APB2_01, APB2_03, APB2_04 and APB2_05
- qualification of coating in accordance with APB2_11
- Quality Assurance, complying with the requirements of PA for the VV equatorial and lower ports
- factory acceptance tests prior to packing and shipment including APB2_04 and APB2_12
- packing, complying with the requirements of APB2_06
- preparation of transportation to the IO in Cadarache of VVGS according to the requirements of APB2_06
- liaison with the KODA and IO for the final inspection of components that are delivered to IO which is at the Cadarache site carried out by the IO.
- site acceptance of vacuum vessel support structure components is at the ITER site
- delivery of all hardware and non-hardware items and components listed in the table Annex B2: 2.1-1 and in APB2_08.
- delivery of all free issued items (if any) to other DAs or IO.
- at the end of factory fabrication, delivery of an End of Manufacturing Report including certificate of compliance and justification/tracking of non-conformance and IO acceptance through a tracking sheet

5. SAFETY, REGULATORY REQUIREMENTS, QUALITY ASSURANCE RULES AND CODES & STANDARDS

Refer to APB1_H, Information Supplied with the Tender, for a detailed explanation of the roles, parts and responsibility of the ANB in every stage of the VVGS manufacture, and for a detailed correspondence between the RCC-MR and the ESR.

5.1. Safety requirements

ITER will be a Nuclear Facility, see TSN law June 2006. (RDB1_2)

The Vacuum Vessel Gravity Supports are Protection Important component (PIC). (RDB1_1)

5.2. Quality assurance rules

The VVGS is a Quality Class 1 component. (Quality Assurance rules are described in PA for the VV equatorial and lower ports section 5)

The supplier Quality Assurance Program subject to approval by the IO in accordance with the ITER QA Program shall be applied to all the work under this contract. The ITER QA Program is based on IAEA Safety Standard GS-R-3 and on conventional QA principles and integrates the requirements of the French Order dated, 7th February 2012 on the quality of design, construction and operation in a Basic Nuclear Installation. For this purpose, the supplier shall ensure that their subcontractors carrying out contracts placed under the prime contract are in compliance with the QA requirements under the relevant QA classifications.

5.3. Regulatory requirements

The VVGS is non-pressure bearing equipment; however, the VVGS supports Level N2 Cat IV Nuclear Pressure Equipment hence it is considered part of this equipment. Design, manufacturing and testing must comply with the applicable parts of the French regulation on pressure equipment:

- a) Order on nuclear pressure equipment (ESPN Order December 12, 2005 : RDB1_3);
- b) Decree on design and construction of pressure equipment (Decree 99-1046 with latest updates : RDB1_4)
- c) Order of 7 February 2012 establishing the general rules for basic nuclear installations (RDB1_5)
- d) Licencing requirements as described in PA for the VV equatorial and lower ports section 6

5.4. Applicable code and associated classification

The VVGS shall be designed and manufactured according to the RCC-MR 2007 Construction Rules for Mechanical Components of Nuclear Installations.

The VVGS is classified as RCC-MR Support Class S1 (RH 1300).

5.5. Definition and roles of the different parties

The IO is the Manufacturer (under the meaning of ESP/ESPN) of complete VV and responsible for design, manufacture and conformity assessment.

The KODA is in charge of the supply of the VVGS according to the PA. The KODA shall also supply the IO with the applicable documentation as in APB2_08 in order for the IO to assess the conformity of the VVGS.

The supplier is the legal entity providing items or services to the KODA in accordance with this contract.

Free access to the supplier is required for the control by KODA inspectors, IO inspectors, ANB agents and French regulator agents who might wish to inspect the quality of ITER procurements on supplier's site. The supplier shall take appropriate measures to ensure that these controls can be carried out at the supplier's premises and any other places (including supplier's sub-contractor) where work for this contract is carried out.

For the application of the RCC-MR, suppliers are considered as Manufacturers for the application of chapters or paragraphs of the RCC-MR applying to them. The IO is the Operator of the ITER facility.

ANB, contracted by the IO will be in charge of the Conformity Assessment in order to demonstrate that the necessary safety requirements are satisfied. Module G conformity Assessment is required which includes:

- review of the technical documentation
- assessment of the material used when these are not in conformity with the relevant harmonized standard
- check the certificate issued by the material manufacturer
- approve the procedures of the permanent joining or check that they have been previously approved
- verify the qualifications or approvals for NDT personnel
- carry out intermediate and final inspections

Distribution of main tasks between Operator, Manufacturer, KODA and ANB are listed in Table Annex B2 5.5-1.

The supplier shall produce a Manufacturing and Inspection Plan (Follow-up document following RCC-MR terminology), for which acceptance by the KODA, IO and ANB is required, in order to be able to manage the KODA, IO and ANB compulsory checks. The supplier shall also nominate an officer for regulatory issues who will be supervised by the KODA, IO and the ANB liaison officer.

Task	Supplier	Operator (IO)	Manufacturer (ESPN definition) (IO)	ANB	Comment
Provides a description of operating conditions in consistency with safety report		O			
Produce the hazard analysis (ESP/ESPN)			O		Checked by ANB

Writes down general technical documents	O		O		Approved and endorsed by KODA and IO
Writes down technical preparation and follow-on documents(MIP)	O				Approved by KODA, IO and ANB
Documents related to design (calculation and stress analysis reports)	O*		O		*: Justification of detailed design changes and Non-conformance under KODA and IO approval Checked by ANB
Manufacture	O				Checked/Approved by KODA and IO Checked by ANB according to Module G
Works out the End of Manufacturing report	O				Approved by KODA and IO
Writes down ESP/ESPN instruction sheets including prescriptions of the radioprotection rules for ESPN			O		Checked by ANB
Gathers ESP/ESPN technical documentation			O		
Assess conformity with ESR			O	O	
Notify conformity to ESR			O		
Notify conformity with RCC-MR			O		

Table Annex B2: 5.5-1 Main Tasks distribution

Details about the structure and contents of the design and manufacturing files to be provided by the supplier and to be approved by the KODA, IO and the ANB are listed in APB2_08.

6. DESIGN AND STUDIES

6.1. General

The supplier shall use the design as provided to develop fabrication/shop drawings. The supplier shall fix detail shaping of parts taking into account the requirements of Technical Annex B2. The supplier can request changes to the detailed design which are subject to KODA and IO approval.

If necessary during the manufacturing design, design optimisation shall be performed by the supplier to incorporate changes foreseen in the VVGS such as;

- Electrical break removal
- Bolt hole size optimisation
- Bolt design optimisation taking into account; type of bolt, material and dimensions
- Wedge dimension optimisation

- Jack Screw rotation from 5° to 27°
- instrumentation supporting features, and fiducials
- Manufacturing tolerances and assembly tolerances
- etc

6.2. Mechanical design studies

The scope of supplier design activities described in detail within APB2_07 includes:

- calculation of VVGS distortion during transportation
- stress analysis in support of the justification of design changes requested by the supplier
- stress analysis in support of the justification of non-conformity

7. MATERIALS PROCUREMENT AND ACCEPTANCE

The main material used in VV support structure are STS316L(N)-IG, Steel 660, Inconel718, STS304, Al-bronze and polyimide.

The specifications for the procurement of the material are given in APB2_09 and its associated reference documents.

8. FABRICATION AND INSPECTION

8.1. Parts submitted to RCC-MR requirements

All the parts belonging to the basic supply hardware items as described in chapter 5.1 are submitted to RCC-MR class 2 requirements.

Main manufacturing requirements are provided in APB2_01 which refers to other Appendices.

NDT requirements are provided in APB2_03.

Clean conditions and vacuum requirements are provided in APB2_05.

Identification and marking requirements are provided in APB2_01.

Tolerances requirements are provided in APB2_01

Specification for dimensional controls is given in APB2_04

8.2. Parts not subject to RCC-MR requirements

Manufacturing tools, jigs, lifting, handling tools and shipping frames are not subject to RCC-MR requirements.

9. ACCEPTANCE REQUIREMENTS

Factory, site and final acceptance requirements are provided in APB2_08

10. HANDLING, PACKING AND SHIPPING

The supplier is responsible for any handling operation carried out in the course of the manufacture, and assembly in the factory.

Handling, shipping and packing requirements are provided in APB2_06

11. DOCUMENTS REQUIRED

Documentation requirements are provided in APB2_08

12. APPLICABLE REFERENCE DOCUMENTS

This Annex is the master document for the contract of procurement for the ITER VVGS. Links to the detailed requirements are found within the mandatory Appendices listed in Table Annex B2 : 13-1. A list of mandatory reference documents can be found in Table Annex B2: 13-2. These reference documents may be revised due to clarify the dubitable articles during this contract.

Appendix	Title	KODA Doc. No.
APB2_01	Manufacturing Requirements	IT-PD-401-14/00015
APB2_02	Drawings	IT-PD-401-14/00016
APB2_03	Non Destructive Examination	IT-PD-401-14/00017
APB2_04	Dimensional Inspection	IT-PD-401-14/00018
APB2_05	Vacuum Requirements and Surface Treatment	IT-PD-401-14/00019
APB2_06	Packing Shipping and Handling	IT-PD-401-14/00020
APB2_07	Engineering Analyses	IT-PD-401-14/00021
APB2_08	Documentation and Acceptance Requirements	IT-PD-401-14/00022
APB2_09	Materials Procurement and Acceptance	IT-PD-401-14/00023
APB2_10	Interfaces	IT-PD-401-14/00024
APB2_11	MoS2 Coating Qualification	IT-PD-401-14/00025
APB2_12	Functional Test of Hinge and Dowel	IT-PD-401-14/00026

Table Annex B2 : 12 – 1 List of Mandatory Appendices

Ref.#	Title	Version	ITER IDM Identifier
RDB1_1	Safety Important Functions and Components Classification Criteria and Methodology	V1.8	ITER_D_347SF3
RDB1_02_1	CAD Manual 01 - Introduction	V7.0	ITER_D_249WLQ
RDB1_2	Loi n° 2006-686 du 13 juin 2006 relative à la transparence et à la sécurité en matière nucléaire	V4.2	ITER_D_256L5M
RDB1_3	Order of 12/12/2005 on Nuclear Pressure Equipment	V1.1	ITER_D_2229CW
RDB1_4	Decree No. 99-1046 dated 13 December 1999 concerning pressure equipment	V2.0	ITER_D_2W7M6M
RDB1_5	Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN	V1.6	ITER_D_7M2YKF
RDB1_05_1	ITER_Vacuum_Handbook	V2.3	ITER_D_2EZ9UM
RDB2_02_1	VV Support Tolerances		ITER_D_3UP7EF
RDB2_02_2	VV Gravity Support Functional Tolerance Drawing		ITER_D_QFTBXZ
RDB2_07_1	Mechanical Loading Conditions for the ITER Vacuum Vessel Gravity Support	V5.3	ITER_D_2F52JY
RDB2_09_1	PPS_X6CrNiTiMoVB25-15-2_Forgings_VVGS	V1.2	ITER_D_AHJVPJ
RDB2_09_2	PPS_X6CrNiTiMoVB25-15-2_Bars_VVGS_and_IWS	V1.1	ITER_D_AHK7DE
RDB2_09_3	PPS_Stainless Steel_316L(N)-IG_Forgings_VVGS	V1.1	ITER_D_AHL5RZ
RDB2_09_4	PPS_NiCr19Fe19Nb5Mo3_Plates_VVGS	V1.2	ITER_D_AHM38M
RDB2_09_5	PPS_NiCr19Fe19Nb5Mo3_Bars_VVGS	V1.3	ITER_D_AHMGDY
RDB2_09_6	PPS_304_Plates_VVGS	V1.2	ITER_D_AHN5P8
RDB2_09_7	PPS_Aluminium_Bronze_Plates_VVGS	V1.1	ITER_D_AHPH2V
RDB2_09_8	PPS_Aluminium_Bronze_Forgings_VVGS	V1.3	ITER_D_AHPTFS
RDB2_09_9	PPS_Polyimide_Laminate_VVGS	V1.3	ITER_D_AHPTAC

Table Annex B2:12-2 Mandatory Reference Documents

RCC-MR Design and construction rules and ISO, EN standards are not allocated Mandatory Reference Documents but referred to directly, for example; EN 29001– “Quality Systems. Specification for Design/Development, Production, Installation and Servicing.” and ISO 9001– “Quality Management Systems Requirements.”



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Mandatory Appendix APB2_01 Manufacturing Requirements

	Name	Action	Affiliation
Author	Chul Kyu Park	19-Jan-2016 : Signed	KODA/TED/VVTST
Reviewer	Hangsung Kim	19-Jan-2016 : recommended	KODA/QMD
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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_01

Manufacturing Requirements

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory manufacturing requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document.

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1.1	2014. 08. 12	Minor changes in sentence & tolerances are updated according to IO comments
1.2	2016. 01. 19	Changes in reviewer and approver for re-tendering. Safety justification is added in the chapter 1. Functional tolerance has been added in chapter 2.1 “N” is added in the List of suppliers and sub-contractors and “H” is added in the Check of End of Manufacturing report of Control point(IO) of the Table APB2_01: 3.2 1

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1. INTRODUCTION

The baseline manufacturing method is defined in this Appendix. Any deviation from this manufacturing method shall be submitted to the KODA, IO and ANB (if need) to review/approve the deviation's impact. The use of any other techniques not described hereinafter, also must be justified and documented. This justification includes, as a minimum, the following activities:

- concept sketches
- description of the method
- safety justification

In case of changes affecting the structural behavior of the VVGS, supporting structural analysis shall also be provided.

A complete summary list of manufacturing requirements, testing requirements is shown below in Table APB2_01: 1-1. A description of these requirements can be found in the various Appendices indicated in the tables.

Requirements are highlighted in BOLD				
No	Title	Description	Appendix	Justification
1	Surface defect detection	Only ITER qualified LDPs (Liquid Dye Penetrants) are acceptable. Further information regarding low impurity penetrants can be found in APB1_C	APB1_C, APB2_03, and APB2_05	Normal liquid dye penetrant inspection fluids are not suitable, for high vacuum surface inspection due to the outgassing associated with the penetrant materials and the inherent risk of spoiling the vacuum.
2	Cleanliness and Cleaning	<p>Prior to incorporation into the fabrication all parts are cleaned in accordance with an approved procedure.</p> <p>Cleanliness is required during the whole manufacturing process to achieve a high quality vacuum. A clean work plan and Work qualification report shall be submitted for approval a minimum of one month before the start of manufacture.</p> <p>RCC-MR cleanliness class B shall apply as a minimum requirement throughout the manufacturing process. Before final cleaning (The baseline method is defined by DA (IO) for vacuum facing surfaces in APB2_05) a work plan is to be submitted to DA, IO and ANB for approval.</p>	APB2_05	
3	Dimensional Inspection during Manufacture	At every important stage during manufacture each assembly is to be dimensionally inspected. Results are to be compared with drawings and calculations. If necessary, remedial action is to be proposed. Acceptance dimensional requirements only refer to the completed VVGS after removal of factory tooling / jigs as defined in APB2_04.	APB2_04	
4	Marking of	The supplier is to issue a marking procedure to be approved by the		

	Parts	<p>DA, IO, ANB prior to the marking process</p> <p>All parts and sub-assemblies are to be identified and marked using low stress marking methods such as low stress stamping, vibro etching or electrolytic etching in compliance with RCC-MR RF 2000 rules.</p> <p>When original marking needs to be removed during the manufacturing process, they shall be transferred before being removed to ensure a permanent identification against relevant material certificates.</p> <p>All permanent records of inspections shall make reference to the above permanent markings.</p>		
5	Machining Fluids	All machining fluids shall be water soluble and approved by the DA , IO and ANB.		
6	Trapped Volumes	Crevices, blind holes, trapped volumes and inaccessible regions shall be avoided.		

Table APB2_01: 1-1 Manufacturing and Testing Requirements Summary Table

2. TOLERANCES AND DIMENSIONS

The supplier fabricates the VVGS in accordance with the following tolerances.

2.1. MANUFACTURING TOLERANCES AND DIMENSIONS

All tolerances given in the drawings 009393-B (ITER_D_3UP7EF) in APB2_02 shall be verified at the final inspection stage for each part. The mandatory tolerances for each part listed below in Tables APB2_01: 2.1-1 shall be measured in a state agreed with the DA (IO) that corrects self-weight deformation. All tolerances are given at room temperature (20°C). If there is inconsistency between the Tables APB2_01: 2.1-1 and the tolerance drawing, tolerance drawing shall have a priority.

Item		Tolerances	Remarks
Upper Block & Lower Block	Geometric	mK	ISO 2768 Unless other tolerance specified on drawing
	Sleeve Inside Diameter	H7 (after shrink fit)	ISO 286-1:2010
	Hole cylindricity	0.05	
	Lugs	Position ± 0.5 Parallelism 0.05 perpendicularity to axis 0.05	
Primary Hinge	Geometric	mK	ISO 2768 Unless other tolerance specified on drawing
	Sleeves Inside Diameter	H7 (after shrink fit)	ISO 286-1:2010
	Hole cylindricity	0.05	Hole cylindricity
	Lugs	Position ± 0.5 Parallelism 0.05 perpendicularity to axis 0.05	
Secondary Hinge	Geometric	mK	ISO 2768 Unless other tolerance specified on drawing
	Cylindrical surfaces	R100 -0.008/-0.022	
	Parallelism of cylindrical surfaces	0.05	
Dowel	Length	mK	ISO 2768
	Outside Diameter	$\Phi 180$ -0.08/-0.092	Before coating
	Cylindricity	0.05	Before coating
Others	-	mK	ISO 2768 Unless other tolerance specified on drawing

Note 1: Tolerances may be adjusted during manufacturing with prior agreement by the DA (IO)

Table APB2_01: 2.1-1 VVGS Tolerances summary

2.2. FUNCTIONAL TOLERANCES AND DIMENSIONS

The functional tolerances (assembly tolerances) given in the drawing 036825-A (ITER_D_QFTBXZ) in APB2_02 shall be verified at the functional test stage for VVGS assembly. The acceptance criteria are described in APB2_12. Functional tolerance shall be measured in a state agreed with the DA (IO) that corrects self-weight deformation. All tolerances are given at room temperature (20°C).

3. TESTING AND INSPECTION

3.1. SEQUENCE FOR TESTING AND INSPECTION OF THE VVGS BY THE SUPPLIER.

Test and inspections	Appendix
Material inspection	APB2_03 & APB2_09
Dimensional Inspection	APB2_04
Factory acceptance test before shipment	APB2_08 & APB2_12

Table APB2_01: 3.1-1 Test/Inspection at the Factory

3.2. PRELIMINARY LIST OF KODA AND IO NOTIFICATION POINTS AND HOLD POINTS

The KODA shall closely monitor the production of its suppliers. This monitoring shall include Notification Points (NP), Witness Point (WP), Authorization-To-Proceed Points (ATPP), and Hold Points (HP) at critical steps in the suppliers' Manufacturing and Inspection plans. The control points shall be integrated into the agreed schedule.

A Notification Point is a milestone where the supplier is required to notify the KODA (who informs the IO) of a specific task or a specific deliverable. A Notification Point is meant to enable the KODA and the IO personnel to witness a critical design and manufacturing step at the supplier's facility. The Notification shall be sent by the supplier to the KODA at least 14 calendar days prior to the scheduled design and manufacturing step. The KODA shall inform the IO of the supplier's Notification. The KODA and the IO shall decide and notify within the 10 calendar days whether or not they will attend. A Notification Point shall not affect the design and production flow of the supplier.

A Witness Point is a milestone where the supplier is required to notify the KODA, who informs the IO, that he will perform a specific operation or deliverable. A WP indicates a mandatory inspection to witness a critical manufacturing operation at the supplier's premises. Notification shall be sent by the supplier to the KODA at least 14 calendar days prior to the scheduled manufacturing operation.

An Authorization-To-Proceed Point is a milestone where the supplier is required to notify the KODA, who informs the IO, that it has completed a specific task or deliverable and must wait for an authorization from the KODA before proceeding to the next task or deliverable. The KODA shall grant the Authorization-To-Proceed on the basis of clearly identified Quality Control data and Acceptance test results provided by the suppliers. The KODA shall have 4 calendar days to review the supplier's data and to notify the IO of its decision. The IO shall

have 3 calendar days to review the KODA decision. Beyond these 7 calendar days, and if there is no IO reaction, the KODA shall notify the supplier of its decision. If authorized, the supplier shall proceed to the next task or action on the specific deliverable. If rejected, the supplier shall develop with the KODA a recovery plan that shall be submitted and reviewed by the IO within 7 calendar days of submission. If IO objects, the IO shall detail its reasons in writing and the KODA shall have 7 calendar days to respond and, whenever suitable, develop a recovery plan with the supplier. An Authorization-To-Proceed Point shall only affect the specific task or deliverable it is associated with and shall not interfere with the execution of other tasks or of the production of other deliverables of the same kind.

A Hold Point is a milestone where the supplier is required to notify the KODA, who informs the IO, that it has completed a specific task or deliverable and must stop the associated processes until a Hold Point Clearance is issued. The Hold Point Clearance shall be issued on the basis of clearly identified Quality Control, data, and acceptance test results provided to the KODA and the IO at the time of the request. The KODA shall have a maximum of 7 calendar days to review the supplier's data and to notify the IO of its decision. The IO shall have a maximum of 7 calendar days to review the KODA assessment and to confirm or reject it. If clearance is granted, the supplier shall resume its activity. If rejected, the supplier shall develop with the KODA a recovery plan that shall be submitted and reviewed by the IO within 14 calendar days of submission. If the IO has any objections, the IO shall detail its objections in writing and the KODA shall have 14 calendar days to answer the IO objections and, whenever suitable, develop a recovery plan with the supplier.

A preliminary list of notification points and hold points for KODA, IO and ANB is given in Table APB2_01 3.2-1. The final list will be set on the supplier's detailed MIP as defined in Annex A and consistent with RCC-MR RA 3900 requirements.

Operation	KODA	Control Point (IO)	ANB	Comment
Contract Award for VVGS	H			
Approval of Contractor follow-up documentation (Contractor Work Schedules) and set of Hold points/Notification points	H	H	H	
List of suppliers and sub-contractors.	W	N		Sent to IO for approval and ANB for information
Completion and Acceptance by ANB of detailed design studies (assembly scheme, drawings, components parts list, material and equipment identification and marking)	H	H	H	
Delivery and acceptance of plates, forgings, and bars for production.	N	N	N	Check all the material certificates and marking procedure
Approval of the manufacturing procedures	H	H	H for quality related procedures	Approval of documentation before each manufacturing

				operation
Jigs and tooling design	N	N		
Jigs and tooling manufacture	N	N		
Completion of machining of forgings or plates.	N	N	N	
Final dimensional inspection	H	H	N	
Final cleaning and packing	H	H	N	
Factory acceptance	H	H	H	
Check of End of Manufacturing report	H	H	H	
Acceptance at ITER site or other DAs	N	H		

Table APB2_01: 3.2 -1 Types of Inspection at suppliers and ITER



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Mandatory Appendix APB2_02 Drawings

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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_02

Drawings

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory drawing requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document.

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1.2	2016. 01. 19	Changes in reviewer and approver. Tolerance drawing has been added.

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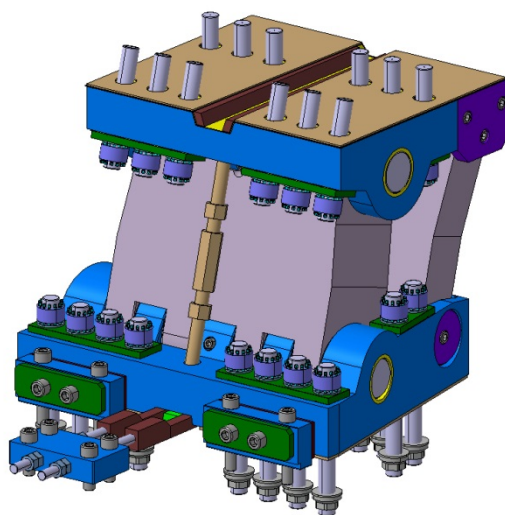
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1. INTRODUCTION

All dimensions from 3D model and drawing are given at reference to room temperature (20°C).

2. 3D CAD MODEL SUPPLIED BY KODA

3D CAD Model of VVGS (DET-02447) shall be provided by KODA. Supplier shall prepare CATIA V5 R2013.



3. TOLERANCE DRAWINGS

The supplier shall apply the tolerance for each part and assembly according to APB2_01. Each part shall be manufactured according to RDB2_02_1. If there is inconsistency for the material between the tolerance drawing and Table Annex B2: 2.1-1 in the TECHNICAL ANNEX B2 Vacuum Vessel Gravity Support, Table Annex B2: 2.1-1 shall have a priority. During functional test, supplier shall meet the tolerance for functional tolerance according to RDB2_02_2.

4. DRAWINGS SUPPLIED BY THE SUPPLIER

The drawings from the supplier shall comply with ITER CAD Manual reference document (RDB1_02_1) and in particular with Section 09, Drawings best practices and Section 10 ISO Drawing Standards. The supplier shall ensure traceability of drawings and parts by using the IO defined numbering system. The tolerance shall be designated for each part in the drawings.

5. MODELS AND SUMMARY OF THE VVGS DESIGN STATUS

Detail design changes may be expected to the model after the contract for the following components:

- Electrical break removal

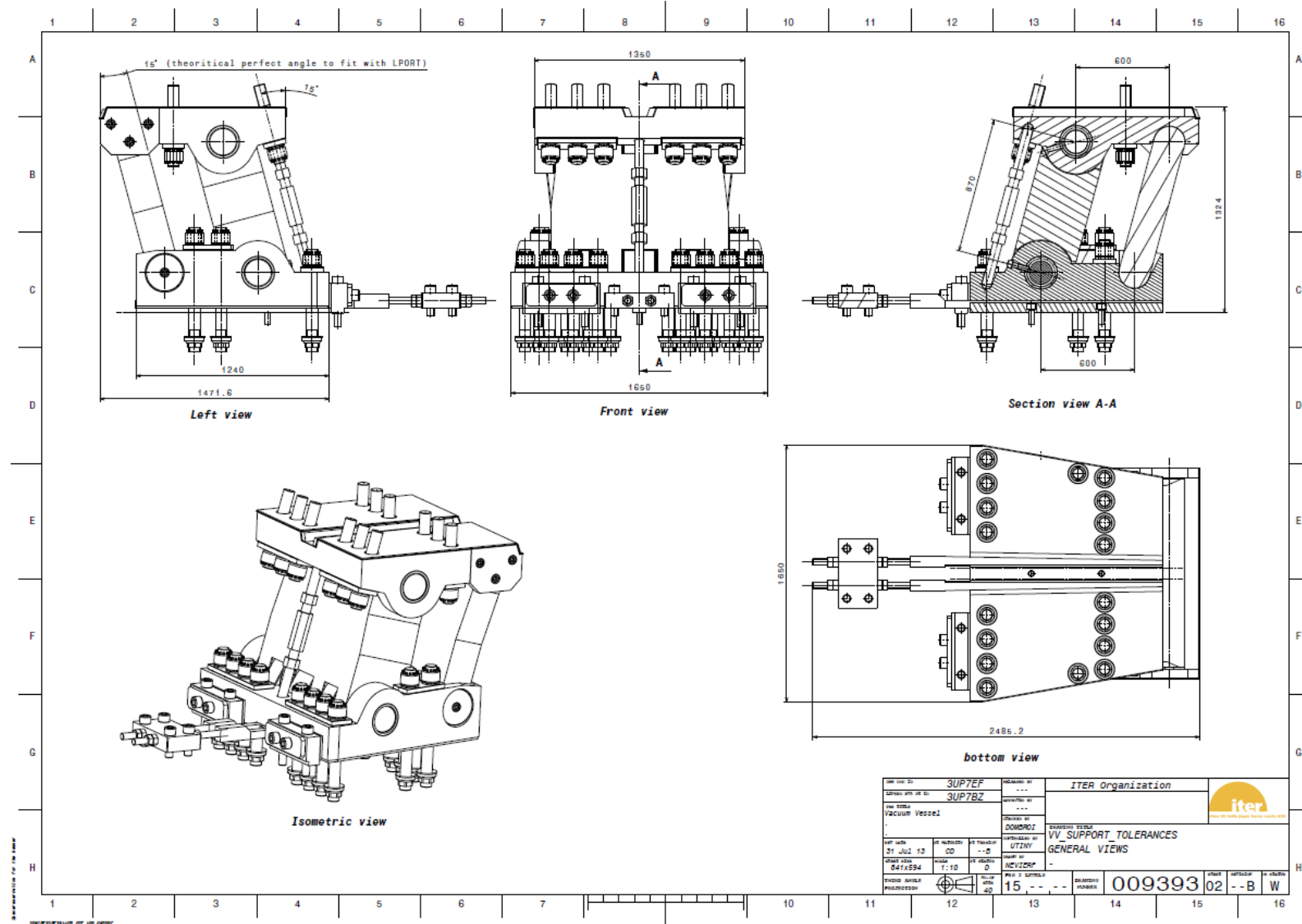
- Bolt hole size optimisation
- Bolt design optimisation taking into account; type of bolt, material and dimensions
- Wedge dimension optimisation
- Jack Screw rotation from 5° to 27°
- instrumentation supporting features, and fiducials
- Others

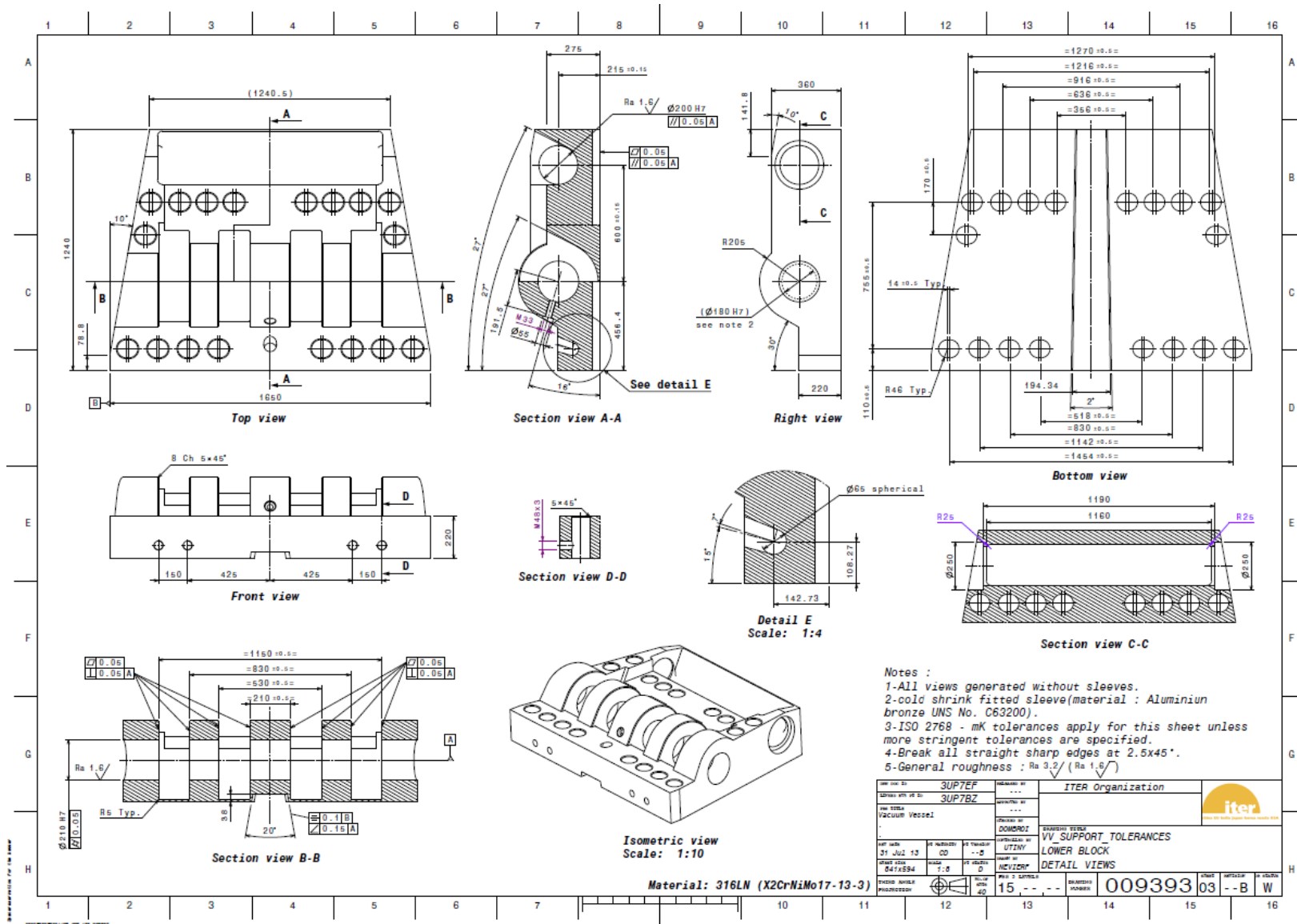
Changes to these parts shall be made by the supplier and approved by the KODA and IO.

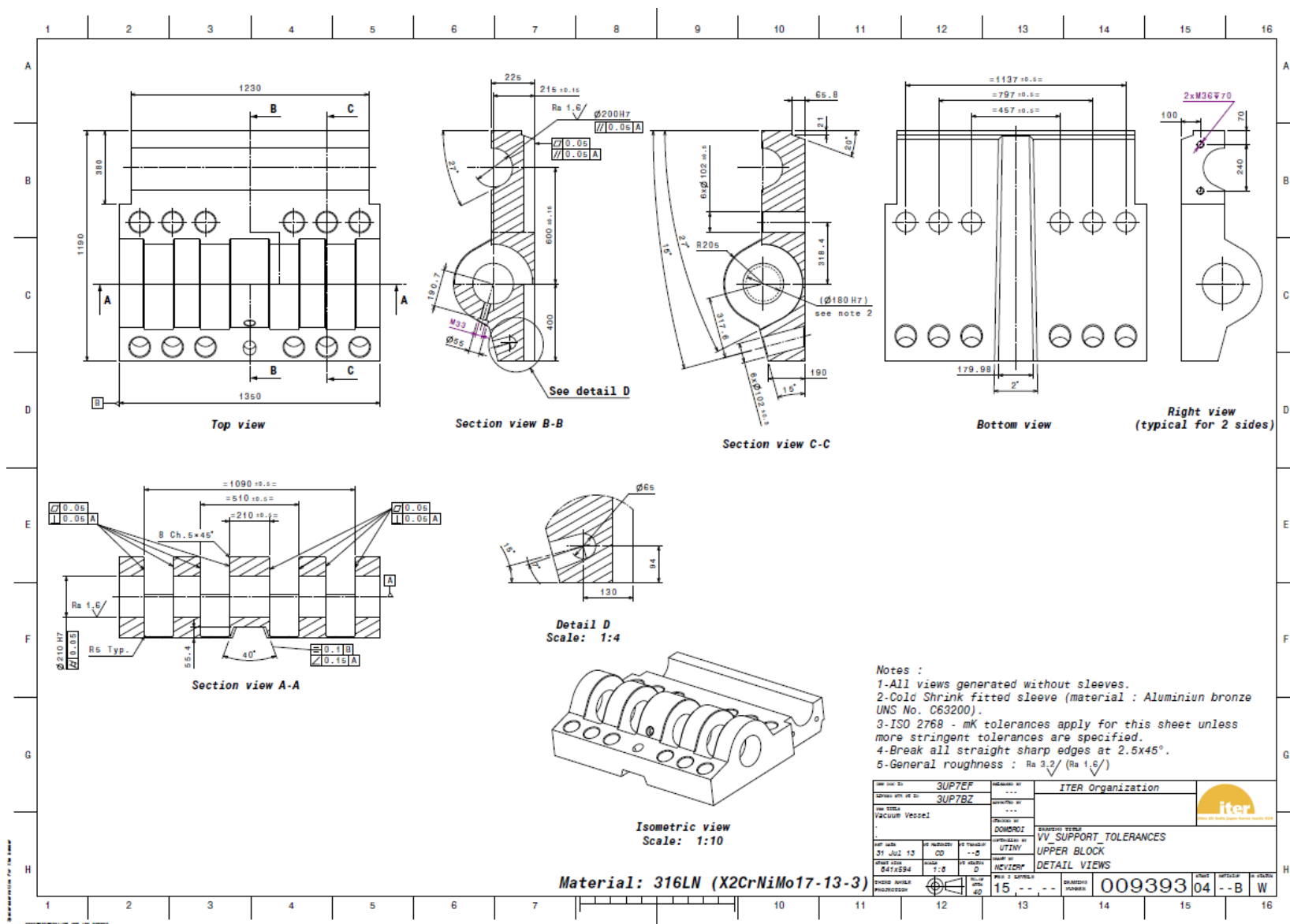
6. VVGS COMPONENTS

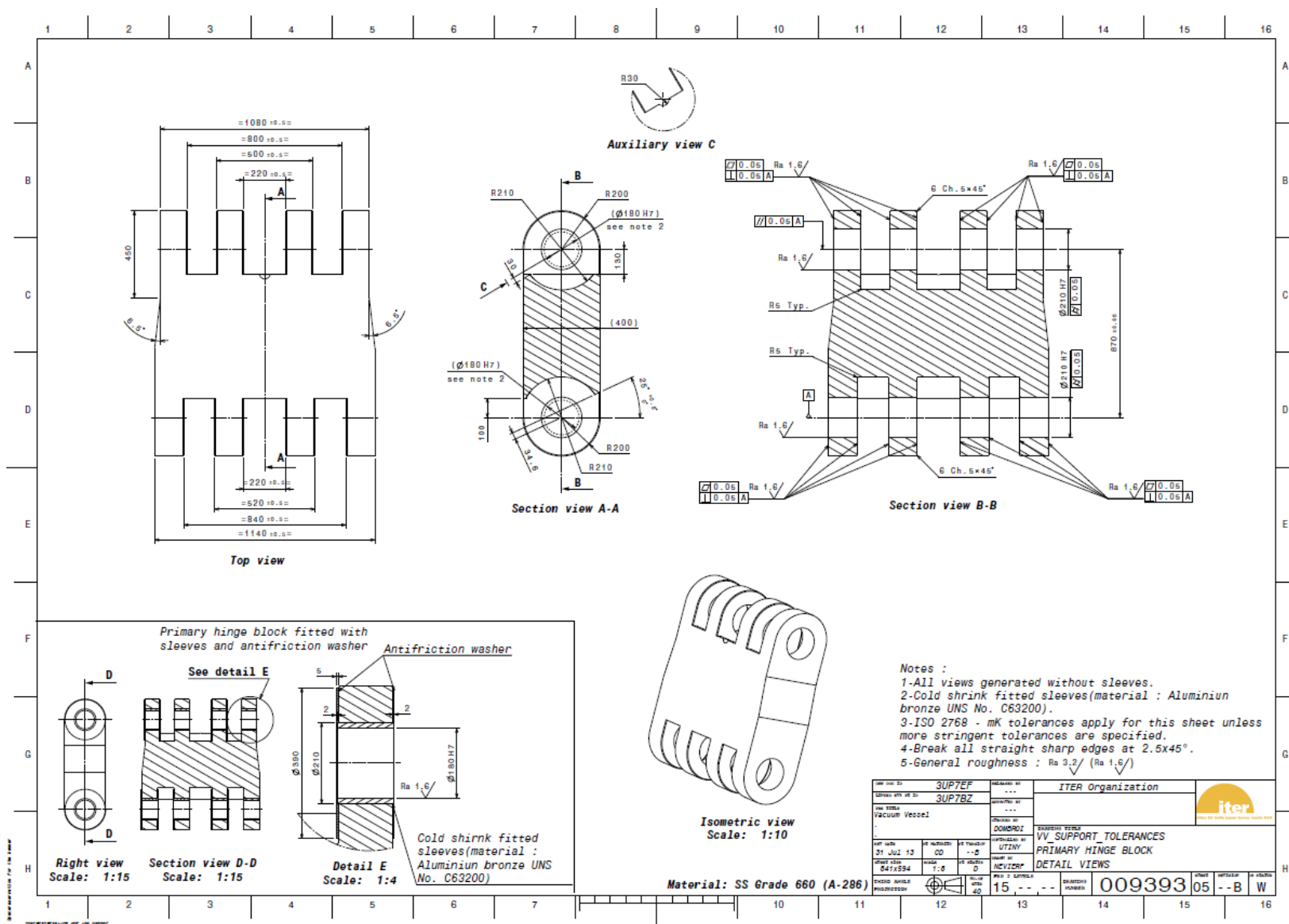
Components of VVGS for this contract are summarized Table Annex B2: 2.1-2 of Technical Annex B2.

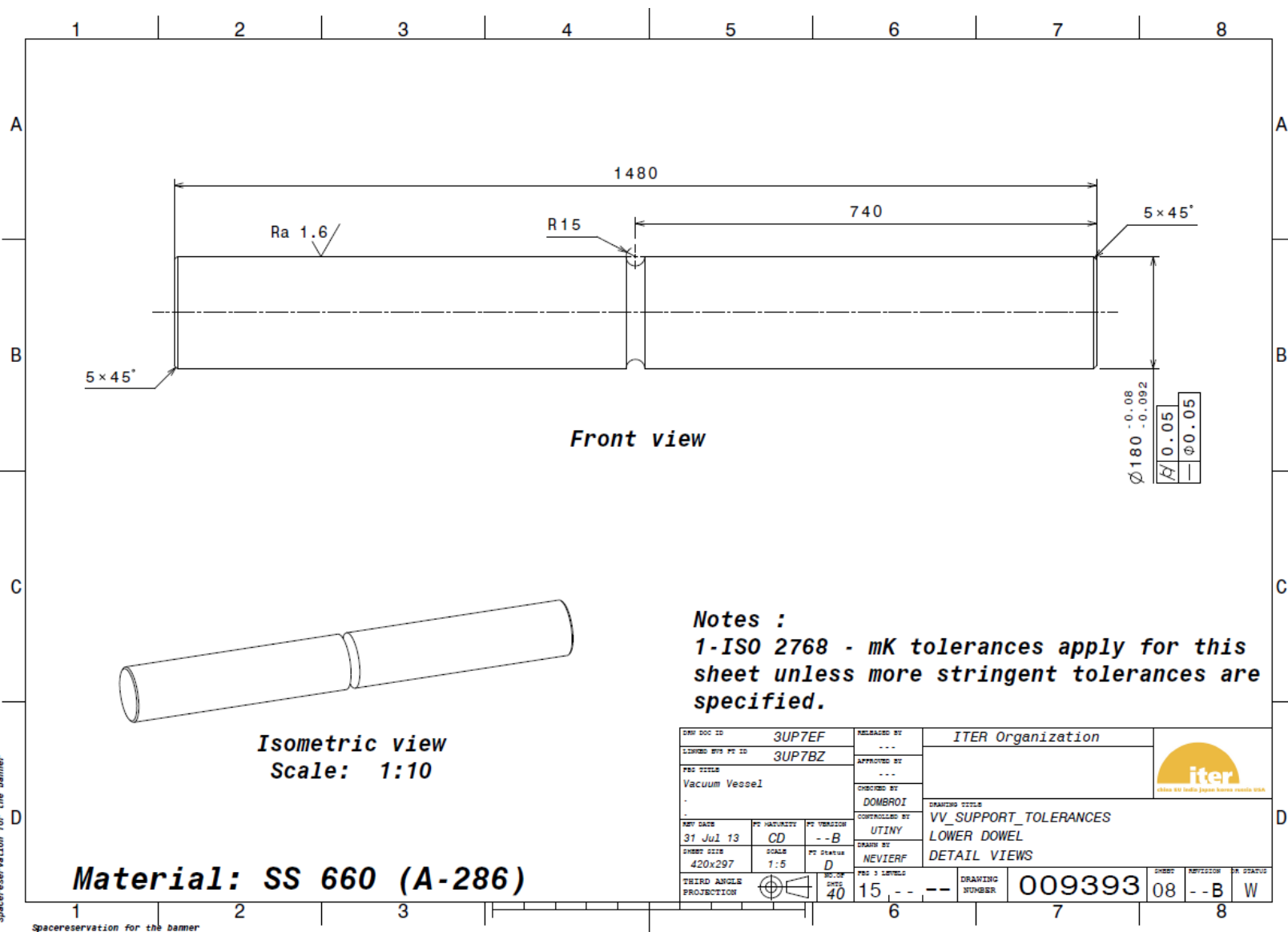
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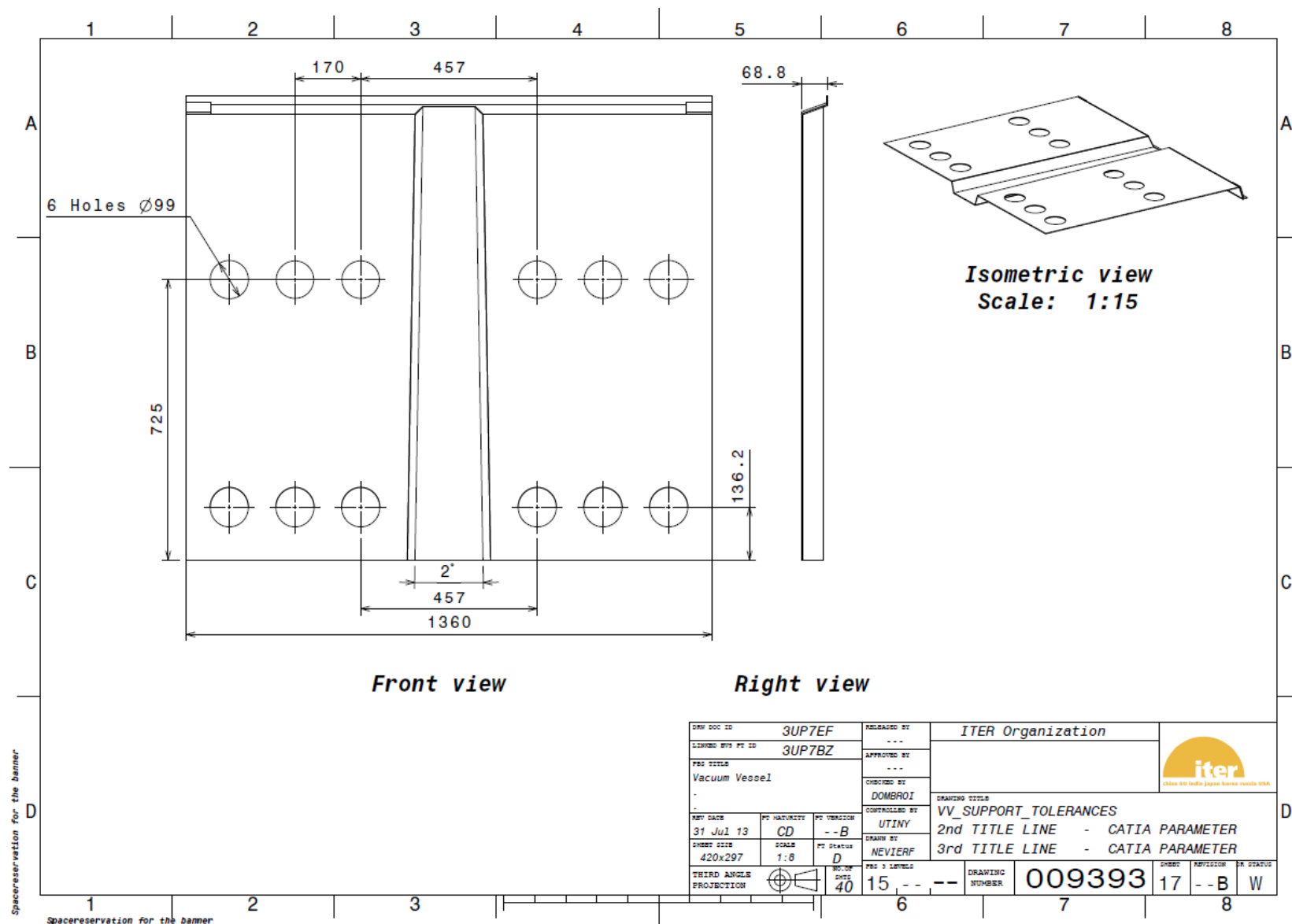


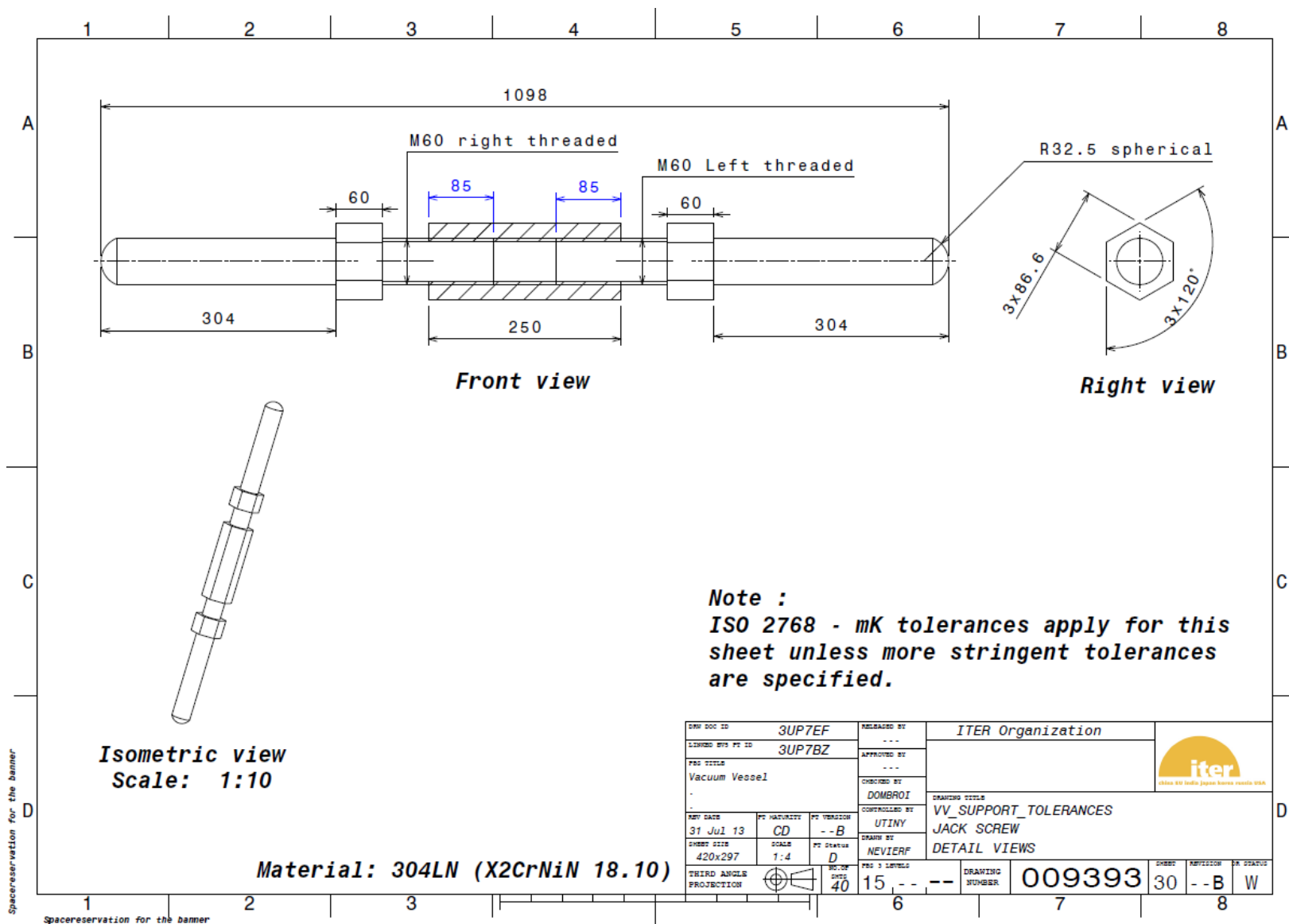














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Mandatory Appendix APB2_03 Non Destructive Examination Method

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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_03

Non Destructive Examination Methods

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory Non Destructive Examination requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

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Approver	W. Chung	Tokamak Eng. Department, Director

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1. SCOPE

This appendix covers the requirements for Non-Destructive Examinations (NDE) involved in VV Gravity Support fabrication.

2. REFERENCE CODES AND STANDARDS

The work shall conform to the RCC-MR 2007 code which also refers to European and ISO Standards.

3. REQUIREMENTS

3.1. General requirements for Non Destructive Examination

The defect interpretation on assemblies shall be in accordance with the RCC-MR code.

General requirements of LDPs for surface examination are contained in APB2_01 Manufacturing requirements.

3.2. Design requirements

General fabrication and associated examinations are provided in RH 4000.

3.3. NDE of base material (products and parts)

3.3.1. NDE of plates

Plates shall undergo visual examination following the requirements of the technical specification (APB2_09, [RDB2 09 4](#), [RDB2 09 6](#), [RDB2 09 7](#) and [RDB2 09 9](#)) and in accordance with RMC 7100. In case of doubt, surface examination by liquid penetrant or *PTC* is required in accordance with RMC 4000.

Plates more than 30 mm thick follow a volumetric examination in compliance with RMC 2400.

Acceptance criteria for visual, surface and volumetric examination shall be within the plate's technical specification.

3.3.2. NDE of forgings and rods

Forgings shall undergo visual examination and surface examination following the requirements of technical specification (APB2_09, [RDB2 09 1](#), [RDB2 09 2](#), [RDB2 09 3](#), [RDB2 09 5](#) and [RDB2 09 8](#)) and shall be in accordance with RMC 7100 and RMC 4000. Visual and surface examination is required at the stage of manufacture and after final machining.

Forgings and rods follow a volumetric examination in compliance with RMC 2300 if requested; refer to the product procurement specifications for the VVGS material.

Acceptance criteria for visual, surface and volumetric examination shall be within the forging and rods technical specification.

3.3.3. NDE of bolts

NDE and its acceptance criteria for final bolting product shall be agreed among the supplier, KODA, IO and ANB after consultation with bolting manufacturer.

3.3.4. NDE Method

NDE methods are described in the material Product Procurement Specifications, refer to Table APB2_09 : 3-1 and shall conform to the referred standards.

3.3.5. NDE Operators and Inspectors Qualification

Qualification and certification of personnel responsible for performance or assessment of non-destructive examination results shall follow all requirements described in RMC 8000 including the certification system, definitions, required qualifications and certification provisions. Following A18.3253.1, NDE personnel shall be approved by ASN agreed RTPO under supplier responsibility. The document shall be available to KODA, IO and ANB for verification.

The following rules apply:

- only personnel qualified and certified in accordance with NF EN 473 perform NDE
- only personnel qualified and certified level 3 in accordance with NF EN 473 approve NDE procedures and reports
- for assemblies submitted to partial examination, the KODA and IO can impose the selection of areas to be inspected

4. DOCUMENTS TO BE PREPARED BY THE SUPPLIER

NDE documentation requirements are provided in APB2_08.

Procedures shall specify examination criteria and methods. They shall be submitted to KODA, IO and ANB approval before the start of NDE operations.



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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_04

DIMENSIONAL INSPECTION

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory dimensional inspection requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

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1. SCOPE

This technical annex covers the requirements for tolerances and dimensional control required for the VVGS fabrication.

2. REFERENCE CODES AND STANDARDS

The work shall be carried out according to RCC-MR 2007 Edition. The following codes and standards apply. In the event that codes conflict, the RCC-MR shall prevail.

- UNE-EN 20286-1:1996: ISO System of Limits And Fits. Part 1: Bases Of Tolerances, Deviations And Fits. (ISO 286-1:1988)
- UNE-EN 20286-2:1996: ISO System Of Limits And Fits. Part 2: Tables Of Standard Tolerance Grades And Limit Deviations For Holes And Shafts. (ISO 286-2:1988)
- ISO 2768-1:1989 General Tolerances – Tolerances for linear and angular dimensions without individual tolerance indicators (designation-f)
- ISO 2768-2:1989 General Tolerances – Geometrical tolerances for features without individual tolerance indicators (tolerance class-f)
- UNE-EN ISO 12085:1998: Geometrical Product Specification (GPS). Surface Texture: Profile Method. Motif Parameters. (ISO 12085:1996)
- UNE-EN ISO 14253-1:1999: Geometrical Product Specifications (GPS). Inspection By Measurement Of Work Pieces And Measuring Equipment. Part 1: Decision Rules For Proving Conformance Or Non-Conformance With Specifications (ISO 14253-1:1998)
- UNE-EN ISO 14660-1:2000: Geometrical Product Specifications (GPS) - Geometrical Features- Part 1: General Terms And Definitions. (ISO 14660-1:1999)
- UNE-EN ISO 3650:2000: Geometrical Product Specification (GPS). Length Standards. Gauge Blocks (ISO 3650:1998)
- UNE-EN ISO 5458:1999: Geometrical Product Specifications (GPS) - Geometrical Tolerancing - Positional Tolerancing (ISO 5458:1998)
- ISO 12857. Field Procedure for determining accuracy of Surveying Instruments
- RCC-MR 2007 Edition, Section 5 Fabrication

The supplier may propose their own design standards and specifications providing they are consistent with or more stringent than those of EN, ISO, etc.

3. REQUIREMENTS

The design drawings and other design documents will derive the fundamental design dimensions and tolerances. The supplier shall produce shop floor documentation, demonstrating how the manufacture is controlled from start to finish. Part of this control will include progressive dimensional inspection and recording.

Prior to contract commencement the supplier shall produce an implementation plan that shall define all quality related activities to be carried out during the contract. Elements relating to dimensional control shall include;

- Reference standards
- Design change control procedures – Drawings and CAD models
- Document control
- Instrument calibrations and test procedures
- Control of non-conformities
- Data management procedures
- Measurement procedures- data acquisition, post processing and validation
- Reporting procedures

The KODA and IO shall be given the opportunity to review the implementation plan and any documents referenced within it, prior to contract commencement.

3.1. Frequency and stages of Dimensional Inspection

Inspection shall be carried out at all crucial stages of the manufacturing process to guarantee adherence to final tolerances and set as early as possible corrective measures. The frequency and details of intermediate surveys shall be defined by the supplier and include as a minimum the stages listed here after.

KODA and IO will witness the dimensional inspections after the following stages:

- Materials supply
- Sleeve Shrink-fit Completion
- Dowels MoS2 Coating Completion
- Stud Bolt Completion
- jigs or bracing tool removal
- final machining operation (if any)
- factory acceptance dimensional inspection on completed component

3.2. Factory acceptance dimensional control requirements

Factory acceptance dimensional inspection will be carried out after completion of the VVGS. Dimensional control for factory acceptance shall be conducted in a temperature-controlled environment with a maximum variation of $\pm 5^{\circ}\text{C}$. Key dimensions shall be measured at the reference temperature of 20°C or corrected to this temperature. This temperature stability requirement applies at least one day before the start of the control to take into account thermal inertia of VVGS. The temperature shall be checked by direct measurements on thickest parts

of the VVGS at different heights in the factory. The accuracy of the measurements shall be better than $\pm 1^{\circ}\text{C}$. Temperature measurements shall be recorded throughout the measurement task, logged against time and saved with the measurement file.

The conditions of support and restraint of the VVGS for the acceptance tests are to be agreed among the IO, KODA and the supplier. The supplier shall submit to the KODA and IO for approval the details of the supporting conditions and finite element calculations identifying the deformation of the VVGS under self-weight during factory acceptance tests.

Tolerance requirements are given in manufacturing appendix APB2_01 and in associated drawings of APB2_02. They refer to nominal geometry of the VVGS at 20°C without taking into account mechanical deformation under self-weight. Measurements shall use co-ordinate systems as specified in the tolerance drawings.

Measurements will use reference coordinates located on each edge of the VVGS. Measuring points and associated fiducials will be agreed by IO, KODA and supplier. Key dimensions include:

- Block final dimension
- Hinge final dimension
- MoS2 Coating inspection
- Bolt final dimension (Screw machining part)
- Sleeve final machining dimension
- geometrical data and marking required for the installation of VVGS
- other interfaces listed in APB2_10

3.3. General requirements

Factory acceptance requirements also apply as far as reasonably achievable during intermediate controls. In case of different temperature conditions, measurements take into account VVGS structures actual temperatures and corrected to reference temperature. During assembly, the temperature difference between all parts is minimized. The following conditions have to be avoided:

- vibrations or unstable ground
- interruptions due to parallel activities
- noise and dust

The dimensional control procedure avoids any temperature and/or load induced displacements of reference points. The supplier shall agree with the KODA and IO on the scaling process to be applied to dimensional survey data.

4. METHODS PERMITTED

4.1. General

All equipment used in Dimensional Control is qualified in accordance with EN standards and holds calibration certificates (released by laboratory accredited) at the time of use.

The equipment selected by the supplier shall be 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. and shall deliver data in a format acceptable to the IO.

The supplier shall draft a dimensional control plan that shall include all inputs to the measurement process i.e. measurement instruments and software to be used and procedures to be followed. The dimensional control plan shall be supplied to the KODA and IO, for approval, prior to commencement of manufacture.

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 20% of the tolerance applicable to the feature being measured.

For measurement surveys utilising multiple instrument stations, bundle adjustment algorithms shall be utilised to ensure error propagation, via multiple best-fit alignments, does not occur.

It is recommended to enable the implementation of as-built data for the manufacturing of interfacing components as far as possible by adaptable design dimensions. This requires checking the fabrication sequence.

The supplier shall produce "as built" drawings/3D models/electronic data that shall demonstrate compliance with the design. Interface dimensions as identified by the IO shall also be recorded. Any discrepancies shall be the subject of a concession.

In order to monitor deformation during the manufacturing process, reference points on the component shall be periodically measured. The location and frequency of measurements shall be agreed among the supplier, DA and IO together with the format of the data.

4.2. Equipment and Tools

The supplier shall have available on site, well in advance, all the equipment and tools required for executing the inspections. Only high quality tools suitable for the assembly of the different equipment comprised in the Contract scope shall be used.

The supplier shall incorporate as many tools as necessary during the execution of the works, and consider the provision and maintenance of as many tools and means as required in order to carry out the work in a timescale compatible with the execution of the work.

The supplier shall provide all necessary equipment to carry out the inspection tasks meeting all applicable safety requirements. The KODA and IO reserve the right to inspect these components and check the fulfilment of the stipulations in order to accept or reject them. The supplier shall abstain from using components rejected by the KODA and IO immediately and replace them with new ones.

5. DIMENSIONAL CONTROL REPORT

All examination reports shall include the following information:

- identification of equipment, used with the purchase order and calibration certificate
- identification of the part examined including grade and fabrication process used for the part (forging, rolling, casting)
- part/component reference drawing and supplier's tolerance drawing (if necessary CAD model identification including issue status)
- issue of the dimensional control documents used
- time of examination
- meteorological data (temperature, humidity, pressure)
- surface preparation (method, cleaning)
- type, make and designation of the equipment used:
 - test unit
 - probes (dimensions, frequencies)
 - targets, if any
 - scale bars
- dimensional control procedure and issue
- scanning direction
- identification of all computer files generated during the inspection
- raw data files in a format acceptable to the IO
- interpretation results, including explanation for any readings that are interpreted as not valid
- identification of the company responsible for dimensional control when subcontracted out
- name and qualification of the operator
- dimensional control date and signature of the operator
- any non-conformity reports raised

In order to avoid unnecessary repetition, some of the information listed above can be provided in documents properly identified by supplier and attached to the examination report.

5.1. Format of Presented Information

The KODA does not prescribe which software should be used however; it is critical that measurement data can be easily transferred between the parties to the ITER agreement. During manufacture this data may be required to qualify measurement processes, address non-conformance issues, and consider concession requests. In addition, the data shall be used to construct a configuration model representing the true geometry of the as-built. The data shall be presented in a format agreed between the supplier, KODA and IO

6. CORRECTIVE MEASURES

The supplier shall specify supplier's own intermediate tolerances on the manufacturing drawings of important stages (e.g. final machining of the parts, sub-assembly, final assembly, etc.) to guarantee the tolerance requirements of Technical Specifications.

The KODA and IO shall be informed in case of deviation to the suppliers own requirements.

The use of corrective measures involving machining or plastic deformation shall be submitted to KODA and IO for approval and backed by documents justifying the measures used. Any deviation to the factory acceptance requirements shall be covered by a Non-conformance report submitted to KODA and IO approval.



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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM
VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER
ORGANISATION

Mandatory Appendix APB2_05

VACUUM REQUIREMENTS AND SURFACE TREATMENT

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory vacuum and surface treatment requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

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1. SCOPE

This appendix covers the requirements for vacuum and surface treatment, involved in the VVGS fabrication.

2. REFERENCE CODES AND STANDARDS

The VVGS shall conform to the ITER Vacuum Handbook ([RDB1_05_1](#)). The surfaces of the VVGS are classified as Vacuum Classification (VQC) 2B. The mandatory requirements of the ITER Vacuum Handbook pertaining to the vacuum performance are detailed in this specification and references to the ITER Vacuum Handbook.

This specification also makes reference to additional mandatory requirements in various codes and standards.

3. REQUIREMENTS

3.1. Design

Bolted connections and other abutments with potential to form trapped volumes shall be provided with vent holes to avoid these.

3.2. Clean Conditions

General requirements on cleanliness and cleaning are provided in APB2_01 and the ITER vacuum Handbook ([RDB1_05_1](#)). In addition to RCC-MR cleanliness class B requirements a procedure is to be developed to ensure that the components of the VVGS are cleaned to the specified requirements, this procedure will include placing the components of the VVGS into a clearly identified clean conditions assembly area which shall include the following requirements:

- the use of approved clothing
- the use of sulphur-bearing fluids shall be strictly controlled to minimize the risk of corrosion in stainless steel
- all items shall be thoroughly degreased, cleaned and sealed in a suitable envelope (polythene, etc.) prior to being introduced into the clean conditions assembly area
- an inventory of all items entering or leaving the clean area shall be maintained. This shall include tools, protective clothing (overshoes etc.), containers for transporting tools or components etc.
- the surfaces of jigs, fixtures and tools that come into contact with the VVGS shall in general be constructed of stainless steel; they shall never be made of carbon steel.
- direct contact of carbon steel or zinc coated slings or chains, and the use of tools containing lead, bronze copper or zinc is not permitted ☐
- lead or other low melting metals (tin, antimony, mercury, zinc, arsenic, cadmium, etc.) their compounds or materials containing low melting metals as a basic chemical constituent shall not be used in direct contact with the surfaces of the component at

any time. This ban includes tooling, fixtures, marking materials, fluxes, paints, coating and sealing compounds used during fabrication and installation operations

- tooling or equipment that produces oil, grease, flux or any organic substance considered a harmful contaminant is not permitted. Only water soluble, non-halogenated, sulphur and phosphorus free machining fluids approved by ITER are permitted.
- overhead cranes and lifting equipment shall be arranged to avoid the dripping of oil in the clean conditions assembly area
- cutting operations in the clean area are to be minimized. Swarf generated by cutting operations shall be collected. Grinding operations should be avoided
- after cleaning of all surfaces shall be “metal clean” and free from oil, grease, ink, paint, dust, rust spots, abrasive particles, chips and any other gross discontinuities or imperfections as defined in EN-ISO(2003) 15607. All surfaces show a uniform metallic color and are absent from evaporation patches from cleaning agents. Stainless steel surfaces shall be protected to avoid further contamination.

These clean conditions apply for the whole process of fabrication.

3.2.1. Handling of Cleaned Components during Assembly

Handling equipment, such as slings, hooks, etc., are sheathed or protected with approved plastic (not PVC), clean wood etc., to avoid contact of the stainless steel pieces with metallic (non S.S.) surfaces. Any tooling which can come in contact with the stainless steel pieces is to be made of stainless steel and cleaned before use.

Final cleaned pieces made of stainless steel are not to be stored directly on the ground or bare floor. They are to be stored on clean surfaces, or surfaces covered with materials such as wood, plastic (not PVC), etc. No nails or resins are to be present on the wood.

Once a component is cleaned and inspected for acceptance, it is handled with the utmost care to preserve the cleanliness condition in preparation for packing. All components are visually inspected using cameras and fibre optics to view all areas immediately before final assembly to check that the cleanliness condition is preserved. Prior to packing, all components are covered with approved plastic film (not PVC) to avoid the accumulation of dust or unwanted debris.

3.2.2. Cleaning and Cleanliness Checks

Surfaces of the VVGS shall be cleaned at the final phase of the assembly stage. This involves cleaning and cleaning checks according to RCC-MR RF 6000 at the following 2 stages:

1. before the assembly
2. final cleaning prior to packing

VVGS are to be wiped or brushed with solvent or alkaline detergents, rinsed with demineralized water and wiped dry with clean lint-free cloth or air dried. The use of halogenated solvents is forbidden.

3.2.3. Personnel Working in the Clean Conditions Assembly Area

Personnel working in the clean area shall be trained in the correct procedures. KODA and IO can request personnel contravening the clean area requirements are excluded from the clean area. The supplier shall retrain and if necessary replace the offending operative.

The supplier shall submit proposals in the documentation form for achieving and maintaining these standards of cleanliness.

3.2.4. Cleaning and Surface Treatment

If alternative surface/treatment/cleaning procedures are proposed by the supplier, the out-gassing values shall be shown to meet the IO requirements using test pieces that have been subjected to all the proposed manufacturing and cleaning cycles. The tests performed by the supplier require prior approval by KODA and IO and shall be witnessed by KODA and IO.

3.2.5. Acceptance Criteria of Final cleaning

The acceptance criteria are according to RCC-MR cleanliness class B requirements.

The cleanliness of surfaces shall be checked by:

- wiping with clean, lint-free cloth - no discoloration is acceptable
- pouring on demineralized water – the water should spread out evenly across the surface (not form globules)
- when visual examination is impossible but surfaces are accessible for a wipe test, sufficient wipe tests in different areas are made in order to evaluate the general cleanliness level of the surface

4. DOCUMENTS TO BE PREPARED BY THE SUPPLIER

The document requirements include at least:

- workshop qualification report (especially for cleanness)
- clean work plan
- cleaning procedure

All documents requirements are described in appendix APB2_08 Documentation and Acceptance Requirements.



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Mandatory Appendix APB2_06 PACKING AND HANDLING PRIOR TO TRANSPORTATION

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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_06

PACKING AND HANDLING PRIOR TO TRANSPORTATION

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory packing and handling requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

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1.1	2014. 08. 12	Document title has been changed from "PACKING, SHIPPING AND HANDLING" to "PACKING AND HANDLING PRIOR TO TRANSPORTATION" and requirements for shipping and transportation have been deleted.
1.2	2016. 01. 19	Changes in reviewer and approver for re-tendering. The scope of transportation is deleted in Chapter 1.

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1. SCOPE

This appendix covers the requirement for final cleaning, handling, packing prior to transportation to IO site by the KODA. This appendix includes the provisions for transportations to IO site for information.

The VVGS shall be isolated from the ambient atmosphere by a hermetically sealed envelope (watertight, ensuring protection of the VVGS against ingress from sea water and air humidity). The VVGS inside their leak tight envelope shall be adequately protected against shock, impacts, and crushing by a removable cover set close to the package.

Single parts to be supplied such as wedges, shims, etc. shall be packed and placed in separate containers properly labelled with its name and quantity. A packing list shall be attached to each container.

2. INFORMATION REQUIREMENTS FOR SHIPPING TRANSPORTATION

Supplier shall submit following information and approved by the KODA and the IO.

- general information: Defines who is the IO, type of cargo to be shipped and route
- cargo description: Defines global dimensions of the component (length, width, and height), weights and centre of gravities with and without saddles or other transport fixtures. The suspension, supporting points and weights shall be clearly marked on the package.
- the supplier shall issue detailed information on the component and fixtures assembly. This information includes:
 - saddles or transport fixtures design report. These fixtures are enough to withstand ship motions and accelerations, hull deflections caused by wave loading. In order to avoid affecting the stability of the ship the centre of gravity of the VVGS is kept low.
 - loading and discharging operations. lifting operations
 - stability
 - calculation of forces acting on cargo

All calculations take into consideration the motions of the ship that affect the inertial loads imposed on the VVGS structure. The drawings of containers/transport frames and associated technical specification shall be made available to IO and other DAs before delivery.

3. CLEANING

The methods and acceptance criteria to perform the cleaning prior to transportation of the VVGS shall be according to APB2_05.

4. PACKING FOR DESPATCH

All components shall be visually inspected immediately before starting final packing for transport.

Packing conditions shall meet the requirements of RCC-MR RF 6000 and the ITER Vacuum Handbook ([RDB1_05_1](#)).

All machined interfaces including seating surfaces are to be protected against damage using compatible covers.

All components are to be wedged, cushioned and blocked to prevent movement and any physical damage to the component or wrapping material during transport.

The VVGS and other components are to be packed suitable for road and sea transportation. To protect the VVGS and components from deterioration during the road and sea transportation it is mandatory that each VVGS and component is hermetically sealed against the climatic elements.

Hermetically sealing can be achieved by double wrapping in a compatible reinforced high density polyethylene bag of the following type:

- the internal area containing the components is slightly pressurised using dry air

Any interfacing of the VVGS or other components includes within the packing: saddles supports etc. made from a compatible material, preferably stainless steel.

Alternatively the supplier can make other recommendations for packing. Whatever method the supplier decides to use has to be approved by the KODA and IO prior to proceeding.

A packing list is to be issued and signed for each despatch. Packing lists are to be numbered sequentially for each despatch. One copy of the packing list is to be sheathed in a watertight envelope and fastened on the inside of the packing.

The supplier shall check the soundness of the packing after installation on the ship. Photographic records should be made.

The packed components are to have the following information permanently marked on the outside of the packaging:

- the ITER Organization and the KODA shall be marked on the outside of the packing
- the Purchase Order Number
- origin of manufacture (country), and a brief description of the component
- overall sizes of the packed item
- gross weight including the packing
- weight of the component
- centre of gravity in three planes
- the lift points with the SWL

If the packing is a purpose made container, it must be marked with a unique identity number, and Purchase Order Number, if different from that of the component.

5. DESIGN AND MANUFACTURING RULES FOR SUPPORT STRUCTURES, LIFTING BEAMS AND LIFTING BRACKETS

Design and manufacturing of support structures, lifting beams and lifting bracket are supplier's work scope. Design of support structures and lifting system, (road and/or ship) are to be accompanied with drawings approved by IO. This equipment is to be designed recognising all loads. A minimum 20% margin is to be added to the loads when carrying out the design. The manufacturing is to be of a high standard, and shall include NDE. The design and manufacturing/NDE methods are to be approved by the KODA and IO. The lifting fixtures to be used in France shall comply with French Order 1st March 2004 "Arrêté du 1er mars 2004 relatif aux vérifications des appareils et accessoires de levage".

The supporting structures and lifting system shall include CE marking and the declaration of conformity in accordance with the Directive 2006/42/EC on Machinery.

5.1. Support Structure Design Rules

The following calculation design rules shall be applied to the support structure:

- RCC-MR 2007 RH3200 (Level S2 shell type supports) applicable to class 2 components

or,

- NFE 52-110 Standard applicable for lifting devices and metallic frameworks

5.2. Manufacturing Rules

The manufacturing rules are as follows:

- for fabrication and associated examinations (level S2 support): RCC-MR 2007 RH4000
- for lifting and handling NFE 52 – 109 – 1 standard manufacture, NFE 52 – 109 -2 lifting and handling

The equipment is to be permanently marked with the following:

- the ITER Organization and the KODA shall be marked on the outside of the packing
- the customers Purchase Order Number
- origin of manufacture (country)
- overall size of the individual pieces of equipment
- the gross weight including attachments
- the lift points with the SWL
- the details of the proof loading tests with reference back to the test certificates
- CE marking

6. DESPATCH AND TRANSPORTATION

6.1. Scope

The responsibility for transport and delivery is described in the main contract document and chapter 1 “scope”.

6.2. Ownership and Responsibility

The responsibility for transport and delivery is described in the main contract document.



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Mandatory Appendix APB2_07 ENGINEERING ANALYSES

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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_07

ENGINEERING ANALYSES

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory engineering analyses requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

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1. SCOPE

This appendix covers the requirements for engineering analysis in support of testing and handling operations as well as in the case of design change requests or Non Conformance treatment.

Calculations and computer codes implemented for design and analysis is qualified in accordance with internal procedures of the supplier, proof of this authorisation will be provided to KODA and IO.

For stress calculations finite element software shall be used to be agreed by supplier, KODA and IO.

2. TRANSPORTATION AND HANDLING ANALYSIS

The components of the VVGS include firm and well located lifting points or hooks and eye positions to guarantee safe loading, lifting, handling and transportation. Before handling the VVGS, the supplier shall justify that the stress and strains induced on the VVGS structures remain sufficiently low. Criteria shall be proposed by the supplier and submitted to the KODA and IO for approval. The stresses on VVGS structure shall not exceed 40 MPa and the maximum deformation shall remain below 1 mm.

For transportation, it is recommended to use a stiff transport frame ensuring a maximum deflection under any transport load conditions of less than 1 mm and compatible with loading of the VVGS. This transport frame is equipped with lifting lugs in order to avoid direct handling of the VVGS structure.

The VVGS has to be properly clamped on its transport frame.

Design of transport frame, lifting lugs and clamping devices are to be justified by mechanical calculations under load conditions associated with the transportation plan described in APB2_06.

3. STRESS ANALYSIS IN SUPPORT OF DESIGN CHANGE REQUESTS

VVGS detailed load specification is provided as reference document for the VVGS baseline design ([RDB2_07_1](#)).

In the event of detailed design changes requested by the supplier, the supplier shall provide the KODA and IO with details of the design modifications (drawings, reports). If necessary, the IO will generate within two weeks an update of the load specification taking into account these design changes.

Subsequently the supplier will assess the impact on VVGS structural analysis of the detailed design changes to be submitted to the KODA and IO for approval. IO shall notify the KODA of its approval or disapproval within four calendar weeks and KODA shall notify the supplier of IO

decision immediately if there is no objection. It can be reduced to two weeks for minor modifications that do not impact the VVGS structural behaviour. The final structural analysis file of the as-built VVGS is the responsibility of the IO.

IO shall provide all input data including finite element model, matched macro files, analysis report to KODA and after completion of preliminary ANB approval. Subsequently, KODA shall provide them to the supplier.

Supplier shall perform the structural analysis using data from IO if necessary.

4. STRESS ANALYSIS IN SUPPORT OF NON CONFORMANCE

In case of non conformance to RCC-MR 2007 and VVGS technical specification, requiring stress analysis justification, supplier shall show compliance with design rules of RCC-MR Section 1. The sequence for stress analysis and schedule for IO acceptance is the same as for Design changes described above in paragraph 4. IO shall notify the KODA of its decision within two weeks and KODA shall notify the supplier of IO decision immediately if there is no objection..



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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM
VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER
ORGANISATION

Mandatory Appendix APB2_08

DOCUMENTATION AND ACCEPTANCE REQUIREMENTS

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory documentation and acceptance requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

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1. INTRODUCTION

This Appendix defines the documentation and acceptance requirements for the VVGS delivery.

2. DOCUMENTATION REQUIREMENTS

The documents to be prepared for the application of the RCC-MR 2007 are defined in RA 3000. Details about the structure and contents of the design and manufacturing reports (regulatory files) to be provided by the supplier, KODA, IO and the ANB are listed below in Tables APB2_08:2-1 to APB2_08:2-3.

After approval, these documents shall be transmitted by the IO to the ANB at least two weeks before associated milestone. All other documents related to design, fabrication and testing (internal procedures, QA controls) are kept available to ANB throughout the manufacture of the components.

Document to be supplied	Provider	Milestone*
Design/Loading data and stress analysis reports	Manufacturer (IO)	BS
Hazard analysis and provisions to meet ESP/ESPN Essential Safety Requirements	Manufacturer (IO)	BS
Quality related documents (incl. Quality Plan)	Supplier	BS
Material documentation (incl. Procurement specification, material certificates, test and examination results) and Particular Material Appraisal	Supplier Manufacturer (IO) with support of DA	BS
Initial follow-up documents (Manufacturing and Inspection Plan) including KODA, IO and ANB hold points	Supplier	BS
List of sub-contractors	Supplier	BS
Document control procedure	Supplier	BS
Shop Qualification Report	Supplier	BS
Clean condition work plan	Supplier	BS
Manufacturing drawings and components part list	Supplier	BS
Equipment identification and marking procedure	Supplier	BS
Materials identification and marking procedure	Supplier with support of material supplier	BS
Cutting & machining procedure	Supplier	BS

Manufacturing & Assembly procedure	Supplier	BS
Applicable document list	Supplier	BS

* BS: Before start of manufacture (cutting or machining operations)

Table APB2_08:2-1 Documents to be supplied before starting manufacture

Documents to be supplied	Provider	Milestone**
Handling procedure	Supplier	BO
Cleaning procedure	Supplier	BO
Dimensional inspection procedure	Supplier	BO
NDE procedures	Supplier	BO
NDE operators approval incl. supporting files	Supplier	BO
Shrink fit procedure	Supplier	BO
Coating procedures and Qualification report	Supplier	BO
Functional test procedure	Supplier	BO
Factory acceptance test procedure	Supplier	BO
Packing procedure	Supplier	BO

** BO: Before the start of the activity.

Table APB2_08:2-2 Documents to be supplied before each manufacturing activity

Documents to be supplied	Provider	Milestone***
End of manufacturing report according to RA 3930. (The end of manufacturing report is progressively built up during manufacturing of the component(s). It shall be approved by KODA and IO and shall be kept available to ANB)	Supplier	BF

***BF: Before the factory acceptance.

Table APB2_08:2-3 Documents to be supplied before final acceptance in the factory

In addition to the RCC-MR manufacturing report, the supplier shall also provide technical and management documents submitted to KODA and IO for approval.

Additional technical documentation

- documentation associated to engineering analysis (see APB2_07)
- documentation associated to detailed design change and Non Conformance
- documentation associated to Deviation Request
- documentation associated to erection/installation of all components/parts listed in the Appendices on Interfaces (APB2_10) and in accordance with RF7000.

Management documentation:

- schedule
- risk management
- QA management organization
- project organization report
- minutes of meetings

Details for data management requirements are specified in chapter 3.

3. DATA MANAGEMENT

The large amount of data generated during the execution of this contract (e.g. technical and QA documents, Minutes of Meetings, ...) shall be handled electronically and entered into a Database like, for example, the KODA IKIMS or ITER IDM. The structure of this Database shall be defined by the supplier and agreed with the KODA. The suppliers shall use this Database to store information related to the contract. All data entered in the Database shall be kept strictly confidential by the supplier, and, in no circumstances, shall be communicated or made accessible to KODA or IO.

Data flow from a supplier to the KODA: relevant data shall be made available to the KODA through the Database each time a notification is issued, an Authorization-To-Proceed or a Hold Point Clearance is requested or a Deviation Request or a Non Conformity Report is filed by a supplier.

4. KODA REVIEWS

The KODA and supplier will organise Status Reviews (SRs) and Quality Control Reviews (QCRs) by mutual agreement. These may be focused on particular areas of production and will be organised by KODA as required by the progress and performance. KODA will appoint the review group and define its terms of reference. For each stage of production, the present schedule for these reviews is as follows:

- Pre-Manufacturing Readiness Review, at the issue of the pre-manufacturing documentation (quality related documents, manufacturing drawings, parts list, Initial follow-up documents and),
- Manufacturing Readiness Review, after at the end of process qualification

- Status and Product Quality Review after the final acceptance tests and issue of End of Manufacturing report.

The Pre-Production Readiness and Production Readiness reviews are carried out in parallel to the contract execution and are not Hold Points.

The KODA shall organise a Pre-Production Readiness Review. This shall consist of representatives of the supplier including those responsible for the procurement being assessed, the KODA and external reviewers appointed by the KODA. The review shall be presented by the supplier under assessment and the review group shall submit a report to the KODA.

The KODA shall organise a Production Readiness Review. This shall consist of representatives of the supplier including those responsible for the procurement being assessed, the KODA and external reviewers appointed by the KODA. The review shall be presented by the supplier under assessment and the review group shall submit a report to the KODA.

The KODA shall organise a Status and Product Quality Review. This shall consist of representatives of the supplier including those responsible for the procurement being assessed, the KODA and external reviewers appointed by the KODA. The review shall be presented by the supplier under assessment and the review group shall submit a report to the KODA.

Typically a supplier may be reviewed up to 2 times per year although the frequency may be higher at the start of the work and less frequent at the end.

5. ACCEPTANCE REQUIREMENTS

5.1. Factory Acceptance

The items shall be construed as acceptable if they are in conformance with the requirements as set out in this contract. It is the obligation the supplier to deliver fully acceptable items. KODA's participation in the execution of the contract does not relieve the supplier from its responsibility to deliver items in accordance with the requirements and criteria as set out in this contract.

The supplier is responsible for checking that all items conform to the contractual requirements as set out in the contracts between the KODA and the suppliers. The supplier shall ensure that the items are in line with regulatory requirements and documentation.

The supplier shall make all components and parts available for final inspection by KODA, IO and ANB.

KODA and IO factory acceptance criteria (non-exhaustive) are :

- identification of the components and parts in the scope of supply
- control of stamping
- successful completion of all tests described in Annex B2 and its Appendices
- conformance with requirements as set out in the Main PA and Annex A
- checks of the final cleaning

- checks of packing provisions and the transportation plan to ensure that the integrity of the component is preserved until arrival at the site,

The factory acceptance will be approved after reviewing and checking the End of Manufacturing report and after a certificate of compliance is established by the supplier and counter signed by the KODA and IO. The KODA and IO shall issue acceptance records countersigned by the supplier.

Acceptance of the results, tests and certificates does not relieve the supplier of the responsibility for compliance with all contractual requirements.

If any test prescribed in the present specification reveals a defect due to a fault or damage during transport, the supplier is entitled to an urgent repair or replacement of the faulty deliverable free of charge.

5.2. Site Acceptance

The IO inspects every component upon arrival to the ITER site and checks the physical state and condition of the packing for possible damage during transportation. The IO also checks the component cleaning and conservation conditions in accordance with RCC-MR cleanliness class B and packing specification APB2_06. In addition, the accompanying documentation is verified.

Acceptance of items is carried out by means of an established reception plan which identifies the general condition of the equipment that may be affected during the transportation process or any failure in the surveillance program at the facilities of the supplier. This shall involve as a minimum visual examination of VVGS structural parts in contact with bearing plates, pads, and fixtures and sampling examination of the VVGS including lifting attachments.

The aforementioned reception plan is based on the surveillance program implemented during previous phases and focuses on any detrimental condition of the component upon arrival.

The main dimensions of the VVGS are checked before and after removal of clamps and pads. Based on the results of these site inspections and tests, the IO takes the decision to provisionally or definitively accept the shipment until the detected anomalies are solved. If the anomalies are unacceptable or cannot be repaired IO takes the decision to reject the items.

Any discrepancy with contractual requirements arising during the handling and loading of the components when they arrive at the site shall be reported immediately, identifying the present process, previous operations and providing a detailed description of the situation. Allocation of responsibilities is defined following the resolution of the non compliance report.

If the supplier is responsible for any reported non-compliance, it is the duty of the supplier to repair or bare the cost of restoring all contractual requirements for the component.

Final acceptance is formalized by the Acceptance records issued by the KODA and IO and countersigned by the supplier.



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Mandatory Appendix APB2_09 MATERIAL PROCUREMENT AND ACCEPTANCE

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Reviewer	Ji Young Jung	19-Jan-2016 : recommended	KODA/PPMD/PSMT
Approver	Wooho Chung	19-Jan-2016 : approved	KODA/TED

TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_09

MATERIAL PROCUREMENT AND ACCEPTANCE

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory material procurement and acceptance requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

	Name	Affiliation
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	J. Y. Jung	Project Planning and Management Department
	H. Kim	Quality Management Department
Approver	W. Chung	Tokamak Eng. Department, Director

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1.0	2014. 08. 05	First issue for the Call for Tender
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1. SCOPE

This mandatory appendix covers the general requirements for the materials and includes the procurement specifications of the main base materials.

The supplier must provide the fabrication of all required materials in accordance with requirements of the French Order on Nuclear Pressure Equipment, December 2005 (ESPN), Order of 7 February 2012 establishing the general rules for basic nuclear installations and the Product Procurement Specifications listed in this Appendix.

2. REQUIREMENTS

2.1. Licensing requirements

The IO as the Manufacturer of nuclear pressure equipment is responsible for compliance of the materials with the regulatory requirements (e.g. Annex 4 of ESPN related to radioprotection requirements).

The supplier shall ensure that the supplier procures material in accordance with the IO Product Procurement Specifications which shall be approved by ANB. The supplier shall submit Purchase Order specifications for approval before commencing any procurement in order to receive confirmation from the ANB, IO and KODA.

The supplier shall provide certificates which comply with the requirements of the procurement specifications and the received order. The confirmation of compliance shall be stated in or appended to the certificate, depending on the type of certificate issued.

A certificate of specific product control is required for all parts of the pressure equipment contributing to the pressure resistance and for parts permanently attached to main pressure bearing parts

Inspection certificate 3.1 in accordance with EN 10204:2004 shall be provided by materials suppliers as indicated in Product Procurement Specifications for other materials.

Before using these materials in the equipment manufacture, the supplier shall confirm the compliance of documentation supplied by their supplier in regard to the order and to the material specifications.

The ANB responsible for the conformity assessment procedure of the VVGS will also check these points. It is highly recommended that the ANB performs this verification before the implementation of the materials, in order to avoid any problems concerning manufactured components.

The KODA, IO and the ANB shall check the materials acceptance documents for control of the compliance of documentation supplied by the material manufacturer in regard to the ESPN order and to the material specification before starting fabrication of the equipment.

2.2. RCC-MR requirements

The VVGS is classified as RCC-MR Support Class S1 (RH 1300) which provides support for the VV and ports (Class 2). Accordingly the VVGS materials shall satisfy requirements for Class 2 components defined in Section 2 – Materials in RCC-MR 2007 where it is applicable.

Before starting the mass production of the some materials (See Table APB2_09 : 3-1 Note 2), RCC-MR, Edition 2007, specifies requirements for Product or Part and Shop Qualification. The requirements for this qualification are described in chapter RM0140.

For materials which are not included in Section 2 – Materials of RCC-MR, Edition 2007, a procurement of materials shall be in accordance with Product Procurement Specifications prepared by IO as indicated in RH 2200 and agreed with ANB.

The supplier shall prepare the qualification reports prior to the procurement of the materials.

These reports shall be presented to the KODA and IO.

3. PROCUREMENT SPECIFICATIONS – BASE MATERIALS

The specifications for the procurement of the base materials are given in reference documents located in Table APB2_09 : 3-1.

Ref.#	Title	ITER IDM Identifier
RDB2_09_1	PPS_X6CrNiTiMoVB25-15-2_Forgings_VVGS	ITER_D_AHJVPJ
RDB2_09_2	PPS_X6CrNiTiMoVB25-15-2_Bars_VVGS_and_IWS	ITER_D_AHK7DE
RDB2_09_3	PPS_Stainless Steel_316L(N)-IG_Forgings_VVGS	ITER_D_AHL5RZ
RDB2_09_4	PPS_NiCr19Fe19Nb5Mo3_Plates_VVGS	ITER_D_AHM38M
RDB2_09_5	PPS_NiCr19Fe19Nb5Mo3_Bars_VVGS	ITER_D_AHMGDY
RDB2_09_6	PPS_304_Plates_VVGS	ITER_D_AHN5P8
RDB2_09_7	PPS_Aluminium_Bronze_Plates_VVGS	ITER_D_AHPH2V
RDB2_09_8	PPS_Aluminium_Bronze_Forgings_VVGS	ITER_D_AHPTFS
RDB2_09_9	PPS_Polyimide_Laminate_VVGS	ITER_D_AHPTAC

Table APB2_09 : 3-1 Material procurement specifications references for the VVGS*

*Note 1: These material specifications are subject to ANB approval

*Note 2: Product or Part and Shop Qualification in accordance with RM 0140 of RCC-MT Edition 2007 are required for these materials.

*Note 3: For NDE of Base Materials refer to APB2_03 Section 3.3.

4. OTHER MATERIAL

During fabrication of the VVGS, various other supporting materials can be used for jigs, temporary supports, lifts, etc.

The supplier shall check the compatibility of these supporting materials with materials used for the VVGS components. The use of materials which can affect the main materials (e.g. corrosion attack during storage, etc.) is not allowed.

The list of possible supporting materials shall be prepared by the supplier.

In addition, other material types may be proposed by the supplier for approval by the KODA and IO (e.g. polyimide insulation tube).

5. BOLTS

Bolting products (bolts, studs, nuts and threads) shall be manufactured according to the requirements in RF 7240 and RF 7280.

Additional test specimens for mechanical properties (tensile test, Charpy V-notch impact test, hardness test) shall be taken from the final bolting product (after precipitation treatment). The tests shall be conducted once per lot.

NDE for final bolting product shall be agreed among the supplier, DA and IO as detailed in APB2_03.

6. TRACEABILITY PROCEDURE

The French regulations (ESPN and ESP) require that suitable procedures must be established and maintained for identifying the material composition of the equipments' components by suitable means from receipt, through production, up to the final test of the manufactured pressure equipment.

Traceability procedures for the materials shall be developed by the supplier and presented to the KODA and IO. These documents are part of technical files that shall be submitted to the ANB for the assessment of the design documentation.

During manufacture consistency between material certificates and material identification at the supplier's shop shall be checked by the ANB.

RCC-MR includes some recommendation about marking procedure (Chapter RF2000) and identification (chapter RC1300).



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Mandatory Appendix APB2_10 INTERFACES

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Reviewer	Hangsung Kim	19-Jan-2016 : recommended	KODA/QMD
Reviewer	Ji Young Jung	19-Jan-2016 : recommended	KODA/PPMD/PSMT
Approver	Wooho Chung	19-Jan-2016 : approved	KODA/TED

TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_10

INTERFACES

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory interfaces requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

	Name	Affiliation
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Approver	W. Chung	Tokamak Eng. Department, Director

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1.2	2016. 01. 19	Changes in reviewer and approver for re-tendering.

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1. SCOPE

This mandatory appendix covers the physical and functional interfaces to the VVGS.

The components that are part of the scope of supply for the VVGS are tabulated in Annex B2 Table Annex B2: 2.1-1.

2. PHYSICAL INTERFACES

2.1. Vacuum Vessel Lower Port

Each VVGS upper block is bolted to a lower port extension through 12 of M72 superbolts. The toroidal and radial forces are transmitted through the permanent key of the lower port.

Shim plates are inserted between the VVGS and the lower port to absorb any tolerance stack up. Toroidal shims are inserted between the key of the lower port and the toroidal key way of the upper block. Vertical shims are inserted between the upper block and lower port.

The VV is electrically insulated from the lower port with a polyimide electrical insulation which is inserted between the VVGS and the Lower port surfaces.

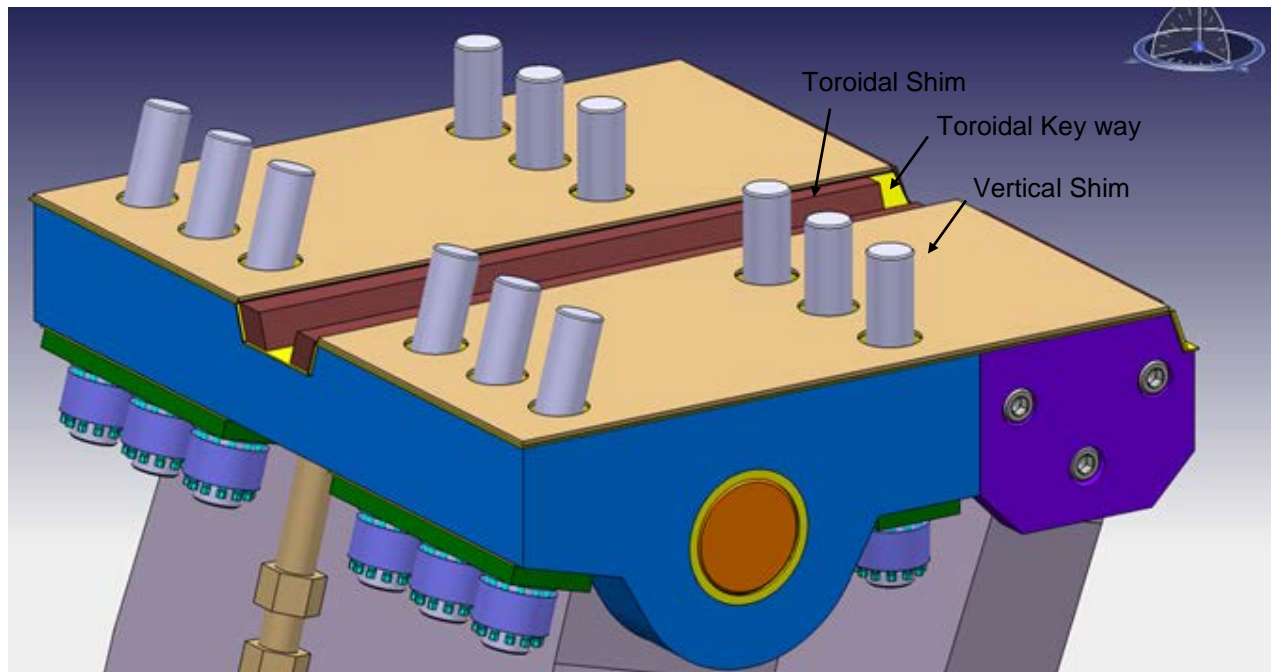


Figure APB2_10: 2.1-1 Interface nomenclature for the VVGS and Lower port

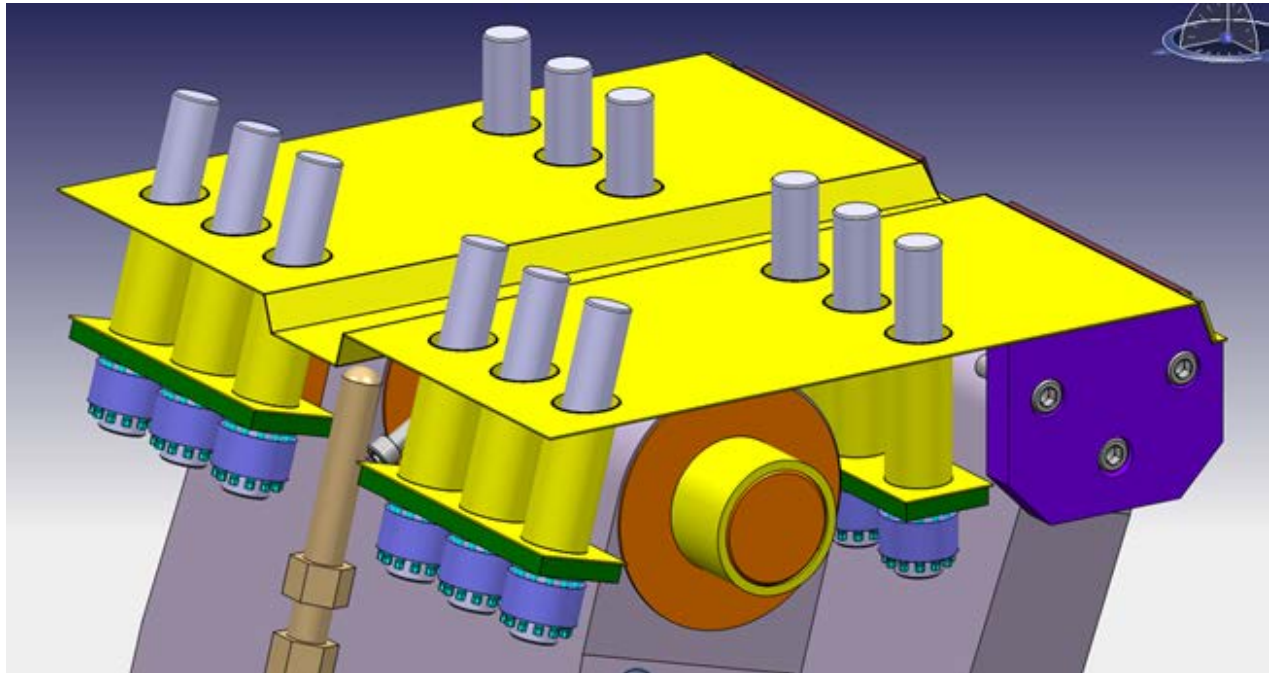


Figure APB2_10: 2.1-2 Electrical insulation (in yellow)

2.2. Cryostat

Each VVGS lower block is bolted to the Cryostat pedestal ring through 18 M72 superbolts. Toroidal and radial forces are transmitted through wedges which are located in key ways in the cryostat pedestal ring.

Shim plates are inserted between the VVGS and the wedges to absorb any tolerance stack up. The toroidal shims are installed with a screw jack mounted on the cryostat base. Radial shims are bolted in series with radial wedges. Vertical shims are inserted between the lower block and cryostat pedestal ring. All shims are machined by the IO after surveying interface components in the Tokamak pit.

Interface loads are defined in the VVGS Load Specification ([RDB2_07_1](#)).

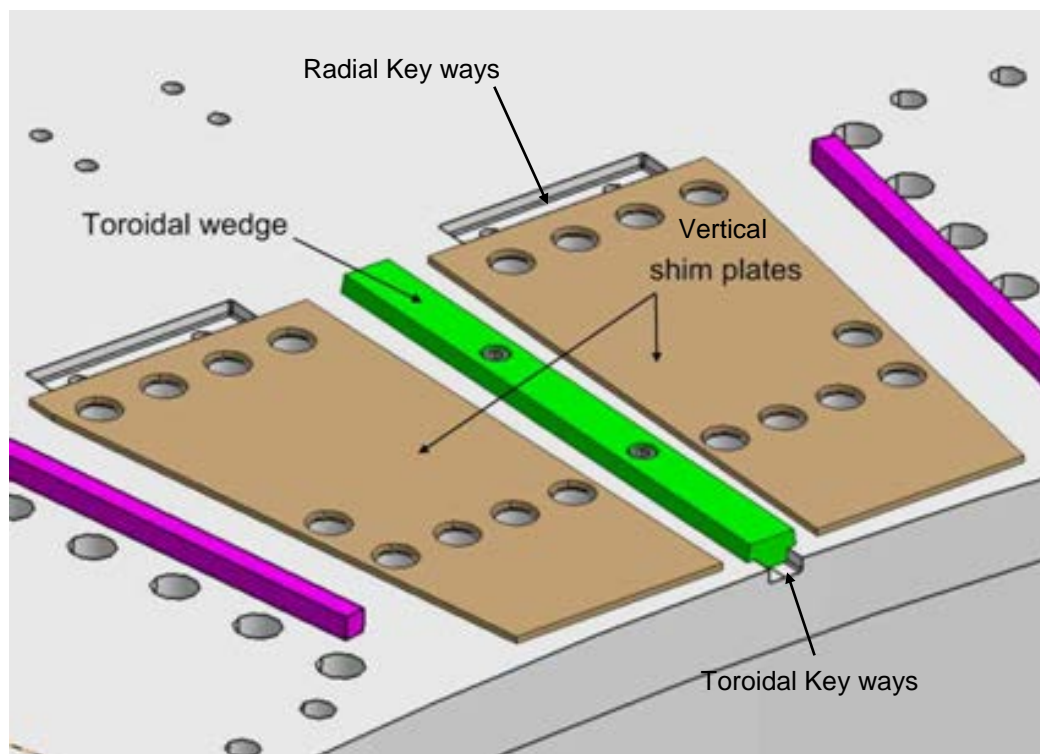


Figure APB2_10: 2.2-1 Interface on the Cryostat Pedestal Ring

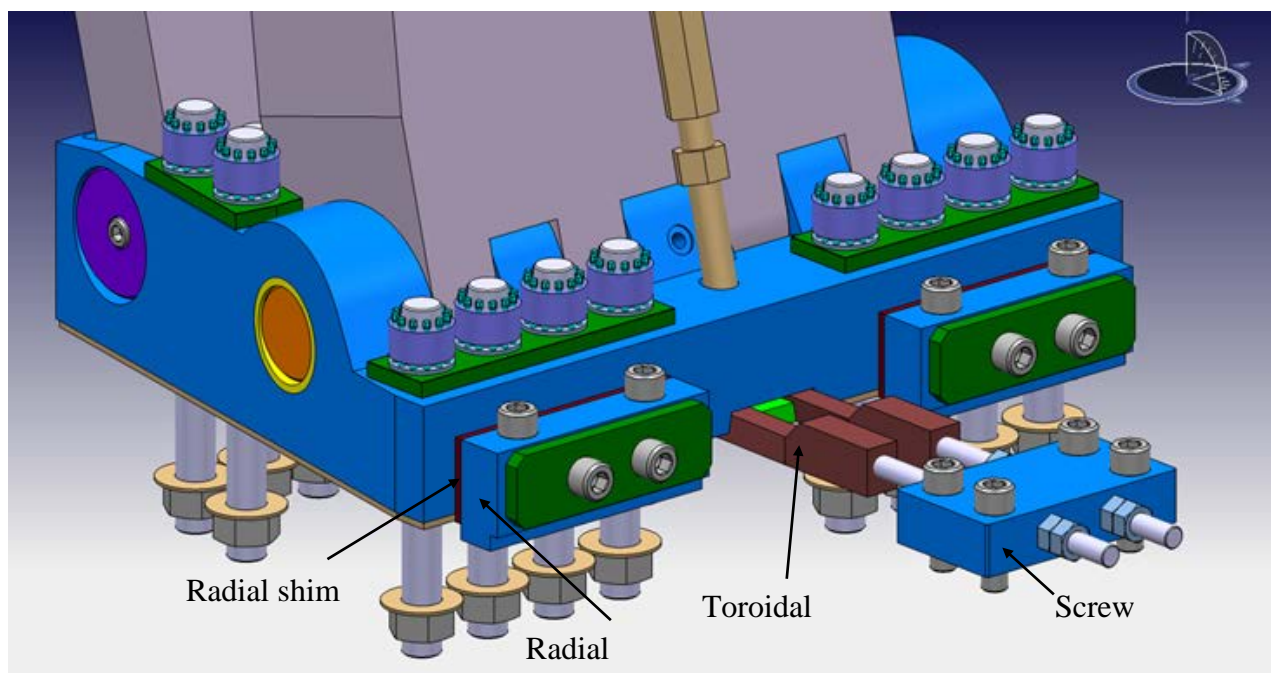


Figure APB2_10: 2.2-2 Interface nomenclature for the VVGS and cryostat

2.3. VVGS Instrumentation

The VVGS has interfaces with the Vacuum Vessel Instrumentation. It is equipped with temperature sensors, strain gages and displacement sensors. No specific interface preparation is needed for the temperature sensors and the strain gages which are welded to the VVGS.

The displacement sensors require 3 studs to be welded on site to the VVGS body. The instrumentation is excluded from this contract scope.

3. FUNCTIONAL INTERFACES

3.1. Installation

An installation procedure may be required to be supplied by the supplier in accordance with RF 7210. The information requested in this procedure includes but not limited to:

- the checks to be made before assembly (type of joints, condition of seating surfaces, condition of threads, surface treatment possibly required, etc.),
- the type of lubricants used,
- the tightening torque (possibly the over tightening value) or the value of elongation required,
- the torque or elongation measurement method,
- the bolt tightening sequence and the type of tools to be used.

3.2. maintenance (replacement)

The VVGS can be replaced through one of the cryostat lower manholes (near ports 5, 9, 15 and 17). This requires the VVGS to have a maximum height of 1230mm and is achieved with a VVGS hinge angle of at least 27° (this height also facilitates tooling access during installation).

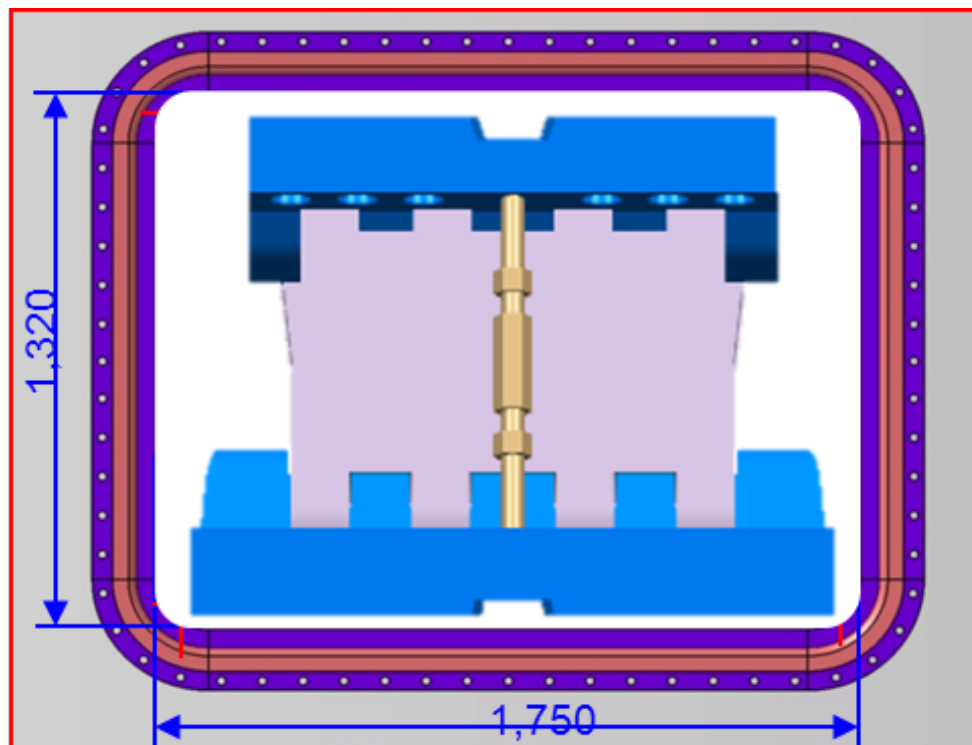


Figure APB2_10: 3.1-1 Interface for assembly of the VVGS and cryostat

3.3. Clearance gaps

In the nominal positioning the VVGS maintains a minimum of 50mm clearance between the neighbouring systems, including:

- Magnets
- Thermal Shield
- Cooling water system



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Mandatory Appendix APB2_11 MoS2 COATING QUALIFICATION

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Reviewer	Ji Young Jung	19-Jan-2016 : recommended	KODA/PPMD/PSMT
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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_11

MoS2 COATING QUALIFICATION

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory MoS2 coating qualification requirements for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

	Name	Affiliation
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1. SCOPE

This mandatory appendix covers the qualification of the molybdenum disulphide (MoS₂) coating to the VVGS upper and lower dowels.

2. REQUIREMENTS

2.1. Coating Procedure

The procedure for applying the MoS₂ coating shall include;

- dowel preparation (surface finish, cleaning and drying procedure.. etc)
- material composition and form
- spray pressure
- spray flow rate
- number of coatings
- curing temperature and time

The procedure shall be approved by the KODA and IO.

2.2. Coating thickness

The MoS₂ shall be 20 ±3µm thick.

The thickness shall be measured in accordance with a standard of the supplier's choice. It is suggested to use eddy current measurement in accordance with ISO 2360:2003 or differential measurements before and after coating.

Average thickness will be checked after curing. Each dowel shall be divided into a matrix of 100mm x 100mm squares. The average thickness of each square shall be compared with that of all squares on the dowel. Maximum variation between all squares shall not exceed ±15%.

2.3. Coating Longevity test

2.3.1. Purpose

The purpose of this test is to prove the longevity of the coating and verify that it maintains its functionality when subjected to representative loads, load cycles and loading conditions. The functionality is assessed by the value of friction coefficient, which shall always remain below 0.3.

2.3.2. Scope

The qualified coating procedure shall be used to coat dowel samples of Steel 660 ([RDB2 09 1](#)) for friction measurements. For the interfacing block there are 2 materials, 1 shall be aluminium bronze ([RDB2 09 7](#) or [RDB2 09 8](#)) and the other Steel 660 ([RDB2 09 1](#)). Each of the following configurations shall be tested at least 3 times:

- MoS₂ coated Steel 660 – Al-Bronze

For the coating procedure to be accepted; the friction coefficient shall be below the target 0.3, at least once, for the entire test regime of each configuration.

The coated sample shall have a spherical contact surface to replicate the Hertzian contact that occurs in the contact between hinge and dowel or block and dowel.

2.3.3. Test Conditions

The tests shall be conducted under the following conditions;

- Vacuum (less than 0.5 Pa)
- Temperature variation between room temperature and 200°C ($\pm 10^\circ\text{C}$)
- Contact pressure variation 160 MPa to 500 MPa ($\pm 5\%$)
- 10 mm stroke (± 1 mm)
- 10 second stroke duration (actual value to be verified with IO)
- 20 second dwell time between strokes (actual value to be verified with IO)

The cycles shall be as shown in Table APB2_11 : 2.3.3-1

Test Case	Temperature ($^\circ\text{C}$)	Pressure (MPa)	Number of Cycles
1	Room temperature	160	10
2	Room temperature	200	25
3	Room temperature to 100	200	125
4	100 to 200	200	125
5	200	200	125
6	200 to 100	200	125
7*	100	500	5
8	100	200	50
9	100 to 200	200	50
10 (optional)	100	200 to 500 (steps of 15)	20 each step

* 5 cycles at high pressure (500MPa) shall be made with 0mm stroke.

Table APB2_11 : 2.3.3-1 Summary of required tests

2.3.4. Test Measurements

The following parameters shall be measured during the test:

- Normal force ($\pm 1\%$)
- Perpendicular force ($\pm 5\%$)
- Velocity of stroke
- Temperature of test samples
- Vacuum pressure
- Acoustic emission (time spectrum and frequency spectrum)

3. DOCUMENTS TO BE PREPARED

3.1. Documents to be prepared before test

Prior to testing, the supplier shall prepare the following documents at least:

- Data package providing the following information about component characteristics:
 - coating procedure including cleaning, drying and coating
 - quality documentation demonstrating that required examinations are performed with satisfactory results

3.2. Documents to be prepared after test

After testing the supplier shall prepare the following documents at least:

- test report including
 - coefficient of friction for all test cases
 - thickness measurement data
 - calibration of measurement equipment



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TECHNICAL SPECIFICATION FOR THE SUPPLY OF THE VACUUM VESSEL GRAVITY SUPPORT COMPONENTS TO THE ITER ORGANISATION

Mandatory Appendix APB2_12

FUNCTIONAL TEST OF HINGE AND DOWEL

Abstract

This document is prepared based on the Technical Annex B2 of the ITER vacuum vessel gravity support according to the ITER vacuum vessel equatorial and lower ports Procurement Arrangement (hereinafter PA) 1.5.P2A.KO.04.0 and describes the mandatory requirements for functional test of hinge and dowel for the supply of the Vacuum Vessel Gravity Support (hereinafter VVGS) to National Fusion Research Institute (hereinafter NFRI). Technical Annex B2 is a top level document of this document

	Name	Affiliation
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Reviewers	J. Y. Jung	Project Planning and Management Department
	H. Kim	Quality Management Department
Approver	W. Chung	Tokamak Eng. Department, Director

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1. SCOPE

This mandatory appendix covers the acceptance test of the assembled VVGS hinge and dowel mechanism.

2. REQUIREMENTS

Each completed VVGS shall be subject to this test in the supplier's factory or dedicated laboratory for functional test of VVGS Hinge and Dowel.

The upper block of the VVGS shall be pushed radially from the initial starting position (5°) until it stops in the intermediate position (27°) and then pulled back to the finish position (5°), refer to Figure APB2_12 : 2-1.

The test shall be deemed successful if the full design movement is achieved without excessive force.

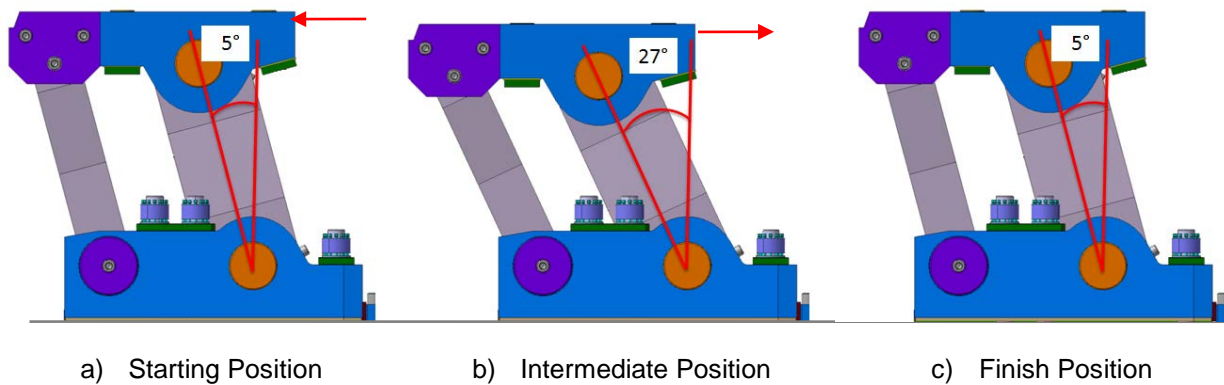


Figure APB2_12 : 2-1 Orientation of the VVGS during the functional test

2.1. Test conditions

The following conditions are required for this functional test;

- VVGS shall be complete other than;
 - Jack Screw shall be removed
 - remove bolts, insulation, shims and wedges which are not used
- The lower block shall be restrained

2.2. Test Measurements

The following measurements are required;

- Starting position angle (5°)
- Intermediate position angle (27°)
- Finish position angle (5°)
- Push force
- Pull force

- Position angle and direction of travel (either + or -)
- Dimensional measurement of the top surface at each stage

2.3. Acceptance criteria

The following acceptance criteria for metrology in factory shall be met as per RDB2_02_2 VV Gravity Support Functional Tolerance Drawing (ITER_D_QFTBXZ)

- Parallelism of upper surface (UB) with respect lower surface (LB) of 0.05
- Profile of upper surface (UB) with respect lower surface (LB) of 1.2
- Position of bolt holes with respect reference datum planes of 1.0
- Profile of upper and lower key way with respect reference datum planes of 1.0

3. DOCUMENTS TO BE PREPARED

3.1. Documents to be prepared before test

Prior to testing, the supplier shall prepare the following documents:

- Data package providing the following information about component characteristics:
 - quality documentation demonstrating that required examinations are performed with satisfactory results
 - written confirmation that no Non-conformance or deviation that may affect the test is still open
 - calibration certificates of the measurement equipment

3.2. Documents to be prepared after test

After testing the supplier shall prepare the following documents:

- test report including
 - Measurement data including applied forces
 - calibration certificates of measurement equipment