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EXTERNAL REFERENCE / VERSION

Guideline (not under Configuration Control)

Appendix 8 Flanges

Approval Process			
	Name	*Action*	*Affiliation*
Author	**Worth L.**	**08 Jan 2015:signed**	**IO/DG/COO/PED/FCED/VS**
Co-Authors			
Reviewers	**Hughes S.**	**09 Jan 2015:recommended (Fast Track)**	**IO/DG/COO/PED/FCED/VS**
Previous Versions Reviews	**Quinn E.**	**28 Jan 2014:recommended v2.3**	**IO/DG/COO/PED/FCED/VS**
Approver	**Pearce R.**	**12 Jan 2015:approved**	**IO/DG/COO/PED/FCED/VS**
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Read Access	**GG: MAC Members and Experts, GG: STAC Members & Experts, AD: ITER, AD: External Collaborators, AD: IO_Director-General, AD: EMAB, AD: Auditors, AD: ITER Management Assessor, project administrator, RO, LG: [CCS] CCS-All for Ext AM, LG: [CCS] CCS-Section Leaders, LG: [CCS] JACOBS, LG: [CCS] CCS-Doc Co...**		

Change Log			
Appendix 8 Flanges (2DJYQA)			
Version	***Latest Status***	***Issue Date***	***Description of Change***
v1.0	In Work	27 Aug 2008	
v1.1	In Work	12 Jan 2009	
v1.2	In Work	18 Jun 2009	New version states development of the appendix is required
v2.0	Approved	03 Apr 2013	Details of demountable vacuum flange sets accepted for use on the ITER project
v2.1	Signed	20 Nov 2013	Added section on demounting flanges in-situ.
v2.2	Revision Required	20 Nov 2013	Updated silver coating to silver jacket for helicoflex class 1 flange set
v2.3	Approved	28 Jan 2014	Revision as requested with expanded table detailing accepted flange/seal combinations
v2.4	Signed	08 Jan 2015	Removed reference to flange class
v2.5	Approved	08 Jan 2015	Header corrected

ITER Vacuum Handbook
Appendix 8

Demountable Vacuum Flanges for use on the ITER Project

	Name	Affiliation
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Contents

8.1 Terms and acronyms

The terms and acronyms detailed in Table 1 are used throughout this document

Term / Acronym	Contextual meaning
Accepted	Accepted by ITER Vacuum RO through submission for Request for *Acceptance* [1].
COTS	Commercial Off The Shelf (item listed in a suppliers catalogue)
Flange set	Demountable vacuum joint and gasket seal
Flange	1 half of demountable joint
Gasket seal	Replaceable piece which forms the vacuum containment.
Mounting	Joining of a flange pair & gasket to make the flange set.
RO	Responsible Officer

Table 1 Terms and acronyms

8.2 Scope

The scope of this appendix is to define the vacuum demountable flange sets *accepted* for use on the ITER Vacuum Systems.

Flange sets (demountable vacuum joint and specified seal arrangements) listed herein may be used, as specified, without further approval.

Demountable vacuum joints not detailed in this appendix shall only be utilised after *acceptance* by the ITER vacuum RO. *Acceptance* of a demountable vacuum joint / seal combination not listed herein will require qualification of the flange set. Qualification of a flange set shall be performed to an *accepted* procedure.

In the case of the ITER style flanges the information included herein shall only be used for information. Finalised drawings, and gasket seal part numbers, will be made available on completion of the qualification process.

8.3 Accepted Flange Set Combinations

8.3.1 Standard Flange Set Nominal Diameter

The flange set nominal diameters used shall comply with Table 2.

	DN10DN16	DN25	DN40	DN50	DN63	DN100	DN150	DN200	DN250	DN300
CF*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
ISO - KF	✓	✓	✓	✓	✓					
ISO-K					✓	✓	✓	✓	✓	✓
VCR[1]	✓	✓								
ITER Style					✓	✓	✓	✓	✓	✓

✓ *Accepted* for use

***** CF sizes shall be in accordance with ISO 3669-2:2007

[1] VCR from 6 to 25 mm (1/4 to 1 inch)

Table 2 Flange Size

8.3.2 Type of Flange Set

The type of flange set and seal combinations shall comply with Table 3.

Vacuum Classification (VQC)	Behind an *Accepted* Isolating Valve (Y/N)[1]	Flange Set	Double Seal Required (Yes = Y / No= N / R = recommend)	Range of size (DN)	1st (Vacuum) Seal Material	2nd (Atmosphere) Seal Material
1	N	ITER Style	Y	63 - 300	Metallic – Silver jacketed Helicoflex [2]	Metallic – Silver jacketed Helicoflex [2]
1	Y	ITER Style	R	63 - 300	Metallic – Silver jacketed Helicoflex [2]	Metallic – Silver jacketed Helicoflex [2]
1	Y	ISO-CF	N	16 - 250[2]	Silver coated copper gasket	N/A
1	Y	ISO-K	N	63 – 100	Aluminium edge type Table 5 [3]	N/A
1	Y	ISO-KF	N	16 - 63	Aluminium edge type Table 5 [3]	N/A
1	Y	VCR [4]	N	¼ -1 inch	Silver coated gasket in carrier Table 4	N/A
2	N/A	ITER Style	Y	63 - 300	Metallic – Silver jacketed Helicoflex [2]	Metallic – Silver jacketed Helicoflex [2]
2	N/A	ITER Style	Y	63 - 300	Metallic – Silver jacketed Helicoflex [2]	Seal material from Table 6
2	N/A	ISO-CF	N	16 - 250[2]	Silver coated copper gasket	N/A
2	N/A	ISO-K	N	63 – 100	Aluminium edge type Table 5 [3]	N/A
2	N/A	ISO-KF	N	16 - 63	Aluminium edge type Table 5 [3]	N/A
2	N/A	VCR [4]	N	¼ -1 inch	Silver coated gasket in carrier Table 4	N/A

3	N/A	ITER Style	Y	63 - 300	Metallic – Silver jacketed Helicoflex [2]	N/A
3	N/A	ITER Style	Y	63 - 300	Metallic – Silver jacketed Helicoflex [2]	N/A
3	N/A	ISO-CF	N	16 - 250[2]	Silver coated copper gasket	N/A
3	N/A	ISO-K	N	63 – 100	Aluminium edge type Table 5 [3]	N/A
3	N/A	ISO-KF	N	16 - 63	Aluminium edge type Table 5 [3]	N/A
3	N/A	VCR [4]	N	¼ -1 inch	Silver coated gasket in carrier Table 4	N/A
4	Y	ISO-CF	N	16 - 250[2]	Silver coated copper gasket	N/A
4	Y	ISO-K	N	63 – 100	Aluminium edge type Table 5 [3]	N/A
4	Y	ISO-KF	N	16 - 63	Aluminium edge type Table 5 [3]	N/A
4	Y	VCR [4]	N	¼ -1 inch	Silver coated gasket in carrier Table 4	N/A
4	N/A	ISO-K	N	63 - 400	Table 6	N/A
4	N/A	ISO-KF	N	16 - 63	Table 6	N/A

[1] Isolates system from main VV

[2] See section 8.4.1 for CF flange restrictions

Table 3 Accepted flange set and seal combination

8.3.3 Flange Mounting / Demounting

8.3.3.1 Design of Vacuum Flanged Systems

The design of VQC 1 systems utilizing flanges shall be such that the system, or components of the system, can be removed from the area of service through the demounting of ITER style flange set (Table 3).

8.3.3.2 Flange Demounting

Where there is a requirement to breach a VQC 1 boundary through the demounting of an accepted vacuum flange (Table 3) the breach shall only be made at an ITER style flange set.

It is prohibited to demount VQC 1 flange sets other than ITER style in the area of service (e.g. in the port cell). The system, or components of the system, shall be transported to a suitably contamination controlled area (e.g. the hot cell) prior to the demounting of a VQC 1 flange set other than ITER style.

8.3.3.3 Vacuum Testing

100 % of vacuum flange sets shall be helium leak tested to ensure the vacuum performance of the flange set is compliant with its VQC.

Where a system or component of a system has been removed from the area of service VQC 1 flange other than ITER style shall be helium leak tested prior to the system / component installation in the area of service.

ITER style flange sets shall be helium leak tested on mounting.

8.3.4 Seal Material Type

8.3.4.1 Metallic Seal Combinations

8.3.4.1.1 ITER Style Flanges

ITER style flanges have been qualified with specific gasket seals. The manufacturer's part number of seals to be used with ITER style flanges is detailed on the manufacturing drawings (Table 8). The use of gasket seals other than those with part numbers compliant with the manufacturing drawings is prohibited unless *accepted* by the ITER Vacuum RO.

8.3.4.1.2 VCR

VCR is a trade name of Swagelok. VCR flange sets shall utilise silver coated stainless steel gaskets with the Swagelok part numbers as listed in Table 4.

VCR (inch)	Product description (part number)[4]
1/4	316 SS VCR Face Seal Fitting, 1/4 in. Silver-Plated Gasket Retainer (SS-4-VCR-2-GR)
1/2	316 SS VCR Face Seal Fitting, 1/2 in. Silver-Plated Gasket Retainer Assembly (SS-8-VCR-2-GR)
3/4	316 SS VCR Face Seal Fitting, 3/4 in. Silver-Plated Gasket Retainer (SS-12-VCR-2-GR)
1	316 SS VCR Face Seal Fitting, 1 in. Silver-Plated Gasket Retainer (SS-16-VCR-2-GR)

Table 4 VCR gasket product description and manufacturers part number

8.3.4.1.3 CF

CF type flange sets shall utilise silver coated high-purity, oxygen-free (OFHC) copper gaskets.

8.3.4.1.4 Aluminium Edge Type

Aluminium edge type seals shall be utilised for ISO – K and ISO - KF flange sets.

For reference a manufacturers part number of aluminium edge type gasket seals are provided in Table 5.

Nominal Diameter (DN)	Manufacturers Part Number[3]	
	ISO - K	ISO - KF
16		34.016001.142.116-iz1
25		34.016001.142.125-iz1
40		34.040001.142.140-iz1
50		34.050001.142.150-iz1
63	34.063001.342.106	34.063001.142.163-iz1
80	34.080001.342.108	
100	34.100001.342.110	

Table 5 EVAC Al edge type gasket seal part numbers

8.3.4.2 Non-metallic Seals

Non-metal seal gasket material shall be chosen from Table 6. The seal gasket material chosen shall be compatible with the area of service. The radiation environment that the seal shall operate is defined in the ITER Environmental Conditions Room Book [5].

Material	Temperature limit (◦C)	Maximum allowable accumulated lifetime dose 1 MeV equivalent (Gray)
Viton	150	1×10^3
EPDM (Ethylene-propylene)	120	5×10^5
Nitrile rubber (Buna – N)	80	1×10^4

Table 6 Seal material temperature and radiation limits

8.3.5 Clamping Arrangement

The flange set clamping arrangement utilised shall comply with Table 7.

Flange set	Clamping Arrangement	Flange Option
ITER Style	Bolt ring	Fixed, rotatable
ConFlat	Bolt arrangement	Fixed, rotatable
ISO - KF	Chain clamp, ISO-K cold steel double clamp.	N/A
ISO - K		

Table 7 Flange clamping arrangement

8.4 Flange Set Manufacture

8.4.1 COTS Flange Sets

CF, VCR ISO-K and ISO-KF flange sets are commercially available items readily available in all parties' countries. It is recommended that these items be purchased from companies supplying vacuum equipment

as part of their core business. The use of flange sets which are not purchased from a company supplying vacuum equipment as part of its core business shall only be by prior *Acceptance*.

To ensure compatibility between flanges (knife edge dimensions etc.) manufacturers of CF > DN 150 shall be *accepted* by the ITER Vacuum RO.

8.4.2 ITER Style Flange Set

ITER style flanges shall be manufactured according to the requirements of this Appendix and following the requirements of the ITER Vacuum Handbook.

8.4.2.1 Manufacturing Drawings

ITER Style flanges shall be manufactured in accordance with the drawings listed in Table 8.

DN	Drawing Reference[1]
63	ITER_D_BFGFDN v1.0
100	ITER_D_BLZJ8N v1.0
150	ITER_D_BLZK9E v1.0
200	ITER_D_BM3LDD v1.0
250	ITER_D_BM3ZRG v1.0
300	ITER_D_BM43TL v1.0
[1]ITER style flange drawings issued at V1.0 are for information only. After the completion of the qualification program drawings will be up-issued to version 2.0 and shall be used for manufacture.	

Table 8 ITER Style flange drawing reference

8.5 Reference

[1] Request for Acceptance (ITER_D_9AY4HD v1.0).

[2] http://www.techneticsgroup.com/products/sealing-solutions/metal-seals/helicoflex/.

[3] www.NEYCO.Fr

[4] http://www.swagelok.com/products/fittings/vcr-metal-gasket-face-seal.aspx.

[5] Environmental Conditions Room Book (ITER_D_2UUZ23)

[6] ITER Vacuum Handbook (ITER_D_2EZ9UM)