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4ADNG4

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06 Nov 2020 / 1.0 / Approved

EXTERNAL REFERENCE / VERSION

Report

DNB Vessel-compliance with construction code RCC-MR

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Author	**Yadav A.**	**06 Nov 2020:signed**	
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Table of Contents

1. Purpose

The purpose of this annexure is to describe and justify the compliance of DNB Vessel Design with construction code requirements, selected for the design and construction, with a view to meet the functional requirements of the ITER.

2. Methodology

S. No.	Activity
1.	Selection of construction Code
2.	Selection of Type of damage
3.	Selection of Criteria level
4.	Material of construction and properties
5.	Determination of Minimum thickness required
6.	Branch (Hydraulic Feed through) design
7.	Design for welded assemblies
8.	Fabrication and associated examination

3. Selection of Construction (Design, Manufacturing and Inspection) Code

According to the ITER classification of safety components, the ITER Safety important Components (SIC) class for the Neutral Beam (NB) first confinement barrier is SIC-1.

As per the functionality, DNB Vacuum Vessel forms the first confinement barrier in the ITER system and hence it is classified as SIC and is therefore classified as Quality Class 1 (QC-1), to be designed and being manufactured according to **RCC-MR 2007 Design and Construction Code subsection C.**

DNB Vacuum Vessel is classified as a Class 2 RCC-MR component. Applicable design rules are those of the class 2 Box structures given in RC 3800. The consideration for materials, fabrication and associated examinations are as described in Subsection C of the Code.

4. Selection of Type of Damage

Considering the various loading conditions mentioned in Load Specification Document, the analysis has been carried out for the P and S type damage defined in the RCC-MR. In addition to the P and S type damage, the additional load shall be of the bolting element, the bolting elements has also been qualified as the RCC-MR requirements.

5. Selection of Criteria Level

Following are the criteria levels selected based on guidelines as applicable, for various loading conditions foreseen during the life span of DNB Vessel.

Loading Event Category	Category I: Operational/ Design Loading	Category II: Likely Loading	Category III: Unlikely Loading	Category IV: Extremely Unlikely Loading	Test Loading
Plant Level	Normal	Normal	Emergency	Faulted	Normal
DNB Vessel	Normal	Normal	Emergency (2)	Faulted (1), (2)	Normal
Interpretation (In accordance with ITER_D_4BDG3Y and RCC-MR criteria level	**Level A:** The Equipment shall meet the stress limits specified in RCC-MR for 304L and deflection limits as per PA Annex B (ITER_D_2MLS3V_v1.2)		**Level C:** Small levels of overall deformation could occur. Consequently, it could be necessary to inspect equipment subjected to these types of loading before re-using it, to ensure that its condition is satisfactory.	**Level D:** Plastic deformation is tolerated as long as the vessel remains leak tight. It will not always be possible to return to service an item of equipment having been subjected to a loading only limited by this level criteria.	

6. Material of Construction

6.1. Material of Main Shell

- X2CrNi18-9 (Solution annealed Austenitic Stainless Steel) is selected as major construction material. This is equivalent to AISI 304L.

- The product procurement specification has been prepared as per requirements specified in RM 3322 (Forgings) / RM 3332 (Plates) / RM 3341-RM3342 (Tubes / Pipes) of RCC-MR 2007.

- In addition to chemical requirements, the material shall have additional restriction on impurity content i.e. Co < 0.05%, Nb < 0.01%, Ta < 0.01%.

- The properties of material shall be as per Subsection Z → Appendix 3→ A3.4S of RCC-MR 2007.

Elastic Properties of SS304L

Maximum Allowable Stress (Sm):

120 MPa for Temp Range of 40 Deg C to 100 Deg C (as per Table A3.4S.41 of Appendix 3, Sub Section Z)

	Level A	Level C @	Level D#
The general primary membrane stress intensity (Pm)	<Sm (120 MPa)	$<Sm^c$ (162 MPa)	$<Sm^D$ (288 MPa)
The local primary membrane stress intensity (Pl)	<1.5 Sm (180 MPa)	$<1.5\ Sm^c$ (243 MPa)	$<1.5\ Sm^D$ (432 MPa)
The primary membrane plus bending stress intensity (Pl + Pb)	<1.5 Sm (180 MPa)	$< 1.5\ Sm^c$ (243 MPa)	$< 1.5\ Sm^D$ (432 MPa)

@Sm^C = Minimum of 1.35 Sm and $R^t_{p0.2}$; Here, Sm=120 MPa, $R^t_{p0.2}$ =180 MPa; So, Sm^C = 162 MPa

#Sm^D = Minimum of 2.4 Sm and 0.7Rm(min); Here, Sm=120 MPa, Rm(min)=460MPa; So, Sm^C = 288 MPa

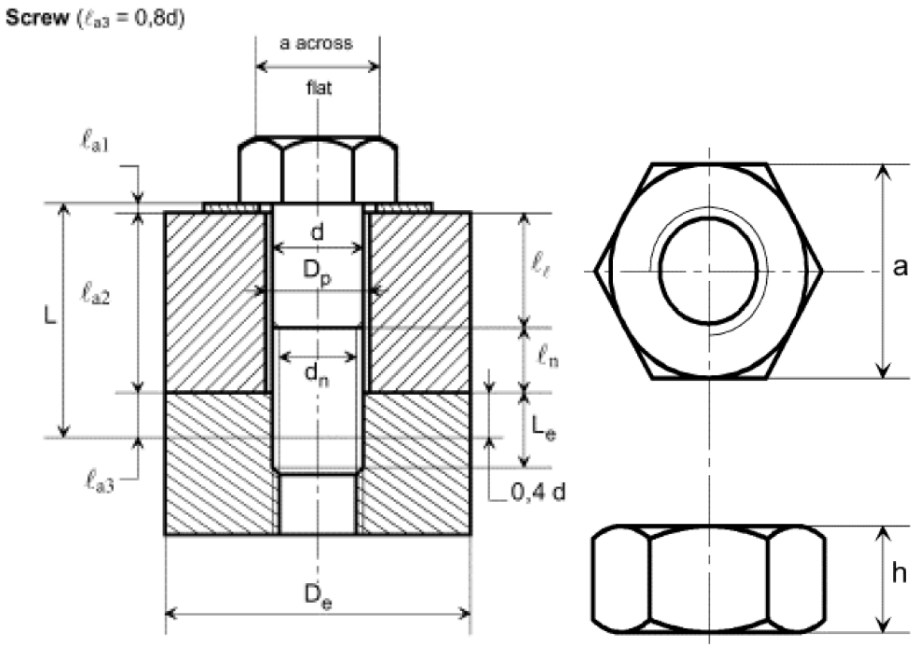
6.2. Superbolts (Top lid bolting)

Selected Bolt Material: Inconel 718

The 220 Superbolts are used to fix the Top lids on the vessels. There are made of Inconel 718. The preload applied on these screws is 330 kN.

Dimensions					
Bolt		Bushing		Other	
d	36	d	50	h	28
dl	36			a	60
p	3	p	3	Dp	42
Le	68	Le	68		

Figure 1: Top lid bolts



6.3. Other than Superbolts

On the front and rear end opening that shall mount the fast shutter and high voltage bushing respectively bolting arrangements are provided. Fixing of the vessel with PMS are also done with support bolts. Material considered for these bolts are also Inconel 718.

Dimensions						
Bolt		Bushing		Other		
d	20	d	33	h	20	A
dl	20			a	30	B
p	2.5	p	2.5	Dp	25	C
Le	30	Le	30			

Figure 2: Fast shutter and HVB bolts

Dimensions							
Bolt		Bushing		Other		Washer	
d	36	d	50	h	40	A	0
dl	31.67			a	55	B	0
p	4	p	5	Dp	40	C	0
Le	45	Le	68				

Figure 3: Bottom support bolts

A - C	RB 3282.1111	$\overline{(\sigma_m)}_{fictitious} \le S_{mB}$
	RB 3282.1112	$\overline{\sigma_m} \le 2 \cdot S_{mB}$
	RB 3282.1113	$\overline{\sigma_m + \sigma_b} \le 3 \cdot S_{mB}$
D	RB 3282.113	$\overline{\sigma_m} \le \min\left[(R^t_{p0.2})_{min}, 0.7 \cdot (R_m)_{min}\right.$
		$\overline{\sigma_m + \sigma_b} \le (R_m)_{min}$

Figure 4: Bolt qualification requirements

Elastic Properties of Inconel 718

Yield Strength = 1035 MPa			
Maximum Allowable Stress (S_{mB}): =1/3 of Yield Strength= 345 MPa			
	Level A	Level C	Level D
Mean fictitious stress intensity ($(\sigma_m)_{fictitious}$)	$\leq S_{mB}$		--
Limitation of the mean stress (σ_m)	$\leq 2\ S_{mB}$ (690 MPa)		892 MPa *
Limitation of maximum stress ($\sigma_m + \sigma_b$)	$\leq 3\ S_{mB}$ (1035 MPa)		$\leq$ Rm (min) (1275 MPa)
**Min ($R^t_{p0.2}$,0.7 Rm(min)); $R^t_{p0.2}$=1035, Rm(min)=1275*			

6.4. Metallic Seal Gasket

Helicoflex metallic seals are used to ensure a high vacuum grade. The compression curve used for the seal is shown in fig 5., this is a data from Helicoflex metallic gasket supplier. The configuration of the metallic seal provided in the vessel flange is shown in fig 6.

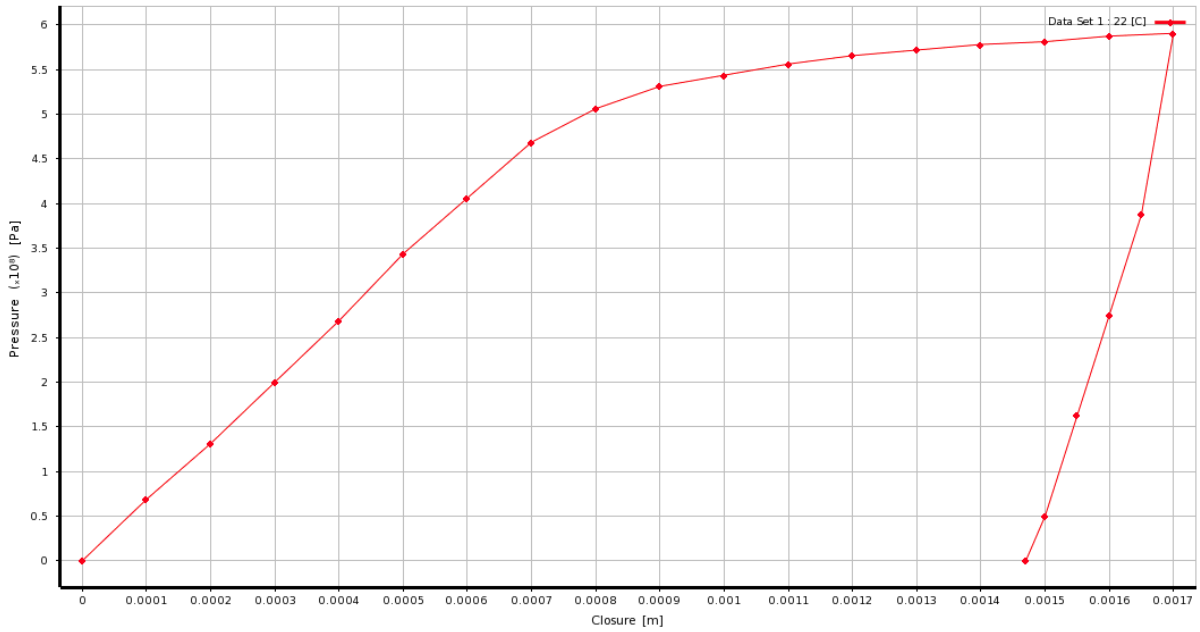


Figure 5: Compression curve for metallic gasket

According to the curve, the gasket maximum compression intended to 1.6mm.

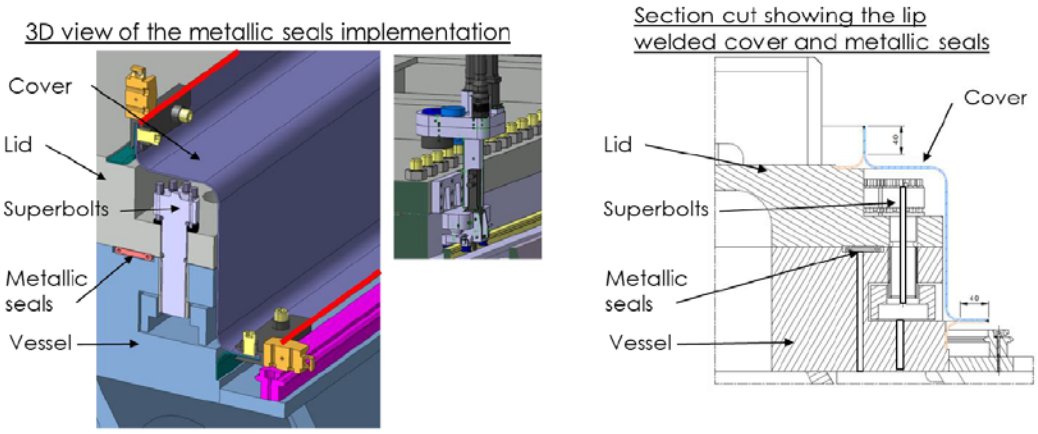


Figure 6: Flange configuration

7. Determination of minimum required vessel thickness

RCC-MR does not provide any guidelines for calculating the minimum thickness required for "BOX Structure" subjected to external pressure.

(Clause RC 3831.2 refers to clause RC 3331.1 which does not exist and clause RC 3332.1 and RC 3332.2 are applicable for cylindrical vessel)

In such situation, the approach is to use ASME Sec VIII Div. 1 for basic calculation of shell thickness and design of stiffening.

With reference to calculations provided in Annexure 5 of the PDR report, following configuration of vessel plate and Stiffeners assembly meets the design stress limits.

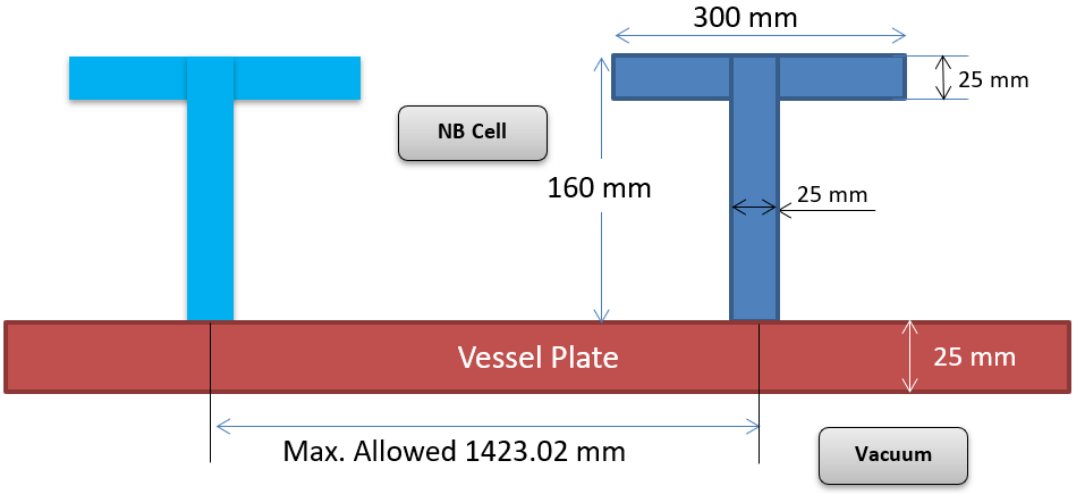


Figure 7: DNB vessel design schematic

8. Hydraulic Feedthrough Connections

There are various openings as provided in Vessel body for performing different functions, which can be considered as 'Branch'. RCC-MR does not provide guidelines for design of Branch for 'Box' structure.

(Clause RC 3832 refers to clause RC 3333 which is applicable for cylindrical vessel)

Referring to ASME Sec VIII Div. 1, Mandatory Appendix 13, Clause 13-4(j)(2), it can be concluded that some of the feed-through need reinforcement but the rules for specific design are not provided.

Under such situation, all the hydraulic feed-through are provided with the reinforcement as per the below schematic (fig 8) and Figure RB 3333.332 (a) as reference sketch. The dimensions may vary based on the diameter and thickness of feed-through. The validation of the reinforcement provided, and effect of internal pressure on the vessel body have been carried out and validated by Design by Analysis.

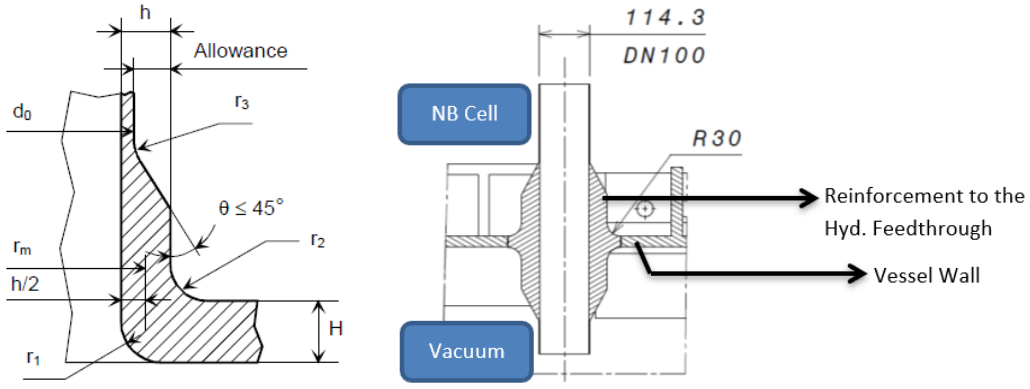


Figure 8: Feedthrough connections

9. Design for Welded Assemblies

Methodology

The welding details are identified for the main shell and top lid fabrication. The von mises stress obtained for the different load case analysis has been compared for the different weld classification and their allowable limits defined in the FEA report.

9.1. Manufacturing and Inspection requirements

Following rules specified in RC 3833.2 have been considered during weld design:

a. No welds assembling the various parts of main shell are crossing each other except the weld joint of stiffeners.
b. The minimum distance between the edges of weld (except stiffeners weld) is maintained as 40mm minimum.
c. The distance between main weld and edge of drill hole or part weld in maintained as 40mm minimum. This however could not be respected for HVB Flange, because of the interface constrains.
d. In such situation the provision for Radiographic Testing (RT) in addition to Ultrasonic Testing (UT) is to be considered to maintain the quality of this welded assembly. Also, as guided in RC 3833.2 (d), requirements of RC 4000 will be fulfilled while preparing the technical specification and defining the examination requirements.
e. The weld joints are designed in such a way that they are as far as possible from gross shape discontinuities.
f. The weld joints are designed in such a way that all the vacuum boundary weld volumes are 100% inspectable so that the weld efficiency is 1. Appropriate care has been taken to ensure that these tests can be performed to the extent specified at a prior stage when accessibility is adequate. The same shall be considered while planning the manufacturing sequence.

When requirements RC 3833.2 cannot be met, the following complementary examinations shall be carried out:

Welded joint intersections:

Ultrasonic examination (for e > 10 mm) of each branch of the weld cross on a minimum length equal to 3e from the theoretical of the cross (e being the greater thickness of the parts to be joined).

Longitudinal welds separated by a distance less than the least of 2e and 40 mm for butt welding (connecting welds) of hoop shells and pipes: ultrasonic (for e > 10 mm) of the following areas:

On the connecting welds, areas from the external edges of longitudinal welds to 2e on each side and on the longitudinal welds, 2e from the connecting weld.

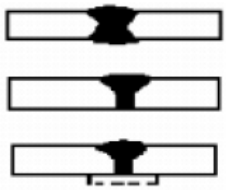
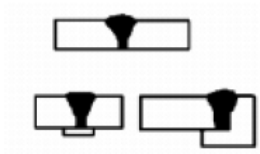
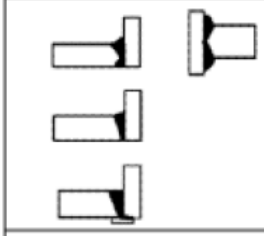
9.2. Welding Classification

The RCC-MR codes define two welding classifications:

- The welded joint type
- The welded assembly category

Weld Joint Type

The welded joint types are defined within the RCC-MR in the table RC 3833.3a. This table is shown below.

Examples	Definition of types welded joints				
	I.1	butt welding	full penetration	two sides accessible	back welding
	I.2	butt welding	full penetration	two sides accessible	gaseous back protection with or without insert
	I.3	butt welding	full penetration	two sides accessible	on temporary backing strip can be inspected after removal of the strip
	II.1	butt welding	full penetration	back side inaccessible	gaseous protection with or without insert
	II.2	butt welding	full penetration	back side inaccessible	permanent backing strip
	III.1	fillet or T	full penetration	two sides accessible	back weld or back machining
	III.2	fillet or T	full penetration	back side inaccessible	gaseous back protection
	III.3	fillet or T	full penetration	back side inaccessible	permanent backing strip
	IV.1 IV.2	fillet or T butt welding	partial penetration	double opening preparation	double bead
	V	fillet or T	partial penetration or no penetration	straight edges or single opening preparation	double bead
	VI	fillet or T butt welding	partial penetration	single opening preparation	single bead
	VII	fillet or T	no penetration	straight edges preparation	single bead

9.3. Welded Assembly Category

The welded categories are split into two main categories:

- The box elements
- The pipe elements

According to RC 3833.3, the "box" elements (constituting the pieces) are defined in four main categories. They are listed as category 1 to category 4. The type of joint allowed depends on the category considered as shown below:

Welded assembly category	Types of welded joint authorized							
1	I.1	I.2	I.3	II.1		III.1		
2	I.1	I.2	I.3	II.1		III.1	III.2	
3	I.1	I.2	I.3	II.1	II.2	III.1	III.2	III.3
4	I.1	I.2	I.3	II.1	II.2	III.1	III.2	III.3
	IV.2	V	VI **(1)**	VII **(1)**				
(1) : Not advised for operating in water								

9.4. Joint Coefficient

A joint coefficient "n" must be applied for the weld calculation depending of the type of the welded joint and the control performed.

This coefficient is defined within the RCC-MR in the table RC 3851. This table is shown below:

: coefficient "n" must be applied for the welds calculation depending of the type of the weld
ıd the control performed.

)efficient is defined within the RCC-MR vol C&D in the table RC 3851. This table is shown he

	Types of welded joints			
Examinations Volumetric examinations: radiography or ultrasonic examinations Surface examinations: liquid penetrant or magnetic particle examinations	**I.1 I.2 I.3 III.1**	**II.1 III.2**	**II.2 III.3**	**IV V VI VII**
Volumetric examinations + surface examinations after welding (both sides)	1			
100% Volumetric examination + Surface examination (after penetration pass and front side after welding)	1	1		

All the vacuum boundary welds shall be of category 1 and shall be welded with the joint types of I.1 and I.2 (full penetration butt welds). Vacuum boundary shall also be subjected to the 100% volumetric examination and surface examination, that provides all the vacuum boundary joint to have joint coefficient 1 for the weld qualification.

Stiffener weld joints to the main shell and top lid shall be of category 2 and shall be welded with III.1 and III.2 (full penetration fillet welds). Considering the weld joint location, weld examination be varied with the joint coefficient ranging from 0.5 to 1. However, all the stiffener weld joints are qualified with the lowest joint coefficient value i.e. 0.5.

9.5. Welding Controls and Examination

The tests to be performed are fully defined in the table RS 7720, which is to be used considering the type of product. Welds have to be checked with a volumetric control. The two kinds of volumetric controls are Ultrasonic (UT) and X-ray.

In addition, an extract from the ITER Vacuum Handbook (2EZ9UM), shows the preferred examination method depending of the thickness of the weld.

7.1.4 Inspection and Testing of Production Welded Joints

All such inspection and testing shall be carried out using approved procedures in accordance with Attachment 1.

For all VQC 1A, VQC 2A water boundaries and vacuum boundary welds which become inaccessible, 100% volumetric examination of production welds shall be performed, unless a method of pre-production proof sampling is approved.

The range of thickness and preferred volumetric examination method to be applied is given in Table 7-2.

Wall Thickness (wt) (mm)	Preferred Volumetric Examination Method
wt < 8	Radiography
8 < wt < 19	Radiography & Ultrasonic
wt > 19	Ultrasonic or radiography
Note: For wt > 19 mm ultrasonic examination of welds is preferred only in cases where radiographic examination would require excessive exposure times.	

9.6. Thickness Transition

Welding between base materials with different thickness is avoided as far as possible. In case of un-avoidable situation, gradual transition is to be provided.

Following method (recommended by RC 3834) shall be followed in case of welding on transition zone. The weld volume of joint shall be 100% examined by RT and / or UT and surface examination.

The same has been adopted for the welding of top lid flange (plate thickness of 115 mm) with the top lid plate (thickness 55 mm).

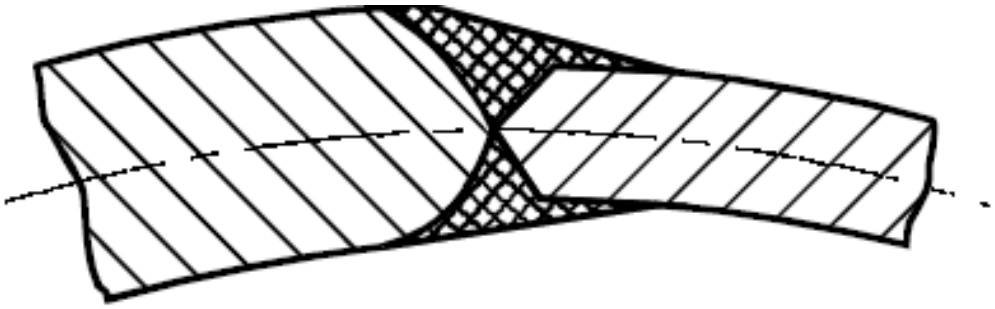


Figure 9: Thickness transition schematic for welding

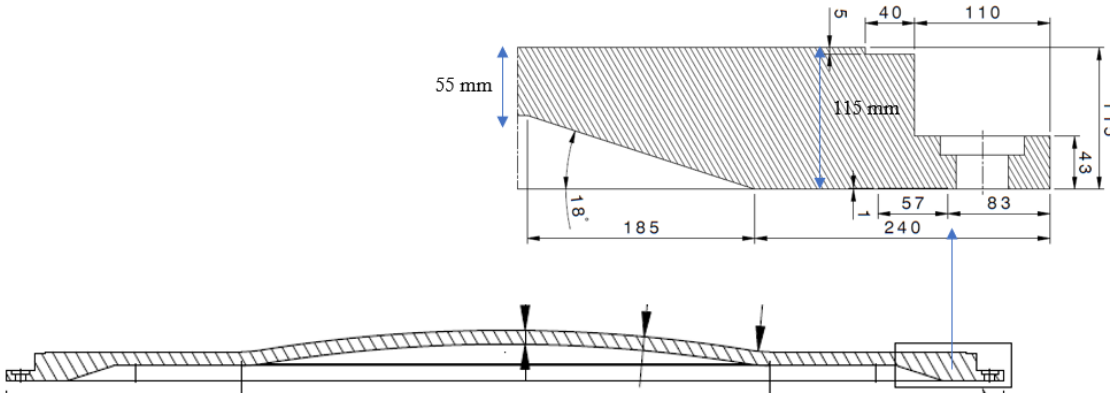
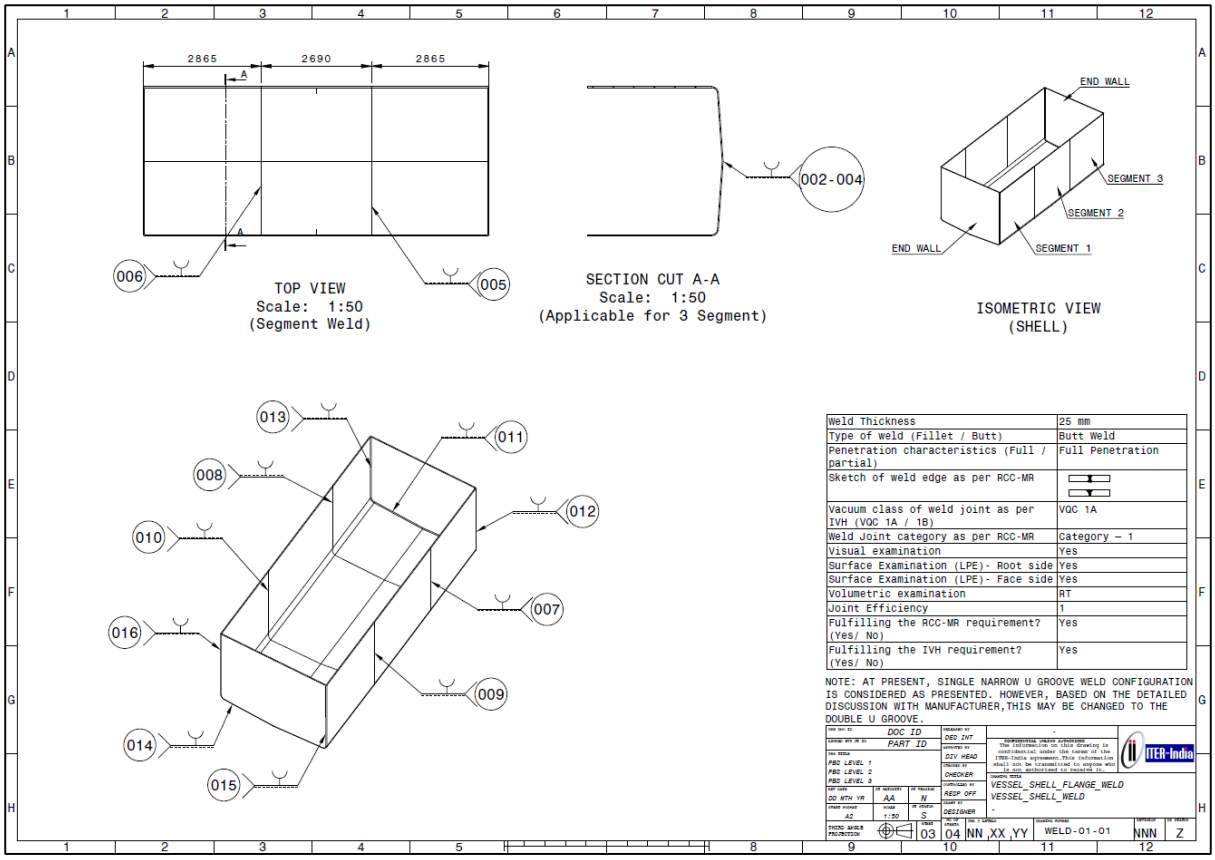


Figure 10: Top lid thickness transition

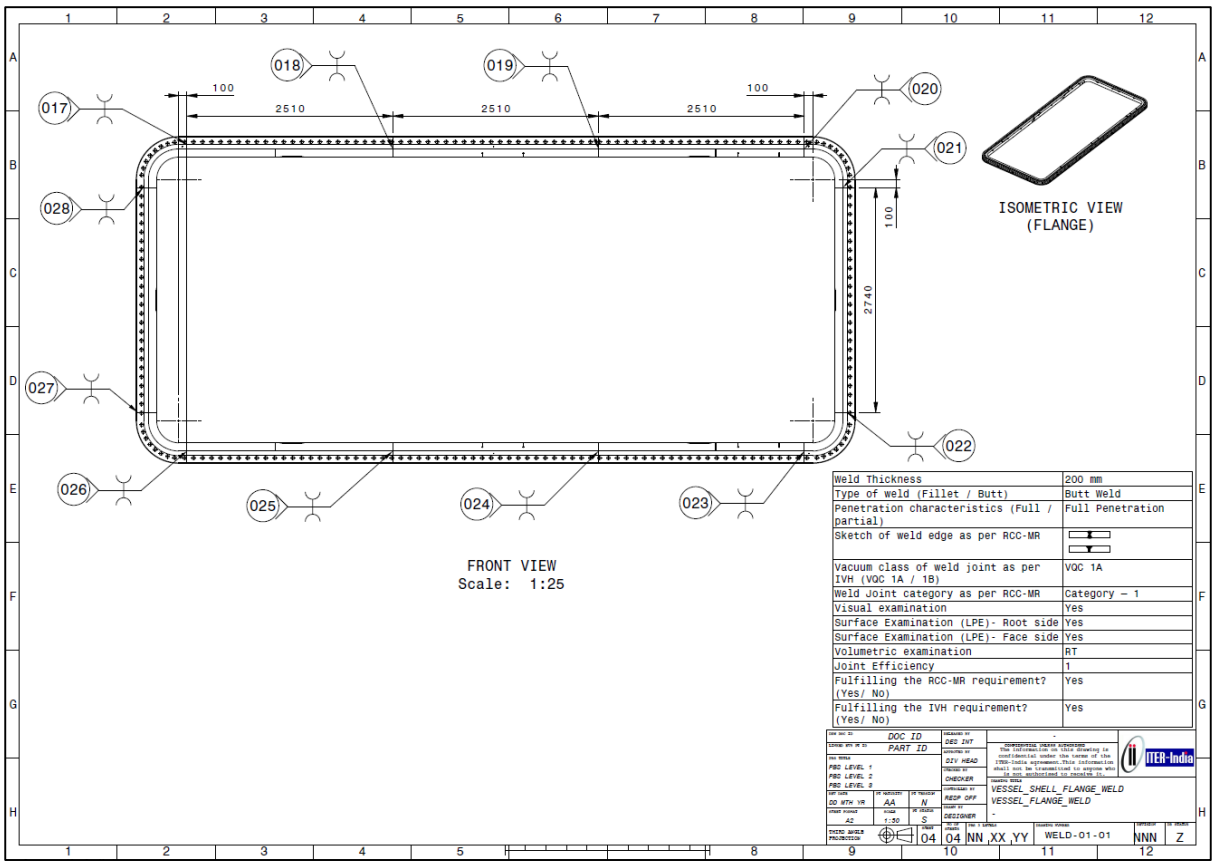
All the welds of the DNB Vessels are compliant with the RCC-MR 2007 code. Weld details for the vessel fabrication is shown in below drawings. The verification for the welds with respect to their joint coefficient are done and presented in FEA report.



Weld Thickness	25 mm
Type of weld (Fillet / Butt)	Butt Weld
Penetration characteristics (Full / partial)	Full Penetration
Sketch of weld edge as per RCC-MR	
Vacuum class of weld joint as per IVH (VQC 1A / 1B)	VQC 1A
Weld Joint category as per RCC-MR	Category – 1
Visual examination	Yes
Surface Examination (LPE)- Root side	Yes
Surface Examination (LPE)- Face side	Yes
Volumetric examination	RT
Joint Efficiency	1
Fulfilling the RCC-MR requirement? (Yes/ No)	Yes
Fulfilling the IVH requirement? (Yes/ No)	Yes

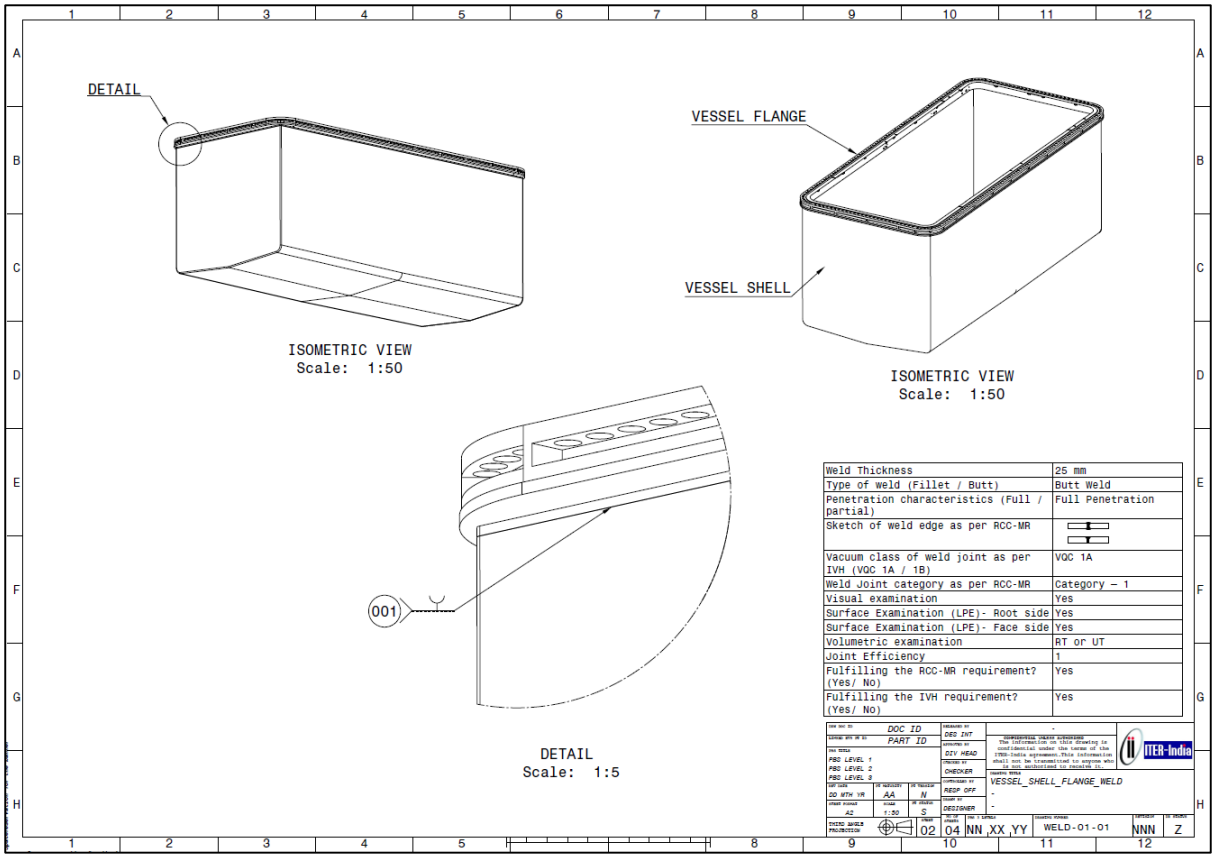
NOTE: AT PRESENT, SINGLE NARROW U GROOVE WELD CONFIGURATION IS CONSIDERED AS PRESENTED. HOWEVER, BASED ON THE DETAILED DISCUSSION WITH MANUFACTURER,THIS MAY BE CHANGED TO THE DOUBLE U GROOVE.

DOC ID
PART ID
DES INT
DIV HEAD
CHECKER
REDP OFF
DESIGNER
VESSEL_SHELL_FLANGE_WELD
VESSEL_SHELL_WELD
ITER-India
AA
N
A2
1:50
S
03
04
NN ,XX ,YY
WELD-01-01
NNN
Z



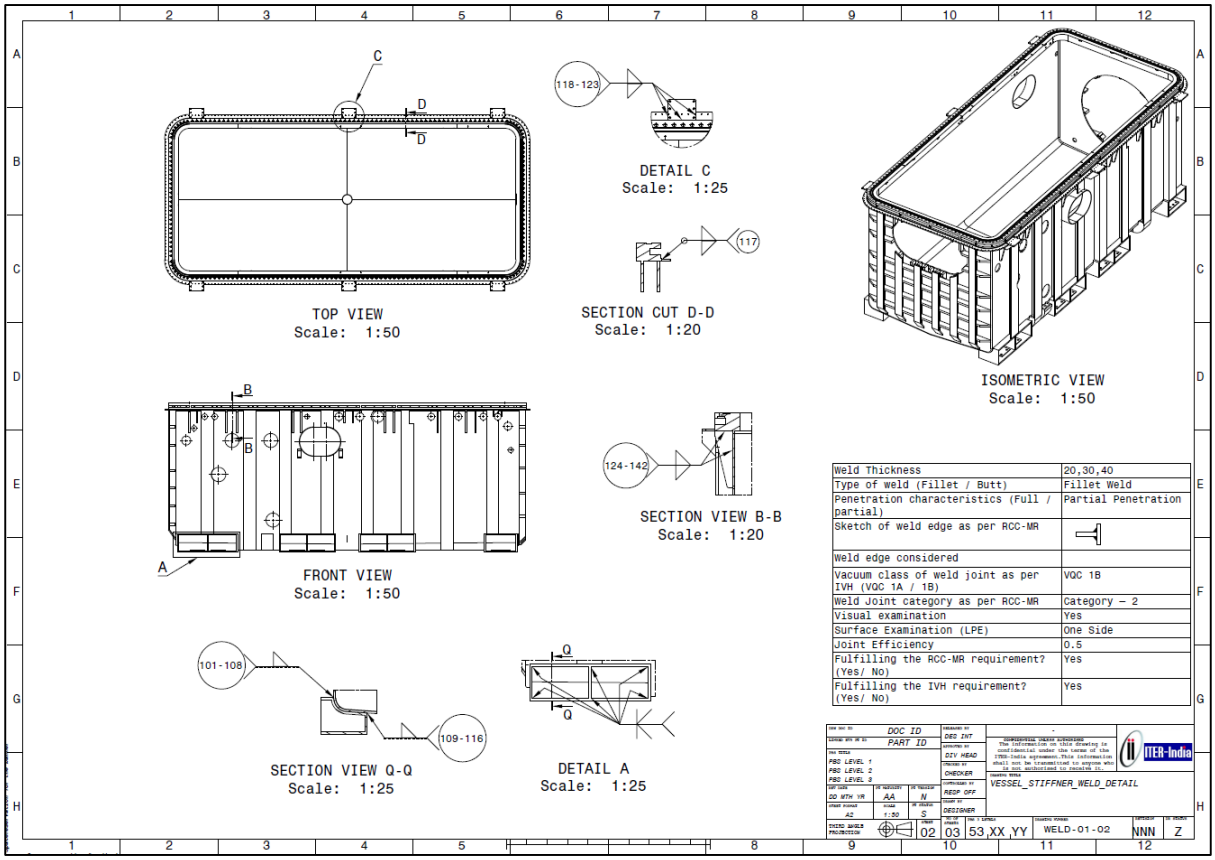
Weld Thickness	200 mm
Type of weld (Fillet / Butt)	Butt Weld
Penetration characteristics (Full / partial)	Full Penetration
Sketch of weld edge as per RCC-MR	
Vacuum class of weld joint as per IVH (VQC 1A / 1B)	VQC 1A
Weld Joint category as per RCC-MR	Category – 1
Visual examination	Yes
Surface Examination (LPE)- Root side	Yes
Surface Examination (LPE)- Face side	Yes
Volumetric examination	RT
Joint Efficiency	1
Fulfilling the RCC-MR requirement? (Yes/ No)	Yes
Fulfilling the IVH requirement? (Yes/ No)	Yes

DOC ID
PART ID
DES INT
DIV HEAD
CHECKER
REDP OFF
DESIGNER
VESSEL_SHELL_FLANGE_WELD
VESSEL_FLANGE_WELD
ITER-India
AA
N
A2
1:50
S
04
04
NN ,XX ,YY
WELD-01-01
NNN
Z



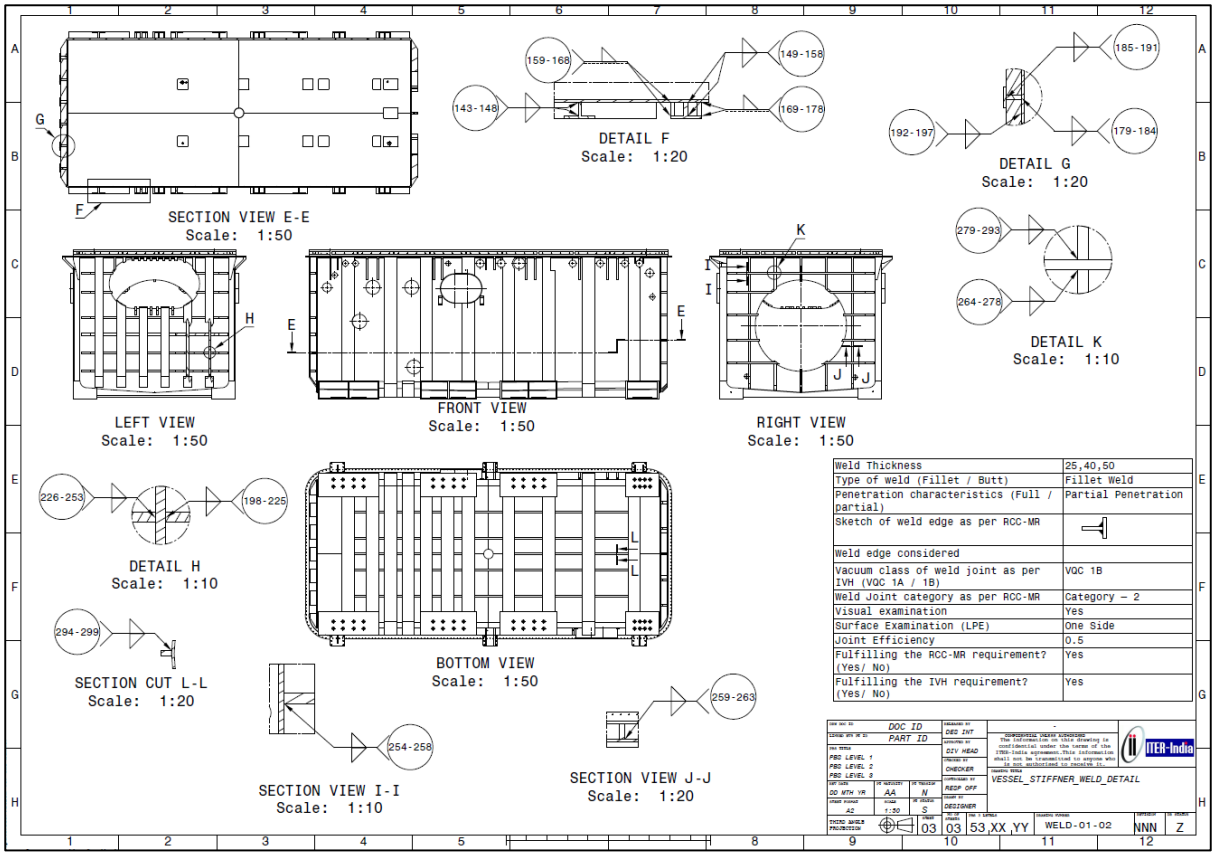
Weld Thickness	25 mm
Type of weld (Fillet / Butt)	Butt Weld
Penetration characteristics (Full / partial)	Full Penetration
Sketch of weld edge as per RCC-MR	
Vacuum class of weld joint as per IVH (VQC 1A / 1B)	VQC 1A
Weld Joint category as per RCC-MR	Category – 1
Visual examination	Yes
Surface Examination (LPE)- Root side	Yes
Surface Examination (LPE)- Face side	Yes
Volumetric examination	RT or UT
Joint Efficiency	1
Fulfilling the RCC-MR requirement? (Yes/ No)	Yes
Fulfilling the IVH requirement? (Yes/ No)	Yes

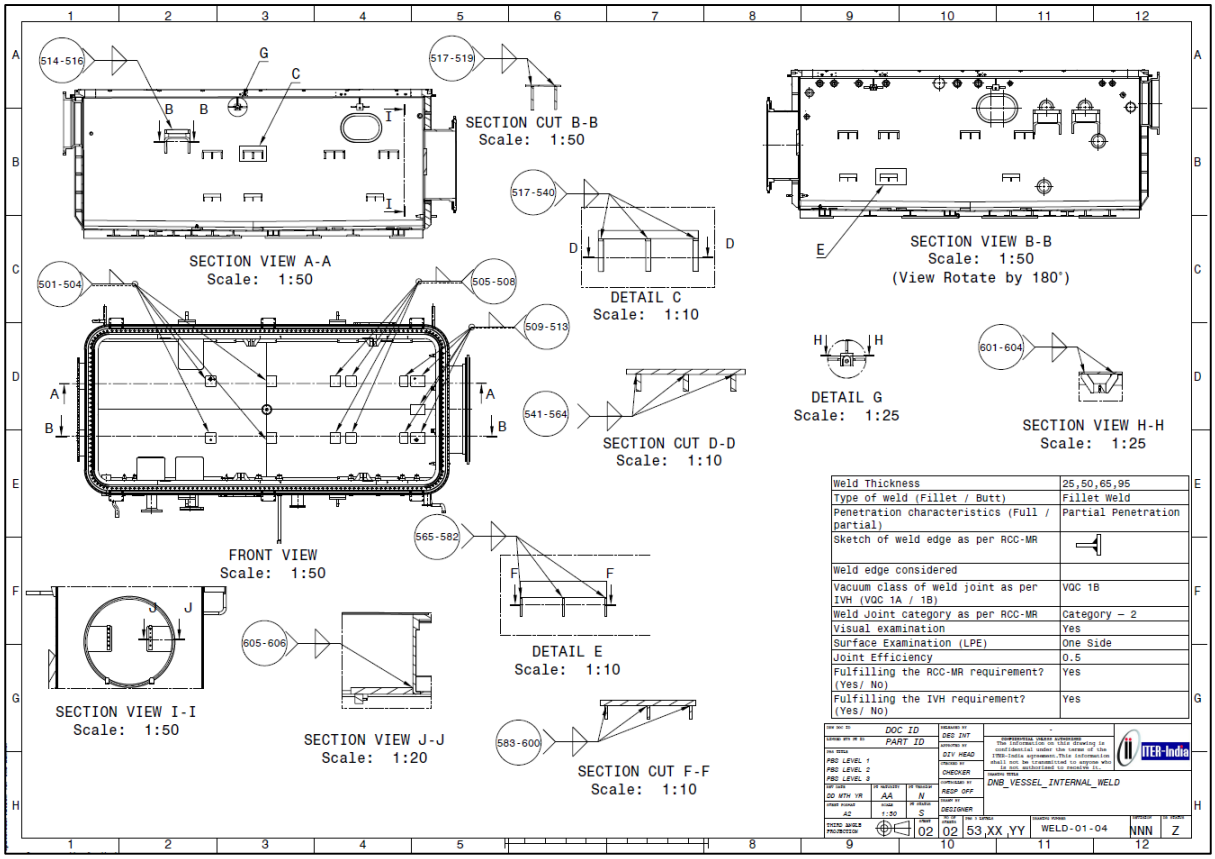
DOC ID / PART ID — DES INT — DIV HEAD — CHECKER — RESP OFF — DESIGNER — VESSEL_SHELL_FLANGE_WELD — WELD-01-01 — NNN — Z — 02 — 04 — NN ,XX ,YY

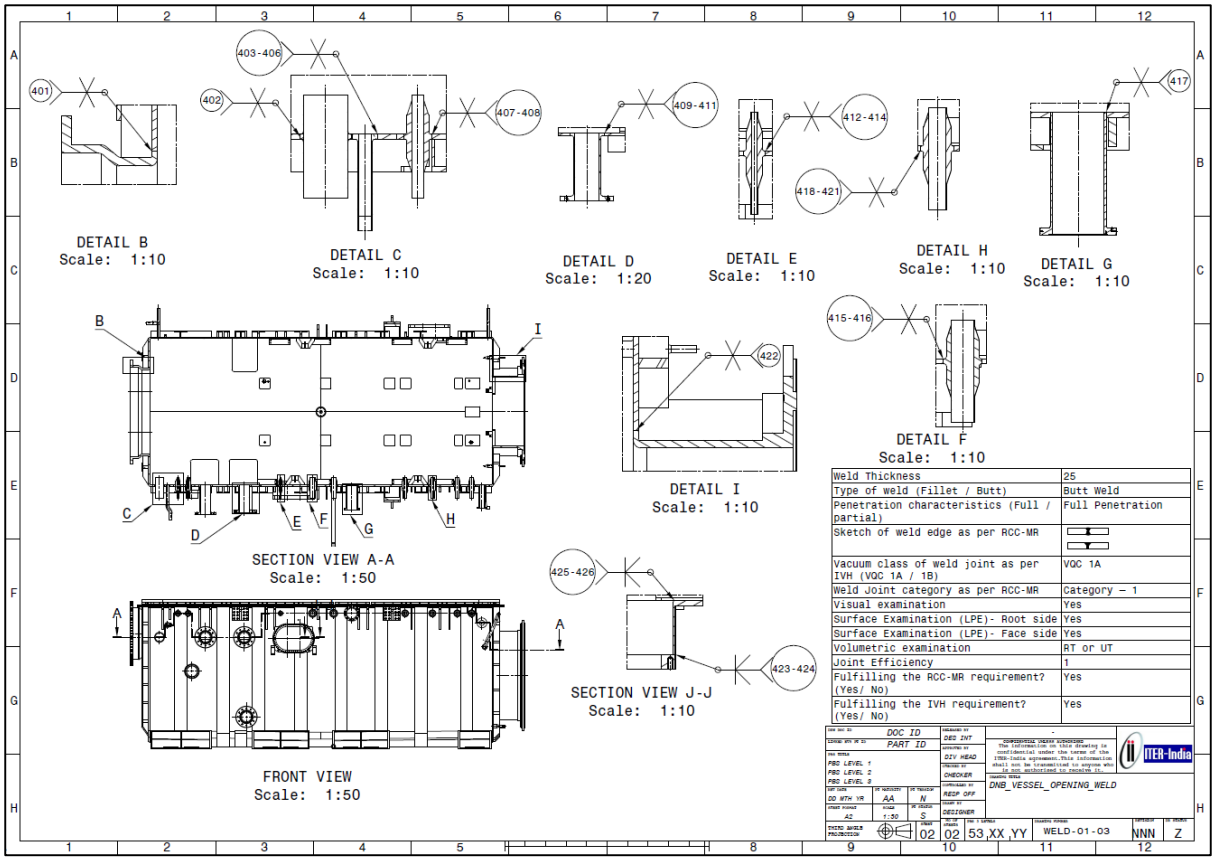


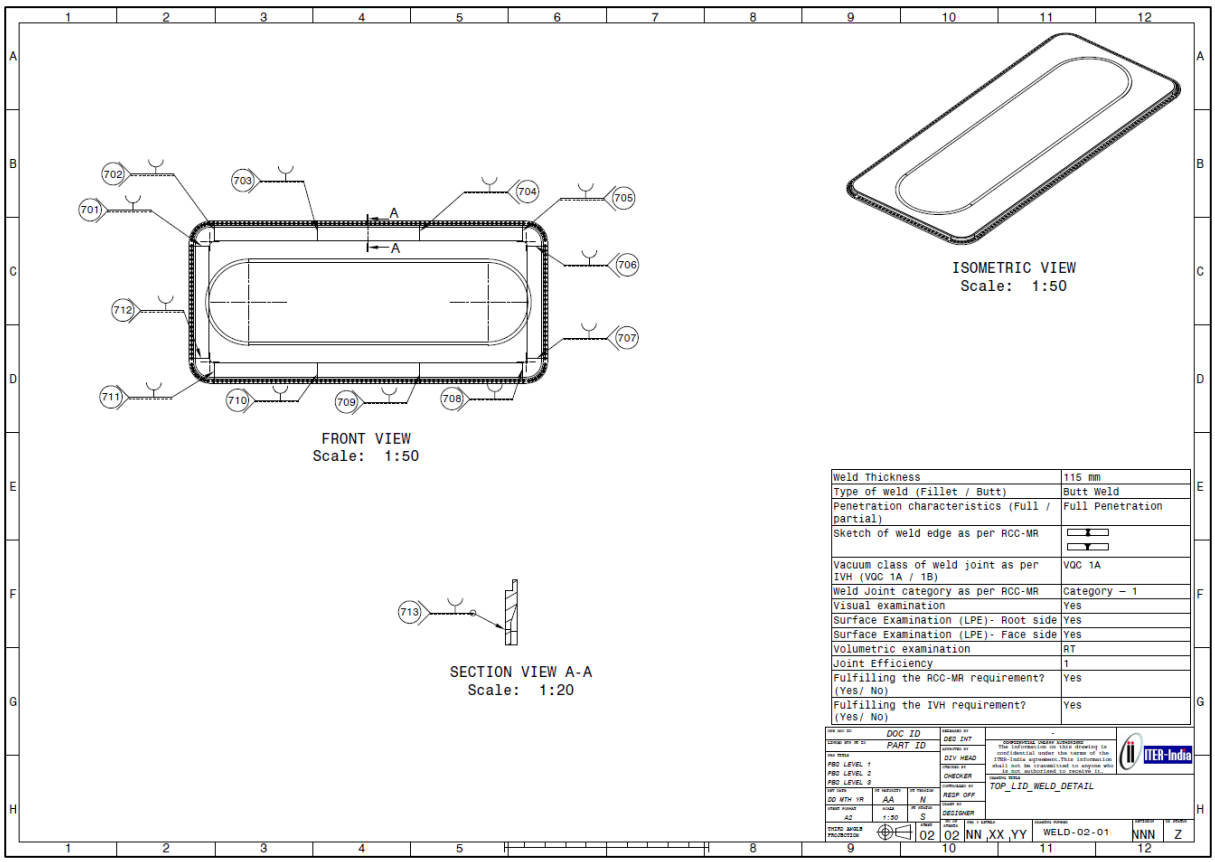
Weld Thickness	20,30,40
Type of weld (Fillet / Butt)	Fillet Weld
Penetration characteristics (Full / partial)	Partial Penetration
Sketch of weld edge as per RCC-MR	
Weld edge considered	
Vacuum class of weld joint as per IVH (VQC 1A / 1B)	VQC 1B
Weld Joint category as per RCC-MR	Category – 2
Visual examination	Yes
Surface Examination (LPE)	One Side
Joint Efficiency	0.5
Fulfilling the RCC-MR requirement? (Yes/ No)	Yes
Fulfilling the IVH requirement? (Yes/ No)	Yes

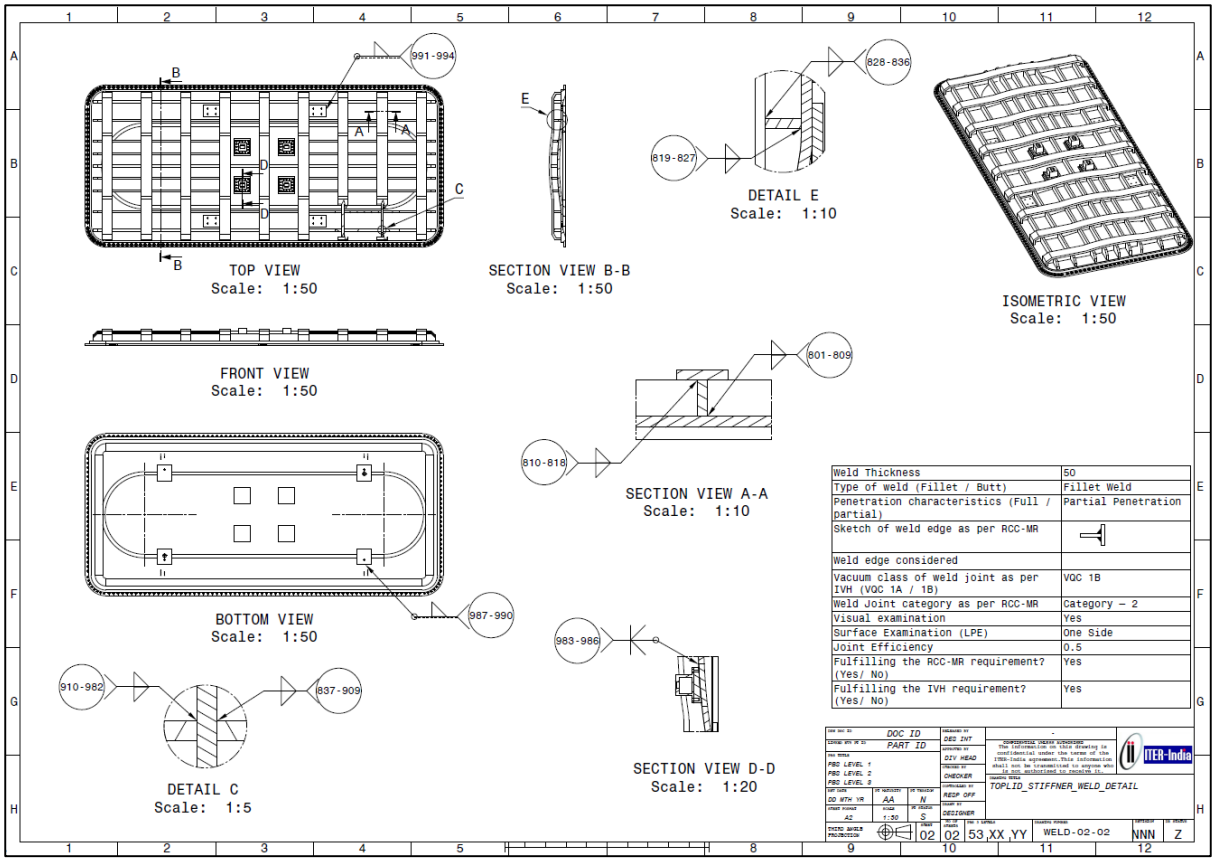
DOC ID / PART ID — DES INT — DIV HEAD — CHECKER — RESP OFF — DESIGNER — VESSEL_STIFFNER_WELD_DETAIL — WELD-01-02 — NNN — Z — 02 — 03 — 53 ,XX ,YY


SECTION VIEW E-E
Scale: 1:50
DETAIL F
Scale: 1:20
DETAIL G
Scale: 1:20
DETAIL K
Scale: 1:10
LEFT VIEW
Scale: 1:50
FRONT VIEW
Scale: 1:50
RIGHT VIEW
Scale: 1:50
DETAIL H
Scale: 1:10
BOTTOM VIEW
Scale: 1:50
SECTION CUT L-L
Scale: 1:20
SECTION VIEW I-I
Scale: 1:10
SECTION VIEW J-J
Scale: 1:20
Weld Thickness | 25,40,50
Type of weld (Fillet / Butt) | Fillet Weld
Penetration characteristics (Full / partial) | Partial Penetration
Sketch of weld edge as per RCC-MR
Weld edge considered
Vacuum class of weld joint as per IVH (VQC 1A / 1B) | VQC 1B
Weld Joint category as per RCC-MR | Category – 2
Visual examination | Yes
Surface Examination (LPE) | One Side
Joint Efficiency | 0.5
Fulfilling the RCC-MR requirement? (Yes/ No) | Yes
Fulfilling the IVH requirement? (Yes/ No) | Yes
VESSEL_STIFFNER_WELD_DETAIL
WELD-01-02
03
53,XX,YY


SECTION VIEW A-A
Scale: 1:50
SECTION CUT B-B
Scale: 1:50
DETAIL C
Scale: 1:10
SECTION VIEW B-B
Scale: 1:50
(View Rotate by 180°)
DETAIL G
Scale: 1:25
SECTION VIEW H-H
Scale: 1:25
FRONT VIEW
Scale: 1:50
SECTION CUT D-D
Scale: 1:10
DETAIL E
Scale: 1:10
SECTION VIEW I-I
Scale: 1:50
SECTION VIEW J-J
Scale: 1:20
SECTION CUT F-F
Scale: 1:10
Weld Thickness | 25,50,65,95
Type of weld (Fillet / Butt) | Fillet Weld
Penetration characteristics (Full / partial) | Partial Penetration
Sketch of weld edge as per RCC-MR
Weld edge considered
Vacuum class of weld joint as per IVH (VQC 1A / 1B) | VQC 1B
Weld Joint category as per RCC-MR | Category – 2
Visual examination | Yes
Surface Examination (LPE) | One Side
Joint Efficiency | 0.5
Fulfilling the RCC-MR requirement? (Yes/ No) | Yes
Fulfilling the IVH requirement? (Yes/ No) | Yes
DNB_VESSEL_INTERNAL_WELD
WELD-01-04
02
53,XX,YY


401
402
403-406
407-408
409-411
412-414
418-421
417
DETAIL B
Scale: 1:10
DETAIL C
Scale: 1:10
DETAIL D
Scale: 1:20
DETAIL E
Scale: 1:10
DETAIL H
Scale: 1:10
DETAIL G
Scale: 1:10
B
I
C
D
E
F
G
H
SECTION VIEW A-A
Scale: 1:50
422
DETAIL I
Scale: 1:10
415-416
DETAIL F
Scale: 1:10
A
A
FRONT VIEW
Scale: 1:50
425-426
423-424
SECTION VIEW J-J
Scale: 1:10
Weld Thickness 25
Type of Weld (Fillet / Butt) Butt Weld
Penetration characteristics (Full / partial) Full Penetration
Sketch of weld edge as per RCC-MR
Vacuum class of weld joint as per IVH (VQC 1A / 1B) VQC 1A
Weld Joint category as per RCC-MR Category – 1
Visual examination Yes
Surface Examination (LPE)- Root side Yes
Surface Examination (LPE)- Face side Yes
Volumetric examination RT or UT
Joint Efficiency 1
Fulfilling the RCC-MR requirement? (Yes/ No) Yes
Fulfilling the IVH requirement? (Yes/ No) Yes
DOC ID
PART ID
DES INT
DIV HEAD
CHECKER
RESP. OFF
DESIGNER
DNB_VESSEL_OPENING_WELD
ITER-India
02
02
53 ,XX ,YY
WELD-01-03
NNN
Z


702
703
704
705
701
A
A
706
712
707
711
710
709
708
FRONT VIEW
Scale: 1:50
ISOMETRIC VIEW
Scale: 1:50
713
SECTION VIEW A-A
Scale: 1:20
Weld Thickness 115 mm
Type of Weld (Fillet / Butt) Butt Weld
Penetration characteristics (Full / partial) Full Penetration
Sketch of weld edge as per RCC-MR
Vacuum class of weld joint as per IVH (VQC 1A / 1B) VQC 1A
Weld Joint category as per RCC-MR Category – 1
Visual examination Yes
Surface Examination (LPE)- Root side Yes
Surface Examination (LPE)- Face side Yes
Volumetric examination RT
Joint Efficiency 1
Fulfilling the RCC-MR requirement? (Yes/ No) Yes
Fulfilling the IVH requirement? (Yes/ No) Yes
DOC ID
PART ID
DES INT
DIV HEAD
CHECKER
RESP. OFF
DESIGNER
TOP_LID_WELD_DETAIL
ITER-India
02
02
NN ,XX ,YY
WELD-02-01
NNN
Z



10. Fabrication and Associated Examination

10.1. Preliminary documents and requirements for fabrication and examination

Following clauses from RCC-MR shall be used to define the documentation requirements in procurement specification of DNB Vessel for various requirements:

Description	Relevant clause from RCC-MR		Implementation
Equipment specification	RA 3100	This shall be prepared for reference at the Purchaser's end, which may not be part of CFT document	Requirements are incorporated in the Technical Specification
General Technical Documents • Comprehensive layout and referencing document • Comprehensive part list • Description of Fabrication shop	RA 3200 RA 3210 RA 3220 RA 3230		
Documents relating to procurement of material • Technical part and product manufacture	Section 2 (Materials)		

programme • Part or Product Sub-Purchase		
Documents relating to fabrication processes (other than welding) Fabrication Processes and Instructions for: • Marking • Forming • Shop cleaning, packing, storage, transportation, cleaning during and after installation on the site • Fit-up and tightening of mechanical joints • Heat treatment (if applicable)	 RF 2000 RF 4130 RF 6150 RF 7000 RF 8000	
Welding Documents Welding Data Package Filler material acceptance and welding procedure documents: • Welding Procedure • Filler material acceptance • Welding Procedure Qualification • Welder and welding operator qualification documents • Production welds Welding Report: • Weldability of material • Filler material acceptance • Welding Procedure qualification • Welding and welding operator qualification • Filler material qualification • Qualification data sheet • Qualification certificate • Technical qualification of production workshop • Transfer of welding procedure qualification • Production weld data sheet • Production weld test coupon report	 RS 1120 RS 1121 RS 2120 RS 3130 RS 4130 RS 7120 RS 1200 RS 2550 RS 3150 RS 4200 RS 5140 RS 5142 RS 5143 RS 6300 RS 6500 RS 7470 RS 7870	
Documents relating to examination Examination Procedure and instructions • Ultrasonic Examination	 RMC 2122 RMC 3122	

• Radiographic Examination • Liquid Penetrant Examination • Visual Examination Examination Reports • Ultrasonic Examination • Radiographic Examination • Liquid Penetrant Examination • Visual Examination	RMC 4122 RMC 7122 RMC 2160 RMC 3170 RMC 4200 RMC7150	
Non-conformance report and deviation report	RA 3800	
Technical preparation, follow-up and final report documents	RA 3900	

10.2. Fabrication Operations

Following clauses of Section 5 are to be considered for respective fabrication operation.

Marking	RC 1300, RF 2000	Requirements are incorporated in the Technical Specification
Cutting-reparation without welding	RS 7350, RF 3600	
Forming and alignment	RF 4000	
Surface treatment	RF 5000	
Cleanliness	RF 6000	
Mechanical Joints	RF 7000	
Heat Treatment (If applicable)	RS 1300, RS 7500, RF 4000	

10.3. Welding and Associated Techniques

Following clauses of Section 4 are to be considered for respective operations related to welding.

Storage and use of welding products	RS 7200	Requirements are incorporated in the Technical Specification
Preparation and examination of edges and surfaces for welding	RS 7300 (In addition, UT of welding location for fillet welds type III.1, III.2, III.3 are to be performed if not carried out to 100% at the procurement stage)	
Welding of production welds	RS 7400 (Para dealing with class 2 equipment) and supplementary requirements for RC 4440	
Repair by welding	RS 7600	
Non-destructive examination of production welds	RS 7720	

Production weld test coupon and destructive testing	RS 7860 (Para dealing with class 2 equipment)	