



ESS
bilbao



**EUROPEAN
SPALLATION
SOURCE**

Target Wheel & Monolith Vessel

Consorcio ESS-BILBAO & IFN-UPM & European Spallation Source ERIC

F. Sordo, on behalf of ESS-Bilbao team

March 14, 2018

Table of contents

- 1 Target Wheel
 - Target Wheel: Spallation material and cassettes
 - Target Wheel: Target Vessel
 - Target Wheel: Shaft

- 2 Monolith Vessel
 - Monolith Vessel: Lower and medium vessel
 - Monolith Vessel: Connection Ring

Target Wheel: Spallation material and cassettes

Target wheel: Spallation material

Spallation Material

The Spallation material produced by AT&M was delivered to ESS-Bilbao in October 2018 (2 months delayed produced by border officers). The Quality acceptance process has been completed by CEIT with excellent results.

CEIT quality acceptance test



Target wheel: Spallation material

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CEIT quality acceptance test

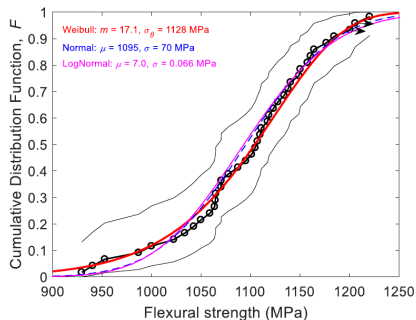


Target wheel: Spallation material

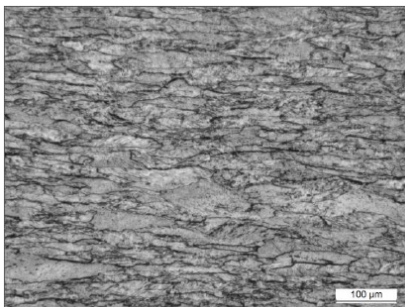
Spallation Material

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CEIT quality acceptance test



Optical micrographs from coupon 218325-7005



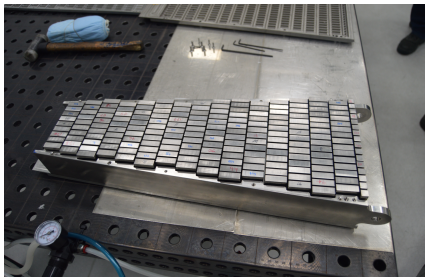
Target wheel: Cassettes

Internal structures

The 37 cassettes manufactured by LEADING S.L. has been deliver and accepted process has been completed. The manufacturing of the hollow bricks is will be completed in the next month.

Leading manufacturing process

Cassette series



Inspection plan completed

LEADING INDUSTRIAL SOLUTIONS

PLAN DE SEGUIMIENTO DE FABRICACIÓN
MANUFACTURING FOLLOW-UP PLAN

PROYECTO: **ESSE**

CLIENTE: **ESS TUBOS**

INDUSTRIA: **ESS TUBOS**

FECHA DE EMISIÓN: **15/03/2018**

FECHA DE REVISIÓN: **15/03/2018**

ELABORADO POR: **ESS TUBOS**

REVISADO POR: **ESS TUBOS**

APROBADO POR: **ESS TUBOS**

ESTADO: **COMPLETADO**

ITEM	ESTADOS FABRICACION / Stage of Manufact		
	01	02	03
01			
02			
03			
04			

REVISOR: **ESS TUBOS**

FECHA: **15/03/2018**

ESTADO: **COMPLETADO**

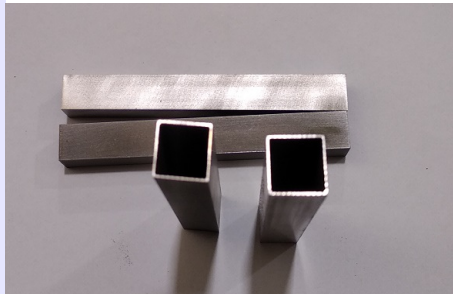
Target wheel: Cassettes

Internal structures

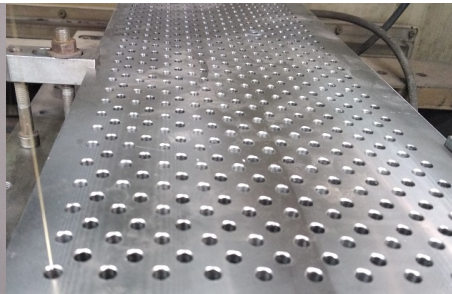
The 37 cassettes manufactured by LEADING S.L. has been deliver and accepted process has been completed. The manufacturing of the hollow bricks is will be completed in the next month.

Leading manufacturing process

Bricks 0.3 mm thickness



Electrocutting for dummy bricks



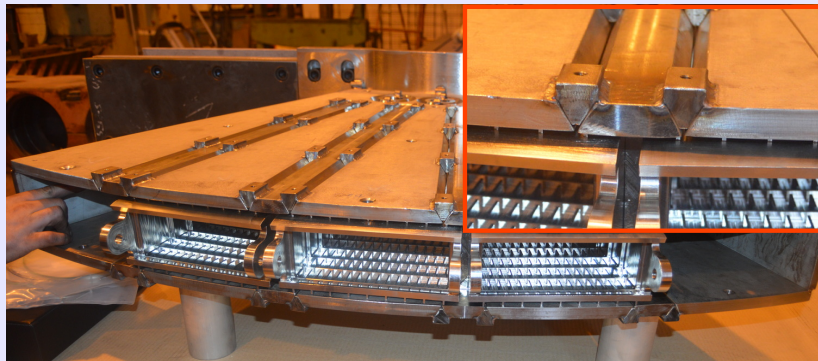
Target Wheel: Target Vessel

Target wheel: Target Vessel

Prototype 2: Cassette insertion

On November 2018, ESS-Bilbao award a Contract to NORTEMECANICA S.L. to manufacture a third target prototype. The model was simplify (only 5 ribs) in order to speed up the production keeping the capacity to check the cassette insertion process

Assembly process

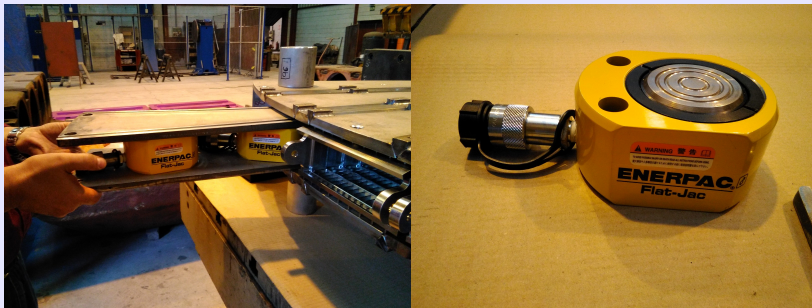


Target wheel: Target Vessel

Prototype 2: Cassette insertion

Jack system was introduced in the cassette position in order to introduce a maximum vertical force in the range of 10 tons to avoid vertical deformation. During the welding process the pressure of the jacks was monitored.

Jack system

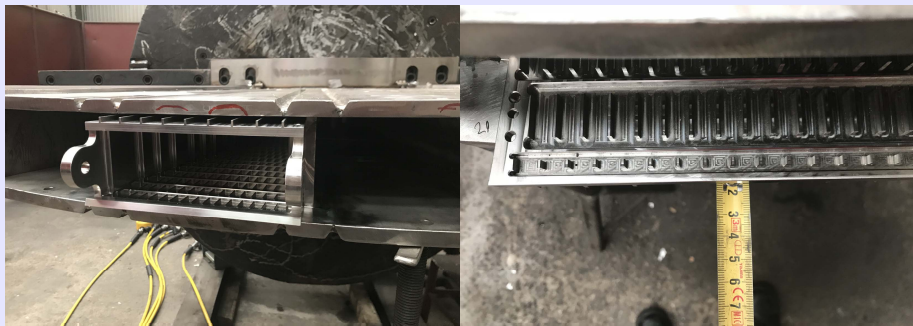


Target wheel: Target Vessel

Prototype 2: Cassette insertion

The final position of the cassette after the polishing of internal surfaces was 30 mm outside. Even with re-machining of the cassettes the insertion is not feasible. **The welding process was reviewed.**

Cassette insertion after polishing the inner surface

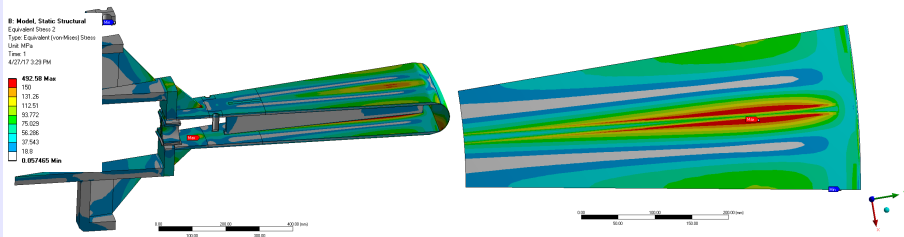


Target wheel: Target Vessel

Prototype 3: Cassette insertion 2

Vessel stress profile shows regions with low stress in which we can reduce the thickness to simplify the welding process. This reduction increase the manufacturing and assembling complexity but probably it will reduce the deformations.

Stress distribution for nominal vessel

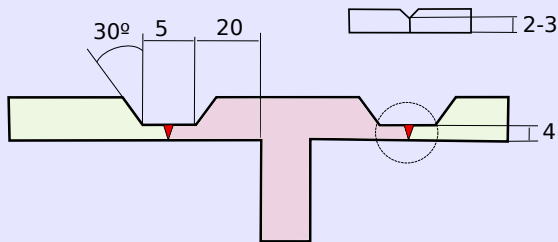


Target wheel: Target Vessel

Prototype 3: Cassette insertion 2

The thickness will be reduced to ~ 4 mm long 5 mm with 30° chamfers. This reduction will decrease the welding volume by a factor of 15 (from 15 passes to 1-2).

Welding proposal



Welding positions for ribs

Target wheel: Target Vessel

Prototype 3: Cassette insertion 2

The welding process takes ~ 1 -2 days compared with the 2-3 weeks process from the previous version of the welding configuration. The welding compression has been reduced by a factor of ~ 20 and the assembling is feasible.

Cassette assembly



Target wheel: Target Vessel

Prototype 3: Cassette insertion 2

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Cassette assembly

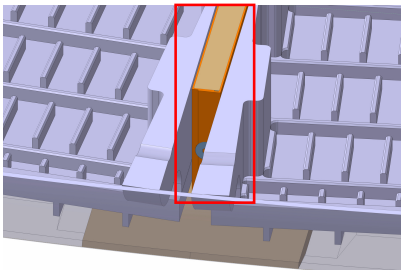


Target wheel: Target Vessel

Prototype 3: Cassette insertion 2

In order to complete the assembly, we proposed to reduce the rib thickness to 8 mm in order to have clearance to the cassette to compensate the compression and fill the gap with calibrated plates (brass or stainless steel). This solution was presented on Mach 12nd on "Target Vessel review panel".

Cassette assembly



Características técnicas del material de 13mm de ancho

Factores de la presión: max. 400% p.u., sin punto 1/20 s. max. 40.000
 El uso de placas para calibrar es opcional en caso de placas que permitan liberar el soporte.
 Proteja el material de la suciedad. Apriete bien las AS. ASK.
 Carga de aplicación: Repetitiva de funcionamiento, que de acuerdo con las especificaciones de fabricación, debe ser aplicable a cualquier preparación de muestra, siempre que se asegure, según el plan de construcción, el tipo de muestra de cada elemento de prueba. C.

Dimensiones	07 7520	07 7530	07 7540	07 7550	07 7560	07 7570	07 7580	07 7590	Dimensiones	07 7520	07 7530	07 7540	07 7550	07 7560	07 7570	07 7580	07 7590
Material	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Material	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable
Min	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	Min	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm
AS1	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	AS1	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS2	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	AS2	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS3	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	AS3	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS4	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	AS4	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS5	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	AS5	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0

Láminas calibradas de ancho 50 mm / 100 mm / 150 mm

Nota: En caso de utilizar láminas, asegúrese de que el material de la placa sea compatible con el material de la muestra. En caso de utilizar láminas de aluminio, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de acero, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de cobre, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de plata, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de oro, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de níquel, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de titanio, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de aluminio, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de acero, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de cobre, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de plata, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de oro, asegúrese de que el ancho sea compatible con el ancho de la muestra. En caso de utilizar láminas de níquel, asegúrese de que el ancho sea compatible con el ancho de la muestra.

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Min	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	Min	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm
AS1	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	AS1	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
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AS5	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0	AS5	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0

Súperes de láminas calibradas 13mm de ancho con soporte manual

Dimensiones	07 7520	07 7530	07 7540	07 7550	07 7560	07 7570	07 7580	07 7590
Material	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable	Acero inoxidable
Min	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm	130x200 mm
AS1	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS2	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS3	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS4	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS5	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS6	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS7	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS8	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS9	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
AS10	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0

Nota: Lámina fabricada en acero con recubrimiento de aluminio de 100µm. Largo: 1000mm, ancho: 13mm. Se suministran en cajas de 10 unidades. Consulte el diagrama de distribución de muestra calibrada, un soporte con clip y un dispositivo de medida.

Target wheel: Target Vessel

Main remarks

- The prototype 3 has been completed with minor incidences and the cassette insertion is feasible with minor operations on the cassette.
- NDE are feasible with a combination of D4 and D7 films.
- If the “calibrated plates proposal” is approved by ESS we are ready to publish the call for tender for vessel manufacturing.

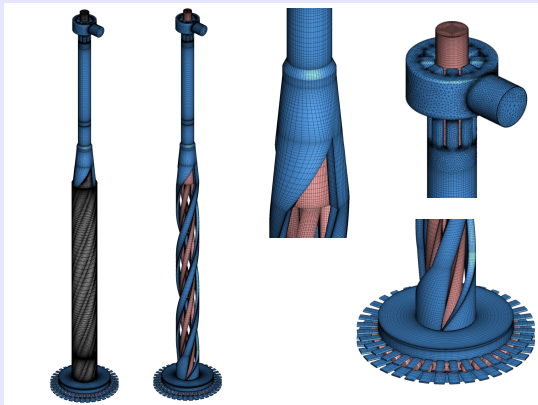
Target Wheel: Shaft

Target wheel: Shaft

CFD model

After several months of work, the complete CFD target model is completed. The convergence issues has been fixed, the mesh quality has been improved and the miss balanced flow solved.

Shaft mesh and CFD analysis for nominal conditions

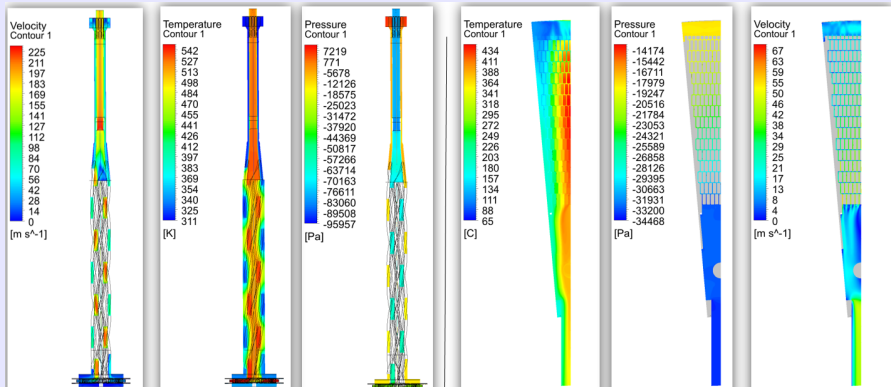


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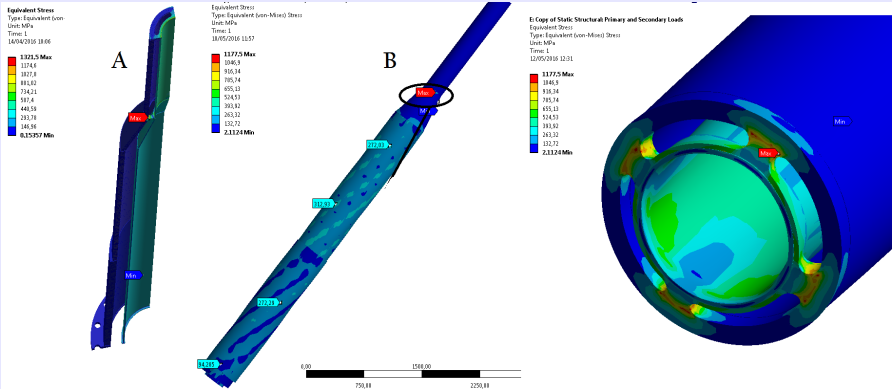


Target wheel: Shaft

Mechanical analysis

Shaft Design report is under ESS review. The analysis is completed and the proposed design withstand all the design loads.

Secondary loads for nominal conditions

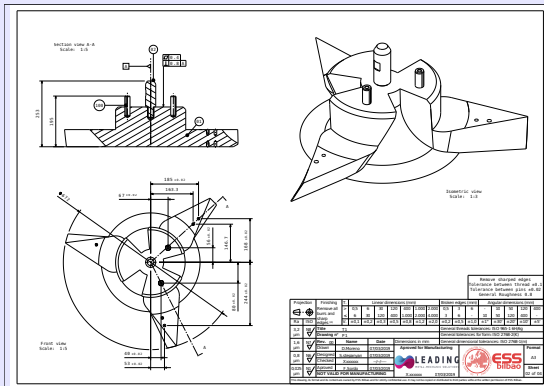


Target wheel: Shaft

Manufacturing

Shaft Call for tender was published on January 25th, 2019 and it will be awarded in the coming weeks. Internal structures was awarded to LEADING and manufacturing process is ready to start.

Internal structures manufacturing drawings.



Target wheel: Shaft

Main remarks

- The design has been completed according to *RCC – MR_x N3R_x*
- Contract has been awarded to Leading for the internal structure production
- Shaft Call for tender is on going. Contract will be awarded in the 1.5 months.

Monolith Vessel: Lower and medium vessel

Monolith Vessel: Lower and medium vessel

All manufacturing contracts in place

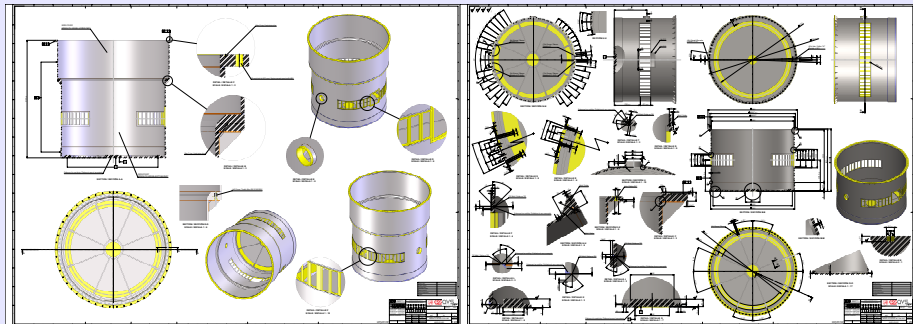
- The contract for manufacturing the monolith vessel has been awarded to AVS+CADINOX. Signature was done in September 2019
- Contract has been awarded to Qualityconsult for manufacturing quality support (Second party acting as ESS-Bilbao QA department)
- Contract has been award to Bureu Veritas for third party insections (Notified body for PED directive)

Monolith Vessel: Lower and medium vessel

Design Status

According to manufacturer requirements the design has been adapted to his manufacturing proposal (split in two sections bolted, ribs in the windows ...). The geometry has been agreed with ESS in collaboration with Port Block designers. The interface for welding the vessel to the ports has been defined.

Manufacturing Drawings



Monolith Vessel: Lower and medium vessel

Design Status

CADINOX has completed the welding book in collaboration with quality consult to ensure the compliance with **RCC – MR_x**. Raw material has been already order from

Welding Book and Raw material order

cadinox	LIBRO DE SOLDADURA WELDING BOOK	Código / Code	WB-5078/18-1
		Fecha / Date	20/02/2019
		Revisión / Review	01

CLIENTE / CUSTOMER AVS
 N° PEDIDO / ORDER -
 REFERENCIA / REFERENCE MONOLITH VESSEL
 PLANO / DRAWING N053.010.001

1		20/02/2019	UPDATED ACCORDING COMMENTS
0		11/02/2019	FIRST ISSUE
Revisión Review	Páginas Pages	Fecha Date	Comentarios Comments

INDICE / INDEX

1. WELDING MAP
2. PROCEDURE QUALIFICATION RECORD (PQR)
3. WELDING PROCEDURE SPECIFICATION (WPS)
4. WELDER PERFORMANCE QUALIFICATION (WPS)

	FÖRFRÅGAN/INQUIRY
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Ref. No./Ref No:	02/19-1714
Datum/Date:	20/02-2019
Författare/Salesman:	T.W. Larsson

DB/DC: Spain Customer: Cadnox

Specif/Specification: EN 10028-7 + customer testing requirements

Ställnings/Grade: 1.4404 Analyser/Analysare: Melt code 230002

Kontroll/Test	Utföres/Performed		Omfattning/Extent	Rem
	Ja/Yes	Nej/No		
Dragprov/Tensile test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1/ mother plate top&Bot at RT	Reduction of Area for information
Värmdragprov/hot tensile test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1/heat 300°C	$R_{p0.2} \geq 118 \text{ MPa}$
Hårdhetsprov/Hardness test	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Ferritkontroll/Ferrite test	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Permeabilitet/Permeability	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Straussprov/Strauss test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1/heat 3651-2	
Huegprov/Huey test	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Stagprov/Impact test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1/mother plate Top&Bot in Longitudinal direction	
Kontrollanalys/Checkanalysis	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1/mother plate	$P \leq 0.2\% (\sigma \leq 0.10\%)$
Ultralutprov/Ultrasonic test	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Administration	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
Kvalitetsplan/Quality plan	<input type="checkbox"/>	<input type="checkbox"/>	Manufacturing plan	
Dye Penetrant test	<input checked="" type="checkbox"/>	<input type="checkbox"/>	By inspection	
Mikrostrukturanalys + photo	<input type="checkbox"/>	<input type="checkbox"/>	1/mother plate	150 643
	<input type="checkbox"/>	<input type="checkbox"/>		

Produkt/Product	Godkännes/Approved		Anm./Notes
	Ja/Yes	Nej/No	
Format/Dimension	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Follow dimprogram
Styckevid/Waigt	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Follow dimprogram
Yttra/Surface condition	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Re gristing to max 5.5 µ

Monolith Vessel: Lower and medium vessel

Main remarks

- Schedule for delivery in November-Delivery 2019 still feasible.
- Raw material has been already order
- Interfaces has been complete identified and agreed with Neutron Ports.

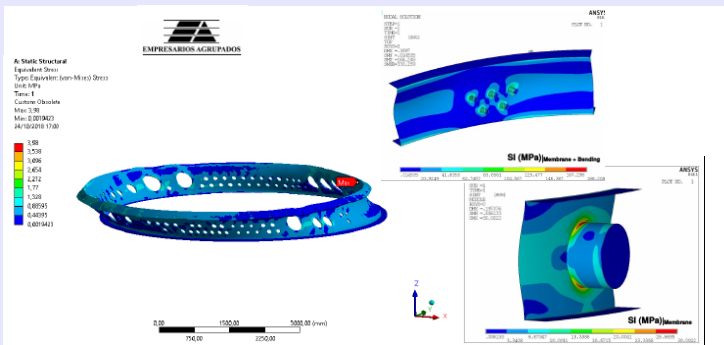
Monolith Vessel: Connection Ring

Monolith Vessel: Connection Ring

Design Status

On Summer 2018, ESS-Bilbao Target Division lose two designers. In order to keep the schedule a design contract was awarded to Empresarios Agrupados S.A. (EA) The mechanical verification of the component was completed in November 2018. The CDR held on December 11st, 2019.

EA mechanical analysis

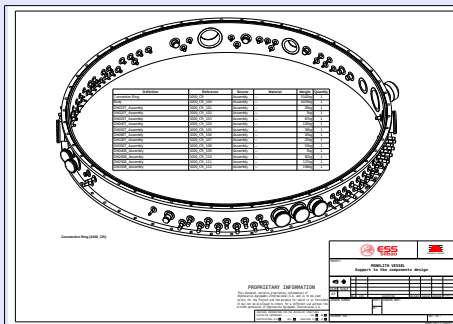


Monolith Vessel: Connection Ring

Design Status

On Summer 2018, ESS-Bilbao Target Division lose two designers. In order to keep the schedule a design contract was awarded to Empresarios Agrupados S.A. (EA) The mechanical verification of the component was completed in November 2018. The CDR held on December 11st, 2019.

EA mechanical analysis



Monolith Vessel: Connection Ring

Main remarks

- CDR has been completed.
- Call for tender is on preparation