Proton Beam Window & Tunning beam dump

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

F. Sordo, on behalf of ESS-Bilbao team

March 14, 2018

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Proton Beam window

Proton beam window

PBW in ESS Project

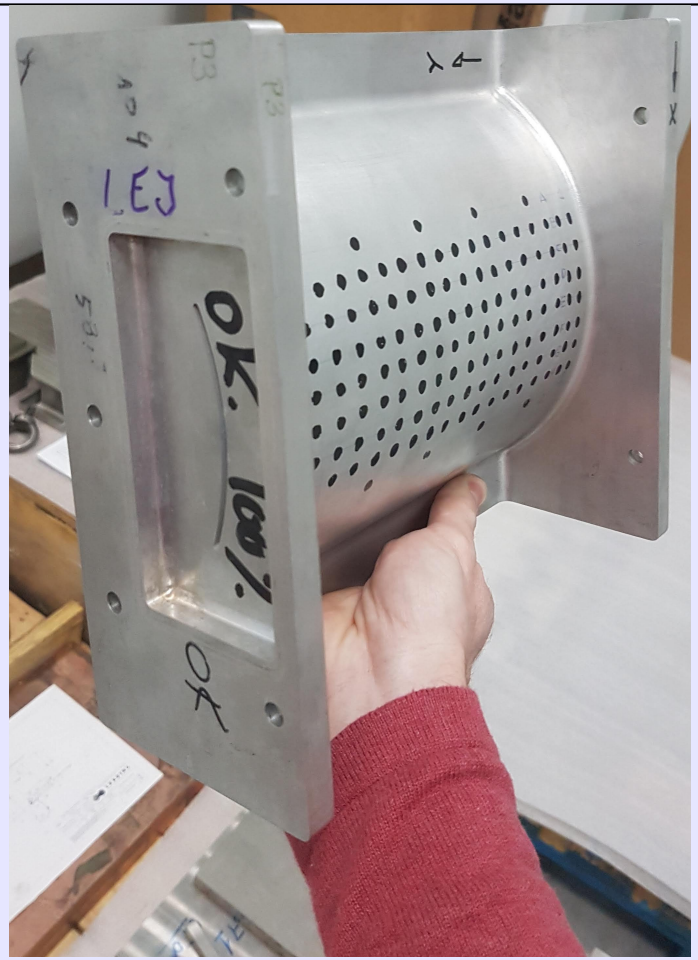
UHV is needed inside the **accelerator tube** to avoid any interaction of gases with proton beam. The **proton beam will enter** this atmosphere through the **PBW**, which **main function** is to **separate both regions** while causing the **minimum interferences to protons'** courses.
The proposed PBW introduces less than **2.5mm of Aluminum** in the **proton path**.
Current proposal is capable to evacuate around 7 kW of proton beam power by means of a full design device, composed of **2 thin plates separated by a water cooled cooling channel**.

PBW Prototyping activities

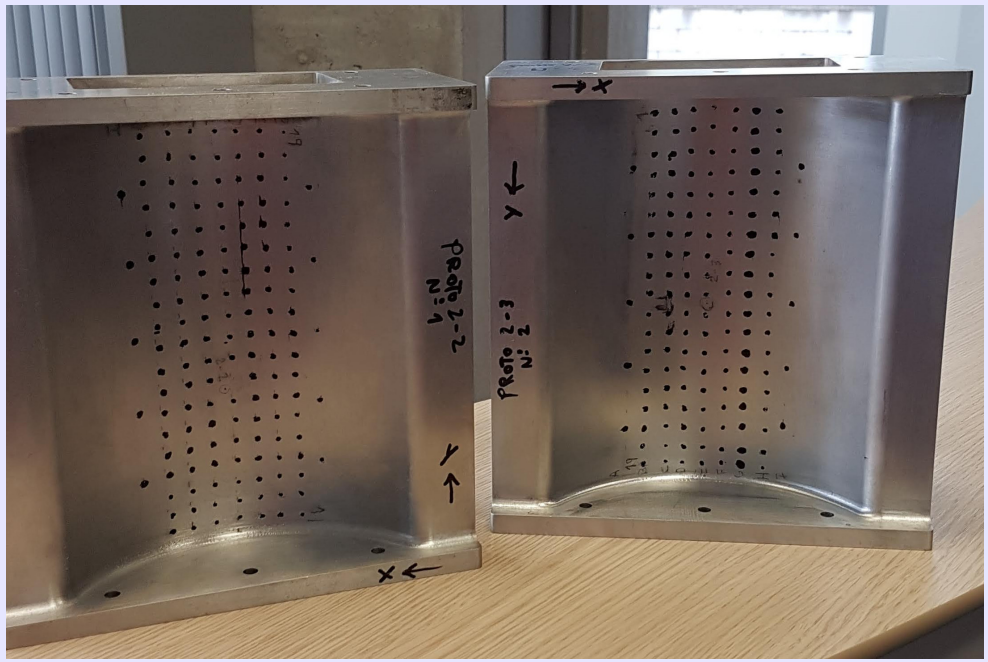
- Problems encountered in manufacturing phase lead to perform multiple tests at every manufacturing stage.
- Manufacturing process includes milling, EDM and WEDM.
- Ultrasonic inspections combined with precise measuring after each manufacturing process revealed small holes after EDM.
- Uncontrolled sparks during EDM where identified as the origin of the small holes in thin walls. This phenomenon is very common, but not usually revealed due to the bigger thickness of the walls. When going down to 1 mm thickness, sparks cross the full wall.
- 4 prototypes already manufactured. 1 of them without holes.

Proton beam window

Manufactured prototypes



1 prototype passed the hydrostatic test.



2 prototypes failed.

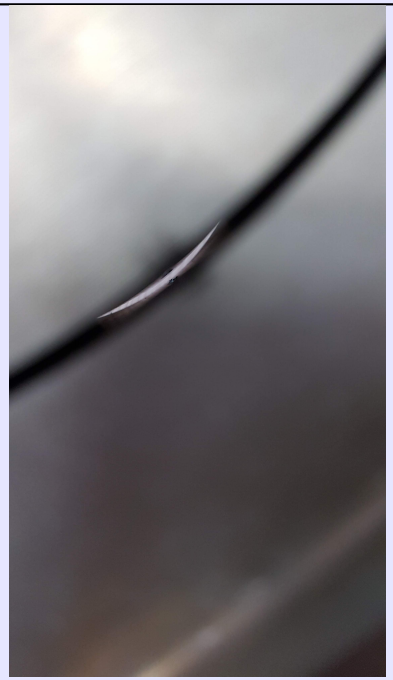
Proton beam window

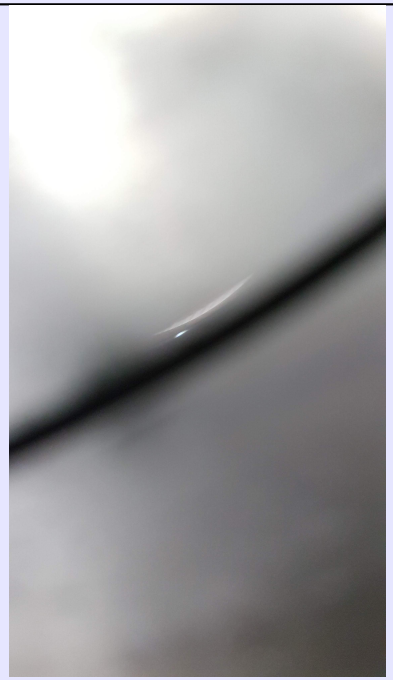
PBW Prototyping

- Small holes (0.2-0.4 mm diameter) in the walls of the cooling channel appeared.
- With results from ultrasonic, measuring and hydrostatic tests, the problem was identified: the electrode from EDM produces undesired sparks due to low thickness of the wall. They can cross the full thickness of the component, producing through holes.

Small holes founded

Surface marked to scan for UT.





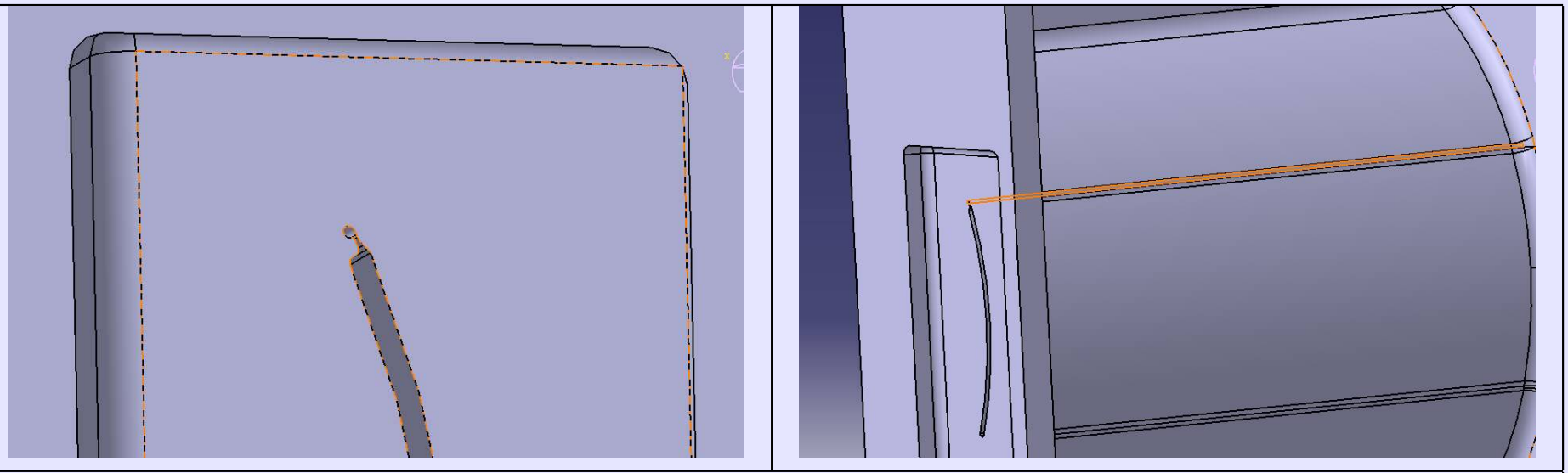
Holes can be appreciated by visual inspection.

Proton beam window

PBW Exploring solutions

- Solution based on drilling the cooling channel from both sides, then threading the wire and perform the WEDM. The results are not good due to hard concentricity tolerances.
- Solution based on opening the starting hole in a safe region, not relevant for the functioning of the PBW. As the WEDM is under control, the hole by EDM can be open far from the main channel, and then wire cut to the desired geometry.

Move the starting hole



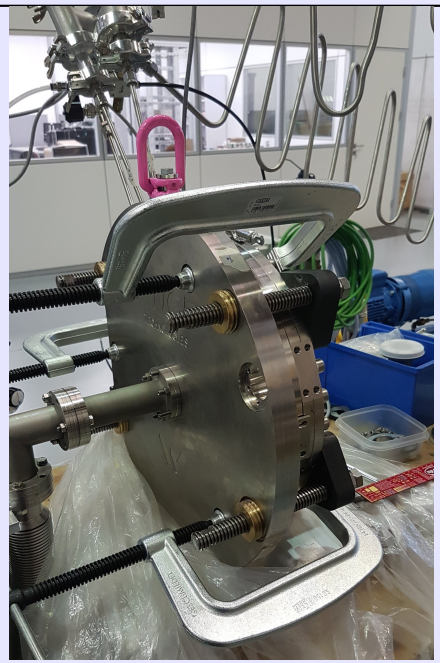
Moving the starting hole to a safe region.

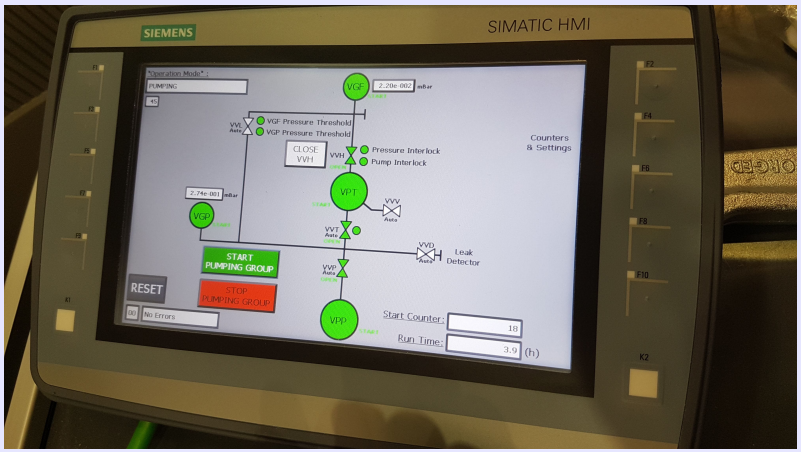
Proton beam window

PBW Seal state

- First prototype, caused by uncontrolled expansion of the bellows during inflation (design failure).
- New prototype was delivered by Dec-19. Sealing capability $\sim 10^{-4}\,\frac{mbar-l}{s}$ (Requirement $10^{-5}\,\frac{mbar-l}{s}$) due to a problem during seal pellows manufacturing.

Move the starting hole





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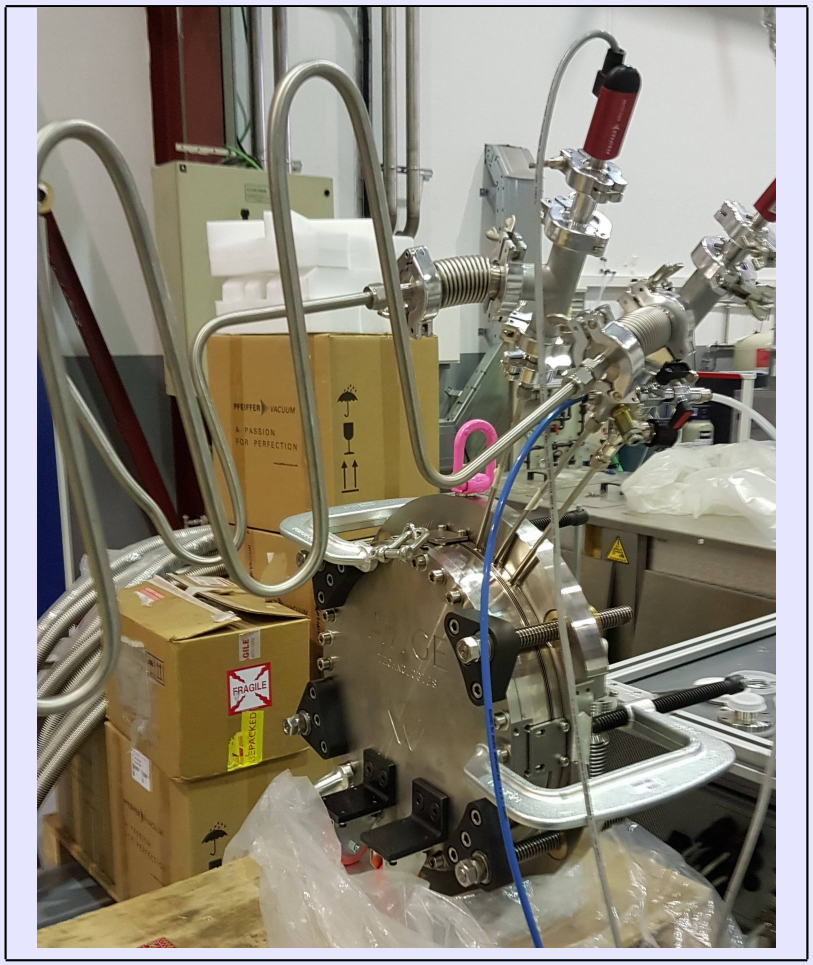
Proton beam window

PBW Seal Mock-up



Proton beam window

Main remarks

- Proton beam manufacturing test shows incidences during the EDM drilling process. Minor modifications in the manufacturing path are needed to complete clarify the production process.
- Regarding the seal, the critical equipment (seal pillows) shows manufacturing errors during testing process. The supplier will delivery a new seal by the end of the month.

Proton beam window port block and vessel

PBW-PB&Vessel Design state

PBW in ESS Project

The PBW-Port Block&Vessel hold the PBW system. It have to active cooled due to the heat load produces by particles deflected in the window.

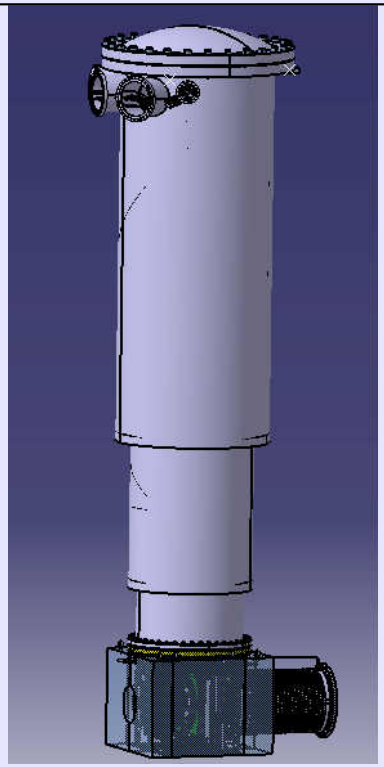
The Connecting pipe is the component that connects the PB to the MV. It has to be active cooled due to power deposition, and contains a bellow inside to ease installation and decouple the movement, thermal expansion and contractions, and vibrations of the PB from the MV.

PBW-PB

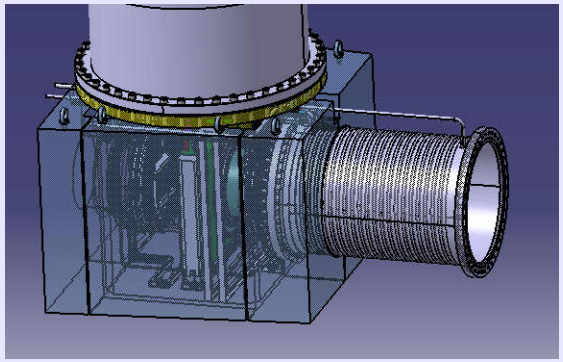
- Design Review already passed by Q3-18.
- CDR planned by Q2-19.
- OCT for manufacturing already published. Final design modifications will be implemented with manufacturer.
- Modification by ESS of RCC-MRx application scope have changed the design.
- Cooling system of connecting pipe between the PB and the Monolith vessel already prototyped and tested.

PBW-PB&Vessel Design state

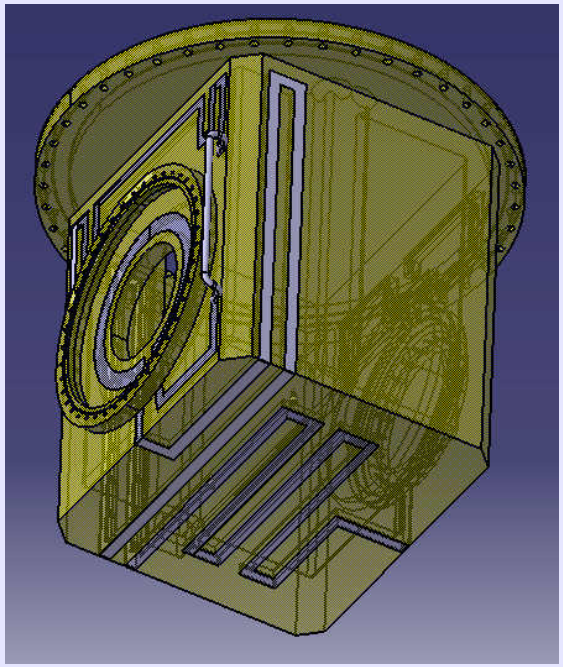
PBW-PB&Vessel Design



PBW-PB&Vessel



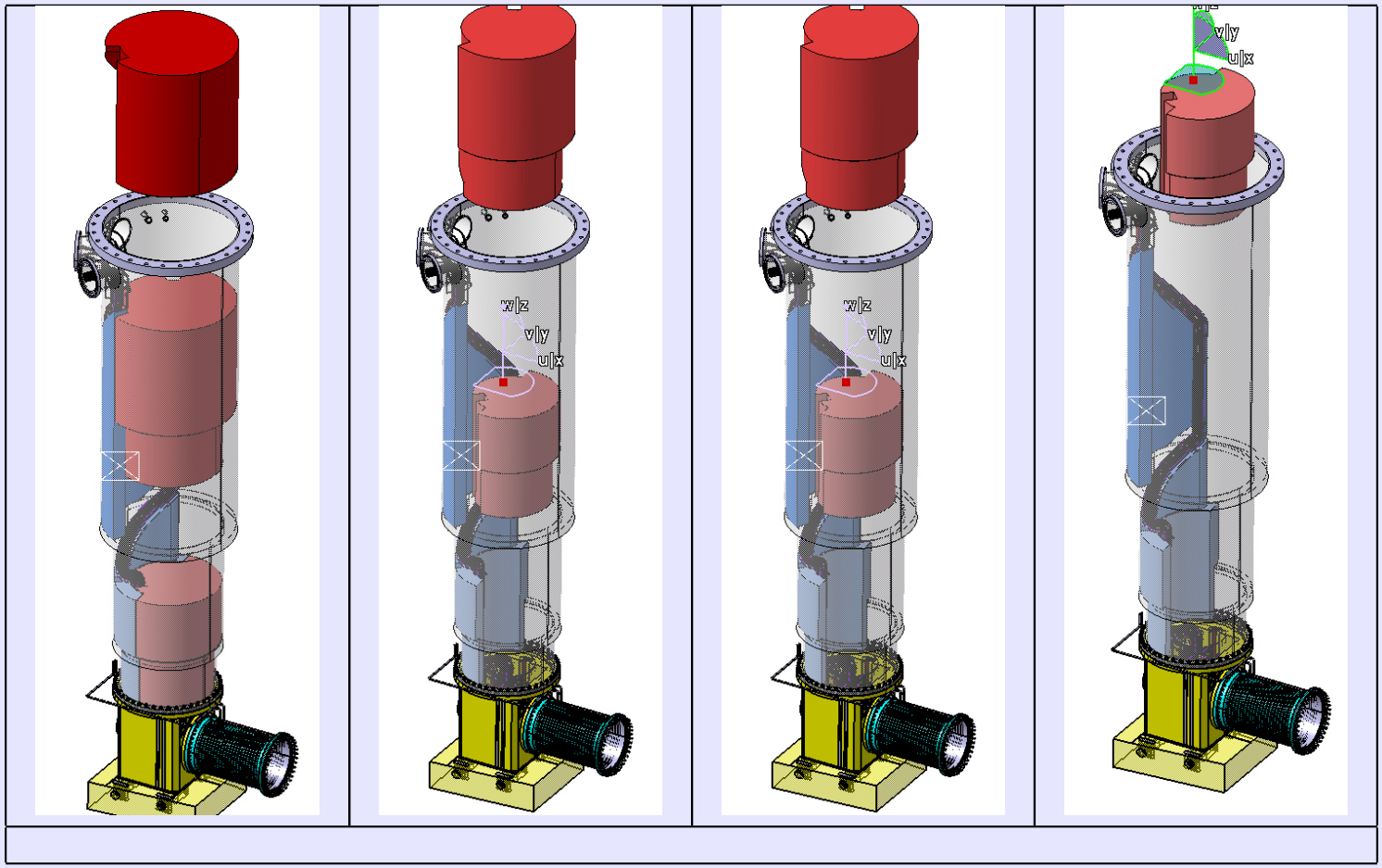
PB Shielding and connecting Pipe



PB Cooling system

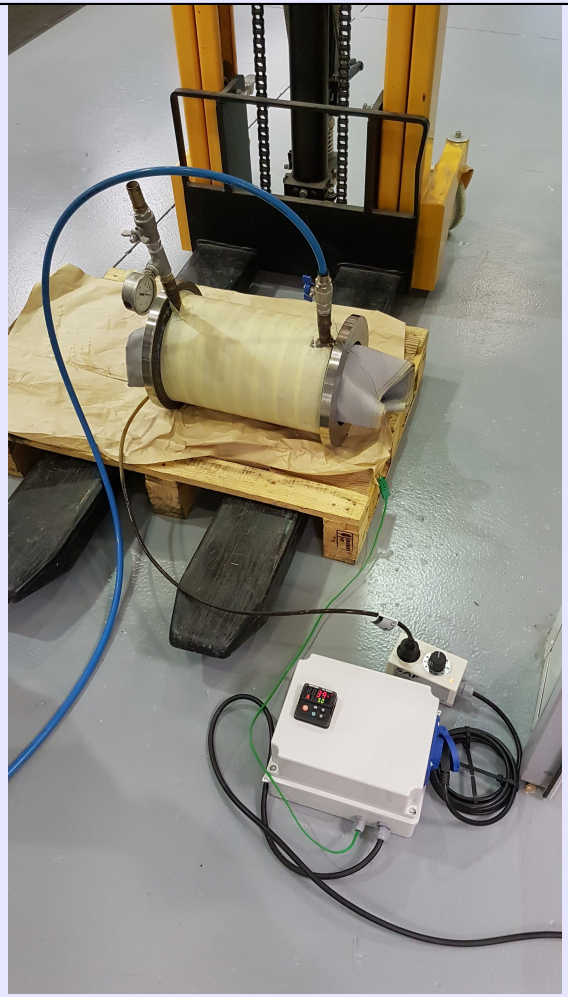
PBW-PB&Vessel Design state

Insertion and extraction sequence of the PBW



PBW-PB&Vessel Design state

PBW-PB&Vessel Prototyping



PBW-PB connecting pipe hydrostatic and cooling test.

PBW-PB&Vessel Design state

Main remarks

- Mechanical verification has been subcontracted to Empresarios Agrupados
- Call for tender for manufacturing was published on February 25^{th}

Tunning Beam Dump

Tunning Beam Dump

Design Status

The complete component (TBD system, T-Copper Block and Carbon Steel shielding is already con manufacturing-

- Design is completed (CDR for all the subsystems)
- Contract for T-Copper block manufacturing was awarded to Nortemecanica S.L. in October 2018.
- Contract for Steel shielding manufacturing was awarded to Nortemecanica S.L. in October 2018.
- Contract for TBD system was awarded to Thuneureka S.L. in November 2018.

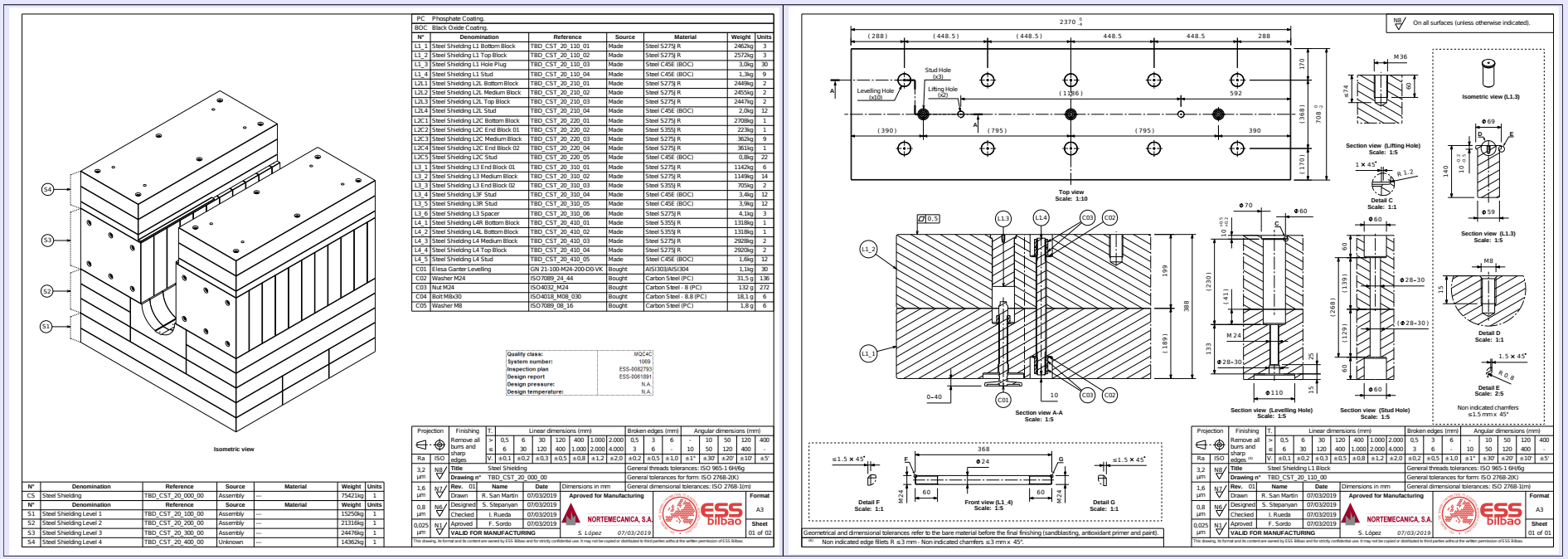
Tunning Beam Dump: Shielding

Tunning Beam Dump: Shielding

Design Status

The carbon steel shielding design is already closed. Manufacturing drawings have been completed in close collaboration between ESS-Bilbao and Nortemecanica.

TBD Cabon Steel shielding manufacturing drawings

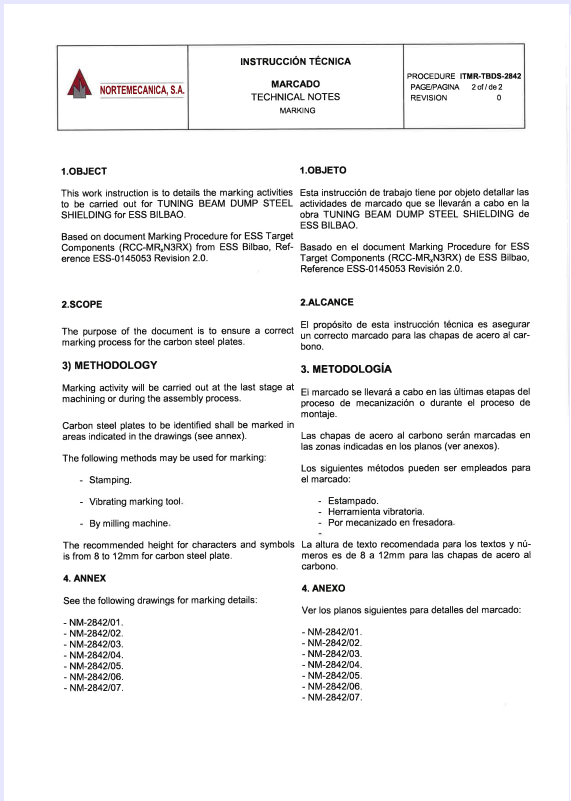


Tunning Beam Dump: Shielding

Quality control

The manufacturing procedures have been completed by ESS-Bilbao and approved by ESS. The manufacturer will produce Technical notes based on the procedures in order to simplify the "interface".

TBD Cabon Steel shielding manufacturing procedures



NORTEMECANICA, S.A.

INSTRUCCIÓN TÉCNICA

MARCADO
TECHNICAL NOTES
MARKING

PROCEDURE ITMR-TBDS-2842
PAGE/PAGINA 2 of / de 2
REVISION 0

1.OBJECT

This work instruction is to details the marking activities to be carried out for TUNING BEAM DUMP STEEL SHIELDING for ESS BILBAO.

Based on document Marking Procedure for ESS Target Components (RCC-MR$_x$N3RX) from ESS Bilbao, Reference ESS-0145053 Revision 2.0.

2.SCOPE

The purpose of the document is to ensure a correct marking process for the carbon steel plates.

3) METHODOLOGY

Marking activity will be carried out at the last stage at machining or during the assembly process.

Carbon steel plates to be identified shall be marked in areas indicated in the drawings (see annex).

The following methods may be used for marking:

- Stamping.
- Vibrating marking tool.
- By milling machine.

The recommended height for characters and symbols is from 8 to 12mm for carbon steel plate.

4. ANNEX

See the following drawings for marking details:

- NM-2842/01.
- NM-2842/02.
- NM-2842/03.
- NM-2842/04.
- NM-2842/05.
- NM-2842/06.
- NM-2842/07.

1.OBJETO

Esta instrucción de trabajo tiene por objeto detallar las actividades de marcado que se llevarán a cabo en la obra TUNING BEAM DUMP STEEL SHIELDING de ESS BILBAO.

Basado en el document Marking Procedure for ESS Target Components (RCC-MR$_x$N3RX) de ESS Bilbao, Reference ESS-0145053 Revisión 2.0.

2.ALCANCE

El propósito de esta instrucción técnica es asegurar un correcto marcado para las chapas de acero al carbono.

3. METODOLOGÍA

El marcado se llevará a cabo en las últimas etapas del proceso de mecanización o durante el proceso de montaje.

Las chapas de acero al carbono serán marcadas en las zonas indicadas en los planos (ver anexos).

Los siguientes métodos pueden ser empleados para el marcado:

- Estampado.
- Herramienta vibratoria.
- Por mecanizado en fresadora.
-

La altura de texto recomendada para los textos y números es de 8 a 12mm para las chapas de acero al carbono.

4. ANEXO

Ver los planos siguientes para detalles del marcado:

- NM-2842/01.
- NM-2842/02.
- NM-2842/03.
- NM-2842/04.
- NM-2842/05.
- NM-2842/06.
- NM-2842/07.

Product Identification & Traceability Procedure for ESS Target Components (RCC-MR$_x$ N3Rx)

Reference	ESS-0405515
Fecha	27/08/18
Revisión	1.0

Author	Review	Approved
Carlos CORTÉS		Fernando SORDO
QA Consult, acting as ESS BILBAO QA Department		Head of Target Division Consorcio ESS BILBAO

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Tunning Beam Dump: Shielding

Raw material

The raw material ($\sim$ 70 tones of S355 and S275 has been received (3.1 certificated). We have completed marking and identification and machining is on going.

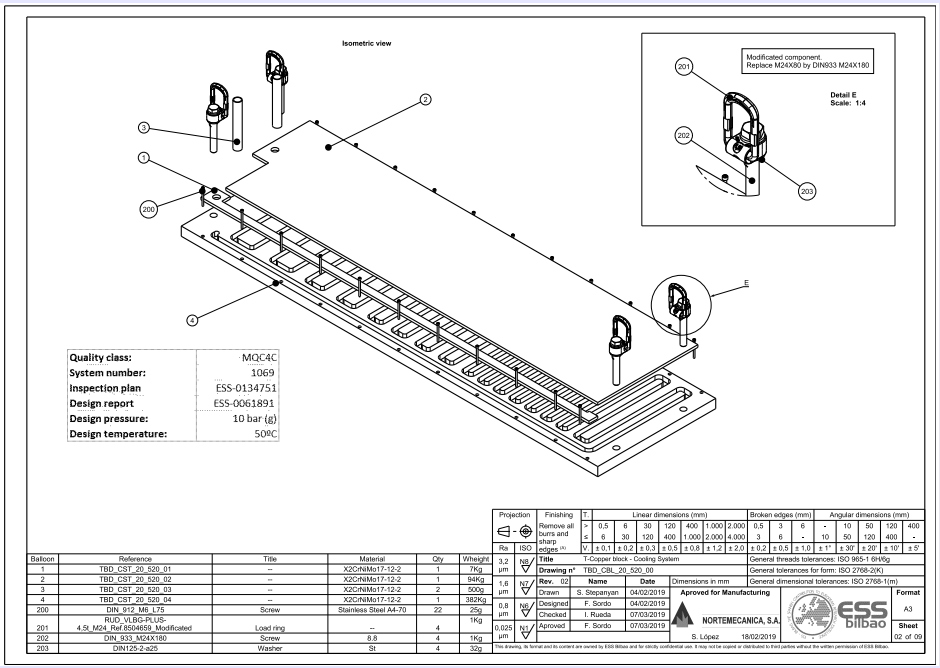
TBD Cabon Steel shielding manufacturing procedures

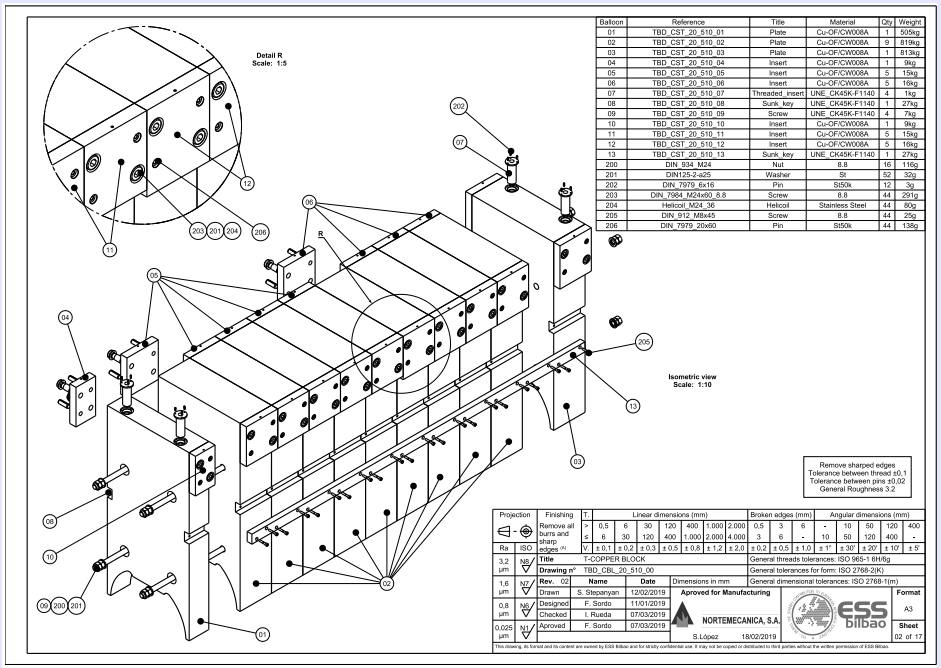
Tunning Beam Dump: T-Copper block

Design Status

Design has been updated according to manufacturer specifications to adapt the design to the production process. Manufacturing drawings has been completed.

T Copper block manufacturing drawings



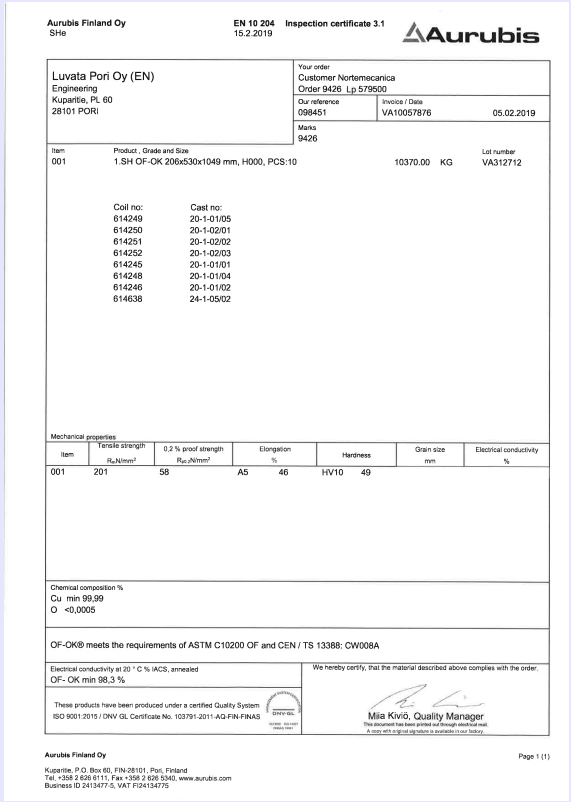


Tunning Beam Dump: T-Copper block

Raw material

The raw material ($\sim$ 7 tones of CW0008A, 3.1 certificated) and stainless steel plates (S316L) has been already ordered. The material will arrived in the coming weeks.

TBD Cabon Steel shielding manufacturing procedures



Aurubis Finland Oy
SHe

EN 10 204 Inspection certificate 3.1
15.2.2019

Aurubis

Luvata Pori Oy (EN)
Engineering
Kupariite, PL 60
28101 PORI

Your order
Customer Nortemecanica
Order 9426 Lp 579500

Our reference: 098451
Invoice / Date: VA10057876 05.02.2019
Marks: 9426

Item	Product , Grade and Size		Lot number
001	1.SH OF-OK 206x530x1049 mm, H000, PCS:10	10370.00 KG	VA312712

Coil no:	Cast no:
614249	20-1-01/05
614250	20-1-02/01
614251	20-1-02/02
614252	20-1-02/03
614245	20-1-01/01
614248	20-1-01/04
614246	20-1-01/02
614638	24-1-05/02

Mechanical properties

Item	Tensile strength R_m N/mm²	0.2 % proof strength $R_{p0.2}$ N/mm²	Elongation %		Hardness		Grain size mm	Electrical conductivity %
001	201	58	A5	46	HV10	49		

Chemical composition %
Cu min 99,99
O <0,0005

OF-OK® meets the requirements of ASTM C10200 OF and CEN / TS 13388: CW008A

Electrical conductivity at 20 ° C % IACS, annealed
OF- OK min 98,3 %

We hereby certify, that the material described above complies with the order.

These products have been produced under a certified Quality System
ISO 9001:2015 / DNV GL Certificate No. 103791-2011-AQ-FIN-FINAS

Miia Kivio, Quality Manager
This document has been printed out through electrical mail.
A copy with original signature is available in our factory.

Aurubis Finland Oy

Page 1 (1)

Kupariite, P.O. Box 60, FIN-28101, Pori, Finland
Tel. +358 2 626 6111, Fax +358 2 626 5340, www.aurubis.com
Business ID 2413477-5, VAT FI02413477S

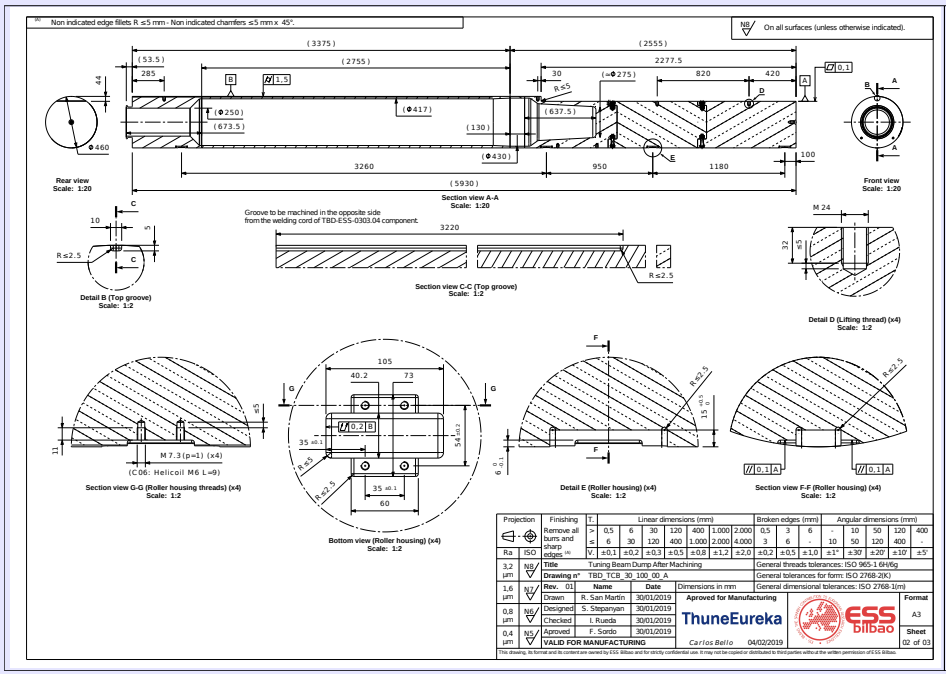
Tunning Beam Dump: System

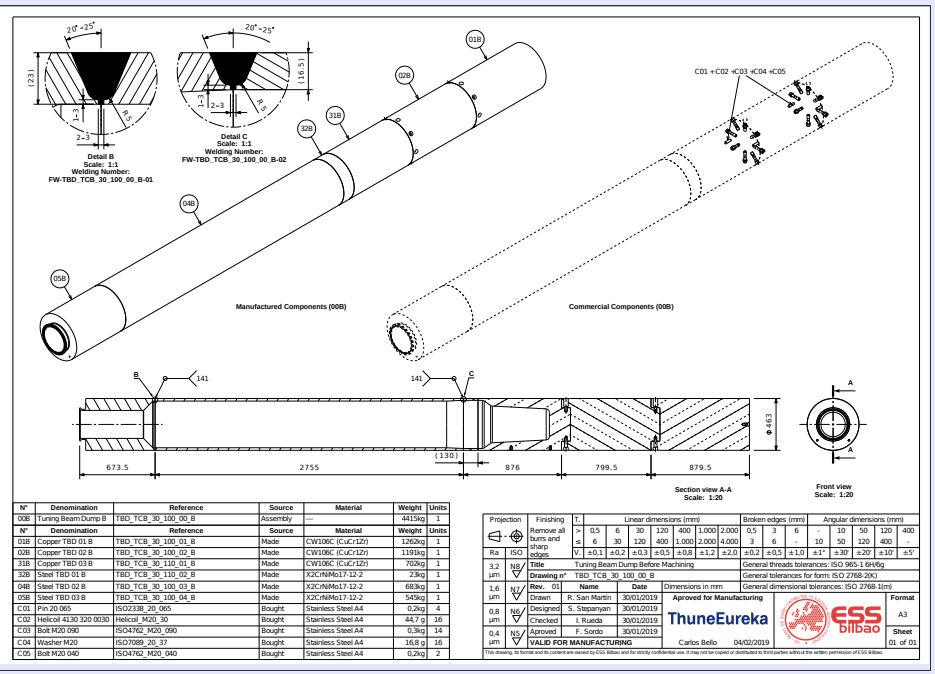
Tunning Beam Dump: System

Design Status

Design has been updated according to manufacturer specifications to adapt the design to the production process. Manufacturing drawings have been completed.

T Copper block manufacturing drawings





N°	Denomination	Reference	Source	Material	Weight	Units
00B	Tuning Beam Dump B	TBD_TCB_30_100_00_B	Assembly	---	4415kg	1
N°	Denomination	Reference	Source	Material	Weight	Units
01B	Copper TBD 01 B	TBD_TCB_30_100_01_B	Made	CW106C (CuCr1Zr)	1260kg	1
02B	Copper TBD 02 B	TBD_TCB_30_100_02_B	Made	CW106C (CuCr1Zr)	1191kg	1
31B	Copper TBD 03 B	TBD_TCB_30_110_01_B	Made	CW106C (CuCr1Zr)	702kg	1
32B	Steel TBD 01 B	TBD_TCB_30_110_02_B	Made	X2CrNiMo17-12-2	23kg	1
04B	Steel TBD 02 B	TBD_TCB_30_100_03_B	Made	X2CrNiMo17-12-2	683kg	1
05B	Steel TBD 03 B	TBD_TCB_30_100_04_B	Made	X2CrNiMo17-12-2	545kg	1
C01	Pin 20 065	ISO2338_20_065	Bought	Stainless Steel A4	0,2kg	4
C02	Helicoil 4130 320 0030	Helicoil_M20_30	Bought	Stainless Steel A4	44,7 g	16
C03	Bolt M20 090	ISO4762_M20_090	Bought	Stainless Steel A4	0,3kg	14
C04	Washer M20	ISO7089_20_37	Bought	Stainless Steel A4	16,8 g	16
C05	Bolt M20 040	ISO4762_M20_040	Bought	Stainless Steel A4	0,2kg	2

Tunning Beam Dump: System

Quality control

The manufacturing procedures have been completed by ESS-Bilbao and approved by ESS. WPS for TIG welding already certified by Notified body.

TBD Cabon Steel shielding manufacturing procedures

E C A

CUALIFICACION DE PROCEDIMIENTO DE SOLDEO
WELDING PROCEDURE QUALIFICATION RECORD (WPQR)

N° ESS-0145103-WPQR001

Fabricante / *Manufacturer* : **ESS Bilbao**

Lugar del soldeo / *Place of welding* : **Polígono Ugaldeguren III, Polígono A - 7B 48170 Zamudio (Bizkaia – España)**

Fecha del soldeo / *Date of welding* : **October 19th, 2018**

WPS preliminar / *pWPS No* : **ESS-0145103-WPQR001 Rev.00**

Norma de referencia / *Reference standard* : **EN 15614-1: 2017**

Requisitos adicionales (si aplica) / *Supplemented by* : **RCC-MRx :2012 Edition with 2013 Addendum**

Ensayo realizado en presencia de / *Test performed in the presence of* : **Conrado Pérez** N° de sello / *Stamp No*: **238**

BUREAU VERITAS

Certifica que los cupones de prueba para la cualificación han sido preparados, soldados y controlados de de forma satisfactoria, conforme a la exigencias de los documentos aquí referenciados.
Certifies that test pieces were prepared, welded and tested satisfactorily in accordance with the requirements of the documents indicated above.

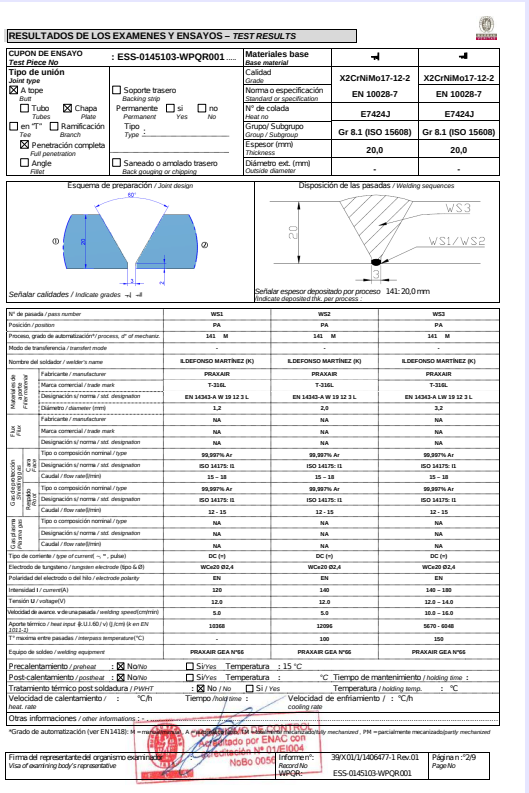
Fecha de emisión de este informe / *Record issued on* : **March 12th, 2019 (Rev.01)**

ORGANISMO EXAMINADOR / *Examining body*	FABRICANTE / *Manufacturer*
Inspector / *Surveyor* : Conrado Pérez	Representado por / *Represented by* :
Firma : / *Visa*	Firma : / *Visa*
Sello del Organismo / *Stamp of the examining body*	Sello del fabricante (opcional) / *Stamp of the manufacturer (optional)*

Otra identificación (si la hay) / *Other identification (as necesary)* :

ORGANISMO DE CONTROL Acreditado por ENAC con Acreditación Nº 01/EI004 NoBo 0056

Firma del representante del organismo examinador / *Visa of examining body's representative* | Informe N°: / *Record No* 39/X.01/1/1406477-1 Rev.01 | WPQR: ESS-0145103-WPQR001 | Página n.°1/9 / *Page No*



RESULTADOS DE LOS EXAMENES Y ENSAYOS – *TEST RESULTS*

CUPON DE ENSAYO / *Test Piece No* : ESS-0145103-WPQR001	Materiales base / *Base material*		
Tipo de unión / *Joint type*	Calidad / *Grade*	X2CrNiMo17-12-2	X2CrNiMo17-12-2
☒ A tope / *Butt*	Norma o especificación / *Standard or specification*	EN 10028-7	EN 10028-7
☐ Tubo / *Tubes* ☒ Chapa / *Plate*	N° de colada / *Heat no*	E724J	E724J
☐ en "T" / *Tee* ☐ Ramificación / *Branch*	Grupo/ Subgrupo / *Group / Subgroup*	Gr 8.1 (ISO 15608)	Gr 8.1 (ISO 15608)
☒ Penetración completa / *Full penetration*	Espesor (mm) / *Thickness*	20,0	20,0
☐ Angle / *Fillet*	Diámetro ext. (mm) / *Outside diameter*	-	-

Soporte trasero / *Backing strip* — Permanente ☐ si ☐ no / *Permanent Yes No* — Tipo / *Type* :

☐ Saneado o arnolado trasero / *Back gouging or chipping*

Esquema de preparación / *Joint design*

Señalar calidades / *Indicate grades* : ◢ ◢

Disposición de las pasadas / *Welding sequences*

Señalar espesor depositado por proceso / *Indicate deposited thk. per process* : 141: 20,0 mm

N° de pasada / *pass number*		WS1	WS2	WS3
Posición / *position*		PA	PA	PA
Proceso, grado de automatización*/ *process, d° of mechaniz.*		141 M	141 M	141 M
Modo de transferencia / *transfert mode*		-	-	-
Nombre del soldador / *welder's name*		ILDEFONSO MARTÍNEZ (K)	ILDEFONSO MARTÍNEZ (K)	ILDEFONSO MARTÍNEZ (K)
Materiales de aportación / *Filler material*	Fabricante / *manufacturer*	PRAXAIR	PRAXAIR	PRAXAIR
	Marca comercial / *trade mark*	T-316L	T-316L	T-316L
	Designación s/ norma / *std. designation*	EN 14343-A W 19 12 3 L	EN 14343-A W 19 12 3 L	EN 14343-A LW 19 12 3 L
	Diámetro / *diameter* (mm)	1,2	2,0	3,2
Flux / *Flux*	Fabricante / *manufacturer*	NA	NA	NA
	Marca comercial / *trade mark*	NA	NA	NA
	Designación s/ norma / *std. designation*	NA	NA	NA
Características del gas / *Gas characteristics*	Tipo o composición nominal / *type*	99,997% Ar	99,997% Ar	99,997% Ar
	Designación s/ norma / *std. designation*	ISO 14175: I1	ISO 14175: I1	ISO 14175: I1
	Caudal / *flow rate*(l/min)	15 – 18	15 – 18	15 – 18
Respaldo / *Backing gas*	Tipo o composición nominal / *type*	99,997% Ar	99,997% Ar	99,997% Ar
	Designación s/ norma / *std. designation*	ISO 14175: I1	ISO 14175: I1	ISO 14175: I1
	Caudal / *flow rate*(l/min)	12 - 15	12 - 15	12 - 15
Características del plasma / *Plasma characteristics*	Tipo o composición nominal / *type*	NA	NA	NA
	Designación s/ norma / *std. designation*	NA	NA	NA
	Caudal / *flow rate*(l/min)	NA	NA	NA
Tipo de corriente / *type of current* (⎓, ⎓ , pulse)		DC (+)	DC (+)	DC (+)
Electrodo de tungsteno / *tungsten electrode* (tipo & Ø)		WCe20 Ø2,4	WCe20 Ø2,4	WCe20 Ø2,4
Polaridad del electrodo o del hilo / *electrode polarity*		EN	EN	EN
Intensidad I / *current*(A)		120	140	140 – 180
Tensión U / *voltage*(V)		12.0	12.0	12.0 – 14.0
Velocidad de avance, v de una pasada / *welding speed*(cm/min)		5.0	5.0	10.0 – 16.0
Aporte térmico / *heat input* (k.U.I.60 / v) ((J/cm) (à en EN 1011-1))		10368	12096	5670 - 8048
T° máxima entre pasadas / *interpass temperature*(°C)		-	100	150
Equipo de soldeo / *welding equipment*		PRAXAIR GEA N°66	PRAXAIR GEA N°66	PRAXAIR GEA N°66

Precalentamiento / *preheat* : ☒ No/*No* ☐ Si/*Yes* Temperatura : 15 °C

Post-calentamiento / *postheat* : ☒ No/*No* ☐ Si/*Yes* Temperatura : °C Tiempo de mantenimiento / *holding time* :

Tratamiento térmico post soldadura / *PWHT* : ☒ No / *No* ☐ Si / *Yes* Temperatura / *holding temp.* : °C

Velocidad de calentamiento / *heat. rate* : °C/h Tiempo /*holding time* : Velocidad de enfriamiento / *cooling rate* : °C/h

Otras informaciones / *other informations* : .....

*Grado de automatización (ver EN1418): M =manualizado, A =mecanizado, P =parcialmente mecanizado/partly mechanized , PM =parcialmente mecanizado/partly mechanized

ORGANISMO DE CONTROL Acreditado por ENAC con Acreditación Nº 01/EI004 NoBo 0056

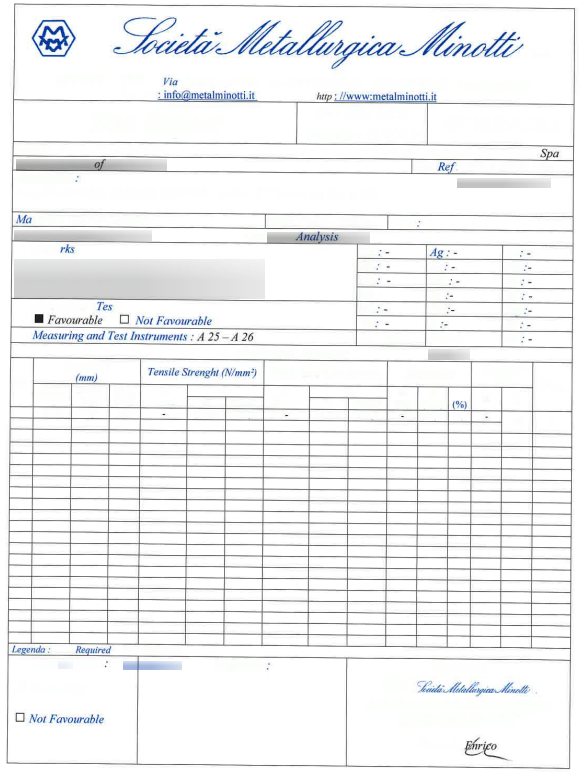
Firma del representante del organismo examinador / *Visa of examining body's representative* | Informe N°: / *Record No* 39/X.01/1/1406477-1 Rev.01 | WPQR: ESS-0145103-WPQR001 | Página n.°2/9 / *Page No*

Tunning Beam Dump: System

Raw material

Cu1CrZr material is directly procured by ESS-Bilbao to Metalminoty (Italy). The first section has been received and characterization has been completed at CEIT.

Cu1CrZr raw material



Società Metallurgica Minotti

Via
: info@metalminotti.it
http ; //www:metalminotti.it

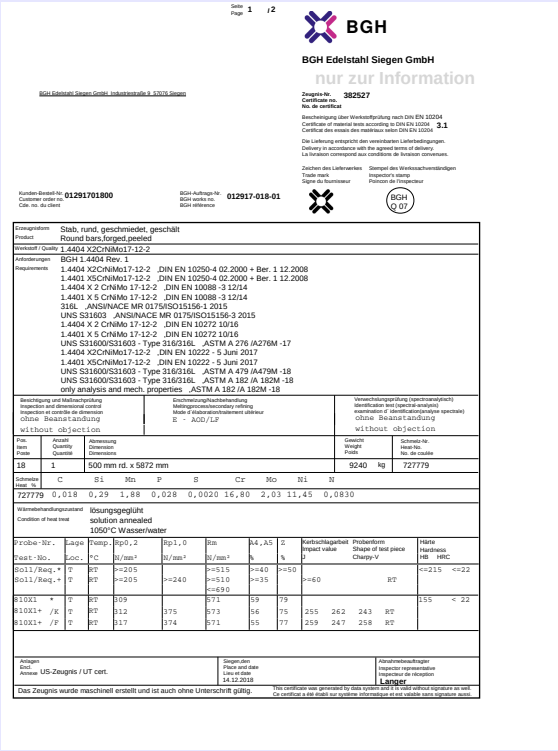
Spa
of
Ref
:
Ma
Analysis
rks
Ag : -
Tes
■ Favourable □ Not Favourable
Measuring and Test Instruments : A 25 – A 26
(mm)
Tensile Strenght (N/mm²)
(%)
Legenda : Required
□ Not Favourable
Società Metallurgica Minotti
Enrico

Tunning Beam Dump: System

Raw material

Stainless steel sections has been already ordered (forgings). The manufacturing will be completed in $\sim$ two months.

Cu1CrZr raw material



BGH

BGH Edelstahl Siegen GmbH

nur zur Information

Zeugnis-Nr. 382527
Certificate no.
No. de certificat

Bescheinigung über Werkstoffprüfung nach DIN EN 10204
Certificate of material tests according to DIN EN 10204 3.1
Certificat des essais des matériaux selon DIN EN 10204

Die Lieferung entspricht den vereinbarten Lieferbedingungen.
Delivery in accordance with the agreed terms of delivery.
La livraison correspond aux conditions de livraison convenues.

Kunden-Bestell-Nr. 01291701800
Customer order no.
Cde. no. du client

BGH-Auftrags-Nr. 012917-018-01
BGH works no.
BGH référence

Erzeugnisform / Product	Stab, rund, geschmiedet, geschält Round bars,forged,peeled
Werkstoff / Quality	1.4404 X2CrNiMo17-12-2
Anforderungen / Requirements	BGH 1.4404 Rev. 1 1.4404 X2CrNiMo17-12-2 ,DIN EN 10250-4 02.2000 + Ber. 1 12.2008 1.4401 X5CrNiMo17-12-2 ,DIN EN 10250-4 02.2000 + Ber. 1 12.2008 1.4404 X 2 CrNiMo 17-12-2 ,DIN EN 10088 -3 12/14 1.4401 X 5 CrNiMo 17-12-2 ,DIN EN 10088 -3 12/14 316L ,ANSI/NACE MR 0175/ISO15156-1 2015 UNS S31603 ,ANSI/NACE MR 0175/ISO15156-3 2015 1.4404 X 2 CrNiMo 17-12-2 ,DIN EN 10272 10/16 1.4401 X 5 CrNiMo 17-12-2 ,DIN EN 10272 10/16 UNS S31600/S31603 - Type 316/316L ,ASTM A 276 /A276M -17 1.4404 X2CrNiMo17-12-2 ,DIN EN 10222 - 5 Juni 2017 1.4401 X5CrNiMo17-12-2 ,DIN EN 10222 - 5 Juni 2017 UNS S31600/S31603 - Type 316/316L ,ASTM A 479 /A479M -18 UNS S31600/S31603 - Type 316/316L ,ASTM A 182 /A 182M -18 only analysis and mech. properties ,ASTM A 182 /A 182M -18

Beschädigung und Maßnahmeprüfung / Inspection and dimensional control / Inspection et contrôle de dimension: ohne Beanstandung / without objection

Entschlackung/Nachbehandlung / Metallurgroccess/secondary refining / Mode d'élaboration/traitement ultérieur: E - AOD/LF

Verwechslungsprüfung (spectroanalytisch) / Identification test (spectral-analysis) / examination d' identification(analyse spectrale): ohne Beanstandung / without objection

Pos. / Item / Poste	Anzahl / Quantity / Quantité	Abmessung / Dimension / Dimensions	Gewicht / Weight / Poids	Schmelz-Nr. / Heat-No. / No. de coulée
18	1	500 mm rd. x 5872 mm	9240 kg	727779

Schmelze / Heat / No	C	Si	Mn	P	S	Cr	Mo	Ni	N
727779	0,018	0,29	1,88	0,028	0,0020	16,80	2,03	11,45	0,0830

Wärmebehandlungszustand / Condition of heat treat: lösungsgeglüht / solution annealed, 1050°C Wasser/water

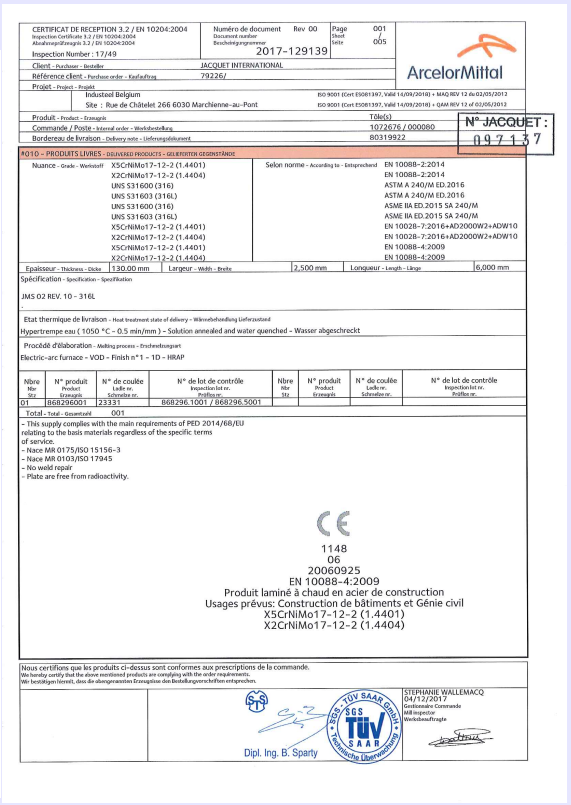
Probe-Nr. / Test-No.	Lage / Loc.	Temp. °C	Rp0,2 N/mm²	Rp1,0 N/mm²	Rm N/mm²	A4,A5 %	Z %	Kerbschlagarbeit / Impact value J	Probenform / Shape of test piece	Härte / Hardness HB	HRC
Soll/Req.*	T	RT	>=205		>=515 <=690	>=40	>=50	>=60	RT	<=215	<=22
Soll/Req.+	T	RT	>=205	>=240	>=510 <=690	>=35					
810X1 *	T	RT	309		571	59	79			155	< 22
810X1+ /K	T	RT	312	375	573	56	75	255 262 243	RT		
810X1+ /F	T	RT	317	374	571	55	77	259 247 258	RT		

Anlagen / Encl. / Annexe: US-Zeugnis / UT cert.

Siegen,den / Place and date / Lieu et date: 14.12.2018

Abnahmebeauftragter / Inspector representative / Inspecteur de réception: Langer

Das Zeugnis wurde maschinell erstellt und ist auch ohne Unterschrift gültig. / This certificate was generated by data system and is is valid without signature as well. / Ce certificat a été établi sur système informatique et est valable sans signature aussi.



CERTIFICAT DE RECEPTION 3.2 / EN 10204:2004
Inspection Certificate 3.2 / EN 10204:2004
Abnahmeprüfzeugnis 3.2 / EN 10204:2004

Numéro de document / Document number / Bescheinigungsnummer: 2017-129139
Rev 00
Page / Short / Seite: 001 / 005

ArcelorMittal

Inspection Number : 17/49

Client – Purchaser – Besteller: JACQUET INTERNATIONAL
Référence client – Purchase order – Kaufauftrag: 79226/
Projet – Project – Projekt:

Industeel Belgium
Site : Rue de Châtelet 266 6030 Marchienne-au-Pont
ISO 9001 (Cert ES081397, Valid 14/09/2018) + MAQ REV 12 du 02/05/2012
ISO 9001 (Cert ES081397, Valid 14/09/2018) + QAM REV 12 of 02/05/2012

Produit – Product – Erzeugnis: Tôle(s)
Commande / Poste – Material order – Werkstestellung: 1072676 / 000080
Bordereau de livraison – Delivery note – Lieferungsbelaternt: 80319922

N° JACQUET : 097137

#010 – PRODUITS LIVRES – DELIVERED PRODUCTS – GELIEFERTEN GEGENSTÄNDE

Nuance – Grade – Werkstoff: X5CrNiMo17-12-2 (1.4401), X2CrNiMo17-12-2 (1.4404), UNS S31600 (316), UNS S31603 (316L), UNS S31600 (316), UNS S31603 (316L), X5CrNiMo17-12-2 (1.4401), X2CrNiMo17-12-2 (1.4404), X5CrNiMo17-12-2 (1.4401), X2CrNiMo17-12-2 (1.4404)

Selon norme – According to – Entsprechend: EN 10088-2:2014, EN 10088-2:2014, ASTM A 240/M ED.2016, ASTM A 240/M ED.2016, ASME IIA ED.2015 SA 240/M, ASME IIA ED.2015 SA 240/M, EN 10028-7:2016+AD2000W2+ADW10, EN 10028-7:2016+AD2000W2+ADW10, EN 10088-4:2009, EN 10088-4:2009

Epaisseur – Thickness – Dicke	Largeur – Width – Breite	Longueur – Length – Länge
130,00 mm	2,500 mm	6,000 mm

Spécification – Specification – Spezifikation: JMS 02 REV. 10 - 316L

Etat thermique de livraison – Heat treatment state of delivery – Wärmebehandlung Lieferzustand: Hypertrempe eau (1050 °C – 0.5 min/mm) – Solution annealed and water quenched – Wasser abgeschreckt

Procédé d'élaboration – Melting process – Erschmelzungsart: Electric-arc furnace – VOD – Finish n°1 – 1D – HRAP

Nbre / Nbr / Stz	N° produit / Product / Erzeugnis	N° de coulée / Lade nr. / Schmelze nr.	N° de lot de contrôle / Inspection lot nr. / Prüflos nr.	Nbre / Nbr / Stz	N° produit / Product / Erzeugnis	N° de coulée / Lade nr. / Schmelze nr.	N° de lot de contrôle / Inspection lot nr. / Prüflos nr.
01	B68296001	23331	B68296.1001 / B68296.5001				

Total – Total – Gesamtzahl: 001

- This supply complies with the main requirements of PED 2014/68/EU relating to the basis materials regardless of the specific terms of service.
- Nace MR 0175/ISO 15156-3
- Nace MR 0103/ISO 17945
- No weld repair
- Plate are free from radioactivity.

CE
1148
06
20060925
EN 10088-4:2009
Produit laminé à chaud en acier de construction
Usages prévus: Construction de bâtiments et Génie civil
X5CrNiMo17-12-2 (1.4401)
X2CrNiMo17-12-2 (1.4404)

Nous certifions que les produits ci-dessus sont conformes aux prescriptions de la commande.
We hereby certify that the above mentioned products are complying with the order requirements.
Wir bestätigen hiermit, dass die obengenannten Erzeugnisse den Bestellungsvorschriften entsprechen.

Dipl. Ing. B. Sparty

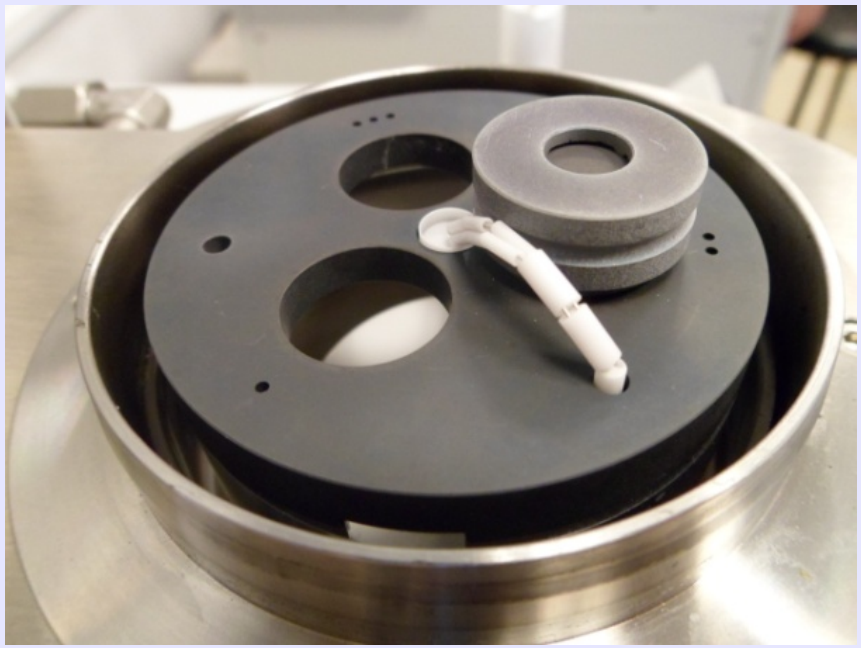
STEPHANIE WALLEMACQ
04/12/2017
Gestionnaire Commande
Mill inspector
Werksbauftragte

Tunning Beam Dump: System

Raw material

CEIT has completed the thermal conductivity analysis. Surface and central section shows homogeneous properties adequate for our application. We will order the next two sections in the coming weeks.

Cu1CrZr raw material



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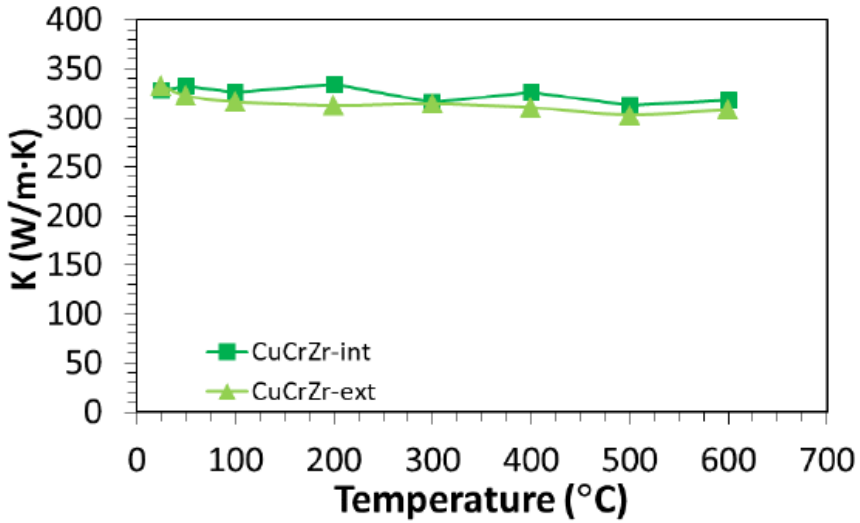
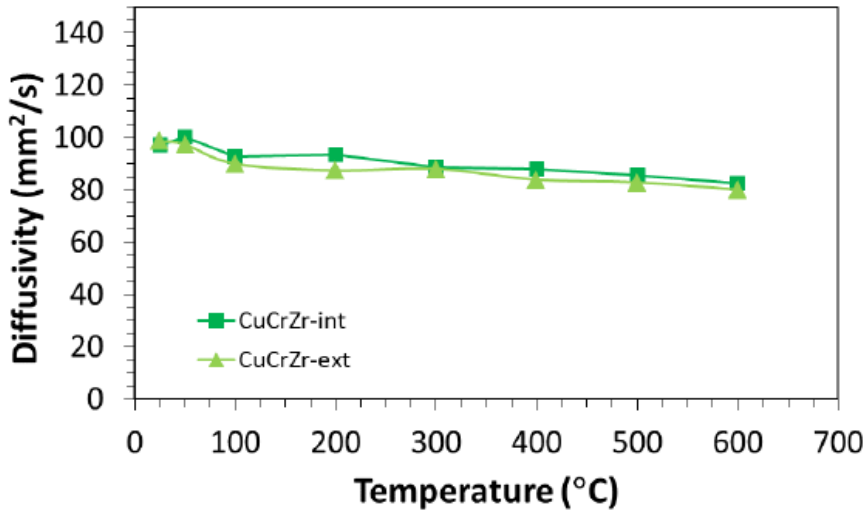


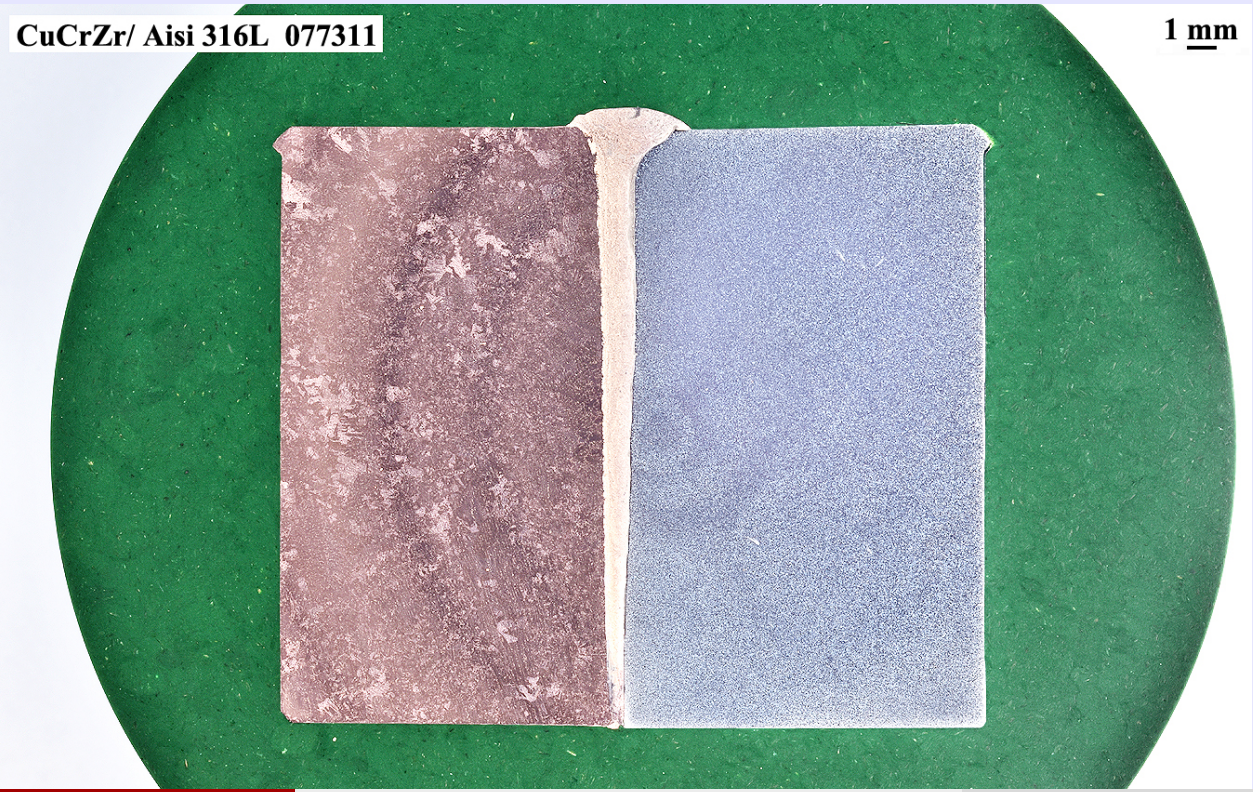


Tunning Beam Dump: System

Transition section welding

Electron beam welding for the transition between SS316L and Cu1CrZr is on going. The initial test shows really good results. Test samples will be provided to Tecnalia along this week for mechanical characterization.

Metalography examination of the welding line



Tunning Beam Dump

Main remarks

The manufacturing process is on going.

- No particular delays has been reported
- Still some uncertainty remains associated to the welding process between Cu1CrZr and the SS316L.