



Strategy for LS2 Collimators Production

7th HL-LHC Collaboration Meeting – 16th November 2017 - Madrid

Inigo Lamas Garcia – CERN (EN-STI-TCD)

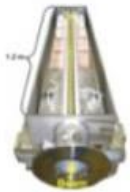


CERN – 7th HL-LHC Collaboration Meeting – 16th November 2017 – Ciemat Madrid

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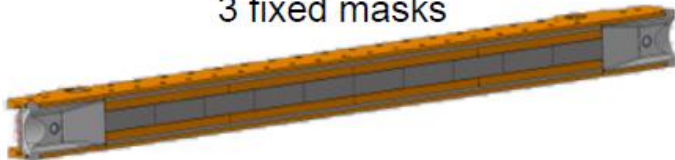
Collimation upgrade for HL-LHC project



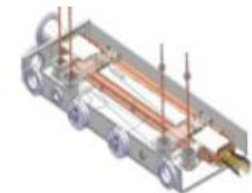
Completely new layouts
Novel materials: TCTs in CuCD

IR1+IR5, per beam:

- 4 tertiary collimators
- 3 physics debris collimators
- 3 fixed masks



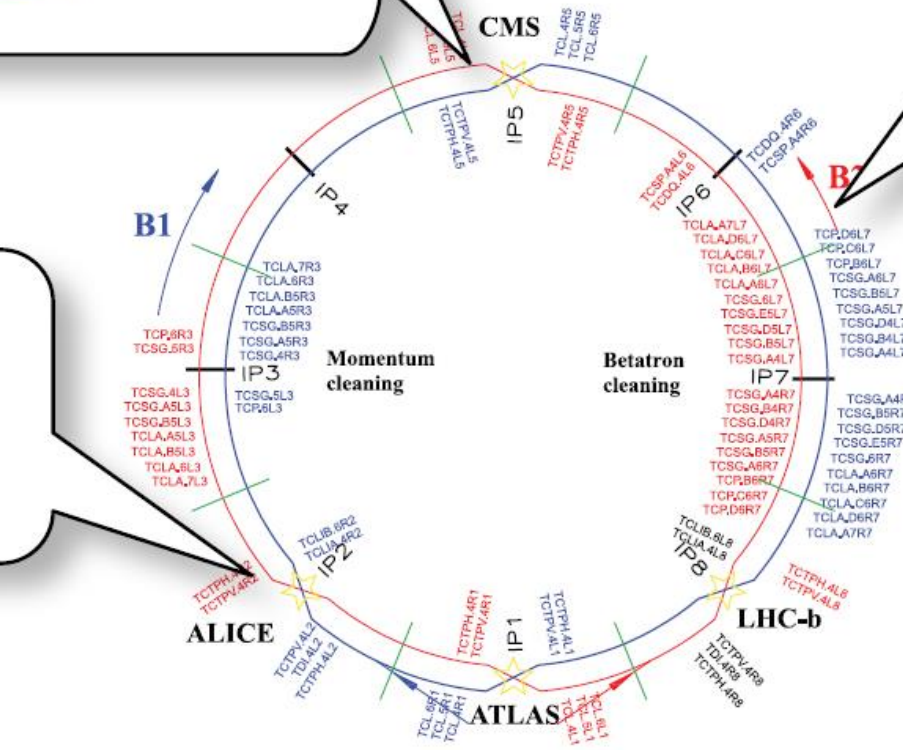
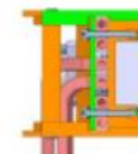
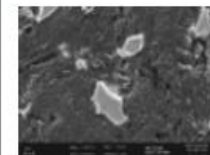
Cleaning: DS coll. + 11T dipoles, **1 unit per beam**



Ion physics debris:
 DS collimation



Low-impedance, high
 robustness secondary
 collimators: coated MoGr



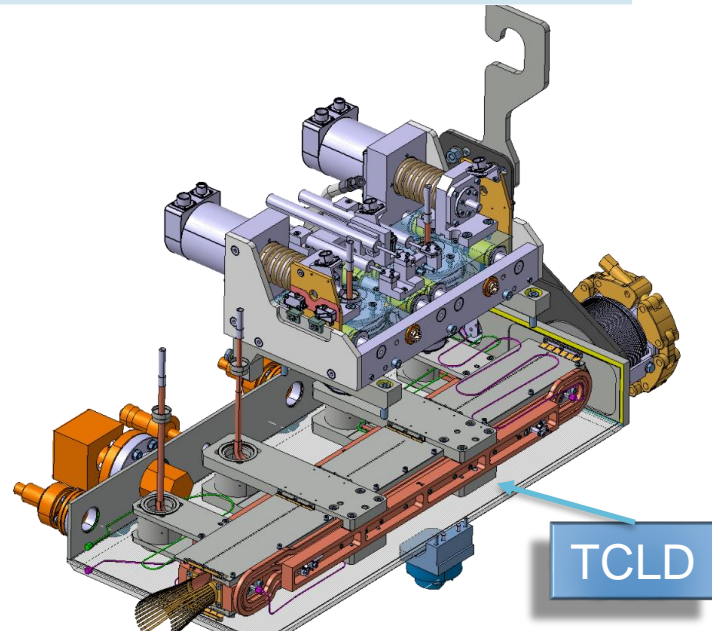
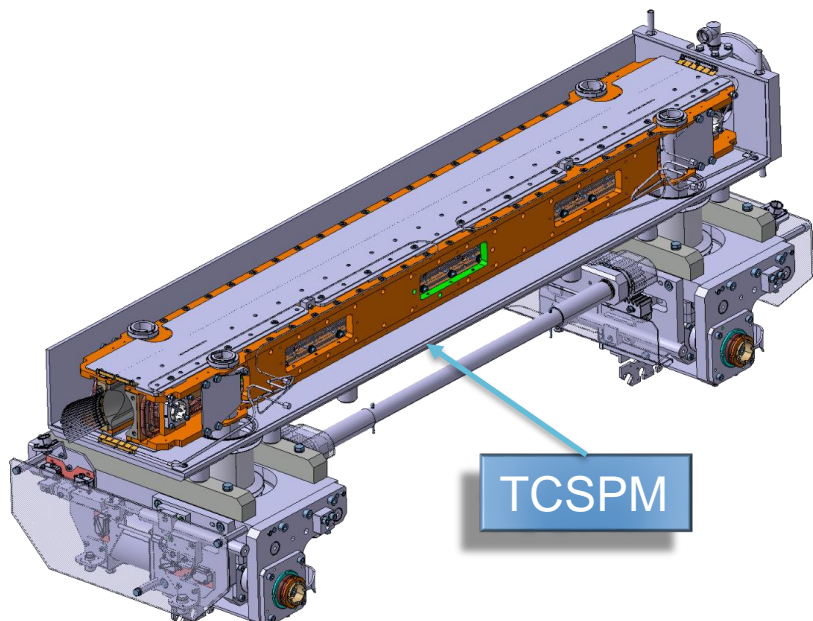
Collimation Production for LS2

Family	Collimator Types	Units
Family 1	TCSPM	10
	TCPPM	5
Family 2	TCLD	5

Options		
Family	Collimator Types	Units
Family 1	TCTPM	4
Family 2	TCLD	2

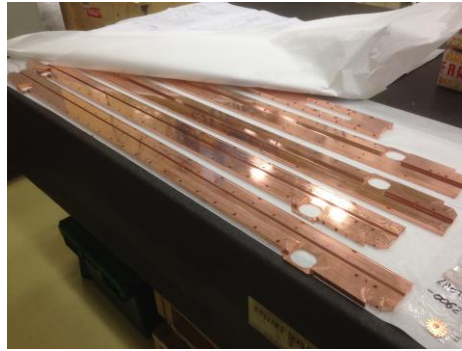
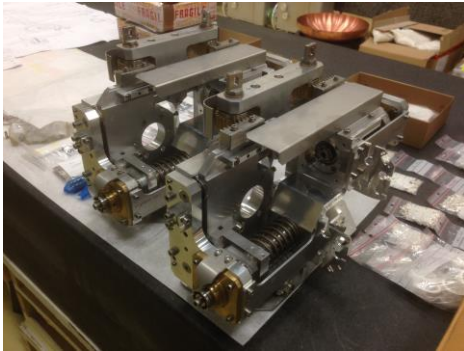
Collimation Production for LS2

Family 1	Family 2
TCPPM	TCLD
TCSPM	
TCTPM	



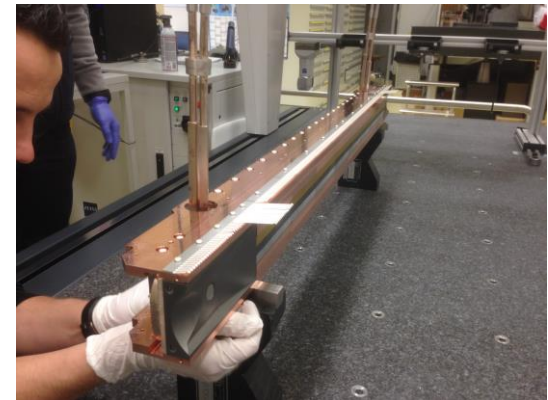
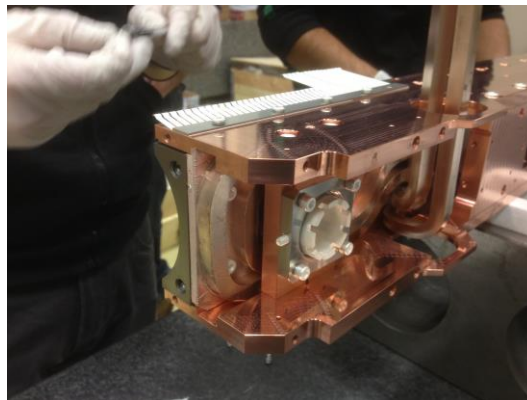
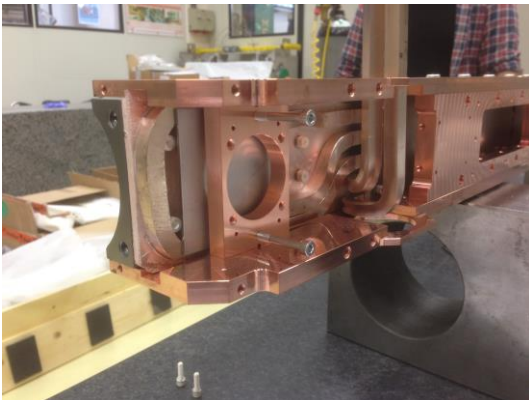
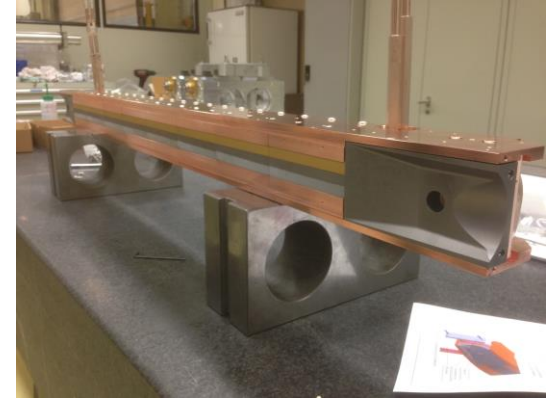
Family 1: different material and shape of absorbing blocks for each type of Collimators

TCSPM Prototype Manufacturing



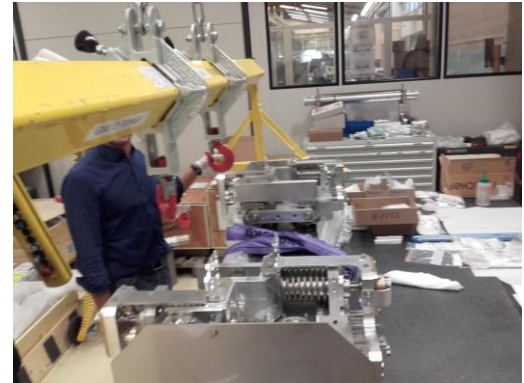
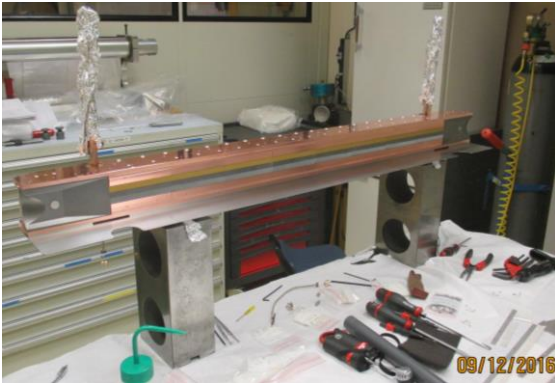
Many thanks to
EN-MME and the
Main Workshop

TCSPM Prototype Jaws Assembly



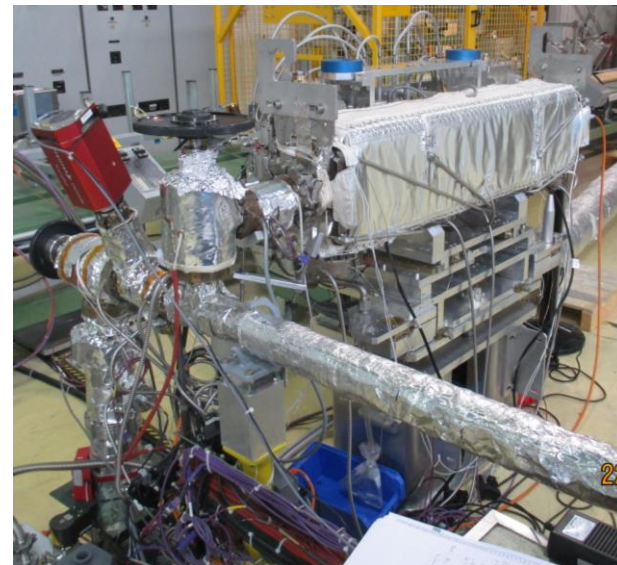
Many thanks to
EN-MME and the
Main Workshop

TCSPM Prototype Assembly



Many thanks to
EN-MME and the
Main Workshop

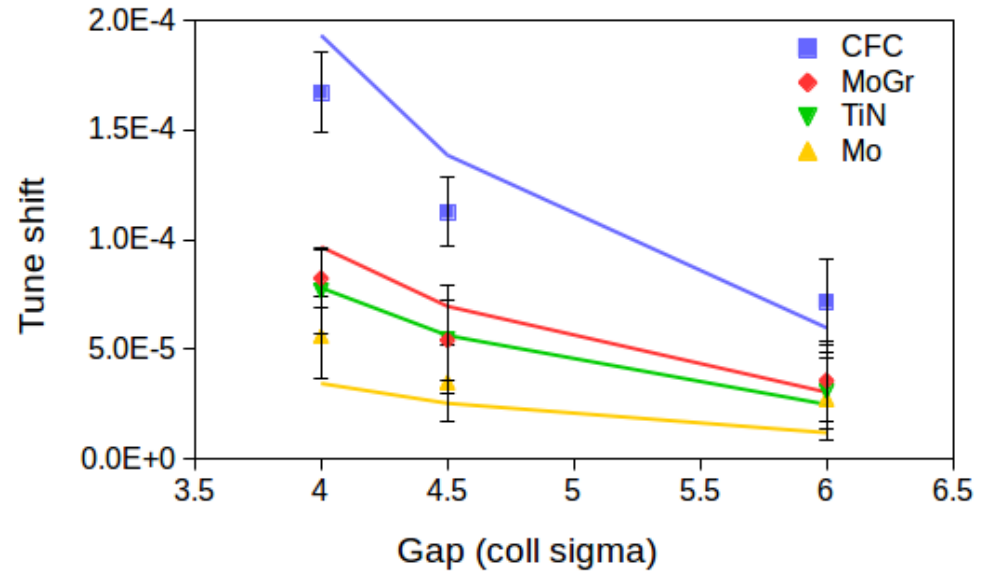
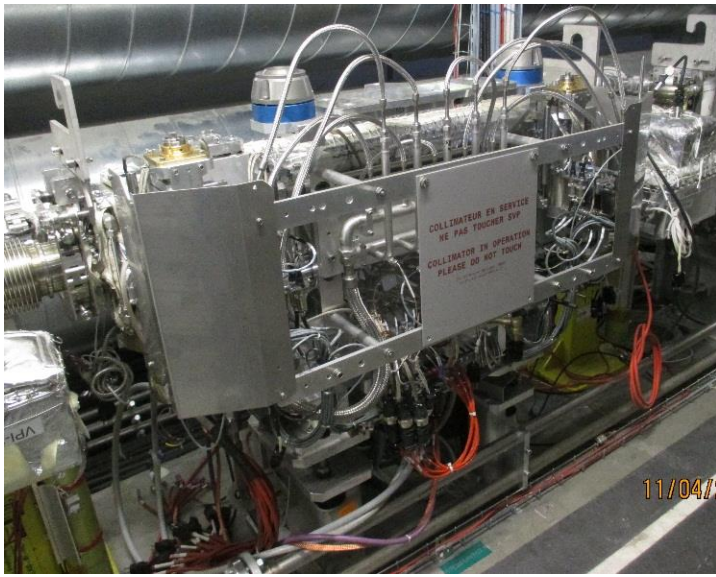
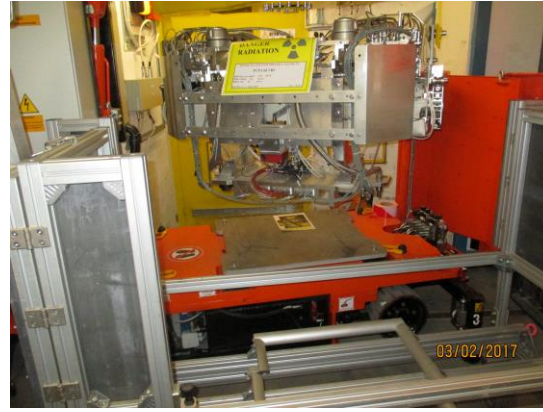
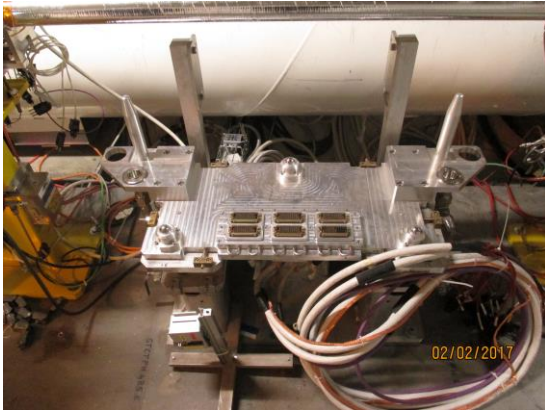
TCSPM Prototype Tests



Many thanks to
EN-ACE and TE-
VSC

TCSPM Prototype Installation

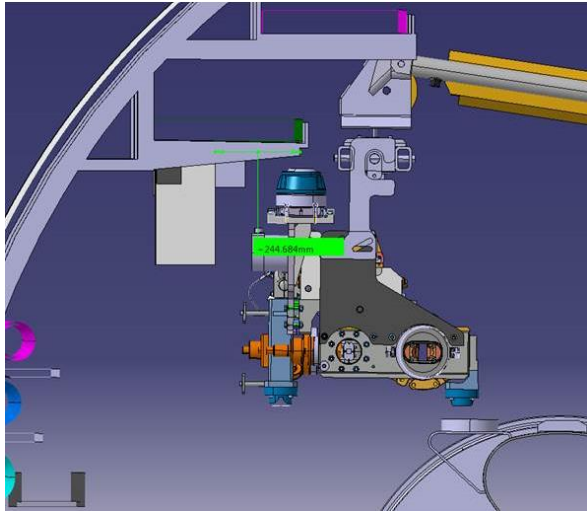
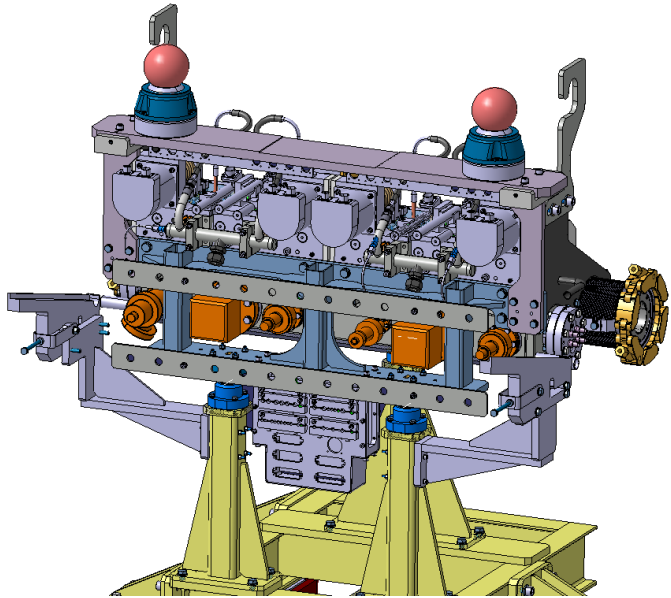
Many thanks to EN-HE and BE-ABP



Installed during YETS16/17

Indirect Impedance Measurements during MD

TCLD Prototype

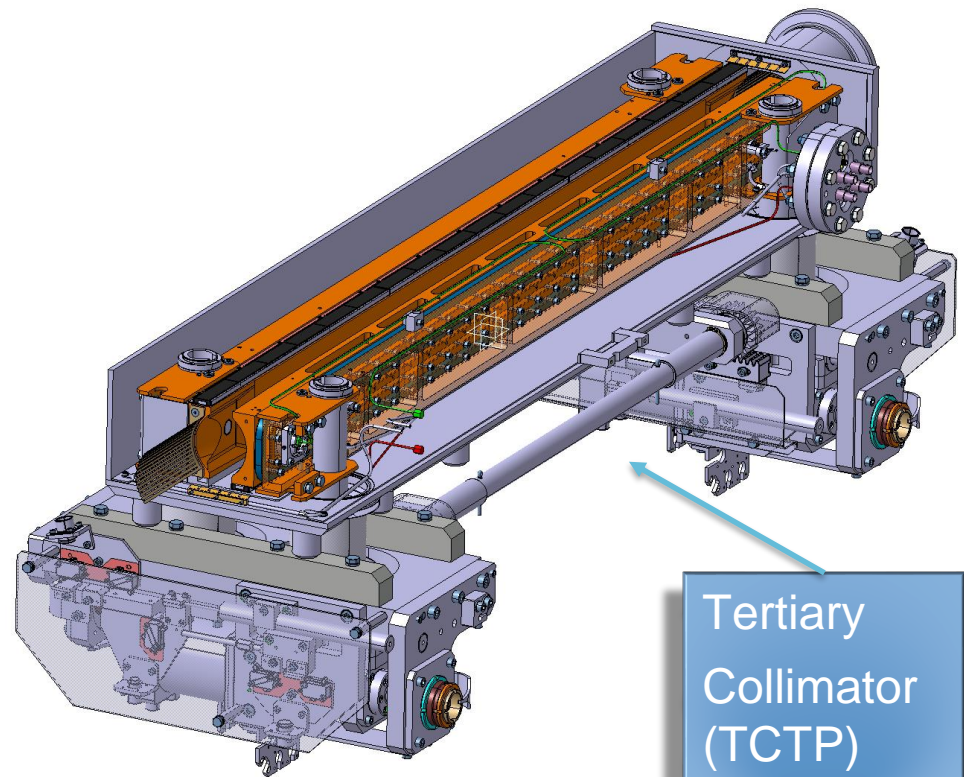


Many thanks to
EN-MME, EN-HE,
EN-ACE and the
Main Workshop

Market Survey (MS-4272)

Need for a company with:

- Manufacturing Engineering;
- High Precision Dry Machining;
- Surface Treatments;
- UHV Cleaning;
- Vacuum Brazing;
- EBW and TIG welding;
- UHV leak testing and outgassing;
- Assembly of UHV components in precise mechanisms;
- 3D metrology and assembly adjustments.



Tertiary
Collimator
(TCTP)

Market Survey (MS-4272)

Pre-qualification phase:

- MS-4272 documents sent to 34 companies on the 20th of February;
- 1726492 v.1.0
- LHC-TC-CS-0002 v.1.0 <https://edms.cern.ch/document/1726492/1.0>
- **Seven firms submitted answers** to the MS-4272 Qualification Questionnaire;
- After a detailed analysis of the answers, **three companies were not Pre-Qualified**;
- **Four companies were Pre-Qualified** after an official visit to their facilities.

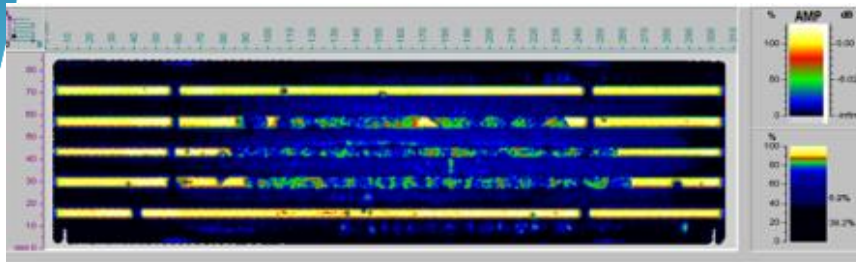
Many thanks to the
Technical Audit Team

Market Survey (MS-4272)

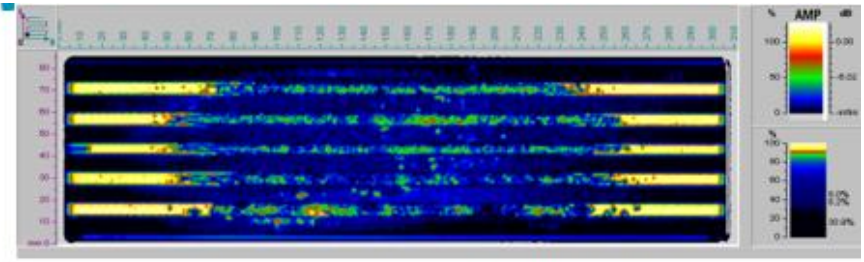
Final Qualification phase, samples characterization:

- High precision dry machining
 - Full metrological control <https://edms.cern.ch/document/1832539/1>
- UHV Cleaning on Cu OFE and St. Steel 316LN
 - Fourier Transform Infrared Spectroscopy (FT-IR) <https://edms.cern.ch/document/1823289/2>
 - X-ray Photoelectron Spectrometry (XPS) <https://edms.cern.ch/document/1825303/1>
- Surface Treatments and Vacuum Brazing
 - Full metrological control
 - UHV conformity by outgassing test
 - Ultrasound test <https://edms.cern.ch/document/1836446/1>
 - Metallography inspections
- TIG and EB welding
 - Leak test
 - Penetrant liquids tests
 - X-rays
 - Metallography inspections <https://edms.cern.ch/document/1856217/1>

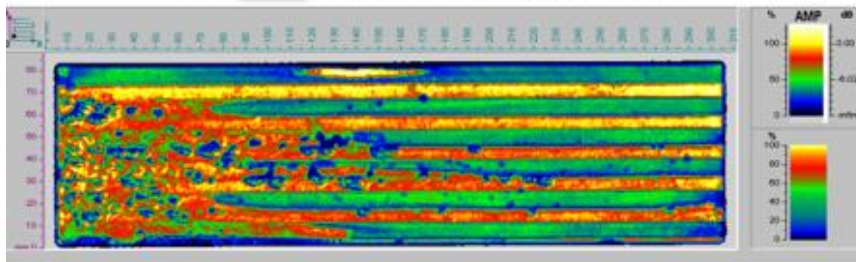
Market Survey (MS-4272)



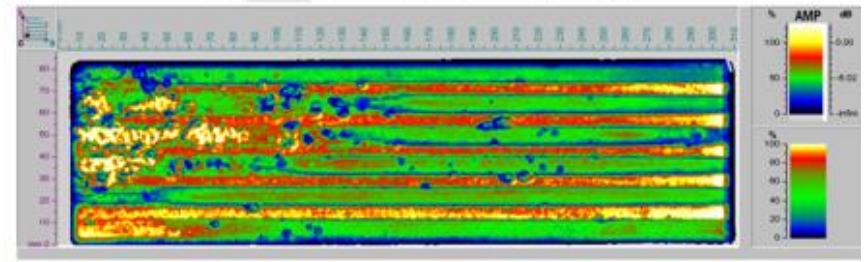
Piece [redacted] brazed interface of 5 mm Glidcop plate.



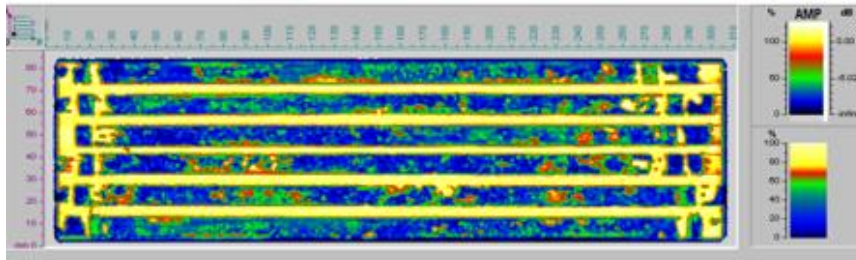
Piece [redacted] brazed interface of 20 mm Glidcop plate.



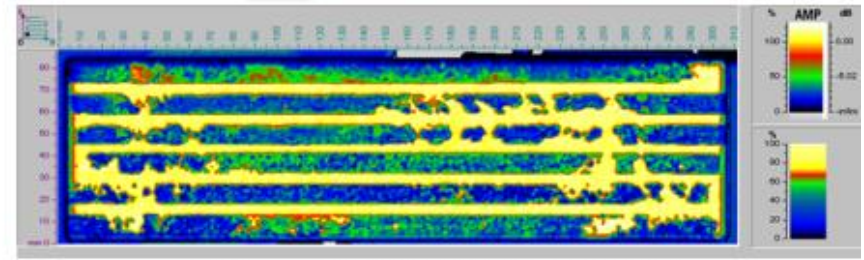
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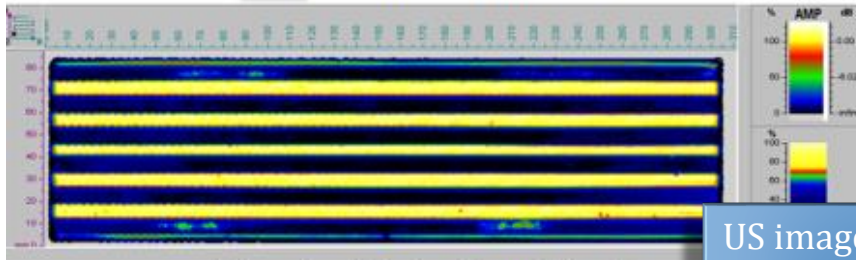
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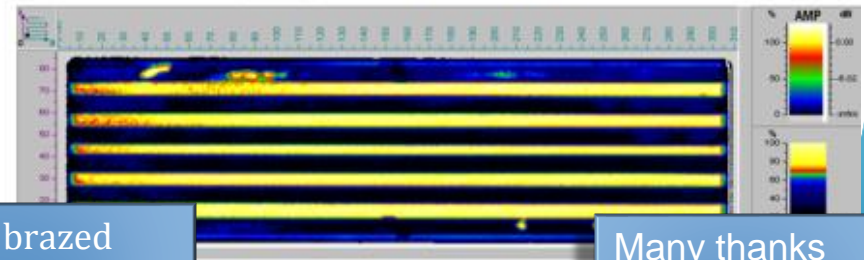
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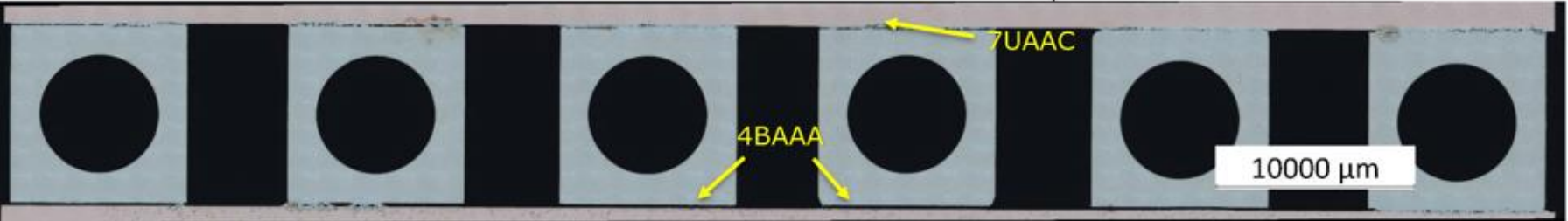
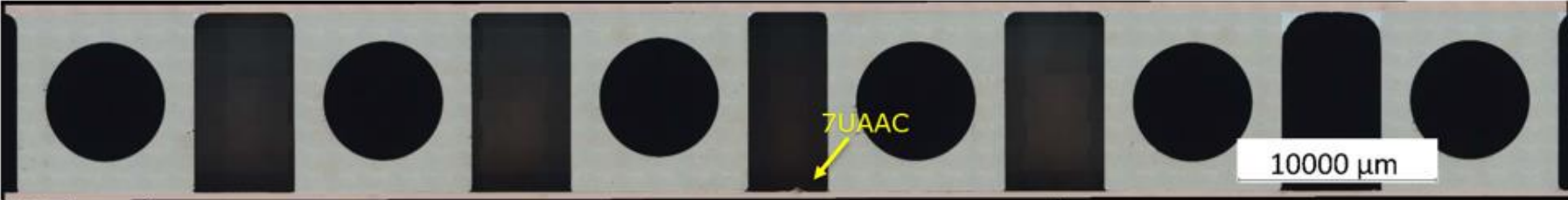


Piece [redacted] brazed interface of 20 mm Glidcop plate.

US images of brazed qualification samples

Many thanks to G. Arnau EN-MME-MM

Market Survey (MS-4272)

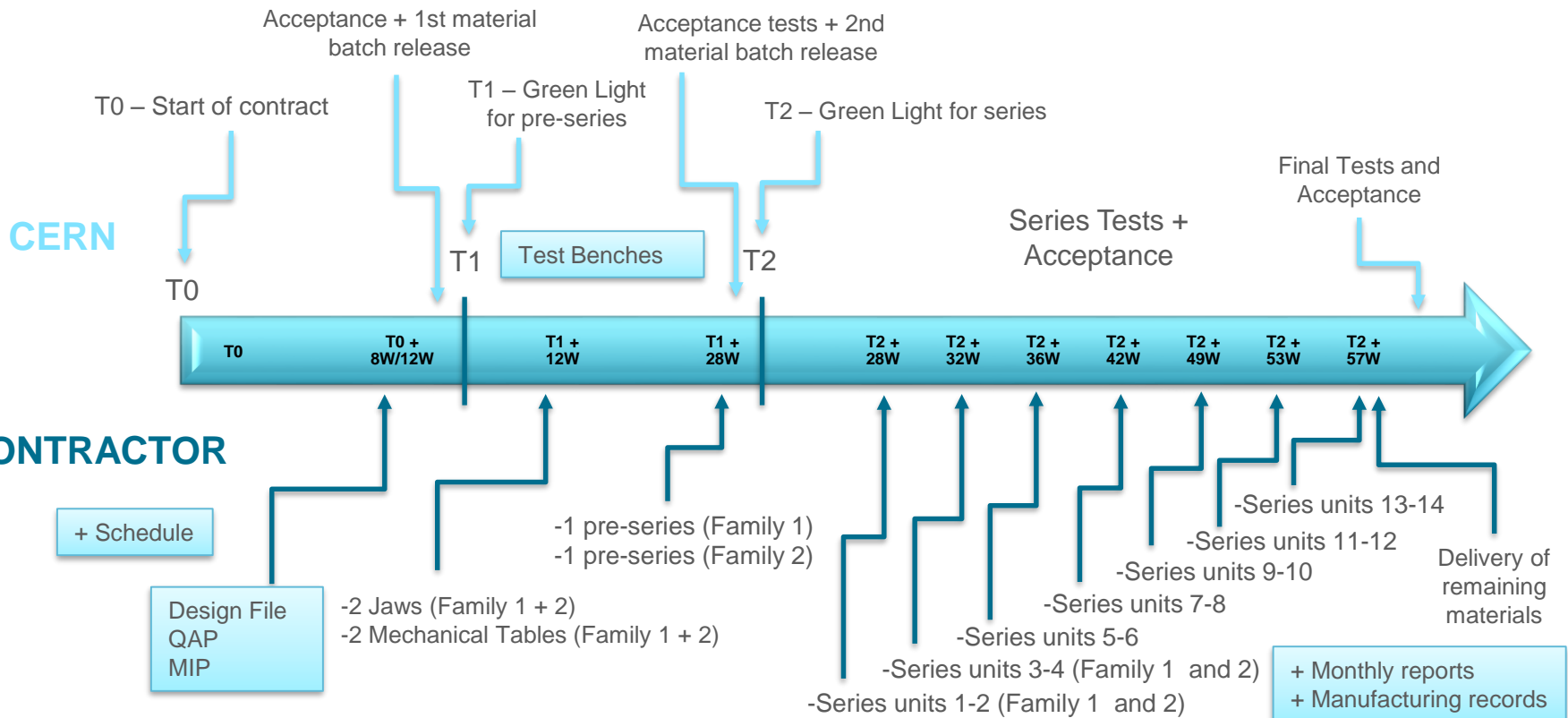


Invitation to Tender (IT-4272)

- **Two out of the four companies successfully passed the samples characterization campaign;**
- IT-4272 documents sent to both companies on the 26th of September;
- 1821032 v.0.6 <https://edms.cern.ch/document/1821032/0.6>
- LHC-TC-CI-0002 v.0.6
- Bidders Conference held on the 11th of October;
- Bids were opened on the 1st of November;
- **One company selected:** Bids difference > 20%, no splitting strategy possible;
- Peers review for the FC0017 document on 17th of November;
- **On time for December Finance Committee;**

Many thanks to the
Technical Audit Team

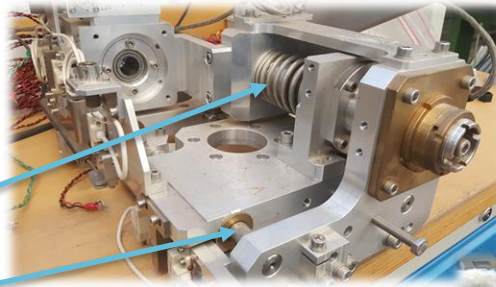
Production Plan



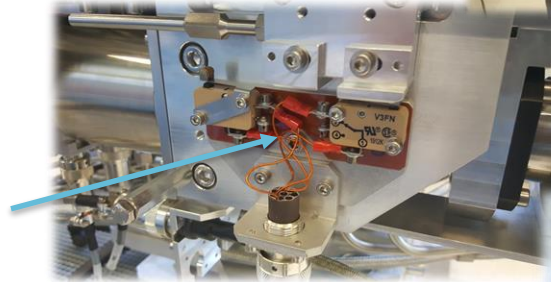
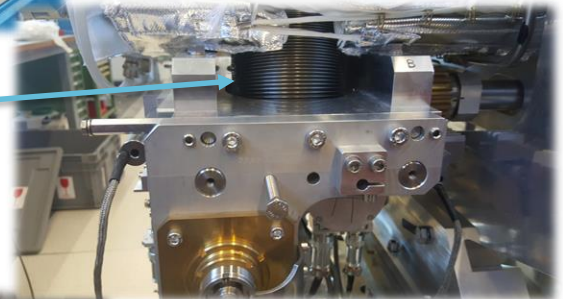
Materials Logistic

Commercial Components

- 90 % already ordered
- Control list
 - Roller Screw
 - Guiding shaft
 - Bellows
 - Cu-Ni Pipes
 - PT100 cables
 - Electrical equipment
 - BPM cables
 - Switches
 - Step Motors
 - TCLD absorbing blocks



Many thanks to R. Illan EN-STI



- Is crucial to match the absorbing material production with the collimators industrial production plan

Production Follow-up

Start of the contract (tentative date: 1st of February 2018)

- Kick-off meeting.
- Monthly report:
 - Current progress;
 - Issues encountered and solutions proposed;
 - Information about risks in failing.
- Stakeholders:
 - Technical Officer (CERN);
 - Procurement officer (CERN);
 - Technical Responsible for production follow-up (Contractor);
 - Technical Responsible for the commercial follow-up (Contractor).

Production Follow-up

- Documentation to be provided by the contractor:

3.7 Information and Documentation

The supply shall include the documents listed below, as a minimum. These documents shall be provided for approval by CERN throughout the execution of the contract:

- Detail Design File (see §3.7.2);
- Quality Assurance Plan (see §3.7.3);
- Manufacturing and Inspection Plan including all the related manufacturing and testing procedures (see §3.7.4);
- Manufacturing Records (see §3.7.5);
- Vacuum brazing documentation (see §3.3.2);
- Periodical calibration reports of the testing equipment provided by CERN.

The documentation shall be provided according to the schedule stated in §4.1 of the Technical Specification.

Production Follow-up

Quality and Acceptance

- Schedule (processes and methods)
- Detailed design file:
 - Production drawings which shall be provided to CERN for approval;
 - List of modifications wrt. the drawings provided by CERN for information.
- Quality Assurance Plan of the firm.
- Manufacturing and Inspection Plan: Sequence of manufacturing and control steps to produce the collimators:
 - Cleaning procedures;
 - Detailed production procedure for the back stiffeners;
 - Assembly procedure of the jaws;
 - Assembly procedure of mechanical tables and jaws to the vacuum vessel;
 - Procedure of preparation of jaw surface;
 - Vacuum brazing procedure;
 - Procedure for the collimator adjustment;
 - UHV Leak Test procedure;
 - Handling procedures;
 - Labelling procedure.

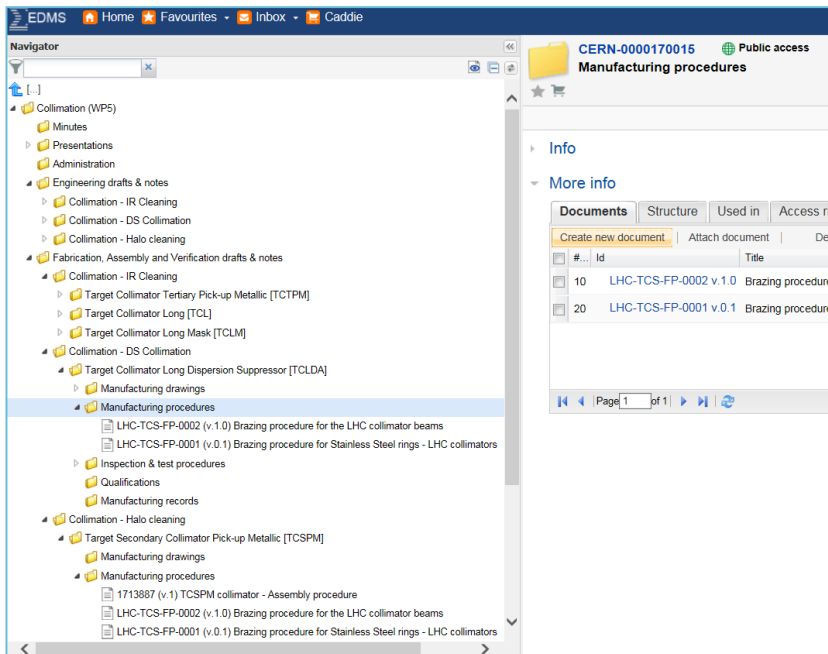
Production Follow-up

Quality and Acceptance

- Manufacturing Records:
 - All metrology and adjustments reports;
 - The vacuum test reports and leak test reports;
 - The torque test reports;
 - All the BPM test reports;
 - All the Thermal Contact Conductance test reports;
 - All non-conformity reports as soon as they occur.
- Vacuum brazing documentation:
 - Brazing procedure;
 - Log of the parameters for the control of the brazing cycle.
- Periodical calibration reports of CERN equipment.
- Tests at contractor premises:
 - Vacuum leak tightness;
 - Outgassing test;
 - Testing of cooling water circuit of the jaws;
 - Testing of the cooling water circuit of the finished collimator;
 - Metrology and adjustments;
 - Torque tests;
 - BPM tests;
 - Thermal contact conductance tests.

QA HL-LHC Project – Handling of documentation

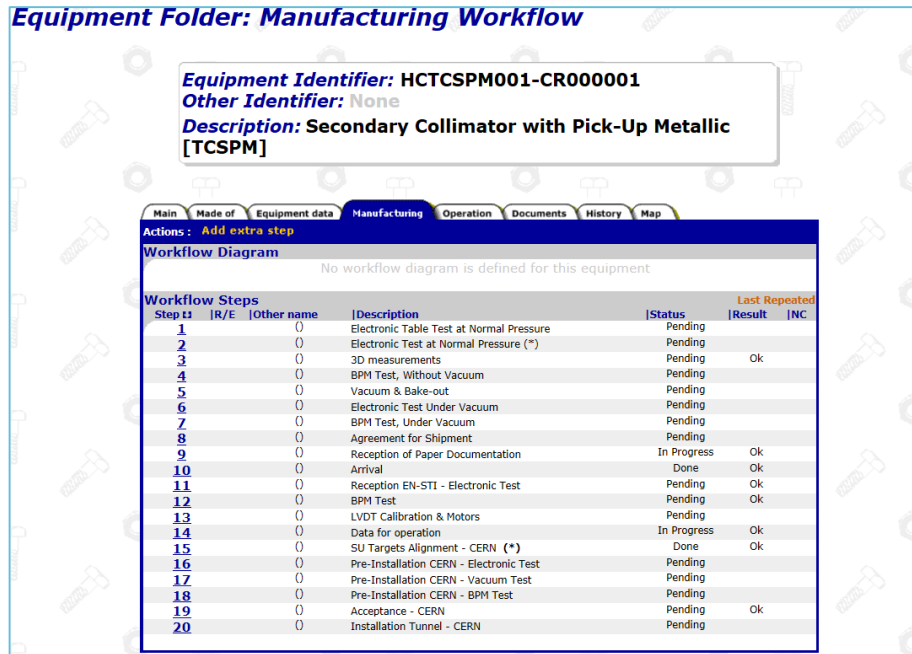
EDMS



Project Documentation - > EDMS

MTF

Many thanks to H. Garcia Gavela
ATS-DO



Manufacturing Records - > MTF

QA HL-LHC Project – Handling of documentation

- The contractor shall use CERN tools for storing and handling the documentation:
 - **EDMS** (*Engineering & Equipment Data Management Service*) to upload the design file, schedule, QAP & MIP (and the requested procedures);
 - **MTF** (*Manufacturing & Testing Folder*): All the manufacturing data (records of QC activities and non conformities) will be handle via MTF.
- CERN will pre-create all the E-documents (both in EDMS and MTF) and the contractor shall just have to upload the files in the corresponding place;
- CERN will provide support to handle the documentation in the tools (and training if necessary);
- To use EDMS, CERN lightweight account is required ([Link to create one](#)) whereas to use MTF a CERN nice account has to be created (instructions will follow);
- E-Groups will be created for communication purposes.

Many thanks to H.
Garcia Gavela
ATS-DO



Thank you for your attention

