



# Activities on MCBXFB to be carried at CERN and general status of documentation

**J. C. Pérez**  
CERN TE-MS-CDT

## **Acknowledgments to:**

Jesus Calero, Jesus Angel Garcia, Pablo Gomez, Fernando Toral from CIEMAT  
Beatriz Almeida, Marta Bajko, Isabel Bejar, Nicolas Bourcey, Hector Garcia, Michael Guinchard,  
Gregory Maury, Jacky Mazet, Francois-Olivier Pincot, Gerard Willering & many others.

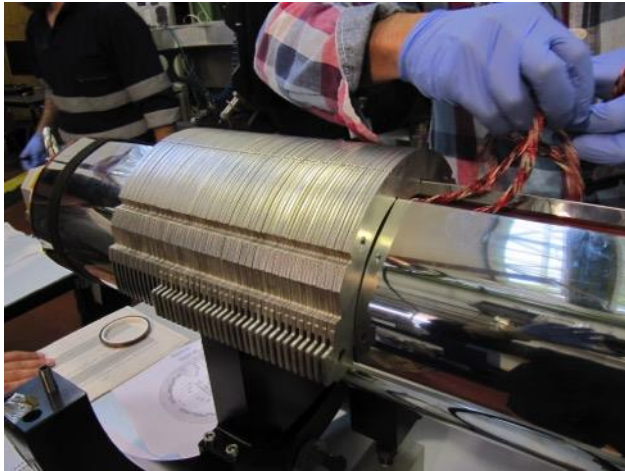


# Index

- Activities on MCBXFB prototype to be carried at CERN
- General status of documentation
- Summary

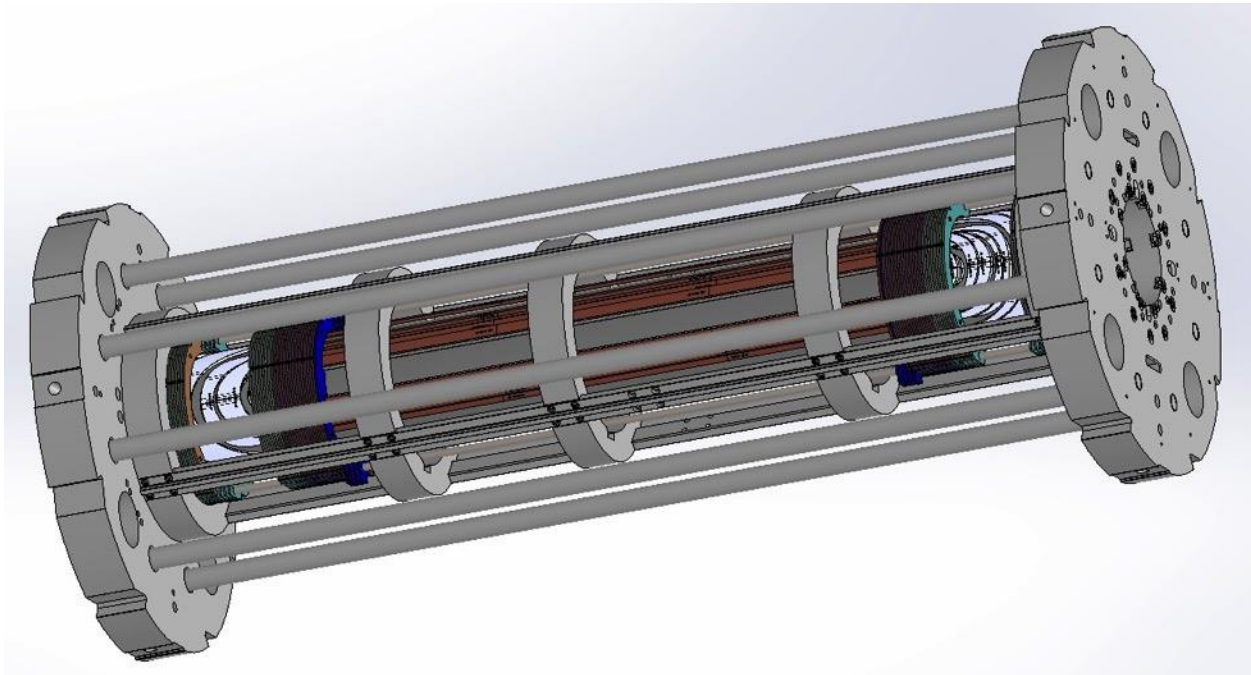
# Inner dipole collaring at CERN

- The inner dipole pre-collared at CEDEX will be delivered at CERN by end of October
- The collaring operation is scheduled on Monday November 5<sup>th</sup> in 927 laboratory.
- The collaring procedure used during the short mechanical model assembly will be applied (control of the cavity size using different shim thickness)
- The collaring tool displacement will be monitored with LVDTs.
- Six cross sections (12 collars equipped with 2 strain-gauge per side in  $\frac{1}{2}$  bridge configuration) are instrumented: two at each magnet extremity and two in the middle of the straight section)



# Inner dipole assembly (1/2)

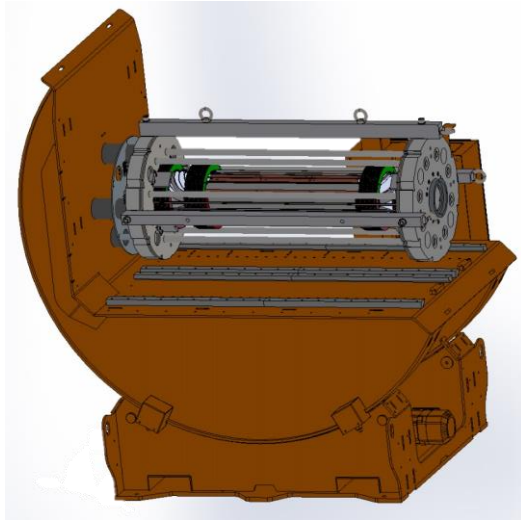
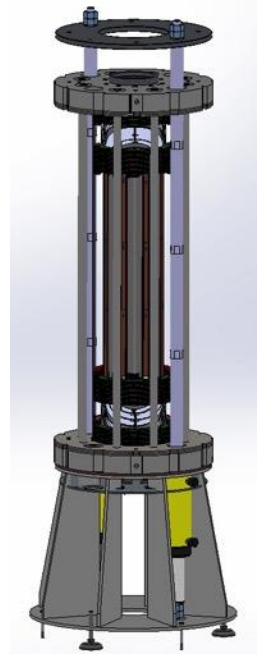
- In order to get an earlier information on the magnet performance, it was decided to test the magnet without the outer dipole.
- As the outer dipole coils are not ready yet, they will be replaced inside the iron yoke by 316 L stainless steel spacers.
- The end-plates with rods will hold the inner collared coils.





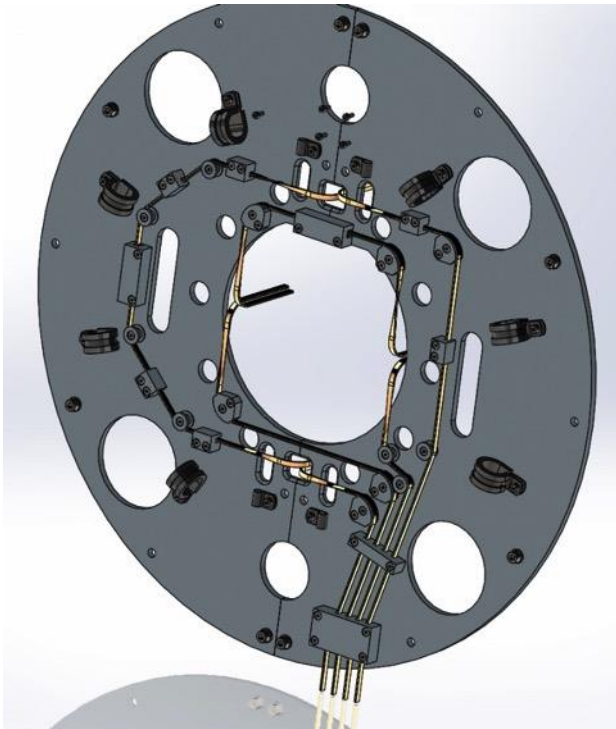
## Inner dipole assembly (2/2)

- The collared coil assembly equipped with the end-plates will be flipped from horizontal to vertical position.
- The iron laminations will be stacked using the yoke assembly tooling designed for MQXC magnet.
- A specific base support to interface MCBXF magnets is being produced and will be delivered by November 14<sup>th</sup>.



# Connection plate

- The magnet leads will be stabilized using a 1.5 mm\* 4.5 mm copper strip
- The leads will be insulated and bent with custom tools.
- The Vtaps and Quench heaters leads will be plugged to specific connectors mounted on the connection plate and compatible with the existing wiring of SM18 cryostats



# Instrumentation (1/2)

- **Voltage taps:** 8 taps per coil (only one in the inner layer to monitor the layer jump). External Vtaps will be installed in the coil leads to monitor/protect the inter-coil splices and the main powering leads.
- **Quench heaters:** Only the outer layer was equipped with a trace including the QH circuit and Vtaps. Even if MCBXFB is a self protected magnet, this first prototype is used to validate the integration of the QH for the long orbit corrector (initial MCBXFA magnet protection base line using QH. Now changed to EE)
- **Strain gauges:** six cross sections per collared dipole. (Installed at CERN by EN-MME team).
- **Bullet gauges:** one coil per dipole will be instrumented with bullet gauges (installed and calibrated at CERN by EN-MME team). The inner dipole will be equipped with 8 bullet gauges (4 on each side of the coil) and 10 will be used for the external dipole

## Instrumentation (2/2)

- The final combined MCBXFB prototype will be equipped with around 600 instrumentation wires.
- CERN cryostats allow the connection of:
  - 400 wires for strain gage and mechanical measurements
  - 160 wires for voltage measurements including protection signals
  - 32 wires for quench heaters.



**Ciemat**

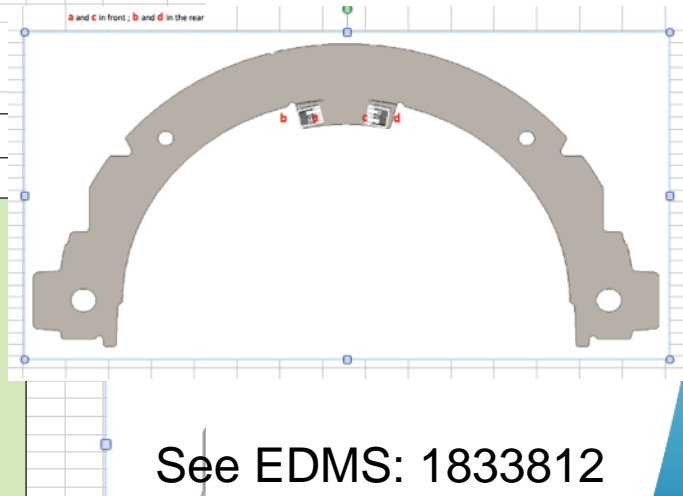
## Wiring plan for MCBXF Magnet

**EDMS number :** 1833812

**Follow this file for the Fischer connection :**



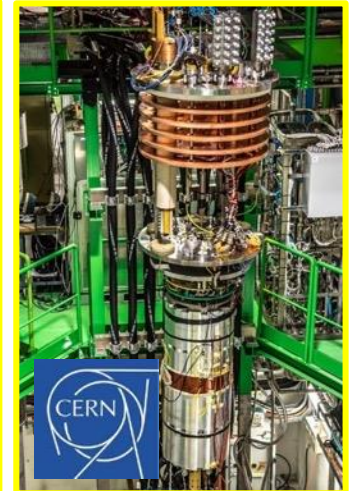
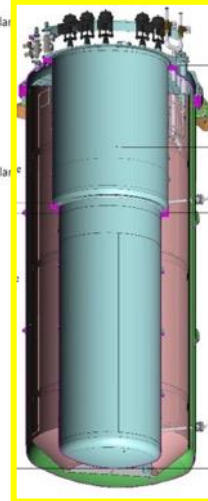
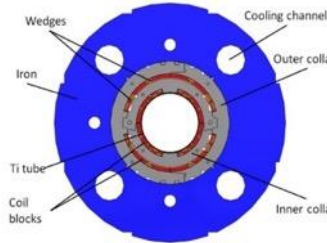
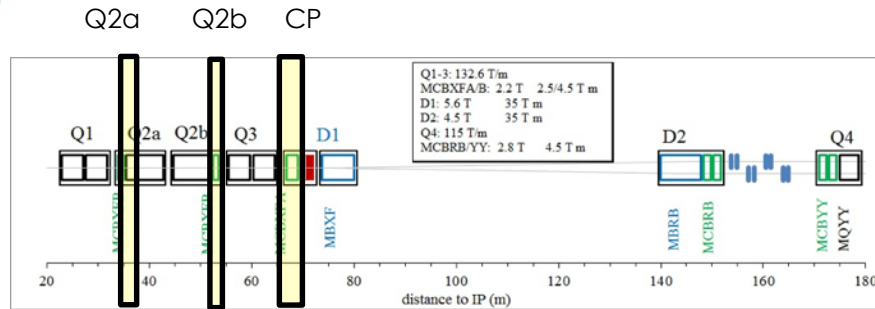
### Collars on the inner dipole

[illegible]

See EDMS: 1833812



# MCBXFA/B series test strategy



## VERTICAL TEST

Single aperture/nested

2 NbTi dipoles

Length/Diameter : 1500/630 mm

Test @ CERN D; @UPSALLA

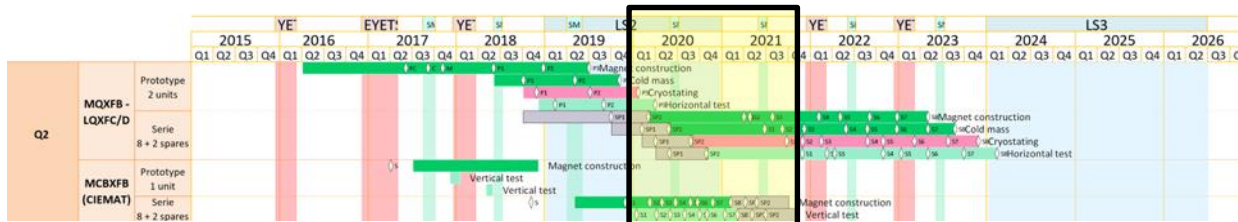
- 1.7 kA with EE and dump
- Test @ 1.9 K
- Max current Proto: 3.2 kA
- Max energy: 0.24 MJ
- Total weight: 2.9 t



UPPSALA  
UNIVERSITET



CERN and FREIA



21 magnets to be tested

Magnetic measurements at cold will only be performed @ CERN

Courtesy: M. Bajko

# MCBXFA/B prototype test @ CERN

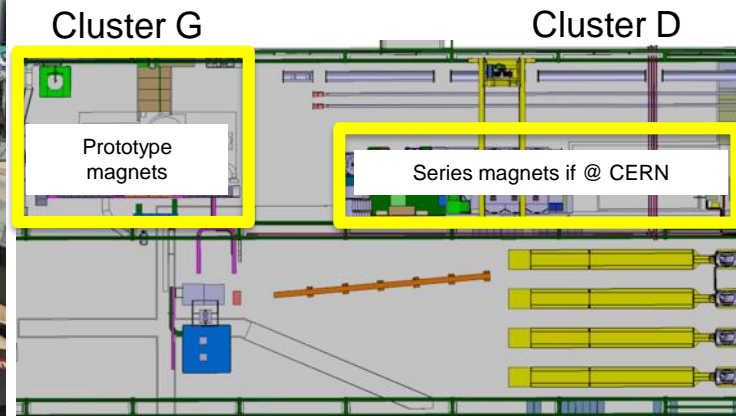


“HFM” CRYOSTAT  
ALLOWS TESTING  
MAGNETS WITH  
1500 mm diameter and  
2.5 m length

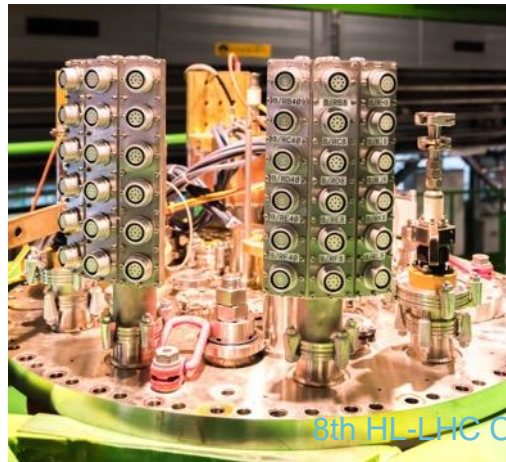
The main electrical circuit with 20 kA and  
associated EE will be used to test the first  
MCBXFB prototype in December 2018

Inner dipole test foreseen in  
December 2018

Complete dipole test scheduled  
in March 2019



400 signals for strain gauges/ 200 for V taps



“Cluster D” CRYOSTAT  
ALLOWS TESTING  
MAGNETS WITH  
800 mm diameter and  
5 m length

A secondary electrical circuit with 2 x 2 kA  
and associated EE will be implemented  
before June 2019

# Test plan

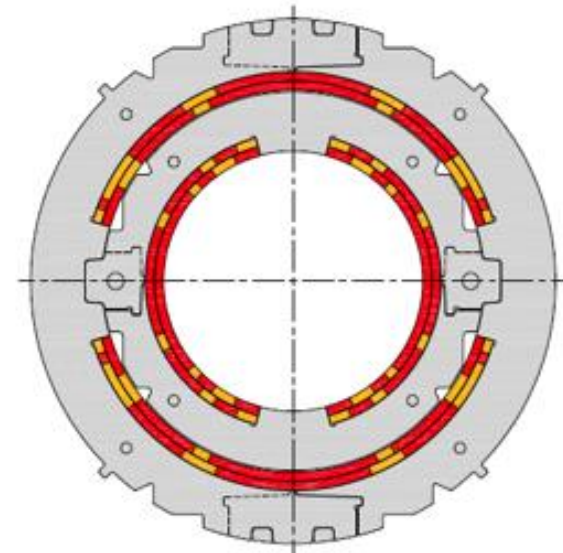
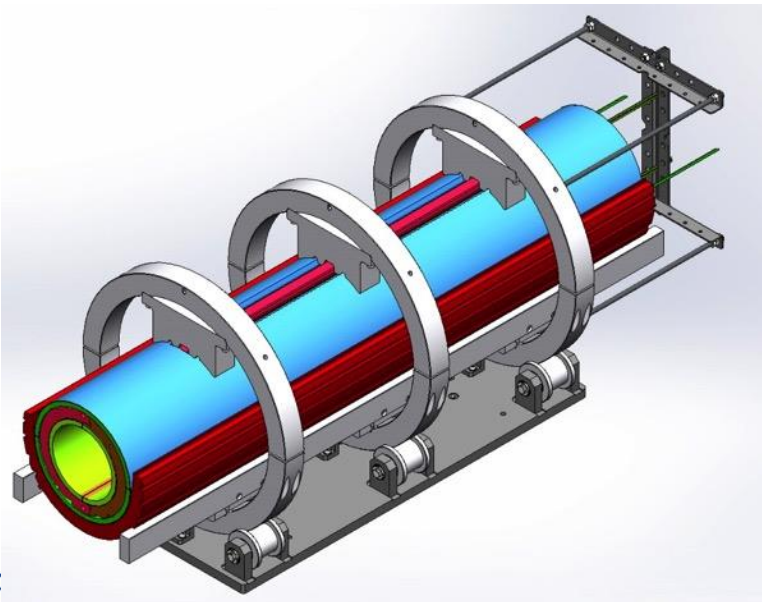
- Every single magnet will be tested at cold and up to  $I_{ultimate} = 108\% I_{nom}$  in nominal cooling conditions (1.9K)
- Systematic Powering at  $I_{nom}$  for 8 h
- High Voltage test will be performed according to individual magnet electrical insulation and design values up to specified value for 120 s, <20 mA
- Magnet protection will be done following the individual design EE
- Protection study for the first prototype using a 0.3 Ohm (variable delays) to qualify self protection of MCBXFB type magnets
- Magnet protection is based on quench detection at 50-100 mV, verification time of 10 ms and protection simultaneously with all systems
- Splice resistances measured individually and < 2 nOHM
- Quench localisation with  $V_{taps}$  and quench antenna
- Magnetic measurement with shaft
- A detailed test plan will be submitted for approval in EDMS.

Integrated into Magnet name	Q2a, Q2b MCBXFB	CP MCBXFA
I nom Inner Dipole (A)	1625	1584
I nom Outer Dipole (A)	1474	1402
Max Diameter(mm)	630.0	630.0
Max Length (mm)	1500	2500
Energy magnet (kJ/m)	60.0	100.0
Inductance (mH/m)	46.0	99.0
Dump (Ohm)	Not	0.3
Protection Heater	Not	Not
nr of magnets	10.0	5.0



# Outer dipole assembly

- We expect to have the outer coils ready and delivered to CERN by end of February 2019 (winding of the first outer coil has started at CEDEX).
- The target will be to have the full magnet assembled at CERN and tested before SM18 shut-down (scheduled in April-May 2019).
- The connection plate, iron yoke and endplates will be disassembled.
- The outer dipole will be assembled and collared around the inner dipole.
- All missing components and tooling will be delivered beginning 2019.





# Index

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# Project EDMS structure for the documentation

The screenshot displays the EDMS web interface. The top navigation bar includes 'EDMS', 'Home', 'Favourites', 'Inbox', and 'Caddie'. A search bar and 'Settings'/'Help' links are on the right. The left sidebar shows a tree view of the project structure under 'CEMAT' and 'Publications WPs'. The main content area shows details for document '1586471 v.1 Conceptual Design Report for the MCBXFB Orbit Corrector' by J. A. Garcia-Matos, F. Toral. It includes an 'Info' section with description (WP3), external reference, and keywords. A 'Details' section lists local administrators, context (HL-LHC-WP), and equipment code. A 'Files' section shows a table with one document: 'HL-WP3-MCBXFB\_Conceptual\_Report.2016.03.03.V01.docx' (4.5 MB, 2016-03-03 14:53:13, modified by Isabel BEJAR ALONSO). A 'More info' section shows tabs for 'Sub-Documents', 'Used In', 'Approval & Comments', 'Access rights', 'Versions', and 'History'. The 'Sub-Documents' tab is active, showing a table with columns: #, Id, Title, Files, Status, Created on, Author, Document type, and Tags. The table is empty, displaying 'No documents'.

All the project documentation will be accessible in EDMS (Minutes, specifications, drawings, manufacturing records, procedures...). A lot of documents have already been uploaded. More will come soon....

Special thanks to Hector, Beatriz, Ruth and Nicolas for their help

# Project EDMS structure for the documentation

The screenshot displays the EDMS web interface. The top navigation bar includes links for Home, Favourites, Inbox, and Caddie, along with a search bar and settings/help options. The left sidebar shows a tree view of the project structure, with the 'Conceptual Design Report for the MCBXFB Orbit Corrector' selected. The main content area shows the details of this document, including its description (WP3), external reference, keywords, and associated links. Below the details, there is a 'Files' section showing a table of documents, and a 'More info' section with tabs for Sub-Documents, Used In, Approval & Comments, Access rights, Versions, and History. The 'Sub-Documents' tab is currently active, showing a table with columns for #, Id, Title, Files, Status, Created on, Author, Document type, and Tags. The table is currently empty, displaying 'No documents'.

EDMS Home Favourites Inbox Caddie Search Settings Help

1586471 v.1 In Work Restricted access  
Conceptual Design Report for the MCBXFB Orbit Corrector by J. A. Garcia-Matos, F. Toral

Note  
Created on 2016-01-26  
Last Modified on 2016-04-01

Edit Status Share Visibility More

**Info**

Description: WP3 External reference: Keywords:

**Details**

Local administrators: List of Administrators  
Context: HL-LHC-WP  
Associated Links: High Luminosity LHC Workpackages Context

Equipment code: HL-OWNER  
Release procedure: HL-OWNER Release Procedure

**This page** <https://edms.cern.ch/document/1586471/1>

**Files**

Add Delete Download all Per page 10 View mode

Name	Size	Last modified date	Last modified by
HL-WP3-MCBXFB_Conceptual_Report.2016.03.03.V01.docx	4.5 MB	2016-03-03 14:53:13	Isabel BEJAR ALONSO

Page 1 of 1 Total: 1 (displaying 1 - 1)

**More info**

Sub-Documents Used In Approval & Comments Access rights Versions History

Create subdocument Attach document Detach Export to Excel Request access Add all to Caddie Edit Tags Download files Hide Obsolete Per page 100 View mode

#	Id	Title	Files	Status	Created on	Author	Document type	Tags
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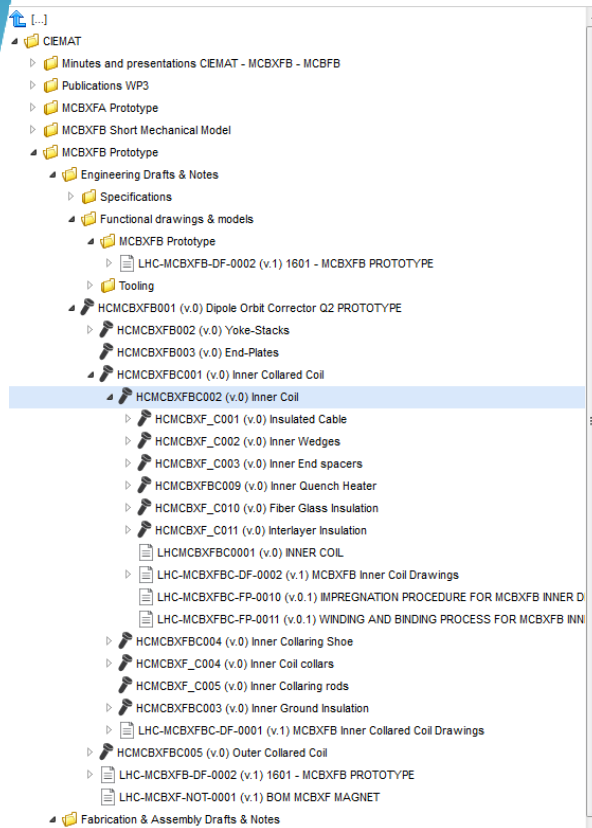
No documents

Page 1 of 1 No data to display

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Special thanks to Hector, Beatriz, Ruth and Nicolas for their help !

# Drawings

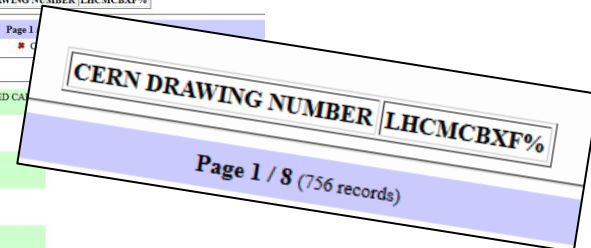


Info									
More info									
Documents									
B.O.M Assets Used in Access rights History									
Create new document Attach document Detach Auto Link Export to Excel Request access Add all to Caddie Edit Tags Download files									
#	Id	Title	Files	Status	Created on	Author	Document type	Tags	
10	LHCMCBXFB0001 v.0	INNER COIL	@ 2	Released	2018-10-03	HL-LHC - CIEMAT	Drawing		
20	LHC-MCBXFB-DF-0002	MCBXFB Inner Coil Drawings		In Work	2018-10-05	CIEMAT	Drawing Folder		
30	LHC-MCBXFB-PP-0010	IMPREGNATION PROCEDURE FOR M...	@ 1	In Work	2018-10-10	Jesus Angel Garcia	Fabrication Proc...		
40	LHC-MCBXFB-PP-0011	WINDING AND BINDING PROCESS F...	@ 1	In Work	2018-10-10	J.A. Garcia Matos	Fabrication Proc...		



## Fast Retrieval Result

CERN DRAWING NUMBER LHCMCBXF%									
Current version archived AND available									
Drawing Number	Current	Last Arch.	Form.	DO	Label	Title	(Click on % to visualize the drawing)		
✓ LHCMCBXFB0001	1st	6.0	1st	A3	01	For Execution HL-LHC DIPOLE NESTED CORRECTOR - INSULATED CA			
✓ LHCMCBXFB0001	1st	6.0	1st	A2	CM	For Execution ext. ref: 1601-07-01 Yoke LAMINATION V4			
✓ LHCMCBXFB0002	1st	6.0	1st	A4	CM	For Execution ext. ref: 1601-08-04 PUSHER			
✓ LHCMCBXFB0001	1st	6.0	1st	A0	CM	For Execution ext. ref: 1601-01 INNER COIL			
✓ LHCMCBXFB0002	1st	6.0	1st	A1	CM	For Execution ext. ref: 1601-01-10 INNER QUENCH HEATER			
✓ LHCMCBXFB0003	1st	6.0	1st	A0	CM	For Execution ext. ref: 1601-02 OUTER COIL			
✓ LHCMCBXFB0004	1st	6.0	1st	A1	CM	For Execution ext. ref: 1601-02-10 OUTER QUENCH HEATER			
✓ LHCMCBXFB0005	1st	6.0	1st	A0	CM	For Execution ext. ref: 1601-03 INNER COIL GROUND INSULATION			



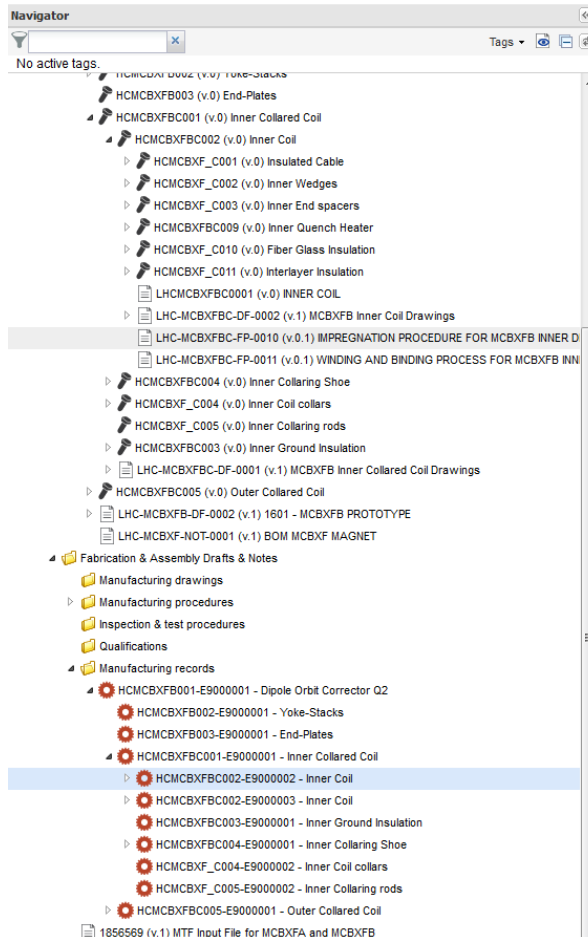
Around 50% of the 900 drawings generated for the project have been uploaded and controlled in EDMS/CDD.

They are linked to the equipment in the EDMS project structure.

The last revision of the missing drawings will be completed at CIEMAT in 2 weeks



# Manufacturing documentation (MTF)

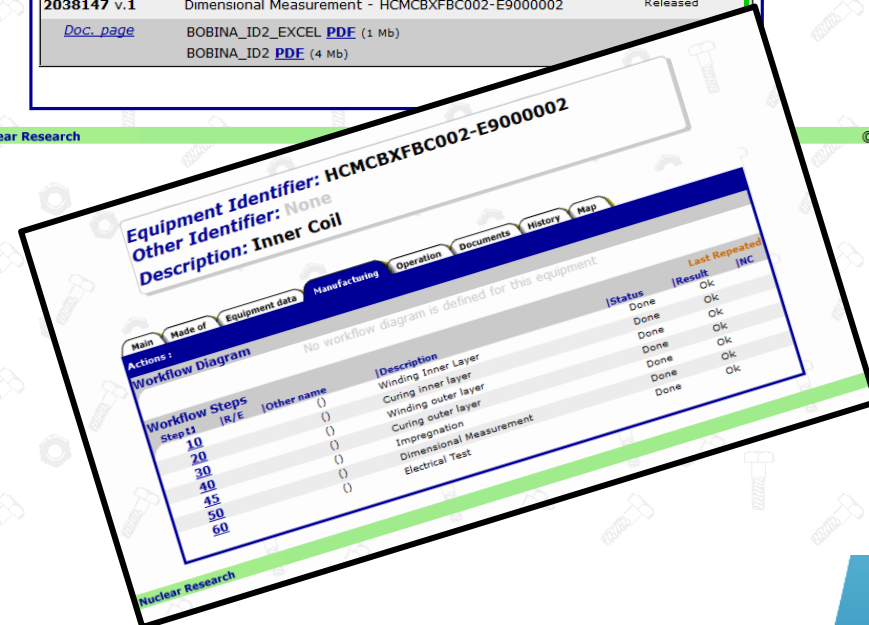


## Equipment Folder: Documents

**Equipment Identifier:** HCMCBXFB002-E9000002  
**Other Identifier:** None  
**Description:** Inner Coil

Main Made of Equipment data Manufacturing Operation Documents History Map			
Actions :			
2037946 v.1	MCBFB Inner Coils Winding Monitoring File	Released	
<a href="#">Doc. page</a>	MCBFB_Inner_Coils_WindingMonitoringFile_V5 <a href="#">xlsx</a> (847 Kb)		
2037973 v.1	Electrical Test - HCMCBXFB002-E9000002	Released	
<a href="#">Doc. page</a>	20180806_Traveler_MCBFB_Coil_ET_IC2_ <a href="#">xslm</a> (65 Kb)		
2038147 v.1	Dimensional Measurement - HCMCBXFB002-E9000002	Released	
<a href="#">Doc. page</a>	BOBINA_ID2_EXCEL <a href="#">PDF</a> (1 Mb)		
	BOBINA_ID2 <a href="#">PDF</a> (4 Mb)		

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The 3 first inner coils produced are documented in MTF

# View of the 1<sup>st</sup> prototype structure in MTF

**MTF**  
Equipment Management Folder  
Actions : [Show NCR Report](#)

### Assembly Tree

- HCMCBXFB001-E9000001 - Dipole Orbit Corrector Q2
  - HCMCBXFB002-E9000001 - Yoke-Stacks
  - HCMCBXFB003-E9000001 - End-Plates
  - HCMCBXFB001-E9000001 - Inner Collared Coil
    - HCMCBXFB002-E9000002 - Inner Coil
    - HCMCBXFB002-E9000003 - Inner Coil
    - HCMCBXFB003-E9000001 - Inner Ground Insulation
    - HCMCBXFB004-E9000001 - Inner Collaring Shoe
    - HCMCBX\_C004-E9000002 - Inner Coil collars
    - HCMCBX\_C005-E9000002 - Inner Collaring rods
  - HCMCBXFB005-E9000001 - Outer Collared Coil

### Equipment Folder : Main Info

**Equipment Identifier:** HCMCBXFB001-E9000001  
**Other Identifier:** None  
**Description:** Dipole Orbit Corrector Q2

Main | Made of | Equipment data | Manufacturing | Operation | Documents | History | Map

Actions : [View summary](#)

**Physical**

Manufacturer	CIEMAT
Resp. Technique	
Status	Manufacturing
Other Identifier	
Parent Equipment	
Parent Slot	
Location	
State	Good
	MRC M01

**Safety**

RP Classification	
-------------------	--

**Comments**

--

**Design**

Item in ABS	Dipole Orbit Corrector Q2 PROTOTYPE (ver.0)
-------------	---



**Audit**

Created on	2017-10-31	by	MANEVES
Last modified on	2018-08-17	by	TKRASTEV
EDMS owner	HGARCIA	EDMS group	HL-LHC-WP3-MCBXF-MTF

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# Procedures

- The first draft procedures (winding and coil binding) are uploaded in EDMS and are being finalized
- The coil impregnation procedure document is well advanced.
- The magnet assembly procedure will be produced in the next weeks, once validated during the prototype assembly at CERN.
- A draft of the MIP exits and will be reviewed in the coming weeks



EDMS NO.  
2036645

REV.  
0.1

VALIDITY  
DRAFT

REFERENCE : LHC-MCBXFB-FP-0011

---

**PROCEDURE**

---

**WINDING AND BINDING PROCESS FOR MCBXFB INNER DIPOLE COILS**

---

**Abstract**  
This document depicts the sequence of operations to be performed for the winding and binding operation of the MCBXFB inner dipole coil. All materials and tools necessary are here described. The operations include winding and binding of the inner layer, interlayer installation and finally, winding and binding of the outer layer. The coil ends ready to be transferred to the impregnation mould assembly table.

---

**TRACEABILITY**

Prepared by: J.A. Garcia Matos	Date: 20YY-MM-DD
Verified by: F. Toral, J. Calero	Date: 20YY-MM-DD
Approved by: J.C. Pérez	Date: 20YY-MM-DD
Distribution: WP Members, PO	

Rev. No.	Date	Description of Changes (major changes only, minor changes in EDMS)

EDMS Home Favourites Inbox Caddie

Navigator

No active tags.

[-]

CEMAT

Minutes and presentations CEMAT - MCBXFB - MCBFB

Publications WP3

MCBXFA Prototype

MCBXFB Short Mechanical Model

MCBXFB Prototype

Engineering Drafts & Notes

Specifications

1586471 (v.1) Conceptual Design Report for the MCBXFB Orbit Corrector

Functional drawings & models

MCBXFB Prototype

LHC-MCBXFB-DF-0002 (v.1) 1601 - MCBXFB PROTOTYPE

Tooling

HCMCBXFB001 (v.0) Dipole Orbit Corrector Q2 PROTOTYPE

Fabrication & Assembly Drafts & Notes

Manufacturing procedures

LHC-MCBXFB-FP-0010 (v.0.1) IMPREGNATION PROCEDURE FOR MCBXFB INNER DIPOLE COILS

LHC-MCBXFB-FP-0011 (v.0.1) WINDING AND BINDING PROCESS FOR MCBXFB INNER DIPOLE COILS

Qualifications

Manufacturing records

1856569 (v.1) MTF Input File for MCBXFA and MCBXFB

Test Drafts & Notes

2036645 v.0.1 | LHC-MCBXFB-FP-0011 v.0.1 In Work Re

WINDING AND BINDING PROCESS FOR MCBXFB INNER DIPOLE COILS

Info

Description:

Details

Local administrators: List of Administrators

Context: HL-LHC-WP3-EXT

Context for WP3 with the QA team from bid 180

Associated Links:

This page <https://edms.cern.ch/document/2036645/0.1>

Files

Add Delete Download all

IC\_Winding\_and\_Binding\_Procedure\_Hilumi.docx

72.2 MB

2018-10-10 16:47:01

BEATRIZ ALMEIDA FERREIRA




More info

Sub-Documents Used In Approval & Comments Access rights Versions History

Create subdocument Attach document Detach Export to Excel Request access Add all to Caddie Edit Tags Download files Hide Obsolete Per page 100

# Id Title Files Status Created on Author Document type Tags

No documents



EDMS NO.  
0000000

REV.  
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VALIDITY  
DRAFT

REFERENCE: LHC-EQCOD-FP-0000X

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**HL-LHC: Quality Manufacturing and Inspection Plan**

---

Prepared by: J. Garcia Matos, F. Toral	Date: DD/MM/20YY	Project: HL-LHC	Supplier: CIEMAT	Item Eq. Code: LHC/MCBXFA/B	Asset Code (LHC Part Identifier): HCMCBXFA001-E9000001 HCMCBXFB001-E9000001
Verified by: J.C. Perez	Date: DD/MM/20YY	Work Package: WP03	Client: CERN	Item description: Q2 Corrector magnet (MCBXFB) and Corrector package magnet (MCBXFA)	EDMS Report No:
Approved by: E. Todesco	Date: DD/MM/20YY				

No	ACTIVITY / OPERATION	APPL. STANDARDS / NORMES APPL.	APPLICABLE DOCUMENTS / DOCUMENTS APPLICABLES	REV. DOC.	INSPECTION / CONTRÔLE				REV. DOC.	NOTES / COMMENTAIRES
					SUPPLIER / CONTRÔLE	CLIENT / VÉRIFICATION	3 <sup>rd</sup> PARTY / SURVEILLANCE	INSPECTION REPORT / RAPPORT D'INSPECTION		
					Code	Signature/Date	Code	Signature/Date	Code	Signature/Date
1	PREPARATION									
1.1	Verification all the components are ready to be used									All the components for coils, collared coils and magnet assembly to be ready and without non conformities
	Verification all the									

	Size	Last modified date	Last modified by
IC_Winding_and_Binding_Procedure_Hilumi.docx	72.2 MB	2018-10-10 16:47:01	BEATRIZ ALMEIDA FERREIRA

# Summary & Conclusions

- The inner dipole of the first MCBXFB prototype will be collared in the model magnet laboratory on 5<sup>th</sup> of November
- The magnet assembly will follow after reception of last remaining components and tooling to be delivered at CERN during 3<sup>rd</sup> week of October
- CERN will give high priority to this magnet assembly (interference with on going activities in the Model Magnet Laboratory)
- We expect to have a first run of cold powering tests before Xmas break
- This is an aggressive planning! We are running out of time!
- A detailed test plan will be submitted for approval
- The magnet documentation upload to EDMS has started and will be completed in the next coming weeks

**Thanks for your attention**