

Status of D2 prototype cold mass

H. Prin, T. Bampton, N. Bourcey

Design Office: Magnets: Cryostat and cold tests interfaces : Assembly procedures and tests : Busbars and Splices: Quality insurance and documentation: Geometry: Magnetic measurements: O. Id Brahmane

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- A. Vande Craen, D. Duarte Ramos
- T. Bampton, N. Bourcey, L. Grand-Clement, A. Milanese
- R. Principe, L. Favier
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- P. Bestmann
- L. Fiscarelli

WP3 meeting https://indico.cern.ch/event/1123666/

16/02/2022

Outline

- Design Status
- Prototype Assembly Process & Status
- Tooling
- Documentation
- Proposed magnet improvements for the series
- Summary



Introduction

In July 2021, a design update for the prototype was requested by the WPL to assess the MBRD prototype performance using the existing SM18 test station.



Main changes with the series:

- Cryo-assembly turned by 180° on the test bench
- 13kA busses routing on the bottom to std position M3
- 600A busses routing on top to std position M2
- Helium feeding line (N) on top to the rear of the cold mass rather than inside
- Bayonet heat exchanger rather than multiple finger version
- Magnets longitudinal positions displaced by 100mm (proposed 200mm for the series)
- Soldering of 3rd lead to test each aperture individually

Design Status

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Prototype Cold Mass

3D Model: ST0796233_01 Drawing Folder: EDMS 2638369

EDMS 🚺 Home 🔛 Favourites - 🥅 Inbox - 🔚 Cadd

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| ¥ | × | aga = 🙀 🖂 (# | D2 | PROTOTYPE ASSE | MBLY - LMBRDP by OUS | SSAMA ID BA | HMANE 📾 | | |
| No active tags. | | | 金芾 | | | | | | |
| ELI. | | | | | | | | | |
| a O2 proto | | | | 6 x | | | | | |
| · [4] 2636369 | (v.1) D2 PROTOTYPE ASSEMBLY - LMERDP | _ | Sub-D | ocuments Used in | Approval & Comments A | ccess rights | Versions H | story | |
| Eline | MERCENSION (VAC) LINEND COLDINASS ASSEMBLY - PROTOTITIE | | | | mountail Dature 1 | Event to Even | Bacunstacca | an I Add all to Ct | atta i li |
| ED LHC | MOXE \$50007 (VAB) COLD MASS TRIPLET SUPPORT | | and a little | monormal Lonarda | and a second of the | Expert to Exce | n neques acce | En contrata de la Ca | Course . |
| E LHC | MBRDE0046 (v 0) LMBRD 4 D SUB CONNECTION OUTLET ASSY | | | | | | | See that they | Created on |
| III UHCI | MBRDE9053 (v.9) LONG BOX CONNECTORS 4 D SUB | | 10 | CHCCMDROP0001 V/ | A LMERD COLUMASS ASSEMBLY | # E | Released | Loading | 2022-02-0 |
| 🗐 инси | MBRDE8049 (v 0) INNER SUPPORT FLANGE 4 D SUB | | 20 | LHCLMBRDS0050 v | D2 COLD MASS PROTOTYPE - | UN 02 | E Released | Loading | 2021-07-3 |
| D LHCI | MBRDE0052 (v 0) SUPPORT FLANGE 4 D SUB | | E 30 | LHCLMQXF_S0007 | . COLD MASS TRIPLET SUPPOR | IT @ 2 | Released | Loading | 2018-06-0 |
| E LHCI | MBHDE9054 (VID) Outer D Sub Connection Plange MOXERTS/022 /VID: PLIMPING TIP | | 40 | LHCLMBRDE0046 v | LMBRD 4 D SUB CONNECTION | 0. #2 | Released | Loading | 2019-03-0 |
| i unci | MERDE0050 (x 0) OUTER SUPPORT FLANGE 4 D SUB | | 50 | LHCLMBRDE0053 vi | LONG BOX CONNECTORS 4 D | SLIR # 2 | Released | Loading | 2019-03-0 |
| DHCI | MBRDE0145 (v.0) D2 COLD MASS - IFS ASSEMBLY - LEFT (MCBRD - PROTO) | | | | | | | | |
| LHCI | MBRDE0136 (v 0) D2 COLD MASS + IFS FLANGE - 010/12 | | 60 | LHCLMBRDE0049 V | INNER SUPPORT FLANGE 4 D | SUB 92 | Released | Loading | 2019-03-0 |
| LHC | MBRDE0137 (v.0) D2 COLD MASS - IFS WARM HEAD 010/12 | | E 70 | LHCLMBRDE0052 v) | SUPPORT FLANGE 4 D SUB | 0.2 | Released | Loading | 2019-03-0 |
| E UHCI | MORF_50033 (v0) INNER TRIPLET_IFS FLANGE | | 171.00 | LHCLMBRDE0054 v | 0 Outer D Sub Connection Flance | 0.2 | Released | Loading | 2019-03-0 |
| E LHCI | MERCENNER OF COLOMARS REPORT FILE AND AN AND AND AND AND AND AND AND AND | | | | | | - | | |
| E LHCI | MERDSNOT (v.d) D2 COLD MASS PROTOTYPE - FLEXIBLE LINE V ASSEMBLY | | E 90 | LHULMUNPD150022 | 2. FOWEING THE | 0.3 | Hereased-App | Loading | 2018-08-2 |
| E LHCI | M6RDE0121 (v.0) D2 COLD MASS - CABLES INSULATING GUIDE -LOCK PLATE | | E 1 | LHCLMBRDE0050 v | OUTER SUPPORT FLANGE 4 D | SUB @ 2 | Released | Loading | 2019-03-0 |
| D LHCI | MERDS4046 (v AB) D2 COLD MASS PROTOTYPE - END COVER FLANGE M2 | | 10.1 | LHCLMBRDE0145 v | 0 D2 COLD MASS - IF'S ASSEMBL | y #2 | Released | Loading | 2021-09-1 |
| EHCI | MBRDSI046 (V AA) D2 COLD MASS PROTOTYPE - END COVER FLANGE M2 | | | | | 2 | | | |
| LHCI | MBRDS0009 (vAA) HL-LHC COLD BORE D2 ASSEMBLY | | E3. * | LHCCMDRDEV136 V | V D2 COLD MASS - IPS FLANGE - | -101 V X | Released | Loading | 2021-07-1 |
| III LHC | /SCSC0301 (vAD) HL4HC COLD BORE D2 TYPE D2 TYPE | | E 1 | LHCLMBRDE0137 v) | 0 D2 COLD MASS - IFS WARM HE | JAD @ 2 | Released | Loading | 2021-07-1 |
| E LHCI | MBRDE9119 (±0) D2 COLD MASS - CCT CABLES INSULATING DUDE FILLER MBRD59647 (±0) D2 COLD MASS PROTOTYPE - FLANGE M3 | | E 1 | LHCLMQXF_S0033 | INNER TRIPLET_IFS FLANGE | 6 2 | 📒 Ready For App | Loading | 2019-10-1 |
| UHCI | MBRDS9051 (v.0) D2 COLD MASS PROTOTYPE - LINE X EXTERNAL ELBOWS | | 10.1. | LHCLMQXF_E0032 | 90' BEND WITH STRAIGHT END | 05_ 02 | Ready For App | Loading | 2020-02-0 |
| E LHCI | M8H50026 (vA8) 11T DIPOLE COLD MASS ASSEMBLY - LINE X MALE WELDING FLANGE V | WTH T | | LUCI MERCINANT | | | - Contract | A sectors | |
| LHCI | MB_50302 (<0) LINE X MALE WELDING FLANGE - WITH PRESSURE TEST RING | | - 1 m | CHCCMDRD DV043 K | V UZ COLD MASS PROTOTTPE - | M 9 * | Released | reading | 2021-06-0 |
| E LHCI | AB_S0090 (xAD) MAGNET BENDING COLD MASS ASS X TYPE EXTERNAL EQUIPED BEL | LOW | E 1 | LHCLMBRDS0057 v) | 0 D2 COLD MASS PROTOTYPE - | FL. # 2 | Released | Loading | 2021-09-2 |
| E LHCI | MERD\$9648 (v 0) D2 COLD MASS PROTOTYPE - END COVER FLANGE - LINE X | | 10.1. | LHCLMBRDE0121 v | D2 COLD MASS - CABLES INSU | RA. #2 | Released | Loading | 2021-03-1 |
| El LHCI | MCAP_SOUT (vAC) is SM USDOMM SHELL MERCIPANT | | - | | | EN # 2 | Released | Loadon | 2021-00-0 |
| ET LINCO | MERCENDA (V 5) 02 COLD MASS - M2 PERABLE DIVIS | | E3 614 | Enclanded Solard C | A DE COLD MASS PROTOTITE - | DATE OF A | - Nereases | Loading | 2021-09-0 |
| ELHO | MERDE0063 (v AA) CCT 600A Leads Spice box bottom part | | E. 1. | LHCLMBRDS0045 v | A D2 COLD MASS PROTOTYPE - | EN_ 0.1 | In Work | Loading | 2021-10-2 |
| I LHC | ME_S0245 (VAA) MAGNET BENDING COLD MASS ASS -N LINE EXTREMITY ASS | | E 2 | LHCLMBRDS0009 v | A HLILHC COLD BORE D2 ASSEM | ABLY 0 2 | Released | Loading | 2021-12-1 |
| E LHCI | MB_50248 (x0) N LINE EXTREMITY ASS - ROTATING FLANGE | | 2 | LHCVSCSC0001 v Al | D HL-LHC COLD BORE D2 TYPE | 02 # 2 | Ready For App | Loading | 2020-11-0 |
| EHC! | VE_S0247 (x.0) N LINE EXTREMITY ASS - ADAPTATOR #1.1 46/#1.1 66 | | | | | | _ | | |



| | 1 LHCLMBRDE0137 v.0 D2 COLD MASS - IFS WARM HEAD | 0.2 | Released | Loading |
|-----------|--|-----|-----------------|---------|
| | T LHCLMOXF_S0033 V/ INNER TRIPLET_IFS FLANGE | 0.2 | 📕 Ready For App | Loading |
| | t LHCLMQXF_E0032 v1 90' BEND WITH STRAIGHT ENDS | 02 | 📕 Ready For App | Loading |
| AE WITH T | T. LHCLMBRDS0043 v0 D2 COLD MASS PROTOTYPE - M | 02 | Released | Loading |
| BELLOW | 1. LHCLMBRDS0057 v0 D2 COLD MASS PROTOTYPE - FL. | # 2 | Released | Loading |
| | 1. LHCLMBRDED121 v0 D2 COLD MASS - CABLES INSULA | # 2 | Released | Loading |
| | 1. LHCLMBRDS0046 vA D2 COLD MASS PROTOTYPE - EN | 82 | Released | Loading |
| | 1. LHCLMBRDS0046 vA D2 COLD MASS PROTOTYPE - EN | 0.1 | In Work | Loading |
| | 2. LHCLMBRDS0009 VA HL-LHC COLD BORE D2 ASSEMBLY | 02 | Released | Loading |
| | 2 LHCVSCSC0001 v AD HLUHC COLD BORE D2 TYPE D2 | # 2 | Ready For Apr | Loading |
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Series Cold Masses

3D Model: 1232783_01 Drawing Folder: EDMS 2684106

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| e tags. | * | 14 | | | | | | | |
| d mass | | | | | | | | | |
| 2684106 (v. 1) LMBRD COLD MASS (D2) | | wore m | JU | | | | | | |
| LHCQIH_0002 (vAA) COPPER PLATE FOR HEATER HS100 | | Sub-Do | ocuments Used In | Approval & Comments | Access n | ights | Versions Histo | Dry. | |
| LHCLMBRDS0003 (v.AB) D2 COLD MASS - EQUIPPED END COVER IP SIDE | | | | ocument Delach | Export to | Excel | Request access | Add all to | Cedde E |
| HCLMBRDS0013 (vAA) D2 COLD MASS - LINE N TUBE 053-50 L+52 | | male | and a second sec | Tala | - separate | Fies | Clabis | SmarTeam | Created on |
| LHCLMBRDS0014 (V.AA) D2 COLD MASS - IFS OUTLET ELBOW ASSEMBLY | | | | CORRER DI ATE EOR HEAT | TED HERAD | 0.2 | - Released | 1 anding | 2021.09.17 |
| LHCLMBRDS0015 (v.AA) D2 COLD MASS - IFS OUTLET MACHINED TUBE 076.1 | | E 1 | LHGGan_0002 \$745 | COPPER PLATE FOR HEAR | IER HOIN | 4.6 | Carato an | Loading | 2021-00-17 |
| LHCLMBRDS002 (vAH) D2 END COVER NON CONNECTION SIDE - SERIES | | 凹 1 | LHCLMBRDS0003 v.AE | D2 COLD MASS - EQUIPPE | ED END C | 01 | Checked | Loading | 2022-01-19 |
| LHCLMBRDS0010 (VAA) D2 COLD MASS - LINE N - FLANGE IN TERFAGE-OD 0104.3 | | E 1 | LHCLMBRDS0013 v.A/ | D2 COLD MASS - LINE N T | UBE Ø53 | 02 | Released | Loading | 2022-01-19 |
| LHCLMBRDS0011 (v) 400 DE RING ANNEAU DE GUIDRE | | - | | - | CT CLO | 0.2 | Defended | Landau | 2022 04 40 |
| LHCDCCM48943 (v0) CLAMP - FOR FIXING SUPPORT | | E tur | LINGLMBR030014 470 | DZ COLD MASS - IFS OUTL | LET ELD | | Keleasen | Loading | 2022-01-18 |
| LHCLMBRDS0034 (vAA) D2 COLD MASS - LINE N CENTRAL PROTECTION SHEET | | E 1 | LHCLMBRDS0015 v.A/ | D2 COLD MASS - IFS OUTL | LET MAC | 02 | Released | Loading | 2022-01-31 |
| LHCDCCM40042 (v.0) CLAMP - FOR SLIDING SUPPORT | | 11. | LHCLMBRDS0002 v Al | D2 FND COVER NON CON | NECTIO. | 03 | Released | Loading | 2020-11-19 |
| LHCLMBRDS0025 (vAA) D2 COLD MASS - LD1 LINE ASSEMBLY | | - | | | | | - | | |
| LHCLMBRDS0028 (v.AA) D2 COLD MASS - LD1 TUBE D2 VERTICAL WING | | 2 1 | LHCLMBRDS0010 VA | D2 COLD MASS - LINE N - I | FLANGE | 0.1 | In Work | Loading | 2022-01-19 |
| HCLMBRDS0027 (v.AA) D2 COLD MASS - LD1 TUBE D2 HORIZONTAL WING | | E 1 | LHCLMQXF_S0011 v.0 | GUIDE RING ANNEAU DE C | GUIDAGE | 02 | Released | Loading | 2018-08-27 |
| LHCLMBRDS1029 (vAA) D2 COLD MASS - LD1 GUIDING TUBE | | - | LHCLMBRDS0011 v.A/ | D2 COLD MASS - LINE N S | ECVE . | 01 | Checked | Loading | 2022-01-19 |
| LHCLMBRDS0026 (v.AA) D2 COLD MASS - LD1 SUPPORT - CCT WING | | E. too | Lindentertertert | · DE COLD INVOD - CI.I.E | LEL | | - united | Lowery | 2022-07-12 |
| LHCLMBRDS0009 (vAA) HL-LHC COLD BORE D2 ASSEMBLY | | E 1 | LHCDCCMA0043 v.0 | CLAMP - FOR FIXING SUPP | PORT | 0.1 | Released | | 1999-04-26 |
| LHCVSCSC0101 (VAD) HULHC COLD BORE D2 TYPE D2 TYPE | | E 1 | LHCLMBRDS0034 v.A/ | D2 COLD MASS - LINE N C | ENTRAL | 82 | Released | Loading | 2022-01-19 |
| LHCLMOXF_S0007 (vAB) COLD MASS TRIPLET SUPPORT | | - | HCDCCMA0042 v0 | | TROOPT | | Bulanced | | -000 04 26 |
| LHCLMBRDS0040 (VAA) D2 COLD MASS - EXTREMITY PROTECTION ONCE T | | E 1 | LHUDGUMMUUML | CLAMP - FUR SLIDING OUR | PPORI | 4. | Released | | 1999-04-50 |
| DECLMBRDS1019 (VAA) 02 COLD MASS - LDT DRE INTERPACE PD-406 DeclmBRD51019 (VAA) 02 COLD MASS - IES ASSEMELY - LEFT (MCERD - SERIE) | | E 1 | LHCLMBRDS0025 v.A/ | D2 COLD MASS - LD1 LINE | ASSEM | 0.1 | E Checked | Loading | 2022-01-19 |
| I HCI MOXE S0033 (VOLINNER TRIPLET JES ELANGE | | E 1. | LHCLMBRDS0028 v.A/ | D2 COLD MASS - LD1 TUB | E D2 VER | 01 | Checked | Loading | 2022-01-19 |
| LHCLMOXF_E0032 (v 0) 90' BEND WITH STRAIGHT ENDS_DN38_MODIFIED | | | | | | | - | | |
| LHCLMBRDE0140 (v.0) D2 COLD MASS - IFS FLANGE - 20/10 | | E 1 | LHCLMBRDS0027 v.v | D2 COLD MASS - LD1 TUB | E D2 H0 | 8.1 | Checked | Loading | 2022-01-19 |
| LHCLMBRDE0139 (v.0) D2 COLD MASS - IFS WARM HEAD @8/10 | | E 1 | LHCLMBRDS0029 v.A/ | D2 COLD MASS - LD1 GUID | DING TUBE | 01 | E Checked | Loading | 2022-01-19 |
| LHCLMBHS0031 (VAA) 11T DIPOLE COLD MASS ASSEMBLY - SUPPORT OF LINE N | | 1 1 | I HOLMBRDS0026 v.A/ | D2 COLD MASS - LD1 SUP | PORT - C | 0.1 | Checked | Loading | 2022-01-19 |
| LHCLMBRD0003 (v0) D2 COLD MASS - MCBRD CYLINDER (CCT) | | - | | DE GOLD HIND BL | -0 | | - | L'erry | free or |
| LHCLMBRDE0121 (v0) D2 COLD MASS - CABLES INSULATING GUIDE 4.OCK PLATE | | 凹 1 | LHCLMBRDS0009 v.A/ | HL-LHC COLD BORE D2 AS | SSEMBLY | 62 | Released | Loading | 2021-12-16 |
| LHCLMBRDE0119 (v.0) D2 COLD MASS - CCT CABLES INSULATING GUIDE FILLER | | E 1 | LHCVSCSC0001 v.AD | HL-LHC COLD BORE D2 TY | PE D2 T | 02 | Ready For Appr | Loading | 2020-11-06 |
| I LHCLMCXF_S0001 (vAC) 6.5m.0630mm SHELL | | - | LHCI MOXE S0007 v/ | | POPT | #2 | Released | Loading | 2012-06-01 |
| LHCMCBRD0050 (vAC) MCBRD Series Magnet Assembly - Ensemble Almant Serie MCBRD | | E | Endemans _over its | COLD MAGS THE LET DOT | FORI | | - Reidered | Loading | 2010-00-01 |
| LHCUMOXP_SOUTO (V.0) WELDING BACKING STROP | | 图 1 | LHCLMBRDS0040 v.A/ | D2 COLD MASS - EXTREM | ITY PRO | 82 | Released | Loading | 2022-01-19 |
| LINCEMERDEDITIS (VII) D2 COLD MASS - COLO MALLA INSOLATING GODE | | E 1 | LHCLMBRDS0019 v.A/ | D2 COLD MASS - LD1 LINE | INTERF | 01 | Checked | Loading | 2022-01-19 |
| LINCI MRRD0002 (VA) D2 COLD MASS - D2 MRRD CVI INDER | | | | | | | | 1 | |
| LHCLMBRDE0135 (v.AA) D2 COLD MASS - D2 CABLES INSULATING GUIDE | | E 1 | LHGLMBRUEV INT VIO | D2 COLD MASS - IFS ASSE | EMBLY - L | 92 | Released | Loading | 2022-01-19 |
| LHCLMBRDE0123 (VAA) D2 COLD MASS - GUIDE FILLER | | E 1 | LHCLMQXF_S0033 v.0 | INNER TRIPLET_IFS FLAN | GE | 02 | Ready For Appr | Loading | 2019-10-15 |
| | | | | | | | | | |

Prototype Assembly Process & Status HCLMBRDP003-CR000001 Corrector Cylinder 1/2



Busbars splicing to the leads



Alignment HL-LHC PROJECT



Busses and instrumentation routing



Insulation covers re-assembly



Additional V-Taps soldering



MCBRDP1b V[-0.07, +0.18]mm, H[-0.16, +0.14]mm MCBRDP2 V[-0.13, +0.14]mm, H[-0.13, +0.14]



Backing strip welding



Transfer to the lower shell on the press conveyor

Prototype Assembly Process & Status HCLMBRDP003-CR000001 Corrector Cylinder 2/2



Transfer to the lower shell on the press conveyor (2nd trial)



Upper alignment cradles installation



Horizontal Alignment ~±0.15mm Yaw <0.04mrad



Total Vertical Alignment [-0.4,0.6]mm Pitch ~0.6mrad Roll <0.2mrad



Aluminium restraint cylinders installation



Gutter installation, busses and instrumentation wires routing



Upper shell installation



Shells longitudinal welding Cutting of the extremities

Prototype Assembly Process & Status HCLMBRDP002-CR000001 Separation dipole Cylinder 1/3



Cold bore tube insertion trial in both apertures



Alignment measurements



V alignment within [-0.13,+0.17]mm H alignment within [-0.6,+0.4]mm



Backing strip installation and welding



Transfer the magnet into the



Gutter and cable puller installation Restraint alignment and welding



Install the shell on top



Transfer to rotating bench and turn the magnet upside down

Prototype Assembly Process & Status HCLMBRDP002-CR000001 Separation dipole Cylinder 2/3



Remove upper shell Install radial restraints



Transfer the magnet and the lower shell to the press conveyor





Alignment measurements Temperature sensors installation



Backing strip to the shell weld and shims tack



Upper shell installation after developed length machining/adjustment



Gaps measurements



Longitudinal welding



Cutting of the extremities and backing strip trimming

Prototype Assembly Process & Status HCLMBRDP002-CR000001 Separation dipole Cylinder 3/3

Third lead soldering between the two apertures







Here we are today



Next Steps



Separation dipole cylinder tilt adjustment towards gravity
Welding of supports

• Orbit correctors cylinder tilt adjustment towards gravity

Cold bore Tubes insertion

Geometrical measurements

• Orbital welding of the two cylinders

Next Steps



• Move the roller to support the welded cylinders

Adjust the longitudinal position of the third support
Weld the third support

Welding of the two end covers

Tooling

Positioning and alignment of cylinders

LHCLMB



Orbital welding

- After evaluation of the different welding options, it was concluded to stay with the initial proposal: orbital TIG
- DMOS completed
- QMOS in April then testing in accordance with PEDQS in April

Documentation 1/2

LHC-LMBRD-FP-0002: D2 Cold mass assembly flowchart **MIP** under development using the prototype assembly experience

LHC-LMBRDE-FP-0005: Electrical test flowcharts throughout the production

- CERN-0000193764: Control Procedures (34 presently)
 - LHC-MBRD-FP-0002: MBRD reception procedure
- LHC-MCBRD-FP-0013: MCBRD reception procedure
 - LHC-LMBRDP-FR-0019: Longitudinal welding report



Documentation 2/2

LHC-LMBRDP-FR-0015: LMBRDP001 Prototype cold mass assembly report



Welding report EDMS: <u>LHC-LMBRDP-FR-0019</u>



- Average welding shrinkage between 2.4 and 2.6mm
- Half of the value given from the first TIG pass



Side A

Shrinkage 1

Shrinkage 2

Shrinkage 3

Shrinkage 1

Shrinkage 2

Shrinkage 3

Shrinkage Total

Side B

Pos

Shrinkage Total

Pos

Measurement accuracy to be improved in the coming weeks thanks to ongoing developments

1.9

Manufacturing and Test Folder (MTF)

| T MTF | Home | Help EDMS Portal News Login |
|---|--|---|
| Equipment Management Folder | | User: HPRIN |
| Actions : Show NCR Report | Search : E | Equipment Location Slot System |
| HCLMBRDP001-CR000001 - Cold mass D2 (prototype) HCLMBRDP002-CR000001 - Cold mass cylinder with separate and the separate | Equipment Folder: Manufacturing Workflow | |
| HOMBRDP001-02000001 - HL Recommandon Dipole (U2) HOMBRDP01-02000002 - Aperture V2 (MBRDP) HOMBRDC001-02000003 - Aperture V1 (MBRDP) HOMBRDP002-3B000001 - ALUMINUM ALLOY SLEE HOMBRDP003-02000001 - IRON YOKE HOMBRDP003-02000001 - IRON YOKE | Equipment Identifier: HCLMBRDP002-CR000001 Other Identifier: None Description: Cold mass cylinder with separation dipole | Parent and child attachme |
| HCMBRDP006-0200001 - INSTRUMENTATION General Construction Construction Construction HCMBRDP006-02000001 - CCLAMPS HCMBRDP007-02000001 - CCLAMP WELDED PLAT HCMBRDP007-02000004 - MQXFB SHELL Q2 PROTC HCMMXE SOLIA-P0000104 - MQXFB SHELL Q2 PROTC HCMMXE SOLIA-P000104 - MQXFB SHELL Q2 PROTC | Main Made of Equipment data Manufacturing Operation Documents History Map Actions : Add extra step | |
| HOLINEAR _SUD 34-00011 - INCAR B SHELL G2 FXOTC HOLITESCKT-CR025040 - Cryo Thermometer (A1, UP) HCAITESCKT-CR025040 - Cryo Thermometer (A2, UP) HCMCBRDP010-CR000001 - Cold mass cylinder with orbit cc HCMCBRDP01-CR000012 - MCBRDP Prototype Correctc | Workflow Diagram No workflow diagram is defined for this equipment Workflow Steps Step 11 R/E Other name Description Step 20 Metrology on assembly bench | Last Repeated |
| HCMCBRDC02-CR000001 - MCBRD Prototype Coil A HCMCBRD_C03-CR000001 - MCBRD Series Coil As HCMCBRDF41-U000001 - MCBRD Prototype Magnet As HCMCBRDC41-IU000001 - MCBRD Prototype Coil As HCMCBRDC41-IU000002 - MCBRD Prototype Coil As HCMCBRDC41-IU000002 - MCBRD Prototype Coil As | 10 0 Aperture 1 cold bore insertion (*) 20 6 Clear the statistication and ster A1 CBT removal (*) 10 6 Clear the statistication and ster A1 CBT removal (*) 10 6 Clear the statistication and ster A1 CBT removal (*) 50 6 Clear the statistication and ster A2 CBT insertion and ster A2 CBT removal (*) 55 6 Magnetic measurement on the cradile (*) 60 6 Clear the statistication and ster A2 CBT insertion (*) | Done Ok Done Ok Done Ok Done Ok |
| HCMCBRDP43-U000001 - Fix End Plate (CS) HCMCBRDP43-U000001 - Fix End Plate (NCS) HCMCBRDP44-U000001 - Yoke Lamination HCMCBRDP45-U000001 - Iron Key, HCMCBRDP46-U000001 - Hybrid Yoking Key Assem | 70 6 0 Electrical tests before welding 80 6 0 Longitudinal weldings 90 6 0 Electrical tests after welding 100 6 0 Assembly report | Done Ok Done Ok Done Ok Pending Pending |
| HCMCBRDP49-IU000001 - Yoke Rod HCMCBRDP50-IU000001 - Coil Insulation Ring (CS) HCMCBRDP51-IU000001 - Coil Insulation Ring (NCS) HCMCBRDP52-IU000001 - Voltage Taps Duct Protecti HCMCBRDP54-IU000001 - Current Lead Duct | Q CERN - European Organization for Nuclear Research | © CERN - 2022-02-11 19:12:46 |
| HCMCBRDP56-IU000001 - Current Lead Cover Duct HCMCBRDP59-IU000001 - Wire Sharing Box HCMCBRDP69-IU000001 - End Plate Wire Cover HCMCBRDP61-IU000001 - End Plate Cover Kaoton SI | | Relevant manufacturing |
| HCLMCXF_S001-AP000003 - HALF SHELL CP | | steps with their associated reports |

List of assets used to assemble the cold mass and its sub-components

MBRD Magnets changes proposal for the series



Screw restraints: use Nordlock rather than tab washers
Instrumentation wires guiding pieces: not needed on the sides
Fiducials: enlarge to Ø12H7 with an additional one on top, radial positions to be revised

Gutter for busses :

- Enlarged slot on the connection side end plate, add two threaded holes
- Ensure the key welding fillets are not protruding into the gutter area
- Splices shall be insulated with Kapton inside the boxes
- Voltage tap fibre glass sleeves shall be fixed immediately after the connection, this has to be soldered on the super conducting cable rather than copper stabilizer
- Leads/cold bore clearance must be maintained during coil fabrication
- Try to improve extremity plates parallelism during the assembly (up to 3mm difference measured during reception)
- Magnet Id engraving on both extremities, no stickers

MCBRD Magnets changes proposal for the series

End plates chamfer removal and diameter equal to the yoke to prevent shell deformation

Nordlock rather than stycast

Review insulation covers to prevent damage from the lifting beam jaws

 Comb boxes to house voltage-tap splices to be added on the magnet extremity plate (see drawing LHCLMBRDE0141)

 Consider a review of the voltage taps routing to prevent any short taking into consideration that machined G11 sharp edges are very abrasive

 Magnet Id engraving on both extremities rather than an additional plate

Open Points in March 2021

Open Points

- MBRD delivery state, date, shipping frame details?
- MBRD PVC tubes can be kept in the apertures?
- MCBRD extremity pieces?
- Alignment references magnetic or mechanical?
- Investigation and testing between the 3 orbital welding options.
- Supporting during the orbital welding?
- Can the tolerance range in the range in the TDR be relaxed

8.6 Twist

After the completion of the cold mass assembly and welding, the geometric axes of the two cold bore tubes may not lie in a perfect plane. At any point along the arcs and the straight ends of the cold mass, the local twist shall be within ± 3 mmd relative to the plane containing the theoretical geometric axes V1 and V2. The average till shall stay inside ± 1 mrad.

8.7.1 Correctors MCBRD



The corrector MCBRD magnets shall be positioned with respect to the straight ends of the theoretical geometric axes to within ± 0.3 mm.

WP3 meeting in 17/03/2021 https://indico.cern.ch/event/1012677/

✓ MBRDP was delivered in Oct the 21st, work on the cold mass started in Dec the 6th after NC correction, cold bore tube insertion trials, strain gauge measurements and issues with the overed crane solved in the facility.

✓ Yoke measurements to define the magnet geometry, no need for the PVC tubes

Pieces procured by SMT

 Orbital TIG was chosen after investigation, welding qualification ongoing

 Tooling assembled and operational, procedures are defined, to be tested and fine-tuned

? First results after the cylinders welding, magnets alignment in the yoke can be improved.





- Cold mass design for prototype and series ha been completed as well as fabrication and assembly drawings.
- Prototype cold mass design was reviewed to fit present cold test station in SM18 in order to test the MBRD prototype asap.
- Longitudinal welding process development to harmonize the WP3 cold masses in particular the Q2
- Assembly procedures and control steps were developed prior to the prototype assembly that is followed and documented day by day by LMF-QA.
- Components and tooling were prepared in advanced and are being proven.
- Assembly will be paused beginning of next week to solve issues with longitudinal loading ⇒ Cold mass delivery for cryostating expected beginning of April





Spare slides

LMBRDP D2 Prototype Cold Mass



MCBRD magnet at reception





MCBRD inside the shell





-0.4

-0.3

-0.2

-0.1

0.1

0.2

0.3

-250

DeltaX (mm)

MCBR

DP2

MBRDP alignment on the transport frame at reception



MBRDP alignment on the assembly bench







MBRDP alignment inside the shell on the press conveyor

