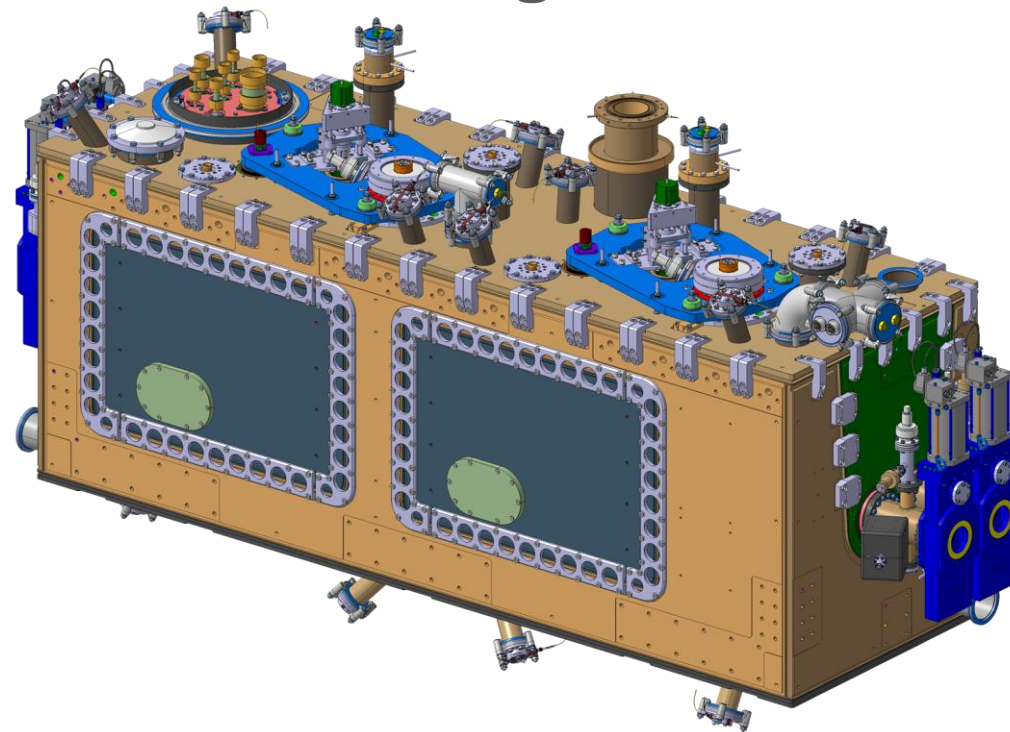


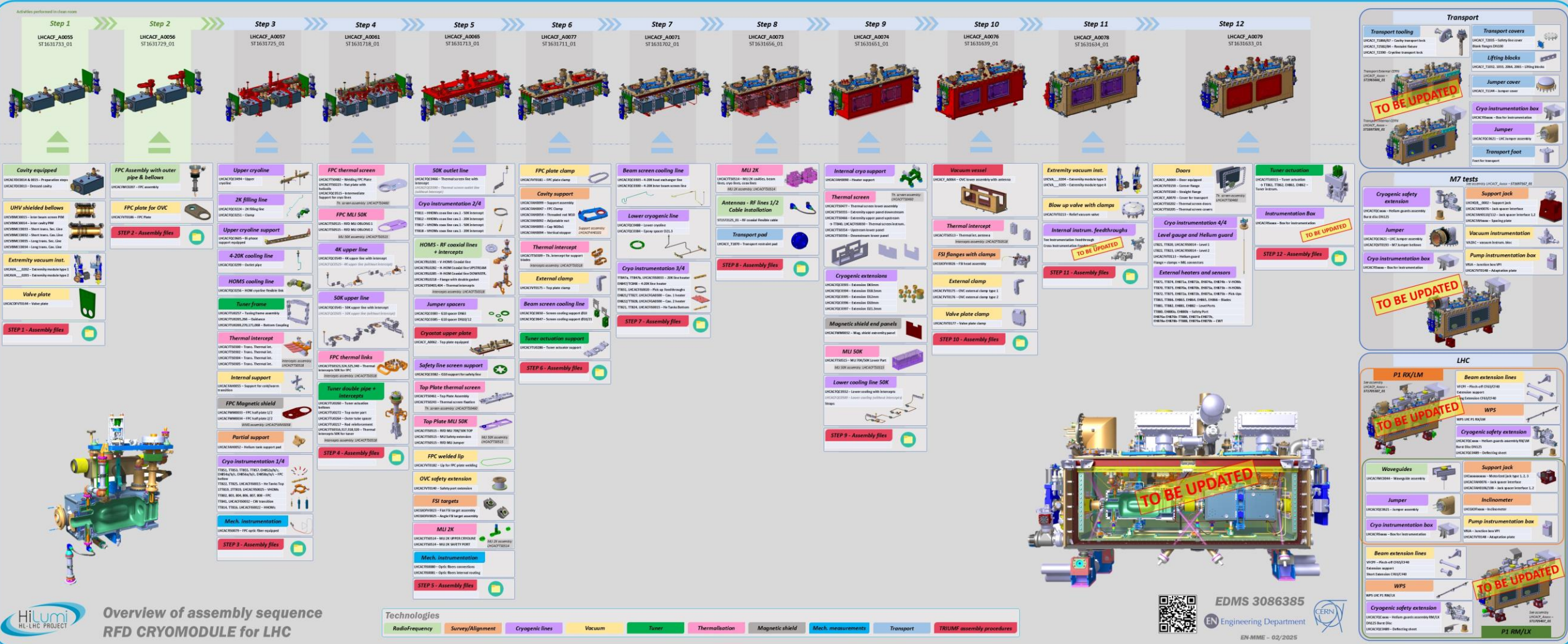


## RFD Cryomodule Design Overview



Laurène Giordanino on behalf of the WP4 collaboration

# RFD Cryomodule assembly sequence



Engineering specifications:

<https://edms.cern.ch/document/2706475> (welded joints for DQW and RFD cryomodules)

<https://edms.cern.ch/document/2043014> (cryomodules for Crab Cavities)

<https://edms.cern.ch/document/3086385>

# RFD Cryomodule assembly sequence

**3D models + 2D drawings Released**

**TO BE UPDATED**

**Transport**

- Transport covers
- Lifting blocks
- Jumper cover
- Cryo instrumentation box
- Jumper
- Transport foot

**M7 tests**

- Cryogenic safety extension
- Jumper
- Cryo instrumentation box
- Vacuum instrument
- Pump instrumentation box

**LHC**

- Beam extension lines
- WPS
- Cryogenic safety extension
- Support jack
- Multimeter
- Pump instrumentation box
- Beam extension lines
- WPS
- Cryogenic safety extension

**Overview of assembly sequence RFD CRYOMODULE for LHC**

Technologies: RadioFrequency, Survey/Alignment, Cryogenic lines, Vacuum, Tuner, Thermalisation, Magnetic shield, Mech. measurements, Transport, TRIUMF assembly procedures

EDMS 3086385  
Engineering Department  
EN-MME - 02/2025

Engineering specifications:

<https://edms.cern.ch/document/2706475> (welded joints for DQW and RFD cryomodules)

<https://edms.cern.ch/document/2043014> (cryomodules for Crab Cavities)

<https://edms.cern.ch/document/3086385>

# RFD Cryomodule assembly sequence

**Step 1** LHCACF\_A0055 ST1631733\_01

**Step 2** LHCACF\_A0056 ST1631729\_01

**Step 3** LHCACF\_A0057 ST1631725\_01

**Step 4** LHCACF\_A0061 ST1631718\_01

**Step 5** LHCACF\_A0065 ST1631713\_01

**Step 6** LHCACF\_A0077 ST1631711\_01

**Step 7** LHCACF\_A0071 ST1631702\_01

**Step 8** LHCACF\_A0073 ST1631656\_01

**Step 9** LHCACF\_A0074 ST1631651\_01

**Step 10** LHCACF\_A0076 ST1631639\_01

**Step 11** LHCACF\_A0078 ST1631634\_01

**Step 12** LHCACF\_A0079 ST1631633\_01

**Finalization of the design ongoing**

**Technologies**  
 RadioFrequency Survey/Alignment Cryogenic lines Vacuum Tuner Thermalisation Magnetic shield Mech. measurements Transport TRIUMF assembly procedures

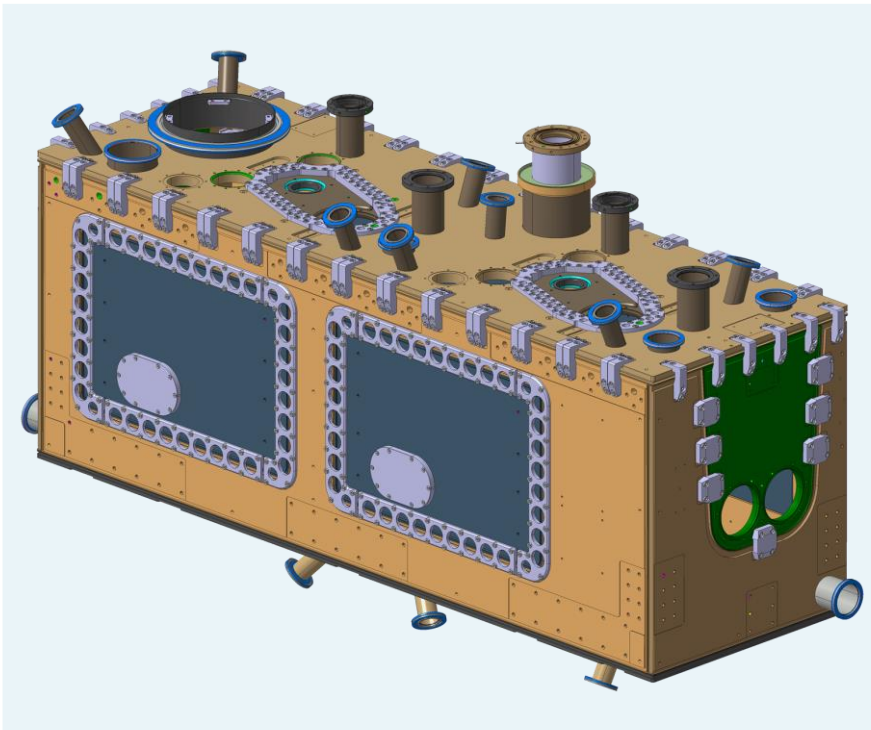
Overview of assembly sequence  
RFD CRYOMODULE for LHC



Engineering specifications:  
<https://edms.cern.ch/document/2706475> (welded joints for DQW and RFD cryomodules)  
<https://edms.cern.ch/document/2043014> (cryomodules for Crab Cavities)

# Main groups of components

# Outer Vacuum Chamber (OVC)



Vacuum Tank  
Dummy Assembly

Drawing number

EDMS references

LHCACFVT0183  
LHCACFVT0184

Drawing folder:

<https://edms.cern.ch/document/2823214>

Engineering specification:

<https://edms.cern.ch/document/2101924>

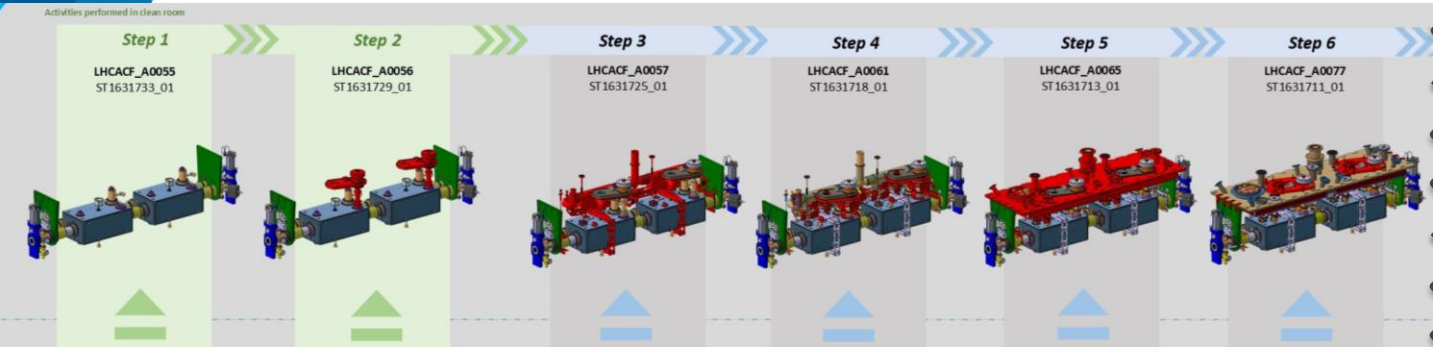
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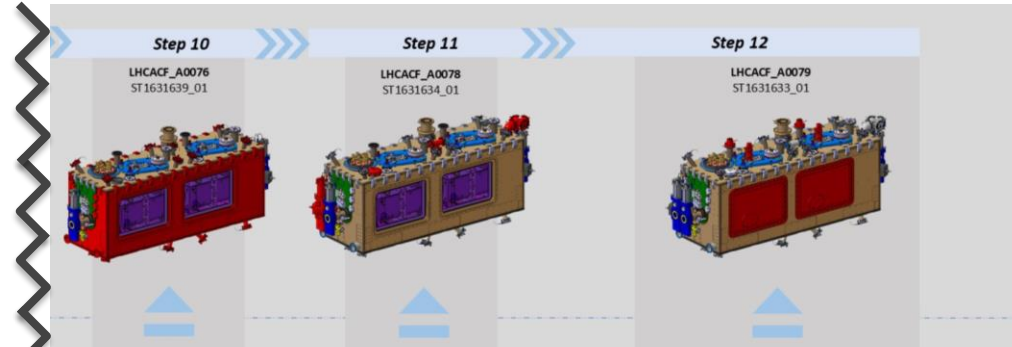
(vacuum vessel)

<https://edms.cern.ch/document/3024966>

(safety port)

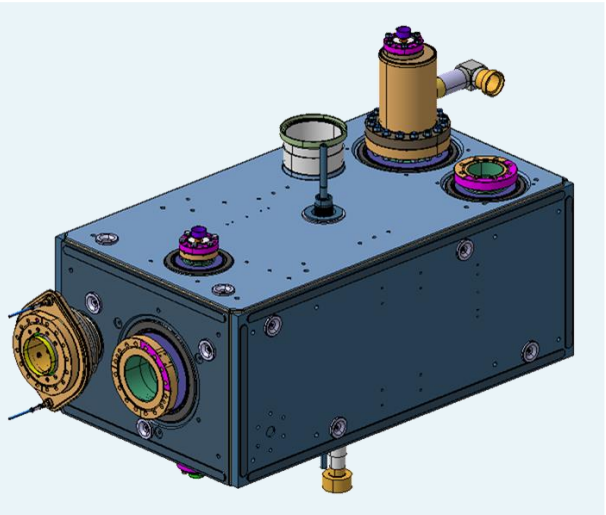
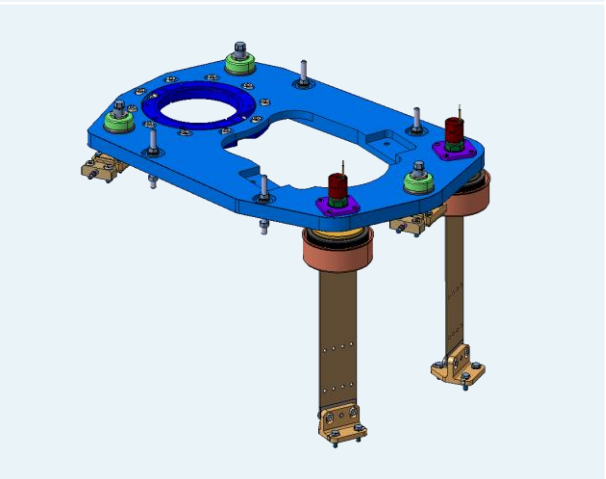


<b>Cavity equipped</b> LHCACF0018 & 0025 - Preparation steps LHCACF0013 - Dressed cavity 	<b>FPC Assembly with outer pipe &amp; bellows</b> LHCACF0007 - FPC assembly 	<b>Upper cryoline</b> LHCACF0049 - Upper cryoline 	<b>FPC thermal screen</b> LHCACF0048 - Welding FPC Plate LHCACF0029 - Heat plate with bellows LHCACF0035 - Intermediate support for cryo lines Th. screen assembly: LHCACF0040 	<b>50K outlet line</b> LHCACF0046 - Thermal screen line with intercept LHCACF0030 - Thermal screen outlet line (without intercept) 	<b>FPC plate clamp</b> LHCACFV0181 - FPC plate clamp 
<b>UHV shielded bellows</b> LHCVBM0015 - Inter beam screens PSM LHCVBM0018 - Short trans. Ser. Line LHCVBM0019 - Short trans. Cav. Line LHCVBM0025 - Long trans. Ser. Line LHCVBM0024 - Long trans. Cav. Line 	<b>FPC plate for OVC</b> LHCACFV0186 - FPC Plate 	<b>2K filling line</b> LHCACF00224 - 2K filling line LHCACF00251 - Clamp 	<b>FPC MLI 50K</b> LHCACF00515 - RFD MLI OBLONG 1 LHCACF00515 - RFD MLI OBLONG 2 MLI 50K assembly: LHCACF00515 	<b>Cryo instrumentation 2/4</b> TR811 - VHM0a coax line cav.1 - 50K Intercept TR812 - VHM0a coax line cav.2 - 50K Intercept TR817 - VHM0a coax line cav.1 - 50K Intercept TR818 - VHM0a coax line cav.1 - 20K Intercept 	<b>Cavity support</b> LHCACF00099 - Support assembly LHCACF00047 - FPC Clamp LHCACF00054 - Threaded rod M10 LHCACF00092 - Adjustable nut LHCACF00093 - Cap M20x1 LHCACF00094 - Vertical stopper Support assembly: LHCACF00091 
<b>Extremity vacuum inst.</b> LHCANA_0202 - Extremity module type 1 LHCANA_0203 - Extremity module type 2 	<b>STEP 2 - Assembly files</b> 	<b>Upper cryoline support</b> LHCACF00605 - Bi-phase support equipped 	<b>4K upper line</b> LHCACF00549 - 4K upper line with intercept LHCACF00525 - 4K upper line (with heat intercept) 	<b>HOMS - RF coaxial lines + intercepts</b> LHCACF00181 - V-HOMS Coaxial line LHCACF00282 - H-HOMS Coaxial line UPSTREAM LHCACF00285 - H-HOMS Coaxial line DOWNSTREAM LHCACF00218 - Flange with double gasket LHCACF00405.004 - Thermal intercepts Intercepts assembly: LHCACF00528 	<b>Thermal intercept</b> LHCACF00309 - Th. intercept for support blades Intercepts assembly: LHCACF00528 
<b>Valve plate</b> LHCACFV0164 - Valve plate 	<b>STEP 1 - Assembly files</b> 	<b>4-20K cooling line</b> LHCACF00299 - Outer pipe 	<b>50K upper line</b> LHCACF00545 - 50K upper line with intercept LHCACF00205 - 50K upper line (without intercept) 	<b>Jumper spacers</b> LHCACF00385 - G10 spacer D163 LHCACF00385 - G10 spacer D103/12 	<b>External clamp</b> LHCACFV0175 - Top plate clamp 
<b>Internal support</b> LHCACF00025 - Support for cold/warm to ambient 	<b>STEP 3 - Assembly files</b> 	<b>Tuner frame</b> LHCACF00217 - Tuning frame assembly LHCACF00265.266 - Guideance LHCACF00269.270.171.004 - Bottom Coupling 	<b>FPC thermal links</b> LHCACF00123.024.025.340 - Thermal intercepts 50K for FPC Intercepts assembly: LHCACF00528 	<b>Cryostat upper plate</b> LHCACF_A0062 - Top plate equipped 	<b>Beam screen cooling line</b> LHCACF00650 - Screen cooling support Ø10 LHCACF00647 - Screen cooling support Ø10/21 
<b>FPC Magnetic shield</b> LHCACF00013 - FPC h-half plate 1/2 LHCACF00014 - FPC h-half plate 2/2 Weld assembly: LHCACF00058 	<b>STEP 4 - Assembly files</b> 	<b>Partial support</b> LHCACF00052 - Helium tank support pad 	<b>Tuner double pipe + intercepts</b> LHCACF00260 - Tuner actuation bellows LHCACF00272 - Top outer part LHCACF00264 - Outer tube spacer LHCACF00217 - Rod reinforcement LHCACF00316.017.318.320 - Thermal intercepts 50K for tuner Intercepts assembly: LHCACF00528 	<b>Safety line screen support</b> LHCACF00382 - G10 support for safety line 	<b>STEP 6 - Assembly files</b> 
<b>Mech. instrumentation</b> LHCACF00079 - FPC optic fiber equipment 	<b>STEP 5 - Assembly files</b> 	<b>Cryo instrumentation 1/4</b> TR811, TR815, TR816, TR817, E1802a/b/c, E1802d/e/f, E1802g/h/i, E1802j/k/l - FPC bellows TR822, TR825, LHCACF00015 - He Tanks Top TR819, TR818, LHCACF00025 - VHM0a TR802, 803, 804, 806, 807, 808 - FPC TR841, LHCACF00012 - CW transmission TR814, TR815, LHCACF00022 - VHM0a 	<b>Top Plate thermal screen</b> LHCACF00461 - Top Plate Assembly LHCACF00243 - Thermal screen flange Th. screen assembly: LHCACF00460 	<b>Top Plate MLI 50K</b> LHCACF00515 - RFD MLI 70K/50K TOP LHCACF00515 - MLI Safety extension LHCACF00515 - RFD MLI Jumper MLI 50K assembly: LHCACF00515 	<b>FPC welded lip</b> LHCACFV0182 - Lip for FPC plate welding 
<b>Mech. instrumentation</b> LHCACF00080 - Optic fibers connections LHCACF00081 - Optic fibers internal routing 	<b>STEP 5 - Assembly files</b> 	<b>OVC safety extension</b> LHCACFV0140 - Safety port extension 	<b>FSI targets</b> LHCACF00023 - Flat FSI target assembly LHCACF00025 - Angled FSI target assembly 	<b>MLI 2K</b> LHCACF00514 - MLI 2K UPPER CRYOLINE LHCACF00514 - MLI 2K SAFETY PORT MLI 2K assembly: LHCACF00514 	<b>STEP 10 - Assembly files</b> 

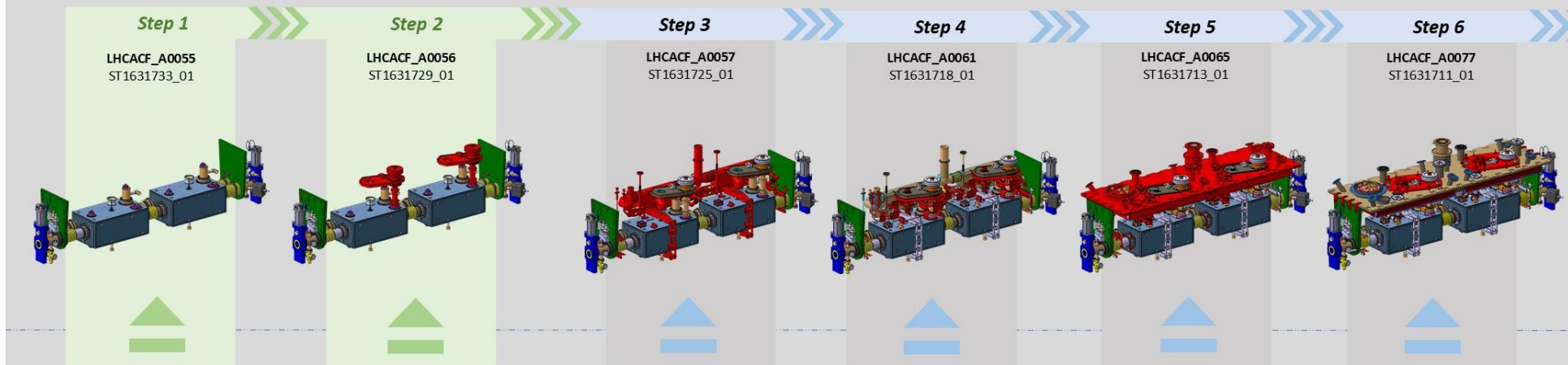











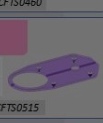


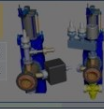


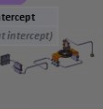




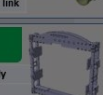
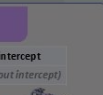



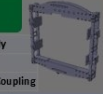










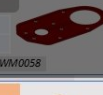



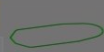
<b>Vacuum vessel</b> LHCACF_A0064 - OVC cover assembly with antenna 	<b>Extremity vacuum inst.</b> LHCVA_0204 - Extremity module type 1 LHCVA_0205 - Extremity module type 4 	<b>Doors</b> LHCACF_A0069 - Door equipped LHCACFV0159 - Cover Flange LHCACFV0160 - Straight Flange LHCACF_A0070 - Cover for transport LHCACF00400 - Thermal screen doors LHCACF00205 - Thermal screen covers Th. screen assembly: LHCACF00400 	<b>Tuner actuation</b> LHCACF00025 - Tuner actuation → TR811, TR842, E1861, E1862 - Tuner Instrum. 
<b>Thermal intercept</b> LHCACF00513 - Thermal int. antenna Intercepts assembly: LHCACF00528 	<b>Blow up valve with clamps</b> LHCACFV0123 - Relief vacuum valve 	<b>Cryo instrumentation 4/4</b> Level gauge and Helium guard TR821, TR820, LHCACF00014 - Level 1 TR821, TR824, LHCACF00014 - Level 2 LHCACFV0113 - Helium guard Flange + clamps + MLI connectors 	<b>Instrumentation Box</b> LHCACF00000 - Box for instrumentation 
<b>FSI flanges with clamps</b> LHCACF00026 - FSI head assembly 	<b>Internal instrum. feedthroughs</b> Tee Instrumentation Feedthrough Cross Instrumentation Feedthrough TO BE UPDATED 	<b>External clamp</b> LHCACFV0175 - OVC external clamp type 1 LHCACFV0176 - OVC external clamp type 2 	<b>STEP 11 - Assembly files</b> 
<b>External clamp</b> LHCACFV0175 - OVC external clamp type 1 LHCACFV0176 - OVC external clamp type 2 	<b>Valve plate clamp</b> LHCACFV0177 - Valve plate clamp 	<b>External heaters and sensors</b> TR871, TR874, E1871a, E1871b, E1871c, E1874a - V-HOMS TR870, TR873, E1870a, E1870b, E1875a, E1875b - H-HOMS TR872, TR875, E1872a, E1872b, E1875a, E1875b - Pick-Ups TR861, TR864, E1864, E1865, E1866 - Blades TR861, TR862, E1861, E1862 - Level Ports TR860, E1860a, E1860b - Safety Port E1870a, E1870b, TR886, E1877a, E1877b, E1878a, E1878b, TR888, E1879a, E1879b - CWI 	<b>STEP 12 - Assembly files</b> 

# Cavity and cavity support

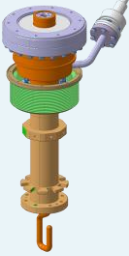
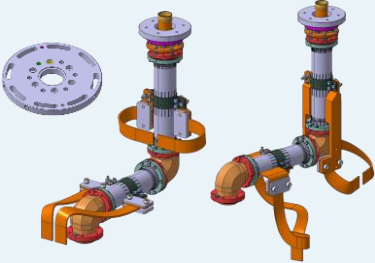

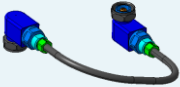
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	Dressed cavity  LHCACFDC0013	Drawing folder: <a href="http://edms.cern.ch/document/2780621">http://edms.cern.ch/document/2780621</a>  Engineering specification: <a href="https://edms.cern.ch/document/1389669">https://edms.cern.ch/document/1389669</a>  Calculation: <a href="https://edms.cern.ch/document/2276057">https://edms.cern.ch/document/2276057</a>
	Cavity support  LHCACFAH0101	Drawing folder: <a href="https://edms.cern.ch/document/2966544">https://edms.cern.ch/document/2966544</a>  Engineering specification: <a href="https://edms.cern.ch/document/2632333">https://edms.cern.ch/document/2632333</a> (material)  Calculation: <a href="https://edms.cern.ch/document/3175999">https://edms.cern.ch/document/3175999</a>





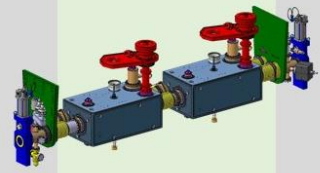
<p><b>Cavity equipped</b></p> <p>LHCACFDC0014 &amp; 0015 – Preparation steps LHCACFDC0013 – Dressed cavity</p> 	<p><b>FPC Assembly with outer pipe &amp; bellows</b></p> <p>LHCACFM0207 – FPC assembly</p> 	<p><b>Upper cryoline</b></p> <p>LHCACFQC0494 – Upper cryoline</p> 	<p><b>FPC thermal screen</b></p> <p>LHCACFTS0482 – Welding FPC Plate LHCACFTS0223 – Nut plate with helicoils LHCACFQC0515 – Intermediate Support for cryo lines <i>Th. screen assembly: LHCACFTS0460</i></p> 	<p><b>50K outlet line</b></p> <p>LHCACFQC0466 – Thermal screen line with intercept LHCACFQC0390 – Thermal screen outlet line (without intercept)</p> 	<p><b>FPC plate clamp</b></p> <p>LHCACFVT0181 – FPC plate clamp</p> 
<p><b>UHV shielded bellows</b></p> <p>LHCVBMCI0015 – Inter beam screen PIM LHCVBMCI0014 – Inter cavity PIM LHCVBMCC0033 – Short trans. Sec. Line LHCVBMCC0032 – Short trans. Cav. Line LHCVBMCC0035 – Long trans. Sec. Line LHCVBMCC0034 – Long trans. Cav. Line</p> 	<p><b>FPC plate for OVC</b></p> <p>LHCACFVT0186 – FPC Plate</p> 	<p><b>2K filling line</b></p> <p>LHCACFQC0224 – 2K filling line LHCACFQC0251 – Clamp</p> 	<p><b>FPC MLI 50K</b></p> <p>LHCACFTS0515 – RFD MLI OBLONG 1 LHCACFTS0515 – RFD MLI OBLONG 2 <i>MLI 50K assembly: LHCACFTS0515</i></p> 	<p><b>Cryo instrumentation 2/4</b></p> <p>TT811 – HHOMs coax line cav.1 - 50K intercept TT812 – HHOMs coax line cav.1 - 20K intercept TT817 – VHOMs coax line cav.1 - 50K intercept TT818 – VHOMs coax line cav.1 - 20K intercept</p> 	<p><b>Cavity support</b></p> <p>LHCACFAH0099 – Support assembly LHCACFAH0047 – FPC Clamp LHCACFAH0054 – Threaded rod M10 LHCACFAH0092 – Adjustable nut LHCACFAH0093 – Cap M20x1 LHCACFAH0094 – Vertical stopper <i>Support assembly: LHCACFAH0101</i></p> 
<p><b>Extremity vacuum inst.</b></p> <p>LHCAVA__0202 – Extremity module type 1 LHCAVA__0203 – Extremity module type 2</p> 	<p><b>STEP 2 - Assembly files</b></p> 	<p><b>Upper cryoline support</b></p> <p>LHCACFQC0605 – Bi-phase support equipped</p> 	<p><b>4K upper line</b></p> <p>LHCACFQC0549 – 4K upper line with intercept <i>LHCACFQC0525 – 4K upper line (without intercept)</i></p> 	<p><b>HOMS - RF coaxial lines + intercepts</b></p> <p>LHCACFRL0281 – V-HOMS Coaxial line LHCACFRL0282 – H-HOM Coaxial line UPSTREAM LHCACFRL0285 – H-HOM Coaxial line DOWNSTR. LHCACFRL0218 – Flange with double gasket LHCACFTS0403,404 – Thermal intercepts <i>Intercepts assembly: LHCACFTS0518</i></p> 	<p><b>Thermal intercept</b></p> <p>LHCACFTS0309 – Th. intercept for support blades <i>Intercepts assembly: LHCACFTS0518</i></p> 
<p><b>Valve plate</b></p> <p>LHCACDFVT0144 – Valve plate</p> 	<p><b>STEP 1 - Assembly files</b></p> 	<p><b>4-20K cooling line</b></p> <p>LHCACFQC0299 – Outlet pipe</p> 	<p><b>50K upper line</b></p> <p>LHCACFQC0545 – 50K upper line with intercept <i>LHCACFQC0505 – 50K upper line (without intercept)</i></p> 	<p><b>Jumper spacers</b></p> <p>LHCACFQC0383 – G10 spacer DN63 LHCACFQC0385 – G10 spacer DN10/12</p> 	<p><b>External clamp</b></p> <p>LHCACFVT0175 – Top plate clamp</p> 
<p><b>Partial support</b></p> <p>LHCACFAH0052 – Helium tank support pad</p> 	<p><b>Tuner frame</b></p> <p>LHCACFTU0257 – Tuning frame assembly LHCACFTU0265,266 – Guidance LHCACFTU0269,270,171,068 – Bottom Coupling</p> 	<p><b>HOMS cooling line</b></p> <p>LHCACFQC0256 – HOM cryoline flexible link</p> 	<p><b>FPC thermal links</b></p> <p>LHCACFTS0323,324,325,340 – Thermal intercepts 50K for FPC <i>Intercepts assembly: LHCACFTS0518</i></p> 	<p><b>Cryostat upper plate</b></p> <p>LHCACF_A0062 - Top plate equipped</p> 	<p><b>Beam screen cooling line</b></p> <p>LHCACFQC0650 – Screen cooling support Ø10 LHCACFQC0647 – Screen cooling support Ø10/21</p> 
<p><b>Cryo instrumentation 1/4</b></p> <p>TT851, TT853, TT855, TT857, EH852a(b)/c, EH853 (b/c), EH854 (b/c), EH855 (b/c), EH856 (b/c), EH857 (b/c)</p> 	<p><b>Thermal intercept</b></p> <p>LHCACFTS0300 – Trans. Thermal int. LHCACFTS0302 – Trans. Thermal int. LHCACFTS0304 – Trans. Thermal int. LHCACFTS0305 – Trans. Thermal int. <i>Intercepts assembly: LHCACFTS0518</i></p> 	<p><b>Internal support</b></p> <p>LHCACFAH0055 – Support for cold/warm transition</p> 	<p><b>Tuner double pipe + intercepts</b></p> <p>LHCACFTU0260 – Tuner actuation bellows LHCACFTU0272 – Top outer part LHCACFTU0264 – Outer tube spacer LHCACFTU0217 – Rod reinforcement LHCACFTS0316,317,318,320 – Thermal intercepts 50K for tuner <i>Intercepts assembly: LHCACFTS0518</i></p> 	<p><b>Safety line screen support</b></p> <p>LHCACFQC0382 – G10 support for safety line</p> 	<p><b>STEP 6 - Assembly files</b></p> 
<p><b>FPC Magnetic shield</b></p> <p>LHCACFWM0033 – FPC half plate 1/2 LHCACFWM0034 – FPC half plate 2/2 <i>WMS assembly: LHCACFWM0058</i></p> 	<p><b>STEP 4 - Assembly files</b></p> 	<p><b>Top Plate thermal screen</b></p> <p>LHCACFTS0461 – Top Plate Assembly LHCACFTS0243 – Thermal screen fixation <i>Th. screen assembly: LHCACFTS0460</i></p> 	<p><b>Top Plate MLI 50K</b></p> <p>LHCACFTS0515 – RFD MLI 70K/50K TOP LHCACFTS0515 – MLI Safety extension LHCACFTS0515 – RFD MLI Jumper <i>MLI 50K assembly: LHCACFTS0515</i></p> 	<p><b>FPC welded lip</b></p> <p>LHCACFVT0182 – Lip for FPC plate welding</p> 	

# RF equipment (design by SY-RF team)

		Drawing number	EDMS references
	FPC with outer pipe	LHCACFMC0207	Drawing folder: <a href="https://edms.cern.ch/document/2595726">https://edms.cern.ch/document/2595726</a> Engineering specification: <a href="https://edms.cern.ch/document/2101934">https://edms.cern.ch/document/2101934</a> Calculation: <a href="https://edms.cern.ch/document/2218580">https://edms.cern.ch/document/2218580</a> <a href="https://edms.cern.ch/document/2767197">https://edms.cern.ch/document/2767197</a>
	H-HOMS/V-HOMS coaxial lines	LHCACFRL0218 LHCACFRL0281 LHCACFRL0282 LHCACFRL0285	Drawing folders: <a href="https://edms.cern.ch/document/2769089">https://edms.cern.ch/document/2769089</a> <a href="https://edms.cern.ch/document/2769165">https://edms.cern.ch/document/2769165</a> Engineering specification: <a href="https://edms.cern.ch/document/2605345">https://edms.cern.ch/document/2605345</a> Calculation: <a href="https://edms.cern.ch/document/2233186">https://edms.cern.ch/document/2233186</a>
	Pick up antenna coaxial lines	LHCACFRL0278	Drawing folder: <a href="https://edms.cern.ch/document/2769047">https://edms.cern.ch/document/2769047</a> Engineering specification: <a href="https://edms.cern.ch/document/2605345">https://edms.cern.ch/document/2605345</a> Calculation: <a href="https://edms.cern.ch/document/2592079">https://edms.cern.ch/document/2592079</a>
	Antennas flexible cable		

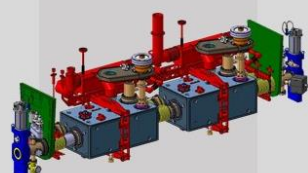
### Step 2

LHCACF\_A0056  
ST1631729\_01



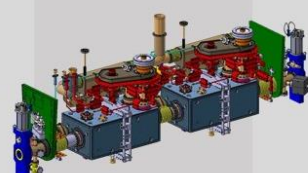
### Step 3

LHCACF\_A0057  
ST1631725\_01



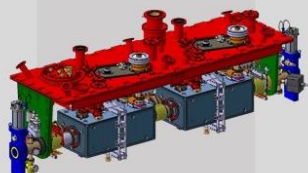
### Step 4

LHCACF\_A0061  
ST1631718\_01



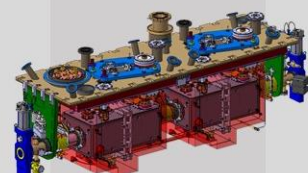
### Step 5

LHCACF\_A0065  
ST1631713\_01



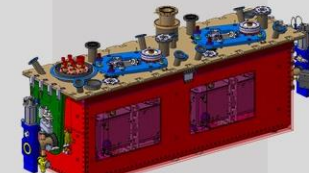
### Step 8

LHCACF\_A0073  
ST1631656\_01



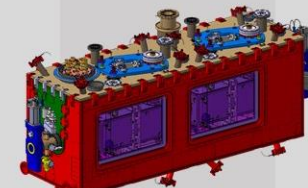
### Step 9

LHCACF\_A0074  
ST1631651\_01



### Step 10

LHCACF\_A0076  
ST1631639\_01




**FPC Assembly with outer pipe & bellows**



LHCACFM0207 – FPC assembly

**FPC plate for OVC**




LHCACFV0186 – FPC Plate

**STEP 2 - Assembly files**




**Upper cryoline**




LHCACFQC0494 – Upper cryoline

**2K filling line**




LHCACFQC0224 – 2K filling line  
LHCACFQC0251 – Clamp

**Upper cryoline support**




LHCACFQC0605 – BI-phase support equipped

**4-20K cooling line**



LHCACFQC0299 – Outlet pipe

**HOMS cooling line**




LHCACFQC0256 – HOM cryoline flexible link

**Tuner frame**



LHCACFTU0257 – Tuning frame assembly  
LHCACFTU0265,266 – Guidance  
LHCACFTU0269,270,171,068 – Bottom Coupling

**Thermal intercept**



LHCACFTS0300 – Trans. Thermal int.  
LHCACFTS0302 – Trans. Thermal int.  
LHCACFTS0304 – Trans. Thermal int.  
LHCACFTS0305 – Trans. Thermal int.  
*Intercepts assembly: LHCACFTS0518*

**Internal support**




LHCACFAH0055 – Support for cold/warm transition

**FPC Magnetic shield**



LHCACFWM0033 – FPC half plate 1/2  
LHCACFWM0034 – FPC half plate 2/2  
*WMS assembly: LHCACFWM0058*

**Partial support**




LHCACFAH0052 – Helium tank support pad

**FPC thermal screen**




LHCACFTS0482 – Welding FPC Plate  
LHCACFTS0223 – Nut plate with helioballs  
LHCACFQC0515 – Intermediate Support for cryo lines  
*Th. screen assembly: LHCACFTS0460*

**FPC MLI 50K**



LHCACFTS0515 – RFD MLI OBLONG 1  
LHCACFTS0515 – RFD MLI OBLONG 2  
*MLI 50K assembly: LHCACFTS0515*

**4K upper line**




LHCACFQC0549 – 4K upper line with intercept  
LHCACFQC0525 – 4K upper line (without intercept)

**50K upper line**




LHCACFQC0545 – 50K upper line with intercept  
LHCACFQC0505 – 50K upper line (without intercept)

**FPC thermal links**




LHCACFTS0323,324,325,340 – Thermal intercepts 50K for FPC  
*Intercepts assembly: LHCACFTS0518*

**Tuner double pipe + intercepts**




LHCACFTU0260 – Tuner actuation bellows  
LHCACFTU0272 – Top outer part  
LHCACFTU0264 – Outer tube spacer  
LHCACFTU0217 – Rod reinforcement  
LHCACFTS0316,317,318,320 – Thermal intercepts 50K for tuner  
*Intercepts assembly: LHCACFTS0518*

**50K outlet line**




LHCACFQC0466 – Thermal screen line with intercept  
LHCACFQC0390 – Thermal screen outlet line (without intercept)

**Cryo instrumentation 2/4**



TT811 – HHOMs coax line cav.1 - 50K intercept  
TT812 – HHOMs coax line cav.1 - 20K intercept  
TT817 – VHOMs coax line cav.1 - 50K intercept  
TT818 – VHOMs coax line cav.1 - 20K intercept

**HOMS - RF coaxial lines + intercepts**



LHCACFRL0281 – V-HOMS Coaxial line  
LHCACFRL0282 – H-HOM Coaxial line UPSTREAM  
LHCACFRL0285 – H-HOM Coaxial line DOWNSTR.  
LHCACFRL0218 – Flange with double gasket  
LHCACFTS0403,404 – Thermal intercepts  
*Intercepts assembly: LHCACFTS0518*

**Jumper spacers**




LHCACFQC0383 – G10 spacer DN63  
LHCACFQC0385 – G10 spacer DN10/12

**Cryostat upper plate**




LHCACF\_A0062 – Top plate equipped

**Safety line screen support**



LHCACFQC0382 – G10 support for safety line

**Top Plate thermal screen**




LHCACFTS0461 – Top Plate Assembly  
LHCACFTS0243 – Thermal screen fixation  
*Th. screen assembly: LHCACFTS0460*

**Top Plate MLI 50K**




LHCACFTS0515 – RFD MLI 70K/50K TOP  
LHCACFTS0515 – MLI Safety extension  
LHCACFTS0515 – RFD MLI Jumper  
*MLI 50K assembly: LHCACFTS0515*

**MLI 2K**




LHCACFTS0514 – MLI 2K cavities, beam lines, cryo lines, coax lines  
*MLI 2K assembly: LHCACFTS0514*

**Antennas - RF lines 1/2 Cable installation**




ST1572125\_01 – RF coaxial Flexible cable

**Transport pad**




LHCACF\_T1870 – Transport restraint pad

**STEP 8 - Assembly files**

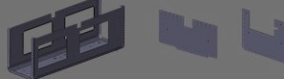


**Internal cryo support**



LHCACFAH0090 – Heater support

**Thermal screen**




*Th. screen assembly: LHCACFTS0460*  
LHCACFTS0477 – Thermal screen lower assembly  
LHCACFTS0355 – Extremity upper panel downstream  
LHCACFTS0466 – Extremity upper panel upstream  
→ TT840, LHCACFS0030 – Thermal screen instrum.  
LHCACFTS0354 – Upstream lower panel  
LHCACFTS0356 – Downstream lower panel

**Cryogenic extensions**




LHCACFQC0393 – Extension D63mm  
LHCACFQC0394 – Extension D18.5mm  
LHCACFQC0395 – Extension D12mm  
LHCACFQC0396 – Extension D10mm  
LHCACFQC0397 – Extension D21.3mm

**Magnetic shield end panels**




LHCACFWM0032 – Mag. shield extremity panel

**MLI 50K**




LHCACFTS0515 – MLI 70K/50K Lower Part  
*MLI 50K assembly: LHCACFTS0515*

**Lower cooling line 50K**



LHCACFQC0552 – Lower cooling with intercepts  
LHCACFQC0500 – Lower cooling (without intercepts)  
Straps

**STEP 9 - Assembly files**



**Vacuum vessel**



LHCACF\_A0064 – OVC lower assembly with antenna

**Thermal intercept**




LHCACFTS0513 – Thermal int. antenna  
*Intercepts assembly: LHCACFTS0518*

**FSI flanges with clamps**




LHCGIOF0026 – FSI head assembly

**External clamp**




LHCACFV0175 – OVC external clamp type 1  
LHCACFV0176 – OVC external clamp type 2

**Valve plate clamp**




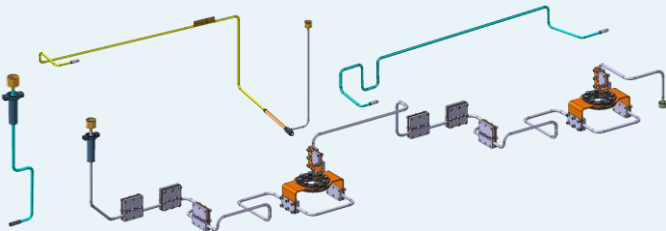
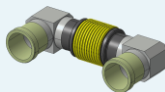
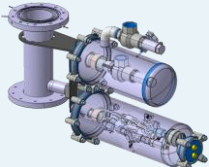


LHCACFV0177 – Valve plate clamp

**STEP 10 - Assembly files**

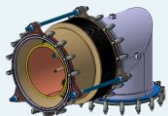

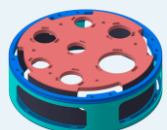
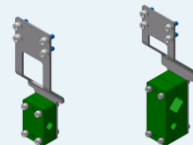
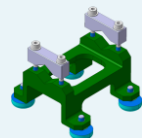



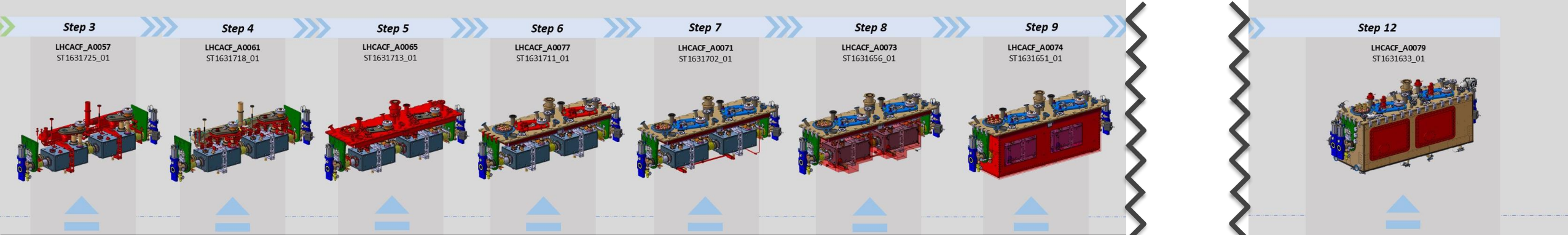
# Cryogenic equipment and supports

		Drawing number	EDMS references
	Biphase line	LHCACFQC0494	Drawing folder: <a href="https://edms.cern.ch/document/2873198">https://edms.cern.ch/document/2873198</a> Engineering specification: <a href="https://edms.cern.ch/document/2093032">https://edms.cern.ch/document/2093032</a> Calculation: <a href="https://edms.cern.ch/document/2477175">https://edms.cern.ch/document/2477175</a>
	2K filling line	LHCACFQC0224	Drawing folder: <a href="https://edms.cern.ch/document/2566161">https://edms.cern.ch/document/2566161</a> Engineering specification: <a href="https://edms.cern.ch/document/2093032">https://edms.cern.ch/document/2093032</a>
	Lower line	LHCACFQC0488	Drawing folder: <a href="https://edms.cern.ch/document/2566179">https://edms.cern.ch/document/2566179</a> Engineering specification: <a href="https://edms.cern.ch/document/2093032">https://edms.cern.ch/document/2093032</a> Calculation: <a href="https://edms.cern.ch/document/2477175">https://edms.cern.ch/document/2477175</a>
	4-20K cooling line	LHCACFQC0303 LHCACFQC0300 LHCACFQC0299 LHCACFQC0525	Drawing folders: <a href="https://edms.cern.ch/document/2566185">https://edms.cern.ch/document/2566185</a> <a href="https://edms.cern.ch/document/2566184">https://edms.cern.ch/document/2566184</a> <a href="https://edms.cern.ch/document/2566181">https://edms.cern.ch/document/2566181</a> <a href="https://edms.cern.ch/document/3007180">https://edms.cern.ch/document/3007180</a> Engineering specification: <a href="https://edms.cern.ch/document/2093032">https://edms.cern.ch/document/2093032</a>
	HOM flexible link	LHCACFQC0256	Drawing folder: <a href="https://edms.cern.ch/document/2566188">https://edms.cern.ch/document/2566188</a> Engineering specification: <a href="https://edms.cern.ch/document/2093032">https://edms.cern.ch/document/2093032</a>
	Cryogenic safety extension	LHCACFQC0428	Drawing folder: <a href="https://edms.cern.ch/document/2721714">https://edms.cern.ch/document/2721714</a> Engineering specification: <a href="https://edms.cern.ch/document/2806004">https://edms.cern.ch/document/2806004</a>

↳ after step 12, design in progress

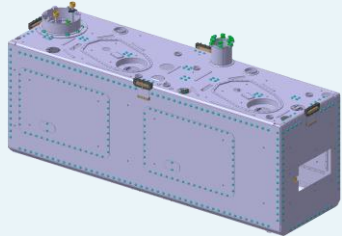
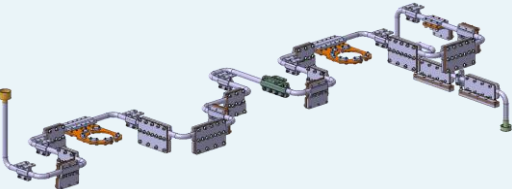

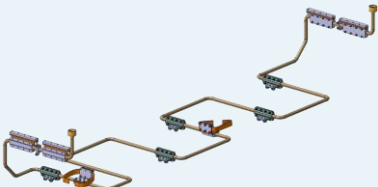

# Cryogenic equipment and supports

		Drawing number	EDMS references
	Jumper ↳ after step 12, design in progress		Engineering specification: <a href="https://edms.cern.ch/document/3055177">https://edms.cern.ch/document/3055177</a>
	Biphase support	LHCACFQC0605	Drawing folder: <a href="https://edms.cern.ch/document/2977699">https://edms.cern.ch/document/2977699</a> Engineering specification: <a href="https://edms.cern.ch/document/2093032">https://edms.cern.ch/document/2093032</a> Calculation: <a href="https://edms.cern.ch/document/3063725">https://edms.cern.ch/document/3063725</a>
	Jumper support	LHCACFQC0310	Drawing folder: <a href="https://edms.cern.ch/document/2577950">https://edms.cern.ch/document/2577950</a>
	4-20K cooling line support	LHCACFQC0647 LHCACFQC0650	Drawing folders: <a href="https://edms.cern.ch/document/3193632">https://edms.cern.ch/document/3193632</a> <a href="https://edms.cern.ch/document/3193633">https://edms.cern.ch/document/3193633</a>
	Heater support	LHCACFAH0090	
	Helium guard for level gauge	LHCACFVT0113	Drawing folder: <a href="https://edms.cern.ch/document/2883208">https://edms.cern.ch/document/2883208</a> Engineering specification: <a href="https://edms.cern.ch/document/2806004">https://edms.cern.ch/document/2806004</a>
	Instrumentation and supports		Drawing folder: <a href="https://edms.cern.ch/document/3140654">https://edms.cern.ch/document/3140654</a>



<p><b>Upper cryoline</b></p> <p>LHCACF0494 – Upper cryoline</p>	<p><b>FPC thermal screen</b></p> <p>LHCACFTS0482 – Welding FPC Plate LHCACFTS0223 – Nut plate with helicoils LHCACFTS0515 – Intermediate Support for cryo lines Th. screen assembly: LHCACFTS0460</p>	<p><b>50K outlet line</b></p> <p>LHCACFQC0466 – Thermal screen line with intercept LHCACFQC0390 – Thermal screen outlet line (without intercept)</p>	<p><b>FPC plate clamp</b></p> <p>LHCACFV0181 – FPC plate clamp</p>	<p><b>Beam screen cooling line</b></p> <p>LHCACFQC0303 – 4-20K heat exchanger line LHCACFQC0300 – 4-20K Inter beam screen line</p>	<p><b>MLI 2K</b></p> <p>LHCACFTS0514 – MLI 2K cavities, beam lines, cryo lines, coax lines MLI 2K assembly: LHCACFTS0514</p>	<p><b>Internal cryo support</b></p> <p>LHCACFAH0090 – Heater support</p>	<p><b>Doors</b></p> <p>LHCACF_A0069 – Door equipped LHCACFV0159 – Corner flange LHCACF_V0160 – Straight flange LHCACF_A0070 – Cover for transport LHCACFTS0202 – Thermal screen doors LHCACFTS0205 – Thermal screen covers</p>	<p><b>Tuner actuation</b></p> <p>LHCACFTU0315 – Tuner actuation → TT861, TT862, EH861, EH862 – Tuner instrum.</p>
<p><b>2K filling line</b></p> <p>LHCACFQC0224 – 2K filling line LHCACFQC0251 – Clamp</p>	<p><b>FPC MLI 50K</b></p> <p>LHCACFTS0515 – RFD MLI OBLONG 1 LHCACFTS0515 – RFD MLI OBLONG 2 MLI 50K assembly: LHCACFTS0515</p>	<p><b>Cryo instrumentation 2/4</b></p> <p>TT811 – VHOMs coax line cav.1. 50K Intercept TT812 – HHOMs coax line cav.1. 20K Intercept TT817 – VHOMs coax line cav.1. 50K Intercept TT818 – VHOMs coax line cav.1. 20K Intercept</p>	<p><b>Cavity support</b></p> <p>LHCACFAH0099 – Support assembly LHCACFAH0054 – FPC Clamp LHCACFAH0054 – Threaded rod MID LHCACFAH0092 – Adjustable nut LHCACFAH0093 – Cap M2x1 LHCACFAH0094 – Vertical stopper Support assembly: LHCACFAH0101</p>	<p><b>Lower cryogenic line</b></p> <p>LHCACFQC0488 – Lower cryoline LHCACFQC0384 – Epoxy spacer D21.3</p>	<p><b>Antennas - RF lines 1/2 Cable installation</b></p> <p>ST1572125_01 – FR co axial flexible cable</p>	<p><b>Internal cryo support</b></p> <p>Th. screen assembly: LHCACFTS0460</p> <p><b>Thermal screen</b></p> <p>LHCACFTS0477 – Thermal screen lower assembly LHCACFTS0355 – Extremity upper panel downstream LHCACFTS0466 – Extremity upper panel upstream → TT840, LHCACFTS0030 – Thermal screen instrum. LHCACFTS0514 – Upstr eam lower panel LHCACFTS0356 – Downstream lower panel</p>	<p><b>Instrumentation Box</b></p> <p>LHCACFSxxxx – Box for instrumentation</p> <p><b>TO BE UPDATED</b></p>	
<p><b>Upper cryoline support</b></p> <p>LHCACFQC0605 – BI-phase support equipped</p>	<p><b>4K upper line</b></p> <p>LHCACFQC0549 – 4K upper line with intercept LHCACFQC0525 – 4K upper line (without intercept)</p>	<p><b>HOMS - RF coaxial lines + intercepts</b></p> <p>LHCACFRL0281 – V-HOMS Coaxial line LHCACFRL0282 – H-HOM Coaxial line UPSTREAM LHCACFRL0283 – H-HOM Coaxial line DOWNSTREAM LHCACFRL0218 – Flange with double gasket LHCACFTS0403, 404 – Thermal intercepts Intercepts assembly: LHCACFTS0518</p>	<p><b>Thermal intercept</b></p> <p>LHCACFTS0309 – Th. intercept for support blades Intercepts assembly: LHCACFTS0518</p>	<p><b>Cryo instrumentation 3/4</b></p> <p>TT847a, TT847b, LHCACFS0033 – 20K line heater EH847/TC848 – 4-20K line heater TT831, LHCACFS0020 – Pick up Feedthroughs EH827/TT828, LHCACFGA0300 – Cav. 1 heater EH827/TT828, LHCACFGA0300 – Cav. 2 heater TT821, TT824, LHCACFS0015 – He Tanks Bottom</p>	<p><b>Transport pad</b></p> <p>LHCACFT11870 – Transport restraint pad</p>	<p><b>Cryo instrumentation 4/4</b></p> <p>Level gauge and Helium guard</p> <p>LT821, TT820, LHCACRS0014 – Level 1 LT822, TT823, LHCACRS0014 – Level 2 LHCACFV0113 – Helium guard Flange + clamps + MIL connectors</p>	<p><b>External heaters and sensors</b></p> <p>TT870, TT874, EH871a, EH871b, EH874a, EH874b – V-HOMs TT870, TT875, EH872a, EH872b, EH873a, EH873b – H-HOMs TT870, TT875, EH872a, EH872b, EH873a, EH873b – Pick-Ups TT863, TT866, EH863, EH864, EH865, EH866 – Blades TT881, TT882, EH881, EH882 – Level Ports TT880, EH880a, EH880b – Safety Port EH876a-EH877b-TT886, EH877a-EH877b, EH876a-EH877b-TT886, EH877a-EH877b – CNT</p>	
<p><b>Tuner frame</b></p> <p>LHCACFQC0257 – Tuning frame assembly LHCACFTU0265, 266 – Guide race LHCACFTU0269, 270, 171, 168 – Bottom Coupling</p>	<p><b>50K upper line</b></p> <p>LHCACFQC0545 – 50K upper line with intercept LHCACFQC0505 – 50K upper line (without intercept)</p>	<p><b>Jumper spacers</b></p> <p>LHCACFQC0383 – G10 spacer DN63 LHCACFQC0385 – G10 spacer DN10/12</p>	<p><b>External clamp</b></p> <p>LHCACFTV0175 – Top plate clamp</p>	<p><b>Beam screen cooling line</b></p> <p>LHCACFQC0650 – Screen cooling support Ø10 LHCACFQC0647 – Screen cooling support Ø10/21</p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>Cryogenic extensions</b></p> <p>LHCACFQC0393 – Extension D63mm LHCACFQC0394 – Extension D18.5mm LHCACFQC0395 – Extension D12mm LHCACFQC0396 – Extension D10mm LHCACFQC0397 – Extension D21.3mm</p>	<p><b>Magnetic shield end panels</b></p> <p>LHCACFWM0032 – Mag. shield extremity panel</p>	
<p><b>Thermal intercept</b></p> <p>LHCACFTS0300 – Trans. Thermal int. LHCACFTS0302 – Trans. Thermal int. LHCACFTS0304 – Trans. Thermal int. LHCACFTS0305 – Trans. Thermal int. Intercepts assembly: LHCACFTS0518</p>	<p><b>FPC thermal links</b></p> <p>LHCACFTS0323, 324, 325, 340 – Thermal intercepts 50K for FPC Intercepts assembly: LHCACFTS0518</p>	<p><b>Safety line screen support</b></p> <p>LHCACFQC0382 – G10 support for safety line</p>	<p><b>Beam screen cooling line</b></p> <p>LHCACFTS0309 – Th. intercept for support blades Intercepts assembly: LHCACFTS0518</p>	<p><b>Tuner actuation support</b></p> <p>LHCACFTU0286 – Tuner actuator support</p>	<p><b>STEP 6 - Assembly files</b></p>	<p><b>Magnetic shield end panels</b></p> <p>LHCACFWM0032 – Mag. shield extremity panel</p>		
<p><b>Internal support</b></p> <p>LHCACFAH0055 – Support for cold/warm transition</p>	<p><b>Tuner double pipe + intercepts</b></p> <p>LHCACFTU0260 – Tuner actuation bellows LHCACFTU0272 – Top outer part LHCACFTU0264 – Outer tube spacer LHCACFTU0217 – Rod reinforcement LHCACFTS0316, 317, 318, 320 – Thermal intercepts 50K for tuner Intercepts assembly: LHCACFTS0518</p>	<p><b>Top Plate thermal screen</b></p> <p>LHCACFTS0461 – Top Plate Assembly LHCACFTS0243 – Thermal screen fixation Th. screen assembly: LHCACFTS0460</p>	<p><b>External clamp</b></p> <p>LHCACFTV0175 – Top plate clamp</p>	<p><b>STEP 7 - Assembly files</b></p>	<p><b>Lower cooling line 50K</b></p> <p>LHCACFQC0552 – Lower cooling with intercepts LHCACFQC0500 – Lower cooling (without intercepts) Straps</p>	<p><b>Magnetic shield end panels</b></p> <p>LHCACFWM0032 – Mag. shield extremity panel</p>		
<p><b>FPC Magnetic shield</b></p> <p>LHCACFWM0033 – FPC half plate 1/2 LHCACFWM0034 – FPC half plate 2/2 WMS assembly: LHCACFWM0058</p>	<p><b>STEP 4 - Assembly files</b></p>	<p><b>Top Plate MLI 50K</b></p> <p>LHCACFTS0515 – RFD MLI 70K/50K TOP LHCACFTS0515 – MLI Safety extension LHCACFTS0515 – RFD MLI Jumper MLI 50K assembly: LHCACFTS0515</p>	<p><b>External clamp</b></p> <p>LHCACFTV0175 – Top plate clamp</p>	<p><b>STEP 9 - Assembly files</b></p>	<p><b>Lower cooling line 50K</b></p> <p>LHCACFQC0552 – Lower cooling with intercepts LHCACFQC0500 – Lower cooling (without intercepts) Straps</p>	<p><b>Magnetic shield end panels</b></p> <p>LHCACFWM0032 – Mag. shield extremity panel</p>		
<p><b>Partial support</b></p> <p>LHCACFAH0052 – Helium tank support pad</p>	<p><b>Cryo instrumentation 1/4</b></p> <p>TT851, TT853, TT855, TT857, EH852a/b/c, EH854a/b/c, EH856a/b/c, EH858a/b/c – FPC bellows TT822, TT825, LHCACFS0015 – He Tanks Top TT819, 2TT819, LHCACFS0025 – VHOMs TT802, 803, 804, 806, 807, 808 – FPC TT841, LHCACFS0032 – CW transition TT814, TT816, LHCACFS0022 – HHOMs</p>	<p><b>FPC welded lip</b></p> <p>LHCACFV0182 – Lip for FPC plate welding</p>	<p><b>External clamp</b></p> <p>LHCACFTV0175 – Top plate clamp</p>	<p><b>STEP 3 - Assembly files</b></p>	<p><b>Lower cooling line 50K</b></p> <p>LHCACFQC0552 – Lower cooling with intercepts LHCACFQC0500 – Lower cooling (without intercepts) Straps</p>	<p><b>Magnetic shield end panels</b></p> <p>LHCACFWM0032 – Mag. shield extremity panel</p>		
<p><b>Mech. instrumentation</b></p> <p>LHCACFS0079 – FPC optic fiber equipped</p>	<p><b>STEP 4 - Assembly files</b></p>	<p><b>FSI targets</b></p> <p>LHCGIOPV0023 – Flat FSI target assembly LHCGIOPV0025 – Angle FSI target assembly</p>	<p><b>External clamp</b></p> <p>LHCACFTV0175 – Top plate clamp</p>	<p><b>STEP 12 - Assembly files</b></p>	<p><b>Lower cooling line 50K</b></p> <p>LHCACFQC0552 – Lower cooling with intercepts LHCACFQC0500 – Lower cooling (without intercepts) Straps</p>	<p><b>Magnetic shield end panels</b></p> <p>LHCACFWM0032 – Mag. shield extremity panel</p>		
<p><b>STEP 3 - Assembly files</b></p>	<p><b>Mech. instrumentation</b></p> <p>LHCACFS0080 – Oxic fibers connections</p>	<p><b>MLI 2K</b></p> <p>LHCACFTS0514 – MLI 2K UPPER CRYOLINE LHCACFTS0514 – MLI 2K SAFETY PORT MLI 2K assembly: LHCACFTS0514</p>	<p><b>External clamp</b></p> <p>LHCACFTV0175 – Top plate clamp</p>	<p><b>STEP 12 - Assembly files</b></p>	<p><b>Lower cooling line 50K</b></p> <p>LHCACFQC0552 – Lower cooling with intercepts LHCACFQC0500 – Lower cooling (without intercepts) Straps</p>	<p><b>Magnetic shield end panels</b></p> <p>LHCACFWM0032 – Mag. shield extremity panel</p>		

# Thermal screen

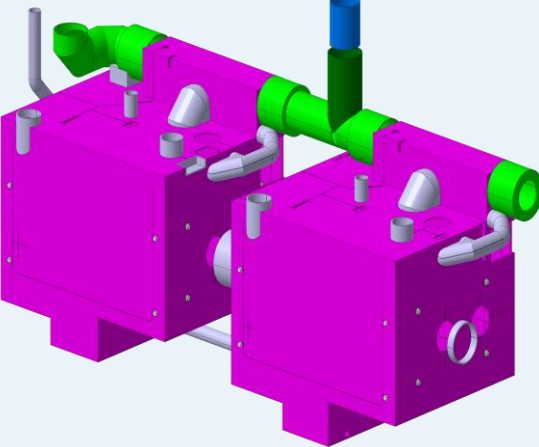
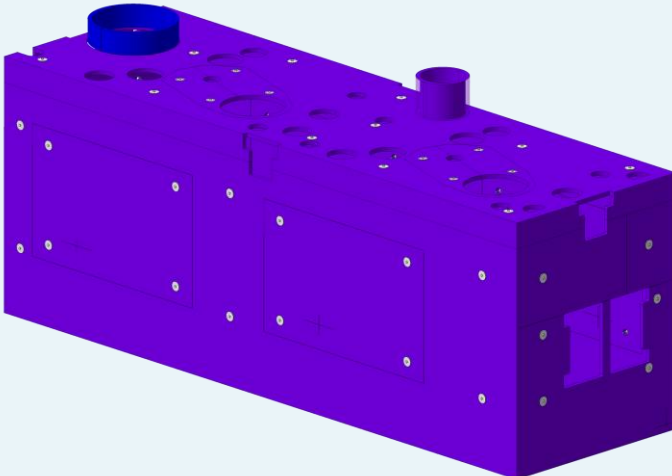
		Drawing number	EDMS references
	Thermal screen	LHCACFTS0460	Drawing folder: <a href="https://edms.cern.ch/document/2826339">https://edms.cern.ch/document/2826339</a> Engineering specification: <a href="https://edms.cern.ch/document/2101922">https://edms.cern.ch/document/2101922</a> Calculation: <a href="https://edms.cern.ch/document/2936498">https://edms.cern.ch/document/2936498</a>
	50K upper line	LHCACFQC0505	Drawing folder: <a href="https://edms.cern.ch/document/3193924">https://edms.cern.ch/document/3193924</a> Engineering specification: <a href="https://edms.cern.ch/document/2101922">https://edms.cern.ch/document/2101922</a> Calculation: <a href="https://edms.cern.ch/document/2936498">https://edms.cern.ch/document/2936498</a>
	50K outlet line	LHCACFQC0390	Drawing folder: <a href="https://edms.cern.ch/document/3193926">https://edms.cern.ch/document/3193926</a> Engineering specification: <a href="https://edms.cern.ch/document/2101922">https://edms.cern.ch/document/2101922</a> Calculation: <a href="https://edms.cern.ch/document/2936498">https://edms.cern.ch/document/2936498</a>
	50K lower line	LHCACFQC0500	Drawing folder: <a href="https://edms.cern.ch/document/3193919">https://edms.cern.ch/document/3193919</a> Engineering specification: <a href="https://edms.cern.ch/document/2101922">https://edms.cern.ch/document/2101922</a> Calculation: <a href="https://edms.cern.ch/document/2936498">https://edms.cern.ch/document/2936498</a>
	Braids for thermal intercept	LHCACFTS0518	Drawing folder: <a href="https://edms.cern.ch/document/3016774">https://edms.cern.ch/document/3016774</a> Engineering specification: <a href="https://edms.cern.ch/document/2101922">https://edms.cern.ch/document/2101922</a> Calculation: see RF lines calculations

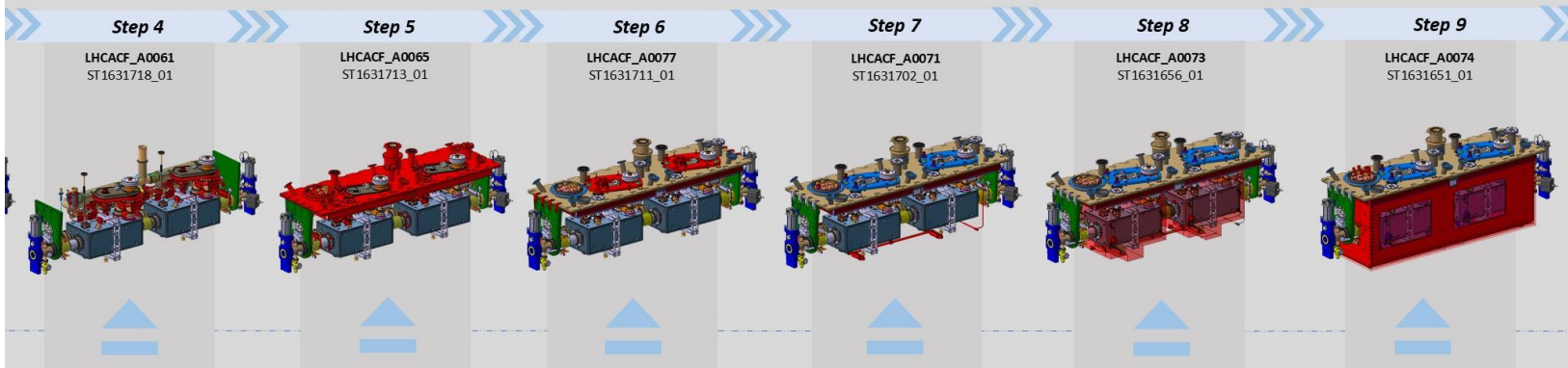
Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10
LHCACF_A0057 ST1631725_01	LHCACF_A0061 ST1631718_01	LHCACF_A0065 ST1631713_01	LHCACF_A0077 ST1631711_01	LHCACF_A0071 ST1631702_01	LHCACF_A0073 ST1631656_01	LHCACF_A0074 ST1631651_01	LHCACF_A0076 ST1631639_01
<b>Upper cryoline</b> LHCACF0084 - Upper cryoline	<b>FPC thermal screen</b> LHCACF50466 - Welding FPC Plate with Intercept LHCACF50390 - Thermal screen outlet line (without intercept)	<b>50K outlet line</b> LHCACF00466 - Thermal screen line with Intercept LHCACF50390 - Thermal screen outlet line (without intercept)	<b>FPC plate clamp</b> LHCACFV0181 - FPC plate clamp	<b>Beam screen cooling line</b> LHCACF00303 - 4-20K heat exchanger line LHCACF00300 - 4-20K Inter beam screen line	<b>MLI 2K</b> LHCACF50514 - MLI 2K cavities, beam lines, cryo lines, coax lines MLI 2K assembly: LHCACF50514	<b>Internal cryo support</b> LHCACFAH0090 - Heater support	<b>Vacuum vessel</b> LHCACF_A0064 - OVC lower assembly with antenna
<b>2K filling line</b> LHCACF00224 - 2K filling line LHCACF00251 - Clamp	<b>FPC MLI 50K</b> LHCACF50515 - RID MLI ORL0UG 1 LHCACF50515 - RID MLI ORL0UG 2 MLI 50K assembly: LHCACF50515	<b>Cryo instrumentation 2/4</b> TTR11 - HHOMs coax line cav.1 - 50K Intercept TTR12 - HHOMs coax line cav.1 - 20K Intercept TTR17 - VHOMs coax line cav.1 - 50K Intercept TTR18 - VHOMs coax line cav.1 - 20K Intercept	<b>Cavity support</b> LHCACFAH0099 - Support assembly LHCACFAH0047 - FPC Clamp LHCACFAH0054 - Threaded rod M10 LHCACFAH0093 - Adjustable nut LHCACFAH0093 - Cap M30x1 LHCACFAH0094 - Vertical stopper Support assembly: LHCACFAH0151	<b>Lower cryogenic line</b> LHCACF00488 - Lower cryoline LHCACF00384 - Epoxy spacer D21.3	<b>Antennas - RF lines 1/2 Cable installation</b> ST1572125_01 - FR coaxial flexible cable	<b>Thermal screen</b> 7% screen assembly: LHCACF50480	<b>Thermal intercept</b> LHCACF50513 - Thermal int. antenna Intercepts assembly: LHCACF50518
<b>Upper cryoline support</b> LHCACF00605 - B-phase support equipped	<b>4K upper line</b> LHCACF00549 - 4K upper line with Intercept LHCACF00525 - 4K upper line (without intercept)	<b>HOMS - RF coaxial lines + intercepts</b> LHCACFR0281 - V-HOMS Coaxial line LHCACFR0282 - H-HOMS Coaxial line UPSTREAM LHCACFR0283 - H-HOMS Coaxial line DOWNSTR. LHCACFR0285 - Storage with double guard LHCACF50503_404 - Thermal intercepts Intercepts assembly: LHCACF50518	<b>Thermal intercept</b> LHCACF50309 - Th. Intercept for support blades Intercepts assembly: LHCACF50518	<b>External clamp</b> LHCACFV0175 - Top plate clamp	<b>Transport pad</b> LHCACF_T1870 - Transport rest airt pad	<b>Thermal intercept</b> LHCACF50513 - Thermal int. antenna Intercepts assembly: LHCACF50518	<b>FSI flanges with clamps</b> LHCACFV0026 - FSI head assembly
<b>4-20K cooling line</b> LHCACF00299 - Outlet pipe	<b>50K upper line</b> LHCACF00545 - 50K upper line with Intercept LHCACF00505 - 50K upper line (with/without intercept)	<b>External clamp</b> LHCACFV0175 - Top plate clamp	<b>Beam screen cooling line</b> LHCACF00360 - Screen cooling support Ø10 LHCACF00447 - Screen cooling support Ø10/21	<b>Beam screen cooling line</b> LHCACF00360 - Screen cooling support Ø10 LHCACF00447 - Screen cooling support Ø10/21	<b>STEP 8 - Assembly files</b>	<b>Cryo extensions</b> LHCACF00391 - Extension D63mm LHCACF00394 - Extension D18.5mm LHCACF00395 - Extension D12mm LHCACF00396 - Extension D10mm LHCACF00397 - Extension D21.3mm	<b>External clamp</b> LHCACFV0175 - OVC external clamp Type 1 LHCACFV0176 - OVC external clamp Type 2
<b>HOMS cooling line</b> LHCACF00254 - HOM cryoline flexible link	<b>Tuner frame</b> LHCACF00257 - Tuning frame assembly LHCACF13045_266 - Guidance LHCACF00268_270_271_268 - Bottom Coupling	<b>External clamp</b> LHCACFV0175 - Top plate clamp	<b>Tuner actuation support</b> LHCACFV0286 - Tuner actuator support	<b>Tuner actuation support</b> LHCACFV0286 - Tuner actuator support	<b>STEP 7 - Assembly files</b>	<b>Magnetic shield end panels</b> LHCACFV00032 - Mag. shield extremity panel	<b>External clamp</b> LHCACFV0175 - OVC external clamp Type 1 LHCACFV0176 - OVC external clamp Type 2
<b>Thermal intercept</b> LHCACF50300 - Trans. Thermal int. LHCACF50302 - Trans. Thermal int. LHCACF50304 - Trans. Thermal int. LHCACF50305 - Trans. Thermal int. Intercepts assembly: LHCACF50518	<b>FPC thermal links</b> LHCACF50323,324,325,340 - Thermal intercepts 50K for FPC Intercepts assembly: LHCACF50518	<b>External clamp</b> LHCACFV0175 - Top plate clamp	<b>STEP 6 - Assembly files</b>	<b>STEP 6 - Assembly files</b>	<b>MLI 50K</b> LHCACF50515 - MLI 70K/50K Lower Part MLI 50K assembly: LHCACF50515	<b>Valve plate clamp</b> LHCACFV0177 - Valve plate clamp	
<b>Internal support</b> LHCACFAH0055 - Support for cold/warm transition	<b>Tuner double pipe + intercepts</b> LHCACFTU0260 - Tuner actuation bellows LHCACFTU0272 - Top outer part LHCACFTU0264 - Outer tube spacer LHCACFR0282 - Blue safety extension LHCACF50166,317,318,320 - Thermal intercepts 50K for tuner Intercepts assembly: LHCACF50518	<b>Safety line screen support</b> LHCACF00382 - Ø10 support for safety line	<b>STEP 5 - Assembly files</b>	<b>STEP 5 - Assembly files</b>	<b>Lower cooling line 50K</b> LHCACF00552 - Lower cooling with intercepts LHCACF00500 - Lower cooling (without intercepts) Straps	<b>STEP 10 - Assembly files</b>	
<b>FPC Magnetic shield</b> LHCACFV00033 - FPC h.all plate 1/2 LHCACFV00034 - FPC h.all plate 2/2 WKB assembly: LHCACFV00032	<b>STEP 4 - Assembly files</b>	<b>Top Plate thermal screen</b> LHCACF50461 - Top Plate Assembly LHCACF50243 - Thermal screen flange 7% screen assembly: LHCACF50480	<b>STEP 4 - Assembly files</b>	<b>STEP 4 - Assembly files</b>	<b>Lower cooling line 50K</b> LHCACF00552 - Lower cooling with intercepts LHCACF00500 - Lower cooling (without intercepts) Straps	<b>STEP 9 - Assembly files</b>	
<b>Partial support</b> LHCACFAH0052 - Helium tank support pad	<b>Top Plate MLI 50K</b> LHCACF50515 - RID MLI 70K/50K TOP LHCACF50515 - MLI safety extension LHCACF50515 - RID MLI jumper MLI 50K assembly: LHCACF50515	<b>Top Plate MLI 50K</b> LHCACF50515 - RID MLI 70K/50K TOP LHCACF50515 - MLI safety extension LHCACF50515 - RID MLI jumper MLI 50K assembly: LHCACF50515	<b>STEP 4 - Assembly files</b>	<b>STEP 4 - Assembly files</b>	<b>STEP 9 - Assembly files</b>	<b>STEP 9 - Assembly files</b>	
<b>Cryo instrumentation 1/4</b> TTR51, TTR53, TTR55, TTR57, EHS52a/h/c, EHS54a/h/c, EHS56a/h/c, EHS58a/h/c - FPC bellows TTR22, TTR25, LHCACF00015 - He Tanks Top TTR19, TTR19, LHCACF00015 - VHOMs TTR02, R03, R04, R06, R07, R08 - FPC TTR41, LHCACF00032 - CW transition TTR14, TTR16, LHCACF00022 - HHOMs	<b>STEP 4 - Assembly files</b>	<b>STEP 4 - Assembly files</b>	<b>STEP 4 - Assembly files</b>	<b>STEP 4 - Assembly files</b>	<b>STEP 9 - Assembly files</b>	<b>STEP 9 - Assembly files</b>	
<b>Mech. instrumentation</b> LHCACF00079 - FPC optic fiber equipped	<b>STEP 3 - Assembly files</b>	<b>STEP 3 - Assembly files</b>	<b>STEP 3 - Assembly files</b>	<b>STEP 3 - Assembly files</b>	<b>STEP 9 - Assembly files</b>	<b>STEP 9 - Assembly files</b>	
<b>Upper cryoline</b> LHCACF0084 - Upper cryoline	<b>2K filling line</b> LHCACF00224 - 2K filling line LHCACF00251 - Clamp	<b>Upper cryoline support</b> LHCACF00605 - B-phase support equipped	<b>4-20K cooling line</b> LHCACF00299 - Outlet pipe	<b>HOMS cooling line</b> LHCACF00254 - HOM cryoline flexible link	<b>Tuner frame</b> LHCACF00257 - Tuning frame assembly LHCACF13045_266 - Guidance LHCACF00268_270_271_268 - Bottom Coupling	<b>Thermal intercept</b> LHCACF50300 - Trans. Thermal int. LHCACF50302 - Trans. Thermal int. LHCACF50304 - Trans. Thermal int. LHCACF50305 - Trans. Thermal int. Intercepts assembly: LHCACF50518	<b>Internal support</b> LHCACFAH0055 - Support for cold/warm transition
<b>FPC Magnetic shield</b> LHCACFV00033 - FPC h.all plate 1/2 LHCACFV00034 - FPC h.all plate 2/2 WKB assembly: LHCACFV00032	<b>Partial support</b> LHCACFAH0052 - Helium tank support pad	<b>Cryo instrumentation 1/4</b> TTR51, TTR53, TTR55, TTR57, EHS52a/h/c, EHS54a/h/c, EHS56a/h/c, EHS58a/h/c - FPC bellows TTR22, TTR25, LHCACF00015 - He Tanks Top TTR19, TTR19, LHCACF00015 - VHOMs TTR02, R03, R04, R06, R07, R08 - FPC TTR41, LHCACF00032 - CW transition TTR14, TTR16, LHCACF00022 - HHOMs	<b>Mech. instrumentation</b> LHCACF00079 - FPC optic fiber equipped	<b>STEP 3 - Assembly files</b>	<b>STEP 3 - Assembly files</b>	<b>STEP 3 - Assembly files</b>	<b>STEP 3 - Assembly files</b>
<b>FPC thermal screen</b> LHCACF50466 - Welding FPC Plate with Intercept LHCACF50390 - Thermal screen outlet line (without intercept)	<b>FPC MLI 50K</b> LHCACF50515 - RID MLI ORL0UG 1 LHCACF50515 - RID MLI ORL0UG 2 MLI 50K assembly: LHCACF50515	<b>Cryo instrumentation 2/4</b> TTR11 - HHOMs coax line cav.1 - 50K Intercept TTR12 - HHOMs coax line cav.1 - 20K Intercept TTR17 - VHOMs coax line cav.1 - 50K Intercept TTR18 - VHOMs coax line cav.1 - 20K Intercept	<b>Cavity support</b> LHCACFAH0099 - Support assembly LHCACFAH0047 - FPC Clamp LHCACFAH0054 - Threaded rod M10 LHCACFAH0093 - Adjustable nut LHCACFAH0093 - Cap M30x1 LHCACFAH0094 - Vertical stopper Support assembly: LHCACFAH0151	<b>Thermal intercept</b> LHCACF50309 - Th. Intercept for support blades Intercepts assembly: LHCACF50518	<b>External clamp</b> LHCACFV0175 - Top plate clamp	<b>Beam screen cooling line</b> LHCACF00360 - Screen cooling support Ø10 LHCACF00447 - Screen cooling support Ø10/21	<b>Tuner actuation support</b> LHCACFV0286 - Tuner actuator support
<b>Thermal intercept</b> LHCACF50309 - Th. Intercept for support blades Intercepts assembly: LHCACF50518	<b>FPC thermal links</b> LHCACF50323,324,325,340 - Thermal intercepts 50K for FPC Intercepts assembly: LHCACF50518	<b>Top Plate thermal screen</b> LHCACF50461 - Top Plate Assembly LHCACF50243 - Thermal screen flange 7% screen assembly: LHCACF50480	<b>Top Plate MLI 50K</b> LHCACF50515 - RID MLI 70K/50K TOP LHCACF50515 - MLI safety extension LHCACF50515 - RID MLI jumper MLI 50K assembly: LHCACF50515	<b>Top Plate MLI 50K</b> LHCACF50515 - RID MLI 70K/50K TOP LHCACF50515 - MLI safety extension LHCACF50515 - RID MLI jumper MLI 50K assembly: LHCACF50515	<b>Lower cooling line 50K</b> LHCACF00552 - Lower cooling with intercepts LHCACF00500 - Lower cooling (without intercepts) Straps	<b>STEP 9 - Assembly files</b>	<b>STEP 9 - Assembly files</b>

Step 12
LHCACF_A0079 ST1631633_01
<b>Doors</b> LHCACF_A0069 - Door equipped LHCACFV0159 - Corner flange LHCACFV0160 - Straight flange LHCACF_A0070 - Cover for measurement LHCACF50203 - Thermal screen down LHCACF50205 - Thermal screen covers
<b>Tuner actuation</b> LHCACFV0155 - Tuner actuation → TTR61, TTR62, EHS61, EHS62 - Tuner bellows
<b>Instrumentation Box</b> LHCACFV0004 - Box for instrumentation
<b>Cryo instrumentation 4/4</b> Level gauge and Helium guard LTR21, TTR20, LHCACF00014 - Level 1 LTR22, TTR23, LHCACF00014 - Level 2 LHCACFV0111 - Helium guard Flange + clamps + MIL connectors
<b>External heaters and sensors</b> TTR71, TTR74, EHS71a, EHS71b, EHS71c, EHS71d, EHS71e - V-HOMs TTR70, TTR73, EHS70a, EHS70b, EHS70c, EHS70d, EHS70e - H-HOMs TTR72, TTR75, EHS72a, EHS72b, EHS72c, EHS72d - Pick-Ups TTR61, TTR62, EHS61, EHS62, EHS63, EHS64 - Blades TTR60, EHS60a, EHS60b - Safety Ports EHS70a-EHS70b, TTR61, EHS70a-EHS70b, EHS70a-EHS70b, TTR68, EHS70a-EHS70b - CW
<b>STEP 12 - Assembly files</b>



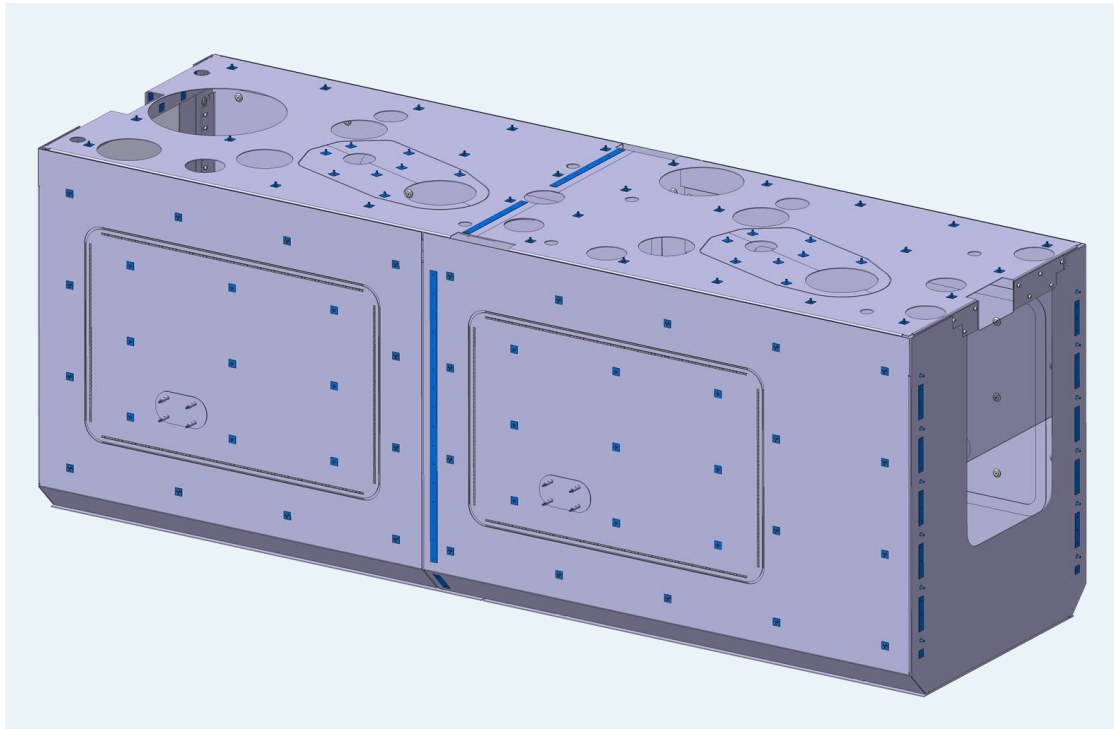
# MLI (detailed design managed by manufacturer)

	Drawing number	EDMS references
	MLI 2K LHCACFTS0514	Drawing folder: <a href="https://edms.cern.ch/document/3015832">https://edms.cern.ch/document/3015832</a>
	MLI 50K LHCACFTS0515	Engineering specification: <a href="https://edms.cern.ch/document/2144140">https://edms.cern.ch/document/2144140</a>

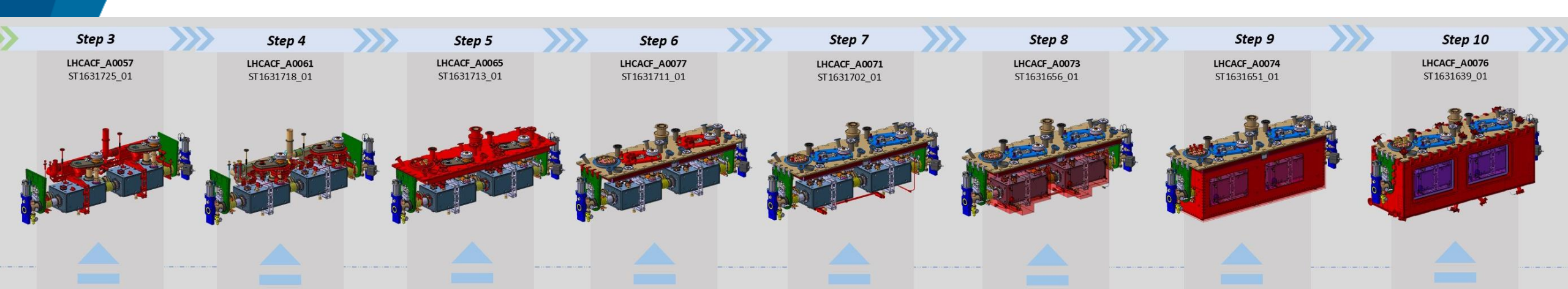


<p><b>FPC thermal screen</b></p> <p>LHCACFS0482 – Welding FPC Plate LHCACFS0223 – Flat plate with helioids LHCACFC0515 – Intermediate Support for cryo lines Th. screen assembly: LHCACFS0480</p> <p><b>FPC MLI 50K</b></p> <p>LHCACFS0515 – RFD MLI OBLONG 1 LHCACFS0515 – RFD MLI OBLONG 2 MLI 50K assembly: LHCACFS0515</p>	<p><b>50K outlet line</b></p> <p>LHCACFC0466 – Thermal screen line with intercept LHCACFC0390 – Thermal screen outlet line (without intercept)</p> <p><b>Cryo instrumentation 2/4</b></p> <p>TT811 – HHOMs coax line cav.1 – 50K Intercept TT812 – HHOMs coax line cav.1 – 20K Intercept TT817 – VHOMs coax line cav.1 – 50K Intercept TT818 – VHOMs coax line cav.1 – 20K Intercept</p>	<p><b>FPC plate clamp</b></p> <p>LHCACFV0181 – FPC plate clamp</p> <p><b>Cavity support</b></p> <p>LHCACFAH0099 – Support assembly LHCACFAH0047 – FPC Clamp LHCACFAH0054 – Threaded rod M10 LHCACFAH0092 – Adjustable nut LHCACFAH0093 – Cap M20x1 LHCACFAH0094 – Vertical stopper Support assembly: LHCACFAH0101</p>	<p><b>Beam screen cooling line</b></p> <p>LHCACFC0303 – 4-20K heat exchanger line LHCACFC0300 – 4-20K inter beam screen line</p> <p><b>Lower cryogenic line</b></p> <p>LHCACFC0488 – Lower cryoline LHCACFC0384 – Epoxy spacer D21.3</p>	<p><b>MLI 2K</b></p> <p>LHCACFS0514 – MLI 2K cavities, beam lines, cryo lines, coax lines MLI 2K assembly: LHCACFS0514</p> <p><b>Antennas - RF lines 1/2 Cable installation</b></p> <p>ST1572125_01 – FR coaxial Flexible cable</p>	<p><b>Internal cryo support</b></p> <p>LHCACFAH0090 – Heater support</p> <p><b>Thermal screen</b></p> <p>Th. screen assembly: LHCACFS0480</p> <p>LHCACFS0477 – Thermal screen lower assembly LHCACFS0355 – Extremity upper panel downstream LHCACFS0466 – Extremity upper panel upstream → TT840, LHCACFS0030 – Thermal screen instrum. LHCACFS0354 – Upstream lower panel LHCACFS0356 – Downstream lower panel</p>
<p><b>4K upper line</b></p> <p>LHCACFC0549 – 4K upper line with intercept LHCACFC0525 – 4K upper line (without intercept)</p>	<p><b>HOMS - RF coaxial lines + intercepts</b></p> <p>LHCACFR0281 – V-HOMS Coaxial line LHCACFR0282 – H-HOM Coaxial line UPSTREAM LHCACFR0285 – H-HOM Coaxial line DOWNSTR. LHCACFR0218 – Flange with double gasket LHCACFS0403_404 – Thermal intercepts Intercepts assembly: LHCACFS0518</p>	<p><b>Thermal intercept</b></p> <p>LHCACFS0309 – Th. intercept for support blades Intercepts assembly: LHCACFS0518</p>	<p><b>Cryo instrumentation 3/4</b></p> <p>TT847a, TT847b, LHCACFS0033 – 20K line heater EH847/TC848 – 4-20K line heater TT831, LHCACFS0020 – Pick up Feedthroughs EH821/TT827, LHCACFGA0300 – Cav. 1 heater EH822/TT828, LHCACFGA0300 – Cav. 2 heater TT821, TT824, LHCACFS0015 – He Tanks Bottom</p>	<p><b>Transport pad</b></p> <p>LHCACF_11870 – Transport restraint pad</p>	<p><b>Cryogenic extensions</b></p> <p>LHCACFC0393 – Extension D63mm LHCACFC0394 – Extension D18.5mm LHCACFC0395 – Extension D12mm LHCACFC0396 – Extension D10mm LHCACFC0397 – Extension D21.3mm</p>
<p><b>50K upper line</b></p> <p>LHCACFC0545 – 50K upper line with intercept LHCACFC0505 – 50K upper line (without intercept)</p>	<p><b>Jumper spacers</b></p> <p>LHCACFC0383 – G10 spacer DN63 LHCACFC0385 – G10 spacer DN10/12</p>	<p><b>External clamp</b></p> <p>LHCACFV0175 – Top plate clamp</p>	<p><b>Beam screen cooling line</b></p> <p>LHCACFC0650 – Screen cooling support Ø10 LHCACFC0647 – Screen cooling support Ø10/21</p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>Magnetic shield end panels</b></p> <p>LHCACFWM0032 – Mag. shield extremity panel</p>
<p><b>FPC thermal links</b></p> <p>LHCACFS0323, 324, 325, 340 – Thermal intercepts 50K for FPC Intercepts assembly: LHCACFS0518</p>	<p><b>Cryostat upper plate</b></p> <p>LHCACF_A0062 – Top plate equipped</p>	<p><b>Tuner actuation support</b></p> <p>LHCACFTU0286 – Tuner actuator support</p>	<p><b>STEP 7 - Assembly files</b></p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>MLI 50K</b></p> <p>LHCACFS0515 – MLI 70K/50K Lower Part MLI 50K assembly: LHCACFS0515</p>
<p><b>Tuner double pipe + intercepts</b></p> <p>LHCACFTU0260 – Tuner actuation bellows LHCACFTU0272 – Top outer part LHCACFTU0264 – Outer tube spacer LHCACFTU0217 – Rod reinforcement LHCACFS0316, 317, 318, 320 – Thermal intercepts 50K for tuner Intercepts assembly: LHCACFS0518</p>	<p><b>Safety line screen support</b></p> <p>LHCACFC0382 – G10 support for safety line</p>	<p><b>Top Plate thermal screen</b></p> <p>LHCACFS0461 – Top Plate Assembly LHCACFS0243 – Thermal screen fixation Th. screen assembly: LHCACFS0480</p>	<p><b>STEP 6 - Assembly files</b></p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>Lower cooling line 50K</b></p> <p>LHCACFC0552 – Lower cooling with intercepts LHCACFC0500 – Lower cooling (without intercepts) Straps</p>
<p><b>STEP 4 - Assembly files</b></p>	<p><b>Top Plate MLI 50K</b></p> <p>LHCACFS0515 – RFD MLI 70K/50K TOP LHCACFS0515 – MLI Safety extension LHCACFS0515 – RFD MLI Jumper MLI 50K assembly: LHCACFS0515</p>	<p><b>FPC welded lip</b></p> <p>LHCACFV0182 – Lip for FPC plate welding</p>	<p><b>OVC safety extension</b></p> <p>LHCACFV0140 – Safety port extension</p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>STEP 9 - Assembly files</b></p>
<p><b>FSI targets</b></p> <p>LHCGIOFV0023 – Flat FSI target assembly LHCGIOFV0025 – Angle FSI target assembly</p>	<p><b>MLI 2K</b></p> <p>LHCACFS0514 – MLI 2K UPPER CRYOLINE LHCACFS0514 – MLI 2K SAFETY PORT MLI 2K assembly: LHCACFS0514</p>	<p><b>FSI targets</b></p> <p>LHCGIOFV0023 – Flat FSI target assembly LHCGIOFV0025 – Angle FSI target assembly</p>	<p><b>Mech. instrumentation</b></p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>STEP 9 - Assembly files</b></p>

# Warm Magnetic Shield

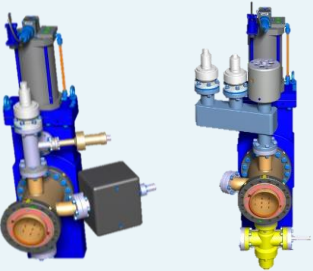
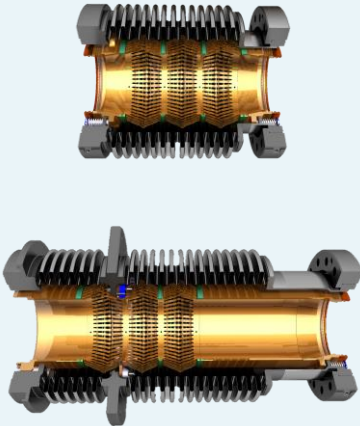
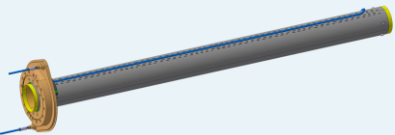


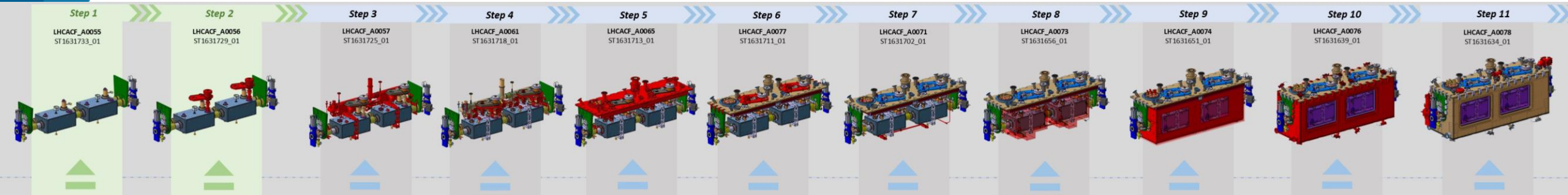
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Warm Magnetic Shield	LHCACFWM0058	Drawing folder: <a href="https://edms.cern.ch/document/2825848">https://edms.cern.ch/document/2825848</a> Engineering specification: <a href="https://edms.cern.ch/document/2101926">https://edms.cern.ch/document/2101926</a>



<p><b>Upper cryoline</b></p> <p>LHCACFC0494 – Upper cryoline</p>	<p><b>FPC thermal screen</b></p> <p>LHCACFTS0482 – Welding FPC Plate LHCACFTS0223 – Nut plate with helicoils LHCACFC0515 – Intermediate Support for cryo lines</p> <p>Th. screen assembly: LHCACFTS0460</p>	<p><b>50K outlet line</b></p> <p>LHCACFC0466 – Thermal screen line with intercept LHCACFC0390 – Thermal screen outlet line (without intercept)</p>	<p><b>FPC plate clamp</b></p> <p>LHCACFVT0181 – FPC plate clamp</p>	<p><b>Beam screen cooling line</b></p> <p>LHCACFCQ0303 – 4-20K heat exchanger line LHCACFCQ0300 – 4-20K inter beam screen line</p>	<p><b>MLI 2K</b></p> <p>LHCACFTS0514 – MLI 2K cavities, beam lines, cryo lines, coax lines</p> <p>MLI 2K assembly: LHCACFTS0514</p>	<p><b>Internal cryo support</b></p> <p>LHCACFAH0090 – Heater support</p>	<p><b>Vacuum vessel</b></p> <p>LHCACFA0064 – OVC lower assembly with antenna</p>
<p><b>2K filling line</b></p> <p>LHCACFCQ0224 – 2K filling line LHCACFCQ0251 – Clamp</p>	<p><b>FPC MLI 50K</b></p> <p>LHCACFTS0515 – RFD MLI OBLONG 1 LHCACFTS0515 – RFD MLI OBLONG 2</p> <p>MLI 50K assembly: LHCACFTS0515</p>	<p><b>Cryo instrumentation 2/4</b></p> <p>TT811 – HHOMs coax line cav.1 – 50K intercept TT812 – HHOMs coax line cav.1 – 20K intercept TT817 – VHOMs coax line cav.1 – 50K intercept TT818 – VHOMs coax line cav.1 – 20K intercept</p>	<p><b>Cavity support</b></p> <p>LHCACFAH0099 – Support assembly LHCACFAH0047 – FPC Clamp LHCACFAH0054 – Threaded rod M10 LHCACFAH0092 – Adjustable nut LHCACFAH0093 – Cap M20x1 LHCACFAH0094 – Vertical stopper</p> <p>Support assembly: LHCACFAH0101</p>	<p><b>Lower cryogenic line</b></p> <p>LHCACFCQ0488 – Lower cryoline LHCACFCQ0384 – Epoxy spacer D21.3</p>	<p><b>Antennas - RF lines 1/2 Cable installation</b></p> <p>ST1572125_01 – FR coaxial Flexible cable</p>	<p><b>Thermal screen</b></p> <p>Th. screen assembly: LHCACFTS0460</p> <p>LHCACFTS0477 – Thermal screen lower assembly LHCACFTS0355 – Extremity upper panel downstream LHCACFTS0466 – Extremity upper panel upstream → TT840, LHCACFTS0030 – Thermal screen in strum. LHCACFTS0354 – Upstream lower panel LHCACFTS0356 – Downstream lower panel</p>	<p><b>Thermal intercept</b></p> <p>LHCACFTS0513 – Thermal int. antenna Intercepts assembly: LHCACFTS0518</p>
<p><b>Upper cryoline support</b></p> <p>LHCACFC0605 – Bi-phase support equipped</p>	<p><b>4K upper line</b></p> <p>LHCACFCQ0549 – 4K upper line with intercept LHCACFCQ0525 – 4K upper line (without intercept)</p>	<p><b>HOMS - RF coaxial lines + intercepts</b></p> <p>LHCACFRL0281 – V-HOMS Coaxial line LHCACFRL0282 – H-HOM Coaxial line UPSTREAM LHCACFRL0285 – H-HOM Coaxial line DOWNSTR. LHCACFRL0218 – Flange with double gasket LHCACFTS0403,404 – Thermal intercepts</p> <p>Intercepts assembly: LHCACFTS0518</p>	<p><b>Thermal intercept</b></p> <p>LHCACFTS0309 – Th. intercept for support blades</p> <p>Intercepts assembly: LHCACFTS0518</p>	<p><b>Cryo instrumentation 3/4</b></p> <p>TT847a, TT847b, LHCACFS0033 – 20K line heater EH847/TC848 – 4-20K line heater TT831, LHCACFS0020 – Pick up Feedthroughs EH821/TT827, LHCACFGA0300 – Cav. 1 heater EH822/TT828, LHCACFGA0300 – Cav. 2 heater TT821, TT824, LHCACFS0015 – He Tanks Bottom</p>	<p><b>Transport pad</b></p> <p>LHCACFT1870 – Transport restraint pad</p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>FSI flanges with clamps</b></p> <p>LHCGIOFV0026 – FSI head assembly</p>
<p><b>4-20K cooling line</b></p> <p>LHCACFCQ0299 – Outlet pipe</p>	<p><b>50K upper line</b></p> <p>LHCACFCQ0545 – 50K upper line with intercept LHCACFCQ0505 – 50K upper line (without intercept)</p>	<p><b>Jumper spacers</b></p> <p>LHCACFCQ0383 – G10 spacer D163 LHCACFCQ0385 – G10 spacer D110/12</p>	<p><b>External clamp</b></p> <p>LHCACFVT0175 – Top plate clamp</p>	<p><b>Beam screen cooling line</b></p> <p>LHCACFCQ0650 – Screen cooling support Ø10 LHCACFCQ0647 – Screen cooling support Ø10/21</p>	<p><b>STEP 7 - Assembly files</b></p>	<p><b>Cryogenic extensions</b></p> <p>LHCACFCQ0393 – Extension D63mm LHCACFCQ0394 – Extension D18.5mm LHCACFCQ0395 – Extension D12mm LHCACFCQ0396 – Extension D10mm LHCACFCQ0397 – Extension D21.3mm</p>	<p><b>External clamp</b></p> <p>LHCACFVT0175 – OVC external clamp type 1 LHCACFVT0176 – OVC external clamp type 2</p>
<p><b>Tuner frame</b></p> <p>LHCACFTU0257 – Tuning frame assembly LHCACFTU0265,266 – Guidance LHCACFTU0269,270,171,068 – Bottom Coupling</p>	<p><b>FPC thermal links</b></p> <p>LHCACFTS0323,324,325,340 – Thermal intercepts 50K for FPC</p> <p>Intercepts assembly: LHCACFTS0518</p>	<p><b>Cryostat upper plate</b></p> <p>LHCACFA0062 - Top plate equipped</p>	<p><b>Beam screen cooling line</b></p> <p>LHCACFCQ0647 – Screen cooling support Ø10/21</p>	<p><b>Tuner actuation support</b></p> <p>LHCACFTU0286 – Tuner actuator support</p>	<p><b>STEP 6 - Assembly files</b></p>	<p><b>Magnetic shield end panels</b></p> <p>LHCACFWM0032 – Mag. shield extremity panel</p>	<p><b>Valve plate clamp</b></p> <p>LHCACFVT0177 – Valve plate clamp</p>
<p><b>Thermal intercept</b></p> <p>LHCACFTS0300 – Trans. Thermal int. LHCACFTS0302 – Trans. Thermal int. LHCACFTS0304 – Trans. Thermal int. LHCACFTS0305 – Trans. Thermal int.</p> <p>Intercepts assembly: LHCACFTS0518</p>	<p><b>Tuner double pipe + intercepts</b></p> <p>LHCACFTU0260 – Tuner actuation bellows LHCACFTU0272 – Top outer part LHCACFTU0264 – Outer tube spacer LHCACFTU0217 – Rod reinforcement LHCACFTS0316,317,318,320 – Thermal intercepts 50K for tuner</p> <p>Intercepts assembly: LHCACFTS0518</p>	<p><b>Safety line screen support</b></p> <p>LHCACFCQ0382 – G10 support for safety line</p>	<p><b>Top Plate thermal screen</b></p> <p>LHCACFTS0461 – Top Plate Assembly LHCACFTS0243 – Thermal screen fixation</p> <p>Th. screen assembly: LHCACFTS0460</p>	<p><b>STEP 5 - Assembly files</b></p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>MLI 50K</b></p> <p>LHCACFTS0515 – MLI 70K/50K Lower Part</p> <p>MLI 50K assembly: LHCACFTS0515</p>	<p><b>STEP 10 - Assembly files</b></p>
<p><b>Internal support</b></p> <p>LHCACFAH0055 – Support for cold/warm transition</p>	<p><b>Top Plate MLI 50K</b></p> <p>LHCACFTS0515 – RFD MLI 70K/50K TOP LHCACFTS0515 – MLI Safety extension LHCACFTS0515 – RFD MLI Jumper</p> <p>MLI 50K assembly: LHCACFTS0515</p>	<p><b>FPC welded lip</b></p>	<p><b>STEP 6 - Assembly files</b></p>	<p><b>STEP 7 - Assembly files</b></p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>Lower cooling line 50K</b></p> <p>LHCACFCQ0552 – Lower cooling with intercepts LHCACFCQ0500 – Lower cooling (without intercepts) Straps</p>	<p><b>STEP 9 - Assembly files</b></p>
<p><b>FPC Magnetic shield</b></p> <p>LHCACFWM0033 – FPC half plate 1/2 LHCACFWM0034 – FPC half plate 2/2</p> <p>WMS assembly: LHCACFWM0058</p>	<p><b>STEP 4 - Assembly files</b></p>	<p><b>STEP 5 - Assembly files</b></p>	<p><b>STEP 6 - Assembly files</b></p>	<p><b>STEP 7 - Assembly files</b></p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>STEP 9 - Assembly files</b></p>	<p><b>STEP 10 - Assembly files</b></p>
<p><b>Partial support</b></p> <p>LHCACFAH0052 – Helium tank support pad</p>	<p><b>STEP 4 - Assembly files</b></p>	<p><b>STEP 5 - Assembly files</b></p>	<p><b>STEP 6 - Assembly files</b></p>	<p><b>STEP 7 - Assembly files</b></p>	<p><b>STEP 8 - Assembly files</b></p>	<p><b>STEP 9 - Assembly files</b></p>	<p><b>STEP 10 - Assembly files</b></p>

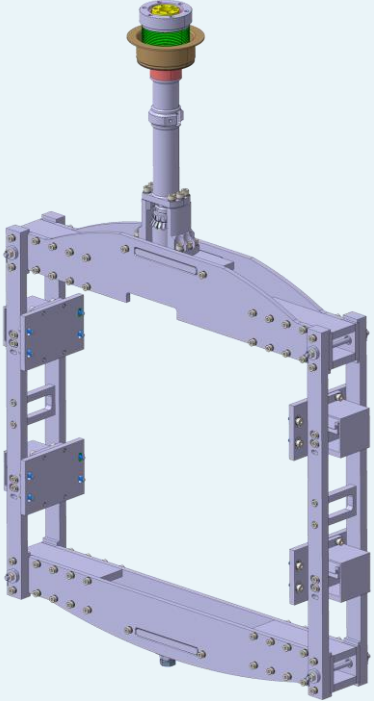
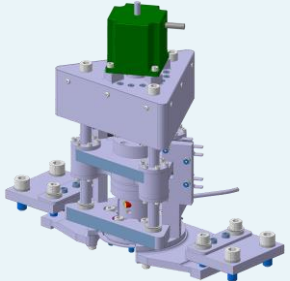
# UHV Chambers

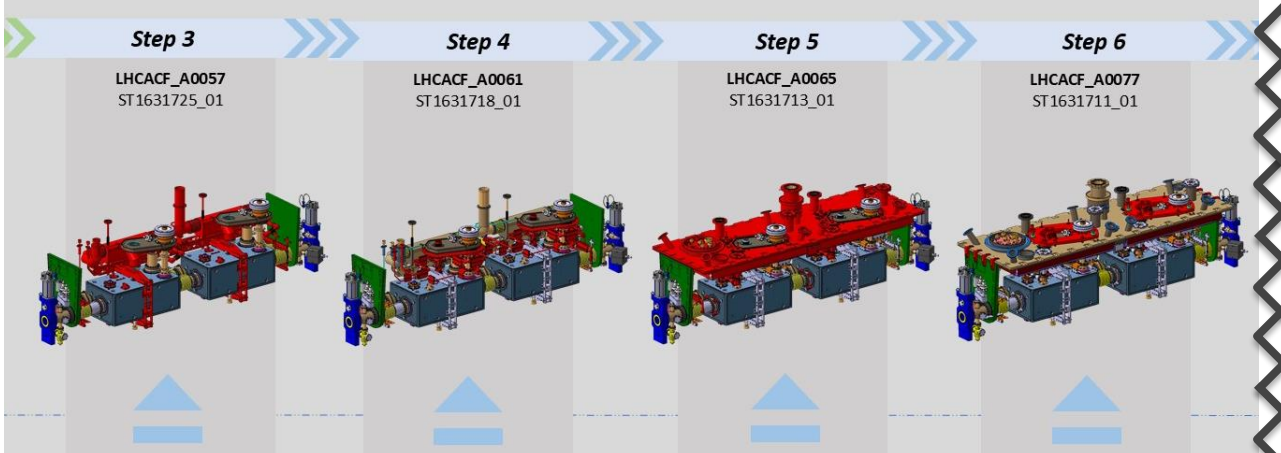
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	Cold warm transition cavity line SHORT	LHCVBMCC0032	Drawing folder: <a href="https://edms.cern.ch/document/2274615">https://edms.cern.ch/document/2274615</a>
	Cold warm transition cavity line LONG	LHCVBMCC0034	Drawing folder: <a href="https://edms.cern.ch/document/2274634">https://edms.cern.ch/document/2274634</a>
	Cold warm transition secondary line SHORT	LHCVBMCC0033	Drawing folder: <a href="https://edms.cern.ch/document/2273908">https://edms.cern.ch/document/2273908</a>
	Cold warm transition secondary line LONG	LHCVBMCC0035	Drawing folder: <a href="https://edms.cern.ch/document/2274732">https://edms.cern.ch/document/2274732</a>
	Inter cavity chamber	LHCVBMCI0014	Drawing folder: <a href="https://edms.cern.ch/document/2396174">https://edms.cern.ch/document/2396174</a>
Inter beam screen chamber	LHCVBMCI0015	Drawing folder: <a href="https://edms.cern.ch/document/2396178">https://edms.cern.ch/document/2396178</a>	
	Beam screen (included in Dressed Cavity)	LHCVSSCA0024	Drawing folder: <a href="https://edms.cern.ch/document/2359491">https://edms.cern.ch/document/2359491</a> Calculation: <a href="https://edms.cern.ch/document/2399620">https://edms.cern.ch/document/2399620</a>







































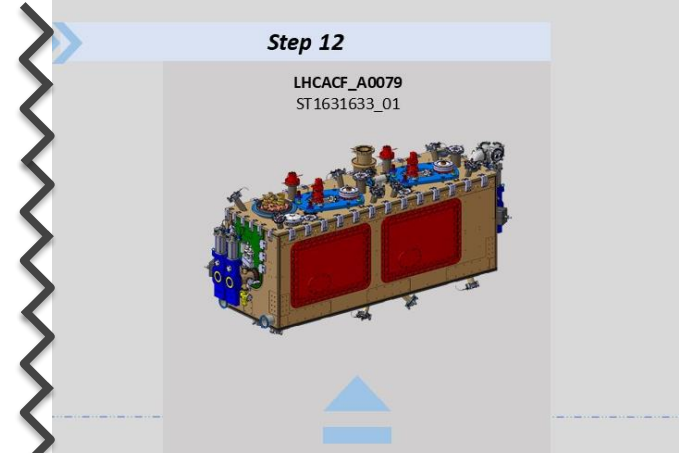
<p><b>Cavity equipped</b> LHCACF00014 &amp; 0015 - Preparation steps LHCACF00013 - Dressed cavity</p> <p><b>UHV shielded bellows</b> LHCVMAC00015 - Inter beam screen PIM LHCVMAC00014 - Inter cavity PIM LHCVMAC00013 - Short trans. Sec. Line LHCVMAC00012 - Long trans. Sec. Line LHCVMAC00011 - Short trans. Sec. Line LHCVMAC00010 - Long trans. Cav. Line</p> <p><b>Extremity vacuum inst.</b> LHCVAV_0202 - Extremity module type 1 LHCVAV_0201 - Extremity module type 2</p> <p><b>Valve plate</b> LHCACFV0104 - Valve plate</p> <p><b>STEP 1 - Assembly files</b></p>	<p><b>FPC Assembly with outer pipe &amp; bellows</b> LHCACF00207 - FPC assembly</p> <p><b>FPC plate for OVC</b> LHCACFV0108 - FPC Plate</p> <p><b>STEP 2 - Assembly files</b></p>	<p><b>Upper cryoline</b> LHCACF00084 - Upper cryoline</p> <p><b>2K filling line</b> LHCACF00124 - 2K filling line LHCACF00251 - Clamp</p> <p><b>Upper cryoline support</b> LHCACF00065 - 8i-phase support equipped</p> <p><b>4-20K cooling line</b> LHCACF00299 - Outlet pipe</p> <p><b>HOMS cooling line</b> LHCACF00256 - HOMS cryoline flexible link</p> <p><b>Tuner frame</b> LHCACF00257 - Tuning frame assembly LHCACF00265,266 - Guidance LHCACF00269,270,171,168 - Bottom Coupling</p> <p><b>Thermal intercept</b> LHCACF00300 - Trans. Thermal int. LHCACF00303 - Trans. Thermal int. LHCACF00304 - Trans. Thermal int. LHCACF00305 - Trans. Thermal int.</p> <p><b>Internal support</b> LHCACF00055 - Support for cold/warm transition</p> <p><b>FPC Magnetic shield</b> LHCACF00033 - FPC half plate 1/2 LHCACF00034 - FPC half plate 1/2 WMS assembly: LHCACF000058</p> <p><b>Partial support</b> LHCACF00052 - Helium tank support pad</p> <p><b>Cryo instrumentation 1/4</b> T1851, T1853, T1855, T1857, E1852a/b/c, E1854a/b/c, E1856a/b/c, E1858a/b/c - FPC below T1822, T1823, LHCACF00015 - He Tanks Top T1818, T1819, LHCACF00025 - VVOs T1802, 801, 804, 806, 807, 808 - FPC T1841, LHCACF00032 - CW transition T1814, T1816, LHCACF00022 - HOMS</p> <p><b>Mech. instrumentation</b> LHCACF00079 - FPC optic fiber equipped</p> <p><b>STEP 3 - Assembly files</b></p>	<p><b>FPC thermal screen</b> LHCACF00042 - Working FPC Plate LHCACF00223 - Flat plate with bellows LHCACF00015 - Intermediate Support for cryo lines Th. screen assembly: LHCACF00460</p> <p><b>FPC MLI 50K</b> LHCACF00015 - 8iD MLI OBLD10 J LHCACF00015 - 8iD MLI OBLD10 J MLI 50K assembly: LHCACF00525</p> <p><b>4K upper line</b> LHCACF00249 - 4K upper line with intercept LHCACF00249 - 4K upper line (with/without intercept)</p> <p><b>50K upper line</b> LHCACF00245 - 50K upper line with intercept LHCACF00245 - 50K upper line (with/without intercept)</p> <p><b>FPC thermal links</b> LHCACF00023,324,325,340 - Thermal intercepts 50K for FPC Intercepts assembly: LHCACF00518</p> <p><b>Tuner double pipe + intercepts</b> LHCACF00260 - Tuner actuation bellows LHCACF00272 - Top outer part LHCACF00264 - Outer tube spacer LHCACF00217 - Rod reinforcement LHCACF00316,317,318,320 - Thermal intercepts 50K for tuner Intercepts assembly: LHCACF00518</p> <p><b>STEP 4 - Assembly files</b></p>	<p><b>50K outlet line</b> LHCACF00046 - Thermal screen line with intercept LHCACF00000 - Thermal screen outlet line (without intercept)</p> <p><b>Cryo instrumentation 2/4</b> T1811 - HOMS coax line cav.1 - 50K intercept T1812 - HOMS coax line cav.1 - 20K intercept T1813 - VHOs coax line cav.1 - 20K intercept T1814 - VHOs coax line cav.1 - 20K intercept</p> <p><b>HOMS - RF coaxial lines + intercepts</b> LHCACF00281 - V-HOMS Coaxial line LHCACF00282 - H-HOMS Coaxial line UPSTREAM LHCACF00283 - H-HOMS Coaxial line DOWNSTREAM LHCACF00218 - Flange with double gasket LHCACF00010,404 - Thermal intercepts Intercepts assembly: LHCACF00518</p> <p><b>Jumpers spacers</b> LHCACF00383 - G130 spacer D163 LHCACF00385 - G130 spacer D10212</p> <p><b>Cryostat upper plate</b> LHCACF_A0062 - Top plate equipped</p> <p><b>Safety line screen support</b> LHCACF00382 - G130 support for safety line</p> <p><b>Top Plate thermal screen</b> LHCACF00461 - Top Plate Assembly LHCACF00443 - Thermal screen fixation Th. screen assembly: LHCACF00460</p> <p><b>Top Plate MLI 50K</b> LHCACF00015 - 8iD MLI 70K/50K TOP LHCACF00015 - MLI Safety extension LHCACF00015 - 8iD MLI Jumper MLI 50K assembly: LHCACF00515</p> <p><b>FPC welded lip</b> LHCACF00182 - Lip for FPC plate welding</p> <p><b>OVC safety extension</b> LHCACF00140 - Safety port extension</p> <p><b>FSI targets</b> LHCACF00023 - Flat FSI target assembly LHCACF00025 - Angle FSI target assembly</p> <p><b>MLI 2K</b> LHCACF00014 - MLI 2K UPPER CRYOLINE LHCACF00014 - MLI 2K SAFETY PORT MLI 2K assembly: LHCACF00514</p> <p><b>Mech. instrumentation</b> LHCACF00080 - Optic fibers connections LHCACF00081 - Optic fibers internal routing</p> <p><b>STEP 5 - Assembly files</b></p>	<p><b>FPC plate clamp</b> LHCACFV0101 - FPC plate clamp</p> <p><b>Cavity support</b> LHCACF00009 - Support assembly LHCACF00047 - FPC Clamp LHCACF00014 - Threaded rod M10 LHCACF00093 - Adjustable nut LHCACF00095 - Cap M20x1 LHCACF00094 - Vertical stopper Support assembly: LHCACF00101</p> <p><b>Thermal Intercept</b> LHCACF00309 - Th. intercept for support blades Intercepts assembly: LHCACF00518</p> <p><b>External clamp</b> LHCACFV01015 - Top plate clamp</p> <p><b>Beam screen cooling line</b> LHCACF00050 - Screen cooling support Ø10 LHCACF00047 - Screen cooling support Ø10/21</p> <p><b>Tuner actuation support</b> LHCACF00286 - Tuner actuator support</p> <p><b>STEP 6 - Assembly files</b></p>	<p><b>Beam screen cooling line</b> LHCACF00011 - 4-20K heat exchanger line LHCACF00000 - 4-20K hot beam screen line</p> <p><b>Lower cryogenic line</b> LHCACF00048 - Lower cryoline LHCACF00044 - Epoxy spacer D21.3</p> <p><b>Cryo instrumentation 3/4</b> T1847a, T1847b, LHCACF00013 - 20K line heater E1847/1848 - 4-20K line heater T1831, LHCACF00020 - Pick up Feedthroughs T1821/T1827, LHCACF00010 - Cav. 1 heater E1822/T1828, LHCACF00010 - Cav. 2 heater T1821, T1824, LHCACF00015 - He Tanks Bottom</p> <p><b>STEP 7 - Assembly files</b></p>	<p><b>MLI 2K</b> LHCACF00014 - MLI 2K coolers, beam lines, cryo lines, coax lines MLI 2K assembly: LHCACF00514</p> <p><b>Antennas - RF lines 1/2 Cable installation</b> ST157225_01 - RF coaxial flexible cable</p> <p><b>Transport pad</b> LHCACF_T1870 - Transport resistalut pad</p> <p><b>STEP 8 - Assembly files</b></p>	<p><b>Internal cryo support</b> LHCACF00000 - Heater support</p> <p><b>Thermal screen</b> Th. screen assembly: LHCACF00460 LHCACF00477 - Thermal screen lower assembly LHCACF00535 - Extremity upper panel downstream LHCACF00466 - Extremity upper panel upstream → T1840, LHCACF00010 - Thermal screen let-trim LHCACF00014 - Upstream lower panel LHCACF00016 - Downstream lower panel</p> <p><b>Cryogenic extensions</b> LHCACF00393 - Extension Ø63mm LHCACF00394 - Extension Ø18,5mm LHCACF00395 - Extension Ø12mm LHCACF00396 - Extension Ø10mm LHCACF00397 - Extension Ø21,3mm</p> <p><b>Magnetic shield end panels</b> LHCACF00012 - Mag. shield extremity panel</p> <p><b>MLI 50K</b> LHCACF00015 - MLI 70K/50K Lower Part MLI 50K assembly: LHCACF00515</p> <p><b>Lower cooling line 50K</b> LHCACF00052 - Lower cooling with intercepts LHCACF00000 - Lower cooling (without intercepts) Staps</p> <p><b>STEP 9 - Assembly files</b></p>	<p><b>Vacuum vessel</b> LHCACF_A0064 - OVC lower assembly with antenna</p> <p><b>Thermal intercept</b> LHCACF00013 - Thermal int. antenna Intercepts assembly: LHCACF00518</p> <p><b>FSI flanges with clamps</b> LHCACF00026 - FSI head assembly</p> <p><b>External clamp</b> LHCACF00175 - OVC external clamp type 1 LHCACF00176 - OVC external clamp type 2</p> <p><b>Valve plate clamp</b> LHCACFV01017 - Valve plate clamp</p> <p><b>STEP 10 - Assembly files</b></p>	<p><b>Extremity vacuum inst.</b> LHCVAV_0204 - Extremity module type 3 LHCVAV_0205 - Extremity module type 4</p> <p><b>Blow up valve with clamps</b> LHCACF00213 - Relief vacuum valve</p> <p><b>Internal instrum. feedthroughs</b> Tee Instrumentation Feedthrough Cross Instrumentation Feedthrough</p> <p><b>STEP 11 - Assembly files</b></p>
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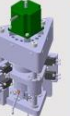


# Tuner

		Drawing number	EDMS references
	Tuner Frame	LHCACFTU0257	
	Tuner Actuation Bellows	LHCACFTU0260	
	Bottom coupling	LHCACFTU0269, 171, 068, 270 + lip washer	Drawing folder: <a href="https://edms.cern.ch/document/3000555">https://edms.cern.ch/document/3000555</a>
	Top coupling	LHCACFTU0271, 272, 210, 211 + lip washer	Engineering specification: <a href="https://edms.cern.ch/document/2101938">https://edms.cern.ch/document/2101938</a>
	Tuning rod reinforcement	LHCACFTU0217	Calculation: <a href="https://edms.cern.ch/document/2310327">https://edms.cern.ch/document/2310327</a>
	Outer tube spacer	LHCACFTU0264	
	Flexural guidance	LHCACFTU0265, 266	
	Tuner actuation	LHCACFTU0286 LHCACFTU0315	Drawing folder: <a href="https://edms.cern.ch/document/3087421">https://edms.cern.ch/document/3087421</a>  Engineering specification: <a href="https://edms.cern.ch/document/2101938">https://edms.cern.ch/document/2101938</a>



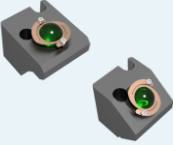
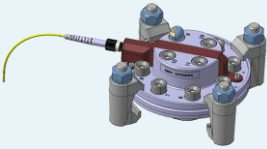

<p><b>Upper cryoline</b></p> <p>LHCACFC0494 – Upper cryoline</p> 	<p><b>FPC thermal screen</b></p> <p>LHCACFTS0482 – Welding FPC Plate LHCACFTS0223 – Nut plate with helicoils LHCACFC0515 – Intermediate Support for cryo lines</p> <p>Th. screen assembly: LHCACFTS0460</p> 	<p><b>50K outlet line</b></p> <p>LHCACFC0466 – Thermal screen line with intercept LHCACFC0390 – Thermal screen outlet line (without intercept)</p> 	<p><b>FPC plate clamp</b></p> <p>LHCACFVT0181 – FPC plate clamp</p> 
<p><b>2K filling line</b></p> <p>LHCACFC0224 – 2K filling line LHCACFC0251 – Clamp</p> 	<p><b>FPC MLI 50K</b></p> <p>LHCACFTS0515 – RFD MLI OBLONG 1 LHCACFTS0515 – RFD MLI OBLONG 2</p> <p>MLI 50K assembly: LHCACFTS0515</p> 	<p><b>Cryo instrumentation 2/4</b></p> <p>TT811 – HHOMs coax line cav.1 - 50K intercept TT812 – HHOMs coax line cav.1 - 20K intercept TT817 – VHOMs coax line cav.1 - 50K intercept TT818 – VHOMs coax line cav.1 - 20K intercept</p> 	<p><b>Cavity support</b></p> <p>LHCACFAH0099 – Support assembly LHCACFAH0047 – FPC Clamp LHCACFAH0054 – Threaded rod M10 LHCACFAH0092 – Adjustable nut LHCACFAH0093 – Cap M20x1 LHCACFAH0094 – Vertical stopper</p> <p>Support assembly: LHCACFAH0101</p> 
<p><b>Upper cryoline support</b></p> <p>LHCACFC0605 – Bi-phase support equipped</p> 	<p><b>4K upper line</b></p> <p>LHCACFC0549 – 4K upper line with intercept LHCACFC0525 – 4K upper line (without intercept)</p> 	<p><b>HOMS - RF coaxial lines + intercepts</b></p> <p>LHCACFRL0281 – V-HOMS Coaxial line LHCACFRL0282 – H-HOM Coaxial line UPSTREAM LHCACFRL0285 – H-HOM Coaxial line DOWNSTR. LHCACFRL0218 – Flange with double gasket LHCACFTS0403,404 – Thermal intercepts</p> <p>Intercepts assembly: LHCACFTS0518</p> 	<p><b>Thermal intercept</b></p> <p>LHCACFTS0309 – Th. intercept for support blades</p> <p>Intercepts assembly: LHCACFTS0518</p> 
<p><b>4-20K cooling line</b></p> <p>LHCACFC0299 – Outlet pipe</p> 	<p><b>50K upper line</b></p> <p>LHCACFC0545 – 50K upper line with intercept LHCACFC0505 – 50K upper line (without intercept)</p> 	<p><b>Jumper spacers</b></p> <p>LHCACFC0383 – G10 spacer DN63 LHCACFC0385 – G10 spacer DN10/12</p> 	<p><b>External clamp</b></p> <p>LHCACFVT0175 – Top plate clamp</p> 
<p><b>HOMS cooling line</b></p> <p>LHCACFC0256 – HOM cryoline flexible link</p> 	<p><b>Tuner frame</b></p> <p>LHCACFTU0257 – Tuning frame assembly LHCACFTU0265,266 – Guidance LHCACFTU0269,270,171,068 – Bottom Coupling</p> 	<p><b>Cryostat upper plate</b></p> <p>LHCACF_A0062 – Top plate equipped</p> 	<p><b>Beam screen cooling line</b></p> <p>LHCACFC0650 – Screen cooling support Ø10 LHCACFC0647 – Screen cooling support Ø10/21</p> 
<p><b>Thermal intercept</b></p> <p>LHCACFTS0300 – Trans. Thermal int. LHCACFTS0302 – Trans. Thermal int. LHCACFTS0304 – Trans. Thermal int. LHCACFTS0305 – Trans. Thermal int.</p> <p>Intercepts assembly: LHCACFTS0518</p> 	<p><b>FPC thermal links</b></p> <p>LHCACFTS0323,324,325,340 – Thermal intercepts 50K for FPC</p> <p>Intercepts assembly: LHCACFTS0518</p> 	<p><b>Safety line screen support</b></p> <p>LHCACFC0382 – G10 support for safety line</p> 	<p><b>STEP 6 - Assembly files</b></p> 
<p><b>Internal support</b></p> <p>LHCACFAH0055 – Support for cold/warm transition</p> 	<p><b>Tuner double pipe + intercepts</b></p> <p>LHCACFTU0260 – Tuner actuation bellows LHCACFTU0272 – Top outer part LHCACFTU0264 – Outer tube spacer LHCACFTU0217 – Rod reinforcement LHCACFTS0316,317,318,320 – Thermal intercepts 50K for tuner</p> <p>Intercepts assembly: LHCACFTS0518</p> 	<p><b>Top Plate thermal screen</b></p> <p>LHCACFTS0461 – Top Plate Assembly LHCACFTS0243 – Thermal screen fixation</p> <p>Th. screen assembly: LHCACFTS0460</p> 	<p><b>STEP 6 - Assembly files</b></p> 
<p><b>FPC Magnetic shield</b></p> <p>LHCACFW0033 – FPC half plate 1/2 LHCACFW0034 – FPC half plate 2/2</p> <p>WMS assembly: LHCACFW0058</p> 	<p><b>Partial support</b></p> <p>LHCACFAH0052 – Helium tank support pad</p> 	<p><b>Top Plate MLI 50K</b></p> <p>LHCACFTS0515 – RFD MLI 70K/50K TOP LHCACFTS0515 – MLI Safety extension LHCACFTS0515 – RFD MLI Jumper</p> <p>MLI 50K assembly: LHCACFTS0515</p> 	<p><b>STEP 6 - Assembly files</b></p> 
<p><b>Cryo instrumentation 1/4</b></p> <p>TT851, TT853, TT855, TT857, EH852a/b/c</p> 	<p><b>STEP 4 - Assembly files</b></p> 	<p><b>FPC welded lip</b></p> <p>LHCACFVT0182 – Lip for FPC plate welding</p> 	<p><b>STEP 6 - Assembly files</b></p> 



<p><b>Doors</b></p> <p>LHCACF_A0069 – Door equipped LHCACFVT0159 – Corner flange LHCACFVT0160 – Straight flange LHCACF_A0070 – Cover for transport LHCACFTS0202 – Thermal screen doors LHCACFTS0205 – Thermal screen covers</p> <p>Th. screen assembly: LHCACFTS0460</p> 	<p><b>Tuner actuation</b></p> <p>LHCACFTU0315 – Tuner actuation → TT861, TT862, EH861, EH862 – Tuner instrum.</p> 
<p><b>Cryo instrumentation 4/4</b></p> <p><b>Level gauge and Helium guard</b></p> <p>LT821, TT820, LHCACRS0014 – Level 1 LT822, TT823, LHCACRS0014 – Level 2 LHCACFVT0113 – Helium guard Flange + clamps + MLI connectors</p> 	<p><b>Instrumentation Box</b></p> <p>LHCACRSxxxx – Box for instrumentation</p> <p><b>TO BE UPDATED</b></p>
<p><b>External heaters and sensors</b></p> <p>TT871, TT874, EH871a, EH871b, EH874a, EH874b – V-HOMs TT870, TT873, EH870a, EH870b, EH873a, EH873b – H-HOMs TT872, TT875, EH872a, EH872b, EH875a, EH875b – Pick-Ups TT863, TT866, EH863, EH864, EH865, EH866 – Blades TT881, TT882, EH881, EH882 – Level Ports TT880, EH880a, EH880b – Safety Port EH876a-EH876b-TT886, EH877a-EH877b, EH878a-EH878b-TT888, EH879a-EH879b – CWT</p>	<p><b>STEP 12 - Assembly files</b></p> 



# Other equipment

	FSI targets	LHCGIOFV0023 LHCGIOFV0025
	FSI flanges	LHCGIOFV0026
	Instrumentation feedthroughs	standard components
	Instrumentation box	design ongoing



<b>50K outlet line</b> LHCACFQC0466 – Thermal screen line with intercept LHCACFQC0390 – Thermal screen outlet line (without intercept)	<b>FPC plate clamp</b> LHCACFV0181 – FPC plate clamp  <b>Cavity support</b> LHCACFAH0099 – Support assembly LHCACFAH0047 – FPC Clamp LHCACFAH0054 – Threaded rod M10 LHCACFAH0093 – Adjustable nut LHCACFAH0093 – Cap M2x61 LHCACFAH0094 – Vertical stopper Support assembly: LHCACFAH0101	<b>Beam screen cooling line</b> LHCACFQC0303 – 4-20K heat exchanger line LHCACFQC0300 – 4-20K Inter beam screen line  <b>Lower cryogenic line</b> LHCACFQC0488 – Lower cryo line LHCACFQC0584 – Epoxy spacer D21.3	<b>MLU 2K</b> LHCACFTS0514 – MLU 2K cavities, beam lines, cryo filers, coax lines MLU 2K assembly: LHCACFTS0514  <b>Antennas - RF lines 1/2 Cable installation</b> ST1572125_01 – RF coaxial Flexible cable  <b>Transport pad</b> LHCACF_T1870 – Transport restraint pad  <b>STEP 8 - Assembly files</b>	<b>Internal cryo support</b> LHCACFAH0090 – Heater support  <b>Thermal screen</b> <small>Th. screen assembly: LHCACFTS0460</small> LHCACFTS0477 – Thermal screen lower assembly LHCACFTS0355 – Extremity upper panel downstream LHCACFTS0466 – Extremity upper panel upstream → TT840, LHCACFTS0350 – Thermal screen in strum. LHCACFTS0354 – Upper eam lower panel LHCACFTS0356 – Downstream lower panel	<b>Vacuum vessel</b> LHCACF_A0064 – OVC lower assembly with antenna  <b>Thermal intercept</b> LHCACFTS0515 – Thermal int. antenna Intercepts assembly: LHCACFTS0518  <b>FSI flanges with clamps</b> LHCGIOFV0026 – FSI head assembly  <b>External clamp</b> LHCACFV0175 – OVC external clamp type 1 LHCACFV0176 – OVC external clamp type 2  <b>Valve plate clamp</b> LHCACFV0177 – Valve plate clamp  <b>STEP 10 - Assembly files</b>	<b>Extremity vacuum inst.</b> LHCVA__0204 – Extremity module type 3 LHCVA__0205 – Extremity module type 4  <b>Blow up valve with clamps</b> LHCACFV0213 – Relief vacuum valve  <b>Internal instrum. feedthroughs</b> <small>Tea Instrumentation Feedthrough Cross Instrumentation Feedthrough</small> <b>TO BE UPDATED</b>  <b>STEP 11 - Assembly files</b>	<b>Doors</b> LHCACF_A0069 – Door equipped LHCACFV0159 – Corner flange LHCACFV0160 – Straight flange LHCACF_A0070 – Cover for transport LHCACFTS0203 – Thermal screen doors LHCACFTS0205 – Thermal screen covers  <b>Cryo instrumentation 4/4</b> <b>Level gauge and Helium guard</b> LTR22, LTR20, LHCACFS0014 – Level 1 LTR22, LTR23, LHCACFS0014 – Level 2 LHCACFV0113 – Helium guard Flange + clamps + MIL connectors  <b>External heaters and sensors</b> TT871, TT874, EH871a, EH871b, EH874a, EH874b – V-HOMs TT870, TT873, EH870a, EH870b, EH871a, EH871b – H-HOMs TT872, TT875, EH872a, EH872b, EH875a, EH875b – Pick-Ups TT863, TT866, EH863, EH864, EH865, EH866 – Blades TT881, TT882, EH881, EH882 – Level Ports TT880, EH880a, EH880b – Safety Port EH876a, EH876b, TT886, EH877a, EH877b, EH878a, EH878b, TT888, EH879a, EH879b – CWT	<b>Tuner actuation</b> LHCACFTU0315 – Tuner actuation → TT861, TT862, EH861, EH862 – Tuner Isolation  <b>Instrumentation Box</b> LHCACFTSxxxx – Box for instrumentation <b>TO BE UPDATED</b>
<b>Jumper spacers</b> LHCACQC0383 – G10 spacer D1x3 LHCACQC0385 – G10 spacer D10/12  <b>Cryostat upper plate</b> LHCACF_A0062 – Top plate equipped  <b>Safety line screen support</b> LHCACQC0382 – G10 support for safety line  <b>Top Plate thermal screen</b> LHCACFTS0463 – Top Plate Assembly LHCACFTS0243 – Thermal screen fixation <small>Th. screen assembly: LHCACFTS0460</small>  <b>Top Plate MLU 50K</b> LHCACFTS0515 – RFD MLU 70K/50K TOP LHCACFTS0515 – MLU Safety extension LHCACFTS0515 – RFD MLU Jumper MLU 50K assembly: LHCACFTS0515	<b>External clamp</b> LHCACFV0175 – Top plate clamp  <b>Beam screen cooling line</b> LHCACFQC0650 – Screen cooling support Ø10 LHCACFQC0647 – Screen cooling support Ø10/21  <b>Tuner actuation support</b> LHCACFTU0286 – Tuner actuator support  <b>STEP 6 - Assembly files</b>	<b>Cryo instrumentation 3/4</b> TT847a, TT847b, LHCACFS0033 – 20K line heater EH847/TC848 – 4-20K line heater TT831, LHCACFS0020 – Pick up Feedthroughs EH823/TT827, LHCACFGA9300 – Cav. 1 heater EH822/TT828, LHCACFGA9300 – Cav. 2 heater TT821, TT824, LHCACFS0015 – He Tanks Bottom  <b>STEP 7 - Assembly files</b>	<b>Magnetic shield end panels</b> LHCACFWM0012 – Mag. shield extremity panel  <b>MLU 50K</b> LHCACFTS0515 – MLU 70K/50K Lower Part MLU 50K assembly: LHCACFTS0515  <b>Lower cooling line 50K</b> LHCACFQC0552 – Lower cooling with intercepts LHCACFQC0500 – Lower cooling (without intercepts) Straps  <b>STEP 9 - Assembly files</b>	<b>Mech. instrumentation</b> LHCACFS0080 – Optic fibers connections LHCACFS0081 – Optic fibers Internal routing  <b>STEP 5 - Assembly files</b>				



Activities performed in clean room



Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10	Step 11	Step 12																			
<b>Cavity equipped</b> UHCACF0001 & 0013 - Preparation steps UHCACF00013 - Dressed cavity 	<b>FPC Assembly with outer pipe &amp; bellows</b> UHCACF00027 - FPC assembly 	<b>Upper cryoline</b> UHCACF00094 - Upper cryoline 	<b>FPC thermal screen</b> UHCACF00042 - Winding FPC Plate UHCACF00033 - Top plate with bellows UHCACF00035 - Intermediate support for cryo lines 	<b>50K outlet line</b> UHCACF00066 - Thermal screen line with intercept UHCACF00038 - Thermal screen outlet line 	<b>FPC plate clamp</b> UHCACF00081 - FPC plate clamp 	<b>Beam screen cooling line</b> UHCACF00083 - 4-20K heat exchanger line UHCACF00080 - 4-20K laser beam line 	<b>MLU 2K</b> UHCACF00034 - MLU 2K cavities, beam Back view links cavity MLU 2K assembly: UHCACF00034 	<b>Internal cryo support</b> UHCACF00088 - Heater support 	<b>Vacuum vessel</b> UHCACF00064 - OVC traver assembly with antenna 	<b>Extremity vacuum inst.</b> UHCACF00084 - Extremity module type 1 UHCACF00085 - Extremity module type 2 	<b>Doors</b> UHCACF00069 - Door equipped UHCACF00068 - Casser Flange UHCACF00066 - Flange Flange UHCACF00070 - Cover for waferport UHCACF00082 - Thermal screen doors UHCACF00083 - Thermal screen covers 	<b>Tuner actuation</b> UHCACF00033 - Tuner actuation → TFB1, TFB2, TFB6, TFB8 - Tuner linkers 																		
<b>UHV shielded bellows</b> UHCACF00035 - Inter beam screen PFM UHCACF00034 - Inter cavity PFM UHCACF00033 - Short trans. Cav. Line UHCACF00031 - Short trans. Cav. Line UHCACF00030 - Long trans. Cav. Line UHCACF00029 - Long trans. Cav. Line 	<b>FPC plate for OVC</b> UHCACF00036 - FPC Plate <b>STEP 2 - Assembly files</b> 	<b>2K filling line</b> UHCACF00034 - 2K filling line UHCACF00035 - Clamp 	<b>FPC MLU 50K</b> UHCACF00033 - RID MLU OBLONG 2 UHCACF00034 - RID MLU OBLONG 2 MLU 50K assembly: UHCACF00033 	<b>Cryo instrumentation 2/4</b> TFB11 - HOMs coax line can.1 - 50K Intercept TFB2 - HOMs coax line can.2 - 50K Intercept TFB3 - HOMs coax line can.1 - 50K Intercept TFB4 - HOMs coax line can.1 - 50K Intercept 	<b>Cavity support</b> UHCACF00086 - Support assembly UHCACF00087 - FPC Clamp UHCACF00054 - Threaded rod M13 UHCACF00052 - Adjustable nut UHCACF00053 - Cap M10x4 UHCACF00054 - Vertical stopper Support assembly: UHCACF00052 	<b>Lower cryogenic line</b> UHCACF00088 - Lower cryoline UHCACF00084 - Equip spacer D12.5 	<b>Antennas - RF lines 1/2 Cable installation</b> ST132127_01 - RF coaxial flexible cable 	<b>Thermal screen</b> UHCACF00087 - Thermal screen tower assembly UHCACF00085 - Extremity upper panel down stream UHCACF00086 - Extremity upper panel upstream → TFB40, UHCACF00089 - Thermal screen brackets UHCACF00084 - Upper beam tower panel UHCACF00085 - Downstream tower panel 	<b>Thermal intercept</b> UHCACF00033 - Thermal link, antenna TH screen assembly: UHCACF00033 	<b>Blow up valve with clamps</b> UHCACF00033 - Relief vacuum valve 	<b>Cryo instrumentation 4/4</b> Level gauge and Helium guard LTB12, TFB1, UHCACF00084 - Level 1 LTB2, TFB2, UHCACF00084 - Level 2 UHCACF00033 - Helium guard Flange + clamp + ML connector 	<b>Instrumentation Box</b> UHCACF00086 - Box for instrumentation <b>TO BE UPDATED</b> 																		
<b>Extremity vacuum inst.</b> UHCACF00084 - Extremity module type 1 UHCACF00085 - Extremity module type 2 	<b>Valve plate</b> UHCACF00046 - Valve plate <b>STEP 1 - Assembly files</b> 	<b>4-20K cooling line</b> UHCACF00029 - Outlet pipe 	<b>4K upper line</b> UHCACF00048 - 4K upper line with intercept UHCACF00029 - 4K upper line (with beam intercept) 	<b>HOMS - RF coaxial lines + intercepts</b> UHCACF00033 - H-HOM Coaxial line UHCACF00032 - H-HOM Coaxial line UPS/STREAM UHCACF00035 - H-HOM Coaxial line DOWN/STR. UHCACF00032 - Flange with double gasket UHCACF00043, 004 - Thermal intercepts Intercept assembly: UHCACF00032 	<b>Thermal intercept</b> UHCACF00087 - Top plate clamp Intercept assembly: UHCACF00087 	<b>Cryo instrumentation 3/4</b> TFB18, TFB17, UHCACF00033 - 20K line heater E0407/E048 - 4-20K line heater TFB13, UHCACF00032 - Pick up Feedthrough E002/TFB2, UHCACF00030 - Cav. 3 heater E002/TFB2, UHCACF00030 - Cav. 2 heater TFB21, TFB24, UHCACF00033 - He Tanks Bottom <b>STEP 7 - Assembly files</b> 	<b>Transport pad</b> UHCACF00070 - Transport rest-plate pad <b>STEP 8 - Assembly files</b> 	<b>Cryogenic extensions</b> UHCACF00085 - Extension D10mm UHCACF00084 - Extension D18.3mm UHCACF00085 - Extension D12mm UHCACF00086 - Extension D10mm UHCACF00087 - Extension D12.3mm 	<b>FSI flanges with clamps</b> UHCACF00088 - FSI heat assembly 	<b>Internal instrum. feedthroughs</b> Tee Instrumentation Feedthrough Cross Instrumentation Feedthrough <b>TO BE UPDATED</b> 	<b>External heaters and sensors</b> TFB7, TFB18, E0875a, E0875b, E0875c, E0875d - V-HOMs TFB2, TFB3, E0875b, E0875c, E0875d - H-HOMs TFB2, TFB3, E0875b, E0875c, E0875d - Pick Ups TFB6, TFB8, E0865, E0865, E0866 - Blades TFB8, TFB8, E0865, E0862 - Level Ports TFB8, E0865, E0866 - Safety Port E0875a, E0875b, TFB8, E0875c, E0875d, E0875e, E0875f, E0875g, E0875h - CAV 	<b>External clamp</b> UHCACF00033 - OVC external clamp type 1 UHCACF00033 - OVC external clamp type 2 	<b>Valve plate clamp</b> UHCACF00046 - Valve plate clamp <b>STEP 10 - Assembly files</b> 	<b>MU 50K</b> UHCACF00033 - MU 50K/50K Lower Part MU 50K assembly: UHCACF00033 	<b>Lower cooling line 50K</b> UHCACF00082 - Lower cooling with intercepts UHCACF00082 - Lower cooling (with beam intercept) Staps <b>STEP 9 - Assembly files</b> 	<b>Magnetic shield end panels</b> UHCACF00032 - Mag. shield ext. entry panel 	<b>Partial support</b> UHCACF00052 - Helium tank support pad 	<b>Cryo instrumentation 1/4</b> TFB1, TFB2, TFB3, TFB4, E0862a/c, E0862b/c, E0862d, E0862e, E0862f - FPC bellows TFB2, TFB3, UHCACF00033 - He Tanks Top TFB18, ZTB18, UHCACF00033 - V-HOMs TFB2, B03, B04, B05, B07, B08 - FPC TFB8, UHCACF00033 - CW Transducer TFB4, TFB18, UHCACF00032 - H-HOMs 	<b>Tuner frame</b> UHCACF00027 - Tuning frame assembly UHCACF00026 - Guide UHCACF00028, ZTB1, ZTB2, ZTB3 - Bottom Coupling 	<b>Tuner activation</b> UHCACF00048 - 50K upper line with intercept UHCACF00029 - 50K upper line (with beam intercept) 	<b>Jumper spacers</b> UHCACF00048 - G10 spacer D16.3 UHCACF00049 - G10 spacer D16.3 UHCACF00049 - G10 spacer D16.3 	<b>Cryostat upper plate</b> UHCACF00082 - Top plate equipped 	<b>Safety line screen support</b> UHCACF00082 - G10 support for safety line 	<b>Top plate thermal screen</b> UHCACF00043 - Top Plate Assembly UHCACF00043 - Thermal screen fixation TH screen assembly: UHCACF00043 	<b>Top Plate MU 50K</b> UHCACF00033 - RID MU 50K TOP UHCACF00033 - RID MU 50K TOP UHCACF00033 - RID MU 50K TOP RID MU 50K assembly: UHCACF00033 	<b>FPC welded lip</b> UHCACF00082 - Lip for FPC plate welding 	<b>OVC safety extension</b> UHCACF00088 - Safety port extension 	<b>FSI targets</b> UHCACF00082 - Fast FSI target assembly UHCACF00082 - Angle FSI target assembly 	<b>MU 2K</b> UHCACF00034 - MU 2K UPPER CRYOLINE UHCACF00034 - MU 2K SAFETY PORT MU 2K assembly: UHCACF00034 	<b>Mech. instrumentation</b> UHCACF00080 - Optic fibers connections UHCACF00081 - Optic fibers internal routing <b>STEP 5 - Assembly files</b> 



Overview of assembly sequence  
**RFD CRYOMODULE for LHC**

Technologies

RadioFrequency
Survey/Alignment
Cryogenic lines
Vacuum
Tuner
Thermalisation
Magnetic shield
Mech. measurements
Transport
TRIUMF assembly procedures

EDMS 3086385  
 EN Engineering Department  
 EN-MME - 02/2025





***Thank you for your attention***