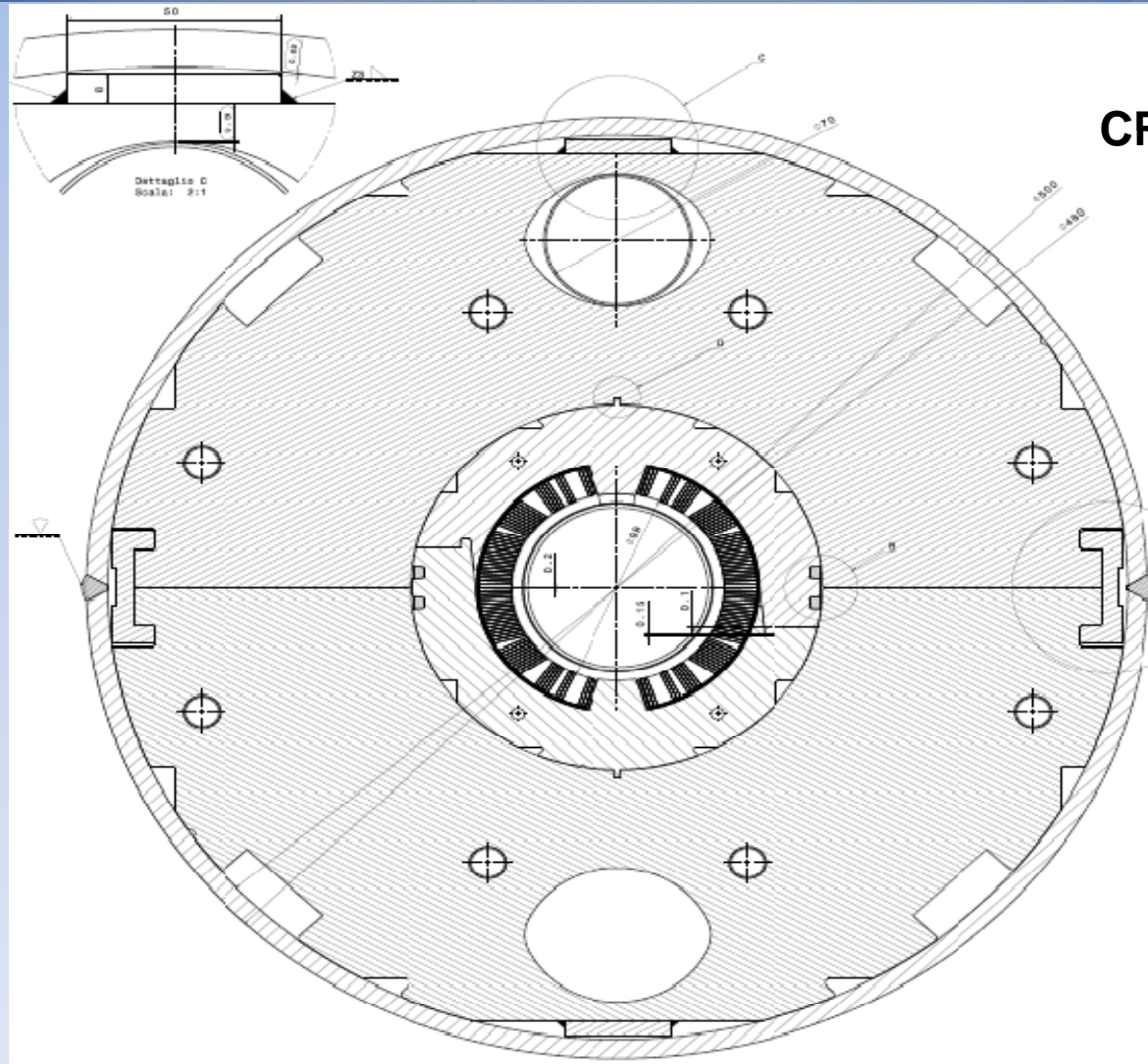


ASG

- **Cold Mass Final Drawings**
- **Materials , Component and Tools Procurement**
- **Cold Mass PED Certification**
- **PCQ**

Reported by R.Marabotto

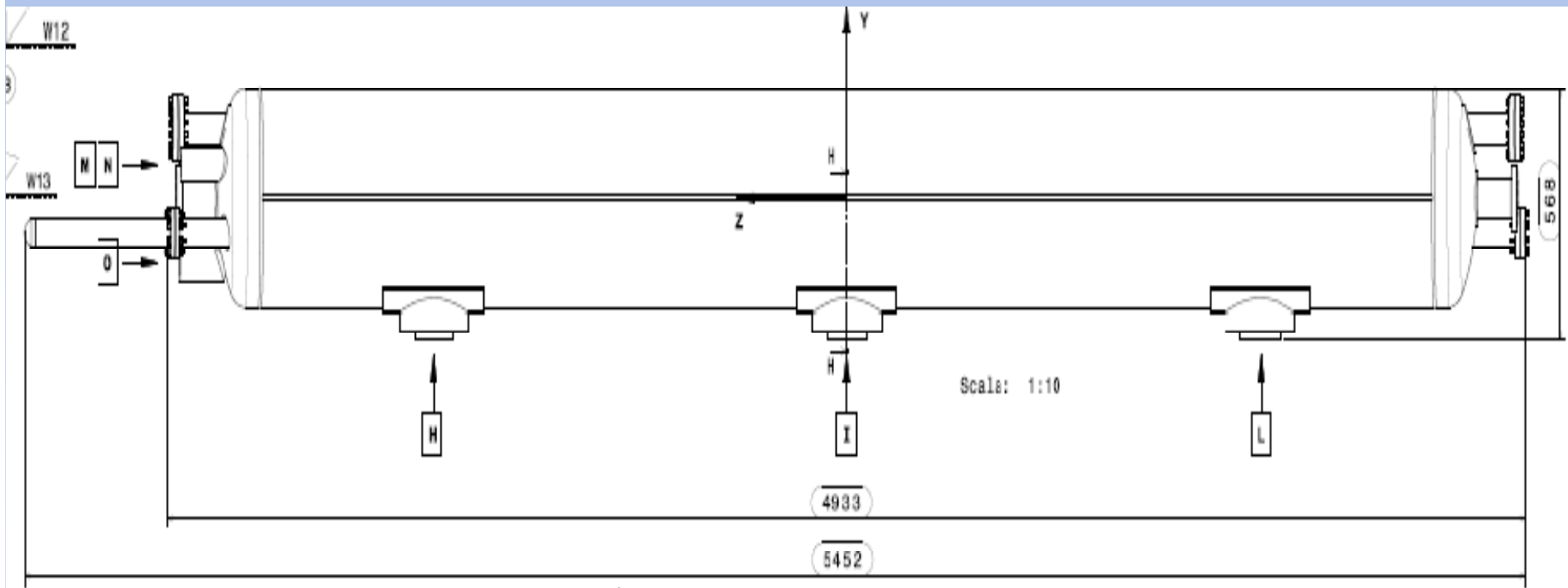


COLD MASS CROSS SECTION

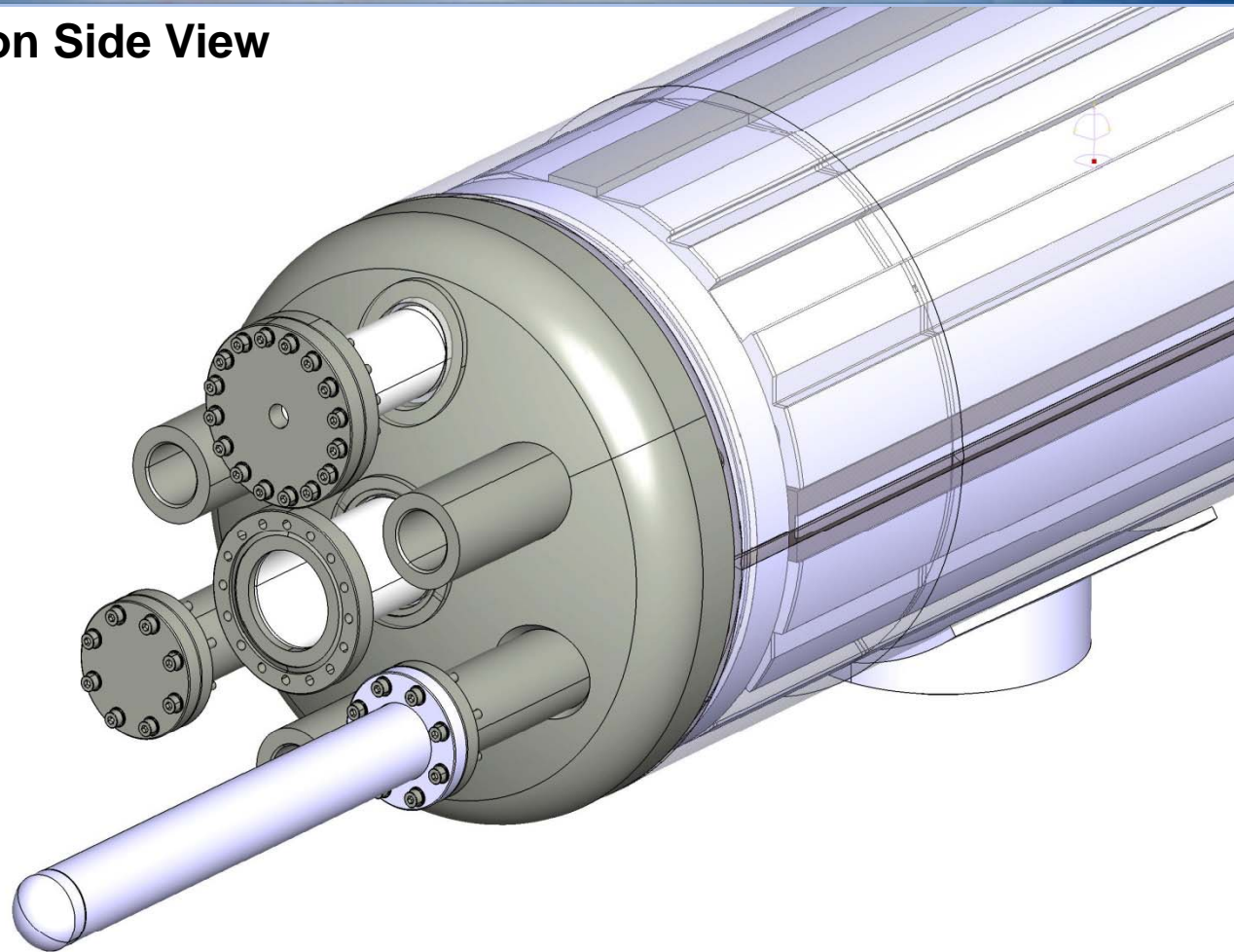
COLD MASS FINAL DRAWINGS



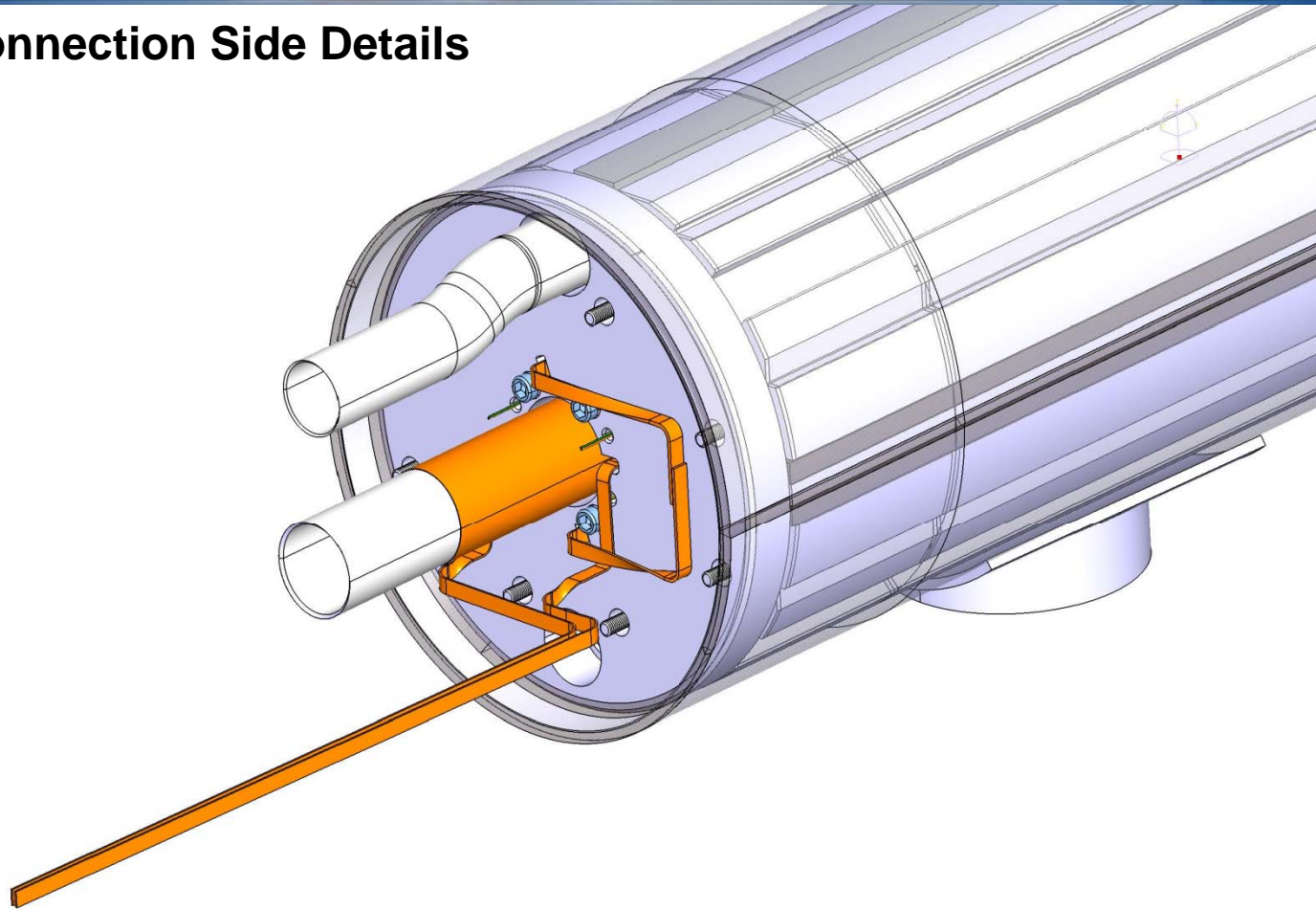
COLD MASS LONGITUDINAL VIEW

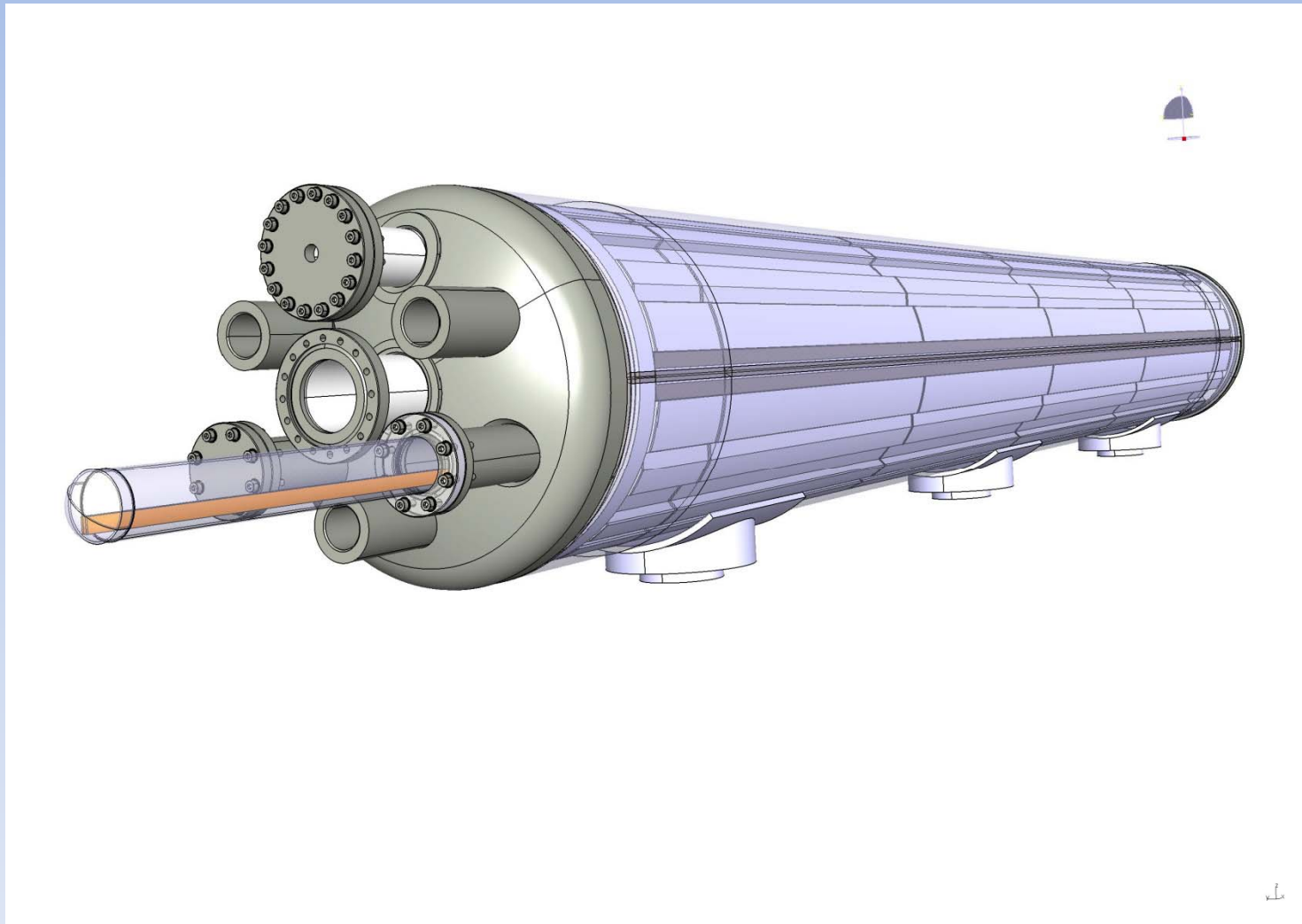


End Cover Connection Side View

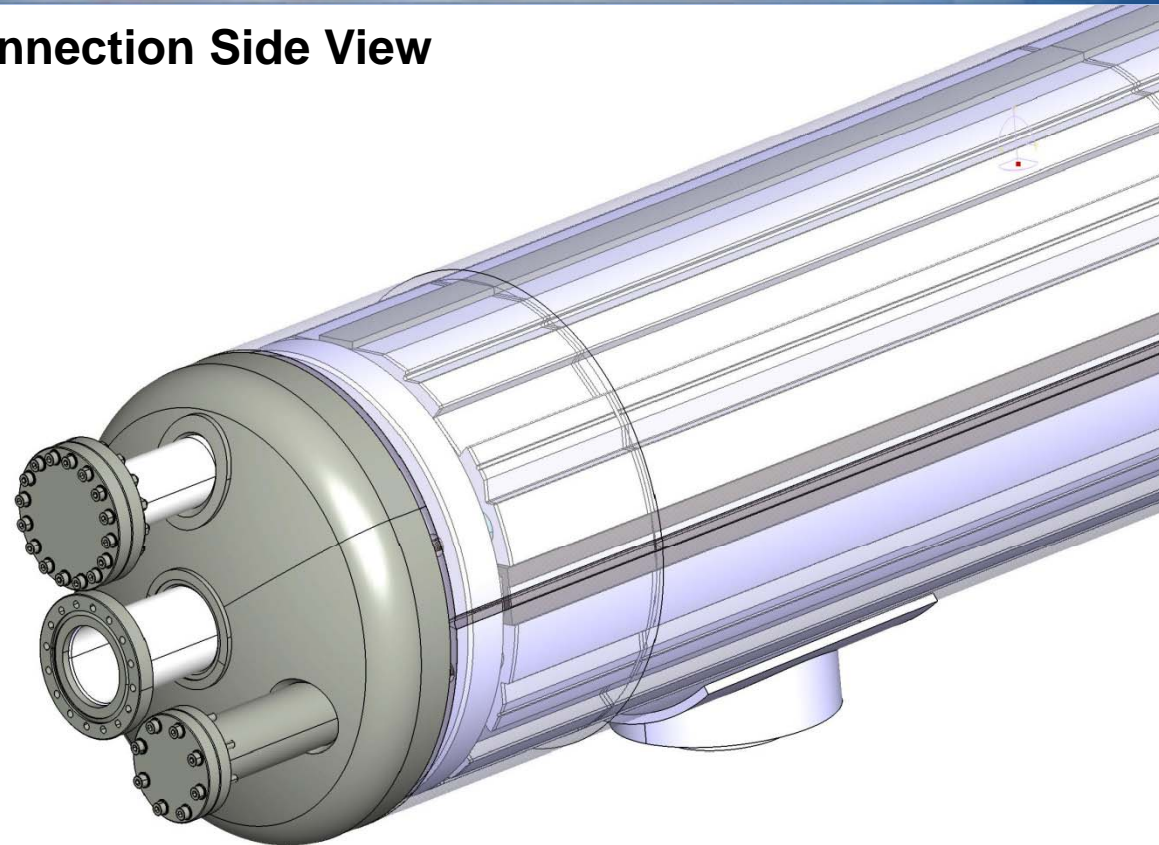


End Cover Connection Side Details





End Cover Opposite Connection Side View



Materials , Components and Tools Procurement

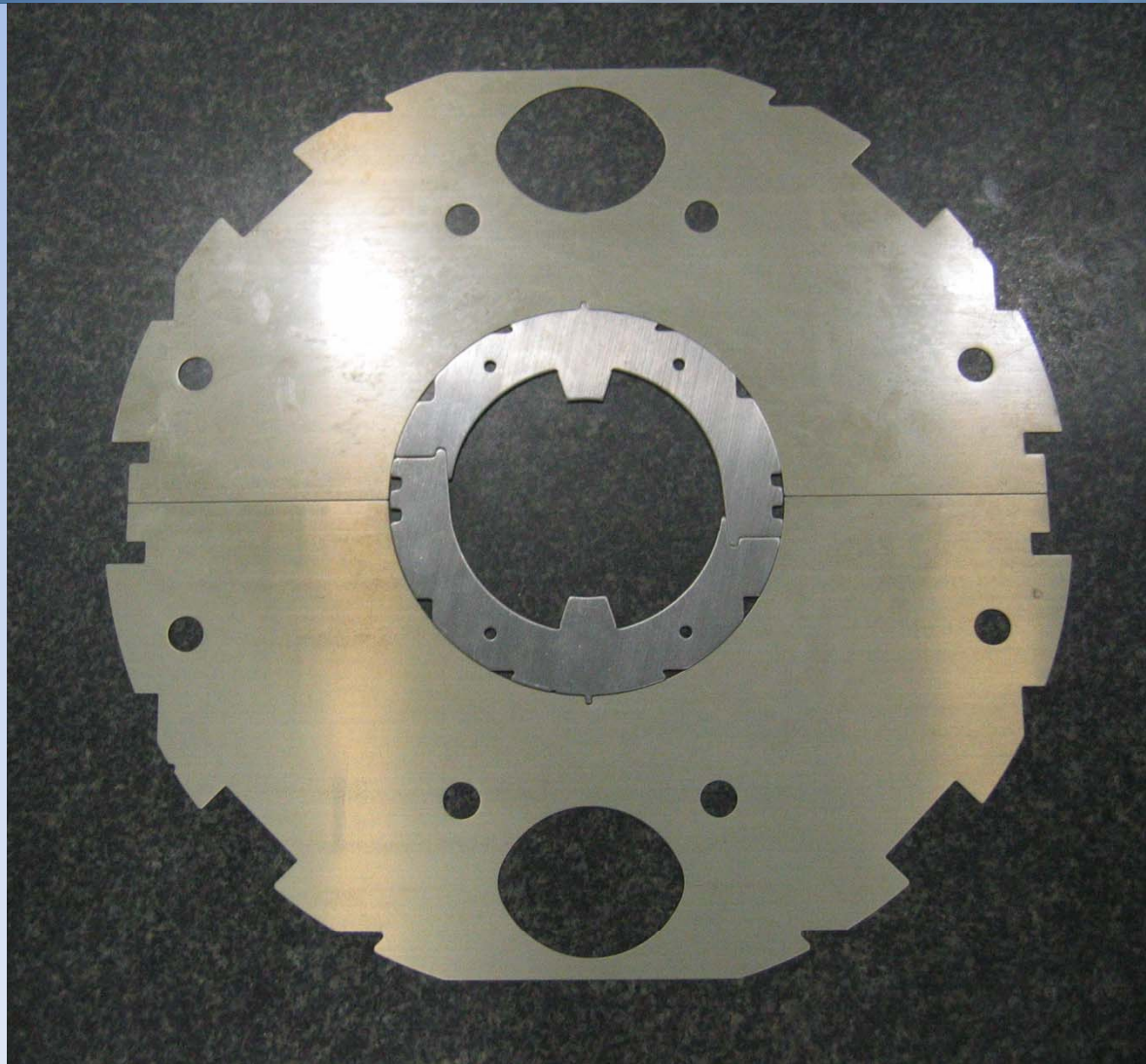


Main Components

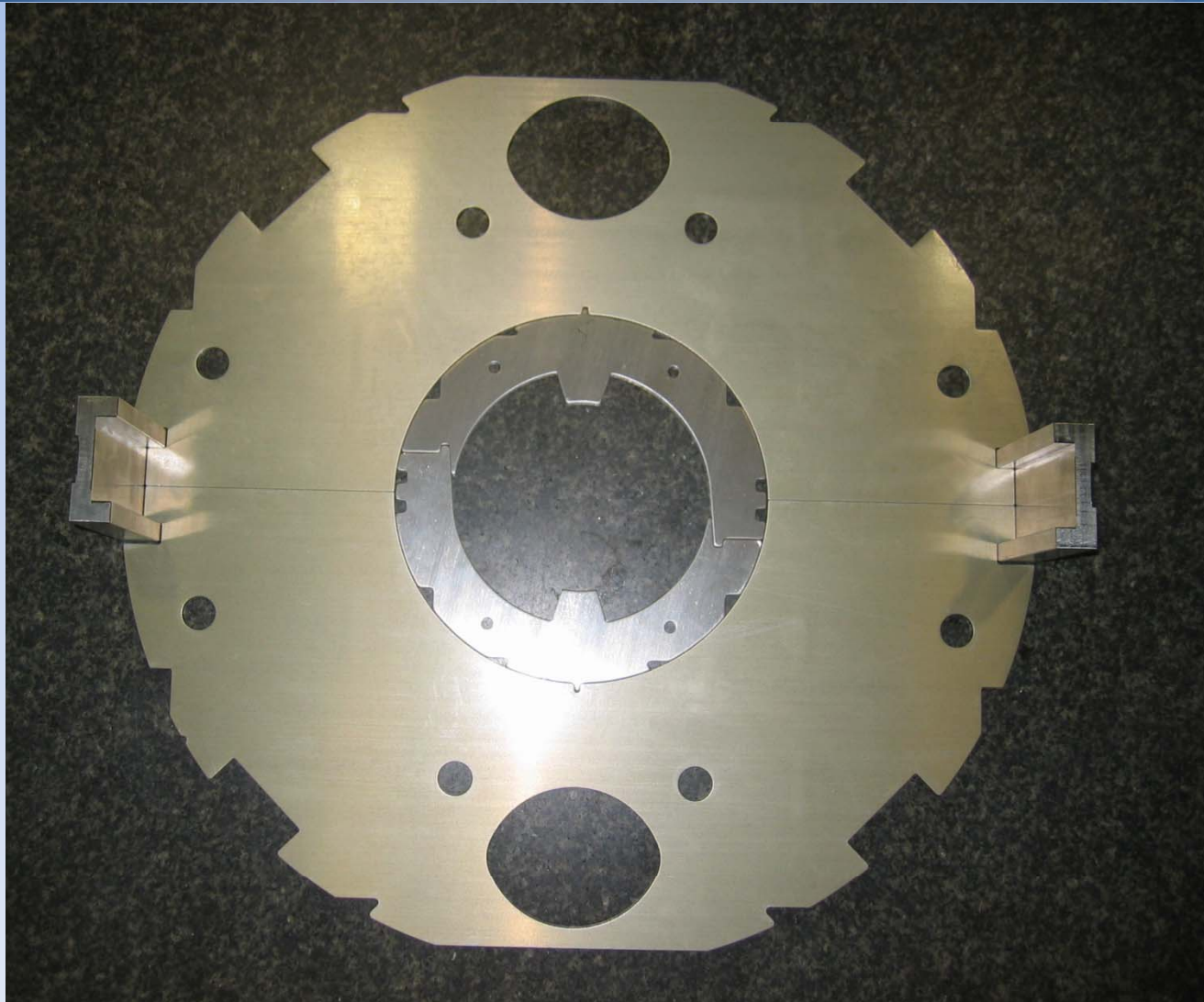
<i>Component</i>	<i>Acquisition Status</i>
Insulated Conductor	OK
Coil Spacers	OK
Collars Material	In Progress (end November)
Collars Punching Die	OK (Punching Test Performed)
Half Yoke lamination Material	OK
Half yoke Laminations Punching Die	OK (Punching Test Performed)
Half Yoke stacking Press	OK
Collaring & Yoke Clamping Tools	In Progress
Curved Half Shells	OK
Q.H./Ground insulation/Coil Protection Sheets	OK
Cold Mass Completion Ancillary Components	In Progress
Thick End Plates	In Progress
End Covers	In Progress



COLD MASS PED CERTIFICATION



COLD MASS PED CERTIFICATION

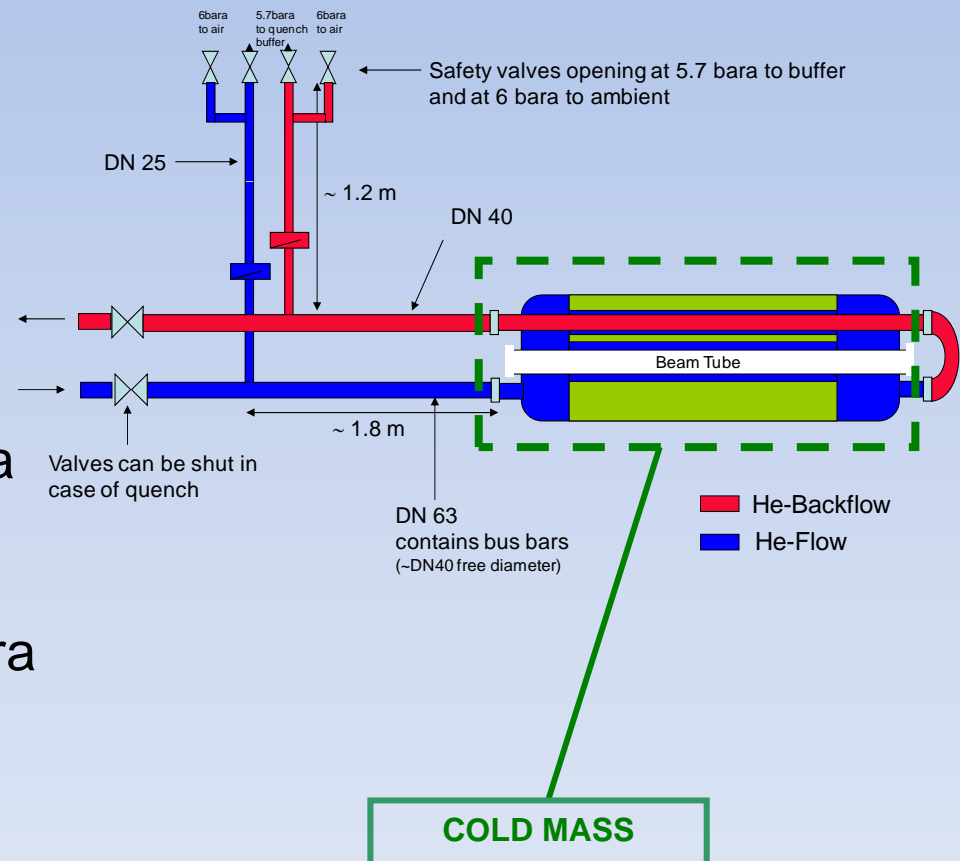


COLD MASS

Pressure Equipment Directive CERTIFICATION

DESIGN CODE PARAMETERS FOR PED COLD MASS CERTIFICATION

- Elium Volume = 102 l
- Nominal Pressure: 3 bara
- Max Pressure During Quench = 8 bara
- External Safety Valves @ 5.7 & 6 bara



COLD MASS

Pressure Equipment Directive CERTIFICATION

➤ $P \times V = 816 < 1000$  **II Category for PED certification**

➤ **II Category for PED certification :**

- Design & Manufacturing Third Part Approval : No**
- Materials Third Part Verification : Yes**
- Pressure Test Third Part Certification : Yes**

➤ **Third Part Certification Body : TUV Italia**

➤ **Design Code for PED Certification:** according to AD 200 Merkblatt, Category II , Design Verification according to Stress Category III

➤ **Stress Category III Safety Factor = 25% of Stress Category I SF (2/3 Yield Strength))**

COLD MASS

Pressure Equipment Directive

CERTIFICATION

DESIGN CODE PARAMETERS FOR PED CERTIFICATION

DATI DI PROGETTO / DESIGN DATA		
	HELIUM CIRCUIT	BEAM CIRCUIT
Codice di progetto / Design code	AD2000 Merkblatt	
Pressione di collaudo pneumatica/ Pneumatic test pressure	7 x 1.1 bar(g) = 7.7 bar(g) 8 x 1.1 bar(a) = 8.8 bar(a)	
Pressione di collaudo idraulica/ Hydraulic test pressure	7 x 1.5 bar(g) = 11 bar(g) 8 x 1.5 bar(a) = 12 bar(a)	
Pressione di progetto / Design pressure	8 bar(a) (7 bar(a) + FV contemporaneo) / 7 bar(g)	-8 bar(g)
Pressione d'esercizio/ Operating pressure	3 bar(a)	
Temperatura d'esercizio/ Operating temperature	4.5 K	
Carico neve / Snow load	assenti (installazione interna) / none (indoor installation)	
Carico vento / Wind load	assenti (installazione interna) / none (indoor installation)	
Peso a vuoto / Empty weight	6 TON	
Peso in prova / Test weight	6 TON	
Carico statico - installazione orizzontale / Static load horizontal set up	sui punti $\text{H} - \text{I} - \text{L}$ on $\text{H} - \text{I} - \text{L}$ points	
	0.4 TON Longitudinale	6.0 TON Verticale
Carico statico - installazione verticale / Static load vertical set up	6 Ton x 9.81 N sui punti $\text{M} - \text{N} - \text{O}$ on $\text{M} - \text{N} - \text{O}$ points	
Carico magnetico interno / Internal magnetic force	± 100000 N lungo la direzione Z, su area centrale POS 15 o 16	
Volume libero interno / Free internal volume	102 L	
Sovrasp. di corrosione (int & est) / Corrosion allowance (int & ext)	0	
Eff. giunti saldati / Weld seams efficiency	0.85	
Dispositivi di sicurezza / Safety devices	valvole di sicurezza : lato bocchello A/nozzle A side PSV = 4.7 bar(g) note 3) safety valves : lato bocchello B/nozzle B side PSV = 5 bar(g) note 3)	
Accelerazioni durante il trasporto / transport acceleration	(ax,ay,az) = (1.5g, 1.5g, 1.0g)	
CATEGORIA PED	II - MODULO A1	

COLD MASS PED CERTIFICATION




Table 1. Grades of steel and grades of cast steel for pressure vessels for low temperatures

No	Type of steel	Grade of steel, grade of cast steel	Lowest possible operating temperature °C for stress case			Maximum permissible thickness, wall thickness for tubes mm γ12)	Maximum permissible diameter	Verification of toughness			Requirements ⁹⁾	Proof of quality characteristics (certification in accordance with DIN EN 10204)
			I	II	III			Shape, position and direction of test piece and scope of test	Test temperature °C	g		
1	2	3	4	5	6			g	g	10	11	
1	Grades of steel and grades of cast steel as specified in AD 2000-Merkblätter W 1, W 4, W 5, W 8, W 9, W 12, and W 13. Killed and semi-killed grades of steel are excluded in the case of operating temperatures below -10 °C.	Suitable grades of steel, or grades of cast steel as specified in column 2.	-10	-60	-85			in accordance with the requirements of the AD 2000-Merkblätter given in column 2 ¹⁰⁾				
2	Fine-grained structural steels suitable for welding, to DIN 17102 (only for rolled long products), DIN 17103, DIN EN 10028-3, DIN EN 10222-4 and DIN EN 10273 in conjunction with VdTUV-Weisheitsblätter 351 to 358	Basic series and elevated temperature properties series (W) S1E255, S1E 265, (W) S1E 315, S1E 355 (W) S1E 380, (W) S1E 420, S1E 460, (W) S1E500, P275N (NH) to P460N (NH) and P285QH, P355QH1 and P420QH	-20	-70	-100	70 ¹⁾	70 ¹⁾	V-notch test pieces; test piece position in accordance with DIN 17102, DIN 17103, DIN EN 10028-1, DIN EN 10222-1 and DIN EN 10273; test piece direction and scope of test in accordance with the relevant W series AD 2000-Merkblatt applicable to the specific product shape	-20	to DIN 17102, DIN 17103, DIN EN 10028-3, DIN EN 10222-4 and DIN EN 10273	(W) S1E 255, S1E 265, P275N (NH) and P285NH (QH); inspection certificate 3.1 (T; E) S1E 255 to (T; E) S1E 265, P275N(L1) (NL2), (W; T; E) S1E 315 to (W; T; E) S1E 500, P355NH (QH1, NL1; NL2), P420QH and P460N (NH; NL1; NL2); inspection certificate 3.2, but flat products made of P355N (NH) to DIN EN 10028-3 in accordance with AD 2000-Merkblatt W 1	
		High impact strength at low temperature series TS1E 265 to TS1E 500 and P275NL1, P355NL1, TS1E 460, P460NL1 TS1E 500	-60	-110	-140	60 ¹⁾	60 ¹⁾		-40			
		Special series with high impact strength at low temperature ES1E 265 to ES1E 315 and P275NL2 ES1E 355 to ES1E 420 and P355NL2 ES1E 460, ES1E 500 and P460NL2	-70	-120	-150	60 ¹⁾	60 ¹⁾		-50			
	Seamless and welded tubes made from alloy fine-grained structural steels as specified in DIN EN 10216-3 and DIN EN 10217-3 in conjunction with VdTUV-Weisheitsblätter 352, 354 and 357	P355N (NH), P460N (NH)	-20	-70	-100	≤ 40 ¹⁾ > 40 ≤ 65 ¹⁾⁴⁾	-	V-notch test pieces; test piece position and direction in accordance with DIN EN 10216-3 or DIN EN 10217-3 and AD 2000-Merkblatt W 4	-20	to DIN EN 10216-3 or DIN EN 10217-3	Inspection certificate 3.2 ¹¹⁾	
		P275NL1, P355NL1	-60	-110	-140	≤ 40 ¹⁾ > 40 ≤ 65 ¹⁾⁴⁾	-		-10			
		P460NL1	-50	-100	-130	≤ 20 ¹⁾	-		-40			
		P275NL2	-70	-120	-150	≤ 40 ¹⁾	-		-30			
		P355NL2	-60	-110	-140	≤ 40 ¹⁾	-		-40			
	P460NL2	-60	-110	-140	≤ 20 ¹⁾	-	-50					
	Stainless austenitic and austenitic-ferritic steels as specified in DIN EN 10028-7 (cold-rolled strip up to 6 mm thick only, hot-rolled strip up to 12 mm thick only), DIN EN 10222-5, DIN EN 10209 (only in heat treatment condition «A») and DIN EN 10272	Symbol	Material No.	-200	-255	-273	75	V-notch test pieces; test piece position and direction in accordance with DIN EN 10028-1, DIN EN 10222-1, DIN EN 10269, DIN EN 10272 and AD 2000-Merkblatt W 2	+20	In accordance with AD 2000-Merkblatt W 4	Inspection certificate 3.1 or 3.2 as specified in AD 2000-Merkblatt W 2, the lowest temperature limit for inspection certificate 3.1 being the minimum operating temperatures in column 4	
X2CrNi18-10		1.4301										
X4CrNi18-12		1.4303										
X2CrNi18-8		1.4307										
X5CrNi18-9		1.4315										
X6CrNiMo18-10		1.4550										
X2CrNiMo17-12-2		1.4401										
X2CrNiMo17-12-2		1.4404										
X2CrNiMo17-12-3		1.4402										
X6CrNiMoNb17-12-2		1.4550										
X2CrNiMoNb18-12-4		1.4434										
X2CrNiMo18-14-3		1.4433										
X3CrNiMo17-13-3		1.4436										
X2CrNiMo18-15-4	1.4438											
X2CrNiMoNb17-13-5 ¹⁾	1.4439											
X2CrNiMo18-12-3	1.4449											

QUALITY CONTROL PLAN



	QUALITY CONTROL PLAN	DOC. n. PCQ 9012361
	Piano Controllo Qualità	ASG ID (drawing N./serial N.) Customer ID: INFN Sheet 1 / 7

Commessa / Job : DISCORAP	COMPONENT : Dipole
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PROJECT NAME DISCORAP	CONSULTANT	CUSTOMER APPROVAL
CUSTOMER INFN	LANGUAGE Italiano / English	Date/Signature
Customer Order n. 2007	Notification period	

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STATUS	Signature	REV.	Change Description
PREPARED: GQL	F. Terzi	0	First issue
QUALITY DEPT: GQL	F. Terzi		
APPROVED: ATS	R. Marabotto		
EMISSION DATE: 26.10.2009			

LEGENDA		WITNESS CODE	
TEST PERFORMED BY / TEST ESEGUITO DA		COLUMN "L" =	COLUMN "K" =
"ASG" =	ASG SUPERCONDUCTORS	COLUMN "K" =	C
"ASGS" =	ASG SUB-SUPPLIER	COLUMN "Z" =	
		COLUMN "W" =	
CONTROL REPORT CODE / CODICE RAPPORTO (C.R.C.)		WITNESS CODE	
"R" =	TEST REPORT / RAPPORTO DI CONTROLLO	"/" or "b"	WITNESS OR
"V" =	INTERNAL VERIFICATION / VERIFICA INTERNA		PRESENZA O
"A" =	TEST CERTIFICATE / CERTIFICATO DI PROVA		
"B" =	ORIGIN CERTIFICATE / CERTIFICATO DI ORIGINE	"N" =	NOTIFICATIO
"C" =	CERTIFICATE OF COMPLIANCE / CERT. DI CONFORMITA	"H" =	HOLD POINT
"D" =	DOSSIER OF ISSUED CERTIFICATION / DOSSIER CERTIF.		
"@" =	MANUFACTURING STEP / FASE DI MANIFATTURA		

5 Main Manufacturing Steps:

1. Coil Manufacturing
2. Collaring
3. Half Yokes Assembly
4. Cold Mass Completion

QUALITY CONTROL PLAN



1) Coil Manufacturing

1	CONTROLLO MATERIALI E ATTREZZATURE PER AVVOLGIMENTO BOBINE / CHECK OF MATERIAL AND TOOLS FOR COIL WINDING			
1.1	Controllo visivo e dimensionale cavo isolato / <i>Visual and dimensional check of insulated cable</i>	doc. Fornitore / <i>Supplier doc.</i>	R	
1.2	Controllo documentazione QA cavo isolato / <i>QA doc. check of insulated cable</i>	doc. Fornitore / <i>Supplier doc.</i>	V	
1.3	Controllo visivo e dimensionale riempitivi di testa e rettilinei isolato / <i>Visual and dimensional check of end spacers and Cu wedge</i>	doc. Fornitore / <i>Supplier doc.</i>	R	
1.4	Controllo visivo della pulizia e del posizionamento del mandrino, delle anime, delle viti, degli skim di protezione e dei coppi / <i>Visual check of cleanliness of winding tools and components</i>		V	



QUALITY CONTROL PLAN



1) Coil Manufacturing

2	1° AVVOLGIMENTO / 1st WINDING			
2.1	Formatura salto strato e stagnatura stabilizzatore in rame / <i>Layer jump shaping and brazing of Cu stabilizer</i>		@	R
2.2	Controllo dimensionale durante avvolgimento / <i>Dimensional check of coil during winding</i>		V	
2.3	Controllo dimensionale della bobina a fine avvolgimento / <i>Dimensional check of coil at the end of winding</i> Controllo dimensionale salto di strato / <i>Dimensional check of layer jump</i>		R	
2.4	Test elettrici: resistenza / <i>Electrical test: resistance</i>		R	
3	POLIMERIZZAZIONE E FINITURA 1° AVVOLGIMENTO / POLIMERIZATION AND FINISHING OF 1st WINDING		@	
3.1	Polimerizzazione: controllo del ciclo e registrazione dei parametri / <i>Polymerization: check of process and record of parameters</i>		R	
3.2	Impregnazione delle testate: registrazione parametri e controllo visivo / <i>Impregnation of coil ends: record of parameters and visual check</i>		@	R
3.3	Stagnatura stabilizzatore di rame per uscite elettriche / <i>Brazing of Cu stabilizer for electrical axis</i>		@	
4	TEST SU 1° AVVOLGIMENTO / TEST OF 1st WINDING			
4.1	Controllo dimensionale della bobina dopo polimerizzazione / <i>Dimensional check of coil after polymerization</i>		R	
4.2	Misura modulo di elasticità / <i>E-modulus measurements</i>		R	
4.3	Test elettrici: resistenza, induttanza, isolamento interspira (Impulse test) / <i>Electrical test: resistance, inductance, interturn insulation (Impulse test)</i>		R	

2) Collaring

8	COLLARAGGIO / COLLARING			
8.1	Controllo visivo e dimensionale <u>lamierini collari</u> / <i>Visual and dimensional check of collars</i>		R	
8.2	Controllo documentazione QA <u>lamierini collari</u> / <i>QA doc. check of collars</i>	doc. Fornitore / <i>Supplier doc.</i>	V	
8.3	Controllo visivo e dimensionale <u>beam tube</u> / <i>Visual and dimensional check of beam tube</i>		R	
8.4	Controllo documentazione QA <u>beam tube</u> / <i>QA doc. check of beam tube</i>	doc. Fornitore / <i>Supplier doc.</i>	V	
8.5	Controllo visivo e dimensionale <u>chiavette (100%) e fogli di protezione</u> / <i>Visual and dimensional check of clamps (100%) and coil protection sheets</i>		R	
8.6	Controllo documentazione QA <u>chiavette e fogli di protezione</u> / <i>QA doc. check of clamps and coil protection sheets</i>	doc. Fornitore / <i>Supplier doc.</i>	V	
8.7	Collaraggio preliminare con inserimento chiavette provvisorie / <i>Preliminary collaring</i>		@	
8.8	Test elettrici dopo collaraggio preliminare: resistenza, induttanza, isolamento interspira (Impulse test), isolamento contromassa / <i>Electrical test after preliminary collaring: resistance, inductance, interturn insulation (Impulse test), ground insulation</i>		R	
8.9	Test elettrici strumentazione dopo collaraggio preliminare: sonde Hall, prese di tensione, QHs / <i>Electrical test of gauges after preliminary collaring: Hall probes, V-taps, QHs</i>		R	
8.10	Collaraggio: controllo processo e registrazione parametri / <i>Collaring: check of process and record of parameters</i>		@ R	

QUALITY CONTROL PLAN



2) Collaring

9	CONTROLLI FINALI SUL MAGNETE COLLARATO / FINAL CHECK OF COLLARED COIL			
9.1	Controllo dimensionale della bobina dopo collaraggio / Dimensional check of coil after collaring		R	
9.2	Test elettrici dopo collaraggio: resistenza, induttanza, isolamento interspira (Impulse test), isolamento contromassa / Electrical test after collaring: resistance, inductance, interturn insulation (Impulse test), ground insulation		R	
9.3	Test elettrici strumentazione dopo collaraggio: sonde Hall, prese di tensione, QEs / Electrical test of gauges after collaring: Hall probes, V-taps, QEs		R	
9.4	Misure magnetiche dipolo collarato / Magnetic measurements of collared coil		R	

QUALITY CONTROL PLAN



3) Half Yokes Assy

10	ASSEMBLACCIO GIOCO MAGNETICO / <i>MAGNETIC YOKE ASSEMBLY</i>			
10.1	Controllo visivo e dimensionale <u>lamierini</u> per giogo magnetico / <i>Visual and dimensional check of laminations for magnetic yoke</i>		R	
10.2	Controllo documentazione QA <u>lamierini</u> per giogo magnetico / <i>QA doc. check of laminations for magnetic yoke</i>	doc. Fornitore / <i>Supplier doc.</i>	V	
10.3	Controllo visivo e dimensionale <u>pacchi lamierini semigiogo L=965mm magnetico</u> / <i>Visual and dimensional check of 1m packs for half yoke</i>		R	
10.4	Controllo documentazione di QA <u>pacchi lamierini semigiogo magnetico</u> / <i>QA doc. check 965mm packs for half yoke</i>	doc. Fornitore / <i>Supplier doc.</i>	V	
10.6	Controllo visivo e dimensionale <u>tubo scambiatore di calore</u> / <i>Visual and dimensional check of heat exchanger tube</i>		R	
10.6	Controllo documentazione di QA <u>tubo scambiatore di calore</u> / <i>QA doc. check of heat exchanger tube</i>	doc. Fornitore / <i>Supplier doc.</i>	V	
10.7	Controllo visivo e dimensionale " <u>C</u> " clamps" (superficie interna delle " <u>C</u> ") magnetico / <i>Visual and dimensional check of "C" clamps" (inner surface check)</i>		R	
10.8	Controllo documentazione QA " <u>C</u> " clamps" magnetico / <i>QA doc. check of "C" clamps"</i>	doc. Fornitore / <i>Supplier doc.</i>	V	
10.9	Assemblaggio <u>semigiogo inferiore</u> : controlli dimensionali su settori di semigiogo durante assemblaggio / <i>Lower half yoke assembly: dimensional check during assembly on sectors of half yoke</i>		@ R	
10.10	Inserimento bobine nel semigiogo inferiore / <i>Coil assembling into lower half yoke</i>		@	
10.11	Assemblaggio <u>semigiogo superiore</u> : controlli dimensionali su settori di semigiogo durante assemblaggio / <i>Upper half yoke assembly: dimensional check during assembly on sectors of half yoke</i>		@ R	



QUALITY CONTROL PLAN



3) Half Yokes Assy

11	CONTROLLI FINALI SUL SISTEMA MAGNETICO / FINAL CHECK OF MAGNETIC SYSTEM		
11.1	Controlli dimensionali sul sistema magnetico / <i>Dimensional check of magnetic system</i>		R
11.2	Test elettrici bobina: resistenza, induttanza, isolamento interspira (Impulse test), isolamento contromassa / <i>Electrical test of coil: resistance, inductance, interturn insulation (Impulse test), ground insulation</i>		R
11.3	Test elettrici strumentazione: sonde Hall, prese di tensione, QHs / <i>Electrical test of gauges: Hall probes, V-taps, QHs</i>		R
11.4	Misure magnetiche preliminari / <i>Preliminary magnetic measurements</i>		R

QUALITY CONTROL PLAN

4) Cold Mass Completion

12	ASSEMBLAGGIO MASSA FREDDA / <i>COLD MASS ASSEMBLY</i>			
12.1	Controllo visivo e dimensionale <u>semigusci</u> / <i>Visual and dimensional check of half shells</i>		R	
12.2	Controllo documentazione QA <u>semigusci</u> / <i>QA doc. check of half shells</i>	doc. Fornitore / <i>Supplier doc.</i>	V	
12.3	Assemblaggio sistema magnetico-semigusci superiore e inferiore / <i>Assembly of magnetic system and upper/lower half shells</i>		@	
12.4	Saldature longitudinali: controllo processo e registrazione parametri / <i>Longitudinal welding: check of process and record of parameters</i>		@ R	
12.5	Controllo ad ultrasuoni delle saldature longitudinali / <i>Ultrasonic testing of longitudinal welds</i>		R	
12.6	Test elettrici bobina <u>prima della chiusura delle estremità</u> : resistenza, induttanza, isolamento interspira (Impulse test), isolamento contromassa / <i>Electrical test of coil before closing of cold mass ends: resistance, inductance, interturn insulation (Impulse test), ground insulation</i>		R	
12.7	Test elettrici strumentazione <u>prima della chiusura delle estremità</u> : sonde Hall, prese di tensione, QHs / <i>Electrical test of gauges before closing of cold mass ends: Hall probes, V-taps, QHs</i>		R	
12.8	Saldatura dei coperchi di estremità / <i>Welding of end covers</i>		@	
12.9	Controllo visivo e test raggi gamma delle saldature circonferenziali / <i>Visual check and gamma-ray test of circumferential welds</i>		R	
12.10	Saldatura supporti cold mass e controlli dimensionali / <i>Welding of cold mass supports and dimensional check</i>		@ R	

QUALITY CONTROL PLAN

4) Cold Mass Completion



13	CONTROLLI FINALI DI ACCETTAZIONE MASSA FREDDA / FINAL ACCEPTANCE TEST OF COLD MASS			
13.1	Controlli dimensionali: massa fredda / <i>Dimensional check of cold mass</i>		R	
13.2	Test elettrici bobina <u>dopo chiusura estremità</u> : resistenza, induttanza, isolamento interspira (Impulse test), isolamento contromassa / <i>Electrical test of coil after closing of cold mass ends: resistance inductance, interturn insulation (Impulse test), ground insulation</i>		R	
13.3	Test elettrici strumentazione dopo chiusura estremità: sonde Hall, prese di tensione, QHs / <i>Electrical test of gauges after closing of cold mass ends: Hall probes, V-taps, QHs</i>		R	
13.4	Test di tenuta in pressione / <i>Pressure test</i> Test di tenuta a vuoto / <i>He leak test</i>		R	
13.5	Misure magnetiche finali di accettazione / <i>Final acceptance magnetic measurements</i>		R	
14	DOCUMENTAZIONE / DOCUMENTS			
14.1	Controllo finale della documentazione di QA (PCQ, rapporti di collaudo, certificati materiali) / <i>Final check of QA documents (PCQ, test reports, material certificates)</i>		R	
14.2	Preparazione dossier PED (<i>Pressure Equipment Directive</i>) / <i>PED test report</i>		R	



ASG
Superconductors

GRUPPO MALACALZA

