ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Laboratoire Européen pour la Physique des Particules
European Laboratory for Particle Physics

Group Code.: AT-MEL-CF

LHC Project document No.: **LHC-DFLE-CI-0001**

The Large Hadron Collider Project ***DO-21889/AT/LHC***

Technical Specification for the Manufacture and Supply of Assemblies of 120 A Current Leads for the LHC Dipole Corrector Magnets

Abstract

This Technical Specification concerns the manufacture and supply of 85 assemblies of conduction-cooled current leads designed for powering the dipole corrector magnets of the Large Hadron Collider. Each assembly consists of four 120 A d.c. current leads mounted on a stainless steel flange at each end and pre-shaped for integration in the final cryostat.

Delivery of the series is expected to be spread over a period of five months from August 2004.

May 2004

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Terms and Definitions

Term	Definition
CDD	CERN Drawing Directory
EDMS	Engineering Data Management System
QAP	Quality Assurance Plan
SSS	Short Straight Section
DCF	Dipole Corrector Feedthroughs
RRR	Residual Resistivity Ratio

1. INTRODUCTION

1.1 Introduction to CERN

The European Organization for Nuclear Research (CERN) is an intergovernmental organization with 20 Member States*. It has its seat in Geneva but straddles the Swiss-French border. Its objective is to provide for collaboration among European States in the field of high energy particle physics research and to this end it designs, constructs and runs the necessary particle accelerators and the associated experimental areas.

At present more than 5000 physicists from research institutes world-wide use the CERN installations for their experiments.

1.2 Introduction to the LHC Project

The Large Hadron Collider (LHC) is the next accelerator being constructed on the CERN site. The LHC machine will mainly accelerate and collide 7 TeV proton beams but also heavier ions up to lead. It will be installed in the existing 27 km circumference tunnel, about 100 m underground, that previously housed the Large Electron Positron Collider (LEP). The LHC design is based on superconducting twin-aperture magnets which operate in a superfluid helium bath at 1.9 K.

1.3 Subject of this Technical Specification

The LHC Short Straight Sections will be equipped with superconducting dipole corrector magnets operating at currents of up to 120 A. These magnets will be powered via conduction-cooled current leads, which will be referred to as DCFs (Dipole Corrector Feedthroughs), transferring the current from the room temperature electrical connection, through the cryostat vacuum insulation, to the 1.9 K superfluid liquid helium bath.

This Technical Specification defines the construction requirements, manufacturing procedure, inspection and acceptance criteria of the DCFs and of their assemblies.

2. SCOPE OF THE TENDER

2.1 Scope of the supply

The total supply shall consist of 85 DCF assemblies (see section 4.1), with a purchase option for up to 10 additional assemblies. Each assembly contains 4 current leads. The supply will consist of the following subtasks:

- Procurement of all necessary tooling.
- Complete design, manufacturing and operation of the required testing facilities.
- Production of complete Manufacturing File and execution drawings.
- Manufacture, shaping and assembly of the DCF assemblies.

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* CERN Member States are: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, The Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Bulgaria and the United Kingdom.

- Inspection and quality control of the leads according to this Technical Specification.
- The supply, in the form of both paper and electronic data files, of all reports and records of inspections and tests carried out within the scope of this Technical Specification, according to forms and formats agreed with CERN.
- Transport packaging and safe transport of the DCF assemblies to CERN or other European sites to be designated.

2.2 Items supplied by CERN

All raw materials will be supplied by CERN (see Annex B).

The tooling for shaping the leads (see section 4.4.2) will be supplied by CERN free of charge. This tooling was manufactured at CERN and was used for the shaping of the leads of 5 DCF pre-series assemblies.

3. GENERAL CONDITIONS FOR TENDERING AND CONTRACTING

Please refer to the commercial documents for more complete information.

Tenders will only be considered from firms having been selected as qualified bidders by CERN, as a result of the Market Survey ref. MS-2901/LHC/LHC. CERN reserves the right to disqualify any bidder whose reply to this Market Survey is found to have been incorrect.

3.1 Tender procedure

3.1.1 Pre-tender discussions

The Bidder is strongly encouraged to contact CERN and discuss details of this Technical Specification before submitting a tender. In particular, CERN wishes to ensure that no doubt exists as to the interpretation of this Technical Specification.

3.1.2 Preliminary programme

The Bidder shall propose a preliminary design and manufacturing schedule with the Tender, based on the specified CERN provisional delivery schedule.

3.1.3 Subcontractors

The Bidder shall declare in his Tender any subcontractors whose services he intends to use in the event of a Contract. Refer to the commercial documents for more details. If awarded the Contract, the Bidder shall restrict himself both to the subcontractors and the amount mentioned in the Tender. If, for some reason, he wants to change any subcontractor, or the scope of subcontracted work, or the amount subcontracted, he shall obtain CERN’s prior agreement in writing.

3.1.4 Technical Questionnaire

The Technical Questionnaire attached to this Technical Specification shall be completely filled in and returned with the Tender Form, otherwise the tender will not be considered as complete and will be discarded.

3.1.5 Presentation of tender

The Bidder may be asked to make a formal presentation of his Tender at CERN at his own expense and shall be ready to do so within a week of notification.

3.1.6 Country of origin

Please refer to the commercial documents for specific conditions concerning the country of origin of the equipment or services to be supplied.

3.2 Contract execution

3.2.1 Responsibility for design, components and performance

The Contractor shall be responsible for conformity with this specification. CERN's approval of the design and component choice does not release the Contractor from his responsibilities in this respect.

3.2.2 Contract follow-up

3.2.2.1 Contract engineer

The Contractor shall assign an engineer to be responsible for the technical execution of the Contract and its follow-up throughout the duration of the Contract.

3.2.2.2 Progress report

The Contractor shall supply, within one month of notification of the Contract, a written programme detailing the manufacturing and testing schedules. The programme shall include preliminary dates for inspections and tests.

A written progress report shall be sent to CERN every month until completion of the Contract.

3.2.2.3 Design approval and production

The complete manufacturing file, including execution drawings, shall be submitted to CERN for approval within one month after notification of the contract. CERN will give its approval or refusal, in writing, within 2 weeks. Equipment manufacture shall not start without CERN’s written prior agreement.

The series production shall be preceded by the production of five pre-series units. Production of the series shall not start before CERN has given its formal approval of the pre-series in writing.

3.2.3 Deviations from this Technical Specification

If, after the Contract is placed, the Contractor discovers that he has misinterpreted this Technical Specification, this will not be accepted as an excuse for deviation from it and the Contractor shall deliver equipment in conformity with this Technical Specification at no extra cost.

During execution of the Contract, all deviations proposed by the Contractor from this Technical Specification, the Tender, or any other subsequent contractual agreement, shall be submitted to CERN in writing. CERN reserves the right to reject or accept such proposals without justification.

CERN reserves the right to modify this Technical Specification during execution of the Contract. The consequences of such modifications shall be mutually agreed between CERN and the Contractor.

3.3 Factory access

CERN and its representatives shall have free access during normal working hours to the manufacturing or assembly sites, including any subcontractor's premises, during the Contract period. The place of manufacture, as stated in the Tender, may only be changed after written approval by CERN.

4. TECHNICAL REQUIREMENTS

4.1 General description

The DCF assembly consists of four current leads mounted on a common flange. Each lead consists of a brass wire copper plated, hereafter referred to as the conductor, two polyimide tubes and a stainless steel tube. The DCF assembly consists of four stainless steel tubes, each containing the polyimide insulated conductor, which have been individually pre-shaped and then welded, at the two extremities, to a stainless steel flange. The assembly includes an insulating flange, which guarantees the electrical insulation of the conductor with respect to the stainless steel flange, and the electrical terminals designed for the connection of the warm power cables. The DCF is part of the leak-tight vacuum enclosure.

In order to achieve the required thermal, electrical and mechanical performances, the material properties (copper RRR[1]) and the tolerances for the component fabrication, as specified in the following sections and as indicated in the attached drawings (see Annex A), shall be respected.

4.2 Design criteria

The DCF leads are designed to carry a maximum current of 120 A d.c. between room temperature and the 1.9 K liquid helium bath. The design is such as to minimise the heat load of the component, operating at nominal current, with respect to the heat sinks and the liquid helium bath. For information, the nominal main parameters of the DCF are listed in Table 1.

[1] RRR is the ratio between the electrical resistivity of the material at room temperature and at liquid helium temperature.

Table 1- Nominal DCF parameters

Maximum d.c. current	120	A
Working temperature	293-1.9	K
Test temperature	293	K
Design pressure	2	MPa
Test pressure	2.5	MPa
Nominal pressure (inside leads, vacuum outside)	0.13	MPa
Overall lead developed length	1412	mm
Brass diameter	5	mm
Brass RRR	Approx.2.2	-
Copper thickness1	0.9	mm
Copper thickness2	0.160	mm
Copper RRR	120-180	-
Inner/Outer polyimide diameter (tube 1)	6.95/7.22	mm
Inner/Outer polyimide diameter (tube 2)	7.3/7.57	mm
Inner/Outer stainless steel tube diameter	7.7/8.1	mm
Total mass of DCF assembly	Approx. 5	kg

4.3 Materials and sub-assemblies

4.3.1 Conductor

The conductor is made from a brass (Cu/Zn 85-15) rod, 5 mm diameter, copper-plated over its entire length (Drwg.LHCDFLES0012). The brass is a poor thermal conductor characterised by a RRR of about 2.2. The total length of the rod is 1411 mm. A length of about 1027 mm is covered with a copper plated layer 0.9 mm thick, while over the remaining length the thickness is reduced to 0.16 mm. The RRR of the copper shall be between 120 and 180. The RRR is an important parameter for the lead design and it shall be measured on the first copper plated rods for the validation of the bath and process and on some samples extracted from the series production. CERN can perform, under request, the RRR measurements. The copper surface shall be smooth (roughness, Ra < 3.6) and free of local high spots. If the specified requirements cannot be achieved directly with the electrolytic deposition, the Contractor can propose an alternative mechanical method to obtain those surface conditions.

Prior to launching the fabrication of the series, the Contractor shall submit 6 full-length copper plated conductors, which will be tested at CERN for approval.

4.3.1.1 Protection against oxidation

The extremity of the conductor corresponding to the 0.9 mm copper coating is covered over a length of about 30 mm with a nickel layer of thickness of about 0.005 mm.

4.3.2 Conductor electrical insulation

Two polyimide tubes, 0.135 mm thick and about 1352 mm long, provide the electrical insulation of the conductor inside the stainless tube.

4.3.3 Stainless steel tube

The stainless steel tube (AISI 316 L) is 1327 mm long and 0.2 mm thick (Drwg.LHCDFLES0014). After pre-shaping (Drwg.LHCDFLES0008), the tube housing the electrical insulated conductor is welded to the two stainless steel flanges.

4.3.4 Stainless steel flanges

Two stainless steel flanges support the four current leads (Drwgs.LHCDFLES0015, LHCDFLES0016). They are manufactured by machining from the AISI 316 L supplied.

4.3.5 Electrical insulating flange

The material of the insulating flange is PEEK™ (Drwg.LHCDFLDS0017), a thermoplastic polymer (PolyEtherEtherKetone), which combines good radiation resistance and electrical insulating properties. To improve its electrical performance in humid or wet environment, after machining the component shall be vacuum impregnated with a thin layer (10-20 micrometre) of Parylene C coating (deposition of polymer poly-para-xylene which takes place at room temperature). This coating shall be made by the Contractor. A number identifying each lead and a number identifying each assembly shall be engraved on the flange. Grooves are foreseen for easy evacuation of water in case of excessive cooling. The insulating flange is mounted on the stainless steel flange (Drwg.LHCDFLES0004). The corresponding stainless steel screws, washers and o-ring form part of the supply.

4.3.6 Warm electrical connection

The electrical connection of each lead to the power cables is made via a fin-type heat exchanger (Drwg.LHCDFLES0019). The heat exchanger is made of ETP copper. The heat exchanger is clamped around the conductor after integration of the DFC assembly in the cryostat (Drwg.LHCDFLES0004). The corresponding stainless steel screws, washers, o-rings, clamping and brass rings are part of the supply.

4.3.6.1 Treatment against oxidation

The heat exchanger shall be protected against oxidation and shall be electrically insulated. This shall be done by depositing a layer of insulating powder (electrostatic powder painting) having a thickness of about 50 μm. The coating shall be black and shall not cover the parts where electrical contacts take place (Drwg.LHCDFLES0018).

4.3.7 O-rings and sealing components

The stainless steel tubes of the DCF assembly are open to the 1.9 K liquid helium bath. The leak tightness between the helium circuit and the outside environment shall be guaranteed by the NBR (Nitril Butadiene rubber) o-ring positioned around each DCF conductor and in the groove machined in the DCF stainless steel flange (Drwg.LHCDFLES0004). NBR is a standard o-ring material that shall be used in view of its good radiation resistance properties.

4.4 DCF assembly

4.4.1 General

The assembly procedure described below is based on the experience gained at CERN with the prototype DCF assemblies and constitutes part of the conforming bid.

The assembly of the DCF shall be performed in a clean area (see Annex C).

4.4.2 Pre-shaping of the leads

The electrically insulated conductor shall be inserted into the stainless steel tube. When this operation is performed, conductor, polyimide and stainless steel tubes shall be clean and free of impurities. After this operation, each DCF lead is pre-shaped (Drwgs.LHCDFLES0003, LHCDFLES0023, LHCDFLES0024 and LHCDFLES0025). It should be noted that the four leads of a DCF assembly have the same length but do not have the same shape. CERN has manufactured a tooling for “hand shaping” one lead at the time. This tooling will be delivered to the Contractor free of charge.

Prior to starting the fabrication of the series production, four pre-shaped leads shall be delivered to CERN for testing and approval.

4.4.3 Welding of the components

After pre-shaping, each stainless steel tube is laser welded to the stainless steel flanges of the DCF assembly. The temperature of the polyimide tube shall always be below 200 °C during the welding to avoid degradation of its electrical properties.

Each welded joint shall be able to:

- withstand at least 50 thermal cycles from room temperature to liquid helium temperature,
- withstand a maximum inner pressure of 2.5 MPa,
- guarantee the leak tightness of the DCF assembly in nominal (0.13 MPa inner pressure) or accidental (2.5 MPa inner pressure) conditions with respect to the vacuum insulation of the cryostat environment.

The laser welding technique was used for the pre-series DCF assemblies manufactured at CERN and proved to be a reliable joining method characterised by the creation of a small Heat Affected Zone (HAZ).

The Contractor shall be responsible for undertaking a series of inspections to ensure the necessary manufacturing standards. Such inspections are mainly concerned with the verification of the welding procedures. Non-destructive and destructive testing shall be conducted to verify the quality of the assembly work.

Before starting the manufacture of the series, the Contractor shall submit to CERN for approval a file collecting the welding parameters and procedure. This file shall also contain the results of the analysis (sectioning and metallography) performed on four short samples (having the same material, thickness and cross section as the final components) of stainless steel tubes welded to the stainless steel inserts and on one sample of the four leads welded to each stainless steel flange. These samples shall have been thermal shocked in liquid nitrogen. CERN will perform similar analysis on some of the serial DCF assemblies. If non-conformities are identified, CERN reserves the right to reject the products and ask for the replacement of the components the cost of which shall be borne by the Contractor.

4.4.4 Flattening and pre-tinning of the conductor

After integration of the insulating flange and fixation of the sealing component at the warm end of the conductor, the part of conductor at the opposite side, which extends about 50 mm beyond the cold stainless steel flange, shall be flattened and pre-tinned (Sn-4Ag) over a length of at least 30 mm (Drwg.LHCDFLES0004).

4.5 Information and documentation management

4.5.1 Manufacturing drawings

Manufacturing drawings prepared by the Contractor for the execution of the Contract shall comply with the procedure defined in chapter 6 of the LHC QAP document No LHC-PM-QA-306.00, "Drawing Process-External Drawings".

4.5.2 Planning and scheduling

Planning and scheduling activities shall be performed according to the procedure defined in the LHC QAP document No LHC-PM-QA-301.01, "Planning and Scheduling Requirements for Institutes, Contractors and Suppliers".

4.5.3 Quality control records

All specified tests and measurements carried out during all stages of production, from raw material procurement up to delivery and installation, shall be recorded in specific files ("Travellers"), collected in the MTF (Manufacturing and Test Folder), according to the procedure defined in the LHC QAP document No LHC-PM-QA-309.00, "Fabrication and Inspection of Purchased Equipment". The Travellers of each DCF assembly shall include the results of the final tests performed on the DCF (see paragraph 7) and the certified welders-qualifications. Copies of these Travellers shall be submitted to CERN for archiving in the CERN central database (see Annex C). The top flange of each assembly shall be marked with its LHC part identification number.

5. APPLICABLE DOCUMENTS

Please refer to the cover letter or Instructions to Bidders for the complete list of enclosed documents that form part of this Invitation to Tender.

Please note that the quality assurance documents, CERN standards and Purchasing documents referred to in this Technical Specification are on the enclosed CD-Rom entitled "CERN Official Documents".

5.1 Standards

The following standards, in order of priority, are applicable for the execution of the Contract.

5.1.1 CERN standards

- CERN Safety Code D2 (May 1998)- "Safety code for industrial pressure vessels and pressurised pipelines".
- CERN Safety Code C1 (1996)- "Electrical safety code".

5.1.2 International standards

Wherever relevant EN or ISO Norm shall be applied:

- EN 287-2: 1992- "Approval testing of welders for fusion welding".
- EN 288-4: 1992- "Specification and approval of welding procedures for metallic materials".
- ISO 3530- "Mass spectrometer type leak detector calibration".
- ISO/AWI 12724- "Testing for leaks using the mass spectrometer leak detector or residual gas analyser".

5.1.3 National standards

- NFA 09-490- "Non-destructive testing: testing for leak tightness recommended practises for the specification and testing of gas tightness".
- NFA 09-492- "Non-destructive testing tightness testing, method under vacuum with tracer-gas".

6. QUALITY ASSURANCE PROVISIONS

The Contractor shall plan, establish, implement and adhere to a documented quality assurance programme that fulfils all the requirements described in this Technical Specification and drawn up according to the Quality Assurance Plan for the LHC Project.

Please note that the quality assurance documents, CERN Standards and Purchasing documents referred to in this Technical Specification can be found on the enclosed CD-Rom entitled "CERN Official Documents".

The list of relevant topics covered by the LHC Quality Assurance Plan, together with the corresponding documents, is given in Table 2 below. Copies of these documents are included with the Invitation to Tender.

Table 2 - LHC QAP topics and documents

Topic	Document Title	Doc. Number
Policy and Organisation	Quality Assurance Policy and Organisation	LHC-PM-QA-100.00
Planning	Planning and Scheduling Requirements for Institutes, Contractors and Suppliers	LHC-PM-QA-301.01
Design	Quality Assurance Categories	LHC-PM-QA-201.00
	Drawing Management and Control	LHC-PM-QA-305.00
	Drawing Process-External Drawings	LHC-PM-QA-306.00
Change Control	Configuration Management - Change Process And Control	LHC-PM-QA-304.00
Manufacturing and Inspection	Manufacturing and Inspection of Equipment	LHC-PM-QA-309.00
	Handling of Non-conforming Equipment	LHC-PM-QA-310.00
	LHC Part Identification	LHC-PM-QA-206.00

6.1 Quality Control

The Contractor shall be able to demonstrate that he has ISO 9002 series certification, or an equivalent quality control certification, which is appropriate to the subject of this Technical Specification.

7. FINAL TESTS ON THE DCF

7.1 Tests to be carried out at the Contractor's premises

CERN reserves the right to be present, or to be represented by an organization of its choice, to witness any tests carried out at the Contractor's or his subcontractors' premises. The Contractor shall give at least 10 working days notice of the proposed date of any such tests. The Contractor shall carry out the tests in the following sequence: dimensional checks, pressure, electrical insulation and leak tightness tests. The results of these checks and tests shall be reported in the Traveller documents.

7.1.1 Dimensional checks to be made by the Contractor

A number of dimensional checks shall be made by the Contractor during the manufacturing process. In particular:

- The size and length of the conductor shall be measured systematically before pre-shaping
- The length of the stainless steel tube shall be checked.
- The length of the polyimide tube shall be checked. After shaping of the conductor, it shall be checked that the length of polyimide tube extending beyond and above the two flanges corresponds to what indicated in the drawings.

7.1.2 Pressure tests to be carried out by the Contractor

The DCF assembly shall be pressurized up to 2.5 MPa (pneumatic test at 1.25 times the design pressure). The Contractor shall provide the tooling necessary for the test.

The test procedure consists of a steady build-up at approximately one tenth of the test pressure per minute until half the pressure level is reached. Thereafter, pressure is increased by steps of one tenth of the test pressure with intervening pauses until the test pressure is attained. It is kept at the test pressure for half an hour.

7.1.3 Electrical tests to be carried out by the Contractor

A voltage of 1 kV, both polarities, shall be applied for 30 s between the current carrying part (non-insulated top part of warm electrical terminal) and the lead stainless steel flange. This test shall be performed between each lead and the DCF stainless steel flange. During the electrical insulation test, the stainless steel tubes of the leads shall be filled with helium gas at room temperature (0.13 MPa absolute pressure). The leakage current shall stay within ± 3 μA. The Contractor shall provide the tooling necessary for the test.

7.1.4 Leak tightness tests to be carried out by the Contractor

The DCF assembly shall be evacuated to below 0.1 Pa (10^{-6} bar) and helium leak tested. The integral of leaks detected shall stay below 10^{-11} Pa m^3 s^{-1} (10^{-13} bar l s^{-1}). The sensitivity of the mass spectrometer leak detector shall be in accordance with the specified leak tightness value. The tests shall be performed in accordance with the international (or national equivalent, see section 5.1) leak testing standards by accredited personnel. The Contractor shall provide the tooling necessary for the test.

7.2. CERN tests

CERN reserves the right to perform any tests on any DCF assembly to check the conformity with this Technical Specification.

The provisional acceptance at CERN may include the repetition by CERN of any of the tests performed at the Contractor' s premises in order to verify possible damage due to transportation.

The DCF assemblies shall pass all the tests performed at the Contractor' s premises prior to integration in the cryostat.

8. DELIVERY AND COMMISSIONING

8.1 Delivery schedule

The DCF assemblies shall be delivered to CERN according to the following delivery schedule:

- 5 DCF assemblies shall be delivered latest by 15/08/2004,
- 10 DCF assemblies shall be delivered latest by 15/09/2004,
- 20 DCF assemblies shall be delivered latest by 15/10/2004,
- 20 DCF assemblies shall be delivered latest by 15/11/2004,
- 30 DCF assemblies shall be delivered latest by 15/12/2004.

8.2 Packing and transport

No shipment shall be carried out without written consent from CERN. The Travellers related to each DCF assembly in a shipment shall be sent to CERN by electronic means (see Annex D) prior to shipment, and CERN will give this approval within two weeks of their reception provided the data are acceptable. Certificates of conformity of each DCF assembly shall accompany the shipment to its destination address.

The Contractor is responsible for the packing and the transport to CERN. He shall ensure that the equipment is delivered safely to CERN in transport conditions protecting the supply from any damage or possible deterioration. The packing shall support the DCF assembly and protect it from moisture and any damage during handling and transport. The packing and storage conditions shall provide for adequate marking or labelling in order to clearly and readily identify the DCF assemblies.

8.3 Acceptance and guarantee

Provisional acceptance will be given by CERN only after all items have been delivered in accordance with the conditions of the contract including documentation referred to in this Technical Specification, all tests specified have been successfully completed, all test or other certificates have been supplied to CERN and the integration at the SSS Assembler has been successfully carried out.

The Contractor shall guarantee the electrical performance of the leads and shall take full responsibility for any manufacturing faults. Should any of the tests described in this Technical Specification reveal any manufacturing defects or damage occurring during transport, CERN will be entitled to the immediate replacement of the faulty DCF assemblies free of charge.

The guarantee period is defined in the commercial documents.

9. CERN CONTACT PERSONS

Persons to be contacted for technical matters:

Name/Division/Group	Tel-Fax	Email
Amalia Ballarino (AT/MEL)	**Tel:** 0041-22-767-3296 **Fax:** 0041-22-767-6180	Amalia.Ballarino@cern.ch
In case of absence: Karl Hubert Mess (AT/MEL)	**Tel:** 0041-22-767-76642 **Fax:** 0041-22-767-6180	Karl.Hubert.Mess@cern.ch

Persons to be contacted for commercial matters:

Name/Division/Group	Tel-Fax	Email
Morten Knutsen (FI/PI)	**Tel:** 0041-22-767-3332 **Fax:** 0041-22-767-7605	Morten.Knutsen@cern.ch
In case of absence: Laura Burguete (FI/PI)	**Tel:** 0041-22-767-5095 **Fax:** 0041-22-767-7605	Laura.Burguete.Oliete@cern.ch

ANNEX A: LIST OF DRAWINGS

Number	Title
LHCDFLES0001	GENERAL ASSEMBLY
LHCDFLES0004	FOUR LEADS FINAL ASSEMBLY
LHCDFLES0008	STAINLESS STEEL TUBE WITH INSERTS
LHCDFLES0012	CONDUCTOR
LHCDFLES0013	INSERT
LHCDFLES0014	STAINLESS STEEL TUBE
LHCDFLES0015	WARM FLANGE
LHCDFLES0016	COLD FLANGE
LHCDFLES0017	INSULATING FLANGE
LHCDFLES0018	SHORT HEAT EXCHANGER
LHCDFLES0019	LONG HEAT EXCHANGER
LHCDFLES0020	BRASS RING
LHCDFLES0021	CLAMPING RING
LHCDFLES0022	LEAD 3 PRE-SHAPED
LHCDFLES0023	LEAD 2 PRE-SHAPED
LHCDFLES0024	LEAD 1 PRE-SHAPED
LHCDFLES0025	LEAD 4 PRE-SHAPED

ANNEX B: RAW MATERIAL SUPPLIED BY CERN

Drawing Number	Component	Material	Dimensions [mm] (as delivered)	Quantity
LHCDFLES0015	Warm flange	AISI 416 L	Rod: Φ=130 L=5000	1
LHCDFLES0016	Cold flange	AISI 416 L	Rod: Φ=75 L=1600	1
LHCDFLES0017	Insulating flange	PEEK	Rod: Φ=125 L=1000	4
LHCDFLES0012	Brass rod	CuZn 85-15	Rod: Φ=5(-0.048,+0) L=2500	400
LHCDFLES008	Kapton tube 1	Kapton	Tube: Φ=6.95±0.025 th=0.135±0.005 L=2000	400
LHCDFLES008	Kapton tube 2	Kapton	Tube: Φ=7.3±0.025 th=0.135±0.005 L=2000	400
LHCDFLES0018	Short heat exch.	Cu ETP	Rod: Φ=40 L=3000	11
LHCDFLES0019	Long heat exch.	Cu ETP	Rod: Φ=40 L=3000	
LHCDFLES0020	Brass ring	CuZn 60-40	Rod: Φ=15 L=8	2
LHCDFLES0021	Brass ring	CuZn 60-40	Rod: Φ=18 L=3000	1
LHCDFLES0014	Stainless steel tube	AISI 316 L	Tube: Φ=7.7(+0.05,-0) th=0.2(+0.04,-0) L=1328 (+1,-0)	400
LHCDFLES0013	Insert	AISI 316 L	Rod: Φ=16 L=3000	5

Screws, washers and o-rings are supplied by CERN.

ANNEX C: REQUIREMENTS FOR CLEAN AREA

1. SCOPE

This Annex outlines the requirements for the area where the DCF assembly will take place.
Any work at the Contractor's premises, made on DCF components in their final (ready to assemble) conditions or on DCF assemblies shall be carried out in a clean condition area.

2. DEFINITION OF CLEAN CONDITIONS

The term CLEAN CONDITIONS refers to the working conditions and special measures which shall be applied to avoid contamination by conventional workshop contaminants such as oil, machine or finger grease, dirt, atmospheric dust, paint, etc.

3. DESCRIPTION OF A CLEAN AREA

A CLEAN AREA is a separate building or annex. A suitable area of the normal workshop space may be adapted, provided it is completely isolated from the rest of the workshop.

The clean area is a controlled area with:

- Environmental control of particulate contamination, temperature 20 °C ± 5 °C, humidity (50 % ± 5 %), air change and filtering of the inlet air.
- Slightly over-pressurized to avoid air in-leaks.
- A floor of fine screed concrete or equivalent, which shall be adequately painted or sealed.
- Adequate lighting for the type of process being carried out.
- Adequate heating well guarded to reduce the risk of fire. NB: Naked-flame heating is not acceptable.
- Specific controls for entrance and exit, including doormats designed for this purpose.

4. WORKSHOP CONDITIONS

4.1. General

Initial work on DCF components e.g. storage and preparation for machining, assembly, etc. may be carried out in normal working conditions, unless otherwise stated in this Technical Specification.
When initial work is complete, the materials shall be cleaned according to the Technical Specification and moved to the CLEAN AREA.

4.2. In the CLEAN AREA

The following conditions shall apply in the CLEAN AREA.

4.2.1 Environment

Smoking is strictly forbidden. Panels indicating that the CLEAN AREA is a NON SMOKING AREA shall be placed at the entrance and in visible places. The storage, preparation and consumption of food and drinks shall not be permitted.

4.2.2 Working dress

Normal working dress shall be clean laboratory type-coat, suitable clean gloves and clean disposable overshoes.

4.2.3 Tools and Equipment

A minimum quantity of degreased and cleaned hand-tools and equipment shall be maintained in the CLEAN AREA as part of its permanent equipment.

Overhead cranes shall have drip trays to prevent oil drips contaminating material being worked on in the CLEAN AREA.

ANNEX D: EXCHANGE OF INFORMATION

The tests reports on each DCF assembly shall be submitted to CERN for approval before delivery of the components and shall be included in the traveller document. The following information shall be included in a data/sheet computer readable file:

- batch number of each subcomponent and relative material certificate,
- DCF assembly serial number,
- results of dimensional checks, pressure, electrical and leak tightness test,
- date and place of the tests.

ANNEX E: CD-ROM "CERN OFFICIAL DOCUMENTS"