Ref.: CTF3/QL3spec - UU

Date: 09/08/2006

CTF3 – Two Beam Test Stand

TECHNICAL SPECIFICATION

12 Resistive Small Aperture Quadrupole Magnets for the CTF3 – Two Beam Test Stand

Abstract

The 12 resistive QL3 quadrupole magnets will be part of the CTF3 – Two Beam Test Stand. This Technical Specification concerns the design, fabrication, testing measurements and transport of these magnets. The quadrupoles have a nominal gradient of 11.2 T/m, an inscribed diameter of 58 mm and an iron length of 200 mm. Delivery shall be completed before the 30th of June 2007.

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1. INTRODUCTION

CLIC, an acronym for “Compact Linear Collider”, is a study of a linear electron/positron collider for the 1 to 5 TeV energy range. A conceptual feature of CLIC is the two beam scheme, where a lower energy, high current drive beam runs in parallel to the high energy beam. The drive beam produces the RF power required to accelerate the main beam. CLIC is recognized as a potential project after the Large Hadron Collider (LHC).

The CLIC Test Facility CTF has already in the past served as a test bench for CLIC technology. In its 3^{rd} stage, CTF3, it can be considered as a CLIC module, designed to demonstrate the RF power generation scheme.

Uppsala University is involved in this experiment with the Two Beam Test Stand. This project consists in providing a beam line to test the devices that transfer the power from the drive beam to the main beam.

This Technical Specification covers the supply of 12 quadrupole magnets plus 4 spare coils. The requirements for the design, fabrication, testing and measurements of these magnets are described in this Technical Specification, based on the CERN technical specification, reference DO 21429/AT.

2. SCOPE OF THE SUPPLY

- 12 Quadrupole magnets
- 4 Spare coils
- Design and construction of all necessary tooling,
- Providing of copper conductor according to this specification,
- Providing of the steel sheet according to this specification and insulated according to this specification,
- Providing thermo-switches type ELMWOOD,
- Manufacturing of coils for the required number of magnet,
- Manufacturing of yokes for the required number of magnet,
- Performance of all tests to ensure the magnet quality,
- Providing of all manufacturing drawings
- Providing of all tooling drawings
- Complete documentation about the manufacture, measurements, and tests. All documentation shall be in English and included with the supplied magnets.
- Appropriate packing and transport to CERN Site.

3. TECHNICAL REQUIREMENTS

3.1 General Description

The quadrupoles are assembled from four quadrants each with a pre-assembled excitation coil. The cross-section is shown in Drawing No. CTFMQUA_0027. The cores are made from precision punched laminations glued together. The excitation coils are wound from hollow copper conductor, insulated with glass-fibre tape and impregnated with a radiation resistant epoxy resin. The quality of the field distribution is ensured by the close tolerances imposed on the pole profile, on the assembly of the magnets and on the properties of the steel. The four quadrants of the quadrupole have to be dismountable to allow installation in the machine without breaking the vacuum, and to exchange the coils. The main parameters of the quadrupole magnet are listed in Table 1.

3.2 Main Paremeters

BASIC		
Nominal gradient	T/m	11.2
Inscribed radius	mm	29
Integrated gradient ∫Gdl	Tm/m	2.53
FIELD QUALITY		
Good field region	mm	$r \leq 20$
Magnetic field integral quality Δ∫Gdl / ∫Gdl at G=11.2 T/m		$\leq \pm 2*10^{-3}$
Magnetic gradient integral dispersion Δ∫Gdl / ∫Gdl between the magnets		$\leq \pm 5*10^{-3}$
EXCITATION		
Nominal current at G=11.2 T/m	A	200
U_{max} Voltage drop on one magnet	V	< 10
Dissipated power at $I_{rms, max}$	W	< 2000
COIL		
Resistance of the magnet full load	mΩ	< 50
Inductance of the magnet at 120 Hz	mH	< 3.3
COOLING		

Coolant		demineralised water
Number of cooling circuits		2
Pressure drop	bar	5
Temperature rise	°C	16
Total cooling flow at 6 bar	l/min	1.8
DIMENSIONS AND WEIGHT		
Yoke length	mm	200
Overall length	mm	≈287
Overall width	mm	282
Total weight	Kg	85

Table 1: Main parameters of the QL3 type quadrupoles.

3.3 Fabrication of the Quadrants

3.3.1 General

The laminated quadrants are stacked from 0.65 mm thick steel sheets, which are glued together.

The assemblies of the quadrants are shown in Drawing No. CTFMQUA_0028 and 0029.

The four quadrants have to be easily dismountable to avoid breaking the vacuum when removing the magnet from the beam line and to allow an easy replacement of damaged coils by opening and rebuilding the magnets with accuracy and efficiency.

3.3.2 Steel Sheet Supply

The steel to be used for the lamination shall be EBG STABOCOR 800-65 AP (reference: Thyssen) or equivalent, to be approved by Uppsala University. The nominal thickness is 0.65mm. The steel sheets have an insulating layer of STABOLIT 70 (reference: Thyssen) or equivalent, to be approved by Uppsala University, on each side, which permits also bounding of the laminations into stacks.

The Bidder may propose an alternative material for approval by Uppsala University.

3.3.3 Punching of the Laminations

The dimensions of the laminations are shown on Drawing No. CTFMQUA_0031

It is essential that the pole profile, the mating surfaces and the reference surfaces is punched in the same operation, so that their relative location is as reproducible as possible.

Before starting the production of the laminations, a certain number of laminations shall be punched and dimensionally measured for approval by Uppsala University.

The height of the burr caused by the punching shall not exceed 0.06 mm.

Uppsala University may take sample laminations at any time for inspection. If any of these fail to meet specifications and tolerance requirements, all laminations punched since the last accepted samples might be rejected.

3.3.4 Assembly of the Quadrants

Before stacking, oil or grease shall be removed from the laminations: The sheet shall be cleaned with alcohol. Laminations shall be stacked in a precision stacking fixture to be designed by the contractor. Stacking shall be done using the reference surfaces as indicated in Drawings No. CTFMQUA_0028 and 0029

The reference surface of the stacking fixture shall be flat and smooth and optically aligned before stacking to a straightness of 0.05 mm in total range. The stacking fixture shall be designed to permit the inspection of the edge of the mating surfaces of the completed stacks.

During stacking, groups of 15 laminations shall be turned alternatively around their vertical axis in order to compensate partially systematic geometrical errors of the laminations. The last package at the end of each quadrant shall contain a minimum of 10 and a maximum of 20 laminations.

Since the laminations are not symmetric, rails with regular gaps will be formed by the alternating stacks. These rails shall be used to bolt the quadrants together.

Since the quadrants are not symmetric, two different types of quadrants are needed.

Care has to be taken to avoid distortion of the stack. During curing in the oven, a suitable pressure shall be applied.

A detailed explanation of the bonding process (curing, curing time …) is provided by the steel manufacturer.

3.3.5 Insulation and Protection of the Quadrants

Prior to the application of the varnish protection coating, the quadrant shall be thoroughly cleaned and any burrs and chips removed. The reference surfaces of the quadrant shall be covered with a masking tape of a type, which will not leave residues on its removal. The cores, with the exception of the poles and the mating surfaces, shall be painted with at least one coat of suitable primer and a radiation-resistant paint: epoxy resin paint. Up to an integrated dose of $5x10^7$ Gy, the painted surfaces shall not show any sign of degradation, such as fissures, blisters, etc. The type, quality, and colour of the paint shall be chosen in agreement with Uppsala University. The poles and the mating surfaces shall be protected with a suitable rust preventive.

3.3.6 Identification of the Quadrants

Each complete quadrant is to be identified by stamping the series number at the end where stacking commenced. This will be a 3 digits number, about 8 mm high. It should be stamped twice, once inverted. The results of all measurements on each quadrant shall be recorded together with its serial number.

3.4 Coil Characteristics

Number of coils per magnet		4

Number of turns per coil		19
Conductor length / coil	[m]	12
Conductor size	[mm × mm]	5 × 5
Cooling hole diameter	[mm]	3.0
Conductor cross sectional area	[mm2]	17
Weight per coil	[kg]	2
Electrical resistance at 20°C	[mΩ]	11.8
Flow per coil at 6 bar	[l/min]	1.3
Interturn insulation	V	70

Table 2: Coil Characteristics

3.4.1 Materials

The copper conductor that is used for the coils of high field resistive accelerator magnets must have a high electrical and thermal conductivity to keep the heat load of the coil below a limit. Inside the hollow conductor, water circulates with pressures of up to 25 bar. Hence, the copper must be suitable for leak tight brazing. Due to the field quality requirements on these magnets and the limited available space for the coils, the mechanical tolerances on the conductor are very tight.

The Contractor shall purchase the necessary quantity of copper conductor from a copper manufacturer approved by Uppsala University. The Contractor has to ensure that the properties of the copper conductor fully satisfy the requirements of this specification. Uppsala University reserves the right to verify that the copper conductor conforms to the specification.

Uppsala University proposes to use Outokumpu OF-OK conductor type 6831. The Bidder may propose an alternative material for approval by Uppsala University. In this case the offer shall contain detailed information about the material to prove that it fulfils the requirements of this specification.

3.4.1.1 Copper Quality

The copper must be free of cracks, porosity and voids. It shall not have any tendency for hydrogen embrittlement. Very good characteristics for brazing are required as well as a ductibility, which permits the winding of the conductor into magnet coils with tight bends. The copper shall be Cu-OF Oxygen Free (ISO designation). The edges of the conductor shall be rounded off and its surface free from burr.

3.4.1.1.1Composition

The composition shall be at minimum 99.95 % Cu (+ Ag). The Oxygen content shall be below 10 ppm.

3.4.1.1.2Electrical Resistivity

The electrical resistivity shall be at maximum $1.724 \cdot 10^{-8}$ Ω·m at 20°C.

3.4.1.1.3Mechanical Properties

The copper shall be annealed (dead soft fully annealed temper).

3.4.1.2 Dimensions and Tolerances

The conductor shall have a square cross section of 5.0 mm (+0.1 mm / -0 mm) × 5.0 mm (+0.1 mm / -0 mm), edge rounding radius of 0.7 mm and a circular cooling hole with a diameter of 3.0 mm (+0.1 mm/ -0 mm).

The Contractor shall obtain the copper conductor from the manufacturer in sufficient lengths so that each coil can be wound from a single length of conductor without brazed joints.

3.4.1.3 Leak Tightness

The conductor shall be leak tight for water at a pressure of 50 bars in the cooling channel.

3.4.2 Manufacturing and Assembly

Temperature gradients due to water cooling and magnetic forces subject the coils to heavy stresses. The Contractor must assume complete responsibility that the coils will satisfy all requirements for the test described hereafter and assure undisturbed, safe operation lasting for years and in the presence of ionizing radiation up to integrated dose levels of 10^8 Gy.

3.4.2.1 Winding

Each coil shall be wound from one conductor length. No conductor joints are admitted inside the coil. The winding shall be done on an appropriate mandrel. During winding the conductor has to be kept under mechanical tension. The winding tool shall be designed by the Contractor.

3.4.2.2 Electrical Insulation

All insulation and winding operations must take place in an environment free of dust, metallic particles or other contaminants. All coil components (conductor, insulation, filler pieces) and related tools shall be handled so as to prevent any contamination by oil, dirt, moisture, etc… The coils must in all respects behave as rigid units so that relative movements between individual turns due to the action of magnetic forces and thermal stresses inside the coils are excluded. The coils must be constructed in such a way and the insulation must be sufficiently strong and elastic to withstand a large number of on-off cycles ($>10^7$) and operation over 20 years.

The inter-turn insulation of the conductor and the insulation to ground must be made of glass fibre tape specially treated to obtain good adhesion to the epoxy resin. Since the coils have to be compatible with two other series of magnets, the tolerances of these coils have to be strictly observed.

All empty spaces shall be completely filled with a conveniently shaped glass fibre laminate and/or a glass fibre clothes to avoid resin rich areas (danger of brittleness and possible cracks). Pure resin excess of 0.5 mm is not permitted. The use of filler materials other than glass fibre is not permitted. The tapes must be of the type specially treated in order to obtain a good adhesion to epoxy resins. For the same reason the conductor must be carefully cleaned with acetone or a similar solvent immediately before the insulating process.

The finished coils shall be free of cracks, voids or dry spots. The coil surface shall not be patched, machined or mechanically processed after molding. Carefull removal of flash will be permitted.

The resin shall be of type Araldite F or equivalent. The choice of impregnation resin, curing agent, accelerator, and of the curing cycle shall be made in agreement with Uppsala University. The following points shall be observed:

- All components (resin, hardener, etc.) used for the impregnation shall come from the same firm.
- The viscosity of the resin and the process of impregnation shall be chosen such as to allow a thorough resin penetration between each turn.
- All components (resin, hardener, etc.) shall withstand a total integrated dose of 10^8 Gy, without significant mechanical or electrical degradation.

3.4.2.3 Coil Identification

An indelible series number, marked on a connecting plate must identify each coil. The results of all tests must refer to this number.

3.5 Magnet Assembly

3.5.1 Assembly of the Magnetic Circuit

The assembly has to comply to tolerances of the drawings.

Before mounting 2 coils, the four quadrants shall be carefully aligned in an assembly jig and bolted together. Five bolts shall be used on each side of the quadrants. A steel bar shall be installed between the bolts and the yoke rails to assure a good load distribution. The four quadrants shall be tightened after positioning. The Contractor may propose any ways to improve this method but it has to be approved by Uppsala University.

Special care shall be taken that the resulting quadrupole is as symmetrical as possible. Tolerances shall be checked during assembly and again verified on the finished quadrupole.

When the tolerances have been checked on the finished quadrupole, two holes shall be drilled in both directions (transversal and longitudinal) for dowel pins to assure accurate positioning of the quadrants in subsequent re-assembling. Then the quadrants shall be dismounted to install the pre-assembled coils. The Contractor may propose any ways to improve this method but it has to be approved by Uppsala University.

3.5.2 Mounting of the Coils

Elastic pads of appropriate thickness shall be inserted between core and coils to take up surface irregularities and to allow for thermal expansion. These pads shall be made from radiation resistant rubber (e.g. polyurethane). On the sides where the coil is pushed towards the yoke because of the Lorenz forces, non-elastic pads (e.g. made of impregnated glass fibre laminate) instead of elastic pads shall be used to fill the gap between the coils and the yoke. Clamps shall be used to press the coils against the yokes.

3.5.3 Electrical and Hydraulic Connections

Electrical and water connections are shown in drawing No. CTFMQUA_0027. All coils are electrically connected in series. There are two cooling circuits in parallel: one supplies both upper coils and the second one both lower coils.

Water connection blocks made of oxygen free copper shall be prepared. A stainless steel union shall be vacuum brazed onto these blocks. Stainless steel tubes connect these blocks to the main water manifolds. The tubes are insulated from the manifolds by means of insulators made of impregnated glass fibre laminate, to be installed by the Contractor. Brazed sleeves join copper connection block and the coil tails.

For brazing operations of copper to copper joints during the magnet fabrication, a brazing filler material shall be used which is specially formulated to join copper to copper without flux. Uppsala University recommends using SILFOS (Cu-Ag-P-Alloy). The brazing operations of copper to stainless steel joints shall be carried out in a vacuum furnace. The brazing filler shall not contain any flux and shall have a melting point, which is sufficiently higher than those of the copper-to-copper brazing filler. All brazing shall be carried out with great care. The Contractor is entirely responsible that neither obstructions nor leakage may occur even after prolonged magnet operation and in the presence of ionising radiation up to integrated dose levels of 10^8 Gy.

All hydraulic connections are made by means of stainless steel 1/8"G SERTO ferrule fittings.

To achieve a low resistive connection between two adjacent coils, one copper bar is screwed on two copper blocks whose goal is to separate and insulate water circuit from electrical circuit.

Since demineralised water will be used, all metallic parts inside the cooling system shall be made of copper or stainless steel. The maximum pressure of the cooling water is 25 bars and the maximum outlet temperature is 65°C. The cooling system is to be suitable for continuous operation under these conditions.

3.5.4 Thermal Protection

Each coil is equipped with a thermal switch fixed to the water outlet conductor. They open at a temperature of 65°C. The fixation method shall be agreed between Uppsala University and the Contractor.

3.5.5 Protection Covers

Protection covers have to be designed and fabricated to avoid any contact with current leadings parts. The cover shall be made of Macrolon and shall be easily dismountable without breaking the vacuum.

3.5.6 Magnet Identification

A unique serial number and a marking plate in a suitable position shall identify each magnet. The plate shall be marked with the following:

1. Serial number
2. Voltage (V) (nominal value)
3. Nominal current (A) (nominal value)
4. Resistance at 20° (mΩ) (measured value)
5. Gradient at I_{nom} (T/m) (nominal value)
6. Permissible temperature rise (°C) (nominal value)
7. Water flow at ΔP_{nom} (l/min) (nominal value)
8. Pressure drop (bar) (nominal value)
9. Iron length (m) (nominal value)
10. Magnet weight (kg) (nominal value)

4. INSPECTION AND TEST REQUIREMENTS

Uppsala University reserves the right to be present, or to be represented by an organisation of its choice, to witness any inspections or tests carried out at the Contractor or his subcontractor's premises. The Contractor shall give at least 10 working days notice of the proposed date of any such tests.

The Contractor shall carry out all necessary tests and inspections to ensure that the magnet, the yoke and the coils meet the requirements, which are defined in this Technical Specification.

4.1 Copper Quality

The Contractor shall obtain complete quality control records from the manufacturer of the copper conductor and is responsible to ensure that the copper quality meets the technical requirements defined in this specification.

Dimensions of the conductor have to be certified by the Contractor.

A copy of the quality control records shall be sent to Uppsala University before the coil construction begins.

4.2 Glass Fibre Quality

Samples of the tapes used for conductor and ground insulation will be tested before beginning the production. The Contractor will apply 5 kV DC. The current will be below 10 µA.

4.3 Insulated Copper Quality

The Contactor will subject insulated copper samples to a shear test to check the quality of the bond. The minimum acceptable bond strength is 5 N/mm^2.

The bond strength samples shall consist of 3 pieces of 10 cm long conductor, insulated in the specified manner and produced together with the coils. These tests are required at least 2 weeks before the impregnation of the first coil and thereafter upon request during the series production.

A copy of the quality control records shall be sent to Uppsala University before the coil construction begins.

4.4 Brazing Process Validation

Before permission can be given to start the production of the coils, ten brazing samples must be made to demonstrate that the brazing technique is entirely satisfactory. The brazing process of these samples shall be documented and communicated to Uppsala University. The brazing shall be carried out in the same way as it is foreseen for the series production. These samples will be subject of detailed metallurgical analysis by the supplier and Helium leakage tests by Uppsala University. If the brazing samples show bad flow of brazing material or porosity or bubbles in the joints or if they show any deterioration during the tests, the Contractor must improve the technique at his own expense until a set of entirely satisfactory samples has been obtained.

4.5 Epoxy Quality

The Contractor shall obtain complete product information from the manufacturer of the epoxy resin and is responsible to ensure that the resin quality meets the technical requirements defined in this specification, in particular radiation hardness. A copy of the product information shall be sent to Uppsala University before the coil construction begins.

4.6 Steel Sheet Quality

The Contractor shall obtain complete quality control records from the manufacturer of the steel sheets and is responsible to ensure that the steel quality meets the technical requirements defined in this specification. A copy of the quality control records shall be sent to Uppsala University before the coil construction begins.

Dimensions of each sheet after the punching operation have to be certified by the Contractor.

4.7 Tolerances and Tests of the Finished Quadrants

After gluing, the dimensions and tolerances of the quadrants shall be checked.

- The length shall be measured at three places (near the center and near the coil windows). The measured values shall be 200 mm (-0.65 mm, + 0 mm).
- Perpendicularity of both end surfaces shall be within ± 1 mrad.
- The individual quadrant shall be straight within 0.05mm. This shall be checked with adequate means
- The packing factor is defined here as the ratio of the mass of steel of the magnetic circuit to the mass of a solid magnetic circuit of the same volume as the laminated part of the stack and of the same density as the steel density of the laminations. The packing factor of each magnetic circuit must not be lower than 97%. The packing factor must be determined to within ± 0.3% by a precise measurement of the weight of the laminations. The nominal packing factor will be determined during the fabrication of the first stack.

4.8 Coil Inspection

4.8.1 Leak Tests of Brazed Joints

All brazed joints must be leak tested before the coil impregnation at 40 bar water pressure for at least 30 minutes. No evidence of leak must appear.

4.8.2 Geometrical Inspection

The dimensions of the coil shall be measured with appropriate measuring equipment and recorded. They have to be within the specified tolerances. The finished coils must be free of cracks, voids, or dry spots.

4.8.3 Hydraulic Tests

The finished coil shall be leak and flow tested. The water flow through each coil shall be measured. For a pressure drop of 6 bar the water flow of the circuit must exceed 1.3 l/min. The measured flow for all cooling circuits of all coils must be equal within 5%.

The finished coils must be leak tested at 40 bars. No evidence of leak must appear.

4.8.4 Electrical Tests

After the hydraulics test specified above, the finished coils must be emptied of water, blown dry and prepared for the succeeding electrical tests.

4.8.4.1 Electrical Resistance

The coil resistance shall be measured and corrected to 20°C, the accuracy of the method for measurement being better than 0.5 %. It shall not exceed 11.8 mΩ at 20°C.

4.8.4.2 Insulation Resistance

The coil shall be completely immersed into tap water. At the beginning and after 8 hours immersion time the insulation resistance shall be measured with a voltage of at least 2.0 kV DC during 10 minutes. The resistance must be recorded after 1 minute and 10 minutes, must be stable with time and shall exceed 10^8 Ω.

4.8.4.3 Dielectric Test

At the end of the immersion time a voltage of 5.0 kV peak to peak, 50Hz, shall be applied for at least one minute. Afterwards the insulation resistance shall be measured as described above and satisfy the same criteria.

4.8.4.4 Inter-turn Insulation Test

Immediately after the dielectric test the interturn insulation must be tested. Uppsala University proposes to use a capacitor discharge with at least 1.5 kV peak. The Contractor may propose a different method for approval by Uppsala University.

4.8.5 Thermal Cycling

Uppsala University reserves the right to test, prior to the insulation tests, one coil with 20 thermal excitation cycles at the nominal excitation current and 50°C temperature increase by adjusting the cooling water flow. The current is then switched off until the temperature reaches the inlet temperature of the cooling water and switched on again until the temperature reaches 50°C temperature increase. Thermal cycling must not be made earlier than one week after impregnation. After 20 complete cycles the insulation must show no sign of degradation and furthermore satisfy the high voltage tests previously described.

4.9 Tests on the Complete Magnets

4.9.1 Mechanical Dimensions

The complete magnets shall be checked dimensionally.

- The straightness shall be measured along the reference surfaces. All sides of the magnet shall be checked. The magnet shall be straight within 0.05 mm.
- The diameter of the inscribed circle of the poles of the assembled quadrupole shall be 58 ±0.05 mm. This shall be measured at three places (at the center and near the two ends) along the quadrupole axis.
- The distances between the edges of the adjacent poles must be equal within ±0.02 mm. This will be measured at three places along the axis (at the center and near the two ends). However, the distance must be everywhere within ±0.05 mm of the nominal value.

- The longitudinal offset of the end surfaces shall not exceed ±0.1 mm on each end of the yoke.

4.9.2 Leak and Water Flow Tests

The complete cooling circuit will be checked for leaks under water pressure of 30 bar, applied for at least 15 min. A flow test shall also be made. For water pressure of 6 bar, the water flow shall exceed 1.8 1/min.

Directly following these tests, the water remaining in the cooling circuits shall be completely evacuated in order to avoid freezing.

4.9.3 Magnet Resistance

The magnet resistance shall be measured and corrected to 20°C, the accuracy of the method for measurement being better than 0.5 %. The resistance shall be equal to the sum of the resistances of the four coils within 0.5 % and shall not exceed 50 mΩ at 20°C.

4.9.4 Magnet Inductance

The magnet inductance shall be measured with accuracy better than 2 %. It shall not exceed 3.3 mH.

4.9.5 Insulation Resistance

The insulation resistance between the coils and the yoke shall be measured with a voltage of at least 2 kV DC during 10 minutes. The resistance must be recorded after 1 minute and 10 minutes, must be stable with time and shall exceed 10^8 Ω.

4.9.6 Thermal Protection

The cooling performance must be checked with a test run. To test the thermo-switches, the coils shall be energised with a maximum current of 300A DC with the nominal water pressure for 30 minutes. Then the water flow shall be reduced slowly to heat up the coil until the thermal protection switches off to prove if it is working properly. This test shall be done on both water-circuits simultaneously.

4.9.7 Lifting Test

To comply with the safety rules concerning equipment handling in effect at CERN, each yoke must follow a lifting test with a static overload of 50 percent of the total magnet weight. This test must be carried out with a crane which has a vertical speed of at least 6m/min. After the lifting test no deformation or deterioration must occur. The dimensional tolerances described hereunder must be checked before and after the lifting test.

5. MISCELLANEOUS

5.1 Technical Information to be Submitted

Uppsala University shall be informed of all technical details of the construction. The following summarises all information required by Uppsala Universtiy:

a) Details of mechanical, electrical and chemical properties of materials used: insulation materials, impregnation resin, tapes, paint, brazing filler,

b) Data of manufacturing processes: curing cycle for the resin, welding and brazing processes, assembly methods,

c) Brazing samples,

d) Complete manufacturing drawings before production starts,

e) Complete tooling drawings before production starts,

f) Time schedule of the manufacture followed by regular written progress reports,.

g) Any technical modifications with respect to the present specification (for approval),

h) Complete sets of final drawings, on CD, readable by AutoCAD software,

i) All test certificats.

5.2 Transport and Precautions to be Taken

It is the responsibility of the manufacturer to deliver all magnets well protected and without any damage to CERN, Site de Prevessin/France. All cooling ducts shall be dried out properly and closed off in order to avoid damage by frost. Parts sticking out of the magnet core, especially coil heads, magnet connections shall be protected by (mechanically) rigid covers. The whole magnet shall be covered with a protective plastic foil.

6. INFORMATION AND DOCUMENTATION MANAGEMENT

6.1 Manufacturing Drawings

All manufacturing drawings are prepared by the Contractor for the execution of the Contract. To avoid errors or misunderstandings, the Contractor shall provide the original version of the detailed technical drawings in accordance with the Quality Assurance Plan. These drawings shall be readable by AutoCAD software. If the drawings are modified by Uppsala University, these corrections will be sent to the Contractor, who will register them and supply new versions of the drawings.

6.2 List of Drawings

The following drawings are part of the Technical Specification.

Drawing	**CERN CDD number**
Quadrupole QL-3 Assembly	CTF MQUA_0027
Quadrupole QL-3 Assembly Yoke 1	CTF MQUA_0028
Quadrupole QL-3 Assembly Yoke 2	CTF MQUA_0029
Quadrupole QL-3 COIL	CTF MQUA_0030
Quadrupole QL-3 Lamination sheet	CTF MQUA_0031
Quadrupole QL-3 Square	CTF MQUA_0032

Quadrupole QL-3 Manifold	CTF MQUA_0033
Quadrupole QL-3 T-insulator	CTF MQUA_0034

Table 3: List of Drawings

7. COMMERCIAL TERMS AND CONDITIONS

- The closing date for this tender is the 8th September 2006.
- It is mandatory that delivery **shall** not be later than June 2007.
- The quadrupoles **shall** be delivered to CERN, Site de Prevessin/France, according to the conditions stipulated as *DDU* under INCOTERMS 2000.
- The ALOS 81 General Regulations of 1981 covering the supply of goods to the public sector in Sweden **shall** apply.
- 80 % of the full payment will be transferred upon delivery and approved acceptance of the quadrupoles.
- The remaining 20 % will be transferred after successful completion of the following tests at CERN:
    - Optical inspection for damages.
    - Operating the magnet at full field for 72 hours without leaks or over-heating.
    - Verification of the field measurements at one excitation.
- The warranty period of the delivered system shall be at least one year after the approved acceptance test at CERN.
- This tender will be conducted according the conditions labelled "förenklad upphandling" (simplified tender).
- Before submitting the tender, the supplier can discuss details of the specification with:

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or

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- The tender offered must be sent to the same address stated in the previous paragraph and **shall** be labeled "Tender for CTF3 Quadrupoles." The offer **shall** be valid for a period of 3 month.
- An offer may be accepted without prior negotiations.

8. EVALUATION OF TENDERS

The evaluation will be performed in two steps. First a check will be performed to ensure that the tenderer is acceptable as supplier and in a second step the tenders will be evaluated.

8.1 Minimum Economic and Technical Standard Required of the Supplier

8.1.1 Requirements

The following minimum technical and economic standards **shall** be fulfilled by the supplier

- The supplier **shall** be registered on the professional or trade register as laid down by the laws of the country in which the supplier is established.
- The supplier **shall** have fulfilled his obligations relating to the payment of social security contributions and taxes in accordance with the legal provisions of the country in which he is established.
- The supplier **shall** possess sufficient technical capacity and capability for the assignment.

8.1.2 Means of proof

As means of proof, the following documents, or equivalent, **shall** be submitted on demand and should be submitted with the tender:

- Certificate of enrollment on the professional or trade register.
- Certificate that the supplier has fulfilled this obligations relating to the payment of social security contributions.
- Certificate that the supplier has fulfilled this obligations relating to the payment of taxes.
- List of similar contracts agreed on during the last two years.

8.1.3 Swedish Supplier

Swedish suppliers **shall**, in addition

- be registered for the payment of value added tax, as applicable.
- be registered for F-tax.

Swedish suppliers can use the form SKV 4820 to verify that the obligations are fulfilled. Furthermore Uppsala University may turn to a credit-rating agency for additional information.

8.1.4 Exclusion from Participation

A supplier may be excluded from participation in the award procedure on the grounds stated in Chapter 1, 17, of The Act (SFS 1992:1528) on Public Procurement (see http://www.nou.se under the headings "Upphandlingsregler" and "in English").

8.2 Criteria for the Award of the Contract

It is mandatory that all "**shall**" criteria shall be met.

The award of the contract will be based on the economically most advantageous tender in terms of the following criteria (in order of precedence):

1. Price
2. Technical merits