MQXA/MQXB Magnets in the LHC Inner Triplets

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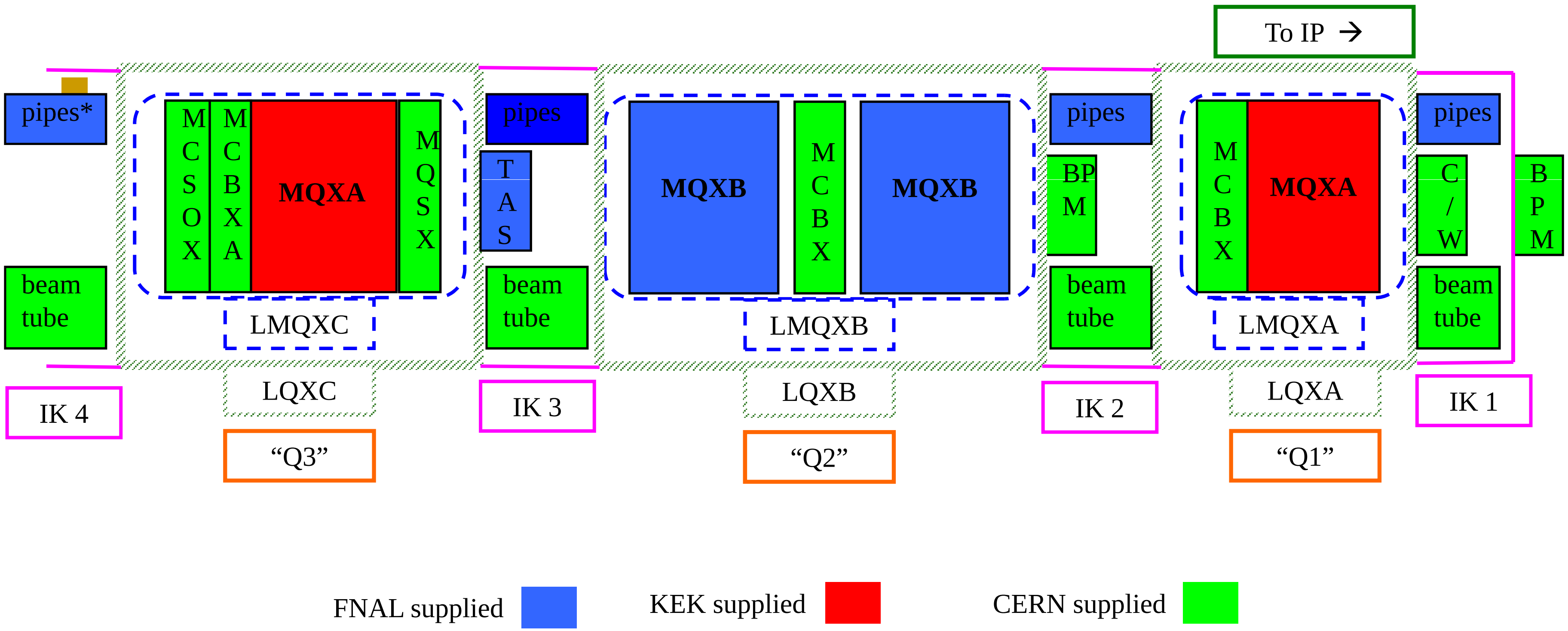
Context of LHC Inner Triplets

- ~1996: SSC Terminated, CERN looking for contributions to LHC machine
- Japan has an ongoing and successful NbTi magnet program
- US HEP (FNAL) restarting NbTi magnet program
- Negotiations for both to participate in Inner Triplet quadrupoles (next to LHC dipoles among most challenging in the machine)
- R&D is required for both programs to demonstrate design…not 'off the shelf'.

IR Inner Triplet




Fermilab

Functional Interfaces

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the **Large Hadron Collider** project

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LHC-MQXA-ES-0001 rev 1.0
CERN Div./Group or Supplier/Contractor Document No.
TD/KEK/JP
EDMS Document No.
313715

Date: 2001-11-16

Functional Specification

INNER TRIPLET QUADRUPOLE MQXA

Abstract

This specification establishes the functional requirements for the MQXA quadrupole magnets. These elements form the Q1/Q3 inner triplet optical element at interaction regions 1, 2, 5 and 8. Since the elements are identical whether installed at the low luminosity or high luminosity interaction regions, the functional requirements to the magnet design are identical for all MQXA assemblies.

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Functional Specification

INNER TRIPLET QUADRUPOLE MQXB

Abstract

This specification establishes the functional requirements for the MQXB quadrupole magnets. Two of these elements form the Q2 inner triplet optical element at interaction regions 1, 2, 5 and 8. Since the elements are identical whether installed at the low luminosity or high luminosity interaction regions, the functional requirements to the magnet design are identical for all MQXB assemblies.

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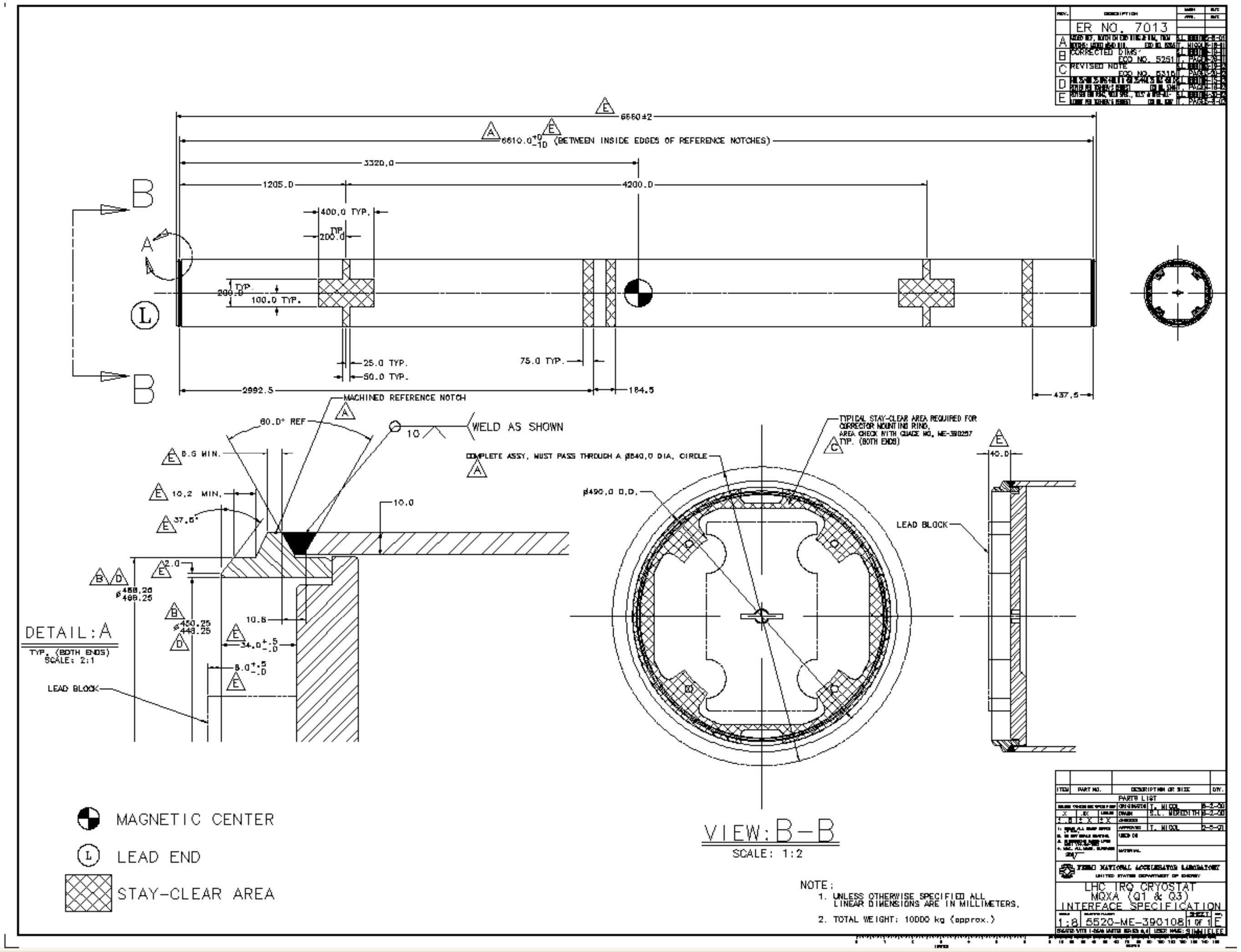
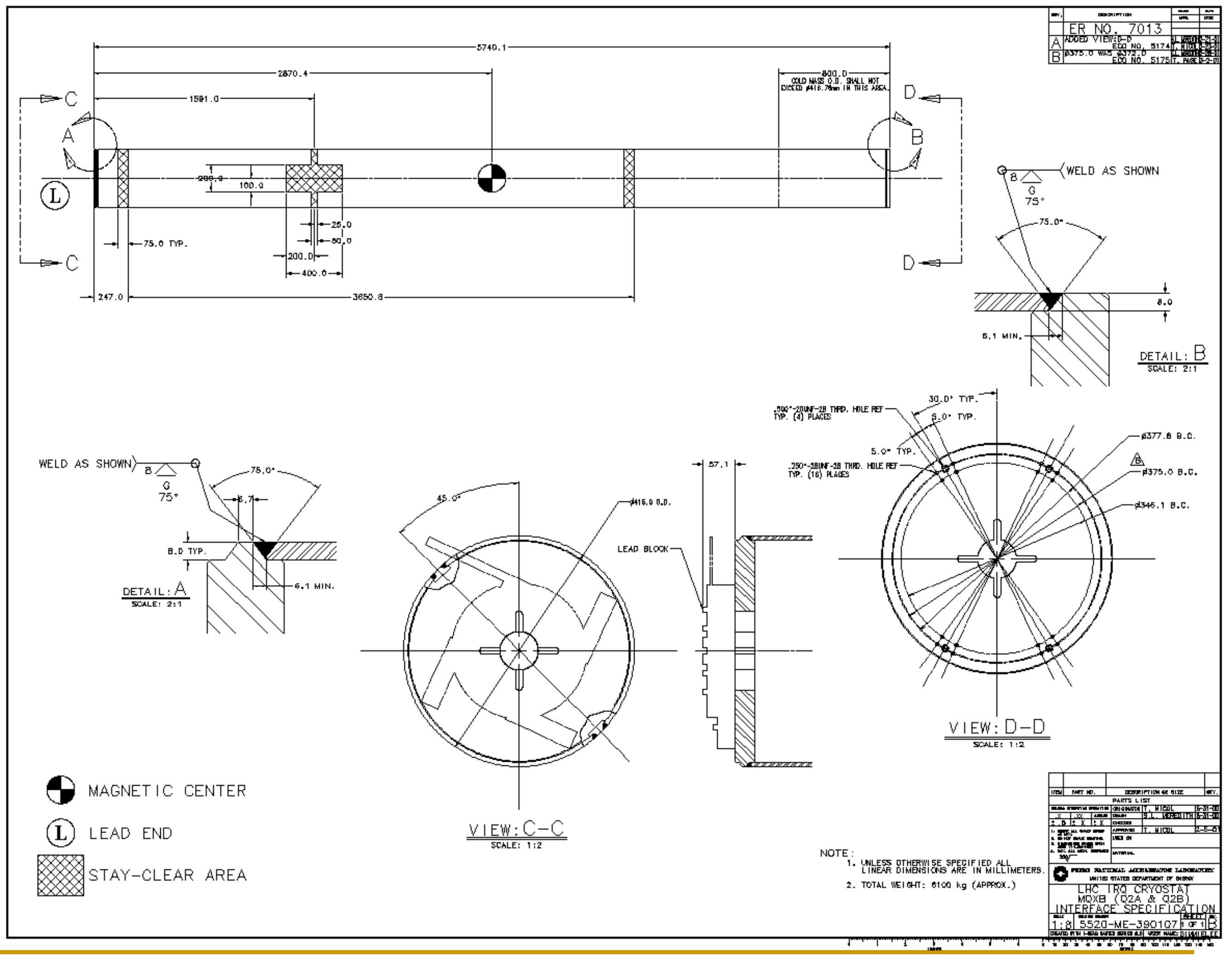
MQXA

- 70mm, 6.37m length, 215T/m quadrupole
- 4 layer coil, >7kA
- Mechanical support through yoke
- 6660mm long
- 490mm OD
- Lead end ~40mm longer than return end mechanical lengths ~same
- Production at Toshiba
- Harmonics not the same as MQXB
- Alignment information transferred by ports through skin to yoke

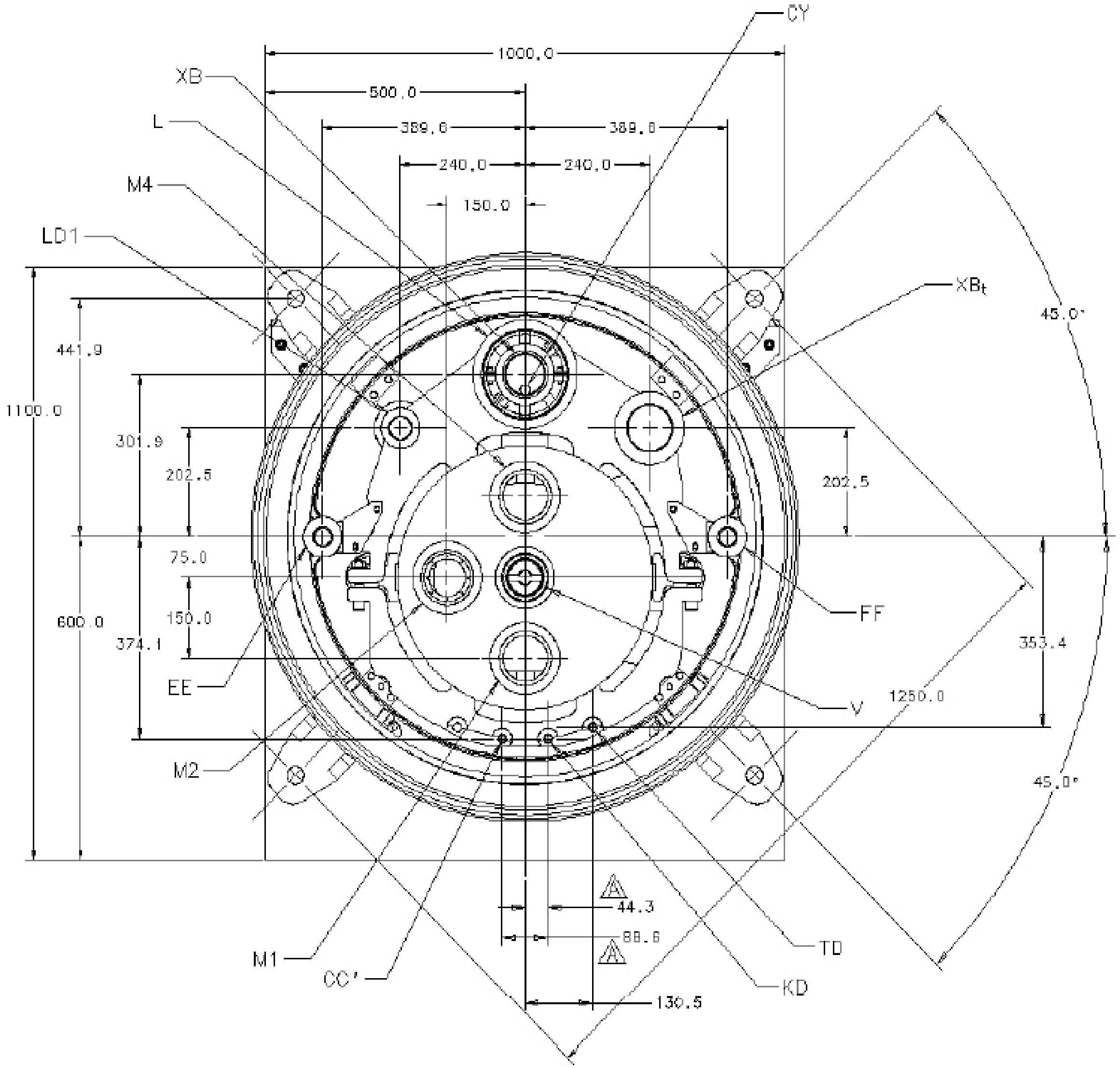


MQXB

- <u>70mm, 5.5m length, 215T/m quadrupole</u>
- 2 layer coil, 12kA
- Mechanical support through collars
- 5740mm long
- 416mm OD
- Lead and return end mechanical lengths ~same
- Final assembly at FNAL
- Harmonics not the same as MQXA
- Alignment information transferred by notch in skin welding key



End View of Cryostat



Specifications

- Every interface needs to be defined and understood from the standpoint of the end user and the next user
  - Mechanical
  - Electrical
  - Alignment
  - Beam Physics
  - Cryogenic
  - Radiation
  - Reliability
  - Shipping / Handling

Plug Compatibility

- IF this can be done, allows for
  - Parallel development
  - Potential future gain due to successful R&D
  - Mitigation of risk in success of end project
  - Variation in industrial relationships