Muon Pulsed Septum Magnet Specifications

(Injection and Abort)

**May 1, 2015**

This specification identifies the basic requirements for design, fabrication, and testing of a pulsed septum magnet to be used for injecting and aborting 8.89 GeV/c protons (Mu2e mode) and 3.10 GeV/c Muons (g-2 mode) from the Muon Delivery Ring. The Technical Division will lead the magnet design effort with significant input from Accelerator Division Muon Department, Electrical Engineering Support Department and Mechanical Support Department personnel.

## General Magnet Parameters

Magnet type: single-turn dipole septum magnet

Quantity required: 3 completed magnets (2 operational and 1 spare)

Design bend angle: 39 mrad (Injection and Abort, both beams)

Maximum bend angle: 47 mrad (Injection and Abort, both beams)

Nominal septum radius of curvature: 53.3 meters (36 mrad in approximately 1.92 m)

Maximum inductance: 3.5H

Maximum DC resistance: 0.0015 ohms

## Magnetic Parameters

Peak integrated strength: 1.4 Tesla-meters

Field limits in field free region: peak integrated field, measured along path of

circulating beam with 1mm closest approach to septum

Good field region: 1.6” square beginning 0.04” from septum conductor surface

Good field criterion: 

End field requirements: end packs to minimize end effect lamination core heating

## Mechanical Parameters

Minimum clear aperture in field region: 2.1” in bend plane, 1.85” orthogonal to bend plane

Minimum clear aperture in field free region: 5.3” in bend plane, 2.5” orthogonal to plane

Total package length: m circulating beam flange to circulating beam flange

Maximum external transverse dimensions: to be determined, work in progress

Mounting orientation: vertical bend (up, both Injection and Abort)

Mounting fixtures: ears with holes for 3/4” threaded rod

Alignment requirements: four external ferrous survey pads on “aisle” side corners of case

Vacuum requirements:  5E-6 torr after two days pumping;  1E-7 torr ultimate

Beam tube: no internal beam tube; electrically isolated stainless vacuum case around core

Beam tube connections: 12” conflate flange at upstream (extraction direction) end, 14” conflat flange with welded bellows (common to both beams) at downstream end

## Operating Parameters

Modes of operation: pulsed with half-sine current pulse, Mu2e 8 GeV/c, g-2 3.1 GeV/c

Current pulse width: 250sec < base width < 300 sec

Pulse repetition rate: Mu2e 21 Hz burst, 6 Hz average, g-2 100 Hz burst, 12 Hz average

Anticipated nominal operating current: Mu2e - 20.5 kA design, 24.8 kA peak, 615 to 860 A rms at 6 Hz, g-2 - 7.2 kA design, 8.7 kA peak, 300 to 425 A rms at 12 Hz

## Thermal and Environmental Parameters

Ambient operating conditions: 75-110F temperature

25-75relative humidity

Cooling water: 95F LCW system available (water temperature typically 90F)

Maximum allowable temperatures:

Core laminations and inner conductor - 130F average bulk temperature

Septum conductor - 180F average bulk temperature

Maximum allowable temperature gradients: TBD, based on septum, power feed, and

water feed stresses

Water connections: compression fittings

Location of water connections: To be determined

Radiation environment: high radiation environment, use best high radiation design

practices consistent with epoxy and glass laminate materials

Other environmental issues:

## Electrical Parameters

Electrical connections: ¾” copper rod to stripline connections

Hipot test:  5A at 6 KV AC

- inner conductor to core (before septum conductor attached)

- conductor to case after final assembly

Maximum nominal operating voltage: 2.5KV

Ability to switch polarity in g-2 mode

Location of power leads: To be determined

## Other Parameters

Historical concerns: electrical insulation of inner conductor

potential water leaks

potential power feed vacuum leaks

Special conditions: define surface shape on field-free side of septum

include vacuum pumpout port in case at ~center of field free region