

## SPECIFICATION OF THE STEEL LAMINATIONS FOR PS PULSED SEPTUM MAGNETS

M.Thivent - R.Valbuena

### 1. INTRODUCTION

#### 1.1 General.

To inject or eject the particule beams between the CERN different accelerators of the PS (Proton Synchrotron) complex , septum magnets are required .These dipole magnets have to produce a very homogenous field between their two pole faces together with a very low leakage field on the outside of the magnet gaps.

These dipole magnets will work inside a vacuum chamber with a pressure level of  $1 \times 10^{-8}$  torr when pulsed and operate at a maximum rate of 1.2 sec. with a pulse duration of 3 msec. These constraints imply the use of very high quality materials and tight tolerances for their manufacture. This specification outlines the requirements to ensure a reliable magnet for these applications.

#### 1.2 Typical Magnet Characteristics.

Nominal magnetic induction	1 to 1.3 Tesla
Vertical gap height	20 to 60 mm
Horizontal gap width	60 to 100 mm
Maximum lamination sizes	160 x 160 mm <sup>2</sup>
Maximum core length	1000 mm

### 2. STEEL CHARACTERISTICS

#### 2.1 Material.

We exclude in advance steels of Fe Co class because of the presence of nuclear radiation , so that the choice is mainly directed towards soft magnetic steel ( i.e non oriented 3% content silicon -steel ).

#### 2.2 Laminations thickness.

Because of the relatively short pulse length corresponding to a frequency of 200 Hz the lamination thickness should not exceed 0.35 mm.

## 2.3 Magnetic characteristics.

Saturation induction level                       $B_{sat} > 1.5 \text{ T.}$   
Coercitive force (after  $B=1.5 \text{ T.}$ )               $H_c < 20 \text{ A/m}$

Minimum values in the final steel state

B en T.	0.5	0.8	1	1.2	1.3	1.4	1.5
H en A/m	40	80	120	200	300	500	1300
relative .perm.	10000	8000	6700	4800	3500	2200	900

## 3. INSULATION

### 3.1 Material

Since the magnet works in ultra-high vacuum ( $P < 5 \times 10^{-9} \text{ Torr}$ ) ***only an inorganic insulation layer would be acceptable***. The laminations must be coated on both faces and insulation thickness should not exceed 3% of the total thickness of the lamination (thickness around 3 microns on each face should be sufficient)

The insulating coating must conserve all properties after a bake-out under vacuum at  $300^\circ\text{C}$

### 3.2 Resistivity

A minimum surface resistance of  $15 \text{ ohm.cm}^2$  is required

## 4. FINAL TREATMENT

The supplier should indicate if a special treatment is necessary after the punching operation in order to reach the magnetic performances

## 5. FORM OF SUPPLY

Material should be delivered in flat sheet form.