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PIXEL SUPPORT TUBE REQUIREMENTS

This is a preliminary description of the requirements of the pixel support tube and related items.

Prepared by:	*Checked by:*	*Approved by:*
E. Anderssen, M. Gilchriese, N. Hartman		

Distribution List

History of Changes			
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1 Introduction and General Requirements

This note describes the preliminary requirements for the pixel support tube and related items. Refer to Figure 1 for a definition of the terminology. The requirements for the pixel support tube and the endplug thermal barrier are given in this note. Preliminary interfaces are defined but not yet detailed interface requirements.

Figure 1. Overview of the pixel support tube and related items.

The general requirements for the pixel support tube/endplug thermal barrier are the following:

1. *to support the pixel system and its services and to allow installation and removal of the pixel system from the end of the Inner Detector volume;*
2. *to provide a stable mounting structure for the pixel system well connected to the barrel SCT;*
3. *to provide an EMI shield around the pixel detector volume;*
4. *to provide a thermal enclosure to maintain the operating temperature of the pixel system and*
5. *to provide a gas barrier between the pixel system and the other elements of the Inner Detector.*

2 Mechanical Requirements

The mechanical requirements for the support tube and the endplug are given in this section. For convenience we separate the requirements into the elements given below but it must be understood that there is substantial coupling among some of these items:

1. *pixel support from the SCT barrel;*
2. *barrel section of the support tube;*
3. *side C of the support tube;*
4. *side A of the support tube;*
5. *rails and;*
6. *endplug thermal barrier.*

2.1 Pixel Support from SCT Barrel

The support of the pixel system in its operating position is provided by the SCT barrel structure. The pixel coordinate system is aligned with respect to the SCT barrel coordinate system, not the ideal coordinate system of the Inner Detector. The pixel support must provide the required placement accuracy, repeatability of placement accuracy(in case of removal and re-insertion) and stability. In addition, the support scheme must allow survey of the pixel system with respect to the SCT-barrel-defined coordinate system. All requirements are given relative to the SCT-barrel-defined coordinate system. The concept for support is illustrated in

Figure 2. Concept for support of pixel system from barrel SCT.

*The placement requirements are given in Table 1. ***These need to be explained obviously****

COORDINATE	*TOLERANCE*
X or Y	*TBD mm*
Z	*TBD mm*
ϕ	*TBD radians*

Table 1. Placement tolerances

*The repeatability-of -placement tolerancess are given in Table 2. ***These need to be explained obviously****

COORDINATE	*TOLERANCE*
X or Y	*TBD mm*
Z	*TBD mm*
ϕ	*TBD radians*

Table 2. Repeatability-of-placement tolerances.

The stability requirements are given in Table 3.

COORDINATE	*TOLERANCE*
X or Y	*TBD mm*
Z	*TBD mm*
ϕ	*TBD radians*

Table 3. Stability tolerances for the pixel support.

2.2 Barrel Section of Support Tube

The barrel section of the support tube(including rails, flanges) has the following requirements:

1. *Must fit within the envelopes as given in ????? and including deflections and as-built tolerances.*
2. *A maximum deflection during pixel insertion of TBD mm(2 mm?)*
3. *A maximum deflection during SCT-forward installation/removal of TBD mm*
4. *A CTE that allows the stability requirements to be met. This implies a CTE of ≤ TBD.*
5. *There are currently no requirements on CME, since it is assumed that the humidity in the region of the barrel support tube reaches a stable value.*

See ??? for tolerances on as-built dimensions.

6. *The as-built average length of the support tube and connecting flanges has a tolerance of TBD mm.*
7. *The length of the support tube including connecting flanges shall not deviate from the average value by more than TBD mm.*
8. *The as-built diameter of the support tube has a tolerance of TBD mm*
9. *The perpendicularity of the end-flanges has a tolerance of TBD mm*

2.3 Side C Section of the Support Tube

The pixel system is inserted from Side C. Side C must therefore have rails for pixel insertion and for services support. The requirements of the support tube on Side C are:

1. *Must fit within the envelopes as given in ????? and including deflections and as-built tolerances.*
2. *A maximum deflection during pixel insertion of TBD mm(2 mm?)*
3. *A maximum deflection during SCT-forward installation/removal of TBD mm*
4. *There are no special stability requirements(to be revisited) for the Side C tube. Hence no special requirements on CTE.*
5. *There are currently no requirements on CME, since it is assumed that the humidity in the region of the barrel support tube reaches a stable value.*
6. *See ??? for tolerances on as-built dimensions.*
7. *The as-built average length of the support tube and connecting flanges has a tolerance of TBD mm.*
8. *The length of the support tube including connecting flanges shall not deviate from the average value by more than TBD mm.*
9. *The as-built diameter of the support tube has a tolerance of TBD mm*
10. *The perpendicularity of the end-flanges has a tolerance of TBD mm*
11. *The Side C support tube is supported on one end by the barrel support tube and the other end by ????(has to be decoupled from beampipe support to allow independent motion?*

2.4 Side A Section of the Support Tube

The requirements for the support tube on Side A are

1. *Must fit within the envelopes as given in ????? and including deflections and as-built tolerances.*
2. *A maximum deflection during pixel insertion of TBD mm(2 mm?)*
3. *A maximum deflection during SCT-forward installation/removal of TBD mm*
4. *There are no special stability requirements(to be revisited) for the Side A tube. Hence no special requirements on CTE.*
5. *There are currently no requirements on CME, since it is assumed that the humidity in the region of the barrel support tube reaches a stable value.*

6. *See ??? for tolerances on as-built dimensions.*
7. *The as-built average length of the support tube and connecting flanges has a tolerance of TBD mm.*
8. *The length of the support tube including connecting flanges shall not deviate from the average value by more than TBD mm.*
9. *The as-built diameter of the support tube has a tolerance of TBD mm*
10. *The perpendicularity of the end-flanges has a tolerance of TBD mm*
11. *The Side A support tube is supported on one end by the barrel support tube and the other end by ????(has to be decoupled from beampipe support to allow independent motion?*

2.5 Rails

The installation rails are used for insertion of the pixel system and possibly also for the services support structure. These rail requirements are:

1. *Must fit within envelope as described in ???*
2. *Coplanar to TBD(±1 mm?) over 4.5 m*
3. *Distance between rails has a tolerance of TBD(±1 mm?)*
4. *Local flatness is TBD(0.25 mm over 10 mm length?)*

There are additional rails for the services supports. The requirements for these...all are TBD.

2.6 Endplug

The endplug thermal barrier must be a clamshelled structure or partly a clamshelled structure to pass over the beam pipe. Services routing in this region is a major constraint on the mechanical design but this is TBD. The endplug must provide a flexible gas barrier to account for possible motion of the beam pipe of TBD in X or Y and TBD in Z. The endplug must not be attached directly to the beampipe. It must not be attached to the SCT forward structure. It must not be attached to the neutron moderator.

3 Thermal Requirements

3.1.1 Normal Operation

The support tube and endplug must allow operation of the pixel detector over the allowed temperature range(-25°C to about 0°C). The outer surface of the support tube and the enddplug exposed to cavern air must have a temperature above the dew point(13°C).

3.1.2 During Pixel Installation, with SCT Already Installed

The endplug is not present during installation. The temperature of the support tube is not controlled during the installation and will be the ambient cavern temperature. This assumes the barrel and forward SCT are thermally controlled as required to meet their operating requirements during pixel installation.

3.1.3 During Pixel Operation, without Forward SCT Installed

The pixel system may operate with one or both forward SCT/TRT sections removed. The requirements in this case are the same as for normal operation. However, the region open to cavern air is larger in this case. Heating on the outside of the support tube and the endplugs is required in this mode.

4 Electrical

The support must provide electrical conductivity over it's outer surface to (a) act as an EMI shield and (b) to provide a current path for potential ground currents. The thickness of the conductor is TBD. The allowed openings in the conductor are TBD. The same requirements apply to the endplug. In addition, the endplug conducting elements must be capable of electrical connection to the conductor on the support tube and to conducting elements on the beam pipe.

5 Gas Containment

The support tube and endplug must provide gas containment for the environment gas circulated through the pixel volume(N_2 or CO_2) and for leakage of the coolant C_3F_8. Allowable leak rates for either gas are TBD.

6 Access, Installation and Removal

Three piece construction of the support tube is required in the long access scenario(this needs to be confirmed). The endplug must be clamshelled or at least partially clamshelled(if made in a number of pieces) to fit over the beam pipe.

7 Miscellaneous

7.1.1 Conducting particles

Conducting particles from the support tube or endplug are not allowed in the interior volume.