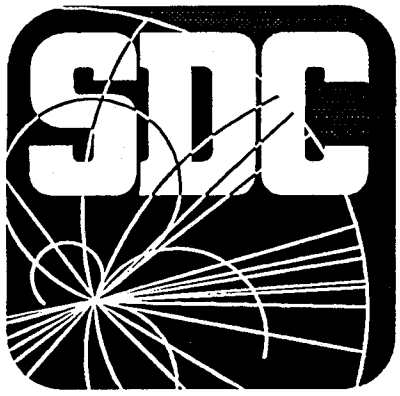
SDC-92-324



SDC
SOLENOIDAL DETECTOR NOTES

SDC ENDPLUG CALORIMETER-WBS 2.2.10
FIBER ROUTING & PMT MOUNTING

August 24, 1992

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INTRODUCTION

This note provides documentation on a brief study of fiber routing to the 320 photomultiplier tubes (PMT's) for the SDC's monolithic Endplug (plug) calorimeter.

Details are provided showing that a practical means has been devised to route the 4800 fibers from tiles within the plug's absorber structure (inside a light-tight conical skin at the plug's outer eta = 2 boundary) to light-tight PMT Mounting Boxes (box) which can be placed either at the rear of the plug (minimum fiber length case) or at the outer radius of the Endcap (maximum PMT access case), depending upon required circumstances.

The described sequence of assembly operation steps retains the Endplug's design feature of relatively simple tile/fiber replacement (with Endcap withdrawn) for those parts subject to excessive radiation damage.

DETAILED DESCRIPTION

The attached design layouts (see **Figures 1** thru **6**) utilize the same low cost PMT support/housing means (commercial PVC plastic pipe and fittings, etc.) as used in LBL's 4x4 Test Station Module (Ref. 1) along with light-tight, injection molded PVC boxes to support and access the PMT's.

Rather than attempt to light seal individual tile fibers, light-tight fiber-containing metal conduits are used for routing the 320 tower plug's fibers between the rear of the plug and the PMT boxes.

Figure 1 shows the routing of hac 1 and hac 2 clear fibers from towers within a given 1/32 delta-phi sector between pizza pans and the rear mounting flange of the plug. There are 5 towers in each delta-phi sector of hac1 and hac2 between the plug's outer (eta=2) and inner (eta=3) boundaries. Hac 1 towers contain 19 scintillator layers; hac 2, 11 layers.

The bundle of 95 ea. hac 1 fibers are routed through a single light tight conduit to 5 ea. PMT's in the box, and the 55 ea. hac 2 fibers go through another conduit to 5 other PMT's in the box.

The lateral extent of the 25 fiber (max) "mini-bundles" shown in **Figure 1** are illustrated *schematically only*--to minimize drawing clutter--we have not firmly settled on the maximum number of fibers in these bundles (which, in part determines the radial gap between active

elements in the hadronic Endcap and Endplug). It is clear from the routing pattern shown, however, that "radially thinner" fiber groups can be selected without violating a reasonable fiber bend radius criteria (say, $(R/d)_{min} \approx 30$, for example).

Figure 2 shows a cross-section through the Endcap, Plug, and Plug Support Flange (PSF), which is equipped with rectangular grooves, radially milled into the inner PSF face (between PSF studs) which are used to provide seals for the ≈1/2 inch diameter tubular metal conduits.

The conduits are inserted into closed-cell foam-rubber continuous gasketing stock which has a square outer profile and a concentric, circular inner hole (see **Figure 2**, section A-A). Pressure applied between mating flanges squeezes the gasket between the flange grooves and the conduit (which encloses the fiber bundles) to provide a reliable, light-tight seal.

With the PMT boxes adjacent the rear of the Plug Support Flange, the metal conduits are "S-shaped" and terminate in 2 circular metal conduit/box flanges which are bolted (and sealed with rubber gaskets) to the "bottom" of the box. If the boxes must be placed at the outer radius of the Endcap (say to allow PMT access for replacement without moving FW1), the metal conduits would be "L-shaped" (and longer)--but otherwise, the light-sealing and PMT support features would be the same.

The 10 PMT's per each 1/32 plug phi sector have been clustered into a compact group of 5 PMT's on each side of the box. The resulting relatively small boxes minimize space, fit between PSF mounting studs, and do not interfere with the structural clips (see **Figure 3**) between ANL's wedge-shaped hadronic Endcap modules in the Endcap support region (for the rear-of-plug mounting case).

These PMT boxes also provide the required amount of space for "slack fiber" to withdraw all hac 1 pizza pans from absorber slots. However, if the plug's hac 2 tiles require replacing for some (unforeseen) reason, these are best removed by first removing the hac 2 cookies from their PMT's, followed by pulling the fiber conduits from the PSF grooves, and finally by withdrawing the cookies through holes in the "bottom" of the box.

Figures 4 & 5 provide other views of the 1/4 inch thick injection molded boxes, which have been configured to accept all 5 PMT's for hac 1 fibers at one side, with the 5 PMT's for hac 2 fibers at the opposite side. The hac 2 fiber bundles are attached to PMT's in the box first (followed by hac 1 bundles), retaining the "last in = first out" assembly sequence for ease of plug tile replacement. These plug assembly operations are described in the next section, which will clarify the forgoing statements.

PLUG ASSEMBLY

This section describes re-assembly of pizza pans, fibers and PMT's into the plug's absorber structure at the SSCL above ground Assembly Building. These operations assume the plug's ≈ 100 tonne absorber structure has been mounted on the Plug Installation Fixture (PIF) adjacent the rear of the Endcap (as described by Pope at the SSCL Surface Assembly Operations meeting held at ANL on July 23, 1992--see Ref. 2), with the Plug Support Flange (PSF) bolted to the plug at the Plug Adaptor Ring (see **Figures 2 & 6**),

1) Remove the 11 pizza pans (and fibers, conduit and cookie) for a given hac 2 plug phi sector from their shipping crate and install the pizza pans into the 11 appropriate hac 2 absorber structure slots. Secure pizza pans with screws provided,

2) Press the hac 2 fiber conduit into the radial groove in the front face of the PSF, orienting the conduit's (round) box flange to the rear of the PSF,

3) Tape the pizza pans' clear fibers to the outer face of the plug absorber structure (see **Figure 1**), with fiber slack accumulation "outside" the conduit/box flange,

4) Repeat steps 1, 2 & 3 for the 19 each hac 1 pizza pans of this phi sector,

5) Repeat steps 1-4 for the remaining 31 plug phi sectors,

6) Install one of the 32 conical sector cover skins over the plug's fibers,

7) Secure the thin front flange of the cone sector over the thin flat gasket at the outer edge of the hac 1 front plate with screws provided,

8) Secure the rear cone flange (with attached thin gasket strip) to the front face of the PSF (over the 2 fiber conduit gaskets),

9) Repeat steps 6 to 8 for the remaining 31 conical sectors.

10) Close all axial seams between cover skin sectors w/suitable black duct tape to affect light tight seals.

At this stage, the plug is installed into the Endcap (undergoing appropriate Plug Support Stud torquing, load transfer operations, and PIF removal), as previously described by Pope and Hoff (Ref. 2).

11) Attach a PMT mounting box (for a given plug phi sector) to the back of the PSF w/4 screws provided,

12) Attach the conduit/box flange to the box (2 plcs for hac 1 & 2),

13) Attach an innermost hac 2 PMT assembly and it's flange gasket to the box and secure w/screws,

14) Attach the appropriate fiber cookie to the light mixer of the forgoing hac 2 PMT, and secure w/retaining ring provided,

15) Repeat steps 11 thru 14 for the remaining 4 hac 2 PMT's of this box, working outward toward the box's cover plate,

16) Repeat steps 11 thru 15 for the remaining 5 hac 1 PMT's of this box,

17) Attach the box's light tight cover plate and gasket.

18) Repeat steps 11 thru 17 for the remaining 31 plug PMT boxes.

19) Connect the plug's PMT power cables and perform tests to verify light tight plug conditions.

CONCLUSIONS

We have provided a detailed description of fiber routing and PMT mounting which can be used on the SDC's Endplug calorimeter.

We feel that the only inconvenience introduced by the fiber sealing conduit is the fact that assemblies of pizza pans, fibers, and PMT cookies must also have the rubber-sealed conduits installed over the fiber bundles when the cookies are bonded to their fibers. This attached fiber conduit becomes a minor nuisance during pizza pan boxing for shipping to the SSCL site, but provides a useful function thereafter.

REFERENCES

Ref. 1 something on the 4x4--what have you guys got?

Ref. 2 W.L. Pope & Matt Hoff, "SDC Hadronic Endplug, SSCL Surface Assembly Operations", SSCL Note (***TBD***), 7/20/92, Lawrence Berkeley Laboratory.

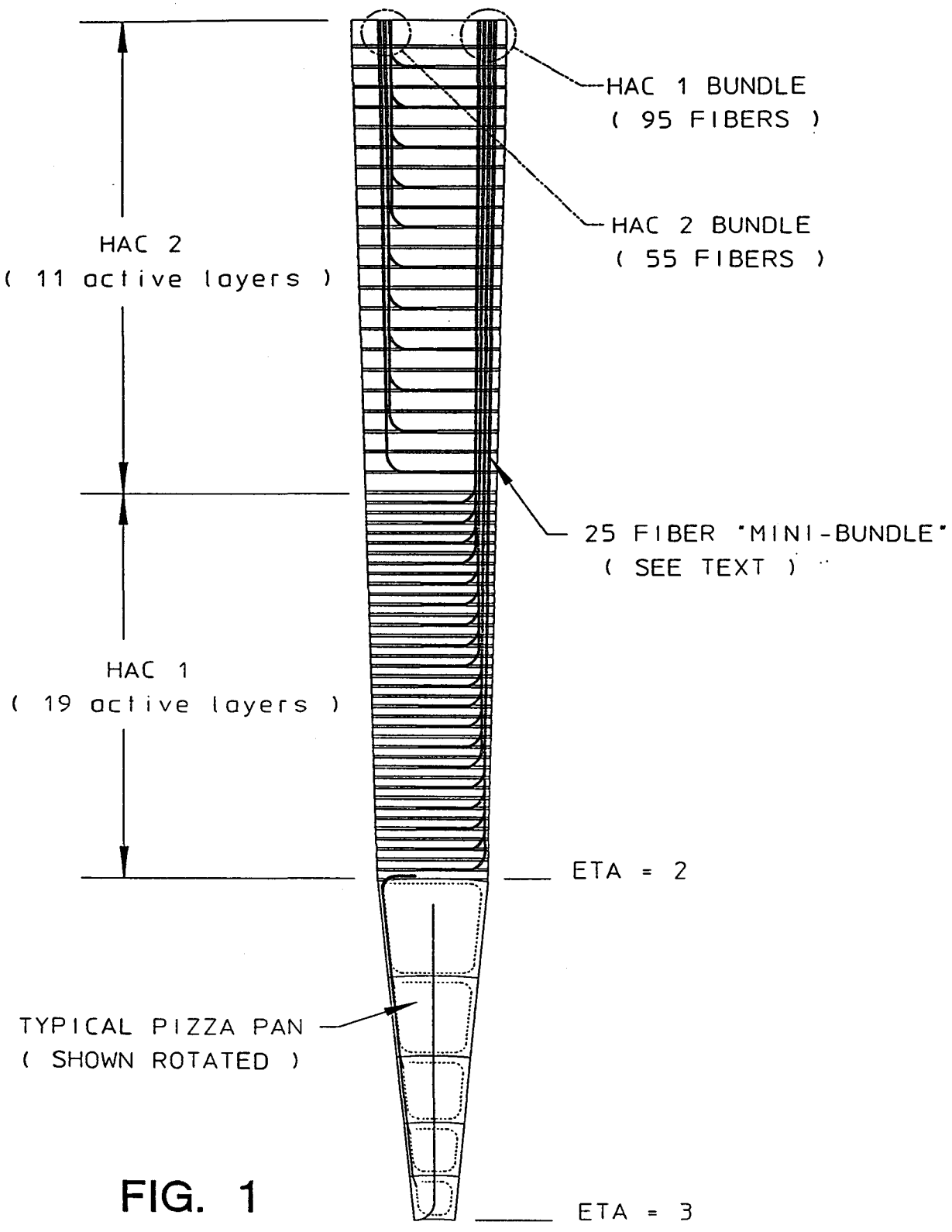
HAC 1 BUNDLE
(95 FIBERS)
HAC 2 BUNDLE
(55 FIBERS)
HAC 2
(11 active layers)
25 FIBER "MINI-BUNDLE"
(SEE TEXT)
HAC 1
(19 active layers)
ETA = 2
TYPICAL PIZZA PAN
(SHOWN ROTATED)
ETA = 3

FIG. 1

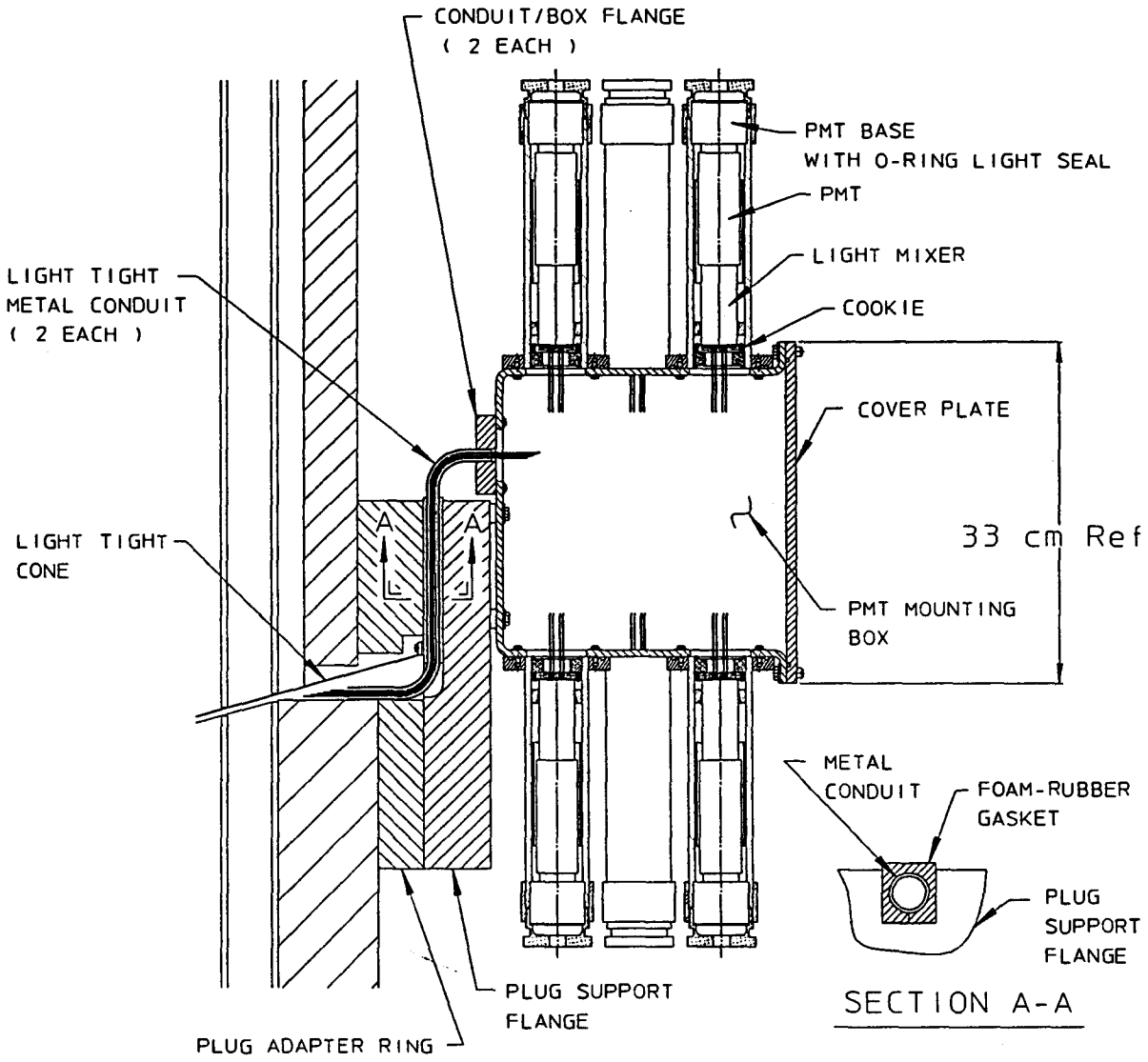
CONDUIT/BOX FLANGE
(2 EACH)
PMT BASE
WITH O-RING LIGHT SEAL
PMT
LIGHT MIXER
COOKIE
LIGHT TIGHT
METAL CONDUIT
(2 EACH)
COVER PLATE
33 cm Ref
LIGHT TIGHT
CONE
A
A
PMT MOUNTING
BOX
METAL
CONDUIT
FOAM-RUBBER
GASKET
PLUG
SUPPORT
FLANGE
PLUG SUPPORT
FLANGE
PLUG ADAPTER RING
SECTION A-A

FIG. 2

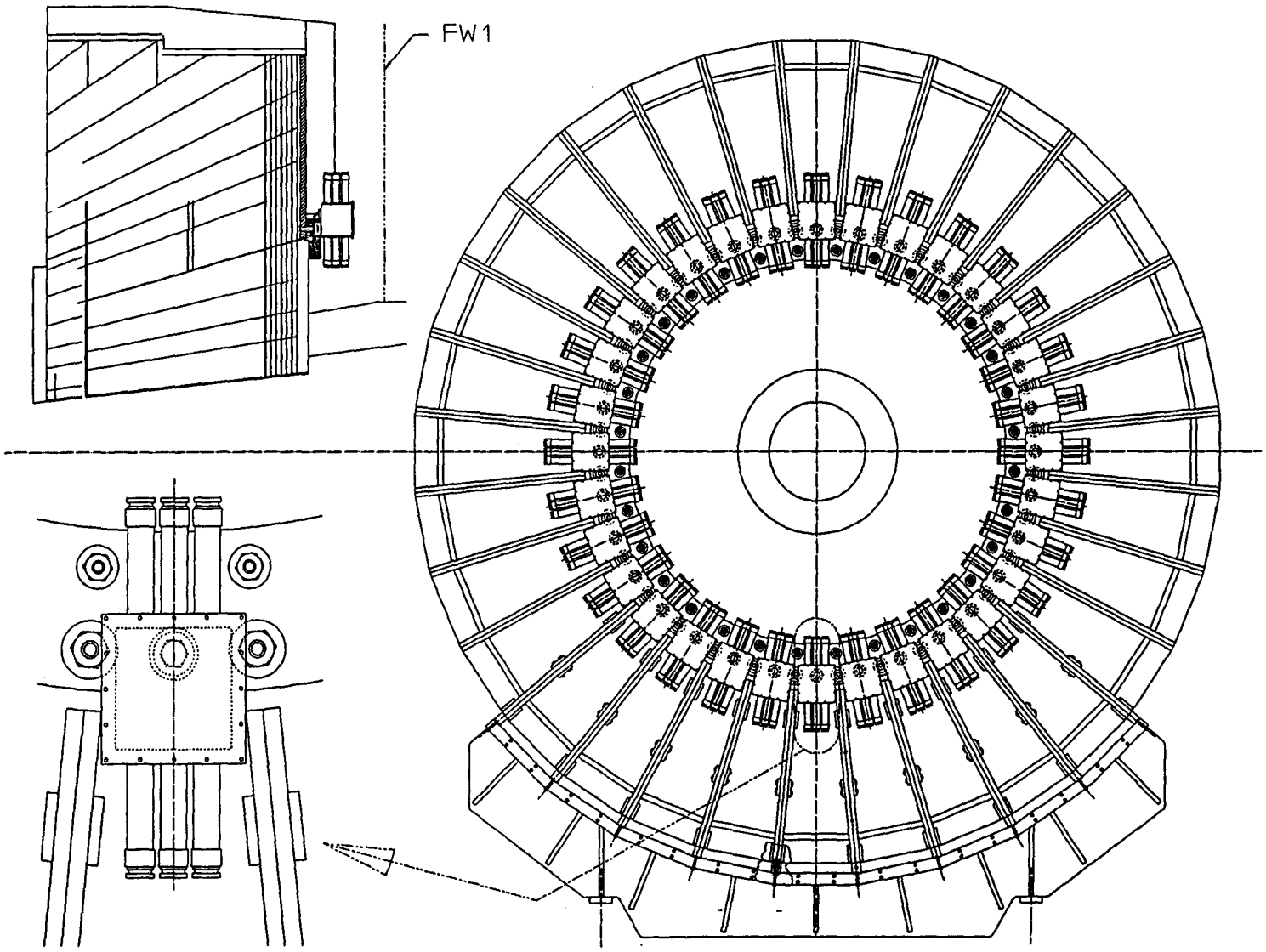

FIG. 3

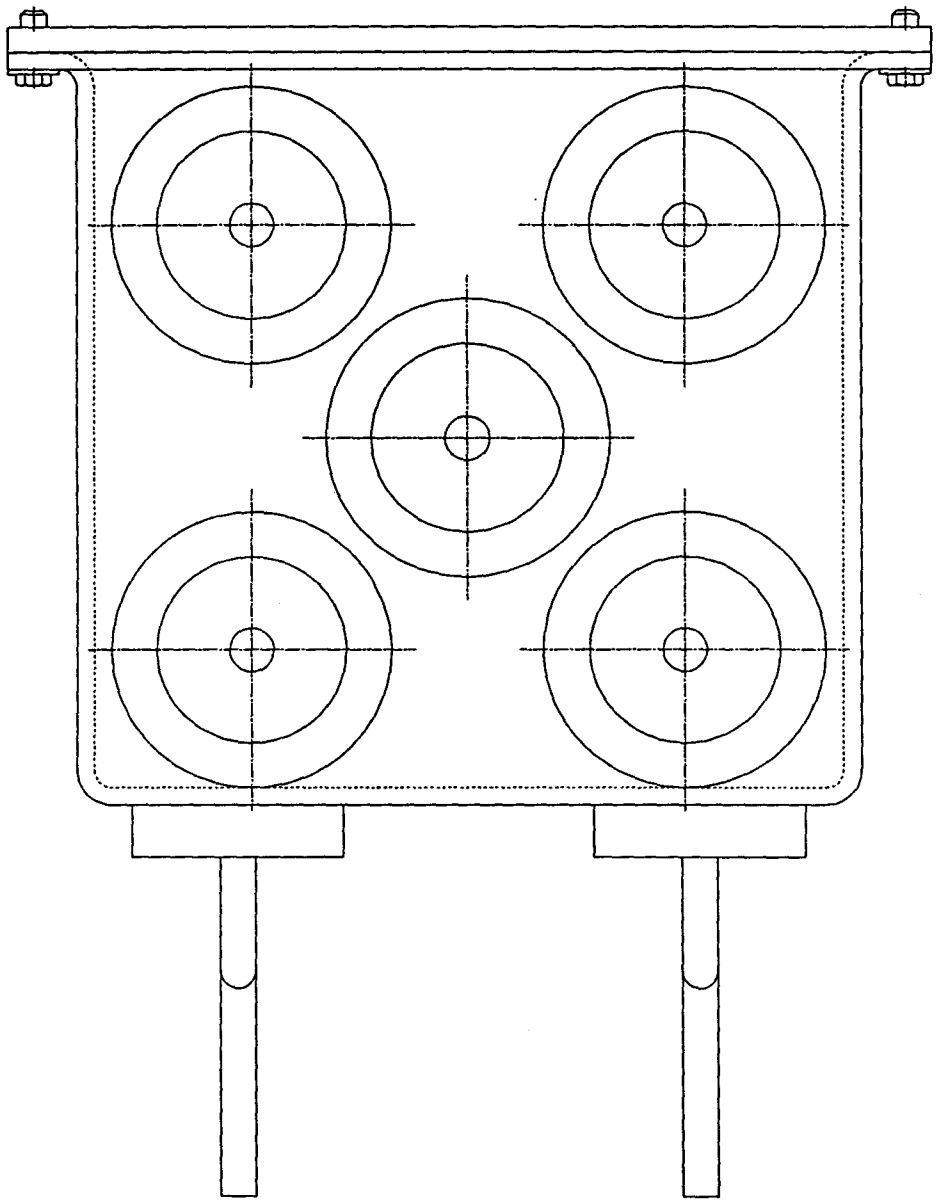

FIG. 4

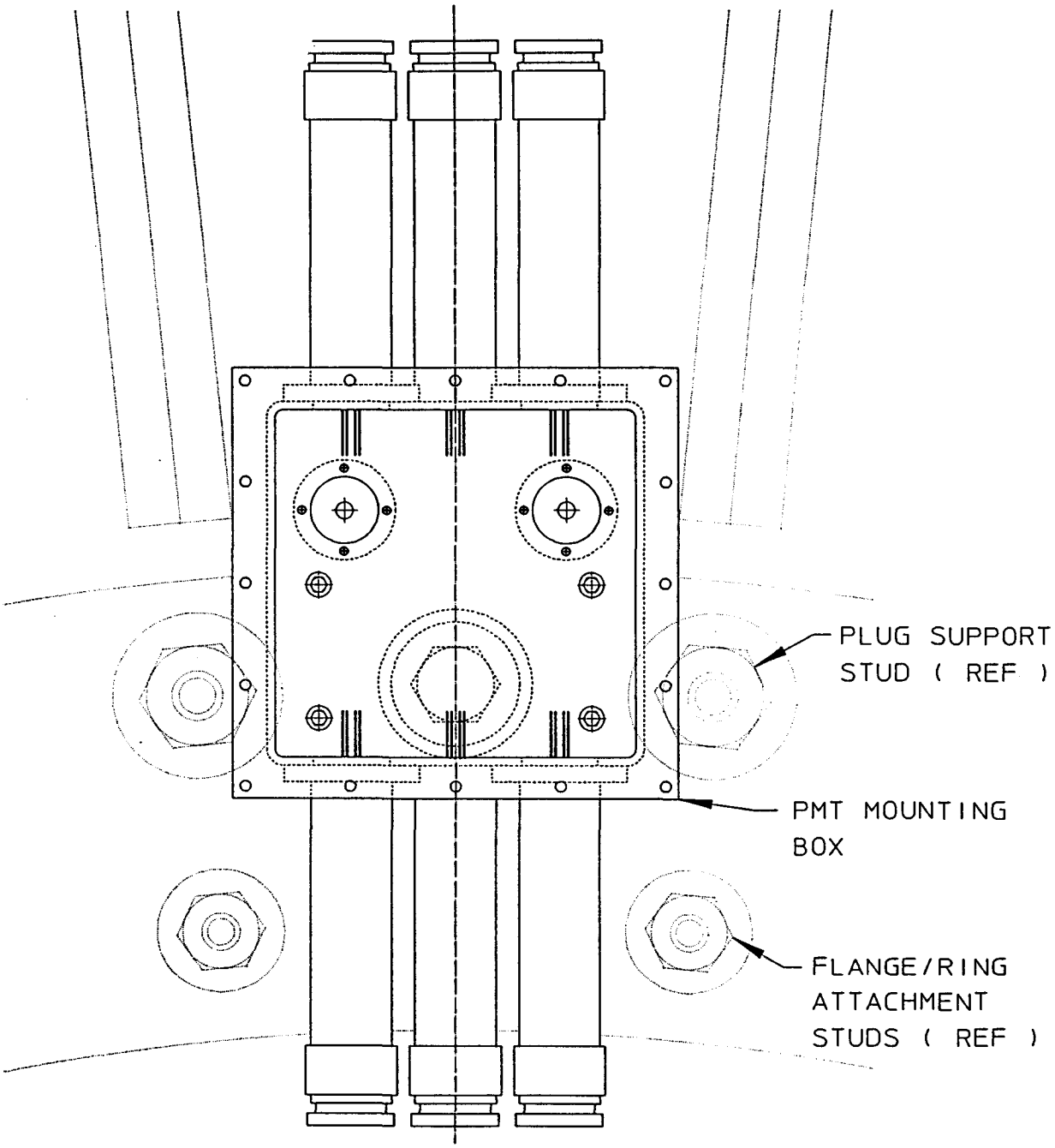
PLUG SUPPORT
STUD (REF)
PMT MOUNTING
BOX
FLANGE/RING
ATTACHMENT
STUDS (REF)

FIG. 5

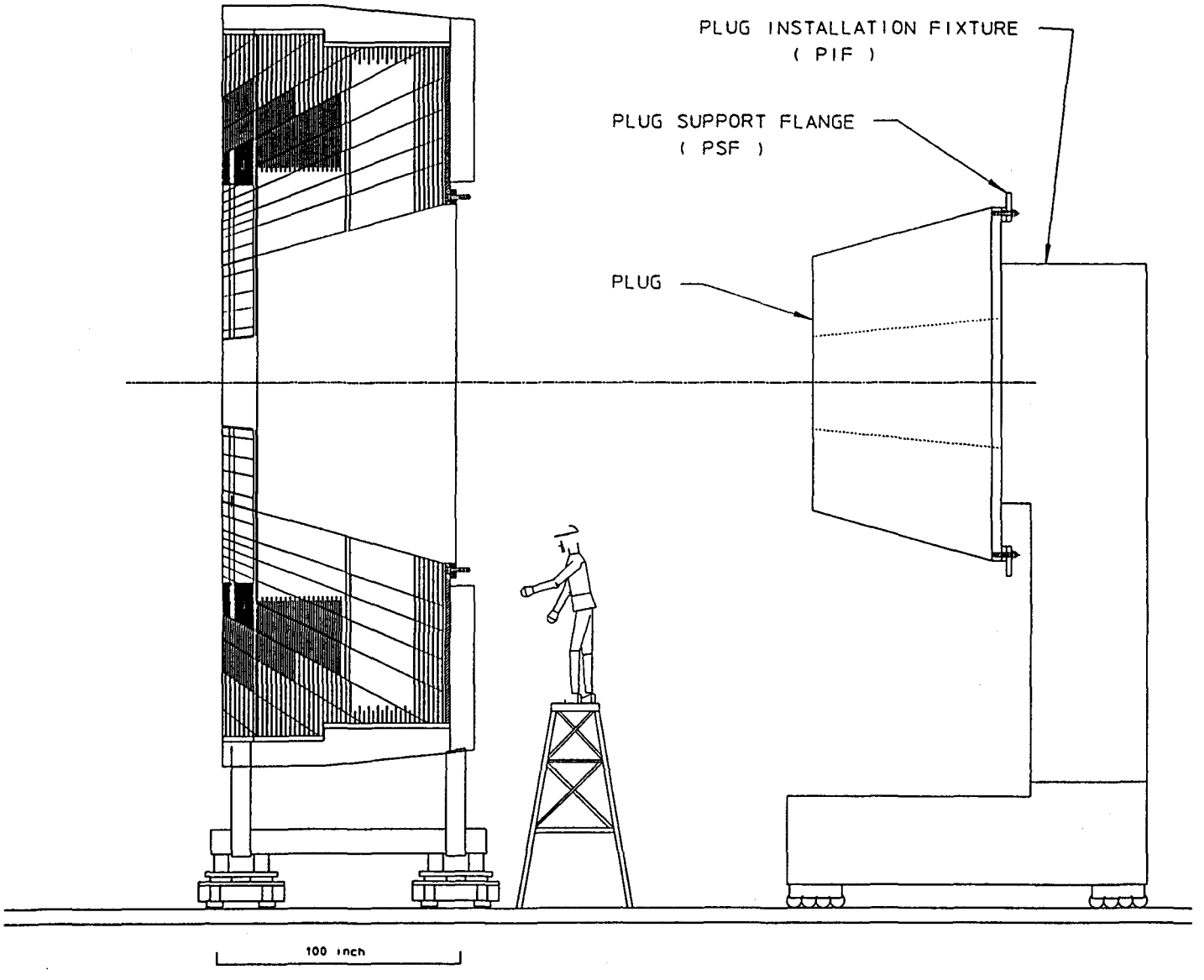
PLUG INSTALLATION FIXTURE
(PIF)
PLUG SUPPORT FLANGE
(PSF)
PLUG
100 inch

FIG. 6