SUBJECT: **SPIRE cover and shutter aperture dimensions**

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KEYWORDS: **apertures, cover, shutter**

COMMENTS: **This document presents data on the dimensional requirements of the apertures required in both the SPIRE instrument cover and the proposed shutter assembly located on top of the cover.**

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1. INTRODUCTION

This note summarises the data needed in order to size and design apertures in the SPIRE cover and in the shutter assembly so that their edges will clear the beams that define the active views out of the FIRST focal plane instruments. Note that all dimensions shown here are assumed to be the 'COLD' values i.e. as they should be with the instrument cooled to its operating temperature.

Two IGES-formatted files have been produced that model rectangular apertures in 12-mm thick rectangular plates meeting at the outer surface of the SPIRE cover. They are intended as an aid to the CAD modelling, and to show the clearances required between the optical beams and each aperture's edges. An IGES file showing a 3-D representation of the optical beams that must be kept clear of aperture boundaries accompanies these aperture files, as does a file showing some of the structural surfaces included in the straylight model. All four files are available on the SPIRE anonymous FTP site (see section 5).

2. OPTICAL BEAM GEOMETRY

Figure 2-1 shows the combined envelope of the optical beams that define the instruments' combined views through the focal plane aperture plate and out towards the telescope. The envelope is shown together with wireframe representations of surfaces such as the focal plane plate and some other SPIRE box surfaces that are being included in the instrument straylight model. Other surfaces have been omitted for clarity.

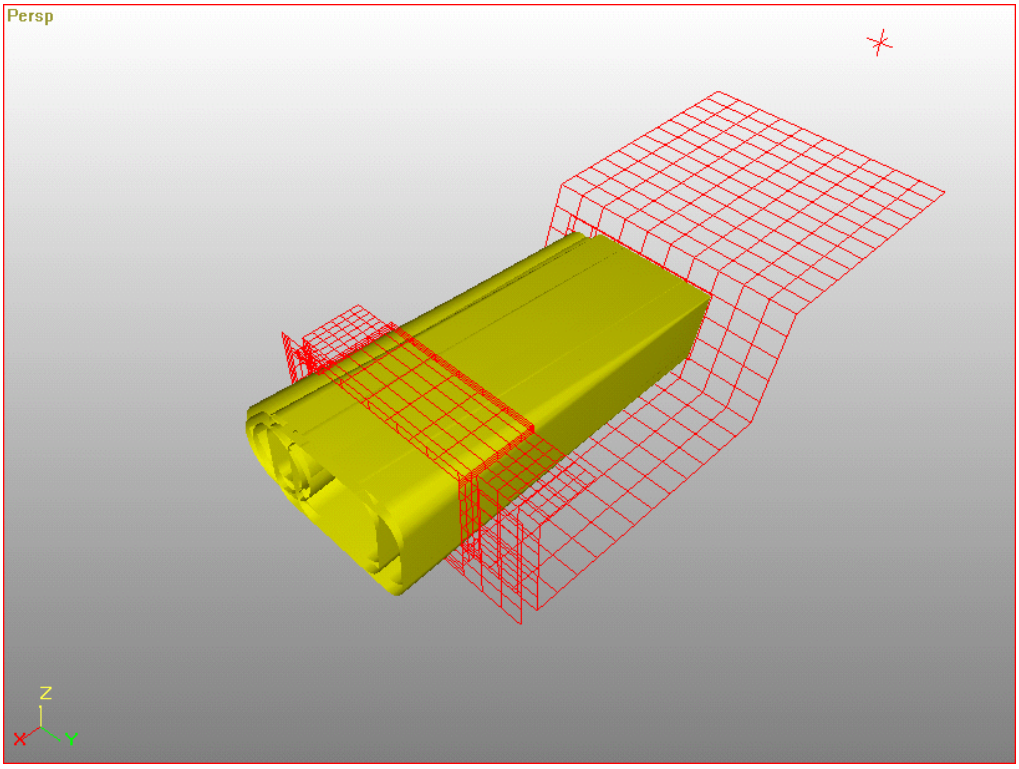

Figure 2-1 Combined beam envelopes and SPIRE structure surfaces

The beam envelope is a composite of four beams from each of the two instruments, each beam representing the instantaneous view of an instrument as the beam steering mirror is tilted to the four combinations of both extremes in the chop and the 'jiggle' directions. The way that the focal plane plate is sized so as to pass these extreme views is fully described in SPIRE-RAL-NOT-000581. Note that **no oversizing** of the beam envelopes is applied in this case.

The format of the combined beam envelope is shown more clearly in figure 2-2, where it is shown surrounded by a rectangular aperture boundary (the apparent lack of clearance at the bottom is an effect of perspective due to the beam envelopes extending beyond the plane of the aperture).

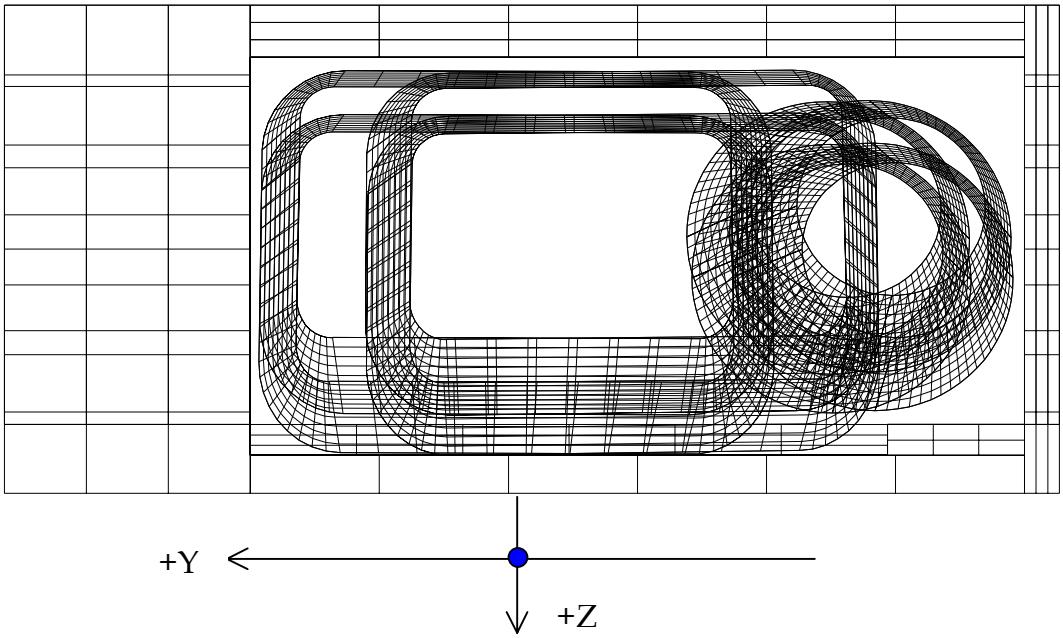

Figure 2-2 Combined beams surrounded by a rectangular aperture.

3. CO-ORDINATE SYSTEM AND DIMENSIONS

The directions of the X-, Y- and Z-axes in the ESA co-ordinate system are indicated in the bottom left-hand corner of figure 2-1. The origin of co-ordinates is indicated by a small axis-triple near the top right-hand corner figure 2-1. The axes' directions are also shown superimposed on figure 2-2. The view in figure 2-2 is obtained by looking IN through the aperture in the -X direction.

In the aperture figures that follow, all dimensions are shown in millimetres. A signed dimension indicates a distance measured parallel to one of the three co-ordinate axes and at 90 degrees to one of the three reference planes that cross at the co-ordinate origin.

All dimensions shown are assumed to be the 'COLD' values i.e. as they should be with the instrument cooled to its operating temperature.

4. APERTURE LOCATIONS AND DIMENSIONS

4.1 SPIRE cover aperture

The SPIRE cover is stated to be 12 mm thick with its outermost surface being located in the X=+445.52 plane[1]. Thus the inner surface will be at X=+433.52. The cross-section through the composite beam envelope was analysed in this plane and an aperture with the dimensions shown in rectangular text boxes in figure 4-1 will clear the nearest points on the envelope by 3 mm.

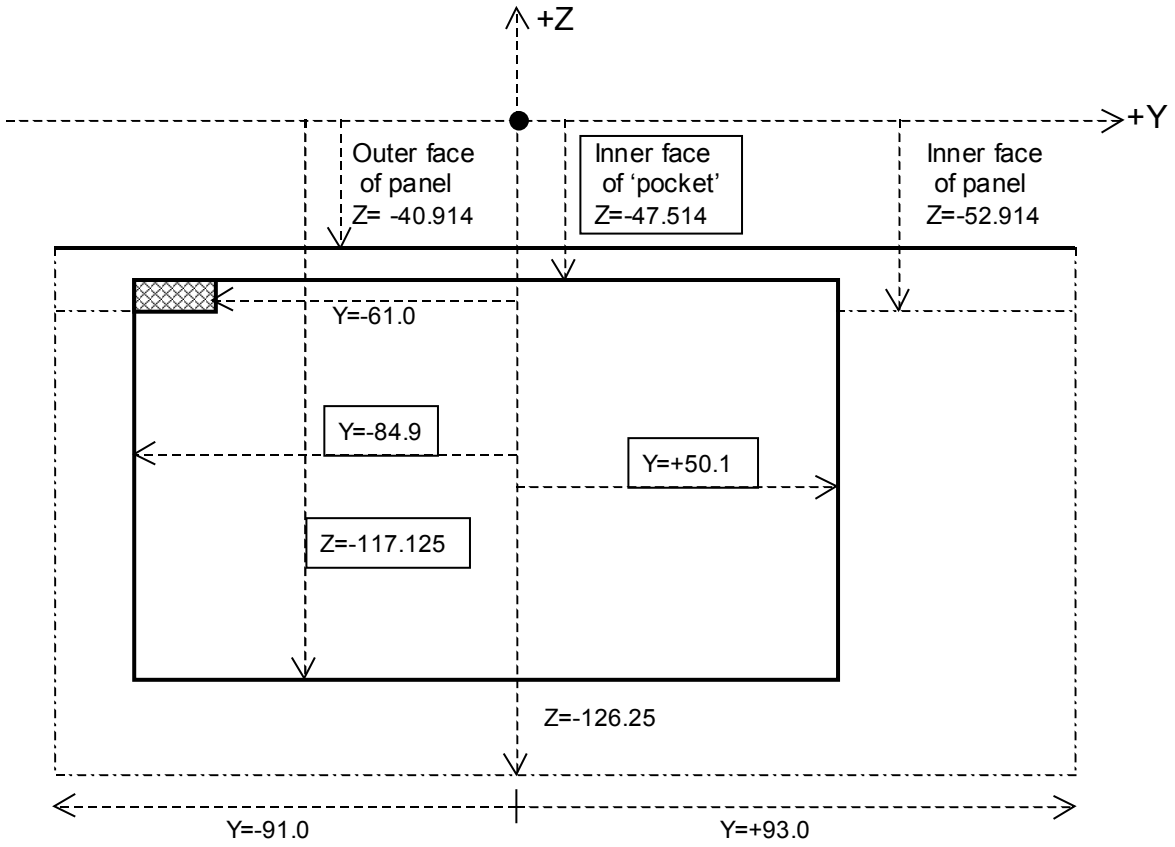

Figure 4-1 Aperture dimensions at X=+445.52

In figure 4-1, the three edges of the outer rectangle shown as dashed lines represent internal cover and optical bench surfaces. The solid line at Z = -40.914 represents the exposed edge of the outer face of the panel nearest to the telescope axis where it meets the X=445.52 plane. This panel is 12 mm thick, so a small pocket has to be machined in it in

[1] E-mail from John Coker, MSSL, 02-05-2001

order to accommodate the aperture boundary on that side. The length of the pocket in the –Y direction need not extend the full width of the aperture and it is shown terminating at Y=-61.0 in the figure. This would leave a small rectangular area of the side panel visible in one corner as shown. The depth of the pocket into the panel is 5.4 mm. The pocket needs to extend down to X=445.52-64 i.e. 64 mm below the level of the top of the panel. The pocket depth could taper linearly from 5.4 mm to zero at this level and still achieve the required 3-mm clearance from the beam envelope.

The dimensions shown in figure 4-1 apply also to the aperture required in the inner face of the cover located 12-mm back along the X-axis.

An IGES model of a 12 mm thick parallel-sided plate containing a rectangular aperture with the dimensions shown in figure 4-1 and having the outer dimensions shown was constructed. This is shown in figure 4-2 added to the structures shown in figure 2-1. The aperture was given 2-mm radius corners. Figure 2-2 shows that larger radius corners can be tolerated if desired.

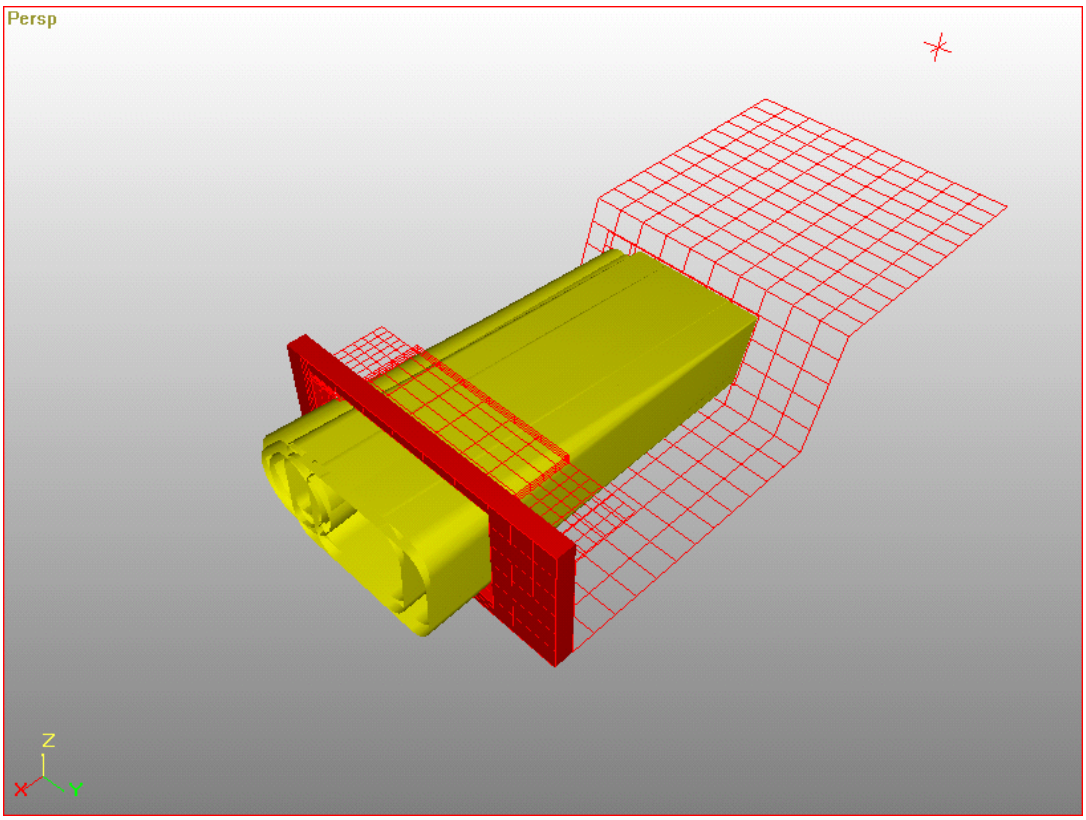

Figure 4-2 Cover aperture added to beam envelopes and structure surfaces

4.2 Shutter aperture

The shutter interface plane was taken to be the outer face of the SPIRE cover at X=+445.52. A nominal thickness of 12 mm was assumed for the shutter extent along +X from this plane, in the region of the beam boundaries. The beam envelope extents in the

X=445.52+12 mm plane were determined as before and another aperture rectangle determined. The dimensions required for this aperture are shown in figure 4-3 in rectangular boxes, as before. All four dimensions show small changes from the dimensions of the aperture in a plane 12-mm lower, and these are summarised in table 4-1. The biggest change is 0.9 mm in the location of the edge nearest the telescope axis (the 'pocket' side). The tabulated data can be used to determine aperture edge locations for any plane within a reasonably small distance from the one used here, if the shutter assembly requires greater depth along the +X direction than that assumed here.

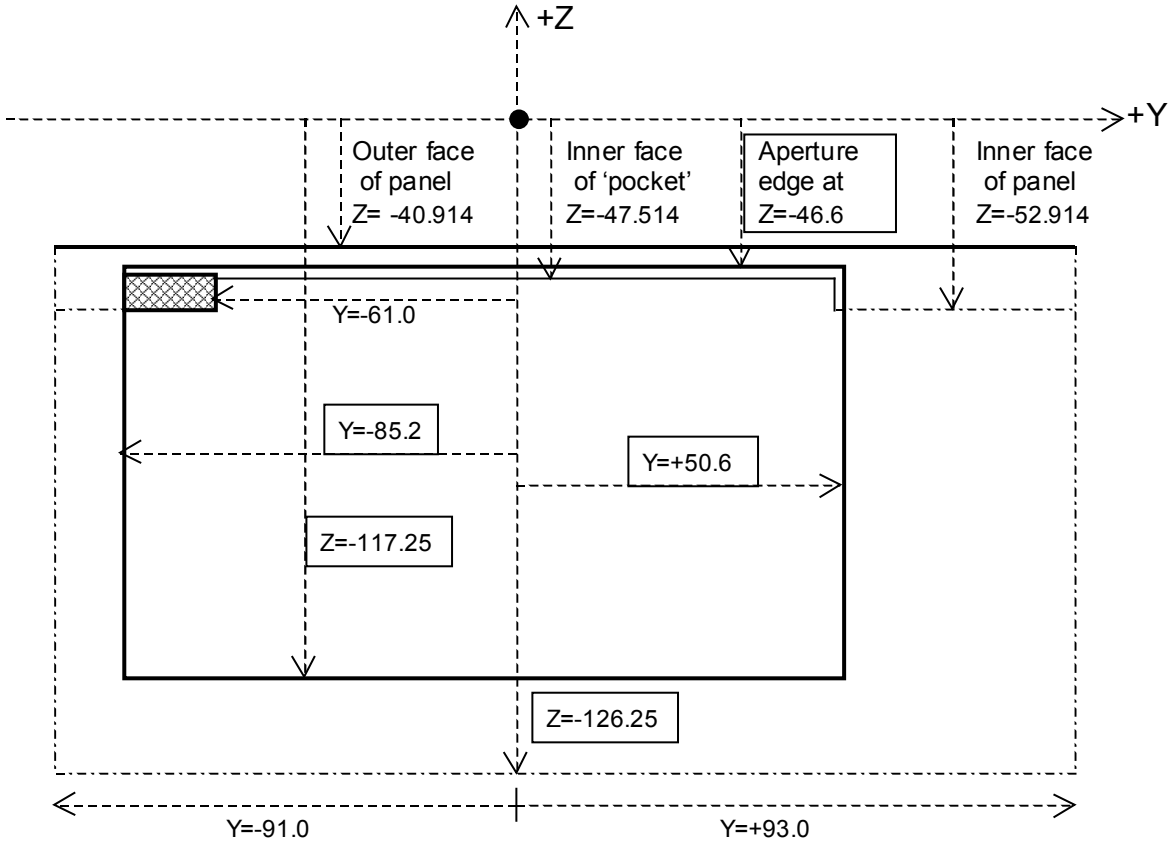

Figure 4-3 Aperture dimensions at X=+445.52+12

		locations of aperture edge sin ESA co-ordinates in MM			
aperture level with	aperture plane X location	MAX Z	MIN Z	MIN Y	MAX Y
SPIRE Cover top	+445.52	-47.51	-117.125	-84.9	+50.1
Shutter plate top	457.52	-46.6	-117.25	-85.2	+50.6
Change in value	+12.0	+0.9	-0.125	-0.3	+0.5

Table 4-1 Aperture dimensions and dimension changes for the two aperture planes

An IGES model of a 12 mm thick parallel-sided plate containing a rectangular aperture with the dimensions shown in figure 4-3 and having the outer dimensions indicated was constructed. The aperture was given 2-mm radius corners. Figure 2-2 shows that larger radius corners can be tolerated if desired. The plate is illustrated in figure 4-4 added to the structures shown in figure 4-2.

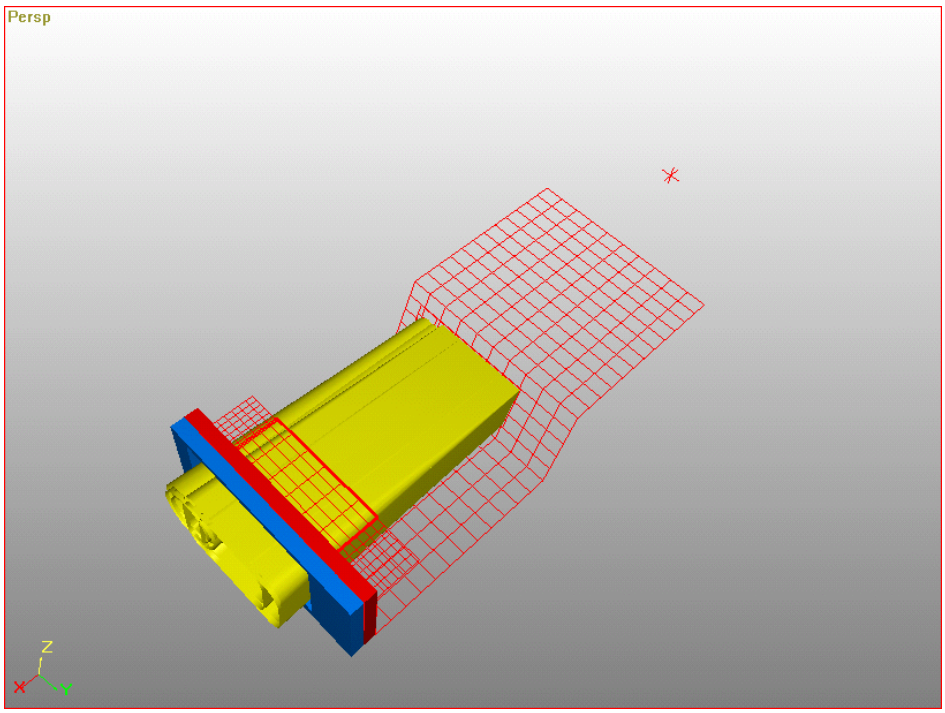

Figure 4-4 Shutter plate added to beam envelopes and structure surfaces

5. FILE RETRIEVAL

The IGES files are available via anonymous FTP from JACKAL.BNSC.RL.AC.UK. When logging-on use 'anonymous' as the username and the files can be found in the sub-folders (see figure 5-1)

…/pub/spire/APERTURES/IGES

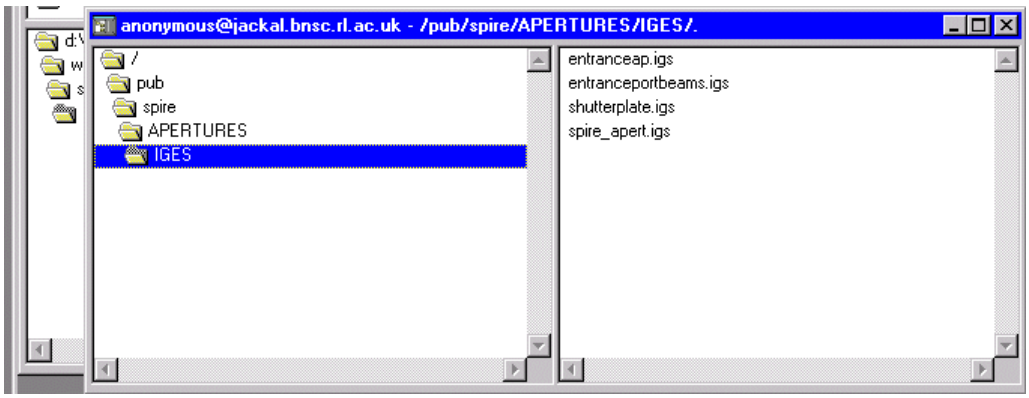

Figure 5-1 Where to find the IGES data at the 'JACKAL' anonymous FTP site

6. REQUESTS FOR FURTHER DATA

If for any reason the text data files referred to above cannot be obtained, please e-mail me at A.G.Richards@RL.AC.UK and I will endeavour to satisfy your requirements.