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Recommendations for Flat and Anti-Cocking Waveguide Flanges

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ABSTRACT: As discussed in ALMA Memo 278 [1], flat and anti-cocking[1] waveguide flanges are preferred over the common Mil-F-3922/67B (UG-387 and -383) type of flange with its central boss. While flat and anti-cocking flanges are in many ways similar to the /67B flange, there are important differences in drilling, counterboring, and pin insertion details if these flanges are to be compatible with the /67B standard.

Introduction

With the standard /67B flange, the outer rim overhangs the raised central boss, making it difficult to ensure that a pair of flanges is mated without cocking. This shortcoming is eliminated in flat and anti-cocking flanges. However, if these are drilled, tapped, and counterbored according to the /67B procedure, it will not be possible to engage a pair of flanges fully with the captive screws inserted. Furthermore, the captive alignment pins may protrude further above the flange face than in the /67B flange; when connected to a mating flange, the pins may bottom in clearance holes drilled deep enough to receive a standard /67B flange.

Flange Screw Considerations

Fig. 1 shows the conventional /67B flange, and mated pairs of flanges with the captive screws retracted and fully inserted. In the retracted position, the 0.110" threaded length of the screw is entirely accommodated within the lengths of the 0.030" boss and the 0.030" counterbore of each flange. This enables the flanges to be engaged fully while the screws are in the flanges and, more important, allows the screws to be fully retracted from a mated pair of flanges without the possibility of cross threading. Fig. 2 shows the flat flange, both waveguide mounted and incorporated into a waveguide block. A mated pair of flanges is also shown, and a flat flange mated with a flat faced waveguide block; the screws are shown engaged and retracted. It is evident that, in the absence of the raised central boss, the counterbore must be 0.060" deep in order to clear the thread of the screws when the flanges are engaged.

Alignment Pin Considerations

Referring again to the standard /67B flange in Fig. 1, the alignment pins protrude approximately 0.156" above the face of the flange. The maximum overall pin length for the /67B flange is this dimension plus 0.030" for the central boss and 0.130" for the main body of the flange — a total of 0.316". This is consistent with the 0.312" length of the standard pin. When standard /67B flanges are engaged, the alignment pins do not protrude through the backs of the flanges, and this is desirable with flat or anti-cocking flanges, too. It follows that for flat or anti-cocking flanges using standard pins to be fully

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[1] The only difference between the *flat* flange and the so-called *anti-cocking* flange is a relieved annulus on the face of the latter — see [1]. They have similar anti-cocking characteristics.

compatible with one another and with flanges or waveguide blocks designed to mate with a standard /67B flange, the flat or anti-cocking flange must be at least 0.160" thick.

Alignment pins are often inserted with a tool which bottoms on the flange surface to give the specified 0.156" pin protrusion relative to the face of a /67B flange. This same tool should not be used on flat or anti-cocking flanges as the pin height relative to the waveguide interface would be 0.186" and the pins could bottom in the clearance holes of a mating /67B-compatible component.

In waveguide blocks, pin holes are often kept as shallow as possible to avoid breaking through to internal cavities. If the hole cannot receive the full 0.156" of a standard pin, then a shorter pin may be considered, but this modification could limit the future usefulness of the component.

The /67B standard pin clearance hole is 0.0670" in diameter, considerably larger than the 0.0615" pin. It is shown in [1] that in the WR-10 band, a pair of /67B flanges with the maximum possible misalignment can have $|S_{11}|^2$ as high as -23 dB. By using 0.0635" clearance holes, this is improved substantially ($|S_{11}|^2 < -35$ dB). The smaller 0.0635" pin clearance hole was adopted by NRAO and NASA for /67B flanges on the MAP spacecraft.

Recommendations

To ensure that flat or anti-cocking flanges are fully compatible with one another and with the standard /67B flange, we make the following recommendations:

(i) The flange thickness should be at least 0.160".

(ii) Screw hole counterbores and alignment pin extensions should be as indicated in Fig. 2.

(iii) Alignment pin clearance holes should be 0.0635" diameter (smaller than the 0.067" specified by the /67B standard) to reduce the maximum possible misalignment of a mated pair of flanges.

(iv) Standard 67/B captive screws and alignment pins should be used.

(v) All other details should be in accordance with the current /67B standard.

Reference

[1] A.R. Kerr, E. Wollack, and N. Horner, "Waveguide Flanges for ALMA Instrumentation," ALMA Memorandum 278, 9 Nov. 1999. See http://www.mma.nrao.edu/memos.

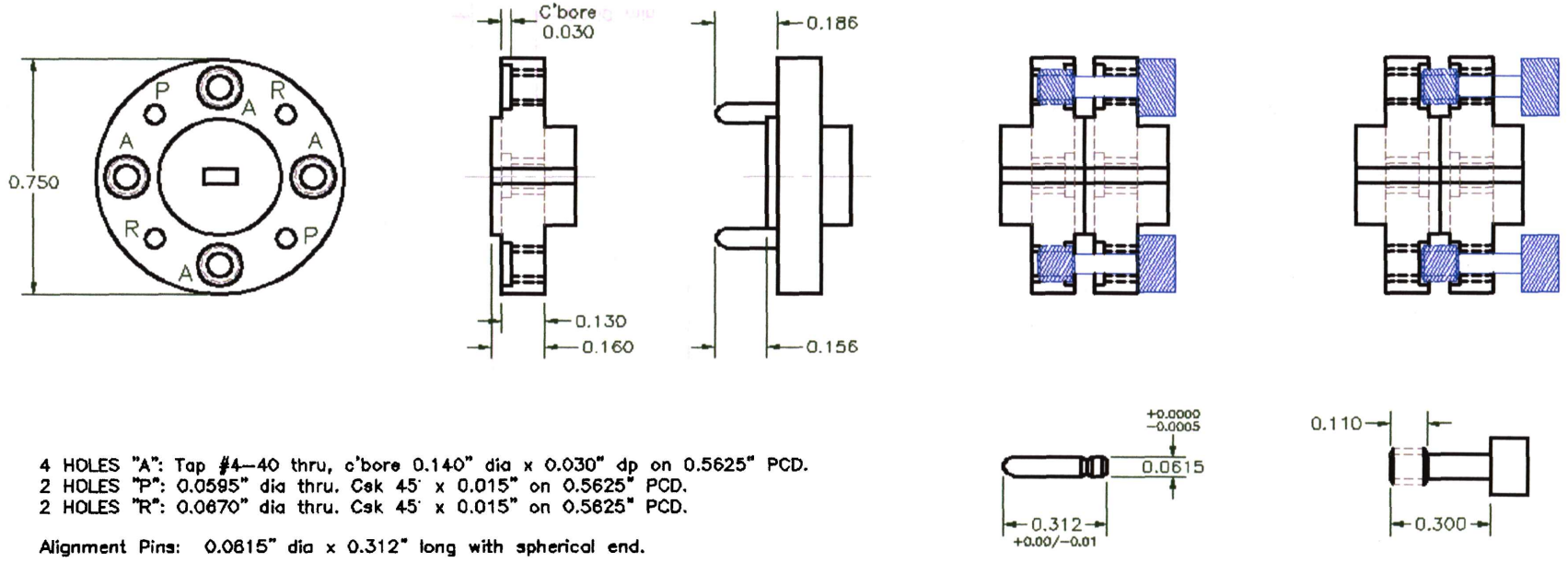

Fig. 1 The standard Mil-F-3922/67B flange with its raised central boss. The right hand diagrams show a pair of flanges engaged with the screws inserted and withdrawn.

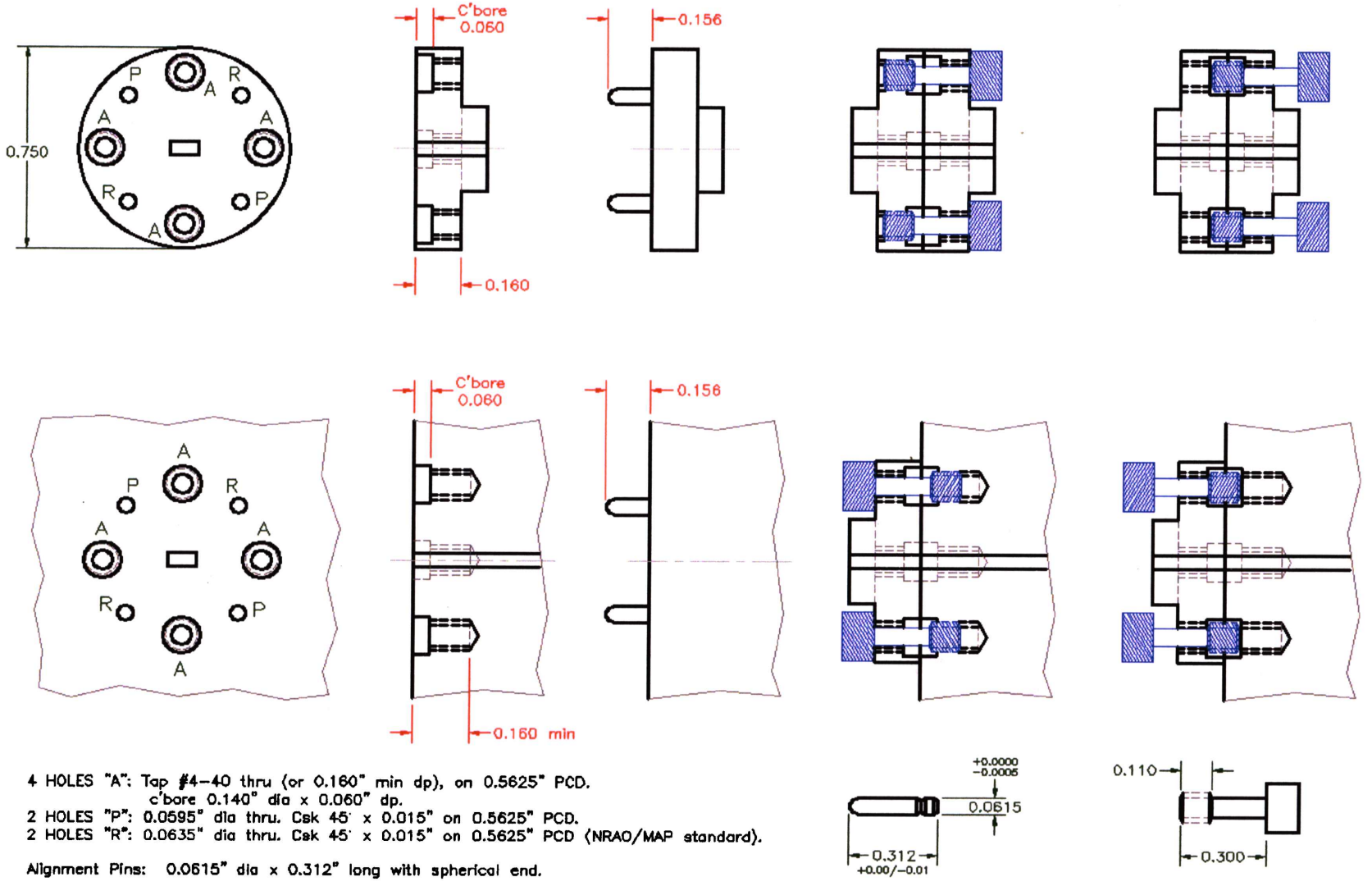

Fig. 2 **Upper**: Flat flange (dimensions also apply to the anti-cocking type of flange). The upper right diagrams show a pair of flanges engaged with the screws inserted and withdrawn. **Lower**: Details of a waveguide block compatible with both the standard /67B flange and the flat or anti-cocking flange types. The lower right diagrams show such a block and a waveguide flange engaged with the screws inserted and withdrawn. In both upper and lower diagrams important differences from the standard /67B flange dimensions are indicated in red.