



Fermilab

**Particle Physics Division
Mechanical Department Engineering Note**

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Project Internal Reference:

Project: *DES*

Title: *DES Imager Vessel Blank Cover Analysis*

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Key Words: *DES imager vessel*

Abstract Summary:

The thickness of a temporary, solid cover for the DES Imager vessel discussed in MD-ENG-179 is verified herein. The use of 0.75" 304 stainless steel is acceptable.

Applicable

Codes: *ASME Boiler and Pressure Vessel Code Section VIII*

1.0 INTRODUCTION

The DES imager is a vacuum vessel with a section of internal tubing that contains LN2, and engineering note MD-ENG-179 (DES project docdb 2841) documents the analysis of the vessel shell and back cover.

During functional testing of the camera, it is desirable to operate it with a temporary front cover that is completely solid (i.e.; without an optical window). A 304 stainless steel solid cover has been designed (drawing 4900.124-MD-480132), and the acceptability of its 0.75" thickness is verified as shown below.

2.0 CONSIDERATION OF INTERNAL & EXTERNAL PRESSURIZATION

The sections below document the various elements of the design. The maximum allowable stress for SS 304L is 16.7 ksi per ASME 2004 II-D Table 1A between -20 and +100 °F (-29 to +38 °C).

UG-34 (Unstayed Flat Heads) for External Pressurization

Calculating required end cover thickness when the bolts do not cause an edge moment

$$t = d (CP / SE)^{0.5}$$

(Formula is conservative for bolted end covers because it does not include the additional edge moment loading from the bolts)

d = 23.375 inches, conservatively selected as the o-ring diameter

S = 16,700 psi

E = 1.0, joint efficiency

C = 0.25 attachment factor for bolted flanges

P = 15 psi

$$\begin{aligned} t &= 23.375'' * [(0.25 * 15) / (16700 * 1.0)]^{0.5} \\ &= 0.350 \text{ inches, which is } \ll \text{ the } 0.75'' \text{ cover thickness} \end{aligned}$$

UG-34 (Unstayed Flat Heads) for Internal Pressurization

Calculating required end cover thickness when the bolts do not cause an edge moment

$$t = d (CP / SE)^{0.5}$$

(Formula is conservative for bolted end covers because it does not include the additional edge moment loading from the bolts)

d = 27.00 inches, bolt circle diameter

S = 16,700 psi

E = 1.0, joint efficiency

C = 0.25 attachment factor for bolted flanges

P = 15 psi

$$\begin{aligned} t &= 27.00'' * [(0.25 * 15) / (16700 * 1.0)]^{0.5} \\ &= 0.405 \text{ inches, which is } \ll \text{ the } 0.75'' \text{ cover thickness} \end{aligned}$$

3.0 CONCLUSION

The 0.75" cover thickness is acceptable for these conditions.