Muon Cryosystem Design Note 24

SUBSYSTEM: [X] CCM [ ] CVM [ ] Cryoplant

TITLE: Design Calculations for the New CCM Chimney Top Hat Cover Plate

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OBJECTIVE

To show that the new top hat cover plate meets all the requirements of the ASME Pressure Vessel Code, Section VIII, Division 1, for an allowable working pressure of 24 psid.

CALCULATIONS

Finding thickness of the bolted cover plate with no openings per UG-34(c)2.

$$t_R = d\sqrt{(CP/SE) + \frac{1.9\ W\ h_G}{S\ E\ d^3}}$$

$C = 0.3$ - Fig. UG-34(j)

$P = 24$ psi

$S = (18.8 \times 10^3)(0.8) = 15{,}040$ psi - per Fermi Safety Manual, Art. SD36

$E = 1$

$d = 16.137$ in

$W = 0.785\ d^2 P = 4{,}906$ lbs

$C = 17.0$ in

$$h_G = \frac{C - d}{2} = 0.431 \text{ in}$$

$\therefore t_R = 0.375$ in

$t_{act} = 0.625$ in

The single and multiple openings are reinforced per the requirements of UG(39)(b) and UG-42, as shown in Table I below.

Table I. Reinforcement Information

Purpose of openings	Item	Type of opening	Dia. of opening (in)	Required reinforcement (in^2)(AR)	Has overlapping area with following openings	Distance (D1) between centers / between openings	Avg. dia. (AD) (in) / openings	Ratio D1/AD
Spare cool-down or steady state return	1	single	1.50	0.281	N/A	N/A / N/A	N/A / N/A	N/A
Helium fill	2	multiple	1.0	0.188	opening 3	2.26 / 2 and 3	1.25 / 2 and 3	1.808
Steady state return	3	multiple	1.50	0.281	opening 4	2.608 / 3 and 4	1.50 / 3 and 4	1.739
Cooldown return	4	multiple	1.50	0.281	opening 3	2.608 / 3 and 4	1.50 / 3 and 4	1.739

Table I (continued)

Distance available (in) toward reinforcement between openings	Area avail. (AA) for reinforcment in^2 between openings	Ratio of AA / *ARTOT between openings	Additional available reinforcement in^2	(TAR) Total Available Reinforcement (in^2)	Ratio TAR/AR
N/A / N/A	0.1875 / N/A	0.667 / N/A	N/A	0.375	1.33
1.0 / 2 and 3	0.250 / 2 and 3	0.533 / 2 and 3	0.125	0.225	1.197
1.125 / 3 and 4	0.281 / 3 and 4	0.500 / 3 and 4	0.188	0.338 / 0.328	1.20 / 1.17
1.125 / 3 and 4	0.281 / 3 and 4	0.500 / 3 and 4	0.188	0.328	1.17

* ARTOT = The sum of the required area of reinforcement for the two openings .

Drawing 2753.700-ME-193337 is included to pictorially show how the new cover plate looks. The differences between the old and new are as follows:

1) The thickness has been increased from 0.375 in to 0.6250 in.
2) An additional 1.805 in opening has been added to the cover plate.

CONCLUSION

The new cover plate has a maximum allowable working pressure of 24 psi.

REVIEWED BY

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