



Fermilab

**Particle Physics Division
Mechanical Department Engineering Note**

Number: MD-ENG-241 Date: 23 February 2010

Project Internal Reference: None

Project: Lab 5 Air Receiver

Title: FESHM 5031 Engineering Note for Lab 5 Air Receiver

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Key Words: Engineering Note, FESHM 5031, Pressure Vessel

Abstract Summary:

Applicable Codes: ASME Section VIII, Division 1, FESHM 5031

**TECHNICAL APPENDIX FORM (TA5031) FOR PRESSURE VESSELS
PRESSURE VESSEL ENGINEERING NOTE PER CHAPTER 5031**

Prepared by: Dave Pushka
Preparation date: 23 February 2010

1. Description and Identification
Fill in the label information below:

THIS VESSEL CONFORMS TO FERMILAB ES&H MANUAL CHAPTER 5031	
Vessel Title	<u>Lab 5 Air Receiver</u>
Vessel Number	<u>PPD 10125</u>
Vessel Drawing No.	<u>Not Applicable</u>
Maximum Allowable Working Pressure (MAWP)	
Internal Pressure	<u>200</u>
External Pressure	<u>Not Rated for external pressure</u>
Working Temperature Range	<u>-20</u> °F <u>400</u> °F
Contents	<u>Compressed Air</u>
Designer / Manufacturer	<u>Steel Fab</u>
Test Pressure (if tested at Fermilab)	Acceptance Date <u>n/a</u>
_____ PSIG, Hydraulic _____	Pneumatic _____
Accepted as conforming to standard by _____	
Of Division / Section _____	Date: _____

← Obtain from Division/Section Safety Officer

← Document per Chapter 5034 of the Fermilab ES&H Manual

← Actual signature required

NOTE: Any subsequent changes in contents, pressures, temperatures, valving, etc., which affect the safety of this vessel shall require another review.

Reviewed by: _____
(Print Name)

Signature: _____ Date: _____

Director's signature (or designee) if the vessel is for manned areas but doesn't conform to the requirements of the chapter.

Signature: _____ Date: _____
 Amendment No.: _____ Reviewed by: _____ Date: _____

Lab Property Number(s): None _____
 Lab Location Code: Vessel installed in Lab 5 _____ (obtain from safety officer)
 Purpose of Vessel(s): Air Receiver from a KAESER AS44 Screw Compressor _____
 Compressor capacity at 125 psig, 164 cfm, 40 HP

Vessel Capacity/Size: _____ Diameter: _____ Length: _____
 Normal Operating Pressure (OP) 125 psig _____
 MAWP-OP = 75 psig _____ PSI

List the numbers of all pertinent drawings and the location of the originals.

<u>Drawing #</u>	<u>Location of Original</u>
None. This is a commercially made vessel. No Drawings were prepared.	
_____	_____
_____	_____
_____	_____

2. Design Verification

Is this vessel designed and built to meet the ASME BPVC or "Experiment Vessel" requirements?
 Yes No _____.

If "No" state the standard that was used _____.
 Demonstrate that design calculations of that standard have been made and that other requirements of that standard have been satisfied.
 Skip to part 3 "system venting verification."

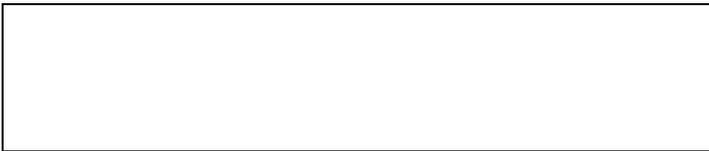
Does the vessel(s) have a U stamp? Yes No _____. If "Yes", complete section 2A; if "No", complete section 2B.

A. Staple photo of U stamp plate below.
 Copy "U" label details to the side



Copy data here:

U Stamp
NB 581855
Certified by
STEEL FAB S0-3327
Abngoon VA
MAWP 200 psi at 400 F
MDMT -20 F at 200 psi
HD .174 Sh .200 Yr
2009
Part No. A10051



Provide ASME design calculations in an appendix. On the sketch below, circle all applicable sections of the ASME code per Section VIII, Division I. (Only for non-coded vessels)

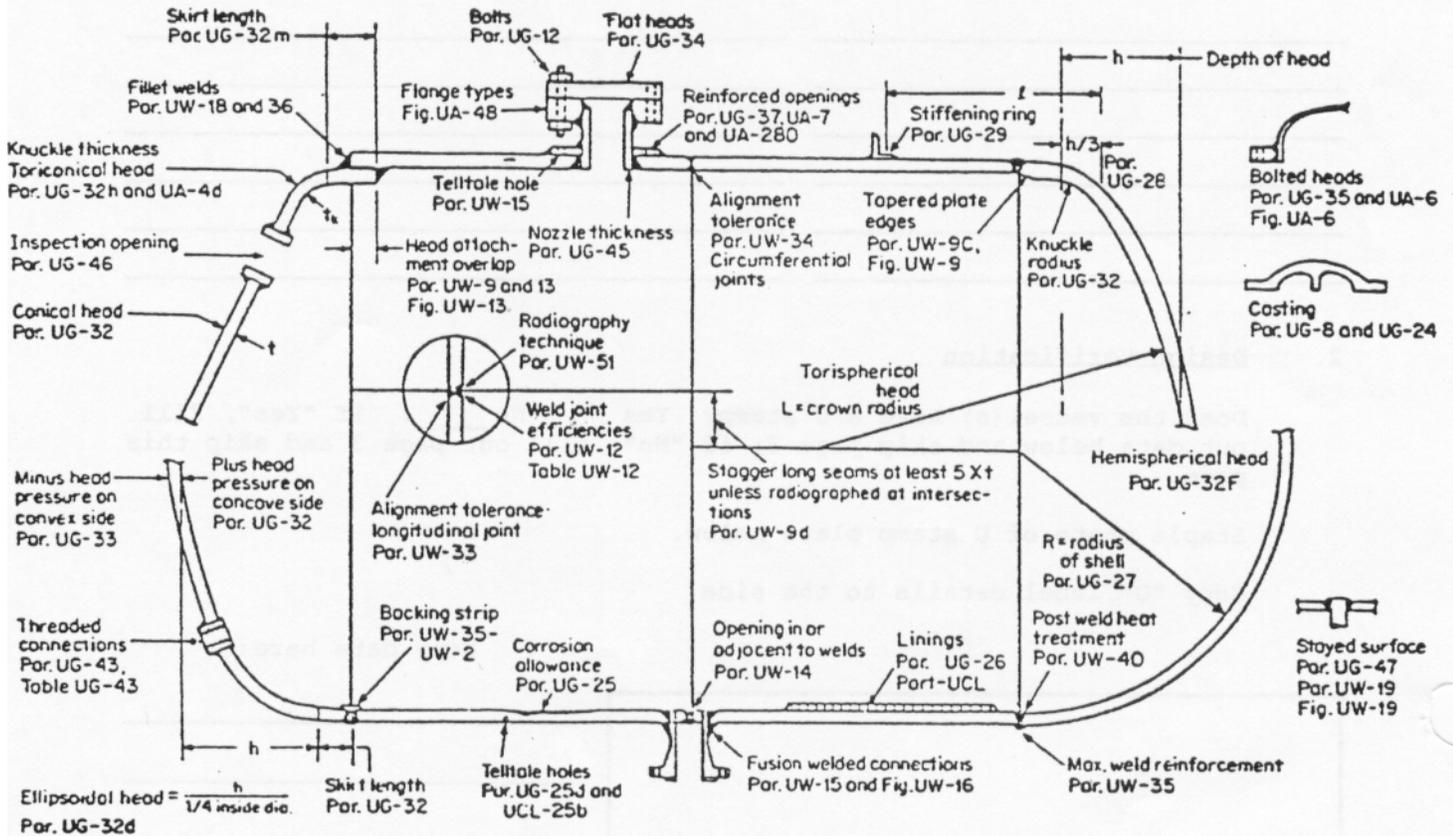


Figure 1. ASME Code: Applicable Sections

2B.

Summary of ASME Code

Item	Reference ASME Code Section	CALCULATION RESULT	
		(Required thickness or stress level vs. actual thickness)	calculated stress level)
_____	_____	_____	VS _____
_____	_____	_____	VS _____
_____	_____	_____	VS _____

_____ VS _____
_____ VS _____

3. System Venting Verification Provide the vent system schematic.

Does the venting system follow the Code UG-125 through UG-137?
 Yes X No ___

Does the venting system also follow the Compressed Gas Association Standards S-1.1 and S-1.3?
 Yes ___ No X

A "no" response to both of the two proceeding questions requires a justification and statement regarding what standards were applied to verify system venting is adequate.

List of reliefs and settings:

Manufacturer	Model #	Set Pressure	Flow Rate	Size
<u>CDI</u>	<u>SF50-1A150</u>	<u>150</u>	<u>274 scfm</u>	<u>½ inch MNPT</u>
<u>CDI</u>	<u>SF50-1A150</u>	<u>150</u>	<u>274 scfm</u>	<u>½ inch MNPT</u>

4. Operating Procedure

Is an operating procedure necessary for the safe operation of this vessel?
 Yes ___ No X (If "Yes", it must be appended)

5. Welding Information

Has the vessel been fabricated in a non-code shop? Yes ___ No X
 If "Yes", append a copy of the welding shop statement of welder qualification (Procedure Qualification Record, PQR) which references the Welding Procedure Specification (WPS) used to weld this vessel.

6. Existing and Unmanned Area Vessels

Is this vessel or any part thereof in the above categories?
 Yes ___ No X

If "Yes", follow the requirements for an Extended Engineering Note for Existing and Unmanned Area Vessels.

7. Exceptional Vessels

Is this vessel or any part thereof in the above category?
 Yes ___ No X

If "Yes", follow the requirements for an Extended Engineering Note for Exceptional Vessels.

Relief Valve Calculations:

Relief Valve Sizing depends on meeting relieving capacity for two conditions:

- 1) Compressor Capacity
- 2) Fire

Condition 1), Compressor Capacity

Compressor is rated at 164 cfm at 125 psig according to name plate data recorded by John Voirin. Compressor manufacture has provided compressor operation and maintenance manuals.

Condition 2), Building Fire

Per CGA S1.3-1995 Section 5.3 for an un-insulated container for non-liquefied compressed gasses.

Q_a = Flow Capacity of the relief valve

$Q_a = 0.00035 P W_C$ where:

$$P = \text{MAWP} + 14.7 \text{ psi} = 200 + 14.7 = 214.7 \text{ psig}$$

W_C = Water capacity of the vessel in pounds mass

Vessel Volume:

Shell tangent to tangent length = 70 inches

Shell diameter = 30 inches

$$\text{Shell volume} = L \cdot \left(\frac{1}{4} \pi D^2\right) = (70/12) \cdot \frac{1}{4} \pi \cdot (2.5 \text{ feet})^2$$

$$\text{Shell volume} = 5.833 \text{ feet} \cdot 4.9087 \text{ ft}^2 = 28.63 \text{ cubic feet}$$

Capacity of vessel heads: $V = \frac{2}{3} \pi K (D(\text{ft})/2)^3$

Head Depth is 0.5 feet (as measured)

Shell radius, D (ft) is 30/2 inches / 12 inches / ft = 1.25 feet

$$K = \text{head depth} / \text{shell radius} = 0.5 / 1.25 = 0.4$$

$$\text{Head capacity } V = \frac{2}{3} \pi K (R^3)$$

$$\text{Head capacity } V = \frac{2}{3} \pi \cdot 0.4 \cdot (1.25^3) = 1.6362 \text{ cubic feet per head}$$

$$\text{Vessel Volume} = 28.63 + 2 \cdot 1.64 = 31.9 \text{ cubic feet.}$$

$$\text{Water capacity} = 62.4 \text{ pounds per cubic foot} \cdot 31.9 \text{ cubic feet}$$

$$\text{Water capacity} = 1990 \text{ pounds}$$

$$Q_a = 0.00035 P W_C = 0.00035 \cdot 214.7 \text{ psig} \cdot 1990 \text{ pounds} = 149.6 \text{ scfm}$$

So, to meet the fire condition per CGA S1.3, the relief valve must be at least 150 scfm capacity.

CGA S-1.3 Section 8, page 22, paragraph 8.6 requires pressure relief valves to be examined and tested at least every 5 years.

FESHM 5031.4 requires a relief valve testing at regular intervals. Specifically:

“PROCEDURE

1. External Inspection: An external inspection of each primary relief system must be made prior to initial operation of the protected system. The inspection must be repeated at regular intervals. The maximum interval between inspections may not exceed three years.

2. Testing of Relief Devices:

- a. Re-closing primary relief devices must be tested prior to their installation. The testing must be repeated at regular intervals. The maximum interval between tests may not exceed six years. In the case of new and not previously used relief devices, certification of the set pressure by the manufacturer will be considered to constitute a test. In this case, the test date will be considered to be the date on which the relief device was delivered at Fermilab and the requirement for further testing prior to installation will be waived.
- b. Non-re-closing (burst disk) and parallel plate primary relief devices (used on vacuum vessels and insulating vacuum spaces) need not be tested, but must be inspected every three years.
- c. If a protected system is provided with n sets of primary relief devices, each of the sets individually satisfies all Fermilab ES&H Manual requirements, and each of the sets is always connected to the protected system, then the interval between tests specified in 2.a. may be extended to n times six years. “

So, install 2 relief valves sized for a minimum capacity of 165 scfm at 150 psig and the relief valve inspection interval will become 12 years. Since the division has not demonstrated an effective program of testing and inspection, maximizing the required interval seems prudent.

Relief valve information from Grainger Supply is:



Valve, Safety

ASME Air Safety Valve, NPT Size (M) 1/2 Inch, Preset Pressure Setting 150 PSI, Rated Flow @ Set Pressure 274 CFM

Grainger Item # 6D925

Price (ea.) **\$19.61**

Brand CDI CONTROL DEVICES

Mfr. Model # SF50-1A150

Ship Qty. 1

Sell Qty. (Will-Call) 1

Ship Weight (lbs.) 0.35

Usually Ships Today

Catalog Page No. 3421

Price shown may not reflect your price. Log in or register.

Additional Info

- **Safety Valves**
- **ASME Soft-Seat Air Safety Valves**
- 1-piece brass body has resilient silicone elastomer poppet for a leakproof seal.
- External threads are coated with thread sealant.

Tech Specs

- **Item:** Air Safety Valve
- **Valve Type:** Bubble Tight
- **(M)NPT Inlet (In.):** 1/2
- **Preset Setting (PSI):** 150
- **Rated CFM @ Set Pressure:** 274
- **Max. Temp. (F):** 250
- **Body Material:** Brass

- **Seal:** Rubber
- **Poppet:** Resilient Silicone Elastomer
- **Spring:** Zinc Plated Music Wire
- **Standards:** ASME, National Board Certified
- **Application:** For Systems Where Large Flow Capacities Are Needed

Notes & Restrictions

There are currently no notes or restrictions for this item.

MSDS

Material Safety Data Sheets (MSDS) are available for this item.

Required Accessories

There are currently no required accessories for this item.

Optional Accessories

Sealant Tape, 1/2 x 260 In



Item #: 4X227

Brand: ANTI-SEIZE

Usually Ships: Today

Price (ea): \$1.53

Alternate Products

Valve, Safety



Item #: 4TK24

Brand: CDI CONTROL DEVICES

Usually Ships: Today

Price (ea): \$22.18

Repair Parts

A Repair Part may be available for this item. Visit our Repair Parts Center or contact your local branch for more information.

