



Particle Physics Division

Mechanical Department Engineering Note

Number: MD-ENG-421

Date: June 8, 2012

Project: NOvA

Project Internal Reference: NOvA docdb # 7560

Title: NOvA Ash River Building Air Compressor Engineering Note

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Reviewer(s): Joe Howell *J Howell*

Key Words: Engineering Note, Silver Sticker, Pressure Vessel

Abstract/Summary: Engineering note for a code stamped pressure vessel used as an air receiver on a shop air compressor installed in the NOvA far detector building at Ash River, Minnesota. Reviewed per Fermilab FESHM 5031

Applicable Codes: ASME Section VIII Division 1
CGA S-1.1

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

Prepared by: Ron Williams
Preparation date: 5/29/2012

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

THIS VESSEL CONFORMS TO FERMILAB ES&H MANUAL CHAPTER 5031			
Vessel Title	<u>FDB Plant Air Compressor</u>		
Vessel Number	<u>PP10149</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>Speedaire</u>		
Test Pressure (if tested at Fermilab)	Acceptance Date	<u>N/A</u>	
<u> </u> PSIG,	Hydraulic <u> </u>	Pneumatic	<u> </u>
Accepted as conforming to standard by			
<u></u>			
Of Division / Section	<u>PP2</u>	Date:	<u>6/5/2012</u>

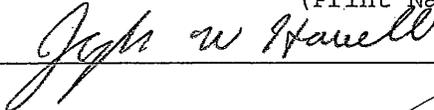
← Obtain from Division/Section Safety Officer

← 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: JOE HOWELL
(Print Name)

Signature:  Date: 6/5/2012

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: Compressor tank located in the NOVA Far Detector Building (FDB) on lower level 1 (LL1) (obtain from safety officer)
 Purpose of Vessel(s): Supplies "house/plant" air to FDB compressed air distribution system; free air CFM @ 175 PSI = 34.8; 10 HP

 Vessel Capacity/Size: 80 Gallons Diameter: 30 inches Length: 42.5 inches
 Normal Operating Pressure (OP) 95 psig
 MAWP-OP = 200-95 = 105 PSI

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

<u>Drawing #</u>	<u>Location of Original</u>
<u>Commercially made vessel, no drawings exist</u>	
_____	_____
_____	_____
_____	_____
_____	_____

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 X 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 651892
Certified by
STEEL FAB SO-17262
Abingdon VA
MAWP 200 PSI at 400 F
MDMT -20 F at 200 PSI
HD .186 SH .250 YR 2011
Part NO P05944D
CRN C6406.1C

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)

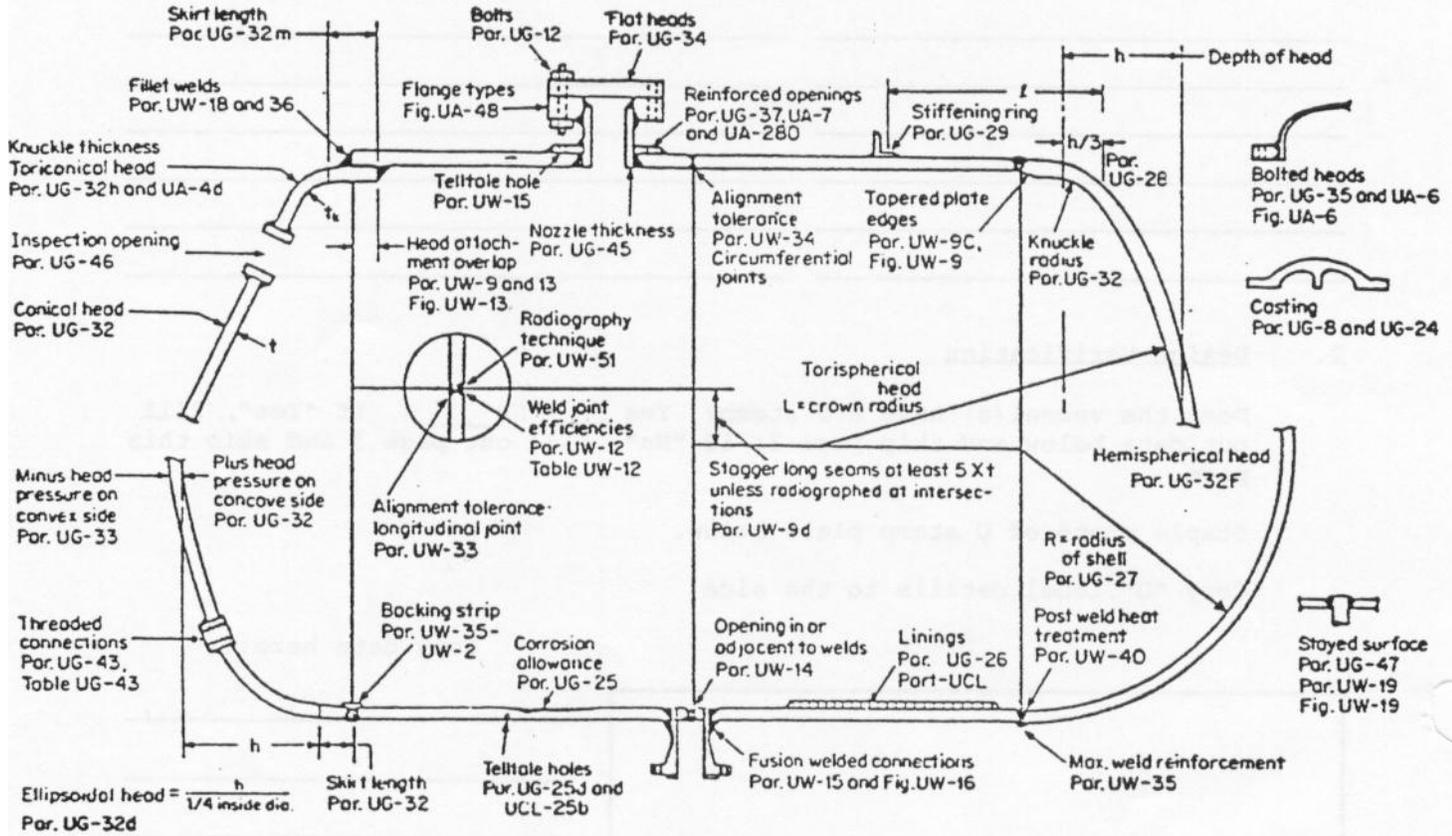


Figure 1. ASME Code: Applicable Sections

2B.

Summary of ASME Code

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

3. System Venting Verification Provide the vent system schematic.

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

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

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>ST25-1A200</u>	<u>200</u>	<u>178 SCFM</u>	<u>¼ inch MNPT</u>

Relief Valve Sizing Calculations:

Source of pressure in the vessel is only the attached compressor.

Compressor is in a building with fire detector and fire suppressions systems. Engulfment in fire is not a credible source of vessel pressurization. This addresses paragraph UG-125 (2).

Compressor has a capacity of 34.8 cfm at 175 psig according to the name plate data read by Ron Williams at the Far Detector Building in Ash River

Relief valve information indicates a relief valve capacity of 178 cfm at 200 psig.

Therefore, the relief valve capacity exceeds the capacity of the air source and this satisfies UG-133

Relief valve set point is equal to the vessel MAWP. This is acceptable per ASME B&PV code paragraph UG-125 (3) (b) and UG-134.

Relief valve is mounted directly on the vessel as required by UG-135. Relief valve discharges directly to the room air, no discharge piping is used.

UG-127 does not apply as a rupture disk is not used.

UG-128 does not apply as the vessel is not filled with liquid.

UG-129 has been satisfied by the relief valve manufacture with the data stamped on the relief valve.

UG-130 has been satisfied by the relief valve manufacture with the data stamped on the relief valve.

UG-131 has been satisfied by the relief valve manufacture.

UG-132 does not apply as a non-reclosing pressure relief is not used.

UG-133 has been satisfied as described above.

UG-134 has been satisfied as the relief valve set point does not exceed the vessel MAWP

UG-135 has been satisfied as the relief in on the top of the vessel.

UG-136 has been satisfied by the relief valve manufacture.

UG-137 does not apply as a rupture disk is not used.

CGA S-1.1 and S-1.3: CGA S-1.1 applies to compressed gas cylinders. This vessel is not a compressed gas cylinder. CGA S-1.3 has two paragraphs applicable to the relief valve sizing for this vessel. Installed relief has more capacity than required by this calculation.

CGA 1.3 paragraph 6.2.1 Minimum Required flow capacity for an uninsulated container of non-liquefied compressed gas

Symbol	description	Units	Value	Comments
Qa	Required Flow capacity	cfm	0.295378	Actual relief valve value is 178 cfm, greatly in excess of 0.3 cfm required by this calculation.
P	MAWP in absolute units	psia	214.4	
V	Receiver Volume	ft ³	10.69444	
C	Gas Constant	n/a	356	for air and k = 1.4
M	molecular weight	n/a	29	for air
Z	Compressibility factor	n/a	0.9962	for air at 200 psi and 68 F

CGA 1.3 paragraph 6.3.1 Minimum Required flow capacity for an uninsulated container of non-liquefied compressed gas under fire conditions

Symbol	description	Units	Value	Comments
A prd	Required relief device flow area	in ²	0.007377	must be larger than 0.003
S	Safeguarding Factor	n/a	0.3	0.3 for vessels in water fire protection, 1.0 otherwise
A	Container exterior area	ft ²	37.3	
k	ratio of specific heats	n/a	1.4	for air
M	molecular weight	n/a	29	for air
C	Gas Constant	n/a	356	for air and k = 1.4
K _d	Discharge Coefficient	n/a	0.975	for gas
P	MAWP in absolute units	psia	214.4	
D	Diameter	2.5	ft	
H	Height	3.5	ft	
A shell	Shell Area	27.5	ft ²	
A End	End Area	4.9	ft ²	
A total	Total area	37.3	ft ²	

Compressor Catalog Data:

Air Compressor, HP Rating 10.0 HP, Free Air Flow @ 175 psi 34.8 CFM, Maximum Pressure 175 PSI, Phase Three, Voltage Rating 230/460 Volts, Current Rating 26.8/13.4 Amps, Tank Capacity 80 Gallons, Tank Type Vertical, Oil Capacity 4 Quarts, Speed 740 RPM, Height 66 3/4 Inches, Length 42 1/2 Inches, Width 30 Inches, NPT Outlet (F) 3/4 NPT Inch, Maintenance Kit Number 1WF47, Includes Motor Starter, Initial Fill of Compressor Oil, Aftercooler, Vibration Isolators, Auto Drain

Grainger Item #	1WD73
Price (ea.)	\$3,837.00
Brand	SPEEDAIRE
Mfr. Model #	1WD73
Ship Qty. 	1
Sell Qty. (Will-Call) 	1
Ship Weight (lbs.)	850.0
Availability	Ready to Ship 
Catalog Page No.	3721 
Country of Origin (Country of Origin is subject to change.)	USA



CDI CONTROL DEVICES Valve, Safety

Pneumatics > Pneumatic System Components > Pneumatic Safety Valves

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Like

ASME Air Safety Valve, NPT Size (M) 1/4 Inch, Preset Pressure Setting 200 PSI, Rated Flow @ Set Pressure 178 CFM

Grainger Item #	5A710
Price (ea.)	\$7.18
Brand	CDI CONTROL DEVICES
Mfr. Model #	ST25-1A200
Ship Qty.	1
Sell Qty. (Will-Call)	1
Ship Weight (lbs.)	0.1
Availability	Ready to Ship
Catalog Page No.	3731
Country of Origin (Country of Origin is subject to change.)	USA



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Qty: ZIP code:

Tech Specs	Additional Information	Compliance & Restrictions	MSDS	Required Accessories	Optional Accessories	Alternate Products	Repair Parts
Item	Air Safety Valve						
Valve Type	Bubble Tight						
(M)NPT Inlet (In.)	1/4						
Preset Setting (PSI)	200						
Rated CFM @ Set Pressure	178						
Max. Temp. (F)	250						
Body Material	Brass						
Poppet	Resilient Silicone Elastomer						
Spring	Zinc Plated Music Wire						
Standards	ASME, National Board Certified						
Application	Used For Small Air Compressors						

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.

