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OPERATION & MAINTENANCE MANUAL

STANDARD MODEL 12-40 GRANULAR ACTIVATED CARBON ADSORPTION SYSTEM

PREPARED BY
CALGON CARBON CORPORATION
PITTSBURGH, PA

DATE: JULY, 2018

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SECTION 1

SYSTEM DESCRIPTION

SECTION 1

SYSTEM DESCRIPTION

1.1 INTRODUCTION

This manual covers a general description and operating procedures for a Model 12-40 Granular Carbon Adsorption System. This system is designed to treat liquid streams containing organic compounds amenable to adsorption using Calgon Carbon Corporation's granular activated carbon products. If the guidelines in this manual are read and followed carefully, the system can be operated efficiently and safely with minimal operating expense.

The recommended operating practices set forth in this manual are patterned to suit normal operating conditions. Different conditions may require modifications of these operating practices. Since varying operating conditions or problems may arise over long-term operation, the skill and judgment of the operating personnel should be exercised when needed.

This manual should be available to operating personnel and engineers so that the operating instructions are followed. Record all operating data and maintenance work (overhauls, repairs, etc.) in an operator's logbook. Only trained personnel should operate the system and perform maintenance. If further information beyond what is contained in this manual is required, please contact the nearest Calgon Carbon Corporation regional sales office for assistance.

Please note that this manual is a description for a standard Model 12-40 System. Some items specific to your installation may be custom designed. Specific information concerning any custom design details for your installation is described in Section 1.2 (Model 12-40 Specifications and Operating Conditions).

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1.2 MODEL 12-40 SPECIFICATIONS AND OPERATING CONDITIONS

1.2.1. Adsorber Vessel Specifications

Material of Construction: Carbon Steel

Tank Lining: Above cone: Plasite 4110, 35-45 MIL DFT

Below cone: Plasite 4110, 10-15 MIL DFT

Type of Heads:

Top: ASME 2:1 Elliptical
Bottom: ASME 2:1 Elliptical

Diameter: 12 Ft. Straight Side Height: 16 Ft.

Design Temperature (° F): Normal: 100 Max: 140

Design Pressure: 125 psig @140° F

Primer and Finish:
Primer: SHERWIN-WILLIAMS ZINC CLAD IV, ORGANIC EPOXY ZINC, 3-5 MILS DFT.
Paint: SHERWIN-WILLIAMS MACROPOXY 646, FAST CURE EPOXY, 5-10 MILS DFT. PER CCC SPEC. RS-17.
Color: HYDRO BLUE (SW 4061)

VESSEL CAPACITIES

Bed Volume: 10,467 Gal. Maximum Flow Rate: 700 gpm

Vessel Volume: 16,899 Gal.

For system pressure drop see Section 8

Backwashing Information (If Required):

Bed Expansion 25%

For backwash rate refer to the bed expansion curve in Section 8.

1.2.2. System Weights and Dimensions (Approximate):

Empty Vessel Shipping Weight: 31,000 Lbs.

Operating Weight (Full with Liquid + Carbon): 191,000 Lbs.

Overall Length: 31'-4" Overall Width: 13'-5" Overall Height: 26'-9"

1.2.3. Vessel Accessories/Piping

Piping:

Process Piping 8" Sch. 40 Carbon Steel
Carbon Transfer Piping: 4" Sch. 40 Carbon Steel (fill)
4" Sch. 40 Lined Carbon Steel (Discharge)
Backwash Piping 8" Sch. 40 Carbon Steel

VESSEL NOZZLES	NUMBER	SIZE	FLANGE TYPE
Side Manway	1	20"	150#F.F.
Lower Manway	1	14"x18"	Elliptical
Process In	1	8"	150# F.F.
Process Out	1	8"	150# F.F.
Carbon In	1	6"	150# F.F.
Carbon Out Upper	1	6"	150# F.F.
Carbon Out Lower	1	4"	150# F.F.
BW In			At Process Outlet
BW Out			At Process Inlet
Vent	1	2”	150# F.F.
Sample Taps	3	2"	150# F.F.
Spare	1	4”	150# F.F.

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Pressure Relief:

Pressure Relief Device:	Rupture Disk
Rupture Disk Material of Construction:	Graphite
Rupture Disk Stamped Burst Pressure:	125 psig
Rupture Disk Recommended Operating Ratio:	80%
Recommended Maximum Inlet Pressure:	100 psig

1.2.4. Carbon

Carbon Type:	F300
Mesh Size:	8 x 30
Quantity per vessel:	40,000 Lbs.

1.2.5. Other Options:

Sample Connections:	Yes
Upper Distributor:	No

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1.2.6 Materials of Construction List

WETTED CONTINUOUSLY		
ITEM	CCC SPECIFICATION NUMBER	MATERIAL OF CONSTRUCTION
Process and Carbon Fill Piping	C2	Sch. 40 Carbon Steel Pipe Cast Iron Fittings EPDM Gaskets
Process Valves	3.44	Cast Iron Body Wafer Style Buna-N Seat Aluminum-Bronze Disk 416 Stainless Steel Shaft TFE Seals
Carbon Discharge Piping	L1	PPL Lined Steel PPL Lined Cast Iron Fittings
Carbon Exchange Valves	4.08	316SS Body, Ball and Stem TFE Seats and Seals
Instrument and Flush Connection Piping	C13 S6	Sch. 40 Galvanized Carbon Steel 316 SS Tube and Fittings
Instrument and Flush Connection Valves	4.03	Bronze/Brass Body, Ball and Stem TFE Seats and Seals
Pressure Gauges	PI-217	316SS Bourdon Tube 316SS Connection
Rupture Disks	PSE-577	Graphite
Expansion Joints	24.06	Neoprene
Vessel Lining	VS7 & VS9	Plasite 4110 Vinyl Ester
Vessel Manway Gaskets	G46	FDA White EPDM Gaskets
Underdrain Materials	22.96	Polypropylene Septa White Buna N (FDA approved) Gasket
Basket Strainer	22.53	316 SS
Differential Pressure Transmitter	PDS 294	Cast Aluminum Case, Buna-N or Silicone Diaphragm, 302 SS or 316 SS Spring
Vent Sample Valve	4.57	316 SS Body, Ball and Stem TFE Seats and Seals
Vent Sample Piping	S15	316 SS Pipe and Fittings
WETTED INTERMITTENTLY OR FOR SHORT TIME PERIODS		
Quick Connect Couplings	32.40 32.60 32.61	Malleable iron Aluminum Aluminum

1.2.7. Carbon Delivery

	DUMP TRUCK (*) (ATMOSPHERIC)	STANDARD TRAILER (15 PSIG HOPPER)	LIFT TRAILER (35 PSIG HOPPER)	TRIPLE COMPARTMENT TRAILER
Carbon (Lbs):	20,000	10,000	20,000	20,000
Utility Requirements:				
Air (SCFM):	--	100	100	100
(PSIG):	--	100 (**)	100 (***)	100 (**)
Water (GPM):	200-250	100	100	100
(PSIG):	80-120	--	--	--
Water Required to Fill				Compartment End Center
Trailer (Gallons):	--	5,000	4,200	2,800 5,000
Dry Carbon:	--	4,200	3,500	2,500 4,200
Pre-Wetted Carbon:				
Height Clearance (Ft):	--	13	26	14
Empty Weight (Lbs):	33,000	32,000	33,000	37,000
Filled Weight (Lbs):				
Dry Carbon:	73,000	52,000	53,000	57,000
Wet Carbon				
(Before Drain):	--	94,000	95,000	99,000
(After Drain):	--	72,000	73,000	77,000

(*) Unloading accomplished with eductor
(**) Regulated down to 15 psig max.
(***) Regulated down to 30 psig max.

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1.3 GENERAL SYSTEM DESCRIPTION

The Model 12-40 Adsorption System is a unit consisting of one (1) vertical pressure vessel, containing 40,000 pounds of granular activated carbon. The vessel is complete with underdrain and carbon transfer piping. After connecting the influent and effluent piping to the system, the vessel is ready to be placed into service. The initial fill of Granular Activated Carbon is shipped to the site for unloading directly as a water slurry.

The stream to be treated is pumped to the adsorption system at a flow rate compatible with the design capacity of the unit. The adsorption system is operated in a downflow mode through the granular carbon bed.

Initially, the impurities are adsorbed onto the carbon in the upper portion of the carbon bed. As this top layer of carbon becomes saturated, adsorption takes place lower in the bed. Eventually all the carbon in the adsorber becomes saturated and the contaminant concentration of the effluent from the adsorber increases until it approaches or equals the influent concentration.

When the carbon in the vessel is exhausted, an empty trailer is sent to the site to remove the load of spent carbon. Pending completion of carbon acceptance by Calgon Carbon, the carbon will be returned to one of our plant sites for thermal reactivation.

The spent carbon is transferred from the adsorber to the bulk trailer by first filling the adsorber with water. The adsorber is then pressurized using compressed air as the motive force to facilitate the carbon transfer to the trailer.

Once the spent carbon transfer operation is completed, a charge of fresh carbon can be transferred into the empty adsorber. This is accomplished by filling the bulk trailer with water and placing a water cushion in the adsorber. The bulk trailer is then pressurized with compressed air to facilitate the carbon transfer into the adsorber.

In normal operation, the influent flow is directed to the vessel through the inlet line. When contaminant breakthrough is detected at the effluent of the vessel, the system is shut down for carbon replacement.

Pressure gauges should be installed on the influent and effluent lines to measure the pressure drop across the carbon bed. Pressure drop through an adsorber carbon bed is a function of many factors:

1. Pressure drop through the carbon bed(s).
2. Nozzle and piping pressure drop.
3. Flow rate, viscosity, and density of the liquid.
4. Solids build-up on top of the bed.
5. Bacteria growth or chemical precipitation in the bed.
6. Gas build-up in the bed.

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Backwashing/backflushing is usually required when the pressure drop across an adsorber increases by 5 to 10 psi during the adsorption cycle.

Model 12-40 units come equipped with a 30° internal cone. This internal cone offers many advantages, such as ease of carbon removal and good flow distribution through the nozzle underdrain. Since the internal cone is not part of the exterior vessel, it is designed to withstand a working differential pressure of 20 psi. Note that this differential pressure is less than the maximum allowable working pressure (MAWP) for the vessel. High cone pressure differential could exist due to:

1. Unlimited backwash water flows. This is probably the most dangerous situation since the cone is weaker in the upflow direction.
2. Nozzle pluggage due to precipitation, fines or bacteria. This could happen either in the backwash or process operation.
3. Unlimited process flow.

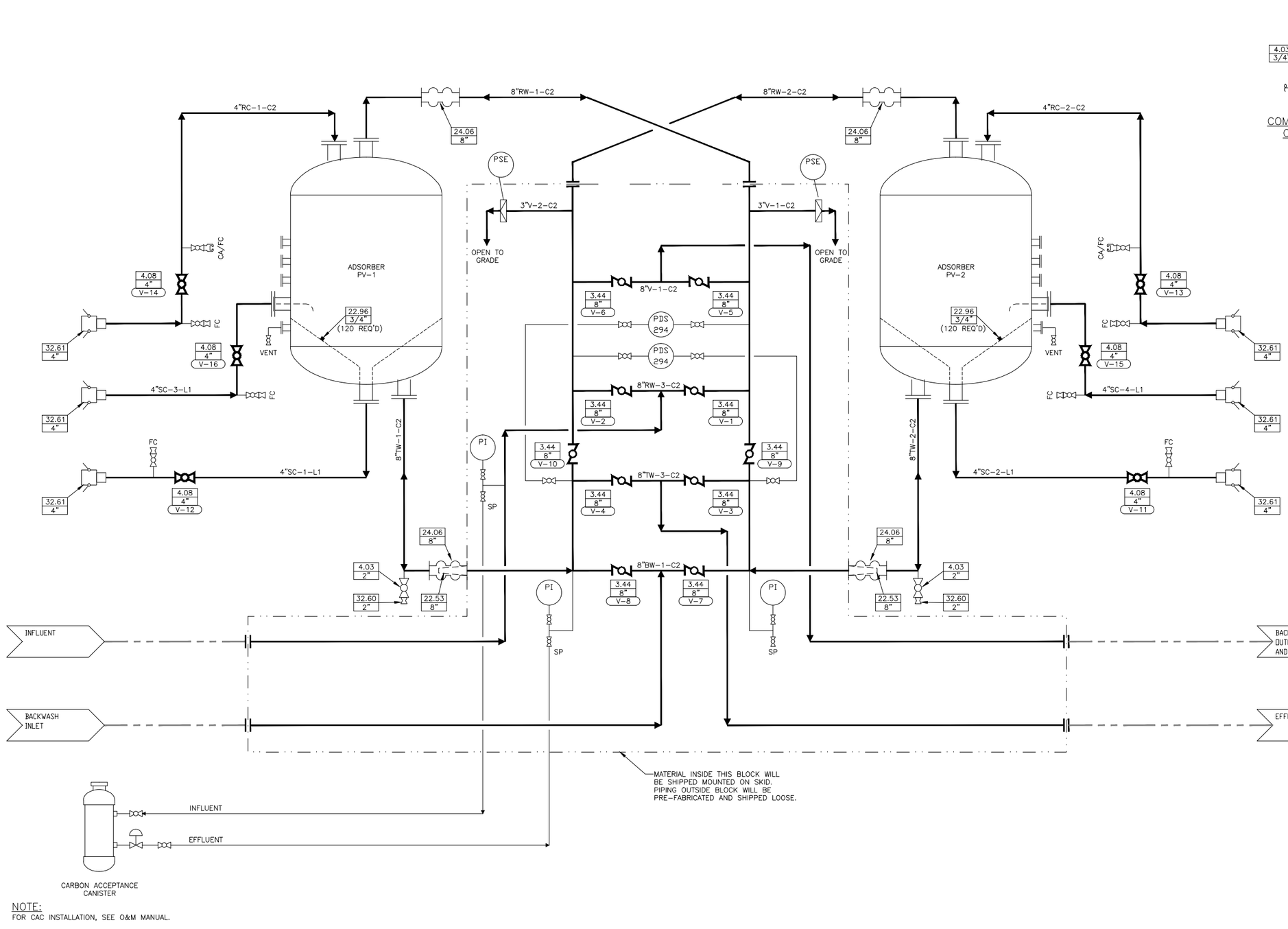
Due to this differential pressure limitation across the cone, Calgon Carbon recommends that the client either install an alarm to indicate or an electrical interlock to shut down feed to the system in the event of high pressure differential develops across the cone. Note that the actual collapse of the cone is a remote possibility.

⚠ CAUTION

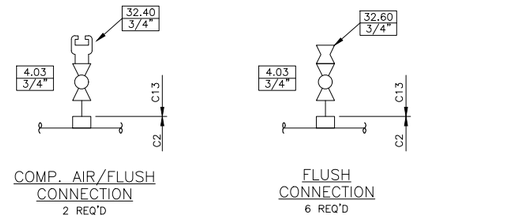
DO NOT OPERATE THE SYSTEM UNLESS THE DIFFERENTIAL PRESSURE SWITCHES ON EACH VESSEL ARE OPERATING PROPERLY. OTHERWISE, A HIGH DIFFERENTIAL PRESSURE THAT COULD CAUSE DAMAGE TO THE INTERNAL CONE MAY GO UNDETECTED.

To prevent damage to the system in the event that the pressure limitation of the vessels is exceeded, pressure relief devices are provided in the adsorber vent lines. Calgon Carbon's standard pressure relief device is a graphite rupture disk rated at the design pressure of the vessels.

After start-up, records should be kept of pertinent data such as flow rate, pressure drop across each bed, total dissolved solids, temperature, pH, toxicity, and organic contaminant levels.



NOTE:
FOR CAC INSTALLATION, SEE O&M MANUAL.



MEDIA	INSTRUMENTATION	DESIGN CONDITIONS	LEGEND	ADSORBERS	UTILITY REQUIREMENTS
MEDIA: GAC QUANTITY PER VESSEL: 40,000 LBS. SERVICE: POTABLE	PI 217 PSE 577 FOR 100 psig MAX. OPER. PRESS. PDS 294	FLOW RATE – 1000 GPM (SERIES) 1400 GPM (PARALLEL) INFLUENT PRESSURE – 100 PSIG MAX. INFLUENT TEMP. – 120°F MAX. BACKWASH RATE – 1000 GPM MAX. ELECTRIC POWER – 120 V, 60~ SINGLE PHASE, 15 AMP	BW – BACKWASH WATER FC – FLUSH CONNECTION RC – REACT.(OR VIRGIN) CARBON RW – RAW WATER SC – SPENT CARBON SLURRY SP – SAMPLE PORT TW – TREATED WATER V – VENT	12'–0" O.D. x 16'–0" S.S. ASME 2:1 ELLIPTICAL TOP AND BOTTOM HEADS. CARBON STEEL CONSTRUCTION. ASME SECT. VIII, DIV. 1 W/ PLASITE 4110 LINING 125 PSIG @ 140°F DESIGN.	AIR, CARBON TRANSFER – 100 SCFM @ 30 PSIG MIN. PLANT WATER – 100 GPM @ 30 PSIG MIN. WIRING – MIN. AWG #16 TO PDS 294

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	NAME	DATE
DRAFTER	JFS	2/3/14
DESIGNER		
CHECKER		
APPROVAL		

PROJECT No. STANDARD

REV	DESCRIPTION	APP	DATE

REVISIONS

TOLERANCES (unless otherwise specified)

ANGULAR	±0°30'	DECIMAL (2 PLACES)	±.010
FRACTIONAL	±1/16"	DECIMAL (3 PLACES)	±.005
DECIMAL (1 PLACE)	±.015	DECIMAL (4 PLACES)	±.0005

CalgonCarbon

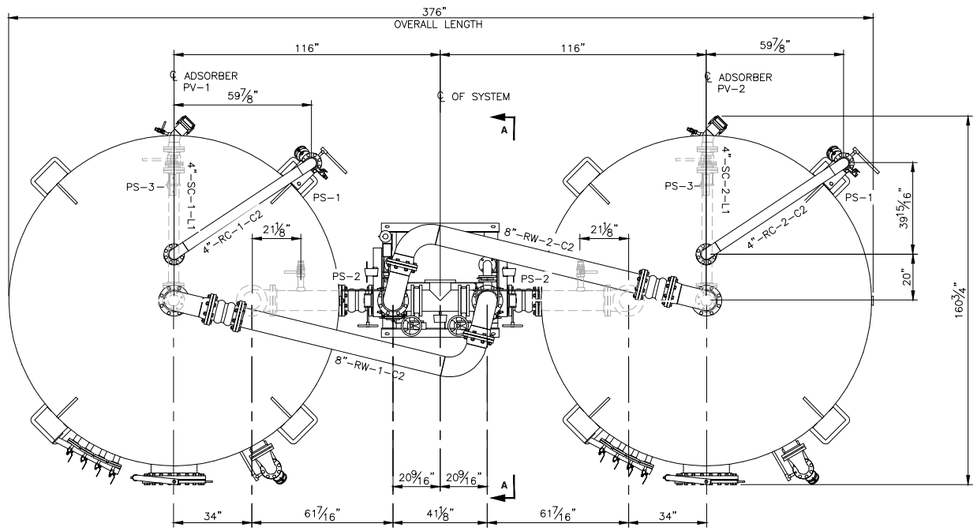
CLIENT

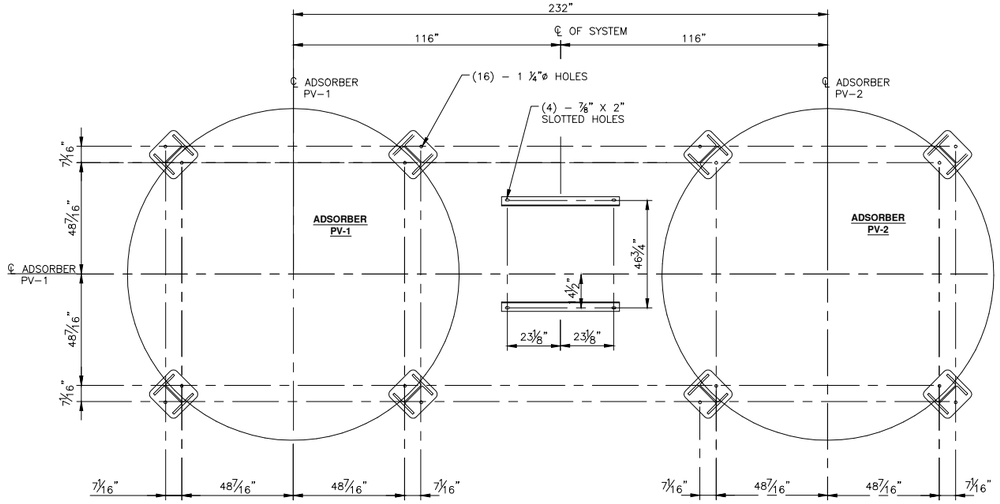
TITLE
MODEL 12-40 SYSTEM
8" PIPING, POTABLE
FLOW DIAGRAM

DWG. Size	SHEET No.	SCALE
D	1 OF 1	NONE

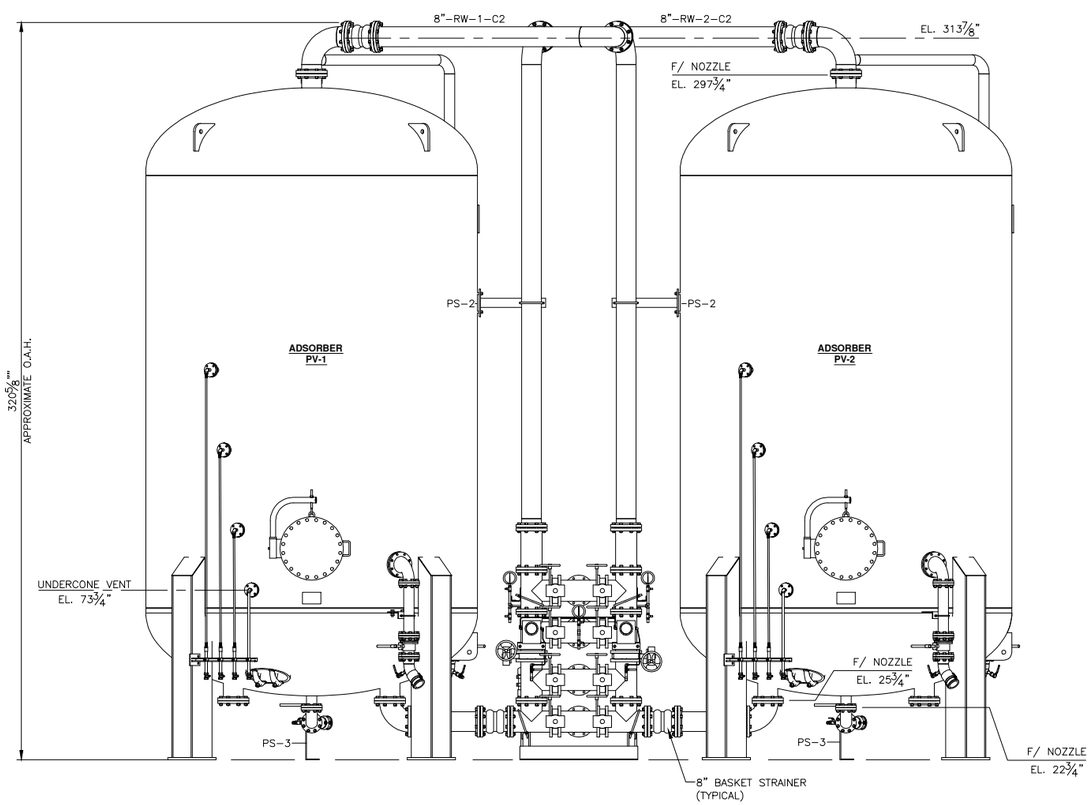
DWG. No. 90140212 REV. 0

V:\Products\Carbon\Model 12-40\Process\90140212 - M12-40 8-BW PID.dwg Mar 21, 2014 - 9:09am

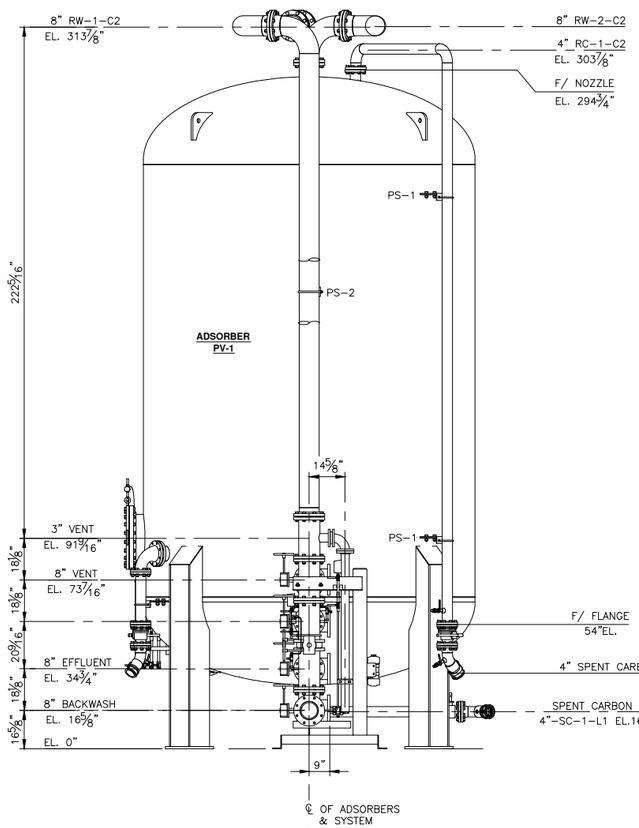




PLAN

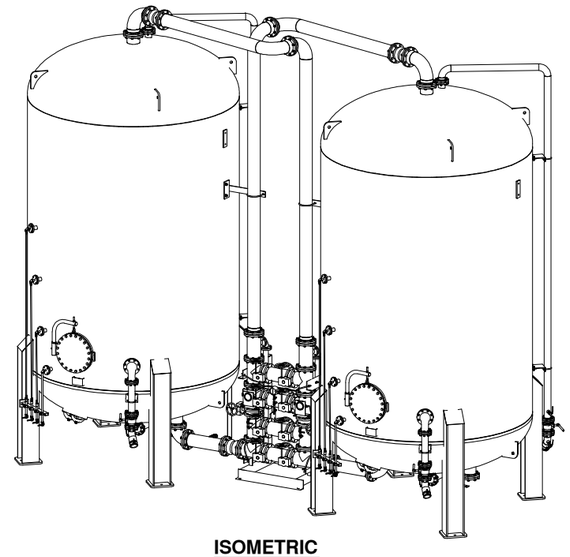


ELEVATION



VIEW A-A

ANCHOR BOLT PLAN



ISOMETRIC

REV	DESCRIPTION	APP	DATE

REVISIONS

TOLERANCES (unless otherwise specified)

ANGULAR	±0°30"	DECIMAL (2 PLACES)	±.010
FRACTIONAL	±1/16"	DECIMAL (3 PLACES)	±.005
DECIMAL (1 PLACE)	±.015	DECIMAL (4 PLACES)	±.0005

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	NAME	DATE
DRAFTER	JGP	6/14/2010
DESIGNER		
CHECKER		
APPROVAL		

PROJECT No. STANDARD

CLIENT: STANDARD

TITLE: MODULAR ADSORBER SYSTEM
MODEL 12-40, 8" PIPING
GENERAL ARRANGEMENT

DWG. Size: D | SHEET No.: 1 OF 1 | SCALE: NONE

DWG. No.: 90110100 | REV.: B

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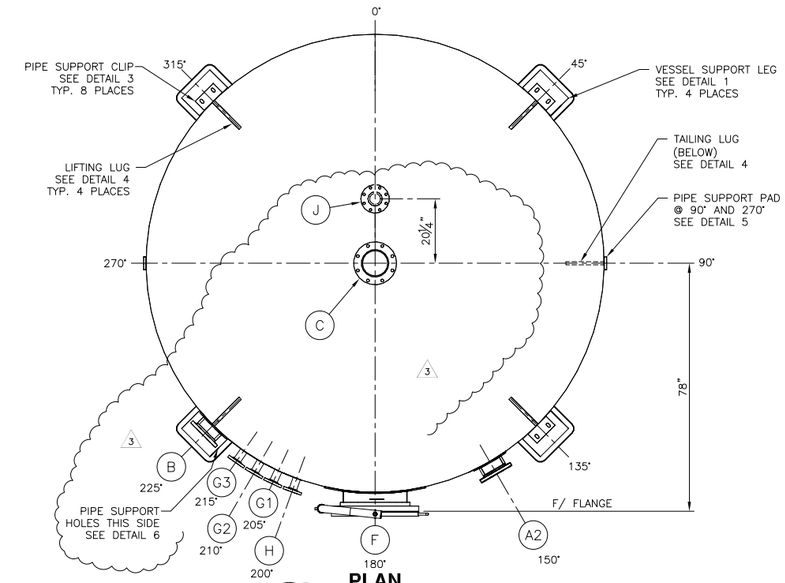
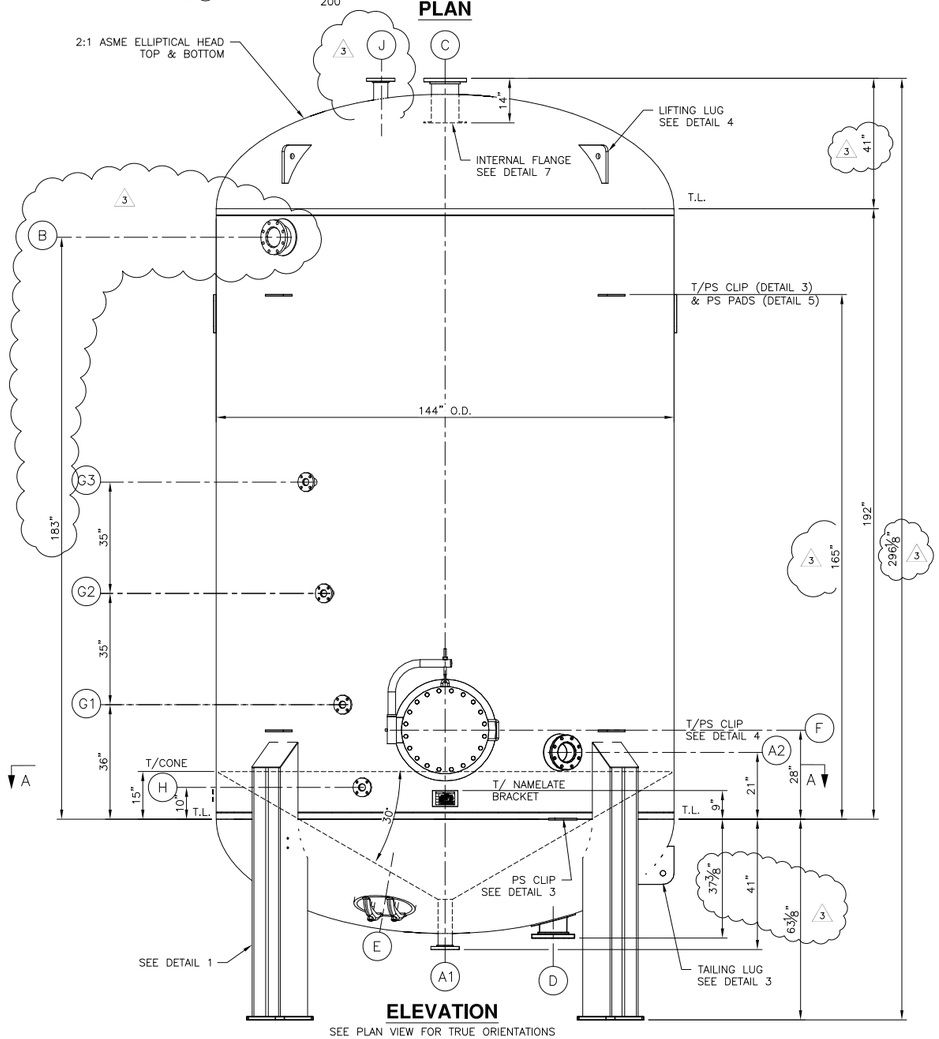
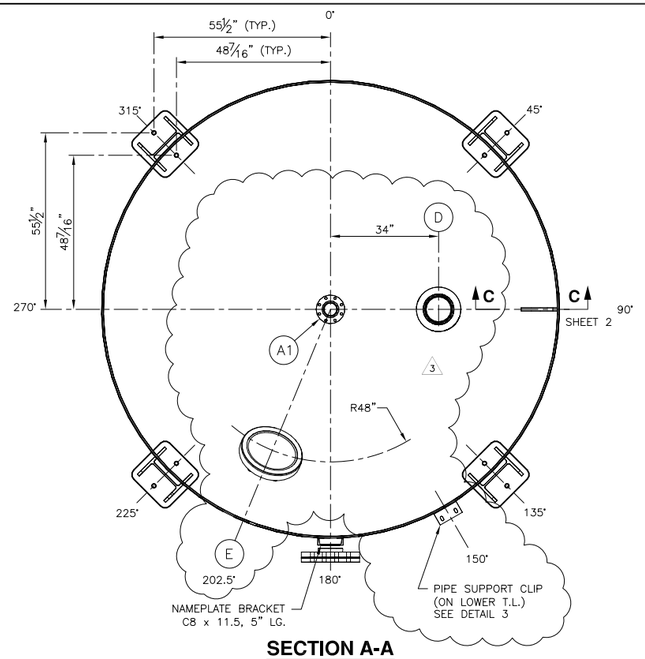


PLAN



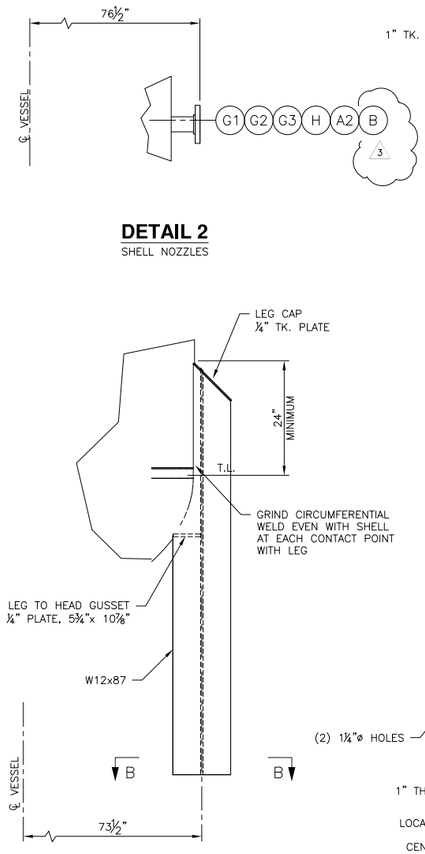
ELEVATION

SEE PLAN VIEW FOR TRUE ORIENTATIONS



SECTION A-A

CONE NOT SHOWN

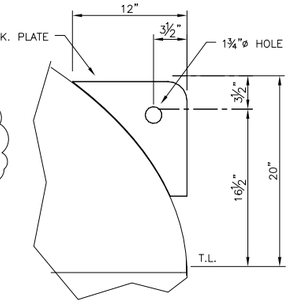


DETAIL 2

SHELL NOZZLES

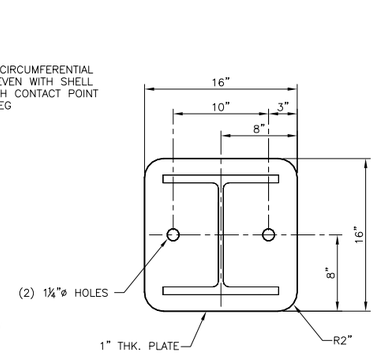
DETAIL 1

VESSEL SUPPORT LEG
(4 REQ'D)



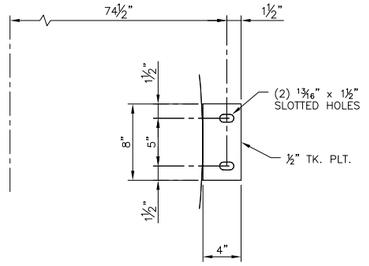
DETAIL 4

(4) LIFTING LUG
(1) TAILING LUG (BTM. HEAD)
(5 REQ'D TOTAL)



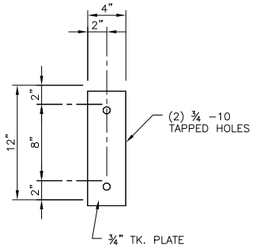
LOCATION OF BASEPLATE ON LEG (W12x87) TO BE SET BY DIMENSIONS FROM CENTERLINE OF VESSEL AFTER LEGS ARE WELDED TO SHELL (SEE SECTION A-A)

SECTION B-B



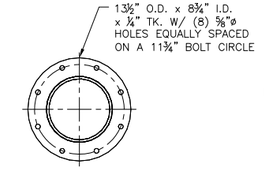
DETAIL 3

PIPE SUPPORT CLIP
(9) REQ'D



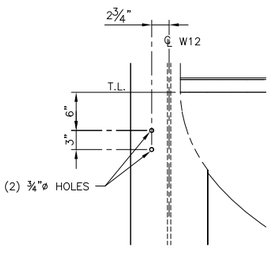
DETAIL 5

PIPE SUPPORT PAD
(2) REQ'D



DETAIL 7

INTERNAL FLANGE
3 316L SS



DETAIL 6

AT LEG LOCATED AT
225° ONLY

VESSEL DESCRIPTION	VESSEL PV-1
REFERENCES	VESSEL SPECIFICATION VS1
DESIGN CONDITIONS	125 PSIG @ 140° F
OPERATING CONDITIONS	
PROCESS FLUID	WATER, S.G. = 1.0
WALL THICKNESS	PER CODE REQUIREMENTS
MATERIALS OF CONSTRUCTION	SHELL: SA-516 GR. 70
	TOP HEAD: SA-516 GR. 70
	BOT. HEAD: SA-516 GR. 70
	NOZZLES: SA-106 GR. B (UNLESS NOTED)
	FLANGES: SA-105 (UNLESS NOTED)
	LINING ABOVE CONE: PLASITE 4110 35-45 MIL NOMINAL DFT PER CCC SPEC. VS-7
	LINING BELOW CONE: PLASITE 4110 10-15 MIL NOMINAL DFT PER CCC SPEC. VS-9
	UNDER CONE SEALANT: PHENOLINE 341 (3)
	FORCE CURED PER NSF 61 CRITERIA: NO
	SUPPORTS: A-992
	BOLTING: MANWAY: A-325 GR 1, GALVANIZED; NOZZLES: A-307 GR B, ZINC PLATED
	GASKETS: EPDM (45-55 DUROMETER)
TYPE CONSTRUCTION	FUSION WELDED
CORROS. ALLOW	NONE
CODE	ASME SECTION VIII, DIVISION 1, LATEST EDITION
INSPECTION	BY CALGON & CODE AGENCY
STAMPING	ASME "U", NBR
TESTING	HYDROSTATIC PER CODE
STRESS RELIEF	PER CODE
RADIOGRAPH	PER CODE AND CALGON CALCULATIONS
NAMEPLATE	ASME
STENCILS	LINED TANK – DO NOT WELD OR BURN
SEISMIC LOAD	IBC, Ss = 1.5, SITE CLASS D, I = 1.25 (3)
INSULATION	NONE – SEE NOTE 6
(3) SURFACE PREP	EXTERIOR: BRUSH BLAST PER SSPC-SP7
	INTERIOR: WHITE METAL BLAST PER SSPC-SP5
PAINTING	5-7 MILS DFT, PER CCC SPEC. RS-17. THE COLOR SHALL MATCH SHERWIN-WILLIAMS SW4026, SLATE GRAY.
CAPACITIES	FULL: 16,600 GAL
	OPERATING: 16,600 GAL AT 100% FILL
	MEDIA: 40,000 LBS.
WIEGHTS	EMPTY: 31,000 LBS.
	FULL H_2O: 170,000 LBS.
	FULL PRODUCT: 71,000 LBS. (DRY CARBON)
	OPERATING: 191,000 LBS.

NOZZLE SCHEDULE

MARK	REQ'D	SIZE	DRILLING	FACING	DESCRIPTION
A1	1	4"	150#	F.F.	CARBON OUTLET (LOWER)
A2	1	6"	150#	F.F.	CARBON OUTLET (UPPER)
B	1	6"	150#	F.F.	CARBON INLET
C	1	8"	150#	F.F.	INFLUENT W/INTERNAL NOZZLE (3)
D	1	8"	150#	F.F.	EFFLUENT
E	1	14X18	ELLIP.		MANWAY W/ ¼" THK. GASKET
F	1	20"	150#	F.F.	MANWAY W/BLIND FLANGE & GASKET
G	3	2"	150#	F.F.	SAMPLE POINT
H	1	2"	150#	F.F.	UNDERCONE VENT
(3) J	1	4"	150#	F.F.	VENT

NOTES:

1. ALL INTERIOR WELDS & EDGES TO BE GROUND TO 1/8" RADIUS MIN.
2. ALL NOZZLES MUST BE FLUSH ON INSIDE OF SHELL, U.O.N
3. 20" MANWAY FLG. TO BE SECURED WITH (2) BOLTS. REMAINDER OF BOLTS & NUTS TO BE PACKAGED AND SHIPPED IN THE CRATE.
4. REMOVE ALL WATER & DIRT AFTER HYDROTEST.
5. REMOVE ALL WELD SPATTER.
6. CONTACT CCC FOR HEAT TRACE REQUIREMENTS.
7. ALL FLANGE BOLT HOLES TO STRADDLE CENTERLINES.
8. FOR MANWAY DETAIL SEE DWG. 90110066.

REV	DESCRIPTION	APP	DATE
3	REVISED UNDERCONE SEALANT, RELOCATED NOZZLE B	MHS	7/8/15
2	GENERAL REVISION		
1	RE-NUMBERED (PREVIOUS #91983542)	RES	2/14/2012

REVISIONS

TOLERANCES (unless otherwise specified)

ANGULAR	±0°30'	DECIMAL (2 PLACES)	±.010
FRACTIONAL	±1/16"	DECIMAL (3 PLACES)	±.005
DECIMAL (1 PLACE)	±.015	DECIMAL (4 PLACES)	±.0005

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	NAME	DATE
DRAFTER	JGP	12/3/2010
DESIGNER		
CHECKER	M. ANTONETTI	12/11/2014
APPROVAL		
PROJECT No.	STANDARD	

CalgonCarbon

CLIENT: STANDARD

TITLE: MODEL 12-40, 125 PSIG 12 FT DIA., INTERNAL CONE VESSEL ARRANGEMENT

DWG. Size	SHEET No.	SCALE
D	1 OF 2	AS NOTED

DWG. No. 90110098 REV. 3

V:\Products\Carbon\Model 12-40\Vessel\90110098 Vessel.dwg Jul 08, 2015 - 10:16am

BILL OF MATERIAL

ITEM	QTY.	DESCRIPTION	MATERIAL	SAP No.	CCC SPEC
1	120	SEPTA	PPL	1001386	22.96
2	1	DECAL, DANGER, MANWAY	---	1058401	---
3	2	DECAL, CALGON LOGO	---	1059524	---
4	2	DECAL, LINED TANK	---	1025014	---
5	1	DECAL, DANGER, ELLIPTICAL MANWAY	---	1002706	---
6	1	GASKET, ELLIPTICAL 14" x 18" x ¼" THICK	WHITE EPDM	1053980	G46
7	1	GASKET, 20", 150#, ¼" THICK	WHITE EPDM	1054140	G46
8	20	BOLT, 1⅛" x 5" LG, HVY. HEX W/ NUT, GALVANIZED	A-325 GR 1	1060550	---
9	3	FLANGE, 2" 150# FF BLIND	SA-105	1001178	C2
10	3	GASKET, 2" 150# BLIND, ⅛" THK	WHITE EPDM	1053526	G46
11	12	BOLT, ⅝" x 2¾" LG, HVY. HEX W/ NUT, ZINC PLATED	A-307 GR B	1001075	F3

△3 MATERIAL FOR ONE VESSEL.

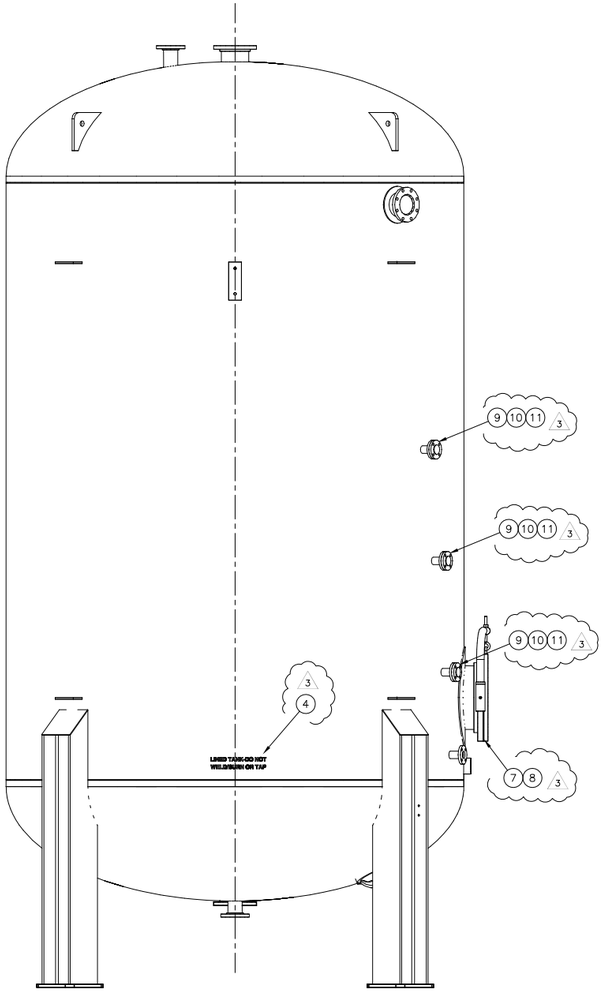
NOTES:

1.) LOCATE MANWAY DANGER DECALS ITEMS (2) & (5) AS SHOWN.

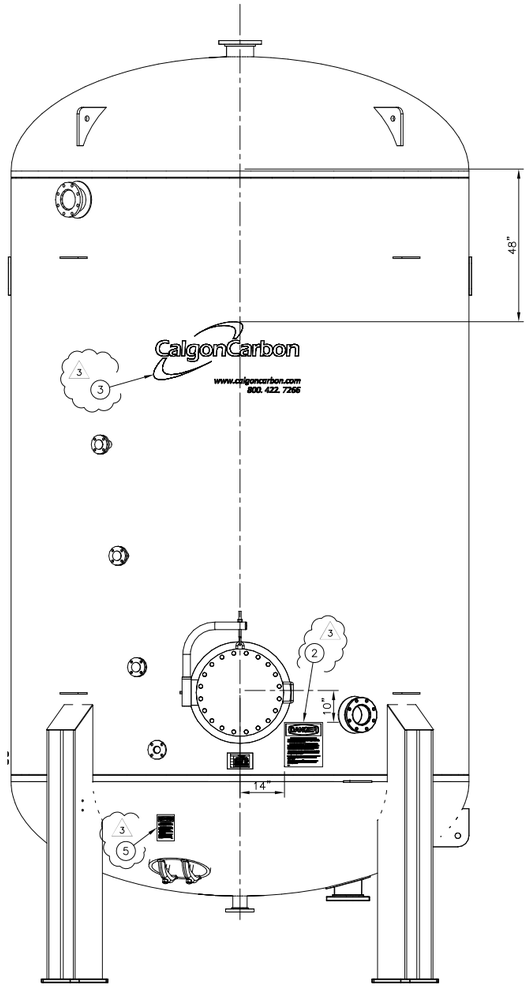
2.) LOCATE LINED TANK DECALS ITEM (4) NEAR BOTTOM WELD SEAM TO CLEAR PIPING.

3.) LOCATE CCC LOGOS ITEM (3) AT 0° & 180°, HEIGHT AS SHOWN.

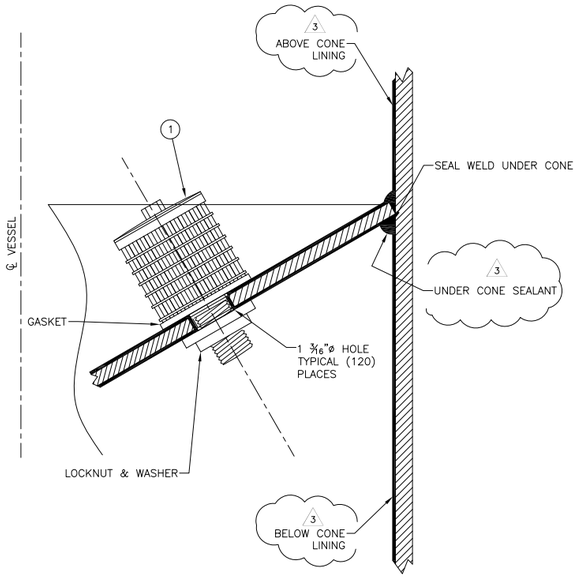
△3



LEFT ELEVATION



FRONT ELEVATION



SECTION C-C

SHEET 1

REV	DESCRIPTION	APP	DATE
3	REVISED UNDERCONE SEALANT, RELOCATED NOZZLE B	MHS	7/8/15
2	GENERAL REVISION		
1	RE-NUMBERED (PREVIOUS #91983542)	RES	2/14/2012

REVISIONS

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DRAFTER	JGP	12/3/2010
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CHECKER	M. ANTONETTI	12/11/2014
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CalgonCarbon

CLIENT: STANDARD

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DWG. Size	SHEET No.	SCALE
D	2 OF 2	AS NOTED

DWG. No. 90110098 REV. 3

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