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Mr. Todd Caffoe
Regional Hazardous Waste Remediation Engineer
New York State Department of Environmental Conservation
6274 Avon-Lima Road
Avon, New York 14414-9519

Subject:
Construction Completion Report
Sub-Slab Depressurization System Installation
Crosman Corporation Site
East Bloomfield, New York

Date:
January 27, 2017

Contact:
William B. Popham

Phone:
585 662 4022

Email:
bill.popham@arcadis.com

Our ref:
B0041501.0001

Dear Mr. Caffoe:

On behalf of Crosman Corporation and New Coleman Holdings, Inc. (collectively, Crosman), Arcadis of New York, Inc. has prepared the attached *Construction Completion Report* (CCR) documenting installation of the sub-slab depressurization system (SSDS) at the Crosman site located in East Bloomfield, New York, per the SSDS design conditionally approved by the Department on February 24, 2016. The attached CCR documents the installation, as well as initial testing, of the SSDS.

If you have any questions, please contact me at 585.662.4022.

Sincerely,

Arcadis of New York, Inc.

William B. Popham
Senior Vice President

Copies:
Justin Deming, New York State Department of Health
Timothy S. Martin, Esq., New Coleman Holdings, Inc.
Benedict Moshier, New Coleman Holdings, Inc.
Thomas F. Walsh, Esq., Barclay Damon, LLP
Gina Thomas, Crosman Corporation
Aaron D. Richardson, Arcadis of New York, Inc.

CONSTRUCTION COMPLETION REPORT

Sub-Slab Depressurization System
Crosman Corporation Site
East Bloomfield, New York

Prepared for:
Crosman Corporation and
New Coleman Holdings, Inc.

January 2017

CONSTRUCTION COMPLETION REPORT

Sub-Slab Depressurization System
Crosman Corporation Site
East Bloomfield, New York

Prepared for:

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Prepared by:

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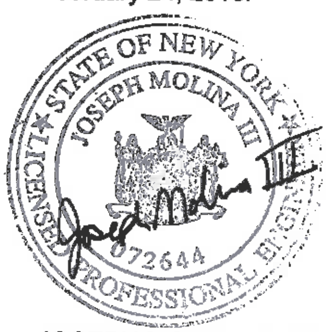
CONTENTS

TABLES

APPENDICES

CERTIFICATION

I, Joseph Molina, certify that I am currently a New York State registered professional engineer, I had primary direct responsibility for the implementation of the subject construction program, and I certify that the sub-slab depressurization system (SSDS) design was implemented and that all construction activities were completed in substantial conformance with the Division of Environmental Remediation-approved SSDS design, as conditioned by the Division of Environmental Remediation approval letter dated February 24, 2016.



JOSEPH MOLINA III, P.E.

1/26/17 DATE

1 INTRODUCTION/BACKGROUND

On behalf of Crosman Corporation and New Coleman Holdings, Inc. (collectively, Crosman), Arcadis of New York, Inc. (Arcadis) has prepared this *Construction Completion Report* to document the implementation of the recent vapor intrusion (VI) interim remedial measure activities conducted by Arcadis at the Crosman Corporation Site located in East Bloomfield, New York (Site). Based on the findings of the VI investigation implemented by Arcadis at the Site that are summarized in the *Vapor Intrusion Investigation and West Side Soil Boring Investigation Report* (Arcadis 2015a), and the radius of influence (ROI) study conducted by Arcadis in May 2015 that are summarized in the *Sub-Slab Depressurization Systems – Radius of Influence Summary* (Arcadis 2015b), sub-slab depressurization was selected as an interim remedial measure to reduce the potential for intrusion of soil vapors detected in the two target depressurization areas identified at the Site. Arcadis completed and submitted to the New York State Department of Environmental Conservation (NYSDEC) in December 2015 a sub-slab depressurization system (SSDS) design. Upon conditional approval of the design by the NYSDEC in a correspondence dated February 24, 2016, Arcadis began installation of the SSDS in March 2016.

2 SUMMARY OF REMEDIAL AND CONSTRUCTION ACTIVITIES

The SSDS design utilizes a vacuum blower to extract soil vapors containing site-related volatile organic compounds (VOCs) from two sub-slab extraction points, with the extracted vapors conveyed via overhead piping to a treatment system that consists of multiple granular-activated carbon (GAC) vessels located in a heated storage container outside of the main Crosman building. The extracted vapors are treated to remove the VOCs as they pass through the GAC vessels and are ultimately discharged to the atmosphere. Appendix A includes the Record Drawings of the SSDS.

2.1 Sub-Slab Depressurization Sumps Point Installation

In May 2015, as part of the ROI study, a sub-slab depressurization sump (SDS point) was installed within each of the two target depressurization areas at the Site. The first SDS point, SDS-1, was installed within the screw machine room in the western end of the main Crosman building. The second SDS point, SDS-2, was installed south of the filler room in the ammo department at the eastern end of the main Crosman building.

As detailed on Drawing M-2 of Appendix A, each SDS point was installed by drilling an 8-inch core hole through the concrete slab. After removing the existing concrete, approximately 1 foot of sub-slab material was removed and a 4-inch-diameter Schedule 40 screened polyvinyl chloride (PVC) slotted screen was then installed to 1 foot below the concrete slab. The open sub-slab annulus was then filled with course gravel to the bottom of the slab. Quickset non-shrinking grout was placed around the PVC screen to seal the concrete slab.

The SDS points were left in place at the completion of the ROI study, with the intent that they would be utilized as the extraction points for the SSDS.

2.2 Piping Installation

After receiving NYSDEC approval of the SSDS design, subject to two conditions that Crosman accepted, Arcadis began installation of the overhead conveyance piping portion of the SSDS in March 2016. Installation of the conveyance piping consisted of connecting 4-inch Schedule 40 PVC pipe to both extraction points (SDS-1 and SDS-2), installing a vertical riser, and then installing overhead piping to connect the vertical risers to the planned location of the SSDS treatment container, outside of the Crosman building (see Record Drawing G-1 [Appendix A]). At each extraction point, a vacuum gage, vapor sample port, and a 4-inch butterfly valve were also installed. Conveyance piping was sloped such that any accumulated water will flow by gravity toward either the associated extraction point sump or the system knockout tank, with the exception of a short section of exterior piping at the wall penetration for SDS-2, where a condensate return line was installed.

2.3 System Installation

Product Level Controls, Inc. constructed the containerized treatment system at their Burnsville, Minnesota facility and delivered it to the Site on June 27, 2016. As shown on Record Drawing M-1 (Appendix A), the containerized system includes a 4.6-horsepower regenerative blower to extract vapors from the two SDS points, a knock-out tank, an air filter, four 1,000-pound vapor-phase GAC vessels, and controls and instrumentation. Upon delivery to the Site, Arcadis connected the existing conveyance piping to the treatment system in the container and began startup testing of the entire SSDS on June 28, 2016. Startup testing was completed on July 7, 2016 and the SSDS was officially started on July 8, 2016, and is operating in accordance with the *Operation, Maintenance, and Monitoring Plan* (Appendix B). No changes were made during installation to the SSDS design as approved by the NYSDEC.

3 SYSTEM EFFECTIVENESS

During the first month of SSDS operation, weekly monitoring was performed to document the effectiveness of the system. Following the first month of operation, monitoring has been performed on a monthly basis. Monitoring included recording sub-slab vacuum pressures and collecting and analyzing soil vapor samples from throughout the system.

3.1 Sub-Slab Vacuum Monitoring

Arcadis recorded instantaneous sub-slab differential pressure readings from the area surrounding the two SDS points. With the system operating, instantaneous sub-slab differential pressures were measured using micromanometers capable of measuring to the nearest 0.001 inches of water column at vacuum monitoring points (VMPs) installed by Arcadis. VMP locations are shown on Record Drawing G-1 (Appendix A). Table 1 summarizes the results and shows that vacuum is being observed throughout the target depressurization area. A vacuum greater than 0.002 inches of water column was achieved on July 15, 2016 at all VMPs, except VMP-10, where water was encountered. By July 29, 2016, the vacuum initially achieved was enhanced at all VMPs in the SDS-1 Area, while the vacuum had dropped at all VMPs in the SDS-2 Area, except VMP-8, where it increased by 0.011 inches of water column.

3.2 System Vapor Sampling

Arcadis collected soil vapor samples from the influent (both individual SDS points and the combined influent) and effluent of the SSDS, with the system operating. Grab samples were collected using laboratory-provided 1-liter Summa canisters. The Summa canisters were submitted to TestAmerica Laboratories in Burlington, Vermont and analyzed for VOCs using United States Environmental Protection Agency Method TO-15. Table 2 summarizes the results and shows that site-related VOCs, specifically trichloroethene and its daughter products, cis-1,2-dichloroethene and total 1,2-dichloroethene, are effectively being removed through the SSDS. The laboratory data sheets and required laboratory data deliverables associated with this sampling effort will be submitted as an electronic submission per the NYSDEC's Electronic Document Standards.

Following the NYSDEC Division of Air Resources (DAR)-1 Guidance, system parameter (e.g., flow rate, stack height) and the concentration of VOCs observed in the system effluent were used to calculate annual and short-term impacts. The calculated impacts were compared against the guidelines for Annual Guidance Concentration (AGC) and Short-term Guidance Concentration (SGC) provided in the DAR-1 Guidance for each VOC. As presented in Table 3, using the maximum detected concentration for each VOC, the effluent from the SSDS is well below both the AGC and SGC for all VOCs detected.

In addition, sampling shows that the concentration of VOCs contained in the combined influent sub-slab vapors fell approximately seven-fold from system startup on July 8, 2016 to December 20, 2016.

As presented in Table 4, system flow rates and the concentration of VOCs in the combined system influent have been used to calculate the mass of VOCs removed by the SSDS. Removed mass is presented in terms of both mass removed during a set time period (i.e., between sampling events), and cumulative mass removal since the system was started. As presented in Table 4, VOC mass continues to be effectively removed by the SSDS. The decline in flow/extraction rates presented in Table 4 is a function of the combined effects of declining flow rates, as well as declining influent VOC concentrations. The declining flow rates are an anticipated change caused by falling ambient temperatures, which causes an increase in condensation in conveyance piping, and the resulting friction losses. The declining influent VOC concentrations is further evidence that the SSDS is effectively removing VOC contamination from the sub-slab environment.

4 REFERENCES

Arcadis. 2015a. *Vapor Intrusion Investigation and West Side Soil Boring Investigation Report*. Crosman Corporation. April 23.

Arcadis. 2015b. *Sub-Slab Depressurization Systems – Radius of Influence Summary*. Crosman Corporation. July 24.

TABLES

Table 1
Sub-Slab Vacuum Monitoring
Construction Completion Report
Crosman Corporation
East Bloomfield, New York

Date	Time	Sub-Slab Differential Pressure (in.wc)											
		SDS-1 Area						SDS-2 Area					
		VMP-1	VMP-2	VMP-3	VMP-4	VMP-5	VMP-6	VMP-7	VMP-8	VMP-9	VMP-10	VMP-11	VMP-12
7/15/2016	9:45	-8.287	-0.020	-0.244	-0.019	-0.007	-0.021	-0.008	-0.002	-0.007	NA[1]	-0.051	-0.032
7/22/2016	14:00	-8.641	-0.076	-0.249	-0.004	-0.050	-0.025	-0.001	-0.015	-0.009	NA[1]	-0.027	-0.019
7/29/2016	9:20	-8.952	-0.071	-0.256	-0.003	-0.046	-0.023	-0.001	-0.013	-0.010	NA[1]	-0.025	-0.016
8/25/2016	8:00	-8.652	-0.066	-0.288	-0.005	-0.051	-0.021	-0.013	-0.006	-0.014	NA[1]	-0.059	-0.035
9/22/2016	9:00	-7.091	-0.055	-0.210	-0.002	-0.033	-0.016	-0.012	-0.005	-0.047	-0.001	-0.135	-0.034
10/26/2016	12:00	-7.308	-0.060	-0.200	-0.014	-0.042	-0.021	-0.012	-0.008	-0.043	-0.004	-0.111	NA[2]
11/30/2016	8:15	-7.947	-0.060	-0.198	-0.002	-0.039	-0.002	-0.021	-0.008	-0.040	-0.002	-0.075	-0.118
12/20/2016	8:00	-7.900	-0.036	-0.184	-0.001	-0.035	-0.023	-0.006	-0.005	-0.007	-0.005	-0.033	-0.233

Notes:

in.wc = inches of water column

SDS = sub-slab depressurization sumps

VMP = vacuum monitoring points

NA[1] = no data collected; water in sample point

NA[2] = no data collected; sample point was inaccessible

Table 2
Soil Vapor Sampling Results
Construction Completion Report
Crosman Corporation
East Bloomfield, New York

Sample ID	SDS-1													
Sample Port ID/Location	SP-001/SDS-1 Influent													
Sample Collection Date	7/8/2016		7/29/2016		8/25/2016		9/22/2016		10/26/2016		11/30/2016		12/20/2016 **	
Analyte	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier
Vinyl chloride	4,800	J	480	U	240	U	270	U	130	U	81	U	NA**	
1,1-Dichloroethene	37,000	U	3,700	U	1,800	U	2,100	U	1,000	U	630	U	NA**	
Acetone	780,000		71,000		8,100	J	40,000		16,000	U	9,400	U	NA**	
Methylene Chloride	81,000	U	8,100	U	4,000	U	4,600	U	2,300	U	1,400	U	NA**	
trans-1,2-Dichloroethene	37,000	U	3,700	U	1,800	U	2,100	U	1,000	U	630	U	NA**	
1,1-Dichloroethane	38,000	U	3,800	U	1,900	U	2,200	U	1,100	U	640	U	NA**	
cis-1,2-Dichloroethene	37,000	U	3,700	U	1,800	U	2,100	U	1,000	U	630	U	NA**	
1,2-Dichloroethene, Total	74,000	U	7,400	U	3,700	U	4,200	U	2,100	U	1,300	U	NA**	
1,1,1-Trichloroethane	51,000	U	5,100	U	2,500	U	2,900	U	1,400	U	860	U	NA**	
Carbon tetrachloride	12,000	U	1,200	U	580	U	670	U	330	U	200	U	NA**	
Benzene	30,000	U	3,000	U	1,500	U	1,700	U	840	U	510	U	NA**	
Trichloroethene	2,800,000		650,000		320,000		420,000		140,000		100,000		NA**	
Toluene	35,000	U	3,500	U	1,700	U	2,000	U	990	U	600	U	NA**	
Tetrachloroethene	64,000	U	6,300	U	3,100	U	3,600	U	1,800	U	1,100	U	NA**	
Chlorobenzene	43,000	U	4,300	U	2,100	U	2,400	U	1,200	U	730	U	NA**	
m,p-Xylene	100,000	U	10,000	U	5,000	U	5,800	U	2,900	U	1,700	U	NA**	
Xylene, o-	41,000	U	4,100	U	2,000	U	2,300	U	1,100	U	690	U	NA**	
Bromoform	97,000	U	9,700	U	4,800	U	5,500	U	2,700	U	1,600	U	NA**	
1,1,2,2-Tetrachloroethane	64,000	U	6,400	U	3,200	U	3,700	U	1,800	U	1,100	U	NA**	
Total VOCs	**3,584,800**		**721,000**		**328,100**		**460,000**		**140,000**		**100,000**		**NA****	

Notes on page 4.

Table 2
Soil Vapor Sampling Results
Construction Completion Report
Crosman Corporation
East Bloomfield, New York

Sample ID	SDS-2													
Sample Port ID/Location	SP-002/SDS-2 Influent													
Sample Collection Date	7/8/2016		7/29/2016		8/25/2016		9/22/2016		10/26/2016		11/30/2016		12/20/2016	
Analyte	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier
Vinyl chloride	470	U	41	U	64	U	92	U	27	U	68	U	25	U
1,1-Dichloroethene	3,600	U	320	U	500	U	720	U	210	U	530	U	200	U
Acetone	430,000		1,400	J	4,100	J	2,200	J	3,100	U	7,900	U	3,000	U
Methylene Chloride	7,900	U	700	U	1,100	U	1,600	U	450	U	1,200	U	430	U
trans-1,2-Dichloroethene	3,600	U	90	J	500	U	720	U	210	U	530	U	200	U
1,1-Dichloroethane	3,700	U	320	U	510	U	730	U	210	U	540	U	200	U
cis-1,2-Dichloroethene	2,600	J	5,600		5,700		4,900		2,100		3,600		2,100	
1,2-Dichloroethene, Total	2,600	J	5,600		5,600		4,800		2,100		3,600		2,100	
1,1,1-Trichloroethane	5,000	U	440	U	680	U	990	U	280	U	720	U	270	U
Carbon tetrachloride	1,100	U	100	U	160	U	230	U	66	U	170	U	63	U
Benzene	2,900	U	260	U	400	U	580	U	170	U	420	U	160	U
Trichloroethene	78,000		76,000		87,000		69,000		31,000		49,000		33,000	
Toluene	3,400	U	300	U	470	U	680	U	200	U	500	U	190	U
Tetrachloroethene	6,200	U	540	U	100	J	1,200	U	350	U	100	J	340	U
Chlorobenzene	4,200	U	370	U	580	U	830	U	240	U	610	U	230	U
m,p-Xylene	9,900	U	870	U	1,400	U	2,000	U	570	U	1,400	U	540	U
Xylene, o-	4,000	U	350	U	540	U	790	U	230	U	580	U	220	U
Bromoform	9,400	U	830	U	1,300	U	1,900	U	540	U	1,400	U	510	U
1,1,2,2-Tetrachloroethane	6,300	U	550	U	860	U	1,200	U	360	U	910	U	340	U
Total VOCs	**513,200**		**88,690**		**102,500**		**80,900**		**35,200**		**56,300**		**37,200**	

Notes on page 4.

Table 2
Soil Vapor Sampling Results
Construction Completion Report
Crosman Corporation
East Bloomfield, New York

Sample ID	Pre-VPGAC-101													
Sample Port ID/Location	SP-103/Combined Influent													
Sample Collection Date	7/15/2016		7/22/2016		8/25/2016		9/22/2016		10/26/2016		11/30/2016		12/20/2016	
Analyte	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier
Vinyl chloride	290	U	200	U	81	U	69	U	77	U	52	U	68	U
1,1-Dichloroethene	2,300	U	1,600	U	630	U	530	U	600	U	400	U	530	U
Acetone	34,000	U	24,000	U	9,400	U	8,000	U	9,000	U	6,000	U	7,900	U
Methylene Chloride	5,000	U	3,500	U	1,400	U	1,200	U	1,300	U	880	U	430	J B
trans-1,2-Dichloroethene	2,300	U	1,600	U	630	U	530	U	600	U	400	U	530	U
1,1-Dichloroethane	2,300	U	1,600	U	640	U	540	U	610	U	410	U	540	U
cis-1,2-Dichloroethene	4,200		4,600		2,700		2,900		2,200		1,900		1,200	
1,2-Dichloroethene, Total	4,400	J	4,800		2,700		2,900		2,200		1,900		1,200	
1,1,1-Trichloroethane	3,100	U	2,200	U	870	U	730	U	830	U	550	U	730	U
Carbon tetrachloride	720	U	500	U	200	U	170	U	190	U	130	U	170	U
Benzene	1,800	U	1,300	U	510	U	430	U	480	U	320	U	430	U
Trichloroethene	370,000		290,000		110,000		99,000		130,000		65,000		51,000	
Toluene	2,200	U	1,500	U	600	U	510	U	570	U	380	U	500	U
Tetrachloroethene	3,900	U	2,700	U	1,100	U	910	U	1,000	U	690	U	900	U
Chlorobenzene	2,700	U	1,800	U	730	U	620	U	700	U	470	U	610	U
m,p-Xylene	6,300	U	4,300	U	1,700	U	1,500	U	1,600	U	1,100	U	1,400	U
Xylene, o-	2,500	U	1,700	U	690	U	580	U	660	U	440	U	580	U
Bromoform	6,000	U	4,100	U	1,600	U	1,400	U	1,600	U	1,100	U	1,400	U
1,1,2,2-Tetrachloroethane	4,000	U	2,700	U	1,100	U	920	U	1,000	U	700	U	910	U
Total VOCs	**378,600**		**299,400**		**115,400**		**104,800**		**134,400**		**68,800**		**53,830**	

Notes on page 4.

Table 2
Soil Vapor Sampling Results
Construction Completion Report
Crosman Corporation
East Bloomfield, New York

Sample ID	Post-Blower/ Effluent																	
Sample Port ID/Location	SP-301/Effluent																	
Sample Collection Date	7/8/2016		7/15/2016		7/22/2016		7/29/2016		8/25/2016		9/22/2016		10/26/2016		11/30/2016		12/20/2016	
Analyte	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier	Result	Lab Qualifier
Vinyl chloride	1	U	1	U	1	U	1	U	1	U	6.3	U	1	U	1	U	1	U
1,1-Dichloroethene	7.9	U	7.9	U	8	U	7.9	U	7.9	U	49	U	7.9	U	7.9	U	7.9	U
Acetone	400		82	J	130		350		54	J	140	J	120	U	120	U	31	J
Methylene Chloride	17	U	17	U	18	U	17	U	17	U	110	U	17	U	17	U	7.3	J B
trans-1,2-Dichloroethene	7.9	U	7.9	U	8	U	7.9	U	7.9	U	49	U	7.9	U	7.9	U	7.9	U
1,1-Dichloroethane	8.1	U	8.1	U	8.2	U	8.1	U	8.1	U	50	U	8.1	U	8.1	U	8.1	U
cis-1,2-Dichloroethene	7.9	U	7.9	U	8	U	7.9	U	7.9	U	49	U	7.9	U	7.9	U	7.9	U
1,2-Dichloroethene, Total	16	U	16	U	16	U	16	U	16	U	97	U	16	U	16	U	16	U
1,1,1-Trichloroethane	11	U	11	U	11	U	11	U	11	U	67	U	11	U	11	U	11	U
Carbon tetrachloride	2.5	U	2.5	U	2.5	U	2.5	U	2.5	U	15	U	2.5	U	2.5	U	2.5	U
Benzene	6.4	U	6.4	U	6.5	U	6.6		6.4	U	39	U	6.4	U	6.4	U	11	
Trichloroethene	470		170		130		2.1	U	280		13	U	4.5		3.2		9.4	
Toluene	3.8	J	7.5	U	7.6	U	6.7	J	7.5	U	46	U	7.5	U	7.5	U	7.5	U
Tetrachloroethene	14	U	14	U	14	U	14	U	14	U	83	U	14	U	14	U	14	U
Chlorobenzene	9.2	U	9.2	U	9.3	U	9.2	U	9.2	U	56	U	9.2	U	9.2	U	9.2	U
m,p-Xylene	7.3	J	4.4	J	4.7	J	8.9	J	22	U	130	U	22	U	22	U	22	U
Xylene, o-	3.3	J	8.7	U	2.4	J	3.5	J	8.7	U	53	U	8.7	U	8.7	U	8.7	U
Bromoform	21	U	21	U	21	U	21	U	21	U	130	U	21	U	21	U	21	U
1,1,2,2-Tetrachloroethane	14	U	14	U	14	U	14	U	14	U	84	U	14	U	14	U	14	U
Total VOCs	**884**		**256**		**267**		**376**		**334**		**140**		**4.5**		**3.2**		**58.7**	

Notes:
1) Samples analyzed for VOCs by USEPA Method TO-15
2) All concentrations are in $\mu g/m^3$.
3) Total VOCs shown include estimated concentrations (e.g., concentrations with "J" lab qualifiers)
4) The sample collected at SDS-1 on 12/20/2016 is believed to be biased high due to condensate getting into the sample container during collection

Abbreviations:
J = Result is less than the Reporting Limit but greater than or equal to the Method Detection Limit, and the concentration is an approximate value
B = Indicates the analyte was detectedin the blank and sample
U = Indicates the analyte was analyzed for but not detected
NA** = Not Available; analytical data has been rejected due to condensate entering the sample container during collection
SDS = sub-slab depressurization sump
SP = sample port
$\mu g/m^3$ = micrograms per cubic meter
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound
VPGAC = vapor-phase granular-activated carbon

Table 3
DAR-1 Calculations
Construction Completion Report
Crosman Corporation
East Bloomfield, New York

Volatile Organic Compounds(1)	AGC(1) ($\mu g/m^3$)	SGC(1) ($\mu g/m^3$)	Maximum SSDS Effluent Concentration ($\mu g/m^3$) (3)	Standard Cubic Feet Per Minute	Number of Discharge Points	Building Height (feet)	Stack Height	Maximum Houly Rate (lb/hr)	Maximum Emission Rate (lb/day)	Actual Annual Impact ($\mu g/m^3$)(2)	Actual Annual Impact Percentage of AGC (%)	Actual Short Term Impact ($\mu g/m^3$)(2)	Actual Short Term Impact Percentage of SGC (%)
Vinyl chloride	0.07	180,000.00	6.30	216	1.00	33.00	38.00	0.00	0.0001	0.0001	0.10	0.00	0.00
1,1-Dichloroethene	200.00	-	49.00	216	1.00	33.00	38.00	0.00	0.0009	0.0005	0.00	0.00	-
Acetone	30,000.00	180,000.00	400.00	216	1.00	33.00	38.00	0.00	0.0077	0.0045	0.00	0.03	0.00
Methylene Chloride	60.00	14,000.00	110.00	216	1.00	33.00	38.00	0.00	0.0021	0.0012	0.00	0.01	0.00
trans-1,2-Dichloroethene	63.00	-	49.00	216	1.00	33.00	38.00	0.00	0.0009	0.0005	0.00	0.00	-
1,1-Dichloroethane	0.63	-	50.00	216	1.00	33.00	38.00	0.00	0.0010	0.0006	0.09	0.00	-
cis-1,2-Dichloroethene	63.00	-	49.00	216	1.00	33.00	38.00	0.00	0.0009	0.0005	0.00	0.00	-
1,2-Dichloroethene, Total	63.00	-	97.00	216	1.00	33.00	38.00	0.00	0.0019	0.0011	0.00	0.01	-
1,1,1-Trichloroethane	5,000.00	9,000.00	67.00	216	1.00	33.00	38.00	0.00	0.0013	0.0007	0.00	0.00	0.00
Carbon tetrachloride	0.17	1,900.00	15.00	216	1.00	33.00	38.00	0.00	0.0003	0.0002	0.10	0.00	0.00
Benzene	0.13	1,300.00	39.00	216	1.00	33.00	38.00	0.00	0.0008	0.0004	0.34	0.00	0.00
Trichloroethene	0.20	14,000.00	470.00	216	1.00	33.00	38.00	0.00	0.0091	0.0052	2.62	0.03	0.00
Toluene	5,000.00	37,000.00	46.00	216	1.00	33.00	38.00	0.00	0.0009	0.0005	0.00	0.00	0.00
Tetrachloroethene	4.00	300.00	83.00	216	1.00	33.00	38.00	0.00	0.0016	0.0009	0.02	0.01	0.00
Chlorobenzene	60.00	-	56.00	216	1.00	33.00	38.00	0.00	0.0011	0.0006	0.00	0.00	-
m,p-Xylene	100.00	22,000.00	130.00	216	1.00	33.00	38.00	0.00	0.0025	0.0015	0.00	0.01	0.00
Xylene, o-	100.00	22,000.00	53.00	216	1.00	33.00	38.00	0.00	0.0010	0.0006	0.00	0.00	0.00
Bromoform	0.91	-	130.00	216	1.00	33.00	38.00	0.00	0.0025	0.0015	0.16	0.01	-
1,1,2,2-Tetrachloroethane	16.00	-	84.00	216	1.00	33.00	38.00	0.00	0.0016	0.0009	0.01	0.01	-

Notes:

1 AGC and SGC values obtained from NYSDEC DAR-1 AGC/SGC Tables, dated 2/28/14.

2 Actual annual impact calculated by following procedures described in NYSDEC DAR-1 Guidelines for the Control of Toxic Ambient Air Contaminants (NYSDEC 1997).

3 For constituents which have not yet been detected in SSDS effluent vapor samples, the laboratory reporting limit has been used.

Abbreviations:

"-" = indicates no guideline as been established
% = percent
AGC = Annual Guideline Concentration
DAR = Division of Air Resources
SGC = Short-term Guideline Concentration
lb/day = pounds per day
lb/hr = pounds per hour
NYSDEC = New York State Department of Environmental Conservation
SSDS = sub-slab depressurization system
$\mu g/m^3$ = micrograms per cubic meter

Table 4
VOC Mass Removal Estimate
Construction Completion Report
Crosman Corporation
East Bloomfield, New York

Sample Date	Period[1]		Sum of VOCs ($\mu g/m^3$)[3]			Flow Rate Used for Mass Removal Rate Calculation (scfm) [4]			Mass Removal Rate for Period (grams/day)[5]	Mass Removed Per Period (kg)	Cumulative Mass Removed (kg)
	Duration (days)	Uptime (%)[2]	SDS-1	SDS-2	Combined Influent	SDS-1	SDS-2	Combined Influent			
7/8/2016	-	-	3,584,800	513,200	-	40	45	85	-	-	-
7/15/2016	7	87.79	-	-	378,600	106	101	207	4,993	30.7	30.7
7/22/2016	7	74.50	-	-	299,400	92	96	188	2,746	14.3	45.0
7/29/2016	7	99.94	721,000	88,690	-	97	101	198	2,756	19.3	64.3
8/25/2016	27	99.81	328,100	102,500	115,400	93	96	189	2,053	55.3	119.6
9/22/2016	28	93.17	460,000	80,900	104,800	78	78	156	778	20.3	139.9
10/26/2016	34	99.82	140,000	35,200	134,400	63	60	123	670	22.8	162.7
11/30/2016	35	99.87	100,000	56,300	68,800	12	20	32	382	13.4	176.0
12/20/2016	20	99.69	NA**	37,200	53,830	17	14	31	79	1.6	177.6

Notes:

[1] Time periods shown for each sample date begin at previous sample date and end at current sample date.

[2] Uptime percentage calculated using system runtime readings from system's human machine interface.

3) Sum of VOCs are based on system vapor sample laboratory analytical results from respective sample date. Combined influent laboratory analytical data, when sampled, have been used for mass removal rate calculations. When not available, SDS-1 and SDS-2 data have been used.
4) Flow rates utilized for mass removal rate calculations obtained by measuring air velocity from the individual extraction points using a handheld anemometer.
5) Mass removal rates have been calculated for each sampling date using laboratory analytical data and system flow rates. Representative mass removal rates have been assigned to each time period (i.e., between sampling dates) by averaging the respective mass removal rates from the start and end of the time period.

Abbreviations:

- = not applicable

kg = kilograms

NA** = not available; analytical data has been rejected due to condensate entering the sample container during collection

scfm = standard cubic feet per minute

$\mu g/m^3$ = micrograms per cubic meter

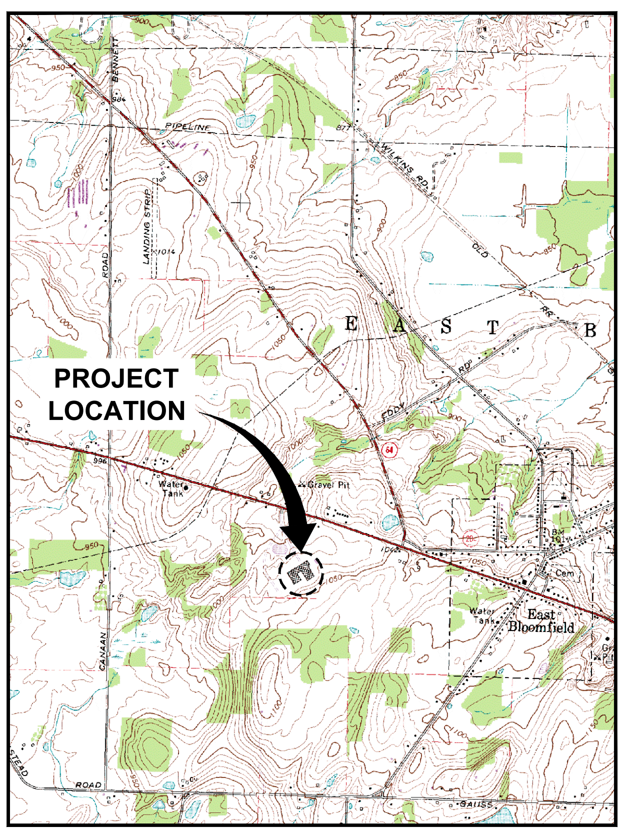
VOC = volatile organic compound

APPENDIX A

Record Drawings

RECORD DRAWINGS

SUB-SLAB DEPRESSURIZATION SYSTEM



LOCATION MAP

0 2000' 4000'

GRAPHIC SCALE

NEW YORK

CROSMAN CORPORATION SITE
7629 ROUTES 5 & 20
EAST BLOOMFIELD, NEW YORK

DATE ISSUED

DECEMBER 2016

RECORD DRAWINGS
TO THE BEST OF OUR KNOWLEDGE, INFORMATION AND BELIEF, THESE RECORD DRAWINGS SUBSTANTIALLY REPRESENT THE PROJECT AS CONSTRUCTED.

DATE__________BY____________________

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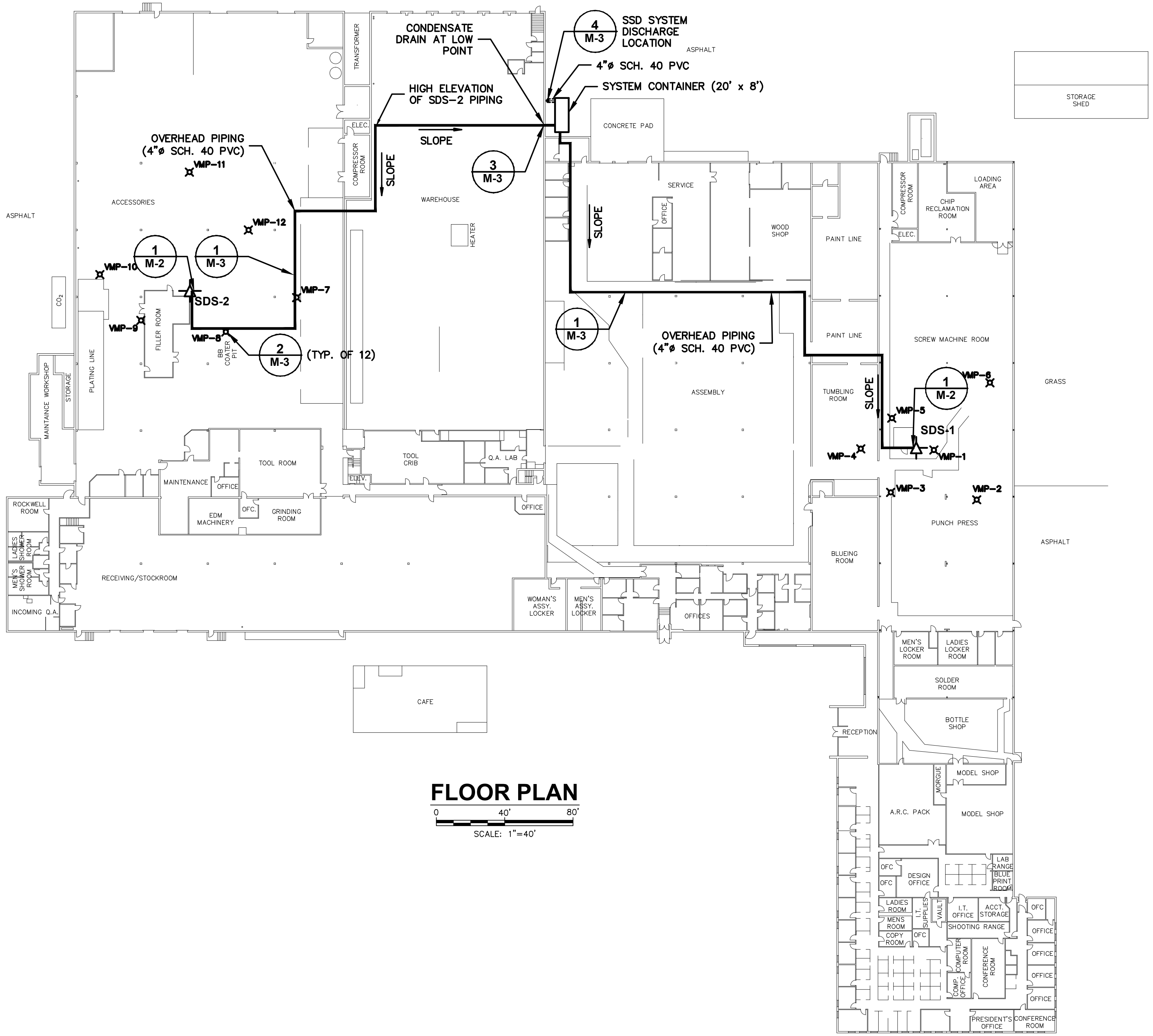
INDEX TO DRAWINGS



FLOOR PLAN

0 40' 80'

SCALE: 1"=40'

LEGEND:

- SSD SYSTEM EXTRACTION POINT
- SSD MONITORING POINT
- OVERHEAD SSD EXTRACTION PIPING
- SSD SYSTEM DISCHARGE PIPING

NOTES:

1. BASE MAP SUPPLIED BY CROSMAN CORPORATION, DRAWING FACILITY-3-14-08, DATED 3/14/2008.
2. NOT ALL PHYSICAL FEATURES SHOWN.
3. ALL LOCATIONS ARE APPROXIMATE.
4. THE SSD SYSTEM IS DESIGNED TO ACHIEVE A 40' RADIUS OF INFLUENCE AT SDS-1 AND 60' RADIUS OF INFLUENCE AT SDS-2.
5. SSD EXTRACTION PIPING SLOPED AS INDICATED TO PROMOTE DRAINAGE OR COLLECTION OF POTENTIALLY ACCUMULATED WATER.
6. LAND SURFACE AT SYSTEM CONTAINER LOCATION IS ASPHALT. CONTAINER LEVELED AS NEEDED USING STEEL SHIMS.
7. SSD SYSTEM DISCHARGE PIPING STACK EXTENDS TO 3 FEET ABOVE ROOFLINE.

RECORD DRAWINGS
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DATE__________BY____________________

SCALE(S) AS INDICATED

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name: **CHRISTOPHER D. ENGLER**
Professional Engineer's No.: 069748

State	Date Signed	Project Mgr.
NY		WBP
Designed by	**Drawn by**	**Checked by**
CD	GHS	CDE

STATE OF NEW YORK · CHRISTOPHER DANE ENGLER · 069748 · LICENSED PROFESSIONAL ENGINEER

ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

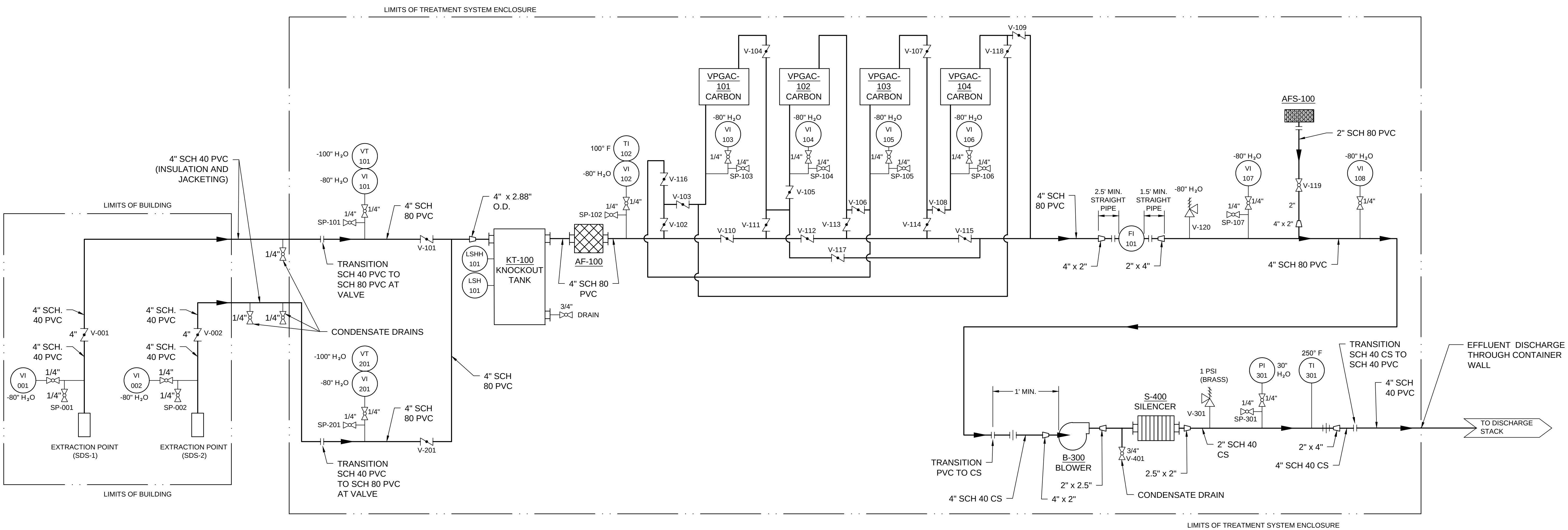
SSD SYSTEM LAYOUT

ARCADIS Project No. B0041501.0001.00010

Date DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

G-1



LEGEND:

	VAPOR PROCESS PIPING
	BUILDING LIMITS
	FLANGE / TRANSITION
	UNION
	BLOWER
	FLANGED BUTTERFLY VALVE
	BALL VALVE
	PRESSURE RELIEF VALVE
	VACUUM RELIEF VALVE
	REDUCER
	AIR FILTER ONLY
	AIR FILTER / SILENCER
	SILENCER ONLY

ABBREVIATIONS:

AF	AIR FILTER
AFS	AIR FILTER/SILENCER
B	BLOWER
CPVC	CHLORINATED POLYVINYL CHLORIDE
CS	CARBON STEEL
FIT	FLOW INDICATING TRANSMITTER
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH-HIGH
KT	KNOCKOUT TANK
PI	PRESSURE INDICATOR
PVC	POLYVINYL CHLORIDE
S	SILENCER
SCH	SCHEDULE
TI	TEMPERATURE INDICATOR
TT	TEMPERATURE TRANSMITTER
V	VALVE
VI	VACUUM INDICATOR
VPGAC	VAPOR PHASE GRANULAR ACTIVATED CARBON
VT	VACUUM TRANSMITTER

NOTES:

1. SEE TABLE 1 OF OM&M PLAN FOR MAKE AND MODEL OF SIGNIFICANT EQUIPMENT.
2. SEE TABLE 3 OF OM&M PLAN FOR SYSTEM ALARM DETAILS.
3. ALL EXTERIOR PIPING INSTALLED WITH 1" FIBERGLASS INSULATION AND ALUMINUM JACKETING.

GENERAL PROCESS DESCRIPTION:

THE SYSTEM IS A SUB-SLAB DEPRESSURIZATION (SSD) SYSTEM DESIGNED TO EXTRACT SUB-SLAB SOIL VAPORS FROM TWO (2) EXTRACTION POINTS (SDS-1 AND SDS-2) TO CREATE A NEGATIVE SUB-SLAB DIFFERENTIAL PRESSURE ACROSS THE TARGET DEPRESSURIZATION AREA. BLOWER (B-300) EXTRACTS SOIL VAPORS SIMULTANEOUSLY FROM TWO SEPARATE EXTRACTION HEADERS (SDS-1 AND SDS-2) EACH WITH ITS OWN VACUUM TRANSMITTER (VT-101 AND VT-201). THE TWO EXTRACTION HEADERS COMBINE INTO A SINGLE EXTRACTION HEADER INSIDE THE TREATMENT SYSTEM ENCLOSURE. THE EXTRACTION HEADER INCLUDES A MOISTURE SEPARATOR TANK (KT-100) TO REMOVE ANY CONDENSATE PRESENT IN THE VAPOR STREAM AND IN-LINE AIR FILTER (AF-100). THE MOISTURE SEPARATOR IS EQUIPPED WITH HIGH AND HIGH-HIGH LIQUID LEVEL SENSORS (LSH-101 AND LSHH-101). CARBON TREATMENT INCLUDES FOUR (4) 1,000-POUND VAPOR PHASE CARBON VESSELS (VPGAC-101, VPGAC-102, VPGAC-103 AND VPGAC-104) WITH FLOW PATTERNS ADJUSTABLE VIA VALVE CONFIGURATION. APPLIED VACUUM FROM THE BLOWER ADJUSTABLE VIA A DILUTION LINE EQUIPPED WITH A COMBINATION AIR FILTER/SILENCER. THE PROCESS STREAM ON THE DISCHARGE SIDE OF THE BLOWER INCLUDES AN IN-LINE SILENCER/MUFFLER (S-400). VAPORS DISCHARGED TO THE ATMOSPHERE VIA A DISCHARGE STACK EXTENDING 3' ABOVE THE WAREHOUSE ROOF LINE AT THE PROPOSED LOCATION OF THE SYSTEM CONTAINER.

RECORD DRAWINGS

TO THE BEST OF OUR KNOWLEDGE, INFORMATION AND BELIEF, THESE RECORD DRAWINGS SUBSTANTIALLY REPRESENT THE PROJECT AS CONSTRUCTED.

DATE__________BY__________

SCALE(S) AS INDICATED

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name: **CHRISTOPHER D. ENGLER**
Professional Engineer's No.: 069748

State	Date Signed	Project Mgr.
NY		WBP
Designed by	Drawn by	Checked by
CD	GHS	CDE

STATE OF NEW YORK · CHRISTOPHER DANE ENGLER · 069748 · LICENSED PROFESSIONAL ENGINEER

ARCADIS Design & Consultancy for natural and built assets
ARCADIS OF NEW YORK, INC.

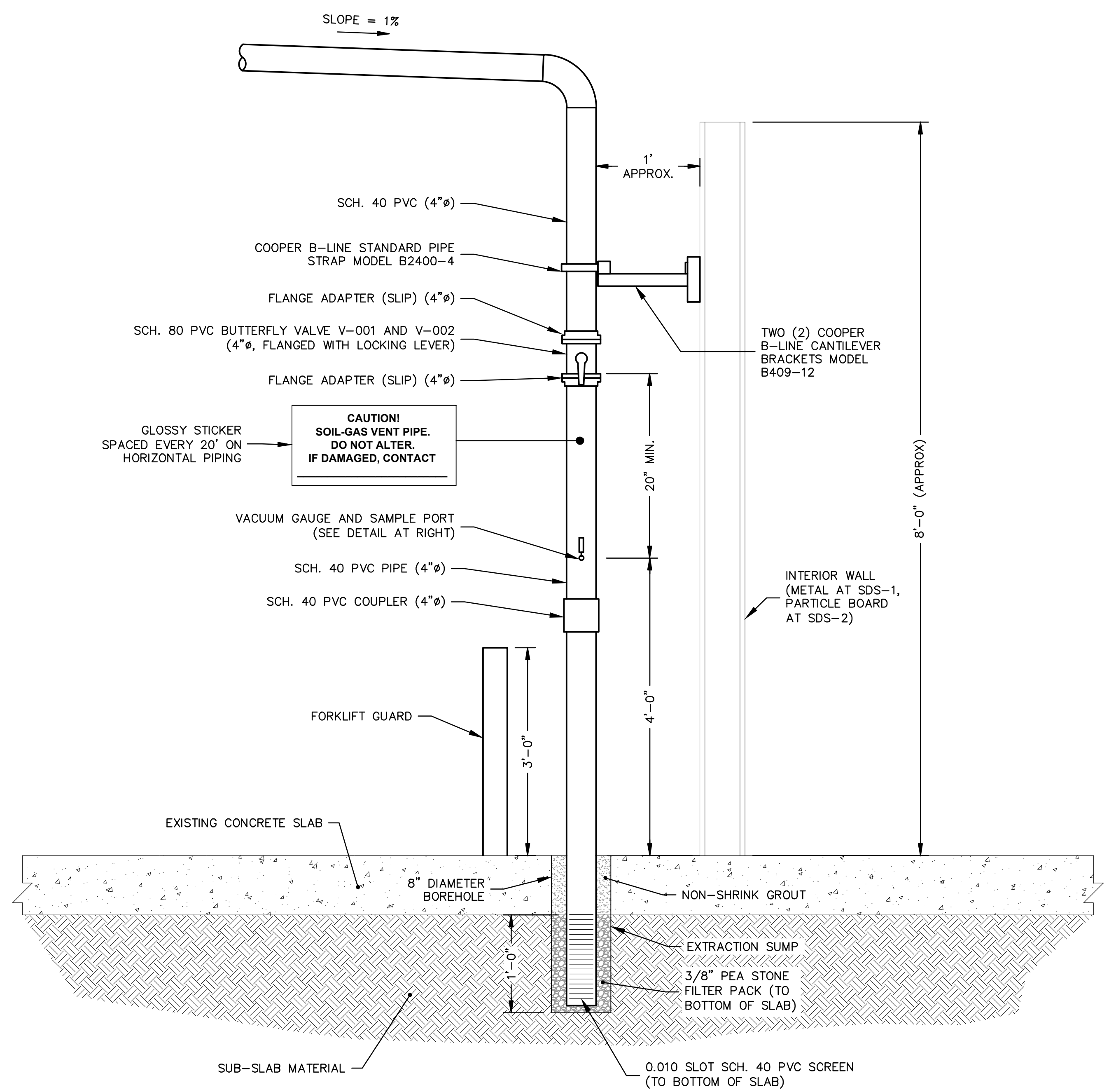
CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

PROCESS AND INSTRUMENTATION DIAGRAM

ARCADIS Project No. B0041501.0001.00010
Date DECEMBER 2016

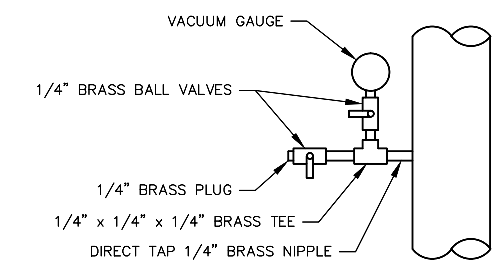
ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

M-1



EXTRACTION POINT RISER DETAIL 1

NOT TO SCALE



VACUUM GAUGE AND SAMPLE PORT DETAIL

NOT TO SCALE

NOTES:

1. HORIZONTAL PIPE SUPPORTED EVERY 4 FEET. VERTICAL PIPE SUPPORTED EVERY 8 FEET.
2. CEILING HEIGHT IS 16' (APPROX.) EXCEPT IN WAREHOUSE (33' APPROX.).

RECORD DRAWINGS

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CD	GHS	CDE

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ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

EXTRACTION POINT DETAILS

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B0041501.0001.00010

Date
DECEMBER 2016

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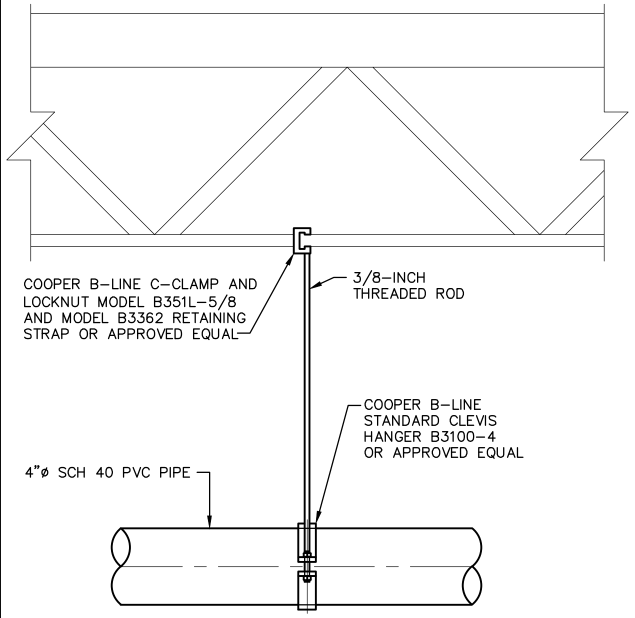
Tel. 585-385-0090

M-2

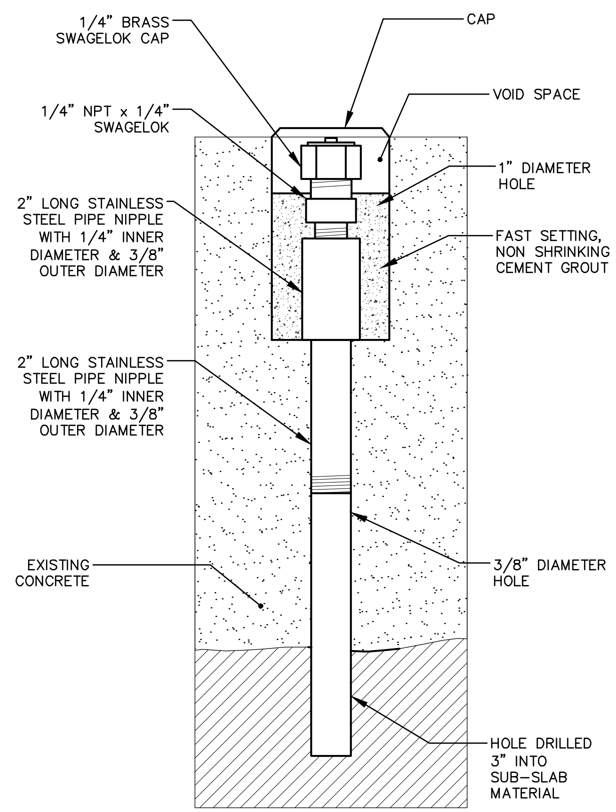


NOTES:

1. HORIZONTAL PIPE SUPPORTED EVERY 4 FEET.
2. HORIZONTAL PIPING PITCHED 1% TOWARDS THE EXTRACTION POINT, UNLESS NOTED OTHERWISE.

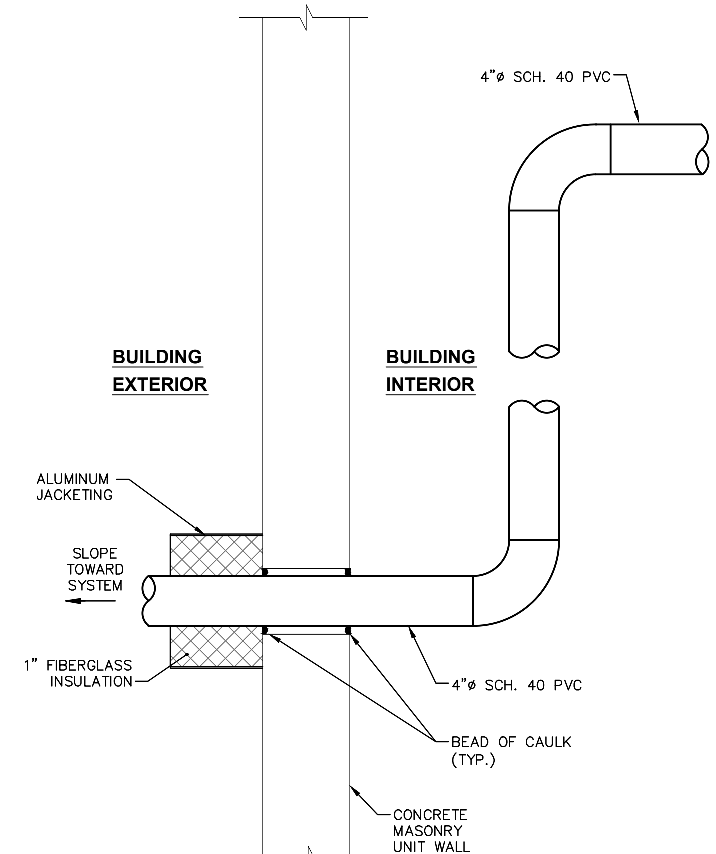
HANGING PIPE SUPPORT DETAIL 1

NOT TO SCALE



SUB-SLAB MONITORING POINT 2

NOT TO SCALE

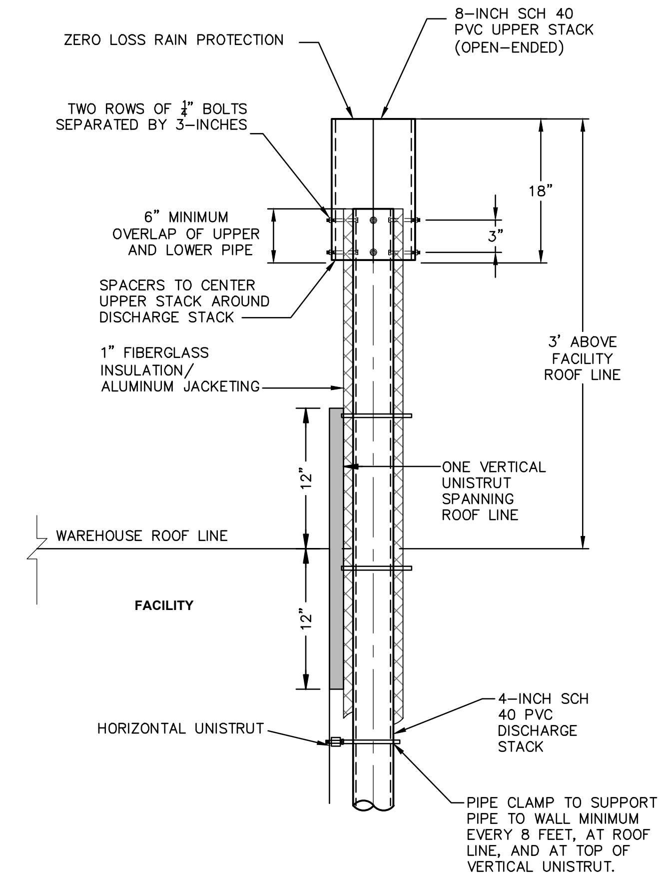


NOTES:

1. ALL EXTERIOR PIPING FITTED WITH FIBERGLASS INSULATION WITH R-VALUE OF 5 AND ALUMINUM JACKETING.
2. PIPING SLOPED AS INDICATED ON DRAWING G-1.

EXTERIOR WALL PENETRATION DETAIL 3

NOT TO SCALE



NOTES:

1. DIMENSIONS ARE RELATIVE TO WAREHOUSE ROOF LINE.
2. UNISTRUT SECURED TO WALL WITH 1/4-INCH CONCRETE SLEEVE ANCHORS SPACED 6" O.C.

NO LOSS CAP DETAIL 4

NOT TO SCALE

RECORD DRAWINGS

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DATE__________BY__________

CITY:SYRACUSE-NY DIV/GROUP:SER DB:G. STEINBERGER LD:G. STEINBERGER PIC: PM: TM: LYR:ON=*;OFF=*REF* G:\ENVCAD\SYRACUSE\ACT\B0041501\0001\00009\DWG\CONTRACT\SSDS-RECORD\41501M03.dwg LAYOUT: M-3 SAVED: 12/12/2016 11:46 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: PDF-D2B PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 1/27/2017 11:04 AM BY: STEINBERGER, GEORGE

XREFS: 41501X00 IMAGES: PE-ENGLER-NY.jpg PROJECTNAME: ----

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
CHRISTOPHER D. ENGLER		
Professional Engineer's No. 069748		
State NY	Date Signed	Project Mgr. WBP
Designed by CD	Drawn by GHS	Checked by CDE

STATE OF NEW YORK · CHRISTOPHER DANE ENGLER · LICENSED PROFESSIONAL ENGINEER · 069748

ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

MISCELLANEOUS DETAILS

ARCADIS Project No. B0041501.0001.00010

Date DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

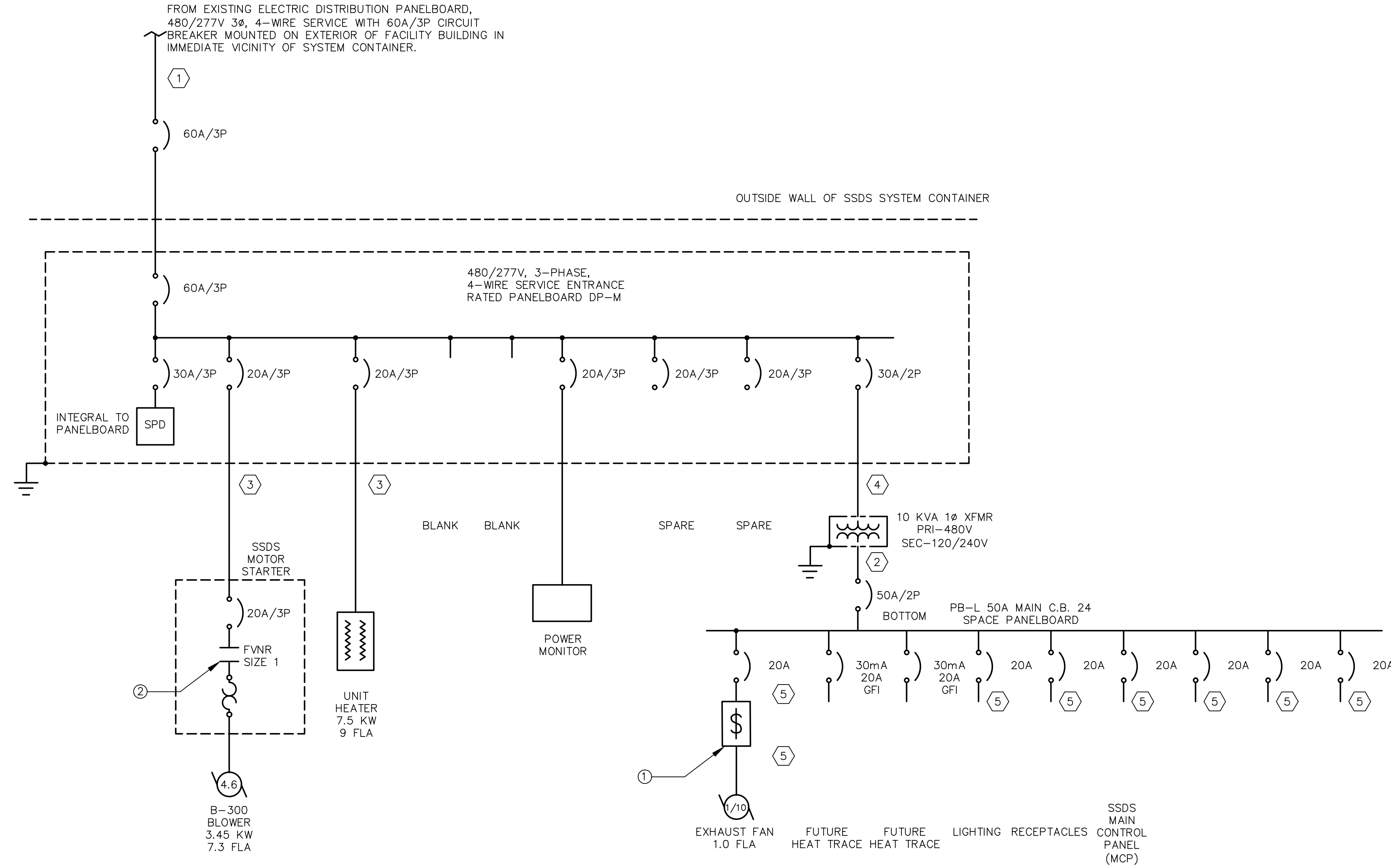
M-3

ELECTRICAL SPECIFICATIONS

GENERAL

1. ALL ELECTRICAL EQUIPMENT IS U.L. LISTED AND LABELED.
2. ALL ELECTRICAL WORK INSTALLED IN ACCORDANCE WITH NFPA-70 NEC.
3. GROUNDING OF ALL ELECTRICAL SYSTEMS AND EQUIPMENT MEETS THE REQUIREMENTS OF NEC ARTICLE 250.
4. ENCLOSURES ARE NEMA RATED FOR LOCATION.
5. 277/480 VAC, THREE PHASE, 4 WIRE

PHASE A – BROWN
PHASE B – ORANGE
PHASE C – YELLOW
NEUTRAL – WHITE
GROUND – GREEN



SINGLE LINE DIAGRAM

ELECTRICAL SYMBOL LEGEND

- SERVICE CONNECTION
- METER
- CIRCUIT BREAKER
- DISCONNECT SWITCH
- SURGE PROTECTIVE DEVICE
- MOTOR
- TRANSFORMER
- MOTOR STARTER W/ MOTOR CIRCUIT PROTECTOR AND OVERLOADS
- ELECTRIC UNIT HEATER
- GROUND ROD
- LIGHT SWITCH XP: EXPLOSION PROOF

CONDUIT AND CABLE SCHEDULE

1. (4) #4, (1) #10 G., 1-1/2" C.
2. (3) #4, (1) #8 G., 1-1/4" C.
3. (3) #12, (1) #12 G., 3/4" C.
4. (2) #10, (1) #10 G., 3/4" C.
5. (2) #12, (1) #12 G., 3/4" C.

ELECTRICAL GENERAL NOTES:

1. THIS IS A GENERAL ELECTRICAL SYMBOLS AND GENERAL NOTES SHEET. SOME SYMBOLS AND/OR NOTES MAY NOT BE USED IN THIS SET OF DRAWINGS.

RECORD DRAWINGS
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SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

Professional Engineer's Name: THOMAS P ARMSTRONG JR.
Professional Engineer's No.: 085236
State: NY | Date Signed: | Project Mgr.: WBP
Designed by: NCP | Drawn by: NCP | Checked by: TPA

STATE OF NEW YORK · THOMAS PAUL ARMSTRONG JR. · 085236 · LICENSED PROFESSIONAL ENGINEER

ARCADIS Design & Consultancy for natural and built assets
ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SINGLE LINE DIAGRAM

ARCADIS Project No. B0041501.0001.00010
Date DECEMBER 2016
ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

E-1

LUMINAIRE SCHEDULE

TYPE	LAMPS QUANTITY	LAMPS TYPE	CONNECTED WATTS	LUMINAIRE DESCRIPTION	MANUFACTURER / CATALOG NUMBER	QUANTITY
A	2	A33	75	SURFACE MOUNTED INCANDESCENT LUMINARIE, WITH PLAIN GLOBE AND GUARD	CROUSE HINDS CAT NO. VDA2759 OR EQUAL	1

LIGHTING NOTES:

1. INCANDESCENT LIGHTING OF TYPE "A" LUMINAIRE EVENLY SPACED WITHIN THE CARGO CONTAINER.

HVAC SCHEDULE

TYPE	AIRFLOW (CFM)	PROPELLER DIA (IN)	MOTOR DATA HP	MOTOR DATA RPM	MOTOR DATA V/PH/HZ	WEIGHT (LBS)	MANUFACTURER	MODEL	QUANTITY
EXHAUST FAN	800	12	1/25	1550	115/1/60	12	GRAINGER	1HLA2	1
HEATER	650	–	1/30	1600	480/3/60	24	QMARK	MUH0704	1

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name
THOMAS P ARMSTRONG JR.
Professional Engineer's No.
085236

State	Date Signed	Project Mgr.
NY		WBP
Designed by	Drawn by	Checked by
NCP	NCP	TPA

STATE OF NEW YORK · THOMAS PAUL ARMSTRONG, JR. · 085236 · LICENSED PROFESSIONAL ENGINEER
12/13/16

ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

HVAC AND LIGHTING SCHEDULE

ARCADIS Project No.
B0041501.0001.00010

Date
DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

E-2

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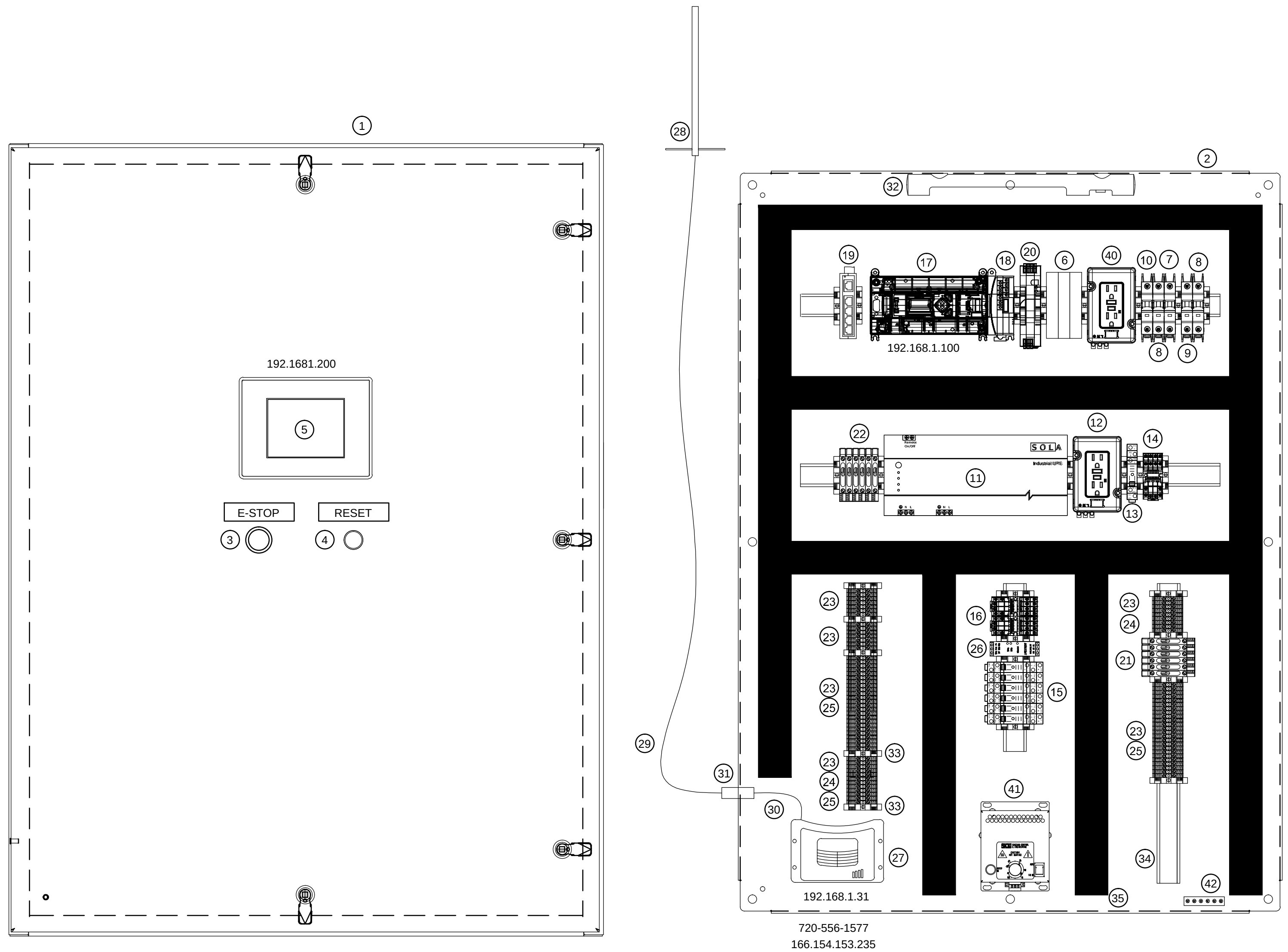
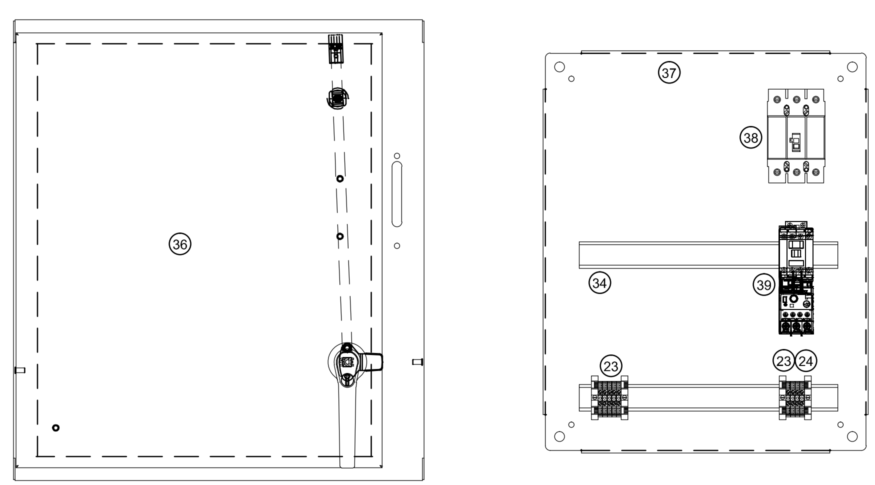


SSDS MAIN CONTROL PANEL (MCP)



SSDS MOTOR STARTER

TAG	QTY	SUB	DESCRIPTION	MANUFACTURER	CATALOG #
1	1		WALL MOUNT STEEL ENCLOSURE 48X36X12	SCE	SCE-48EL3612LP
2	1		BACK PANEL FOR ENCLOSURE	SCE	SCE-48P36
3	1		RED MUSHROOM HEAD E-STOP TWIST RELEASE	AB	800FP-MT44
		1	22.5MM PB BASE MOUNT, SCREW CONTACT BLOCK, 1 N.C.	AB	800F-BX01
4	1		BLACK, 22 MM, MOMENTARY PUSH BUTTON	AB	800FP-F2PX20
5	1		6" C_MORE COLOR TOUCH PANEL	AUTOMATION DIRECT	EA9-T6CL-4983-DC
6			120 VAC SURGE PROTECTION DEVICE (10A)	AB	4983-DC
7	1		10 AMP MINIATURE CIRCUIT BREAKER (1 POLE, 120 VAC)	AB	1489-M1C100
8	2		8 AMP MINIATURE CIRCUIT BREAKER (1 POLE, 120 VAC)	AB	1489-M1C080
9	1		7 AMP MINIATURE CIRCUIT BREAKER (1 POLE, 120 VAC)	AB	1489-M1C070
10	1		2 AMP MINIATURE CIRCUIT BREAKER (1 POLE, 120 VAC)	AB	1489-M1C020
11	1		UPS, 850 KVA	SOLA	S1K850
		1	MOUNTING BRACKET FOR UPS	SOLA	S1K-PMBRK
12	1		DUAL RECEPTACLE	AB	1492-REC15
13	1		RELAY - 1 POLE, 120 VAC, 16 A CONTACT	AB	700-HK36A1
		1	RELAY SOCKET (5 PIN)	AB	700-HN221
14	1		RELAY - 4 POLE, 120 VAC, 7 A CONTACT	AB	700-HC24A1
		1	RELAY SOCKET (14 PIN)	AB	700-HN104
15	6		RELAY - 1 POLE, 24 VDC, 8 A CONTACT	AB	700-HK36A24
		6	RELAY SOCKET (5 PIN)	AB	700-HN221
16	2		RELAY - 4 POLE, 24VDC, 7 A CONTACT	AB	700-HC24Z24
		2	RELAY SOCKET (14 PIN)	AB	700-HN104
17	1		MICROLOGIX 1400 PLC, (20) 24 VDC IN, 12 OUT, 110 AC PWR	AB	1766-L32BWA
18	1		4 CHANNEL CURRENT/VOLTAGE ANALOG INPUT MODULE	AB	1762-IF4
19	1		5 PORT ETHERNET SWITCH	AB	1783-US5T
20	1		24 VDC POWER SUPPLY (120 W)	AB	1606-XLE120E
21	5		120 VAC FUSE BLOCKS	AB	1492-WFB4250
		5	2 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S505-2-R
22	7		24 VDC FUSE BLOCKS	AB	1492-WFB424
		1	5 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S506-5-R
		6	2 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S506-2-R
23	TBD		IEC TERMINAL BLOCK	AB	1492-J3
24	TBD		IEC GROUND TERMINAL BLOCK	AB	1492-J3G
25	15		IEC TERMINAL BLOCK WITH PLUG IN FUSE	AB	1492-J3P
		9	FUSE PLUG 10-36 V WITH BLOW FUSE INDICATION	AB	1492-FPK224
		5	0.50 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S506-500-R
		4	0.25 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S506-250-R
		6	FUSE PLUG 60-150 V WITH BLOW FUSE INDICATION	AB	1492-FPK2120
		6	1 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S505-1-R
26	1		DUAL CHANNEL, AUTO/MANUAL RESET, 24V AC/DC SAFETY RELAY	AB	440R-N23117
27	1		4G CELLULAR MODEM	SIERRA WIRLESS	GX-450
28	1		OMNI DIRECTIONAL LTE/CELLULAR/PCS COMBO ANTENNA	WILSON ELECTRONICS	
29	1		COAXIAL CABLE - N MALE TO N MALE (20 ft)	TBD	
30	1		COAXIAL CABLE - SMA MALE TO N MALE (2 ft)	TBD	
31	1		RF COAXIAL SURGE PROTECTOR	POLYPHASER	TSX-NFF
32	1		24VDC PANEL LIGHT	AUTOMATION DIRECT	25401-00
	1		CONNECTION CABLE 2 X 16 AWG WITH INPUT CONNECTOR	AUTOMATION DIRECT	244361
33	TBD		END BARRIERS	TBD	
34	TBD		DIN RAIL	TBD	
35	TBD		WIRING DUCT	TBD	
36	1		WALL MOUNT DISCONNECT ENCLOSURE 24X21X8	SCE	SCE-24XEL2108LP
37	1		BACK PANEL FOR ENCLOSURE	SCE	SCE-24P20
38	1		20 A MOLDED CASE CIRCUIT BREAKER, 3 POLE, 25 KA INTERRUPT RATING	AB	140G-G2C3-C20
		1	DISC CABLE/HANDLE, FRAME G.I	AB	140G-G-FCX04
39	1		NON-REVERSING E-COMBO STARTER FOR 4 HP MOTOR WITH 120 VAC COIL	AB	309-AOD-EEE
40	1		DUAL GFCI RECEPTACLE	WEIDMULLER	DRAC GF15
41	1		PANEL HEATER	HOFFMAN	DAH2001A
42	1		GROUND BAR	TBD	

LEGEND

DENOTES TERMINAL BLOCK CONNECTION

DASHED LINES DENOTES WIRING TO FIELD DEVICES

DASHED WITH PATTERN DENOTES DEVICES IN REMOTE LOCATIONS

LINE NUMBER DESCRIPTION

0000
WIRING DIAGRAM SHEET NUMBER (1 OR 2 DIGITS)
LINE NUMBER (ALWAYS 2 DIGITS)

WIRE NUMBER DESCRIPTION

00000
WIRING DIAGRAM SHEET NUMBER (1 OR 2 DIGITS)
WIRE NUMBER (ALWAYS 1 DIGIT)
LINE NUMBER (ALWAYS 2 DIGITS)

TB TERMINAL BLOCK

RECORD DRAWINGS

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SCALE IN INCHES

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Professional Engineer's No.: 085236
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12/8/16

ARCADIS Design & Consultancy for natural and built assets
ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS PANEL LAYOUTS

ARCADIS Project No. B0041501.0001.00010
Date DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
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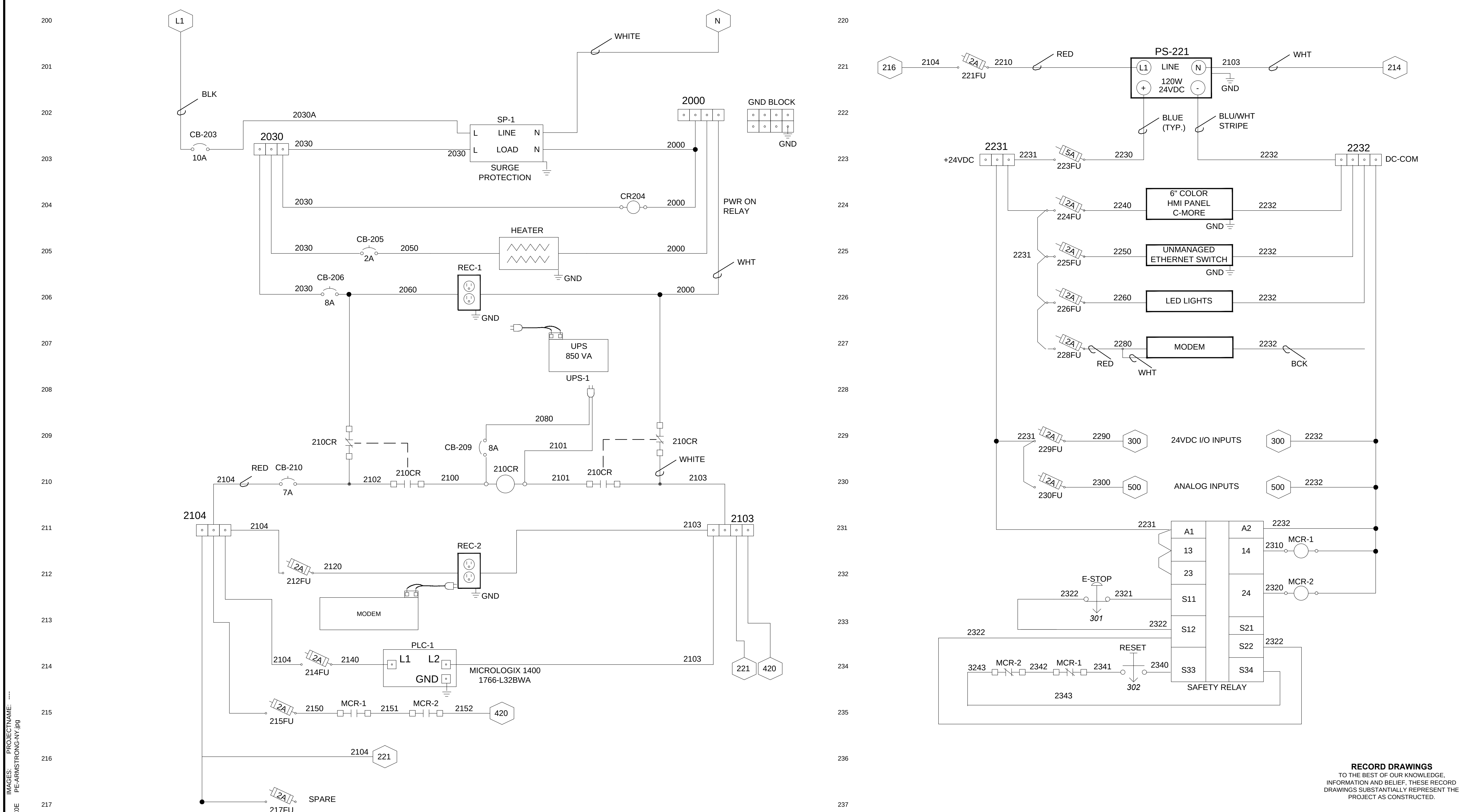

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SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MAIN CONTROL PANEL POWER DISTRIBUTION

ARCADIS Project No. B0041501.0001.00010

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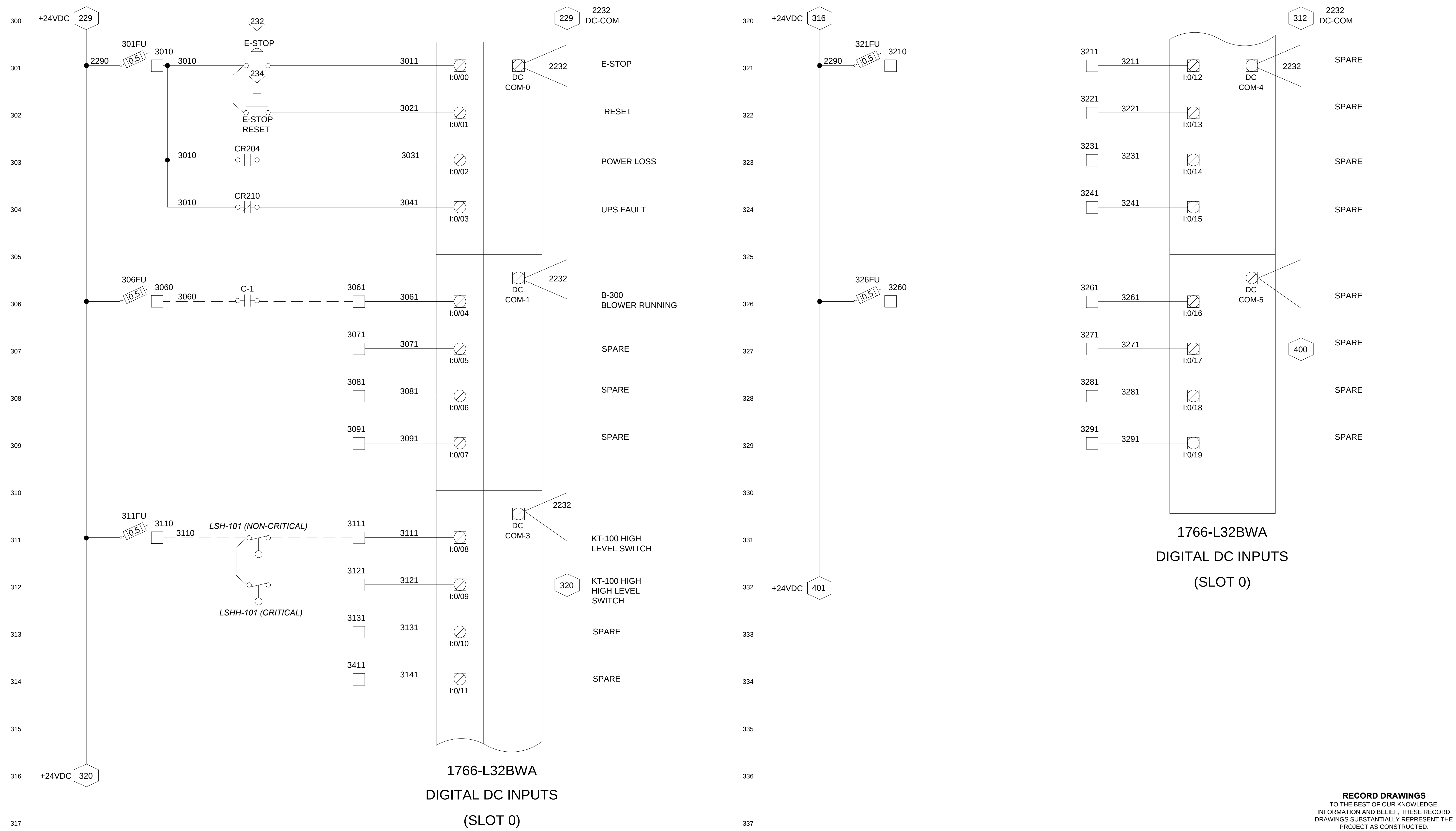

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SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MAIN CONTROL PANEL MICROLOGIX DIGITAL INPUTS

ARCADIS Project No. B0041501.0001.00010
Date DECEMBER 2016
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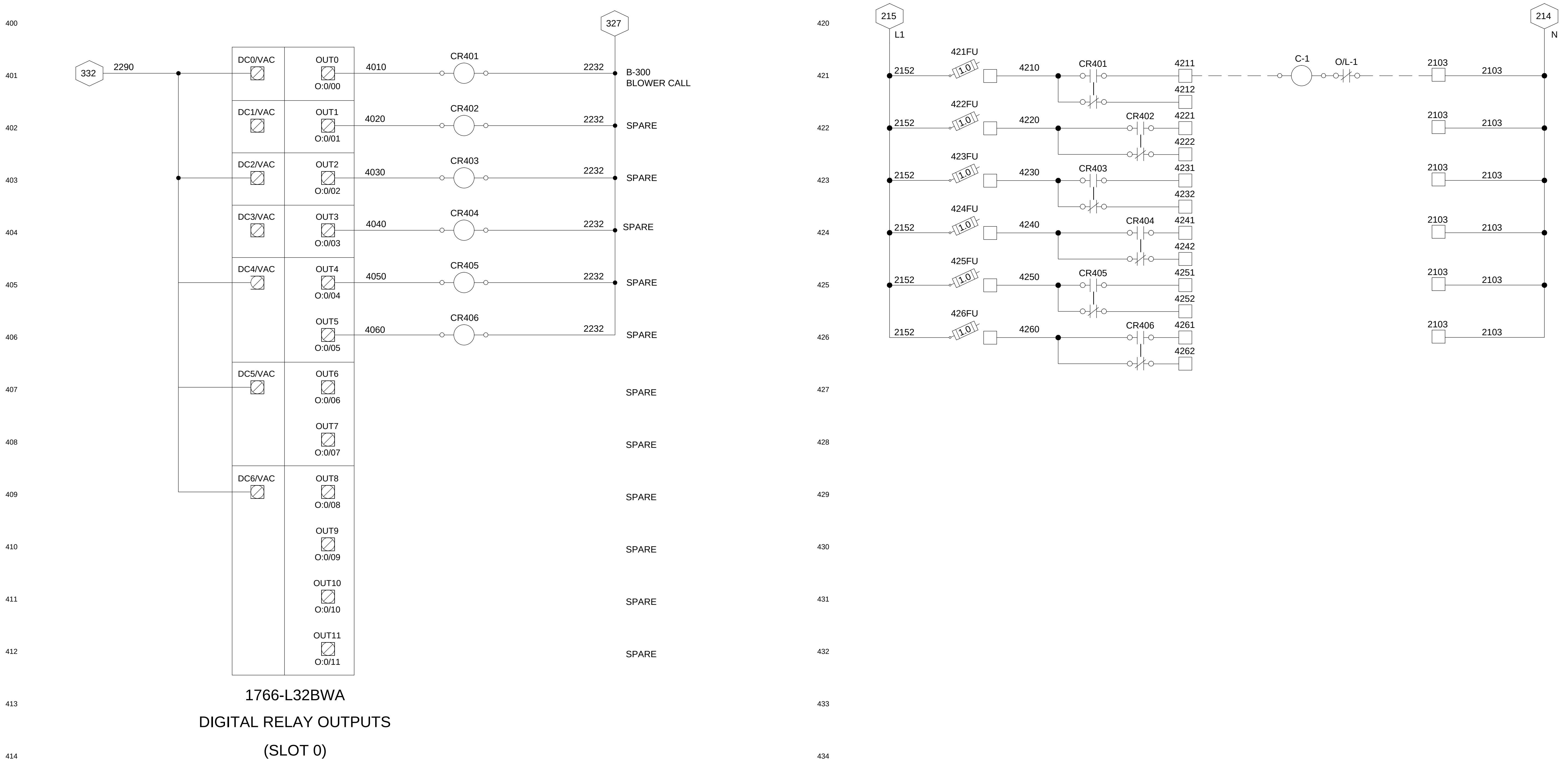

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ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK

SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MAIN CONTROL PANEL MICROLOGIX RELAY OUTPUTS

ARCADIS Project No. B0041501.0001.00010

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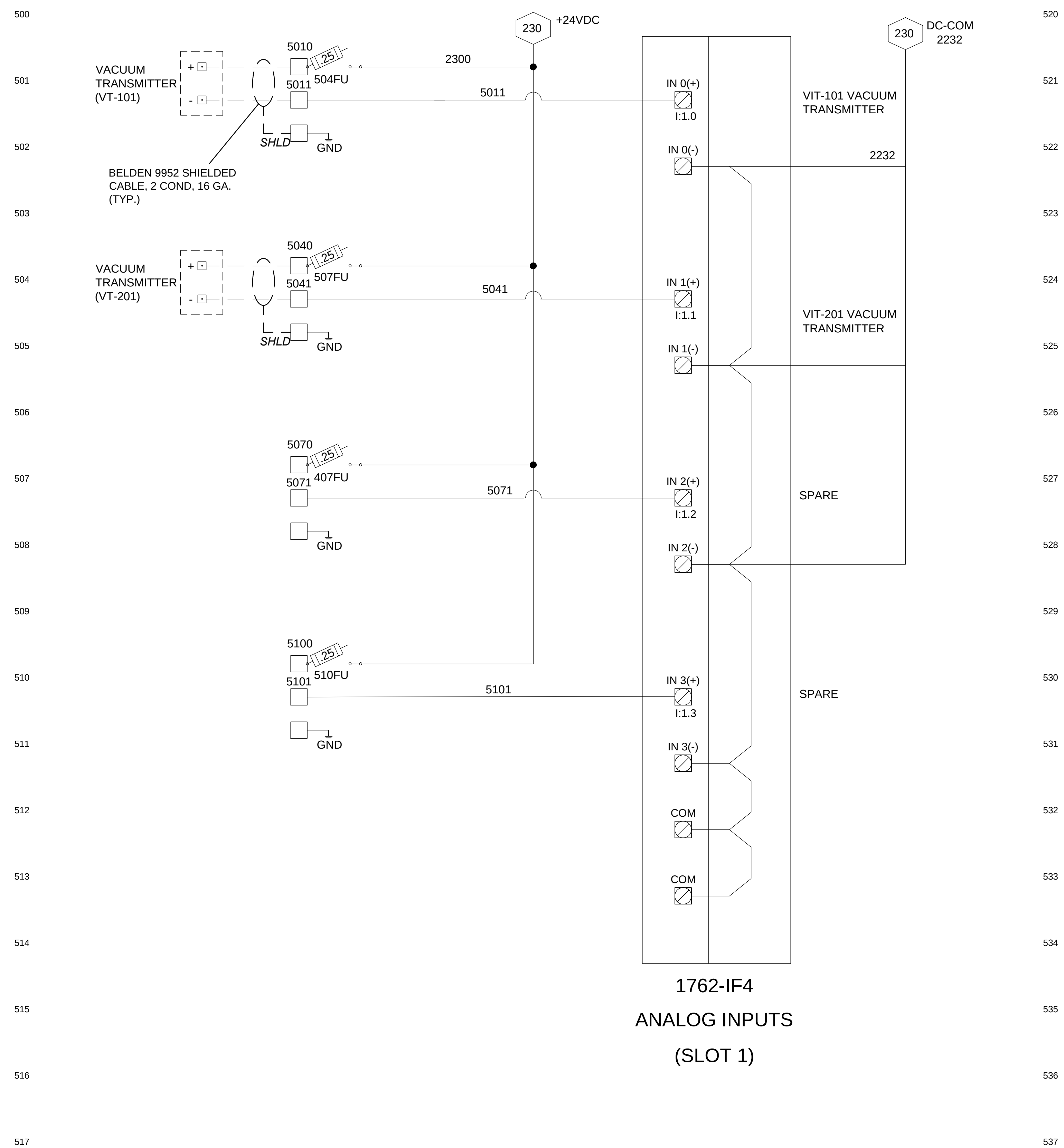

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CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MAIN CONTROL PANEL SLOT 1: ANALOG INPUTS

ARCADIS Project No. B0041501.0001.00010

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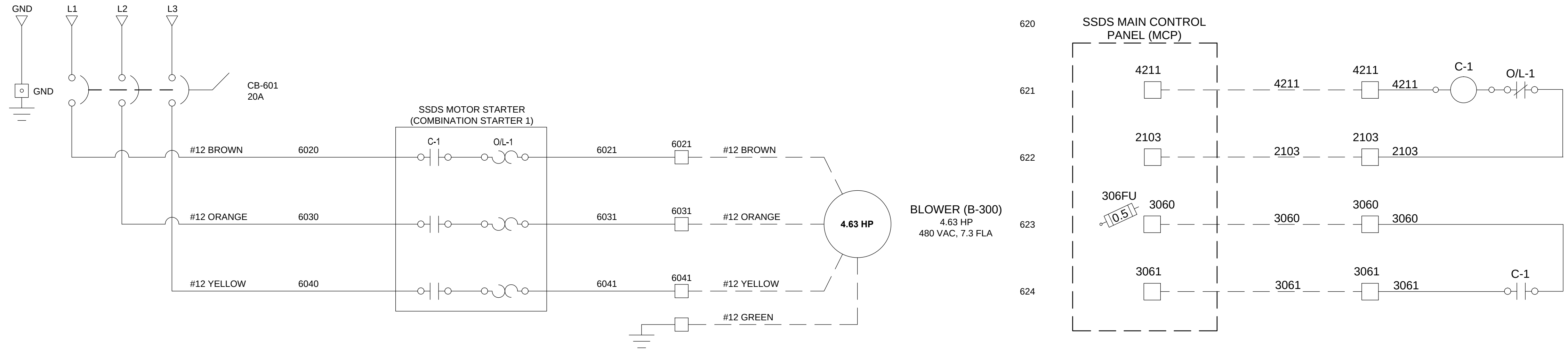

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SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MOTOR STARTER WIRING DETAILS

ARCADIS Project No.
B0041501.0001.00010

Date
DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
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I-6

APPENDIX B

Operation, Maintenance, and Monitoring Plan

OPERATION, MAINTENANCE, AND MONITORING PLAN

Crosman Corporation Site
East Bloomfield, New York

Prepared for:
Crosman Corporation and
New Coleman Holdings, Inc.

January 2017

OPERATION, MAINTENANCE, AND MONITORING PLAN

Crosman Corporation Site
East Bloomfield, New York

Aaron Richardson
Project Environmental Engineer

Prepared for:

Crosman Corporation and

New Coleman Holdings, Inc.

Prepared by:

Arcadis U.S., Inc.

295 Woodcliff Drive

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Tel 585 385 0090

Fax 585 385 4198

Our Ref.:

B0041051.0001

Date:

January 2017

CONTENTS

TABLES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AFS	air filter/silencer
Arcadis	Arcadis U.S., Inc.
HMI	human machine interface
hp	horsepower
in w.c.	inches of water column
MCP	main control panel
NYSDEC	New York State Department of Environmental Conservation
OMM	operation, maintenance, and monitoring
PVC	polyvinyl chloride
SSDS	sub-slab depressurization system
VI	vapor intrusion
VMP	vacuum monitoring point
VOC	volatile organic compound
VPGAC	vapor-phase granular-activated carbon

1 INTRODUCTION

Arcadis U.S., Inc. (Arcadis) prepared this Operation, Maintenance, and Monitoring Plan for Crosman Corporation and New Coleman Holdings, Inc. (collectively, Crosman) for the sub-slab depressurization system (SSDS) at the Crosman Site located in East Bloomfield, New York (Site). The *Vapor Intrusion Investigation and West Side Soil Boring Investigation Report* (Arcadis 2015a), submitted to the New York State Department of Environmental Conservation (NYSDEC) in January 2015, summarizes the vapor intrusion (VI) investigation activities conducted by Arcadis in January 2014. Arcadis conducted a radius of influence study in May 2015, which was summarized in the *Sub-Slab Depressurization Systems – Radius of Influence Summary* (Arcadis 2015b), submitted to the NYSDEC in July 2015. As a result of VI and radius of influence findings, sub-slab depressurization was selected as the corrective measure to reduce the potential for VI in the target depressurization areas. As defined on Record Drawing G-1 (Appendix A), the target depressurization areas are portions of the screw machine room on the west side of the building and the ammo department on the east side of the building, which are both involved in production.

2 SYSTEM OBJECTIVES

The objective of the SSDS is to mitigate soil vapor concentrations detected in the sub-slab environment beneath the screw machine room and ammo department. A benefit of achieving the objective of the SSDS will be to maintain acceptable indoor air quality by reducing the potential for sub-slab VI from the target depressurization areas into the screw machine room and the ammo department. More specifically, the system operational objectives include:

- Maintain vacuum influence (i.e., negative differential pressure) in the sub-slab environment beneath the building floor across the target depressurization areas.
- Reduce the potential for indoor air concentrations of trichloroethene (TCE) and other volatile organic compounds (VOCs) by decreasing concentrations in the sub-slab environment.

3 SYSTEM OVERVIEW

The SSDS consists of two sub-slab depressurization extraction points, SDS-1 located in the screw machine room, and SDS-2 located in the ammo department. Vacuum is applied to extract sub-slab vapors from each of the extraction points using a 4.6-horsepower (hp) regenerative blower. The blower is designed to continuously apply vacuum at the extraction points to induce a negative sub-slab differential pressure across the target depressurization areas. Sub-slab vapors are conveyed to the SSDS equipment enclosure, which is located outside of the main plant building, adjacent to the southwestern corner of the warehouse. Sub-slab vapors are conveyed through a knockout tank and vapor-phase granular-activated carbon (VPGAC) treatment vessels and discharged to the atmosphere through piping installed along the outside of the warehouse and extending above the roofline. The SSDS is equipped with monitoring devices and instrumentation to allow system operators to confirm proper system operation and to provide notification of system alarm conditions. The SSDS layout is depicted on Record Drawing G-1 in Appendix A.

4 SUB-SLAB DEPRESSURIZATION SYSTEM COMPONENTS

This section describes SSDS components and specifications, including equipment designations for each major system component. An equipment list is provided in Table 1. Record Drawings of the SSDS, including a system layout, extraction point details, and a process and instrumentation diagram, are provided in Appendix A. Manufacturer's manuals for major system equipment are included in Appendix B. Additional system construction details are provided in Appendix C, including an equipment enclosure layout, electrical panel layout, breaker schedule, and parts list.

4.1 Sub-Slab Depressurization System Extraction Points

The SSDS extracts sub-slab soil vapors from two extraction points, SDS-1 and SDS-2. These two extraction points were installed by drilling an 8-inch core hole through the concrete slab. After removing the existing concrete, approximately 1 foot of sub-slab material was removed. A 4-inch-diameter Schedule 40 screened polyvinyl chloride (PVC) pipe was then installed to 1 foot below the concrete slab, with the open sub-slab annulus filled with course gravel to the bottom of the slab. Quickset non-shrinking grout was then placed to seal the remaining void in the concrete slab.

The vertical riser pipes for both extraction points are constructed of 4-inch Schedule 40 PVC pipe and include a vacuum gage, vapor sample port, and a 4-inch butterfly valve to allow for adjustment of applied vacuum at the extraction point. Vapors from the respective extraction points are conveyed separately to the SSDS equipment enclosure via dedicated overhead 4-inch Schedule 40 PVC conveyance piping. Conveyance piping is sloped such that any accumulated water will flow by gravity toward either an extraction point sump or the system knockout tank, with the exception of a short section of exterior piping for SDS-2 where a condensate drain has been installed. All exterior conveyance piping is fitted with 1-inch fiberglass insulation and aluminum jacketing.

The extraction piping for SDS-1 and SDS-2 include vacuum transmitters VT-101 and VT-201, respectively, located immediately inside the system enclosure. Both vacuum transmitters (Wike model #S10-50020021) measure vacuum between 0 and 100 inches of water column (in w.c.).

4.2 Knockout Tank KT-100

Extracted soil vapors from the respective extraction points are combined into a single extraction header after soil vapors reach the system enclosure. Extracted soil vapors are routed through knockout tank KT-100 to remove any accumulated condensation from the vapor stream. KT-100 is a high efficiency moisture separator (Product Level Control model #MDXX-WSR60-XXS) rated for a maximum vacuum of 20 inches of mercury. The liquid capacity of KT-100 is 60 gallons, and two normally closed liquid level switches (LSH-101 and LSHH-101) are installed in the sight gauge for KT-100.

4.3 Air Filter AF-100

Extracted soil vapors are filtered by inline filter AF-100 (Solberg-CSL-235P-300) to remove particulates or other solids.

4.4 Carbon Vessels VPGAC-101, VPGAC-102, VPGAC-103, and VPGAC-104

Vapor-phase treatment consists of four VPGAC vessels (VPGAC-101 through VPGAC-104) arranged in series. The VPGAC vessels (Tetrasolv VFV-1000-SD48) are each filled with 1,000 pounds of virgin coconut-based carbon media. The VPGAC manifold was constructed such that vapors may be directed through VPGAC vessels in a variety of flow paths by adjustment of valve configurations. Potential VPGAC vessel flow paths and the corresponding valve configurations are shown in Table 2.

The flow path through the VPGAC vessels will be in accordance with the Project Engineer's direction and will be based on vapor sampling data and carbon media usage.

4.5 Flow Indicator FI-101

Flow indicator FI-101 measures the combined influent sub-slab soil vapor extraction flow rate. FI-101 is a 2-inch-diameter venturi-style flow meter (Rotron model FM30C250Q) that allows direct reading of flow rates ranging from 45 to 225 standard cubic feet per minute. The flow indicator was installed within the manufacturer's recommended straight pipe length of a minimum of 30 inches on the inlet side and 18 inches on the outlet side. This straight length of piping with a diameter matching the flow meter diameter must be maintained, and the manufacturer's recommended flow meter orientation must be maintained to enable accurate flow measurements.

4.6 Air Filter/Silencer AFS-100

A manual dilution valve assembly on the suction side of the blower allows applied vacuum to the extraction points to be adjusted. The dilution valve assembly includes a 2-inch-diameter brass ball valve (V-119) and combination air filter/silencer AFS-100 (Solberg-FS-31P-200).

4.7 Blower B-300

A 4.6-hp regenerative blower (B-300), Elmo Rietschle Model 2BH1610-7HH26 (60 hz) capable of a flow rate of 175 actual cubic feet per minute at a maximum vacuum of 84 in w.c. is used to apply vacuum at the extraction points. As mentioned previously, a dilution valve assembly located on the suction side of the blower allows for manual adjustment of the soil vapor extraction rate and applied vacuum.

A vacuum relief valve (V-120) is located directly on the suction side of the blower to protect the blower in the event that the influent flow rate is substantially restricted due to line blockage or improper valve configuration. V-120 is factory-set to open at a set point as indicated in Table 1.

4.8 Silencer S-400

The blower discharge line includes adsorptive silencer S-400 (Solberg-SLCRT250) to provide noise reduction for the environment surrounding the system enclosure.

4.9 Controls and Alarms

The SSDS is fed by 480/277 volt, 3-phase power from the Crosman Corporation facility. All major electrical components, including a main disconnect switch, main distribution panel (DP-M), transformer, low-voltage distribution panel (PB-L), and main control panel (MCP), are mounted on the outside of the system enclosure. Electrical and instrumentation Record Drawings are included in Appendix A, and additional electrical information (e.g., panel board layout and breaker schedule) is included in Appendix C.

The SSDS is controlled by a programmable logic controller and is designed to operate automatically. The MCP includes emergency stop and reset buttons. Additionally, a human machine interface (HMI) located on the MCP allows local operators to control the system and view system parameters. The HMI also provides remote control and monitoring capabilities, and is accessible via the internet. Operator notification for all alarm conditions is provided via e-mail. A full list of alarms integrated into the SSDS are summarized in Table 3. Process-related alarms include the following:

- High liquid level in the knockout tank based on level switch LSH-101; results in alarm notification
- High-high liquid level in the knockout tank based on level switch LSHH-101; results in alarm notification and system shutdown
- Low vacuum at vacuum transmitters VT-101 or VT-201; results in alarm notification
- Low-low vacuum at vacuum transmitters VT-101 or VT-201; results in alarm notification and system shutdown

Any tasks involving working on live electrical circuits (e.g., inside the control panel) should only be completed by persons deemed to be qualified and National Fire Protection Association 70E trained.

5 MAINTENANCE AND MONITORING

This section describes basic system operation, maintenance, and monitoring (OMM) requirements. The recommended schedule for OMM tasks is shown in Table 4. All completed log sheets and checklists should be stored onsite in a binder.

5.1 System Monitoring

Onsite system monitoring will be conducted to verify that the system is operating efficiently. The System Monitoring Log included in Appendix D should be completed at the frequency indicated in Table 4. The System Monitoring Log will be used to summarize the visual observations and data necessary to monitor system performance. System monitoring will include, but is not limited to, the following:

- General site inspection to verify that the system is running properly
- Recording influent sub-slab vapor extraction flow rate
- Recording applied vacuum and air velocity at extraction points
- Recording system process gauges for vacuum, pressure, and temperature
- Recording the electric meter reading
- Recording the position of process valves, including the dilution valve and VPGAC manifold valves

5.2 Performance Monitoring

Onsite performance monitoring will be conducted to collect data required to assess the system's effectiveness. The Performance Monitoring Log included in Appendix D should be completed at the frequency indicated in Table 4.

5.2.1 Instantaneous Sub-Slab Differential Pressure Monitoring

Instantaneous sub-slab differential pressures will be measured at vacuum monitoring points (VMPs) at the frequency indicated in Table 5 and recorded in the Performance Monitoring Log. A micromanometer capable of measuring to the nearest 0.001 in w.c. will be used to measure instantaneous differential pressure at the VMPs with the system operating. To measure sub-slab differential pressures, the cap on the VMPs will be removed and a compression fitting and tubing installed. With the other end of the tubing connected to the positive port on the micromanometer, negative readings measured by the micromanometer indicate a vacuum at the VMP. The micromanometer will be zeroed before each VMP measurement with both ports vented to the atmosphere. Micromanometers owned by system operators will be factory-calibrated annually or anytime the unit is dropped or otherwise suspected to be reading inaccurately.

5.2.2 Continuous Sub-Slab Differential Pressure Monitoring

To confirm that a sustained negative sub-slab differential pressure is being achieved, differential pressure data loggers will be installed at VMPs and used to monitor differential pressure for a period of 24 hours while the system is operating. The schedule for continuous sub-slab differential pressure monitoring, including which VMP locations to monitor, is indicated in Table 5. The SSDS SOP-02 included in Appendix E will be followed when performing continuous sub-slab differential pressure monitoring.

5.2.3 System Vapor Sampling

System vapor sampling will periodically be conducted at extraction points throughout the treatment process, and at the effluent location in accordance with the schedule indicated in Table 6. System effluent sampling will be conducted to demonstrate that the SSDS effluent VOC mass concentrations remain below the Division of Air Resources 1 air emission guideline values. Sampling will also be conducted throughout the treatment process to indicate when carbon media is in need of replacement. Lastly, vapor sampling will be conducted at each extraction point to evaluate the estimated mass extraction rates for each extraction point, monitor for trends over time, and guide any SSDS operational modifications that may be recommended to increase system effectiveness. It should be noted that the sampling schedule (i.e., Table 6) may be revised or reduced in the future. The SSDS-SOP-01 included in Appendix E should be followed when conducting system vapor sampling. Samples will be submitted to the laboratory and analyzed for VOCs using United States Environmental Protection Agency Method TO-15.

5.3 Routine Maintenance

General routine maintenance items for the system's major components are discussed below. Any work requiring lockout/tagout of equipment, or work on energized equipment, will be completed in accordance with the Arcadis Safety Procedures.

5.3.1 Vapor-Phase Granular-Activated Carbon Vessels

Carbon media for vapor-phase treatment vessels (VPGAC-101 through 104) will be replaced as needed based on periodic system sampling results described previously and as recommended by the Project Engineer.

5.3.2 Blower B-300

Blower B-300 should be inspected for abnormal sounds, odor, or vibration on a monthly basis. The performance (i.e., flow rate and applied vacuum) achieved by B-300, as well as the blower effluent temperature, should routinely be compared to the manufacturer's performance curves. If the blower's performance differs appreciably from the manufacturer's performance curves (included in Appendix B), and both inline air filter AF-100 and dilution line air filter/silencer AFS-100 have been inspected, then the blower motor voltage and current draw should be checked by a competent person in accordance with the Arcadis Safety Procedures regarding work on energized equipment. The blower does not require any routine maintenance. For more specific information on the blower maintenance and troubleshooting, see the manufacturer's service and parts manual included in Appendix B.

5.3.3 Air Filters

Both the inline air filter (AF-100) and the dilution line air filter/silencer (AFS-100) capture solids that could damage the blower. These filters should be visually inspected in accordance with the schedule in Table 4.

The AF-100 filter element should be cleaned or replaced based on visual inspection or if the pressure differential across the filter is more than 5 in w.c. greater than the pressure differential when the filter element is new (i.e., 1 in w.c.). The filter element in AFS-100 should be cleaned or replaced based on visual inspection. Replacement or inspection of AF-100 requires a system shutdown, while replacement or inspection of AFS-100 requires dilution line valve V-119 to be closed. Filters fitted with polyester filter elements may be cleaned, while paper filter elements usually require replacement. For more specific information regarding the air filters, see Appendix B.

5.3.4 Knockout Tank KT-100

Maintenance required for knockout tank KT-100 includes observing the liquid level in the tank and draining as needed in accordance with the schedule in Table 4. If draining of the knockout tank liquid is required, then a system shutdown will be initiated. Liquid will be containerized and treated through the onsite water treatment system operated by Crosman. Specific information on the knockout tank is provided in Appendix B.

5.3.5 Vacuum Relief Valve V-112

Vacuum relief valve V-120 should be tested at a frequency in accordance with Table 4. V-120 should open at a set point as indicated in Table 1. To allow vacuum to be solely controlled by nearby dilution line valve V-119, V-119 should be opened 100% and butterfly valves V-101 and V-201 should be closed approximately 50%. V-119 can then be slowly closed to increase vacuum on the suction side of the blower. Vacuum gauge VI-108 should be visually monitored as V-119 closes to confirm the vacuum relief valve V-120 opens at the required set point.

5.3.6 Piping

Extraction point riser piping and discharge stack piping will be inspected from floor/ground level in accordance with the schedule in Table 4. Extraction point riser piping should be inspected for cracked piping or fittings, leaks, and lack of structural integrity. System discharge stack piping should be inspected for leaks, damaged insulation, freezing, potential blockage, lack of structural integrity and abnormal exhaust appearance.

5.3.7 Silencer S-400

Silencer S-400 does not require any routine maintenance.

5.3.8 Condensation

In addition to inspecting knockout tank KT-100 for liquid, condensation drain valve V-401 should be opened and drained of potential condensate or other water in accordance with the schedule in Table 4. Any liquid drained will be containerized and passed through activated carbon and discharged to the ground surface.

5.3.9 System Monitoring Devices

The system has four monitoring devices that are interlocked with the control panel: high liquid level switch LSH-101, high-high liquid level switch LSHH-101, and low vacuum transmitter VT-101 and vacuum transmitter VT-201. Alarm details for each monitoring device are summarized in Table 3. Each monitoring device will be tested at the frequency as indicated in Table 4 to confirm device functioning and alarm response.

6 SYSTEM OPERATION

This section covers the general procedures to be followed when starting the system, performing a system shutdown, and responding to alarm conditions.

6.1 Remote Access

The system HMI may be accessed remotely via the internet to allow system operators to control the system's operation, monitor system parameters, and adjust alarm set points. The SSDS-SOP-03 included in Appendix E may be utilized to remotely connect to the system.

6.2 Starting the System

The following steps should be taken to properly start the system under normal conditions:

1. Communicate with the Crosman Project Manager to confirm that a system startup should be initiated. Follow the Arcadis Safety Procedures protocol in the event that the blower skid is locked or tagged out.
2. Conduct a visual inspection of the system to verify that there are no obvious problems with any system equipment, process piping, or electrical components.
3. Record the blower runtime from the HMI and note the apparent reason for the system being offline.
4. Confirm that the electrical panels are closed securely. Then confirm that the disconnect handle on the control panel is in the "on" position.
5. The HMI controls may be used to start the system. Confirm that the virtual blower hand-off-auto switch is in the "auto" position via the HMI. Initiate a system startup by pressing the green virtual "start" button on the HMI. The blower icon displayed on the HMI system screen should turn green, indicating the blower is running.
6. Complete a System Monitoring Log within 30 minutes after a system startup and provide to the Crosman Project Manager. If the system has been offline for a significant period of time (e.g., more than 1 month), then all routine OMM tasks will be performed in accordance with Table 4 and the Monthly OMM Checklist completed (Appendix D).

6.3 Shutting the System Down

The following steps should be taken to initiate a system shutdown:

1. A normal system shutdown may be initiated via the HMI by pressing the red virtual "stop" button.
2. An emergency stop button mounted on the MCP may also be used to initiate a system shutdown.
3. If lockout/tagout of the system is required (i.e., when work involves potentially exposing personnel to a stored energy source), it will be conducted in accordance with the Arcadis Safety Procedures.

6.4 Responding to Alarms

The following steps should be taken to respond to an alarm condition:

1. Record the blower runtime from the HMI and note which alarm condition is present.
2. Conduct a visual inspection of the system to verify there are no obvious problems with any of the system equipment, process piping, or electrical components.
3. Within the alarms screen on the HMI, press the “reset” button. If the alarm conditions have been corrected, then a system startup may be initiated.
4. If the blower does not start, check the motor starter located inside the control panel to see if it is tripped and reset as necessary. Any tasks involving working on live electrical circuits (e.g., inside the control panel) should only be completed by persons deemed qualified by Arcadis and in accordance with the Arcadis Safety Procedures.
5. If the blower still does not start, investigate the potential causes listed in Table 3 and/or the manufacturer’s manuals included in Appendix B. Utilize a licensed electrician or qualified person in accordance with the Arcadis Safety Procedures for further diagnosis of a blower malfunction as necessary. If necessary, replacement parts should be procured and installed in accordance with manufacturer’s recommendations.
6. If the alarm condition cannot be corrected, consult the Crosman Project Manager.
7. An Alarm Response Log (Appendix D) should be completed documenting alarm response activities.

7 REFERENCES

Arcadis. 2015a. *Vapor Intrusion Investigation and West Side Soil Boring Investigation Report*. January.

Arcadis. 2015b. *Sub-Slab Depressurization Systems – Radius of Influence Summary*. July.

TABLES

Table 1
Major Equipment List
Operation, Maintenance, and Monitoring Plan
Sub-Slab Depressurization System
Crosman Corporation
East Bloomfield, New York

ARCADIS Design & Consultancy for natural and built assets

Quantity	Description	Designation	Specification
1	Regenerative Blower	B-300	Elmo Rietschle Model 2BH1610-7HH26 (60hz), 175 scfm at max vacuum of 84 in w.c., 4.6 hp, three phase
1	Knockout Tank	KT-100	Product Level Control Model MDXX-WSR60-XXS, rated for 20 in Hg vacuum, 60 gallons liquid capacity, manual drain valve
1	Flow Meter	FI-101	Rotron Model FM30C250Q, 2.5 in w.c. loss at 165 scfm, flow range 45-225 scfm
1	Inline Filter	AF-100	Solberg Model CSL-235P-300, rated for 300 acfm, polyester filter element
1	Silencer	S-400	Solberg Model SLCRT250, rated for 385 scfm
1	Filter/Silencer	AFS-100	Solberg Model FS-31P-200, rated for 135 scfm, polyester filter element
1	Vacuum Relief Valve	V-120	Kunkle Model 215V-H01AQE (set for 80 in w.c.)
1	Pressure Relief Valve	V-301	Kunkle Model 0337-H01ANE (set for 1 psi)
2	Liquid Level Sensor	LSH-101 & LSHH-101	Product Level Control 2-float system, both normally closed, mounted vertically inside clear PVC site tube
2	Vacuum Transmitter	VT-101 & VT-201	Wika Model s10(50020021), range 0 to 100 in w.c. 316 S.S. 4-20 mA signal
4	Vapor Phase Carbon	VPGAC-101, 102, 103 & 104	Tetrasolv Model VFV-1000-SD 48, 7 ft^2 bed area, 35 ft^3 bed volume, rated 700 scfm, max vacuum 20 in Hg., 48" Ø x 56" high, with false floor, 4" inlet/outlet, 18" Ø top manway, 1" drain valve
6	Vacuum Gauges	VI-102 through VI-107	PIC Gauges, 0-100 in w.c. vacuum, 2.5" dial, 1/4" MNPT threads
2	Temperature Gauges	TI-102 & TI-301	Trerice Model B831X0205, 20-240°F, 2.5" dial, 1/2" MNPT threads
1	Pressure Gauge	PI-301	PIC Gauges, 0-60 in w.c. pressure, 2.5" dial, 1/4" MNPT threads
17	Butterfly Valves	V-102 through V-118	Red-White Valve Model 937DESL-4"
2	Butterfly Valves	V-101 & V-201	Milwaukee Model 4CW223E
1	Ball Valve	V-119	MATCO Model 759T08, 2" brass/TFE

Notes:
1) See Appendix B for additional equipment information
2) See Drawing M-1 (Appendix A) for equipment designations

Definitions:

Ø = diameter	LSH = level switch high
AFS = air filter/silencer	LSHH = level switch high-high
B = blower	MNPT = Male National Pipe Thread
cfm = cubic feet per minute	PI = pressure indicator
FI = flow indicator	psi = pounds per square inch
hp = horsepower	S = silencer
hz = hertz	scfm = standard cubic feet per minute
inHg = inches of mercury	V = valve
in. w.c. = inches of water column	VPGAC = vapor-phase granular-activated carbon
KT = knockout tank	VT = vacuum transmitter

Table 2
VPGAC Vessel Valve Configurations
Operation, Maintenance, and Monitoring Plan
Sub-Slab Depressurization System
Crosman Corporation
East Bloomfield, New York

Valve Designation	Flow Path Through VPGAC Vessels[1]											
	101→102→103→104	103→104→101→102	101→102→103	102→103→104	103→104→101	101→102→104	101→102	101→104	102→103	102→104	103→104	104→101
V-102	open	open	open	closed	open	open	open	open	closed	closed	open	closed
V-103	open	closed	open	closed	closed	open	open	open	closed	closed	closed	closed
V-104	open	open	open	closed	open	open	open	open	closed	closed	closed	open
V-105	open	open	open	open	closed	open	open	closed	open	open	closed	closed
V-106	open	closed	open	open	closed	closed	closed	closed	open	closed	closed	closed
V-107	open	open	open	open	open	closed	closed	closed	open	closed	open	closed
V-108	open	open	closed	open	open	open	closed	open	closed	open	open	open
V-109	open	closed	closed	open	closed	open	closed	open	closed	open	open	closed
V-110	closed	closed	closed	open	closed	closed	closed	closed	open	open	closed	open
V-111	closed	closed	closed	open	open	closed	closed	open	open	open	closed	closed
V-112	closed	closed	closed	closed	open	closed	closed	open	closed	closed	closed	open
V-113	closed	open	closed	closed	closed	open	open	closed	closed	open	closed	closed
V-114	closed	closed	open	closed	closed	open	closed	open	open	open	closed	open
V-115	closed	open	open	closed	open	closed	open	closed	open	closed	closed	closed
V-116	closed	open	closed	closed	open	closed	closed	closed	closed	closed	open	closed
V-117	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	closed	open
V-118	closed	open	closed	closed	open	closed	closed	closed	closed	closed	closed	open

Notes:
1) VPGAC vessel ID's shown. All possible flow paths not shown. Consult project engineer if different flow paths are required.

Definitions:
V = valve
VPGAC = vapor-phase granular-activated carbon

Table 3
Alarm Details
Operation, Maintenance, and Monitoring Plan
Sub-Slab Depressurization System
Crosman Corporation
East Bloomfield, New York

Instrument	Alarm Condition	Type[1]	Alarm Range	Delay	Potential Cause(s)
B-300	Blower Motor Failure	Critical	No run	10 seconds	Power failure, overcurrent breaker tripped, plugged blower inlet or outlet
VT-101	Low vacuum	Non-Critical	< 50 in w.c. vacuum	20 seconds	Blower shutdown, leak in extraction piping, vacuum relief valve stuck open, clogged discharge line
VT-101	Low-Low Vacuum	Critical	< 40 in w.c. vacuum	20 seconds	Blower shutdown, leak in extraction piping, vacuum relief valve stuck open, clogged discharge line
VT-201	Low vacuum	Non-Critical	< 50 in w.c. vacuum	20 seconds	Blower shutdown, leak in extraction piping, vacuum relief valve stuck open, clogged discharge line
VT-201	Low-Low Vacuum	Critical	< 40 in w.c. vacuum	20 seconds	Blower shutdown, leak in extraction piping, vacuum relief valve stuck open, clogged discharge line
VT-101	Transmitter Failure	Critical	No function	5 seconds	Bad wire connection, exceeding transmitter operational range
VT-201	Transmitter Failure	Critical	No function	5 seconds	Bad wire connection, exceeding transmitter operational range
LSH-101	High liquid level knockout tank (KT-100)	Non-Critical	Raised	5 seconds	Knockout tank requires emptying, switch stuck in raised position
LSHH-101	High-High liquid level knockout tank (KT-100)	Critical	Raised	5 seconds	Knockout tank requires emptying, switch stuck in raised position
UPS	UPS Fault	Critical	No function	5 seconds	Power failure or spike, faulty UPS
-	AC Power Failure	Critical	No power	5 seconds	Power failure or spike, tripped breaker

Notes:
1. Critical alarms result in system shutdown and alarm notification. Non-critical alarms result in alarm notification.

Definitions:
B = blower
in w.c. = inches of water column
KT = knockout tank
LSH = level sensor high
LSHH = level sensor high-high
UPS = uninterruptable power supply
VT = vacuum transmitter

Table 4
Operation, Maintenance, and Monitoring Schedule
Operation, Maintenance, and Monitoring Plan
Sub-Slab Depressurization System
Crosman Corporation
East Bloomfield, New York

Task	Frequency	Notes
Complete Monthly OMM Checklist	Monthly	
Complete System Monitoring Log	Monthly	
Complete Performance Monitoring Log	Monthly	
Complete Alarm Response Log	As Needed	Should be completed anytime an alarm response is required.
Conduct Instantaneous Sub-Slab Differential Pressure Monitoring	See Table 5	
Conduct 24-Hour Continuous Differential Pressure Monitoring	See Table 5	
Conduct System Vapor Sampling	See Table 6	
Blower Inspection	Monthly	Inspect for abnormal sounds, odors and vibrations.
Knockout Tank Liquid Level Check and/or Draining (1)	Monthly	If the liquid level is greater than 50% of the tank volume, the water shall be drained.
Condensation Check (1)	Monthly	Condensation shall be drained from valve V-401.
In-Line Air Filter Element Inspection (2)(3)	Monthly	
Dilution Line Air Filter Element Inspection	Monthly	Close dilution valve V-119 100% prior to inspecting filter.
Extraction Point Riser Inspection	Monthly	Inspect for cracked piping or fittings, leaks and structural integrity.
Discharge Stack Inspection	Monthly	Inspect for leaks, potential blockage, structural integrity and abnormal appearance.
Knockout Tank Liquid Level Switches Test (4)(5)	Annual	Confirm LSH-101 functions as non-critical alarm and LSHH-101 as critical alarm.
Vacuum Transmitters Test (4)(6)	Annual	Confirm transmitter functioning including initiation of system shutdown.
Vacuum Relief Valve Test (should open at 80 in w.c. vacuum)	Annual	
VPGAC Changeout	As Needed	As recommended by Project Engineer
Blower Voltage and Current Check (3)	As Needed	Nameplate current maximum of 7.2 amps shall not be exceeded.

Notes:
1) Condensation shall be containerized and disposed of in coordination with Crosman Corporation procedures
2) System shall be shutdown prior to performing
3) Lockout/tagout and work on energized equipment shall be conducted in accordance with Arcadis Safety Procedures
4) Will cause system shutdown.
5) Knockout tank shall be filled with water using lower drain port
6) Vacuum transmitters VT-101 and VT-201 shall read between +/- 5% of vacuum gauges VI-101 and VI-201, respectively

Definitions:
in w.c. = inches of water column
LSH = level sensor high
LSHH = level sensor high-high
OMM = operation, maintenance and monitoring
V = valve
VI = vacuum indicator
VPGAC = vapor-phase granular-activated carbon
VT = vacuum transmitter

Table 5
Sub-Slab Differential Pressure Monitoring Schedule
Operation, Maintenance, and Monitoring Plan
Sub-Slab Depressurization System
Crosman Corporation
East Bloomfield, New York

Instantaneous Differential Pressure Monitoring Schedule [(1)]

Vacuum Monitoring Point	Frequency
VMP-1	monthly
VMP-2	monthly
VMP-3	monthly
VMP-4	monthly
VMP-5	monthly
VMP-6	monthly
VMP-7	monthly
VMP-8	monthly
VMP-9	monthly
VMP-10	monthly
VMP-11	monthly
VMP-12	monthly

24-Hour Continuous Differential Pressure Monitoring Schedule [(2)]

Vacuum Monitoring Point	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
VMP-1	X			
VMP-2	X			
VMP-3		X		
VMP-4			X	
VMP-5			X	
VMP-6				X
VMP-7	X			
VMP-8		X		
VMP-9		X		
VMP-10			X	
VMP-11				X
VMP-12				X

Notes:
1) A micromanometer capable of measuring +/- 0.001 inches of water column shall be used.
2) Refer to SSD SOP-02 in Appendix E for 24-hour continuous differential monitoring procedure.

Definitions:
SOP = standard operating procedure
VMP = vacuum monitoring point

Table 6
System Vapor Sampling Schedule
Operation, Maintenance, and Monitoring Plan
Sub-Slab Depressurization System
Crosman Corporation
East Bloomfield, New York

ARCADIS Design & Consultancy for natural and built assets

Sample Location	Sample Port ID	Phase	PID Readings		Laboratory Analysis		
			Frequency	Sampling Method	Frequency	Sampling Method	Analysis
SDS-1	SP-001	vapor	monthly	vacuum pump and tedlar bag	monthly	grab sample via summa canister	USEPA TO-15
SDS-2	SP-002	vapor	monthly		monthly		
Pre-VPGAC-101 (1)	SP-103	vapor	monthly		monthly		
Pre-VPGAC-102 (1)	SP-104	vapor	monthly		monthly		
Pre-VPGAC-103 (1)	SP-105	vapor	monthly		monthly		
Pre-VPGAC-104 (1)	SP-106	vapor	monthly		monthly		
Effluent (Post-VPGAC-104/Pre-Dilution)	SP-107	vapor	monthly		monthly		
Effluent (Post-Blower) (2)	SP-301	vapor	monthly		monthly		

Notes:
1) Pre-VPGAC vapor sampling for each respective VPGAC vessel shall only be conducted if that respective VPGAC vessel is in use.
2) Post-Blower effluent sample shall only be collected if the dilution valve is opened.
3) Refer to SSDS-SOP-01 in Appendix E for air sampling procedure.

Definitions:
SDS = sub-slab depressurization sump
SOP = standard operating procedure
SP = sample port
USEPA = United States Environmental Protection Agency
VOC = volatile organic compound
VPGAC = vapor-phase granular-activated carbon

APPENDIX A

Record Drawings

CITY: DIV/GROUP: DB: LD: PIC: PM: TM: LYR:ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\B0041501\0001\00009\DWG\CONTRACT\SSDS-RECORD\41501Q01.dwg LAYOUT: C-C0VER SAVED: 12/12/2016 11:40 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: PDF-D2B PLOTSTYLETABLE: PLTCONT.CTB PLOTTED: 1/27/2017 11:02 AM BY: STEINBERGER, GEORGE
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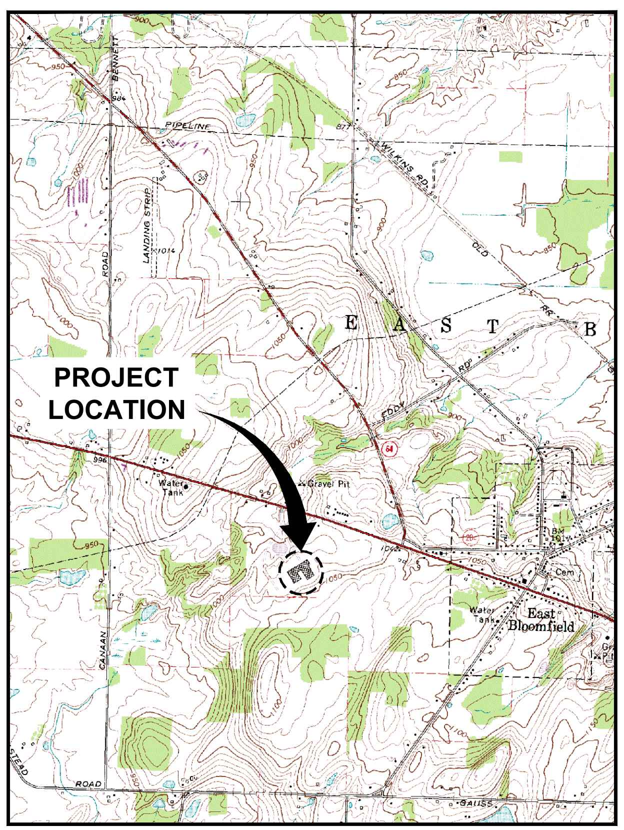
PE-ENGLER-NY.jpg

RECORD DRAWINGS

SUB-SLAB DEPRESSURIZATION SYSTEM



LOCATION MAP

0 2000' 4000'
GRAPHIC SCALE

CROSMAN CORPORATION SITE
7629 ROUTES 5 & 20
EAST BLOOMFIELD, NEW YORK

DATE ISSUED

DECEMBER 2016

RECORD DRAWINGS
TO THE BEST OF OUR KNOWLEDGE, INFORMATION AND BELIEF, THESE RECORD DRAWINGS SUBSTANTIALLY REPRESENT THE PROJECT AS CONSTRUCTED.

DATE_________BY__________________

ARCADIS Design & Consultancy for natural and built assets

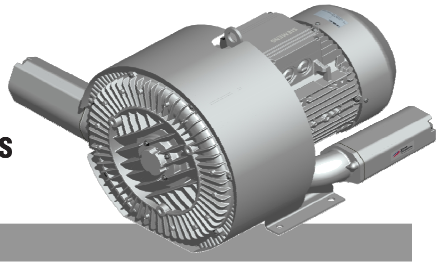
ARCADIS OF NEW YORK, INC.

INDEX TO DRAWINGS

G-BH1

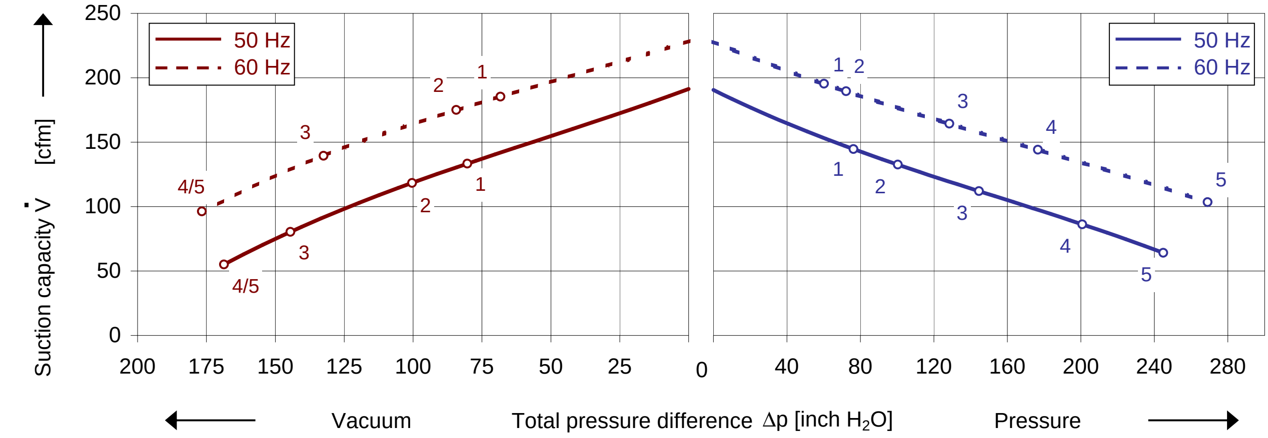
Data sheet 2BH1 610

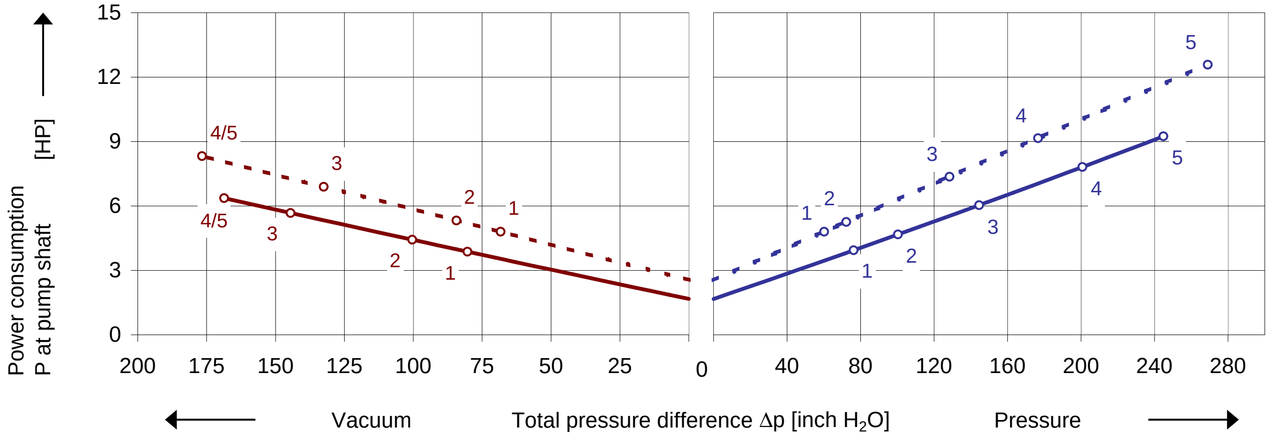
Side channel blower

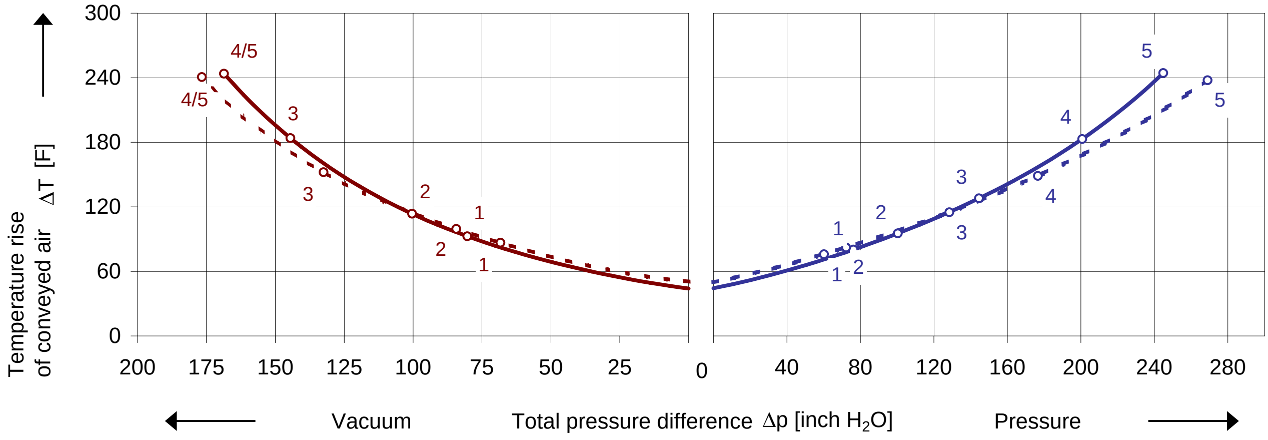


Performance curves

Vacuum operation (acfm) | **Pressure operation (scfm)**







The performance curves are based on air at a temperature of 59 F and an atmospheric pressure of 29.91 inch Hg with a tolerance of ± 10 %. The total pressure differences are valid for inlet and ambient temperature up to 77 F. Suction capacity relates to inlet conditions. Pressure capacity relates to atmospheric conditions. For other conditions please get in touch with us.

Every G-BH blower can be used either for vacuum or pressure in continuous operation over the total performance curve range. The motors are available as standard in protection category IP 55 and insulation class F. These blowers are UL and CSA approved.

Selection and ordering data

Type 2BH1 610									
No.	Frequency	Rated			Max. differential pressure [2]		Sound pressure level [3]	Weight Approx.	Order No.
		Voltage [1]	Current	Power	Vacuum	Pressure			
	Hz	V	A	HP			dB(A)	ibs	
3~ 50/60 Hz, IP55, Insulation material class F, UL 507 and CSA 22.2 No 113 (certificate number E225239)									
1	50	200-240 Δ / 345-415 Y	9.7 Δ / 5.6 Y	2.95	-80	76	73	95	**2BH1610-7HH16**
	60	220-275 Δ / 380-480 Y	10.3 Δ / 6 Y	3.42	-68	60	75		
2	50	200-240 Δ / 345-415 Y	12.5 Δ / 7.2 Y	4.02	-100	100	73	110	**2BH1610-7HH26**
	60	220-275 Δ / 380-480 Y	12.6 Δ / 7.3 Y	4.63	-84	72	75		
3	50	200-240 Δ / 345-415 Y	17.3 Δ / 10 Y	5.8	-145	145	73	115	**2BH1610-7HH36**
	60	220-275 Δ / 380-480 Y	18.0 Δ / 10.4 Y	6.4	-132	128	75		
4	50	200-240 Δ / 345-415 Y	23.0 Δ / 13.3 Y	7.4	-169	201	73	179	**2BH1610-7HH46**
	60	220-275 Δ / 380-480 Y	23.0 Δ / 13.3 Y	8.4	-177	177	75		
5	50	200-240 Δ / 345-415 Y	29.0 Δ / 16.7 Y	10.1	-169	245	73	190	**2BH1610-7HH56**
	60	220-275 Δ / 380-480 Y	30.0 Δ / 17.3 Y	11.5	-177	269	75		
3~ 50/60 Hz, IP55, Insulation material class F, UL 507 and CSA 22.2 No 113 (certificate number E225239)									
1	50	500 Y	4.5 Y	2.95	-80	76	73	95	**2BH1610-7HC13**
	60	575 Y	4.55 Y	3.42	-68	60	75		
2	50	500 Δ	5.8 Δ	4.02	-100	100	73	110	**2BH1610-7HC25**
	60	575 Δ	6.0 Δ	4.63	-84	72	75		
3	50	500 Δ	7.5 Δ	5.4	-145	145	73	115	**2BH1610-7HC35**
	60	575 Δ	7.6 Δ	6.2	-132	128	75		
4	50	500 Δ	10.5 Δ	7.4	-169	201	73	179	**2BH1610-7HC45**
	60	575 Δ	10.4 Δ	8.4	-177	177	75		
5	50	500 Δ	13.0 Δ	10.1	-169	245	73	190	**2BH1610-7HC55**
	60	575 Δ	13.6 Δ	11.5	-177	269	75		

1) In case of frequency converter operation the standard motor insulation system is suitable for converter input voltages up to 460 V.

2) Relief valves available for limiting differential pressure.

3) Measuring surface sound pressure level acc. to EN ISO 3744, measured with an equivalent unit at a distance of 1 m. The pump is throttled to an average suction pressure, with piping connected, but no relief valves fitted, tolerance ±3 dB (A).

All G-BH match the 2006/42/EC (machinery) and 2006/95/EC (low voltage) directives and the EN 60034-1 norm “Rotating electrical machines”.

The motors comply with EN 60 034-1 / -2 / -30 (IEC 60034) and thermal class F.
For three phase motors tolerances are +/-10% for fixed voltage motors and +/-5% for voltage range motors. Single phase machines are designed with a +/- 5% tolerance.
The frequency tolerance is +/- 2 % maximum.

Motors for other mains

Voltage range		Fixed voltage		VFD	cULus			
50 Hz	**60 Hz**	**50 Hz**	**60 Hz**	**87 Hz**	**60 Hz** Δ	**60 Hz** Y	**2BH1610-7.** □	. □
3~								
185 - 225 V Δ / 320 - 390 V Y	200 - 240 V Δ / 345 - 415 V Y				•	•	H	1
200 - 240 V Δ / 345 - 415 V Y	220 - 275 V Δ / 380 - 480 V Y			380 V Δ	•	•	H	6
345 - 415 V Δ / 600 - 720 V Y	380 - 480 V Δ / 660 - 720 V Y				•		H	7
		500 V Y	575 V Y			•	C	3
		500 V Δ	575 V Δ		•		C	5
3~		**IE2 3~** [5]						
180 - 240 V Δ / 310 - 415 V Y	200 - 275 V Δ / 345 - 480 V Y	200 V Δ / 345 V Y	230 V Δ / 400 V Y		•	•	P	1
450 - 550 V Y	520 - 600 V Y	500 V Y	575 V Y			•	P	3
450 - 550 V Δ	520 - 600 V Δ	500 V Δ	575 V Δ		•		P	5
200 - 260 V Δ / 350 - 450 V Y	230 - 290 V Δ / 400 - 500 V Y	230 V Δ / 400 V Y	265 V Δ / 460 V Y	400 V Δ	•	•	P	6
350 - 450 V Δ / 610 - 725 V Y	400 - 500 V Δ / 690 - 725 V Y	400 V Δ / 690 V Y	460 V Δ		•		P	7

5) Performance can differ if IE2 motors are used. Please refer to corresponding data sheets.

Elmo Rietschle is a brand of Gardner Denver
Your Ultimate Source for Vacuum and Pressure

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1800 Gardner Expressway
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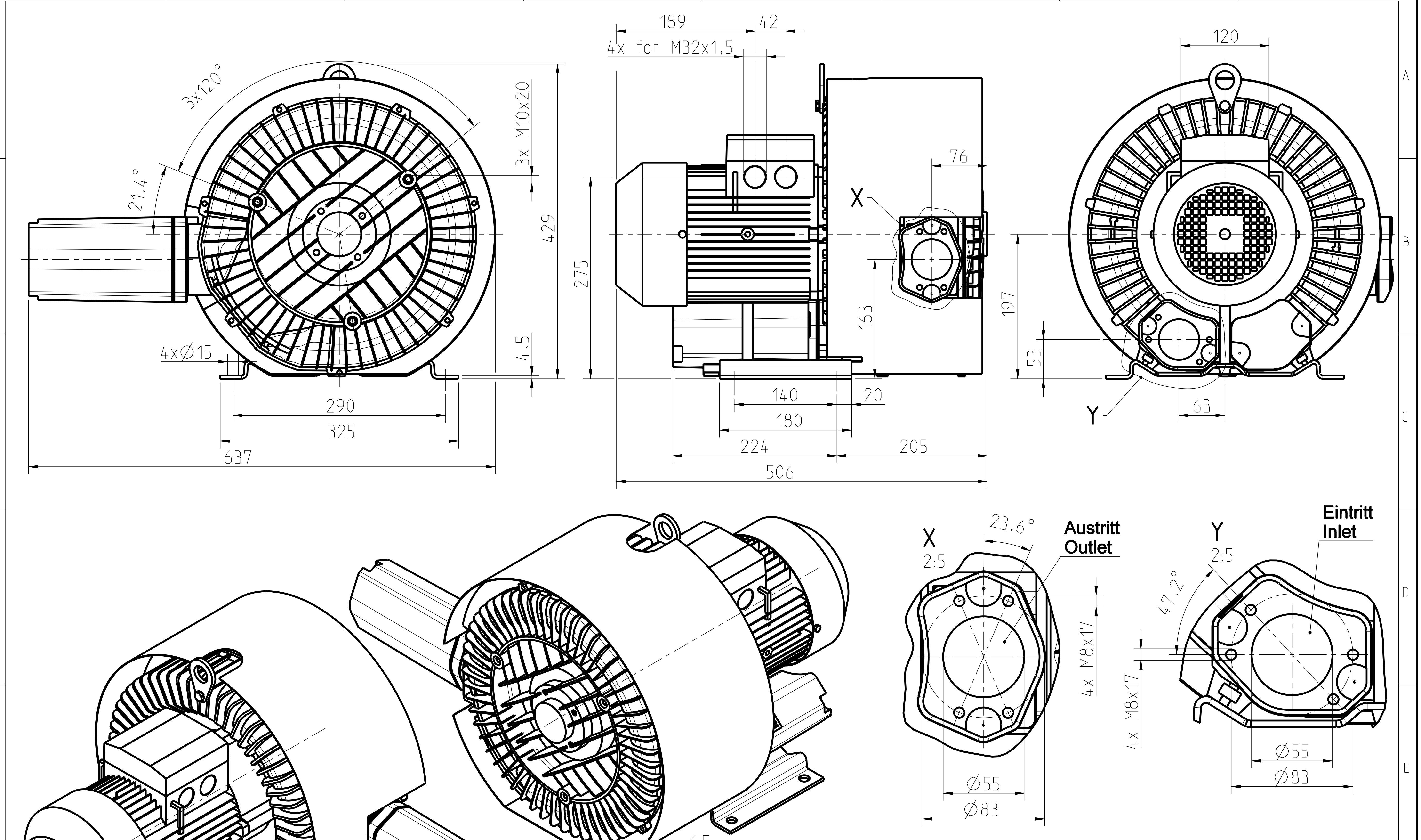
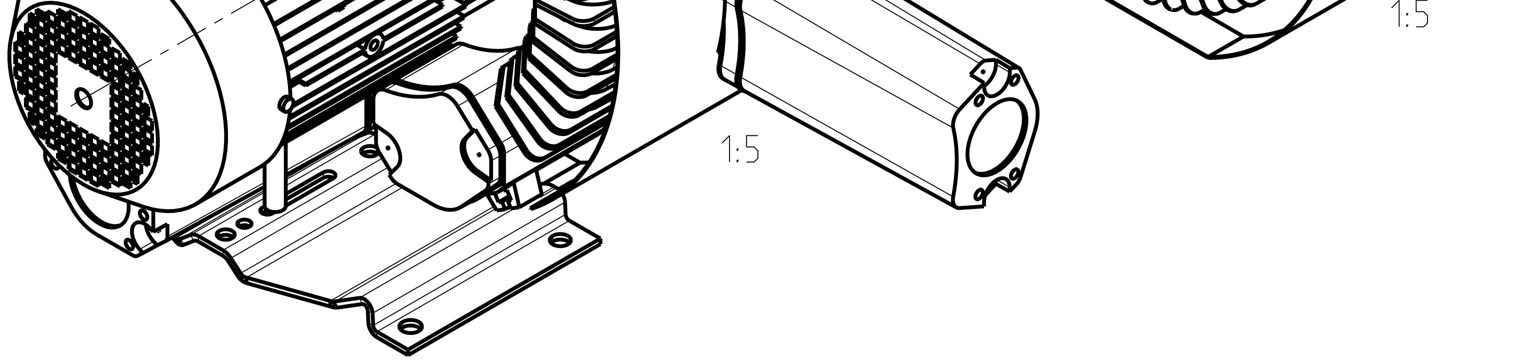
Fax: 217-221-8780





Das Verwenden von gesetzlich verbotenen und bei Gardner Denver gelisteten Stoffen ist nicht erlaubt./The use of hazardous substances banned by law and listed by Gardner Denver is not allowed.

Pro/ENGINEER Wildfire

Werkstoff / material:	.
Halbzeug / semi-finished part:	.
Beschichtung coating:	. .

Änderung / Change management

Mitteilung / information:
o. ÄM., 3D-Datensatz berichtigt
.
.

Datum / date:	Name / name:	Geprüft / checked:
26.10.2009	Fischer	/Fis

Ersatz für replacement for: .

Version: 1+

Datum / date:	20.01.2000
Name / name:	Fenn
Geprüft / checked:	Fischer
Abt. / dept.:	R&D D

Gardner Denver
Industriestraße 26
97616 Bad Neustadt a. d. Saale

Maßblatt
Drehstrom mit Standardklemmenkasten

dimension sheet
three-phase with standard terminal box

2BH1610-7H.2.

510_31112_21 f

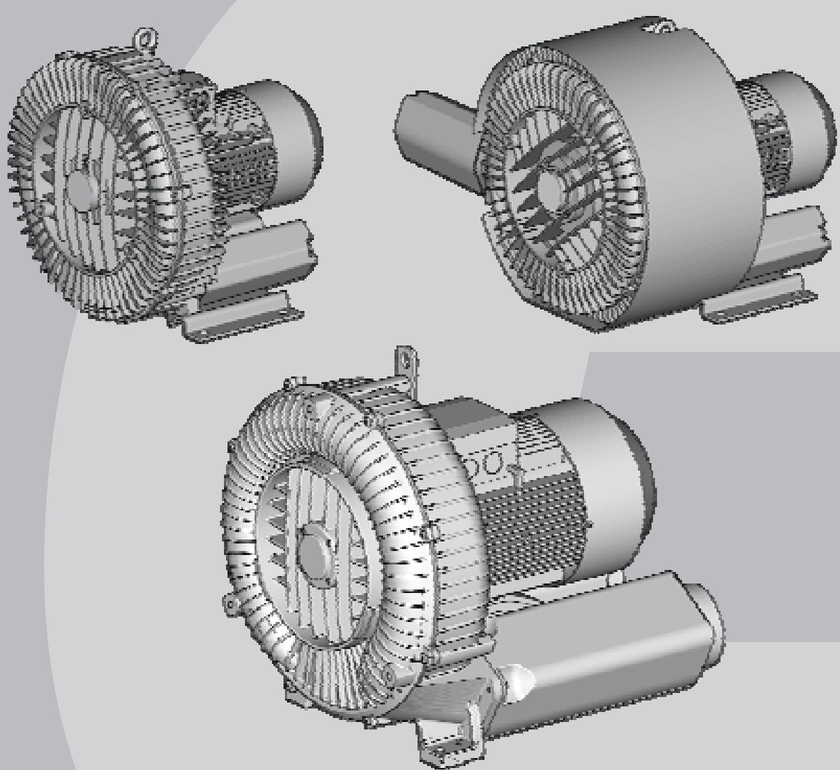
Masse / mass:	ca. 48 kg
Einheit / unit:	mm
Maßstab / scale:	1:5
Format:	A3
Blatt / sheet Nr.	1 von / of 1

Gardner Denver A3-12-2006, DIN EN ISO 7200-2004

Edition: 09.2011 · 610.44434.40.000

Original operating instructions · English

Operating instructions G-BH1, G-BH9



2BH1 1
2BH1 2
2BH1 3
2BH1 4
2BH1 5
2BH1 6
2BH1 8
2BH1 9
2BH9 23

G-Serie
G-Series

Seitenkanal
Side Channel

Contents

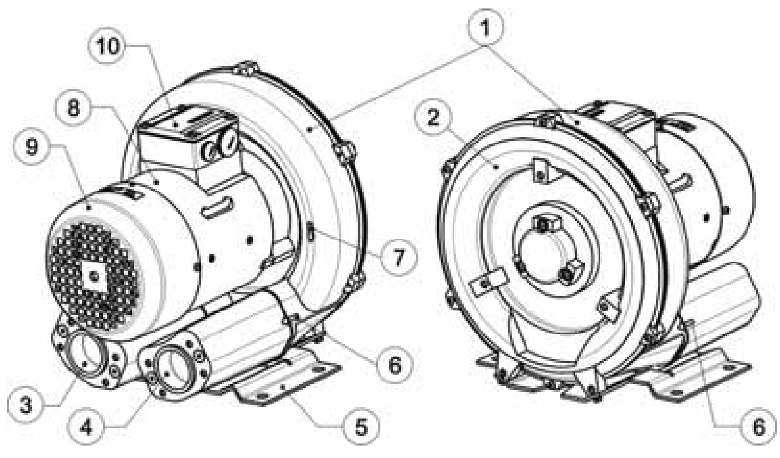


Fig. 1: Design of gas-ring vacuum pump/compressor

1 Vacuum pump/compressor housing
2 Vacuum pump/compressor cover
3 Inlet connection with muffler
4 Discharge connection with muffler
5 Base
6 Arrow indicating delivery direction
7 Arrow indicating direction of rotation
8 Drive motor
9 Fan guard (over external fan)
10 Terminal box

1 Safety

1.1 Definitions

To point out dangers and important information, the following signal words and symbols are used in these operating instructions:

1.1.1 Safety alert symbol

The **safety alert symbol** ⚠ is located in the safety precautions in the highlighted heading field on the left next to the signal word (DANGER, WARNING, CAUTION).

Safety precautions **with** a safety alert symbol indicate a danger of **injuries**.

Be sure to follow these safety precautions to protect against **injuries or death**!

Safety precautions **without** a safety alert symbol indicate a danger of **damage**.

1.1.2 Signal words

DANGER **WARNING** **CAUTION** **NOTICE** **NOTE**	The **signal words** are located in the safety precautions in the highlighted heading field. They follow a certain hierarchy and indicate (in conjunction with the safety alert symbol, see Chapter 1.1.1) the **seriousness of the danger** and the **type of warning.** See the following explanations:

⚠ DANGER
Danger of injuries. Indicates an imminently hazardous situation, that **will** result in **death or serious injury** if the corresponding measures are not taken.

⚠ WARNING
Danger of injuries. Indicates a potentially hazardous situation, that **could** result in **death or serious injury** if the corresponding measures are not taken.

⚠ CAUTION
Danger of injuries. Indicates a potentially hazardous situation, that may result in **minor or moderate injury** if the corresponding measures are not taken.

CAUTION
Danger of damage. Indicates a potentially hazardous situation that may result in **property damage** if the corresponding measures are not taken.

NOTICE
Indicates a possible **disadvantage**, i.e. undesirable conditions or consequences can occur if the corresponding measures are not taken.

NOTE
Indicates a possible **advantage** if the corresponding measures are taken; tip.

1.2 General safety precautions

⚠ WARNING
Improper use of the unit can result in serious or even fatal injuries! These operating instructions • must have been read completely and understood before beginning any work with or at the pump-motor unit, • must be strictly observed, • must be available at the operating location of the pump-motor unit.

⚠ WARNING
Improper use of the unit can result in serious or even fatal injuries! Only operate the pump-motor unit • for the purposes indicated under "Intended Use"! • with the fluids indicated under 'Intended Use'! • with the values indicated under 'Technical Data'!

⚠ WARNING
Improper use of the unit can result in serious or even fatal injuries! All work on and with the pump-motor unit (transport, installation, operation, shut-down, maintenance, disposal) may only be carried out by **trained, reliable expert personnel**!

⚠ WARNING

When working on the unit, there is a danger of injury, e.g. in the form of cuts/cutting off, crushing and burns!
During all work on and with the pump-motor unit (transport, installation, operation, shut-down, maintenance, disposal) wear **personal safety equipment (safety helmet, protective gloves, safety shoes)**!

⚠ WARNING

Hair and clothing can be pulled into the unit or caught and wound up moving parts!
Do not wear long, loose hair or wide, loose clothes! Use a hair net!

⚠ DANGER

Electrical danger!
Work on electrical installations may be carried out by trained and authorized electricians only!

⚠ DANGER

Electrical danger!
Before beginning work on the unit or system, the following measures must be carried out:

- Deenergize.
- Secure against being switched on again.
- Determine whether deenergized.
- Ground and short-circuit.
- Cover or block off adjacent energized parts.

⚠ DANGER

Electrical danger!
Do not open the motor terminal box until absence of electricity has been ensured!

⚠ WARNING

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries),
sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!
Use mounting elements, connections, lines, fittings and containers with sufficient freedom from leaks and strength for the pressures which occur.

Check the mounting elements, connections, lines, fittings and containers for strength, leaks and firm seating at regular intervals!

⚠ WARNING

Danger from rotating parts (external fan, impeller, shaft):
Cutting/cutting off of extremities,
Grasping/winding up of hair and clothing!

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries), sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!
<u>Start-up</u> and <u>operation</u> only under the following conditions:

- The pump-motor unit must be completely assembled. When doing so, pay particular attention to the following components:
  - the vacuum pump/compressor cover,
  - the muffler on inlet and discharge connections,
  - the fan guard.
- The pipes/hoses must be connected to inlet and discharge connections.
- Inlet and discharge connections and the connected pipes/hoses may not be closed, clogged or soiled.
- Check the mounting elements, connections of the pipe/hose connections, lines, fittings and containers for strength, leaks and firm seating at regular intervals.

⚠ WARNING

Danger from rotating parts (external fan, impeller, shaft):
Cutting/cutting off of extremities,
Grasping/winding up of hair and clothing!

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries), sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!
Before <u>beginning work on the pump-motor unit</u>, take the following measures:

- Shut down pump-motor unit and secure against being switched on again.
- Attach a sign on the system controller and on the control elements for the pump-motor unit: "DANGER! Maintenance work on vacuum pump/compressor! Do not switch on!"
- Wait for pump-motor unit to come to a complete stop. Observe run-on time!
- Allow pump-motor unit to cool!
- Shut-off lines. Release pressure.
- Make sure that no vacuum or gauge pressure is present in the lines/tanks to be opened.
- Make sure that no fluids can escape.

⚠ WARNING

Danger from rotating impeller:
Cutting/cutting of off extremities!
The rotating impeller is accessible with the inlet and discharge connections open!

Do not reach into the unit through open connections!

Do not insert objects into the unit through the openings!

⚠ WARNING

Danger from rotating impeller:
Cutting/cutting of off extremities!
The rotating impeller is accessible with the inlet and discharge connections open!

With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, the following therefore applies:

Provide the inlet and discharge connections of the pump-motor unit either with additional mufflers or with additional piping of a sufficient length to prevent access to the impeller!

⚠ WARNING

Danger of burns from hot surfaces of the pump-motor unit and from hot fluids!
High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

Cover the pump-motor unit with a suitable touch protection (e.g. perforated plate cover or wire cover). Do not touch during operation!
Allow to cool after shut-down!

1.3 Residual risks

⚠ WARNING

Danger zone:
Hot surface up to approx. 160°C [320°F].

Hazard:
Possible burns.

Protective measures:
Cover the pump-motor unit with a suitable touch protection (e.g. perforated plate cover or wire cover).

⚠ WARNING

Danger zone:
Fan guard

Hazard:
Long, loose hair can be drawn into external fan through fan guard grate, even with fan guard mounted!

Protective measures:
Wear hair net!

⚠ WARNING

Danger zone:
Missing or defective muffler inlet or discharge connection.

Hazard:
Possible serious hearing damage due to emitted noise.

Protective measures:
Have missing or defective mufflers replaced.
Conduct a noise measurement in the system after installing the pump-motor unit. The following measures can be taken from 85 dB(A) and must be taken from 90 dB(A):

- Mark noise area with a warning sign.
- Wear hearing protection.

⚠ WARNING

Danger zone:
Environment of pump-motor unit.

Hazard:
Possible serious hearing damage due to emitted noise.

Protective measures:
Conduct a noise measurement in the system during operation after installing the pump-motor unit.

The following measures can be taken from 85 dB(A) and must be taken from 90 dB(A):

- Mark noise area with a warning sign.
- Wear hearing protection.
- With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, attach an additional muffler.

2 Intended Use

This operating manual

- is intended for side channel compressors of the
  G-BH1 and G-BH9 series, types 2BH1 1
  2BH1 2 2BH1 3 2BH1 4 2BH1 5 2BH1 6
  2BH1 8 2BH1 9 2BH9 23,
- contains instructions bearing on transport and handling, installation, commissioning, operation, shut-down, storage, servicing and disposal of the G-BH1,G-BH9,
- must be completely read and understood by all operating and servicing personnel before beginning to work with or on the G-BH1, G-BH9,
- must be strictly observed,
- must be available at the site of operation of the G-BH1, G-BH9.

About the operating and servicing personnel of the G-BH1, G-BH9

- These persons must be trained and authorized for the work to be carried out.
- Work on electrical installations may be carried out by trained and authorized electricians only.

The G-BH1,G-BH9

- are pump-motor units for generating vacuum or gauge pressure;
- are used to **extract**, **pump** and **compress the following gases**:
  - Air,
  - Non-flammable, non-aggressive, non-toxic and non-explosive gases or gas-air mixtures.
  - With differing gases/gas-air mixtures, inquire with the Service Department.
- are equipped with one of the following kind of drive motors:
  - 3-phase AC drive motor
    with a standard or explosion-protected design
  - Single-phase AC drive motor

  These operating instructions apply **only to** pump-motor units with a **standard design**. For an explosion-protected design (EEx e II), see the separate operating instructions.
- are intended for industrial applications,
- are designed for continuous operation.
  With increased switch-on frequency (6x per hour with equal pauses and operating times) or with increased gas inflow and ambient temperature, the excess temperature limit of the coil and the bearing can be exceeded. Consult the manufacturer when using under such conditions.

When operating the G-BH1, G-BH9 the limits listed in Chapter 3, "Technical Data", Pg. 7 ff. must always be complied with.

Foreseeable Misuse

It is prohibited

- to use the G-BH1, G-BH9 in applications other than industrial applications unless the necessary protection is provided on the system, e.g. guards suitable for children's fingers;
- to use the device in rooms in which explosive gases can occur if the G-BH1, G-BH9 is not expressly intended for this purpose;
- to extract, to deliver and to compress explosive, flammable, corrosive or toxic fluids, unless the G-BH1, G-BH9 is specifically designed for this purpose;
- to operate the G-BH1 with values other than those specified in Chapter 3, "Technical Data", Pg. 7 ff.

Any unauthorized modifications of the G-BH1, G-BH9 are prohibited for safety reasons.

The operator is only permitted to perform the maintenance and service work described in these operating instructions.

Maintenance and servicing work which goes beyond this may only be carried out by companies which have been authorised by the manufacturer (ask the service department for details).

3 Technical Data

3.1 Mechanical data

Weight

Single-impeller design		
Type	Weight [kg] approx.	Weight [lbs] approx.
2BH1100-7..0.	9	20
2BH1200-7..0.	9	20
2BH1300-7..0.	9	20
2BH1300-7..1.	10	22
2BH1300-7..2.	11	24
2BH1330-7..0.	10	22
2BH1330-7..1.	11	24
2BH1330-7..2.	12	26
2BH1400-7..0.	13	29
2BH1400-7..1.	16	35
2BH1400-7..2.	17	37
2BH1430-7..0.	14	31
2BH1430-7..1.	17	37
2BH1430-7..2.	18	40
2BH1500-7..0.	20	44
2BH1500-7..1.	22	49
2BH1500-7..2.	23	51
2BH1500-7..3.	25	55
2BH1530-7..0.	21	46
2BH1530-7..1.	23	51
2BH1530-7..2.	24	53
2BH1530-7..3.	26	57
2BH1600-7..0.	27	60
2BH1600-7..1.	30	66
2BH1600-7..2.	36	79
2BH1600-7..3.	40	88
2BH1600-7..6.	32	71
2BH1600-7..7.	39	86
2BH1630-7..0.	29	64
2BH1630-7..1.	32	71
2BH1630-7..2.	37	82
2BH1630-7..3.	43	95
2BH1630-7..6.	34	75
2BH1630-7..7.	40	88

Single-impeller design		
Type	Weight [kg] approx.	Weight [lbs] approx.
2BH180.-7..0.	117	258
2BH180.-7..1.	126	278
2BH180.-7..2.	132	291
2BH183.-7..0.	120	265
2BH183.-7..1.	129	284
2BH183.-7..2.	135	298
2BH190.-7..0.	179	395
2BH190.-7..1.	198	437
2BH190.-7..3.	210	463
2BH193.-7..0.	179	395
2BH193.-7..1.	198	437
2BH193.-7..3.	209	463
2BH923..-…P	167	368
2BH923..-…Q	145	320
2BH923..-…H	151	333

Two-impeller design		
Type	Weight [kg] approx.	Weight [lbs] approx.
2BH1310-7..2.	15	33
2BH1410-7..3.	25	55
2BH1410-7..4.	27	60
2BH1510-7..4.	40	88
2BH1510-7..5.	44	97
2BH1610-7..1.	43	95
2BH1610-7..2.	48	106
2BH1610-7..3.	54	119
2BH1610-7..4.	66	146
2BH1610-7..5.	73	161
2BH1610-7..7.	50	110
2BH1610-7..8.	62	137
2BH1640-7..3.	54	119
2BH1640-7..4.	69	152
2BH1640-7..5.	75	165
2BH1640-7..8.	62	137
2BH181.-7..1.	171	377
2BH181.-7..2.	177	390

Two-impeller design		
	Weight	
Type	[kg] approx.	[lbs] approx.
2BH181.-7..3.	203	448
2BH181.-7..4.	215	474
2BH184.-7..2.	177	390
2BH184.-7..3.	203	448
2BH191.-7..1.	274	604
2BH191.-7..2.	288	635
2BH191.-7..3.	299	659
2BH191.-7..4.	309	681
2BH1940-7B.2.	275	606
2BH1940-7B.3.	314	692
2BH1940-7B.4.	324	714
2BH1943-7..2.	330	728
2BH1943-7..3.	339	747
2BH1943-7..4.	349	769

Minimum distances

Minimum distance to fan guard (for sucking in cooling air):

Type	[mm]	[inches]
2BH1 1.. - 2BH1 4	34	1.34
2BH1 5.. - 2BH1 9	53	2.09
2BH923…	52	2.05

Minimum distance to face of vacuum pump/compressor cover:

Type	[mm]	[inches]
2BH1 1.. - 2BH1 5	20	0.79
2BH1 6..	30	1.18
2BH1 8.. - 2BH1 9	40	1.57
2BH923..	52	2.05

Noise level

Measuring-surface sound-pressure level as per EN ISO 3744, measured at a distance of 1 m [3.28 ft] at an operating point of approximately 2/3 of the permissible total pressure difference with the lines connected without a vacuum or pressure relief valve, tolerance ±3 dB (A).

Single-impeller design		
Type	1-m measuring-surface sound pressure level L [dB (A)]	
	50 Hz approx.	60 Hz approx.
2BH1100-7..0.	52	55
2BH1200-7..0.	57	61
2BH1300-7..0.	53	56
2BH1300-7..1.	53	56
2BH1300-7..2.	53	56
2BH1330-7..0.	53	56
2BH1330-7..1.	53	56
2BH1330-7..2.	53	56
2BH1400-7..0.	63	64
2BH1400-7..1.	63	64
2BH1400-7..2.	63	64
2BH1430-7..0.	63	64
2BH1430-7..1.	63	64
2BH1430-7..2.	63	64
2BH1500-7..0.	64	70
2BH1500-7..1.	64	70
2BH1500-7..2.	64	70
2BH1500-7..3.	64	70
2BH1530-7..0.	64	70
2BH1530-7..1.	64	70
2BH1530-7..2.	64	70
2BH1530-7..3.	64	70
2BH1600-7..0.	69	72
2BH1600-7..1.	69	72
2BH1600-7..2.	69	72
2BH1600-7..3.	69	72
2BH1600-7..6.	69	72
2BH1600-7..7.	69	72
2BH1630-7..0.	69	72

Single-impeller design		
Type	1-m measuring-surface sound pressure level L [dB (A)]	
	50 Hz approx.	60 Hz approx.
2BH1630-7..1.	69	72
2BH1630-7..2.	69	72
2BH1630-7..3.	69	72
2BH1630-7..6.	69	72
2BH1630-7..7.	69	72
2BH180.-7..0.	70	74
2BH180.-7..1.	70	74
2BH180.-7..2.	70	74
2BH183.-7..0.	70	74
2BH183.-7..1.	70	74
2BH183.-7..2.	70	74
2BH190.-7..0.	74	79
2BH190.-7..1.	74	79
2BH190.-7..3.	74	79
2BH193.-7..0.	75	80
2BH193.-7..1.	75	80
2BH193.-7..3.	75	80
2BH923..	79	81

Two-impeller design		
Type	1-m measuring-surface sound pressure level L [dB (A)]	
	50 Hz approx.	60 Hz approx.
2BH1310-7..2.	55	61
2BH1410-7..3.	66	69
2BH1410-7..4.	66	69
2BH1510-7..4.	72	74
2BH1510-7..5.	72	74
2BH1610-7..1.	73	76
2BH1610-7..2.	73	76
2BH1610-7..3.	73	76
2BH1610-7..4.	73	76
2BH1610-7..5.	73	76
2BH1610-7..7.	73	76
2BH1610-7..8.	73	76
2BH1640-7..3.	74	78
2BH1640-7..4.	74	78
2BH1640-7..5.	74	78
2BH1640-7..8.	74	---
2BH181.-7..1.	74	---
2BH181.-7..2.	74	78
2BH181.-7..3.	74	78
2BH181.-7..4.	74	78
2BH184.-7..2.	74	78
2BH184.-7..3.	74	78
2BH191.-7..1.	74	84
2BH191.-7..2.	74	84
2BH191.-7..3.	74	84
2BH1940-7B.2.	75	84
2BH1940-7B.3.	75	84
2BH1940-7B.4.	75	84
2BH1943-7..2.	75	84
2BH1943-7..3.	75	84
2BH1943-7..4.	75	84

Sound power level

Sound power level L_W as per EN ISO 3744, tolerance ±3 dB (A).

Two-impeller design		
	Sound power level L_W [dB (A)]	
Type	**50 Hz**	**60 Hz**
2BH191.	-	98
2BH1940	-	98
2BH1943	-	99
2BH923..	-	93

Tightening torques for screw connections

The following values apply if no other information is available.

With non-electrical connections, property classes of 8.8 and 8 or higher as per ISO 898-1 are assumed.

	Tightening torques for non-electrical connections	
Thread	**[Nm]**	**[ft lbs]**
M4	2.7 - 3.3	1.99 - 4.44
M5	3.6 - 4.4	2.65 - 3.25
M6	7.2 - 8.8	5.31 - 6.5
M8	21.6 - 26.4	15.9 - 19.5
M10	37.8 - 46.2	27.9 - 34.1
M12	63.0 - 77.0	46.5 - 56.8

The following information for electrical connection applies to all terminal board connections with the exception of terminal strips.

	Tightening torques for electrical connections	
Thread	**[Nm]**	**[ft lbs]**
M4	0.8 - 1.2	0.59 - 0.89
M5	1.8 - 2.5	1.33 - 1.84

Especially for metal and plastic threaded cable glands and pipe unions, the following values apply:

	Tightening torques for metal threaded glands/unions	
Thread	**[Nm]**	**[ft lbs]**
M12x1,5	4 - 6	2.95 - 4.43
M16x1,5	5 - 7.5	3.69 - 5.53
M25x1,5	6 - 9	4.43 - 6.64
M32x1,5	8 - 12	5.9 - 8.85
M40x1,5		

	Tightening torques for plastic threaded glands/unions	
Thread	**[Nm]**	**[ft lbs]**
M12x1,5	2 - 3.5	1.48 - 2.58
M16x1,5	3 - 4	2.21 - 2.95
M25x1,5	4 - 5	2.95 - 3.69
M32x1,5	5 - 7	3.69 - 5.16
M40x1,5		

3.2 Electrical data

See rating plate.

3.3 Operating conditions

Temperatures

Temperature of pumped gases:	max. permissible temperature: +40°C [+104°F] Nominal value: +15°C [+59°F] Pump-motor units for higher fluid temperatures on request.
Ambient temperature:	max. permissible temperature: +40°C [+104°F] min. permissible temperature: -15°C [+5°F] Nominal value: +25°C [+77°F] Ambient temperatures between 25°C [+77°F] and 40°C [+104°F] affect the permissible total pressure difference. At higher temperatures the winding may be damaged and the grease change interval may be shortened.

Pressures

Min. suction pressure:	See rating plate
Max. discharge pressure in compressor mode:	See rating plate

* The total pressure difference, shown on the rating plate, applies only for the following conditions:

- Ambient temperature: 25°C
- Pressure for vacuum operation:
  1013 mbar at pressure connection;
- Pressure for compressor operation:
  1013 mbar at suction connection;
- Intake temperature (temperature of conveyed gases at suction connection): 15°C
  For ambient temperatures between 25°C and 40°C, the total pressure difference specified on the rating plate must be reduced (at 40°C by 10%).

Consultation with the manufacturer is essential for such operational conditions.

Installation altitude

Max. of 1,000 m [3,280 ft] above sea level.

When installing the pump-motor unit at an altitude of more than 1,000 m [3,280 ft] above sea level, first inquire with the Service department.

4 Transport and Handling

⚠ WARNING

Tipping or falling can lead to crushing, broken bones etc.! Sharp edges can cause cuts!
Wear personal safety equipment (gloves, safety shoes and protective helmet) during transport!

⚠ WARNING

Danger from tipping or falling loads!
Prior to transport and handling make sure that all components are securely assembled and secure or remove all components the fasteners of which have been loosened!

Manual handling:

⚠ WARNING

Danger from lifting heavy loads!
Manual handling of the unit is only permitted within the following limits:

- max. 30 kg [max. 66 lbs] for men
- max. 10 kg [max. 22 lbs] for women
- max. 5 kg [max. 11 lbs] for pregnant women

For the weight of the pump-motor unit, see Chapter 3.1, "Mechanical data", Section "Weight", Pg. 7. For weights above the given values use suitable lifting appliances and handling equipment!

Handling by means of lifting equipment:

⚠ WARNING

Danger from tipping or falling loads!
When transporting with lifting equipment, observe the following basic rules:

- Before each transport, check the tight fit of the eye bolt/lifting attachment, see "Tightening torques for screw connections", p. 10.
- The lifting capacity of lifting equipment and lifting gear must be at least equal to the unit's weight. For the weight of the pump-motor unit, see Chapter 3.1, "Mechanical data", Section "Weight", Pg. 7.
- The pump-motor unit must be secured so that it cannot tip or fall.
- Do not stand or walk under suspended loads!

The transport must be carried out in different ways depending on the type:

- 2BH11., 2BH12., 2BH13., 2BH14., 2BH15. (single-impeller): Manual handling
- 2BH15. (two-impeller), 2BH16., 2BH18., 2BH19., 2BH923…
  Transport with crane, hooked onto eye bolt/lifting attachment (1 attachment point)
- 2BH1943:
  Transport with crane, hooked with lifting belts onto eye bolt and onto the holes in the two feet of the vacuum pump/compressor housing (3 attachment points).

For **transport with a crane**, the pump-motor unit can be hooked into the crane hook as follows:

- directly on the eye bolt/lifting attachment (With 2BH194 the eye bolt and the two foot holes should be used)

or possibly

- with lifting belts.

Eye bolt/lifting attachment:

Types with a weight of up to 30 kg [66 lbs] are **not** equipped with an eye bolt/lifting attachment (2BH11., 2BH12., 2BH13., 2BH14., 2BH15 [single-impeller]).

Types with a weight of more than 30 kg [66 lbs] are equipped with an eye bolt/lifting attachment as **standard** (2BH15. [two-impeller], 2BH16., 2BH18., 2BH19., 2BH9…).

The eye bolt/lifting attachment is mounted on the vacuum pump/compressor housing.

In case of possible removal and remounting of the eye bolt, it must be ensured that the eye level is positioned exactly in the axis direction of the pump-motor unit. Lay shims under the eye bolt if necessary.

The eye bolt/lifting attachment must be firmly tightened.

Loads laterally to the ring level are not permissible. Heavy impact loads during transport must be avoided.

5 Installation

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?

Otherwise you many not carry out any work with or on the pump-motor unit!

⚠ DANGER

Danger from missing view into area of pump-motor unit!
When operating the control elements without a view into the area of the pump-motor unit, there is a danger that the pump-motor unit will be switched on while other persons are still performing work on it. Extreme injuries are possible!

Provide control elements at a location with a view of the pump-motor unit.

⚠ DANGER

Electrical danger!
The pump-motor unit must be installed so that the electrical device cannot be damaged by external influences!

In particular, the feed pipes must be securely routed, e.g. in cable ducts, in the floor etc.

⚠ WARNING

Danger from balance damage caused by vibration!
Vibrating environments can cause balance damage!

Install the pump-motor unit on a solid foundation or on a solid mounting surface.

Check screw glands/unions for mounting the pump-motor unit on the mounting surface regularly for strength and firm seating.

⚠ WARNING

Danger from crushing due to pump-motor unit tipping over!
Wear personal safety equipment (protective gloves and safety shoes). Handle the unit with the appropriate care. Install the pump-motor unit on a solid foundation or on a solid mounting surface! Check screw glands/unions for mounting the pump-motor unit on the mounting surface regularly for strength.

⚠ WARNING

Danger of fire from flammable substances!
The pump-motor unit must never come into contact with flammable substances.

⚠ WARNING

Danger of burns from hot surfaces of the pump-motor unit and from hot fluids!
High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

The pump-motor unit must be installed so that accidental touch of its surface is not possible. Cover the pump-motor unit with a suitable touch protection (e.g. perforated plate cover or wire cover).

⚠ WARNING

Danger of injuries from flying parts!
Select installation so that parts that are thrown out through the grate if the external fan breaks cannot hit persons!

⚠ CAUTION

Danger of tripping and falling!
Make sure the unit does not present a danger of tripping. Lay cables and pipes so that they cannot be reached during operation(recessed in floor, in ducts on the wall etc.).

CAUTION

Danger of overheating due to hot surface of pump-motor unit!
High temperatures can occur on the surface of the pump-motor unit.

Temperature sensitive parts, such as lines or electronic components, may not come into contact with the surface of the pump-motor unit.

The pump-motor unit is ready to connect on delivery. However, if the time from delivery to commissioning of the pump-motor unit exceeds a certain period, the lubrication of the rolling bearings must be renewed.
See Chapter 8.2, "Storage conditions", Section "Lubrication of rolling bearings after longer storage", Pg. 24 for information on this topic.

Carry out the following work to install the pump-motor unit:

- Installation and securing,
- Attachment of the included loose muffler if necessary,
- Attachment of threaded flange or hose flange (available as accessories)
  for the connection of inlet or discharge pipe to the muffler,
- Electrical connection,
- Connection of inlet and discharge connection to the system.

5.1 Installation

⚠ WARNING

For an installation that differs from the following specifications, it is necessary to inquire with the Service Department!

Ambient conditions:

The pump-motor unit is suitable for installation in the following environments:

- In a dusty or damp environment,
- in buildings,
- in the open.
  When properly installed in the open, the pump-motor unit must be protected from exposure to intensive sunlight, e.g. by attaching a protective roof. Otherwise, no special protective devices against the effects of weathering are required.

The drive motors of the pump-motor units have the following design:

- with degree of protection IP55 (see rating plate),
- with tropicalized insulation.

Installation conditions:

The pump-motor unit must be installed as follows:

- on level surfaces,
- at a maximum height of 1000 m [3280 ft] above sea level.
  When installing at an altitude of more than 1,000 m [3,280 ft] above sea level, first inquire with the Service Department.

Minimum distances:

To ensure sufficient cooling of the pump-motor unit, it is absolutely necessary that the required minimum distances to the **fan guard** and to the **face of the vacuum pump/compressor cover** be maintained. see Chapter 3.1, "Mechanical data", Section "Minimum distances", Pg. 8.

The minimum distances to the face of the vacuum pump/compressor cover are especially important when installing on the vacuum pump/compressor cover or near a wall.

CAUTION

To ensure sufficient cooling of the pump-motor unit, also observe the following:

- Ventilation screens and openings must remain clear.
- Discharge air of other units may not be directly sucked in again!

Noise radiation:

To reduce the noise radiation, the following must be observed:

- Do not mount pump-motor unit on noise-conducting or noise-radiating parts (e.g. thin walls or sheet-metal plates).
- Provide pump-motor unit with sound-insulating intermediate layers (e.g. rubber buffers under the base of the pump-motor unit) if necessary.
- Install the pump-motor unit on a stable foundation or on a rigid mounting surface. This provides for smooth, low-vibration running of the pump-motor unit.

Components for reducing noise on the pump-motor unit:

- **Mufflers** (included as standard equipment):
  On delivery the pump-motor units are equipped with attached mufflers as standard. The noise radiation is considerably reduced by the mufflers. See Fig. 2 to Fig. 9, Pg. 18 ff.
- **Additional silencer** (available as an accessory for the 2BH1):
  The additional mufflers enable a further noise reduction. They may only be used with free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere **without piping**.

- **Sound protection hood** (available as an accessory for the 2BH1):
  Noise protection hoods are suitable for installation in rooms and in the open. They reduce both the total sound pressure level and tonal components that are perceived as particularly annoying.

Installation variants/axis position:

Basically, when installing the pump-motor unit, the following variants are possible with a different axis position (horizontal or vertical):

- Horizontal installation
- Vertical installation on the vacuum pump/compressor cover ("cover installation")
- Vertical mounting on the wall

Basically, all variants are possible with all type.

Exceptions

- For the 2BH1943, vertical axis mounting on the compressor cover ("cover position") is necessary.
- For the 2BH923, only horizontal axis mounting and vertical axis mounting on the compressor cover are possible.
- For units with condensate water opening, horizontal axis mounting with a foot below is necessary.

Horizontal axis mounting

The foot of the unit has fastening holes.

- Screw the foot of the unit to the base using suitable screws.
  All fastening holes must have screws!

Vertical axis mounting on the compressor cover ("cover position")

For vertical axis mounting on the compressor cover, use spring elements.

Spring elements are available as accessories and come in a set of 3. The upper part has a threaded stud and the lower part a threaded hole.

- fFastening spring elements to the unit:
  Screw threaded studs of the spring elements into the holes on the front side of the compressor cover and tighten.
- Fastening the unit with spring elements to the foundation:
  Select suitable fastening elements for the threaded hole.
  Screw spring elements over the threaded hole into the base or foundation.

Vertical axis mounting on the wall with the compressor cover pointing downward

For vertical axis mounting of the unit on the wall, the unit is fastened using the holes in the foot. The foot of the unit has fastening holes.

- Place the unit with the foot to the wall on a base plate with sufficient load-bearing capability in the mounting position.
- Screw the foot of the unit to the wall using suitable screws.
  All fastening holes must have screws!
- Remove the base plate.

Eye bolt/lifting attachment:

After set-up, the eye bolt/lifting attachment can be removed.

5.2 Electrical connection (motor)

⚠ DANGER
Electrical danger! Malpractice can result in severe injuries and material damage!

⚠ DANGER
Electrical danger! The electrical connection may be carried out by trained and authorized electricians only!

⚠ DANGER
Electrical danger! Before beginning work on the unit or system, the following measures must be carried out: • Deenergize. • Secure against being switched on again. • Determine whether deenergized. • Ground and short-circuit. • Cover or block off adjacent energized parts.

CAUTION
Incorrect connection of the motor can lead to serious damage to the unit!

Regulations:

The electrical connection must be carried out as follows:

- according to the applicable national and local laws and regulations,
- according to the applicable system-dependent prescriptions and requirements,
- according to the applicable regulations of the utility company.

Electrical power supply:

Observe the **rating plate**.
It is imperative that the operating conditions correspond to the data given on the rating plate!

Deviations permissible without reduction in performance:

- ±5 % voltage deviation
- ±2 % frequency deviation

Connection to drive-motor terminal box:

Open the required cable entry openings on the terminal box. Here the following two cases are differentiated:

- The cable entry opening is prefabricated and provided with a sealing plug.
- Screw out sealing plug.

OR

- The cable entry opening is closed off with a casting skin (only on pump-motor units with drive-motor axis heights of 100 to 160 in standard design).
- Break out casting skin using a suitable tool. For example, use a metal pin with a corresponding diameter or a chisel and hammer.

CAUTION

When pounding out the casting skin on the cable entry openings in the terminal box, the terminal box or its parts can be damaged (e.g. terminal board, cable connections).

Proceed with suitable caution and precision when doing so! Prevent flash formation!

Mount cable glands on the terminal box. Proceed as follows:

- Select one cable gland in each case which is suitable for the cable diameter.
- Insert this cable gland in the opening of the terminal box.
  Use a reducer if necessary.
- Screw on the cable gland so that no moisture, dirt etc. can penetrate into the terminal box.

Carry out the connection and the arrangement of the jumpers in accordance with the **circuit diagram in the terminal box**.

Connect the protective conductor to the terminal with the following symbol:

.

The electrical connection must be carried out as follows:

- The electrical connection must be permanently safe.
- There may be no protruding wire ends.
- Clearance between bare live parts and between bare live parts and ground: ≥ 5.5 mm [0.217"] (at a nominal voltage of U_N ≤ 690V).
- For the tightening torques for terminal board connections (except terminal strips), see Chapter 3.1, "Mechanical data", Section "Tightening torques for screw connections", Pg. 10.
- For terminals with clamping straps (e.g. as per DIN 46282), the conductors must be inserted so that approximately the same clamping height results on both sides of the bar. Individual conductors must therefore be bent into a U-shape or connected with a cable lug (DIN 46234).

This also applies to:

- the protective conductor,
- the outer ground conductor.

Both conductors can be recognized from their color (green/yellow).

⚠ DANGER

Electrical danger!
The terminal box must be free from

- foreign bodies,
- dirt,
- humidity.

Terminal box cover and cable entries must be tightly closed so as to make them dustproof and waterproof. Check for tightness at regular intervals.

⚠ DANGER

Electrical danger!
Clearance between bare live parts and between bare live parts and ground:

at least **5.5 mm [0.217"]** (at a nominal voltage of U_N ≤ 690V).

There may be no protruding wire ends!

For **motor overload protection**:

- Use motor circuit breakers.
- This must be adjusted to the specified nominal current (see rating plate).

⚠ DANGER
Electrical danger! There is danger of an electrical shock when a defective pump-motor unit is touched! Mount motor circuit breaker. Have electrical equipment checked regularly by an electrician.

Interference immunity of drive motor:

For drive motors with integrated sensors, the operator must provide for a sufficient interference immunity itself. Select a suitable sensor signal cable (e.g. with screening, connection as for a motor power-supply cable) and analyzing unit.

Operation with frequency converter:

⚠ WARNING
Pump-motor units with a UL approbation may not be operated on frequency converters in the US without testing by a suitable test agency!

With a power supply by a frequency converter, the following must be observed:

- High-frequency current and voltage harmonics in the motor supply cables can lead to emitted electromagnetic interference. This is dependent on the converter design (type, manufacturer, interference suppression measures).
- Be sure to observe the EMC notes of the converter manufacturer!
- Use screened power supply cables if necessary. For optimal screening, the screen must be conductively connected over a large area to the metal terminal box of the drive motor with a screwed metal gland.
- In the case of drive motors with integrated sensors (e.g. PTC thermistors) interference voltage can occur on the sensor cable depending on the converter type.
- Limit speed:
  see specifications on the rating plate.

5.3 Connecting pipes/hoses (vacuum pump/compressor)

Mufflers:

The pump-motor units are delivered with mufflers (indicated with arrows in the following illustrations) for the inlet and discharge connections as standard equipment.

On delivery the mufflers are already mounted on the following pump-motor units.

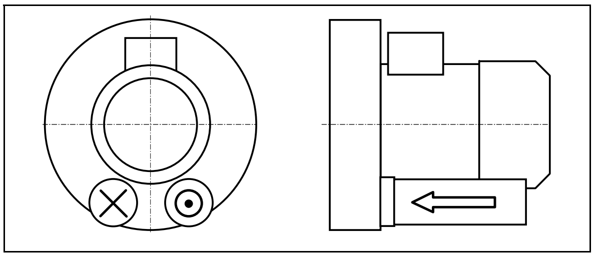


Fig. 2: 2BH1… (single-impeller pump-motor units), 2BH9 23

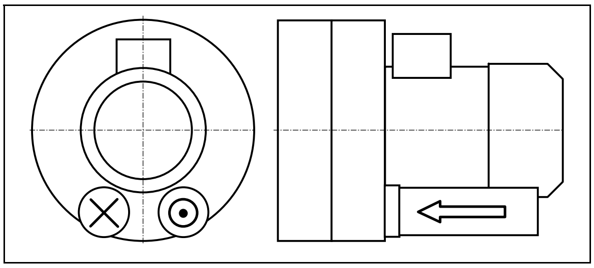


Fig. 3: 2BH1640 (two-impeller pump-motor unit with double-flow design)

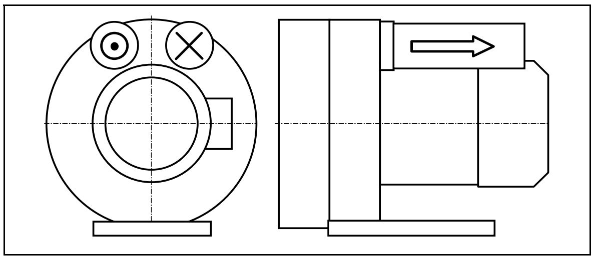


Fig. 4: 2BH1840-7G... (two-impeller pump-motor unit with double-flow design)

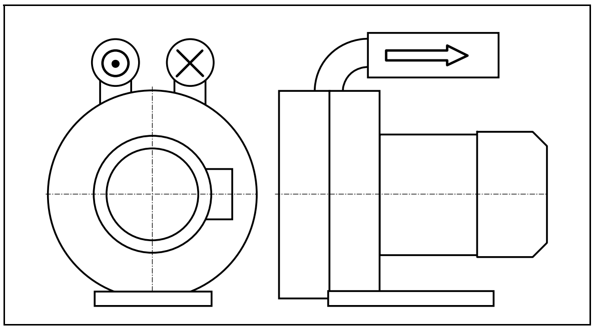


Fig. 5: 2BH1840-7J... (two-impeller pump-motor unit with double-flow design)

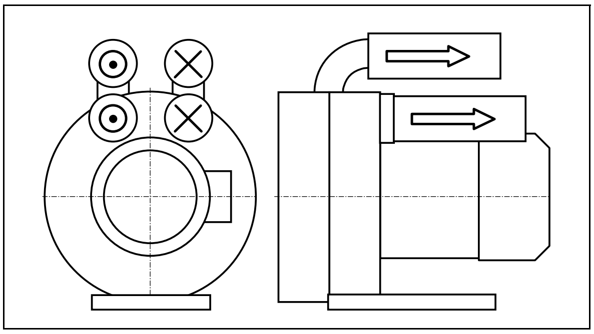


Fig. 6: 2BH1840-7L... (two-impeller pump-motor unit with double-flow design)

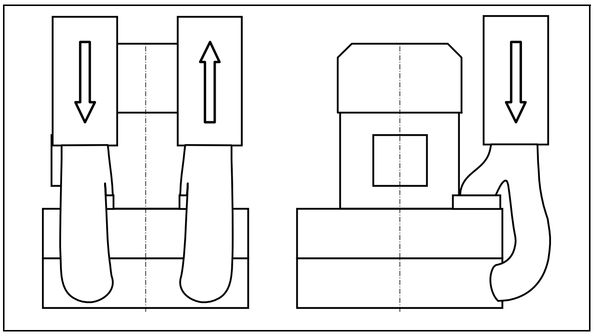


Fig. 7: 2BH1943 (two-impeller pump-motor unit with double-flow design)

On **two-impeller pump-motor units with a two-stage design of the types 2BH1310 to 2BH1910** the discharge-side muffler is included loose for packing-related reasons and must be mounted by the customer.

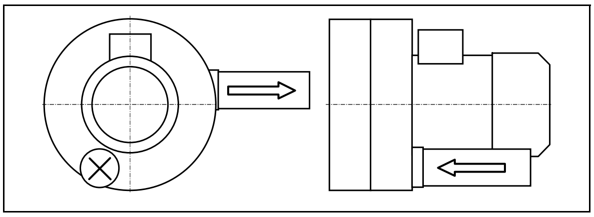


Fig. 8: 2BH1310 ... 2BH1610, 2BH1910 (two-impeller pump-motor units with a two-stage design)

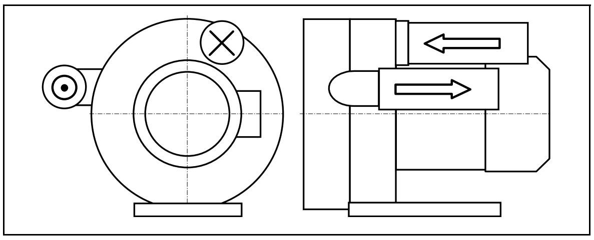


Fig. 9: 2BH1810 (two-impeller pump-motor unit with a two-stage design)

⚠ WARNING

Danger from rotating impeller: Cutting/cutting of off extremities!

The rotating impeller is accessible with the inlet and discharge connections open!

With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, the following therefore applies:

Provide the inlet and discharge connections of the pump-motor unit either with additional mufflers or with additional piping of a sufficient length to prevent access to the impeller!

Connections:

To prevent foreign bodies from entering the unit, all connections are sealed off when delivered. Do not remove the sealing plugs until immediately before connecting the pipes/hoses.

The following applies for the arrangement of the pipe/hose connections:

The **pumped gases** are sucked in via the inlet connection (see Chapter 5.3.1, Pg. 19) and discharged via the discharge connection (see Chapter 5.3.2, Pg. 19).

The **shaft rotating direction** is marked with an arrow on the back of the vacuum pump/compressor housing (Fig. 1, Pg. 2, Item 7).

The **delivery direction of the gases** is marked with arrows on both connections (Fig. 1, Pg. 2, Item 6).

⚠ WARNING

Danger from interchanging inlet and pressure line!

Interchanged inlet and pressure lines can lead to damage to the pump-motor unit and the system, and as a result of this to serious injuries!

Make sure that the inlet and pressure line cannot be confused when connecting.

Look for the clear marking with the arrow indicating the delivery direction on the inlet and discharge connections.

⚠ WARNING

Danger due to vacuum and gauge pressure!

Danger due to escaping fluid!

During operation, connected pipes and vessels are vacuumized or pressurized!

Use only mounting elements, connections, lines, fittings and containers with sufficient freedom from leaks and strength for the pressures which occur.

Make sure that the mounting elements and connections are mounted sufficiently firmly and leak-free!

CAUTION

If the pumped gases are passed on on the discharge side in a closed pipe system, then it must be ensured that the pipe system is adapted to the maximum discharge pressure. See Chapter 3.3: "Operating conditions", Section "Pressures", Pg. 11. Connect a pressure relief valve upstream if necessary.

NOTICE

Attach pipes/hoses free of mechanical tensions. Support the weight of the pipes/hoses.

5.3.1 Inlet connection

The inlet connection with the related muffler (Fig. 1, Pg. 2, Item 3) is marked with an arrow pointing into the vacuum pump/compressor. Connect the inlet pipe here. The pumped gases are sucked in via this.
Procedure: see Chapter 5.3.3.

⚠ WARNING

Danger from solid bodies and impurities in the pump-motor unit!

If solid bodies penetrate into the pump-motor unit, blades of the impellers can break and broken pieces can be thrown out.

Install a filter in the inlet pipe.
Replace filter regularly!

5.3.2 Discharge connection

The discharge connection with the related muffler (Fig. 1, Pg. 2, Item 4) is marked with an arrow pointing out of the vacuum pump/compressor. Connect the discharge pipe here. The pumped gases are discharged via this. Procedure: see Chapter 5.3.3.

5.3.3 Procedure when connecting pipes/hoses

Attach the pipes/hoses to the unit as described in the following. The pipes/hoses are connected differently to inlet and discharge connections depending on the muffler design and the type of line (pipe or hose):

- Muffler with inside threads:
  The pipe is screwed directly into the muffler.
- Muffler without inside thread:
  - Screw threaded flange (available as an accessory) onto the muffler.
  - Screw the pipe into the threaded flange.
- Hose connection:
  - for 2BH1 Screw the hose flange (available as an accessory) onto the silencer.
  - Push the hose onto the hose flange and secure it with a hose clamp. See Chapter 3.1, "Mechanical data", Section "Tightening torques for screw connections", Pg. 10 for information on this topic.

6 Commissioning

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.? Otherwise you many not carry out any work with or on the pump-motor unit!

⚠ WARNING

Danger from rotating parts (external fan, impeller, shaft): Cutting/cutting off of extremities, Grasping/winding up of hair and clothing!

Danger due to vacuum and gauge pressure: sudden escape of fluids (skin and eye injuries), sudden drawing in of hair and clothing!

Danger due to escaping fluid: Burns!

Start-up and operation only under the following conditions:

- The pump-motor unit must be completely assembled. When doing so, pay particular attention to the following components:
  - the vacuum pump/compressor cover,
  - the muffler on inlet and discharge connections,
  - the fan guard.
- The pipes/hoses must be connected to inlet and discharge connections.
- Inlet and discharge connections and the connected pipes/hoses may not be closed, clogged or soiled.
- Check the mounting elements, connections of the pipe/hose connections, lines, fittings and containers for strength, leaks and firm seating at regular intervals.

6.1 Preparation

⚠ WARNING

Danger from closed connections!

With closed/soiled intake or discharge connections vacuum or gauge pressure results in the pump-motor unit.

This can overheat and damage the drive motor winding.

Before start-up, make sure that the inlet and discharge connections are not closed, clogged or soiled!

CAUTION

Before starting up again after a longer standstill: Measure the insulation resistance of the motor. With values ≤ 1 kΩ per volt of nominal voltage, the winding is too dry.

Measures before start-up:

- If a shut-off device is installed in the discharge pipe:
  Make sure that the unit is NOT operated with the shut-off device closed.
- Before starting up the pump-motor unit, observe the values specified on the rating plate. Specifications on the drive-motor nominal current apply at a gas entry and ambient temperature of +40° C [104°F].
- Adjust the motor circuit breaker to the drive-motor nominal current.

Check direction of rotation:

- The intended rotating direction of the shaft is marked with arrows on the vacuum pump/compressor housing (Fig. 1, Pg. 2, Item. 7).
- The gas delivery direction is marked with arrows on the inlet and discharge connections (Fig. 1, Pg. 2, Item 6).
- Make sure the pipes/hoses on the inlet and discharge connections are properly connected.
- Switch the pump-motor unit on briefly and then off again.
- Compare the actual rotating direction of the external fan with the intended shaft rotating direction indicated with the arrows shortly before the pump-motor unit comes to a standstill.
- If necessary, reverse the direction of rotation of the motor.

⚠ WARNING

Danger due to rotating parts! Danger due to vacuum and gauge pressure! Danger due to escaping fluid!
Test runs may also only be conducted with the pump-motor unit completely mounted.

⚠ DANGER

Electrical danger!
The electrical connection may be carried out by trained and authorized electricians only!

⚠ DANGER

Electrical danger!
Before beginning work on the unit or system, the following measures must be carried out:

- Deenergize.
- Secure against being switched on again.
- Determine whether deenergized.
- Ground and short-circuit.
- Cover or block off adjacent energized parts.

Check operating speeds:

Observe the operating speed specified on the rating plate. This may not be exceeded, as otherwise the noise radiation, vibration behavior, grease consumption duration and bearing change interval worsen. To prevent damage as a result of higher speeds, it may be necessary to inquire with the Service Department as to the maximum speed.

⚠ WARNING

Danger of hearing damage due to noise radiation!
For the noise emission of the pump-motor unit measured by the manufacturer, see Chapter 3.1, "Mechanical data", Section "Noise level", Pg. 8. However, the actual noise emission during operation is highly dependent on the installation and system conditions. Conduct a noise measurement in the system during operation after installing the pump-motor unit. The following measures can be taken from 85 dB(A) and must be taken from 90 dB(A):

- Mark noise area with a warning sign.
- Wear hearing protection.
- With free entry and exit of gases, i.e. with direct intake out of or direct feeding into the atmosphere without piping, attach an additional muffler.

6.2 Start-up and shut-down

Start-up

- Open shut-off device in intake/discharge pipe.
- Switch on power supply for drive motor.

Shut-down:

- Switch off power supply for drive motor.
- Close shut-off device in intake/discharge pipe.

7 Operation

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!
Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?
Otherwise you many not carry out any work with or on the pump-motor unit!

Also **be sure** to read the safety precautions in Chapter 6, "Commissioning", Pg. 21!

Starting up and shutting down

See Chapter 6, "Commissioning", Sub-Chapter 6.2, "Start-up and shut-down", Pg. 22.

Also be sure to observe the following important notes especially for operation:

⚠ WARNING

Danger of burns from hot surfaces of the pump-motor unit and from hot fluids!
High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

Do not touch during operation!
Allow to cool after shut-down!

CAUTION

Danger of overheating due to hot surface of pump-motor unit!
High temperatures of up to approx. 160°C [320°F] can occur on the surface of the pump-motor unit.

Temperature sensitive parts, such as lines or electronic components, may not come into contact with the surface of the pump-motor unit.

CAUTION

Danger of overheating!
During operation the standstill heating may, if installed, **not** be switched on!

CAUTION

Danger of rusting due to collection of condensed water in drive motor area!
On drive motors with closed condensed water openings:
Remove closures occasionally to allow any water which has collected to drain off.

CAUTION

Danger of bearing damage!
Heavy mechanical impacts must be avoided during operating and while at a standstill.

8 Shut-Down and Longer Standstills

8.1 Preparing for shut-down or longer standstill

⚠ WARNING
Improper use of the unit can result in serious or even fatal injuries! Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.? Otherwise you many not carry out any work with or on the pump-motor unit!

CAUTION
Danger of rusting due to collection of condensed water in drive motor area! On drive motors with closed condensed water openings: Remove closures occasionally to allow any water which has collected to drain off.

CAUTION
Danger of bearing damage! Avoid mechanical shocks during operation and shut-down.

Prior to shut-down or longer standstill, proceed as follows:

- Switch off the pump-motor unit.
- Close shut-off device in inlet and pressure line if installed.
- Disconnect pump-motor unit from power supply.
- Release pressure.
  When doing so, open pipes/hoses slowly and carefully so that the vacuum or gauge pressure in the pump-motor unit can be released.
- Remove pipes/hoses.
- Provide mufflers on inlet and discharge side with sealing plugs.

8.2 Storage conditions

To prevent standstill damage during storage, the environment must provide the following conditions:

- dry,
- dust-free,
- low-vibration ($V_{eff} \leq 2.8$ mm/s [0.11"/sec]).
- Ambient temperature:
  min. -30°C [-22°F]
  max. 40°C [+104°F].

CAUTION
Danger of overheating due to high temperature! When storing in an environment with a temperature of over 40°C [104°F], the winding may be damaged and the grease change interval may be shortened.

Lubrication of rolling bearings after longer storage:

The new pump-motor unit may at first be stored following delivery. If the time from deliver to commissioning exceeds the following periods, the lubrication of the rolling bearings must be renewed:

- Under advantageous storage conditions (as specified above): 4 years.
- Under disadvantageous storage conditions (e.g. high humidity, salty air, sandy or dusty air): 2 years.

In these cases open rolling bearings must be relubricated and closed rolling bearings must be completely replaced. In this case be sure to inquire with the Service Department. In particular, exact information with regard to the procedure and grease type are required.

⚠ WARNING
Improper use of the unit can result in serious or even fatal injuries! All maintenance work on the pump-motor unit must always be performed by the Service Department! Maintenance work on the pump-motor unit may only be conducted by the operator itself when the related **maintenance manual** on hand! Inquire with the Service Department!

Commissioning after longer standstill:

Before recommissioning after a longer standstill, measure the insulation resistance of the drive motor. With values ≤ 1 kΩ per volt of nominal voltage, the winding is too dry.

9 Servicing

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!

Have you read the safety precautions in Chapter 1, "Safety", Pg. 3 f.?

Otherwise you many not carry out any work with or on the pump-motor unit!

⚠ WARNING

Improper use of the unit can result in serious or even fatal injuries!

All maintenance work on the pump-motor unit must always be performed by the Service Department!

Maintenance work on the pump-motor unit may only be conducted by the operator itself when the related **maintenance manual** on hand!

Inquire with the Service Department!

9.1 Emptying/Rinsing/Cleaning

Before any maintenance/servicing work, empty, rinse and clean the outside of the unit.

- Empty unit with air and rinse until all residues have been removed.
- Clean the outside of the unit with compressed air.
  - Wear gloves and protective safety glasses.
  - Secure the surrounding area.
  - Clean the entire surface of the unit and exterior fan with compressed air.

9.2 Repairs/troubleshooting

Fault	Cause	Remedy	Carried out by
Motor does not start; no motor noise.	At least two power supply leads interrupted.	Eliminate interruption by fuses, terminals or power supply cables.	Electrician
Motor does not start; humming noise..	One power supply lead interrupted.	Eliminate interruption by fuses, terminals or power supply cables.	Electrician
	Impeller is jammed.	Open vacuum pump/compressor cover, remove foreign body, clean.	Service*)
		Check or correct impeller gap setting if necessary.	Service
	Impeller defective.	Replace impeller.	Service*)
	Rolling bearing on drive motor side or vacuum pump/compressor side defective.	Replace motor bearing or vacuum pump/compressor bearing.	Service*)
Protective motor switch trips when motor is switched on. Power consumption too high.	Winding short-circuit.	Have winding checked.	Electrician
	Motor overloaded. Throttling does not match specification on rating plate.	Reduce throttling.	Service*)
		Clean filters, mufflers and connection pipes if necessary.	Service*)
	Compressor is jammed.	See fault: "Motor does not start; humming noise." with cause: "Impeller is jammed.".	Service*)

Fault	Cause	Remedy	Carried out by
Pump-motor unit does not generate any or generates insufficient pressure difference.	Leak in system.	Seal leak in the system.	Operator
	Wrong direction of rotation.	Reverse direction of rotation by interchanging two connecting leads.	Electrician
	Incorrect frequency (on pump-motor units with frequency converter).	Correct frequency.	Electrician
	Shaft seal defective.	Replace shaft seal.	Service*)
	Different density of pumped gas.	Take conversion of pressure values into account. Inquire with Service Department.	Service
	Change in blade profile due to soiling.	Clean impeller, check for wear and replace if necessary.	Service*)
Abnormal flow noises.	Flow speed too high.	Clean pipes. Use pipe with larger cross-section if necessary.	Operator
	Muffler soiled.	Clean muffler inserts, check condition and replace if necessary.	Service*)
Abnormal running noise.	Ball bearing lacking grease or defective.	Regrease or replace ball bearing.	Service*)
Compressor leaky.	Seals on muffler defective.	Check muffler seals and replace if necessary.	Service*)
	Seals in motor area defective.	Check motor seals and replace if necessary.	Service

*) Only when the maintenance manual is at hand: rectification by the operator.

9.3 Service/After-sales service

Our Service is available for work (in particular the installation of spare parts, as well as maintenance and repair work), not described in these operating instruction.

A list of spare parts with an exploded drawing is available on the Internet at www.gd-elmorietschle.com.

Observe the following when **returning** pump-motor unit:

- The pump-motor unit must be delivered complete, i.e. not dismantled.
- The pump-motor unit may not present a danger to the workshop personnel.
  Each pump motor unit on delivery to the workshop must be accompanied with a fully completed "Statement on health safety and on the protection of the environment", Pg. 29.
- The original rating plate of the pump-motor unit must be properly mounted, intact and legible.
  All warranty claims are voided for pump-motor units delivered for a damage expertise without the original rating plate or with a destroyed original rating plate.
- In case of warranty claims, the manufacturer must be informed of the operating conditions, operating duration etc. and additional detailed information provided on request if necessary.

10 Disposal

Have the entire pump-motor unit scrapped by a suitable disposal company. No special measures are required when doing so.
For additional information on disposing of the unit, ask the Service Department.

11 Explosion-Protected Design

An additional set of operating instructions with supplementary or specific information is provided with these pump-motor units.

EU declaration of conformity

Manufacturer:	Gardner Denver Deutschland GmbH Industriestraße 26 97616 Bad Neustadt Germany
Responsible for documentation:	Holger Krause Industriestraße 26 97616 Bad Neustadt Germany
Designation:	G series Side channel blower G-BH1, G-BH9 Types 2BH1 1 2BH1 2 2BH1 3 2BH1 4 2BH1 5 2BH1 6 2BH1 8 2BH1 9 2BH9 23

The side channel blower described above meets the following applicable Community harmonisation legislation:

2004/108/EC*)	Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC
2006/42/EC	Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC The protection targets of the directive 2006/95/EC have been met

Harmonised standards applied:

EN 1012-1:2010	Compressors and vacuum pumps - Safety requirements - Part 1: Air compressors
EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines Part 1: General requirements

Bad Neustadt, 26.09.2011
(Place and date of issue)
Thomas Kurth, Managing Director
(Name and function)

(Signature)

*) Only applicable for version with frequency converter 2FC

664.44434.40.000

Statement on health safety and on the protection of the environment

- For the safety of our employees and to comply with statutory requirements on handling substances harmful to the health and the environment, this statement must be enclosed, fully completed, with **each** unit/system sent.
- **Without the fully completed statement, repair/disposal is not possible and delays are unavoidable!**
- The statement is to be completed and signed by suitably qualified, authorised personnel at the operating organisation.
- In the case of shipment to Germany, the statement is to be completed in German or English.
- The statement is to be attached to the outside of the packing on shipment.
- If necessary, the carrier is to be informed.

1. **Product designation (type):** ....
2. **Serial number (no. BN):** ....
3. **Reason for sending:** ....
4. **The unit/system**
   ☐ has **not** come into contact with hazardous substances. There will be **no** hazards for personnel or the environment during repair/disposal. Continue with "6. Legally binding statement"
   ☐ has come into contact with hazardous substances. Continue with "5. Information on the contamination"
5. **Information on the contamination** (if necessary provide more information on an additional sheet)
   The unit/system was used in the following application:
   ....
   and has come into contact with the following classifiable substances or substances presenting a hazard to health/environment:

Trade name:	Chemical designation:	Hazardous substance class:	Properties (e.g. toxic, inflammable, caustic, radioactive):

☐ The unit/system has been emptied in accordance with the operating instructions, flushed and cleaned externally.

☐ Safety data sheets in accordance with the applicable regulations are enclosed (......... sheet).

☐ The following safety precautions are necessary for handling (e.g. personal protective equipment):

....

....

6. **Legally binding statement**
   I herewith guarantee that the details specified are true and complete and that I, as signatory, am in a position to judge that this is so.
   We are aware that we are liable to the contractor for any damages arising from incomplete or incorrect specifications. We are obliged to indemnify the contractor against claims for damages by third parties arising from incomplete or incorrect specifications. We are aware that, irrespective of this statement, we are directly liable to third parties - in particular including the contractor's employees tasked with repair/disposal.

Company/institute: ....

Name, position: .... Phone: ....

Street: .... Fax: ....

Post code, city: ....

Country: .... Stamp:

Date, signature: ....

 610.00250.40.905

P.O. box 1510 Phone: +49 7622 392 0 E-mail: er.de@gardnerdenver.com
97605 Bad Neustadt Fax: +49 7622 392 300 Internet: www.gd-elmorietschle.com

10.2009
English

Elmo Rietschle
A Gardner Denver Product

www.gd-elmorietschle.de
er.de@gardnerdenver.com

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Roggenbachstraße 58
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Tel. +49 7622 392-0
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Gardner Denver

Elmo Rietschle is a brand of Gardner Denver's Industrial Products Group and part of Blower Operations.

Figure # 937

Ductile Iron Wafer Style Butterfly Valve

Product Features

4"

- 200 PSI Sizes 2”-12”
- 150 PSI Sizes 14” - UP
- Ductile Iron Body
- Wafer Style Body
- Cartridge Seat
- ISO 5211 Mounting Flange
- MSS-SP-67

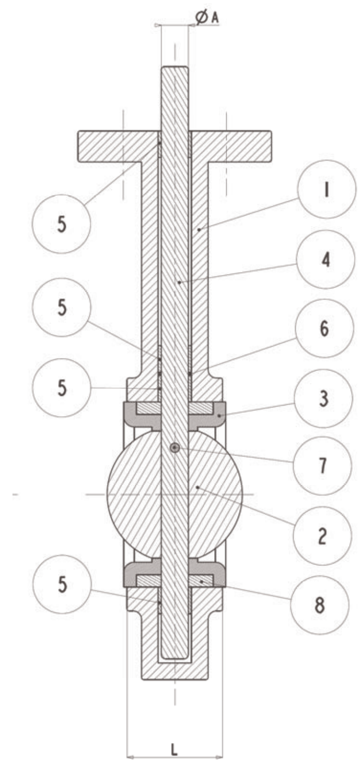
Figure Number Breakdown (Example 937DNSL)

Disc Matl.	Seat Matl.	Stem Matl.	Topworks
B = Aluminum Bronze	E = EPDM	M = 316 SS.	L = Lever
D = Ductile Iron w/ Nickel plating	N = Buna N	S = 416 SS.	G = Gear
M = 316 Stainless Steel	------	------	X = Bare Stem

Materials & Specifications

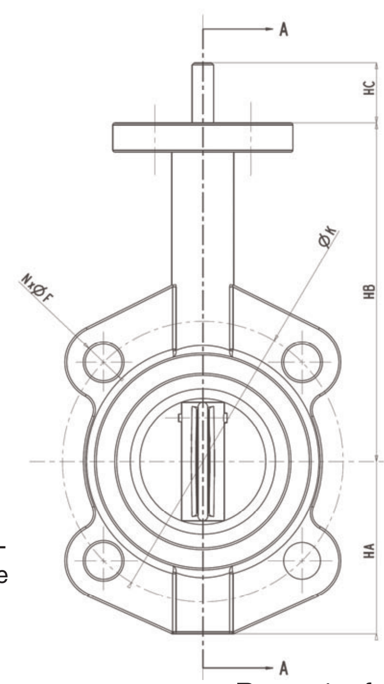
Item	Description	Material
1	Body	Ductile Iron
2	Disc	~~Alum. Bronze~~, Ductile Iron or ~~316 SS.~~
3	Seat	~~Buna or~~ EPDM
4	Stem	416 ~~or 316~~ Stainless Steel
5	Bushings	PTFE
6	O-Ring	NBR
7	Taper Pin	Stainless Steel
8	Seat Support	Plastic

Note: Ductile Iron Disc are electroless Nickel plated



Dimensions, Weights (inches-lbs.) & Valve Data

Size	2”	2-1/2”	3”	4”	5”	6”	8”	10”	12”	14”	16”	18”	20”	24”
HA	2.99	3.5	3.74	4.49	5.0	5.51	6.81	7.99	9.57	10.51	11.73	12.52	13.74	16.14
HB	6.38	6.89	7.13	7.87	8.39	8.86	10.24	11.5	13.27	14.49	15.75	16.61	18.86	22.13
HC	1.26	1.26	1.26	1.26	1.26	1.26	1.77	1.77	1.77	1.77	2.01	2.01	2.52	2.8
L	1.69	1.81	1.81	2.05	2.2	2.2	2.36	2.68	3.07	3.07	4.02	4.49	5.0	6.0
ØK	4.75	5.5	6.0	7.5	8.5	9.5	11.75	14.25	17.0	18.75	21.25	22.75	25.0	29.5
ØF	.75	.75	.75	.75	.88	.88	.88	1.0	1.0	1.12	1.12	1.25	1.25	1.38
ØA	.5	.5	.5	.63	.75	.75	.87	1.13	1.25	1.25	1.31	1.5	1.62	1.99
N	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Wt. lever	8	9	12	15	20	22	36	46	74	-	-	-	-	-
Wt. Gear	24	25	28	31	36	38	55	65	93	118	177	225	373	538



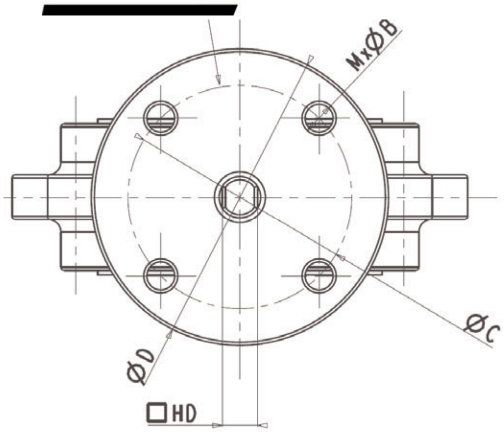
Seating torques (inch/lbs.)

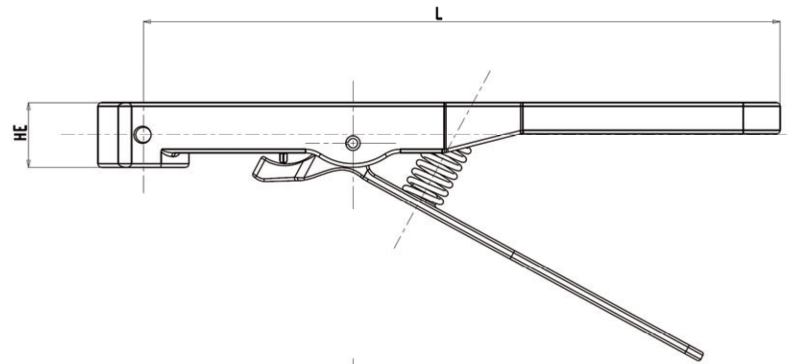
PSI	2”	2-1/2”	3”	4”	5’	6”	8”	10”	12”	14”	16”	18”	20”	24”
50	100	150	207	290	423	599	1060	1671	2568	2640	4260	6287	8360	15427
100	106	163	220	323	481	691	1183	1872	2795	3070	4880	7243	9180	16813
150	111	176	232	357	540	783	1307	2074	3023	3500	5500	8200	10000	18200
200	117	189	244	390	598	875	1430	2275	3250	-	-	-	-	-

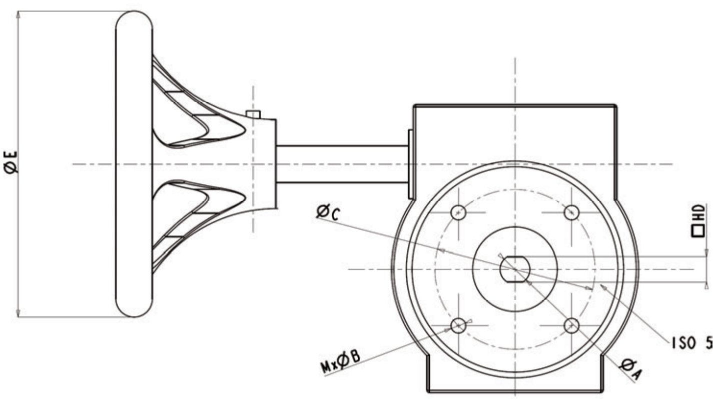
All torque values shown are for wet (water and other non-lubricating media) on-off service. For dry services (dry gas, etc.) multiply values by 1.15. For lubed service (clean, non-abrasive lubricating media) multiply values by .85. These values do not include a safety factor. An appropriate safety factor should be used when sizing any actuator.

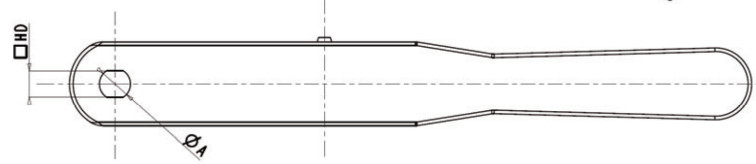
Figure # 937

Ductile Iron Wafer Style Butterfly Valve









Material	Temperature Rating
BUNA- N	+10 to 180
EPDM	-30 to 275

Dimensions (inches) of Stem, Lever and Gear Mounting Information

Size	2”	2-1/2”	3”	4”	5”	6”	8”	10”	12”	14”	16”	18”	20”	24”
ØA	.5	.5	.5	.63	.75	.75	.87	1.13	1.25	1.25	1.31	1.5	1.62	1.99
HD	.39	.39	.39	.47	.55	.55	.67	.87	.94	.94	1.06	1.06	1.26	1.42
HE	1.06	1.06	1.06	1.06	1.06	1.06	1.22	1.22	1.22	-	-	-	-	-
L	10.51	10.51	10.51	10.51	10.51	10.51	14.13	14.13	14.13	-	-	-	-	-
E	5.91	5.91	5.91	5.91	5.91	5.91	11.81	11.81	11.81	11.81	11.81	11.81	15.75	15.75
ØC	2.76	2.76	2.76	2.76	2.76	2.76	4.02	4.02	4.92	4.92	6.5	6.5	6.50	10.0
ØD	3.62	3.62	3.62	3.62	3.62	3.62	4.92	4.92	5.91	5.91	8.27	8.27	8.27	11.81
ISO	F07	F07	F07	F07	F07	F07	F10	F10	F12	F12	F16	F16	F16	F25

Cv Values - Valve Sizing (US Gallons/minute at 1PSI drop)

	Degrees Open								
Size	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
2”	.06	3	7	15	27	44	70	105	115
2-1/2”	.1	6	12	25	45	75	119	178	196
3”	.2	9	18	39	70	116	183	275	302
4”	.3	17	36	78	139	230	364	546	600
5”	.5	29	61	133	237	392	620	930	1022
6”	.8	34	94	153	257	422	706	1154	1320
8”	2	56	154	251	422	693	1158	1892	2165
10”	3	87	238	385	654	1073	1794	2931	3353
12”	4	153	417	681	1145	189	3142	5132	5827
14”	6	183	500	816	1372	2252	3765	6150	7037
16”	8	271	740	1208	2031	3333	5573	9104	10416
18”	11	318	867	1417	2382	3909	6535	10676	12215
20”	14	415	1133	1851	3112	5107	8538	13948	15959
24”	22	543	1482	2421	4069	668	11165	18240	20869

RWV®
RED-WHITE VALVE 20600 Regency Lane • Lake Forest, CA 92630
tel: 949.859.1010 • fax: 949.859.7200 • www.redwhitevalveusa.com

ACTIVATED CARBON DATA SHEET

Stags - CV 1100

Applications

VOC Abatement
Odor Control
Air Purification
BTEX Removal

Features / Benefits

High Activity
High Hardness
Low Attrition Rates
High Purity
No Preconditioning Required

Packaging

25 Kg bags
500 Kg bulk bags

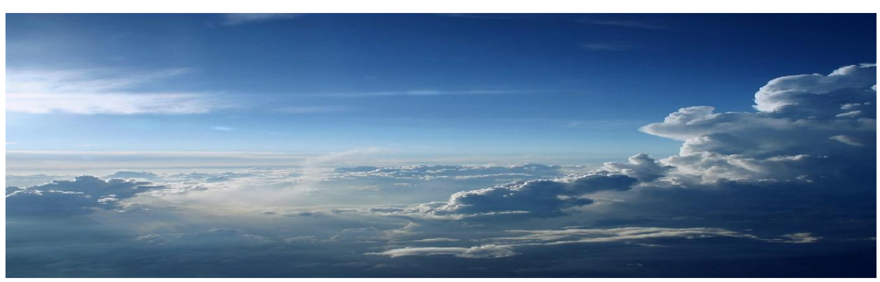
STAGS

Phone: 713.703.6516
E-mail: info@tetrasolv.com

Stags - CV 1100 is a high activity, coconut based produced via the steam activation process. **Stags - CV 1100** is a high VOC capacity carbon which is excellent for fugitive emissions and odor control. The high hardness and low dust levels makes it very easy to use. **Stags - CV 1100** can be sold separately or part of a turnkey package involving equipment and service.

Specifications

Ball Pan Hardness	99.5
Carbon Tetrachloride Activity	60 min (g/100g)
Iodine Number	1100 mg/g
Apparent Density	0.50-0.52 g/cc
	28 - 30 lbs/ft3
Total Surface Area	1100 m^2/g
Moisture	5% max
Mesh Size +4	less than 5%
Mesh Size –8	less than 5%



__CAUTION__ Activated carbon can remove oxygen from air under wet or humid conditions. Care should be taken when entering confined spaces where wet activated carbon is present. Use proper breathing apparatus to prevent prolong dust exposure.

SMALL COMPACT FILTER SILENCERS WITH STANDARD FILTER DESIGN
"FS" Series 1/2" - 3" MPT

APPLICATIONS

Blowers-PD Type	Blowers-Side Channel	Compressor-Piston
Compressor-Screw	Construction\Contractor Industry	Dental
Engines	Hydraulic Breathers - fine filtration	Industrial & Severe Duty
Medical	Pneumatic Conveying Systems	Sparging
Waste Water Aeration	Workshop	

FEATURES & SPECIFICATIONS

;99%+ removal efficiency std: Paper=2 micron, Polyester=5 micron

Filter change out differential: 10"-15" in. H_2O above initial Delta P

Interchangeable elements: Polyester, Paper, HEPA

Pressure drop graphs available upon request

Tubular silencing design - tube is positioned to maximize attenuation and air flow while minimizing pressure drop

Durable carbon steel construction with powder coated finish or galvanized steel

Fully drawn weatherhood - no welds to rust or vibrate apart

Low pressure drop center bracket and outlet pipe design

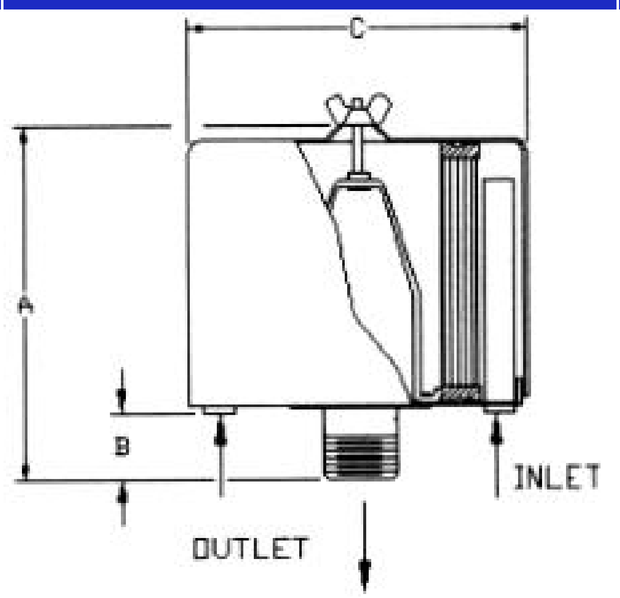
Temp (continuous): min -15° F (-26° C) max 220° F (104° C)

Typical noise attenuation up to 25 dB's (due to the wide range of applications and machines these units are used on, a single graph is insufficient. Please inquire for your specific requirement)

OPTIONS

1/8" tap holes for differential pressure gauges	Available in *Stainless Steel*	Epoxy coated housings
Hot dipped galvanized housings	Special connections, BSPT/Metric	Various elements available

Line Drawing



***All measurements are shown in standards.**

Typical Lead Times:

	1 - 2 weeks		Normally in stock
	3 - 4 weeks		5 - 7 weeks
			8 + weeks

Add To Order	Model Number	Element Type	Outlet in. NPT or FLG	Connection Style	Dim A in.	Dim B in.	Dim C in.	Rated Flow Piston SCFM	Rated Flow Screw Blower Fan SCFM	Element Parent Flow SCFM	Tube Count	Approx. Weight lbs.
	FS-15-050	Polyester	0.5	MPT	4	1.5	6	10	10	35	1	1.8
	FS-15-075	Polyester	0.75	MPT	4	1.5	6	20	25	35	2	2
	FS-15-100	Polyester	1	MPT	4	1.5	6	25	35	35	3	2.1
	FS-19P-100	Polyester	1	MPT	6.63	1.5	6	35	55	100	3	3
	FS-19P-125	Polyester	1.25	MPT	6.63	1.63	6.1	55	70	100	5	3.3
	FS-19P-150	Polyester	1.5	MPT	6.63	1.5	6	70	85	100	5	3.5
	FS-231P-200	Polyester	2	MPT	12.25	2.25	10	135	135	300	7	14
	FS-31P-200	Polyester	2	MPT	7.25	2.25	10	85	135	195	5	7.8
	FS-231P-250	Polyester	2.5	MPT	12.5	2.5	10	195	195	300	9	14.5
	FS-31P-250	Polyester	2.5	MPT	7.5	2.5	10	100	195	195	5	8.2
	FS-231P-300	Polyester	3	MPT	13	3	10	200	300	300	9	15
	FS-14-050	Paper	0.5	MPT	4	1.5	6	10	10	35	1	1.8
	FS-14-075	Paper	0.75	MPT	4	1.5	6	20	25	35	2	2
	FS-14-100	Paper	1	MPT	4	1.5	6	25	35	35	3	2.1
	FS-18P-100	Paper	1	MPT	6.63	1.5	6	35	55	100	3	3
	FS-18P-125	Paper	1.25	MPT	6.63	1.63	6.1	55	70	100	5	3.3
	FS-18P-150	Paper	1.5	MPT	6.63	1.5	6	70	85	100	5	3.5
	FS-230P-200	Paper	2	MPT	12.25	2.25	10	135	135	300	9	14
	FS-30P-200	Paper	2	MPT	7.25	2.25	10	85	135	195	5	8.2
	FS-230P-250	Paper	2.5	MPT	12.5	2.5	10	195	195	300	9	14.5
	FS-30P-250	Paper	2.5	MPT	7.5	2.5	10	100	195	195	5	8.2
	FS-230P-300	Paper	3	MPT	13	3	10	200	300	300	9	15

E-Mon D-Mon®
Installation Manual

Class 2000
kWh & kWh/Demand Meter

Energy Monitoring Products

Dear Valued Customer,

We are pleased that you chose to buy one of our products, and want you to be just as pleased with owning it. Before installing your new E-Mon product, please read the information on the following pages carefully.

We believe that you will f nd the E-Mon D-Mon meters easy to install and to use for monitoring and evaluating your electrical usage.

If you have questions, we can handle them quickly and effectively with a telephone call. Please let us try to help you BEFORE you remove your meter. And to help us help you, we ask that you have all relevant information on hand when you call (model or part numbers, nature of diff culty, etc.)

Be sure to forward this manual to the owner after installation is complete, so that they may use it as a reference guide when reading the E-Mon D-Mon meter.

Thank you.

®

Energy Monitoring Products

Table Of Contents

* Applies to meters equipped with the Demand option.

1.0 Pre-Installation Information

The E-Mon D-Mon® Class 2000 kWh/Demand meter is a 3-element meter used to monitor electric power usage of individual loads after the utility meter. I**nstallation must only be performed by qualified personnel and in accordance with these instructions and all applicable local and national electrical codes.** E-Mon or its representatives assume no responsibility for damages or injury resulting from the improper installation of this meter.

Meters are supplied in a NEMA 12 steel enclosure appropriate for indoor installation where it will not be affected by the elements, such as moisture and extreme temperatures.

Units designated by the "R" suff x on the model number have an extended environmental operating range and are enclosed in a NEMA 4X enclosure to accommodate outdoor environments.

Verify the input voltage rating and conf guration on the meter label to ensure it is suitable for the intended electrical services. Class 2000 meters labeled for 120/208V service MUST NOT be installed on service feeds of 277/480V and vice versa.

Verify the current sensors are sized suitably for the load to be monitored. Compare the color of the arrows on the current sensors to the chart below to conf rm the correct current sensor is being used.

Sensor Arrow Color Code		Sensor Rating
Brown	-	100 Amp
Red	-	200 Amp
Y ellow	-	400 Amp
Black	-	800 Amp
Blue	-	1600 Amp
White/Black	-	3200 Amp

CAUTION: Internal circuit card components are extremely sensitive to electrostatic discharge. Prior to handling or touching internal circuitry, discharge any static buildup on your person. To discharge yourself, touch a grounded metal object such as conduit or an earth grounded metal enclosure.

WARNING: Use of this instrument, Class 2000, in a manner inconsistent with this manual or not specified by the manufacturer in writing, can cause permanent damage to the unit and/or serious injury to the operator. The protection and safety features provided by this equipment may become impared or otherwise compromised.

NOTE: If any trouble arises during installation or functional verification operations, do not immediately remove unit. Before removing the unit, contact E-Mon's technical support department at (800) 334-3666. E-Mon's technical department will assist you in detailed troubleshooting of the Class 2000 installation.

1.0 <u>Pre-Installation Information (Continued)</u>

Internal Electronic Assemblies

The unit is comprised of two major subassembly boards, Main Power Board and Display Board. All circuit cards are mounted inside a NEMA 12 (standard) or NEMA 4X (optional) enclosure.

Power Supply Board (Showing MI Conf g.) Display Board

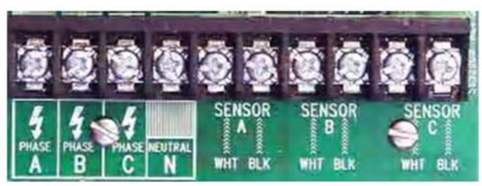
NOTE: Units are supplied in a NEMA 12 metal enclosure suitable for indoor applications only. Units supplied in the optional NEMA 4X f berglass enclosure are suitable for either indoor or outdoor applications, within the def ned specif cations. Refer to Section 12.0 for a def nition of suitable environmental conditions for indoor and outdoor units.

Main Power Board

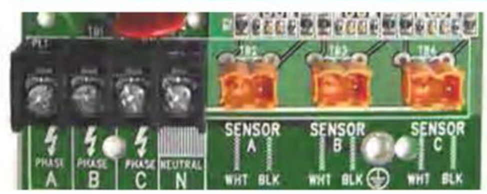
Connections to this board include the MAINS Input Voltage, Current Sensors, external IDR interface and Isolated Pulse Output.

The MAINS input terminals are covered with a protective clear shield for safety purposes. The current sensor assemblies interface to either TB1 (MI conf guration) or to three header connectors, TB2, TB3 and TB4 (MI conf guration). Each header connector input corresponds to an input voltage phase, so care must be taken to ensure each current sensor is connected to the correct input header.

(Standard Conf g.)



(Optional MI Conf g.)



Display Board

The display board connects to the main power board via a f ex-ribbon cable and the board is mounted on the inside of the enclosure door. The display board LCD readout indicates the cumulative kWh (on kWh meters) and instantaneous kW value or cumulative kWh, peak demand and instantaneous kW values (on kWh/ Demand meters). Additionally, errors such as low battery conditions or sensor error conditions are displayed.

2.0 Safety Label Definitions and Information

The Class 2000 meter may contain one or more of the following labels. Operator(s) should familiarize themselves with the meaning of each label to minimize risk.

The presence of this label is a cautionary indicator identifying a danger risk. The manual should be consulted prior to proceeding.

The presence of this label indicates an electrical shock hazard exists in the location or area where the label is placed. Prior to proceeding, the MAINS power must be disconnected and the manual consulted for safety information.

3.0 Precautionary/Safety Information

CAUTION: **Internal circuit card components are extremely sensitive to electrostatic discharge. Be careful not to touch internal circuitry prior to discharging any static buildup on your person. To discharge yourself, touch a grounded metal object such as conduit or an earth-grounded metal enclosure.**

WARNING: High voltages present on main PCB terminal block TB1. Risk of serious injury and/or electrical shock exists. Prior to performing any wiring operations, review all contents of the user manual and de-energize the MAINS power switch. Only qualified personnel should perform installation wiring. Installation wiring must comply with all local and national electrical codes.

WARNING: Failure to ground the enclosure creates a possible shock hazard. Do not operate the Class 2000 meter without a protective earth wire attached securely to the PE terminal screw. After installing protective earth wiring, secure the screw tightly (10 N-m torque.)

WARNING: NEVER open front panel of unit while unit has MAINS power applied. Failure to comply can increase the risk of serious injury and/or electrical shock.

4.0 Meter Installation

4.1 Mounting

STEP 1: Using the appropriate sized mounting hardware, fasten the Class 2000 meter enclosure to the selected mounting surface. The four mounting holes are centered 6.75” H x 4” W. The mounting hole spacing is identical for either the NEMA 12 or NEMA 4X enclosure.

NOTE: Only the NEMA 4X enclosed unit is suitable for outdoor environmental conditions. Units housed in NEMA 12 enclosures must only be installed in indoor environments where it will not be affected by the elements, such as moisture and extreme temperatures.

4.2 Main Power Board Connections

STEP 1: Install a temporary ground for ESD (Electrostatic Discharge) protection. With all circuits de-energized, connect a temporary protective earth ground connection for ESD protection. Prior to performing any unit wiring, be sure to discharge any static on your person.

STEP 2: Install the Class 2000 Protective Earth Ground. Connect an earth ground wire to the Class 2000 protective earth ground terminal screw located on the bottom right side of the main power board. After installing the protective earth ground wire, securely fasten the protective earth ground screw.

WARNING: Failure to attach the protective earth ground wire securely to the enclosure creates a potential shock hazard. Do not operate the Class 2000 meter without a protective earth ground connection securely installed.

STEP 3: Wire Entry
Two openings exist on the unit enclosure, one for 1/2” conduit and one for 3/4” conduit. The 3/4” conduit opening located on the bottom of the enclosure is used to bring in MAINS Power (voltage lines to power meter) and current sensor wiring. The 1/2” conduit opening located on the top of the enclosure is used to interface low voltage signals, such as the IDR interface and isolated pulse output. (Outdoor enclosures equipped with one 3/4” conduit opening on bottom of enclosure only.)

Route the appropriate cabling to and through the respective enclosure opening. The conduit and f ttings interfacing the enclosure entrances must be UL listed and properly sized to the enclosure port diameter, The interfacing f tting must use a gasketed seal ring to interface between the conduit f tting and the enclosure entry point. After installing the conduit f tting and conduit, verify that the conduit f ttings are aligned properly to their respective enclosure entrance ports and tightened securely to prevent moisture entry. VERIFY that each conduit slip nut is securely tightened to its respective conduit f tting.

4.0 Meter Installation (Continued)

4.2 Main Power Board Connections (Continued)

STEP 3: Wire Entry (continued)

Outdoor applications require the use of the optional NEMA 4X enclosure. The same principles outlined for indoor meter installations as def ned in the aforementioned paragraph carry over and apply to outdoor installations with one exception. This exception is that the conduit and f ttings for outdoor installations require an outdoor material rating.

STEP 4: Unit MAINS Wiring (Voltage Wiring Connections)

Remove the clear shield located over terminal block TB1 on the main power board. This shield can be removed by pressing in on each locking tab located at the top of each standoff. While pressing the tabs inward, lift the shield from the standoffs. Wire each connection to Terminal Block TB1 with stranded wire 14-12 AWG, rated at 600 VAC.

Strip back all wire insulation to expose between 1/4" and 3/8" of the copper conductors. Gently twist each wire to prevent fraying. Insert the conductors into their respective terminal block position and tighten down the terminal block screw to securely fasten the conductor. Terminal block TB1 is clearly labeled PHASE A, PHASE B, PHASE C and NEUTRAL.

Connect the NEUTRAL wire to the appropriate terminal block position.

NOTE: For Delta MAINS input wiring, DO NOT connect the NEUTRAL wire. Remove the terminal block screw for this position.

Connect the AC mains power wires (Phase A, Phase B and Phase C) to their respective positions as labeled on terminal block TB1.

After all conductors are connected to their respective terminal block positions and tightened down, verify that each terminal block screw is securely fastened by gently tugging on each conductor. Verify no conductor wires are frayed or are shorting to adjacent terminal block positions.

STEP 5: External Switch Mechanism/In-Line Fuse Installation

To ensure a safe installation, the Class 2000 meter requires an external switch mechanism, such as a circuit breaker, be installed on the Class 2000 MAINS input wiring. The switch mechanism must be installed in close proximity to the meter and easily reachable for the operator. This device must also be marked as the disconnecting device for the Class 2000 meter.

4.0 Meter Installation (Continued)

4.2 Main Power Board Connections (Continued)

STEP 5: External Switch Mechanism/In-Line Fuse Installation (Continued)

Install 1/10 Amp Slow Activation inline fuses with the suitable voltage rating for each conductor phase at the MAINS input to the meter. The fuses must be labeled to indicate voltage and current rating as well as element characteristics. The fuse element must be slow activating type.

STEP 6: Once the MAINS wiring is complete, replace the clear lexan protective shield over terminal block TB1 and close the enclosure front panel. Secure the enclosure cover using the locking mechanism. Activate the external circuit breaker or equivalent switch to apply AC MAINS power to the unit.

The Class 2000 meter display should turn on and indicate total kWh accumulation reading.

NOTE: The unit display, clock and other critical configuration parameters will be reset once the unit installation and wiring is complete.

STEP 7: Using an AC Voltmeter, verify the input voltage readings are within the limits specif ed below.

NOTE: For 3-Wire systems, the voltages are measured Phase to Phase. On 4-Wire systems the voltages are measured Phase to Neutral.

Meter Input Voltage Conf guration	Nominal Voltage	Limits (+/- 10%)
120/208V, 3 Ph, 4 Wire	120 VAC	108 to 132 VAC
277/480V, 3 Ph, 4 Wire	277 VAC	249 to 305 VAC
240V, 3 Ph, 3 Wire	240 VAC	216 to 264 VAC
480V, 3 Ph, 3 Wire	480 VAC	432 to 528 VAC

STEP 8: Remove power from the unit by de-energizing the external switch.

4.0 <u>Meter Installation (Continued)</u>

4.3 Current Sensor Installation & Wiring

Once the AC voltages have been conf rmed to be within acceptable limits, you are ready to install the current sensors. The MAIN power board contains either a 10-position terminal block (TB1) (standard conf guration) or three header connectors located at the bottom center of the board, TB2, TB3 and TB4 (MI conf guration). If supplied with the TB1 terminal block, the current sensors are connected to the 6 positions on the right side. Both styles are marked with the appropriate phase designation and conductor color. This format must be followed in order for the meter to function correctly.

The Class 2000 meter will be used with one of two basic types of current sensors:

a. Split-Core Current Sensor: This sensor opens so that it can be attached around the circuit conductor being monitored without interrupting power. Unless otherwise specif ed, all Class 2000 meters are supplied with this sensor type.

b. Solid-Core Current Sensor: This sensor does not open and requires the monitored conductor be removed from the circuit to install the current sensor. This type is only supplied when specif ed at time of order.

NOTE: The unit serial label specifies if the unit is set up for split or solid core current sensors.

Both types of current sensors output a 0-2 VAC signal proportional to the current being measured.

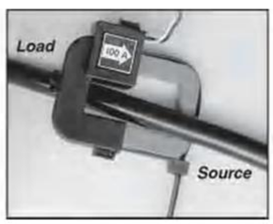
4.0 <u>Meter Installation (Continued)</u>

4.3 Current Sensor Installation & Wiring (Continued)

Installing the Split-Core Current Sensor Assembly

STEP 1: Each phase being monitored will require one two-piece current sensor assembly. Therefore, a three-phase meter will require three (3) assemblies. Open the two-piece current sensor assembly by releasing the nylon clamp using a f at head screwdriver.

STEP 2: Reassemble the current sensor assembly around the conductor(s) to be monitored. Ensure the current sensor halves marked “Load” are both facing the load side of the conductor. The colored arrow will be on the source side of the conductor being monitored and MUST be pointed in a clockwise direction around the conductor being monitored. Tighten the nylon clamp to complete the assembly.



IMPORTANT: When looking from the source side of the conductor(s) being monitored, you should see the arrow on the current sensor assembly. The arrow should be pointing in a clockwise direction around the conductor(s) being monitored. If the arrow is not positioned on the source side, inaccurate readings will result.

4.0 Meter Installation (Continued)

4.3 Current Sensor Installation & Wiring (Continued)

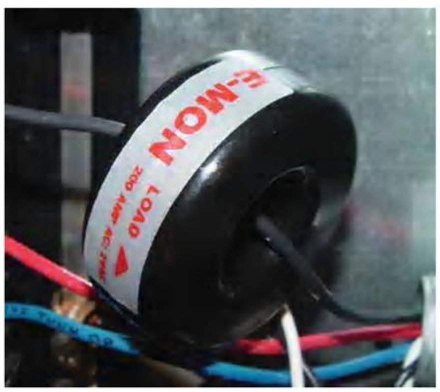
Installing the Solid-Core Current Sensor Assembly

The optional solid-core current sensors can be installed in the same applications as the standard split-core units, however, the conductors that they are monitoring must f rst be disconnected.

NOTE: Under no circumstances is this operation to take place without shutting off the power to the conductor(s) being monitored.

With the power off, disconnect the conductor from its breaker or terminal. Slide the solid-core current sensor over the conductor, making sure that the indicator on the sensor is pointing in the direction of the load. After this is done, reconnect the conductor and verify that it is properly installed.

Run the black and white wires from the solid-core current sensors and install them according to the standard installation diagram. When this is completed, the power to the monitored conductor can be turned back on.



4.0 Meter Installation (Continued)

4.3 Current Sensor Installation & Wiring (Continued)

Current Sensor Wiring

Once all the current sensors are installed on their appropriate phase conductors, you can begin terminating the current sensors on to the Class 2000 main power board.

The current sensor leads can be extended up to 2,000 feet (using #14-22 AWG wire) for remote monitoring applications. Consult your local electrical codes for proper wire sizing (#22 AWG twisted pair wire with a black and white conductor, rated for 600 VAC recommended.)

The current sensor connection points are located on the bottom center of the main power board. If supplied with the terminal block (TB1) (standard conf guration), the current sensors are connected to the 6 positions on the right side.

If your meter is equipped with removable current sensor terminal blocks (MI conf guration), you can f nd the current censor connection points located on the bottom center of the main power board. Three removable plugs exist, one for each current sensor phase input. The header portions of the connectors are labeled TB2, TB3 and TB4. Text silkscreened on each of the connectors instruct you which terminal of the plug is for the white conductor and which terminal is wired to the black conductor. Once each current sensor is wired to its respective plug, insert each plug into the appropriate header.

4.0 Meter Installation (Continued)

4.4 MAINS Line Voltage & Current Sensor Wiring Diagrams

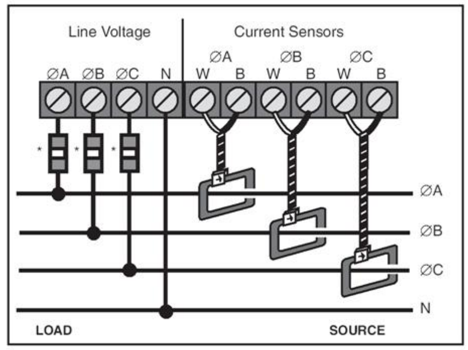
3-Phase, 4-Wire Installation Diagram

Line Voltage Connections: # 14-22 AWG

Sensor Connections: B = Black Lead
W = White Lead

* 1/10 A, 600 VAC inline fuse per conductor.
Littlefuse part number KLDR .100.

** Neutral not used in delta system.
Remove neutral terminal block screw for Delta systems.



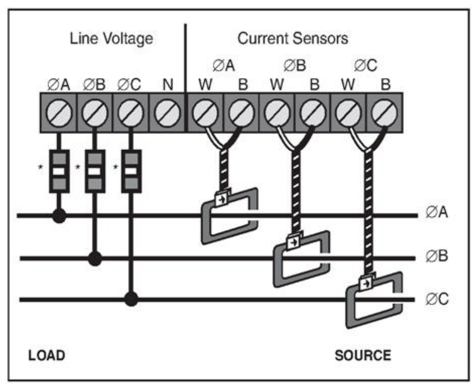
3-Phase, 3-Wire Installation Diagram

Line Voltage Connections: # 14-22 AWG

Sensor Connections: B = Black Lead
W = White Lead

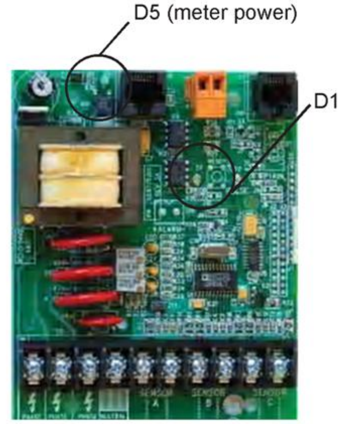
*1/10 A , 600 VAC inline fuse per conductor.
Littlefuse part number KLDR .100.

** Neutral not used in delta system.
Remove neutral terminal block screw for Delta Systems.



4.0 <u>Meter Installation (Continued)</u>

4.5 Line Voltage/Current Sensor Diagnostics



(Main Board Standard Conf g. Shown)

The three-phase AC MAINS voltage wiring and the current sensor wiring must be connected in the proper phase sequence. If there is a phase sequence error, the display LCD will display a message 'Check Sensor" in the upper right hand corner. Additionally, LED D1, Check Sensor, will illuminate if there is a phasing error.

Verify that the AC MAINS voltage wires are all connected to the correct positions on terminal block TB1. Inspect the MAINS input wiring to verify each conductor is terminated at the correct terminal block position. Using an AC voltmeter, measure the AC voltage for each Phase to Neutral terminal and to the Frame ground point.

Verify each current sensor by running at least 1% of the full scale rated current through the conductor being monitored by each phase. (e.g. 2 amp load required for each phase to perform sensor diagnostic procedures.)

- Verify that the current sensor white and black conductors are installed in the correct header positions.

- Verify the current sensors are installed in the correct direction on the conductor being monitored.

- Verify that the current sensor plugs are terminated in the correct header on the Main power board if meter is equipped with removable ST terminal blocks.

If the error messages still haven't been cleared, measure the AC voltage inputs across the plug terminals of each current sensor, individually. Set the AC voltmeter to the 20 Volt scale. If a reading of zero volts is indicated on the voltmeter, check for an open circuit. An open connection could exist at the plug terminals or at a splicing junction. Also verify a tight connection exists between the core halves.

If error message is still appearing, contact E-Mon technical support at (800) 334-3666 for further assistance.

Final Main Board Checks

Once the phase error has been corrected, the Display LCD "Check Sensor" error should extinguish and the Main Power Board LED D1 should extinguish.

5.0 Monitoring Multiple Loads with One Meter

The Class 2000 meter provides extreme f exibility by allowing additional sets of current sensors to be used in parallel so that multiple load locations can be monitored by one meter. This feature allows a totalized display readout from two or more load circuits.

You may use parallel sensors to monitor specif c breakers from one panel, specif c breakers from more than one panel, two or more complete panels, etc.

When paralleling current sensors, the following rules must be followed for accurate readings:

Rule 1: Current sensors must be installed in complete sets of three, with a maximum of three sensors installed in parallel per phase.

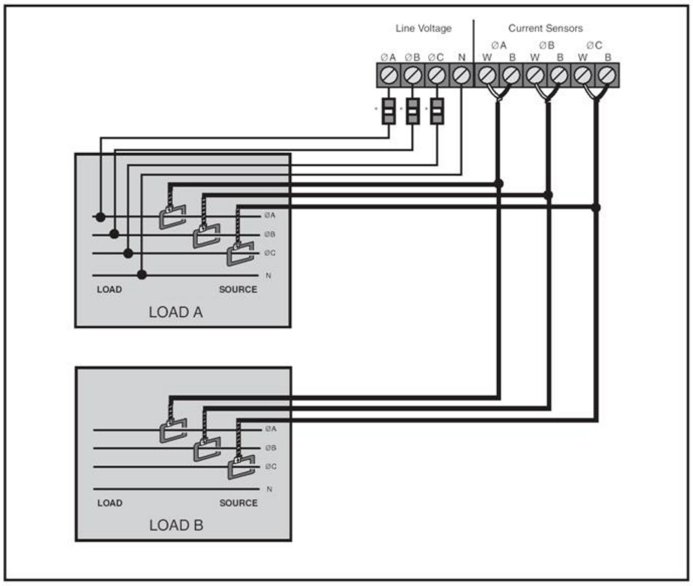
Rule 2: All sensors used in parallel must be of the same amperage rating (i.e. 100 amp, 200 amp, etc.) The rating is determined by the current rating (amperage) of the Class 2000 meter. For example, a 200 amp meter must use extra sets of 200 amp current sensors.

Rule 3: All locations being monitored must have the same power source. A 480 volt meter cannot monitor a 208 volt load nor can a meter monitor two 480 or 208 volt loads if they are from different originating power sources or from different transformers.

Rule 4: The display readings must be multiplied by the number of sets of current sensors installed. E.g. meter reading of 5 kWh with 2 sets of current sensors....5 x 2 = 10 kWh (actual usage.)

NOTE: One set of current sensors equates to three sensors, one per phase. The multiplier only applies when extra sets of current sensors are installed on one meter. Therefore, if you are using only one set of three sensors (one per phase) the multiplier is not required.

5.0 Monitoring Multiple Loads with One Meter (Continued)



6.0 <u>KWh Meter Features & Functions</u>

6.1 KWh Meter Display Features

Normal Mode (kWh Reading)

The Class 2000 kWh meter display requires no multiplier and shows kilowatt-hours consumed. See section 6.2 for information on calculating cost based on kWh usage.

KW Load Mode (Current Load in kW)

Pressing the “UP” button on the meter display board will switch the display to the Load mode and will show the present load in kW (kilowatts). (Allow 6 seconds for correct reading to stabilize.) This feature is useful to the consumer as it shows the actual load on the meter and can be valuable in showing the effects of large loads-such as air conditioning, electric hot water heaters, and electrical appliances on power consumption. Pressing the “UP” button again returns the meter display to normal mode.

Test Mode

Pressing the “CPU” button on the meter display board will cycle the display through the test mode. The two screens below will be seen.

The f rst screen activates all the digits and icons on the display. This is to verify that all segments on the display are functional.

The second screen will show the amp rating of the meter. The f rst digit (on the left side of the dash) will always be zero on the kWh meter. The four digits on the right side of the dash indicate the amp rating.

Upon completion of the cycling, the meter will return to the normal display mode. When the meter is f rst energized it will automatically cycle through the test screens.

6.0 <u>KWh Meter Features & Functions (Continued)</u>

6.2 How to read the kWh Meter

The Class 2000 kWh meter displays readings in whole numbers, there are no decimals.

To f nd the dollar cost for the power used by the load(s) being monitored, you must f rst f nd out what the cost per kWh is in your area (this cost can be found on your utility electric bill, or call your local utility and ask for their cost per kilo-watt hour.) Simply multiply the cost per kWh by the kWh reading from the E-Mon D-Mon meter. The resultant f gure is the dollar cost for power used by the load(s) being monitored by this meter.

Example:

8-digit display reading	00000250
Cost per kWh from utility	$0.12100

250 x $0.121 = $30.25

NOTE: THE FOLLOWING ONLY APPLIES TO METERS USING MORE THAN ONE SET OF CURRENT SENSORS. For meters using parallel current sensors you must multiply the kWh display reading by the number of sets of current sensors installed.

Example:

250 (meter display reading) x 2 (sets of sensors in parallel) = 500 kWh

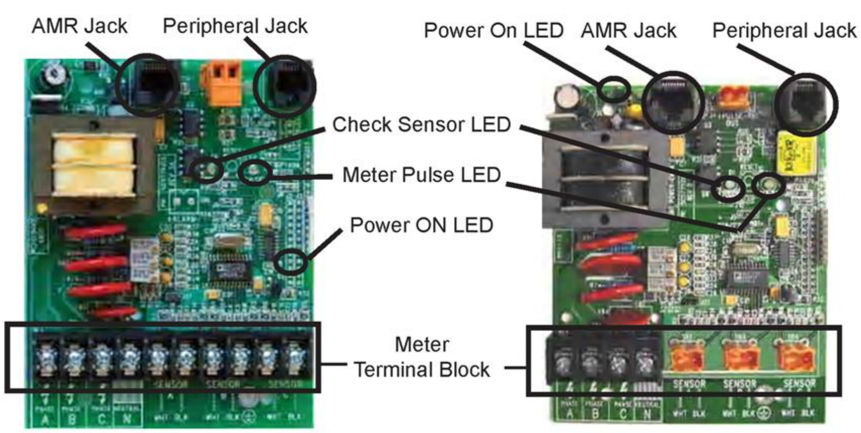
500 kWh x $0.121 (utility cost per kWh) = $60.50

6.0 KWh Meter Features & Functions (Continued)

6.3 KWh Meter Hardware Functions

AMR Jack	8-pin RJ-45-used to connect kWh meter to the E-Mon Energy automatic meter reading system.
Peripheral Jack	6-pin RJ-11-used to interface with E-Mon meter options such as the P2 Pulser or D/A Converter.
Check Sensor LED	When lit, indicates that the current sensor is backwards or on the incorrect phase.
Meter Pulse LED with	Blinks to show the meter load. Blink rate increases load.
Power On LED	When lit, indicates power to meter is on.
Real-Time Load PB	Press (UP) once and wait 6 seconds to display present load in kW, press again to return to standard kWh display (update is not instantaneous.)
Reset PB	Press (RESET) to reset display to zero.
Display Test PB	Press (CPU) to test display. Shows "88888888" then amp rating of meter.
DIP Switch personnel.	Meter set-up. Used ONLY by E-Mon factory
CPU Active LED	One blink per second indicates normal operation.

Main circuit board located inside meter enclosure

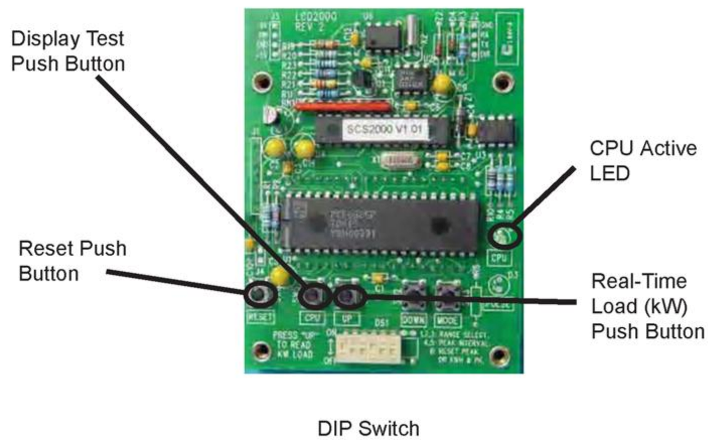


Standard Conf guration MI Conf guration

6.0 <u>KWh Meter Features & Functions (Continued)</u>

6.3 KWh Meter Hardware Functions (Continued)

Circuit board located inside door of meter enclosure.



7.0 KWh/Demand Meter Features & Functions (Only applies to meters ordered with the Demand Option)

7.1 KWh/Demand Meter Display Functions

The Class 2000 kWh/Demand meter has a single display window that cycles through the energy data screens. The meter will cycle through four (4) separate screens. The screens are described below.

Display	Description
00004723 *kWh*	KWh display shows the amount of energy consumed in kilowatt hours (kWh). Reading is in whole numbers, there are no decimals and the meter requires no multipliers.
000059.3 *kW*	KW display shows the electrical Demand in kilowatts (kW). Demand interval is either 15 minutes or 30 minutes. (Default is 15 minutes.)
04-22-08	Date display shows the date of the demand (kW) peak.
12-30	Time display shows the time of the day that the demand peak occurred.

7.0 <u>KWh/Demand Meter Features & Functions (Only applies to meters ordered with the Demand Option)</u>

7.2 How to Read the kWh/Demand Meter

<u>KWh Reading</u>

The Class 2000 kWh meter displays readings in whole numbers, there are no decimals.

To f nd the dollar cost for the power used by the load(s) being monitored, you must f rst f nd out what the cost per kWh is in your area (this cost can be found on your utility electric bill, or call your local utility and ask for their cost per kilowatt hour.) Simply multiply the cost per kWh by the kWh reading from the E-Mon D-Mon meter. The resultant f gure is the dollar cost for power used by the load(s) being monitored by this meter.

Example:

8-digit display reading	00000250
Cost per kWh from utility	$0.12100

250 x $0.121 = $30.25

<u>KW (Demand) Reading</u>

The kW (Demand) reading is the peak usage over a specif ed time period (15 minute standard, 30 minute optional). While kWh costs are interpreted as cents, Kilowatt costs are usually represented in dollars, and interpretation of demand costs are based on your utility's tariff and rate structures. You will need to contact your utility to see how your utility structures their kilowatt demand charges to ensure proper allocation of costs utilizing data from the E-Mon D-Mon meter.

NOTE: THE FOLLOWING ONLY APPLIES TO METERS USING MORE THAN ONE SET OF CURRENT SENSORS. For meters using parallel current sensors you must multiply the kWh display reading by the number of sets of current sensors installed.

Example:

250 (meter display reading) x 2 (sets of sensors in parallel) = 500 kWh

500 kWh x $0.121 (utility cost per kWh) = $60.50

7.0 KWh/Demand Meter Features & Functions (Only applies to meters ordered with the Demand Option)

7.3 KWh/Demand Display Set-Up

The demand meter display is set-up using the Mode Select, Up and Down buttons located on the meter display board which is mounted on the door inside the meter enclosure. The CPU Reset button may also be utilized for certain functions. (See Section 7.4 for details on button locations.)

STEP 1: Date Setting

00-00-00

Press the Mode Select button and the display screen shown will appear. The date is entered MM-DD-YY. A zero will proceed a single digit entry. Using the Up and Down buttons, enter the correct numbers. After entering the correct number in the f rst set of digits, press the Mode Select button to move to the next set of digits. When completed, pressing the Mode Select button will advance the display to the next screen.

STEP 2: Day of Week and Time Setting

04 22-08

Time shown is Wednesday, 10:08 pm

The f rst section of the next screen calls for the entry of the recent day of the week. Using the Up and Down buttons, enter “1” for Sunday, “2” for Monday, “3” for Tuesday, “4” for Wednesday, “5” for Thursday, “6” for Friday or “7” for Saturday. This is important so the meter can automatically keep track of daylight savings time. Using the Mode Select button, move to the next f eld where the hour is entered through the Up and Down buttons. As the meter uses a 24 hour clock, this number will be from 1 to 24. (eg. 2:00pm=14). The f nal f eld will be the minute display which is also entered by pressing the Up and Down buttons. Again, press the Mode Select button to move to the f nal display screen.

NOTE: When the meter is first energized, or after pressing the CPU Reset button, the display will appear as seen below:

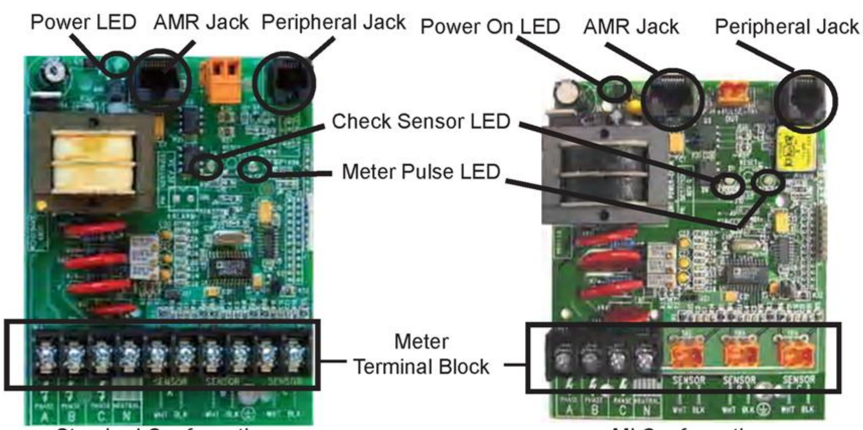
00-00-00

7.0 <u>KWh/Demand Meter Features & Functions</u>
<u>(Only applies to meters ordered with the Demand Option)</u>

7.4 KWh/Demand Meter Hardware Functions

AMR Jack	8-pin RJ-45-used to connect kWh meter to the E-Mon Energy automatic meter reading system.
Peripheral Jack	6-pin RJ-11-used to interface with E-Mon meter options such as the P2 Pulser or D/A Converter.
Check Sensor LED	When lit, indicates that the current sensor is backwards or on the incorrect phase.
Meter Pulse LED with	Blinks to show the meter load. Blink rate increases load.
Power On LED	When lit, indicates power to meter is on.
Real-Time Load PB	Press (UP) once and wait 6 seconds to display present load in kW, press again to return to standard kWh display (update is not instantaneous.)
Reset PB	Press (RESET) to reset display to zero.
Display Test PB	Press (CPU) to test display. Shows "88888888" then amp rating of meter.
DIP Switch personnel.	Meter set-up. Used ONLY by E-Mon factory
CPU Active LED	One blink per second indicates normal operation.

Main circuit board located inside meter enclosure



Standard Conf guration

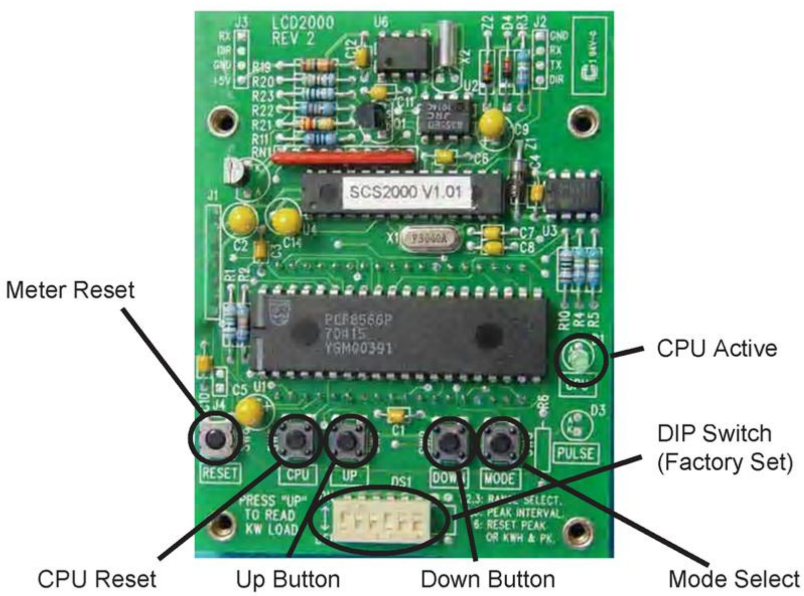
MI Conf guration

7.0 KWh/Demand Meter Features & Functions (continued) (Only applies to meters ordered with the Demand Option)

7.4 KWh/Demand Meter Hardware Functions

CPU Active	LED (D1) blinks indicating the CPU is active and operating.
Mode Select	Button used to select adjustment mode when setting up the meter (clock adjust, date adjust, input select.)
Down Button	Used when adjusting time and date for meter display.
Dip Switch	For use by E-Mon factory personnel only.
Up Button	Used when adjusting time and date for meter display.
CPU Reset	Resets the CPU; Used by f eld service personnel.
Meter Reset	All meter display readings reset to zero.

The picture below shows the various hardware points on the KWh/Demand meter display board that are utilized when setting up the meter for operation. The board is located on the inside of the door of the meter and is accessible by opening the enclosure. A padlocking hasp is provided on the meter enclosure to prevent unauthorized access. The functions of these hardware points are outlined above.



8.0 Preventative/Scheduled Maintenance

The Class 2000 kWh/Demand meter is shipped in a calibrated, tested and fully functional condition.

- All potentiometers are sealed. No f eld adjustments are required.

- No preventative or scheduled maintenance is required.

- No cleaning or decontamination procedures are required for this instrument.

9.0 Lithium Battery Replacement Instructions

The Class 2000 kWh/Demand meter has a Lithium Battery Cell, which is used to retain the contents of SRAM and the RTC during power outages. The battery has a life expectancy of greater than 8 years.

Battery Specif cations:	25 Degrees Celsius
Nominal Working Voltage:	3.5 VDC Output
Nominal Current Capacity:	350 mAHr
Cell Chemical: Lithium-Thionyl	Chloride
Operating Temperature Range:	-40 to +95 Degrees Celsius
Manufacturer: Eagle-Picher	
Manufacturer's Part Number:	LTC-3PN-S2

WARNING: Only replace battery with exact manufacturer and manufacturer's part number specified above.

The battery cell is mounted in a socket on the right side of the main power board. Should the battery drop below 2.4 VDC in capacity, the display will illuminate a battery symbol on the left margin indicating a low condition. Additionally, the internal f rmware will set a f ag indicating the low battery condition. Use the following procedure to replace the lithium battery cell.

CAUTION: The battery is not completely discharged, therefore DO NOT short the terminals on the battery with any conductive material.

CAUTION: Internal circuit card components are extremely sensitive to electrostatic discharge. Be careful not to touch internal circuitry prior to discharging any static buildup on your person. To discharge yourself, touch a grounded metal object such as conduit or a metal enclosure exterior.

9.0 Lithium Battery Replacement Instructions (Continued)

STEP 1: Disconnect power from the meter at the unit external circuit breaker.

STEP 2: Remove the battery from its socket and place on a non-conductive surface.

STEP 3: Install new battery into the PCB battery socket.

NOTE: Observe polarity of battery terminals. Be sure to align battery terminal polarities with pcb silkscreen markings. No damage to unit or battery will occur if battery is inadvertently installed in the wrong direction.

STEP 4: Visually inspect new battery to verify that all leads are fully inserted into their respective socket positions.

STEP 5: Dispose of the used battery in accordance with the manufacturers' (Eagle Picher) instructions.

10.0 Troubleshooting

The Class 2000 kWh/Demand meter is calibrated and tested at the factory before being packaged and shipped. If installed properly and in accordance with these installation instructions, your Class 2000 meter should provide years of trouble-free service. If the meter should not function, the following guide will assist in troubleshooting the installation.

Problem	Procedure to follow
1. Display window is blank.	A. Check wiring to voltage terminals. B. Check circuit breakers or fuses. C. Verify that the power is turned on. D. Test source for correct voltage.
2. Display shows incomplete f gures or numbers other than zeros when power is turned on.	A. Press RESET button located on door inside meter enclosure (5 sec.)
3. Display reading all zeros (00000000)	A. Determine if load is suff cient to update the display. B. Check RESET button to ensure there are no wires or other objects pressing against it when the door is closed. C. Check the current sensors for installation and polarity. D. Be sure the current and voltage inputs have the proper phase relationship. E. Check wiring to voltage terminals. F. Check circuit breaker or fuses. G. Test source for correct voltage.
4. Display reads only a fraction of consumption	A. Check the supply voltage to be sure that it is on continuously 24 hrs/day. B. Check the current sensors for installation and polarity. C. Check sensor wiring to the terminal strip in meter (color coding B & W.)

NOTE: If you still need assistance after performing the above troubleshooting procedures, do not remove the unit. Before removing the unit, contact E-Mon's technical support department at (800) 334-3666, our support experts will assist you in detailed troubleshooting of the meter installation and assist you in getting the unit operating correctly.

11.0 Frequently Asked Questions

Q. When providing line voltage to the meter, can I tap off of the same breaker I am monitoring?

A. Yes, the voltage can be pulled from the same breaker being monitored.

Q. Can the meter's line voltage wires be run in the same conduit as the sensor leads?

A. Yes, there will be no effect on the meter if the sensor leads and line voltage wires are run in the same conduit.

Q. Can the meter communication wires and line voltage wires be run in the same conduit?

A. It is NOT recommended to run these wires together due to noise concerns and their effects on the communications signal integrity. Communication wires can be routed separately using the 1/2" conduit port.

Q. How do I find the cost for kWh and kW to bill my tenants?

A. Your local utility bill should list the cost per kWh and kW. If not, simply call your utility and ask them to provide you with the cost per kWh and kW.

Q. What size wire do I use for the line voltage leads?

A. These wires are normally #14 AWG, but be sure to consult your local electrical codes for proper sizing requirements.

Q. What size wire should I use to extend the current sensor leads?

A. These wires are normally sized at #14-22 AWG, twisted pair arrangement. Consult your local electrical codes for proper sizing requirements.

Q. The load I need to monitor has parallel feeds. How do I install the current sensors for this application?

A. There are two ways you can monitor parallel feeds. One method is to clamp the sensors around all feed wires for each phase (no additional reading multiplier required). The second way to monitor parallel feeds is to clamp the sensor around one of the feed wires for each phase, and when you read the kWh meter the f nal reading must be multiplied by the number of feed wires for each phase.

Q. I have two subpanels I would like to monitor with one meter. These subpanels are fed by different transformers in the building. Can I parallel sensors and monitor both panels with one meter?

A. No. These panels cannot be monitored by one meter because they are different power sources. When you parallel current sensors, all loads must be from the same voltage source.

Q. I have 5 breakers in one subpanel I would like to monitor with one meter. Can this be done without having to parallel current sensors?

A. Yes. Simply run all the breaker wires through one set of current sensors. Make sure all A phase circuits are run through the A phase sensor, and the same for B & C phases. The meter should be sized by the highest amount of current being monitored by one sensor.

Q. I've gone through the troubleshooting guides and I still can't get my meter to work. What should I do?

A. Before removing the unit, contact E-Mon's technical support department at (800) 334-3666. Our technical support experts will assist you in detailed troubleshooting of the meter installation and assist you in getting the meter functional without having to remove and return the unit.

12.0 Meter Technical Specifications

Ordering Information: Def ne input voltage, current sensor rating (amperage) and options.

Example: 208 200 D P R

Input Voltage
Amperage
Demand Option
Pulse Output Option
Outdoor Enclosure Option

Input Voltage Conf guration:	3-Wire (Delta) or 4-Wire (Wye)
MAINS Voltage Input:	Up to 480 VAC RMS Available
Input Power: 6V	A Maximum Rating
Current Sensor Rating:	Up to 3200 Amp RMS AC Available
Power Factor:	.5 leading or lagging
Line Frequency: 50-60	Hz
Metering Accuracy: Certi	f ed to ANSI C12.16 (+/- 1% from
1%	to 100% of rated load)
Voltage Operating Range:	+/- 10% of rated load
Temperature Range (Standard indoor enclosure):	-20 degrees C to +50 degrees C
Temperature Range: (NEMA 4X outdoor enclosure):	-20 degrees C to +70 degrees C
Relative Humidity Range:	0-95% Non-Condensing
Altitude: 2000	meters maximum
Voltage Overload:	+25% Continuously; +100% for 20 Cycles
Current Sensor Overload:	100% for 1 minute without damaging meter
Pollution Degree:	Degree 2 in accordance with IEC 664
Installation (Overvoltage) Category:	Category III
Measurement Category: Category	III
Indoor Housing Rating (Standard):	NEMA 12
Outdoor Housing Rating (Optional):	NEMA 4X
Display Readout: KWh	Accumulated, Peak Demand,
Instantaneous	kWh

Standard Ranges:	4-Wire Wye, 120/208 VAC:	100, 200, 400, 800, 1600 and 3200 Amp
	2 Phase, 120/240 VAC:	100, 200, 400, 800, 1600 and 3200 Amp
	4-Wire Wye, 277/480 VAC:	100, 200, 400, 800, 1600 and 3200 Amp
	3-Wire Delta, 220/240 VAC:	100, 200, 400, 800, 1600 and 3200 Amp
	3-Wire Delta, 480 VAC:	100, 200, 400, 800, 1600 and 3200 Amp

IDR Interface Port:	Cable Specif catons:	UL Listed/Rated Telephone Cord, 6-conductor
300		VAC, stranded conductors, 22-26 AWG.
Input/Output	Voltage: +5	VDC/18 VAC
Cable	Connector: RJ-45	male IDC
	Ckt Input Isolation:	5.3K VAC for 1 Minute
Ckt	Output Isolation: 2.5K	VAC

Isolated Pulse/Alarm Outputs (TB5, TB6):

Output Voltage Potential:	0 VDC to +5 VDC Logic Levels
Mating Plug Connector:	Weidmuller PN: 152876
Signal Isolation Voltage:	5.3K VAC for 1 Minute

Recommended in-Line Fuse:

Manufacturer:		Littlefuse
Mfg	Part No.:	KLDR.100
	Rating:	100mA, Time Delay, 600 VAC Cartridge Fuse

Battery Cell:	Description:	Non-rechargeable cell used for memory
retention.		
Manufacturer:		Eagle-Picher
Mfg	Part No.:	L TC-3PN-S2
W	orking Voltage:	3.5 VDC
Current	Capacity:	350mAHr
Electrolyte:	Lithium	Thionyl Nitrate

13.0 Meter Limited Warranty

Subject to the exclusions listed below, E-Mon will either repair or replace (at its option) any product that it manufactures and which contains a defect in material or workmanship.

The following exclusions apply:

1. This Limited Warranty is only effective for a period of (5) f ve years following the date of manufacture when installed in accordance with manufacturer's instructions by qualif ed personnel.

2. E-Mon must be notif ed of the defect within ninety (90) days after the defect becomes apparent or known.

3. Buyer's remedies shall be limited to repair or replacement of the product or component which failed to conform to E-mon's express warranty set forth above.

4. Buyer shall be responsible for all freight costs and shall bear all risk of loss or damage to returned goods while in transit.

5. This Limited Warranty does not cover installation, removal, reinstallation, or labor costs, and excludes normal wear and tear. Buyer shall provide labor for the removal of the defective component or item and installation of its replacement at no charge to E-Mon.

6. This Limited Warranty does not cover any product if: (i) a product is altered or modif ed from its original manufactured condition, (ii) any repairs, alterations or other work has been performed by Buyer or others on such item, other than work performed with E-Mon's authorization and according to its approved procedures; (iii) the alleged defect is a result of abuse, misuse, improper maintenance, improper installation, accident or the negligence of any party; (iv) damaged as a result of events beyond E-Mon's control or other force majeure events or (v) used in conjunction with equipment, components, accessories, parts or materials not supplied or approved by E-Mon.

7. This Limited Warranty is limited to the obligation to repair or replace the manufactured product. This is the sole and exclusive remedy for any breach of warranty. IN NO EVENT SHALL E-MON BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES (INCLUDING ANY DAMAGE FOR LOST PROFITS) ARISING OUT OF OR IN CONNECTION WITH THE FURNISHING OF PRODUCTS, PARTS OR SERVICES, OR THE PERFORMANCE, USE OF, OR INABILITY TO USE ANY PRODUCTS, PARTS OR SERVICES, SALE OF OR OTHERWISE, WHETHER BASED IN CONTRACT, WARRANTY, TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, OR ANY OTHER LEGAL OR EQUITABLE THEORY.

8. EXCEPT AS EXPRESSLY PROVIDED HEREIN, E-MON MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED WITH RESPECT TO ANY PRODUCTS, PARTS OR SERVICES PROVIDED BY E-MON INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. PRODUCTS OR COMPONENTS DISTRIBUTED, BUT NOT MANUFACTURED, BY E-MON ARE NOT WARRANTED BY E-MON AND BUYER MUST INSTEAD RELY ON THE REPRESENTATIONS AND WARRANTIES, IF ANY, PROVIDED DIRECTLY TO THE BUYER BY THE MANUFACTURER OF SUCH PRODUCT OR COMPONENT.

Measurement Accessories

Blower Connection Key
NPT – American National Standard Taper Pipe Thread (Male)
NPSC – American National Standard Straight Pipe Thread for Coupling (Female)
SO – Slip On (Smooth – No Threads)

Air Flow Meter

FEATURES

- Direct reading in SCFM
- Low pressure drop (2-4" typical) across the flow meter
- Non-clogging, low impedance air stream
- Light weight aluminum
- No moving parts
- Large easy-to-read dial
- Accurate within 2% at standard conditions
- Good repeatability
- Available in 2", 3" and 4" sizes
- Factory configured for quick installation
- .048" Allen key supplied for gauge adjustment

OPTIONS

- For 4-20 mA outputs and digital readouts see page G-9
- High temperature version (above 140°F)
- Corrosion-resistant version with Chem-Tough™ or in stainless steel
- FDA-approved Food Tough™ surface conversion
- High pressure version (100 PSI)

BENEFITS

- OPTIMIZE SYSTEM EFFICIENCY
  Measuring the correct air flow can assist you in fine-tuning to your system's optimal efficiency.
- BALANCE MULTI-PIPING SYSTEMS
  When evacuating CFM from more than one pipe, different run lengths or end system impedance can cause one pipe to handle more CFM than the other. With an accurate CFM reading, piping can be balanced by bleeding air in/out or by creating an extra impedance.
- DETECT CHANNELING OR PLUGGING
  For systems in which channeling or plugging can occur, a change in the CFM measured can help indicate the unseen changes in your system.

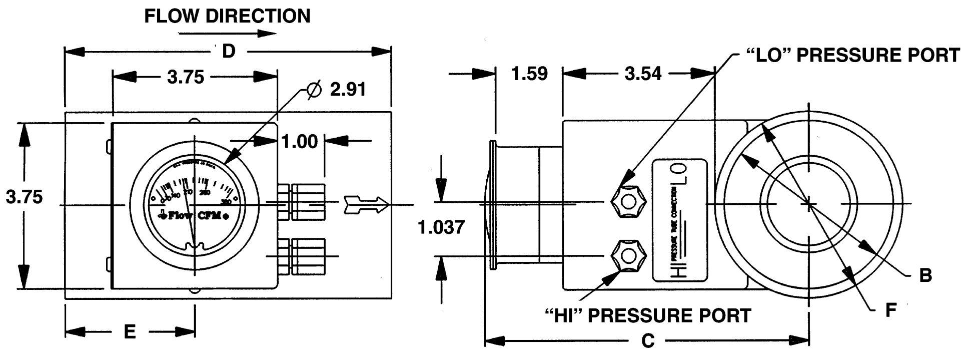
Current Models		Flow Range	B	C	D	E	F
Model	Part #	(SCFM)	Threads	Length	Width		
FM20C030Q	550599	6-30	2" - 11.5 NPSC	7.18"	7.0"	2.0"	3.75"
FM20C045Q	550600	9-45					
FM20C065Q	550601	13-65					
FM20C125Q	550602	25-125			5.6"		
FM20C175Q	550603	35-175					
FM20C225Q	550604	45-225					
FM30C250Q	550605	50-250	3" - 8 NPSC	7.52"	7.4"	2.5"	4.43"
FM30C350Q	550606	70-350					
FM30C475Q	550607	95-475					
FM40C450Q	550608	90-450	4" - 8 NPSC	8.00"	7.7"	2.7"	5.43"
FM40C600Q	550609	120-600					
FM40C850Q	550610	170-850					

Rev. 2/01

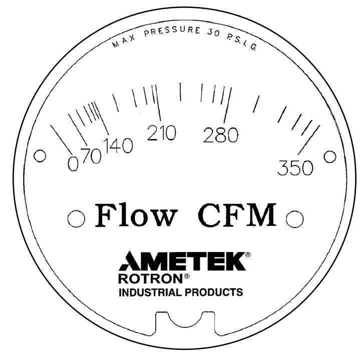
Blower Model Reference Key	
A = SPIRAL	E = DR/EN/CP 656, 6, 623, S7
B = DR/EN/CP 068, 083, 101, 202	F = DR/EN/CP 707, 808, 858, S9, P9 (Inlet Only)
C = DR/EN/CP 303, 312, 313, 353	G = DR/EN/CP 823, S13, P13 (Inlet Only)
D = DR/EN/CP 404, 454, 513, 505, 555, 523	H = DR/EN/CP 909, 979, 1223, 14, S15, P15 (Inlet Only)

Measurement Accessories

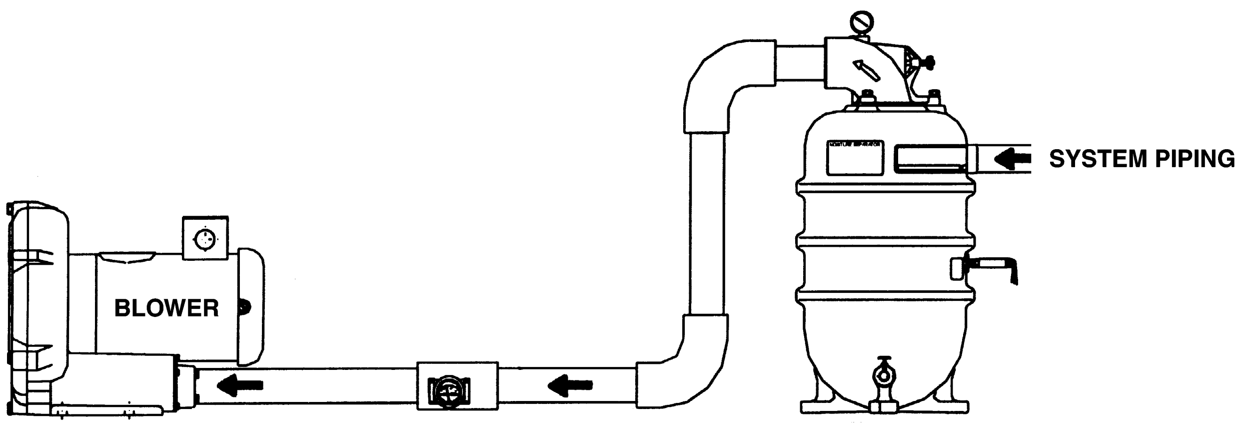
TYPICAL FLOW METER ARRANGEMENT



ANALOG FLOW METER



TYPICAL GAUGE FACE



HIGH TEMPERATURE/PRESSURE CORRECTION

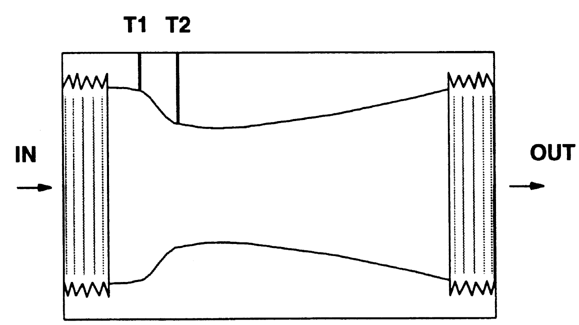
$$SCFM_2 = \frac{SCFM_1}{\sqrt{\left(\frac{14.7}{Pf_2}\right) \times \left(\frac{530}{Tf_2 + 460}\right)}}$$

Pf_2 = Absolute Pressure in PSIA

Tf_2 = Temperature in °F

- Use on inlet to limit need to correct for high pressure or elevated outlet temperature
- Standard model limits = 140°F and 30 PSIG

HOW IT WORKS



Rotron's flow meter is a venturi style design. After air enters the inlet, the pressure is measured in the T1 tap. The second tap, T2, measures the pressure at the throat. The differential between T1 and T2 registers across a special calibrated CFM gauge to provide accurate readings. The throat is then expanded back to the original size to keep pressure loss to under 2-4 IWG.

Rev. 2/01

J&D Manufacturing

LEADERS IN MOVING THE WORLD'S AIR

ES Shutter Fan With or Without Cord

J&D Manufacturing's ES Shutter Fan is a durable agriculture grade exhaust fan perfect for barn and building peaks, greenhouses, warehouses and more. ES Shutter Fans are available without a cord, or pre-wired with a cord and plug for "No Electrician Required" installation. Fans ship fully assembled out of the box so you're up and running in no time!

No Electrician Required for Corded Models

Features

- Smooth and quiet operation
- Comes totally assembled out of the box
- Models with cord are pre-wired for 115 Volts with 3-prong plug. No electrician required.
- Balanced 3 bladed aluminum prop with a zinc plated steel hub
- Chrome guard allows for easy cleaning and meets OSHA 1910.212(a)(5) requirements to mount at any height on inlet side of fan. (When mounted, shutter side should be 7' above ground.)
- High efficiency aluminum shutters with tie bar to eliminate shutter flapping and opening on windy days
- Energy efficient, totally enclosed, maintenance free, direct drive high efficiency motors have completely sealed ball bearings, covered by a **Full Two Year Warranty**.

MADE IN U. S. A.

Optional Weather Hood

Shutter Fan Size	Weather Hood
10"	VFT140855
12"	VFT140855
16"	VFT140856
20"	VFT140857
24"	VFT140858
30"	VFT140859

Weather hood for exterior shutter side

Part#	Size	HP	Volt	Amps	HZ	Phs	Spd	CFM @.0" SP	CFM / Watt Hi / Low @.0" SP	CFM @.05" SP	CFM / Watt Hi / Low @.05" SP	RPM Hi / Low	Rough Opening
With Cord													
VES10C	10"	1/8	115	0.8	60	1	3	697	12/9	670	11/9	1,706/1,390	12½" x 12½"
VES12C	12"	1/10	115˜	1.0	60	1	S/Var^	1,846	9/7	1,775	9/7	1,625/600	12½" x 12½"
VES161C	16"	1/10	115˜	1.0	60	1	S/Var^	2,951	12/9	2,810	11/9	1,625/600	16½" x 16½"
VES201C	20"	1/10	115˜	1.0	60	1	S/Var^	3,233	12/10	3,050	12/9	1,625/600	20½" x 20½"
VES20C	20"	1/3	115˜	3.5	60	1	S/Var^	5,077	13/10	4,790	12/10	1,725/600	20½" x 20½"
VES24C	24"	1/2	115˜	4.8	50/60	1	S/Var^	6,487	17/14	6,120	16/12	1,725/600	24½" x 24½"
VES30C	30"	1/2	115˜	5.1	50/60	1	1	7,086	23/18	6,685	21/17	844/600	30½" x 30½"
Without Cord													
VES12	12"	1/10	115/230	1.0/0.5	60	1	S/Var^	1,846	9/7	1,775	9/7	1,625/600	12½" x 12½"
VES161	16"	1/10	115/230	1.0/0.5	60	1	S/Var^	2,951	12/9	2,810	11/9	1,625/600	16½" x 16½"
VES201	20"	1/10	115/230	1.0/0.5	60	1	S/Var^	3,233	12/10	3,050	12/9	1,625/600	20½" x 20½"
VES20	20"	1/3	115/230	3.5/1.7	60	1	S/Var^	5,077	13/10	4,790	12/10	1,725/600	20½" x 20½"
VES24	24"	1/2	115/230	4.8/2.4	50/60	1	S/Var^	6,487	17/14	6,120	16/12	1,725/600	24½" x 24½"
VES30	30"	1/2	115/230	5.1/2.6	50/60	1	1	7,086	13/11	6,685	12/10	844/600	30½" x 30½"
VES303	30"	1/2	230/460	2.6/1.3	50/60	3	1	6,922	13/10	6,530	12/9	825/600	30½" x 30½"

˜ These units come prewired for 115 Volts (electrician may rewire for 230 Volts)

^ Variable speed fans require separate variable speed control to adjust fan speed.

6200 Highway 12, Eau Claire, WI 54701
ph. 800-998-2398 • fax. 888-972-4454
ph. 715-834-1439 • fax. 715-834-3812
www.jdmfg.com • e-mail: jdmfg@jdmfg.com

5600 Series Multiple Wattage Fan Forced Unit Heater

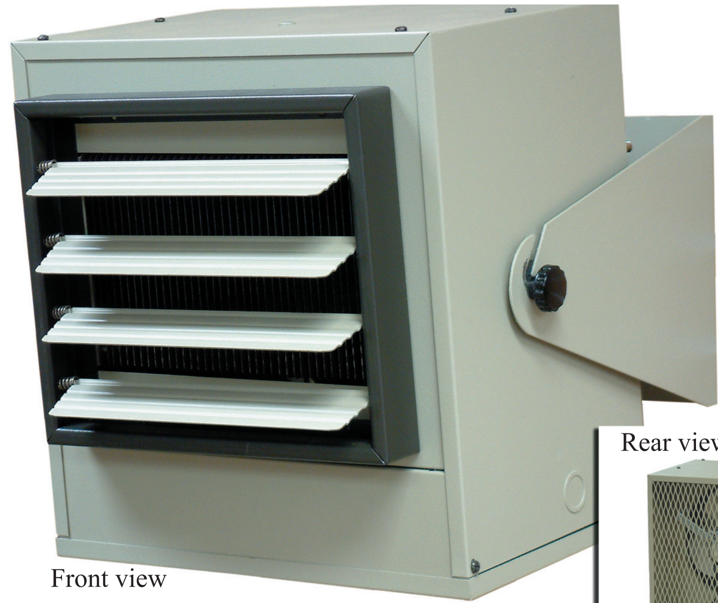
Product Specifications

CASING: Fabricated of die formed, heavy Gauge steel and finished with two tone, brown and beige, durable powder coated paint. Supply air is drawn through the rear heavy duty expanded steel inlet grill. Heated air is discharged through front adjustable louvers, which are spring loaded for individual adjustment.

ELEMENT: Heavy-duty block fin element design. The multiple tap electric connection design allows field conversion to eight wattage settings at 208/240-Volt single phase or 240/480 Volt, 3 phase. Units are available on special order with a specific wattage/voltage setting.

MOTOR: Motor shall be totally enclosed, permanently lubricated, all angle industrial rated with thermal overload protection.

WIRING: Wiring to terminal block adjacent to incoming knockout in accordance with NEC and local codes.



Front view

Rear view

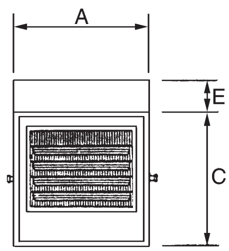
Manufactured in U.S.A.

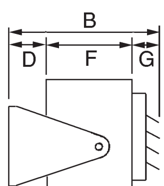
THERMAL OVERLOAD: All heaters shall be equipped with an automatic reset thermal cutout to shut down the element and motor circuits if unsafe operating temperatures are exceeded.

CONTROLS: The heater shall have a heavy-duty hydraulic thermostat factory installed and wired. All controls and wiring shall be in a large wiring compartment with hinged door for easy access. An optional disconnect switch shall be available for field installation.

MOUNTING: Heaters are standard with a three position-mounting bracket for wall, ceiling or workbench. Heaters can be mounted for horizontal or vertical discharge. Note: Minimum mounting height is 6 feet, and minimum distance from side of heater to nearest wall is 6 inches. Note: Approved for residential applications.

Product Dimensions





A	B	C	D	E	F	G
14”	12-11/16”	14”	1-9/16”	1-9/16”	9”	2-3/4”

Standard Models

UPC# 686334	MODEL	WATTS	BTU's	VOLTS	PHASE	AMPS	TEMP RISE	AIR THROW	CFM	WT. (LBS.)	LIST
707282	HF5605T	5000	17065			21	57 ºF				772
		4165	14215	240	1	17	48 ºF	16'	275	32	
		3332	11365			14	38 ºF				
		2500	8533			10	29 ºF				
		3750	12798			18	43 ºF				
		3123	10659	208	1	15	36 ºF			32	
		2500	8553			12	29 ºF	16'	275		
		1874	6396			9	21 ºF				
707299	H3H5605T	3750	12799	208	3	10.4	57 ºF	16’	375	32	
		5000	17065	240	3	12	57 ºF	16'	275	32	832
707305	P3P5605T	5000	17065	480	3	6	57 ºF	16'	275	32	
707367	DCS-MT303	Optional Field Installed Disconnect Switch, 30 Amp @ 600Volts									57
For 24V control on single phase models delete "T" suffix											146

Johnson Controls

A19 Series

Remote Bulb Control

Description

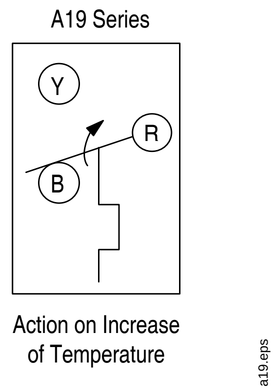
The A19 Series are single-stage temperature controls that incorporate environmentally friendly liquid-filled sensing elements.

Features

- wide temperature ranges available
- constant differential throughout the entire range
- compact enclosure
- fixed or adjustable differential available
- variety of sensing element styles
- unaffected by cross-ambient conditions

Applications

The A19 is suitable for temperature control in heating, ventilating, air conditioning, and refrigeration.



A19 Series
Terminal Arrangement for SPDT

A19ABC-24

Selection Charts

A19 Series Remote Bulb Control[1]

Code Number	Switch Action	Range °F (°C)	Diff F° (C°)	Bulb and Capillary	Bulb Well No. (order separately)	Range Adjuster	Max. Bulb Temp. °F (°C)
Adjustable Differential (Wide Range)							
A19ABA-40C [2]	SPST Open Low	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver Slot	140 (60)
A19ABC-4C	SPDT	50 to 130 (10 to 55)	3 1/2 to 14 (1.9 to 8)	3/8 in. x 5 in., 8 ft. Cap.	WEL14A-603R	Knob	170 (77)
A19ABC-24C [3]	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 8 ft. Cap.	WEL14A-602R	Convertible	140 (60)
A19ABC-36C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 20 ft. Cap.	WEL14A-602R	Convertible	140 (60)
A19ABC-37C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 10 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ABC-74C	SPDT	-30 to 100 (-34 to 38)	3 to 12 (1.7 to 6.7)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
Fixed Differential							
A19AAF-12C	SPDT	25 to 225 (-4 to 107)	3 1/2 (1.9)	3/8 in. x 3 in., 10 ft. Cap.	WEL14A-602R	Screwdriver slot	275 (135)
Fixed Differential (Case Compensated)							
A19AAC-4C	SPDT	0 to 80 (-18 to 27)	5 (2.8)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19AAD-12C	SPST Open Low	-30 to 50 (-34 to 10)	2 1/2 (1.4)	3/8 in. x 4 in., 7 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
Fixed Differential (Close)							
A19AAD-5C [4]	SPST Open Low	30 to 50 (-1 to 10) (**Bulk Milk Cooler**)	2 1/2 (1.4)	3/8 in. x 2 5/8 in., 6 ft. Cap.	WEL16A-601R	Screwdriver slot	190 (88)
A19AAF-20C	SPDT	-30 to 100 (-34 to 38)	2 1/2 (1.4)	3/8 in. x 4 in., 6 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19AAF-21C	SPDT	40 to 90 (4 to 32)	1 1/2 (0.8)	3/8 in. x 5 3/4 in., 6 ft. Cap.	WEL14A-603R	Screwdriver slot	140 (60)
Manual Reset							
A19ACA-14C	SPST Open Low	-30 to 100 (-34 to 38)	Manual Reset	3/8 in. x 4 in. 6 ft .Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ACA-15C	SPST Open Low	-30 to 100 (-34 to 38)	Manual Reset	3/8 in. x 4 in. 10 ft. Cap.	WEL14A-602R	Screwdriver slot	140 (60)
A19ADB-1C	SPST Open High	100 to 240 (38 to 116)	Manual Reset	3/8 in. x 3 1/2 in. 6 ft. Cap.	WEL14A-602R	Knob	290 (143)
A19ADN-1C	SPST Open High	100 to 240 (38 to 116)	Manual Reset	3/8 in. x 4 in. 6 ft. Cap.	WEL14A-602R	Screwdriver slot	290 (143)

1. Specify the control model code number, packing nut code number (if required), and bulb well code number (if required).
2. Replaces White-Rodgers 1609-101
3. Replaces White-Rodgers 1609-12, -13; Ranco 010-1408, -1409, - 1410, -1490, 060-110; Honeywell L6018C-1006, L6021A-1005, T675A-1011, -1508, -1516, -1821, T4301A-1008, T6031A-1011, T6031A-1029
4. Case-Compensated

Remote Bulb Control (Continued)

Selection Charts (Continued)

Replacement Parts

Code Number	Description
CVR28A-617R	Concealed adjustment cover
CVR28A-618R	Visible scale cover
KNB20A-602R	Replacement Knob Kit

Accessories

A packing nut is available for closed tank application.
Specify the part number **FTG13A-600R**.

Bulb wells (WEL14A Series) are available for liquid immersion applications.
Refer to the selection chart or to *Bulb Wells Catalog Page, LIT-1922135*.

Technical Specifications

Electrical Ratings

Motor Ratings VAC	120	208	240
	Wide Range – Adjustable Differential		
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A [1]	22 A, 120 to 277 VAC		
Pilot Duty – 125 VA, 24 to 600 VAC			
	Fixed Differential and Close Differential		
AC Full Load A	6.0	3.4	3.0
AC Locked Rotor A	36.0	20.4	18.0
Non-Inductive A	10 A, 24 to 277 VAC		
Pilot Duty – 125 VA, 24 to 277 VAC			
	Case Compensated – Fixed Differential A19AAC-4		
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A [1]	22 A, 120 to 277 VAC		
Pilot Duty – 125 VA, 24 to 600 VAC			
	A19AAD-12		
AC Full Load A	6.0	3.4	3.0
AC Locked Rotor A	36.0	20.4	18.0
Non-Inductive A	10 A, 24 to 277 VAC		
Pilot Duty – 125 VA, 24 to 277 VAC			
	Manual Reset		
AC Full Load A	16.0	9.2	8.0
AC Locked Rotor A	96.0	55.2	48.0
Non-Inductive A	16.0	9.2	8.0
Pilot Duty – 125 VA, 24 to 600 VAC			

1. SPST and N.O. contact of SPDT control;
   SPDT N.C. contact- 16 amps 120 to 277 VAC

Inlet Vacuum Filters

"CSL" Series 3" - 6" MPT

APPLICATIONS & EQUIPMENT

- Vacuum Pumps & Systems – P.D., Side Channel, Rotary Vane, Screw, Piston
- Vacuum Packaging Equipment
- Vacuum Furnaces
- Blowers - Side Channel & P.D.
- Intake Suction Filters
- Pneumatic Conveying Systems
- Remote Install for Piston, Screw & Centrifugal Compressors
- Factory Automation Equip
- Ash Handling
- Food Industry
- Paper Processing
- Glass, Ceramic Processing
- Waste Water Treatment
- Woodworking
- Cement
- Bag House Systems
- Envelope Manufacturing
- Medical Industry
- Chemical Processing

FEATURES & SPECIFICATIONS

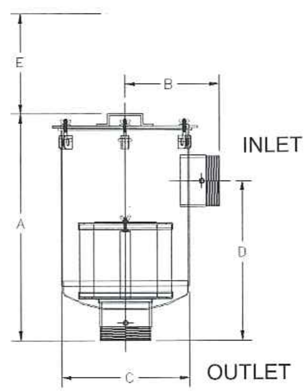
- **Vacuum level**: Typically 1×10^{-3} mmHg (1.3×10^{-3} mbar)
- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron
- Heavy duty T bolts for easy maintenance
- Hydrostatically tested to 0.5 bar pressure for vacuum tightness
- Low pressure drop
- Positive engagement O-ring seal system
- **Large** dirt holding capacity and **Easy** field cleaning, especially when mounted horizontally or inverted
- Inlet/outlet 1/4" gauge taps standard
- Rugged all steel construction w/baked gray enamel finish
- Temp (continuous): min -15°F (-26°C) 220°F (max 104°C)
- Filter change out differential: 10" - 15" H_2O over initial delta P
- Pressure drop graphs available upon request

OPTIONS (Inquiries Encouraged)

- Various media
- Larger sizes available
- Straight-Through Configurations
- Available in ***Stainless Steel***
- Epoxy coated housings
- Support brackets
- Special connections
- Activated carbon prefilters to reduce order

CONFIGURATION

DRAWING



Dimension tolerance ± 1/4"

I = Industrial Duty S = Severe Duty E = Extreme Duty

	with Polyester Element	with Paper Element	MPT Inlet & Outlet	DIMENSIONS - inches A	B	C	D	E	Rated Flow SCFM Nominal Rating	Element Rating	Approx. Wt. lbs
I	CSL-235P-300	CSL-234P-300	3"	27 1/8	9	14	18 1/2	10	300	570	47
S	CSL-335P-300	CSL-334P-300	3"	27 1/8	9	14	18 1/2	15	300	800	50
I	CSL-235P-400	CSL-234P-400	4"	27 1/8	9	14	18 1/2	10	520	570	52
S	CSL-335P-400	CSL-334P-400	4"	27 1/8	9	14	18 1/2	15	520	800	55
I	CSL-245P-500	CSL-244P-500	5"	28 1/8	11	18 1/2	19 1/2	10	800	880	82
S	CSL-345P-500	CSL-344P-500	5"	28 1/8	11	18 1/2	19 1/2	15	800	1100	88
I	CSL-275P-600	CSL-274P-600	6"	29 1/8	12	18 1/2	20 1/2	10	1100	1100	95
S	CSL-375P-600	CSL-374P-600	6"	29 1/8	12	18 1/2	20 1/2	15	1100	1500	97

INLET VACUUM FILTERS
CSL, CT, VL, VS, LRS Series

Note: Model offerings and design parameters may change without notice.

1151 Ardmore Ave. • Itasca, IL 60143 USA
Sales/Service: 630.773.1363 • Fax: 630.773.0727
E-mail: sales@solbergmfg.com • Web Site: www.solbergmfg.com

Air Water Separators

Low Vacuum Model

Product Level Control

Product Level Control manufactures a variety of air water separators (AWS), custom-equipped for optimal on-site performance. By offering flexible system designs with a wide range of available product parts and accessories, we meet your individual project goals for the best possible value.

FEATURES

- **Protects vacuum blowers from damage caused by corrosion**
- **Designed and fabricated to meet various air flow rates and holding capacities**
- **Efficient separation of entrained liquids — up to 99.9%**
- **Rust-resistant**
- **Easily installed and serviced**
- **Removable lid for easy cleaning and inspection**
- **Factory wet-tested for reliable system operation**

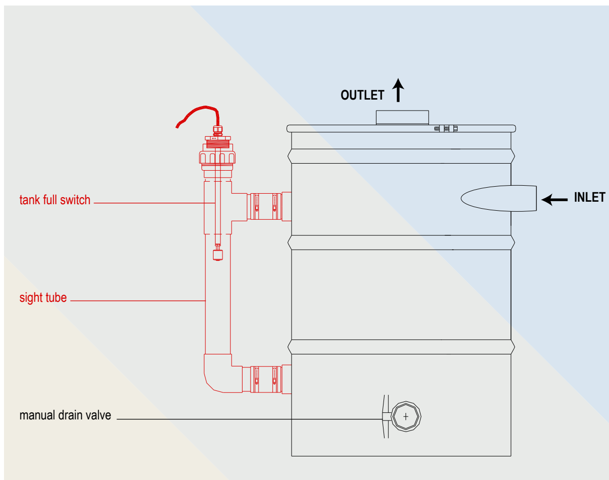
PERFORMANCE*

- System accommodates any air flow
- Models size up to a maximum vacuum rate of 20" Hg
- Vessels size to meet client specifications

* Due to the custom nature of our AWS models, individual specifications can be provided once proper project requirements have been established. Specifications are subject to change without notice.

STANDARD CONSTRUCTION

- Heavy-gauge steel construction
- Custom-sized vessel
- Rust-resistant finish (premium alkyd enamel)
- Corrosion-resistant epoxy phenolic interior lining
- Manual drain valve



PLC PERSONALIZED ORDERING NUMBER

Holding Tank Capacity (nominal gallons)
30-30☐
55-55☐
85-85☐
110-110

Separation Efficiency
S-Standard, cyclonic
C-High efficiency, cyclonic (99% efficient separation of entrained liquids 150+ micron)
M-Extra high efficiency, mist eliminator (99.9% efficient separation of entrained liquids 50+ micron)

Air Flow Rate (number in ICFM or ACFM)

Operational Vacuum (number in inches of Hg Vac)

Optional Accessories

GA-Vacuum gauge	ST-Sight tube
TF-Tank full switch	BC-Ball check float valve
PC-Pump control level switch	LG-Legs

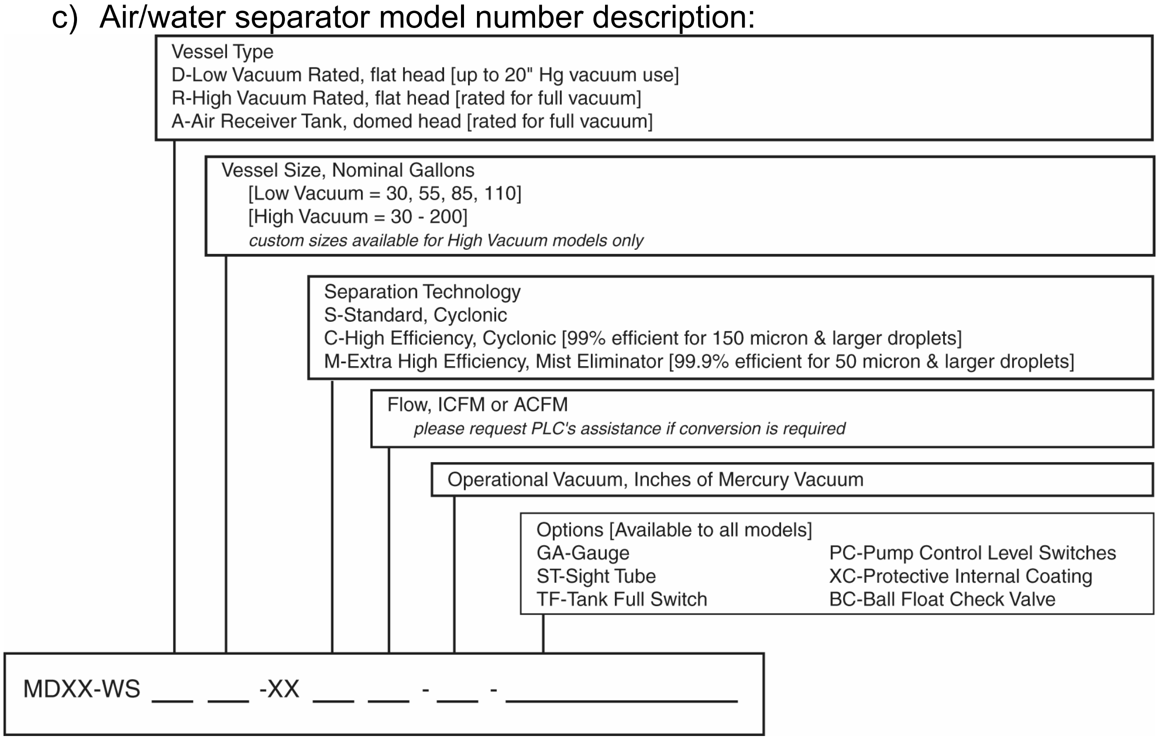
MDXX - WSD __ -XX __ __ - __ - ________

Air/Water Separator
Operation and Maintenance

SECTION INCLUDES
1.1 Application
1.2 Receiving and Unpacking
1.3 Tools required
1.4 Installation
1.5 Operation
1.6 Maintenance
1.7 Troubleshooting

1.1 APPLICATION

a) Product Level Control's air/water separators are designed to remove water from moisture-laden air streams. Proper selection and sizing of your air/water separator will ensure effective operation and longevity
b) Appurtenances required in addition to an air/water separator include:
   i) High water level switch. The high level switch will shut down the airflow when the separator becomes full of water.
   ii) Vacuum relief valve. The vacuum relief valve protects the separator from over pressurization.
   iii) Inline filter. The inline filter protects downstream equipment from foreign particles.
c) Air/water separator model number description:



1.2 RECEIVING AND UNPACKING

a) Upon receiving the unit, inspect carefully for any damage that may have occurred during shipment.
b) Shipping damage claims must be filed with the carrier at time of delivery.

1.3 TOOLS REQUIRED

i) No special tools are required to install the unit. Some separators can be heavy. Make sure you have appropriate equipment to place the separator in position.

1.4 INSTALLATION

a) Secure separator to floor. Separator must be mounted vertically and secured to prevent movement during operation.
b) Connect inlet and discharge piping to the separator. Inlet is horizontal while the outlet is on top. Use flexible couplings to avoid transferring vibration and stress to separator. Inlet and discharge piping must be secured such that the separator does not support the weight of the piping. Note: Keep in mind the weight of the pipe and its contents (air and water) when installing pipe supports.
c) Install water level switch (es). This switch is either installed in a sight tube or directly through the wall of the separator. Install and wire switch according to manufacturer's instructions and local codes. Typically this switch is wired to a control panel to control either a transfer pump or shut the system down when the separator becomes full of water.
d) Install and adjust vacuum relief valve according to manufacturer's instructions. Set the vacuum relief valve at the lowest of the following values: maximum vacuum rating of the vacuum blower, or maximum vacuum that can be applied to the separator. For separator models MDXX-WSR and MDXX-WSA, the vacuum relief valve can be set at full vacuum, or 28" mercury vacuum. For separator models MDXX-WSD (drum type), set the vacuum relief valve at 20" mercury vacuum. Note these are the maximum vacuum levels the separators can handle.
e) In cold climates, prevent the separator from freezing. Catastrophic failures can occur if water in the separator or water in transmission piping freezes.

1.5 OPERATION

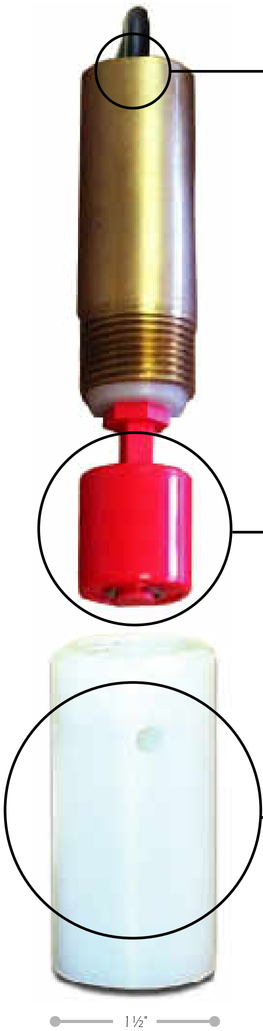
a) Moisture-laden air enters the air/water separator through the horizontal inlet. After entering the separator, tangential forces created by cyclonic motion remove free moisture contained in the air stream. This separated moisture falls to the bottom of the separator as a liquid due to gravity. Air continues to swirl around the separator until it reaches the discharge at the top.
b) Manually drain the separator by opening the drain valve. It may be necessary to turn off the vacuum blower in order to allow the water to drain from the separator. This water may be considered hazardous waste. Be sure to wear appropriate safety clothing and follow proper procedures for disposal. Some locations require this water to be treated before discharge.

c) For systems with automatic water pump out: Water level switches will automatically operate the water transfer pump to empty the separator. Be sure the transfer pump is primed before operation. Also consult the transfer pump's literature for specific operating instructions. As stated above, this water may be hazardous. Follow above guidelines for disposal.

1.6 MAINTENANCE

a) Product Level Control's air/water separators require minimal maintenance.
b) Gain access to the interior of the separator through the removable lid or the clean out port. Lids are removed by removing the bolt and band at the top of the separator, remove discharge piping, and then remove the lid while being careful to prevent damage to the gasket. When reinstalling the lid, carefully place the gasket, ring, and tighten the bolt until the ends of the ring are ¼" apart. White tightening the bolt, tap the band horizontally with a hammer on the side opposite the bolt. If lid leaks, bolt may be tightened slightly more and silicone can be applied to gasket.
c) Periodically, a layer of sludge may form on the bottom of the separator. Remove the top lid of the separator and remove the sludge with water. Remember this sludge may be considered hazardous so be sure to wear appropriate safety clothing. If the separator does not contain a removable lid, gain access through the clean out port located on the side of the separator and remove the sludge as indicated above.
d) If your separator contains a high efficiency demister, periodically check the pressure drop across the separator. If the pressure drop increases to an unacceptable value, or when the separator's performance decreases, remove the demister and clean with an appropriate solution. Do not unwrap the demister. If the demister is unwrapped and then rewrapped, performance will be sacrificed.
e) Periodically, consult the maintenance instructions for the vacuum relief valve. Also, verify the vacuum setting in order to protect the separator.

Product Level Control



Product Level Control manufactures our own line of treatment sensors, custom-equipped for optimal on-site performance. By offering flexible product designs with a wide range of available options, we meet your individual project goals for the best possible value.

FEATURES

Constructed to meet client specifications
Easily changed between Normally Open (NO) and Normally Closed (NC) — simply remove the E-clip and invert the float
Various materials of construction allow for chemical resistance to contaminants
Delivered fully assembled
1-year warranty

ELECTRICAL SPECIFICATIONS

- Maximum contact ratings:
  0.080 Amp, 120V, 60 Hz Resistive
  0.040 Amp, 240V, 60 Hz Resistive
  3.36 VA, 240V, 60 Hz Pilot Study
  1 Amp Max @ 24 VDC Resistive
- Single pole, single throw switch (SPST)
- 18/2 stranded copper conductors

MECHANICAL SPECIFICATIONS

- Maximum pressure rating of 100 PSI @ 20°C
- Maximum temperature rating of 100°C
- Minimum specific gravity rating of 0.8□
- Operable at angles up to 30° from vertical
- Length equals 6.5"
- Diameter equals 0.5"

PROCESS OF OPERATION

Operating as a vertically-orientated level switch, a single float unit is used with a total fluid system to detect the presence of liquid in a recovery well or tank. When liquid is present, the float rises. Simply secure the sensor in a well or tank by restraining the power cord.

PLC PERSONALIZED ORDERING NUMBER

SDXX-SF T 1 7 5

Cord Type	Cord Length	Float Type	Body Type
S-SJOW	0-N/A	6-Polypropylene	1-304SS
T-TFFN	1-25'	7-Acetal	2-316SS
	2-50'	9-PVDF	5-Brass
	3-75'		
	4-100'		

High-quality pressure transmitter for general industrial applications
Model S-10

for further approvals see page 4

Applications

- Machine building
- Hydraulics and pneumatics
- Pumps
- Chemical industry

Special features

- Measuring ranges from 0 ... 5 to 0 ... 15,000 psi (0 ... 0.1 to 0 ... 1,000 bar)
- Non-linearity 0.2 % of span (BFSL)
- Output signals 4 ... 20 mA, DC 0 ... 10 V, DC 0 ... 5 V and others
- Electrical connections: Angular connector form A, circular connector M12 x 1, various cable outlets and others
- Zero point and span adjustable via internal potentiometer

Pressure transmitter model S-10

Description

The model S-10 pressure transmitter for general industrial applications is the ideal solution for customers with demanding measuring requirements. It features a very good accuracy, a robust design and an exceptional number of variants, meaning it can be suited to the widest range of applications.

Versatile
The model S-10 offers continuous measuring ranges between 0 ... 5 and 0 ... 15,000 psi (0 ... 0.1 and 0 ... 1,000 bar) in all the major units. These measuring ranges can be combined in almost any way with all the standard industry output signals, the most common international process connections and a wide number of electrical connections.

Furthermore, it offers numerous options, such as different accuracy classes, extended temperature ranges and customer-specific pin assignments.

High quality
The robust design turns the model S-10 into a very high quality product, which even the most adverse environmental conditions cannot affect. Whether with the lowest temperatures when used outdoors, with extreme shock and vibration in machine building or with aggressive media in the chemical industry, this transmitter can meet all requirements.

Availability
All variants described in this data sheet are available on very short lead times. For particularly urgent demands, there is a sizeable stock available.

Data sheets showing similar products:
Ex pressure transmitter; model IS-2x; see data sheet PE 81.50
Pressure transmitter for general industrial applications; model A-10; see data sheet PE 81.60
OEM pressure transmitter for general industrial applications; model O-10; see data sheet PE 81.65
Flush pressure transmitter for viscous and solids-containing media; model S-11; see data sheet PE 81.02

Part of your business

Measuring ranges

Relative pressure								
bar	**Measuring range**	**0 ... 0.1**	**0 ... 0.16**	**0 ... 0.25**	**0 ... 0.4**	**0 ... 0.6**	**0 ... 1**	**0 ... 1.6**
	Overpressure limit	1	1.5	2	2	4	5	10
	Measuring range	**0 ... 2.5**	**0 ... 4**	**0 ... 6**	**0 ... 10**	**0 ... 16**	**0 ... 25**	**0 ... 40**
	Overpressure limit	10	17	35	35	80	50	80
	Measuring range	**0 ... 60**	**0 ... 100**	**0 ... 160**	**0 ... 250**	**0 ... 400**	**0 ... 600**	**0 ... 1,000**
	Overpressure limit	120	200	320	500	800	1,200	1,500
psi	**Measuring range**	**0 ... 5**	**0 ... 10**	**0 ... 15**	**0 ... 20**	**0 ... 25**	**0 ... 30**	**0 ... 50**
	Overpressure limit	29	29	72.5	145	145	145	240
	Measuring range	**0 ... 60**	**0 ... 100**	**0 ... 150**	**0 ... 160**	**0 ... 170**	**0 ... 200**	**0 ... 250**
	Overpressure limit	240	500	500	1,160	1,160	1,160	1,160
	Measuring range	**0 ... 300**	**0 ... 400**	**0 ... 500**	**0 ... 600**	**0 ... 750**	**0 ... 800**	**0 ... 1,000**
	Overpressure limit	1,160	1,160	1,160	1,160	1,740	1,740	1,740
	Measuring range	**0 ... 1,500**	**0 ... 1,600**	**0 ... 2,000**	**0 ... 3,000**	**0 ... 4,000**	**0 ... 5,000**	**0 ... 6,000**
	Overpressure limit	2,900	4,600	4,600	7,200	7,200	11,600	11,600
	Measuring range	**0 ... 7,500**	**0 ... 8,000**	**0 ... 10,000**	**0 ... 15,000**			
	Overpressure limit	17,400	17,400	17,400	21,700			

Absolute pressure								
bar	**Measuring range**	**0 ... 0.25**	**0 ... 0.4**	**0 ... 0.6**	**0 ... 1**	**0 ... 1.6**	**0 ... 2.5**	**0 ... 4**
	Overpressure limit	2	2	4	5	10	10	17
	Measuring range	**0 ... 6**	**0 ... 10**	**0 ... 16**	**0 ... 25**	**0.8 ... 1.2**		
	Overpressure limit	35	35	80	80	5		
psi	**Measuring range**	**0 ... 15**	**0 ... 25**	**0 ... 50**	**0 ... 100**	**0 ... 250**		
	Overpressure limit	72.5	145	240	500	1,160		

Vacuum and +/- measuring range						
bar	**Measuring range**	**-0.6 ... 0**	**-0.4 ... 0**	**-0.25 ... 0**	**-0.16 ... 0**	**-0.1 ... 0**
	Overpressure limit	4	2	2	1.5	1
	Measuring range	**-1 ... 0**	**-1 ... +0.6**	**-1 ... +1.5**	**-1 ... +3**	**-1 ... +5**
	Overpressure limit	5	10	10	17	35
	Measuring range	**-1 ... +9**	**-1 ... +15**	**-1 ... +24**		
	Overpressure limit	35	80	50		
psi	**Measuring range**	**- 15 inHg ... 0**	**-30 inHg ... 0**	**-30 inHg ... +15**	**-30 inHg ... +30**	**-30 inHg ... +60**
	Overpressure limit	72.5	72.5	145	240	240
	Measuring range	**-30 inHg ... +100**	**-30 inHg ... +160**	**-30 inHg ... +200**	**-30 inHg ... +300**	
	Overpressure limit	500	1,160	1,160	1,160	

The given measuring ranges are also available in kg/cm^2 and MPa.
Burst pressures on request

Vacuum tightness
Yes

Output signals

Signal type	Signal
Current (2-wire)	4 ... 20 mA 20 ... 4 mA
Current (3-wire)	0 ... 20 mA
Voltage (3-wire)	DC 0 ... 10 V DC 0 ... 5 V DC 1 ... 5 V DC 0.5 ... 4.5 V ratiometric

Other output signals on request.

Load in Ω

- Current output (2-wire):
  ≤ (power supply - 10 V) / 0.02 A
- Current output (3-wire):
  ≤ (power supply - 3 V) / 0.02 A
- Voltage output (3-wire):
  > maximum output signal / 1 mA

Voltage supply

Power supply

The power supply depends on the selected output signal

- 4 ... 20 mA: DC 10 ...30 V
- 20 ... 4 mA: DC 10 ...30 V
- 0 ... 20 mA: DC 10 ...30 V
- DC 0 ... 5 V: DC 10 ...30 V
- DC 1 ... 5 V: DC 10 ...30 V
- DC 0 ... 10 V: DC 14 ... 30 V
- DC 0.5 ... 4.5 V ratiometric: DC 4.5 ...5.5 V

Accuracy specifications

Non-linearity (per IEC 61298-2)

≤ ± 0.2 % of span BFSL

Non-repeatability

≤ ±0.1 % of span

Accuracy at reference conditions

Including non-linearity, hysteresis, zero offset and end value deviation (corresponds to measured error per IEC 61298-2).

Accuracy	
Standard	≤ ±0.50 % of span
Option	≤ ±0.25 % of span 1)

1) Only for measuring ranges ≥ 0.25 bar

Adjustability of zero point and span

Adjustment is made using potentiometers inside the instrument.

- Zero point: ± 5 %
- Span: ± 5 %

Temperature error at 32 ... 176 °F (0 ... 80 °C)

- Mean temperature coefficient of zero point:
  - Measuring ranges ≤ 0.25 bar: ≤ 0.4 % of span/10 K
  - Measuring ranges > 0.25 bar: ≤ 0.2 % of span/10 K
- Mean temperature coefficient of span:
  ≤ 0.2 % of span/10 K

Long-term stability at reference conditions

≤ ±0.2 % of span/year

Reference conditions (per IEC 61298-1)

Temperature

59 ... 77 °F (15 ... 25 °C)

Atmospheric pressure

12.5 ... 15.4 psi (860 ... 1,060 mbar)

Humidity

45 ... 75 % relative

Power supply

DC 24 V

Mounting position

Calibrated in vertical mounting position with pressure connection facing downwards.

Time response

Settling time

- ≤ 1 ms
- ≤ 2 ms for output signal DC 0.5…4.5 V ratiometric and measuring ranges < 400 mbar, 10 psi

Operating conditions

Ingress protection (per IEC 60529)
For ingress protections see "Electrical connections"
The stated ingress protection only applies when plugged in using mating connectors that have the appropriate ingress protection

Vibration resistance (per IEC 60068-2-6)
20 g

Shock resistance (per IEC 60068-2-27)
1,000 g (mechanical)

Temperatures

Permissible temperature ranges		
	Standard	Option
Medium	-22 ... 212 °F(-30 ... +100 °C)	-40 ... 257 °F(-40 ... +125 °C)
Ambient	-4 ... 176 °F(-20 ... +80 °C)	-4 ... 176 °F(-20 ... +80 °C)
Storage	-40 ... 212 °F(-40 ... +100 °C)	-40 ... 212 °F(-40 ... +100 °C)

Materials

Wetted parts
Stainless steel

Non-wetted parts
- Case: Stainless steel
- Internal pressure transmission medium: Synthetic oil
- Clamping nut: PA
- Angular connector: PA
- O-rings at the clamping nut: NBR
- Flat gasket: VMQ

Instruments with a measuring range of > 25 bar relative do not contain any pressure transmission medium (dry measuring cell).

Process connections

Standard	Thread size
EN 837	G ¼ B G ½ B
DIN 3852-E	G ¼ A 1)
-	G ¼ female
ANSI/ASME B1.20.1	¼ NPT ½ NPT
SAE J514 E	7/16-20 UNF with 74° taper
-	M20 x 1.5
-	G ½ male / G ¼ female
ISO 7	R ¼

1) Maximum overpressure limit 600 bar

Other process connections on request

Approvals, directives and certificates

Approvals
- CSA
- GOST

For further approvals see www.wika.com

CE conformity
- EMC directive 2004/108/EC, EN 61326 emission (group 1, class B) and interference immunity (industrial application)
- Pressure equipment directive 97/23/EC

Electrical connections

Available connections

Electrical connection	Ingress protection	Wire cross-section	Cable diameter	Cable lengths
Angular connector DIN 175301-803 A	IP 65	max. 1.5 mm^2	6 ... 8 mm	-
Angular connector DIN 175301-803 with ½ NPT	IP 65	max. 1.5 mm^2	-	-
Circular connector M12 x 1 (4-pin)	IP 67	-	-	-
Bayonet connector (6-pin)	IP 67	-	-	-
½ NPT conduit male, with cable outlet	IP 67	3 x 0.5 mm^2	6.8 mm	1.5 m, 3 m, 5 m, 10 m, 5 ft, 10 ft, 20 ft, 30 ft, others on request
Cable outlet				
■ Standard	IP 67	3 x 0.5 mm^2	6.8 mm	1.5 m, 3 m, 5 m, 10 m, 5 ft, 10 ft, 20 ft, 30 ft, others on request
■ not adjustable	IP 68	3 x 0.5 mm^2	6.8 mm	1.5 m, 3 m, 5 m, 10 m, 5 ft, 10 ft, 20 ft, 30 ft, others on request
■ adjustable	IP 68	3 x 0.5 mm^2	6.8 mm	1.5 m, 3 m, 5 m, 10 m, 5 ft, 10 ft, 20 ft, 30 ft, others on request

Short-circuit resistance
S_+ vs. U-

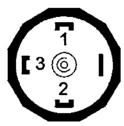
Reverse polarity protection
U_+ vs. U-

Overvoltage protection
DC 36 V

Insulation voltage
DC 500 V

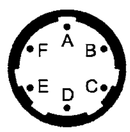
Connection diagrams

Angular connector DIN 175301-803 A



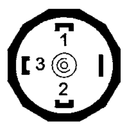
	2-wire	3-wire
U_+	1	1
U-	2	2
S_+	-	3

Bayonet connector (6-pin)



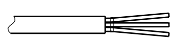
	2-wire	3-wire
U_+	A	A
U-	B	B
S_+	-	C

Angular connector DIN 175301-803 with ½ NPT



	2-wire	3-wire
U_+	1	1
U-	2	2
S_+	-	3

½ NPT conduit male, with cable outlet

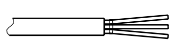


	2-wire	3-wire
U_+	red	red
U-	black	black
S_+	-	brown

Circular connector M12 x 1 (4-pin)

	2-wire	3-wire
U_+	1	1
U-	3	3
S_+	-	4

Cable outlets

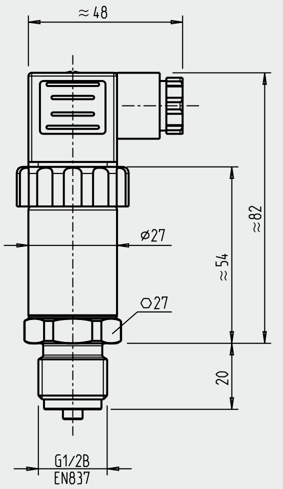


	2-wire	3-wire
U_+	brown	brown
U-	green	green
S_+	-	white
Shield	grey	grey

Dimensions in mm

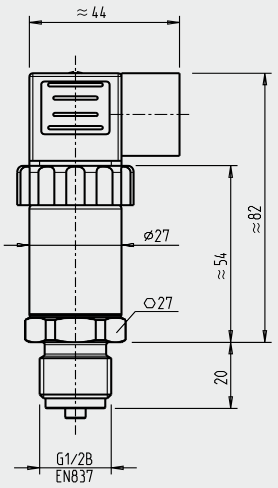
Pressure transmitter model S-10

with angular connector DIN 175301-803 A



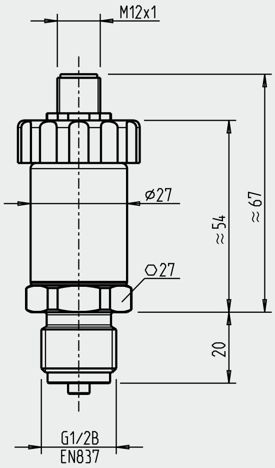
Weight: approx. 0.2 kg

with angular connector DIN 175301-803 with ½ NPT



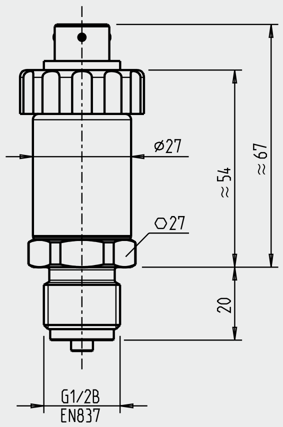
Weight: approx. 0.2 kg

with circular connector M12 x 1 (4-pin)



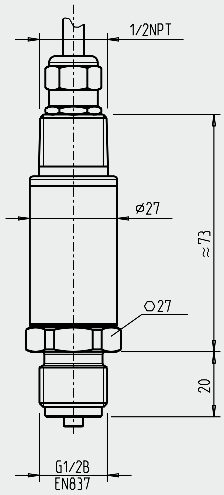
Weight: approx. 0.2 kg

with bayonet connector (6-pin)



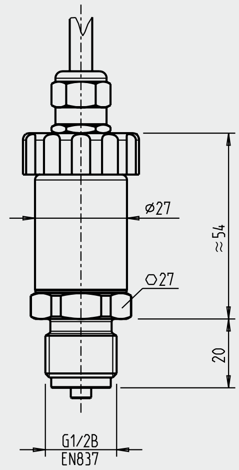
Weight: approx. 0.2 kg

with ½ NPT conduit male, with cable outlet



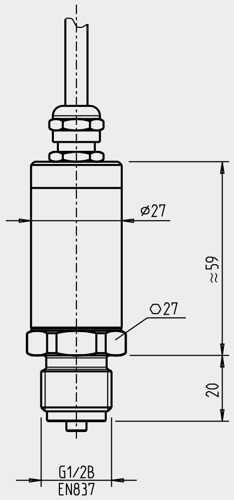
Weight: approx. 0.2 kg

with cable outlet, standard



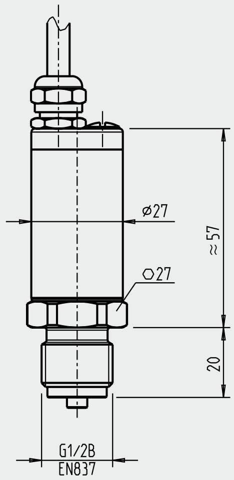
Weight: approx. 0.2 kg

with cable outlet, not adjustable



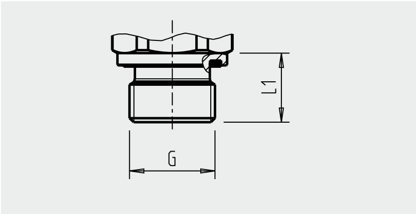
Weight: approx. 0.2 kg

with cable outlet, adjustable

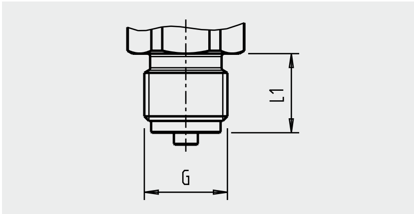


Weight: approx. 0.2 kg

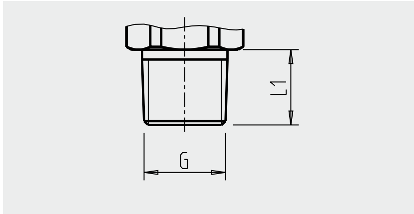
Process connections



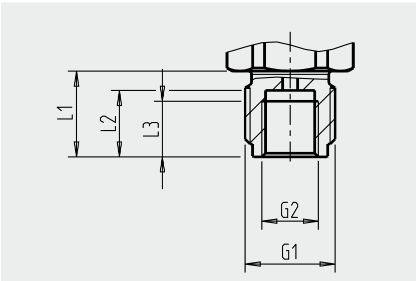
G	L1
G ¼ A	12



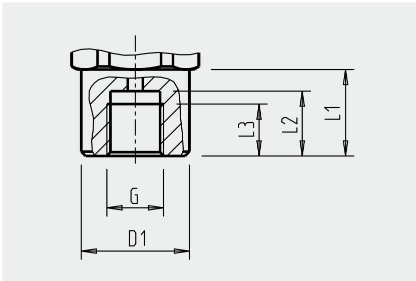
G	L1
G ¼ B	13
G ½ B	20
M20 x 1.5	20



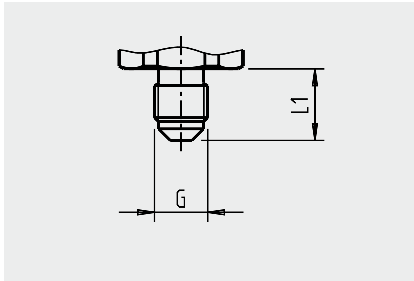
G	L1
¼ NPT	13
½ NPT	19
R ¼	13



G1	G2	L1	L2	L3
G ½ B	G ¼	20	15.5	13



G	D1	L1	L2	L3
G ¼ female	25	20	15	12



G	L1
7/16-20 UNF with 74° taper	15

For information on tapped holes and welding sockets, see Technical Information IN 00.14 at www.wika.com.

Accessories and spare parts

Mating connector

Description	Order number without cable	with 2 m cable	with 5 m cable
Angular connector DIN 175301-803 A			
■ with cable gland, metric	11427567	11225793	11250186
■ with cable gland, conduit	11022485	-	-
Circular connector M12 x 1 (4-pin)			
■ straight	2421262	11250780	11250259
■ angled	2421270	11250798	11250232

Sealings for mating connectors

Mating connector	Order number
Angular connector DIN 175301-803 A	1576240

Sealings for process connection

Thread size	Order number Cu	Stainless steel	NBR	FKM
G ¼ B EN 837	11250810	11250844	-	-
G ½ B EN 837	11250861	11251042	-	-
G ¼ A DIN 3852-E	-	-	1537857	1576534
M20 x 1.5	11250861	11251042	-	-

Ordering information

Model / Measuring range / Output signal / Accuracy / Electrical connection / Medium temperature / Process connection

WIKA Instrument Corporation
1000 Wiegand Boulevard
Lawrenceville, GA 30043-5868
Tel: 888-WIKA-USA • 770-513-8200
Fax: 770-338-5118
E-Mail: info@wika.com
www.wika.com

Models 215V and 337

Model 215V is Non-code Vacuum and Model 337 is ASME Section VIII, Air/Gas Vacuum, 'UV' National Board Certified, Safety Valves

tyco

KUNKLE

Features

- **Large nozzle design** provides high capacity.
- **Flat bronze valve seats are lapped** for optimum performance.
- **Warn ring offers easy adjustability** for precise opening with minimum pre-open or simmer and exact blowdown control.
- **Pivot between disc and spring** corrects misalignment and compensates for spring side thrust.

Model Descriptions

- **Model 337 has 'pull-ring' lift device** for easy manual testing.
- **Every valve is 100% tested/inspected** for pressure setting, blowdown and leakage.
- **All adjustments are factory sealed** to prevent tampering or disassembly.

Option

- SS trim. (nozzle and disc) (Variation 03)

Applications

- Protection of low to medium pressure high volume blowers, compressors and pneumatic conveying systems.
- Bulk hauling trailers/equipment.
- Light gauge tanks.
- Protection of high volume vacuum pumps and conveying systems.

Vacuum Limits

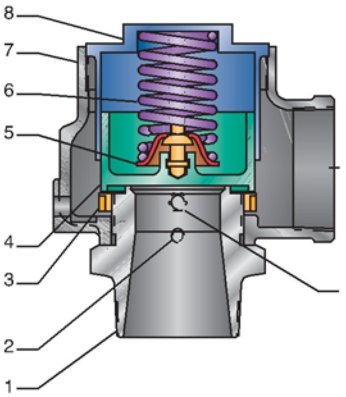
Model 215V:
2-inch HG
to 29-inch HG
[67.7 to 982 mbarg]
-20° to 406°F [-29° to 208°C]

Pressure and Temperature Limits

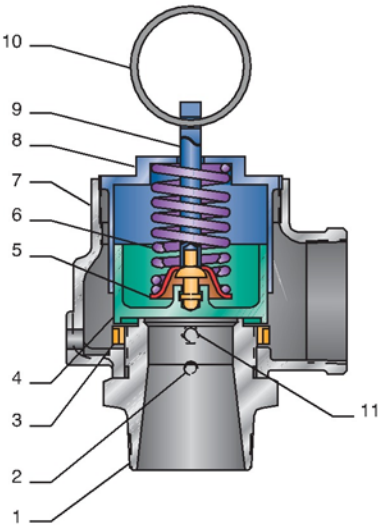
Model 337:
1 to 60 psig [0.07 to 4.1 barg]
-20° to 406°F [-29° to 208°C]

Models 215V and 337

Parts and Materials



Model 215V



Model 337

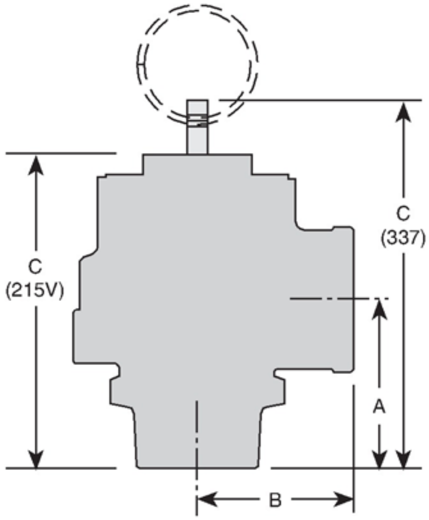
Models 215V and 337			
No.	**Part Name**	**215V**	**337**
1	Nozzle[1]	Bronze, SB62	Bronze, SB62
2	Set Screw	Steel A108-1018 Brass Plated	Steel A108-1018 Brass Plated
3	Regulator Ring	Bronze B584 Alloy 84400	Bronze B584-C84400
4	Disc[1]	Bronze B584 Alloy 84400	Bronze B584-C84400
5	Spring Step	Steel A-109 Coated[3]	Steel A109 Coated[3]
6	Spring	SS, A313 TY 302	SS A313-302
7	Body	Cast Iron, Zinc Plated, B633	Iron A-126, CL A or B
8	Compression Screw	Bronze, B-584 Alloy 84400	Bronze, B584-C84400
9	Stem[2]	N/A	Brass B16
10	Lift Ring[2]	N/A	SS A313-302
11	Regulator Ring Set Screw	N/A	Brass B16

Notes

1. Disc and nozzle available in SSA-479 TY 316.
2. Stem and lift ring available on Model 337 only.
3. Corrosion preventative coating.

Specifications

Size Inlet and Outlet	Dimensions, in [mm] A	B	C 215V	C 337	Weight lb [kg]
2" [50.8 mm]	3 1/4 [82.5]	3 [76.2]	6 1/2 [165.1]	7 [177.8]	8 [3.6]
2 1/2" [63.5 mm]	3 3/4 [95.2]	3 1/2 [88.9]	7 5/8 [194.6]	8 [203.2]	12 [5.4]
3" [76.2 mm]	4 1/4 [107.9]	4 [101.6]	8 1/2 [215.9]	9 [228.6]	20 [4.1]



Model 337

Models 215V and 337

Model 215V

Non-code Vacuum Air (SCFM) - Flow Coefficient			
Relief Set (in, HG)	Valve Inlet and Outlet Size 2" Orifice Area, in^2 1.84	2½" Orifice Area, in^2 2.79	3" Orifice Area, in^2 4.04
2	229	347	503
5	338	512	742
10	415	630	912
15	426	646	936
20	426	646	936

Non-code Vacuum Air [Metric, Nm^3/h]			
Relief Set [mbarg]	Valve Inlet and Outlet Size 5.08 cm Orifice Area [11.86 cm^2]	6.35 cm Orifice Area [17.97 cm^2]	7.62 cm Orifice Area [26.05 cm^2]
50	328	498	722
100	450	682	988
150	533	807	1170
200	593	899	1303
250	638	966	1400
300	669	1014	1470
350	690	1046	1516
400	701	1062	1540
450	704	1067	1546
500	704	1067	1546
550	704	1067	1546
600	704	1067	1546
650	704	1067	1546
700	704	1067	1546
750	704	1067	1546

Model 337

Non-code[1] and ASME Section VIII Air (English, SCFM)			
Set Pressure (psig)	Valve Inlet and Outlet Size 2"	2½"	3"
1	240	364	527
5	531	805	1166
10	741	1124	1628
15	948	1436	2081
20	1092	1656	2399
25	1237	1875	2718
30	1382	2095	3036
35	1542	2337	3386
40	1701	2578	3736
45	1860	2820	4086
50	2020	3061	4436
55	2179	3303	4786
60	2338	3544	5136

Note

1. No code stamp or 'NB' on nameplate below 15 psig set.

Non-code[1] and ASME Section VIII Air [Metric, Nm^3/h]			
Set Pressure [barg]	Valve Inlet and Outlet Size 50 mm	63 mm	80 mm
0.5	1049	1589	2303
1.0	1457	2208	3200
1.5	1888	2861	4147
2.0	2235	3387	4910
2.5	2613	3959	5739
3.0	2995	4538	6579
3.5	3377	5117	7418
4.0	3760	5696	8258

Note

1. No code stamp or 'NB' on nameplate below 1.1 barg set.

Models 215V and 337

Model Number/Order Guide

Model Number Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Example	2	1	5	V	—	H	0	1	A	Q	E	0	0	5	0

Model
215V
0337

Inlet Size
H - 2-inch [50.8 mm]
J - 2 1/2-inch [63.5 mm]
K - 3-inch [76.2 mm]

Variation (01 through 99)
01 - Bronze Disc and Nozzle
03 - SS Disc and Nozzle
60 - BSP Connections

Design Revision
Indicates non-interchangeable revision. Current Design is at Revision ‘A’

Valve Service
K - Air ASME Section VIII (Model 337 only)
Q - Vacuum (Model 215V only)
N - Non-code Air/Gas (Model 337 only)

Spring Material
E - SS Type 316
M - SS (26 psi thru 60 psi set) Type 17-7

Set Pressure
Model 337, 1 psig [0.7 barg] (0001) through 60 psig [4.1 barg] (0060)
Model 215V, 2-inch HG [68 mbarg] (0002) through 29-inch HG [982 mbarg] (0029) vacuum

Facility Phone: 828-669-3700

tyco / Valves & Controls

www.kunklevalve.com

ABSORPTIVE SILENCERS
Air Intake and Exhaust "SLCR" Series 1/2" - 4"

®

APPLICATIONS

- Blowers-Centrifugal
- Blowers-Regenerative
- Blowers-Side Channel
- Compressors-Air
- Vacuum Lifters
- Vacuum Pumps & Systems

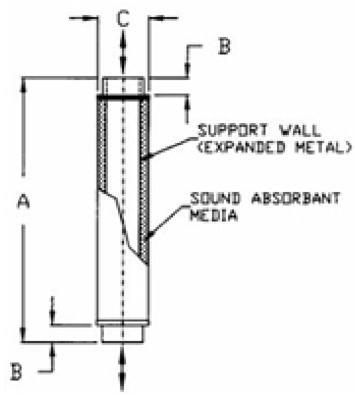
FEATURES & SPECIFICATIONS

- Durable inline carbon steel construction with baked enamel finish
- Layered sound absorbant media
- Pressure drop graphs available upon request
- Inlet or discharge applications with max temperature 212° F (100° C)
- Minimal pressure drop because it does not rely on internal baffles, tubes, or other restrictive devices
- Reduces high frequency noise up to 30 decibels (Due to the wide range of applications and machines these units are used on, please inquire for your specific application.)

OPTIONS

- Flange Adapters
- Larger sizes available
- NPT connections

Line Drawing

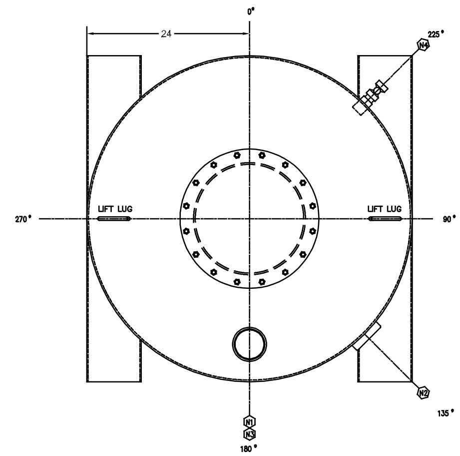


***All measurements are shown in standards.**

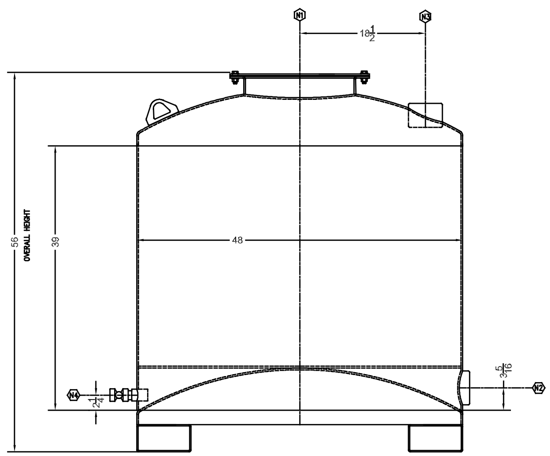
Typical Lead Times:
- 1 - 2 weeks
- 3 - 4 weeks
- Normally in stock
- 5 - 7 weeks
- 8 + weeks

Add To Order	Model Number	Inlet in. NPT or FLG	Outlet in. NPT or FLG	Connection Style	Dim A in.	Dim B in.	Dim C in.	Parent Flow SCFM	Approx. Weight lbs.	CAD
	SLCRT050	0.5	0.5	MPT	14.5	2	2.5	25	2	CAD
	SLCRT075	0.75	0.75	MPT	14.5	2	2.5	35	2	CAD
	SLCR100	1	1	FPT	12	0.69	2.5	42	2	CAD
	SLCRT100	1	1	MPT	14.5	2	2.5	42	2	CAD
	SLCR125	1.25	1.25	FPT	12	0.69	2.5	55	2	CAD
	SLCRT125	1.25	1.25	MPT	14.5	2	2.5	55	2	CAD
	SLCR150	1.5	1.5	FPT	12	0.69	3.12	155	3	CAD
	SLCRT150	1.5	1.5	MPT	14	1.75	3.12	155	3	CAD
	SLCR200	2	2	FPT	15.75	0.69	3.63	270	4	CAD
	SLCRT200	2	2	MPT	18.5	2.12	3.63	270	4	CAD
	SLCR250	2.5	2.5	FPT	21	1.5	4.63	385	8	CAD
	SLCRT250	2.5	2.5	MPT	23.68	2.63	4.63	385	8	CAD
	SLCR300	3	3	FPT	26	1.56	5.12	575	10	CAD
	SLCRT300	3	3	MPT	28	2.63	5.12	575	10	CAD
	SLCR400	4	4	FPT	23.88	1.69	10	575	26	CAD
	SLCRT400	4	4	MPT	29.31	4	10	575	26	CAD

RevNo	Revision note	Date	Signature	Checked
-	-	-	-	-



PLAN VIEW
TRUE ORIENTATION



ELEVATION VIEW
NOT TRUE ORIENTATION

NOZZLE SCHEDULE

ID	Description	Service
N1	18" Round Manway with 1/4' Cover	Clean out Access
N2	4" 3000# Thd Cplg (SA-105)	Process Inlet
N3	4" 3000# Thd Cplg (SA-105)	Process Effluent
N4	1" 3000# Thd Cplg (SA-105)	Vessel Drain with 1" Ball Valve (Brz/SS/TFE)
N5		
N6		
N7		

COATINGS SCHEDULE

Surface	Surface Preparation	Product Specification
Internal - 1	SSPC-SP6	CArboline Carboguard 635 6-10 mils DFT per Coat
Internal - 2	Inspect	n/a
External - 1	SSPC-SP6	CArboline Carboguard 635 6-10 mils DFT per Coat
External - 2	n/a	Carboline Carbothane 8845 3-5 mils DFT (Blue)
External - 3	n/a	n/a

NOTES

Item	Details
Construction	Non-Code Design Pressure: 10 PSIG @ 140 DEG F.
Mtrls Vessel	Shell: SA-36 Heads: SA-36 Pipe: SA-53 (see nozzle detail for others)
Mtrls Interls	Perforated False Floor: SS Gaskets: Buna-N
n/a	n/a
QTY	TBD
Media	TBD

Designed by	Approved by	Customer	Job Number	Date	Scale/Unit
D. Shreves	E. Patterson	Product Level Control	4645HS	April 18, 2016	NTS / Inch

tetraSOLV FILTRATION
1424 ABRAHAM DRIVE
ANDERSON, INDIANA 46013
Ph: (765) 643-3941
Fx: (765) 643-3949

VFV-1000-SD48

-
-

Drawing# V48-1000

Tetrasolv Filtration

PRODUCT DATA SHEET
VFV SERIES FILTERS
MODEL VFV-1000

GENERAL DESCRIPTION

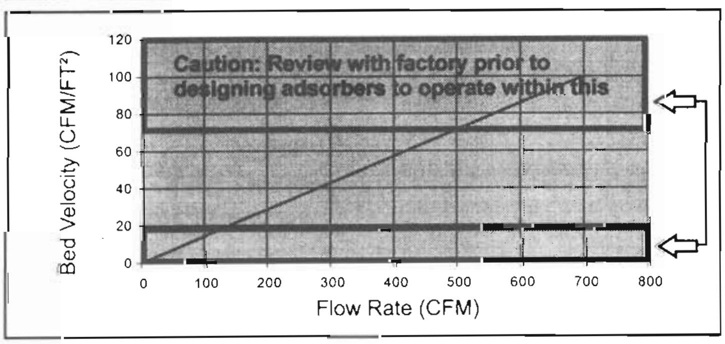
The VFV-1000 filter is a media filter vessel designed to treat vapor streams. While the typical design application is a activated carbon adsorbtion unit, the filter can easily accommodate many medias. The sturdy construction makes these filter vessels ideal for long term treatment units. Some applications include:

- Soil Vapor Extraction Treatment
- Air Stripper Off Gas Treatment
- Odor Removal System
- Storage Tank Purge Vapor Treatment
- Pilot Study
- Industrial Process Treatment

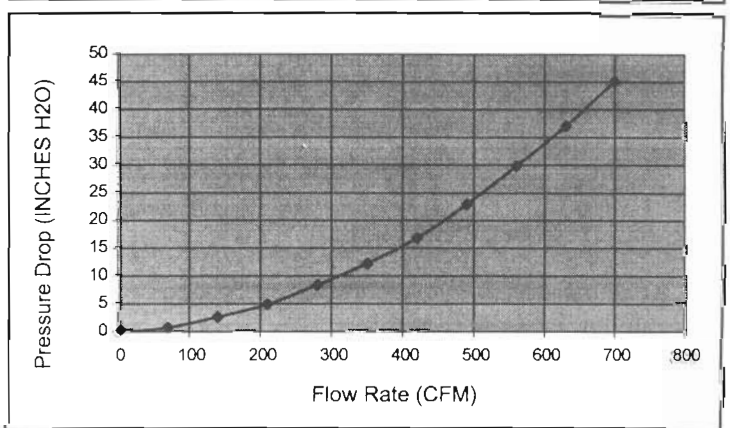
VFV-1000 STANDARD SPECIFICATIONS

Specification	Specification Value	Options
Materials (Vessel)	Carbon Steel	Stainless Steel, HDPE
Materials (Internal Piping)	SCH 40 PVC (Optional False Floor)	Polypropylene, CPVC, 304SS, 316SS
Materials (Collector Nozzles)	SCH 40 PVC	304SS, 316SS, Polypropylene
Internal Coating	Polyamide Epoxy Resin	Vinyl Ester, PVC
External Coating	Urethane Enamel	Any available coating
Maximum Pressure / Vacuum	10 PSIG / 20" HG	Specials Designs Available
Maximum Temperature	140° F (Limited by coating and PVC Internals)	Up to 450° F
Cross Sectional Bed Area	7 FT^2	NA
Bed Depth	5 FT (Using 1000 Lbs. 4*10 GAC)	Dependent upon supplied media
Bed Volume	35 FT^3 (Using 1000 Lbs. 4*10 GAC)	NA

BED VELOCITY GRAPH
(Line Indicates Flow to Velocity Relationship)



PRESSURE DROP GRAPH
(As Filled - 4x10 GAC)



Rev. 10/17/2000

1200 E. 26th Street · Anderson, Indiana 46016
Phn: 765-643-3941 Fax: 765-643-3949 Email: info@tetrasolv.com

Operation & Maintenance Manual

VFD ● VFV ● VF ● VR SERIES

Tetrasolv Filtration Vapor Filters

Liquid & Vapor Filtration
Remedial • Industrial • Municipal

CONTENTS

1.0 GENERAL DESCRIPTION

The liquid series filters utilize fixed bed filtration to treat vapor. The filters employ a variety of medias to remove or catalyze contaminants. Flow through the filter may be either up flow or down flow depending upon the media supplied and the operation parameters. Generally inlet and outlet locations are indicated on the filter and or the filter drawings.

The most common application utilizes activated carbon as the adsorption media. Typically vapor which contains low levels of organic contaminants flows upward through the column of activated carbon where the larger organic molecules adhere to the porous structure of the activated carbon granules. This adsorption begins at the bottom of the “bed” and continues upward as the original adsorptive area becomes saturated.

Complete saturation of the carbon is dependent upon many factors such as contaminant levels, temperature, compounds being adsorbed, humidity, etc. Typically a carbon isotherm has been run on the influent stream to determine the expected rate of consumption of the activated carbon media. When monitoring has determined discharge air no longer meets discharge requirements the carbon will have to be removed and replaced ***(refer to section 5.0)***.

2.0 SAFETY CONSIDERATIONS

It is important that the entire O&M manual be read prior to set up and operation of the carbon system. If you have any questions please contact Tetrasolv Filtration at the number listed below or support@tetrasolv.com.

- ***WARNING: Where system pressure may exceed design pressure we strongly recommend the use of a relief device. Exceeding the maximum pressure of the filter could result in catastrophic failure***

of the vessel.

- Always adhere to "lockout/tagout" procedures when servicing the system.

- Wear appropriate safety equipment when operating system.

♦ ***WARNING: Wet or dry activated carbon preferentially removes oxygen from air. In closed or partially closed containers, oxygen depletion may reach hazardous levels. If workers must enter a container containing carbon, appropriate sampling and work procedures should be followed for potentially low-oxygen spaces - including all applicable federal and state requirements.***

♦ ***WARNING: High concentrations of certain compounds such as BETX and low concentrations such as ketones, aldehydes, organic acids and sulphur may cause severe temperature rises.***

- Understand the potential hazards of the stream being treated by the system. The activated carbon may contain higher concentrations of the contaminants being adsorbed than is in the influent stream. In addition the carbon may be considered hazardous material and therefore may require specific handling precautions unknown to Tetrasolv Filtration.

3.0 INSTALLATION

3.1 Shipment

Typically filters are shipped with media installed. However, in certain instances media is shipped to the site to be installed after installation. In very large systems it may be advisable to not install the media until adsorbers have been placed into final position and secured.

3.2 Unloading

Refer to the product data sheet for weight information for appropriate sizing information for the equipment to be used.

All components should be lifted either by crane or forklift as designated by the model.

♦ ***WARNING: Failure to follow the procedures outlined below can result in catastrophic damage to the system.***

Crane Lift - If a crane lift is to be used we recommend the following method. A "spreader" equaling 75% of the distance between the opposing lifting eyes on each adsorber should be used to insure proper lifting force direction. Attach an appropriately sized spreader beam and lifting cables to each lift eye of the component. The use of an experienced crane operator and quality equipment is highly recommended.

Fork-Lift - When using a forklift we recommend that the fork tubes on the filter be used or a pallet if the unit was shipped on a pallet.

3.3 Inspection

Perform the following inspections after un-loading the system. Note any discrepancies and contact TetraSolv immediately.

- Check the vessel exterior for damage which may have occurred during shipment. Inspect the support structures and piping support for damage.

- Inspect the piping system for damage. Insure the valves operate properly. Check installed instruments and instrument installation points for damage.

- If the filters are shipped without carbon visually inspect the interior of the vessel for damaged internals.

- Inspect the carbon discharge, drain and vent valves for damage

3.4 Set Up

The filter should be placed on a level concrete pad of appropriate thickness to support the system at it's maximum operational weight. The filter should be secured to the pad using appropriately sized anchor bolts.

Connect the site piping to the filter inlet and outlet connection points. It is important that all piping connected to the filter should be self supported. We also recommend in hard pipe installation that a flexible joint be used to further insulate the filter from vibration and stress.

Connect any gauges and instrumentation shipped loose with the system.

The outlet piping if connected to a stack or vent should be designed to prevent the introduction of water or debris into the adsorber piping. Discharge piping should be sized equal to or greater than the diameter of the system piping or back pressure could occur creating excess pressure drop on the system.

Flowrates greater than 60 cfm / sq ft can produce bed fluidization in vapor phase filters. When this occurs carbon granules can be lifted and propelled out of the carbon bed in up-flow applications. In extreme cases large amounts of carbon can be expelled. If the system will be operating near or greater than the amount stated above please contact Tetrasolv for recommendations.

Carbon filters can be manifold in parallel operation for higher flowrates. Series operation is the preferred method of operation as it provides for the greatest degree of bed utilization.

Vapor conditions such as high humidity and high temperature (> 125º F) can cause inefficient adsorbtion to occur. If these conditions exist contact Tetrasolv for support. Also, any free water or product and debris should be eliminated with a knockout filter prior to the vapor stream entering the system. Many other vapor issues may effect Adsorber operation and we therefore recommend you discuss your specific installation with a representative.

4.0 OPERATION

4.1 Modes of Operation

With certain applications (2) filters in series flow are utilized. Listed below are typical operational modes.

- Shutdown - Both filters completely off-line and isolated.

- Series Flow - Influent enters primary filter and exits through secondary adsorber (this is the preferred method of operation)

- Isolation Flow - Only one filter is receiving influent. This mode is typically used when the operator is maintaining the off-line filter.

- Parallel Flow - Both filters are receiving the influent as the primary. Flow is split equally between the filters. This mode is used when higher flow rates need to be achieved and contact times are not critical.

4.3 Monitoring

Adsorber units only require periodic monitoring if properly installed. The following items may be monitored:

Pressure: Check inlet and outlet pressure. Increase in pressure differential may indicate media breakdown or presence of high moisture. Rapid increase in pressure drop could indicate adsorber failure.

Samples: Inlet and outlet sample points if provided for vapor analysis to determine system performance.

5.0 ADSORBER SERVICING

The Adsorber may be serviced on-site using a vacuum removal method. Prior to servicing the unit should be closed off from influent and effluent lines and any electrical devices or connections should be tagged off.

After removal of the spent carbon is complete, it is recommended that the inside of the Adsorber be checked thoroughly and any minor maintenance conducted.

5.1 Carbon Loading - Bulk Bag

♦ ***WARNING - Dry activated carbon generates considerable dust. While activated carbon poses no health risk the dust can cause respiratory irritation and occasional skin rash. Therefore we recommended the use of proper clothing and dust mask during filling operation.***

Hoist the bag over the manway and untie the outer bag exposing the inner chute. Untie the inner chute while clasping it shut. Remain holding the chute and carefully lower the chute into the manway. Un-clasp the chute and allow the carbon to discharge from the sack. The carbon should flow out very quickly and completely. When finished shake the bag and invert the chute into the bag.

If at any time you wish to stop the flow of carbon simply re-grasp the chute up high and cinch. Re-tie the bag.

5.2 Carbon Loading - Vacuum Method

In this method dry-activated carbon will be loaded into to the adsorbers using a vacuum rig. To add the carbon to the filters use the following method:

WARNING: Due to the low vacuum rating of the VF series adsorbers (< 60” $H_2 0$) only experienced change-out personnel should attempt this method of re-filling. Exceeding the recommend vacuum rating could lead to failure of the superstructure of the vessel.

1. Connect a 3” vacuum source to the auxiliary connection of the adsorber to be filled.

2. Install a 16” bolted transfer lid onto the manway opening of the adsorber to be filled.

3. Turn on the vacuum and check for good flow of air through the adsorber. Connect the fill line to the transfer lid and lead enough hose to reach the fresh carbon source (Note: This should be as short of a distance as possible).

4. Begin vacuuming carbon into the adsorber. It is important to note that the loading method is actually conveying and not true vacuum. The hose should contain 1/3 air with the carbon. Closely view the adsorber being filled. If the adsorber is collasping in excessively take less carbon and more air. This is something from experience and cannot be adequately explained here.

5. When transfer is complete the transfer lid should be removed and the carbon in the adsorber should be leveled out to insure even pressure drop across the bed.

6. Close the manway and turn the adsorber back on.

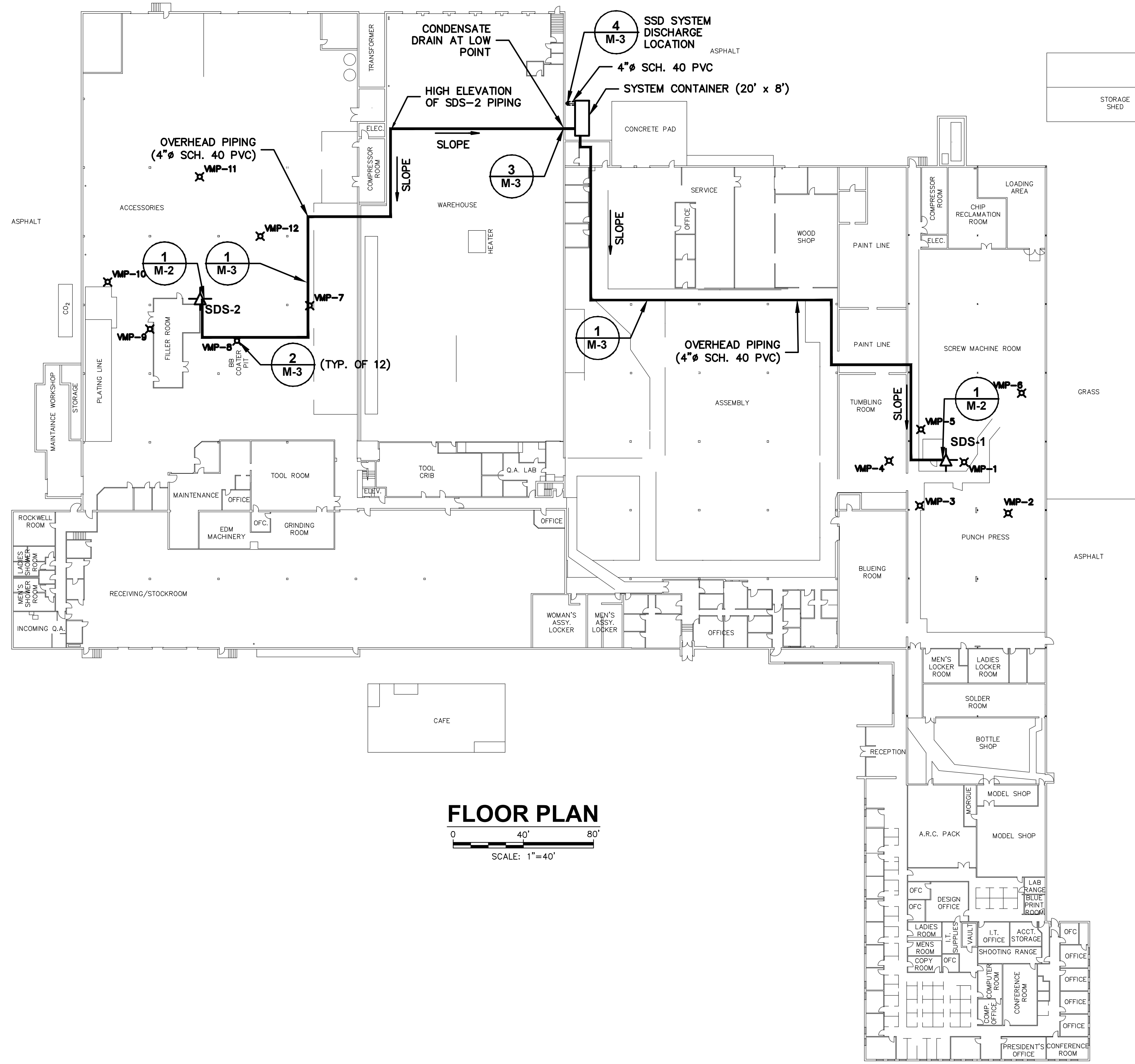
> ***Note: When the system if first started up small amounts of fines may be present in the discharge stream. This is normal and should discontinue within a short period of time.***

6.0 MAINTENANCE

6.1 Extended Shutdown

If the system is to be shutdown for extended period of time it is recommended that the valve be placed in shutdown mode and the system water drain valve be left open.

Monitor the system closely after extended shutdown for signs of potential problems such as interior manifold failure or leaking valves and gaskets.



FLOOR PLAN

0 40' 80'

SCALE: 1"=40'

LEGEND:

- SSD SYSTEM EXTRACTION POINT
- SSD MONITORING POINT
- OVERHEAD SSD EXTRACTION PIPING
- SSD SYSTEM DISCHARGE PIPING

NOTES:

1. BASE MAP SUPPLIED BY CROSMAN CORPORATION, DRAWING FACILITY-3-14-08, DATED 3/14/2008.
2. NOT ALL PHYSICAL FEATURES SHOWN.
3. ALL LOCATIONS ARE APPROXIMATE.
4. THE SSD SYSTEM IS DESIGNED TO ACHIEVE A 40' RADIUS OF INFLUENCE AT SDS-1 AND 60' RADIUS OF INFLUENCE AT SDS-2.
5. SSD EXTRACTION PIPING SLOPED AS INDICATED TO PROMOTE DRAINAGE OR COLLECTION OF POTENTIALLY ACCUMULATED WATER.
6. LAND SURFACE AT SYSTEM CONTAINER LOCATION IS ASPHALT. CONTAINER LEVELED AS NEEDED USING STEEL SHIMS.
7. SSD SYSTEM DISCHARGE PIPING STACK EXTENDS TO 3 FEET ABOVE ROOFLINE.

RECORD DRAWINGS
TO THE BEST OF OUR KNOWLEDGE, INFORMATION AND BELIEF, THESE RECORD DRAWINGS SUBSTANTIALLY REPRESENT THE PROJECT AS CONSTRUCTED.

DATE__________BY____________________

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
CHRISTOPHER D. ENGLER		
Professional Engineer's No. 069748		
State NY	Date Signed	Project Mgr. WBP
Designed by CD	Drawn by GHS	Checked by CDE

STATE OF NEW YORK · CHRISTOPHER DANE ENGLER · 069748 · LICENSED PROFESSIONAL ENGINEER

ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

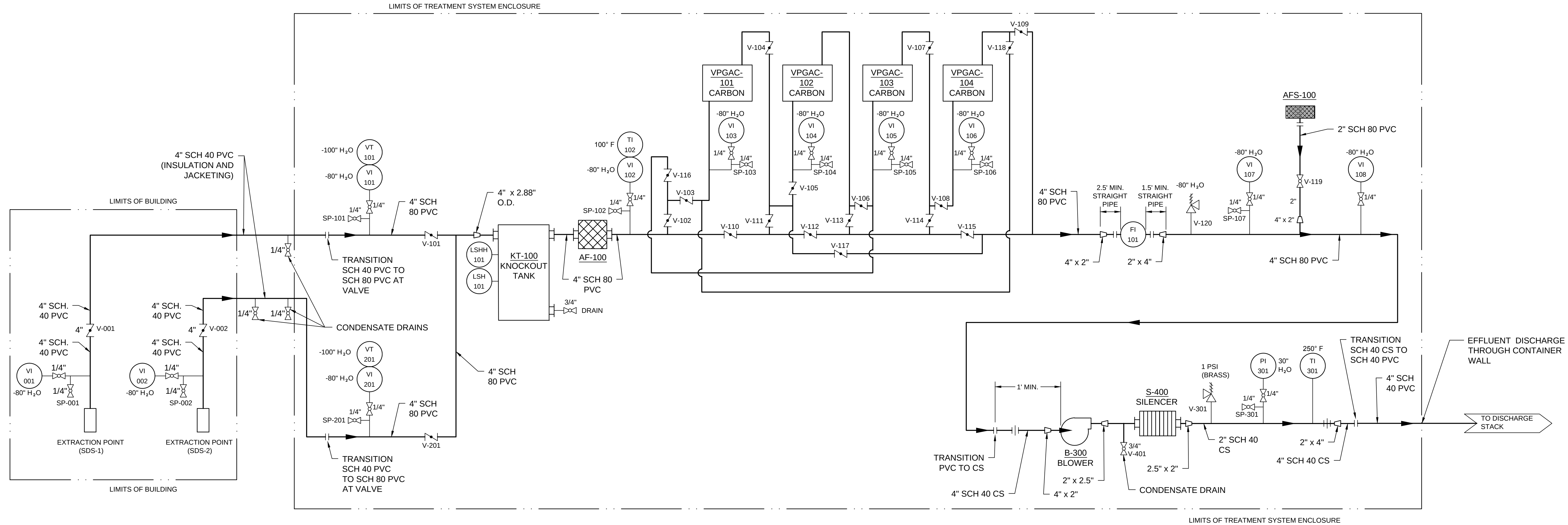
SSD SYSTEM LAYOUT

ARCADIS Project No. B0041501.0001.00010

Date DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

G-1



LEGEND:

	VAPOR PROCESS PIPING
	BUILDING LIMITS
	FLANGE / TRANSITION
	UNION
	BLOWER
	FLANGED BUTTERFLY VALVE
	BALL VALVE
	PRESSURE RELIEF VALVE
	VACUUM RELIEF VALVE
	REDUCER
	AIR FILTER ONLY
	AIR FILTER / SILENCER
	SILENCER ONLY

ABBREVIATIONS:

AF	AIR FILTER
AFS	AIR FILTER/SILENCER
B	BLOWER
CPVC	CHLORINATED POLYVINYL CHLORIDE
CS	CARBON STEEL
FIT	FLOW INDICATING TRANSMITTER
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH-HIGH
KT	KNOCKOUT TANK
PI	PRESSURE INDICATOR
PVC	POLYVINYL CHLORIDE
S	SILENCER
SCH	SCHEDULE
TI	TEMPERATURE INDICATOR
TT	TEMPERATURE TRANSMITTER
V	VALVE
VI	VACUUM INDICATOR
VPGAC	VAPOR PHASE GRANULAR ACTIVATED CARBON
VT	VACUUM TRANSMITTER

NOTES:

1. SEE TABLE 1 OF OM&M PLAN FOR MAKE AND MODEL OF SIGNIFICANT EQUIPMENT.
2. SEE TABLE 3 OF OM&M PLAN FOR SYSTEM ALARM DETAILS.
3. ALL EXTERIOR PIPING INSTALLED WITH 1" FIBERGLASS INSULATION AND ALUMINUM JACKETING.

GENERAL PROCESS DESCRIPTION:

THE SYSTEM IS A SUB-SLAB DEPRESSURIZATION (SSD) SYSTEM DESIGNED TO EXTRACT SUB-SLAB SOIL VAPORS FROM TWO (2) EXTRACTION POINTS (SDS-1 AND SDS-2) TO CREATE A NEGATIVE SUB-SLAB DIFFERENTIAL PRESSURE ACROSS THE TARGET DEPRESSURIZATION AREA. BLOWER (B-300) EXTRACTS SOIL VAPORS SIMULTANEOUSLY FROM TWO SEPARATE EXTRACTION HEADERS (SDS-1 AND SDS-2) EACH WITH ITS OWN VACUUM TRANSMITTER (VT-101 AND VT-201). THE TWO EXTRACTION HEADERS COMBINE INTO A SINGLE EXTRACTION HEADER INSIDE THE TREATMENT SYSTEM ENCLOSURE. THE EXTRACTION HEADER INCLUDES A MOISTURE SEPARATOR TANK (KT-100) TO REMOVE ANY CONDENSATE PRESENT IN THE VAPOR STREAM AND IN-LINE AIR FILTER (AF-100). THE MOISTURE SEPARATOR IS EQUIPPED WITH HIGH AND HIGH-HIGH LIQUID LEVEL SENSORS (LSH-101 AND LSHH-101). CARBON TREATMENT INCLUDES FOUR (4) 1,000-POUND VAPOR PHASE CARBON VESSELS (VPGAC-101, VPGAC-102, VPGAC-103 AND VPGAC-104) WITH FLOW PATTERNS ADJUSTABLE VIA VALVE CONFIGURATION. APPLIED VACUUM FROM THE BLOWER ADJUSTABLE VIA A DILUTION LINE EQUIPPED WITH A COMBINATION AIR FILTER/SILENCER. THE PROCESS STREAM ON THE DISCHARGE SIDE OF THE BLOWER INCLUDES AN IN-LINE SILENCER/MUFFLER (S-400). VAPORS DISCHARGED TO THE ATMOSPHERE VIA A DISCHARGE STACK EXTENDING 3' ABOVE THE WAREHOUSE ROOF LINE AT THE PROPOSED LOCATION OF THE SYSTEM CONTAINER.

RECORD DRAWINGS

TO THE BEST OF OUR KNOWLEDGE, INFORMATION AND BELIEF, THESE RECORD DRAWINGS SUBSTANTIALLY REPRESENT THE PROJECT AS CONSTRUCTED.

DATE__________BY__________

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
CHRISTOPHER D. ENGLER		
Professional Engineer's No. 069748		
State: NY	Date Signed	Project Mgr.: WBP
Designed by: CD	Drawn by: GHS	Checked by: CDE

STATE OF NEW YORK · CHRISTOPHER DANE ENGLER · 069748 · LICENSED PROFESSIONAL ENGINEER

ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

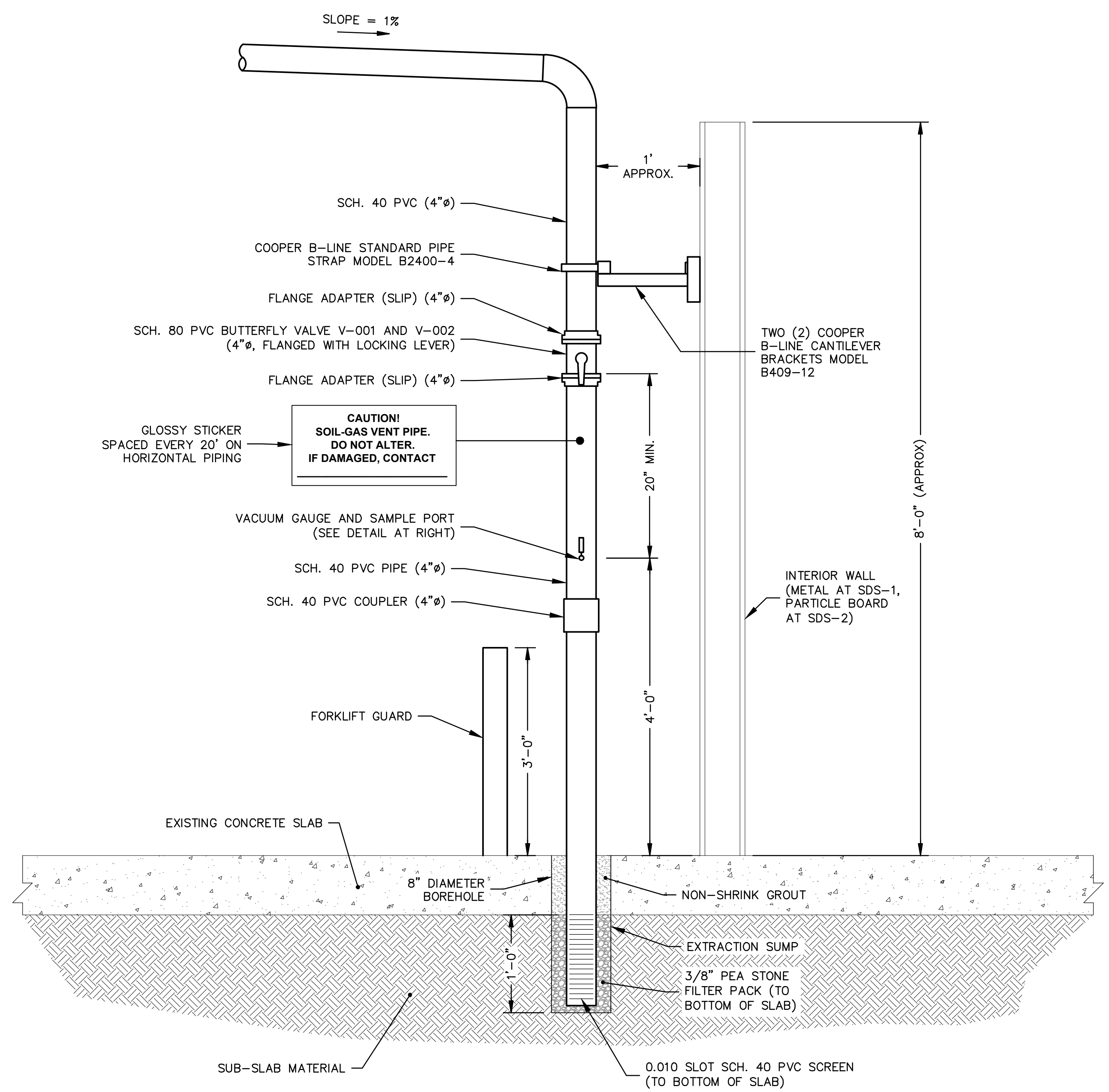
PROCESS AND INSTRUMENTATION DIAGRAM

ARCADIS Project No. B0041501.0001.00010

Date DECEMBER 2016

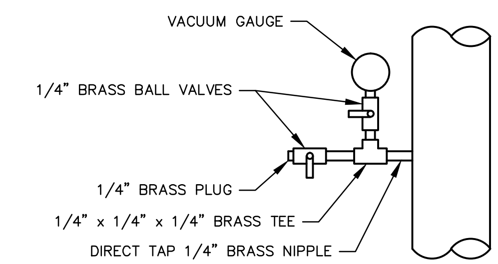
ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

M-1



EXTRACTION POINT RISER DETAIL (1)

NOT TO SCALE



VACUUM GAUGE AND SAMPLE PORT DETAIL

NOT TO SCALE

NOTES:

1. HORIZONTAL PIPE SUPPORTED EVERY 4 FEET. VERTICAL PIPE SUPPORTED EVERY 8 FEET.
2. CEILING HEIGHT IS 16' (APPROX.) EXCEPT IN WAREHOUSE (33' APPROX.).

RECORD DRAWINGS
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DATE__________BY__________________

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STATE OF NEW YORK · CHRISTOPHER DANE ENGLER · LICENSED PROFESSIONAL ENGINEER · No. 069748

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CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

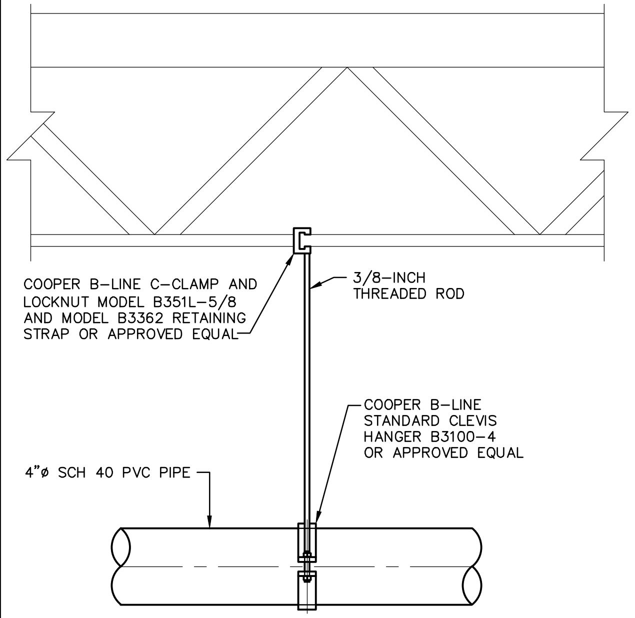
EXTRACTION POINT DETAILS

ARCADIS Project No. B0041501.0001.00010

Date DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

M-2

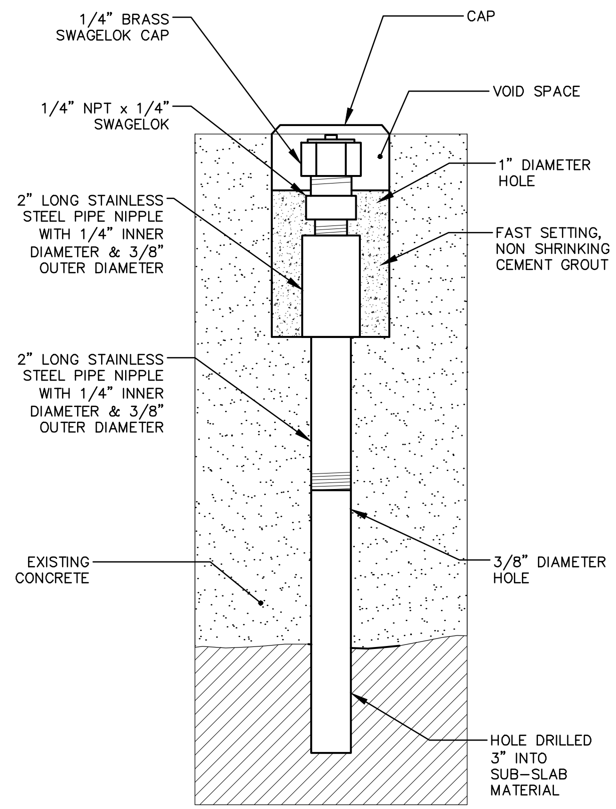


NOTES:

1. HORIZONTAL PIPE SUPPORTED EVERY 4 FEET.
2. HORIZONTAL PIPING PITCHED 1% TOWARDS THE EXTRACTION POINT, UNLESS NOTED OTHERWISE.

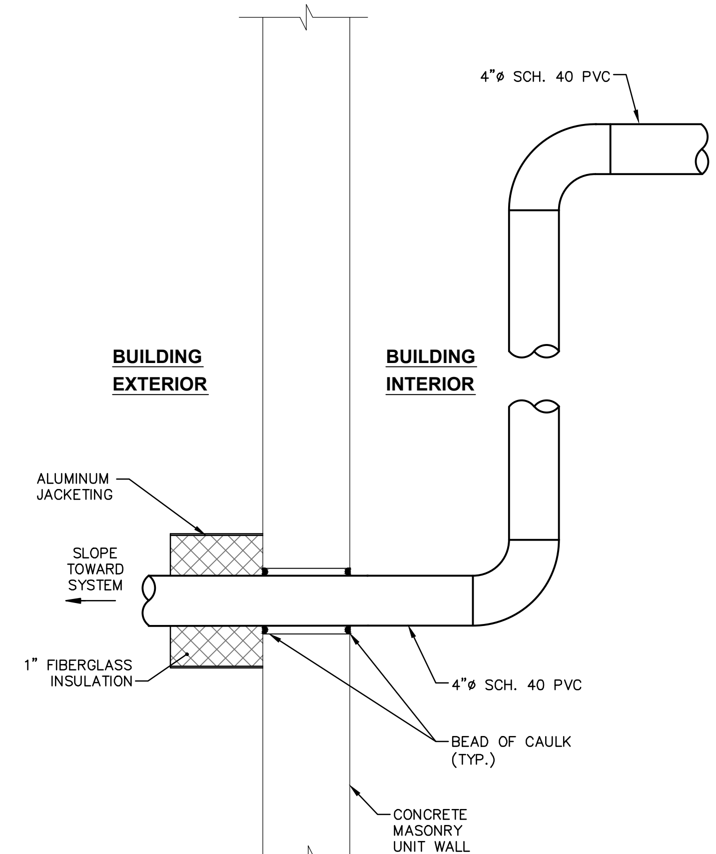
HANGING PIPE SUPPORT DETAIL 1

NOT TO SCALE



SUB-SLAB MONITORING POINT 2

NOT TO SCALE

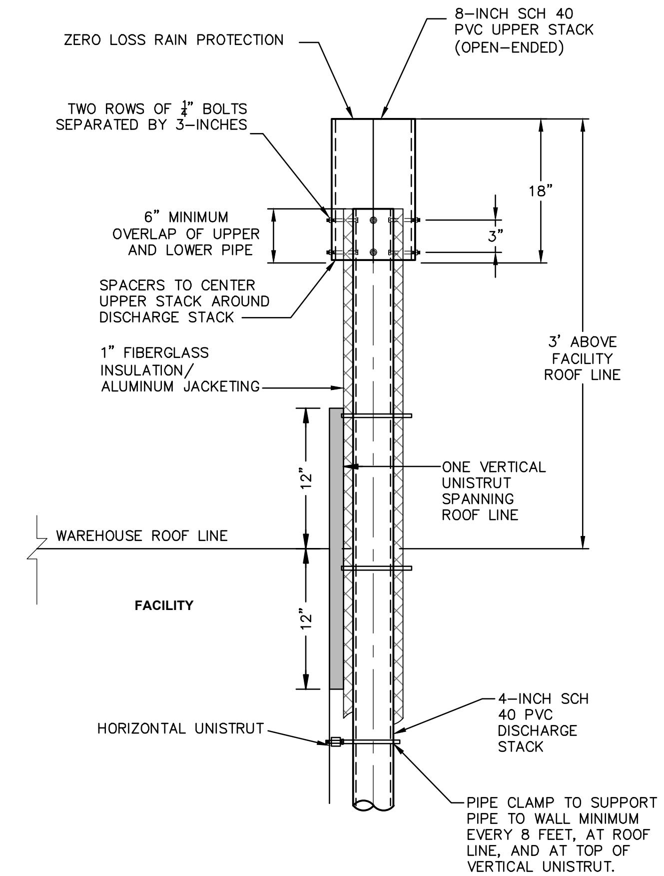


NOTES:

1. ALL EXTERIOR PIPING FITTED WITH FIBERGLASS INSULATION WITH R-VALUE OF 5 AND ALUMINUM JACKETING.
2. PIPING SLOPED AS INDICATED ON DRAWING G-1.

EXTERIOR WALL PENETRATION DETAIL 3

NOT TO SCALE



NOTES:

1. DIMENSIONS ARE RELATIVE TO WAREHOUSE ROOF LINE.
2. UNISTRUT SECURED TO WALL WITH 1/4-INCH CONCRETE SLEEVE ANCHORS SPACED 6" O.C.

NO LOSS CAP DETAIL 4

NOT TO SCALE

RECORD DRAWINGS

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SCALE(S) AS INDICATED

THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING: USE TO VERIFY FIGURE REPRODUCTION SCALE

No.	Date	Revisions	By	Ckd

Professional Engineer's Name
CHRISTOPHER D. ENGLER
Professional Engineer's No.
069748

State	Date Signed	Project Mgr.
NY		WBP
Designed by	Drawn by	Checked by
CD	GHS	CDE

ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

MISCELLANEOUS DETAILS

ARCADIS Project No.
B0041501.0001.00010

Date
DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

M-3

CITY:SYRACUSE-NY DIV/GROUP:ENVCAD DB:G.STEINBERGER LD: PIC: PM: TM:D.ZUCK LYR:ON=*;OFF=*REF*
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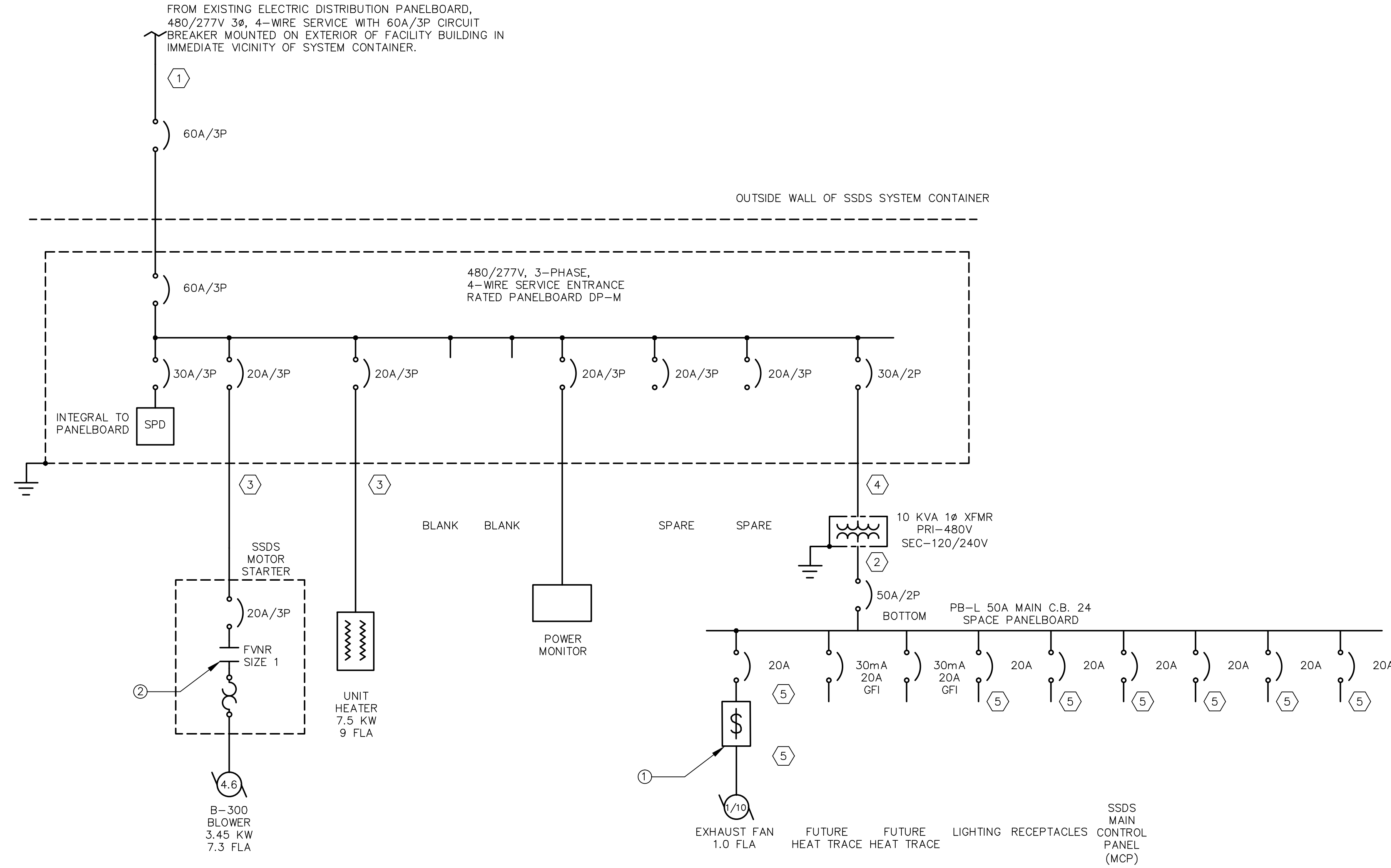
XREFS: 41501X0E IMAGES: PE-ARMSTRONG-NY.jpg PROJECTNAME: ----

ELECTRICAL SPECIFICATIONS

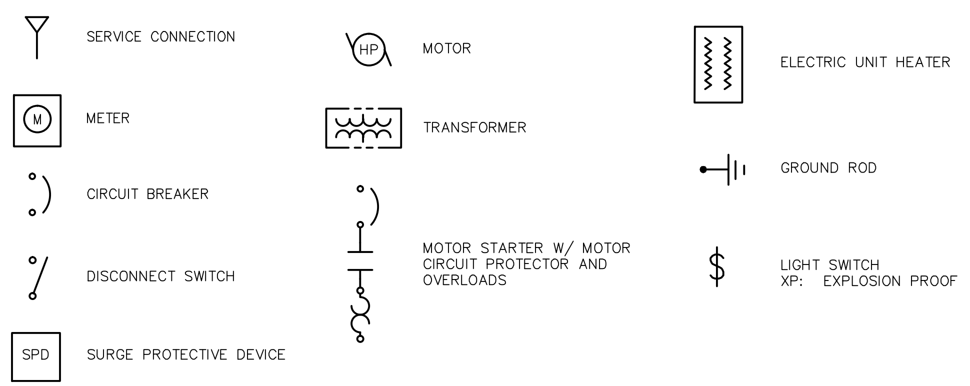
GENERAL

1. ALL ELECTRICAL EQUIPMENT IS U.L. LISTED AND LABELED.
2. ALL ELECTRICAL WORK INSTALLED IN ACCORDANCE WITH NFPA–70 NEC.
3. GROUNDING OF ALL ELECTRICAL SYSTEMS AND EQUIPMENT MEETS THE REQUIREMENTS OF NEC ARTICLE 250.
4. ENCLOSURES ARE NEMA RATED FOR LOCATION.
5. 277/480 VAC, THREE PHASE, 4 WIRE

   PHASE A – BROWN
   PHASE B – ORANGE
   PHASE C – YELLOW
   NEUTRAL – WHITE
   GROUND – GREEN



ELECTRICAL SYMBOL LEGEND



SINGLE LINE DIAGRAM

CONDUIT AND CABLE SCHEDULE

1 (4) #4, (1) #10 G., 1–1/2" C.
2 (3) #4, (1) #8 G., 1–1/4" C.
3 (3) #12, (1) #12 G., 3/4" C.
4 (2) #10, (1) #10 G., 3/4" C.
5 (2) #12, (1) #12 G., 3/4" C.

ELECTRICAL GENERAL NOTES:

1. THIS IS A GENERAL ELECTRICAL SYMBOLS AND GENERAL NOTES SHEET. SOME SYMBOLS AND/OR NOTES MAY NOT BE USED IN THIS SET OF DRAWINGS.

RECORD DRAWINGS
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No.	Date	Revisions	By	Ckd

Professional Engineer's Name		
THOMAS P ARMSTRONG JR.		
Professional Engineer's No. 085236		
State: NY	Date Signed	Project Mgr.: WBP
Designed by: NCP	Drawn by: NCP	Checked by: TPA

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CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SINGLE LINE DIAGRAM

ARCADIS Project No. B0041501.0001.00010

Date DECEMBER 2016

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295 Woodcliff Drive, Suite 301
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Tel. 585-385-0090

E-1

LUMINAIRE SCHEDULE

TYPE	LAMPS QUANTITY	LAMPS TYPE	CONNECTED WATTS	LUMINAIRE DESCRIPTION	MANUFACTURER / CATALOG NUMBER	QUANTITY
A	2	A33	75	SURFACE MOUNTED INCANDESCENT LUMINARIE, WITH PLAIN GLOBE AND GUARD	CROUSE HINDS CAT NO. VDA2759 OR EQUAL	1

LIGHTING NOTES:

1. INCANDESCENT LIGHTING OF TYPE "A" LUMINAIRE EVENLY SPACED WITHIN THE CARGO CONTAINER.

HVAC SCHEDULE

TYPE	AIRFLOW (CFM)	PROPELLER DIA (IN)	MOTOR DATA HP	MOTOR DATA RPM	MOTOR DATA V/PH/HZ	WEIGHT (LBS)	MANUFACTURER	MODEL	QUANTITY
EXHAUST FAN	800	12	1/25	1550	115/1/60	12	GRAINGER	1HLA2	1
HEATER	650	–	1/30	1600	480/3/60	24	QMARK	MUH0704	1

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Professional Engineer's No.: 085236

State	Date Signed	Project Mgr.
NY		WBP
Designed by	**Drawn by**	**Checked by**
NCP	NCP	TPA

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ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

HVAC AND LIGHTING SCHEDULE

ARCADIS Project No.
B0041501.0001.00010

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E-2

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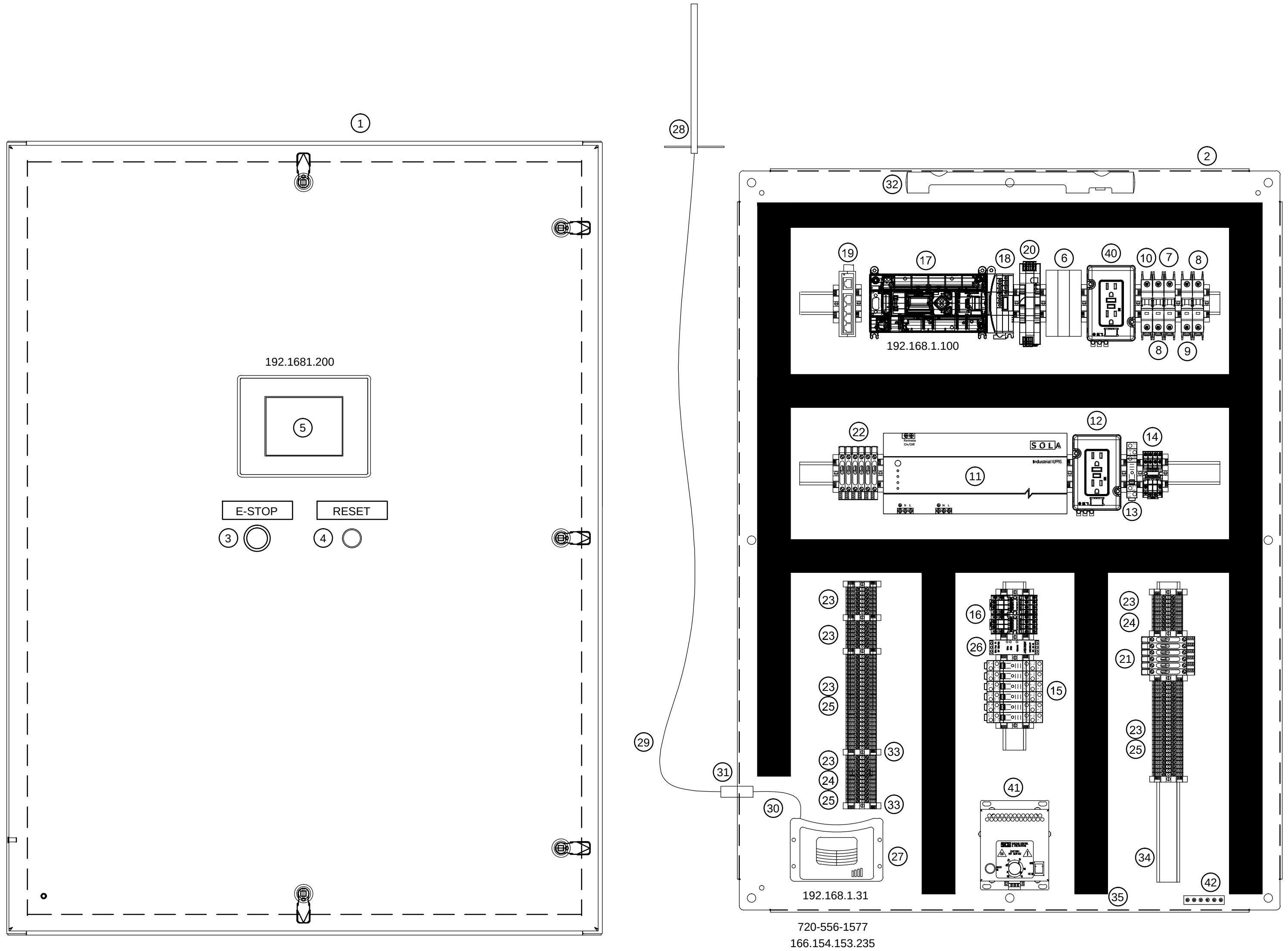
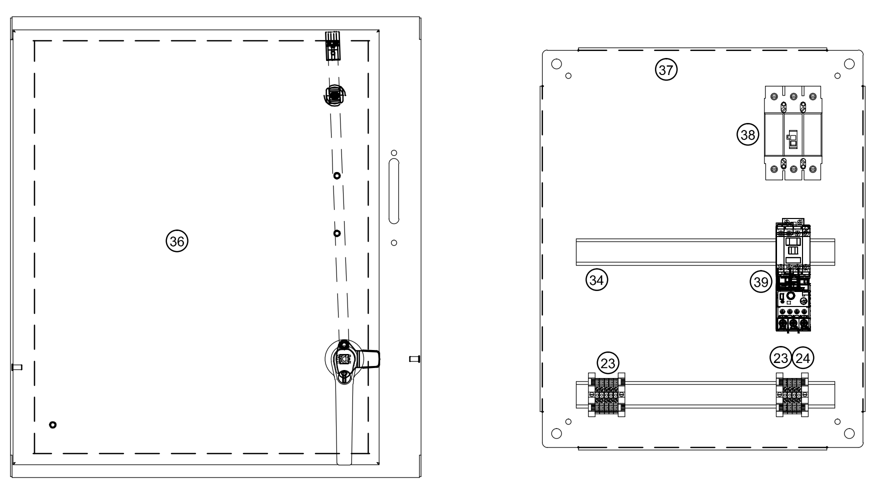


SSDS MAIN CONTROL PANEL (MCP)



SSDS MOTOR STARTER

TAG	QTY	SUB	DESCRIPTION	MANUFACTURER	CATALOG #
1	1		WALL MOUNT STEEL ENCLOSURE 48X36X12	SCE	SCE-48EL3612LP
2	1		BACK PANEL FOR ENCLOSURE	SCE	SCE-48P36
3	1		RED MUSHROOM HEAD E-STOP TWIST RELEASE	AB	800FP-MT44
		1	22.5MM PB BASE MOUNT, SCREW CONTACT BLOCK, 1 N.C.	AB	800F-BX01
4	1		BLACK, 22 MM, MOMENTARY PUSH BUTTON	AB	800FP-F2PX20
5	1		6" C_MORE COLOR TOUCH PANEL	AUTOMATION DIRECT	EA9-T6CL-4983-DC
6			120 VAC SURGE PROTECTION DEVICE (10A)	AB	4983-DC
7	1		10 AMP MINIATURE CIRCUIT BREAKER (1 POLE, 120 VAC)	AB	1489-M1C100
8	2		8 AMP MINIATURE CIRCUIT BREAKER (1 POLE, 120 VAC)	AB	1489-M1C080
9	1		7 AMP MINIATURE CIRCUIT BREAKER (1 POLE, 120 VAC)	AB	1489-M1C070
10	1		2 AMP MINIATURE CIRCUIT BREAKER (1 POLE, 120 VAC)	AB	1489-M1C020
11	1		UPS, 850 KVA	SOLA	S1K850
		1	MOUNTING BRACKET FOR UPS	SOLA	S1K-PMBRK
12	1		DUAL RECEPTACLE	AB	1492-REC15
13	1		RELAY - 1 POLE, 120 VAC, 16 A CONTACT	AB	700-HK36A1
		1	RELAY SOCKET (5 PIN)	AB	700-HN221
14	1		RELAY - 4 POLE, 120 VAC, 7 A CONTACT	AB	700-HC24A1
		1	RELAY SOCKET (14 PIN)	AB	700-HN104
15	6		RELAY - 1 POLE, 24 VDC, 8 A CONTACT	AB	700-HK36A24
		6	RELAY SOCKET (5 PIN)	AB	700-HN221
16	2		RELAY - 4 POLE, 24VDC, 7 A CONTACT	AB	700-HC24Z24
		2	RELAY SOCKET (14 PIN)	AB	700-HN104
17	1		MICROLOGIX 1400 PLC, (20) 24 VDC IN, 12 OUT, 110 AC PWR	AB	1766-L32BWA
18	1		4 CHANNEL CURRENT/VOLTAGE ANALOG INPUT MODULE	AB	1762-IF4
19	1		5 PORT ETHERNET SWITCH	AB	1783-US5T
20	1		24 VDC POWER SUPPLY (120 W)	AB	1606-XLE120E
21	5		120 VAC FUSE BLOCKS	AB	1492-WFB4250
		5	2 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S505-2-R
22	7		24 VDC FUSE BLOCKS	AB	1492-WFB424
		1	5 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S506-5-R
		6	2 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S506-2-R
23	TBD		IEC TERMINAL BLOCK	AB	1492-J3
24	TBD		IEC GROUND TERMINAL BLOCK	AB	1492-J3G
25	15		IEC TERMINAL BLOCK WITH PLUG IN FUSE	AB	1492-J3P
		9	FUSE PLUG 10-36 V WITH BLOW FUSE INDICATION	AB	1492-FPK224
		5	0.50 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S506-500-R
		4	0.25 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S506-250-R
		6	FUSE PLUG 60-150 V WITH BLOW FUSE INDICATION	AB	1492-FPK2120
		6	1 A, 250 V, TIME DELAY 5 X 20 MM FUSES	BUSSMANN	S505-1-R
26	1		DUAL CHANNEL, AUTO/MANUAL RESET, 24V AC/DC SAFETY RELAY	AB	440R-N23117
27	1		4G CELLULAR MODEM	SIERRA WIRLESS	GX-450
28	1		OMNI DIRECTIONAL LTE/CELLULAR/PCS COMBO ANTENNA	WILSON ELECTRONICS	
29	1		COAXIAL CABLE - N MALE TO N MALE (20 ft)	TBD	
30	1		COAXIAL CABLE - SMA MALE TO N MALE (2 ft)	TBD	
31	1		RF COAXIAL SURGE PROTECTOR	POLYPHASER	TSX-NFF
32	1		24VDC PANEL LIGHT	AUTOMATION DIRECT	25401-00
	1		CONNECTION CABLE 2 X 16 AWG WITH INPUT CONNECTOR	AUTOMATION DIRECT	244361
33	TBD		END BARRIERS	TBD	
34	TBD		DIN RAIL	TBD	
35	TBD		WIRING DUCT	TBD	
36	1		WALL MOUNT DISCONNECT ENCLOSURE 24X21X8	SCE	SCE-24XEL2108LP
37	1		BACK PANEL FOR ENCLOSURE	SCE	SCE-24P20
38	1		20 A MOLDED CASE CIRCUIT BREAKER, 3 POLE, 25 KA INTERRUPT RATING	AB	140G-G2C3-C20
		1	DISC CABLE/HANDLE, FRAME G.I	AB	140G-G-FCX04
39	1		NON-REVERSING E-COMBO STARTER FOR 4 HP MOTOR WITH 120 VAC COIL	AB	309-AOD-EEE
40	1		DUAL GFCI RECEPTACLE	WEIDMULLER	DRAC GF15
41	1		PANEL HEATER	HOFFMAN	DAH2001A
42	1		GROUND BAR	TBD	

LEGEND

DENOTES TERMINAL BLOCK CONNECTION

DASHED LINES DENOTES WIRING TO FIELD DEVICES

DASHED WITH PATTERN DENOTES DEVICES IN REMOTE LOCATIONS

LINE NUMBER DESCRIPTION

0000
WIRING DIAGRAM SHEET NUMBER (1 OR 2 DIGITS)
LINE NUMBER (ALWAYS 2 DIGITS)

WIRE NUMBER DESCRIPTION

00000
WIRING DIAGRAM SHEET NUMBER (1 OR 2 DIGITS)
WIRE NUMBER (ALWAYS 1 DIGIT)
LINE NUMBER (ALWAYS 2 DIGITS)

TB TERMINAL BLOCK

RECORD DRAWINGS
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0 5" 10" 15"
SCALE IN INCHES

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No.	Date	Revisions	By	Ckd

Professional Engineer's Name: THOMAS P ARMSTRONG JR.
Professional Engineer's No.: 085236
State: NY | Date Signed: | Project Mgr.: WBP
Designed by: NCP | Drawn by: NCP | Checked by: TPA

STATE OF NEW YORK • THOMAS PAUL ARMSTRONG, JR. • LICENSED PROFESSIONAL ENGINEER • 085236
12/8/16

ARCADIS Design & Consultancy for natural and built assets
ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS PANEL LAYOUTS

ARCADIS Project No. B0041501.0001.00010
Date DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

CITY: Milwaukee, WI DIV/GROUP: ENV DB: J. Yuen, C. McKeough PIC:(Opt) PM: TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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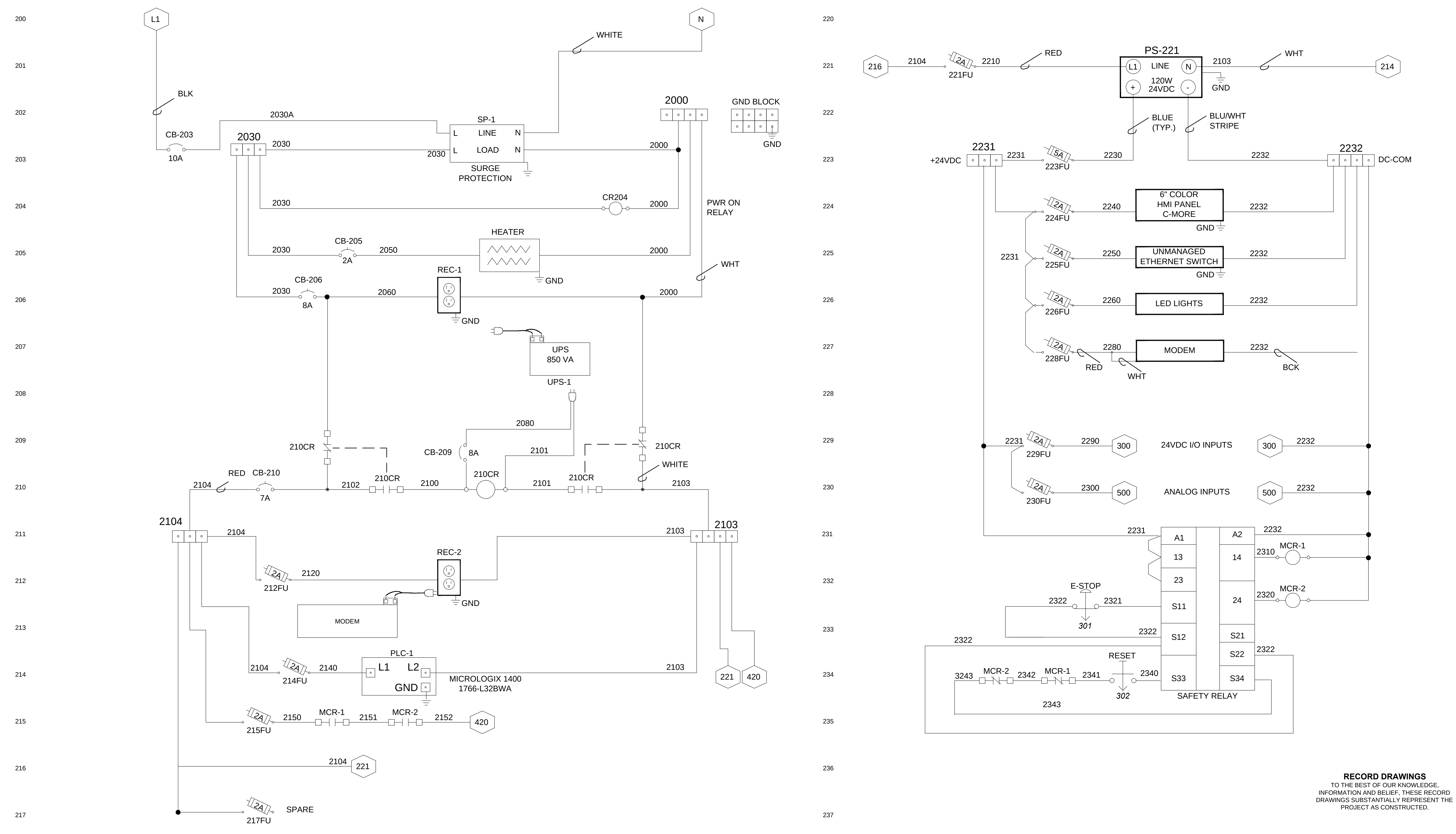

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ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MAIN CONTROL PANEL POWER DISTRIBUTION

ARCADIS Project No. B0041501.0001.00010
Date: DECEMBER 2016
ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

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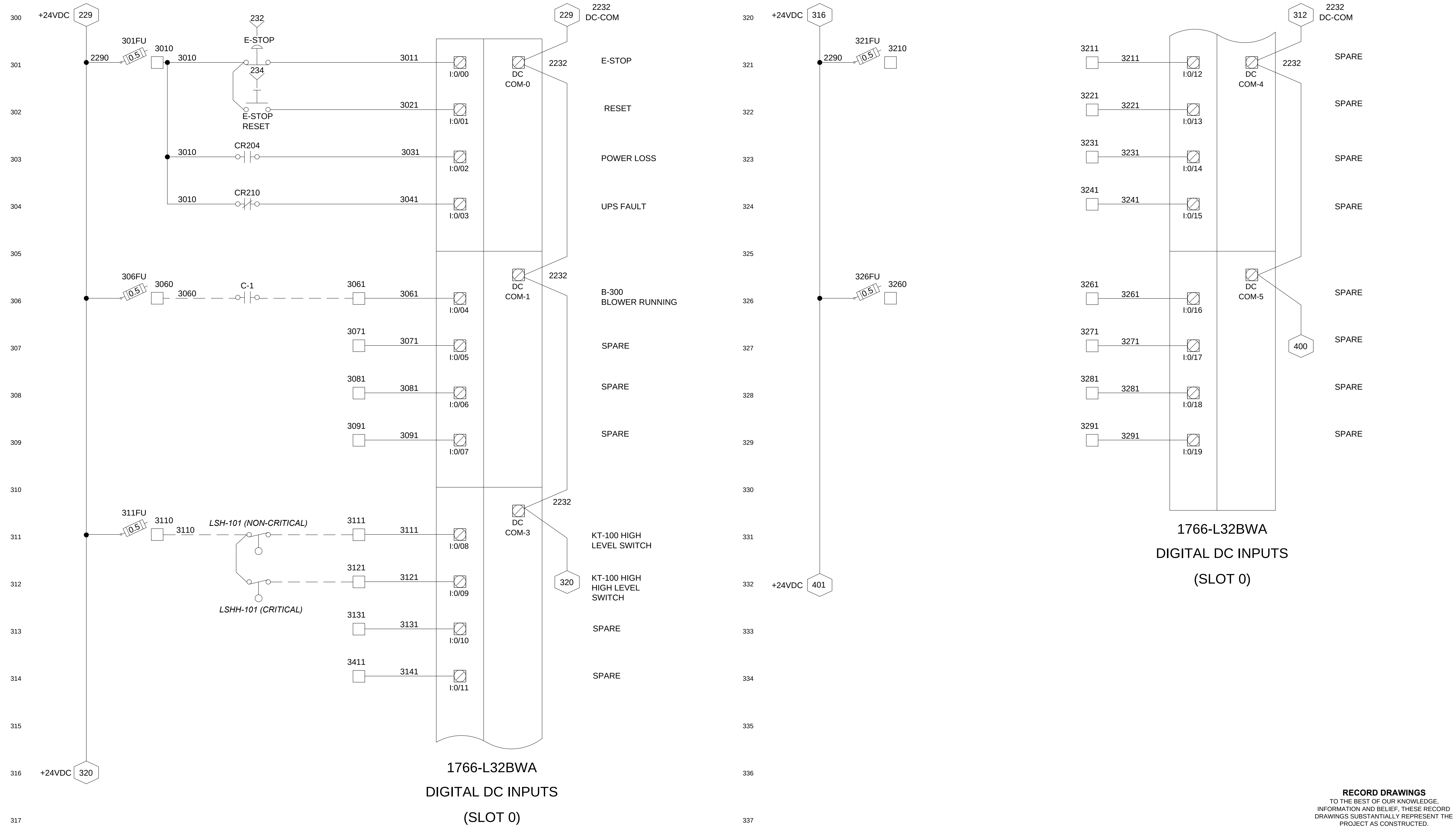

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Professional Engineer's Name: THOMAS P ARMSTRONG JR.
Professional Engineer's No.: 085236
State: NY | Date Signed: | Project Mgr.: WBP
Designed by: NCP | Drawn by: NCP | Checked by: TPA

ARCADIS — Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MAIN CONTROL PANEL MICROLOGIX DIGITAL INPUTS

ARCADIS Project No. B0041501.0001.00010

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295 Woodcliff Drive, Suite 301
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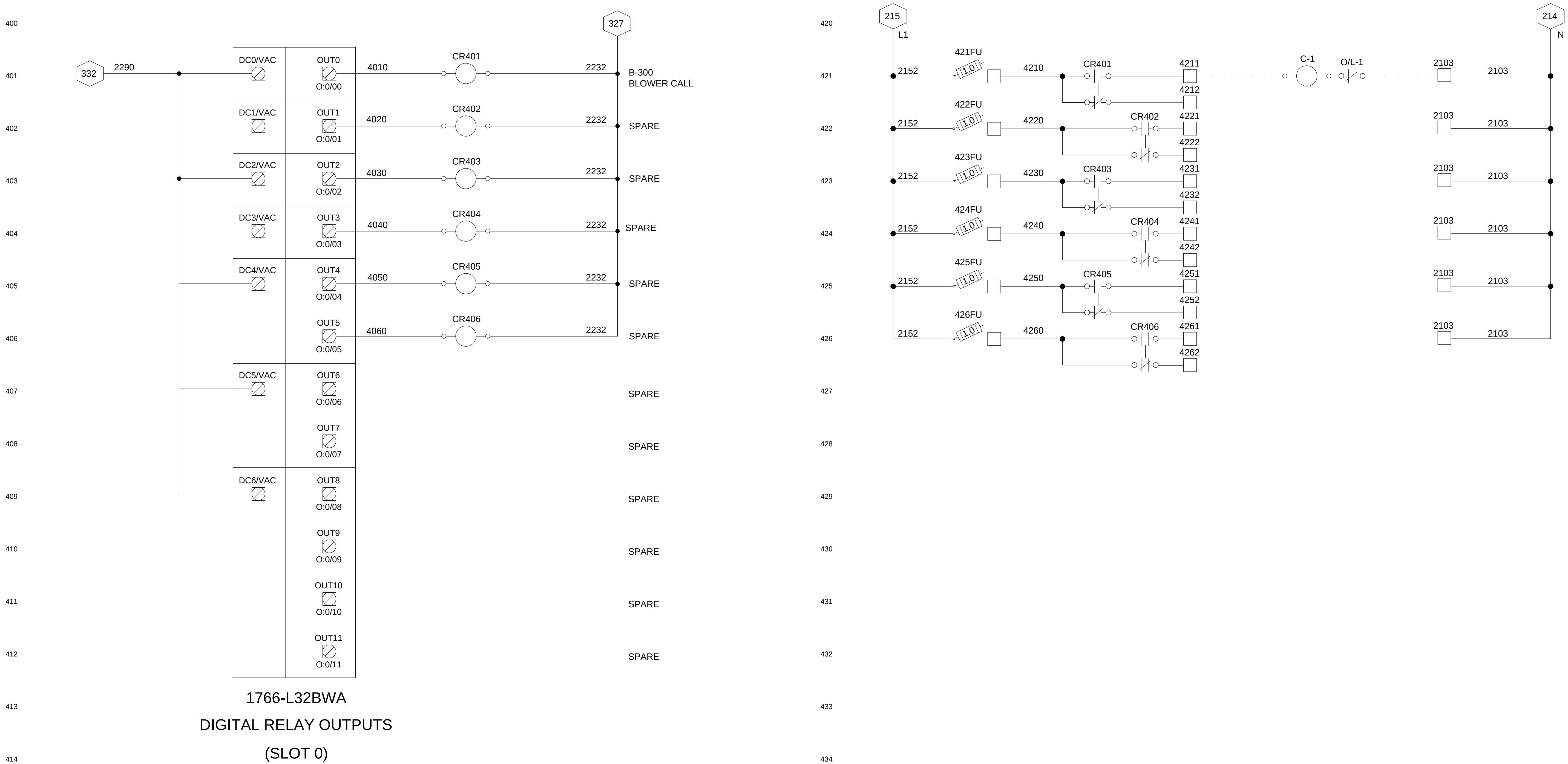
I-3



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ARCADIS Design & Consultancy for natural and built assets

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CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MAIN CONTROL PANEL MICROLOGIX RELAY OUTPUTS

ARCADIS Project No. B0041501.0001.00010
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ARCADIS
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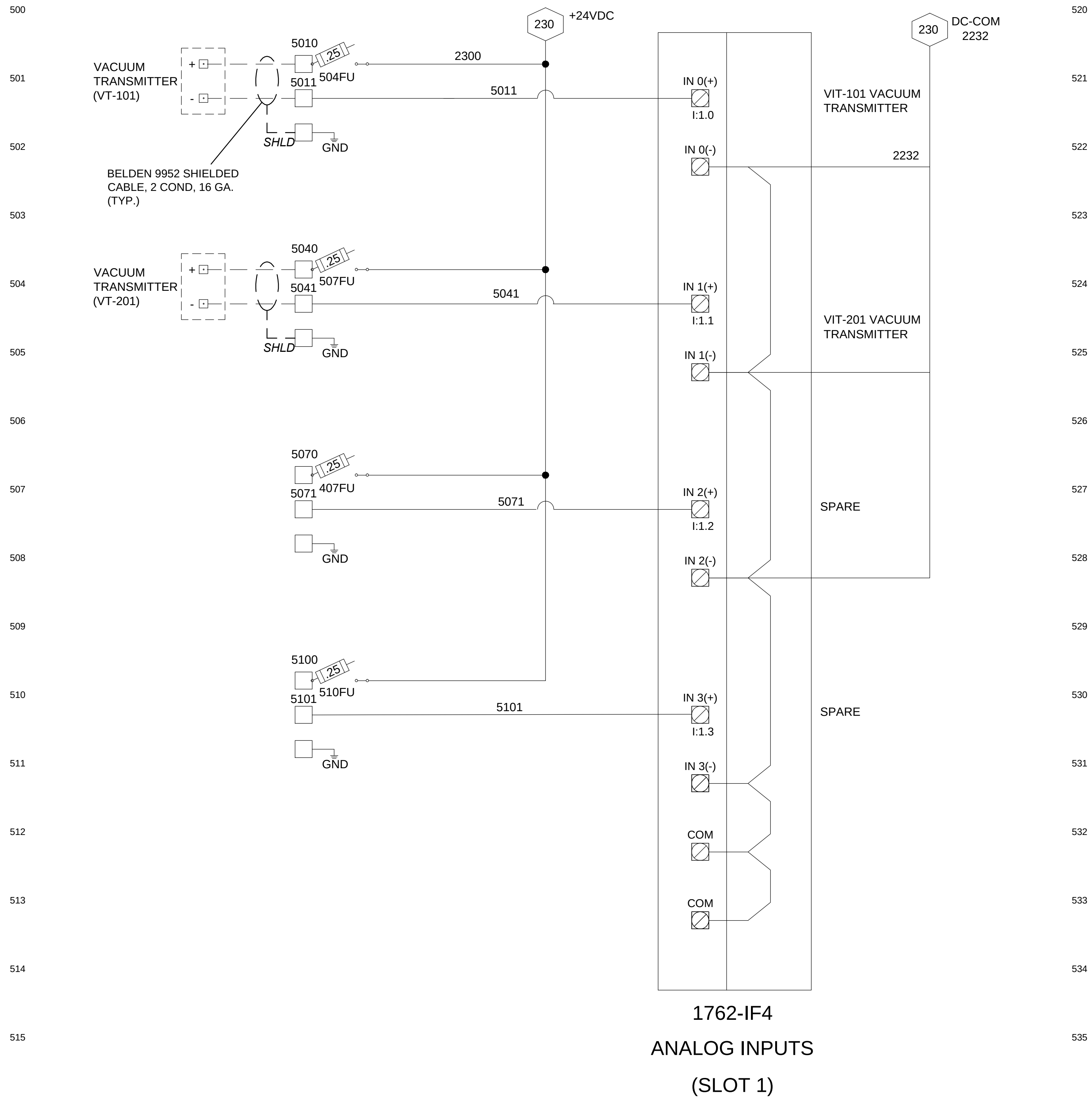
I-4



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NY		WBP
Designed by	**Drawn by**	**Checked by**
NCP	NCP	TPA

STATE OF NEW YORK · THOMAS PAUL ARMSTRONG, JR. · 085236 · LICENSED PROFESSIONAL ENGINEER

ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MAIN CONTROL PANEL SLOT 1: ANALOG INPUTS

ARCADIS Project No. B0041501.0001.00010

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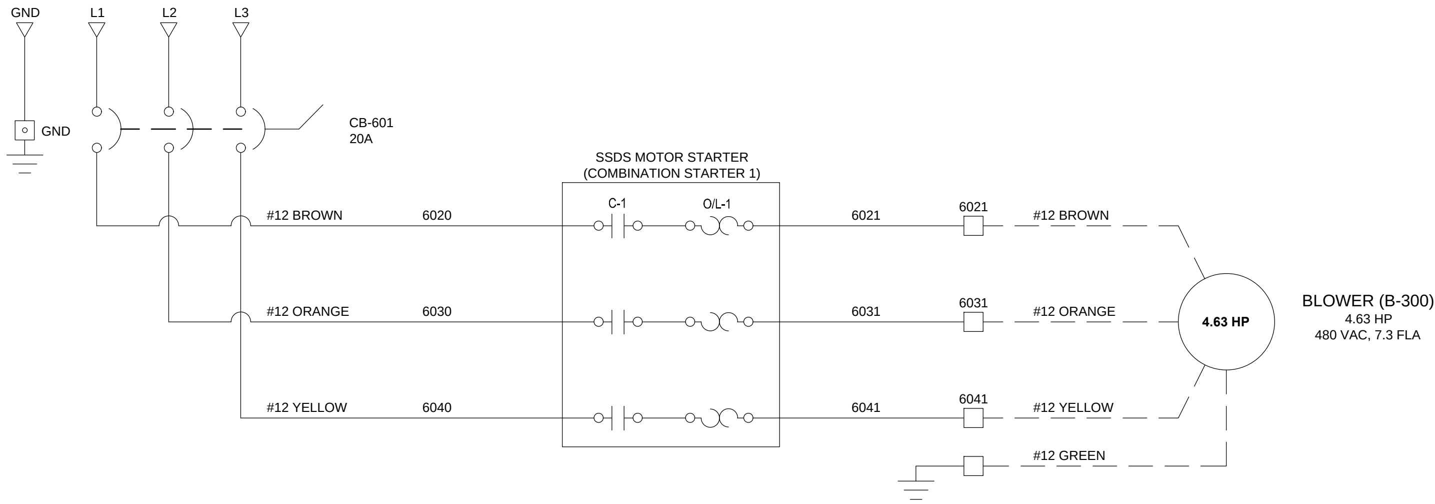

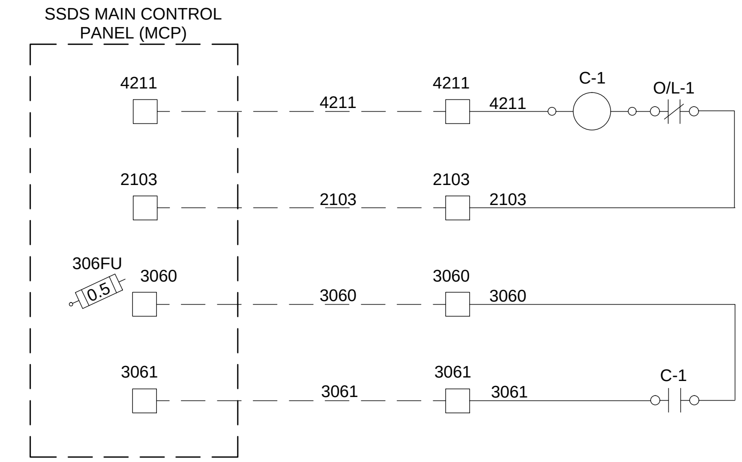

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No.	Date	Revisions	By	Ckd

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Professional Engineer's Name: THOMAS P ARMSTRONG JR.
Professional Engineer's No.: 085236
State: NY | Date Signed: | Project Mgr.: WBP
Designed by: NCP | Drawn by: NCP | Checked by: TPA

STATE OF NEW YORK · THOMAS PAUL ARMSTRONG, JR. · 085236 · LICENSED PROFESSIONAL ENGINEER

ARCADIS Design & Consultancy for natural and built assets

ARCADIS OF NEW YORK, INC.

CROSMAN CORPORATION • EAST BLOOMFIELD, NEW YORK
SUB-SLAB DEPRESSURIZATION SYSTEM

SSDS MOTOR STARTER WIRING DETAILS

ARCADIS Project No. B0041501.0001.00010

Date: DECEMBER 2016

ARCADIS
295 Woodcliff Drive, Suite 301
Fairport, NY 14450
Tel. 585-385-0090

I-6

APPENDIX B

Manufacturer's Manuals for Major System Equipment

APPENDIX C

Equipment Layout, Panelboard Layout, Breaker Schedule, and Parts List

REVISIONS			
Rev	Date	By	Description
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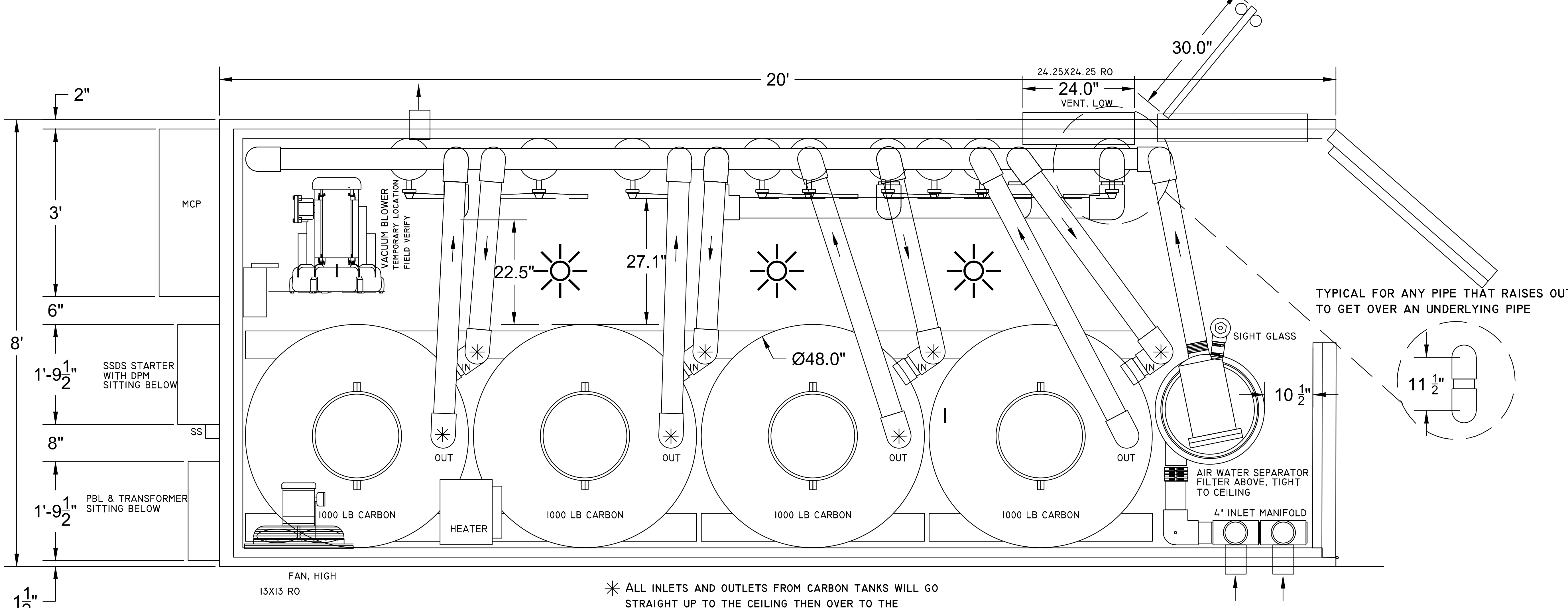
1			
2			
3			
4			

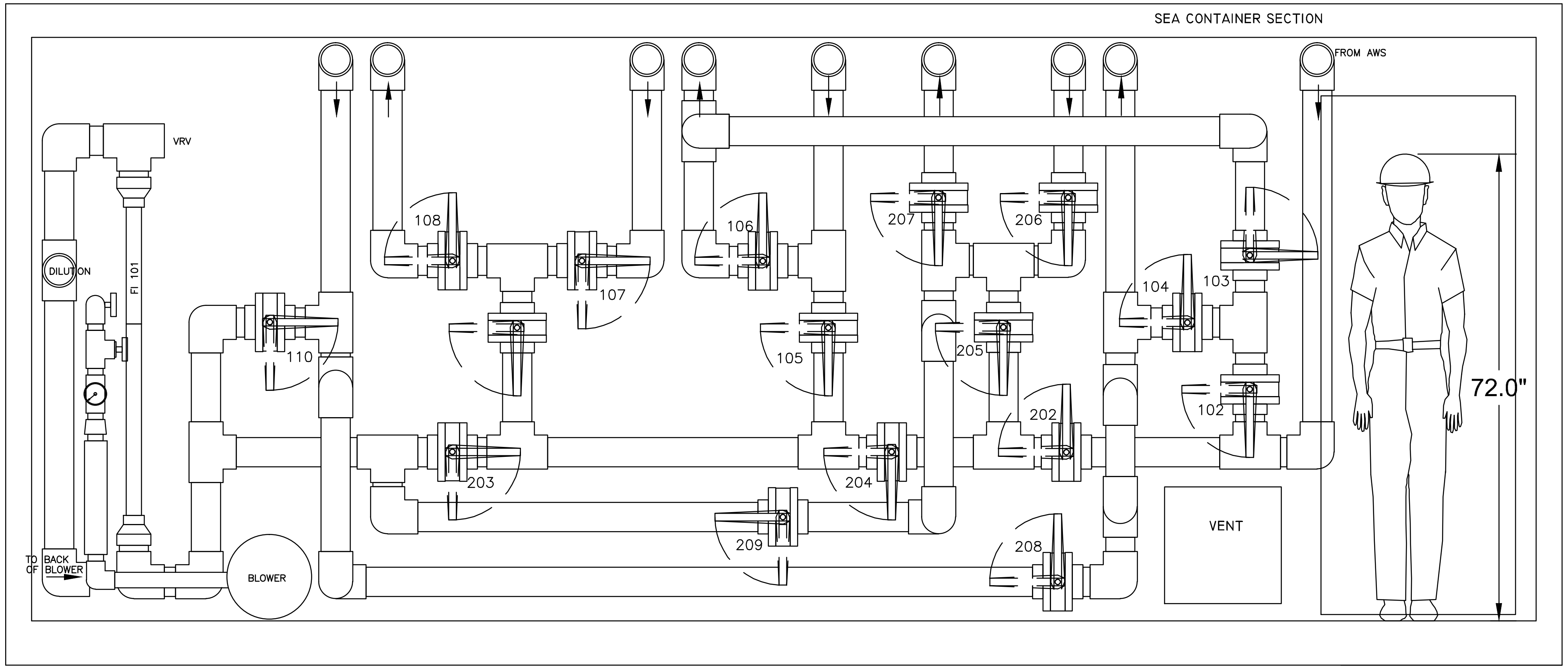


✳ All inlets and outlets from carbon tanks will go straight up to the ceiling then over to the manifold. This will allow for walking underneath. Field verify the height up and the angle over to the manifold.

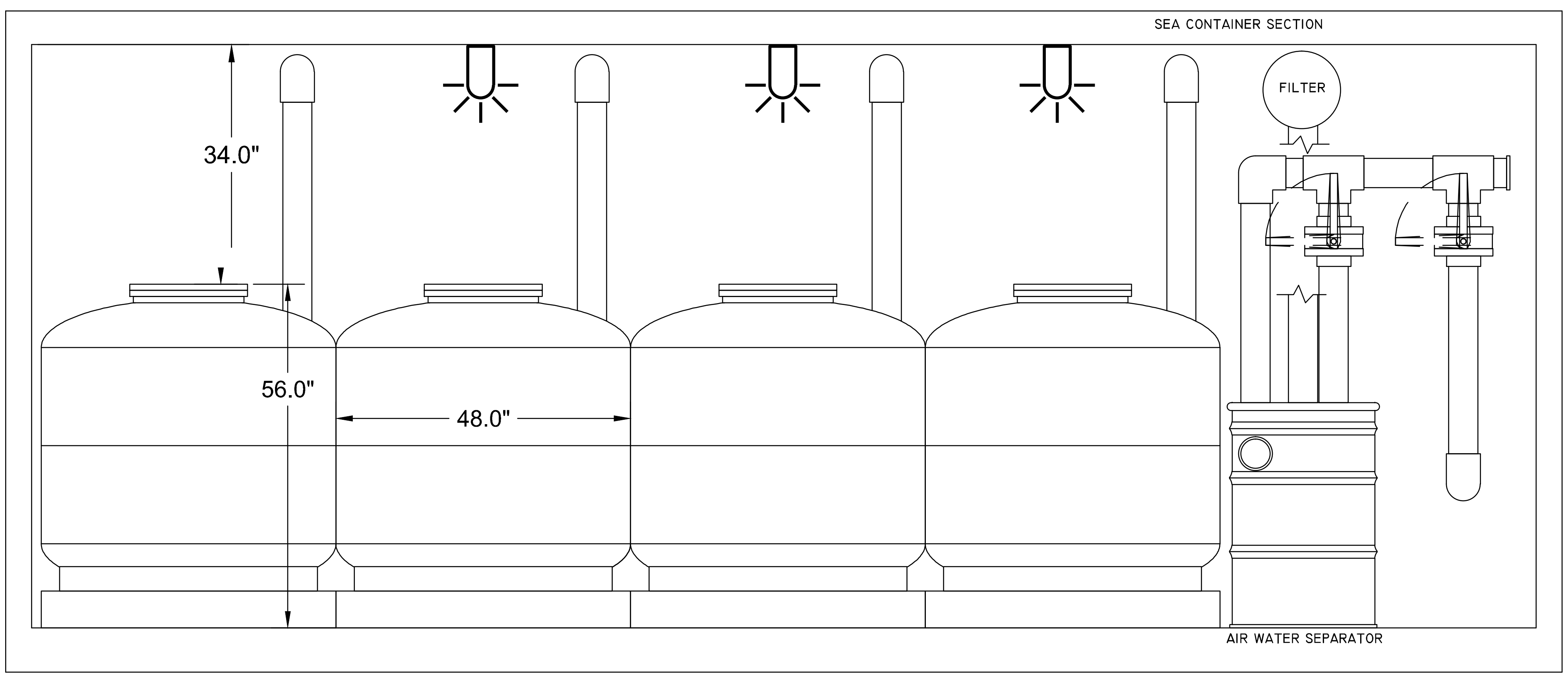
PRODUCT LEVEL CONTROL, INC.
ENVIRONMENTAL EQUIPMENT & CONTROLS

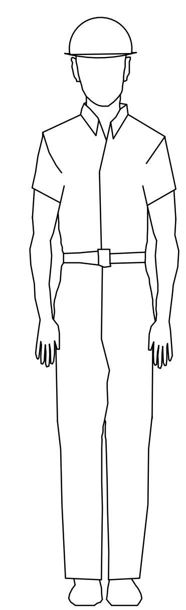
11929 Portland Ave S.
Burnsville, MN 55377
Phone: 952-707-9101
Fax: 952-707-1075

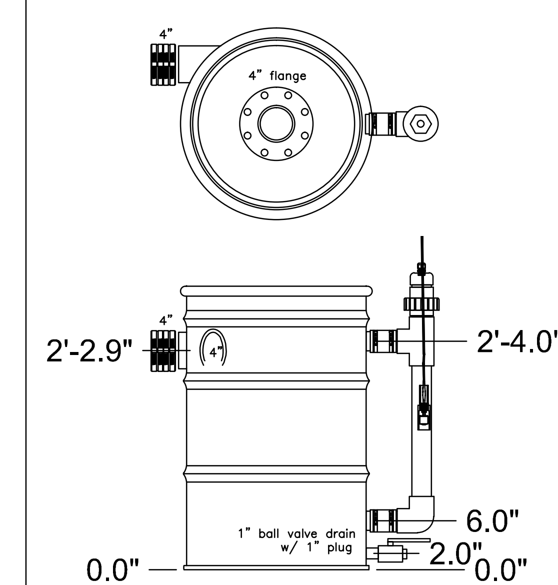
Customer	ARCADIS
Site Reference	CROSSMAN
Cust. No.	
PLC Job No.	16-020
Tolerance	±0.5"
Rev.	0
Drawing No.	PLAN
Sheet No.	Sheet 1 of 1
Scale	1/2"=1'-0" (11" x 17")
Drawn By	FOX-1
Drawn Date	2016-06-15
Title	PLAN



SEA CONTAINER SECTION







AIR WATER SEPARATOR DETAIL

REVISIONS

Rev	Date	By	Description
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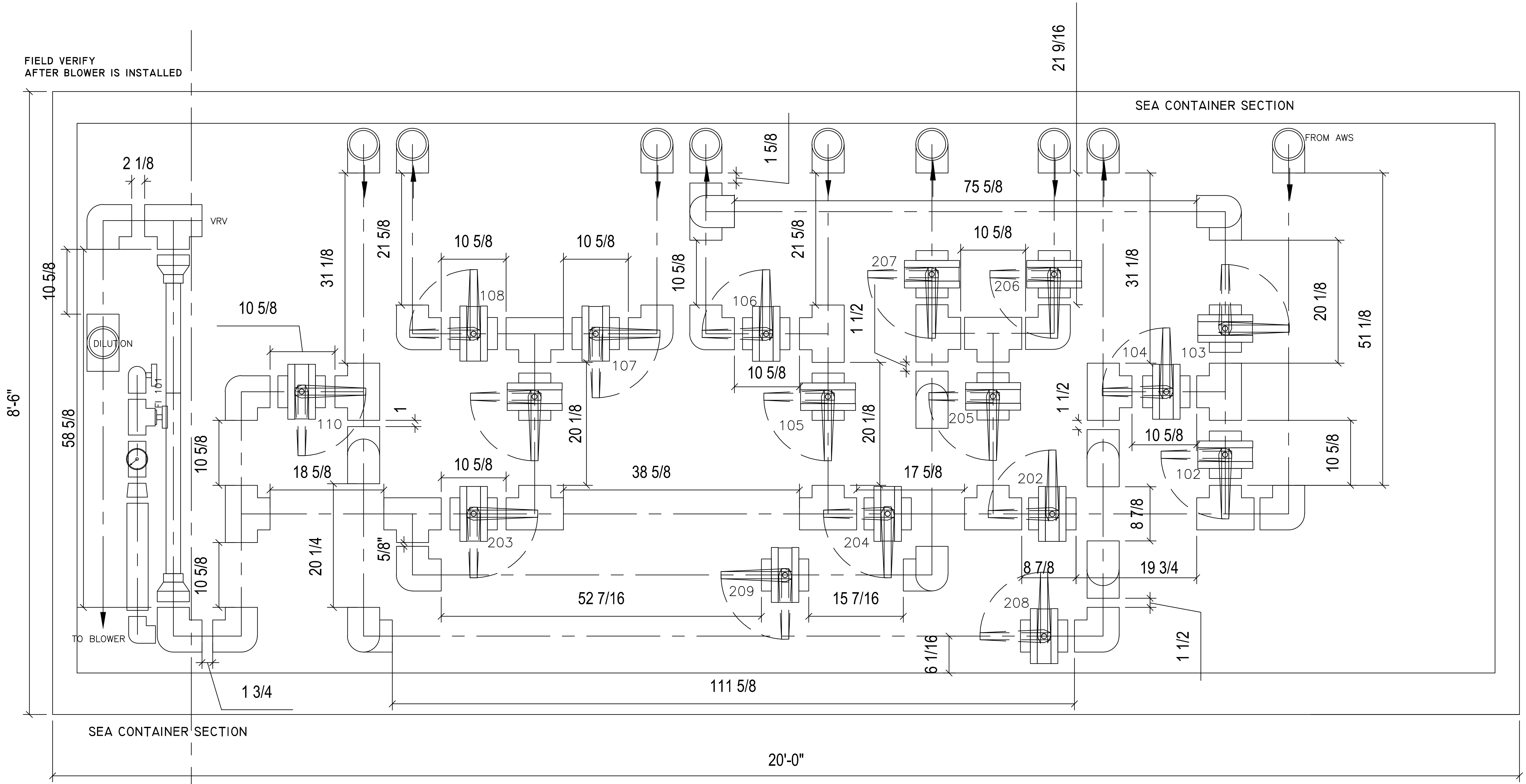
Fax: 952-707-1075

Customer	ARCADIS
Site Reference	CROSSMAN
Cust. No.	
PLC Job No.	16-020
Tolerance	±0.5"
Rev.	0
Drawing No.	CROSS SECTIONS
Sheet No.	Sheet 1 of 1
Scale	1/2"=1'-0" (11" x 17")
Drawn By	FOX-1
Drawn Date	2016-06-15
Title	CROSS SECTIONS



SCALE = 3/4" = 1'-0"

REVISIONS

Rev	Date	By	Description
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1			
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3			
4			

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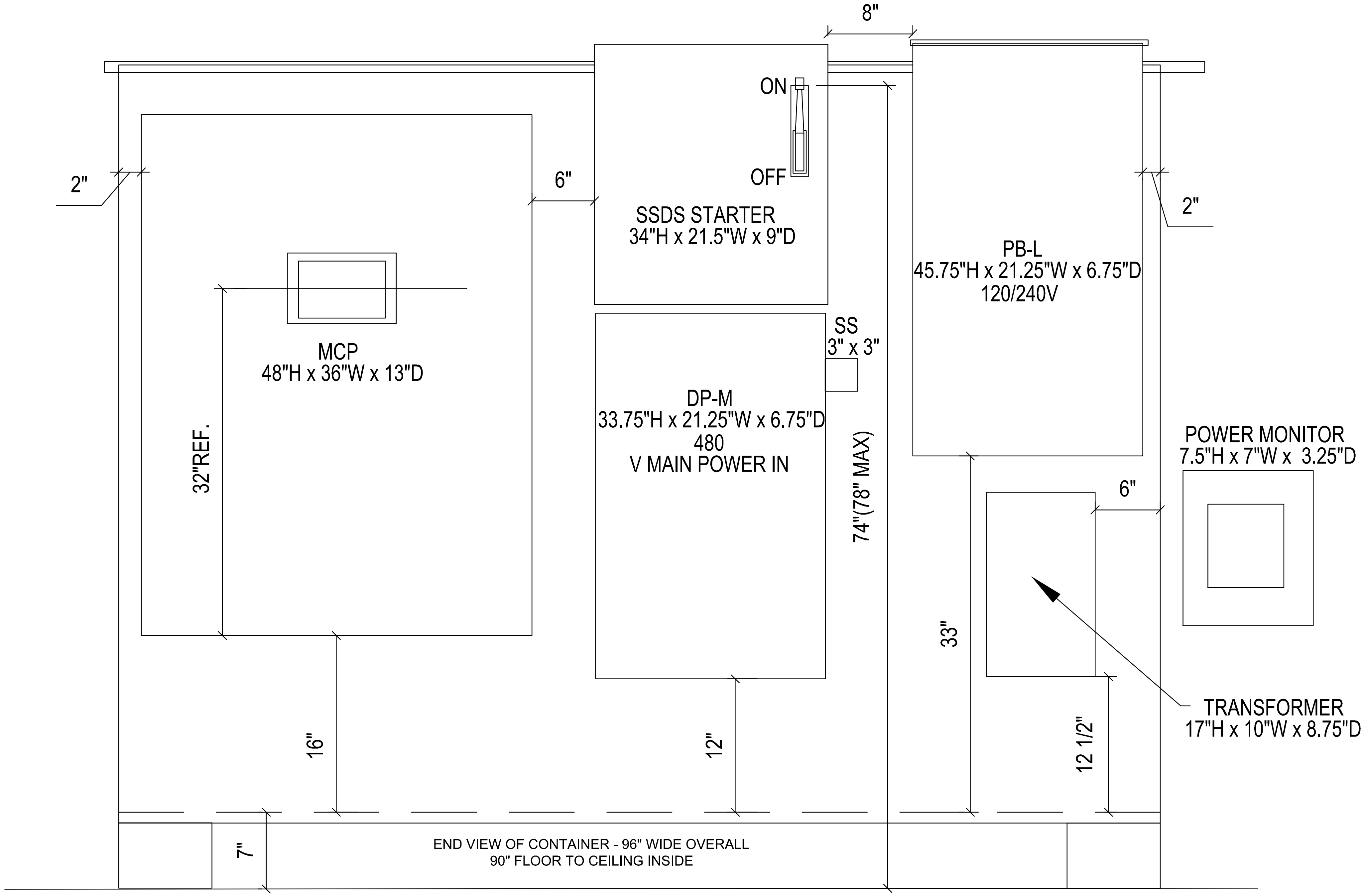
Fax: 952-707-1075

Customer	ARCADIS
Site Reference	CROSSMAN
Cust. No.	
PLC Job No.	16-020
Tolerance	±0.5"
Rev.	0
Drawing No.	PIPING LAYOUT
Sheet No.	Sheet 1 of 1
Scale	3/4"=1'-0" (11" x 17")
Drawn By	FOX-1
Drawn Date	2016-06-15
Title	PIPING LAYOUT



REVISIONS

Rev	Date	By	Description
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Fax: 952-707-1075

Customer	ARCADIS
Site Reference	CROSSMAN
Cust. No.	
PLC Job No.	16-020
Tolerance	±0.5"
Rev.	0
Drawing No.	PANEL LAYOUT
Sheet No.	Sheet 1 of 1
Scale	1"=1'-0" (11" x 17")
Drawn By	FOX-1
Drawn Date	2016-06-15
Title	PANEL LAYOUT

ARCADIS - CROSMAN
PANELBOARD DP-M
BREAKER SCHEDULE

Model: SquareD NF with MH50WP Enclosure
Type: 3R/5/12, 30 Circuit, Surface Mount, Service Entrance Rated

	KVA LOAD								KVA LOAD			
DIRECTORY	**A**	**B**	**C**	**CIRCUIT**	**CB AMPS**	**PHASE**	**CB AMPS**	**CIRCUIT**	**A**	**B**	**C**	**DIRECTORY**
SPARE				1	**20/3**	A	**20/3**	2	0	0	0	METER
				3		B		4				
				5		C		6				
SSDS BLOWER	2			7	**20/3**	A	**20/3**	8				SPARE
		2		9		B		10				
			2	11		C		12				
HEATER 7.5kW	2.5			13	**20/3**	A		14				BLANK
		2.5		15		B		16				
			2.5	17		C		18				
TRANSFORMER	5			19	**30/2**	A		20				BLANK
		5		21		B		22				
				23		C		24				
MAIN BREAKER				25	**60/3**	A	**30/3**	26	0	0	0	SPD
				27		B		28				
				29		C		30				
SUBTOTAL	9.5	9.5	4.5						0	0	0	SUBTOTAL
SYSTEM: 480Y/277 VAC, 3 PH, 4 WIRE									9.5	9.5	4.5	TOTAL / PHASE
MAIN BREAKER: EDB 60A/3 POLE									23.5			**TOTAL KVA**
BRANCH CIRCUITS: EDB 20A/3 POLE, 30A/2 POLE												
SCCR: 18kA @ 480VAC, FULLY RATED												

ARCADIS - CROSMAN
PANEL BOARD PB-L
BREAKER SCHEDULE

Model: Schneider Electric NQ30L2 with MH44WP enclosure
Type: 3R/5/12, 30 Circuit, Surface Mount

	KVA LOAD							KVA LOAD		
DIRECTORY	**A**	**B**	**CIRCUIT**	**CB AMPS**	**PHASE**	**CB AMPS**	**CIRCUIT**	**A**	**B**	**DIRECTORY**
MCP	1.9		1	**20/1**	A	**20/1**	2	1.5		Heat Trace GFI
Receptacles		1.9	3	**20/1**	B	**20/1**	4		1.5	Heat Trace GFI
Spare			5	**20/1**	A	**20/1**	6	0.2		Ex Fan 0.1 Hp
Interior Lights		1.2	7	**20/1**	B	**20/1**	8			Spare
Spare			9	**20/1**	A		10			
			11		B		12			
			13		A		14			
			15		B		16			
			17		A		18			
			19		B		20			
			21		A		22			
			23		B		24			
			25		A		26			
			27		B		28			
			29		A		30			
SUBTOTAL	1.9	3.1						1.7	1.5	SUBTOTAL
VOLTAGE: 120/240 VAC PHASE: 1 WIRE: 3								3.6	4.6	TOTAL / PHASE
MAIN BREAKER: HD 50A/2P								8.2		**TOTAL KVA**
BRANCH CIRCUITS: QOB 20A/1P, 20A/1P EPD										
SCCR: 10kA FULLY RATED										

Reference	Qty	Units	Description	Material	Part Number
BLOWER, VACUUM SYSTEM					
B-300	1	each	RIETSCHLE MODEL 2BH1610-7HH26-Z 26 SIDE CHANEL BLOWER		
AF-100	1	each	SOLBERG-CSL-235P-300 FILTER, AIR, INLINE, 3" MNPT-300 ACFM	STEEL/POLY ESTER	SOLBERG-CSL-235P-300
V-111	1	each	VALVE, BALL, FNPT, 2" FULL PORT, 600 NSWOG 150 WSP, 0-400°F	BRASS/TFE	MATCO-759T08
AFS-100	1	each	SOLBERG-FS-31P-200 FILTER, AIR, INLET SILENCER, DILUTION FILTER SILENCER, 2" MNPT-135 SCFM	STEEL/POLY ESTER	SOLBERG-FS-31P-200
S-400	1	each	SILENCER, ABSORPTIVE TYPE, MINIMAL PRESSURE DROP, REDUCES HIGH FREQUENCY NOISE UP TO 30dBA, LAYERED SOUND ABSORBENT MEDIA, INLET OR DISCHARGE APPLICATION, UP TO 212F, 15 PSIG, 2 1/2" MNPT I/O, 23.7" LONG, RATED FOR 385 SCFM, 15 PSIG	STEEL/ABSO RBENT MEDIA	SOLBERG-SLCRT250
V-112	1	each	VACUUM RELIEF VALVE, 2" FNPT, 2/229, 5/338, 10/415, 15/426, 20/426 ("HG/SCFM RATING) RATED FOR SERVICE UP TO 29"HG	BRONZE, CAST	KUNKLE-215V-H01AQEXXXX (SET VACUUM, xx INCH Hg)
V-301	1	each	PRESSURE RELIEF VALVE, 2" MNPT, 1/240, 5/531, 10/741, 15/948, 20/1092, 50/2020 (PSIG/SCFM RATING) RATED FOR SERVICE UP TO 60 PSIG, 406°F MAX, WITH LIFT RING	BRONZE, SS, IRON	KUNKLE-0337-H01ANEXXXX (SET PRESURE, xx PSIG)
FI-101	1	each	ROTRON-FM20C225Q VENTURI FLOWMETER, 2" FPT, 45-225 SCFM	ALUMINUM	ROTRON-FM20C225Q-550604
V102-107	7	each	GAUGE, VACUUM, 0-100" WC 2 1/2" DIAL 1/4" MNPT CBM -20-180°F		PIC
	8	each	Miniature Chrome-Plated Brass Ball Valve Wedge Handle, 1/8" NPT Male X 1/8" NPT Female	BRASS	4912K71
SP	8	each	1/4" MNPT BARBED SAMPLE PORT	BRASS	4793K2
PI-301	1	each	GAUGE, PRESSURE, 0-60" WC 2 1/2" DIAL 1/4" MNPT CBM -20-180°F		PIC
TI-102, 301	2	each	THERMOMETER, 20-240°F 3" DIAL 2 1/2" STEM 1/2" MNPT CBM	300 SS	TRERICE-B831X0205
	1	each	4" PVC EXHAUST STACK		
KT-100	1	each	60 GALLON VESSEL WITH MANUAL DRAIN VALVE, 29" Hg MAX	.25 & 10 GA STEEL	PLC-MDXX-WSR60-XXS
LEVEL SWITCHES	1	each	TWO-LEVEL FLOAT SYSTEM (EACH FLOAT HAS ITS OWN SWITCH THAT CAN BE ADJUSTED) ALL INSIDE A CLEAR PVC SITE TUBE		
V-102, 201	2	each	VALVE, BUTTERFLY, WAFER TYPE, LOCKABLE LEVER HANDLE, 4", 200 NSWOG	CAST/ALBRO NZE/EPDM	MILWAUKEE-4CW223E
V-101-201	3	each	GAUGE, VACUUM, 0-100" WC 2 1/2" DIAL 1/4" MNPT CBM -20-180°F		PIC
VI	2	each	Miniature Chrome-Plated Brass Ball Valve Wedge Handle, 1/8" NPT Male X 1/8" NPT Female	BRASS	4912K71
SP	2	each	1/4" MNPT BARBED SAMPLE PORT	BRASS	4793K2
VT	2	each	WIKA VACUUM TRANSMITTER, 2 WIRE 4-20 mA OUTPUT, M12X1 4 PIN CONNECTION CABLE, -0.25 … 0 BAR VACUUM RANGE, STANDARD 0.50% OF SPAN ACCURACY, 10-30 VDC SUPPLY, 1/4" NPT PROCESS CONNECTION,		WIKS S-10
VT	2	each	M12 cable for quick-disconnect sensors, 12mm right-angle female plug, 4-pole, 7 meter length, gray PVC outer jacket		CD12M-0B-070-C1
BUILDING					
BUILDING	1	each	20' SEA CONTAINER, DRY FREIGHT, EXTERIOR DIMENSIONS: 8' W X 8'-6" H X 19'-10 1/2" L, INTERIOR DIMENSIONS: 7'-8 1/2" W X 7'-9 7/8" H X 19'-4 1/4" L, REAR FULL 7'-8 1/2" W X 7'-5 5/8" T DOOR WITH CAMS AND KEEPERS, 67200 LB GROSS, 4755 LB TARE, 62445 LB CAPACITY, HIGH TENSILE STEEL, HARDWOOD FLOOR, NEW CONTAINER OR ONE TRIP	STEEL	
BUILDING	1	each	INSULATION AND INTERIOR FINISH KIT FOR 20' SEA CONTAINER, R 7.5 EXTRUDED POLYSTYRENE INSULATION, 7/16" OSB		PLC-20' SEA CONTAINER INSULATE AND OSB
BUILDING	1		INSULATE THE UNDER SIDE OF THE SEA CONTAINER		
DOOR	1	each	Mastercraft P-1 32" x 80" Flush Steel Prehung Exterior Door - Left Outswing: When pulling the door toward you, the knob is on the left side, Primed and ready to finish, Prehung with 4-9/16" primed wood and high performance weatherstrip, Energy-saving, foam-in-place polyurethane core, Outswing, adjustable, aluminum sill, Double bored and prepped for deadbolt, Rough Opening: 34-1/4" W x 82" H	___/ ___	Menards® SKU: 4141198
DOOR KNOB	1	each	DOORKNOB AND DEADBOLT KIT		KEYED THE SAME 219-6069 DEXTER KEY #33486
DOOR KNOB	1	each	DOOR KEY		DEXTER KEY #33486
DOOR	1	each	Gate Hook With Staple		225-0735
LIGHTS	2	each	Ceiling Mount Metallic Weatherproof Utility Light Kit, Electric Lampholder, Clear Glass Globe, Heavy Duty, Die-Cast Aluminum, Suitable for Wet Locations, Surface Mounted or Mounted to a Junction Box, Listed for Through Branch Wiring, Max Lamp Size 150 Watts, 120VAC, Incandescent Bulb Only		365-2830, CARLON-MCL150C
EXHAUST FAN	1	each	EXHAUST FAN, 12"		JDMFG-VES12C
VENT	1	each	Heavy Duty Fixed-Blade Wall Louver, Drop-in, Extruded Aluminum, 24" Wide x 24" High Opening	AL	2100K252
EXHAUST FAN	1	each	LINE VOLTAGE HEATING OR COOLING INDUSTRIAL THERMOSTAT, 8' REMOTE BULB, -30 TO +100°F, SPDT, 120-277VAC 22AMPS, NEMA 1		McMASTER-1846K26, Johnson Controls A19ABC-24C
HEATER WITH STAT	1	each	17,100 BTU CEILING MOUNT HEATER FORCED AIR 5000 WATTS 3 PHASE 480 VOLT 6.1 AMPS, WITH STAT	3239025	TPI P3P5605T - 5000W 480V 3 PH, B45465, WITH STAT
CARBON					
CARBON	4	each	TETRASOLV MODEL VFV-1000- SD 48 48" DIA BY 59" TALL 4" NPT PORTS WITH 18" TOP MANWAY CW WITH 1000 LBS VIRGIN CARBON		MODEL VFV-1000- SD 48 DRAWINGS TO BE APPROVED BY PLC
VALVES	20	each	Cast Iron Butterfly Valve 4" Pipe, Wafer Style, Lever Handle, EPDM Seat	DUCTILE IRON, EPDM	RED-WHITE FIGURE NO. 937DESL-4"

APPENDIX D

System OMM Logs

System Monitoring Log
Sub-Slab Depressurization System
Crosman Corporation, East Bloomfield, New York

ARCADIS Design & Consultancy for natural and built assets

Date: ____________ **Time:** ____________ **Technician:** ____________

SYSTEM STATUS

	YES	NO	Notes
Is blower running?			
Is virtual hand-off-auto switch in the "auto" position?			
Are electrical panel doors securely closed?			

List any active alarms including date/time of occurrence: ____________

Record electric meter reading (kWh) ____________ Record blower runtime (hours) ____________

SYSTEM PARAMETERS

SDS-1 applied vacuum (in w.c.) (*VI-001*)		Post-air filter/pre-VPGAC-101 vacuum (in w.c.) *(VI-102)*	
SDS-1 header vacuum (in w.c.) (*VI-101*)			
(transmitter VT-101)		Pre-VPGAC-101 vacuum (in w.c.) *(VI-103)*	
SDS-2 applied vacuum (in w.c.) (*VI-002*)		Pre-VPGAC-102 vacuum (in w.c.) *(VI-104)*	
SDS-2 header vacuum (in w.c.) (*VI-201*)		Pre-VPGAC-103 vacuum (in w.c.) *(VI-105)*	
(transmitter VT-201)		Pre-VPGAC-104 vacuum (in w.c.) *(VI-106)*	
Knockout tank level *(inches in site gauge)*		Post-VPGAC-104/pre-dilution vacuum *(VI-107)*	
Influent temperature *(TI-102)*		Post-dilution/pre-blower vacuum *(VI-108)*	
Influent flow rate *(FI-101)*		Post-blower pressure (in w.c.) *(PI-301)*	
SDS-1 Air Velocity (fpm)		Post-blower temperature (°F) *(TI-301)*	
SDS-2 Air Velocity (fpm)			

System Valve Positions

	OPENED	CLOSED		OPENED	CLOSED		OPENED	CLOSED
SDS-1 extraction point valve V-001			V-102			V-111		
SDS-2 extraction point valve V-002			V-103			V-112		
SDS-1 header valve V-101			V-104			V-113		
SDS-2 header valve V-201			V-105			V-114		
Dilution valve V-119			V-106			V-115		
Vacuum relief valve V-120			V-107			V-116		
Pressure relief valve V-301			V-108			V-117		
			V-109			V-118		
			V-110					

GENERAL

Are there any unusual noises, vibrations or odors detected at the system? ____________

Inspect all fittings, piping, relief valves and sample ports for leaks. Note any observations: ____________

Was enclosure secure upon arrival? (Y/N) ____________

Other notes: ____________

Monthly OMM Checklist
Sub-Slab Depressurization System
Crosman Corporation, East Bloomfield, New York

ARCADIS Design & Consultancy for natural and built assets

Date: ____________________ **Time:** ____________ **Technician:** ____________________________________

Task	Frequency	Conducted (Y/N)	Notes
Complete System Monitoring Log	Monthly		
Complete Performance Monitoring Log	Monthly		
Complete Alarm Response Log	As Needed		
Conduct Instantaneous Sub-Slab Differential Pressure Monitoring	See Table 4		
Conduct 24-Hour Continuous Differential Pressure Monitoring	See Table 4		
Conduct System Vapor sampling	See Table 5		
Blower Inspection	Monthly		
Knockout Tank Liquid Level Check and/or Draining (1)	Monthly		
Condensation Check (1)	Monthly		
In-Line Air Filter Element Inspection and/or Replacement (2)(3)	Monthly		
Dilution Line Air Filter Element Inspection and/or Replacement	Monthly		
Extraction Point Riser Inspection	Monthly		
Discharge Stack Inspection	Monthly		
Knockout Tank Liquid Level Switches Test(4)(5)	Annual		
Vacuum Transmitters Test (4)(6)	Annual		
Vacuum Relief Valve Test (should open at 80 in w.c. vacuum)	Annual		
Alarm Notification Test	Annual		
VPGAC Changeout	Annual		
Blower Voltage and Current Check (3)	As Needed		

Notes:

1) Condensation shall be containerized and disposed of in coordination with Crosman Corporation's procedures.
2) System shall be shutdown prior to performing.
3) Lockout/tagout and work on energized equipment shall be conducted in accordance with Arcadis Safety Program.
4) Will cause system shutdown.
5) Knockout tank shall be filled with water using lower drain port.
6) Vacuum transmitters VT-101 and VT-201 shall read between +/- 5% of vacuum gauges VI-101 and VI-201, respectively.

Performance Monitoring Log
Sub-Slab Depressurization System
Crosman Corporation, East Bloomfield, New York

Date: ____________________ **Time:** ____________ **Technician:** ____________________________________

System Status

	YES	NO	Notes
Is blower running?			
Was monthly OM&M Log Sheet completed?			
Was instantaneous sub-slab differential pressure monitoring conducted?			
Was air sampling conducted?			
Was 24-hour continous differential pressure monitoring conducted?			

Indicate indoor air temperature (°F): ____________

Sub-Slab Differential Pressure Monitoring

Vacuum Monitoring Point	Instantaneous Differential Pressure (in w.c.) [*use negative sign to indicate vacuum*]	24-Hour Continuous Monitoring Conducted (Y/N)
VMP-1		
VMP-2		
VMP-3		
VMP-4		
VMP-5		
VMP-6		
VMP-7		
VMP-8		
VMP-9		
VMP-10		
VMP-11		
VMP-12		

System Vapor Sampling

Sample Location	Sample Collected (Y/N)	Time	Grab or Integrated Sample?	Canister Vacuum (inHg)		PID Measurement
				Start	Finish	

Alarm Response Log
Sub-Slab Depressurization System
Crosman Corporation, East Bloomfield, New York

ARCADIS Design & Consultancy for natural and built assets

Date: ____________________ **Time:** ____________ **Technician:** ____________________________________

Alarm Condition:

____
____
____

Cause of Alarm:

____
____
____

Corrective Action:

____
____
____
____
____
____
____
____
____
____
____
____
____
____

APPENDIX E

Standard Operating Procedures

SOP Author:	Arcadis
SOP #:	SSDS SOP-01
Revision #:	1
Date Implemented:	July 2016
Approval:	

Crosman Corporation – SSD System Vapor Sampling

Description

This SOP is to be used when performing vapor sampling of the SSD system.

Abbreviations

KT	Knockout Tank
LSH	Level Switch High
PI	Pressure Indicator
PS	Pressure Switch
SOP	Standard Operating Procedure
SP	Sample Port
SSDS	Sub-Slab Depressurization System
VI	Vacuum Indicator
VT	Vacuum Transmitter

System Sampling

1. System sampling locations and frequency shall be in accordance with Table 6 in the OM&M Plan.

2. Grab samples will be collected directly from the sample ports. Sample locations are shown on Drawing M-1. Samples should be analyzed using USEPA Method TO-15 and submitted to the approved testing laboratory.

3. At each sampling port location the threaded male ¼” plug will have to be removed and replaced with a clean brass or stainless steel ¼” male NPT x 3/16” barb fitting. The barbed fitting shall be cleaned in accordance with the site-specific Field Sampling Plan / Quality Assurance Assessment Program.

Photo 1: SDS-1 Sampling Location

Photo 2: Particulate Filter

4. Obtain the lab-provided 1-liter Summa canister. Make sure that the canister valve is 100% closed (i.e, turned clockwise, hand-tight).

5. Note that the Summa canisters are under vacuum. As soon as the canister valve is opened a sample is being collected.

6. Use a wrench to tighten/loosen lab-provided threaded Swagelok fittings. Be sure not to overtighten fittings (each joint contains compression fitting).

7. Remove the threaded cap from the canister. Attach the lab-provided vacuum gauge. If the gauge fitting contains a tee fitting then attach the threaded cap to the tee fitting so the

Crosman Corporation –
SSD System Vapor Sampling

SOP Author:	Arcadis
SOP #:	SSDS SOP-01
Revision #:	1
Date Implemented:	July 2016
Approval:	

gauge is not open to atmosphere. Open the canister valve a ½ turn. Record the vacuum reading.

8. The initial vacuum reading should be around 30 inches of mercury. If the vacuum is less than 28 inches of mercury then contact the laboratory to confirm the canister may be used.

9. Close the canister valve 100% (i.e., turn clockwise). Remove the vacuum gauge.

10. Attach the lab-provided particulate filter.

11. Attach the lab-provided compression fitting to the end of the particulate filter.

Photo 3: Top of Summa Canister, Removing Cap

12. Obtain a short section of lab-provided Teflon tubing (1/4" OD x 3/16" ID). Connect one end of the tubing to the compression fitting on the Summa canister and the other end to the barbed fitting on the sample port. Use a hose clamp to tighten the tubing onto the barb. Be sure not to overtighten the hose clamp.

13. If the sample port has an inline valve, then open the valve 100%.

14. To collect the sample, open the Summa canister valve a ½ turn (turn counter-clockwise). Sufficient sample volume should be collected after 1 minute.

15. After 1 minute close the canister valve 100% and remove the particulate filter. Attach the lab-provided vacuum gauge. If the gauge fitting contains a tee fitting then attach a threaded cap to the tee fitting so the gauge is not open to atmosphere. Open the canister valve a ½ turn and record the vacuum reading.

16. The vacuum reading should be less than 5 inches of mercury. If the vapor stream being sampled is under vacuum then the canister vacuum at the conclusion of the sampling may read approximately the vacuum of the vapor stream. If the vapor stream being sampled is under pressure then the canister vacuum at the conclusion of the sampling may read approximately 0 inches of mercury. If the vacuum reading is greater than 5 inches of mercury, then additional sample volume is required.

17. If the canister vacuum is between 0 and 5 inches of mercury, then sampling is complete. Close the canister valve 100%, disconnect the vacuum gauge and attach the threaded cap. Remove the barbed fitting from the sample port and thread the male ¼" plug.

SOP Author:	Arcadis
SOP #:	SSDS SOP-02
Revision #:	1
Date Implemented:	July 2016
Approval:	

Crosman Corporation

Sub-Slab Continuous Monitoring

Description

This SOP is to be used when performing sub-slab continuous monitoring.

Abbreviations

KT	Knockout Tank
LSH	Level Switch High
PI	Pressure Indicator
PS	Pressure Switch
SOP	Standard Operating Procedure
SP	Sample Port
SSDS	Sub-Slab Depressurization System
VI	Vacuum Indicator
VT	Vacuum Transmitter

Sub Slab Continuous Monitoring

1. 24-hour continuous sub-slab differential pressure monitoring is to be conducted at the locations and frequencies in accordance with Table 5 in the OM&M Plan.

2. The OmniGuard 4 differential pressure recorder is a micromanometer with data logging capabilities. This device or an equivalent will be used and set to record continuous pressure differential readings.

Instructions for Installing Continuous Monitoring and Data Logging Devices

1. Plug unit into extension cord or connect to portable battery and power on by pushing the "POWER ON/OFF" key (See Figure 1, #1).

2. Set the upper and lower alarm limits as follows:
   a. Press the "MENU" (See Figure 1, #2) button to view the main menu.
   b. Scroll to the "ALARM SETPOINTS" option using the up and down arrow keys (Figure 1, #3) and press the "SELECT" (Figure 1, #4) button.
   c. Use the up and down arrow keys (Figure 1, #3) to change the Alarm 1 set point. Note that you can only change the values in increments of 0.005 inches of water column. Set the Alarm 1 set point to -0.245 inches of water column. Once the alarm is at the appropriate value, press the right arrow key (Figure 1, #5) to move to the Alarm 2.
   d. Set the Alarm 2 set point using the up and down arrow keys (Figure 1, #3). The Alarm 2 set point should be set to -0.005 inches of water column. Once the appropriate value is selected, press the "SAVE" (Figure 1, #6) key to return to the main menu.

3. Set the print/log rates as follows:
   a. Scroll through the menu using the up and down arrow keys (Figure 1, #3) until the "PRINT/LOG RATES" is highlighted. Press the "SELECT" (Figure 1, #4) button.
   b. Use the up and down arrow keys (Figure 1, #3) to change the "NORMAL RATE". Set the "NORMAL RATE" to 5 minutes. Once the 5 minute option is highlighted, press the right arrow key (Figure 1, #5) to move to the "ALARM RATE".
   c. Use the up and down arrow keys (Figure 1, #3) to change the "ALARM RATE". Set the "ALARM RATE" to 120 seconds (2 minutes). Once the appropriate value is highlighted, press the "SAVE" (Figure 1, #6) key to return to the main menu.

4. Set the response rate as follows:
   a. Scroll through the main menu using the up and down arrow keys (Figure 1, #3) until the "RESPONSE RATE" option is highlighted. Press the "SELECT" button (Figure 1, #4).
   b. Use the up and down arrow keys (Figure 1, #3) to scroll to the appropriate

rate. The “RESPONSE RATE” should be set to “SLOW”. Once the “SLOW” option is highlighted, press the “SAVE” (Figure 1, #6) key to return to the main menu. Document what the response rate was set to on the system parameter form.

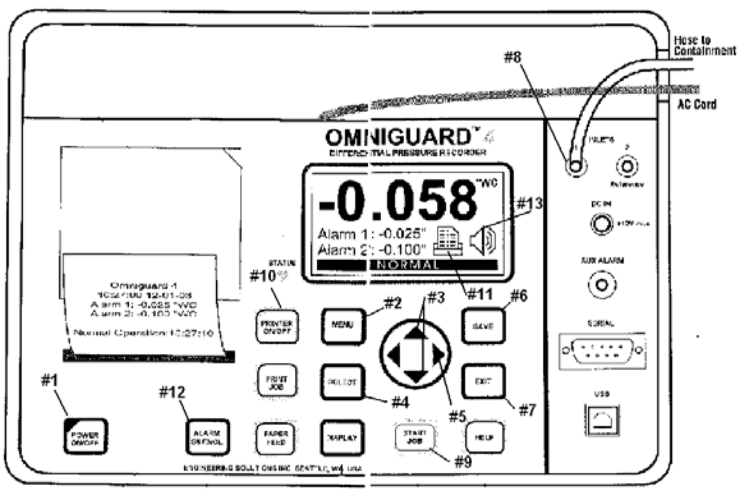


Figure 1: Schematic of OmniGuard 4

5. Press the “EXIT” (Figure 1, #7) button on the data logger to return to the main screen.

6. Connect one end of the tubing to “Inlet 1” (Figure 1, #8) on the data logger, and connect the other end to the monitoring point.

7. Start the data logging as follows:
   a. Press the “START JOB” (Figure 1, #9) key on the data logger.
   b. Enter the name of the location where the data logger is being installed using the up and down arrow keys (Figure 1, #3). Once the name is complete, press the “SAVE” (Figure 1, #6) button. This will start the current data logging job.

8. Turn off the printing option on the data logger as follows:
   a. Press the “PRINTER ON/OFF” button (Figure 1, #10) on the data logger. Confirm that the printer is off by checking the printer symbol on the main screen (Figure 1, #11); it should have an X through it. If it does not, press the “PRINTER ON/OFF” (Figure 1, #10) key until there is an X through the symbol.

9. Turn off the audible alarm as follows:
   a. Press the “ALARM SILENCE” (Figure 1, #12) key on the data logger. Confirm that the audible alarm is off by checking the sound symbol on the main screen (Figure 1, #13); it should have an X through it. If it does not, press the “ALARM SILENCE” (Figure 1, #12) key until there is an X through the symbol.

10. Ensure that the instrument is recording:
    a. The green light will stop flashing and the status display will change from “WAITING FOR PRESSURE” to NORMAL OP”.
    b. Note that the instrument will not begin recording until the measured value is between the two alarm set points. If a pressure is not displayed on the main screen, use a portable micromanometer with a measurable pressure range greater than the OmniGuard 4 to determine if the pressure is above or below the alarm set points.

Downloading the Data

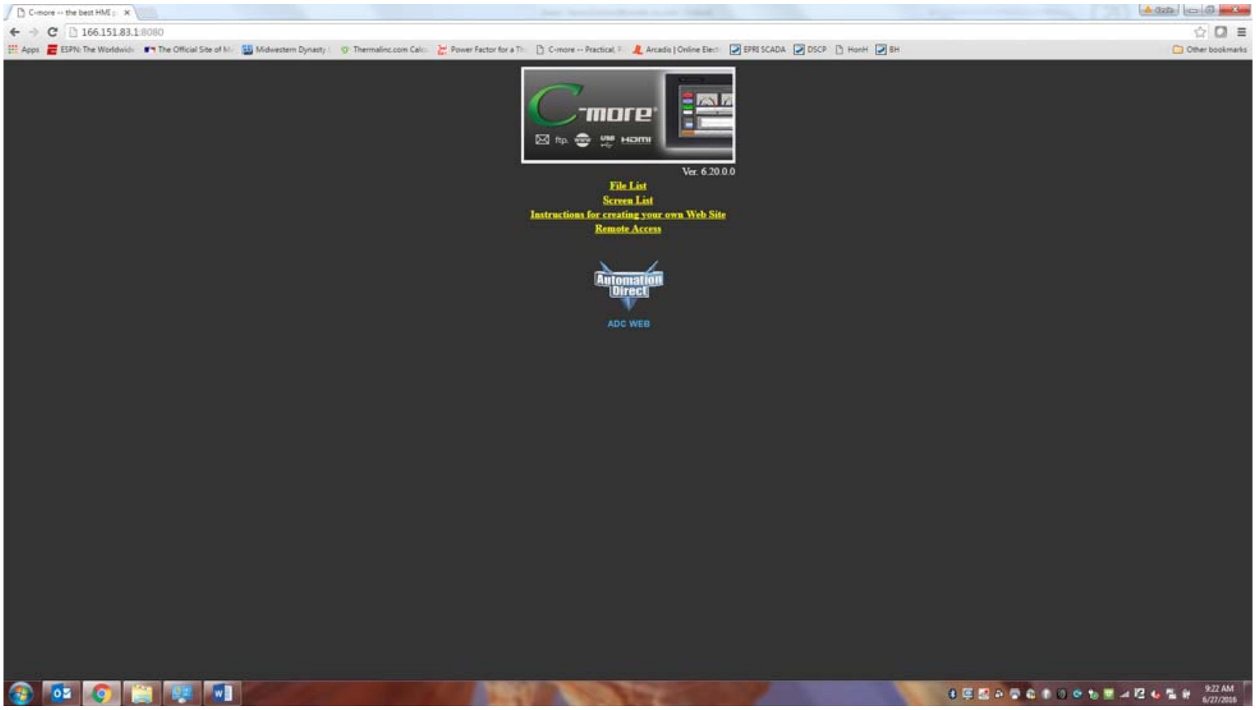
After installing the necessary communication software (OmniGuard Communication Software) on a computer, the data may be downloaded.

If the OmniGuard unit will be moved to a different location for downloading of the data, the unit may be turned off using the “POWER ON/OFF” button. To communicate with the OmniGuard, the OmniGuard will need to be turned on and connected to your computer using one of the cables provided. After the desired files are downloaded from the OmniGuard, make sure that the files are named correctly and provide to the GE Project Manager.

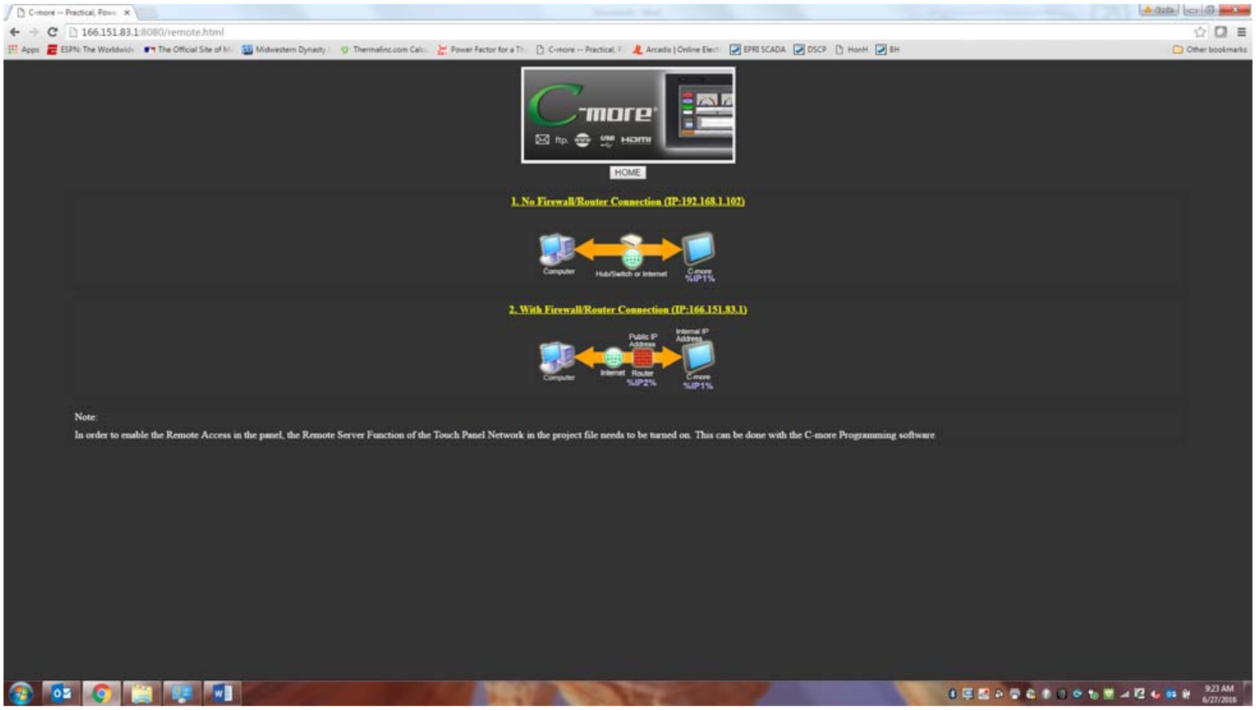
Crosman Corporation
Remote Access Instructions
SSDS SOP-03

Step 1: If ARCADIS employee, then disable unified agent software in task bar

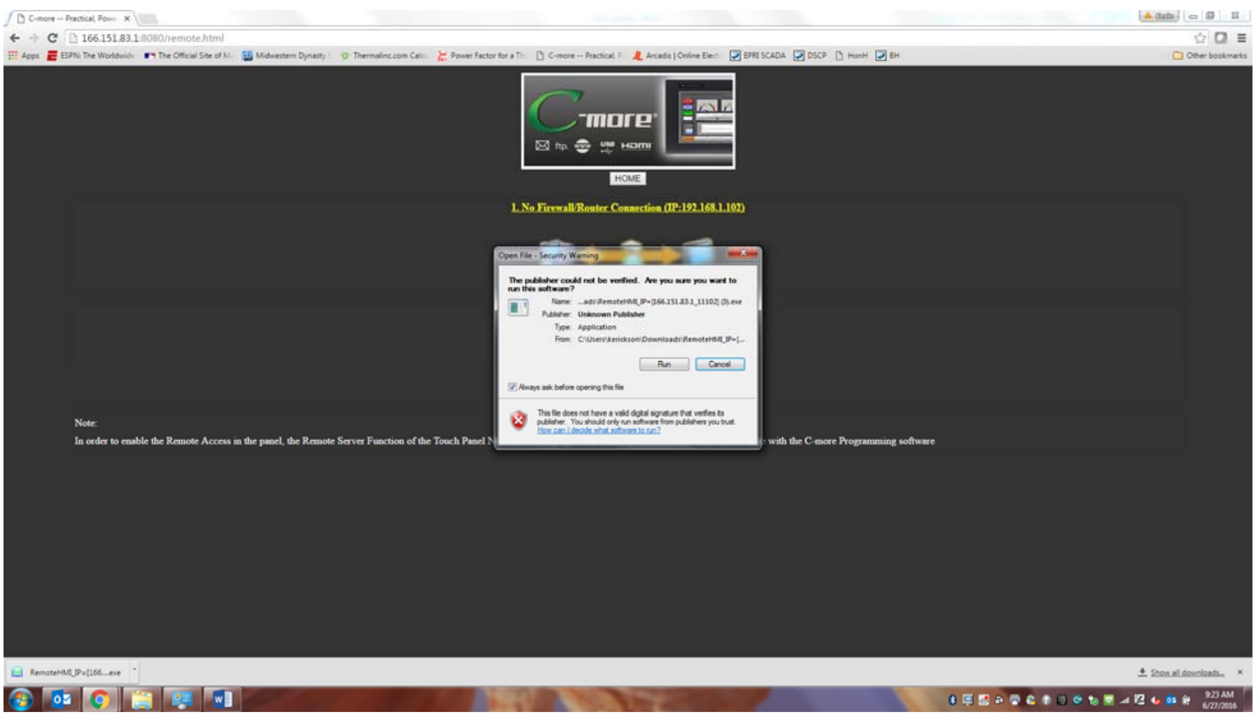
Step 2: Open a web browser and type in the following to the address bar: 166.154.153.235:8080



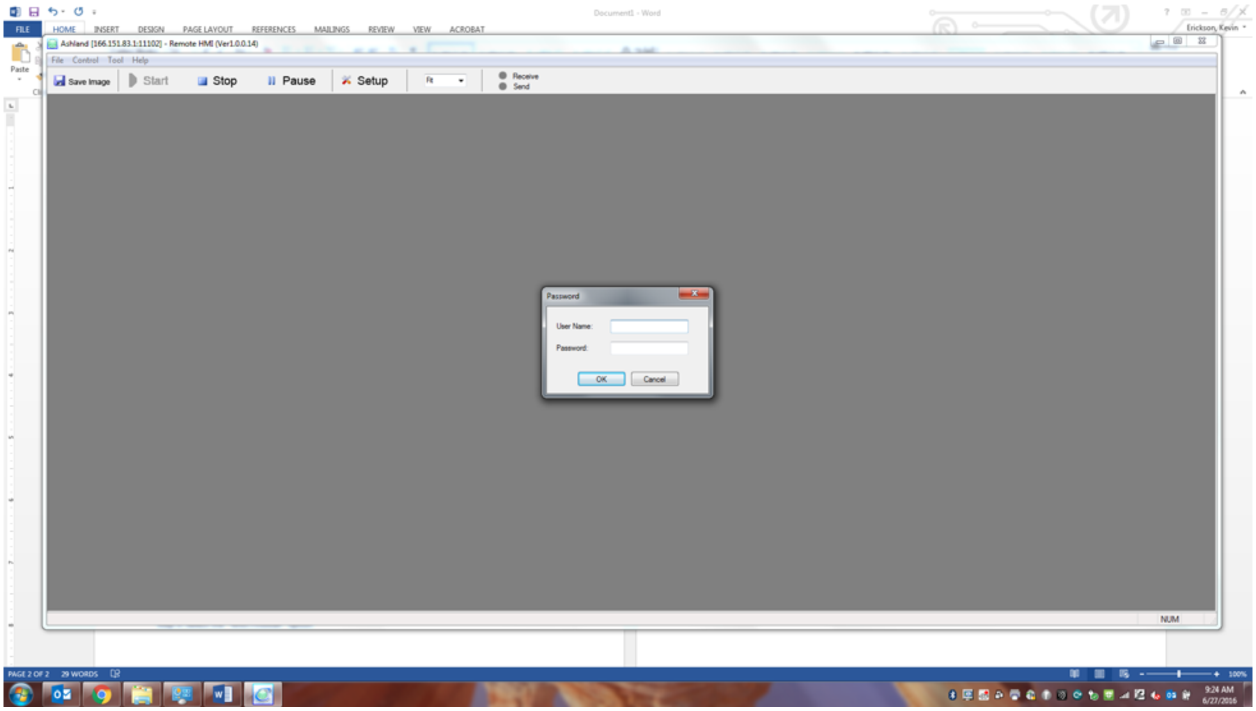
Step 2: Select the “Remote Access” option



Step 3: Select the "With Firewall" option



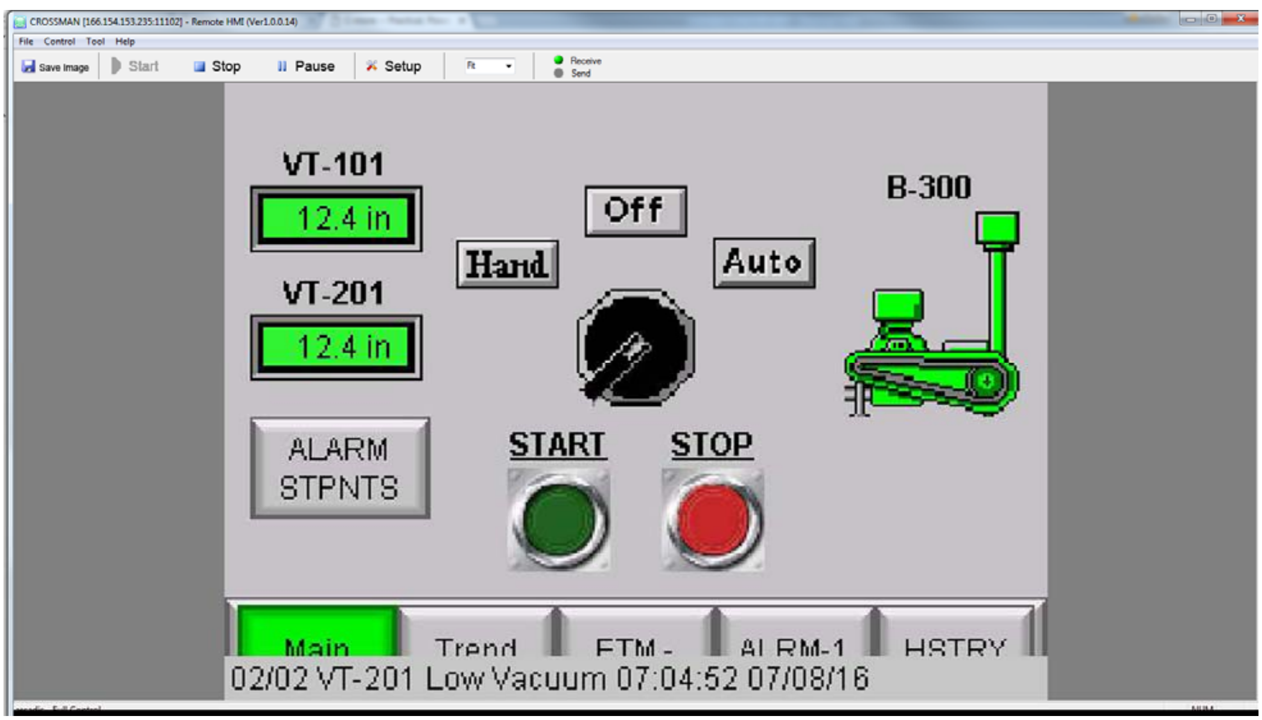
Step 5: A file will download, open if it doesn't open automatically, and select "Run"



Step 6: Log in credentials are prompted for, use the below:

User Name: arcadis

Password: 5alamander



Step 7: Control system as if in front of the screen

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