

Interim Remedial Measure (IRM) Work Plan

Buildings 1A and 3A Active Subslab Depressurization System

BCP Site #C915315
170 Jamison Road Site

Revised October 2017

0400-017-001

Prepared For:

Moog Inc.



Prepared By:



INTERIM REMEDIAL MEASURE (IRM) WORK PLAN

BUILDINGS 1A AND 3A ACTIVE SUBSLAB DEPRESSURIZATION SYSTEM

**170 JAMISON ROAD SITE
ELMA, NEW YORK**

(NYSDEC BCP SITE No. C915315)

Revised October 2017

0400-017-001

Prepared for:
MOOG INC.

Prepared by:



Benchmark Environmental Engineering & Science, PLLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716)856-0599

CERTIFICATION

I, Thomas H. Forbes, P.E., certify that I am currently a NYS registered professional engineer and that this Interim Remedial Measures Work Plan (IRMWP) Buildings 1A and 3A Active Sub-slab Depressurization (ASD) System for the 170 Jamison Road Site (Site No. C915315) was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

License No.: 070950

Date: 11-7-17

Registration State: New York

SEAL:



INTERIM REMEDIAL MEASURES WORK PLAN
ACTIVE SUBSLAB DEPRESSURIZATION SYSTEM
170 Jamison Road Site
Elma, New York

1.0	INTRODUCTION.....	1
1.1	Background and History.....	1
2.0	Active Sub-Slab Depressurization (ASD) System Design & Installation	2
2.1	General	2
2.2	ASD System Design	3
2.3	ASD System Installation.....	4
3.0	Post Mitigation/ Confirmation Testing	5
3.1	General	5
3.2	Visual Inspection.....	5
3.3	ASD System Confirmation.....	5
4.0	ASD System Operation, Maintenance, & Monitoring	7
4.1	ASD System Operation	7
4.2	Annual Certification/Inspection	7
4.3	System Failure Protocols	8

**INTERIM REMEDIAL MEASURES WORK PLAN
ACTIVE SUBSLAB DEPRESSURIZATION SYSTEM**

**170 Jamison Road Site
Elma, New York**

LIST OF FIGURES

Figure No.	Description
Figure 1	Site Location and Vicinity Map
Figure 2	Site Plan
Figure 3	Active Sub-slab Depressurization System Layout
Figure 4	Active Sub-slab Depressurization System Design

LIST OF APPENDICES

Appendix	Description
1	Exhaust Fan Product Information
2	Warning Device Products Information

1.0 INTRODUCTION

This document presents the proposed active subslab depressurization (ASD) system design for the new building(s) construction planned for the 170 Jamison Road Brownfield Cleanup Program (BCP) site (Site), located at 170 Jamison Road, Elma, New York (see Figures 1 and 2).

1.1 Background and History

The Applicant, Moog Inc. (Moog), has elected to pursue cleanup and redevelopment of the Site under the New York BCP and submitted a BCP application to the New York State Department of Environmental Conservation (NYSDEC), which was approved and a Brownfield Cleanup Agreement (BCA) signed in June 2017 (BCP Site No. C915315).

The Site has historically been used for designing and supplying aircraft and missile components, has operated as a design, manufacture, and supply facility from 1951 to present, and is currently active. The property is zoned commercial and industrial. Moog's plans are to add on to existing Buildings 1 and 3 by constructing a 2-story addition consisting of a building footprint of nominally 45,950 square feet (sf).

A Remedial Investigation/Alternative Analysis (RI/AA) Work Plan was submitted to the NYSDEC and approved in June 2017. The RI field work was implemented in June and July 2017. Results of the RI, including soil, groundwater, stormwater, soil vapor and sub-slab vapor/indoor air sampling, were presented to the NYSDEC during a meeting in August 2017. On the basis of this meeting and subsequent discussions with Moog and the NYSDEC, it was determined that supplemental storm water and groundwater sampling was required to more fully characterize the extent of residual chlorinated solvents that exist in Site groundwater and stormwater. Moog recently submitted a Supplemental Remedial Investigation (SRI) and Interim Remedial Measures (IRM) work plan. This work plan addresses the additional sampling and testing planned and two IRMs: one of which details the soil excavation required to support the building construction, and the other which details plans to install ASD systems in existing Buildings 1 and 3. The purpose of this ASD IRM Work Plan is to document the measures to be undertaken by Moog to protect the new Buildings 1A and 3A from potential soil vapor intrusion from residual subsurface contamination.

2.0 ACTIVE SUB-SLAB DEPRESSURIZATION (ASD) SYSTEM DESIGN & INSTALLATION

2.1 General

An ASD system creates a low-pressure zone beneath a building slab using a powered fan connected via piping to create negative pressure beneath the building foundation. The low pressure field prevents soil gas from entering the building. Generally, essential components of an ASD include:

- a clean layer of washed crushed No. 1 or No. 2 stone aggregate beneath the slab (typically 6" thick);
- installation of a 4" perforated piping installed in the aggregate beneath the slab for each building area;
- installation of a 6" vent stack from the 4" piping to the roof;
- installation of a continuous operation fan equipped with a pressure gauge to assure the system is under negative pressure; and,
- sealing all major slab and foundation penetrations, including joints, cracks and utility and pipe penetrations.

The ASD system for this project has been designed in accordance with the EPA design document entitled "Radon Prevention in the Design and Construction of Schools and Other Large Buildings" Third Printing with Addendum, June 1994, the NYSDOH "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" dated October 2006, and (ASTM) "Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings". The designed system consists of a polyolefin vapor barrier, approximately 1,100 feet of 4" perforated PVC piping, three (3) vertical piping vent stacks and associated materials, three (3) exhaust fans, and three (3) Magnahelic® pressure gauges. The following text details portions of the design criteria, methodology, and critical installation methods.

2.2 ASD System Design

The performance objective of the ASD is to achieve and maintain a minimum negative pressure differential of -0.004 inches of H₂O within the sub-slab of the approximate 46,000 square foot area identified for ASD. Structural requirements for the building will require a 6" compacted aggregate to be placed under the slab. Four-inch perforated PVC piping will be installed in the aggregate as shown on Figure 3. The system design will consist of three (3) independently operating blowers and vent stacks.

A 10-mil polyolefin vapor barrier (Perminator® manufactured by WR Meadows or similar) will be placed above the aggregate prior to pouring the concrete floor slab as a passive secondary engineering control and to assist in maintaining a sub-slab pressure differential. The 4" perforated piping will be connected to a 6" vertical solid PVC vertical pipe and will be extended above the roof line. The pipe will be supported at penetrations of floors and ceilings. The vent will exhaust a minimum of 12-inches above the surface of the roof and at least 10 feet away from any air intake (refer to Figure 4).

A differential pressure indicating transmitter, Magnehelic® gauge, (Dwyer Model 605-2 or similar) will be installed on the vertical vent pipe approximately 5 feet above the floor at a location agreeable with the building maintenance supervisor (See Appendix 2). The Magnehelic gauge will measure and display the instantaneous negative pressure produced by the fan and indicates the system is operational.

A RadonAway® Model RP380 fan (or similar fan; refer to Appendix 1 for specifications) will be installed in-line with each vent pipe on the roof or above the ceiling of the second floor to provide negative pressure in the sub-slab aggregate. Each fan will be hard-wired to a dedicated electrical circuit for which a dedicated breaker will be installed and properly labeled in the breaker box.

Upon system installation all slab, wall, floor or ceiling penetrations, expansion joints, cracks, and/or any other gaps in the slab and/or subsurface walls, will be sealed using a polyurethane sealant or non-shrink grout applied in accordance with manufacturer's instructions.

Continuous remote monitoring of the ASD system will be done using a Sensaphone® Cell 682 auto-dialer (or equivalent; refer to Appendix 2 for specifications), which provides a website-based platform to monitor vacuum measurements and transmit alarm notifications via email and/or voice-based messaging if the vacuum falls below user-prescribed levels. A battery backup provides continued monitoring/notification in case of a

power failure. The 4-20 mA scalable output signal from each of the magnehelic gauges will be tied to the auto-dialer, which will be converted to vacuum in inches of water column to facilitate website monitoring. A list of designated personnel will be contacted in the event of an alarm condition (e.g., vacuum drops below 50% of normal conditions, indicative of fan failure or extraction piping obstruction/break) with repeat contacts made until the alarm condition is acknowledged.

2.3 ASD System Installation

The ASD system will be installed in accordance with the design criteria and specifications contained in Figures 3 & 4 of this document and/or typical construction practices.

Installation of the sub-slab aggregate, 4" sub-slab piping, and the 10-mil polyolefin vapor barrier will be completed prior to pouring the slab. All other piping and fixtures will be installed following significant completion of the overall structure, and/or at the scheduling discretion of the owner and contractor. The vertical vent pipes will be labeled "Sub-Slab Vent Pipe" with 3 inch high letters on both floors.

An exhaust fan (refer to Appendix 1 for specifications) will be installed and vented a min. of 12-inches above the finished roof elevation for each system. Each fan will be hard-wired to a dedicated electrical circuit for which a dedicated breaker will be installed and properly labeled in the breaker box.

Each vent stack will extend above the exhaust fan to a point not less than 12-inches above the finished roof elevation to which a rain cap will be fastened. The vent pipe wall penetration will be sealed using a polyurethane sealant applied in accordance with the manufacturer's instructions.

Upon system installation all penetrations, expansion joints, cracks, and/or any other gaps in the slab and/or subsurface walls, will require a polyurethane sealant or non-shrink grout to be applied in accordance with manufacturer's instructions.

3.0 POST MITIGATION/ CONFIRMATION TESTING

3.1 General

The ASD System will require performance testing to confirm the system's effectiveness and proper installation. Post-mitigation testing will be conducted prior to building occupation and within 60 days of system installation. The following steps will be performed, documented, and then reported in the Final Engineering Report.

3.2 Visual Inspection

All system components will be visually inspected by a qualified person to ensure proper installation. With the depressurization system operating, smoke tubes may be used to check for leaks through floor joints and at suction points. Any leaks will be identified, noted, and repaired prior to continuing with testing and confirmation.

3.3 ASD System Confirmation

A field test will be conducted to confirm the negative pressure created beneath the slab. Nominal 1/4 inch-diameter holes will be drilled through the concrete slab at up to 10 locations in Building 3A, up to 6 locations in Building 1A, and 4 locations in the southern portion of Building 1A, as shown on Figure 3. Points will be located strategically through the buildings to demonstrate that the project objective has been met (i.e., creation of a negative pressure zone beneath the building slab of at least -0.004" of WC)¹. With the depressurization system operating, the vacuum will be measured using a handheld digital micro-manometer or comparable instrument at the test locations. One sample point in Building 1A and two sample points in Building 3A will be converted to permanent sampling points to allow for long-term monitoring; these sample locations were selected based on their locations within mechanical and electrical rooms for future ease of access.

If adequate depressurization is not occurring the following procedures will be enacted:

- All testing procedures will be repeated to ensure proper testing protocol
- Client and NYSDEC personnel will be informed of inadequate vacuum results

¹ Upon completion of the testing, the holes will be sealed with polyurethane caulk.

Troubleshooting of the system will then be completed, including the following:

- Confirmation of fan operation;
- Inspection of and sealing of all major entry routes and penetrations (if necessary);
- Inspection of the HVAC system and determination whether the HVAC system has a negative effect on the performance of the ASD system.

Upon completion of troubleshooting as described above, if re-testing sub-slab test points indicates insufficient communication the following measures will be considered:

- Adjustment of the HVAC system;
- Installation of vacuum suction points; and/or
- Fan modification or replacement.

4.0 ASD SYSTEM OPERATION, MAINTENANCE, & MONITORING

4.1 ASD System Operation

This ASD System has been designed for continuous operation with minimal maintenance and/or operational oversight. A “normal” operating pressure will be established for each fan by measuring the pressure at each Magnehelic gauge and establishing a benchmark. Initially, the pressure will be measured approximately 4 hours after initial system start-up. Another reading will be taken and recorded after approximately 1 week of operation to check if significant change in pressure readings is observed relative to the initial “normal” operating pressure. If there is a significant pressure difference from the “normal” operating pressure, additional inspections will be made until the pressure stabilizes. If readings do not stabilize within four weeks, troubleshooting of the system will be completed as described in Section 3.3.

4.2 Annual Certification/Inspection

An annual system certification inspection and report documenting that the system is performing properly and remains effective will be required by the NYSDEC and is to be certified by a professional engineer or environmental professional. The certification report will contain an annual inspection checklist. The annual inspection will require:

- system components to be visually inspected by a qualified person;
- the exhaust fan to be inspected for signs of abnormal operation or bearing failure (service and/or replacement if necessary);
- discharge location inspection - to verify no air intake has been located nearby vent pipes;
- HVAC system inspection to determine if it is being maintained and operated as designed; and,
- detailed floor, wall, and slab inspection for cracks (resealing if necessary); smoke tubes may be used to check for leaks through floor joints and at suction points with the ASD system running.

4.3 System Failure Protocols

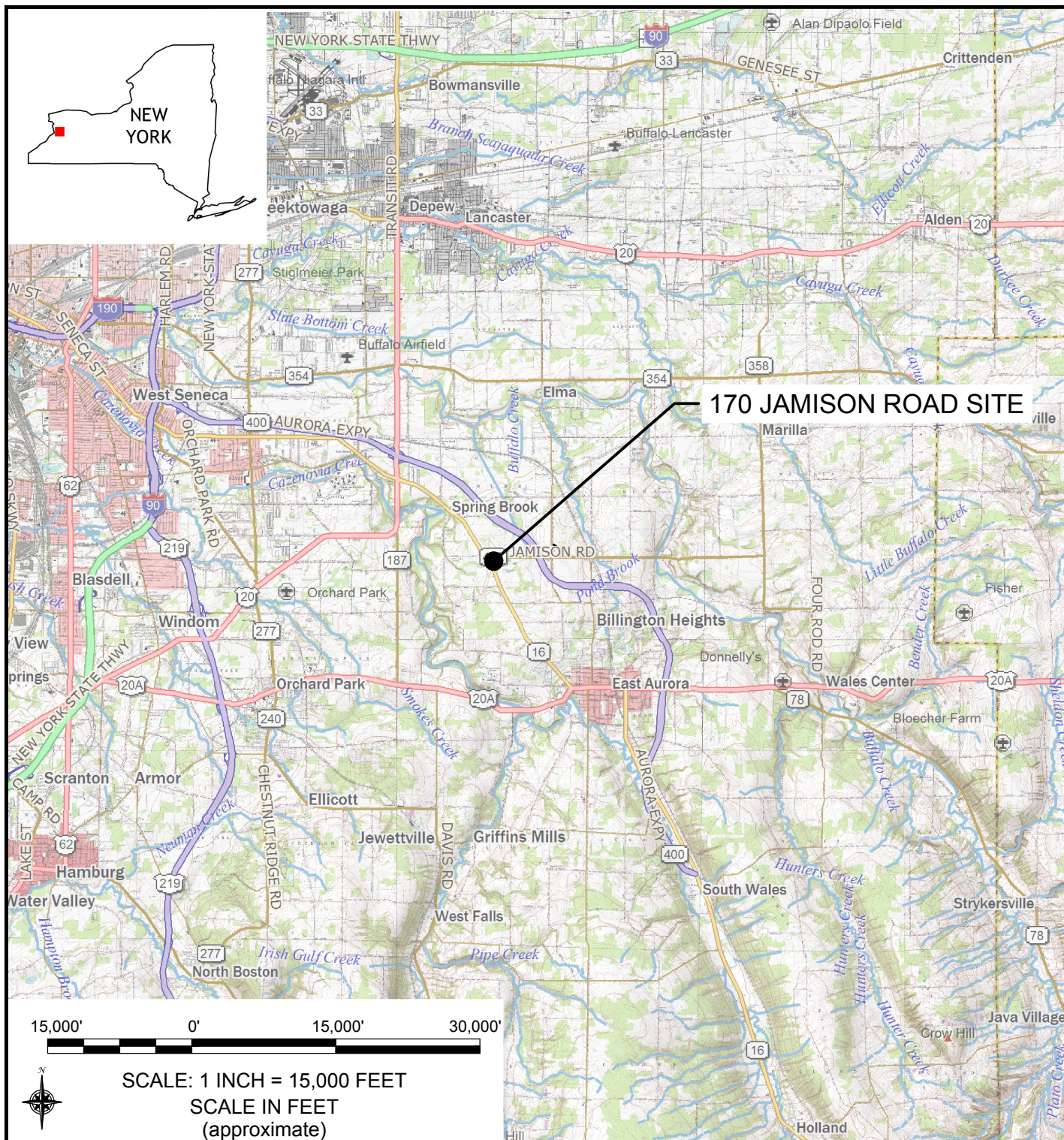
In the event that the system is not working properly (i.e., loss of vacuum), the Sensaphone® Cell 682 auto-dialer (see Appendix 2) or equivalent will contact designated personnel with repeat contacts made until the alarm condition is acknowledged. The following protocol should be followed:

- The building owner/operator and head maintenance person will be contacted immediately;
- The building owner/operator will apprise the NYSDEC of the system failure;
- The date and time will be recorded;
- The warning device will be identified (e.g., Magnehelic Gauge 1, 2, etc.)
- The fans will be inspected to confirm operation; if a circuit breaker was tripped causing the fan to cease operation, the circuit breaker will be reset; and,
- System components will be visually inspected for signs of damage or dysfunction.


If the system failure is not remedied, the building owner should contact a qualified engineer or other person with experience in ASD systems to inspect the system and take the necessary measures to place the system back in service. The NYSDEC will be apprised of any system failure or other defect that compromises the system in accordance within 48-hours or as otherwise required in the approved site management plan; full monitoring and notifications requirements will be detailed in the final site management plan, which will supersede this document.

FIGURES

FIGURE 1



170 JAMISON ROAD SITE

	<p>2558 HAMBURG TURNPIKE SUITE 300 BUFFALO, NY 14218 (716) 856-0599</p>	<h2>SITE LOCATION & VICINITY MAP</h2> <p>ASD SYSTEM DESIGN REPORT</p> <p>170 JAMISON ROAD SITE ELMA, NEW YORK</p> <p>PREPARED FOR MOOG INC.</p>
<p>PROJECT NO.: 0400-017-001</p>		
<p>DATE: SEPTEMBER 2017</p>		
<p>DRAFTED BY: RFL</p>		

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LEGEND:

- BCP SITE BOUNDARY
- PARCEL BOUNDARY
- PLANNED BUILDING ADDITION

NOTES:

- GOOGLE IMAGE FROM OCTOBER 2016



SCALE: 1 INCH = 100 FEET
SCALE IN FEET
(approximate)



SITE PLAN

ASD SYSTEM DESIGN
170 JAMISON ROAD SITE
ELMA, NEW YORK

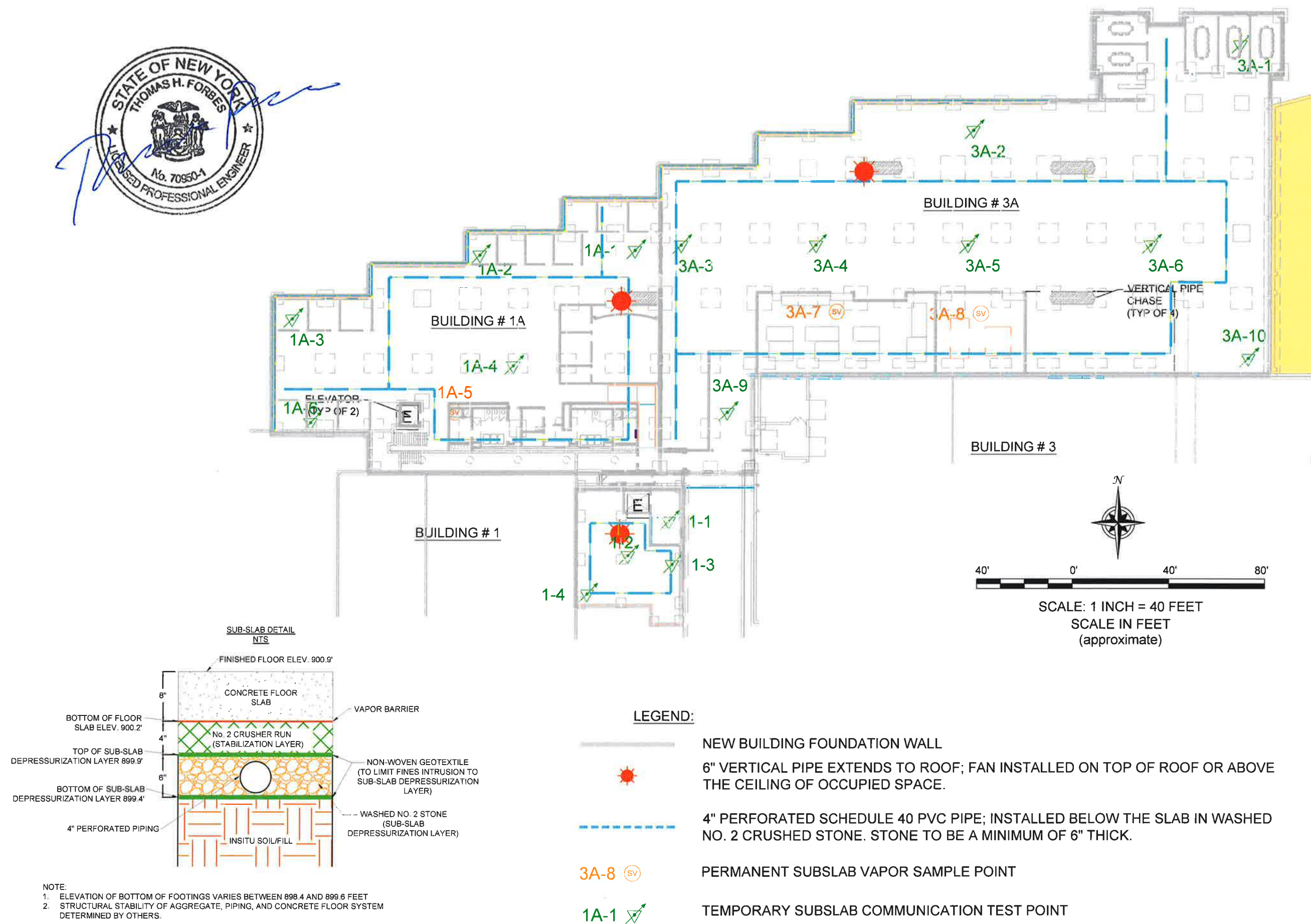
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FIGURE 2

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NEW BUILDINGS ASD SYSTEM LAYOUT

ASD SYSTEM DESIGN REPORT
170 JAMISON ROAD SITE
ELMA, NEW YORK

PREPARED FOR
MOOG INC.

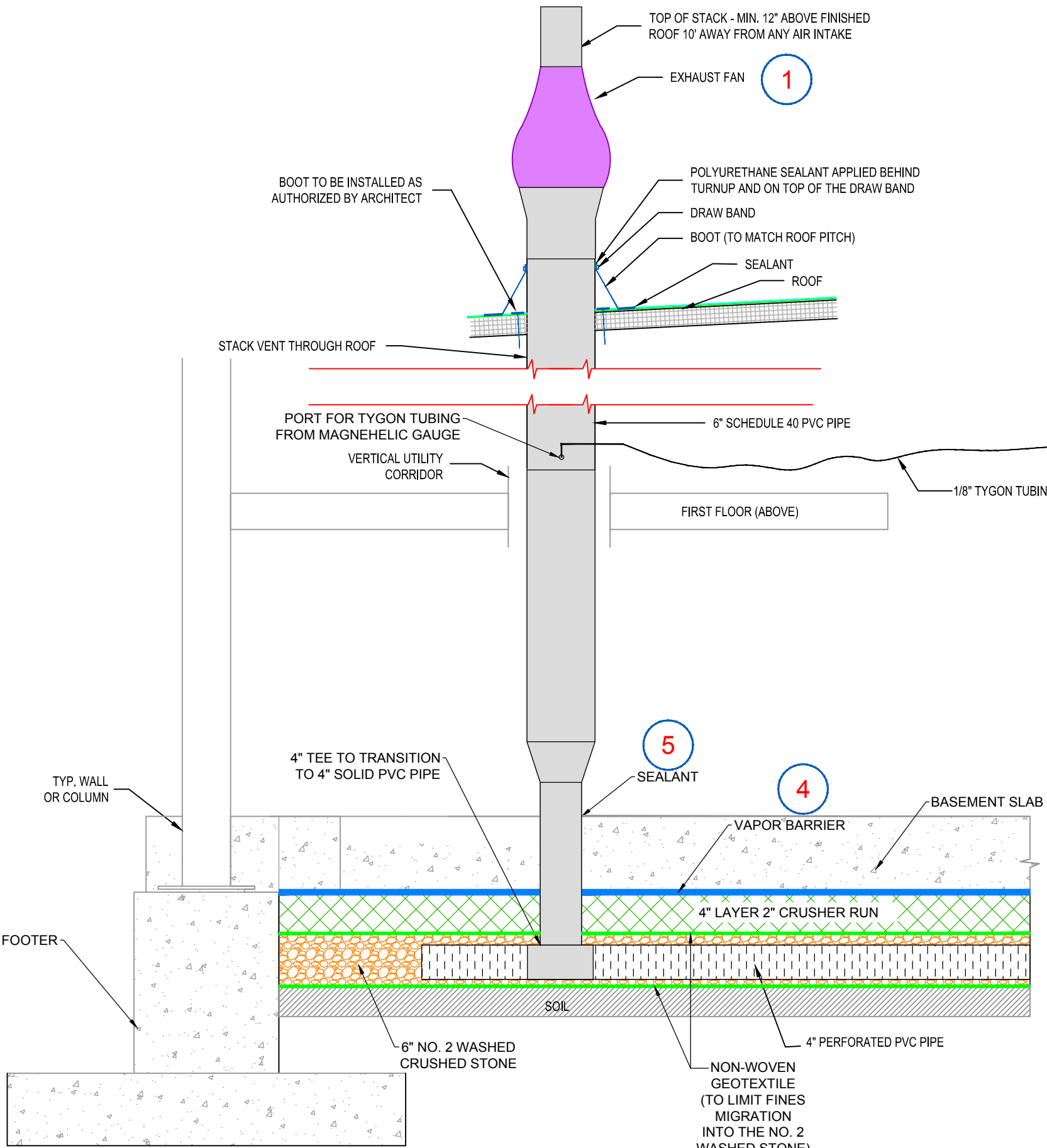
BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
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FIGURE 3

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NOTES:

- 1. RADONAWAY MODEL RP380 FAN, WIRED TO LOCAL OUTLET DEDICATED TO THE FAN OPERATION AND LABELED AS SUCH.
- 2. DWYER MODEL 605-2 MAGNEHELIC INDICATING TRANSMITTER; MOUNT ON COLUMN AT 5 FEET ABOVE FINISHED FLOOR. WIRED TO LOCAL OUTLET, INDEPENDENT OF FAN CIRCUIT BREAKER.
- 3. REMOTE MONITORING USING A SENSAPHONE CELL 682 AUTO-DIALER. TRANSMITS ALARM NOTIFICATIONS VIA EMAIL AND/OR VOICE BASED MESSAGING WHEN THE VACUUM FALLS BELOW USER-PREScribed LEVELS.
- 4. VAPOR BARRIER 10-MIL POLYOLEFIN SHEETING (PERMINATOR® OR SIMILAR).
- 5. POLYURETHANE SEALANT APPLIED IN ACCORDANCE WITH MANUFACTURE'S INSTRUCTIONS TO SEAL ALL GAPS. USE OF SILICONE SEALANTS IS PROHIBITED.

TYPICAL ASD SYSTEM SCHEMATIC

ASD SYSTEM DESIGN
170 JAMISON ROAD SITE
ELMA, NEW YORK

PREPARED FOR
MOOG INC.



2558 HAMBURG TURNPIKE, SUITE 300, BUFFALO, NY 14218, (716) 856-0599

JOB NO.: 0400-017-001

FIGURE 4

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APPENDIX 1

EXHAUST FAN PRODUCT INFORMATION

RPc Series

Radon Mitigation Fan

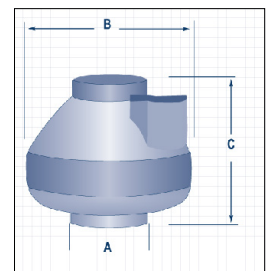
All RadonAway® fans are specifically designed for radon mitigation. RPc Series Fans provide superb performance, run ultra-quiet and are attractive. They are ideal for most sub-slab radon mitigation systems.

Features

- Energy efficient
- Ultra-quiet operation
- Meets all electrical code requirements
- Water-hardened motorized impeller
- Seams sealed to inhibit radon leakage (RP140c & RP145c double snap sealed)
- ETL Listed - for indoor or outdoor use
- Thermally protected motor
- Rated for commercial and residential use



MODEL	P/N	FAN DUCT DIAMETER	WATTS	RECOM. MAX. OP. PRESSURE "WC	TYPICAL CFM vs. STATIC PRESSURE WC				
					0"	.5"	1.0"	1.5"	2.0"
RP140c*	23029-1	4"	15-21	0.7	135	70	-	-	-
RP145c	23030-1	4"	41-72	1.7	166	126	82	41	3
RP260c	23032-1	6"	47-65	1.3	251	157	70	-	-
RP265c	23033-1	6"	91-129	2.2	334	247	176	116	52
RP380	28208	8"	95-152	2.0	497	353	220	130	38



Model	A	B	C
RP140c	4.5"	9.7"	8.5"
RP145c	4.5"	9.7"	8.5"
RP260c	6"	11.75"	8.6"
RP265c	6"	11.75"	8.6"
RP380	8"	13.41"	10.53"



Made in USA with U.S. and imported parts.



ETL Listed



All RadonAway® inline radon fans are covered by our 5-year, hassle-free warranty.



For Further Information Contact Your Radon Professional:

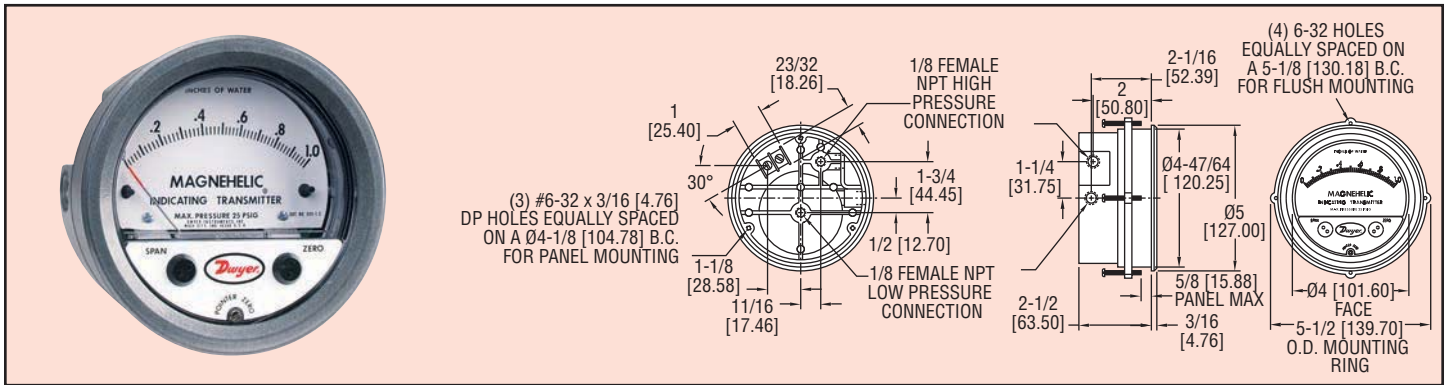
APPENDIX 2

WARNING DEVICE PRODUCT INFORMATION



Series
605

Magnehelic® Differential Pressure Indicating Transmitter



The Series 605 Magnehelic® Indicating Transmitter provides for both visual monitoring and electronic control of very low differential pressure. The Series 605 is ideal for control applications in building HVAC systems where local indication is desired during routine maintenance checks or necessary when trouble shooting the system. The easily read dial gage is complimented by the two-wire, 4-20 mA control signal utilizing the time-proven Dwyer® Magnehelic® gage mechanical design and Series 600 transmitter technology. The 2-wire design with terminal strip on the rear simplifies connection in any 4-20 mA control loop powered by a 10-35 VDC supply.

SPECIFICATIONS

GAGE SPECIFICATIONS

Service: Air and non-combustible, compatible gases.

Wetted Materials: Consult factory.

Accuracy: See chart.

Stability: ±1% FS/yr.

Pressure Limits: See chart.

Temperature Limits: 20 to 120°F (-6.67 to 48.9°C).

Process Connections: 1/8" female NPT.

Size: 4" (101.6 mm) dial face, 5" (127 mm) OD x 2-11/16" (68.3 mm).

Weight: 1 lb, 12.6 oz (811 g).

Agency Approvals: CE.

TRANSMITTER SPECIFICATIONS

Accuracy: See chart (includes linearity, hysteresis, repeatability).

Temperature Limits: 20 to 120°F (-6.67 to 48.9°C).

Compensated Temperature Range: 32 to 120°F (0 to 48.9°C).

Thermal Effect: ±0.025% FS/°F (0.045% FS/°C).

Power Requirements: 10-35 VDC (2-wire).

Output Signal: 4 to 20 mA.

Zero and Span Adjustments: Protected potentiometers.

Loop Resistance: DC; 0-1250 Ω max.

Current Consumption: DC; 38 mA max.

Electrical Connections: Screw terminal block.

Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.

Model	Range in w.c.	Maximum Pressure	Electrical Accuracy ±%	Mechanical Accuracy ±%
605-00N	.05-0-.20	25 psi (1.7 bar)	2	4
605-11	.25-0-.25	25 psi (1.7 bar)	2	3
605-0	0-.50	25 psi (1.7 bar)	2	3
605-1	0-1.0	25 psi (1.7 bar)	2	2
605-2	0-2.0	2 psi (13.79 kPa)	0.5	2
605-3	0-3.0	2 psi (13.79 kPa)	0.5	2
605-6	0-6.0	2 psi (13.79 kPa)	0.5	2
605-10	0-10	2 psi (13.79 kPa)	0.5	2
605-20	0-20.0	11 psi (75.8 kPa)	0.5	2
605-30	0-30	11 psi (75.8 kPa)	0.5	2
605-50	0-50	11 psi (75.8 kPa)	0.5	2
	Range in Pa			
605-60PA	0-60	25 psi (1.7 bar)	2	4
605-125PA	0-125	25 psi (1.7 bar)	2	3
605-250PA	0-250	25 psi (1.7 bar)	2	2
605-500PA	0-500	2 psi (13.79 kPa)	0.5	2

ACCESSORIES

A-298, Flat Aluminum Bracket - for flush mounting

A-370, Mounting Bracket - flush mount Series 605 Transmitter in bracket. Bracket is then surface mounted. Steel with gray hammertone epoxy finish

OPTION

For NIST traceable calibration certificate, add suffix -NIST to model numbers.

Example: 605-3-NIST.

SENSAPHONE®

REMOTE MONITORING SOLUTIONS

Sensaphone CELL682

Remote Monitoring via Cellular



ASSURANCE

COUNTLESS INDUSTRIES DEPEND ON SENSAPHONE FOR THE MOST COMPREHENSIVE REMOTE MONITORING SOLUTIONS AVAILABLE. WHEN YOU NEED TO BE ABSOLUTELY SURE A REMOTE SITE IS STABLE, SECURE AND MONITORED AROUND THE CLOCK, THERE'S NO SUBSTITUTE FOR CERTAINTY.

Easy to use – everyday

The Sensaphone CELL682 is easy to use – everyday. And we offer free tech support to walk you setup or any problems you may encounter.

We've got a sensor for that

Sensaphone has a sensor for monitoring everything from environmental conditions to security and more.

Your business is our business

With over 400,000 systems installed worldwide, we've put Sensaphone to the test in just about every application imaginable.

Suggested Applications



Agriculture

Know that the temperature, humidity, or other critical conditions where plants or animals live are in check while you're away.



Water & Wastewater

Use your Sensaphone CELL682 to monitor pumps, power failure and other conditions in water and wastewater applications.



Oil & Gas

Don't find out about equipment failure until the morning. The Sensaphone CELL682 will call or e-mail as soon as an alarm condition exists.

Sensaphone CELL682

Features and Specifications

Cellular

Use the CELL682 in locations where a traditional land line is not available. Receive alarms via a phone call, text, or e-mail.

LEDs

LED lights give a quick visual status. Know everything is okay by simply looking at the CELL682.

Power

Comes with a plug in power supply that also monitors for power failures.

Battery Backup

Rest easy knowing that even if the power goes out, the CELL682 will keep monitoring.

Output

Connect to an output such as a light or horn to alert anyone nearby there's a problem.

Inputs

Accept fourteen different inputs – a wide range of sensors are available.

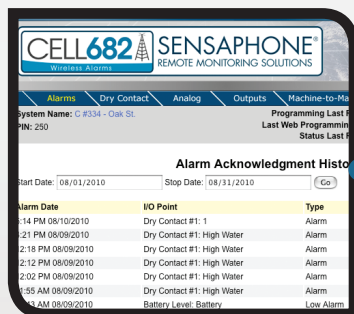


Enclosure

The CELL682 comes sealed in a NEXA 4X enclosure which allows it to be placed in less than ideal environments.

Web Services

Program, adjust and monitor the status of the sensors on a webpage the CELL682 creates.



Popular Compatible Sensors & Accessories

2.8K Room Temperature Sensor FGD-0100

2.8K Weatherproof Temperature Sensor . . . FGD-0101

2.8K Temperature Sensor in Glass Bead Vial FGD-0107

Temp Alert Temperature Switch FGD-0022

Humidistat Humidity Switch FGD-0027

PowerOut Alert Power Failure Switch FGD-0054

Magnetic Reed Door and Window Switch . . FGD-0006

Zone Water Detection Sensor FGD-0056

Additional 10' of Water Rope FGD-0063

Infrared Motion Detection Sensor FGD-0007

Float Switch FGD-0222

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