FINAL
AOC-65 SOIL VAPOR EXTRACTION OPERATIONS AND MAINTENANCE PLAN

Prepared for:

Camp Stanley Storage Activity
Boerne, Texas

JUNE 2008 UPDATE

Operation and Maintenance Plan
for
AOC-65 Soil Vapor Extraction Systems
at
Camp Stanley Storage Activity
Boerne, Texas

Prepared For:

Camp Stanley Storage Activity
Boerne, Texas

Prepared By:

Parsons Infrastructure and Technology Group
Austin, Texas

June 2008 Update

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

ABBREVIATIONS AND ACRONYMS

ºF	Degrees Fahrenheit
acfm	Actual cubic feet per minute
AOC	Area of Concern
B	burn area
cfm	cubic feet per minute (actual)
CSSA	Camp Stanley Storage Activity
DCE	dichloroethene
FCV	flow control valve
GAC	granular activated carbon
Inches of H_2O	inches of water column
lb	pound or pounds
lb/hr	pounds per hour
MCL	maximum contaminant level
N/A	not applicable
O&M	operations and maintenance
Parsons	Parsons Infrastructure and Technology Group
PBR	Permit by Rule
PCE	tetrachloroethene
PSI	Pounds per square inch
QAPP	Quality Assurance Program Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
rpm	revolutions per minutes
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SP/FM	Sample Port/Flow Measurement
SVE	soil vapor extraction
SWMU	Solid Waste Management Unit
TAC	Texas Administrative Code
TCE	trichloroethene
tpy	tons per year
V	volts
VEW	vapor extraction well
VOC	volatile organic compound
VRV	vacuum relief valve

SECTION 1
INTRODUCTION AND SUMMARY OF REMEDIAL DESIGNS

This Operations and Maintenance (O&M) Plan was created as a guide for operating, monitoring and maintaining soil vapor extraction (SVE) equipment and vapor well plumbing installed at Camp Stanley Storage Activity (CSSA) in Boerne, Texas. An SVE system was installed to remediate soil, fractured rock and groundwater contamination underneath and around Building 90 and Area of Concern (AOC)-65.

SVE is the forced evacuation of vapor from the subsurface using vacuum equipment. Vacuum blowers connected to vapor extraction wells (VEWs) with pipe are typically used to evacuate volatile organic compounds (VOC), water vapor, and any air from the subsurface. Contaminated soil gas as well as VOC dissolved in groundwater can be removed using SVE, thereby removing contamination and potentially reducing its continued migration.

In 2002, Parsons Infrastructure and Technology Inc. (Parsons) installed seven VEWs on the west side of Building 90 and 12 VEWs beneath Building 90 along with the associated piping and equipment comprising the eastern SVE system(s) of the AOC-65 SVE system. In 2007, Parsons added one deep nested VEW cluster near the Building 90 west loading dock, four shallow VEWs, and three intermediate-depth VEWs west of the ditch at Building 90. The nested VEW cluster consists of two VEWs installed to depths of 125 and 180 feet (ft) below ground surface (bgs). Two additional regenerative vacuum blowers were installed and piping systems updated during the 2007 SVE expansion efforts and comprise the western SVE system(s) of the AOC-65 SVE system.

The objective of operating these pilot SVE system(s) is to optimize the removal of VOC vapor to promote remediation and reduce migration of contaminants in the groundwater. The objectives of continued monitoring activities are to gather additional data to allow an evaluation and optimization of the systems' performance. The results of preliminary O&M activities at the AOC-65 site are examined in the **AOC-65 Soil Vapor Extraction Operations and Maintenance Report**, Parsons, October 2003 (Parsons 2003a). Additional observations for O&M activities and expansion details at the AOC-65 site are provided in **Draft AOC-65 Soil Vapor Extraction Assessment Report**, Parsons, April 2008 (Parsons 2008b).

Although SVE systems are relatively simple, routine monitoring and maintenance of the SVE systems is required to keep it operating at its optimum condition. If significant problems are encountered with the operation of the system, the CSSA Environmental Office at (210) 698-5208 should be notified so repairs can be initiated and coordinated. Additional contact individuals include Parsons Project Manager (Ms. Julie Burdey) at (512) 719-6000 and Parsons Onsite Manager (Ms .Samantha Elliott) at (210) 347-6012.

Site background and current conditions are discussed on Section 2 of this document. Descriptions of the SVE systems including layout drawings and schematics are provided in Sections 3. System operation and monitoring is discussed in Section 4 and system maintenance is included in Section 5 of this plan. Manufacturer's information for SVE monitoring equipment is included in Appendix A and data collection sheets are included in Appendix B. Appendix C provides photos of the AOC-65 SVE systems pertinent components.

SECTION 2
SITE CONDITIONS

2.1 BACKGROUND

Chlorinated solvents, which contain VOCs, were used in Building 90 for more than 30 years. Chlorinated solvent usage at CSSA was eliminated in 1995 and replaced with a citrus-based cleaning solvent.

Source characterization of the Building 90 vicinity (main portion of AOC-65) included a 2001 soil gas survey that included collection and analyses of 319 soil gas samples. Around and inside Building 90, tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE) and trans-1,2-DCE were detected. The detection of DCE indicates that natural degradation of PCE/TCE is occurring in the subsurface. No definitive conclusions were made as to the source of the contamination for AOC-65.

The final Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) report for AOC-65 was completed in September 2002 (Parsons, 2002b). An interim removal action was also completed in 2002 included excavation of soils underlying the pavement and drainage swale on the west side of the building.

Pilot testing was initiated at AOC-65 to evaluate the effectiveness of SVE for the removal of VOC contamination from the vadose zone. SVE was demonstrated to be an effective method for source removal in surface formations at CSSA during the earlier pilot and treatability study at SWMU B-3. Two SVE systems were installed at AOC-65 in late 2002. These systems, known as the eastern and western AOC-65 SVE system(s), have the primary objectives of removing VOC contaminants from the soils, fractured limestone, and groundwater around AOC-65 and to decrease the migration of contaminants from the site.

Expansion of the western AOC-65 SVE system(s) included installation of additional 10 VEWs to extract VOCs from zones within the shallow bedrock where elevated levels of VOCs are present. The system expansion included installation of 5 shallow (20-foot) and 3 intermediate-depth (50-foot) VEWs west of the drainage ditch next to Building 90. VEW locations were selected based on the results from existing VEWs and groundwater concentrations that suggested significant VOC mass removal may be possible from this area. Additionally, a deeper two-VEW nested well was installed adjacent to the western loading dock of Building 90 to assess the potential for significant mass removal from deeper zones beneath the building, and to investigate the vertical extent under the building and suspected source areas. Additional details regarding the expansion to the existing SVE systems at AOC-65 are described in the Draft 2008 AOC-65 SVE Assessment Report (Parsons, 2008).

2.2 AOC-65 SITE DELINEATION

Based on the results of the site investigation and groundwater results from Westbay monitoring data located in the **TO 42 Well Installation Report, Volume 5-2.3, CSSA Environmental Encyclopedia**, the area within AOC-65 containing VOCs that may be successfully treated by SVE appears to extend immediately around Building 90 in the apparent down gradient direction to the west/southwest. VOC concentrations above the Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) for groundwater have been encountered at depths as deep as 300 feet below grade and at significantly higher levels in monitoring wells screened near the surface (upper 50 feet). The total volume of the treatment area within AOC-65 is unknown. The location of the AOC-65 SVE system wells are shown on **Figure 2.1**.

2.3 AIR EMISSIONS AND PERMITTING

The AOC-65 SVE system operates within a Texas Commission on Environmental Quality (TCEQ) permit by rule (PBR) exemption as specified in Texas Administrative Code (TAC) Title 30 - Environmental Quality, Part 1 - TCEQ, Chapter 106-Permits By Rule, Subchapter X Waste Processes and Remediation Rule §106.533. This PBR exemption is applicable to "Equipment used to reclaim or destroy chemicals removed from contaminated materials for the purpose of a remedial action". Its provisions allow air emissions from treatment of groundwater and soil media contaminated with petroleum compounds and chemicals other than petroleum products.

The emission of chemicals other than petroleum products must also be compliant with the limitations of the Facilities (Emission and Distance Limitations) rule §106.262(2), (3) and (4) (formerly Standard Exemption 118). "New or increased emissions, including fugitives, of chemicals shall not be emitted in a quantity greater than 5 tons per year (tpy) nor in a quantity greater than E as determined using the equation E=L/K" where K is a parameter corresponding to distance to the nearest receptor and where L (Limit Value) is an emission limit of concentration provided for specific chemicals in Table 262 of §106.262. The maximum emission on an hourly basis of any chemical having an L value in Table 262 is determined by the equation E=L/K. The emission of any chemical not having an L value in Table 262 is one pound per hour (lb/hr), with or without abatement devices. These limitations are applicable only to on-site remediation processes.

The application for a PBR was prepared for off-gas emissions from both AOC-65 SVE systems (western and eastern) and submitted to the TCEQ on January 10, 2008 (Parsons, 2008a). The calculated emissions rates for VOCs, based on existing sampling data. The estimated hourly emission is 0.273 lb/hr (1.2 tpy), about 93 percent of which is estimated to be PCE for the AOC-65 SVE system(s). This estimate is below the maximum allowable emission rate of 6 lb/hr (but no more than a total of 5 tpy) for VOC emissions.

Although no off-gas abatement device(s) is necessary according to the provisions of the PBR regulations, CSSA requested that the eastern SVE systems be constructed with off-gas treatment pollutant prevention devices to eliminate potential for exposure to on-site workers, especially in proximity to Building 90, and reduce VOC emissions in Bexar County. Consequently, off-gas treatment in the form of a carbon adsorption system (CAS) was installed to ensure that VOC contaminant levels in exhaust emissions do not exceed emission standards during operation of the blowers. Emissions will continue to be monitored as part of O&M measures and compliance documentation completed, which are available at CSSA's environmental office.

Figure 2.1 AOC-65 SVE System Layout

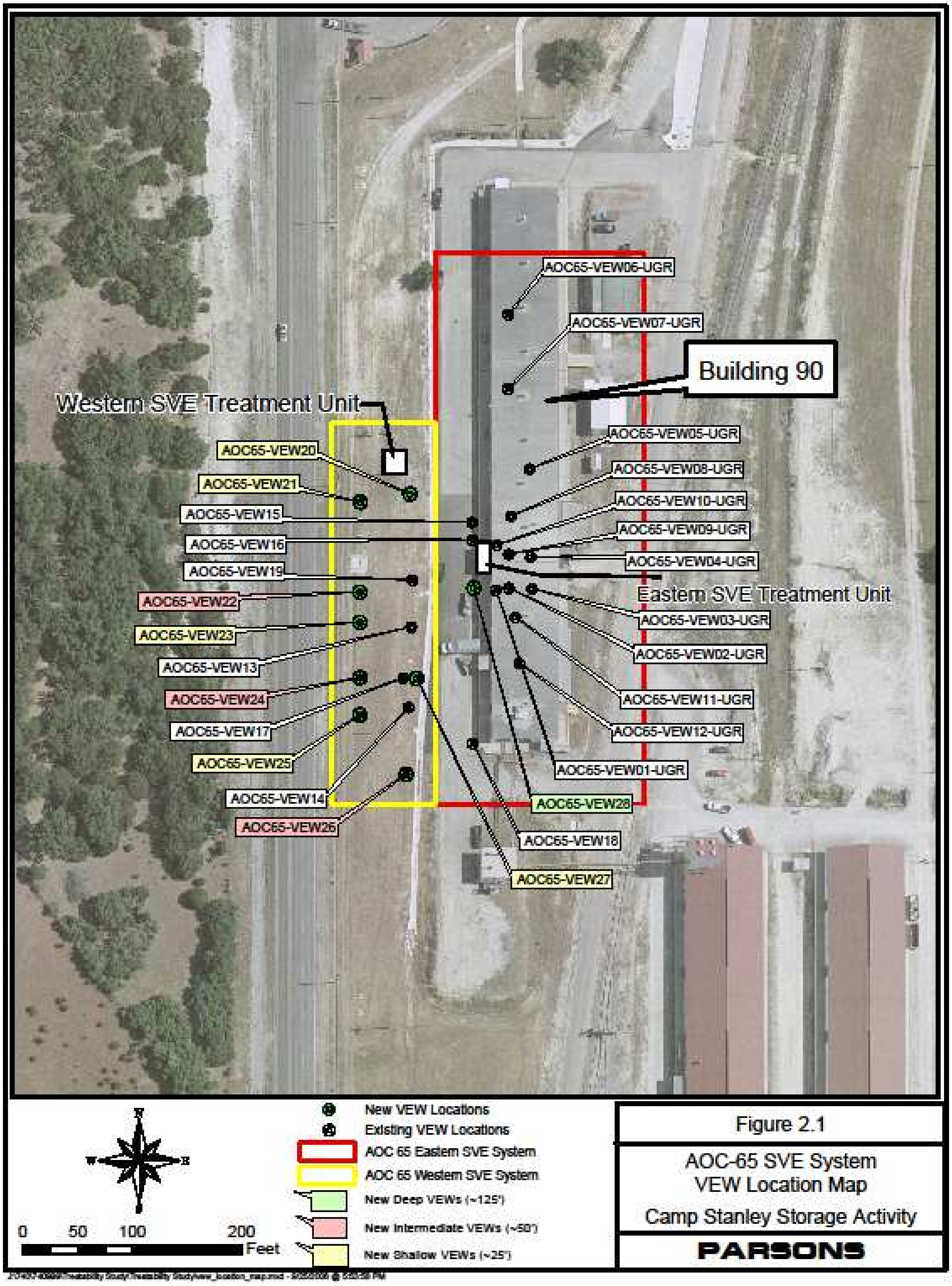


Table 2.1
PBR Estimated Maximum Allowable Emission for CSSA AOC-65 SVE Systems

Chemical Compound	Allowable Emission Rate	
	lb/hr	Tons Per Year
DCE	1.0	4.4
trans-1,2-DCE	1.0	4.4
PCE	6.0	5.0
TCE	6.0	5.0
Vinyl Chloride	6.0	5.0

Emission samples will be collected as part of O&M activities described in this plan and will be evaluated to verify that allowable emission limits are not exceeded. If the data indicate that the aggregate contaminant levels in the exhausts from SVE systems exceed applicable criteria, then abatement measures may be required to reduce emissions to allowable levels.

SECTION 3
SYSTEM DESCRIPTION

3.1 EQUIPMENT SPECIFICATIONS

Specifications of major equipment and other pertinent information for the AOC-65 SVE systems (eastern and western systems) are provided in **Table 3.1**. The eastern and western SVE schematics are shown in **Figure 3.1** and **Figure 3.2**, respectively. Photographs of the AOC-65 SVE system including sample point locations are presented in Appendix C.

Table 3.1
AOC-65 SVE Equipment Specifications

Unit	Manufacturer/ Model	Rating	Capacity	Motor
Blower (subslab unit)	GAST® R6130Q-50	70 inches of H_2O vacuum	215 cubic feet per minute (cfm)	3 horsepower (Hp), 208 volts (V), 3-phase, 3450 revolutions per minute (rpm)
Blower (eastern exterior wells unit)	GAST® R6325A-2	55 inches of H_2O vacuum	215 cfm	2.5 Hp, 208V, 3-phase, 3450 rpm
Blowers (western units)	GAST® R6335A-2	80 inches of H_2O vacuum	215 cfm	3.5 Hp, 208V, 3-phase, 3450 rpm
Moisture Separators	GAST® RMS400	Not applicable (N/A)	40 gallon	N/A
Filter Housing	GAST® AJ151G	10 micron	N/A	N/A
Replacement Filters	GAST® AJ135G	10 micron	N/A	N/A
Pressure/Vacuum Reliefs	GAST® AG258	30-200 inches of H_2O pressure or vacuum	200 cfm	N/A
Vacuum gauges	GAST® AE134	0-160 inches of H_2O vacuum	N/A	N/A
Pressure gauges	GAST® AE133	0-160 inches of H_2O	N/A	N/A
GAC Adsorber (eastern system)	Waterlink/Barnebey Sutcliffe V-1M Vapor Phase	1000 LB GAC	675 cfm	N/A

3.1.1 Vacuum Blowers

The main component of the SVE system is the device producing the vacuum. The SVE systems at AOC-65 use regenerative blowers mounted on square steel tubing anchored to concrete slabs. Rubber grommets underneath the blowers dampen vibrations.

At AOC-65 four blowers are in use in the eastern and western AOC-65 SVE systems. The first blower, a GAST R6 Series Regenair® blower, which was used periodically at the SWMU B-3 site for approximately three years, was installed at AOC-65 to vent the subslab VEWs. The other regenerative blowers, GAST Regenair R6 Series unit were procured to produce the vacuum for the remaining VEWs installed outside or exterior to Building 90. These R6 Series blowers share the same electrical requirements, and are similar in size and components (gauges, filters, plumbing, etc.). The R6 Series blowers can maintain a vacuum of about 55 to 70 inches of water (inches of H_2O) at the blower inlet depending on the flow rate.

Motor disconnects are used for stopping and starting the units. At the eastern AOC-65 SVE system they are mounted on west wall of Building 90. At the western AOC-65 system they are mounted on the walls of the western AOC-65 SVE blower building. All blowers are installed on individual circuits so they operate independently of one another.

The blowers are relatively maintenance free and should not require any mechanical maintenance during the operational period. Blowers and motors have sealed bearings that do not require periodic lubrication.

Table 3.1 shows the blower rated flow rates in actual cubic feet per minute (acfm) and vacuum in inches of H2O for the AOC-65 systems. Blower systems include inlet air filters and several valves and monitoring gauges, which will be described later in this section. Blower performance curves and other blower information are provided in Appendix A, Manufacturers' Equipment Information.

3.1.2 Moisture Separators

Four 40-gallon moisture separating knockout tanks were installed between the VEW manifolds and each of the blower inlets at AOC-65. Each knockout tank separates any condensate from the vapor recovered from the VEWs. The tanks are placed between the VEWs and SVE blowers. Knockout tanks and associated controls prevent blower damage via a vacuum relief valve (VRV) and a float switch within the tank. The VRV allows fresh air to be drawn into the system when high condensate levels in the tank restrict blower suction to the VEWs. A high-level float switch shuts down the vacuum blower associated with that knockout tank in the event excess liquid accumulates in the separator. This seemingly redundant instrumentation protects the blowers, minimizes power consumption and alerts operators to a high liquid level in the moisture separators.

Condensate accumulation in the moisture separators should not normally be of concern. However, during the cooler months of the year, weather systems with cooler ambient air, can result in the ambient temperature being considerably below that of the soil vapor. Since the soil vapor has a relative humidity of essentially 100 percent, condensate can readily fall out of the vapor and collect in the separator. This could occur whenever the ambient air temperature is lower than the dew point of the soil vapor.

Figure 3.1 AOC-65 Eastern SVE System Schematic

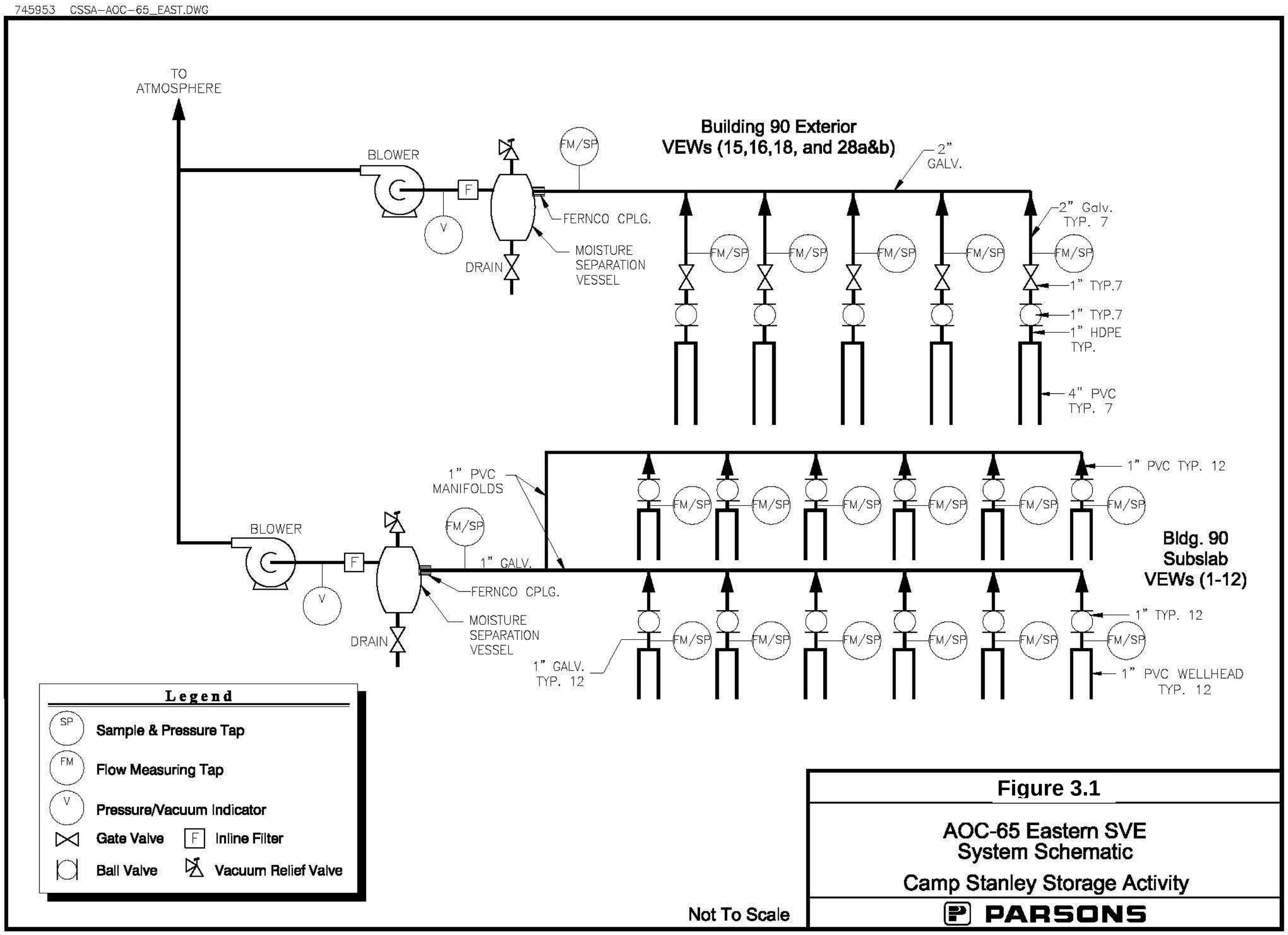
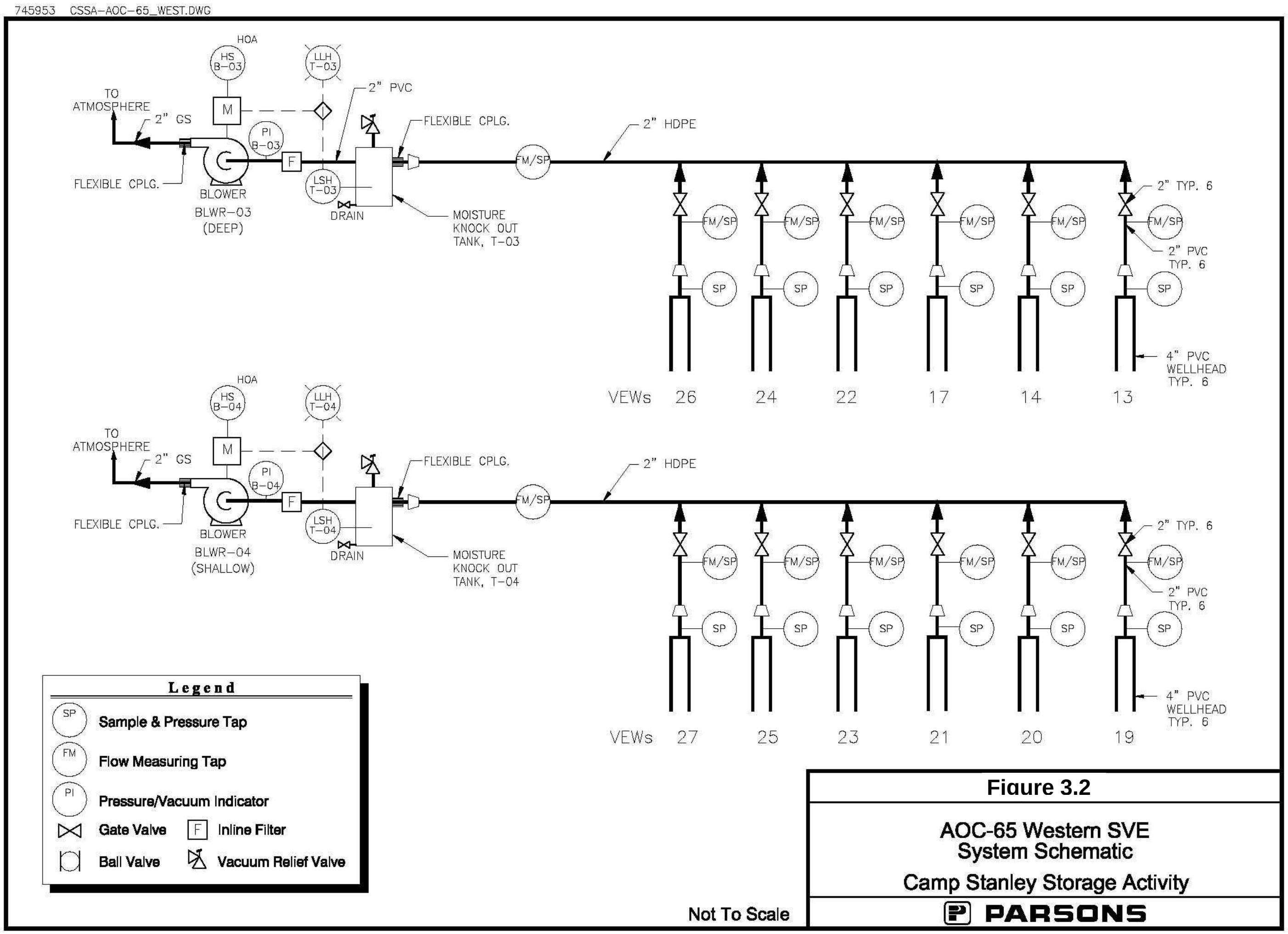


Figure 3.2 AOC-65 Western SVE System Schematic



3.1.3 Blower Inlet Filter

To prevent damage caused by particles entering the blowers, an 8” diameter inlet filter with 2.5-in. diameter pipe connections is installed in-line upstream of each blower at AOC-65. The pressure (or vacuum) drop across a clean filter is approximately 2 inches of H_2O at 200 cfm. The filters will slowly accumulate particles. Once the pressure drop across a filter is greater than 6 inches of H_2O, the filter element will need to be replaced with a new element.

3.2 EMISSIONS CONTROL

3.2.1 Recovered Vapor Treatment

A Waterlink/Barnebey Sutcliffe V-1M vapor phase GAC canister is utilized to control emissions from both blowers of the eastern AOC-65 SVE system(s). The vessel has a 16-in. manway on top for removal and refill of absorbent material. The GAC unit captures most VOCs discharging from the blowers. The vessel is movable by forklift but can be emptied and recharged in place. The GAC vessel was installed on the loading dock directly adjacent to the two blowers.

Sampling ports on the inlet and the discharge piping of the AOC-65 GAC unit allows sampling of influent and effluent air streams to monitor removal efficiency of the unit and ensure that contaminant break through does not occur. The interval between GAC recharge is estimated at more than a year, depending on quantity of VOC recovered and the operational continuity and usage time of the SVE systems. Recharge intervals will be estimated based on vapor concentrations and flow rates over the operating life of the system.

3.2.2 Recovered Liquid Treatment

Routine recovery of the free liquids that accumulate in moisture separators will be required to prevent automatic shutdown of the systems. The moisture separation vessels are equipped with high-level shutdown sensors that will shut the SVE system down to prevent overfilling of the vessel. To ensure that the SVE systems operate without interruptions, during routine twice monthly site visits, any liquids in the moisture separators will be transferred to the temporary storage drums located proximal to each separation vessel. Previous operations of the SVE systems indicates that decanting the accumulated liquids in the separation vessels on a twice monthly basis should be sufficient to prevent shutdown of the system even during periods of high accumulation (i.e., when the ambient air temperature is below the dew point of the VEW vapor). If the liquid accumulation rate becomes sufficiently high to cause the SVE system to shutdown, decanting of the accumulated liquids should be performed more frequently than the bimonthly basis in order to maintain continuous SVE operation.

Liquids that accumulate in the moisture separators will be transferred to temporary storage drums located near the separation vessels. When the drums become full, they will be transported to the on-post GAC unit and emptied into the GAC unit’s temporary storage tank. As the drum is returned and reconnected to SVE system, a new non-hazardous waste label will be affixed to the drum and marked with a new accumulation start date. Characterization of the accumulated liquid during initial start-up indicates the groundwater meets non-hazardous criteria as specified by 30 TAC Subchapter R.

3.3 MONITORING AND CONTROL EQUIPMENT

3.3.1 Airflow Measurement Equipment

Airflow is measured at various points within each SVE system to determine extraction rates and assess system performance. Airflow rates in cfm are determined by using direct-read in-line airflow gauges, or by measuring air speed, which is combined with the pipes' cross-sections area to determine volumetric airflow. Air speed is measured using an anemometer or a pitot tube and pressure gauge or manometer.

3.3.1.1 Pitot Tube Use

Pitot tubes are specialized tubes permanently installed into the extraction piping and provide a means of accurately measuring air speed when combined with a manometer or pressure gage. Installation of the pitot tubes are model specific and manufacturer's instruction should be followed. Once the tube is installed, the air pressure in inches of water (inches of H_2O) within the tube is measured using a manometer or pressure gauge. The airflow speed is then calculated in accordance with the manufacturer's directions.

3.3.1.2 Anemometer Use

To use the anemometer, it is inserted into the measurement port with the probe tip positioned in the center of the pipe. Press the ON/OFF button to turn on the anemometer. Make sure the units for velocity are feet per minute and degrees Fahrenheit (ºF) for temperature. Insert the probe tip into the appropriate port to the center of the pipe. The probe tip is very fragile and must be treated delicately and protected from contact with foreign objects. Record the values in the appropriate place on the O&M Forms. Additional information is provided in Appendix A.

3.3.1.3 Manometer Use

To use the manometer, the barb tube connector is screwed into the port and the tube from the manometer vent is attached thereon. Press the ON/OFF button to power up the digital manometer. Before any measurements are taken, zero the meter by pressing the ZERO/RESTORE key. Keep both meter vents open to the atmosphere without any applied pressure. Within seconds the meter will automatically zero and the screen will return to ready mode. Units should be set to inches of H_2O. Attach the tube from the **+** vent (right side) to the port to be monitored. Leave the vent marked **–** (left side) open to the atmosphere. Read the digital screen. If the vacuum (negative pressure) is operating properly the value should be negative. Record the value in the appropriate place on the O&M Forms. Additional information is provided in Appendix A.

3.3.2 Vacuum Gauges

The SVE systems are equipped with gauges and a flow velocity measurement port at each well. Gauges were installed on the blower units to allow monitoring of operational conditions. Monitoring will be done in accordance with the schedules and checklists provided in Appendix B.

3.3.3 Flow Control Equipment

Manually operated ball or gate valves were installed in the piping to each VEW to serve as flow control valves (FCVs). This allows the individual flow rate from each VEW to be manually balanced. Initially, the FCVs were set in the fully open position to maximize airflow out of the VEWs. Airflows for each of the subslab VEWs at AOC-65 were all set in open position. Balancing flows from the subslab lines can only be accomplished by taking selective

VEWs off-line, which must be done inside Building 90. Access to the inside of Building 90 is strictly controlled and advance requests must be submitted to the Environmental Office prior to any Parsons entrance.

Attainable flowrates were lower than expected for the exterior AOC-65 SVE system due to excessive friction losses in the SVE piping network. To balance the flow rates, some of the FCVs to the higher flow VEWs were partially closed. The optimal flow settings were established during the final site visit on July 30, 2003 for the exterior VEW system. FCVs should probably remain 100 percent open until piping restrictions are reduced or some of the VEWs are selectively taken off line. However, if adjustment is desired to balance the flows from the exterior VEWs, then the FCVs are the proper tool to achieve that objective.

Combination flow measurement and sample collection ports, which consist of brass bushings threaded into the galvanized piping, were installed in line to allow direct measurement of flows and sampling of soil gases. Flow ports were installed at each wellhead and at the blowers. These ports allow the insertion of a thermal anemometer for the measurement of vapor velocity, which can then be converted to estimate the flow of vapor out of each individual VEW. However, the bushings should be plugged during normal system operation when measurements are not being taken. These ports can also be used to take soil gas samples to obtain contaminant concentrations for estimating mass removal rates.

SECTION 4
SYSTEMS OPERATION AND MONITORING

The O&M activities that will be performed at the CSSA SVE systems include system start-up procedures and the system O&M monitoring. In addition, system optimization and repair activities will be performed prior to implementation of the O&M activities. These O&M and optimization/repair activities are discussed in the following section.

4.1 SYSTEM OPTIMIZATION AND REPAIR

The following activities will be implemented at the start of the O&M activities.

1) The Building 90 "subslab" SVE system will be optimized to focus extraction to those VEWs where significant mass removal is occurring. Vacuum levels, airflow measurements and soil gas samples will be collected at each VEW to assess mass removal rates at each VEW. Initial sampling of the subslab SVE system will be sampled as baseline followed by semi-annual sampling events.
2) The VEWs outside of Building 90 near the loading docks and west of the drainage ditch at AOC-65 will be evaluated and sampled to determine mass removal rates to ensure compliance with PBR exemption. To assess the newly installed VEWs, each well will be connected to the AOC-65 blower individually so that a vacuum pressure and airflow can be measured at the wellhead. Vacuum, airflow, and TVH readings will be measured at the VEW from the well head. Based on the results of the screening, VEWs which do not produce significant airflow or VOC concentrations may not be incorporated into the SVE system(s).

4.2 SYSTEM START-UP

The following items comprise a system start-up list:

- Check the liquid level in the moisture separator(s) – drain and transport fluid to GAC unit as necessary;
- Open FCVs to extract from desired VEWs, and close, if desired, any FCVs to VEWs not desired;
- Check condition and operation of equipment and repair or replace as needed;
- Adjust vacuum relief/bleed valve(s) to maximum vacuum allowed (generally 55 inches of H_2O) to protect blower(s) from mechanical damage; and
- Start-up blower(s) and adjust FCVs to balance flows from VEWs in service, as desired. On the wall panel, the black button is *RESET* (should there be a power interruption), green is *START*, and red is *STOP*.

4.3 OPERATION, MAINTENANCE, AND PERFORMANCE MONITORING DATA COLLECTION

The primary operating activities include monthly and semi-annual monitoring of system performance, and twice-monthly monitoring of equipment operation. Performance data will be used to assess system effectiveness, while equipment operational data will be used as it is gathered to ensure that the equipment is functioning properly and identify need for equipment maintenance and/or repair.

The operation and monitoring work described in this section include:

1) Monthly screening of soil vapor/emissions at the SVE VEWs, blowers, and GAC vessel;
2) Monthly monitoring of flow rates, and vacuum pressures in the individual VEW flow streams, and at the equipment;
3) Twice monthly drive-by system checks of the SVE equipment, piping network and moisture accumulation adjustments, repair and replace components as needed to maintain the systems in good operating condition; and
4) Semi-annual monitoring and data collection of individual well flows and air emissions from all systems.

These data will all be recorded and compiled on data collection sheets shown in Appendix B. Parameters for each well are measured at the corresponding port at the manifold. Parameters may also be collected at the wellhead itself for troubleshooting suspected system problems. Parameters for blowers are taken at the port on the outflow pipe, and for a moisture separator (KO pot) at the port on the pipe just prior to entering the tank (see Appendix C for photos locating pertinent monitoring points for the AOC-65 SVE systems).

4.4 OPERATION/MAINTENANCE MONITORING

4.4.1 Twice Monthly and Monthly Monitoring Visits

Twice monthly system checks will be performed to assure that the systems are operating satisfactorily. A check of the systems includes visual inspection of the equipment and the piping network for cracks, separations, holes and other problems. Where assessable, each of the well-heads and pipe joints will also be inspected for leaks or weakness of structure. Blower operation, filter cleanliness and vacuum relief valve (VRV) operation and lubrication will also be addressed. Finally, these visits include assessment and management of any accumulated liquid in the moisture separators. Monthly checks will include flow monitoring, and VEW gas screening in addition to the twice-monthly checks and servicing.

4.4.2 Vent Well Airflow Rate

The flow rate into each vent well will be calculated using direct measurements of in-line air velocity and pipe size data. Air velocity will typically be measured at the vent wells by placing an anemometer into the air measurement port located on each vent well pipe (see Appendix C). The volumetric flow rate is calculated by multiplying the velocity obtained times the cross-sectional area of the pipe. Flow data allow more accurate adjustment of the FCVs at each vent well to balance flows through the system, and is also used to calculate mass removal estimates from each VEW and from the system exhaust.

4.5 PERFORMANCE DATA

To monitor the performance of the blowers, the inlet vacuum, the outlet pressure, and outlet temperature will be monitored on each blower on a twice-monthly basis. All measurements should be taken at the same time, while the system is running. (Note: Because the blowers are noisy, hearing protection should be worn when working around the blowers).

4.5.1 VEW, Exhaust Emissions and Soil Vapor

Blowers and knockout pots will be monitored twice monthly. Every other system check will correspond with the monthly monitoring effort, during which VEWs and equipment points will be checked for VOC, oxygen and carbon dioxide concentrations.

4.5.2 Semi-Annual Data Collection

Soil vapor emission and/or flux samples will be collected on a semi-annual basis for laboratory analyses to confirm trends and field measurements. All such vapor samples (emissions and flux) will be tested for VOCs by Method TO-15. The CSSA Quality Assurance Program Plan (QAPP) will be followed for sample collection, analysis, and data validation. Samples will be collected in accordance with current work plan and Sampling and Analysis Plan (SAP) schedules, or as amended by the project manager. Semi-annual monitoring events shall include all twice-monthly and monthly checks and servicing. Sample collection at individual VEWs may also be performed during semi-annual data collection to assess individual contributions with regard to contaminant mass removal.

4.5.3 Flows and Pressures

During operation of the SVE systems, flows and vacuum pressures from each SVE VEW will be measured and recorded on a monthly basis. The FCVs will be adjusted to balance the flow as desired. Each SVE system may be optimized by increasing flows to VEWs producing high levels of VOCs and reducing or shutting-off flow from VEWs producing low VOC concentrations.

4.6 MONITORING SCHEDULE

The following monitoring schedule in Table 4.1 is planned for the AOC-65 SVE systems operating at CSSA.

Table 4.1
Monitoring Schedule

Monitoring Effort	Date
Baseline	4/17/2008
Start up	5/5/2008
Biweekly	5/19/2008
Month 1	6/2/2008
Biweekly	6/16/2008
Month 2	7/7/2008
Biweekly	7/21/2008
Month 3	8/4/2008
Biweekly	8/18/2008
Month 4	9/8/2008
Biweekly	9/22/2008
Month 5	10/6/2008
Biweekly	10/20/2008
Semi-Annual	11/3/2008
Biweekly	11/17/2008
Month 7	12/8/2008
Biweekly	12/22/2008
Month 8	1/5/2009
Biweekly	1/19/2009
Month 9	2/2/2009
Biweekly	2/16/2009
Month 10	3/2/2009
Biweekly	3/16/2009
Month 11	4/6/2009
Biweekly	4/20/2009
Annual	5/4/2009

Biweekly =	system checks (blowers, vacuum relief valves, knock-out pots)
Monthly =	field data collection (flow, vac., temp., VOC, O_2, CO_2)
Semi-Annual =	16 summas needed, samples collected from newly installed wells and blower exhaust

SECTION 5
SYSTEM MAINTENANCE

Although the blower systems installed are expected to be very low maintenance, periodic system checks are required to ensure proper operation and long life. Recommended maintenance procedures and schedule are described below. Manufacturers' equipment information is presented in Appendix A.

5.1 VACUUM BLOWER, PIPING AND INSTRUMENTATION

5.1.1 Vacuum Blowers

The blowers and motors are relatively low maintenance and may not require any maintenance during the operational period. The blower and motor have sealed bearings that do not require periodic lubrication.

The blowers will be checked twice per month to ensure that VRVs respond to adjustments and that they operate smoothly. Apply mineral oil as necessary to lubricate and protect from corrosion.

5.1.2 Piping

The different piping (or plumbing) materials used were selected both for durability and environmental resistance as well as ease of installation. Only periodic visual inspection of aboveground piping is required to make sure the network is intact, tight, and undamaged. Damage to piping could occur due to landscaping, unloading activities or any other work activities in the area.

5.1.3 Blower Filter

Filter inspection must be performed with the system turned off. Do not change the FCV settings before re-starting a blower unless a rebalancing of the VEWs is desired.

The filter elements should be checked monthly and replaced a minimum of every six months. Typical filter element replacement intervals are estimated at three to six months depending on blower run time.

To remove the filter:

1. Turn the system off by pressing the "OFF" button on the wall panel;
2. Loosen the three clamps or the wing nut on the filter top;
3. Lift the metal top off the filter;
4. Lift the filter element from the metal housing; and
5. Reinstall new element by reversing order of disassembly.

If a plugged filter is suspected a pressure drop check should also be performed. Attach a vacuum gauge to the Sample Port/Flow Measurement (SP/FM) port upstream of the moisture separator to check pressure drop across filter (also see manometer instructions). A pressure drop across the filter exceeding six inches of water may indicate the filter requires replacement.

The replaceable air filter element is manufactured by GAST Manufacturing, Inc. in Benton Harbor, MI (269) 926-6171. Spare filter elements were not purchased. However, replacement filter elements can be obtained directly from the manufacturer or from the supplier

Southwestern Controls, San Antonio office, 1-800-444-9369 or Houston office at 1-800-444-9368 (replacement filter elements for R6 blowers are GAST Model AJ 135G).

5.2 GRANULAR ACTIVATED CARBON ADSORPTION UNITS

The GAC adsorber at AOC-65 is a Waterlink/Barnebey Sutcliffe V-1M Vapor Phase Adsorber with 16" manway on top for removal and fill of GAC. The unit has no moving parts and does not require any routine maintenance other than replacement of GAC. Breakthrough of VOCs will indicate when the GAC is spent, but this is strictly a function of blower flowrate and VOC concentration, or more precisely the mass quantity of VOC removed. Periodic monitoring of inlet and outlet concentrations should provide an indication of when GAC will require replacement. In general, vapor phase adsorption is fairly efficient, so a year or more would not be an excessive period between change-outs, especially since removal rates are low and a 1000lb GAC is in place. Nonetheless, GAC analysis is proposed annually under this plan.

Spent GAC material will be managed off-site in accordance with applicable State of Texas and federal requirements as well as CSSA requirements. Waste characterization and disposal will be coordinated through CSSA Environmental.

5.3 MAINTENANCE SCHEDULE

In general, SVE systems are very reliable when properly maintained. Occasionally, however, a motor or blower will develop a problem. If a blower fails to start, and an electrician verifies that power is available at the blower or starter, Parsons should be contacted to arrange for repairs.

Twice monthly inspections are recommended for the blower systems. During the initial operation, more frequent monitoring may be needed to ensure that any startup problems are quickly corrected. See Appendix B data collection sheets for recording maintenance activities.

SECTION 6
REPORTING REQUIREMENTS

At the end of the next operations and monitoring period, the 2008 Annual Operations and Monitoring Report will be prepared. This report will include documentation of any new VEW installations and SVE systems maintenance, analytical data from quarterly sampling events, SVE systems assessments, and a summary of O&M activities carried out during the next operational period.

No Federal or State Agency reporting is required for this project, but the final report will be incorporated into the CSSA Administrative Records (Environmental Encyclopedia).

SECTION 7
BIBLIOGRAPHY AND REFERENCES

Parsons 2008a. *Area of Concern-65 Permit By Rule Application for Removal Action*, Parsons Infrastructure and Technology Group, Austin, Texas, January 10, 2008.

Parsons 2008b. Draft *Area of Concern-65 Assessment Report*, Parsons Infrastructure and Technology Group, Austin, Texas, April, 2008.

Parsons 2005. *Final Interim Treatability Test Report*, Parsons Infrastructure and Technology Group, Austin, Texas, 2005.

Parsons 2003a. *Area of Concern 65 Soil Vapor Extraction Operations & Maintenance Report*, Parsons Infrastructure and Technology Group, Austin, Texas, August, 2003.

Parsons 2003b. *Area of Concern 65 Interim Removal Action*, Parsons Infrastructure and Technology Group, Austin, Texas, August, 2003.

Parsons 2003c. *Westbay Study Report*, Parsons Infrastructure and Technology Group, Austin, Texas, 2003.

Parsons 2002a. *Area of Concern-65 Permit By Rule Application for Removal Action*, Parsons Infrastructure and Technology Group, Austin, Texas, August 2002.

Parsons 2002b. *Area of Concern-65 RCRA Facility Investigation Report*, Parsons Infrastructure and Technology Group, Austin, Texas, September 2002.

APPENDIX A

MANUFACTURERS' EQUIPMENT INFORMATION

Blower System Design Tips

In order to utilize your regenerative blower most efficiently, proper system design is essential. The most important thing to recognize is that by utilizing large diameter plumbing, friction losses in plumbing can be greatly reduced. Here are some guidelines to use when setting up your blower system:

1. The plumbing should at least be the same size as the blower port or ideally one size larger (example - blower has ports that are 1-1/2" NPT, plumbing should be 2" NPT). The plumbing should remain this size until it has reached the location of the work area.
2. Plumbing for Separate Drive Blowers operating above 3500 RPM should be at least one pipe size larger than the blower ports.
3. Elbows create additional friction which causes pressure loss and back pressure. Plumbing at least one pipe size larger than the blower pipe ports minimizes the friction loss they create.
4. The pressure/vacuum relief valve should be installed in a "T" which is at least one pipe size larger than that of the exhaust of the blower. To properly protect a large horsepower blower, set the relief value to limit the blowers duty to 5 in. H_2O below its continuous duty rating.
5. Operating the blowers at high altitude decreases their maximum pressure or vacuum duty rating. If this is a consideration, review the information on Fan Laws in the Application Engineering section of this catalog.
6. The exhaust air temperature of the blowers increases with increasing duty. At duties over 70 in. H_2O it is too hot for most plastic pipe. Metal pipe must be considered. To prevent danger of burns, access to these pipes should be limited, guarded or marked "Danger Hot."

Performance Data

The performance data shown in this catalog was determined under the following conditions:

- Line voltage @ 60 Hz. 230V or 460V for three-phase units. 115V or 230V for single-phase units.
- Line voltage @ 50Hz. 220V for three-phase or single-phase units.
- Units in a temperature stable condition.
- Delivery measurements made with output port throttled.
- Suction measurements made with input port throttled.
- Test Conditions: Inlet air density at 0.075 lbs. per cu.ft. [20°C (68°F), 29.92 in. Hg (14.7 PSIA)].
- Normal performance variations on the resistance curve within ± 10% of supplied data can be expected.

Pictorial and dimensional data is subject to change without notice.

The information presented in this catalog is based on technical data and test results of nominal units. It is believed to be accurate and is offered as an aid in the selection of Gast products. It is the user's responsibility to determine suitability of the product for intended use and the user assumes all risk and liability whatsoever in connection therewith.

Gast can also provide CE compliant blowers with BSP threads, as well as customized blowers for specific applications. Consult a Gast Representative/Distributor for more information.

Environmental and application conditions may affect advertised life.

Warning:
Models Without Explosion-Proof Motors Should Not Pump Combustible Gases or Be Used In Combustible Ambients

R6 SERIES

MODELS R6125-2, R6325A-2, R6135J-10, R6335A-2, R6335B, R6150J-2, R6350A-2, R6350B-2

MAXIMUM PRESSURE, VACUUM AND AIR FLOW VARIES FOR THE R6 SERIES, DEPENDING ON THE MODEL(S). REFERENCE THE CHART FOR THE SPECIFIC MODEL PERFORMANCE

MODELS	Maximum Pressure ("H_2O) 60 Hz	50 Hz	Maximum Vacuum ("H_2O) 60 Hz	50 Hz	Maximum Air Flow (CFM) 60 Hz	50 Hz
R6125-2 R6325A-2	45	40	55	50	215	180
R6135J-10 R6335A-2 R6335B	80	75	80	65	215	180
R6150J-2 R6350A-2 R6350B-2	105	78	88	70	207	180

PRODUCT FEATURES

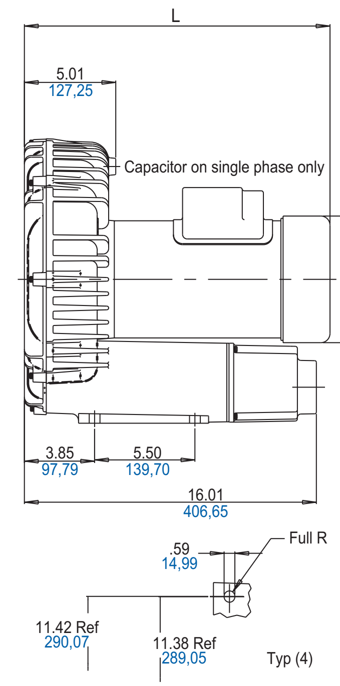
- Made in the U.S.A.
- Rugged construction, low maintenance
- Oilless operation
- UL and CSA approved TEFC motors with permanently sealed ball bearings (R6150J-2 and R6135J-10 has ODP motor)
- Automatic restart thermal protection on R6150J-2, R6125-2, R6335A-2, R6325A-2
- Aluminum cover, impeller and housing
- Inlet and outlet have internal muffling

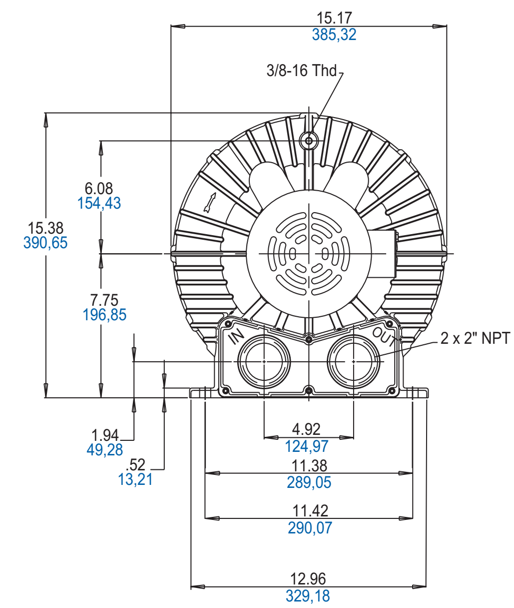
RECOMMENDED ACCESSORIES

- Pressure gauge AE133
- Inlet filter AJ126F (pressure)
- Vacuum gauge AE134
- Inline filter AJ151G (vacuum)
- Muffler AJ121F
- Relief valve AG258
- Liquid separator RMS300 (vacuum)

Product Dimensions (in. mm)

Note: Unit must be mounted horizontally, foot pad down





MODEL	L (in)	L (mm)
R6125-2	16.75	425,45
R6325A-2	15.53	394,46
R6135J-10	15.86	402,84
R6335A-2	16.59	421,39
R6335B	16.00	406,40
R6150J-2	17.46	443,48
R6350A-2 R6350B-2	17.35	440,69

Gast Manufacturing Inc., A Unit of IDEX Corporation, Benton Harbor, MI USA • ph 616-926-6171 • fx 616-925-8288 • www.gastmfg.com

Proposed eastern exterior blower

Proposed western blowers

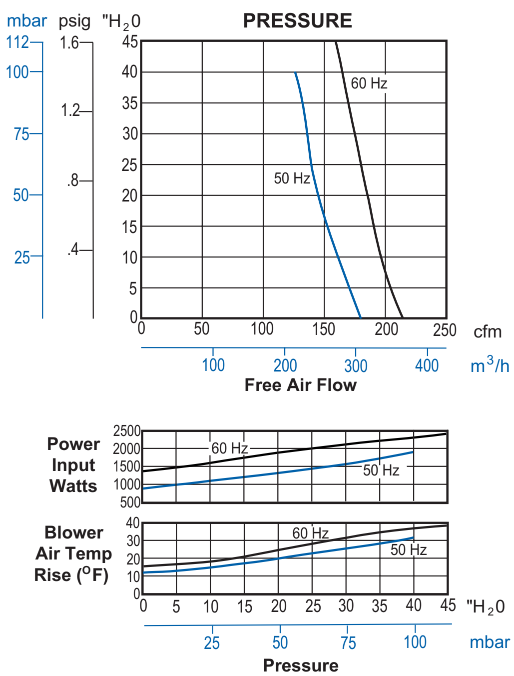
Product Specifications

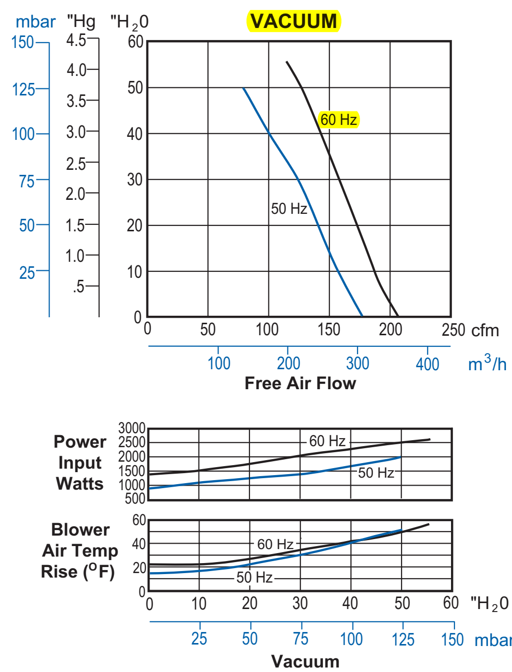
MODEL NUMBER		R6125-2	R6325A-2	R6135J-10	R6335A-2
Motor Enclosure		TEFC	TEFC	ODP	TEFC
HP/kW	60 Hz	2.5/1,9	2.5/1,9	3.5/2,6	3.5/2,6
	50 Hz	1.5/1,1	1.85/1,38	-	2.5/1,9
Voltage	60 Hz	115/208-230-1	208-230/460-3	230-1	208-230/460-3
	50 Hz	110/220-240-1	190-220/380-415-3	-	190-220/380-415-3
Amps	60 Hz	23.6/12.9-11.8	6.9-6.9/3.45	19	9.7-8.8/4.4
	50 Hz	17.6/8.8-9.5	6.6-6.7/3.3-3.5	-	8.8/4-3.9
Starting Amps	60 Hz	76 @ 230V	58 @ 230V	125 @ 230V	50 @ 460V
	50 Hz	87 @ 240V	23.5 @ 380V	-	40.5 @ 380V
Insulation Class		B	B	F	F
Recommended NEMA Starter Size		1/0	0/00	1P	1/0
Net Weight (lbs/kg)		87/39,5	76/34,5	112/50,8	82/37,2

MODEL NUMBER		R6335B	R6150J-2	R6350A-2	R6350B-2
Motor Enclosure		TEFC	ODP	TEFC	TEFC
HP/kW	60 Hz	3.5/2,6	5.0/3,7	5.0/3,7	5.0/3,7
	50 Hz	-	-	4.8/3,6	-
Voltage	60 Hz	575-3	230-1	208-230/460-3	575-3
	50 Hz	-	-	190-220/380-415-3	-
Amps	60 Hz	3.6	22.3	13.0-12.0/6.0	4.8
	50 Hz	-	-	14.4-13.4/7.2-6.8	-
Starting Amps	60 Hz	34.9 @ 575V	96 @ 230V	125 @ 230V	35 @ 575V
	50 Hz	-	-	57 @ 380V	-
Insulation Class		F	F	F	F
Recommended NEMA Starter Size		0	1P	1/0	0
Net Weight (lbs/kg)		82/37,2	125/56,8	112/50,8	112/50,8

Product Performance

Models R6125-2, R6325A-2

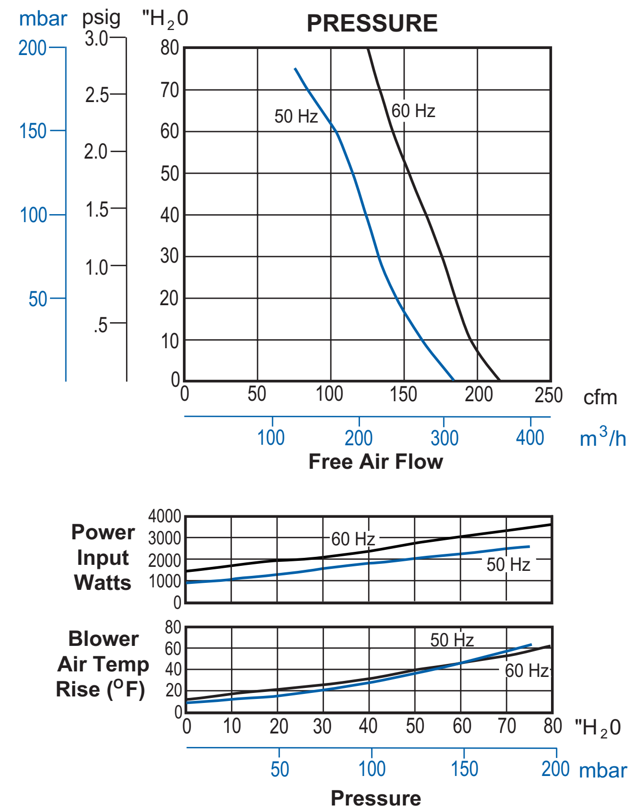


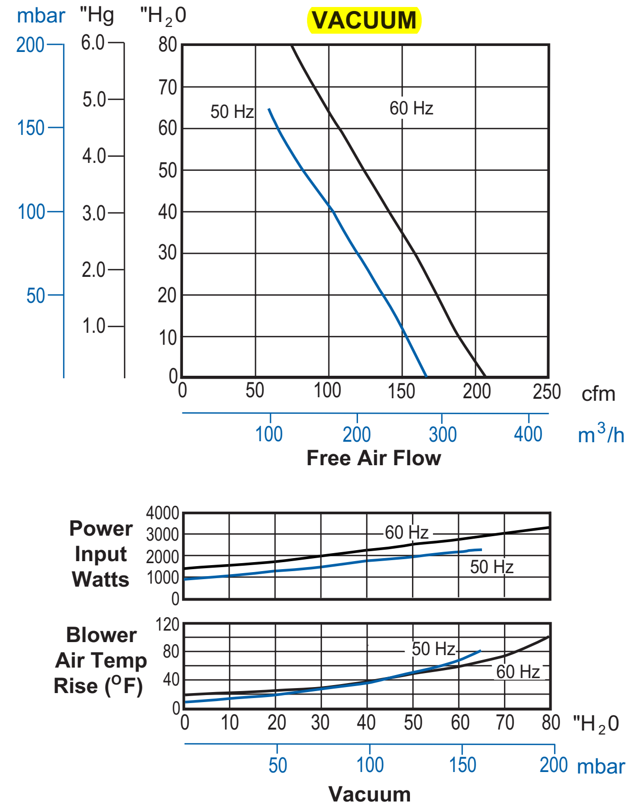


GAST

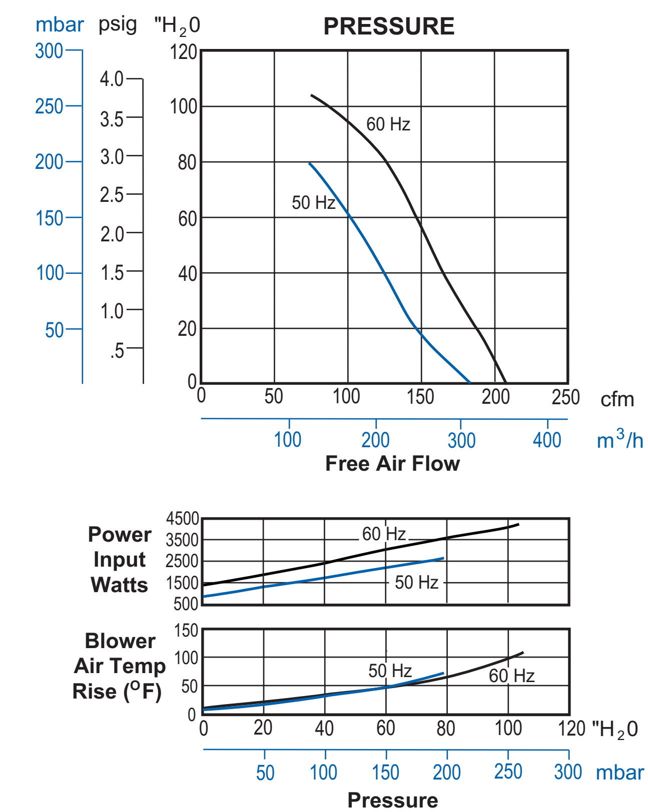
Product Performance

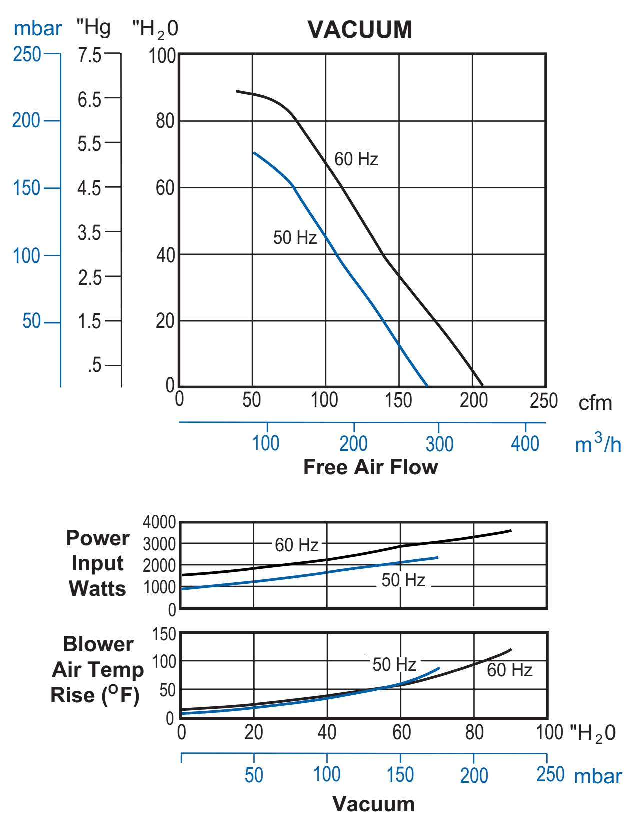
Models R6135J-10, R6335A-2, R6335B





Models R6150J-2, R6350A-2, R6350B-2





R3-R7 Series - Explosion Proof Motors

R3105N-50

R4 - R7 Series

MODELS	Maximum Pressure ("H_2O) 60 Hz	Maximum Pressure ("H_2O) 50 Hz	Maximum Vacuum ("H_2O) 60 Hz	Maximum Vacuum ("H_2O) 50 Hz	Maximum Air Flow (CFM) 60 Hz	Maximum Air Flow (CFM) 50 Hz
R3105N-50	43	31	40	28	53	44
R4110N-50 **R4310P-50**	51	38	48	35	92	74
R4P115N-50	65	45	60	40	133	112
R5125Q-50 **R5325R-50**	55 65	- 50	60 65	- 47	160 160	- 133
R6130Q-50 **R6340R-50**	60 100	75 75	70 80	65 65	215 215	180 180
R6P155Q-50 **R6P355R-50**	95 100	80 80	85 85	65 65	280 280	235 232
R7100R-50	100	90	110	85	425	350

PRODUCT FEATURES

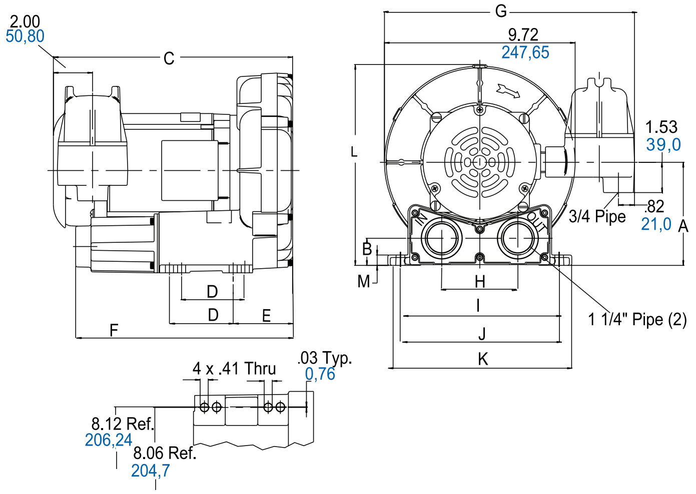
- Rugged design, maintenance free
- Quiet operation within OSHA standards
- Blowers and motors rated for continuous duty
- UL and CSA approved multi-voltage motors, incorporating approved thermal protection
- Motors classified as Explosion Proof Division 1 and 2, for Group D explosive atmospheres
- Motors carry full rated load at temperatures below Class B motor insulation limits
- Class F motor insulation used in motors larger than 1 HP
- Motors conform to NEMA frame sizes; motor enclosures conform to IP54 (suitable for outdoor use)
- Pilot duty thermal overload protection is standard on all 1 HP and larger motors
- Double sealed motor ball bearings with a B10 life exceeding 30,000 hours of continuous operation at the maximum rated continuous blower load
- Sealed air streams
- Aluminum impeller, housing and cover; viton shaft seal.
- Pressurized and leak-tested to less than 5cc/minute

Recommended Accessories	**R3 Series**	**R4 Series**	**R4P Series**	**R5 Series**	**R6 Series**	**R6P Series**	**R7 Series**
Pressure Gauge	AJ496	AJ496	AE133	AE133	AE133	AE133	AE133
Vacuum Gauge	AJ497	AJ497	AE134	AE134	AE134	AE134	AE134
Pressure Filter	AJ126C	AJ126D	AJ126D	AJ126D	AJ126F	AJ126F	AJ126G
Vacuum Filter (Inline)	AJ151C	AJ151D	AJ151D	AJ151E	AJ151G	AJ151G	AJ151H

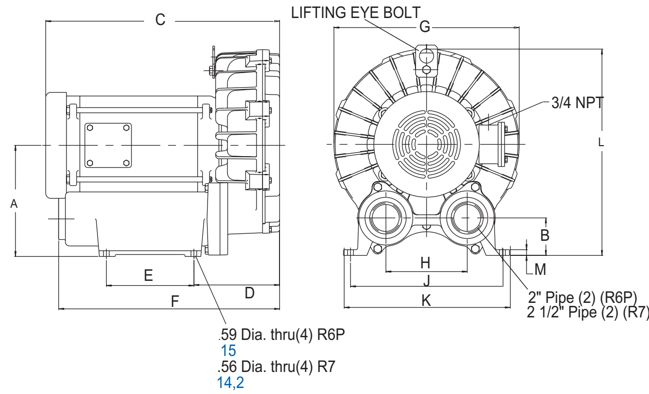
Gast Manufacturing Inc., A Unit of IDEX Corporation, Benton Harbor, MI USA • ph 616-926-6171 • fx 616-925-8288 • www.gastmfg.com

Product Dimensions (in. mm)

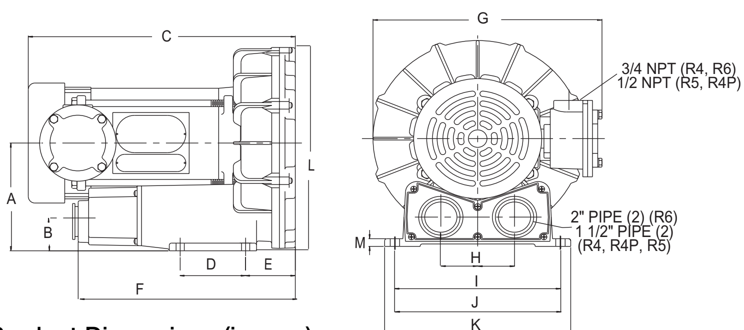
Model R3



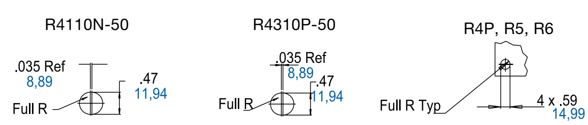
Models R6P, R7



Models R4, R4P, R5, R6



Mounting Hole Detail



Product Dimensions (in. mm)

Model	A	B	C	D	E	F	G	H	I	J	K	L	M
R3105N-50	5.21 132	1.37 35	12.3 312	3.25 83	3.06 78	11.06 281	12.75 324	3.88 99	8.06 205	8.12 206	9.38 238	10.15 258	.53 13
R41 10N-50	6.18 157	1.68 43	15.34 390	3.75 95	2.85 72	12.44 316	12.34 313	3.96 101	8.86 225	8.93 227	10.00 254	11.80 300	.44 11
R4310P-50	6.18 157	1.68 43	14.09 358	3.75 95	2.84 74	12.44 316	12.34 313	3.96 101	8.86 225	8.93 227	10.00 254	11.80 300	.44 11
R4P1 15N-50	6.98 177	1.84 47	17.41 442	4.50 114	3.25 83	13.93 354	13.75 349	4.75 121	10.25 260	10.31 262	11.75 298	13.61 346	.60 15
R5125Q-50	7.02 178	1.82 46	17.59 447	4.50 114	3.55 90	14.22 361	13.72 348	4.75 121	10.25 260	10.31 262	11.75 298	13.80 351	.59 15
R5325R-50	7.02 178	1.82 46	16.75 1425	4.50 114	3.55 90	14.22 361	13.56 344	4.75 121	10.25 260	10.31 262	11.75 298	13.80 351	.59 15
R6130Q-50	7.75 197	1.94 49	18.97 482	5.50 140	3.85 98	16.02 407	15.17 385	4.92 125	11.38 289	11.42 290	12.96 329	15.34 390	.52 13
R6340R-50	7.75 197	1.94 49	18.82 478	5.50 140	3.85 98	15.89 404	15.17 385	4.92 125	11.38 298	11.42 290	12.96 329	15.34 390	.52 13
R6P155Q-50	9.77 248	3.15 80	22.81 579	5.12 130	5.51 140	16.85 428	16.75 425	5.00 127	- -	11.42 290	12.80 325	18.14 461	.50 13
R6P355R-50	9.77 248	3.15 80	19.92 506	5.12 130	5.51 140	16.85 428	16.75 425	5.00 127	- -	11.42 290	12.80 325	18.14 461	.50 13
R7100R-50	10.79 274	3.64 92	22.77 578	8.36 212	8.50 216	21.50 546	18.00 457	7.90 201	- -	14.76 375	16.14 410	20.03 509	.56 14

Notice: Specifications subject to change without notice.

Product Specifications

MODEL NUMBER		R3105N-50	R4110N-50	R4310P-50	R4P115N-50
Motor Enclosure		XPFC	XPFC	XPFC	XPFC
HP/kW	60 Hz	.50/0,37	1.0/0,75	1.0/0,75	1.5/1,1
	50 Hz	.33/0,25	.60/0,45	.60/0,45	1.0/0,75
Voltage	60 Hz	115/208-230-1	115/208-230-1	208-230/460-3	115/208-230-1
	50 Hz	110/220-240-1	110/220-240-1	220/380-3	110/220-240-1
Amps	60 Hz	5.2/2.9-2.6	11.4/6.2-5.6	3.4-3.3/1.6	20.3/11.2-10.6
	50 Hz	4.8/2.4-2.2	9.2/5.2-4.6	3.2/1.6	15.2/7.6-8
Starting Amps	60 Hz	12.5 @ 230V	36.5 @ 230V	19.7 @ 230V	60.6 @ 230V
	50 Hz	13 @ 220V	40.6 @ 240V	23.3 @ 220V	Consult Factory
Insulation Class		B	B	B	F
Recommended NEMA Starter Size		00/00	0/00	0/0	1/0
Net Weight (lbs/kg)		52/24	60/28	58/27	79/36

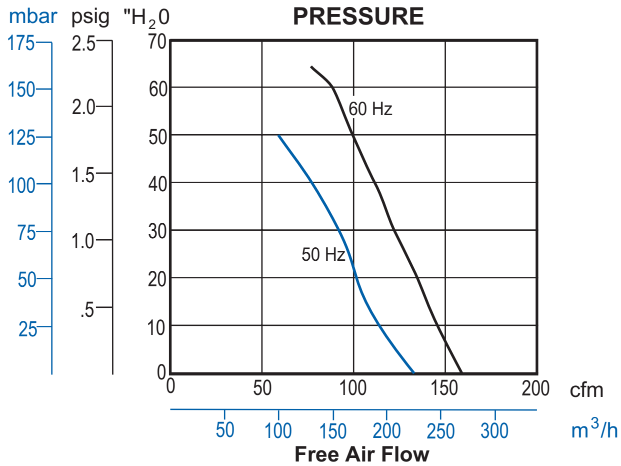
Bldg 90 Subslab blower

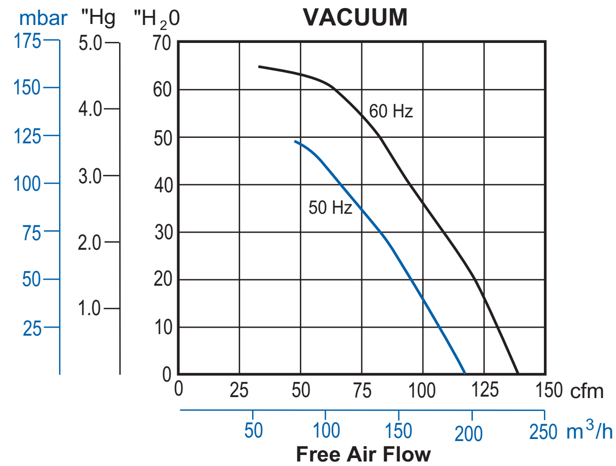
MODEL NUMBER		R5125Q-50	R5325R-50	R6130Q-50	R6340R-50
Motor Enclosure		XPFC	XPFC	XPFC	XPFC
HP/kW	60 Hz	2.0/1,5	2.0/1,5	3.0/2,2	4.0/3,0
	50 Hz	-	1.5/1,1	2.5/1,9	3.0/2,2
Voltage	60 Hz	115/230-1	208-230/460-3	230-1	208-230/460-3
	50 Hz	-	190-220/380-415-3	220-240-1	190-220/380-415-3
Amps	60 Hz	25/12.5	6.6-6.1/3.05	16.3	13-12/6
	50 Hz	-	5.0-4.4/2.5-2.6	14.7-13.5	14.4-13.4/7.2-6.8
Starting Amps	60 Hz	78 @ 230V	48 @ 230V	64 @ 230V	125 @ 230V
	50 Hz	-	Consult Factory	Consult Factory	Consult Factory
Insulation Class		F	F	F	F
Recommended NEMA Starter Size		1/0	0/0	1	1/0
Net Weight (lbs/kg)		77/35	75/34	129/59	112/51

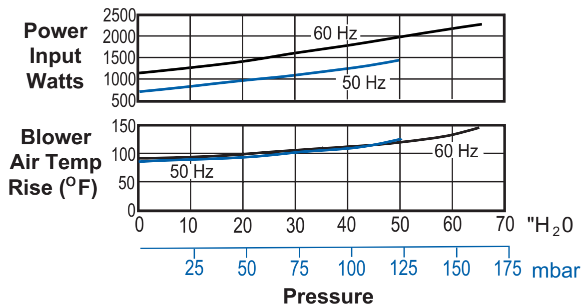
MODEL NUMBER		R6P155Q-50	R6P355R-50	R7100R-50
Motor Enclosure		XPFC	XPFC	XPFC
HP/kW	60 Hz	5.5/4,1	6.0/4,5	10/7,5
	50 Hz	4.0/3,0	4.5/3,4	8.0/6,0
Voltage	60 Hz	230-1	208-230/460-3	208-230/460-3
	50 Hz	220-240-1	190-220/380-415-3	190-220/380-415-3
Amps	60 Hz	29.9	20-18/9	26.5-24/12
	50 Hz	20.8-19.1	14.9-11/7.45-5.8	23.2-21.0/11.6-10.9
Starting Amps	60 Hz	198.4 @ 230V	59 @ 460V	105 @ 460V
	50 Hz	189 @ 240V	Consult Factory	Consult Factory
Insulation Class		F	F	F
Recommended NEMA Starter Size		0/2	1/0	2/1
Net Weight (lbs/kg)		243/110	233/105	297/134

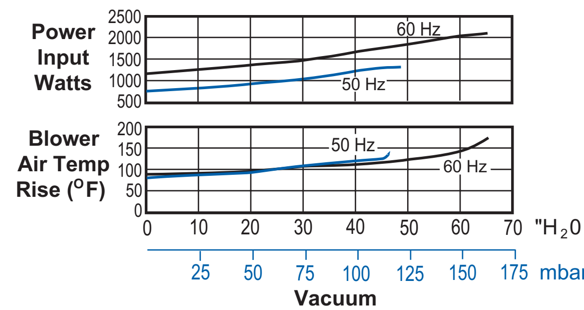
Gast Manufacturing Inc., A Unit of IDEX Corporation, Benton Harbor, MI USA • ph 616-926-6171 • fx 616-925-8288 • www.gastmfg.com

R5325R-50

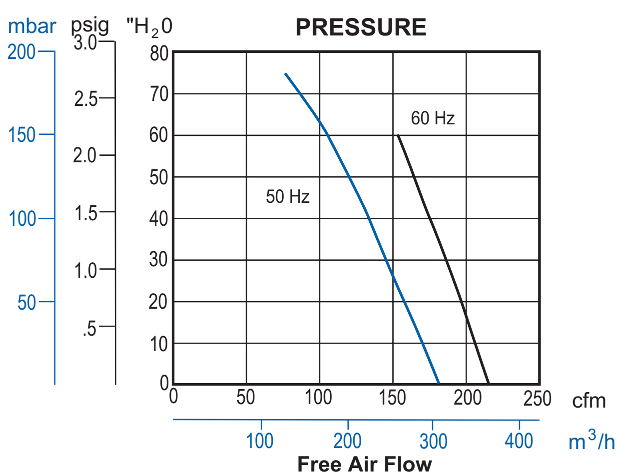


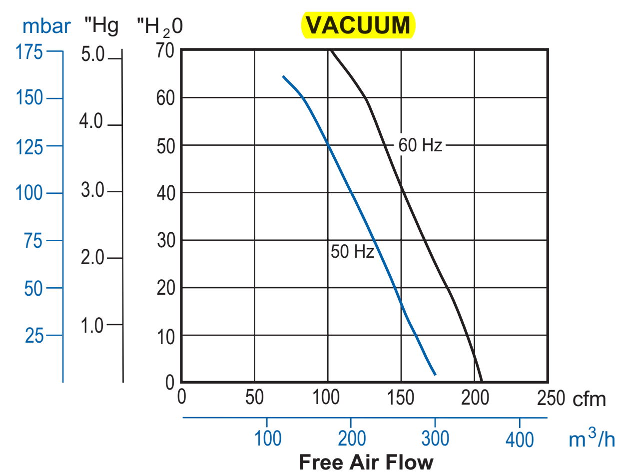


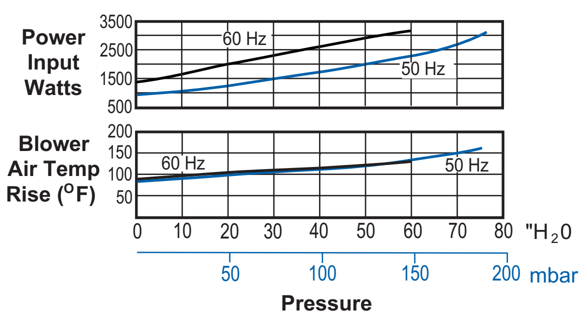


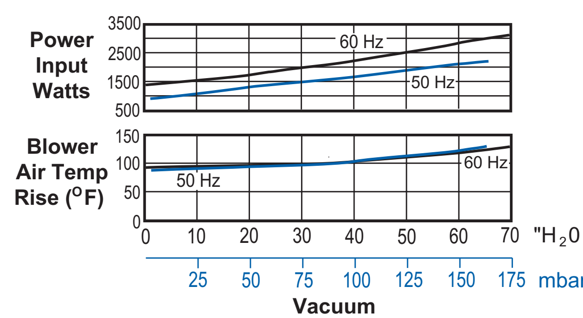


R6130Q-50





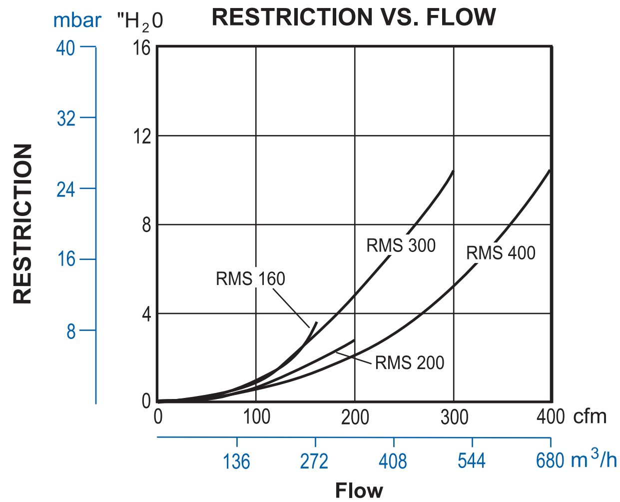




Regenair® Liquid Separator

The separator removes liquids from the gas stream in a soil vapor extraction process, to help protect both blower and vapor treatment system from corrosion and mineral deposit buildup. The separator is located between the extraction wells and the blower. An inline filter is installed between separator and blower.

Cut away to show ball float. Above model shows optional explosion proof float switch AJ213

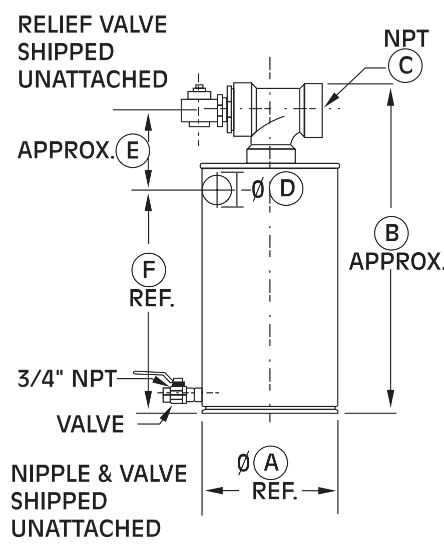


Specifications

Practical Design Engineered to remove and contain moisture ranging from a fine mist to slugs of water from blower inlet air streams, Gast separators incorporate a cyclonic action which results in a very high degree of efficiency.
A floating ball valve which closes when the liquid level becomes too high prevents collected liquid from overflowing back into the air stream. When the float valve closes an integral vacuum relief valve opens, admitting air to cool the blower and prevent overheating.

Rugged Construction Gast separator drums are made from ribbed heavy gauge cold-rolled steel, with heavy steel inlet, drain and float switch ports welded to the drum wall. Drum interiors are epoxy coated to resist abrasion, corrosion and chemicals, while the drum exterior is coated with durable urethane. For ease of connection, the outlet port of female pipe threaded. The heavy-duty 304 stainless steel ball float resists chemicals. Maximum rated vacuum is 22" Hg (299 "H_2O).

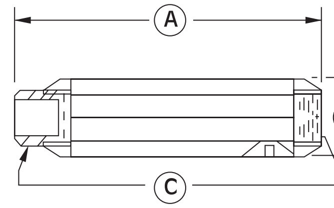
Included is a pilot operated precision relief valve capable of functioning over a wide duty range. This vacuum relief valve is designed and built to proven reliability and durability standards. Moving parts are nickelplated for corrosion resistance and smooth operation. Explosion proof AJ213 float switch is optional; single pole double throw, electrical rating 5 amp @ 125/250 VAC, 1" NPT mounting.



Part No.	Liq. Cap.(gal.)	A(dia.)	Dim. B	C(NPT)	D(dia.)	Dim. E	Dim. F	Used On
RMS160	10	14.8"	37.5"	2"	2"	7.5"	26.6"	R3, R4, R5
RMS200	19	19.7"	35"	2"	2"	7.5"	26.6"	R4, R4H, R4P, R5
RMS300	19	19.7"	35"	2.5"	2.5"	7.5"	26.6"	R4H, R4M, R5, R6, R6P, R6PS, R7H
RMS400	40	24"	44"	3"	3"	9.7"	29"	R6PP, R4M, R6, R6P, R7, R7S, R7P, R7H,R9, R9S

Mufflers

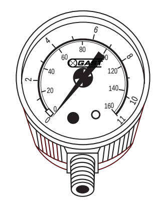
Designed to reduce noise by 5-8 dBa and remove high frequency sound associated with all blowers .



Part No.	Dim. A	Dim. B	Dim. C	Used On
AJ121B	7.46"	2.38"	1" NPT	R1, R2
AJ121C	7.94"	2.62"	$1\frac{1}{4}$" NPT	R3
AJ121D	12.75"	3.25"	$1\frac{1}{2}$" NPT	R4, R5, R4P, R4M, R4H, R7
AJ121F	17.05"	3.63"	2" NPT	R4H, R4M, R6, R6P, R6PP, R6PS
AJ121G	17.44"	4.25"	$2\frac{1}{2}$" NPT	R7, R7P, R7S, R7H
AJ121H	20.25"	4.75"	3" NPT	R6PP (Exhaust), R9, R9P, R9S
AJ121M	33.50"	6.00"	4" NPT	R7P (Exhaust)
AJ121N	39"	7.00"	5" NPT	R9P

Pressure-Vacuum Gauge

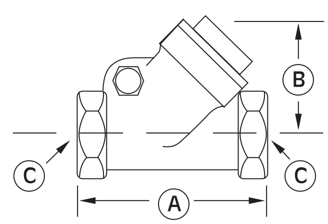
To monitor the system performance so maximum duties are not exceeded. Using two gauges (one on each side of the filter) is a great way to know when the filter needs servicing.



Part No.			Used On
AJ497	Vacuum gauge	0-60" H_2O, 1/4" NPT connection	R1, R2, R3, R4 R4H, R4M, R4P, R5, R7, R7P, R7H, R7S, R9, R9P, R9S
AE134	Vacuum gauge	0-160" H_2O, 1/4" NPT connection	R4P, R6PP, R6PS, R6P, R4M, R6, R7, R7S, R7P, R9, R9P, R9S
AE134F	Vacuum gauge	0-15" Hg, 1/4" NPT connection	R4H, R4M, R7H
AE133	Pressure gauge	0-160" H_2O, 1/4" NPT connection	R6PP, R6P, R5, R4P, R6, R7P, R9, R9P
AE133A	Pressure gauge	0-200" H_2O, 1/4" NPT connection	R4M, R6PS, R7, R7S
AE133F	Pressure gauge	0-15 psi, 1/4" NPT connection	R4H, R7H, R9S
AJ496	Pressure gauge	0-60" H_2O, 1/4" NPT connection	R1, R2, R3, R4

Check Valve

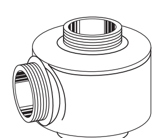
Designed to prevent back-wash of fluids that would enter the blower. Also prevents air back-streaming if needed. Can be mounted with discharge either vertical or horizontal. Valve will open with 3" of water pressure.

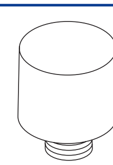


Part No.	Dim. A	Dim. B	Dia. C
AH326B	3.57"	2.32"	1" NPT
AH326C	4.19"	2.69"	$1\frac{1}{4}$" NPT
AH326D	4.50"	2.94"	$1\frac{1}{2}$" NPT
AH326F	5.25"	3.82"	2" NPT
AH326G	8.00"	5.07"	$2\frac{1}{2}$" NPT

Relief Valve

By setting a relief valve at a given pressure/vacuum you can ensure excessive duties will not harm the blower or products in your application.


AG258 Series

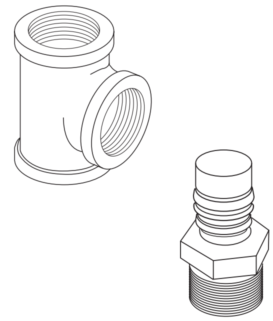

PV Series

Part No.			Used On
AG258	Relief valve	1-1/2" NPT adjustable 30-200" H2O, vac. or press., 200 CFM max.	R4, R4H, R4M, R4P, R5, R6, R6P, R6PS, R7
AG258F	Relief valve	2-1/2" NPT adjustable 25-200" H2Os, vacuum or pressure, 570 CFM	R6PP, R7H, R7P, R7S, R9, R9P, R9S
PV072	Relief valve	For pressure, pre-set for 7.2 psi, 1-1/4" NPT connection (60Hz)	Consult factory
PV098	Relief valve	For pressure, pre-set for 9.8 psi, 1-1/4" NPT connection (50Hz)	R4H, R7H
PV102	Relief valve	For pressure, pre-set for 10.2 psi, 1-1/4" NPT connection (60Hz)	R4H, R7H

Fittings

Gast has a complete line of male hose barbs, tees, common elbows and close nipples for easy hook-up

Pipe Size	1"	1 1/4"	1 1/2"	2"	2 1/2"
Tee	BA415	BA431	BA432	BA433	BA434
Common Elbow	BA220	BA244	BA230	BA247	BA248
Nipple	BA752	BA809	BA783	BA810	BA813
Plastic Male Pipe Hose Barb	AJ117A	AJ117B	-	-	-
Hose I.D.	1.25	1.25	-	-	-
Metal Male Pipe Hose Barb	AJ117D	AJ117F	AJ117C	AJ117G	AJ117H
Hose I.D.	1.00	1.25	1.50	2.50	3.00



Filters

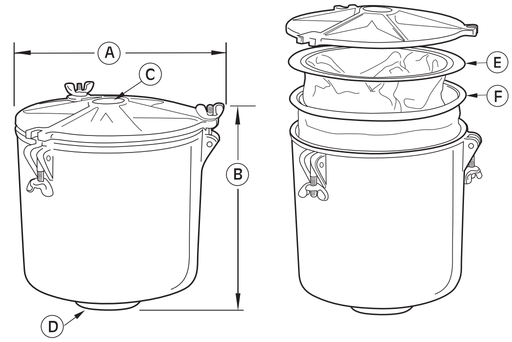
In locations where there are high amounts of dust, powder or dirt suspended in the air, inline filters (for vacuum applications) and inlet filters (pressure applications), should be used. Keeping particulates from entering the blower will ensure smooth operation and trouble free service life.

Inline filters (for vacuum)

AV series

Part No.	Dim. A	Dim. B	Dim. C	Dim. D	Used On
AV460	8 1/4"	8 7/8"	1" FPT	1" FPT	R1, R2
AV460C	8 1/4"	8 7/8"	1 1/4" FPT	1 1/4" FPT	R3

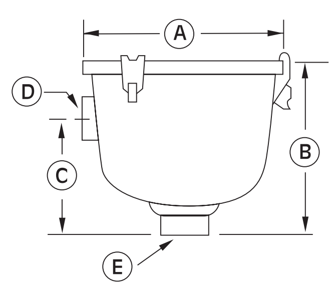
Replacement elements for AV460 and AV460C:
AV469A - Paper filter, 5-10 micron, sold in 12 pack (letter E on diagram).
AV463A - Cloth bag, 50 micron, sold in 3 pack (letter F on diagram).

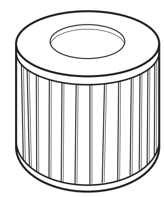


AJ series

Part No.	Dim. A	Dim. B	Dim. C	Dim. D	Dim.E	Filter Replacement	Used On
AJ151A	5.88"	4.50"	2.75"	1" FPT	1" FPT	AJ135D (10 micron)	R1
AJ151B	7.38"	6.81"	4.62"	1" FPT	1" FPT	AJ135E (10 micron)	R2
AJ151C	7.38"	6.81"	4.62"	1 1/4" FPT	1 1/4" FPT	AJ135E (10 micron)	R3
AJ151D	7.38"	6.81"	4.62"	1 1/2" FPT	1 1/2" FPT	AJ135E (10 micron)	R4, R4P
AJ151E	8.75"	10.25"	5.00"	2" FPT	2" FPT	AJ135F (10 micron)	R4H, R4P, R5
AJ151G	8.75"	10.50"	5.50"	2 1/2" FPT	2 1/2" FPT	AJ135G (10 micron)	R4M, R6, R6P, R7H
AJ151H	14.00"	27.13"	18.50"	3" MPT	3" MPT	AJ135C (10 micron)	R6PP, R6PS, R7, R7S
AJ151L	14.00"	27.13"	18.50"	4" MPT	4" MPT	AJ135C (10 micron)	R7P
AJ151M	18.50"	28.13"	19.50"	5" MPT	5" MPT	AJ135H (10 micron)	R7P, R7S, R9, R9P, R9S

MPT = Male Pipe Thread FPT = Female Pipe Thread All are heavy-duty for high amounts of particulates.
Inline filters for REGENAIR® blowers are drip-proof when mounted as shown.





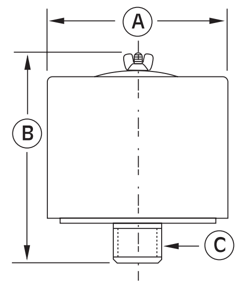
Filter Replacement

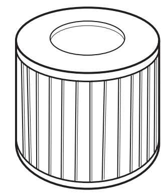
Filters

Inlet filters (for pressure)

Part No.	Dim. A	Dim. B	Dim. C	Filter Replacement	Used On
AJ126B	6.00"	4.62"	1" MPT	AJ134B (10 micron)	R1, R2
AJ126C	6.00"	7.12"	1¼" MPT	AJ134C (10 micron)	R3
AJ126D	7.70"	7.25"	1½" MPT	AJ134E (10 micron)	R4, R4H, R4P, R5
AJ126F	10.63"	4.81"	2" MPT	AG340 (10 micron)	R4M, R6, R6P, R6PS, R6PP, R9
AJ126G	10.00"	13.12"	2½" MPT	AJ135A (10 micron)	R7, R7H, R7P, R7S
AJ126L	10.00"	14.62"	4" MPT	AJ135C (10 micron)	Consult factory
AJ126MA	16.00"	14.00"	4" MPT	AJ135H (10 micron)	R9, R9P

MPT = Male Pipe Thread FPT = Female Pipe Thread All are heavy-duty for high amounts of particulates. Inlet filters for REGENAIR® blowers are drip-proof when mounted as shown.

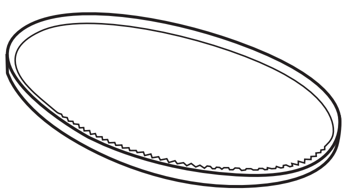




Filter Replacement

Additional Accessories for Separate Drive Blowers

Belts

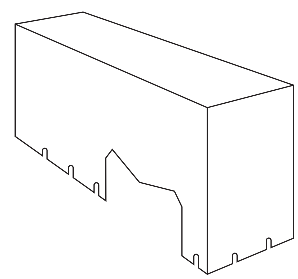


- 39” Gates Poly Chain GT for SDR4-54 **Part #AK371**
- 44” Gates Poly Chain GT for SDR5-54 **Part #AK371A**

We strongly suggest the use of Gates Poly Chain Drive. If you intend to design a system with V-belts consult the Operating and Maintenance Instructions.

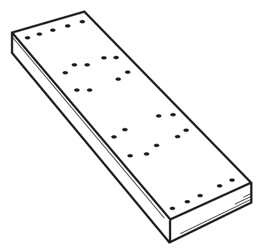
Belt Guard

- V-Belt Guard for Separate-Drive Models R4, R5, R6 **Part #AK372**



Base

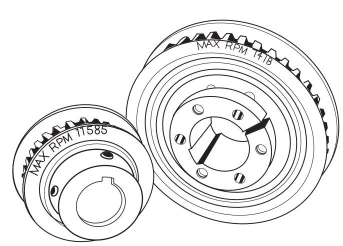
- Metal base for all Separate-Drive Models **Part #AK367**



Sprockets for Poly Chain Drive

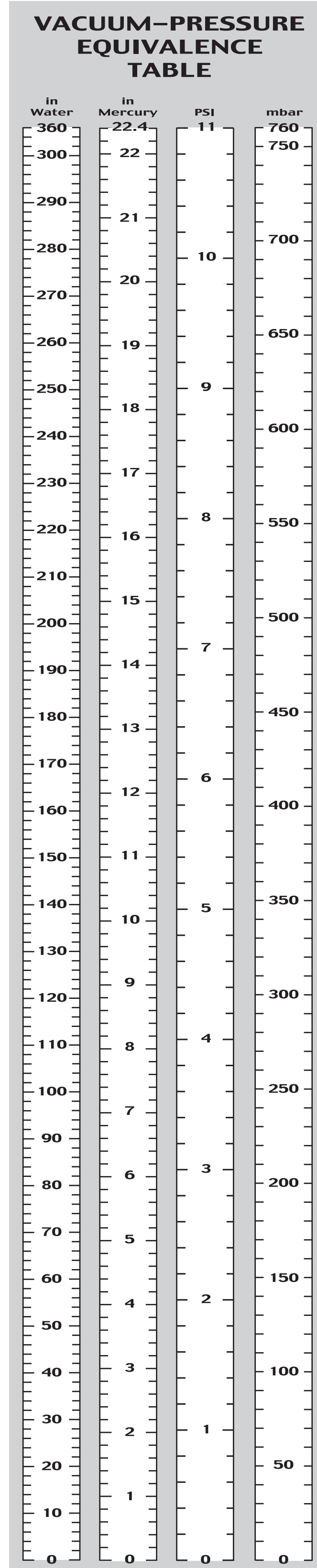
Part #	Description	For Use on
AK370A	22 teeth (7/8" shaft)	SDR4-6P, 143T and 145T- frame motors
AK370C	30 teeth (7/8" shaft)	SDR4-6P, 143T and 145T- frame motors
AK370K	38 teeth (needs AK444F bushing to go on 1 5/8" shaft)	254T and 256T-frame motors

To find blower RPM: $\frac{\text{Number of motor sprocket teeth}}{\text{Number of blower sprocket teeth}}$ x Motor RPM = Blower Speed

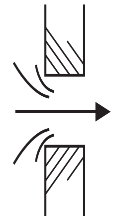


Standard Conversions

Multiply	By	To Get
Atmospheres	29.92	Inches of Mercury
Atmospheres	14.70	Psi
Atomspheres	76.0	Cms of Mercury
Bars	0.9869	Atmospheres
Bars	14.50	Psi
British Thermal Units	3.927 x 10^{-4}	Horsepower-Hours
British Thermal Units	2.928 x 10^{-4}	Kilowatt-Hours
Centimeters of Mercury	0.1934	Psi
Cubic Feet	7.481	Gallons
Cubic Feet	28.32	Liters
Cubic Feet/Minute	1.6992	Cubic Meters/Hour
Cubic Meters/Hour	.5886	Cubic Feet/Minute
Cubic Meters	35.31	Cubic Feet
Cubic Meters	61,023	Cubic Inches
Cubic Meters	1.308	Cubic Yards
Horsepower	42.44	British Thermal Units/Min.
Horsepower	745.7	Watts
Horsepower	.746	Kilowatts
Horsepower-Hours	2547	British Thermal Units
Inches	2.540	Centimeters
Inches	25.40	Millimeters
Inches of Mercury	0.03342	Atomspheres
Inches of Mercury	13.60	Inches of Water
Inches of Mercury	0.4912	Psi
Inches of Water	0.07355	Inches of Mercury
Inches of Water	25.40	Kgs/Sq. Meter
Inches of Water	0.03613	Psi
Inches of Water	1.868	Mm of Mercury
Inches of Water	2.491	mbar
Kilograms/Sq. cm	14.22	Psi
Kilopascals (kpa)	0.145	Psi
Kilowatts	1.341	Horsepower
Kilowatts	56.92	British Thermal Units/Min.
Kilowatt-Hours	3415	British Thermal Units
Liters	61.02	Cubic Inches
Liters	0.03531	Cubic Feet
Millibar	.0145	Psi
Millibar	.402	Inches of Water
Mms. of Mercury	0.0394	Inches of Mercury
Mms. of Mercury	0.01934	Psi
Psi	0.06804	Atmospheres
Psi	27.7	Inches of Water
Psi	2.036	Inches of Mercury
Psi	.07031	Kgs/Sq. Centimeter
Psi	6.895	Kilopascals (kpa)
Psi	68.95	mbar
Psi	.069	bar
Pounds of Water	27.68	Cubic Inches
Pounds of Water Evaporated at 212° F	970.3	British Thermal Units
Temp. (Degs.C.) + 273	1	Abs. Temp. (Degs.C.)
Temp. (Degs.C.) + 17.8	1.8	Temp. (Degs. Fahr.)
Temp. (Degs. F.) + 460	1	Abs. Temp. (Degs F.)
Temp. (Degs. F.) - 32	5/9	Temp. (Degs. Cent.)
Watts	0.05692	British Thermal Units/Min.
Watts	1.341 x 10^{-3}	Horsepower
Watts	10^{-3}	Kilowatts
Watts-Hour	3.415	British Thermal Units
Watts-Hour	1.341 x 10-	Horsepower/Hours
Watts-Hour	10^{-3}	Kilowatt-Hours



Air Flow Through An Orifice (in CFM)



- Downstream pressure = 14.7 psia (standard atmospheric pressure)
- Air Temperature = 70°F (21°C)
- Cd (discharge coefficient) = 0.65 (for sharp edge orifice — See drawing

Up Stream Pressure — **Orifice Diameters (in Inches)**

in. H_2O	1/32	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3
1.00	0.014	0.054	0.217	0.489	0.869	1.36	1.96	2.66	3.48	7.82	13.9	21.7	31.3	42.6	55.6	70.4	86.9	105	125
2.00	0.019	0.077	0.307	0.691	1.23	1.92	2.76	3.76	4.92	11.1	19.7	30.7	44.2	60.2	78.6	99.5	123	149	177
3.00	0.024	0.094	0.376	0.846	1.50	2.35	3.39	4.61	6.02	13.5	24.1	37.6	54.2	73.7	96.3	122	150	182	217
4.00	0.027	0.109	0.434	0.977	1.74	2.71	3.91	5.32	6.95	15.6	27.8	43.4	62.6	85.1	111	141	174	210	250
5.00	0.030	0.121	0.486	1.09	1.94	3.04	4.37	5.95	7.77	17.5	31.1	48.6	69.9	95.2	124	157	194	235	280
10.00	0.043	0.172	0.686	1.54	2.75	4.29	6.18	8.41	11.0	24.7	43.9	68.6	98.9	135	176	222	275	332	395
15.00	0.053	0.210	0.840	1.89	3.36	5.25	7.56	10.3	13.4	30.3	53.8	84.0	121	165	215	272	336	407	484
20.00	0.061	0.242	0.970	2.18	3.88	6.06	8.73	11.9	15.5	34.9	62.1	97.0	140	190	248	314	388	469	559
25.00	0.068	0.271	1.08	2.44	4.34	6.77	9.76	13.3	17.3	39.0	69.4	108	156	212	277	351	434	525	624
30.00	0.074	0.297	1.19	2.67	4.75	7.42	10.7	14.5	19.0	42.7	76.0	119	171	233	304	385	475	574	684
35.00	0.080	0.320	1.28	2.88	5.13	8.01	11.5	15.7	20.5	46.1	82.0	128	185	251	328	415	513	620	738
40.00	0.086	0.342	1.37	3.08	5.48	8.56	12.3	16.8	21.9	49.3	87.6	137	197	268	351	444	548	663	789
45.00	0.091	0.363	1.45	3.27	5.81	9.07	13.1	17.8	23.2	52.3	92.9	145	209	285	372	470	581	703	836
50.00	0.096	0.382	1.53	3.44	6.12	9.56	13.8	18.7	24.5	55.1	97.9	153	220	300	392	496	612	740	881
55.00	0.100	0.401	1.60	3.61	6.41	10.0	14.4	19.6	25.7	57.7	10.3	160	231	314	411	520	641	776	924
60.00	0.105	0.419	1.67	3.77	6.70	10.5	15.1	20.5	26.8	60.3	107	167	241	328	429	542	670	810	964
65.00	0.109	0.435	1.74	3.92	6.97	10.9	15.7	21.3	27.9	62.7	111	174	251	341	446	564	697	843	1003
70.00	0.113	0.452	1.81	4.06	7.23	11.3	16.3	22.1	28.9	65.0	116	181	260	354	463	585	723	874	1041
75.00	0.117	0.467	1.87	4.21	7.48	11.7	16.8	22.9	29.9	67.3	120	187	269	366	479	606	748	905	1077
80.00	0.121	0.482	1.93	4.34	7.72	12.1	17.4	23.6	30.9	69.5	124	193	278	378	494	625	772	934	1112
85.00	0.124	0.497	1.99	4.47	7.95	12.4	17.9	24.4	31.8	71.6	127	199	286	390	509	644	795	962	1145
90.00	0.128	0.511	2.04	4.60	8.18	12.8	18.4	25.1	32.7	73.6	131	204	294	401	524	663	818	990	1178
95.00	0.131	0.525	2.10	4.73	8.40	13.1	18.9	25.7	33.6	75.6	134	210	302	412	538	680	840	1016	1210
100.00	0.135	0.538	2.15	4.85	8.61	13.5	19.4	26.4	34.5	77.5	138	215	310	422	551	698	861	1042	1241
105.00	0.138	0.551	2.21	4.96	8.82	13.8	19.9	27.0	35.3	79.4	141	221	318	432	565	7151	882	1068	1271
110.00	0.141	0.564	2.26	5.08	9.03	14.1	20.3	27.6	36.1	81.2	144	226	325	442	578	731	903	1092	1300

Regenair® Filter Restrictions with Clean Element

Inlet Filters

Blower Size	Filter Number	Restriction in Inches of H_2O at CFM Flow Indicated
R1	AJ126B	2.2" @ 27 CFM
R2	AJ126B	4.5" @ 40 CFM
R3	AJ126C	2.5" @ 50 CFM
R4H	AJ126D	8" @ 120 CFM
R4	AJ126D	4" @ 85 CFM
R4P	AJ126D	8" @ 120 CFM
R5	AJ126D	11" @ 146 CFM
R4M	AJ126F	10" @ 240 CFM
R6	AJ126F	7" @ 200 CFM
R6P/R6PS	AJ126F	11" @ 265 CFM
R7H	AJ126F	7" @ 200 CFM
R6PP	(2) AJ126F	10" @ 240 CFM
R7/R7S	AJ126G	12" @ 400 CFM
R7P	(2) AJ126G	12"@ 400 CFM
R9	AJ126L	4" @ 600 CFM
R9S	AJ126M	Consult factory
R9P	AJ126M	Consult factory

Inline Filters

Blower Size	Filter Number	Restriction in Inches of H_2O at CFM Flow Indicated
R1	AJ151A	1" @ 25 CFM
	AV460	2" @ 25 CFM
R2	AJ151B	2" @ 40 CFM
	AV460	5" @ 40 CFM
R3	AJ151C	2" @ 50 CFM
	AV460C	3" @ 50 CFM
R4	AJ151D	3" @ 100 CFM
R4P	AJ151E	3" @ 100 CFM
R4H	AJ151E	3" @ 120 CFM
R5	AJ151E	4" @ 160 CFM
R6	AJ151G	2" @ 200 CFM
R4M	AJ151G	2.5 @ 240 CFM
R7H	AJ151G	2" @ 200 CFM
R6P/R6PS	AJ151G	3" @ 300 CFM
R7/R6PP	AJ151H	8"@ 400 CFM
R9	AJ151L	2" @ 600 CFM
R9S	AJ151 M	Consult factory
R9P	AJ151 M	Consult factory

Technical Information and Definitions

Definitions:

CFM–cubic feet of air per minute

SP–static pressure inches of water

HP–horsepower

RPM–speed in revolutions per minute

d–density in pounds per cubic foot

1–known conditions

2–desired conditions

Standard Air-air at 68°F (absolute temperature 528°) and 29.92" Hg. (barometric pressure at sea level). The density of such air is 0.075 lbs./cu.ft. and the specific volume is 13.29 cu. ft./lb. The specific gravity is 1.0.

H_2O CFM vs SCFM
The difference between "Cubic Feet Per Minute" and "Standard Cubic Feet Per Minute" is simply one of air density. The word "Standard", in this unit of measure, refers to the air being at standard temperature and pressure. In this case it will have standard air density. Regenair blowers performance is stated in terms of CFM, the volume of air they move.

Fan Laws

The following fan laws apply for the range of air performance where induction motor-driven blowers operate, that is, under 100 inches of water static pressure or vacuum (where it may be assumed that air is incompressible). The fan laws may also be used if the pressure of both fan conditions is over 100 inches of water but the pressure change is less than 30%.

1. Effect Of A Speed Change

CFM is proportional to Speed — $CFM_2 = CFM_1 X (RPM_2/RPM_1)$

(The volume changes in direct ratio to the speed)

SP is proporational to Speed^2 — $SP_2 = SP_1 X (RPM_2/RPM_1)^2$

(The pressure changes as the square of the speed ratio)

HP is proportional to Speed^3 — $HP_2 = HP_1 X (RPM_2/RPM_1)^3$

(The horsepower changes as the cube of the speed ratio) — (Also known as the 1-2-3 rule of blowers)

2. Altitude And Temperature Change The Density Of Air

CFM is constant — $CFM_2 = CFM_1$

SP is proportional to density — $SP_2 = SP_1 (d_2/d_1)$

HP is proportional to density — $HP_2 = HP_1 (d_2/d_1)$

Volume Changes In Direct Ratio To Speed

For example, a blower is operating at 3500 RPM and delivering 800 cfm. If the speed is reduced to 3000 RPM, what is the new volume?

Let:

V_1 –original volume

V_2 –new volume

RPM_1 –orginal speed

RPM_2 –new speed

$V_2 = V_1 X (RPM_2/RPM_1)^1$ — $V_2 = 800 X (3000/3500)^1 = 800 X .857 = 686$ CFM

Pressure Changes As The Square Of The Speed Ratio

For example, a blower is operating at a speed of 3500 RPM and delivering air at 3 psi. If the speed is reduced to 3000 RPM, what is the new pressure?

Let:

P_1 –orginal pressure (3 psi)

P_2 –new pressure

RPM_1 –original speed

RPM_2 –new speed

$P_2 = P_1 X (RPM_2/RPM_1)^2$ — $P_2 = 3 X (3000/3500)^2 = 3 X .735 = 2.21$ psig = 83 inches of water pressure

Air Density Varies In Inverse Proportion To Absolute Temperature

For example, a blower is to handle 150°F air at 40 inches of water pressure. What pressure (standard air) blower is required?

Let:

P_1 –pressure hot air (40 inches of water)

P_2 –pressure standard air

AT_1 –absolute temperature hot air (150+460=610°)

AT_2 –absolute temperature standard air (68+460=528°)

$P_2 = P_1 \text{ X } (AT_1/AT_2)$

$P_2 = 40 \text{ X } (610/528) = 40 \text{ X } 1.15 = 46$ inches of water

Temperature in Degrees of Fahrenheit	% Of Change In Air Density Compared to 70°
100	–5
90	–4
70	0
60	+2
50	+4
40	+6
30	+8
20	+10
10	+13

If a blower is capable of delivering 30 inches of water pressure with standard air, what pressure will it develop handling 150°F inlet air?

$P_1 = P_2 \text{ X } (AT_2/AT_1)$

$P_1 = 30 \text{ X } (528/610) = 30 \text{ X} .866 = 26$ inches of water pressure

Relation Of Density To Inlet Volume

At high altitudes it is frequently specified that a specific blower must be capable of handling a given volume of "standard air". For example, a blower is to operate at 5000 feet and is to handle 500 CFM of standard air. To determine the equivalent volume of air the blower must handle at the higher altitude:

Let:

V_1 –volume of standard air (500 CFM)

V_2 –volume of thinner air

Hg_1 –barometric pressure sea level (29.92)

Hg_2 –barometric pressure at altitude (24.89 for 5000 feet)

$V_2 = V_1 \text{ X } (Hg1/Hg2)$

$V_2 = 500 \text{ X } (29.92/24.89) = 601$ CFM of air at 5000 feet altitude

Pressure Varies In Direct Proportion To Density

For example, a blower operating at 80 inches of water with standard air is to be used to handle air having a specific gravity of 0.8. What pressure does the blower create when handling the air?

Let:

Pa – air pressure

Pg – gas pressure

SG – specific gravity of gas

Pg = Pa X SG

Pg = 80 X 0.8 = 64 inches of water

Horsepower Changes As The Cube Of The Speed Ratio

For example, a blower is operating at a speed of 3500 RPM and requiring 5 horsepower. If the speed is reduced to 3000 RPM, what is the new required horsepower?

Let:

HP_1 –original horsepower

HP_2 –new horsepower

RPM_1 –original speed

RPM_2 –new speed

$HP_2 = HP_1 \text{ X } (RPM_2/RPM_1)^3$

$HP_2 = 5 \text{ X } (3000/3500)^3 = 5 \text{ X } .630 = 3.15$ horsepower

Calculating System Friction Loss

Friction causes pressure loss in all systems. Plumbing design and length affect this loss in air flow.

1. Determine total straight pipe equivalent.
List number of each fitting in system. Circle the column under the supply pipe size. Multiply the number of each item by the pipe size conversion factor to find the equivalent amount of straight pipe. Add equivalent figures to actual straight pipe figures.

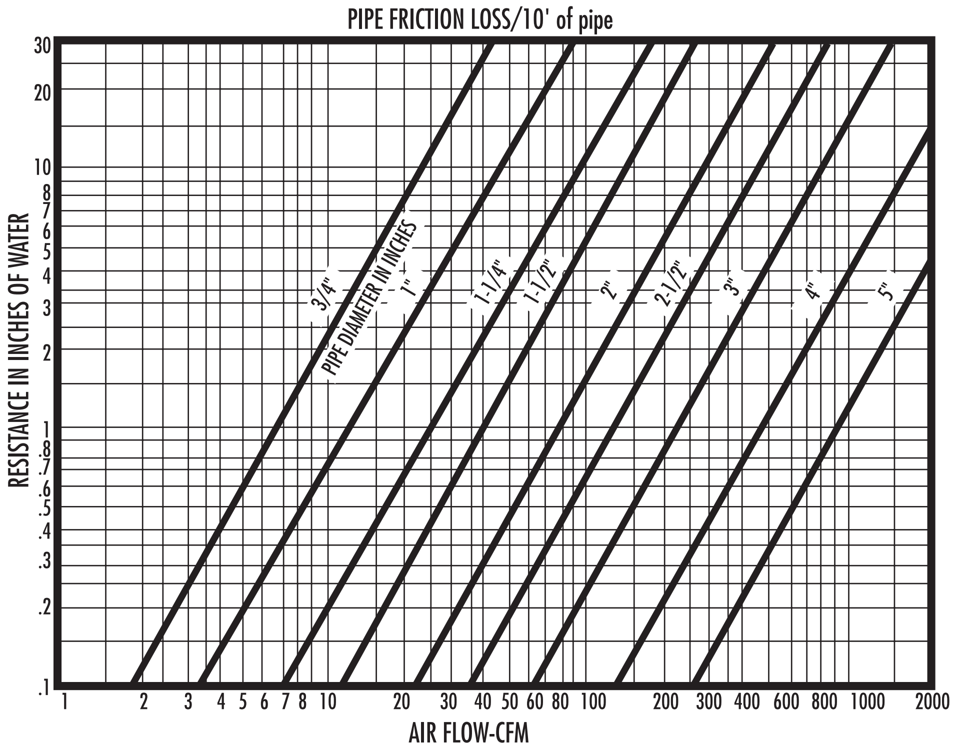
Friction loss in pipe fittings equivalent length of straight pipe

Fitting	#	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"	5"	Equivalent Ft.
90° Elbows	___x	2.0	3.0	3.5	4.0	5.0	6.0	8.0	10.0	12.6	= _______
Std. through tees	___x	1.5	2.0	2.5	3.0	3.5	4.0	5.0	7.0	8.4	= _______
Std. branch tees	___x	4.0	5.0	7.0	8.0	10.5	12.5	15.5	20.0	25.2	= _______
Check valves	____x	7.0	9.0	11.5	13.5	17.0	20.5	25.5	34.0	42.0	= _______
Gate Valves	____x	0.55	0.7	0.9	1.0	1.5	2.0	2.0	3.0	3.4	= _______

Total length of straight pipe = _______ft.

Total straight pipe equivalent = _______ft.

2. Determine total friction loss in pipe system.
On bottom line of the pipe friction loss chart, mark the air flow needed. Using a ruler, scan vertically from the CFM figure to the diagonal line for the proper pipe size. Mark the intersection and then scan to the left (vertical) axis to find the friction loss figure.



3. Divide the Total straight pipe equivalent from step 1 by 10; multiply by friction loss figure just determined to get the total friction loss in the pipe system.

_________________________ ÷ 10 x _____________________ = __________________

Total feet of pipe in system Friction loss factor Total friction loss in system in inches of H_2O

Sound Data

OSHA Regulation Occupational Noise Exposure 1910.95 provides that protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table 1 when measured on the A scale of a standard sound level meter at slow response.

Table 1

Duration per day, hours	Sound level dBa slow response
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or less	115

The Sound Pressure Levels Of Various Common Noises And Typical Quantitative Evaluation By The Human Ear

Noise Source	Sound Pressure Level (dB)	Human Evaluation
Jet Engine	130	Threshold of feeling
Thunder	120	Deafening
Jackhammer	110	
Heavy Machinery Factory	100	
Lound street noise		Very loud
Noisy factory	90	
Referee's whistle	80	
Noisy office		Loud
Average street noise	70	
Average radio		
Average factory	60	
Noisy home		Moderate
Average office	50	
Average conversation		
Quiet radio	40	
Quiet home		
Private Office	30	Faint
Average auditorium		
Quiet conversation	20	
Rustle of leaves	10	Very faint
Whisper	0	<– Threshold of audibility

Sound Pressure Level Decreases With Distance According To This Formula:

(SPL)2 = (SPL)1 - 20LOG (d2/d1)

Where:

(SPL)2 = New Sound Pressure Level
(SPL)1 = Original Sound Pressure Level
d2 = New distance from sound generator
d1 = Original distance from sound generator

Thus, each doubling of distance results in 6 dBa reduction in Sound Pressure Level

NOTE: this formula assumes that no noise is reflected. In a room that reflects most sound energy (having walls with a low noise reduction co-efficient) much less reduction in noise level with increased distance will be observed than is predicted with this formula.

Noise Q & A

Q. How do I decrease blower noise?

A. Common methods used to decrease blower noise include:

- Having the cover side face where you want the reduction in noise to be and having sound absorbing material diminish sound reflected from the motor side of the blower
- Checking the supporting structure for rattling
- Controlling reflected noise with sound absorbing material
- Moving the blower away from the operator, in another room, possibly in a different area or outside.

Q. Typically how much does the noise output of Gast blowers vary with changes in pressure or vacuum?

A. This varies a lot from model to model with some models little or no change and with others, as much as 9 dBa.

Q. Tyically how much does the noise output of Gast blowers change between 60 Hz and 50 Hz?

A. Generally 50 Hz is 3 dBa quieter than 60Hz but this varies from model to model.

Q. On Gast dual blowers when do I need the large accessory muffler?

A. These blowers provide silencing for either the inlet or exhaust but not both. If, for example, the discharge of the blower is underwater or in some location where the noise passing through the pipe is contained and not objectionable no additional silencer is needed. Where this ringing noise is not contained and noise control is needed, we manufacture accessory mufflers to greatly reduce noise levels.

Q. What happens to the noise when I locate two blowers close together?

A. If the blowers are of the same design they produce sound frequencies that are close together. These may cause a "beating" change in volume of the blower noise. This is because the units are not synchronized. If two small blowers are needed this change in volume can be reduced by moving tham further apart. With larger blowers a dual blower with two blowers on one motor will solve this problem.

Q. What causes the noise relief valves make?

A. Air rush through the valve.

Q. How do I control relief valve or bleed off valve noise?

A. Attach AJ121 series silencer on the port of the relief valve that is open to atmosphere.

Contact Gast at 616-926-6171 or www.gastmfg.com with any further questions you may have on reducing blower noise in your application.

Noise Reduction and Absorption Coefficients for Common and Specialty Noise Reduction Materials

	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	NRC
Brick, unglazed	.03	.03	.03	.04	.05	.07	.04
Carpet 1/4 in pile height	.05	.10	.15	.30	.50	.55	.26
Fabric Heavy Velour 18 oz per sq. yd draped to 1/2 area	.14	.35	.55	.72	.70	.65	.62
Hardwood Plywood Paneling 1/4 in thick wood frame	.58	.22	.07	.04	.03	.07	.09
Tecnifoam* TFP4 Pyramind shape	.39	.60	1.21	1.14	1.16	1.13	1.05
Tecnifoam* TFW4000 Anaechoic Wedge shape	.64	1.10	1.34	1.23	1.24	1.21	1.25

Source: Mechancial Engineering Reference Manual

*TFP4 and TFW4000 are products of Tecnifoam, Inc., 7145 Boone Avenue North, Minneapolis, MN., 55428

Blower Sound Levels of Gast Blowers

Data is highest sound level out of 4 places around the blower at 1 meter.

Data represents average of several units run at nominal voltage.

Lowest to highest maximum dba level throughout performance range is shown.

Readings at other than the maximum around the blower at 1 meter may be from 2 to 10 dba less than data shown.

Readings taken in a laboratory sound room that does not reflect much noise.

Note: For comparison purposes, some blower manufacturers show sound data from 1–1/2 meters instead of from 1 meter; also, some blower manufacturers show an "average" sound level across performance instead of the full range between minimum and maximum sound levels; either of these methods will provide different and usually lower sound levels compared to Gast's sound level method.

60Hz	dBa at Pressure	50Hz	dBa at Pressure
R1	59-67	R1	59-64
R2	66	R2	61-63
R3	67-70	R3	63-68
R4	69-73	R4	64-69
R4P	69-75	R4P	64-71
R5	73-77	R5	71-77
R6	73-79	R6	70-79
R6P	82-83	R6P	77-80
R6PP	77-79	R6PP	73-76
R6PS	76-77	R6PS	72-75
R7	82-84	R7	77-79
R7P	77-80	R7P	74-79
R7S	75-77	R7S	72-76
R9	82-85	R9	78-85
R9P	81-88	R9P	79-86
R9S	79-81	R9S	77-81
R4H	80-82	R4H	75-81
R4M	82-83	R4M	78-79
R7H	83	R7H	79-81

60Hz	dBa at Vacuum	50Hz	dBa at Vacuum
R1	58-63	R1	54-60
R2	67	R2	63-64
R3	67-71	R3	64-69
R4	70-72	R4	66-70
R4P	73-74	R4P	68-71
R5	75-76	R5	71-73
R6	78-80	R6	74-77
R6P	81-85	R6P	79-81
R6PP	81-83	R6PP	78-79
R6PS	79-81	R6PS	76-77
R7	85-87	R7	79-84
R7P	84-86	R7P	80-83
R7S	82-83	R7S	78-80
R9	85-90	R9	83-84
R9P	88-90	R9P	84-87
R9S	87-88	R9S	83-86
R4H	82-89	R4H	79-88
R4M	85-89	R4M	80-85
R7H	82-91	R7H	80-90

GAST CERTIFIED SERVICE CENTER®

GAST Manufacturing, Incorporated is making pump repair and maintenance a little easier.

If you want to keep your pneumatic pumps running at peak performance and with lower operating costs, contact one of our GAST Certified Service Centers listed below for more details:

Gast Manufacturing Inc.
2550 Meadowbrook Road
Benton Harbor, MI 49022
TEL: 616-926-6171
FAX: 616-925-8288
www.gastmfg.com

Gast Manufacturing Inc.
505 Washington Avenue
Carlstadt, NJ 07072
TEL: 201-933-8484
FAX: 201-933-5545
www.gastmfg.com

Hydraulic & Pneumatic Sales
11100 Park Charlotte Blvd.
Charlotte NC 28273
TEL: 704-588-3234
FAX: 704-588-1569
www.hpsales.com

D & F Distributors
1144 Indy Court
Evansville, IN 47725
TEL: 812/867-2441
FAX: 812/867-6822
www.dfdistrib.com

John Henry Foster Co.
4700 Lebourget Drive
St. Louis, MO 63134-0820
TEL: 314-427-0600
TEL: 1-800-444-0522
FAX: 314-427-3502
www.jhf.com

Brenner Fiedler & Assoc
13824 Bentley Place
Cerritos, CA 90701
TEL: 800-843-5558
TEL: 310-404-2721
FAX: 310-404-7975
www.brenner-fiedler.com

Air-Oil Products Corporation
301 30th Street NE 31, #112
Auburn, WA 98002
TEL: 800-282-2672
FAX: 877-808-4601
www/air-oilproducts.com

Wainbee Limited
5789 Coopers Avenue
Mississauga, Ontario
Canada L4Z 3S6
TEL: 905-568-1700
FAX: 905-568-0083
http://www.wainbee.ca

Wainbee Limited
215 boul Brunswick
Pointe Claire, Quebec
Canada H9R 4R7
TEL: 514-697-8810
FAX: 514-697-3070
http://www.wainbee.ca

Gast Manufacturing Co., Ltd.
Beech House
Knaves Beech Business Centre
Loudwater, High Wycombe
Bucks, England HP10 9SD
TEL: 011-44 1628 532600
FAX: 011-44 1628 532470
http://www.gastltd.com

Japan Machinery Co., Ltd
Central PO Box 1451
Tokyo, 100-91 Japan
TEL: 813 3573 5421
FAX: 813 3571 7865
or: 81-3-3571-7896
www.japanmachinery.com

APPENDIX B

DATA COLLECTION SHEETS

Building 90 SVE Inspection and Monitoring Form
Camp Stanley Storage Activity, Texas

Date/Time : _______________ ***Operator:*** _____________________ ***Ambient T (℉)*** __________

Monitoring Event (circle one): Biweekly / Monthly / Quarterly / Other _____________________

	Wellhead Readings								
Monitoring Point	***Vac in.H_2O***	***Flow fpm***	***Temp °F***	***VOC ppm***	***O_2 vol %***	***CO_2 vol %***	Analytical Sample Collected: ***Time***	***Summa Canister #***	***Comments***
				Subslab Wells					
AOC65-VEW1	-								
AOC65-VEW2	-								
AOC65-VEW3	-								**OFFLINE**
AOC65-VEW4	-								**OFFLINE**
AOC65-VEW5	-								**OFFLINE**
AOC65-VEW6	-								**OFFLINE**
AOC65-VEW7	-								**OFFLINE**
AOC65-VEW8	-								
AOC65-VEW9	-								
AOC65-VEW10	-								
AOC65-VEW11	-								**OFFLINE**
AOC65-VEW12	-								
B90-INTAKE-SS	-								

Exterior Wells

	Manifold Readings								Wellhead	
Monitoring Point	***Vac (in. H_2O)***	***Flow fpm***	***Temp °F***	***VOC ppm***	***O_2 vol %***	***CO_2 vol %***	Analytical Sample Collected: ***Time***	***Summa Canister #***	**Vac *(in. H_2O)***	***Comments***
AOC65-VEW15	-								-	
AOC65-VEW16	-								-	
AOC65-VEW18	-								-	
AOC65-VEW28A	-								-	
AOC65-VEW28B	-								-	
B90-INTAKE-EX	-									
B90-EXHAUST	+									

Blower Information	***System***	Pre Adjustment: **Blower On**	**Intake Pressure Gauge**	**Adjusted Pressure**	Vacuum Relief Valve: **Check**	**Lube**	**Hours Meter**
	Subslab	Y / N			Y / N	Y / N	
	Exterior	Y / N			Y / N	Y / N	

Moisture Separator Information	***System***	**Inspected**	**Emptied**	**Amount Xfered (gals)**
	Subslab	Y / N	Y / N	
	Exterior	Y / N	Y / N	

Observations/Notes:

in.H_2O: inches of water fpm: feet per minute ppm: parts per million VRV: vacuum relief valve psi: pounds per square inch

AOC-65 SVE Inspection and Monitoring Form
Camp Stanley Storage Activity, Texas

*Date/Time :*_______________ *Operator:*_____________________ *Ambient T (°F)* __________

Monitoring Event (circle one): Biweekly / Monthly / Quarterly / Other _____________________

Monitoring Point	Manifold Readings: Vac in.H_2O	Flow fpm	Temp °F	VOC ppm	O_2 vol %	CO_2 vol %	Analytical Sample Collected: Time	Summa Canister #	Wellhead: Vac in. H_2O	Comments
Shallow Wells										
AOC65-VEW19	-								-	
AOC65-VEW20	-								-	
AOC65-VEW21	-								-	
AOC65-VEW23	-								-	
AOC65-VEW25	-								-	
AOC65-VEW27	-								-	
AOC65-INTAKE-SW	-									intake flow meter (SCFM)=
Deep Wells										
AOC65-VEW13	-								-	
AOC65-VEW14	-								-	
AOC65-VEW17	-								-	
AOC65-VEW22	-								-	
AOC65-VEW24	-								-	
AOC65-VEW26	-								-	
AOC65-INTAKE-DW	-									intake flow meter (SCFM)=
B90-EXHAUST	+									

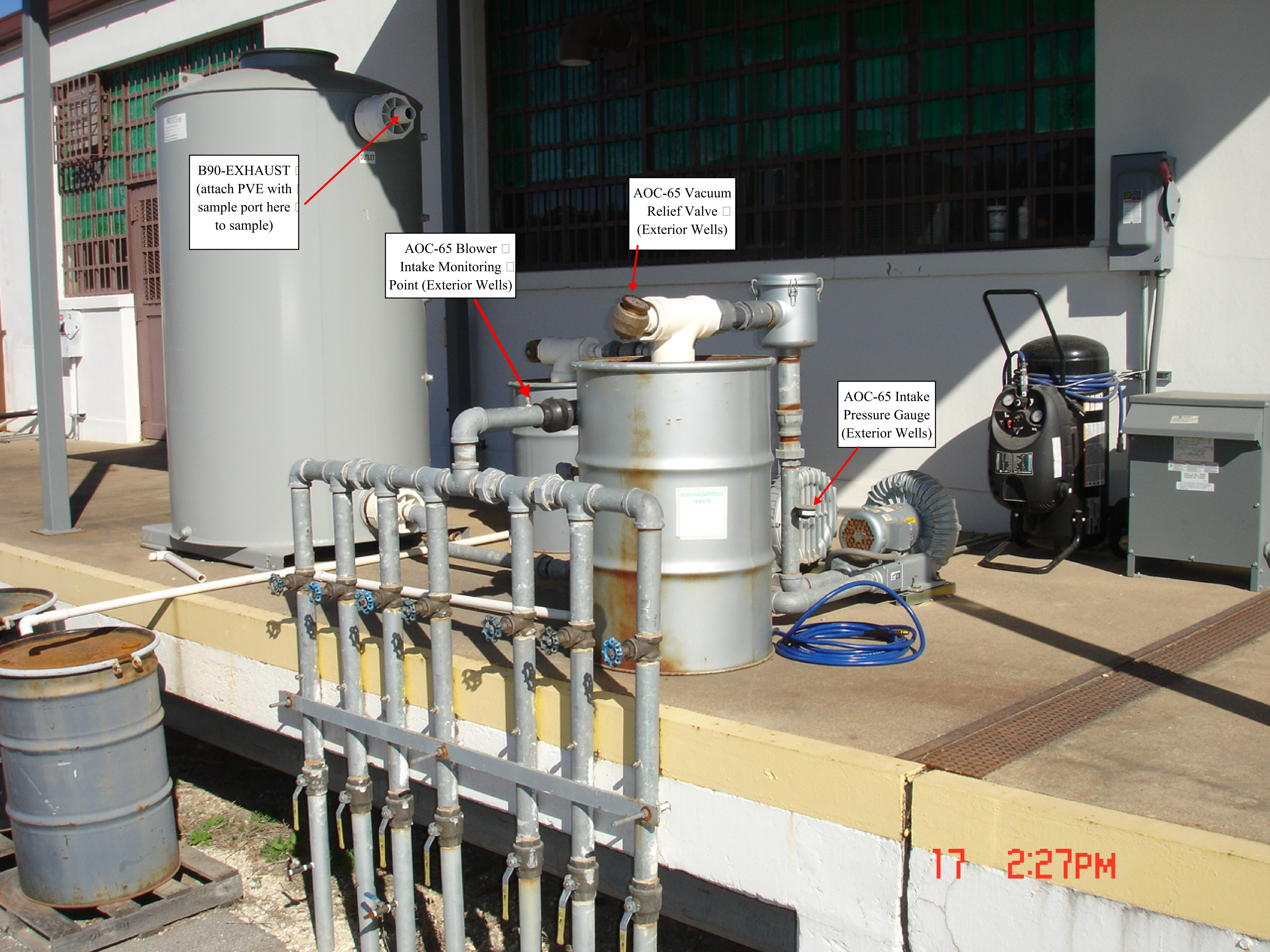
Blower Information	System	Pre Adjustment: Blower On	Intake Pressure Gauge	Adjusted Pressure	Vacuum Relief Valve: Check	Lube	Hours Meter
	Shallow	Y / N			Y / N	Y / N	
	Deep	Y / N			Y / N	Y / N	

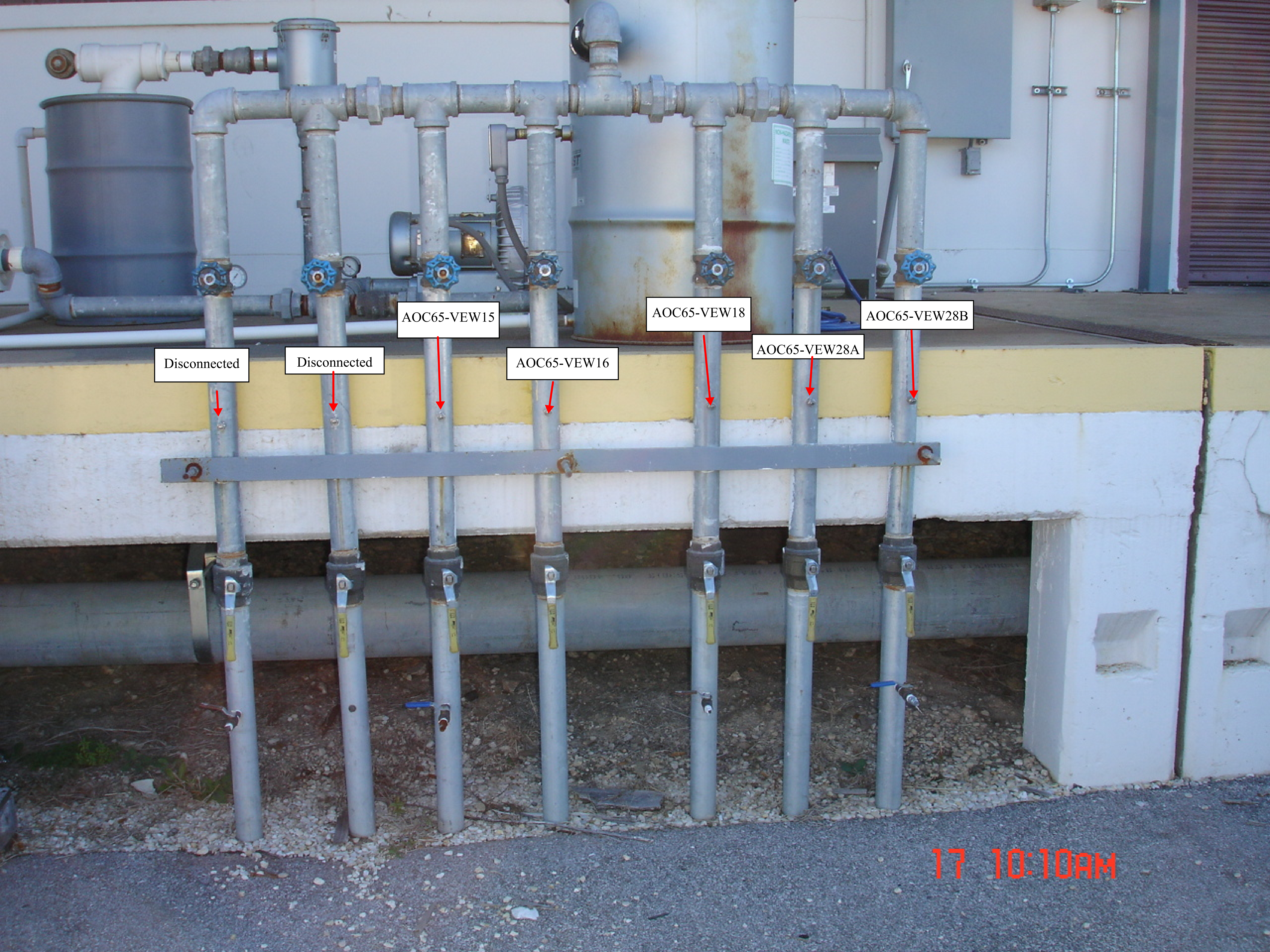
Moisture Separator Information	System	Inspected	Emptied	Amount Xfered (gals)	Observations/Notes:
	Shallow	Y / N	Y / N		
	Deep	Y / N	Y / N		

in.H_2O: inches of water fpm: feet per minute ppm: parts per million VRV: vacuum relief valve psi: pounds per square inch

APPENDIX C

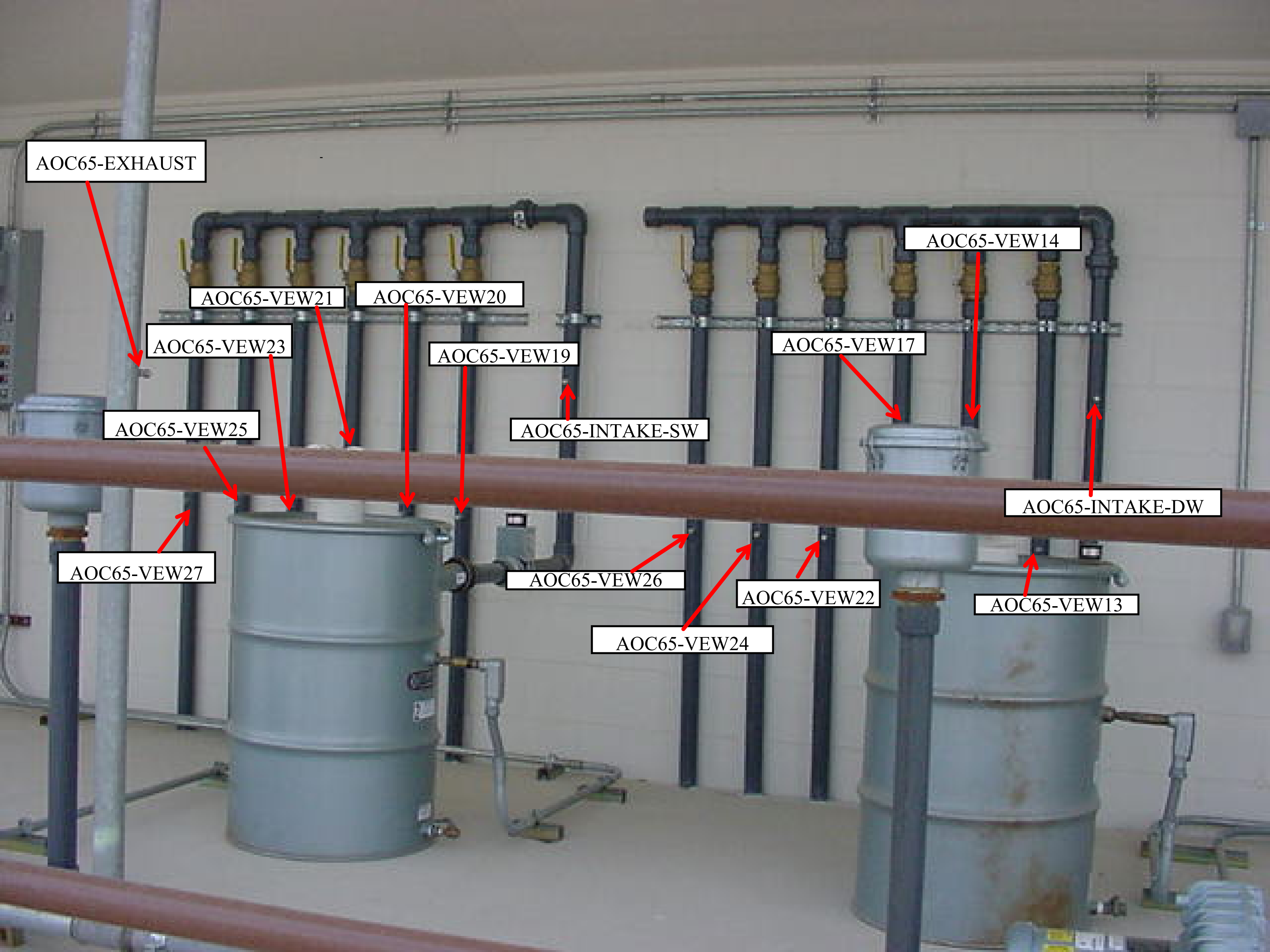
SVE MONITORING PHOTOS

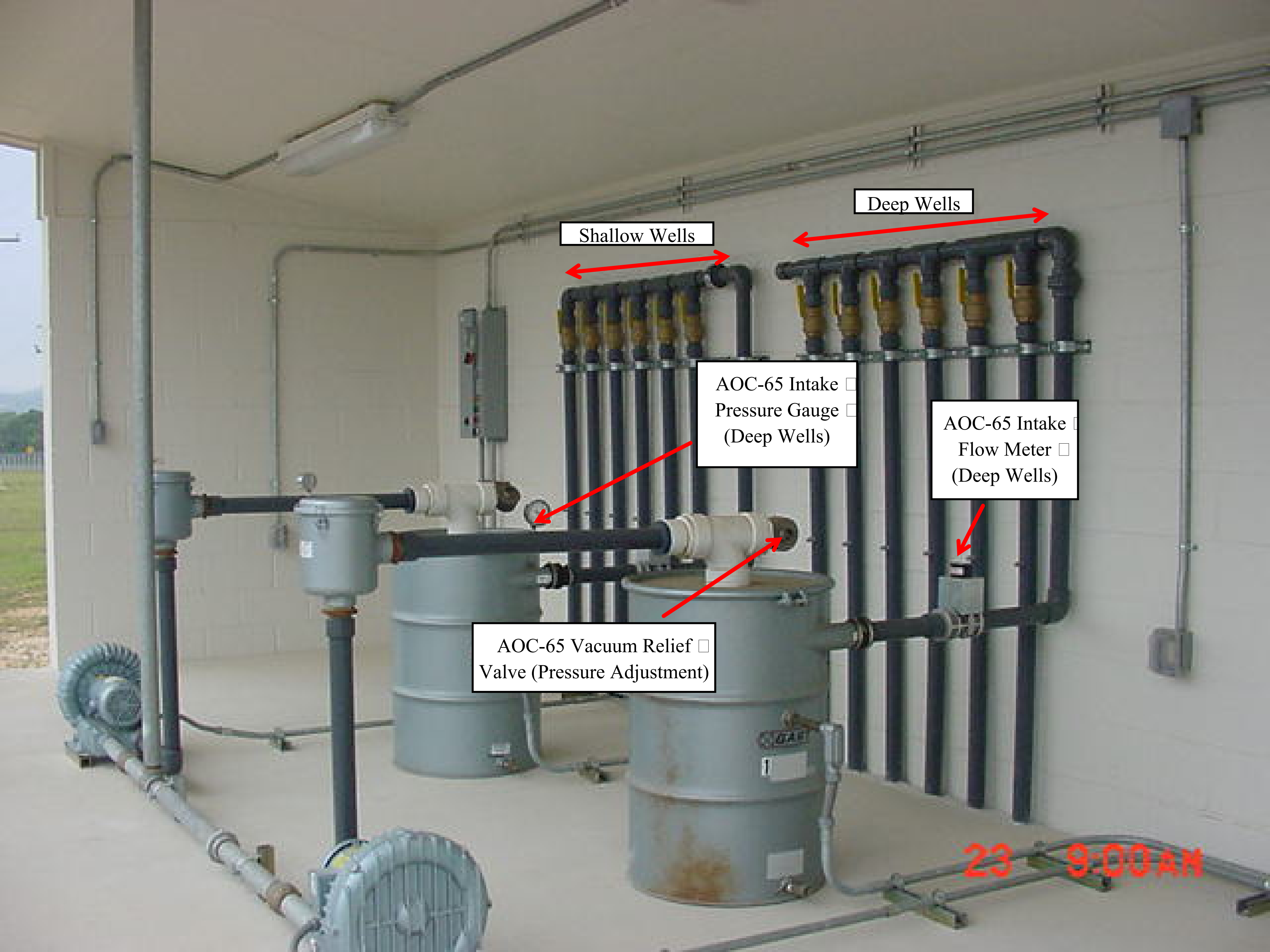

B90-EXHAUST (attach PVE with sample port here to sample)
AOC-65 Vacuum Relief Valve (Exterior Wells)
AOC-65 Blower Intake Monitoring Point (Exterior Wells)
AOC-65 Intake Pressure Gauge (Exterior Wells)
17 2:27PM


Disconnected
Disconnected
AOC65-VEW15
AOC65-VEW16
AOC65-VEW18
AOC65-VEW28A
AOC65-VEW28B
17 10:10AM


Building 90
Subslab VRV
(vacuum relief
valve)
Building 90
Subslab Blower
Intake
Monitoring Point
CAMPBELL HAUSFELD
IRONFORCE
GAST
17 10:10AM


Building 90
Subslab Pressure
Gauge
17 10:12AM


AOC65-EXHAUST
AOC65-VEW21
AOC65-VEW20
AOC65-VEW23
AOC65-VEW19
AOC65-VEW25
AOC65-INTAKE-SW
AOC65-VEW27
AOC65-VEW26
AOC65-VEW24
AOC65-VEW22
AOC65-VEW17
AOC65-VEW14
AOC65-INTAKE-DW
AOC65-VEW13



Shallow Wells
Deep Wells
AOC-65 Intake Pressure Gauge (Deep Wells)
AOC-65 Intake Flow Meter (Deep Wells)
AOC-65 Vacuum Relief Valve (Pressure Adjustment)
23 9:00AM


AOC-65 Vacuum Relief Valve (Shallow Wells)
AOC-65 Intake Flow Meter (Shallow Wells)
AOC-65 Intake Pressure Gauge (Shallow Wells)
23 8:59AM