REVISED OPERATION, MAINTENANCE, AND MONITORING PLAN
VAPOR MITIGATION SYSTEMS
FORMER HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
SITE NO. A3-0372-9807

PREPARED

BY

WSP ENGINEERING OF NEW YORK, P.C.

October 31, 2008

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Contents

Acronym List

EPDM	ethylene propylene diene monomer
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operation, Maintenance, and Monitoring
PVC	polyvinyl chloride
SMD	sub-membrane depressurization
SSD	sub-slab depressurization

1.0 Introduction

WSP Engineering of New York, P.C., (formerly ESC Engineering of New York) on behalf of Federal-Mogul Corporation, has prepared this operation, maintenance, and monitoring (OM&M) plan for the vapor mitigation system previously installed in the onsite office building and the existing (and potential future) offsite vapor mitigation systems installed in the vicinity of the former Huck manufacturing facility in Kingston, New York. This OM&M plan was prepared in accordance with the New York State Department of Health's (NYSDOH's) *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, dated October 2006, and Environmental Strategies Consulting's Revised Work Plan for Addressing Offsite Indoor Air Quality, dated November 28, 2005. The proposed OM&M activities outlined in this document are designed to ensure that each mitigation system continues to operate effectively.

The remainder of this plan consists of three sections. Section 2 provides a brief description of the mitigation systems installed in the vicinity of the former Huck facility and the proposed maintenance and monitoring activities. Section 3 presents the schedule and reporting of OM&M activities. Section 4 lists the project contacts.

2.0 Vapor Mitigation Systems

This section provides a general description of the vapor mitigation systems installed (or to be installed) in the vicinity of the former Huck manufacturing facility. This is followed by a discussion of the proposed system maintenance and monitoring activities. A description of the vapor mitigation system installed in the onsite office building in March 2004, including as-built drawings, is provided in the Interim Remedial Measures Summary Report, dated August 6, 2004, which is presented in Appendix C. A description of the routine operation and maintenance activities performed on the onsite soil vapor extraction (SVE) system is presented in Section 3.1 of this report and Appendix F of the summary report (Appendix C).

2.1 Description of Vapor Mitigation Systems

As of May 2008, WSP Engineering has installed vapor mitigation systems in nine buildings adjacent to the former Huck facility. The mitigated structures consist of single-family residences and commercial buildings that were constructed in the late 1800s and early 1900s and have foundations constructed primarily of brick and fieldstone. Schematic drawings for each system are presented in Appendix A; however, to maintain confidentiality, the systems are identified only by the corresponding property identification number. The owner names and addresses associated with each property identification number have been provided to the New York State Department of Environmental Conservation (NYSDEC) and NYSDOH under separate cover. All mitigation systems were designed and installed in accordance with NYSDOH (2006) guidance and the ASTM Standard Practice for Installing Radon Mitigation Systems in Existing Low-rise Residential Buildings (ASTM E-2121), dated February 10, 2003. In addition, all systems were installed by a contractor certified by the National Environmental Health Association's National Radon Proficiency Program. The mitigation system installed at each property depended on the type of building foundation (i.e., slab-on-grade, basement only, or basement with crawl space), the presence and condition of a concrete floor slab, and the results of subslab communication testing.

The process for installing the SSD systems varied depending on whether the basement had a complete or partial slab and whether the slab was competent or in poor condition. For buildings with a competent slab that covered the entire basement, the initial step was to seal potential subsurface vapor entry points (e.g., joints, cracks, pipe penetrations through the slab, and openings where the concrete slab meets the foundation walls) using an elastromeric joint sealant. In addition, significant cracks or voids in the foundation walls were sealed with expansion foam. Sealing openings in the floor slab and foundation walls also minimized the potential for the vacuum induced by the SSD system to short-circuit to the indoor air.

Once the basement floor was sealed, subslab communication testing was performed to measure the ability of a vacuum field to extend through the material beneath the slab. Communication testing consisted of drilling an approximately 0.5-inch-diameter hole near the middle of the basement and applying a vacuum to the opening using a wet/dry shop vacuum. Next, a series of 3/8-inch diameter holes were drilled through the slab in the corners of the basement as vacuum monitoring points. A digital manometer was then used to measure the vacuum at each monitoring location. If insufficient vacuum was measured at a monitoring location, additional holes were drilled and placed under vacuum until an acceptable vacuum was measured in each corner of the basement. At the conclusion of the test, each hole was sealed with elastromeric joint sealant. The results of the communication testing were then used to determine the appropriate number and location for the SSD vacuum points and to select the appropriate fan size. In the case of property ID 7, the basement floor consisted of a partial concrete slab surrounded by a surface of loosely fitted bricks and pieces of slate. Therefore, WSP Engineering installed a Sonoshield® polypropylene drain board over the existing floor and covered it with a new concrete floor. The drain board is a high-strength, woven monofilament filter fabric attached to the back of a polymeric core that is designed to provide drainage under concrete slabs. Due to the high permeability of the drain board, a vacuum field can usually be induced over the entire footprint of the slab using a single suction point. Therefore, communication testing was not performed before the system was installed.

The SSD systems were designed to create a negative pressure differential below the concrete slab, which reverses the pressure gradient and prevents the intrusion of vapors from the subsurface into indoor air. To accomplish this objective, the SSD systems consisted of one or more vacuum points that were installed through the floor slab and into the underlying soil or drain board.

At each suction point location, an approximately 5-inch-diameter opening was created through the slab and a cavity was excavated below the slab to enhance the propagation of the vacuum field. A vertical, 4-inch-diameter polyvinyl chloride (PVC) pipe was then installed in the opening and sealed to the surrounding concrete slab using an elastromeric joint sealant. The vertical pipes were connected to an inline fan on the exterior of the building, via PVC piping, which draws vapors from the soil below the slab and exhausts them to the atmosphere through a stack on the outside of the building. The exhaust stacks were constructed in accordance with the applicable guidelines (i.e., exhaust at least 12 inches above the surface of the roof, in a location at least 10 feet away from any window or other opening into the conditioned spaces of the building that is less than 2 feet below the exhaust point, and 10 feet from any adjoining or adjacent buildings). Liquid-filled manometers were installed on the vertical PVC riser(s) to measure the pressure differential, or vacuum. If two or more suction points were used, inline valves are installed to control the air flow from each suction location. A summary of the vapor mitigation fans used at each property is provided in Table 1.

Once the system was turned on, post-installation communication testing was conducted on SSD systems to demonstrate that a vacuum was being induced beneath the entire slab. Similar to the pre-installation testing, the test was conducted by re-opening the 3/8-inch-diameter holes drilled through the slab in each corner of the basement and measuring the vacuum using a digital manometer. After completing the test, each hole was resealed with elastromeric joint sealant.

On completing the installation of an SSD system, WSP Engineering’s field personnel explained to the homeowner how to read the system manometers and instructed them to periodically check the manometers for proper operation. Homeowners were also shown the signs on the SSD system piping that contained contact information for the general contractor that installed the system. Homeowners were instructed to contact WSP Engineering or the general contractor if they noticed a problem with their SSD system (e.g., abnormal fan noise, manometer shows no vacuum), or if a component of the SSD system became damaged.

Crawl spaces were addressed by installing a sub-membrane depressurization (SMD) system. The installation of a SMD involved placing a 45-mil-thick synthetic ethylene propylene diene monomer (EPDM) liner on the ground in the crawl space to impede the flow of soil vapor into the home. The sheets of liner were sealed at the seams with at least a 12-inch overlap, and

Crawl spaces were addressed by installing a sub-membrane depressurization (SMD) system. The installation of a SMD involved placing a 45-mil-thick synthetic ethylene propylene diene monomer (EPDM) liner on the ground in the crawl space to impede the flow of soil vapor into the home. The sheets of liner were sealed at the seams with at least a 12-inch overlap, and were sealed around the perimeter of any interior piers and around the foundation walls. A vacuum point consisting of a 2-inch or 4-inch-diameter PVC pipe was installed through the EPDM liner to draw vapors from beneath the membrane and discharge them to the atmosphere using an in-line fan. This resulted in a lower pressure beneath the membrane relative to the air pressure in the crawl space, which prevented the infiltration of subsurface vapors into the home. Homes requiring a SMD system for crawl spaces also had a SSD system to address the basement. Therefore, a common fan, conveyance piping, and discharge stack was used to operate both systems. SMDs were checked for leaks at the membrane seams, edge seals, and at locations where the membrane was sealed around obstructions (e.g., piers) once the installation was complete.

2.2 System Maintenance and Monitoring

Each vapor mitigation system will be inspected annually, and maintenance will be performed, as appropriate, to ensure the system is operating satisfactorily. During each visit, the following routine maintenance and monitoring activities will be conducted:

- A visual inspection of the entire system will be conducted including the fan, piping, warning device (liquid-filled manometers), labeling on the system, and any membranes installed as a soil vapor retarder. The fan will be inspected to ensure proper operation and continued effectiveness at providing the appropriate vacuum. Manufacturer's specifications will be referenced to determine if, and when, replacement parts and/or system adjustments are required. Observations will be recorded on the log sheet presented as Table 2.
- Any leaks identified will be repaired. This will include, at a minimum, inspecting all sealed joints and cracks on the concrete floor, foundation walls, vacuum points, and soil vapor retarder membrane (where it is attached to the walls and around foundation piers). Smoke tests will be performed, as necessary, to verify there are no leaks.

- The mitigation system (e.g., piping, valves, soil vapor retarder membrane, fan) becomes damaged.
- The building undergoes renovations that may reduce the effectiveness of the mitigation system.

The required non-routine maintenance activities will be determined and conducted after an evaluation is completed. As discussed in Section 3, all non-routine maintenance will be documented and reported to the NYSDEC and NYSDOH within 24 hours.

3.0 Operation and Maintenance Schedule and Reporting

Routine inspections and maintenance on the vapor mitigation systems will be conducted annually. During each visit, a log sheet (Table 2) will be completed. Any system components requiring repair work will be identified during this inspection and addressed as soon as possible based on contractor availability.

All OM&M activities and annual inspection results will be documented and reported to the NYSDEC and NYSDOH in the bi-monthly progress reports. All non-routine maintenance will be documented and reported to the NYSDEC and NYSDOH within 24 hours.

4.0 Project Contact List

The following is a list of key contacts related to the OM&M plan. Should there be any problems related to the mitigation systems installed in the homes within the study area, one of the following personnel will be contacted.

Site Engineer:	Todd Musterait, P.E.	
	716-662-6876	
Project Manager:	Brian Silfer	
	315-655-3900	
Federal-Mogul Corporation Contact:	Mark Bauer	248-354-8912

Tables

Table 1

Summary of Mitigation Fan Information
Former Huck Manufacturing Facility
Kingston, New York

Property ID	Fan Manufactuer	Fan Model	No. of Fans
1	Fantech	HP220	1
2	Fantech	HP220	1
3	Fantech	HP220	1
7	Fantech	HP220	1
10	Fantech	HP220	1
15	RadonAway	GP501	1
16	Fantech	HP220	1
17	RadonAway	HS3000	4
20	RadonAway	GP501	1

Table 2

Checklist
Vapor Intrusion Mitigation System
Federal-Mogul Corporation
Kingston, NY

Property: ______________________________ Inspector (print): ___________________________
Date: ________________________________ Inspector (sign): ___________________________
Arrival Time: _________________________ Weather Conditions: ________________________
Departure Time: _______________________

Reason for Visit: ____

Mitigation System Inspection Observations

Piping ____
____

Manometer(s) ____
____

Concrete Floor ____
____

Sump(s) ____
____

Drainger(s) ____
____

EPDM Liner ____
____

Exhaust Stack ____
____

Fan ____
____

Other ____
____

Manometer Reading(s)

Location	**Reading (Inches of H_2O)**
Manometer 1	
Manometer 2	
Manometer 3	
Manometer 4	
Manometer 5	

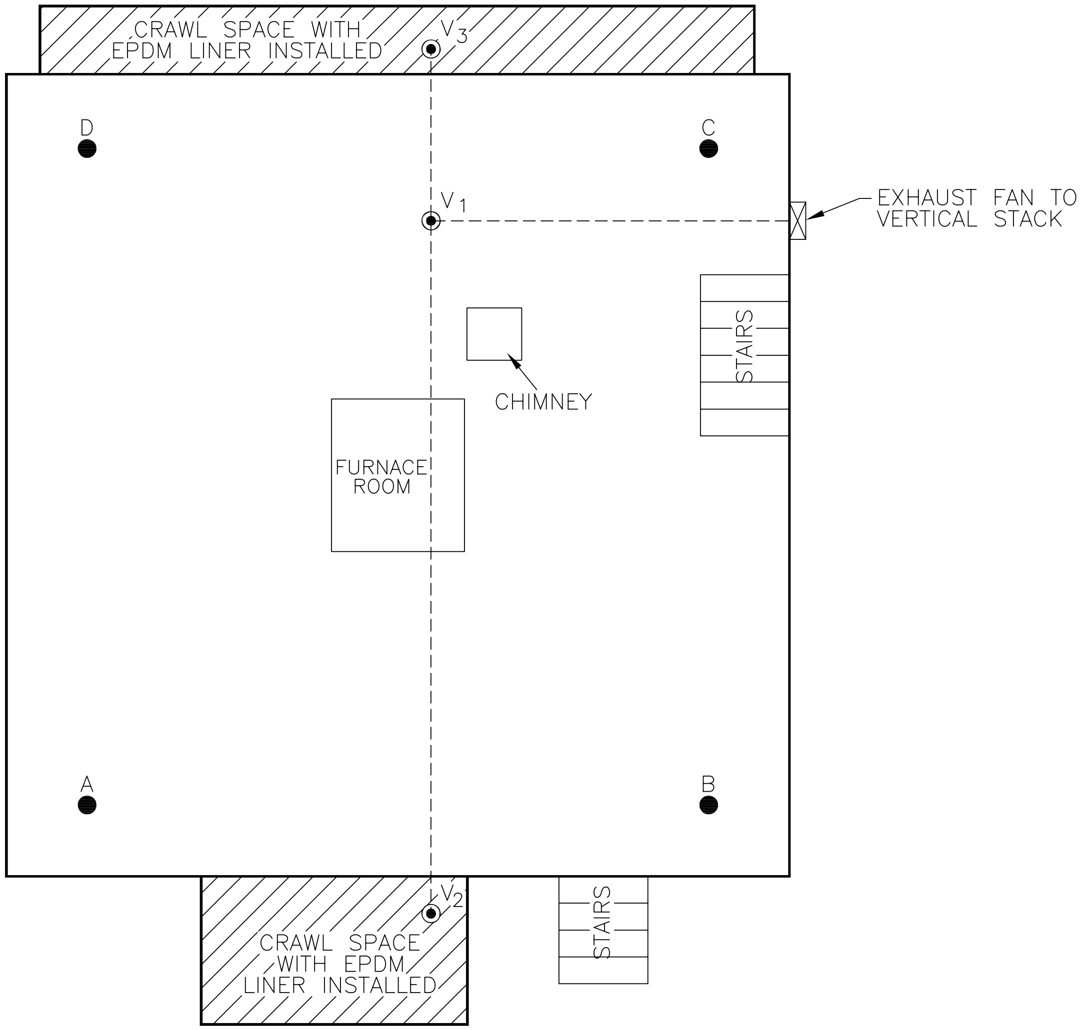
System Maintenance

Description of Maintenance Needed: ____

____

Date Maintenance Completed: ____

Appendix A – Vapor Mitigation System As-Built Drawings



LEGEND

◉ VACUUM POINT

● VACUUM MONITORING LOCATION

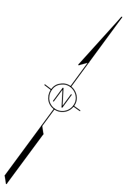
------- PVC PIPE

NOTES:

1. V_1 IS A SUBSLAB VACUUM POINT.
2. V_2 AND V_3 ARE SUB-MEMBRANE VACUUM POINTS.
3. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.

POST-MITIGATION VACUUM RESULTS (JANUARY 19, 2007)

LOCATION	DISTANCE FROM VACUUM POINT V_1 (FT)	READING (INCHES OF WATER COLUMN)
A	–	–0.005 to –0.010
B	–	–0.005
C	–	–0.082
D	–	–0.063



NOT TO SCALE

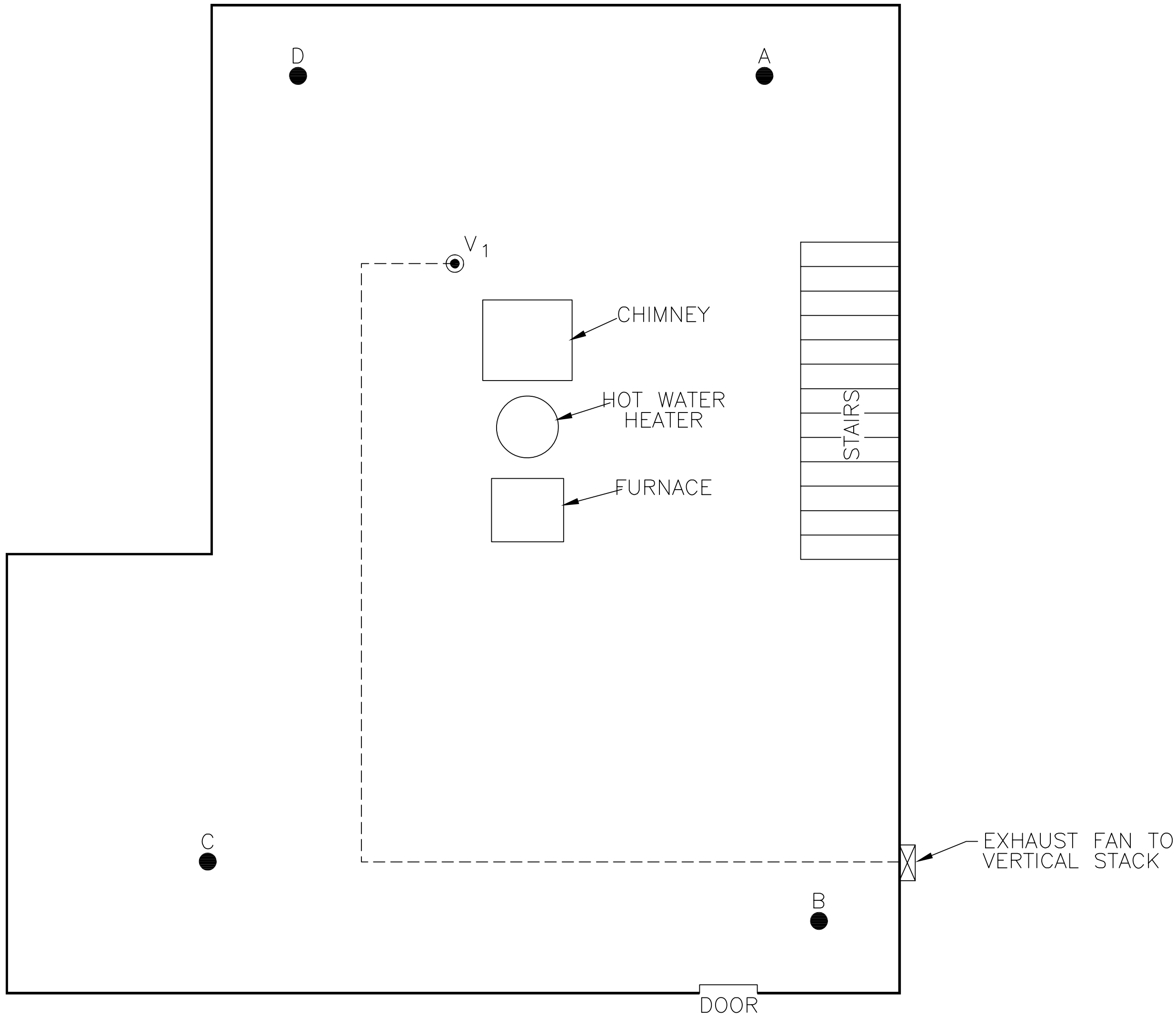
WSP ENGINEERING OF NEW YORK, P.C.

Figure A–1

VAPOR MITIGATION SYSTEM SCHEMATIC FOR PROPERTY ID 1

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
PREPARED FOR
FEDERAL–MOGUL

DWG Name: 138008120
Checked: SBP
Approved: TMM
Drawn By: EGC



LEGEND

◉ VACUUM POINT

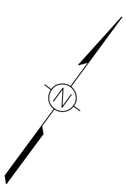
● VACUUM MONITORING LOCATION

------- PVC PIPE

NOTE:

1. V_1 IS A SUBSLAB VACUUM POINT.
2. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.

POST–MITIGATION VACUUM RESULTS (MAY 16, 2006)		
LOCATION	DISTANCE FROM VACUUM POINT V_1 (FT)	READING (INCHES OF WATER COLUMN)
A	13	−0.012
B	12	−0.013
C	9	−0.038
D	13	−0.045



NOT TO SCALE

WSP ENGINEERING OF NEW YORK, P.C.

Figure A–2

VAPOR MITIGATION SYSTEM SCHEMATIC FOR PROPERTY ID 10

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
PREPARED FOR
FEDERAL–MOGUL

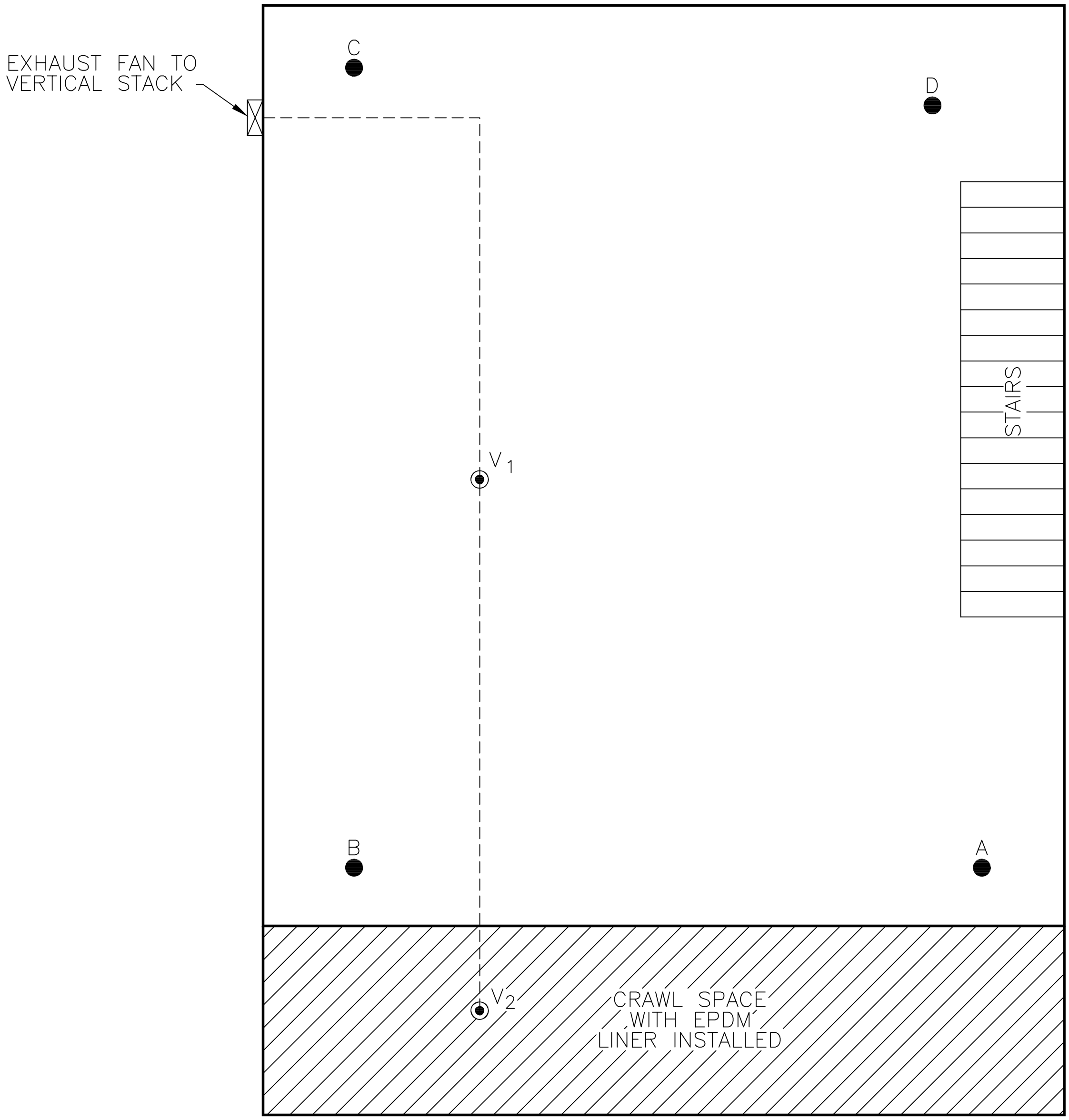
DWG Name: 138008120
Checked: SBP
Approved: TMM
Drawn By: EGC

DWG Name: 138008120

Checked: SBP

Approved: TMM

Drawn By: EGC



LEGEND

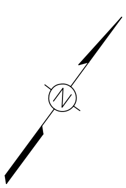
VACUUM POINT

VACUUM MONITORING LOCATION

------- PVC PIPE

NOTES:

1. V_1 IS A SUBSLAB VACUUM POINT.
2. V_2 IS A SUB-MEMBRANE VACUUM POINT.
3. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.



NOT TO SCALE

POST-MITIGATION VACUUM RESULTS (FEBRUARY 22, 2007)

LOCATION	DISTANCE FROM VACUUM POINT V_1 (FT)	READING (INCHES OF WATER COLUMN)
A	22	−0.021
B	22	−0.017
C	10	−0.054
D	15	−0.046

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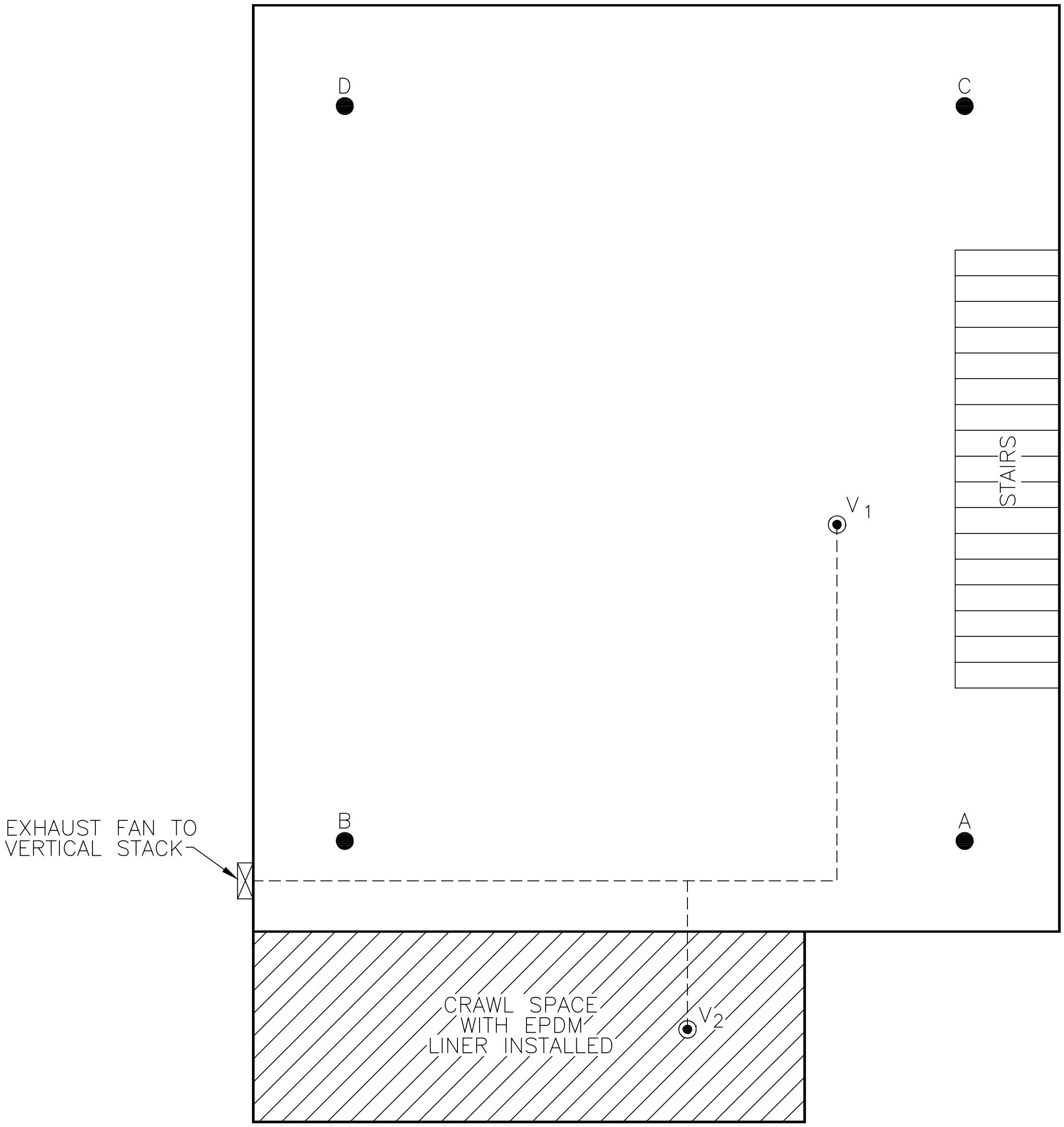
Figure A-3

VAPOR MITIGATION SYSTEM SCHEMATIC FOR PROPERTY ID 15

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK

PREPARED FOR
FEDERAL-MOGUL



LEGEND

- ⦿ VACUUM POINT
- ● VACUUM MONITORING LOCATION
- ------- PVC PIPE

NOTES:

1. V_1 IS A SUBSLAB VACUUM POINT.
2. V_2 IS A SUB-MEMBRANE VACUUM POINT.
3. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.

NOT TO SCALE

POST-MITIGATION VACUUM RESULTS (JANUARY 19, 2007)		
LOCATION	DISTANCE FROM VACUUM POINT V_1 (FT)	READING (INCHES OF WATER COLUMN)
A	13	−0.093
B	16	−0.012
C	14	−0.090
D	16	−0.030

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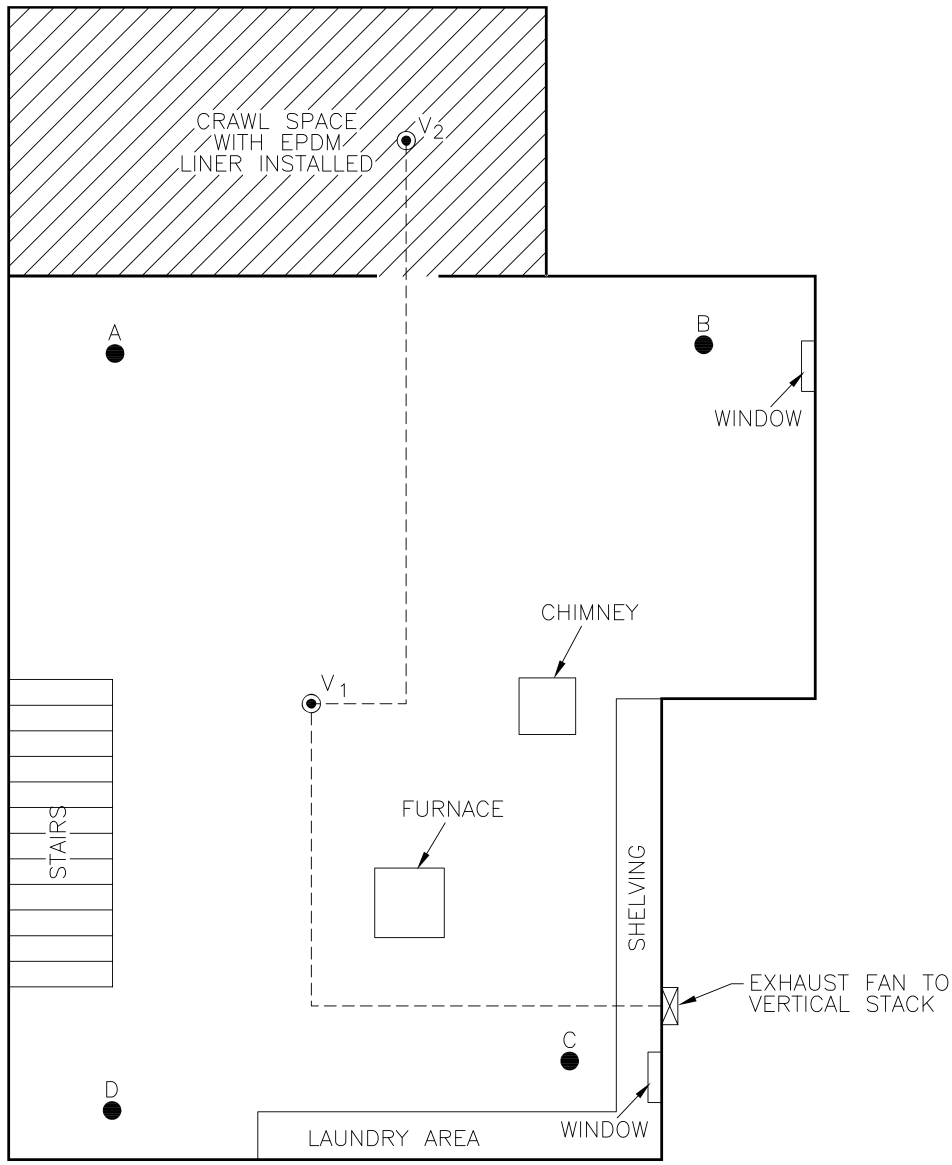
Figure A–4

VAPOR MITIGATION SYSTEM SCHEMATIC FOR PROPERTY ID 16

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
PREPARED FOR
FEDERAL–MOGUL

DWG Name: 138008120
Checked: SBP
Approved: TMM
Drawn By: EGC



LEGEND

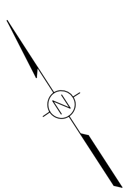
- ⊙ VACUUM POINT
- ● VACUUM MONITORING LOCATION
- ------- PVC PIPE

NOTES:

1. V_1 IS A SUBSLAB VACUUM POINT.
2. V_2 IS A SUB-MEMBRANE VACUUM POINT.
3. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.

POST-MITIGATION VACUUM RESULTS (MAY 16, 2006)

LOCATION	DISTANCE FROM VACUUM POINT V_1 (FT)	READING (INCHES OF WATER COLUMN)
A	10	−0.011
B	16	−0.004
C	12	−0.004
D	10	−0.01



NOT TO SCALE

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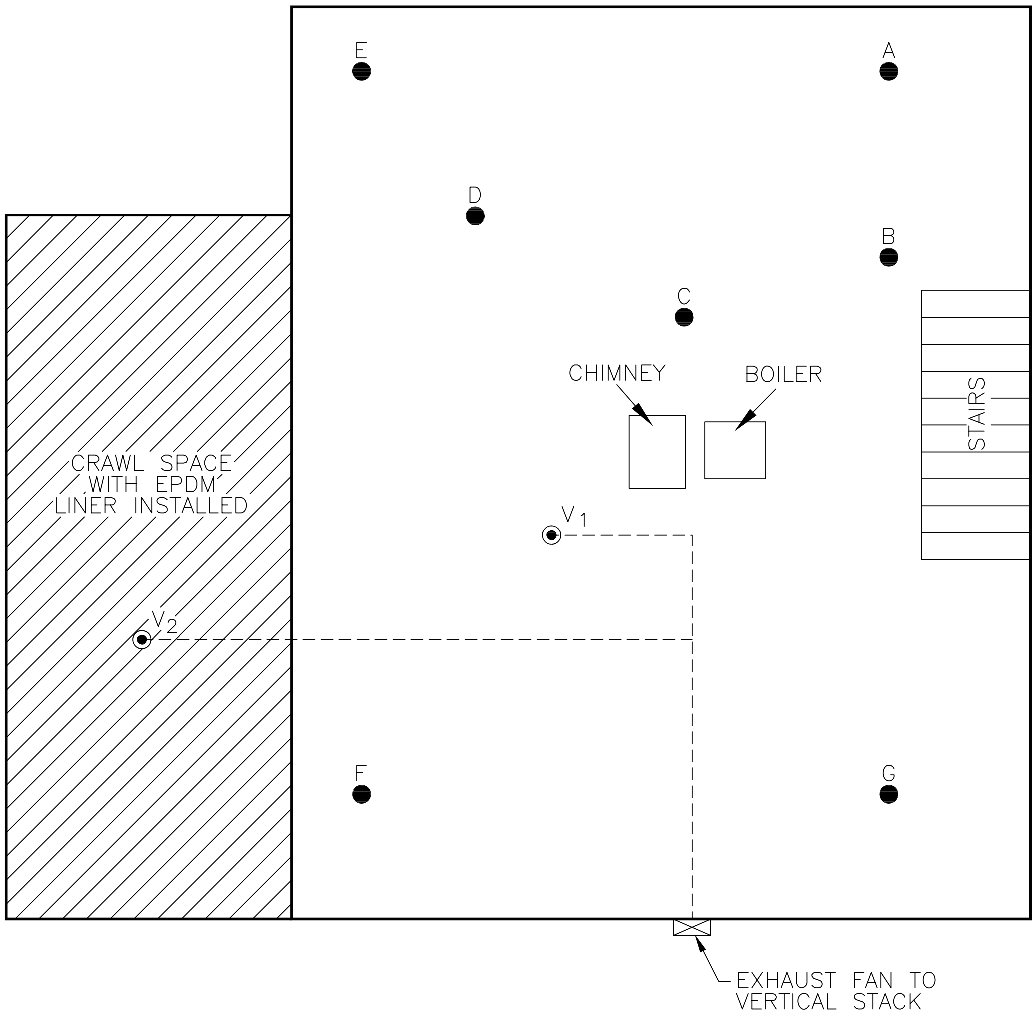
Figure A-5

VAPOR MITIGATION SYSTEM SCHEMATIC FOR PROPERTY ID 2

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
PREPARED FOR
FEDERAL-MOGUL

DWG Name: 138008120
Checked: SBP
Approved: TMM
Drawn By: EGC

DWG Name: 138008120
Checked: SBP
Approved: TMM
Drawn By: EGC



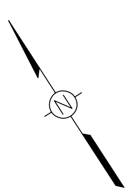
LEGEND

- ◉ VACUUM POINT
- ● VACUUM MONITORING LOCATION
- \- - - - - - - PVC PIPE

NOTES:

1. V_1 IS A SUBSLAB VACUUM POINT.
2. V_2 IS A SUB-MEMBRANE VACUUM POINT.
3. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.

POST-MITIGATION VACUUM RESULTS (MARCH 14, 2006)		
LOCATION	DISTANCE FROM VACUUM POINT V_1 (FT)	READING (INCHES OF WATER COLUMN)
A	17	-0.002
B	14	-0.013
C	9	-0.037
D	13	-0.015
E	15	-0.005
F	10	-0.028
G	9	-0.027



NOT TO SCALE

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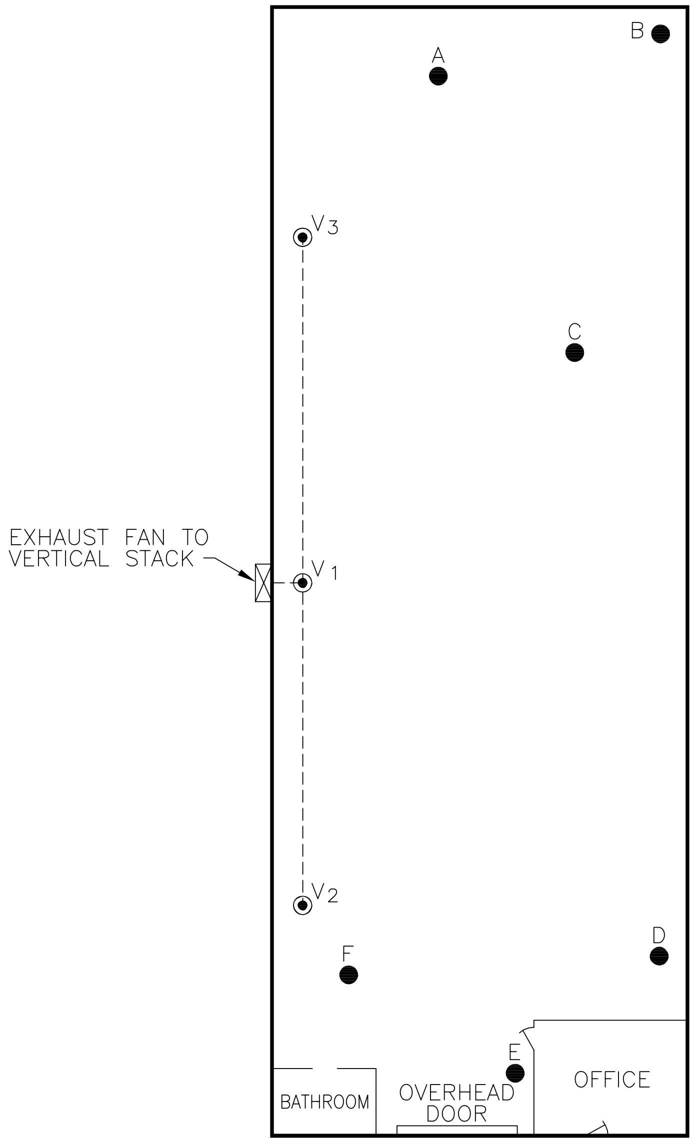
Figure A-6

VAPOR MITIGATION SYSTEM SCHEMATIC FOR PROPERTY ID 20

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
PREPARED FOR
FEDERAL-MOGUL

Drawn By: EGC
Checked: SBP
Approved: TMM
DWG Name: 138008120

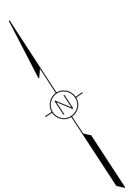


LEGEND

◉ VACUUM POINT
● VACUUM MONITORING LOCATION
------- PVC PIPE

NOTE:
1. V_1, V_2, AND V_3 ARE SUBSLAB VACUUM POINTS.
2. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.

POST–MITIGATION VACUUM RESULTS (JANUARY 19, 2007)		
LOCATION	DISTANCE FROM VACUUM POINT (FT)	READING (INCHES OF WATER COLUMN)
A	–	–0.106
B	–	–0.057
C	–	–0.050
D	–	–0.003
E	–	–0.003
F	–	–0.026



NOT TO SCALE

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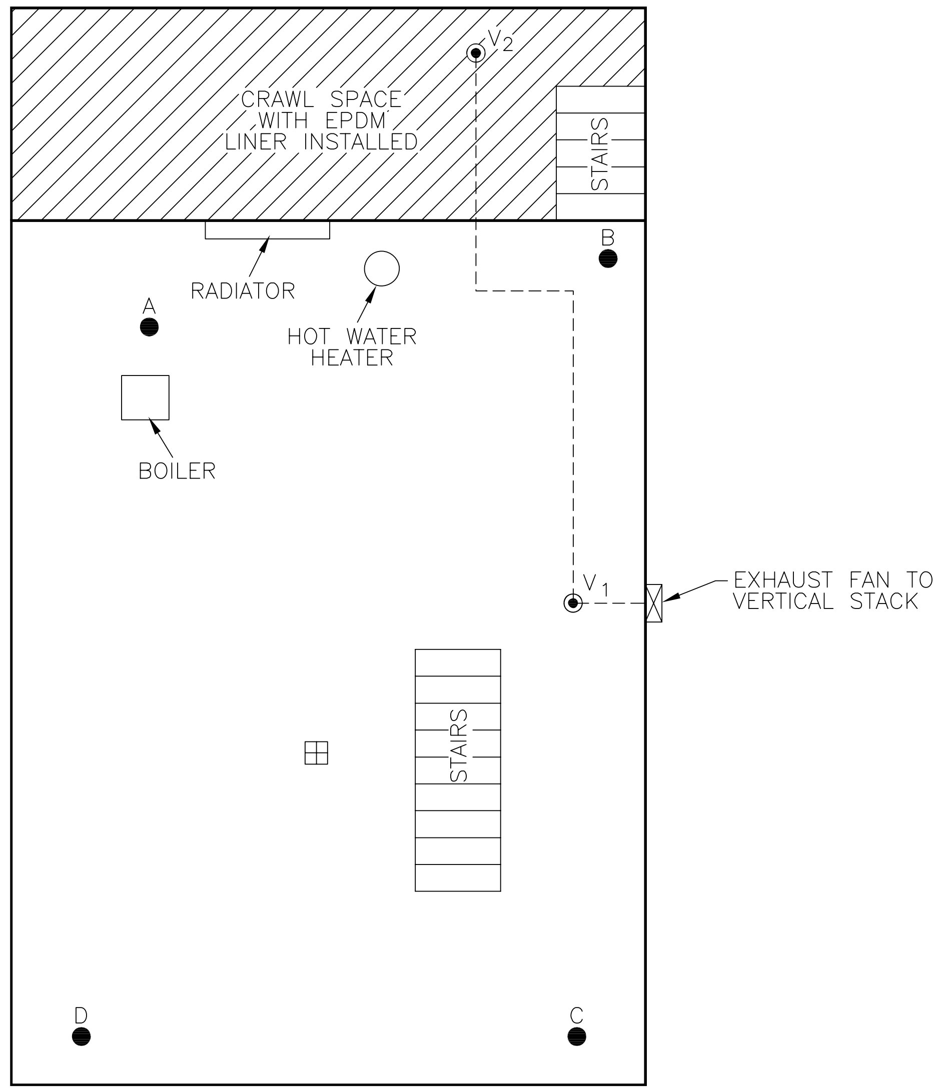
Figure A–7

VAPOR MITIGATION SYSTEM SCHEMATIC FOR PROPERTY ID 3

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
PREPARED FOR
FEDERAL–MOGUL



LEGEND

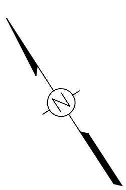
- ⦿ VACUUM POINT
- ● VACUUM MONITORING LOCATION
- - - - - - - - PVC PIPE
- ⊞ FLOOR DRAIN

NOTES:

1. V_1 IS A SUBSLAB VACUUM POINT.
2. V_2 IS A SUB–MEMBRANE VACUUM POINT.
3. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.

POST–MITIGATION VACUUM RESULTS (JULY 13, 2007)

LOCATION	DISTANCE FROM VACUUM POINT V_1 (FT)	READING (INCHES OF WATER COLUMN)
A	19	–0.239
B	8	–0.107
C	10	–0.230
D	23	–0.235



NOT TO SCALE

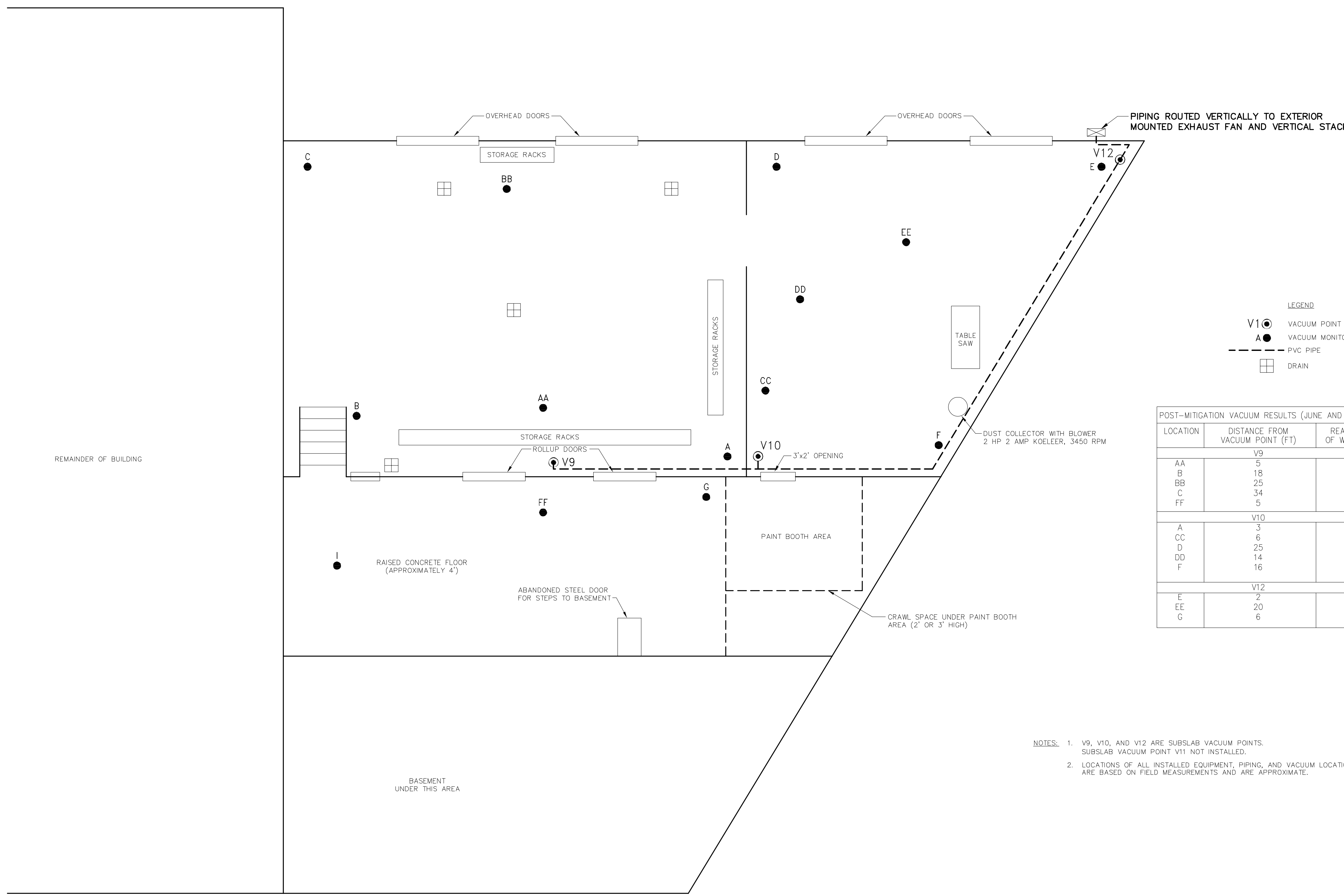
WSP ENGINEERING OF NEW YORK, P.C.

Figure A–8

VAPOR MITIGATION SYSTEM SCHEMATIC FOR PROPERTY ID 7

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
PREPARED FOR
FEDERAL–MOGUL

DWG Name: 138008120
Checked: SBP
Approved: TMM
Drawn By: EGC



LEGEND

V1 ◉ VACUUM POINT

A ● VACUUM MONITORING LOCATION

– – – PVC PIPE

⊞ DRAIN

POST–MITIGATION VACUUM RESULTS (JUNE AND OCTOBER 2007)		
LOCATION	DISTANCE FROM VACUUM POINT (FT)	READING (INCHES OF WATER COLUMN)
V9		
AA	5	–0.093
B	18	–0.002
BB	25	–0.005
C	34	–0.001
FF	5	–0.003
V10		
A	3	–0.002
CC	6	–0.012
D	25	–0.002
DD	14	0.000
F	16	–0.003
V12		
E	2	–0.006
EE	20	–0.002
G	6	–0.003

NOTES:
1. V9, V10, AND V12 ARE SUBSLAB VACUUM POINTS. SUBSLAB VACUUM POINT V11 NOT INSTALLED.
2. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.

SCALE IN FEET
4 0 4 8

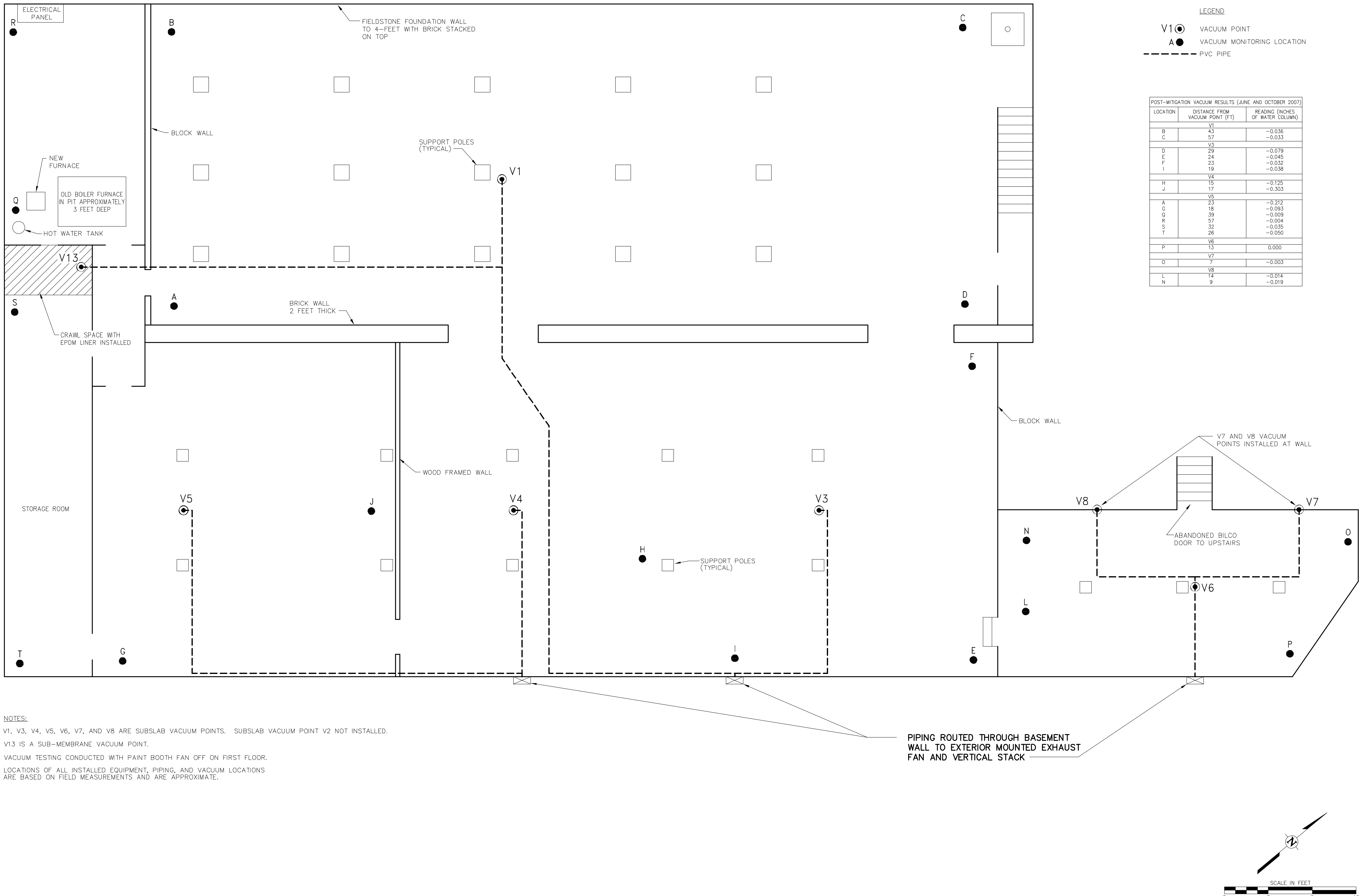
REVISIONS
REV | DESCRIPTION

DRAWN BY EGC
CHECKED SBP
APPROVED TMM

VAPOR MITIGATION SYSTEM SCHEMATIC
FOR PROPERTY ID–17 FIRST FLOOR
REAR OF BUILDING
HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
PREPARED FOR
FEDERAL–MOGUL

WSP ENGINEERING OF NEW YORK, P.C.

FIGURE A–9
SHEET 1
Drawing Number
138008125



POST-MITIGATION VACUUM RESULTS (JUNE AND OCTOBER 2007)

LOCATION	DISTANCE FROM VACUUM POINT (FT)	READING (INCHES OF WATER COLUMN)
	V1	
B	43	−0.036
C	57	−0.033
	V3	
D	29	−0.079
E	24	−0.045
F	23	−0.032
I	19	−0.038
	V4	
H	15	−0.125
J	17	−0.303
	V5	
A	23	−0.212
G	18	−0.093
Q	39	−0.009
R	57	−0.004
S	32	−0.035
T	26	−0.050
	V6	
P	13	0.000
	V7	
O	7	−0.003
	V8	
L	14	−0.014
N	9	−0.019

NOTES:

1. V1, V3, V4, V5, V6, V7, AND V8 ARE SUBSLAB VACUUM POINTS. SUBSLAB VACUUM POINT V2 NOT INSTALLED.
2. V13 IS A SUB-MEMBRANE VACUUM POINT.
3. VACUUM TESTING CONDUCTED WITH PAINT BOOTH FAN OFF ON FIRST FLOOR.
4. LOCATIONS OF ALL INSTALLED EQUIPMENT, PIPING, AND VACUUM LOCATIONS ARE BASED ON FIELD MEASUREMENTS AND ARE APPROXIMATE.

REVISIONS | REV | DESCRIPTION

DRAWN BY EGC
CHECKED SBP
APPROVED TMM

VAPOR MITIGATION SYSTEM SCHEMATIC FOR PROPERTY ID-17 – BASEMENT

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK

PREPARED FOR
FEDERAL-MOGUL

WSP ENGINEERING OF NEW YORK, P.C.

FIGURE A-9
SHEET 2

Drawing Number
138008125

Appendix B – Manufacturer's Specifications and/or Operation Manuals

Fantech

Installation Instructions for
Radon Fans Model HP/FR

READ & SAVE THESE INSTRUCTIONS!

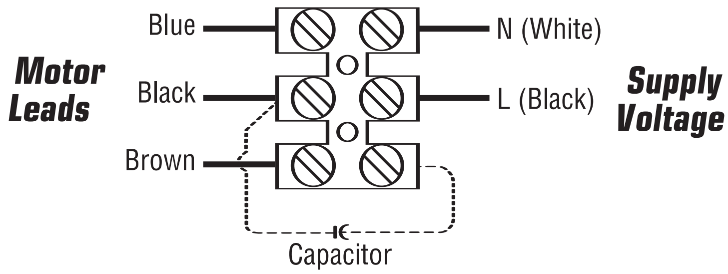
Warnings

DO NOT CONNECT POWER SUPPLY UNTIL FAN IS COMPLETELY INSTALLED, MAKE SURE ELECTRICAL SERVICE TO THE FAN IS LOCKED IN "OFF: POSITION.

1. Suitable for use with solid-state speed control.
2. This unit has rotating parts and safety precautions should be exercised during installation, operation and maintenance.
3. CAUTION: "For General Ventilation Use Only. Do Not Use To Exhaust Hazardous Or Explosives Materials and Vapors."
4. **WARNING: TO REDUCE THE RISK OF FIRE, ELECTRIC SHOCK, OR INJURY TO PERSONS-OBSERVE THE FOLLOWING:**
   a. Use this unit only in the manner intended by the manufacturer. If you have questions, contact the factory.
   b. Before servicing or cleaning unit, switch power off at service panel and lock the service disconnecting means to prevent power from being switched on accidentally. When the service disconnecting means cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.
   c. Installation work and electrical wiring must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.
   d. The combustion airflow needed for safe operation of fuel burning equipment may be affected by this unit's operation. Follow the heating equipment manufacturer's guidelines and safety standards such as those published by the National Fire Protection Association (NFPA), the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) and the local code authorities.
   e. When cutting or drilling into wall or ceiling, do not damage electrical wires or other hidden utilities.
   f. Ducted fans must always be vented to the outdoors.
   g. If this unit is to be installed over a tub or shower, it must be marked as appropriate for the application.
   h. NEVER place a switch where it can be reached from a tub or shower.
5. WARNING! Check voltage at the fan to see if it corresponds to the motor nameplate.

GUARDS MUST BE INSTALLED WHEN FAN IS WITHIN REACH OF PERSONNEL OR WITHIN SEVEN (7) FEET OF WORKING LEVEL OR WHEN DEEMED ADVISABLE FOR SAFETY.

Wiring Diagram



Five (5) Year Warranty

This warranty supersedes all prior warranties

Installation that will result in condensate forming in the outlet ducting should have a condensate bypass installed to route the condensate outside of the fan housing. Conditions that are likely to produce condensate include but are not limited to: outdoor installations in cold climates, long lengths of outlet duction, high moisture content in soil and thin wall or aluminum outlet ducting. Failure to install a proper condensate bypass may void any warranty claims.

DURING ENTIRE WARRANTY PERIOD:

FANTECH will repair or replace any part which has a factory defect in workmanship or material. Product may need to be returned to the fantech factory, together with a copy of the bill of sale and identified with RMA number.

FOR FACTORY RETURN YOU MUST:

- Have a Return Materials Authorization (RMA) number. This may be obtained by calling FANTECH either in the USA at 1.800.747.1762 or in CANADA at 1.800.565.3548. Please have bill of sale available.
- The RMA number must be clearly written on the outside of the carton, or the carton will be refused.
- All parts and/or product will be repaired/replaced and shipped back to buyer; no credit will be issued.

OR

The Distributor may place an order for the warranty part and/or product and is invoiced. The Distributor will receive a credit equal to the invoice only after product is returned prepaid and verified to be defective.

FANTECH WARRANTY TERMS DO NOT PROVIDE FOR REPLACEMENT WITHOUT CHARGE PRIOR TO INSPECTION FOR A DEFECT. REPLACEMENTS ISSUED IN ADVANCE OF DEFECT INSPECTION ARE INVOICED, AND CREDIT IS PENDING INSPECTION OF RETURNED MATERIAL. DEFECTIVE MATERIAL RETURNED BY END USERS SHOULD NOT BE REPLACED BY THE DISTRIBUTOR WITHOUT CHARGE TO THE END USER, AS CREDIT TO DISTRIBUTOR'S ACCOUNT WILL BE PENDING INSPECTION AND VERIFICATION OF ACTUAL DEFECT BY FANTECH.

THE FOLLOWING WARRANTIES DO NOT APPLY:

- Damages from shipping, either concealed or visible. Claim must be filed with freight company.
- Damages resulting from improper wiring or installation.
- Damages or failure caused by acts of God, or resulting from improper consumer procedures, such as:
  1. Improper maintenance
  2. Misuse, abuse, abnormal use, or accident, and
  3. Incorrect electrical voltage or current.
- Removal or any alteration made on the FANTECH label control number or date of manufacture.
- Any other warranty, expressed, implied or written, and to any consequential or incidental damages, loss or property, revenues, or profit, or costs of removal, installation or reinstallation, for any breach of warranty.

WARRANTY VALIDATION

- The user must keep a copy of the bill of sale to verify purchase date.
- These warranties give you specific legal rights, and are subject to an applicable consumer protection legislation. You may have additional rights which vary from state to state.

United States
1712 Northgate Blvd.,
Sarasota, FL. 34234
Phone: 800.747.1762; 941.309.6000
Fax: 800.487.9915; 941.309.6099
www.fantech.net; info@fantech.net

Canada
50 Kanalflakt Way,
Bouctouche, NB E4S 3M5
Phone: 800.565.3548; 506.743.9500
Fax: 877.747.8116; 506.743.9600
www.fantech.ca; info@fantech.ca

Article #: 301077
Item #: 401443
Rev Date: 010307

HP Series Fans are Specially Designed with Higher Pressure Capabilities for Radon Mitigation Applications

Fantech has developed the HP Series fans specifically to suit the higher pressure capability requirements needed in Radon Mitigation applications. Most Radon Mitigators who previously used the Fantech FR Series fans have switched to the new HP Series.

Performance Data

Model	Volts	Wattage Range	Mo	0†	.50†	.75†	1.0†	1.25†	1.5†	1.25†	1.5†	Max. Pres.
HP 2133	115	14-20	0.17	134	68	19	-	-	-	-	-	0.84†
HP 2190	115	60-85	0.78	163	126	104	81	58	35	15	-	1.93†
HP 175	115	44-65	0.57	151	112	91	70	40	12	-	-	1.66†
HP 190	115	60-85	0.78	157	123	106	89	67	45	18	1	2.01†
HP 220	115	85-152	1.30	344	260	226	193	166	137	102	58	2.46†

CFM @

HP installation instructions in PDF (191 kb)
If you do not have Adobe Acrobat Reader, click here.

HP FEATURES INCLUDE

- Improved UV resistant housings approved for commercial applications.
- UL Approved for Wet Locations (Outdoors)
- Sealed housings and wiring boxes to prevent Radon leakage or water penetration
- Energy efficient permanent split capacitor motors
- External wiring box
- Full Five Year Factory Warranty HP Series Fans are specially designed with higher pressure capabilities for Radon Mitigation applications

Performance Curves

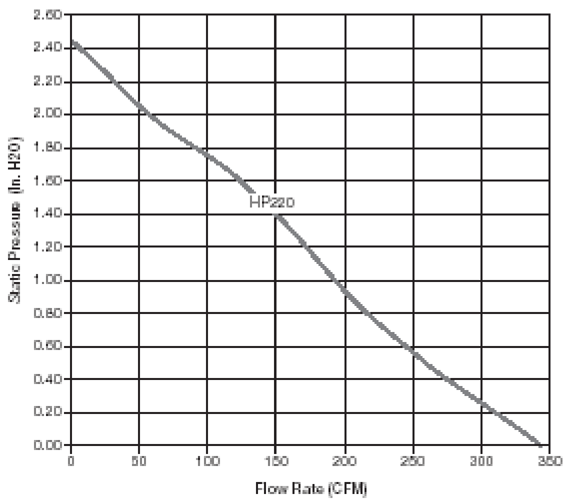
Fantech provides you with independently tested performance specifications.

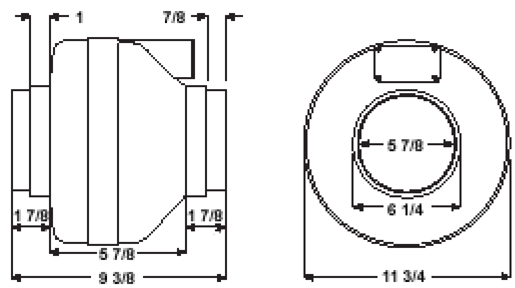
The performance curves shown in this brochure are representative of the actual test results recorded at Texas Engineering Experiment Station/Energy Systems Lab, a recognized testing authority for HVI. Testing was done in accordance with AMCA Standard 210-85 and HVI 916 Test Procedures. Performance graphs show air flow vs. static pressure.

Use of HP Series fans in low resistance applications such as bathroom venting will result in elevated sound levels. We suggest FR Series or other Fantech fans for such applications.

NOTE: Installations that will result in condensate forming in the outlet ducting should have a condensate bypass installed to route the condensate outside of the fan housing.
Conditions that are likely to produce condensate include but are not limited to: outdoor installations in cold climates, long lengths of outlet ducting, high moisture content in soil and thin wall or aluminum outlet ducting. Failure to install a proper condensate bypass may void any warranty claims.

HP220 Radon Mitigation Fan





Tested with 6" ID duct and standard couplings.

HP 220 – Excellent choice for systems with elevated radon levels, poor communication, multiple suction points and large subslab footprint. Replaces FR 175.

Fans are attached to PVC pipe using flexible couplings.
For 4” PVC pipe use Indiana Seals #156-64, Pipeconx PCX 56-64 or equivalent.
For 3” PVC pipe use Indiana Seals #156-63, Pipeconx PCX 56-63 or equivalent.

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HP 175	115	44-65	0.57	151	112	91	70	40	12	-	-	1.66†
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CFM @

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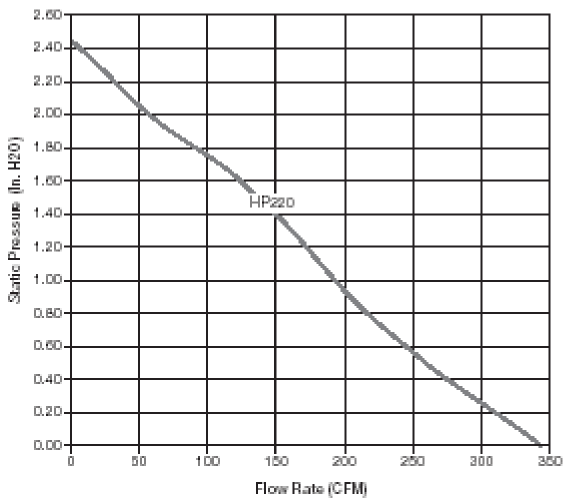
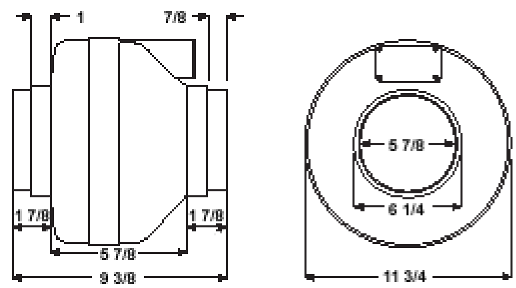
HP220 Radon Mitigation Fan





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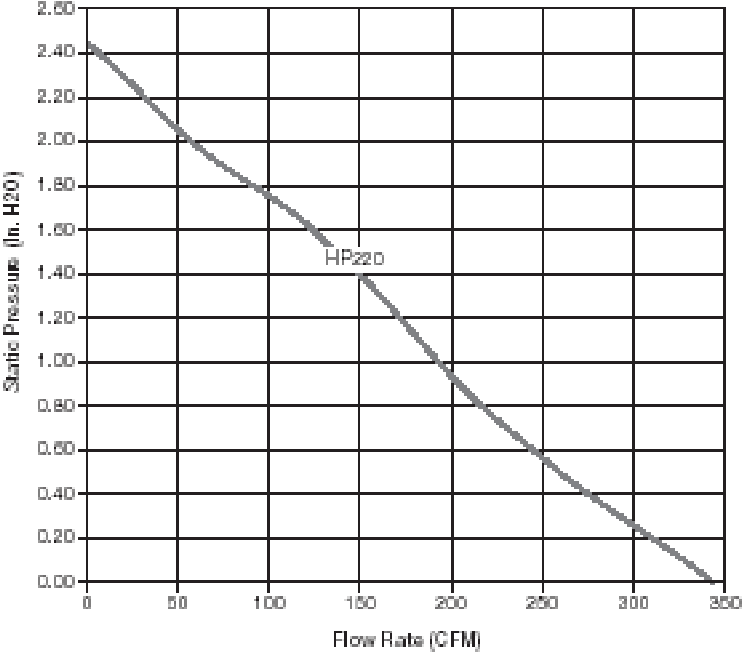
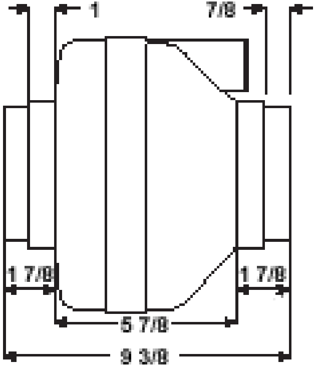
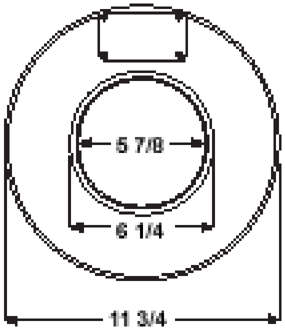


Static Pressure (In. H2O)
2.60
2.40
2.20
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
HP220
0
50
100
150
200
250
300
350
Flow Rate (CFM)



1
7/8
1 7/8
1 7/8
5 7/8
9 3/8



5 7/8
6 1/4
11 3/4

RadonAway Ward Hill, MA IN014 Rev E

XP/GP/XR Series Fan Installation Instructions

Please Read And Save These Instructions.

DO NOT CONNECT POWER SUPPLY UNTIL FAN IS COMPLETELY INSTALLED. MAKE SURE ELECTRICAL SERVICE TO FAN IS LOCKED IN "OFF" POSITION. DISCONNECT POWER BEFORE SERVICING FAN.

1. **WARNING!** Do not use fan in hazardous environments where fan electrical system could provide ignition to combustible of flammable materials.

2. **WARNING!** Do not use fan to pump explosive or corrosive gases.

3. **WARNING!** Check voltage at the fan to insure it corresponds with nameplate.

4. **WARNING!** Normal operation of this device may affect the combustion airflow needed for safe operation of fuel burning equipment. Check for possible backdraft conditions on all combustion devices after installation.

5. **NOTICE!** There are no user serviceable parts located inside the fan unit. **Do NOT attempt to open.** Return unit to the factory for service.

6. All wiring must be in accordance with local and national electrical codes.

RadonAway™

INSTALLATION INSTRUCTION IN014 Rev E

DynaVac - XP/XR Series		**DynaVac - GP Series**	
XP101	p/n 23008-1,-2	GP201	p/n 23007-1
XP151	p/n 23010-1,-2	GP301	p/n 23006-1,-2
XP201	p/n 23011-1,-2	GP401	p/n 23009-1
XR161	p/n 23018-1,-2	GP501	p/n 23005-1,-2
XR261	p/n 23019-1,-2		

1.0 SYSTEM DESIGN CONSIDERATIONS

1.1 INTRODUCTION

The DynaVac GP/XP/XR Series Radon Fans are intended for use by trained, professional Radon mitigators. The purpose of this instruction is to provide additional guidance for the most effective use of a DynaVac Fan. This instruction should be considered as a supplement to EPA standard practices, state and local building codes and state regulations. In the event of a conflict, those codes, practices and regulations take precedence over this instruction.

1.2 ENVIRONMENTALS

The GP/XP/XR Series Fans are designed to perform year-round in all but the harshest climates without additional concern for temperature or weather. For installations in an area of severe cold weather, please contact RadonAway for assistance. When not in operation, the fan should be stored in an area where the temperature is never less than 32 degrees F. or more than 100 degrees F.

1.3 ACOUSTICS

The GP/XP/XR Series Fan, when installed properly, operates with little or no noticeable noise to the building occupants. The velocity of the outgoing air should be considered in the overall system design. In some cases the "rushing" sound of the outlet air may be disturbing. In these instances, the use of a RadonAway Exhaust Muffler is recommended.

1.4 GROUND WATER

In the event that a temporary high water table results in water at or above slab level, water may be drawn into the riser pipes thus blocking air flow to the GP/XP/XR Series Fan. The lack of cooling air may result in the fan cycling on and off as the internal temperature rises above the thermal cutoff and falls upon shutoff. Should this condition arise, it is recommended that the fan be turned off until the water recedes allowing for return to normal operation.

1.5 SLAB COVERAGE

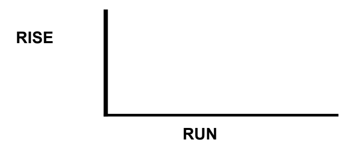
The GP/XP/XR Series Fan can provide coverage up to 2000+ sq. ft. per slab penetration. This will primarily depend on the sub-slab material in any particular installation. In general, the tighter the material, the smaller the area covered per penetration. Appropriate selection of the GP/XP/XR Series Fan best suited for the sub-slab material can improve the slab coverage. The GP & XP series have a wide range of models to choose from to cover a wide range of subslab material. The higher static suction fans are generally used for tighter subslab materials. The XR Series is specifically designed for high flow applications such as stone/gravel and drain tile. Additional suction points can be added as required. It is recommended that a small pit (5 to 10 gallons in size) be created below the slab at each suction hole.

1.6 CONDENSATION & DRAINAGE

Condensation is formed in the piping of a mitigation system when the air in the piping is chilled below its dew point. This can occur at points where the system piping goes through unheated space such as an attic, garage or outside. The system design must provide a means for water to drain back to a slab hole to remove the condensation. The GP/XP/XR Series Fan **MUST** be mounted vertically plumb and level, with the outlet pointing up for proper drainage through the fan. Avoid mounting the fan in any orientation that will allow water to accumulate inside the fan housing. The GP/XP/XR Series Fans are **NOT** suitable for underground burial.

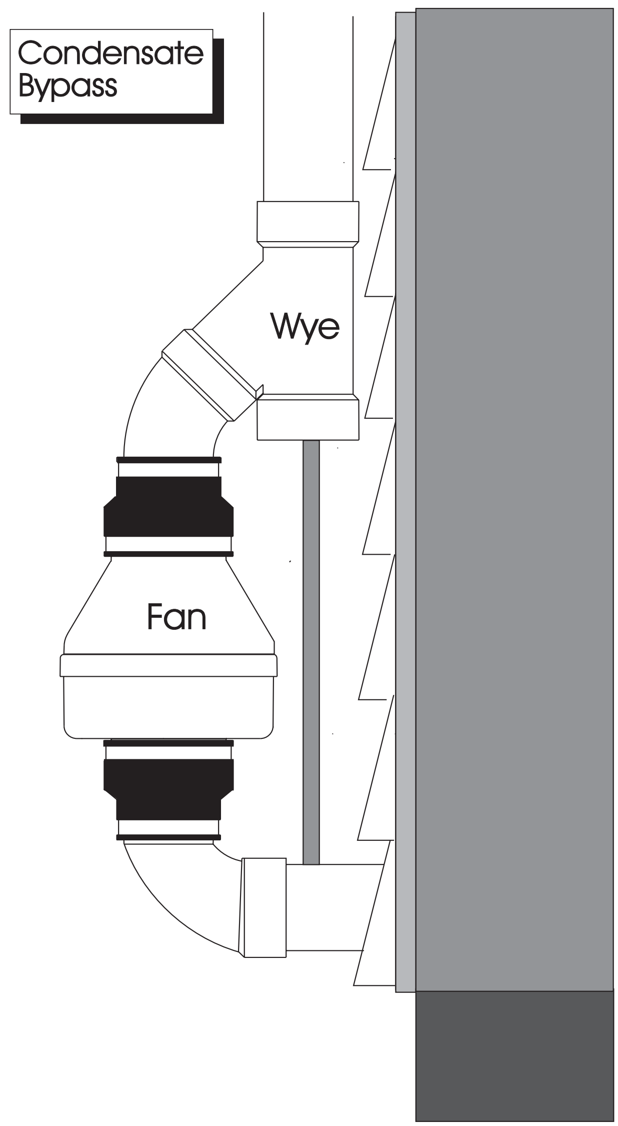
For GP/XP/XR Series Fan piping, the following table provides the minimum recommended pipe diameter and pitch under several system conditions.

Pipe Dia.	Minimum Rise per Foot of Run* @25 CFM	@50 CFM	@100 CFM
4″	1/8″	1/4″	3/8″
3"	1/4"	3/8"	1 1/2"



*Typical GP/XP/XR Series Fan operational flow rate is 25 - 90 CFM.
(For more precision, determine flow rate by using the chart in the addendum.)

Under some circumstances in an outdoor installation a condensate bypass should be installed in the outlet ducting as shown. This may be particularly true in cold climate installations which require long lengths of outlet ducting or where the outlet ducting is likely to produce large amounts of condensation because of high soil moisture or outlet duct material. Schedule 20 piping and other thin-walled plastic ducting and Aluminum downspout will normally produce much more condensation than Schedule 40 piping.



The bypass is constructed with a 45 degree Wye fitting at the bottom of the outlet stack. The bottom of the Wye is capped and fitted with a tube that connects to the inlet piping or other drain. The condensation produced in the outlet stack is collected in the Wye fitting and drained through the bypass tube. The bypass tubing may be insulated to prevent freezing.

1.7 "SYSTEM ON" INDICATOR

A properly designed system should incorporate a "System On" Indicator for affirmation of system operation. A manometer, such as a U-Tube, or a vacuum alarm is recommended for this purpose.

1.8 ELECTRICAL WIRING

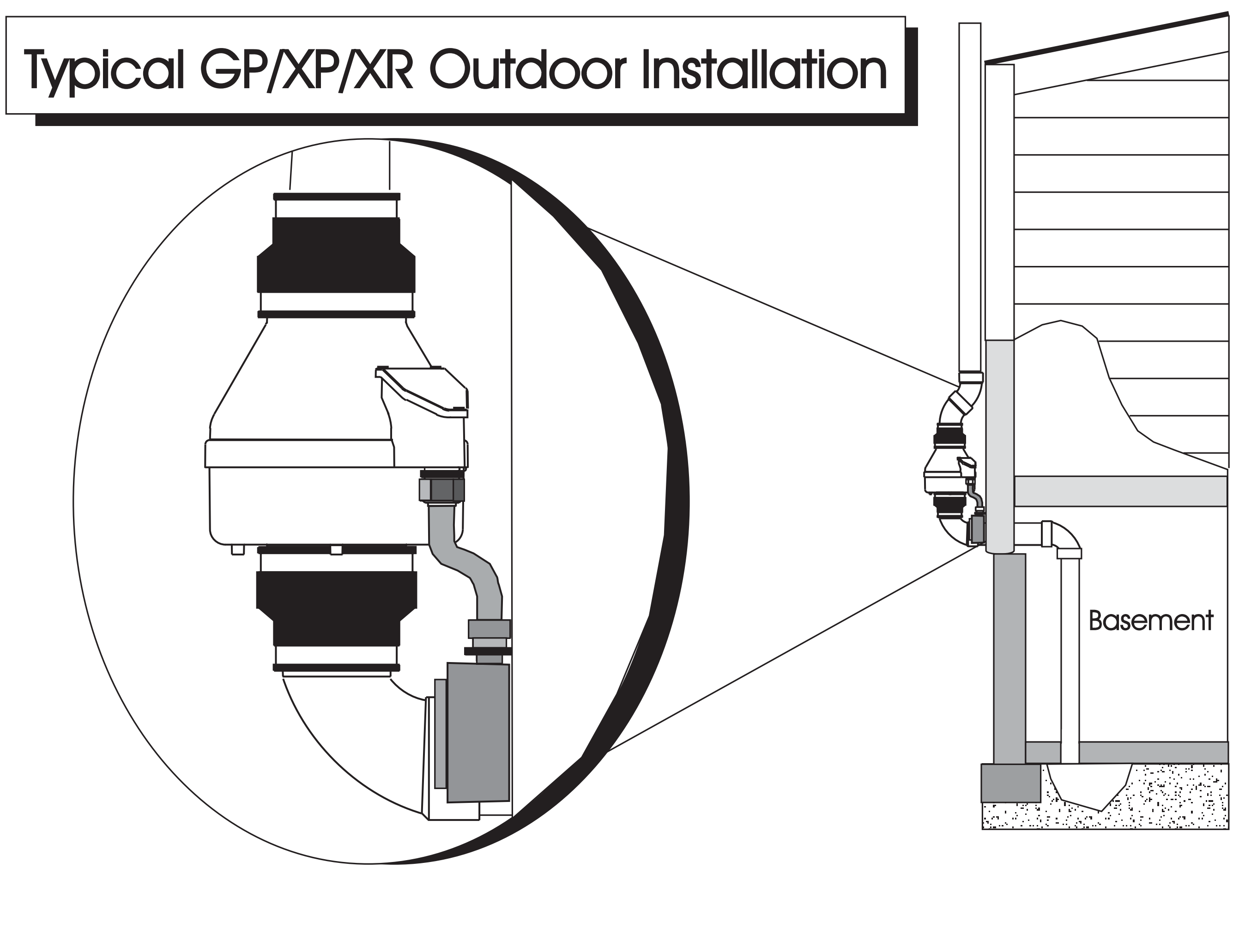
The GP/XP/XR Series Fans operate on standard 120V 60 Hz. AC. All wiring must be performed in accordance with the National Electrical Code and state and local building codes. All electrical work should be performed by a qualified electrician. Outdoor installations require the use of a U.L. listed watertight conduit.

1.9 SPEED CONTROLS

The GP/XP/XR Series Fans are rated for use with electronic speed controls ,however, they are generally not recommended.

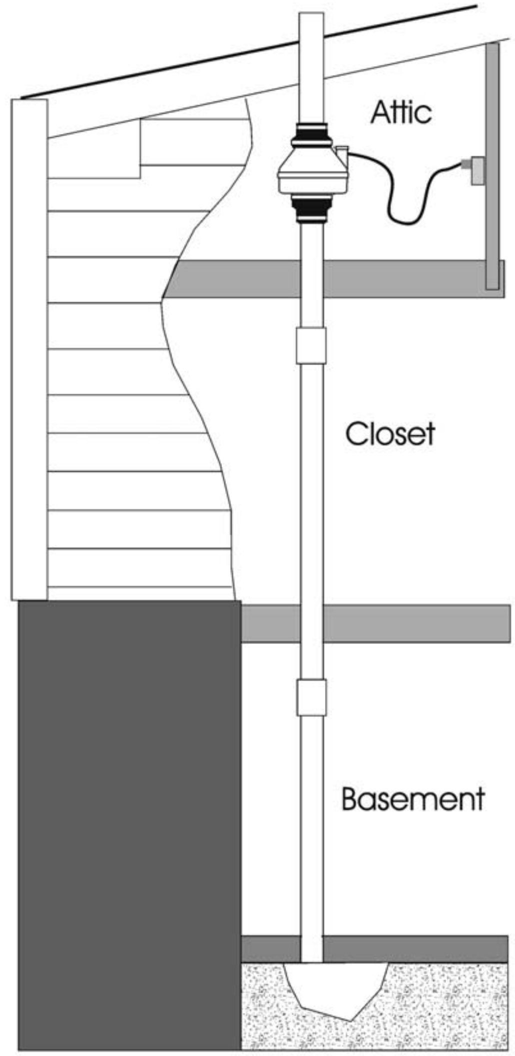
2.0 INSTALLATION

The GP/XP/XR Series Fan can be mounted indoors or outdoors. (It is suggested that EPA recommendations be followed in choosing the fan location.) The GP/XP/XR Series Fan may be mounted directly on the system piping or fastened to a supporting structure by means of optional mounting bracket.



2.1 MOUNTING

Mount the GP/XP/XR Series Fan vertically with outlet up. Insure the unit is plumb and level. When mounting directly on the system piping assure that the fan does not contact any building surface to avoid vibration noise.



2.2 MOUNTING BRACKET (optional)

The GP/XP/XR Series fan may be optionally secured with the integral mounting bracket on the GP Series fan or with RadonAway P/N 25007-2 mounting bracket for an XP/XR Series fan. Foam or rubber grommets may also be used between the bracket and mounting surface for vibration isolation.

2.3 SYSTEM PIPING

Complete piping run, using flexible couplings as means of disconnect for servicing the unit and vibration isolation.

2.4 ELECTRICAL CONNECTION

Connect wiring with wire nuts provided, observing proper connections:

Fan Wire	Connection
Green	Ground
Black	AC Hot
White	AC Common

2.5 VENT MUFFLER (optional)

Install the muffler assembly in the selected location in the outlet ducting. Solvent weld all connections. The muffler is normally installed at the end of the vent pipe.

2.6 OPERATION CHECKS

_____ **Verify** all connections are tight and **leak-free**.

_____ **Insure** the GP/XP/XR Series Fan and all ducting is secure and vibration-free.

_____ **Verify** system vacuum pressure with manometer. **Insure** vacuum pressure is **less than** maximum recommended operating pressure

(Based on sea-level operation, at higher altitudes reduce by about 4% per 1000 Feet.)

(Further reduce Maximum Operating Pressure by 10% for High Temperature environments)

See Product Specifications. If this is exceeded, increase the number of suction points.

_____ **Verify Radon levels by testing to EPA protocol.**

XP/XR SERIES PRODUCT SPECIFICATIONS

The following chart shows fan performance for the XP & XR Series Fan:

Typical CFM Vs Static Suction "WC

	0"	.25"	.5"	.75"	1.0"	1.25"	1.5"	1.75"	2.0"
XP101	125	118	90	56	5	-	-	-	-
XP151	180	162	140	117	78	46	10	-	-
XP201	150	130	110	93	74	57	38	20	-
XR161	215	175	145	105	75	45	15	-	-
XR261	250	215	185	150	115	80	50	20	-

Maximum Recommended Operating Pressure*

XP101	0.9" W.C.	(Sea Level Operation)**
XP151	1.3" W.C.	(Sea Level Operation)**
XP201	1.7" W.C.	(Sea Level Operation)**
XR161	1.3" W.C.	(Sea Level Operation)**
XR261	1.6" W.C.	(Sea Level Operation)**

**Reduce by 10% for High Temperature Operation*

***Reduce by 4% per 1000 feet of altitude*

Power Consumption @ 120 VAC

XP101	40 - 49 watts
XP151	45 - 60 watts
XP201	45 - 66 watts
XR161	48 - 75 watts
XR261	65 - 105 watts

XP Series Inlet/Outlet: 4.5" OD (4.0" PVC Sched 40 size compatible)

XR Series Inlet/Outlet: 5.875" OD

Mounting: Mount on the duct pipe or with optional mounting bracket.

Recommended ducting: 3" or 4" Schedule 20/40 PVC Pipe

Storage temperature range: 32 - 100 degrees F.

Normal operating temperature range: -20 - 120 degrees F.

Maximum inlet air temperature: 80 degrees F.

Size: 9.5H" x 8.5" Dia. **Weight**: 6 lbs. (XR261 - 7 lbs)

Continuous Duty **Thermally protected**

Class B Insulation **3000 RPM**

Residential Use Only **Rated for Indoor or Outdoor use**

LISTED Electric Fan — ETL® 77728 — Tested to UL Std. 507

GP SERIES PRODUCT SPECIFICATIONS

The following chart shows fan performance for the GPx01 Series Fan:

Typical CFM Vs Static Suction "WC	1.0"	1.5"	2.0"	2.5"	3.0"	3.5"	4.0"
GP501	95	87	80	70	57	30	5
GP401	93	82	60	38	12	-	-
GP301	92	77	45	10	-	-	-
GP201	82	58	5	-	-	-	-

Maximum Recommended Operating Pressure*		
GP501	3.8" W.C.	(Sea Level Operation)**
GP401	3.0" W.C.	(Sea Level Operation)**
GP301	2.4" W.C.	(Sea Level Operation)**
GP201	1.8" W.C.	(Sea Level Operation)**

**Reduce by 10% for High Temperature Operation*

***Reduce by 4% per 1000 feet of altitude*

Power Consumption @ 120 VAC	
GP501	70 - 140 watts
GP401	60 - 110 watts
GP301	55 - 90 watts
GP201	40 - 60 watts

Inlet/Outlet: 3.5" OD (3.0" PVC Sched 40 size compatible)

Mounting: Fan may be mounted on the duct pipe or with integral flanges.

Weight: 12 lbs.

Size: 13H" x 12.5" x 12.5"

Recommended ducting: 3″ or 4" Schedule 20/40 PVC Pipe

Storage temperature range: 32 - 100 degrees F.

Normal operating temperature range: -20 - 120 degrees F.

Maximum inlet air temperature: 80 degrees F.

Continuous Duty

Class B Insulation

3000 RPM

Thermally protected

Rated for Indoor or Outdoor Use

GP301C / GP501C Rated for Commercial Use

LISTED
Electric Fan

Tested to
UL
Std. 507

77728

IMPORTANT INSTRUCTIONS TO INSTALLER

Inspect the GPx01/XP/XR Series Fan for shipping damage within 15 days of receipt. Notify RadonAway of any damages immediately. Radonaway is not responsible for damages incurred during shipping. However, for your benefit, Radonaway does insure shipments.

There are no user serviceable parts inside the fan. **Do not attempt to open.** Return unit to factory for service.

Install the GPx01/XP/XR Series Fan in accordance with all EPA standard practices, and state and local building codes and state regulations.

WARRANTY

Subject to any applicable consumer protection legislation, RadonAway warrants that the GPX01/XP/XR/RP Series Fan (the "Fan") will be free from defects in materials and workmanship for a period of 90 days from the date of purchase (the "Warranty Term").

RadonAway will replace any Fan which fails due to defects in materials or workmanship. The Fan must be returned (at Owner's cost) to the RadonAway factory. Any Fan returned to the factory will be discarded unless the Owner provides specific instructions along with the Fan when it is returned regardless of whether or not the Fan is actually replaced under this warranty. Proof of purchase must be supplied upon request for service under this Warranty.

This Warranty is contingent on installation of the Fan in accordance with the instructions provided. This Warranty does not apply where any repairs or alterations have been made or attempted by others, or if the unit has been abused or misused. Warranty does not cover damage in shipment unless the damage is due to the negligence of RadonAway.

5 YEAR EXTENDED WARRANTY WITH PROFESSIONAL INSTALLATION.

RadonAway will extend the Warranty Term of the fan to 5 years from date of manufacture if the Fan is installed in a professionally designed and professionally installed radon system or installed as a replacement fan in a professionally designed and professionally installed radon system. Proof of purchase and/or proof of professional installation may be required for service under this warranty. Outside the Continental United States and Canada the extended Warranty Term is limited to one (1) year from the date of manufacture.

RadonAway is not responsible for installation, removal or delivery costs associated with this Warranty.

EXCEPT AS STATED ABOVE, THE GPx01/XP/XR/RP SERIES FANS ARE PROVIDED WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

IN NO EVENT SHALL RADONAWAY BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR RELATING TO, THE FAN OR THE PERFORMANCE THEREOF. RADONAWAY'S AGGREGATE LIABILITY HEREUNDER SHALL NOT IN ANY EVENT EXCEED THE AMOUNT OF THE PURCHASE PRICE OF SAID PRODUCT. THE SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY SHALL BE THE REPAIR OR REPLACEMENT OF THE PRODUCT, TO THE EXTENT THE SAME DOES NOT MEET WITH RADONAWAY'S WARRANTY AS PROVIDED ABOVE.

For service under this Warranty, contact RadonAway for a Return Material Authorization (RMA) number and shipping information. No returns can be accepted without an RMA. If factory return is required, the customer assumes all shipping cost to and from factory.

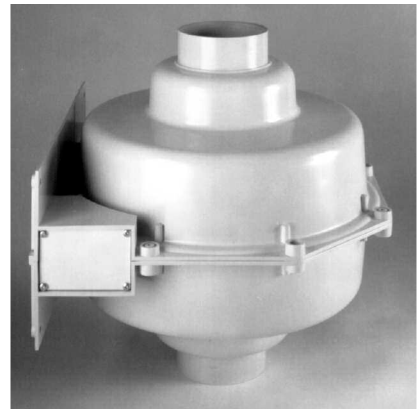
RadonAway
3 Saber Way
Ward Hill, MA 01835
TEL. (978) 521-3703
FAX (978) 521-3964

Record the following information for your records:

Serial No.____
Purchase Date________________________________

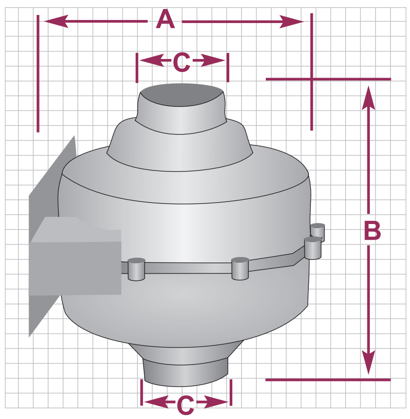
RadonAway™

GP Series



Radon Mitigation Fans

Specially designed for radon mitigation, GP Series Fans provide a wide range of performance that makes them ideal for most subslab radon mitigation systems.



Conforms to UL STD. 507
77728 Cert. to CAN/CSA STD. C22.2 No.113

- **5-Year Warranty**
- **Mounts on duct pipe or with integral flange**
- **3" diameter ducts for use with 3" or 4" pipe**
- **Electrical box for hard wire or plug in**
- **ETL Listed - for indoor or outdoor use.**

Model	Dimensions		
	A	B	C Duct Size
GP series	12.5"	13"	3"

The following chart shows performance of GP Series fans:

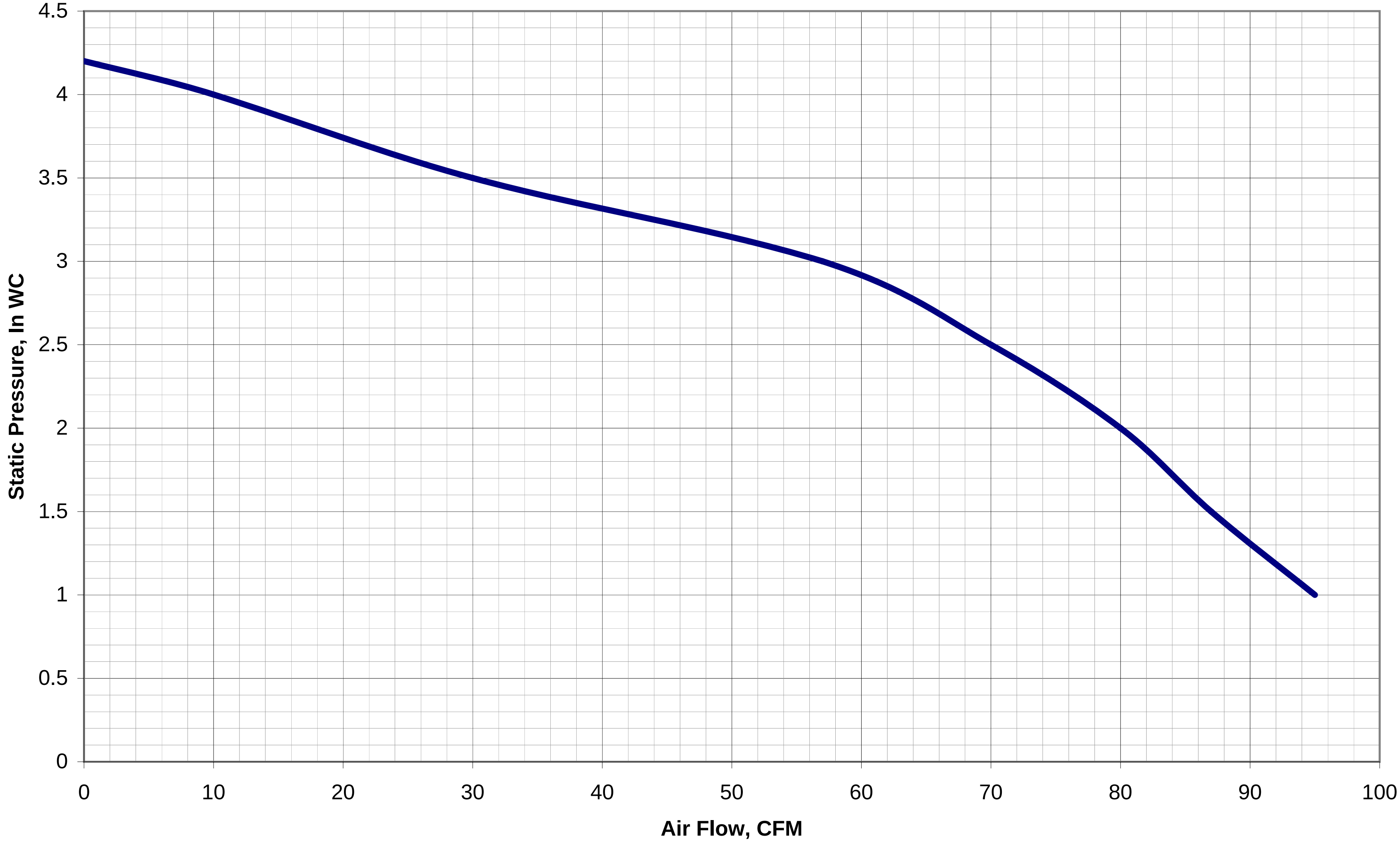
Model	Watts	Maximum Pressure "WC	Typical CFM vs. Static Pressure WC						
			1.0"	1.5"	2.0"	2.5"	3.0"	3.5"	4.0"
GP201	40-60	2.0	82	58	5	-	-	-	-
GP301	55-90	2.6	92	77	45	10	-	-	-
GP401	60-110	3.4	93	82	60	40	15	-	-
GP501	70-140	4.2	95	87	80	70	57	30	10

Choice of model is dependent on certain building characteristics including sub-slab materials and should be made by a radon professional.

For Further Information Contact:

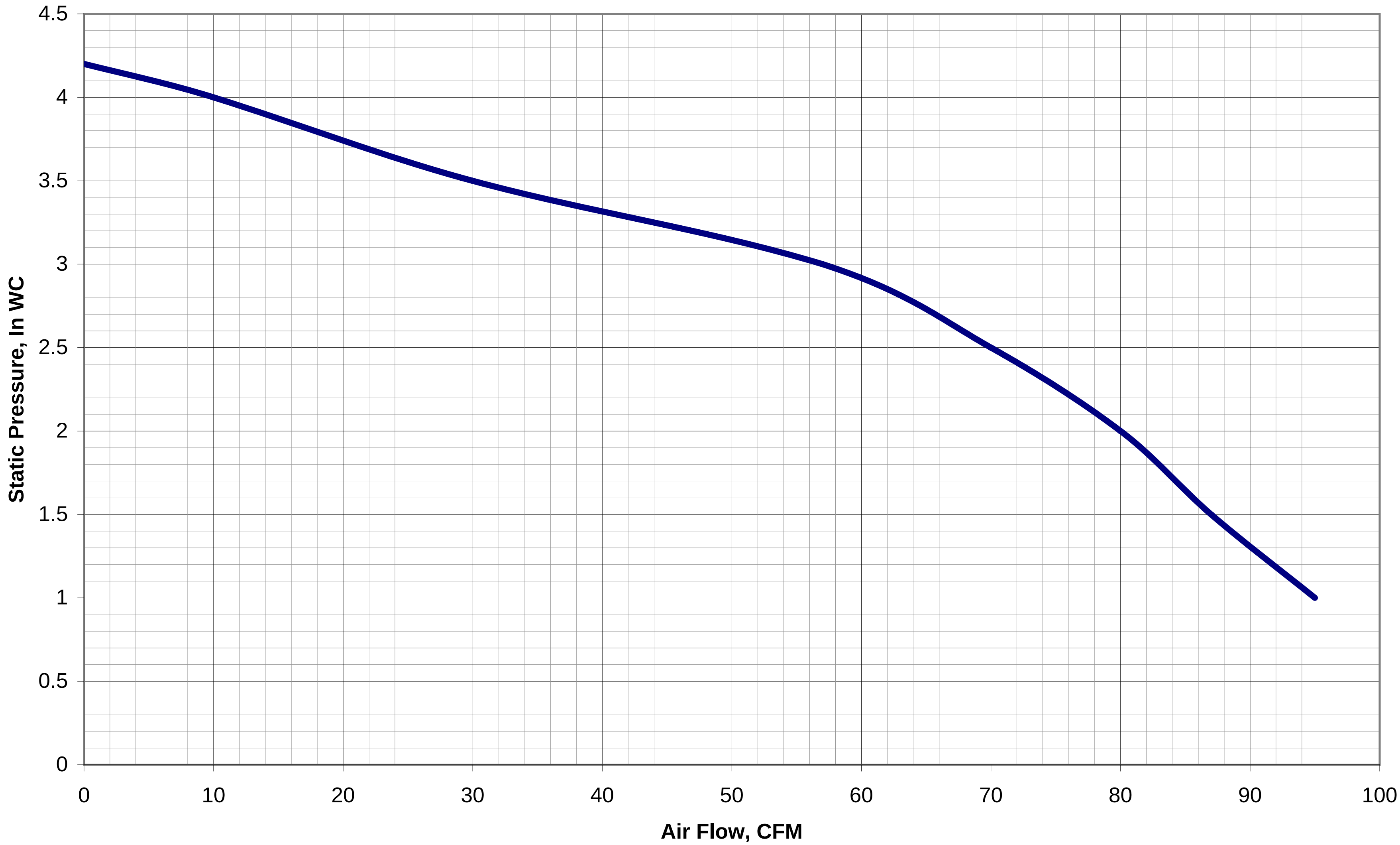
Performance Curve, GP501.

By: TS
Date:10/14/05



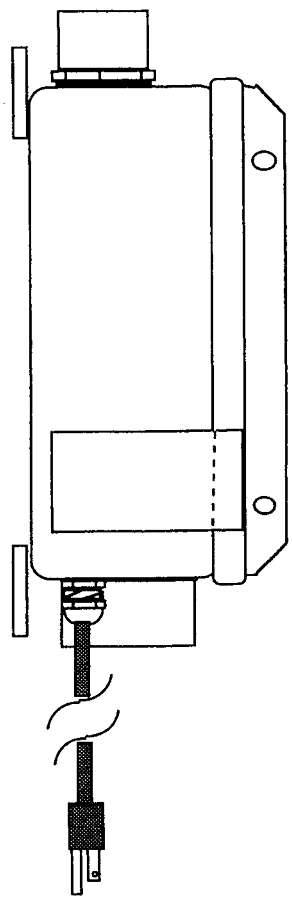
Performance Curve, GP501.

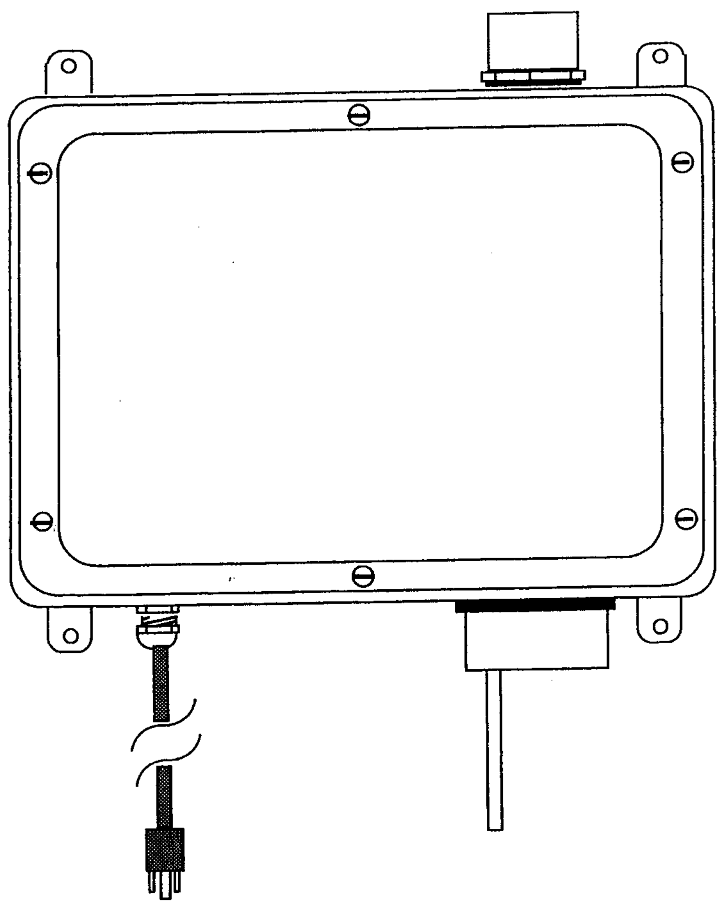
By: TS
Date:10/14/05



HS SERIES INSTALLATION INSTRUCTIONS

BY RadonAway™





RadonAway, Inc.   Ward Hill, MA.

P/N IN007 Rev E

RadonAway Ward Hill, MA.

HS Series Fan Installation Instructions

Please Read and Save These Instructions.

DO NOT CONNECT POWER SUPPLY UNTIL FAN IS COMPLETELY INSTALLED. MAKE SURE ELECTRICAL SERVICE TO FAN IS LOCKED IN "OFF" POSITION. DISCONNECT POWER BEFORE SERVICING FAN.

1. **WARNING!** Do not use fan in hazardous environments where fan electrical system could provide ignition to combustible or flammable materials.

2. **WARNING!** Do not use fan to pump explosive or corrosive gases.

3. **WARNING!** Check voltage at the fan to insure it corresponds with nameplate.

4. **WARNING!** Normal operation of this device may affect the combustion airflow needed for safe operation of fuel burning equipment. Check for possible backdraft conditions on all combustion devices after installation.

5. **NOTICE!** There are no user serviceable parts located inside the fan unit. **Do NOT attempt to open.** Return unit to the factory for service.

6. All wiring must be in accordance with local and national electrical codes.

7. **WARNING!** In the event that the fan is immersed in water, return unit to factory for service before operating.

8. **WARNING!** Do not twist or torque fan inlet or outlet piping as Leakage may result.

INSTALLATION INSTRUCTIONS (Rev D)
for DynaVac High Suction Series
HS2000 p/n 23004-1
HS3000 p/n 23004-2
HS5000 p/n 23004-3

1.0 SYSTEM DESIGN CONSIDERATIONS

1.1 INTRODUCTION

The DynaVac is intended for use by trained, professional Radon mitigators. The purpose of this instruction is to provide additional guidance for the most effective use of the DynaVac. This instruction should be considered as a supplement to EPA standard practices, state and local building codes and state regulations. In the event of a conflict, those codes, practices and regulations take precedence over this instruction.

1.2 ENVIRONMENTALS

The DynaVac is designed to perform year-round in all but the harshest climates without additional concern for temperature or weather. For installations in an area of severe cold weather, please contact RadonAway for assistance. When not in operation, the DynaVac should be stored in an area where the temperature is never less than 32 degrees F. or more than 100 degrees F. The DynaVac is thermally protected such that it will shut off when the internal temperature is above 104 degrees F. Thus if the DynaVac is idle in an area where the ambient temperature exceeds this shut off, it will not restart until the internal temperature falls below 104 degrees F.

1.3 ACOUSTICS

The DynaVac, when installed properly, operates with little or no noticable noise to the building occupants. There are, however, some considerations to be taken into account in the system design and installation. When installing the DynaVac above sleeping areas, select a location for mounting which is as far away as possible from those areas. Avoid mounting near doors, fold-down stairs or other uninsulated structures which may transmit sound. Insure a solid mounting for the DynaVac to avoid structure-borne vibration or noise.

The velocity of the outgoing air must also be considered in the overall system design. With small diameter piping, the "rushing" sound of the outlet air can be disturbing. The system design should incorporate a means to slow and quiet the outlet air. The use of the RadonAway Exhaust Muffler, p/n 24001, is strongly recommended.

1.4 GROUND WATER

Under no circumstances should water be allowed to be drawn into the inlet of the DynaVac as this may result in damage to the unit. The DynaVac should be mounted at least 5 feet above the slab penetration to minimize the risk of filling the DynaVac with water in installations with occasional high water tables.

In the event that a temporary high water table results in water at or above slab level, water will be drawn into the riser pipes thus blocking air flow to the DynaVac. The lack of cooling air will result in the DynaVac cycling on and off as the internal temperature rises above the thermal cutoff and falls upon shutoff. Should this condition arise, it is recommended that the DynaVac be disconnected until the water recedes allowing for return to normal operation.

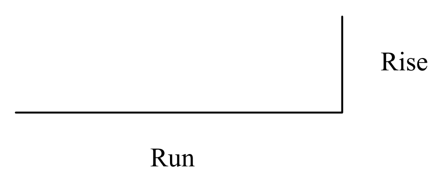
1.5 CONDENSATION & DRAINAGE

(WARNING!: Failure to provide adequate drainage for condensation can result in system failure and damage the DynaVac).

Condensation is formed in the piping of a mitigation system when the air in the piping is chilled below its dew point. This can occur at points where the system piping goes through unheated space such as an attic, garage or outside. The system design must provide a means for water to drain back to a slab hole to remove the condensation.

The use of small diameter piping in a system increases the speed at which the air moves. The speed of the air can pull water uphill and at sufficient velocity it can actually move water vertically up the side walls of the pipe. This has the potential of creating a problem in the negative pressure (inlet) side piping. For DynaVac inlet piping, the following table provides the minimum recommended pipe diameters as well as minimum pitch under several system condition. Use this chart to size piping for a system.

Pipe Diam.	Minimum Rise per Foot of Run*		
	@ 25 CFM	@ 50 CFM	@ 100 CFM
4"	1/32 "	3/32 "	3/8 "
3"	1/8 "	3/8 "	1 1/2 "



*Typical operational flow rates:

HS3000, or HS5000 20 - 40 CFM
HS2000 50 - 90 CFM

All exhaust piping should be 2" PVC.

1.6 "SYSTEM ON" INDICATOR

A properly designed system should incorporate a "System On" Indicator for affirmation of system operation. A Magnehelic pressure gauge is recommended for this purpose. The indicator should be mounted at least 5 feet above the slab penetration to minimize the risk of filling the gauge with water in installations with occasional high water tables.

1.7 SLAB COVERAGE

The DynaVac can provide coverage of well over 1000 sq. ft. per slab penetration. This will, of course, depend on the sub-slab aggregate in any particular installation and the diagnostic results. In general, sand and gravel are much looser aggregates than dirt and clay. Additional suction points can be added as required. It is recommended that a small pit (2 to 10 gallons in size) be created below the slab at each suction hole.

1.8 ELECTRICAL WIRING

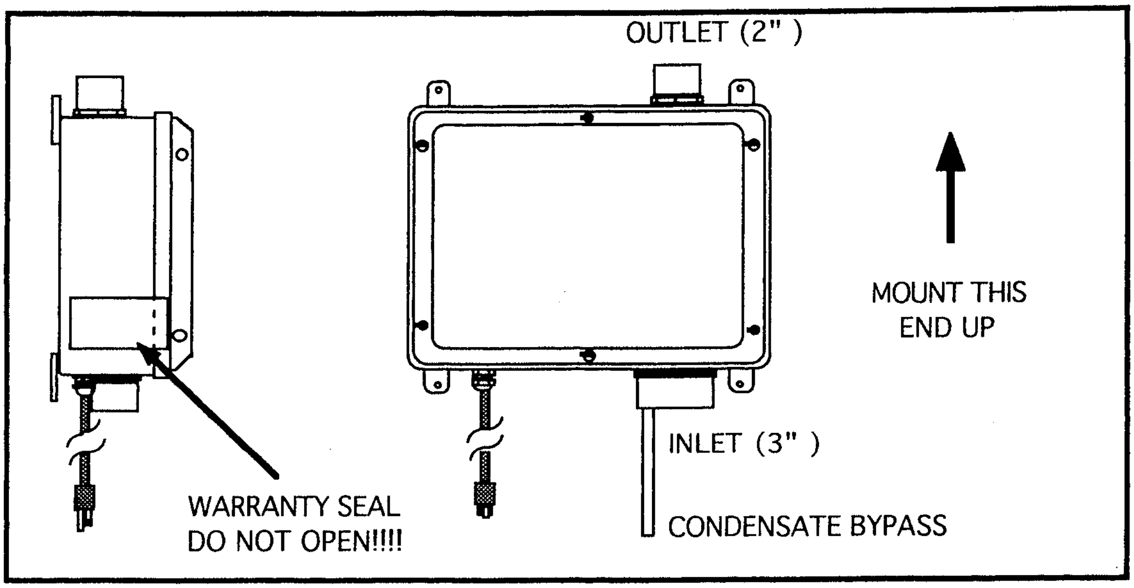
The DynaVac plugs into a standard 120V outlet. All wiring must be performed in accordance with the National Electrical Code and state and local building codes.

1.8a ELECTRICAL BOX (optional)

The optional Electrical Box (p/n 20003) provides a weathertight box with switch for outdoor hardwire connection. All wiring must be performed in accordance with the National Electrical Code and state and local building codes. All electrical work should be performed by a qualified electrician. Outdoor installations require the use of a U.L. listed watertight conduit.

1.9 SPEED CONTROLS

Electronic speed controls can **NOT** be used on HS series units.



2.0 INSTALLATION

2.1 MOUNTING

Mount the DynaVac to the wall studs, or similar structure, in the selected location with (4) 1/4" x 1 1/2" lag screws (not provided). Insure the DynaVac is both plumb and level.

2.2 DUCTING CONNECTIONS

Make final ducting connection to DynaVac with flexible couplings. Insure all connections are tight. Do not twist or torque inlet and outlet piping on DynaVac or leaks may result.

2.3 VENT MUFFLER INSTALLATION

Install the muffler assembly in the selected location in the outlet ducting. Solvent weld all connections. The muffler is normally installed above the roofline at the end of the vent pipe.

2.5 OPERATION CHECKS

____ Make final operation checks by verifying all connections are tight and leak-free.

____ Insure the DynaVac and all ducting is secure and vibration-free.

____ Verify system vacuum pressure with Magnehelic. Insure vacuum pressure is less than the maximum recommended as shown below:

DynaVac	HS2000	14" WC
DynaVac	HS3000	21" WC
DynaVac	HS5000	40" WC

(Above are based on sea-level operation, at higher altitudes reduce above by about 4% per 1000 Feet.)
If these are exceeded, increase number of suction points.

____ Verify Radon levels by testing to EPA protocol.

Addendum

PRODUCT SPECIFICATIONS

Model	Maximum Static Suction	Typical CFM vs Static Suction WC (Recommended Operating Range)						Power* Watts @ 115 VAC
		0"	10"	15"	20"	25"	35"	
HS2000	18"	110	72	40	-	-	-	150-270
HS3000	27"	40	33	30	23	18	-	105-195
HS5000	50"	53	47	42	38	34	24	180-320

*Power consumption varies with actual load conditions

Inlet: 3.0" PVC
Outlet: 2.0" PVC
Mounting: Brackets for vertical mount
Weight: Approximately 18 lbs.
Size: Approximately 15"W x 13"H x 8"D
Minimum recommended inlet ducting (greater diameter may always be used):
HS3000, HS5000 --- 2.0" PVC Pipe
HS2000 --- Main feeder line of 3.0" or greater PVC Pipe
Branch lines (if 3 or more) may be 2.0" PVC Pipe
Outlet ducting: 2.0" PVC
Storage temperature range: 32 - 100 degrees F.
Thermally protected
Locked rotor protection
Internal Condensate Bypass

IMPORTANT INSTRUCTIONS TO INSTALLER

Inspect the HS Series Fan for shipping damage within 15 days of receipt. Notify **RadonAway of any damages immediately**. Radonaway is not responsible for damages incurred during shipping. However, for your benefit, Radonaway does insure shipments.

There are no user serviceable parts inside the fan. **Do not attempt to open.** Return unit to factory for service.

Install the HS Series Fan in accordance with all EPA standard practices, and state and local building codes and state regulations.

WARRANTY

Subject to any applicable consumer protection legislation, RadonAway warrants that the HS Series Fan (the "Fan") will be free from defects in materials and workmanship for a period of one (1) year from the date of manufacture (the "Warranty Term"). Outside the Continental United States and Canada the Warranty Term is one (1) year from the date of manufacture.

RadonAway will replace any Fan which fails due to defects in materials or workmanship. The Fan must be returned (at owner's cost) to the RadonAway factory. Proof of purchase must be supplied upon request for service under this Warranty.

This Warranty is contingent on installation of the Fan in accordance with the instructions provided. This Warranty does not apply where any repairs or alterations have been made or attempted by others, or if the unit has been abused or misused. Warranty does not include damage in shipment unless the damage is due to the negligence of RadonAway.

RadonAway is not responsible for installation, removal or delivery costs associated with this Warranty.

EXCEPT AS STATED ABOVE, THE HS SERIES FANS ARE PROVIDED WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

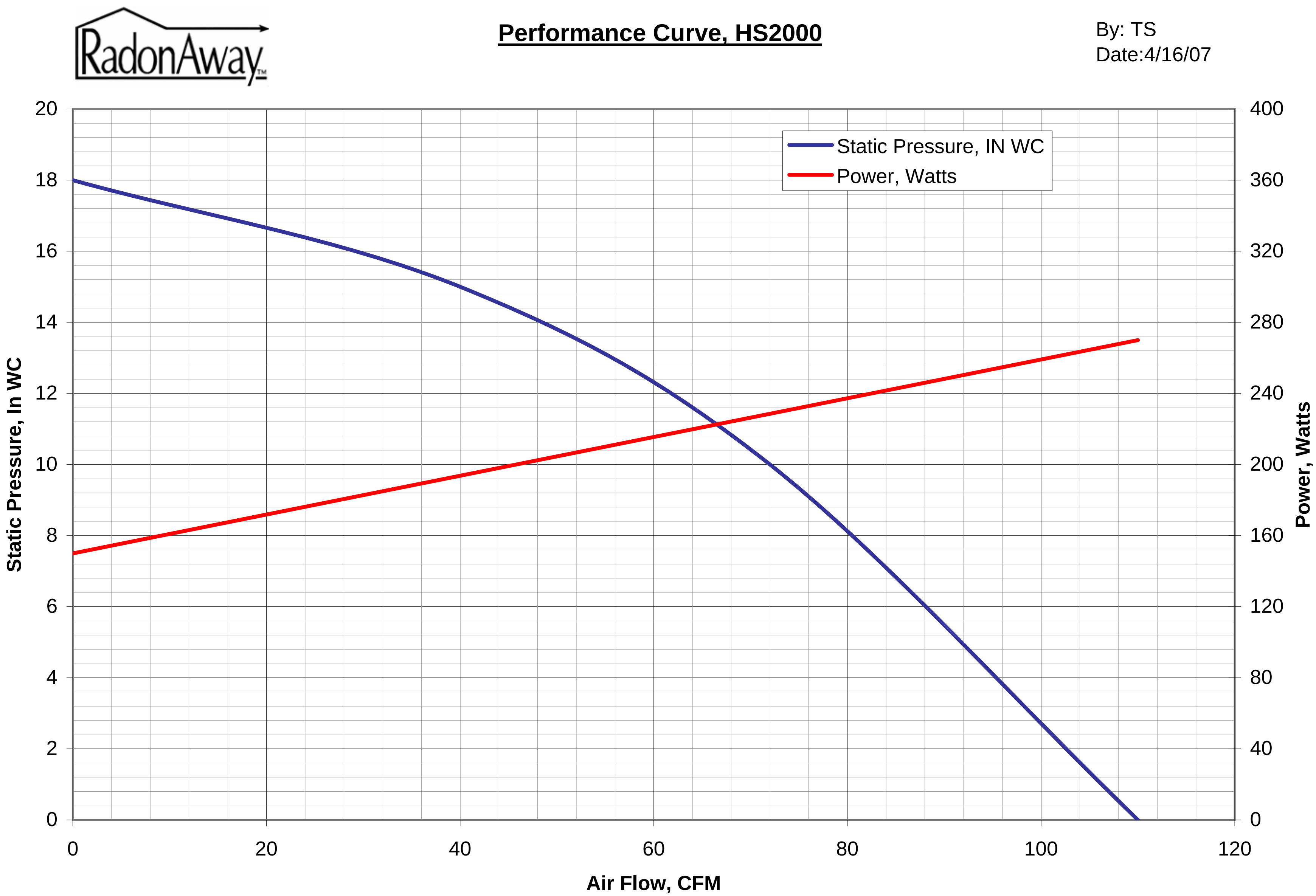
IN NO EVENT SHALL RADONAWAY BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR RELATING TO, THE FAN OR THE PERFORMANCE THEREOF. RADONAWAY'S AGGREGATE LIABILITY HEREUNDER SHALL NOT IN ANY EVENT EXCEED THE AMOUNT OF THE PURCHASE PRICE OF SAID PRODUCT. THE SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY SHALL BE THE REPAIR OR REPLACEMENT OF THE PRODUCT, TO THE EXTENT THE SAME DOES NOT MEET WITH RADONAWAY'S WARRANTY AS PROVIDED ABOVE.

For service under this Warranty, contact RadonAway for a Return Material Authorization (RMA) number and shipping information. No returns can be accepted without an RMA. If factory return is required, the customer assumes all shipping cost to and from factory.

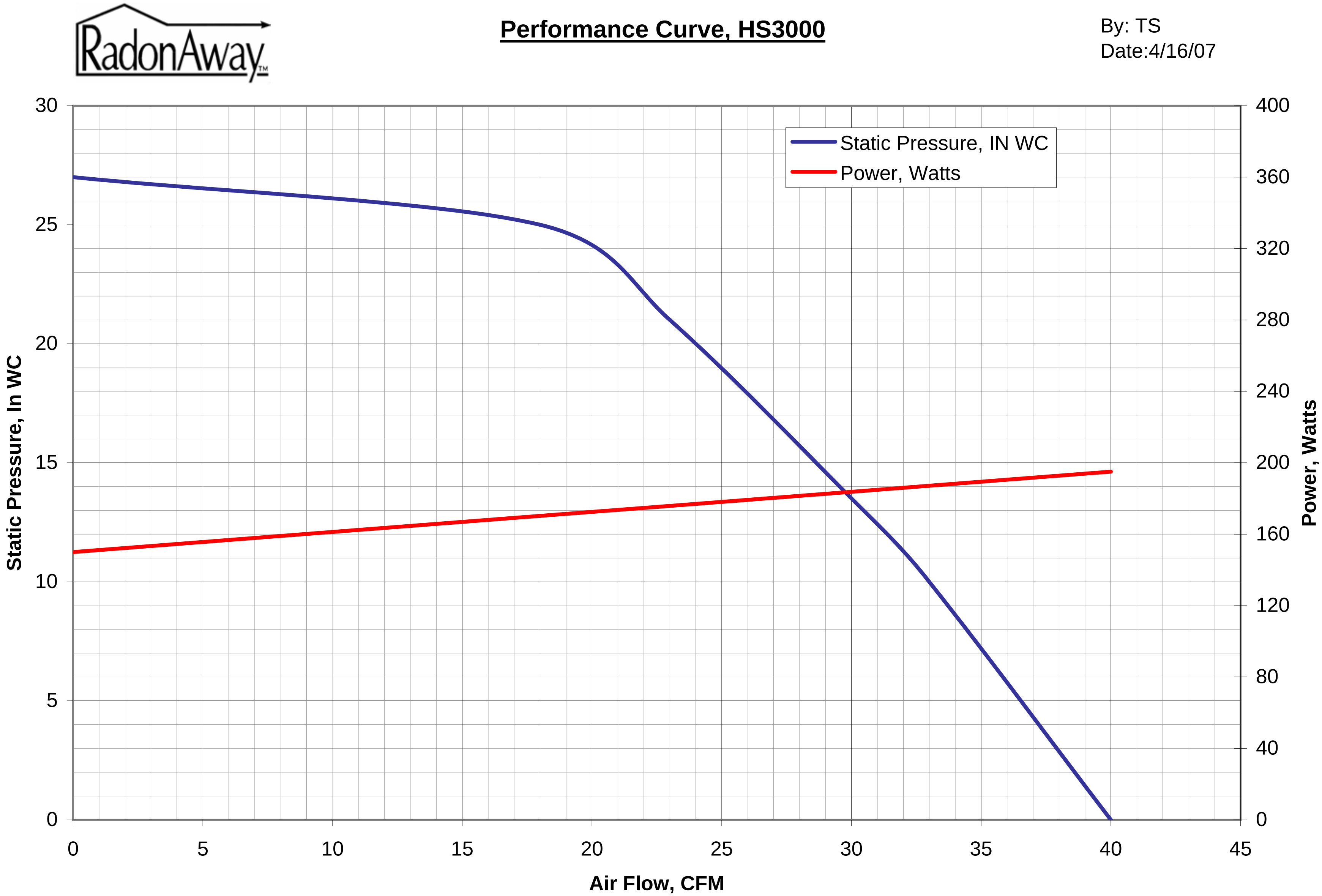
RadonAway
3 Saber Way
Ward Hill, MA 01835
TEL. (978) 521-3703
FAX (978) 521-3964

Record the following information for your records:

Serial No.____________________________________
Purchase Date____________________________



RadonAway™
Performance Curve, HS2000
By: TS
Date:4/16/07
Static Pressure, IN WC
Power, Watts
Static Pressure, In WC
Power, Watts
Air Flow, CFM
0
2
4
6
8
10
12
14
16
18
20
0
40
80
120
160
200
240
280
320
360
400
0
20
40
60
80
100
120

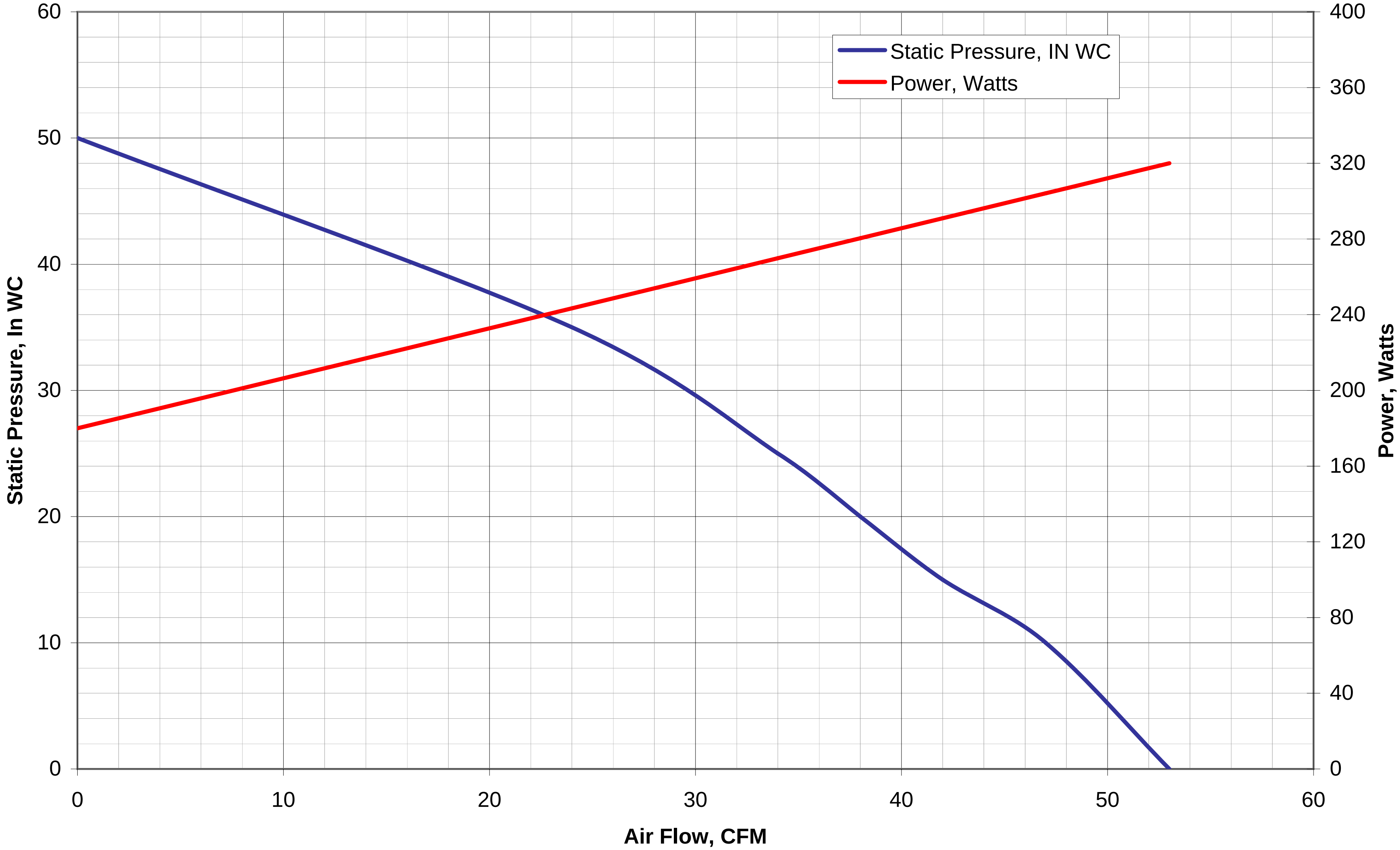


Performance Curve, HS3000

By: TS
Date:4/16/07

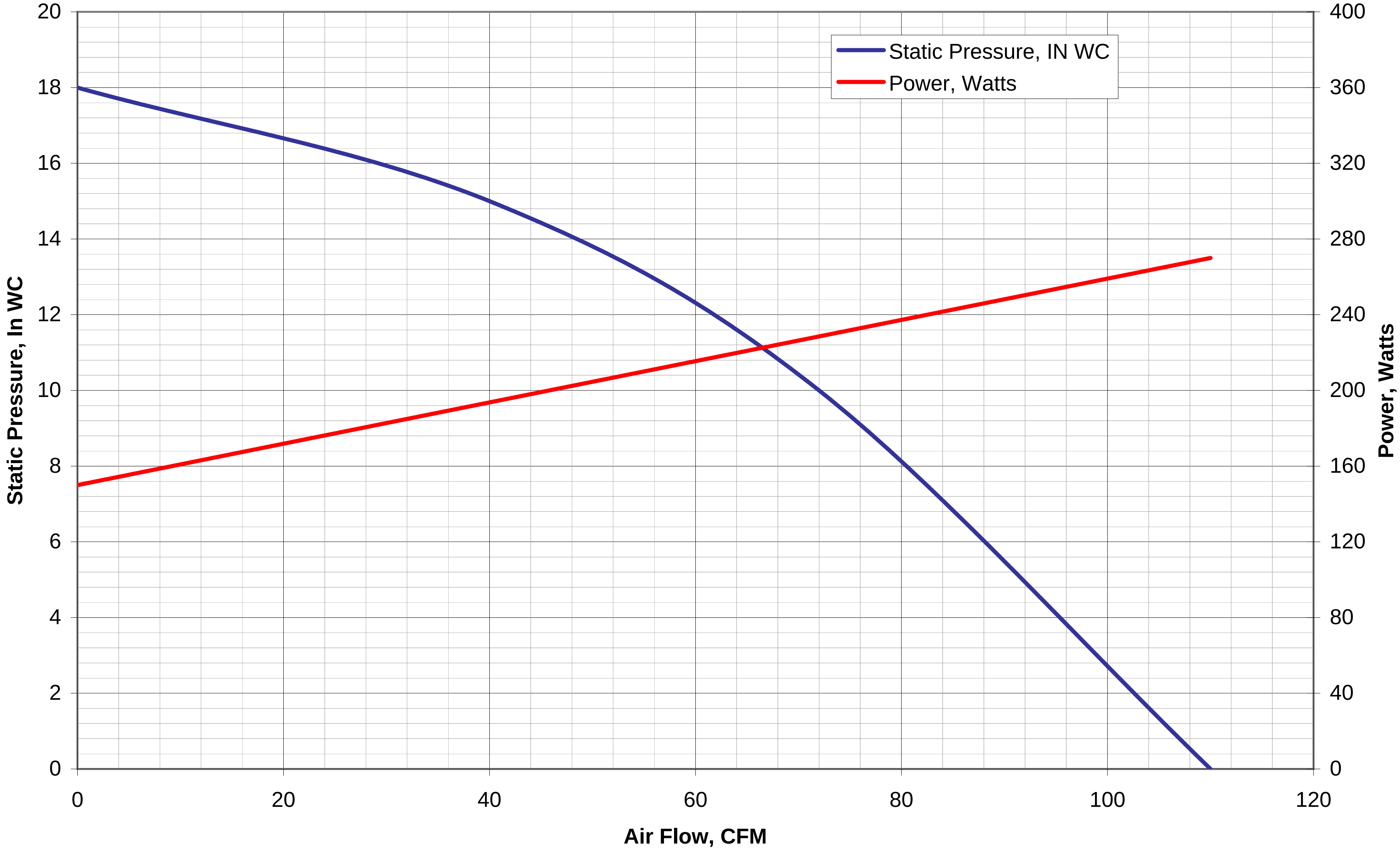
Performance Curve, HS5000

By: TS
Date:4/16/07



Performance Curve, HS2000

By: TS
Date:4/16/07



Appendix C – Interim Remedial Measures Summary Report, dated August 6, 2004

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INTERIM REMEDIAL MEASURES SUMMARY REPORT

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK

PREPARED

BY

ESC ENGINEERING OF NEW YORK, P.C.

August 6, 2004

Contents

Contents
(continued)

List of Figures:

List of Tables:

List of Appendices:

Acronym List

ACM	asbestos-containing material
AQES	Air Quality and Environmental Services, LLC
ATL	Atlantic Testing Laboratories, Limited
bgs	below the ground surface
cis-1,2-DCE	cis-1,2-dichloroethylene
EPA	U.S. Environmental Protection Agency
GAC	granular activated carbon
HASP	health and safety plan
Hg	mercury
HP	horsepower
ID	inside diameter
IRM	interim remedial measure
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	operation and maintenance
PCE	tetrachloroethene
ppbv	parts per billion by volume
ppmv	parts per million by volume
PCBs	polychlorinated biphenyls
PCM	phase contrast microscopy
PID	photoionization detector
PVC	polyvinyl chloride
QAPP	quality assurance project plan
RSI	Remediation Services, Inc.
scfm	standard cubic feet per minute
SOP	standard operating procedure
SVE	soil vapor extraction
SVOCs	semi-volatile organic compounds
TAGM	Technical Assistance Guidance Memorandum
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons
ug/kg	micrograms per kilogram
VOCs	volatile organic compounds

1.0 Introduction

1.1 General

ESC Engineering of New York, P.C. was retained by Federal-Mogul Corporation to prepare this Interim Remedial Measures (IRM) Summary Report for the recent activities performed at the Huck manufacturing facility in Kingston, New York (Figure 1). This report is being submitted to the New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH) to serve as documentation that the IRM activities were completed in substantial conformance with the requirements identified in the following documents and approved field changes detailed in this report:

- the February 6, 2002, Voluntary Cleanup Agreement (Index Number: A3-0372-9807) between Federal-Mogul Corporation and the NYSDEC
- the NYSDEC and NYSDOH-approved IRM Work Plan (ESC Engineering, 2003); the NYSDEC and NYSDOH approved the IRM Work Plan in a November 26, 2003, letter to ESC Engineering

The IRMs were conducted to address indoor air quality within the main building and within the attached office building, volatile organic compounds (VOCs) in shallow soils in the eastern parking lot, and VOCs in onsite and offsite soil gas. The November 7, 2003, work plan also discussed the presence of VOCs in soil above the water table in the former metal finishing and chemical storage area and the former degreaser area. However, additional investigation is required in these areas and, thus, no IRMs were proposed to address these soils. Therefore, these areas are not discussed in this report.

All construction and site work associated with the IRMs were completed in accordance with applicable federal, state, and local laws and regulations. All monitoring activities discussed herein were conducted in accordance with procedures outlined in ESC Engineering's standard operating procedures (SOPs) which are included in the Quality Assurance Project Plan (QAPP) prepared for the site (ESC, 2001). All work was performed in accordance with the site-specific Health and Safety Plan (HASP; ESC, 2001).

The purpose and organization of this IRM Summary Report is described below, followed by a discussion of general background information relating to the site and the IRM activities.

1.2 Purpose and Organization of Report

The purpose of this IRM Summary Report is to provide a detailed description of the activities associated with the IRMs. The report has been organized into the following sections:

- Section 1 – Introduction
- Section 2 – Description of IRM Activities
- Section 3 – Operation and Maintenance
- Section 4 – Engineering Certification
- Section 5 – References

1.3 Site Location and Description

The Huck manufacturing facility is located at 85 Grand Street in Kingston, New York and consists of two buildings occupying 105,000 square feet on 4.5 acres (Figures 1 and 2). The remainder of the site consists of asphalt parking areas, access roads, and a small grass-covered area near the southeast corner of the main manufacturing building. A chain-link fence controls access to the western portion of the facility. Currently, Allways Moving and Storage, which uses the facility for indoor self-storage, leases the site from Federal-Mogul (current site owner). Portions of the onsite buildings are subleased to local businesses.

The property is in a mixed light industrial, commercial, and residential area. Tenbroeck Avenue borders the site to the northeast. Northeast of Tenbroeck Avenue are mixed residential and commercial properties. Grand Street and residences border the site to the southeast. West of the site is CSX Transportation, Inc. railroad tracks, across which lie light industrial and commercial properties.

1.4 Previous Investigations

This section of the report summarizes the results of previous investigations performed by ESC Engineering that are relevant to the IRMs. Specifically, this section reviews the VOC results from soil investigations performed in the former metal finish area, eastern parking lot transformer area, and former degreaser area; onsite and offsite soil gas investigations; and the onsite indoor air investigations.

ESC Engineering performed soil and groundwater investigations at the site in March 2002 and August 2003. The results of the March 2002 investigations were presented to the NYSDEC in the Supplemental Investigative Report, dated November 2, 2002. ESC Engineering is currently preparing a report on the additional soil and groundwater investigations conducted in August 2003 and the report will be submitted to the NYSDEC in the near future. A table summarizing the soil VOC results from the relevant areas of concern at the site is presented in Table 1. Indoor air and soil gas sampling activities were conducted at the site in April and August 2003. The results of the April 2003 investigations were summarized in ESC Engineering's Indoor Air and Soil Gas Sampling Report, dated July 18, 2003. The results of the August 2003 indoor air and soil gas investigations are presented in the IRM Work Plan, dated November 7, 2003. Tables 2 and 3 presents the results of the soil gas and indoor air investigations, respectively.

1.4.1 Soil Investigations

Below is a summary of the soil investigation activities conducted in three areas of the site. This section addresses only the results of soil samples analyzed for VOCs. In accordance with ESC Engineering's Supplemental Investigative Work Plan, dated June 18, 2000, the VOC results have been compared to the recommended soil cleanup objectives provided in the NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) 4046: Determination of Soil Cleanup Objectives and Cleanup Levels, dated January 24, 1994.

Eastern Parking Lot Transformer Area

ESC Engineering has advanced 16 soil borings in the eastern parking lot to delineate the horizontal and vertical extent of VOCs in soil (Figure 3). These borings include SB-4 through SB-7, SB-9 through SB-14, SB-35, SB-36, SB-47, SB-48, SB-64, and SB-65. Soil samples were collected from each boring at 1 to 3 feet below ground surface (bgs) and 6 to 8 feet bgs. Soil samples were also collected from the two-foot-thick interval directly above the water table (i.e., approximately 16 to 18 feet bgs) at borings SB-9 and SB-14. The soil samples collected from 1 to 3 feet and above the water table were analyzed for VOCs. Samples collected from 6 to 8 feet were analyzed only if constituents were detected in the 1 to 3 foot interval above the evaluation criteria.

The analytical results indicated the presence of trichloroethene (TCE; 890 micrograms per kilogram [ug/kg] to 370,000 ug/kg), tetrachloroethene (PCE; 2,500 ug/kg to 110,000 ug/kg), acetone (450 ug/kg to 8,300 ug/kg), and methylene chloride (2,800 ug/kg) at concentrations above the evaluation criteria in the 1 to 3 foot interval of SB-6, SB-10, SB-14, SB-36, SB-64, and SB-65 (Figure 3). The evaluation criteria for these compounds are 700 ug/kg for TCE, 1,400 ug/kg for PCE, 110 ug/kg for acetone, and 100 ug/kg for methylene chloride (Table 1). No VOCs were detected above the evaluation criteria in samples collected from these borings at 6 to 8 feet bgs, or in the two-foot-thick interval directly above the groundwater table.

ESC Engineering anticipates conducting limited additional soil sampling to define the southern extent of VOCs in shallow soil in the eastern parking lot. The proposed investigations will be described in the upcoming report summarizing the August 2003 investigations.

Former Metal Finish Area

ESC Engineering has advanced nine soil borings in the former metal finish and chemical storage area (SB-1 though SB-3, SB-8, SB-34, SB-37, SB-38, SB-42, and SB-49) to evaluate the horizontal and vertical extent of VOCs in soil (Figure 3). Soil samples were collected from each boring for chemical analysis from 1 to 3 feet bgs and from directly above the water table from borings SB-1 (17.5 to 19.5 feet bgs) and SB-38 (13 to 15 feet bgs). No VOCs were detected above the evaluation criteria in these borings in the 1 to 3 foot interval or in the 13 to 15 foot interval of SB-38. The sample collected from SB-1 directly above the water table contained TCE at a concentration of 47,000 ug/kg, which is above the evaluation criterion of 700 ug/kg. Based on the absence of VOCs at concentrations above the evaluation criteria above the water table in soil borings SB-9, SB-14, and SB-38, the affected soil above the water table in this area appears to be limited in horizontal extent.

ESC Engineering anticipates conducting limited additional soil sampling above the water table in this area to determine the western and northern limits of VOCs detected at SB-1. The proposed investigations will be described in the upcoming report summarizing the August 2003 investigations.

Former Degreaser Area

ESC Engineering has advanced five soil borings (SB-29, SB-30, SB-33, SB-66, and SB-67) in the former degreaser area to evaluate the horizontal extent of VOCs in soil above the water table. Investigations in this area by a previous consultant indicated that VOC concentrations in the upper portion of the vadose zone are below the evaluation criteria. Soil samples were collected from each boring directly above the water table for VOC analysis. The analytical results from SB-33 indicated 65,000 ug/kg of TCE and 93,000 ug/kg of PCE. No VOCs were detected above the water table in the remaining borings at concentrations above the evaluation criteria. Therefore, the horizontal extent of VOCs in soil above the water table in this area is limited.

1.4.2 Soil Gas Investigations

In April and August 2003, ESC Engineering collected 24 soil gas samples at the locations designated SG-1 through SG-24 on Figure 4. The soil gas samples were collected to determine the presence and horizontal extent of VOCs in soil gas onsite and offsite. The soil gas samples were collected at a depth of approximately 6 feet bgs using 6-liter Summa canisters and dedicated 6-inch-long, 0.5-inch-diameter stainless steel screens and Teflon tubing. The soil gas samples were collected in accordance with the procedures outlined in the NYSDEC and NYSDOH-approved work plan, dated April 2, 2003, and the proposed scope of work outlined in the July 18, 2003, Indoor Air and Soil Gas Sampling Report. The soil gas samples were analyzed for TCE, PCE, and cis-1,2-dichloroethene (cis-1,2-DCE) by U.S. Environmental Protection Agency (EPA) Method TO-15. The soil gas results indicated the presence of TCE in 22 samples at concentrations from 1.7 parts per billion by volume (ppbv) to 97,000 ppbv. PCE was detected in 22 samples at concentrations from 4.8 ppbv to 45,000 ppbv and cis-1,2,-DCE was detected in 10 samples at concentrations from 2.7 ppbv to 8,800 ppbv (Table 2).

The highest concentrations of the target VOCs were detected onsite along the eastern property line (Figure 4). These levels decreased abruptly toward the east at SG-1 through SG-3, to the west at SG-5, and to the north at SG-6. As described above, shallow soil in the northern portion of the eastern parking lot contains elevated concentrations of TCE and PCE from 1 to 3 feet bgs. These soils are believed to be the primary source for VOCs in soil gas. The majority of the property is covered with buildings, concrete sidewalks, or asphalt, with the exception of a small grassy area around the office building and the narrow landscaped areas in the eastern and southern parking lots. Furthermore, the pavement of Grand Street and Tenbroeck Avenue directly abuts the paved portions of the site. Therefore, given the shallow depth of VOCs in soil in the eastern parking lot, and the fact that the majority of the site is covered with an impervious surface, the VOCs appeared to have volatilized and migrated horizontally under this cap and into the utility corridors of the adjacent streets.

1.4.3 Indoor Air Investigations

On April 29, 2003, ESC Engineering collected indoor air samples inside the main building in the office complex and in the space formerly leased by Scheffel Furniture. The soil gas samples were analyzed for TCE, PCE, and cis-1,2-DCE by EPA Method TO-15. The indoor air sample locations are designated IA-1 and IA-2 on Figure 5. These sample locations were selected to evaluate indoor air quality in the two areas of the main building that were routinely occupied. The Scheffel Furniture space was being used for furniture refinishing during the sampling activities, but has since been vacated. ESC Engineering completed the NYSDOH's indoor air quality questionnaire for each sample location and inventoried the VOC-containing products stored in each space. Products containing VOCs were recorded on the NYSDOH's Household Products Inventory Form along with the VOC ingredients and the concentration of organic vapors detected near the lid of the containers, which were measured with a photoionization detector (PID). Copies of the completed indoor air quality questionnaires are provided in the July 18, 2003, Indoor Air and Soil Gas Sampling Report.

The analytical results indicated the presence of TCE in sample IA-1 at a concentration of 1.7 ppbv and in sample IA-2 at a concentration of 10 ppbv. Low levels of PCE and cis-1,2-DCE were also detected in the office complex (Table 3).

In accordance with the proposed scope of work in ESC Engineering's Indoor Air and Soil Gas Sampling Report, dated July 18, 2003, ESC Engineering collected 12 additional indoor air samples inside the main building and one outdoor air sample in August 2003. The purpose of the additional sampling activities was to confirm the results from IA-1 and IA-2 and to evaluate the indoor air quality in the remainder of the main building. In addition, indoor air samples were collected on the first floor (IA-6) and basement (IA-7) levels of the attached office building. The additional indoor air sample locations are designated IA-3 through IA-16 on Figure 5. ESC Engineering completed the NYSDOH's indoor air quality questionnaire and household products inventory form for each sample location and used a PID to measure the organic vapor concentration near the lid of containers with VOC ingredients (forms provided in Enclosure C of the November 7, 2003, IRM work plan).

The analytical results from the additional indoor air samples indicated low levels of TCE in each sample at concentrations ranging from 3.3 ppbv to 48 ppbv. PCE was detected in 13 samples at concentrations from 1.3 ppbv to 9.7 ppbv and cis-1,2-DCE was detected in 11 samples at concentrations from 0.5 ppbv to 9.5 ppbv. TCE was detected in the attached office building at concentrations of 18 ppbv on the first floor and 31 ppbv in the basement. PCE was detected in the office building at 10 ppbv on the first floor and 6.9 ppbv in the basement. Cis-1,2-DCE was not detected in the office building. TCE was the only compound detected in outdoor air sample OA-2 at a concentration of 0.77 ppbv. A copy of the analytical results is presented in Enclosure D of the November 7, 2003, IRM work plan.

The concentration of TCE detected in the former Scheffel Furniture space (3.3 ppbv) and inside the main office complex (14 ppbv) in August 2003 were similar to the concentrations detected in these areas in April 2003. The concentration of TCE detected in sample IA-4 (11 ppbv), which was collected directly outside the office door, was similar to the concentration detected inside the office at sample IA-3 (14 ppbv). These data suggest that the repeated opening and closing of the office door may result in a TCE concentration inside the office that is similar to the TCE level in the surrounding indoor air. TCE was detected in the office bathroom at a concentration of 35 ppbv, which is higher than in the office area. These data suggest that the bathroom's isolated location may reduce mixing with the surrounding indoor air, or VOCs may be entering the bathroom along a potential seam between the floor slab and a below-grade sump in that room. The sump reportedly collects sanitary waste before it is pumped overhead and out to the sanitary sewer. The TCE concentrations detected in the remaining areas of the main building are relatively homogenous (Figure 5).

2.0 Description of IRM Activities

2.1 IRM Objectives and Components

The objectives of the IRMs at the site were identified in the IRM Work Plan and are summarized below:

- prevent the infiltration of soil gas containing VOCs into the attached office building
- remediate shallow soils (less than 6 feet bgs) in the eastern parking lot containing VOCs (primarily TCE and PCE) above the evaluation criteria
- collect and treat soil gas containing VOCs along the eastern and southern property lines and in the adjacent offsite areas
- address VOCs in soil gas under the former manufacturing building in the vicinity of the former metal finish and chemical storage area and the main office complex

Presented below are the main components of the IRM activities that were implemented at the Huck manufacturing facility to achieve the objectives specified above:

- installed subsurface conveyance piping along the former finish and chemical storage area of the main building, adjacent to Grand Street, and along the southwestern property line
- installed soil vapor extraction (SVE) treatment equipment in the main manufacturing building
- conducted system start-up and operation and maintenance activities
- removed asbestos containing material from the office building basement
- installed a sub-slab depressurization system in the basement of the office building
- managed and disposed of waste materials generated during implementation of the IRM activities in accordance with applicable rules and regulations

A detailed description of each of these IRM activities is presented below.

2.2 Soil Vapor Extraction System

This section presents a detailed description of the SVE system installation activities. During implementation of the SVE system, the NYSDEC provided a field representative during most of the IRM activities and ESC Engineering provided full-time, engineering services to observe the work performed by Remediation Services Inc. (RSI) for substantial conformance with the NYSDEC and NYSDOH-approved IRM Work Plan. RSI was the remedial contractor retained by ESC Engineering to implement the SVE IRM.

ESC Engineering conducted the following activities during the installation of the SVE system:

- reviewed contractor submittals for adequacy relative to the requirements presented in the NYSDEC and NYSDOH-approved IRM Work Plan and NYSDEC-approved field changes
- coordinated with Federal-Mogul, NYSDEC, and subcontractors, as detailed herein, regarding the IRM
- maintained detailed written records of the field activities performed by the contractor, including documentation of field conditions encountered
- observed the work performed by the contractor for the duration of the IRM for substantial conformance with the NYSDEC and NYSDOH-approved IRM Work Plan
- conducted air monitoring in accordance with the procedures and requirements set forth in ESC Engineering's HASP
- characterized for offsite disposal the waste material generated during implementation of the IRM
- signed manifests on behalf of Federal-Mogul

A description of the SVE IRM activities that were implemented at the site is detailed below.

2.2.1 SVE System Piping Installation

The piping layout for the SVE system was based on analytical results from previous soil gas, soil, and indoor air investigations, as well as best engineering judgement. The targeted treatment zone extends from beneath the pavement to approximately 6 feet bgs. The unconsolidated sediments within the treatment zone consist of fine to medium grained sand. In order to effectively treat this shallow zone and remove soil vapor from the site boundary and adjacent offsite areas, ESC Engineering installed the vapor extraction piping in trenches. Figure 6 presents the SVE system piping layout and estimated radius of influence of the horizontal extraction pipes. The actual radius of influence observed during startup is discussed in Section 3.1.1.

The SVE system piping was divided into three horizontal extraction lines (i.e., Line 1, Line 2, and Line 3) with separate screened intervals. Line 1 consists of approximately 120 feet of 6-inch inside-diameter (ID) screened polyvinyl chloride (PVC) pipe along the former finish and chemical storage area of the main building. The purpose of Line 1 is to remediate shallow vadose zone soils in the eastern parking lot in excess of TAGM and collect and treat vapors containing VOCs that may be present beneath the former manufacturing building. Line 2 consists of approximately 200 feet of 6-inch ID screened PVC pipe installed along a portion of the eastern property line adjacent to Grand Street. A portion of the piping was installed on a 45 degree diagonal to avoid gas feed piping entering the property from Grand Street at the southern corner of the former finish and chemical storage area of the main manufacturing building. This line addresses shallow soils in the parking area (shown in blue on Figure 6) and soil gas containing VOCs along Grand Street (both onsite and offsite). Line 3 consists of approximately 490 feet of 6-inch ID screened PVC installed along Grand Street and the southwestern property line where soil gas samples indicated elevated levels of VOCs.

To provide flexibility in isolating portions of the extraction lines, valve boxes where installed at four locations as shown on Figure 6. The first valve is located approximately 90 feet from the start of Line 2 screened pipe. This valve allows the SVE system to extract more air along the first 90 feet of screened pipe, which corresponds to the area of shallow soil with VOC concentrations above TAGM. The remaining three valves were installed along the Line 3 screened pipe. The first valve along Line 3 is located at the beginning of the screened interval to shut off Line 3. The second valve along Line 3 was installed approximately 130 feet from the first valve. This valve allows soil vapor to be extracted only from the first 130 feet of screened piping. The third valve on Line 3 was installed at the 90 degree turn at the southeast corner of the property to isolate vapor extraction along Grand Street.

Figure 7 presents three as-built cross-sections of the extraction trench. The top of the extraction pipes were installed a minimum of 3.5 feet bgs in most instances. Some of the piping was locally installed at a shallower depth due to subsurface utilities. Screened pipe located in the same trench as solid pipe was offset by installing the pipe below the invert of the solid pipe. This was done to minimize any potential restriction in horizontal airflow that may occur if the pipes were installed at the same invert elevation. The slot size of the screen is 0.040-inch. Each section of PVC pipe was glued together and placed in the trench. A silica sand filter pack (U.S. Silica No. 2) was installed around the pipe in the trench to provide a secure bedding for the pipe and enhance air flow into the pipe. A 0.25-inch diameter washed stone was installed between the silica sand pack and PVC pipe to prevent the infiltration of fine particulates into the pipe. Excavated soil was then placed back into the trench on top of the filter pack for treatment. A geomembrane cover was placed above the backfill to provide a seal between the underlying soil backfill and the overlying flowable fill. Flowable fill (e.g., a mixture of cement, fly ash, and sand aggregate) was placed above the geomembrane as an additional low permeability layer to enhance the lateral vacuum influence of the trench, prevent short-circuiting to the atmosphere, and provide some structural integrity for vehicular traffic over the trenching. Approximately 6-inches of concrete was placed over the flowable fill to provide a restored surface.

2.2.2 SVE Treatment Equipment Installation

On completion of the pipe installation activities, the SVE treatment equipment was installed in a room of the main building (Figure 6). Larger doorways were installed in the treatment room to facilitate installation of the treatment equipment. Based on a hydraulic analysis detailed in the IRM Work Plan, two separate SVE systems were installed. One blower unit was installed to provide system vacuum to Lines 1 and 2. A second blower unit was installed for Line 3. These two blowers are operating in parallel. Further discussion of Lines 1 and 2 in this report will be referred to as Zone 1, and Line 3 as Zone 2.

To control the dynamic flow regime, various valving, filters, and treatment equipment were installed with each blower. Air flow from Zone 1 contains dedicated inlet valves for Lines 1 and 2. A separate inlet valve was installed for Zone 2. The process and instrumentation for both systems are essentially the same. The only main difference is the size of the blowers, as discussed later in this section. The extracted vapor stream is conveyed through an inlet air filter to remove particulates such as sand and grit. The vapor stream is then conveyed through a 120-

gallon separator to remove moisture. Water removed from the vapor stream is pumped to a 300-gallon polyethylene condensation tank by a set of float switches that actuate a water transfer pump. The vapor stream is then treated with a 2,000-pound vapor phase granular activated carbon (GAC) unit. The treated vapor stream is transferred through a second inlet air filter before entering a positive displacement blower. The blower for Zone 1 is a 25 horsepower (HP) unit capable of 550 standard cubic feet per minute (scfm) at 8.5 inches of mercury (Hg) vacuum. The blower for Zone 2 is a 40 HP unit capable of 750 scfm at 9.5 Hg. Both units are constructed with discharge silencers to reduce noise. The exhaust from both blowers are combined and discharged to the atmosphere through a common PVC stack. Both SVE systems include a dilution air filter/valve and vacuum relief valve in order to operate each blower at maximum efficiency.

Both SVE systems have similar telemetry and instrumentation (vacuum gauges, air flow gauges, temperature gauges, air sample ports) that allow for automated operation (Figure 8). On/off sensors in the air/water separator automatically operate a water transfer pump that transfers collected condensate from the separator to the condensate storage tank. A high level switch will shutdown the system to prevent this unit from overflowing (in case of transfer pump failure). The condensate storage tank is also outfitted with a high level switch that will shut off both SVE systems if triggered (the volume of water in the tank hits the predetermined level of the high level switch). Each blower is equipped with an internal amperage/volt sensor that will shut down the blower if the amperage draw exceeds a pre-set limit. This device prevents motor overload on the blower. Each SVE system also has a vacuum transmitter in the inlet air line located between the air/water separator and the GAC unit that will shutdown the blower in case of a low vacuum (see Figure 8). A low vacuum would be indicative of a break in a pipe or connection causing loss of vacuum. In addition to these alarm conditions, each SVE system is equipped with air flow rate meters and transmitters, vacuum indicators, pressure indicators, temperature gauges and transmitters, flow control valves, sample ports, and vacuum relief valves at the blower inlet. Controls and inputs from the vacuum transmitters, air flow transmitters, water flow transmitter, and temperature transmitters interface with a EOS Research Ltd. Series 2 plus master control panel. Proview™ software is used to monitor the system operation remotely using a computer. Some features that can be conducted remotely include the following:

- monitor the system sensors

- control equipment that are outputs on the control panel
- change the way the system operates
- view and change the system setpoints and alarm levels

An as-built process and instrumentation diagram detailing the SVE system is provided as Figure 8.

2.2.3 Waste Material Management

281.38 tons of soil were generated from the trenching activities and stockpiled onsite. A composite soil sample was collected on December 18, 2003, to characterize the material for offsite disposal/treatment. The soil sample was submitted to Severn Trent Laboratories in Newburgh, New York, for analysis of VOCs, semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), metals, pesticides, and herbicides by the Toxicity Characteristic Leaching Procedure (TCLP), total petroleum hydrocarbons (TPH), PCBs, ignitability, reactivity, corrosivity, and pH. The analytical results from the characterization sample indicated non-detectable concentrations of VOCs, SVOCs, metals, PCBs, pesticides, herbicides, and TPH. The soil pH was 7.69 standard units. A copy of the analytical results are presented in Appendix A. Based on the analytical results, the excavated soil was managed as a non-hazardous waste. The excavated soil was transported to the City of Albany Landfill in Albany, New York for disposal as a non-hazardous waste. Approximately 48 cubic yards of asphalt removed to facilitate excavation of the piping trench was transported to Blacktop Maintenance Corporation in Poughkeepsie, New York as a recyclable material. Copies of non-hazardous waste bill of ladings are provided in Appendix B.

2.2.4 Site Restoration

The surface of the soil vapor extraction trenches were restored by placing concrete level with the surrounding pavement or sidewalk along Grand Street. Significant cracks that developed between the concrete and surrounding pavement/sidewalk were filled with asphalt material on June 1, 2004. Remediation support areas and equipment staging areas mobilized to the site during the construction activities were removed. Silica sand and washed stone was staged in front of the office building during the construction activities. This area has been graded and seeded.

2.2.5 Installation of Vapor and Vacuum Monitoring Points

ESC Engineering installed 12 vapor and vacuum monitoring points, designated VM-1 through VM-12 on Figure 9, to measure vacuum influence and to allow the collection of soil gas samples. The vacuum and vapor monitoring points were installed by advancing a soil boring to a depth of approximately 6 feet using a drill rig equipped with 4.25-inch ID hollow-stem augers. The augers were withdrawn from the ground and the monitoring point was constructed in the open borehole. The vapor monitoring points consist of a 6-inch-long, 0.5-inch diameter stainless steel wire mesh screen (0.0057 inch pore size) attached to a sufficient length of 0.25-inch ID Teflon tubing to reach the ground surface. The screen and tubing were lowered to the bottom of the borehole and approximately 1 foot of quartz sand was placed around the screen. An approximately one-foot-thick granular bentonite seal was placed on top of the sand pack and the bentonite was hydrated with potable water. A vacuum monitoring point was installed on top of the bentonite seal at a depth of 4 feet bgs. The vacuum monitoring point was constructed of one-inch ID schedule 40 PVC casing and consisted of 2.5 feet of 0.01-inch machine-slotted PVC screen and 1.5 feet of solid PVC riser. An approximately 1.75-foot-thick sand pack was placed around the well casing followed by a 0.75-foot-thick hydrated bentonite seal. Each monitoring point was completed with a sand drain and a flush-mounted protective steel cover set in a concrete pad. The construction details for the vacuum and vapor monitoring point is presented on Figure 7. Boring logs for offsite vapor monitoring points VP-7 through VP-12 are presented in Appendix C. Due to the large number of borings previously drilled onsite (i.e., over 70), no soil samples were collected for lithologic description during installation of vapor monitoring points VP-1 through VP-6 and, thus, no logs were prepared for these borings.

2.3 Office Building Sub-Slab Depressurization System

ESC Engineering contracted Air Quality and Environmental Services, LLC (AQES) to install a sub-slab depressurization system in the basement of the two-story brick office building to prevent the infiltration of soil gas. As discussed above, ESC Engineering previously collected an indoor air sample in the basement of the structure in August 2003 for analysis of TCE, PCE, and cis-1,2-DCE. The indoor air sample contained 31 ppbv of TCE and 6.9 ppbv of PCE.

During installation of the sub-slab system, the NYSDEC provided a field representative during a portion of the work and ESC Engineering provided part-time engineering services to observe the work performed by AQES for substantial conformance with the NYSDEC and

NYSDOH-approved IRM Work Plan. Services provided by ESC Engineering during the installation of the sub-slab depressurization system included the following:

- reviewed Contractor submittals for adequacy relative to the requirements presented in the NYSDEC and NYSDOH-approved IRM Work Plan and NYSDEC-approved field changes
- coordinated with Federal-Mogul, NYSDEC, and subcontractors, as detailed herein, regarding the IRM
- maintained detailed written records of the field activities performed by the Contractor, including documentation of field conditions encountered
- observed the work performed by the Contractor at key project milestones for substantial conformance with the NYSDEC and NYSDOH-approved IRM Work Plan
- conducted air monitoring in accordance with the procedures and requirements set forth in ESC Engineering's HASP
- coordinated and subcontracted the removal of asbestos-containing material (ACM) before construction activities were initiated

A description of the IRM activities associated with the installation of the sub-slab depressurization system at the site is detailed below.

2.3.1 Asbestos Removal

During a pre-construction reconnaissance visit with AQES, suspected ACM were observed in the basement of the office building. Before construction activities for the depressurization system could commence, the ACM was removed. On February 4, 2004, Atlantic Testing Laboratories, Limited (ATL) performed a visual survey to identify asbestos-containing building materials present on exposed surfaces (i.e., pipe insulation, floor tile and ceiling tile) within the office building. The visual examination was limited to the pipe insulation in the basement, ceiling tiles on the second floor, and floor tiles on the first and second floors. Based on this survey, approximately 31 linear feet of asbestos-containing pipe insulation was identified in the basement of the office building. This insulation exhibited localized damage from impact and/or excessive moisture. In addition, there was evidence of potential ACM debris in the immediate areas surrounding the damaged insulation. Floor and ceiling tiles on the first and second floors were observed to be in good condition and no abatement of these materials was recommended or warranted.

Based on the results of this inspection, Lambert's Asbestos Removal Service, Inc., was subcontracted by ESC Engineering to remove the asbestos-containing pipe insulation in the basement. During the asbestos removal activities, ATL performed airborne sampling and analysis by phase contrast microscopy (PCM). Air samples were obtained in accordance with 12 New York Code of Rules and Regulations (NYCRR) 56-17. PCM samples were sent to Envirologic of New York, Inc., a NYSDOH-approved laboratory. The clearance criteria for all work areas was determined to be in compliance with 12 NYCRR 56-17. A copy of the PCM air sampling and analysis report is provided in Appendix D. Four hundred-twenty pounds of ACM were removed and disposed at Steuben County Landfill in Bath, New York, on March 15, 2004. A copy of the asbestos waste manifest is provided in Appendix B.

2.3.2 Sub-Slab Depressurization System Installation

On completion of the asbestos removal activities, AQES initiated construction of the sub-slab depressurization system. Nine below grade suction points were installed in the main basement area by removing the concrete slab, excavating sufficient soil to accommodate perforated sump basins, lining the excavation with filter fabric, installing the sump basin, backfilling around the basin with crushed stone, and restoring the concrete slab. Manometers were installed on all nine suction points and the sub-membrane suction line in the crawl space of the basement. A single blower fan (Spruce Environmental Technologies, Inc. RB400 inline fan) was installed on the single exhaust stack at the west side of the building. The exhaust stack extends at least 2 feet above the eave line of the building. At the completion of system installation, visible cracks and holes in the floor slab were sealed to improve the efficiency of the system. As-built construction drawings for this system are provided in Appendix E.

2.3.3 Waste Material Management

Concrete and soil excavated to install the suction points were removed from the basement with a conveyor and placed in 25 U.S. Department of Transportation-authorized 55-gallon steel drums and staged onsite for characterization and offsite disposal. ESC Engineering is currently coordinating the disposal of these materials with PSC Environmental Services and will include copies of the disposal documentation in a future bi-monthly progress report.

3.0 Operation and Maintenance

3.1 Soil Vapor Extraction System

After installing the SVE system, start-up and testing activities were performed on February 18 through 20, 2004, before initiating full-scale (normal) operations. A description of the start-up activities is presented below followed by a discussion of the operation and maintenance activities.

3.1.1 System Start-Up

Each piece of equipment was tested and operated to verify that it functioned in accordance with the manufacturer's design specifications. Once each piece of equipment was inspected and operated satisfactorily, SVE system start-up activities were conducted. Each blower was energized and set at a minimum vacuum by fully opening the air dilution valve on both systems. The air dilution valve was slowly closed, increasing the vacuum from the extraction trenches. The vacuum was increased incrementally to facilitate periodic inspection of the entire system to ensure proper operation. Once both SVE systems were running at, or close to, the designed flow rates of 400 scfm and 612.5 scfm for Zone 1 and 2, respectively, measurements were obtained from both systems for flow, pressure, vacuum, and temperature. Table 4 presents a start-up monitoring log (PID readings, vacuum measurements, vacuum monitoring point measurements) for the initial days of system start-up. After approximately one hour of operation, operating data (i.e., vacuums, flow rates) indicated that both SVE systems had nearly stabilized. Influent PID readings were collected periodically from both Zones to monitor the influent VOC loading to each SVE system. These samples were collected from sample ports located on the air/water separator before the GAC unit. The samples were collected on the vacuum side of the blower using a hand pump to fill a Tedlar bag. A PID reading was collected by inserting the PID probe tip into a tube connected to the Tedlar bag and opening the valve of the Tedlar bag.

Initial vapor flow rates were 560 cfm for Zone 1 and 640 cfm for Zone 2, exceeding the design operation point of both systems (400 cfm for Zone 1 and 612.5 cfm for Zone 2). Influent PID readings within the first hour of operation were 21.9 parts per million by volume (ppmv) and 21.4 ppmv from Zones 1 and 2, respectively. This VOC loading is less than the system design influent total VOC loading of approximately 60 ppmv. Influent vapor samples were collected from Zones 1 and 2 to verify the PID readings. A result was not reported for the influent vapor sample collected from Zone 2 due to sampling equipment malfunction. The influent vapor sample results from Zone 1 indicated total VOCs of 11.91 ppmv. This result is approximately half the reading collected with the PID; however, the vapor sample was collected over an hour using a Summa canister as compared to an instantaneous reading from the PID. Average influent VOC concentrations most likely decreased over the span of that hour resulting in a lower total VOC concentration.

After approximately 3.5 hours, a round of vacuum measurements were collected from the vacuum monitoring locations shown on Figure 9. All vacuum monitoring points located onsite indicated a vacuum (Table 4). A slight vacuum was observed in only two of the six offsite vacuum monitoring points. However, the development of a vacuum response in these monitoring points was expected to take longer to attain steady-state operation than the aboveground system.

Influent and effluent vapor samples were collected again after approximately 24 hours of system operation. Total VOCs in the influent vapor sample collected from Zone 1 was 6 ppmv and 7.05 ppmv from Zone 2 (Table 5). PID measurements collected from the influent of Zone 1 and Zone 2 before collecting the Summa canister vapor samples were 8.6 ppmv and 8.7 ppmv, respectively, which represented a much better correlation between laboratory analytical data and PID field measurements than was observed earlier in the startup activities. Influent VOC concentrations typically show an initial spike, followed by a rapid decline to a sustained contaminant concentration. This condition is illustrated on Figure 10 presenting total influent VOC concentrations measured by a PID from Zones 1 and 2 over time.

The influent samples collected from both Zones 1 and 2 contained only cis-1,2-DCE, TCE, and PCE. The effluent vapor sample collected from Zone 1 contained 0.268 ppmv total VOCs including cis-1,2-DCE, TCE, PCE, toluene, xylenes, and 1,1,2,2-tetrachloroethane (Table 5). Toluene, xylenes, and 1,1,2,2-tetrachloroethane are VOC compounds found in the material that lines the interior of the GAC vessel. The VOC removal efficiency of the GAC vessel for Zone 1 was approximately 97 percent.

During start-up operations, no condensate water was generated from the vapor stream. However, approximately 250 gallons of water was removed from the vapor stream during the first month of full-scale operation. This was due to the infiltration of surface water into the extraction trenches from large cracks/holes between the existing pavement and the restored concrete surface of the extraction trenches. As discussed in Section 2.2.4, these cracks/holes were sealed with asphalt material to prevent surface water infiltration into the extraction trenches.

Initial start-up operations were completed by February 20, 2004. Modifications to the SVE systems were conducted in March 2004 as discussed below.

3.1.2 System Operation and Performance Monitoring

On completing the start-up activities, both SVE systems were operated under full-scale conditions until March 5, 2004. Both SVE systems were shut down to change out the screened PVC internals of the GAC units because excessive headloss appeared to be occurring through each of the GAC units. On March 10, 2004, the SVE systems were turned back on after the screened PVC internals were replaced with larger screened internals. The system was shut down again on March 17, 2004, to replace the 4-inch ID PVC piping entering and exiting each GAC units with 6-inch diameter PVC pipe. Installation of a larger diameter pipe decreased the overall system headloss and allowed the blowers to operate more efficiently. The systems were turned on again on March 18, 2004, and have been operating continuously to date.

To verify that the system is operating satisfactorily, operation and maintenance (O&M) personnel will conduct monthly observations of the system. A system operation log sheet will be completed during each inspection event (Appendix F). The following activities will be conducted as part of the system monitoring.

- observe the blowers and listen for unusual sounds; also check to confirm that the blowers are properly secured to the floor
- observe the air flow meters for proper operation by checking the instantaneous flow measurements; if the flow meters appear to be inoperable, clean the flow meter in accordance with manufacturers recommendations
- record the vacuum readings for the following:
  - the influent before and after the inlet filters for both systems
  - the effluent of the air/water separator for both systems
  - the influent of each blower
- record the effluent temperature from both blower units
- collect influent and effluent PID readings from both systems

- record the total gallons of water recovered from the air/water separators
- observe the treatment building piping for signs of leaks.

If system repairs and/or replacement of system components are necessary, O&M personnel will perform the appropriate system maintenance/repair.

ESC Engineering will periodically collect influent and effluent air samples using Summa canisters to determine the influent loading on each system and the VOC removal efficiency of the GAC units. These air samples are scheduled to be collected on a semi-annual basis. In addition to collecting treatment system samples, air samples will be collected using Summa canisters from the vacuum monitoring points shown on Figure 9 on a semi-annual basis during the first year of operation. This data will be used to determine the effectiveness of the system operation at meeting the remedial objectives for the site. The sampling schedule after the first year of operation will be determined based on the results of the first year of system operation.

Figure 10 presents influent total VOC concentrations measured by a PID over time for each treatment Zone. As shown on this figure, a rapid decline in influent VOC concentrations was observed after the first few days of system operation. Both Zones appear to be reaching an asymptotic state within a couple weeks of operation. Figure 11 presents the cumulative PCE, TCE, and cis-1,2-DCE removal of both Zones over time. Based on the influent laboratory analytical data, by April 23, 2004, approximately 41 pounds of VOC mass has been removed from Zone 1 and approximately 31 pounds of VOC mass has been removed from Zone 2. Cumulative VOC mass removed from each Zone will be provided to the NYSDEC in future bi-monthly progress reports.

3.2 Office Building Sub-Slab Depressurization System

After installing the sub-slab depressurization system, start-up and testing activities were performed on March 26, 2004, before initiating full-scale (normal) operations. The start-up activities involved energizing the blower and then balancing the air flows and vacuums from each suction point using a portable flow meter and the manometers installed on the vertical pipes attached to each suction point. Each of the nine suction pumps were balanced to a vacuum of 0.013 inches of water at 39.9 cfm. The crawl space suction line was balanced to 0.06 inches of water at 85.5 cfm. The total system flow at startup was 443.7 cfm.

To verify that the sub-slab system operates satisfactorily, O&M personnel will periodically conduct observations of the system. The following activities will be conducted as part of the system monitoring.

- observe the blower and verify that it is operational.
- record the vacuum from each manometer to ensure that similar vacuums are being applied to each suction point.
- observe the system piping for signs of leaks.

If system repairs and/or replacement of system components are necessary, O&M personnel will perform the appropriate system maintenance/repair.

ESC Engineering collected indoor air samples from the basement and first floor of the office building on April 23, 2004, to confirm that the sub-slab depressurization system is operating satisfactorily. In addition, two concurrent outdoor air samples were collected to establish VOC concentrations in the ambient air. The indoor air samples collected from the basement and first floor of the office building contained TCE at concentrations of 0.91 ppbv and 0.73 ppbv, respectively. The TCE levels in both samples are below the New York State Department of Health's 75th percentile value for background indoor air of <1 ppbv. The two concurrent outdoor air contained 1.7 ppbv and 3 ppbv of TCE. The results from the office building indicate that the sub-slab system is effectively controlling vapor intrusion. The analytical results for the indoor and outdoor air samples were submitted to the NYSDEC in the June 2004 bi-monthly report.

4.0 Engineering Certification

ENGINEER'S CERTIFICATION

HUCK MANUFACTURING FACILITY
KINGSTON, NEW YORK
INTERIM REMEDIAL MEASURES

I, Todd M. Musterait, P.E., hereby certify, as a Professional Engineer registered in the State of New York, that based on ESC Engineering of New York, P.C.'s observation of the IRM activities conducted by the remedial contractors, Remediation Services, Inc. and Air Quality and Environmental Services, LLC, the IRM activities were completed in substantial conformance with the requirements presented in the following documents and/or approved field changes detailed in this IRM Summary Report:

- Voluntary Cleanup Agreement (VCA), Index Number: A3-0372-9807, February 6, 2002
- NYSDEC and NYSDOH-approved IRM Work Plan (ESC Engineering, 2003).

______________________________________ ______________________

Todd M. Musterait, P.E. Date

New York State P.E. No. 076923

ESC Engineering of New York, P.C.
9 Albany Street
Cazenovia, New York 13035
(315) 655-3900

5.0 References

Environmental Strategies Corporation. 2001. Supplemental Investigative Work Plan, Federal-Mogul Corporation, Kingston, New York. June 18.

ESC Engineering of New York, P.C. 2003. Interim Remedial Measures Work Plan, Huck manufacturing facility, Kingston, New York. November 7.

Figures

Tables

Appendix A – Waste Characterization Soil Results

ANALYTICAL REPORT

JOB NUMBER: 231758

Prepared For:

Environmental Strategies Corporation
11911 Freedom Drive
Suite 900
Reston, VA 20190

Attention: Jim Bowie

Date: 06/03/2004

Signature

Date 6/3/04

Name: Kelly A. Pryor

Title: Project Manager

E-Mail: kpryor@stl-inc.com

315 Fullerton Avenue
Newburgh, NY 12550

PHONE: (845) 562-0890
FAX..: (845) 562-0841

231758

No. 023009

CHAIN OF CUSTODY RECORD

Page 1 of 1

PROJECT NO.	PROJECT NAME AND LOCATION:
138008	FEDERAL MOGUL

SAMPLERS: (Signature) [signature]

PRINT NAME: JIM BOWIE

SAMPLE I.D.	SAMPLE LOCATION	DATE	TIME	MATRIX	NO. OF CONTAINERS	PH	FLASHPOINT	TCLP METALS (8 RCRA METALS)	TCLP 8260	TCLP 8270	TPH	REACTIVITY	REMARKS
EXCAVATED SOIL		12/18	13:00	SOIL	1	/							Add:
EXCAVATED SOIL		↓	↓	↓	1		/						TCLP Pests
EXCAVATED SOIL		↓	↓	↓	1			/					TCLP Herbs
EXCAVATED SOIL		↓	↓	↓	1				/				Total PCBs.
EXCAVATED SOIL		↓	↓	↓	1					/			per J. Bowie's
EXCAVATED SOIL		↓	↓	↓	1						/		e-mail dated
EXCAVATED SOIL		↓	↓	↓	1							/	12/22/03
													KB 12/30/03

Relinquished by: (Signature)	Date/Time	Received by: (Signature)
[signature]	12/18 1800	[signature] 12:00 12/19/03
Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Received for Laboratory by: (Signature)	PRINT NAME:	Date/Time

LAB NAME: STL

CITY: NEWBURGH

COURIER: FEDEX

AIRBILL NO. 836908946760

CUSTODY SEAL NOS: 6611

COOLER NO: 1of1

ENVIRONMENTAL STRATEGIES CORPORATION
11911 Freedom Drive
Reston, Virginia 20190
(703) 709-6500 • Fax (703) 318-3995
Fax (412) 787-8065

Rec. Temp 9.8 on Ice

ESC

ATTENTION LAB: SEND ANALYTICAL RESULTS TO THE FOLLOWING ESC STAFF MEMBER: TODD MUSTERAIT JIM BOWIE

CA ____ MA ____ PA ____ MN ____

DISTRIBUTION: ORIGINAL ACCOMPANIES SHIPMENT: COPY TO ESC FILES

S A M P L E   I N F O R M A T I O N

Date: 05/03/2004

Job Number.: 231758	Project Number.........: 20000988
Customer...: Environmental Strategies Corporation	Customer Project ID....: 138008
Attn.......: Jim Bowie	Project Description....: ESC

Laboratory Sample ID	Customer Sample ID	Sample Matrix	Date Sampled	Time Sampled	Date Received	Time Received
231758-1	Excavated Soil	Soil	12/18/2003	13:00	12/19/2003	12:00

L A B O R A T O R Y   T E S T   R E S U L T S

Job Number: 231758 | Date: 06/03/2004

CUSTOMER: Environmental Strategies Corporation   PROJECT: 138008   ATTN: Jim Bowie

Customer Sample ID: Excavated Soil
Date Sampled......: 12/18/2003
Time Sampled......: 13:00
Sample Matrix.....: Soil

Laboratory Sample ID: 231758-1
Date Received.......: 12/19/2003
Time Received.......: 12:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	Q	FLAGS	REPORTING LIMIT	UNITS	ANALYZED	TECH
SW846 7740	Selenium (Se), TCLP	25.0	U		25.0	ug/L	01/06/03	mwh
SW846 7470A	Mercury (Hg), TCLP	0.50	U		0.50	ug/L	12/31/03	lms
SW846 1311	TCLP Extraction, TCLP	Complete					12/29/03	smo
SW846 1311	TCLP Extraction, TCLP	Complete					01/05/04	smo
SW846 3550B	Ultrasonic Extraction	Complete					12/31/03	smo
EPA 418.1	TPH, Recoverable*	24	U		24	mg/Kg	12/22/03	smo
EPA 160.3	% Moisture	11.4			0.10	%	12/28/03	lms
EPA 160.3	% Solids	88.6			0.10	%	12/28/03	lms
SW846 1311	TCLP Zero Head Space (ZHE) Extraction, TCLP	Complete						ljc
SW846 1010	Ignitability (Flashpoint)	>200			70.000	degrees F	12/30/03	lms
SW846 9045C	pH	7.69			0.20	pH Units	12/23/03	se
SW846 8151A	Herbicides							
	Subcontract, TCLP	Complete				* Text	01/14/04	smg
CH 7.3.2	Reactivity CH 7.3.2							
	Subcontract	Complete					01/09/04	smg
SW846 8081A	Organochlorine Pesticide Analysis							
	gamma-BHC (Lindane), TCLP	21	U		21	ug/L	01/09/04	smo
	Heptachlor, TCLP	1.0	U		1.0	ug/L	01/09/04	smo
	Heptachlor epoxide, TCLP	1.0	U		1.0	ug/L	01/09/04	smo
	Endrin, TCLP	1.0	U		1.0	ug/L	01/09/04	smo
	Methoxychlor, TCLP	210	U		210	ug/L	01/09/04	smo
	Toxaphene, TCLP	21	U		21	ug/L	01/09/04	smo
	Technical Chlordane, TCLP	21	U		21	ug/L	01/09/04	smo
SW846 8082	PCB Analysis							
	Aroclor 1016*	19	U		19	ug/Kg	01/07/04	smo
	Aroclor 1221*	19	U		19	ug/Kg	01/07/04	smo
	Aroclor 1232*	19	U		19	ug/Kg	01/07/04	smo
	Aroclor 1242*	19	U		19	ug/Kg	01/07/04	smo
	Aroclor 1248*	19	U		19	ug/Kg	01/07/04	smo
	Aroclor 1254*	38	U		38	ug/Kg	01/07/04	smo
	Aroclor 1260*	38	U		38	ug/Kg	01/07/04	smo
SW846 6010B	Metals Analysis (ICAP)							
	Arsenic (As), TCLP	200	U		200	ug/L	01/06/04	mad

* In Description = Dry Wgt.

STL Newburgh
315 Fullerton Avenue
Newburgh, NY 12550
Tel (845) 562-0890
Fax (845) 562-0841

LABORATORY TEST RESULTS

Job Number: 231758 Date: 06/03/2004

CUSTOMER: Environmental Strategies Corporation PROJECT: 138008 ATTN: Jim Bowie

Customer Sample ID: Excavated Soil
Date Sampled......: 12/18/2003
Time Sampled......: 13:00
Sample Matrix.....: Soil

Laboratory Sample ID: 231758-1
Date Received.......: 12/19/2003
Time Received.......: 12:00

TEST METHOD	PARAMETER/TEST DESCRIPTION	SAMPLE RESULT	Q	FLAGS	REPORTING LIMIT	UNITS	ANALYZED	TECH
	Barium (Ba), TCLP	400	U		400	ug/L	01/06/04	mad
	Cadmium (Cd), TCLP	20.0	U		20.0	ug/L	01/06/04	mad
	Chromium (Cr), TCLP	20.0	U		20.0	ug/L	01/06/04	mad
	Lead (Pb), TCLP	200	U		200	ug/L	01/06/04	mad
	Silver (Ag), TCLP	20.0	U		20.0	ug/L	01/06/04	mad
SW846 8270C	Semivolatile Organics							
	Pyridine, TCLP	20	U		20	ug/L	12/31/03	caw
	1,4-Dichlorobenzene, TCLP	20	U		20	ug/L	12/31/03	caw
	2-Methylphenol (o-cresol), TCLP	20	U		20	ug/L	12/31/03	caw
	Hexachloroethane, TCLP	20	U		20	ug/L	12/31/03	caw
	4-Methylphenol (m/p-cresol), TCLP	20	U		20	ug/L	12/31/03	caw
	Nitrobenzene, TCLP	20	U		20	ug/L	12/31/03	caw
	Hexachlorobutadiene, TCLP	20	U		20	ug/L	12/31/03	caw
	2,4,6-Trichlorophenol, TCLP	20	U		20	ug/L	12/31/03	caw
	2,4,5-Trichlorophenol, TCLP	100	U		100	ug/L	12/31/03	caw
	2,4-Dinitrotoluene, TCLP	20	U		20	ug/L	12/31/03	caw
	Hexachlorobenzene, TCLP	20	U		20	ug/L	12/31/03	caw
	Pentachlorophenol, TCLP	51	U		51	ug/L	12/31/03	caw
SW846 8260B	Volatile Organics							
	Vinyl chloride, TCLP	100	U		100	ug/L	12/31/03	pcp
	1,1-Dichloroethene, TCLP	100	U		100	ug/L	12/31/03	pcp
	2-Butanone (MEK), TCLP	100	U		100	ug/L	12/31/03	pcp
	Chloroform, TCLP	100	U		100	ug/L	12/31/03	pcp
	Carbon tetrachloride, TCLP	100	U		100	ug/L	12/31/03	pcp
	Benzene, TCLP	100	U		100	ug/L	12/31/03	pcp
	1,2-Dichloroethane, TCLP	100	U		100	ug/L	12/31/03	pcp
	Trichloroethene, TCLP	26	J		100	ug/L	12/31/03	pcp
	Tetrachloroethene, TCLP	21	J		100	ug/L	12/31/03	pcp
	Chlorobenzene, TCLP	100	U		100	ug/L	12/31/03	pcp

* In Description = Dry Wgt.

STL Newburgh
315 Fullerton Avenue
Newburgh, NY 12550
Tel (845) 562-0890
Fax (845) 562-0841

Date: 01/07/2004
Time: 10:24:20

STL Newburgh
TCLP Herbicide & Reactivity
METHOD 8151 - TCLP HERBICIDES

Rept: AN0326

Client ID / Job No / Sample Date / Lab ID		EXCAVATED SOIL A03-C505 12/18/2003 A3C50501							
Analyte	Units	Sample Value	Reporting Limit	Sample Value	Reporting Limit	Sample Value	Reporting Limit	Sample Value	Reporting Limit
2,4-D	MG/L	ND	0.0020	NA		NA		NA	
2,4,5-TP (Silvex)	MG/L	ND	0.0020	NA		NA		NA	
SURROGATE(S)									
Dichlorophenyl Acetic Acid	%	34	17-133	NA		NA		NA	

NA = Not Applicable ND = Not Detected

STL Buffalo

8\15

Date: 01/07/2004
Time: 10:24:24

STL Newburgh
TCLP Herbicide & Reactivity
WET CHEMISTRY ANALYSIS

Rept: AN0326

Client ID Job No Sample Date	Lab ID	EXCAVATED SOIL A03-C505 12/18/2003	A3C50501						
Analyte	Units	Sample Value	Reporting Limit	Sample Value	Reporting Limit	Sample Value	Reporting Limit	Sample Value	Reporting Limit
H2S Released From Waste	MG/KG	20.0	10	NA		NA		NA	
HCN Released From Waste	MG/KG	ND	10	NA		NA		NA	

NA = Not Applicable ND = Not Detected

STL Buffalo

9\15

LABORATORY CHRONICLE

Job Number: 231758

Date: 06/03/2004

CUSTOMER: Environmental Strategies Corporation PROJECT: 138008 ATTN: Jim Bowie

Lab ID: 231758-1 Client ID: Excavated Soil Date Recvd: 12/19/2003 Sample Date: 12/18/2003

METHOD	DESCRIPTION	RUN#	BATCH#	PREP BT #(S)	DATE/TIME ANALYZED		DILUTION
EPA 200.7	Acid Digestion,Total Recoverable(ICAP)	1	59548		12/26/2003	1000	
SW846 3550B	Extraction Ultrasonic (PCBs)	1	60221		12/31/2003	1200	
SW846 8151A	Herbicides	1	60683		01/14/2004	0000	
SW846 1010	Ignitability (Pensky-Martens Closed-Cup)	1	59825		12/30/2003	0000	
SW846 7470A	Mercury (CVAA) Liquid Waste	1	59972		12/31/2003	1919	
SW846 6010B	Metals Analysis (ICAP)	1	60272	59548	01/06/2004	2237	2.000
SW846 8081A	Organochlorine Pesticide Analysis	1	60568		01/09/2004	0000	
SW846 8082	PCB Analysis	1	60569		01/07/2004	0000	
CH 7.3.2	Reactivity CH 7.3.2	1	60383		01/09/2004	0000	
SW846 7740	Selenium (GFAA)	1	60167	59548	01/06/2003	1102	5
SW846 8270C	Semivolatile Organics	1	60309		12/31/2003	0000	2.0408
EPA 160.3	Solids, Total	1	59758		12/28/2003	1400	
SW846 1311	TCLP Extraction BN/Acids	1	59784		12/29/2003	1200	
SW846 1311	TCLP Extraction Metals	1	59440		12/22/2003	1500	
SW846 1311	TCLP Extraction Pesticides	1	60219		01/05/2004	1200	
SW846 1311	TCLP Zero Headspace Extraction	1	60510				
EPA 418.1	Total Recoverable Petroleum Hydrocarbons	1	59537		12/22/2003	0000	
SW846 8260B	Volatile Organics	1	60141		12/31/2003	0000	10
SW846 9045C	pH (Soil)	1	59699		12/23/2003	1555	

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Newburgh, NY 12550
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Fax (845) 562-0841

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements will be noted in a case narrative.
Report Comments

1) All pages of this report are integral parts of the analytical data. Therefore, this report should be reproduced only in its entirety.

2) Soil, sediment and sludge sample results are reported on a "dry weight" basis.

3) Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

Glossary of flags and qualifiers.

Inorganic Qualifiers (Q-Column)

U Indicates that the compound was analyzed for but not detected.
1 Result fails applicable drinking water standards.
* Duplicate analysis not within control limits.
N Spiked sample recovery not within control limits.
E Indicates an estimated value because of the presence of interferences.
W Post digestion spike for furnace AA analysis is out of the control limits (85-115%) while sample absorbance is less than 50% of spike absorbance.
+ Correlation coefficient for the MSA is less than 0.995
B The reported value is less than the Contract Required Detection Limit (CRDL), but greater than the Instrument Detection Limit (IDL).

Organic Qualifiers (Q-Column)

U Indicates that the compound was analyzed for but not detected.
J Indicates an estimated value. This compound meets the identification criteria, but the result is less than the specified detection limit.
B Indicates that the analyte was found in both the sample and its associated laboratory blank.
D Indicates all compounds identified in an analysis at a secondary dilution factor.
E Indicates that the analyte in an analysis has exceeded the linear calibration range.

Glossary of Terms

Surrogates (Surrogate Standards) - an organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process. For semi-volatiles, volatiles and pesticides/Arochlors, surrogate compounds are added to every blank, sample, matrix sample, matrix spike, matrix sample duplicate, matrix spike blank, and standard. These are used to evaluate analytical efficiency by measuring recovery. Poor surrogate recovery may indicate a problem with the sample composition.

Matrix Spike - an aliquot of a sample (water or soil) fortified (spiked) with known quantities of specific compounds (target analytes) and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. The spiking occurs prior to sample preparation and analysis. Poor spike recovery may indicate a problem with the sample composition.

Internal Standards - an organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process. For GC/MS semi-volatiles and volatiles, internal standards are added to every blank, sample, matrix spike, matrix spike duplicate, matrix spike blank, and standard. Internal standard responses outside of established limits will adversely affect the quantitation and final concentration of target compounds.

STL Newburgh is a part of Severn Trent Laboratories, Inc.

SEVERN TRENT STL

NYSDOH 10142 NJDEP 73015 CTDOHS PH-0554 EPA NY049 PA 68-378 M-NY049

STL Newburgh
315 Fullerton Avenue
Newburgh, NY 12550
Tel (845) 562-0890
Fax (845) 562-0841

Appendix B – Waste Disposal Documentation

Lot #2176

Date 02/23/04
Time 07:41:52 AM

City of Albany, NY

Grid Summary Report

Detailed Report for For the Period 02/09/2004 - 02/10/2004
Sites 00 - 99 Grids - zzzzzzzzzz
Materials - ZZZZZZZZZZ Material Types - z Accounts 6025 - 6025 Customer Types - z

Date	Grid	Material	Customer	Tickets	Count	Volume	Net Wt.
02/09/04	P4 Phase II cells 10 & 11	PCS	Capitol Environmental	02-177018	0	0	28.34
02/09/04	P4 Phase II cells 10 & 11	PCS	Capitol Environmental	02-177019	0	0	32.28
02/09/04	P4 Phase II cells 10 & 11	PCS	Capitol Environmental	02-177047	0	0	34.32
02/09/04	P4 Phase II cells 10 & 11	PCS	Capitol Environmental	02-177052	0	0	33.89
02/09/04	P4 Phase II cells 10 & 11	PCS	Capitol Environmental	02-177098	0	0	37.28
02/09/04	P4 Phase II cells 10 & 11	PCS	Capitol Environmental	02-177099	0	0	34.68
02/09/04	P4 Phase II cells 10 & 11	PCS	Capitol Environmental	02-177110	0	0	38.24
02/10/04	P4 Phase II cells 10 & 11	PCS	Capitol Environmental	02-177264	0	0	42.35
			Total	8	0	0	281.38
			Report Total	8	0	0	281.38

This Memorandum is an acknowledgment that a Bill of Lading has been issued and is not the Original Bill of Lading, nor a copy or duplicate, covering the property named herein, and is intended solely for filing or record.

MANGIARDI BROS. TRUCKING
1960 Pittsfield Road, Route 20
Castleton, New York 12033
(Name of Carrier)

Shipper No. 4A-209
Carrier No. B 26463
Date 2/9/04

TO: Consignee Albany Landfill
Street Rapp Rd
Destination Albany NY
Route

FROM: Shipper Environmental Strategies
Street 55 Grand St.
Origin Kingston NY
Emergency Response Phone No.
Vehicle Number

No. Shipping Units	HM*	Kind of Packaging, Description of Articles, Special Marks and Exceptions	Weight (subject to correction)	Rate	CHARGES
1		Load Non hazardous Soil			
		Lot #2176			

When transporting hazardous materials include the technical or chemical name for n.o.s. (not otherwise specified) or generic description of material with appropriate UN or NA number as defined in US DOT Emergency Communication Standard (HM-126C). Provide emergency response phone number in case of incident or accident in box above.

REMIT C.O.D. TO: ADDRESS:

COD Amt: $

C.O.D. FEE: PREPAID ☐ COLLECT ☐ $

TOTAL CHARGES: $

NOTE - Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding $ ______ per ______

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.
______ Signature

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.
______ (Signature of Consignor)

FREIGHT CHARGES: FREIGHT PREPAID except when box at right is checked. Check box if charges are to be collect ☐

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the Bill of Lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the Bill of Lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

NOTICE: Freight moving under this Bill of Lading is subject to the classifications and lawfully filed tariffs in effect on the date of this Bill of Lading. This notice supersedes and negates any claimed, alleged or asserted oral or written contract, promise, representation or understanding between the parties with respect to this freight, except to the extent of any written contract which establishes lawful contract carriage and is signed by authorized representatives of both parties to the contract.

SHIPPER [signature]
PER

CARRIER MANGIARDI BROS. TRUCKING
PER [signature]
DATE 2/9/04

3

*HAZARDOUS MATERIALS MARK WITH "X" TO DESIGNATE HAZARDOUS MATERIALS AS REFERENCED IN 49CFR § 172.202.

This Memorandum is an acknowledgment that a Bill of Lading has been issued and is not the Original Bill of Lading, nor a copy or duplicate, covering the property named herein, and is intended solely for filing or record.

MANGIARDI BROS. TRUCKING
1960 Pittsfield Road, Route 20
Castleton, New York 12033
(Name of Carrier)

Shipper No. 4A-209
Carrier No. B 26473
Date 2/9/04

TO:
Consignee Albany Lanfill
Street Rapp Rd
Destination Albany NY
Route

FROM:
Shipper Environmental Strategies
Street 85 Grand St
Origin Kingston NY
Emergency Response Phone No.

Vehicle Number

No. Shipping Units	HM*	Kind of Packaging, Description of Articles, Special Marks and Exceptions	Weight (subject to correction)	Rate	CHARGES
1		Load Non-Hazarous Soil			
		Lot # 2176			

When transporting hazardous materials include the technical or chemical name for n.o.s. (not otherwise specified) or generic description of material with appropriate UN or NA number as defined in US DOT Emergency Communication Standard (HM-126C). Provide emergency response phone number in case of incident or accident in box above.

REMIT C.O.D. TO:
ADDRESS:

COD Amt: $

C.O.D. FEE: PREPAID ☐ COLLECT ☐ $

TOTAL CHARGES: $

FREIGHT CHARGES: FREIGHT PREPAID except when box at right is checked ☐ Check box if charges are to be collect

NOTE – Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding $ ______ per ______

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. ______ Signature

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges. ______ (Signature of Consignor)

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the Bill of Lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the Bill of Lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

NOTICE: Freight moving under this Bill of Lading is subject to the classifications and lawfully filed tariffs in effect on the date of this Bill of Lading. This notice supersedes and negates any claimed, alleged or asserted oral or written contract, promise, representation or understanding between the parties with respect to this freight, except to the extent of any written contract which establishes lawful contract carriage and is signed by authorized representatives of both parties to the contract.

SHIPPER [signature] Agent For Environ / Mangt
PER

CARRIER MANGIARDI BROS. TRUCKING
PER [signature]
DATE 2/9/04

3

*HAZARDOUS MATERIALS MARK WITH "X" TO DESIGNATE HAZARDOUS MATERIALS AS REFERENCED IN 49CFR § 172.202.

This Shipping Order must be legibly filled in, in Ink, in Indelible Pencil, or in Carbon, and retained by the Agent.

MANGIARDI BROS. TRUCKING
1960 Pittsfield Road, Route 20
Castleton, New York 12033
(Name of Carrier)

Shipper No. 4A-209
Carrier No. B 27305
Date 2/10

TO: Consignee Albany Landfill
Street Rapp Rd.
Destination Albany NY
Route

FROM: Shipper Environmental Strategies
Street 85 Grand St.
Origin Kingston NY
Emergency Response Phone No.
Vehicle Number M-45

No. Shipping Units	HM*	Kind of Packaging, Description of Articles, Special Marks and Exceptions	Weight (subject to correction)	Rate	CHARGES
1		Load Non-Hazardous Contaminated Soil			

When transporting hazardous materials include the technical or chemical name for n.o.s. (not otherwise specified) or generic description of material with appropriate UN or NA number as defined in US DOT Emergency Communication Standard (HM-126C). Provide emergency response phone number in case of incident or accident in box above.

REMIT C.O.D. TO: ADDRESS:

COD Amt: $

C.O.D. FEE: PREPAID ☐ COLLECT ☐ $

NOTE — Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding $ ____ per ____

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.
Signature

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.
(Signature of Consignor)

TOTAL CHARGES: $

FREIGHT CHARGES: FREIGHT PREPAID except when box at right is checked. Check box if charges are to be collect ☐

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the Bill of Lading terms and conditions in the governing classification on the date of shipment. Shipper hereby certifies that he is familiar with all the Bill of Lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.
NOTICE: Freight moving under this Bill of Lading is subject to the classifications and lawfully filed tariffs in effect on the date of this Bill of Lading. This notice supersedes and negates any claimed, alleged or asserted oral or written contract, promise, representation or understanding between the parties with respect to this freight, except to the extent of any written contract which establishes lawful contract carriage and is signed by authorized representatives of both parties to the contract.

SHIPPER [signature]
PER Agent for Podgam-Mobil

CARRIER MANGIARDI BROS. TRUCKING
PER [signature]
DATE 2/10

2

HAZARDOUS MATERIALS MARK WITH "X" TO DESIGNATE HAZARDOUS MATERIALS AS REFERENCED IN 49CFR 172.202.

Agent must detach and retain this Shipping Order and must sign the Original Bill of Lading.

MANGIARDI BROS. TRUCKING
1960 Pittsfield Road, Route 20
Castleton, New York 12033
(Name of Carrier)

Shipper No. 4A-209
Carrier No. B 27306
Date 2/9

TO: Consignee Albany Landfill
Street Rapp Rd.
Destination Albany NY
Route

FROM: Shipper Environmental Strategies
Street 85 Grand St.
Origin Kingston NY
Emergency Response Phone No.
Vehicle Number M-45

No. Shipping Units	HM*	Kind of Packaging, Description of Articles, Special Marks and Exceptions	Weight (subject to correction)	Rate	CHARGES
1		Load NON-Hazardous Contaminated Soil			
		Lot # 2176			

When transporting hazardous materials include the technical or chemical name for n.o.s. (not otherwise specified) or generic description of material with appropriate UN or NA number as defined in US DOT Emergency Communication Standard (HM-126C). Provide emergency response phone number in case of incident or accident in box above.

REMIT C.O.D. TO: ADDRESS:

COD Amt: $

C.O.D. FEE: PREPAID ☐ COLLECT ☐ $

TOTAL CHARGES: $

NOTE — Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding $ ____ per ____

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation. Signature

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges. (Signature of Consignor)

FREIGHT CHARGES: FREIGHT PREPAID except when box at right is checked. Check box if charges are to be collect ☐

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the Bill of Lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the Bill of Lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

NOTICE: Freight moving under this Bill of Lading is subject to the classifications and lawfully filed tariffs in effect on the date of this Bill of Lading. This notice supersedes and negates any claimed, alleged or asserted oral or written contract, promise, representation or understanding between the parties with respect to this freight, except to the extent of any written contract which establishes lawful contract carriage and is signed by authorized representatives of both parties to the contract.

SHIPPER [signature] Agent For Federal Mogul
PER

CARRIER MANGIARDI BROS. TRUCKING
PER [signature]
DATE 2/9

2

*HAZARDOUS MATERIALS MARK WITH "X" TO DESIGNATE HAZARDOUS MATERIALS AS REFERENCED IN 49CFR/172.202.

Agent must detach and retain this Shipping Order and must sign the Original Bill of Lading.

This Shipping Order must be legibly filled in, in Ink, in Indelible Pencil, or in Carbon, and retained by the Agent.

MANGIARDI BROS. TRUCKING
1960 Pittsfield Road, Route 20
Castleton, New York 12033
(Name of Carrier)

Shipper No. 4A-209
Carrier No. B 27307
Date 2/9

TO:
Consignee: Albany Landfill
Street: Rapp Rd.
Destination: Albany NY
Route:

FROM:
Shipper: Environmental Strategies
Street:
Origin:
Emergency Response Phone No.:
Vehicle Number: M-45

No. Shipping Units	HM*	Kind of Packaging, Description of Articles, Special Marks and Exceptions	Weight (subject to correction)	Rate	CHARGES
1		Load non-Hazardous Contaminated Soil			

When transporting hazardous materials include the technical or chemical name for n.o.s. (not otherwise specified) or generic description of material with appropriate UN or NA number as defined in US DOT Emergency Communication Standard (HM-126C). Provide emergency response phone number in case of incident or accident in box above.

REMIT C.O.D. TO:
ADDRESS: [redacted]

COD Amt: $

C.O.D. FEE: PREPAID ☐ COLLECT ☐ $
TOTAL CHARGES: $
FREIGHT CHARGES: FREIGHT PREPAID except when box at right is checked. Check box if charges are to be collect ☐

NOTE — Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding $ ______ per ______

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

______ Signature

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

______ (Signature of Consignor)

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the Bill of Lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the Bill of Lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

NOTICE: Freight moving under this Bill of Lading is subject to the classifications and lawfully filed tariffs in effect on the date of this Bill of Lading. This notice supersedes and negates any claimed, alleged or asserted oral or written contract, promise, representation or understanding between the parties with respect to this freight, except to the extent of any written contract which establishes lawful contract carriage and is signed by authorized representatives of both parties to the contract.

SHIPPER: [signature] Agent for Federal Mogul
PER

CARRIER: MANGIARDI BROS. TRUCKING
PER: [signature]
DATE: 2/9

2

*HAZARDOUS MATERIALS MARK WITH "X" TO DESIGNATE HAZARDOUS MATERIALS AS REFERENCED IN 49CFR/172.202.

Agent must detach and retain this Shipping Order and must sign the Original Bill of Lading.

This Memorandum ... is not the Original Bill of Lading, nor a copy or duplicate, covering the property named herein, and is intended solely for filing or record.

MANGIARDI BROS. TRUCKING
1960 Pittsfield Road, Route 20
Castleton, New York 12033
(Name of Carrier)

Shipper No. 11229
Carrier No. B 26464
Date 2-9-04

TO:
Consignee Albany Land Fill
Street Rapp Rd
Destination Albany NY
Route

FROM:
Shipper Environmental Storage
Street 25 Sn... St
Origin Kingston NY
Emergency Response Phone No.

Vehicle Number 11-37

No. Shipping Units	HM*	Kind of Packaging, Description of Articles, Special Marks and Exceptions	Weight (subject to correction)	Rate	CHARGES
1		Non Haz contaminated soil			
		Lot NO 2176			

When transporting hazardous materials include the technical or chemical name for n.o.s. (not otherwise specified) or generic description of material with appropriate UN or NA number as defined in US DOT Emergency Communication Standard (HM-126C). Provide emergency response phone number in case of incident or accident in box above.

REMIT
C.O.D. TO:
ADDRESS:

COD Amt: $

C.O.D. FEE:
PREPAID ☐ $
COLLECT ☐

TOTAL CHARGES: $

NOTE – Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding

$ ____ per ____

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Signature

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

(Signature of Consignor)

FREIGHT CHARGES:
FREIGHT PREPAID except when box at right is checked
Check box if charges are to be collect ☐

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the Bill of Lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the Bill of Lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

NOTICE: Freight moving under this Bill of Lading is subject to the classifications and lawfully filed tariffs in effect on the date of this Bill of Lading. This notice supersedes and negates any claimed, alleged or asserted oral or written contract, promise, representation or understanding between the parties with respect to this freight, except to the extent of any written contract which establishes lawful contract carriage and is signed by authorized representatives of both parties to the contract.

SHIPPER [signature]
PER

CARRIER **MANGIARDI BROS. TRUCKING**
PER [signature]
DATE 2-9-04

4

*HAZARDOUS MATERIALS MARK WITH "X" TO DESIGNATE HAZARDOUS MATERIALS AS REFERENCED IN 49CFR § 172.202.

This Memorandum is an acknowledgment that a Bill of Lading has been issued and is not the Original Bill of Lading, nor a copy or duplicate, covering the property named herein, and is intended solely for filing or record.

MANGIARDI BROS. TRUCKING
1960 Pittsfield Road, Route 20
Castleton, New York 12033
(Name of Carrier)

Shipper No. 48209
Carrier No. B 26467
Date 2-9-04

TO:
Consignee Al Bany Landfill
Street Rapp Rd
Destination Albany NY
Route

FROM:
Shipper Environmental Regional Aggregate
Street 80 Strand St
Origin Kingston NY
Emergency Response Phone No.

Vehicle Number 11-32

No. Shipping Units	HM*	Kind of Packaging, Description of Articles, Special Marks and Exceptions	Weight (subject to correction)	Rate	CHARGES
1		(Non Haz) contaminated Soil			

When transporting hazardous materials include the technical or chemical name for n.o.s. (not otherwise specified) or generic description of material with appropriate UN or NA number as defined in US DOT Emergency Communication Standard (HM-126C). Provide emergency response phone number in case of incident or accident in box above.

REMIT
C.O.D. TO:
ADDRESS:

COD Amt: $

C.O.D. FEE:
PREPAID ☐ $
COLLECT ☐

TOTAL CHARGES: $

FREIGHT CHARGES:
FREIGHT PREPAID except when box at right is checked ☐ Check box if charges are to be collect

NOTE – Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property.
The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding
$ ____________ per ____________

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.
____________ Signature

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement:
The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.
____________ (Signature of Consignor)

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the Bill of Lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the Bill of Lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

NOTICE: Freight moving under this Bill of Lading is subject to the classifications and lawfully filed tariffs in effect on the date of this Bill of Lading. This notice supersedes and negates any claimed, alleged or asserted oral or written contract, promise, representation or understanding between the parties with respect to this freight, except to the extent of any written contract which establishes lawful contract carriage and is signed by authorized representatives of both parties to the contract.

SHIPPER [signature] Agent For Federal Mogul
PER

CARRIER **MANGIARDI BROS. TRUCKING**
PER [signature]
DATE 2-9-04

4

*HAZARDOUS MATERIALS MARK WITH "X" TO DESIGNATE HAZARDOUS MATERIALS AS REFERENCED IN 49CFR § 172.202.

... a copy or duplicate, covering the property named herein, and is intended solely for filing or record.

MANGIARDI BROS. TRUCKING
1960 Pittsfield Road, Route 20
Castleton, New York 12033
(Name of Carrier)

Shipper No. 4A-209
Carrier No. B 26654
Date 2/9/04

TO:
Consignee Albany Landfill
Street 525 Rapp Rd.
Destination Albany N.Y.
Route

FROM:
Shipper Environmental Serv...
Street 85 ...
Origin
Emergency Response Phone No.
Vehicle Number 41

No. Shipping Units	HM*	Kind of Packaging, Description of Articles, Special Marks and Exceptions	Weight (subject to correction)	Rate	CHARGES
1		Load cont. soil (non-HAZ.)			
		LOT # 2176			

When transporting hazardous materials include the technical or chemical name for n.o.s. (not otherwise specified) or generic description of material with appropriate UN or NA number as defined in US DOT Emergency Communication Standard (HM-126C). Provide emergency response phone number in case of incident or accident in box above.

REMIT C.O.D. TO:
ADDRESS:

COD Amt: $

C.O.D. FEE: PREPAID ☐ COLLECT ☐ $

TOTAL CHARGES: $

FREIGHT CHARGES: FREIGHT PREPAID except when box at right is checked. Check box if charges are to be collect ☐

NOTE – Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding $ ______ per ______

This is to certify that the above named materials are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

______ Signature

Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

______ (Signature of Consignor)

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the Bill of Lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the Bill of Lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

NOTICE: Freight moving under this Bill of Lading is subject to the classifications and lawfully filed tariffs in effect on the date of this Bill of Lading. This notice supersedes and negates any claimed, alleged or asserted oral or written contract, promise, representation or understanding between the parties with respect to this freight, except to the extent of any written contract which establishes lawful contract carriage and is signed by authorized representatives of both parties to the contract.

SHIPPER ... Agent for Federal Mogul
PER

CARRIER **MANGIARDI BROS. TRUCKING**
PER Tom ...
DATE 2/9/04

4

*HAZARDOUS MATERIALS MARK WITH "X" TO DESIGNATE HAZARDOUS MATERIALS AS REFERENCED IN 49CFR § 172.202.

Original - Not Negotiable

STRAIGHT BILL OF LADING

SHORT FORM

Carrier's Pro No. ______
Shipper's Bill of Lading No. 20527-1
Consignee's Reference/PO No. ______
Carrier's Code (SCAC) ______

(Name of Carrier)

RECEIVED, subject to individually determined rates or contracts that have been agreed upon in writing between the carrier and shipper, if applicable, otherwise to the rates, classifications and rules that have been established by the carrier and are available to the shipper, on request;

at ______ 20 04 From Hudson Mobil 85 Grand Kingston, NY

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract), agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Official, Southern, Western and Illinois Freight Classification in effect on the date hereof, if this is a rail or a rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment.

Shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

Consigned to Blacktop Maint. Corp / RCT Route 82 Sand & Gravel, Inc

Destination 27 Commerce St. State NY Zip 12603 County ______ (Mail or street address of consignee — For purposes of notification only) Delivery Address ★ ______

★ To be filled in only when shipper desires and governing tariffs provide for delivery thereat.

Route ______

Delivering Carrier Blacktop Maint. Corp Car or Vehicle Initials ______ No. ______

No. Packages	Kind of Packages, Description of Articles, Special Marks, and Exceptions	*Weight (Subject to Correction)	Class or Rate	Check Column
16	Cubic Yards of Asphalt Debris			

Subject to Section 7 of Conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement. The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

______ (Signature of Consignor)

Freight charges are PREPAID unless marked collect. CHECK BOX IF COLLECT ☐

Received $ ______ to apply in prepayment of the charges on the property described hereon.

______ Agent or Cashier

Per ______ (The signature here acknowledges only the amount prepaid.)

Charges Advanced: $ ______

* If the shipment moves between two ports by a carrier by water, the law requires that the bill of lading state whether it is carrier's or shipper's weight.

NOTE - Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding ______ per ______

Liability Limitation for loss or damage on this shipment may be applicable. See 49 U.S.C. § 14706(c)(1)(A) and (B).

†The fibre boxes used for this shipment conform to the specifications set forth in the box maker's certificate thereon, and all other requirements of the Consolidated Freight Classification.

†Shipper's imprint in lieu of stamp; not a part of Bill of Lading approved by the Interstate Commerce Commission.

Shipper, Per [signature] Agent, Per Hudson-Mobil

Permanent post-office address of shipper [signature]

1

REDIFORM

Carbonless Speedisef® Forms Rediform, Inc. Made in U.S.A.

44-301 Triplicate
44-302 Quadruplicate

Original – Not Negotiable

STRAIGHT BILL OF LADING SHORT FORM

Carrier's Pro No.
Shipper's Bill of Lading No. 27349-2
Consignee's Reference/PO No.
Carrier's Code (SCAC)

(Name of Carrier)

RECEIVED, subject to individually determined rates or contracts that have been agreed upon in writing between the carrier and shipper, if applicable, otherwise to the rates, classifications and rules that have been established by the carrier and are available to the shipper, on request;

at 20 04 From Federal ... 85 ... Hudson NY

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract), agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Official, Southern, Western and Illinois Freight Classification in effect on the date hereof, if this is a rail or a rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment.

Shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

Consigned to Blacktop Maint. Corp / Rt Route 82
Sand - Gravel, Inc

(Mail or street address of consignee – For purposes of notification only.)

Destination 22 Commerce St State NY Zip 12603 County

Delivery Address ★

★ To be filled in only when shipper desires and governing tariffs provide for delivery thereat.

Route

Delivering Carrier Blacktop Maint. Corp. Car or Vehicle Initials No.

No. Packages	Kind of Package, Description of Articles, Special Marks, and Exceptions	*Weight (Subject to Correction)	Class or Rate	Check Column
16	Cubic yards of Asphalt ...			

Subject to Section 7 of Conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

(Signature of Consignor)

Freight charges are PREPAID unless marked collect. CHECK BOX IF COLLECT ☐

Received $ to apply in prepayment of the charges on the property described hereon.

Agent or Cashier

Per
(The signature here acknowledges only the amount prepaid.)

Charges Advanced:
$

* If the shipment moves between two ports by a carrier by water, the law requires that the bill of lading shall state whether it is carrier's or shipper's weight.
NOTE – Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property.
The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding
per

Liability Limitation for loss or damage on this shipment may be applicable. See 49 U.S.C. § 14706(c)(1)(A) and (B).

†The fibre boxes used for this shipment conform to the specifications set forth in the box maker's certificate thereon, and all other requirements of the Consolidated Freight Classification.

†Shipper's imprint in lieu of stamp; not a part of Bill of Lading approved by the Interstate Commerce Commission.

Shipper, Per Agent, Per Federal ...

1

Permanent post-office address of shipper

REDIFORM.

Carbonless Specified® Forms Made in U.S.A.

44-301 Triplicate
44-302 Quadruplicate

Original – Not Negotiable

STRAIGHT BILL OF LADING SHORT FORM

Carrier's Pro No. ____
Shipper's Bill of Lading No. ____
Consignee's Reference/PO No. ____
Carrier's Code (SCAC) ____

(Name of Carrier)

RECEIVED, subject to individually determined rates or contracts that have been agreed upon in writing between the carrier and shipper, if applicable, otherwise to the rates, classifications and rules that have been established by the carrier and are available to the shipper, on request;

at ____ 2004 From Sadowski Meyer 85 gravel Kingston NY

the property described below, in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated below, which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract), agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed, as to each carrier of all or any of said property over all or any portion of said route to destination, and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the terms and conditions of the Uniform Domestic Straight Bill of Lading set forth (1) in Official, Southern, Western and Illinois Freight Classification in effect on the date hereof, if this is a rail or a rail-water shipment, or (2) in the applicable motor carrier classification or tariff if this is a motor carrier shipment.

Shipper hereby certifies that he is familiar with all the terms and conditions of the said bill of lading, including those on the back thereof, set forth in the classification or tariff which governs the transportation of this shipment, and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

Consigned to Blacktop maint. corp at Route 52 sand & gravel, inc

(Mail or street address of consignee – For purposes of notification only.)

Destination 87 Commerce St State NY Zip 12603 County ____

Delivery Address ★ ____

★ To be filled in only when shipper desires and governing tariffs provide for delivery thereat.

Route ____

Delivering Carrier Blacktop maint. corp. Car or Vehicle Initials ____ No. ____

No. Packages	Kind of Package, Description of Articles, Special Marks, and Exceptions	*Weight (Subject to Correction)	Class or Rate	Check Column
16	cubic yards of Asphalt Debris			

Subject to Section 7 of Conditions of applicable bill of lading, if this shipment is to be delivered to the consignee without recourse on the consignor the consignor shall sign the following statement.
The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges.

(Signature of Consignor)

Freight charges are PREPAID unless marked collect. CHECK BOX IF COLLECT ☐

Received $ ____ to apply in prepayment of the charges on the property described hereon.

Agent or Cashier

Per ____
(The signature here acknowledges only the amount prepaid.)

Charges Advanced:

$ ____

†Shipper's imprint in lieu of stamp; not a part of Bill of Lading approved by the Interstate Commerce Commission.

* If the shipment moves between two ports by a carrier by water, the law requires that the bill of lading state whether it is carrier's or shipper's weight.
NOTE - Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property.
The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding ____ per ____

Liability Limitation for loss or damage on this shipment may be applicable. See 49 U.S.C. § 14706(c)(1)(A) and (B).

†The fibre boxes used for this shipment conform to the specifications set forth in the box maker's certificate thereon, and all other requirements of the Consolidated Freight Classification.

S. Ciry Shipper, Per ____ Agent, Per Sadowski Meyer

Permanent post-office address of shipper ____

1

REDIFORM

Exclusive Speedisnap Forms Rediform, Inc. Made in U.S.A.

44-301 Triplicate
44-302 Quadruplicate

3986
14.34

STEUBEN COUNTY D.P.W.
BATH LANDFILL

Bill Acct: **LAMBASBE** Haul Acct: LAMBASBE Tran#: **287421**
Company: LAMBERTS ASBESTOS 290 Company: LAMBERTS ASBESTOS 290
Vehicle# : I1021

	---In---	---Out---
Date	03/15/04	03/15/04
Time	08:00	08:13

TT = 100 - Commercial BY WEIGH
PT = 1 - Charge
OT = 1 - Not Specified

Material Types	Rate/UM	Vol/QY	lbs	Tip
1060 - Asbestos	$250.00/TN	0	420	$52.50

	Lbs	Tons
Gross	8940	4.47
Tare	8520	4.26
NET	**420**	**0.21**

In/Out: I

Tip Fee 52.50 @ $250.00/tn
Spec Fee 0.00
========

Total $52.50

VOL/QY/CYD = 0

Driver: Alan Wine Weighmaster: Anna Martin-Miller 460266

Lambert's Asbestos Removal Service Inc. 68 Kahler Road, S., Elmira, NY 14903
607 562-8426

ASBESTOS WASTE MANIFEST

Job 3986

GENERATOR

Project Name Allways Moving
Address 85 Grand ST. City Kingston State NY Zip
Building Owner
Address City State Zip

WASTE

Description of Waste	# Containers	Total Quantity
Friable Asbestos (31 LF)		3 bags

Name and address of responsible agency administering NESHAP program:
EPA, Region 2, 290 Broadway, #1539, New York, NY 10007-1823

OPERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations

Chris Rozell Supervisor 3-11-04
Printed/Typed Name & Title Signature Date

TRANSPORTER #1

Name Lambert's Asbestos Removal inc. Telephone (607) 562-8426
Address 68 South Kahler Road City Elmira State NY Zip 14903

I certify that the above material was picked up from and delivered to the place listed upon this manifest.
Driver Signature Date 3-12-04

TRANSPORTER #2

Name Telephone
Address City State Zip

I certify that the above material was picked up from and delivered to the place listed upon this manifest.
Driver Signature Date

DESTINATION

Landfill Name Steuben County Landfill Telephone 776-9245
Address Turnpike RD. City Bath State NY Zip

I certify that the material described above was received and that the landfill has been approved for the disposal of asbestos. The delivered material will be covered with 6 inches of non-asbestos material within 24 hours.

Landfill Owner/Operator Signature Date 3/15/04

WHITE – Lambert's YELLOW – Owner's Copy PINK – Transporter's Copy GOLDENROD – Disposal Facility Copy

Appendix C – Boring Logs

Boring Log: VM-8

Project: Federal-Mogul **Surface Elevation (feet AMSL*):** Not determined

Project No.: 138008 **Total Depth (feet):** 6

Location: Kingston, NY **Borehole Diameter (inches):** 8.25

Completion Date: February 12, 2004

Sample Data					Subsurface Profile	
Depth	Sample Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description
0						Ground Surface
0–2	1	-	-	-		***Asphalt***
						Not Sampled
2–4	2	0.0	7,4,2,2	75		***Sand (SP)*** Strong brown (7.5 YR 4/6) fine to medium-grained sand, little silt; loose; dry.
4–6	3	0.0	4,5,4,5	50		
6						Boring Terminated

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): David P. Bouchard **Method:** HSA **ID(inches):** 4.25

Subcontractor: Parratt Wolff, Inc.

Driller/ Operator: Jim Lansing

**AMSL= Above mean sea level*

Boring Log: VM-9

Project: Federal-Mogul

Project No.: 138008

Location: Kingston, NY

Completion Date: February 11, 2004

Surface Elevation (feet AMSL*): Not determined

Total Depth (feet): 6

Borehole Diameter (inches): 8.25

Sample Data					Subsurface Profile	
Depth	**Sample Interval**	**PID/OVM (ppm)**	**Blow Count**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0	1	-	-	-		***Asphalt***
						Not Sampled
2	2	0.0	9,6,3,2	100	▨	***Sand (SP)*** Strong brown (7.5 YR 4/6) fine to medium-grained sand, little silt; medium dense; dry.
4	3	0.0	4,5,5,4	100	▨	
6						Boring Terminated
8						
10						
12						
14						
16						
18						

Geologist(s): David P. Bouchard

Subcontractor: Parratt Wolff, Inc.

Driller/ Operator: Jim Lansing

Method: HSA **ID(inches):** 4.25

**AMSL= Above mean sea level*

Boring Log: VM-10

Project: Federal-Mogul

Project No.: 138008

Location: Kingston, NY

Completion Date: February 12, 2004

Surface Elevation (feet AMSL*): Not determined

Total Depth (feet): 6

Borehole Diameter (inches): 8.25

Sample Data					Subsurface Profile	
Depth	**Sample Interval**	**PID/OVM (ppm)**	**Blow Count**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0						***Asphalt***
	1	-	-	-		***Not Sampled***
2	2	0.0	5,4,3,4	100	▨	***Sand (SP)*** Strong brown (7.5 YR 4/6) fine to medium-grained sand, trace to little fine gravel; loose to medium dense; dry.
4	3	0.0	4,3,3,3	100	▨	***Sand (SP)*** Dark brown (7.5 YR 3/4) fine to medium-grained sand, little silt; medium dense; moist.
6						Boring Terminated
8						
10						
12						
14						
16						
18						

Geologist(s): David P. Bouchard

Subcontractor: Parratt Wolff, Inc.

Driller/ Operator: Jim Lansing

Method: HSA **ID(inches):** 4.25

**AMSL= Above mean sea level*

Boring Log: VM-11

Project: Federal-Mogul

Project No.: 138008

Location: Kingston, NY

Completion Date: February 12, 2004

Surface Elevation (feet AMSL*): Not determined

Total Depth (feet): 6

Borehole Diameter (inches): 8.25

Depth	Sample Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description
						Ground Surface
0–2	1	0.0	-	0		***Asphalt*** / ***Not Sampled***
2–4	2	0.0	7,3,3,2	50		***Sand (SP)*** Strong brown (7.5 YR 4/6) fine to medium-grained sand, trace gravel; loose; dry.
4–6	3	0.0	3,2,2,2	75		
6						Boring Terminated

Geologist(s): David P. Bouchard

Subcontractor: Parratt Wolff, Inc.

Driller/ Operator: Jim Lansing

Method: HSA **ID(inches):** 4.25

**AMSL= Above mean sea level*

Boring Log: VM-12

Project: Federal-Mogul

Project No.: 138008

Location: Kingston, NY

Completion Date: February 12, 2004

Surface Elevation (feet AMSL*): Not determined

Total Depth (feet): 6

Borehole Diameter (inches): 8.25

Sample Data					Subsurface Profile	
Depth	Sample Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description
						Ground Surface
0						***Asphalt***
	1	-	-	-		***Not Sampled***
2	2	0.0	8,3,3,3	100	▨	***Sand (SP)*** Strong brown (7.5 YR 4/6) fine to medium-grained sand, trace gravel; loose; dry.
4	3	0.0	4,3,3,3	75	▨	
6						Boring Terminated
8						
10						
12						
14						
16						
18						

Geologist(s): David P. Bouchard

Subcontractor: Parratt Wolff, Inc.

Driller/ Operator: Jim Lansing

Method: HSA **ID(inches):** 4.25

**AMSL= Above mean sea level*

Appendix D - PCM Air Sampling Analysis Report

ATLANTIC TESTING LABORATORIES, Limited

Syracuse
5866 State Route 31
Cicero, NY 13039
315/699-5281 (T)
315/699-3374 (F)

March 18, 2004

Environmental Strategies Corporation
9 Albany Street
Cazenovia, New York 13035

Attn.: Mr. Brian Silfer

Re: Air Sampling and Analysis
Former Huck Manufacturing Facility
Always Moving and Storage-The Mansion
Kingston, New York
ATL No. ST5266-2-03-04

Ladies/Gentlemen:

In accordance with our proposal dated February 6, 2004, (ATL No. ST5998-006-02-04), Atlantic Testing Laboratories, Limited (ATL) performed airborne sampling and analysis by phase contrast microscopy (PCM), for thermal system insulation abatement, on March 10 through 12, 2004.

Air samples were obtained in accordance with 12 NYCRR 56-17 regulations. PCM air samples collected were sent to a New York State Department of Health approved laboratory (ELAP # 11555). The clearance criteria for all work areas was determined to be in compliance with 12 NYCRR 56-17. The abatement within the work area has been completed. The laboratory reports and sample custody documentation are enclosed.

Please contact our office should you have any questions, or if we may be of further assistance.

Respectfully submitted,
ATLANTIC TESTING LABORATORIES, Limited

Kevin W. Samolis
Project Manager

/kws

Enclosures

envirologic of New York, Inc.

PCM AIR SAMPLING ANALYSIS REPORT
NYS DOH ELAP # 11577

Client: *Atlantic Testing Laboratories, Limited*	Project Number: *ELE04A-166*	Client Project Number: *ST5266*
Project Description: *Former Huck Manufacturing Building*	Report Number: *3665*	Sampling Phase: *Background Air Sampling*
Project Location: *Kingston, New York*	Date Sampled: *Wednesday, March 10, 2004*	Date Received: *Friday, March 12, 2004*
Client Contact: *Mr. Joe Grabowski*	Date Analyzed: *Friday, March 12, 2004*	Date Reported: *Friday, March 12, 2004*

Summary:

On Friday, March 12, 2004, Envirologic of New York, Inc. received samples for PCM Analysis. Envirologic of New York, Inc. is solely responsible for fiber counts.

Sample Number	Lab ID Number	Sample Description	Sample Location	Sample Type	Volume (liters)	Result (f/cc)	Result (f/mm^2)
310-001	136581	Inside Work Area	North	BA	1200	**0.004**	**13.004**
310-002	136582	Inside Work Area	Center	BA	1200	**0.006**	**17.555**
310-003	136583	Inside Work Area	South	BA	1200	**0.006**	**18.856**
310-004	136584	Outside Work Area	North	BA	1200	**0.007**	**20.806**
310-005	136585	Outside Work Area	Center	BA	1200	**0.006**	**18.205**
310-006	136586	Outside Work Area	South	BA	1200	**0.004**	**13.004**
310-007	136587	Field Blank	Field Blank	FB	NA	NC	NC
310-008	136588	Field Blank	Field Blank	FB	NA	NC	NC

Abbreviations:

BA	=	Background Air Sample	FB	=	Field Blank Sample
PA	=	Pre-Abatement Air Sample	NC	=	Non-Contaminated Sample
A	=	Abatement Air Sample	MD	=	Mineral Dust (Unable to Analyze)
F	=	Final Air Clearance Air Sample	SD	=	Sample Damaged (Unable to Analyze)
AMB	=	Ambient Air Sample	NA	=	Not Applicable
f/cc	=	Fibers per Cubic Centimeter	<	=	Below Detection Limit
f/mm^2	=	Fibers per Square Millimeter			

Analyzed by:	Date:	Approved By:	Date:
	3/12/2004		3/12/2004
Mr. Jack Kunicki - Analyst Envirologic of New York, Inc.		Mr. Jack Kunicki - Technical Laboratory Director Envirologic of New York, Inc.	

Disclaimers:

Disclaimer: NIOSH Method 7400 - Phase Contrast Microscopy

PCM analysis using NIOSH Method 7400 is a means of analysis for fiber counting. However, this method is not specific for the analysis of airborne asbestos fibers. The analytical results presented in this report, and the laboratory procedures used, are considered to be accurate and reliable for the samples analyzed. This report may not be reproduced without the approval of Envirologic of New York, Inc., and then only in full. PCM analysis is performed using an Olympus CH30 (model # CH30RF100).

Shaded sample results indicate an air sample results that is equal or greater than 0.1 f/cc or the Background Level. Bolded sample results indicate an air sample that is unreadable due to mineral dust overloading.

envirologic of New York, Inc.

PCM AIR SAMPLING ANALYSIS REPORT
NYS DOH ELAP # 11577

Client:	Project Number:	Client Project Number:
Atlantic Testing Laboratories, Limited	*ELE04A-166*	*ST5266*
Project Description:	**Report Number:**	**Sampling Phase:**
Former Huck Manufacturing Building	*3665*	*Pre-Abatement Air Sampling*
Project Location:	**Date Sampled:**	**Date Received:**
Kingston, New York	*Wednesday, March 10, 2004*	*Friday, March 12, 2004*
Client Contact:	**Date Analyzed:**	**Date Reported:**
Mr. Joe Grabowski	*Friday, March 12, 2004*	*Friday, March 12, 2004*

Summary:

On Friday, March 12, 2004, Envirologic of New York, Inc. received samples for PCM Analysis. Envirologic of New York, Inc. is solely responsible for fiber counts.

Sample Number	Lab ID Number	Sample Description	Sample Location	Sample Type	Volume (liters)	Result (f/cc)	Result (f/mm^2)
310-009	***136589***	***Inside Work Area***	***North***	***PA***	***1150***	***MD***	***MD***
310-010	***136590***	***Inside Work Area***	***Center***	***PA***	***1150***	***MD***	***MD***
310-011	***136591***	***Inside Work Area***	***South***	***PA***	***1150***	***MD***	***MD***
310-012	136592	Outside Work Area	North	PA	1150	0.003	10.403
310-013	***136593***	***Outside Work Area***	***Center***	***PA***	***1150***	***MD***	***MD***
310-014	***136594***	***Outside Work Area***	***South***	***PA***	***1150***	***MD***	***MD***
310-015	136595	Field Blank	Field Blank	FB	NA	NC	NC
310-016	136596	Field Blank	Field Blank	FB	NA	NC	NC

Abbreviations:

BA	=	Background Air Sample	FB	=	Field Blank Sample
PA	=	Pre-Abatement Air Sample	NC	=	Non-Contaminated Sample
A	=	Abatement Air Sample	MD	=	Mineral Dust (Unable to Analyze)
F	=	Final Air Clearance Air Sample	SD	=	Sample Damaged (Unable to Analyze)
AMB	=	Ambient Air Sample	NA	=	Not Applicable
f/cc	=	Fibers per Cubic Centimeter	<	=	Below Detection Limit
f/mm^2	=	Fibers per Square Millimeter			

Analyzed by:	Date:	Approved By:	Date:
	3/12/2004		3/12/2004
Mr. Jack Kunicki - Analyst Envirologic of New York, Inc.		Mr. Jack Kunicki - Technical Laboratory Director Envirologic of New York, Inc.	

Disclaimers:

Disclaimer: NIOSH Method 7400 - Phase Contrast Microscopy

PCM analysis using NIOSH Method 7400 is a means of analysis for fiber counting. However, this method is not specific for the analysis of airborne asbestos fibers. The analytical results presented in this report, and the laboratory procedures used, are considered to be accurate and reliable for the samples analyzed. This report may not be reproduced without the approval of Envirologic of New York, Inc., and then only in full. PCM analysis is performed using an Olympus CH30 (model # CH30RF100).

Shaded sample results indicate an air sample results that is equal or greater than 0.1 f/cc or the Background Level. Bolded sample results indicate an air sample that is unreadable due to mineral dust overloading.

envirologic of New York, Inc.

PCM AIR SAMPLING ANALYSIS REPORT
NYS DOH ELAP # 11577

Client: *Atlantic Testing Laboratories, Limited*	Project Number: *ELE04A-166*	Client Project Number: *ST5266*
Project Description: *Former Huck Manufacturing Building*	Report Number: *3665*	Sampling Phase: *Abatement Air Sampling*
Project Location: *Kingston, New York*	Date Sampled: *Thursday, March 11, 2004*	Date Received: *Friday, March 12, 2004*
Client Contact: *Mr. Joe Grabowski*	Date Analyzed: *Friday, March 12, 2004*	Date Reported: *Friday, March 12, 2004*

Summary:

On Friday, March 12, 2004, Envirologic of New York, Inc. received samples for PCM Analysis. Envirologic of New York, Inc. is solely responsible for fiber counts.

Sample Number	Lab ID Number	Sample Description	Sample Location	Sample Type	Volume (liters)	Result (f/cc)	Result (f/mm²)
311-017	*136597*	*Inside Work Area*	*North*	*A*	*190*	*Insufficient Volume*	
311-018	*136598*	*Outside Work Area*	*Center*	*A*	*178*	*Insufficient Volume*	
311-019	136599	Field Blank	Field Blank	FB	NA	NC	NC
311-020	136600	Field Blank	Field Blank	FB	NA	NC	NC

Abbreviations:

BA	=	Background Air Sample	FB	=	Field Blank Sample
PA	=	Pre-Abatement Air Sample	NC	=	Non-Contaminated Sample
A	=	Abatement Air Sample	MD	=	Mineral Dust (Unable to Analyze)
F	=	Final Air Clearance Air Sample	SD	=	Sample Damaged (Unable to Analyze)
AMB	=	Ambient Air Sample	NA	=	Not Applicable
f/cc	=	Fibers per Cubic Centimeter	<	=	Below Detection Limit
f/mm²	=	Fibers per Square Millimeter			

Analyzed by:	Date: 3/12/2004	Approved By:	Date: 3/12/2004
Mr. Jack Kunicki - Analyst Envirologic of New York, Inc.		Mr. Jack Kunicki - Technical Laboratory Director Envirologic of New York, Inc.	

Disclaimers:

Disclaimer: NIOSH Method 7400 - Phase Contrast Microscopy

PCM analysis using NIOSH Method 7400 is a means of analysis for fiber counting. However, this method is not specific for the analysis of airborne asbestos fibers. The analytical results presented in this report, and the laboratory procedures used, are considered to be accurate and reliable for the samples analyzed. This report may not be reproduced without the approval of Envirologic of New York, Inc., and then only in full. PCM analysis is performed using an Olympus CH30 (model # CH30RF100).

Shaded sample results indicate an air sample results that is equal or greater than 0.1 f/cc or the Background Level. Bolded sample results indicate an air sample that is unreadable due to mineral dust overloading.

envirologic of New York, Inc.

PCM AIR SAMPLING ANALYSIS REPORT
NYS DOH ELAP # 11577

Client:	Project Number:	Client Project Number:
Atlantic Testing Laboratories, Limited	*ELE04A-166*	*ST5266*
Project Description:	**Report Number:**	**Sampling Phase:**
Former Huck Manufacturing Building	*3665*	*Clearance Air Sampling*
Project Location:	**Date Sampled:**	**Date Received:**
Kingston, New York	*Thursday, March 11, 2004*	*Friday, March 12, 2004*
Client Contact:	**Date Analyzed:**	**Date Reported:**
Mr. Joe Grabowski	*Friday, March 12, 2004*	*Friday, March 12, 2004*

Summary:

On Friday, March 12, 2004, Envirologic of New York, Inc. received samples for PCM Analysis. Envirologic of New York, Inc. is solely responsible for fiber counts.

Sample Number	Lab ID Number	Sample Description	Sample Location	Sample Type	Volume (liters)	Result (f/cc)	Result (f/mm^2)
311-021	136601	Inside Work Area	North	F	1200	<0.002	<7.152
311-022	136602	Inside Work Area	Center	F	1200	<0.002	<7.152
311-023	136603	Inside Work Area	South	F	1200	<0.002	<7.152
311-024	136604	Outside Work Area	North	F	1200	<0.002	<7.152
311-025	136605	Outside Work Area	Center	F	1200	<0.002	<7.152
311-026	136606	Outside Work Area	South	F	1200	<0.002	<7.152
311-027	136607	Field Blank	Field Blank	FB	NA	NC	NC
311-028	136608	Field Blank	Field Blank	FB	NA	NC	NC

Abbreviations:

BA	=	Background Air Sample	FB	=	Field Blank Sample
PA	=	Pre-Abatement Air Sample	NC	=	Non-Contaminated Sample
A	=	Abatement Air Sample	MD	=	Mineral Dust (Unable to Analyze)
F	=	Final Air Clearance Air Sample	SD	=	Sample Damaged (Unable to Analyze)
AMB	=	Ambient Air Sample	NA	=	Not Applicable
f/cc	=	Fibers per Cubic Centimeter	<	=	Below Detection Limit
f/mm^2	=	Fibers per Square Millimeter			

Analyzed by:	Date:	Approved By:	Date:
	3/12/2004		3/12/2004
Mr. Jack Kunicki - Analyst Envirologic of New York, Inc.		Mr. Jack Kunicki - Technical Laboratory Director Envirologic of New York, Inc.	

Disclaimers:

Disclaimer: NIOSH Method 7400 - Phase Contrast Microscopy

PCM analysis using NIOSH Method 7400 is a means of analysis for fiber counting. However, this method is not specific for the analysis of airborne asbestos fibers. The analytical results presented in this report, and the laboratory procedures used, are considered to be accurate and reliable for the samples analyzed. This report may not be reproduced without the approval of Envirologic of New York, Inc., and then only in full. PCM analysis is performed using an Olympus CH30 (model # CH30RF100).

Upon analysis, Final Air Clearance Air Samples were found to be within acceptable limits as defined by NYSDOL Industrial Code Rule 56-17.8. Based upon these results, the abatement work area meets applicable re-entry requirements.

04A 166 / 3665

ATLANTIC TESTING LABORATORIES, Limited
ASBESTOS SAMPLE - CHAIN OF CUSTODY

Albany 12 Arrowhead Lane Cohoes, NY 12047 518/783-9073 (T) 518/783-6567 (F)
Binghamton 406 North Street Endicott, NY 13670 607/757-9326 (T) 607/757-9252 (F)
Canton P.O. Box 29 Canton, NY 13617 315/386-4578 (T) 315/386-1012 (F)
Ithaca 798 Cascadilla Street Ithaca, NY 14850 607/272-1723 (T) 607/272-1723 (F)
Plattsburgh 1080 Military Trpk. Plattsburgh, NY 12901 518/563-6878 (T) 518/562-1321 (F)
Poughkeepsie 1601 Route 376 Wappingers Falls, NY 12590 845/463-1128 (T) 845/426-1127 (F)
Syracuse 5888 State Rt. 31 Cicero, NY 13039 315/699-5281 (T) 315/699-3374 (F)
Utica 301 St. Andrews St. Utica, NY 13502 315/738-3309 (T) 315/735-0742 (F)
Watertown P.O. Box 91 Falls Mills, NY 13638 315/773-5390 (T) 315/773-0334 (F)

Project No.	Client Name	Chain of Custody No.	Sample Information		Report Distribution	
STS266	ESC	001	Cassette Type:	Backgrounds	Dates Required:	24hr TAT
		Date Collected: 3/10/04	Analysis Requested:	P.C.M.	Send Report To:	Kevin Samolis
Project Contact:	Kevin Samolis	Page 1 of 1	Analyzed By:		Copy Sent To:	315-699-3374
Project Name:	Former Huck Manuf. Blds / Always moving & storage	Project Location: Kingston, NY	Analyzed By (SIG):		Fax Results:	☒ YES ☐ NO

Field Sample No.	Sample Location	Pump No.	Start (Hr:Min)	Stop (Hr:Min)	Total Minutes (Min)	Start Flow (LPM)	Final Flow (LPM)	Volume (LTRS)	Laboratory Identific. No.	Fibers/100 Fields	Fibers/100 Fields Blank	Fibers/CC	Date Analz.	Checked By
310 001	Inside North	9	7:50	9:50	120	10	10	1200	136581	10				
310 002	Inside center	8	7:50	9:50	120	10	10	1200	136582	13.5				
310 003	Inside south	8	7:50	9:50	120	10	10	1200	136583	14.5				
310 004	outside North	6	7:51	9:50	120	10	10	1200	136584	16				
310 005	outside center	7	7:51	9:51	120	10	10	1200	136585	14				
310 006	outside south	50	7:51	9:51	120	10	10	1200	136586	10				
310 007	Blank 1	–	–	–	–	–	–	–	136587	0				
310 008	Blank 2	–	–	–	–	–	–	–	136588	0				

Samplers Name:	Joseph Grzadowski	Date:	3/10/04	Received for Name:		Date:	
Samplers Signature:	Joseph Grzadowski	Time:	8:15	Laboratory Signature:		Time:	
Shipment Rec'd Intact?	☐ YES ☐ NO						

Samples Relinquished By				Samples Received By				Field and Laboratory Remarks
Name:	Joe Grzadowski	Date:	3/11/04	Name:	Jack Kunicki	Date:	3/12/04	
Signature:	Joseph Grzadowski	Time:	10:15	Signature:	Jack Kunicki	Time:	1715	
Name:		Date:		Name:		Date:		
Signature:		Time:		Signature:		Time:		

Think Quality

Distribution: White with Samples
Yellow to Laboratory
Pink to ATL Files

QF-7A
Revised: 2/03

04A166 / 3665

ATLANTIC TESTING LABORATORIES, Limited

ASBESTOS SAMPLE - CHAIN OF CUSTODY

Albany 12 Arrowhead Lane Cohoes, NY 12047 518/783-9073 (T) 518/783-6987 (F)
Binghamton 406 North Street Endicott, NY 13670 607/757-9326 (T) 607/757-9252 (F)
Canton P.O. Box 29 Canton, NY 13617 315/386-4578 (T) 315/386-1012 (F)
Ithaca 798 Cascadilla Street Ithaca, NY 14850 607/272-1723 (T) 607/272-1723 (F)
Plattsburgh 1080 Military Tpk. Plattsburgh, NY 12901 518/563-6878 (T) 518/562-1321 (F)
Poughkeepsie 1601 Route 376 Wappingers Falls, NY 12590 845/463-1128 (T) 845/426-1127 (F)
Syracuse 5688 State Rt. 31 Cicero, NY 13039 315/699-5281 (T) 315/699-3374 (F)
Utica 301 St. Andrews St. Utica, NY 13502 315/735-3309 (T) 315/735-0742 (F)
Watertown P.O. Box 91 Falls Mills, NY 13638 315/773-5390 (T) 315/773-0334 (F)

Project No.	Client Name	Chain of Custody No.
STS266	E.B.C.	002
		Date Collected: 3/10/04
Project Contact:	Kevin Samolis	Page 1 of 1
Project Name:	Former Heck Manuf. Bldg Albany Molding Storage	Project Location: Kingston, NY

Sample Information	
Cassette Type:	Pre-AGreement
Analysis Requested:	
Analyzed By:	
Analyzed By: (SIG)	

Report Distribution	
Dates Required:	24hr TAT
Send Report To:	Kevin Samolis
Copy Sent To:	315-699-3374
Fax Results:	☒ YES ☐ NO

Field Sample No.	Sample Location	Pump No.	Start (Hr:Min)	Stop (Hr:Min)	Total Minutes (Min)	Start Flow (LPM)	Final Flow (LPM)	Volume (LTRS)	Laboratory Identific. No.	Fibers 100 Fields	Fibers/100 Fields Blank	Fibers/CC	Date Analz.	Checked By
310 009	Inside North	8	10:15	12:10	115	10	10	1150	136589	MD				
310 010	Inside center	9	10:15	12:10	115	10	10	1150	136590	MD				
310 011	Inside South	9	10:15	12:10	115	10	10	1150	136591	MD				
310 012	outside North	8	10:16	12:11	115	10	10	1150	136592	8				
310 013	outside center	7	10:16	12:11	115	10	10	1150	136593	MD				
310 014	outside South	50	10:16	12:11	115	10	10	1150	136594	MD				
310 015	Blank 1	–	–	–	–	–	–	–	136595	0				
310 016	Blank 2	–	–	–	–	–	–	–	136596	0				

Samplers Name:	Joseph Grabowski	Date:	3/10/04
Samplers Signature:	[signature]	Time:	10:25
Received for Name:	Jack Kurzicki	Date:	3/12/04
Laboratory Signature:	[signature]	Time:	17/6
Shipment Recd Intact?	☐ YES ☐ NO		

Samples Relinquished By:				Samples Received By:				Filed and Laboratory Remarks
Name:	Joe Grabowski	Date:	3/11/04	Name:		Date:		
Signature:	[signature]	Time:	10:15	Signature:		Time:		
Name:		Date:		Name:		Date:		
Signature:		Time:		Signature:		Time:		

Think Quality

Distribution: White with Samples
Yellow to Laboratory
Pink to ATL Files

QF-7A
Revised: 2/03

04A166 / 3665

ATLANTIC TESTING LABORATORIES, Limited

ASBESTOS SAMPLE - CHAIN OF CUSTODY

Albany 12 Arrowhead Lane, Cohoes, NY 12047, 518/783-9073 (T), 518/783-5967 (F)
Binghamton 406 North Street, Endicott, NY 13670, 607/757-9326 (T), 607/757-9252 (F)
Canton P.O. Box 29, Canton, NY 13617, 315/386-4578 (T), 315/386-1012 (F)
Ithaca 798 Cascadilla Street, Ithaca, NY 14850, 607/272-1723 (T), 607/272-1723 (F)
Plattsburgh 1080 Military Tpk, Plattsburgh, NY 12901, 518/563-6878 (T), 518/562-1321 (F)
Poughkeepsie 1601 Route 376, Wappingers Falls, NY 12590, 845/463-1128 (T), 845/426-1127 (F)
Syracuse 5866 State Rt. 31, Cicero, NY 13039, 315/699-5281 (T), 315/699-3374 (F)
Utica 301 St. Andrews St., Utica, NY 13502, 315/738-3309 (T), 315/736-0742 (F)
Watertown P.O. Box 91, Falls Mills, NY 13638, 315/773-5390 (T), 315/773-0334 (F)

Project No.	Client Name	Chain of Custody No.
STS266	E.S.C.	003
		Date Collected: 3/11/04
Project Contact:	Kevin Samollis	Page 1 of 1
Project Name:	Former Huck manufacturing bldg / Always Moving and Storage	Project Location: Kingston, NY

Sample Information	
Cassette Type:	Abatement
Analysis Requested:	PCM
Analyzed By:	
Analyzed By: (SIG)	

Report Distribution	
Dates Required:	24hr TAT
Send Report To:	Kevin Samollis
Copy Sent To:	315-699-3374
Fax Results:	☒ YES ☐ NO

Field Sample No.	Sample Location	Pump No.	Start (Hr:Min)	Stop (Hr:Min)	Total Minutes (Min)	Start Flow (LPM)	Final Flow (LPM)	Volume (LTRS)	Laboratory Identific. No.	Fibers/100 Fields	Fibers/100 Fields Blank	Fibers/CC	Date Analz.	Checked By
311 017	Inside Tent	6389	1:30	3:05	95	2	2	190	136597	18.5				
311 018	1st Floor Bldg	52	1:31	3:00	89	2	2	178	136598	6				
311 019	Blank 1	-	-	-	-	-	-	-	136599	0				
311 020	Blank 2	-	-	-	-	-	-	-	136600	0				

Samplers Name:	Joseph Grabowski	Date:	3/11/04
Samplers Signature:	[signature]	Time:	1:40
Received for Name:		Date:	
Laboratory Signature:		Time:	

Shipment Rec'd Intact? ☐ YES ☐ NO

Samples Relinquished By:				Samples Received By:			
Name:	Joe Grabowski	Date:	3/11/04	Name:	Jack Kusicki	Date:	3/12/04
Signature:	[signature]	Time:	10:45	Signature:	[signature]	Time:	1717
Name:		Date:		Name:		Date:	
Signature:		Time:		Signature:		Time:	

Field and Laboratory Remarks:

Think Quality

Distribution: White with Samples
Yellow to Laboratory
Pink to ATL Files

QF-7A
Revised: 2/03

04A166/3655

ATLANTIC TESTING LABORATORIES, Limited

ASBESTOS SAMPLE - CHAIN OF CUSTODY

Albany 12 Arrowhead Lane, Cohoes, NY 12047, 518/783-9073 (T), 518/783-6987 (F)
Binghamton 406 North Street, Endicott, NY 13670, 607/757-9326 (T), 607/757-9252 (F)
Canton P.O. Box 29, Canton, NY 13617, 315/386-4578 (T), 315/386-1012 (F)
Ithaca 798 Cascadilla Street, Ithaca, NY 14850, 607/272-1723 (T), 607/272-1723 (F)
Plattsburgh 1080 Military Trpk, Plattsburgh, NY 12901, 518/563-5878 (T), 518/562-1321 (F)
Poughkeepsie 1601 Route 376, Wappingers Falls, NY 12590, 845/463-1126 (T), 845/426-1127 (F)
Syracuse 5856 State Rt. 31, Cicero, NY 13039, 315/699-5281 (T), 315/699-3374 (F)
Utica 301 St. Andrews St., Utica, NY 13502, 315/735-3309 (T), 315/735-0742 (F)
Watertown P.O. Box 97, Felts Mills, NY 13638, 315/773-5390 (T), 315/773-0334 (F)

Project No.	Client Name	Chain of Custody No.
STS266	E.S.C.	604
		Date Collected: 3/11/04
Project Contact:	Kevin Samolis	Page 1 of 1
Project Name:	Former Hackmann-UF Blds / Always moving and storage	Project Location: Kingston, NY

Sample Information	
Cassette Type:	Finals
Analysis Requested:	P.C.M.
Analyzed By:	
Analyzed By: (SIG)	

Report Distribution	
Dates Required:	Same Day "Rush"
Send Report To:	Kevin Samolis
Copy Sent To:	Fax 315-699-3377
Fax Results:	☑ YES ☐ NO

Field Sample No.	Sample Location	Pump No.	Start (Hr:Min)	Stop (Hr:Min)	Total Minutes (Min)	Start Flow (LPM)	Final Flow (LPM)	Volume (LTRS)	Laboratory Identific. No.	Fibers 100 Fields	Fibers/100 Fields Blank	Fibers/CC	Date Analz.	Checked By
311 021	Inside North	50	7:00	9:00	120	10	10	1200	136601	3				
311 022	Inside Center	6	7:00	9:00	120	10	10	1200	136602	2				
311 023	Inside South	6	7:00	9:00	120	10	10	1200	136603	1.5				
311 024	outside North	52	6:55	8:55	120	10	10	1200	136604	4				
311 025	outside center	9	6:55	8:55	120	10	10	1200	136605	2				
311 026	outside South	8	6:55	8:55	120	10	10	1200	136606	0.5				
311 027	Blank 1	–	–	–	–	–	–	–	136607	3				
311 028	Blank 2	–	–	–	–	–	–	–	136608	0				

Samplers Name:	Joseph Grabowski	Date:	3/11/04
Samplers Signature:	[signature]	Time:	7:10

Received for Name:	Jack Kurzicki	Date:	3/10/04	Shipment Recd Intact?	
Laboratory Signature:	[signature]	Time:	0803	☐ YES ☐ NO	

Samples Relinquished By:				Samples Received By:				Field and Laboratory Remarks
Name:	Joe Grabowski	Date:	3/11/04	Name:		Date:		
Signature:	[signature]	Time:	10:15	Signature:		Time:		
Name:		Date:		Name:		Date:		
Signature:		Time:		Signature:		Time:		

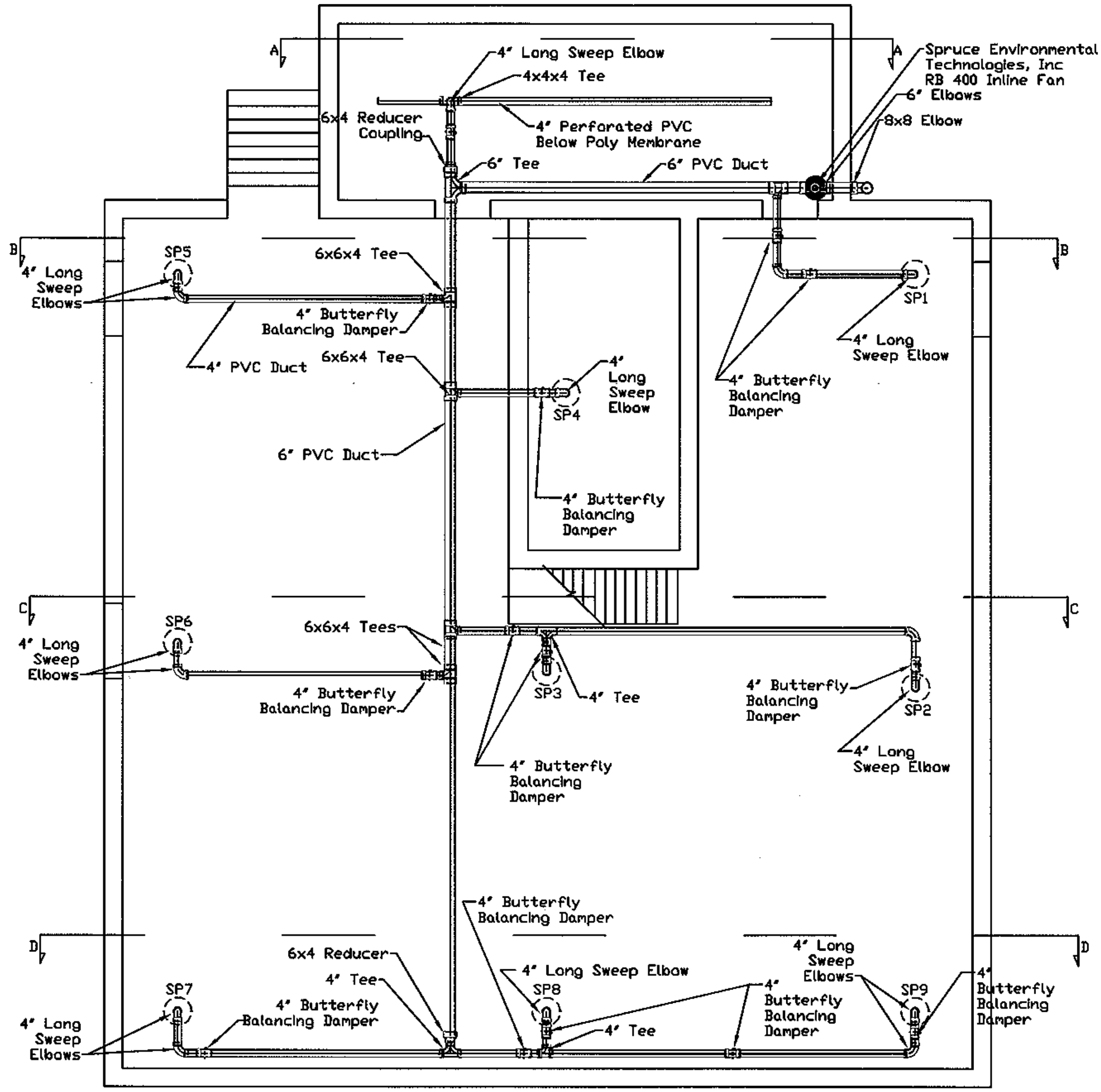
Think Quality

Distribution: White with Samples
Yellow to Laboratory
Pink to ATL Files

OF-7A
Revised: 2/03

Appendix E – As-Built Diagrams for the Sub-Slab Depressurization System

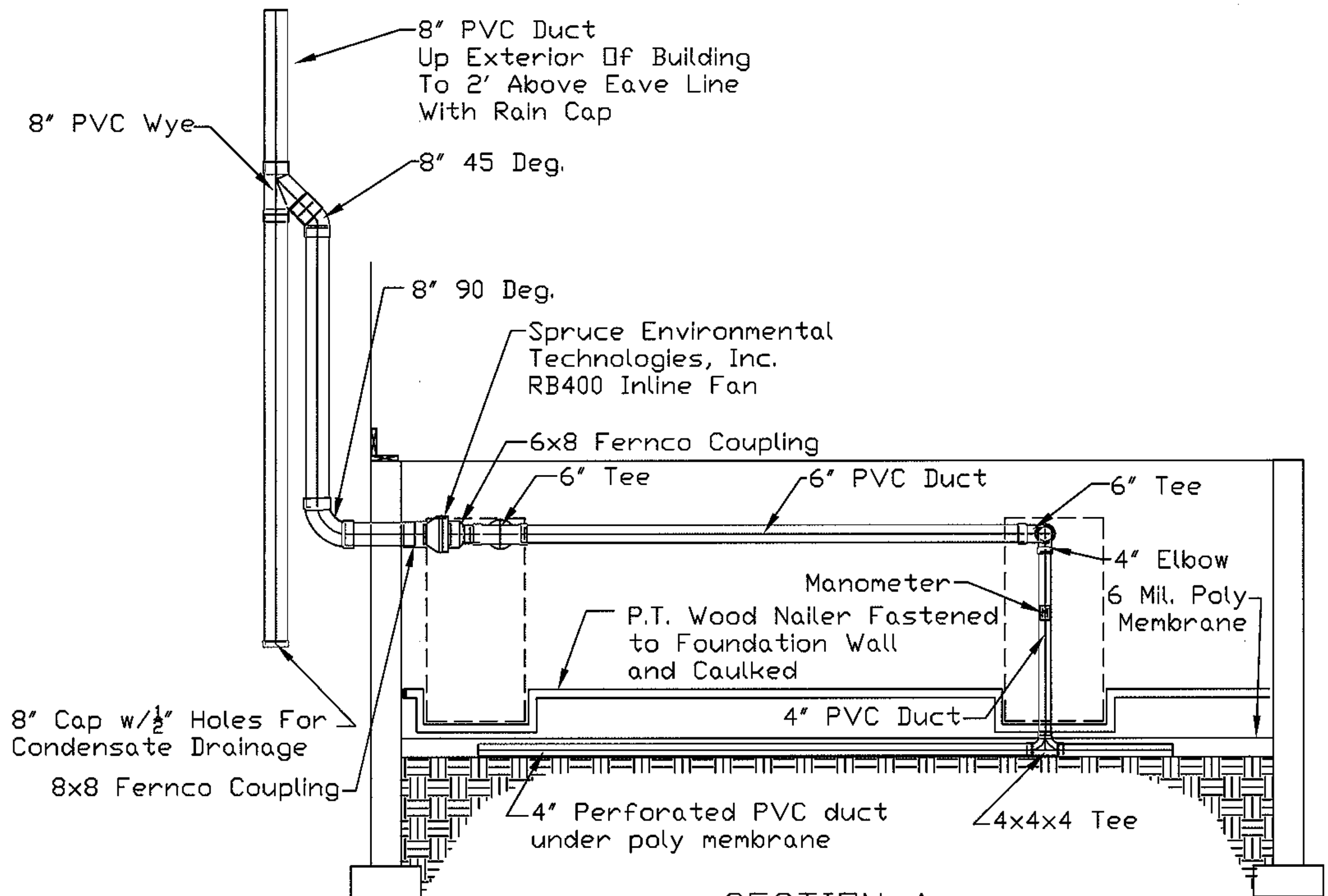
NOTE: A U-tube manometer shall be installed on the vertical duct at each suction point.



SUB-SLAB / SUB-MEMBRANE
SUCTION SYSTEM #1

AS BUILT

AQES Air Quality and Environmental Services, LLC 425 Eastline Road Ballston Spa, NY 12020 (518) 885-3488Fax: (518) 885-3548	
	85 GRAND STREET KINGSTON, NEW YORK
	DRAWN BY: Eric L. Dingeman, P.E.
	SCALE: Not To Scale — SHEET 1 of 5



SECTION A

AS BUILT

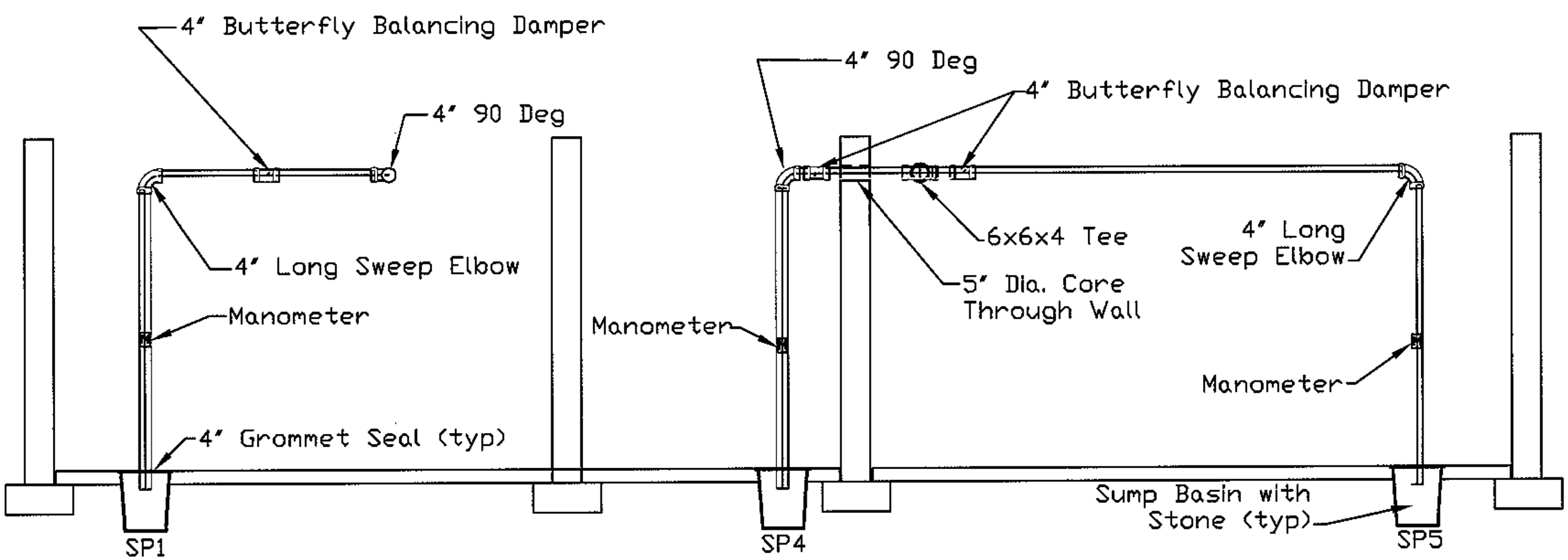
AQES
Air Quality and Environmental Services, LLC

425 Eastline Road
Ballston Spa, NY 12020
(518) 885-3488Fax: (518) 885-3548

85 GRAND STREET
KINGSTON, NEW YORK

DRAWN BY: Eric L. Dingeman, P.E.

SCALE: Not To Scale



SECTION B

AS BUILT

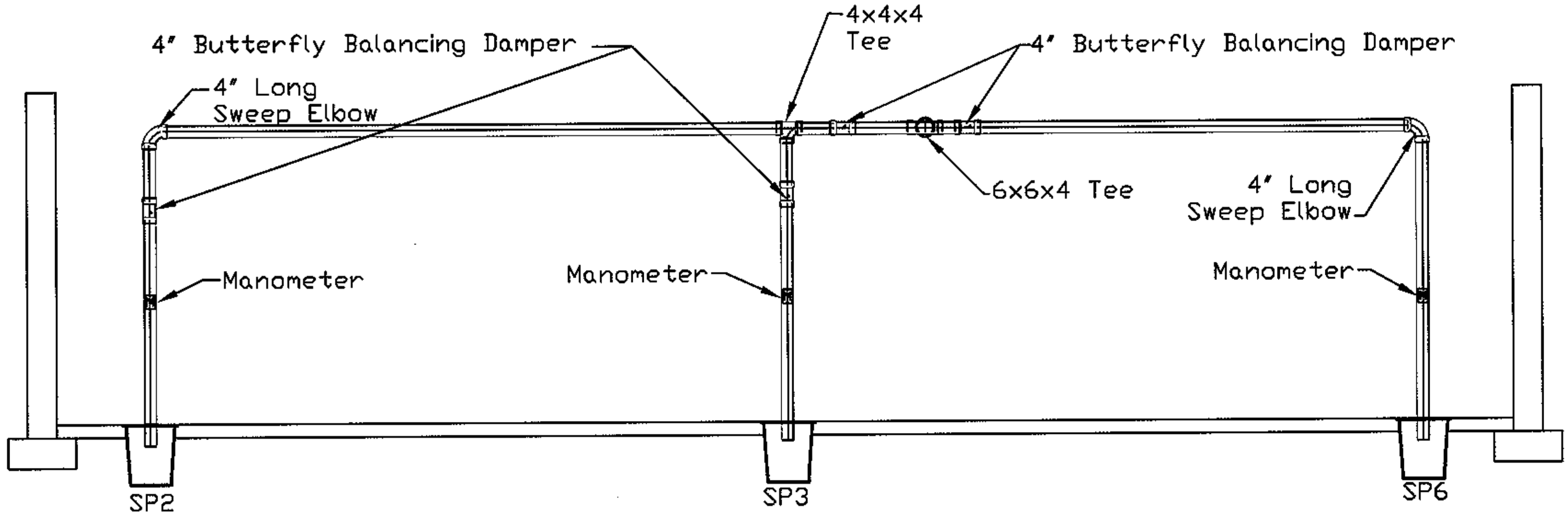
AQES
Air Quality and Environmental Services, LLC
425 Eastline Road
Ballston Spa, NY 12020
(518) 885-3488Fax: (518) 885-3548

85 GRAND STREET
KINGSTON, NEW YORK

DRAWN BY: Eric L. Dingeman, P.E.

SCALE: Not To Scale

SHEET 3 of 5



SECTION C

AS BUILT

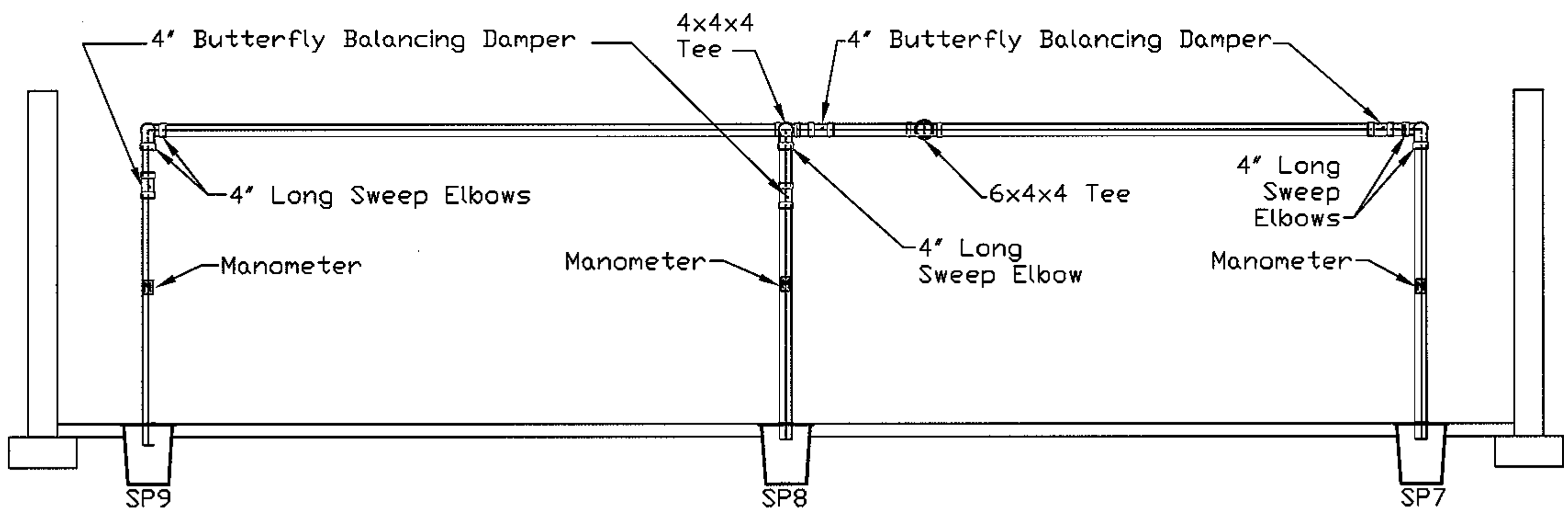
AQES
Air Quality and
Environmental Services, LLC
425 Eastline Road
Ballston Spa, NY 12020
(518) 885-3488Fax: (518) 885-3548

85 GRAND STREET
KINGSTON, NEW YORK

DRAWN BY: Eric L. Dingeman, P.E.

SCALE: Not To Scale

SHEET 4 of 5



SECTION D

AS BUILT

AQES **Air Quality and Environmental Services, LLC** 425 Eastline Road Ballston Spa, NY 12020 (518) 885-3488Fax: (518) 885-3548	 85 GRAND STREET KINGSTON, NEW YORK DRAWN BY: Eric L. Dingeman, P.E. SCALE: Not To Scale — SHEET 5 of 5

Appendix F - Operation and Maintenance Manual (Under Separate Cover)

ESC ENGINEERING OF NEW YORK, P.C.
9 Albany Street • Cazenovia, New York 13035 • (315) 655-3900 • Fax (315) 655-3907

APPENDIX F

OPERATION AND MAINTENANCE MANUAL

Operational Checklist
Huck Manufacturing Facility
Kingston, NY

Date: ____________________
Arrival Time: ____________________
Departure Time: ____________________

Inspector (print): ____________________
Inspector (sign): ____________________
Weather Conditions: ____________________

Reason for Visit (check all that apply):

Weekly O&M ____________________
Monthly O&M ____________________
Other ____________________

Collect influent/effluent samples ____________________
Response to alarm ____________________

TREATMENT SYSTEM OPERATIONAL CHECKLIST

Location

Zone 1

	Reading	Units
Inlet Vacuum - Before Inlet Filter		"Hg
Inlet Vacuum - After Inlet Filter		"Hg
Vacuum - Effluent Separator		"Hg
Vacuum - Inlet Blower		"Hg
Flow Rate		cfm
Influent PID Reading		ppm
Effluent PID Reading		ppm
Effluent Temperature		F

Zone 2

	Reading	Units
Inlet Vacuum - Before Inlet Filter		"Hg
Inlet Vacuum - After Inlet Filter		"Hg
Vacuum - Effluent Separator		"Hg
Vacuum - Inlet Blower		"Hg
Flow Rate		cfm
Influent PID Reading		ppm
Effluent PID Reading		ppm
Effluent Temperature		F

Total Gallons in Poly Storage Tank = ____________________ gallons

Notable Observations:

System Maintenance

Equipment ____________________

Reason for Maintenance ____________________

Description of Maintenance Action ____________________

Vapor Extraction System

Operation & Maintenance Manual

Job No. 11432

for

Mid-Atlantic Environmental Equipment

155 Oak Forest
Bluffton, SC 29910

---

project

Kingston, NY

---

by

BISCO Environmental

91 Pacella Park Drive
Randolph, Massachusetts 02368
Phone: (781)-963-0090
Fax: (781) 986-1540
Contact: Robert Bennett

Table of Contents

Section 4 – Control Panel

- Control Panel Layout Drawing & Wiring Diagrams
- EOS Series II ProControl ProView Configuration File Information
- EOS ProControl Series 2plus User Manual
- EOS ProView for ProControl Series 2plus User's Guide

Section 5 - System Drawings

- Vapor Extraction System Process & Instrumentation Diagram (P&ID)
- Vapor Extraction System Structural Layout #1
- Vapor Extraction System Structural Layout #1

Section 6 – Warranty

- Limitation of Warranty & Limitation of Remedy

BISCO Environmental

Section 1 – Vapor Extraction System

- SVE System 1 & 2 Blower, Roots 615URAI Positive Displacement Blower Modeling & Specifications
- SVE System 1 & 2 Blower Roots 615URAI Positive Displacement Blower Installation, Operation & Maintenance Manual
- SVE System 1 Blower Motor, Marathon Model E984 Motor Data Sheet, Dimensional Detail & Connection Diagram
- SVE System 2 Blower Motor, Marathon Model E961 Motor Data Sheet, Dimensional Detail & Connection Diagram
- Marathon Electric Standard Induction Motors Installation, Operation & Maintenance Manual
- SVE System 1 V-Belt & Sheave Specifications
- SVE System 2 V-Belt & Sheave Specifications
- SVE System 1 ACS Industries Fine Mist Eliminator Specifications
- SVE System 2 ACS Industries Fine Mist Eliminator Specifications

Company:	Dresser ROOTS
Address:	2135 Highway 6 South; Houston, TX 77077
	281-966-4464/ Fax: 281-966-4711
Contact:	Phil Gordon
Customer:	ESC
Project:	Kingston - NY (SVE SYSTEM # 1)

ROOTS BLOWER PERFORMANCE SUMMARY: (11/11/2003)

****************************ERRORS/WARNINGS*********************
1) ** 750 SCFM @ 9.5" Hg vacuum @ the blower inlet ** Carbon to be piped on the inlet side of blower package.
****

AMBIENT CONDITIONS:			
Gas	AIR		
Relative Humidity	100%		
Molecular Wt.	28.59		
k-Value	1.392		
Specific Gravity	.987		
Ambient Temp.	85	deg F	
Ambient Pressure	14.7	PSIA	
INPUT CONDITIONS:			
Actual Volume	1155	ICFM	+/-5 %
Std. Volume	750	SCFM	
Mass/Wt. Flow	59	#/min	+/-5 %
System Inlet Pressure	9.5	in Hg Vac	
Inlet Pr. Loss	10	in H2O	
Blower Inlet Pressure	9.69	PSIA	
System Disch Pressure	10	in H2OG	
Disch Pr. Loss	10	in H2O	
Blower Disch Pressure	15.42	PSIA	
Inlet Temperature	68	deg F	
STANDARD CONDITIONS:			
Pressure	14.7	PSIA	
Temperature	68	deg F	
Relative Humidity	36	%	
SELECTED UNIT DETAIL:			
Model	615	URAI	
Speed	1952	RPM	83%
Power at Blower Shaft	36.9	BHP	+/- 4%
Blower Differential Pressure	5.73	PSI	95%
Temperature Rise	107	deg F	82%
Discharge Temperature	175	deg F	
Discharge Volume	872	ACFM	
Gear Tip Speed	3069	FPM	
V-Belt: Est. B10 Brg Life:	39335	hours	
Coupling: Est. B10 Brg Life:	39335	hours	
Est. Free Field Noise @ 1 m.	88.1	dBa	
CFR	0.74		
Weight	425	lbs.	
Shaft Dia.	1.375	in.	
Min. Sheave Dia.	8	in.	
Inlet/Disch Conn.	6F		

Company: Dresser ROOTS
Address: 2135 Highway 6 South; Houston, TX 77077
281-966-4464/ Fax: 281-966-4711
Contact: Phil Gordon
Customer: ESC
Project: Kingston- NY (SVE SYSTEM # 2)

ROOTS BLOWER PERFORMANCE SUMMARY: (11/11/2003)

***************************ERRORS/WARNINGS*********************
1) ** 550 SCFM @ 8.5" Hg vacuum @ the blower inlet ** Carbon to be piped on the inlet side of blower.
****

AMBIENT CONDITIONS:

Gas	AIR	
Relative Humidity	100%	
Molecular Wt.	28.608	
k-Value	1.392	
Specific Gravity	.988	
Ambient Temp.	85	deg F
Ambient Pressure	14.7	PSIA

INPUT CONDITIONS:

Actual Volume	806	ICFM	+/-5 %
Std. Volume	550	SCFM	
Mass/Wt. Flow	43	#/min	+/-5 %
System Inlet Pressure	8.5	in Hg Vac	
Inlet Pr. Loss	10	in H2O	
Blower Inlet Pressure	10.18	PSIA	
System Disch Pressure	0	in H2OG	
Disch Pr. Loss	10	in H2O	
Blower Disch Pressure	15.06	PSIA	
Inlet Temperature	68	deg F	

STANDARD CONDITIONS:

Pressure	14.7	PSIA
Temperature	68	deg F
Relative Humidity	36	%

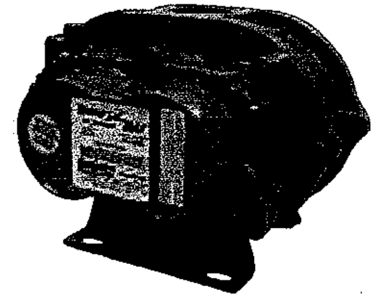
SELECTED UNIT DETAIL:

Model	615	URAI	
Speed	1442	RPM	61%
Power at Blower Shaft	23.0	BHP	+/- 4%
Blower Differential Pressure	4.88	PSI	81%
Temperature Rise	91	deg F	70%
Discharge Temperature	159	deg F	
Discharge Volume	638	ACFM	
Gear Tip Speed	2267	FPM	
V-Belt: Est. B10 Brg Life:	90901	hours	
Coupling: Est. B10 Brg Life:	90901	hours	
Est. Free Field Noise @ 1 m.	82.7	dBa	
CFR	0.74		
Weight	425	lbs.	
Shaft Dia.	1.375	in.	
Min. Sheave Dia.	8	in.	
Inlet/Disch Conn.	6F		

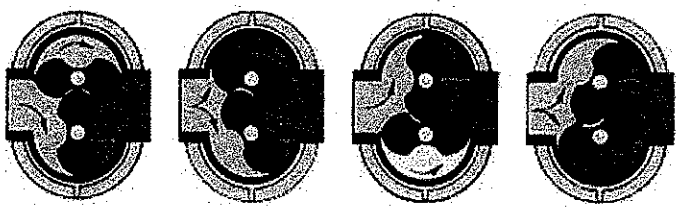
SPECIFICATIONS

ROOTS™ Universal RAI Rotary Positive Blowers

Frames 22 thru 718



OPERATING PRINCIPLE

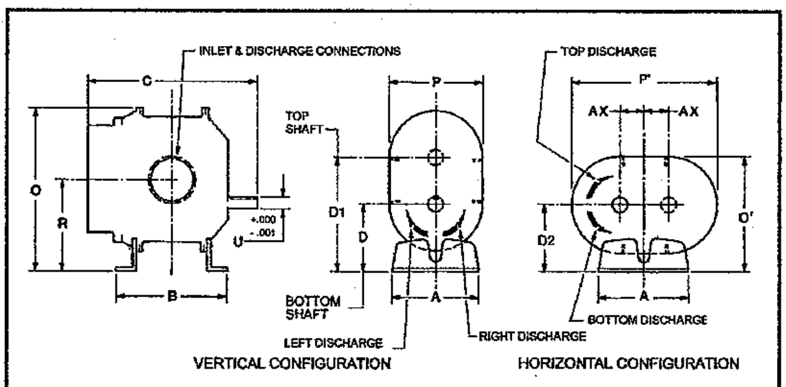


POSITION 1 POSITION 2 POSITION 3 POSITION 4

Two figure-eight lobe impellers mounted on parallel shafts rotate in opposite directions. As each impeller passes the blower inlet, it traps a definite volume of air and carries it around the case to the blower outlet, where the air is discharged. With constant speed operation, the displaced volume is essentially the same regardless of pressure, temperature or barometric pressure.

Timing gears control the relative position of the impellers to each other and maintain small but definite clearances. This allows operation without lubrication being required inside the gas casing.

OUTLINE DRAWING & DIMENSIONAL TABLE



Frame Size	A	B	C	Drive Shaft Location D	Drive Shaft Location D1	Drive Shaft Location D2	O	O'	P	P'	R	U	Keyway	Inlet & disch. Dia.	AX	Approx. Net Wt. (lbs.)
22	5.13	5.00	9.75	3.75	6.25	3.75	9.63	6.88	6.25	9.25	5.00	.625	.188 x .094	1.0 NPT	1.25	32
24	5.13	7.00	11.75	3.75	6.25	3.75	9.63	6.88	6.25	9.25	5.00	.625	.188 x .094	2.0 NPT	1.25	43
32	7.25	6.75	11.25	5.00	8.50	5.00	12.81	8.88	7.75	12.13	6.75	.750	.188 x .094	1.25 NPT	1.75	69
33	7.25	7.63	12.13	5.00	8.50	5.00	12.81	8.88	7.75	12.13	6.75	.750	.188 x .094	2.0 NPT	1.75	74
36	7.25	10.00	14.63	5.00	8.50	5.00	12.81	8.88	7.75	12.13	6.75	.750	.188 x .094	2.5 NPT	1.75	102
42	8.00	7.25	13.00	6.25	10.25	6.25	15.06	10.63	8.75	13.63	8.25	.875	.188 x .094	1.5 NPT	2.00	88
45	8.00	10.00	15.50	6.25	10.25	6.25	15.06	10.63	8.75	13.63	8.25	.875	.188 x .094	2.5 NPT	2.00	109
47	8.00	11.75	17.63	6.25	10.25	6.25	15.06	10.50	8.50	13.63	8.25	.875	.188 x .094	3.0 NPT	2.00	128
53	10.50	8.38	15.38	6.25	11.25	6.75	17.38	11.88	10.25	17.25	8.75	1.125	.250 x .125	2.5 NPT	2.50	143
56	10.50	11.00	18.00	6.25	11.25	6.75	17.38	12.25	11.00	17.25	8.75	1.125	.250 x .125	4.0 NPT	2.50	170
59	10.50	14.00	21.18	6.25	11.25	6.75	17.38	12.25	11.00	17.25	8.75	1.125	.250 x .125	4.0 NPT	2.50	204
65	11.00*	10.00	18.38	8.75	14.75	8.75	21.63	15.13	12.75	18.75	11.75	1.375	.312 x .156	3.0 NPT	3.00	245
68	11.00*	13.00	21.38	8.75	14.75	8.75	21.63	15.13	12.75	19.75	11.75	1.375	.312 x .156	5.0 NPT	3.00	285
615	11.00*	20.00	28.38	8.75	14.75	8.75	21.63	16.25	15.00	18.75	11.75	1.375	.312 x .156	6.0 FLG	3.00	425
76	14.00**	11.75	19.84	11.00	18.00	11.00	26.13	20.69	18.38	23.25	14.50	1.562	.375 x .188	4.0 NPT	3.50	400
711	14.00**	16.75	25.19	11.00	18.00	11.00	26.13	19.50	17.00	23.25	14.50	1.562	.375 x .188	6.0 FLG	3.50	530
718	14.00**	23.75	32.19	11.00	18.00	11.00	26.13	19.50	17.00	23.25	14.50	1.562	.375 x .188	6.0 FLG	3.50	650

S-12K84

BASIC BLOWER DESCRIPTION

Universal RAI blowers are heavy duty rotary blowers designed with detachable rugged steel mounting feet, which permit easy in-field adaptability to either vertical or horizontal installation requirements.

Because of the detachable mounting feet, these units can be easily adapted to any of four drive shaft positions - right hand, left hand, bottom or top. The compact, sturdy design is engineered for continuous service when operated in accordance with speed and pressure ratings.

The basic model consists of a cast iron casing, carburized and ground alloy steel spur timing gears secured to steel shafts with a taper mounting and locknut, and cast iron involute impellers. Oversized antifriction bearings are used, with a cylindrical roller bearing at the drive shaft to withstand V-belt pull. The Universal RAI features thrust control, with splash oil lube on the gear end and grease lube on the drive end. After standard tests, the unit is sprayed with a protective paint and boxed or placed on skids.

Available accessories include driver, relief valve, inlet and discharge silencer, inlet filter, check valve, extended base, V-belt or flexible coupling and drive guards.

DRESSER
Roots

PERFORMANCE TABLE

Frame Size	Speed RPM	1 PSI		2 PSI		3 PSI		4 PSI		5 PSI		6 PSI		7 PSI		10 PSI		11 PSI		12 PSI		13 PSI		14 PSI		15 PSI		MAX. VACUUM		
		CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	"Hg	CFM	BHP
22	1160	10	0.2	7	0.3	4	0.3	2	0.4																			4	6	0.3
	3600	49	0.6	46	0.8	43	1.1	41	1.3	39	1.6	38	1.8	36	2.1	32	2.8	31	3.1	29	3.3							14	28	2.0
	5275	76	0.8	73	1.2	70	1.6	68	1.9	66	2.3	64	2.7	63	3.1	59	4.2	57	4.5	56	4.9							15	53	3.1
24	1160	24	0.3	19	0.4	15	0.6	11	0.8	8	0.9																	6	12	0.6
	3600	102	0.8	97	1.3	93	1.8	89	2.3	86	2.8	83	3.3	81	3.8													14	69	3.8
	5275	156	1.2	150	1.9	146	2.7	143	3.4	140	4.2	137	4.9	135	5.6													15	119	5.8
32	1160	40	0.4	34	0.6	30	0.9	27	1.1	24	1.3	21	1.6	19	1.8													10	18	1.3
	2800	113	1.0	108	1.6	104	2.1	101	2.7	98	3.2	95	3.8	93	4.3	86	6.0	84	6.5	82	7.1	81	7.6	79	8.2	77	8.7	15	78	4.5
	3600	149	1.3	144	2.0	140	2.7	137	3.4	134	4.1	131	4.8	129	5.5	122	7.7	120	8.4	118	9.1	117	9.8	115	10.5	113	11.2	16	110	5.9
33	1160	55	0.5	48	0.8	43	1.1	39	1.4	35	1.7	31	2.1	28	2.4													10	27	1.7
	2800	156	1.2	149	2.0	144	2.7	140	3.5	136	4.2	132	5.0	129	5.7	120	8.0	118	8.7	116	9.5							14	113	5.6
	3600	205	1.6	199	2.5	193	3.5	189	4.5	185	5.4	181	6.4	178	7.4	170	10.3	167	11.2	165	12.2							15	159	7.6
36	1160	95	0.7	85	1.2	78	1.7	72	2.3	66	2.8	61	3.3	57	3.8													10	55	2.7
	2800	262	2.0	253	3.3	245	4.5	239	5.8	234	7.0	229	8.3	224	9.5													12	213	7.9
	3600	344	2.9	334	4.5	327	6.1	321	7.7	315	9.3	310	10.9	306	12.5													15	278	12.7
42	860	38	0.4	32	0.6	28	0.9	24	1.1	21	1.3	18	1.5	15	1.8													8	19	1.1
	1760	92	0.8	87	1.3	82	1.8	78	2.2	75	2.7	72	3.1	69	3.6	62	5.0	60	5.5	58	5.9							14	56	3.5
	3600	204	1.7	198	2.6	194	3.6	190	4.5	186	5.5	183	6.4	181	7.4	173	10.2	171	11.2	169	12.1	167	13.1	165	14.1	163	15.0	15	160	8.0
45	860	79	0.6	68	1.1	60	1.5	53	2.0	48	2.4	42	2.9	37	3.4													8	46	1.9
	1760	188	1.3	177	2.2	169	3.1	162	4.1	156	5.0	151	5.9	146	6.9	133	9.6											12	134	5.8
	3600	410	3.4	400	5.3	392	7.2	385	9.1	379	11.0	374	12.9	369	14.8	356	20.5											15	332	15.9
47	860	105	0.8	92	1.4	82	2.0	73	2.6	66	3.2	59	3.8	53	4.4													8	63	2.5
	1760	249	1.6	236	2.8	225	4.0	217	5.3	209	6.5	203	7.7	196	8.9													12	181	7.5
	3600	542	4.5	529	7.0	519	9.5	510	12.0	503	14.3	496	17.0	490	19.5													15	452	19.8
53	700	72	0.6	63	1.0	56	1.4	51	1.8	46	2.2	42	2.6	38	3.0													10	36	2.2
	1760	211	1.7	203	2.7	196	3.7	191	4.7	186	5.7	181	6.7	177	7.7	167	10.8	163	11.8	160	12.8	157	14.2	155	15.2			14	158	7.5
	2850	355	3.3	346	5.0	340	6.6	334	8.2	329	9.9	325	11.5	321	13.2	310	18.1	307	19.7	304	21.3	301	23.0	298	24.6	295	26.2	16	391	14.0
56	700	123	0.9	110	1.6	100	2.2	92	2.9	85	3.6	78	4.3	72	4.9													10	70	3.5
	1760	358	2.6	345	4.6	335	6.0	326	7.7	319	9.4	312	11.1	306	12.8	290	17.9	285	19.6	280	276	23.0						14	276	12.3
	2850	598	5.2	585	8.0	575	10.7	567	13.5	560	16.2	553	19.0	547	21.7	531	30.0	526	32.7	521	517	38.2						16	501	23.2
59	700	187	1.2	170	2.2	158	3.2	147	4.2	138	5.1	130	6.1															8	135	4.1
	1760	529	3.9	513	6.4	500	8.9	490	11.4	480	13.8	472	16.3	464	18.8													12	445	15.6
	2850	881	7.8	865	11.8	852	15.8	842	19.9	832	23.9	824	27.9	816	31.9													15	770	32.1
65	700	140	1.0	126	1.8	116	2.6	107	3.3	100	4.1	93	4.8	86	5.5	70	7.8											12	71	4.7
	1760	400	3.4	387	5.3	377	7.2	368	9.1	360	11.0	353	12.8	347	14.7	330	20.4	325	22.3	320	24.2	316	26.1	311	27.9	307	29.8	16	300	15.8
	2350	546	5.2	523	7.7	522	10.3	513	12.8	506	15.3	499	17.8	492	20.3	475	27.4	470	30.4	466	32.9	461	35.5	457	38.0	452	40.5	16	445	21.6
68	700	224	1.5	203	2.7	187	3.9	172	5.1	160	6.3	149	7.5	139	8.7													10	135	6.2
	1760	643	4.9	621	7.9	605	10.9	591	14.0	579	17.0	567	20.0	557	23.1	530	32.2	522	35.2	515	38.2	507	41.3	500	44.3			15	495	23.5
	2350	876	7.3	855	11.4	838	15.4	824	19.5	812	23.5	801	27.6	790	31.6	763	43.8	755	47.8	748	51.9	740	55.9	733	60.0			16	715	34.0
615	700	420	2.6	380	4.8	351	7.1	323	9.3	301	11.6	279	13.8	260	16.2													8	292	9.1
	1760	1205	8.1	1164	13.9	1133	19.5	1107	25.2	1084	30.8	1063	36.5	1044	42.2													12	997	35.0
	2350	1641	11.9	1601	19.3	1570	27.0	1544	34.6	1521	43.2	1500	49.8	1481	57.4													14	1389	54.9
76	575	195	1.3	179	2.3	168	3.3	158	4.3	150	5.4	142	6.4	134	7.4	115	10.4											12	117	6.2
	1400	526	4.0	511	6.4	500	9.0	490	11.5	481	13.9	473	16.4	466	18.8	447	26.3	441	28.7	436	31.2	421	33.7	415	36.1	421	38.6	16	413	20.4
	2050	788	6.9	772	10.5	761	14.2	751	17.8	742	21.4	734	25.0	727	28.6	708	39.5	703	43.1	697	46.7	684	50.4	679	54.0	682	57.6	16	674	30.6
711	575	362	2.2	336	4.0	316	5.9	299	7.7	284	9.6	271	11.4	258	13.3	226	18.8											12	228	11.2
	1400	970	6.5	944	11.0	925	15.5	908	20.0	893	24.5	880	29.0	867	33.5	835	47.1											15	793	34.4
	2050	1450	10.9	1424	17.5	1404	24.1	1387	30.7	1373	37.3	1359	43.9	1347	50.5	1315	70.3											16	1256	54.6
718	575	600	3.3	563	6.3	534	9.3	510	12.3	489	15.4	470	18.4															10	446	15.0
	1400	1590	9.7	1553	17.0	1524	24.3	1500	31.6	1479	39.0	1460	46.3															12	1398	44.66
	2050	2370	15.7	2333	26.9	2304	37.2	2280	47.9	2259	58.6	2240	69.4															12	2178	6.4

Notes:
1. Performance based on inlet air at standard pressure of 14.7 psia, standard temperature of 68° F, and specific gravity of 1.0.
2. Vacuum ratings based on inlet air at standard temperature of 68° F, discharge pressure of 30" Hg and specific gravity of 1.0.

DESIGN AND CONSTRUCTION FEATURES

1. Detachable steel mounting feet
2. Rigid one-piece cast iron casing
3. Anti-friction bearings
4. Thrust Control
5. Splash oil lubricated spur timing gears
6. Connections in standard pipe sizes
7. Straight, precision machined two-lobe impellers
8. Ground steel shafts

Dresser, Inc.

DRESSER Roots

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S-12K84
April 2002

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INSTALLATION OPERATION MAINTENANCE

BLOWERS EXHAUSTERS COMPRESSORS

ROOTS™

US $3.00, Canada $4.50

UNIVERSAL RAI® & RAM™ SERIES

CONTENTS

DO THESE THINGS TO GET THE MOST FROM YOUR ROOTS™ BLOWER

- ❑ Check shipment for damage. If found, file claim with carrier and notify ROOTS.
- ❑ Unpack shipment carefully, and check contents against Packing List. Notify ROOTS if a shortage appears.
- ❑ Store in a clean, dry location until ready for installation. Lift by methods discussed under INSTALLATION to avoid straining or distorting the equipment. Keep covers on all openings. Protect against weather and corrosion if outdoor storage is necessary.
- ❑ Read OPERATING LIMITATIONS and INSTALLATION sections in this manual and plan the complete installation.
- ❑ Provide for adequate safeguards against accidents to persons working on or near the equipment during both installation and operation. See SAFETY PRECAUTIONS.
- ❑ Install all equipment correctly. Foundation design must be adequate and piping carefully done. Use recommended accessories for operating protection.
- ❑ Make sure both driving and driven equipment is correctly lubricated before start-up. See LUBRICATION.
- ❑ Read starting check points under OPERATION. Run equipment briefly to check for installation errors and make corrections. Follow with a trial run under normal operating conditions.
- ❑ In event of trouble during installation or operation, do not attempt repairs of ROOTS furnished equipment. Notify ROOTS, giving all nameplate information plus an outline of operating conditions and a description of the trouble. Unauthorized attempts at equipment repair may void ROOTS warranty.
- ❑ Units out of warranty may be repaired or adjusted by the owner. It is recommended that such work be limited to the operations described in this manual, using ROOTS™ parts. Good inspection and maintenance practices should reduce the need for repairs.

NOTE: Information in this manual is correct as of the date of publication. ROOTS reserves the right to make design or material changes without notice, and without obligation to make similar changes on equipment of prior manufacture.

For your nearest ROOTS Office, dial our Customer Service Hot Line toll free; 1 877 363 ROOT(S) (7668) or direct 281-966-4700.

DRESSER
Roots

IRB-180-102
Rev. 12/02

ROOTS™ products are sold subject to the current General terms of Sale, GTS-5001 and Warranty Policy WP-5020. Copies are available upon request.
Contact your local ROOTS Office or ROOTS Customer Service Hot Line 1.877.363.ROOT(S) (7668).

Safety Precautions

It is important that all personnel observe safety precautions to minimize the chances of injury. Among many considerations, the following should be particularly noted:

- Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.
- Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening in the blower while it is operating, or while subject to accidental starting. Protect external moving parts with adequate guards.
- Disconnect power before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.
- If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream. **CAUTION: Never cover the blower inlet with your hand or other part of body.**
- Stay clear of open inlet piping (suction area) of pressure blowers, and the open discharge blast from vacuum blowers.
- Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.
- Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.
- Casing pressure must not exceed 25 PSI (1725 mbar) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents without first consulting ROOTS.
- Do not use air blowers on explosive or hazardous gases.
- Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be trained to exercise adequate general safety precautions.

Operating Limitations

A ROOTS™ blower or exhauster must be operated within certain approved limiting conditions to enable continued satisfactory performance. Warranty is contingent on such operation.

Maximum limits for pressure, temperature and speed are specified in TABLE 1 for various models & sizes of blowers & exhausters. These limits apply to all units of normal construction, when operated under standard atmospheric conditions. Be sure to arrange connections or taps for thermometers and pressure or vacuum gauges at or near the inlet and discharge connections of the unit. These, along with a good tachometer, will enable periodic checks of operating conditions.

PRESSURE – The pressure rise, between inlet and discharge, must not exceed the figure listed for the specific unit frame size concerned. Also, in any system where the unit inlet is at a positive pressure above atmosphere a maximum case rating of 25 PSI gauge (1725 mbar) should not be exceeded without first consulting the ROOTS. Never should the maximum allowable differential pressure be exceeded.

On vacuum service, with the discharge to atmospheric pressure, the inlet suction or vacuum must not be greater than values listed for the specific frame size.

TEMPERATURE – Blower & exhauster frame sizes are approved only for installations where the following temperature limitations can be maintained in service:

- Measured temperature rise must not exceed listed values when the inlet is at ambient temperature. Ambient is considered as the general temperature of the space around the unit. This is not outdoor temperature unless the unit is installed outdoors.
- If inlet temperature is higher than ambient, the listed allowable temperature rise values must be **reduced** by 2/3 of the difference between the actual measured inlet temperature and the ambient temperature.
- The average of the inlet and discharge temperature must not exceed 250°F. (121°C).

SPEED – These blowers & exhausters may be operated at speeds up to the maximum listed for the various frame sizes. They may be direct coupled to suitable constant speed drivers if pressure/temperature conditions are also within limits. At low speeds, excessive temperature rise may be a limiting factor.

Special Note: The listed maximum allowable temperature rise for any particular blower & exhauster may occur well before its maximum pressure or vacuum rating is reached. This may occur at high altitude, low vacuum or at very low speed. The units' operating limit is always determined by the maximum rating reached first. It can be any one of the three: Pressure, Temperature or Speed.

ROOTS™ blowers & exhausters are treated after factory assembly to protect against normal atmospheric corrosion. The maximum period of internal protection is considered to be one year under average conditions, if shipping plugs & seals are not removed. Protection against chemical or salt water atmosphere is not provided. Avoid opening the unit until ready to start installation, as corrosion protection will be quickly lost due to evaporation.

If there is to be an extended period between installation and start up, the following steps should be taken to ensure corrosion protection.

- ❑ Coat internals of cylinder, gearbox and drive end bearing reservoir with Nox-Rust VCI-10 or equivalent. Repeat once a year or as conditions may require. Nox-Rust VCI-10 is petroleum soluble and does not have to be removed before lubricating. It may be obtained from Daubert Chemical Co., 2000 Spring Rd., Oak Brook, Ill. 60521.
- ❑ Paint shaft extension, inlet and discharge flanges, and all other exposed surfaces with Nox-Rust X-110 or equivalent.
- ❑ Seal inlet, discharge, and vent openings. It is not recommended that the unit be set in place, piped to the system, and allowed to remain idle for extended periods. If any part is left open to the atmosphere, the Nox-Rust VCI-10 vapor will escape and lose its effectiveness.
- ❑ Protect units from excessive vibration during storage.
- ❑ Rotate shaft three or four revolutions every two weeks.
- ❑ Prior to start up, remove flange covers on both inlet and discharge and inspect internals to insure absence of rust. Check all internal clearances. Also, at this time, remove gearbox and drive end bearing cover and inspect gear teeth and bearings for rust.

Because of the completely enclosed unit design, location of the installation is generally not a critical matter. A clean, dry and protected indoor location is preferred. However, an outdoor location will normally give satisfactory service. Important requirements are that the correct grade of lubricating oil be provided for expected operating temperatures, and that the unit be located so that routine checking and servicing can be performed conveniently. Proper care in locating driver and accessory equipment must also be considered.

Supervision of the installation by a ROOTS Service Engineer is not usually required for these units. Workmen with experience in installing light to medium weight machinery should be able to produce satisfactory results. Handling of the equipment needs to be accomplished with care, and in compliance with safe practices. Unit mounting must be solid, without strain or twist, and air piping must be clean, accurately aligned and properly connected.

Bare-shaft Units: Two methods are used to handle a unit without base. One is to use lifting lugs bolted into the top of the unit headplates. Test them first for tightness and fractures by tapping with a hammer. In lifting, keep the direction of cable pull on these bolts as nearly vertical as possible. If lifting lugs are not available, lifting slings may be passed under the cylinder adjacent to the headplates. Either method prevents strain on the extended drive shaft.

Packaged Units: When the unit is furnished mounted on a baseplate, with or without a driver, use of lifting slings passing under the base flanges is required. Arrange these slings so that no strains are placed on the unit casing or mounting feet, or on any mounted accessory equipment. **DO NOT** use the lifting lugs in the top of the unit headplates.

Before starting the installation, remove plugs, covers or seals from unit inlet and discharge connections and inspect the interior completely for foreign material. If cleaning is required, finish by washing the cylinder, headplates and impeller thoroughly with a petroleum solvent. Turn the drive shaft by hand to make sure that the impellers turn freely at all points. Anti-rust compound on the connection flanges and drive shaft extension may also be removed at this time with the same solvent. Cover the flanges until ready to connect piping.

Mounting

Care will pay dividends when arranging the unit mounting. This is especially true when the unit is a "bare-shaft" unit furnished without a baseplate. The convenient procedure may be to mount such a unit directly on a floor or small concrete pad, but this generally produces the least satisfactory results. It definitely causes the most problems in leveling and alignment and may result in a "Soft Foot" condition. Correct soft foot before operation to avoid unnecessary loading on the casing and bearings. Direct use of building structural framing members is not recommended.

For blowers without a base, it is recommended that a well anchored and carefully leveled steel or cast iron mounting plate be provided. The plate should be at least 1 inch (25 mm) thick, with its top surface machined flat, and large enough to provide leveling areas at one side and one end after the unit is mounted. It should have properly sized studs or tapped holes located to match the unit foot drilling. Proper use of a high quality machinist's level is necessary for adequate installation.

With the mounting plate in place and leveled, set the unit on it without bolting and check for rocking. If it is not solid, determine the total thickness of shims required under one foot to stop rocking. Place half of this under each of the diagonally-opposite short feet, and tighten the mounting studs or screws. Rotate the drive shaft to make sure the impellers turn freely. If the unit is to be direct coupled to a driving motor, consider the height of the motor shaft and the necessity for it to be aligned very accurately with the unit shaft. Best unit arrangement is directly bolted to the mounting plate while the driver is on shims of at least 1/8 inch (3mm) thickness. This allows adjustment of motor position in final shaft alignment by varying the shim thickness.

Aligning

When unit and driver are factory mounted on a common baseplate, the assembly will have been properly aligned and is to be treated as a unit for leveling purposes. Satisfactory installation can be obtained by setting the baseplate on a concrete slab that is rigid and free of vibration, and leveling the top of the base carefully in two directions so that it is free of twist. The slab must be provided with suitable anchor bolts. The use of grouting under and partly inside the leveled and shimmed base is recommended.

It is possible for a base-mounted assembly to become twisted during shipment, thus disturbing the original alignment. For this reason, make the following checks after the base has been leveled and bolted down. Disconnect the drive and rotate the unit shaft by hand. It should turn freely at all points. Loosen the unit foot hold-down screws and determine whether all feet are evenly in contact with the base. If not, insert shims as required and again check for free impeller rotation. Finally, if unit is direct coupled to the driver, check shaft and coupling alignment carefully and make any necessary corrections.

In planning the installation, and before setting the unit, consider how piping arrangements are dictated by the unit design and assembly. Drive shaft rotation must be established accordingly and is indicated by an arrow near the shaft.

Typical arrangement on vertical units has the drive shaft at the top with counterclockwise rotation and discharge to the left. Horizontal units are typically arranged with the drive shaft at the left with counter-clockwise rotation and discharge down. See Figure 3 and 4 for other various unit arrangements and possible conversions.

When a unit is DIRECT COUPLED to its driver, the driver RPM must be selected or governed so as not to exceed the maximum speed rating of the unit. Refer to Table 1 for allowable speeds of various unit sizes. A flexible type coupling should always be used to connect the driver and unit shafts.

Coupling halves must be accurately aligned, and a sufficient gap between shaft ends provided so that side strains and end thrust on either shaft are avoided or minimized. This will require considerable care in the mounting of the driver. The two shafts must be in as near perfect alignment in all directions as possible, and the gap must be established with the motor armature on its electrical center if end-play exists.

The following requirements of a good installation are recommended. Coupling halves must be fitted to the two shafts with a line to line thru .001" interference fit. Coupling halves must be warmed up, so that only light tapping is required to install them. Maximum deviation in offset alignment of the shafts should not exceed .005" (.13 mm) total indicator reading, taken on the two coupling hubs. Maximum deviation from parallel of the inside coupling faces should not exceed .001" (.03 mm) when checked at six points around the coupling.

When a unit is BELT DRIVEN, the proper selection of sheave diameters will result in the required unit speed. This flexibility can lead to operating temperature problems caused by unit speed being too low. Make sure the drive speed selected is within the allowable range for the specific unit size, as specified under Table 1.

Belt drive arrangements usually employ two or more V-belts running in grooved sheaves. Installation of the driver is less critical than for direct coupling, but its shaft must be level and parallel with the unit shaft. **The driver should be mounted on the inlet side of a vertical unit (horizontal piping) and on the side nearest to the shaft on a horizontal unit.** The driver must also be mounted on an adjustable base to permit installing, adjusting and removing the V-belts. To position the driver correctly, both sheaves need to be mounted on their shafts and the nominal shaft center distance known for the belt lengths to be used.

Install the unit sheave so that its inner hub face is not more than 1/8 inch (3mm) from the drive end cover. See page 18 for minimum sheave diameter and maximum sheave width. The shaft fit should be such that the sheave can be worked into place by hand or by very light tapping. A tight or driving fit can damage a bearing, and may cause internal unit damage by forcing the impeller out of its normal operating position. A loose fit or wobbly sheave will cause vibration, and may result in shaft breakage.

CAUTION: Couplings as well as sheave bushings must have a slight slide fit with the unit shaft such that they can be installed in place by hand. Any force used to install them could change unit end clearance resulting in unit damage. If interference fit is desired for the coupling, the coupling hub should be heated and shrunk on the shaft. For engine drives, use "locktite" between the coupling hubs and the shafts and on the threads of the coupling set screws.

The driver sheave should also be mounted as close to its bearing as possible, and again should fit the shaft correctly. Position the driver on its adjustable base so that 2/3 of the total movement is available in the direction away from the unit, and mount the assembly so that the face of the sheave is accurately in line with the unit sheave. This position minimizes belt wear, and allows sufficient adjustment for both installing and tightening the belts. After belts are installed, adjust their tension in accordance with the manufacturer's instructions. However, only enough tension should be applied to prevent slippage when the unit is operating under load. Excessive tightening can lead to early bearing failures or shaft breakage.

Before operating the drive under power to check initial belt tension, first remove covers from the unit connections. Make sure the interior is still clean, then rotate the shaft by hand. Place a coarse screen over the inlet connection to prevent anything being drawn into the unit while it is operating, and avoid standing in line with the discharge opening. Put oil in the sumps per instructions under **LUBRICATION.**

Piping

Before connecting piping, remove any remaining anti-rust compound from Unit connections. Clean pipe should be no smaller than unit connections. In addition, make sure it is free of scale, cuttings, weld beads, or foreign material of any kind. To further guard against damage to the unit, especially when an inlet filter is not used, install a substantial screen of 16 mesh backed with hardware cloth at or near the inlet connections. Make provisions to clean this screen of collected debris after a few hours of operation. It should be removed when its usefulness has ended, as the wire will eventually deteriorate and small pieces going into the unit may cause serious damage.

Pipe flanges or male threads must meet the unit connections accurately and squarely. DO NOT attempt to correct misalignment by springing or cramping the pipe. In most cases this will distort the unit casing and cause impeller rubbing. In severe cases it can prevent operation or result in a broken drive shaft. For similar reasons, piping should be supported near the unit to eliminate dead weight strains. Also, if pipe expansion is likely to occur from temperature change, installation of flexible connectors or expansion joints is advisable.

Figure 2 represents an installation with all accessory items that might be required under various operating conditions. Inlet piping should be completely free of valves or other restrictions. When a shut-off valve can not be avoided, make sure a full size vacuum relief is installed nearest the unit inlet. This will protect against unit overload caused by accidental closing of the shut-off valve.

Need for an inlet silencer will depend on unit speed and pressure, as well as sound-level requirements in the general surroundings. An inlet filter is recommended, especially in dusty or sandy locations. A discharge silencer is also normally suggested, even though Whispair units operate at generally lower noise levels than conventional rotary blowers. Specific recommendations on silencing can be obtained from ROOTS.

Discharge piping requires a pressure relief valve, and should include a manual unloading valve to permit starting the unit under no-load conditions. Reliable pressure/vacuum gauges and good thermometers at both inlet and discharge are recommended to allow making the important checks on unit operating conditions. The back-pressure regulator shown in Figure 2 is useful mainly when volume demands vary while the unit operates at constant output. If demand is constant, but somewhat lower than the unit output, excess may be blown off through the manual unloading valve.

In multiple unit installations where two or more units operate with a common header, use of check valves is mandatory. These should be of a direct acting or free swinging type, with one valve located in each line between the unit and header. Properly installed, they will protect against damage from reverse rotation caused by air and material back-flow through an idle unit.

After piping is completed, and before applying power, rotate the drive shaft by hand again. If it does not move with uniform freedom, look for uneven mounting, piping strain, excessive belt tension or coupling misalignment.

DO NOT operate the unit at this time unless it has been lubricated per instructions.

LUBRICATION: For Units with a Grease Lubricated Drive End

A simple but very effective lubrication system is employed on the drive shaft end bearings. Hydraulic pressure relief fittings are provided to vent any excess grease, preventing pressure build-up on the seals. A restriction plug and metering orifice prevent loss of lubricant from initial surges in lubricant pressure but permit venting excess lubricant under steadily rising pressures.

When servicing drive end bearings, use a NLGI #2 premium grade grease with 300°F (149°C) service temperature and moisture resistance and good mechanical stability. Using a pressure gun, slowly force new lubricant into each drive end bearing housing until traces of clean grease comes out of the relief fitting.

After a long shutdown, it is recommended that the grease fittings be removed, the old grease flushed out with kerosene or #10 lubricating oil, drained thoroughly, and bearings refilled with new grease. Be sure grease relief fittings are reinstalled. Grease should be added using a hand operated grease gun to the drive end bearings at varying time intervals depending on duty cycle and RPM. Table 4 has been prepared as a general greasing schedule guide based on average operating conditions. More frequent intervals may be necessary depending on the grease operating temperature and unusual circumstances. ROOTS™ synthetic grease (ROOTS P/N T20019-) is highly recommended.

LUBRICATION: For Units with Splash Lubrication on Both Ends

Bearings and oil seals are lubricated by the action of the timing gears or oil slingers which dip into the main oil sumps causing oil to splash directly on gears and into bearings and seals. A drain port is provided below each bearing to prevent an excessive amount of oil in the bearings. Seals located inboard of the bearings in each headplate effectively retain oil within the sumps. Any small leakage that may occur should the seals wear passes into a cavity in each vented headplate and is drained downward.

Oil sumps on each end of the blower are filled by removing top vent plugs, Item (21), and filling until oil reaches the middle of the oil level sight gauge, Item (37), or the overflow plug.

Initial filling of the sumps should be accomplished with the blower not operating, in order to obtain the correct oil level. Approximate oil quantities required for blowers of the various models and configurations are listed in Table 3. Use a good grade of industrial type non-detergent, rust inhibiting, anti-foaming oil and of correct viscosity per Table 2. ROOTS™ synthetic oil (ROOTS P/N 813-106-) is highly recommended.

The oil level should not fall below the middle of the site gauge when the blower is idle. It may rise on the gauge during operation, to an extent depending somewhat on oil temperature and blower speed.

Proper lubrication is usually the most important single consideration in obtaining maximum service life and satisfactory operation from the unit. Unless operating conditions are quite severe, a weekly check of oil level and necessary addition of lubricant should be sufficient. During the first week of operation, check the oil levels in the oil sumps about once a day, and watch for leaks. Replenish as necessary. Thereafter, an occasional check should be sufficient. It is recommended that the oil be changed after initial 100 hours of operation. Frequent oil changing is not necessary unless the blower is operated in a very dusty location. Normal life expectancy of petroleum based oils is about 2000 hours with an oil temperature of about 200°F (93°C). As the oil temperature increases by increments of 15-18°F (8°C - 10°C), the life is reduced by half. Example: Oil temperatures of 230-236°F (110°C - 113°C) will produce life expectancy of 1/4 or 500 hours. Therefore, it is considered normal to have oil change periods of 500 hours with petroleum based oils.

Before operating a blower under power for the first time, recheck the unit and the installation thoroughly to reduce the likelihood of avoidable troubles. Use the following procedure check list as a guide, but consider any other special conditions in the installation.

- ☐ Be certain that no bolts, tools, rags, or debris have been left in the blower air chamber or piping.
- ☐ If an outdoor intake without filter is used, be sure the opening is located so it cannot pick up dirt and is protected by a strong screen or grille. Use of the temporary protective screen as described under INSTALLATION is strongly recommended.
- ☐ Recheck blower leveling, drive alignment and tightness of all mounting bolts if installation is not recent. If belt drive is used, adjust belt tension correctly.
- ☐ Turn drive shaft by hand to make sure impellers still rotate without bumping or rubbing at any point.
- ☐ Make sure oil levels in the main oil sumps are correct.
- ☐ Check lubrication of driver. If it is an electric motor, be sure that power is available and that electrical overload devices are installed and workable.
- ☐ Open the manual unloading valve in the discharge air line. If a valve is in the inlet piping, be sure it is open.
- ☐ Bump blower a few revolutions with driver to check that direction of rotation agrees with arrow near blower shaft, and that both coast freely to a stop.

After the preceding points are cleared, blower is ready for trial operation under "no-load" conditions. The following procedure is suggested to cover this initial operation test period.

a. Start blower, let it accelerate to full speed, then shut off. Listen for knocking sounds, both with power on and as speed slows down.

b. Repeat above, but let blower run 2 or 3 minutes. Check for noises, such as knocking sounds.

c. Operate blower for about 10 minutes unloaded. Check oil levels. Observe cylinder and headplate surfaces for development of hot spots such as burned paint, indicating impeller rubs. Be aware of any noticeable increase in vibration.

Assuming that all trials have been satisfactory, or that necessary corrections have been made, the blower should now have a final check run of at least one hour under normal operating conditions. After blower is restarted, gradually close the discharge unloading valve to apply working pressure. At this point it is recommended that a good pressure gauge or manometer be connected into the discharge line if not already provided, and that thermometers be in both inlet and discharge lines. Readings from these instruments will show whether pressure or temperature ratings of the blower are being exceeded.

During the final run, check operating conditions frequently and observe the oil levels at reasonable intervals. If excessive noise or local heating develops, shut down immediately and determine the cause. If either pressure rise or temperature rise across the blower exceeds the limit specified in this manual, shut down and investigate conditions in the piping system. Refer to the **TROUBLESHOOTING CHECKLIST** for suggestions on various problems that may appear.

The blower should now be ready for continuous duty operation at full load. During the first few days make periodic checks to determine whether all conditions remain steady, or at least acceptable. This may be particularly important if the blower is supplying air to a process system where conditions can vary. At the first opportunity, stop the blower and clean the temporary inlet protective screen. If no appreciable amount of debris has collected, the screen may be removed. See comments under **INSTALLATION**. At this same time, verify leveling, coupling alignment or belt tension, and mounting bolt tightness.

Should operating experience prove that blower capacity is a little too high for the actual air requirements, a small excess may be blown off continuously through the manual unloading or vent valve. Never rely on the pressure relief valve as an automatic vent. Such use may cause the discharge pressure to become excessive, and can also result in failure of the valve itself. If blower capacity appears to be too low, refer to the **TROUBLESHOOTING CHECKLIST.**

Vibration Assessment Criteria

With measurements taken at the bearing locations on the housings, see chart below for an appropriate assessment guide for rotary lobe blowers rigidly mounted on stiff foundations.

In general, blower vibration levels should be monitored on a regular basis and the vibration trend observed for progressive or sudden change in level. If such a change occurs, the cause should be determined through spectral analysis.

As shown on the chart below, the level of all pass vibration will determine the need to measure discrete frequency vibration levels and the action required.

All Pass Vibration (in/sec)	Discrete Frequency Vibration (in/sec)	Action
0.45 or less	N/R	Approved
Greater than 0.45 but 1.0 or less	0.45 or less @ any frequency	Approved
	Greater than 0.45 @ any frequency	ROOTS™ Approval Required
Greater than 1.0	Less than 1.0	ROOTS™ Approval Required
	Greater than 1.0	ROOTS™ Approval Required

Operating Characteristics

ROOTS™ rotary blowers and exhausters, as covered in this manual, are available in basic frame sizes ranging from 2 inch to 7 inch gear diameter. Various models, within this gear diameter range, are available with different case lengths to produce reasonable steps in flow capacity. The shorter case lengths have lower volumetric capacities, but are capable of operating against higher pressures. All models are available for air service and there are specifically designed models for gas service.

The basic ROOTS™ rotary lobe blower is a positive displacement type unit. Flow capacity is determined by frame size, operating speed and pressure conditions. It employs two impellers mounted on parallel shafts rotating in opposite directions within a cylinder closed at the ends by head-plates. As the impellers rotate, gas is drawn into one side of the cylinder and forced out the opposite side. The pressure or vacuum developed depends on the resistance of the piping and process system.

The unit is a precision engineered product with very fine clearances between the rotating impellers and stationary case. Since there is no actual contact between these surfaces, internal lubrication is not required. Clearances are maintained by a pair of accurately machined timing gears, mounted on the two shafts extended outside the blower casing.

Operation of the familiar basic rotary lobe blower is illustrated in FIGURE 1, where air flow is left to right from inlet to discharge with the top impeller rotating clockwise. In Position 1 it is delivering a known volume (B) to the discharge, while space (A) between the lower impeller and cylinder wall is being filled. Counterclockwise rotation of this impeller then traps equal volume (A) in Position 2, and further rotation delivers it to the discharge in Position 3.

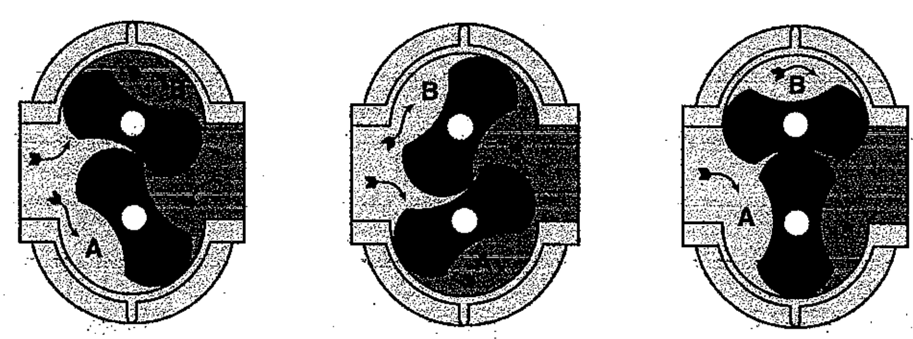
One complete revolution of the driving shaft alternately traps four fixed and equal volumes of air (two by each impeller) and pushes them through to the discharge. The volume capacity of a lobe blower operating at a constant speed therefore remains relatively independent of reasonable inlet of discharge pressure variations. To change capacity, it is necessary either to change speed of rotation or blow off some of the discharge air.

No attempt should ever be made to control capacity by means of a throttle valve in the intake or discharge piping. This will not only increase the power load on the driver, but can also overload and seriously damage the blower. If a possibility does exist that flow to the blower inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve must be installed near the blower. A pressure type relief valve in the discharge line near the blower is required for protection against cut-off or blocking in this line. Refer to FIGURE 3 for a complete piping schematic.

When a belt drive is installed, blower speed can usually be adjusted to obtain desired capacity by changing the diameter of one or both sheaves. In a direct coupled arrangement a variable speed motor or transmission is required, or excess air may be blown off through a manually controlled unloading valve and silencer. If returned to the blower inlet, the air must be cooled to 100°F (38°C) through a by-pass arrangement to maintain acceptable blower temperatures.

Before making any change in blower capacity, or operating conditions, contact ROOTS for specific information applying to your particular blower. In all cases, operating conditions must be maintained within the approved range of pressures, temperatures and speeds as stated under **LIMITATIONS.** The air blower must not be used to handle liquids or solids as serious damage to the rotating parts may result.

Figure 1 – Flow Through a Basic Rotary Lobe Blower



POSITION 1 **POSITION 2** **POSITION 3**

TROUBLESHOOTING

Trouble	Item	Possible Cause	Remedy
No flow	1	Speed too low	Check by tachometer and compare with published performance
	2	Wrong rotation	Compare actual rotation with Figure 1 or 2 Change driver if wrong
	3	Obstruction in piping	Check piping, valves, silencer to assure open flow path
Low capacity	4	Speed too low	See item 1, If belt drive, check for slippage and readjust tension
	5	Excessive pressure rise	Check inlet vacuum and discharge pressure and compare with Published performance
	6	Obstruction in piping	See item 3
	7	Excessive slip	Check inside of casing for worn or eroded surfaces causing excessive clearances
Excessive power	8	Speed too high	Check speed and compare with published performance
	9	Excessive pressure rise	See Item 5
	10	Impeller rubbing	Inspect outside of cylinder for high temperature areas, then check for impeller contact at these points. Correct blower mounting, drive alignment
	11	Scale, sludge, rust or product build up	Clean blower appropriately
Overheating of bearing or gears	12	Inadequate lubrication	Check oil sump levels in gear and drive end headplates
	13	Excessive lubrication	Check oil levels. If correct, drain and refill with clean oil of recommended grade
	14	Excessive pressure rise	See Item 5
	15	Coupling misalignment	Check carefully. Realign if questionable
	16	Excessive belt tension	Readjust for correct tension
Vibration	17	Misalignment	See Item 15
	18	Impellers rubbing	See Item 10
	19	Worn bearings/gears	Check gear backlash and condition of bearings, and replace as indicated
	20	Unbalanced or rubbing impeller	Scale or process material may build up on casing and impellers, or inside impellers. Remove build-up to restore original clearances and impeller balance
	21	Driver or blower loose	Tighten mounting bolts securely
	22	Piping resonances	Determine whether standing wave pressure pulsations are present in the piping
	23	Scale/sludge build-ups	Clean out interior of impeller lobes to restore dynamic balance
	24	Casing strain	re-work piping alignment to remove excess strain
Driver stops, or will not start	25	Impeller stuck	Check for excessive hot spot on headplate or cylinder. See item 10. Look for defective shaft bearing and/or gear teeth
	26	Scale, sludge, rust or product build-up	Clean blower appropriately
Excessive breather	27	Broken seal	Replace seals
Blow-by or excessive oil leakage to vent area	28	Defective O-ring	Replace seals and O-ring

A good program of consistent inspection and maintenance is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are:

- Lubrication
- Checking for hot spots
- Checking for increases or changes in vibration and noise
- Recording of operating pressures and temperatures

Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked often during the first month of full-time operation. Attention thereafter may be less frequent assuming satisfactory performance. Lubrication is normally the most important consideration and weekly checks of lubricant levels in the gearbox and bearing reservoirs should be customary. Complete oil change schedules are discussed under **LUBRICATION.**

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent unnecessary vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts.

In a new, and properly installed, unit there is no contact between the two impellers, or between the impellers and cylinder or headplates. Wear is confined to the bearings (which support and locate the shafts) the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil of the correct grade is always used. Seals are subject to deterioration as well as wear, and may require replacement at varying periods.

Shaft bearings are designed for optimum life under average conditions with proper lubrication and are critical to the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and casing. This will cause spot heating, which can be detected by observing these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for any reason. Sealing effectiveness can vary considerably from seal to seal and is also affected to surprising degree by shaft finish under the seal lip. Because of these normal variables, minor seal leakage should not be considered as indicating seal replacement.

Timing gear wear, when correct lubrication is maintained, should be negligible over a period of years. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers. However, too high an oil level will cause churning and excessive heating. This is indicated by unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance , backlash and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interference or casing rubs to result from shifts in the blower mounting, or from changes in piping support. If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely Foreign materials in the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

A wide range of causes & solutions for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST.** The remedies suggested should be performed by qualified mechanics with a good background, using procedures detailed in this manual. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to ROOTS.

Warranty failures should not be repaired at all, unless specific approval has been obtained through ROOTS before starting work. Unauthorized disassembly within the warranty period will void the warranty.

It is recommended that major repairs be performed at an authorized ROOTS facility. However, it is recognized that this may not always be practical. If a blower is out of warranty, mechanical adjustments and parts replacement may be undertaken locally at the owner's option and risk. It is recommended that ROOTS™ parts be used to insure fit and suitability. The maintenance of a small stock of on-hand spare parts can eliminate possible delays. When ordering parts give item numbers and their word descriptions from the appropriate sectional drawings. Also specify quantities required and the blower model and serial number from the nameplate.

Repairs or adjustments are best performed by personnel with good mechanical experience and the ability to follow the instructions in this manual. Some operations involve extra care, patience, and a degree of precision work. This is especially true in timing impellers and in handling bearings. Experience indicates that high percentages of bearing failures are caused by dirt contamination before or during assembly. Therefore, the work area should be cleaned before starting disassembly, and new or re-usable parts protected during progress of the work.

In the following repair procedures, numbers shown in brackets ( ) correspond to the item numbers used in sectional drawings. It is recommended that the procedures be studied carefully and completely, with frequent reference to the drawings, before starting work. This will produce better efficiency through an understanding of what work is to be done, and the order of doing it. Before disassembly, mark all parts so that they may be returned to original locations or relative positions.

Requirements for special tools will depend on the work to be done. If impeller clearances and float are to be checked or re-set, a dial indicator and a set of long feeler gauges will be needed. Work involving removal of the timing gears cannot be accomplished without a suitable puller.

Design of ROOTS™ blower is simple, and most repair operations are straightforward. For this reason, the following procedures are intended mainly to indicate a preferred work order and to call out points to be observed. Where special operations are required, detailed coverage is given.

A – Replacing Timing Gears

1. Drain all oil from the gearhouse by removing drain plug (21) in the bottom. Remove gearhouse by taking out all cap screws (23) in its flange. It may be necessary to bump the sides with a wood block or mallet to break the flange joint.
2. Reach through one of the blower pipe connections and place a chalk mark on the strip of one impeller and the mating waist of the other, so that they may easily be returned to their original relative positions.
3. **GEAR REMOVAL:** CAUTION: Do not remove gear nuts (17) completely before the gears are unseated from the taper fits or damage/injury may result. For this operation, the impellers should be wedged, as shown in Table 5. Back off gear clamping nuts (17) about 1/4". Use a suitable puller or wedge. As the puller set screw is torqued, the puller will have a tendency to turn and contact teeth of the other gear. To prevent this contact, hold the puller corner nut with a wrench while torquing the set screw. Once the gear is unseated, remove the puller. Remove gear nuts (17) and the gear.
4. **GEAR INSTALLATION:** Place impellers in correct position as previously marked. Be sure shafts and gear bores are clean, oil free and free of scratches. Clean the shaft tapered fits. Place hardwood wedges as shown in Table 5. Install drive gear (4) and gear nut (17). Tighten the drive gear nut to the torque given below. Blower assembly must be fastened down for torquing operation.
5. Installing driven gear (4) – Insert a long, metal feeler gauge between the impellers' lobes at the fronts or backs as shown below. Feeler gauge thickness to be a middle value from Table 5 for fronts and backs. Install nut (17). Tighten lightly with a small wrench, then check front and back clearances against Table 5 for each 45° position. Both fronts and backs should be about the same and within the specified range in Table 5. Adjust gear position, if necessary, then insert the corrected feeler gauge and wedges and use a torque wrench to tighten the gear nut to the torque specified in below. Remove wedges and rotate the drive shaft by hand to make sure there are no gear tight spots or impeller contacts. **CAUTION!** *Keep fingers away from impellers and gears.*

Univeral RAI® Series Blower Gear Nut Torque

Frame Size	Torque	
	lb.-ft.	(kg-m)
22, 24,	60	(8.3)
32, 33, 36	110	(15.2)
42, 45, 47	190	(26.3)
53, 56, 59	250	(34.6)
65, 68, 615	400	(55.3)
76, 711, 718	550	(76.1)

6. Check the end clearances between impellers and headplates. Adjust clearances per B-15 below.
7. When clearances are correct, clean and re-install the gearhouse. Check condition of flange gasket (7) and replace if questionable. Fill gearhouse to correct level with proper grade oil.

B – Replacing Shaft Bearings and Impellers

Remove coupling or sheave from the drive shaft. Drain and remove gearhouse, and pull the timing gears. If gears are to be re-used, mark them so they may be returned to the same shafts.

1. Break corners and deburr the keyway. Remove bearing end cover at the drive end. Remove bearing clamp plates (34).
2. Make single and double identifying punch marks on the mating edges of headplate and cylinder flanges at the two ends of the blower.
3. At the drive end, drive out the two dowel pins and remove all capscrews holding headplate to cylinder. By inserting jacking screws into the two threaded flange holed, and turning them in evenly, the headplate will be separated from the cylinder. As the headplate comes off the shafts it will bring bearings with it. 2-1/2" and 3-1/2" gear diameter units do not have tapped holes for jack screws in the drive end headplates. Remove dowel pins and all capscrews holding headplate to cylinder and foot on the drive end. Support unit under gear end cylinder flange with the shafts vertical. Using soft metal block against gear end shafts, push them out of gear end headplate.
4. For 2-1/2" and 3-1/2" gear diameter units, support the drive end headplate on the underside, and using soft metal block against drive end shafts, push them out of drive end headplate.

   For 4", 6" & 7" gear diameter units, from the gear end, using a wood or soft metal block against the ends of the shafts, drive them out of the head plate. If they are to be reused, protect them from damage in this operation.
5. If blower interior surfaces need cleaning, it may be advisable to separate the gear end headplate from the cylinder. Use the same general procedure as employed at the drive end.
6. Working from the back (flat) face of each head plate, push or tap out the bearings and seals. Use a round bar or tube that will pass through the shaft clearance holes in the headplates. All lip seals will be damaged during removal and must be replaced.
7. Clean bearing and seal pockets in headplates and remove burrs or rough edges. (Apply a thin coating of sealant on seal O.D.) Press new seals (27) into gear end headplate using a round tube or bar with recessed end that will bear on the outer metal edge of seal enclosure. Seal lip should point toward the driving tool. Seals to be flush without board bore face. Apply a light coat of oil or grease to the seal lips. In a similar fashion, install lip seals into the drive end headplate.
8. Place cylinder on a flat surface. Assemble gear end headplate to cylinder after checking flange punch marks. Drive in the two locating dowel pins before tightening flange screws. Also install gear end foot using the same longer cap screws (32) and washers (41). (On 6" & 7" UNIVERSAL RAI® blower install both gear end feet.)
9. Place the assembly horizontally on steel blocks with gear end headplate on bottom. The height of the blocks should be sufficient to clear gear end shaft extensions. Assemble impellers into the cylinder with the drive shaft (longer shaft) in same location as in original assembly. Before starting the shafts through the headplate holes, make sure shaft ends have no sharp or rough edges to damage seal lips. Position impellers at 90° to each other in the cylinder, using lobe-and-waist match marks if original impellers are being re-installed. Install drive end headplate and feet in same manner as gear end.
10. It is recommended that new bearings be used for rebuild. Apply thin film of machine oil on the shaft bearing fit, bearing I.D., and headplate bearing bore. Install drive end bearings into headplate. Use a tube with flanged end that will contact both bearing faces simultaneously. Refer to Assembly Drawing for proper bearing depths.
    NOTE: *Cylindrical drive bearing should be installed with inner race large shoulder facing outboard.*
11. Place blower on its feet on a flat surface. Loosen feet capscrews (32) and square up unit. Re-tighten capscrews (32). Clamp unit down to a solid base for further assembly.
12. Oil the gear end bearing fits as described previously. Install 2-1/2" thru 5" blower gear end bearings flush with the headplate bearing shoulders using proper drivers. On 6" & 7" gear diameter units, install thrust washer (29) in bearing bores then install gear end bearings so they protrude 1/16" (1.6mm) above headplate surface.
13. Install bearing clamp plates (34). On 6" & 7" gear diameter units, blower impeller end clearances are also to be set during this step. Install clamp plates (34) with capscrews (31) making sure that the gap between the clamp plates and the headplate is even all around. At the same time, set end clearances per Table 5.
14. Install gears and time impellers as in (A).

15. For setting end clearances on 2-1/2" thru 5" gear diameter units, special tools, thrust adjuster fork and thrust adjuster saddle are required. Refer to Table 5 for installation of tools. The flat side of the saddle rests against the bearing inner race and the flat side of the fork rests against the back side of the gear. Install a shim, with thickness equal to gear end clearance (Table 5), between the impeller and the gear end headplates. Tap on top of the fork until the shim becomes snug. Remove the shim and check end clearances. To increase gear end clearance, tap on the end of the gear end shaft with a soft metal mallet. Set end clearances for 6" & 7" by turning capscrews (31) evenly in or out.
16. Install drive end cover (5) after packing bearing cavities with suitable grease. Replace drive shaft seal. Lip must point toward (33) the bearing. Exercise care not to damage the lip as it passes over shaft keyway.
17. Install gasket item (7). Install the gear house after cleaning out the inside. Tighten gear box cap screws (23) evenly. Fill with correct grade of oil until oil flows out through oil level hole. Grease drive and bearings. (See Lubrication.)
18. Reinstall coupling or belt sheave making sure that they have a slight slide fit with the shaft and could be installed by hand.

TECHNICAL SUPPLEMENT

for 32, 33, 36, 42, 45, 47, 53, 56, 59, 65, 68, 615 UNIVERAL RAI®-G BLOWERS

ROOTS™ Universal RAI™-G rotary positive gas blowers are a design extension of the basic Universal RAI™ blower model. URAI™-G blower uses (4) mechanical seals in place of the standard in board lip seals to minimize gas leakage into the atmosphere. The seal vent chambers are plugged. These units are intended for gases which are compatible with cast iron case material, steel shafts, 300/400 series stainless steel and carbon seal components, viton o-rings and the oil/grease lubricants. If there are any questions regarding application or operation of this gas blower, please contact factory.

Precaution: ***URAI™-G blowers: Care must be used when opening the head plate seal vent chamber plugs (43) as some gas will escape–if it is a pressure system, or the atmospheric air will leak in-if the system is under vacuum. There is a possibility of some gas leakage through the mechanical seals. This leakage on the gear end will escape through the gear box vent, and on the drive end, through the grease release fittings. If the gas leakage is undesirable, each seal chamber must be purged with an inert gas through one purge gas hole (43) per seal . There are two plugged purge gas holes(1/8 NPT) provided per seal. The purge gas pressure must be maintained one psi above the discharge gas pressure. Also, there exists a possibility of gear end oil and drive end grease leakage into the gas stream.***

The lubricants selected must be compatible with the gas. Mechanical Seal Replacement: Disassemble the blower. During disassembly, damage to mechanical seals is very likely. During rebuild, always use new mechanical seals. Prior to any assembly, make sure that all parts are completely clean and free from nicks and scratches.

(1) Place head plate on an assembly table with seal bores pointing up. Coat the OD of the stationary seal element and install it with carbon facing up in the seal bore with a seal driver that is guided by the bearing bore. Drive the seal flush with front face of the seal bore. Repeat this procedure for all four seals. Apply a light coating of lubricating oil on the sealing surface. Protect sealing faces during assembly from any damage.

(2) Apply teflon based sealant on the cylinder flanges before installing head plates. Continue the assembly procedure as outlined up to bearing installation. Before installation of the bearings, the seal mating rings need to be installed. Apply light film of lubricating oil on mating ring o-rings and sealing faces. Slide mating rings on the shaft and up to carbon faces making sure that no damage to the o-rings occur during installation (break sharp shaft corners to avoid damage to the o-rings during initial preparation). Install bearings all the way against the back bearing bore shoulders.

(3) Complete the rest of the assembly.Make sure all plugged holes are sealed with teflon thread liquid sealant.

Note: On 6" gear diameter units, shims (44) are used between the bearing clamp plates and the head plate on the gear end.

Also, on size 32 and 42, washers with embedded o-rings are used on the center head plate to cylinder bolts.

After the assembly is completed, plug the blower inlet and discharge connections and run static soap bubble. Leak test to assure leak free assembly.

For satisfactory operation of mechanical seals, synthetic lubricants are recommended (Check suitability to gases before using.)

Oils:

(1) ROOTS™ GT Synthetic Lubricant ROOTS P/N 13-106-001 (1) one quart ISO-220

(2) Mobil SHC 600 Series Lubricating Oils

Grease:

ROOTS™ Synthetic Grease – NLGI # 2
ROOTS P/N T20-019-001 (1) one 14 oz tube

MAINTENANCE & REPLACEMENTS: RAM™ SERIES BLOWERS

A good program of consistent inspection and maintenance is the most reliable method of minimizing repairs to a blower. A simple record of services and dates will help keep this work on a regular schedule. Basic service needs are:

- Lubrication
- Checking for hot spots
- Checking for increases or changes in vibration and noise
- Recording of operating pressures and temperatures

Above all, a blower must be operated within its specified rating limits, to obtain satisfactory service life.

A newly installed blower should be checked often during the first month of full-time operation. Attention thereafter may be less frequent assuming satisfactory performance. Lubrication is normally the most important consideration and weekly checks of lubricant levels in the gearbox and bearing reservoirs should be customary. Complete oil change schedules are discussed under **LUBRICATION.**

Driver lubrication practices should be in accordance with the manufacturer's instructions. If direct connected to the blower through a lubricated type coupling, the coupling should be checked and greased each time blower oil is changed. This will help reduce wear and prevent unnecessary vibration. In a belted drive system, check belt tension periodically and inspect for frayed or cracked belts.

In a new, and properly installed, unit there is no contact between the two impellers, or between the impellers and cylinder or headplates. Wear is confined to the bearings (which support and locate the shafts) the oil seals, and the timing gears. All are lubricated and wear should be minimal if clean oil of the correct grade is always used. Seals are subject to deterioration and wear, and may require replacement at varying periods.

Piston ring seals (28) are designed to operate without rubbing contact, once temperature and thermal growth have stabilized. The stationary rings will rub the rotating sleeve (38) briefly as a result of temperature cycles that occur during the startup and shutdown of the unit. The sleeves are hardened and the rings are coated with dry lubricant that provides for temporary break in wear. Replace piston ring seals if they become excessively worn or inspection shows more than .010" (.25mm) axial clearance between ring and groove.

Shaft bearings are designed for optimum life under average conditions with proper lubrication and are critical to the service life of the blower. Gradual bearing wear may allow a shaft position to change slightly, until rubbing develops between impeller and casing. This will cause spot heating, which can be detected by observing these surfaces. Sudden bearing failure is usually more serious. Since the shaft and impeller are no longer supported and properly located, extensive general damage to the blower casing and gears is likely to occur.

Oil seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive or when the blower is disassembled for any reason. Sealing effectiveness can vary considerably from seal to seal and is also affected to surprising degree by shaft finish under the seal lip. Because of these normal variables, minor seal leakage should not be considered as indicating seal replacement.

Timing gear wear, when correct lubrication is maintained, should be negligible over a period of years. Gear teeth are cut to provide the correct amount of backlash, and gears correctly mounted on the shafts will accommodate a normal amount of tooth wear without permitting contact between lobes of the two impellers. However, too high an oil level will cause churning and excessive heating. This is indicated by unusually high temperature at the bottom of the gear housing. Consequent heating of the gears will result in loss of tooth-clearance , backlash and rapid wear of the gear teeth usually will develop. Continuation of this tooth wear will eventually produce impeller contacts (knocking), and from this point serious damage will be unavoidable if blower operation is continued. A similar situation can be produced suddenly by gear tooth fracture, which is usually brought on by sustained overloading or momentary shock loads.

Problems may also develop from causes other than internal parts failure. Operating clearances within a blower are only a few thousandths of an inch. This makes it possible for impeller interferences or casing rubs to result from shifts in the blower mounting, or from changes in piping support. If this type of trouble is experienced, and the blower is found to be clean, try removing mounting strains. Loosen blower mounting bolts and reset the leveling and drive alignment. Then tighten mounting again, and make sure that all piping meets blower connections accurately and squarely Foreign materials sucked into the blower will also cause trouble, which can only be cured by disconnecting the piping and thoroughly cleaning the blower interior.

A wide range of causes & solutions for operating troubles are covered in the **TROUBLE SHOOTING CHECKLIST**. The remedies suggested should be performed by qualified mechanics with a good background, using procedures detailed in this manual. Major repairs generally are to be considered beyond the scope of maintenance, and should be referred to ROOTS.

Warranty failures should not be repaired at all, unless specific approval has been obtained through a Sales Office or the factory before starting work. Unauthorized disassembly within the warranty period will void the warranty.

It is recommended that major repairs be performed at an authorized ROOTS facility. However, it is recognized that this may not always be practical. If a blower is out of warranty, mechanical adjustments and parts replacement may be undertaken locally at the owner's option and risk. It is recommended that ROOTS™ parts be used to insure fit and suitability. The maintenance of a small stock of on-hand spare parts can eliminate possible delays. When ordering parts give Item numbers and their word descriptions from sectional drawings and parts lists. Also specify quantities wanted and the blower size and serial number from the nameplate.

Repairs or adjustments are best performed by personnel with good mechanical experience and the ability to follow the instructions in this manual. Some operations involve extra care, patience, and a degree of precision work. This is especially true in timing impellers and in handling bearings. Experience indicates that high percentages of bearing failures are caused by dirt contamination before or during assembly. Therefore, the work area should be cleaned before starting disassembly, and new or re-usable parts protected during progress of the work.

In the following repair procedures, numbers shown in brackets ( ) correspond to the Item numbers used in assembly drawings, and parts lists. It is recommended that the procedures be studied carefully and completely, with frequent reference to the drawings, before starting work. This will produce better efficiency through an understanding of what work is to be done, and the order of doing it. Before disassembly, mark all parts so that they may be returned to original locations or relative positions.

Requirements for special tools will depend on the work to be done. If impeller clearances and float are to be checked or re-set, a dial indicator and a set of long feeler gauges will be needed. Work involving removal of the timing gears cannot be accomplished without a puller suitable. Heat must be used during bearing and sleeve installation.

Design of ROOTS™ blower is simple, and most repair operations are straightforward. For this reason, the following procedures are intended mainly to indicate a preferred work order and to call out points to be observed. Where special operations are required, detailed coverage is given.

DISASSEMBLY OF DRIVE END

1. Remove the sheave or coupling and key from the drive shaft. File off any burrs or sharp edges along the keyway.
2. Drain oil by removing drain plug (22).
3. Remove the flange screws (75). Tap the drive end cover to loosen it, then slide it along the shaft care fully to avoid damaging the lip seal (33) on the drive shaft keyway. Remove the gasket (7). Remove oil slinger (40) and cap screw (60).
4. Remove bearing clamp plates (34) by unscrewing capscrews (32) and removing lock washers (35). Keep shim halves (10) together exactly as removed by tagging them with each clamping plate.
5. Remove the headplate – remove all capscrews (23) holding headplate to the cylinder. Insert jacking screws into the four threaded flange holes and turn them in evenly. The headplate will separate from the cylinder. The lip seals (27), and bearing outer race and rollers, are removed with the headplate and can be pressed out later.
6. Remove the bearing inner race and sleeve (38) from the shaft with aid of a bearing puller by inserting the puller jaws in the groove in the sleeve and applying the jacking screw against the end of the shaft. Protect the threaded hole and the end of the shaft with a small, flat spacer between the shaft and the puller.

DISASSEMBLY OF GEAR END

1. Drain oil completely from the gearbox sump by removing plugs (22) in bottom of the headplate (1).
2. Loosen all flange screws (75) in the gearbox and remove all but two upper screws. Bump the gear box to break the joint if it cannot be pulled free by hand, then remove the last two screws and lift off the gearbox. Remove gasket (7).
3. Removing gears: CAUTION: Do not remove gear nuts (31) completely before the gears are unseated from the taper fits or damage/injury may result. Be sure that each gear is marked for return to the same shaft in the same angular position and that the gears have match marks for the teeth. For this operation, the impellers should be wedged as shown in Figure 8. Back off nuts (31) and slinger (46). The timing gears (4) have two 1/2" – 13 holes for pulling purposes. Use a suitable puller.
4. Remove bearing clamp plates (54) by unscrewing capscrews (32) and removing lock washers. Group the shims (10), the wavy spring washers (29) with each clamp plate and tag for ease of reassembly.
5. Remove the headplate – remove all capscrews 23) holding the headplate to the cylinder. Insert jacking screws into the four (4) threaded flange holes and turn them in evenly. They headplate will separate from the cylinder. The lip seals (27), and bearing outer race and rollers, are removed with the headplate and can be pressed out later.

   For RAM™-J WHISPAIR™ gas pump units: The gear end headplate which is removed next requires a different approach from the drive end. On this end, the shafts are forced from the bearing bore by using a bar across the end of the shaft with threaded rods to the headplate. Once the headplates are removed from the assembly, the seal housings can be pressed or driven from the headplate bores. Generally, new seals will be required prior to reassembly.

6. Remove the bearing inner race and sleeve (38) from the shaft with the aid of a bearing puller by inserting the puller jaws in the groove in the sleeve and applying the jacking screw against the end of the shaft. Protect the threaded hole and the end of the shaft with a small, flat spacer between the shaft and the puller.

ASSEMBLY

Prior to any assembly operation, it is essential that all parts are completely clean and free from nicks and scratches.

Prior to assembly, lightly coat the groove in the sleave with slip plate. ROOTS P/N813-314-000.

1. Assembly of Piston ring seals (28) – To avoid scratching the lip seal surface, install the Piston ring seals (28) in the sleeves (38) from the end nearest the groove before assembling the sleeve on the shaft.

   Unhook the gap joint and expand the ring while sliding it to the groove, then compress it so one end of the hook joint slides over the other. Move the ring in the groove to be sure it is free.

   NOTE: *Care must be taken not to scratch or dent the sleeve surface since it is the sealing surface for the lip seal.*

2. Installation of sleeves (38) – heat the sleeve to 300° F. (149°C) then quickly slide it on the shaft tightly against the impeller. If the sleeve hangs up during assembly, it can be pressed into place using a tubular pressing tool with square, clean ends.

3. Assembly of seals (27) in headplate (1) – Place headplate flat with seal bores up. Be sure the pressing tool face is clean and square and there is a smooth, clean entering bevel in the headplate. Lubricate the seal lips. Place seal over the bore with lip facing up, then press the seal evenly until it is flush with bore face.

   For Gas Sealed Units: Assemble mechanical seals (27) in headplate – (**CAUTION:** *Care must be used to avoid damaging the carbon face. Before proceeding with this step, you should have a piloted seal driver which is designed to clear the carbon face.*) with headplate positioned horizontally with seal bores up. Be sure the pressing tool face is clean and square and there is a smooth, clean entering bevel in the headplate. Place the seal over the bore with carbon facing up. Then press the seal evenly on its steel shell using the piloted seal driver until the driver seats against the stop.

4. Assembly of impellers (12 and 13) to headplate (1) – Place gear end headplate flat on 3 in. (76 mm) blocks with the smallest bores facing up. Inspect entering bevels to be sure they are smooth and clean. Locate the drive impeller correctly (top for vertical units and toward the driver for horizontal units). Place the seal ring gaps toward the inlet for pressure applications and towards dis charge for vacuum applications. Insert the impeller shafts in the headplate so the impellers rest on the headplate. Use care to avoid damaging the lip seals.

5. Assembly of cylinder (11) to gear end headplate (1) – Install dowel pins (16) and secure cylinder to headplate with capscrews (23). Torque to 35 ft.-lbs (4.5 Kg-m). Then, install drive end headplate (1) and dowel pins (16) and secure with capscrews (23). Install feet (76) & 77) to both headplates and secure with capscrews (66). Torque to 35 ft.-lbs. (4.5 kg-m).

   For Gas Sealed Units: Use a Teflon sealant between headplate and cylinder joint. Assemble rotating seal – apply a light coating of oil to the O-ring and seal face. Then with flute side out install the rotating seat tight to the shaft sleeve. Check and record seal compression – With the seal body in place and the impeller against the opposite headplate, check that seal compression is adequate. This can be checked using a depth gauge or dial indicator from the face of the head plate to the face of the mating ring. First, measure this distance while the carbon is out at its full length. Then, push the mating ring back against its stop and measure it again. The difference between these measurements is the compression. This can be done easily with finger pressure as the spring force is only 10 lbs. The correct travel is given below (record actual compression on clearance sheets).

Seal Compression

Frame	Minimum	Maximum
400	.047"	.097"
600	.108"	.151"

* Prior to to assembly, lightly coat the groove in the sleave(38) with slip plate. ROOTS™ P/N 813-314-000

6. Installation of bearings (14) – Heat bearing inner race to 300°F (149°C) in an oven or hot oil; then slide it onto the shaft so the bearing shoulder is snugly against the sleeve. Note: Be sure to install the shaft shim (70) behind the shaft sleeve before installing the drive end drive bearing inner race. This is required to compensate for the oil leader for shimming. Insert the bearing outer race and rollers in each bore and tap lightly in place. Spray bearings with lubricant.

7. Measure and record the end clearances between the impellers and drive headplate using long feeler gauges. Then, subtract the allowed average drive end clearance. See Table 6. The result is the space required between clamping plates (34) and bearing outer race. Place shims (10) as required to get this clearance. Then, fasten the clamping

plates to the headplate with capscrews (32) and lock washers (35).

8. Installation of gear end bearings (14) – Turn the blower so that the gear end headplates is up. Heat bearing inner race to 300°F (149°C) in an oven or hot oil; then slide it onto the shaft so that the bearing shoulder is snugly against the sleeve. Insert the bearing outer race and rollers in each bore and tap lightly into place.

9. Measure and record the end clearance between the impellers and gear end headplate, then subtract the allowed average gear end clearance. See Table 6. The result is the space required between clamping plate (54) and bearing outer race. Place shims (10) as required to get this clearance. Then fasten the clamping plates (54) to the headplate using capscrews (32) and lock washers (35). Do not install wavy-spring washers (29) at this time, as a final check of clearances is required first.

10. Final check of end clearances and float – Using long feeler gauges, check the clearance between the impellers and drive end headplate. See Table 6. Place the blower assembly on its feet and correct shimming as required. Then, force the impellers as close to the gear end headplate as possible, and check the clearance between impellers and gear end headplate for agreement with Table 6. Adjust shimming on the gear end as required. With unit securely fastened down, use a dial indicator to measure the impeller float. Again push the impeller to one end of the cylinder. With indicator firmly mounted, place contact point on the end of the shaft just pushed and set dial on zero. Force the impeller to the opposite end (toward indicator). Indicator reading will be a measurement of the impeller float. Repeat process on second impeller and compare float to Table 6. Adjust shimming at bearing clamp plates to obtain both float and end clearances specified in Table 6.

    Finally, after clearances and float have been corrected and checked, remove the gear end clamping places (54) and install wavy-spring washers (29) and reinstall shims (10) and clamping plates (54). Be sure oil feed grooves are up and toward bearings.

11. Installing drive gear (4) – Be sure shafts and gear bores are clean and free of scratches. Oil gear nut threads lightly. Place hardwood wedges as shown in Figure 8. Install gear (4) and nut (31) so match mark at the tooth is at the line of engagement. Tighten the drive gear to the torque given below. Blower assembly must be fastened down for torquing operation.

12. **Left side discharge machine**
    Installing driven gear (14) – Insert a long metal feeler gauge between the impellers' lobes at the fronts as shown in Table 6. Feeler gauge thickness to be a middle value from Table 6 for fronts.

13. **Right side discharge machine**
    Installing driven gear (4) – Insert a long metal feeler gauge between the impellers' lobes at the backs. Feeler gauge thickness to be minimum value from Table 6 for backs.

RAM™ SERIES BLOWER GEAR NUT TORQUE

Frame Size	Torque	
	lb.-ft.	(kg-m)
404, 406, 409, 412, 418	400	(56)
616, 624	630	(88)

RAM™ SERIES BLOWER OIL SLINGER SCREW TORQUE

Frame Size	Torque	
	lb.-ft.	(kg-m)
404, 406, 409, 412, 418	75	(10)
616, 624	140	(19)

Align the gear so the tooth match marks agree with the drive gear, then install slinger (46) and nuts (31). Tighten lightly with a small wrench, then check front and back clearances against Table 6 for each 45° position. Both fronts should be about the same and backs should about equal and be within the specified range in Table 6. Adjust gear position if necessary, then insert the corrected feeler gauge and wedges and use a torque wrench to tighten the gear nut to the torque specified above. Remove wedges and rotate the drive shaft by hand to make sure there are no gear tight spots or impeller contacts. **CAUTION: Keep fingers away from impeller end gears.**

Install gearbox (3) with gasket (7) and tighten the capscrews (75) evenly to 10 ft.-lbs. (1.3 kg-m).

Install drive end oil slinger (40) and capscrew (60), apply Locktite to threads and torque to value specified above.

Install drive end cover (5) and gasket (7) with drive lock pins (17) in place, being careful not to dent or scratch drive shaft lip seal surface. Tighten capscrews (75) evenly. Check seal bore for concentricity with shaft using an indicator; reposition drive lock pins, if necessary. Install seal (33) with lip facing inward, using care to avoid tearing or scratching seal on shaft keyway. Use a pressing tool with clean, square ends to insure correct positioning of the seal. For hydrodynamic style seals, the shaft rotation is critical for correct installation and proper sealing. Match the directional arrow shown on the seal faces with the required shaft rotation. An installation protective sleeve is required to protect seal lip during installation.

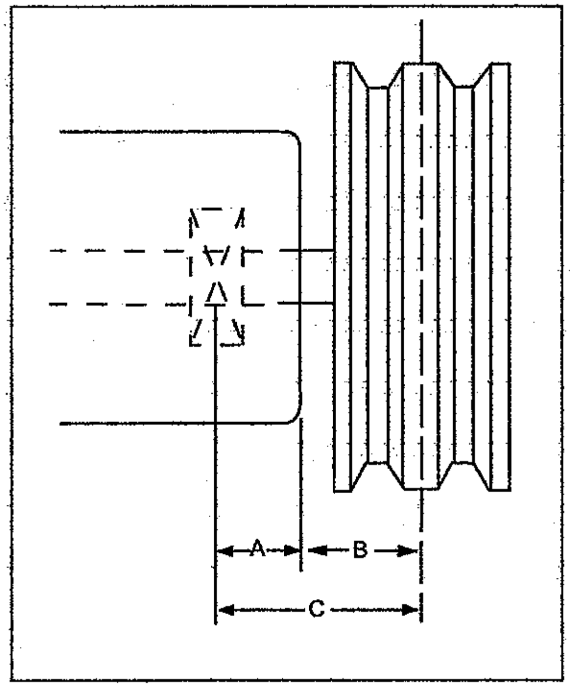
Install vent plug (21) in each headplate.

Replace oil drain plugs (22) and refill drive end and gear sumps with proper grade of oil as discussed under **LUBRICATION**.

Install drive sheave or coupling half and install blower, refer to **INSTALLATION instructions.**

Figure 2

Allowable Overhung Loads for V-Belt Drives Universal RAI®/URAI™-J units



$$\text{Belt Pull lbs} = \frac{252100 \cdot \text{Motor HP}}{\text{Blower RPM} \cdot \text{Sheave Diameter}}$$

C = Distance between drive bearing center line and sheave center line (A+B)

$$B = (1/8'' + \frac{\text{Sheave Width}}{2})$$

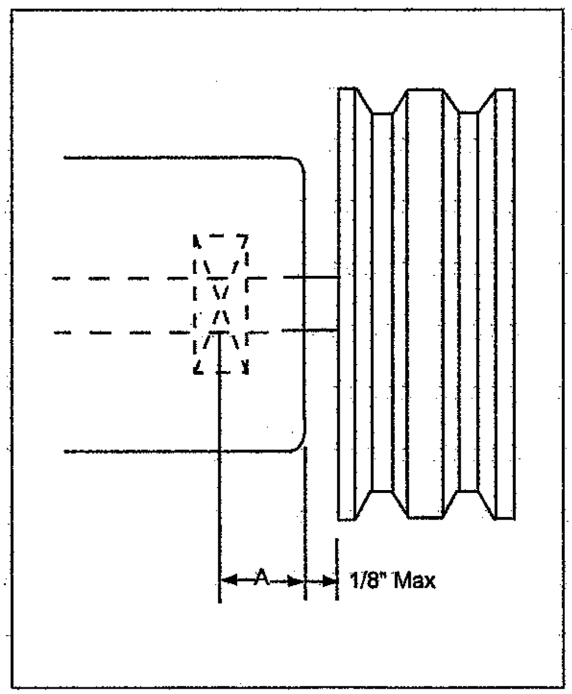
Shaft Load (lb.in) = Belt Pull • C

Frame Size	Dimension "A"	Max Allowable Shaft Load (lb-in.)
22, 24	0.61	80
32, 33, 36	0.80	300
42, 45, 47	1.02	640
53, 56, 59	1.13	1,110
65, 68, 615	1.36	1,550
76, 711, 718	1.16	2,300

NOTE: Arc of sheave belt contact on the smaller sheave not to be less than 170°

Driver to be installed on the inlet side for vertical units, and on the drive shaft side for horizontal units.

Allowable Overhung Loads for V-Belt Drives 400 - 600 RAM™ units



$$\text{Belt Pull lbs} = \frac{27500 \cdot \text{Motor HP}}{\text{Blower RPM} \cdot \text{Sheave Diameter}}$$

$$\text{Shaft Load (lb.in)} = \text{Belt Pull} \cdot (A + 1/8'' + \frac{\text{Sheve Width}}{2})$$

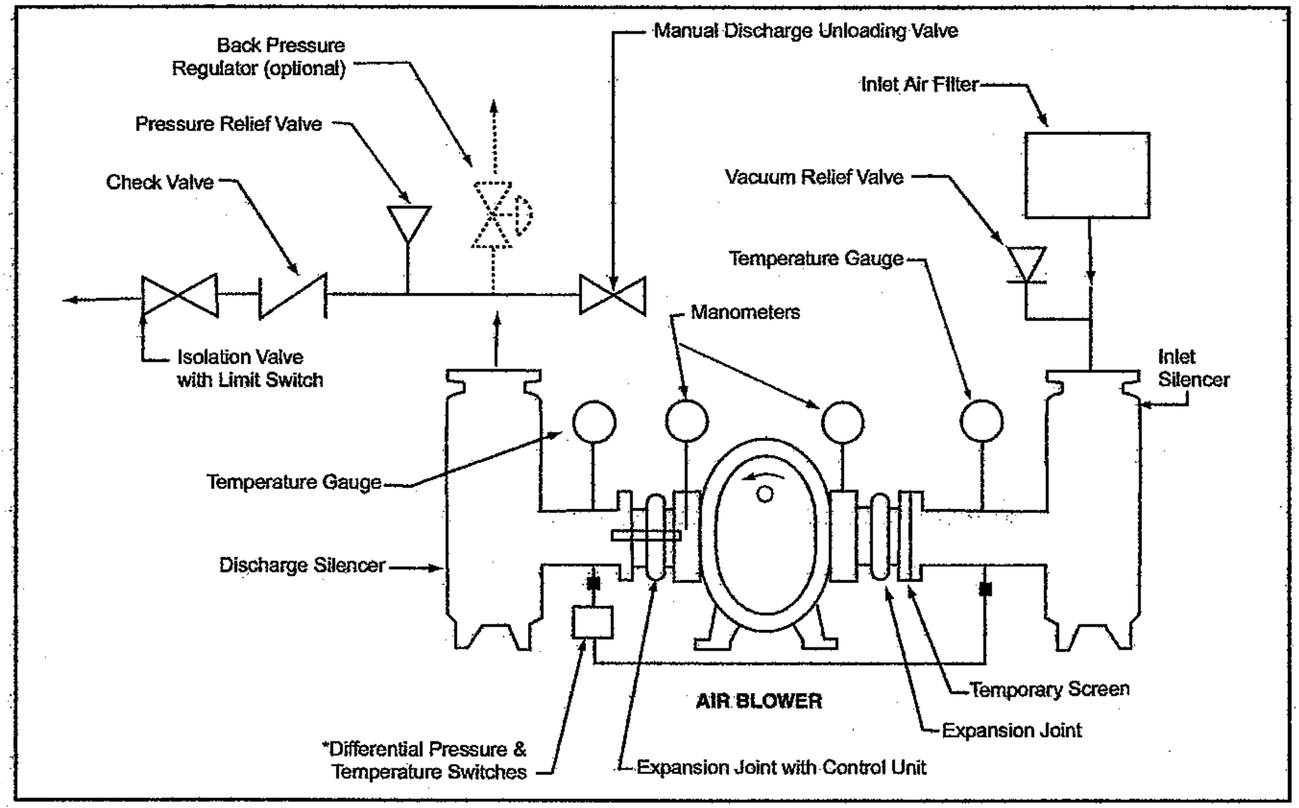
	Dimension "A"		
Frame Size	Standard Unit	Bottom Drive or Double Shaft Seal	Max Allowable Shaft Load (lb-in.)
404, 406	1.90	2.11	3,200
409, 412, 418	1.90	2.11	3,200
616, 624	2.11	2.67	7,975

NOTE: Arc of sheave belt contact on the smaller sheave not to be less than 170°

Driver to be installed on the inlet side for vertical units, and on the drive shaft side for horizontal units.

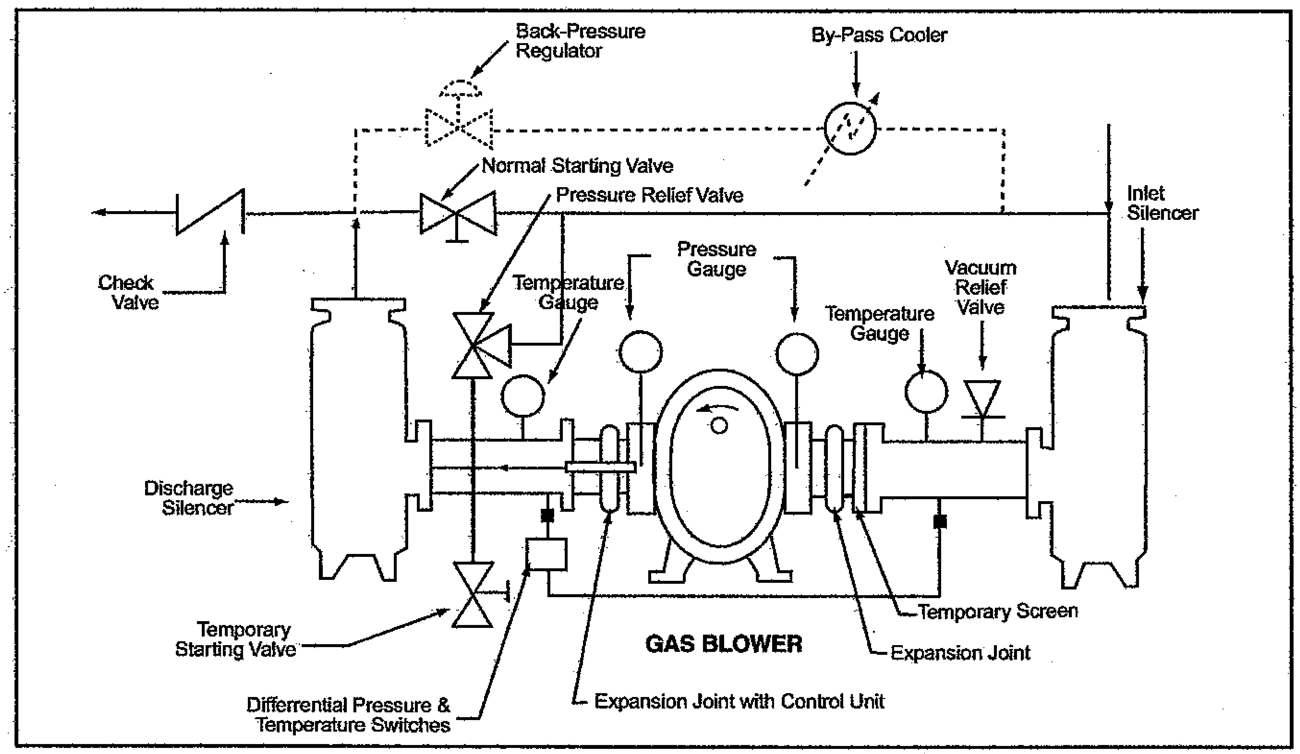
Figure 3

Air Blower Installation with Accessories



Above are suggested locations for available accessories.

Gas Blower Installation with Accessories



Above are suggested locations for available accessories.

Figure 4

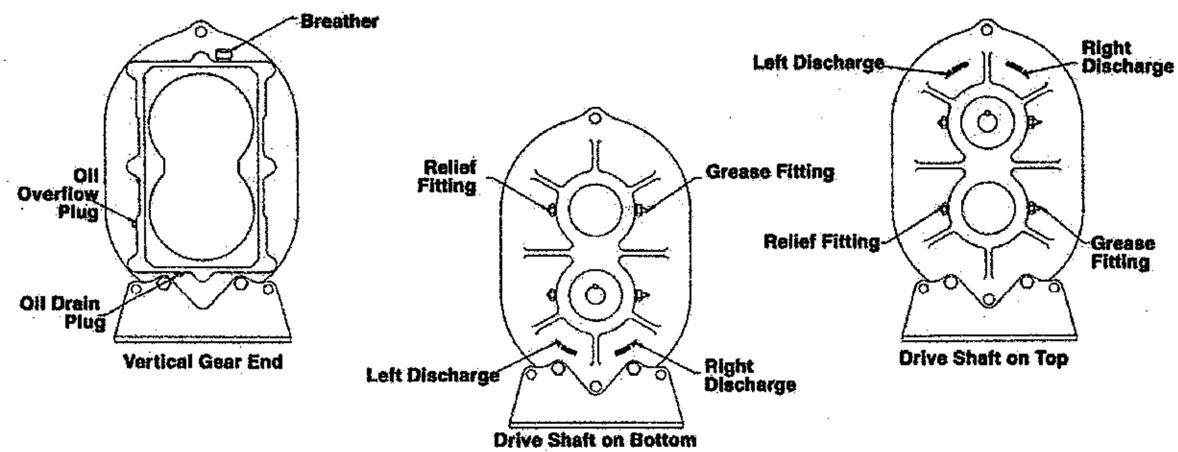
Blower Orientation Conversion

Model	Reversible Rotation	Whispair Design
Universal RAI	yes	no
URAI-J	no	yes
URAI-G	yes	no
RAM	yes	no
RAM-J	no	yes
RAM-GJ	no	yes

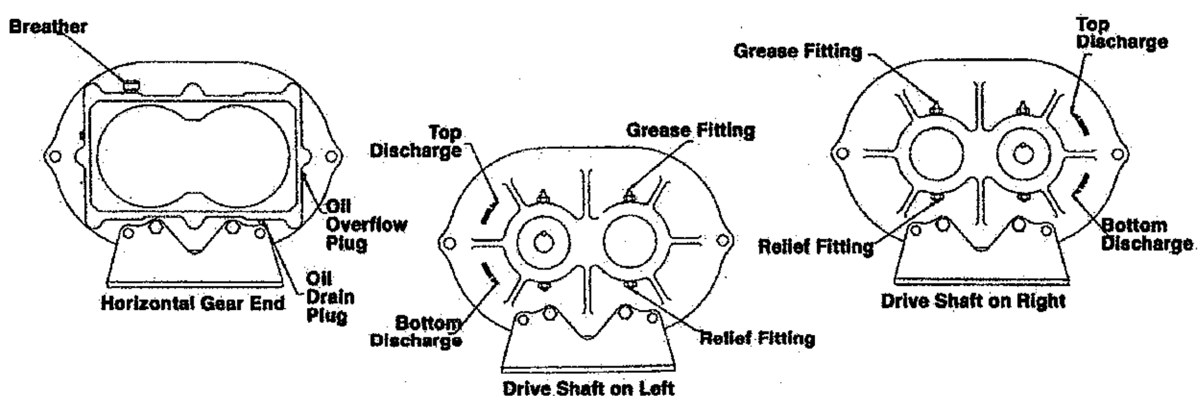
Special Note: WHISPAIR™ models are designed to operate with only one shaft rotation direction to take full advantage of the Whispair feature. Therefore, a WHISPAIR™ blower should be operated in the following combinations only.

- **CCW Rotation:** Bottom Shaft; Right side discharge or a Left Shaft; Bottom discharge
- **CCW Rotation:** Top Shaft; Left side discharge or a Right Shaft; Top discharge
- **CW Rotation:** Bottom Shaft; Left side discharge or a Right Shaft Bottom discharge
- **CW Rotation:** Top Shaft; Right side discharge or a Left Shaft Top discharge

Blower Orientation and Lubrication Points: Universal RAI® & URAI™-G gas blowers



Vertical Mounting

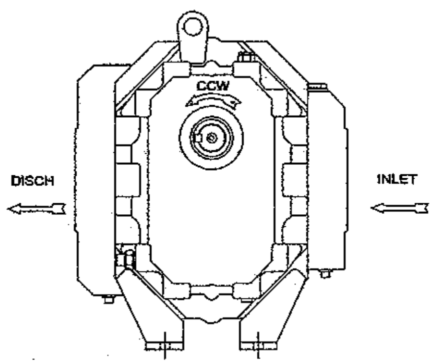


Horizontal Mounting

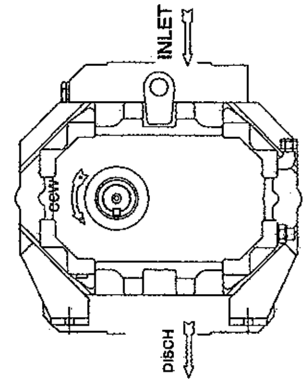
FIGURE 5

BLOWER ORIENTATION CONVERSION - WHISPAIR™ UNITS

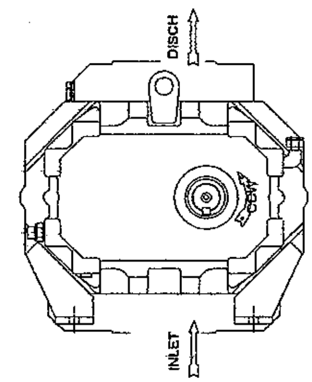
1. STANDARD ARRANGEMENT (3-WAY UNIVERSAL)
EXTERNAL SIGHT GLASSES (37) & BREATHERS (21) MUST BE RELOCATED AS SHOWN.
FEET (76&77) & LIFTING LUGS (63) MUST BE RELOCATED AS SHOWN.



TOP DRV, L.S. DISCH

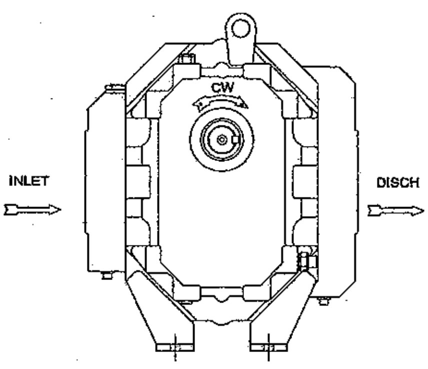


L.H. DRV, BTM DISCH

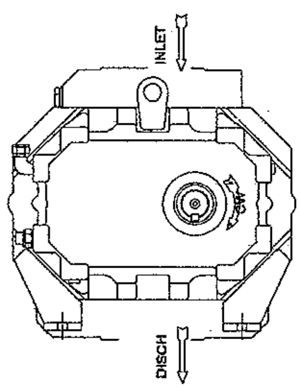


R.H. DRV, TOP DISCH

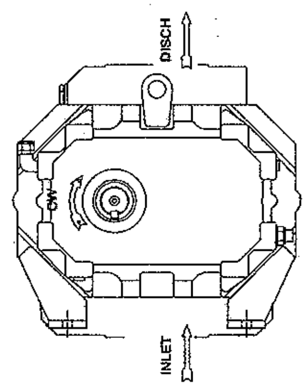
2. NON-STANDARD ARRANGEMENT (3-WAY UNIVERSAL)
CYLINDER (11) MUST BE UNBOLTED FROM HEADPLATES (1) AND DISCHARGE
RELOCATED AS SHOWN. **MUST HAVE AUTHORIZATION FOR CONVERSION SO NOT TO VOID WARRANTY.**
EXTERNAL SIGHT GLASSES (37) & BREATHERS (21) MUST BE RELOCATED ALSO.
FEET (76&77) & LIFTING LUGS (63) MUST BE RELOCATED AS SHOWN



TOP DRV, R.S. DISCH

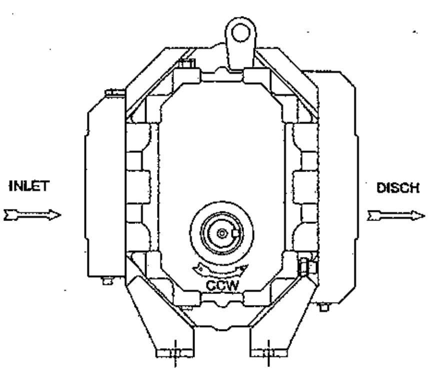


R.H. DRV, BTM DISCH

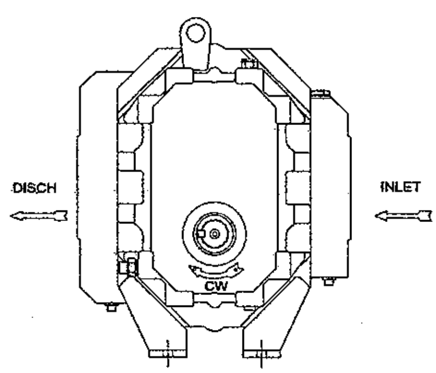


L.H. DRV, TOP DISCH

3. BOTTOM DRIVE SHAFT ARRANGEMENT "SPECIAL ORDER" (3-WAY UNIVERSAL)
SPECIAL OGE OIL SLINGER REQUIRED FOR ASSEMBLY.
MAY BE CONVERTED TO HORIZONTAL CONFIGURATION AS PREVIOUSLY SHOWN.



BTM DRV, R.S. DISCH



BTM DRV, L.S. DISCH

TABLE 1 -

URAI™-J WHISPAIR™ & URAI™-G GAS BLOWER, MAXIMUM ALLOWABLE OPERATING CONDITIONS

Frame Size	Gear Diameter (Inch)	Speed RPM	Temp. Rise F° (C°)	Delta Pressure PSI (mbar)	Inlet Vacuum INHG (mbar)
22	2.5	5275	225 (125)	12 (227)	15 (500)
24	2.5	5275	210 (117)	7 (483)	15 (500)
32	3.5	3600	240 (133)	15 1034	16 (539)
33	3.5	3600	225 (125)	12 (827)	15 (500)
36	3.5	3600	225 (125)	7 (483)	15 (500)
42	4.0	3600	240 (133)	15 (1034)	16 (539)
45	4.0	3600	225 (125)	10 (690)	16 (539)
47	4.0	3600	225 (125)	7 (483)	15 (500)
53	5.0	2850	225 (125)	15 (1034)	16 (539)
56	5.0	2850	225 (125)	13 (896)	16 (539)
59	5.0	2850	225 (125)	7 (483)	15 (500)
65	6.0	2350	250 (130)	15 (1034)	16 (539)
68	6.0	2350	240 (133)	14 (965)	16 (539)
615	6.0	2350	130 (72)	7 (483)	12 (405)
76	7.0	2050	250 (139)	15 (1034)	16 (539)
711	7.0	2050	225 (125)	10 (690)	16 (539)
718	7.0	2050	130 (72)	6 (414)	12 (405)

RAM™, RAM™-J WHISPAIR™ BLOWER, RAM™-GJ GAS BLOWER
MAXIMUM ALLOWABLE OPERATING CONDITIONS

Frame Size	Gear Diameter (Inch)	Speed RPM	Temp. Rise F° (C°)	Delta Pressure PSI (mbar)	Inlet Vacuum INHG (mbar)
404	4.5	4000	240 (133)	18 (1241)	16 (539)
406	4.5	4000	240 (133)	18 (1241)	16 (539)
409	4.5	4000	240 (133)	18 (1241)	16 (539)
412	4.5	4000	240 (133)	15 (1034)	16 (539)
418	4.5	4000	240 (133)	10 (690)	16 (539)
616	6.0	3000	230 (128)	15 (1034)	16 (539)
624	6.0	3000	230 (128)	10 (690)	16 (539)

Table 3

Recommended Oil Grades

Ambient Temperature °F (°C)	Viscosity Range SSU at 100°F	ISO No.	Approximate SAE No.
Above 90° (32°)	1000-1200	320	60
32° to 90° (0° to 32°)	700-1000	220	50
0° to 32° (-18° to 0°)	500-700	150	40
Below 0° (-18°)	300-500	100	30

UNIVERSAL RAI®, URAI™-J, URAI™-G Oil Sump Capacities

Frame Size	Capacity Fl. Oz. (Liters)	
	Vertical	Horizontal
22	3.4 (.1)	6.1 (.18)
24	3.4 (.1)	6.1 (.18)
32	8.5 (.25)	16.0 (.47)
33	8.5 (.25)	16.0 (.47)
36	8.5 (.25)	16.0 (.47)
42	12.7 (.37)	22.8 (.67)
45	12.7 (.37)	22.8 (.67)
47	12.7 (.37)	22.8 (.67)
53	16.0 (.47)	27.6 (.82)
56	16.0 (.47)	27.6 (.82)
59	16.0 (.47)	27.6 (.82)
65	28.3 (.84)	52.1 (1.54)
68	28.3 (.84)	52.1 (1.54)
615	28.3 (.84)	52.1 (1.54)
76	32.3 (.96)	59.5 (1.76)
711	32.3 (.96)	59.5 (1.76)
718	32.3 (.96)	59.5 (1.76)

RAM™, RAM™-J & RAM™-GJ Oil Sump Capacities

Orientation	Gearbox		Drive End	
	Fl. Oz.	(Liters)	Fl. Oz.	(Liters)
400 (Horizontal)	36	1.06	19	.56
400 (Vertical)	18	.52	9	.27
600 (Horizontal)	95	2.81	50	1.48
600 (Vertical)	55	1.63	28	0.83

Table 4

Suggested Bearing Greasing Intervals

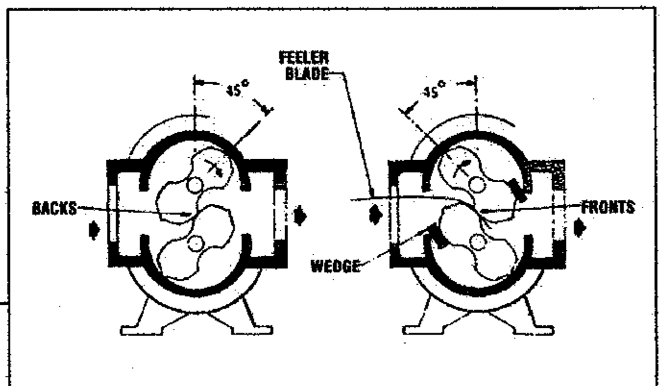
Speed In RPM	Operating Hours Per Day		
	8	16	24
	Greasing Intervals in Weeks		
750-1000	7	4	2
1000-1500	5	2	1
1500-2000	4	2	1
2000-2500	3	1	1
2500-3000	2	1	1
3000 and up	1	1	1

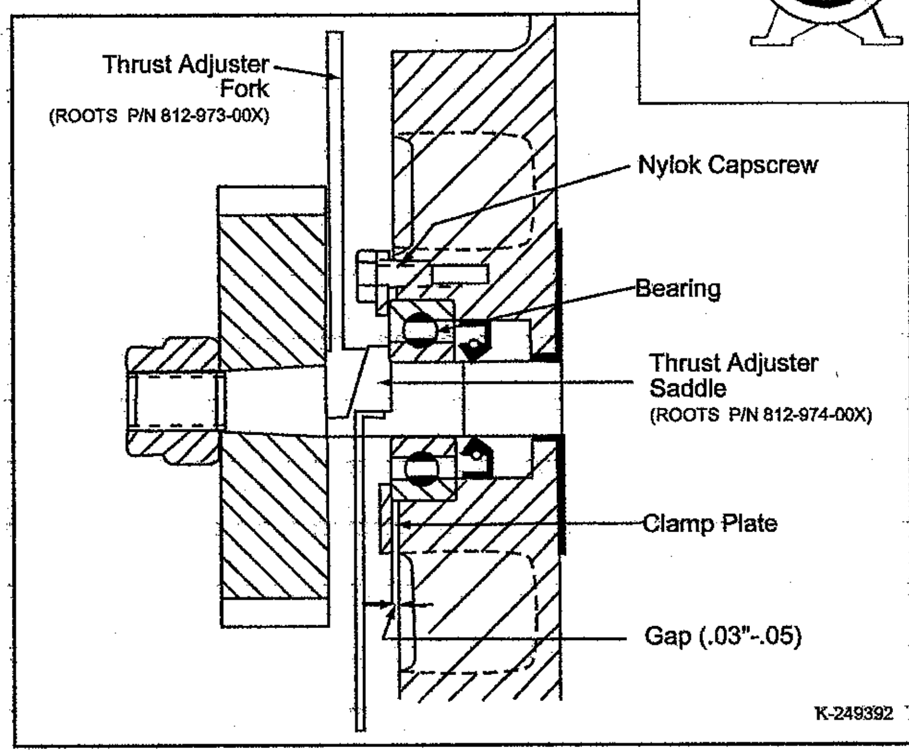
TABLE 5

NORMAL CLEARANCES FOR UNIVERSAL RAI® AND URAI™-J, URAI™-G BLOWERS - INCHES (MM)

Frame Size	Impeller Ends: Total	Impeller Ends: Drive End Minimum	Impeller Ends: Gear End Minimum	Cylinder: Inlet & Discharge	Cylinder: Center Center	Impeller: * Fronts/Backs
22	.006/.010 (.15-.25)	.003 (.08)	.003 (.08)	.004/.005 (.10-.13)	.002/.003 (.05-.08)	.007/.01 (.18-.25)
24	.006/.010 (.15-.25)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.007/.01 (.18-.25)
32	.006/.011 (.15-.28)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.01/.012 (.25-.30)
33	.006/.011 (.15-.28)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.01/.012 (.25-.30)
36	.006/.011 (.15-.28)	.003 (.08)	.003 (.08)	.004/.006 (.10-.15)	.002/.003 (.05-.08)	.01/.012 (.25-.30)
42	.008/.011 (.20-.28)	.004 (.10)	.004 (.10)	.005/.007 (.13-.18)	.003/.004 (.08-.10)	.009/.012 (.23-.30)
45	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.007 (.13-.18)	.003/.004 (.08-.10)	.012/.015 (.30-.38)
47	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.007 (.13-.18)	.003/.004 (.08-.10)	.012/.015 (.30-.38)
53	.008/.011 (.20-.28)	.004 (.10)	.004 (.10)	.005/.008 (.13-.20)	.003/.004 (.08-.10)	.011/.013 (.28-.33)
56	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.008 (.13-.20)	.003/.004 (.08-.10)	.015/.017 (.38-.43)
59	.008/.013 (.20-.33)	.004 (.10)	.004 (.10)	.005/.008 (.13-.20)	.003/.004 (.08-.10)	.015/.017 (.38-.43)
65	.012/.016 (.30-.40)	.008 (.20)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.010/.014 (.25-.36)
68	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.010/.014 (.25-.36)
615	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.010/.014 (.25-.36)
76	.012/.016 (.30-.40)	.008 (.13)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.013/.015 (.33-.38)
711	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.013/.015 (.33-.38)
718	.014/.018 (.36-.46)	.010 (.25)	.004 (.10)	.006/.008 (.15-.20)	.006/.008 (.15-.20)	.013/.015 (.33-.38)

*** IMPELLER TIMING FOR STANDARD ROTATION VIEWED FROM GEAR END**





THRUST SETTING, 2-1/2" THRU 5" UNIVERSAL RAI® BLOWERS

Table 6

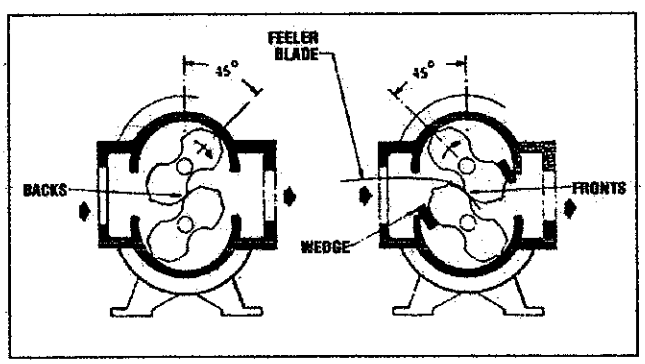
Normal Clearances for RAM™-J & RAM™-GJ WHISPAIR™ Blowers - Inches (MM)

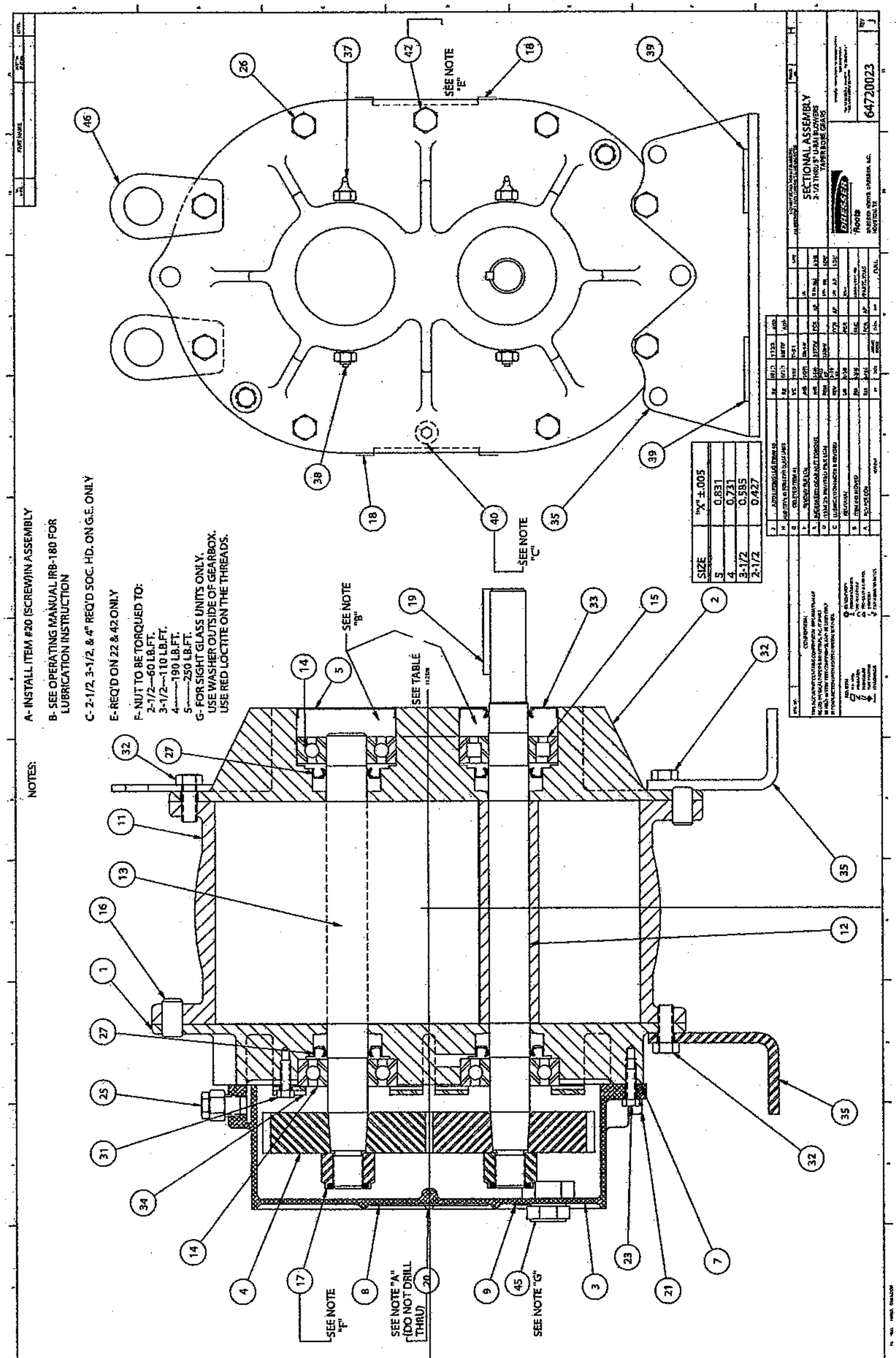
Blower Frame Size	* Impeller Lobes at 45°		End Clearance			Impeller Tips to Cylinders		
	Fronts	Backs	Each End Without Wavy Spring	Gear End Without Spring Installed	Required End Float	Inlet	Center	Discharge
	Min-Max	Min-Max	Min-Max	Min-Max	Minimum	Min-Max	Min-Max	Min-Max
404	.012-.014	.006-.009	.003-.005	.003-.008	.003	.004-.006	.002-.004	.002-.004
	(.31-.36)	(.15-.23)	(.08-.13)	(.10-.15)	(.08-.20)	(.08)	(.05-.10)	(.05-.10)
406	.012-.014	.006-.009	.003-.005	.007-.012	.006	.005-.007	.003-.005	.002-.004
	(.31-.36)	(.15-.23)	(.08-.13)	(.15-.30)	(.13)	(.13-.18)	(.08-.13)	(.05-.10)
409	.013-.015	.006-.009	.003-.005	.013-.018	.008	.005-.007	.003-.005	.002-.004
	(.33-.38)	(.15-.23)	(.08-.13)	(.31-.43)	(.17)	(.13-.18)	(.08-.13)	(.05-.10)
412	.013-.015	.006-.009	.003-.005	.016-.021	.011	.006-.008	.004-.006	.004-.006
	(.33-.38)	(.15-.23)	(.08-.13)	(.36-.48)	(.28)	(.15-.20)	(.10-.15)	(.10-.15)
418	.013-.015	.006-.009	.003-.005	.022-.027	.017	.008-.010	.004-.006	.004-.006
	(.33-.38)	(.15-.23)	(.08-.13)	(.51-.64)	(.38)	(.20-.25)	(.10-.15)	(.10-.15)
616	.012-.014	.006-.008	.004-.006	.017-.022	.011	.009-.011	.004-.006	.002-.005
	(.31-.36)	(.15-.20)	(.10-.15)	(.38-.51)	(.28)	(.23-.28)	(.10-.15)	(.05-.13)
624	.012-.015	.006-.009	.004-.006	.024-.029	.018	.013-.015	.005-.007	.002-.005
	(.31-.36)	(.15-.23)	(.10-.15)	(.61-.74)	(.46)	(.33-.38)	(.13-.18)	(.05-.13)

Normal Clearances for RAM™ Blowers - Inches (MM)

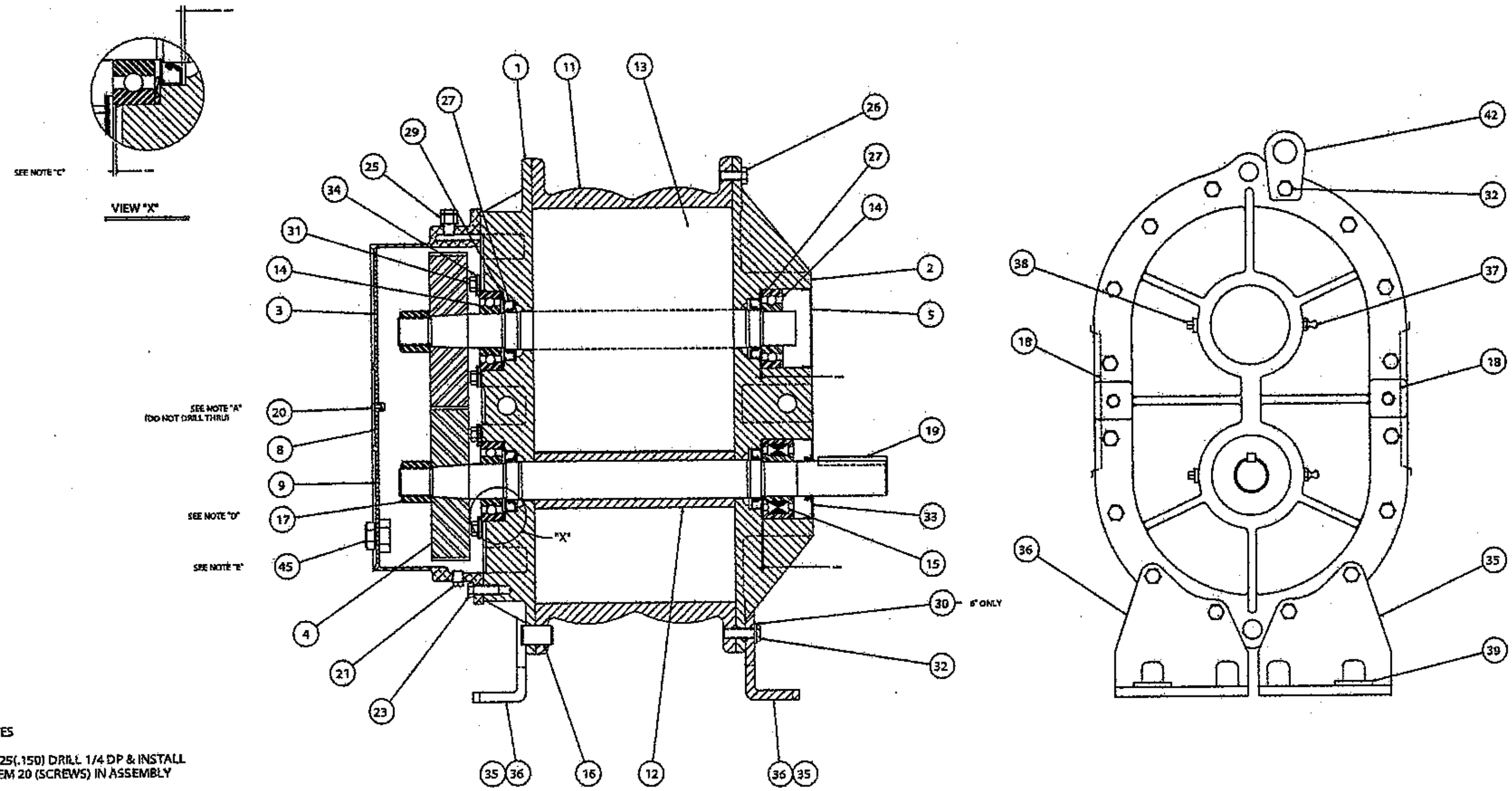
Blower Frame Size	* Impeller Lobes at 45°		End Clearance			Impeller Tips to Cylinders		
	Fronts	Backs	Each End Without Wavy Spring	Gear End Without Spring Installed	Required End Float	Inlet	Center	Discharge
	Min-Max	Min-Max	Min-Max	Min-Max	Minimum	Min-Max	Min-Max	Min-Max
404	.009-.013	.009-.013	.003-.005	.003-.008	.003	.004-.006	.002-.004	.004-.006
	(.23-.33)	(.23-.33)	(.08-.13)	(.08-.20)	(.08)	(.10-.15)	(.05-.10)	(.10-.15)
406	.009-.013	.000-.013	.003-.005	.007-.012	.006	.005-.007	.003-.005	.005-.007
	(.23-.33)	(.23-.33)	(.08-.13)	(.15-.30)	(.13)	(.13-.18)	(.08-.13)	(.13-.18)
409	.010-.014	.010-.014	.003-.005	.013-.018	.008	.005-.007	.003-.005	.005-.007
	(.25-.36)	(.25-.36)	(.08-.13)	(.31-.43)	(.17)	(.13-.18)	(.08-.13)	(.13-.18)
412	.010-.014	.010-.014	.003-.005	.016-.021	.011	.006-.008	.004-.006	.006-.008
	(.25-.36)	(.25-.36)	(.08-.13)	(.36-.48)	(.28)	(.15-.20)	(.10-.15)	(.15-.20)
418	.010-.014	.010-.014	.003-.005	.022-.027	.017	.008-.010	.004-.006	.008-.010
	(.25-.36)	(.25-.36)	(.08-.13)	(.51-.64)	(.38)	(.20-.25)	(.10-.15)	(.20-.25)
616	.011-.013	.011-.013	.004-.006	.017-.022	.011	.009-.011	.004-.006	.009-.011
	(.28-.33)	(.28-.33)	(.10-.15)	(.38-.51)	(.28)	(.23-.28)	(.10-.15)	(.23-.28)
624	.011-.013	.011-.013	.004-.006	.024-.029	.018	.013-.015	.005-.007	.013-.015
	(.28-.33)	(.28-.33)	(.10-.15)	(.61-.74)	(.46)	(.33-.38)	(.13-.18)	(.33-.38)

* Impeller Timing for Standard Rotation Viewed from Gear End





ASSEMBLY OF UNIVERSAL RAI® SERIES, AIR BLOWERS, 2-1/2" THRU 5" GEAR DIAMETER



NOTES

A #25(.150) DRILL 1/4 DP & INSTALL ITEM 20 (SCREWS) IN ASSEMBLY

B SEE OPERATING MANUAL IRB-180 FOR LUBRICATION INSTRUCTION

C INSTALL BEARINGS AS SHOWN BEFORE SETTING END CLEARANCE

D NUT TO BE TORQUED TO:
6"—400 LB. FT.
7"—550 LB. FT.

E FOR SIGHT GLASS UNITS ONLY. USE WASHER OUTSIDE OF GEARBOX. USE RED LOCTITE ON THE THREADS.

REF. 862-600-023

CONFIDENTIAL

	ORIGINAL LOST/REDRAWN ON CAD	DAC	
E	INCREASED GEAR NUT TORQUE	REM	FCR AGP
D	REMOVED ITEM #43	REM	
C	ITEM 25 REVISED	REM	AGP
B	ADDED ITEM #43	REM	
A	ADDED 7"	REM	
	REDRAWN	DB	

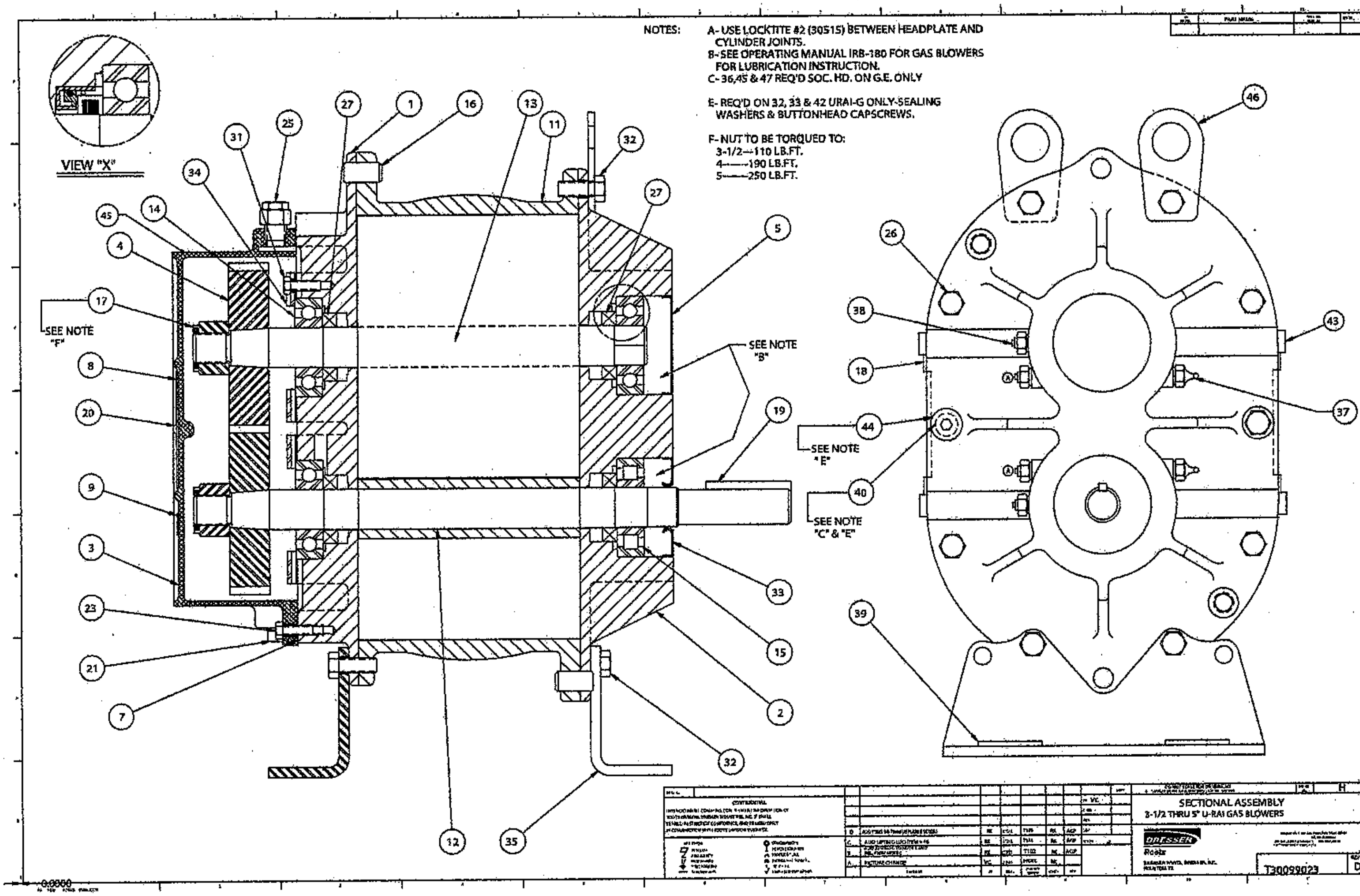
55-3242-2

SECTIONAL ASSEMBLY
FOR 6" & 7" U-RAI BLOWER
WITH TAPER GEAR FIT

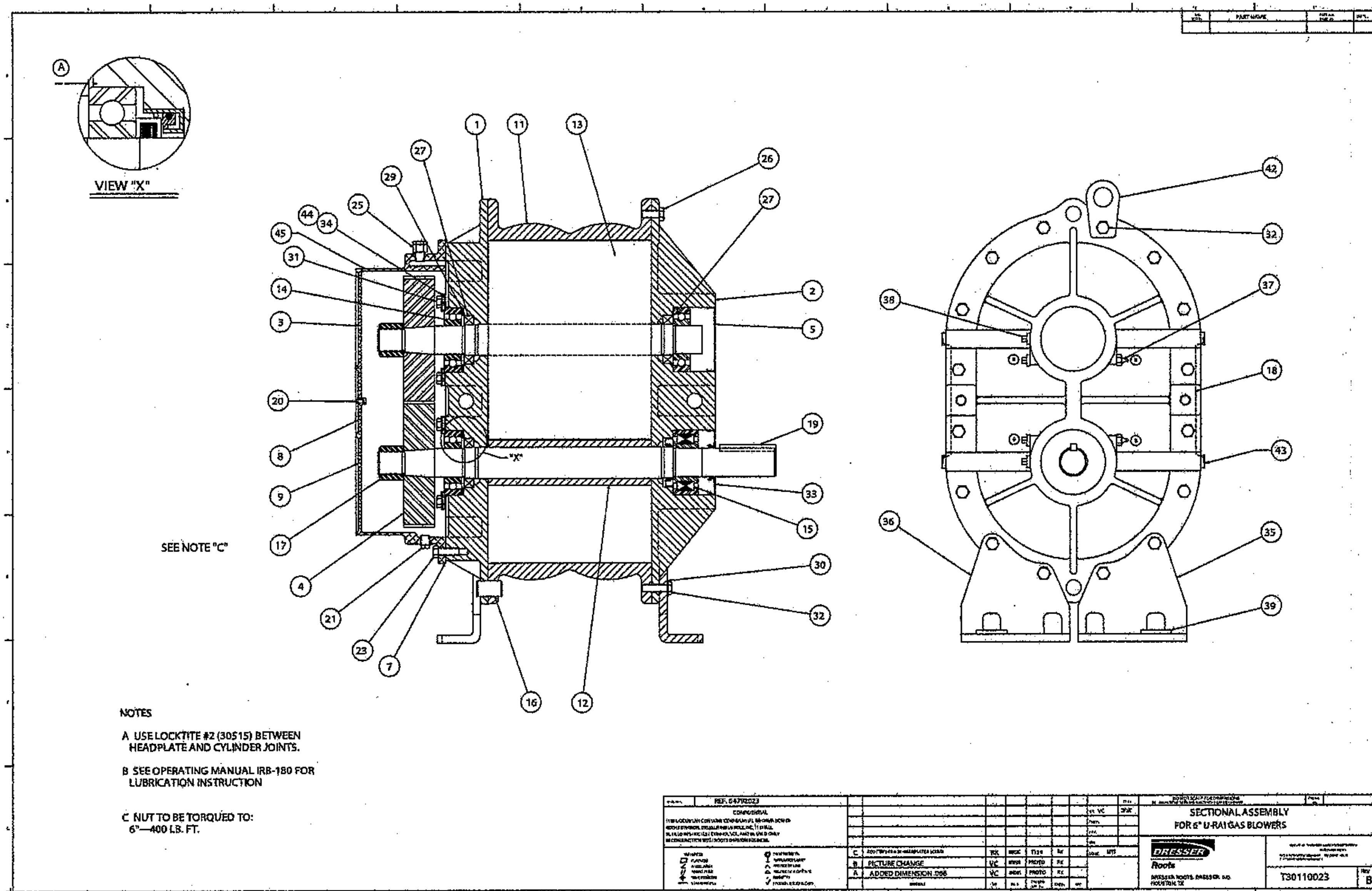
DRESSER Roots

64792023 REV F

ASSEMBLY OF UNIVERSAL RAI® BLOWERS, 6" AND 7" DIAMETER



ASSEMBLY OF UNIVERSAL RAI™-G SERIES GAS BLOWERS, 3-1/2" THRU 5" GEAR DIAMETER



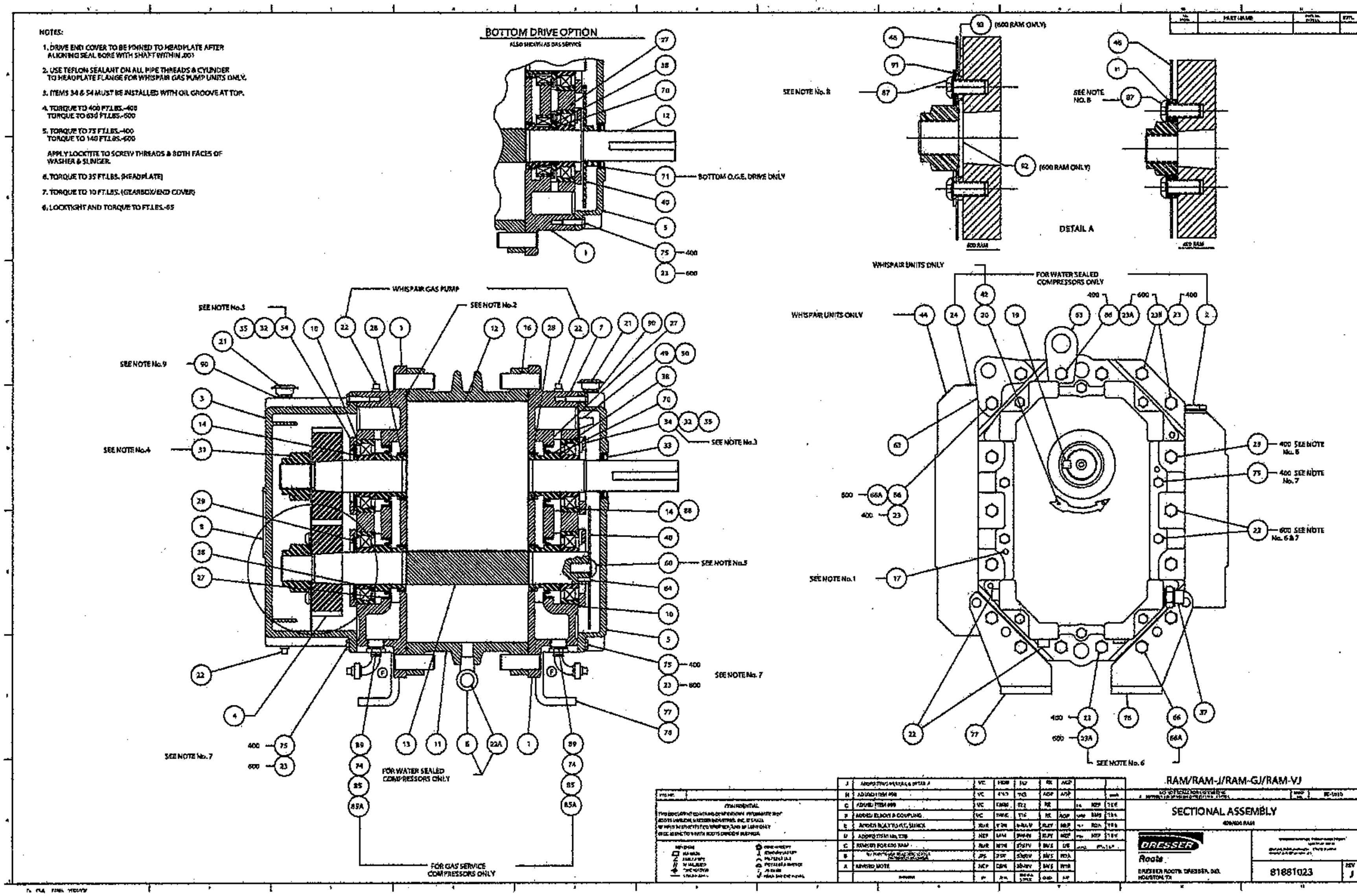
NOTES

A USE LOCKTITE #2 (30515) BETWEEN HEADPLATE AND CYLINDER JOINTS.

B SEE OPERATING MANUAL IRB-180 FOR LUBRICATION INSTRUCTION

C NUT TO BE TORQUED TO:
6"—400 LB. FT.

ASSEMBLY OF UNIVERSAL RAI® SERIES GAS BLOWERS, 6" GEAR DIAMETER



ASSEMBLY OF RAM™ SERIES AIR & GAS BLOWERS

UNIVERSAL RAI® SERIES BLOWERS PARTS LIST

Item No.	Part Name	Qty.
1	Headplate Gear End	1
2	Headplate Drive End	1
3	Gearbox	1
4	Gears	1
5	Cover-Blind (Plug Opening)	1
7	Gasket	1
9	Nameplate Lube	1
14	Bearing G.E., - Driven	3
15	Bearing Drive D.E., - Drive	1
16	Pin, Dowel	4
17	Gear Nut	2
19	Key	1
20	Screw, Self Tap	1
21	Plug, Pipe	3
23	Screw Hex	6
25	Breather (Plug Vent)	1
26	Screw, Hex	14
27	Seal	4
29	Washer - wavy Spring	2
30	Washer	8
31	Screw, Hex	4
32	Screw, Hex	4
33	Seal Lip-Drive	1
34	Clamp Plate	2
35	Foot	2
36	Foot	2
37	Fitting, Grease	2
38	Fitting, Relief	2
39	Washer Flat	4
40	Screw Socket	2
40*	Screw, Button Hd.	4
42	Screw Hex	2
43	Plug	8
44*	Washer	4

*For 32 and 42 URAI-G only.

RAM™ SERIES PARTS LIST

Item No.	Part Name	Qty.
01	Headplate	2
03	Gearbox	1
04	Gear, Assembly	1
05	End Cover	1
07	Gasket – Gearbox/Cover	2
09	Installation Tag	2
10	Shims-(.010)	Lot
14	Bearing Roller	4
16	Pin, Dowel (Pull Out)	4
17	Pin, Dowel	2
19	Key Square	1
20	Screw, Drive - Rd. Hd.	4
21	Breather	2
22	Plug, Pipe	12
23	Screw, Cap Hex Hd.	24
27	Seal, (Viton)	4
28	Piston, Ring-Seal	4
29	Washer, Wavy Spring	2
31	Nut, Hex ESNA	2
32	Scr, Cap Hex Hd.	16
33	Seal, Lip	1
34	Brg. Clamp Plate - D. E.	2
35	Lock Washer - Spring	16
37	Sight Plug - Oil Level	2
38	Sleeve - GE & DE	4
38	Sleeve - Piston Ring	4
40	Slinger - D.E. (Top Drive)	1
40	Slinger - D. E. (Bottom Drive)	1
42	Rotation Arrow	1
44	Label	1
46	Slinger - G.E.	1
49	Oil Leader L/S	1
50	Oil, Leader-R/S	1
54	Brg Clamp Plate - G. E.	2
60	Screw, Cap Butt. HD.	1
63	Lifting Lug	2
64	Pin, Spring	1
66	Screw, Cap Hex HD.	12
66.1	Whispair, Spring Lock 3/8M	12
70	Shims D.E. Brg.	1
75	Screw, Cap - Hex HD.	20
76	Blower Foot - RH	2
77	Blower Foot - LH	2
85	Elb, Pipe-Black	2
85.1	Plug, Pipe	2
87	Scr, Cap BH	2
88	Ball Spherical	4
90	BSHG-RDCG	2
91	Washer, Plain Flat	2
92	Washer, Plain Flat	2
93	Washer	2

NOTES

CUSTOMER SERVICE

Dresser ROOTS
2135 Hwy 6 South
Houston, TX 77077
Toll Free Hot Line: 1-877-363-ROOT(S) (7668)
Toll Free Fax: 1-877-357-7238
Local Fax: 281-966-4309

ROOTS Factory Service & Repair Center
11611B Tanner RD
Houston, TX 77041
Toll Free: 1-800-866-6182
Local Phone: 713-896-4810
Local Fax: 713-896-4927

Service & Warranty
Toll Free: 1-800-866-6182
Local Phone: 832-467-4614
Local Fax: 713-896-4927

MARATHON ELECTRIC
A Subsidiary of Regal-Beloit Corporation

P.O. Box 8003
Wausau, WI 54401-8003
PH:(715) 675-3311

Certification Data Sheet

(DATA IS BASED ON 460 VOLTS)

Model #:324TTFC4026 **Outline Drawing:** B-SS200093-1362
Winding: 2864203 **Connection Diagram:** A-EE7308

NP HP:	40	**DESIGN:**	B	**Frame:**	324T
NP VOLTS:	460	**FREQ:**	60 HZ	**Max Load Inertia:**	200
NP AMPS:	46	**LR CODE:**	G	**Approx Mtr Wgt:**	606
NP RPM:	1765	**95% PF Corr:**	11	**Rotor Inertia:**	5
NP EFF:	93%	**Sound @ 1M:**	72 dBA	**Starts/Hour:**	4 (NEMA WK2)
NP PF:	87.5%	**Ambient**	40 C	**Stall Time:**	20 Sec
GTD EFF:	91.7%	**Service Factor:**	1.15	**Insulation:**	F
Thermal Protection:	NONE			**Duty:**	CONTINUOUS

EQUIVALENT WYE CKT. PARAMETERS (OHMS PER PHASE)

R1	R2	X1	X2	XM
0.103514	0.095006	0.573581	0.87916	17.0869

RM	ZREF	XR	TD	TD0
93.5	7.09	6.1	0.023	0.5

	AMPS	KW	RPM	TQ(ft-lb)	EFF(%)	PF(%)	R/R(C)
No LD	15	.8	1800	0	0	7.5	0
1/2 LD	26	16	1785	59	92.4	78.5	0
3/4 LD	36	24	1775	88.5	93	85.5	0
1.0 LD	46	32	1765	119	93	87.5	55
1.15 LD	53	37	1760	138	92	88	75

	MTR AMPS	NEMA AMPS	MTR TQ	NEMA TQ	PF (%)
L.R.	290	290	184 %	141 %	36
B.D.	175		277 %	202 %	71

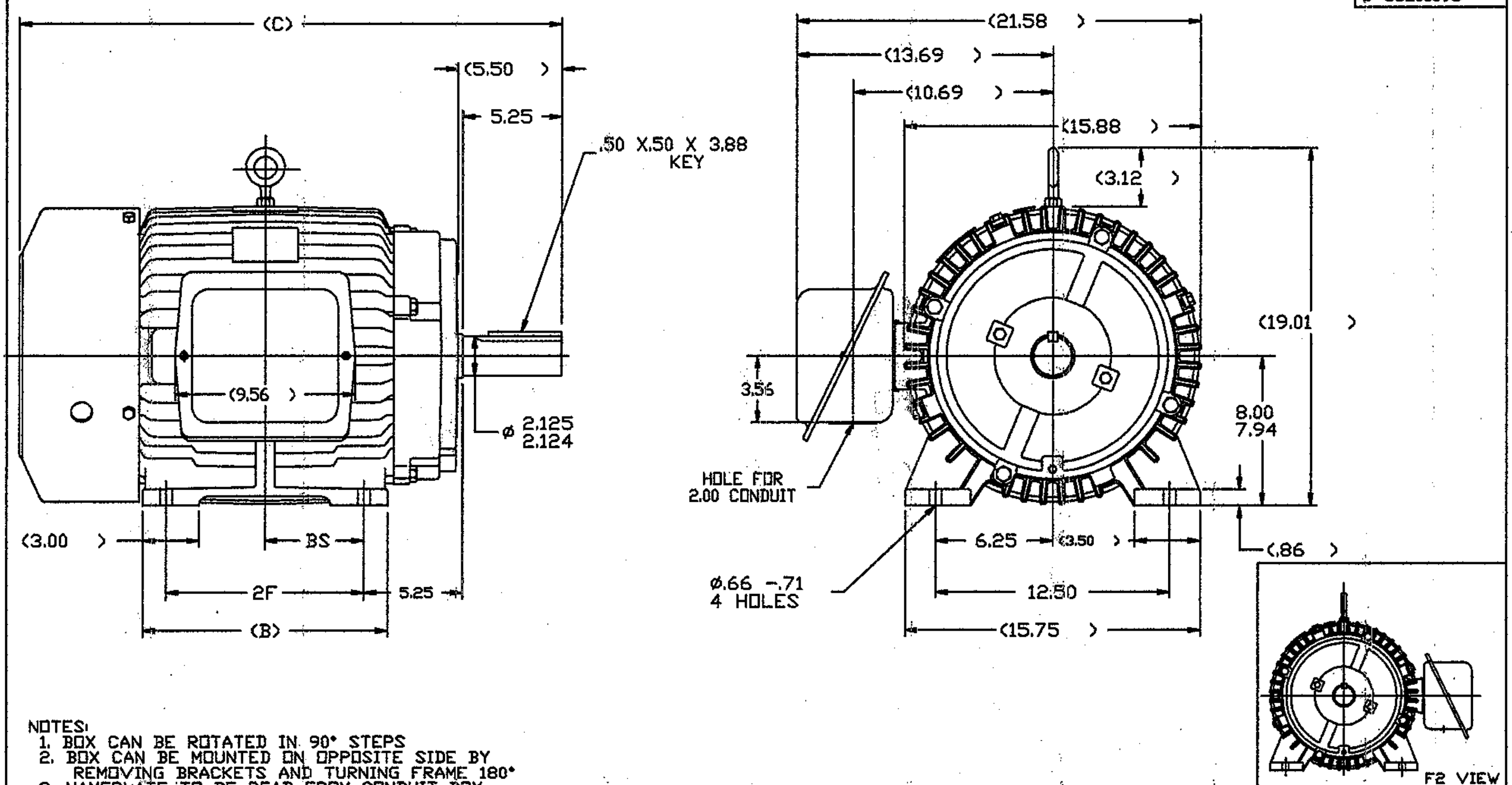
Mechanical Information

Shaft Material:	STANDARD	**Mounting:**	RIGID
Enclosure:	TEFC	**Electrical Type:**	STANDARD
Frame:	324T	**Spaceheaters:**	NONE
Frame Material:	CAST IRON	**Orientation:**	HORIZONTAL
Shaft:	T	**Conduit Assembly:**	F1
Grease:	STANDARD	**Bearings DE:**	312
Hazardous Location:	NONE	**Bearings ODE:**	311

FORM 4118 8-20-2002 *Date Printed: 2/14/2004*

The Above is Typical, Sinewave Power Data Unless Stated Otherwise.

B-SS200093



NOTES:
1. BOX CAN BE ROTATED IN 90° STEPS
2. BOX CAN BE MOUNTED ON OPPOSITE SIDE BY REMOVING BRACKETS AND TURNING FRAME 180°
3. NAMEPLATE TO BE READ FROM CONDUIT BOX SIDE OF MOTOR

DASH	FRAME	B	C	2F	BS
1362	324T	13.00	28.82	10.50	5.25
1512	326T	14.50	30.32	12.00	6.00

REV	DATE	CHANGE	
5	02-14-2000	REVISED TO NEC CONDUIT BOX CN 28428	NJS
4	11-10-1997	REVISED SHAFT TOL. CN 24000-977	MH
3	08-16-1996	UPDATED SHAFT HEIGHT CN 16763	DRS

MAX. SURFACE ROUGHNESS UNLESS NOTED OTHERWISE
MATL SPEC
FINISH

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOL. ON XXA .03 XXXA .005 XXXXA .0005 ANGLES± 7°30'

MARATHON ELECTRIC
WAUSAU, WISCONSIN 54401

DRAWN BY JL 03-02-1988
CHKD BY JPN 03-08-1988
APPD BY LS 03-21-1988

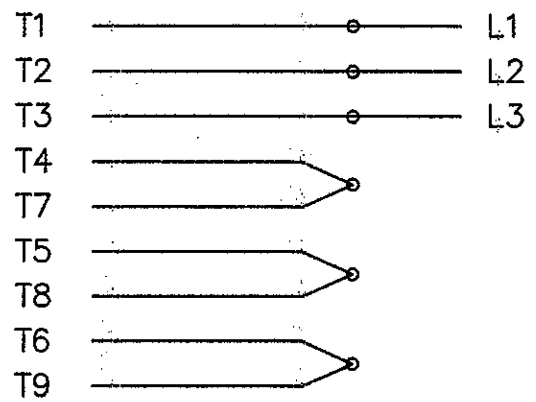
PART NAME OUTLINE - TEFC
NAME 320T FR. - BB - TS - SHT. METAL C. BOX
DRWG NO B- SS200093

L | SHOP BOOK | PURCHASED | DISTRIBUTION - WA - LB - WP - LM - BR | CADD FILE NO. SS200093

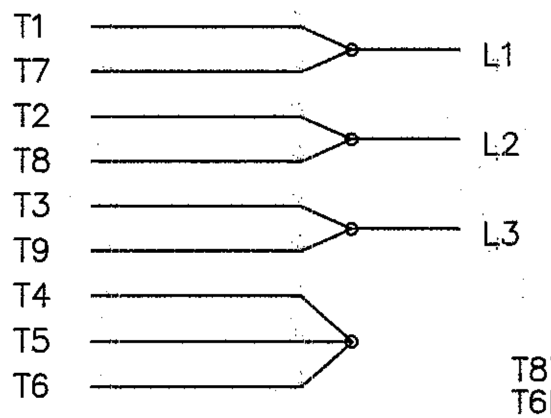
EE7308

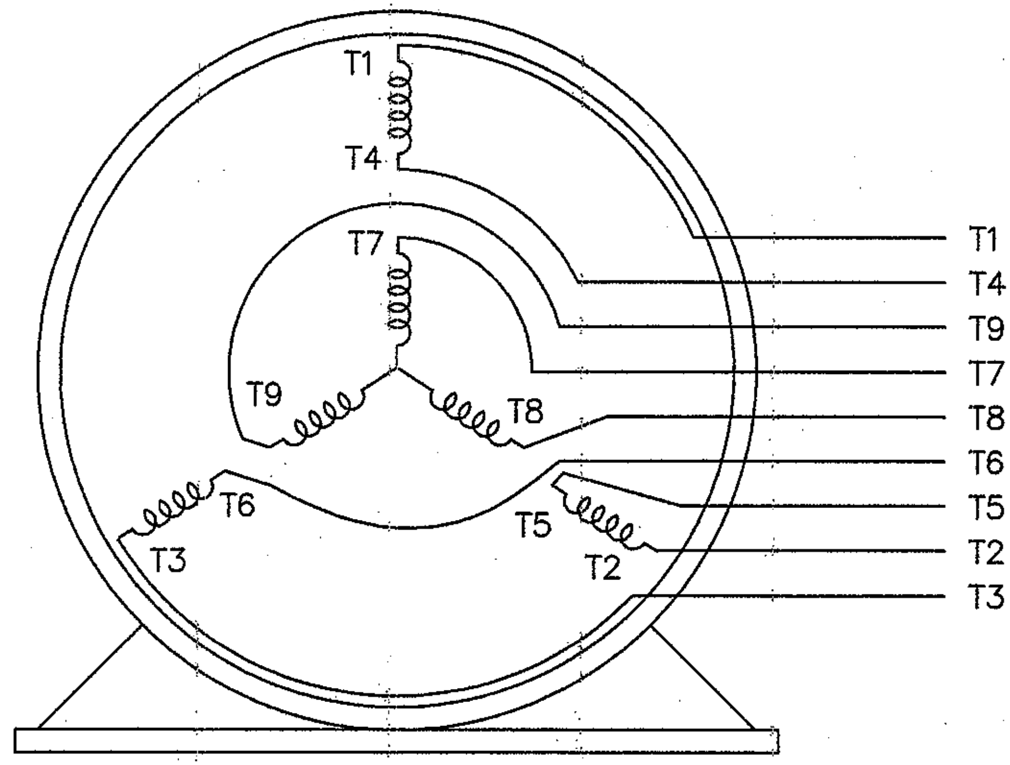
THREE PHASE DUAL VOLTAGE MOTOR

HIGH VOLTAGE



LOW VOLTAGE





VIEW OF TERMINAL END

REF.
WINDING DIAGRAM

T8Y, T2Y, T2BL, T4BX, T2EC, T2G
T6BZ, T2B, T6BL, T4AV, T6B, T4B

OPTIONAL CORD CONNECTION

L1 — WHITE
L2 — RED
L3 — BLACK

NO.	REVISION	BY & DATE	CHK
2	ADDED THE OPTIONAL CORD CONNECTION MU46318	RDH 04/24/2003	DRS
1	REDRAWN	RM 11/20/1990	

TOLERANCES UNLESS SPECIFIED	
DEC.	INCHES
.X	±.1
.XX	±.02
.XXX	±.005
.XXXX	±.0005
ANG	±7'30"

MARATHON ELECTRIC

TITLE CONNECTION DIAGRAM
3Ø – DUAL VOLTAGE MOTOR

MAT'L

FINISH

DRAWN	RM	11/20/1990
CHK	ML	11/21/1990
APPD	SAS	04/24/2003
SCALE		1=1
REF		
FMF		
PREV		

RFP

DIST WP

CAD FILE EE7308

SIZE	DRAWING NO.	PAGE	OF	REV.
A	EE7308			2

MARATHON ELECTRIC
A Subsidiary of Regal-Beloit Corporation

P.O. Box 8003
Wausau, WI 54401-8003
PH:(715) 675-3311

Certification Data Sheet

(DATA IS BASED ON 460 VOLTS)

Model #:284TTFC4026
Winding: 2564218

Outline Drawing: B-SS200144-1275
Connection Diagram: A-EE7308

NP HP:	25	**DESIGN:**	BC	**Frame:**	284T
NP VOLTS:	460	**FREQ:**	60 HZ	**Max Load Inertia:**	150
NP AMPS:	30	**LR CODE:**	G	**Approx Mtr Wgt:**	438
NP RPM:	1770	**95% PF Corr:**	7.5	**Rotor Inertia:**	3.4
NP EFF:	92.4%	**Sound @ 1M:**	69 dBA	**Starts/Hour:**	7 (NEMA WK2)
NP PF:	84%	**Ambient**	40 C	**Stall Time:**	25 Sec
GTD EFF:	91%	**Service Factor:**	1.15	**Insulation:**	F
Thermal Protection:	NONE			**Duty:**	CONTINUOUS

EQUIVALENT WYE CKT. PARAMETERS (OHMS PER PHASE)

R1	R2	X1	X2	XM
0.17898	0.15504	0.76722	1.2084	23.256

RM	ZREF	XR	TD	TD0
154	11.4	5.6	0.018	0.418

	AMPS	KW	RPM	TQ(ft-lb)	EFF(%)	PF(%)	R/R(C)
No LD	11	.5	1800	0	0	4.5	0
1/2 LD	18	10	1785	36.5	92.4	71	0
3/4 LD	23	15	1778	55.5	93	80	0
1.0 LD	30	20	1770	74	92.4	84	55
1.15 LD	34	23	1765	85.5	92.4	84.5	75

	MTR AMPS	NEMA AMPS	MTR TQ	NEMA TQ	PF (%)
L.R.	182	182	223 %	151 %	41
B.D.	115		277 %	203 %	66

Mechanical Information

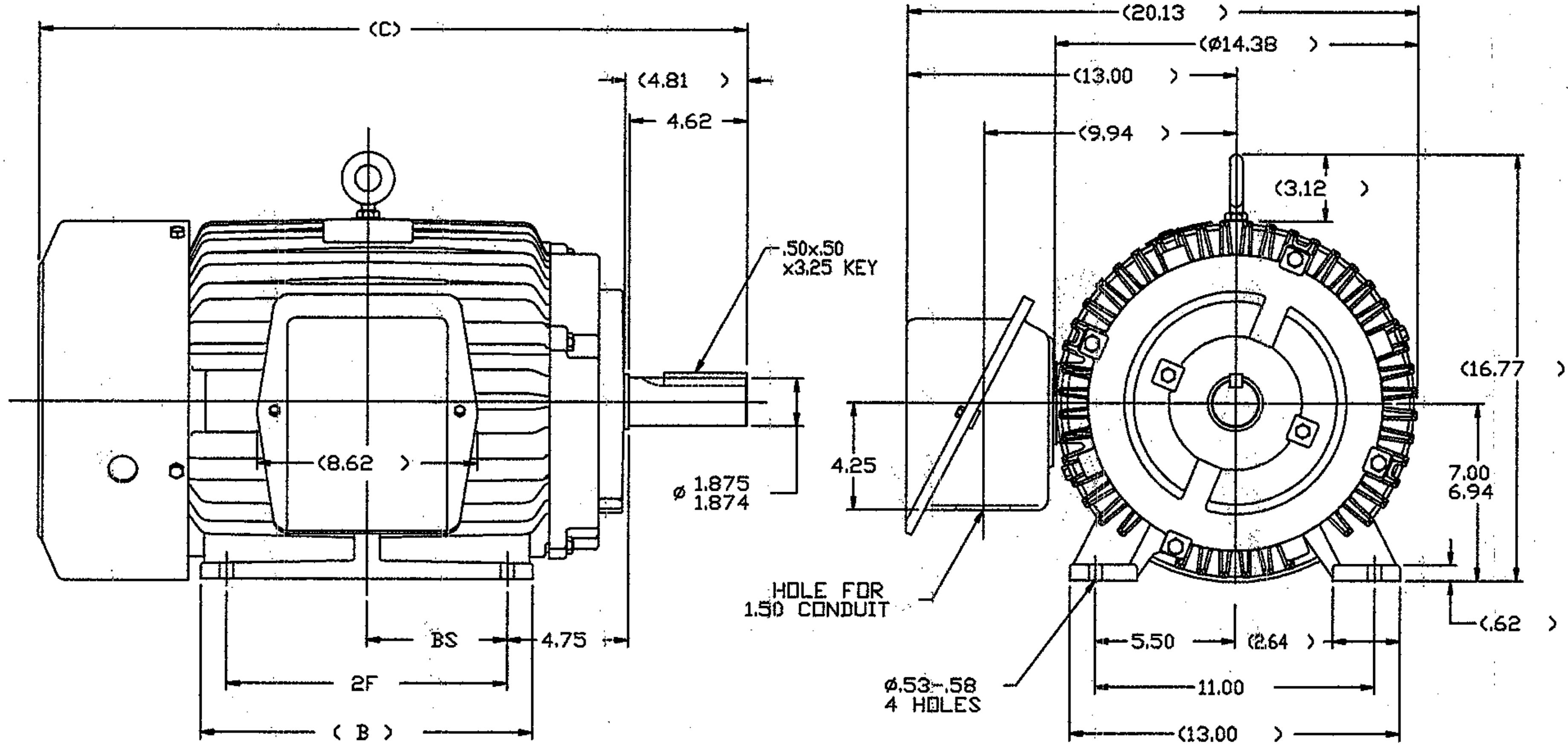
Shaft Material:	STANDARD	**Mounting:**	RIGID
Enclosure:	TEFC	**Electrical Type:**	STANDARD
Frame:	284T	**Spaceheaters:**	NONE
Frame Material:	CAST IRON	**Orientation:**	HORIZONTAL
Shaft:	T	**Conduit Assembly:**	F1
Grease:	STANDARD	**Bearings DE:**	311
Hazardous Location:	NONE	**Bearings ODE:**	210

FORM 4118 8-20-2002

Date Printed: 2/14/2004

The Above Is Typical, Sinewave Power Data Unless Stated Otherwise.

B-SS200144



NOTES

1. BOX CAN BE ROTATED IN 90° STEPS
2. BOX CAN BE MOUNTED ON OPPOSITE SIDE BY REMOVING BRACKETS AND TURNING FRAME 180°
3. NAMEPLATE TO BE READ FROM CONDUIT BOX SIDE OF MOTOR

(SS200046,SS200126)

DASH	FRAME	B	C	2F	BS
1275	284T	11.50	26.44	9.50	4.75
1425	286T	13.00	27.94	11.00	5.50

REV	DATE	CHANGE		NAME
2	09-20-96	UPDATED SHAFT HEIGHT	CN-16763	DRS
1	09-22-88	NEW DRAWING	CN-10014	JL

MAX. SURFACE ROUGHNESS UNLESS NOTED OTHERWISE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOL. ON XX± .03 XXX±.005 XXXX±.0005 ANGLES± 7'30"

MATL SPEC

FINISH

MARATHON ELECTRIC
WAUSAU, WISCONSIN 54401

DRAWN BY	JL	09-21-88
CHKD BY	ML	09-21-88
APPD BY	GK	09-21-88

PART NAME OUTLINE - TEFC 280T FR. - BB - TS - CAST C'BOX

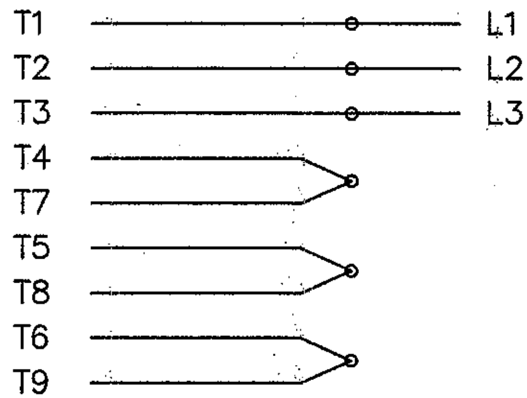
DRWG NO B-SS200144

SHOP BOOK | PURCHASED | DISTRIBUTION - WA - LB - WP - LM - YK | CADD FILE NO. SS200144

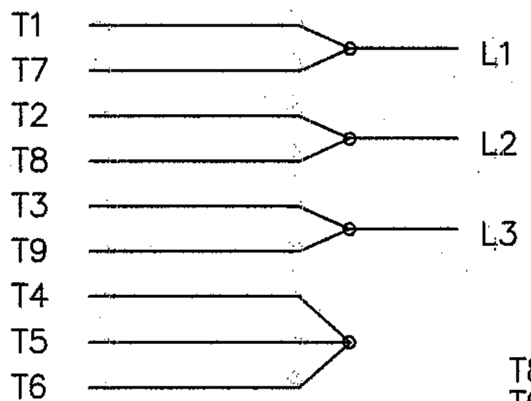
THREE PHASE DUAL VOLTAGE MOTOR

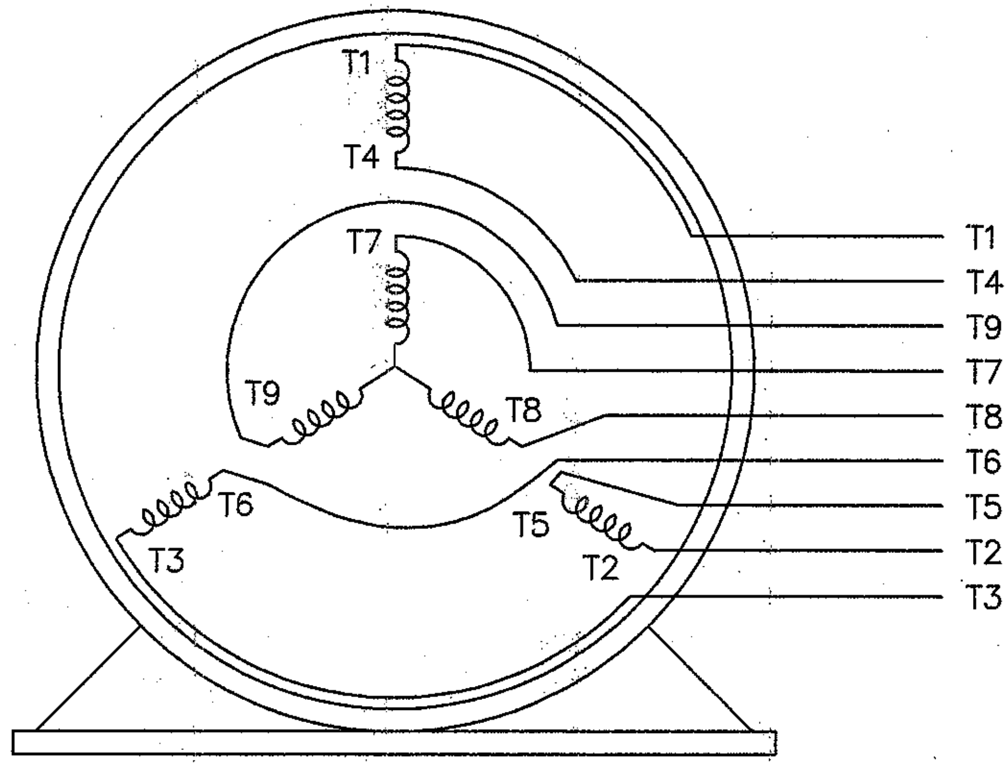
EE7308

HIGH VOLTAGE



LOW VOLTAGE





VIEW OF TERMINAL END

REF.
WINDING DIAGRAM

T8Y, T2Y, T2BL, T4BX, T2EC, T2G
T6BZ, T2B, T6BL, T4AV, T6B, T4B

OPTIONAL CORD CONNECTION

L1 WHITE
L2 RED
L3 BLACK

NO.	REVISION	BY & DATE	CHK
2	ADDED THE OPTIONAL CORD CONNECTION MU46318	RDH 04/24/2003	DRS
1	REDRAWN	RM 11/20/1990	

TOLERANCES UNLESS SPECIFIED	
DEC.	INCHES
.X	±.1
.XX	±.02
.XXX	±.005
.XXXX	±.0005
ANG	±7'30"

MARATHON ELECTRIC

TITLE CONNECTION DIAGRAM
3ø – DUAL VOLTAGE MOTOR

MAT'L.

FINISH

CAD FILE EE7308

RFP

DIST WP

DRAWN	RM 11/20/1990
CHK	ML 11/21/1990
APPD	SAS 04/24/2003
SCALE	1=1
REF	
FMF	
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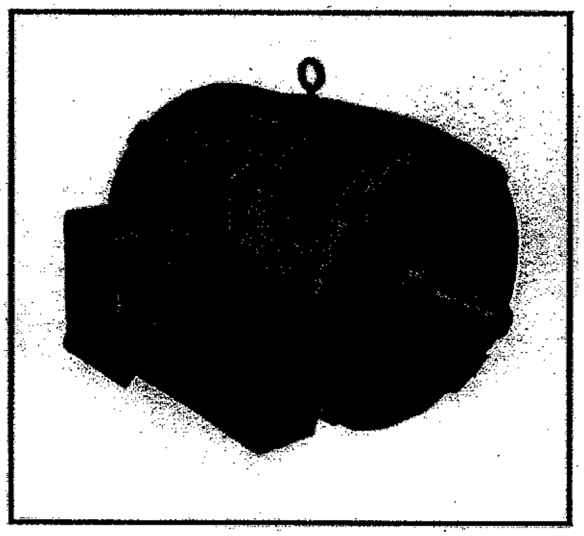
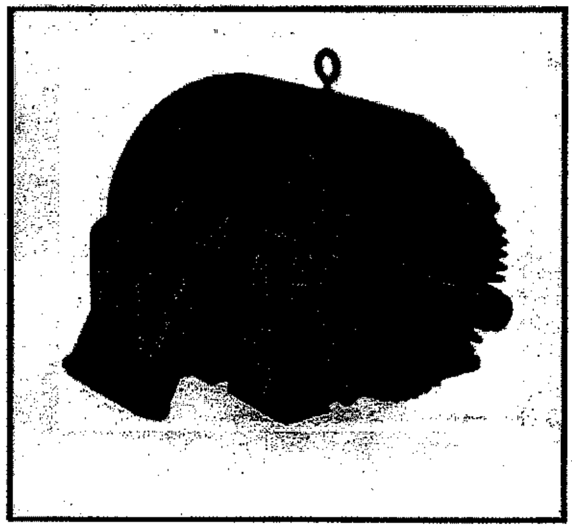
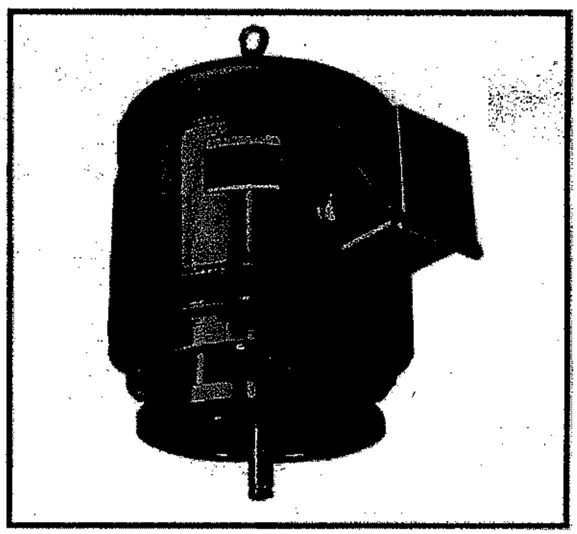
MARATHON ELECTRIC

Standard Induction Motors

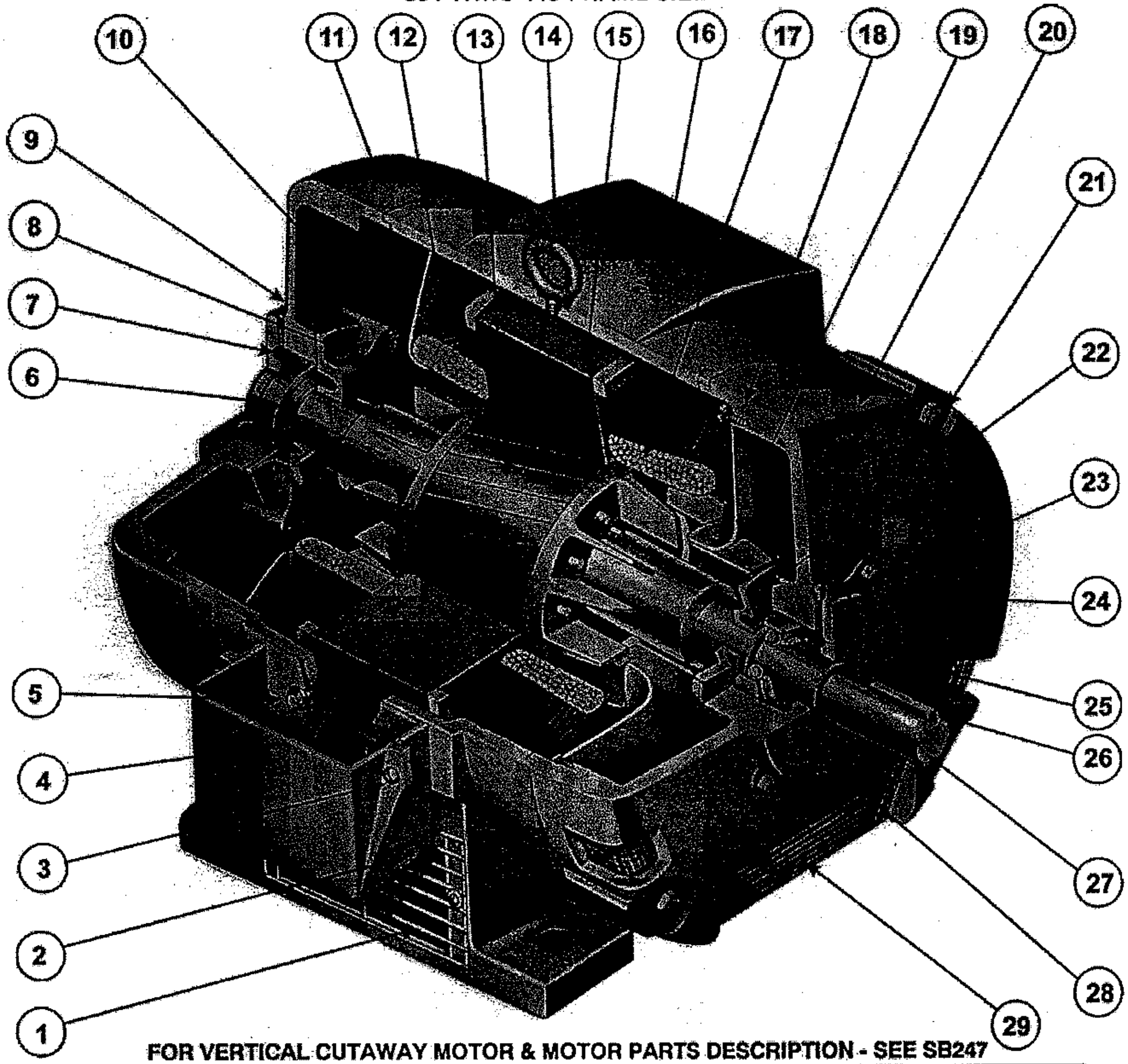






Installation, Operation, & Maintenance Instructions

TYPICAL CUTAWAY VIEW
OF A MARATHON DESIGNED, DRIPPROOF, HORIZONTAL
INTEGRAL HORSEPOWER MOTOR & PARTS DESCRIPTION
364 THRU 445 FRAME SIZE



FOR VERTICAL CUTAWAY MOTOR & MOTOR PARTS DESCRIPTION - SEE SB247

ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1.	**Frame Vent Screen	11.	Bracket O.P.E.	21.	Bracket Holding Bolt
2.	Conduit Box Bottom	12.	Baffle Plate O.P.E.	22.	Inner Bearing Cap P.E.
3.	Conduit Box Top-Holding Screw	13.	Rotor Core	23.	Inner Bearing Cap Bolt
4.	Conduit Box Top	14.	Lifting Eye Bolt	24.	Grease Plug
5.	Conduit Box Bottom-Holding Bolt	15.	Stator Core	25.	*Ball Bearing P.E.
6.	*Ball Bearing O.P.E.	16.	Frame	26.	Shaft Extention Key
7.	Pre-loading Spring	17.	Stator Winding	27.	Shaft
8.	Inner Bearing Cap O.P.E.	18.	Baffel Plate Holding Screw	28.	Drain Plug (grease)
9.	Grease Plug	19.	Baffle Plate P.E.	29.	** Bracket Screen
10.	Inner Bearing Cap Bolt	20.	Bracket P.E.		

P.E. = Pulley End
O.P.E. = Opposite Pulley End
* = Bearing Numbers are shown on motor nameplate when requesting information or parts always give complete motor description, model and serial numbers.
** = Bracket and frame screens are optional.

> WARNING
>
> **These instructions must be followed to ensure safe and proper installation, operation and maintenance of the motor. They should be brought to the attention of all persons who install, operate or maintain this equipment.**

GENERAL INFORMATION

Marathon Electric motors are all fully factory tested and inspected before shipping. Damage during shipment and storage can occur. Motors not correctly matched to the power supply and/or the load will not operate properly. These instructions are intended as a guide to identify and eliminate these problems before they are overlooked or cause further damage.

ACCEPTANCE

Check carefully for any damage that may have occurred in transit. If any damage or shortage is discovered, do not accept until an appropriate notation on the freight bill is made. Any damage discovered after receipt of equipment should be immediately reported to the carrier.

STORAGE

A. Keep motors clean
  1. Store indoors
  2. Keep covered to eliminate airborne dust and dirt.
  3. Cover openings for ventilation, conduit connections, etc. to prevent entry of rodents, snakes, birds, and insects, etc.

B. Keep motors dry
  1. Store in a dry area indoors
  2. Temperature swings should be minimal to prevent condensation.
  3. Space heaters are recommended to prevent condensation.
  4. Treat unpainted flanges, shafts, and fittings with a rust inhibitor.
  5. Check insulation resistance before putting motor into service. (Consult manufacturer for guidelines).

C. Keep Bearings Lubricated
  1. Once per month, rotate shaft several turns to distribute grease in bearings.
  2. If unit has been stored more than one year, add grease before start-up. (Refer to lubrication procedure).

INSTALLATION

UNCRATING AND INSPECTION

After uncrating, check for any damage which may have been incurred in handling. The motor shaft should turn freely by hand. Repair or replace any loose or broken parts before attempting to use the motor.

Check to be sure that motor has not been exposed to dirt, grit, or excessive moisture in shipment or storage before installation.

Measure insulation resistance (see operation). Clean and dry the windings as required.

Never start a motor which has been wet without having it thoroughly dried.

SAFETY

Motors should be installed, protected and fused in accordance with latest issue of National Electrical Code, NEMA Standard Publication No. MG 2 and local codes.

Eyebolts or lifting lugs are intended for lifting the motor only. These lifting provisions should never be used when lifting or handling the motor with other equipment (i.e. pumps, gear boxes, fans or other driven equipment) as a single unit. Be sure the eyebolt is fully threaded and tight in its mounting hole.

Eyebolt lifting capacity ratings is based on a lifting alignment coincident with the eyebolt centerline. Eyebolt capacity reduces as deviation from this alignment increases. See NEMA MG 2.

Frames and accessories of motors should be grounded in accordance with National Electrical Code (NEC) Article 430. For general information of grounding refer to NEC Article 250.

Rotating parts such as pulleys, couplings, external fans, and shaft extensions should be permanently guarded.

LOCATION

In selecting a location for the motor, consideration should be given to environment and ventilation. A motor with the proper enclosure for the expected operating condition should be selected.

The ambient temperature of the air surrounding the motor should not exceed 40°C (104°F) unless the motor has been especially designed for high ambient temperature applications. The free flow of air around the motor should not be obstructed.

The motor should never be placed in a room with a hazardous process, or where flammable gases or combustible material may be present, unless it it specifically designed for this type of service.

1. Dripproof (open) motors are intended for use indoors where atmosphere is relatively clean, dry and non-corrosive.
2. Dripproof (open) fire pump motors are to be installed in a Type 2 dripproof environment as defined in NEMA 250.
3. Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations.
4. Explosion proof motors are built for use in hazardous locations as indicated by Underwriters' label on motor. Consult UL, NEC, and local codes for guidance.

Refer to Marathon Electric for application assistance.

FLOOR MOUNTING

Motors should be provided with a firm, rigid foundation, with the plane of four mounting pads flat within .010" for 56 to 210 frame; .015" from 250 through 500 frame. This may be accomplished by shims under the motor feet. For special isolation mounting, contact Marathon Electric for assistance.

V-BELT DRIVE

1. Select proper type and number of belts and sheaves. Excessive belt load will damage bearings. Sheaves should be in accordance to NEMA Spec. MG-1 or as approved by the manufacturer for a specific application.
2. Align sheaves carefully to avoid axial thrust on motor bearing. The drive sheave on the motor should be positioned toward the motor so it is as close as possible to the bearing.

3. When adjusting belt tension, make sure the motor is secured by all mounting bolts before tightening belts.
4. Adjust belt tension to belt manufacturers recommendations. Excessive tension will decrease bearing life.
5. For more information see Marathon Electric Publication SB588.

DIRECT CONNECTED DRIVE

Flexible or solid shaft couplings must be properly aligned for satisfactory operation. On flexible couplings, the clearance between the ends of the shafts should be in accordance with the coupling manufacturer's recommendations or NEMA standards for end play and limited travel in coupling.

MISALIGNMENT and RUN-OUT between direct connected shafts will cause increased bearing loads and vibration even when the connection is made by means of a flexible coupling. Excessive misalignment will decrease bearing life. Proper alignment, per the specifications of the coupling being used, is critical.

Some large motors are furnished with roller bearings. Roller bearings should **not** be used for direct drive.

ELECTRICAL CONNECTIONS

CAUTION

Install and ground per local and national codes. Consult qualified personnel with questions or if repairs are required.

WARNING

1. Disconnect power before working on motor or driven equipment.
2. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
3. Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
4. Discharge all capacitors before servicing motor.
5. Always keep hands and clothing away from moving parts.
6. Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
7. Electrical repairs should be performed by trained and qualified personnel only.
8. Failure to follow instructions and safe electrical procedures could result in serious injury or death.
9. If safety guards are required, be sure the guards are in use.

1. All wiring, fusing, and grounding must comply with National Electrical Codes and local codes.
2. To determine proper wiring, rotation and voltage connections, refer to the information and diagram on the nameplate, separate connection plate or decal. If the plate or decal has been removed, contact Marathon Electric for assistance.
3. Use the proper size of line current protection and motor controls as required by the National Electrical Code and local codes. Recommended use is 125% of full load amps as shown on the nameplate for motors with 40°C ambient and a service factor over 1.0. Recommended use is 115% of full load amps as shown on the nameplate for all other motors. Do not use protection with larger capacities than recommended. Three phase motors must have all three phases protected.

THERMAL PROTECTOR INFORMATION

The nameplate will indicate one of the following:

1. Motor is thermally protected
2. Motor is not thermally protected
3. Motor is provided with overheat protective device

For examples, refer to paragraphs below:

1. Motors equipped with built-in thermal protection have "THERMALLY PROTECTED" stamped on the nameplate. Thermal protectors open the motor circuit electrically when the motor overheats or is overloaded.
   The protector cannot be reset until the motor cools. If the protector is automatic, it will reset itself. If the protector is manual, press the red button to reset.
2. Motors without thermal protection have nothing stamped on nameplate about thermal protection.
3. Motors that are provided with overheat protective device that does not open the motor circuit directly will indicate "WITH OVERHEAT PROTECTIVE DEVICE".
   A. Motors with this type of "Overheat Protective Device" have protector leads brought out in the motor conduit box marked "P1" and "P2". These leads are intended for connection in series with the stop button of the 3-wire pilot circuit for the magnetic starter which controls the motor. See Figure 1.
   B. The circuit controlled by the above "Overheat Protective Device" must be limited to a maximum of 600 volts and 360 volt-amps.

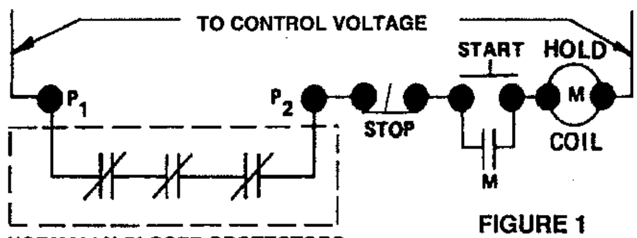
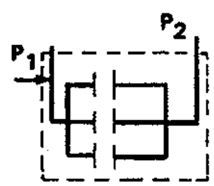


FIGURE 1



Normally Open (N/O) Motor Thermostats may be used in conjunction with controls installed by Original Equipment Manufacturers.

FIGURE 1A

CHANGING ROTATION

1. Keep hands and clothing away from rotating parts.
2. Before the motor is coupled to the load, determine proper rotation.
3. Check rotation by jogging or bumping. Apply power to the motor leads for a short period of time, enough to just get motor shaft to rotate a slight amount to observe shaft rotating direction.
4. Three phase - interchange any two (2) of the three (3) line leads. Single phase - reconnect per the connection diagram on the motor.

REDUCED VOLTAGE STARTING

Motors used on reduced voltage starting, should be carefully selected based upon power supply limitations and driven load requirements. The motors starting torque will be reduced when using reduced voltage starting. The elapsed time on the start step should be kept as short as possible and should not exceed 5 seconds. It is recommended that this time be limited to 2 seconds. Refer to Marathon Electric for application assistance.

OPERATION

WARNING
Disconnect and lock out before working on motor or driven equipment.

BEFORE INITIAL STARTING

1. If a motor has become damp in shipment or in storage, measure the insulation resistance of the stator winding.

$$\text{Minimum Insulation Resistance In Megohms} = 1 + \frac{\text{Rated Voltage}}{1000}$$

Do not attempt to run the motor if the insulation resistance is below this value.

2. If insulation resistance is low, dry out the moisture in one of the following ways:
   a. Bake in oven at temperature not more than 90°C (194°F).
   b. Enclose motor with canvas or similar covering, leaving a hole at the top for moisture to escape, and insert heating units or lamps.
   c. Pass a current at low voltage (rotor locked) through the stator winding. Increase the current gradually until the winding temperature, measured with a thermometer, reaches 90°C (194°F). Do not exceed this temperature.
3. See that voltage and frequency stamped on motor and control nameplates correspond with that of the power line.
4. Check all connections to the motor and control with the wiring diagram.
5. Be sure rotor turns freely when disconnected from the load. Any foreign matter in the air gap should be removed.
6. Leave the motor disconnected from the load for the initial start (see following caution). Check for proper rotation. Check for correct voltage (within $\pm$10% of nameplate value) and that it is balanced within 1% at the motor terminals. After the machine is coupled to the load, check that the nameplate amps are not exceeded. Recheck the voltage level and balance under load per the above guidelines.

Shut down the motor if the above parameters are not met or if any other noise or vibration disturbances are present. Consult NEMA guidelines or the equipment manufacturer if any questions exist before operating equipment.

CAUTION
For motors nameplated as "belted duty only", do not run motor without belts properly installed.

COLLECTOR RINGS (Wound Rotor Motors Only)

The collector rings are sometimes treated at the factory to protect them while in stock and during shipment. The brushes have been fastened in a raised position. Before putting the motor into service, the collector rings should be cleaned to remove this treatment. Use a cleaning fluid that is made for degreasing electrical equipment. All of the brushes must be released and lowered to the collector surface. Keep the rings clean and maintain their polished surfaces. Ordinarily, the rings will require only occasional wiping with a piece of canvas or non-linting cloth. Do not let dust or dirt accumulate between the collector rings.

BRUSHES (Wound Rotor Motors Only)

See that the brushes move freely in the holders and at the same time make firm, even contact with the collector rings. The pressure should be between 2 and 3 pounds per square inch of brush surface.

When installing new brushes, fit them carefully to the collector rings. Be sure that the copper pigtail conductors are securely fastened to, and make good contact with, the brushholders.

ALLOWABLE VOLTAGE AND FREQUENCY RANGE

If voltage and frequency are within the following range, motors will operate, but with somewhat different characteristics than obtained with correct nameplate values.

1. Voltage: Within 10% above or below the value stamped on the nameplate. On three phase systems the voltage should be balanced within 1%. A small voltage unbalance will cause a significant current unbalance.
2. Frequency: Within 5% above or below the value stamped on the nameplate.
3. Voltage and Frequency together: Within 10% (providing frequency above is less than 5%) above or below values stamped on the nameplate.

CLEANLINESS

Keep both the interior and exterior of the motor free from dirt, water, oil and grease. Motors operating in dirty places should be periodically disassembled and thoroughly cleaned.

CONDENSATION DRAIN PLUGS

All explosion proof and some totally enclosed motors are equipped with automatic drain plugs, they should be free of oil, grease, paint, grit and dirt so they don't clog up. The drain system is designed for normal floor (feet down) mounting. For other mounting positions, modification of the drain system may be required, consult Marathon Electric.

SERVICE

WARNING

Disconnect power before working on motor or driven equipment. Motors with automatic thermal protectors will automatically restart when the protector cools. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.

CAUTION
Overgreasing bearings can cause premature bearing and/or motor failure. The amount of grease added should be carefully controlled.

NOTE
If lubrication instructions are shown on the motor nameplate, they will supersede this general instruction.

Marathon Electric motors are pregreased with a polyurea mineral oil NGLI grade 2 type grease unless stated otherwise on the motor nameplate. Some compatible brands of polyurea mineral base type grease are: Chevron SRI #2, Rykon Premium #2, Exxon Polyrex EM or Texaco Polystar RB.

Motors are properly lubricated at the time of manufacture. It is not necessary to lubricate at the time of installation unless the motor has been in storage for a period of 12 months or longer (refer to lubrication procedure that follows).

LUBRICATION PROCEDURES

1. Stop motor. Disconnect and lock out of service.
2. Remove contaminants from grease inlet area.
3. Remove filler and drain plugs.
4. Check filler and drain holes for blockage and clean as necessary.
5. Add proper type and amount of grease. See the Relubrication Time Intervals table for service schedule and Relubrication Amounts table for volume of grease required.
6. Wipe off excess grease and replace filler and drain plugs (see following warning).
7. Motor is ready for operation.

WARNING
If motor is nameplated for hazardous locations, do not run motor without all of the grease or drain plugs installed.

RELUBRICATION TIME INTERVAL

(For motors with regreasing provisions).

Service Condition	NEMA FRAME SIZE 140-180: 1800 RPM and less	140-180: Over 1800 RPM	210-360: 1800 RPM and less	210-360: Over 1800 RPM	400-510: 1800 RPM and less	400-510: Over 1800 RPM
Standard	3 yrs.	6 months	2 yrs.	6 months	1 yr.	3 months
Severe	1 yr.	3 months	1 yr.	3 months	6 months	1 month
Seasonal	See Note 2.					

NOTE
1. For motors nameplated as "belted duty only" divide the above intervals by 3.
2. Lubricate at the beginning of the season. Then follow service schedule above.

SEASONAL SERVICE: The motor remains idle for a period of 6 months or more.

STANDARD SERVICE: Up to 16 hours of operation per day, indoors, 100°F maximum ambient.

SEVERE SERVICE: Greater than 16 hours of operation per day. Continuous operation under high ambient temperatures (100° to 150°F) and/or any of the following: dirty, moist locations, high vibration (above NEMA standards), heavy shock loading, or where shaft extension end is hot.

RELUBRICATION AMOUNTS

(For motors with regreasing provisions).

NEMA FRAME SIZE	VOLUME cu. in. (fluid oz.)
140	.25 (.14)
180	.50 (.28)
210	.75 (.42)
250	1.00 (.55)
280	1.25 (.69)
320	1.50 (.83)
360	1.75 (.97)
400	2.25 (1.2)
440	2.75 (1.5)
500	3.00 (1.7)

TROUBLESHOOTING

WARNING

1. Disconnect power before working on motor or driven equipment.
2. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
3. Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
4. Discharge all capacitors before servicing motor.
5. Always keep hands and clothing away from moving parts.
6. Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
7. Electrical repairs should be performed by trained and qualified personnel only.
8. Failure to follow instructions and safe electrical procedures could result in serious injury or death.
9. If safety guards are required, be sure the guards are in use.

If trouble is experienced in the operation of the motor, make sure that:

1. The bearings are in good condition and operating properly.
2. There is no mechanical obstruction to prevent rotation in the motor or in the driven load.
3. The air gap is uniform. (Consult manufacturer for specifications).
4. All bolts and nuts are tightened securely.
5. Proper connection to drive machine or load has been made.

In checking for electrical troubles, be sure that:

1. The line voltage and frequency correspond to the voltage and frequency stamped on the nameplate of the motor.
2. The voltage is actually available at motor terminals.
3. The fuses and other protective devices are in proper condition.
4. All connections and contacts are properly made in the circuits between the control apparatus and motor.

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Should additional information be desired for the purchaser's purposes, the matter should be referred to the nearest Marathon Electric Manufacturing Corp. sales office listed on the back page.

MOTOR TROUBLE SHOOTING CHART

Your motor service and any trouble shooting must be handled by qualified persons who have proper tools and equipment.

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating
	Overload trips	Check and reset overload in starter.
	Improper power supply	Check to see that power supplied agrees with motor nameplate and load factor.
	Improper line connections	Check connections with diagram supplied with motor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections. Also see that all control contacts are closing.
	Mechanical failure	Check to see if motor and drive turn freely. Check bearings and lubrication.
	Short circuited stator	Indicated by blown fuses. Motor must be rewound.
	Poor stator coil connection	Remove end bells, locate with test lamp.
	Rotor defective	Look for broken bars or end rings.
	Motor may be overloaded	Reduce load.
Motor stalls	One phase may be open	Check lines for open phase.
	Wrong application	Change type or size. Consult manufacturer.
	Overload	Reduce load.
	Low voltage	See that nameplate voltage is maintained. Check connection.
	Open circuit	Fuses blown, check overload relay, stator and pushbuttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, to fuses and to control.
Motor does not come up to speed	Not applied properly	Consult supplier for proper type.
	Voltage too low at motor terminals because of line drop.	Use higher voltage on transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Starting load too high	Check load motor is supposed to carry at start.
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required as repairs are usually temporary.
	Open primary circuit	Locate fault with testing device and repair.
Motor takes too long to accelerate and/or draws high amp	Excessive load	Reduce load.
	Low voltage during start	Check for high resistance. Adequate wire size.
	Defective squirrel cage rotor	Replace with new rotor.
	Applied voltage too low	Get power company to increase power tap.
Wrong rotation	Wrong sequence of phases	Reverse connections at motor or at switchboard.
Motor overheats while running under load	Overload	Reduce load.
	Frame or bracket vents may be clogged with dirt and prevent proper ventialation of motor.	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check to make sure that all leads are well connected.
	Grounded coil	Locate and repair.
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.
Motor vibrates	Motor misaligned	Realign.
	Weak support	Strengthen base
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective bearings	Replace bearing.
	Bearings not in line	Line up properly.
	Balancing weights shifted	Rebalance motor.
	Polyphase motor running single phase	Check for open circuit.
	Excessive end play	Adjust bearing or add shim.
Unbalanced line current on polyphase motors during normal operation	Unequal terminal volts	Check leads and connections.
	Single phase operation	Check for open contacts.
	Unbalanced voltage	Correct unbalanced power supply.
Scraping noise	Fan rubbing air shield	Remove interference.
	Fan striking insulation	Clear fan.
	Loose on bedplate	Tighten holding bolts.
Noisy operation	Airgap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
Hot bearings general	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing.
	Pulley diameter too small.	Use larger pulleys.
	Misalignment	Correct by realignment of drive.
Hot bearings ball	Insufficient grease	Maintain proper quantity of grease in bearing.
	Deterioration of grease or lubircant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease, bearing should not be more than 1/2 filled.
	Overloaded bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Replace bearing, first clean housing thoroughly.

Marathon Electric Mfg. Corp.
P.O. Box 8003
100 E. Randolph Street
Wausau, WI 54402-8003
Phone: (715) 675-3311
FAX: (715) 675-6361

This manual is printed on recycled stock.

This Solution is based on the use of EPT COMPONENTS. Substitution of competitive product may result in reduced drive life and/or unsatisfactory performance.

Solution #194636, Selection #5

ESC-Kingston S.O. #11432 (SVE #1)
615 URAI Marathon E984 (40 HP)
1800 RPM to 1952 RPM

Bill of Materials

Qty	Part Number
1	2B5V90
1	B 2 1/8
1	2Q5V85
1	Q1 1 3/8 5/16
2	5VX730

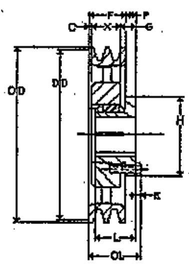
EPT EDGE Browning Drive Technical Specifications

	Required	Actual
Driver Speed:	1800	1800
Driven Speed:	1952	1950/1950
Center Distance:	22.00-26.00	22.76
Horsepower:	40.00	40.00
Service Factor:	1.3	1.33
Options Invoked:	Yes	
Tension:	9.26 Lb. should deflect belt 0.36 in.	
Hub Load:	531 Lb. "running" Hub Load	

7120 Buffington Rd.
Florence, KY 41042
Customer Service: 1-800-354-9825
Technical Questions: 1-800-626-2093

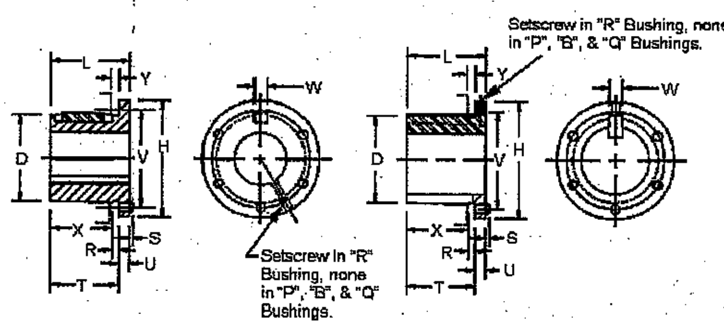
Driver Sheave: 2B5V90

PD (5V)=9.1
PD (A)=8.8
DD (A)=8.6
PD (B)=9.3
DD (B)=9
OL=2.546875
OD=9.28
F=1.71875
L=1.9375
P=0.625
C=0.234375
X=1.25
G=0.859375
E=0.203125
H=3.6875
WT=11



Driver Bushing: B 2 1/8

Bore (In)=2.125
D (Large End)=2.625
D (Small End)=2.5567
H=3.6875
L=1.9375
R=0.34375
S=0.203125
T=1.421875
U=0.515625
V=3.125
W=0.5
X=1.078125
Y=0.34375
WT=1.75



"P", "B", "Q", & "R" BUSHINGS

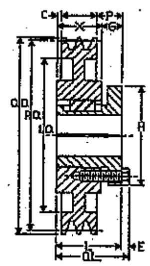
Type 1 Type 2

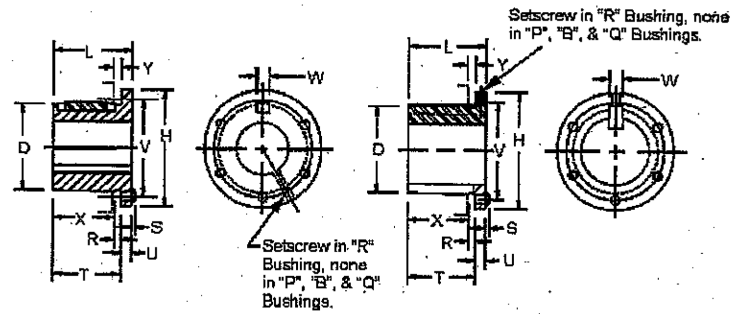
Driven Sheave: 2Q5V85

PD (5V)=8.4
OL=2.828125
OD=8.5
F=1.6875
L=2.5
P=0.875
C=0.03125
X=1.75
G=0.84375
E=0.234375
H=4.125
WT=14

Driven Bushing: Q1 1 3/8 5/16

Bore (In)=1.375
D (Large End)=2.875
D (Small End)=2.7857
H=4.125
L=2.5
R=0.3125
S=0.234375
T=1.96875
U=0.53125
V=3.375
W=0.5
X=1.65625
Y=0.3125
WT=3.95





"P", "B", "Q", & "R" BUSHINGS

Type 1

Type 2

This Solution is based on the use of EPT COMPONENTS. Substitution of competitive product may result in reduced drive life and/or unsatisfactory performance.

Solution #194655, Selection #3

ESC-Kingston S.O. #11432 (SVE #2)
615 URAI Marathon E961 (25 HP)
1800 RPM to 1442 RPM

Bill of Materials

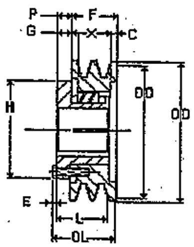
Qty	Part Number
1	2B5V64
1	B 1 7/8
1	2B5V80
1	B 1 3/8 5/16
2	5VX670

EPT EDGE Browning Drive Technical Specifications

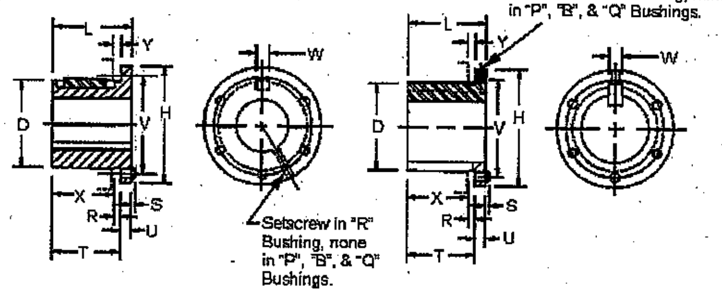
	Required	Actual
Driver Speed:	1800	1800
Driven Speed:	1442	1444/1444
Center Distance:	22.00-26.00	22.02
Horsepower:	25.00	25.00
Service Factor:	1.30	1.39
Options Invoked:	Yes	
Tension:	7.86 Lb. should deflect belt 0.34 In.	
Hub Load:	470 Lb. "running" Hub Load	

Browning, KOP-FLEX, EPT, SEALMASTER, Rollway, McGILL, Morse
7120 Buffington Rd.
Florence, KY 41042
Customer Service: 1-800-354-9825
Technical Questions: 1-800-626-2093

Driver Sheave: 2B5V64
PD (5V)=6.5
PD (A)=6.2
DD (A)=6
PD (B)=6.7
DD (B)=6.4
OL=2.546875
OD=6.68
F=1.71875
L=1.9375
P=0.625
C=0.234375
X=1.25
G=0.859375
E=0.203125
H=3.6875
WT=9.1



Driver Bushing: B 1 7/8
Bore (In)=1.875
D (Large End)=2.625
D (Small End)=2.5567
H=3.6875
L=1.9375
R=0.34375
S=0.203125
T=1.421875
U=0.515625
V=3.125
W=0.5
X=1.078125
Y=0.34375
WT=1.95

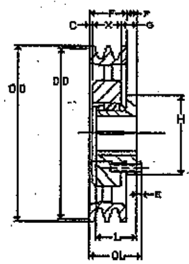


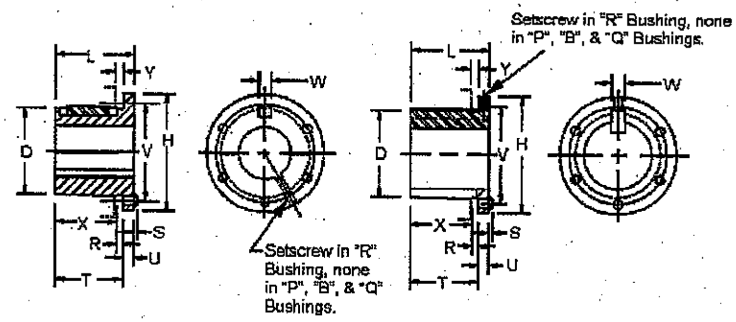
"P", "B", "Q", & "R" BUSHINGS

Type 1 Type 2

Driven Sheave: 2B5V80
PD (5V)=8.1
PD (A)=7.8
DD (A)=7.6
PD (B)=8.3
DD (B)=8
OL=2.546875
OD=8.28
F=1.71875
L=1.9375
P=0.625
C=0.140625
X=1.34375
G=0.859375
E=0.203125
H=3.6875
WT=11.1

Driven Bushing: B 1 3/8 5/16
Bore (In)=1.375
D (Large End)=2.625
D (Small End)=2.5567
H=3.6875
L=1.9375
R=0.34375
S=0.203125
T=1.421875
U=0.515625
V=3.125
W=0.5
X=1.078125
Y=0.34375
WT=2.55





"P", "B", "Q", & "R" BUSHINGS

Type 1 Type 2

ACS Industries, LP
Separations Technology Division
14211 Industry Road
Houston, TX 77053
(800) 231-0077 · (713) 434-0934 · Fax: (713) 433-6201
http://www.acsindustries.com, e-mail: acstx@flash.net

Customer:	ESC
Contact:	
Quote Number:	
Date:	12/04/2003
Reference Number:	Federal Mogul - Kingston
Engineer:	RMB

System # 2 550 SCFM @ 8" HG

PROCESS	**CASE 1**
Gas/Liquid system	Air / Water
Temperature, °F	68
Pressure, in Hg, gauge	-8
Compressibility factor	1
Gas density, lb/ft³	0.0551
Gas viscosity, centipoise	0.0187
Gas flow rate, scfm	550
Liquid density, lb/ft³	62.29
Liquid viscosity, centipoise	1.009
Fouling	No
PAD/VANE DEFINITION	
Pad style	5CA
MistMaster®	No
Pad density	7.0
Wire diameter(s)	0.011
Surface area(s)	65
Percent voids	98.6
Material	Metal
PERFORMANCE	
% Collection Eff. @ 5 µm	95.56
10 µm	99.51
15 µm	99.78
20 µm	99.84
50 µm	99.89
Dry pressure drop, in-water	0.1692
GEOMETRY	
Pad/vane thickness, inch	6
Pad shape	Round
Actual Dimension 1, in*	18
Actual Dimension 2, in**	--
Actual Capacity factor	0.2355
Actual Velocity, fps	7.912
Actual Area, ft²	1.767
Optimum Capacity factor	0.2904
Optimum Velocity, fps	9.755
Optimum Area, ft²	1.433

Dimension 1: Diameter (round, segment); Length (rectangle)
** Dimension 2: Width (rectangle); Segment width (segment)

ACS INDUSTRIES, LP
Separations Technology Division

ACS Industries, LP
Separations Technology Division
14211 Industry Road
Houston, TX 77053
(800) 231-0077 · (713) 434-0934 · Fax: (713) 433-6201
http://www.acsindustries.com, e-mail: acstx@flash.net

Customer:	ESC	System # 1 750 SCFM @ 10" HG
Contact:		
Quote Number:		
Date:	12/04/2003	
Reference Number:	Federal Mogul - Kingston	
Engineer:	RMB	

PROCESS	CASE 1
Gas/Liquid system	Air / Water
Temperature, °F	68
Pressure, in Hg, gauge	-10
Compressibility factor	1
Gas density, lb/ft³	0.0501
Gas viscosity, centipoise	0.0187
Gas flow rate, scfm	750
Liquid density, lb/ft³	62.29
Liquid viscosity, centipoise	1.009
Fouling	No
PAD/VANE DEFINITION	
Pad style	5CA
MistMaster®	No
Pad density	7.0
Wire diameter(s)	0.011
Surface area(s)	65
Percent voids	98.6
Material	Metal
PERFORMANCE	
% Collection Eff. @ 5 µm	92.59
10 µm	99.3
15 µm	99.73
20 µm	99.81
50 µm	99.89
Dry pressure drop, in-water	0.1025
GEOMETRY	
Pad/vane thickness, inch	6
Pad shape	Round
Actual Dimension 1, in*	24
Actual Dimension 2, in**	--
Actual Capacity factor	0.1722
Actual Velocity, fps	6.067
Actual Area, ft²	3.142
Optimum Capacity factor	0.2839
Optimum Velocity, fps	10
Optimum Area, ft²	1.906

* Dimension 1: Diameter (round, segment); Length (rectangle)
** Dimension 2: Width (rectangle); Segment width (segment)

BISCO Environmental

Section 2 – Transfer Pumps

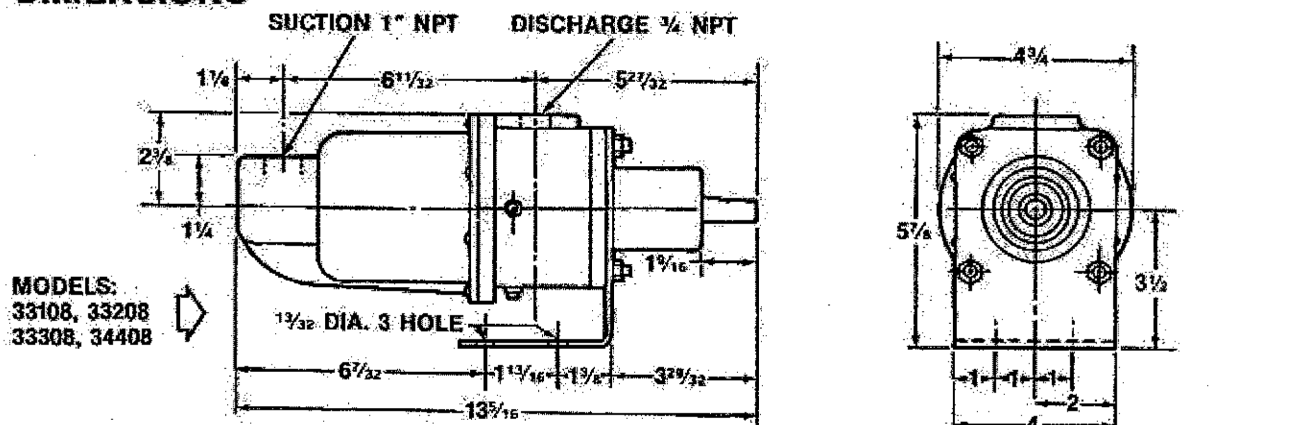
- SVE System 1 & 2 Transfer Pump, Moyno Model 35601 Specification Data
- SVE System 1 & 2 Transfer Pump, Moyno Model 35601 Service Manual

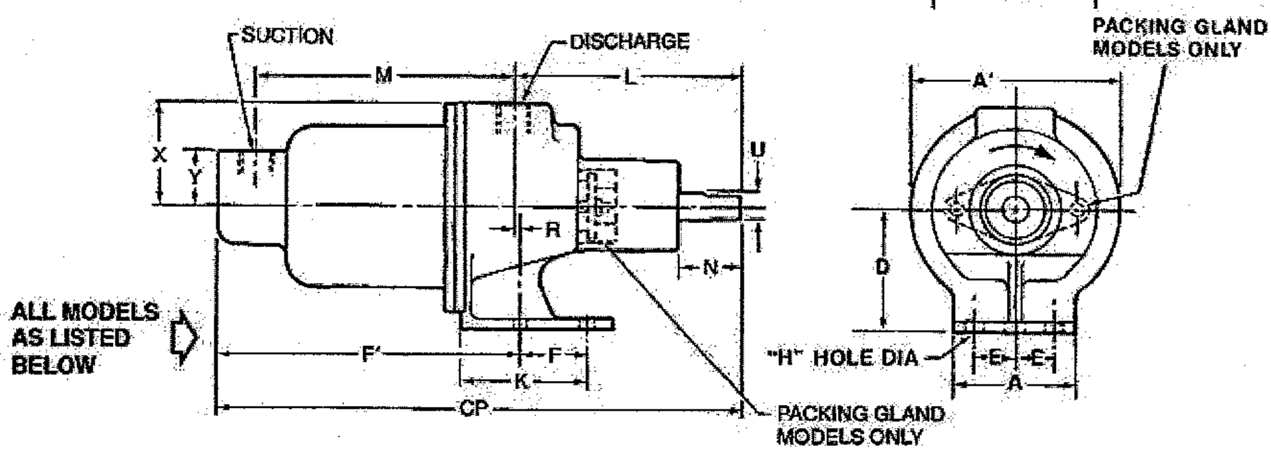
SPECIFICATION DATA

MOYNO® 500 PUMPS

300 SERIES
331, 332, 333, 344, 356 AND 367 MODELS

DIMENSIONS





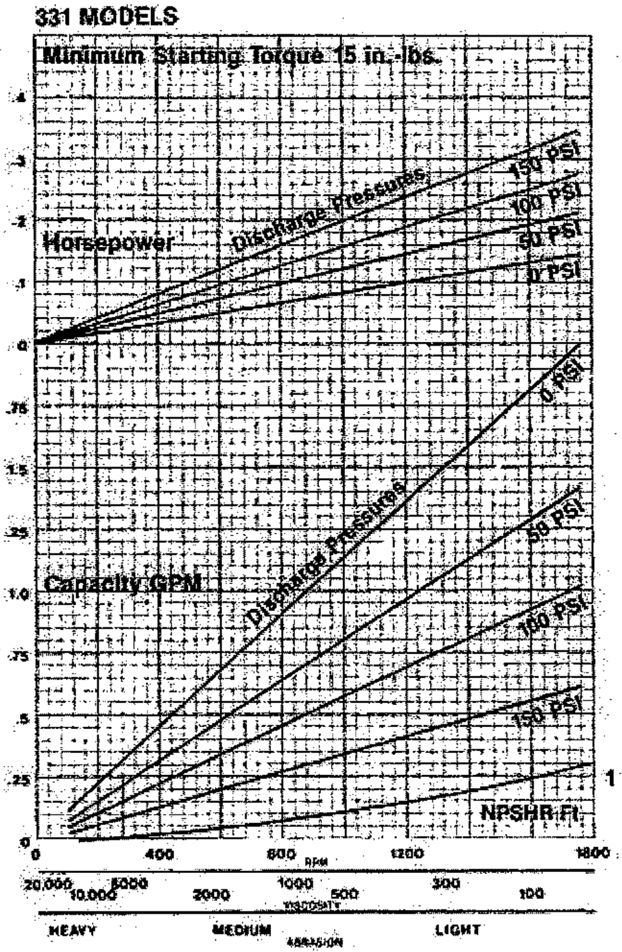
MODELS	CP	A	A'	D	E	F	F'	H	K	L	M	N	R	U	X	Y	SUCT (NPT)	DISCH (NPT)
33101, 33201 33301, 33104 33204, 33304 34401, 34404	12 5/8	3 1/8	4 3/4	2 3/4	1	1 13/16	6 15/16	13/32	3 1/32	5 11/16	6 1/16	1 7/16	—	5/8	2 3/8	1 1/4	3/4	3/4
*34411	13 15/16	3 1/4	4 3/4	2 3/4	1 1/8	—	7 3/16	13/32	2 7/8	7	6 1/16	1 3/8	1/4	5/8	2 5/16	1 1/4	3/4	3/4
35601, 35604	17 1/2	6 1/2	7 9/16	4 9/32	1 3/4	2	10 19/32	13/32	4 1/2	7 3/8	8 5/8	2 3/8	15/32	3/4	3 25/32	2 1/8	1 1/2	1 1/4
*35611, *35613	19 3/8	6 1/2	7 9/16	4 9/32	1 3/4	2 1/2	10 19/32	13/32	4	9 11/32	8 5/8	2 13/32	9/16	3/4	3 25/32	2 1/8	1 1/2	1 1/4
36701, 36704	20 15/16	5 1/4	8	4 1/2	2	2 5/16	13	9/16	4 1/16	7 15/16	11 3/16	2 1/8	—	1	4	2 1/2	2	2

*Packing Gland Model

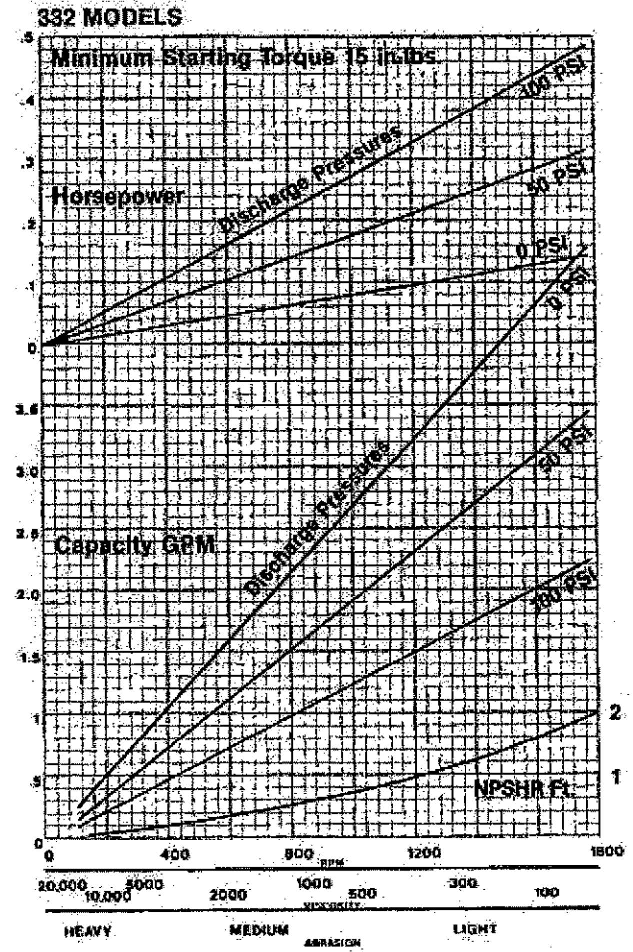
All dimensions are in inches. Specifications subject to change without notice.

331, 332, 333 and 344 MODELS
PERFORMANCE (water at 70ºF)

331 MODELS



332 MODELS



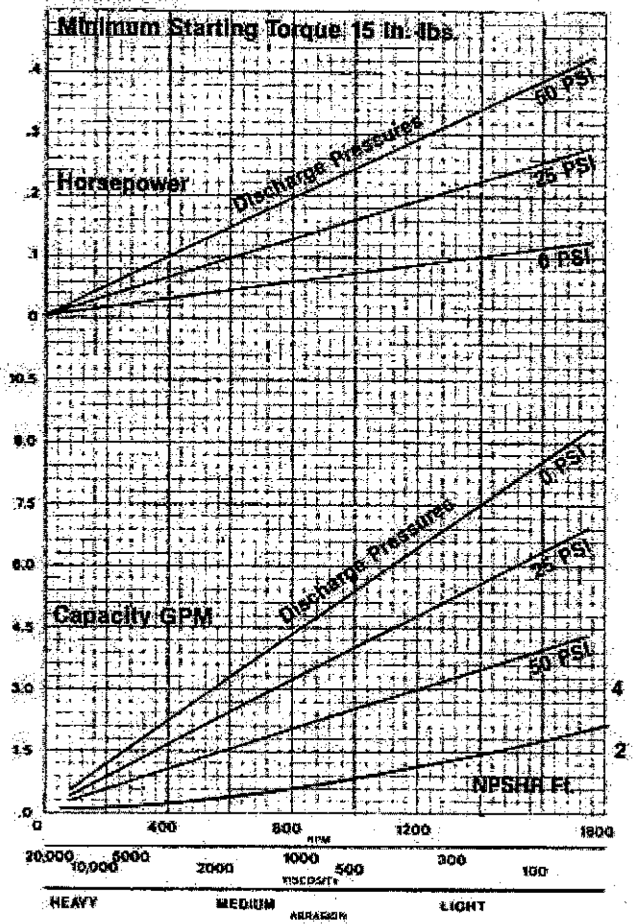
NOTE: For fluids with viscosity over 200 CP (1000 SSU), pump capacity is reduced by 20%.

MATERIALS OF CONSTRUCTION

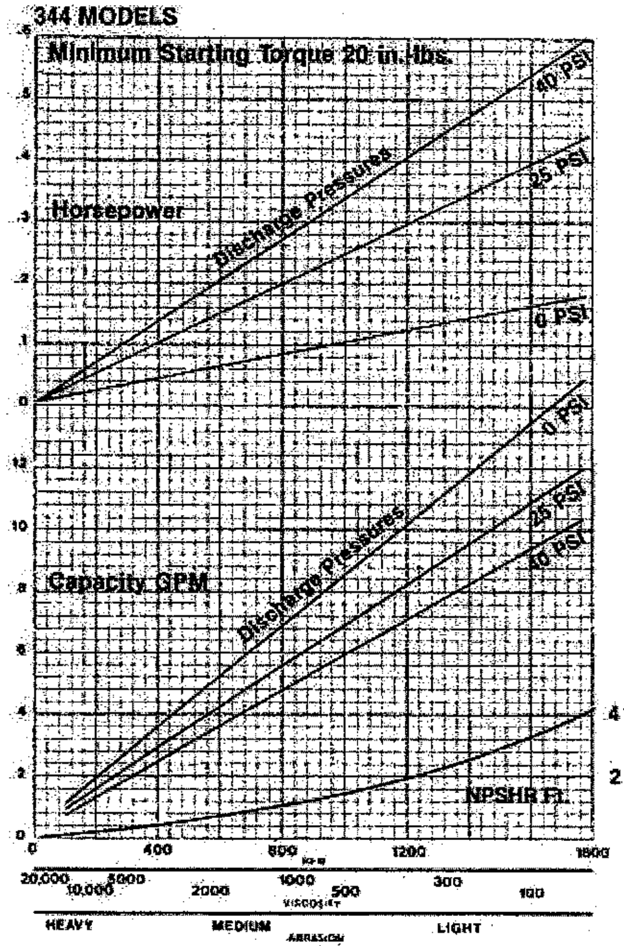
COMPONENT	MODELS			
	33101, 33201 33301, 34401	**33104, 33204 33304, 34404**	**33108, 33208 33308, 34408**	***34411**
Housing	Cast iron	316 SS	Nylon	Cast iron
Rotor	416 SS/CP	316 SS/CP	416 SS/CP	416 SS/CP
Stator	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)
Weight (lbs)	16	16	8	16

* Packing Gland Model
CP = Chrome plated

333 MODELS

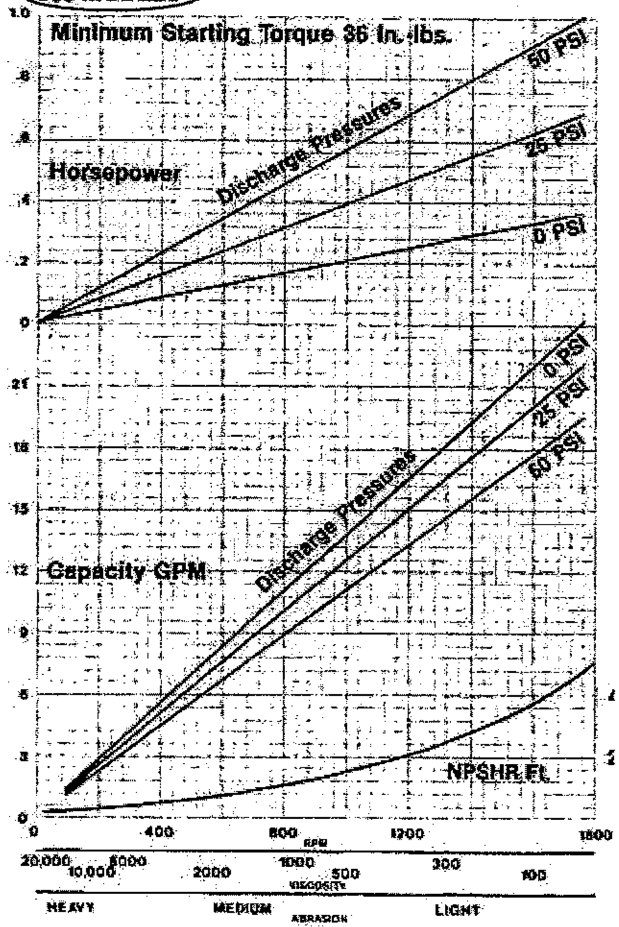


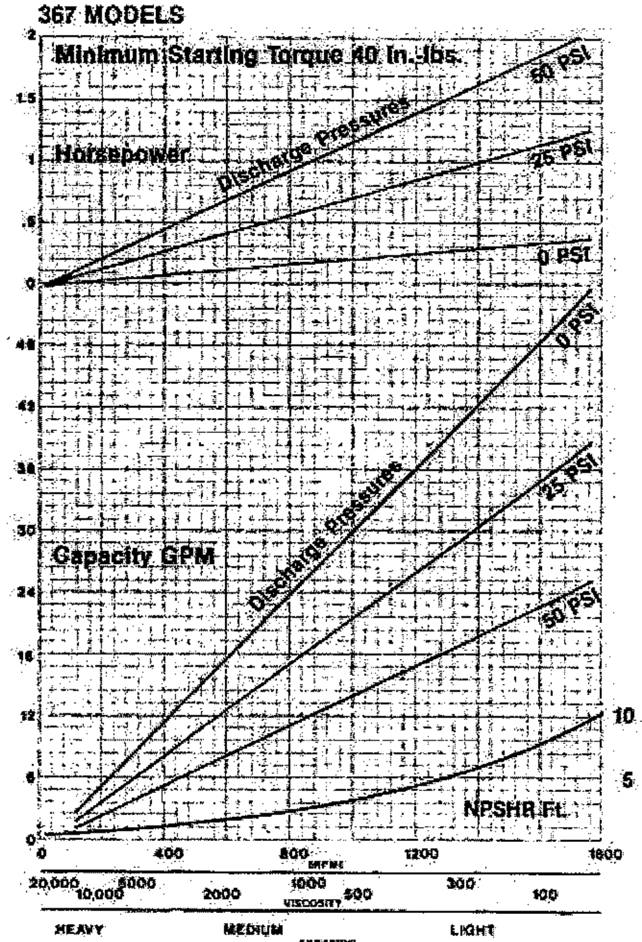
344 MODELS



NOTE: For fluids with viscosity over 200 CP (1000 SSU), pump capacity is reduced by 20%.

356 and 367 MODELS PERFORMANCE (water at 70°F)





NOTE: For fluids with viscosity over 200 CP (1,000 SSU), pump capacity is reduced by 20%.

MATERIALS OF CONSTRUCTION

COMPONENT	MODELS					
	35601, 35611		35604, 35613		36701	36704
Housing Rotor Stator	Cast iron 416 SS/CP NBR (Nitrile)		316 SS 316 SS/CP NBR (Nitrile)		Cast iron 416 SS/CP NBR (Nitrile)	316 SS 316 SS/CP NBR (Nitrile)
Weight (lbs)	37	40	37	40	54	54

CP=Chrome plated

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MOYNO

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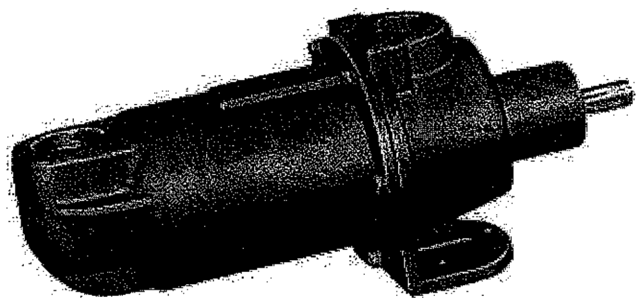
SERVICE MANUAL

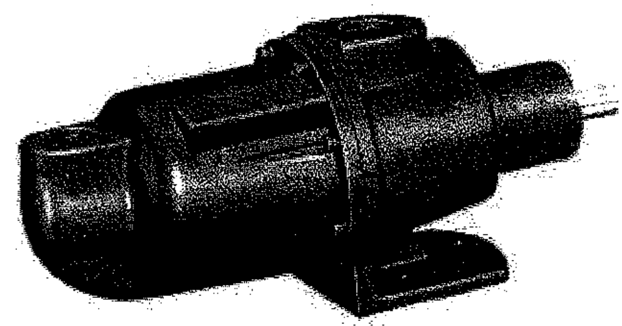
MOYNO® 500 PUMPS

300 SERIES

331, 332, 333, 344, 356 AND 367 MODELS



Mechanical Seal Models



Packing Gland Models

DESIGN FEATURES	MODELS				
	33101 34401 33201 35601 33301 36701	33104 34404 33204 35604 33304 36704	33108 33308 33208 34408	34411 35611	35613
Housing:	Cast Iron	AISI 316 SS	Nylon	Cast Iron	AISI 316 SS
Pump Rotor:	Chrome plated 416 SS	Chrome plated 316 SS	Chrome plated 416 SS	Chrome plated 416 SS	Chrome plated 316 SS
Pump Stator:	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)
Shaft:	416 SS	316 SS	416 SS	416 SS	316 SS
Flexible Joint:	Carbon steel/ NBR	316 SS/ NBR	Carbon steel/ NBR	Carbon steel/ NBR	316 SS/ NBR
Bearings:	Ball (sealed)	Ball (sealed)	Ball (sealed)	Ball (sealed)	Ball (sealed)
Mechanical Seal:	Carbon-ceramic	Carbon-ceramic	Carbon-ceramic	---	---
Packing:	---	---	---	Braided PTFE	Braided PTFE

Note: Alternate elastomers available. Refer to Repair/Conversion kit numbers, page 8.

INSTALLATION

Mounting Position. Pump may be mounted in any position. When mounting vertically, it is necessary to keep bearings above seals to prevent possible seal leakage into bearings.

Pre-Wetting. Prior to connecting pump, wet pump elements and mechanical seal or packing by adding fluid to be pumped into suction and discharge ports. Turn shaft over several times in a clockwise direction to work fluid into elements.

Piping. Piping to pump should be self-supporting to avoid excessive strain on pump housings. See Table 1 for suction and discharge port sizes of each pump model. Use pipe "dope" or tape to facilitate disassembly and to provide seal.

Drive. On belt driven units, adjust belt tension to point of non-slip. Do not overtighten.

On direct drive units, coupling components should be aligned and spaced at least 1/16" apart.

Pump rotation must be clockwise when facing shaft to prevent damage to pump. Check direction of rotation before startup.

Water Flush of Packing (356 Models Only). The packing may be either grease lubricated through a grease fitting in the stuffing box or have plumbing connected to the housing to allow a water flush.

Maximum speed is 1750 rpm.

When the material being pumped is abrasive in nature, it may be advantageous to flush the packing to prevent leakage under packing and excessive shaft wear.

Clean water can be injected through a 1/8" NPT tapped hole that normally houses the grease fitting for lubricating the packing. The water can be permitted to leak axially along the shaft in either direction or can be removed from the second tapped hole in the stuffing box. In both cases, the discharge from the stuffing box should be throttled slightly to maintain 10-15 PSI higher pressure in the stuffing box than is present in the discharge housing.

Table 1. Pump Data

Pump Models	331	332	333	344	356	367
Suction Port (NPT)	3/4*	3/4*	3/4*	3/4*	1-1/2	2
Discharge Port (NPT)	3/4	3/4	3/4	3/4	1-1/4	2
Discharge Pressure (psig)	150	100	50	40	50	50

*08 versions = 1" NPT

Table 2. Temperature Limits

Elastomer	Temperature Limits
*NBR	10°-160°F
*EPDM	10°-210°F
*FPM	10°-240°F

*NBR = Nitrile
*EPDM = Ethylene-Propylene-Diene Terpolymer
*FPM = Fluoroelastomer

OPERATION

Self-Priming. With wetted pumping elements, the pump is capable of 25 feet of suction lift when operating at 1750 rpm with pipe size equal to port size.

DO NOT RUN DRY. Unit depends on liquid pumped for lubrication. For proper lubrication, flow rate should be at least 10% of rated capacity.

Pressure and Temperature Limits. See Table 1 for maximum discharge pressure of each model. Unit is suitable for service at temperatures shown in Table 2.

Storage. Always drain pump for extended storage periods by removing suction housing bolts and loosening suction housing.

TROUBLE SHOOTING

WARNING: **Before making adjustments, disconnect power source and thoroughly bleed pressure from system. Failure to do so could result in electric shock or serious bodily harm.**

Failure To Pump.

1. Belt or coupling slip: Adjust belt tension or tighten set screw on coupling.
2. Stator torn; possibly excessive pressure: Replace stator, check pressure at discharge port.
3. Wrong rotation: Rotation must be clockwise when facing shaft.
4. Threads in rotor or on shaft stripped: Replace part. Check for proper rotation.
5. Excessive suction lift or vacuum.

Pump Overloads.

1. Excessive discharge pressure: Check discharge pressure for maximum rating given in Table 1. Check for obstruction in discharge pipe.
2. Fluid viscosity too high: Limit fluid viscosity to 20,000 CP or 100,000 SSU.

Viscosity CP	Limit RPM
1-300	1750
300-1,000	1200
1,000-2,000	700
2,000-5,000	350
5,000-10,000	180
10,000-20,000	100

3. Insufficient motor HP: Check HP requirement.

Noisy Operation.

1. Starved suction: Check fluid supply, length of suction line, and obstructions in pipe.
2. Bearings worn: Replace parts; check alignment, belt tension, pressure at discharge port.
3. Broken flexible joint: Replace part, check pressure at discharge port.
4. Insufficient mounting: Mount to be secure to firm base. Vibration induced noise can be reduced by using mount pads and short sections of hose on suction and discharge ports.

Mechanical Seal Leakage (Mechanical Seal Models Only).

1. Leakage at startup: If leakage is slight, allow pump to run several hours to let faces run in.
2. Persistent seal leakage: Faces may be cracked from freezing or thermal shock. Replace seal.

Packing Leakage (Packing Models Only).

1. Leakage at startup: Adjust packing as outlined in maintenance instructions.

Note: Slight leakage is necessary for lubrication of packing.

2. Persistent leakage: Packing rings and/or shaft may be worn. Replace parts as required.

Pump Will Not Prime.

1. Air leak on suction side: Check pipe connections.

MAINTENANCE

General. These pumps have been designed for a minimum of maintenance, the extent of which is routine lubrication and adjustment of packing. The pump is one of the easiest to work on in that the main elements are very accessible and require few tools to disassemble.

Packing Lubrication (356 Models Only). The zerk fitting on the side of the suction housing leads to the lantern ring halves in the mid-section of the packings. At least once a week, inject a small quantity of good quality grease, such as MPG-2 Multi Purpose Grease (Du Bois Chemical), or equivalent, into the zerk fitting to lubricate the packings.

Note: For Model 34411, lubricate packing by applying a liberal amount of grease during assembly.

Packing Adjustment (Packing Models Only). Packing gland attaching nuts should be evenly adjusted so they are little more than finger tight. Over-tightening of the packing gland may result in premature packing failure and possible damage to the shaft and gland.

When the packing is new, frequent minor adjustments are recommended for the first few hours of operation in order to compress and seat the packing. Be sure to allow slight leakage for lubrication of packing.

When excessive leakage can no longer be regulated by tightening the gland nuts, remove and replace the packings in accordance with the DISASSEMBLY and REASSEMBLY instructions. The entire pump need not be disassembled to replace the packings.

Bearing Lubrication. The prelubricated, fully sealed bearings do not require additional lubrication.

PUMP DISASSEMBLY

WARNING: Before disassembling pump, disconnect power source and thoroughly bleed pressure from system. Failure to do so could result in electric shock or serious bodily harm.

To Disassemble Mechanical Seal Models:

1. Disconnect suction and discharge piping.
2. Remove screws (112) holding suction housing (2) to pump body (1). Remove suction housing and stator (21).
3. Remove rotor (22) from flexible joint (24) by turning counter-clockwise (RH thread). Use 3/16 inch diameter punch to remove rotor pin (45) on Model 36701.
4. Flexible joint (24) can be removed from shaft (26) by using a 3/16 inch allen wrench in end of joint (1/4 inch wrench on 356 Models) and turn counter-clockwise. Use 3/16 inch diameter punch to remove shaft pin (46) on Model 36701.
5. Carefully slide mechanical seal (69) off shaft (26). Carefully pry seal seat out of pump body (1). If any parts of mechanical seal are worn or broken, the complete seal assembly should be replaced. Seal components are matched parts and are not interchangeable.
6. The bearings (29) and shaft (26) assembly can be removed from pump body (1) after snap ring (66) has been removed. To remove the assembly, lightly tap the shaft at threaded end using a block of wood to protect the threads. The bearings may be pressed off the shaft.

To Disassemble Packing Models:

1. Disconnect suction and discharge piping.
2. Remove screws (112) which hold suction housing (2) to pump body (1). Remove suction housing and stator (21).
3. Remove rotor (22) from flexible joint (24) by turning in a counter-clockwise direction (RH thread).
4. Flexible joint (24) can be removed by using a 3/16 inch allen wrench in end of joint (1/4 inch wrench on 356 Models) and turn in a counter-clockwise direction.
5. The packing (42) can be removed without removing the shaft (26) using the following procedure:
   a. Remove gland bolts (47).
   b. Slide gland (41) away from packing (42).
   c. Pull out packing (42) (and lantern ring halves (57) on 356 Models) using a packing removing tool.

Note: Packing can be removed after shaft has been removed by pushing out from pump side of pump body after gland (41) has been detached.

6. The bearings (29) and shaft (26) assembly can be removed from pump body (1) after snap ring (66) has been removed. To remove the assembly, lightly tap the shaft at threaded end using a block of wood to protect the threads.
7. To disassemble shaft assembly, remove snap ring (66A) from shaft (26) and press bearings (29) and bearing spacer (33) off the shaft.

PUMP ASSEMBLY

To Assemble Mechanical Seal Models:

1. Press bearings (29) on shaft (26), and locate slinger ring (77) near bearing on threaded end of shaft.

Note: When replacing bearings, always press on the inner race when assembling to shaft, and on the outer race when pressing bearings into the housings.

2. Press shaft assembly into pump body (1) securing with snap ring (66).
3. Install mechanical seal (69) using the following procedure:
   a. Clean and oil sealing faces using a clean light oil (not grease).

Caution: Do not use oil on EPDM parts. Substitute glycerin or soap and water.

   b. Oil the outer surface of the seal seat, and push the assembly into the bore in the pump body (1), seating it firmly and squarely.
   c. After cleaning and oiling the shaft, slide the seal body along the shaft until it meets the seal seat.
   d. Install seal spring and spring retainer on shaft.
4. Thread flexible joint (24) into shaft (26) in a clockwise direction (RH thread). On 356 Models, install seal spacer (69A) and washer (116) before threading flexible joint onto shaft in a clockwise direction. On Model 36701, use shaft pin (46) to pin flexible joint (24) to shaft.
5. Thread rotor (22) onto flexible joint (24) in a clockwise direction (RH thread). On Model 36701, pin rotor (22) to joint using rotor pin (45).
6. Slide stator (21) on rotor (22). On 331 and 332 Models, insert rounded end of stator ring (135) into end of stator prior to installing stator on rotor.
7. Secure stator (21) and suction housing (2), with suction port vertically up, to pump body (1) using screws (112).
8. Proceed as in installation instructions.

To Assemble Packing Models:

1. Press bearings (29), with bearing spacer (33) in between, on shaft (26) and secure in place using snap ring (66A).

Note: When replacing bearings, always press on the inner race when assembling to shaft, and on the outer race when pressing bearings into the housings.

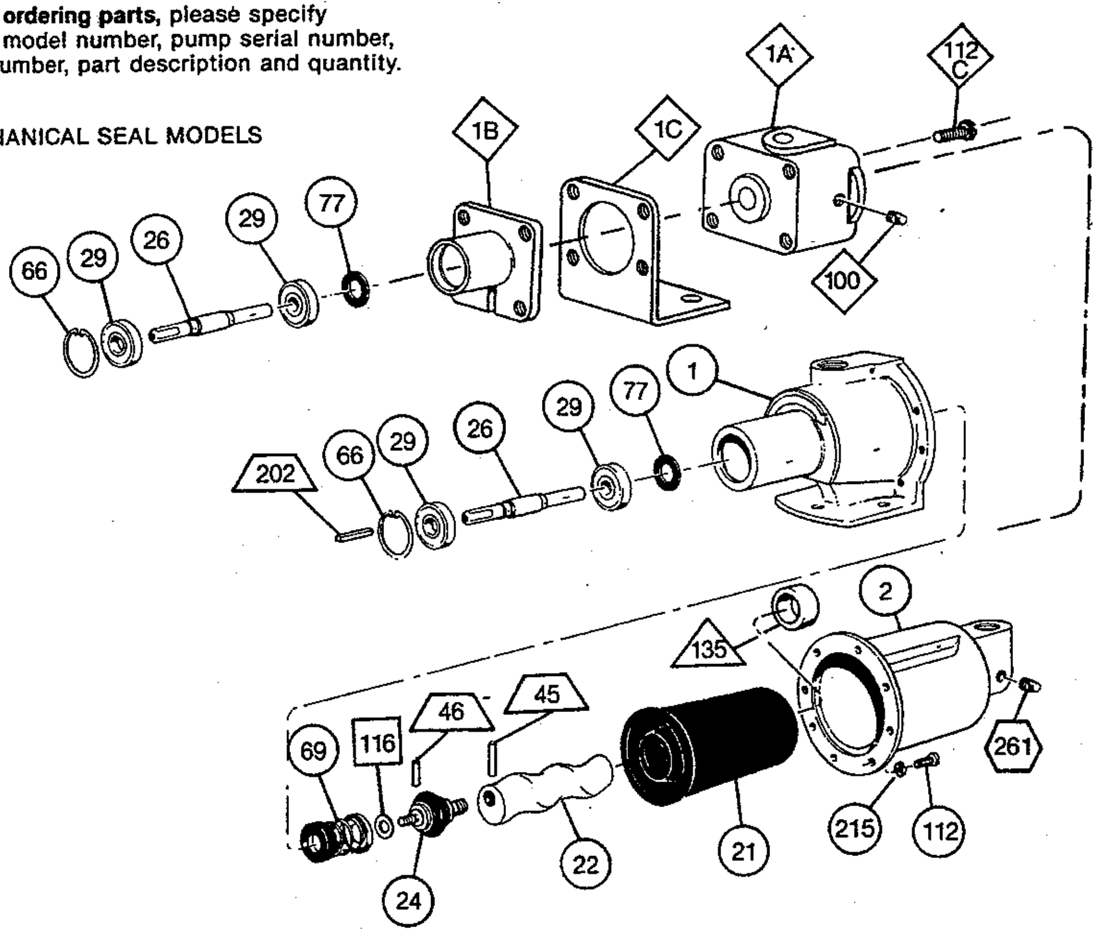
2. Install packing (42) before installing shaft assembly using the following procedure:
   a. Lubricate each individual ring of packing with a grease that is insoluble in the fluid being pumped.
   b. Individually assemble each ring of packing loosely in the packing chamber of the pump body (1). Stagger splits on rings. (Four rings, 3/16 inch square required on Model 34411; four rings, 1/4 inch square and two lantern ring halves (57) assembled between two rings on 356 Models).
   c. Loosely install packing gland (41) on pump body (1) using gland bolts (47).
3. Press shaft assembly into pump body (1) positioning slinger ring (77) between packing gland (41) and bearing end of pump body. Secure the shaft assembly with snap ring (66).
4. Thread flexible joint (24) into shaft (26) in a clockwise direction (RH thread).
5. Thread rotor (22) onto flexible joint (24) in a clockwise direction (RH thread).
6. Slide stator (21) on rotor (22). On 331 and 332 Models, insert rounded end of stator ring (135) into end of stator prior to installing stator on rotor.
7. Secure stator (21) and suction housing (2), with suction port vertically up, to pump body (1) using screws (112).
8. Proceed as in installation instructions.

Note: Adjust newly installed packing as described in maintenance procedure.

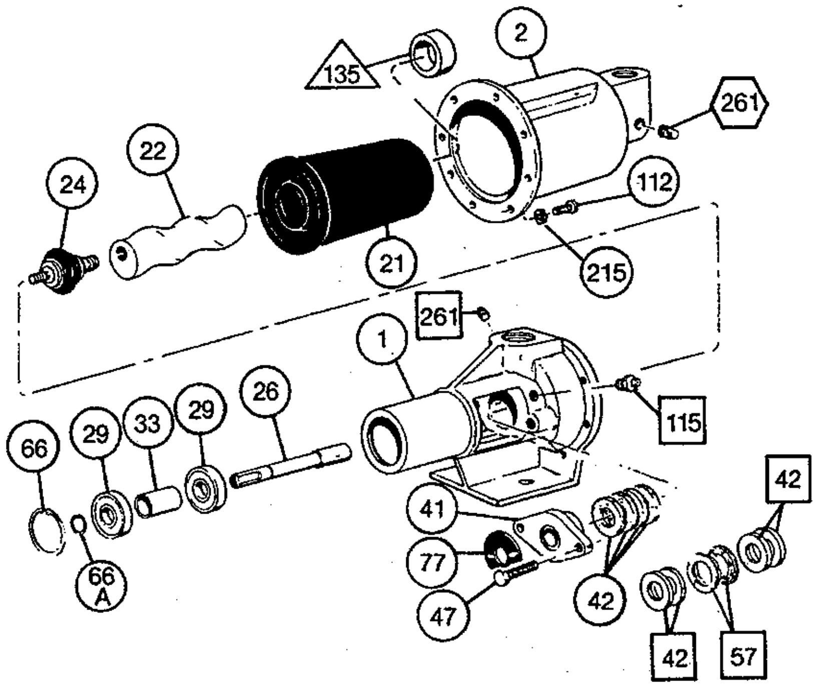
WARNING: Replace belt or coupling guards before reconnecting power.

When ordering parts, please specify pump model number, pump serial number, part number, part description and quantity.

MECHANICAL SEAL MODELS



PACKING MODELS



- Used on 332 and 367 only.
- Used on 356 only.
- Used on 356 and 367 only.
- Used on -08 only.
- Used on 367 only.

PARTS LIST — 331, 332, 333, AND 344 MODELS

Item No.	Description	Mechanical Seal Models			Packing Gland Models
		33101 33201 33301 34401	33104 33204 33304 34404	33108 33208 33308 34408	34411
1	Pump Body	330-1065-002	330-1910-002		340-1000-001
1A	Discharge Housing			340-2362-000	
1B	Bearing Housing			330-4587-000	
1C	Pump Base			340-2369-000	
2	Suction Housing	330-1064-002	330-1911-002	330-4536-000	330-1064-002
*21	Stator	See Stator section below.			
*22	Rotor	See Rotor section below with circled numbers for each series.			
		1	2	1	1
24	Joint	Carbon Steel/NBR 320-1511-000	316 SS/NBR 320-3759-000	Carbon Steel/NBR 320-1511-000	
26	Drive Shaft	320-1499-000	320-2938-000	320-1499-000	320-2448-000
29	Bearing (2 req.)	630-0502-031			
33	Bearing Spacer				320-1900-000
41	Packing Gland				320-0101-004
42	Packing				340-3396-005
47	Gland Bolt				619-1520-161
66	Snap Ring	320-1506-000			
66A	Snap Ring				320-4182000
69	Mechanical Seal	320-2424-000			
77	Slinger Ring	320-6382-000			320-6384-000
100	Pipe Plug (3 req.)			610-0120-021	
112	Screws (8 req.)	619-1430-103	320-5968-000	619-0860-081	619-1430-103
112C	Screws (4 req.)			61 9-0890-281	
135	Stator Ring (331 -332 only)	320-7812-000			
215	Lock Washer (8 req.)	320-6464-000			

*Recommended spare parts.

STATORS		Models			
		331	332	333	344
21	Standard Stator, NBR All Models	340-3501-120	340-3502-120	340-3503-120	340-3504-120
21	EPDM Stator	340-3501-320	340-3502-320	340-3503-320	340-3504-320
21	FPM Stator	340-3501-520	340-3502-520	340-3503-520	340-3504-520
ROTORS					
22	1 416SS - All Models	320-2729-000	330-0906-000	320-1394-000	320-1841-000
22	2 316SS – All Models	320-2933-000	320-2942-000	320-2936-000	320-2934-000

See page 8 for Repair/Conversion Kits

PARTS LIST — 356 AND 367 MODELS

Item No.	Description	Mechanical Seal Models		Packing Gland Models		Mechanical Seal Model	
		35601	35604	35611	35613	36701	36704
1	Pump Body	Cast Iron 340-0636-000	316SS 340-1550-000	Cast Iron 350-0420-000	316SS 350-0491-000	Cast Iron 350-0423-000	316SS 350-0423-007
2	Suction Housing	350-0280-000	350-0489-000	350-0280-000	350-0489-000	350-0302-000	350-0302-007
*21	Stator	NBR 340-3505-120		NBR 340-3505-120		NBR 340-3506-120	
22	Rotor	416SS 320-2304-000	316SS 320-4431-000	416SS 320-2304-000	316SS 320-4431-000	416SS 330-2042-000	316SS 330-3077-000
24	Flex Joint	Carbon Steel 320-1583-000	316SS 320-4427-000	Carbon Steel 320-1583-000	316SS 320-4427-000	Carbon Steel 320-1749-000	316SS 320-4436-000
26	Drive Shaft	320-1759-000	320-4430-000	320-2765-000	320-4435-000	330-1805-000	330-1805-015
29	Bearing (2 req.)	630-0552-051				630-0552-061	
33	Bearing Spacer			320-2764-000			
41	Packing Gland			320-0003-004	320-0003-007		
*42	Packing			340-3396-008			
45	Rotor Pin					320-4439-002	
46	Shaft Pin					320-4439-001	
47	Gland Bolt			619-1530-241			
57	Lantern Ring Half**			320-6585-000			
66	Snap Ring	320-1758-000				320-2794-000	
66A	Snap Ring			320-3533-000			
*69	Mechanical Seal	320-3945-000				320-1750-000	
69A	Seal Spacer	320-4434-000					
77	Slinger Ring	320-6383-000		320-6385-000		320-6385-000	
112	Screws (6 req.)	619-1530-161				619-1530-161	
115	Zerk Fitting			320-2503-001			
135	Stator Spacer	330-7594-000					
202	Shaft Key					611-0040-240	
215	Lock Washer (6 req.)	623-0010-411					
261	Pipe Plug	610-0120-011	610-0420-010	610-0120-011	610-0420-010	610-0120-011	610-0420-010

*Recommended spare parts.
**2 Required

See page 8 for Repair/Conversion Kits

REPAIR/CONVERSION KIT NUMBERS

ELASTOMER REPAIR/CONVERSION KITS

Item No.	Description	331 Models			332 Models		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No.	311-9026-000	311-9025-000	311-9054-000	311-9027-000	311-9038-000	311-9055-000
21	• Stator	340-3501-120	340-3501-320	340-3501-520	340-3502-120	340-3502-320	340-3502-520
24	• Joint	320-1511-000‡	320-6367-000†	320-4670-000†	320-1511-000‡	320-6367-000†	320-4670-000†
69	• Seal	320-2424-000	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000
Item No.	Description	333 Models			344 Models		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No.	311-9029-000	311-9028-000	311-9056-000	311-9031-000	311-9030-000	311-9057-000
21	• Stator	340-3503-120	340-3503-320	340-3503-520	340-3504-120	340-3504320	340-3504520
24	• Joint	320-1511-000‡	320-6367-000†	320-4670-000†	320-1511-000‡	320-6367-000†	320-4670-000†
69	• Seal	320-2424-000	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000

t316SS/with appropriate elastomer.
‡Carbon steel. NBR kits are available only with carbon steel joints; a 316SS/NBR joint for 331-344 Models is available as 320-3759-000.

Item No.	Description	356 Models			367 Models		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No. (Mech. Seal Models)	311-9033-000	311-9032-000	311-9058-000	311-9060-000	311-9036-000	311-9124-000
21	• Stator	340-3505-120	340-3505-320	340-3505-520	340-3506-120	340-3506-320	340-3506-520
24	• Flex Joint	320-1583-000‡	320-6369-000†	320-4671-000†	320-1749-000‡	320-6378-000‡	3206515-000‡
69	• Seal	320-3945-000	320-6380-000	320-6510-000	320-1750-000	320-6390-000	320-6517-000
45	• Rotor Pins				320-4439-002	320-4439-002	320-4439-002
46	• Shaft Pin				320-4439-001	320-4439-001	320-4439-001
—	Kit No (Packing Gland Models)	311-9035-000	311-9034-000	311-9059-000			
21	• Stator	340-3505-120	340-3505-320	340-3505-520			
24	• Joint	320-1583-000‡	320-6369-000†	320-4671-000†			

†316SS/with appropriate elastomer.
‡Carbon steel. NBR kits are available only with carbon steel joints; a 316SS/NBR joint for Model 35604 and 35613 pumps is available as 320-4427-000; a 316SS/NBR joint for model 36704 is available as 320-4436-000.

ABRASION RESISTANT SEALS

Elastomer	Models 331-344	356	36701
NBR	3206460000	3206505000	3206511000
EPDM	3206502000	3206506000	3206512000
FPM	3206503000	3206507000	3206513000

NBR = Nitrile
EPDM = Ethylene-Propylene-Diene Terpolymer
FPM = Fluoroelastomer

BISCO Environmental

Section 3 – Instrumentation

- SVE System 1 & 2 Float Switch Assembly, Innovative Solutions Model L500 Specifications & Operating Instructions
- SVE System 1 & 2Water Transmitter, Kobold Model DRB-1165 Specifications & Operating Instructions
- SVE System 1 & 2 Vacuum Transmitter, Ashcroft K1 Specifications & Instruction Sheet
- SVE System 1 & 2 Air Flow Transmitter, Erdco Model 3611Installation, Operation & Technical Manual
- Erdco Model 3611Flow Meter Transmitter Calibration Curve
- SVE System 1 & 2 Temperature Transmitter, Pyromation Series 440 Installation & Operating Instructions.

Multiple-Stage Switches: **Vertical Mount**

L500 Series Custom Switches with a Maximum Length of 11'

The L500 series level switches are individually designed from over 1,400 component parts to create a custom switch available in lengths from six inches (152 mm) to 11 feet (3.3 meters).

To specify, review the choices in mounting types, stem and mounting, float sizes, switching points and electrical specifications that appear on these pages.

L500

Product Configuration Choices:

Mounting & Materials:	Select mounting size, mount and stem material, float material, switch type, and optional enclosure from **Table A.**
Float Size:	Select float from **Table B.**
Switch Wiring:	Select switch wiring from **Table C.**
Actuation Levels:	Select switch actuation level(s) from **Table D.**

A. Component Choices L500:

Series	Mounting* Types		Mounting* & Stem Materials		Float Materials		Switch Types		Enclosures	
	04	½" NPT	01	Brass	02	Polypropylene (hollow)	20	20VA SPST	00	No enclosure
	06	1" NPT	02	Polypropylene	05	PVC	03	50VA SPST (standard)	01	Polypropylene NEMA 4
	07	1¼" NPT	05	PVC	08	316 SS	04	100VA SPST	02	Cast aluminum NEMA 4/7/9
	08	1½" NPT	08	316 SS	20	Buna-N	06	3VA SPDT		
L500	09	2" NPT							03	Cast Iron NEMA 4/7/9
	73	2" 150# ANSI Flange								
	75	3" 150# ANSI Flange								
	76	4" 150# ANSI Flange								

Example: **L500-0901-0803-00** = 2" NPT mounting; brass mounting & stem material; 316 SS float; 50VA SPST switches; no enclosure

**Other mountings and materials are available. Consult factory for details.*

Multiple-Stage Switches: **Vertical Mount**

Innovative Solutions

L500 Series Custom Switches with a Maximum Length of 11'

B. Float Sizes and Operating Specifications

Float Materials	Dimensions	Available Mount Types	Temperature	Pressure	Minimum Specific Gravity
Polypropylene (hollow)	1.810" x 1.875"	04, 06, 09, 73, 75, 76	-40° to +150° F	50 psig	.55
316 stainless steel	1.5" x 1.3"	04, 06, 09, 73, 75, 76	-40° to +300° F	120 psig	.85
316 stainless steel	2" ball	04, 06, 09, 73, 75, 76	-40° to +300° F	750 psig	.75
Teflon (hollow)	2.150" x 1.980"	04, 06, 09, 73, 75, 76	-40° to +500° F	100 psig	.95
Buna-N	1.250" x 1.875"	04, 06, 07, 09, 73, 75, 76	-40° to +180° F	150 psig	.65
Buna-N	1.875" x 1.750"	04, 06, 09, 73, 75, 76	-40° to +180° F	150 psig	.65

C. Switch Wiring and Electrical Specifications

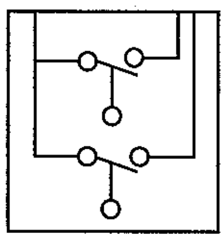
Each switching point requires one float. For special applications, a single float can be used to activate two switch points, though these points must have a minimum separation of ⅛" (3mm). The maximum number of actuation levels depends on the wiring type selected.

Ratings: 20, 50, or 100 VA @ 120 VAC SPST
50 VA @ 240 VAC SPST
100 W @ 240 VAC SPDT

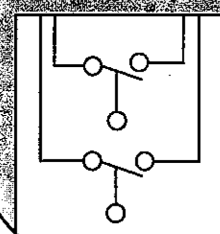
Connection: 24" Free Leads
#22 AWG

Mounting Attitude: Vertical ±30°

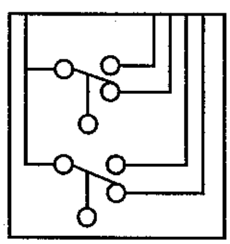
Group 1 SPST
One Common Wire



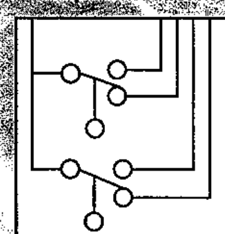
Group 2 SPST
Independent Circuits



Group 3 SPDT
One Common Wire



Group 4 SPDT
Independent Circuits



Switch Wiring Codes

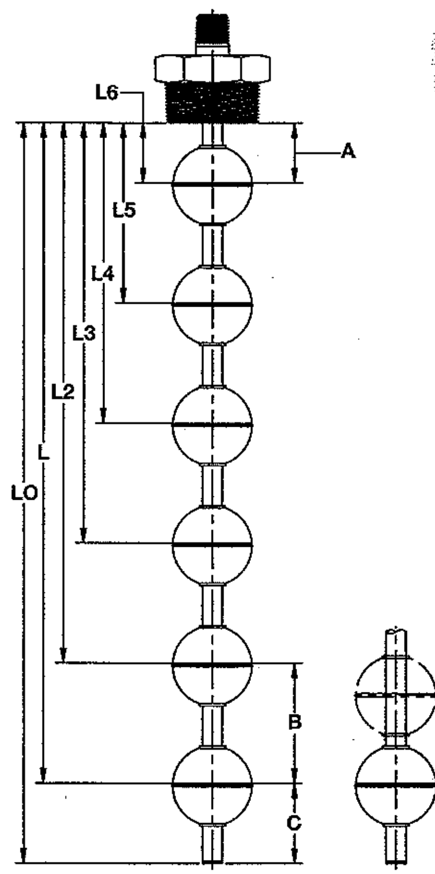
Wiring Options	Group 1 SPST	Group 2 SPST		Group 3 SPDT		Group 4 SPDT		
Common Wire	Black	None		Black		None		
	NO/NC	NO or NC		NO	NC	Common	NO	NC
L1	Red	Red	Red	Red	White-Red	Red	White-Red	White-Black-Red
L2	Yellow	Yellow	Yellow	Yellow	White-Yellow	Yellow	White-Yellow	White-Black-Yellow
L3	Blue	Blue	Blue	Blue	White-Blue			
L4	Brown	Brown	Brown					
L5	Orange							
L6	Gray							

L500 Series Custom Switches with a Maximum Length of 11'

D. Actuation Level Dimensions

A = 1½" (38mm) minimum distance from actuation point to inside surface of tank or mounting pad.
B = 3" (76mm) minimum distance between actuation levels.
C = 2" (51mm) minimum distance from end of unit to lowest actuation level.
D = ¼" (6mm) minimum distance between points when a single float is used to activate two switches. (One float can activate two switches when the lower switch is NC and the upper switch is NO).

Notes:
1. A, B, and C dimensions are based on a specific gravity of 1.0.
2. When using one float for two actuation positions, contact the factory for available switch ratings.
3. Actuation levels are calibrated on descending fluid level, with water as the fluid, unless otherwise specified.
4. Standard tolerance on actuation levels is ±⅛" (3mm).



Integrated Temperature Sensors

All Innovative Solutions L500, multi- level switches can be specially equipped with integrated temperature sensors. Please contact Innovative for more information.

Thermistor:	Variable resistance, continuous output
Thermocouple:	"Type K Junction" continuous readout
Thermostat:	Fixed set point for high/low alarm switching

Innovative Solutions

Multi-Point Liquid Level Switch
(L500 Large Size Vertical Mount)

Installation & Maintenance
General Information:

Switches should be installed securely and clear of obstructions so the float(s) are free to move with liquid level changes.

Switches should be mounted in an area of the tank free of turbulence or direct streams.

Operate only within listed electrical ratings.

Maintenance

Periodically inspect the float to be sure it is not coated or contaminated by any material or substance that would significantly change its weight or volume.

Important Points

- Always operate within specified temperature and pressure ratings. Possible surges in temperature and pressure should also be observed, (see table below).
- Only use with liquids compatible with the material of construction. (Consult factory for information).
- Changes in fluid temperature can affect switch set-points since density/specific gravity may vary with temperature.

General Temperature & Pressure Limits

Float Material	*Temperature*	*Pressure*
Polypropylene	150°F	50 PSIG
Buna-N	180°F	150 PSIG
Stainless Steel (1 ½")	300°F	120 PSIG
~~Stainless Steel (2" Ball)~~	300°F	750 PSIG

Electrical Ratings and Wiring Diagrams

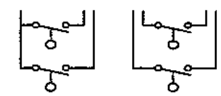
Reed switches used in *Innovative Solutions* level switches are hermetically sealed and a magnetically actuated SPST or SPDT rated as maximum power limits in Volt-Amps, (VA).

CAUTION: DO NOT EXCEED MAXIMUM LOAD RATINGS
Contact protection such as a diode, (DC), or resistor, (AC), should be used to suppress high transient voltages or in rush currents that may cause burning or welding of the switch contacts.

Switch Ratings—Maximum Loads (Resistive)

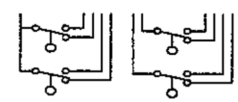
VA	Volts	Amps (AC)	Amps (DC)
50 (SPST)	0-50	0.5	0.5
	120	0.4	0.4
100 (SPST)	120	0.8	0.8
	240	0.2	0.2
3.0 (SPDT)	30 VDC		0.2

Group 1 SPST
One Common Wire



Group 2 SPST
Independent Circuits

Group 3 SPDT
One Common Wire



Group 4 SPDT
Independent Circuits

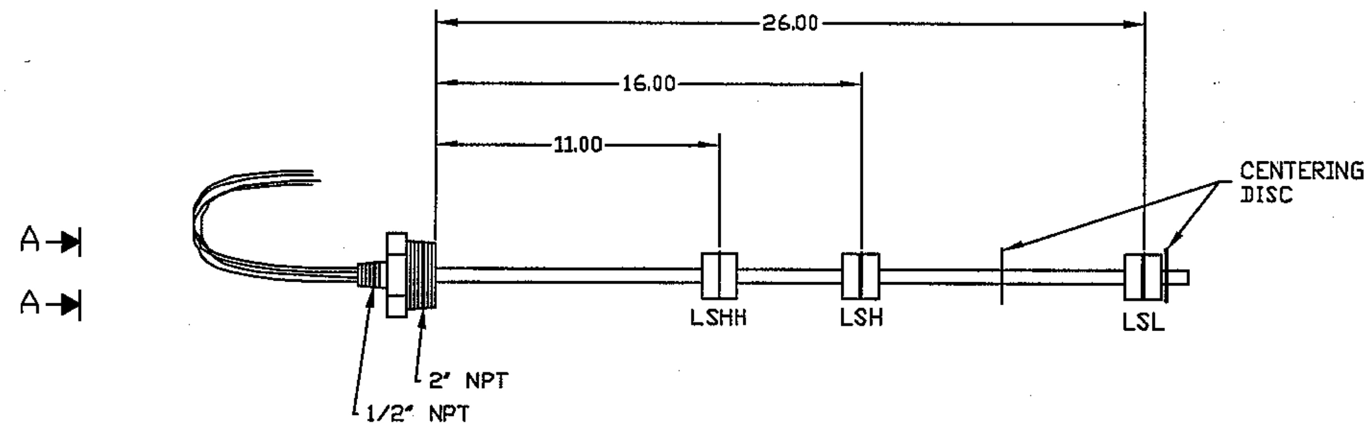
c UL us

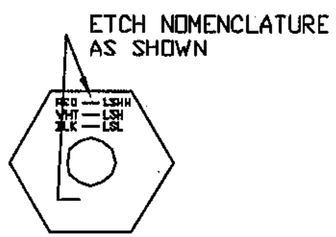
Note: Only two actuation points are shown in the diagrams above

Wire Color Code Table
NOTE: More than one color designation denotes striped or multi-color wire jackets

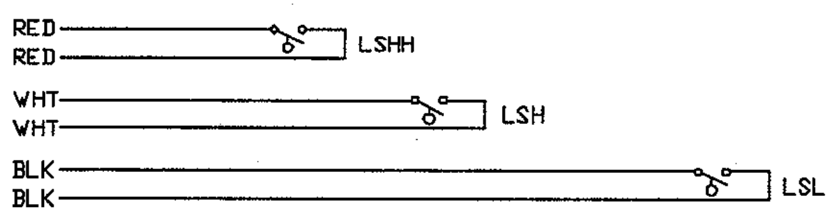
Common Wire	GROUP 1 Black	GROUP 2 None		GROUP 3 Black			GROUP 4 See Below	
	NO/NC	NO or NC		NO	NC	Common	NO	NC
Level 1	Red	Red	Red	Red	White/Red	Red	White/Red	White/Black/Red
Level 2	Yellow	Yellow	Yellow	Yellow	White/Yellow	Yellow	White/Yellow	White/Black/Yellow
Level 3	Blue	Blue	Blue	Blue	White/Blue	Blue	White/Blue	White/Black/Blue
Level 4	Brown	Brown	Brown	Brown	White/Brown	Brown	White/Brown	White/Black/Brown
Level 5	Orange	Orange	Orange	Orange	White/Orange	Orange	White/Orange	White/Black/Orange
Level 6	Gray	Gray	Gray	Gray	White/Gray	Gray	White/Gray	White/Black/Gray

Innovative Solutions, LLC 60 Great Hill Road Naugatuck, CT 06770 Ph: (203) 729-6434 Fax: (203) 729-6696
WWW.INNOVATIVESENSING.COM





VIEW A-A



WIRING SCHEMATIC

NOTE:

1. ALL MATERIAL TO BE 316 ST. ST'L.
2. SPECIFIC GRAVITY 0.6.
3. REED SWITCHES RATED AT 50VA, 125V.
4. SWITCH SHOULD BE IN THE DOWN POSITION FOR MEASUREMENT.
5. ALL WIRE TO BE 18 AWG., PVC JACKETED, 24" MIN. FREE LENGTH.

REV.	DESCRIPTION	DATE	APPR.
1	ADD SECOND CENTERING DISC	3/21/02	PRS

REVISIONS

BISCO Environmental
Soil & Groundwater Remediation Equipment
Randolph, Massachusetts 02368

TITLE: PHASE SEPARATOR 3 LEVEL FLOAT SWITCH

DRWN BY	DATE	CHK BY	DATE	APPR BY	DATE
PRS	05/29/01				

SCALE	SIZE	DWG NO.	JOB NO.	SHEET	REV
NONE	B	3FLTSEPLEV		1 OF 1	1

Features

- Flow range 1.5-8 GPM to 15-200 GPM
- Bronze or stainless steel bodies
- Frequency or 4-20 mA output
- Electronic displays and controllers
- Max. pressure 580 PSIG

The DRB and DPE series turbine wheel flowmeters are an economical yet very reliable solution for measuring liquid flows in pipes up to 3 inches in diameter. The unique "insertion" impeller design protrudes minimally into the flow stream which minimizes head loss and allows measurement of dirty liquids, and liquids with high solid content, without risk of failure. The DRB and DPE series feature a PVDF impeller supported on a sapphire bearing system which provides an exceptionally long life and excellent chemical resistance properties. The DRB and DPE series are available with either bronze or stainless steel threaded bodies. A Hall effect sensor detects the passing of permanent magnets imbedded in the impeller blades. The output of the Hall sensor is converted to a linear pulse or 4-20 mA signal. Optionally, a variety of displays and controllers is available to provide flow rate indication, analog outputs and programmable setpoint switches. The DRB and DPE series' combination of simple, reliable design and variety of body materials and electronics options makes them a sure solution for the toughest flow metering applications.

Specifications

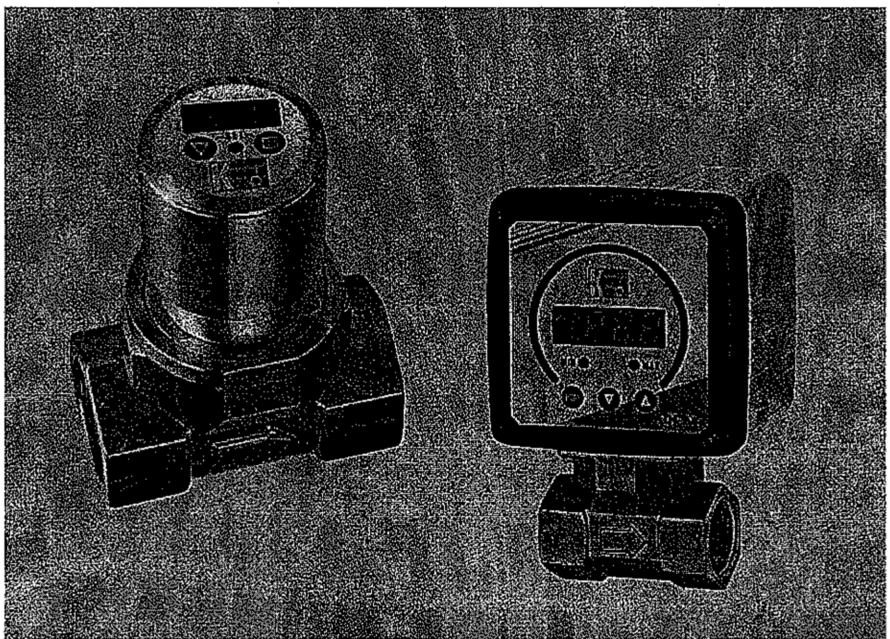
Accuracy:
- DRB Series: ±3% of full scale
- DPE Series: ±2.5% of full scale

Maximum Pressure
- DRB Series: 250 PSIG
- DPE Series: 580 PSIG

Operating Temperature: -10 to 176°F

Materials of Construction
- **Body:** Bronze or 316 stainless steel
- **Impeller:** PVDF
- **Axle:** 316 stainless steel
- **Bearings:** Sapphire
- **O-rings:** Buna-N for bronze bodies, Viton for SS bodies

Piping Straight Run Requirement: 20 X pipe diameter upstream; 10 X pipe diameter downstream



KOBOLD DRB/DPE Series Turbine Flowmeters

Electrical Specifications

Frequency Output
- **Output Type:** PNP open collector, 25 mA max.
- **Power Requirement:** 14-28 VDC
- **Electrical Protection:** NEMA 4X
- **Electrical Connection:** Micro-DC plug, 4-pin male

4-20 mA Output
- **Output Type:** 4-20 mA, 2-wire or 3-wire depending on model
- **Max. Loop Load:** 500 ohms
- **Power Requirement:** 24 VDC ±20%
- **Electrical Connection:** Micro-DC plug, 4-pin male or DIN 43650 (Hirschmann) plug
- **Electrical Protection:** NEMA 4X

Compact Electronics
- **Output Type:** 4-20 mA, 3-wire & PNP switch or 2 PNP switches
- **Switch Rating:** 300 mA Max. short circuit protected flow switch or frequency transmitter
- **Power Requirement:** 24 VDC ±20%
- **Display Type:** 3 digit LED
- **User Programmable Functions:** Transmitter span, switch setpoint, lockout code
- **Housing:** 304 SS, NEMA 4X
- **Electrical Connection:** Micro-DC plug, 5-pin male

Electronic Display/Controller
- **Output Type:** 4-20 mA, 4-wire and 2 adjustable setpoint relays
- **Relay Rating:** SPDT 5 amps @ 230 VAC
- **Input Power:** 115 VAC
- **Display Type:** 3-1/2 digit LED and 270° bargraph
- **Enclosure:** Epoxy coated aluminum and polycarbonate, NEMA 4X

Ordering Codes for DRB Series

Range GPM	Materials: Bronze	Materials: Stainless Steel	Fitting	Output/Electronics
1.5-8	DRB-1150	DRB-1250	N4=1/2" NPT	F300=Frequency output, Micro-DC plug
3-13	DRB-1155	DRB-1255	N5=3/4" NPT	L342 = 4-20 mA, 2-wire, Micro-DC plug L343=4-20 mA, 3-wire, Micro-DC plug
5.5-20	DRB-1160	DRB-1260	N6=1" NPT	L442=4-20 mA, DIN 43650 plug
6.6-65	DRB-1165	DRB-1265	N8=1-1/2" NPT	C34P=Compact electronic, 4-20 mA + 1 PNP switch
8-90	DRB-1170	DRB-1270	N9= 2" NPT	
15-200	DRB-1175	DRB-1275	NB=3" NPT	C30R=Compact electronic, 2 PNP switches K442=Display & Controller Z340=Analog Indicator + 4-20mA, 3-wire
Accessories				
Part Number 807.037=Mating 4-pin Micro-DC plug with 6 ft. cable for output F300, L342, L343 & Z340 Part Number 807.007=Mating 5-pin Micro-DC plug with 6 ft. cable for output C34P & C30R				

Example DRB-1150N4F300

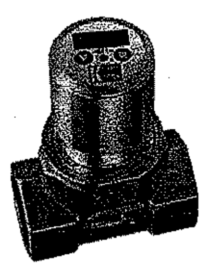
Ordering Codes for DPE Series

Range GPM	Materials: Bronze	Materials: Stainless Steel	Fitting	Output/Electronics
1.5-8	DPE-1150	DPE-1250	N4=1/2" NPT	F300=Frequency output, Micro-DC plug
3-13	DPE-1155	DPE-1255	N5=3/4" NPT	L342=4-20 mA, 2-wire, Micro-DC plug L343=4-20 mA, 3-wire, Micro-DC plug
5.5-20	DPE-1160	DPE-1260	N6=1" NPT	L442=4-20 mA, DIN 43650 plug
6.6-65	DPE-1165	DPE-1265	N8=1-1/2" NPT	C34P=Compact electronic, 4-20 mA + 1 PNP switch
8-90	DPE-1170	DPE-1270	N9= 2" NPT	
15-200	DPE-1175	DPE-1275	NB=3" NPT	C30R=Compact electronic, 2 PNP switches K442=Display & Controller Z340=Analog Indicator + 4-20mA, 3-wire
Accessories				
Part Number 807.037=Mating 4-pin Micro-DC plug with 6 ft. cable for output F300, L342, L343 & Z340 Part Number 807.007=Mating 5-pin Micro-DC plug with 6 ft. cable for output C34P & C30R				

Example DPE-1150N4F300

S4

DRB/DPE with Analog Indicator

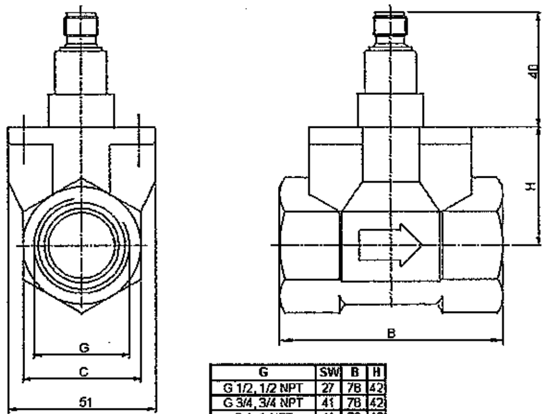


DRB/DPE with compact electronics

DRB/DPE with display /controller

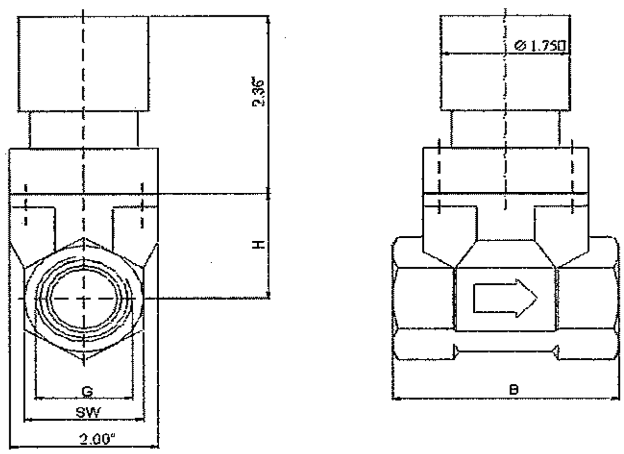
Dimensions

DRB/DPE transmitter only (frequency or 4-20 mA)



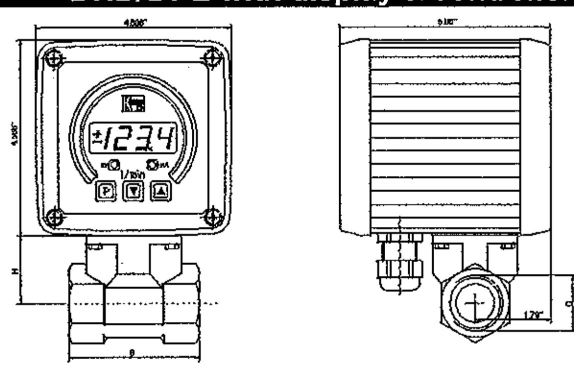
G	SW	B	H
G 1/2, 1/2 NPT	27	78	42
G 3/4, 3/4 NPT	41	78	42
G 1, 1 NPT	41	78	42
G 1 1/2, 1 1/2 NPT	55	78	57
G 2, 2 NPT	70	81	55
G 3, 3 NPT	100	106	72

DRB/DPE with compact electronics



G	SW	B	H
G 1/2, 1/2 NPT	1.06"	3.07"	1.65"
G 3/4, 3/4 NPT	1.61"	3.07"	1.65"
G 1, 1 NPT	1.61"	3.07"	1.65"
G 1 1/2, 1 1/2 NPT	2.16"	3.07"	2.24"
G 2, 2 NPT	2.75"	3.18"	2.16"
G 3, 3 NPT	3.93"	4.17"	2.83"

DRB/DPE with display & controller



G	SW	B	H
G 1/2, 1/2 NPT	1.06"	3.07"	1.65"
G 3/4, 3/4 NPT	1.61"	3.07"	1.65"
G 1, 1 NPT	1.61"	3.07"	1.65"
G 1 1/2, 1 1/2 NPT	2.16"	3.07"	2.24"
G 2, 2 NPT	2.75"	3.18"	2.16"
G 3, 3 NPT	3.93"	4.17"	2.83"

KOBOLD Instruments Inc.
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Pittsburgh, PA 15205
PH: 412-788-2830
FAX: 412-788-4890
www.koboldusa.com

Series DRB
Turbine Flow Sensor

Precautions

- **User's Responsibility for Safety:** KOBOLD manufactures a wide range of process sensors and technologies. While each of these technologies are designed to operate in a wide variety of applications, it is the user's responsibility to select a technology that is appropriate for the application, to install it properly, to perform tests of the installed system, and to maintain all components. The failure to do so could result in property damage or serious injury.
- **Proper Installation and Handling:** Use a proper sealant with all installations. Never overtighten the sensor within its fittings. Always check for leaks prior to system start-up.
- **Wiring and Electrical:** Because this is an electrically operated device, only properly trained personnel should install and maintain this product. Be sure that the power supplied to the flow sensor is appropriate for the electronics version supplied. Electrical wiring of the sensor should be performed in accordance with all applicable national, state and local codes.
- **Temperature and Pressure:** The DRB is designed for use in application temperatures from -10°F to 176°F. Operation outside these limitations will cause damage to the unit.
- **Material Compatibility:** The DRB process wetted parts for the various body materials are stated below. Make sure that the DRB is chemically compatible with the application liquids. While the sensor's outer housing is liquid resistant when installed properly, it is not designed to be immersed. It should be mounted in such a way that it does not normally come into contact with fluid.
- **Flammable, Explosive and Hazardous Applications:** The DRB is not an explosion-proof design. It should not be used in applications where an explosion-proof design is required.
- **Make a Fail-Safe System:** Design a fail-safe system that accommodates the possibility of sensor or power failure. In critical applications, KOBOLD recommends the use of redundant backup systems and alarms in addition to the primary system.

Specifications

Accuracy: ±3.0% of full scale

Wetted Parts

Bronze Body: Bronze, PVDF, 316 SS, Sapphire, and Buna-N

Stainless Steel Body: 316 SS, PVDF, Sapphire, and Viton

Max. Pressure: 250 PSIG

Temperature Range: -10°F to +176°F

Electrical (see model number table for model codes and descriptions for each output type)

Electrical Protection (all versions): NEMA 4X/IP 65

Output K442

Output Type: 4-20 mA, 4-wire and 2 adjustable set-point relays (SPDT 5A @ 230 VAC)

Input Power: 115 VAC

Display Type: 3-1/2 digit LED and 270° bargraph

Enclosure: Epoxy coated aluminum and polycarbonate

Output F300

PNP Pulse Output: PNP open collector, 25mA max. Power: 14-28 VDC

Electrical Connection: 4 pin micro-DC plug, male

Electrical (continued)

Output L342: 4-20 mA, 2-wire, Rmax < 500 ohms, power= 24 VDC

Electrical Connector = 4 pin micro-DC plug, male

Output L343: 4-20 mA, 3-wire, Rmax < 500 ohms, power= 24 VDC

Electrical Connector = 4 pin micro-DC plug, male

Output L442: 4-20 mA, 2-wire, Rmax < 500 ohms, power= 24 VDC

Electrical Connector = DIN 43650 (hirschmann) plug

Output Type C34P & C30R

Compact Electronics: 4-20 mA + 1 PNP switch or 2 PNP switches depending on model code

Power Supply: 24 VDC ±20%, 80 mA max.

Analog Output: 4-20 mA, 3-wire, Rmax < 500 ohm

Switch Type: PNP open collector, 24 VDC, 300 mA max.

Electrical Conncetion: 5 pin micro-DC plug, male

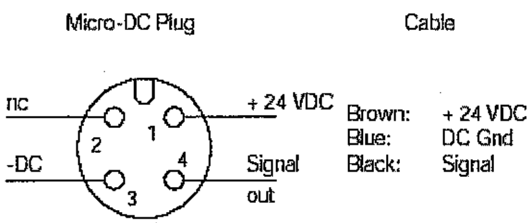
Part Number Decoding

Range GPM	Freq. at f.s. (Hz)	Bronze	Stainless Steel	Fitting	Output/Electronics
1.5 - 8	40	DRB-1150	DRB-1250	N4=1/2" NPT	F300=Frequency output, Micro-DC plug
3 - 13	40	DRB-1155	DRB-1255	N5=3/4" NPT	L342=4-20 mA, 2 wire, Micro-DC plug
5.5 - 20	50	DRB-1160	DRB-1260	N6=1" NPT	L343=4-20 mA, 3 wire, Micro-DC plug L442=4-20 mA, DIN 43650 plug
6.6 - 65	85	DRB-1165	DRB-1265	N8=1 1/2" NPT	C34P=Compact electronic, 4-20 mA w/
8 - 90	80	DRB-1170	DRB-1270	N9=2" NPT	1 PNP switch
15 - 200	70	DRB-1175	DRB-1275	NB=3" NPT	C30R=Compact electronic, 2 PNP switches K442=Display and Controller

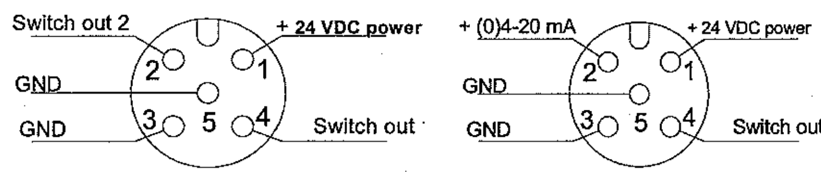
Accessories

Part Number 807.037 = Mating 4-pin Micro-DC plug with 6 ft. cable for output F300, L342, & L343
Part Number 807.007 = Mating 5-pin Micro-DC plug with 6 ft. cable for output C34P & C30R

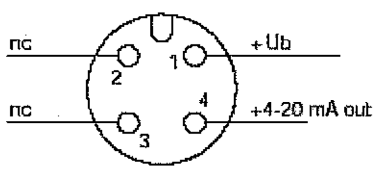
Electrical Connection for Output F300 & L343 (3-wire transmitters)



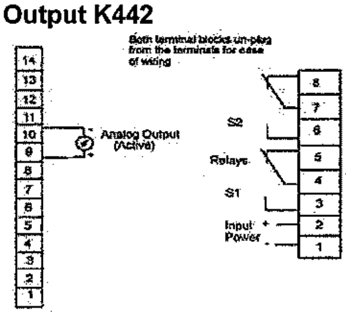
Electrical Connection for Output C34P & C30R (5-wire Micro-DC Plug)



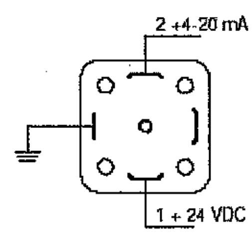
Electrical Connection for Output L342 (2-wire 4-20 mA)



Electrical Connection for Output K442



Electrical Connection for Output L442 (2-wire 4-20 mA)



Mechanical Installation

Piping Preparation: Piping should be rigidly supported at both the inlet and outlet of the sensor to prevent potential damage due to excessive stress on the sensor fittings. In order to ensure that the fluid flow profile is fully developed and symmetrical, a minimum straight piping run of 20 pipe diameters upstream and 10 diameters downstream of the sensor are required. The straight runs should be free of tees, elbows, valves, reducers and other disturbances.

Pumps: All pumps cause pulsations in the fluid. Centrifugal pumps cause the least amount of pulsations in the fluid and positive displacement or reciprocating pumps cause the most. In order to minimize the effect of these pulsations on sensor accuracy, the sensor should be located as far away from the pump as possible. A pulsation dampener or accumulator may be used to dampen pulsations if required. If the fluid pulsations cannot be reduced to an acceptable level, a field calibration to determine the new K-factor for the sensor installed in a pulsating system may be required.

Viscosity: All flow range and calibration data provided with this sensor are for water. All turbine type transducers are affected by viscosity. higher viscosities tend to make the turbine wheel turn slower for a given flow rate. This results in a lower K-factor for the sensor when it is used with a viscous media (i.e. viscosity > 10 cSt.) and the calibration data provided for water flow is no longer valid. If the sensor is to be used with viscous media, a field calibration is required to determine the new K-factor for the sensor.

Field calibration: For frequency output versions, a simple field calibration can be performed to determine the new K-factor for the sensor when it is to be used in a manner in which the above specified calibration information does not apply (i.e. use with viscous or pulsating media, insufficient straight run etc.). With the sensor installed in the system, dispense a known quantity of the fluid to be measured while using a pulse counter to count the number of pulses generated by the sensor during the dispense. This information can be used to determine the new K-factor specific to your system and fluid.

KOBOLD Instruments Inc.
1801 Parkway View Drive
Pittsburgh, PA 15205
PH: 412-788-2830
FAX: 412-788-4890
www.koboldusa.com

Series DPE
Turbine Flow Sensor

Precautions

- **User's Responsibility for Safety:** KOBOLD manufactures a wide range of process sensors and technologies. While each of these technologies are designed to operate in a wide variety of applications, it is the user's responsibility to select a technology that is appropriate for the application, to install it properly, to perform tests of the installed system, and to maintain all components. The failure to do so could result in property damage or serious injury.
- **Proper Installation and Handling:** Use a proper sealant with all installations. Never overtighten the sensor within its fittings. Always check for leaks prior to system start-up.
- **Wiring and Electrical:** Because this is an electrically operated device, only properly trained personnel should install and maintain this product. Be sure that the power supplied to the flow sensor is appropriate for the electronics version supplied. Electrical wiring of the sensor should be performed in accordance with all applicable national, state and local codes.
- **Temperature and Pressure:** The DPE is designed for use in application temperatures from -10°F to 176°F. Operation outside these limitations will cause damage to the unit.
- **Material Compatibility:** The DPE process wetted parts for the various body materials are stated below. Make sure that the DPE is chemically compatible with the application liquids. While the sensor's outer housing is liquid resistant when installed properly, it is not designed to be immersed. It should be mounted in such a way that it does not normally come into contact with fluid.
- **Flammable, Explosive and Hazardous Applications:** The DPE is not an explosion-proof design. It should not be used in applications where an explosion-proof design is required.
- **Make a Fail-Safe System:** Design a fail-safe system that accommodates the possibility of sensor or power failure. In critical applications, KOBOLD recommends the use of redundant backup systems and alarms in addition to the primary system.

Specifications

Accuracy: ±2.5% of full scale

Wetted Parts

Bronze Body: Bronze, PVDF, 316 SS, Sapphire, and Buna-N

Stainless Steel Body: 316 SS, PVDF, Sapphire, and Viton

Max. Pressure: 580 PSIG

Temperature Range: -10°F to +176°F

Electrical (see model number table for model codes and descriptions for each output type)

Electrical Protection (all versions): NEMA 4X/IP 65

Output K442

Output Type: 4-20 mA, 4-wire and 2 adjustable set-point relays (SPDT 5A @ 230 VAC)

Input Power: 115 VAC

Display Type: 3-1/2 digit LED and 270° bargraph

Enclosure: Epoxy coated aluminum and polycarbonate

Output F300

PNP Pulse Output: PNP open collector, 25mA max. Power: 14-28 VDC

Electrical Connection: 4 pin micro-DC plug, male

Electrical (continued)

Output L342: 4-20 mA, 2-wire, Rmax < 500 ohms, power= 24 VDC

Electrical Connector = 4 pin micro-DC plug, male

Output L343: 4-20 mA, 3-wire, Rmax < 500 ohms, power= 24 VDC

Electrical Connector = 4 pin micro-DC plug, male

Output L442: 4-20 mA, 2-wire, Rmax < 500 ohms, power= 24 VDC

Electrical Connector = DIN 43650 (hirschmann) plug

Output Type C34P & C30R

Compact Electronics: 4-20 mA + 1 PNP switch or 2 PNP switches depending on model code

Power Supply: 24 VDC ±20%, 80 mA max.

Analog Output: 4-20 mA, 3-wire, Rmax < 500 ohm

Switch Type: PNP open collector, 24 VDC, 300 mA max.

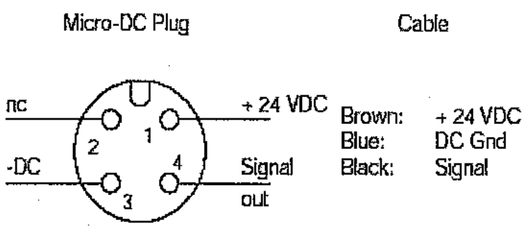
Electrical Conncetion: 5 pin micro-DC plug, male

FM Rev. 9/02
DPE_manual_rev1_9-02

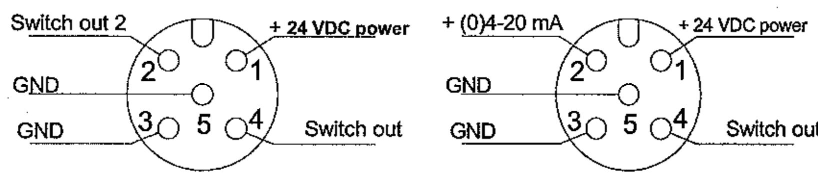
Part Number Decoding

Range GPM	Freq. at f.s. (Hz)	Bronze	Stainless Steel	Fitting	Output/Electronics
1.5 - 8	80	DPE-1150	DPE-1250	N4=1/2" NPT	F300=Frequency output, Micro-DC plug
3 - 13	80	DPE-1155	DPE-1255	N5=3/4" NPT	L342=4-20 mA, 2 wire, Micro-DC plug
5.5 - 20	65	DPE-1160	DPE-1260	N6=1" NPT	L343=4-20 mA, 3 wire, Micro-DC plug
6.6 - 65	140	DPE-1165	DPE-1265	N8=1 1/2" NPT	L442=4-20 mA, DIN 43650 plug
8 - 90	135	DPE-1170	DPE-1270	N9=2" NPT	C34P=Compact electronic, 4-20 mA w/ 1 PNP switch
15 - 200	110	DPE-1175	DPE-1275	NB=3" NPT	C30R=Compact electronic, 2 PNP switches
					K442=Display and Controller
Accessories					
Part Number 807.037 = Mating 4-pin Micro-DC plug with 6 ft. cable for output F300, L342, & L343					
Part Number 807.007 = Mating 5-pin Micro-DC plug with 6 ft. cable for output C34P & C30R					

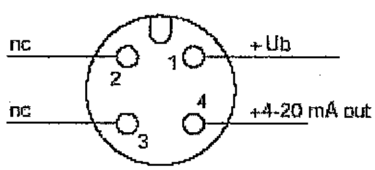
Electrical Connection for Output F300 and L343
(3-wire transmitters)



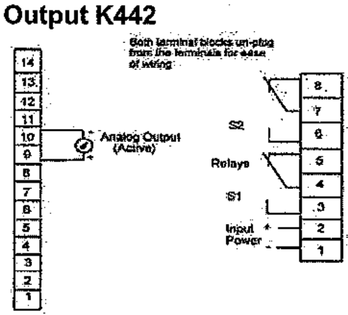
Electrical Connection for Output C30R & C34P
(5-wire Micro-DC plug)



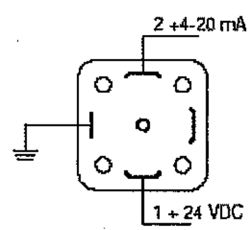
Electrical Connection for Output L342
(2-wire 4-20 mA)



Electrical Connection for Output K442



Electrical Connection for Output L442
(2-wire 4-20 mA)



Mechanical Installation

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Field calibration: For frequency output versions, a simple field calibration can be performed to determine the new K-factor for the sensor when it is to be used in a manner in which the above specified calibration information does not apply (i.e. use with viscous or pulsating media, insufficient straight run etc.). With the sensor installed in the system, dispense a known quantity of the fluid to be measured while using a pulse counter to count the number of pulses generated by the sensor during the dispense. This information can be used to determine the new K-factor specific to your system and fluid.

ASHCROFT®

Type K1 Thin Film Pressure Transducer/Transmitter

APPLICATIONS:

Hydraulic, refrigeration, machine tool, test/measurement, pump control, HVAC, medical, construction equipment and all general purpose industrial process applications

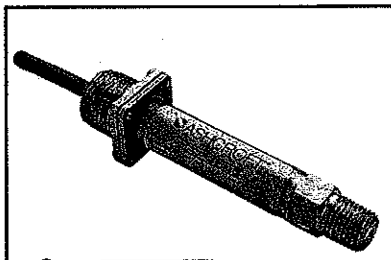
BENEFITS & FEATURES:

- ***0.5% and 1.0% accuracy***
- ***Vac.-2000 psi pressure range***
- ***FM approved and UL listed***
- ***Superior long-term stability and repeatability***
- ***Stainless steel NEMA 4X enclosure***
- ***Current/voltage output***
- ***Wide range of electrical connections available***

The Ashcroft® K1 transmitter introduces the benefits of polysilicon thin film performance at affordable prices. Modern low-pressure chemical vapor deposition methods provide simple, stable molecular bonds between a proven metal diaphragm and a polysilicon strain gage bridge. There are no epoxies or bonding agents to contribute to signal instability or drift.

The integral metal diaphragm and polysilicon bridge are virtually unaffected by shock, vibration or mounting.

These transmitters are offered in many standard pressure ranges with either current or voltage output signals. Transmitter performance is



directly traceable to the National Institute of Standards and Technology and specifications are conservatively stated. A calibration test certificate is available with each transmitter.

PERFORMANCE CHARACTERISTICS

Standard Ranges (psi)

0/15*	0/300	0/5000*	vac./60*
0/30*	0/500	0/7500*	vac./45*
0/60*	0/750	0/10,000*	vac./30*
0/100	0/1000	0/15,000*	vac./15*
0/150	0/2000	0/20,000*	vac./0*
0/200	0/3000		

*1% accuracy ranges only.
Consult factory for nonstandard ranges.

Accuracy Class (F.S.): (Using T.P. method)	0.5%	1%
Best fit straight line (BFSL)	±0.25	±0.4
Hysteresis	±0.15	±0.2
Nonrepeatability	±0.05	±0.07
Interchangeability	±0.5%	±1.0%

Durability:
10^8 cycles 20/80%F.S. with negligible performance change

Stability: ±0.5% F.S./yr

ENVIRONMENTAL CHARACTERISTICS

Temperature Limits:

Storage:	−65 to +250°F
Operating:	−20 to +180°F
Compensated Range:	−20 to +160°F

Thermal Coefficients: (68°F ref.) %F.S./°F

	0.5%	1%
Standard:		
ZERO	±0.028%	±0.04%
SPAN	±0.028%	±0.04%
Optional:		
ZERO	±0.014%	N/A
SPAN	±0.014%	N/A

Multiply thermal zero coefficients by 1.5 on 0/30 psi, vac/15 range and by 3 on 0/15 and vac/0 ranges

Humidity:
No performance effect at 95% relative humidity-noncondensing

FUNCTIONAL CHARACTERISTICS

Overpressure Limits (F.S.):

	0/15-0/2000	0/3000-0/5000	0/7500-20,000
Proof	200%	150%	120%
Burst	800%	300%	150%

Vibration Sweep:
Less than ±0.1%F.S. effect for 0-2000 Hz at 20 g's in any axis

Shock: Less than ±0.05% F.S. effect for 100 g's, 20ms shock in any axis

Position Effect: Less than 0.01% F.S.

ELECTRICAL SPECIFICATIONS

Output Signal:
4-20mA (2 wire)
1-5 Vdc (3 wire)
1-6 Vdc (3 wire)
1-11 Vdc (3 wire) (minimum excitation 15 Vdc)

Power Requirements:
10-36 Vdc unregulated

Response Time: Less than 5 ms

Reverse Polarity Protected

Supply Current: <3mA for voltage outut

PHYSICAL CHARACTERISTICS

Enclosure: NEMA 4X (NEMA 1 only if <500 psig if electrical termination is Bendix® or Hirschman®)

Weight: 2 oz. (approx. w/o cable)

MATERIALS:

Case: 300 series stainless steel

Cable: No. 24 AWG, 36″ PVC, shielded, vented, UL approved

Diaphragm: 17-4 PH stainless steel

Standard Process Connections:
(316 stainless steel)
1/8 NPT male or female
1/4 NPT male or female
1/4 SAE-J-514 (male)
1/4 AMINCO (female) required for pressures over 10,000 psi
Other connections available

HAZARDOUS LOCATION CERTIFICATIONS

(Available optional on 0.5% model only)
Factory Mutual FM approvals
Intrinsically Safe for use in:
Class I, II, III, Div. 1, Groups A, B, C, D, F, G when used with safety barriers connected in accordance with Dresser drawing 71B212 Sht (1-3).
Nonincendive for:
Class I, Div. 2, Groups A, B, C, D
Special Protection for:
Class II, III, Div. 2, Group F, G

TO ORDER THIS TYPE K1 TRANSDUCER/TRANSMITTER:

Select: K1 □ □□□ □□ □□ □□□□□□ □□□

1. **Type Configuration (K1)**
2. **Accuracy/TC**
   (3) 0.50%, ±0.014%/°F (5) 0.50%, ±0.028%/°F
   (7) 1.0%, ±0.040%/°F
3. **Pressure Connection**
   (M01) 1/8 NPT-M (F01) 1/8 NPT-F (M02) 1/4 NPT-M (F02) 1/4 NPT-F
   (MEK) 7/16 -20-M (F09) aminco 9/16-18-Female
4. **Output Signal**
   (42) 4-20mA (15) 1/5 Vdc (16) 1/6 Vdc (11) 1/11 Vdc
5. **Electrical Termination**
   (F2) 36″ cable, shielded, PVC sheathing (B4) Bendix 4-pin # PT02A-8-4P* (HM) Hirschmann miniature
   (B6) Bendix 6-pin # PT02A-10-6P* (B8) WP Bendix 4-pin # PT02E-8-4P*
   (B9) WP Bendix 6-pin # PT02E-10-6P* (C1) 1/2 NPT-M Conduit w/36″ Cable
6. **Pressure Range**
   (Vac./0) Vac./0 through (20000) 20,000 psi (see standard ranges). Call for more options.
7. **Optional X-Variations**
   (XFM) FM Approval Option

*Mating connector available as necessary

Consult factory for guidance in product selection
Phone (203) 783-6650, FAX (203) 783-6659 or visit our web site at www.ashcroft.com

DRESSER
Measurement

K1, K2, K8 PRESSURE TRANSMITTER INSTRUCTION SHEET

ASHCROFT®

Mounting
The transmitter requires no special mounting hardware, and can be mounted in any plane with negligible position error.

Although the unit can withstand normal vibration without damage or significant output effects, it is always good practice to mount the transmitter where there is minimum vibration. For units with NPT type pressure fittings apply teflon tape or an equivalent sealant to the threads before installing.

When tightening, apply a wrench to the hex wrench flats located just above the pressure fitting. **DO NOT** tighten by using a pipe wrench on the housing.

Power Supply – K1 Models Only
The supply voltage for the 1-5 and 1-6 Vdc output transmitters must be within the range of 10 to 36 Vdc. The maximum supply voltage for a current output transmitter is 36 Vdc while the minimum supply voltage is dependent upon the loop resistance of the circuit. The figure below shows the minimum supply voltage (V_{min}) required for a given loop resistance (R_{LOOP}).

Noise
For minimum noise susceptibility, avoid running the transmitter's cable in a conduit that contains high current AC power cables. Where possible avoid running the cable near inductive equipment.

Adjustment Potentiometers
The zero and span pots are accessible through the top of the case. Loosen the four screws and separate the top carefully. The zero pot is marked with a white dot. Connect the braided shield to the guard terminal on the reading instrument (meter, etc.) if available or to ground or to the power supply negative terminal.

WARNING!

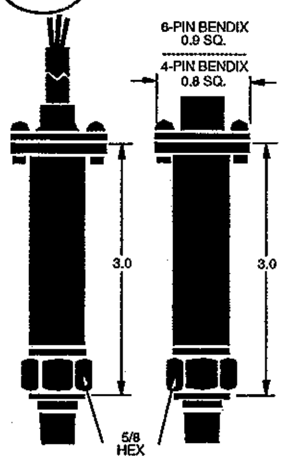
This instrument is susceptible to damage when exposed to static electrical charges. To avoid damage to the transducer observe the following:

- Ground the body of the transducer ***BEFORE*** making any electrical connections
- When disconnecting, remove the ground ***LAST***.

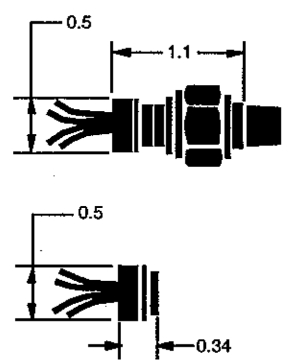
Note: The braided shield and drain wire in the cable (if supplied) is not connected to the transducer body, and is not a suitable ground.

CAUTION: Pressure spikes in excess of the rated overpressure capability of the transmitter (transducer) may cause irreversible electrical and/or mechanical damage to the pressure measuring and containing element(s).

K1, K2 Tranducers



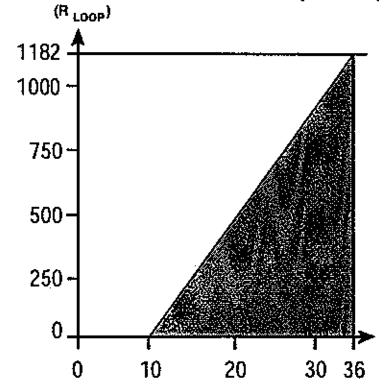
K8 Tranducers



Output – K8 Only
Sensitivity may be from 6 mV/V to 18 mV/V for any individual transducer. Zero offset is within ±3 mV/V. Output is proportional to supply voltage.

Excitation – K8 & K2
For proper operation a voltage within the range of 5 to 10 Vdc must be applied between the transducer's supply terminals.

Load Limitations 4-20mA Output Only



K1 Transducers – Electrical Connections

Voltage Output Units 1-5, 1-6 Vdc

Cable Type F2
Red = +Power
White = Common
Green = Output

Cable Type C1
Red = + Power
White = . Common
Green = Output

Hirshmann Type
PIN-1 = +Power
PIN-2 = Common
PIN-4 = Output

Bendix 4-Pin, 6 Pin
Pin A = +Power
Pin B = Output
Pin D = Common

Current Output Units 4-20 mA

Cable Type F2
Red = +Power
Black = –Power

Cable Type C1
Red = +Power
Black = –Power

Hirshmann Type
PIN-1 = +Power
PIN-2 = –Power

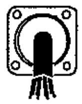
Bendix 4 Pin, 6 Pin
Pin A = +Power
Pin B = –Power

INSTRUMENT DIVISION DRESSER
TRANSDUCER OPERATIONS
DRESSER INDUSTRIES, INC.
INSTRUMENT DIVISION
38 WELLINGTON ROAD
MILFORD, CONNECTICUT 06460 U.S.A.
(203) 783-6650 VOICE
(203) 783-6659 FAX

K2 Transducers – Electrical Connections

Ratiometric (mV/V)

Cable Type F2
Red = +Power
White = –Power
Green = +Output
Black = –Output



Cable Type C1
Red = + Power
White = – Power
Green = + Output
Black = – Output

Bendix 4-Pin
Pin A = +Power
Pin B = +Output
Pin C = –Output
Pin D = –Power

*Signal and power commons (neg.) must be electrically isolated from each other.

Bendix 6-pin
Pin A = +Power
Pin D = –Power
Pin B = +Output
Pin C = –Output
Pin E = Shunt Cal.
Pin F = Shunt Cal.

K8 Transducers – Electrical Connections

Ratiometric (mV/V)

Cable Type F2
Red = +Power
White = –Power
Green = +Output
Black = –Output

4 Inch Leads
Red = +Power
White = –Power
Green = +Output
Blue = –Output

Special Wiring – See "X" Variation On Unit Label

Variation	Wire Hookup	Pin
#2239	+ Output	A
#2281	– Output	B
	+ Power	C
	– Power	D
	Shunt Cal.	E&F**

** B6 Connector Only

XTQ	Red	=	+Power	
	Black	=	Common	
	White	=	Output	
XTG	Red	=	+Power	
	Black	=	Common	
	Green	=	Output	

WARNING: READ BEFORE INSTALLATION

Fluid hammer and surges can destroy any pressure transducer and must always be avoided. A pressure snubber should be installed to eliminate the damaging hammer effects. Fluid hammer occurs when a liquid flow is suddenly stopped, as with quick closing solenoid valves. Surges occur when flow is suddenly begun, as when a pump is turned on at full power or a valve is quickly opened.

Liquid surges are particularly damaging to pressure transducers if the pipe is originally empty. To avoid damaging surges, fluid lines should remain full (if possible), pumps should be brought up to power slowly, and valves opened slowly. To avoid damage from both fluid hammer and surges, a surge chamber should be installed.

Symptoms of fluid hammer and surge's damaging effects:

a) Pressure transducer exhibits an output at zero pressure (large zero offset). If zero offset is less than 10% FS, user can usually re-zero transducer, install proper snubber and continue monitoring pressures.

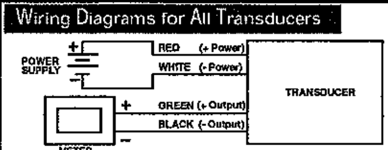
b) Pressure transducer output remains constant regardless of pressure.

c) In severe cases, there will be no output.

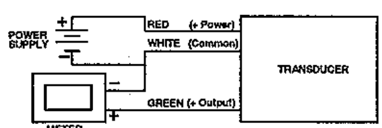
Recalibration Instructions:

1. **Apply 0% Full Scale Pressure.**
2. **Set the output using the *Zero adjustment potentiometer.***
3. **Apply 100% Full Scale Pressure.**
4. **Set the output using the *Span adjustment potentiometer.***
5. **Repeat steps 1 thru 4 as necessary.**

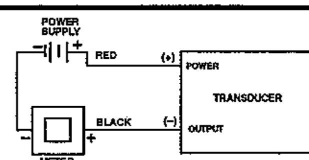
Wiring Diagrams for All Transducers



4-Wire Ratiometric (mV/V)



3-Wire Voltage



4-20 mA

Installation & Operation

ERDCO direct reading flowmeters provide simple and reliable flow rate measurement. These rugged variable area meters work well in a wide variety of applications. Linearity is optimized over 80% of the measuring range.

See-Flo® 3100 & 3200 Series

The indicating pointer is part of the vane and directly visible through the sight window. To read the meter, compare the vane position with the externally mounted scale. The sight window may also be used to observe turbulence, cleanliness and other fluid conditions.

Armor-Flo™ 3400-3700 Series

This product range utilizes the same simple design as the See-Flo with the added benefit of a flow isolated housing. High intensity magnets couple the vane and indicator without any mechanical linkage or dynamic seals. Temporary decoupling of the vane and indicator can occur under erratic flow conditions, but will self correct as the indicator moves through the flow range.

Installation

Your ERDCO flowmeter is complete and ready to use. It has been individually calibrated and tested in accordance with your order. When installing, observe these recommended practices:

1. Install in a full pipe system.
2. Connect observing the "IN" and "OUT" markings on the meter.
3. For best performance, install with ten pipe diameters of straight pipe upstream and five diameters of straight pipe downstream.
4. Locate valves and other turbulence creating devices downstream of the flowmeter where possible.
5. Mount the meter in its intended orientation (i.e. in a horizontal or vertical piping section) as designated by the model number.
6. Orient the face of the meter in a vertical plane. It should not point to the sky or the ground.
7. Maintain the fluid conditions on the nameplate. Different conditions can affect accuracy. Do not exceed the maximum ratings of the meter.

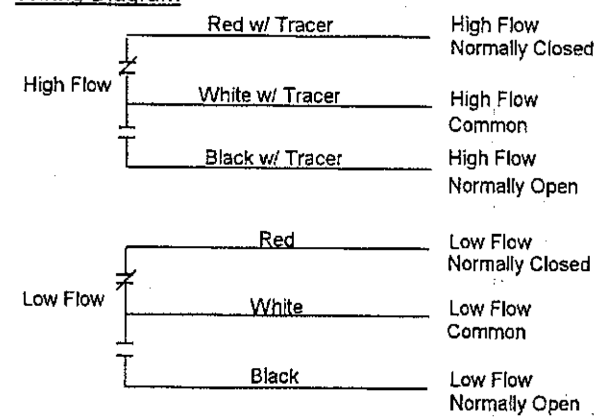
Limit Switch Adjustment

3500 Series and certain 3700 Series flowmeters include single pole double throw switches rated at 0.25 amperes at 120 vac (1.5 amperes at 24 vdc). The switches are configured for low or high flow actuation depending on order specifications.

To adjust the switch actuation point:

1. Remove the window retaining ring and window.
2. Locate the indicator at the desired trip point, and temporarily hold it in place. Do not bend the indicator or use force.
3. Monitor switch continuity (light, horn, multi-meter, etc.) while sliding the switch along the switch guide until the switch contacts open or close. Do not allow magnet on indicator to be in contact with switch. The hold off screw is a factory adjustment. (Note: If magnet on pointer is allowed to contact switch, the vane magnet may decouple from indicator and meter will not read flow.)
4. Tighten slotted screw to secure switch in position.
5. Repeat steps 2 through 4 if there is a second switch.
6. Position window on o-ring for a good seal. Reinstall retaining ring.

Wiring Diagram



Notes:
1. Switches shown in normal condition (not actuated).
2. Select low / high switch diagram as applicable.

Transmitters

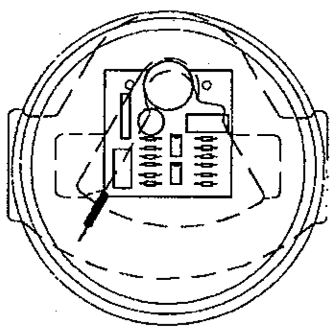
Refer to the detailed instructions provided separately.

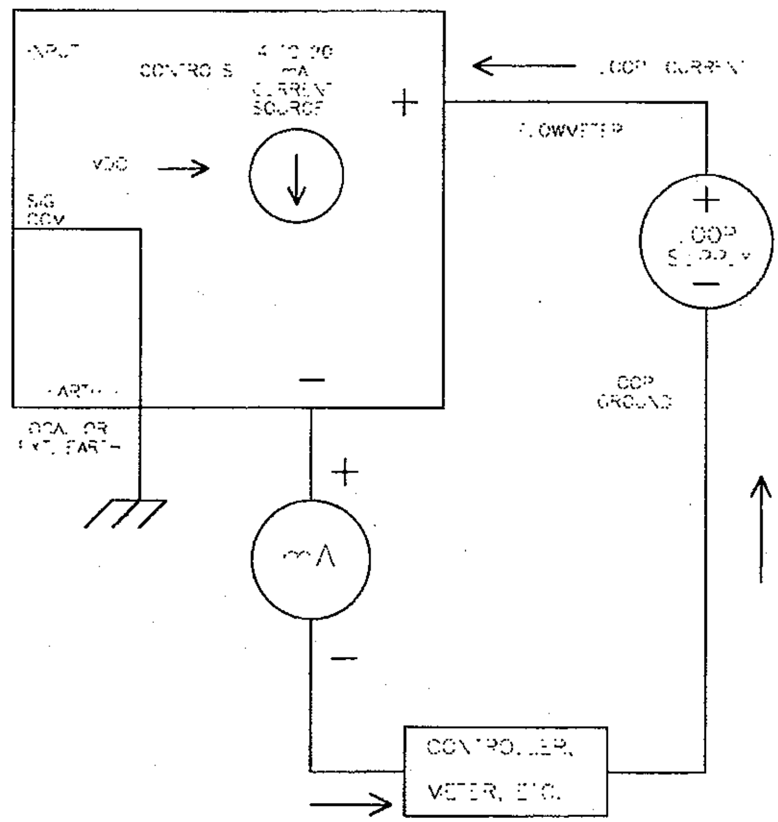
Service

Factory repair and recalibration services are available. For more information call 847-328-0550 or fax 847-328-3535.

ERDCO Engineering Corporation
721 Custer Ave. ◆ Post Office Box 6318
Evanston, IL 60204-6318 USA

Transmitter
FM-15425
TECHNICAL MANUAL





ERDCO Engineering Corporation
P.O. Box 6318, 721 Custer Ave.
Evanston, Illinois 60202-6318 USA
Telephone: 847-328-0550
Fax: 847-328-3535

Data Form: FM-15445

CONTENTS

Section I

Purpose

The ERDCO Series 3600/3700 Flowmeter with integral Transmitter provides an interface between an ERDCO Direct Reading Flowmeter and the user's electrical control, display and/or remote readout. A 4 to 20 mA signal is provided for remote readout, controller operation, recorder, etc.

Section II

Information

ERDCO Direct Reading Flowmeters with integral Transmitter are provided with a precision servo-type potentiometer and integral electronic circuitry to provide a 4 to 20 mA analog output signal.

ERDCO flowmeters are linear over a major portion of the scale range. To achieve this degree of linearity, the flowmeter design dictates scale compression and expansion at the extreme low and high ends respectively. The signal is plotted for each instrument and is included in this manual.

If electrical isolation is required, use devices provided by others.

Section III

Specifications

Operating Loop Voltage Supply	20 to 30v, dc
Operating Temperature Range*	0 to 75°C (32 to 163°F)
Storage Temperature Range	-40°C to 85°C (-40°F to 170°F)
Output Signal	4 to 20 mA
Output Load Range	$0<R_L<750$ ohms
Transmitter Signal Linearity	Better than 5%
Output Signal Repeatability	$\pm$0.5% full scale
Circuitry	Two wire

*As the Transmitter is integral to the flowmeter, the flowmeter is to be located in an application whereby the fluid being measured is within this temperature range.

Section IV

Installation

4.1 CONNECTION TO FLOWMETER - The transmitter circuitry which is integral to the flowmeter includes terminals for user connections. For flowmeter with explosion proof enclosure for transmitter, refer to Technical Manual FM-15432. The circuit component placement drawing Fig. 1, below locates the terminals.

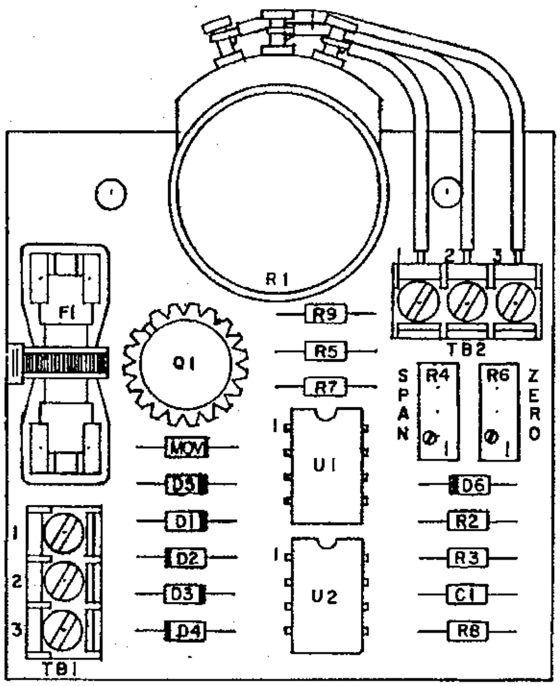


Figure 1

Terminal 1 24v + Nominal

Terminal 2 Controller, Meter, etc.

Terminal 3 Earth Ground (No Internal Connection)

The flowmeter is supplied with a ½ inch NPT(F) electrical conduit connector. This fitting does not prevent the entrance of moisture or any foreign matter into the indicator/electronic area of the flowmeter. Therefore, when conditions may allow the introduction of any material into the electrical conduit, or condensation may occur, a seal must be provided in the user's conduit to protect the flowmeter. A sealing fitting for rigid conduit, such as Appleton Electric Company part number EYSM-50 can be used for this purpose. Be certain that the sealing fitting is oriented so that when potted, no sealing compound is allowed to enter the flowmeter.

4.2 REMOTE POWER CONNECTION - Connect a source of 24 volts, dc capable of supplying 0.05 amperes or more with less than 1 volt peak-to-peak ripple as follows:

Positive to Terminal 1
Negative to Controller, Meter, etc. to Terminal 2
External Earth Ground: Terminal 3 (No internal connection. Provided only for connecting wire shield to local earth ground.)

Section V

Alignment

Each Flowmeter-Transmitter is factory calibrated at room temperature so that the no flow position produces 4mA output and full scale output produces 20mA output. It may be necessary to readjust these settings for a different input range or for a different operating temperature. In such cases, ensure that the unit has fully attained the ambient operating temperature with power on. Then observe the following procedures:

5.1 ADJUSTMENT ACCESSIBILITY - Remove the retaining ring securing the window from the flowmeter and carefully remove the window and "O" ring.

5.2 SCALE ADJUSTMENTS - Refer to Fig. 1 for adjustment locations.

5.2.2 Let the flow indicator rest at no flow position and adjust the ZERO control for an output indication of 3.98mA to 4.02mA or ZERO reading on recorder, etc.

5.2.3 Manually position the flow indicator at maximum scale reading and adjust SPAN control for an output indication of 20.0 milliamperes or maximum scale reading on recorder, controller, etc.

5.2.4 Repeat steps 5.2.2 and 5.2.3 until no further adjustment is required and no flow and maximum flow scale corresponds to 4 and 19.9 to 20.1 mA respectively.

5.2.5 The calibration curve, FMA-14350 identifies the actual signal output as a function of flow for measurement purposes.

5.3 Reinstall the "O" ring, window and retaining ring.

Section VI

Circuit Description

The transmitter section of the Flowmeter is shown schematically in Fig. 2. A diode protects the circuit against reverse polarity in case of miswiring. A 47V MOV and a 50 mA (0.05A) quick blow fuse provides transient overvoltage protection on the nominal 24VDC supply line. A high precision and accuracy 5V regulator produces a floating 5VDC for operation of the transmitter and for voltage reference.

This voltage reference is applied to a precision potentiometer. This potentiometer is rotated by fluid flow via magnetic coupling between the flowmeter vane and the indicator. The potentiometer wiper then produces a voltage which varies with the position of the indicator and hence, the flow.

A low power, low offset voltage operational amplifier (UIB) buffers this voltage into a voltage to current converter, which is comprised mainly of UIA, transistor Q1 and their ancillary components. This converter regulates the output current through the current loop by monitoring the voltage across R8.

Independent potentiometers are provided for ZERO and SPAN. As long as the minimum output current is 4mA or more, adjustments on either potentiometers do not affect the setting of the other. Operation of the circuit is also insensitive to load resistance of the loop, with the maximum load at 750 Ohms including the resistance of the electrical conductors in the loop.

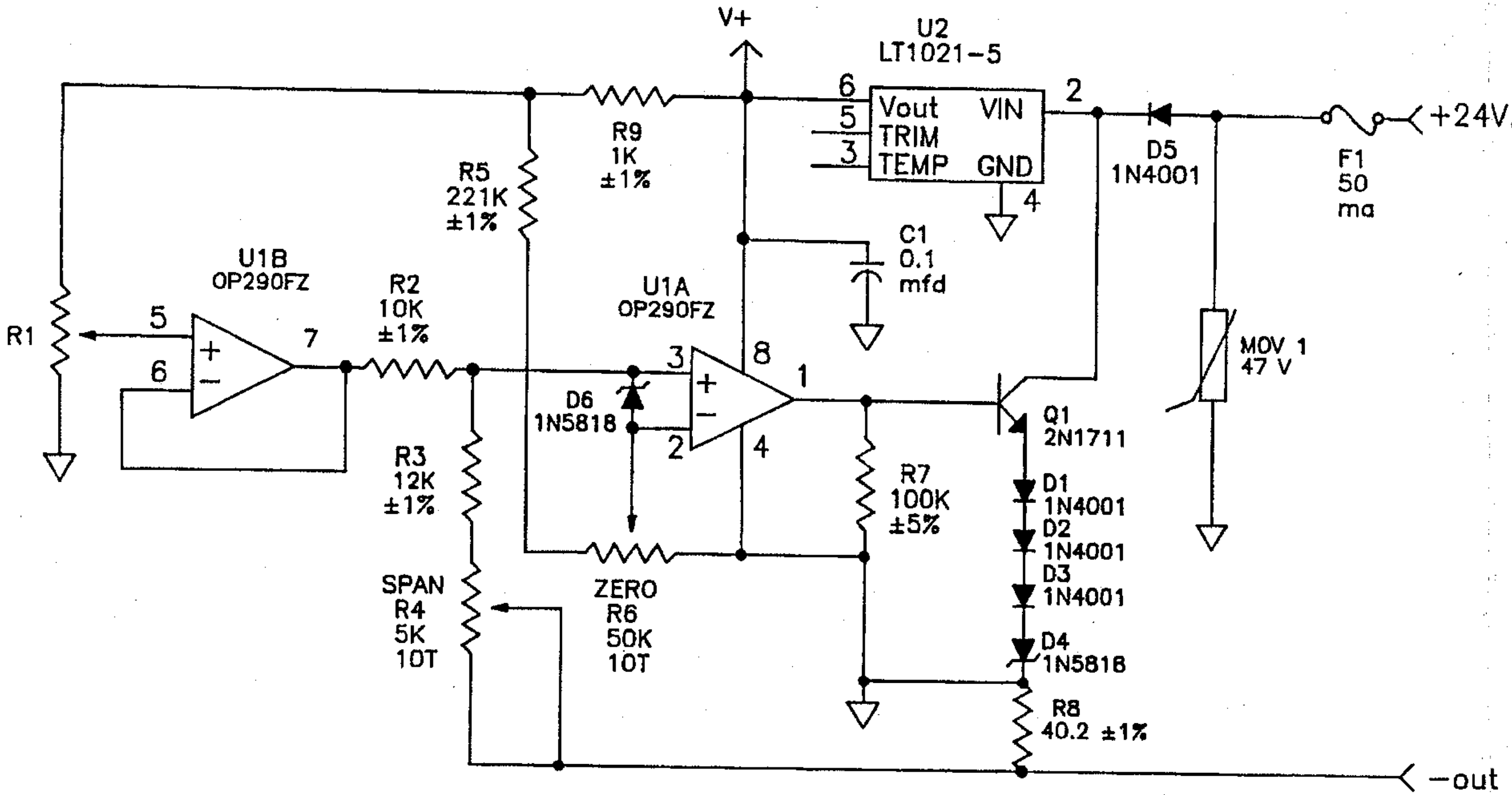
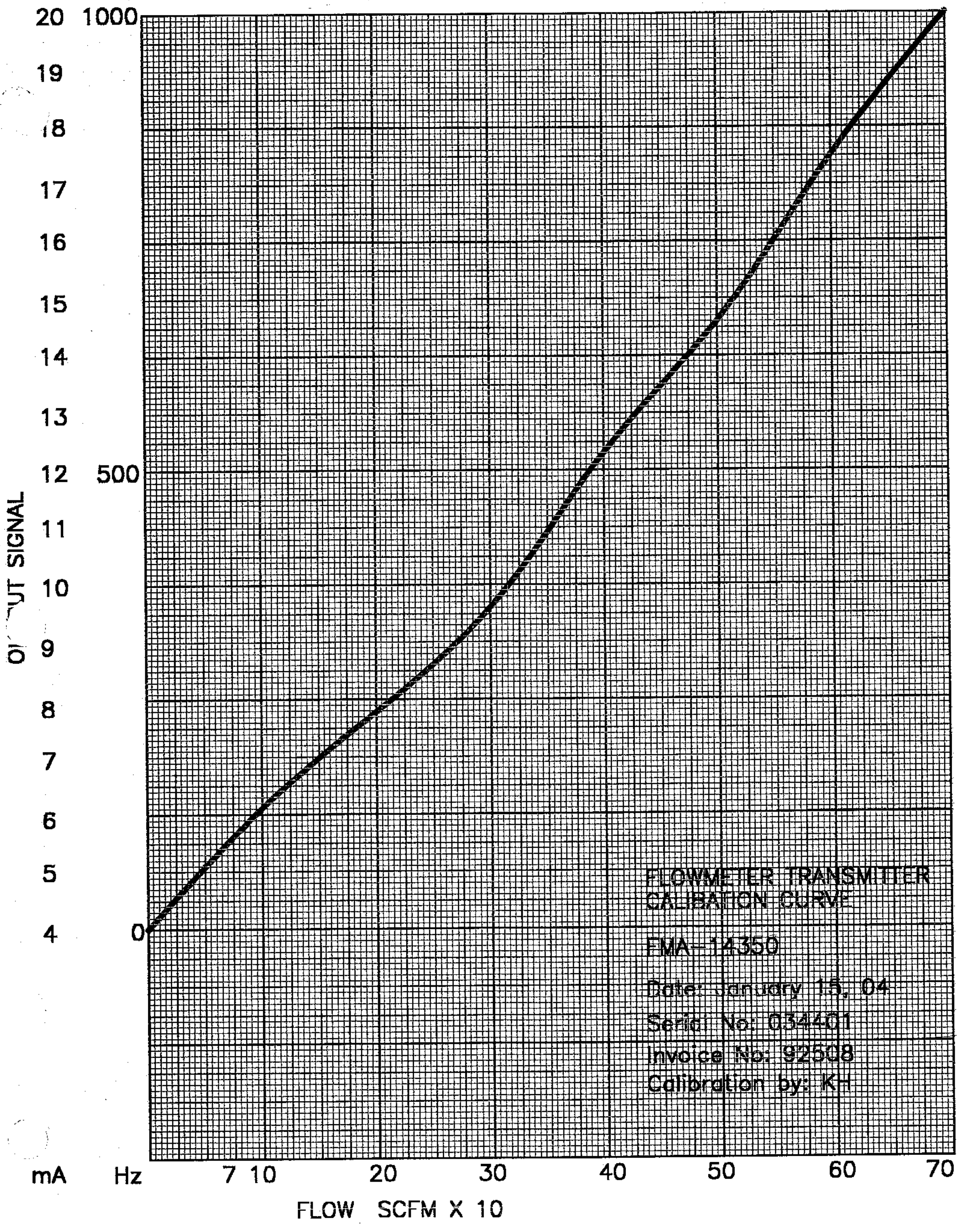

V+
U2
LT1021-5
Vout
TRIM
TEMP
VIN
GND
6
5
3
2
4
+24V.
F1
50
ma
D5
1N4001
MOV 1
47 V
C1
0.1
mfd
R9
1K
±1%
R5
221K
±1%
U1B
OP290FZ
R1
5
6
7
R2
10K
±1%
U1A
OP290FZ
3
2
8
1
4
D6
1N5818
R3
12K
±1%
SPAN
R4
5K
10T
ZERO
R6
50K
10T
R7
100K
±5%
Q1
2N1711
D1
1N4001
D2
1N4001
D3
1N4001
D4
1N5818
R8
40.2 ±1%
-out

Figure 2



SIGNAL
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
1000
500
0
mA
Hz
7 10
20
30
40
50
60
70
FLOW SCFM X 10
FLOWMETER TRANSMITTER
CALIBRATION CURVE
FMA-14350
Date: January 15, 04
Serial No: 034401
Invoice No: 92508
Calibration by: KH

1 Safety notes

Safe and secure operation of the head transmitter can only be guaranteed if the operating instructions and all safety notes contained are understood and followed.

1.1 Correct Use

The unit is a universal, presettable temperature transmitter for resistance thermometer (RTD). The unit is constructed for mounting in a connection head and a field housing. The manufacturer cannot be held responsible for damage caused by misuse of the unit.

1.2 Installation, commissioning and operation

The unit is constructed using the most up-to-date production equipment and complies with the safety requirements of the EU guidelines. If it is installed incorrectly or is misused, certain application dangers can occur. Trained personnel must do installation, wiring and maintenance of the unit. These personnel must have read and understood these instructions and must follow them to the letter.

2 Function and system construction

2.1 Function

Electronic monitoring of input signals into an analog output signal in industrial temperature measurement. The head transmitter is mounted in a connection head or separated from the sensor in a field housing. Setting up of the head transmitter is done using PC and configuration software. The configuration kit is required for setting up the head transmitter.

2.2 Measurement system

Transforming the following input signals:
- Resistance thermometers (RTD) (in 2 or 3 wire connection systems)

Fault monitoring of:
- Measurement range override or undercut
- Sensor breakage and short circuit

3 Installation

3.1 Installation conditions

Ambient temperature: (-40 to 85) °C [-40 to 185] °F
Installation area: Field housing; connection head according to DIN 43 729
Installation angle: No limit

Safety notes: The unit must only be powered by a power supply that operates using an IEC 61010-1 compliant energy limited circuit.

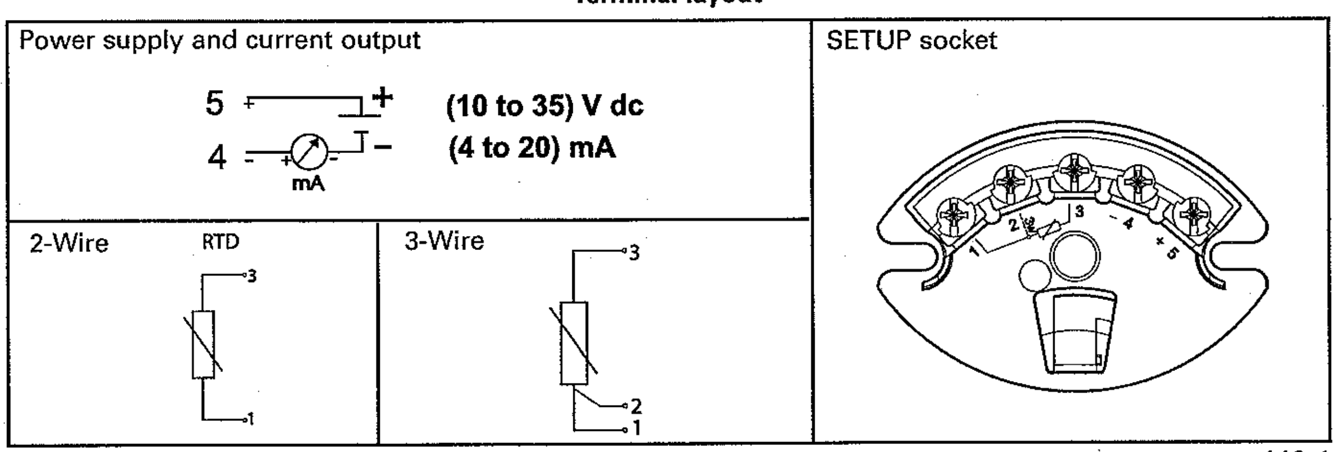
3.2 Installation

- Feed the sensor inset cables through the central hole in the head transmitter
- Position the head transmitter in the connection head
- Feed the installation screws through the slots in the head transmitter.
- Screw the head transmitter into the field housing using a screwdriver while not over tightening.

4 Wiring

4.1 Overview

Terminal layout



4.2 Measurement unit connection

Attention: Switch off power supply before opening the housing cover. Do not install or connect the unit to mains power. If this is not followed, parts of the electronic circuit will be damaged.

• Sensors:
Connect the sensor cables to the respective head transmitter terminals (Terminals 1 to 3) by following the wiring diagram (see figure 4.1).

• Output signal and power supply:
Open the PG cable gland on the head transmitter or field housing. Feed the cable through the opening in the PG cable gland and connect the cable cores to terminals 4 and 5 according to the wiring diagram (see figure 4.1).

• PC configuration (SETUP socket):
Open the flap on the SETUP socket (Figure 4.1) and connect the SETUP connection cable.

Hint: The screws on the terminals must be screwed tightly. Head transmitter configuration during measurement operation is possible. There is no need to disconnect cables!

Potential leveling
Please take note when installing the head transmitter remotely in a field housing. The screen on the (4 to 20) mA signal output must have the same potential as the screen at the sensor connections! When using earthed thermocouples, screening of the output (4 to 20) mA cable is recommended. In plants with strong electromagnetic fields, screening of all cables with a low ohm connection to the transmitter housing is recommended.

5 Operation
5.1 Short form instructions (SETUP)

Presettable Parameters	
Standard settings	• Sensor type • Connection mode (2 or 3 wire connection) • Units (°C or °F) • Measurement range start (depends on sensor) • Measurement range end (depends on sensor)
Expanded settings	• Compensation resistance (0 to 20) Ω on 2 wire connection • Fault condition reaction (≤ 3.6 mA or ≥ 21.0 mA) • Output (analog standard/inverse) • Damping (0 to 8) s • Offset (-9.9 to +9.9) °C [-17.8 to +17.8] °F • Measurement point identification/TAG Service functions
Service functions	• Simulation (on/off)

For detailed TransComm operating instructions please read the online documentation contained in the software.

5.2 Communication
The head transmitter must be set up using a PC and configuration kit. The following points must be taken into account if trouble free setting up is to be achieved:
• Configuration software installation
• Connect the head transmitter to the PC using the connection cable from the configuration kit.

Configuration software installation	
System conditions	• IBM PC or compatible computer (minimum Pentium 166 MHz) • Windows 95/98/ME/NT4.0/2000 • 64 MB RAM • Minimum 30 MB free memory on hard drive • CD-ROM drive • Screen resolution 800 x 600 Pixel • Free serial interface
Recommended minimum configuration	• Pentium 400 MHz • 128 MB main RAM • 120 MB free hard drive memory • Screen resolution 1024 x 768 Pixel
Installation start	Start Windows 1. Place installations-CD in the respective drive 2. Start "Setup.exe" and follow the installation instructions 3. If required, the help/operating manual can be printed once the software has been successfully installed.

Connecting the head transmitter to the PC using the configuration kit connection cable

1. Connect the SETUP connector of the interface cable to the SETUP socket in the head transmitter (see figure 4.1).

2. Connect the RS232C connector to a free serial interface socket on the PC. In order to achieve optimum connection, tighten the RS232C connector screws to the PC.

Note: Configuration of the head transmitter must be done with or without power applied.

6 Commissioning

6.1 Installation check

Monitor all connections making sure they are tight. In order to guarantee fault free operation, the terminal screws must be tight onto the connection cables. The unit is now ready for operation.

6.2 Commissioning

Once the power supply has been connected the head transmitter is operational.

Setting up using the PC configuration software

The head transmitter left the factory with a default parameter configuration. If no customer specific configuration was mentioned on the order, the default parameter configuration is constructed as follows:

Sensor	Pt100 (RTD)
Connection mode	3-wire
Measurement range and units	(0 to 100) °C

Hint: If a change has been made to the measurement point, the head transmitter can be re-configured. In order to re-configure the parameters follow these instructions:

- Install the configuration software and make connection to the PC (see Chapter 5, Operation).
- For detailed operating instructions for the PC configuration software, please read the online documentation contained in the software.

Interactive setting up of the temperature transmitter

Customer specific linearization and sensor matching is done using the TransComm configuration software. The program calculates the linearization coefficients X0 to X4, that need to be entered into the PC configuration software.

6.3 Function check

Measuring the analogue (4 to 20) mA output signal or following failure signals:

Measurement range undercut	Linear fall to 3.8 mA
Measurement range excess	Linear rise to 20.5 mA
Sensor break; sensor short circuit	≤ 3.6 mA or ≥ 21.0 mA selectable

7 Maintenance

The head transmitter is maintenance free.

8 Fault finding

8.1 Repair concept and disposal

Due to its construction, the head transmitter cannot be repaired. When disposing of the head transmitter please take note of local disposal regulations.

8.2 Faultfinding and repairs

Trouble shooting in general

Fault	Cause	Action/Cure
No communication	2 wire connection incorrect	Re-connect correctly (see connection diagram)
	No power supply to the 2 wire connection	Check the current loop
	Power supply too low (< 10 V dc)	Check power supply
	Interface cable defective	Check the interface cable
	PC-interface defective	Check the interface of your PC
	Head transmitter defective	Replace head transmitter

Trouble shooting on RTDs (Pt100)

Fault	Cause	Action/Cure
Current (≤ 3.6 or ≥ 21.0) mA	Sensor defective	Check sensor
	Incorrect RTD connection	Connect the cables correctly (see connection diagram)
	Incorrect 2 wire connection	Connect the cables correctly (see connection diagram)(Polarity)
	No power supply on the 2 wire connection	Check the current loop; the supply should be > 10 V dc
	Incorrect transmitter programming (number of wires)	Change parameter 'connection mode' (see chap. Operation)
	Programming	Thermocouple set up (see chap. Operation). Change to RTD
	Head transmitter defective	Replace head transmitter
Incorrect or inaccurate measured value	Sensor is incorrectly installed	Reinstall sensor correctly
	Heat dissipation via sensor	Monitor sensor installation positioning
	Incorrect transmitter programming (number of wires)	Change parameter 'connection mode'
	Incorrect transmitter programming (Scale)	Change scale
	Wrong RTD set up	Change parameter 'sensor type'
	Sensor connection (2 wire)	Monitor sensor connection
	Sensor cable resistance not compensated (2 wire)	Compensate cable resistance
	Offset incorrectly set up	Monitor offset

BISCO Environmental

Section 4 – Control Panel

- Control Panel Layout Drawing & Wiring Diagrams
- EOS Series II ProControl ProView Configuration File Information
- EOS ProControl Series 2plus User Manual
- EOS ProView for ProControl Series 2plus User's Guide

EOS RESEARCH LTD.
ProControl Series II+

ProView Configuration File Information

```
*******************************************************
***** FAX Recipient:     BISCO ENVIRONMENTAL     *****
***** Customer:          BISCO                   *****
***** Site Location:     RANDOLPH MASS           *****
*******************************************************
***** Setup:             1                       *****
***** Option:            S2P                     *****
***** Type:              103                     *****
***** Serial Number:     8171                    *****
***** Date:              01/28/2004              *****
***** Time:              13:13:11                *****
***** ProView:           Version 2.153           *****
*******************************************************
```

THE INPUTS INCLUDED IN THIS SYSTEM ARE:

#	TAGNAME	TAGNAME DESCRIPTION	SETUP*	RANGE
1	MS1_HH	Moisture Separator 1 Level Switch High-High	D,NO,AL	
2	MS1_H	Moisture Separator 1 Level Switch High	D,NO,ST	
3	MS1_L	Moisture Separator 1 Level Switch Low	D,NC,ST	
4	CT1_HH	Condensate Tank 1 Level Switch High-High	D,NO,AL	
5	MS2_HH	Moisture Separator 2 Level Switch High-High	D,NO,AL	
6	MS2_H	Moisture Separator 2 Level Switch High	D,NO,ST	
7	MS2_L	Moisture Separator 2 Level Switch Low	D,NC,ST	
8	CT2_HH	Condensate Tank Level 2 Switch High-High	D,NO,AL	
9	B101_S	SVE Blower 1 Motor Status	D,NO,ST	
10	TP101S	Moisture Separator Transfer Pump 1 Status	D,NO,ST	
11	B201_S	SVE Blower 2 Motor Status	D,NO,ST	
12	TP201S	Moisture Separator Transfer Pump 2 Status	D,NO,ST	
13	RESET	Reset Pushbutton	D,NO,ST,SU	
17	VT_101	Vacuum Transmitter	A,EP,ST	0-30 IHG
18	FIT101	Flow Indicating Transmitter	A,EP,ST	0-900 CFM
19	FT_101	Flow Transmitter	A,EP,ST	0-65 GPM
20	TT_101	Temperaure Transmitter	A,EP,ST	0-200 F
21	VT_201	Vacuum Transmitter	A,EP,ST	0-30 IHG
22	FIT201	Flow Indicating Transmitter	A,EP,ST	0-700 CFM
23	FT_201	Flow Transmitter	A,EP,ST	0-65 GPM
24	TT_201	Temperaure Transmitter	A,EP,ST	0-200 F

*INPUT SETUP NOTES

D - This input is a (Discrete) or ON/OFF Input.

A - This input is a (Analog) or Variable Input.
C - This input is a Pulse Flowmeter Input.
P - This input is a Pulse Accumulator Input.
UPP - Units per Pulse. Number of units (i.e. Gallons) to record for each pulse
NO-This input is a (Normally Open) Discrete Input.
NC-This input is a (Normally Closed) Discrete Input.
EP-(Endpoint) This input is "Active" when its value is outside the low to high alarm levels.
WD-(Window) This input is "Active" when its value is between the low and high alarm levels.
ST-(Status) This input shows a green LED in ProView when it is in its Active State.
AL-(Alarm) This input shows a red alarm bell in ProView when it is in its Active State.
SU-(Startup) This is a menu function input. When activated it will run the startup routine.
SD-(Shutdown) This is a menu function input. When activated it will run an emergency shutdown.
MN-(Manual) This is a menu function input. When activated it place the unit in Manual Mode.
AU-(Auto) This is a menu function input. When activated it place the unit in Auto Mode.
SQ-(Square Root) This analog channel's reading is proportional to the square root of the input.
LT-(Lamp Test) This is a Lamp Test input. When activated it will turn on all Alarm Light outputs.

THE DISCRETE OUTPUTS INCLUDED IN THIS SYSTEM ARE:

#	TAGNAME	TAGNAME DESCRIPTION	SETUP*
1	B_101	SVE Blower 1 Motor Coil	
2	TP_101	Moisture Separator Transfer Pump 1 Motor Coil	
3	B_201	SVE Blower 2 Motor Coil	
4	TP_201	Moisture Separator Transfer Pump 2 Motor Coil	
5	MS1_HH	Moisture Separator 1 Level High-High Alarm	AI
6	SVE1LV	SVE Blower 1 Low Vacuum Alarm	AI
7	CT1_HH	Condensate Tank 1 Level High-High Alarm	AI
8	MS2_HH	Moisture Separator 2 Level High-High Alarm	AI
9	SVE2LV	SVE Blower 2 Low Vacuum Alarm	AI
10	CT2_HH	Condensate Tank 2 Level High-High Alarm	AI

*OUTPUT SETUP NOTES

G1-(Group 1)- This output will not respond to processes 17-32.
G2-(Group 2)- This output will not respond to processes 01-16.
LT-(Lamp Test) - This output has been declared as an alarm light.
AI-(Alternate Image) - This output is displayed as an icon other than the default switch.

THE ANALOG OUTPUTS INCLUDED IN THIS SYSTEM ARE:

#	TAGNAME	TAGNAME DESCRIPTION	SETUP*	INPUT

*ANALOG OUTPUT SETUP NOTES

```
PID  -This output is involved in a PID
(Proportional,Integral,Derivative) control loop.
PRO  -This output is involved in an open (Proportional) control loop.
FOR  -The PID or PRO loop will run in the (Forward) direction.
REV  -The PID or PRO loop will run in the (Reverse) direction.
INPUT-This Tagname will serve as the input to the control loop.


THE PROCESS CONTROL TASKS EXERCISED BY THIS SYSTEM ARE:

Process 01: If MS1_HH is ON
            THEN Delay for 2 Seconds, Send Report[FAX #1;FAX #2;Page #
1;Page #2],
            Switch B_101 OFF AND MS1_HH ON
            Page Message: ' '

Process 02: If B101_S is ON AND VT_101 is Low
            THEN Delay for 10 Seconds, Send Report[FAX #1;FAX #2;Page #
1;Page #2],
            Switch B_101 OFF AND SVE1LV ON
            Page Message: ' '

Process 03: If CT1_HH is ON
            THEN Delay for 2 Seconds, Send Report[FAX #1;FAX #2;Page #
1;Page #2],
            Switch TP_101 OFF AND CT1_HH ON
            Page Message: ' '

Process 04: If MS2_HH is ON
            THEN Delay for 2 Seconds, Send Report[FAX #1;FAX #2;Page #
1;Page #2],
            Switch B_201 OFF AND MS2_HH ON
            Page Message: ' '

Process 05: If B201_S is ON AND VT_201 is Low
            THEN Delay for 10 Seconds, Send Report[FAX #1;FAX #2;Page #
1;Page #2],
            Switch B_201 OFF AND SVE2LV ON
            Page Message: ' '

Process 06: If CT2_HH is ON
            THEN Delay for 2 Seconds, Send Report[FAX #1;FAX #2;Page #
1;Page #2],
            Switch TP_201 OFF AND CT2_HH ON
            Page Message: ' '

Process 07: If MS1_HH is OFF AND SVE1LV is OFF
            THEN Switch B_101 ON

Process 08: If MS1_H is ON AND CT1_HH is OFF
            THEN Switch TP_101 ON

Process 09: If MS1_L is ON
            THEN Switch TP_101 OFF

Process 10: If MS2_HH is OFF AND SVE2LV is OFF
            THEN Switch B_201 ON

Process 11: If MS2_H is ON AND CT2_HH is OFF
            THEN Switch TP_201 ON
```

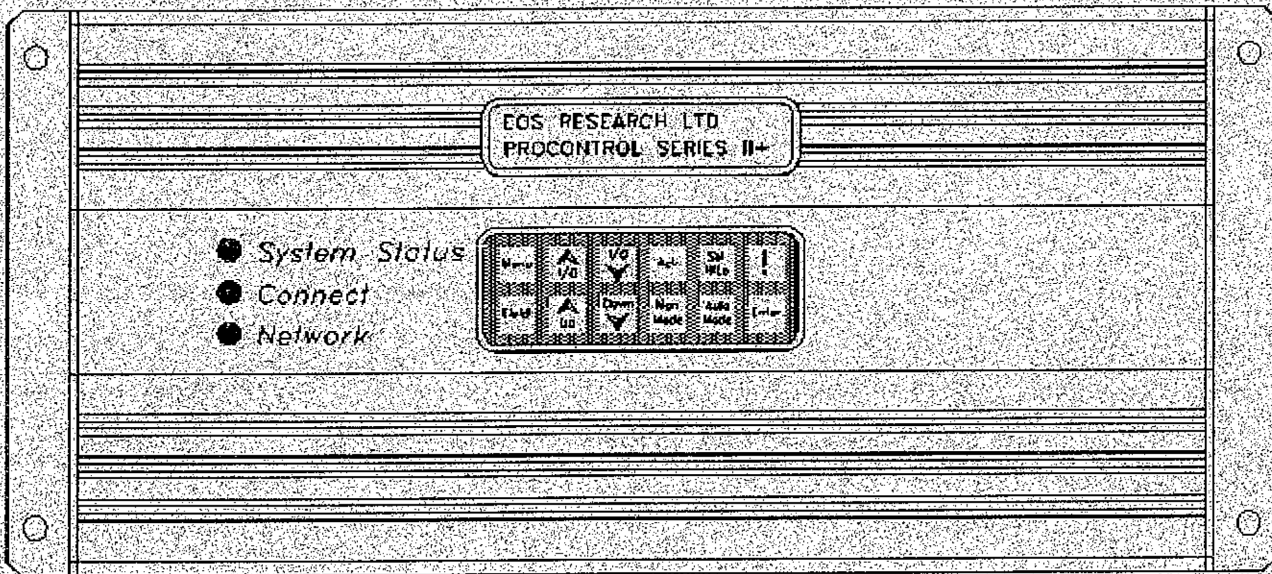
```
Process 12: If MS2_L is ON
            THEN Switch TP_201 OFF
```

Startup 01: Switch MS1_HH OFF AND SVE1LV OFF AND CT1_HH OFF AND MS2_HH OFF AND SVE2LV OFF AND CT2_HH OFF

Shutdown 01: Switch B_101 OFF AND TP_101 OFF AND B_201 OFF AND TP_201 OFF

PROCONTROL

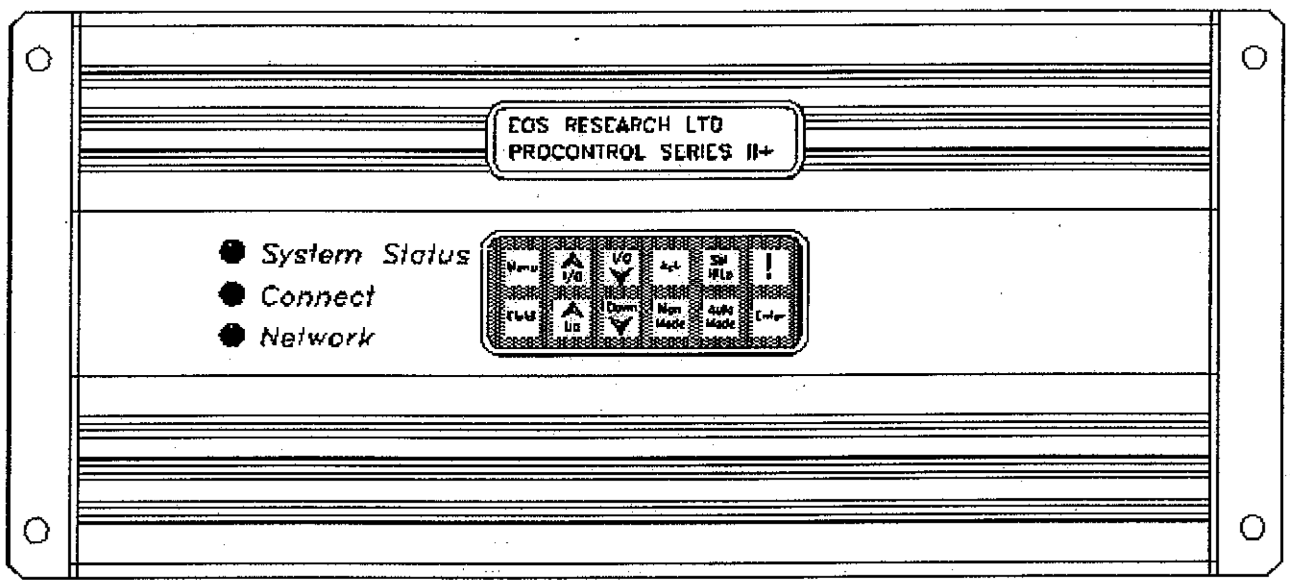
SERIES 2^plus USER MANUAL



Version 2.X

ProControl

Series 2^{plus} User Manual



Version 2.X

LIMITED WARRANTY

EOS Research Ltd. (EOS) warrants its products to be free from defects in materials and workmanship for a period of one year from the date of purchase. Its obligation under this warranty is limited to repairing or replacing, at its sole option, any such defective products. This warranty includes parts and labor. This warranty does not apply to equipment which has been damaged by accident, negligence or misapplication or has been altered or modified in any way.

EXCEPT AS PROVIDED HEREIN, EOS RESEARCH LTD. MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MECHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Some states do not permit limitation or exclusion of implied warranties, therefore the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

IMPORTANT SAFETY PRECAUTIONS

Any complex hardware or software may be difficult to document, explain or understand. It is important to consider the consequences or unexpected or abnormal behavior which may be caused by a defect or human failure to comprehend. In order to protect people and property from damage, a thorough safety analysis should always be performed. When the consequences of a failure are serious, it is essential to protect life and property against such a failure with redundant backup systems or safety devices. It is agreed between the purchaser and EOS Research Ltd. that protection against and the consequences of any such failure are entirely the purchaser's responsibility.

This device is not approved for use in life support or medical systems.

As installed, this product may be part of a system which is required to meet various electrical, fire, safety or other codes and regulations. Compliance with these codes is the purchaser's responsibility.

Specifications subject to change without notice.

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TABLE OF CONTENTS

Please see the ProView manual for operation of the remote access software which is supplied with the ProControl Series 2*plus*.

1.0 System Overview

1.1 General

The *ProControl Series* 2^{plus} is a small but powerful microprocessor based control/ telemonitoring system. By combining a control panel and remote monitor in one unit, the Series 2^{plus} can act as a central supervisory and data management tool for any stand-alone operation. The *ProControl Series* 2^{plus} can perform multiple tasks:

- **Stand-Alone Control:** The *ProControl Series* 2^{plus} is a sophisticated programmable logic controller that will efficiently supervise and control your operation. It can interface with up to 70 electrical devices (float switches, pressure transducers, pH transmitters, flow meters, pumps, blowers, etc.), and execute numerous control functions simultaneously. Automatic shutdown routines can be programmed in to protect you operation during alarm conditions. It is extremely versatile in terms of the control algorithms it can execute.

- **Remote Control and Monitoring:** The *ProControl Series* 2^{plus} gives you a window into your operation from any remote location, using the easy-to-use Windows-based software supplied with the system. You communicate with the ProControl over a modem link, which allows you to view all of your system's operating conditions, while also providing the same access to control functions that you would have if you were at the site (e.g., turning pumps on and off, adjusting alarm setpoints, etc.). No other telemonitoring device gives you the ProControl's level of remote control capability.

- **Reporting:** The *ProControl Series* 2^{plus} will keep you informed. It will send you periodic fax status reports of your project operations on a schedule specified by you, and will alert you immediately either by fax or by numeric or alpha-numeric pager if an alarm condition warrants attention. No longer do you have to assume what's happening at your remote operation.....the ProControl will tell you exactly.

- **Datalogging:** The *ProControl Series* 2^{plus} is your information manager. It is a powerful datalogger that automatically records all operating conditions in its battery-backed memory. You can access your logged data remotely at any time, and download it to your office computer for further processing. The datalogging capability is an invaluable tool for reporting purposes, troubleshooting, and trend graphing.

One or more of these features can be used in your installation; they are standard in every ProControl unit.

1.2 Key Concepts

The following are the building blocks of any Series **2*plus*** monitoring and control system.

Inputs and Outputs (I/O's)

No system can be effective in the real world without communication and one of the principal ways the ProControl communicates is by responding to information collected by sensors and by issuing "commands" to other electronic or electrical devices. Sensor information constitutes an *Input* while a "command" to another device constitutes an *Output*. The Series **2*plus*** works with all of the more important types of I/O devices in general use. Appendix A demonstrates how a variety of I/O devices are connected to the ProControl.

Digital Inputs

These inputs are designed to detect the closure of switch contacts such as those found on float switches or overpressure sensors. They can respond to any normally open or normally closed dry contact. The Series **2*plus*** provides its own wetting (supply) voltage of 5 volts DC for each digital input circuit. The Series **2*plus*** can respond to changes in state as fast as 4 Hz or 3 Hz (cycles per second) depending on the model purchased. Digital inputs are "debounced" for 125 or 150 milliseconds, respectively. This means that a switch or other input that changes state (becomes open or closed) must stay in that state for 125 or 150 milliseconds before the Series **2*plus*** will respond to the change.

Eight high-speed digital inputs can also be used for traditional digital (pulse-output) flow meters. These inputs can detect signal changes at up to a 200/500 Hz rate. All high-speed digital inputs are "debounced" for 1250/500 microseconds. The faster rate applies only to those systems containing the 18.432 MHz processor.

Analog Inputs

These inputs are compatible with sensors which send out a 4 - 20 milliamp (mA) signal. Most analog sensors are available with this type of signal, examples being pressure transducers, pH transmitters, and many flow meters. These inputs allow the operator to read the actual "value" of a parameter, such as pressure, instead of an on/off signal.

Digital Outputs

Digital outputs turn things like pumps, solenoid valves, and alarm lights on and off. The Series **2*plus*** digital outputs are relay outputs designed to switch small loads directly, such as motor starters, lamps, and solenoid valves.

Analog Outputs

Analog outputs are typically used in process control schemes where a controlled piece of equipment can accept a signal which is variable over a range. This output is expressed as a percentage (0 - 100%) and is used to control pump speeds, chemical dosing rates, etc., instead of conventional on/off operation. The equipment that the ProControl sends the analog output to must accept a 4 - 20 mA signal. Often, an analog output is used in conjunction with an analog input such as a pH transmitter to form a control scheme known as *feedback control.* In essence, the input and output will work together to maintain a user set input level. This concept is described further in the next section under *Analog Output Processes*.

Tagnames

Each input and output is given a descriptive *Tagname* by the user that uniquely identifies it to the system operator. For instance, a digital input could be called "TANKHI", an analog input could be called "AIRFLO" and a digital output could be called "PUMP_1". This tagname is used by the local LCD display, the FAX report and by the ProView software. The analog inputs are also given a *Units Tagname* which identifies the unit of measure associated with the input sensor. Each tagname can be up to six characters long and each units tagname can be up to three characters long ("PSI", for instance). The tagnames can include the uppercase letters A-Z, the numbers 0-9, a blank space, and the underscore (_) character.

1.3 Control Basics

The status of all inputs or outputs can easily be monitored both locally and remotely. What gives the Series **2*plus*** its real power, however, is the ability to automatically initiate actions based on the status of the inputs and your pre-programmed instructions (this is often called *Process Control*). These actions can include switching certain outputs, faxing back a report, sending an alphanumeric or numeric page, shutting down the entire system or sounding the local alarm. Process control functions are programmed into your ProControl by EOS Research or one of our technology partners according to your specifications.

Active State

Central to the use of control on the Series 2^{plus} is the concept of *Active State*. Each input on the ProControl receives certain signals from a sensor which constitute "normal" operation and other signals which constitute an exception to normal operation.

A digital input can monitor only two states, ON or OFF (alternatively, CLOSED or OPEN). The *Active State* would be the state in which the controller would respond to the digital input, and perform certain actions or generate an alarm. For example, if a high level float switch in a tank is tripped (turned ON) by rising fluid level, we can say that its *Active State* correlates to a situation in which the fluid level is high. The active state of the float switch could cause the Series 2^{plus} to trigger an alarm, turn off a pump, or initiate some other action. The Series 2^{plus} can be set up so that either ON or OFF is the active state.

An analog input sensor can take on many states (or values) between the minimum and maximum of its measurement range. The ProControl operator, however, can set two threshold values which divide the total input span into two functional regions. These threshold values are more commonly called the *Low Alarm Limit* and the *High Alarm Limit*, although on the Series 2^{plus} these thresholds are somewhat more flexible in use than those names imply. An analog input which has transcended either its Low Alarm Limit or High Alarm Limit is said to be in its active state.

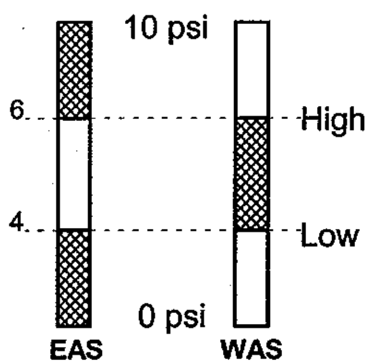


Figure 1. Active State

For instance, consider an analog input sensor which measures pressure from 0 to 10 PSI. The system operator could set the low limit to 4 PSI and the high limit to 6 PSI. In this case the *Active State* would usually be considered as the input state greater than 6 PSI or less than 4 PSI. This interpretation is called *Endpoint Active State* (EAS) on the Series 2^{plus} because the endpoints of the range are the areas which need to trigger action or generate alarms. The opposite interpretation is also possible and is called *Window Active State* (WAS). Any input values between 4 PSI and 6 PSI would trigger action or generate alarms.

If the ProControl has *Alarms Set*, when any input enters its active state, a local beeper will sound on the ProControl. The word *Alarm* here applies only to the sounding of a local beeper and is not associated with any process control. The active state condition is indicated on the LCD display and can be acknowledged by the operator. The beeper is silenced when it has been acknowledged or after 30 seconds have elapsed. The beeper only operates when the system is operating in Manual mode.

Startup Sequence The *Startup Sequence* is a series of control algorithms or steps which run in succession and which are designed to place the system in its normal operating mode. It can be as simple as turning all the outputs on simultaneously, or as complex as a multi-stage delay with many conditions. Up to 8 or 16 individual startup steps can be declared depending on the model of the controller. The ProControl can be configured to automatically run this sequence when the unit is powered up.

Process Tasks A *Process Task* is an ongoing control algorithm which runs continuously. Think of each process task as an IF-THEN statement, in which an action is initiated if a certain condition or combination of conditions exists. Some examples are:

- IF Tank Level Sensor 2 is on, THEN turn Pump 2 off
- IF Air Flow Rate < 10 cfm AND Reactor Temperature > 250^{o}, THEN open Bleed Valve 2

Up to 16 or 64 separate process tasks can be run simultaneously depending on the model of the controller. Process tasks can trigger FAX reports, pager alerts, and system shutdowns.

Shutdown Sequence The *Shutdown Sequence* is a series of control steps which run in succession and which are designed to shut your system down in a manner which is best for the equipment or treatment processes involved. The shutdown sequence can be activated manually or automatically due to an alarm condition. Here is a typical shutdown sequence:

- Turn off Well Pumps 1 and 2
- Wait 5 minutes, then turn off Stripper Blower
- Open Bleed Valve 2
- When Oxidizer Temperature < 150^{o}, turn off SVE Blower

Automatic Operation The use of the startup sequence, process tasks, and the shutdown sequence constitutes *Automatic Operation* of your system with the ProControl Series **2*plus*** (otherwise known as *Auto Mode*). The Series **2*plus*** will be placed into auto mode (automatically) when your system has been started up using the programmed startup sequence. If one condition of the programmed startup sequence is not met during the startup process, your system will be completely shut down by the ProControl as a safety measure. Once the startup sequence has been successfully completed, the ProControl begins running the process tasks continuously. **PROCESS TASKS WILL RUN ONLY WHEN IN AUTO MODE.** Please note that the audible beeper will <u>not</u> sound even if the ProControl has *Alarms Set* when it is in Auto Mode, since the process tasks will control these situations as the user has specified.

Manual Operation

You can override the Series 2^{plus} programmed control functions by operating in *Manual Mode*. In manual mode, your process will respond only to operator input from the keypad of the ProControl, or to commands issued from the ProView software. PLEASE NOTE THAT PROCESS TASKS AND THEIR ERROR-CHECKING MECHANISMS DO NOT RUN DURING MANUAL MODE! Manual mode is useful when you wish to troubleshoot your system, but none of the system safeguards built into auto mode are available. You can place your operation into auto mode any time by issuing the command from the keypad.

Analog Output Processes

In some cases, you may want to use an analog output to control equipment that maintains an analog input at a certain constant level. For example, you may wish to automatically maintain a pH of 8.5 in a reaction tank by varying the dosing rate of a chemical feed pump. The pH you wish to maintain (8.5) is called the *SetPoint* of the analog output process. An analog input to the ProControl (in this case, a pH transmitter) is said to provide *feedback* to the unit, and combined with an analog output, constitute *feedback control.*

PID Loops

A reliable type of feedback control can be obtained through a *PID Loop*. PID stands for *Proportional-Integral-Derivative*, and is a commonly-used process control technique. We'll skip the details of the mathematics involved, but suffice it to say that a PID loop is the favored control technique for most analog output processes. With only a *Proportional* term applied in the equation, the analog output is controlled based on an error signal generated from the difference between the SetPoint and the actual analog input. The PID loop can also improve its performance as it continues to run if an *Integral* term is used and can respond to quick changes in the controlling analog input if a *Derivative* term is used. EOS Research will configure your PID loops for you and can provide further information if necessary.

Proportional Outputs

In some cases, it may be desirable to base an analog output signal on an analog input value. In this situation, no specific SetPoint is used because there is a direct relationship between the output and input values. For example, if you wanted to base the output of a metering pump on some flow rate, you might use a proportional output to relate the amount of chemical metered to the flow rate.

2.0 On-Site Operation

2.1 LCD Display

If your unit did not come with an LCD display, the following sections *do not* apply.

The 2 line x 20 character LCD display is used to display and control system operations. The display is divided into separate areas or fields, as outlined below.

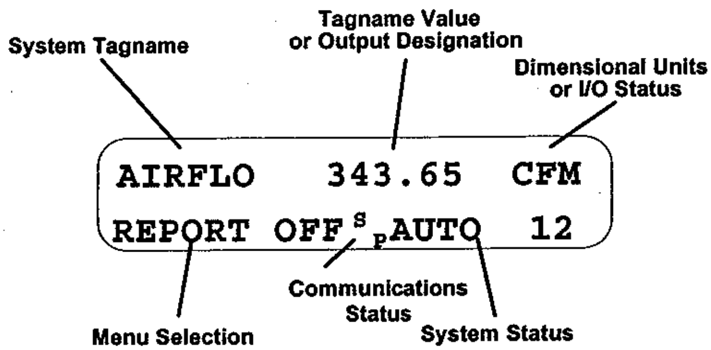


Figure 2. Display Fields

System Tagname This six-character field is used to identify the I/O point displayed. Descriptive names such as WELL1 or BLOWER are used.

Tagname Value For analog inputs, this field displays the value of the input, the high alarm limit, or the low alarm limit. For digital outputs, OUTPUT is displayed. For digital inputs, this field is unused. For analog outputs, this field displays the output percentage, the output level, or the associated input setpoint.

Dimensional Units or I/O Status For analog inputs, this three-character field displays the dimensional units associated with the input sensor, such as GPM or PSI. For digital inputs and outputs, this field displays either ON or OFF. For analog outputs, this field abbreviates percent with PCT. In the case of digital outputs, if the particular output displayed has been designated a lamp output (*see ProView manual*), and a lamp test is currently running, an asterisk (*) will appear before ON or OFF to indicate the lamp is illuminated despite the indicated output status (the output will return to this indicated status once the lamp test has been completed).

Menu Selection This field displays the current menu selection.

Communications Status	This field displays one of five different descriptors which indicate any of several special functions of the ProControl. If no communications action is being taken, ">" will appear. Communications messages include: **SP** (Sending Page) - indicates that the unit is attempting to send either an alphanumeric or numeric page; **EF** (Encoding Fax) - indicates that the unit is presently encoding a facsimile report as a result of a request by either the operator or the unit itself; **SF** (Sending Fax) - indicates that the unit is attempting to send a fax report; and **DC** (Data Communications) - indicates that the unit is presently interfaced with ProView.
System Status	This area displays the current system status: AUTO, MANUAL, START, or SHUTD and an associated process task number indicating the last successfully completed Auto process, current Startup process, or current Shutdown process.

2.2 Keypad

The Series 2^{plus} keypad contains 12 buttons which are used along with the LCD Display to control the operations of the system.

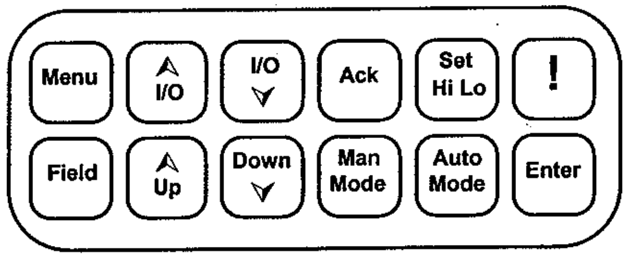
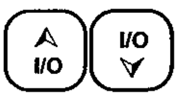


Figure 3. Series 2^{plus} Keypad

This key is used to scroll through a series of options which are displayed on the LCD screen, and which allow the user to configure various aspects of system behavior.



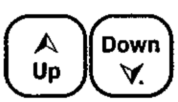
These keys are used to display information about particular I/O points on the LCD Screen. The keys allow the user to scroll through all of the system I/O points either forward or backward.

The Acknowledge key is used to silence the audible beeper or to acknowledge a memo sent from a remote ProView user.

The Set Hi Lo key allows the user to change the high and low alarm limits for analog inputs or to toggle the display in the I/O Summary.

The Emergency Shutdown key is used to turn off all outputs and return the system to manual mode. The programmed shutdown sequence is <u>not</u> executed using this key.

The Field key is used to select a character position to be edited. It is used in conjunction with any direct alphanumeric entry.



These keys are used to toggle system variables from one state to the next or to scroll through possible character entries when used in conjunction with the Field key.

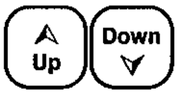
This key is used to place the system in manual mode.

This key is used to place the system in auto mode.

The Enter key is used to initiate certain actions selected by other keys or to confirm alphanumeric editing done using other keys.

2.3 Password

When the system is first turned on the password screen is displayed and the user is prompted to enter the password to gain access to the system. "EOS" is the default password. The password on the Series **2**^{plus} was designed as a *low-level* security feature. It is not sufficient in and of itself to withstand a determined effort at system entry. The ProControl unit can be configured to bypass the password screen when the unit is powered up.

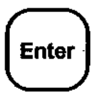



```
CUSTOMER ID TAGNAME
ENTER PASSWORD: BAA
```

Use the Up and Down keys to change the character displayed above the cursor.


```
CUSTOMER ID TAGNAME
ENTER PASSWORD: BAA
```

The Field key is used to move the cursor to the next character to be edited.




```
CUSTOMER ID TAGNAME
ENTER PASSWORD: EOS
```

The enter key submits the password for approval.

If the password was entered correctly, the following screen will be displayed for about a second before the operations screen is displayed:

```
Password Accepted
VER 2.XXX    : 1
```

ROM Version # **User Setup Version #**

Otherwise, the following message will be displayed for a second and the user will be returned to the password menu:

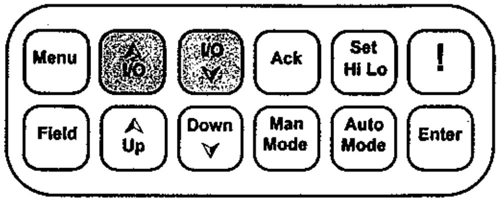
```
Incorrect Password
```

2.4 Operations Screen

After the password has been entered correctly, the operations screen is displayed. The operations screen allows the user to set system parameters and to review the status of all system inputs and outputs.

```
WELL1               OFF
ALARMS  SET >MANUAL
```


2.5 I/O Keys



Pressing the I/O Up or I/O Down keys will scroll through the operational I/O points in the system. Data relevant to a particular I/O point will be displayed to right of the point's Tagname.


```
WELL2                ON
ALARMS  SET >MANUAL
```

Forward scroll through I/O points


```
WELL3               OFF
ALARMS  SET >MANUAL
```

Forward scroll through I/O points


```
WELL2                ON
ALARMS  SET >MANUAL
```

Backward scroll through I/O points

2.6 Digital Input Menu

Input Tagname   Input Status

```
WELL2                ON
ALARMS  SET >MANUAL
```

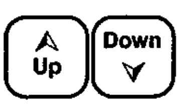
A digital input displayed in the operations screen will be displayed as shown. When the input is in its Active State "ON" will be displayed in the Input Status area. Otherwise, "OFF" will be displayed.

2.7 Digital Output Menu

Output Tagname   Lamp Status   Output Status

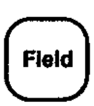
```
PUMP1     OUTPUT  *OFF
ALARMS  SET >MANUAL
```

A digital output displayed in the operations screen will appear as shown. When the output has been turned on, "ON" will be displayed in the Output Status area. Otherwise, "OFF" will be displayed. The cursor is displayed under the first character in the status field to indicate that it can be changed. The Lamp Status character (*) will be shown for a lamp output if a *lamp test* is running regardless of the output's true state.




```
PUMP1     OUTPUT   ON
ALARMS  SET >MANUAL
```

Pressing the Up or Down key will toggle the digital output state and turn the corresponding relay OFF or ON.




```
PUMP1     OUTPUT   ON
ALARMS  SET >MANUAL
```

Pressing the Field key will move the cursor to the Menu selection field.

2.8 Analog Input Menu

Analog Tagname — Analog Value — Units

	H2OFLO 54.6 GPM ALARMS SET >MANUAL	An analog input displayed in the operations screen will be displayed as shown to the left. The value of the analog input will be shown along with the dimensional units. In the case of a pulse accumulator (totalizer only), you will see only TOT where units is normally displayed.
Set Hi Lo	H2OFLO 20.0 GPM LOW ALARM >MANUAL	Use the Set Hi Lo key to set the low alarm limit.
Set Hi Lo	H2OFLO 80.0 GPM HIGH ALARM >MANUAL	Press the Set Hi Lo key again to set the high alarm limit.
Set Hi Lo	H2OFLO 120817 GAL TOTAL FLOW >MANUAL	Press the Set Hi Lo key again to see the total flow on a flow type input, and once more to return.
Up / Down	H2OFLO 30.0 GPM LOW ALARM >MANUAL	The Up and Down keys are used to change the value of the current character, as denoted by the cursor.
Field	H2OFLO 30.0 GPM LOW ALARM >MANUAL	The Field key is used to move to the next character to be edited.
Enter	H2OFLO 30.0 GPM LOW ALARM >MANUAL	To save the low alarm limit changes, press the enter key.

2.9 Analog Output Menu

Analog Tagname

Percentage

```
VRPUMP      25.0   PCT
ALARMS  SET >MANUAL
```

An analog output displayed in the operations screen will be displayed as shown to the left. The percentage of full scale output will be displayed as well.

Set Hi Lo

```
VRPUMP      25.0   PCT
OUTPUT  LVL >MANUAL
```

The Set Hi Lo key can be used to set the output percentage.

Set Hi Lo

```
WTRLVL      33.0   FT
SETPOINT    >MANUAL
```

Press the Set Hi Lo key again to declare the SetPoint of an associated analog input. The SetPoint is used only if a PID control loop is in use as an analog output process.

Pressing Set Hi Lo again returns to the original menu.

Up Down

```
VRPUMP      35.0   PCT
OUTPUT  LVL >MANUAL
```

The Up and Down keys are used to change the value of the current character, as denoted by the cursor.

Field

```
VRPUMP      35.0   PCT
OUTPUT  LVL >MANUAL
```

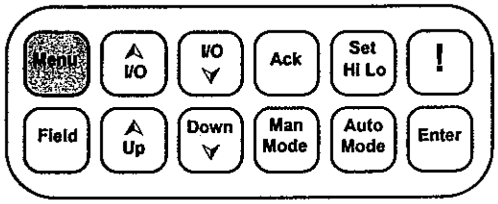
The Field key is used to move to the next character to be edited.

Enter

```
VRPUMP      35.0   PCT
OUTPUT  LVL >MANUAL
```

To save the output level changes, press the enter key.

2.10 Menu Key



When pressed, the Menu key will scroll through a series of items which allow the user to configure various aspects of system behavior. A description of these items appear in a 10 character field at the bottom left of the display. Either the Up and Down keys or the Enter key is used to change the item.

ALARMS Use the Up and Down keys to enable or disable Alarms.

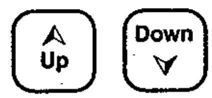

```
TAGNAM              DIM
ALARMS  OFF  >MANUAL
```

```
TAGNAM              DIM
ALARMS  SET  >MANUAL
```

REPORT Use the Up and Down keys to enable or disable the unit's reporting capabilities (fax or page).

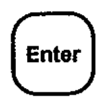

```
TAGNAM              DIM
REPORT  OFF  >MANUAL
```

```
TAGNAM              DIM
REPORT  ON   >MANUAL
```



FAX NOW Use the Enter key to send a FAX report immediately.


```
TAGNAM              DIM
FAX  NOW     >MANUAL
```



STARTUP Use the Enter key to run the Startup Sequence.


```
TAGNAM              DIM
STARTUP      >MANUAL
```

SHUTDOWN Use the Enter key to run the Shutdown Sequence.

Menu

```
TAGNAM              DIM
SHUTDOWN     >MANUAL
```

Enter

LAST SHUTDOWN This display item shows what input or output caused the last shutdown.

Menu

```
TAGNAM              DIM
SDN TAGNAM >MANUAL
```

LOG OFF Use the Enter key to Log Off the system and return to the password menu.

Menu

```
TAGNAM              DIM
LOGOFF       >MANUAL
```

Enter

LAST MEMO Use the Enter key to see the last memo sent from the remote ProView user. Up and Down are used to scroll through the message, and Ack is used to return to the ProControl menus. If you hit any other key you will see an informative message telling you which keys are valid. The message will be displayed for 3 seconds if no keys are pressed, but can be acknowledged before the 3-second period by pressing either the Ack or Enter keys.

Menu

```
TAGNAM              DIM
LAST MEMO   >MANUAL
```

Enter

```
HEY BULLWINKLE,
REMEMBER TO SHUT THE
```

Down

```
LIGHTS OFF!
PUSH <ACK> TO RETURN
```

Field

```
UP & DOWN TO SCROLL
OR <ACK>NOWLEDGE
```

Ack

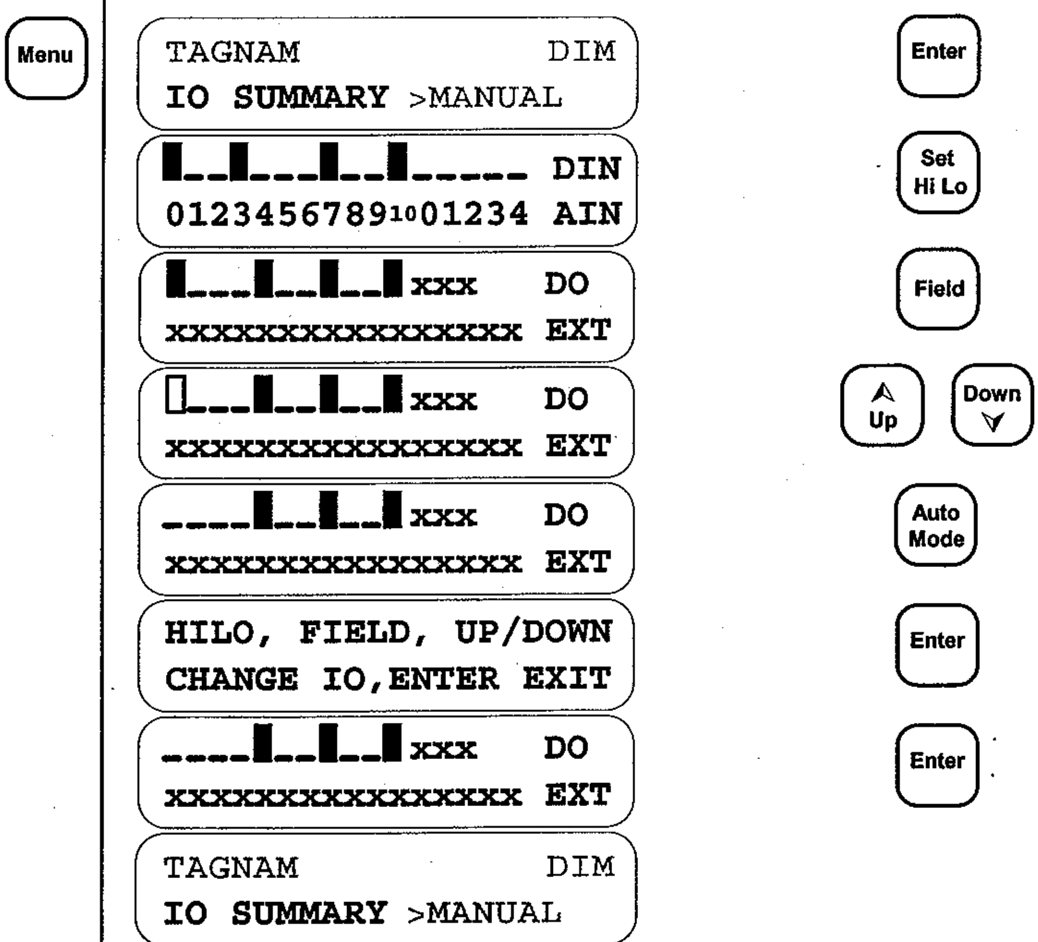
```
LIGHTS OFF!
PUSH <ACK> TO RETURN
```

Ack

```
TAGNAM              DIM
LAST MEMO   >MANUAL
```

IO SUMMARY

Use the Enter key to enter the I/O summary. The analog input values 0-10 represent a percentage of full scale (i.e. 0 ≅ 4 mA, 5 ≅ 12 mA). Set HiLo is used to toggle between input/output summaries. An underscore represents an open input or an unswitched output. A block indicates a closed input or a switched output. An x or X is displayed when an output is not enabled and is unswitched or switched, respectively. An asterisk (*) will be displayed if an output is declared as a lamp and a lamp test is currently being performed. The Field key can be used to move the blinking cursor through the outputs. The Up/Down keys can be used to toggle the state of the output whose position is covered by the blinking cursor. The Enter key will return the ProControl back to its standard menus. If you press any other keys you will see an informative message telling you which keys are valid. The message will be displayed for 3 seconds if no keys are pressed, but can be interrupted before the 3-second period by pressing the Enter key.



MODES

Use the Up and Down keys to toggle an Analog Output from Manual control to PID control or Proportional control, depending on which analog output process is being used. This selection will only appear if an analog output tagname is displayed and the analog output is part of an analog output process.

Menu

```
TAGNAM    100.0   PCT
MODE MAN    >MANUAL
```

```
TAGNAM     96.3   PCT
MODE PID    >MANUAL
```

```
TAGNAM     25.0   PCT
MODE PRO    >MANUAL
```

Up Down

GROUP

The ProControl allows outputs to be assigned to different *Groups* to allow greater process control flexibility. In some cases, you may wish to be able to specify alternate process tasks for a given output. For instance, you can have the operation of a pump be controlled by a series of level switches in a tank, or alternately, the pump can be run on a timed cycle. By selecting the appropriate process Group, you can change the control strategy for that piece of equipment. EOS Research will configure the groups for you according to your specifications

Use the Up and Down keys to select a Group for the displayed output. This menu item is displayed only for outputs that have been configured by EOS to have alternate process Groups.

Menu

```
TAGNAM   OUTPUT   DIM
GROUP 1     >MANUAL
```

```
TAGNAM   OUTPUT   DIM
GROUP 2     >MANUAL
```

Up Down

2.11 LED Indicators

Your ProControl unit has three status LEDs to the left of the keypad, which are used to indicate the following:

System Status:	Normally ON when unit is powered. One blink - The system has internally reset. Two blinks - An internal error has occurred.
Connect:	ON if user is remotely or locally connected. ON if system is faxing or paging. Slow blink - last fax or page failed, press ACK to clear. Fast blink - local connect cable inadvertantly left plugged in, press ACK to clear.
Network:	Rapid blinking indicates an active network connection.

3.0 Reporting Features

3.1 Fax Report

The ProControl unit will keep you informed of your system's operations with facsimile status reports. With the supplied ProView software you can configure the unit to send fax reports to up to two different numbers. You can also have these reports sent on a daily basis, at regular intervals during the day, or when triggered by specific process tasks. You can send one at any time by using the *Fax Now* option either from the menu on the ProControl's display, or through the ProView software.

The fax report you receive will contain several fields, each denoted by a shadow box. The number of fields will depend on the configuration of your system. For instance, you would not see a field indicating *Analog Outputs* if your system does not contain any of these.

The fields as you will see them are shown below. All information enclosed in brackets is variable and depends on your particular system configuration.

To:

```
<FAX RECIPIENT>
```

will indicate the intended fax recipient's name.

From:

```
THE <SYSTEM NAME>          SYSTEM IN <SITE LOCATION>    AT <TIME> ON <DATE>
SETUP VERSION X        :   ROM VERSION 2.x           :  MODEL B1
```

will indicate the name and location of your system, the date and time at which the fax report was initiated, your current ProView setup version, and the current on-board software version 2.X.

System Status:

```
<MODE><PXX>  :    LAST SHUTDOWN AT <TIME> ON <DATE> BY <SHUTDOWN CAUSE>
                  FAX REPORT INITIATED BY <FAX CAUSE>
```

will indicate the current `<MODE>` of the controller and associated process. For example, if the controller is running the startup or shutdown sequence, you would see either `START` or `SHUTD` followed by the current algorithm. Similarly, in auto mode, you would see `AUTO` followed by the last successfully completed process task.

The `LAST SHUTDOWN` indicates when the system last initiated the shutdown sequence and what caused it to happen. For example, if the shutdown sequence were initiated by a key press, the cause you would see would be `KEYPAD`. Similarly, if the shutdown sequence were caused by a process task such as a high pressure sensor whose tagname was HIPRES, you would see `HIPRES` as the `<SHUTDOWN CAUSE>`. If multiple inputs or outputs caused the shutdown (i.e. a process task was dependent on more than one input being in the active state and/or multiple outputs being ON), the most recent one which changed will appear as the cause.

Similarly, the `FAX REPORT INITIATED BY` line will indicate the tagname of the I/O point which caused the fax to be sent, provided there was only one I/O point responsible. If multiple I/O points were responsible, the process itself will be indicated. Consider, for example, a process task where a shutdown was caused by HIPRES and BLOWER, and a fax was also generated. The `<FAX CAUSE>` would be `PROCESS XX`, where *XX* is the number from 1 - 64 of this process task. In the case where *Fax Now* was selected from the menu option on the LCD, the `<FAX CAUSE>` would be `KEYPAD`. The `<FAX CAUSE>` from a ProView generated *Fax Now* command would be `REMOTE`. This line will <u>not</u> appear on daily or interval scheduled fax reports.

Discrete Inputs:

```
<TAGNAME> is <STATE>   <TAGNAME> is <STATE> ...
```

will indicate the status of all of the digital inputs in four columns. Inputs which are in the active state will appear as ON and those which are in their normal state will appear as OFF.

Discrete Outputs:

```
<TAGNAME> is <STATE>   <TAGNAME> is <STATE> ...
```

will indicate the status of all of the digital outputs in four columns.

Analog Inputs:

```
<TAGNAME> is <VALUE> <DIM> LIMITS are L: <LO-LIM> <DIM> H: <HI-LIM> <DIM>
<TAGNAME> is <VALUE> <DIM> TOTAL FLOW is <FLOW>   <DIM>
<TAGNAME>                  TOTAL FLOW is <FLOW>   <DIM>
...
```

will indicate the current value, dimensional units, low alarm limit, and high alarm limit for all analog inputs which are not flow-type inputs. The precision of the values displayed can be selected through ProView. Any flow-type analog input which is responsible for maintaining a total flow will display that flow in place of the alarm limits. Any pulse-type digital input used for a digital flow meter will appear here since the information being obtained by that type of flow meter is analog in nature. In addition, pulse accumulators (volume totalizers) will appear here.

Analog Outputs:

```
<TAGNAME>   <PCT>  PCT  <MODE>      <TAGNAME>   <PCT>  PCT  <MODE>
...
```

will indicate the output percentage and mode of operation of all analog outputs. The precision is fixed to one decimal place and will range from 0.0 to 100.0, expressed as a percentage. The <MODE> of operation will be PID if the analog output is currently being used in a PID loop, or PRO if the analog output is currently being used in a Proportional scheme, otherwise it will be MAN indicating that the analog output is under manual control.

The next two pages contain examples of scheduled and alarm fax reports.

ProControl Series II+

EOS Research Ltd. Fax Report

To:

BULLWINKLE J MOOSE

From:

THE NORTH WATER SUPPLY SYSTEM IN MAYBERRY USA @ 09:44:00 ON 12/10/1999
SETUP VERSION 1 : ROM VERSION 2.156 : MODEL B2

System Status:

AUTO P04 : NO PREVIOUS SHUTDOWN

Discrete Inputs:

WEL1LO is OFF	WEL2LO is OFF	TWR_HH is OFF	TNK_HH is OFF
RESET is OFF			

Discrete Outputs:

WLPMP1 is ON	WLPMP2 is ON	FINPMP is ON	CHLMET is ON
NAOMET is ON	PH_ALM is ON	CL_ALM is ON	TWRALM is OFF
WL1ALM is OFF	WL2ALM is OFF	TNKALM is OFF	

Analog Inputs:

TWRLVL is 59.2	FT	LIMITS are	L: 8.0	FT	H: 70.0	FT
TNKLVL is 0.00	FT	LIMITS are	L: 8.00	FT	H: 12.00	FT
FINFLO is 501.3	GPM	TOTAL FLOW is	14794	GAL		
FLOW_2 is 399.3	GPM	TOTAL FLOW is	12561	GAL		
FLOW_1 is 0.0	GPM	TOTAL FLOW is	0	GAL		
FIN_PH is 0.00	PH	LIMITS are	L: 6.00	PH	H: 8.00	PH
FIN_CL is 0.00	PPM	LIMITS are	L: 0.75	PPM	H: 2.00	PPM

Analog Outputs:

VSPMP1	86.8	PCT	PID	VSPMP2	100.0	PCT	PID
NAOHFD	100.0	PCT	PID	CHLRFD	20.0	PCT	PRO

ALARM Fax Report

EOS Research Ltd. ProControl Series II+

To:

```
BULLWINKLE J MOOSE
```

From:

```
THE NORTH WATER SUPPLY   SYSTEM IN MAYBERRY USA     @ 09:34:12 ON 12/10/1999
SETUP VERSION 1        : ROM VERSION 2.156   : MODEL B2
```

System Status:

```
AUTO  P04 :    NO PREVIOUS SHUTDOWN
               FAX REPORT INITIATED BY REMOTE
```

Discrete Inputs:

```
WEL1LO is OFF        WEL2LO is OFF        TWR_HH is OFF        TNK_HH is OFF
RESET  is OFF
```

Discrete Outputs:

```
WLPMP1 is ON         WLPMP2 is ON         FINPMP is ON         CHLMET is ON
NAOMET is ON         PH_ALM is ON         CL_ALM is ON         TWRALM is OFF
WL1ALM is OFF        WL2ALM is OFF        TNKALM is OFF
```

Analog Inputs:

```
TWRLVL is 59.1     FT   LIMITS are  L: 8.0        FT    H: 70.0      FT
TNKLVL is 0.00     FT   LIMITS are  L: 8.00       FT    H: 12.00     FT
FINFLO is 203.5    GPM  TOTAL FLOW is  11348      GAL
FLOW_2 is 399.6    GPM  TOTAL FLOW is  8671       GAL
FLOW_1 is 0.0      GPM  TOTAL FLOW is  0          GAL
FIN_PH is 0.00     PH   LIMITS are  L: 6.00       PH    H: 8.00      PH
FIN_CL is 0.00     PPM  LIMITS are  L: 0.75       PPM   H: 2.00      PPM
```

Analog Outputs:

```
VSPMP1   37.4 PCT  PID        VSPMP2  100.0 PCT  PID
NAOHFD  100.0 PCT  PID        CHLRFD   20.0 PCT  PRO
```

3.2 Page Alerts

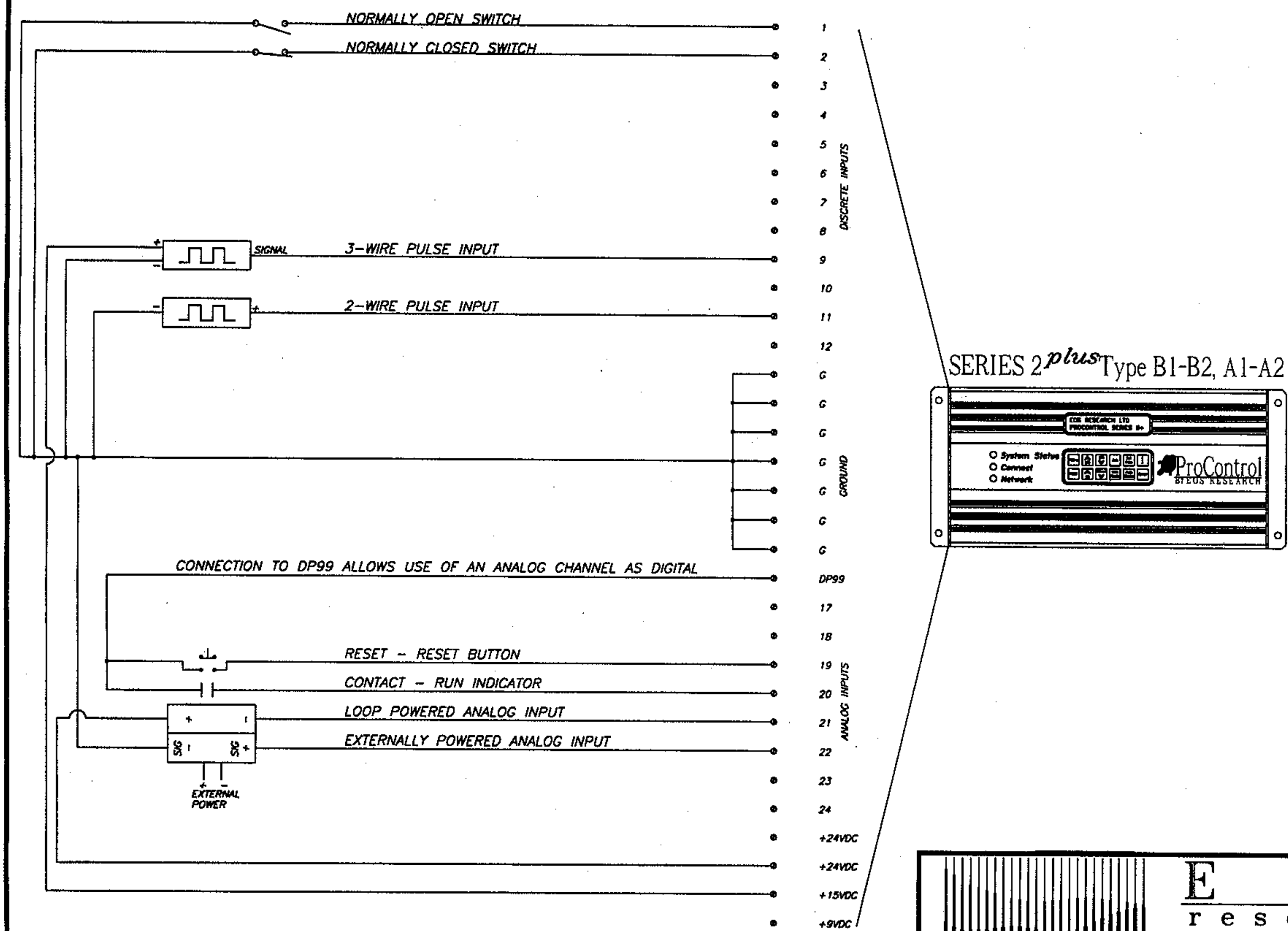
The ProControl unit can alert you to important conditions at your site via a page alert. Any system that is not in manual mode, that is, executing process tasks or the startup or shutdown sequences, can send a message up to eighty characters in length to an alphanumeric pager or up to nineteen digits in length to a numeric pager. If you are out of the office and away from a fax machine, you will still be alerted to any trouble at your site. With ProView you can select up to two pager numbers to be called. Each process task or startup/shutdown algorithm is capable of sending a message to either or both of these pagers. The pager messages are configured by EOS Research according to your specifications.

An example message for an alphanumeric pager would be:

```
ANYTOWN SITE
High water level EQ Tank
System shut down!
Call Fred to fix: 555-6789
```

APPENDIX A

EXAMPLE WIRING DIAGRAM



NOTES:
1. FOR ANALOG INPUTS, MAINTAIN VOLTAGE AND TOTAL LOOP RESISTANCE PER MFG. SPECIFICATIONS.
2. INPUT IMPEDANCE FOR SERIES 2Plus ANALOG INPUTS IS 135 OHMS.
3. ACTIVE DISCRETE INPUTS WILL SOURCE 1mA WHEN GROUNDED.
4. THE ProControl SOURCES 5VDC FOR DISCRETE INPUTS.
5. DISTRIBUTE ANALOG INSTRUMENTS EVENLY ACROSS +24VDC TERMINALS.

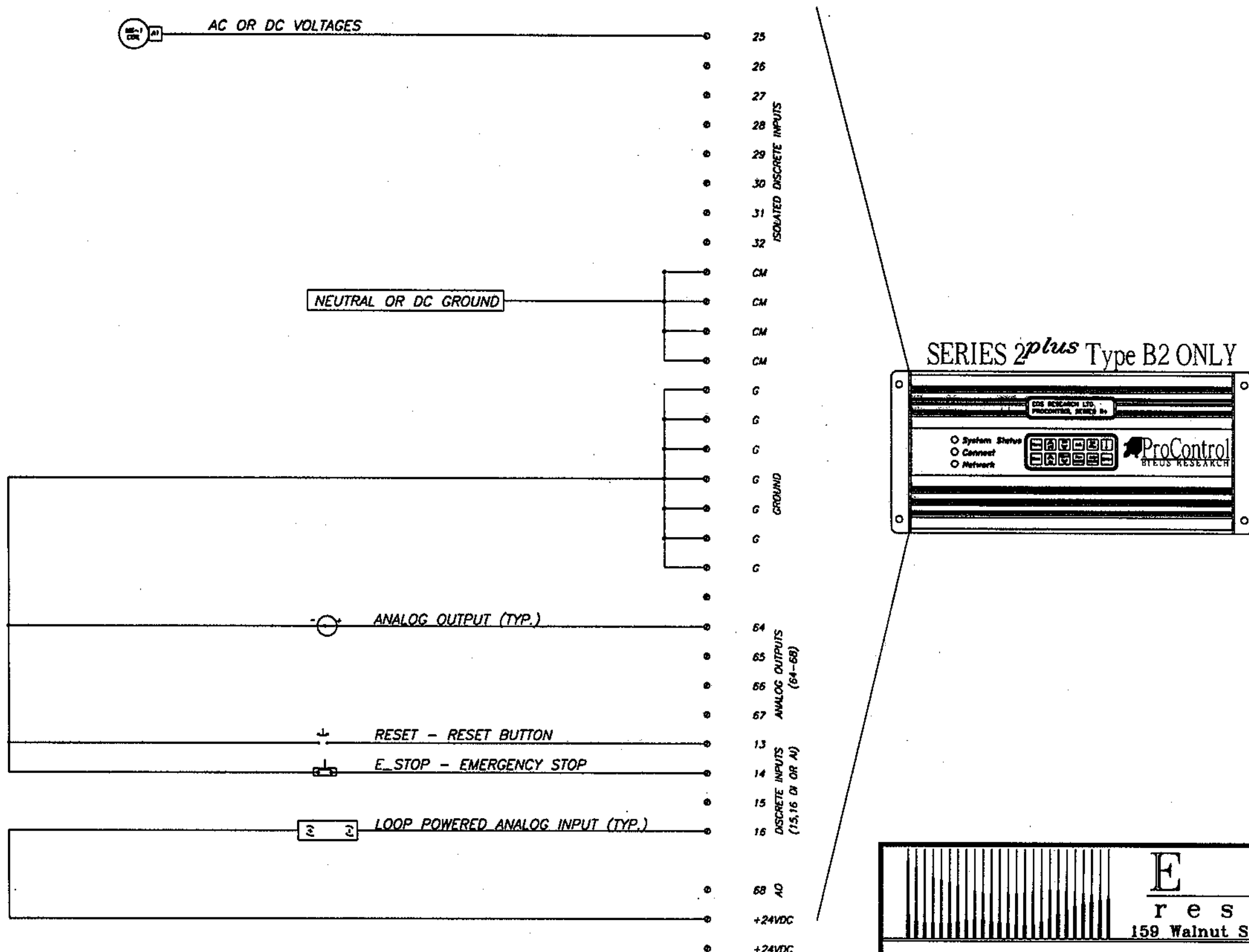
EOS research
159 Walnut Street, Rochester, NH

TYPICAL ProControl WIRING
DIGITAL & ANALOG INPUTS - BOTTOM LEFT SIDE

REV 5.3 11/29/99

GENINBOT.DWG

EXAMPLE WIRING DIAGRAM

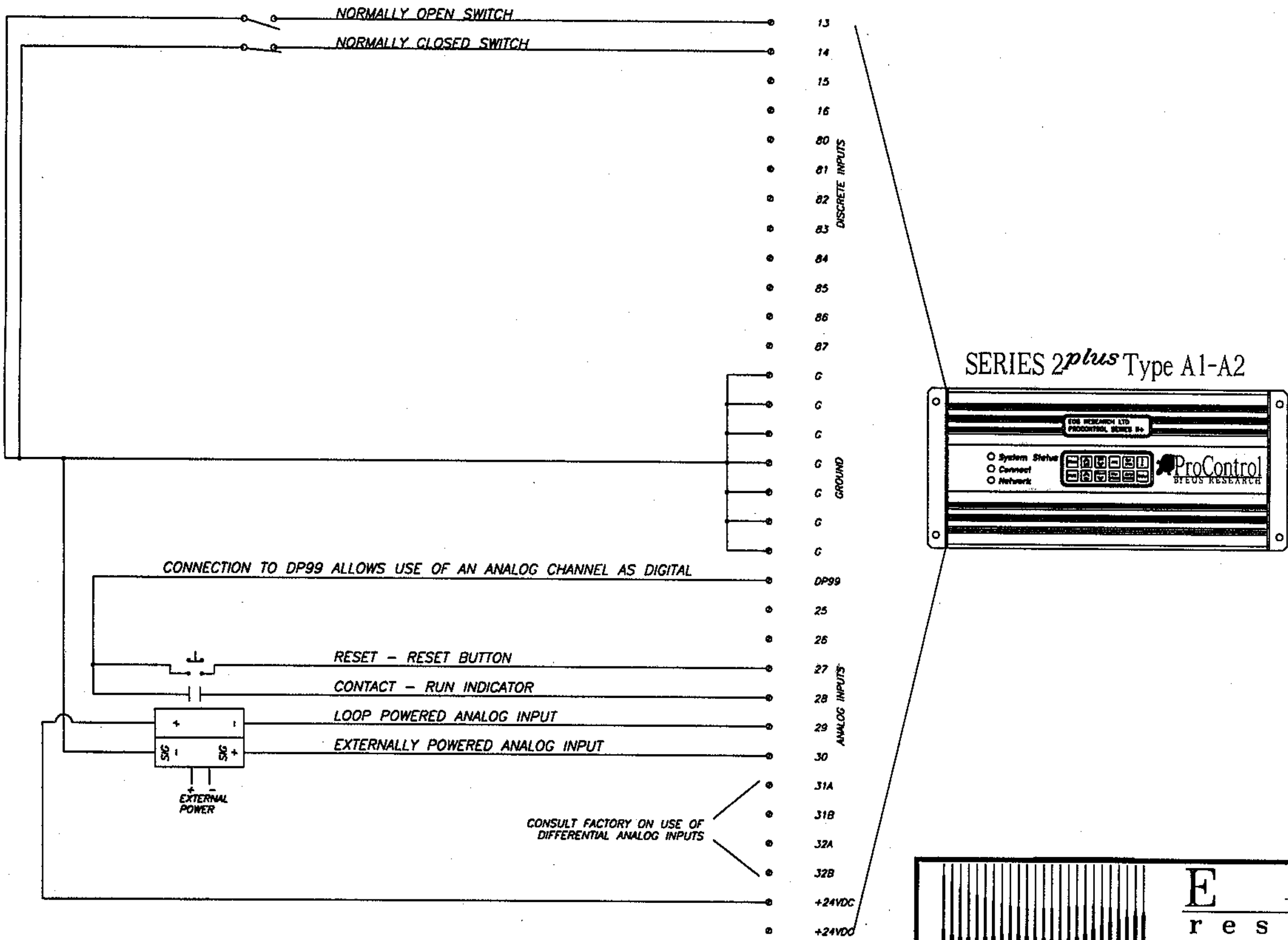


NOTES:
1. FOR ANALOG INPUTS, MAINTAIN VOLTAGE AND TOTAL LOOP RESISTANCE PER MFG. SPECIFICATIONS.
2. INPUT IMPEDANCE FOR SERIES 2Plus ANALOG INPUTS IS 135 OHMS.
3. MAXIMUM ISOLATED DISCRETE INPUT VOLTAGE 120V. ALL INPUTS MUST BE SAME VOLTAGE AND SHARE THE SAME COMMON OR NEUTRAL!
4. CM REPRESENTS COMMON FOR INPUTS 25-32. (ie. 120VAC, CM=NEUTRAL/ 24VDC, CM=DC GROUND)

E O S
research
159 Walnut Street, Rochester, NH

TYPICAL ProControl WIRING
DIGITAL INPUTS & ANALOG OUTPUTS
TYPE B2 - TOP LEFT SIDE

EXAMPLE WIRING DIAGRAM



NOTES:
1. FOR ANALOG INPUTS, MAINTAIN VOLTAGE AND TOTAL LOOP RESISTANCE PER MFG. SPECIFICATIONS.
2. INPUT IMPEDANCE FOR SERIES 2Plus ANALOG INPUTS IS 135 OHMS.
3. ACTIVE DISCRETE INPUTS WILL SOURCE 1mA WHEN GROUNDED.
4. THE ProControl SOURCES 5VDC FOR DISCRETE INPUTS.
5. DISTRIBUTE ANALOG INSTRUMENTS EVENLY ACROSS +24VDC TERMINALS.

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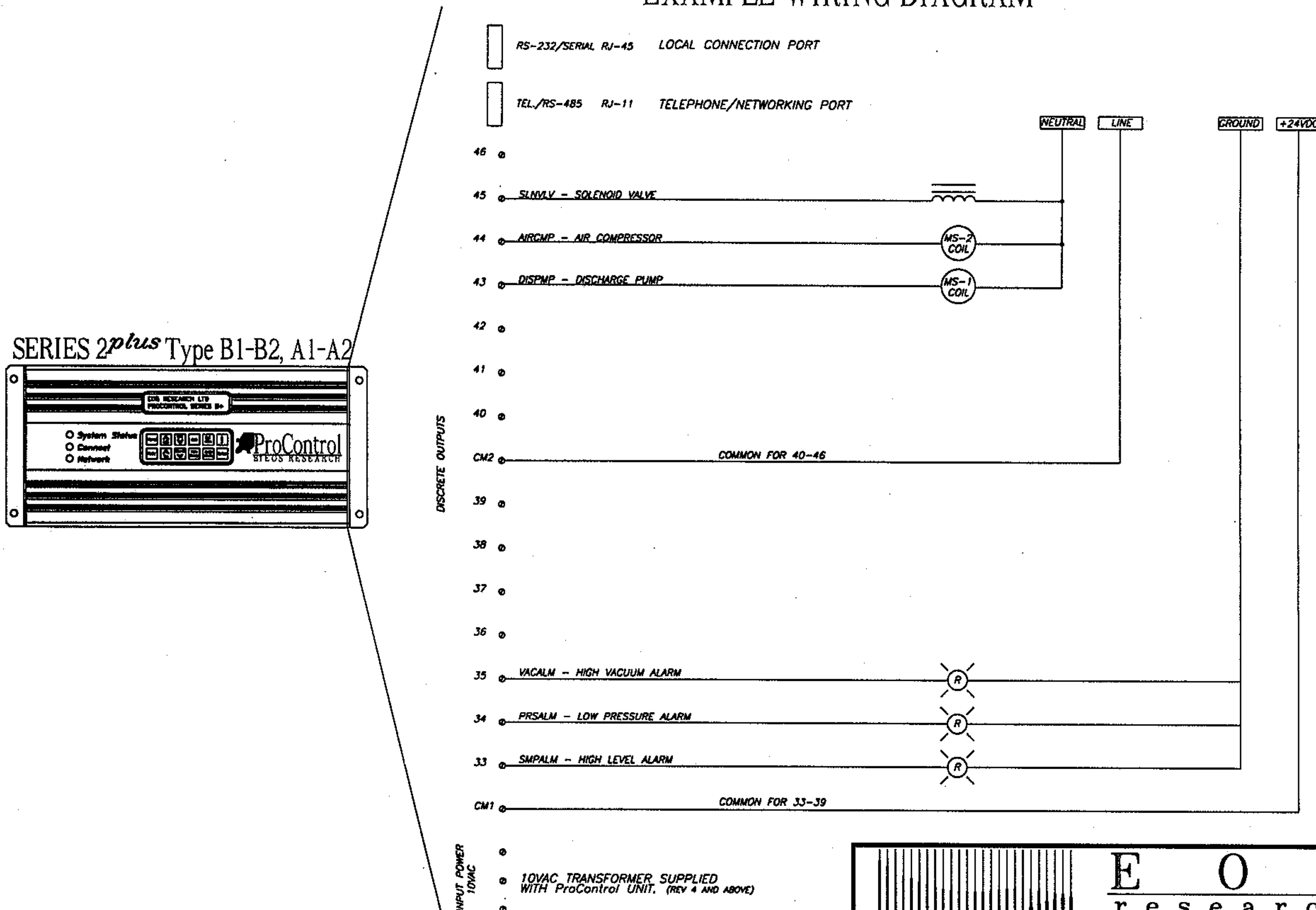
159 Walnut Street, Rochester, NH

TYPICAL ProControl WIRING
DIGITAL & ANALOG INPUTS -
TYPE A - TOP LEFT SIDE

REV 3 11/29/99

GNINTOPA.DWG

EXAMPLE WIRING DIAGRAM



NOTE: 20VAC-CT TRANSFORMER SUPPLIED PRIOR TO REV 4.
<u>DO NOT USE 20VAC TRANSFORMER ON REV 4 AND ABOVE!!</u>

NOTES:
1. OUTPUT RELAYS RATED AT 125VAC/0.5A, 24VDC/0.5A.
   UNITS SHIPPED AFTER 12/1/99 RATED AT 125VAC/1.0A, 24VDC/1.0A
2. CM1 IS SWITCHED TO 33-39 AND CM2 IS SWITCHED TO 40-46 WHEN OUTPUT IS ACTIVE.
3. DO <u>NOT</u> USE +24VDC FROM ProControl TO DRIVE OUTPUTS. FOR TRANSDUCER POWER ONLY.

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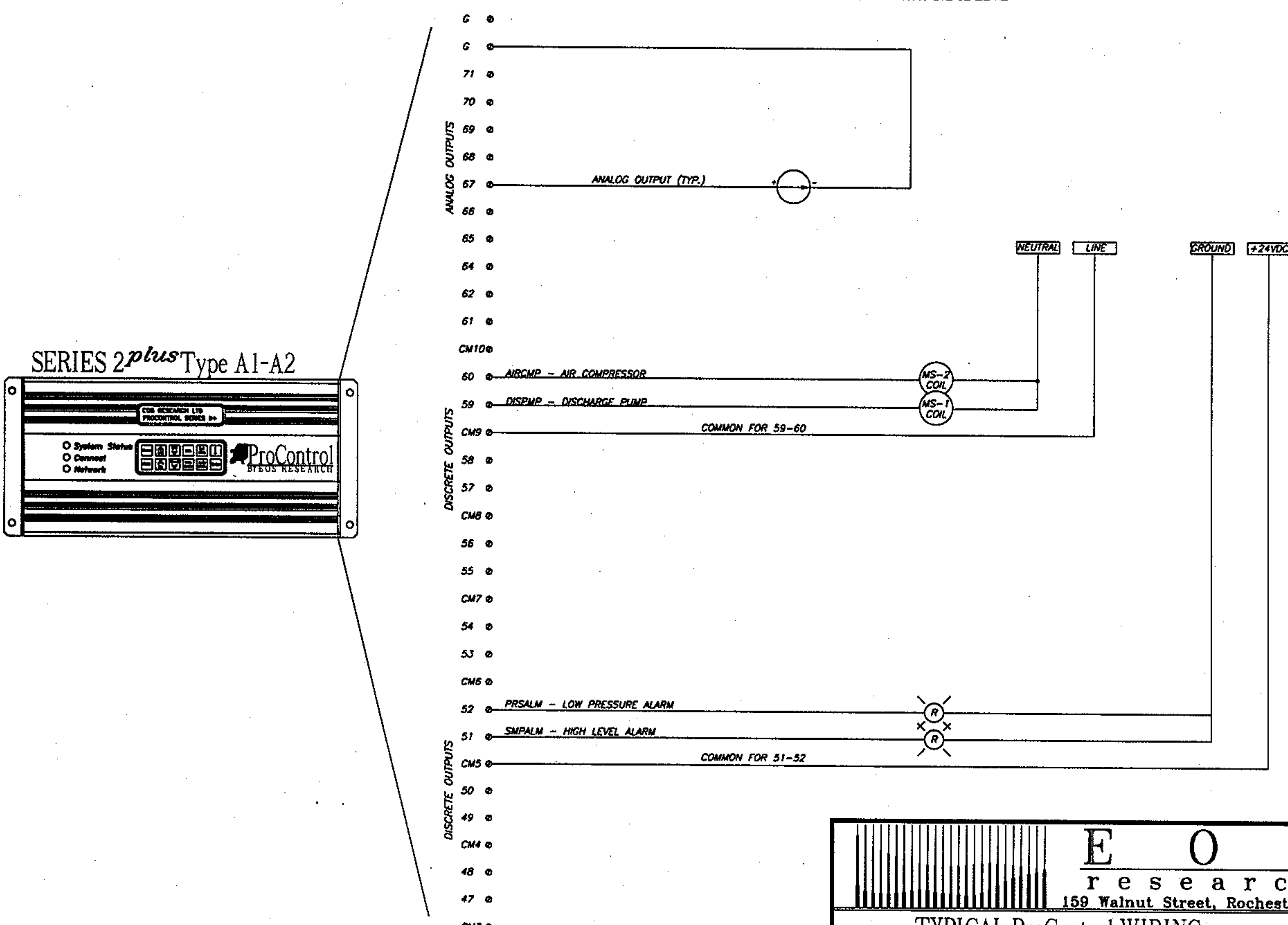
TYPICAL ProControl WIRING
DIGITAL OUTPUTS - RIGHT SIDE

REV 5.3 11/29/99

GENOUT.DWG

EXAMPLE WIRING DIAGRAM



NOTES:
1. OUTPUT RELAYS ARE RATED AT 125VAC/0.5A, 24VDC/0.5A
2. CM3 IS SWITCHED TO 47–48, CM4 IS SWITCHED TO 49–50, ETC. WHEN OUTPUT IS ACTIVE.
3. DO <u>NOT</u> USE +24VDC FROM ProControl TO DRIVE OUTPUTS. FOR TRANSDUCER POWER ONLY.

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TYPICAL ProControl WIRING
DIGITAL & ANALOG OUTPUTS
TYPE A - TOP RIGHT SIDE

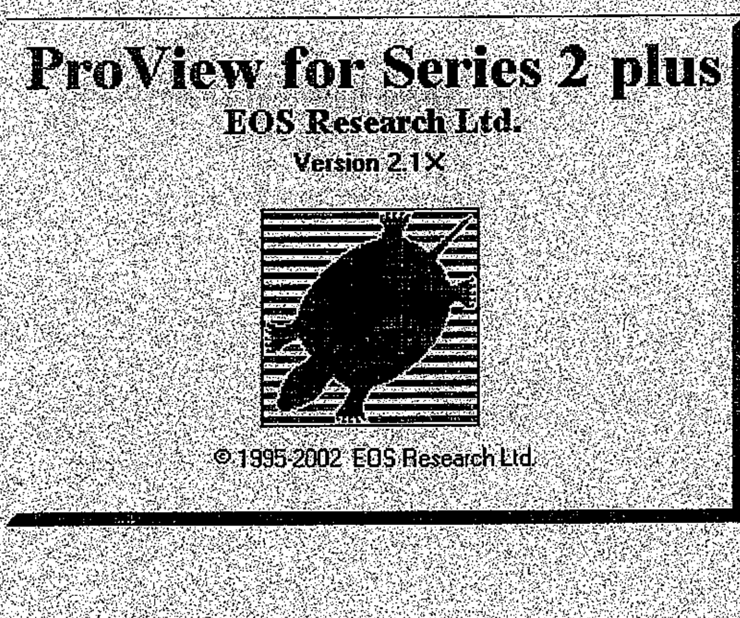
REV 4 2/21/02

GENOUTA.DWG

ProView™

for ProControl Series 2 plus

USER'S GUIDE



Version 2.1x

EOS Research, Ltd.

ProView™

for ProControl Series 2^{plus}

USER'S GUIDE

ProView for Series 2 plus
EOS Research Ltd.
Version 2.1X

Version 2.1x

EOS Research, Ltd.

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Email: procontrol@eosresearch.com

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION AND INSTALLATION

This chapter provides a brief introduction to ProView features, system requirements for running the program, and instructions for installing it.

Introduction to PROVIEW

ProView is a powerful but straightforward software package used in conjunction with the ProControl system to provide integrated stand-alone control and remote telemetry for your operation. ProView versions 2.1 and higher can serve as an on-site or remote human-machine interface (HMI) for both the Series II and Series *2plus* ProControls. With ProView you can:

- Monitor system sensors
- Control equipment that are outputs on the ProControl
- Change the way the system operates
- View and change system setpoints, alarm levels, etc.
- Extract datalogged system information

In short, ProView can be used to remotely gain the same level of control over your operation as if you were at the site. Although many system parameters can be set with the ProControl's display and keypad (if included), ProView allows a more comprehensive, easy-to-access view into system operations.

In order for ProView to function, your PC must be connected to the ProControl unit. It can be connected in one of two ways. The first way is with a cable (provided with your ProControl system) that connects your PC's serial port with the ProControl unit. This method of connection is most often used at the system site using a laptop PC. The second method is via dial-up modem from your office or from anywhere that a connection to the telephone system can be established.

You should be familiar with the operation of the ProControl unit and have read the ProControl User Manual before using ProView.

System Requirements

COMPUTER: You will need an PC or compatible with a 486 (minimum) or greater microprocessor with 4MB RAM and Microsoft Windows version 3.1 or later. A minimum of 4MB of Hard Disk space needs to be available. A mouse or similar pointing device is also required.

Several functions in ProView require the use of the right mouse button. Make sure the right mouse button is not assigned to some other function such as double-click. See your mouse driver software for details.

MODEM: You need a Hayes compatible (AT) Modem that supports a data rate of 9600 baud (this means almost any commonly-available modem). The modem can be external or internal. It must be connected to COM Port 1, 2, 3 or 4.

> ! *Some PCs are now being supplied with so-called "WinModems", which are not true hardware modems and will __not__ work with ProView for communication with a ProControl system. A true Hayes-compatible hardware modem is an inexpensive investment in reliable communications.*

How to Install ProView from Windows Explorer

1. Close **all** open programs before beginning the ProView installation procedure. Close any task bars for software packages like Microsoft Office that may be lurking at the edge of your screen. *If a ProView installation fails, it is almost always the result of having other programs open at the time of installation. Certain programs, when included in the Windows Startup group, may cause the ProView installation to fail, and must be removed temporarily from the Startup group prior to installing ProView.*

2. Open the Windows Explorer and insert Disk 1 of the ProView diskettes in your **a:** drive.

3. Click on the **a:** drive, then double-click on the **setup.exe** file *Or* click on the Windows **Start** button, choose **Run...** and type in **a:setup.exe**.

4. The ProView installation program will begin and will guide you through the rest of the installation process.

After the appropriate files from Disk #1 have been installed, you will be asked to insert Disk #2, and then Disk #3. ProView uses a default folder of C:\ProView for the program installation, but you can specify a different one if you'd like.

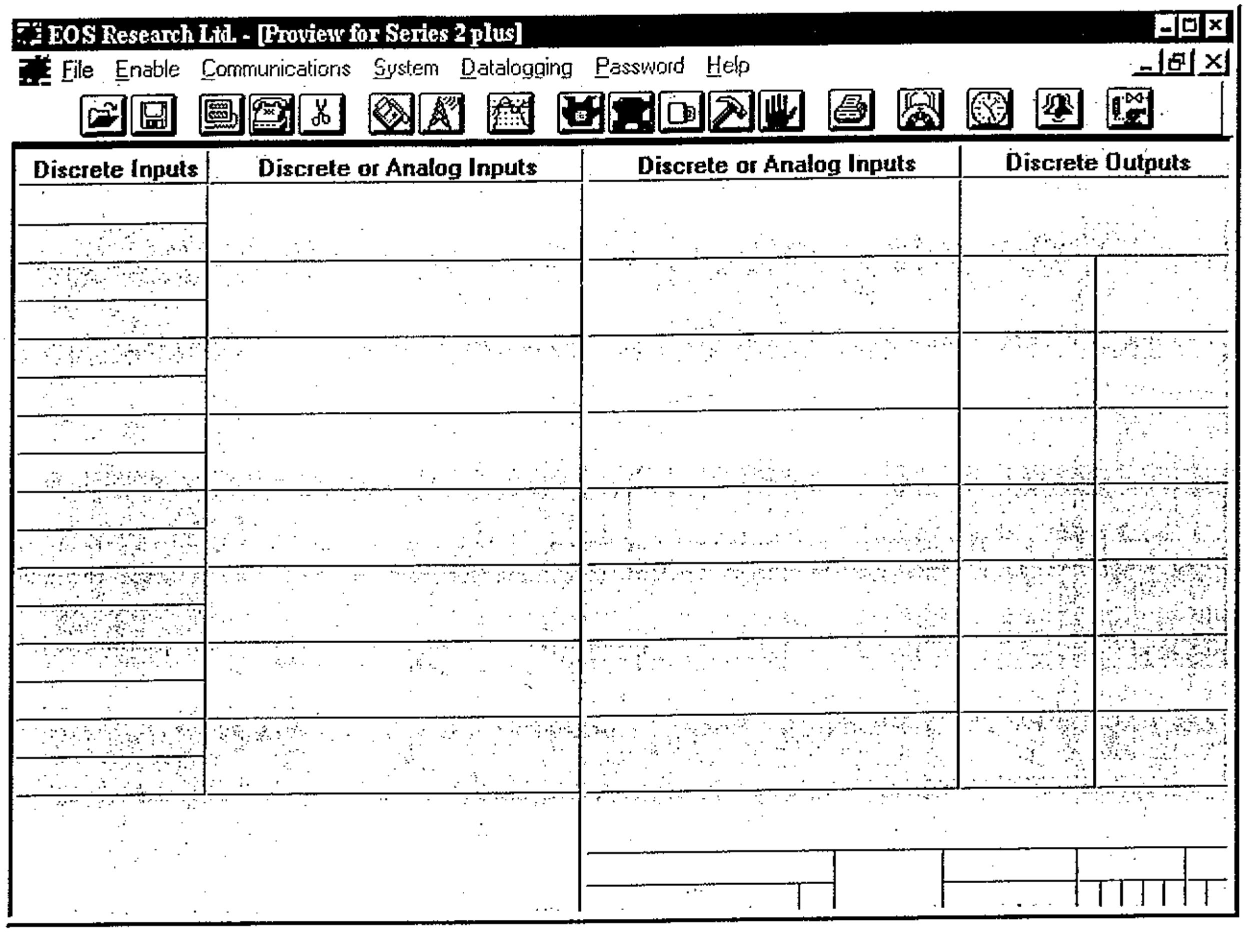
You will also be provided with configuration files (or ***site files***) for every ProControl unit you need to access. At a minimum, you will have a configuration file with a ".pvs" extension and one with a ".not" extension (these are normally supplied pre-configured for you on a separate diskette). Using Windows Explorer, copy these site files to the folder in which your ProView software was installed. Depending on your site configuration, you may have other files included along with the two standard site files. The files will have the extensions of .pid or .pvg. You must copy these files to the ProView folder as well.

When the installation is complete, you will see the ProView program group and icon. We recommend making a shortcut to ProView that you can then move to your main Windows screen. *Right*-click on the ProView turtle icon in the program group, then click on **Create Shortcut**. Drag your new shortcut to a prominent position on your Windows main screen.

Shortcut to
ProView 2.153

Running ProView

After installing ProView as described above, double-click on the ProView icon. After an introduction screen, you will see the ProView Main screen.



The main screen contains a series of pull-down menus and a ***Toolbar*** that provides shortcut buttons for commonly-used commands. Placing the cursor over a Toolbar button and leaving it there for a short while produces a "balloon". A ***balloon*** is a small pop-up message that describes the action to be taken if the Toolbar button is "pushed".

Right now, since no site file has been loaded, the main screen is blank, and the toolbar is disabled. All menus except the **File** menu have been "ghosted". A selection is ghosted when the operation represented by the selection is unavailable.

Below the Toolbar are four columns of information arranged in a standard format. These columns are filled in based on the system setup and the current system status. The **Discrete Inputs** column contains information about the switches or sensors connected to inputs 1 through 16 on the ProControl unit. The two columns labeled **Discrete or Analog Inputs** contain information about the 4-20 milliamp (mA) sensors or discrete switches connected to ProControl inputs 17 through 32 (examples include analog instruments such as flow meters or pressure transducers and digital devices such as float switches). The **Analog Outputs** area resides behind the third column, and is accessed by clicking on the **Discrete or Analog Inputs** label at the top of the column. The **Discrete Outputs** column contains information regarding the devices connected to the ProControl's output relays. The **Extended Outputs** area, behind the **Discrete Outputs** column, contains information regarding any outputs configured beyond the first 14, if available on the ProControl model you are using.

At the bottom of the screen are a series of information boxes. These show the status of certain important system parameters when ProView is connected to a ProControl unit.

A Word About Changing Settings

ProView has been designed to make it easy to view and change the settings that govern the way your system works. However, ProView must always be *connected* to the ProControl unit in order for these changes to take effect. It is important to remember that ProView itself is only a window into the operation of the ProControl unit. It does not provide any control functionality on its own. Chapter 3 discusses how to connect to the ProControl.

When a setting is changed in ProView (e.g., alarm level, password, datalog interval), a "?" is temporarily appended to the description or title of the information to indicate that the new value has been sent to the ProControl. When the "?" disappears, the data has been received by the ProControl and confirmed by ProView.

While many of the controls that change information in ProView are represented graphically, much of the information is displayed in text form. To edit text-based information, click on it and make your changes as you would in any Windows application. When you click on the text, it is highlighted to show that it has the current focus.

! *After completing your text editing the changes must be saved by first pressing the* ***ENTER*** *key while the cursor is still within the text box being edited, and then clicking on the "OK" button for the current form.*

CHAPTER 2: GETTING STARTED

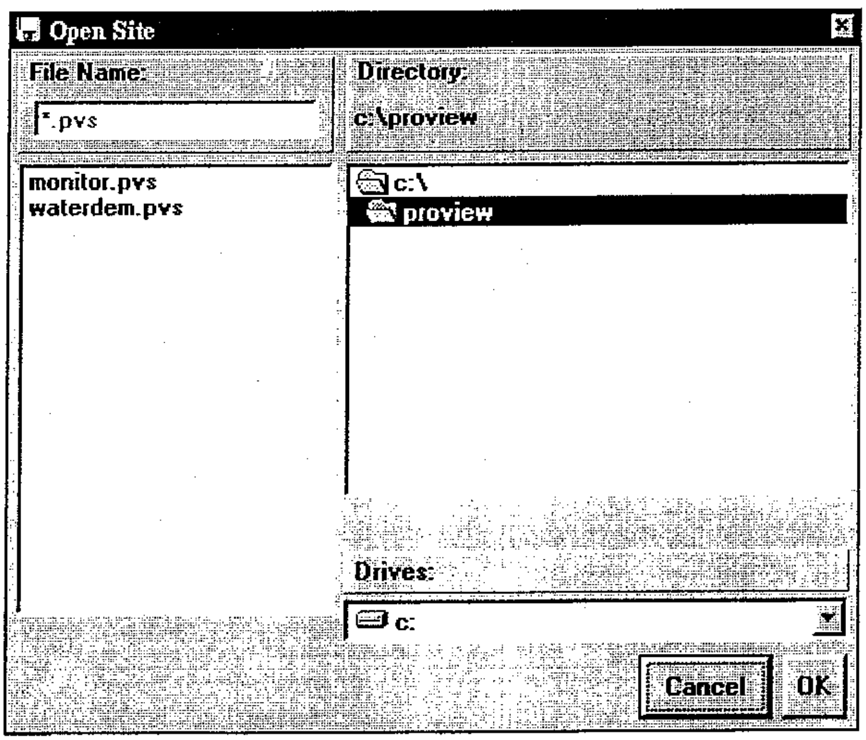
This chapter explains how to open a ProView site file, describes what's in all those little boxes on the screen, and shows you how to print the system configuration to a file.

Opening a Site File

Every ProControl unit has a ***site file*** that tells the unit which inputs or outputs are enabled, what their descriptive ***Tagnames*** are and how they should respond to changes in input status. This same file is used by ProView to provide a window into what is going on within the remote ProControl unit and, by extension, with the site operation. To open a site file:

1. Click on the **File** menu, then click **Open Site**. You will see the **Open Site** dialog box. You can also use the ALT-Key combination represented by the first underlined character in the menu name. In this case, use ALT-F.

*For opening subsequent site files, you can use the **Open Site** Toolbar button at the top of the main screen. ProView will also list the last four site files that you accessed at the bottom of the **File** menu. If you wish to open one of these, just click on the appropriate file name.*



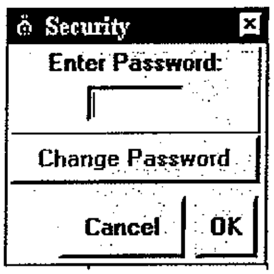
2. In the **Drives** area of the dialog box click once on the down arrow to pull down the Drives list, then click on the drive that contains the file you wish to open.

3. In the **Directory** area of the dialog box, click on the folder that contains the file. To move "up" in the directory tree, double-click on the level to which you want to move. To move "down" in the directory structure, double-click on the appropriate folder.

4. In the **File** area you will see all files in the selected drive and folder that have the extension **.pvs** or **.pvg**. Only files with these extensions can be opened. Select the file you wish to open by clicking on the file name in the file list box, then click the **OK** button to open the selected file.

The title bar of the main screen will change to include the file name and version number. The file name and version number are enclosed within brackets.

5. In the **Security** dialog box, enter the password for your site file, and click on the **OK** button or hit Enter.



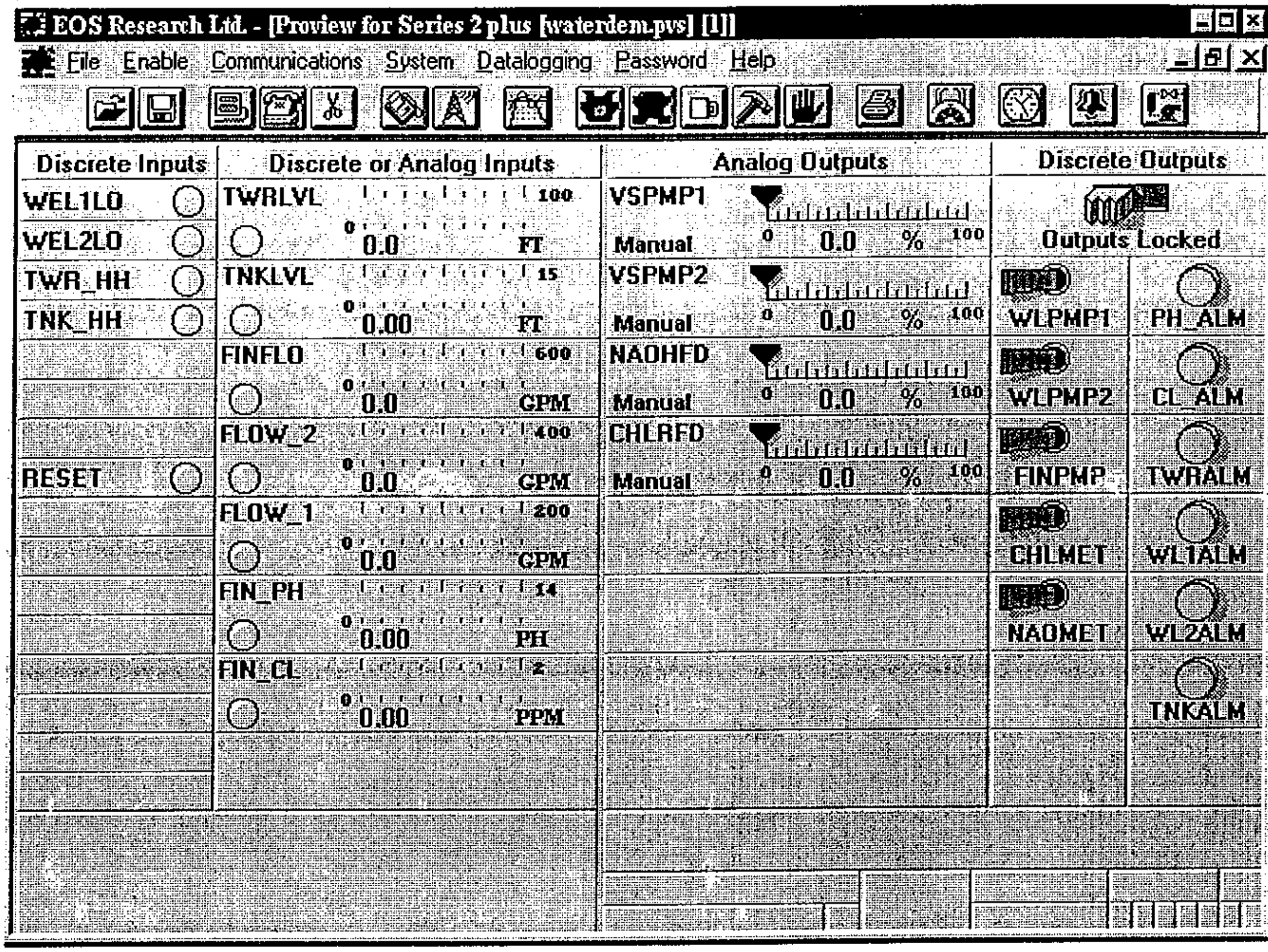
A word about passwords: *The password used in ProView can be different than the one used to access the ProControl unit through its on-board display. In either case the valid characters are 0-9 and A-Z, upper case only. Up to three characters are permitted. The password was designed as a low-level security feature sufficient to prevent inadvertent operation and to deter tampering. It is **NOT** sufficient in and of itself to withstand a **determined** effort at system entry. The default password is supplied to you with your ProControl unit by your system integrator.*

6. If the password is incorrect, the dialog box will disappear and a beep will sound. No system configuration information will be shown. You will need to select the **Password** menu and re-enter it.

7. If the password is correct, the **Security** dialog box will disappear and the system configuration information will be shown on the main screen.

FYI

ProView is supplied with a View-Only Mode password, "VOM", which may be used to connect to the ProControl to observe the system status and obtain logged data; however, no changes to any ProControl operating settings may be made when in this mode.



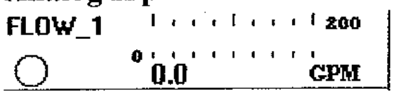
Examining the Main Screen

This particular site file shows five discrete inputs, seven analog inputs, eleven discrete outputs, and four analog outputs.

Discrete Inputs

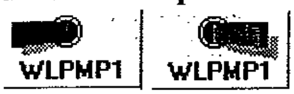
On the left side of the screen below the heading **Discrete Inputs** are shown the tagnames of enabled discrete (or digital) inputs. To the right of the tagname is a virtual "LED". This LED's color or shape will change based on the status of the input. If a discrete input is "OFF", the LED next to the tagname is gray in color. If a discrete input is "ON", then the LED is green. If the discrete input is "ON" and has been set up as an alarm input the LED becomes a red "Alarm Bell". Some panels are blank because those inputs have not been enabled in this particular site configuration.

Analog Inputs

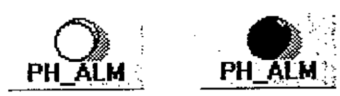


In the second column below the heading **Analog or Discrete Inputs** are shown the enabled analog inputs. Analog inputs can also be configured as simple discrete inputs. Below the tagname is another LED. This LED behaves in a similar fashion to those for discrete inputs; it is gray when the input is not "active", and green or red when it is in the active state (see the definition for Active State in the ProControl User Manual). A small bar graph provides a visual indication of the value of the analog input. At the left and right ends of the bar graph are numbers that represent the lower and upper limits, respectively, of the analog input values (corresponding to 4 and 20 mA). In this case FLOW_1 has been set up with a range of 0 to 200 GPM. Below the bar graph is a numerical representation of the current value of FLOW_1.

Discrete Outputs

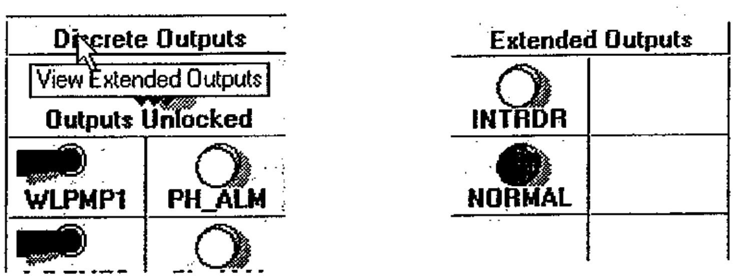


On the right side of the screen below the heading **Discrete Outputs** are shown the enabled discrete outputs, corresponding to the relay outputs in the ProControl. In this site configuration there are 11 outputs. Above the tagname of the output is either a virtual "Toggle Switch" or lamp/button representation. By its position and/or its color it shows the state of discrete output: if the switch is left-leaning and gray the output is "OFF"; if the switch is right-leaning and green then the output is "ON".



Discrete outputs can be configured as an alarm lamp or button when this would be more appropriate. If the lamp/button appears gray then the output is "OFF". If the lamp/button appears red or green then the output is "ON".

Your system may also have **Extended Outputs**, which are located on a panel behind the discrete outputs. To access these outputs, point your mouse at the words **Discrete Outputs** at the top of the column and click the left mouse button.



FYI

Regardless of what the discrete outputs look like in ProView, they all behave the same way on the ProControl itself – namely, the associated relay output is energized when the output is ON.

Analog Outputs

The third column contains the **Analog Outputs** area. It may be concealed by the second column of **Discrete or Analog Inputs**. To pull the analog outputs to the front, click on the title **Discrete or Analog Inputs** at the top of the third column of the ProView screen.

To the right of the tagname there is a slide-scale that indicates the current percentage of full-scale output (0% to 100%), displayed both graphically and with text. Below the tagname is the current mode of the output. This mode can be changed from **Manual**, which indicates the output is under user control, to **PID** or **PRO**, which would indicate that the output is involved in an output control scheme and is under automatic control. These output control schemes are described in Chapter 5 under <u>Analog Output Options</u>.

Printing the Setup to File

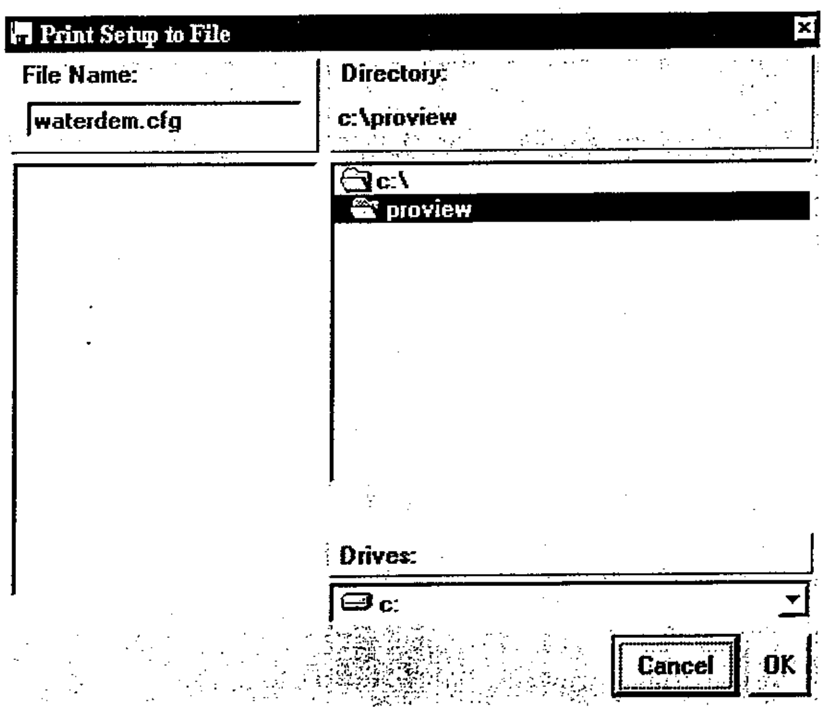
A more detailed listing of the site configuration can be made by printing the setup data to a text file. To print the setup, do the following:

1. Click on **Print Setup** in the **File** menu.

   Or

   Click on the Print Setup button. 

2. You will see the **Print Setup to File** dialog box.

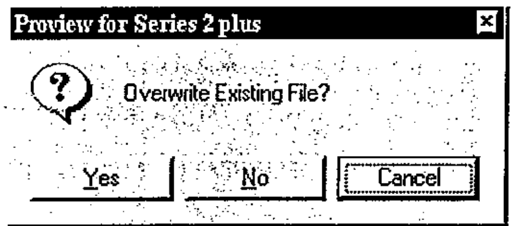


3. Specify the drive and folder in which the text file will be saved.

4. ProView will select a default file name for you, with the extension **.cfg**. However, you can give the file another name if you wish. You can also select an existing .cfg file name by clicking on the file name in the file list box.

5. Click on the OK button to print the setup to the selected file.

If you are overwriting an existing file, a message box pops up to make sure that you don't make a mistake.



A word about Files:
Do not confuse the site configuration file (.pvs), which is a binary file, with the printed setup file (.cfg), which is a text file. A text file can be viewed with a word processing program while a binary file typically cannot.

Examining the Setup File

To examine your site configuration file, use a text editor or word processor such as Notepad or Word to open the file you have just created.

The file produced by our sample site is shown below. The first section consists of identifying information about the ProControl unit and information about the inputs and outputs wired to it.

```
                    EOS RESEARCH LTD.
                  ProControl Series II+

          ProView Configuration File Information

*********************************************************
***** FAX Recipient:     BULLWINKLE MOOSE          *****
***** Customer:          MAYBERRY WATER DEPT       *****
***** Site Location:     MAYBERRY RFD              *****
*********************************************************
***** Setup:             1                         *****
***** Option:            B                         *****
***** Type:              102                       *****
***** Serial Number:     7421                      *****
***** Date:              09/06/2000                *****
***** Time:              10:17:01                  *****
***** ProView:           Version 2.153             *****
*********************************************************
```

THE INPUTS INCLUDED IN THIS SYSTEM ARE:

#	TAGNAME	TAGNAME DESCRIPTION	SETUP*	RANGE
1	WEL1LO	Well 1 Low Level	D,NO,AL	
2	WEL2LO	Well 2 Low Level	D,NO,AL	
3	TWR_HH	Water Tower High Alarm Level	D,NO,AL	
4	TNK_HH	Clearwell Tank High Alarm Level	D,NO,AL	
8	RESET	Reset Switch	D,NO,ST,SU	
17	TWRLVL	Water Tower Level	A,EP,ST	0-100 FT
18	TNKLVL	Clearwell Tank Water Level	A,EP,AL	0-15 FT
19	FINFLO	Finish Flow Rate	A,EP,ST	0-600 GPM
20	FLOW_2	Well 2 Flow Rate	A,EP,ST	0-400 GPM
21	FLOW_1	Well 1 Flow Rate	A,EP,ST	0-200 GPM
22	FIN_PH	Finish Water pH	A,EP,AL	0-14 PH
23	FIN_CL	Finish Water Chlorine Residual	A,EP,AL	0-2 PPM

*INPUT SETUP NOTES

D - This input is a (Discrete) or ON/OFF Input.
A - This input is a (Analog) or Variable Input.
C - This input is a Pulse Flowmeter Input.
P - This input is a Pulse Accumulator Input.
UPP - Units per Pulse. Number of units (i.e. Gallons) to record for each pulse
NO-This input is a (Normally Open) Discrete Input.
NC-This input is a (Normally Closed) Discrete Input.
EP-(Endpoint) This input is "Active" when its value is outside the low to high alarm levels.
WD-(Window) This input is "Active" when its value is between the low and high alarm levels.
ST-(Status) This input shows a green LED in ProView when it is in its Active State.
AL-(Alarm) This input shows a red alarm bell in ProView when it is in its Active State.
SU-(Startup) This is a menu function input. When activated it will run the startup routine.
SD-(Shutdown) This is a menu function input. When activated it will run an emergency shutdown.
MN-(Manual) This is a menu function input. When activated it place the unit in Manual Mode.
AU-(Auto) This is a menu function input. When activated it place the unit in Auto Mode.
SQ-(Square Root) This analog channel's reading is proportional to the square root of the input.
LT-(Lamp Test) This is a Lamp Test input. When activated it will turn on all Alarm Light outputs.

THE DISCRETE OUTPUTS INCLUDED IN THIS SYSTEM ARE:

#	TAGNAME	TAGNAME DESCRIPTION	SETUP*
1	WLPMP1	Well 1 Pump	
2	WLPMP2	Well 2 Pump	
3	FINPMP	Finish Water Pump	
4	CHLMET	Chlorine Metering Pump	
5	NAOMET	Sodium Hydroxide Metering Pump	
8	PH_ALM	pH Alarm	AI
9	CL_ALM	Chlorine Alarm	AI
10	TWRALM	Water Tower High Alarm	AI
11	WL1ALM	Well 1 Low Level Alarm	AI
12	WL2ALM	Well 2 Low Level Alarm	AI
13	TNKALM	Clearwell Tank High Level Alarm	AI

*OUTPUT SETUP NOTES

G1-(Group 1)- This output will not respond to processes 17-32.
G2-(Group 2)- This output will not respond to processes 01-16.
LT-(Lamp Test) - This output has been declared as an alarm light.
AI-(Alternate Image) - This output is displayed as an icon other than the default switch.

```
THE ANALOG OUTPUTS INCLUDED IN THIS SYSTEM ARE:

#  TAGNAME               TAGNAME DESCRIPTION                   SETUP*     INPUT
-- ------- -------------------------------------------------- ---------- ------
1  VSPMP1  Variable Speed Drive for Finish Water Pump          PID,FOR    TWRLVL
2  VSPMP2  Variable Speed Drive for Well 2 Pump                PID,FOR    TNKLVL
3  NAOHFD  Caustic Soda Feed Rate                              PID,FOR    FIN_PH
4  CHLRFD  Chlorine Feed Rate                                  PRO,FOR    FLOW_2

*ANALOG OUTPUT SETUP NOTES
--------------------------
PID  -This output is involved in a PID (Proportional,Integral,Derivative) control loop.
PRO  -This output is involved in an open (Proportional) control loop.
FOR  -The PID or PRO loop will run in the (Forward) direction.
REV  -The PID or PRO loop will run in the (Reverse) direction.
INPUT-This Tagname will serve as the input to the control loop.
```

Input and Output Configuration

The INPUTS section identifies all enabled system inputs from 1 to 32 and describes how they are configured. the input number is followed by its TAGNAME and the TAGNAME DESCRIPTION, which is taken from the Notes file (more on that in Chapter 5). In addition, a SETUP section further identifies each input in terms of its signal nature, analog (A) or discrete (D); its configuration if discrete as Normally Open (NO) or Normally Closed (NC); and its alarm display nature when active, Alarm (AL) or Status (ST). Discrete Inputs can also be configured as functions such as Startup (SU) or Emergency Shutdown (SD), and can be used as a lamp tester (LT) which will illuminate any Discrete Outputs that are configured as lamps. A RANGE is specified for all Analog Inputs as well as the Active State region, denoted Endpoint (EP) or Window (WD).

FYI *See the ProControl User Manual for a further explanation of Normally Open, Normally Closed, and related terminology and a description of Endpoint and Window Active States.*

The DISCRETE OUTPUTS section is similar except that there are some different SETUP codes. Some outputs may be assigned to groups (G1,G2) that affect the way they are viewed by the process tasks. Outputs which display an Alternate Image (lamp image) than the standard switch image are designated AI.

The ANALOG OUTPUTS section details the setup of any enabled 4-20 mA output loops. The SETUP codes PID and PRO indicate whether or not the output is involved in one of two analog output control schemes known as PID loops or open loop Proportional control. The direction of the analog output control scheme is indicated by forward (FOR) or reverse (REV). The input that provides the reference signal upon which the analog output scheme is based is designated under the INPUT heading.

FYI *For a further explanation of PID or open loop Proportional control please see the <u>Analog Output Options</u> section in Chapter 5.*

In this particular setup, TWRLVL is the input to the PID control loop that operates on the variable speed pump VSPMP1, with VSPMP1 maintaining a "setpoint" for the value of TWRLVL. The chlorine feed rate CHLRFD will be varied in proportion to the flow rate FLOW_2 under open loop proportional control.

Process Tasks

The next section of the setup file is a listing of PROCESS CONTROL TASKS. These determine how the ProControl unit responds to input changes while in Auto, Startup or Shutdown modes. It is important to note that the ProView software does not take any independent action itself. All automated control decisions are made by the ProControl unit, although you can change many operating parameters via ProView.

```
THE PROCESS CONTROL TASKS EXERCISED BY THIS SYSTEM ARE:

Process 01: If WEL1LO is ON
            THEN Delay for 2 Seconds, Send Report[FAX #1;Page #1],
            Switch WLPMP1 OFF
            Page Message: 'Well 1 Low Level Mayberry North '

Process 02: If WLPMP1 is OFF AND PH_ALM is OFF AND
               CL_ALM is OFF AND TWRALM is OFF AND TNKALM is OFF
            THEN Delay for 30 Seconds, Switch WLPMP1 ON

Process 03: If FIN_PH is High
            THEN Delay for 5 Seconds, Switch NAOMET OFF AND PH_ALM ON

Process 04: If FIN_CL is High
            THEN Delay for 5 Seconds, Switch CHLMET OFF AND CL_ALM ON

Process 05: If TWR_HH is ON
            THEN Delay for 2 Seconds, Send Report[FAX #1;FAX #2;Page #1;Page #2],
            Initiate Shutdown, Switch TWRALM ON
            Page Message: 'Tower's about to overflow, Bullwinkle - COME OUT NOW! '

Process 06: If TNK_HH is ON
            THEN Delay for 2 Seconds, Send Report[FAX #1;FAX #2;Page #1;Page #2],
            Switch TNKALM ON
            Page Message: 'Clearwell Tank High Mayberry North '

Process 07: If TWRLVL is High
            THEN Delay for 5 Seconds, Switch TWRALM ON

Process 08: If TWRLVL is NOT High or Low
            THEN Delay for 5 Seconds, Switch TWRALM OFF

Process 09: If TNKLVL is High
            THEN Delay for 5 Seconds, Switch TNKALM ON

Process 10: If TNKLVL is NOT High or Low
            THEN Delay for 5 Seconds, Switch TNKALM OFF

Process 11: If FIN_PH is High or Low
            THEN Delay for 5 Seconds, Send Report[FAX #1;Page #1],
            Switch PH_ALM ON
            Page Message: 'Finish Water pH Alarm Mayberry North '

Process 12: If FIN_PH is NOT High or Low
            THEN Delay for 5 Seconds, Switch NAOMET ON AND PH_ALM OFF

Process 13: If FIN_CL is High or Low
            THEN Delay for 5 Seconds, Send Report[FAX #1;FAX #2;Page #1;Page #2],
            Switch CL_ALM ON
            Page Message: 'Finish Water Chlorine Alarm Mayberry North '

Process 14: If FIN_CL is NOT High or Low
            THEN Delay for 5 Seconds, Switch CHLMET ON AND CL_ALM OFF
```

```
Startup 01: Switch WLPMP1 ON AND PH_ALM OFF AND CL_ALM OFF AND TWRALM OFF AND WL1ALM OFF AND
WL2ALM OFF AND TNKALM OFF

Startup 02: Delay for 2 Seconds, Switch WLPMP2 ON

Startup 03: Delay for 2 Seconds, Switch FINPMP ON

Startup 04: Delay for 5 Seconds, Switch CHLMET ON AND NAOMET ON


Shutdown 01: Switch CHLMET OFF AND NAOMET OFF

Shutdown 02: Delay for 2 Seconds, Switch WLPMP1 OFF AND WLPMP2 OFF

Shutdown 03: Delay for 2 Seconds, Switch FINPMP OFF
```

This sample configuration has a fairly straightforward process flow. On startup, some of the system outputs are switched on sequentially and all alarm indicators are switched off. On shutdown, all pump outputs and chemical metering devices are turned off. The process tasks are mostly self-explanatory. Some process tasks include fax and pager reporting functions. It is important to remember how and when the process tasks are run:

- Process tasks are run continuously while the ProControl unit is in AUTO mode. Process control tasks are ***event-driven***, i.e., they occur once when the "IF…" conditions are true (subject to any delays). No automatic action is taken in MANUAL mode.

- Startup and Shutdown processes are run in sequence. When the Startup sequence is finished, the unit is placed in AUTO mode and the **Process Tasks** are run. If any Startup process in the sequence fails, then all the non-lamp outputs are turned "OFF" and the unit reverts to MANUAL mode. A Startup process fails when any IF condition is not satisfied for 60 seconds after the Startup process begins (there may not be any IF conditions in your Startup sequence). The Startup sequence begins when the ProControl or ProView operator initiates it. The Startup sequence can also begin when power is first applied to the ProControl unit if the "Auto Startup" option has been enabled.

- The Shutdown sequence works in a similar manner. When the Shutdown sequence is finished, the ProControl unit reverts to MANUAL mode. If any Shutdown process in the sequence fails (is not run after 60 seconds), then all the non-lamp outputs are immediately turned "OFF" and the unit reverts to MANUAL mode. The Shutdown sequence can be initiated either by the ProControl or ProView operator or by a process task (Process 5 does this in our example).

Process Capability

The ProControl runs process tasks which are based on Boolean IF ___ AND ___ THEN ___ logic. There are 64 available processes, 16 of which can be used as part of a startup sequence, and 16 of which can be used as part of a shutdown sequence. Each process can:

- be based on several, simultaneously existing I/O conditions
- include short or long delays for de-bouncing or simple time delay
- use memory variables (registers) for linking processes
- cycle outputs with timers or during certain times of the day
- perform system shutdowns

- send reports to fax and/or pagers

FYI

If you wish to modify the ProControl programming, please contact your Control System Integrator for assistance.

CHAPTER 3: ESTABLISHING COMMUNICATION

This chapter explains how to connect to the ProControl unit using ProView by local serial cable and by remote modem.

By itself, ProView does not reveal very much about your site's operation. It must be connected to the ProControl unit in order to yield any data.

Local Connection

To establish a local connection, perform the following:

1. Use the local serial cable supplied with the ProControl to connect the computer you are using to a ProControl unit. One end of the cable terminates with a female 9-pin connector. Use this end to plug into the serial port on your computer. The other end of the serial cable is terminated with a 9-pin RJ-45 "Ethernet" connector. Use this connector to plug into the "RS-232/Serial" port on the right hand side of the ProControl unit.

! *Be sure to disconnect the serial cable from the ProControl unit after you are finished. If you do not, remote communications and alarm reporting will not be possible.*

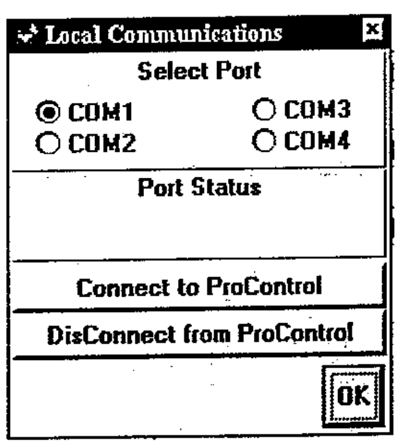
! *If the ProControl unit is powered OFF for any reason, wait 45 seconds after power up before plugging in the cable to attempt a local connection. Otherwise, the ProControl's modem may not be properly configured.*

2. Click on **Local Connection** in the **Communications** menu. You can also use ALT-C.

Or

Click on the **Local Connection** toolbar button. 

You will see the **Local Communications** dialog box.



3. Select the COM port to which the ProControl is connected by clicking on the "radio button" next to the COM port you want to use. COM ports 1 through 4 are supported.

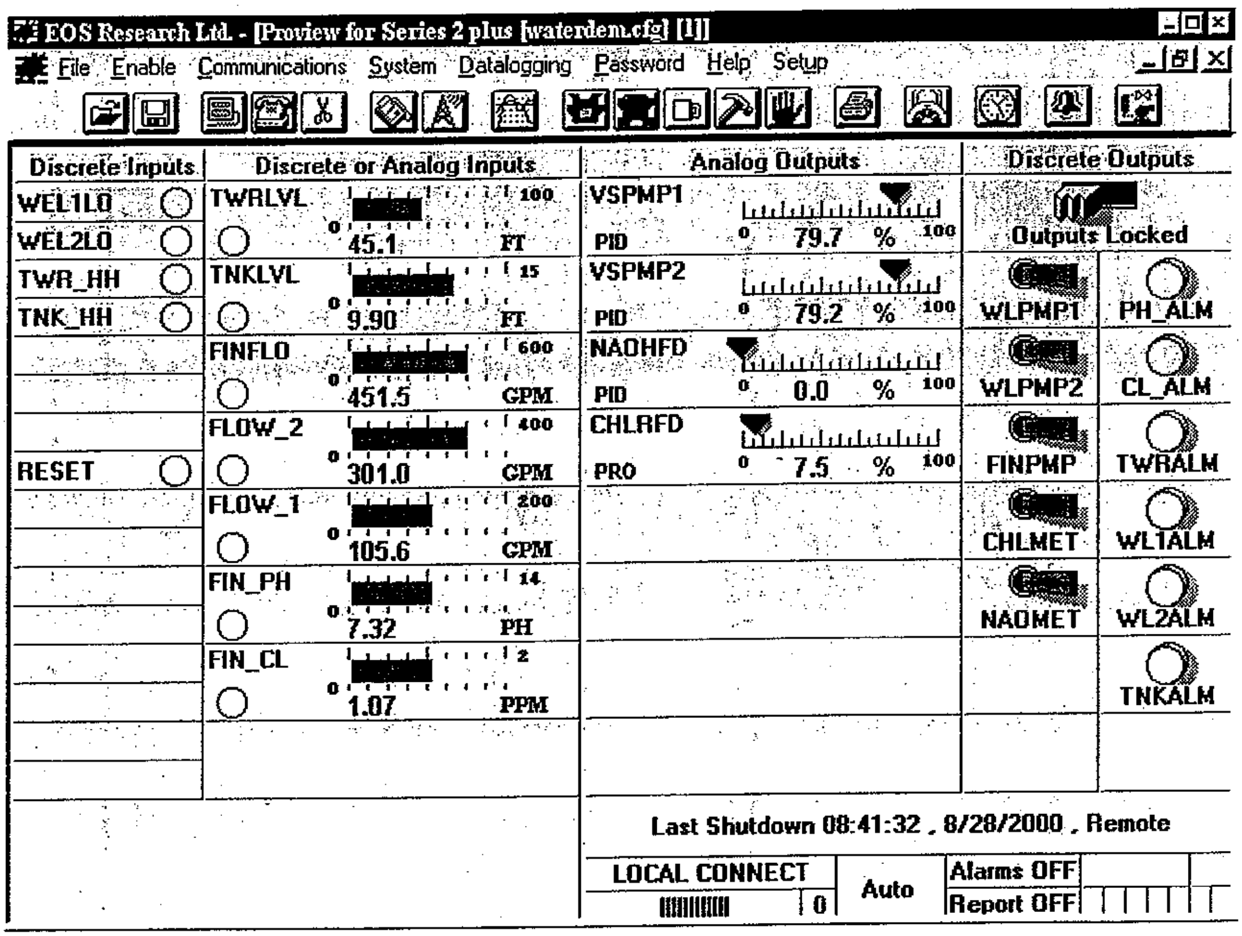
4. Click on the **Connect to ProControl** button.

5. You will see status messages in both the **Port Status** area of the **Local Communications** dialog box and in a small information box near the bottom of the main screen. Usually you will see "Trying Local..." followed by "LOCAL CONNECT" if the attempt is successful. If the attempt is unsuccessful you will see message boxes outlining the suspected problem.

6. After connecting, click on the **OK** button to hide the **Local Communications** dialog box.

After establishing a local connection, ProView will perform an initial scan of site conditions. This will take a few moments during which time the mouse pointer will turn into an hourglass. After the initial scan, data will be updated on the screen every second or so.

Here is a view of the main screen after a local connection has been established:



Note that the screen has been updated to reflect the current operating conditions at the site. At the bottom of the screen, various message panels have been filled in as well.

Remote Connection

For a remote connection, the procedure is a little different. Follow these steps:

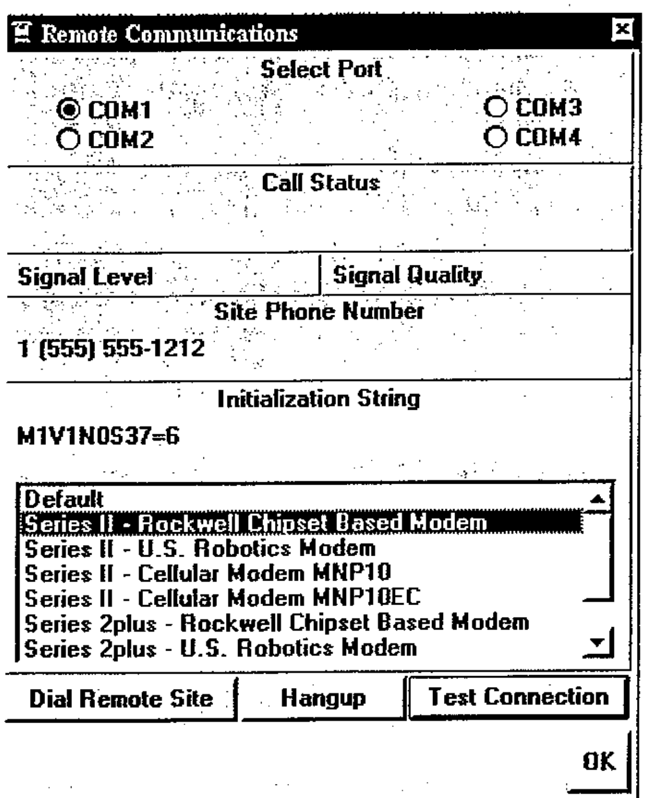
1. Make sure that your modem has been installed properly and that the phone line is plugged in to the proper port on the modem.

Your modem must be Hayes (AT) compatible and capable of operation at 9600 baud.

2. Click on **Remote Connection** in the **Communications** menu. You can also use ALT-C.
   Or

   Click on the **Remote Connection** toolbar button.

   You will see the **Remote Communications** dialog box.



3. Select the COM port to which your modem is connected by clicking on the "radio button" next to the COM port you want to use. COM ports 1 through 4 are supported.

4. Check to see that the **Site Phone Number** is the one you want to dial. If not, click on the phone number and change it. If you need to dial an 8, 9 or some other prefix first to get an outside line, add

a comma or two after the prefix to obtain a pause before dialing the main number (e.g., 8,555-1212). Do not add parentheses or dashes.

5. Examine the **Initialization String** to see if it is correct for your type of modem. For Series 2^{plus} systems, you will usually use the **Initialization String** for Rockwell Chipset or U.S. Robotics modems. If these do not work, use the Default string instead.

6. Click on the **Dial Remote Site** button.

7. You will see status messages in both the **Call Status** area of the **Remote Communications** dialog box and in the lower portion of the main screen. Usually you will see the following messages:

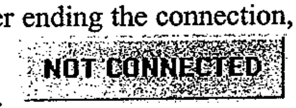
Trying Remote...	ProView is attempting to contact your PC's modem
OK	ProView has successfully connected to the modem
Setup...	ProView is sending the initialization string to the modem
Dialing...	ProView is dialing the site phone number
CONNECT 9600	Connection has been established with the remote modem
REMOTE CONNECT	Connection has been established with the remote ProControl unit

8. If the attempt is unsuccessful you will see message boxes outlining the suspected problem.

9. After connecting, click on the **OK** button to hide the **Local Communications** dialog box.

Ending a Connection

The simplest way to end a connection, to hang up in essence, is to click on the **Disconnect** button on the Toolbar.  This works for either a local or remote connection.

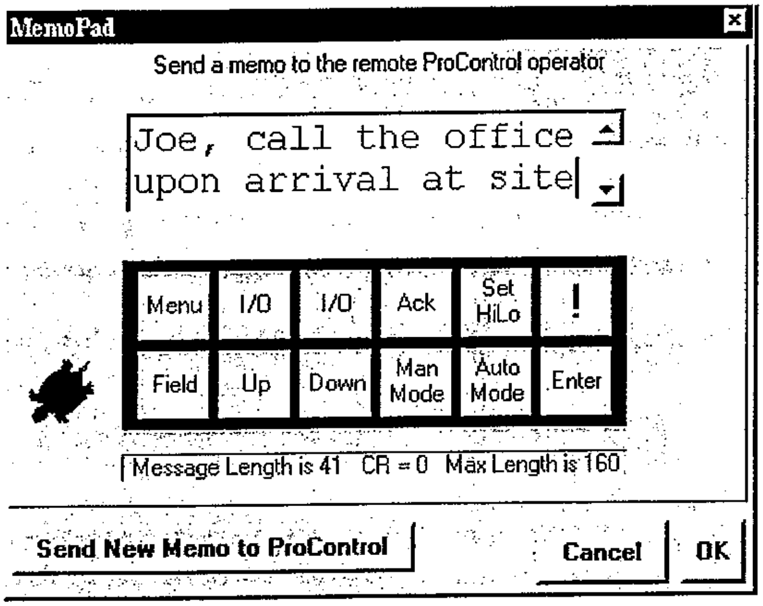
Alternatively, you can re-open the **Local or Remote Communications** dialog box and click on either the **Disconnect from ProControl** button (Local) or the **Hangup** button (Remote). After ending the connection, you should see **NOT CONNECTED** in a message box near the bottom of the screen. 

Sending a Memo

A useful feature of the ProControl is the ability to transmit short memos to a site operator. From ProView, you can send a message of up to 160 characters to the display of the ProControl unit. The site operator must acknowledge your memo before returning to his normal display. This feature is useful in communicating with a person at the remote site while the phone line is in use for a connection to the ProControl.

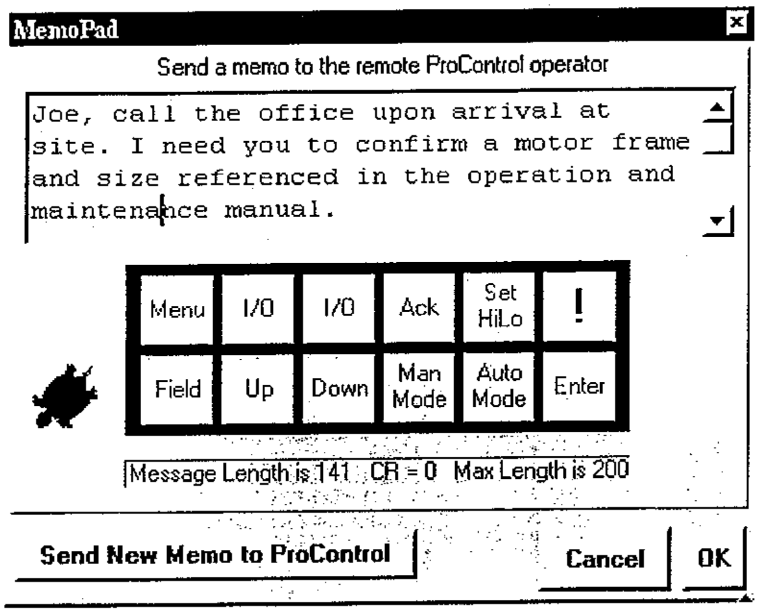
To send a memo, follow these steps:

1. From the **Communications** menu, select **Send Memo**.



2. Type your memo onto the screen of the **MemoPad**. It will appear on the ProControl's display exactly as it appears to you on the MemoPad, two lines at a time. Words will automatically wrap around to the next line, but you may hit Enter (Carriage Return or CR) to jump to the next line if necessary. However, the fewer <CR> characters you use, the longer the text message you can type, since each <CR> represents 20 characters. The **Message Length** counter will keep track of the number of characters you have used. The **Max Length** counter will decrease to let you know how many more characters can be entered.

3. By clicking the right mouse button when the pointer is over the text window, the text window will become larger, allowing you to view more text without having to scroll up and down.



4. Click the **Send New Memo to ProControl** button to send the memo to the ProControl's display, **OK** to temporarily save the memo but not transmit it, or **Cancel** to abort the entire procedure.

5. The **Ack** button on the MemoPad will flash red and your PC will beep to indicate when the ProControl operator has acknowledged your memo.

CHAPTER 4: MANAGING YOUR SITE

This chapter explains how to change the way your ProControl system operates by switching between Manual and Automatic modes, initiating a startup or shutdown sequence, and changing other general system settings.

Switching Between System Modes

There are four modes of operation for the ProControl: Manual, Automatic, Startup and Shutdown. To initiate a switch to a different mode, simply click on the appropriate Toolbar button or click on **Process Operations** in the **System** menu.

Goto AUTO Mode: Clicking on the coffee cup will place the ProControl into Automatic mode.

Goto MANUAL Mode: Clicking on the hammer will place the ProControl into Manual mode.

STARTUP System: Clicking on the green traffic light causes the ProControl to initiate a Startup sequence.

SHUTDOWN System: Clicking on the red traffic light causes the ProControl to initiate a Shutdown sequence.

Emergency OFF: Clicking on the red hand will cause an Emergency Shutdown, which turns off all outputs immediately and places the ProControl in Manual mode.

! *Be sure you understand the safety risks and other implications of issuing these commands. When the icons are clicked, the actions are immediate and equipment may start up or shut down automatically.* ***Most importantly, switching the ProControl to Manual mode will defeat any safeguards programmed into the system and allow equipment to continue running without any process control.*** *Manual mode should only be used on a short-term basis for system troubleshooting or clearing alarm conditions, preferably with de-powered equipment circuits.*

You can monitor the current system mode by looking at the message panel at the bottom of the main screen.

Manual	The system is currently in Manual mode.
Auto	The system is currently in Auto mode.
Start 2	The system is currently in Startup mode, the last startup task run was startup task #2.
Shut 2	The system is currently in Shutdown mode, the last shutdown task run was shutdown task #2.

The last action to initiate a Shutdown is listed in another message panel at the bottom of the screen. In the example below, the shutdown was initiated by a remote user.

Last Shutdown 12:28:13 , 9/6/2000 , Remote

System Operations

Following are several other operational parameters that can be set by ProView.

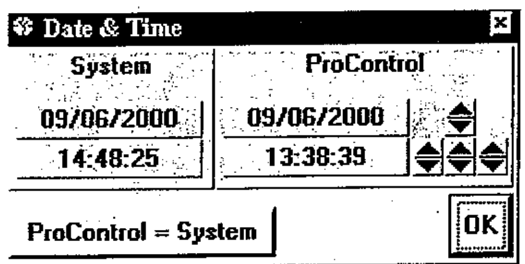
Date & Time

The ProControl unit maintains an internal real-time clock which it uses to time-stamp datalogged information and control other important system functions. To set the **Date & Time**:

1. Click on the **System Time** toolbar button.

   Or

   Choose **System Operations** from the **System** menu and click **System Time**. You will see the **Date & Time** dialog box.



2. The left side of the dialog box displays the current date and time kept on your PC. The right side of the dialog box is the date and time according to the ProControl unit. Follow the procedure outlined below if you need to change the time.

3. To set the ProControl's clock equal to the PC's clock click on the **ProControl = System** button. To set the ProControl's clock to a specific time use the time spinners. The upper spinner changes the date and lower set of three spinners change the hour, minute and second (left to right, respectively).

4. To set your PC's time (System time) use the Windows Control Panel.

FYI

Daylight Savings Time is not supported by the ProControl's clock. You will need to make any necessary changes manually.

! *Changing the time by a large amount can lead to discontinuities in the datalogging history of your ProControl unit, particularly if you move the ProControl's time forward. See the section on Datalogging Setup in Chapter 5 to check on your system's datalogging status.*

Alarms

An alarm is only an **audible** indication to the operator that an input signal is in its ***active state***. On the ProControl unit, the beeper sounds if the **Alarms** are **Set**, the unit is in Manual mode and an input is in the active state. The Alarm continues to sound until it either is acknowledged by the operator or times out by itself. In ProView, a "Beep" sounds from the PC if the **Alarms** are **Set**, and an input that has been configured as an **Alarm Input** enters the active state. No acknowledgment is necessary.

The current status of the alarm feature is displayed in a message box at the bottom of the main screen. |Alarms OFF|

To enable or disable Alarms, click on the **Alarms** toolbar button,  which toggles this feature on and off.

Or

Click on **Set Alarms** in the **Enable** menu.

Remote Reporting

A report is a fax or a pager message sent by the ProControl unit. In order for any reporting to occur, **Remote Reporting** must be enabled. The current status of the reporting feature is indicated in a message box at the bottom of the main screen. Report OFF|

To enable or disable remote reporting, click on **Remote Reporting** under the **Enable** menu. A check mark is displayed if reporting is enabled.

Log Off Remote User

This function is used occasionally to reset the remote ProControl's display to the password menu. It is often used to ensure that an on-site user does not change any ProControl settings while you are remotely connected, and to ensure that password protection is restored if the last user did not Log Off locally.

To Log Off the remote user, choose **System Operations** from the **Systems** menu, and click on **Log Off Remote User.**

Initiate FAX NOW!

This function is the equivalent of pressing FAX NOW on the ProControl unit. It is used to generate and send a current fax status report to the currently enabled fax numbers. Fax reports must be enabled in the **FAX Report Setup** dialog box and ProView must be connected via modem (remotely) for this command to proceed.

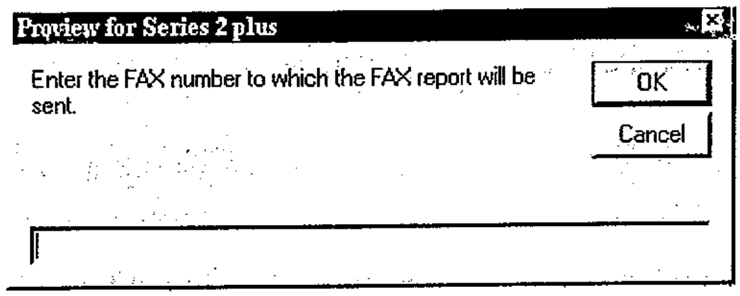
ProView will disconnect from the ProControl unit (hang up) after issuing this command to free the remote phone line for fax use. Normal FAX back operations and times will not be affected.

To initiate the fax, choose **System Operations** from the **Systems** menu, and click on **Initiate FAX NOW!**

Initiate New FAX NOW!

This function is identical to **Initiate FAX NOW!** except that you can specify a number that is not currently enabled to receive faxes from the ProControl. You can use this for testing the fax capabilities or to send a fax update to a third party.

To initiate the fax, choose **System Operations** from the **Systems** menu, and click on **Initiate New FAX NOW!**



ProView will alert you first that you will be disconnected from the system in order for the fax to proceed. Enter the FAX number to which the fax report will be sent, making sure you include a prefix or the numeral 1 and the area code, if necessary. Click the OK button to send the fax report.

CHAPTER 5: CHANGING SYSTEM PARAMETERS

This chapter explains how to change the settings that govern much of the operation of your system, such as the state of a discrete output, analog alarm levels and fax and datalogging setups.

Switching an Output State

The state of a discrete output can be changed manually by clicking on the "switch" associated with its tagname. ProView includes a "locking" feature for discrete outputs as a safety measure to prevent inadvertent output changes; you must "unlock" the outputs in order to turn them on or off. The outputs are locked and unlocked by clicking on the "slide switch" at the top of the **Discrete Outputs** section of the main screen.

You should leave the slide switch in the **Locked** position whenever possible.

! *Bear in mind that if the ProControl unit is in Auto mode, any discrete output change you make may be "overridden" by a process control task. Do not turn outputs on or off unless you are familiar with the process control in effect for your system.*

1. 

To change the state of a discrete output, click on the toggle switch.

2. 

The toggle switch will change positions, and a "?" will appear for a moment after the tagname. This indicates that the command was sent to the ProControl unit but that confirmation of the state change has not yet been received.

3. 

The "?" will disappear after confirmation of the state change has been received from the ProControl unit.

Depending on your site configuration, you may be able to change certain parameters that affect how the discrete outputs in your system operate in Auto mode.

Process Groups

The ability to set a ***Process Group*** is a rarely-used feature that prevents an individual output from being switched by certain process tasks when in Auto mode. If your ProControl has been configured for Process Groups, you can switch between Group 1 (ignore processes 17 – 32) and Group 2 (ignore processes 1 – 16).

! *Do NOT enable process groups unless your ProControl has been configured specifically to use this feature! Be sure you understand the safety risks and other implications of issuing these commands.*

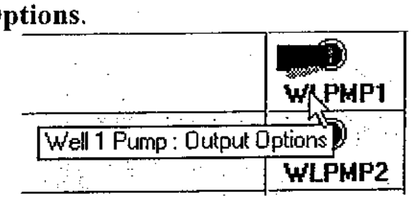
Output Cycle

Some of your outputs may have been configured as "Switched" outputs, where the output is turned on and off according to a timed cycle, or during a specific time of day.

Output Options

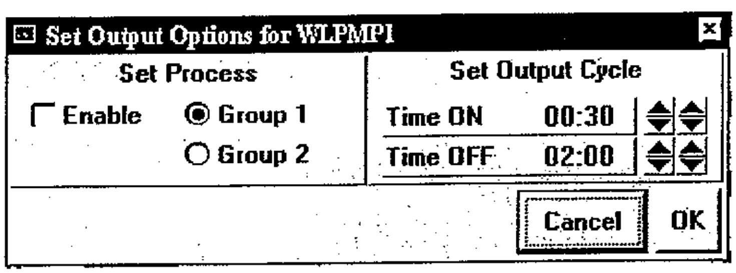
To change an output option, do the following:

1. Place your mouse pointer over the output's tagname until a balloon appears. Click the *right* mouse button until you see **Output Options**.



2. Click the *left* mouse button.

3. You will see the **Set Output Options** dialog box. The **Set Process** or **Set Output Cycle** panels may not be visible if those options do not apply. Both panels will be disabled if ProView is not connected to a ProControl unit.



4. To enable a Process Group click on the **Enable** check box and click either the **Group 1** or **Group 2** radio buttons in the **Set Process** panel. Once again, ***Do NOT enable process groups unless your ProControl has been configured specifically to use this feature!***

5. If the output has been configured to run in a switched mode, you will be able to change the **Output Cycle** times by clicking on the value you want to change and entering the new time in an **hours:minutes** format (be sure to hit Enter after you type in the new time). Alternatively, click on the up or down spinners to increase or decrease the time you want to change.

6. Click on the **OK** button to confirm the changes and send them to the ProControl unit. Click on **Cancel** to get rid of any changes.

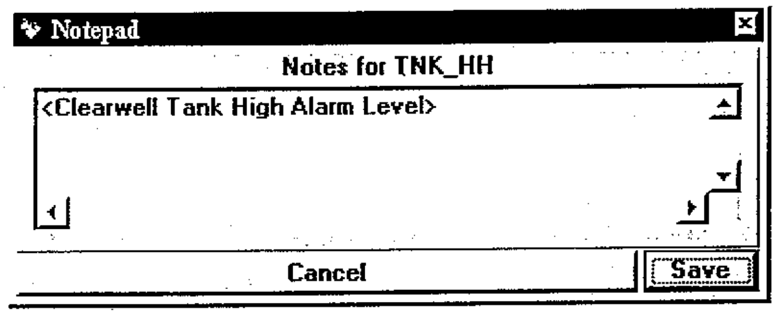
Notes

Each I/O point can have its own set of associated *Notes*. The notes are stored on your PC in a file with a **.not** extension along with your **.pvs** file. You can attach notes which explain the functional purpose of the I/O point or define the I/O point in more detail. This can eliminate uncertainty that may result from the limitation of six characters in each point's tagname.

To edit an I/O point's notes do the following:

1. Position the mouse pointer over the I/O point's tagname until a balloon appears, and *right*-click until you see **Notes**.

2. Click the left mouse button to enter the "Notes" feature. The **Notepad** dialog box appears.



3. Click in the **Notes** window to edit or add descriptive text. Any notes enclosed in angle-brackets (i.e. <note>) will appear within the balloon when you position the mouse pointer over the tagname, and at the top of the main screen.

4. Click the **Save** button to save your notes and/or definitions or press **Cancel** to exit without saving. You must also save the site file before exiting ProView to retain any changes made in Notes.

FYI

Sometimes it is a good idea to provide a more complete description of what an input or output does in the Notes; e.g., "Causes System Shutdown" or "Turns ON when Tank is Full". Feel free to customize the notes to suit your purposes; they are stored locally on your PC and do not affect the operation of the ProControl itself.

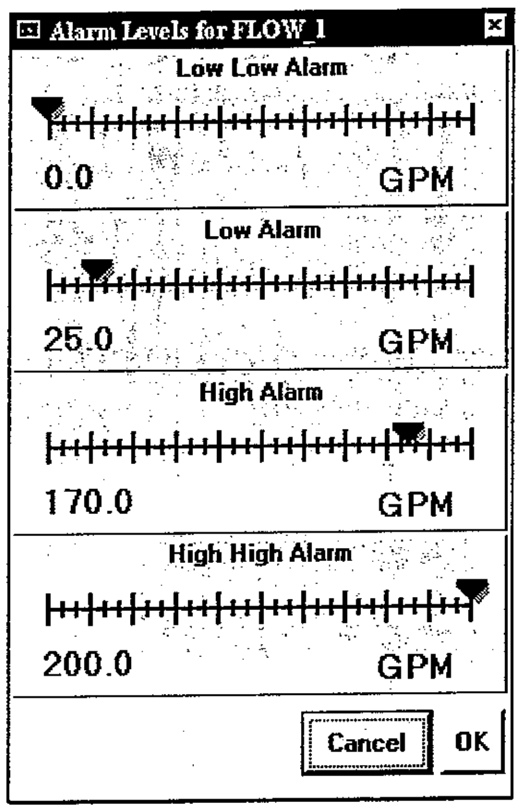
Analog Alarm Levels

The analog alarm levels define what parts of an analog input's range are considered "active" and which are not. This affects not only the color of LED's and bar graphs on the main screen but also can affect process control if the analog input is used in a process task. Depending on how your system has been configured, you will be able to set up to four "activation levels" that define when an input becomes active. Some ProControl configurations allow you to set a ***Low Alarm Limit*** and a ***High Alarm Limit***, while others allow you to additionally define a ***Low-Low Alarm Limit*** and a ***High-High Alarm Limit***. These activation levels are somewhat more flexible in use than their names imply, in that they are not only used to trigger alarms. If an alarm limit value is exceeded, it could be used to simply turn on a pump or reset a switch, for example.

To set an analog alarm level, do the following:

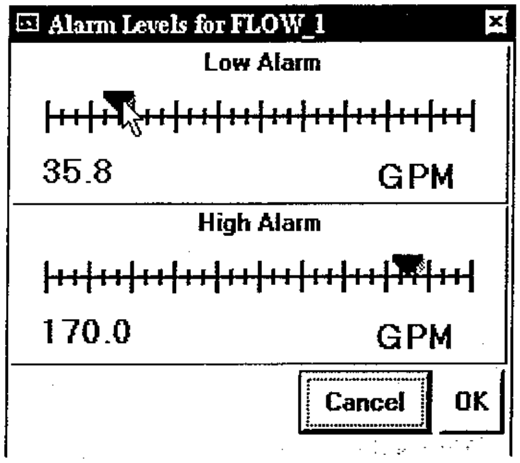
1. Position the mouse pointer over the I/O point's tagname until a balloon appears, *right*-click until you see **Alarm Levels.**

2. Left-click and the **Alarm Levels** dialog box appears.

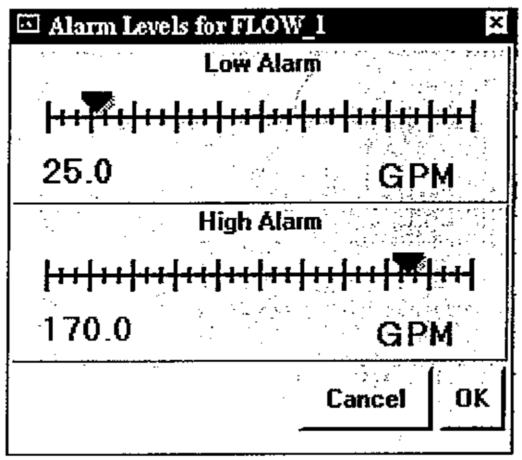


3. The present alarm levels are shown in text as well as in the position of the sliders. Note that the **High Alarm** value must be greater than the **Low Alarm** value, and the **High High Alarm** value must be greater than the **Low Low Alarm** value.

4. You may adjust the alarm values by clicking and holding a red slider and moving it to the left or right. As you move the slider the numeric value is updated to reflect the change you are making. The alarm level will be set to a new value when you release the mouse button.



5. Alternatively, you may click on the alarm level text and edit the value for the alarm level. This is usually a better way to input a precise value. Be sure to hit the Enter key to send the new value to the ProControl unit. Click on the **OK** button to hide the **Alarm Levels** dialog box.



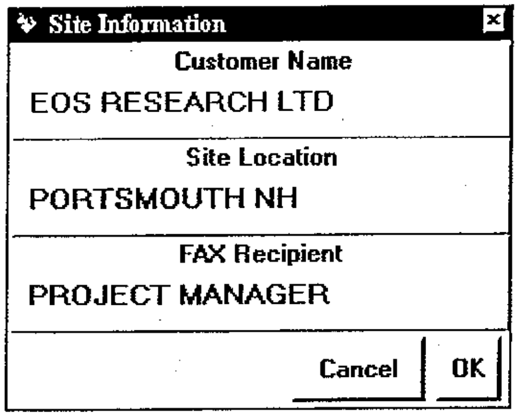
! *Remember that any changes you make to the alarm levels are **immediate** and may impact the process control for your system. Be sure you understand the safety risks and other implications of issuing these commands.*

Site Information

Site Information refers to data used in the fax report and in the various files printed by ProView.

To view or change the Site Information do the following:

1. Click on **Site Information** in the **File** menu. The **Site Information** dialog box appears.



2. To change the **Customer Name, Site Location** or **FAX Recipient** click on the text you want to change and edit it. Only uppercase letters, numbers and blank spaces are allowed. The **Customer Name** field also appears on the main screen of the ProControl unit's display.

3. Click on the **OK** button to confirm the changes and send them to the ProControl unit. Click on **Cancel** to get rid of any changes.

FAX Report Setup

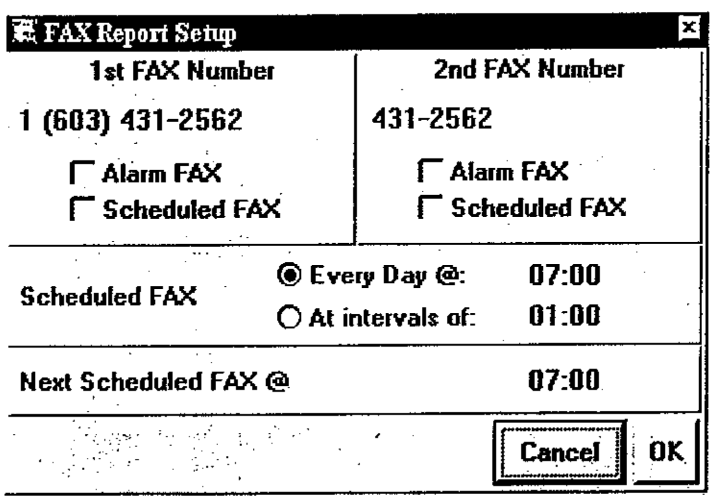
This setup screen is used to change when and where the ProControl's fax report is sent, and whether individual fax recipients are enabled.

To view or change the FAX Report Setup, do the following:

1. Click on **FAX Report Setup** in the **Communications** menu.

Or

Click on the **FAX Report Setup** toolbar button.  You will see the **FAX Report Setup** dialog box.



2. If **Remote Reporting** is not enabled, the contents of the dialog box will appear "grayed out" or disabled.

3. The first and second FAX number panels determine what kinds of fax reports are sent by the ProControl unit and where they will be delivered. There are two kinds of fax reports generated by the ProControl. A **Scheduled FAX** report occurs on a regular basis to provide a status report, while an **Alarm FAX** report will be sent when issued by a Process Task that has been configured to do so (usually to report an alarm condition). To enable either type of fax report click on the **Alarm FAX** or **Scheduled FAX** check boxes. If you enable Scheduled FAX reports the Alarm FAX reports for that same number are automatically enabled as well. You cannot enable only Scheduled FAX reports.

4. To change the phone number to which the ProControl will fax reports click on the phone number and edit it. The ProControl can fax to two different phone numbers. It will make up to three attempts to send the fax. If the first try is unsuccessful, the second try will be initiated 5 minutes later, and a third attempt will be made 5 minutes after that. If the third try is unsuccessful the fax attempt will be abandoned and the ProControl will enter a fax failure into the Events log (see Chapter 6). The ProControl will try both phone numbers (if they are both enabled) on the first try before moving on to a second attempt.

5. In the **Scheduled FAX** panel, you can select when the regularly scheduled faxes are sent. Choose the **Every Day @** button and edit the time to the right of it to have a report sent at the same time every day (24-hour clock). To have a report sent at a specific time *interval,* choose the **At intervals of** button and enter the time interval in HH:MM format. When you hit Enter, the data will be sent to the ProControl unit.

6. The **Next Scheduled FAX** variable indicates when the next *scheduled* fax report will be sent. You can also change it yourself if, for instance, the ProControl is set to fax every hour but you would like it to skip a few hours before resuming. To set the **Next Scheduled FAX** time click on the time in that panel and enter the new time in 24 hour format. Note that if you enter a Next Scheduled FAX time that is earlier than the current time as determined by the ProControl's clock, you will prevent any scheduled faxes from being sent until the next day at that time.

7. Click on the **OK** button to confirm the changes and send them to the ProControl unit.

Paging Setup

This setup screen is used to change where the ProControl's alarm pager messages are sent, and whether individual page recipients are enabled. You will need to contact your paging service directly to obtain some of the information necessary for proper paging setup. The paging capability is similar to the ProControl's fax capability in that you can send information to two pagers and it will make three attempts at reaching each number.

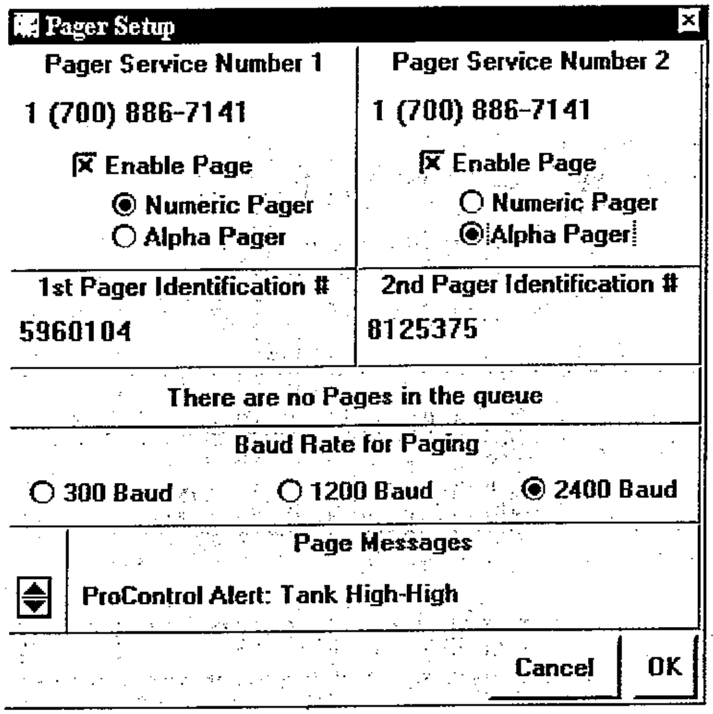
! *You will need to obtain your pager company's modem dial-up phone number and your pager's modem dial-up ID (this is often different than your regular pager ID). This information is generally not available from the customer service staff at the pager company. You may need to ask for someone in technical support who is familiar with pager modem dial-up.*

To view or change the **Paging Setup** do the following:

1. Click on **Paging Setup** in the **Communications** menu.

   Or

   Click on the **Paging Setup** toolbar button. You will see the **Pager Setup** dialog box.



2. In the **Pager Service Number** panels, enter the telephone number for your pager company's modem dial-up.

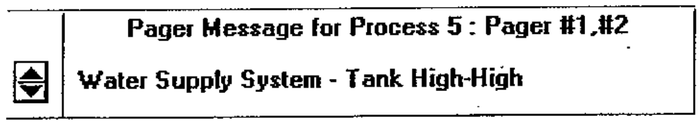
3. Click on the **Enable Page** check box, and choose **Numeric Pager** or **Alpha Pager** (text).

4. Enter the pager ID number you obtained from the pager company in the **Pager Identification #** panels.

5. The next panel indicates whether there are any queued pages. In other words, if a page has not yet been successfully completed and you have dialed into the ProControl with ProView, you may be interfering with the ProControl's attempts to send a page.

6. Select the baud rate in the **Baud Rate for Paging** panel, which is the speed at which the page information is sent to your paging company. It is generally recommended that you use 300 baud for the greatest reliability. Even at 300 baud, the ProControl takes only a few seconds to transmit the information to your pager company.

7. The **Pager Message** field allows you to view and/or change the information which will be transmitted to your pager from specific events. If you are using a numeric pager, this message cannot exceed nineteen digits in length and may contain only numerals. If you are using an alphanumeric pager, this message can be up to 80 characters in length. After you edit the message, hit Enter to send the updated message to the ProControl unit. Use the up and down spinners to view the other Process Tasks that cause pages to be sent. You should be familiar with the process control of your system before attempting to make changes to these messages.



8. Once you have finished making your changes click **OK** to close the dialog box.

Datalogging Setup

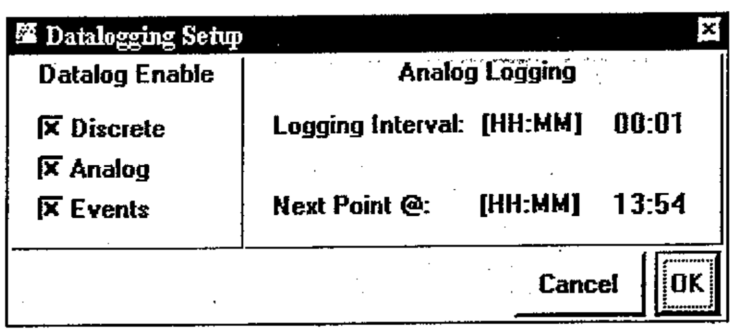
There are three different types of datalogging on the ProControl. Discrete input and output changes are logged as they happen. Events are also logged as they happen, and include changes in control mode (e.g., Auto, Manual), local and remote connections to the ProControl, system startup/shutdowns, fax or page failures, and execution of *Process Tasks*. Analog input and output values are logged at specific time intervals determined by the user. The **Datalogging Setup** dialog box is used to determine how datalogging is carried out in the ProControl unit.

To view or change the **Datalogging Setup** do the following:

1. Click on **Datalogging Setup** in the **Datalogging** menu.

   Or

   Click on the **Datalogging Setup** toolbar button.  You will see the **Datalogging Setup** dialog box.



2. To enable a type of datalogging click on the **Discrete, Analog** or **Event** check boxes located in the **Datalog Enable** panel.

3. To change the logging interval for analog inputs click on the time value indicated for **Logging Interval** and edit it. This interval can range from 1 second to 24 hours, expressed in minute/second

format or hour/minute format (default). Clicking on the **HH:MM** adjacent to the **Logging Interval** will toggle between hour/minute format and minute/second format.

4. The **Next Point @** variable is set by the ProControl every time a data point is logged to show you when the next analog data points will be logged. You can change this value if you wish the ProControl to delay before resuming analog datalogging. Click on the time associated with **Next Point @** and enter the new time in either HH:MM or MM:SS format. Note that if you enter a **Next Point @** time that is earlier than the current time *as determined by the ProControl's clock*, you will prevent any analog datalogging from occurring until the next day at that time (or next hour if using MM:SS format).

4. Once you have finished making your changes click **OK** to close the dialog box.

FYI

When setting your analog logging interval, be aware of the available memory in the ProControl unit you are using. If, for instance, your ProControl has a capacity of 5,000 analog data points per input channel and you specify a 5-minute logging interval, there will be available memory for approximately 17 days worth of analog data. Changing the log interval to 10 minutes will make the memory last twice that long. Once the memory is full, the oldest data is purged to make room for the current data.

Changing the Password

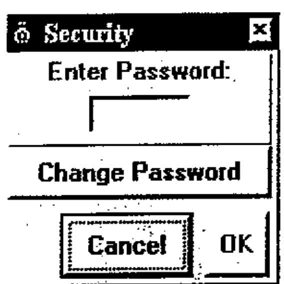
You can change the password for opening a site file in ProView or for access to the ProControl unit from its keypad. The passwords do not have to be the same. If you change the password while ProView is connected to a ProControl unit, the new password will be used for both ProView and the ProControl unit. If you change the password while not connected to a ProControl unit, the new password will be used only for that site file in ProView. In order to save the new password for the site file in ProView, you must save the site file (**File...Save Site**). However, any change to the password in the ProControl unit itself is immediate.

To change the password, follow these steps:

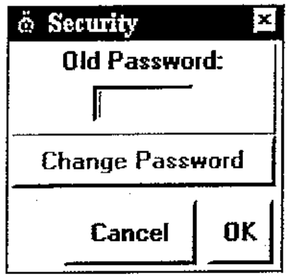
1. Click on the **Password** menu.

Or

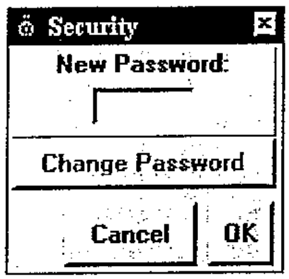
Click on the **Password** toolbar button.  You will see the **Security** dialog box.



2. Click on the **Change Password** button. You will prompted to enter the **Old Password** in the text box. Click the **OK** button or hit the enter key. If you do not enter the password correctly, a beep sounds and the security dialog box disappears.



3. You will then be prompted to enter the **New Password** in the text box. Recall that the password can be up to three characters consisting of the numbers 0-9 and the letters A-Z. After clicking on the **OK** button or hitting the enter key, you will be prompted for the new password again.



4. If both new password attempts were identical, the new password will be accepted and the **Security** dialog box will disappear. If ProView is connected to the ProControl, the new password will be in effect for both ProView and the ProControl unit.

Analog Output Options

If your ProControl system is configured with analog outputs, you will be able to adjust the output level, or the parameters used in a control algorithm associated with that output. Your system integrator should have already configured your analog outputs with these algorithms if they apply to your process. Analog outputs can be involved in one of two different types of control scheme: **PID** or **Proportional** control. A **PID** (Proportional-Integral-Derivative) Loop is a feedback-based loop that maintains an analog input at a user-defined ***Setpoint***. The ProControl automatically adjusts the analog output using a mathematical formula that includes ***Gains*** for the proportional, integral and derivative terms. PID control is a commonly-used process control technique, descriptions of which can be found in most control theory texts.

FYI

If you are familiar with PID control terms, note that the PID gains used by the ProControl are defined differently than some of the terms in traditional use. **Proportional Gain** *on the ProControl corresponds with the classic definition of* **proportional band**. *However, the* **Integral Gain** *and* **Derivative Gain** *are the* ***inverse*** *of* **integral (or reset) time** *and* **derivative time**. *Hence, an* ***increase*** *in any of these gains tends to* ***increase*** *the corresponding proportional, integral and derivative action.*

A **PRO** (Open-loop Proportional) algorithm generates an analog output signal that is directly proportional to the value of an analog input. The analog output percentage is computed by multiplying a constant of proportionality by the associated input's percentage of full-scale.

If a control scheme is not assigned to an analog output (or if the output has been placed in **Manual** mode), you can change the output value by clicking on the slider for that output and dragging it up or down, or by highlighting the number beneath the slider scale and typing a new value.

You can modify the PID parameters of a PID-controlled analog output (the **P**, **I** and **D Gains**) if your analog output is not responding smoothly or quickly enough to changes in its associated input. The proportional **(P)** gain specifies the output level based on the error between the **Set Point** (desired input level) and the actual input level. Integral **(I)** gain smoothes the output level based on the tracking history of the input to the **Set Point** and provides a means of better steady state control. Derivative **(D)** gain will allow the output to respond to quick changes in the input and provides a means of establishing good transient or instantaneous control.

In the case of a **PRO** output, you can modify the **P Gain** to alter how much the output value changes as the associated input changes. A value of 100 indicates that the output will be 100% when the input is at full scale. A value of 50 indicates that the output will be 50% when the input is at full scale

The **Max Change** parameter allows you to regulate how much the analog output can change in one control cycle (one control cycle is about 1/4 of a second).

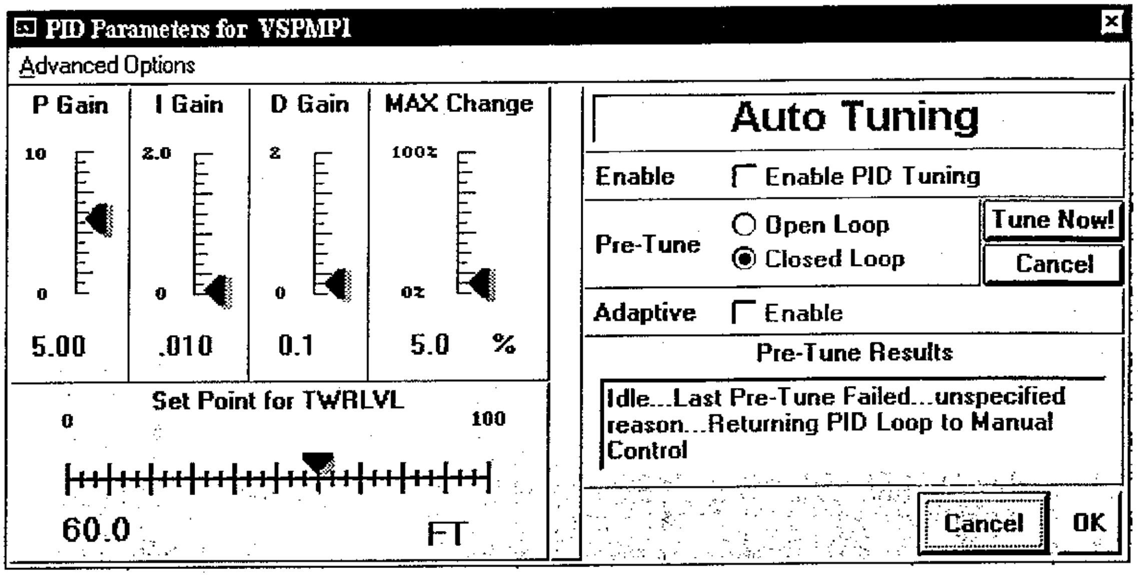
! *Be sure you fully understand PID and proportional control concepts before adjusting any of these parameters. Large changes in output can result from changing the gains or the set point, which can cause equipment damage or unforeseen safety hazards. For help in choosing appropriate gains for your process, contact EOS Research technical support.*

To change the **PRO** or **PID** parameters, **Set Point**, or **Max Change** parameters:

1. It is highly recommended to first place your analog output into **Manual** mode. Click on the **PID** (or **PRO**) beneath the Tagname and wait a second for it to change to **Manual.**

2. Position the mouse pointer over the analog output's tagname until a balloon appears, and *right*-click until you see **PID Options**.

3. Left-click and the **PID Parameters** dialog box appears.



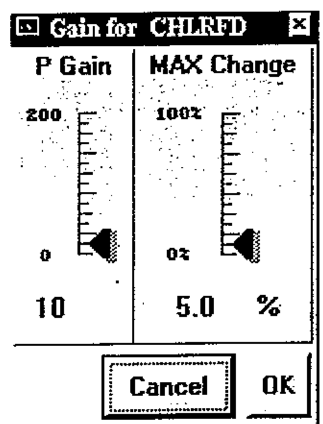
4. To change any of these parameters, you can either click and drag the sliding scale or click the numerical text and enter the value through the keyboard. You can also change the upper limit on all of the gain scales.

5. Click the **OK** button to save your changes. If not, click the **Cancel** button.

6. To restart your PID loop, click the word **Manual** underneath the Tagname and wait a second for it to change to **PID**. Your new parameters are now in use by the ProControl.

One type of auto-tuning algorithm is provided with ProView, and can be used to calculate optimal PID parameters for certain types of process loops. Contact EOS Research technical support to see if auto-tuning may benefit your process.

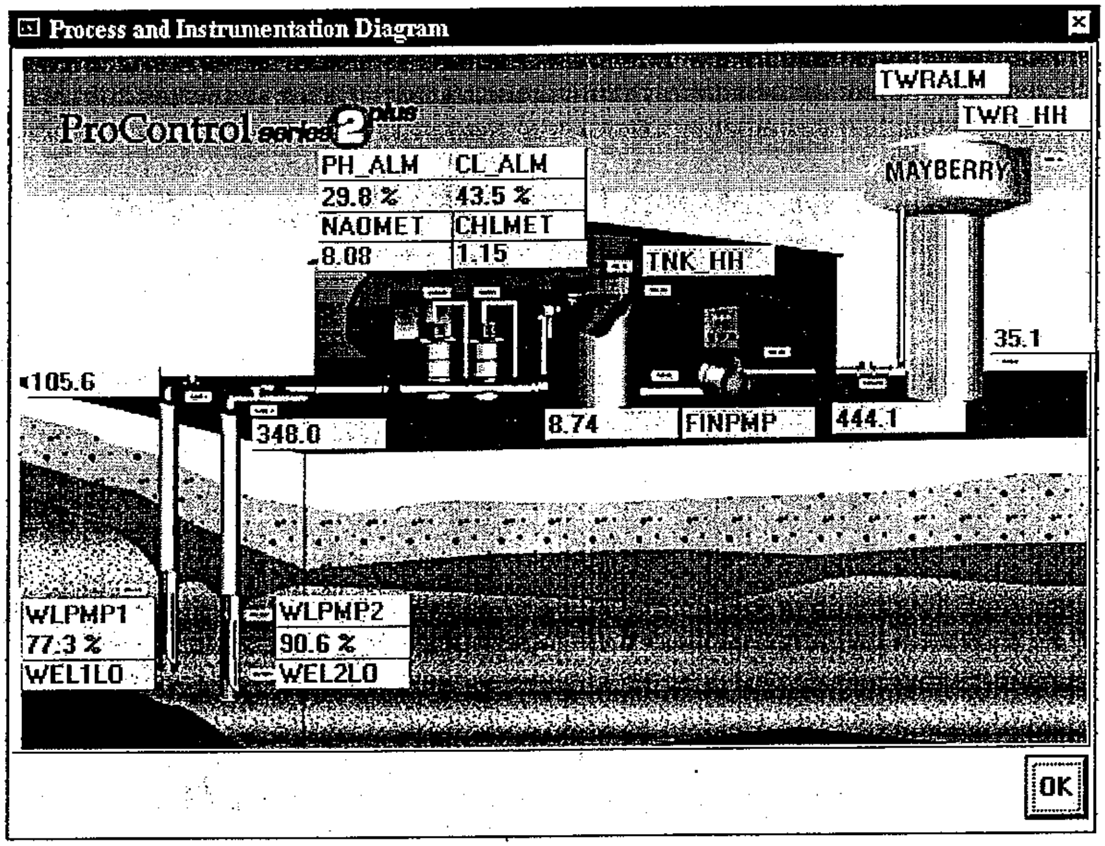
If the analog output is configured for proportional output, the dialog box on the right will be displayed. You can make changes as outlined above.



Process and Instrumentation Diagram

The **P&ID** option allows you to pull up an alternate "process and instrumentation diagram" representation of your system, which can be used to display operating data that is superimposed on a process diagram (or map, or picture of your dog, etc.). The P&ID option is designed to provide an alternate human-machine interface (HMI) for ProView with customizable graphics. Note that the P&ID screen is not interactive like the main ProView screen is; that is, data can be displayed on this screen, but commands cannot be issued from it.

Typically, your system integrator would configure this screen for you. The P&ID capability must be enabled by the integrator in order for you to use this feature. If this option has been included in your system configuration, you can view this diagram by clicking on the P & ID icon .



The **Process and Instrumentation Diagram** contains a graphical representation of your system. Digital inputs and outputs are displayed as tagname boxes that change color when the I/O point is active (red or green). Analog I/O are displayed as numerical values, with analog outputs also containing the % symbol to distinguish them from analog inputs. Click the **OK** button to go back to the main ProView screen.

As discussed above, the P&ID screen is typically supplied by your system integrator. However, if you would like to make changes to the P&ID screen, follow the procedures outlined below. If you want to change the background image, you can create a new **.pid** file. The P&ID must be a bitmap format file (.bmp) that can be created with Paintbrush™ or other drawing programs. The bitmap image can be any size you choose, the file name must be the same as your ProView site file (**.pvs**) with the filename extension changed to **.pid**, and it must be placed in the same folder as your .pvs file.

When you open the P&ID screen in ProView, you can move or remove the I/O boxes as you choose. Remember to **Save** the site file before you exit ProView to store these changes.

To change the appearance of the P & ID:

1. To move a descriptive box containing either a tagname or value, hold the shift key and click the left mouse button when positioned on the appropriate box. This will enable you to drag and re-position the box wherever you choose.
2. To remove a descriptive box, double-click on the box. Once you have removed a box, it will no longer be available to you unless you restore all boxes.
3. To restore all descriptive boxes, position the mouse at the bottom of the P & ID window in the gray area. Then hold down the control and shift keys while simultaneously clicking the left mouse button.

Chapter 6: Working with Logged Data

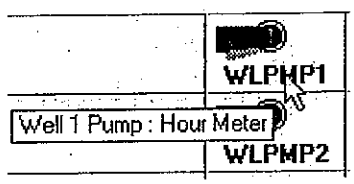
This chapter explains how to gather and analyze logged data that is being stored in the ProControl unit's battery-backed memory.

Hour Meters

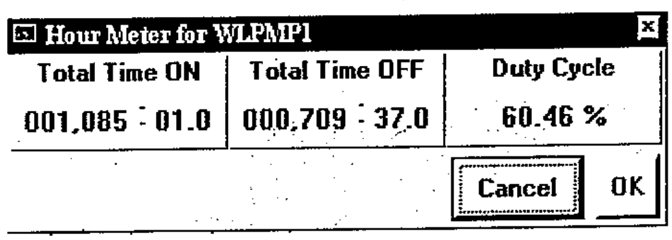
The ProControl maintains **Hour Meters** for inputs and outputs to indicate how long the I/O point has been ON and OFF. The hour meters are particularly useful in keeping track of equipment "run" times (discrete outputs), but are also maintained for discrete and analog inputs. For analog inputs, the hour meters indicate the time the input has been in and out of its *Active State* (see the definition of Active State in the Series 2^{plus} User Manual). The hour meters are updated every second on the ProControl unit. The ON and OFF times are displayed at a resolution of 1/10 (0.1) of a minute.

To read the Hour Meters, follow these steps:

1. Position the mouse pointer over the I/O point's tagname until a balloon appears, then *right*-click until you see **Hour Meter**.



2. Click the left mouse button to view the hour meter. The **Hour Meter** dialog box appears.



3. The **Hour Meter** box displays information in the form of **Hours : Minutes.10th Minutes** for both ON time and OFF time. The **Duty Cycle** or ratio of ON time to total time is also displayed. It may take a few seconds for the display to be updated once the dialog box appears.

4. To edit the **Total Time ON** or **Total Time OFF**, click and highlight the total time text and make the required changes. Press the enter key to confirm the changes and send the new value to the ProControl unit. Resetting the time values to zero, for instance, can be used when a motor is changed out, to keep track of lubrication intervals, etc.

5. Click on the **OK** button to close the **Hour Meter** dialog box.

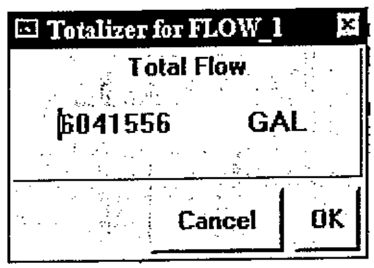
Totalizers

If your site configuration includes an analog input to which a flow meter or pulse counter is connected, it may also include a **Totalizer**. Totalizers provide the ability to view the cumulative total of a flow-based input or accumulated pulses from a counting device.

To view the **Totalizer** do the following:

1. Position the mouse pointer over the I/O point's tagname until a balloon appears, then *right*-click until you see **Totalizer**.

2. Click the left mouse button to view the totalizer. The **Totalizer** dialog box appears.



3. The **Total Flow** for this input since the totalizer was last reset is displayed. It is updated every second while the dialog box is visible and while ProView is connected to the ProControl unit.

4. If you would like to set the totalizer to a different value, click on the value displayed in the dialog box. Enter the new value for the totalizer and press the enter key.

5. Click on the **OK** button to close the **Totalizer** dialog box.

Trend Graphing

ProView can display a real-time trend graph while you are connected either locally or remotely to the ProControl. A 5-minute trend can be displayed in the lower left hand side of the ProView window.

To start trend graphing:

1. Position the mouse pointer over an analog input's tagname until a balloon appears, then *right*-click until you see **Trend**.

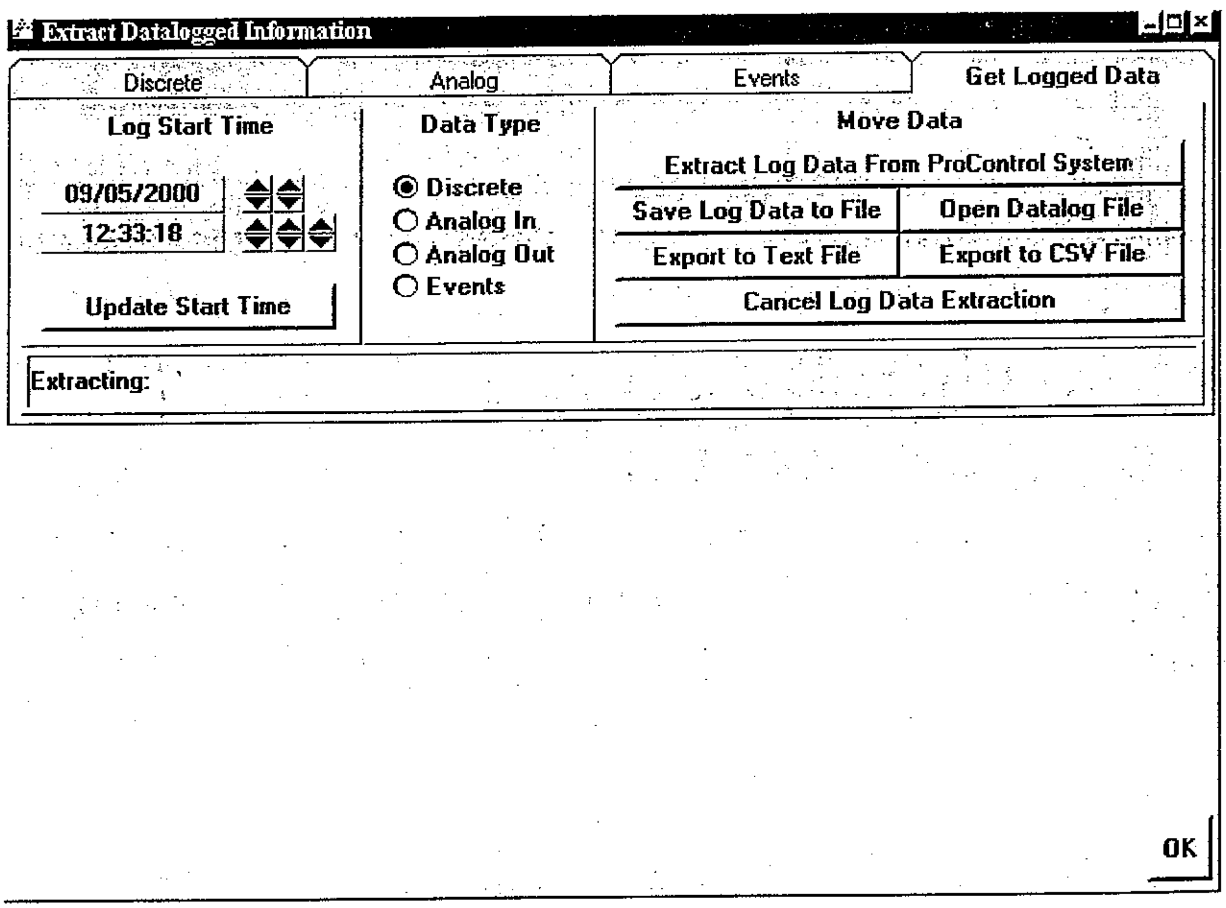
2. Click the left mouse button to produce the **Trend** window for that input.

3. The trend window provides a 5-minute history of the real-time data for that analog input. You will see the trend "drift" from right to left across the window, and it will be updated as long as you are connected to the ProControl. If you wish to observe another trend, click on the tagname of another analog input and the trend window will be refreshed with the new data.

4. To stop trending and empty the trend window, click on the **Trend for...** text block in the trend panel.

Downloading Logged Data

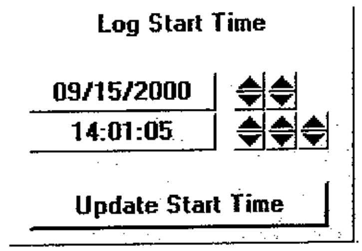
Operations data is stored electronically in the ProControl's memory in accordance with the datalogging setup (Chapter 5). To view the logged data, click on **Get Logged Data** in the **Datalogging** menu. This opens the **Extract Datalogged Information** dialog box.



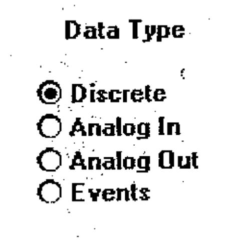
Getting Logged Data

To extract datalogged information from the ProControl unit, do the following:

1. Select the start time in the **Log Start Time** panel. ProView will extract all data that has been logged since this time. Change the start time by clicking on the spin buttons to increase or decrease the Month, Day, Hour, Minute or Second. Click on the **Update Start Time** button to reset the start time to the current time.

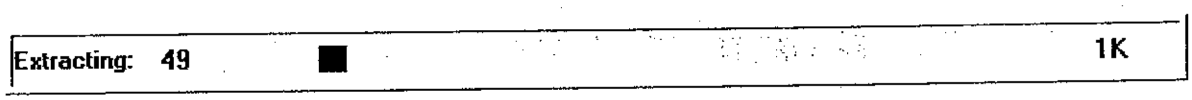


2. Select the type of data you wish to extract. Click on the **Discrete, Analog In, Analog Out** or **Events** radio button.

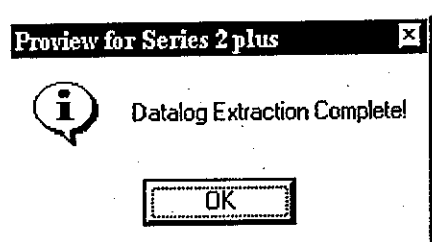


3. Click on the **Extract Log Data From ProControl System** button.

4. ProView performs a scan of available data. You can then monitor the progress of the data extraction.

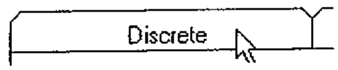


5. A message box will appear when the data extraction process is complete.

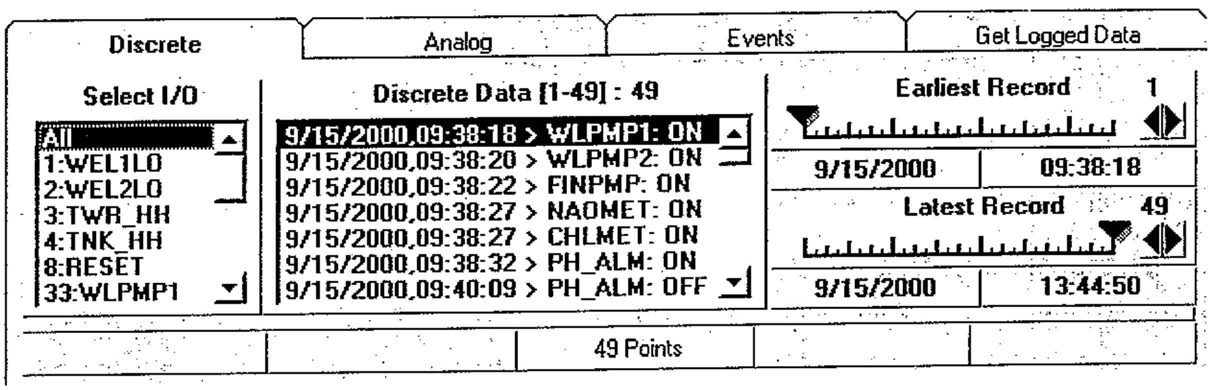


Looking at Discrete Data

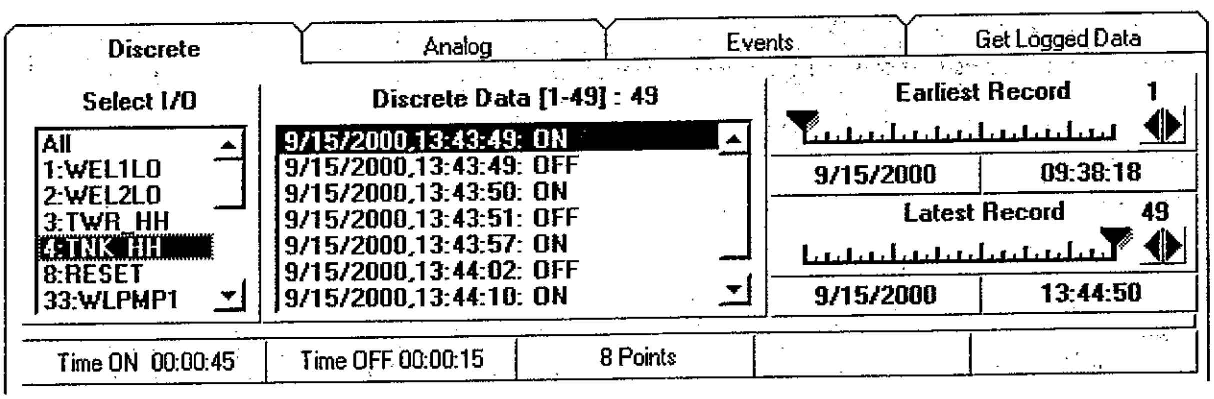
To examine the discrete datalog record that you have extracted click on the **Discrete** tab.



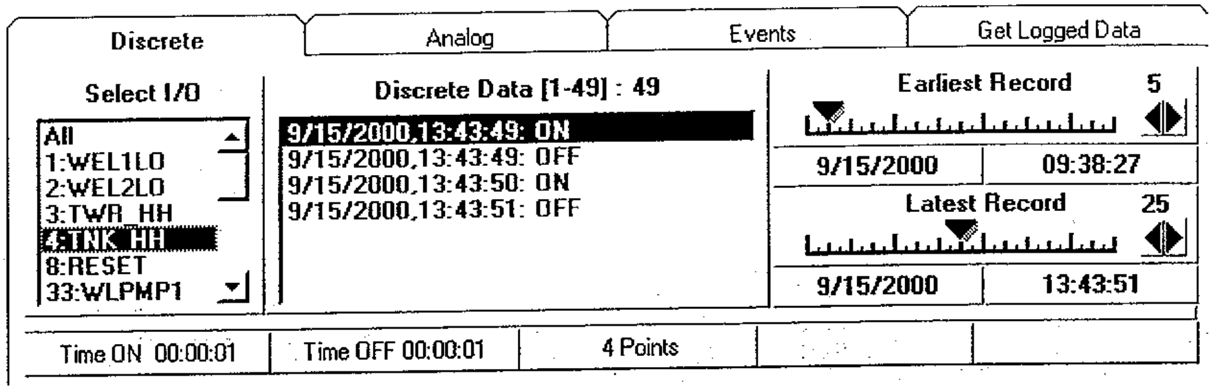
The **Discrete** data window appears. On the left, the **Select I/O** list box contains a list of all enabled discrete inputs and outputs. In the middle is the **Discrete Data** record. On the right, the **Earliest Record** extracted is shown as 9:38:18 on 9/15/2000. The **Latest Record** is 13:44:50 on 9/15/2000. A total of 49 records were extracted. Clicking on **All** in the **Select I/O** list box will show the entire discrete record in the **Discrete Data** window. You can scroll through the discrete records in the window.



The **Select I/O** list box can be used to filter the data record to include just one discrete input or output. In the example below, the **TNK_HH** input has been selected. Whenever a single input or output is selected, statistics are generated regarding the selected input or output, spanning the period of time from the first state change to the last one in the record. There are 8 data points for **TNK_HH** below, and the input was ON for 45 seconds and OFF for 15 seconds for the period of time between the first and last record.



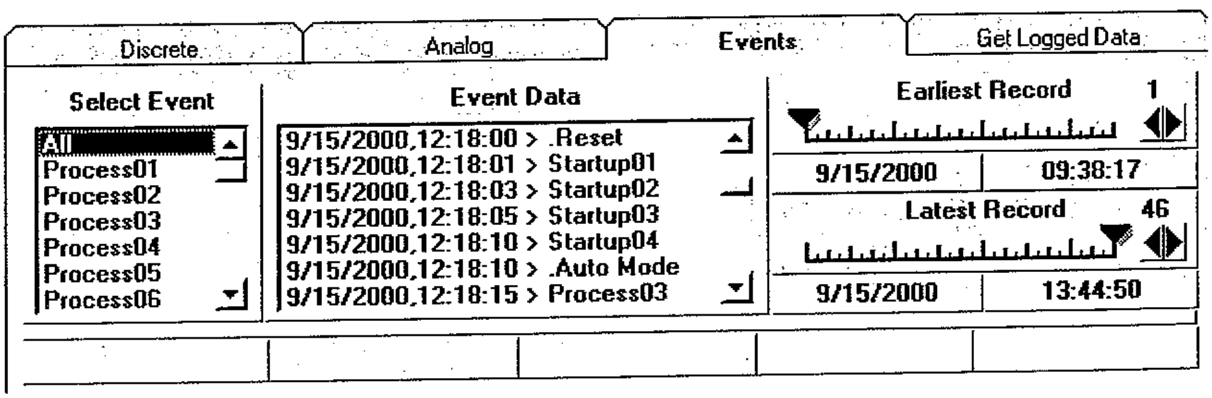
Moving the **Earliest Record** and **Latest Record** sliders or spin buttons will filter the total record with respect to time. Click and hold a slider and move the mouse to the left or right. You can also click on the spin buttons to change the time window. When you are finished filtering the time, click again on the input you wish to examine in the **Select I/O** list box to see the results of your changes. In the example below, the total record has been limited to records 5 through 25. Within this time interval, 4 state changes of **TNK_HH** occurred.



Looking at Events Data

First, go back to the **Get Logged Data** tab and extract the **Events** data. After the data has been extracted, click on the **Events** tab to examine the event datalogging record.

The **Events** data window appears. The **Select Event** list box contains a list of all enabled processes and other ProControl events. In the middle is the **Event Data** record. The **Earliest Record** and **Latest Record** extracted are shown to the right.

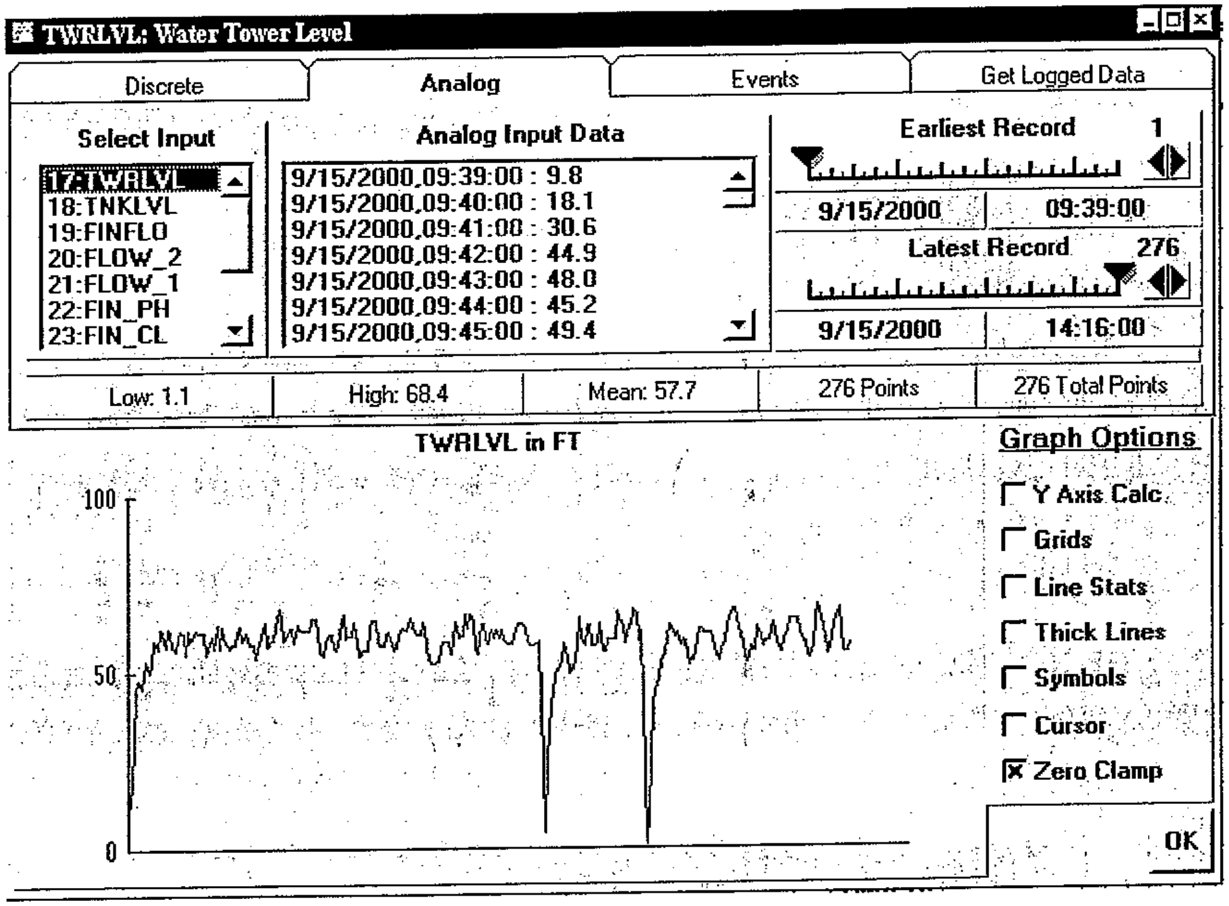


To view the data, follow the same procedure described for **Discrete Data**. Clicking on **All** in the **Select Event** list box will display all the events that were extracted. By clicking on an event in the **Event Data** window, a description is provided in the **Process Description** window below.

Looking at Analog Data

First, go back to the **Get Logged Data** tab and extract the **Analog In** or **Analog Out** data. After the data has been extracted, click on the **Analog** tab to examine the event datalogging record.

The **Analog** data window appears. The **Select Input** list box contains a list of all enabled analog inputs and outputs. In the middle is the **Analog Input Data** record. The **Earliest Record** and **Latest Record** extracted are shown to the right. By clicking on an input or output in the **Select Input** list box, a graph will be displayed in the window below.



In the example above, a water tower level is shown as it varies over time. Immediately above the graph, statistics are shown regarding the selected analog point (in this case there are 276 data points with a **Low** of 1.1, a **High** of 68.4 and a **Mean** of 57.7). As with the digital and events data, the **Earliest Record** and **Latest Record** sliders and spin buttons can be used to filter the total record with respect to time, which is helpful in focusing on a smaller portion of the graph. If you filter the data in this way, be sure to click on the input tagname again in the **Select Input** list box to see the results of your changes.

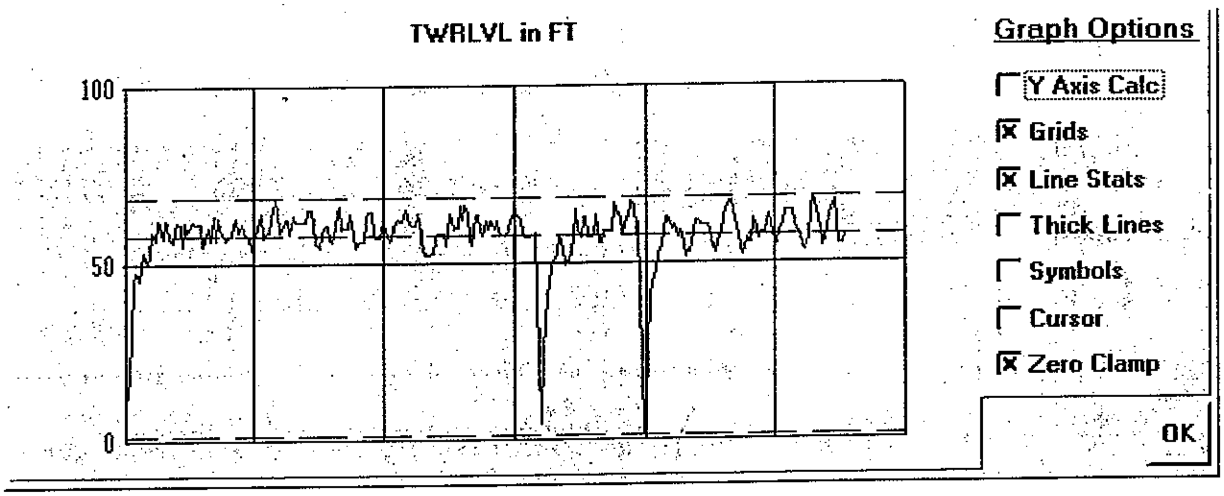
Graphing Options

Graph Options are available to change the look of the analog graph. Click on the check box adjacent to the option you want to use to enable it. The graphing options are described below.

Y Axis Calc: The default Y axis range displayed by ProView is that which is configured for that input in the ProControl unit. By clicking on **Y Axis Calc**, ProView redraws the graph with a calculated Y axis range based on the data in the sample. This will typically "tighten" the vertical axis on the graph to aid in showing smaller changes in the sampled data. Holding down the Shift, Control, or Alt key, respectively, while clicking **Y Axis Calc** will produce progressively tighter calculations of the vertical scale.

Grids: The grid option places some vertical and horizontal lines on the graph for reference.

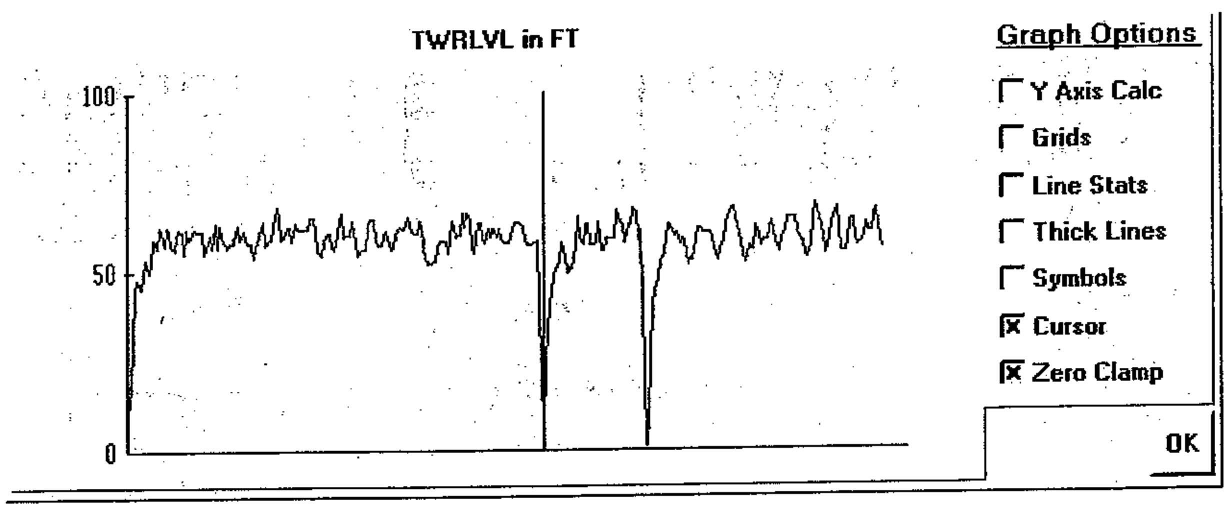
Line Stats: This option will draw dashed lines across the graph at the **Low, High** and **Mean** input levels. In the example below, the **Grids** and **Line Stats** options have been checked.



Thick Lines: This option increases the line weight of the graph.

Symbols: This option places a small "+" at each data point.

Cursor: This option places a vertical line on the graph at a data point selected in the **Analog Input Data** window. This option makes it easier to correlate the list data with the graph.



Zero Clamp: This option is selected by default, and forces the graph to display zero at all points where data was logged with a value less than zero. Negative values can be logged when an analog transmitter outputs less than 4 mA.

FYI

Be sure to disable the Zero Clamp option if you are viewing data for an analog input whose value can drop below zero under typical operating conditions.

After you are finished examining the datalogged information, you may want to save it for future reference within ProView or export it to a spreadsheet, database program or word processor.

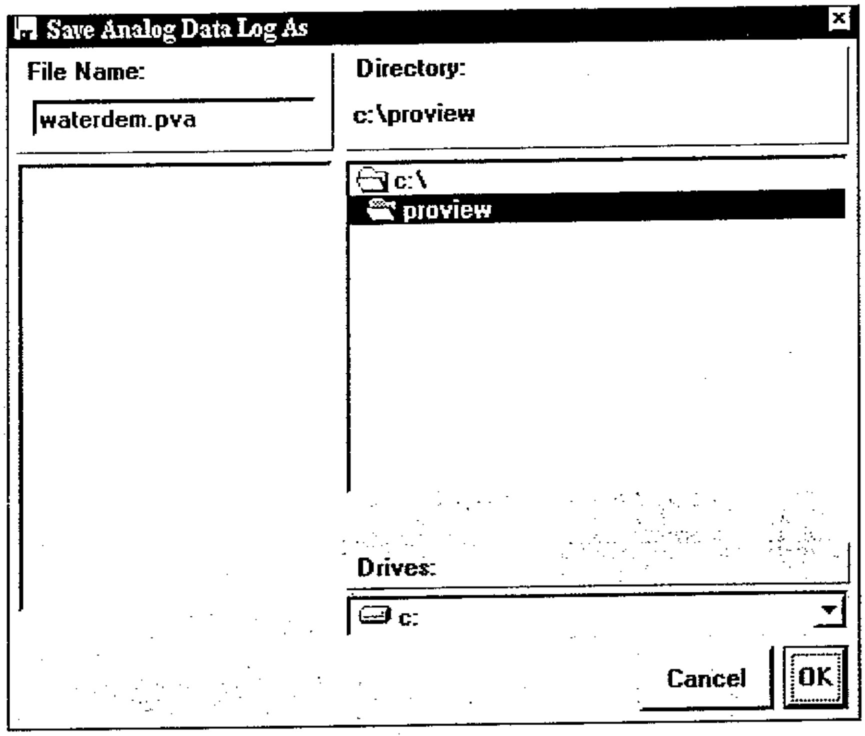
Saving Logged Data to File

To save a datalogging record to a ProView-readable file, do the following:

1. Click on the **Get Logged Data** tab. Select the type of file you wish to save by clicking on the appropriate button in the **Data Type** panel. *Remember that you must have already completed the separate step of extracting the data type you wish to save.*

2. Click on the **Save Log Data to File** button.

3. This opens the **Save** *xxxxxx* **Data Log As** dialog box, where *xxxxxx* is the type of data you wish to save. ProView selects a default file name for you, which is the name of the site configuration file with the .pvd, .pva or .pve file extension depending on the type of data file you intend to save (discrete, analog, or events, respectively). However, you may wish to change the file name to indicate a date representative of the log you are saving, for instance.



5. Click the **OK** button to save the file.

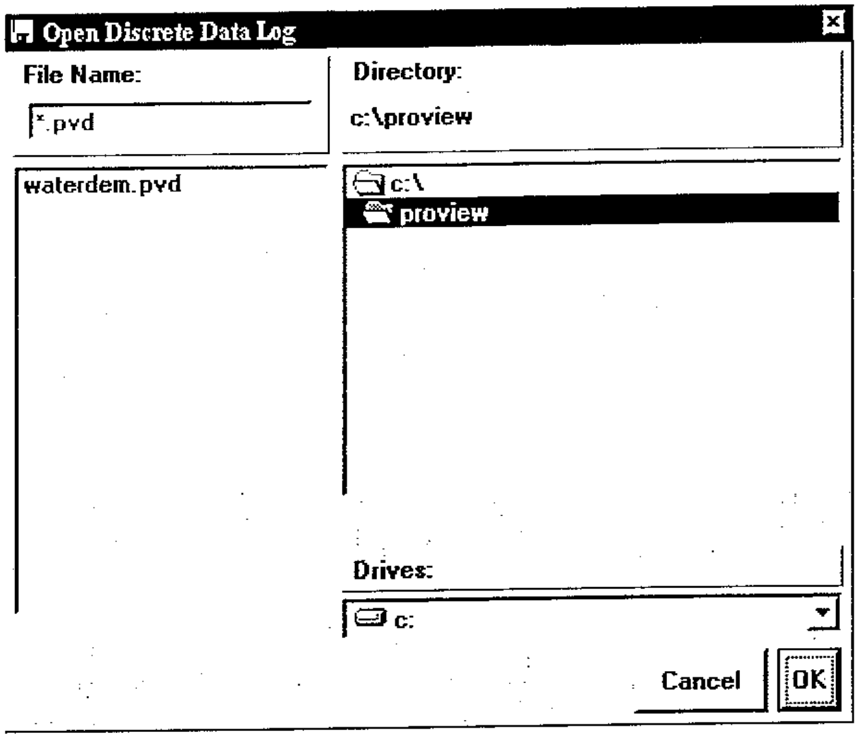
Opening a Datalog File

To view data that was previously saved in ProView-readable format, do the following:

1. In the **Get Logged Data** tab of the **Extract Datalogged Information** dialog box, select the type of data file you wish to open by clicking on the appropriate button in the **Data Type** panel.

2. Click on the **Open Datalog File** button.

3. This opens the **Open *xxxxxx* Data Log As** dialog box, where *xxxxxx* is the type of data you wish to view. ProView lists any files in the folder you have selected that contain the .pvd, .pva or .pve file extension (depending on the type of data file you intend to open). Click on the name of the file you wish to open, and it will appear in the **File Name:** text box. If the file you wish to open is stored elsewhere, select the location in the **Drives:** and **Directory:** list boxes.



4. Click on the **OK** button to open the file. View the data as you would any logged data that you have just extracted.

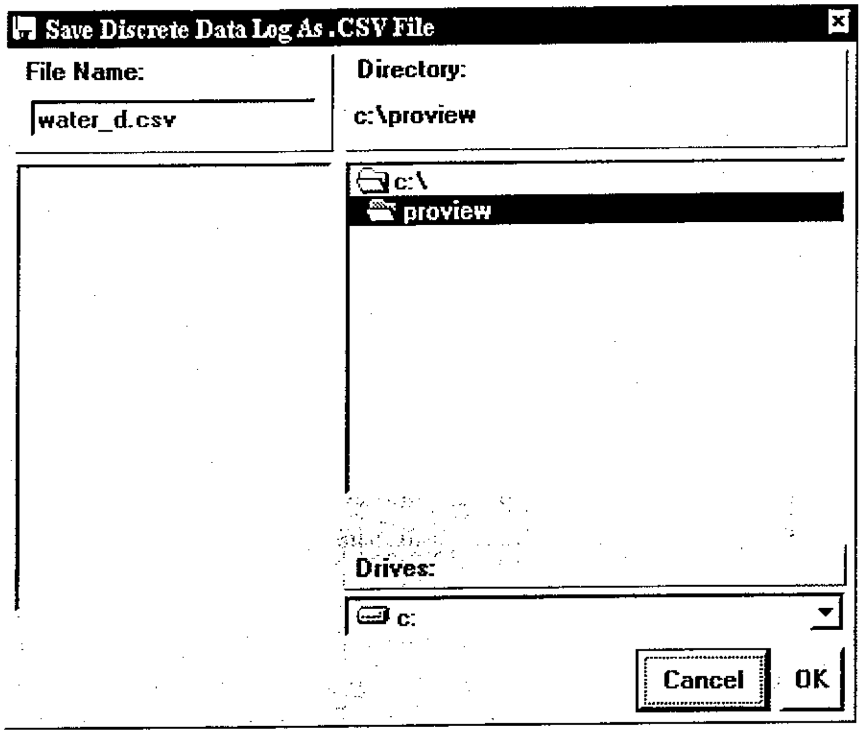
Exporting Logged Data for use in Other Applications

ProView provides users the ability to export data for use in other applications, so that you can take advantage of the data manipulation and graphing capabilities provided by widely-used software. ProView allows you to export analog, discrete or event data to a CSV (Comma-Separated Variable) file, which can then be opened by any spreadsheet or database program (e.g., Microsoft Excel™, Access™). You can also export discrete and event data to a text file for use in a word processor.

1. In the **Extract Datalogged Information** dialog box, click on the **Get Logged Data** tab. Select the type of file you wish to export by clicking on the appropriate button in the **Data Type** panel. Note that analog output data cannot be exported.

2. Click on the **Export to Text File** or **Export to CSV File** button.

3. This opens the **Save Analog Data Log As .CSV File,** the **Save Discrete Data Log As .TXT File** or other dialog box, depending on the type of file you wish to export. The default file name is the truncated name of the site configuration file with the .csv or .txt extension. However, you may wish to change the file name to indicate a date representative of the log you are saving, for instance.



5. Click the **OK** button to export the file.

6. You will be asked whether you would like to include header information in the file that is saved. The header provides two lines of basic site information and titles for the columns of data.

! *The CSV file format is considered a **Text** format by most spreadsheet and database software. When you open the .csv file created by ProView, be sure to specify that you are opening a Text file. For instance, in Excel, in the **File....Open** dialog box, choose **Text Files** from the list in the **File of type** list box.*

FYI *A word about the date format in the exported files: Discrete and event data are exported using a time stamp in which the date and the time are in separate columns or separated by a comma (for example, 9/15/2000,09:39:08). Analog data are exported using a combined date/time in standard Windows format (which is the decimal equivalent of the number of days and fractions of a day since January 1, 1900). When an analog data file is opened in a spreadsheet or database software package, you will probably want to reformat the date/time information in the leftmost column. For instance, in Excel, select the column, choose **Format....Cells**, and select a **Number** format that includes both the date and the time.*

CHAPTER 7: OTHER OPERATIONS

This chapter explains how to save the site setup, print current operating data to a file, view the process configuration, use the annunciator feature and exit the program.

Saving the Site Configuration to File

While you work in ProView, you may change certain system settings that are stored in your site configuration (or .pvs) file. Examples of some of the parameters stored with your site file include remote communication settings, passwords, and notes for your tagnames. You should save your .pvs file before closing ProView if you make any changes to these parameters.

FYI

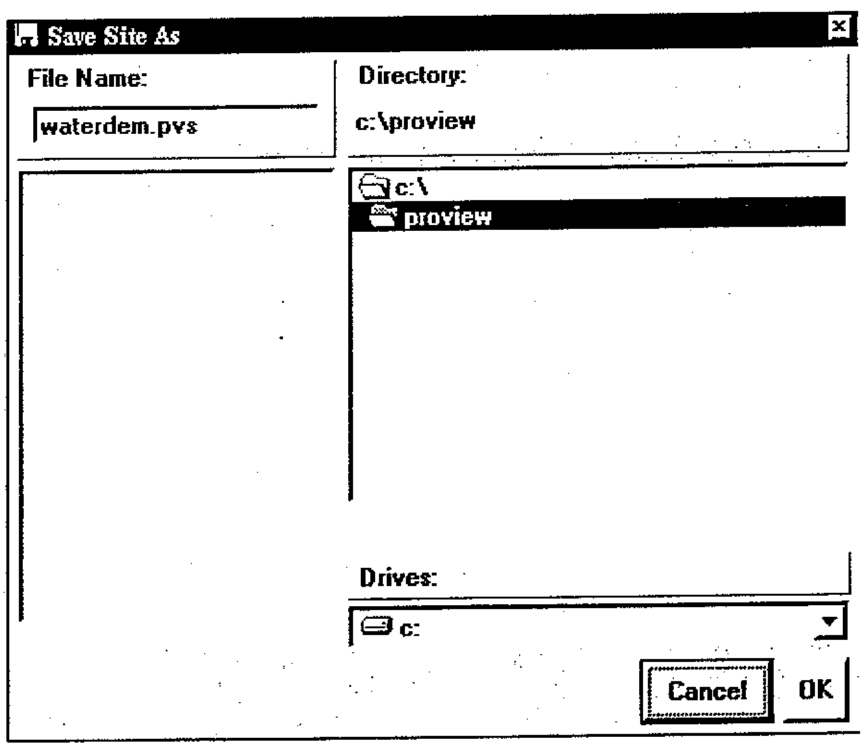
Remember that most operational settings, such as alarm levels, fax report numbers, datalogging setup, PID gains, etc. are stored in the ProControl unit, not in your site file. ProView "pulls up" this information stored in the ProControl unit when you connect to it. There is no need to save your site file if you only make changes to these operational settings.

To save your site configuration do the following:

1. Click on **Save Site** or **Save Site As...** in the **File** menu.

   Or

   Click on the **Save File** button on the toolbar.  The **Save Site As** dialog box appears. If you chose **File...Save Site**, ProView bypasses the dialog box.



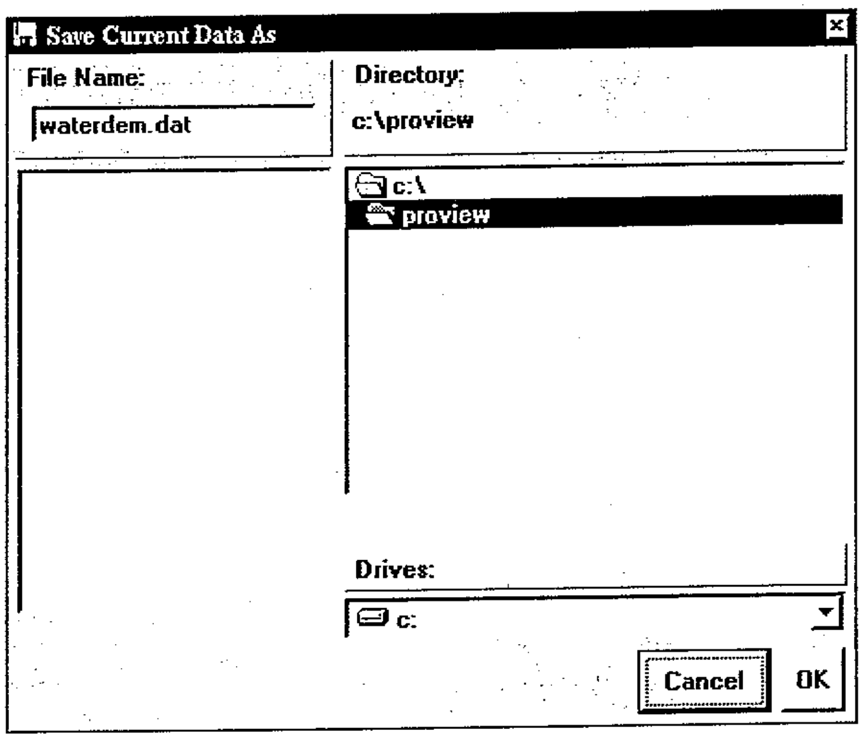
2. Select the **Drive, Directory** and **File Name** you would like and click on the **OK** button to save the file. You will be asked whether you wish to overwrite the existing file. Choose **Yes** to complete the file save.

Printing the Current Data to File

While you are connected to your ProControl via ProView, you can print the current operating data to a text file for future reference. This can prove useful for documentation and reporting purposes.

To save your current process data to a text file, do the following:

1. Click on **Print Current Data** in the **File** menu. You will see the **Save Current Data As** dialog box.



2. Select the **Drive, Directory** and **File Name** you would like. ProView selects a default file name for you, which is the name of the site configuration file with a .dat file extension. However, you may wish to change the file name to indicate a date representative of the information you are saving, for instance. Click the **OK** button to save the current data to the file.

You can examine the current data file with any text editor or word processor. An example of a file generated for our sample operation is shown on the following pages.

```
                    EOS RESEARCH LTD.
                  ProControl Series II+

            ProView Current Operational Information

    *************************************************************************
    ***** FAX Recipient:    BULLWINKLE MOOSE                          *****
    ***** Customer:         MAYBERRY WATER DEPT                       *****
    ***** Site Location:    MAYBERRY RFD                              *****
    *************************************************************************
    ***** Setup:            1                                         *****
    ***** Option:           B                                         *****
    ***** Type:             102                                       *****
    ***** Serial Number:    7429                                      *****
    ***** Date:             04/23/2000                                *****
    ***** Time:             14:52:35                                  *****
    ***** ProView:          Version 2.153                             *****
    *************************************************************************

 ******************************************************************
 ***** Communications State:    REMOTE CONNECT             *****
 ***** System Mode:             Auto 14                    *****
 ***** Last Shutdown:           Last Shutdown 12:28:27 , 2/20/2000 , Remote
                                                           *****
 ***** Alarms:                  Alarms SET                 *****
 ***** FAX:                     Report ON                  *****
 ******************************************************************
```

THE CURRENT INPUT STATUS:

#	TAGNAME	CURRENT VALUE	LO ALARM	HI ALARM	TOTALIZER		HOURS ON		HOURS OFF	
1	WEL1LO	is OFF					000,000	23.6	002,704	52.8
2	WEL2LO	is OFF					000,000	02.7	002,705	13.8
3	TWR_HH	is OFF					000,000	01.0	002,705	15.5
4	TNK_HH	is OFF					000,000	01.5	002,705	14.9
8	RESET	is OFF					000,000	00.8	002,705	15.7
17	TWRLVL	41.0 FT	30.0	55.0			000,044	36.7	002,660	39.6
18	TNKLVL	10.07 FT	9.00	11.00			000,018	38.8	002,686	37.7
19	FINFLO	220.0 GPM	0.0	600.0	2,707,032	GAL	000,749	30.0	001,955	46.4
20	FLOW_2	178.1 GPM	0.0	400.0	11,535,456	GAL	000,758	50.8	001,946	25.6
21	FLOW_1	95.8 GPM	35.8	170.0	10,479,505	GAL	000,003	03.4	002,702	13.1
22	FIN_PH	8.39 PH	7.50	8.50			001,004	05.6	001,701	10.8
23	FIN_CL	0.99 PPM	0.80	1.15			000,499	10.1	002,206	06.3

THE CURRENT OUTPUT STATUS:

#	TAGNAME	CURRENT VALUE	HOURS ON		HOURS OFF	
1	WLPMP1	is ON	001,871	40.2	000,833	36.1
2	WLPMP2	is ON	001,871	26.7	000,833	48.8
3	FINPMP	is ON	001,871	27.5	000,833	48.5
4	CHLMET	is ON	001,655	51.6	001,049	24.9
5	NAOMET	is ON	001,099	11.9	001,606	04.6
8	PH_ALM	is OFF	000,991	03.1	001,714	13.3
9	CL_ALM	is OFF	000,485	39.2	002,219	37.3
10	TWRALM	is OFF	000,028	11.2	002,677	05.1
11	WL1ALM	is OFF	000,000	12.0	002,705	04.6
12	WL2ALM	is OFF	000,000	00.1	002,705	16.5
13	TNKALM	is OFF	000,003	42.3	002,701	34.3

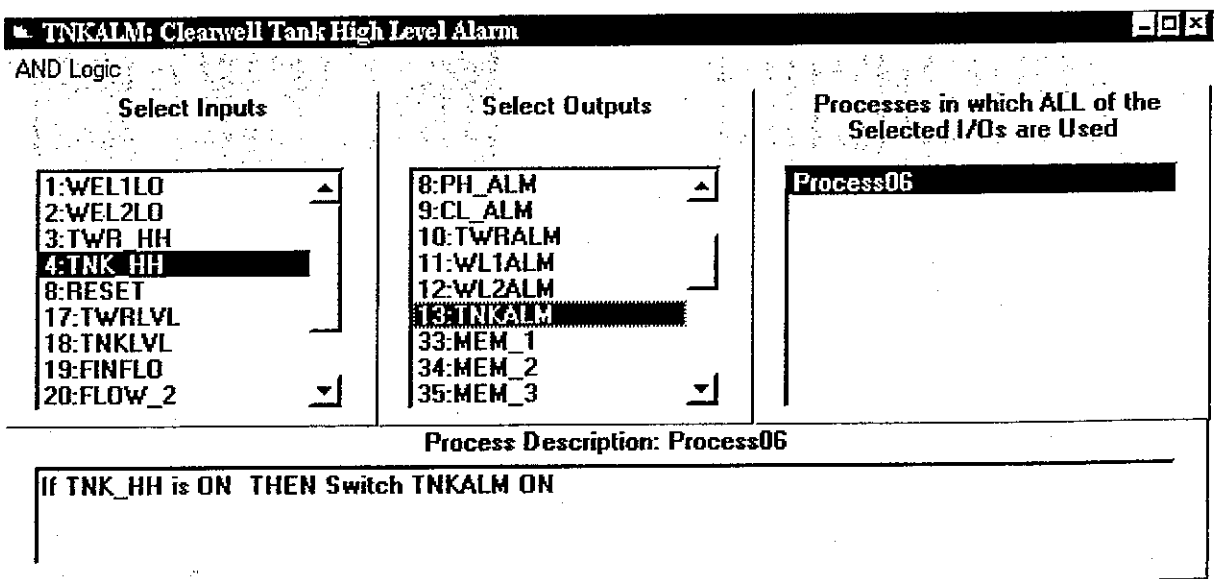
THE CURRENT ANALOG OUTPUT STATUS:

#	TAGNAME	VALUE	PID Mode	SETPOINT	P Gain	I Gain	D Gain	MAX CHG
1	VSPMP1	39.1 %	ALG	40.0	10.0	.010	0.1	5.0 %
2	VSPMP2	46.9 %	ALG	10.00	7.33	.010	0.5	5.0 %
3	NAOHFD	32.0 %	ALG	8.25	9.16	.010	0.1	5.0 %
4	CHLRFD	22.3 %	ALG		50			5.0 %

```
ANALOG OUTPUT NOTES
-------------------
VALUE   - The current output level expressed as a percentage 0%=4ma 100%=20ma.
MAN     - (Manual) The PID or PRO control loop algorithm has been turned off.
PID     - The (Proportional, Integral, Derivative) control loop is running.
PRO     - The open loop (Proportional) algorithm is running.
MAX CHG - The maximum amount the output can change in one control cycle.


THE CURRENT REPORTING SETUP:

     *****************************************************************************
     ***** Report Enable:           ON                                      *****
     ***** FAX Number 1:            1 (999) 555-1234                        *****
     ***** FAX Number 2:            555-4321                                *****
     ***** Scheduled FAX:           Every Day at:       07:00               *****
     ***** Next Scheduled FAX:      07:00                                   *****
     ***** Pager #1:                Enabled, Numeric                        *****
     ***** Pager #2:                Enabled, AlphaNumeric                   *****
     ***** Paging:                  Will occur at 2400 baud                 *****
     ***** Page Number 1:           1 (700) 555-6789                        *****
     ***** Pager ID    1:           9876543                                 *****
     ***** Page Number 2:           1 (700) 555-6789                        *****
     ***** Pager ID    2:           3456789                                 *****
     *****************************************************************************

THE CURRENT DATALOGGING SETUP:

     *****************************************************************************
     ***** Enabled Datalogging:     Digital ,Analog ,Event                  *****
     ***** Datalogging Interval:    00:01                                   *****
     ***** Next Datalog Time:       13:47                                   *****
     *****************************************************************************
```

Reviewing the Process Configuration

ProView includes a utility that can help you understand the control logic that is programmed into your ProControl unit (if your site file is not the most up-to-date version, note that the control logic shown may not match what is in your ProControl unit). Click on **Process Configuration** under the **File** menu, and the following screen will appear, showing the inputs and outputs that are configured for your system:



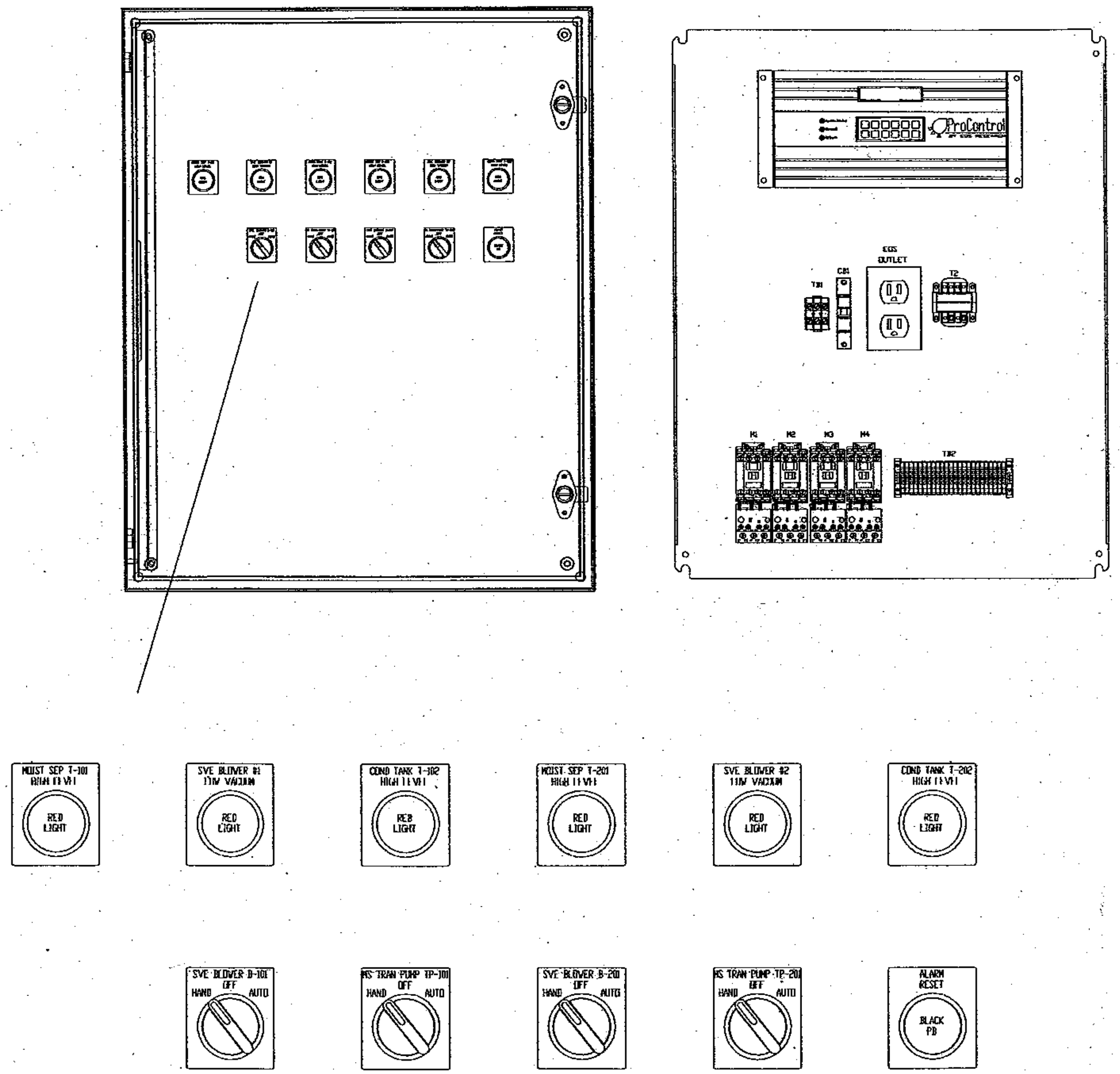
By selecting inputs and outputs from the left and center columns, respectively, you will see a listing of process tasks that include your selected I/O. For instance, if you choose an output from the center column, you will see a list of processes that turn that output ON or OFF in the window on the right. Clicking on a process will provide a description in the **Process Description** window. You can select both inputs and outputs to filter the list of processes. To de-select an I/O point, **<Ctrl> - left click** on it.

Annunciators

The Annunciator feature is useful for those ProControl users that remain connected to their systems for extended periods of time via ProView. The Annunciator is a visual alarm indicator for the ProView screen that is designed to draw attention to an alarm condition that *presently exists*, or *has occurred but has now cleared*. Clicking on **Annunciation** in the **File** menu toggles the Annunciation feature on and off. If any discrete or analog input that is configured as an alarm input becomes *active*, the input's tagname will turn red, and the System Status panel (the panel that indicates **Auto** or **Manual** mode) will begin to flash red. The annunciator continues to flash even if the input is no longer active, so that the operator does not miss an alarm condition. To acknowledge the alarm, click on **Clear Annunciators** in the **System** menu. If an alarm condition still exists, the annunciator will begin flashing again. *Note that only those alarm conditions that occur in the current ProView session will be annunciated.*

Exiting ProView

You can exit ProView by clicking on the at the top of the main screen or by clicking **Exit** in the **File** menu. You will be asked whether you want to save your site file and any logged date that you have extracted.



COMPONENT	QTY	TYPE	MODEL #	DESCRIPTION
Control Enclosure	1	Hoffman	C-SD30248	NEMA 4, Single door, 30"H x 24"W x 8"D.
Control Enclosure	1	Hoffman	C-P3024	Subpanel
Circuit Breaker (CB1)	1	Merlin Gerin	MG17424	Circuit breaker, 120V, 1-pole, 5A
Motor Contactor (M1)	1	Allen Bradley	100-C60D10	IEC contactor for 40 HP, 460V, 3-phase
Motor Contactor (M2,4)	2	Allen Bradley	100-C09D10	IEC contactor for 5 HP, 460V, 3-phase
Motor Contactor (M3)	1	Allen Bradley	100-C37D10	IEC contactor for 25 HP, 460V, 3-phase
Overload Block (OL1)	1	Allen Bradley	193-EA1KE	26-85A OL block
Overload Block (OL2,4)	2	Allen Bradley	193-EA1EB	1.6-5.0A OL block
Overload Block (OL3)	1	Allen Bradley	193-EA1HC	12-37A OL block
HOA Switch (SS1-4)	4	Allen Bradley	800EM-LSM33	Selector switch, 3-position, illuminated
HOA Switch (SS1-4)	4	Allen Bradley	800E-2DL5G	Light module
Switch contact (SS1-4)	8	Allen Bradley	800E-2X10	Normally open contact
Reset button (PB1)	1	Allen Bradley	800EM-F2	Type 4X, 22mm, momentary
Reset button (PB1)	1	Allen Bradley	800E-A2L	Latch
Reset button (PB1)	1	Allen Bradley	800E-2X10	NO contact
Pilot Light (PL1-6)	6	Allen Bradley	800EP-PLM4D5R	Pilot light, 120V, Red
Programmable Controller	1	EOS	Series 2+ type B2	Programmable logic controller
Phone box	1	Bell	5753-0	Weather proof cover and box while in use
Phone Jack	1	Leviton	625B	Flush Phone Jack

UL 508A LISTED

REV.	DESCRIPTION	DATE	APPR.

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MID-ATLANTIC ENVIRONMENTAL EQUIPMENT, INC.
155 Oak Forest Road
Bluffton, SC 29910
Tel: (843) 706-5659

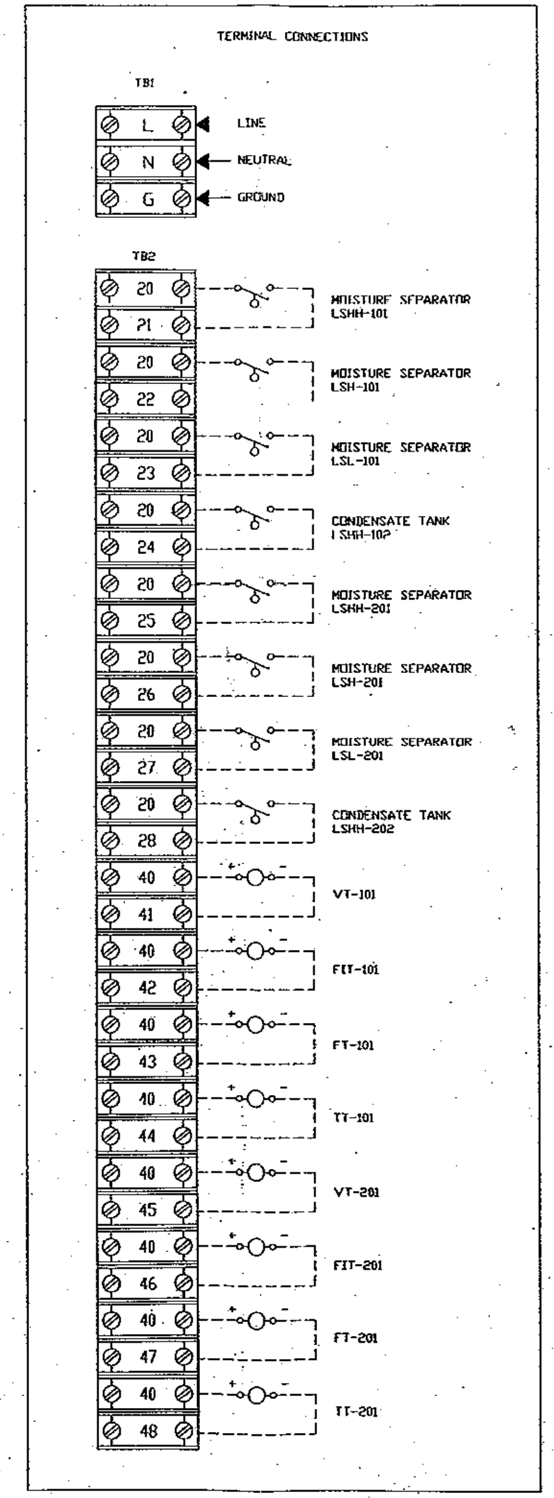
DRWN BY: SDH	DATE: 1/7/04
CHK BY	DATE
APPR BY	DATE

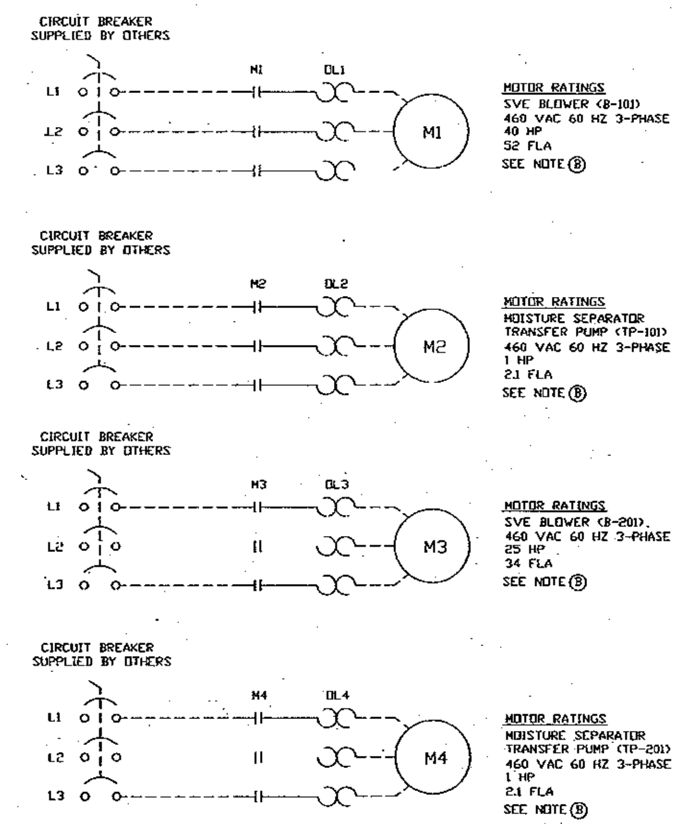
TITLE: CONTROL PANEL LAYOUT

LSC
KINGSTON, NY

JOB NO. 11432

SCALE	SIZE	DWG NO.	SHEET	REV
N/A	B	11432RBS	4 OF 4	ASBUILT





NOTE (A): REMOVE JUMPER IF OPTIONAL THERMISTER IS TO BE CONNECTED

NOTE (B): BASED ON THE 1996 NEC
ACTUAL RATINGS MAY VARY
SET OVERLOAD RELAYS ACCORDINGLY

UL698A LISTED

REV.	DESCRIPTION	DATE	APPR.

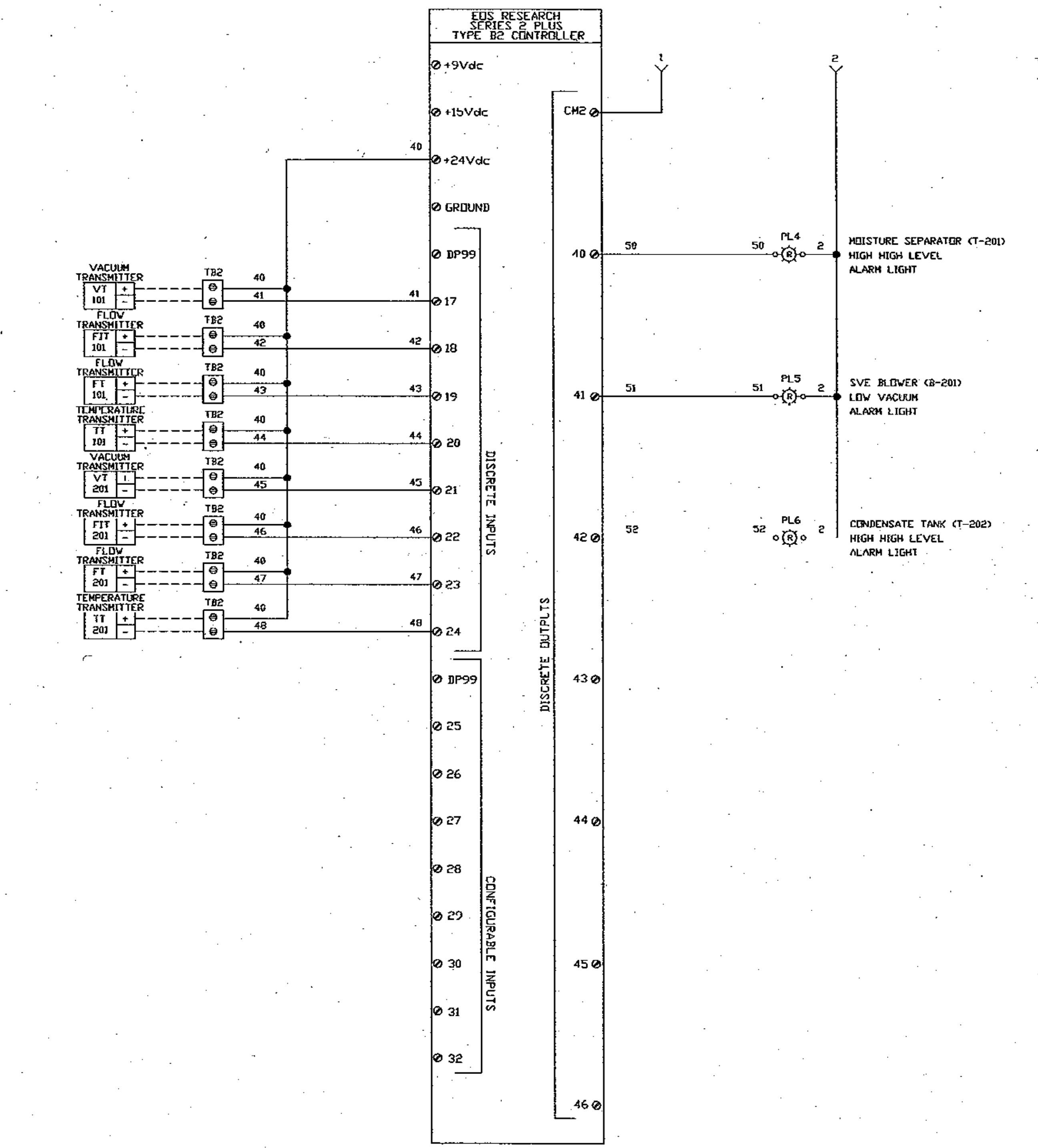
MID-ATLANTIC ENVIRONMENTAL EQUIPMENT, INC.
155 Oak Forest Road
Bluffton, SC 29910
Tel: (843) 706-5659

DRWN BY SDH	DATE 1/7/04
CHK BY	DATE
APPR BY	DATE

TITLE
CONTROL PANEL LAYOUT

LSC
KINGSTON, NY

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
11432	N/A	B	11432RBS	3 OF 4	ASBUILT



UL 508A LISTED

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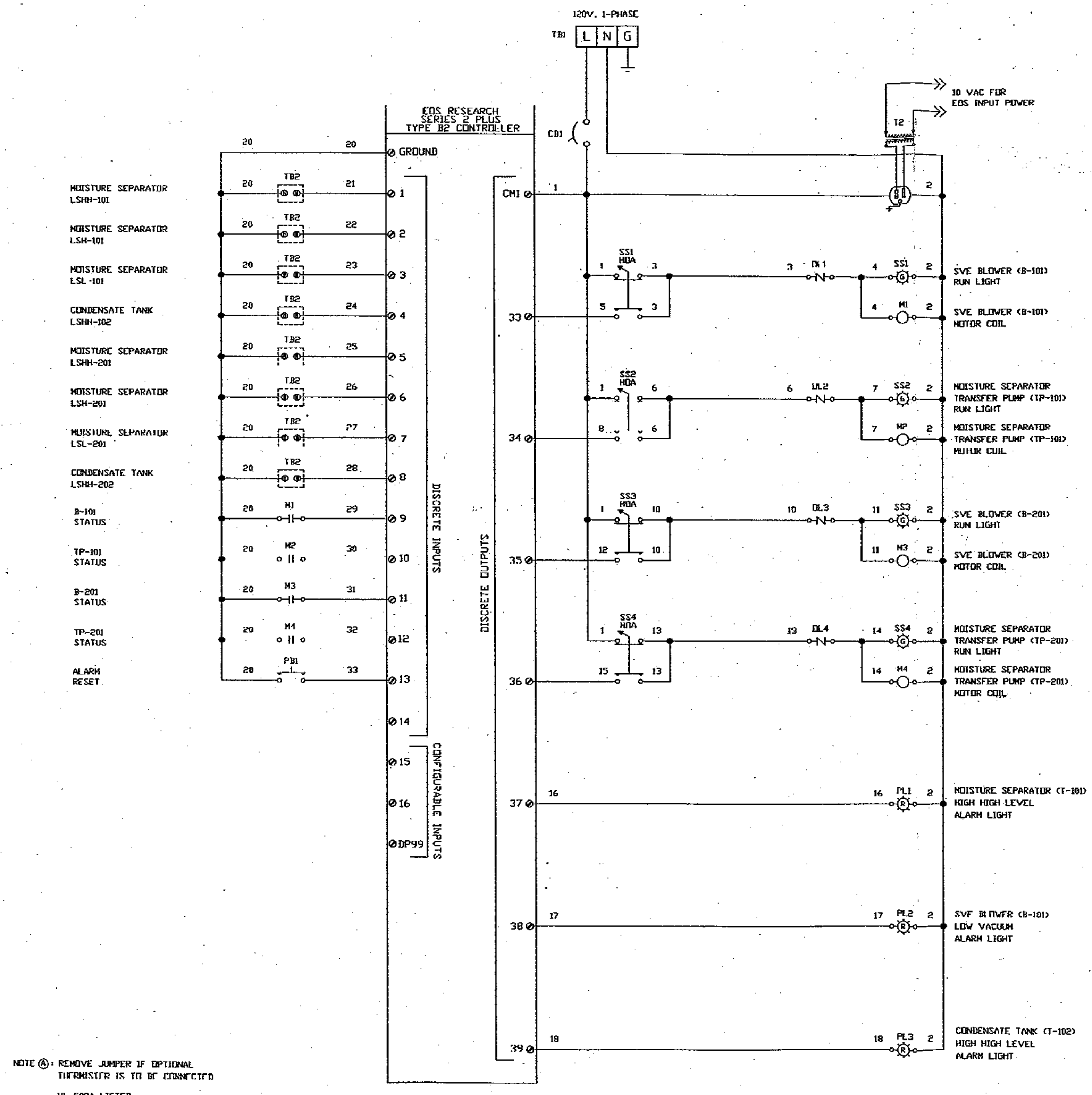
155 Oak Forest Road
Bluffton, SC 29910
Tel: (843) 706-5659

DRWN BY SDH	DATE 1/7/04	TITLE	CONTROL PANEL LAYOUT
CHK BY	DATE	ESC KINGSTON, NY	JOB NO. 11432
APPR BY	DATE	SCALE N/A · SIZE B · DWG NO. 11432RBS	SHEET 2 OF 4 · REV ASBUILT

REV.	DESCRIPTION	DATE	APPR.



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155 Oak Forest Road
Bluffton, SC 29910
Tel: (843) 706-5659

TITLE: CONTROL PANEL LAYOUT

DRWN BY SDH	DATE 1/7/04	ESC KINGSTON, NY		JOB NO. 11432
CHK BY	DATE			
APPR BY	DATE	SCALE N/A	SIZE B	DWG NO. 11432RBS
		SHEET 1 OF 4	REV ASBUILT	

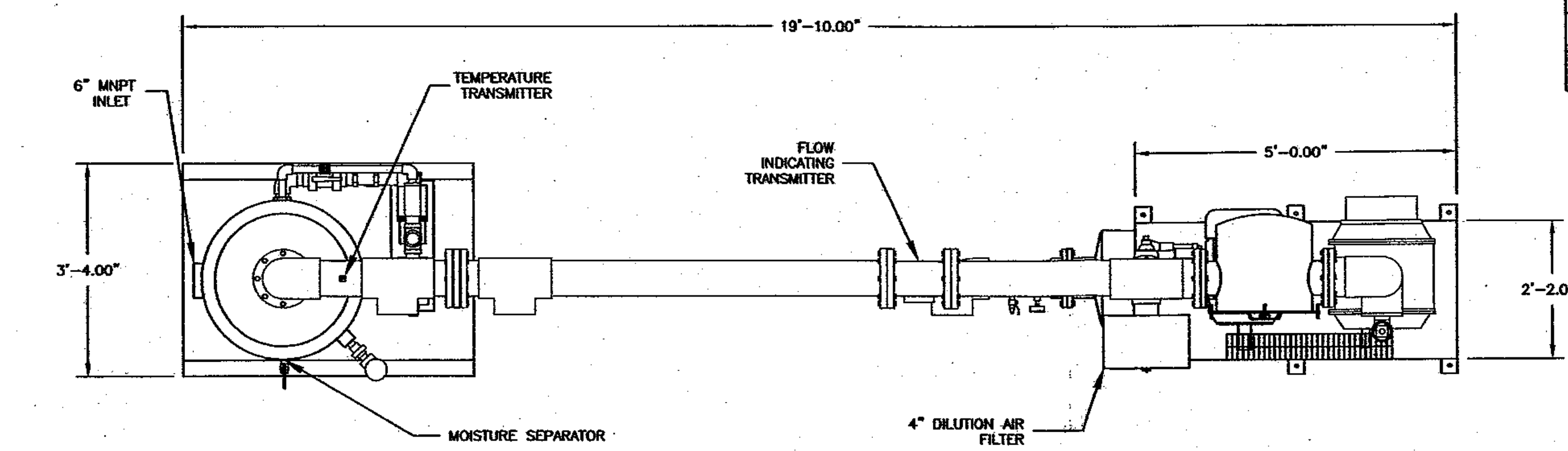
REV.	DESCRIPTION	DATE	APPR.

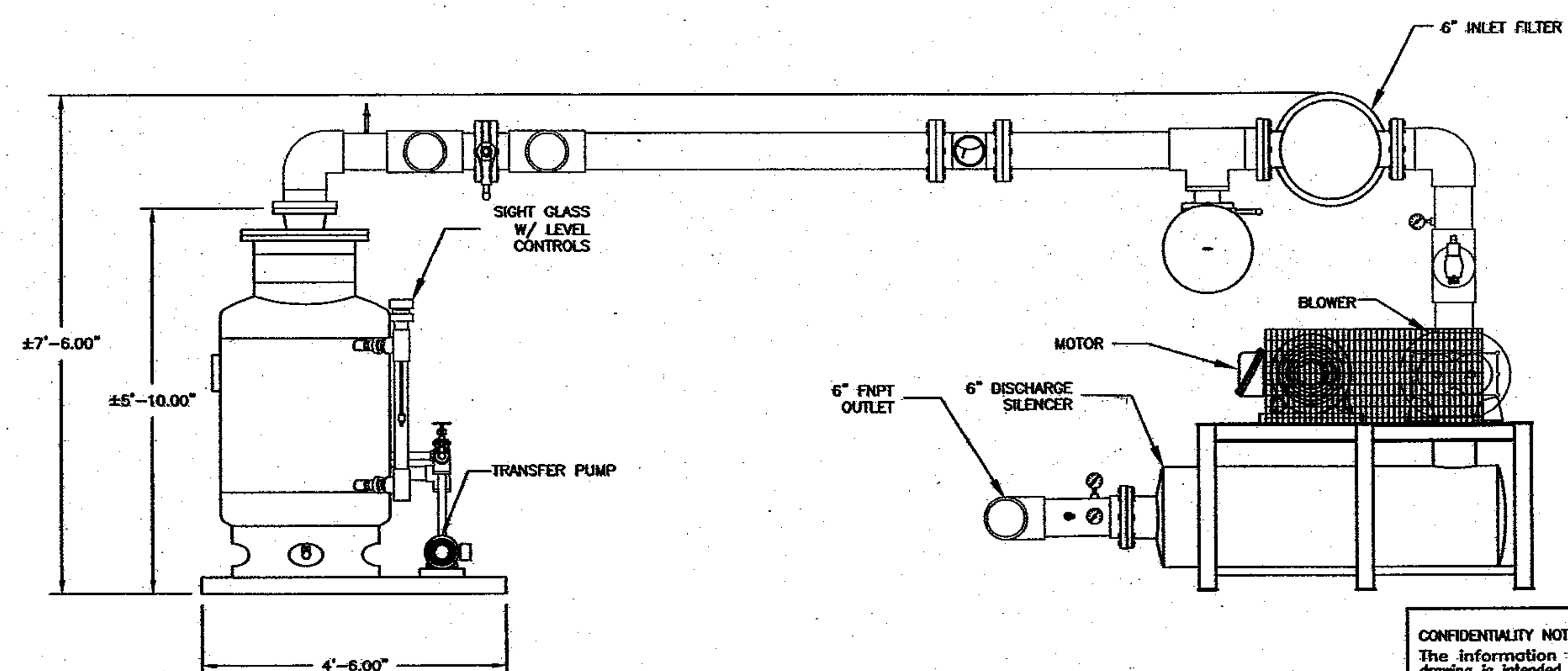
BISCO Environmental

Section 5 - System Drawings

- Vapor Extraction System Process & Instrumentation Diagram (P&ID)
- Vapor Extraction System Structural Layout #1
- Vapor Extraction System Structural Layout #2

REVISIONS			
REV.	DESCRIPTION	DATE	APPR.
1	RELOCATED TEMPERATURE TRANSMITTER	1/7/04	JAD





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[redacted]

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155 Oak Forest Road
Bluffton, SC 29910
Tel: (843) 706-5659

TITLE: VAPOR EXTRACTION STRUCTURAL LAYOUT

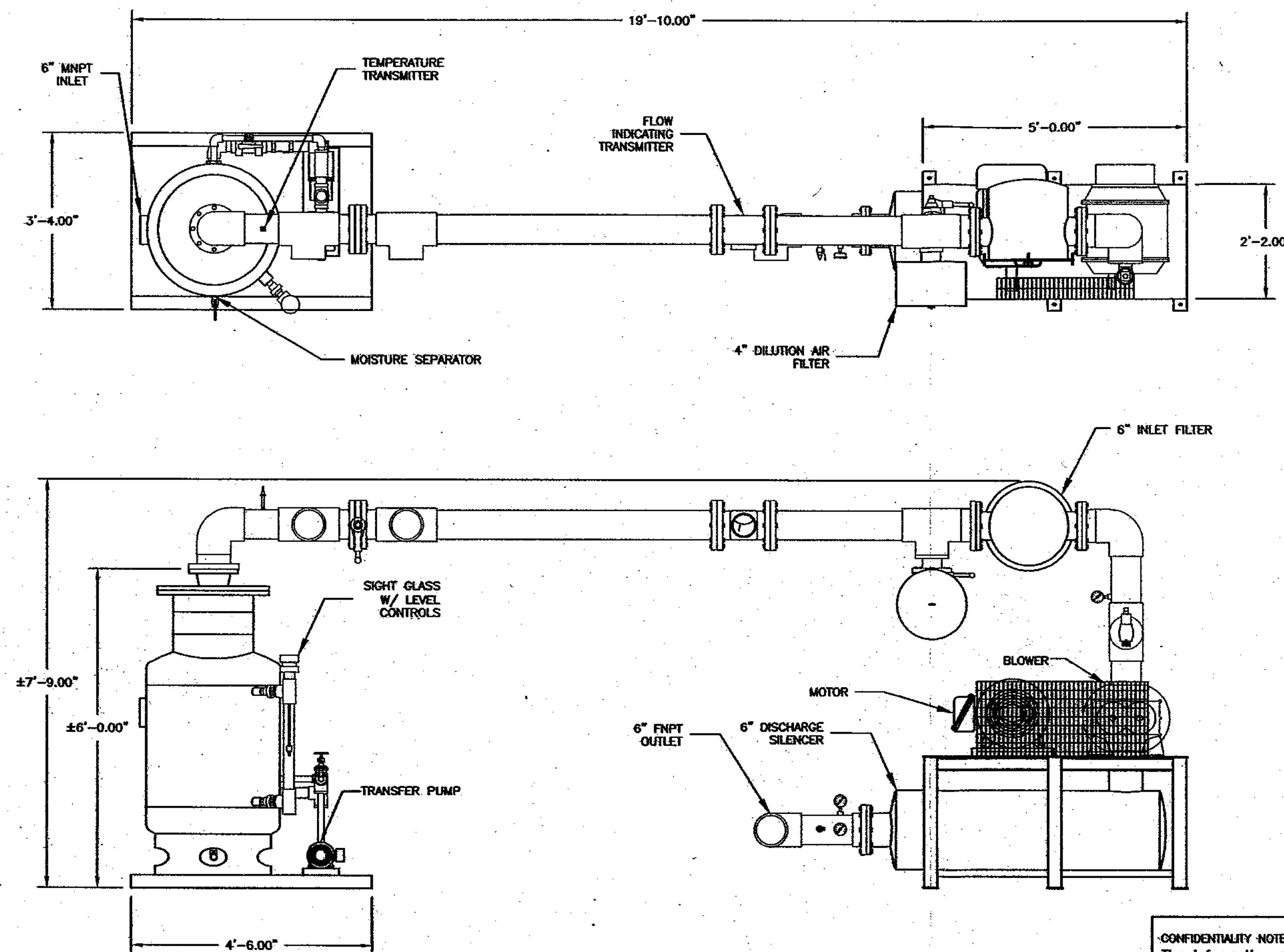
DRWN BY	DATE
DRF	12/19/03
CHK BY	DATE
APPR BY	DATE

ESC
KINGSTON, NY

JOB NO. 11432

SCALE	SIZE	DWG NO.	SHEET	REV
N/A	B	11432RBL-2	1 OF 1	1

REVISIONS			
REV.	DESCRIPTION	DATE	APPR.
1	RELOCATED TEMPERATURE TRANSMITTER	1/7/04	JAD



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155 Oak Forest Road
Bluffton, SC 29910
Tel: (843) 706-5659

DRWN BY DRF	DATE 12/19/03	TITLE VAPOR EXTRACTION STRUCTURAL LAYOUT				
CHK BY	DATE	ESC KINGSTON, NY			JOB NO. 11432	
APPR BY	DATE	SCALE N/A	SIZE B	DWG. NO. 11432RBL-1	SHEET 1 OF 1	REV 1

BISCO Environmental

Section 6 - Warranty

- Limitation of Warranty & Limitation of Remedy

Limitation of Warranty
&
Limitation of Remedy

All products not manufactured by BISCO Environmental carry the original manufacturer's warranty. Copies are available upon request.

BISCO Environmental warrants its packaged and manufactured equipment against any defect in material or workmanship, under normal use and storage, for a period of twelve (12) months from date of manufacture. In the event that products are found to be defective within the warranty period, BISCO Environmental's sole obligation and remedy shall be the furnishing of replacements for any defective parts, and such replacement shall be furnished but not installed by BISCO Environmental. BISCO Environmental will not be liable for special or consequential damages in any claim, suit or proceedings arising under this warranty, nor will BISCO Environmental accept any liability for claims for labor, loss of profit, repairs or other expenses incidental to replacement. The product warranty expressed above is our only warranty and may not be verbally changed or modified by any representative of BISCO Environmental. All freight costs incurred in shipping parts to or from BISCO Environmental or to the manufacturer if necessary, are at the expense of the customer.

BISCO Environmental expressly disclaims any warranties, expressed or implied, including any warranty of merchantability or fitness for a particular purpose or any warranty arising from a course of dealing or usage of trade. Except to the extent required by applicable law, BISCO Environmental shall not be liable, in tort, contract or otherwise, for any loss or damage, whether direct, consequential or incidental, of any person or entity arising in connection with the equipment.