WHEELABRATOR®
OPERATION & MAINTENANCE MANUAL

Dust Collector Model: JPSM 2D4

Sold To:

IMPERIAL DIE CASTING

Ship To:

2249 Old Liberty Road
Liberty, South Carolina
29657

Purchase Order No: 40444
Wheelabrator Serial Number: 2994

1600 CFM @ 10" S.P.

Table of Content

1. Introduction

1.1 Foreword

Enclosed in this manual you will find the necessary information to operate and maintain the equipment at its optimum efficiency with a minimum of maintenance and down-time.
If there are questions that need answered, please contact us directly at the address below and we would be more that happy to assist you in every way possible.

1.2 Introduction

The operation and maintenance of the Dust Collector should form an important part of every user's ***preventive maintenance*** and ***machinery operation program.***

1.3 Wheelabrator Contact Information

Technical:	**Wheelabrator** **1219 Corporate Drive,** **Burlington, Ontario, Canada** **L7L 5V5** **800-845-8508**	**Spare Parts:**	**Wheelabrator** **1606 Executive Drive** **LaGrange, Georgia, USA** **30240** **800-544-4144**

1.4 Customer's Responsibilities

The equipment will perform safely and reliably only when operated, maintained, and repaired in accordance with the instructions provided. Components must be checked periodically and repaired, replaced, or reset as necessary for continued safe and reliable performance. Defective equipment should not be used. Parts that are broken, missing, plainly worn or distorted should be replaced immediately with parts that are manufactured or sold by Wheelabrator. The equipment or any of its parts should not be modified without the prior written approval of Wheelabrator Engineering Department. The user of this equipment shall have the sole responsibility for any malfunction, which results, from improper use, faulty maintenance, or from parts that have been damaged or modified by anyone other than Wheelabrator.

2. General Safety

2.1 Safety Instructions

NOTE:
It is very important to read this Section before operating or maintaining this machine.

This **Wheelabrator** Operator's Manual has been specifically prepared for operating and maintenance personnel working with **Wheelabrator** Equipment.
The information in this manual is intended to provide an understanding of the equipment for a safer operation and maintenance procedures.

2.2 Safety Signs

The following safety signs may appear on and around the machine, it is important that their meaning is fully understood by all operators and maintenance personnel who will come into contact with the machine:

DANGER
Watch out for moving equipment

DANGER
No Smoking
Smoking in designated areas only.

NOTICE.

Keep Door Closed

All access doors into the equipment must be kept closed during operation.

DANGER

Starts Automatically

This equipment is controlled through the main control panel and once initiated by the operator and the system starts automatically.

Caution.

Wear Eye Protection

Eye protection must be worn at all times around this equipment.

Caution.

Lifting Points

Only lift the equipment for the signed lifting points.

3.0 Safety Instructions

LOCK IT OUT – THE LIFE YOU SAVE MAY BE YOUR OWN

DO observe all warning and precautions that are listed in this Operating and Maintenance Manual.

DO observe all the Safety and Warning labels posted on the machine and the Safety Program established by your management.

3.1 During Installation and Start-up

DO ensure all safety signs are in place.

DO check that all mechanical components and mountings are firmly fixed.

DO ensure that all air connections are mechanically and pneumatically tight. Loose pipe work can be dangerous.

DO double check that all pipe work connections have been made to the correct ports.

DO ensure all electrical devices are suitably fused, insulated and earthed.

DO ensure when checking the installation, make sure that this is done under fully safe conditions i.e. with any guards and other safety arrangements in operation.

DO ensure operation and maintenance personnel fully understand the design, functionality and safety related to the equipment

3.2 During Operation

DO NOT place the human body in contact with the compressed air system, i.e. do not attempt to block exhausting orifices by hand.

DO take care when making operating adjustments to flow regulators, cushion screws, etc., that threaded components do not blow out under pressure.

DO NOT attempt to remove silencers, exhaust port filters and other types of port fittings should not be removed while the system is pressurized.

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3.3 Operation and Maintenance Safety Instructions

Note: ***It is very important that you read this Section before Operating or Maintaining this machine.***

Operators and Maintenance Personnel

DO ensure the dust collector and associated equipment is operated by competent, trained personnel.

DO ensure at the time of start-up the Wheelabrator service technician has instructed the designated personnel of your company in the correct operation and maintenance of the equipment and that the Operator and Maintenance Personnel fully understand the machine function and safety.

Safety/Protective Clothing

DO wear Approved Personnel Safety Equipment for all operators/maintenance personnel.

- Safety Hat
- Hearing protection
- Eye protection
- Safety Boots
- Suitable protective Clothing

Good House-keeping

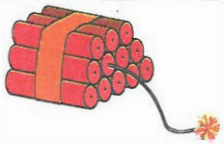
DO maintain a good state of housekeeping around the machine at all times.

DO ensure fines and oversize trash bins should be emptied regularly.

DO clean up any spilled abrasive immediately and ensure it is cleared, particularly from the floor and walkway areas.

DO ensure to designate the area around the shot blast machine as a **No Smoking** area.

DO ensure no combustible material i.e.; wood, paper, string etc be placed inside the machine.



3.4 Mechanical Safety Considerations

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Before performing maintenance on Wheelabrator Equipment, a Zero Mechanical State (ZMS) must be obtained:

DO ensure every power source that can produce mechanical movement has been locked off. This includes test actuation of the start initiator after lockout.

DO ensure pressurized fluid (air, oil or other) is locked off by shutoff valves.

DO ensure the mechanical potential energy of all portions of the machine must be at its lowest practical value.

DO ensure the kinetic energy of the machine members must be at its lowest practical value.

DO ensure loose or freely movable machine members and parts are secured against accidental movement.

Observe the following general safety rules and common-sense practices:

DO keep all guards in place, the only exception is during maintenance or repair work, special attention to safety should be observed at all times.

DO replace all guards upon completion of any work and if any guards are missing, report the safety violation immediately.

DO wear safety glasses at all times when working near or on blast equipment.

DO NOT wear loose fitting clothes.

DO NOT wear rings, watches or jewelry of any kind by maintenance or operators

DO keep the dust collector and the footing areas around the machine must be kept clean as loose abrasive can make footing dangerous.

DO ensure that if a mechanical component is jammed, disconnect all power to the machine.

DO obey all safety and danger signs and other precautionary information posted on the machine or in the machine operating area

DO ensure safe access to parts of the equipment, which are not accessible from either floor level or a fixed maintenance platform. Erect scaffolding or work from a hydraulic platform.

DO erect danger boards and barriers, particularly when working at high level, to safe guard other personnel in the area.

DO work in an adequately illuminated and ventilated area. Erect floodlights etc.

DO replace all worn or damaged parts with genuine **Wheelabrator** spares obtained from your local **Wheelabrator** representative.

DO ensure after service or maintenance work is complete, all inspection covers, guards etc. are replaced securely and test the machine operation before handing over to the machine operator.

3.5 Pneumatic Safety Considerations

DO ensure compressed air is de-energize & locked out. Like any other form of energy, can be dangerous if subject to misuse, not only in its basic form but also via the plant and machinery, which it is used to operate.

DO ensure that all equipment must only be operated within the correct design parameters for pressure and temperature. Care should be taken to guard against accidental valve operation either by the operator or a third party (e.g. cover for a foot-operated valve).

DO check where a valve or other component performs a critical function in a system, it should be used in such a manner that any failure in the component would cause the circuit to revert to a safe condition.

3.6 Electrical Safety Considerations

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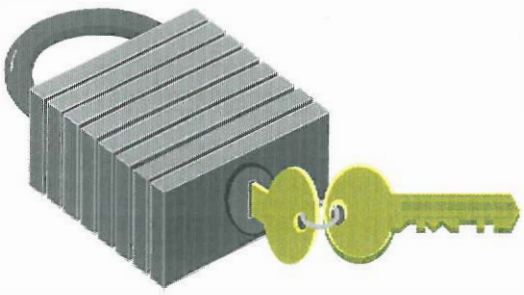
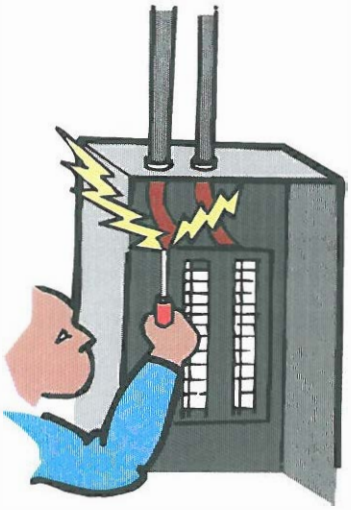


WARNING

BEFORE ANY MAINTENANCE WORK
IS CARRIED OUT ON THIS EQUIPMENT,
THE MAIN ELECTRICAL SUPPLY SWITCH
MUST BE IN THE "OFF" POSITION.
ANY PERSONNEL PREFORMING ANY
MAINTENANCE ON THIS EQUIPMENT MUST
FOLLOW ALL APPLICABLE PLANT SAFETY
STANDARD OPERATING PROCEDURES
SUCH AS LOCK-OUT, TAG-OUT, ETC...



DO NOT operate the machine with the electrical control panel door open. A door interlock should prevent opening the door unless the main disconnect switch is off.

DO NOT use oversize fuses or bypass any fuses. Always refer to the electrical drawings provided for the individual machines for proper fuse size.

DO ensure that all personnel working on the machine has their own lock to lockout and tagout the power before performing any work on the equipment.

DO use only overload coils for the motor starter(s) that are for the proper amperage ratings of the motor(s) as shown on the motor nameplate. Do not "bump up" the setting just to keep the overload from tripping. Find out why the motor is faulting before continuing machine operation. Repeated resets on the overload could damage the overload or the motor.

DO disconnect all power sources before attempting maintenance or repair of electric motors on the equipment.

DO ensure compatibility if replacing limit switches or contact blocks, ensure that a positive break contact is fitted. All replacement parts should be sourced through Wheelabrator.

DO NOT make contact with rotating parts of the motors, drives or driven components.

DO de-energize before starting the motor(s), check that the correct power supply (voltage, frequency and phase) is being used and that the motor(s) are connected per the connection diagram on the motor nameplate. Check the motor for the correct rotation.

DO NOT undertake any maintenance with the control panel isolator in the 'on' position, unless authorized to do so.

DO NOT use test meters on resistance settings to monitor:

a) any electronic units
b) any electronic height read out units
c) any DC shot solenoid circuits

As the voltage used by these meters could damage the components.

DO NOT over-ride safety interlocks, switches, etc.

3.7 Dust Collectors and Ventilation Safety Considerations.

3.7.1 Highly Explosive Dust

Products (parts), which produce highly explosive dust, such as **Magnesium, Titanium**, **Zirconium, Thorium**, etc., should not be processed in this equipment, unless appropriate safety measures are followed (consult expert authority). Obtain approval of your plant safety director and comply with applicable NFPA (National Fire Protection Association) guidelines.

Note: Personnel should not smoke, use matches nor have open flames around this equipment during operation.

3.7.2 Aluminum Media & Parts

Comply with all applicable sections of NFPA guidelines for processing or handling of aluminum dust and fines that may be pertinent to your specific operation.

In applications involving the use of dry type bag or cartridge dust collector system and Aluminum Media or surface blasting of Aluminum Parts, precautionary measures must be taken to minimize the risk of dust collector fires and/or explosions. The following procedures should be followed.

3.7.2.1 Adding Limestone – Dry Type Collectors

No. 200 mesh agricultural limestone ($CaCO_3$) should be added to the ventilation system at a continuous rate of 0.2 oz per hour per square foot of filter area. Caution: $CaCO_3$ is crushed limestone rock (not to be confused with lime, otherwise known as hot lime, burnt lime or hydrated lime. These highly reactive lime products should not be used).

3.7.2.2 Dust Collector Hopper(s)

The dust collector's refuse hopper(s) must be emptied at frequent intervals and at the end of each shift of operation. Collection of more than 1/3 the hopper capacity should not be exceeded. If external containers are used to collect refuse, they must never be allowed to overfill and back up into the collector hopper. All equipment must be grounded in accordance with the National Electrical Codes (NEC) to minimize static electric charges.

3.7.2.3 Ductwork Velocity – Aluminum Applications

Maintain ductwork air velocity of not less than 4500 FPM.

All abrasive blast equipment must be properly ventilated to be environmentally effective. This benefits the operator, the machine efficiency, and minimizes wear and maintenance.

DO keep the dust hoppers as empty as practical.

DO keep the dust drums at the end of the operating day or more frequently.

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3.8 Additional Training

DO ensure that a regular maintenance program using trained personnel is established. Wheelabrator conducts Operating and Maintenance Schools several times each calendar year for our user customers.

These O & M Schools train our customers' operating and maintenance personnel in proper procedures. At these schools, there are opportunities for the individual attendees to request assistance on special problem areas or to pass on experience that could be of benefit to other attendees.

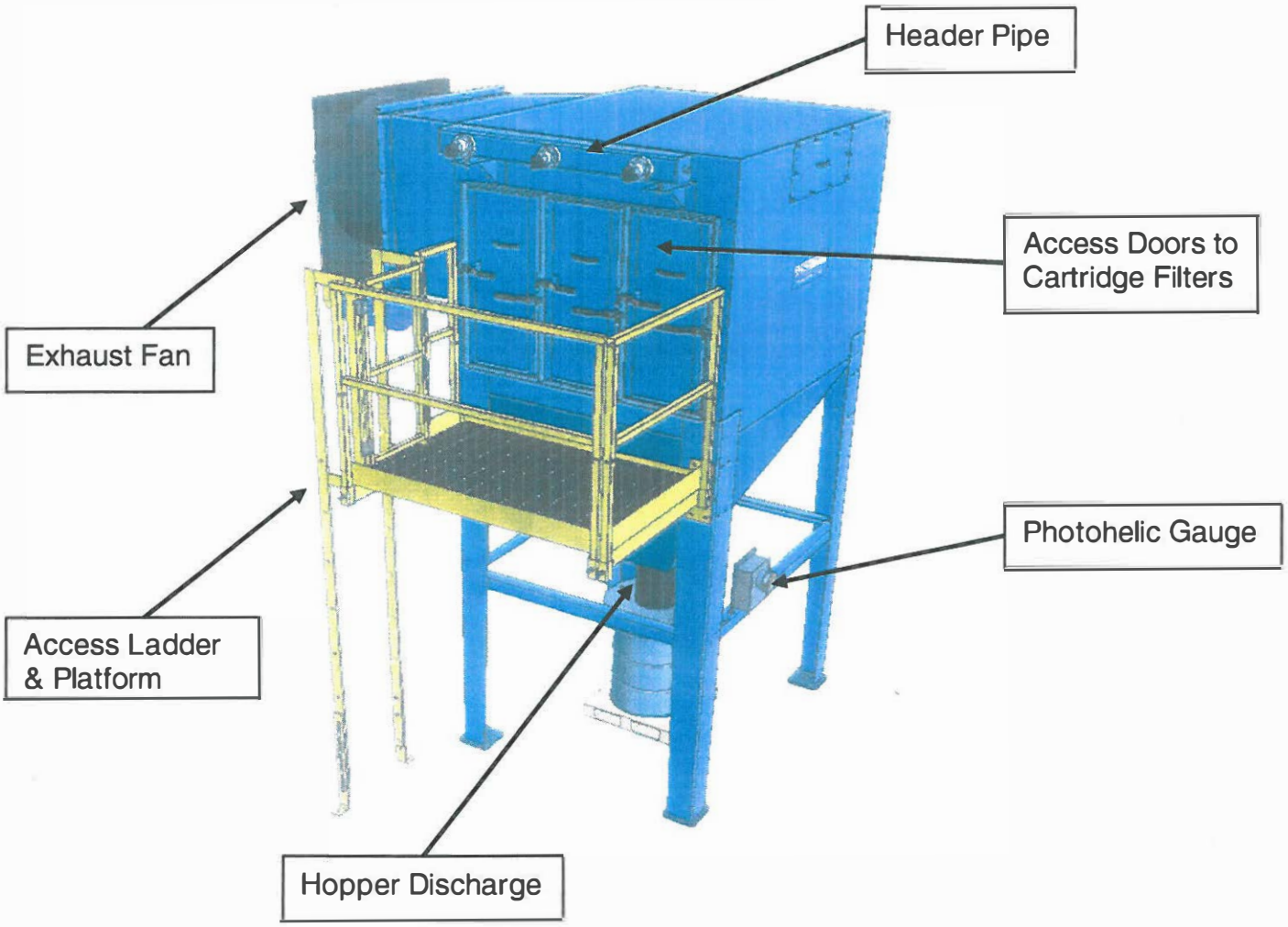
3.9 Hot Work

To carry out any "hot work" i.e. arc welding, gas cutting or grinding in or around the machine, extra care must be taken to prevent any potential source of ignition. The waste product of the shot blast process is fine dust which when subjected to these conditions, may be combustible. In the unlikely event of any ignition being discovered in or around the machine, the Fire Brigade must be informed.
Observe your own company safety regulations in addition to any listed here.

4.0 "JPSM" – Series Cartridge Dust Collector - Group No 30

4.1 Jet Pulse Slide-in Cartridge

The information and drawings contained in this manual have been issued to help in the installation, operation and inspection as well as to provide a reference for ordering repair parts as needed.
We recommend that you familiarize yourself with the drawings and pamphlets listed in the Table of Contents. This material has been included to aid in the proper operation, maintenance and servicing of this collector. With the proper care and maintenance, your machine will provide maximum performance and long service.



4.2 Dust Collector Theory of Operation

The Cartridge Type Dust Collector is a continuous automatic, suction type Dust Collector capable of filtering dust-laden air through a porous filter media.

The dirty or contaminated air enters the dust collector through the module inlet, the air is distributed uniformly throughout the housing and heavy particulate drops out into the hopper. The dust-laden air then passes through a number of filter elements, which retain the dust particles on the exterior surface while allowing the clean air to pass through to the module outlet.

As the collector operates, the collected dust begins to form a dust cake on the filter element, which will increase the filtration efficiency while diminishing the ability of the filter element to pass air. This increased resistance is measured by a differential pressure gauge and is defined as the differential pressure (or pressure drop). As the dust continues to build up, the system resistance will increase, decreasing the ventilation volume.

To maintain the optimum efficiency and correct pressure drop, a cleaning cycle is employed to provide continuous cleaning of the filter element. This is accomplished by a timer or differential pressure setting, which energizes electric solenoids, activating the diaphragm valves. The diaphragm valves deliver a momentary pulse of compressed air through the manifold pipe and into the venturies. The venturies, which act as natural jet pumps, induce secondary air several times the original volume. This creates a reverse airflow through the row of filters, removing the dust build-up.

This cleaning process occurs on a row by row basis via the timer board and pressure switch, thus, only a fraction of the total filter air is interrupted for cleaning allowing continuous ventilation.

The dust cake, when pulsed from the filter elements, falls directly into the hopper where it is discharged into a drum or screw conveyor below the hopper.

NOTE: The dust collector hopper is not designed to store the contaminant as any build-up within the hopper can be re-entrained into the air stream and deposited back into the filter elements

4.3 Pulse Cleaning System Components:

- Differential Pressure Gauge
- Timer and Controls
- Internal Components
- Cartridge Type Collector Filter Locking Mechanism
- Solenoid Valves
- Air Piping

4.4 Filter Element Installation

Make sure that the cartridge clamping beams are positioned so that they are in the lowest position.

Check filter elements to ensure that they are not damaged in any manner and that the gaskets are secured at the top of the element and not damaged.

Slide-in element, complete with the top plate onto the locating side slide rails.
Push each filter into the collector until the element stops. Repeat this procedure by sliding appropriate number of elements (3, 4, and etc.) until the row is complete.

Alignment of filters to Venturi is automatically accomplished by the self-aligning top plates once all elements are in their respective row.

By means of cam type locking mechanism, turn the cam rod using the hex nut and lock the filters in place. Repeat procedure on each cam mechanism. The filter element seal is now properly compressed.

Close maintenance/access doors tightly to obtain a good seal.

NOTES:

- The filter element head gasket must be compressed to prevent leakage.
- Proper storage of filter elements is essential in maintaining maximum collecting efficiency of your Air Pollution Control Unit.

4.5 Pre-Commissioning, Start-Up and Shutdown of the Cartridge Dust Collectors

The following should be checked and corrected before introducing dust laden air into the filter:

When servicing any electrical components, make sure that the electrical supply has been disconnected and secured. (Lockout and Tagout)

Shut off and bleed the compressed air supply before servicing the cleaning system. (Lockout and Tagout)

A moisture separator and an air regulator must be installed prior to the inlet on the compressed air manifold. The separator should be checked and drained, (if not self-draining), daily. Separator & regulator should be located indoors to prevent from freezing in cold weather.

If the collector is installed outdoors in cold weather, a compressed air dryer should be installed in front of the compressed air connection, with coalescing and particulate filters and drains. (Dryer should be located indoor)

Inspect the interior of the hopper to ensure that the discharge area is completely free of debris and unwanted materials.

Check filter elements for proper fit against the tube sheet (cell plate).

Make sure that the filter element locking cams are in the correct position and the element gasket is securely compressed against the tube sheet.

Ensure that the access doors are closed and properly secured and sealed.

Check to ensure the collector is fitted with a differential pressure gauge. The gauge should have a zero reading prior to starting the fan. Be sure that lines are clean & unobstructed, and connections are tight.

Important: If the photohelic pressure gauge supplied,
High set point at 4.5" Differential Pressure.
Low set point at 2.0" Differential Pressure.

Check the drive system for the exhaust fan (i.e., tensioning of V-belts; proper alignment of sheaves) and ensure hold-down bolts are tightened properly. Refer to Fan Operation (auxiliary Section).

Test start (bump) the exhaust fan motor to ensure proper wheel rotation.

Start mechanical dust handling system. Screw conveyor(s) and/or rotary air lock valves. (Where applicable)

Start the exhaust fan under throttled conditions to ensure design volume is not exceeded.

Note and record the differential pressure reading. The system should be allowed to operate in the "throttled" position, starting with low to medium volume flow until the differential pressure reading reaches 4" to 5" W.G.

NOTE: **To avoid filter blinding & other possible damages due to condensation, the following measures shall be considered: If high humidity is expected in the gas stream (or low skin temperature due to cold weather), it is necessary to preheat the system so that the module skin temperature of the complete dust control system is above the dew point temperatures. Instrumentation should be adjusted to maintain the gas temperature above the dew point of the gas stream and below the maximum limit of the filter media. If condensation persists due to cold weather (specially for outdoor units), complete thermal insulation and skin heat tracing,(or drying) may be required.**

Important - **For new installation or new replacement filters it is advisable to start gas flow at low to medium rate, until pressure drop reading reaches minimum 3"w.g. before pulse cleaning. The idea is to allow a gentle and gradual initial accumulation of dust coating on the new filter to ensure high filter efficiency. This precondition procedure will also help prevent premature filter blinding & prolong filter life.**

After the unit is in operation, the system can be fine-tuned by adjusting the "DWELL TIME" on the sequence timer panel to obtain the desired results.

NOTE: **Do not operate system without cleaning system actuated. Prolonged operation without cleaning will permanently plug the filter and cause premature cartridge failures.**
Typical operating pressure drops indicated on the differential gauge:
3" - 5"w.g.
Typical "DWELL" time: 5 to 20 seconds depending on dust loading etc.

Skip steps 16 & 17 if Photohelic pressure gauge is provided.

When the Photohelic high point (4.5") and low point (2") are set, the jet-pulse system will automatically start cleaning when differential pressure reaches its high set point. Pulsing will continue until differential pressure back to its low set point. Photohelic will provide a start & stop, the timer will provide sequencing for the cleaning.

At this point, start the pulse cleaning system. The timer "dwell-time" should be set for 15 second pulse frequency and should be increased or decreased if the differential pressure begins to climb or fall beyond the 3" to 5" range.

Slowly, and in small increments, open the fan damper if applicable. Observe differential pressure reading for the effect on resistance. Increase or decrease the timer setting to pulse as required to maintain a differential pressure reading between 3" and 5" W.G.

Continue over the next few hours by opening the fan damper until design volume is reached or adequate ventilation have been attained at the dust control hoods.

With the collector operating at design volume, the pulse frequency should ideally be set for the fewest pulses/minute while holding the pressure differential across the filter at a stable condition above 3" W.G.

NOTE:
Differential pressure recordings between 1"& 6"can be considered normal. During some instances, the differential pressure may creep beyond 6" W.G. due to surge dust loading, moisture, etc. This can also be considered normal, provided the differential pressure can be regained after the surge.

When replacing cartridge filter elements, always make certain that they are tightly sealed so that the gasket ends will maintain an effective seal between the clean and dirty air tube sheet of the collector. Be sure to check for torn gasket and Perform 'pre-conditioning' procedure for all new filters.

The dust collector is an automatic, self-cleaning filter, once it is placed in service, it requires little maintenance effort to ensure satisfactory performance. It is recommended that units be thoroughly inspected at least once every month, to maintain optimal performance and to minimize potential for equipment downtime.

Inspection of the unit should include checking the differential pressure across the filter elements to note any abnormal changes. Check pulse valves & compressed air line to make sure no leakage or blockage (cause by dust build up or freezing.

A semi-annual maintenance inspection should be accomplished to included the following:

- Check doors to ensure gaskets are maintaining a seal.
- Visually check the cartridge filters to note their general condition.
  If cartridges show wear or damage, they must be replaced.
- Inspect and observe operation of the compressed air system to ensure that an adequate air supply exists. A pressure regulator/indicator is a useful device for this purpose, placed at the dust collector compressed air receiver.

Note:
Dust collector filters will become plugged if exposed to water, moisture or oil. Avoid over cleaning of the filter. Shut down the timer for prolonged period of work stoppage when system is not handling dust-laden air. (specially for continuous timer control cleaning)

The dust collector is now ready for operation!!!

4.6 General Exhaust Ducting

The Exhaust system shall be constructed with materials recommended below and shall be installed in a permanent manner. The interiors of the pipes and fittings shall be smooth and free of constructions to minimize the resistance to air flow, and reduce wear. The system shall be as air tight as possible, except where air is intended to be drawn in or out.

Duct gauge requirement:

Size Duct	Straight	Elbows	Material
Medium Duty :			
4" to 18"	18 ga	16 ga	Steel / Galvanized
Over 18"	16 ga	14 ga	Steel / Galvanized
Heavy Duty :			
4" to 30"	16 ga	14 ga	Steel / Galvanized
Over 30"	12 ga	10 ga	Steel / Galvanized
Extra Heavy Duty :			
4" to 30"	14 ga	12 ga	Steel / Galvanized
Over 30"	12 ga	10 ga	Steel / Galvanized

Air Flow Controls:

The butterfly type adjustable dampers give better control than any other type of dampers. Usually a ready-made butterfly damper of the same diameter and the same gauge thickness is recommended.

In the situation where butterfly dampers are not available, a suitable sized Sliding type blast gate (full gate design) is recommended.

Pipe Construction:

Exhaust systems should be constructed with materials suitable for the conditions of service and installed in a permanent with good workmanship practices. To minimize friction loss and turbulence, the interior of all ducts should be smooth and free from constructions – especially at joints. Ducts usually are constructed of steel, which has been welded, flanged and gasketed or of welded galvanized sheet metal.

Round duct is recommended for most of the dust collection systems.

Rectangular duct should only be used when space requirements preclude the use of round construction. Rectangular ducts should be as nearly square as possible to minimize resistance.

Longitudinal joints or seams should be welded. All welding should conform to the standards established by the American Welding Society (AWS) structural code.

Elbows and bends should be a minimum of 2 gauges heavier than straight lengths of equal diameter and have a centerline radius of at least 1.5 and preferably 2 times the pipe diameter. Large centerline radius elbows are recommended where highly abrasive ducts are being conveyed.

Elbows of 90 degrees should be of a five-piece construction for round ducts up to six inches and of seven-piece construction for larger diameters. Bends less than 90 degrees should have a proportional number of pieces. Prefabricated elbows of smooth construction may be used.

Transitions in mains and sub mains should be tapered. The taper should be at least 5 units long for each 1 unit change in a diameter or 30 degree included angle.

All branches should enter the main at the center of the center of the transition at an angle not to exceed 45 degrees with 30 degrees preferred. To minimize turbulence and possible particular fall out, connections should be to the top or side of the main with no two branches entering at opposite sides.

5.0 Inspection Schedule

Please refer to the Daily and Weekly Checklists – this section is an expanded description of those lists.

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The most important function and one that cannot be emphasized too strongly in the preventative maintenance of the dust collector is that of regular visual inspection. The dust collector does not usually break down suddenly but will show gradual wear over time. Regular inspection will give plenty of warning, so that repairs can be made before unnecessary damage is done to other components. The required frequency of inspections will vary depending on the application and usage.

Before performing any internal inspection or maintenance on your machine or associated equipment, make sure that the proper shutdown procedures have been executed and that all pressurized elements have been depressurized appropriately, and the machine is electrically isolated.

In addition to this manual, be sure to read all manufacturers instructions before performing any maintenance work and follow their recommendations with regard to safety procedures and safe working practices.

A good inspection and maintenance program is the best assurance of a productive machine.

For safety and performance, always use genuine Wheelabrator replacement parts.

Reduce maintenance and operating costs by preventing breakdowns before they occur.

Preventative maintenance is that part of overall maintenance, which aims to prevent unexpected failure of the machine. A log should be kept of all inspections and maintenance operations. Listing parts replaced; when and who by. Frequent inspection determines what maintenance is required and whether or not a maintenance operation should be performed immediately or may be safely deferred until the next scheduled maintenance period.

Only experienced personnel should perform the inspection. Inspectors should be thoroughly instructed and experienced in both the function and adjustment of the various components.

Due to the nature of the equipment to be inspected, suitable protective measures and equipment should be utilized as necessary to the task being undertaken.

The following section will indicate the work to be undertaken to service the machine on a routine basis.

Where items are listed below as "check", it is to be understood that this also means that any appropriate remedial action found to be required should also be undertaken.

Control Panel:

- Check for a dirty control panel which would indicate failing door seals.
- Inspect for any signs of loose or failing electrical components or loose wiring
- DO NOT operate the machine with the panel doors open

6.0 Inspection Checklist

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Daily Inspection Checklist

Date: _____ **Checked By:** _____ **Wheel Hour Meter:** _____

Inspection Item	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Remarks
Pre-Production								
Visual inspection of the machine								
During Production								
General machine operation								
Dust collector photohelic gauge								
Dust collector afterfilter magnehelic gauge								
Dust Emissions								
Dust collector pulse valves are operating								
Dust collector – drain water from header								
Dust discharge drum								
Compressed air leaks								
Drain water traps								
Gearbox condition and any leaks								
Post-Production								
Check for debris around machine								
Check dust collector drum								

Comments:

_____

_____

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Weekly Inspection Checklist

Date: _____ **Checked By:** _____ **Wheel Hour Meter:** _____

Inspection Item	*Checked*	*Remarks*
Pre-Production		
Visual inspection of the machine		
During Production		
General machine operation		
Dust collector photohelic gauge		
Dust collector afterfilter magnehelic gauge		
Dust Emissions		
Dust collector pulse valves are operating		
Dust collector – drain water from header		
Dust discharge drum		
Compressed air leaks		
Drain water traps		
Gearbox condition and any leaks		
Post-Production		
Check for debris around machine		
Check dust collector drum		

Comments:

_____

_____

7.0 Troubleshooting

Before attempting any troubleshooting, maintenance personnel and operating personnel should become thoroughly familiar with the machine.
Before making any repair or replacement of defective parts, it is very important that the reason for the original failure be determined and corrected. A failure to correct the cause of the problem will inevitably lead to a reoccurrence of the problem, etc.

Potential Problem	Probable Cause	Solution
Group No 19 – Ducting (Ventilation System)		
Abrasive carryout to dust collector.	Too much air	Close blast gate slightly
Fines and contaminants not properly removed from abrasive	Too little air or improper separator adjustments	Open blast gate slightly
		Check for build-up of particles near blast gates – remove.
		Check dust collector discharge container – empty at regular intervals.
		Overloaded ventilation system cannot function properly. Check for holes in flexible hose and any obstructions. Repair/remove. System should be as free as possible from air leakage
Loss of abrasive – carryout of good abrasive from machine	The dust collector is delivering too great a flow of air.	Close the dust collector blast gate slightly for proper ventilation.
Contaminated abrasive – fines and contaminants not properly removed from abrasive	Insufficient flow of air through separator to collector delivered by the dust collector.	• Check exhausts fan rotation. • Open blower exhaust gate. • Check Magnehelic reading. • Check pulse operation of collector and increase, if necessary. Replace filters, if necessary
Group No 30 - Dust Collector		
Visible Stack Emissions	Improperly Installed Filters	Check to ensure that the locking cams are fully locked.
		Check to ensure that venturi lip is located within the gasket.
		Check and make sure all gaskets are properly seated and compressed against the tube sheet.
		Check and make sure for respective number of filters installed inside the housing.

7.0 Troubleshooting

Potential Problem	Probable Cause	Solution
Group No 30 - Dust Collector – continued		
	Dirty/Clean Air Plenum.	Always clean the tube sheet when dust accumulation is present.
		After filter failure or sometimes during routine filter change-outs, dust can accumulate in dead air zones on the clean air side of the unit.
	Torn or Punctured Filters	Inspect filters for tears or punctures caused by mechanical damage, abrasion, thermal or chemical attack. Replace filters as and where required.
High Differential Pressure	Over Volume	Check fan and motor speeds and V-belt drive ratio.
		Reset fan damper or fan speed to handle collector design volume.
	System Resistance Static is too low	Re-calculate ductwork design to ensure proper static losses. If too low reduce fan speed or add system resistance with balancing dampers.
	Plugged Magnehelic Line	Check and clean out if lines are plugged
	Lack of Compressed Air	Check pulsing system for compressed air leakage and seal as required.
		Check compressor output to ensure it exceeds pulse cleaning system usage, Add extra volume as required.
		Compressed air pressure too low - increase line pressure from regulator - compressor. (Not to exceed 90 p.s.i.)
		Check clogged feed lines for oil, water, rust or debris.
	Malfunctioning Timer	Check timer outputs to ensure all terminals are firing. If timer is faulty, return to Int'l Surface Preparation for repair.
		On some system, all the channels may not be used. A faulty channel may be bypassed and a spare channel used in this case.

7.0 Troubleshooting

Potential Problem	Probable Cause	Solution
Group No 30 - Dust Collector - continued		
High Differential Pressure	Dust Re-Entrainment	Check dust removal system for worn or faulty seals. Repair or replace as required.
		Check mating flanges - apply gasketing and/or tighten fasteners as required.
		Dust disposal system plugged or jammed - clean and check disposal system for capacity. Speed up system, install vibrators or enlarge hopper opening as required.
		Check baffle for abrasion and wear.
	Dust on Clean Air Side	Check tube-sheet floor and clean as necessary to prevent dust from entering cartridges from clean air side.
		Check inside of filters for dust and empty as required. Dust in filters will cause stack emissions on a cycle synchronized with pulse blasts.
	Filter Blinding	Check system so that oil or free moisture is not entering the filters either from the process or the compressed air system.
		Check fan to ensure collector was started under ***throttled*** conditions. Extra high speed impingement of fine particles on new media can permanently blind filter media.
Inadequate System Volume	Fan Rotating Backwards	Check rotation of fan and correct if necessary.
	Fan RPM & Volume Too Low	Check drive ratio between fan and motor. Check drive for slippage - re-tighten or replace as required.
		Fan damper improperly adjusted. Check damper position and adjust to maintain collector design volumes.
	Leakage in System	Check all ducting and flanges to and from collector for leaks. Re-gasket and tighten fasteners as required.
	System Resistance Static Too High	Re-calculate ductwork design to ensure proper static losses. If too high, increase fan speed or lower system resistance by changing ductwork and/or hoods.

7.0 Troubleshooting

Potential Problem	Probable Cause	Solution
Group No 30 - Dust Collector - continued		
Inadequate System Volume	System Resistance Static Too High	Check ductwork for material build-up or blockages. Clean and re-design if necessary.
	Blinded Filters	Inspect filter elements for possible blinding
		Blinded filters usually result in high differential pressure. Clean with fan off until differential pressure drops off. If differential pressure is still high, install new cartridges.
	Fugitive Air Entrainment	Check all doors and cover plates for proper sealing.
		Check all ductwork flanges for airtight seals. Apply gaskets and retighten fasteners.
Low Compressed Air Pressure At the Header	Sticking Solenoid Valves	Check solenoid plungers for dirt. Clean or replace as required.
		Short circuit in wiring may cause one or more solenoids to remain open - check wiring and repair or replace as required.
	Pulse Time is Too Long	The "Pulse Time" is factory preset and sealed at 100 m/s elect. time maximum. If this has been tampered with, set back to original setting of 100 m/s.
	Sticking Diaphragm Valves	Check for torn or damaged diaphragms.
	Debris in Diaphragm Valves	Check for dirt, desiccant, oil or ice on diaphragm. Clean or replace as required. If oil, water or ice is present, repair or install dryer on compressed air system to eliminate.
	Leaks in Compressed Air Piping	Inspect compressed air lines for leaks and seal failure.
	Insufficient Supply of Compressed Air	Check capacity of air compressor to ensure proper sizing. See Detail of Order to determine demand of unit. Also check for undersized branch lines in compressed air run.
	Header/Air Valve Connection is Faulty	Inspect connection and repair as required.

7.0 Troubleshooting

Potential Problem	Probable Cause	Solution
Group No 30 - Dust Collector - continued		
Filter Element Problems (Poor Life, Blinding, etc.)	Check System Operating Temperature Against Filter Media Rating.	Lower temperature of system or refurbish with media suitable to higher temperatures encountered.
	Check Physical and Chemical Characteristics of process Against Filter Media Rating.	Adjust system gas stream or install new media compatible with gas stream.
Check Abrasion Patterns on Collector Walls, Baffles, Etc.	Check Material Build-up in Hopper	Inspect dust disposal equipment for proper operation. Repair as required.
		Check for hopper bridging.
		Install vibrators, poke hole, etc. or enlarge discharge opening.
	Incorrectly Installed Filter Elements	Check for proper seating of filters to tube sheet.
	Dirty/Clean Air Plenum	Inspect tube sheet floor for dust accumulations. Dust on tube sheet can reenter into the inside surface and blinding the filters by reverse pulse-jet cleaning action.

7.0 Troubleshooting

Potential Problem	Probable Cause	Solution
Group No 96 - Electrical		

Note: DISCONNECT ALL ELECTRICAL POWER SOURCES BEFORE ATTEMPTING MAINTENANCE OR REPAIR.

Electric Motors do not Start	Main power cable disconnected at electrical source.	Check main power cable at electrical source. Must be 230, 460 or 575 volt, 60 hertz, 3 phase
	Blown Fuses	Check fuses. Replace if defective.
	Applicable motor starter overload relay trips out	Reset starter.
Electric Motors do not Come Up to Speed, Run Slow	All phases of 230 or 460-volt supply not connected properly.	Recheck wiring for loose or improper connections
	One fuse blown in disconnect box.	Check all fuses. Replace as required.

7.0 Troubleshooting

Potential Problem	Probable Cause	Solution
Group No 96 - Electrical		
Overload Relay	Overloads trip out.	Do not increase the overload setting; check load with ammeter; compare with overload relay setting. If load is excessive, determine cause and correct.
Contacts and Contact Springs	Contacts badly pitted	Replace
Fuse Protection	Fuses blow.	For the occasional "blow", fuses may be loose in fuse holders, or temporarily overloaded. If persistent, check for grounded circuit, bare wire.
Overload Relays Trip continuously	Overload in circuit low power.	Shut down particular circuit. Check power source for proper voltage
	Broken, damaged or loose wiring.	Inspect wiring for broken, cut wires and loose terminals. Replace/repair as required
	Dirt or contaminates at terminals.	Clean contacts and terminals
Pushbuttons	Buttons stick.	Probable cause – abrasive dust. Remove cover and clean.
	Erratic Operation	Check contacts for dirt, springs broken or out of place.

8.0. Mechanical Engineering Drawings

Drawing Number	Group Number	Description
A1-76677	30	Dust Collector – JPSM 2D4
A1-72021	30	Dust Collector Jet Pulse Arrangement
A2-39186	30	Dust Collector Header Pipe & Diaphragm Valve
A1-66953	30	Dust Collector Door Assembly
A3-27841	30	Dust Collector Photohelic & Timer
A2-26625	30	Rotary Valve Assembly
A3-43483	30	Dust Collector Fan Data
A3-24239	30	Dust Collector Discharge Assembly
A2-19860	30	Pressure Relief Door
A1-71195	30	Service Access

9.0. Electrical Engineering Drawings

Drawing Number	Group Number	Description
DE00005R	96	4 Chnl Pulse Board – Photohelic Connection

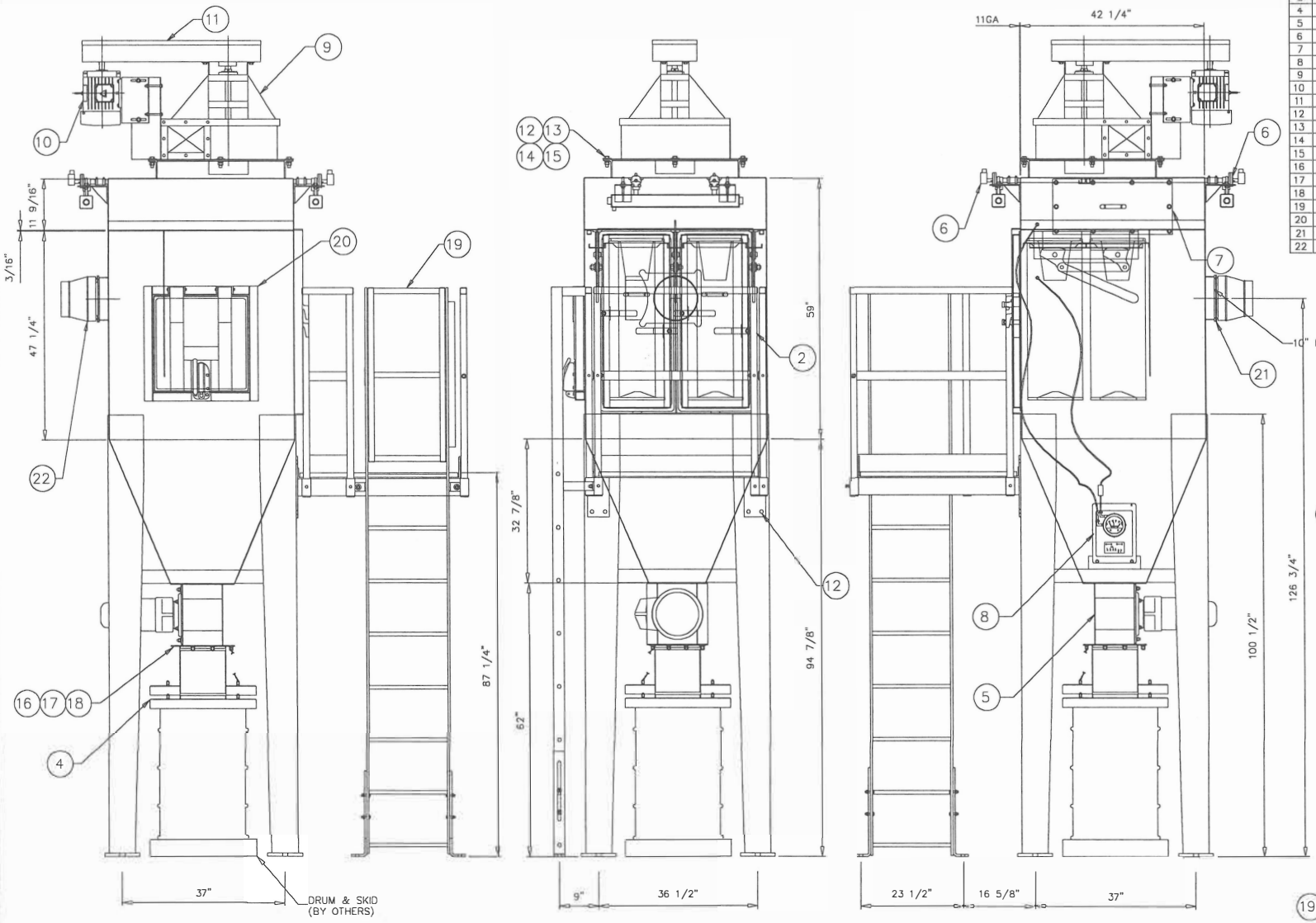
10.0. Spare Parts List

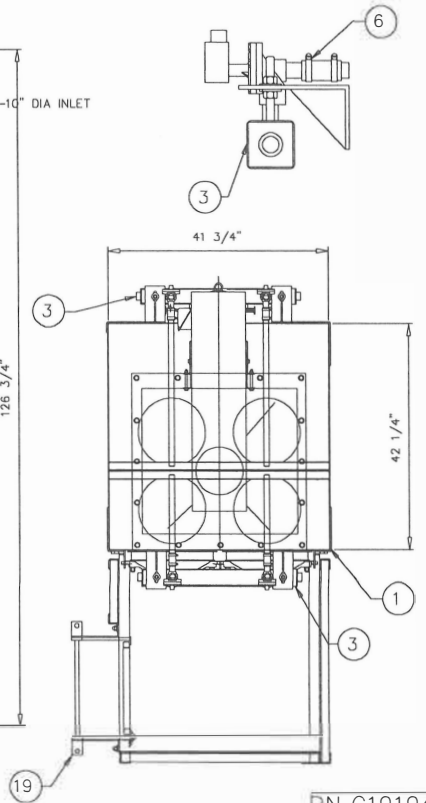
Qty.	Part #	Description	Lead Time
4	C181144	Filter Cartridge 36" – Flame Retardant	Normally Stock
1	C106586	Inline Compressed Air Filter	Normally Stock
1	C52665	Pulse Control Valve c/w Solenoid	Normally Stock
2	C83106	Pulse Control Valve Repair Kit	Normally Stock
2	C150221	Fan V-Belt B-85	Normally Stock
1	C154638	Photohelic Gauge & Timer	Normally Stock

DRAWING NO A1-76677 REV 0

DRAWING NO A1-76677 REV 0

ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	C182819	A1-71975	JPSM-2D 4 HOUSING WELDMENT	1400
2	2	C172316	A1-66953	JPSM DUST COLLECTOR DOOR	90
3	2	C181157	A2-39186	DUST COLLECTOR (2) 3/4" DIA VALVE HEADER	74
4	1	C122076	A3-24239	DUST COLLECTOR HOPPER DISCHARGE	39
5	1	C137372	A2-26625	ROTARY VALVE ASSEMBLY	–
6	2	C182891	A1-72021	DUST COLLECTOR JET PULSE ARRANGEMENT	–
7	1	C119614	A3-23346	DUST COLLECTOR INSPECTION COVER	12
8	1	C131901	A3-27841	PHOTOHELIC GAUGE & PULSE TIMER BOARD	4
9	1	C183012	–	FAN SIZE 9 DESIGN 7991 C/W FIP TYPE "C"	–
10	1	C9051	–	MOTOR 5 HP 1800 RPM FR 184T 460/3/60	–
11	1	C191942	A3-43483	FAN DRIVE 1600 CFM @ 10" SP	–
12	8	–	–	1/2" NC X 1 1/2" LG HEX HD BOLT	–
13	16	–	–	1/2" DIA FLAT WASHER	–
14	8	–	–	1/2" DIA LOCK WASHER	–
15	8	–	–	1/2" NC HEX CAPNUT	–
16	24	–	–	3/8" DIA FLAT WASHER	–
17	24	–	–	3/8" DIA LOCK WASHER	–
18	24	–	–	3/8" NC HEX CAP NUT	–
19	1	C181271	A1-71195	SERVICE ACCESS	421
20	1	C115600	A2-19860	PRESSURE RELIEF DOOR	84
21	1	C18253	–	10" DIA SLIDE GATE	–
22	1	C191944	–	REDUCE CR 10" X 8"	–





PN C191941

U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
CANADA
L7L 5V5
TELEPHONE: (905) 319-7930
FACSIMILE: (905) 319-7632

REV	DATE	DESCRIPTION	BY

JPSM-2D 4 DUST COLLECTOR
1600 CFM @ 10" SP
C/W ROTARY VALVE & RELIEF DOOR

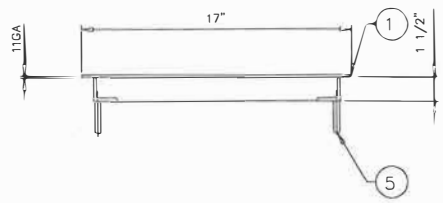
DATE	DRAWN	COPY OF
15 APRIL 2004	HOLIERHH	–

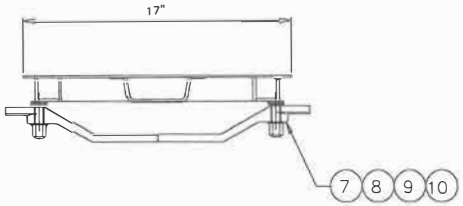
GROUP	SCALE	DRAWING NO	REV	WEIGHT
30	1"=1"	A1-76677	0	2124

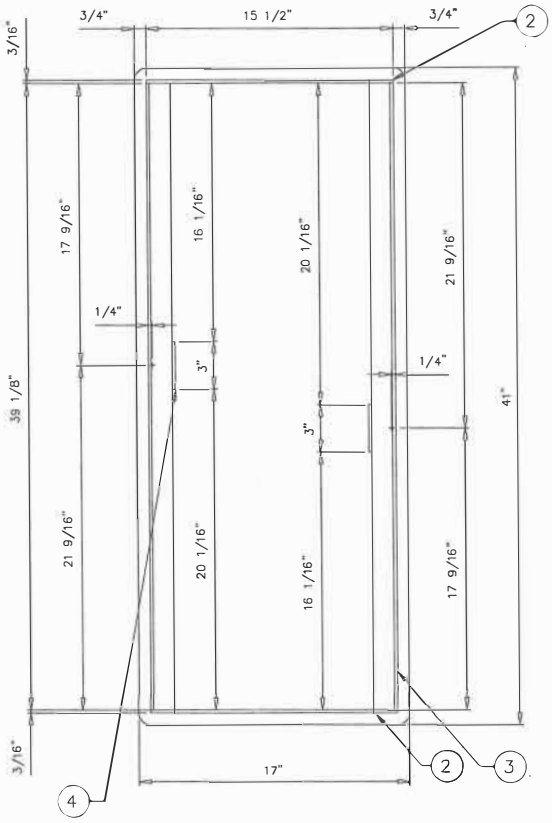
DRAWING NO A1-66953 REV B

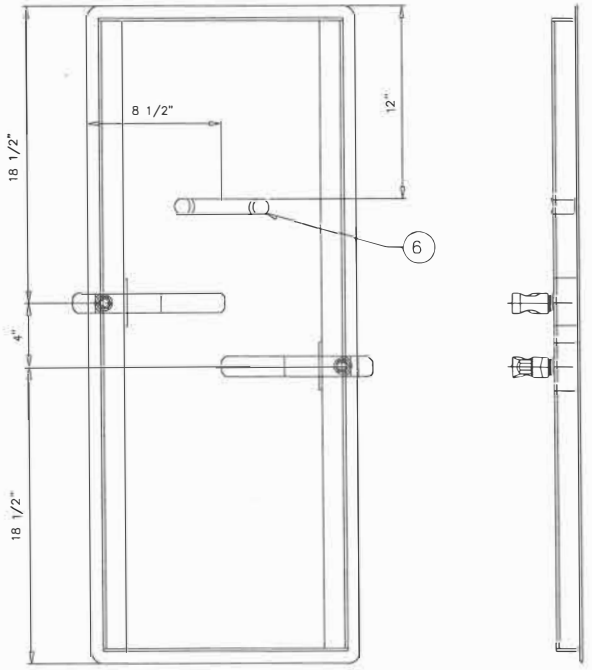
DRAWING NO A1-66953 | REV B

ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	–	–	11GA X 41" X 17"	25
2	2	–	–	BAR 3/16" X 1 1/2" X 15 1/2"	4
3	2	–	–	< 1 1/2" X 1 1/2" X 3/16" X 39 1/8"	12
4	2	–	–	BAR 3/16" X 1 1/2" X 3"	2
5	2	–	–	3/8" UNC X 2" LG WELDSTUD	–
6	1	C14828	–	HANDLE	–
7	2	C13688	–	BCP CAST HANDLE	–
8	2	–	–	PIPE 3/8" STD X 1 1/16"	1
9	4	–	–	3/8" FLAT WASHER	–
10	2	–	–	3/8" NC CAP NUT	–









PN C172316

REV	DATE	DESCRIPTION	BY
B	18 OCT 2002	ITEM 7 PART NUMBER CORRECTED	JC
A	08 OCT 2002	BALLOONS ADDED	DF

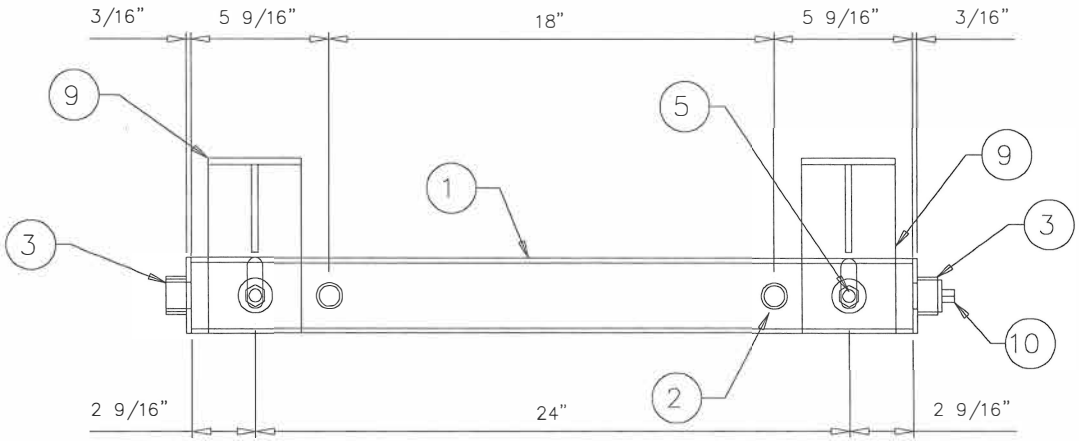
U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
CANADA
L7L 5V5
TELEPHONE: (905) 319-7930
FACSIMILE: (905) 319-7632

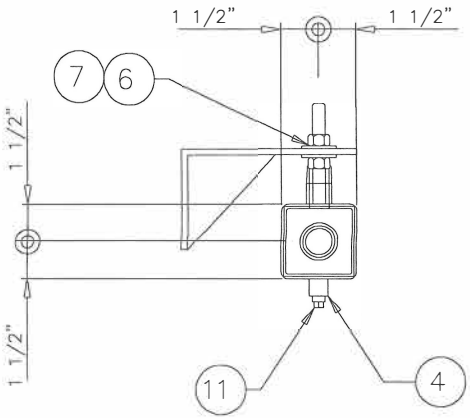
JPSM DUST COLLECTOR DOOR ASSEMBLY

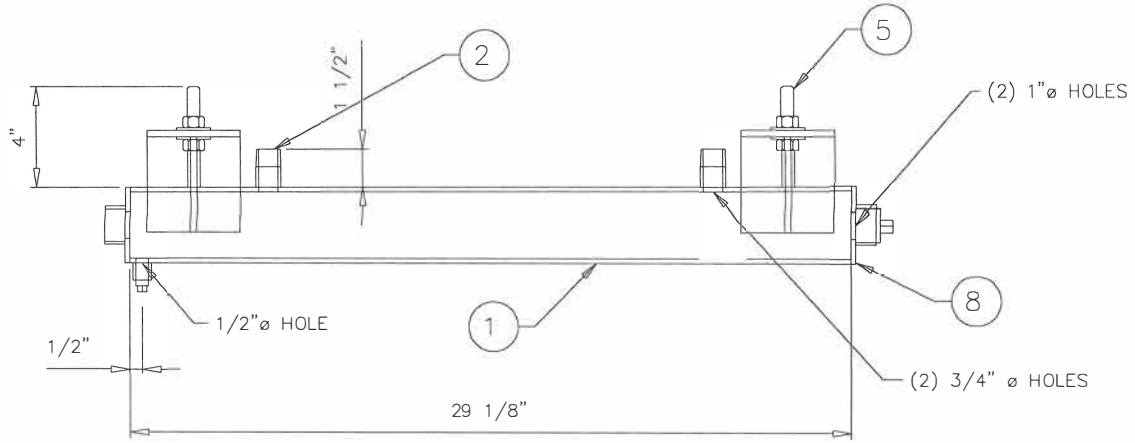
DATE	DRAWN	COPY OF
25 JUNE 2002	HOLIERHH	–

GROUP	SCALE	DRAWING NO	REV	WEIGHT
30	3"=1'	A1-66953	B	45

ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	–	–	HSS 3" X 3" X 0.188" WL X 29 1/8"	17
2	2	C35377	–	PIPE 3/4" STD X 1 1/2"	2
3	2	C35378	–	3/4" DIA –150# HALF COUPLING	–
4	1	C28037	–	1/4" DIA –150# HALF COUPLING	–
5	2	–	–	1/2"NC X 4" LG TH'D WELD STUD	–
6	4	–	–	1/2" FLAT WASHER	–
7	4	–	–	1/2"NC HEX NUT	–
8	2	–	–	PL 3/16" X 2 3/4" X 2 3/4"	2
9	2	C87978	A2-11393	HEADER SUPPORT BRACKET	16
10	1	C180509	–	3/4" NPT STD PIPE PLUG	–
11	1	C179417	–	1/4" NPT STD PIPPE PLUG	–







PN C181157

U.S. FILTER BCP

U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
CANADA
L7L 5V5
TELEPHONE: (905) 319-7930
FACSIMILE: (905) 319-7632

REV	DATE	DESCRIPTION	BY

JPSM-2D DUST COLLECTOR HEADER DETAIL (2) 3/4" DIA OUTLETS

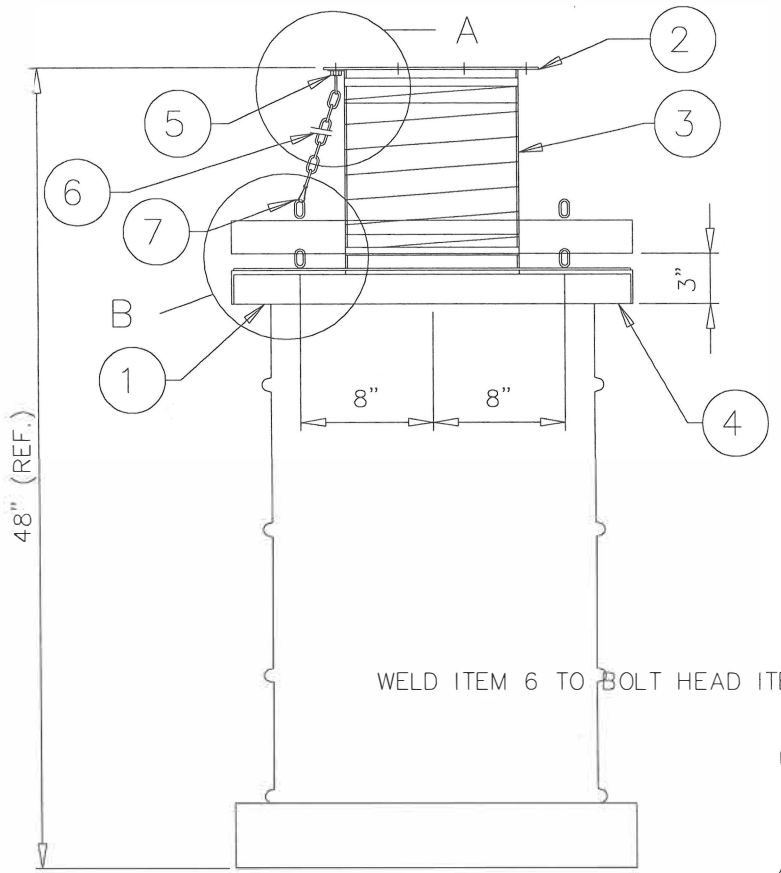
DATE	DRAWN	COPY OF
10 MAR 2003	H HOLIERHOEK	–

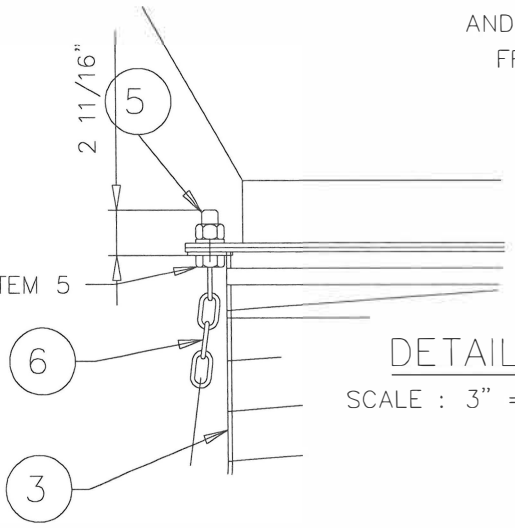
GROUP	SCALE	DRAWING NO	REV	WEIGHT
30	3"=1'-0"	A2-39186	0	37

DRAWING NO A3-24239 REV 0

DRAWING NO	REV
A3-24239	0

ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	C98874	A3-16088	DRUM LID	29
2	1	C98876	A2-14515	ADAPTER FLANGE	10
3	1	C98790	–	FLEXIBLE HOSE 10" DIA X 14" LG	–
4	2	C12744	–	BAND CLAMP X 10" DIA	–
5	2	–	–	1/2" NC HEX BOLT X 1 1/4" C/W NUT FW & LW	–
6	2	C100462	–	1/8" LINK CHAIN X 10" LG	–
7	2	C99693	–	SNAP HOOK	–



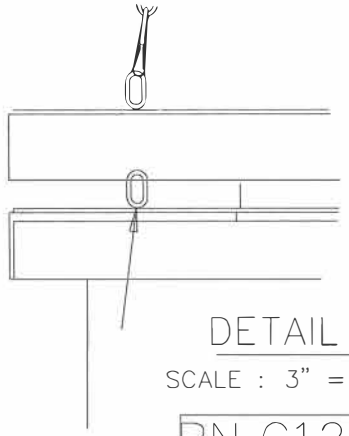


WELD ITEM 6 TO BOLT HEAD ITEM 5

DETAIL A

SCALE : 3" = 1'-0"

REMOVE 1 LINK FROM EACH CHAIN
AND WELD TO DRUM LID EQUI-SPACED
FROM CL & OPPOSITE EACH OTHER



DETAIL B

SCALE : 3" = 1'-0"

PN C122076

U.S. FILTER BCP

U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
CANADA
L7L 5V5
TELEPHONE: (905) 319-7930
FAX: (905) 319-7632

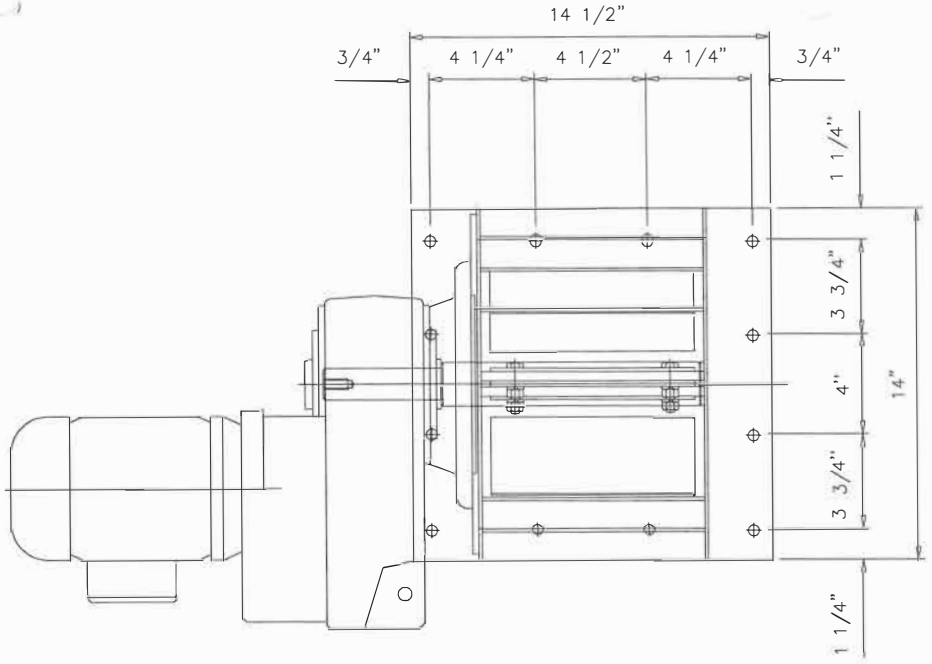
REV	DATE	DESCRIPTION	BY

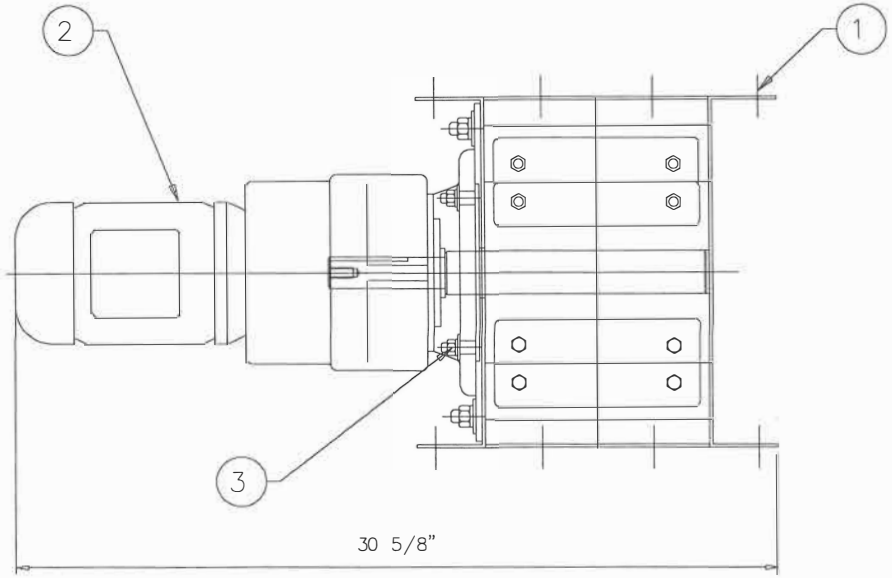
DUST COLLECTOR DISCHARGE ASSEMBLY

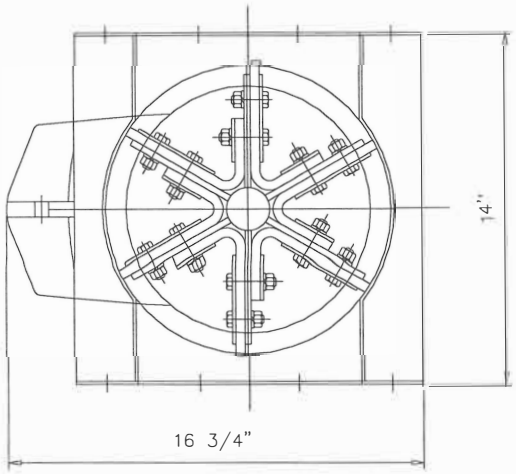
DATE	DRAWN	COPY OF
11 DEC 1997	J. ZIELINSKI	A3-16397

GROUP	SCALE	DRAWING NO	REV	WEIGHT
30	1/2"=1'-0"	A3-24239	0	39

ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	C137436	–	ROTARY VALVE VALVE BODY	–
2	1	C137390	–	REDUCER 1/3 HP @ 11 RPM	–
3	4	–	–	3/8" NC HEX NUT C/W F/W & L/W	–







PN C137372

U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
CANADA
L7L 5V5
TELEPHONE: (905) 319-7930
FACSIMILE: (905) 319-7632

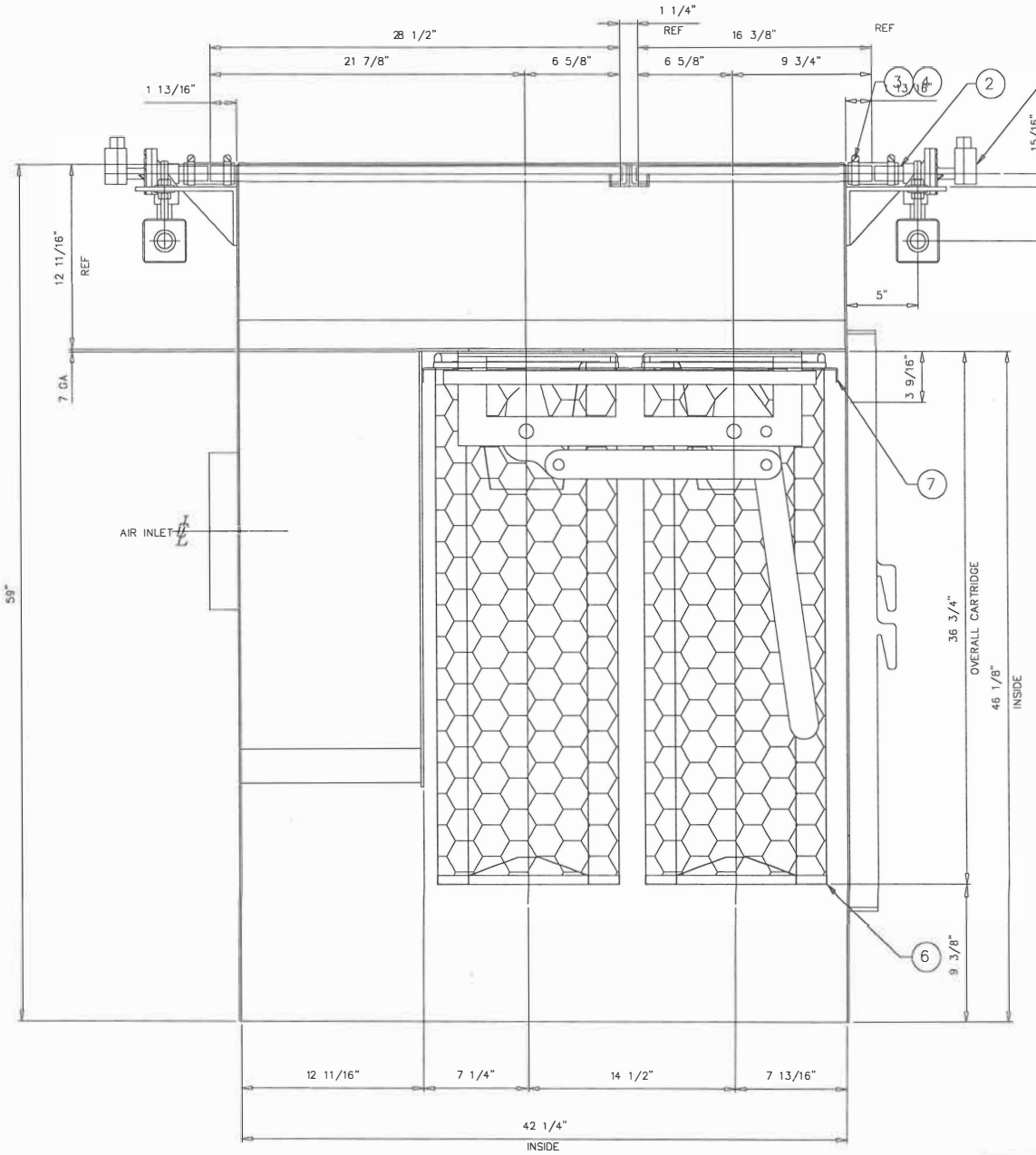
REV	DATE	DESCRIPTION	BY

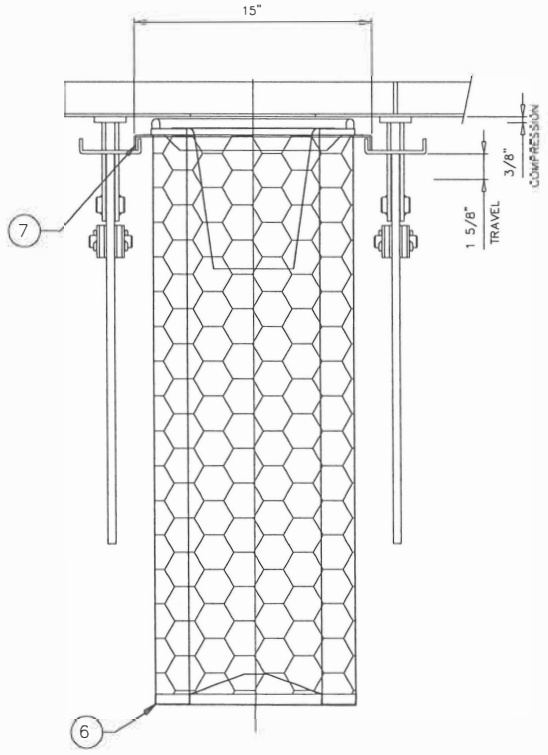
ROTARY VALVE ASSEMBLY 460/3/60
1/3 HP 11 RPM NORD DRIVE

DATE	DRAWN	COPY OF
10 MARCH 1999	W WACLAWSKI	–

GROUP	SCALE	DRAWING NO	REV	WEIGHT
30	3"=1'-0"	A2-26625	0	–

DRAWING NO A1-72021 REV 0





ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	2	C52665	–	DIAPHRAGM VALVE 3/4" C/W SOLENOID	–
2	2	C35376	–	PIPE NIPPLE	–
3	2	C59394	–	RUBBER SLEEVE 2" LG	–
4	4	C29113	–	HOSE BAND CLAMP	–
5	2	C14064	–	VENTURI	–
6	2	C181144	–	FILTER CARTRIDGE 36"	–
7	2	C119828	–	CARTRIDGE SUPPORT	–

PULSECONTROL VALVE REPAIR KIT P/N C83106

PN C182891

U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
CANADA
L7L 5V5
TELEPHONE: (905) 319-7930
FACSIMILE: (905) 319-7632

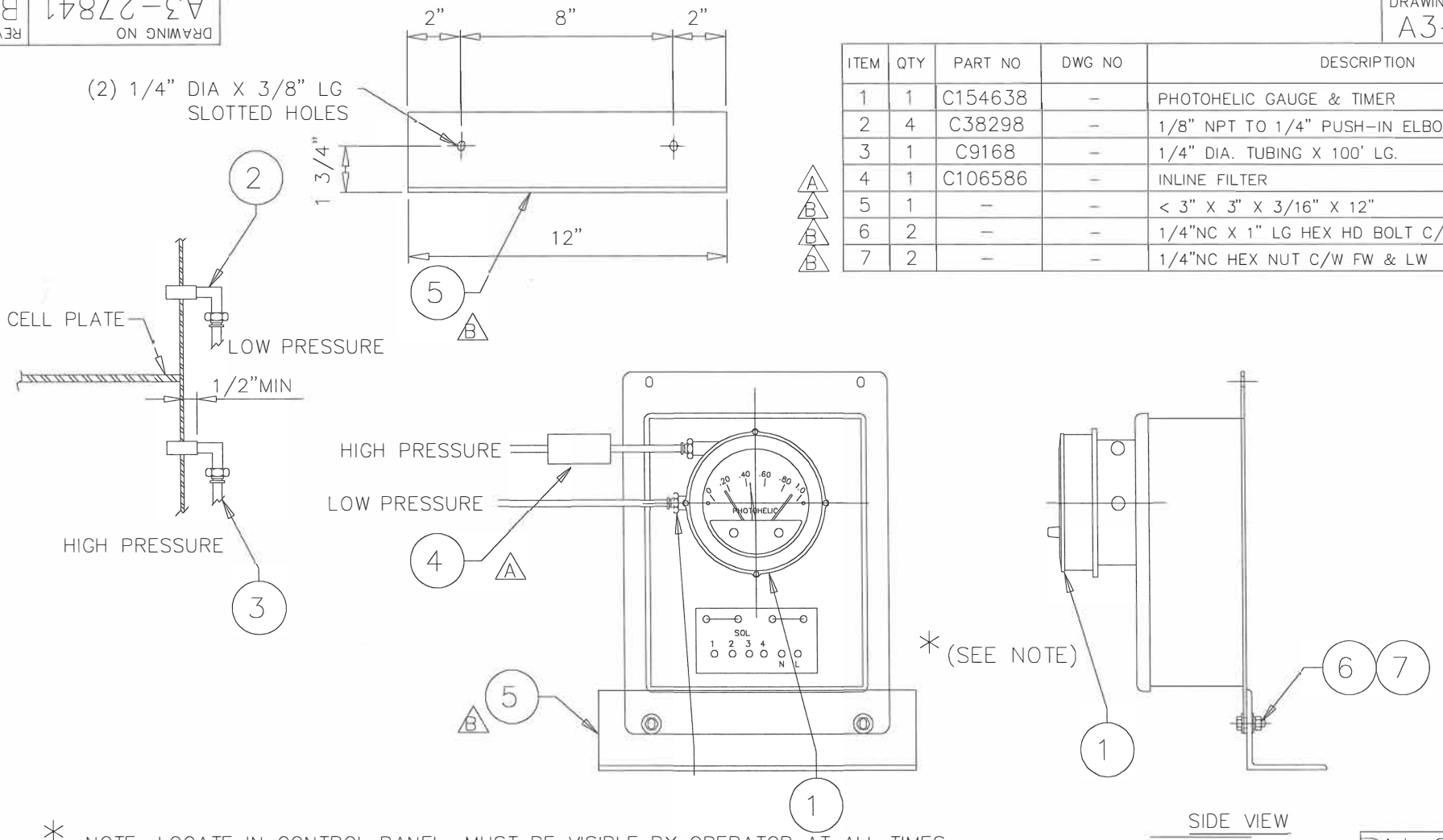
REV	DATE	DESCRIPTION	BY

JPSM-2D JET PULSE ARRANGEMENT
3/4" DIA COYEN VALVES
80/20 FLAME RETARDENT CARTRIDGES

DATE	DRAWN	COPY OF
14 MAY 2003	H. HOLIERHOEK	A2-42293

GROUP	SCALE	DRAWING NO	REV	WEIGHT
30	3"=1'-0"	A1-72021	0	–

REV B DRAWING NO A3-27841



ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	C154638	–	PHOTOHELIC GAUGE & TIMER	–
2	4	C38298	–	1/8" NPT TO 1/4" PUSH-IN ELBOW	–
3	1	C9168	–	1/4" DIA. TUBING X 100' LG.	–
4	1	C106586	–	INLINE FILTER	–
5	1	–	–	< 3" X 3" X 3/16" X 12"	4
6	2	–	–	1/4"NC X 1" LG HEX HD BOLT C/W FW	–
7	2	–	–	1/4"NC HEX NUT C/W FW & LW	–

* NOTE: LOCATE IN CONTROL PANEL; MUST BE VISIBLE BY OPERATOR AT ALL TIMES

PN C131901

REV	DATE	DESCRIPTION	BY
B	25 APRIL 2000	ADDED TIMER BOARD & PANEL	HH
A	27 OCT 1998	ADDED INLINE FILTER.	MC

U.S. FILTER BCP
U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
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L7L 5V5
TELEPHONE: (905) 319-7930
FAX: (905) 319-7632

PHOTOHELIC & TIMER MNT ASSEMBLY
0-10", C/W 4 CHANNEL TIMER
110/1/60

DATE	DRAWN	COPY OF
19 OCT 1998	M. CISCO	A3-5022

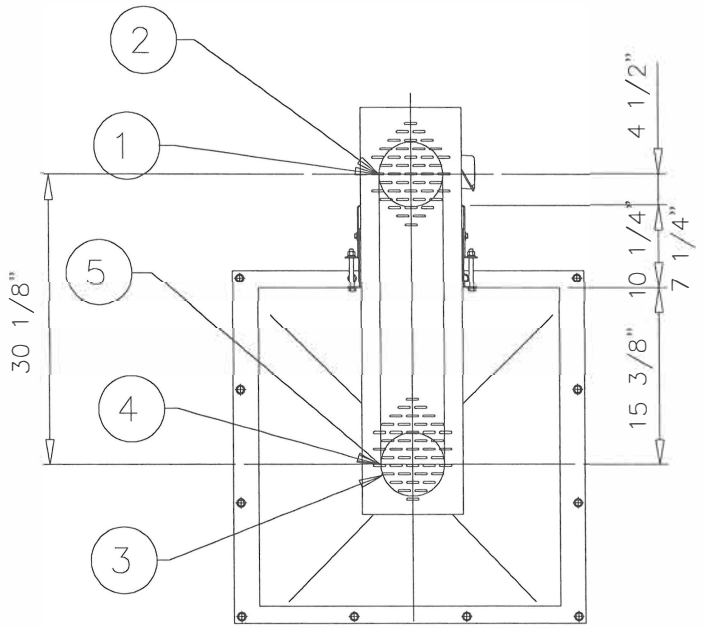
GROUP	SCALE	DRAWING NO	REV	WEIGHT
30	3"=1'-0"	A3-27841	B	4

DRAWING NO	REV
A3-43483	0

ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	C139029	–	MOTOR SHEAVE 2B GROOVE 11.0" PD	
2	1	C139047	–	MOTOR BUSHING SK 1 1/8" BORE	
3	1	C145761	–	FAN SHEAVE 2B GROOVE 6.4" PD	
4	1	C147795	–	FAN BUSHING SDS 1 3/16" BORE	
5	2	C150221	–	VEE BELT B-85	

NORTHERN BLOWER

FAN SIZE DRIVE: 9 SISW DESIGN 7991 CLASS II
OUTPUT: 1600 C.F.M. @ 10" S.P.
MOTOR: 5H.P. @ 1800 R.P.M. FR. 184T
MAX. BHP: 4.77
OUTPUT R.P.M. 2919
OUTLET VEL.: 3606
ELEVATION: S.L.
TEMP.: 70° F



ARRANGEMENT 9-TH-CCW-T

1) OSHA BELT GUARD
2) V-BELTS AND SHEAVES
BELT CENTRES 30.125"
RATIO: 1.68:1

PN C191942

U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
CANADA
L7L 5V5
TELEPHONE: (905) 319-7930
FAX: (905) 319-7632

REV	DATE	DESCRIPTION	BY

FAN DRIVE, 1,600 CFM @ 10" SP
FAN SIZE 9 DES 7991
MOTOR POSITION ON TOP

DATE	DRAWN	COPY OF
15 APRIL 2004	HOLIERHOEK	A4-9717

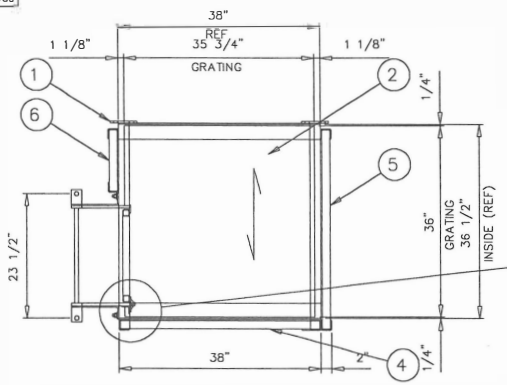
GROUP	SCALE	DRAWING NO	REV	WEIGHT
30	FULL	A3-43483	0	-

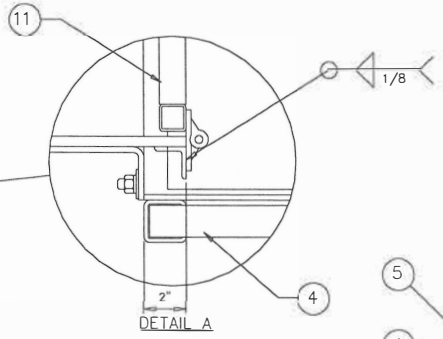
DRAWING NO A3-43483 REV 0

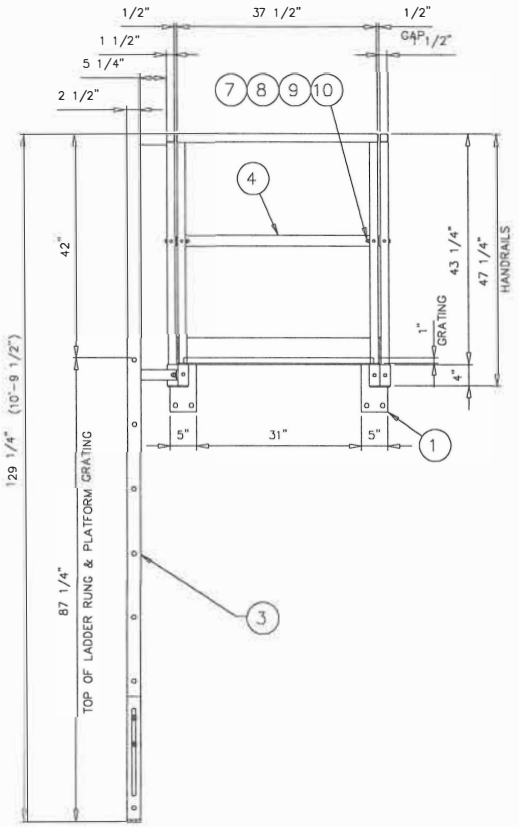
DRAWING NO A1-71195 REV 0

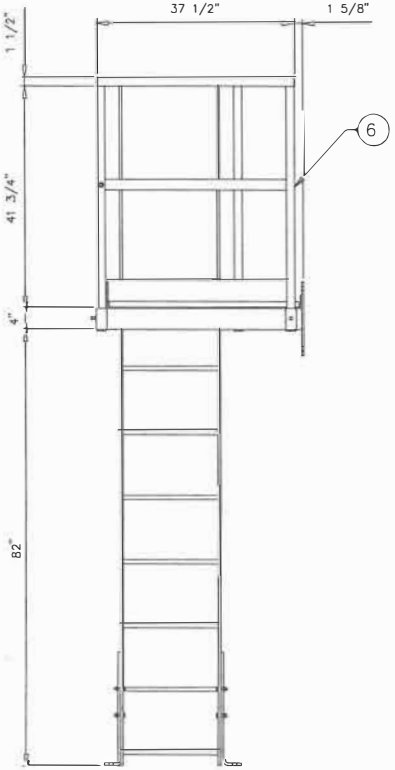
DRAWING NO A1-71195 REV 0

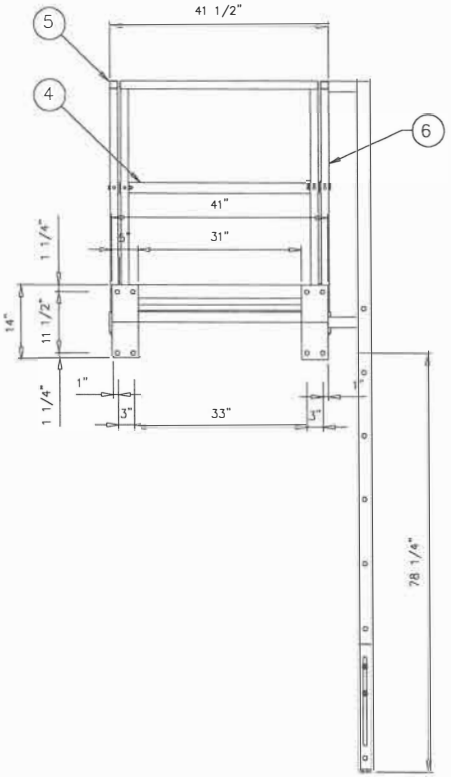
ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	C123666	A2-22455	ACCESS FRAME WELDMENT	125
2	1	C123093	A2-22233	JPSC STANDARD BARGRATING PANEL	–
3	1	C138566	A1-51410	ACCESS LADDER	162
4	1	C123660	A1-44179	HANDRAIL-FRONT	34
5	1	C120795	A1-43191	HANDRAIL-NON LADDER END	45
6	1	C121483	A1-43193	HANDRAIL-LADDER END	29
7	2	–	–	1/2"NC X 4 1/2" LG HEX HD BOLT	–
8	8	–	–	1/2" FLAT WASHER	–
9	2	–	–	1/2" LOCK WASHER	–
10	2	–	–	1/2"NC HEX NUT	–
11	1	C78033	A2-8852	SWING GATE	26

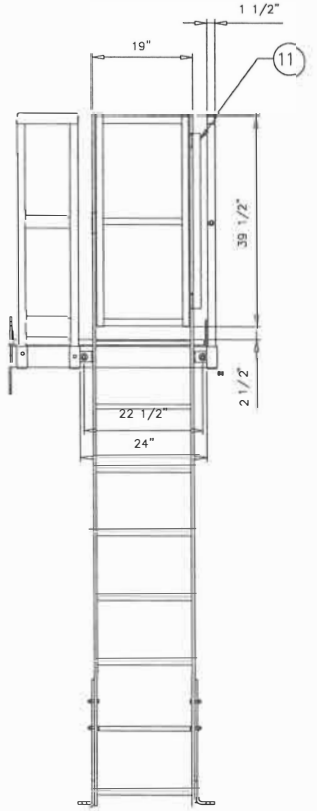












PN C181271

REV	DATE	DESCRIPTION	BY

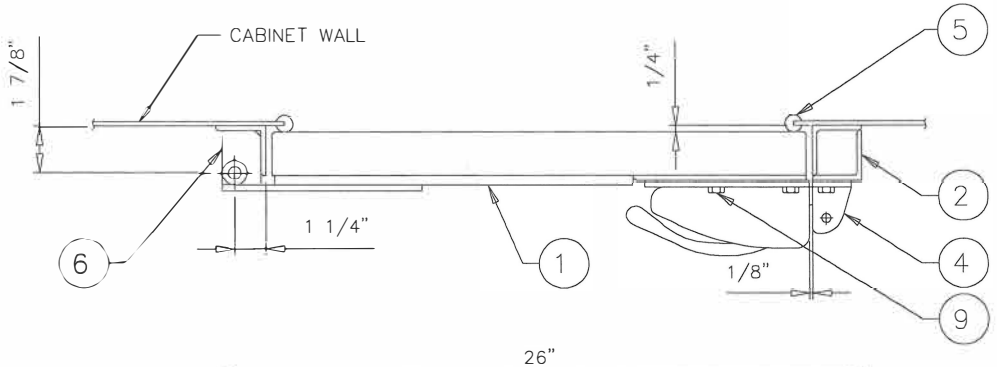
U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
CANADA
L7L 5V5
TELEPHONE: (905) 319-7930
FACSIMILE: (905) 319-7632

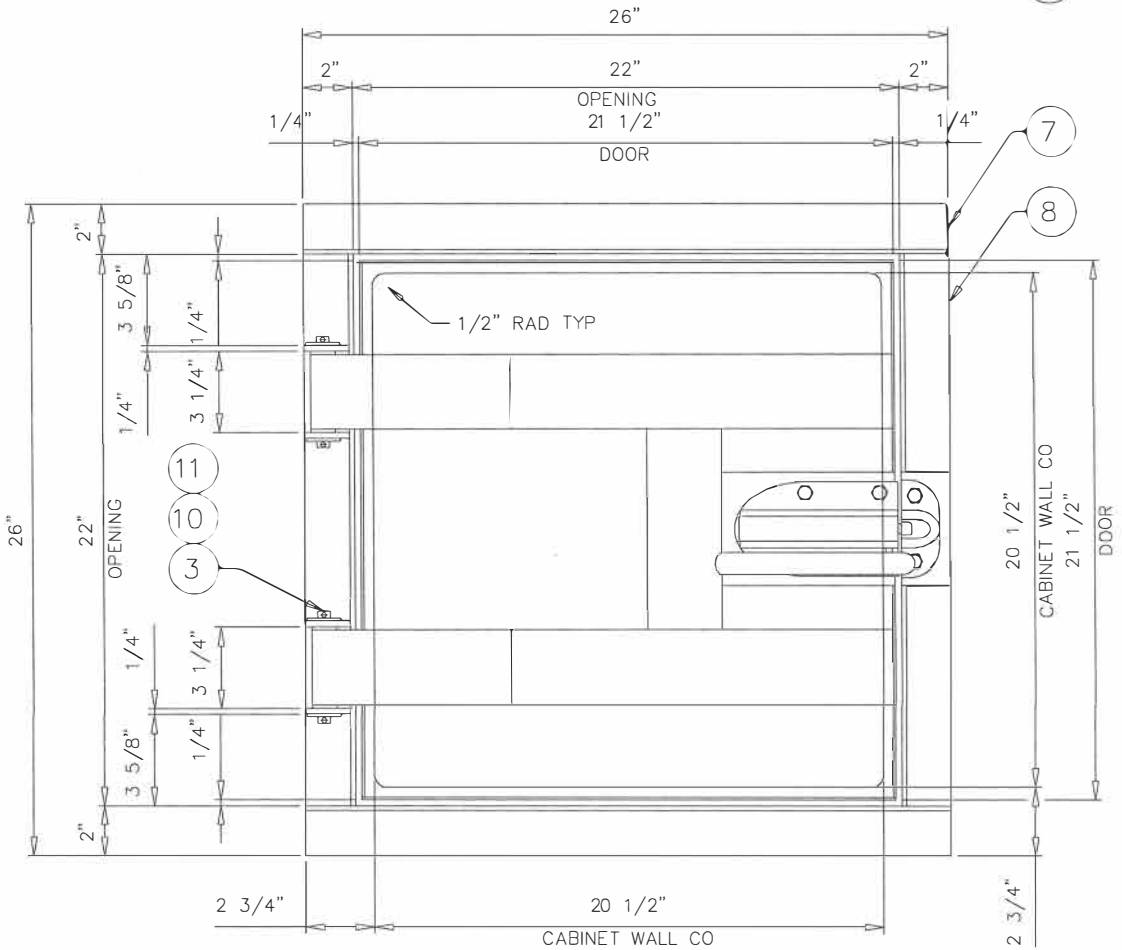
JPSM-20 4 SERVICE ACCESS ARRANGEMENT

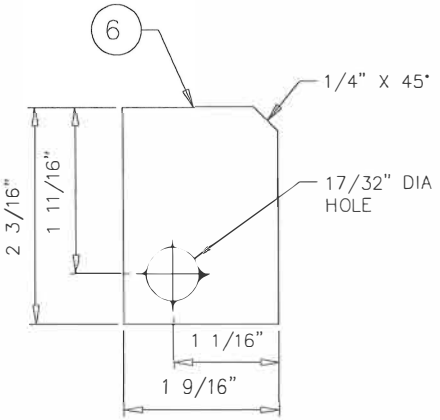
DATE	DRAWN	COPY OF
17 MAR 2003	H. HOLJERHOEK	A1-43140

GROUP	SCALE	DRAWING NO	REV	WEIGHT
30	1"=1'-0"	A1-71195	0	421

ITEM	QTY	PART NO	DWG NO	DESCRIPTION	WT
1	1	C115611	A1-40253	DOOR PANEL	56
2	1	C30339	A3-2286	STRIKER BRACKET	2
3	2	C30344	A4-1408	HINGE PIN	2
4	1	C30345	–	LATCH	–
5	1	C17488	–	NEOPRENE SEAL X 6'-6"	–
6	4	–	–	PL 1/4" X 1 9/16" X 2 3/16"	2
7	2	–	–	< 2" X 2" X 3/16" X 26"	12
8	2	–	–	< 2" X 2" X 3/16" X 22"	10
9	6	–	–	3/8" NC HEX BOLT X 1 1/4" C/W NUT & LW	–
10	4	–	–	1/2" FLAT WASHER	–
11	4	–	–	3/16" DIA COTTER PIN X 1"	–







DETAIL ITEM 6
SCALE : FULL SIZE

NOTE: DOOR TO BE HANG DOWN WITH LATCH DOWN

PN C115600

U.S. FILTER/BCP
1219 CORPORATE DRIVE
BURLINGTON, ONTARIO
CANADA
L7L 5V5
TELEPHONE: (905) 319-7930
FACSIMILE: (905) 319-7632

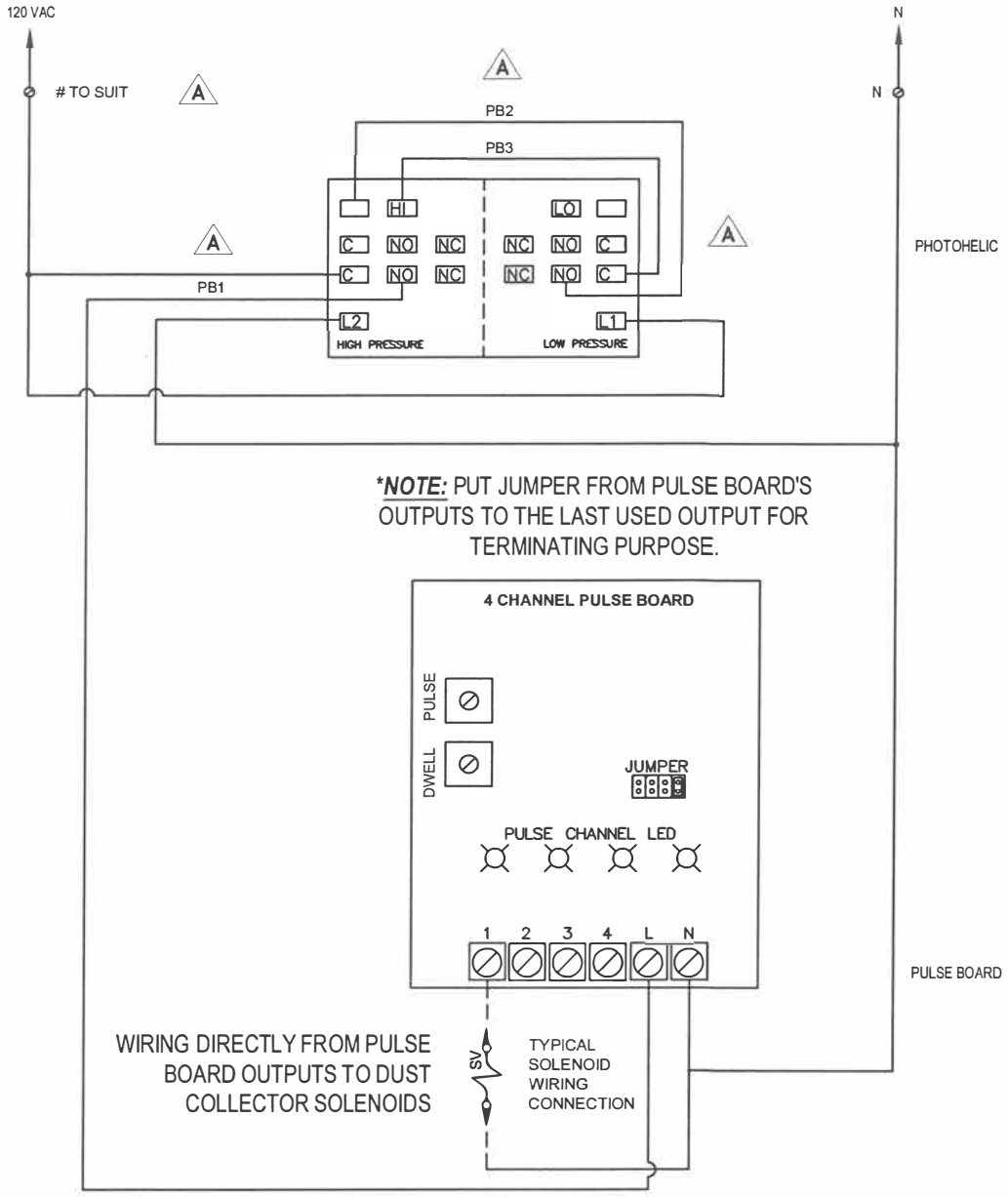
REV	DATE	DESCRIPTION	BY

PRESSURE RELIEF DOOR (3.Sq Ft)

DATE	DRAWN	COPY OF
8 APRIL 1997	J A BEER	A1-29869

GROUP	SCALE	DRAWING NO	REV	WEIGHT
19	3"=1'-0"	A2-19860	0	84

4-CHANNEL PULSE BOARD AND PHOTOHELIC CONNECTION FOR DUST COLLECTOR



HIGH SET POINT: WHEN GAUGE REACHES HIGH SET POINT, PULSE BOARD STARTS PULSING.

LOW SET POINT: WHEN GAUGE REACHES LOW SET POINT, PULSE BOARD STOPS PULSING.

REV.	REVISION DESCRIPTION	DATE	BY
A	ADDED TEXT	01/17/2000	TN

PRODUCT # DE00005R | REV A

USF SPG BGP

ELECTRICAL CONTROL PANELS

4-CHNL PULSE BOARD--PHOTOHELIC CONNECTION

ELECTRICAL

DRAWN: TRUONG | GROUP: 396 | DATE: 07/10/1999 | FINAL REVIEW: — | MULTIPLIER: 2"=1'

TOLERANCE

11.0. Warranty.

Seller warrants that the equipment described herein will be free from defects in material and workmanship for a period of twelve (12) months from installation ("Warranty Period"). If within the Warranty Period Seller receives written notice promptly after the discovery of any defect in the material or workmanship Seller shall correct each such defect FCA point of manufacture. Seller shall undertake its warranty obligation of repair, replacement within a reasonable time of receiving actual notice of the warranty defect. Seller shall be fully compensated for expenses of travel and for job time (at Seller's then prevailing per diem rates for straight time and premium time, as applicable) of its service representatives who inspect warranty claims that are not warranty issues. Purchaser has no right to and may not back charge Seller for warranty claims without prior approval. Normal wear parts are not included. The liability of Seller to Purchaser/Buyer arising out of or the supplying of the equipment whether under warranty, tort, contract, negligence, strict liability or otherwise, shall not in any case exceed the cost of correcting defects in Equipment and upon the expiration of said warranty, all such liability shall terminate. This warranty is conditioned upon the Equipment being handled, operated, and maintained in accordance with written instructions provided or approved in writing by Seller. This Warranty is not applicable to commercial items used on Seller's assembled equipment; such issues shall be covered by any terms provided by the original equipment manufacturer for any respective commercial item. Seller makes no warranties which extend to damage to the Equipment due to deterioration or wear occasioned by chemicals, abrasion, corrosion or erosion, improper erection, operation or maintenance, abnormal conditions of temperature or dirt, or operation of the Equipment, and Purchaser's exclusive remedy shall be limited as above provided. THE WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABLITY OR FITNESS FOR PARTICULAR PURPOSE. The remedies set forth herein are expressly declared to be the sole and exclusive remedies hereunder. There shall be no liability to anyone for special, incidental or consequential damages with respect to the Equipment or for any related economic loss or property damage.

12. Terms and Conditions

Buyer agrees to pay the full purchase price and other charges for the goods ("Equipment") described in this document. All purchase orders received by ISPC/Wheelabrator (Canada) Inc. ("Seller") are subject to acceptance or rejection by Seller. Seller shall not be obligated to Buyer unless Seller accepts such purchase order in writing. Acceptance of these terms and conditions, orally or in writing, or acceptance of the subject Equipment by Buyer, or Buyer's acceptance of Seller's quotation, shall evidence Buyer's agreement to be bound by the following terms, covenants and conditions of sale, notwithstanding the terms set forth in Buyer's purchase orders or any other document. **BUYER UNDERSTANDS AND AGREES THAT THE TERMS OF THIS CONTRACT SHALL SUPERSEDE ANY TERMS CONTAINED ON BUYER'S PURCHASE ORDER OR ANY DOCUMENT OR INSTRUMENT SUBMITTED BY BUYER.**

1. Prices, Payment and Late Charges. Prices are FCA point of shipment. Buyer will pay all freight charges. If such costs are prepaid by Seller, Buyer shall immediately reimburse Seller for such costs. In addition, Buyer shall pay all costs and expenses incurred in connection with excess packing. Payment of the purchase price and other charges is due as indicated in Seller's invoice or within thirty (30) days after invoice date. Each incremental shipment of Goods or other items covered by this order may be invoiced at the time of shipment in an amount proportionate to the total contract price. If full payment is not received by the applicable due date, Buyer agrees to pay Seller attorneys' fees and other costs of collection incurred by Seller, and a monthly late charge equal to one and one-half percent (1.5%) of all outstanding amounts. Buyer understands that Seller may refuse to sell any Equipment to Buyer until overdue accounts are paid in full. Buyer shall be responsible for the payment of all taxes, duties, customs and other fees of any nature imposed relating to this transaction, the Equipment, or their construction, or inventory, or upon the manufacture, storage, sale, transportation, importation, delivery, use or consumption of the Equipment, by any federal, state, local or foreign government authority including, without limitation, all state and local sales and use taxes and all taxes of a similar nature. In the event Seller is required to prepay any such tax, duty or fee, Buyer will reimburse Seller immediately.

2. Credit Approval. All orders are subject to approval of Buyer's credit. If Buyer's credit is not approved by Seller, Seller may require, in its sole discretion, different terms of payment from those specified in this document, including, without limitation, requiring Buyer to pay Seller cash prior to delivery. Any such demand may be oral or in writing and Seller may, upon making such demand, stop production and suspend shipments hereunder. If within the period stated in such demand Buyer fails or refuses to agree to such different terms of payment or refuses to give adequate assurance of due performance, Seller may, at its option, treat such failure or refusal as a repudiation of the portion of this agreement which has not been fully performed or may resume production and make shipment under reservation of a security interest and may demand payment against tender of documents of title.

3. Telephone Orders. If the Equipment is sold to Buyer as a result of a telephone order or under other circumstances when Buyer is not available to execute this agreement at the time the order is placed, Buyer agrees, in any event, to be bound by these terms and conditions of sale.

4. Delivery. Seller shall ship the Equipment to the location designated by Buyer via commercial carrier at the earliest available shipment date. Shipping date are estimates only. Changes in the shipping schedule by Buyer may at Sellers' discretion result in an increase in the purchase price of the Equipment.

5. Irrevocability. Buyer acknowledges that Seller may not have on hand in Sellers' open stock all of the items purchased by Buyer and that Seller will be relying on Buyer's agreement to purchase such items as a basis for Seller to enter into binding agreements with others for the delivery of such items.

Because of Sellers' reliance, Buyer agrees that Buyer's obligation to purchase the Equipment shall be unconditional and irrevocable. Buyer's cancellation or refusal to accept the Equipment shall be subject to such cancellation charges, as Seller shall determine is appropriate, together with such other remedies as may be provided herein and under applicable law.

6. Seller's Right to Substitute. Seller shall have the right to substitute Goods of comparable quality for Equipment ordered by Buyer, which are not currently in Seller's open stock. The obligation of Seller to sell the Equipment to Buyer is subject to prior sale, and if Seller is unable to furnish some or all of the Equipment specified, Seller reserves the privilege to cancel such items and deduct the price thereof from the balance owed by Buyer.

7. Nonconforming Equipment. Buyer shall notify Seller in writing within ten (10) days after delivery of any nonconforming Equipment or any deficiencies or shortages; otherwise all such claims shall be deemed waived by Buyer. The use or resale by Buyer of any Equipment claimed to be nonconforming or deficient shall constitute acceptance of such items by Buyer. Buyer shall have no right to withhold payment of the purchase price or to adjust the amount of the purchase price because of any such claim. The sole remedy of Buyer shall be the replacement or repair by Seller, at Seller's option, of nonconforming or deficient items, which remedy shall be in lieu of Buyer's right to consequential damages or any other remedy available under applicable laws; provided, Seller shall have no obligation to replace or repair any such items if Buyer is in default under this agreement in any respect. Any Equipment delivered to Buyer but not accepted shall be held and stored by Buyer in a commercially reasonable manner until returned by Buyer to Seller upon Seller's authorization, freight prepaid. Claims of Buyer for damages or loss of Equipment during shipment shall be made solely against the carrier.

8. Title and Risk of Loss. Title to all Equipment shall pass to Buyer when full payment has been made for the Equipment, which was purchased by Buyer. Risk of Loss shall pass to Buyer at the time the Equipment are delivered to the carrier for shipment, or when delivered to the location specified by Buyer, whichever occurs first.

9. Assignment. No loss, injury, destruction, sale, transfer or pledge of all or a portion of the Equipment shall release Buyer from Buyer's obligations or operate to pass title to all or any portion of such Equipment to any third party. Seller shall have the right to assign all or a portion of its rights under this agreement and such assignee shall be entitled to all the rights and remedies of Seller without liability for any right of recoupment, setoff or counterclaim which Buyer may have against Seller.

10. Disclaimer and Limited Warranty. The Equipment shall be covered by the applicable ISPC/Wheelabrator (Canada) Inc. standard warranty attached hereto as exhibit "A" (the "Warranty"). Any description of the equipment in an invoice or purchase order s for the sole purpose of identifying the Equipment, and any such description is not part of the basis of the bargain, and does not constitute a warranty that the Equipment shall conform to that description. The use of any model or sample in connection with this contract is for illustrative purposes only, is not part of the basis of the bargain and is not to be construed as a warranty that the Equipment will conform to the sample.

10.1 Any express or implied reference to specifications or plans outside of the specifications set forth in attached exhibit "A" shall not alter or enlarge the Seller's warranty. Equipment and services supplied by other vendors are excluded from Seller's warranty and only carry such warranties as provided by those vendors to Purchaser

10.2 In the event a defect is determined by Seller in material or Seller's workmanship, Seller's sole obligation and Buyer's sole remedy shall be as set forth in Section 11.3. If such defect is not covered by the Warranty, Seller shall have no obligation or liability with respect to such defect.

10.3 All Equipment and any component or part thereof, replaced or repaired by Seller under an applicable warranty shall be warranted by Seller for the remainder of the original warranty period.

10.4 The Warranty is conditional upon the Buyer's (i) giving Seller notice of the warranty breach within 30 days from the date Buyer discovers or should have discovered such breach, (ii) giving Seller prompt and reasonable opportunity to inspect the Equipment, (iii) operating the Equipment according to the manner prescribed by Seller and without alteration or substitution to the Equipment, (iv) keeping adequate logs and records to establish proper operation of the Equipment, and (v) Buyer's being in full compliance with, and not being in default under, the terms of this agreement. The Warranty shall not apply to normal wear and tear, nor to any damages to the Equipment caused in transit or by misuse, neglect, accident, improper installation, alterations or repairs made by anyone (including Buyer) other than Seller or its authorized representative.

10.5 Buyer has no right to and may not back charge Seller for warranty claims.

10.6 Seller shall undertake its warranty obligation of repair, replacement or repayment within a reasonable time of receiving actual notice of the warranted defect. Seller shall be fully compensated for expenses of travel and for job time (at the Seller's then prevailing per diem rates for straight time and premium time, as applicable) of its service representatives who inspect warranty claims, supervise repairs, or advise and consult during the replacement or repair of Equipment.

10.7 If Seller determines the defects in the Equipment returned by Buyer are not covered by the Warranty, Seller shall charge Buyer the customary repair and replacement charges of Seller then in effect.

10.8 This warranty is given only to Buyer and is not transferable and shall terminate immediately upon the sale or other disposition by Buyer.

10.9 No agent, employee or other representative has the right to modify or expand any warranty applicable to the Equipment or to make any representations as to the Equipment other than those set forth herein, and any such affirmation, representation or warranty, if made, should not be relied upon by Buyer and shall not be a part of this contract.

10.10 "THE WARRANTY" IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANT ABILITY OR FITNESS FOR PARTICULAR PURPOSE, WHICH WARRANTIES ARE EXCLUDED. THE REMEDIES SET FORTH HEREIN ARE EXPRESSLY DECLARED TO BE THE SOLE AND EXCLUSIVE REMEDIES HEREUNDER, AND, NOT WITH STANDING ANY TERM IN THIS AGREEMENT TO THE CONTRARY, THERE SHALL BE NO LIABILITY TO ANYONE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WITH RESPECT TO THE GOODS OR FOR ANY RELATED ECONOMIC LOSS OR PROPERTY DAMAGE.

11. Limitation of Liability; Remedies.

11.1 The aggregate liability of Seller, including with respect to Seller's subcontractors, employees and agents, for or with respect to claims of Buyer (and any successor to or assignee of Buyer) arising out of the performance or nonperformance of Seller's obligations under or in connection with this agreement including liquidated damages or for claims for indemnity, and whether based on contract, tort (including negligence), strict liability, pollution, disease or otherwise, shall not exceed an amount equal to the purchase price set forth on the Buyer's purchase order.

11.2 In no event shall Seller be liable for damages for loss of profits or revenues, the loss of use of the facility in which the Equipment is located, including due to shutdowns or operation at less than capacity, claims of Buyer's customers, or incidental, special or consequential damages of any other kind or nature. Further, no claim may be asserted against Seller, including Seller's employees, agents, or subcontractors, unless the injury, loss or damage giving rise to the claim occurs or is sustained prior to the expiration of the warranty period specified in the Warranty and no suit or action thereon may be instituted or maintained unless it is initiated by Buyer in accordance with and is filed in a court of competent jurisdiction within one year after the date the cause of action first accrues.

11.3 In the event a defect is determined by Seller in material or Seller's workmanship, or in the event of any other breach by Seller of any obligation hereunder or relating to the subject matter of this agreement, Buyer's sole remedy, if any, shall be to require Seller (i) to repair the defective Goods; or (ii) to provide replacement parts for or to repair the defective Equipment, with the remedy provided to be determined by Seller, at its option. All replaced and repaired Goods shall be shipped FCA point of manufacture, with removal and reinstallation expenses and transportation costs payable by the Buyer. Buyer understands and agrees that it shall have no remedy whatsoever unless Seller is in material breach of this agreement and has failed to cure such breach within a reasonable time period.

11.4 The provisions of this Section 11 shall prevail over any conflicting or inconsistent provision contained elsewhere in this agreement, except to the extent that such conflicting or inconsistent provisions act to further restrict or reduce Seller's liability under this agreement.

12. Technical Advice. Seller may, in its discretion, furnish technical assistance, advice and information with respect to the Equipment. Such assistance, advice or information shall be provided at Buyer's risk, and Seller shall have no liability with respect thereto.

13. Cancellation. Cancellation charges after the date of this document will be the greater of 20% of the purchase amount or the sum of expected profit plus the loss amount of materials, labor and overhead.

14. Liens and Insurance. Prior to full payment of the purchase price, Buyer shall not permit any lien, encumbrance, or security interest to attach to the Equipment or to be levied upon the Equipment under legal process or dispose of the Equipment, other than in the ordinary course of business, or permit anything to be done that may impair the value of the Equipment. Buyer shall insure the Goods against risk of loss or damage by fire, including extended coverage, theft and such other casualties in an amount equal to full replacement value.

15. Buyer's Default. Occurrence of any of the following with respect to Buyer shall constitute an event of default under this agreement:

15.1. Failure to pay any amount when due;

15.2 Failure to pay when due any costs or expenses necessary to preserve or protect the Equipment;

15.3 Failure to perform any covenant or obligation in this agreement;

15.4 Giving any representation of warranty or furnishing any financial information to Seller that should prove untrue or materially misleading;

15.5 Refusal by Buyer to accept delivery of all or a portion of the Equipment or Buyer's rejection of all or a portion of the Equipment upon delivery;

15.6 Business failure or failure or inability to pay debts in the ordinary course or as they become due, or insolvency within the meaning of the federal bankruptcy laws or insolvency laws or otherwise;

15.7 Commission of any act of bankruptcy, assignment for the benefit of creditors, composition of creditors or commencement of any proceedings, whether voluntary or involuntary, under any federal or state bankruptcy, reorganization or insolvency laws; or

15.8 Attachment or garnishment of or levy or execution upon the assets, property, business or income of Buyer or appointment of a receiver or trustee of or for any part of the assets, property or business of Buyer.

16. Seller's Remedies Upon Buyer's Default. Upon the occurrence of any event of default, Seller shall have all the rights and remedies available to Seller under the laws of Canada or other applicable laws and all rights provided in this agreement, all of which rights and remedies shall, to the fullest extent permitted by law, be cumulative. Without limiting the generality of the foregoing, upon the occurrence of any such event of default, Seller shall have the right, either in person or by agent with or without bringing any action or proceeding, or by a receiver to be appointed by a court, to take possession of all or part of the Goods, to reclaim the Goods, to withhold delivery or stop delivery in transit, or otherwise, or to rescind this agreement and to take such other action as

Seller may deem necessary and appropriate for the protection of its interests. After any such event of default, Seller may require Buyer to assemble the Goods and to make them available to Seller at a place designated by Seller, which is reasonably convenient to Seller and Buyer. Seller shall have the right to take immediate possession of the Equipment and shall have the right to take such action as may be required to enforce Buyer's obligations to Seller, including the retention of the Equipment without accounting to Buyer, sale of the Equipment at public or private sale upon reasonable notice to Buyer of Seller's intent to resell, such sale to include, at the option of Seller, all Equipment reclaimed by Seller as well as Equipment not yet delivered to Seller. Seller shall not be accountable to Buyer for any proceeds received by Seller as a result of such private or public sale, but Seller shall have the right to recover from Buyer the difference between such resale price and Buyer's purchase price of the Equipment, together with all expenses of sale, including without limitation, transportation, removal, storage, repair, maintenance, sales commission and such other expenses as may be allowed under the any applicable laws, less the expenses actually saved by Seller in consequence of Buyer's default. Seller shall have the right to purchase the Equipment at any such private or public sale.

17. Subsidiaries and Affiliates. This order may be performed and its parent corporation or any one or more subsidiary or affiliate of Seller may enforce all rights hereunder against Buyer, in whole or in part, by Seller or affiliate of Seller.

18. Indemnity. Buyer shall release, hold harmless, indemnify and defend Seller from and against any loss, liability, claims, suits and costs caused by, arising out of, or relating to (i) the design of Equipment supplied hereunder or the design of the packages or containers in which they are shipped, if such Equipment, packages or containers are made in compliance with Buyer's design or specifications, (ii) the condition of Buyer's premises, including without limitation accidents or injuries occurring on such premises in connection with the delivery or installation of the Equipment, or (iii) the breach by Buyer of its obligations hereunder.

19. Force Majeure. Seller shall not be liable to Buyer for any breach hereunder, including for failure to deliver or delays in delivery, construction, erection, or startup, occasioned by causes beyond the control of Seller or Seller's suppliers or subcontractors, including, but not limited to, unavailability or excessive cost of materials, strikes, labor slowdowns and stoppages, labor shortages, lockouts, fires, floods, earthquakes, storms, drought, adverse weather, riots, thefts, accidents, embargoes, war (whether or not declared) or other outbreak of hostilities, civil strife, acts of governments, acts of God, acts of the public enemy, unusually severe weather, machinery breakdowns, delay or unavailability of carriers or suppliers, shortages of labor, and governmental acts or regulations, orders or injunctions, or other reasons, whether similar or dissimilar to the foregoing (together a "Force Majeure Event"). In addition, in the event of a Force Majeure Event, (i) the time for Seller's performance shall be reasonably extended, (ii) Seller and Buyer shall take reasonable steps to adjust all affected dates in this agreement, and (iii) an adjustment in the purchase price shall be made for the resulting additional costs to Seller.

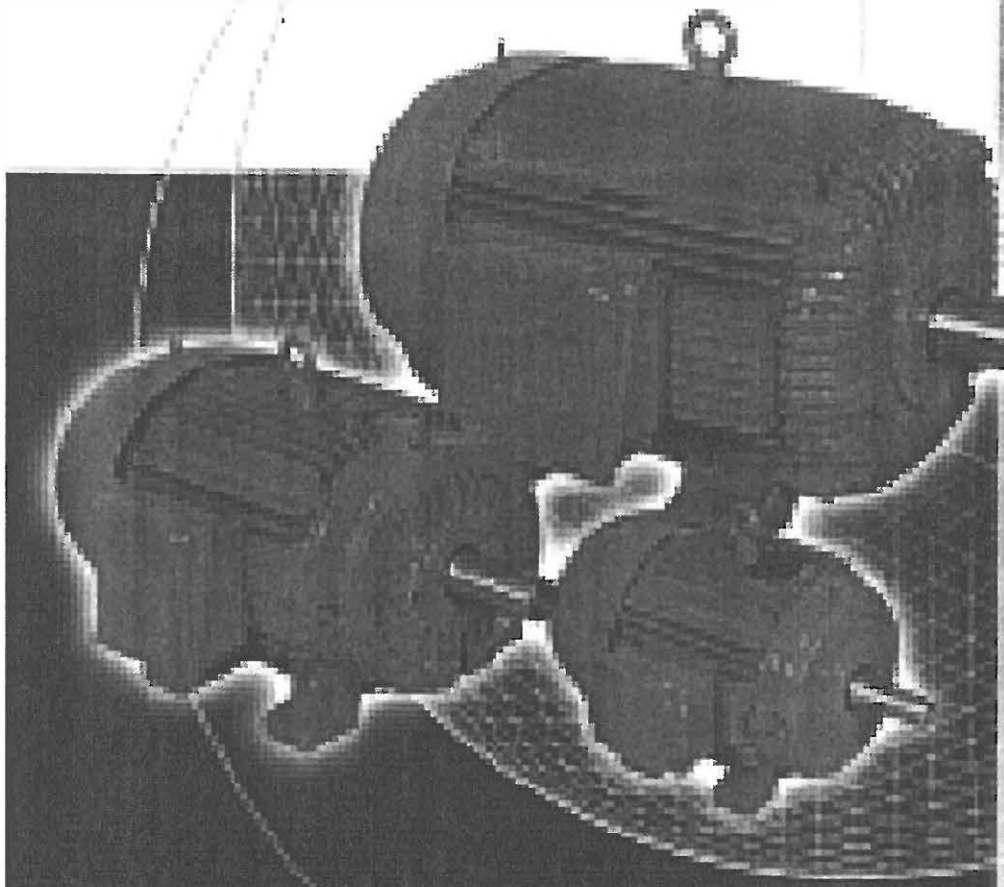
20. Patent Indemnification. Seller agrees to defend and indemnify Buyer against all judgments, decrees and reasonable costs resulting from the claim that the Equipment infringe any United States or Canadian Letters Patent, provided, that, Buyer shall not be entitled to such defense and indemnification as to any claim of infringement relating to designs, drawings, plans or specifications provided by Buyer or concerning claims which Buyer does not give or provide to Seller (i) prompt and timely notice in writing thereof, (ii) full opportunity, at the expense of Seller, to defend and dispose of such claim of infringement and (iii) reasonable cooperation and assistance in the defense. Pursuant to the foregoing, Seller may, at Seller's expense and option, either procure for Buyer the right to use the Equipment or modify them so that they no longer infringe, or replace them with non-infringing Equipment. The sale of the Equipment shall not grant to Buyer any right or license of any kind under any patent owned or controlled by Seller or under which Seller is licensed, but the foregoing shall not be understood to limit in any way the right of Buyer to use and sell the Equipment in the event that the Equipment as sold hereunder are covered by any such patent.

21. General Provisions. If either party commences or is made a party to any action or proceeding to enforce or interpret this agreement, the prevailing party in such action or proceeding shall be entitled to recover from the other party all attorneys' fees, costs and expenses (including the allocated costs of in-house counsel) incurred in connection with such action or proceeding or any appeal or enforcement of any judgment obtained in any such action or proceeding. All notices, request, demands and other communications under this agreement shall be in writing and shall be deemed duly given (i) on the date of delivery if personally delivered, (ii) if transmitted by facsimile transmission, upon telephone confirmation of receipt of the transmission thereof, (iii) if sent by overnight courier, one business day after delivery to the subject overnight courier, or (iv) three business days after mailing if mailed by first-class mail, postage prepaid, to the parties at their addresses on the reverse side of this document, or such other address designated from time to time in writing by such party to all other parties. This agreement may be amended only by a written agreement signed by all parties to this agreement. Waiver of any provision of this agreement shall not be deemed to constitute a waiver of any other provision, nor shall such waiver constitute a continuing waiver. This agreement shall be binding upon and inure to the benefit of the parties and their respective heirs, beneficiaries, legal representatives, successors and assigns, provided that Buyer shall not have the right to assign this agreement without the written consent of Seller which Seller may withhold in its sole and absolute discretion. This agreement may be executed in any number of counterparts, and each such counterpart shall be deemed to be an original instrument. This agreement shall be governed by and construed in accordance with the laws of Canada. Nothing contained herein shall be construed so as to require the commission of any acts contrary to law, and wherever any provisions of this agreement are invalid or there is a conflict between any provisions of this agreement and any present or future statute, law, ordinance or regulation, such provisions shall (a) be curtailed, limited and/or deemed not to be a part of this agreement only to the extent necessary to make it comply with such statute, law, ordinance or regulation, and (b) not affect the validity or enforceability of the remaining provisions. This agreement represents the entire agreement between the parties with respect to the subject matter set forth above, and supersedes all previous oral and written agreements, communications, representations or commitments.

EXHIBIT A

Seller warrants that the equipment described herein will be free from defects in material and workmanship for a period of 12 months from date of delivery ("Warranty Period"). If, within the Warranty Period Seller receives written notice promptly after the discovery of any defect in the material or workmanship, Seller shall correct each such defect, FCA point of manufacture. Seller shall undertake its Warranty obligation of repair, replacement within a reasonable time of receiving actual notice of the Warranty defect. Seller shall be fully compensated for expenses of travel and for job time (at Seller's then prevailing per diem rates for straight time and premium time, as applicable) of its service representatives who inspect Warranty claims that are not Warranty issues. Purchaser has no right to and may not back charge Seller for Warranty claims without prior approval. Normal wear parts are not included. The liability of Seller to Purchaser arising out of or the supplying of the Equipment whether under Warranty, tort, contract, negligence, strict liability or otherwise, shall not in any case exceed the cost of correcting defects in Equipment and upon the expiration of said Warranty, all such liability shall terminate. This Warranty is conditioned upon the Equipment being handled, erected, operated, and maintained in accordance with written instructions provided or approved in writing by Seller. This Warranty is not applicable to commercial items used on Seller's assembled Equipment; such issues shall be covered by the original equipment manufacturer for any respective commercial item. Seller makes no Warranties which extend to damage to the Equipment due to deterioration or wear occasioned by chemicals, abrasion, corrosion or erosion, improper erection, operation or maintenance, abnormal conditions of temperature or dirt, or operation of the Equipment, and Purchaser's exclusive remedy shall be limited as above provided. THE WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE. The remedies set forth herein are expressly declared to be the sole and exclusive remedies hereunder. There shall be no liability to anyone for special, incidental or consequential damages with respect to the Equipment or for any related economic loss or property damage.

MOTORS AND DRIVES



INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR ELECTRIC MOTORS

Frames 143/5T - 586/7T

QUALITY SYSTEM ISO9001 WEG MOTORES

BVQI ISO 9001

READ CAREFULLY THIS MANUAL BEFORE INSTALLING THE MOTOR.

RECEIVING CHECK

- ✓ Check if any damage has occured during transportation.
- ✓ Check nameplate data.
- ✓ Remove shaft locking device (if any) before operating the motor.
- ✓ Turn the shaft with the hand to make sure if it is turning freely.

HANDLING AND TRANSPORTATION

1 - General

MOTORS MUST NOT BE LIFTED BY THE SHAFT, BUT BY THE EYE BOLTS WHICH ARE PROPERLY DESIGNED TO SUPPORT THE MOTOR WEIGHT.

Lifting devices, when supplied, are designed only to support the motor. If the motor has two lifting devices then a double chain must be used to lift it.

Lifting and lowering must be done gently without any shocks, otherwise the bearings can get damaged.

DURING TRANSPORTATION, MOTORS FITTED WITH ROLLER OR ANGULAR CONTACT BEARINGS ARE PROTECTED AGAINST BEARING DAMAGES WITH A SHAFT LOCKING DEVICE.

THIS LOCKING DEVICE MUST BE USED ON ANY FURTHER TRANSPORT OF THE MOTOR, EVEN WHEN THIS MEANS TO UNCOPULE THE MOTOR FROM THE DRIVEN MACHINE.

STORAGE

If motors are not immediately installed, they must be stored in dry places, free of dust, vibrations, gases, corrosive smokes, under constant temperature and in normal position free from other objects.

In case the motors are stored for more than two years, the bearings must be changed or the lubrication grease must be totally replaced after cleaning.

Single phase motors when kept in stock for 2 years or more must have their capacitors replaced (if any).

We recommend to turn the shaft (by hands) at least once a month, and to measure the insulation resistance before installing it, in cases of motors stored for more than 6 months or when subject to high humidity areas.

If motor is fitted with space heaters, these should be switched on.

Insulation Resistance Check

Measure the insulation resistance before operating the motor and/or when there is any sign of humidity in the winding.

The resistance measured at 25°C (77°F) must be:

Ri > (20 x U) / (1000 + 2P) [Mohm] (measured with a MEGGER at 500 V d.c.); where U = voltage (V); P = power (kW).

If the insulation resistance is less than 2 megaohms, the winding must be dried according to the following:
✓ Warm it up inside an oven at a minimum temperature of 80°C (176°F) increasing 5°C (41°F) every hour until 105°C (221°F), remaining under this temperature for at least one hour. Check if the stator insulation resistance remains constant within the accepted values. If not, stator must be reimpregnated.

INSTALLATION

1 - Safety

All personnel involved with electrical installations, either handling, lifting, operation or maintenance must be well informed and up-to-dated concerning the safety standard and principles that govern the work and carefully follow them.

We strongly recommend that these jobs are carried out by qualified personnel.

MAKE SURE THAT THE ELECTRIC MOTORS ARE SWITCHED OFF BEFORE STARTING ANY MAINTENANCE SERVICE.

Motors must be protected against accidental starts.

When performing any maintenance service, disconnect the motor from the power supply. Make sure all accessories have been switched off and disconnected.

Do not change the regulation of the protecting devices to avoid damaging.

LEAD CONNECTION IN SULATION INSIDE THE TERMINAL BOX MUST BE DONE WITH AN INSULATING MATERIAL COMPATIBLE WITH MOTOR THERMAL CLASS WHICH IS SHOWN ON THE MOTOR NAMEPLATE.

2 - Operating Conditions

Electric motors, in general, are designed for operation at an altitude of 1000m above sea level for an ambient temperature between 25°C (77°F) and 40°C (104°F). Any variation is stated on the nameplate.

COMPARE THE CURRENT, VOLTAGE, FREQUENCY, SPEED, OUTPUT AND OTHER VALUES DEMANDED BY THE APPLICATION WITH THE DATA GIVEN ON THE NAMEPLATE.

Motors supplied for hazardous locations must be installed in areas that comply with that specified on the motor nameplate.

KEEP AIR INLET AND OUTLET FREE AND CLEAN. THE AIR BLOWN OUT BY THE MOTOR SHALL NOT ENTER AGAIN. THE DISTANCE BETWEEN THE AIR INLET AND THE WALL MUST BE AROUND ¼ OF THE INLET OPENING DIAMETER.

3 - Foundation

Motors provided with feet must be installed on though foundations to avoid excessive vibrations.

The purchaser is fully responsible for the foundation.

Metal parts must be painted to avoid corrosion.

The foundation must be uniform and sufficiently tough to support any short circuit strengths. It must be designed in such a way to stop any vibration originated from resonance.

4 - Drain Holes

Make sure the drains are placed in the lower part of the motor when the mounting configuration differs from that specified on the motor purchase order.

5 - Balancing

WEG MOTORS ARE DYNAMICALLY BALANCED, WITH HALF KEY AT NO LOAD AND UNCOUPLED.

Transmission elements such as pulleys, couplings, etc must be dynamically balanced with half key before installation. Use always appropriate tools for installation and removal.

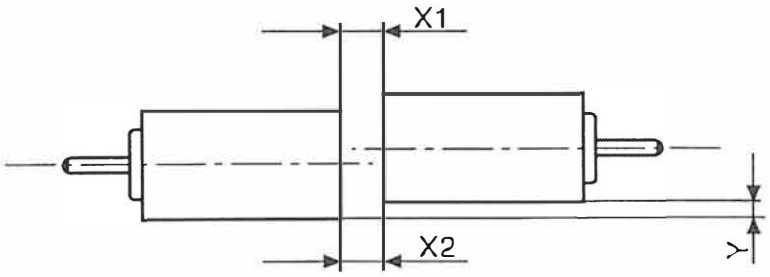
6 - Alignment

ALIGN THE SHAFT ENDS AND USE FLEXIBLE COUPLING, WHENEVER POSSIBLE.

Ensure that the motor mounting devices do not allow modifications on the alignment and further damages to the bearings.

When assembling a half-coupling, be sure to use suitable equipment and tools to protect the bearings.

Suitable assembly of half-coupling: check that clearance Y is less than 0.05mm and that the difference X1 to X2 is less than 0.05m as well.



Note: The "X" dimension must be at least 3mm.

7 - Belt Drive

When using pulley or belt coupling the following must be observed:

✓ Belts must be tighten just enough to avoid slippage when running, according to the specifications stated on the belt supplier recommendation.

WARNING:
Excessive tension on the pulleys will damage the bearings and lead to a probable shaft rupture.

8 - Connection

WARNING: Voltage may be connected at standstill inside the terminal box for heating elements or direct winding heating.

WARNING: The capacitor on single-phase motors can retain a charge which appears across the motor terminals, even when the motor has reached standstill.

A WRONG CONNECTION CAN BURN THE MOTOR.

Voltage and connection are indicated on the nameplate. The acceptable voltage variation is ± 10%, the acceptable frequency variation is ± 5% and the total acceptable variation is ± 10%.

9 - Starting Methods

The motor is rather started through direct starting. All Weg motors must be connected as shown on the motor nameplate, failure to follow the motor nameplate could lead to motor failure.

In case this is not possible, use compatible methods to the motor load and voltage.

✓ 3 lead single voltage and 9 lead dual voltage motors can be started as follows:
Full Voltage Direct On Line.
Auto-Transformer Starting.
Electronic Soft-Starting.
VFD Starting - subject to verification and application analysis.

✓ 6 lead single voltage motors and 12 lead dual voltage motors can be connected as follows:
Full Voltage Direct On Line.
WYE/DELTA Starting.
Auto-Transformer Starting.
Electronic Soft-Starting.
VFD Starting - subject to verification and application analysis.

The rotation direction is clockwise if the motor is viewed from DE side and if the phases are connected according to the sequence L1, L2, L3.

To change the rotation direction, interchange two of the connecting leads.

THE CONNECTION TO THE POWER SUPPLY MUST BE DONE BY QUALIFIED PERSONNEL AND WITH FULL ATTENTION TO ASSURE A SAFE AND PERMANENT CONNECTION. AFTER CONNECTING THE MOTOR, CHECK FOR ANY STRANGE BODY INSIDE THE TERMINAL BOX. THE CABLE INLETS NOT IN USE MUST BE CLOSED.

Make sure to use the correct cable dimension, based on the rated current stamped on the motor nameplate.

BEFORE ENERGIZING THE TERMINALS, CHECK IF THE EARTHING IS MADE ACCORDING TO THE ACTUAL STANDARDS. THIS IS ESSENTIAL AGAINST ACCIDENT RISKS.

When the motor is supplied with protective or monitor temperature device such as thermostats, thermistors, thermal protector, etc, connect their terminals to the corresponding devices on the control panel.

10- Start-Up

THE KEY MUST BE FASTENED OR REMOVED BEFORE STARTING THE MOTOR.

a) The motor must start and operate smoothly. In case this does not occur, turn it off and check the connections and the mounting before starting it again.

b) If there is excessive vibration, check if the fastening screws are correctly fastened. Check also if the vibration comes from a neighbour machine. Periodical vibration checks must be done.

c) Run the motor under rated load for a short period of time and compare if the running current is equal to that stamped on the nameplate.

MAINTENANCE

WARNING:
SAFETY CHECK LIST.

1 - General Inspection

- ✓ Check the motor periodically.
- ✓ Keep the motor clean and assure free air flow.
- ✓ Check the seals or V Ring and replace them, if required.
- ✓ Check the connections as well as supporting screws.
- ✓ Check the bearings and observe:
  Any excessive noise, bearing temperature and grease condition.
- ✓ When a changing, under normal conditions, is detected, check the motor and replace the required parts.
  The frequency of the inspections depends on the motor type and on the application conditions.

LUBRICATION

FOLLOW THE REGREASING INTERVALS. THIS IS FUNDAMENTAL FOR PROPER MOTOR OPERATION.

1 - Machines without Grease Nipples

Motors up to frame 324/6T are normally fitted without grease nipples. In these cases the regreasing shall be done at the preventive maintenance job observing the following aspects:

✓ Disassemble carefully the motors.
✓ Take all the grease out.
✓ Wash the bearing with querosene or diesel.
✓ Regrease the bearing immediately.

2 - Machines Fitted with Grease Nipples

It is strongly recommended to grease the machine while running. This allows the grease renewal in the bearing housing. When this is not possible due to turning parts by the grease device (pulleys, bushing, etc) that offer some risk to the physical integrity of the operator, proceed as follows:

✓ Clean the area near to the grease nipple.
✓ Put approximately half of the total grease and run the motor for 1 minute at full speed. Then turn off the motor and pump the rest of the grease.
✓ The injection of all the grease with the motor in standstill can make the grease penetrate into the motor, through the inner seal of the bearing housing.

When regreasing, use only special bearing grease with the following properties:

RELUBRICATION INTERVALS RECOMMENDED - POLYREX® EM GREASE (ESSO/EXXON)

Frame	Amount of grease (g)	3600 rpm	3000 rpm	1800 rpm	1500 rpm	1200 rpm	1000 rpm	900 rpm	750 rpm	720 rpm	600 rpm	500 rpm
Relubrication intervals in hours - ball bearings												
254/6T	13	15700	18100	20000	20000	20000	20000	20000	20000	20000	20000	20000
284/6T	18	11500	13700	20000	20000	20000	20000	20000	20000	20000	20000	20000
324/6T	21	9800	11900	20000	20000	20000	20000	20000	20000	20000	20000	20000
364/5T	27	3600	4500	9700	11600	14200	16400	17300	19700	20000	20000	20000
404/5TS	27	3600	4500	9700	11600	14200	16400	17300	19700	20000	20000	20000
444/5TS	27	3600	4500	9700	11600	14200	16400	17300	19700	20000	20000	20000
504/5TS	27	3600	4500	9700	11600	14200	16400	17300	19700	20000	20000	20000
586/7TS	27	3600	4500	9700	11600	14200	16400	17300	19700	20000	20000	20000
Relubrication intervals in hours - cylindrical roller bearings												
324/5T	21	9800	11900	20000	20000	20000	20000	20000	20000	20000	20000	20000
364/5T	27			9700	11600	14200	16400	17300	19700	20000	20000	20000
404/5T	34			6000	7600	9500	11600	13800	15500	15500	17800	20000
444/5T	45			4700	6000	7600	9800	12200	13700	13700	15700	20000
447/5T	45			4700	6000	7600	9800	12200	13700	13700	15700	20000
504/5T	45			4700	6000	7600	9800	12200	13700	13700	15700	20000
586/7T	60			3300	4400	5900	7800	10700	11500	11500	13400	17300

WARNING:

The table above is specifically intended for relubrication with Polyrex® EM grease and bearing absolute operating temperature of:

✓ 70°C (158°F) for 254/6T to 324/6T frame motors;
✓ 85°C (185°F) for 364/5T to 586/7T frame motors.

For every 15°C (59°F) above these limits, relubrication interval must be reduced by half.

Shielded bearing (ZZ) are lubricated for berings life as long as they operate under normal ambient conditions and temperature of 70°C(158°F).

WE RECOMMEND TO USE BALL BEARINGS FOR MOTORS DIRECTLY COUPLED TO THE LOAD.

WARNING:
EXCESS OF GREASE CAN CAUSE BEARING OVERHEATING RESULTING IN COMPLETE DAMAGE.

Compatibility of Polyre**x**® EM grease **with** other types of grease:

Containing polyurea thickener and mineral oil, the Polyrex® EM grease is compatible with other types of grease that contain:

- ✓ Lithium base or complex of lithium or polyurea and highly refined mineral oil;
- ✓ Inhibitor additive against corrosion, rust and anti-oxidant additive.

Notes:

- ✓ Although Polyrex® EM is compatible with the types of grease given above, we do no recommend to mix it with any other greases.
- ✓ If you intend to use a type of grease different than those recommended above, first contact WEG.
- ✓ On applications (with high or low temperatures, speed variation, etc), the type of grease and relubrication interval are given on an additicional nameplate attached to the motor.
- ✓ Vertical mounted motors must have the relubrication intervals reduced by half.

THE USE OF STANDARD MOTORS IN SPECIFIC AREAS OR SPECIAL APPLICATIONS MUST BE DONE BY CONSULT TO THE GREASE MANUFACTURER OR WEG.

ASSEMBLY AND DISASSEMBLY

Disassembly and assembly must be done by qualified personnel using only suitable tools and appropriated methods. The stator grips must be applied over the side face of the inner ring to be disassembled or over and adjacent part.

It is essential that the bearings disassembly and assembly be done under cleanning conditions to ensure good operation

and to avoid damages. New bearings shall only be taken out from their cases when assembling them.

Before installing a new bearing it is required to check the shaft fitting for any sharp edge or strike signals.

For bearing assembly, warm their inner parts with suitable equipment - inductive process - or use suitable tools.

SPARE PARTS

When ordering spare parts, please specify the full type designation and product code as stated on the motor nameplate.

Please also inform the motor serial number stated on the nameplate.

MOTORS FOR HAZARDOUS LOCATIONS

Besides the recommendations given previously, these ones must be also followed:

THE SPECIFICATION OF THE MOTOR INSTALLATION PLACE IS FOR CUSTOMER'S RESPONSIBILITY, WHO WILL ALSO DETERMINE THE ENVIRONMENT CHARACTERISTICS.

Motors for hazardous locations are manufactured according to specific standards for such environments and they are certified by worldwide certifying entities.

1 - Installation

The complete installation must follow procedures given by the local legislation in effect.

THE INSTALLATION OF HAZARDOUS LOCATION MOTORS MUST BE CARRIED OUT BY SKILLED PEOPLE, AND THE THERMAL PROTECTION MUST BE ALWAYS INSTALLED, EITHER INSIDE OR OUTSIDE THE MOTOR, OPERATING AT THE RATED CURRENT.

2 - Maintenance

Maintenance must be carried out by repair shops authorized by WEG.

Repair shops and people without WEG's authorization who will perform any service or hazardous location motors will be fully responsible for such service as well as for any consequential damage.

ANY ELECTRICAL OR MECHANICAL MODIFICATION MADE ON HAZARDOUS LOCATION MOTORS WILL VOID THE CERTIFICATION.

When performing maintenance, installation or relubrication, follow these instructions:

- ✓ Check if all components are free of edges, knocks or dirt.
- ✓ Make sure all parts are in perfect conditions.
- ✓ Lubricate the surfaces of the endshield fittings with protective oil to make the assembly easier.
- ✓ Use only rubber hammer to fit the parts.
- ✓ Check for correct bolts tightening.
- ✓ Use clearance calibrator for correct T-box fitting (smaller than 0.05mm).

DO NOT REUSE DAMAGED OR WORN PARTS. REPLACE THEM BY NEW ONES SUPPLIED BY THE FACTORY.

MOTORS DRIVEN BY VFD

Applications using VFD´s without filter can affect motor performance as follows:

- ✓ Lower efficiency.
- ✓ Higher vibration.
- ✓ Higher noise level.
- ✓ Higher rated current.
- ✓ Higher temperature rise.
- ✓ Reduced motor insulation.
- ✓ Reduced bearing life.

1 - Standard Motors

- ✓ Voltages lower than 440V do not require filter.
- ✓ Voltages equal or higher than 440V or lower than 575V require filter for motor power supply cables longer than 20 meters.
- ✓ Voltages equal or higher than 575V require filter for any size of power supply cables.

IF SUCH RECOMMENDATIONS ARE NOT FOLLOWED ACCORDINGLY, MOTOR WARRANTY WILL BE VOID.

2 - Inverter Duty Motors

- ✓ Check power supply voltage of the forced cooling set.
- ✓ Filters are not required.

WARRANTY TERMS
SERIES AND ENGINEERING PRODUCTS

WEG warrants its products against defects in workmanship and materials for 18 months from the invoice date issued by the factory, authorized distributor or agent limited to 24 months from manufacturing date independent of installation date as long as the following items are fulfilled accordingly:

- Proper transportation, handling and storage;

- Correct installation based on the specified ambient conditions and free of corrosive gases;

- Operation under motor capacity limits;

- Observation of the periodical maintenance services;

- Repair and/or replacement effected only by personnel duly authorized in writing by WEG;

- The failed product be available to the supplier and/or repair shop for a required period to detect the cause of the failure and corresponding repair;

- Immediate notice by the purchaser about failures occured and that these are accepted by WEG as manufacturing defects.

This warranty does not include disassembly services at the urchaser facilities, transportation costs with product, tickets, accomodation and meals for technical personnel when requested by the customer. The warranty service will be only carried out at WEG Authorized Repair Shops or at WEG´s facilities.

Components whose useful life, under normal use, is shorter than the warranty period are not covered by these warranty terms.

The repair and/or replacement of parts or components, when effected by WEG and/or any WEG Authorized Repair Shop, will not give warranty extension.

This constitutes WEG´s only warranty in connection with this sale and the company will have no obligation or liability whatsoever to people, third parties, other equipment or installations, including without limitation, any claims for consequential damages or labor costs.

GOYEN

Model RCA 5D
RCA 6V56

INSTALLATION and SERVICE INSTRUCTIONS

DESCRIPTION

The model RCA5D is a single solenoid valve and the model RCA6V56 is a Nema 4 aluminum enclosure with up to 6 integral solenoid valves. The last digit in the model number of the Nema 4 assembly indicates the number of solenoid valves (example, RCA6V56, indicates six solenoid valves.)

Both models have encapsulated coils and screw terminals for one step electrical connections. .Each solenoid valve has a 1/4" FNPT inlet connection, 3/16" orifice, rated 110 PSI and exhausts to atmosphere.

OPERATION

Each valve opens when voltage is applied to the coil and the resultant magnetic field attracts the 430 SS plunger with integral disc off the seat. In the de-energized position the plunger is held on the seat by a spring and the system pressure assists in seating. The only moving parts are the plunger and spring. To manually override the valve, simply insert a rod, diameter of a paper clip, into the outlet and push.

INSTALLATION

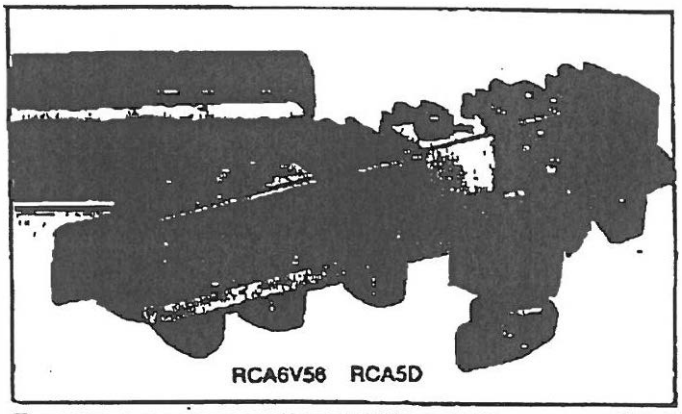
The ideal mounting arrangement is to have the coils in the verical and upright position. This position shields the outlet, preventing rain or other foreign substances from settling therein. Screw terminals in the coil provide for one step electrical connections.

SERVICE

The valve requires no periodic service. Should a valve malfunction the cause is usually dirt from the system. A kit, M1141, is available to restore a worn valve to a new condition.

VALVE WILL NOT OPEN:

Step 1. Confirm adequate electrical service.
Step 2. Remove cover on RCA6V5__ Assemblies.
Step 3. Coil—check continuity, or, if metallic click is heard when coil is energized, the coil is not the source of the problem.
Step 4. Depressurize the system.
Step 5. Remove body for access to plunger, spring and orifice. Check orifice to be sure it is not blocked or for other foreign objects that may prohibit operation.
Step 6. If dirt was problem clean and reassemble.
Step 7. If plunger is excessively worn, to where it lodged in the ferrule assembly, rebuild valve with kit M1141.*

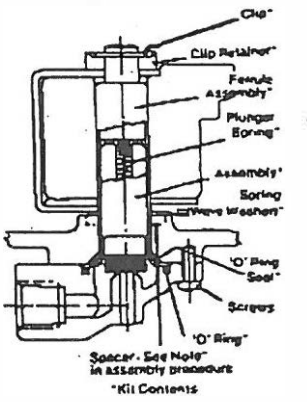


RCA6V56 RCA5D

Assembly Procedure KIT [redacted] K0580

1. Mount ferrule assembly, plunger assembly, spring, 'O' rings and valve body onto base with 3 screws. (NOTE: Plunger and spring must be fitted as shown).
2. Fit spacer over ferrule and into recess in base — discard spacer if no recess exists.
3. Fit wave washer onto ferrule.
4. Fit coil and bracket assembly, and clip retainer onto ferrule.
5. To fit retaining clip, press down on coil (compressing wave washer) and slide clip into recess in clip retainer.

Assembly Details



VALVE WILL NOT CLOSE:

Step 1. Disconnect the electrical signal to be sure coil is not continuously energized.
Step 2. Depressurize the system.
Step 3. Remove body for access to plunger, spring and orifice, check for dirt in valve preventing disc from sealing on seat.
Step 4. If dirt was the problem clean and reassemble.
Step 5. If disc is excessively worn to where it will not seal on the seat or plunger is jammed in enclosing tube because of excessive wear, rebuild valve with kit, M1141.*

**To restore a valve to a new condition, all parts included in the kit should be changed.*

GOYEN CONTROLS of AMERICA, LTD.

777 Airport Road • Lakewood, N.J. 08701

Telephone (201) 364-7800

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GOYEN CONTROLS

OPERATOR'S MANUAL
REVERSE JET PULSE, DUST COLLECTOR VALVES

INDEX

1. DESCRIPTION/SPECIFICATION

The Goyen Clean Air System (CAS) consists of a 2 way normally closed diaphragm valve and an electrically operated normally closed pilot valve that can be either combined with the diaphragm valve (CA series) or remote from the diaphragm valve (RCA series).

The diaphragm valves are designed specifically to meet the market need for a quick-acting high flow unit with outstanding reliability and durability.

CONSTRUCTION

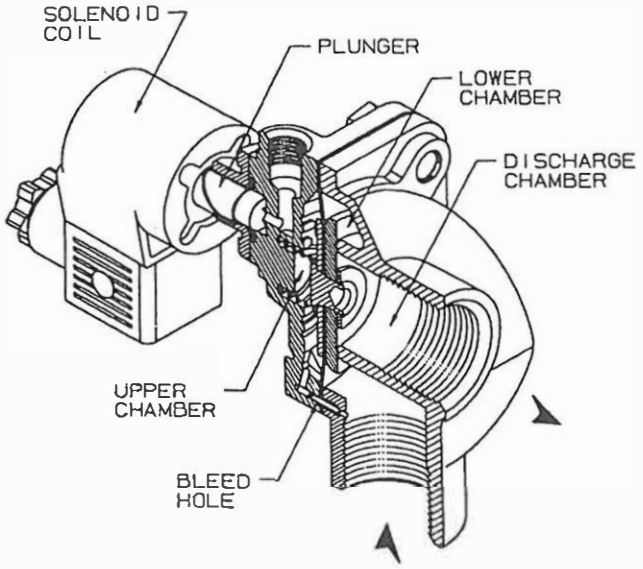
Body and cover, are pressure diecast aluminium. General purpose diaphragms are made from a Buna N elastomer, reinforced with nylon mesh, and are suitable for temperatures ranging from 180°F (82°C) down to -40°F (-40°C). High temperature diaphragms are made from reinforced Viton, and are suitable for temperatures up to 450°F (232°C). All seals are designed to meet the same criteria.

SPECIFICATION

Fluid: Air or Nitrogen
Maximum Working Pressure: 0.86 MPa (125 psi)
Recommended Working Pressure: 0.76 MPa (110 psi)
Minimum Working Pressure: 0.21 MPa (30 psi)
Fluid Temperature: -40°C to 82°C (Buna N)
to 232°C (Viton)
Ambient Temperature: As above.
Mounting Position: Any
Coil Encapsulation: Nylon
Coil Rating: Intermittent, Class B. (130°C)

Goyen valves come in a number of body styles/ configurations. For further details see the following Techspecs:-

CAS-1 – "-T" Series Diaphragm Valves
CAS-2 – "-OO" Series Diaphragm Valves
CAS-3 – "-MM" Series Diaphragm Valves
CAS-4 – Pilot Valves and Enclosures
CAS-5 – Enclosures for Hazardous Locations



2. DESCRIPTION OF OPERATION

Goyen valves come in both single and double diaphragm configurations, depending on the size of the valve.

For simplicity sake, we describe here the operation of a single diaphragm valve with integral pilot (CA version). Valves with remote pilots (RCA version) or with double diaphragms act in exactly the same way.

When the coil is energised, a plunger inside the pilot valve is lifted off its seat causing the chamber above the diaphragm (upper chamber) to commence discharging to atmosphere.

While there is continuous replacement of this air through the bleed hole (see sketch), the sizing of the pilot valve orifice and the bleed hole is such that the pressure in this upper chamber drops rapidly. In a short time, the air pressure on the valve inlet (lower chamber) will substantially exceed the pressure in the upper chamber, to the extent that the diaphragm will commence to lift. As soon as this happens, air enters the discharge chamber (valve outlet) and the diaphragm rapidly opens fully.

When the coil is de-energised, the plunger inside the pilot valve returns to its seat. The pressure inside the upper chamber increases due to air flow through the bleed hole. The pressure above the diaphragm rises to an extent that a nett closing force is generated, and the valve closes rapidly.

5. TROUBLE SHOOTING

PROBLEM	POSSIBLE CAUSE
1. Diaphragm Valve fails to operate (open)	• No pressure in header • Low or no power to coil • Coil inoperative • Pilot valve plunger jammed shut • Pilot orifice blocked • Secondary bleed-hold blocked • Main diaphragm perforated • Secondary diaphragm perforated • Pilot valve connecting line too long • Silencer, if fitted, may be blocked
2. Diaphragm Valve fails to shut	• Pilot valve plunger jammed open • Foreign matter under pilot valve • Secondary diaphragm spring broken • Foreign matter under secondary diaphragm • Main diaphragm spring broken • Foreign matter under main diaphragm • Main diaphragm seating disc damaged • Main bleed hole blocked • Secondary bleed hole blocked • Leak in line connecting pilot valve
3. Unable to build header pressure	• Excessive leakage from main diaphragm seat • Broken main valve spring • Secondary diaphragm not seating • Foreign matter under main or secondary diaphragm seat or under pilot valve seat • Air supply line too small • Compressor too small
4. Sluggish operation of diaphragm valve	• Partial blockage of one of the bleed-holes • Silencer, if fitted, may be blocked

SPECIAL NOTE

To prevent premature failure of a diaphragm valve, special attention must be paid to the quality of the compressed air being handled.

An adequate moisture and oil removal system must be incorporated that takes into account:

- relative humidities likely to be experienced
- ambient temperatures
- system operating temperatures
- pressure drops (and associated temperature drops) through the valve and also through the blow tube holes (dew point problem)

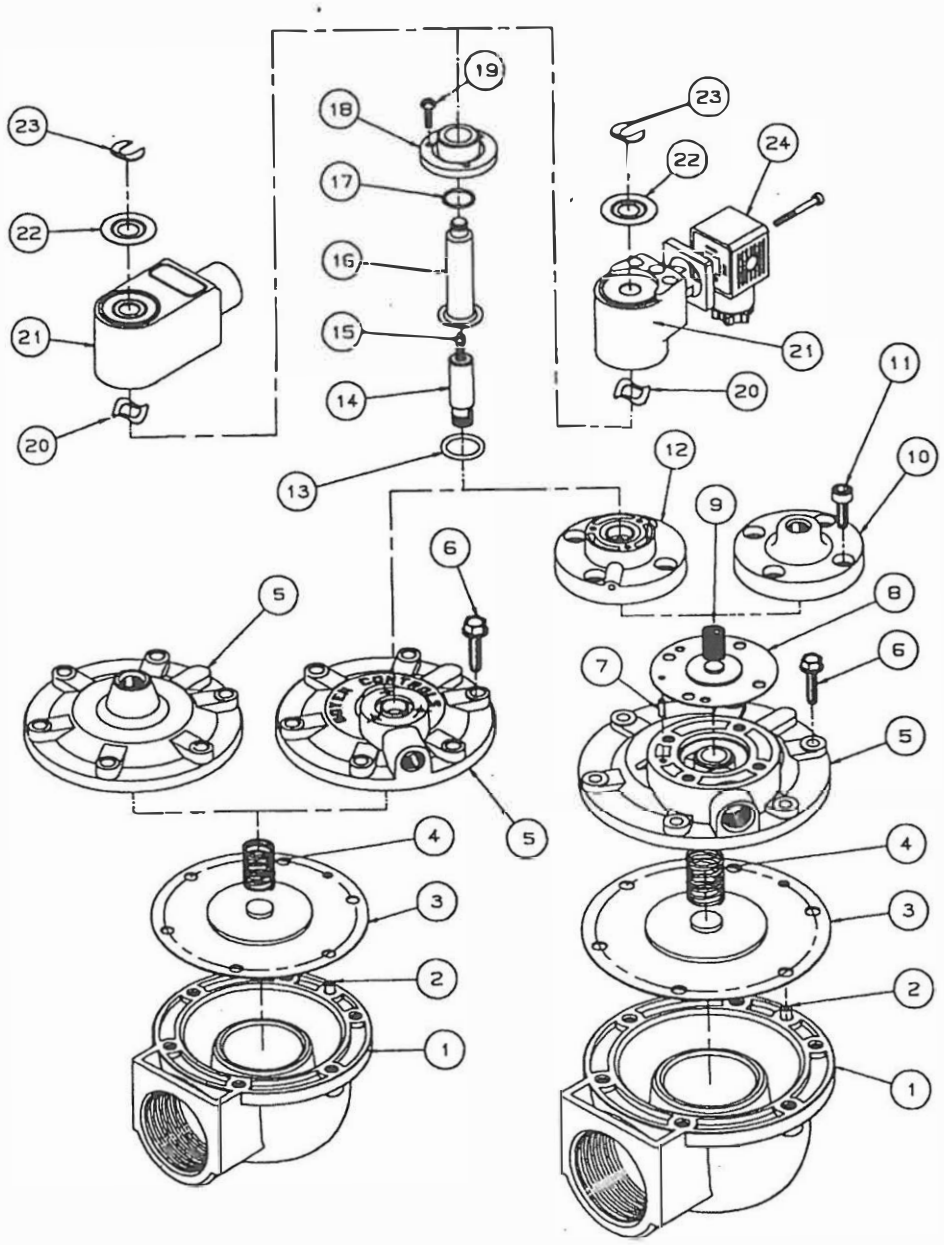
Small traces of chlorine and other aggressive gases, often present in filter air flows, can be absorbed in wet areas resulting in corrosion and premature failure.

Apart from valve failures, systems may not perform to expectation for a number of reasons including the following:

- poorly prepared orifice holes in the blow tube
- incorrect sizing of the valves, blow tube and orifice holes
- inaccurate positioning of the blow tube relative to the venturis or bag entries
- inadequately sized header and/or air supply
- incorrect pulse time
- incorrect intervals between pulses
- malfunction of the timer

6. PARTS LIST

"-T" SERIES DIAPHRAGM VALVES



Item	Description	Qty
1	Body	1
2	Main Bleed Pin	1
3	Main Diaphragm Assy.	1
4	Spring, Main Diaphragm	1
5	Main Cover	1
6	Hexagonal Screw	4 or 6
7	Secondary Bleed Pin	1
8	Secondary Diaphragm	1
9	Spring, Sec. Diaphragm	1
10	Secondary Cover (RCA)	1
11	Socket Screw	4
12	Secondary Cover (CA)	1
13	O-Ring	1
14	Plunger	1
15	Spring, Plunger	1
16	Ferrule Assembly	1
17	O-Ring	1
18	Ferrule Retainer	1
19	Screw	3
20	Wave Washer	1
21	Coil-(QR/QD)	1
22	Nameplate	1
23	Clip	1
24	Din Socket	1

SINGLE DIAPHRAGM MODELS
CA/RCA 20T, 25T, 35T

DOUBLE DIAPHRAGM MODELS
CA/RCA 45T2, 50T, 62T, 76T

GOYEN CONTROLS

7. SPARE PARTS

The following repair kits are available from your nearest Goyen distributor.

MODEL	PIPE SIZE	REPAIR KITS	
		BUNA N	VITON
RCA20M	3/4"	M1174	M1328B
CA/RCA 20T*	3/4"	M1204B	M2082B
CA/RCA25T*	1"	M1183B	M1887
CA/RCA35T*	1-1/2"	M1581	M1761
CA/RCA 45T2	1-1/2"	M2162	M2163
CA/RCA 50T	2"	M1638A	M1157A
CA/RCA 62T	2-1/2"	M1638A	M1157A
CA/RCA 76T	3"	M1798	M1925
CA/RCA 20DD*	3/4"	M1204	M2082
CA/RCA 25DD*	1"	M1183B	M1887
CA/RCA 40DD	1-1/2"	M1182	M1156
CA/RCA 45DD2	1-1/2"	M2162	M2163

MODEL	PIPE SIZE	REPAIR KITS	
		BUNA N	VITON
CA/RCA 25MM.D*	1"	M1183B	M1887
CA/RCA 25MM.P*	1"	M1183B	M1887
CA/RCA 40MM.D	1-1/2"	M2201	M1156
CA/RCA 40MM.P	1-1/2"	M2201	M1156
CA/RCA 76MM2.S	3"	M1798	M1925

*Single diaphragm models.

Part numbers of diaphragm repair kits are shown in Table for both standard (Buna-N) and high temperature (Viton) elastomers.

Spare parts kits for pilot solenoid valves consist of ferrule tube, plunger and spring. The part numbers for these kits are M1131B (Buna-N) and M1167B (Viton). These kits service all CA and 1/8" pilot valves, AC or DC voltages.

GOYEN

. . AVAILABLE INTERNATIONALLY

U.S.A. ... COAST TO COAST & CANADA
GOYEN VALVE CORPORATION.
25327 AVENUE STANFORD
VALENCIA CALIFORNIA 91355
TELEPHONE (805) 257 0566 FAX (805) 257 8990
661 661
1195 AIRPORT ROAD
LAKEWOOD. NEW JERSEY 08701
TELEPHONE (908) 364 7800 FAX (908) 364 1356

UNITED KINGDOM
GOYEN CONTROLS (U.K.) LTD.
UNIT 38, BEECHWOOD
CHINEHAM BUSINESS PARK
BASINGSTOKE. HAMPSHIRE. RG24 OWA.
TELEPHONE (0256) 81 7800 FAX (0256) 84 3164

DISTRIBUTOR:

GERMANY
GOYEN CONTROLS OEUTSCHLAND
SIEMENSRING 79
POSTFACH 1113
D-4156 WILLICH 1
TELEPHONE (02154) 42 8879 FAX (02154) 42 7277

NEW ZEALAND
GOYEN CONTROLS
40 HONAN PLACE, AVONDALE, AUCKLAND
TELEPHONE (09) 828 7187 FAX (09) 828 7654

AUSTRALIA
GOYEN CONTROLS CO. PTY. LTD A.C.N. 000 168 098

SYDNEY
HEAD OFFICE & MAIN MANUFACTURING PLANT
268-292 MILPERRA ROAD
MILPERRA. N.S.W. 2214 AUSTRALIA
TELEPHONE (02) 771 4111 FAX (02) 771 5380

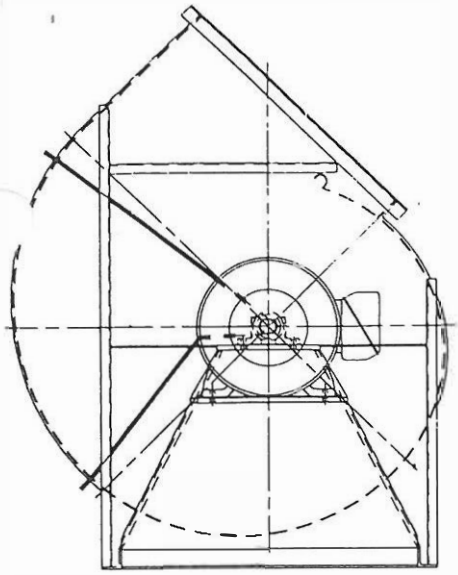
ADELAIDE
35-37 HALIFAX STREET, ADELAIDE S.A. 5000
TELEPHONE (08) 231 4522 FAX (08) 231 1874

BRISBANE
UNIT 1, 9 VIRGINIA STREET, VIRGINIA. QLD. 4014
TELEPHONE (07) 865 1644 FAX (07) 865 1454

MELBOURNE
23 ALLEN STREET, MORELAND. VIC. 3058
TELEPHONE (03) 383 1233 FAX (03) 383 4247

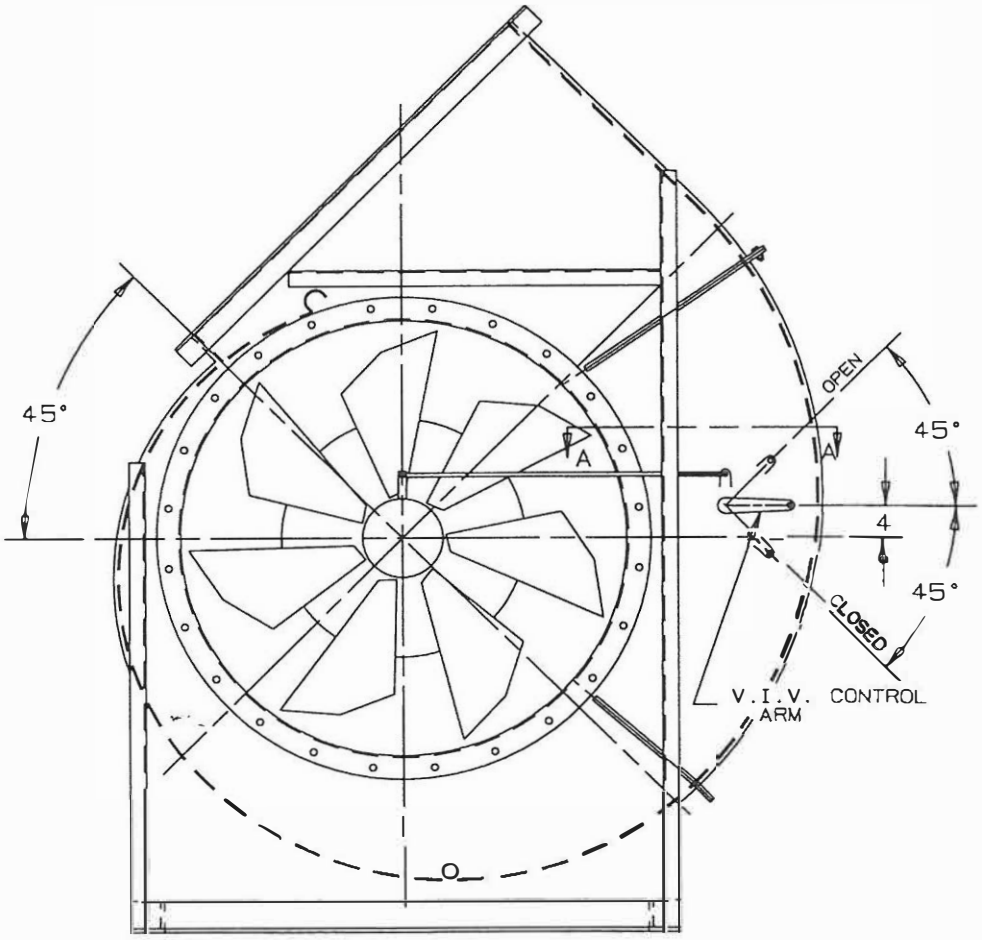
616 MOUNTAIN HIGHWAY, BAYSWATER. VIC. 3153
TELEPHONE (03) 729 5355 FAX (03) 720 6003

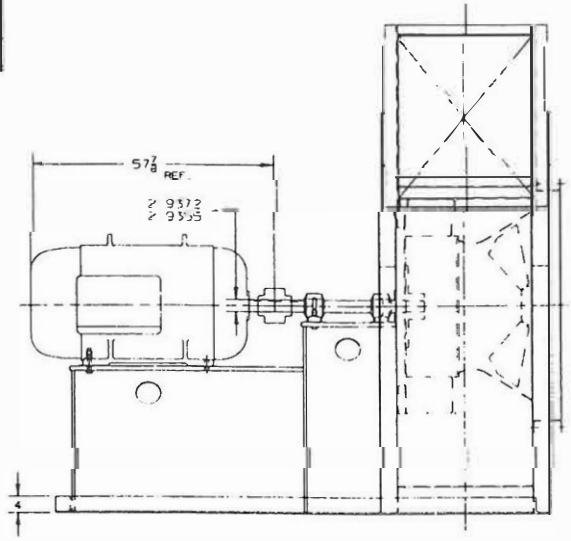
PERTH
UNIT 3, COMMERCE COURT
92 ROBINSON AVENUE, BELMONT. W.A. 6104
P.O. BOX 860. CLOVERDALE. W.A. 6105
TELEPHONE (09) 479 1877 FAX (09) 479 1581



FAN EQUIPMENT OPERATION MANUAL

Fan Serial No. _____





NORTHERN BLOWER

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Published by

CML NORTHERN BLOWER INC.

Telephone 204-222-4216

Telefacsimile 204-222-7601

901 Regent Avenue West

WINNIPEG, MANITOBA

CANADA

R2C 2Z8

1990

CML NORTHERN BLOWER INC.
STANDARD TERMS AND CONDITIONS and WARRANTY

STANDARD TERMS AND CONDITIONS

TERMS OF PAYMENT: Terms of payment are net thirty (30) days subject to the prior approval of the CML Northern Blower Inc. ("CML Northern") Credit Department. Notwithstanding such approval, if in CML Northern's judgement the customer's financial condition does not warrant the continuation of production or shipment on the original terms, CML Northern reserves the right to request payment in advance. Overdue accounts will bear interest at the prevailing bank rate charged to CML Northern.

ACCEPTANCE AND PRICES: Prices quoted for products manufactured by CML Northern are subject to acceptance by the purchaser no later than thirty (30) days from the date of the Quotation - Proposal.

Prices quoted for items which are not manufactured by CML Northern such as motors and drives, etc. are subject to change at any time the cost of such items charged to CML Northern changes.

Prices on orders for products manufactured by CML Northern are firm provided approval and release for production and shipment is received from the customer within ninety (90) days of the date of CML Northern's receipt of the customer's order and the products are shipped within twelve (12) months of the date of CML Northern's receipt of the customer's order. When such approval and release for production and shipment is received after ninety (90) days of the date of CML Northern's receipt of the customer's order or products are shipped after twelve (12) months of the date of CML Northern's receipt of the customer's order, such prices are subject to adjustment to CML Northern prices in effect on the date approval and release from customer is received by CML Northern or at time of shipment.

Orders for non-stock equipment released for production and scheduled by CML Northern cannot be rescheduled by the customer unless it is done at least eight (8) weeks before the CML Northern scheduled shipping date. If production is started the customer must accept delivery when the order is ready for shipment.

CANCELLATIONS: Accepted orders cancelled by the customer are subject to cancellation charges for all expenses incurred and commitments made by CML Northern. The cancellation charges on completed items will be one hundred (100%) percent of the selling price. The aforementioned cancellation charges shall not in any way whatsoever limit CML Northern's other remedies it may have at law including, without limiting the generality of the foregoing, the ability of CML Northern to claim and recover any amounts or damages to which CML Northern would otherwise be entitled by reason of accepted orders cancelled by the customer.

FREIGHT CLAIMS: Unless otherwise expressly agreed in writing, delivery of the product is made FOB CML Northern Plant. The liability and responsibility of CML Northern for the product ceases upon delivery of the product in good order to the carrier. **All claims for damage and shortage in transit are the customer's responsibility and the customer must file the claim against the carrier.** Claims for factory shortage will not be recognized unless such alleged shortage is reported to CML Northern in writing within ten (10) days after receipt of the product.

TAXES: The amount of any present or future taxes shall be added to the price contained herein and shall be paid by the customer in the same manner and with the same effect as if originally added thereto.

DELAYS: CML Northern shall not be liable to the customer or to any third party for any delays caused by riots, strikes, lockouts, weather, fire, floods, lack of transportation, accidents, the failure of CML Northern's suppliers to meet their contractual obligations, breakdowns, or any other contingency beyond CML Northern's reasonable control and receipt of the product by the customer shall constitute a waiver of all claims for loss or damage due to delay.

PRODUCT CHANGES: CML Northern reserves the right to change or modify the product in the interest of continuous product improvement without liability.

RETURNED GOODS: Goods may not be returned except by the written permission of the President, General Manager or General Sales Manager of CML Northern and when so returned will be subject to a handling charge and transportation costs.

MODIFICATION: These Standard Terms and Conditions may not be modified except by written agreement signed by the President, General Manager or General Sales Manager of CML Northern. **The failure of CML Northern to object to provisions contained in the customer's purchase orders or other communications shall not be deemed waiver of the Standard Terms and Conditions hereof or acceptance of such provisions.** No other terms and conditions other than the Standard Terms and Conditions contained herein and those terms and conditions with respect to the description of product, quantity and price contained in the "Quotation-Proposal" shall be binding upon CML Northern unless made in writing and signed by the President, General Manger or General Sales Manager of CML Northern. Without restricting the generality of the foregoing, agents and sales representatives of CML Northern do not have authority to modify these Standard Terms and Conditions.

WARRANTY

CML Northern Blower Inc. (the "Seller") warrants products of its manufacture (the "product", "equipment" or "fan") to be free of defects in material and workmanship if properly installed, and cared for, and operated under normal conditions, and with competent supervision, all in accordance with the Seller's Operation Manual. If any questions exist as to whether the proposed operation of the Seller's equipment is within "normal conditions" for such equipment, details of such proposed operation should be provided to the Seller at its Winnipeg factory. The Seller will review the proposed operation of the equipment (at a fee) and advise if the proposed operation is acceptable.

(1) The Seller's obligation under this warranty is limited to the repair or replacement, at its option at its Winnipeg factory, of any defective part or parts which shall within one (1) year after shipment thereof to the original purchaser (the "Purchaser"), be returned to its Winnipeg factory with transportation charges prepaid by the Purchaser and upon such repair or replacement the Seller shall have fulfilled all its obligations to the Purchaser. The Seller will not be liable, in any circumstances, for costs or expenses incurred by the Purchaser or any person claiming through the Purchaser in the removal or replacement of equipment alleged to be defective. Except as specifically provided herein, the Seller will not be liable, in any circumstances, for any loss or damage of whatever nature or kind (including, without limiting the generality of the foregoing, direct, indirect, incidental or consequential loss or damage or damage resulting from business interruption) should the equipment be so defective as to preclude the remedy of warranted defects by repair or replacement. In such event, the Purchaser's sole and exclusive remedy shall be the refund of the purchase price paid by the Purchaser for all the defective equipment.

(2) The Seller shall not be liable for the repair or replacement of any such defective part or parts, or for loss, damage, or any expense of repairs when any adjustment, alteration or repair shall have been made or attempted outside of its factory, except if such adjustment, alteration or repair outside its factory is made or attempted after the Seller's written consent is first obtained.

(3) The Seller shall not be liable for any corrosion or fouling caused by any foreign substance deposited in or on the equipment.

(4) Because the Seller is unaware of any forms of construction, materials, alloys or coatings which will successfully resist all abrasion, erosion , corrosion, or deterioration from excessive heat, the Seller's warranty does not apply when any of its products or equipment are subjected to conditions which cause such abrasion, erosion , corrosion or deterioration from excessive heat or any damages similar or related thereto.

(5) The performance of the Seller's fan equipment outside of the laboratory may vary widely and differ from the performance specifications contained in its sales literature. Therefore, the Seller cannot and does not guarantee or warrant the performance of its fan equipment at the Purchaser's location.

(6) ALL WARRANTIES OF THE SELLER, EXPRESS OR IMPLIED, WITH RESPECT TO MOTORS, SWITCHES, CONTROLS OR OTHER ACCESSORIES NOT MANUFACTURED BY THE SELLER, INCLUDING WARRANTIES OF MERCHANTABILITY, QUALITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE HEREBY EXCLUDED.

(7) The Seller shall have no liability under the terms of this Warranty or otherwise where the Purchaser undertakes the responsibility of mounting the fan wheel directly to the motor or turbine shafts without the Seller having inspected and tested the assembled unit (at a fee) before the fan is operated in any fashion. If the Seller does not inspect and test the assembled unit within ten (10) days of being requested to do so by the Purchaser and receipt of payment of the aforementioned fee, the Seller shall be deemed to have waived its requirement to inspect and test the assembled unit.

(8) The Seller shall have no liability under the terms of this warranty or otherwise until the Purchaser has made full payment to the Seller for the product or equipment to which this warranty is to apply.

(9) NO WARRANTIES WHATSOEVER, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY, QUALITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE MADE BY THE SELLER EXCEPT AS EXPRESSLY PROVIDED HEREIN.

(10) The terms of this warranty may not be modified except by written agreement signed by the President, General Manager or General Sales Manager of the Seller. The Seller's failure to object to provisions contained in the Purchaser's purchase orders or other communications shall not be deemed waiver of the terms and conditions hereof nor acceptance of such provisions. No representations or warranties other than those contained herein shall be binding upon the Seller unless made in writing and signed by the President, General Manager or General Sales Manager of the Seller. Without restricting the generality of the foregoing, agents and sales representatives of the Seller do not have authority to modify the the terms of this Warranty or make representations or warranties other than those contained herein.

CML NORTHERN BLOWER INC.
OPERATION MANUAL - FAN EQUIPMENT

SAFETY PRECAUTIONS

FAN EQUIPMENT CAN BECOME A SOURCE OF INJURY AND DEATH IF NOT PROPERLY INSTALLED, OPERATED OR MAINTAINED. Do not exceed the maximum operating temperature or speed limits for which the fan equipment was designed. Limits for some lines of fan equipment are given in CML Northern Blower Inc. ("CML Northern") catalogues. Limits for non-catalogued lines of fan equipment should be obtained in writing from the CML Northern Winnipeg factory and not otherwise. Do not rely on limits obtained in any other manner.

The user should make all personnel who operate or maintain the fan equipment aware of all possible hazards.

THE RESPONSIBILITY FOR PROVIDING SAFETY ACCESSORIES FOR FAN EQUIPMENT SUPPLIED BY CML NORTHERN IS THAT OF THE USER OF THE FAN EQUIPMENT. CML Northern sells its fan equipment with or without safety accessories, and accordingly, it can supply standard safety accessories upon receipt of an order. Ensure that all necessary safety accessories have been installed before operation of the fan equipment.

The warning notice set out below should be affixed upon the fan equipment:

CML NORTHERN BLOWER INC.

WARNING

This fan has rotating parts and may be hot. Keep body, hands and foreign objects away from inlet and outlet. Do not touch fan or motor during operation.

Operate, install and maintain only in strict accordance with safety practices and instructions in manufacturer's Operation Manual. Do not exceed the maximum operating temperature, speed,or vibration level identified in the manufacturer's catalogues and Operation Manual. Untrained personnel should never operate, install, adjust or maintain fan or motor.

ADDITIONAL SAFETY ACCESSORIES FOR THE FAN EQUIPMENT ARE AVAILABLE FROM THE MANUFACTURER. THE RESPONSIBILITY FOR PROVIDING SUCH ADDITIONAL SAFETY ACCESSORIES IS THAT OF THE USER OF THE FAN EQUIPMENT. CONSULT THE MANUFACTURER'S OPERATION MANUAL FOR GUIDANCE.

Before starting maintenance work, lock disconnect switch in the off position,de-energize and disconnect all power sources to the motor and to accessory devices and secure fan impeller. Cleanout doors must be secure during operation. Unsecured cleanout doors may shoot open during operation because of pressure build up inside the fan.

Do not start-up when fan impeller is rotating backwards.

FAILURE TO FOLLOW MANUFACTURER'S INSTRUCTIONS AS TO OPERATION, INSTALLATION, ADJUSTMENT, MAINTENANCE, SAFETY EQUIPMENT OR APPROPRIATE OPERATING CONDITIONS COULD RESULT IN DAMAGE TO THIS EQUIPMENT, DAMAGE TO OTHER EQUIPMENT, PERSONAL INJURY OR DEATH.

Should the warning notice not be affixed to the fan equipment purchased, CML Northern will supply such a warning notice upon request made to its head office.

The user of the fan equipment, in making its determination as to the appropriate safety accessories to be installed and any additional warning notices to be affixed upon the fan equipment, should consider (1) the location of the installation of the fan equipment, (2) the accessibility of employees and other persons to the fan equipment, (3) any adjacent equipment, (4) applicable building codes, and (5) applicable health and safety legislation.

Users and installers of the fan equipment should read "RECOMMENDED SAFETY PRACTICES FOR AIR MOVING DEVICES" which is published by the Air Movement and Control Association, 30 West University Drive, Arlington Heights, Illinois, 60004.

INSTALLATION, OPERATION & MAINTENANCE OF CML NORTHERN FAN EQUIPMENT

INTRODUCTION

The purpose of this section is to aid in the proper installation. operation, and maintenance of CML Northern fan equipment. These instructions are intended to supplement good general practices and are not intended to cover detailed instruction procedures.

The receipt, handling, installation, operation and maintenance of CML Northern fan equipment is the responsibility of the user. It is important that the installation and start-up of the fan equipment be supervised or inspected by personnel experienced in such work and equipment. Trained personnel are available from CML Northern, and arrangements for such supervision and inspection (at a fee) should be made through your local CML Northern representative or at CML Northern's head office. Failure to arrange for such supervision or inspection may affect or void the CML Northern Warranty (please refer to paragraph 7 of CML Northern's Warranty).

SHIPMENT & RECEIVING

CML Northern has thoroughly inspected the fan equipment at its factory and has prepared the fan equipment for shipment in accordance with the uniform freight classification followed by all carriers. The fan equipment should be in perfect condition when received, unless damaged in transit. Upon acceptance by the carrier, as evidenced by a signed bill of lading, the carrier accepts responsibility for all shortages or damage, whether concealed or evident. Claims covering shortages or damage must be made to the carrier by the purchaser. Any shortages or damage should be noted by the user on the delivery receipt.

The fan equipment may contain components manufactured by manufacturers other than CML Northern. Such other manufacturers may have furnished instructions and/or other literature concerning their component. A list of such instructions and/or other literature is forwarded with the fan equipment (see page 15 of this manual). If any of the items on the list are missing, please contact your CML Northern representative, CML Northern at it's head office or contact the component's manufacturer directly.

HANDLING

The fan equipment should be handled with care. Some fans are provided with lifting lugs or holes for easy handling. Others must be handled using nylon straps or well-padded chains and cables which protect the fan's coating and housing. Spreader bars should be used when lifting large parts.

Axial fans should be lifted by using straps around the fan housing only. DO NOT LIFT AXIAL FANS BY THE MOTOR, MOTOR BASE, IMPELLER OR FLANGES.

Centrifugal fans are best lifted using straps attached to structural base members of the fan. DO NOT LIFT CENTRIFUGAL FANS BY THE FAN SHAFT, IMPELLER, FLANGES OR INLET SUPPORTS.

Roof ventilators should be lifted by using straps attached to lifting lugs or base only. Spreader bars should also be used to avoid damage to the butterfly damper assembly or the weatherhood. DO NOT LIFT ROOF VENTILATORS BY THE BUTTERFLY DAMPER ASSEMBLY OR WEATHERHOOD.

Centrifugal rotor assemblies (i.e. impeller and shaft assemblies) have been designed to be supported by the shaft, and should be lifted by slings around the shaft as close as possible to the hub on each side of the impeller (wheel). Slings should not press against the side plates of the wheel as this may damage and distort the wheel. A spreader bar should be used when lifting the rotor assembly (Figure 1). The wheel should never rest on the side plates or blades, nor should the rotor assembly be lifted by any components of the fan wheel. To do so may damage the rotor assembly and destroy the dynamic balance that is necessary for low vibration operation. If this balance is destroyed, rebalancing of the rotor assembly will be necessary. If the wheel and shaft have not been assembled, the fan wheel may be lifted by a timber or wrapped bar of sufficient strength passed through the hub. The finished bore of the hub and the bearing surfaces of the shaft must also be protected from damage.

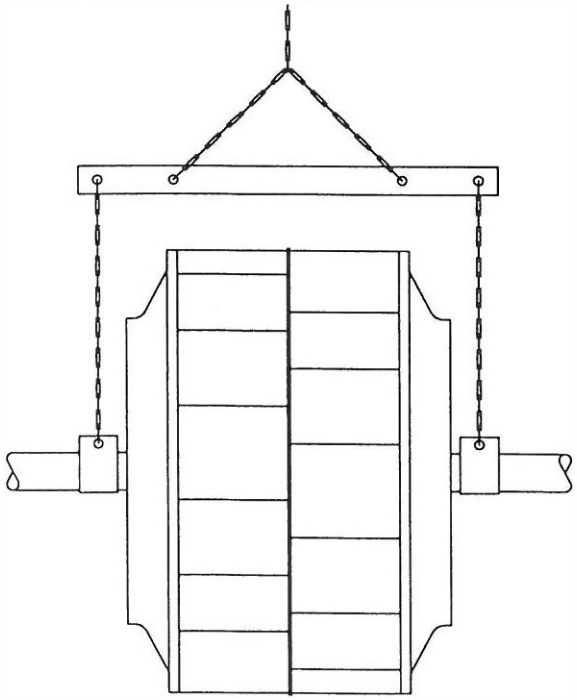

Fig. 1 *Correct use of spreader bar when lifting centrifugal rotor assembly.*

STORAGE

If fan equipment is not installed immediately, fans should be protected so as to remain dry at all times.

(1) If temporary storage is necessary:

Store in a dry area which is free of any vibration, and protect from extremes and rapid changes in humidity and temperature.

(A) Temperatures: between 50°F (10°C) and 120°F (49°C).

(B) Maximum relative humidity: 60%.

(C) Shock or vibration: 2 mils displacement maximum to prevent bearings from brinelling. Exceeding this limit will require vibration dampening material under the fan equipment.

(2) If extended storage is necessary:

Motor bearings and fan bearings are to be lubricated at the time of placement into extended storage. Motor shafts and fan shafts are to be manually rotated every month and additional lubricant added, purging some of the lubricant in the bearing cavity every six (6) months. LUBRICANT IN THE BEARINGS IS TO BE PURGED AT THE TIME OF REMOVAL FROM STORAGE, ENSURING THAT AN AMPLE SUPPLY OF FRESH LUBRICANT IS IN EACH LUBRICANT CAVITY. LUBRICANT USED MUST BE COMPATIBLE WITH THE LUBRICANT ALREADY IN THE MOTOR AND FAN BEARINGS.

Electric motors in storage may absorb moisture in their windings which may result in a significant loss of insulation resistance. When removed from storage the insulation resistance of all motors should be checked in accordance with the motor manufacturer's instructions or in accordance with IEEE standard 43-1974 "IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery". Motors with insufficient insulation resistance must be cleaned and dried in accordance with motor manufacturer's instructions or IEEE standard 43-1974 to return the insulation resistance to acceptable levels. THE APPLICATION OF POWER TO A MOTOR WITH INSUFFICIENT INSULATION RESISTANCE MAY RESULT IN DAMAGE TO THE MOTOR OR DAMAGE TO OTHER EQUIPMENT.

On v-belt drive fans,belts should be checked at the time of removal from storage for proper v-belt tension. Tighten belts if necessary (refer to the "V-BELT DRIVE INSTALLATION" section on page 9 of this manual) .

When installing fan equipment after storage, follow the instructions contained in the "INSTALLATION OF FAN EQUIPMENT " and "OPERATION OF FAN EQUIPMENT" appearing at pages 8 and pages 10 of this manual respectively.

Storage records evidencing compliance with the above requirements should be maintained by the purchaser.

INSTALLATION OF FAN EQUIPMENT

(1) Safe and smooth operation of the fan equipment requires a proper foundation that is level, rigid, and of sufficient structure and mass to support the equipment. IT IS ALWAYS IMPERATIVE TO CONSULT A QUALIFIED STRUCTURAL ENGINEER IN ORDER TO DESIGN A PROPER FOUNDATION.

A properly designed concrete base is the preferred foundation. The concrete base mass should be a minimum of four times that of the fan equipment when the plan view area of the concrete base is no more than twice the plan view area of the fan equipment.

Steel platforms or bases are good alternatives when properly designed. Steel platforms must be braced in all directions. Care must be taken to ensure that the natural frequency of all steel base components differs significantly from the rotating speed of the fan and the driver. FAILURE TO HEED THIS GOOD DESIGN PRACTICE MAY RESULT IN A RESONANT CONDITION AND CONSEQUENT LIFE THREATENING CATASTROPHIC STRUCTURAL FAILURE.

Fans mounted off ground level should be rigidly mounted to a structural platform and should be placed as near as possible to, or over, a solid wall or column (refer to paragraph one of this section).

Supports for suspended fans must be crossbraced to prevent side sway.

(2) Fan equipment must be level prior to operation. Do not twist or distort fan equipment. Shim fan support points before tightening foundation bolts to help ensure distortion does not occur.

(3) For roof mounted fans, place the fan curb panel on the roof curb. Level and then anchor the unit to the curb using lag screws, neoprene washers and flat washers. DO NOT MOUNT UNSUPPORTED STACKS ON THE FAN. STACKS MUST BE INDEPENDENTLY MOUNTED TO THE ROOF. Anchor independently mounted stacks with guy wires to prevent side sway.

(4) Ducts must be independently supported, and must never be supported by the fan. Use flexible duct connections wherever possible. The independent mounting of stacks and ducts to the fan will ensure that the fan will not be twisted or deformed with the addition of external loads.

(5) It is recommended that access doors be placed in ductwork just ahead of the fan inlet and just behind the fan outlet for ease of inspection and maintenance. IN ORDER TO AVOID EQUIPMENT DAMAGE AND PERSONAL INJURY ACCESS DOORS IN A DUCT SYSTEM SHOULD BE SECURELY CLOSED AND SHOULD NEVER BE OPENED WITH THE FAN RUNNING.

(6) Lubricate fan bearings in strict accordance with bearing manufacturer's recommendations. Lubricate bearings upon receipt of fan. Do not overlubricate. Bearings should be locked to the shaft. Ensure that locking mechanisms on bearings are in correct position and that locking mechanisms are fastened before operation of fan.

(7) Flexible couplings must be installed and maintained in accordance with the coupling manufacturer's instructions. Refer to fan submittal drawings for details of drive arrangements and the general location of the coupling halves on the fan and motor shafts.

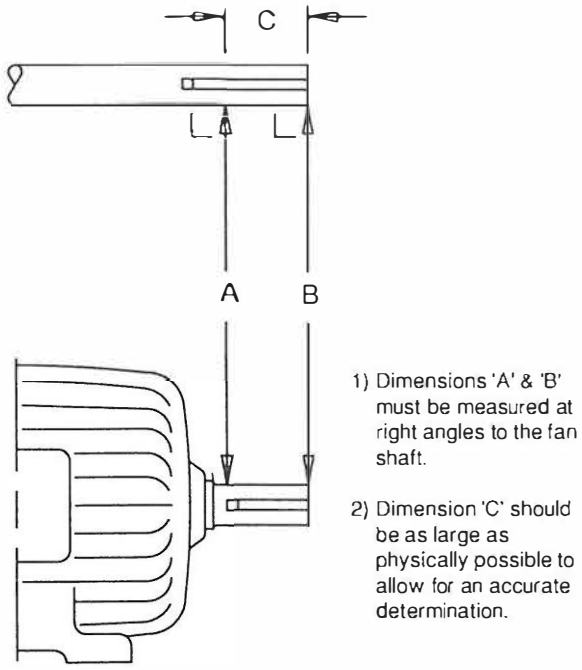

Fig. 2 *Determination of parallel shafts.*

V-BELT DRIVE INSTALLATION

V-belt drive systems are the most common type of belt systems used to drive fan equipment. Other types of belt systems are used ("cog", belts etc.) but are not discussed in this manual.

Proper alignment is essential to long fan bearing, driver bearing, v-belt and sheave life. Ensure that driver and fan shafts are parallel. The most common causes of misalignment are nonparallel shafts and improperly located sheaves. Where shafts are not parallel, v-belts on one side are drawn tighter and pull more than their share of the load. As a result, these v-belts wear out faster, requiring the entire set to be replaced before it has given maximum service. If the sheaves are misaligned, v-belts will enter and leave the grooves at an angle, causing excessive v-belt and sheave wear .

Shaft alignment can be checked by measuring the distance between the shafts at two or more locations as shown in Figure 2. If the distances are equal, the shafts are parallel.

Check the location of the sheaves on the shaft with a straight edge or a length of string. If the sheaves are properly aligned the string will touch them at the points indicated by the arrows in Figure 3. Rotating each sheave one-half (1/2) revolution will indicate if the sheave is misaligned or the shaft is bent. Correct any causes of misalignment.

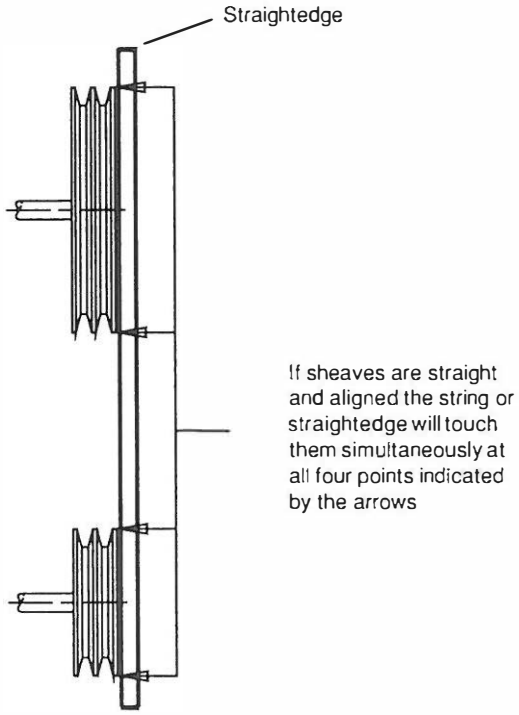

Fig. 3 *Sheave alignment.*

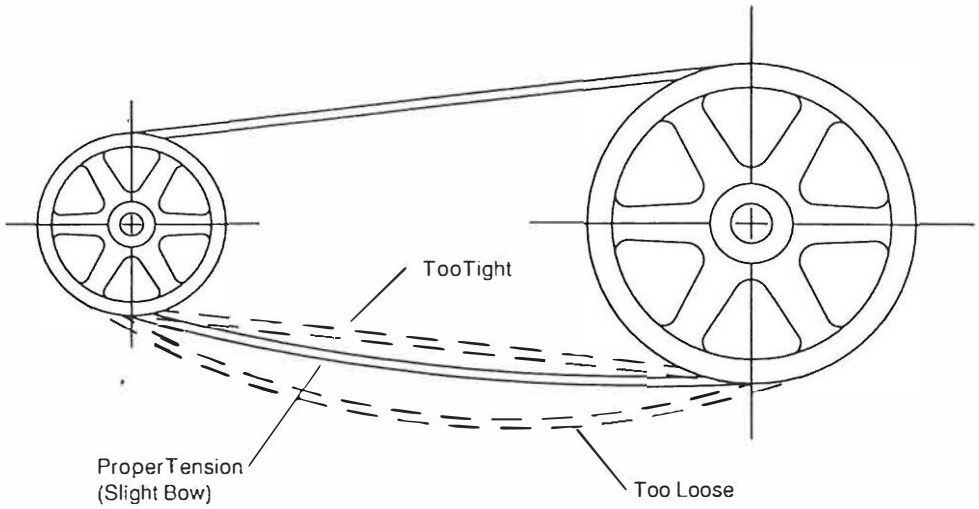

Fig. 4 *Belt tension.*

Always use matched v-belts and never mix new and used v-belts on a drive. Install v-belts correctly:

(i) Shorten the center distance between the driven and driver sheave so the v-belts can be slipped into the sheave groove without damage. While the v-belts are still loose on the drive, rotate the drive until all the slack is on one side. Then increase the center distance until the v-belts are snug (Figure 4). NOTE: Never "roll" or "pry" the v-belts into the sheave grooves. This can damage the v-belt cords and lead to v-belt turnover, short life, or actual breakage. Moreover, it is both difficult and unsafe to install v-belts this way. Keeptakeup rails, motor base, or other means of center distance adjustment free of dirt, rust, and grit. Lubricate adjusting screws and slide rails as required.

(ii) Operate the drive and fan a few minutes to seat the v-belts in the sheave grooves (operate the fan equipment only after following the procedure listed in the "Operation of Equipment" section of this manual). Observe the operation of the drive under its highest load condition (usually starting). A slight bowing of the slack side of the drive indicates proper tension. If the slack side remains taught during peak load, the drive is too tight. Excessive bowing or slippage indicates insufficient tension. If the v-belts squeal severely as the motor comes on or at some subsequent peak load, they are not tight enough to deliver the torque demanded by the fan. The fan should be stopped and the v-belts tightened.

(iii) Check the tension on a new drive frequently during the first day of operation by observing the slack side span. After a few days of operation the belts will seat themselves in the sheave grooves and it may become necessary to readjust so that the drive again shows a slight bow in the slack side.

OPERATION OF FAN EQUIPMENT

(1) Lock out all power sources.

(2) Ensure that bearings are properly aligned and lubricated with special attention to the locking mechanisms. cleanliness, and possible corrosion. Bearings showing signs of corrosion must be replaced prior to operation of fan equipment.

(3) Check set screws and keys (or taperlock hub if present) in fan impeller, and bolts on cooling wheel.

(4) Check foundation bolts and other hardware for tightness.

(5) Ensure that the fan housing, ducts, etc., are free of foreign objects.

(6) Ensure that all access doors are secure.

(7) Check the impeller to inlet cone and impeller to fan housing clearance to ensure that there is no interference. Turn the impeller by hand, ensuring that it rotates freely.

(8) On belt drive fans, check sheave alignment and v-belt tension (refer to the section entitled "V-BELT DRIVE INSTALLATION" on page 9 of this manual).

(9) If the fan is equipped with damper or variable inlet vane, close same to lessen starting load on motor. Ensure any dampers or variable inlet vanes furnished with the fan, or used in conjunction with the fan, do not stick or bind. If an automatic control mechanism is used to operate the damper or variable inlet vane, adjust the limits of travel of the automatic control mechanism in accordance with the control manufacturer's instructions to avoid putting force on the damper or variable inlet vane when it is fully opened or fully closed.

(10) If the fan is driven by an electric motor, read instructions of motor and starter manufacturer. Ensure that the motor and starter are set up in compliance with the motor and starter manufacturers' instructions prior to any application of electric power. If the fan is powered by some other form of driver, read the manufacturer's instructions prior start-up.

(11) If the fan is equipped with water cooled bearings turn on the water supply to the bearings prior to starting the fan. Consult the water cooled bearing manufacturer's instructions.

(12) If the fan is to handle a "hot gas" (i.e. a gas with a temperature greater than 150°F [65°C]) it is imperative that the fan be subject to only a slow gradual rate of gas temperature change, not to exceed a rate of 15°F/minute (8°C/minute). When the fan is being put in operation the temperature of the gas must not rise at a rate greater than 15°F/minute (8°C/minute). Never subject a "cold" fan to a "hot" gas stream. When the fan is being taken out of operation the temperature of the gas must not decline at a rate greater than 15°F/minute (8°C/minute), and when the gas temperature has reached a level of 150°F (65°C) or less it is imperative that the fan be operated at this temperature for a period of time sufficient to allow the entire fan structure to reach an equilibrium temperature of 150°F (65°C). Only when the entire fan structure has reached an equilibrium temperature of 150°F (65°C) or less can the fan be shut off and removed from operation. Failure to follow these instructions may result in damage to the fan equipment. NEVER EXCEED THE MAXIMUM OPERATING TEMPERATURE OR SPEED FOR WHICH THE FAN WAS DESIGNED.

(13) Connect the power source.

(14) Fan impeller should always be stationary prior to startup. Startup while fan impeller is rotating backwards can cause damage.

(15) Apply power to the driver momentarily (i.e. "bump") to check for proper rotation. Any dampers or other air control devices in the system should be at least partially closed during starting periods to reduce power requirements. Damper closure is particularly important in the case of a fan designed for high temperature operation being "run in" at a temperature less than design temperature.

(16) Apply power to the driver and allow the fan to come up to design speed. Turn off. Look and listen for any unusual noise or mechanical action while the impeller is still spinning. If any are noticed, lockout all power sources, locate cause and correct.

(17) Lock out all power sources and recheck tightness of all set screws, keys, foundation bolts and any other hardware. The initial start up will tend to relieve their tightness and they may require re-tightening.

(18) Reconnect all power sources.

(19) It is recommended that upon fan installation, the operating vibration levels be checked to ensure that the levels do not exceed the levels indicated on the inspection sheets shipped with the fan and/or the vibration levels set forth in the "Vibration" section of this manual.

Once it has been determined that the fan equipment is operating satisfactorily, it should be operated, if practical, for at least eight (8) continuous hours. Operation should be monitored at least once each hour during this period. Inspection should be made for any change of operation during this period. Some bearings will have to "run in" and will heat up during this period. The maximum bearing temperature should not exceed 200°F (93°C). It is normal for bearings lubricated with grease to purge a small amount of the grease through the bearing seals during run-in.

NOTE THAT ALL BOLTS, SETSCREWS AND V-BELTS SHOULD BE RE-TIGHTENED AFTER TWO (2) DAYS OF INITIAL OPERATION.

MAINTENANCE OF FAN EQUIPMENT

BEFORE STARTING MAINTENANCE WORK ON FAN EQUIPMENT LOCK MOTOR, LOCK DISCONNECT SWITCH IN THE OFF POSITION, DE-ENERGIZE AND DISCONNECT ALL POWER SOURCES TO THE MOTOR AND TO ACCESSORY DEVICES, AND SECURE FAN IMPELLER.

Bearings and Lubrication

Selection of the correct fan bearing lubricant and lubrication intervals depends on several factors. Extreme high or low temperatures and dirty or damp surroundings are all conditions that will create a requirement for more frequent lubrication or special lubricants. READ THE BEARING

MANUFACTURER'S INSTRUCTIONS TO DETERMINE THE TYPE AND FREQUENCY OF BEARING LUBRICATION REQUIRED.

THE MOTOR BEARINGS SHOULD BE LUBRICATED IN ACCORDANCE WITH MOTOR MANUFACTURER'S LUBRICATION INSTRUCTIONS AND RECOMMENDATIONS SHOULD BE FOLLOWED CLOSELY.

Bearing failure may be caused by failure to lubricate as often as required, use of an excessive quantity of lubricant or the use of incompatible lubricants. Excessive vibration, especially if the bearing is not rotating, will also cause bearings to fail. Bearings must also be protected from water and moisture to avoid internal corrosion.

Bearings are susceptible to damage from exposure to excess shaft heat transfer which may occur when a fan operating at a temperature greater than 200°F (93°C) is shut down without a sufficient period of gradual temperature reduction. See section (12) of "Operation of Fan Equipment" set forth on page 11 of this manual.

Bearing Replacement
Replacement of fan bearings should not be required for many years if cared for strictly in accordance with bearing manufacturer's instructions. The procedure used to replace fan bearings will vary depending on the type of fan and the type of bearing. It is important that the replacement of bearings be supervised or inspected by personnel experienced in such work and equipment. Trained personnel are available from CML Northern and arrangements for such supervision or inspection (at a fee) should be made through your local CML Northern representative or at CML Northern's head office.

Variable Inlet Vane
Once a year, the variable inlet vane coverplate should be removed and the moving parts re-packed with grease. The lubrication interval should be increased where moisture or particles are present in the airstream.

CAUTION: Where automatic control mechanisms are used to operate the variable inlet vane, care should be taken to correctly adjust control mechanism stroke limits as OVERTRAVEL MAY DAMAGE THE VARIABLE INLET VANE OPERATING MECHANISM.

Motors
DO NOT OPERATE THE MOTOR WITHOUT FIRST READING THE MOTOR MANUFACTURER'S INSTRUCTIONS. OPERATE THE MOTOR ONLY IN ACCORDANCE WITH THE INSTRUCTIONS.

The fundamental principle of electrical maintenance is to KEEP THE MOTOR CLEAN AND DRY. This requires periodic inspection of the motor. The frequency of the inspections depends upon the type of motor, the service and the motor manufacturer's instructions.

Periodic checks of voltage, frequency and current of a motor while in operation are recommended. Such checks ensure the correctness of frequency and voltage applied to the motor and yield an indication of the fan load. Comparison of this data with previous data will give an indication of the fan performance. Any serious deviations should be investigated and corrected.

Spare Parts
Spare parts may be ordered through your CML Northern sales office by providing the following information:

(1) Part name (e.g. impeller, shaft, motor, bearing, etc).

(2) Fan Serial Number from the nameplate.

(3) If possible, the fan shaft diameter or bearing size together with the fan class specified on the nameplate.

DUE TO THE SMALL NUMBER OF PARTS REQUIRED, SPARE PARTS LISTS ARE NEITHER NECESSARY NOR AVAILABLE.

Vibration
A vibration analyzer must be used to accurately determine the level of fan vibration. Vibration readings should be taken by personnel experienced with vibration analysis and vibration analysis equipment. Trained personnel are available from CML Northern, and arrangements for vibration analysis (at a fee) may be made through your local CML Northern representative or at CML Northern's head office.

The fan should not be operated unless the **vibration velocity** of the fan is less than 0.20 inches per second.

If the vibration analyzer being used to measure vibration levels will provide only **vibration displacement** readings refer to Figure 5. Figure 5 is a graph used to determine whether the **vibration velocity** of a fan is acceptable or unacceptable if the vibration analyser is capable of measuring only the **vibration displacement**. To utilize Figure 5 it is necessary to identify the following:

(1) the **vibration displacement** in mils (where 1 mil is equal to 1/1000th of an inch).

(2) the **vibration frequency** in cycles per minute (generally taken as the fan speed in rpm).

Find the vibration displacement on the left vertical axis of Figure 5, and the vibration frequency on the horizontal axis. DO NOT OPERATE THE FAN if the point of intersection of these values lies in the region labelled "UNACCEPTABLE". All points in the region labelled "UNACCEPTABLE" are indicative of vibration velocities exceeding 0.20 inches per second and corrective action must be taken to reduce the vibration velocity below this value before the fan is returned to normal operation.

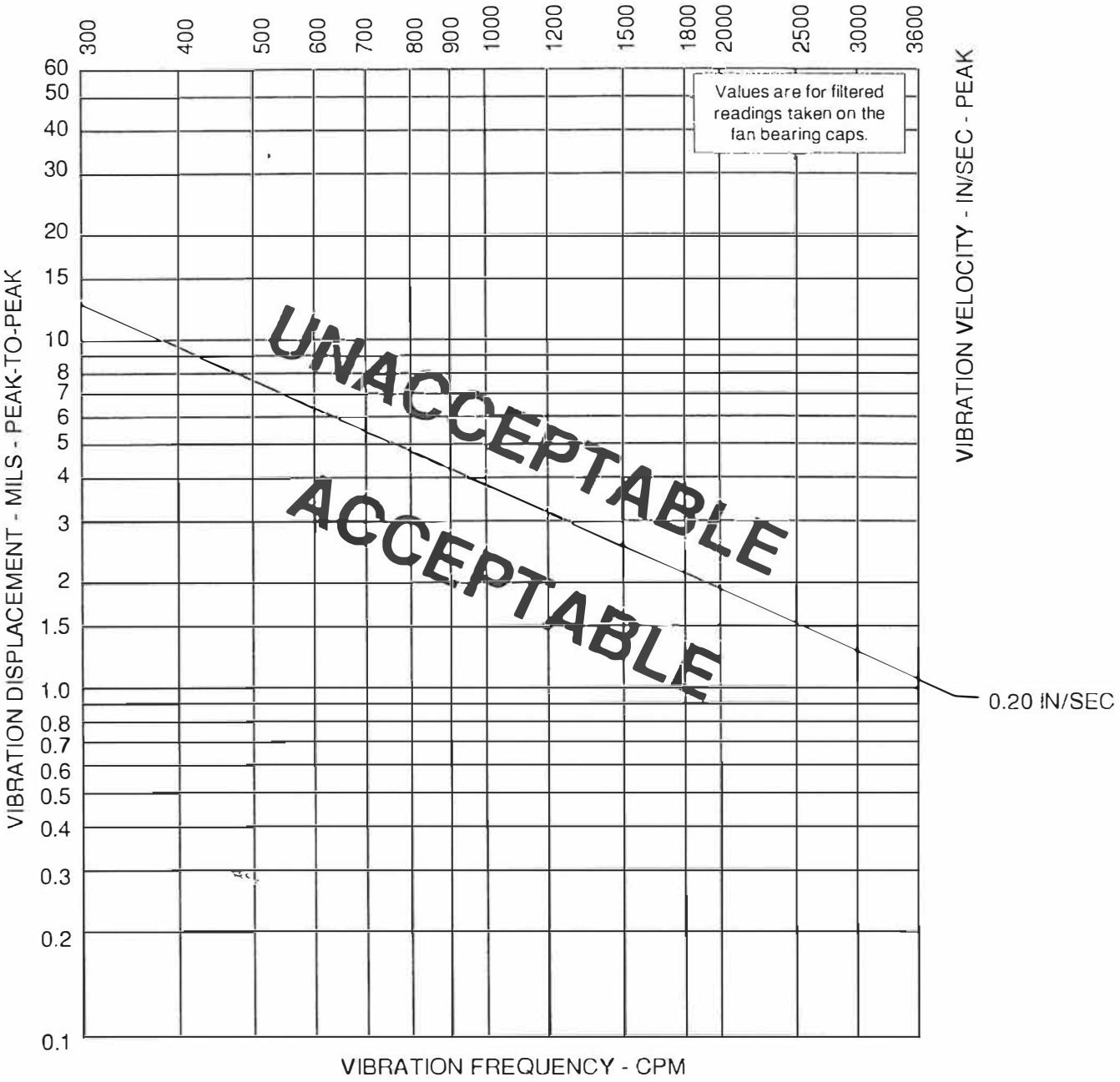

Fig. 5 *Fan Vibration Severity Chart*

FAN TROUBLE-SHOOTING CHART

PROBLEMS	PROBABLE CAUSES
INSUFFICIENT AIR FLOW	. duct elbows near fan inlet or outlet . restricted fan inlet or outlet . impeller rotating in wrong direction . fan speed lower than design . system resistance higher than design . dampers shut . faulty ductwork . dirty or clogged filters and/or coils . inlet or outlet screens clogged
EXCESSIVE AIR FLOW	. system resistance less than design . fan speed too high . filters not in place . registers or grilles not installed . improper damper adjustment
EXCESSIVE HORSEPOWER DRAW	. fan speed higher than design . gas density higher than design . impeller rotating in wrong direction . static pressure less than anticipated . fan size or type not appropriate for application
EXCESSIVE VIBRATION	. accumulated material on impeller . worn or corroded impeller . bent shaft . impeller or sheaves loose on shaft . motor out of balance . impeller out of balance . sheaves eccentric or out of balance . bearing or drive misalignment . mismatched belts . belts too loose or too tight . loose or worn bearings . loose bearing bolts . loose fan mounting bolts . weak or resonant foundation . foundation unlevel . structures not crossbraced . fan operating in unstable system condition
INOPERATIVE FAN	. blown fuse . broken belts . loose sheave . motor too small . wrong voltage

OTHER INSTRUCTIONS and LITERATURE

FAN EQUIPMENT SERIAL No._____ MAY CONTAIN COMPONENTS MANUFACTURED BY MANUFACTURERS OTHER THAN CML NORTHERN. SUCH MANUFACTURERS MAY HAVE FURNISHED INSTRUCTIONS AND/OR OTHER LITERATURE CONCERNING THEIR COMPONENT. A LIST OF SUCH INSTRUCTIONS AND/OR OTHER LITERATURE FORWARDED WITH FAN EQUIPMENT SERIAL No._____ IS GIVEN BELOW.

(1) **CML NORTHERN BEARING LUBRICATION INSTRUCTIONS:**

- ☐ LUBRICATION INSTRUCTIONS FOR DOUBLE ROW SPHERICAL ROLLER BEARINGS 22500 SERIES SPLIT PILLOW BLOCK.
- ☐ LUBRICATION INSTRUCTIONS FOR SERIES 22400 SERIES DOUBLE ROW SPHERICAL ROLLER BEARINGS.
- ☐ LUBRICATION INSTRUCTIONS FOR 300 SERIES BALL BEARINGS.
- ☐ LUBRICATION INSTRUCTIONS FOR 200 SERIES BALL BEARINGS.

(2) **BEARING MANUFACTURER'S INSTRUCTIONS:**

☐ YES ☐ NO

(3) **MOTOR MANUFACTURER'S INSTRUCTIONS:**

☐ YES ☐ NO

(4) **COUPLING INSTRUCTIONS:**

CML NORTHERN COUPLING INSTRUCTIONS ☐ YES ☐ NO

COUPLING MANUFACTURER'S INSTRUCTIONS ☐ YES ☐ NO

(5) **ACTUATOR/CONTROLLER MANUFACTURER'S INSTRUCTIONS:**

☐ YES ☐ NO

(6) **OTHER LITERATURE/INSTRUCTIONS:**

_____

_____

_____

_____

_____

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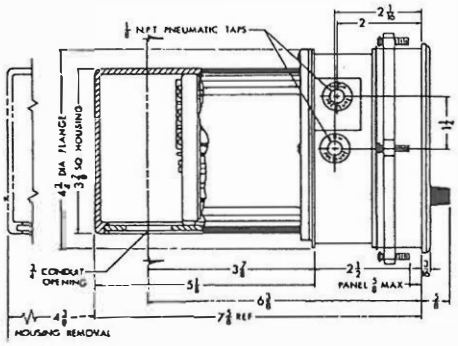
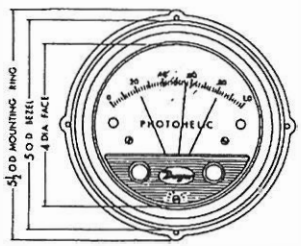
OPERATING INSTRUCTIONS AND PARTS LIST

PHOTOHELIC® PRESSURE SWITCH/GAGE*

Figure 1 Series 3000 Photohelic® Switch/Gage.





The Photohelic® Switch/Gage is a most versatile, precise pressure switch combined with the timeproven Magnehelic® pressure gage. Available with one or two photocell actuated relays. Gage reading is unaffected by switch operation. Easy to adjust set points with knob controls. Applied pressure and switch set points are fully visible at all times. Deadband is one pointer width - less than 1% of full scale. Double-pole double-throw relays can be easily interlocked to provide variable deadband control. For positive, negative or differential pressures as low as 0 to .25" water column and as high as 0 to 20 psig full scale; set points as low as .005" WC on .25" scale unit.

PHOTOHELIC SENSING - HOW IT WORKS

In a typical control application, the Photohelic switch/gage controls between high and low pressure set points. When pressure changes, reaching either set point pressure, the light to the limiting photocell will be cut off by the helix-driven light shield. The resulting photocell signal is electronically amplified to actuate its DPDT slave relay and switching occurs. Dead band between make and break is 1% of full scale or less - just enough to assure positive, chatter-free operation.

*Patent No. 3,862,416

SPECIFICATIONS

1. Dimensions: 5" Diameter x 8 ¼" Length.
2. Weight: 4 Lbs. 12 oz.
3. Gage Bezel: 5" O.D. x 4" I.D. across gage face. Fits panel Up to ⅜" thick; 4 ¼" diameter hole required. Optional, 120 MM.
4. Gage Connections: ⅛" N.P.T.
5. Finish: Baked Dark Gray Epoxy Enamel.
6. Pressure Rating: 25 psig. (35 psig on 10, 15 and 20 psi units). High pressure model for 80 psig is also available.
7. Ambient Temperature Range: 20 Deg. to 120 Deg. F standard. Low temperature model available.
8. Standard Accessories: Two (2) brass ⅛" N.P.T. to rubber tubing adapters, two (2) ⅛" N.P.T. pipe plugs, mounting ring, snap ring and screws for flush panel mounting. Instructions.
9. Load Relays: D.P.D.T. for each set-point, 10 Amps, 117 V., 50, 60 Hz. A.C. resistive.
10. Power Required: 117 V., 50, 60 Hz. A.C., 5 watts average (220V. and 240V. units also available).
11. Conduit Opening: ¾" Conduit.
12. Accuracy: 2 percent of full scale (3% on -0 and 4% on -00 Ranges) at 70 Deg. F.
13. For use with air or compatible gases only.

For repeated over-ranging or high cycle rates, refer to factory.

DWYER INSTRUMENTS, INC.
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Telephone 219/879-8000
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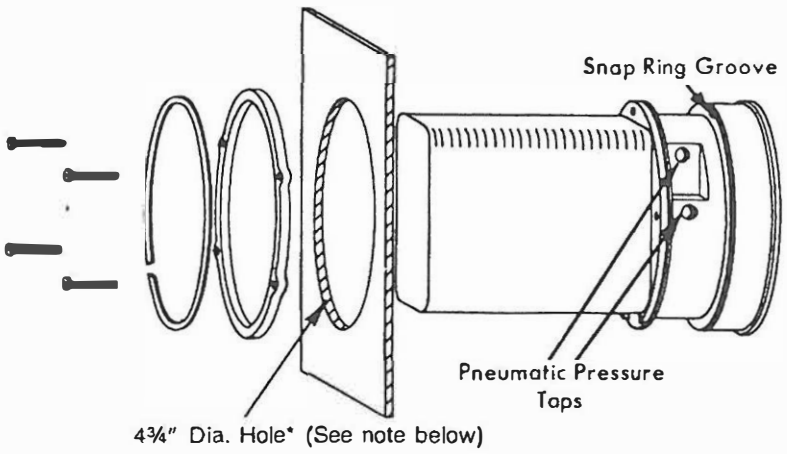


Figure 2
Through Panel Mounting

INSTALLATION

1. **Location:** All parts of the Dwyer PHOTOHELIC® pressure switch/gage are ruggedly constructed and will stand a moderate amount of vibration, physical shock, and handling. Normal care in handling and installation is all that is required. In cases where instrument panel vibration is severe, the panel should be spring mounted or the amplifier-relay unit mounted remotely on a more stable surface.

   Select a location where the ambient temperature will not exceed 120°F. Pneumatic pressure sensing lines may be run any necessary distance. For example, 250 foot sensing lines will not affect accuracy but will damp the reading slightly. Do not restrict lines. If pulsating pressure or vibration causes excessive pointer oscillation or relay chatter, consult factory for additional, damping means. See accessory Bulletin S-101 for fittings.

   Avoid locating the front of the PHOTOHELIC® switch/gage in sun light or other areas with high ambient light levels. Bright light shining on the photocells can cause false. actuation of the load relays. For such applications, specify optional Light Shield when ordering.

2. **Position:** The PHOTOHELIC® may be mounted as an integral package or the amplifier-load relay assembly and housing may be mounted remotely from the indicating gage-photocell unit. Extension cords with 7 pin plugs and receptacles are available from Dwyer for interconnection of the two units.

   The unit may be mounted in any desired position, scale vertical or horizontal, without affecting its accuracy, but must be rezeroed if position should be changed from horizontal to vertical or vice versa. The -0 and -00 models must be mounted with the scale vertical.

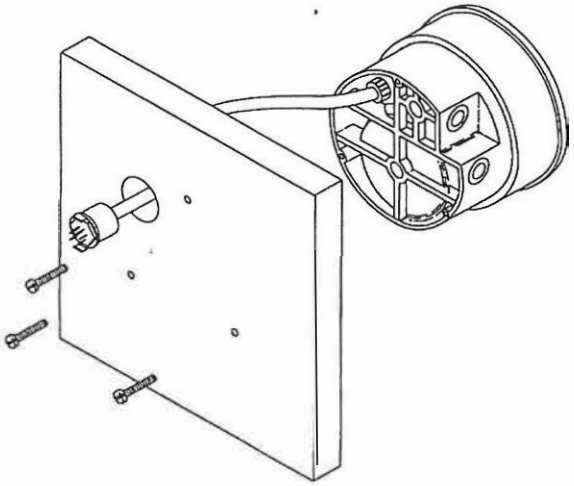
3. **Mounting:** The PHOTOHELIC® is normally mounted before making electrical connections, as the electrical enclosure is independent of the mounting means and may be removed at any time.

   A. Panel Mounting: Normal mounting is flush or through panel as shown in Fig. 2. Be sure to allow 4 ⅜" extra space behind the unit for electrical enclosure removal. Make a single 4 ¾" diameter hole in the panel. Insert the entire PHOTOHELIC® unit from the front, then slip on the mounting ring and snap ring from the rear. Seat the snap ring in its groove, back up the mounting ring against snap ring and tighten the four (4) 2" No. 6-32 clamp screws provided. If behind panel space is critical, the ampli fier-relay unit can be mounted remotely. See the Remote-Relay Mounting Instructions for details.

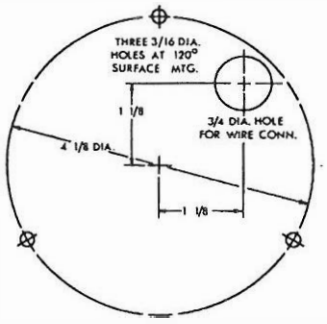
**For convenience, this hole can be made with Model 730E, 120 MM chassis punch manufactured by Greenlee Tool Co. Contact your machine tool distributor. Not available from Dwyer Instruments.*

Litho in USA 3/89

B. Gage Mountings with Relays Remote: Where it is desirable to mount the amplifier-relay unit separate from the gage-photocell unit, the gage may be mounted either as shown in Fig. 2 (except less amplifier-relay portion) or surface mounted as shown in Fig. 3A. Use the layout shown in Fig. 3B to locate holes. The complete package cannot be surface mounted.



A
Surface Mounting

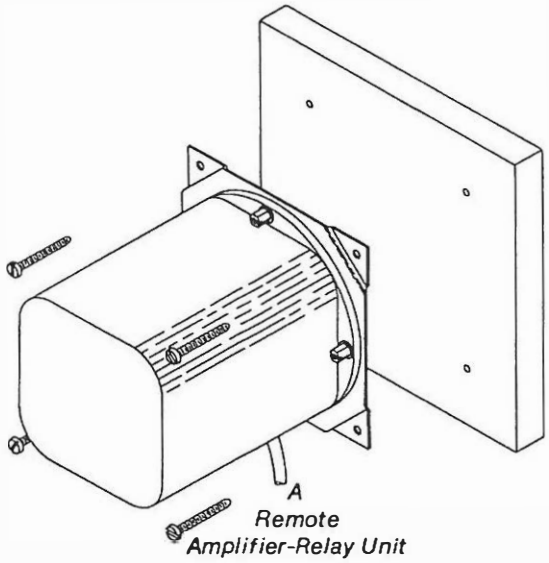


B
Hole Layout (Front)

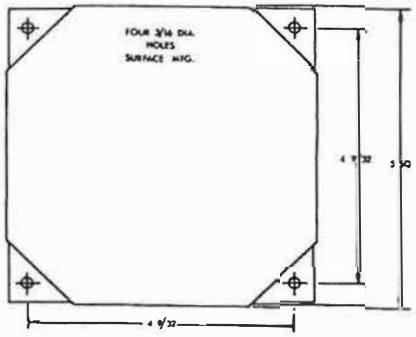
Figure 3

C. Remote Relays Mounting: The amplifier - relay unit may be mounted remotely as shown in Fig. 4A. Use the hole layout as shown in Fig. 4B for this option.

Additional mounting information for special requirements is available from the factory.



A
Remote
Amplifier-Relay Unit



B
Hole Layout

Figure 4

4. Pneumatic Connections & Zeroing: After installation but before making pressure connections, set the indicating pointer exactly on the zero mark, using the zero adjust screw located at the bottom of the front cover. Note that this adjustment can only be made with the high and low pressure taps both open to atmosphere.

Connect the high and low pressure taps to positive, negative, or differential pressure sensing points. Use ¼" diameter metal or other instrument tubing and ⅛" N.P.T. adapters at the Dwyer PHOTOHELIC® pressure switch gage. Adapters for rubber or soft plastic tubing are furnished with the instrument for use where this type of connection is preferred.

If the PHOTOHELIC® is not used to sense differential pressure, one of the pressure taps must be left open to atmosphere. This will allow the reference pressure to enter. In this case, installation of a Dwyer No. A-331 Filter Plug or similar fitting in the reference pressure tap is recommended to reduce the possibility of dust entering the instrument.

NOTE: If the Photohelic switch/gage is over pressured, pointer may "jump" from full scale back to zero and remain there until the excess pressure condition is relieved. Users should be aware of possible false zero pressure indications under this condition.

ELECTRICAL CONNECTIONS

1. **Cover:** The amplifier-relay unit has an easy to remove housing. Remove the three (3) screws as shown in Fig. 5 and slide the housing off. Make all the electrical connections before reinstalling and refastening the housing.
2. **Conduit:** Electrical access to the connection box portion of the relay housing is by bottom opening for ¾" conduit. Use of flexible conduit is recommended. It should be supported from the panel or other suitable surface to prevent the wiring system from exerting undue strain on the instrument. See Fig. 5.

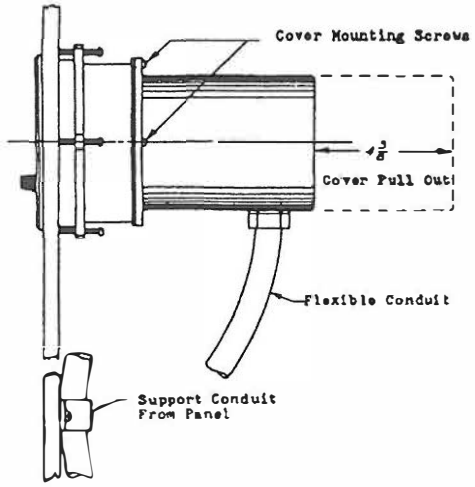
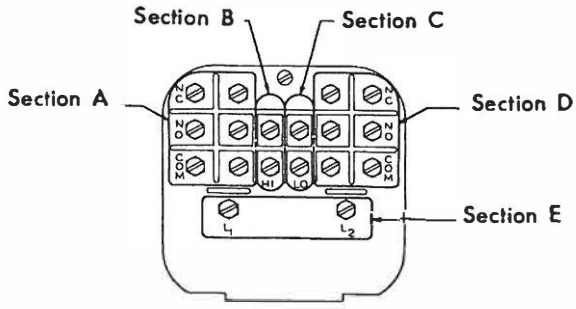


Figure 5
Mounting Details

3. **Terminal or Connection Board Layout**: In Fig. 6, "Terminal Board," **Section A** contains the connections for the load or slave relay actuated by the high or right set-point photocell. This relay is a double pole, double throw type. The two top connections are normally closed, the two middle connections are normally open, and the bottom connections are the common pair. The relay is in its normal or De-Energized position when pressure is below the right hand set-point.

   Section D is exactly the same as **Section A** except that its load or slave relay is controlled by the low or left set-point. The De-Energized position is below the left hand pointer set-point.

   Section B contains the external connections to the holding coil circuit for the high or right set-point relay and **Section C** contains similar connections for the low or left set-point relay. The function and use of these connections varies somewhat depending on the circuit style of the instrument. See paragraphs 5 and 6 for details.



CAUTION: Do not apply electrical current to terminals in sections B and C.

Figure 6
Terminal Board

Section E contains the power connections for the control unit transformer primary. The transformer in turn supplies reduced voltage power for the light bulb, photocells, amplifier unit, and load relay pull in and holding coils. Connections must always be made to this section in order to put the unit in operation. Standard units are designed for 117 V.A.C. input to the transformer. Special units are also available for other voltages.

Separate Ground Wire attachment is provided for by a No. 6-32 screw on the mounting bracket near the conduit opening. An additional ground wire connection is located on the side of the gage body for use when the amplifier-relay unit is mounted remotely.

Single Set-Point instruments are furnished with the right or high set-point components and circuitry in place. These are connected to Sections A and B of the terminal board. The left or low set-point components are omitted.

4. **Circuit Style:** The PHOTOHELIC® is available with several factory installed optional internal circuits. They are identified as to style by a label shown in Fig. 7. This label is mounted prominently on the terminal board of each instrument. The letter H denotes a circuit in which the relay can be made to latch or remain energized after pressure increase to its set-point.

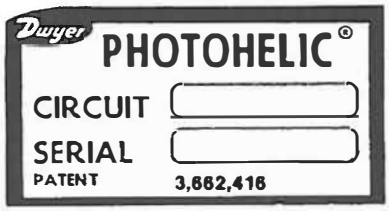


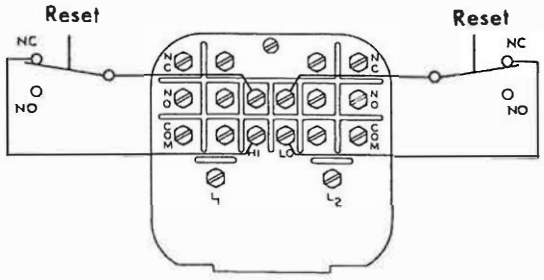
Figure 7
Circuit Label

The letter L denotes a circuit in which the relay can be made to latch or remain de-energized after pressure decrease to its set-point. Two letters are required to fully identify a dual setpoint unit. Thus, circuit style HH, which is standard, is a dual set-point circuit which has provisions for latching on pressure increase to either set-point. Single relay units are identified by the letters SR followed by H for the standard unit or L for the special low latch unit. Units for use with other than standard 117 VAC will be so indicated on the label.

5. **Dual Set Point Automatic Reset:** Circuit Style HH is used for simple on-off switching applications. To place in service, connect load circuits to the appropriate terminals in Section A (Fig. 6) for the right set-point and Section D for the left setpoint. Note that the N.O. contacts are open when the gage pressure pointer is to the left of the set-point pointers. No connections are necessary in Sections B and C. Make external ground connections as required and connect power to Section E for the control unit. To use circuit style LL for automatic reset, a jumper wire must be installed between the upper and lower terminals in sections B and/or C.

6. **Dual Set Point Manual Reset:** Circuit Style HH may also be used for manual reset applications where it is desired to have maintained contact on either relay following pressure increase above its set-point. Load or signal connections are made to the appropriate terminals in Sections A and D (as in paragraph 5 above). Connect terminals in Sections B and C through normally closed switches or push buttons as shown in Fig. 8. Use of "dry-circuit" type switches such as Dwyer Part No. A-601 with paladium, gold, etc. or rotary wiping action type contacts is recommended. Make external ground connections as required and connect power to Section E for the control unit.

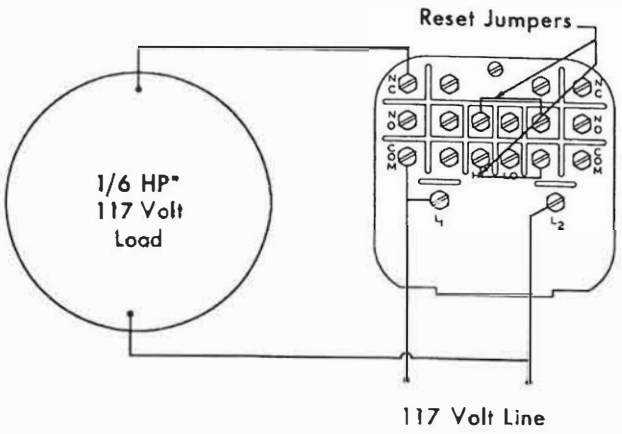
Circuit style LL is used for manual reset applications which require that contact be maintained following pressure decrease below the set-point. Load connections are made to the appropriate terminals in Sections A and D. A normally open type manual reset switch such as Dwyer Part No. A-601 is connected to the terminals in sections B and C. The circuit must be "armed" by momentarily closing the switch while the black pointer is to the right of the set-point. From that point on, the circuit will latch on pressure decrease below the set-point and remain latched on pressure increase until manually reset with the optional switch.



CAUTION: Do not apply electrical current to terminals in sections B and C.

Figure 8
Manual Reset with Circuit HH

7. **Dual Set Point Automatic and Manual Reset Combinations:** Circuit style HH may be used with either set-point wired and operating as in paragraph 5 above and other set-point wired and operating as in paragraph 6.
8. **High Low Limit Control - Dual Set-Point:** Circuit Style HH may be used to control fans, dampers, pumps, etc., between the set-points of a PHOTOHELIC® To accomplish this, use one set-point relay to reset the other as shown in the wiring diagram Fig. 9. In this typical application, the load (for instance a fan) would be connected to the N.C. contacts of the right set-point relay, Section A (Fig. 6). On pressure rise to the right set-point, its relay would pull in and hold even though pressure might then fall below that set-point. If the pressure continued to fall to the left set-point, its relay would automatically be DE-ENERGIZED, return to its normal position and in so doing, open the holding coil circuit from Section B (Fig. 6). The right set-point relay would thus be reset and the cycle could repeat.
9. **Dual Set-Point Special Purpose Circuits:** Circuit Style LL may be used where manual reset following maintained contact on pressure decrease to either set-point is desired. Circuit Styles HL and LH are combination units. For special combinations of features, special units, and detailed instructions regarding their use, consult the factory.
10. **Single Set-Point PHOTOHELIC®** The single set-point PHOTOHELIC® is furnished with the right set-point only. Terminals in Section A and B (Fig. 6) are connected to this relay. Circuit Style SRH is wired for automatic reset as in paragraph 5 above. Manual reset is accomplished by adding a normally closed reset switch or push button to the circuit as described in paragraph 6 above.
11. **Single Set-Point Special:** Manual reset after actuation on failing pressure can be obtained by using Circuit Style SRL. Consult the factory for special units and detailed instructions regarding their use.



**Note: For larger motors, use the Photohelic® in a maintained contact, 117 Volt Control or Push Button Circuit of the motor starter.*

Figure 9
High-Low Limit Control
(Circuit HH)

12. **Placing In Service:** In normal operation each relay is de-energized when the pressure applied to the instrument is below its set-point. An exception occurs when the PHOTOHELIC® is put in service or plugged in. Because of the fraction of a second required by the light bulb to reach full brightness, the right relay will energize momentarily on plug in. In the case of a high latching application, the right circuit may have to be reset before normal operation can be established. In applications where momentary energization is objectionable, it can be eliminated by incorporating a time delay relay into the connecting circuitry. Special low-latching units will ordinarily have to be reset before placing on the line in normal operation.

MAINTENANCE AND SERVICE

Dwyer PHOTOHELIC® Switch/Gages are precision instruments, expertly assembled and calibrated at the factory. They require no lubrication or periodic servicing. If the interior is protected from dust, dirt, corrosive gases and fluids, years of trouble-free service may be expected. Zero adjustment should be checked and reset occasionally to maintain accuracy. Any repairs necessary to either the Dwyer Magnehelic® pressure gage or the electronic components should be performed by a trained instrument mechanic. In most cases, this is best accomplished by returning the complete PHOTOHELIC® Switch/Gage to the Dwyer factory.

SERIES 3000
PHOTOHELIC®
PRESSURE SWITCH/GAGE
MODELS AND RANGES

Model Number	Range, Inches of Water	Minor Div.
3000-00	0- .25	.005
3000-0	0- .50	.01
3001	0-1.0	.02
3002	0-2.0	.05
3003	0-3.0	.10
3004	0-4.0	.10
3005	0-5.0	.10
3006	0-6.0	.20
3008	0-8.0	.20
3010	0-10	.20
3015	0-15	.50
3020	0-20	.50
3025	0-25	.50
3030	0-30	1.0
3040	0-40	1.0
3050	0-50	1.0
3060	0-60	2.0
3080	0-80	2.0
3100	0-100	2.0
3150	0-150	5.0

Model Number	Range, Zero Center Inches of Water	Minor Div.
3300-0	.25-0-.25	.01
3301	.5-0-.5	.02
3302	1-0-1	.05
3304	2-0-2	.10
3310	5-0-5	.20
3320	10-0-10	.50
3330	15-0-15	1.0

Model Number	Range PSIG	Minor Div. PSIG
3201	0-1	.02
3202	0-2	.05
3203	0-3	.10
3204	0-4	.10
3205	0-5	.10
3210*	0-10	.20
3215*	0-15	.50
3220*	0-20	.50
3230**	0-30	1.0

*MP option std.
**HP option std.

Dual Scale Air Velocity Units*

Model Number	Range, Inches of Water	Range, Air Velocity FPM
3000-00AV	0- .25	300- 2000
3000-0AV	0- .50	500- 2800
3001-AV	0-1.0	500- 4000
3002-AV	0-2.0	1000- 5600
3010-AV	0-10	2000-12500

*for use with pitot tube

Model Number	Range MM of Water	Minor Div. MM
3000-6MM	0-6	.20
3000-10MM	0-10	.50
3000-25MM	0-25	.50
3000-50MM	0-50	1.0
3000-80MM	0-80	2.0
3000-100MM	0-100	2.0

Model Number	Range, Zero Center MM of Water	Minor Div. MM
3300-20MM	10-0-10	.50

Model Number	Range, CM of Water	minor Div. CM
3000-15CM	0-15	.50
3000-20CM	0-20	.50
3000-25CM	0-25	.50
3000-50CM	0-50	1.0
3000-80CM	0-80	2.0
3000-100CM	0-100	2.0
3000-150CM	0-150	5.0
3000-200CM	0-200	5.0
3000-250CM	0-250	5.0
3000-300CM	0-300	10.0

Model Number	Range, Zero Center CM of Water	Minor Div. CM
3300-4CM	2-0-2	.10
3300-10CM	5-0-5	.20
3300-30CM	15-0-15	1.0

Model Number	Range, Pascals	Minor Div. Pascals
3000-60Pa	0-60	2.0
3000-125Pa	0-125	5.0
3000-250pa	0-250	5.0
3000-500Pa	0-500	10.0
3000-750Pa	0-750	25.0

Model Number	Range, Zero Center pascals	Minor Div. pascals
3300-250Pa	125-0-125	5.0
3300-500Pa	250-0-250	10.0

Model Number	Range Kilo-pascals	Minor Div. Kilo-pascals
3000-1kPa	0-1.0	.02
3000-1.5kPa	0-1.5	.05
3000-2kPa	0-2.0	.05
3000-3kPa	0-3.0	.10
3000-4kPA	0-4.0	.10
3000-5kPa	0-5.0	.10
3000-8kPa	0-8.0	.20
3000-10kPa	0-10	.20
3000-15kPa	0-15	.50
3000-20kPa	0-20	.50
3000-25kPa	0-25	.50
3000-30kPa	0-30	1.0

Model Number	Range, Zero Center Kilo-pascals	Minor Div. Kilo-pascals
3300-1kPa	.5-0- .5	.02
3300-3kPa	1.5-0-1.5	.10

Note: The Photohelic® pressure switch/gage may be used in an Underwriters Laboratories approved industrial control panel if the usage conforms to U/L specifications for the acceptance of unlisted components.

PHOTOHELIC® PRESSURE-SWITCH/GAGE

SERIES NO. 3000

EXPLODED VIEW

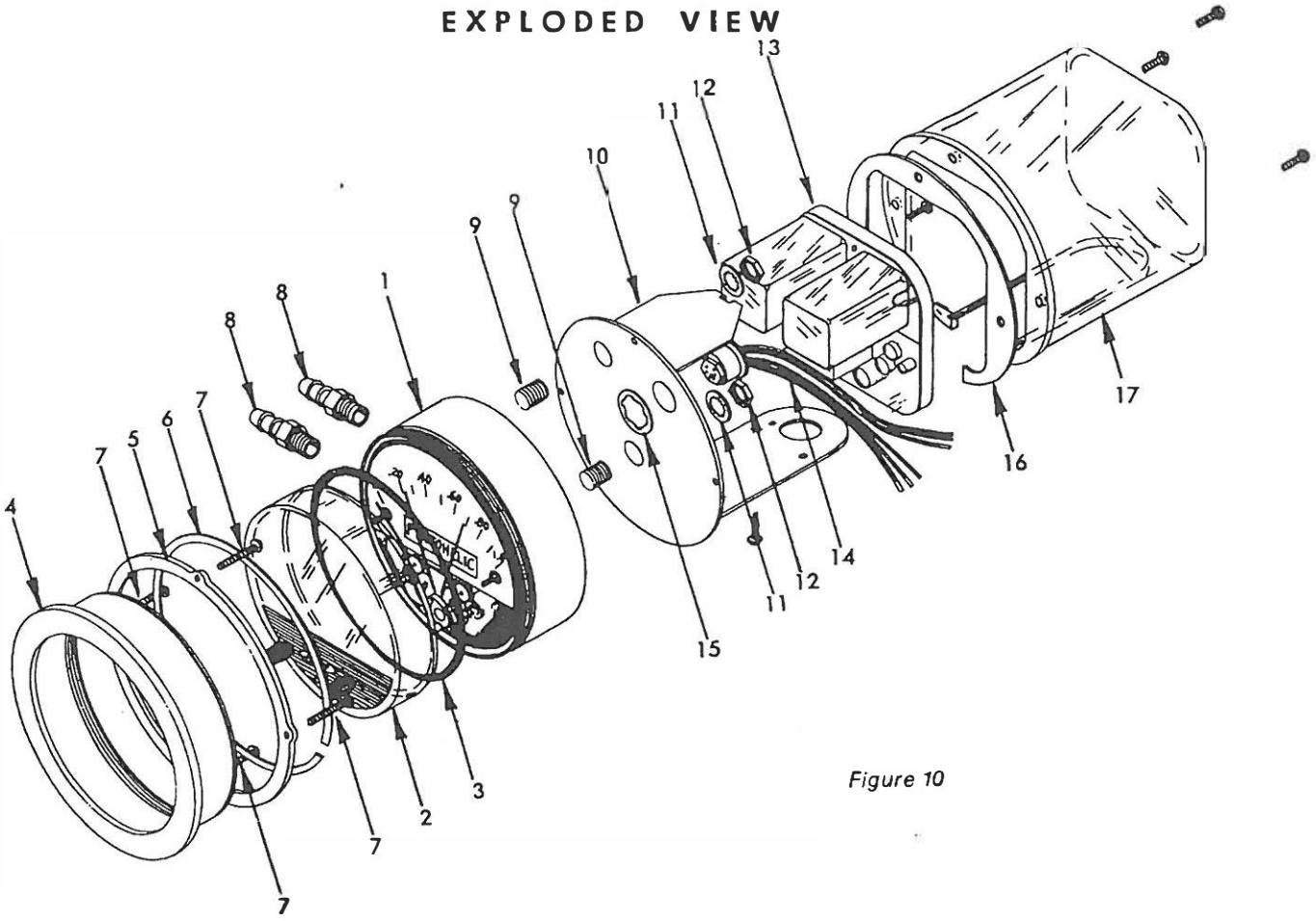


Figure 10

1. Photohelic® Gage Body & Sensor Assembly.
2. Cover, Knob and Zero Adjust Assembly.
3. Cover "0" Ring Seal.
4. Bezel.
5. Mounting Ring.
6. Snap Ring (Mounting).
7. Clamp S-crews (Mounting).
8. ⅛ N.P.T. to Rubber Tubing Adapter (No. A-339).
9. ⅛ N.P.T. Mounting Studs.
10. Flange Plate and Bracket Assembly with Circuit Board Mounting Screws.
11. Lock Washer.
12. ⅛ N.P.T. Mounting Nut.
13. Amplifier-Relay Circuit Assembly.
14. Wiring Harness and Receptacle.
15. Retainer.
16. Gasket, Flange Plate to Amplifier-Relay Unit Housing.
17. Amplifier-Relay Unit Housing with Mounting Screws.

When corresponding with the factory regarding Photohelic® switch/gage problems, refer to the call-out numbers in this view. Be sure to include range, single or double circuit and circuit style letters where required. Field repair is not recommended; contact the factory for service information.

FR 13-440202-00

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