OPERATING MANUAL

NB20 Vapor Phase Carbon Adsorption System

For

POSILLICO ENVIRONMENTAL

Former MGP Site
ROCKAWAY, NY

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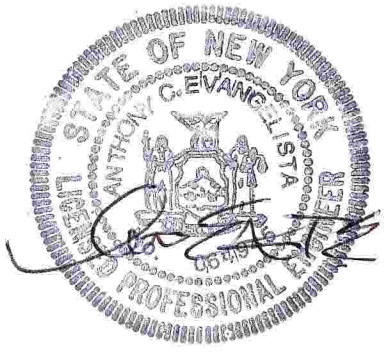
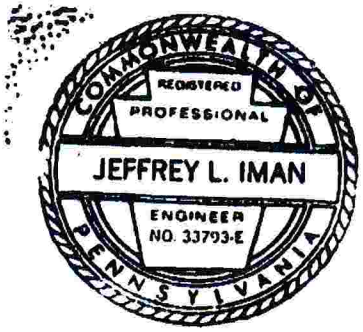
February 2008





Document Developed and Approved by TIGG
Execution of Procedures stated herein by Posillico
Jeffrey L. Iman, P.E. – Project Mgr., TIGG Corp

Operating Manual for TIGG model NB-20
Vapor Phase Granular Carbon Adsorption System
TIGG Corporation

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ATTACHMENTS

1.0 INTRODUCTION

The following sections discuss the specifications, design basis and recommended operating procedures for a TIGG Model NB-20 vapor phase granular carbon adsorption system

2.0 SPECIFICATIONS

Vessel Nomenclature	TIGG Model NB-20
Interior Width	86 in
Interior Length	352 in
Inside Height	92 in
Top Access	(6) 18 x 36 " Openings
Side Access	(1) 30 x 86 " Doors
Maximum Operating Pressure	14 in H_2O
Maximum Operating Temperature	140 deg F
Material of Construction	Carbon Steel
Lining	High Solids Epoxy
Exterior Paint	Acrylic Waterborne Primer and Enamel
Approximate Weight	15,000 lbs Empty; 35,000 lbs Full

3.0 DESIGN

3.1 Application

The vapor phase activated carbon unit is designed for the adsorption of VOC's and other contaminants from a process and/or waste stream.

3.2 Design Basis

The design basis for this operation is as follows:

Influent Type	Vapor with low relative humidity
Flow Rate	20,000 cfm per adsorber (max)
Temperature	<140 ^{o} F
Outlet Pressure	Ambient
Carbon Fill	16,000 lbs. std. fills
Contact Time	1.7 sec @ flow & fill

3.3 Air Volume

The air volume for the Structure is calculated using the following dimensions 118'w x 197'l x 45'h . The volume of the building is calculated at 696,682 cubic ft or rounding to 697,000 cu. ft. The largest excavation volume in the building is planned to be 92'w x 138' l x 8' dp or 101,568 cuft. The required air exchange rate is to be 6 air changes per hour so multiplying the total of (697,000 cu. ft + 101,568) x 6 = 4,791,408 cu.ft. / hour. This converts to 79,856 cu. ft./min which is within the capacity of four TIGG NB20 air flows @ 20,000 cfm/unit.

4.0 GENERAL PROCESS DESCRIPTION

4.1 Mode of Operation

The NB-20 utilizes a horizontal bed of TIGG 5C 0410 virgin/reactivated vapor phase granular activated carbon for the adsorption of organic compounds. Influent vapor will enter the NB-20 through two 20" OD duct fittings on one end of the unit. The vapors will then be distributed throughout the plenum chamber in the bottom of the unit. A support structure of carbon steel and stainless steel is installed horizontally on the top of the plenum to support a minimum 30" deep carbon bed. Influent vapors will flow from the bottom of the NB-20, up through the carbon bed and into the headspace of the unit. Treated vapor will exit the unit through two 20" OD duct fittings in the top of the NB-20. These vapors will be discharged through two silencer style stacks provided by TIGG Corporation.

4.2 Effluent Sampling / Change out Determination

The NB-20 units are provided with sample ports in the carbon bed at preset points representing 1/3 of the bed depth. Sample ports are also provided above and below the carbon bed to provide influent and effluent sampling points. It is not the intent of this section to describe a specific method of sampling or whether sampling is required. This is at the discretion of the operator.
NOTE: Not all NB20 rental units contain sample ports.

4.3 Excessive Moisture Accumulation

If excessive moisture is present in process vapors, liquid may accumulate within the open bottom portion of the unit. Four ¾" drain plugs are located at the four corners of the unit floor. The drain plugs can be removed from the bottom side of the NB-20. ***Note – removal of a drain plug may expose personnel to untreated process vapor and may result in spillage of contaminated liquid. Use appropriate personnel protection and dispose of any liquids in accordance with local regulations.***

5.0 INSTALLATION

5.1 Unpacking

When the NB-20 is delivered to the site, it should be checked thoroughly to ensure all required items have been received and the equipment is free of any shipping damage ***prior to signing the bill of lading***.

5.2 Rigging

The NB-20 units will be shipped to the jobsite with the full initial charge of carbon. The combined, loaded weight of the equipment will be 35,000 lbs. The unit is fitted with lifting lugs on the four corners. The unit should only be rigged by qualified personnel using proper rigging and techniques. The unit does not need to be installed on a concrete surface, a solid packed gravel or dirt surface will suffice.

5.3 Ducting and Peripheral Equipment

In addition to the adsorber, the system includes building inlet louvers and outlet building

transitions. The fan/filter unit has an inlet vane damper on if for adjusting flow characteristics if require. This skid also contains the NEMA 3R combination reduced motor voltage starter and quick disconnect. The fan specifications are:

Fan Capacity	20,000 CFM
Fan Static Pressure	20 in-wg
Fan MOC	Steel
Fan Motor	100 HP, TEFC, 3/60/460
Fan Controls – Soft	NEMA 4, Start/Stop PB, Disconnect, Pilot Light.
Pre-filter	24" x 24" x 2" High Capacity pleated filter and 24"x24"x 9" deep pocket filters
Filter Outlet Connection	Two (2) 20" dia. - plain end.
Fan Outlet Connection	See drawings
Stack	20" dia.x 4' OAH.

6.0 STARTUP PROCEDURES

6.1 System start-up

The following items need to be completed before starting up the system. It is assumed that all equipment has been properly installed and that the ducting is installed and power has been terminated at the starter panels.

1. Inspect all inlet louvers to ensure that they are clear of all obstructions and that the mechanism operates freely.

2. Install air filter elements in the filter housing. Close and seal all access doors.

3. The adsorber will come loaded with carbon, check the carbon bed and level if required.

4. Examine the duct work to ensure that it has been installed correctly.

5. Make sure all sample valves, doors and hatches are closed on the adsorbers.

6. Open inlet vane damper on fan inlet.

7. Start fan and check for air flow.

8. Adjust damper, open or closed, to desired air flow.

6.2 Operation

1. Initially record the pressure drop across the filter section by reading the magnehelic gage on the side wall of the filter section. Initial differential pressures should be in the .25-.5 " w.c. range. If not, please call TIGG Corporation to inquire.

2. Check differential pressure daily and record the numbers. Once the differential pressure are 1.0" a filter section change should occur. If the 2" thick prefilters seem to be highly blinded, change these filters and start the system. If the differential pressure drops close to the starting dP then continue operation with the new prefilters only. If the pressure drop

continues above the recommended starting pressures, change out the second row of deep pocket filters.

3. On a daily basis, please listen for the fan and it's operation and please note and strange sounds coming from this equipment, then contact TIGG Corporation with this information..

6.3 Removing Spent Carbon

Spent carbon may be removed by using a vacuum source, generally supplied by a vac-truck. Upon arrival of the truck, the following steps should be taken:

1. Open the top hatches, the side door should remain closed at this time.

2. The vacuum source is generally connected by hose to a section of ***plastic pipe***, which is inserted into one of the openings on the unit. ***Any metal fittings should be protected from the plenum and sides of the unit to prevent damage***.

3. Move the pipe around as the carbon level is lowered. The adsorber may require entry to remove any residual amounts of spent carbon. ***Follow appropriate OSHA confined space entry procedures to prevent worker injury.*** Spent carbon vacuumed from the adsorber is typically disposed of with other waste residuals generated at the site. At this site, the spent carbon will be collected for recycle at a licensed regeneration facility. The spent carbon should be collected in super sacks from the vacuum truck for proper transport. Once the superacks are filled and sealed, they are loaded on a flat bed trailer for transport to the regeneration facility. The regeneration facility employs a rotary kiln operated at 1800^0F to destroy adsorbed organics on the carbon.

4. If the adsorber is being emptied for return, reattach the access covers and prepare the unit for loading onto the truck. If the unit is being refilled with carbon for continued use, please continue with steps 5 & 6.

5. Thoroughly inspect the interior lining and plenum material for damage once all of the spent carbon has been removed.

6. If the interior lining is undamaged and the plenum material is intact, the unit may be refilled in accordance with Section 6.4.

6.4 Refill of Fresh Carbon

NOTE: FOLLOW ALL LOCAL SAFETY REGULATIONS WHEN WORKING ON OR NEAR THE ADSORBERS.

Fresh carbon will arrive on one truck, in super sacks for the refill of the NB-20. Upon arrival of the truck, the following steps should be taken:

1. Remove the top hatches by loosening four clamps on each hatch and placing each hatch to the side.

2. Inspect the interior of the adsorber to ensure that there is no shipping damage to the plenum.

3. Prepare to load through hatch number 1.

4. Suspend a super sack above the hatch.

5. Lower the super sack as close to one side of the hatch as possible and empty.

6. Load 2 super sacks through the hatch. The carbon will have formed a cone shaped pile which could have an angle of repose between 20 and 30 degrees.

7. Push the carbon toward the sides and ends of the adsorber in an attempt to level it.

8. Move to the next hatch and empty a super sack into the hatch.

9. Continue until carbon is within 1 - 2 feet of the opening, approximately two (2) super sacks.

10. Repeat Step 7.

11. Repeat Steps 4 through 7 for hatch number 3.

12. Repeat Steps 4 through 7 for hatch number 4.

13. Repeat Steps 4 through 7 for hatch number 5.

14. Level carbon throughout the entire bed by using a steel (or aluminum) straight head rake and push/pull the carbon toward and away from the ends of the adsorber until level. ***Be careful to prevent damage of the high solids epoxy liner while raking the carbon.***

15. Close the top hatches by reversing Steps 1 and 2. ***Note: Do not tighten the access clamps more than 2 complete turns from first resistance.***

The actual depth of the carbon bed is a function of the packing density. For 20,000 lbs. of carbon the depth may vary as much as four (4) to five (5) inches. This variation will not affect the adsorption performance.

For a (20,000 pound) dense packing with an apparent density (AD) of 27 lbs/ft^3 the bed height is approximately 30". If the carbon bed is loosely packed, or 90% of AD, the bed height is 3 feet.

7.0 TROUBLESHOOTING

This section is intended to identify a portion of the more common problems which may be encountered during the operation of a granular activated carbon system. The following "cause and effect" discussion is not intended to be all inclusive since situations and circumstances will vary with each individual system by virtue of design, operating philosophy, etc. Therefore, this section should only be considered as a guideline for troubleshooting.

7.1 General

The problems which arise generally fall under the following categories:

- High pressure drop
- Poor adsorption and inefficient carbon usage

- Reduced air flow

7.2 High Pressure Drop in the Adsorber

High pressure drop in the adsorber can be caused by:

1. Excessive moisture accumulation in the plenum, and/or
2. Blinding of the plenum by particulates.

7.2.1 Excessive Moisture Accumulation

As discussed in Section 4.3, if excessive moisture is present in process vapors, liquid may accumulate within the open bottom portion of the unit. Excessive moisture accumulation may restrict or completely block portions of the inlet duct connection and the open space beneath the plenum. Either restriction or blockage will increase inlet velocities and pressure drop through the unit. Excessive moisture accumulation may be avoided by periodically inspecting the drain plugs and interior of the unit.

7.2.2 Blinding of the Plenum

The plenum is constructed of stainless steel support plate. If the influent vapor contains an excessive amount of particulates, the particulates may build up on the underside of the plate, causing a restriction of the open area and an increase in pressure drop. If excessive blinding occurs within the unit, an upstream filter may be installed to remove the particulates prior to the adsorption unit.

7.3 Poor Adsorption and Inefficient Carbon Usage

Poor adsorption and/or inefficient carbon usage may be caused/remedied by the following:

1. Channeling – Level the carbon bed.
2. Carbon saturation - Change the carbon.
3. Increase in effluent concentration - Compare influent analyses.
4. Change in types of contaminants in the influent - Compare influent analyses.
5. Presence of non-adsorbable organics - Compare influent analyses.

7.4 Reduced Air Flow

Reduced air flow through the system can be caused by the following:

1. Blinding of the plenum.
2. Dirty pre-filters
3. Debris in the duct.

8.0 MAINTENANCE

8.1 Adsorber

The NB-20 Adsorber is designed to require minimal maintenance. The following items should be inspected and maintained as noted:

1. Internal inspection of the lining and plenum should be performed each time carbon is removed.
2. Inspect all attachment hardware (sliding hinges, safety catches and clamps) for damage.
3. Grease door hinges once every three (3) months.
4. Grease sliding fittings on doors (plates and brackets on hinge side) once every three months.
5. Grease turnbuckles (if applicable) once every three months.
6. Inspect all mechanical parts before and after carbon fill/replacement for signs of wear or damage. ***Repair or replace any excessively worn or damaged mechanical parts (hinges, chains, turnbuckles, clamps, etc.) immediately to prevent worker injury.***
7. Inlet pressure should be checked periodically to insure proper operation.
8. Process connections should be periodically inspected for signs of wear and/or leakage.

8.2 Fan & Filter

- Make sure fans are not operating when performing maintenance on the air handling system.
- Open drain in fan housing to remove any condensation.
- Inspect pre-filters and replace if necessary
- Perform fan maintenance per attached Fan Operation Manual.-

9.0 MINIMUM SAFETY PRECAUTIONS

All electrical, mechanical and rotating machinery constitute a potential hazard, particularly for those not familiar with the design, construction and operation. Accordingly, adequate safeguards (including use of protective equipment when necessary) should be taken with this equipment to safeguard the public (including minors) from injury and to prevent damage to the equipment, the associated system and the premises.

The operation, maintenance and repair of this equipment should be undertaken only by personnel qualified to do so. All such personnel should be thoroughly familiar with the equipment, the associated system and controls, and the procedures set forth in this manual. Proper care, procedures and tools must be used in handling, lifting, installing, operating, maintaining and repairing this equipment to prevent personal injury and/or property damage.

ACTIVATED CARBON CAN REDUCE OXYGEN LEVELS IN CONFINED SPACES. USE LOW OXYGEN SAFETY PROCEDURES WHEN ENTERING ADSORBER VESSELS CONTAINING CARBON, OR FROM WHICH CARBON HAS BEEN REMOVED.

Contaminated water may contain chemicals or biological contaminants which could be harmful if exposed to the skin, inhaled or ingested. Accordingly, personnel who may be exposed directly to the mists produced by water jets or compressed air should wear appropriate OSHA protective equipment.

10.0 SPARE PARTS

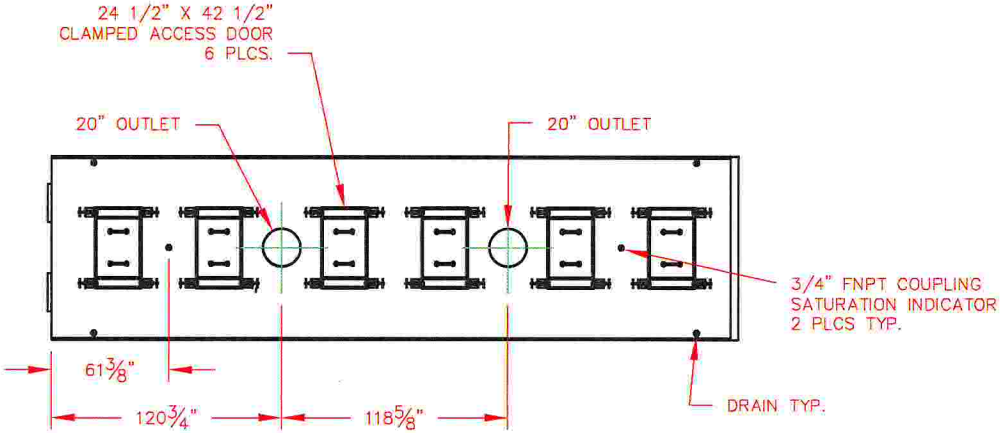
The NB-20 adsorber does not require much in the way of spare parts. If, however, the unit does require replacement parts or maintenance, please contact TIGG Corporation at (800) 925-0011 for service.

ATTACHMENTS

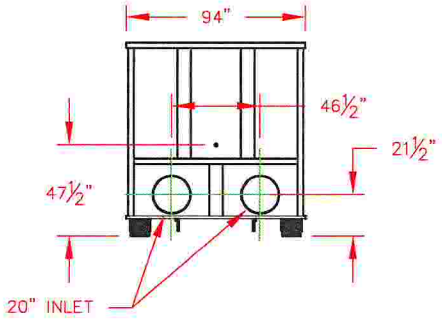
SYSTEM EQUIPMENT LIST & DRAWINGS

NOTES: TIGG CORPORATION RESERVES THE RIGHT TO CHANGE ANY AND ALL DIMENSIONS– AND DESIGNS
OVERALL OUT TO OUT DIMENSIONS AND INLET/OUTLET LOCATIONS ARE FIXED.

CONTAMINATED AIR SHALL ENTER UNIT THROUGH BOTH INLETS AND MUST EXIT USING BOTH OUTLETS.



TOP VIEW



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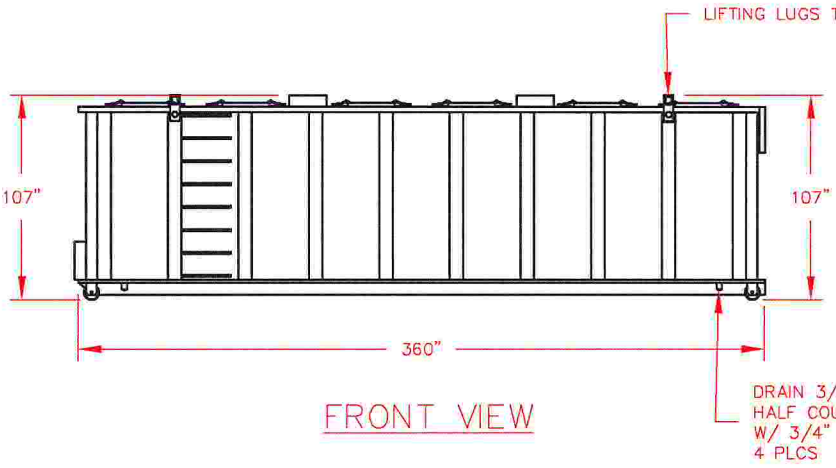
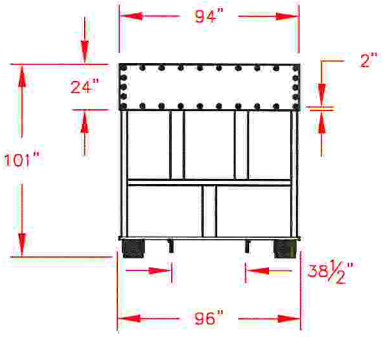


FRONT VIEW



RIGHT SIDE

NO.	REVISION	BY	DATE
1	REVISE STANDARDS	JB	6/10/03

PROJECT

VESSEL STANDARDS

VESSEL MATERIALS : CARBON STEEL	BED VOLUME STD/MAX : 640 FT³ / 780 FT³
LINING : HIGH SOLIDS EPOXY	STD / MAX CARBON FILL : 17,000 LBS/20,000 LBS
EXTERIOR PAINT : ACRYLIC WATERBORNE PRIMER & PAINT	SHIP WT. EMPTY/MAX.FILL : 15,000 LBS/35,000 LBS
WALL THICKNESS : 12 GAUGE STD.	CARBON TYPE : TIGG 5CP-4MM VAPOR PHASE
FLOOR THICKNESS : 3/16" STD.	MAX. OPERATING PRESSURE : 14"H_2O
INTERNALS : CARBON STEEL & POLYPROPYLENE	MAX. OPERATING TEMP. : 140°F
ADSORBENT OUTLET ASSEMBLY : 24" X 42" ACCESS AND HINGED DOORS	

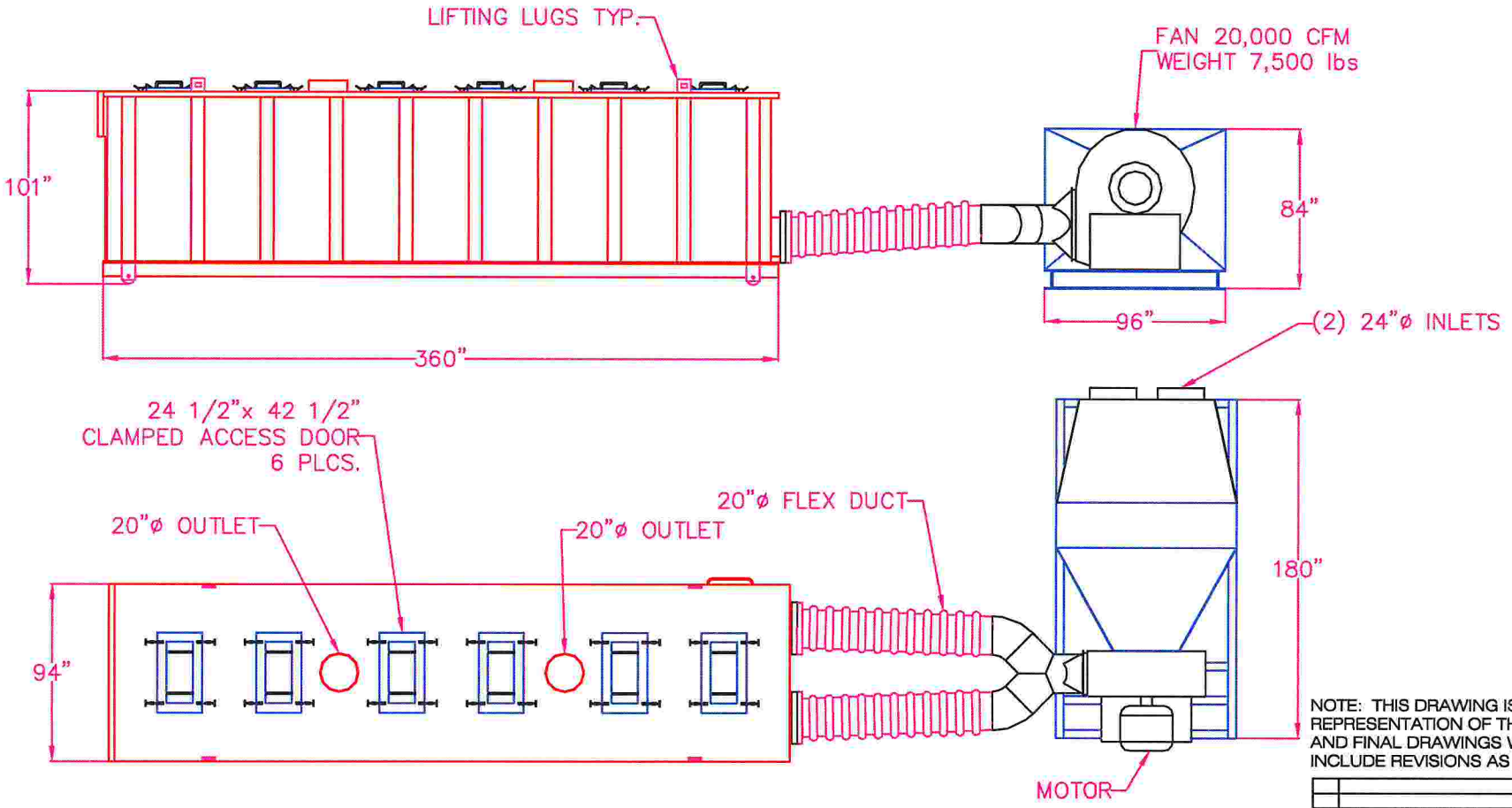
PROJ. NO. SALES
P.O. NO.

DRAWN BY	JB
DESIGN BY	BL
CHKD. BY	BL
DATE	05/15/02
SCALE	NTS

TIGG corporation

NB–20–1001

DWG. NO. NB–20–1001 REV. 1



NOTE: THIS DRAWING IS A REPRESENTATION OF THE DESIGN AND FINAL DRAWINGS WILL INCLUDE REVISIONS AS REQUIRED.

NO.	REVISION	BY	DATE
1	CHANGE BLOWER	JB	10/04/01

NOTE: TIGG CORPORATION RESERVES THE RIGHT TO CHANGE ANY AND ALL DIMENSION-DESIGNS OVERALL OUT TO OUT DIMENSIONS AND INLET/OUTLET LOCATIONS ARE FIXED.

NOTE: CONTAMINATED AIR SHALL ENTER UNIT THROUGH BOTH INLETS AND MUST EXIT USING BOTH OUTLETS.

PROJECT
GENERAL LAYOUT

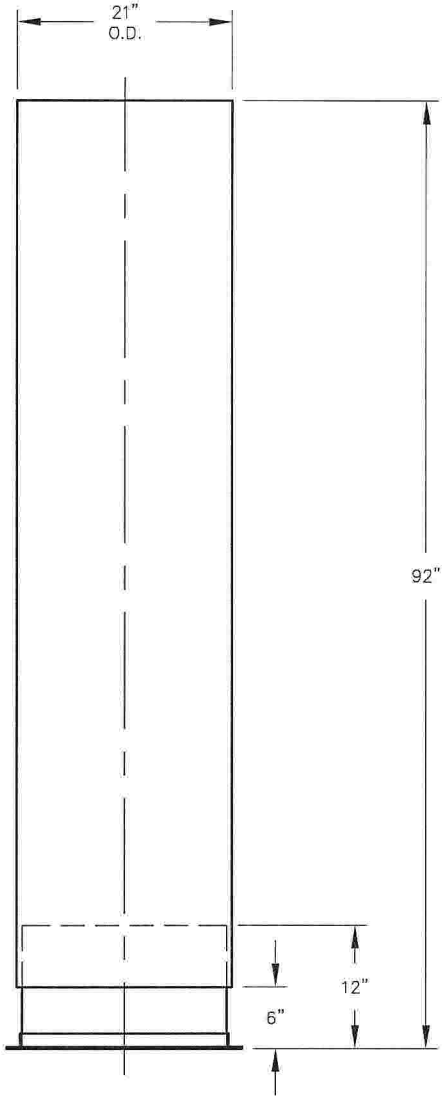
PROJ. NO.
P.O. NO.

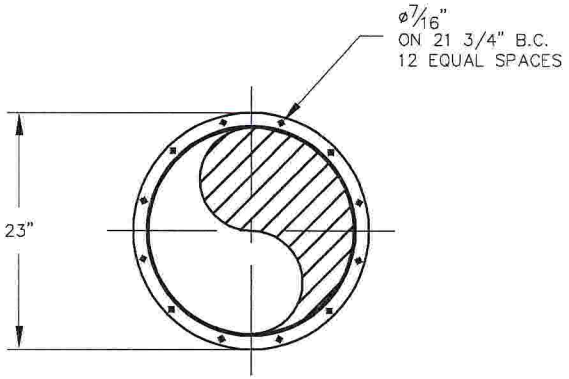
DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	
DATE	10/03/01
SCALE	NTS

TIGG corporation

CARBON ADSORBER,
AIR HANDLING SYSTEM

DWG. NO. NB-20-1002 REV. 1





NO.	REVISION	BY	DATE

PROJECT

DUCT

TIGG corporation

PROJ. NO.	FABRICATION DRAWING
P.O. NO.	

DRAWN BY	JB
DESIGN BY	JB
CHKD. BY	
DATE	3/2/04
SCALE	NTS

20"ø STACK

DWG. NO. 20"øSTACK-3001

REV. 0

LIFTING INSTRUCTIONS

NIXTOX BOX – LIFTING INSTRUCTIONS (NB10 AND NB20)

CARBON STEEL HIGH FLOW VAPOR ADSORBER

MODEL	MAX FLOW (CFM)	MAX PRESS (PSIG)	MAX TEMP (deg F)	Inlet/ Outlet	L X W X H (FT)	EMPTY BOX Weight (lbs)	STANDARD ADSORBENT FILL (LBS)	SHIPPING WEIGHT - STANDARD FILL (LBS)
NB-10	10000	AMB	130	20	264 X 94 X112	9000	12000	21000
NB-20	20000	AMB	130	20	360 X 94 X 112	15000	20000	35000

NOTES:

1) Do not exceed maximum flow conditions listed.
2) Dry virgin activated or reactivated carbon provided as standard adsorbent.
3) Standard adsorbent fill is based on a bed density of 29 lb/ft^3.
4) Standard adsorbent fill can differ based on variable bed density and alternate adsorbents.

The NB-10 and NB-20 high flow vapor adsorbers are intended to be lifted using a crane. When lifting the unit by a crane, install a 1-5/8" shackle in each of the four lifting lugs. Contact a rigging contractor for sizing of the crane and proper design of the lift.

TIGG corporation

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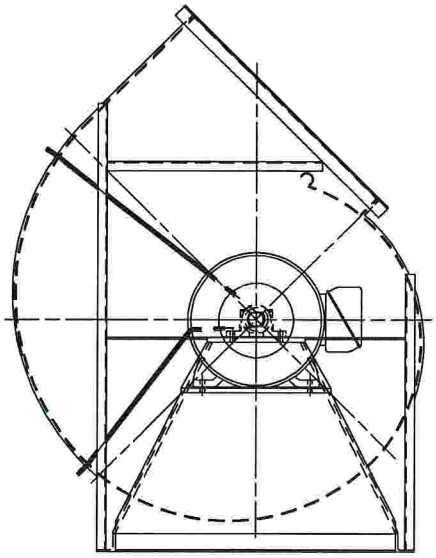
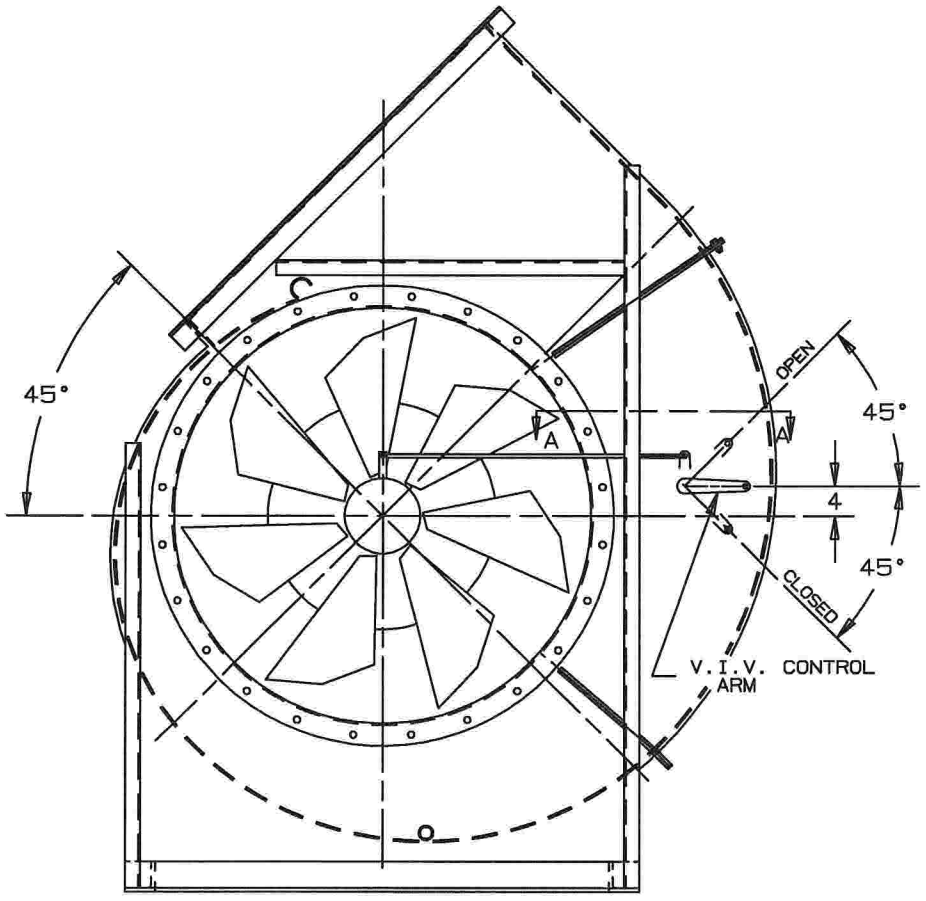
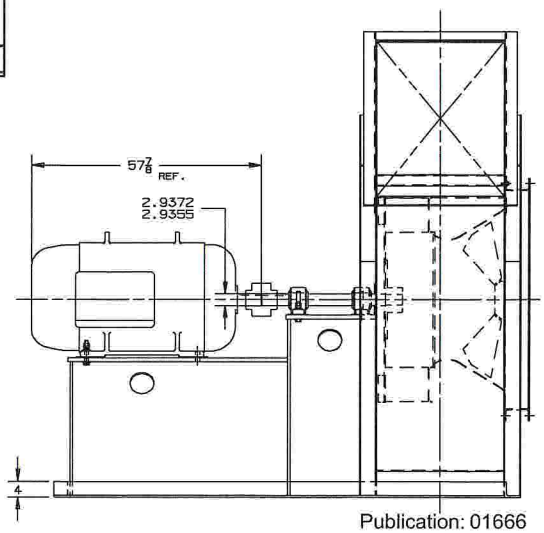
FAN OPERATION MANUAL



FAN EQUIPMENT OPERATION MANUAL

Fan Serial No. _____





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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.

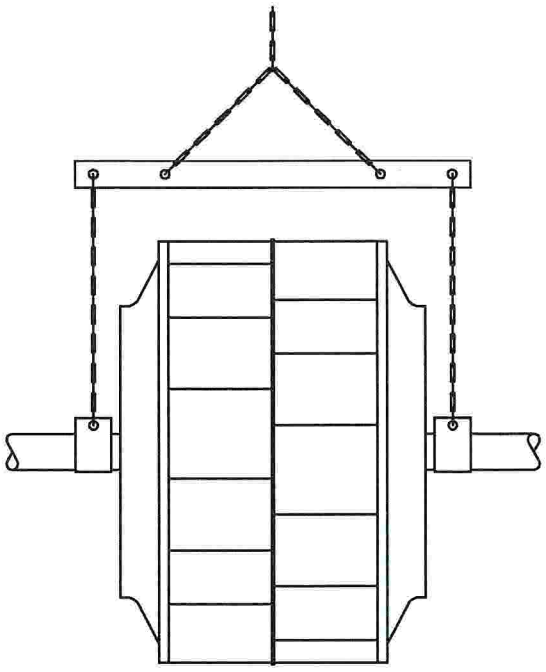


Fig. 1 *Correct use of spreader bar when lifting centrifugal rotor assembly.*

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.

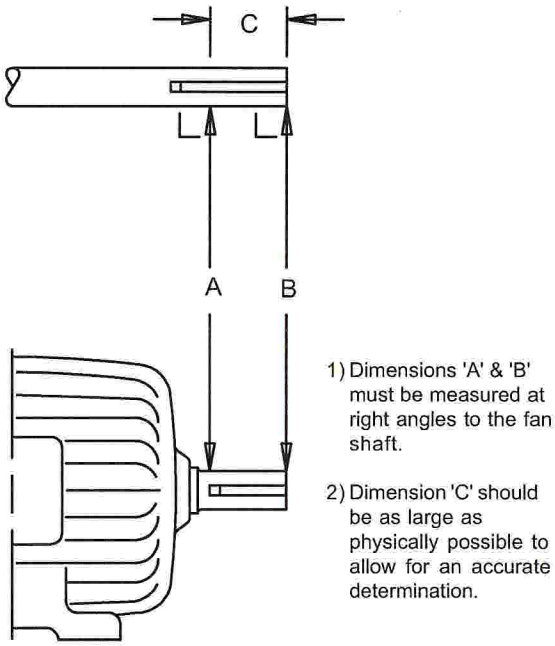


Fig. 2 *Determination of parallel shafts.*

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.

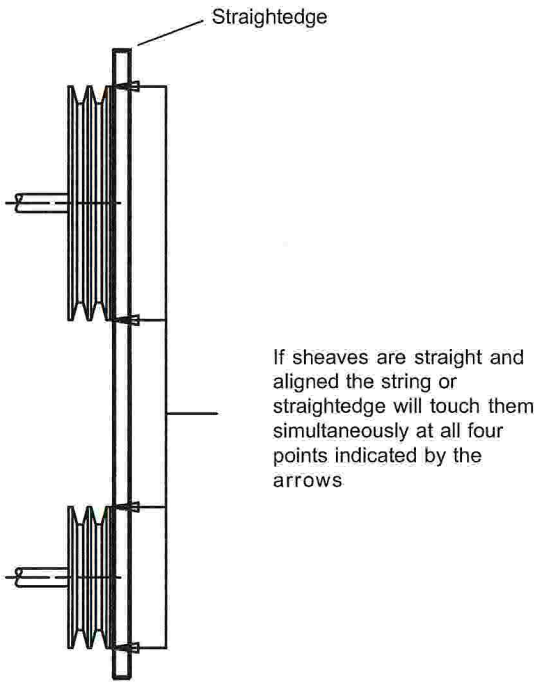


Fig. 3 *Sheave alignment.*

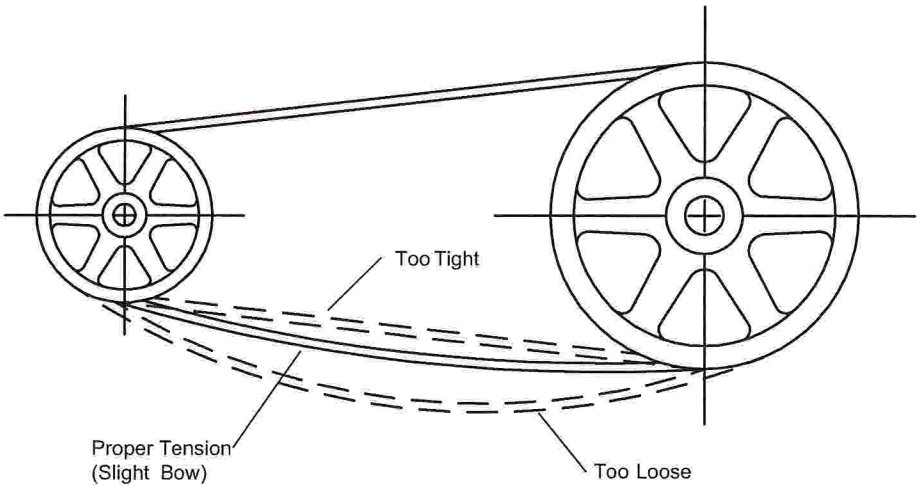


Fig. 4 *Belt tension.*

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. Keep takeup rails, motorbase, 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, lock out 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.

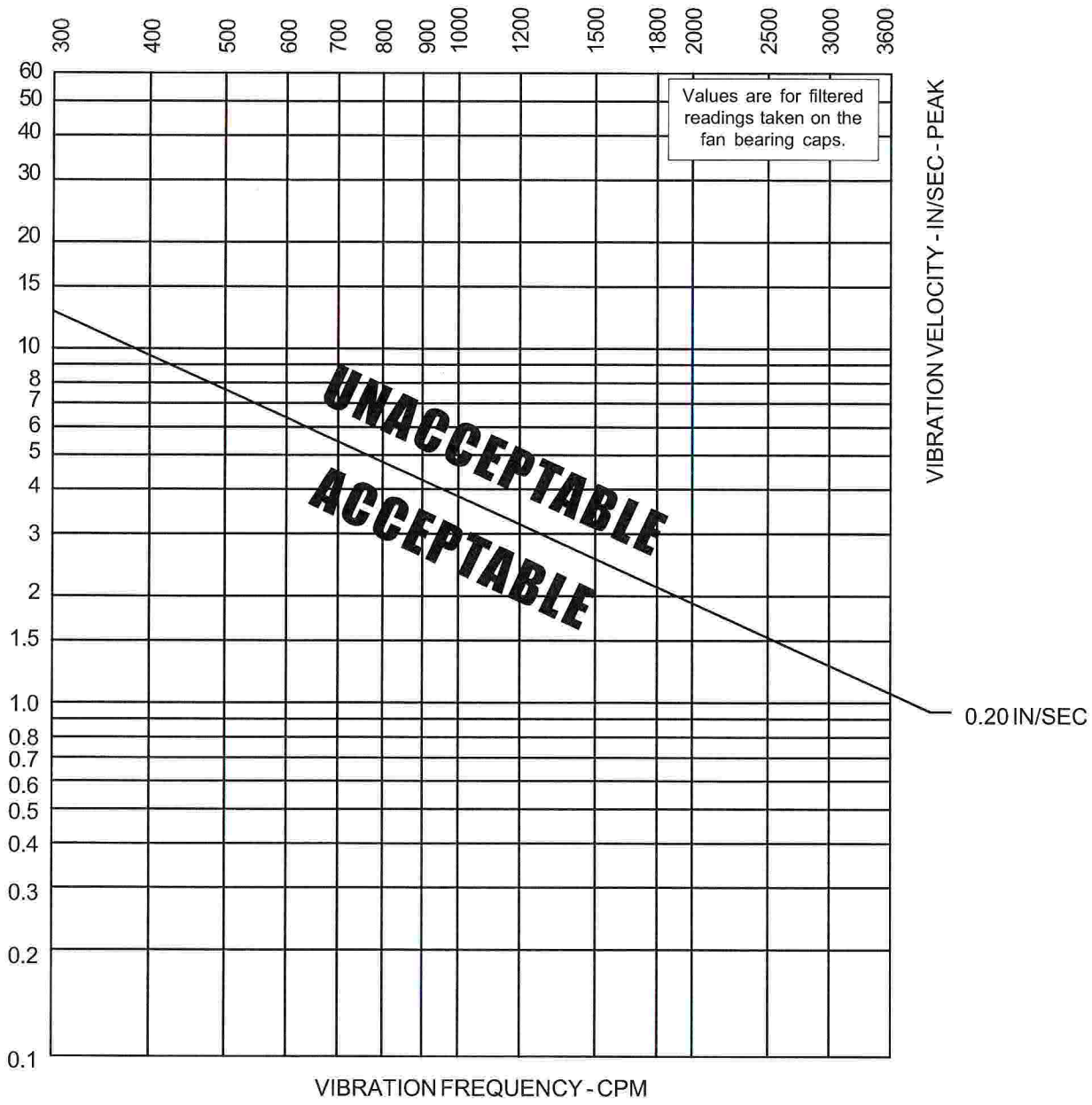


Fig. 5 *Fan Vibration Severity Chart*

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:

_____

_____

_____

_____

_____

NORTHERN BLOWER

FAN SERIAL NO. :

DRAWN : 2/21/2003 Neal Boyd

SALES OFFICE : CML Northern Blower Inc.

CUSTOMER : P.O. No. :

PROJECT :

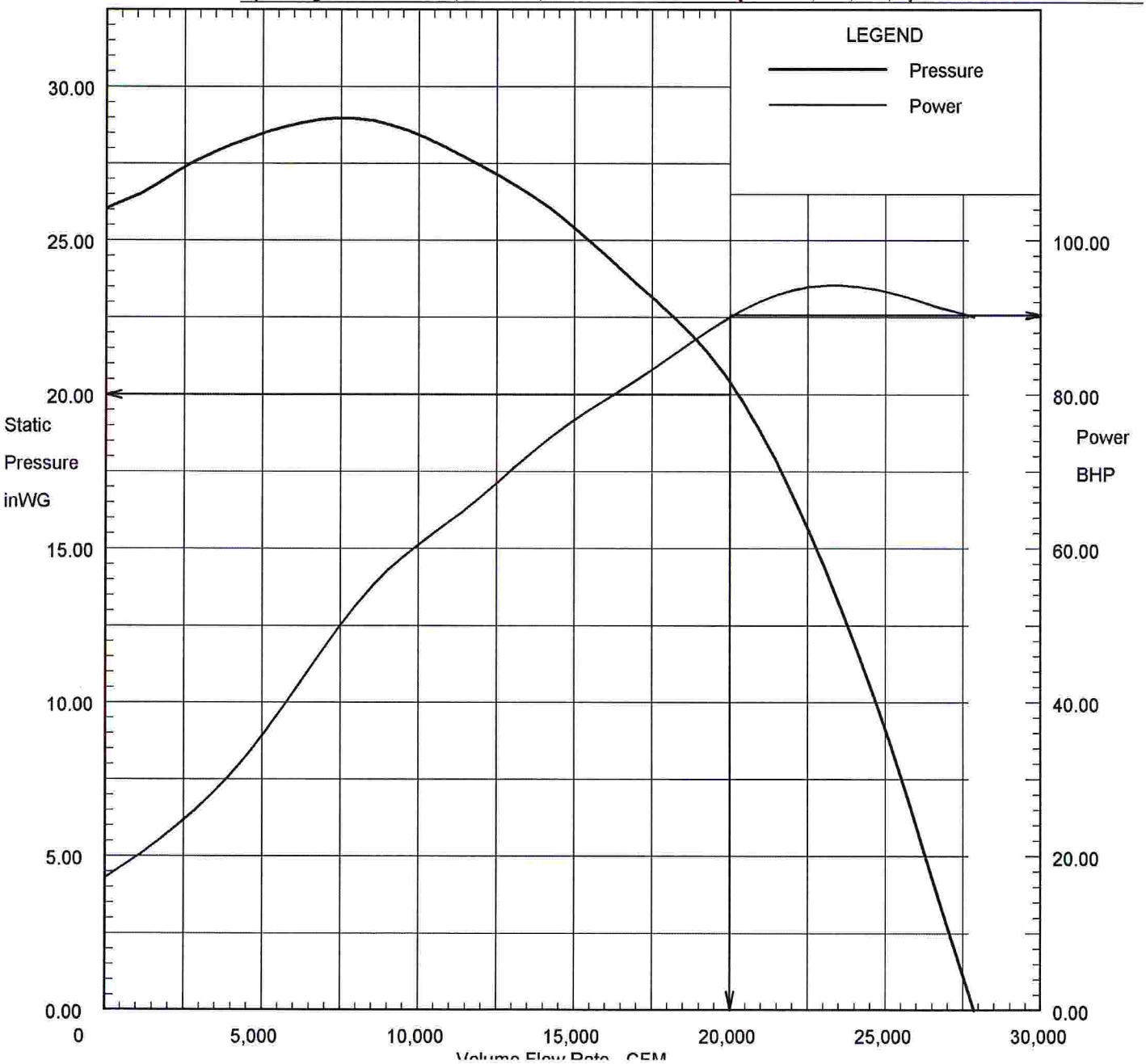
ENGINEER :

TAG :

FAN - DESCRIPTION : Design No. 4270 Size 4025- 4150 SISW Centrifugal

SELECTION : 20,000 CFM, 20.000 inWG SP, 90.29 BHP

CONDITIONS : Operating: 0.0750 lb/cu.ft, 70.0 F, 1780 RPM [142616A3,4270,3300,95]



MOTOR STARTERS

Connections

The following connections are standard on the RSD starter:

Terminal	Use
TB1-1	Control Power - Line.
TB1-2	Control Power - Neutral.
TB1-3	Start/Stop relay - Seal-in contact.
TB1-4	Start/Stop relay - Line.
TB1-5	Start/Stop relay - neutral.
TB1-6	Fault contact - normally open.
TB1-7	Fault contact - common (rated 2A resistive, 1A inductive).
TB1-8	Fault contact - normally closed.
TB1-9	Up-to-Speed contact - normally open.
TB1-10	Up-to-Speed contact - common (rated 16A resistive, 8A inductive).
TB1-11	Up-to-Speed contact - normally closed.
TB1-12	Motor power - normally open.
TB1-13	Motor power - common (rated 16A resistive, 8A inductive).
TB1-14	Motor power - normally closed.
TB1-15	External fault input - line.
TB1-16	External fault input - neutral.
TB2-1	Internal power for potentiometer control voltage.
TB2-2	Voltage control signal input.
TB2-3	Voltage control signal common.
L1	Phase 1 power connection.
L2	Phase 2 power connection.
L3	Phase 3 power connection (three phase units only).
T1	Phase 1 motor connection.
T2	Phase 2 motor connection.
T3	Phase 3 motor connection (three phase units only).

Hazardous voltages can exist at the starter motor terminals even when the starter is in a stopped condition.

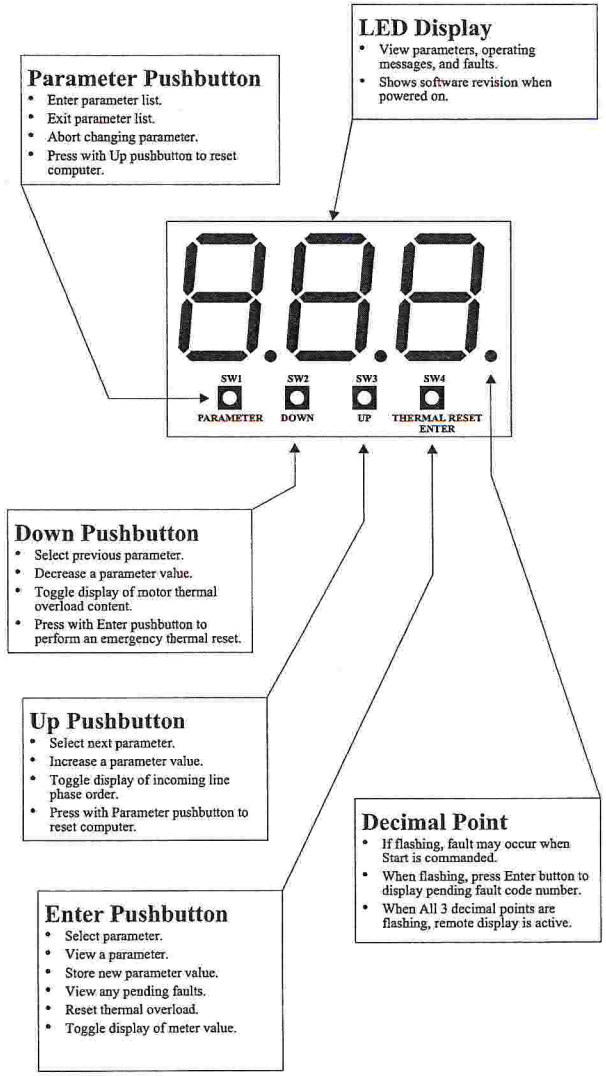
Do not connect power factor correction capacitors or surge capacitors between the RSD and the motor. Damage to the starter will result. Connect capacitors before the RSD utilizing a contactor with the coil energized by the up-to-speed contact.

Jumper Settings

Setting	JP1	JP2	JP3	JP4
Deceleration Enable	Out	x	x	x
4-20mA External Control	x	In	1-2	x
0-5VDC External Control	x	Out	2-3	1-2
0-10VDC External Control	x	Out	2-3	2-3
Potentiometer Control	x	In	Out	x

x = not relevant to setting

Operation



Operating Parameters

Parameter	Description	Default	Values
P1	Motor Full Load Amps	1	1A to 1.20kA
P2	Overload Multiplier	1.15	1.00, 1.05, 1.10, 1.15, 1.20, 1.25, 1.30, 1.35, 1.40
P3	Motor Thermal Overload	10	OFF, 10, 20, 30
P4	Initial Motor Starting Current	100	50% to 400%
P5	Maximum Motor Starting Current	600	200% to 600%
P6	Motor Ramp Time	15	0 sec. to 120 sec.
P7	Motor Stall Time	30	0 sec. to 240 sec.
P8	Deceleration Level 1	40	0% to 100%
P9	Deceleration Level 2	10	0% to 100%
P10	Deceleration Time	OFF	OFF, 1 sec. to 60 sec.
P11	Overcurrent Trip Level	50	50% to 400%
P12	Overcurrent Trip Time	OFF	A IS-AD I, OFF, E IS-tD I
P13	Undercurrent Trip Level	25	25% to 100%
P14	Undercurrent Trip Time	OFF	A IS-AD I, OFF, E IS-tD I
P15	Line Phase Sensitivity	InS	AbC, CbA, InS, SPH
P16	Motor Current Imbalance	20	5% to 40%
P17	Current Transformer Ratio	288	72, 96, 144, 288, 864, 2.64, 2.88, 5.76
P18	Meter Mode	10	0, 1, 2, 3, 4, 5, 10, 11, 12, 13, 14, 15
P19	Meter Dwell Time	2	OFF, 2 sec. to 30 sec.
P20	Passcode	OFF	1 to 255
P21	500% Current Kick Time	OFF	OFF, 0.1 to 5.0 sec.
P22	Starter Mode	nor	nor, Cn 1, Cn2, Cn3

Programming

- Press the P button.
- Use the Up or Down button to select parameter to edit.
- Press the Enter button.
- Use the Up or Down button to select new value.
- Press the Enter button to store the new value or the P button to cancel.

Operating Messages

Message	Description
noL	No Line - Line voltage is not present.
rdY	Ready - Line voltage is present and starter is ready to run.
Acc	Accelerating - Start command was given and motor is accelerating.
uES	Up to Speed - The motor is at full speed.
run	Run - The ramp time has expired and the motor is at full speed.
dcL	Decelerating - Stop was given and the motor is decelerating (if set).
OL	Overload Warning - The overload is between 90% and 99% content.
OLL	Overload Lock - The overload has tripped and reset is not yet allowed.
OLt	Overload Trip - The overload has tripped and reset is allowed.
EnA	Enabled - Passcode protection is enabled.
d IS	Disabled - Passcode protection is disabled.
oxx	xx = overload thermal content in percentage. Press Down button to toggle.
cxx	xx = pending fault. Press enter button to toggle.
Fxx	xx = fault code.
no	No Change - Parameter is passcode protected and cannot be changed.
. . .	External display is active (flashing decimal points).
Axx	Automatically reset over/undercurrent fault after tripping in xx seconds.
txx	Manual reset over/undercurrent fault after tripping in xx seconds.

CT Burden Switch Settings

P17 = Current Transformer Ratio	P1 = Motor FLA (Amps)	Switch Settings (SW1 - SW2)
72:1 (4 passes through 288:1)	2A to 3A	Off - Off
72:1 (4 passes through 288:1)	5A to 8A	On - Off
72:1 (4 passes through 288:1)	9A to 16A	Off - On
72:1 (4 passes through 288:1)	12A to 21A	On - On
144:1 (2 passes through 288:1)	4A to 7A	Off - Off
144:1 (2 passes through 288:1)	10A to 17A	On - Off
144:1 (2 passes through 288:1)	18A to 33A	Off - On
144:1 (2 passes through 288:1)	23A to 43A	On - On
288:1	8A to 14A	Off - Off
288:1	19A to 35A	On - Off
288:1	35A to 66A	Off - On
288:1	46A to 87A	On - On
864:1	22A to 42A	Off - Off
864:1	55A to 105A	On - Off
864:1	104A to 199A	Off - On
864:1	136A to 263A	On - On
2640:1	67A to 128A	Off - Off
2640:1	167A to 322A	On - Off
2640:1	315A to 610A	Off - On
2640:1	416A to 804A	On - On
5760:1	146A to 281A	Off - Off
5760:1	364A to 704A	On - Off
5760:1	688A to 1330A	Off - On
5760:1	906A to 1600A	On - On

Fault Codes

Code	Description
F1	Line phase sequence not ABC.
F2	Line phase sequence not CBA.
F3	System power is not three phase.
F4	System power is not single phase.
F5	Line frequency less than 23hz.
F6	Line frequency greater than 75hz.
F23	Line current unbalance is greater than set level.
F24	Line currents are very unbalanced.
F29	Operating parameters have been lost.
F30	3-phase default operating parameters have been loaded.
F31	1-phase default operating parameters have been loaded.
F52	Current flow is present while starter is in stopped state.
F54	Undercurrent trip.
F55	Overcurrent trip.
F60	No control input (4-20mA).
F70	Control power is low.
F71	CT burden switch changed while running.
F74	Motor stalled time elapsed before motor reached full speed.
F75	External Fault occured (Power removed from input).
F77	Control card fault.
F78	Control card Fault.
F90	Full-load amp (P1), CT ratio (P17), or CT Burden Switch set incorrectly
F92	Shorted SCR.
F97	Control Card Fault.
F98	Lost mains power.
F99	Excessively high load current.

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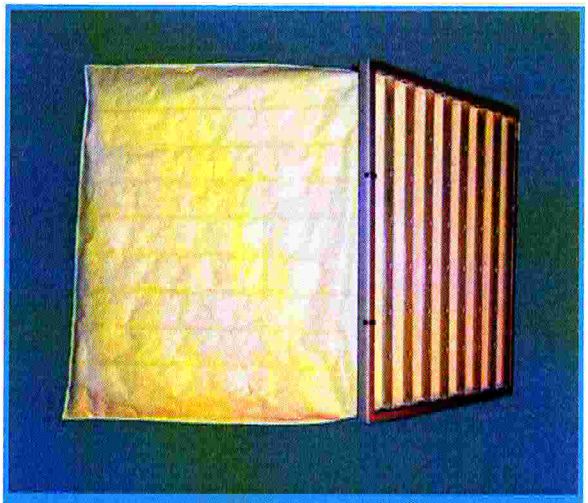
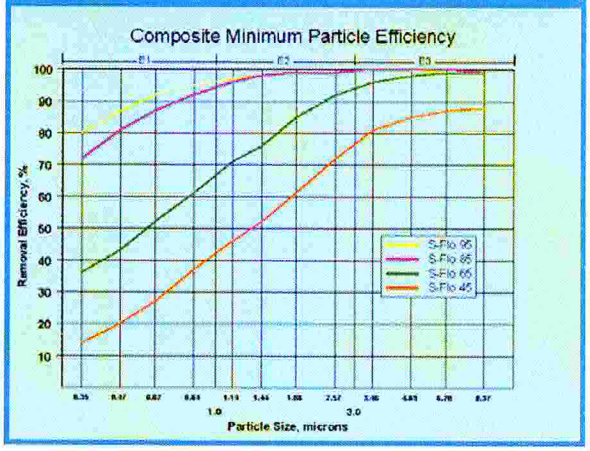
PLEATED FILTER PANELS & POCKET FILTERS

s-flo

Extended Surface Multi-Pocket Synthetic Air Filters



Synthetic media extended surface air filter for high efficiency particulate removal



Values are MERVs when evaluated per ASHRAE 52.2.

The Camfil Farr S-Flo offers high efficiency particulate air filtration to address today's indoor air quality concerns. The S-Flo can remove contaminants such as fumes, smoke, bacteria, fungi, and virus-bearing droplet nuclei. S-Flo filters are available in the following efficiencies:

ASHRAE 52.1	ASHRAE 52.2	Eurovent/CEN
40-45%	MERV 9	EU5
60-65%	MERV 11	EU6
80-85%	MERV 13	EU7
90-95%	MERV 14	EU8

High Lofted Melt-Blown Synthetic Media

The Camfil Farr S-Flo includes a unique melt-blown synthetic media that provides critical capture of particles as small as 0.3 micron. The media incorporates a uniform high loft to provide a lower resistance to airflow than comparable high efficiency air filters. A lightweight scrim media backing ensures protection of the media and prevents media erosion.

Stronger than conventional media, the S-Flo can withstand the rigors of turbulent airflow common in certain industrial applications. Performance and configuration are unaffected by dust loading or humidity. The S-Flo may also be used in industrial applications involving chemicals that may be hostile to other types of filters.

The S-Flo is also the filter of choice for the removal of nuisance contaminants such as pollens, paper dust, and other atmospheric impurities.

Applications include commercial buildings, medical facilities, and industrial manufacturing facilities.

Camfil Farr	Product sheet
S-Flo	1205 - 0704
Camfil Farr—clean air solutions	

Melt-blown Synthetic Media (continued)

The Camfil S-Flo incorporates an exclusive blend of synthetic microfibers that are electrostatically enhanced during the fiber manufacturing process to enhance particle capture efficiency. Biologically inert, these fibers will not support microbial growth. The media is color-coded to allow quick identification of filter efficiency.

Yellow	90-95%	
Pink	80-85%	
Green	60-65%	
White	40-45%	

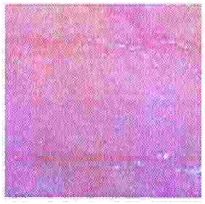
Individual pockets include internal stitching to maintain uniform airflow channels for even dust loading and long filter life. The S-Flo may be operated to a final resistance of 1.5" w.g. without affecting product performance. Camfil Farr manufactures the S-Flo to be capable of withstanding up to 5.0" w.g., ensuring product durability in the most demanding applications.

Performance

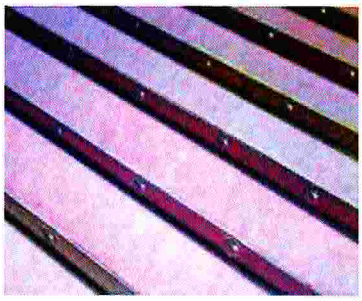
Synthetic fibers also offer a higher initial efficiency than media manufactured of many other types of fibers, making synthetics the obvious choice for applications where higher initial efficiencies may be critical. Camfil Farr S-Flo filters are available in fractional efficiencies from 40% to 95% on particles as small as 0.3 micron in size. MERV values range from 9 to 14 when evaluated under ASHRAE Standard 52.2 and dust spot efficiencies range from 40% to 95% when evaluated under ASHRAE Standard 52.1.

Stitch Sealant & Adhesive Bonding

Camfil Farr completely seals pocket stitching to eliminate the possibility of particle bypass through stitching penetrations. This unique sealant maintains a flexibility that is unaffected by varying airflows. The media is bonded around the pocket retainers to ensure a strong pocket-to-retainer seal and minimize the potential for pocket failure.



Sure-Clench® Crimp



Each galvanized steel pocket retainer is fastened with Camfil Farr's exclusive Sure-Clench crimp, creating a positive lock between pockets and eliminating the possibility of air bypass. Each pocket retainer includes rolled edges to prevent damage to the media and minimize sharp edges that may create a hazard to filter installers.

Galvanized Steel Header

A "J" return channel header, of one-piece corrosion resistant galvanized steel, has rolled edges to prevent damage to the filter media. When combined with the Sure-Clench Crimp and galvanized pocket retainers, a rigid and durable assembly is created for installation into side-access or built-up bank applications.

Leak-Free Filter Performance

Every Camfil Farr S-Flo includes a gasket on the vertical edge of the filter header. In a side-access housing, filters are mated header-to-header. A ¼" gap around a 24" by 24" filter can equate to 18% air bypass at 500 fpm. The S-Flo filter's gasket prevents air bypass and ensures that the air filter will clean all of the air moving through the system.

Configurations for any Application

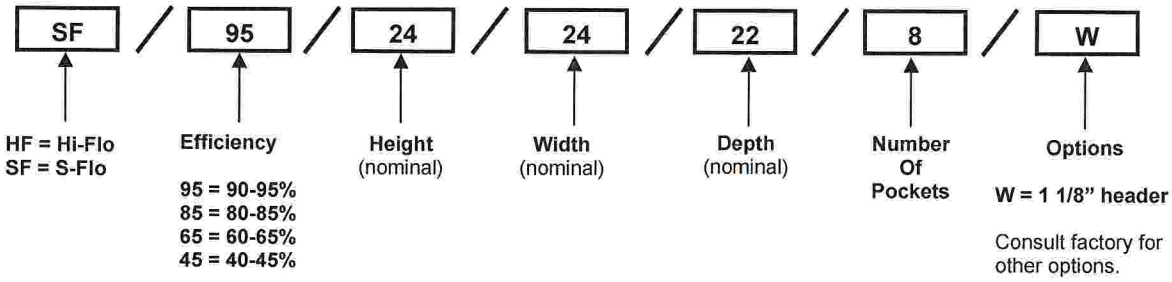
Camfil Farr S-Flo filters are available in a variety of configurations to suit your air quality requirements. Common configurations include from 3 to 12 pockets, depths of 15" to 30", and up to 101 square feet of effective media area.

When selecting an S-Flo for your system, you should select a filter with the greatest effective media area within the airflow parameters and space limitations for your system.

With effective removal of sub-micron particles, dependable construction, and high dust holding capacity, the S-Flo is the perfect fit for any application.

Camfil Farr S-Flo Selection Chart

Model Number (precede with SF and insert efficiency for *)	Number of Pockets	Dimensions[a] (nominal size) (inches) H x W x D	Airflow Capacity[b] (cfm)			Initial Resistance to Airflow (inches w.g.) [c]												Media Area (sq. ft.)
						MERV 14 (90-95%)			MERV 13 (80-85%)			MERV 11 (60-65%)			MERV 9 (40-45%)			
			Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High	Low	Med	High	
*/24/24/15/12	12	24 x 24 x 15	1000	1500	2000	0.21	0.35	0.50	0.17	0.28	0.40	0.13	0.21	0.30	0.11	0.18	0.25	58
*/24/20/15/9	9	24 x 20 x 15	750	1100	1500													44
*/24/12/15/6	6	24 x 12 x 15	500	750	1000													29
*/20/20/15/9	9	20 x 20 x 15	650	950	1275													37
*/24/24/30/10	10	24 x 24 x 30	2000	2400	2800	0.40	0.51	0.62	0.30	0.38	0.47	0.25	0.32	0.39	0.20	0.26	0.31	101
*/24/20/30/8	8	24 x 20 x 30	1600	1900	2250													81
*/24/12/30/5	5	24 x 12 x 30	1000	1200	1400													50
*/20/20/30/8	8	20 x 20 x 30	1350	1625	1875													68
*/24/24/22/10	10	24 x 24 x 22	1500	1750	2000	0.32	0.38	0.45	0.25	0.29	0.35	0.19	0.23	0.27	0.15	0.18	0.22	73
*/24/20/22/8	8	24 x 20 x 22	1200	1400	1600													58
*/24/12/22/5	5	24 x 12 x 22	750	875	1000													36
*/20/20/22/8	8	20 x 20 x 22	1000	1175	1350													49
*/24/24/30/8	8	24 x 24 x 30	1600	2000	2400	0.34	0.45	0.58	0.27	0.35	0.45	0.21	0.27	0.35	0.17	0.22	0.28	81
*/24/20/30/7	7	24 x 20 x 30	1400	1750	2100													70
*/24/12/30/4	4	24 x 12 x 30	800	1000	1200													40
*/20/20/30/7	7	20 x 20 x 30	1150	1450	1750													59
*/24/24/22/8	8	24 x 24 x 22	1500	1750	2000	0.35	0.42	0.50	0.28	0.34	0.40	0.21	0.25	0.30	0.18	0.21	0.25	58
*/24/20/22/7	7	24 x 20 x 22	1300	1500	1750													51
*/24/12/22/4	4	24 x 12 x 22	750	875	1000													29
*/20/20/22/7	7	20 x 20 x 22	1100	1300	1450													43
*/24/24/30/6	6	24 x 24 x 30	1500	1750	2000	0.39	0.46	0.55	0.32	0.38	0.45	0.25	0.29	0.35	0.20	0.24	0.28	63
*/24/20/30/5	5	24 x 20 x 30	1300	1500	1700													52
*/24/12/30/3	3	24 x 12 x 30	750	875	1000													31
*/20/20/30/5	5	20 x 20 x 30	1050	1225	1400													44
*/24/24/22/6	6	24 x 24 x 22	1500	1750	2000	0.44	0.53	0.63	0.36	0.43	0.51	0.27	0.32	0.38	0.21	0.25	0.30	45
*/24/20/22/5	5	24 x 20 x 22	1300	1500	1700													38
*/24/12/22/3	3	24 x 12 x 22	750	875	1000													23
*/20/20/22/5	5	20 x 20 x 22	1050	1225	1400													32



DATA NOTES:

[a] Standard S-Flo includes 0.88" (1" nominal) header. For 1.12" (1¼" nominal) header add a W to the end of the model number. Contact factory for lead times.

[b] Select 100% for constant volume systems and 80% of maximum design airflow for VAV systems. S-Flo filters perform satisfactorily over listed CFM range. Rated capacity is medium on chart.

[c] Recommended final resistance is 1.0" w.g. The Hi-Flo may be operated to 1.5" w.g. without affecting performance.

Special sizes are available, please contact factory. Pocket loops are recommended for 32" & 36" deep filters.

S-Flo filters with a 20" by 24" header size are available, consult factory for pricing and availability. System resistance is the same as 24" by 20" listed in above chart.

The S-Flo is classified by Underwriters Laboratories as UL Class 2.

Maximum operating temperature 158° F (70° C).

Performance tolerances conform to Section 7.4 of ARI Standard 850-78.

For lowest life cycle cost, select the filter with the greatest depth and media area that may be accommodated within the listed operating range of the filter.

Extended Surface Pocket Filter Options

S-Flo

Camfil Farr Hi-Flo®

Camfil Farr also offers a glass microfiber media extended surface pocket filter that offers consistent efficiencies in the sub-micron particle ranges throughout the life of the filter. The Camfil Farr Hi-Flo is available in efficiencies of MERV 9, MERV 11, MERV 13 and MERV14 based upon evaluation using ASHRAE Standard 52.2-1999. Consult Camfil Farr Bulletin 1203-0602.

Cambridge-Style Header

S-Flo filters include a 0.88" header for installation into a nominal 1" deep filter track. The Cambridge Air Filter Company manufactured side-access housings that required a 1.12" header to fit in a nominal 1¼" filter track. To order S-Flo filters for these housings, add a 'W' to your model number or seek factory guidance.

UL Class 1 Hi-Flo®

The S-Flo is only available in UL Class 2. If UL Class 1 is required, the Camfil Farr Hi-Flo is available in a Underwriters Laboratories UL Class 1 configuration. It is important to note that both classes of filters will burn when attacked by flames, and both will self-extinguish when clean.

UL Class 1 - Air filters which, when clean, do not contribute fuel when attacked by flame and emit only negligible amounts of smoke.

UL Class 2 - Air filters which, when clean, burn moderately when attacked by flame, or emit moderate amounts of smoke, or both.

Consult Camfil Farr Bulletin 1203-0602. Consult factory for pricing and availability.

SPECIFICATIONS

1.0 General

1.1 - Air filters shall be high efficiency ASHRAE extended surface pocket style filters consisting of a melt-blown lofted synthetic media, a galvanized steel header and pocket retainers, and bonding agents to prevent air bypass and ensure leak free performance. The filter shall be capable of withstanding 5.0" w.g. without pocket failure.

1.2 - Sizes shall be as noted on drawings or other supporting materials.

2.0 Construction

2.1 - Filter media shall consist of melt-blown lofted synthetic media that is bonded to a permeable media support backing forming a uniform lofted filter blanket.
2.2 - Individual pockets shall contain a minimum of 40 stitching support points per square foot of media area. All stitching centers shall be sealed through the use of a foam based sealant that shall remain pliable throughout the life of the filter. The sides and ends of each pocket shall be sewn with a chain-link over lock stitch.
2.3 - Pockets shall be internally sewn with a variable pocket support stitch to promote uniform airflow across the surface of the media.
2.4 - Support members shall include a galvanized steel header and galvanized steel pocket retainers. The header shall be bonded to the media to prevent air bypass. Individual pocket retainers shall be fastened with a mechanical crimp to lock individual pockets together. The media pockets shall be bonded to the pocket retainers to prevent air bypass. The frame shall form a rigid and durable support assembly.
2.5 - A filter-to-filter sealing gasket shall be installed on one of the vertical members of the filter header.

3.0 Performance

3.1 - The filter shall have a Minimum Efficiency Reporting Value of (MERV 9, MERV 11, MERV 13, MERV 14) per ASHRAE Standard 52.2-1999.
3.2 - Supporting data; provide laboratory test reports for each listed efficiency including all details as prescribed in ASHRAE Standards 52.1 and 52.2.
3.3 - The filter shall be classified by Underwriters Laboratories as UL Class 2.
3.4 - Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

Items in parentheses () require selection.

Camfil Farr, Inc.
United States Tel: (973) 616-7300 Fax: (973) 616-7771
Canada Tel: (450) 629-3030 Fax: (450) 662-6035
E-mail: camfilfarr@camfilfarr.com

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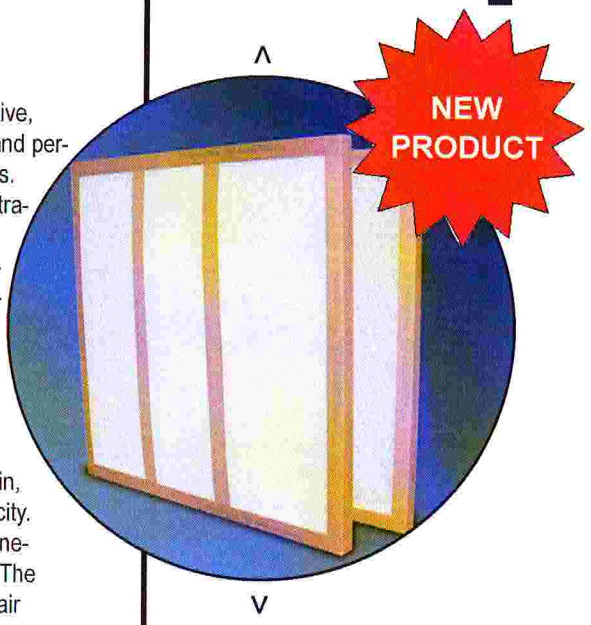


- New " Double Strut" Design
- 10% Greater Open Media Area
- Lighter Weight, Reduced Shipping Costs
- Easier Incineration and Disposal

FEATURES

The Glasfloss GDS disposable panel filter features an innovative, reinforced, "double strut" construction for excellent durability and performance in commercial, industrial, and residential applications. The new design provides 10% greater open media area than traditional metal grill filters and offers excellent dust holding capacity. In addition, the new design allows for easier disposal, eliminates sharp edges for safer handling and reduces carton weight for lower shipping costs.The new GDS disposable panel filter is available in 1" and 2" depths in many standard sizes.

CONSTRUCTION

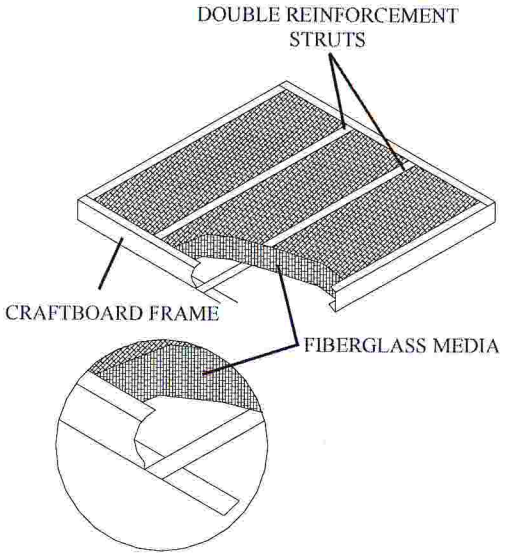
The Glasfloss GDS disposable panel filters utilize a double-skin, progressively dense fiberglass to maximize dust holding capacity. The media and strut retainers are glued and sealed inside a one-piece, craftboard frame made from 100% recycled materials. The filter frame is clearly marked with size, U.L. classification and air flow direction.

APPLICATIONS

The Glasfloss GDS Series of disposable panel filters can be used as a direct replacement for filters supplied in original equipment. Standard sizes are available in 1" and 2" depths to accommodate most filter tracks and return air grills.

SPECIFICATIONS

The standard size filter element shall be constructed of a heavy-duty, one piece craftboard frame. All corners shall be closed and sealed. The fiberglass filter media shall be coated with a non-toxic, non-flammable, odor free adhesive. The fiberglass media shall be constructed in a progressively dense fashion from air entering to air leaving side. The fiberglass media shall have a skin backing on the air entering and air leaving side. The media and reinforced strut retainers shall be glued and sealed inside a heavy-duty, craftboard frame. The GDS disposable panel filter shall be rated to withstand temperatures of 180 degrees Fahrenheit. All filters shall be rated Class 2 under U.L. std. 900.



"Serving You With Locations Throughout The Nation"

GDS Series

Fiberglass Double Strut Disposable Panel Filters

1" Performance Data

SIZE W x H x D NOMINAL	SIZE W x H x D EXACT	RATED VELOCITY FPM	INITIAL RESIST. IN. W.G.	MEDIA SQUARE FOOT	SIZE W x H x D NOMINAL MM	RATED VELOCITY M/H	INITIAL RESIST. PASCALS
8 x 16 x 1	7-5/8 x 15-5/8 x 3/4	300	0.07	0.88	203 x 407 x 25	5490	17.42
10 x 10 x 1	9-5/8 x 9-5/8 x 3/4	300	0.07	0.69	254 x 254 x 25	5490	17.42
10 x 20 x 1	9-5/8 x 19-5/8 x 3/4	300	0.07	1.38	254 x 508 x 25	5490	17.42
10 x 24 x 1	9-5/8 x 23-5/8 x 3/4	300	0.07	1.66	254 x 610 x 25	5490	17.42
10 x 25 x 1	9-5/8 x 24-5/8 x 3/4	300	0.07	1.75	254 x 635 x 25	5490	17.42
10 x 30 x 1	9-5/8 x 29-5/8 x 3/4	300	0.07	2.08	254 x 762 x 25	5490	17.42
12 x 20 x 1	11-5/8 x 19-5/8 x 3/4	300	0.07	1.66	305 x 508 x 25	5490	17.42
12 x 24 x 1	11-5/8 x 23-5/8 x 3/4	300	0.07	2.00	305 x 610 x 25	5490	17.42
12 x 25 x 1	11-5/8 x 24-5/8 x 3/4	300	0.07	2.08	305 x 635 x 25	5490	17.42
12 x 30 x 1	11-5/8 x 29-5/8 x 3/4	300	0.07	2.50	305 x 762 x 25	5490	17.42
12 x 30-5/8 x 1	11-5/8 x 30-1/4 x 3/4	300	0.07	2.55	305 x 778 x 25	5490	17.42
14 x 20 x 1	13-5/8 x 19-5/8 x 3/4	300	0.07	1.94	356 x 508 x 25	5490	17.42
14 x 25 x 1	13-5/8 x 24-5/8 x 3/4	300	0.07	2.43	356 x 635 x 25	5490	17.42
14 x 30 x 1	13-5/8 x 29-5/8 x 3/4	300	0.07	2.91	356 x 762 x 25	5490	17.42
15 x 20 x 1	14-5/8 x 19-5/8 x 3/4	300	0.07	2.08	381 x 508 x 25	5490	17.42
15 x 30-5/8 x 1	14-5/8 x 30-1/4 x 3/4	300	0.07	3.19	381 x 778 x 25	5490	17.42
16 x 16 x 1	15-5/8 x 15-5/8 x 3/4	300	0.07	1.77	407 x 407 x 25	5490	17.42
16 x 20 x 1	15-5/8 x 19-5/8 x 3/4	300	0.07	2.22	407 x 508 x 25	5490	17.42
16 x 22-1/4 x 1	15-5/8 x 21-7/8 x 3/4	300	0.07	2.77	407 x 571 x 25	5490	17.42
16 x 25 x 1	15-5/8 x 24-5/8 x 3/4	300	0.07	2.47	407 x 635 x 25	5490	17.42
18 x 25 x 1	17-5/8 x 24-5/8 x 3/4	300	0.07	3.13	457 x 635 x 25	5490	17.42
19 x 27 x 1	18-5/8 x 26-5/8 x 3/4	300	0.07	3.56	483 x 686 x 25	5490	17.42
20 x 20 x 1	19-5/8 x 19-5/8 x 3/4	300	0.07	2.77	559 x 559 x 25	5490	17.42
20 x 25 x 1	19-5/8 x 24-5/8 x 3/4	300	0.07	3.47	508 x 635 x 25	5490	17.42
22 x 22 x 1	21-5/8 x 21-5/8 x 3/4	300	0.07	3.36	508 x 508 x 25	5490	17.42
24 x 24 x 1	23-5/8 x 23-5/8 x 3/4	300	0.07	4.00	610 x 610 x 25	5490	17.42
25 x 25 x 1	24-5/8 x 24-5/8 x 3/4	300	0.07	4.34	635 x 635 x 25	5490	17.42
8 x 30 x 1	7-5/8 x 29-5/8 x 3/4	300	0.07	1.66	203 x 762 x 25	5490	17.42
12 x 12 x 1	11-5/8 x 11-5/8 x 3/4	300	0.07	1.00	305 x 305 x 25	5490	17.42
12 x 16 x 1	11-5/8 x 15-5/8 x 3/4	300	0.07	1.33	305 x 407 x 25	5490	17.42
12 x 18 x 1	11-5/8 x 17-5/8 x 3/4	300	0.07	1.50	305 x 457 x 25	5490	17.42
12 x 36 x 1	11-5/8 x 35-5/8 x 3/4	300	0.07	3.00	305 x 914 x 25	5490	17.42
14 x 14 x 1	13 5/8 x 13 5/8 x 3/4	300	0.07	1.36	356 x 356 x 25	5490	17.42
14 x 18 x 1	13-5/8 x 17-5/8 x 3/4	300	0.07	1.75	356 x 457 x 25	5490	17.42
14 x 24 x 1	13-5/8 x 23-5/8 x 3/4	300	0.07	2.33	356 x 610 x 25	5490	17.42
15 x 25 x 1	14-5/8 x 24-5/8 x 3/4	300	0.07	2.60	381 x 635 x 25	5490	17.42
15 x 30 x 1	14-5/8 x 29-5/8 x 3/4	300	0.07	3.12	381 x 762 x 25	5490	17.42
16 x 18 x 1	15-5/8 x 17-5/8 x 3/4	300	0.07	2.00	407 x 457 x 25	5490	17.42
16 x 24 x 1	15-5/8 x 23-5/8 x 3/4	300	0.07	2.67	407 x 610 x 25	5490	17.42
16 x 30 x 1	15-5/8 x 29-5/8 x 3/4	300	0.07	3.33	407 x 762 x 25	5490	17.42
16 x 32 x 1	15-5/8 x 31-5/8 x 3/4	300	0.07	3.56	407 x 813 x 25	5490	17.42
16 x 36 x 1	15-5/8 x 35-5/8 x 3/4	300	0.07	4.00	407 x 914 x 25	5490	17.42
18 x 18 x 1	17-5/8 x 17-5/8 x 3/4	300	0.07	2.25	457 x 457 x 25	5490	17.42
18 x 20 x 1	17-5/8 x 19-5/8 x 3/4	300	0.07	2.50	457 x 508 x 25	5490	17.42
18 x 24 x 1	17-5/8 x 23-5/8 x 3/4	300	0.07	3.00	457 x 610 x 25	5490	17.42
18 x 30 x 1	17-5/8 x 29-5/8 x 3/4	300	0.07	3.75	457 x 762 x 25	5490	17.42

*Some sizes use one strut on the air entering and air leaving sides. Tolerances shall be +/- 1/8" for height and width & +/- 1/16" for depth.
Recommended final resistance is 0.50" in. w. g.

Glasfloss® Industries
Excellence in Air Filtration Since 1936

GDS Series
Fiberglass Double Strut Disposable Panel Filters

1" Performance Data - cont'd

SIZE W x H x D NOMINAL	SIZE W x H x D EXACT	RATED VELOCITY FPM	INITIAL RESIST. IN. W.G.	MEDIA SQUARE FOOT	SIZE W x H x D NOMINAL MM	RATED VELOCITY M/H	INITIAL RESIST. PASCALS
18 x 36 x 1	17-5/8 x 35-5/8 x 3/4	300	0.07	4.50	457 x 914 x 25	5490	17.42
20 x 22-1/4 x 1	19-5/8 x 21-7/8 x 3/4	300	0.07	3.09	508 x 565 x 25	5490	17.42
20 x 24 x 1	19-5/8 x 23-5/8 x 3/4	300	0.07	3.33	508 x 610 x 25	5490	17.42
20 x 30 x 1	19-5/8 x 29-5/8 x 3/4	300	0.07	4.17	508 x 762 x 25	5490	17.42
20 x 32 x 1	19-5/8 x 31-5/8 x 3/4	300	0.07	4.44	508 x 813 x 25	5490	17.42
20 x 36 x 1	19-5/8 x 35-5/8 x 3/4	300	0.07	5.00	508 x 914 x 25	5490	17.42
21 x 21 x 1	20-5/8 x 20-5/8 x 3/4	300	0.07	3.06	533 x 533 x 25	5490	17.42
21-1/2 x 21-1/2 x 1	21-1/8 x 21-1/8 x 3/4	300	0.07	3.21	546 x 564 x 25	5490	17.42
24 x 30 x 1	23-5/8 x 29-5/8 x 3/4	300	0.07	5.00	610 x 762 x 25	5490	17.42
24 x 36 x 1	23-5/8 x 35-5/8 x 3/4	300	0.07	6.00	610 x 914 x 25	5490	17.42
25 x 32 x 1	24-5/8 x 31-5/8 x 3/4	300	0.07	5.56	635 x 813 x 25	5490	17.42

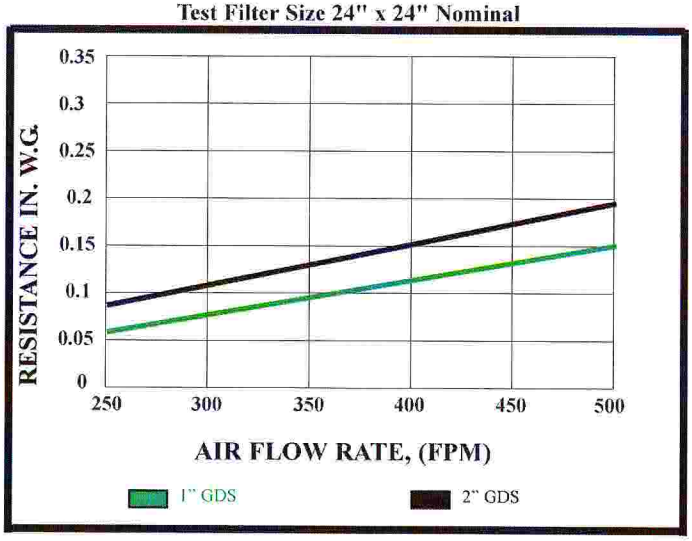
2" Performance Data

10 x 10 x 2	9-5/8 x 9-5/8 x 1-5/8	500	0.18	0.69	254 x 254 x 50	9150	44.78
10 x 20 x 2	9-5/8 x 19-5/8 x 1-5/8	500	0.18	1.38	254 x 508 x 50	9150	44.78
12 x 24 x 2	11-3/8 x 23-3/8 x 1-5/8	500	0.18	2.00	305 x 610 x 50	9150	44.78
14 x 20 x 2	13-5/8 x 19-5/8 x 1-5/8	500	0.18	1.94	356 x 508 x 50	9150	44.78
14 x 25 x 2	13-5/8 x 24-5/8 x 1-5/8	500	0.18	2.43	356 x 635 x 50	9150	44.78
15 x 20 x 2	14-5/8 x 19-5/8 x 1-5/8	500	0.18	2.08	381 x 508 x 50	9150	44.78
16 x 20 x 2	15-5/8 x 19-5/8 x 1-5/8	500	0.18	2.22	407 x 508 x 50	9150	44.78
16 x 24 x 2	15-5/8 x 23-5/8 x 1-5/8	500	0.18	2.67	407 x 610 x 50	9150	44.78
16 x 25 x 2	15-5/8 x 24-5/8 x 1-5/8	500	0.18	2.77	407 x 635 x 50	9150	44.78
18 x 24 x 2	17-5/8 x 23-5/8 x 1-5/8	500	0.18	3.00	457 x 610 x 50	9150	44.78
20 x 20 x 2	19-5/8 x 19-5/8 x 1-5/8	500	0.18	2.77	508 x 508 x 50	9150	44.78
20 x 24 x 2	19-3/8 x 23-3/8 x 1-5/8	500	0.18	3.33	508 x 610 x 50	9150	44.78
20 x 25 x 2	19-5/8 x 24-5/8 x 1-5/8	500	0.18	3.47	508 x 635 x 50	9150	44.78
24 x 24 x 2	23-3/8 x 23-3/8 x 1-5/8	500	0.18	4.00	610 x 610 x 50	9150	44.78
25 x 25 x 2	24-5/8 x 24-5/8 x 1-5/8	500	0.18	4.34	635 x 635 x 50	9150	44.78

*Some sizes use one strut on the air entering and air leaving sides. Tolerances shall be +/- 1/8" for height and width & +/- 1/16" for depth.
Recommended final resistance is 0.50" in. w. g.

STANDARD PRESSURE DROP

Test Filter Size 24" x 24" Nominal



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Glasfloss® Industries
Excellence in Air Filtration Since 1936

GDS Series
Fiberglass Double Strut Disposable Panel Filters

SPECIFICATIONS FOR GDS FILTERS

The standard size filter element shall be constructed of a heavy-duty, one piece craftboard frame. All corners shall be closed and sealed. The fiberglass filter media shall be coated with a non-toxic, non-flammable, odor free adhesive. The fiberglass media shall be constructed in a progressively dense fashion from air entering to air leaving side. The fiberglass media shall have a skin backing on the air entering and air leaving side. The media and reinforced strut retainers shall be glued and sealed inside a heavy-duty, craftboard frame. The GDS disposable panel filter shall be rated to withstand temperatures of 180 degrees Fahrenheit. All filters shall be rated Class 2 under U.L. std. 900

Distributed by:

National Air Filtration Association

HARDI
HEATING, AIR CONDITIONING & REFRIGERATION DISTRIBUTORS INTERNATIONAL

UL

"Serving You With Locations Throughout The Nation"

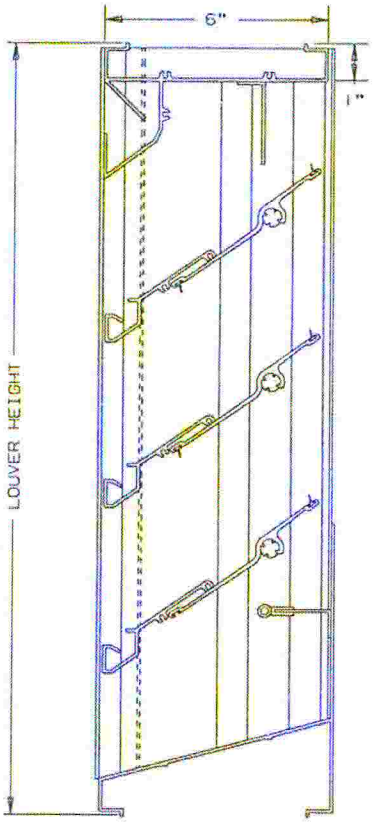
INLET LOUVERS

ARROW

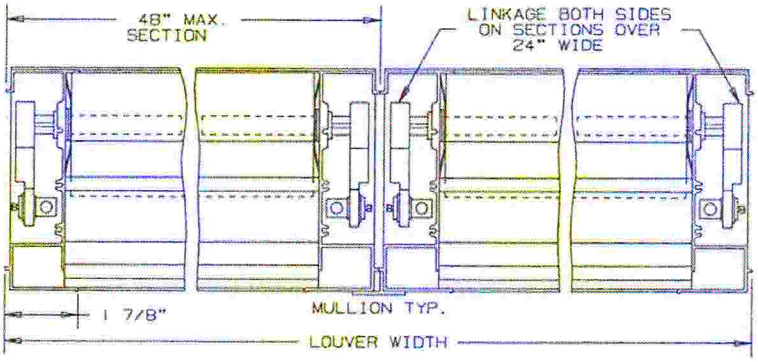
EXTRUDED ALUMINUM LOUVERS
COMBINATION ADJUSTABLE AND STATIONARY DRAIN
6" DEEP

TYPE EA-680-D

DRAIN LOUVER - 35° STATIONARY BLADES



NOT TO SCALE

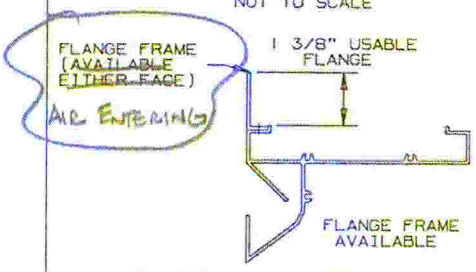


SPECIFICATIONS

FRAME AND STATIONARY BLADE: EXTRUDED ALUMINUM 6063-T6/T52 ALLOY, FRAME IS .080" THK., BLADE IS .080" THK. ON 4 1/2" CENTERS.
ADJUSTABLE BLADE: EXTRUDED ALUMINUM 6063-T6/T52 ALLOY, .125" THK.
FACE OF LOUVER: FULL WIDTH SILL WITH HEAD AND BLADES CONTAINED WITHIN THE JAMBS.
LINKAGE: EXTRUDED ALUMINUM, CONCEALED IN CHANNEL OUT OF AIRSTREAM. PIVOTS ARE .050" DIA. MACHINED STEEL, CADMIUM PLATED AND CHROMATE TREATED. PIVOTS ROTATE IN A CELCON BEARING. A .312" DIA. ALUMINUM LINKAGE ROD IS LOCKED TO THE PIVOT BY A 1/4-20 SET SCREW WITH AN EPOXY LOCKING PATCH.
SHAFTS: .50" DIA. ALUMINUM "PIN-LOCK" ROD.
SEALS: EXTRUDED SILICONE RUBBER SEAL AT BLADE EDGE. STAINLESS STEEL AT JAMB.
SCREENS: WHEN INDICATED, IN A REMOVABLE FRAME.
BIRD SCREEN - 1/2" FLATTENED ALUMINUM, .051" THK.
OR - 1/2" SQ. MESH, INTERMEDIATE DOUBLE-CRIMPED ALUMINUM WIRE, .063 DIA.
OR - 18/16 MESH, .011" DIA. ALUMINUM WIRE, INSECT SCREEN.
FINISH: MILL.
LOUVER SIZES: 12" x 12" MINIMUM PANEL SIZE.
48" x 96" MAXIMUM PANEL SIZE.

LOUVER PERFORMANCE STATEMENT

LOUVER MODEL EA-680-D SHALL BE FABRICATED TO PROVIDE A MINIMUM OF (52%), 8.24 SQUARE FEET OF FREE AREA FOR A 48" x 48" SIZE LOUVER AND BEAR THE AMCA CERTIFIED RATINGS PROGRAM SEAL FOR AIR PERFORMANCE AND WATER PENETRATION. THE RATINGS SHALL SHOW A BEGINNING POINT OF WATER PENETRATION AT .01 OUNCES PER SQUARE FOOT OF FREE AREA AT A FREE AREA VELOCITY OF 1029 FEET PER MINUTE, (8479) CUBIC FEET PER MINUTE, WITH A .11 INCHES WATER GAUGE PRESSURE DROP FOR AIR INTAKE.



FLANGE FRAME AVAILABLE

OPTIONAL
- OTHER SCREENS
- ARCHITECTURAL FINISHES
- ACTUATORS (ELECTRIC, PNEUMATIC, MANUAL, ETC.)

FOR CERTIFIED RATINGS AUTHORIZED BY AMCA - SEE REVERSE SIDE

NOMINAL DEDUCTIONS WILL BE MADE TO THE OPENING SIZE GIVEN.

ITEM	QTY.	OPENING SIZE WIDTH	OPENING SIZE HEIGHT	LOUVER SIZE WIDTH	LOUVER SIZE HEIGHT	MULL	SCREENS TYPE	SCREENS LOC
1	12	48	48					

UNION MADE

ARROW UNITED INDUSTRIES
A DIVISION OF MESTEK, INC.
314 RIVERSIDE DRIVE
WYALUSING, PA 18853
TEL: (570)746-1888 FAX: (570)746-9286

AGENT: _____

ARCH./ENG.:
CONTR.:
PROJECT:
EDR: ECN: JOB:
DATE: DWN.: DWG.:

LOUVER MODEL EA-680-D

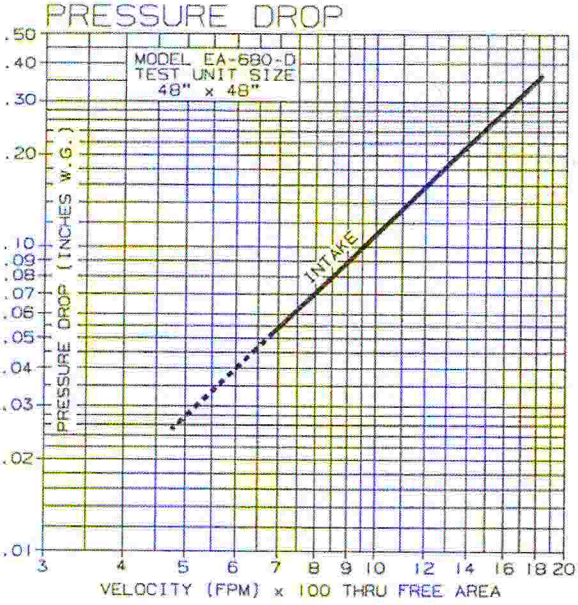
DRAIN LOUVERS

EXTRUDED ALUMINUM - COMBINATION ADJUSTABLE

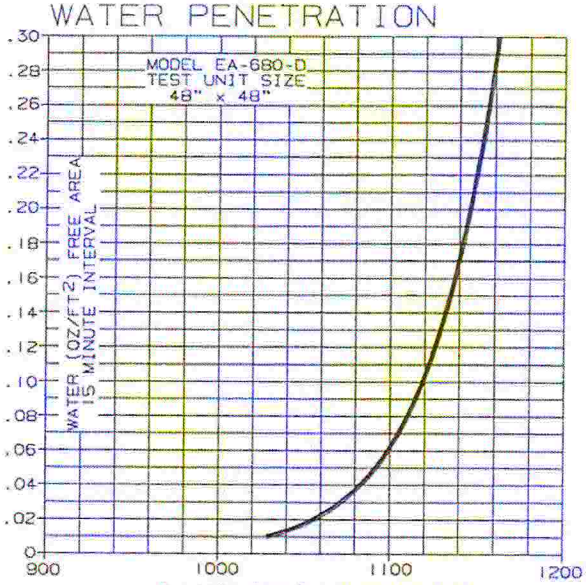
PERFORMANCE DATA

RATINGS DO NOT INCLUDE EFFECTS OF BIROSCREEN.

PRESSURE DROP



WATER PENETRATION



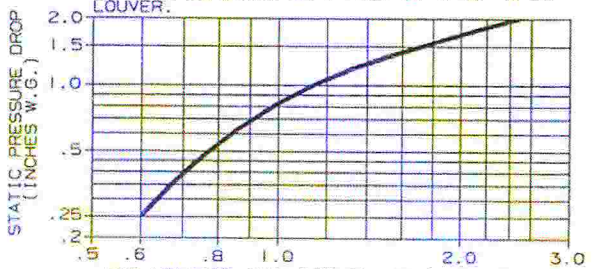
1029 (FPM) BEGINNING OF WATER PENETRATION

FREE AREA

FREE AREA (SQ. FT.)							
HEIGHT \ WIDTH	12"	18"	24"	30"	36"	42"	48"
12"	.14	.24	.34	.45	.55	.65	.76
24"	.64	1.12	1.60	2.08	2.55	3.03	3.51
36"	1.00	1.76	2.51	3.26	4.02	4.77	5.52
48"	1.50	2.62	3.74	4.87	5.99	7.11	8.24
60"	2.00	3.50	4.99	6.49	7.99	9.49	10.99
72"	2.36	4.14	5.91	7.68	9.45	11.23	13.00
84"	2.86	5.00	7.14	9.28	11.42	13.57	15.71
96"	3.36	5.87	8.39	10.91	13.43	15.94	18.46

AIR LEAKAGE (LOUVER INSTALLATION POSITION, INTAKE) IS PER AMCA STANDARD 500 PROCEDURE FIG. 5.5.

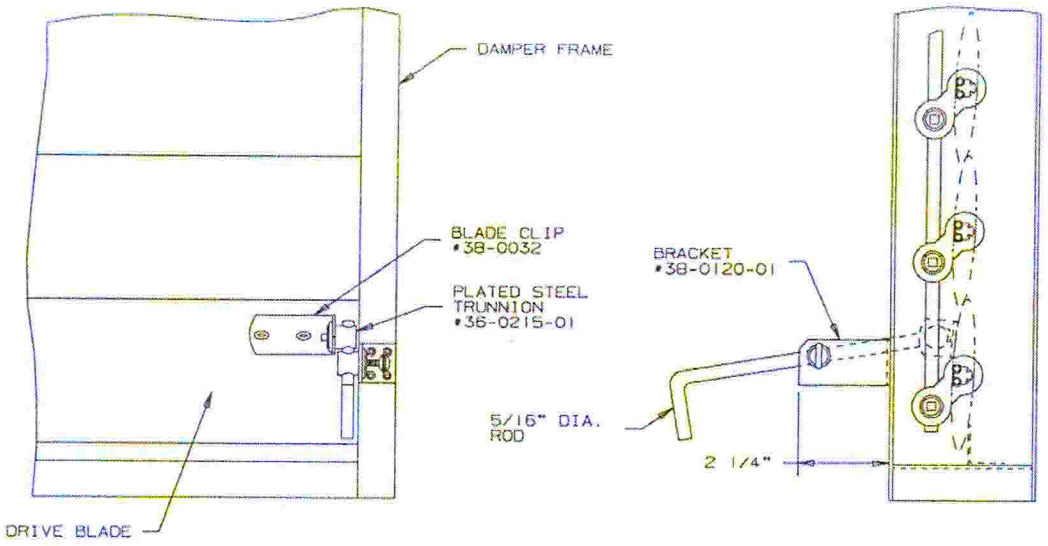
AIR LEAKAGE WITH ADJUSTABLE BLADE IN CLOSED POSITION WITH A SEATING TORQUE OF 6.25 IN.LB./SQ. FT. OF LOUVER FACE AREA. LEAKAGE IS BASED ON A TEST OF A 48" x 48" LOUVER.



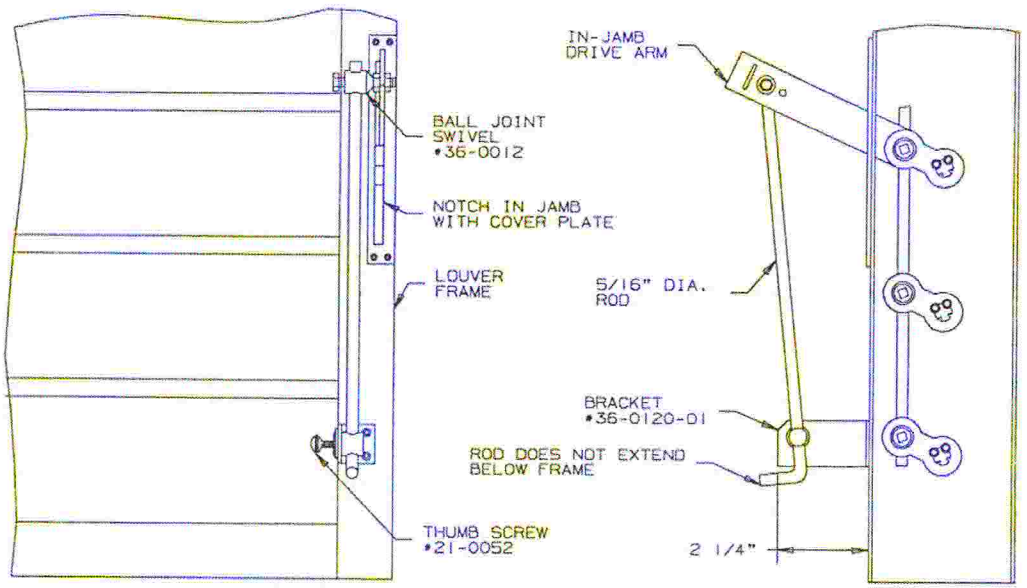
amca CERTIFIED RATINGS
WATER
AIR PERFORMANCE
AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

ARROW UNITED INDUSTRIES CERTIFIES THAT THE MODEL EA-680-D LOUVER SHOWN HEREIN IS LICENSED TO BEAR THE AMCA SEAL. THE RATINGS SHOWN ARE BASED ON TESTS AND PROCEDURES PERFORMED IN ACCORDANCE WITH AMCA PUBLICATION 511 AND COMPLY WITH THE REQUIREMENTS OF THE AMCA CERTIFIED RATINGS PROGRAM.

THE AMCA CERTIFIED RATINGS SEAL APPLIES TO AIR PERFORMANCE RATINGS AND WATER PENETRATION RATINGS.



TYPICAL WING SCREW OPERATOR CONNECTED TO BLADE



TYPICAL WING SCREW OPERATOR CONNECTED TO BLADE SHAFT

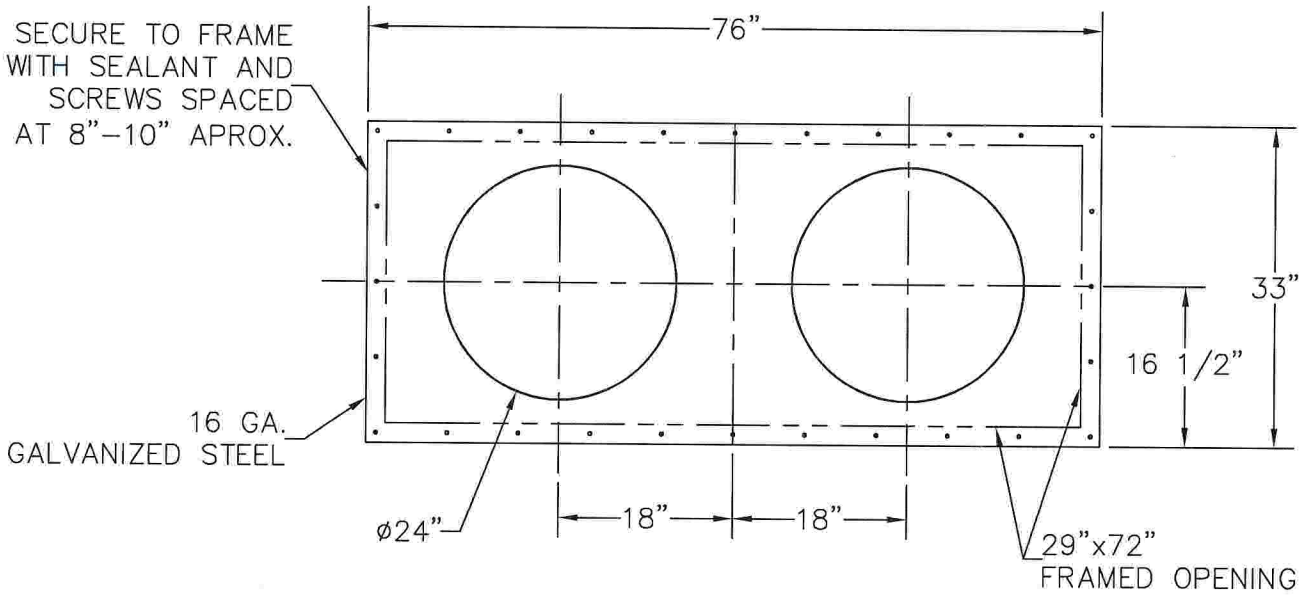
ARROW UNITED INDUSTRIES
A DIVISION OF MESTEK, INC.
314 RIVERSIDE DRIVE
WYALUSING, PA 18853
TEL: (717)746-1888 FAX: (717)746-9286

AGENT: _____

INSTALLATION, O-13 WING SCREW OPERATOR

781-C-1998

BUILDING TRANSITIONS



NO.	REVISION	BY	DATE

PROJECT

PROJ. NO. E-05-048

P.O. NO.

DRAWN BY	JB
DESIGN BY	BB
CHKD. BY	BB
DATE	7/15/05
SCALE	NTS

TIGG corporation

OUTLET TRANSITION

DWG. NO. C05-1044

REV. 0