The Great Lakes Construction Co.

TRANSMITTAL
No. 162

10737 Medallion Drive
Cincinnati, Ohio 45241

PROJECT: ODOT 150085 HAM 71-1.34

DATE: June 15, 2017

TO: ODOT District 8
505 South SR 741
Lebanon, OH 45036

REF: TVS Axial Fans & Silencer User Manual R-01

ATTN: Marvin Lennon

WE ARE SENDING		SUBMITTED FOR:		ACTION TAKEN:	
	Shop Drawings		Approval		Approved as Submitted
	Letter		Your Use		Approved as Needed
	Prints		As Requested		Returned after Loan
	Change Order	X	Review and Comment		Resubmit
	Plans			X	Submit
	Samples	**SENT VIA:**			Returned
	Specifications	X	Attached		Returned for Correction
X	Other: Submittals per Plan Notes		Separate Cover:		Due Date: 6/22/2017

SUBMITTAL	COPIES	DATE	DESCRIPTION
TVS Axial Fans & Silencer User Manual	1pdf	6/15/2017	TVS Axial Fans & Silencer User Manual R-01

REMARKS: This TVS Axial Fans & Silencer User Manual R-01 submittal provides information per plansheet 348/555 and 363/555.

Plan Notes do not include a review/approval timeframe. We are requesting to have the review of submittal completed by 6/22/17.

Signed:

Ryan W. Jones, P.E.

Service Manual for the Installation, Operation and Maintenance of

ODOT-I-71 Lytle Tunnel
Cincinnati, OH
Customer PO # LT-102
Clarage Contract # 710889

Service Manual for the Installation,
Operation, and Maintenance of

ODOT-I71 Lytle Tunnel
Cincinnati, OH
Customer Purchase Order # LT-102
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Table of Contents

Section 1

Clarage Axial Fan Manual

Section 1.1
INTRODUCTION

These instructions are intended to provide information to describe the fan, to maintain the fan, and to be able to make most repairs during the service life of the fan. This manual contains work safety instructions, instructions for receipt, transport, assembly and installation of fans, operating information, instructions for maintenance, repair and storage, information on how to dismantle the fan.

Adherence to these instructions is necessary for safe, reliable and economical operation of the fan. People appointed to operate and perform the maintenance of the fan (hereinafter referred to as operating personnel), should familiarize themselves with these instructions and all regulations and standards relating to the operation of the fan, especially safety regulations. The fan can best be operated, cleaned, maintained and repaired by qualified and trained persons according to the instructions herein. Each fan is equipped with the name plate indicating important information regarding your equipment. Record this data and retain with your maintenance records.

Section 1.2
MANNER OF USE

The ATVCR range of fans is intended for ventilation of underground tunnels. Fans of this type are usually installed in a central location and connected to the tunnel system via metal or concrete ducts. For alternative uses, we recommend that you consult with the fan manufacturer. Fans are designed to be reversible by reversing rotation of the impeller such that air may be exhausted from or supplied to the tunnels.

Provided the motor does not become coated with dirt, dust, or other solid matter to restrict surface cooling, the carcass temperature will never exceed 80°F when operating in the ambient temperature of 40°F. Fans are designed to continue operating for a minimum of one hour when ambient temperatures rise up to 482 deg F as in the case of (perhaps) a fire in the tunnel. After a "temperature event" it is necessary to replace all critical components and complete a thorough inspection of the entire fan.

Section 1.3
DESCRIPTION

HORIZONTAL tunnel Ventilation fans are designed to operate at ONE speed and in the FORWARD and REVERSE directions. The impeller has manually adjustable blades set at a pitch angle to provide air performance as per the factory test data. The blades are made from a special forged aluminum. The impeller hub is forged steel.
Fans are direct driven Arr. 4 type with the fan impeller directly mounted on the motor shaft. Changes in the fan operating curve can be made by changing the angle of each impeller blade. This can be done when the fan is not operating. There are different methods used to secure the impeller to the shaft depending on the specific project requirements.

The motor impeller assembly is mounted inside the circular fan housing. The fan may be connected to ductwork at one or both ends. Accessory equipment such as silencers, dampers etc. may be connected to the duct system. Refer to the general arrangement drawing for identification of parts. Power wiring from the electric motor is brought to the exterior of the fan and terminated in an enclosed terminal box. Any required instrumentation such as vibration monitors, temperature sensors and flow switches are terminated in a separate terminal box on the exterior of the fan casing.

Bolted access doors are provided for internal access to the motor and fan impeller. In some cases the fan casing may be split horizontally to allow for easy removal of the electric motor. The ends of the fan casing may be supplied with flange or slip fit connections. Check the project drawing to determine which type applies in this case.

Section 1.4
SAFETY

For the protection of personnel, the data in the Operation and Maintenance manual must be read and understood before proceeding with handling, installation, operation or servicing of the equipment under this contract. All local safety codes, standards and regulations must be observed during the handling, installation or operation of the equipment supplied under this contract.

All safety devices including guards, screens, disconnect switches etc. must be in place and functioning before equipment is energized. All power must be disconnected or locked out (preferably both) while handling, installing or performing maintenance or inspection on these fans and associated equipment.

The electrical installation must be executed by a licensed contractor and in accordance with all government or site regulations and standards for the given location and according to the instructions of manufacturers of individual electric motors and instrumentation. It is recommended that the connection of vibration sensors and their interconnection with monitoring systems should be completed by a Clarage field service representative, or, area service specialist under Clarage supervision.

The fan equipment must not be operated until it has been properly installed as described in the Operation and Maintenance Manual and associated drawings nor should it be operated except in strict accordance with the above safety precautions.

Warning ! When the fan is in operation, take great care when entering the proximity of the suction or delivery side of the fan. Do not wear loose clothing and be conscious of scarves, hats, ties, long hair and other items that could be drawn into the fan.

Section 1.5
SUPPLY, TRANSPORT, RECEIPT, HANDLING, STORAGE

Supply
The extent of the supply is limited to the approved contract documents. All documentation is to be supplied as per the contract agreements.

Transport
All Clarage products are carefully constructed and inspected before shipment to ensure the highest standards of quality and performance.

Receipt
The reception shall be carried out in consent with the contract (agreement) between the supplier and customer. Compare all components with the bill of lading or packing list to verify that the proper unit was received. Check each unit for any damage that may have occurred in transit. Any damage should be reported immediately to the carrier and the necessary damage report filed.

Handling
Handling of all air handling equipment should be conducted by trained personnel and should be consistent with safe handling practices. Verify the lift capacity and operating condition of handling equipment. Maintain handling equipment to avoid serious personal injury.

Units shipped completely assembled may be lifted with slings and spreader bars cables or nylon straps Lift the fan in a fashion that protects the fan and fan coating from damage. Never lift a fan by the inlet or discharge flange, shafting or drives, wheel or impeller, motor or motor base, or in any other manner that may bend or distort parts. The lifting lugs on the top of the casing are for split removal only! They will not support the entire fan assembly. The assembly must be lifted from underneath the fan base.

Storage
If fan installation is to be delayed, store the unit in a protected area. Protect the fan and motor from moisture and vibration (or shock loading). For extended storage, wrap the entire unit in plastic. Extended storage requires monthly inspections. Check for corrosion or damage to the unit and for debris within the fan. Rotate the fan wheel a few revolutions to ensure brinelling of the motor bearings will not occur. Stop the wheel in a position other than the initial position. Grease motor bearings monthly with the grease recommended for these bearings.

If the fan is to be stored or installed more than three (3) months after delivery, take the following actions prior to start up:

a) The fan shaft and motor shaft shall be rotated a minimum of sixty revolutions at least once a month with the shaft resting position different from the previous position.
b) Bearings and motor should be checked for proper lubrication during this process and grease or oil added as required.
c) Motor storage per the manufacturer's instructions. Should include care in keeping the motor dry (space heaters should be used if necessary).

NOTE: Ensure proper supply power is connected to any two motor windings for moisture elimination the windings. This method simulates the Winding Heater. It is the responsibility of the Contractor to energize these windings during motor storage.

d) Where the fan has been installed on anti vibration mountings but will not be run for some time, the mountings must be leveled and unlocked.
e) Keep a record of maintenance and any damage. Investigate the cause of any damage and immediately make repairs.
f) It is recommended that any fan stored for any length of time in excess of 12 months be inspected again by a TCF Clarage representative before start-up. Fans stored more than 2 years may require new bearings.

Section 1.6
INSTALLATION

Mechanical

The ATVCR tunnel fan is supplied completely assembled and is tested at the factory, in dry conditions unless otherwise stated. For horizontal mounting a structural base is supplied under the fan. See General Arrangement drawing for the specific layout. The fan may be hard bolted to the foundation or mounted on vibration isolators. In either case, the fan should be installed on a flat, level, rigid concrete foundation pad. Normally, it is required that mass of foundation be at least three times the mass of the fan. This can be reduced if vibration isolators are used.

Anchor bolts should be installed in the concrete and be long enough for nuts, washers, shims and threads for draw-down. Each bolt should be placed in a sleeve or pipe with a diameter larger than the bolt to allow for adjustment. When the mounting surface of the fan and base do not match, shim or make allowance for grouting. Do not distort the fan when tightening the anchor bolts. For vertical mounting, the fan is usually supported from an end flange or a structural support ring around the fan casing. It is most common to have the fan positioned over an opening in the floor. Most of the above horizontal-related comments apply equally to a vertically mounted fan.

Electrical
The wiring connection must be made in accordance with that indicated in the Approved Fan Data Package. The direction of rotation is marked on the casing to comply with the form of running required. Three phase motors require a trial connection to the supply; if the direction of rotation is incorrect, interchange any two phases of the 3-phase supply.

Section 1.7
COMMISSIONING / START-UP

Pre-start
1. A TCF Clarage engineer or an appointed agent should carry out pre- commissioning inspections.
2. Ensure that no tools, pieces of wood, etc. are left in the fan casing or ductwork.
3. Check freedom of rotation of shaft assembly.
4. Check security of all safety guards.

Groundwork
The fan must be earthed in accordance with the requirements of the local supply authority or code of practice. Use of the ground lugs supplied in the main conduit box is recommended.

Conduit
Wiring should be in accordance with the local regulations or code of practice.

Starting
Starting of the fan may be carried out manually or automatically. The number of starts in a given time is determined by contract requirements, and fan(s) will be in accordance with contract documents.
NOTE: After a few hours running; shut down, isolate supplies, check security of guards and major fasteners, etc.

Operation
Fans are capable of operating continuously, but depending on the local conditions, their use may be infrequent. Generally, there is some slow movement of the impeller due to pressure changes in the tunnel caused by traffic movement. This is normal and is a benefit to the fan. No action should be taken to prevent this rotation. Fan is capable of starting in either direction regardless of the direction of the induced rotation.

Since the fans are primarily intended for use in an emergency it is possible that they may not be operated for an extended period. It is recommended that fans be operated for at least 30 mins in each direction once per month. During this operation, the instrumentation should be checked to ensure it is operating satisfactorily.

Section 1.8
MAINTENANCE

Routine Maintenance
After three months, and thereafter as experience dictates, the fan should be inspected to ensure that there is no build-up of dirt or other matter that would cause overheating of the motor or obstruct the impeller track. Fan internals should be visually inspected at least once per month. Cleaning can be done with air or, preferably with a soft brush and vacuum. All connections and fastenings – bolts, clamps etc should be checked to ensure nothing is loose.

The component requiring most maintenance is the electric motor. Please see separate section for motor vendor recommendations regarding maintenance. Regular greasing of the electric motor according to the service interval recommended by the motor supplier should be followed for optimal motor performance. It is important that the noted weight should be applied and **not more.** Over-greasing of the motor can lead to impaired motor function and other problems. The fan is supplied with extended lubrication lines. It is important that not to continue to input grease even if no grease is coming out from the relief line. Be careful to use only grease approved for use at high temperature and do not mix with other types of grease.

In addition:

1. Check for undue vibration. If present, stop the fan at the earliest opportunity, check impeller for any dirt build-up on the blades, and clean as necessary.
2. Check clearances of impeller, level of shaft, and general alignment.

Adjust as necessary.

3. Check all bolts for tightness.
4. Refer to motor manufacturer's maintenance instructions and act accordingly.
5. Grease-lubricated bearing should be cleaned out and grease renewed BI- annually.

Torque Loading - All bolt/nut assemblies should be tightened to the specified torque as shown in the table below.

TORQUE TABLE

Material =>	Steel 8.8 Fe/Zn		Steel A4-80	Steel Grade 2
Type of Lubrication =>	Dry	Oil/MeS2	Oil/MoS2	Dry
Dimension	Torque Ft.-Lbf(Nm)		Torque Ft.-Lbf(Nm)	Torque Ft.-Lbf(Nm)
¼"/M6	7 (9.4)	6 (84)	57 (78)	3.7 (5)
5/16" / M8	21 (28)	19 (26)	14 (19)	8.1 (11)
3/8" / M10	41 (55)	37 (50)	27 (37)	14 (19)
½" / M12	70 (95)	64 (87)	47 (64)	35 (48)
5/8" / M16	170 (230)	156 (211)	116 (157)	66 (90)
¾" / M20	332 (450)	302 (410)	226 (306)	140 (190)
1" / M24	575 (780)	523 (710)	391 (530)	295 (400)

Blade Bolts, torque value = 200 ft-lbs

Blade Angle Adjustment

The performance point of the fan can be changed by adjusting the angle of the blades individually. Access for angle adjustment is through the access door located on the casing. If additional space is required for this process, the upper section of the fan casing can be removed. Once access is obtained the four bolts retaining the blade base can be loosened (about two turns) until the blade can be turned by hand. Once the new angle has been set against the hub marking (higher or lower) the bolts must be re- tightened to the correct torque setting – see table above. This process is repeated until all blades have been set to the new angle. The angle is defined as the cord of the blade referenced to a line perpendicular with the axis of the motor.

Once all blades have been set the tip clearance should be checked. Nominal clearance for this impeller according to drawing is 0.134" @ 70°F. The clearance of one blade should be checked at minimum four points on the casing. Once the closest point has been found all blades should be checked at that point with the minimum clearance allowed being 0.134" at 70°F.

Impeller Removal and Installation

Before the impeller is removed from the motor shaft it is important that correlation marks are made on mating components. This is accomplished with a standard marker tool. Motor and impeller positions should be marked or measured and recorded. This will ensure that refitting of the components will be exactly as originally supplied and will retain the balance readings.

Warning! Only technicians authorized by TCF Clarage should carry out removal of the impeller blades form the hub. Unauthorized blade or impeller removal will invalidate the warranty on the unit. TCF Clarage Technicians can be reached at 763-551-7500.

Horizontal unit

1. Remove the nose cone spinning by unscrewing the self-tapping screws on the perimeter.
2. Remove Locking Collar as described in Appendix A.
3. Remove the four allen screws (5/8"—11 UNC) on one of blades. Remove the blade.
4. Use the opening in the impeller hub to insert the lifting strap and hook. Using a suitable backing plate with a central eye bolt, connect the eyebolt to the lift hook. The impeller weighs 838 pounds. Do NOT simply strap through the opening.

Vertical Unit

1. One person should enter the access door in the upper transition and stand directly on the fan blades (blades are capable of supporting 300 pounds).
2. Remove the nose cone spinning by unscrewing the self-tapping screws on the perimeter.
3. Secure 3 straps around 3 blades equally spaced around the hub.
4. Connect the straps to an overhead hoist or chain fall and place the straps under light tension.
5. Remove Locking Collar as described in Appendix A.

Locking Collar Removal

The attached page states the directions for the installation and removal of the locking collar. Carefully slide the impeller assembly off of the motor shaft and place it on prepared blocks or a mandrel.

Impeller refitting

1. Ensure that the motor shaft and impeller bore are clean and free from burrs.
2. Lightly oil the motor shaft and position the impeller on the shaft. The shaft must take the impeller weight at this stage.
3. Slide the impeller over the shaft.
4. Tighten the locking collar screws to fix hub in place, as per the locking collar instructions.

Motor Removal and Installation

1. **NOTE:** Ensure that all safety procedures are followed – specifically locking out the equipment electrically.
2. Remove the fan assembly top half from the ductwork system and relocate it in a safe area.
3. Using suitable blocks (timber not steel) fix the impeller to avoid it turning utilizing the eyelets and strap provided.
4. Remove the impeller in accordance with the previous section.
5. Remove the grease lubrication pipes.

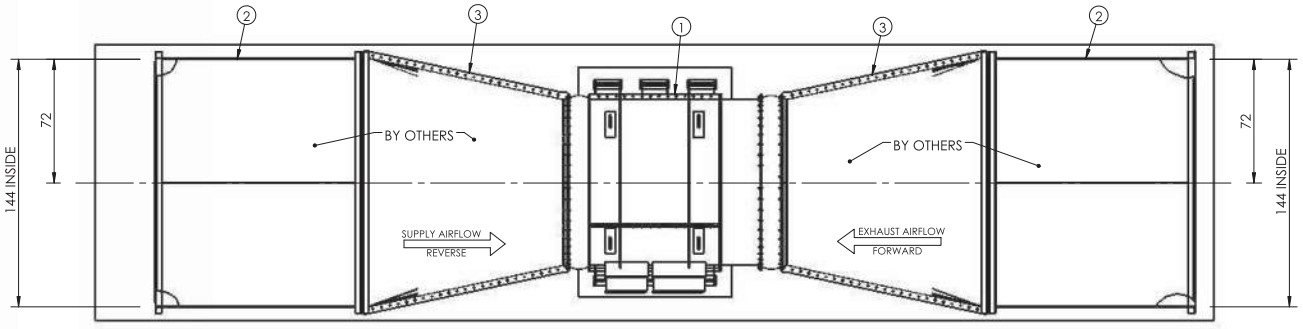
6. Remove the bolts retaining both the terminal and auxiliary box lids, and remove them.
7. Notice the wiring connections to enable refitting in the correct location (main power, thermocouples, vibration sensors, and speed sensor). Take notes during disassembly to indicate correct connection for reassembly.
8. Disconnect the wiring.
9. Remove both terminal boxes from the fan casing by removing the fixing screws. (Note: The terminal strips should also be removed with the box.)
10. With the terminal box removed, the conduit locking nut can be seen. Remove this nut.
11. By using a pipe grip, the conduit can be removed.
12. Remove the conduit, taking care not to damage the cables passing through it.
13. The motor is now ready for removal.
14. Support the motor using timber, lifting equipment, or fork truck as available.
15. Mark the motor to enable the unit to be re-assembled in the same position, then remove the mounting bolts, taking care to retain any packing. (note where this was fitted for re-assembly).
16. Remove the motor from the duct.
17. Re-assembly is reverse of above, making sure all fixings are tightened as specified in torque table.
18. All fixings should be retained and re-used unless damages during dismantling. If damaged, they must be replaced.
19. Before commissioning, fan back into service, check to make sure that the impellers rotates freely in both directions. Also check that when the fan is energized, fan rotation is correct (see arrow on fan casing. If rotation is wrong, change phases.

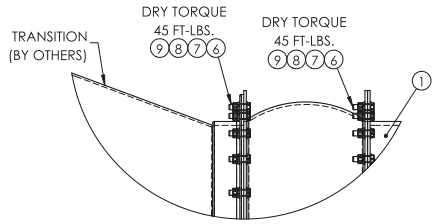
Tools Required

1. Standard socket set, 1/2" drive.
2. Philips and common screw driver set.
3. Raw hide or rubber mallet
4. Large and small pry bar.
5. Standard grease gun.
6. ½" drive 250 ft-lb torque wrench

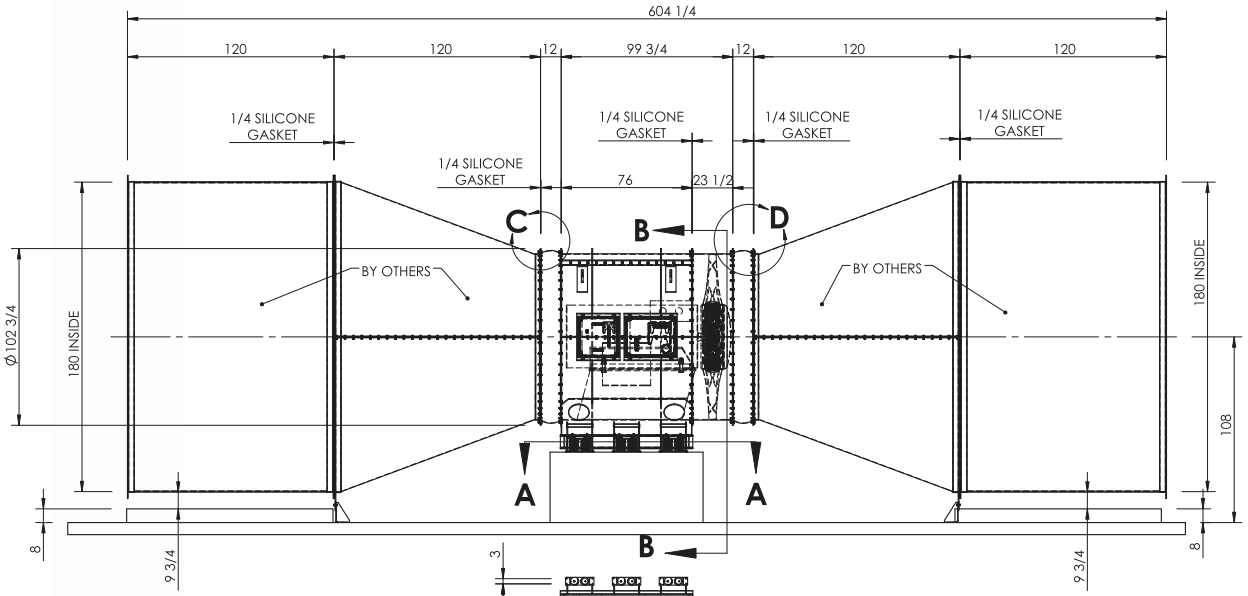
Section 2

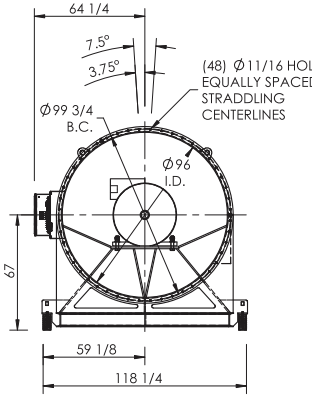
General Arrangement Drawings

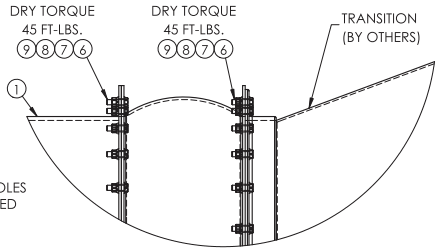




DETAIL C
SCALE 1 : 12

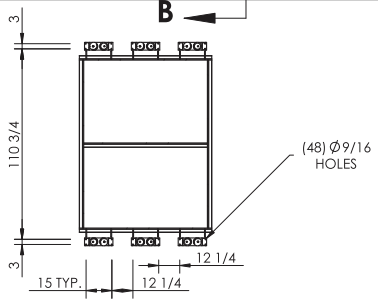






DETAIL D
SCALE 1 : 12

SECTION B-B



SECTION A-A

COST CATEGORY: -

COST CATEGORY: -

CUSTOMER: DEBRA-KUEMPEL

USER: ODOT-I-71 LYTLE TUNNEL

DRAWING TITLE: GENERAL ARRANGEMENT FOR ATVCR 24THC2N AXIAL FAN FAN TAG # TV-F2

NO.	BY	DATE	REVISIONS
A	PS	8/31/15	ORIGINAL ISSUE
B	FK	10/8/15	TRANSITION WERE REMOVED
C	RH	12/3/15	ADDED COMPONENTS AND DETAILS
D	GC	2/15/16	REMOVED SQUARE FLEX, INSTALLED ROUND FLEX

NO.	BY	DATE	REVISIONS

-	FIT-UP	-	
-	WELD	-	
-	FINISH	-	
-	DO NOT SCALE DWG.		
-	UNLESS OTHERWISE SPECIFIED DIMENSIONS AR IN INCH S TOL RANC S		
REF. DWG.	TC CLARAGE, INC. STD.		

DRAWN BY	PS	DATE	8/3/15
CHECKED BY	-	DATE	-
APPROVED BY	-	DATE	-
APPROVED BY	-	DATE	-

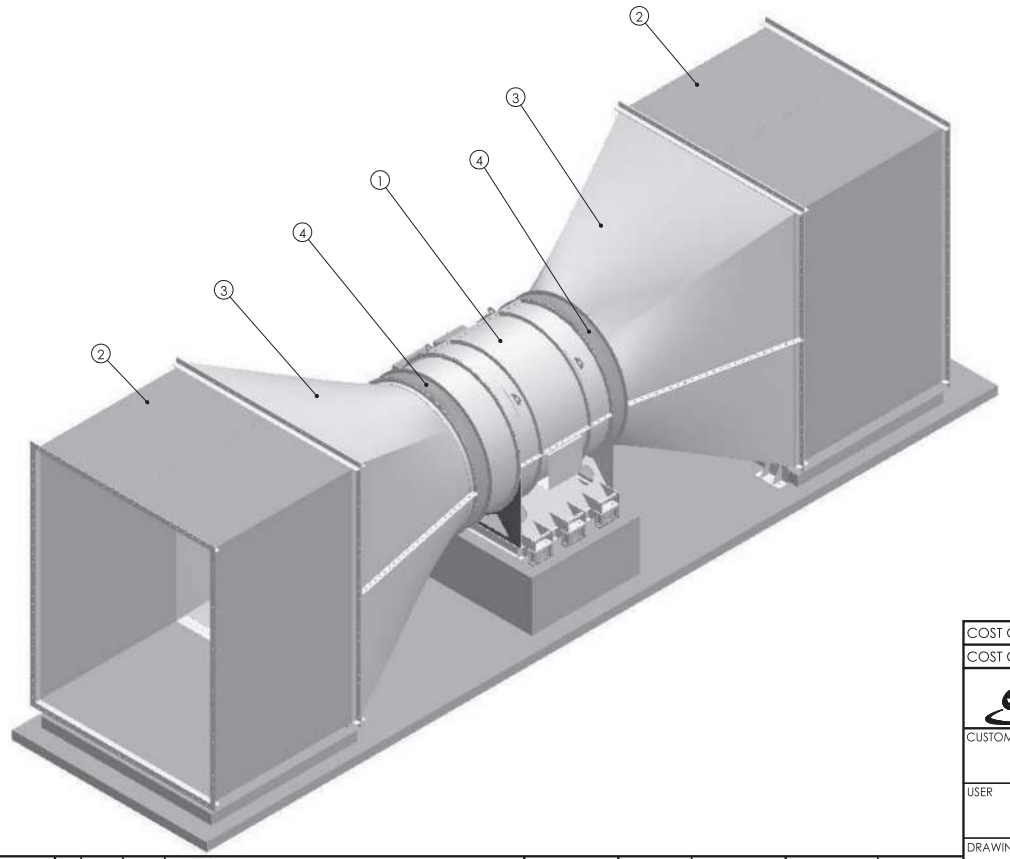
SCALE: 1:72 | DRAWING NUMBER: B710889F01 | REV.: D

WORK ORDER NUMBER: 710889-1-2 | SHEET 1 OF 2

NOTES:

1. ONE (1) FAN ASSEMBLIES REQUIRED AS SHOWN. (F1 ARRANGEMENT)
2. EXPANSION JOINTS MUST BE PROVIDED AT FAN INLET AND OUTLET WHERE DUCT OR BREECHI G MAY CAUSE EXPA SION STRESSES OR VIBRATIONS.
3. FAN AND ASSOCIATED DUCT WORK MUST BE LEVELED AND PROPERLY ANCHORED DURI G I STALLATION - TAKI G GREAT CARE OT HAVE THE EQUIPME T TWISTED OR IN A BIND.
4. BEARINGS TO BE LUBRICATED WITH GREASE PER MOTOR MANUFACTURER REQUIREMENTS PRIOR TO STARTI G THE FA .
5. MOTOR MODIFICATION SPECIFIC FOR CONTRACT REQUIRED SENSORS.
6. FAN AND DUCT WORK TO BE PAINTED AS FOLLOWS: AMERON PAI T SYSTEM 370 A D TOP COAT 450H SAFETY BLUE.
7. IMPELLER HUB AND SPINNER TO BE PAINTED SAME COLOR AS FAN HOUSING/BLADES NOT TO BE PAI TED.
8. ALL MACHINED SURFACES TO BE COATED WITH ANTI-RUST COMPOUND.
9. IMPELLER IS DESIGNED FOR MAXIMUM SPEED OF 1200 RPM, MAXIMUM TEMP 482 °F 250 °C FOR 1 HOUR. IMPELLER ATTACHED TO THE MOTOR SHAFT VIA B-LOCK MECHA ISM. FOLLOW ALL MA UFACTURERS I STRUCTIONS FOR I STALLATION.
10. ADEQUATE CONCRETE MASS AND STIFNESS MUST BE SUPPLIED UNDER THE FAN TO A HORIZONTAL STIFF ESS OF AT LEAST 4,000,000 LBS/I .
11. BEFORE OPERATING FAN, ALL CONNECTIONS HARDWARE AND SENSORS MUST BE IN PROPER OPERATIONAL ORDER.
12. HIGH TEMPERATURE CAULK TO BE APPLIED BETWEEN SPLIT FLANGES ON FAN HOUSINGS.
13. FAN TAG #(S) TO BE TV-F2
14. IMPELLER TO BE MARKED PER IN ACCORDANCE WITH CLARAGE ITP.
15. THIS EQUIPMENT SHALL BE SHIPPED WITH SHIPPING BRACES AND/OR CLAMPS. THESE ITEMS ARE PAI TED RED A D MUST BE REMOVED PRIOR TO OPERATION OF EQUIPME T.
16. PERFORMANCE IS BASED ON EQUIPMENT INSTALLED IN ACCORDANCE WITH THIS ARRA GEME T DRAWI G A D FA IOM.
17. ALL COMPONENTS SHIPPED LOOSE MUST BE INSTALLED ACCORDING TO THIS ARRANGEMENT DRAWI G A D FA IOM PRIOR TO FA START-UP.
18. ALL NON-CLARAGE MANUFACTURED COMPONENTS TO BE INSTALLED, OPERATED AND MAI TAI ED PER I STRUCTIONS PROVIDED BY THAT MA UFACTURER.
19. TIP CLEARANCE OF THE IMPELLER MUST BE CONFIRMED TO MATCH THE REQUIREMENTS OF THE CLARAGE ITP A D PROPER DOCUME TATION FOR THE TIP A D SHROUD MUST BE VERIFIED I THE FIELD PRIOR TO START-UP.
20. MINOR FITUP AND STRAIGHTENING IS NORMAL DURING FAN INSTALLATION AND IS THE RESPONSIBILITY OF THE CO TRACTOR I STALLI G THE FA .
21. CONNECTING HARDWARE BETWEEN COMPONENTS SHOWN ON THE ARRANGEMENT DRAWING IS PROVIDED BY CLARAGE A D I STALLED BY OTHERS. HARDWARE REQUIRED FOR THE E D FLA GE CO ECTIONS A D ALL OTHER CO ECTION ARE THE RESPONSIBILITY OF THE I STALLATION CO TRACTOR.
22. ALL FIELD WELDING AND WELDING ELECTRODES FURNISHED BY OTHERS. NO FIELD WELDING IS ALLOWED ON IMPELLER ASSEMBLY OR SHAFT.
23. CUSTOMER SUPPLIED MATERIAL: AS NOTED, ARE SHOWN FOR REFERENCE ONLY AND IS BASED ON DATA SUPPLIED BY CUSTOMER. CLARAGE ASSUMES O LIABILITY FOR THE ACCURACY OF THIS I FORMATION.
24. FAN HOUSING, INLETS AND INSPECTIONS DOORS MUST BE COMPLETELY SEALED TO PREVENT HARM TO SUPPOU DI G EQUIPME T, FOU DATION A D PERSON EL..
25. CUSTOMER IS RESPONSIBLE TO HAVE IN PLACE ADEQUATE MEANS TO SHUT THE FAN OFF WHEN A Y SAFE OPERATI G LIMIT IS EXCEEDED FOR BEARI G TEMPERATURE, BEARI G VIBRATION, FA AIR TEMPERATURE A D FA SPEED. FAILURE TO COMPLY COULD RESULT I PERSONAL I JURY OR PROPERTY DAMAGE A D A Y RESULTING FA FAILURE IS OT COVERED BY CLARAGE WARRA TEE.
26. FACTORY TESTING REQUIRED - REFERENCE CLARAGE ITP FOR SPECIFIC INSTRUCTIONS: MECHA ICAL TEST, PERFORMA CE TEST, SOU D TEST, REVERSAL START TEST.
27. CAST BLADES WILL BE FULLY X-RAY INSTECTED - ALL FORGED HUB COMPONENTS WILL RECEIVE ULTRASONIC I SPECTION.
28. FAN MAY REQUIRE TOUCH-UP PAINT AFTER INSTALLATION.
29. THIS DRAWING AND REVIEWED SUBMITTAL PACKAGE SERVES AS THE GOVERNING DOCUMENTS TO DEFI E CLARAGE SCOPE OF SUPPLY.

SHIP ITEMS LOOSE	ITEM NO.	QTY.	PART NO.	DESCRIPTION	MATERIAL	THK.	AMT.	WEIGHT	WEIGHT TOTAL
	1	1	B710889F02	FAN ASSEMBLY (F-1)	ASTM A36			21471	21471
	2	2		SILENCER					0
	3	2		TRANSITION ASSEMBLY (BY OTHERS)				4220	8440
	4	2		FLEX CONNECTOR (BY OTHERS)					0
	5	2		GASKET (SQUARE FLANGE)	SILICONE	1/4		56	112
	6	192		HEX BOLT: 1/2-13 UNC x 1 3/4" LG.	316 S.S.			0.14	26.88
	7	384		FLAT WASHER: 1/2" DIA.	316 S.S.			0.01	3.84
	8	192		LOCK WASHER: 1/2" DIA.	316 S.S.			0.02	3.84
	9	192		HEX NUT: 1/2"-13 UNC	316 S.S.			0.04	7.68
							APPROXIMATE TOTAL WEIGHT		30057.56



COST CATEGORY: -

COST CATEGORY: -

CUSTOMER: DEBRA-KUEMPEL

USER: ODOT-I-71 LYTLE TUNNEL

DRAWING TITLE: GENERAL ARRANGEMENT FOR ATVCR 24THC2N AXIAL FAN FA TAG # TV-F

NO.	BY	DATE	REVISIONS	NO.	BY	DATE	REVISIONS
A	PS	8/31/15	ORIGINAL ISSUE				
B	FK	10/8/15	TRANSITION WERE REMOVED				
C	RH	12/3/15	ADDED COMPONENTS AND DETAILS				
D	GC	2/15/16	REMOVED SQUARE FLEX. INSTALLED ROUND FLEX				

REF. DWG. -

FIT-UP -

WELD -

FINISH -

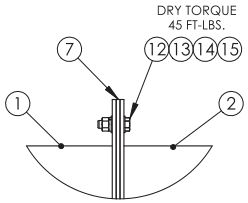
DO NOT SCALE DWG.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES TC CLARAGE, INC. STD.

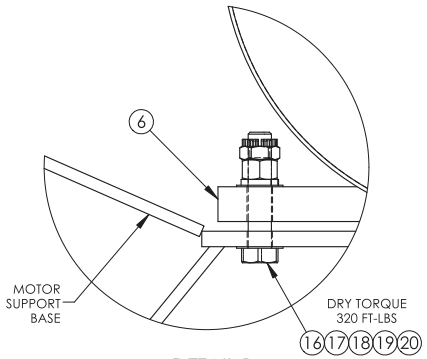
DRAWN BY	PS	DATE 8/3/15
CHECKED BY	-	DATE -
APPROVED BY	-	DATE -
APPROVED BY	-	DATE -

SCALE 1:72 | DRAWING NUMBER B710889F01 | REV. D

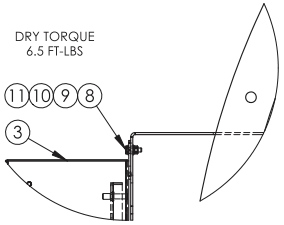
WORK ORDER NUMBER 710889-1-2 | SHEET 2 OF 2



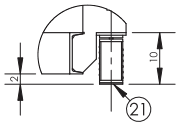
DETAIL A
SCALE 1 : 8



DETAIL B
SCALE 1 : 8

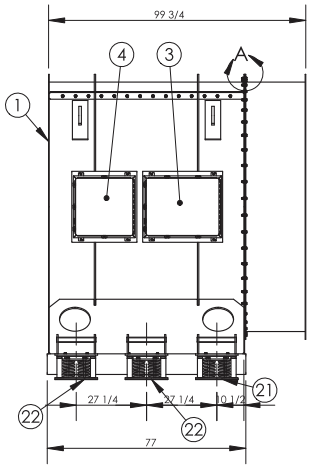


DETAIL C
SCALE 1 : 8
TYPICAL BOX MOUNTING

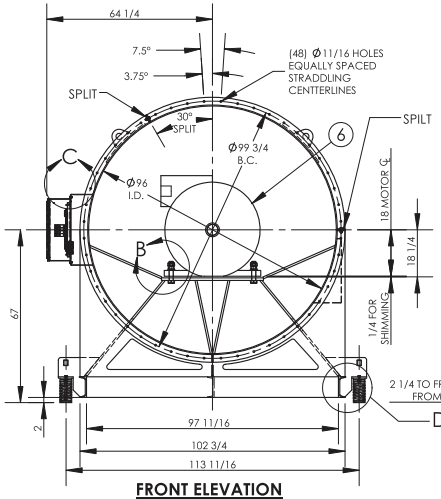


DETAIL D
SCALE 1 : 24

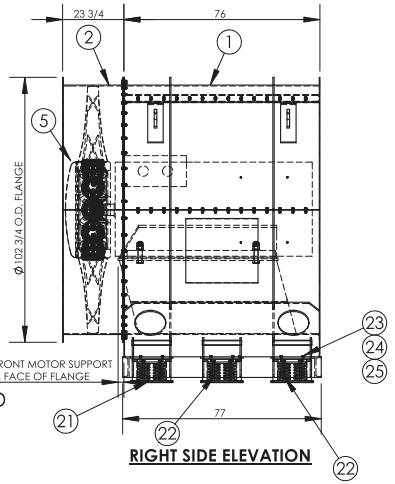
SHIP ITEMS LOOSE	ITEM NO.	QTY.	Part No.	DESCRIPTION	MATERIAL	THK.	AMT.	WEIGHT	WEIGHT TOTAL
	1	1	B710889F03	MOTOR HOUSING WELDMENT (F-1)	ASTM A36			7937	7937
	2	1	B710889F08	IMPELLER HOUSING ASSEMBLY	ASTM A36			871	871
	3	1	B710889F09	MOTOR TERMINAL BOX: 24h x 30w x 8d, NEMA 4x	S.S.			74	74
	4	1	B710889F10	INSTRUMENTATION BOX: 24" x 24" x 8" NEMA 4X	S.S.			49	49
	5	1	B710889R10	IMPELLER ASSEMBLY				2026	2026
	6	1		MOTOR: 600RPM, 500HP				10450	10450
	7	1		GASKET (ROUND FLANGE)	SILICONE	1/4"		19	19
	8	8		HEX BOLT: 1/4"-20 UNC x 7/8" LG.	316 S.S.			0.02	0.16
	9	16		FLAT WASHER: 1/4" DIA.	316 S.S.			0.00	0
	10	8		LOCK WASHER: 1/4" DIA.	316 S.S.			0.00	0
	11	8		HEX NUT: 1/4"-20 UNC	316 S.S.			0.01	0.08
	12	48		HEX BOLT: 1/2-13 UNC x 1 3/4" LG.	316 S.S.			0.14	6.72
	13	96		FLAT WASHER: 1/2" DIA.	316 S.S.			0.01	0.96
	14	48		LOCK WASHER: 1/2" DIA.	316 S.S.			0.02	0.96
	15	48		HEX NUT: 1/2"-13 UNC	316 S.S.			0.04	1.92
	16	4		HEX HEAD BOLT: 1 1/2"-6 UNC x 7 1/2" LG.	SAE GR. 8			5	20
	17	8		FLAT WASHER: 1 1/2" DIA.	SAE GR. 8			0.1	0.8
	18	4		LOCK WASHER: 1 1/2" DIA.	SAE GR. 8			0.3	1.2
	19	4		HEX NUT: 1 1/2"-6 UNC	SAE GR. 8			1	4
	20	4		SLOTTED HEX NUT: 1 1/2"-6 UNC	SAE GR. 8			1	4
	21	2		SPRING ISOLATOR 2KW4-F59					0
	22	4		SPRING ISOALTOR 2KW4-F58					0
	23	12		FLAT WASHER 1/2"	SAE GR.8				0
	24	12		HEX BOLT: 1/2"-13 UNC x 1 1/8" LG.	SAE GR.8			0.16	1.92
	25	12		LOCK WASHER: 1/2" DIA.	SAE GR.8			0.01	0.12
							APPROXIMATE WEIGHT		21547.00



LEFT SIDE ELEVATION



FRONT ELEVATION
IMPELLER NOT SHOWN FOR CLARITY



RIGHT SIDE ELEVATION

NOTES:

1. **QUANTITY IN BOM IS FOR (1) ASSEMBLY. (1) ASSEMBLY REQUIRED AS SHOWN WITH F-1 MOTOR ARRANGEMENT.**
2. **MOTOR MOUNTING HARDWARE, MOTOR FOOT, AND MOTOR PLATE ARE TO BE DRILLED AND READY TO ACCEPT COTTER PINS/ROLL PINS DURING ASSEMBLY. THE COTTER AND ROLL PINS WILL BE INSTALLED AFTER TESTING.**

COST CATEGORY: -

COST CATEGORY: -

CUSTOMER: DEBRA-KUEMPEL

USER: ODOT-I-71 LYTLE TUNNEL

DRAWING TITLE: FAN ASSEMBLY FOR ATVCR 24THC2N
AXIAL FAN (F-1 ARRANGEMENT)
FAN TAG #'S TV-F2

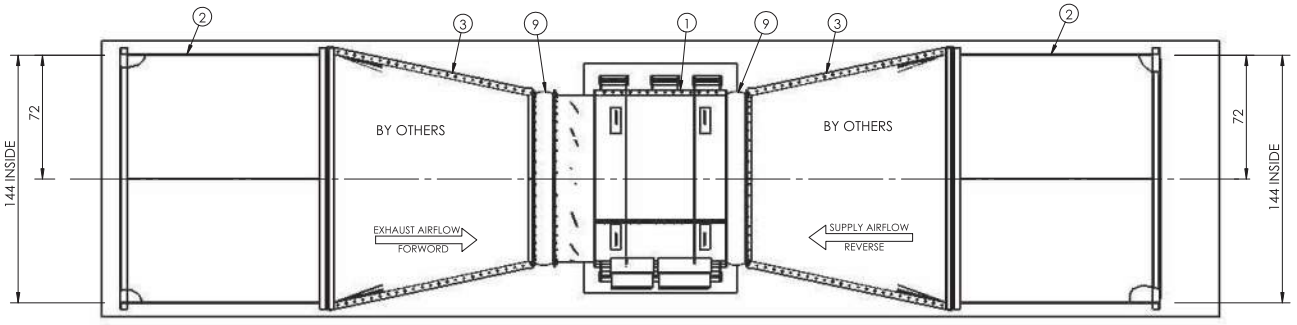
TC CLARAGE, INC. GUARANTEES PERFORMANCE OF EQUIPMENT ONLY IF IT IS FREE FROM EXPANSION STRESSES, PROPERLY ALIGNED, AND MOUNTED ON AMPLE FOUNDATIONS.

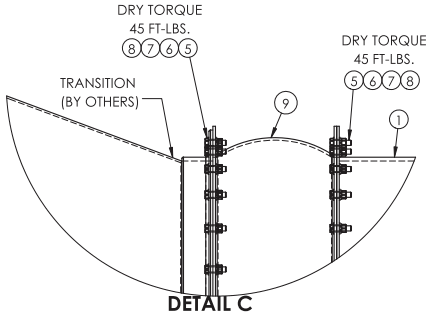
NO.	BY	DATE	REVISIONS
A	RH	-	ORIGINAL ISSUE
B	GC	3/29/16	HARDWARE QUANITY IN BOM PART # 22, 23, & 24 TO 6
C	GC	4/19/16	REDESIGNED ISOLATOR SPRINGS & BRACKETS
D	GC	5/09/16	ADDEDE DIMENSIONS TO ISOLATOR SPRING BRACKETS

-	FIT-UP	-	
-	WELD	-	
-	FINISH	-	
-	DO NOT SCALE DWG.		
B710889F01	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES		
REF. DWG.	TC CLARAGE, INC. STD.		

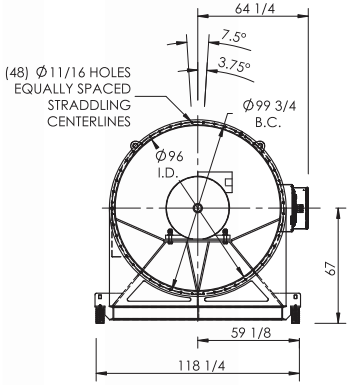
DRAWN BY	RH	DATE	12/3/15
CHECKED BY	SRW	DATE	3/16/16
APPROVED BY	-	DATE	-
APPROVED BY	-	DATE	-

SCALE: 1:48
DRAWING NUMBER: B710889F02
REV.: D
WORK ORDER NUMBER: 710889-1-2
SHEET 1 OF 1

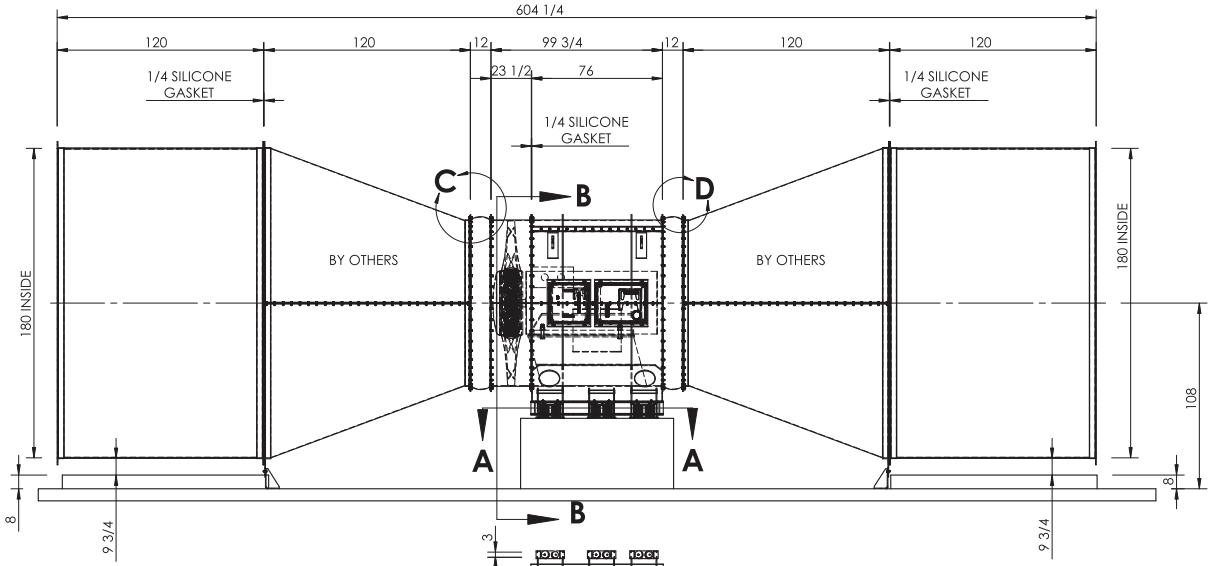


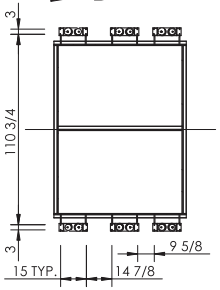


DETAIL C
SCALE 1 : 12

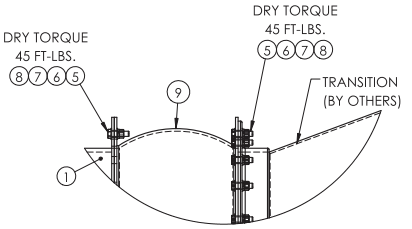


SECTION B-B





SECTION A-A



DETAIL D
SCALE 1 : 12

COST CATEGORY: -

COST CATEGORY: -

CUSTOMER: DEBRA-KUEMPEL

USER: ODOT-I-71 LYTLE TUNNEL

DRAWING TITLE: GENERAL ARRANGEMENT FOR ATVCR 24THC2N AXIAL FAN FAN TAG # TV-F1, F3

NO.	BY	DATE	REVISIONS
A	PS	8/31/15	ORIGINAL ISSUE
B	FK	10/8/15	TRANSITION WERE REMOVED
C	RH	12/3/15	ADDED COMPONENTS AND DETAILS
D	GC	2/15/16	REMOVED SQ FLEX CONNECTOR, ADDED RD FLEX

FIT-UP	-
WELD	-
FINISH	-
DO NOT SCALE DWG.	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES	
TC CLARAGE, INC. STD.	
REF. DWG.	-

DRAWN BY	PS
DATE	8/3/15
CHECKED BY	SRW
DATE	3/16/16
APPROVED BY	-
DATE	-
APPROVED BY	-
DATE	-

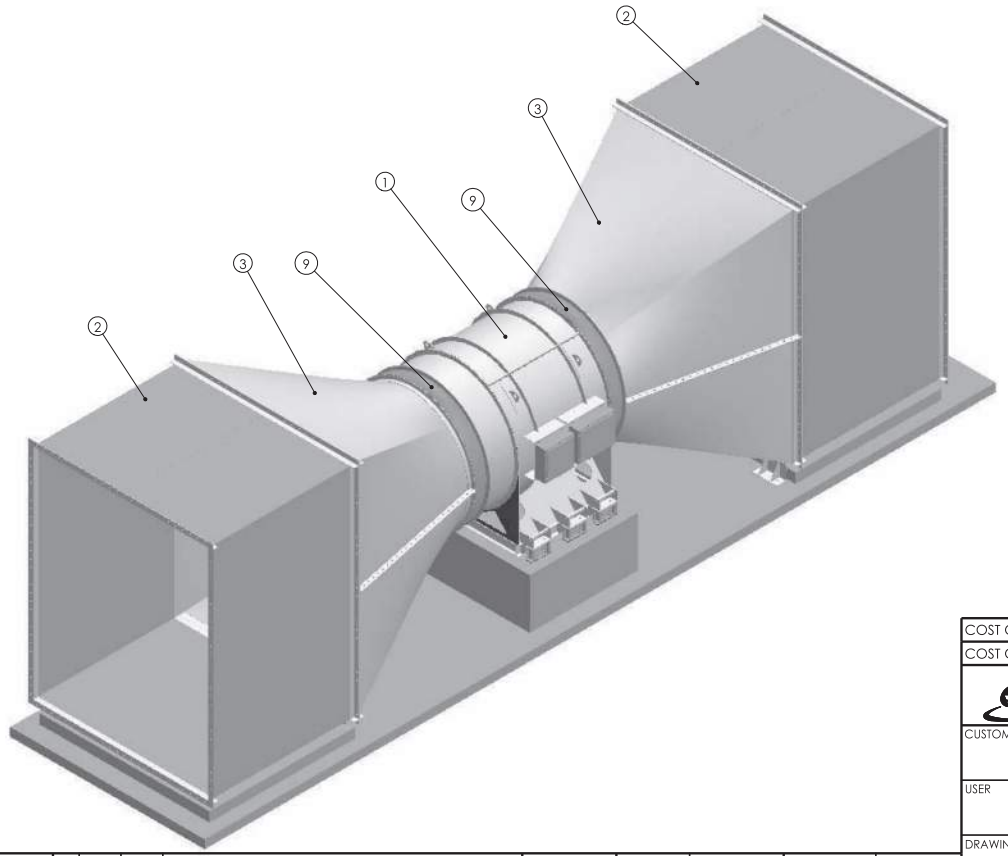
SCALE 1:72 | DRAWING NUMBER B710889F31 | REV. D

WORK ORDER NUMBER 710889-1-1 | SHEET 1 OF 2

NOTES:

1. 2 FAN ASSEMBLIES REQUIRED AS SHOWN. (F-2 ARRANGEMENT)
2. EXPANSION JOINTS MUST BE PROVIDED AT FAN INLET AND OUTLET WHERE DUCT OR BREECHING MAY CAUSE EXP NSION STRESSES OR VIBR TIONS.
3. FAN AND ASSOCIATED DUCT WORK MUST BE LEVELED AND PROPERLY ANCHORED DURING INST LL TION - T KING GRE T CARE NOT H VE THE EQUIPMENT TWISTED OR IN A BIND.
4. BEARINGS TO BE LUBRICATED WITH GREASE PER MOTOR MANUFACTURER REQUIREMENTS PRIOR TO ST RTING THE F N.
5. MOTOR MODIFICATION SPECIFIC FOR CONTRACT REQUIRED SENSORS.
6. FAN AND DUCT WORK TO BE PAINTED AS FOLLOWS: MERON P INT SYSTEM 370 ND TOP CO T 450H S FETY BLUE.
7. IMPELLER HUB AND SPINNER TO BE PAINTED SAME COLOR AS FAN HOUSING/BLADES NOT TO BE P INTED.
8. ALL MACHINED SURFACES TO BE COATED WITH ANTI-RUST COMPOUND.
9. IMPELLER IS DESIGNED FOR MAXIMUM SPEED OF 1200 RPM, MAXIMUM TEMP 482 °F 250 °C FOR 1 HOUR. IMPELLER TT CHED TO THE MOTOR SH FT VI B-LOCK MECH NISM. FOLLOW LL MANUF CTURERS INSTRUCTIONS FOR INST LL TION.
10. ADEQUATE CONCRETE MASS AND STIFNESS MUST BE SUPPLIED UNDER THE FAN TO A HORIZONTAL STIFFNESS OF T LE ST 4,000,000 LBS/IN.
11. BEFORE OPERATING FAN, ALL CONNECTIONS HARDWARE AND SENSORS MUST BE IN PROPER OPER TION L ORDER.
12. HIGH TEMPERATURE CAULK TO BE APPLIED BETWEEN SPLIT FLANGES ON FAN HOUSINGS.
13. FAN TAG #(S) TO BE TV-F1, TV-F3
14. IMPELLER TO BE MARKED PER IN ACCORDANCE WITH CLARAGE ITP.
15. THIS EQUIPMENT SHALL BE SHIPPED WITH SHIPPING BRACES AND/OR CLAMPS. THESE ITEMS RE P INTED RED ND MUST BE REMOVED PRIOR TO OPER TION OF EQUIPMENT.
16. PERFORMANCE IS BASED ON EQUIPMENT INSTALLED IN ACCORDANCE WITH THIS RR NGEMENT DR WING ND F N IOM.
17. ALL COMPONENTS SHIPPED LOOSE MUST BE INSTALLED ACCORDING TO THIS ARRANGEMENT DR WING ND F N IOM PRIOR TO F N ST RT-UP.
18. ALL NON-CLARAGE MANUFACTURED COMPONENTS TO BE INSTALLED, OPERATED AND MAINT INED PER INSTRUCTIONS PROVIDED BY TH T MANUF CTURER.
19. TIP CLEARANCE OF THE IMPELLER MUST BE CONFIRMED TO MATCH THE REQUIREMENTS OF THE CL R GE ITP ND PROPER DOCUMENT TION FOR THE TIP ND SHROUD MUST BE VERIFIED IN THE FIELD PRIOR TO ST RT-UP.
20. MINOR FITUP AND STRAIGHTENING IS NORMAL DURING FAN INSTALLATION AND IS THE RESPONSIBILITY OF THE CONTR CTOR INST LLING THE F N.
21. CONNECTING HARDWARE BETWEEN COMPONENTS SHOWN ON THE ARRANGEMENT DRAWING IS PROVIDED BY CL R GE ND INST LLED BY OTHERS. H RDWARE REQUIRED FOR THE END FL NGE CO ECTIONS ND LL OTHER CO ECTION RE THE RESPONSIBILITY OF THE I STALLATION CO TR CTOR.
22. ALL FIELD WELDING AND WELDING ELECTRODES FURNISHED BY OTHERS. NO FIELD WELDING IS LLOWED ON IMPELLER SSEMBLY OR SH FT.
23. CUSTOMER SUPPLIED MATERIAL: AS NOTED, ARE SHOWN FOR REFERENCE ONLY AND IS BASED ON D T SUPPLIED BY CUSTOMER. CL R GE SSUMES NO LI BILITY FOR THE CCUR CY OF THIS I FORMATION.
24. FAN HOUSING, INLETS AND INSPECTIONS DOORS MUST BE COMPLETELY SEALED TO PREVENT H RM TO SUPPOUNDING EQUIPMENT, FOUND TION ND PERSONNEL..
25. CUSTOMER IS RESPONSIBLE TO HAVE IN PLACE ADEQUATE MEANS TO SHUT THE FAN OFF WHEN NY S FE OPER TING LIMIT IS EXCEEDED FOR BE RING TEMPER TURE, BE RING VIBR TION, F N IR TEMPER TURE ND F N SPEED. F ILURE TO COMPLY COULD RESULT IN PERSON L I JURY OR PROPERTY D M GE D NY RESULTI G F N F ILURE IS NOT COVERED BY CL R GE W RR NTEE.
26. FACTORY TESTING REQUIRED - REFERENCE CLARAGE ITP FOR SPECIFIC INSTRUCTIONS: MECH NICAL TEST, PERFORMANCE TEST, SOUND TEST, REVERS L ST RT TEST.
27. CAST BLADES WILL BE FULLY X-RAY INSTECTED - ALL FORGED HUB COMPONENTS WILL RECEIVE ULTR SONIC INSPECTION.
28. FAN MAY REQUIRE TOUCH-UP PAINT AFTER INSTALLATION.
29. THIS DRAWING AND REVIEWED SUBMITTAL PACKAGE SERVES AS THE GOVERNING DOCUMENTS TO DEFINE CL R GE SCOPE OF SUPPLY.

SHIP ITEMS LOOSE	ITEM NO.	QTY.	PART NO.	DESCRIPTION	MATERIAL	THK.	AMT.	WEIGHT	WEIGHT TOTAL
	1	1	B710889F32	FAN ASSEMBLY	ASTM A36			21471	21180
	2	2		SILENCER (BY OTHERS)					0
	3	2		TRANSITION ASSEMBLY (BY OTHERS)				4220	9842
	4	2		GASKET (SQUARE FLANGE)	SILICONE	1/4		56	112
	5	192		HEX BOLT: 1/2-13 UNC x 1 3/4" LG.	316 S.S.			0.14	26.88
	6	384		FLAT WASHER: 1/2" DIA.	316 S.S.			0.01	3.84
	7	192		LOCK WASHER: 1/2" DIA.	316 S.S.			0.02	3.84
	8	192		HEX NUT: 1/2"-13 UNC	316 S.S.			0.04	7.68
	9	2		FLEX CONNECTOR (BY OTHERS)					0
								APPROXIMATE WEIGHT	31176.24



COST CATEGORY: -

COST CATEGORY: -

CUSTOMER: DEBRA-KUEMPEL

USER: ODOT-I-71 LYTLE TUNNEL

DRAWING TITLE: GENERAL ARRANGEMENT FOR ATVCR 24THC2N AXIAL FAN F N T G # TV-F1, TV-F3

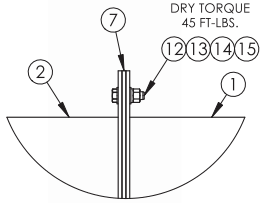
NO.	BY	DATE	REVISIONS
A	PS	8/31/15	ORIGINAL ISSUE
B	FK	10/8/15	TRANSITION WERE REMOVED
C	RH	12/3/15	ADDED COMPONENTS AND DETAILS
D	GC	2/15/16	REMOVED SQ FLEX CONNECTOR, ADDED RD FLEX

NO.	BY	DATE	REVISIONS

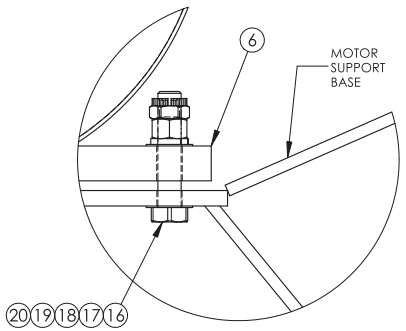
-	FIT-UP	-	
-	WELD	-	
-	FINISH	-	
DO NOT SCALE DWG.			
UNLESS OTHERWISE SPECIFIED DIMENSIONS RE IN INCHES TOLERANCES TC CLARAGE, INC. STD.			
REF. DWG.			

DRAWN BY	PS
DATE	8/3/15
CHECKED BY	SRW
DATE	3/16/16
APPROVED BY	-
DATE	-
APPROVED BY	-
DATE	-

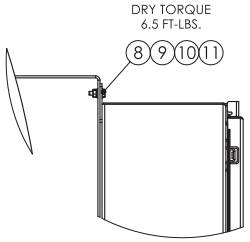
SCALE 1:72	DRAWING NUMBER B710889F31	REV. D
WORK ORDER NUMBER 710889-1-1	SHEET 2 OF 2	



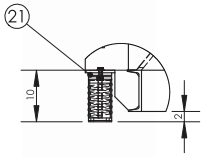
DETAIL A
SCALE 1 : 8



DETAIL B
SCALE 1 : 8

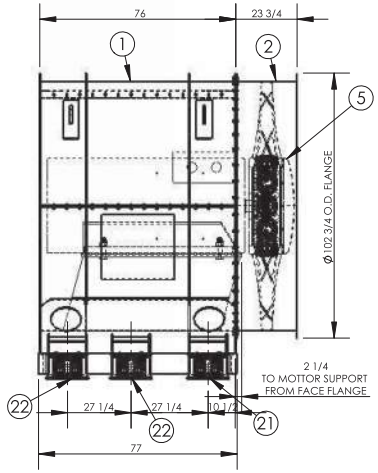


DETAIL C
SCALE 1 : 8
TYPICAL BOX MOUNTING

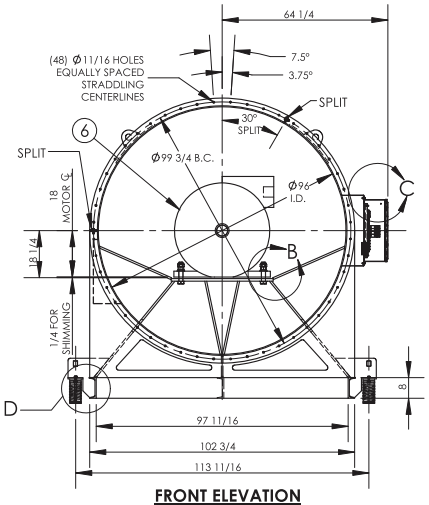


DETAIL D
SCALE 1 : 24

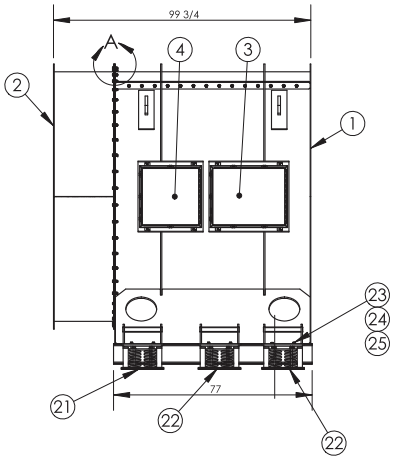
SHIP ITEMS LOOSE	ITEM NO.	QTY	Part No.	DESCRIPTION	MATERIAL	THK.	AMT.	WEIGHT	WEIGHT TOTAL
	1	1	B710889F33	MOTOR HOUSING WELDMENT (F-2)	ASTM A36			7937	7937
	2	1	B710889F08	IMPELLER HOUSING ASSEMBLY	ASTM A36			871	871
	3	1	B710889F09	MOTOR TERMINAL BOX: 24h x 30w x 8d, NEMA 4x	S.S.			74	74
	4	1	B710889F10	INSTRUMENTATION BOX: 24" x 24" x 8" NEMA 4X	S.S.			49	49
	5	1	B710889R10	IMPELLER ASSEMBLY				2026	2026
	6	1		MOTOR: 600RPM, 500HP				10450	10450
	7	1		GASKET (ROUND FLANGE)	SILICONE	1/4"		19	19
	8	8		HEX BOLT: 1/4"-20 UNC x 7/8" LG.	316 S.S.			0.02	0.16
	9	16		FLAT WASHER: 1/4" DIA.	316 S.S.			0.00	0
	10	8		LOCK WASHER: 1/4" DIA.	316 S.S.			0.00	0
	11	8		HEX NUT: 1/4"-20 UNC	316 S.S.			0.01	0.08
	12	48		HEX BOLT: 1/2-13 UNC x 1 3/4" LG.	316 S.S.			0.14	6.72
	13	96		FLAT WASHER: 1/2" DIA.	316 S.S.			0.01	0.96
	14	48		LOCK WASHER: 1/2" DIA.	316 S.S.			0.02	0.96
	15	48		HEX NUT: 1/2"-13 UNC	316 S.S.			0.04	1.92
	16	4		HEX HEAD BOLT: 1 1/2"-6 UNC x 7 1/2" LG.	SAE GR. 8			5	20
	17	8		FLAT WASHER: 1 1/2" DIA.	SAE GR. 8			0.1	0.8
	18	4		LOCK WASHER: 1 1/2" DIA.	SAE GR. 8			0.3	1.2
	19	4		HEX NUT: 1 1/2"-6 UNC	SAE GR. 8			1	4
	20	4		SLOTTED HEX NUT: 1 1/2"-6 UNC	SAE GR. 8			1	4
	21	2		SPRING ISOLATOR 2KW4-F59					0
	22	4		SPRING ISOLATOR 2KW4-F58	316 S.S.			0.13	0.52
	23	12		FLAT WASHER 1/2"	SAE GR.8			0	0.12
	24	12		LOCK WASHER: 1/2" DIA.	SAE GR.8			00	0.12
	25	12		HEX BOLT: 1/2"-13 UNC x 1 1/8" LG.	SAE GR.8			.50	0.50
							APPROXIMATE WEIGHT		21547.00



LEFT SIDE ELEVATION



FRONT ELEVATION
IMPELLER NOT SHOWN FOR CLARITY



RIGHT SIDE ELEVATION

NOTES:

1. **QUANTITY IN BOM IS FOR (1) ASSEMBLY. (2) SSEMBLIES REQUIRED S SHOWN WITH F-2 MOTOR RR NGEMENT.**
2. **MOTOR MOUNTING HARDWARE, MOTOR FOOT, ND MOTOR PL TE RE TO BE DRILLED ND RE DY TO CCEPT COTTER PINS/ROLL PINS DURING SSEMBLY. THE COTTER ND ROLL PINS WILL E INST LLED FTER TESTING.**

COST CATEGORY: -

COST CATEGORY: -

Clarage

CUSTOMER
DEBRA-KUEMPEL
-

USER
ODOT-I-71 LYTLE YUNNEL

DRAWING TITLE
FAN ASSEMBLY FOR ATVCR 24THC2N
AXIAL FAN (F-2 ARRANGEMENT)
FAN TAG #'S TV-F1, TV-F3

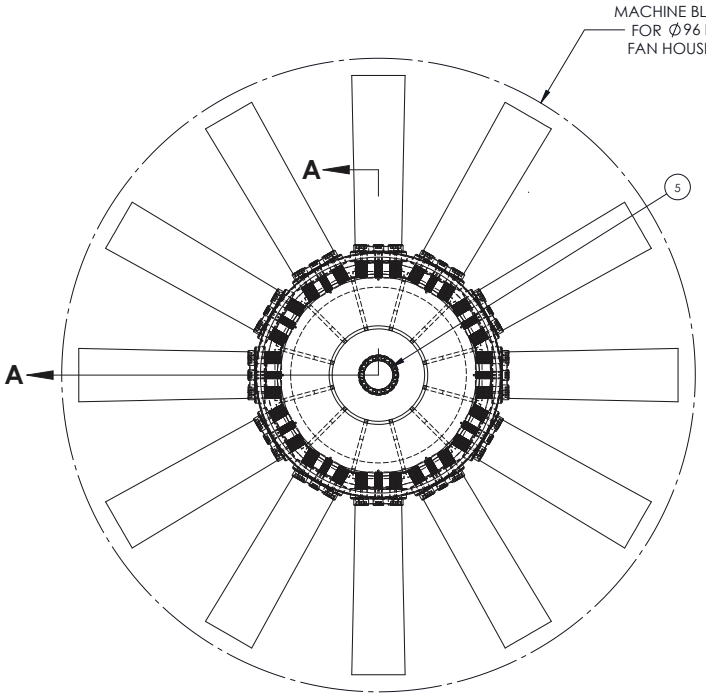
NO.	BY	DATE	REVISIONS
A	RH	-	ORIGINAL ISSUE
B	GC	3/29/16	CHANGED QUANITY IN BOM PART # 22,23, &24 TO 6
C	GC	4/19/16	REDESIGNED ISOLATOR SPRING & BRACKET
D	GC	5/09/16	ADDED DIMENSION TO ISOLATOR SPRING BRACKETS

-	FIT-UP	-	
-	WELD	-	
-	FINISH	-	
-	DO NOT SCALE DWG.		
B710889F31	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES		
REF. DWG.	TC CLARAGE, INC. STD.		

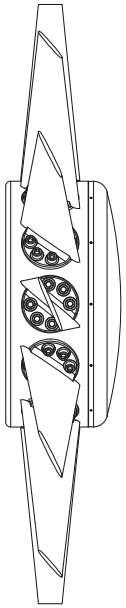
DRAWN BY	RH
DATE	12/2/15
CHECKED BY	SRW
DATE	3/16/16
APPROVED BY	
DATE	
APPROVED BY	
DATE	

SCALE	DRAWING NUMBER	REV.
1:48	B710889F32	D
WORK ORDER NUMBER		
710889-1-1	SHEET 1 OF 1	

SHIP ITEMS LOOSE	ITEM NO.	QTY.	Part No.	DESCRIPTION	MATERIAL	THK.	AMT.	WEIGHT	WEIGHT TOTAL
	1	1	LATER	H-HUB ASSEMBLY				1337	1337
	2	12	LATER	IMPELLER BLADE	C355-T6			40	480
	3	12	B710889R05	RETAINER PLATE	ASTM A514S	1		12	144
	4	1	B710889R07	IMPELLER SPINNER	AISI 1011	12 GA.		40	40
	5	1	T122406	B-LOC B112 4.375 DIA. SHAFT				13	13
	6	72		SOCKET HEAD CAPSCREW: 1"-8 UNC x 4" LG.	ASTM A574			1	72
	7	72		BEVELED WASHER	STEEL	3/16		0.12	8.64
								APPROXIMATE TOTAL WEIGHT	**2094.64**

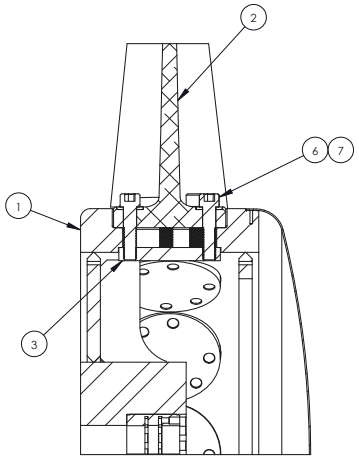


MOTOR SIDE VIEW



NOTES:

1. BLADE PASS FREQUENCY = 240
2. IMPELLER WT. = 2095 LBS.
3. B-LOC LOCKING SCREW TORQUE - 105 FT-LBS
4. IMPELLER WR^2 = 7125 LB-FT^2
5. BLADE BOLT TORQUE = 220 LB-FT
6. BLADE ANGLE SHOULD BE 20° AT THE TIP AND 44° AT THE ROOT (BLADE BOLTS)
7. TIP CLEARENCE AS FOLLOWS AT 70° F: MINIMUM 0.26 INCHES
   DESIRED 0.33 INCHES
   MAXIAMUM 0.50 INCHES



SECTION A-A
SCALE 1 : 8

TC CLARAGE, INC. GUARANTEES PERFORMANCE OF EQUIPMENT ONLY IF IT IS FREE FROM EXPANSION STRESSES, PROPERLY ALIGNED, AND MOUNTED ON AMPLE FOUNDATIONS.

NO.	BY	DATE	REVISIONS
A	RH	-	ORIGINAL ISSUE
B	RH	2/2/16	RE-DESIGNED IMEPLLER

REF. DWG.

FIT-UP	
WELD	
FINISH	

DO NOT SCALE DWG.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES
TC CLARAGE, INC. STD.

DRAWN BY	RH	DATE	12/4/15
CHECKED BY	-	DATE	-
APPROVED BY	-	DATE	-
APPROVED BY	-	DATE	-

CUSTOMER: DEBRA-KUEMPEL -

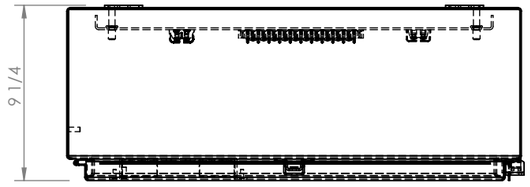
USER: ODOT-I-71 LYTLE TUNNEL

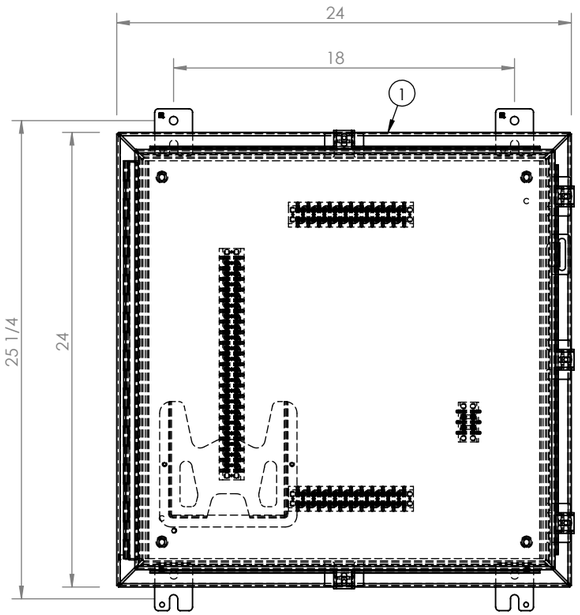
DRAWING TITLE: IMPELLER ASSEMBLY FOR ATVCR 24THC2N AXIAL FAN

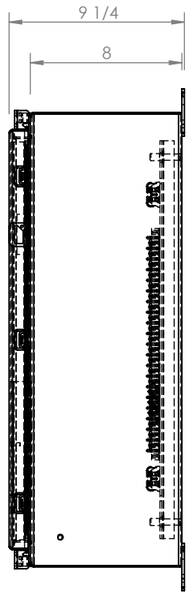
SCALE	DRAWING NUMBER	REV.
1:16	B710889F14	B

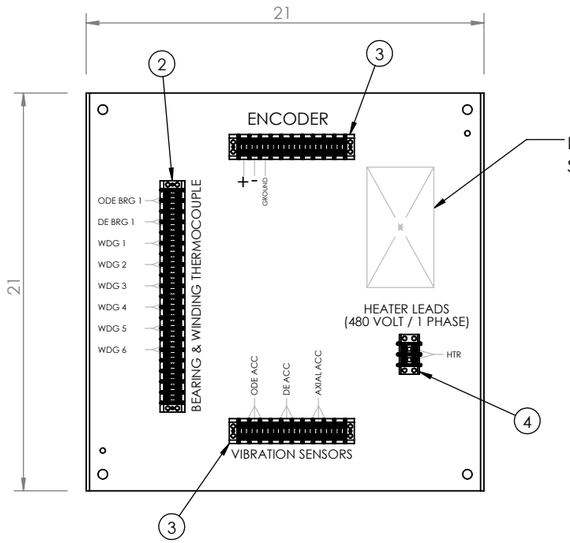
WORK ORDER NUMBER: 710889-001 SHEET 1 OF 1

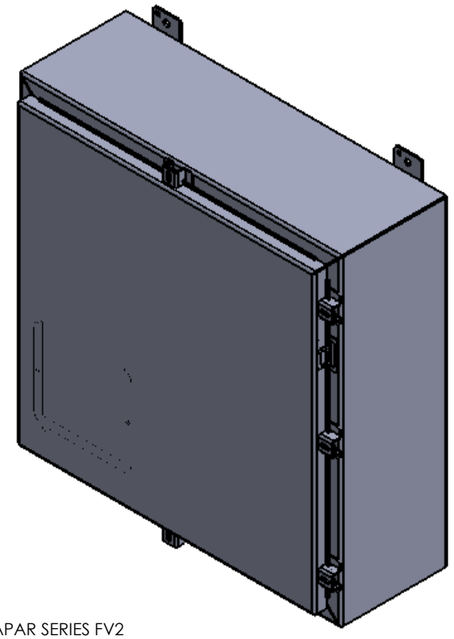
SHIP ITEMS LOOSE	ITEM NO.	QTY.	PART NO.	DESCRIPTION	MATERIAL	THK.	AMT.	WEIGHT	WEIGHT TOTAL
	1	1		INSTRUMENTATION CONTROL BOX: 24" x 24" x 8", NEMA 4X	S.S.			48.00	48
	2	1		20 CIRCUIT TERMINAL BLOCK					0
	3	2		10 CIRCUIT TERMINAL BLOCK					0
	4	1		TWO CIRCUIT TERMINAL BLOCK					0
								APPROXIMATE TOTAL WEIGHT	**48**











COST CATEGORY: -

COST CATEGORY: -

CUSTOMER
DEBRA-KUEMPEL

USER
ODOT-I-71 LYTLE TUNNEL

DRAWING TITLE
I &C JUNCTION BOX
-

SCALE	DRAWING NUMBER	REV.
1:8	B710889F10	C

WORK ORDER NUMBER: 710889-1-(1-2) | SHEET 1 OF 1

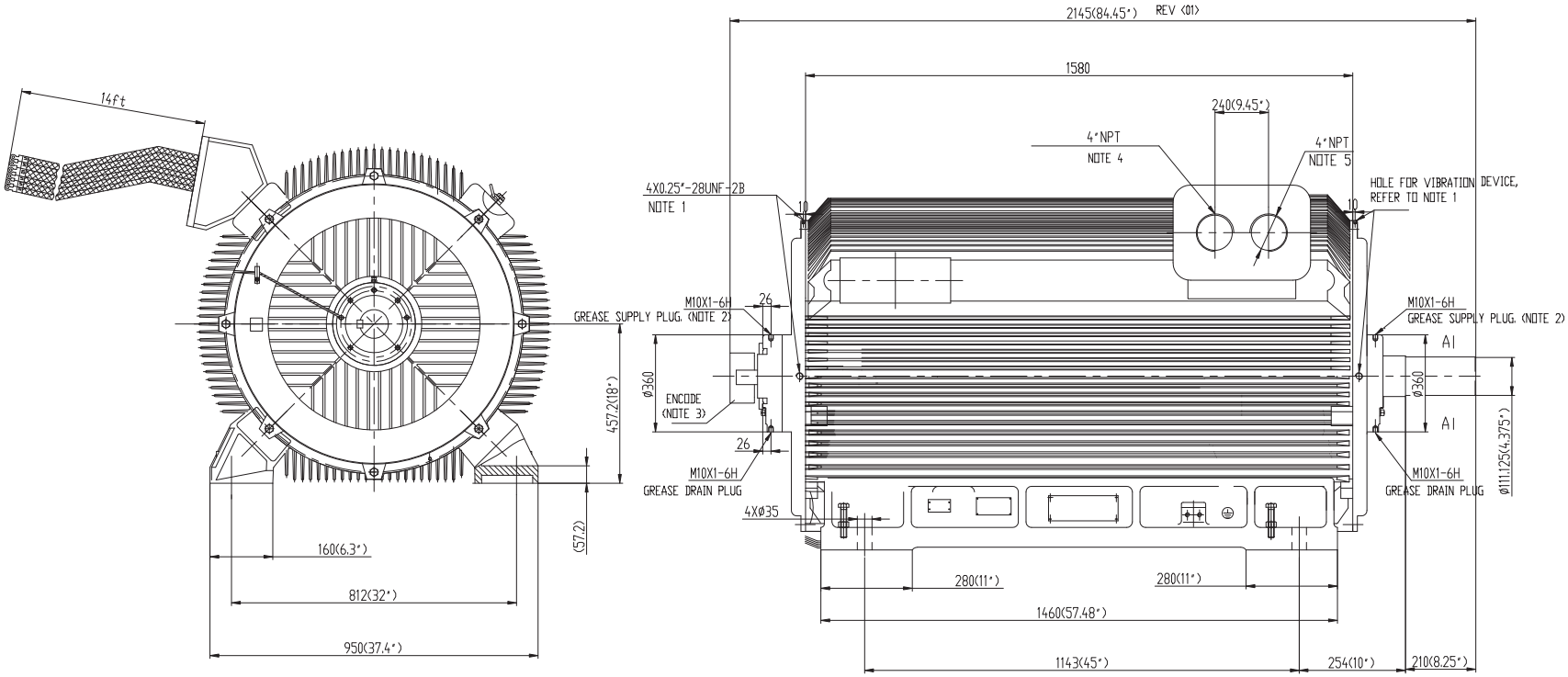
NO.	BY	DATE	REVISIONS	NO.	BY	DATE	REVISIONS
A	JB	9/1/15	ORIGINAL ISSUE				
B	RH	12/4/15	ADDED HEATER BLOCK				
C	RH	7/18/16	ADDED SIGNAL CONVERTER				

-	FIT-UP	-
-	WELD	-
-	FINISH	-
B710889F32	DO NOT SCALE DWG.	
B710889F02	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES TC CLARAGE, INC. STD.	
REF. DWG.		

DRAWN BY	JB	DATE	9/1/15
CHECKED BY	-	DATE	-
APPROVED BY	-	DATE	-
APPROVED BY	-	DATE	-

Section 3

Motor Information



NOTE 1:
THREADED HOLES TO FIT VIBRATION DETECTORS.4 HOLES ARE PROVIDED ON EACH END OF MOTOR AT BOTH VERTICAL AND HORIZONTAL DIRECTION AS SHOWN.
10MM THREADED HOLES WITH TOTAL TOTAL DEPTH 12MM, SPOT FACE DIA ø20MM.

NOTE 2:
GREASE SUPPLY&DRAINAGE PIPES TO BE SUPPLIED AND FITTED BY CUSTOMER.

NOTE 3:
ENCODE DETAILS TO BE ADVISED AND CONFIRMED BY CUSTOMER.

NOTE 4:
THERE ARE 6 POWER CABLES FOR 6 POLE AND 3 POWER CABLES FOR 12 POLE.ALL CABLE SIZE ARE AWG 1/0 #.

NOTE 5:
THERE ARE TOTAL 8 PIECES OF 3-WIRE TYPE RTD CABLES. 2 FOR BEARINGS, 6 FOR STATOR WINDINGS, WITH DIAMETER 5MM EACH.
THERE ARE TOTAL 4 CABLES FOR 2 HEATERS, WITH DIAMETER 5MM EACH.

REVISIONS
<1> THIS DIMENSION WAS 2060.

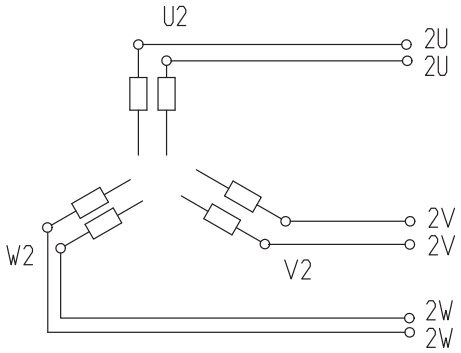
LET	REVISION	DATE	BY
	01	20151027	
DESIGN	Xie Xiaolong		
CHECK	Yu Jiabin		
APPROVE	Li Menglin		
DATE	20151021		

NEHE7210-6P\12P

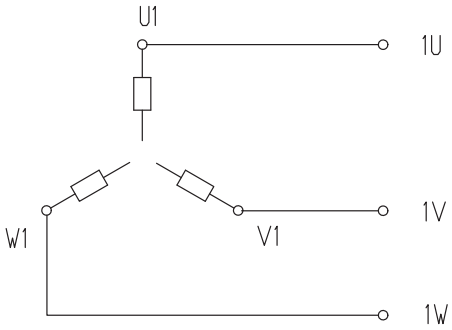
IP55 F-1

WEIGHT	SCALE
	2:1

WOLONG ELECTRIC NANYANG EXPLOSION PROTECTION GROUP CO.,LTD.



HIGH SPEED



LOW SPEED

MOTOR WIRING

SPEED	OPEN		
LOW	1U	1V	1W
HIGH	2U 2U	2V 2V	2W 2W

MOTOR CONNECTION

				WIRE DIAGRAM	
					WEIGHT: — SCALE: 1:1
LET.	REVISION	BY	DATE		
DESIGN					NANYANG EXPLOSION PROTECTION GROUP CO.,LTD.
CHECK					
APPROVE					
DATE					

卧龙电气南阳防爆集团股份有限公司

WOLONG ELECTRIC NANYANG EXPLOSION PROTECTION GROUP CO., LTD.

NO：WJF150428-2

MOTOR DATA SHEET

1 TECHNICAL DATA 技术数据

1.1 MOTOR DATA SHEET 电机数据表

Client 用户		Twin City Fan 双城风机
Client Project 用户项目名称		
General Information 基本信息	**Unit 单位**	**Data 数据**
Standard 采用标准		NEMA MG1 IEEE
Motor Type 电机类型		NEHE
Frame size 机座号		7210
Rated output 额定输出功率	HP	500/62.5
	kW	375/46.5
Rated voltage 额定电压	V	460
Rated current 额定电流	A	582.6/119.1
Connection 接线方式		Wye / Wye Y 接
Frequency 频率	Hz	60
No of Pole 极数	P	6/12
Service Factor 功率因数		1.15
NEMA Design NEMA 设计		B
Mechanical Protection 防护等级		IP55
Cooling Method 冷却方式		TEAO/IC418
Mounting 安装方式		F-1
Max ambient Temperature 最高环境温度	℉	104
Emergency Operation Temperature 紧急运行温度	℉	482
Emergency Operation Temperature Duration 紧急运行时间	h	1
Altitude 海拔高度	m	≤1000
Mounting Location 安装地点		-
Insulation Class 绝缘等级		H
Temperature Rise @ S.F. 1.0 在 1.0 服务系数下的温升		F
Time rating 工作制		Cont 连续运行
Type of Starting 启动方式		DOL 直接启动
No. of Starts 启动次数/每小时		4
Rotation Direction 旋转方向		CW/ CCW 双向
Ex-Protection Type 防爆类型		N.A.

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NO：WJF150428-2

MOTOR DATA SHEET

Hazardous Area Requirement 防爆场所			
Ex Certification 防爆证书			N.A.
Moment of Inertia 转动惯量		kg.m2	36.5
Motor Weight 电机重量		lbs	10450
Inverter Capabilities 变频能力			N.A.
Mechanical & Electrical Performance 机械和电气性能		**Unit 单位**	**Data 数据**
Rated Speed 额定转速		rpm	1192/597
Rated Torque 额定转矩		N.m	3004/719
Efficiency 效率	25% P2	%	93.3/73.3
	50% P2	%	95.0/78.0
	75% P2	%	95.3/82.5
	100%P2	%	95.2/87.5
Power Factor 功率因数	25% P2	%	61/43.4
	50% P2	%	78.5/50.1
	75% P2	%	82.3/55.3
	100%P2	%	85.0/60.6
Locked rotor Current 堵转电流		A	3625
		times	
KVA Code KVA 代码			G/J
Locked rotor Torque/ Rated Torque 堵转转矩/额定转矩			≥100%/≥135%
Break-down Torque/ Rated Torque 最大转矩/额定转矩			≥175%/≥200%
Vibration Velocity (peak) 振动速度（峰值）		mm/s	≤2.8
Maximum Noise, (Lp) * at no load 空载最大噪音（Lp）		dB(A)	85 (+3)
Accessories 配件		**Unit 单位**	**Data 数值**
Fan Material 风扇材料			Cast iron 铸铁
Bearing 轴承	Type 类型		Ball bearing 球轴承
	Manufacturer 供货商		FAG or SKF
	DE 驱动端		6326
	NDE 非驱动端		7326BCBM
	Lubrication 润滑		Grease 油脂
T/Box 接线盒	Ex Type of T/B 防爆类型		All terminal boxes and cable conduits to be supplied and mounted by Twin City. Wolong-Nanyang only provide 2 of
	T/B Material 接线盒材质		

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WOLONG ELECTRIC NANYANG EXPLOSION PROTECTION GROUP CO., LTD.

NO：WJF150428-2

MOTOR DATA SHEET

	IP 防护等级		4”NPT holes on motor as provision to fit the cable conduits. 所有的接线盒以及电缆套管由双城风机供货、安装。 卧龙-南阳只在电机上提供 2 个 4”的螺纹口用来安装电缆套管。
	No. of leads 引线数量		
	Connection 接线方式		
	Terminal board 接线板		
	NPT 接线口尺寸		2X4”
Space Heater 空间加热器		V/W	120/750W/60Hz Heater to be Wolong/Nanyang standard. Replacement or maintenance would require removal of end shields. 卧龙/南阳标准加热装置，维修或者更换时候需要拆掉端盖。
Winding and Bearing Temp. Detector 绕组和轴承测温装置	Winding 绕组测温		PT100
	Nr. 数量	off	2 per phase, totally 6 每相 2 个，共 6 个
	Bearing 轴承测温		PT100
	Nr.数量	off	1 per bearing, total 2 每个轴承 1 个，共 2 个
Vibration detector 测振装置	Shock pulse sensor 测振探头		Not supplied, provision with fitting hole 0.25”-28UNF-2B only 只提供接口，注排油均为 M10x1-6H
Grease supply and drainage pipes line 注排油管			Not supplied. Provision only with M10x1-6H for both supply and drainage pipes. 只提供接口，注排油均为 M10x6H。
Grease 油脂			Chvron SRI
Paint 喷漆			Paint to be as per Wolong/Nanyang standard, suitable for the required high temperature requirement. Paint color to be advised by TCF/Clarage. 南阳标准，需满足隧道高温风机电机要求。 颜色待定。
Others 其他	Extended Shaft with Speed Sensing Device (Encoder) Mounted 轴端安装速度编码器		Supplied. Details to be confirmed by TCF. 提供。具体参数需要 TCF 确认。

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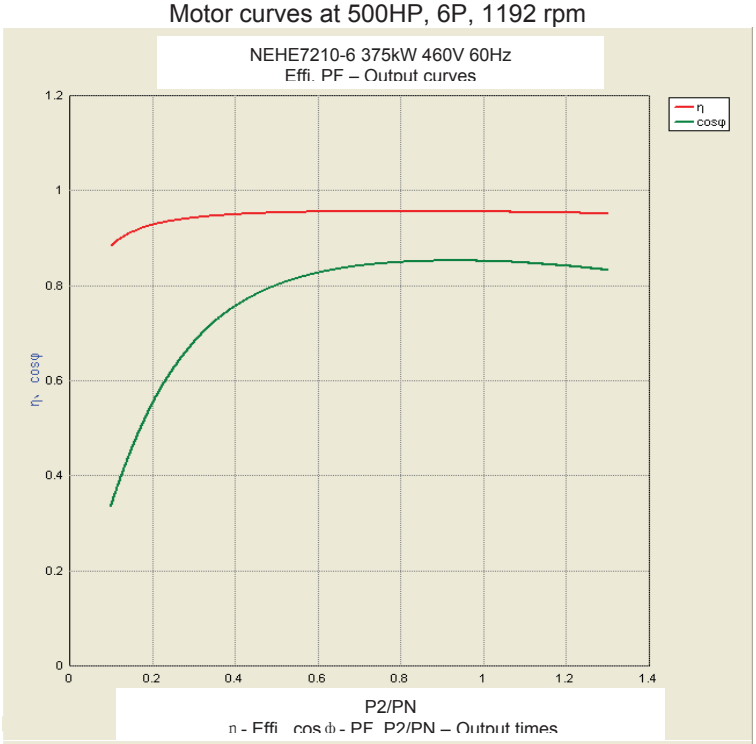
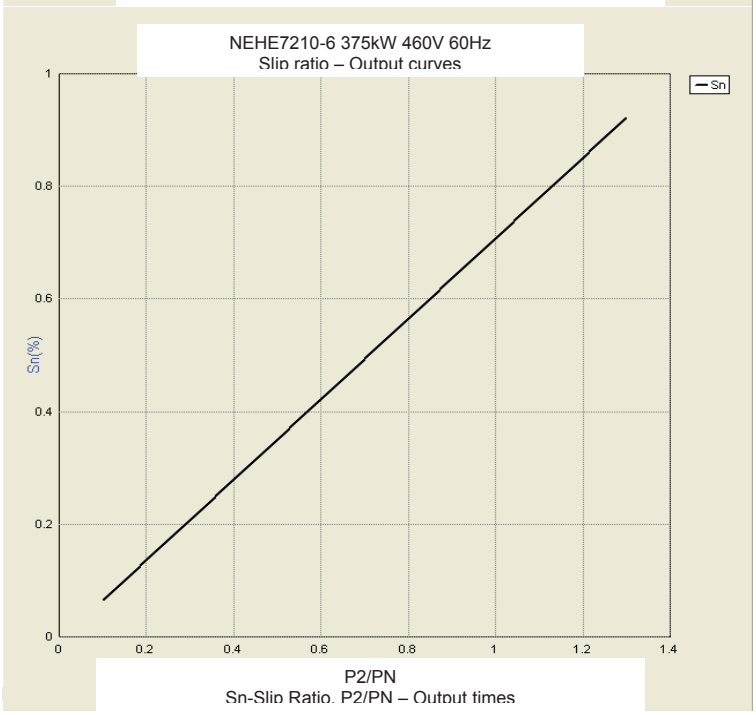
NO：WJF150428-2

MOTOR DATA SHEET

1.3 MOTOR CURVES 电机曲线

Motor curves at 500HP, 6P, 1192 rpm





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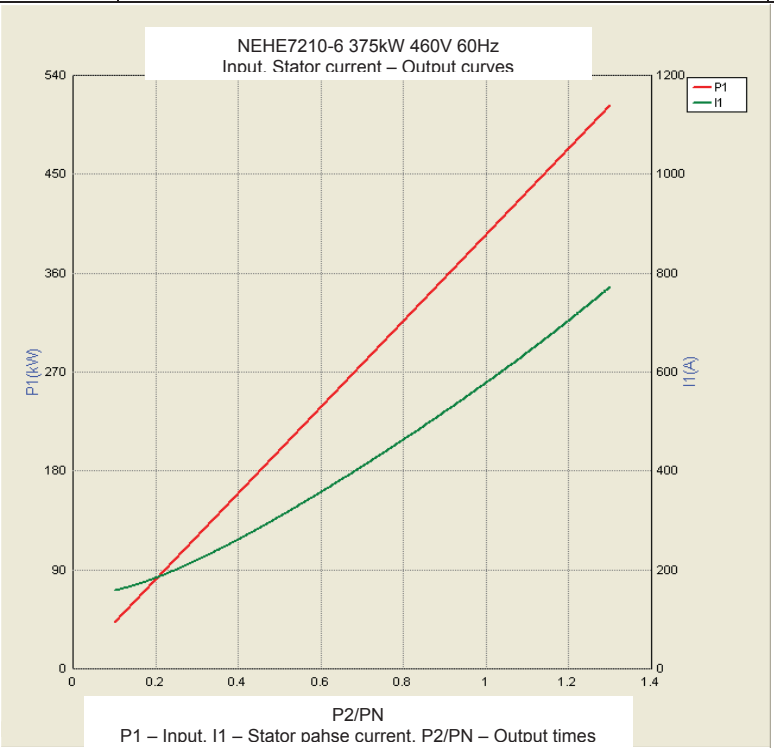
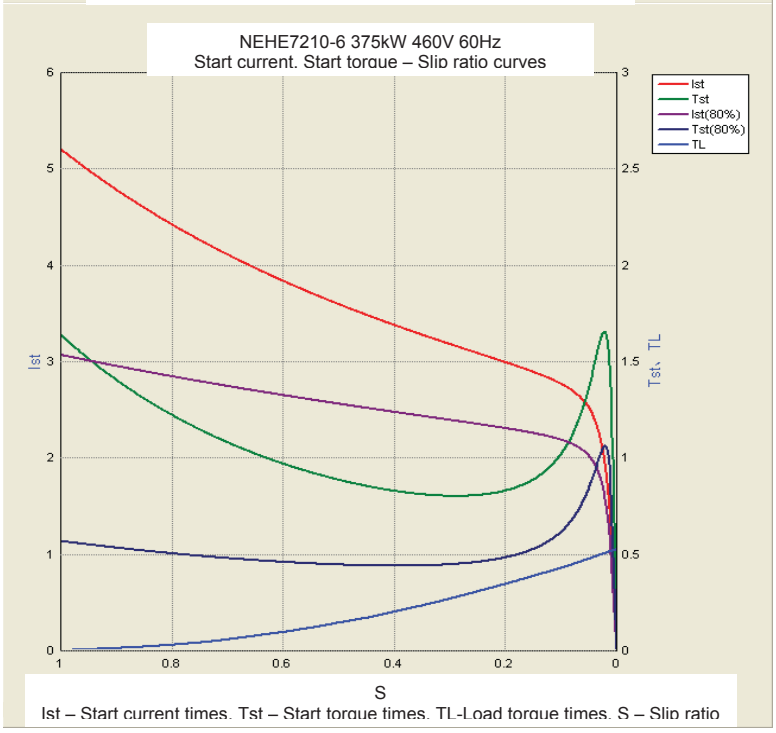
WOLONG ELECTRIC NANYANG EXPLOSION PROTECTION GROUP CO., LTD.

NO：WJF150428-2	**MOTOR DATA SHEET**	





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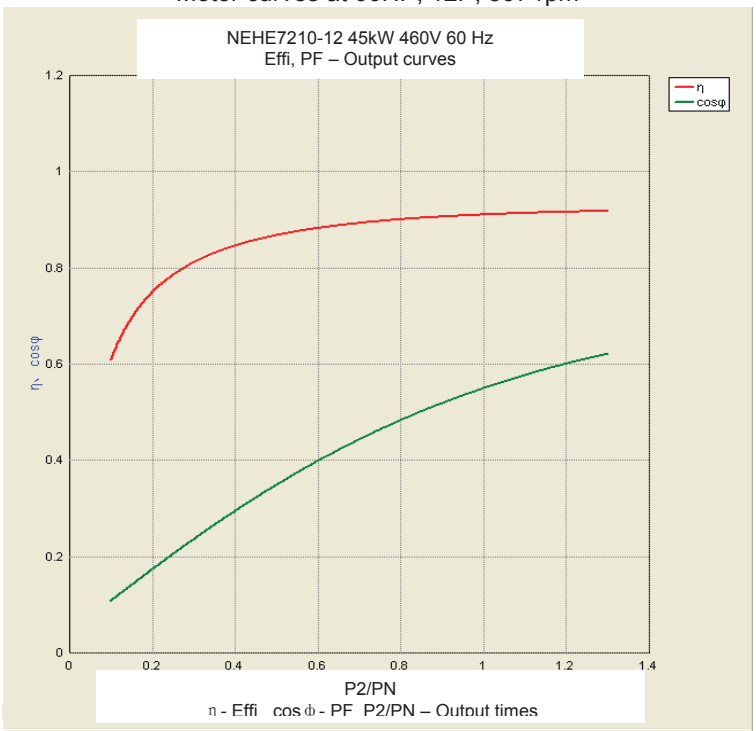
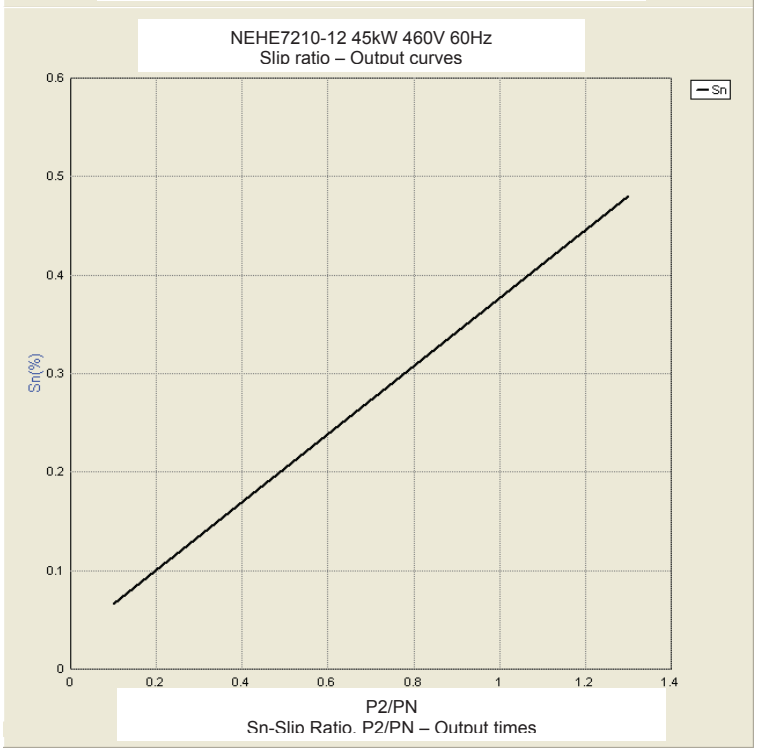
WOLONG ELECTRIC NANYANG EXPLOSION PROTECTION GROUP CO., LTD.

NO：WJF150428-2	**MOTOR DATA SHEET**	

Motor curves at 60HP, 12P, 597 rpm





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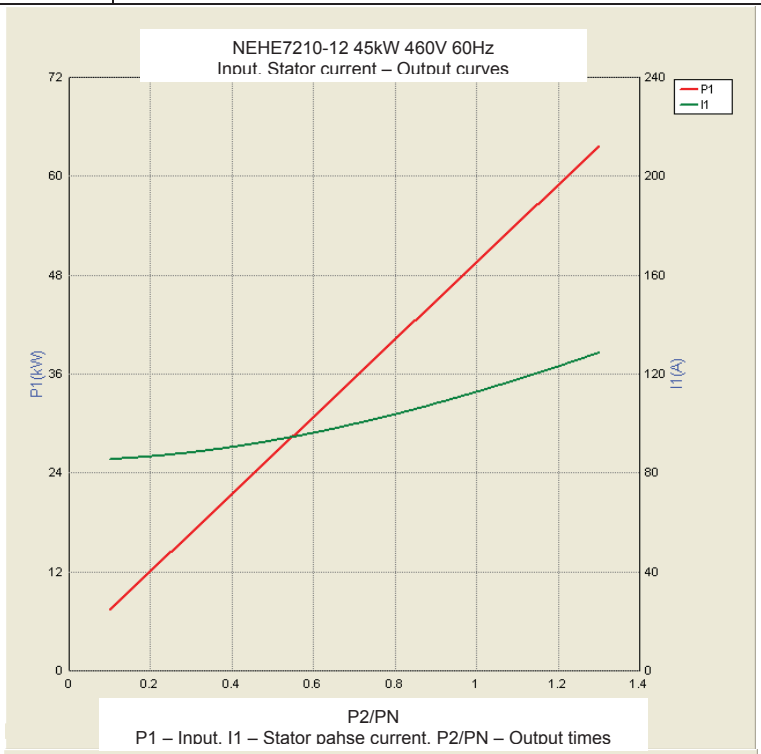
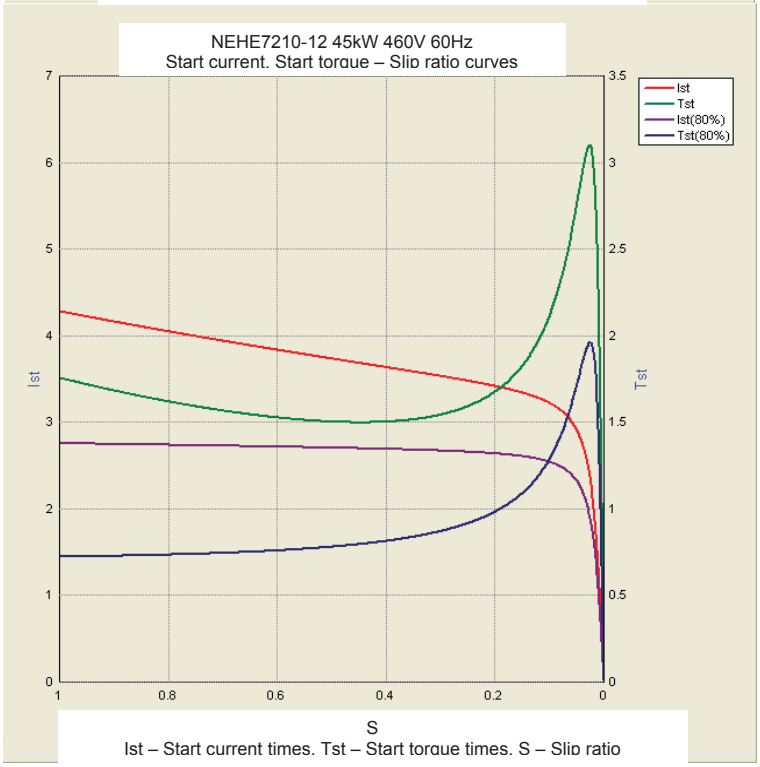
WOLONG ELECTRIC NANYANG EXPLOSION PROTECTION GROUP CO., LTD.

NO：WJF150428-2	**MOTOR DATA SHEET**	





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Tel: 0086 377 63258993 Fax: 0086 377 63258353
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Operation & Maintenance Manual

Project: Lytle Tunnel Fan Motor
TCF P.O. No.: 106586
WOLONG/CNE Job No.: 16A4002AW000 1pc
16D0105AW000 2pcs

Wolong Electric Nanyang Explosion Protection Group Co., Ltd.
March 7th, 2016

Address: 22 North Zhongjing Road, Nanyang, Henan, P.R. China
Tel: 0086 377 6325 8315/8320/8349 Fax: 0086 377 63258353
Email: nftrade@wolong.com nytrade@wolong.com Web site: www.cn-nf.com

Operation & Maintenance Manual

THE FOLLOWING SAFETY PRECAUTIONS MUST BE OBSERVED:

- Electric rotating machinery and high voltage can cause serious or fatal injury if improperly installed, operated or maintained. Responsible personnel should be familiarized with NEMA MG-1; Safety Standards for Construction and Guide Selection. Installation and Use of Electric Motors and Generators; National Electric Code and all local safety requirements.
- When servicing, all power sources to the motor and to the accessory devices should be de-energized and disconnected and all rotating parts should be at standstill.
- Lifting means, when supplied, are intended for lifting the motor only. When two lifting devices are supplied with the motor a dual chain must be used.
- Suitable protection must be used when working near machinery with high noise levels.
- Safeguard or protective devices must not be by-passed or rendered inoperative.
- The frame of this machine must be grounded in accordance with the National Electric Code and applicable local codes.
- A suitable enclosure should be provided to prevent access to the motor by other than authorized personnel. Extra caution should be observed around motors that are automatically or have automatic re-setting relays as they may restart unexpectedly.
- Shaft key must be fully captive or removed before motor is started.
- Provide proper safeguards for personnel against possible failure of motor-mounted brake, particularly on applications involving overhauling loads.

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1 MOTOR TECHNICAL DETAILS

1.1 Motor ratings

Item	Motor Model	HP	V/Hz	Mounting	Wolong/CNE Job No.	Qty.
1	NEHE7210-6/12P	500/62.5	460/60	F-1	16A4002AW000	1
2	NEHE7210-6/12P	500/62.5	460/60	F-2	16D0105AW000	2

1.2 Motor Data Sheet

Client		TCF / CLARAGE
Client Project		Lytle Tunnel Fan
General Information	**Unit**	**Data**
Standard		NEMA MG1 IEEE
Motor Type		NEHE
Frame size		7210
Rated output	HP	500/62.5
	kW	375/46.5
Rated voltage	V	460
Rated current	A	559.3/119.1
Connection		Wye / Wye
Frequency	Hz	60
No of Pole	P	6/12
Service Factor		1.15
NEMA Design NEMA		B
Mechanical Protection		IP55
Cooling Method		TEAO/IC418
Mounting		F-1
Max ambient Temperature	℉	104
Emergency Operation Temperature	℉	482
Emergency Operation Temperature Duration	h	1
Altitude	m	≤1000
Mounting Location		-
Insulation Class		H
Temperature Rise @ S.F. 1.0		F
Time rating		Cont.
Type of Starting		DOL
No. of Starts		4
Rotation Direction		CW/ CCW
Ex-Protection Type		N.A.
Hazardous Area Requirement		

Ex Certification			N.A.
Moment of Inertia		kg.m2	36.5
Motor Weight		lbs	10450
Inverter Capabilities			N.A.
Mechanical & Electrical Performance		**Unit**	**Data**
Rated Speed		rpm	1192/597
Rated Torque		N.m	3004/719
Efficiency	25% P2	%	93.3/73.3
	50% P2	%	95.0/78.0
	75% P2	%	95.3/82.5
	100%P2	%	95.2/87.5
Power Factor	25% P2	%	61/43.4
	50% P2	%	78.5/50.1
	75% P2	%	82.3/55.3
	100%P2	%	85.0/60.6
Locked rotor Current		A	3625
		times	-
KVA Code			G/J
Locked rotor Torque/ Rated Torque			≥100% / ≥135%
Break-down Torque/ Rated Torque			≥175% / ≥200%
Vibration Velocity (peak)		mm/s	≤2.8
Maximum Noise, (Lp) * at no load		dB(A)	85 (+3)
Accessories		**Unit**	**Data**
Fan Material			Cast iron
Bearing	Type		Ball bearing
	Manufacturer		FAG/SKF
	DE		6326
	NDE		7326BCBM
	Lubrication		Grease
T/Box	Ex Type of T/B		All terminal boxes and cable conduits to be supplied and mounted by Twin City. Wolong-Nanyang only provide 2 of 4”NPT holes on motor as provision to fit the cable conduits. 9 off leads supplied, 6 off leads for high speed, and another 3 off leads for low speed.
	T/B Material		
	IP		
	No. of leads		
	Connection		
	Terminal board		
	NPT		2X4”
Space Heater		V/W/Hz	120V/250W/60Hz Heater to be Wolong / Nanyang standard. Replacement or maintenance would require removal of end shields.
Winding and	Winding		PT100

Bearing Temp. Detector	Nr.	off	2 per phase, totally 6
	Bearing		PT100
	Nr.	off	1 per bearing, total 2
Vibration detector	Shock pulse sensor		Not supplied, provision only 0.25"-28UNF-2B
Grease Pipe Line			Not supplied, provision only M10X1-6H
Grease			Chevron SRI
Paint			Paint to be as per Wolong/Nanyang standard, suitable for the required high temperature..
Others	Extended Shaft with Speed Sensing Device (Encoder) Mounted		CNE Supply

1.3 Motor Layout

2 TRANSPORTATION

- The motor should be secured safely during transportation.
- During any shipment (by motor alone or installed with another piece of equipment), the shaft must be clamped to prevent axial movement.

3 STORAGE

- The motor should be kept dry and free from sudden change in ambient temperature during storage.
- Effective ventilation should be maintained during storage.

4 INSTALLATION LOCATION

- Totally enclosed motors may be installed where dirt, moisture, or dust are present and in outdoor locations.
- Chemical duty enclosed motors are designed for installation in high corrosion or excessive moisture locations.
- Note: in all cases, no surrounding structure should obstruct normal flow or ventilating air through or over the motor.

Special Note for this project:

- Normally the ambient temp. shall be 40℃(104°F), and In emergency, the temp. can reach 250℃(482°F) lasting for 1 hour.

5 RECEIVE CHECKS

- Check whether any damage has occurred during transportation.
- Check nameplate data to see if the motor meets the application requirements and to verify that the correct motor was shipped.
- After removal of shaft clamp, turn shaft by hand to check that it turns freely.
- Check the insulation resistance using a 500 volt megger. The value should be no less than 0.46 megohms.
- If the insulation resistance is lower than the above value, the windings should be dried in one of the following two ways:
  1) Bake in oven at temperatures not exceeding 120℃(248°F) until insulation resistance becomes constant;
  2) With rotor locked, apply low voltage and gradually increase the current through windings until temperature measured with a thermometer reaches 120℃(248°F). Do not exceed this temperature.

6 INSTALLATION & WIRING

- The motor is designed to drive couplings, gears, and pulleys. If the application is belt driven, the shaft centre line of both motor and machine must be parallel. If the motor is connected to the load with a coupling, be sure both shafts are aligned (see NEMA MG1-14).
- Be sure the motor rotates in the same direction as the machine it drives.

Special Note for this project:

- Motors with 9 leads and detailed wiring method as per "2.4 motor wiring drawing" shown above.

7 START UP

- Start the motor unloaded:
  - ✓ Check the direction of rotation. If rotation direction must be changed, interchange any two leads of a three-phase motor.
  - ✓ Check the motor if there is any of the following premature bearing failures:
    - ■ Loose / tight fit
    - ■ Heat (bearing temperature shall not exceed 95℃/203°F)
    - ■ Lack of Grease or grease needs to be changed
    - ■ Abnormal noise

    If any of them occurs, stop the motor immediately and repair.
  - ✓ Check supply power voltage, which should not deviate from the rated value by more than±10%. Frequency should not deviate by more than ±5% from rated value. The absolute value of both voltage and frequency should not deviate from the rated value by more than ±10%. If the motor data sheet specifies different voltage and frequency variation, follow the data sheet.
- Start the motor with load.
  - ✓ The motor should start quickly and run smoothly. If no, shut power off at once. Recheck the assembly including all connections before restarting.
  - ✓ If excessive vibration is noted, check for loose mounting bolts too flexible motor support structure or transmitted vibration from adjacent machinery. Periodic vibration checks should be made; foundations often settle.
  - ✓ Operate under load for short period of time and check operating current against nameplate.

8 MAINTENANCE

Maintenance should be carried out periodically, which can be divided into two parts: monthly maintenance and yearly maintenance.

Special Note for this project:

- High temperature grease must be adopted according to the motor data sheet.
- The motors are supplied with loose leads. Where a terminal box is fitted, all cable terminations should be tightly secured.

8.1 Monthly maintenance

- Clean up: clear away the dust and dirt on outside surface of enclosure and measure insulation resistance.
- Check connecting terminals：Check the connecting bolts (nuts) in terminal box to see whether connecting bolts (nuts) are loose or not. Replace them when necessary.
- Check the bolts (nuts): check earthing bolts (nuts), fastening bolts on end shield and internal and external bearing covers, connection of ground lead and setting.

- Check bearing: dismounting bearing cap, check whether the grease in bearings has been dirty and dried up or not. It should be replenished as required if there is short of grease. Replace the bearings when necessary.
- Check motor fan to see whether it has been ruptured or damaged and fixed firmly, fastening bolts (nuts) loosened, damaged, worn and deformed. Replace them when necessary.

8.2 Yearly maintenance

- Yearly maintenance or overhaul consists of monthly maintenance or routine repair.
- Check the appearance of motors: Check the appearance of motors to see whether it has been damaged. Clear away dust and dirt and repair damaged sections.
- Clear the inside of motors：
  a) Check to see whether the stator windings are dirt and damaged. Clean away dust and dirt on the stators. If oil dirt can be found on stators, clean them with dry cloth first and then with dry cloth dipped a bit oil. At the same time, check winding insulation carefully to see whether there is any aging or scale off traces. If these traces are present, the stators should be repaired and painted.
  b) Check rotor winding to see whether rotor windings are dirt or damaged, observed visually the rotor end ring or color comparison to see whether there is any crack, staining and damage.
  c) Check stator and rotor cores to see whether there is any deformation, otherwise the stator and rotor cores should be repaired.
- Check windings：
  a) Check the stator windings and rotor windings to see whether short circuit or open circuit between inter-phases or inter-turns, tip-off and burnt out occur. If any, solve these discovered problems.
  b) Measure insulation resistance on all live parts with a megger and the insulation resistance value should be larger than 1MΩ.
- Bearing clean and check：
  a) Put the bearings into a container filled with gasoline and stir them time and again. Then hold bearing inner circle by hand and rotate top circle. During rotating, put them into another container for cleaning. It is enable to adopt shrink-on method when mounting bearings but the oil temperature should not be higher than 100℃ /212°F and bearings should be heated even.
  b) Check bearing surface roughness and ball or bearing race to see whether bearings have become purple and annealed by heating. Replace bearings if necessary.
  c) Measure bearing internal and external diameter and width, if the condition permits.
- Preliminary operation after overhaul：
  The preliminary operation should be done after overhaul if motor windings are in good condition. Measure insulation resistance and check the condition of all parts.
  Motors should run without load for half an hour and then with load.

8.3 Cautions:

- During the operation, the maximum permissible temperature of the bearings should not exceed 95℃/203°F (with a thermometer). The bearings must be inspected at least once for operation of 2500h. And it is necessary to change for lubricating-grease in time after clean them with gasoline if any degeneration is found. Clean away the waste

grease from grease drain and replenish devices in order to make the devices clean and unblock. Bearings should be cleaned up with gasoline. The amount of grease should be increased by degrees along with frame size upgrade. Generally, No. 2 Lithium-base grease is recommended. The special grease is indicated on nameplate.

- While the motor being assembled or dismantled, its fitting surface must be kept from damage, and shall be coated with Anti-rust Grease 204-1 and no rust or damage appears.
- When the stator is taken out from the motor or insert into the motor, the stator windings and insulation should be paid attention in order to avoid them being damaged.
- When renewing windings, the winding data and insulating construction should not be changed. Changing windings at will often make certain or some performance worsen and make the motor useless.

9 TYPICAL FAILURES & SOLUTIONS

9.1 Common electrical failures and solutions

Failure	Source of failure	Method of handling
1. Motor fails to start	1)Power supply is not switched on	1) Check switch, fuse element, each pair of contact points and outlet.
	2) Windings are broken	2) Heat the broken part to permissible insulation temperature to have varnish paint soften, then pick up the disconnection and repair-weld the broken conductor with the wire of the same specification，finally insulation， painting and dry-out procedure are carried out.
	3)Either windings are earthed or inter-phases short circuit	3)The method of handling is the same as above, except that the earth or short circuit parts should be pillowed with insulation，then paint and dry them.
	4)Windings are connected in error	4) Check wiring diagram，connect wires again according to correctly rejoining method after heating head ends (including binding, insulation treatment and painting).
	5) Fuse elements burn out	5) Checkout cause of fault and shoot the fault, and fit new fuse element according to motor specification.
	6) Leads are connected in error in control equipments	6) Adjust connection.
2. Fuse elements are broken by burning after energizing	1) Single-phase start	1) Check power line, motor outlet, fuse and each contact point in switch，found out broken conductor or dummy connecting failure and deal with them.
	2) Motor is overloaded or seized	2) Adjust load value to rated one and deal with driven machine failure.
	3) Sectional area of fuse elements is too small	3) This fuse element can not prevent motor from overload. Select it generally from the formula: rated current of fuse element＝starting current /(2~3).
	4) Connecting line between power and motor is short circuit	4) Check short-circuit point and deal with it.

3. Motors can not start but sent out noise.	1) Motor is overloaded or seized	1) Inspect equipment and shoot the trouble.
	2) Power supply is not all switched on	2) Replace fuse element in fuse box, fasten loosened bolts on connect rod, shoot the broken or dummy connecting failures with multimeter and then deal with them.
	3) Voltage is too low	3) If motor is Y connected instead of delta connected，change back the delta connecting. When supply voltage is too low, contact with power supply department. If the voltage in power line dropped too much，change with thick cable.
	4) Grease is hardness for small-sized motors or motors are mounted too tight	4) Select right grease and increase mounting quality.
4. Motor cases charging	1) Power line and earth lead are in error	1) Correct the error.
	2) Motor windings damp and insulation ages severely	2) Dry motor and renew aged insulation.
	3)Outlet and terminal box are earthed	3) Bind or renew outlet insulation and repair terminal box.
5. Motors start difficultly and motor speed is lower than rated speed at rate-load condition.	1) Supply voltage is too low	1) Check supply voltage at the input end of the motor with a voltmeter or multimeter，then deal with it.
	2) △ connecting windings are misconnected as Y connecting	2) Change Y connecting back to delta connecting.
	3) Squirrel cage rotor is sealing-off or rupture	3) Check sealing-off or rupture and repair them.
	4) Number of turns is more when rewinded	4) Rewind windings according to correct number of turns.
6. Low insulation resistance	1) Windings damp or are showered by water	1) Heat and dry process should be carried out.
	2) Winding insulation is aging	2) If insulation can continue in service after checkup, clean up，dry and repaint it. Otherwise, replace the insulation.
7. When operation, motors can set out abnormal noise	1) Bearings are worn or out of order	1) Repair or replace bearing.
	2) Stator or rotor core is loose	2) Check up the cause of vibration，press the core again and deal with it.
	3) Voltage is too high or unbalance	3) Measure the voltage on power supply，check the cause of over tension and off-balance and deal with them.
	4) Bearings run short of grease	4) Clean up bearing and replenish grease. The amount of grease to be filled up should be half to one third the net volume of the bearing house.
	5) Fans knock against fan covers or air tunnels are blocked	5) Repair fan and fan cover to achieve correct dimension and clear up ventilation tunnel.

	6) Air gaps are not even and stator and rotor rubbed	6) Adjust air gap and increase mounting quality.
8. Motors superheat or smoke	1) Supply voltage is too high to make the flux density in iron core over saturated and motor temperature-rise too high	1) If supply voltage excesses standard value too much, contact with power supply department.
	2) Supply voltage is too low to make motor temperature-rise too high	2) If voltage in power line dropped too much, replace thicker one. If supply voltage is too low, contact with power supply department to increase supply voltage.
	3) Stator and rotor iron cores rub to each other	3) Check source of failure. If bearing clearance is larger than limiting value, replace the bearing. If shaft has bent, align it. If the core has loosed or deformed, handle iron core to troubleshoot.
	4) Motor overloads or resistance is too large when driving manufacturing machine to have motors heating	4) Remove the failure of driven machine to decrease resistance. According to the indication of electric current, if the current excesses rated value，reduce load，replace larger output motor or increase capacity.
	5) Motor is started or positive and negative rotates frequently	5) Decrease number of just- and reverse-rotation or replace a suitable motor.
	6) Fan is in trouble to out of condition to ventilation	6) Check the motor fan to see whether the fan has damaged, fan leaves deformed or fixed in poor. Replace fan, when necessary.
9. When no-load operation, motor electric current is imbalance and phase difference is very large	1) Supply voltage is unbalance	1) Measure supply voltage to find out the cause of failure.
	2) Windings are out of order, such as turn-to-turn short circuit, certain coils connected in reverse etc.	2) Disassemble the motor to check polarity and failure in windings，then correction polarity or troubleshoot.

9.2 Common mechanical failures and solutions

Failure	Source of failure	Method of handling
1. Motors vibrate	1) Bearings have worn out and gaps are not up to grade	1) Check bearing clearance.
	2) Air gaps are not even	2) Adjust air gap to meet specifications.
	3) Rotor is unbalance	3) Find out the cause of failure and adjust dynamic balance after cleaning the rotor and fastening each bolt.

	4) The rigidity of enclosure is not enough	4) Find out and reinforce the trouble spot to increase enclosure rigidity.
	5) The foundation is not strong enough and so the motor is mounted out of level	5) Strengthen the foundation and align , level up and fasten the motor feet.
	6) Fan is out of balance	6) Repair the fan，adjust the geometric shape or adjust balance.
	7) Shaft is bending	7) Align the shaft.
	8) Rotor core has deformed or been looseness	8) Adjust the iron core and then stack up iron core again.
	9) The foundation bolts for motor have been loosening	9) Fasten the foundation bolts for motor or replace unqualified foundation bolts.
2. Bearing heating in excess of specification	1) Grease is either too much or little	1) Replenish the bearing with grease according to operation instruction.
	2) Oiliness is out of condition and impure	2) Check whether the grease is impurity. Replenish with purity grease, when necessary.
	3) Oil seal is fit too tight	3) Replace or repair oil seal.
	4) Inner bearing covers decenter and rub with shaft	4) Repair inner bearing cover to achieve the appropriate bearing gap.
	5) End shields or bearing covers at both ends of motor are mounted out of level	5) Place end shield or bearing cover into spigot by correct process and then fasten bolts evenly.
	6) Bearings are out of order，worn out and dirt etc.	6) Replace the damaged bearing. Clean up the dirt bearings thoroughly and replenish oil (grease).
	7) The linking between motor and driven gear decenter or driving belt is mounted too tightly	7) Adjust the center line between motor and driven gear and the tension of driving belt.
	8) The selection of bearing brand is not correct to have rolling body bear load too heavy	8) Select suitable bearing brand.
	9) Bearing clearance is either too much or too little	9) Replace the bearing.

10 RENEWAL PARTS

- Use only genuine WOLONG/CNE renewal parts or as recommended by WOLONG /CNE motor company.
- When you order renewal parts please specify complete information to WOLONG CNE. Such as type, frame no., poles, horsepower, voltage, series no., quantity, and so on.

11 CONTACT

FOR FURTHER INFORMATION PLEASE CONTACT,

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Section 4

Impeller Locking Device

SEPT
2012

Fenner Drives®

Keyless Locking Devices

Trantorque®

B-LOC®

B-LOC®

Series B112, B115 & B113 ..... page 28

- Wide, double taper design for enhanced bending moment capacity
- Exceptional concentricity with thru-bored hubs
- No axial movement during installation
- Available in Standard, Heavy and Extra-Heavy Duty models

Series B117 ..... page 32

- Shorter length than other locking assemblies with two tapers
- Exceptional concentricity and ability to transmit bending loads
- High bending moment capacity ($M_b = 0.65 \times M_t$)
- Continuous inner promotes ease of removal
- No axial movement during installation

Series B109 ..... page 33

- Designed for shafts as small as 1/4" or 6mm
- Shallow, single taper design with integrated push-off threads
- Exceptional concentricity and ability to transmit bending loads
- No axial movement during installation

Series B106 ..... page 34

- Shallow, single taper design with integrated push-off threads
- Exceptional concentricity and ability to transmit bending loads
- Use optional integrated spacer sleeve to mount narrow hub components
- No axial movement during installation

Series B103 ..... page 36

- Shallow, single taper design with integrated push-off threads
- Exceptional concentricity and ability to transmit bending loads
- Limited axial movement during installation

Series B800 ..... page 38

- Shallow, single taper design
- Exceptional concentricity
- Thin, extra wide sleeves provide low contact pressures allowing for smaller diameter hubs
- Integrated spacer sleeve eliminates axial movement during installation
- Minimal OD/ID ratio

Series B400 ..... page 40

- Self-releasing, double taper design permits simple adjustment and removal
- Not self-centering. Available pilot bushings provide pre-centering when required
- No axial movement during installation

Series 10, 20 & 30 Shrink Discs ..... page 43

- External locking device
- Provides extremely concentric and well-balanced mechanical interference fit
- Offered in Standard, Light, and Heavy Duty series
- Also available in Split and Half Shrink Disc designs (see page 45)

Series 40 Shrink Discs ..... page 50

- External locking device
- Easy and quick installation with no torque wrench required
- High torque performance and dynamic balance

WK Shaft Couplings ..... page 52

- Rigid shaft coupling
- External locking device
- Transmits high torque and bending moments using the same principles as the Shrink Disc

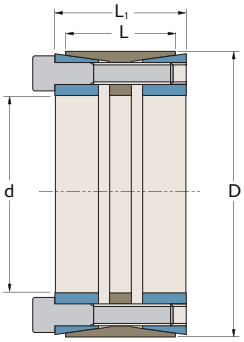
B-Loc series B112 has been utilized during high temperature testing at Clarage facility for temperatures upto 300 C for 1 hour. Test reports available upon request

B-LOC B112

Locking screws transfer to integrated push-off holes for disassembly.

Metric socket head locking screws ISO 4762 grade 12.9 (See M_a for install torque).

Screw head height = screw diameter (mm)



TOLERANCE (T_L)

Bore diameter machined to D -0/+T_L

T_L = .002" for bores up to 4.724"
.003" for bores up to 12.008"
.004" for bores up to 25.000"
.005" for bores over 25.000"

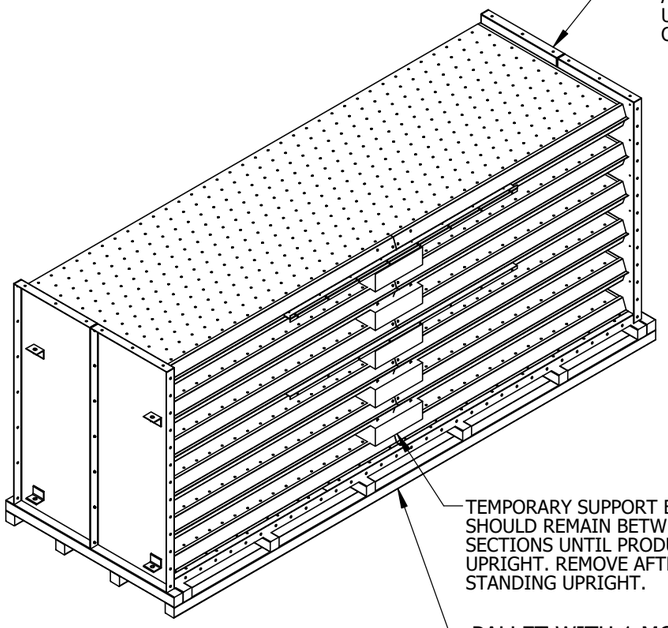
d = shaft diameter machined to d +0/-T_L.

B112 – Heavy Duty – Inch

Part Number	d (inch)	D (inch)	L (inch)	L_1 (inch)	Locking Screws Qty	Locking Screws Size	M_a Install Torque (ft lb)	M_t Maximum Transmitted Torque (ft lb)	Th Maximum Transmitted Thrust (lbs)	P_h Hub Pressure (psi)	Shipping Weight (lb)
B122100	1	2.165	1.260	1.575	6	M6 x 35	12	600	14390	18656	1.0
T122102	1 1/8	2.165	1.260	1.575	6	M6 x 35	12	675	14390	18656	1.0
B122103	1 3/16	2.165	1.260	1.575	6	M6 x 35	12	712	14390	18656	0.9
B122104	1 1/4	2.362	1.732	2.126	7	M6 x 45	12	874	16788	14083	1.5
B122106	1 3/8	2.362	1.732	2.126	7	M6 x 45	12	962	16788	14083	1.4
B122107	1 7/16	2.362	1.732	2.126	7	M6 x 45	12	1006	16788	14083	1.3
B122108	1 1/2	2.953	1.732	2.126	7	M8 x 50	30	2011	32182	21598	2.4
B122110	1 5/8	2.953	1.732	2.126	7	M8 x 50	30	2179	32182	21598	2.3
T122111	1 11/16	2.953	1.732	2.126	7	M8 x 50	30	2263	32182	21598	2.3
B122112	1 3/4	2.953	1.732	2.126	7	M8 x 50	30	2347	32182	21598	2.1
B122114	1 7/8	3.150	2.205	2.598	8	M8 x 55	30	2873	36779	17881	2.9
B122115	1 15/16	3.150	2.205	2.598	8	M8 x 55	30	2969	36779	17881	2.8
B122200	2	3.150	2.205	2.598	8	M8 x 55	30	3065	36779	17881	2.6
B122202	2 1/8	3.346	2.205	2.598	9	M8 x 55	30	3664	41377	18933	2.9
B122203	2 3/16	3.346	2.205	2.598	9	M8 x 55	30	3771	41377	18933	2.8
B122204	2 1/4	3.543	2.205	2.598	10	M8 x 55	30	4310	45974	19868	3.3
B122206	2 3/8	3.543	2.205	2.598	10	M8 x 55	30	4550	45974	19868	3.1
B122207	2 7/16	3.740	2.205	2.598	10	M8 x 55	30	4669	45974	18822	3.6
B122208	2 1/2	3.740	2.205	2.598	10	M8 x 55	30	4789	45974	18822	3.4
B122209	2 9/16	3.740	2.205	2.598	10	M8 x 55	30	4909	45974	18822	3.3
B122210	2 5/8	4.331	2.756	3.150	10	M10 x 60	60	8155	74561	20714	7
T122211	2 11/16	4.331	2.756	3.150	10	M10 x 60	60	8349	74561	20714	7
B122212	2 3/4	4.331	2.756	3.150	10	M10 x 60	60	8543	74561	20714	6
B122214	2 7/8	4.331	2.756	3.150	10	M10 x 60	60	8932	74561	20714	6
B122215	2 15/16	4.724	2.756	3.150	11	M10 x 60	60	10039	82017	20887	8
B122300	3	4.724	2.756	3.150	11	M10 x 60	60	10252	82017	20887	7
T122302	3 1/8	4.724	2.756	3.150	11	M10 x 60	60	10679	82017	20887	7
B122304	3 1/4	4.724	2.756	3.150	11	M10 x 60	60	11107	82017	20887	7
B122306	3 3/8	5.118	2.756	3.150	12	M10 x 60	60	12582	89474	21033	8
B122307	3 7/16	5.118	2.756	3.150	12	M10 x 60	60	12815	89474	21033	8
B122308	3 1/2	5.118	2.756	3.150	12	M10 x 60	60	13048	89474	21033	8
T122310	3 5/8	5.118	2.756	3.150	12	M10 x 60	60	13514	89474	21033	7
B122312	3 3/4	5.709	3.543	4.016	11	M12 x 80	105	19172	122699	20688	13
B122314	3 7/8	5.709	3.543	4.016	11	M12 x 80	105	19811	122699	20688	12
T122315	3 15/16	5.709	3.543	4.016	11	M12 x 80	105	20130	122699	20688	13
B122400	4	5.709	3.543	4.016	11	M12 x 80	105	20450	122699	20688	12
T122404	4 1/4	6.102	3.543	4.016	12	M12 x 80	105	23703	133853	21112	14
T122406	4 3/8	6.102	3.543	4.016	12	M12 x 80	105	24400	133853	21112	13
B122407	4 7/16	6.496	3.543	4.016	14	M12 x 80	105	28874	156162	23138	16
B122408	4 1/2	6.496	3.543	4.016	14	M12 x 80	105	29280	156162	23138	16
T122412	4 3/4	6.496	3.543	4.016	14	M12 x 80	105	30907	156162	23138	14
B122415	4 15/16	7.087	4.094	4.567	12	M14 x 90	166	37477	182167	20618	21
B122500	5	7.087	4.094	4.567	12	M14 x 90	166	37952	182167	20618	21
B122504	5 1/4	7.480	4.094	4.567	14	M14 x 90	166	46491	212528	22789	24
B122507	5 7/16	7.480	4.094	4.567	14	M14 x 90	166	48151	212528	22789	22
T122508	5 1/2	7.480	4.094	4.567	14	M14 x 90	166	48704	212528	22789	21
T122512	5 3/4	7.874	4.094	4.567	15	M14 x 90	166	54555	227709	23196	24
B122515	5 15/16	7.874	4.094	4.567	15	M14 x 90	166	56334	227709	23196	22
B122600	6	8.268	4.094	4.567	16	M14 x 90	166	60722	242890	23564	26
T122607	6 7/16	8.858	5.276	5.866	14	M16 x 110	257	77782	289982	20051	40
T122608	6 1/2	8.858	5.276	5.866	14	M16 x 110	257	78537	289982	20051	39
B122615	6 15/16	9.252	5.276	5.866	15	M16 x 110	257	89810	310695	20569	40
B122700	7	9.252	5.276	5.866	15	M16 x 110	257	90619	310695	20569	38
T122704	7 1/4	9.843	5.276	5.866	16	M16 x 110	257	100113	331408	20624	47
T122707	7 7/16	9.843	5.276	5.866	16	M16 x 110	257	102702	331408	20624	44
T122708	7 1/2	9.843	5.276	5.866	16	M16 x 110	257	103565	331408	20624	43
T122712	7 3/4	10.236	5.276	5.866	16	M16 x 110	257	107017	331408	19830	48
T122715	7 15/16	10.236	5.276	5.866	16	M16 x 110	257	109606	331408	19830	45
T122800	8	10.236	5.276	5.866	16	M16 x 110	257	110469	331408	19830	44

Section 5

Silencer



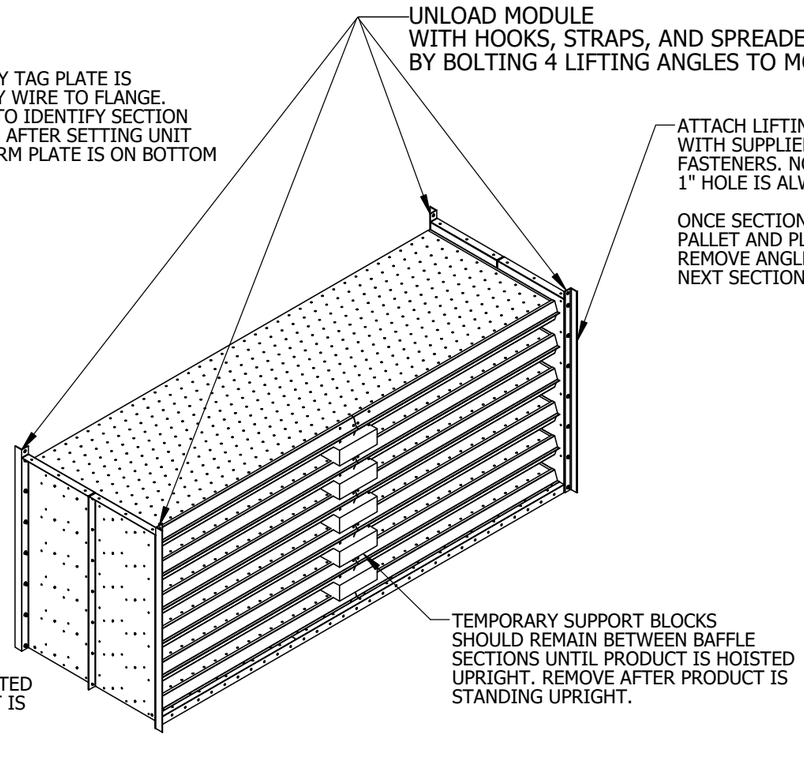
A TEMPORARY TAG PLATE IS ATTACHED BY WIRE TO FLANGE. PLEASE USE TO IDENTIFY SECTION AND REMOVE AFTER SETTING UNIT UPRIGHT. PERM PLATE IS ON BOTTOM OF UNIT.

TEMPORARY SUPPORT BLOCKS SHOULD REMAIN BETWEEN BAFFLE SECTIONS UNTIL PRODUCT IS HOISTED UPRIGHT. REMOVE AFTER PRODUCT IS STANDING UPRIGHT.

PALLET WITH 1 MODULE
WEIGHS APPROX 3,625 LBS.

SINGLE MODULES ON SHIPPING PALLET

1 OF 24 MODULE PALLETS

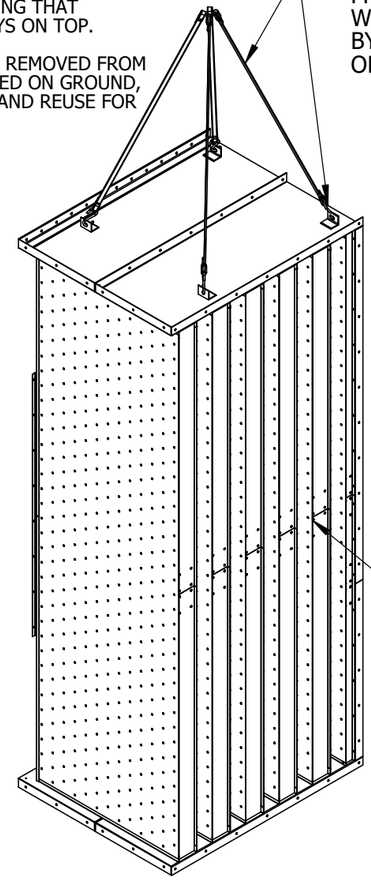


UNLOAD MODULE
WITH HOOKS, STRAPS, AND SPREADER BAR
BY BOLTING 4 LIFTING ANGLES TO MODULE ENDS.

ATTACH LIFTING ANGLES WITH SUPPLIED 1/2" FASTENERS. NOTING THAT 1" HOLE IS ALWAYS ON TOP.

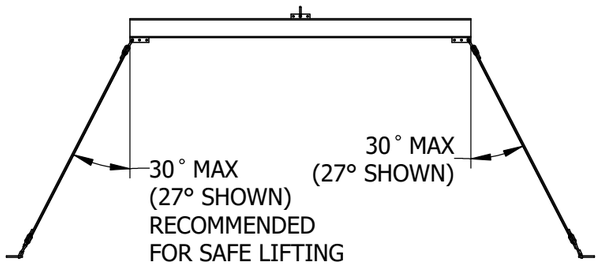
ONCE SECTION IS REMOVED FROM PALLET AND PLACED ON GROUND, REMOVE ANGLES AND REUSE FOR NEXT SECTION.

TEMPORARY SUPPORT BLOCKS SHOULD REMAIN BETWEEN BAFFLE SECTIONS UNTIL PRODUCT IS HOISTED UPRIGHT. REMOVE AFTER PRODUCT IS STANDING UPRIGHT.



LIFT MODULE
FROM HORIZONTAL TO VERTICAL
WITH HOOKS AND STRAPS
BY HOOKING INTO 4 LIFTING LUGS
ON THE MODULE TOP.

ALL TEMPORARY SUPPORT BLOCKS MUST BE REMOVED ONCE MODULE IS UPRIGHT. (BLOCKS NOT SHOWN)



TYP FOR ALL LIFTING

(SEE NOTE 3 THIS SHEET)

NOTES:

1. STEP 1 OF 5. UNLOAD LOOSE GOODS FROM PALLETS
2. STEP 2 OF 5. LAYOUT AND ARRANGE CHANNELS FOR ASSEMBLING 1 ATTENUATOR. (SEE SHEET 2)
3. STEP 3 OF 5. UNLOAD MODULES FROM PALLET. USE STRAPS (BY OTHERS), HOOKS (BY OTHERS), BOLT-ON LIFTING ANGLES (SUPPLIED BY POTTORFF) AND A SPREADER BAR (SUPPLIED BY OTHERS) TO LIFT AS SHOWN. EACH MODULE WEIGHS APPROX. 3,125 LBS.
4. STEP 4 OF 5. STAND MODULES UP. USE STRAPS AND HOOKS IN LIFTING LUGS THAT ARE WELDED ON THE TOP OF EACH MODULE.

UNLESS OTHERWISE SPECIFIED DIMENSION ARE IN INCHES.

TOLERANCE UNLESS NOTED:
X.X ±0.060
X.XX ±0.030
X.XXX ±0.010
ANGLE ±1°
FRACTION ±1/16

MAX HOLE BREAKOUT:
15% OF MATERIAL THICKNESS

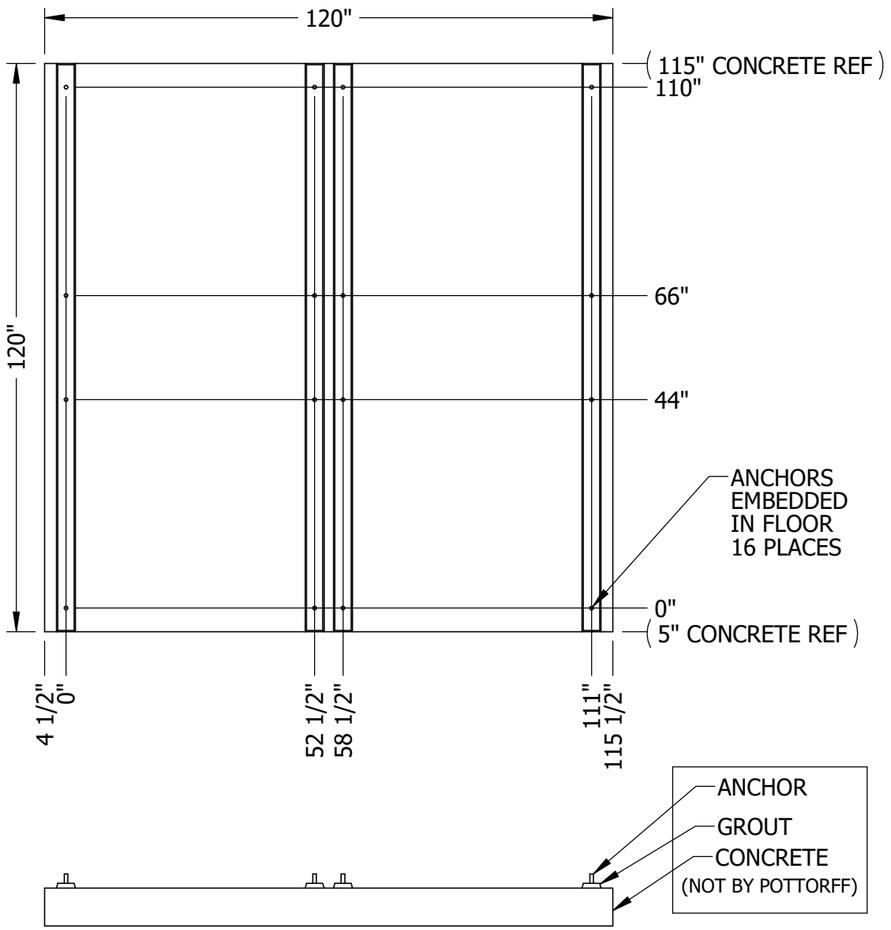
5101 Blue Mound Road
Fort Worth, Texas 76106
Phone: 817-509-2300
Fax: 817-831-3110

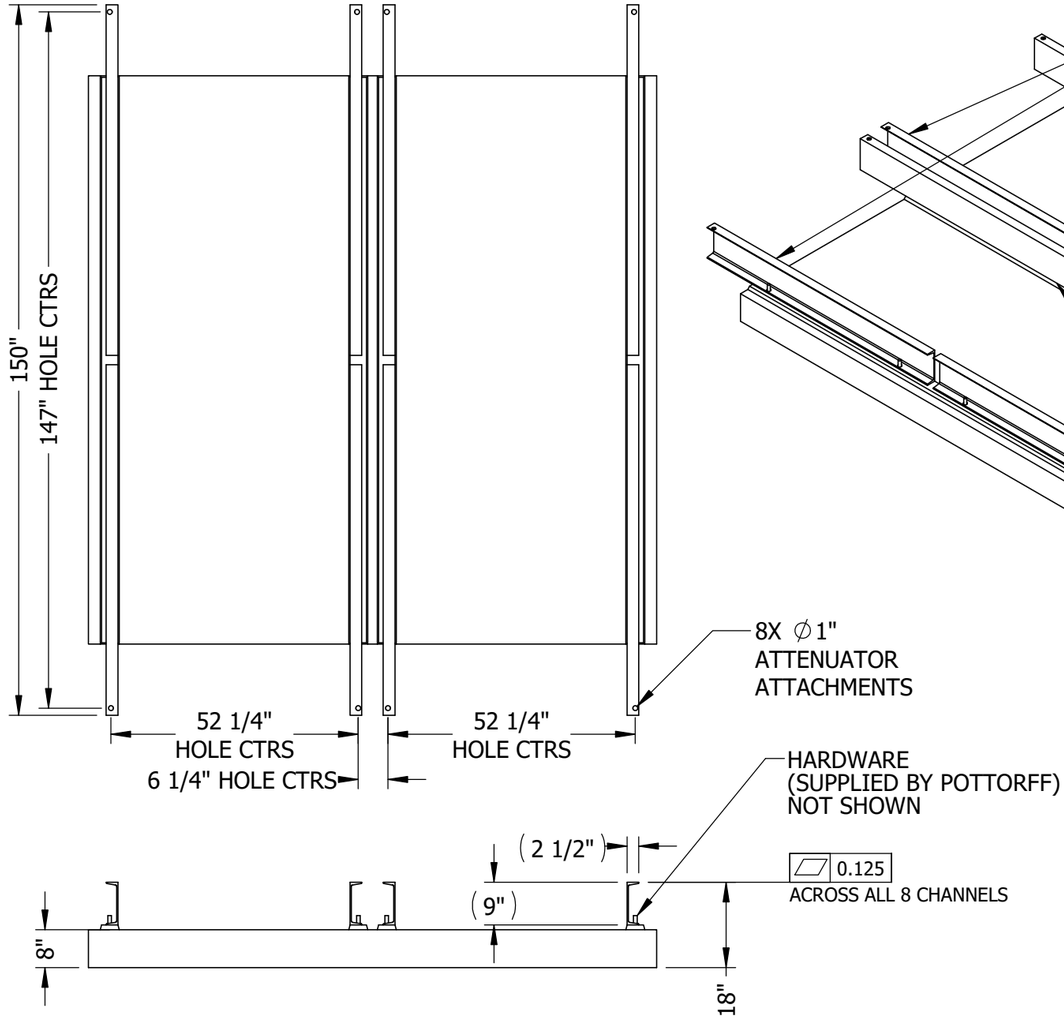
THIRD ANGLE PROJECTION

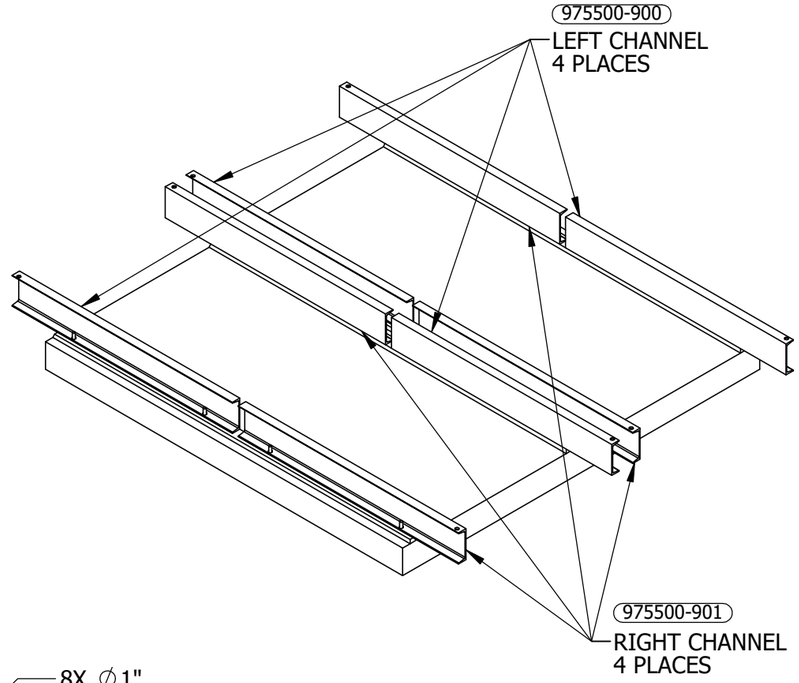
POTTORFF

DRAWING DESCR: SHIPPING AND UNLOADING				
PROJECT: LYTLE TUNNEL				
LOCATION: CINCINNATI, OH 45202				
CUSTOMER: TWIN CITY FAN COMPANIES				
PROJ. MGR.: ZAC PARKER		DRAWN BY: DP		
DATE: 6/7/2016	CHK'D BY: --	ORDER NUMBER	P.O. NUMBER	DRAWING NUMBER
SHEET: 1 of 7	SCALE: 3/4"=1'-0"	975500	106742	INSTALL-1

I:\0 ENGINEERING PROJECTS\ACOUSTICAL\975500 Lytle Tunnel, RFN 12H Large Silencer Bank\CAD Models\Installation Instructions\







CUSTOMER PAD LAYOUT

I:\0 ENGINEERING PROJECTS\ACOUSTICAL\975500 Lytle Tunnel, RFN 12H Large Silencer Bank\CAD Models\Installation Instructions\

UNLESS OTHERWISE SPECIFIED DIMENSION ARE IN INCHES.

TOLERANCE UNLESS NOTED:
X.X ±0.060
X.XX ±0.030
X.XXX ±0.010
ANGLE ±1°
FRACTION ±1/16

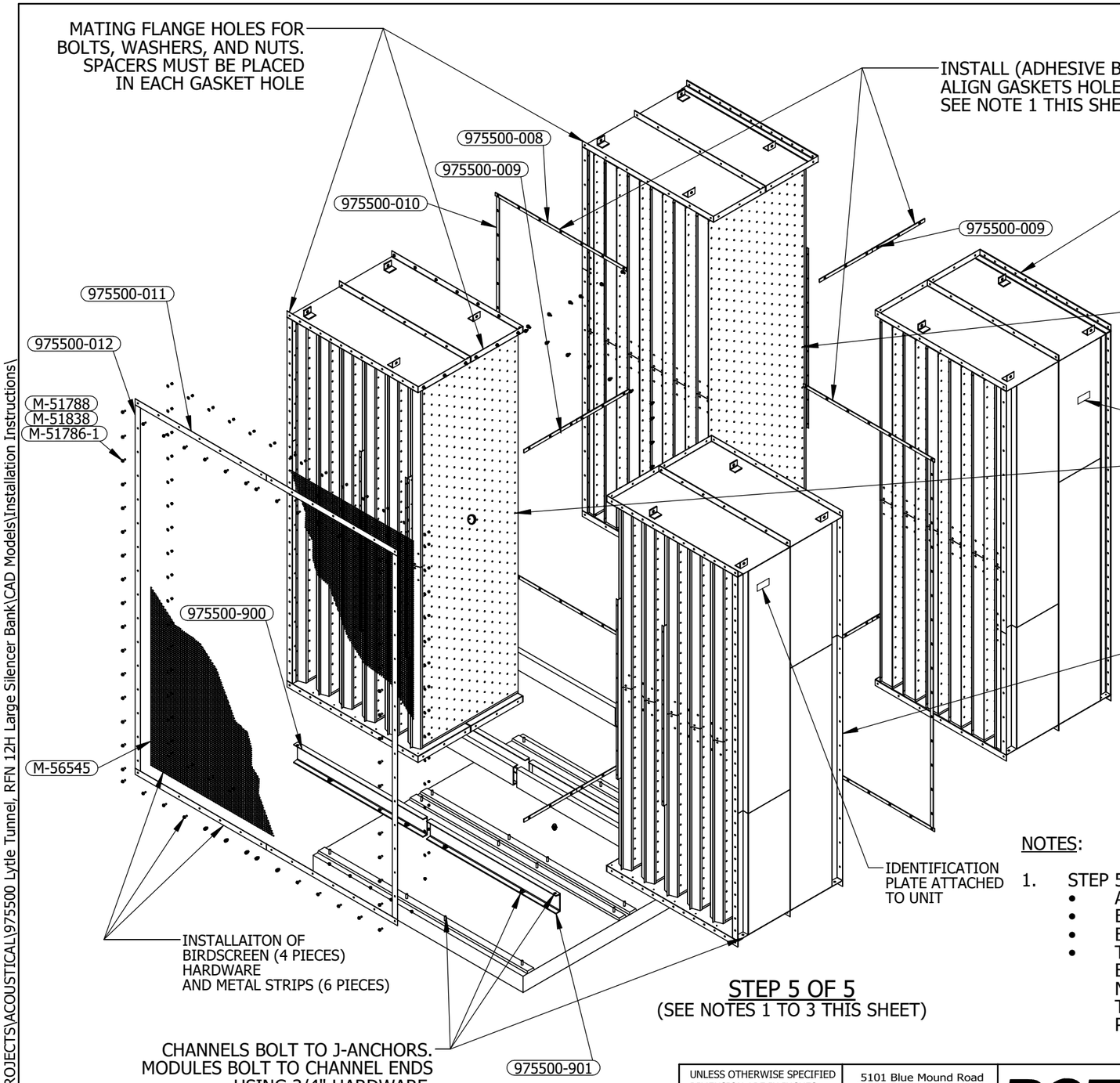
MAX HOLE BREAKOUT:
15% OF MATERIAL THICKNESS

5101 Blue Mound Road
Fort Worth, Texas 76106
Phone: 817-509-2300
Fax: 817-831-3110

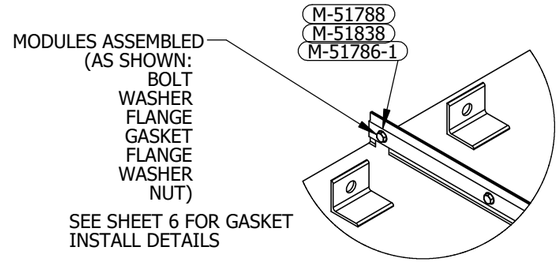
THIRD ANGLE PROJECTION

POTTORFF

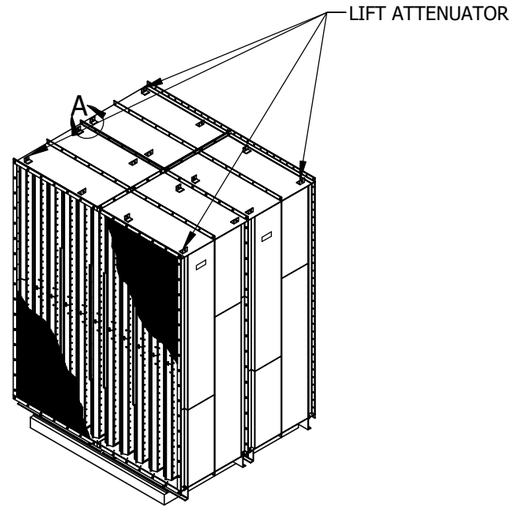
DRAWING DESCR: CUSTOMER PAD LAYOUT			
PROJECT: LYTLE TUNNEL			
LOCATION: CINCINNATI, OH 45202			
CUSTOMER: TWIN CITY FAN COMPANIES			
PROJ. MGR.: ZAC PARKER		DRAWN BY: DP	
DATE: 6/7/2016	CHK'D BY: --	ORDER NUMBER	P.O. NUMBER / DRAWING NUMBER
SHEET: 2 of 7	SCALE: NTS	975500	106742 / INSTALL-2



STEP 5 OF 5
(SEE NOTES 1 TO 3 THIS SHEET)



DETAIL A
SCALE 1 : 12



ASSEMBLED ATTENUATOR
(SEE NOTES 1 TO 3 THIS SHEET)

NOTES:

1. STEP 5 OF 5
   - ADHERE GASKETS TO MATING FLANGES BY CENTERING HOLES.
   - BOLT MODULES TO CHANNELS J-ANCHORS AND TO EACH OTHER AT FLANGES.
   - BOLT BIRDSCREENS TO INLET FACE FLANGES ON ATTENUATORS WHERE SPECIFIED.
   - TEMPORARILY ELEVATE MODULES TO ALLOW ACCESS TO HARDWARE AND CONNECTIONS AT BOTTOM FLANGES. PERMANENTLY BOLT ALL MODULES TOGETHER. BY CORRESPONDING TAG NUMBERS (TS-A1 TOGETHER FOR EXAMPLE) AND LOCATIONAL DASH NUMBERS -01, -02, -03, -04. THEN MOVE ASSEMBLED ATTENUATOR ONTO LEVELED CHANNELS. SECURE ATTENUATOR IN PLACE WITH 3/4" HARDWARE.

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UNLESS OTHERWISE SPECIFIED DIMENSION ARE IN INCHES.

TOLERANCE UNLESS NOTED:
X.X ±0.060
X.XX ±0.030
X.XXX ±0.010
ANGLE ±1°
FRACTION ±1/16

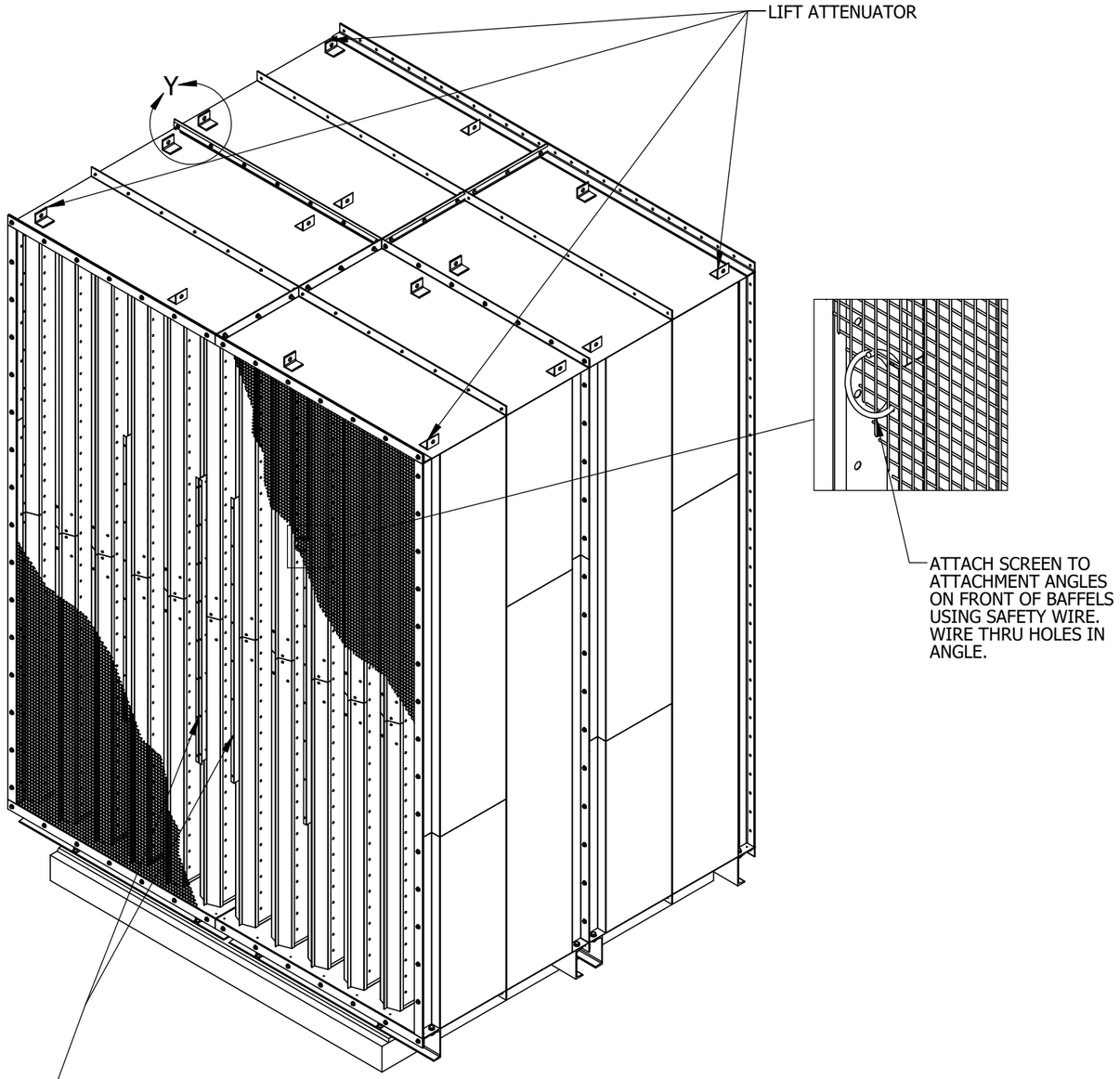
MAX HOLE BREAKOUT:
15% OF MATERIAL THICKNESS

5101 Blue Mound Road
Fort Worth, Texas 76106
Phone: 817-509-2300
Fax: 817-831-3110

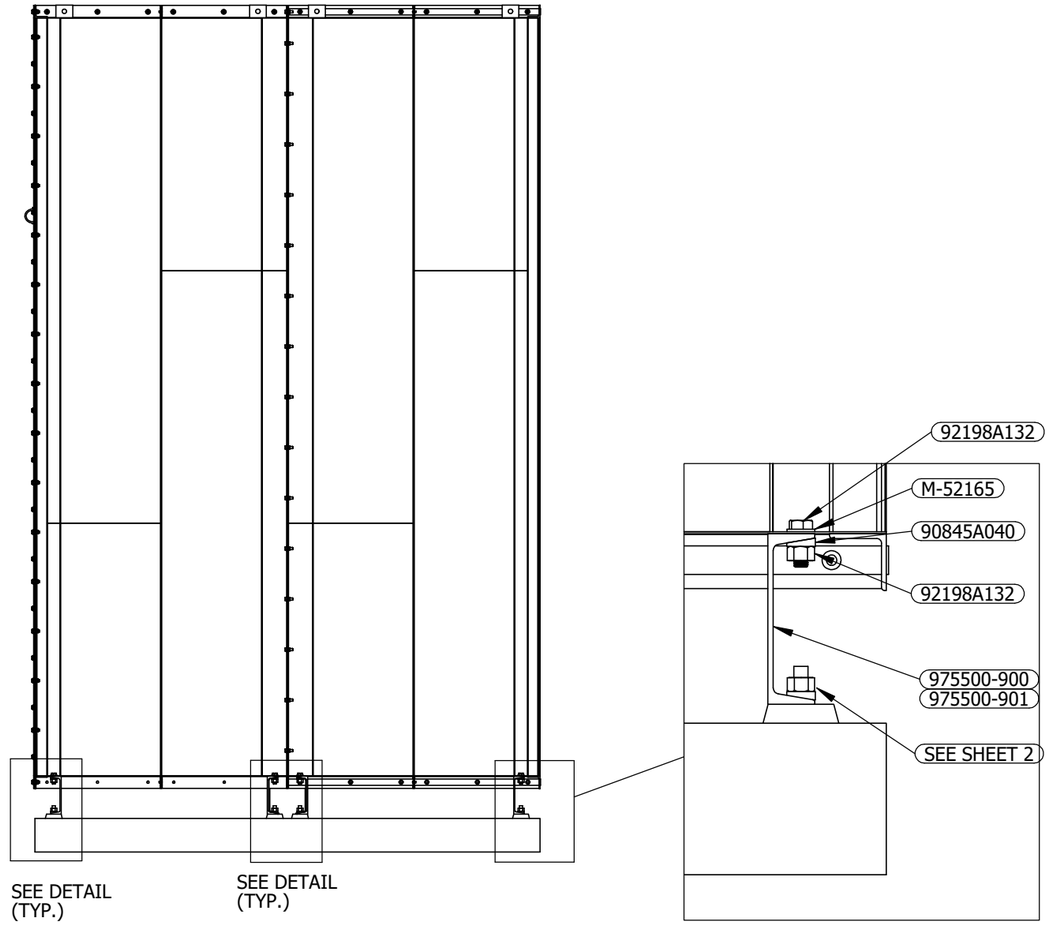
THIRD ANGLE PROJECTION

POTTORFF

DRAWING DESCR: FULL BAFFLE ASSEMBLY				
PROJECT: LYTLE TUNNEL				
LOCATION: CINCINNATI, OH 45202				
CUSTOMER: TWIN CITY FAN COMPANIES				
PROJ. MGR.: ZAC PARKER		DRAWN BY: DP		
DATE: 6/7/2016	CHK'D BY: --	ORDER NUMBER	P.O. NUMBER	DRAWING NUMBER
SHEET: 3 of 7	SCALE: 3/4"=1'-0"	975500	106742	INSTALL-3



SCREEN ATTACHMENT DETAIL



ATTACHMENT TO CUSTOMER PAD

UNLESS OTHERWISE SPECIFIED DIMENSION ARE IN INCHES.

TOLERANCE UNLESS NOTED:

X.X	±0.060
X.XX	±0.030
X.XXX	±0.010
ANGLE	±1°
FRACTION	±1/16

MAX HOLE BREAKOUT: 15% OF MATERIAL THICKNESS

5101 Blue Mound Road
Fort Worth, Texas 76106
Phone: 817-509-2300
Fax: 817-831-3110

THIRD ANGLE PROJECTION

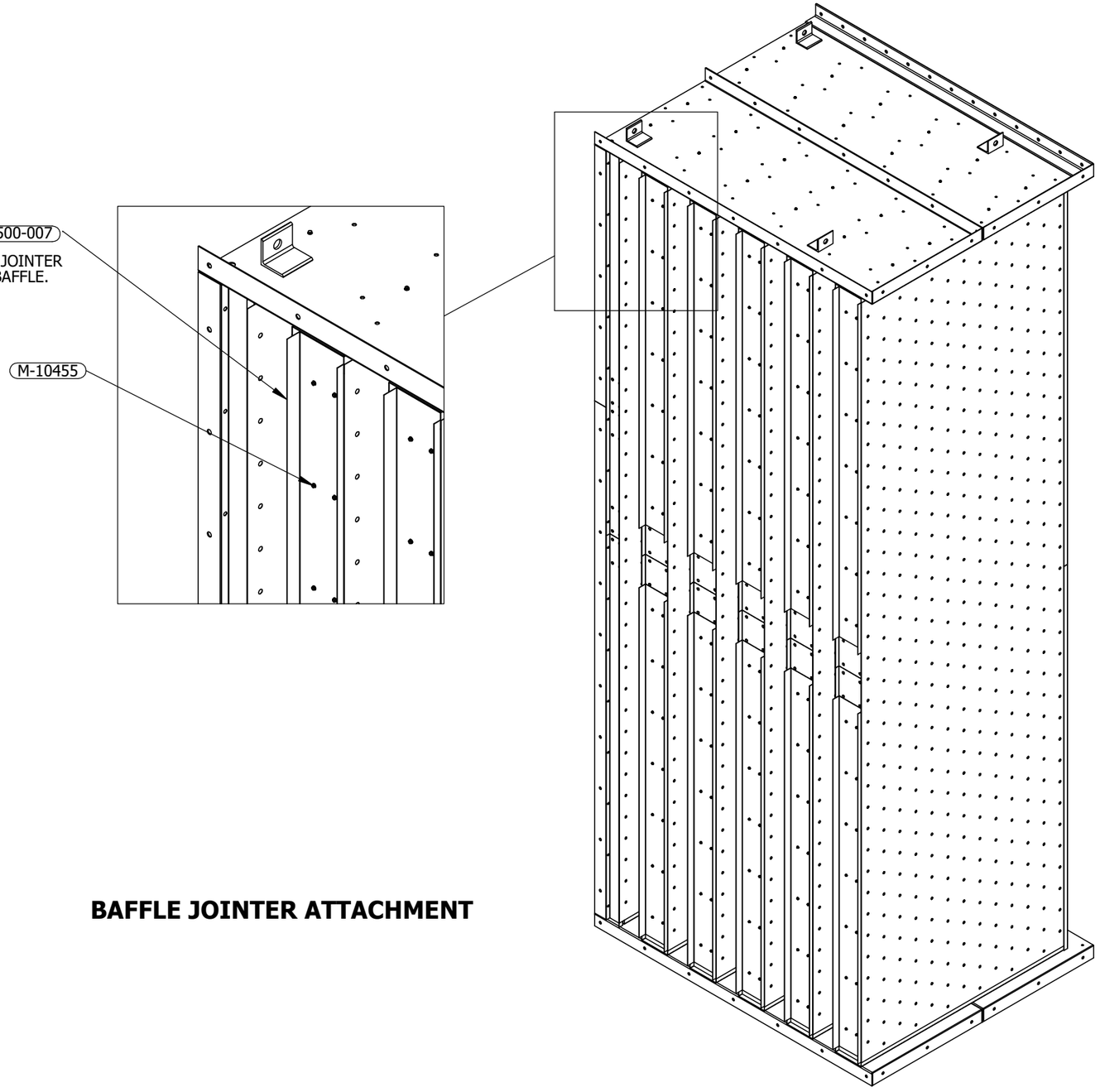
POTTORFF

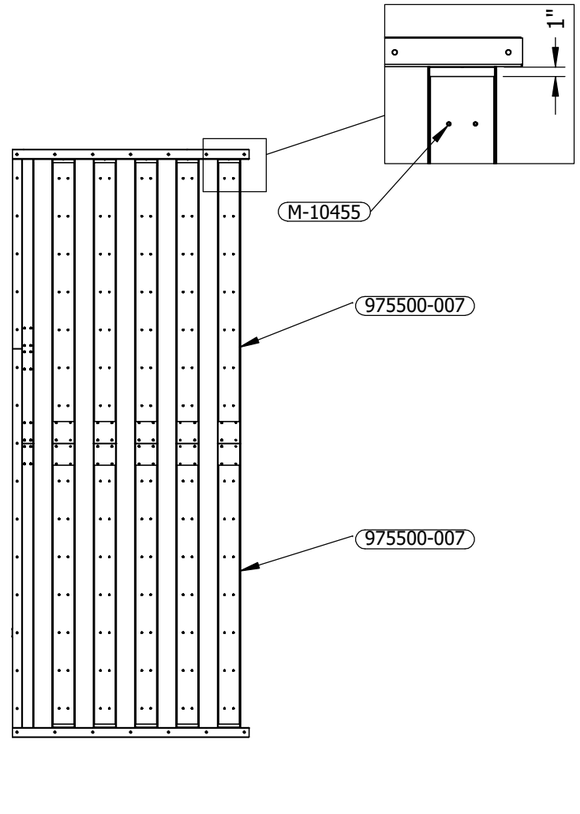
DRAWING DESCR: SCREEN & SLAB INSTALLATION
PROJECT: LYTLE TUNNEL
LOCATION: CINCINNATI, OH 45202
CUSTOMER: TWIN CITY FAN COMPANIES
PROJ. MGR.: ZAC PARKER
DRAWN BY: DP
DATE: 6/7/2016
CHK'D BY: --
SHEET: 4 of 7
SCALE: 3/4"=1'-0"

ORDER NUMBER	P.O. NUMBER	DRAWING NUMBER
975500	106742	INSTALL-4

I:\0 ENGINEERING PROJECTS\ACOUSTICAL\975500 Lytle Tunnel, RFN 12H Large Silencer Bank\CAD Models\Installation Instructions\

BAFFLE JOINTER ATTACHMENT





CUSTOMER IS TO:
~VERIFY ALL CONDITIONS
~VERIFY ALL DIMENSIONS
~VERIFY ALL QUANTITIES
~VERIFY FINISH TYPE & COLOR SELECTION

UNLESS OTHERWISE SPECIFIED DIMENSION ARE IN INCHES.

TOLERANCE UNLESS NOTED:

X.X	±0.060
X.XX	±0.030
X.XXX	±0.010
ANGLE	±1°
FRACTION	±1/16

MAX HOLE BREAKOUT:
15% OF MATERIAL THICKNESS

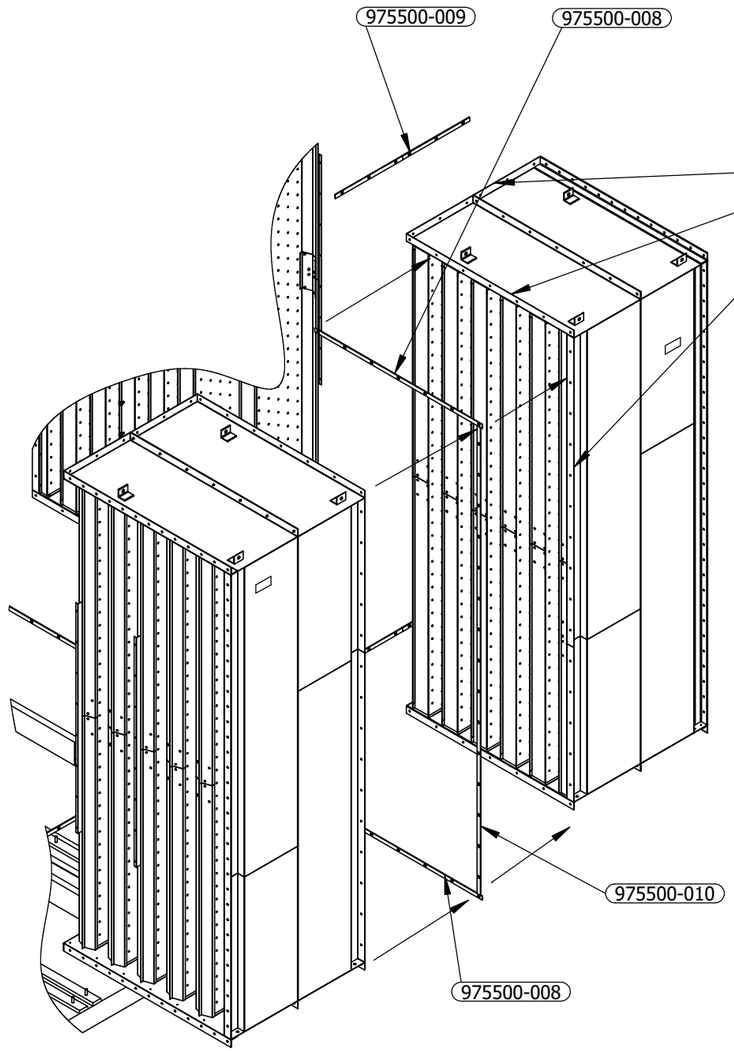
5101 Blue Mound Road
Fort Worth, Texas 76106
Phone: 817-509-2300
Fax: 817-831-3110

THIRD ANGLE PROJECTION

POTTORFF

DRAWING DESCR: BAFFLE JOINTER INSTALLATION
PROJECT: LYTLE TUNNEL
LOCATION: CINCINNATI, OH 45202
CUSTOMER: TWIN CITY FAN COMPANIES

PROJ. MGR.: ZAC PARKER		DRAWN BY: DP		
DATE: 6/7/2016	CHK'D BY: --	ORDER NUMBER	P.O. NUMBER	DRAWING NUMBER
SHEET: 5 of 7	SCALE: NTS	975500	106742	INSTALL-5



BEFORE INSTALLING GASKETS TO SECTIONS, CLEAN FLANGES FACING GASKETS WITH DENATURED ALCOHOL. MAKE SURE THE FLANGES ARE DEBRIS FREE. APPLY GASKET TO FLANGE ALIGN THE HOLES. GASKETS ARE INTENSIONALLY SHIPPED LONG, SO TRIMMING WILL BE REQUIRED.

GASKET ATTACHMENT

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UNLESS OTHERWISE SPECIFIED DIMENSION ARE IN INCHES.

TOLERANCE UNLESS NOTED:
X.X ±0.060
X.XX ±0.030
X.XXX ±0.010
ANGLE ±1°
FRACTION ±1/16

MAX HOLE BREAKOUT:
15% OF MATERIAL THICKNESS

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THIRD ANGLE PROJECTION

POTTORFF

DRAWING DESCR: FULL BAFFLE ASSEMBLY				
PROJECT: LYTLE TUNNEL				
LOCATION: CINCINNATI, OH 45202				
CUSTOMER: TWIN CITY FAN COMPANIES				
PROJ. MGR.: ZAC PARKER		DRAWN BY: DP		
DATE: 6/7/2016	CHK'D BY: --	ORDER NUMBER	P.O. NUMBER	DRAWING NUMBER
SHEET: 6 of 7	SCALE: 3/4"=1'-0"	975500	106742	INSTALL-6

SHIP LOOSE LIST						
PART NO.	QTY.	DESCRIPTION	THICKNESS	LENGTH	WIDTH	NOTES
975500-003	9	RIGHT MODULE, NO SCREEN				
975500-004	9	LEFT MODULE, NO SCREEN				
975500-005	3	LEFT MODULE, WITH SCREEN				
975500-006	3	RIGHT MODULE, WITH SCREEN				
975500-007	120	BAFFLE JOINTER (M-10316)	20 GA	82.000	10.191	
975500-008	24	GASKET, 1/4" X 1 1/2" COMPANION FLANGE, WIDTH	0.25	74.813	1.500	
975500-009	24	GASKET, 1/4" X 1 1/2" COMPANION FLANGE, DEPTH	0.25	59.767	1.500	
975500-010	24	GASKET, 1/4" X 1 1/2" COMPANION FLANGE, LENGTH	0.25	90.000	1.500	
975500-011	12	SCREEN PLATE	18 GA	75.000	3.000	
975506-012	12	SCREEN PLATE	18 GA	90.000	3.000	
M-10455	1680	SCREW, TEK, HWH, 12-14 X 1, 410 SST				
M-51788	1400	WASHER, FLAT, 1/2" I.D.	0.083			
M-51786-1	700	BOLT, HEX HEAD, 1/2-13 UNC X 1-1/2"				
M-51838	700	1/2-13 UNC, HEX NUT				
M-54546	18	1/8 SCREEN, WITH 1 X 1 SQUARES, GALVANZIED	0.12	84.000	68.000	
M-54547	1	SAFETY WIRE, SPOOL				
975500-900	24	C9 X 15 STRUCTURAL LEFT	0.285	74.000		
975500-901	24	C9 X 15 STRUCTURAL RIGHT	0.285	74.000		
90845A040	48	LEVELING WASHER, 3/4" X 0.812 ID X 1.5				
M-52165	48	WASHER, FLAT, 3/4"	0.134			
92198A132	48	HEX HEAD CAP SCREW, 3/4"-10 THREAD		2.000		
M-52166	48	NUT, HEX 3/4"-10, 18-8 SST				
LIFT ANGLES 1A	1	LIFT ANGLE	0.250	78.000		
LIFT ANGLES 1B	1	LIFT ANGLE	0.250	78.000		
LIFT ANGLES 2A	1	LIFT ANGLE	0.250	78.000		
LIFT ANGLES 2B	1	LIFT ANGLE	0.250	78.000		

CUSTOMER IS TO:
~VERIFY ALL CONDITIONS
~VERIFY ALL DIMENSIONS
~VERIFY ALL QUANTITIES
~VERIFY FINISH TYPE & COLOR SELECTION

UNLESS OTHERWISE SPECIFIED DIMENSION ARE IN INCHES.

TOLERANCE UNLESS NOTED:
X.X ±0.060
X.XX ±0.030
X.XXX ±0.010
ANGLE ±1°
FRACTION ±1/16

MAX HOLE BREAKOUT:
15% OF MATERIAL THICKNESS

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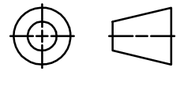
THIRD ANGLE PROJECTION



POTTORFF

DRAWING DESCR: SHIP LIST
PROJECT: LYTLE TUNNEL
LOCATION: CINCINNATI, OH 45202
CUSTOMER: TWIN CITY FAN COMPANIES
PROJ. MGR.: ZAC PARKER | DRAWN BY: DP
DATE: 6/7/2016 | CHK'D BY: --
SHEET: 7 of 7 | SCALE: NTS

ORDER NUMBER	P.O. NUMBER	DRAWING NUMBER
975500	106742	INSTALL-7

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POTTORFF®

5101 Blue Mound Road • Fort Worth, Texas 76106
tel: 817.509.2300 • fax: 817.831.3110

website: www.pottorff.com

Operation and Maintenance Instructions – Duct Silencers

1. Pottorff silencers are “passive” type silencers and therefore have no moving or electronic parts that require start-up procedures, lubrication or routine maintenance.

2. Pottorff silencers should be visually inspected at least once a year, verifying that baffles are undamaged and parallel, airspaces are free of debris and the perforations are free of dust or other foreign matter.

3. If debris must be cleaned from either the airspaces or the perforated material, the silencer should be vacuum-cleaned or wiped down with a soft cloth and mild detergent. No cleaner or other agent should ever be used that could affect the galvanized protection on the steel.

4. "White Rust" (zinc oxide) may appear and is a normal occurrence. No maintenance is required.

If we can be of further service, please feel free to call (817) 509-2300, or email us at info@pci-industries.com.

Section 6

Instrumentation

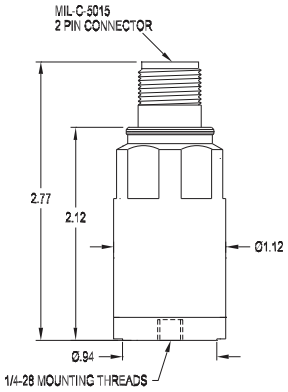
Wilcoxon Research

Model PC420V Series - RMS and peak Velocity loop powered sensors (LPS™)

Features
- True RMS or calculated peak output
- Corrosion resistant
- Hermetic seal
- ESD protection
- Overload protection
- Reverse wiring protection

Benefits
- Choice of output: RMS or peak, permits you to choose the sensor that best fits your industrial requirements
- Provides continuous trending of overall machine vibration
- Can help guide maintenance in prioritizing need for service
- Helps notify of impending equipment failure

The 4-20 mA output of the PC420V Series is proportional to velocity vibration. An output of 4 mA indicates a level of 0 ips or no vibration present. A full-scale reading of 20 mA indicates that the maximum range (RMS or peak) of vibration is present.



Output, 4-20 mA

Full scale, 20 mA (±5%)	see table 1 on back
Frequency response:	
±10%	10 Hz - 1.0 kHz
±3 dB	3.5 Hz - 2.0 kHz
Repeatability	±2%
Transverse sensitivity, max.	5%

Electrical

Power requirements (two wire loop power):	
Voltage at PC420 series sensor terminals	10 VDC min, 30 VDC max
Loop resistance at 24 VDC, maximum	700Ω
Turn on time, 4-20 mA loop	30 seconds
Grounding	case isolated, internally shielded

Environmental

Operating temperature range[1]	–40 to 105°C
Vibration limit	250 g peak
Shock limit	2,500 g peak
Sealing	hermetic

Physical

Sensing element design	PZT ceramic / shear
Weight	160 grams
Case material	stainless steel
Mounting	1/4 - 28 tapped hole
Output connector	2 pin, MIL-C-5015 style
Mating connector	R6 type
Recommended cabling	J9T2A

Connector pin	Function
Shell	ground
A	loop positive (+)
B	loop negative (–)

Notes: [1] 105°C operating temperature applies to units shipped after July 1, 2009, and with serial numbers greater than 50000.

Accessories supplied: SF6 mounting stud (International customers specify mounting requirements); calibration data (level 2)

Vibration sensors will be mounted directly to the motor end bells for best posible monitoring.

The unit will no longer transmit a vibration signal but will not fail mechanically during a high temperture event.

CE

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Table 1: PC420Vx-yy model number selection

x (4-20 mA output type)	yy (4-20 mA full scale)
R = RMS output, velocity	05 = 0.5 ips
P = Calculated peak output, velocity	10 = 1.0 ips
	20 = 2.0 ips
	30 = 3.0 ips
	50 = 5.0 ips

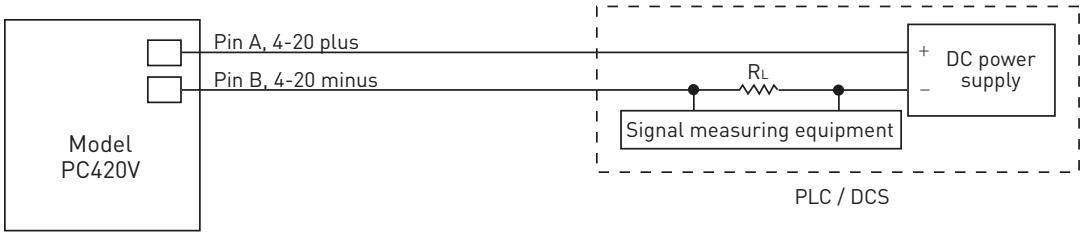
Notes: [1] Maximum loop resistance (R_L) can be calculated by:

$$R_L \text{ (max resistance)} = \frac{V_{DC\ power} - 10\ V}{20\ mA}$$

DC supply voltage	R_L (max resistance)[2]	R_L (minimum wattage capability)[3]
12 VDC	100Ω	1/8 Watt
20 VDC	500Ω	1/4 Watt
24 VDC	700Ω	1/2 Watt
26 VDC	800Ω	1/2 Watt
30 VDC	1.0kΩ	1/2 Watt

[2] Lower resistance is allowed, greater than 10Ω recommended.
[3] Minimum R_L wattage determined by: (0.0004 x R_L).

Typical circuit



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Cable and connector selection

Wilcoxon's extensive selection of cables and connectors offers a full spectrum of possibilities

Cable Length = 15 feet

Some of the most popular cables and connectors are pictured below. Want something you don't see here?
Call your customer sales and service representative at 1-800-WILCOXON or send an email to sensors@wilcoxon.com

In I&C box Landed on terminal strip

Connectors	Description	Recommended cables	IP
0	Blunt cut	All	00
1	Microdot 10-32	J1, J3, J4, J93	50
1A	Microdot 10-32, right angle	J1, J3	50
2	BNC, plug, male	J1, J3, J4, J5A, J6, J9T, J9T2, J9T2A, J9T3A, J9T4, J10, J44, J51,	50
2F	BNC, female	J61, J81, J93 J5A, J6, J9, J51, J61, J93	50
2T	BNC, twinaxial	J9	50
6	Amphenol, MIL-C-5015 style, 2 socket, metallic **Note: Electrical isolation between shield and transducer housing**	J3, J4, J5A, J6, J9, J9T, J9T2, J9T2A, J10, J51, J61, J81, J93	50
6GSL/6GSLI	MIL-C-5015 style, 3 socket, splash proof, premium GSL: Electrical contact between shield and transducer housing	J9T3, J9T3A	66
6GQ/6GQI	MIL-C-5015 style, 3 socket, splash proof, premium GSL: Electrical contact between shield and transducer housing GSLI: Electrical isolation between shield and transducer	J9T3, J9T3A	66
6Q/6QI	MIL-C-5015 style, 2 socket, high temperature (200°C / 392°F) Q: Electrical contact between shield and transducer housing QI: Electrical isolation between shield and transducer housing	J5A, J9A, J9T, J9T2A, J10, J51, J61	68
6QA/6QAI	MIL-C-5015 style, 2 socket, high temperature (200°C / 392°F) Q: Electrical contact between shield and transducer housing QI: Electrical isolation between shield and transducer housing	J9F	68
6SL/6SLI	MIL-C-5015 style, 2 socket, splash proof, premium SL: Electrical contact between shield and transducer housing SLI: Electrical isolation between shield and transducer housing	J5A, J9, J9T, J9T2, J9T2A, J9T2AS, J9T3, J9T3A, J9T4, J10, J51, J61	66
6W	MIL-C-5015 style, 2 socket, molded **Note: Electrical isolation between shield and transducer housing**	J5A, J9T2A, J10	64
6WR	MIL-C-5015 style, right angle, molded **Note: Electrical isolation between shield and transducer housing**	J9T2A, J10	64
9W	Bendix, 4 socket, threaded, weatherproof	J9T2S, J9T4, J9T4A	50
19SL/19SLI	MIL-C-5015 style, 6 socket SL: Electrical contact between shield and transducer housing SLI: Electrical isolation between shield and transducer housing	J9T4, J9T4A	66
20	LEMO, 7 pin	J9T, J9T2A, J10, J61	50

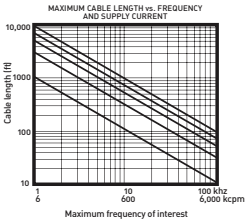
On Sensor Side

Common cables	Description	C° range	F° range	Diameter in.	pF/ft
J1	Coaxial, low noise, orange PVC jacket	-55 to 80	-67 to 176	0.088	30
J3	Coaxial, low noise, high temperature, red Teflon® jacket	-100 to 260	-148 to 500	0.085	30
J5A	Coaxial, RG 58, black PVC jacket	-40 to 105	-40 to 221	0.190	30
J9T	Coaxial, RG 59, black Teflon® jacket	-80 to 150	-112 to 302	0.190	20
J9T2	Twisted pair, shielded, white Tefzel® jacket	-80 to 150	-112 to 302	0.190	27
J9T2A	Twisted pair, shielded, yellow Teflon® jacket	-80 to 200	-112 to 392	0.190	27
J9T2AS	Twisted pair, shielded, yellow Teflon® jacket with stainless steel braid	-80 to 200	-112 to 392	0.210	27
J9T2S	Twisted pair, shielded, white Tefzel® jacket with stainless steel braid	-80 to 150	-112 to 302	0.210	27
J9T3	Three conductor, shielded, white Tefzel® jacket	-80 to 150	-112 to 302	0.190	27
J9T3A	Three conductor, shielded, yellow Teflon® jacket	-80 to 200	-112 to 392	0.190	27
J9T4	Four conductor, shielded, red Teflon® jacket	-80 to 200	-112 to 392	0.190	30
J9T4A	Four conductor, shielded, yellow Teflon® jacket	-80 to 200	-112 to 392	0.190	27
J10	Twisted pair, shielded, gray Enviroprene jacket	-50 to 125	-58 to 257	0.190	30
J88	Twisted pair, shielded, black Polyurethane jacket	-40 to 80	-40 to 176	0.175	60
J88C	Twisted pair, shielded, black Polyurethane jacket, coiled with 6" straight ends	-40 to 80	-40 to 176	0.175	60
J95	Five conductor, shielded, black Polyurethane jacket	-20 to 90	-4 to 194	0.240	22
J96	Twisted pair, shielded, white Teflon® jacket	-80 to 150	-112 to 302	0.145	35
J9F	Twisted pair, foil shielded with drain wire, red Teflon® jacket	-70 to 200	-94 to 392	0.125	51

Tech tips

Cable length

An accelerometer cable can be run one hundred feet without losing most signals. The exact length can be determined knowing the cable capacitance (30 picoFarads per foot is common) and the available voltage swing (typically at least 5V peak to peak). Given these values, the mazimum length is a function of supply current and highest frequency of interest. The chart to the right helps determine maximum cable lengths.



Note: Graph values assume cable capacitance of 30pF/ft and an available voltage swing of 5Vp-p. (I) represents current available to power the sensor.

IP ratings

Splashproof connectors for sensors are categorized according to an Ingress Protection or IP rating. IP ratings are industry standards that indicate how connectors withstand invasion in harsh environments. In order to qualify the level of sealing provided by a sensor connector, use the following chart:

Ingress protection ratings

First numeral Protection against solid bodies		Second numeral Protection against liquid
No protection	0	0 – No protection
Objects greater than 50mm	1	1 – Vertically dripping water
Objects greater than 12.5mm	2	2 – Angled dripping water
Objects greater than 2.5mm	3	3 – Sprayed water
Objects greater than 1.0mm	4	4 – Splashed water
Dust-protected	5	5 – Water jets
Dust-tight	6	6 – Pressure jets
		7 – Immersion to 1 meter
		8 – Indefinite immersion

Wilcoxon's 6SL connector has an IP rating of 66, making it dust tight and protected against liquid from pressure jets. Even at this high rating, it is not appropriate for temporary or permanent immersion in water.

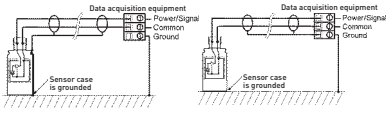
Avoiding ground loops

In order to provide proper shielding and prevent ground loops, shield and common grounding should be carefully considered. Ground loops are developed when a common line (i.e. signal return/shield) is grounded at two points of differing electrical potential.

For sensors with coaxial cable, the center conductor carries the signal and power, while the outer braiding provides the shielding and signal return. Normally the cable shield is electrically isolated from the sensor housing. This isolates the shield from the mounting point of the machine and prevents ground loops. If a non-isolated sensor is used, it is recommended that an isolated mounting pad be used to break up possible ground loops.

For sensors using two conductor/shielded cable, the signal and power are carried on one lead and the signal common on the other. The cable shield serves to protect the signal from Electrostatic Discharge (ESD) and Electromagnetic Interference (EMI). The shield should be grounded at only one point, normally to the readout equipment.

In all cases, it is very important that the cable shield terminations be properly grounded. Failure to do so in high ESD/EMI environments can result in damage to the sensor electronics.



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McMaster-Carr Item Number 7549A15

2300ºF ADHESIVE AND SEALANT PUTTY

Bonds, Seals, Fills and Protects

RESBOND™ 907GF

Resbond 907GF Fireproof Adhesive and Sealant is a moist, creamy putty for use from -300ºF to 2350ºF.

It is easily applied from standard caulking cartridges and air dries in 4- 12 hours at room temperature. (Curing may be accelerated with mild heat).

Resbond 907GF has excellent adhesion to clean steel, stainless, iron, most metals, ceramics, ceramic cloths, tapes, gaskets, tadpoles gaskets, etc.

Resistant to most chemicals, solvents, oxidizing and reducing atmospheres, aging, thermal cycling, and electricity.

Applications Include:

- **Bonds** - Ceramic tapes, metals, ceramics, glass, assemblies instruments, etc.
- **Repairs** - Exhaust systems, diesel engines, gas turbines, heating plant equipment, ceramics, fire bricks, mortar etc.
- **Assembles** - High temperature equipment, brazing fixtures, brazing supports, stacks, etc.
- **Seals** - Exhaust systems, stacks, flues, gaskets, fills surface irregularities, etc.

Users Report:

- Resbond 907GF seals exhaust ducts against corrosive chemicals and high temperatures.
- Resbond 907GF replaces ceramic gaskets and successfully seals pipe joints for use up to 1800ºF.
- Resbond 907GF bonds over lapping layers of stainless steel to form air ducts for furnaces that operate at 1200ºF continuously.

Packaged in convenient dispenser tubes and standard caulking cartridges.

Resbond 907GF is ideal for use in any high temperature Assembly, Production, Repair or Maintenance Application.

Availability:

Cat #	Description
Resbond 907GF-5	3- 4 oz. Dispenser Tubes
Resbond 907GF-6	11 oz. Caulking Cartridge
Resbond 907GF-6CP	Case Pack . . . . 12 - 11 oz. Cartridges
Resbond 907GF-7	Smooth, Fine Grade, 11 oz
Resbond 907GF-1	1 lb. Container (1/2 pint)
Resbond 907GF-2	3.5 lbs. Container (quart)

907GF Seals Exhaust Ducts Carrying Corrosive Chemicals

Applying 907GF to a Flange Forming a Hi-Temp. Seal

Physical Properties	907GF
Max Use Temp.	**3000°F**
Continuous Service Temp.	2350°F
Density # / ft^3	65-80
Compressive Strength psi	1500
Elongation %	5
Specific Heat BTU/# °F	0.25
Dielectric Constant @ 10^8 cps	3.0
Volume Resistivity ohm-cm	10^9
Dielectric Strength Volts/mil.	145
Thermal Cond. BTU in/ºF hr. ft^2 @ 500°F	6.0
Shrinkage %	2
Shelf Life (Months)	6

DURABOND™ EPOXY AND CERAMIC PUTTIES

These smooth, creamy putties combine the high temperature performance of Cotronics' specialty formulations with easy to use, dispensing systems. Perfect for on site repairs.
Choose from systems based on: Machinable Aluminum (**500°F** - RK454 or **1200°F** - 7025), 316 Stainless Steel (**500°F** - RK456 or **2000°F** - 7032), Ceramic (**2300°F** - 907GF) or Alumina (**3000°F** - 7020).
Just dispense and apply. These smooth, creamy putties will not run, drip or sag while applying and can be easily cured at room temperature.



Surface Preparation

Surfaces should be free of oil, grease, dirt, corrosives or other contaminants.
Porous materials should be soaked in solvents to remove any soluble contaminants.
For best results, roughen all smooth, metal surfaces with abrasives or grit blast them with a coarse media.

Mixing

For one component systems: re-mix thoroughly before applying.
For two component systems: thoroughly re-mix the components before dispensing. Check label for mix ratios where applicable. Weigh out each component and thoroughly mix to a uniform consistency. The viscosity may be reduced by adding a small amount of thinner (5% by weight maximum) if required.

Application

Putties may be applied using a spatula, putty knife or caulking gun. Multiple layers may be required for cross-sections larger than 1/8" to 1/4" to avoid blistering. Epoxy based systems can be applied in thicker sections without blistering.

Curing

Individual cure cycles are specified on each product label. Below instructions are guidelines for curing. Alternative cure times may be appropriate for high volume production applications and should be tested in the specific application prior to use.
Note: excessive fast drying (or applying high heat when moist) may cause blisters.

For ceramic based systems a typical cure schedule is shown below.

1. Air dry for a minimum of 2 hours at room temperature. Thick cross-sections will require 4-16 hours to cure. Putties should be applied in layers carefully drying material in between coatings.
2. Heat cure at 150-200°F for 2 - 4 hours.
3. Post curing at 400°F is required for water insolubility.

For epoxy based systems a typical cure schedule is shown below.

1. Cure at room temperature for a minimum of 16 - 24 hours prior to use.
2. Post curing is recommended for optimum proprieties. For room temperature curing systems post cure for a minimum of 2 - 4 hours at 250°F. For heat curing systems post cure for 2-4 hours at 350°F.

Storage

Tightly close opened containers after each use to prevent evaporation.
Periodically invert containers to help reduce settling.
Store containers between 40°F and 80°F.

Safety read MSDS carefully before use. Prolonged skin contact may cause irritation. Uncured materials can be washed from the skin with a mild soap and water. If any material contacts eyes, flush continuously with water and consult a physician immediately.

INDUSTRIAL DUTY

SERIES HS35R

Dynapar™ brand

Heavy Duty Hollowshaft Encoder

Key Features

- **Phased Array Sensor for Reliable Signal Output**
- **Rugged Design Withstands up to 400g Shock and 20g Vibration**
- **Unbreakable Code Disc up to 5000PPR**
- **Heavy Duty Design Rated for IP67**
- **Customizable Mounting Options including Torque Arm with Optional Grounding Strap**

CE RoHS

SPECIFICATIONS

STANDARD OPERATING CHARACTERISTICS

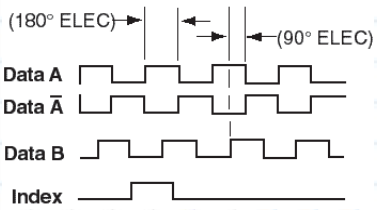
Code: Incremental
Resolution: to 5000 PPR (pulses/revolution) See Ordering Information
Format: Two channel quadrature (AB) with optional Index (Z), and complementary outputs
Phase Sense: A leads B for CW shaft rotation viewing the shaft clamp end of the encoder
Quadrature Phasing:
For resolutions 200 to 300PPR and 1200PPR and above: 90° ±30° electrical; all other resolutions: 90° ±15°
Symmetry:
For resolutions 200-300PPR and above1024PPR:180° ±25° electrical; all other resolutions: 180° ±18°
Waveforms: Squarewave with rise and fall times less than 1 microsecond into a load capacitance of 1000 pf

ELECTRICAL

Input Power: 5-26VDC, 5-15VDC. 80 mA max., not including output loads.
Outputs: ET7272, ET7273, 4469, High-Power-Line-Driver

Frequency Response: 125 kHz (data & index)
Noise Immunity: Tested to EN61326-1 EMC
Termination: MS Connector; M12 Connector; cable exit w/seal. See Ordering Information
Mating Connector:
6 pin MS, style MS3106A-14S-6S (MCN-N4)
7 pin MS, style MS3106A-16S-1S (MCN-N5)
10 pin MS, style MS3106A-18-1S (MCN-N6)
10 pin Bayonet, MS3116-F12-10S (607545-0001)
Cable w/ 5 pin M12 connector, p/n 112859-xxx
Cable w/ 8 pin M12 connector, p/n 112860-xxx

DATA AND INDEX
Not all complements shown
$\bar{A}$ shown for reference



Index Width: 150° to 330°
A leads B, CW (from clamp end)

(Reverse Phasing, A leads B for CCW also available: See Code 7 in Ordering Information)

MECHANICAL

Shaft Material: 6061-T6 Aluminum
Bore Diameter: 6mm to 28mm, 1/4" to 1-1/8", electrically isolated
Mating Shaft Length: 1.25", Minimum, 1.60", Recommended
Shaft Speed: 6000 RPM, Maximum (Enclosure Rating is IP64 at speed over 5000 RPM)
Starting torque: 8.0 in-oz. maximum (at 25°C)
Running torque: 5.0 in-oz. maximum (at ambient)
Bearings: ABEC 1
Housing and cover: Powder Coated Aluminum
Disc material: Plastic
Weight: 1.76lb (28 Oz) Typical

ENVIRONMENTAL

Standard Operating Temperature: -40 to +85°C (0 to +70°C with 4469 line driver, see "Ordering Information"). At shaft speed above 3000 RPM, derate 10°C per 1000 RPM
Extended Temperature Range: -40 to +100°C (See ordering information)
Storage temperature: -40 to +100°C
Shock: 400g, 6mSec
Vibration: 5 to 3000 Hz, 20g
Humidity: 100%
Enclosure Rating: IP67 (IP64 at shaft speed above 5000 RPM)

Note: "MS" type mating connectors and pre-built cables are rated NEMA 12. "M12" Cable assemblies are rated IP67

INDUSTRIAL DUTY

Dynapar™ brand SERIES HS35R

Ordering Information

HS35R-0010-H-3-0-1-01 code for specific information

To order, complete the model number with code numbers from the table below:

Code 1: Model	Code 2: PPR	Code 3: Bore Size	Code 4: Fixing	Code 5: Output Format	Code 6: Termination	Code 7: Options
HS35R □□□□	□	□	□	□	□	□□
Ordering Information						
HS35R Heavy-Duty, Hollowshaft Encoder	**0001** **0500** **0003** **0512** **0010** **0600** **0012** **0900** **0015** **1000** **0032** **1024** **0050** **1200** **0060** **1500** **0100** **2000** **0120** **2048** **0200** **2400** **0240** **2500** **0250** **3072** **0300** **4000** **0360** **4096** **5000**	**0** 6mm **1** 1/4" **2** 5/16" **3** 8mm **4** 3/8" **5** 10mm **6** 12mm **7** 1/2" **8** 5/8" **9** 15mm **A** 16mm **C** 19mm **D** 3/4" **E** 20mm **F** 7/8" **G** 24mm **H** 1" **J** 1-1/8" **M** 14mm **N** 18mm **P** 25mm **R** 28mm Not Electrically Isolated **K** 1-1/4"	**0** None **1** 4.5" C-face tether **2** 8.5" C-face tether **3** Slotted tether (to fit standard AC motor fan cover) Not available when Code 5 is D,E,F,G, Q, R **4** Same as 1 w/cover **5** Same as 3 w/cover **C** Same as A with 56C cover (Single Only) Available when Code 5 is D,E,F,G, Q, R **6** Same as 1 w/dual cover **7** Same as 3 w/dual cover **8** Same as 2 w/ 180 C-face cover (single or dual output) **A** Rod tether **B** Rod tether with ground strap. **D** Same as B with 56C cover (Single Output)	**0** ABZ, 5-26VDC push-pull **1** ABZ, 5-26VDC O/C **2** ABZ, 5-26VDC O/C w2.2kOhm **H** Same as "0" with Extended temp range **J** Same as "1" with Extended temp range **K** Same as "2" with Extended temp range Not available when Code 6 is H **4** Differential AB only, 5-26VDC, 5-26VDC out (7272) **5** Differential AB only, 5-26VDC in, 5VDC out (7272) **A** Differential AB only, 5-26VDC in, 5VDC out (4469) **C** Differential AB only, 5-15VDC in, 5-15VDC out (4469) **L** Same as "4" with Extended temp range **M** Same as "5" with Extended temp range Not available when Code 6 is 0, 1, 5, 6, or H **6** Differential ABZ, 5-26VDC in, 5VDC out (7272) **7** Differential ABZ, 5-26VDC in, 5-26VDC out (7272) **8** Differential ABZ, 5-26VDC in, 5VDC out (4469) **9** Differential ABZ, 5-15VDC in, 5-15VDC out (4469) **D** Dual isolated outputs, same as "6" **E** Dual isolated outputs, same as "7" **F** Dual isolated outputs, same as "8" **G** Dual isolated outputs, same as "9" **N** Same as "6" with Extended temp range **P** Same as "7" with Extended temp range **Q** Same as "D" with Extended temp range **R** Same as "E" with Extended temp range **W** ABZ, 10-24VDC Line Driver for cable runs up to 500 ft/120m using the Dynapar cable assemblies listed below	**0** 6 pin **1** 7 pin **2** 10 pin **3** 12 pin **4** 10 pin bayonet **5** 6 pin+mating **6** 7 pin+mating **7** 10 pin+mating **8** 12 pin+mating **9** 10pin bayonet+mating **A** 0.5m (18") cable **C** 1m (36") cable **D** 2m (72") cable **E** 3m (120") cable **F** 0.3m (13") cable with 10-pin bulkhead connector and mate **G** 0.3m (13") cable **H** 5 pin M12 **J** 8 pin M12	**Blank** No Option **01** Reverse Phasing (A leads B, CCW) Available when Code 5 is 0-2, 6 and 7 and when Code 6 is 0-2 or 5-7 **PS** LED Output

10 foot Cable Assemblies with MS Connector

108594-0010 6 Pin MS, Cable Assy. For Use with Single Ended Outputs
108595-0010 7 Pin MS, Cable Assy. For Use with Single Ended Outputs
108596-0010 7 Pin MS, Cable Assy. For Use with Differential Line Driver w/o Index Outputs
112123-0010 6 Pin MS, Cable Assy. For Use with Differential Line Driver w/o Index Outputs
1400635-0010 10 Pin MS, Cable Assy. For Use with Differential Line Driver with Index Outputs
114448-0010 10 Bayonet, Cable Assy. For Use with Differential Line Driver with Index Outputs
109209-0010 NEMA4 10 pin MS, Cable Assy. For Use with Differential Lne Driver with Index Outputs

10 foot Cable Assemblies with M23 Connector

108615-0010 12 M23, Cable Assy. For Use with Differential Line Driver with Index Outputs, CCW

15 foot Cable Assemblies with M12 Connector

112859-0015 5 Pin M12, Cable Assy. For Use with Single Ended Outputs
112860-0015 8 Pin M12, Cable Assy. For Use with Single Ended Outputs
112860-0015 8 Pin M12, Cable Assy. For Use with Differential Line Driver Outputs

Mating Connectors (no cable)

MCN-N4 6 pin, style MS3106A-14S-6S
MCN-N5 7 pin, style MS3106A-16S-1S
MCN-N6 10 pin, style MS3106A-18-1S
607545-0001 10 pin bayonet, style MS3116-F12-10S

Accessory Kits:

114573-0001 Tether Kit, 4.5" C-face single point with 3/8" bolt
114574-0001 Tether Kit, Slotted with T-bolts for standard AC motor fan covers
114575-0001 Tether Kit, 8.5" C-face single point with 1/2" bolt
114591-0001 Cover Kit, 56C face
114592-0001 Cover Kit, fan cover
114593-0001 Dual Cover Kit, 56C face
114928-0001 Dual Cover Kit, 180C-face
114594-0001 Dual Cover Kit, fan cover
116233-0001 Rod Tether only
116233-0002 Rod Tether + 56C face cover (single)
116233-0004 Rod Tether + grounding strap
116233-0005 Rod Tether + grounding strap +56C face cover (single)

SERIES HS35R

by DYNAPAR™

ELECTRICAL CONNECTIONS

6, 7 & 10 Pin MS Connectors and Cables - Code 6 = 0 to 9, A to G

Connector & mate/accessory cable assembly pin numbers and wire color information is provided here for reference. Models with direct cable exit carry the same color coding as shown for each output configuration.

Encoder Function	Cable #108594-* 6 Pin Single Ended		Cable #112123-* 6 Pin Dif Line Drv w/o Id x		Cable #108596-* 7 Pin Dif Line Drv w/o Id x		Cable #108595-* 7 Pin (If Used)		Cable # 1400635- or 109209- (NEMA4)10 Pin Dif Line Drv w/Idx (If Used)		Cable #108615-* 12 Pin CCW (If Used)		Cable # 114448-* 10Pin Bayonet	
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color
Sig. A	E	BRN	E	BRN	A	BRN	A	BRN	A	BRN	5	BRN	A	BRN
Sig. B	D	ORN	D	ORN	B	ORN	B	ORN	B	ORN	8	ORN	B	ORN
Sig. Z	C	YEL	—	—	—	—	C	YEL	C	YEL	3	YEL	C	YEL
Power +V	B	RED	B	RED	D	RED	D	RED	D	RED	12	RED	D	RED
N/C	F	—	—	—	—	—	E	—	E	—	7	—	E	—
Com	A	BLK	A	BLK	F	BLK	F	BLK	F	BLK	10	BLK	F	BLK
Case	—	—	—	—	G	GRN	G	GRN	G	GRN	9	—	G	GRN
Sig. $\overline{A}$	—	—	C	BRN/WHT	C	BRN/WHT	—	—	H	BRN/WHT	6	BRN/WHT	H	BRN/WHT
Sig. $\overline{B}$	—	—	F	ORN/WHT	E	ORN/WHT	—	—	I	ORN/WHT	1	ORN/WHT	J	ORN/WHT
Sig. $\overline{Z}$	—	—	—	—	—	—	—	—	J	YEL/WHT	4	YEL/WHT	K	YEL/WHT
0V Sense	—	—	—	—	—	—	—	—	—	—	2	BLK/WHT	—	—
5V Sense	—	—	—	—	—	—	—	—	—	—	11	GRN	—	—

* 1) Note: Standard cable length is 10 feet but may be ordered in any length in 5 foot increment. For example, -0020 is a 20 foot cable.
2) "MS" type mating connectors and prebuilt cables are rated NEMA 12. "M12" Cable assemblies are rated IP67
3) For watertight applications,use NEMA4 10 pin cable &connector 109209-XXXX.
‡ Only with cable option A thru G.

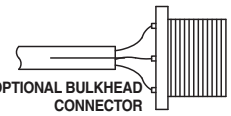
5 & 8 Pin M12 Accessory Cables when Code 6 = H orJ

Connector pin numbers and cable assembly wire color information is provided here for reference.

Encoder Function	Cable # 112859- 5 Pin Single Ended		Cable # 112860- 8 Pin Single Ended		Cable # 112860- 8Pin Differential	
	Pin	Wire Color	Pin	Wire Color	Pin	Wire Color
Sig.A	4	BLK	1	BRN	1	BRN
Sig.B	2	WHT	4	ORG	4	ORG
†Sig.Z	5	GRY	6	YEL	6	YEL
Power +V	1	BRN	2	RED	2	RED
Com	3	BLU	7	BLK	7	BLK
Sig. $\overline{A}$	–	–	–	–	3	BRN/WHT
Sig. $\overline{B}$	–	–	–	–	5	ORG/WHT
†Sig. $\overline{Z}$	–	–	–	–	8	YEL/WHT

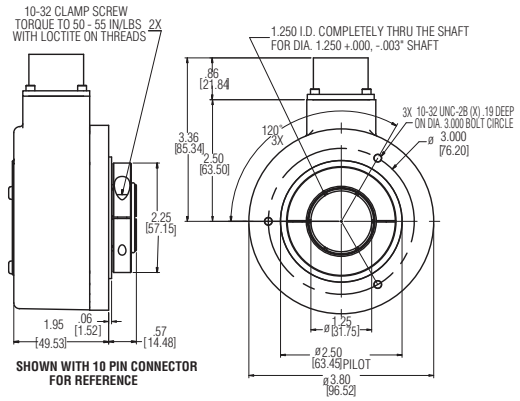
† Index not provided on all models. See ordering information

Cable Configuration: PVC jacket, 105 °C rated, overall foil shield; 24 AWG conductors, minimum

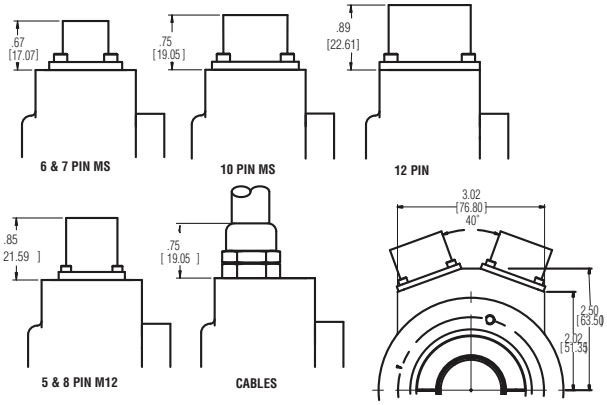


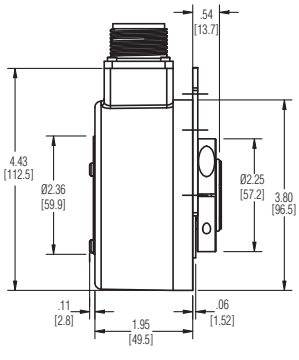
OPTIONAL BULKHEAD CONNECTOR (OPTION F)

DIMENSIONS inch [mm]

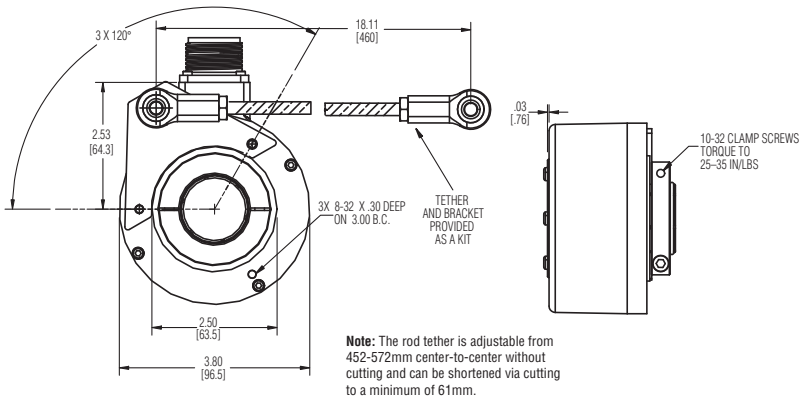


SHOWN WITH 10 PIN CONNECTOR FOR REFERENCE





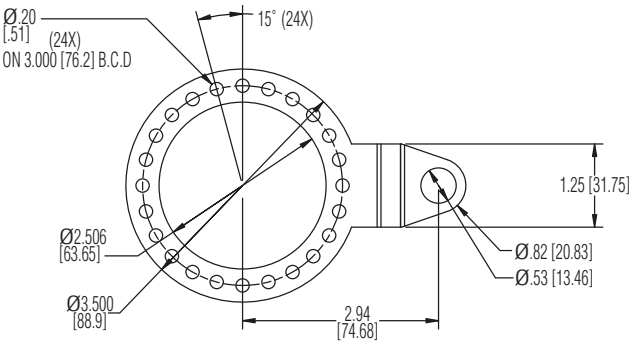
SHOWN WITH TORQUE ARM

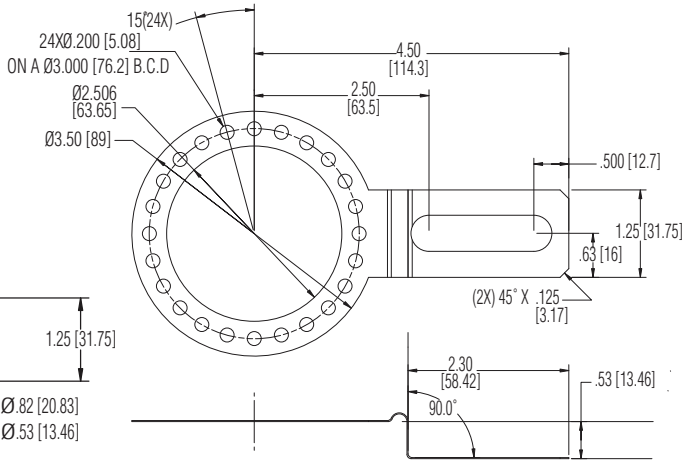


Note: The rod tether is adjustable from 452-572mm center-to-center without cutting and can be shortened via cutting to a minimum of 61mm.

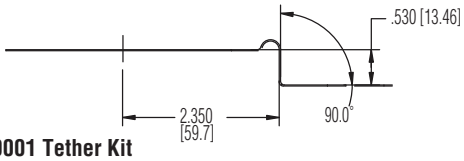
Dynapar™ brand SERIES HS35R

DIMENSIONS inch [mm]

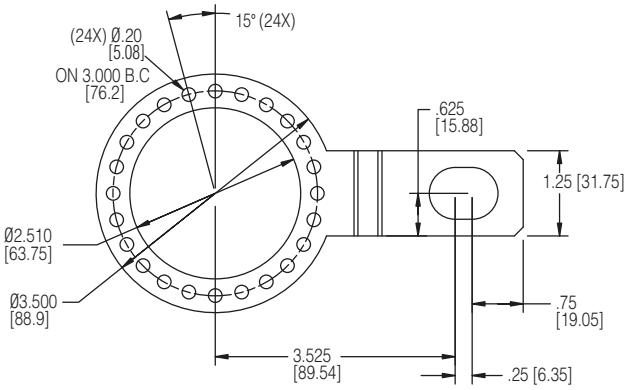


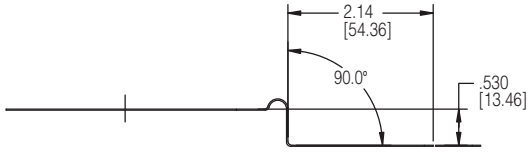


114574-0001 Slotted Tether Kit

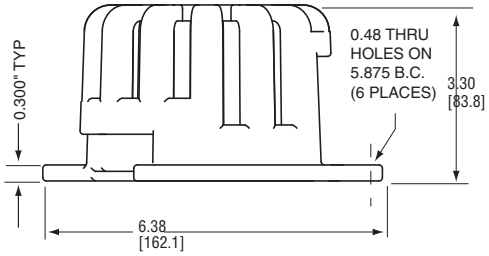


114573-0001 Tether Kit





114575-0001 Tether Kit



OPTIONAL SAFETY COVER(S)

Worldwide Brands: NorthStar™ • Acuro™ • Dynapar™ • Hengstler™ • Harowe™

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www.hengstler.com

Document No. 702761-0002, Rev. X

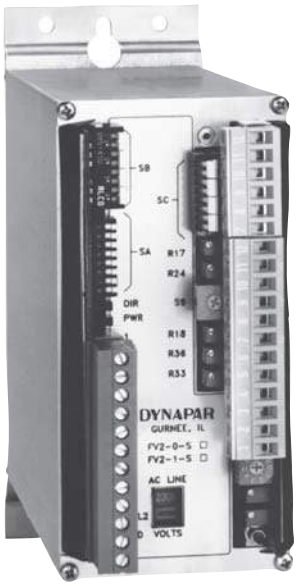
SERIES FV2

Dynapar™ brand

Brushless Digital Feedback

Key Features

- **Bidirectional Frequency/Voltage or Frequency/Current Converter**
- **An FV2 and an Encoder Replace a DC Tachometer when Precision Feedback is Required.**



SPECIFICATIONS

STANDARD OPERATING CHARACTERISTICS

Electrical

Input Power Requirements: 115/230 VAC ±10%, 50/60 Hz; 120 mA @ 115 VAC, 60 mA @ 230 VAC
Available Power for the Transducer: 12 VDC ±5%, 200 mA max.
Input Signal: (Field-Selectable) 4 to 15V differential; or 8 to 15V single-ended; or magnetic 1.5 to 15V peak-to-peak
Input Frequency Range: (Field-Selectable)
Bidirectional: 0-500 Hz to 0-100 kHz;
Unidirectional: 0-1 kHz to 0-100 kHz;
Analog Output: ±10V bidirectional; 0-10V unidirectional @ 25 mA
Output Linearity: ±.01% of span
Temperature Stability: ±.02% per °F
Current Range: 4-20 mA
Current Linearity: ±0.2% max.
Compliance: +16V min.
Response Time: <10 msec. switch selectable to <20, <36, or <46 msec.
Output Ripple: Volts RMS is generally less than brush generators and is predictable depending on input frequency from an encoder. For 240 PPR, open loop ripple is 0.080V at 25 RPM, 0.03V at 250 RPM and 0.015V at 2500 RPM
Output Overrange: 10% min. (volt. or current)
Output Offset: Adjustable

Environmental

Operating Temperature: 0 to 60°C
Storage Temperature: -18° to +85°C
Relative Humidity: to 90% non-condensing

OPTIONAL FEATURES

The following features are available with the FV2 option board, which can be factory- or field-installed:

Auxiliary Isolated Digital Outputs
When supplied separately with 12 ±3 VDC, an isolated digital differential line driver output is supplied corresponding to the A and B input phases. By connecting the analog power supply cable to the option board, the analog outputs can also be powered by the separate supply and optically isolated from the digital inputs.

Transducer Phase Reversal Detector
This feature monitors the A and B phases and detects reverse rotation. When reversal is detected, there is a user-selectable delay (2048 pulses max.) before the output relay drops out. The relay will not re-energize until: 1) the reset button is pressed, 2) an external reset signal is applied, or 3) power is removed and restored. An inhibit input is provided to override the reversal detection circuit.

Transducer Phase Failure Detector
This feature monitors the A and B phase inputs and detects a failure (i.e. one phase failed high or low). Its output is a normally-open relay contact which opens upon failure detection. This relay contact is shared with a Phase Loss Detection circuit.

Transducer Phase Loss Detector
This feature monitors current supplied to the encoder and reacts to a decrease in current required. Failure is indicated by opening the relay contact shared with the Phase Failure Detector. Current trip level is field-adjustable. Transducer supply must be provided by FV2.

Zero Speed Detector
This feature monitors transducer speed, and can be set by the user to trip at a specific level corresponding to desired speed. A relay with a single-pole-double-throw contact is used for the output.

SPECIFICATIONS FOR FV2 OPTIONS

Auxiliary Digital Outputs

Power Requirements: 12 ±3 VDC
Current Requirements: 25 mA w/ digital outputs only; 250 mA w/ analog outputs only

Outputs	Voltage Range	Sink (mA)	Source (mA)	Standard IC
Differential Line Driver	12 ±3 VDC	22	40	88C30

Transducer Reversal Detector

Forward Input Phasing: A leads B
Reversal Delay: 16, 32, 64, 128, 256, 512, 1024, or 2048 pulses, selectable.
Output: Relay contacts*, latched upon failure.
Latch Reset & Inhibit Input Requirements: TTL/CMOS, activates on high,10K pull-down, 17V max.

Transducer Phase Failure Detector

Failure Type: A or B phase
Delay: 4 transitions
Output: N.O. contact* shared with Phase Loss Detector

Transducer Phase Loss Detector

Current Level: 30 to 200 mA, adjustable
Output: N.O. contact* shared with Phase Failure Detector

Zero Speed Detector

Adjustable Range: 10 Hz to 300 Hz
Response Time: Less than 0.1 sec.
Output: SPDT relay contact*
*Relay contacts are rated at (1) 1.0 amps, 24 VDC, or (2) 0.3 amps, 115 VDC resistive, or (3) 0.3 amps, 24 VDC, or (4) 0.2 amps, 115 VAC inductive.

ORDERING INFORMATION

Model No.	Description
FV2-0-S	Frequency-to-Voltage Converter
FV2-1-S	Same as FV2-0-S with Factory-Installed Option Board
FV2-N1	Option Board Only (Kit for Field Installation with FV2-0-S)
845-24*	Technical Manual

*A technical manual is automatically included with each FV2 unit shipped. Use this publication number for ordering extra copies.

DYNAPAR™
INNOVATION - CUSTOMIZATION - DELIVERY

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- **West Indies:** St. Kitts • **Europe:** United Kingdom, Italy, France, Germany, Spain, Slovakia
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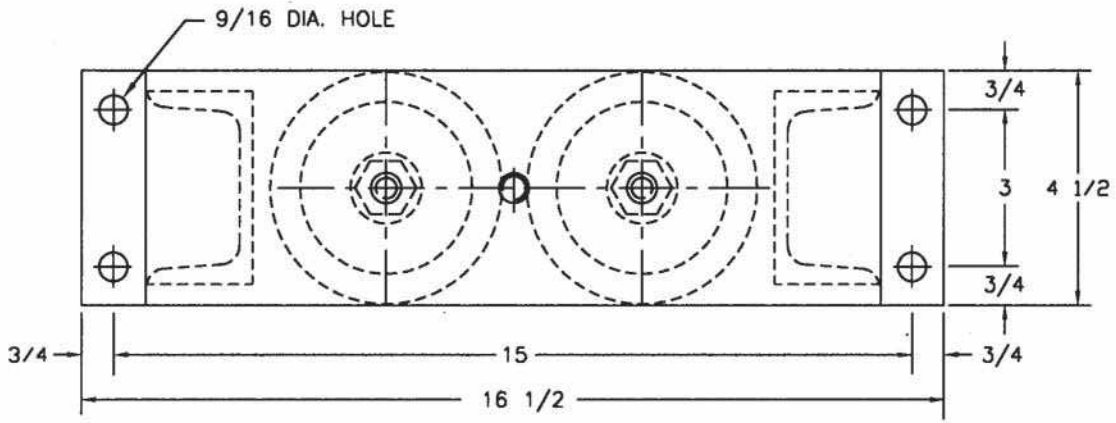
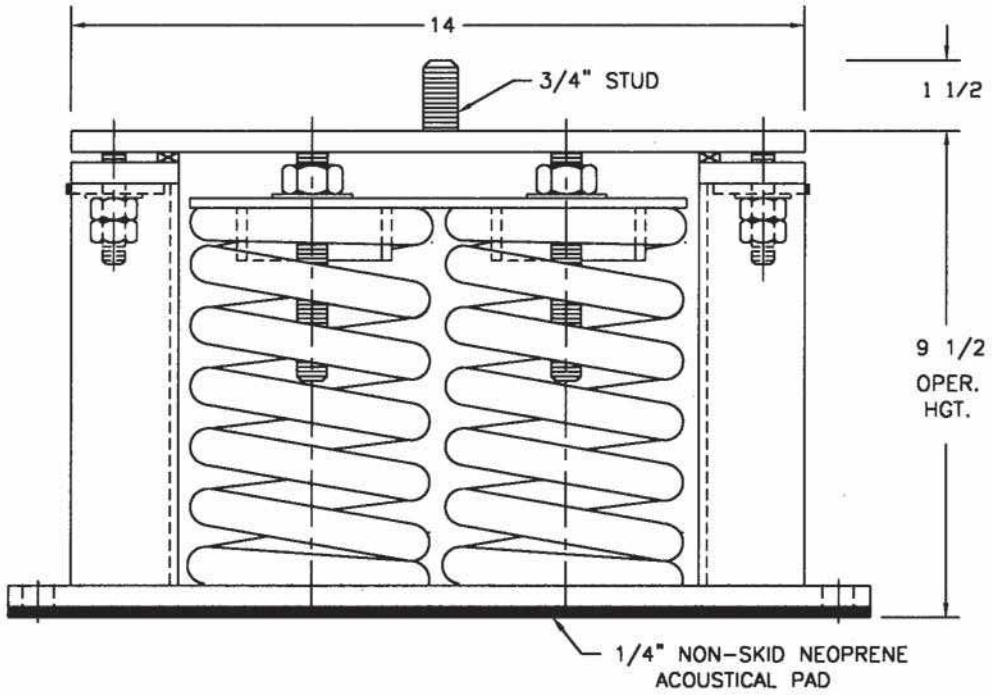
Fax: +1.847.782.5277
dynapar.techsupport@dynapar.com
northstar.techsupport@dynapar.com

Document No.: 702940-0001 Rev. –

TYPE "2KW4-ST" VERTICALLY RESTRAINED SPRING ISOLATOR





ISOLATOR TYPE		COLOR CODE	RATED LOAD	RATED DEFL.
2KW4	F56-ST	Orange	2440#	2.00"
	F57-ST	Gold	3460#	2.16"
	F58-ST	Red/Silver	4680#	2.00"
	F59-ST	Red/Yellow	6000#	2.00"
	F59/F69-ST	Red/White	7360#	2.00"

ALL HARDWARE ZINC-ELECTROPLATED

C2000/2KW4-sm.DWG

JOB : _____

CONTRACTOR : _____

P.O. NO. : _____

VIBRATION ELIMINATOR CO. INC.
15 Dixon Avenue
Copiague, NY 11726
TEL. (631)841-4000 FAX (631)841-0020

Dwg. No.

Section 7

Finish Information

PPG Amercoat

Amercoat® 450H

450 Series

Gloss aliphatic polyurethane topcoat

Product Data/ Application Instructions

- Gloss topcoat with unlimited recoatability
- Outstanding weather resistance with excellent color and gloss retention
- Low VOC
- Resistant to a broad range of corrosive atmospheres
- Resists soil pickup – cleans easily
- Cures through wide temperature range
- Hard, flexible and abrasion resistant

Typical Uses

Amercoat 450H can be used as a finish coat where attractive appearance and a wide range of corrosive resistance is required.

- Chemical plants
- Pulp and paper mills
- Off shore platforms
- Petroleum refineries and containers.
- General industrial and marine applications

Typical Systems

1st Coat	2nd Coat	3rd Coat
Dimetcote 9 Series or 21-5	Amercoat 385	Amercoat 450H
Amercoat 235, Amercoat 236, Amercoat 370 or Amercoat 385	Amercoat 450H	—
Amerlock Series	Amercoat 450H	—
Amercoat 68HS	Amercoat 385	Amercoat 450H
Amercoat 68WS	Amercoat 450H	—

Physical Data

Finish	Gloss
Color*	See color card
Components	2
Mixing ratio (by volume)	4 parts resin to 1 part cure
Curing mechanism	Solvent release and chemical reaction between components
Volume Solids	67% ± 3%

VOC (EPA Method 24)	lb/gal	g/L
unthinned	2.6	311
thinned (5% by volume)	2.8	340

Dry film thickness (per coat)	2-5 mils (50-125 microns)
Coats	1 or 2

Theoretical coverage

	ft^2/gal	m^2/L
1 mil	1074	26.4
2 mils	537	13.2

Temperature resistance, dry	°F/°C	
	°F	°C
continuous	200	93
intermittent	250	121

Flash Point	°F	°C
cure	92	33
resin	97	36
Amercoat 65	81	27
Amercoat 101	145	63
Amercoat 12	2	-17

Thinners	Amercoat 65, Amercoat 101
Cleaner	Amercoat 12

**Certain colors (especially yellow, red and orange) may require additional coats to achieve adequate hiding, particularly when applied over dark or contrasting primer color. Color variance with rapid response tinted colors may be greater than with standard production batches. If color is critical, change batches at natural breaks in structure or intermix batches for consistency.*

Yellow, red and orange colors will fade faster than other colors due to the replacement of lead-based pigments with lead-free pigments in these colors.

*** Application up to 5 mils are acceptable. The recommended dry film thickness over Amercoat 68HS is a 3-5 mils dry film thickness. When brush or roller applied, multiple coats may be needed to achieve dry thickness. Multiple wet passes may be required to achieve 5 mils in certain applications.*

Chemical Resistance Guide

When applied over suitable primer or intermediate coat:

Environment	Splash and Spillage	Fumes and Weather
Acidic	VG	E
Alkaline	VG	E
Solvents	G	E
Salt solutions		
Acidic	E	E
Neutral	E	E
Alkaline	E	E
Water	E	E

G-Good VG-Very Good E-Excellent

This table is only a guide. For specific recommendations, contact your PPG representative for your particular corrosion protection needs. Amercoat 450H is not recommended for immersion service.

Surface Preparation

Coating performance, in general, is proportional to the degree of surface preparation. Refer to application instructions for specific primers and intermediate coats being used for application and curing procedures. All previous coats must be clean and dry. Adhere to all minimum and maximum topcoat times for specific primers and intermediate coats. Aged epoxy coatings must be roughened before applying Amercoat 450H.

Application Equipment

The following is a guide; suitable equipment from other manufacturers may be used. Changes in pressure and tip size may be needed for proper spray characteristics.

Airless spray—Standard equipment such as Graco, DeVilbiss, Binks, Speeflo, or others having a 28:1 or higher pump ratio and a fluid tip with 0.013- to 0.015-inch (0.33- to 0.38-mm) orifice.

Conventional spray—Industrial equipment such as DeVilbiss MBC or Binks BBR spray gun. Separate air and fluid pressure regulators, and a moisture and oil trap in main air supply line are recommended.

Brush or roller - Natural bristle brush or solvent-resistant roller with ¼-inch to ⅜-inch nap. For best appearance when rolling, level any air bubbles with bristle brush.

Application Procedure

Amercoat 450H is packaged in two components in the proper proportions which must be mixed together before use:

1. Flush equipment with thinner or Amercoat 12 before use.
2. Stir each component thoroughly, then add cure to resin and mix until uniformly blended to a workable consistency. Do not mix more material than will be used within 4 hours at 65-80°F (18-27°C). Pot life is shortened by higher temperatures. See pot life data.
3. Thin only if necessary for workability.
4. When applying by conventional spray, use adequate air pressure and volume to ensure proper atomization.
5. Apply a wet coat in even parallel passes, overlap 50 percent to avoid holidays, bare areas and pinholes. If required, cross spray at right angles.
6. Application of 3 mils (75 microns) wet film thickness will normally provide 2 mils (50 microns) dry film.
7. Clean all equipment with thinner or Amercoat 12 immediately after use.
8. Keep containers tightly closed since repeated exposure to moisture will cause gelation. Moisture contaminated material is also subject to gassing on storage. Handle bulged containers with caution; lids may eject forcibly.

Application Data

Substrates	Prepared and primed steel, concrete, aluminum, galvanizing, or aged coatings.
Surface preparation:	Refer to Product Data Sheet/ Application Instructions of specific primer or intermediate coat being used.
Method	Airless or conventional spray, roller, brush (touch-up only)
Mixing ratio (by volume)	4 parts resin to 1 part cure

Environmental conditions	˚F	˚C
air and surface temp	20 to 120	-7 to 49

Surface temperatures must be at least 5˚F (3˚C) above dew point to prevent condensation.

Pot life (hours)	F°/C°		
	90/32	70/21	50/10
	2	4	6

Dry times	F°/C°		
	90/32	70/21	50/10
touch (minutes)	10	30	90
through (hours)	4	8	24

Recoat times	F°/C°		
	90/32	70/21	50/10
minimum (hours)	2	4	12
maximum	Unlimited*		

*Surface must be dry and free of all contaminants.

(w/866m accelerator)	90/32	70/21	50/10	32/0
touch (minutes) @½ pt per mixed 5-gal unit	7	25	75	240
through @½ pt per mixed 5-gal unit	1¾	2½	8	36

Recoat times	F°/C°			
(w/866m)	90/32	70/21	50/10	32/0
minimum (hours)	1	1½	4	16
maximum	Unlimited*			

*Surface must be dry and free of all contaminants.

Thinner	Amercoat 65 or 101
Equipment cleaner	Amercoat 12

Shipping Data

Packaging units	1 gal	5-gal
cure	0.2 gal in 1-qt can	1 gal in 1-gal can
resin	0.8 gal in 1-gal can	4 gal in 5-gal can

Shipping weight (approx)	lb	kg
1-gal unit		
cure	2	0.9
resin	10.2	4.6
5-gal unit		
cure	9	4.1
resin	49	22

Shelf life when stored indoors at 40 to 100˚F (4 to 38˚C)
resin and cure 1 year from shipment date

Safety Precautions

Read each component's material safety data sheet before use. Mixed material has hazards of each component. Safety precautions must be strictly followed during storage, handling and use.

CAUTION – Improper use and handling of this product can be hazardous to health and cause fire or explosion.

Do not use this product without first taking all appropriate safety measures to prevent property damage and injuries. These measures may include, without limitation: implementation of proper ventilation, use of proper lamps, wearing of proper protective clothing and masks, tenting and proper separation of application areas. Consult your supervisor. Proper ventilation and protective measures must be provided during application and drying to keep spray mists and vapor concentrations within safe limits and to protect against toxic hazards. Necessary safety equipment must be used and ventilation requirements carefully observed, especially in confined or enclosed spaces, such as tank interiors and buildings.

This product is to be used by those knowledgeable about proper application methods. PPG makes no recommendation about the types of safety measures that may need to be adopted because these depend on application environment and space, of which PPG is unaware and over which it has no control.

If you do not fully understand these warnings and instructions or if you cannot strictly comply with them, do not use the product.

Note: Consult Code of Federal Regulations Title 29, Labor, parts 1910 and 1915 concerning occupational safety and health standards and regulations, as well as any other applicable federal, state and local regulations on safe practices in coating operations.

This product is for industrial use only. Not for residential use.

PPG Protective & Marine Coatings
www.ppgpmc.com

One PPG Place, Pittsburgh, PA 15272 • Tel: (800) 441-9695

Standard Colors

YE-314
Offshore Yellow

RD-1
Bright Red

2968
Dark Gray

4829
Super Blue

GN-1
Forest Green

8557
Signal Yellow

7522
Signal Red

GR-1
Deep Gray

4752
Cobalt Blue

5506
Medium Green

YE-2
Ivory

7821
Oxide Red

GR-2
Medium Gray

4200
National Blue

GN-2
Meadow Green

1600
Clay Tan

2531
I.M. Gray

FS26270
Haze Gray

BL-2
Deep Blue

GN-3
Medium Green

BR-4
Sand

FS16440
Gray

GR-3
Pearl Gray

BL-4
Light Blue

GN-5
Haze Green

BR-3
Buff Brown

ANSI 70
Gray

2973
Light Gray

BL-5
Horizon Blue

Blue white

Standard White

WH-1
White

Standard Black

BK-1
Black

Aluminum

AL-1
Aluminum

Safety Colors (AN

RD-2
Safety Red

6900
Int'l Orange

OR-2
Safety Orange

YE-3
Safety Yellow

GN-6
Safety Green

BL-6
Safety Blue

AMERON INTERNATIONAL

Protective Coatings

Amercoat® 370

Fast-dry multi-purpose epoxy

Product Data

- High performance, corrosion resistance
- Fast drying, fast curing epoxy composition
- Application over wide range of surface temperatures from 20°F (-7°C) to 120°F (60°C)
- Self-priming, high-build coating
- Primer for wide range of topcoats
- Excellent shop primer for corrosion resistance
- Compatible with inorganic zinc silicate primers
- No lead pigments added
- VOC compliant
- Suitable for immersion in fresh and salt water
- Compatible with compromised surface preparation

Amercoat 370 forms an excellent corrosion barrier and is suitable for most industrial and marine new construction, repair, and field maintenance applications.

The fast curing properties of Amercoat 370 make it especially beneficial as a shop-applied coating where fast-drying and handling of coated parts are required.

Amercoat 370 is user-friendly and can be applied by a variety of spray application methods.

Typical Uses

Tank exteriors, structural steel, and piping in chemical plants, refineries, pulp and paper mills, offshore platforms, ship hulls, ballast tank service, anticorrosive under antifoulings and other structures exposed to severe weathering or salt spray.

Typical Properties

Physical

Abrasion (ASTM D4060) 1 kg load/1000 cycles CS-17 wheel	250 mg weight loss
Adhesion, Elcometer (ASTM D4541)	>1000 psi

Performance

Salt spray – 1 coat @ 6 mils 3000 hours exposure	
face corrosion (ASTM B117)	None
face blistering (ASTM B117)	None
Humidity (condensation) (ASTM D4585) 3000 hours exposure	
face corrosion	None
Steam cleanable	Yes
Chemical resistance – Condition after 1 year immersion	
salt water	Excellent
fresh water	Excellent

Physical Data

Finish	Flat	
Color	Medium gray, white, oxide red	
Components	2	
Curing mechanism	Solvent release and chemical reaction between components	
Volume solids (calculated)	63% ± 3%	
Dry film thickness per coat	4-6 mils (100 - 150 microns)	
Coats	1 or 2	
Coverage	ft^2/gal	m^2/L
1 mil (25 microns)	1011	24.9
5 mils (125 microns)	202	5
VOC	lb/gal	g/L
mixed	2.5	300
mixed/thinned ($^1/_2$ pt/gal)	2.8	335
mixed/thinned (1pt/gal)	3.0	359
Temperature limit	°F	°C
continuous (dry)	200	93
intermittent (dry)	250	121
Flash point (SETA)	°F	°C
cure	82	28
resin	82	28
Amercoat 927	60	16
Amercoat 12	2	-17
Amercoat 101	145	63

Application Data

Applied over	Primed or prepared steel
Surface preparation	
new steel	SSP-SP6
primed steel	See specific primer
previously painted or pitted steel	SSPC-SP10
Primer	Dimetcote®
Method	Airless or conventional spray
Mixing ratio (by volume)	4 parts resin to 1 part cure
Environmental conditions	

Temperature	°F	°C
air and surface	20 to 120	-7 to 49
material (minimum)	40	4

Surface temperatures must be at least 5°F (3°C) above dew point to prevent condensation.

Thinner	
below 60°F	Amercoat 927
over Dimetcote or above 60°F	Amercoat 101
Equipment cleaner	Thinner or Amercoat 12

Formerly Amercoat 3303

Amercoat 370 Chemical Resistance Guide

Environment	Splash and Spillage	Fumes and Weather
Acidic	F	G
Alkaline	E	E
Solvents	E	E
Salt solutions		
Acidic	G	VG
Neutral	E	E
Alkaline	E	E
Water	E	E

F-Fair G-Good E-Excellent VG-Very Good

This chart shows typical resistance of Amercoat 370. Contact your Ameron representative for your specific requirements.

Systems Using Amercoat 370

1st Coat	2nd Coat	3rd Coat
Amercoat 370	–	–
Amercoat 370	Amershield™	–
Amercoat 370	450HS	–
Dimetcote 21-9, 21-5	370	Amershield, 450HS
Amercoat 68HS	370	Amershield, 450HS, 3203
Amercoat 370	370	698HS, 70ESP, 635, 279, 275E

Confirm compliance with VOC regulations before using coating systems. For immersion service, apply 2 coats at a minimum of 8 mils total DFT.

Over Dimetcote or Amercoat 68HS primer, a mist coat and thinning with Amercoat 101 may be required to prevent application bubbling.

Application Data Summary

See Application Instructions for complete information on surface preparation, environmental conditions, application procedures and equipment. To obtain maximum performance, apply as recommended. Adhere to all safety precautions during storage, handling, application and drying periods.

Safety Precautions

Read each component's material safety data sheet before use. Mixed material has hazards of each component.

This product is for professional use only. Not for residential use in California.

Warranty

Ameron warrants its products to be free from defects in material and workmanship. Ameron's sole obligation and Buyer's exclusive remedy in connection with the products shall be limited, at Ameron's option, to either replacement of products not conforming to this Warranty or credit to Buyer's account in the invoiced amount of the nonconforming products. Any claim under this Warranty must be made by Buyer to Ameron in writing within five (5) days of Buyer's discovery of the claimed defect, but in no event later than the expiration of the applicable shelf life, or one year from the delivery date, whichever is earlier. Buyer's failure to notify Ameron of such nonconformance as required herein shall bar Buyer from recovery under this Warranty.

Ameron makes no other warranties concerning the product. No other warranties, whether express, implied, or statutory, such as warranties of merchantability or fitness for a particular purpose, shall apply. In no event shall Ameron be liable for consequential or incidental damages.

Any recommendation or suggestion relating to the use of the products made by Ameron, whether in its technical literature, or in response to specific inquiry, or otherwise, is based on data believed to be reliable; however, the products and information are intended for use by Buyers having requisite skill and know-how in the industry, and therefore it is for Buyer to satisfy itself of the suitability of the products for its own particular use and it shall be deemed that Buyer has done so, at its sole discretion and risk. Variation in environment, changes in procedures of use, or extrapolation of data may cause unsatisfactory results.

Pot Life and Dry Times

Temperature (°F/°C)	Pot-Life (Hours)	Touch Dry (Min.)	Through Dry (Hours)	Recoat (Hours)
20/-7	—	90	20	$2^{1}/_{2}$
32/0	—	60	9	2
40/4	7	45	7	2
50/10	6	30	$4^{1}/_{2}$	$1^{1}/_{2}$
60/16	5	22	$2^{3}/_{4}$	1
70/21	4	15	$1^{1}/_{3}$	$^{1}/_{2}$
80/27	3	12	$1^{1}/_{4}$	$^{1}/_{2}$
90/32	2	10	1	$^{1}/_{3}$

Topcoat or recoat time (days) (maximum)	°F/°C 90/32	70/21	50/10	20/-7
450HS, Amershield™	14	30	45	60

Amercoat 370
non-immersion — 6 months – Clean surface required
immersion — 1 month – Clean surface
698HS, 70ESP, 635, 279, 275E — Apply while 370 is tacky, soft to fingernail

Failure to apply antifoulings while coating is still tacky or soft to fingernail may result in poor adhesion and eventual delamination.

Time before service @ 8 mils (hours)	°F/°C 90/32	70/21	50/10	32/0	20/-7
Amercoat 370					
non-immersion*	6	12	24	96	120
immersion	12	24	48	168	NR

NR=Not recommended

Cure to full physical properties.

Shipping Data

Packaging units	1 gal	5 gal
cure	0.2 gal in 1-qt can	1 gal in 1-gal can
resin	0.8 gal in 1-gal can	4 gal in 5-gal can

Shipping weight (approx)	lb	kg
1-gal unit		
cure	1.9	0.9
resin	14.2	6.5
5-gal can		
cure	8.6	3.9
resin	70.4	32

Shelf life when stored indoors at 40 to 100°F (4 to 38°C)
cure and resin — 1 year from shipment date

Numerical values are subject to normal manufacturing tolerances, colors and testing variances. Allow for application losses and surface irregularities.

This product is photochemically reactive as defined by the South Coast Air Quality Management District's Rule 102 or equivalent regulations.

Limitation of Liability

Ameron's liability on any claim of any kind, including claims based upon Ameron's negligence or strict liability, for any loss or damage arising out of, connected with, or resulting from the use of the products, shall in no case exceed the purchase price allocable to the products or part thereof which give rise to the claim. **In no event shall Ameron be liable for consequential or incidental damages.**

AMERON INTERNATIONAL

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AMERON
Coatings

Amercoat® 68HS VOC

Zinc rich epoxy primer *(68 Series)*

Product Data/ Application Instruction

- High zinc content in dry film.
- Outstanding resistance to severe weathering
- Excellent adhesion to inorganic zincs
- Easily applied by airless or conventional spray
- Fast dry times allow for rapid topcoating
- Amercoat 861 Accelerator can be used for low temperature curing.

Typical Uses

Amercoat 68HS VOC is a shop primer for bare steel on new construction or major repair projects. Amercoat 68HS VOC can also be used as a field maintenance primer over bare steel or steel coated with organic or inorganic zinc primers and epoxy topcoats such as, Amercoat 385, Amerlock® Series or Amershield™. Amercoat 68HS VOC may be used to repair itself or inorganic zinc primers.

Typical Properties

Adhesion, Elcometer D4541	1000 psi

Physical Data

Finish	Flat	
Color	Reddish gray	
Components	3	
Mixing ratio	1- or 5-gal unit package	
Curing mechanism	Solvent release and chemical reaction between components	
Volume solids (ASTM D2697 modified)	70% ± 3%	
Coats	1	
Typical dry film thickness	3 mils (75 microns)	
Theoretical coverage	ft^2/gal	m^2/L
1 mil (25 microns)	1123	27.5
3 mils (75 microns)	374	9.2
VOC	lb/gal	g/L
mixed	0.7	84
mixed/thinned (5 oz/gal)	0.82	99
Temperature resistance, dry	°F	°C
continuous (maximum)	400	204
Flash point (SETA)	°F	°C
cure	60	16
resin	60	16
mixed	60	16
Amercoat 65	81	27
Amercoat 12	2	-17
Thinner	Amercoat 65	
Cleaner	Amercoat 12	

Typical Systems

1st Coat	2nd Coat	3rd Coat
Amercoat 68 Series	Amercoat 385 or Amercoat 370	Amercoat 450 Series
Amercoat 68 Series	PSX 700	
Amercoat 68 Series	Amershield	
Amercoat 68 Series	Amerlock Series	Amercoat 450 Series

Surface Preparation

Coating performance, in general, is proportional to the degree of surface preparation. Surface must be clean, dry and free of all contaminants.

Steel – Without pits or depressions: blast SSPC-SP6.
Rusted and pitted: blast SSPC-SP10.

Blast to achieve a 1- to 2-mil (25- to 50-micron) profile as indicated by a Keane-Tator Surface Profile Comparator. Testex Tape or similar device.

For touch-up or repair, power tool clean per SSPC-SP11 is acceptable.

Apply Amercoat 68HS VOC as soon as possible to prevent blasted surface from rusting. Keep moisture, oil, grease or other organic matter off surface before coating. Spot blast to remove any contamination; solvent-wiping is not satisfactory.

Repair inorganic zinc surfaces – must be clean, dry, free of all contaminants and loose paint. Blast damaged areas to SSPC-SP10 or mechanically clean to SSPC-SP3 or SP11.

Epoxy or urethane surfaces – abrasive or brush blast damaged areas down to bare metal. Remove all contaminants before applying coating.

Environmental Conditions

Resin and cure material must be a minimum of 50°F before mixing. For satisfactory cure, air and surface temperatures must be above 50°F (10°C). Use Amercoat 861 Accelerator when air and surface temperatures are below 50˚F (10˚C)

Temperature	°F	°C
air	32 to 120	0 to 49
surface	32 to 140	0 to 60
material (minimum)	50	10

Surface temperatures must be minimum 5°F (3°C) above the dew point to prevent condensation.

Application Data

Applied over	Steel
Surface preparation	SSPC-SP 6 or 10
Method	Airless or conventional spray
Mixing ratio (by volume)	1- or 5-gal unit package

Pot life (hours)

	°F/°C		
	90/32	70/21	50/10
nonaccelerated	8	16	24
accelerated (¼ pt 861/5 gal)	5	9	16

Environmental conditions

Temperature	°F	°C
air	32 to 120	0 to 49
surface	32 to 140	0 to 60
material (minimum)	50	10

Surface temperatures must be minimum 5°F (3°C) above the dew point to prevent condensation.

Drying time (ASTM D1640) (hours)

	°F/°C			
	90/32	70/21	50/10	32/0
nonaccelerated				
touch	¼	½	1	NR
through	4	8	36	NR
topcoat (minimum)	1	2	6	NR
topcoat (maximum months)	6	6	6	NR
accelerated (¼ pt 861/5 gal)				
touch	–	⅓	½	2
through	1½	4	16	96
topcoat (minimum)	¾	1½	4	24
topcoat (maximum months)	6	6	6	6

NR = Not Recommended

Application Equipment

The following is a guide; suitable equipment from other manufacturers may be used. Changes in pressure, hose and tip size may be needed for proper spray characteristics.

Conventional spray – Industrial equipment such as DeVilbiss MBC or JGA, or Binks #18 or 62 spray gun. A moisture and oil trap in the main air supply, mechanical pot agitator, separate regulators for air and fluid pressure are recommended.

Airless spray – Standard equipment such as a 33:1 pump or larger with a 0.017-inch tip with preorifice or fine finish tip.

Power mixer – Jiffy Mixer powered by an air or explosion-proof electric motor.

Application Procedure

1. Flush all equipment with thinner or Amercoat 12 before use.
2. Stir each component separately, then mix cure into resin and mix until uniform. Slowly stir in zinc dust and mix until uniformly blended. Maintain slow agitation during application to ensure the material remains uniformly blended.

Pot life (hours)	°F/°C		
	90/32	70/21	50/10
nonaccelerated	8	16	24
accelerated (¼ pt 861/5 gal)	5	9	16

3. Thinning may be required; thin with up to 5oz/gal of Amercoat 65 thinner to maintain compliance with SCAQMD Rule 1113.
4. Apply a wet coat in even, parallel passes; overlap each pass 50 percent to avoid holidays, bare areas and pinholes. If required, cross spray at right angles to first pass.
5. Check dry film thickness using nondestructive dry film thickness gauge such as Mikrotest or Elcometer. If less than the specified thickness, apply additional material. Typical dry film thickness is 3 mils in one coat, however dry film thickness up to 5 mils in one coat is acceptable. Do not exceed 5 mils in one coat as excess dry film thickness may result in increased mechanical damage during handling or shipping.
6. Touch up random pinholes, holidays and small damaged or bare areas by brush when film dry to touch. Larger areas should be resprayed.

Drying time (ASTM D1640) (hours)	°F/°C			
	90/32	70/21	50/10	32/0
nonaccelerated	¼	½	1	NR
touch	4	8	36	NR
topcoat (minimum)	1	2	6	NR
topcoat (maximum months)	6	6	6	NR
accelerated (¼ pt 861/5 gal)				
touch	–	⅓	½	2
through	1½	4	16	96
topcoat (minimum)	¾	1½	4	24
topcoat (maximum months)	6	6	6	6

NR=Not Recommended

Drying times are dependent on air and surface temperatures as well as film thickness, ventilation and relative humidity. Maximum recoating time is highly dependent upon actual surface temperatures - not simply ambient air temperatures. Surface temperatures should be monitored, especially with sun-exposed or otherwise heated surfaces. Higher surface tempertures shorten the maximum recoat window.

7. Clean equipment with thinner or Amercoat 12 immediately after use.

Shipping Data

Packaging units	1 gal	5 gal
cure	1-qt can	1-gal can
resin	1-gal can	5-gal can
powder	1-gal can	EnviroPac
Shipping weight (approx)	lb	kg
1-gal unit		
cure	2	0.9
resin	5.4	2.5
powder	20.2	9.2
5-gal unit		
cure	8.4	3.8
resin	26.6	12
powder	98.5	44.7

Shelf life when stored indoors at 40 to 100°F (4 to 38°C)
cure, resin, powder 1 year from shipment date

Numerical values are subject to normal manufacturing tolerances, color and testing variances. Allow for application losses and surface irregularities. See application instructions for complete information and safety precautions.

This mixed product is photochemically reactive as defined by the South Coast Air Quality Management District's Rule 102 or equivalent regulations.

Safety Precautions

Read each component's material safety data sheet before use. Mixed material has hazards of each component. Safety precautions must be strictly followed during storing, handling and use.

CAUTION – Improper use and handling of this product can be hazardous to health.

Do not use this product without first taking all appropriate safety measures to prevent property damage and injuries. These measures may include, without limitation: implementation of proper ventilation, use of proper lamps, wearing of proper protective clothing and masks, tenting and proper separation of application areas. Consult your supervisor. Proper ventilation and protective measures must be provided during application and drying to keep spray mists and vapor concentrations within safe limits and to protect against toxic hazards. Necessary safety equipment must be used and ventilation requirements carefully observed, especially in confined or enclosed spaces, such as tank interiors and buildings.

This product is to be used by those knowledgeable about proper application methods. Ameron makes no recommendation about the types of safety measures that may need to be adopted because these depend on application environment and space, of which Ameron is unaware and over which it has no control.

If you do not fully understand these warnings and instructions or if you cannot strictly comply with them, do not use the product.

Note: Consult Code of Federal Regulations Title 29, Labor, parts 1910 and 1915 concerning occupational safety and health standards and regulations, as well as any other applicable federal, state and local regulations on safe practices in coating operations.

This product is for industrial use only. Not for residential use.

Warranty

Ameron warrants its products to be free from defects in material and workmanship. Ameron's sole obligation and Buyer's exclusive remedy in connection with the products shall be limited, at Ameron's option, to either replacement of products not conforming to this Warranty or credit to Buyer's account in the invoiced amount of the nonconforming products. Any claim under this Warranty must be made by Buyer to Ameron in writing within five (5) days of Buyer's discovery of the claimed defect, but in no event later than the expiration of the applicable shelf life, or one year from the delivery date, whichever is earlier. Buyer's failure to notify Ameron of such nonconformance as required herein shall bar Buyer from recovery under this Warranty.

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Limitation of Liability

Ameron's liability on any claim of any kind, including claims based upon Ameron's negligence or strict liability, for any loss or damage arising out of, connected with, or resulting from the use of the products, shall in no case exceed the purchase price allocable to the products or part thereof which give rise to the claim. **In no event shall Ameron be liable for consequential or incidental damages.**

Due to Ameron's policy of continuous product improvement, the information contained in this Product Data/Application Instructions sheet is subject to change without notice. It is the Buyer's responsibility to check that this issue is current prior to using the product. For the most up-to-date Product Data/Application Instructions always refer to the Ameron International Performance Coatings & Finishes website at www.ameroncoatings.com.

AMERON Coatings

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Section 8

Clarage Services Brochure

Clarage

A Twin City Fan Company

CLARAGE SERVICES

CUSTOM. TOUGH. PROVEN.

BUILDING THE BIGGEST, TOUGHEST AND MOST EFFICIENT FANS IN THE INDUSTRY SINCE 1874.

ON-SITE SERVICES

INSTALLATION ADVISORS

INSPECTION

FIELD SERVICES

Clarage is the heavy duty division of Twin City Fan Companies Ltd. that specializes in designing and manufacturing custom heavy duty fans. Established in 1874, our long-standing reputation and market expertise has made us the industry-leading manufacturer for countless industries and thousands of process applications.

When dealing with fans of this magnitude, having the peace of mind that your fan is installed and operating properly is crucial. That is why Clarage offers a wide range of on-site services to ensure the success of your project. As part of our standard startup services, Clarage field personnel will conduct a variety of inspection checks to ensure the fan is ready for startup – all the way from the foundation bolts to the lubrication of the fan.

Whether your project involves the installation and commissioning of new equipment or conducting preventative maintenance, our technicians have the tools and expertise to perform a variety of field testing services.

- > Installation Advisors
- > Inspection
- > In-Field Balance & Laser Alignment
- > Operational Training
- > Performance Testing
- > Vibration Analysis
- > Troubleshooting
- > Startup

Clarage

WWW.CLARAGE.COM

TURNKEY SOLUTIONS

CONSTRUCTION SERVICES

In addition to manufacturing heavy duty fans and dust collectors, Clarage can offer a full spectrum of Turnkey Construction Services, from a single technician to work side-by-side with maintenance crews, all the way to a full team of welders, crane operators, foreman and safety personnel.

REBUILD & REPAIR

Not all fan applications make it easy for a fan to provide 20 years of operational life. The effects of corrosion, erosion, temperature and infrequent maintenance on a fan all work to degrade its structural integrity, balance and aerodynamic performance.

As systems change to suit environmental regulations, process enhancements, and energy consumption, our ability to retrofit existing fans is an extremely important aspect of our business. We are proficient at applying our engineering experience to make the necessary modifications to existing equipment and can provide complete turnkey solutions for rebuilding and repairing fans in the field. Without limitation for the original fan manufacturer, materials of construction or design, Clarage can provide quick response to return a fan to service.

- > Installation & Commissioning
- > Retrofits - All Brands
- > Demolition
- > Technical Services
- > Repair & Rebuild
- > Duct Work Modification
- > Damper Installation
- > Motor/Turbine Alignment
- > Preventive Maintenance
- > Inlet Cones
- > Coupling Alignment
- > Material Upgrades

ON-SITE SERVICES

COMMISSIONING

RETROFITS

TECHNICAL SERVICES

IN-HOUSE SERVICES

AIR PERFORMANCE TESTING (AMCA 210)

JET FAN THRUST TESTING

HIGH TEMPERATURE TESTING

TESTING SERVICES

Clarage's state-of-the-art laboratories and cutting-edge design tools have given us the ability to offer the most comprehensive range of in-house testing services in the entire industry. These testing services are designed to validate our products prior to field installation. And when dealing with fans of this magnitude and complexity, providing our customers with proven solutions for their exact requirements is critical.

Our individualized efforts to satisfy the specific needs of our customers is yet another way we continue to distinguish ourselves in the market. Because when you need the job done right, you need a partner you can count on who has the collective experience and knowledge for tackling the most technically complex projects.

TESTING SERVICES

- Performance & Mechanical Run Tests
  - Up to 4,000 HP (2,983 kW)
- Seismic Testing
- Non-Destructive Testing (NDT)
  - Magnetic Particle Testing
  - Dye Penetration Testing
  - Radiographic Testing
  - Ultrasonic Testing
- Rotor Balancing
  - Up to 160 inch diameters (4,065 mm)
- Aerodynamic Performance Test
- Thrust Testing
- Sound Surveys
- High Temperature/Survivability Testing
- Overspeed Testing

ENGINEERING SERVICES

Clarage has been engineering special fan applications for more than 125 years and has maintained our engineering standards current for the day. The dynamic nature of custom fans, the greater acceptability of variable frequency drives, and the variety of industrial applications into which the fans are placed gives engineering a significant role in determining the final quality and operational life of the product.

Clarage sizes our fans exactly for the duty point that is required. Where other manufacturers pick a fan close in size, we custom design and engineer a fan down to an eighth of an inch to match the exact wheel diameter that meets the performance you require.

When specified, Clarage will apply Finite Element Analysis, Torsional Analysis, Transient Torsional Analysis and Bearing Analysis into the fan design.

ENGINEERING SERVICES

- > Finite Element Analysis (FEA)
- > Torsional Analysis
- > Transient Torsional Analysis
- > Bearing Analysis
- > Modal Analysis
- > Computational Fluid Dynamics (CFD)
- > System Model Evaluation

Clarage

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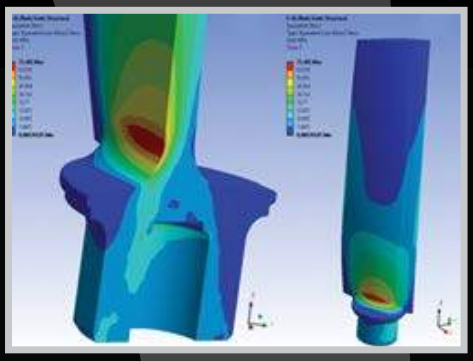
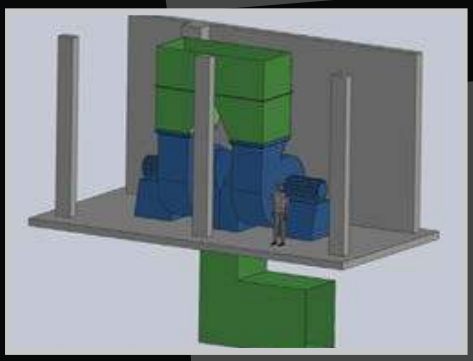
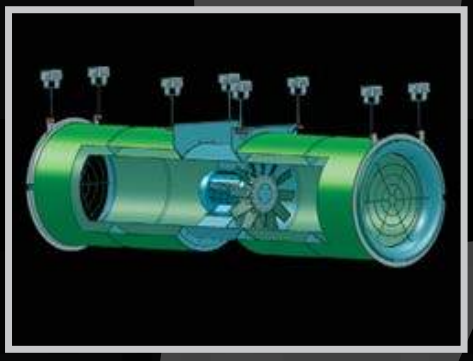
IN-HOUSE SERVICES



FINITE ELEMENT ANALYSIS



SYSTEM EVALUATION



PRODUCT REDESIGN

CUSTOMIZED SOLUTIONS

CENTRIFUGAL FANS

AXIAL FANS

DUST COLLECTORS

PRODUCT OFFERINGS

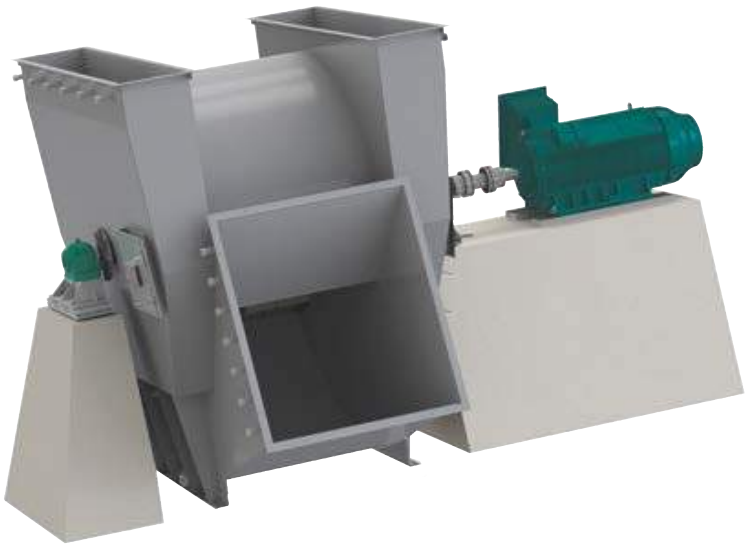
CUSTOM ENGINEERED FAN TYPES
Forced Draft | Induced Draft | Process Fans
Two Stage | Pressure Blowers | Industrial Exhausters
Material Handling | Adjustable Pitch Axial Fans

CENTRIFUGAL FANS
Airfoil | Backward Curved | Backward Inclined | Radial
Radial Tip | Modified Radial | Forward Curved

VARIABLE PITCH AXIAL FANS
Cast Aluminum | Forged Aluminum | High Temp Aluminum
Cast Steel | Formed Steel | Forged Steel

DUST COLLECTORS
Standard sizes up through 2 million CFM
6", 9" & 11.5" (152 mm, 228 mm, & 292 mm) Tube Availability | Standard or Totally Accessible (TA) Design

DAMPERS
Opposed Blade | Parallel Blade | Butterfly | Shut-Off
Nested Variable Inlet Vane | Bolt-On Radial Blade



HIGHEST EFFICIENCIES

If your process calls for custom heavy duty axial fans or centrifugal fans, Clarage's custom approach to fan design has given us the unique capability to engineer our products to the maximum point of efficiency. Why can Clarage give you higher efficiency, better performance, and longer life? The answer is simple. We custom engineer every fan to handle the exact application for which it is intended. And as the push for reduced power consumption continues to grow on a global basis, let Clarage help you tackle your GREEN energy initiatives.

Have an existing fan? Our team of experts can test and analyze your fan and the associated system. This analysis can lead to improvements in efficiency that can have pay backs in as little as a couple of months. Clarage can often meet new requirements with fan retrofits while improving efficiency and minimizing project costs.

PRODUCT CAPABILITIES

Impeller Sizes

> Centrifugal - Up to 160 inches (4,065 mm)
> Axial - Up to 315 inches (8,000 mm)

Airflow

> Single Width (Centrifugal) – Up to 900,000 CFM (1,529,100 m^3/hour)
> Double Width (Centrifugal) – Up to 1,500,000 CFM (2,548,500 m^3/hour)
> Single Stage (Axial) – Up to 1,500,000 CFM (2,548,500 m^3/hour)
> Two-Stage (Axial) – Up to 1,500,000 CFM (2,548,500 m^3/hour)

Static Pressures

> Single Stage – Centrifugal up to 95 inches w.g. (23,620 Pa)
Axial up to 36 inches w.g. (8,950 Pa)
> Two-Stage – Centrifugal up to 150 inches w.g. (37,294 Pa)
Axial up to 72 inches w.g. (17,901 Pa)

Motor Sizes

> Up to 15,000 HP (11,185 kW)

Temperature Range

> Up to 1,500°F (815°C)

Operating / Rotational Speeds

> Up to 3,600 RPM

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CUSTOM ENGINEERED CENTRIFUGAL & AXIAL FANS

Forced Draft | Induced Draft | Process Fans | Pressure Blowers | Industrial Exhausters | Material Handling
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