



INSTALLATION, OPERATION & MAINTENANCE

VERTICAL HIGH PERFORMANCE FAN COIL UNIT

MODEL TVHC - FRONT AND BOTTOM RETURN



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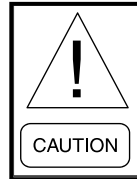
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SAFETY SYMBOLS

The following symbols are used in this document to alert the reader to areas of potential hazard:



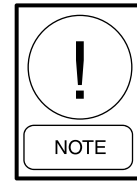
DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



CAUTION identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution. Usually an instruction will be given, together with a brief explanation.



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



NOTE is used to highlight additional information which may be helpful to you.

SAFETY CONSIDERATIONS

The equipment covered by this manual is designed for safe and reliable operation when installed and operated within its design specification limits. To avoid personal injury or damage to equipment or property while installing or operating this equipment, it is essential that qualified, experienced personnel perform these functions using good judgment and safe practices. See the following cautionary statements.



ELECTRICAL SHOCK HAZARDS. *All power must be disconnected prior to installation and servicing this equipment. More than one source of power may be present. Disconnect all power sources to avoid electrocution or shock injuries.*



MOVING PARTS HAZARDS. *Motor and Blower must be disconnected prior to opening access panels. Motors can start automatically, disconnect all power and control circuits prior to servicing to avoid serious crushing or dismemberment injuries.*



HOT PARTS HAZARDS. *Electric Resistance heating elements must be disconnected prior to servicing. Electric Heaters may start automatically, disconnect all power and control circuits prior to servicing to avoid burns.*



Check that the unit assembly and component weights can be safely supported by rigging and lifting equipment.



All assemblies must be adequately secured during lifting and rigging by temporary supports and restraints until equipment is permanently fastened and set in its final location.



All unit temporary and permanent supports must be capable of safely supporting the equipment's weight and any additional live or dead loads that may be encountered. All supports must

be designed to meet applicable local codes and ordinances.



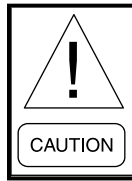
All fastening devices must be designed to mechanically lock the assembly in place without the capability of loosening or breaking away due to system operation and vibration.



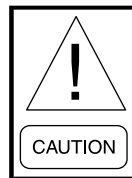
Secure all dampers when servicing damper, actuator or linkages. Dampers may activate automatically, disconnect control circuits or pneumatic control systems to avoid injury.



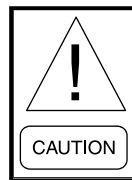
Protect adjacent flammable materials when brazing, Use flame and heat protection barriers where needed. Have fire extinguisher available and ready for immediate use.



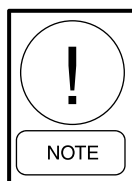
The unit's Intertek listing specifies a maximum external static pressure of 0.5" when a unit is selected with Electric Heat; operation above this limit exceeds the certified parameters.



The auto air vent must not be used with Glycol to ensure compliance and safe operation.



To prevent personal injury, avoid direct contact with sharp edges. Always handle parts and service the unit with care, wearing appropriate protective gear such as gloves, safety glasses, and protective clothing.



This unit is ETL listed to UL/CSA standards. Specifically, it conforms to UL Std. 60335, Cert. to CSA Std. C22.2 No. 60335. All modifications to line voltage wiring must be performed in accordance with the NEC and inspected by ETL to maintain listing. Unauthorized modification to any wiring may impact unit performance and void ETL listing and/or product warranty.

TVHC FEATURES

MODEL TVHC

Many standard features on the TVHC fan coil unit are expensive add-ons for other manufacturers.

Piping and supply duct connections are from top of unit, eliminating the need for side or back access

Right or left hand configurations for coil (same end only) and electrical connections

Product labeling including tagging, airflow and electrical information

Single point power connection for simple installation and wiring

All hot water and chilled water coils are AHRI 410 listed and bear the AHRI label (see page 7)

Galvanized steel drain pan with 3/4" MPT connection

Drain connection at front of unit — side access not required

1/2" thick, fiberglass insulation (standard) complying with UL 181 and NFPA 90A (optional foil faced insulation shown) Elastomeric closed cell foam is also available.

Insulation mechanically fastened for added strength

PSC, ECM three-speed and new ECM Spoked Rotor constant torque motors offer a variety of control options

Bottom (shown) or front return air connection

Integral discharge collar for simple field installation

Galvanized steel casing with-standing 125 hour salt spray specifications per ASTM B-117

Electric heat, piping packages and thermostats available

Statically and dynamically balanced direct drive fan assembly
Galvanized forward curved fan wheel in galvanized housing
Permanently lubricated three speed ODP PSC fan motors with inherent thermal overload protection motors, ECM three speed fixed, or three speed adjustable constant torque spoked rotor ECM available in 115, 208-230 or 277 volt, single phase 60 Hz, or 220-240 volt, single phase, 50 Hz

Removable access panels sized for easy handling and maintenance

All unit configurations listed with ETL for safety compliance

Small footprint

All access from the front panels — units can be mounted in a pipe chase (ducted units require optional return plenum for access)

1" glass fiber throwaway, MERV8, MERV13 filter, or 2" glass fiber throwaway, MERV8 or MERV13 filter



SECTION 1 - RECEIPT & INITIAL INSTALLATION

PREFACE

Titus blower coil units represent a prudent investment which can, with proper installation, operation, and regular maintenance, give trouble-free operation and long service.

Your equipment is initially protected under the manufacturer's standard warranty; however, this warranty is provided under the condition that the steps outlined in this manual for initial inspection, proper installation, regular periodic maintenance, and everyday operation of the equipment be followed in detail. This manual should be fully reviewed in advance of any actual work being done on the equipment. Should any questions arise, please contact your local Sales Representative or the factory BEFORE proceeding.

The equipment covered by this manual is available with a vast variety of options and accessories. Consult the approved unit submittal, order acknowledgement, and other manuals for details on the options and accessories provided with the equipment on each project.



No attempt should be made to handle, install, or service any unit without following safe practices regarding mechanical equipment.



All power must be disconnected before any installation or service should be attempted. More than one power source may be supplied to a unit. Power to remote mounted control devices may not be supplied through the unit. Never wear bulky or loose fitting clothing when working on any mechanical equipment. Gloves should only be worn when required for proper protection from heat or other possible injury. Safety glasses or goggles should always be worn when drilling, cutting, or working with chemicals such as refrigerants or lubricants.



Never pressurize any equipment beyond specified operating pressures. Always pressure test with some inert fluid or gas such as clear water or dry nitrogen to avoid possible damage or injury in the event of a leak or component failure during testing.



Always protect adjacent flammable material when welding or soldering. Use suitable heat shield material to contain sparks or drops of solder. Have fire extinguisher available for use when welding or brazing.

The manufacturer assumes no responsibility for personal injury or property damage resulting from improper or unsafe practices during the handling, installation, service, or operation of any equipment.

UNPACKING & INSPECTION

All units are carefully inspected at the factory throughout the manufacturing process under a strict detailed quality assurance program, and where possible, all major components and subassemblies are carefully tested for proper operation and verified to be in full compliance with the factory manufacturing documents. Customer furnished components such as control valves, switches and DDC controls are not factory tested.

Each unit is carefully packaged for shipment to avoid damage during normal transport and handling. The equipment should always be stored in a dry place in the proper orientation as marked on the carton.

All shipments are made F.O.B. factory and it is the responsibility of the receiving party to inspect the equipment upon arrival. Any obvious damage to the carton and/or its contents should be recorded on the bill of lading and a claim should be filed with the freight carrier.

After determining the condition of the carton exterior, carefully remove each unit from the carton and inspect for hidden damage. At this time check to make sure that "furnished only" items such as switches, thermostats, etc. are accounted for. Any hidden damage should be recorded and immediately reported to the carrier and a claim filed as before. In the event a claim for shipping

damage is filed, the unit, shipping carton, and all packing must be retained for physical inspection by the freight carrier. All equipment should be stored in the factory-shipping carton with internal packing in place until installation.

At the time of receipt, the equipment type and arrangement should be verified against the order documents. Should any discrepancy be found, the local Sales Representative should be notified immediately so that the proper action may be instituted. Should any question arise concerning warranty repairs, the factory must be notified BEFORE any corrective action is taken. Where local repairs or alterations can be accomplished, the factory must be fully informed as to the extent and expected cost of those repairs before work is begun. Where factory operations are required, the factory must be contacted for authorization to return equipment and a Return Authorization Number will be issued. Unauthorized return shipments of equipment and shipments not marked with an authorization number will be refused. In addition, the manufacturer will not accept any claims for unauthorized expenses.

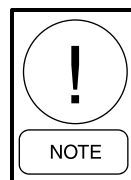
HANDLING & INSTALLATION

While all equipment is designed for durability and fabricated for sturdy construction and may present a rugged appearance, great care must be taken to assure that no force or pressure be applied to the coil, piping or drain stub-outs during handling. Also, depending on the options and accessories, some units could contain delicate components that may be damaged by improper handling. Wherever possible, all units should be maintained in an upright position and handled by the chassis as close as possible to the mounting point locations.

The unit must be handled by the exterior casing. This is acceptable providing the unit is again maintained in an upright position and no impact forces are applied that may damage internal components, or access panels. The equipment covered in this manual IS NOT suitable for outdoor installations. The equipment should never be stored or installed where it may be subjected to a hostile environment such as rain, snow, or extreme temperatures.

During and after installation, special care must be taken to prevent foreign material such as paint, plaster, and drywall dust from being deposited in the drain pan or on the motor or blower wheels. Failure to do so may have serious adverse effects on unit operation and in the case of the motor and blower assembly, may result in immediate or premature failure. All manufacturers' warranties are void if foreign material is allowed to be deposited on the motor or blower wheels of any unit. Some units and/or job conditions may require some form of temporary covering during construction.

While the manufacturer does not become involved in the design and selection of support methods and components, it should be noted that unacceptable system operating characteristics and/or performance may result from improper or inadequate unit structural support. In addition, adequate clearance must be provided for service and removal of the equipment and its accessory components. Anchoring the equipment in place is accomplished by using the mounting points provided and positioning the unit to maintain the unit on a LEVEL plane. Care must be taken to insure that the unit drain pan does not slope away from the outlet connection.



The unit's drain pan must be sloped toward the drain connection when the unit is installed.

UNIT WEIGHT DATA

COMPONENT		UNIT SIZE						
		04	06	08	10	12	16	20
BASE UNIT		81 [37]	81 [37]	103 [47]	103 [47]	106 [48]	128 [58]	134 [61]
MIXING BOX		24 [11]	24 [11]	24 [11]	37 [17]	37 [17]	54 [24]	54 [24]
DISCHARGE PLENUM		21 [10]	21 [10]	21 [10]	33 [15]	33 [15]	48 [22]	48 [22]
RETURN PLENUM		17 [8]	17 [8]	17 [8]	25 [11]	25 [11]	33 [15]	33 [15]
COIL ROWS	1 ROW - DRY	7 [3]	7 [3]	8 [4]	11 [5]	11 [5]	16 [7]	16 [7]
	1 ROW - WET	8 [4]	8 [4]	9 [4]	14 [6]	14 [6]	19 [9]	19 [9]
	2 ROW - DRY	10 [5]	10 [5]	12 [5]	17 [8]	17 [8]	25 [11]	25 [11]
	2 ROW - WET	12 [5]	12 [5]	14 [6]	21 [10]	21 [10]	31 [14]	31 [14]
	3 ROW - DRY	16 [7]	19 [9]	21 [10]	27 [12]	29 [13]	38 [17]	46 [21]
	3 ROW - WET	20 [9]	23 [10]	26 [12]	35 [16]	38 [17]	49 [22]	60 [27]
	4 ROW - DRY	20 [9]	23 [10]	26 [12]	34 [15]	37 [17]	49 [22]	59 [27]
	4 ROW - WET	25 [11]	29 [13]	34 [15]	44 [20]	48 [22]	64 [29]	77 [35]

NOTE: Unit weight data is shipping weight in pounds [kilograms].

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COILS

Verify that the proper types of service are actually provided to the unit. On units with steam heating coils, the maximum steam pressure applied to the unit should never exceed 15 PSIG. The drain piping and steam trap should be sized and routed to allow for proper condensate flow. The electrical service to the unit should be compared to the unit nameplate to verify compatibility. The routing and sizing of all piping, and the type and sizing of all wiring and other electrical components such as circuit breakers, disconnect switches, etc. should be determined by the individual job requirements and should not be based on the size and/or type of connection provided on the equipment. All installations should be made in compliance with all governing codes and ordinances. Compliance with all codes is the responsibility of the installing contractor.

COOLING/HEATING MEDIUM CONNECTIONS



Toxic residues and loose particles resulting from manufacturing and field piping techniques such as joint compounds, soldering flux, and metal shavings may be present in the unit and the piping system. Special consideration must be given to system cleanliness when connecting to solar, domestic or potable water systems.

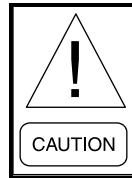
Submittals and Product Catalogs detailing unit operation, controls, and connections should be thoroughly reviewed BEFORE beginning the connection of the various cooling and/or heating mediums to the unit.

All accessory valve packages should be installed as required, and all service valves should be checked for proper operation.

If coil and valve package connections are to be made with “sweat” or solder joint, care should be taken to assure that no components in the valve package are subjected to a high temperature which may damage seals or other materials. Many two-position electric control valves, depending on valve operation, are provided with a manual-opening lever. This lever should be placed in the “open” position during all soldering or brazing operations. Valve bodies should be wrapped with a wet rag to help dissipate heat encountered during brazing.

If the valve package connection at the coil is made with a union, the coil side of the union must be prevented from twisting (“backed up”) during tightening to prevent damage to the coil tubing. Over-tightening must be avoided to prevent distorting the union seal surface and destroying the union. In the case of field installed valves and piping, the chilled water valve cluster should be installed in such a way that any dripping or sweating is contained in the auxiliary drain pan or other device. Valves should be secured or supported to avoid damage to coil headers.

After the connections are completed, the system should then be tested for leaks. Since some components are not designed to hold pressure with a gas, hydronic systems should be tested with water.



All water coils must be protected from freezing after initial filling with water. Even if the system is drained, unit coils may still hold enough water to cause damage when exposed to temperatures below freezing.

HEATING CAPACITY

UNIT SIZE	NOMINAL CFM	1 ROW			2 ROW		
		QS (MBH)	GPM	WPD	QS (MBH)	GPM	WPD
04	400	12.5	1.3	1.5	21.2	2.2	1.5
06	600	14.9	1.5	2.1	26.4	2.7	2.2
08	800	20.5	2.1	4.9	36.3	3.7	4.9
10	1000	30.7	3.2	2.9	52.9	5.4	4.3
12	1200	33.5	3.4	3.4	58.5	6.0	5.2
16	1600	50.4	5.2	4.4	89.0	9.1	12.3
20	2000	56.0	5.7	5.4	100.9	10.3	15.7

NOTES:

1. Based on 70°F EAT, 180°F EWT, 20°F temperature drop, high fan speed.

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In the event that leaking or defective components are discovered, the Sales Representative must be notified BEFORE any repairs are attempted. All leaks should be repaired before proceeding with the installation.

After system integrity has been established the piping should be insulated in accordance with the project specifications. ALL chilled water piping and valves not located over drain pans must be insulated to prevent damage from sweating. This includes factory and field piping inside the unit cabinet.

The drain should always be connected and piped to an acceptable disposal point. For proper moisture carry-off, the drain piping should be sloped away from the unit at least 1/8" per foot. A drain trap may be required by local codes and it is strongly recommended for odor containment.

CONDENSATE DRAIN AND TRAPS

Drain lines should be at least the same size as the drain pan connection. Properly sized traps should be used to allow the condensate from the coils to drain from the drain pan. *See Fig. 1.*

DUCTWORK CONNECTIONS

All ductwork and/or supply and return grilles should be installed in accordance with the project plans and specifications. If not included on the unit or furnished from the factory, Titus supply and return grilles are available in a variety of types.

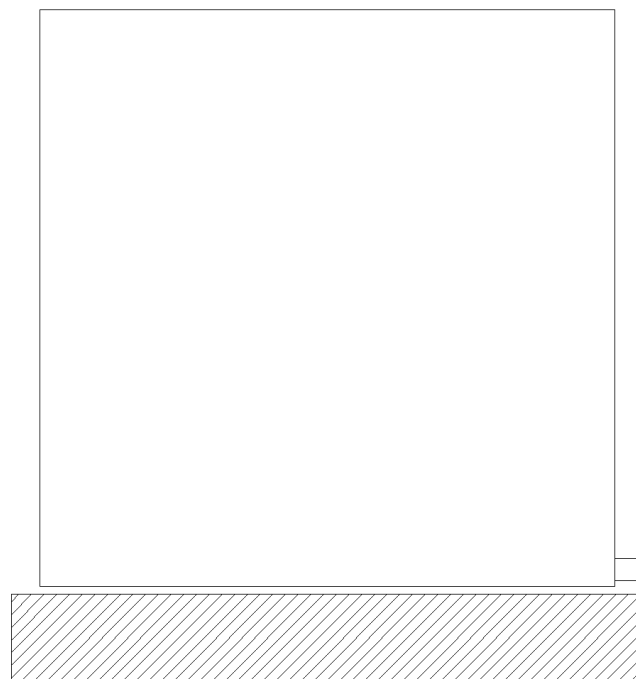
All units must be installed in non-combustible areas.

Some models are designed to be connected to duct-work with a MINIMUM amount of external static pressure. Consult the approved submittals and the product catalog for unit external static pressure limitations.

Units provided with outside air for ventilation should have some form of low temperature protection to prevent coil freeze-up.

It should be noted that none of these methods would adequately protect a coil in the event of power failure. The safest method of freeze protection is to use glycol in the proper percent solution for the coldest expected air temperature.

The manufacturer assumes no responsibility for undesirable system operation due to improper design, equipment or component selection, and/or installation of ductwork, grilles, and other field supplied components.



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FIGURE 1 - HOUSEKEEPING PAD

Required to accommodate trap height (Horizontal Units only)

ELECTRICAL CONNECTIONS

The unit nameplate lists the unit electrical characteristics such as the required supply voltage, fan and heater amperage and required circuit ampacities. The unit-wiring diagram shows all unit and field wiring. Since each project is different and each unit on a project may be different, the installer must be familiar with the wiring diagram and nameplate on the unit BEFORE beginning any wiring. This unit is not acceptable for installation in hazardous/explosive areas.

Electrical Enclosure

The electrical enclosure provides access to a spacious electrical compartment. This compartment houses all electric heat and control components. Terminal strips are furnished for simple power and control (where applicable) wiring connections.

All components furnished for field installation, by either the factory or the controls contractor should be located and checked for proper function and compatibility. All internal components should be checked for shipping damage and all electrical connections should be tightened to minimize problems during start up.

Any devices such as fan switches or thermostats that have been furnished from the factory for field installation must be wired in strict accordance with the applicable wiring diagrams. Failure to do so could result in personal injury or damage to components and will void all manufacturers' warranties.

The fan motor(s) should never be controlled by any wiring or device other than the factory furnished switch, thermostat/switch combination or SCR, without factory authorization.

All field wiring should be done in accordance with governing codes and ordinances. Any modification of the unit wiring without factory authorization will result in voiding of all factory warranties and will nullify any agency listings.

The manufacturer assumes no responsibility for any damages and/or injuries resulting from improperly field installed or wired components.

SECTION 2 - START-UP

GENERAL

Before beginning any start-up operation, the start-up personnel should familiarize themselves with the unit, options and accessories, and control sequence to understand the proper system operation. All personnel should have a good working knowledge of general start-up procedures and have the appropriate start-up and balancing guides available for consultation.

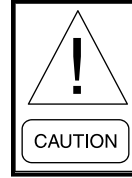
The initial step in any startup operation should be a final visual inspection. All equipment, plenums, duct-work, and piping should be inspected to verify that all systems are complete and properly installed and mounted, and that no debris or foreign articles such as paper or drink cans are left in the units or other areas. Each unit should be checked for loose wires, free blower wheel operation, and loose or missing access panels or doors. Except as required during start-up and balancing operations, no unit should be operated without all the proper ductwork attached, supply and return grilles in place, and all access doors and panels in place and secure. A clean filter of the proper size and type must also be installed. Failure to do so could result in damage to the equipment or building and furnishings, and/or void all manufacturers' warranties.

COOLING/HEATING SYSTEM

Prior to the water system start-up and balancing, the chilled/hot water systems should be flushed to clean out dirt and debris, which may have collected in the piping during construction. During this procedure, all unit service valves must be in the closed position. This prevents foreign matter from entering the unit and clogging the valves and metering devices. Strainers should be installed in the piping mains to prevent this material from entering the units during normal operation.

During system filling, air venting from the unit is accomplished by the use of a manual or automatic air vent fitting installed in the system. In the case of the

manual air vent fitting, the screw should be turned counterclockwise no more than 1-¼ turns to operate the air vent. Automatic air vents may be unscrewed one turn counterclockwise to speed initial venting but should be screwed in for automatic venting after start-up operations. Automatic air vents must not be used with glycol in order to ensure compliance and safe operation.



Air vents provided on the unit are not intended to replace the main system air vents and may not release air trapped in other parts of the system. Inspect the entire system for potential air traps and vent those areas as required, independently. In addition, some systems may require repeated venting over a period of time to properly eliminate air from the system.

AIR SYSTEM BALANCING

All ductwork must be complete and connected, and all grilles, filters, access doors and panels must be properly installed to establish actual system operating conditions BEFORE beginning air balancing operations.

Each individual unit and attached ductwork is a unique system with its own operating characteristics. For this reason, air balancing is normally done by balance specialists who are familiar with all procedures required to properly establish air distribution and fan system operating conditions. These procedures should not be attempted by unqualified personnel.

After the proper system operation is established, the actual unit air delivery and the actual fan motor amperage draw for each unit should be recorded in a convenient place for future reference such as the inspection, installation, & start-up check sheet, a copy of which is provided at the back of this manual.

NOMINAL AIRFLOW

UNIT SIZE	04	06	08	10	12	16	20
NOMINAL CFM	400	600	800	1000	1200	1600	2000

NOTES:

1. Unit sizes are nominal.
2. CFM data based on high speed tap with 115/1/60 PSC motor.
3. All CFM data include pressure losses for cabinet, electric heat, 4 row coil, and clean 1" throwaway filter.

PSC MOTOR AND FAN DATA

UNIT SIZE	MOTOR TAP	MOTOR (QTY.) HP	NUMBER OF FANS	AMPS			
				115V	208V	230V	277V
04	HI	(1) 1/6	1	2.7	1.4	1.4	1.0
	MED	(1) 1/8		2.4	0.9	0.9	0.9
	LOW	(1) 1/10		2.2	0.6	0.6	0.8
06	HI	(1) 1/6	1	2.7	1.4	1.4	1.0
	MED	(1) 1/8		2.4	0.9	0.9	0.9
	LOW	(1) 1/10		2.2	0.6	0.6	0.8
08	HI	(1) 1/4	1	4.9	2.2	2.2	2.0
	MED	(1) 1/5		4.1	1.5	1.5	1.7
	LOW	(1) 1/8		3.2	1.1	1.1	1.4
10	HI	(1) 1/4	1	4.9	2.2	2.2	2.0
	MED	(1) 1/5		4.1	1.5	1.5	1.7
	LOW	(1) 1/8		3.2	1.1	1.1	1.4
12	HI	(1) 1/2	1	9.6	4.0	4.0	3.6
	MED	(1) 1/3		9.3	2.7	2.7	2.9
	LOW	(1) 1/4		8.8	2.0	2.0	2.8
16	HI	(2) 1/4	2	9.8	4.4	4.4	4.0
	MED	(2) 1/5		8.2	3.0	3.0	3.4
	LOW	(2) 1/8		6.4	2.2	2.2	2.8
20	HI	(2) 1/4	2	9.8	4.4	4.4	4.0
	MED	(2) 1/5		8.2	3.0	3.0	3.4
	LOW	(2) 1/8		6.4	2.2	2.2	2.8

NOTES:

1. Motor electrical data is nameplate data. Actual data will vary with application.
2. 230 volt motor is nameplated for 208-230/1/60. Use 230 volt motor data for 208 volt applications.

SOUND DATA

UNIT SIZE	FAN SPEED	CFM	RPM	TOTAL SOUND POWER LEVEL						
				OCTAVE BAND / CENTER FREQUENCY (HZ)						
				2/125	3/250	4/500	5/1000	6/2000	7/4000	8/8000
04	HI	610	1107	70	62	57	53	51	49	42
	MED	570	1040	69	61	55	51	49	49	42
	LOW	515	949	69	63	58	53	50	49	42
06	HI	750	1050	78	71	63	59	57	56	49
	MED	650	895	73	66	59	55	53	51	47
	LOW	540	735	68	61	54	50	48	45	41
08	HI	1050	1114	75	70	64	59	57	56	49
	MED	1000	1023	72	68	62	57	55	54	46
	LOW	895	877	69	64	58	53	51	48	40
10	HI	1275	1051	74	70	64	64	62	61	53
	MED	1050	849	70	64	60	59	56	55	47
	LOW	825	671	65	58	54	53	50	48	40
12	HI	1490	1089	77	72	67	68	68	67	62
	MED	1420	1035	76	71	66	67	66	65	60
	LOW	1320	964	74	69	64	65	64	63	58
16	HI	2300	1099	77	71	67	65	64	63	57
	MED	2030	988	75	69	65	63	61	60	54
	LOW	1600	785	71	63	59	57	55	54	46
20	HI	2290	1088	77	73	68	66	64	64	58
	MED	1970	941	76	69	65	63	61	60	54
	LOW	1590	769	71	64	60	57	56	53	46

NOTES:

1. Sound data tested in accordance with AHRI 350-86.
2. Sound levels are expressed in decibels, dB RE: 1 x 10⁻¹² watts.
3. Total sound power level data based on fan CFM at corresponding motor tap with 115/1/60 volt motor, 0.0" external static pressure and standard rated internal pressure losses.

ECM MOTOR AND FAN DATA

UNIT SIZE	MOTOR (QTY.) HP	NUMBER OF FANS	NAMEPLATE AMPS (MAX ALLOWED)				UNIT LABEL AMPS (CERTIFICATION TESTED)			
			115V	208V	230V	277V	115V	208V	230V	277V
04	1/3	1	5.0	3.0	2.8	2.6	1.9	1.2	1.1	1.0
06	1/3	1	5.0	3.0	2.8	2.6	3.4	2.1	2.0	1.7
08	1/3	1	5.0	3.0	2.8	2.6	5.0	3.0	2.8	2.6
10	1/3	1	5.0	3.0	2.8	2.6	5.0	3.0	2.8	2.6
12	1/2	1	7.7	5.0	4.3	4.1	7.7	5.0	4.3	4.0
16	2/3	2	10.0	6.0	5.6	5.2	8.2	5.0	4.7	4.1
20	1	2	15.4	10.0	8.6	8.2	11.5	7.0	6.5	5.7

SOUND DATA

UNIT SIZE	ESP	CFM	RPM	CASING RADIATED FREE INLET						
				OCTAVE BAND / CENTER FREQUENCY (HZ)						
				2/125	3/250	4/500	5/1000	6/2000	7/4000	8/8000
04	0.1	500	900	59	55	53	49	43	36	35
	0.3	550	1200	67	60	57	55	51	47	40
	0.6	600	1600	75	67	62	63	58	61	49
06	0.1	550	900	58	55	55	50	44	36	33
	0.3	650	1200	65	61	59	56	51	45	39
	0.6	750	1600	72	67	63	63	57	55	49
08	0.1	900	900	58	55	54	50	41	35	33
	0.3	1000	1200	65	62	58	56	49	43	37
	0.6	1100	1600	73	69	63	61	56	52	47
10	0.1	950	900	68	62	62	61	59	58	50
	0.3	1100	1200	74	67	66	67	66	66	59
	0.6	1250	1600	80	74	70	74	75	77	73
12	0.1	1300	900	64	61	54	53	48	42	37
	0.3	1400	1200	69	65	59	59	55	50	45
	0.6	1500	1600	74	69	63	65	63	60	57
16	0.1	1600	900	66	60	57	55	51	44	37
	0.3	2000	1200	73	67	61	62	57	53	44
	0.6	2400	1600	80	74	65	68	63	62	56
20	0.1	1600	900	69	67	66	65	62	58	51
	0.3	2000	1200	75	73	70	72	69	66	61
	0.6	2400	1600	82	81	74	79	76	75	75

NOTES:

1. Sound data tested in accordance with AHRI 350-86.
2. Sound levels are expressed in decibels, dB RE: 1 x 10⁻¹² watts.
3. Total sound power level data based on fan CFM at corresponding motor tap with 115/1/60 volt ECM motor and standard rated internal pressure losses.

WATER SYSTEM BALANCING

A complete knowledge of the hydronic system, its components, and controls is essential to proper water system balancing and this procedure should not be attempted by unqualified personnel. The system must be complete and all components must be in operating condition BEFORE beginning water system balancing operations.

Each hydronic system has different operating characteristics depending on the devices and controls in the system. The actual balancing technique may vary from one system to another.

After the proper system operation is established, the appropriate system operating conditions such as various water temperatures and flow rates should be recorded in a convenient place for future reference.

Before and during water system balancing, conditions may exist which can result in noticeable water noise or undesired valve operation due to incorrect system pressures. After the entire system is balanced, these conditions will not exist on properly designed systems.

CONTROLS OPERATION

Before proper control operation can be verified all other systems must be in proper operation. The correct water and air temperatures must be present for the control function being tested. Some controls and features are designed to not operate under certain conditions.

A wide range of controls and electrical options and accessories may be used with the equipment covered in this manual. Consult the approved unit submittals, order acknowledgement, and other manuals for detailed information regarding each individual unit and its controls. Since controls and features may vary from one unit to another, care should be taken to identify the controls to be used on each unit and their proper control sequence. Information provided by component manufacturers regarding installation, operation, and maintenance of their individual controls is available upon request.

SECTION 3 - NORMAL OPERATION & PERIODIC MAINTENANCE

GENERAL

Each unit on a job will have its own unique operating environment and conditions that may dictate a maintenance schedule for that unit that is different from other equipment on the job. A formal schedule of regular maintenance and an individual unit log should be established and maintained. This will help to achieve the maximum performance and service life of each unit on the job.

Information regarding safety precautions contained in the preface at the beginning of this manual should be followed during any service and maintenance operations. For more detailed information concerning service operations, consult your Sales Representative or the Factory.

MOTOR/BLOWER ASSEMBLY

The type of fan operation is determined by the control components and their method of wiring, and may vary from unit to unit. *Refer to the wiring diagram for each unit for that unit's individual operating characteristics.* Motors are permanently lubricated, PSC or ECM type and do not require field lubrication.

Fan Assembly

Should the assembly require more extensive service, the motor/blower assembly may be removed from the unit to facilitate such operations as motor or blower wheel/housing replacement, etc. Dirt and dust should not be allowed to accumulate on the blower wheel or housing. This can result in an unbalanced blower wheel condition that can damage a blower wheel or motor. The wheel and housing may be cleaned periodically using a vacuum cleaner and a brush taking care not to dislodge the factory balancing weights on the blower wheel blades.

COIL

Coils may be cleaned in place by gently brushing the entering air face between fins with a soft brush parallel to fins. Do not brush perpendicular to fin orientation as damage may occur. Brushing should be followed by cleaning with a vacuum cleaner. If a compressed air source is available, the coil may also be cleaned by blowing air through the coil fins from the leaving air face. Vacuuming should again follow this.

ELECTRIC RESISTANCE HEATER ASSEMBLY

Electric resistance heaters typically require no normal periodic maintenance when unit air filters are changed properly. Other conditions and equipment may affect the operation and service life in the system. The two most important operating conditions for an electric heater are proper airflow and proper supply voltage. High supply voltage and/or poorly distributed or insufficient airflow over the element will result in element overheating. This condition may result in the heater cycling on the high limit thermal cutout.

Open wire type heaters provided have an automatic reset switch with a back-up manual high limit thermal switch. Automatic reset switches are as the name implies; they reset automatically after the heater has cooled down. The high limit thermal cutout device is a manual reset safety device. With proper unit application and during normal operation, the high limit thermal cutout will not operate. This device only operates when some problem exists. ANY condition that causes high limit cutout MUST be corrected immediately. This high limit secondary manual reset breaks every energized leg. Once the high limit trips, it may be reset once the unit has cooled down, and manual reset requires a button push inside the unit. Refer to troubleshooting section for high limit reset instructions. High supply voltage also causes excessive amperage draw and may result in tripping of the circuit breaker or blowing of the fuses on the incoming power supply.

ELECTRICAL WIRING & CONTROLS

The electrical operation of each unit is determined by the components and wiring of the unit and may vary from unit to unit. Consult the wiring diagram for the actual type and number of controls provided on each unit. The integrity of all electrical connections should be verified at least twice during the first year of operation. Afterwards, all controls should be inspected regularly for proper operation. Some components may experience erratic operation or failure due to age. Wall thermostats may also become clogged with dust and lint and should be periodically inspected and cleaned to provide reliable operation.

When replacing any components such as fuses, contactors, or relays, use only the exact type, size, and voltage component as furnished from the factory. Any deviation without factory authorization could result in personnel injury or damage to the unit and will void all factory warranties. All repair work should be done in such a manner as to maintain the equipment in compliance with governing codes and ordinances or testing agency listings.

More specific information regarding the use and operating characteristics of the standard controls offered by this manufacturer is contained in other manuals.

FILTERS, THROWAWAY

The throwaway type of filter is most commonly used on these units and should be replaced on a regular basis. The time interval between each replacement should be established based on regular inspection of the filter and should be recorded in the log for each unit. Refer to the chart below for recommended filter size for *each product type and size*. If the replacement filters are not purchased from the factory, the filters used should be the same type and size as that furnished from or recommended by the factory. Consult factory for applications using filter types other than the factory standard or optional product.

COIL FACE AREA AND FILTER SIZES

UNIT SIZE	AUXILIARY HEATING COIL	COOLING COIL	NOMINAL FILTER SIZES			
	FACE AREA	FACE AREA	WITH FRONT RETURN		WITH BOTTOM RETURN	
04	0.9 [0.08]	1.3 [0.12]	16 x 22 x 1	[406 x 559 x 25]	(2) 14 x 10.5 x 1	[356 x 267 x 25]
06	0.9 [0.08]	1.6 [0.15]	16 x 22 x 1	[406 x 559 x 25]	(2) 14 x 10.5 x 1	[356 x 267 x 25]
08	1.2 [0.11]	1.8 [0.17]	16 x 22 x 1	[406 x 559 x 25]	(2) 14 x 10.5 x 1	[356 x 267 x 25]
10	2.0 [0.19]	2.6 [0.24]	16 x 29 x 1	[406 x 737 x 25]	(2) 14 x 17 x 1	[356 x 432 x 25]
12	2.0 [0.19]	2.9 [0.27]	16 x 29 x 1	[406 x 737 x 25]	(2) 14 x 17 x 1	[356 x 432 x 25]
16	3.3 [0.31]	4.0 [0.37]	(2) 16 x 23 x 1	[406 x 584 x 25]	(2) 17 x 22.5 x 1	[432 x 572 x 25]
20	3.3 [0.31]	5.1 [0.47]	(2) 16 x 23 x 1	[406 x 584 x 25]	(2) 17 x 22.5 x 1	[432 x 572 x 25]

NOTES:

1. Standard filters are 1" throwaway; optional filters are 2" throwaway.
2. Coil face areas are measured in square feet [square meters].
3. Filter sizes are measured in inches [millimeters].

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COMPONENT STATIC PRESSURE LOSS - INCHES W.G.

UNIT SIZE	NOMINAL CFM	FILTER ¹		COOLING COILS ^{2,3,6}		AUXILIARY HEATING COIL ^{2,4,6}		SUPPLY PLENUM WITH D.D. GRILLE	SUPPLY PLENUM WITHOUT D.D. GRILLE	MIXING BOX
		1" T/A	2" T/A	3 ROW	4 ROW ⁵	1 ROW	2 ROW			
04	400	0.04	0.09	0.14	0.19	0.06	0.12	0.11	0.09	0.03
06	600	0.08	0.11	0.2	0.26	0.11	0.22	0.11	0.06	0.06
08	800	0.12	0.17	0.24	0.32	0.11	0.22	0.11	0.03	0.10
10	1000	0.08	0.12	0.2	0.26	0.06	0.13	0.11	0.07	0.08
12	1200	0.12	0.16	0.23	0.30	0.08	0.17	0.11	0.06	0.12
16	1600	0.08	0.12	0.21	0.28	0.06	0.12	0.11	0.08	0.06
20	2000	0.12	0.16	0.21	0.27	0.09	0.17	0.11	0.06	0.09

NOTES:

- Filter static pressure is for standard flat filter rack with clean filter.
- Coil static pressure for number of rows indicated with 10 fins per inch.
- Based on a wet (operational) coil.
- Hot water coil mounted in reheat position.
- Losses for cabinet, electric heater, 4 row coil, and clean throwaway filter are included in fan curves in Direct Drive catalog.
- At AHRI conditions.

USE OF TABLE

When selecting unit sizes to meet specified performance levels, simply add or deduct the static pressure losses in the above table for the various options required to meet the specification (1" throwaway filter and 4 row coil included in fan curves). Once the combined component static pressure losses are totalled, add the value of the specified external static pressure requirements for the project. Refer to the fan curves in Direct Drive catalog for unit sizing. Match the project CFM requirements on the horizontal axis with the combined static pressure requirements on the vertical axis.

NOMINAL COIL CONNECTION SIZES

UNIT SIZE	COIL TYPE							
	WATER				REFRIGERANT			
	1 ROW	2 ROW	3 ROW	4 ROW	3 ROW		4 ROW	
					Liquid	Suction	Liquid	Suction
04	5/8" [16]	5/8" [16]	5/8" [16]	5/8" [16]	3/8" [10]	5/8" [16]	3/8" [10]	5/8" [16]
06	5/8" [16]	5/8" [16]	5/8" [16]	5/8" [16]	3/8" [10]	5/8" [16]	3/8" [10]	5/8" [16]
08	5/8" [16]	5/8" [16]	7/8" [22]	5/8" [16]	3/8" [10]	7/8" [22]	1/2" [13]	7/8" [22]
10	5/8" [16]	5/8" [16]	7/8" [22]	7/8" [22]	1/2" [13]	7/8" [22]	1/2" [13]	7/8" [22]
12	5/8" [16]	5/8" [16]	7/8" [22]	7/8" [22]	1/2" [13]	7/8" [22]	1/2" [13]	1 1/8" [29]
16	5/8" [16]	5/8" [16]	1 1/8" [29]	1 1/8" [29]	1/2" [13]	1 1/8" [29]	1/2" [13]	1 1/8" [29]
20	5/8" [16]	5/8" [16]	1 1/8" [29]	1 1/8" [29]	1/2" [13]	1 1/8" [29]	1/2" [13]	1 1/8" [29]

NOTES:

- Connection sizes are for standard circuit coils. Consult factory for special applications.
- See submittal drawings at www.titus-hvac.com for connection locations.
- All dimensional data is outside diameter (O.D.), measured in inches [millimeters].

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DRAIN

The drain should be checked before initial start-up and at the beginning of each cooling season to assure that the lines are clear. If it is clogged, steps should be taken to clear the debris so that condensate will flow easily.

Periodic checks of the drain should be made during the cooling season to maintain a free flowing condensate. Should the growth of algae and/or bacteria be a concern, consult an air conditioning and refrigeration supply organization familiar with local conditions for chemicals available to control these agents.

REPLACEMENT PARTS

Factory replacement parts should be used wherever possible to maintain the unit performance and operating characteristics and the testing agency listings. Replacement parts may be purchased through the local Sales Representative.

Contact the local Sales Representative or the factory before attempting any unit modifications. Any modifications not authorized by the factory could result in personnel injury and damage to the unit and could void all factory warranties.

When ordering parts, the following information must be supplied to ensure proper part identification:

1. Complete unit model number.
2. Unit hand connection (right or left hand) while facing the direction of airflow at the inlet.
3. Complete part description including any numbers.

On warranty replacements, in addition to the information previously listed, the project CO # that appears on the unit nameplate, is required. Contact the factory for authorization to return any parts such as defective parts replaced in warranty. All shipments returned to the factory MUST be marked with a Return Authorization Number, which is provided by the factory.

All equipment and components sold through the Parts Department are warranted under the same conditions as the standard manufacturer's warranty with the exception that the warranty period is 12 months unless the component is furnished as warranty replacement. Parts furnished as warranty replacements are warranted for the remaining term of the original unit warranties.

SECTION 4 - INSPECTION, INSTALLATION & START-UP CHECKLIST

Receiving & Inspection

- ☐ Unit Received Undamaged
- ☐ Unit Arrangement/Hand Correct

- ☐ Unit Received Complete As Ordered
- ☐ Unit Structural Support Complete & Correct

Handling & Installation

- ☐ Unit Mounted Level & Square
- ☐ Proper Electrical Service Provided
- ☐ Proper Service Switch/Disconnect Provided

- ☐ Proper Access Provided For Unit & Accessories
- ☐ Proper Overcurrent Protection Provided

Handling & Installation (continued)

- ☐ Proper Chilled Water Line Size To Unit
- ☐ Proper Steam Condensate Trap On Return Line
- ☐ All Services To Unit In Code Compliance

- ☐ Proper Hot Water Line To Unit
- ☐ Proper Steam Line Sizes To Unit
- ☐ Proper Steam Supply Pressure To Unit (15psi Max)
- ☐ All Shipping Screws & Braces Removed

Cooling/Heating Connections

- ☐ Protect Valve Package Components From Heat
- ☐ Connect Field Piping To Unit
- ☐ Install Drain Line & Traps As Required
- ☐ Install Condensate Pan Under Piping As Required

- ☐ Mount Valve Packages
- ☐ Pressure Test All Piping For Leaks
- ☐ Insulate All Piping As Required

Ductwork Connections

- ☐ Install Ductwork, Fittings & Grilles As Required
- ☐ Control Outside Air For Freeze Protection

- ☐ Proper Supply & Return Grille Type & Size Used
- ☐ Insulate All Ductwork As Required

Electrical Connections

- ☐ Refer To Unit Wiring Diagram
- ☐ All Field Wiring In Code Compliance

- ☐ Connect Incoming Power Service or Services

Unit Startup

- ☐ General Visual Unit & System Inspection
- ☐ Record Ambient Temperature
- ☐ Close All Unit Isolation Valves
- ☐ Fill Systems With Water/Refrigerant
- ☐ All Ductwork & Grilles In Place
- ☐ Start Fans, Etc.
- ☐ Check All Ductwork & Units For Air Leaks
- ☐ Record All Final Settings For Future Use
- ☐ Check All Dampers For Proper Operation
- ☐ Verify Proper Heating Operation

- ☐ Record Electrical Supply Voltage
- ☐ Check All Wiring For Secure Connections
- ☐ Flush Water Systems
- ☐ Vent Water Systems As Required
- ☐ All Unit Panels & Filters In Place
- ☐ Check For Overload Condition Of All Units
- ☐ Balance Air Systems As Required
- ☐ Check Piping & Ductwork For Vibration
- ☐ Verify Proper Cooling Operation
- ☐ Reinstall All Covers & Access Panels

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605 Shiloh Rd
Plano TX 75074
ofc: 972.212.4800
fax: 972.212.4884