

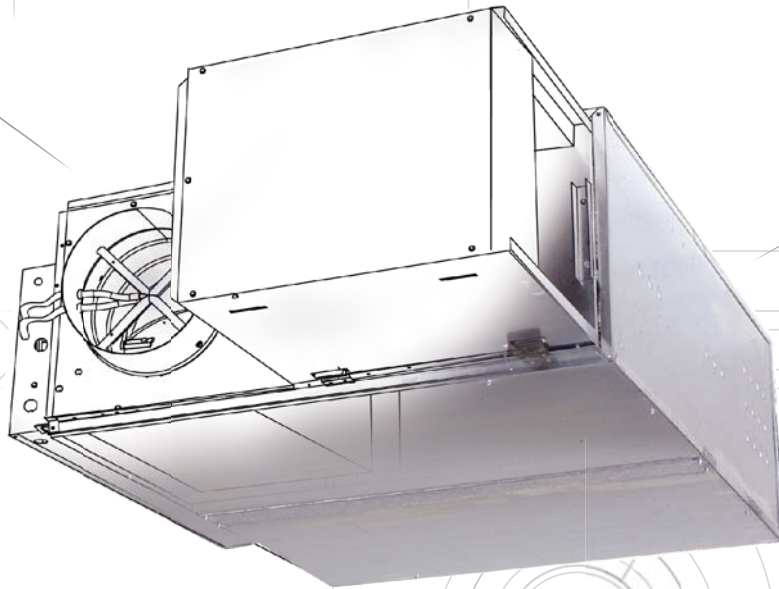
TFS Series

Terminal Units

Models TFS and TFS-F, the **Fantom IQ™**

Quiet

Acoustic



Advanced

Leading Edge



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The New Standard in Fan Powered Terminal Units



The **F**antom IQ™

Titus introduces the quietest fan-powered terminal in the market. Fantom IQ™ utilizes the patent pending FAST™ attenuator system that greatly reduces radiated sound power levels. The unique FAST™ attenuator is shipped completely assembled inside the casing, and is easily pulled out and snapped into place for operation.

Fantom IQ™ is available with an ultra-high efficiency GE ECM motor. Titus uses the TITAN™ ECM Programming Process in the ISO certified Harold Straub Aero-Acoustics and Vibration Research Lab. The TITAN™ process ensures the performance of ECM motors in all Titus fan-powered terminals.

Additional features include easy access with top and bottom access, left/right interchangeability, and center discharge.

Titus leads the way with an innovative approach to produce the industry's quietest fan-powered terminal.

Changing Market

Titus designed the new TFS series fan powered terminal using a base box plus options concept borrowed from the automotive industry. The TFS base box is cost competitive with other manufacturers' non-quiet fan powered terminals. The TFS can be upgraded to a TFS-F by adding the Fantom™ Intelligently Quiet™ (Fantom IQ™) acoustic upgrade package. The TFS-F Fantom IQ is the quietest fan box in the industry!

Development Process

Extensive research was done to look at all areas of the box design. Titus investigated and tested technologies related to motor development, motor mounting, motor positioning, acoustic materials, cabinet design, blower technology, and alternate liner options. Many of these technologies have been incorporated into the TFS and TFS-F Fantom IQ design.

Flexibility

The TFS and TFS-F Fantom IQ series fan powered terminals provide the flexibility to be cost competitive when sound is not an issue and extremely quiet when sound is an issue. The TFS and TFS-F Fantom IQ can be mixed on projects to get the best combination of quiet units and cost effective units to meet the needs of the project.

TITAN ECM Programming Process

The TFS and TFS-F Fantom IQ are available with the optional ultra high efficiency GE ECM motor. Any manufacturer can purchase the ECM motor. The difference is in the development and programming of the ECM motor to operate effectively and efficiency within the specific fan powered terminal's design and configuration. The ECM motor only offers a benefit, if it is developed and programmed correctly within the specific fan box.

Titus uses the Titus Iterative Test & Analysis Network™ (TITAN™) ECM Programming Process in its ISO 9001:2000 certified lab, the Harold Straub Research & Training Center. The TITAN process ensures the performance of the ECM motor in all of the Titus fan-powered terminals.

Features

Features	Benefits
Access doors	<ul style="list-style-type: none"> Easier both top and bottom access to the motor and damper sections. Improved flanged design means fewer screws and easier removal.
Center Discharge	<ul style="list-style-type: none"> Same location between right and left hand units. Better shipping protection of water coils.
Interchangeable motor/blower	<ul style="list-style-type: none"> Easy size changes when necessary in the field.
Interchangeable inlets	<ul style="list-style-type: none"> Easily change inlet sizes in the field.
Shaft down motor	<ul style="list-style-type: none"> Reduces shaft loading and increases motor reliability. Shaft down position eliminates the need for fan packing, which eliminates the possibility of the motor being started with fan packing in place. Lower profile casing. Shaft down positions provides vibro-acoustic benefits.
Easy to install motor/blower assembly	<ul style="list-style-type: none"> Tabbed brackets allow motor/blower assembly to "hang" in place to allow for quick alignment of screw holes for easy field installation.

Optional Upgrades

Upgrade	Benefits
FAST acoustic upgrade system	<ul style="list-style-type: none"> Allows the base and quiet boxes to be mixed and matched on a project. Adding FAST attenuators make the TFS Fantom IQ the quietest fan box in the market.
TITAN programmed ECM motor	<ul style="list-style-type: none"> Energy efficient operation. Pressure independent operation. Uses Titus Iterative Test & Analysis Network (TITAN™).

Please visit <http://www.titus-hvac.com> or contact your local Titus representative for additional information.



Fantom IQ™

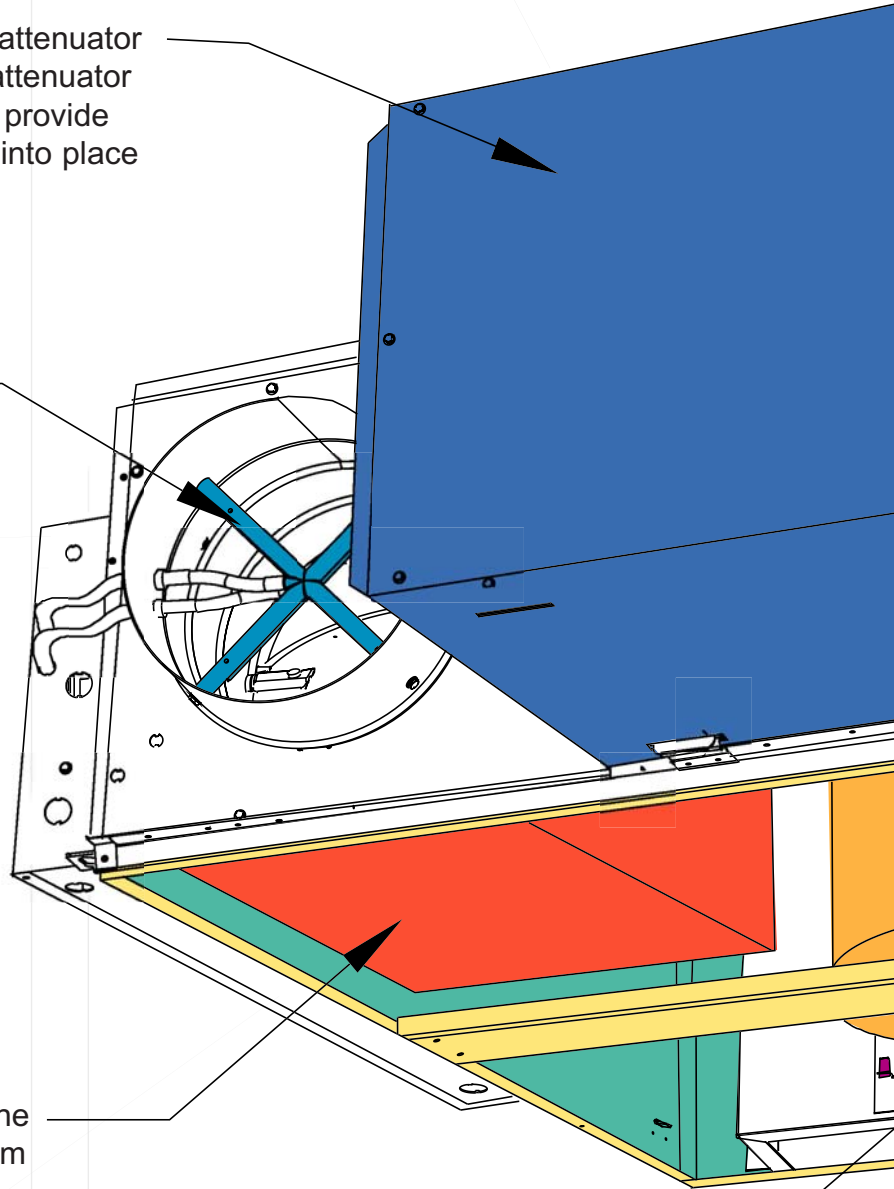
Quiet

The integral patent pending FAST™ attenuator system, has a telescoping external attenuator that is shipped internal to the unit to provide secure shipping and is easily pulled into place when installed.

AeroCross multipoint center averaging flow sensor provides excellent flow control.

The internal section of the FAST™ attenuator system reduces primary air generated radiated sound.

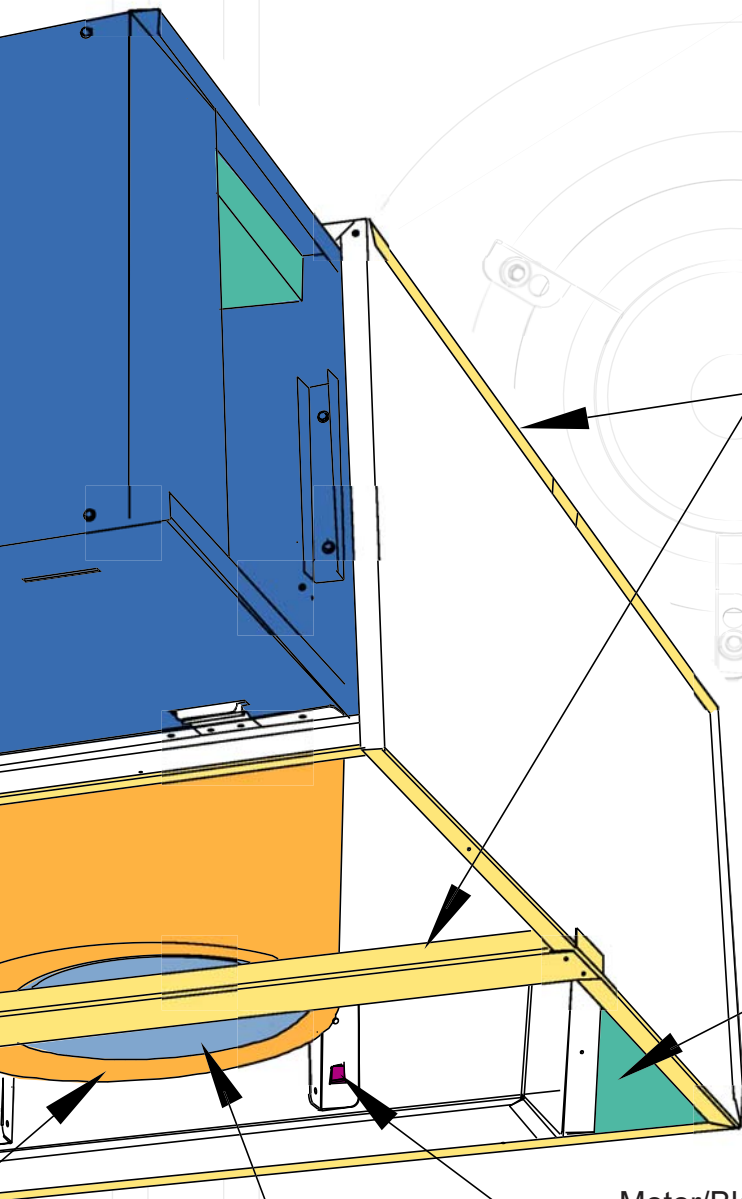
Shaft down, vertical mount motor arrangement provides even weight distribution on the motor mounting system and reduced acoustic characteristics.



Accurate

Innovative

Sustainable



Top and Bottom access to both the damper and fan section of the unit.

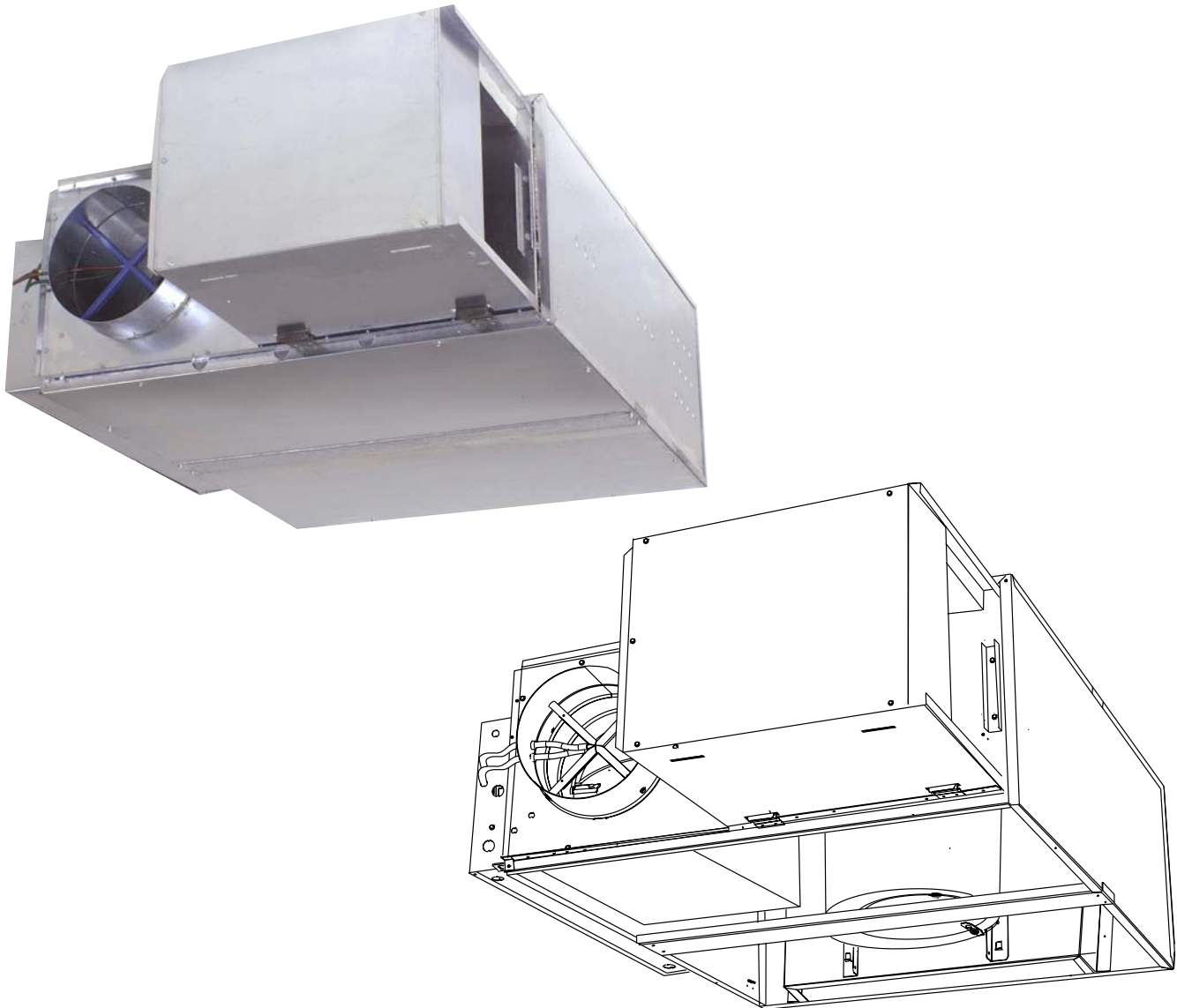
EnviroLoc natural fiber liner is an environmentally friendly, thermally bonded, high density, acoustic/thermal insulation designed for HVAC systems.

Motor/Blower assembly has a tabbed bracket that mounts to the blower deck which allows for quick removal and installation of the motor/blower.

Optional TITAN™ programmed ECM motor provides ultra high efficiency, pressure independent operation.

Efficient

We are happy to announce the TFS and TFS-F Fantom IQ series fan powered terminals.



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Titus uses the Titus Iterative Test & Analysis Network™ (TITAN™) ECM Programming Process in its ISO 9001:2000 certified lab, the Harold Straub Research & Training Center. The TITAN process ensures the performance of the ECM motor in all of the Titus fan powered terminals.

History of ECM Motors in Commercial HVAC

Titus has been programming ECM motors for almost a decade. In early 1995, GE and Titus worked together to bring their ECM motors into the commercial HVAC market.

Understanding that the ECM motor was a significant first cost increase over standard PSC motors, Titus retrofitted one floor of an office building in Dallas, TX with ECM motors and compared the energy usage of that floor against a floor with PSC motors over an eighteen month period to prove the energy savings would provide an acceptable payback of three years or less.

Titus shipped the first ECM fan powered terminal to a school district in Houston in 1997. Titus has been shipping ECM motors ever since. This extensive history and commitment to the development of the ECM motor for commercial applications, makes Titus an expert in ECM development. This expertise is the basis of the TITAN ECM Programming Process.

Process Summary

The TITAN ECM Programming Process is an iterative process of developing constants for the ECM motor to operate at the optimum efficiency and provide pressure independent airflow. Up to a dozen test runs are performed using the GE ECM motor programming interface equipment to ensure the correct motor constants. Developing the correct motor constants allows optimal control of the speed and torque of the motor in the particular fan box design.

The minimum and maximum fan curves are determined based on minimum and maximum rpm of the ECM motor (300 rpm and 1200 rpm respectively). The GE interface unit plots rpm vs. torque of the motor and determines the difference between measured venturi CFM and the ECM calculated CFM. This test is repeated until the difference in venturi CFM and the ECM calculated CFM equals zero. Once the CFM difference is zero, or as close to zero as possible, the ECM constants are saved for that unit's airflow characteristics.

All Titus fan powered terminals with ECM motors are provided with a factory installed PWM controller. The PWM voltage signal is calibrated to provide 100% fan at full voltage (10.0V) and minimum fan at minimum voltage (1.0V). The calibrated PWM allows the ECM motor to operate as programmed by Titus regardless of what manufacturer's DDC controller provides the voltage signal to the PWM controller. This ensures the pressure independent operation of the motor with any DDC controller. The PWM signal can also be controlled manually using a dial pot much like a SCR on a standard PSC motor.

The TITAN ECM Programming Process extends from the lab to the ISO 9001:2000 certified factories where individual ECM motors are programmed with the appropriate ECM program for each order.

Fan Powered Series Type

Quiet Operation

Models:

- PTFS
 - Pneumatic Control
- ATFS
 - Analog Control
- DTFS
 - Digital Control

Performance Data

PTFS	.....	.10
ATFS	.....	.10
DTFS	.....	.10

Specifications

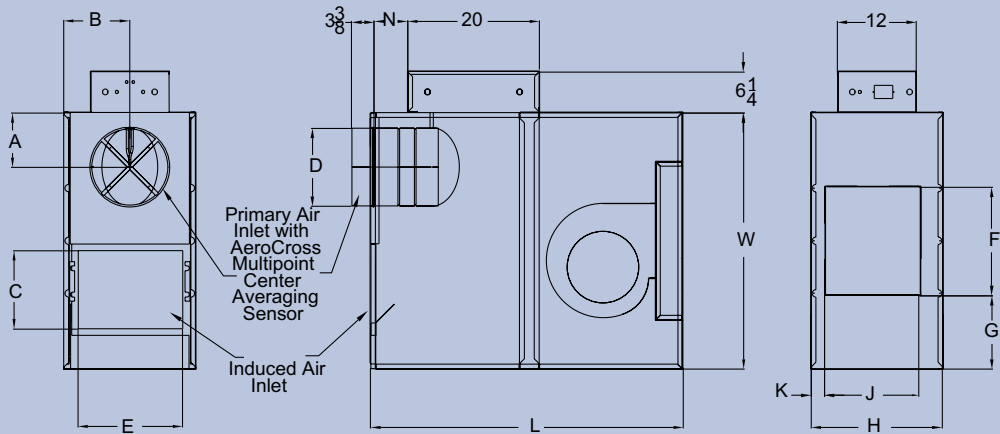
PTFS	.....	.35
ATFS	.....	.35
DTFS	.....	.35



- Two casings for easy design layout.
- Pressure independent primary airflow control.
- AeroCross™ multi-point inlet velocity sensor with center averaging.
- Energy-efficient fan motor, permanent split capacitor type, mounted with vibration isolators.
- Optional TITAN™ programmed ECM motor provides ultra-high efficiency, pressure independent operation.

- Adjustable SCR fan speed control with minimum voltage stop.
- Single point electrical, pneumatic main, and thermostat connections.
- EnviroLoc, natural fiber insulation, covered to prevent air erosion, meets requirements of NFPA 90A and UL 181.
- 20-gauge galvanized steel casing.
- Rectangular discharge opening is designed for flanged duct connections.
- Centered, rectangular discharge opening is designed for flanged duct connections.
- Top and bottom access panels can be removed for service.

TFS: Sizes B-E



Model TFS Series Unit

Size	Unit	A	B	C	D	E	F	G	H	J	K	L	N	W	Filter Size
B	6	6	8	13 7/8	5 7/8	11 7/8	14 1/8	11 1/2	16	11 1/8	2 1/4	42	2 7/8	37	16 x 14
	8	7 7/8			4 7/8										
	10	9 7/8			4 7/8										
	12	11 7/8			4 7/8										
C	6	6	8	13 7/8	5 7/8	11 7/8	14 1/8	11 1/2	16	11 1/8	2 1/4	42	2 7/8	37	16 x 14
	8	7 7/8			2 7/8										
	10	9 7/8			4 7/8										
	12	11 7/8			4 7/8										
D	10	7	8	11 7/8	9 7/8	11 7/8	14 1/8	11 1/2	16	11 1/8	2 1/4	42	4 7/8	37	16 x 14
	12	8			4 7/8										
	14	10			6 7/8										
	16	11			6 7/8										
E	12	8	8	11 7/8	11 7/8	11 7/8	14 1/8	11 1/2	16	11 1/8	2 1/4	42	4 7/8	37	16 x 14
	14	10			6 7/8										
	16	11			6 7/8										

Hot Water Coil Section

Standard Features

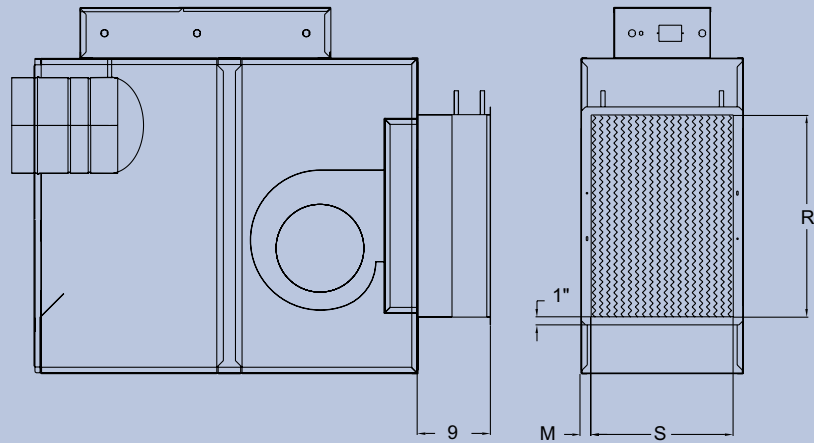
- 1/2-inch copper tubes.
- Aluminum ripple fins.
- Connections: Male solder. 5/8-inch for both 1- and 2-row. Left or right hand connections.
- Galvanized steel casing.
- Flanged duct connection.
- Coil is installed at discharge of unit.

Coil Rows

- 1-Row
- 2-Row

Supply Voltage

- 120V, 1 ph, 60 Hz.
- 208/240V, 1 ph, 60 Hz.
- 277V, 1 ph, 60 Hz.



Hot Water Coil Section (Discharge Mounted)

Unit Size	M (1-Row)	M (2-Row)	R	S
B, C	1	1	20 1/2	12 1/2
D, E	1	1 1/4	25	17 1/2

Electric Coil Section

Standard Features

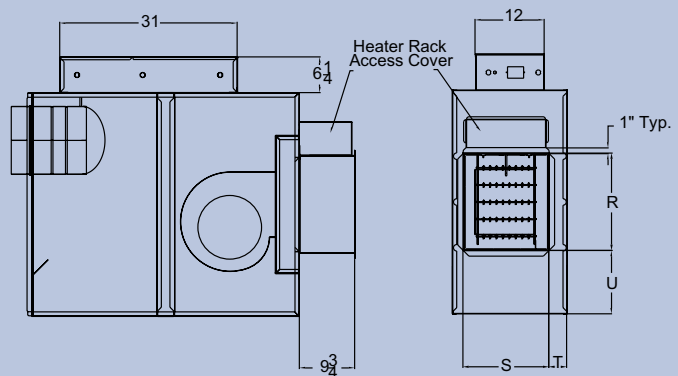
- Automatic reset thermal cutouts, one per element.
- Single point electrical connection for entire unit, including coil.
- Positive pressure air flow switch.
- Flanged duct connection.
- Coil is installed at discharge of unit.
- Preset P/E switches with pneumatic units.
- 80/20 nickel chrome element wire
- Transformers (analog and digital models only)

Options

- Mercury contactors.
- Fuse block.
- Disconnect switch, door interlock type.
- Manual reset cutout.
- Dust tight construction.

Supply Voltage

- 208V, 1 ph, 60 Hz.
- 240V, 1 ph, 60 Hz.
- 277V, 1 ph, 60 Hz.
- 208V, 3 ph, 60 Hz.
- 480V, 3 ph, 60 Hz. (4 wire wye only)



Electric Coil Section (Discharge Mounted)

Unit Size	U	R	S	T
B, C	11 3/8	14 1/2	11 1/2	2 3/8
D, E	11	17	15	3 1/8

Note: R and S are inside dimensions.

Additional Accessories (Optional)

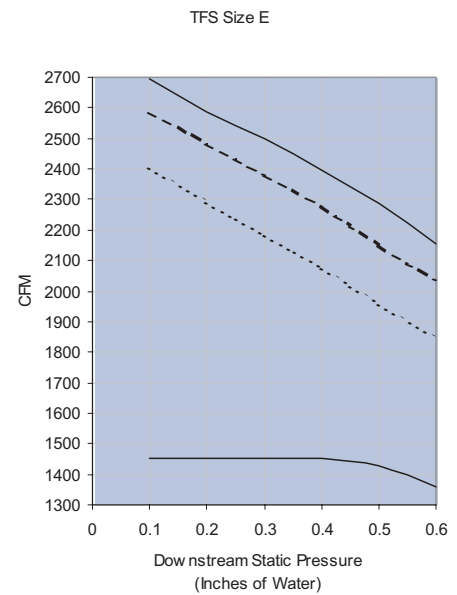
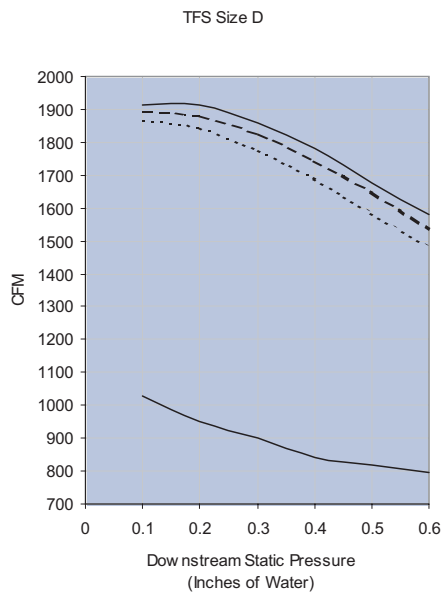
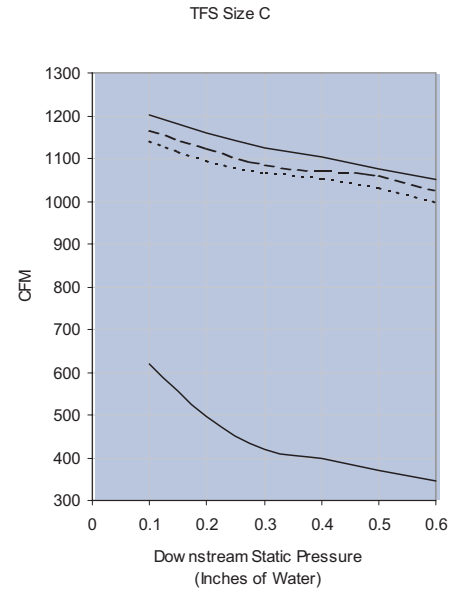
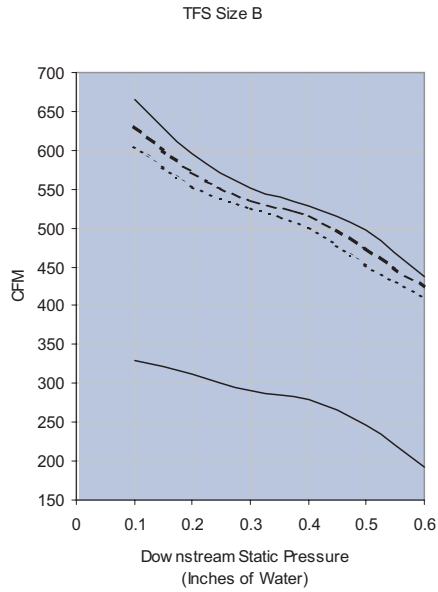
- Induced air filter, 1-inch thick disposable construction type.
- Fan disconnect switch (not available on units with optional electric coils).
- 1-inch Liner.
- EnviroLoc Liner.
- Fibre-Free Liner.
- SteriLoc Liner.
- Fan unit fusing.
- Hanger brackets.
- Camlocks on fan access door.

Electrical Data

Unit Size	Motor hp	120/1/60 FLA	208/240/1/60 FLA	277/1/60 FLA
B	1/6	2.3	0.9	0.8
C	1/4	4	1.8	1.4
D	1/3	8.5	3.6	3
E	3/4	8.6	4.2	4.5

FLA = Full Load Amperage, as tested in accordance with UL 1995. All fan motors are single phase, same voltage as electric coil (when supplied), with exception that 277V motors are used with 480V, 3 phase coils (4 wire wye).

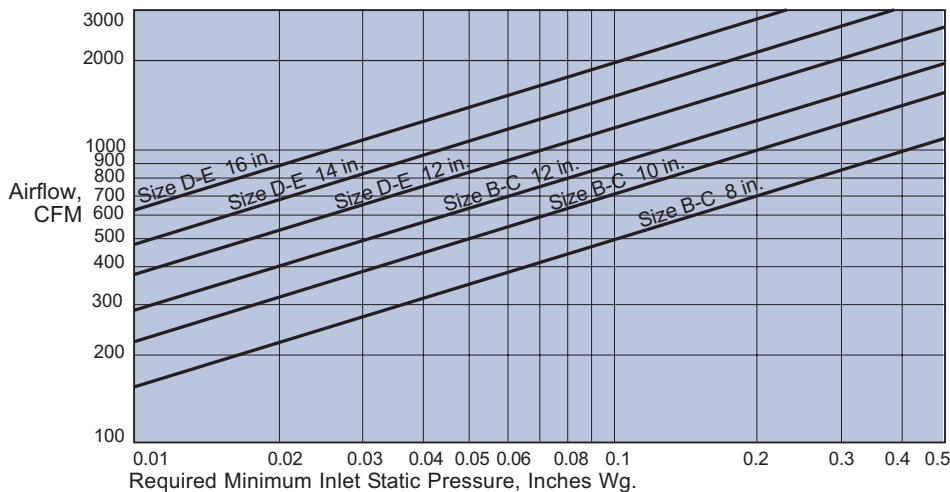
Models: PTFS, ATFS, DTFS · Airflow vs. Downstream Static Pressure



No Coil or with Electric Coil ———
 1 Row Water Coil - - - -
 2 Row Water Coil - · - · -

TFS

Primary Air Inlet Pressure · PTFS, ATFS, DTFS



Note: For selection procedure, see the *Engineering Guidelines* and the topic, 'Sizing Basic Terminals from Capacity Tables'.

Models: PTFS, ATFS, DTFS · Water Coil Heating Capacity (MBH)

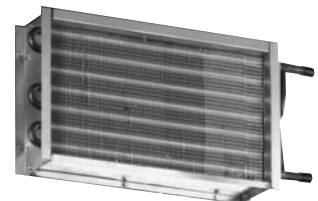
Unit Size	Rows	GPM	Head Loss	Airflow, CFM								
				200	250	300	350	400	450	500	550	600
B	One Row	1.0	0.15	10.1	11.3	12.3	13.2	14.0	14.7	15.3	15.8	16.3
		2.0	0.52	11.2	12.7	14.0	15.1	16.1	17.1	17.9	18.7	19.4
		4.0	1.86	11.8	13.5	15.0	16.3	17.5	18.6	19.6	20.6	21.5
		6.0	2.77	12.1	13.8	15.4	16.8	18.1	19.2	20.3	21.3	22.3
		Airside ΔPs		0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04
B	Two Row	1.0	0.27	15.8	18.0	19.8	21.3	22.7	23.9	25.0	25.9	26.8
		2.0	0.92	17.6	20.4	22.9	25.0	27.0	28.8	30.4	31.9	33.2
		4.0	3.20	18.7	21.9	24.8	27.4	29.8	32.0	34.0	35.9	37.6
		6.0	5.49	19.1	22.5	25.5	28.3	30.8	33.2	35.4	37.5	39.4
		Airside ΔPs		0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.08	0.09

Unit Size	Rows	GPM	Head Loss	Airflow, CFM								
				400	490	580	670	760	850	940	1030	1100
C	One Row	1.0	0.15	14.0	15.2	16.1	17.0	17.7	18.3	18.9	19.4	19.7
		2.0	0.52	16.1	17.7	19.1	20.3	21.4	22.3	23.2	24.0	24.5
		4.0	1.86	17.5	19.4	21.1	22.6	23.9	25.1	26.3	27.3	28.0
		6.0	2.77	18.1	20.1	21.9	23.5	25.0	26.3	27.5	28.6	29.5
		Airside ΔPs		0.02	0.03	0.04	0.05	0.07	0.08	0.10	0.12	0.13
C	Two Row	1.0	0.27	22.7	24.8	26.5	27.9	29.1	30.1	31.0	31.8	32.4
		2.0	0.92	27.0	30.1	32.7	35.0	37.0	38.7	40.3	41.8	42.8
		4.0	3.20	29.8	33.6	36.9	39.9	42.6	45.1	47.3	49.3	50.8
		6.0	5.49	30.8	35.0	38.6	41.9	44.9	47.6	50.1	52.5	54.2
		Airside ΔPs		0.04	0.06	0.08	0.11	0.14	0.17	0.20	0.24	0.27

Unit Size	Rows	GPM	Head Loss	Airflow, CFM								
				800	925	1050	1175	1300	1425	1550	1675	1800
D	One Row	1.0	0.22	22.7	23.8	24.7	25.6	26.3	26.9	27.5	28.0	28.5
		2.0	0.76	27.8	29.6	31.1	32.5	33.7	34.8	35.8	36.8	37.6
		4.0	2.64	31.4	33.6	35.6	37.5	39.2	40.7	42.1	43.5	44.7
		6.0	4.35	32.8	35.3	37.5	39.5	41.4	43.2	44.8	46.3	47.7
		Airside ΔPs		0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12
D	Two Row	1.0	0.42	34.8	36.4	37.8	39.0	39.9	40.8	41.6	42.2	42.8
		2.0	1.40	45.3	48.4	51.0	53.4	55.4	57.3	59.0	60.5	61.9
		4.0	4.78	52.9	57.2	61.1	64.6	67.8	70.7	73.4	75.8	78.2
		6.0	8.68	56.0	60.9	65.3	69.3	73.0	76.5	79.6	82.6	85.4
		Airside ΔPs		0.06	0.07	0.09	0.11	0.14	0.16	0.19	0.22	0.25

Unit Size	Rows	GPM	Head Loss	Airflow, CFM								
				1400	1525	1650	1775	1900	2025	2150	2275	2400
E	One Row	1.0	0.22	26.8	27.4	27.9	28.4	28.9	29.3	29.7	30.0	30.4
		2.0	0.76	34.6	35.6	36.6	37.5	38.3	39.1	39.8	40.4	41.1
		4.0	2.64	40.4	41.9	43.2	44.5	45.6	47.7	47.8	48.8	49.7
		6.0	4.35	42.8	44.5	46.0	47.4	47.8	50.0	51.3	52.4	53.5
		Airside ΔPs		0.08	0.09	0.11	0.12	0.14	0.15	0.17	0.19	0.21
E	Two Row	1.0	0.42	50.6	41.4	42.1	42.7	43.3	43.8	44.2	N/A	N/A
		2.0	1.40	56.9	58.6	60.2	61.6	62.9	64.1	65.2	N/A	N/A
		4.0	4.78	70.1	72.8	75.4	77.7	79.9	81.9	83.9	N/A	N/A
		6.0	8.68	75.8	79.0	82.0	84.9	87.5	90.0	92.3	N/A	N/A
		Airside ΔPs		0.16	0.18	0.21	0.24	0.27	0.31	0.34	N/A	N/A

- Hot water capacities are in MBH.
- Data are based upon 180° F entering water 65° F entering air.
- HD (head) loss is in feet of water.
- Tables are based upon a temperature difference of 115° F between entering air and entering water. For other temperature differences multiply MBH values by factors below.
- Air temperature rise = 927 x MBH/CFM.
- Connections: All coils are 5/8-inch O.D. male solder.
- Coils are not for steam application.
- Water enters at lower coil connection to prevent air entrapment.


Correction factors for other entering conditions:

ΔT	50	60	70	80	90	100	115	125	140	150
Factor	0.44	0.52	0.61	0.70	0.79	0.88	1.00	1.07	1.20	1.30

Models: PTFS, ATFS, DTFS · Radiated Sound Application Data · NC Values

Unit Size	Inlet Size	CFM	Min. ΔPs	Noise Criteria (NC)			
				Fan Only	ΔPs		
					0.5"	1.0"	2.0"
B	8	300	0.020	22	24	26	29
		350	0.027	24	26	28	31
		400	0.036	26	27	30	32
		470	0.049	28	29	32	34
		550	0.067	30	31	33	36
C	10	500	0.033	23	25	29	32
		650	0.056	27	28	32	36
		800	0.085	29	31	35	39
		950	0.120	32	33	37	41
		1100	0.160	34	35	39	43
D	12	1000	0.035	27	30	32	34
		1100	0.042	28	32	34	36
		1300	0.058	31	34	36	39
		1500	0.078	34	37	39	41
		1700	0.100	36	39	41	44
E	14	1500	0.045	36	37	38	40
		1700	0.057	37	39	41	43
		1900	0.071	38	42	44	46
		2100	0.087	40	44	46	48
		2400	0.114	43	48	50	52

Radiated Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Ceiling/Space Effect	16	18	20	26	31	36
Total dB reduction	18	19	20	26	31	36

Application data based upon factors found in ARI Standard 885-98.

- Ceiling Type - Mineral Fiber Tile - 5/8 inch thick 20 pounds per cubic foot density.
- Min. ΔPs is the minimum static pressure required to achieve rated airflow.
- Dash (-) in space denotes NC level less than 20.

TFS

Primary Air CFM Ranges

Inlet Size	Total CFM Range	PTFS TITUS II Pneumatic Controller		PTFS TITUS I Pneumatic Controller		ATFS TITUS TA1 Analog Electronic Controller		DTFS TITUS TD1 Digital Controller	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
6	0-500	*80-330	150-500	*105-350	150-500	*80-500	80-500	*80-500	80-500
8	0-900	*145-590	265-900	*190-590	265-900	*145-900	145-900	*145-900	145-900
10	0-1400	*230-925	415-1400	*300-925	415-1400	*230-1400	230-1400	*230-1400	230-1400
12	0-2000	*325-1330	600-2000	*425-1330	600-2000	*325-2000	325-2000	*325-2000	325-2000
14	0-3000	*450-1800	840-3000	*575-1800	810-3000	*450-3000	450-3000	*450-3000	450-3000
16	0-4000	*580-2350	1100-4000	*750-2350	1100-4000	*580-4000	580-4000	*580-4000	580-4000

Note: An asterisk (*) indicates factory CFM settings (except zero) will not be made below this range because control accuracy is reduced.

Models: PTFS, ATFS, DTFS • Discharge Sound Application Data • NC Values

Unit Size	Inlet Size	CFM	Min. ΔPs	Noise Criteria (NC)			
				Fan Only	ΔPs		
					0.5"	1.0"	2.0"
B	8	300	0.020	-	-	-	-
		350	0.027	-	-	-	21
		400	0.036	-	-	21	23
		470	0.049	23	21	23	25
		550	0.067	27	24	25	27
C	10	500	0.033	27	28	29	29
		650	0.056	28	30	30	31
		800	0.085	28	31	31	32
		950	0.120	29	32	32	33
		1100	0.160	30	32	33	33
D	12	1000	0.035	25	32	33	35
		1100	0.042	26	34	35	36
		1300	0.058	29	36	38	39
		1500	0.078	30	38	39	40
		1700	0.100	34	41	42	44
E	14	1500	0.045	32	41	43	44
		1700	0.057	35	44	45	46
		1900	0.071	36	45	46	48
		2100	0.087	38	48	49	50
		2400	0.114	40	50	52	53

Discharge Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Duct Lining	3	6	12	25	29	18
End Reflection	9	5	2	0	0	0
Flex Duct	6	10	18	20	21	12
Space Effect	5	6	7	8	9	10
Total dB reduction	25	28	39	53	59	40

- Flex Duct - Vinyl Core Flex.
- End Reflection - 8-inch termination to Diffuser.
- Fiberglass Flex Duct - 5-foot length, 1-inch duct work.
- Room Size - 2400 Cubic Feet Room, 5 feet from sound source.
- Min. ΔPs is the minimum static pressure required to achieve rated airflow.
- Dash (-) in space denotes NC level less than 20.

The following dB adjustments are used, per ARI 885-98, for the calculation of NC above 300 CFM.

	Octave Bands					
	2	3	4	5	6	7
300-700 CFM	2	1	1	-2	-5	-1
Over 700 CFM	4	3	2	-2	-7	-1

Models: PTFS, ATFS, DTFS · Radiated Sound Power Levels · Fan and 100% Primary

Unit Size	Inlet Size	CFM	Fan Only							Fan Plus 100% Primary																				
			Sound Power Octave Bands							0.5" ΔPs							1.0" ΔPs							2.0" ΔPs						
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7				
B	8	300	53	50	48	43	32	29	55	50	50	46	37	35	57	53	52	47	40	40	58	56	54	48	44	45				
		350	56	53	50	46	35	32	57	52	51	48	38	37	58	55	54	49	42	42	60	58	56	51	46	47				
		400	59	55	52	48	38	36	58	54	53	49	40	38	60	57	55	51	44	43	62	60	57	52	47	48				
		470	62	58	54	50	41	39	60	56	54	52	42	40	62	59	57	53	45	45	64	62	59	55	49	50				
		550	65	60	55	53	44	43	62	58	56	54	44	42	64	61	58	55	47	47	65	64	61	57	51	52				
C	10	500	60	47	49	43	34	30	60	52	51	47	39	36	63	57	54	50	43	41	67	62	58	53	48	47				
		650	62	51	52	48	39	36	63	55	54	50	42	39	66	60	57	53	46	45	69	65	61	56	51	50				
		800	64	54	55	52	43	41	65	57	56	53	44	42	68	62	60	56	49	47	71	67	63	59	53	53				
		950	65	57	57	55	47	46	66	59	58	55	46	44	70	64	62	58	51	49	73	69	65	61	55	55				
		1100	66	59	59	58	49	50	68	60	60	57	48	46	71	56	63	60	52	51	74	70	67	63	57	57				
D	12	1000	60	54	52	48	42	38	65	58	56	53	46	42	67	61	58	56	50	45	69	63	59	58	54	48				
		1100	62	56	54	50	44	41	66	60	57	54	47	43	68	62	59	57	51	47	70	64	61	59	55	50				
		1300	65	59	56	53	47	45	68	62	59	56	49	46	71	65	61	59	53	49	73	67	63	62	57	52				
		1500	67	61	59	56	50	48	71	64	61	58	50	49	73	67	63	61	55	52	75	69	65	63	59	55				
		1700	69	63	61	58	53	52	72	66	63	60	52	51	75	69	65	63	56	54	77	71	67	65	60	57				
E	14	1500	68	62	60	56	48	44	70	64	62	58	50	46	72	66	63	60	53	49	74	68	64	62	57	51				
		1700	70	64	62	58	51	47	73	66	63	60	51	48	75	68	65	62	55	51	76	70	66	64	59	54				
		1900	72	65	63	60	54	50	75	68	65	62	53	50	77	70	66	64	57	53	78	72	68	66	60	56				
		2100	74	67	64	62	56	53	77	70	66	63	54	52	79	72	68	65	58	55	80	74	69	67	62	58				
		2400	76	69	66	64	59	57	80	72	68	65	56	55	81	74	70	67	60	58	83	76	71	69	64	60				

ARI Certification Points

Fan Size	Inlet Size	Prim. CFM	Fan CFM	Fan Watts	Min Ps	Fan Only Sound Power							Fan Plus Primary @ 1.5" Inlet						
						2	3	4	5	6	7	2	3	4	5	6	7		
B	8	550	550	210	0.068	65	60	55	53	44	43	65	63	60	56	49	50		
C	10	1100	1100	410	0.161	66	59	59	58	49	50	73	68	65	62	55	54		
D	12	1600	1600	680	0.089	68	62	60	57	52	50	75	69	65	63	58	55		
E	14	2100	2100	860	0.087	73	67	64	62	56	53	80	73	69	66	60	57		

- N/A in a space denotes a minimum inlet static pressure greater than 0.5 inch at rated airflow.
- Outlet ΔPs, the difference in static pressure from the terminal discharge to the room, is 0.25 inch.
- Radiated sound power is the noise transmitted through the casing walls.
- Sound power levels are in decibels, re 10⁻¹² watts.
- Ratings in accordance with ARI Standard 880-98 and certified to ARI.



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Models: PTFS, ATFS, DTFS · Discharge Sound Power Levels · Fan and 100% Primary

Unit Size	Inlet Size	CFM	Fan Only							Fan Plus 100% Primary																				
			Sound Power Octave Bands							0.5" ΔPs							1.0" ΔPs							2.0" ΔPs						
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7				
B	8	300	61	51	50	51	49	46	63	54	52	53	53	51	65	56	52	53	53	50	67	57	53	52	53	50				
		350	64	54	52	53	52	49	65	56	54	55	55	53	67	57	54	55	55	53	68	59	54	54	55	53				
		400	67	57	54	55	54	52	66	58	55	56	57	55	68	59	55	56	57	55	70	60	56	56	57	55				
		470	70	60	56	57	57	55	68	60	57	59	59	58	70	61	57	58	59	57	71	62	57	58	59	57				
		550	73	63	58	60	60	58	69	61	59	61	61	60	71	63	59	60	61	60	73	64	59	60	61	60				
C	10	500	72	53	52	51	51	49	74	54	53	52	52	50	74	56	54	52	52	51	75	58	54	53	52	51				
		650	73	57	56	56	56	54	75	59	57	57	57	56	75	60	58	57	57	57	76	62	58	57	57	57				
		800	74	60	58	60	60	59	76	62	60	61	61	61	76	64	61	61	61	61	76	65	61	61	62	62				
		950	74	63	61	63	63	62	76	65	63	64	64	64	77	67	63	64	65	65	77	68	63	65	65	65				
		1100	75	65	63	65	65	65	77	67	65	67	67	67	77	69	65	67	68	68	78	71	65	67	68	68				
D	12	1000	73	61	55	56	61	59	79	67	62	64	67	67	80	68	63	66	64	65	81	69	63	67	60	62				
		1100	74	63	57	58	63	61	80	68	64	65	68	68	81	69	64	67	65	66	82	70	65	68	61	63				
		1300	76	66	61	62	66	65	82	71	66	67	70	70	83	72	66	68	66	67	84	72	67	70	63	65				
		1400	77	68	62	64	67	66	83	72	67	67	70	70	84	73	67	69	67	68	85	73	68	71	64	65				
		1700	79	72	66	69	71	70	86	74	69	70	72	72	87	75	70	71	69	69	88	76	70	73	66	67				
E	14	1500	79	73	65	67	69	66	86	76	67	68	71	70	87	77	70	72	70	71	88	77	71	74	70	71				
		1700	81	75	67	70	71	69	88	78	70	68	72	71	89	79	72	74	72	72	90	79	73	75	72	72				
		1900	82	76	68	72	73	71	89	80	72	70	73	72	90	80	74	75	73	73	91	80	74	77	73	73				
		2100	83	78	70	73	75	74	91	81	73	72	75	73	92	82	75	76	74	74	93	82	75	78	75	74				
		2400	83	80	72	76	77	77	93	84	76	75	76	75	94	84	77	78	75	75	95	84	77	79	76	75				

ARI Certification Points

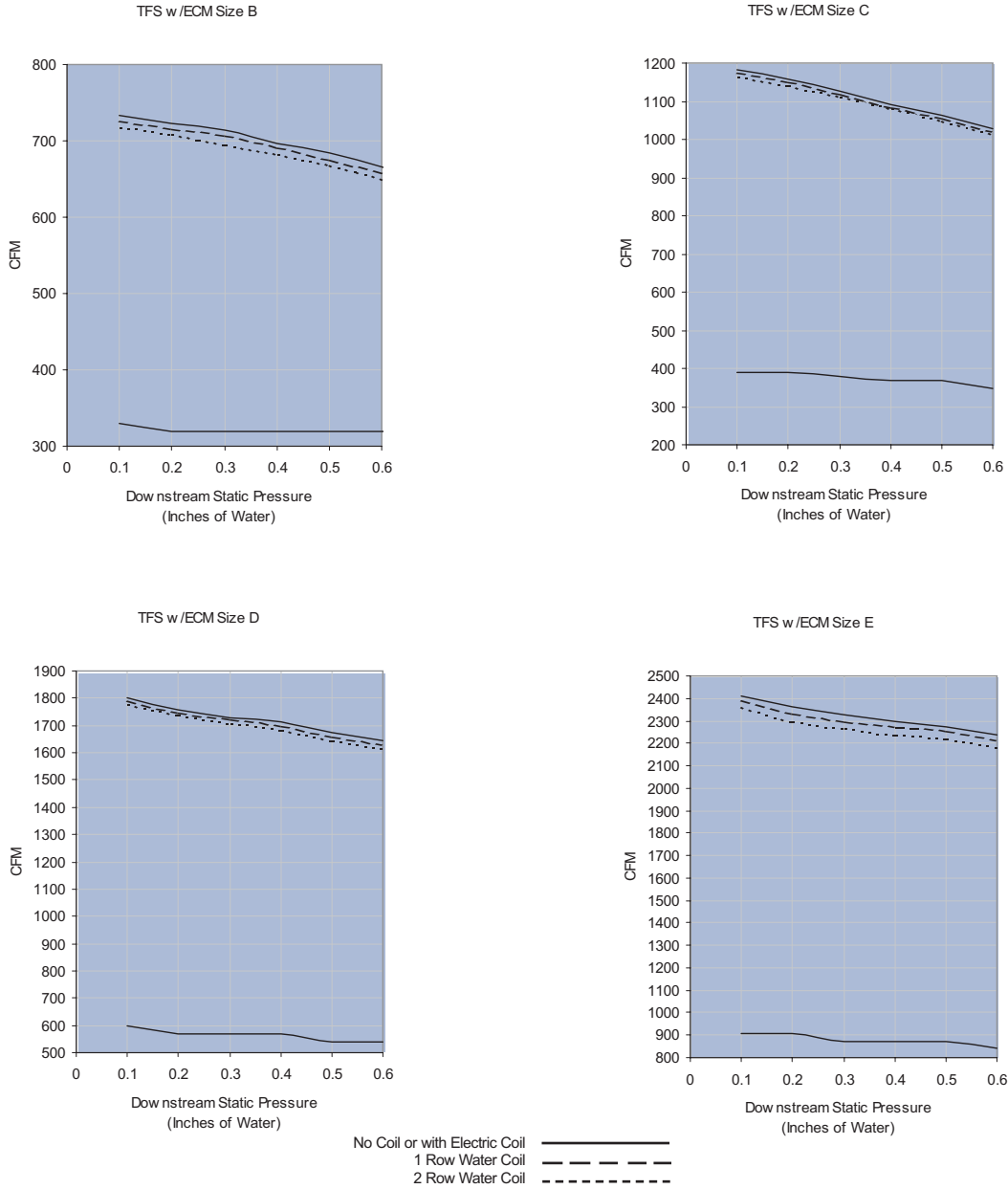
Fan Size	Inlet Size	Rated CFM	Fan CFM	Fan Watts	Min Ps	Fan Only Sound Power						
						2	3	4	5	6	7	
B	8	550	550	210	0.068	73	63	58	60	60	58	
C	10	1100	1100	430	0.161	75	65	63	65	65	65	
D	12	1600	1600	690	0.089	74	69	67	69	70	66	
E	14	2100	2100	870	0.087	79	74	71	74	74	69	

- N/A in a space denotes a minimum inlet static pressure greater than 0.5 inch at rated airflow.
- Outlet ΔPs, the difference in static pressure from the terminal discharge to the room, is 0.25 inch.
- Discharge sound power is the noise emitted from the unit discharge into the downstream duct.
- Sound power levels are in decibels, re 10⁻¹² watts.
- Ratings in accordance with ARI Standard 880-98 and certified to ARI.



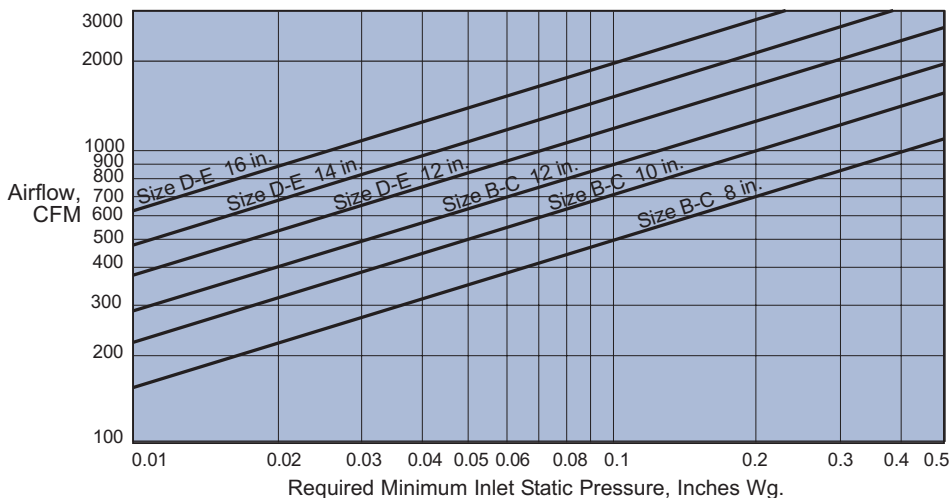
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Models: PTFS, ATFS, DTFS with ECM Motor • Airflow vs Downstream Static Pressure



TFS

Primary Air Inlet Pressure • PTQS, ATQS, DTQS



ECM Electrical Data

Unit Size	Motor hp	120/1/60 FLA	277/1/60 FLA
B	1/3	3.0	1.6
C	1/3	4.6	2.1
D	1/2	5.6	2.8
E	3/4	9.7	4.9

Note: For selection procedure, See the section *Engineering Guidelines* and the topic 'ECM Motors - Fan Powered Terminals' for additional information.

Model: TFS-ECM • Radiated Sound Application Data • NC Values

Unit Size	Inlet Size	CFM	Min. ΔPs	Noise Criteria (NC)			
				Fan Only	ΔPs		
					0.5"	1.0"	2.0"
B	8	350	0.028	23	24	27	30
		400	0.036	25	25	29	32
		500	0.056	29	28	32	35
		600	0.081	33	31	34	37
		700	0.110	36	33	36	40
C	10	500	0.033	21	24	28	32
		650	0.056	26	27	31	35
		800	0.085	30	30	34	38
		950	0.120	33	32	36	40
		1100	0.160	36	34	38	42
D	12	700	0.017	21	26	28	30
		900	0.028	26	30	32	34
		1100	0.042	29	33	35	37
		1400	0.068	33	36	38	41
		1700	0.100	36	39	41	43
E	14	1000	0.020	25	28	31	33
		1300	0.033	30	33	35	37
		1600	0.051	34	37	39	42
		2000	0.079	38	43	45	48
		2400	0.114	42	47	50	52

Radiated Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Ceiling/Space Effect	16	18	20	26	31	36
Total dB reduction	18	19	20	26	31	36

Application data based upon factors found in ARI Standard 885-98:

- Ceiling Type - Mineral Fiber Tile - $\frac{5}{8}$ inch, 20 pounds per cubic foot density.
- Min. Ps is the minimum static pressure required to achieve rated airflow.
- Dash (-) in space denotes NC level less than 20.

Model: TFS-ECM · Discharge Sound Application Data · NC Values

Unit Size	Inlet Size	CFM	Min. ΔPs	Noise Criteria (NC)			
				Fan Only	ΔPs		
					0.5"	1.0"	2.0"
B	8	350	0.028	24	-	-	-
		400	0.036	25	-	-	-
		500	0.056	26	20	21	22
		600	0.081	28	24	25	26
		700	0.110	26	28	28	28
C	10	500	0.033	21	-	-	-
		650	0.056	23	-	20	22
		800	0.085	24	23	24	24
		950	0.120	26	27	27	28
		1100	0.160	27	30	31	31
D	12	700	0.017	20	-	-	-
		900	0.028	22	-	-	20
		1100	0.042	24	23	24	25
		1400	0.068	27	28	30	31
		1700	0.100	29	33	34	35
E	14	1000	0.020	-	-	-	-
		1300	0.033	25	22	22	23
		1600	0.051	30	27	28	28
		2000	0.079	36	33	33	34
		2400	0.114	40	38	38	39

Discharge Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Duct Lining	3	6	12	25	29	18
End Reflection	9	5	2	0	0	0
Flex Duct	6	10	18	20	21	12
Space Effect	5	6	7	8	9	10
Total dB reduction	25	28	39	53	59	40

Application Data are based upon factors found in ARI Standard 885-98 plus flow division as follows:

- Flex Duct - Vinyl Core Flex.
- End Reflection - 8-inch Termination to Diffuser.
- Fiberglass Flex Duct - 5-foot length, 1-inch Duct work.
- Room Size - 2400 Cubic Feet Room, 5 feet from sound source.
- Min. P_s is the minimum static pressure required to achieve rated airflow.
- Dash (-) in space denotes NC level less than 20.

The following dB adjustments are used, per ARI 885-98, for the calculation of NC above 300 CFM.

	Octave Bands					
	2	3	4	5	6	7
300-700 CFM	2	1	1	-2	-5	-1
Over 700 CFM	4	3	2	-2	-7	-1

Model: TFS-ECM • Radiated Sound Power Data

Unit Size	Inlet Size	CFM	Fan Only							Fan Plus 100% Primary																				
			Sound Power Octave Bands							0.5" ΔPs							1.0" ΔPs							2.0" ΔPs						
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7				
B	8	350	56	53	48	46	36	34	56	53	49	47	39	37	57	55	52	49	42	42	59	58	55	51	46	47				
		400	59	55	51	49	39	37	58	55	51	49	40	38	59	57	54	51	44	43	61	60	57	53	48	48				
		500	63	59	54	52	43	42	61	58	54	52	43	41	63	61	57	54	46	46	64	63	60	55	50	51				
		600	67	63	57	55	46	46	64	61	56	54	45	43	65	63	59	56	49	48	67	66	62	58	52	53				
		700	70	66	59	57	49	49	66	63	58	56	46	45	68	66	61	58	50	50	69	69	64	60	54	55				
C	10	500	46	43	47	43	34	30	56	52	50	46	38	36	60	57	53	49	43	41	64	62	57	52	48	47				
		650	53	50	52	48	39	37	59	54	53	49	41	39	63	59	56	52	46	44	67	65	60	55	50	50				
		800	59	55	55	52	44	42	62	56	55	52	43	41	66	61	59	55	48	47	70	67	62	58	53	52				
		950	64	59	58	55	47	47	64	58	57	54	45	43	68	63	61	57	50	49	72	68	64	60	55	54				
		1100	69	62	61	58	51	50	65	59	59	56	47	45	69	64	62	59	52	50	73	70	66	62	56	56				
D	12	700	55	49	47	43	37	32	58	53	52	48	42	37	60	56	54	51	46	41	63	58	56	54	51	44				
		900	59	53	51	48	41	37	61	57	55	52	45	41	64	59	57	54	49	44	66	62	59	57	54	48				
		1100	61	56	54	51	45	42	64	60	58	54	47	44	67	62	60	57	51	47	69	65	62	60	56	50				
		1400	65	60	58	55	49	48	68	63	61	57	49	48	70	66	63	60	54	51	73	69	65	63	59	54				
		1700	68	63	61	58	53	52	71	66	64	59	52	50	73	69	66	62	56	54	76	72	68	65	61	57				
E	14	1000	57	51	50	48	38	33	62	55	54	52	44	38	64	58	56	54	48	41	66	60	58	57	52	45				
		1300	63	57	55	53	44	40	67	60	58	56	47	43	69	63	60	58	52	46	71	65	62	60	56	50				
		1600	67	61	59	56	49	45	71	64	61	59	50	46	74	67	63	61	54	50	76	69	65	63	59	53				
		2000	71	65	63	60	54	51	76	68	65	62	53	50	78	71	67	64	57	54	80	73	69	66	61	57				
		2400	75	69	66	64	58	56	79	72	68	64	55	54	82	74	70	67	60	57	84	77	72	69	64	61				

ARI Certification Points

Fan Size	Inlet Size	Prim. CFM	Fan CFM	Fan Watts	Min Ps	Fan Only Sound Power							Fan Plus Primary @ 1.5" Inlet						
						2	3	4	5	6	7	2	3	4	5	6	7		
B	8	700	700	210	0.110	70	66	59	57	49	49	69	67	63	59	52	53		
C	10	1100	1100	280	0.161	69	62	61	58	51	50	72	67	64	60	54	54		
D	12	1600	1600	390	0.089	67	62	60	57	52	51	74	70	66	63	58	55		
E	14	2100	2100	580	0.087	72	66	64	61	55	53	80	73	69	66	60	57		

- N/A in a space denotes a minimum inlet static pressure greater than 0.5 inch at rated airflow.
- Outlet ΔPs, the difference in static pressure from the terminal discharge to the room, is 0.25 inch.
- Radiated sound power is the noise transmitted through the casing walls.
- Sound power levels are in decibels, re 10⁻¹² watts.
- Ratings in accordance with ARI Standard 880 and certified to ARI.



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Model: TFS-ECM • Discharge Sound Power Data

Unit Size	Inlet Size	CFM	Fan Only							Fan Plus 100% Primary																				
			Sound Power Octave Bands							0.5" ΔPs							1.0" ΔPs							2.0" ΔPs						
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7				
B	8	350	71	62	59	59	59	57	61	52	49	51	51	48	61	52	49	51	51	48	62	53	50	51	51	48				
		400	71	63	59	60	60	58	63	55	51	53	54	51	64	55	52	54	54	51	64	56	52	54	54	51				
		500	72	64	60	62	61	60	67	59	55	58	58	56	68	60	56	58	58	57	69	61	56	58	59	57				
		600	73	66	61	63	63	61	71	63	58	61	62	61	71	64	59	61	62	61	72	64	59	61	62	61				
		700	74	67	62	64	64	63	74	66	61	64	65	64	74	67	61	64	65	64	75	68	62	64	65	64				
C	10	500	63	58	57	58	58	57	63	55	52	52	50	49	64	56	52	52	51	49	65	56	52	52	51	49				
		650	66	60	58	59	60	59	66	60	56	57	56	55	67	60	56	57	56	55	69	61	59	57	56	55				
		800	68	62	59	61	62	61	69	63	59	61	60	59	70	64	59	61	60	60	71	65	60	61	61	60				
		950	70	64	60	62	63	62	72	66	62	64	64	63	73	67	62	64	64	64	74	68	63	64	64	64				
		1100	72	65	61	63	64	63	74	69	64	67	67	67	75	70	64	67	67	67	76	70	65	67	67	68				
D	12	700	65	56	52	55	57	56	63	49	50	53	50	48	63	51	52	55	51	49	63	53	55	57	53	51				
		900	67	59	55	58	60	58	67	54	55	57	55	54	67	56	58	60	57	55	66	58	60	62	58	57				
		1100	69	61	57	60	62	61	70	58	59	61	60	59	70	60	62	63	61	60	69	62	64	66	62	61				
		1400	71	64	60	63	64	63	73	64	64	65	65	65	73	66	67	68	66	66	73	68	69	70	68	67				
		1700	72	67	63	65	66	65	76	68	68	69	69	69	76	70	70	71	71	71	76	72	73	74	72	72				
E	14	1000	66	61	55	59	59	55	61	58	53	55	55	51	63	59	53	55	55	52	64	60	54	54	56	52				
		1300	71	67	60	64	64	62	66	63	58	60	61	58	67	64	58	61	61	59	69	65	59	59	62	59				
		1600	75	72	65	68	69	67	70	68	62	65	66	63	71	69	63	66	66	64	72	70	63	63	67	65				
		2000	79	77	69	73	74	72	74	73	67	70	71	69	75	74	67	70	71	70	76	75	67	67	72	71				
		2400	82	81	73	76	78	77	77	77	70	74	75	74	78	78	71	74	75	75	80	78	71	71	76	75				

ARI Certification Points

Fan Size	Inlet Size	Rated CFM	Fan CFM	Fan Watts	Min Ps	Fan Only Sound Power						
						2	3	4	5	6	7	
B	8	700	700	210	0.11	74	67	62	64	64	63	
C	10	1100	1100	340	0.161	72	65	61	63	64	63	
D	12	1600	1600	460	0.089	69	65	64	66	67	64	
E	14	2100	2100	690	0.087	74	70	66	69	70	65	

- N/A in a space denotes a minimum inlet static pressure greater than 0.5-inch at rated airflow.
- Outlet ΔPs, the difference in static pressure from the terminal discharge to the room, is 0.25-inch.
- Discharge sound power is the noise emitted from the unit discharge into the downstream duct.
- Sound power levels are in decibels, re 10⁻¹² watts.
- Ratings in accordance with ARI Standard 880 and certified to ARI.



A Participating Corporation in the ARI 880 Certification Program

Fan Powered Series Type

Quiet Operation

Models:

- PTFS-F
 - Pneumatic Control
- ATFS-F
 - Analog Control
- DTFS-F
 - Digital Control

Performance Data

PTFS-F .....	.24
ATFS-F .....	.24
DTFS-F .....	.24

Specifications

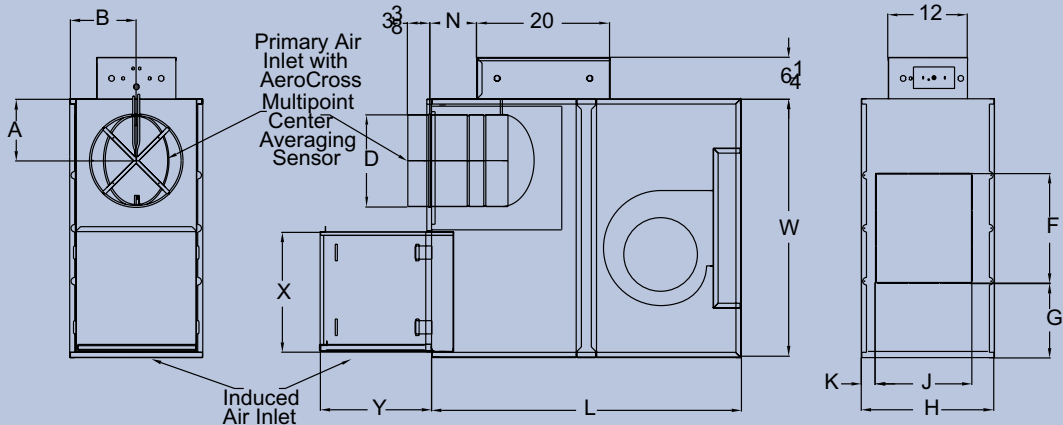
PTFS-F .....	.35
ATFS-F .....	.35
DTFS-F .....	.35



- Two casings for easy design layout
- Integral patent pending FAST™ attenuator system, has internal and external attenuator sections.
- Pressure independent primary airflow control.
- AeroCross™ multi-point inlet velocity sensor with center averaging.
- Energy-efficient fan motor, permanent split capacitor type, mounted with vibration isolators.

- Optional TITAN™ programmed ECM motor provides ultra-high efficiency, pressure independent operation.
- Adjustable SCR fan speed control with minimum voltage stop.
- Single point electrical, pneumatic main, and thermostat connections.
- EnviroLoc, natural fiber insulation, covered to prevent air erosion, meets requirements of NFPA 90A and UL 181.
- 20-gauge galvanized steel casing.
- Rectangular discharge opening is designed for flanged duct connections.
- Centered, rectangular discharge opening is designed for flanged duct connections.
- Top and bottom access panels can be removed for service.

TFS-F: Sizes B-E



TFS-F Fantom IQ

Model TFS-F Series Unit

Unit Size	Inlet Size	A	B	X	Y	D	Induced Air Inlet		F	G	H	J	K	L	N	W	Filter Size
							height	width									
B	6	6	8	18 7/8	13 7/8	5 7/8	11 7/8	8 7/8	14 1/8	11 1/2	16	11 1/8	2 1/4	42	2 7/8	37	11 x 14
	8	6				7 7/8									4 7/8		
	10	7				9 7/8									4 7/8		
	12	8				11 7/8									4 7/8		
C	6	6	8	18 1/8	11 7/8	5 7/8	15 7/8	14 7/8	16 1/2	11 1/8	20	14 5/8	2	46 3/4	2 7/8	39	18 x 17
	8	6				7 7/8									4 7/8		
	10	7				9 7/8									4 7/8		
	12	8				11 7/8									4 7/8		
D	10	7	8	18 1/8	11 7/8	9 7/8	15 7/8	14 7/8	16 1/2	11 1/8	20	14 5/8	2	46 3/4	4 7/8	39	18 x 17
	12	8				11 7/8									4 7/8		
	14	10				13 7/8									6 7/8		
	16	11				15 7/8									6 7/8		
E	12	8	8	18 1/8	11 7/8	11 7/8	15 7/8	14 7/8	16 1/2	11 1/8	20	14 5/8	2	46 3/4	4 7/8	39	18 x 17
	14	10				13 7/8									6 7/8		
	16	11				15 7/8									6 7/8		

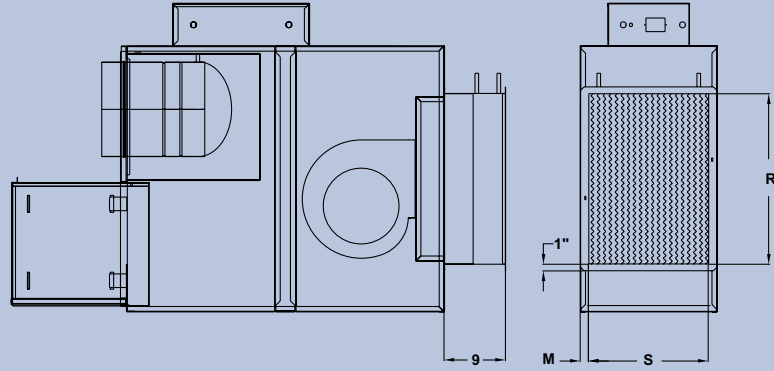
Hot Water Coil Section

Standard Features

- 1/2-inch copper tubes.
- Aluminum ripple fins.
- Connections: Male solder. 5/8-inch for both 1- and 2-row. Left or right hand connections.
- Galvanized steel casing.
- Flanged duct connection.
- Coil is installed at discharge of unit.

Coil Rows

- 1-Row
- 2-Row



Hot Water Coil Section (Discharge Mounted)

Unit Size	M (1-Row)	M (2-Row)	R	S
B, C	1	1	20 1/2	12 1/2
D, E	1	1 1/4	25	17 1/2

Note: R and S are inside dimensions.

Electric Coil Section

Standard Features

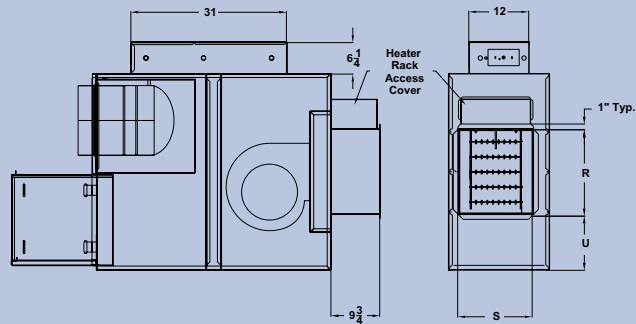
- Automatic reset thermal cutouts, one per element.
- Single point electrical connection for entire unit, including coil.
- Positive pressure air flow switch.
- Flanged duct connection.
- Coil is installed at discharge of unit.
- Preset P/E switches with pneumatic units.
- 80/20 nickel chrome element wire
- Transformers (analog and digital models only)

Options

- Mercury contactors.
- Fuse block.
- Disconnect switch, door interlock type.
- Manual reset cutout.
- Dust tight construction.

Supply Voltage

- 208V, 1 ph, 60 Hz.
- 240V, 1 ph, 60 Hz.
- 277V, 1 ph, 60 Hz.
- 208V, 3 ph, 60 Hz.
- 480V, 3 ph, 60 Hz. (4 wire wye only)



Electric Coil Section (Discharge Mounted)

Unit Size	U	R	S	T
B, C	11 3/8	14 1/2	11 1/2	2 3/8
D, E	11	17	15	3 1/8

Note: R and S are inside dimensions.

TFS-F Phantom IQ

Additional Accessories (Optional)

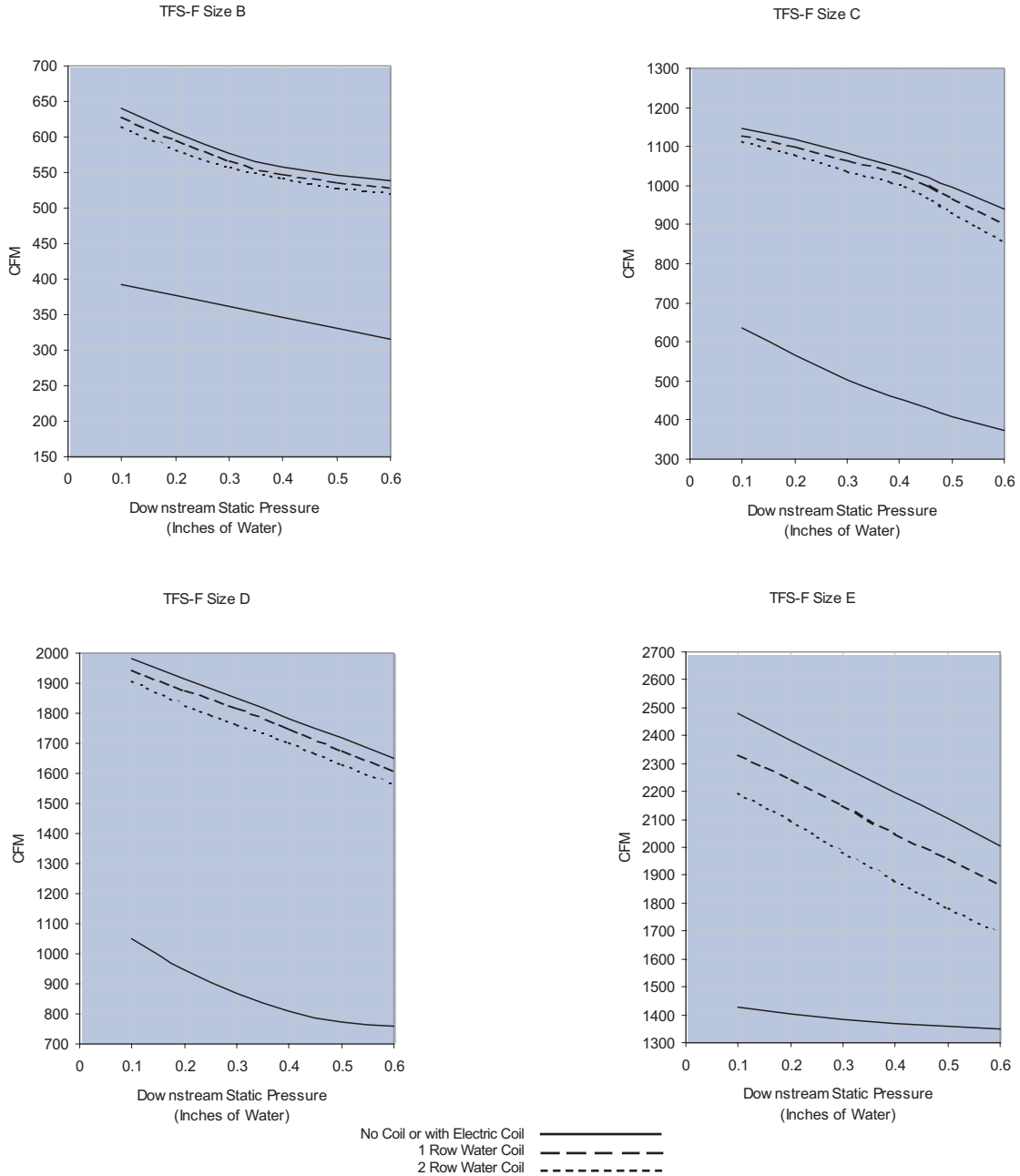
- Induced air filter, 1-inch thick disposable construction type.
- Fan disconnect switch (not available on units with optional electric coils).
- 1-inch Liner.
- EnviroLoc Liner.
- Fibre-Free Liner.
- SteriLoc Liner.
- Fan unit fusing.
- Hanger brackets.
- Camlocks on fan access door.

Electrical Data

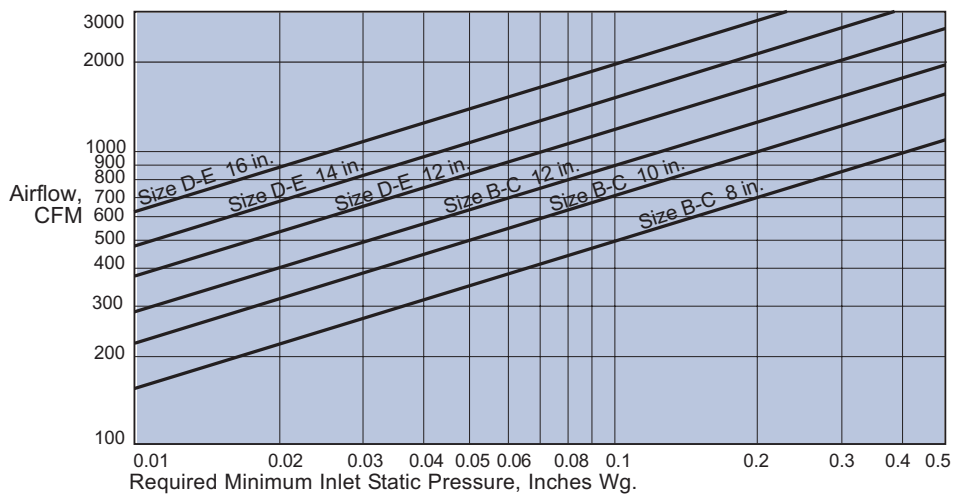
Unit Size	Motor hp	120/1/60 FLA	208/240/1/60 FLA	277/1/60 FLA
B	1/6	2.3	0.9	0.8
C	1/4	4.0	1.8	1.4
D	1/3	8.5	3.6	3.0
E	3/4	8.6	4.2	4.5

FLA = Full Load Amperage, as tested in accordance with UL 1995. All fan motors are single phase, same voltage as electric coil (when supplied), with exception that 277V motors are used with 480V, 3 phase coils (4 wire wye).

Models: PTFS-F, ATFS-F, DTFS-F • Airflow vs. Downstream Static Pressure



Primary Air Inlet Pressure • PTFS-F, ATFS-F, DTFS-F



Note: For selection procedure, see the *Engineering Guidelines* and the topic, 'Sizing Basic Terminals from Capacity Tables'.

Models: PTFS-F, ATFS-F, DTFS-F • Water Coil Heating Capacity (MBH)

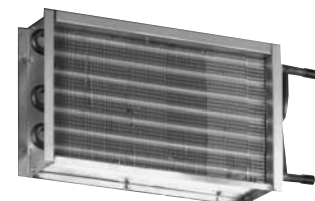
Unit Size	Rows	GPM	Head Loss	Airflow, CFM								
				200	250	300	350	400	450	500	550	600
B	One Row	1.0	0.15	10.1	11.3	12.3	13.2	14.0	14.7	15.3	15.8	16.3
		2.0	0.52	11.2	12.7	14.0	15.1	16.1	17.1	17.9	18.7	19.4
		4.0	1.86	11.8	13.5	15.0	16.3	17.5	18.6	19.6	20.6	21.5
		6.0	2.77	12.1	13.8	15.4	16.8	18.1	19.2	20.3	21.3	22.3
		Airside ΔPs		0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04
B	Two Row	1.0	0.27	15.8	18.0	19.8	21.3	22.7	23.9	25.0	25.9	26.8
		2.0	0.92	17.6	20.4	22.9	25.0	27.0	28.8	30.4	31.9	33.2
		4.0	3.20	18.7	21.9	24.8	27.4	29.8	32.0	34.0	35.9	37.6
		6.0	5.49	19.1	22.5	25.5	28.3	30.8	33.2	35.4	37.5	39.4
		Airside ΔPs		0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.08	0.09

Unit Size	Rows	GPM	Head Loss	Airflow, CFM								
				400	490	580	670	760	850	940	1030	1100
C	One Row	1.0	0.15	14.0	15.2	16.1	17.0	17.7	18.3	18.9	19.4	19.7
		2.0	0.52	16.1	17.7	19.1	20.3	21.4	22.3	23.2	24.0	24.5
		4.0	1.86	17.5	19.4	21.1	22.6	23.9	25.1	26.3	27.3	28.0
		6.0	2.77	18.1	20.1	21.9	23.5	25.0	26.3	27.5	28.6	29.5
		Airside ΔPs		0.02	0.03	0.04	0.05	0.07	0.08	0.10	0.12	0.13
C	Two Row	1.0	0.27	22.7	24.8	26.5	27.9	29.1	30.1	31.0	31.8	32.4
		2.0	0.92	27.0	30.1	32.7	35.0	37.0	38.7	40.3	41.8	42.8
		4.0	3.20	29.8	33.6	36.9	39.9	42.6	45.1	47.3	49.3	50.8
		6.0	5.49	30.8	35.0	38.6	41.9	44.9	47.6	50.1	52.5	54.2
		Airside ΔPs		0.04	0.06	0.08	0.11	0.14	0.17	0.20	0.24	0.27

Unit Size	Rows	GPM	Head Loss	Airflow, CFM								
				800	925	1050	1175	1300	1425	1550	1675	1800
D	One Row	1.0	0.22	22.7	23.8	24.7	25.6	26.3	26.9	27.5	28.0	28.5
		2.0	0.76	27.8	29.6	31.1	32.5	33.7	34.8	35.8	36.8	37.6
		4.0	2.64	31.4	33.6	35.6	37.5	39.2	40.7	42.1	43.5	44.7
		6.0	4.35	32.8	35.3	37.5	39.5	41.4	43.2	44.8	46.3	47.7
		Airside ΔPs		0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12
D	Two Row	1.0	0.42	34.8	36.4	37.8	39.0	39.9	40.8	41.6	42.2	42.8
		2.0	1.40	45.3	48.4	51.0	53.4	55.4	57.3	59.0	60.5	61.9
		4.0	4.78	52.9	57.2	61.1	64.6	67.8	70.7	73.4	75.8	78.2
		6.0	8.68	56.0	60.9	65.3	69.3	73.0	76.5	79.6	82.6	85.4
		Airside ΔPs		0.06	0.07	0.09	0.11	0.14	0.16	0.19	0.22	0.25

Unit Size	Rows	GPM	Head Loss	Airflow, CFM								
				1400	1525	1650	1775	1900	2025	2150	2275	2400
E	One Row	1.0	0.22	26.8	27.4	27.9	28.4	28.9	29.3	29.7	30.0	30.4
		2.0	0.76	34.6	35.6	36.6	37.5	38.3	39.1	39.8	40.4	41.1
		4.0	2.64	40.4	41.9	43.2	44.5	45.6	47.7	47.8	48.8	49.7
		6.0	4.35	42.8	44.5	46.0	47.4	47.8	50.0	51.3	52.4	53.5
		Airside ΔPs		0.08	0.09	0.11	0.12	0.14	0.15	0.17	0.19	0.21
E	Two Row	1.0	0.42	50.6	41.4	42.1	42.7	43.3	43.8	44.2	N/A	N/A
		2.0	1.40	56.9	58.6	60.2	61.6	62.9	64.1	65.2	N/A	N/A
		4.0	4.78	70.1	72.8	75.4	77.7	79.9	81.9	83.9	N/A	N/A
		6.0	8.68	75.8	79.0	82.0	84.9	87.5	90.0	92.3	N/A	N/A
		Airside ΔPs		0.16	0.18	0.21	0.24	0.27	0.31	0.34	N/A	N/A

- Hot water capacities are in MBH.
- Data are based upon 180° F entering water 65° F entering air.
- HD (head) loss is in feet of water.
- Tables are based upon a temperature difference of 115° F between entering air and entering water. For other temperature differences multiply MBH values by factors below.
- Air temperature rise = 927 x MBH/CFM.
- Connections: All coils are 5/8-inch O.D. male solder.
- Coils are not for steam application.
- Water enters at lower coil connection to prevent air entrapment.



Correction factors for other entering conditions:

ΔT	50	60	70	80	90	100	115	125	140	150
Factor	0.44	0.52	0.61	0.70	0.79	0.88	1.00	1.07	1.20	1.30

Models: PTFS-F, ATFS-F, DTFS-F • Radiated Sound Application Data • NC Values

Unit Size	Inlet Size	CFM	Min. ΔPs	Noise Criteria (NC)			
				Fan Only	ΔPs		
					0.5"	1.0"	2.0"
B	8	400	0.036	-	-	-	20
		440	0.044	20	-	20	22
		480	0.052	22	20	22	23
		520	0.061	24	21	23	25
		550	0.068	26	22	24	26
C	10	600	0.048	25	26	27	28
		700	0.065	26	27	27	28
		800	0.085	27	27	28	28
		900	0.108	28	27	28	29
		1000	0.133	28	27	28	29
D	12	1000	0.035	23	23	27	30
		1200	0.050	27	25	29	32
		1400	0.068	31	27	31	34
		1600	0.089	34	29	30	36
		1800	0.112	37	31	34	38
E	14	1400	0.039	33	33	35	36
		1600	0.051	36	34	36	38
		1800	0.064	39	35	37	39
		2000	0.079	41	37	38	40
		2300	0.105	44	40	41	43

Radiated Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Ceiling/Space Effect	16	18	20	26	31	36
Total dB reduction	18	19	20	26	31	36

Application data based upon factors found in ARI Standard 885-98.

- Ceiling Type - Mineral Fiber Tile - 5/8 inch thick 20 pounds per cubic foot density.
- Min. ΔPs is the minimum static pressure required to achieve rated airflow.
- Dash (-) in space denotes NC level less than 20.

Primary Air CFM Ranges

Inlet Size	Total CFM Range	PTFS TITUS II Pneumatic Controller		PTFS TITUS I Pneumatic Controller		ATFS TITUS TA1 Analog Electronic Controller		DTFS TITUS TD1 Digital Controller	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
6	0-500	*80-330	150-500	*105-350	150-500	*80-500	80-500	*80-500	80-500
8	0-900	*145-590	265-900	*190-590	265-900	*145-900	145-900	*145-900	145-900
10	0-1400	*230-925	415-1400	*300-925	415-1400	*230-1400	230-1400	*230-1400	230-1400
12	0-2000	*325-1330	600-2000	*425-1330	600-2000	*325-2000	325-2000	*325-2000	325-2000
14	0-3000	*450-1800	840-3000	*575-1800	810-3000	*450-3000	450-3000	*450-3000	450-3000
16	0-4000	*580-2350	1100-4000	*750-2350	1100-4000	*580-4000	580-4000	*580-4000	580-4000

Note: An asterisk (*) indicates factory CFM settings (except zero) will not be made below this range because control accuracy is reduced.

Models: PTFS-F, ATFS-F, DTFS-F • Discharge Sound Application Data • NC Values

Unit Size	Inlet Size	CFM	Min. ΔPs	Noise Criteria (NC)			
				Fan Only	ΔPs		
					0.5"	1.0"	2.0"
B	8	400	0.036	-	-	-	-
		440	0.044	-	-	-	-
		480	0.052	-	-	-	-
		520	0.061	-	20	20	20
		550	0.068	20	21	21	21
C	10	600	0.048	-	-	-	-
		700	0.065	21	-	-	-
		800	0.085	23	21	21	22
		900	0.108	25	23	24	24
		1000	0.133	27	25	26	26
D	12	1000	0.035	20	-	-	-
		1200	0.050	24	23	23	23
		1400	0.068	28	26	26	26
		1600	0.089	31	29	29	29
		1800	0.112	34	32	32	32
E	14	1400	0.039	29	27	28	29
		1600	0.051	31	30	31	32
		1800	0.064	34	33	33	34
		2000	0.079	36	35	36	36
		2300	0.105	39	38	39	40

Discharge Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Duct Lining	3	6	12	25	29	18
End Reflection	9	5	2	0	0	0
Flex Duct	6	10	18	20	21	12
Space Effect	5	6	7	8	9	10
Total dB reduction	25	28	39	53	59	40

- Flex Duct - Vinyl Core Flex
- End Reflection - 8-inch termination to Diffuser
- Fiberglass Flex Duct - 5-foot length, 1-inch duct work
- Room Size - 2400 Cubic Feet Room, 5 feet from sound source
- Min. ΔPs is the minimum static pressure required to achieve rated airflow.
- Dash (-) in space denotes NC level less than 20.

The following dB adjustments are used, per ARI 885-98, for the calculation of NC above 300 CFM.

	Octave Bands					
	2	3	4	5	6	7
300-700 CFM	2	1	1	-2	-5	-1
Over 700 CFM	4	3	2	-2	-7	-1

Models: PTFS-F, ATFS-F, DTFS-F • Radiated Sound Power Levels • Fan and 100% Primary

Unit Size	Inlet Size	CFM	Fan Only							Fan Plus 100% Primary																				
			Sound Power Octave Bands							0.5" ΔPs							1.0" ΔPs							2.0" ΔPs						
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7				
B	8	400	57	45	43	36	36	33	55	45	43	41	40	37	57	48	44	42	42	40	58	50	45	43	44	44				
		440	59	47	45	37	36	33	57	46	44	42	41	38	58	49	46	43	43	41	60	52	47	44	45	44				
		480	60	48	46	39	36	34	58	48	45	42	41	39	60	51	47	44	43	42	61	54	48	45	45	45				
		520	62	50	47	40	37	34	59	49	46	43	42	39	61	52	48	44	44	43	62	55	49	46	46	46				
		550	63	51	48	41	37	34	60	50	47	44	42	40	62	53	48	45	44	43	63	56	49	46	46	46				
C	10	600	62	51	46	39	36	34	63	52	46	42	37	33	64	54	47	42	40	39	64	56	48	43	43	45				
		700	63	52	48	42	38	35	63	53	48	43	38	34	64	55	49	44	41	40	65	56	50	45	44	46				
		800	64	53	49	44	39	36	64	53	49	44	39	35	64	55	50	45	42	41	65	57	51	46	45	47				
		900	64	54	51	46	40	36	64	54	50	46	40	36	64	56	51	46	43	41	65	57	52	47	46	47				
		1000	65	55	52	48	41	37	64	54	51	47	41	36	65	56	52	47	44	42	65	58	53	48	46	48				
D	12	1000	61	50	46	40	36	31	61	52	48	43	39	35	63	55	49	44	42	40	66	57	51	45	44	45				
		1200	64	53	49	44	39	35	63	54	50	45	42	38	65	57	51	46	44	42	68	59	53	47	47	47				
		1400	67	56	51	47	43	40	64	56	52	47	43	40	67	58	53	48	46	44	70	61	55	49	49	49				
		1600	69	58	53	50	45	43	65	57	54	49	45	41	68	60	55	50	48	46	71	63	56	51	50	51				
		1800	72	61	55	52	48	46	67	59	55	50	47	43	69	61	57	52	49	48	72	64	58	53	52	52				
E	14	1400	69	61	55	50	45	40	69	60	53	48	44	40	70	61	54	49	46	44	71	63	56	50	49	48				
		1600	71	64	57	52	47	43	69	62	55	50	46	42	71	63	57	51	48	46	72	65	58	53	50	50				
		1800	73	66	59	54	50	46	70	63	57	52	47	43	72	65	58	53	50	47	73	66	60	54	52	52				
		2000	75	67	61	56	52	49	72	65	59	54	49	45	73	66	60	55	51	49	74	68	61	56	54	53				
		2300	77	70	63	58	55	53	74	66	61	56	51	47	75	68	62	57	53	51	76	69	64	58	56	55				

ARI Certification Points

Fan Size	Inlet Size	Prim. CFM	Fan CFM	Fan Watts	Min Ps	Fan Only Sound Power						Fan Plus Primary @ 1.5" Inlet					
						2	3	4	5	6	7	2	3	4	5	6	7
B	8	550	550	210	0.07	63	51	48	41	37	34	62	55	49	46	45	45
C	10	1050	1050	470	0.15	65	55	53	49	41	37	68	57	53	49	45	46
D	12	1600	1600	790	0.09	69	58	53	50	45	43	71	61	56	51	49	49
E	14	2100	2100	870	0.09	75	67	61	56	52	48	75	68	62	57	53	52

- N/A in a space denotes a minimum inlet static pressure greater than 0.5 inch at rated airflow.
- Outlet ΔPs, the difference in static pressure from the terminal discharge to the room, is 0.25 inch.
- Radiated sound power is the noise transmitted through the casing walls.
- Sound power levels are in decibels, re 10⁻¹² watts.
- Ratings in accordance with ARI Standard 880-98 and certified to ARI.



A Participating Corporation
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Certification Program

Models: PTFS-F, ATFS-F, DTFS-F • Discharge Sound Power Levels • Fan and 100% Primary

Unit Size	Inlet Size	CFM	Fan Only							Fan Plus 100% Primary																				
			Sound Power Octave Bands							0.5" ΔPs							1.0" ΔPs							2.0" ΔPs						
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7				
B	8	400	62	51	53	51	51	49	62	54	53	54	52	50	62	54	53	54	52	51	62	54	52	54	52	51				
		440	64	53	54	53	53	51	64	56	54	55	54	52	64	56	54	55	54	53	64	56	54	55	54	53				
		480	65	55	55	54	54	52	65	58	56	57	55	54	66	58	55	57	56	54	66	58	55	56	56	55				
		520	66	57	56	56	56	54	67	59	57	58	57	56	67	59	57	58	57	56	67	59	56	58	57	56				
		550	67	58	56	57	56	55	68	60	58	59	58	57	68	60	57	59	58	57	68	60	57	59	58	58				
C	10	600	65	60	55	54	54	52	63	58	54	53	52	50	64	59	54	53	52	51	65	60	54	53	53	51				
		700	67	62	57	57	57	56	64	60	56	56	55	54	65	61	56	56	55	54	66	61	55	56	55	55				
		800	69	64	59	59	59	59	65	61	57	58	57	57	66	62	57	58	58	57	67	62	57	58	58	58				
		900	70	66	60	61	61	61	66	63	59	60	59	59	67	63	59	60	60	60	68	64	58	60	60	60				
		1000	72	67	61	63	63	63	66	64	60	61	61	62	67	64	60	61	62	62	68	65	60	61	62	63				
D	12	1000	63	60	57	58	58	56	64	61	56	57	56	55	66	61	56	56	56	55	69	61	56	56	56	55				
		1200	67	64	60	62	61	61	66	63	59	61	60	59	68	63	59	60	60	59	70	64	59	60	60	59				
		1400	71	67	63	65	65	64	67	65	61	64	63	63	69	65	61	63	63	63	72	66	61	63	63	62				
		1600	73	70	65	68	68	68	69	67	63	67	65	66	71	67	63	66	65	65	76	67	63	65	65	65				
		1800	76	72	67	70	70	70	70	68	65	69	68	68	72	69	65	68	68	68	74	69	65	68	68	68				
E	14	1400	73	71	64	66	67	64	73	70	62	64	63	61	74	71	62	64	63	61	76	71	63	65	64	62				
		1600	76	74	66	68	69	67	75	72	65	66	66	64	77	73	65	67	66	64	78	74	65	68	67	65				
		1800	78	75	68	71	71	70	77	75	67	69	68	67	79	75	67	69	69	67	80	76	67	70	70	68				
		2000	80	77	69	73	74	73	79	77	69	71	71	69	80	77	69	72	71	70	82	78	69	72	72	71				
		2300	82	79	71	75	76	76	81	79	72	74	74	73	83	80	72	74	74	74	84	80	72	75	75	74				

ARI Certification Points

Fan Size	Inlet Size	Rated CFM	Fan CFM	Fan Watts	Min Ps	Fan Only Sound Power						
						2	3	4	5	6	7	
B	8	550	550	210	0.068	67	58	56	57	56	55	
C	10	1050	1050	450	0.147	72	68	62	64	64	65	
D	12	1600	1600	800	0.089	73	70	65	68	68	68	
E	14	2100	2100	870	0.087	80	77	70	73	73	73	

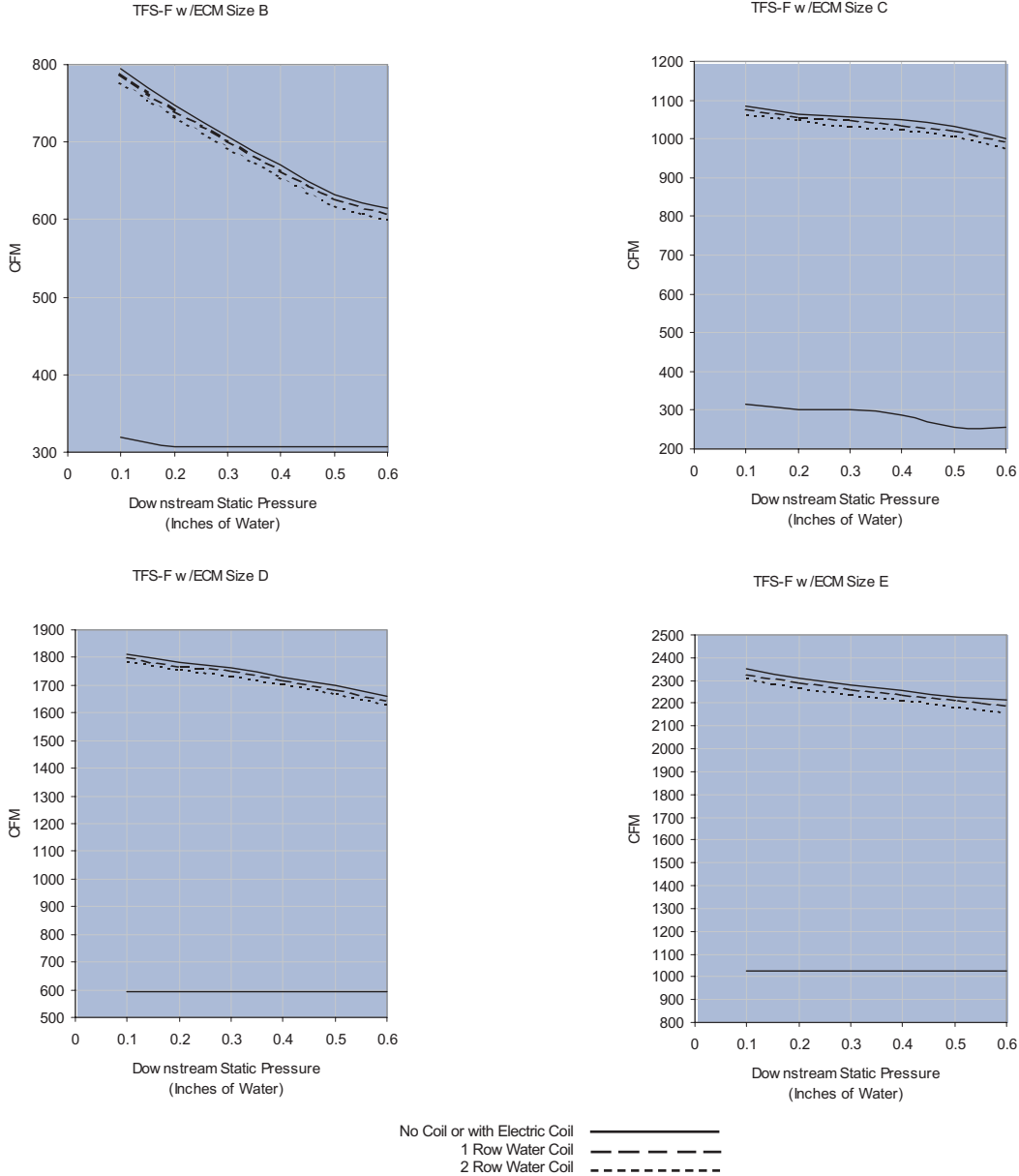
- N/A in a space denotes a minimum inlet static pressure greater than 0.5 inch at rated airflow.
- Outlet ΔPs, the difference in static pressure from the terminal discharge to the room, is 0.25 inch.
- Discharge sound power is the noise emitted from the unit discharge into the downstream duct.
- Sound power levels are in decibels, re 10⁻¹² watts.
- Ratings in accordance with ARI Standard 880-98 and certified to ARI.

TFS-F Phantom IQ

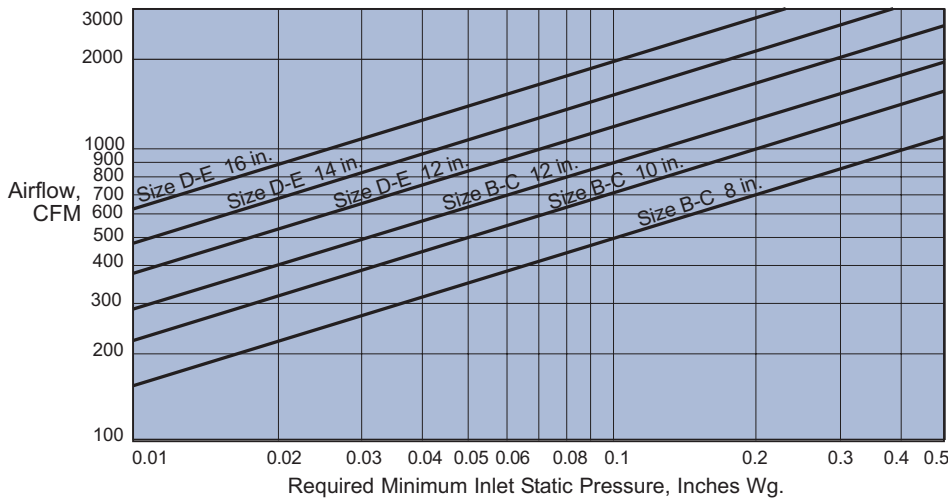


A Participating Corporation in the ARI 880 Certification Program

Models: PTFS-F, ATFS-F, DTFS-F with ECM Motor • Airflow vs Downstream Static Pressure



Primary Air Inlet Pressure • PTFS-F, ATFS-F, DTFS-F



ECM Electrical Data

Unit Size	Motor hp	120/1/60 FLA	277/1/60 FLA
B	1/3	3.0	1.6
C	1/3	4.6	2.1
D	1/2	5.6	2.8
E	3/4	9.7	4.9

Note: For selection procedure, See the section *Engineering Guidelines* and the topic 'ECM Motors - Fan Powered Terminals' for additional information.

Model: TFS-F-ECM • Radiated Sound Application Data • NC Values

Unit Size	Inlet Size	CFM	Min. ΔPs	Noise Criteria (NC)			
				Fan Only	ΔPs		
					0.5"	1.0"	2.0"
B	8	350	0.028	-	-	-	20
		400	0.036	21	-	20	22
		500	0.056	24	22	24	27
		600	0.081	27	26	28	30
		700	0.110	29	29	31	33
C	10	400	0.021	-	-	-	-
		500	0.033	-	-	-	21
		600	0.048	20	-	20	23
		800	0.085	25	21	24	27
		1000	0.133	28	24	26	30
D	12	700	0.017	-	-	20	24
		900	0.028	-	-	23	28
		1100	0.042	23	22	29	31
		1400	0.068	28	25	30	34
		1700	0.100	32	28	33	37
E	14	1100	0.024	24	23	24	26
		1300	0.033	28	26	27	30
		1600	0.051	34	30	32	35
		1900	0.071	39	35	37	40
		2300	0.105	43	38	41	43

Radiated Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Ceiling/Space Effect	16	18	20	26	31	36
Total dB reduction	18	19	20	26	31	36

Application data based upon factors found in ARI Standard 885-98:

- Ceiling Type - Mineral Fiber Tile - 5/8 inch, 20 pounds per cubic foot density.
- Min. Ps is the minimum static pressure required to achieve rated airflow.
- Dash (-) in space denotes NC level less than 20.

Model: TFS-F-ECM • Discharge Sound Application Data • NC Values

Unit Size	Inlet Size	CFM	Min. ΔPs	Noise Criteria (NC)			
				Fan Only	ΔPs		
					0.5"	1.0"	2.0"
B	8	350	0.028	-	-	-	-
		400	0.036	-	-	-	-
		500	0.056	21	20	20	21
		600	0.081	27	24	24	25
		700	0.110	29	27	27	27
C	10	400	0.021	-	-	-	-
		500	0.033	-	-	-	-
		600	0.048	-	-	-	-
		800	0.085	23	21	21	22
		1000	0.133	27	26	26	26
D	12	700	0.017	-	-	-	-
		900	0.028	-	-	-	-
		1100	0.042	21	21	21	22
		1400	0.068	27	26	27	27
		1700	0.100	32	31	31	31
E	14	1100	0.024	21	-	-	-
		1300	0.033	25	22	22	23
		1600	0.051	30	27	28	28
		2100	0.087	37	34	35	35
		2300	0.105	39	36	37	38

Discharge Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Duct Lining	3	6	12	25	29	18
End Reflection	9	5	2	0	0	0
Flex Duct	6	10	18	20	21	12
Space Effect	5	6	7	8	9	10
Total dB reduction	25	28	39	53	59	40

Application Data are based upon factors found in ARI Standard 885-98 plus flow division as follows:

- Flex Duct - Vinyl Core Flex
- End Reflection - 8-inch Termination to Diffuser
- Fiberglass Flex Duct - 5-foot length, 1-inch Duct work
- Room Size - 2400 Cubic Feet Room, 5 feet from sound source
- Min. P_s is the minimum static pressure required to achieve rated airflow.
- Dash (-) in space denotes NC level less than 20.

The following dB adjustments are used, per ARI 885-98, for the calculation of NC above 300 CFM.

	Octave Bands					
	2	3	4	5	6	7
300-700 CFM	2	1	1	-2	-5	-1
Over 700 CFM	4	3	2	-2	-7	-1

Model: TFS-F-ECM • Radiated Sound Power Data

Unit Size	Inlet Size	CFM	Fan Only							Fan Plus 100% Primary																				
			Sound Power Octave Bands							0.5" ΔPs							1.0" ΔPs							2.0" ΔPs						
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7				
B	8	350	58	48	45	39	32	27	54	45	42	39	35	31	56	48	44	40	39	37	58	51	45	42	42	44				
		400	59	49	46	40	36	31	57	47	44	40	37	32	58	50	45	42	40	39	60	53	47	43	44	46				
		500	62	51	48	43	42	38	60	50	47	42	39	34	62	54	48	44	43	41	64	57	49	46	46	48				
		600	64	53	49	45	46	43	63	53	49	45	41	36	65	56	51	46	44	43	66	60	52	48	48	49				
		700	65	54	51	46	51	48	65	56	51	46	43	37	67	59	53	48	46	44	69	62	54	50	50	51				
C	10	400	47	41	40	32	27	23	50	43	40	35	32	27	52	47	42	37	36	35	55	51	44	40	41	42				
		500	51	44	43	36	31	27	52	45	42	38	34	29	55	49	44	40	38	36	58	53	46	42	42	44				
		600	54	47	46	40	35	30	54	46	44	40	35	30	57	50	46	42	40	38	60	54	48	44	44	45				
		800	60	52	50	45	40	35	58	49	47	43	38	33	61	53	49	45	42	40	64	57	51	47	46	48				
		1000	64	56	54	49	44	38	60	51	50	45	39	34	63	55	52	47	44	42	66	59	54	49	48	49				
D	12	700	53	44	40	38	32	25	55	45	42	39	35	31	58	48	44	41	38	36	62	51	45	43	41	42				
		900	58	48	44	41	36	31	57	48	45	42	38	34	61	51	47	44	41	39	64	54	49	45	44	44				
		1100	61	52	47	44	39	35	60	51	48	44	40	36	63	54	49	46	43	41	67	57	51	47	46	47				
		1400	65	56	51	47	43	40	62	54	51	47	43	39	66	57	53	48	46	44	69	60	54	50	49	50				
		1700	68	59	54	49	46	44	65	56	53	49	45	41	68	60	55	50	48	46	72	63	57	52	51	52				
E	14	1100	61	53	48	44	38	32	59	52	49	44	40	36	61	54	50	45	43	41	63	57	52	47	45	45				
		1300	65	56	52	47	42	37	62	55	51	46	43	39	64	57	53	48	45	43	66	59	54	49	48	47				
		1600	69	61	56	51	47	43	66	58	55	50	46	41	68	60	56	51	48	46	70	63	57	52	51	50				
		1900	73	66	61	56	52	49	70	62	58	53	49	45	72	64	60	55	51	49	74	66	61	56	54	53				
		2300	76	69	64	58	55	53	72	64	60	55	51	46	75	66	62	57	53	51	77	69	63	58	56	55				

ARI Certification Points

Fan Size	Inlet Size	Prim. CFM	Fan CFM	Fan Watts	Min Ps	Fan Only Sound Power							Fan Plus Primary @ 1.5" Inlet						
						2	3	4	5	6	7	2	3	4	5	6	7		
B	8	700	700	210	0.11	65	54	51	46	51	48	68	61	53	49	48	48		
C	10	1050	1050	280	0.15	65	57	55	50	45	39	66	58	53	49	46	47		
D	12	1600	1600	370	0.09	67	58	53	48	45	43	71	62	55	51	49	49		
E	14	2100	2100	580	0.09	74	67	62	57	53	50	74	66	61	56	53	52		

- N/A in a space denotes a minimum inlet static pressure greater than 0.5 inch at rated airflow.
- Outlet ΔPs, the difference in static pressure from the terminal discharge to the room, is 0.25 inch.
- Radiated sound power is the noise transmitted through the casing walls.
- Sound power levels are in decibels, re 10⁻¹² watts.
- Ratings in accordance with ARI Standard 880 and certified to ARI.



A Participating Corporation in the ARI 880 Certification Program

Model: TFS-F-ECM • Discharge Sound Power Data

Unit Size	Inlet Size	CFM	Fan Only							Fan Plus 100% Primary																				
			Sound Power Octave Bands							0.5" ΔPs							1.0" ΔPs							2.0" ΔPs						
			2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7				
B	8	350	60	53	52	52	51	49	58	51	51	51	50	49	59	52	51	51	50	49	60	53	51	51	51	49				
		400	63	56	54	55	54	52	60	54	53	53	53	51	62	55	53	54	53	52	63	55	53	54	53	52				
		500	68	61	58	59	59	58	65	59	57	57	57	56	66	59	57	57	57	56	67	60	57	58	58	57				
		600	72	65	61	63	63	62	69	63	59	60	61	60	70	63	60	61	61	60	71	64	60	61	61	61				
		700	76	68	64	66	66	65	72	66	62	63	64	63	73	67	62	63	64	63	75	67	62	63	64	64				
C	10	400	61	55	51	52	51	47	57	50	48	46	45	42	59	51	47	46	45	42	60	51	47	46	45	42				
		500	64	57	54	55	54	51	60	53	51	50	49	47	61	53	50	50	49	47	62	54	50	50	49	47				
		600	66	60	55	57	56	54	61	55	53	53	52	51	63	56	53	53	52	51	64	56	53	53	53	51				
		800	69	63	58	60	60	59	64	59	57	58	58	57	65	59	57	58	58	58	67	60	57	58	58	58				
		1000	72	65	61	63	63	63	66	62	60	62	62	62	67	62	60	62	62	63	69	63	60	62	62	63				
D	12	700	55	49	48	51	50	46	56	49	51	51	49	47	58	51	51	51	50	48	60	52	52	51	50	48				
		900	61	55	53	56	55	52	60	54	55	56	54	53	62	55	55	56	55	53	64	56	55	56	55	53				
		1100	65	49	57	60	59	58	63	57	58	60	58	57	65	58	58	60	59	58	67	59	58	60	59	58				
		1400	70	65	62	65	64	64	67	61	62	64	63	63	68	62	62	64	63	63	70	63	62	64	64	63				
		1700	74	69	65	68	69	69	69	64	65	68	67	67	71	66	65	67	67	67	73	67	65	68	68	68				
E	14	1100	68	63	57	61	61	57	63	60	55	57	57	54	64	61	55	57	58	54	66	62	56	58	58	55				
		1300	71	67	60	64	64	62	66	63	58	60	61	58	67	64	58	61	61	59	69	65	59	62	62	59				
		1600	75	72	65	68	69	67	70	68	62	65	66	63	71	69	63	66	66	64	72	70	63	66	67	65				
		2100	80	78	70	74	75	73	74	74	68	71	72	71	76	75	68	71	72	71	77	76	68	72	73	72				
		2300	81	80	72	75	77	76	76	76	69	73	74	73	77	77	70	73	74	74	79	78	70	74	75	74				

ARI Certification Points

Fan Size	Inlet Size	Rated CFM	Fan CFM	Fan Watts	Min Ps	Fan Only Sound Power						
						2	3	4	5	6	7	
B	8	700	700	210	0.110	76	68	64	66	66	65	
C	10	1050	1050	270	0.147	72	66	61	63	64	64	
D	12	1600	1600	390	0.089	73	68	64	67	67	67	
E	14	2100	2100	490	0.087	80	78	70	74	75	73	

- N/A in a space denotes a minimum inlet static pressure greater than 0.5-inch at rated airflow.
- Outlet ΔPs, the difference in static pressure from the terminal discharge to the room, is 0.25-inch.
- Discharge sound power is the noise emitted from the unit discharge into the downstream duct.
- Sound power levels are in decibels, re 10⁻¹² watts.
- Ratings in accordance with ARI Standard 880 and certified to ARI.



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Suggested Specifications

Series Flow Fan Powered Terminals

Series Flow (Constant Volume) Fan Powered Terminals TFS Basic Unit, Quiet

See Section S for Control Specifications.

1. Furnish and install TITUS Model (P)(A)(D)TFS series flow fan powered terminals of the sizes and capacities shown on the plans. Space limitations shall be reviewed carefully to ensure that all terminals will fit the available space.
2. Terminals should be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Non-certified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineer in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
3. The terminal shall be designed, built, and tested as a single unit including motor and fan assembly, primary air damper assembly, water or electric heating coils, and accessories as shipped. Unit shall ship as a complete assembly requiring no field assembly (including accessories). All electrical components shall be UL listed and installed in accordance with the UL Standard 1995. Electrical connection shall be single point. All electrical components, including low voltage controls, shall be mounted in sheet metal control enclosures. The entire terminal shall be ETL listed as a complete assembly.
4. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with ½-inch matte faced, natural fiber insulation that complies with UL 181 and NFPA 90A. The liner shall comply with ASTM G21 and G22 for fungi and bacterial resistance. The casing shall be designed for hanging by sheet metal brackets. The terminal shall have a round duct collar for the primary air connection and a centered rectangular discharge suitable for flanged duct connection.
5. The terminal casing shall have top and bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections.
6. The fan shall be constructed of steel and have a forward curved, dynamically balanced wheel with direct drive motor. The motor shall be suitable for 120, 208, 240, or 277 volt, 60 cycle, single-phase power. The motor shall be of energy efficient design, permanent split capacitor type, with integral thermal overload protection and permanently lubricated bearings, and be specifically designed for use with an SCR for fan speed adjustment. Fan assembly shall include a tuned spring steel suspension and isolation between motor and fan housing.
7. The terminals shall utilize a manual SCR, which allows continuously adjustable fan speed from maximum to minimum, as a means of setting fan airflow. Setting fan airflow with any device that raises the pressure across the fan to reduce airflow is not acceptable. The speed control shall incorporate a minimum voltage stop to ensure that the motor cannot operate in a stall mode.
8. The primary air damper assembly shall be heavy gauge steel with shaft rotating in Delrin self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking, and a synthetic seal to limit close-off leakage to the maximum values shown in the following table. Provide an AeroCross™ four point, center-averaging differential pressure airflow sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

Maximum Damper Leakage

Inlet Size	Damper Leakage, CFM		
	1.5" ΔPs	3.0" ΔPs	6.0" ΔPs
6	4	5	7
8	4	5	7
10	4	5	7
12	4	5	7
14	4	6	8
16	5	7	9

Suggested Specifications

(continued)

Radiated Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Ceiling/Space Effect	16	18	20	26	31	36
Total dB reduction	18	19	20	26	31	36

Discharge Sound	Octave Bands					
	2	3	4	5	6	7
Environmental Effect	2	1	0	0	0	0
Duct Lining	3	6	12	25	29	18
End Reflection	9	5	2	0	0	0
Flex Duct	6	10	18	20	21	12
Space Effect	5	6	7	8	9	10
Total dB reduction	25	28	39	53	59	40

The following dB adjustments are used, per ARI 885-98, for the calculation of NC above 300 CFM.

	Octave Bands					
	2	3	4	5	6	7
300-700 CFM	2	1	1	-2	-5	-1
Over 700 CFM	4	3	2	-2	-7	-1

Radiated	Octave Band					
	2	3	4	5	6	7
NC35	70	61	54	53	52	51
NC40	74	68	61	59	58	57

Maximum Radiated Sound Power Level

Discharge	Octave Band					
	2	3	4	5	6	7
NC35	80	77	69	73	74	73
NC40	84	80	72	75	75	74

Maximum Discharge Sound Power Level

9. The sound levels shall not exceed the octave band sound power levels indicated in the table above. Sound performance shall be ARI certified. If NC is provided instead of octave band sound power data, the radiated and discharge path attenuation function for the specified NC shall be based upon factors found in ARI Standard 885-98, Appendix E. No additional attenuation factors shall be deducted from the sound power.

TFS-F Fantom IQ™

(Substitute paragraphs 1, 5 and 9 below for paragraphs 1 and 5 in the TFS Basic Unit Specification)

- Furnish and install TITUS Model (P)(A)(D)TFS-F Fantom IQ series flow fan powered terminals of the sizes and capacities shown on the plans. Space limitations shall be reviewed carefully to ensure that all terminals will fit the available space.
- The terminal casing shall have two top and two bottom access panels, which allows removal of fan assembly and servicing of terminal without disturbing duct connections. The terminal shall have internal and external attenuators factory installed. The external attenuator shall be shipped internal to the unit to protect it from shipping damage. The external attenuator shall be slid into the operation position and secured without the need for additional screws. Factory provided attenuators that require field installation are not acceptable.

Suggested Specifications

(continued)

ECM Motor

(Substitute paragraphs 6 and 7 below for paragraphs 6 and 7 in the TFS Basic Unit Specification)

6. Fan motor assembly shall be forward curved centrifugal fan with a direct drive motor. Motors shall be General Electric ECM variable-speed dc brushless motors specifically designed for use with single phase, 277 volt, 60 hertz electrical input. Motor shall be complete and operated by a single phase integrated controller/inverter that operates the wound stator and senses rotor position to electronically commutate the stator. All motors shall be designed for synchronous rotation. Rotor shall be permanent magnet type with near zero rotor losses. Motor shall have built-in soft start and soft speed change ramps. Motor shall be able to be mounted with shaft in horizontal or vertical orientation. Motor shall be permanently lubricated with ball bearings. Motor shall be directly coupled to the blower. Motor shall maintain a minimum of 70 percent efficiency over its entire operating range. Provide a motor that is designed to overcome reverse rotation and not affect life expectancy.
7. The terminal unit manufacturer shall provide a factory installed PWM controller for either manual or DDC controlled fan CFM adjustment. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM controller shall be capable of receiving a 0-10 Vdc signal from the DDC controller (provided by the controls contractor) to control the fan CFM. When the manual PWM controller is used, the factory shall preset the fan CFMs as shown on the schedule.

Accessories

Steri-Loc Liner

(Substitute paragraph 4 below for paragraph 4 in the TFS Basic Unit Specification)

4. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with non-porous, sealed liner, which complies with UL 181 and NFPA 90A. Insulation shall be 4 pound density. All cut edges must be sealed from the airstream using barrier strips. Liners made of Tedlar, Silane, or woven fiberglass cloth are not acceptable. Insulation shall be equivalent to Titus Steri-Loc. Double wall lining is acceptable. The terminal shall have a round duct connection and a rectangular discharge suitable for flanged duct connection. The casing shall be designed for hanging by sheet metal straps.

Fibre-Free Liner

(Substitute paragraph 4 below for paragraph 4 in the TFS Basic Unit Specification)

4. The terminal casing shall be minimum 20-gauge galvanized steel, internally lined with engineered polymer foam insulation, which complies to UL181 and NFPA 90A. Insulation shall be 1 1/2 pound density, closed cell foam. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The casing shall be designed for hanging by sheet metal brackets.

Hot Water Heating Coils

4. Hot water heating coils shall be enclosed in a minimum 20-gauge galvanized steel casing, with flanged construction for attachment to metal ductwork. Coils shall be factory installed on the terminal. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016 inch, with male solder header connections. Coils shall be leak tested to 300 psi, with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as required per the plans. Coil performance data shall be based on tests run in accordance with ARI Standard 410.

Suggested Specifications

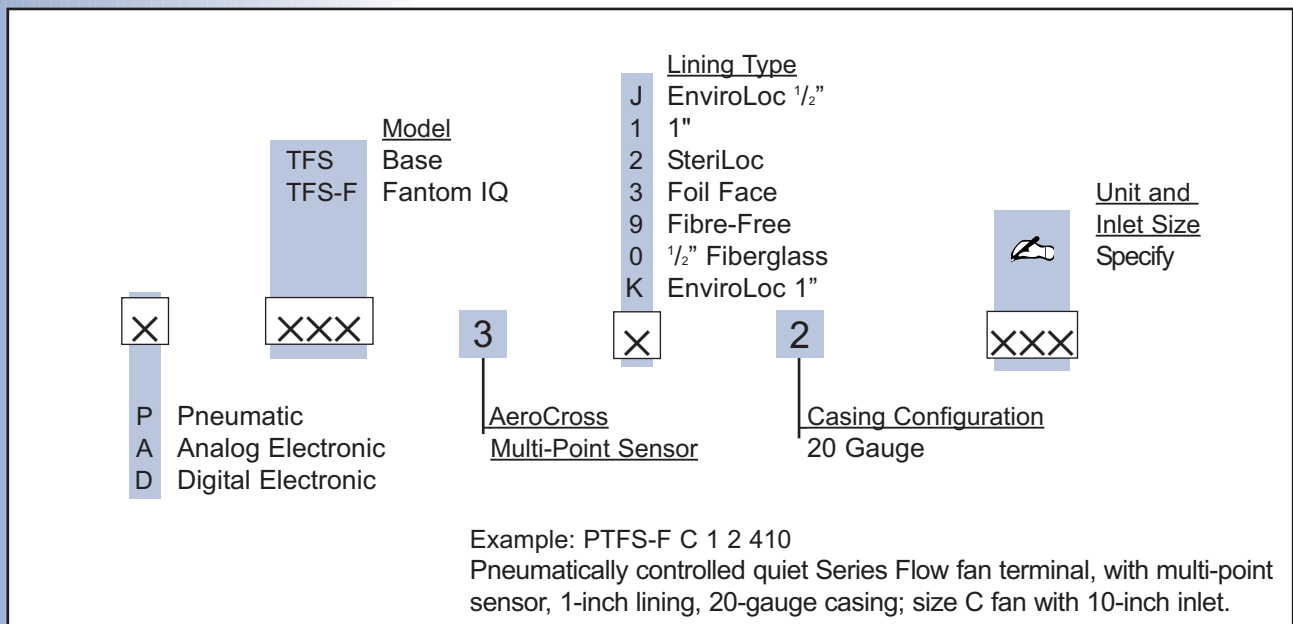
(continued)

Accessories, continued.

Electric Heating Coils

1. Electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coil shall be integral with the terminal. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3.5 inches apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure, with hinged access door for access to all controls and safety devices.
2. Electric coils shall contain a primary automatic reset thermal cutout, a secondary replaceable heat limiter per element, differential pressure airflow switch for proof of flow, and line terminal block. Coil shall include an integral door interlock type disconnect switch, which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.
3. (Optional) Electric coils shall include (manual reset secondary thermal cutouts), (line fusing), (mercury contactors) mounted and wired within the control enclosure.

Model Number Specification



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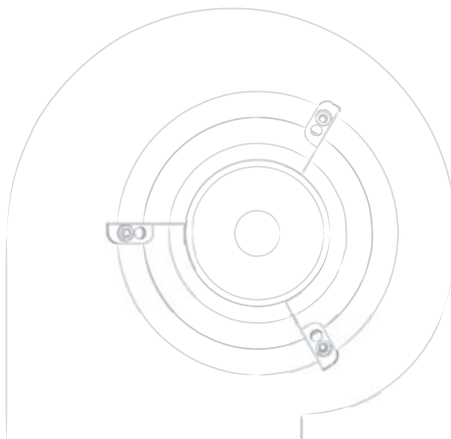
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