23 36 00
AIR TERMINAL UNITS

PART 1: GENERAL

1.1 Purpose:

A. This standard is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design. PSP is to apply the principles of this section such that the University of Texas at Arlington (UTA) may achieve a level of quality and consistency in the design and construction of their facilities. Deviations from these guidelines must be approved by UTA and may require a justification through Life Cycle Cost (LCC) analysis and submitted to the University for approval.

1.2 LESSONS LEARNED AND DESIGN CONSIDERATIONS

A. Verify equipment as it is unloaded from delivery trucks, and as the equipment is being installed that the proper piece of equipment as indicated on the construction documents is being installed

B. DC fan power VAV boxes will be used as standard.

C. Ensure upstream duct has length is sufficient per manufacturers recommendations. Titus usually requires 4 duct diameters upstream of the terminal box.

D. Dual duct terminal boxes will have two independent electric dampers for cold and hot deck. Mixing of the cold and warm air should be avoided or minimized.

E. Ensure the minimum flowrate is sufficient to not trip electric reheat coils.

F. When using a parallel fan powered unit ensure that the primary damper closes when the air handling unit is off.

G. Provide a terminal box for no more than three spaces with similar load.

H. Design downstream duct system to avoid a tee directly at the discharge of the terminal box.

I. Designer should consider sound radiated down the ductwork to the space and design ductwork accordingly to minimize the sound transmission.

J. Flexible duct will not be used on the inlet of any terminal box. A maximum of 5 feet of flexible duct will be used downstream of the terminal box.

K. No fiberglass insulation will be used for liners of any VAV terminal.

L. Use mixing attenuator when possible for dual duct boxes.

M. The terminal box will control to a single temperature set point.

1.3 Requirements

A. Base acoustic performance of terminal units upon units tested according to AHRI 880 and ASHRAE Standard 130.

B. Base occupied space sound level estimates on AHRI 885.

C. Terminal heating coil shall conform to AHRI 410.

D. Provide unit with factory-mounted 24 volt transformer for single point electrical connection.

PART 2: PRODUCTS

2.1 Single Duct Variable Air Volume Units:

A. Units shall be capable of controlling air volume to within plus or minus 5% of air volume set-point, as determined by the zone temperature sensor demand with variations in inlet pressures from 0.10" to 6" w.g.

B. Units shall have internal air resistance, including hydronic heating coil, not to exceed 0.4" w.g. at maximum flow.

C. Provide external differential pressure taps separate from the control pressure taps for airflow measurement with a 0"-1"w.g. range.

D. Select units at maximum 2,000 FPM and minimum 400 FPM inlet velocity.

E. Units shall be constructed with minimum 22 gauge galvanized steel enclosures.

F. Casing Leakage: Assembled units shall be so constructed and sealed to limit air leakage to the following listed quantities at 3" static pressure. If sealing is required to obtain the leakage performance, seal as for medium pressure ductwork Hardcast 1602 tape may be used to seal lap joints and flat seams only. Leakage curves or tables will be required as part of the submittal data. The following is the maximum allowable casing leakage including all components:

Diameter	Maximum Allowed CFM (Area x 2000fpm)	Maximum Allowable CFM Casing Leakage
4"-5"-6"	393	8.0
7"-8"	698	14.0
9"-10"	1091	22.0
11"-12"	1571	30.0
13"-14"	2138	40.0

G. The following is the maximum damper leakage allowable for the various size diameter inlets. The damper leakage shall not exceed the values listed in the table below at 6" w.g. differential pressure, following AHRI 880 Testing Procedures.

Diameter	Maximum Allowed CFM (Area x 2000fpm)	Maximum Allowable CFM Casing Leakage
4"-5"-6"	393	6.0
7"-8"	698	10.5
9"-10"	1091	16.5
11"-12"	1571	20.0
13"-14"	2138	30.0

H. Provide minimum ¾" non-fiberglass internal lining with all edges sealed against airflow erosion in accordance with NFPA 90A and UL 181.

I. Unit air volume shall be set at factory and provided such that special tools are not required for field adjustment.

2.2 Fan Powered Variable Air Volume Units:

A. Units shall be capable of controlling air volume to within plus or minus 5% of air volume set-point, as determined by the zone thermostat demand with variations in inlet pressures from 0.10" to 6" w.g.

B. Units shall be constructed with minimum 20 gauge galvanized steel enclosures.

C. Fans in parallel terminal units shall be forward curved, centrifugal, direct-drive motor with SCR controller for airflow adjustments from 60%-100%. The SCR controller and fan motor shall be harmonically balanced to reduce electrical noise

D. Fans in series terminal units shall be forward curved, centrifugal with direct-drive electronic commutated motors (ECM).

E. Fan and motor assembly shall be internally suspended and isolated from the casing on rubber in shear isolators. Fan and motor assembly shall be easily accessible through access panels without disassembling the entire unit. Fan assembly shall include an anti-backward rotation device.

2.3 Terminal Heating Coils:

A. Shall be hot water fin and tube type constructed of seamless copper with aluminum fins mechanically bonded to the tubes and copper headers. Electric coils as approved by UTA.

B. Casing and tube supports shall be minimum 16 gauge galvanized steel.

C. Coils shall be drainable, suitable for 250 psig working pressure, with circulated tubes factory tested at not less than 300 psig air pressure.

2.4 Dual Duct Terminal Units:

A. Damper casings shall be constructed of 18 gauge galvanized sheet metal, sized with female connections each end.

B. The damper blades shall be 16 gauge cold rolled, galvanized steel and shall be spot welded to shaft.

C. The damper shafts shall be round and operate in rustproof self-lubricating bearings (not plastic). The end of the shaft at the operator end shall be scored in line with the damper blade to reference the damper blade position.

D. Electric actuators shall be furnished, mounted and adjusted by the BAS contractor. Terminal volume damper manufacturer shall provide mounting base on terminal unit for mounting of actuator. Actuator shall be sized for specific application with a minimum torque of 40"/lb. and shall utilize brushless motor. Housing shall be designed for reversing rotation. Actuator shall be proportional control, 0-10V, spring return with maximum run time of 150 seconds and spring return time of less than 60 seconds. Maximum power draw of actuator shall be 10VA. All actuators installed throughout project shall be of the same manufacturer and model.

PART 3: EXECUTION

3.1 Installation:

A. Maintain NEC and manufacturer's recommended clearances for control enclosures.

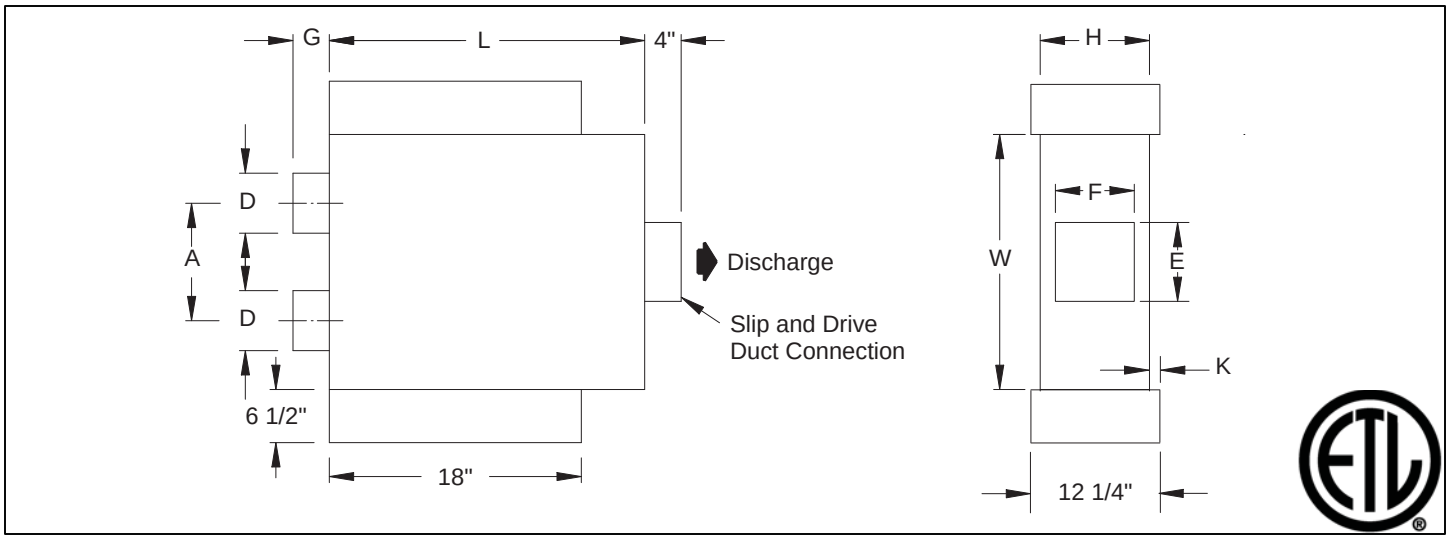
PART 4: Appendix

3.2 Digital Single Duct Terminal Unit
3.3 Digital Dual Duct Terminal Unit
3.4 Digital Parallel Fan Powered Terminal Unit
3.5 Digital Series Fan Powered Terminal Unit

END OF SECTION 23 36 00

DEDV

Dual Duct Terminal Unit
Direct Digital Control, Pressure Independent, with Integral Mixer/Attenuator



Inlet Size	CFM Range	A	D	E	F	G	H	L	W	J
4	0-225	8 7/8	3 7/8	5 7/8	5 7/8	5 3/8	8 1/4	19	19	2
5	0-350	8 7/8	4 7/8	5 7/8	5 7/8	5 3/8	8 1/4	19	19	2
6	0-500	8 7/8	5 7/8	5 7/8	5 7/8	3 3/8	8 1/4	19	19	2
7	0-650	10 7/8	6 7/8	7 1/8	8 1/8	5 3/8	10 1/4	23	23	1
8	0-900	10 7/8	7 7/8	7 1/8	8 1/8	3 3/8	10 1/4	23	23	1
9	0-1050	12 7/8	8 7/8	10 1/8	11 1/8	5 3/8	12 3/4	27	27	-
10	0-1400	12 7/8	9 7/8	10 1/8	11 1/8	3 3/8	12 3/4	27	27	-
12	0-2000	14 7/8	11 7/8	11 1/8	13 1/8	3 3/8	15 1/8	31	31	-
14	0-3000	16 7/8	13 7/8	12 1/2	16 1/8	3 3/8	18 1/8	35	35	-
16	0-4000	18 7/8	15 7/8	15 1/8	16 1/8	3 3/8	18 1/8	38	38	-

Accessories (Optional)

Check ☑ if provided.

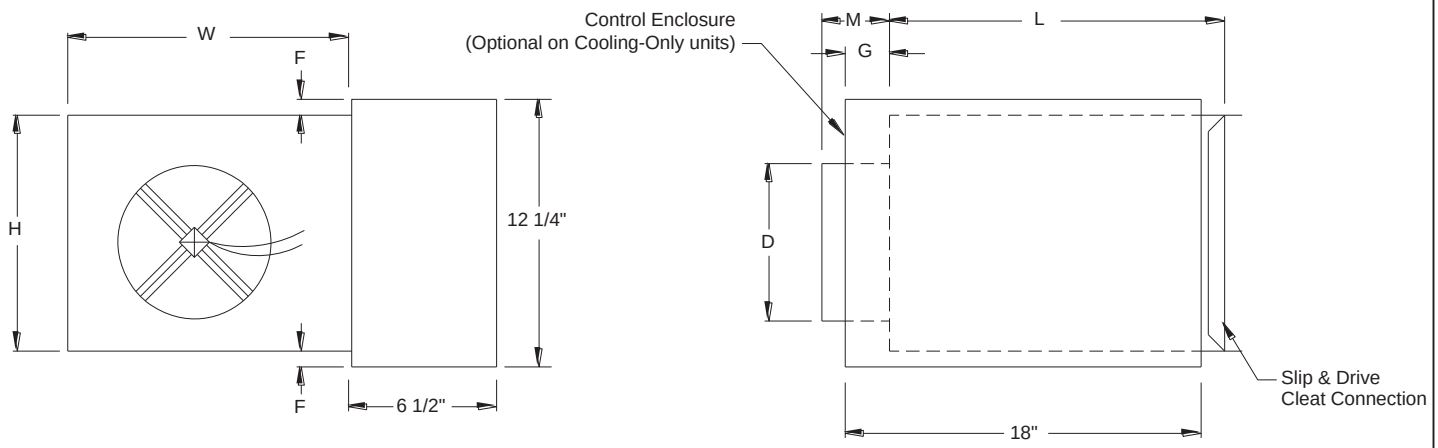
- ☐ 24V Control Transformer
- ☐ Disconnect Switch
- ☐ Fibre Free Liner
- ☐ SteriLoc Liner
- ☐ 1" Fiberglass Liner
- ☐ Hanger Brackets
- ☐ Special Mixing Baffle
- ☐ _____

General Description

- Standard construction is 22 gauge steel housing with 20 gauge construction as optional.. Mechanically sealed and gasketed, leak resistant construction. Less than 2% of nominal cfm at 1.5" sp wg.
- Dual density internal insulation, treated to resist air erosion. Meets requirements of NFPA 90A and UL 181.
- Rectangular discharge opening is designed for slip and drive cleat duct connection.
- Multipoint center averaging inlet velocity sensor. Placement must be specified based on control sequence.
- Direct digital control package supplied by Titus includes direct digital controller, damper actuators, and flow transducers (all tested and calibrated.) Room sensor is optional.
- Direct digital control package can be factory mounted by Titus from various manufacturers. Consult your Titus representative for availability.
- Gauge tees for cfm measurement.
- Choice of right hand or left hand cold duct location. Right hand is standard.

DESV

Single Duct Terminal Unit
Direct Digital Control, Pressure Independent



Right hand unit shown. All dimensions are in inches.

Inlet Size	CFM Range	D	F	G	H	L	M	W
4	0-225	3 7/8	2 1/8	7 3/8	8	15 1/2	5 3/8	12
5	0-350	4 7/8	2 1/8	7 3/8	8	15 1/2	5 3/8	12
6	0-500	5 7/8	2 1/8	7 3/8	8	15 1/2	3 3/8	12
7	0-650	6 7/8	1 1/8	7 3/8	10	15 1/2	3 3/8	12
8	0-900	7 7/8	1 1/8	7 3/8	10	15 1/2	3 3/8	12
9	0-1050	8 7/8	-	5 3/8	12 1/2	15 1/2	3 3/8	14
10	0-1400	9 7/8	-	5 3/8	12 1/2	15 1/2	3 3/8	14
12	0-2000	11 7/8	-	5 3/8	15	15 1/2	3 3/8	16
14	0-3000	13 7/8	-	3 3/8	17 1/2	15 1/2	3 3/8	20
16	0-4000	15 7/8	-	3 3/8	18	15 1/2	3 3/8	24
24 x 16	0-8000	23 7/8 x 15 7/8	1 1/8	5 3/8	18	15	3 3/8	38

Accessories (Optional)

Check ☑ if provided.

- ☐ 24 V Control Transformer
- ☐ Dust Tight Enclosure Seal
- ☐ Fibre Free Liner
- ☐ ½" EcoShield Liner
- ☐ ½" Fibre Free Liner
- ☐ 1" Fiberglass Liner
- ☐ 1" EcoShield Liner
- ☐ 1" Fibre Free Liner
- ☐ Low Leakage Seal/Test/Certify
- ☐ SteriLoc Liner
- ☐ UltraLoc Liner
- ☐ ½" EcoShield Liner (Foil Face)
- ☐ 1" EcoShield Liner (Foil Face)
- ☐ Disconnect Switch
- ☐ Hanger Brackets
- ☐ Removable Air Flow Sensor
- ☐ Bottom Access Door
- ☐ OSP & IBC Certification
- ☐ Red List Compliant "Google" Gasketing
- ☐ _____

General Description

- Heavy gauge steel housing. Mechanically sealed and gasketed, leak resistant construction. Less than 2% of nominal cfm at 1.5" sp wg.
- Dual density internal insulation, treated to resist air erosion. Meets requirements of NFPA 90A and UL 181.
- Rectangular discharge opening is designed for slip and drive cleat duct connection.
- Multipoint center averaging inlet velocity sensor.
- Digital control packages can be factory mounted by Titus.
- Choice of right hand or left hand control location.
- Model DESV without coils can be installed horizontally, vertically, or at any angle. Operation is not affected by position. For units with coils, consult technical support.
- Gauge tees for cfm measurement.
- OSHPD Seismic Certification: OSP-0352-10
- Only Titus Alpha digital controls package approved for seismic installation.

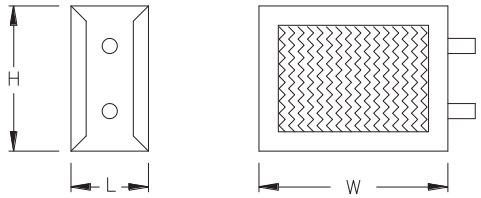
This submittal is meant to demonstrate general dimensions of this product. The drawings are not meant to detail every aspect of the product. Drawings are not to scale. Titus reserves the right to make changes without written notice.

Accessories (Optional)

☐ Hot Water Coil Section

- Aluminum ripple fins, 10 per inch
- Coil pipe connections are male, sweat, type “L” copper. Connection sizes are ½” OD for 1 row coil unit sizes 04-08. All other coils have $^{7}/_{8}$" OD.
- Coil is installed at discharge of unit.
- On units with attenuators, coil are installed at the discharge of attenuator.

☐ 1 Row
☐ 2 Row
☐ 3 Row
☐ 4 Row



☐ Electric Coil Section ☐ Optional SCR Controlled Electric Heater ☐ Optional Lynergy Controlled Electric Heater

Standard Features

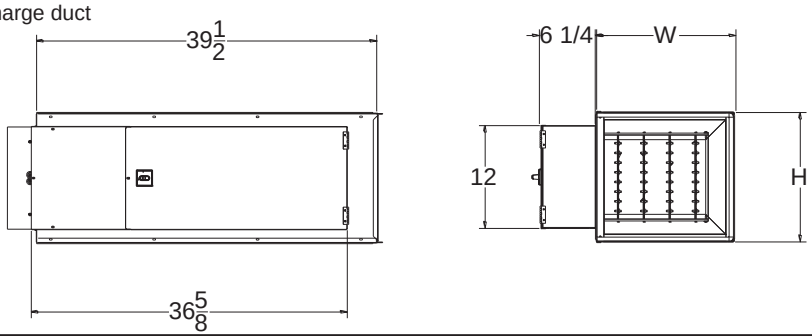
- Single side access to low voltage, high voltage, and electric heater controls.
- Automatic reset thermal cutouts, one per element
- Manual reset secondary protection.
- Positive pressure flow switch
- Magnetic contactor for each step.
- Slip and drive cleat discharge duct connection.

Options

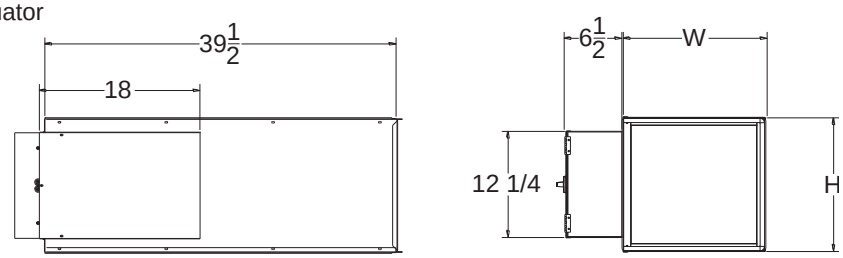
☐ Fuse Block
☐ Disconnect switch, door interlock type
☐ Dust tight construction
☐ Mercury contactors

Supply Voltage

☐ 120V, 1 ph, 60Hz
☐ 208V, 1 ph, 60Hz
☐ 240V, 1 ph, 60Hz
☐ 277V, 1 ph, 60Hz
☐ 208V, 3 ph, 60Hz
☐ 480V, 3 ph, 60Hz (4 wire wye standard)



☐ Integral Sound Attenuator



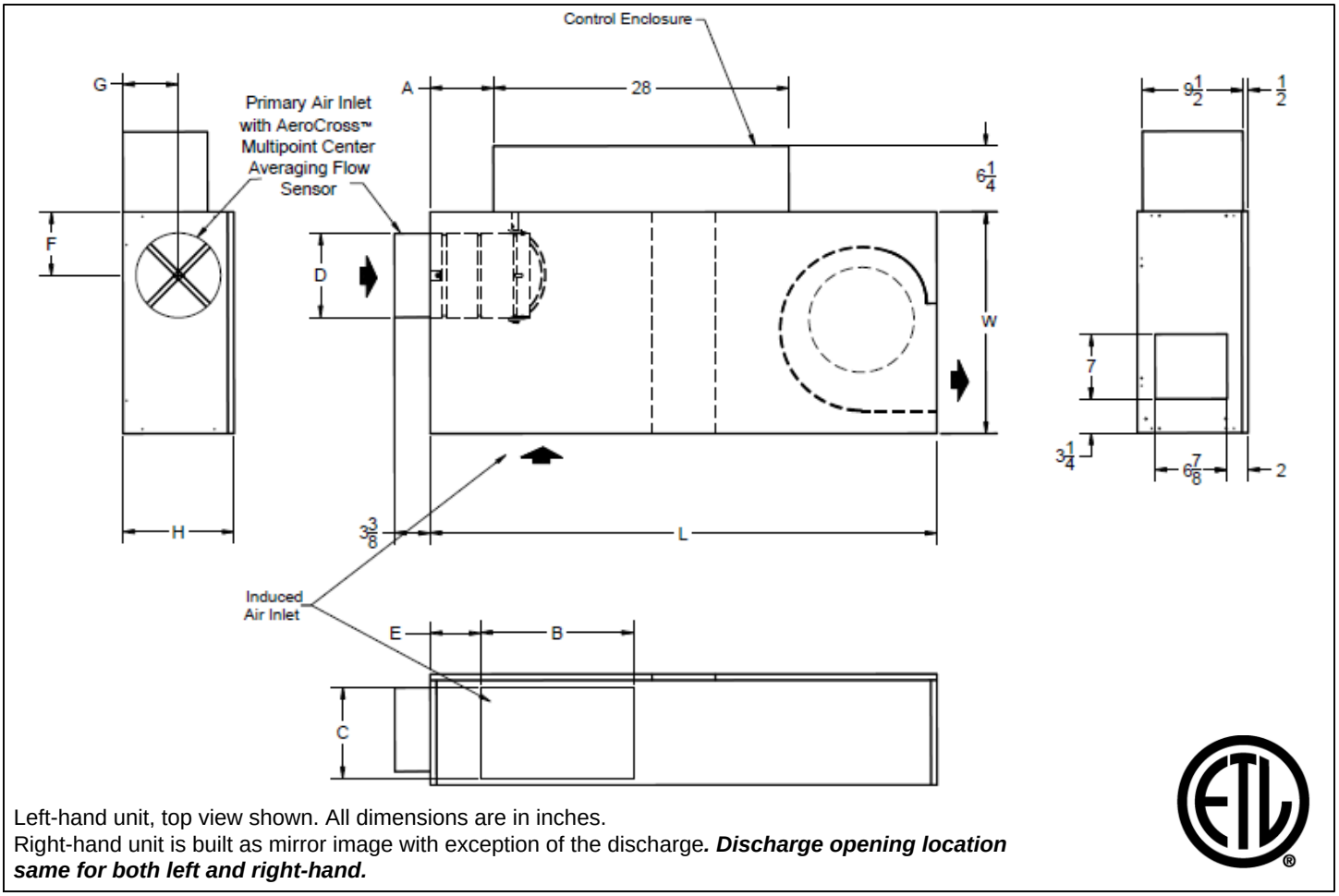
Inlet Size	H	W	Water Coil	
			L (1-2 Row)	L (3-4 Row)
4	8	12	5	7 1/4
5	8	12	5	7 1/4
6	8	12	5	7 1/4
7	10	12	5	7 1/4
8	10	12	5	7 1/4
9	12 1/2	14	5	7 1/4
10	12 1/2	14	5	7 1/4
12	15	16	5	7 1/4
14	17 1/2	20	7 1/2	9 3/4
16	18	24	7 1/2	9 3/4
24 x 16	18	38	5	7 1/4

The total length of the DESV unit is the summation of the unit length (with or without attenuator) and the length of the optional water coil.

This submittal is meant to demonstrate general dimensions of this product. The drawings are not meant to detail every aspect of the product. Drawings are not to scale. Titus reserves the right to make changes without written notice.

DTFS - Size A

Fan Powered Terminal, Series Flow
Direct Digital Control, Pressure Independent



Left-hand unit, top view shown. All dimensions are in inches.
Right-hand unit is built as mirror image with exception of the discharge. ***Discharge opening location same for both left and right-hand.***

Unit Size	Inlet Size	A	B	C	D	E	F	G	H	L	W	Filter Size
A	6" Diameter	6	14	8	5 7/8	3	5 5/8	5 1/4	10 1/2	48	21	10 x 16

Motor Amperage Ratings

Unit Size	Motor hp	120/1/60 FLA	208/240/1/60 FLA	277/1/60 FLA
A	1/10	1.25	0.6	0.54

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 277 V motors are used with 480V, 3 phase coils (4 wire wye).

Accessories (Optional)

Check ☑ if provided.

- ☐ Induced Air Filter, 1" thick, disposable construction type.
- ☐ Toggle disconnect switch (not available on units with optional electric coils.)
- ☐ Fibre Free Liner
- ☐ ½" EcoShield Liner
- ☐ ½" Fibre Free Liner
- ☐ Foil Face Liner
- ☐ Fan unit fusing
- ☐ Cam Latch for Access Door
- ☐ ½" EcoShield Liner (Foil Face)
- ☐ Hanger Brackets
- ☐ OSP & IBC Certification
- ☐ _____

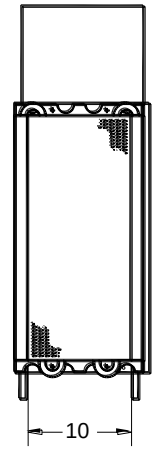
Accessories (Optional)

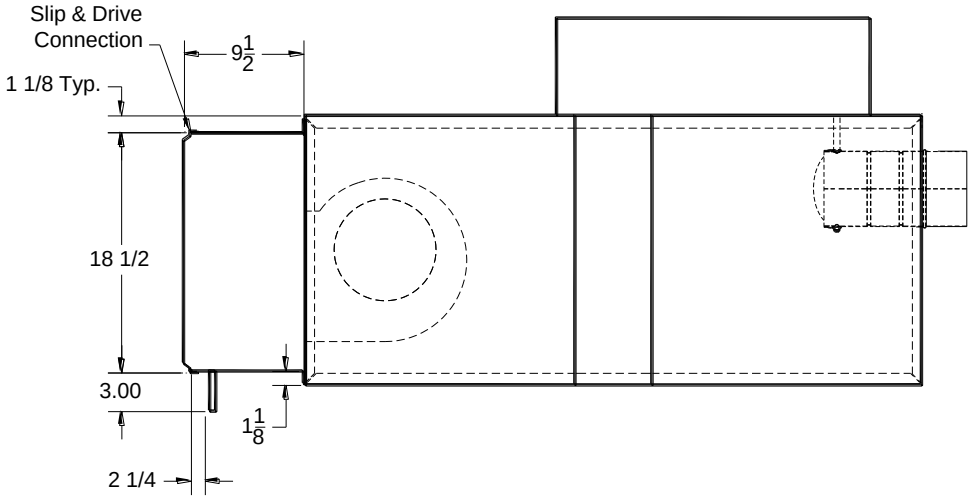
☐ Hot Water Coil Section

- 1/2" copper tubes
- Aluminum ripple fins, 10 per inch
- Connections: Male solder, 1/2" for 1-row and 7/8" for 2-row. Left or right hand connections.
- Galvanized steel casing
- Flanged duct connection.
- Coil is installed at discharge of unit.

☐ 1 Row
☐ 2 Row

☐ 1 Row
☐ 2 Row





☐ Electric Coil Section ☐ Optional Lynergy Controlled Electric Heater

Standard Features

- Automatic reset thermal cutouts, one per element
- Single point electrical connection for entire unit
- Positive pressure flow switch
- Transformer

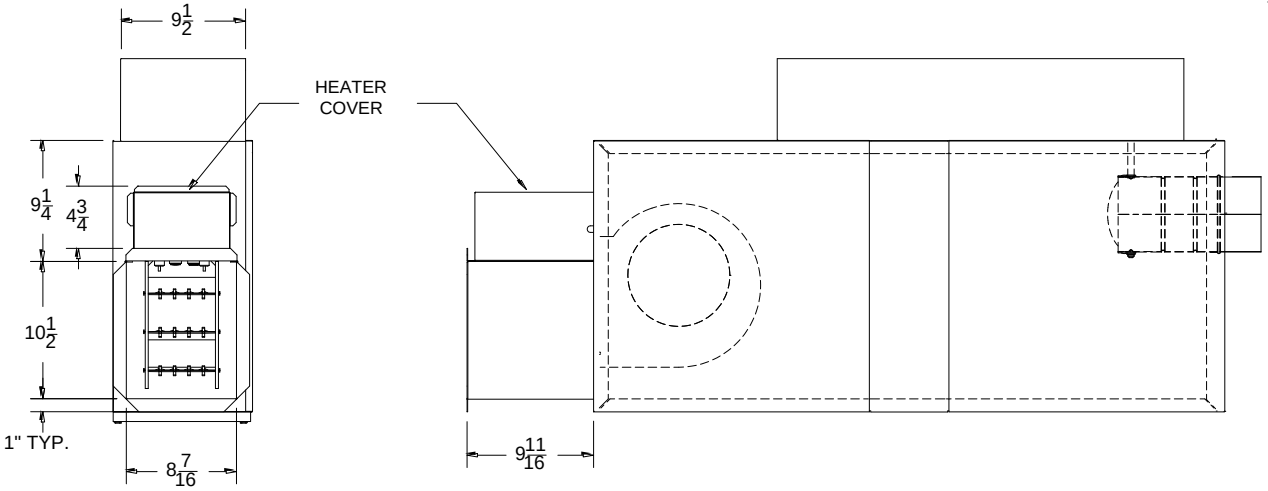
Options

☐ Fuse Block
☐ Disconnect switch, door interlock type
☐ Manual reset cutout
☐

Supply Voltage

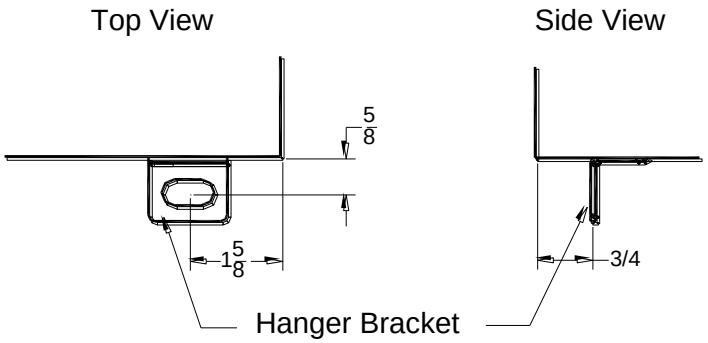
☐ 208V, 1 ph, 60Hz
☐ 240V, 1 ph, 60Hz
☐ 277V, 1 ph, 60Hz
☐ 208V, 3 ph, 60Hz
☐ 480V, 3 ph, 60Hz *

*4 wire yee only



Accessories (Optional)

Hanger Bracket Location



General Description

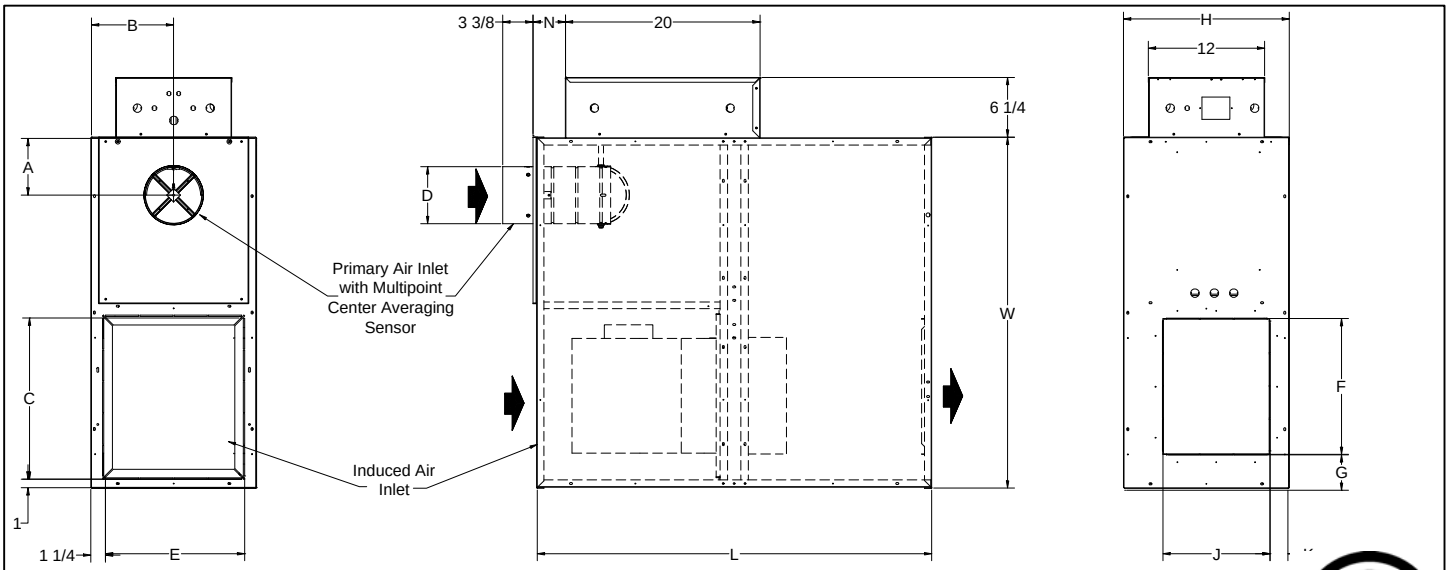
- Heavy steel casing, with leak resistant construction.
- Dual density insulation, coated to prevent air erosion, meet requirements of NFPA 90A and UL 181.
- Energy efficient fan motor, permanent split capacitor type, mounted in vibration isolators.
- Discharge opening location is the same for both left-hand and right-hand units. Only the controls and inlet locations change.
- Adjustable SCR fan speed control with minimum voltage stop.
- Bottom access panels can be removed for service.
- Multipoint, center averaging velocity sensor.
- Primary air flow balancing connections.
- Pressure independent primary flow control.
- Single point electrical connections.
- Rectangular discharge opening is designed for flanged duct connections.
- OSHPD Seismic Certification: OSP-0352-10
- Only Titus Alpha digital controls package approved for seismic installation.

Titus Submittal

DTQP-1.0 5-24-16

DTQP

Fan Powered Terminal, Parallel Flow
Direct Digital Control, Pressure Independent



Left hand unit, top view shown. All dimensions are in inches.
Right hand units are built as a mirror image. Inlets, discharge, and control enclosure are opposite of the drawing above.

Unit Size	Inlet Size	A	B	C	D	E	F	G	H	J	K	L	W	N	Filter Size
2, 3	6 8 10 12	6 6 7 8	8 9/16	16 3/4	5 7/8 7 7/8 9 7/8 11 7/8	14 1/2	14	3 1/2	17 1/8	11	2 1/8	40 7/8	36 1/8	2 7/8 2 7/8 4 7/8 4 7/8	19 x 17
4	8 10 12 14	6 7 8 10			7 7/8 9 7/8 11 7/8 13 7/8									2 7/8 4 7/8 4 7/8 6 7/8	
5	10 12 14 16	7 8 10 11	10 1/16	24 1/2	9 7/8 11 7/8 13 7/8 15 7/8	17 1/2	16 1/2	9 1/2	20 1/8	14 1/2	3 1/8	46 7/8	48 1/8	4 7/8 4 7/8 6 7/8 6 7/8	27 x 20
6	12 14 16	8 10 11			11 7/8 13 7/8 15 7/8									4 7/8 6 7/8 6 7/8	

Motor Amperage Ratings

Unit Size	Motor hp	120/1/60 FLA	208/240/1/60 FLA	277/1/60 FLA
2	1/6	3.6	1.5	1.3
3	1/4	5.3	2.6	2.2
4	1/3	7.8	3.2	2.9
5	1/3	9.2	3.3	3.2
6	3/4	12.3	6.3	5.4

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 277 V motors are used with 480V, 3 phase coils (4 wire wye).

Accessories (Optional)

Check ☑ if provided.

- ☐ Induced Air Filter, 1" thick, disposable construction type
- ☐ Fan disconnect switch (not available on units with optional electric coils.)
- ☐ Fibre Free Liner
- ☐ SteriLoc Liner
- ☐ ½" EcoShield Liner
- ☐ ½" EcoShield Liner (Foil Face)
- ☐ ½" Fibre Free Liner
- ☐ UltraLoc Liner
- ☐ Fan unit fusing
- ☐ 1" Fiberglass Liner
- ☐ 1" EcoShield Liner
- ☐ 1" EcoShield Liner (Foil Face)
- ☐ 1" Fibre Free Liner
- ☐ Hanger Brackets
- ☐ Cam Latch for Access Door
- ☐ _____

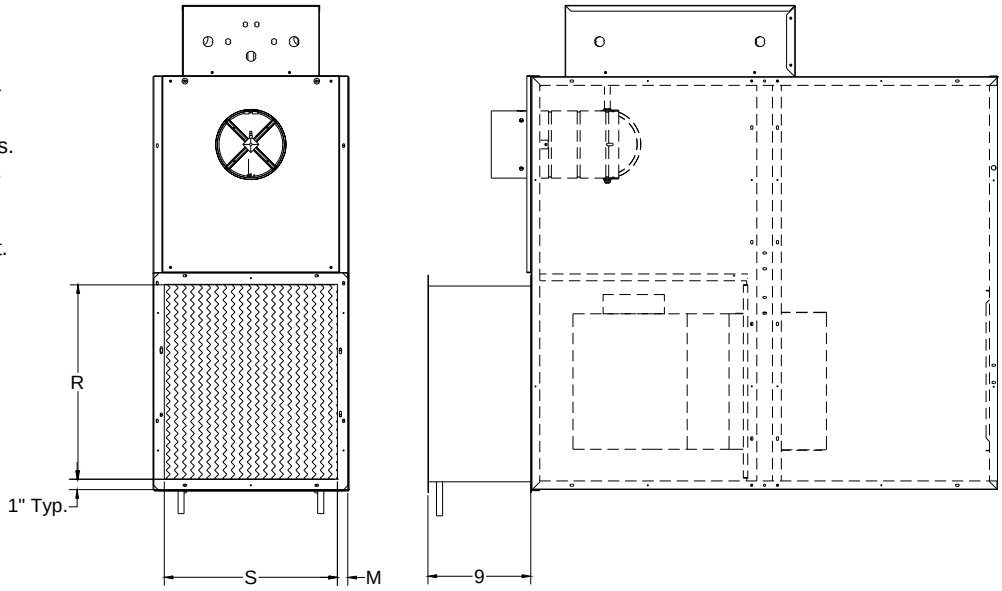
Accessories (Optional)

☐ Hot Water Coil Section

- 1/2" copper tubes
- Aluminum ripple fins, 10 per inch
- Connections: Male solder, 5/8" for both 1-row and 2-row. Right hand connections only on left hand units. Left hand only on right hand units.
- Galvanized steel casing
- Flanged duct connection.
- Coil is installed at induced air inlet.

☐ 1 Row

☐ 2 Row



Unit Size	M (1 row)	M (2 row)	R	S
2, 3, 4	1	1 1/4	17	15
5, 6	1	1 1/4	25	17 1/2

R and S are inside dimensions.

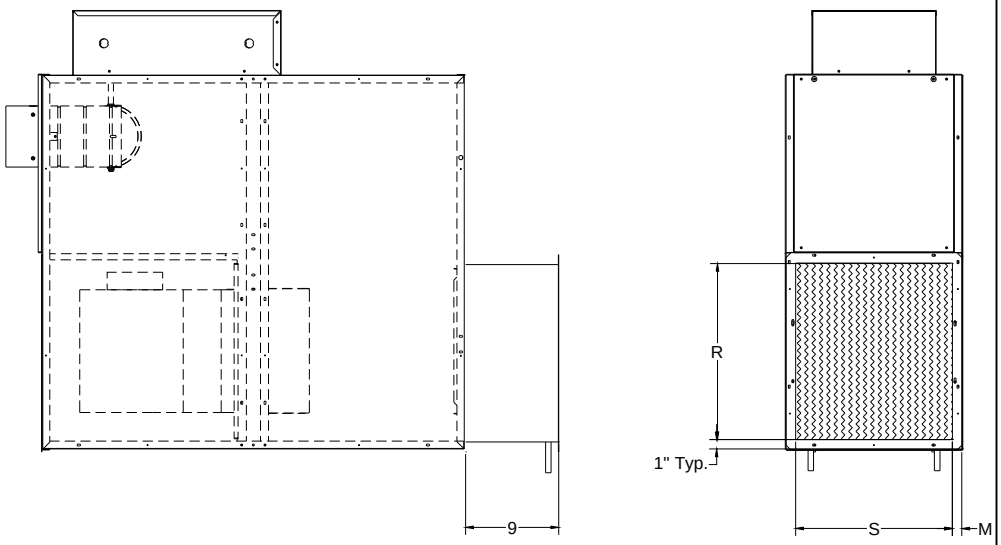
Accessories (Optional)

☐ Hot Water Coil Section (Discharge Side)

- 1/2" copper tubes
- Aluminum ripple fins, 10 per inch
- Connections: Male solder, 5/8" for both 1-row and 2-row. Right hand and left-hand connections available regardless of handing of controls.
- Galvanized steel casing
- Flanged duct connection.
- Coil is installed at induced air inlet.

☐ 1 Row

☐ 2 Row



Unit Size	M (1 row)	M (2 row)	R	S
3, 4	1	1 1/4	17	15
5, 6	1	1 1/4	25	17 1/2

R and S are inside dimensions.

☐ Electric Coil Section ☐ Optional SCR Controlled Electric Heater ☐ Optional Lynergy Controlled Electric Heater

Standard Features

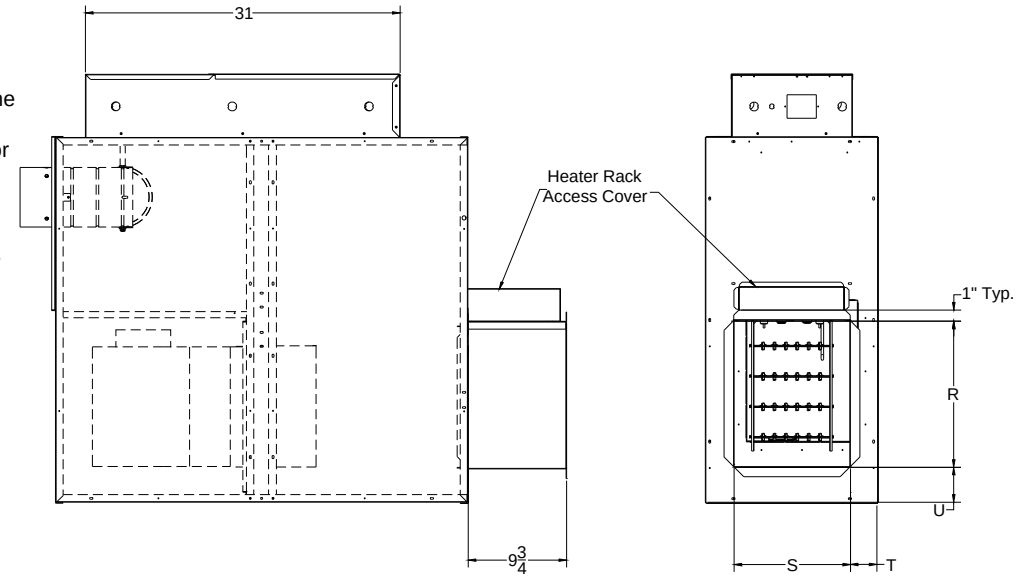
- Single side access to low voltage, high voltage, and electric heater controls.
- Automatic reset thermal cutouts, one per element
- Single point electrical connection for entire unit
- Positive pressure flow switch
- Flanged duct connection
- Coil is installed at discharge of unit.
- Transformer

Options

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

Supply Voltage

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



Unit Size	U	R	S	T
2, 3, 4	3 1/2	14	11	2 1/8
5, 6	9 1/2	16 1/2	14 1/2	3 1/8

R and S are inside dimensions.

General Description

- Heavy steel casing, with leak resistant construction.
- Dual density insulation, coated to prevent air erosion, meet requirements of NFPA 90A and UL 181.
- Energy efficient fan motor, permanent split capacitor type, mounted in vibration isolators.
- Adjustable SCR fan speed control with minimum voltage stop.
- Bottom access panels can be removed for service.
- Multipoint, center averaging velocity sensor.
- Primary air flow balancing connections.
- Pressure independent primary flow control.
- Single point electrical connections.
- Rectangular discharge opening is designed for flanged duct connections.