ENGINEERING GUIDE

TSL Single-Duct, Low-Height, VAV Terminals

Johnson Controls

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NOTES:
- All data herein is subject to change without notice. Some drawings are not shown in this catalog.
- Drawings not for installation purposes.
- Construction drawings and performance data contained herein should not be used for submittal purposes.
- ETL Report Number 3052383-001.

FEATURES AND BENEFITS

QUIET COMFORT

Model TSL terminals are only 10" in height, making them ideal for shallow or congested ceiling plenum applications. TSL terminals provide variable air volume (VAV) control beyond the typical single duct box. They are specifically designed for precise air delivery throughout the entire operating range. They also offer improved space comfort and flexibility for a wide variety of HVAC applications.

TSL terminals take advantage of typical benefits provided by single duct units, while performing at extremely low sound levels. This is critical in today's buildings, where occupants are placing more emphasis on indoor acoustics.

The ability to provide comfort to the occupant is the measurement of quality for any VAV terminal. Comfort is achieved through quiet and precise control of airflow to the occupied space.

The TSL terminal provides the ultimate in airflow control with the patented FlowStar™ airflow sensor. No other sensor in the industry can match the FlowStar's ability to quietly and precisely measure airflow. Accurate airflow measurement is the basis for airflow control.

DESIGN FLEXIBILITY

Selection and Layout. The TSL provides flexibility in system design. The compact cabinet design and quiet operation give the system designer the versatility to place units directly above occupied spaces. It is not necessary to locate the unit in the crowded space above a hall or corridor. This will reduce lengthy and expensive discharge duct runs. The FlowStar™ sensor ensures accurate control, even when space constraints do not permit long straight inlet duct runs to the terminal.

For added flexibility, Model TSL terminals with electric heat are invertible. They may be installed with the control enclosure on the left or right, except when position sensitive control options are required (e.g. mercury contactors).

Sizes. Model TSL terminals are available in four unit sizes (10, 12, 14 and 16) to handle airflow capacities up to 4100 CFM. See the Model TSS catalog for construction details and performance data for unit sizes 4, 5, 6, and 8 (also 10" in height).

CONVENIENT INSTALLATION

Quality. All TSL terminals are thoroughly inspected during each step of the manufacturing process, including a comprehensive "pre-ship" inspection, to assure the highest quality product available. All TSL terminals are packaged to minimize damage during shipment.

Quick Installation. A standard single point electrical main power connection is provided with all electronic controls and electrical components located on the same side of the casing, for quick access, adjustment, and

FEATURES AND BENEFITS

troubleshooting. Installation time is minimized with the availability of factory calibrated controls and a low profile compact design.

The FlowStar™ sensor ensures accurate airflow measurement, regardless of the field installation conditions. A calibration label and wiring diagram is located on the terminal for quick reference during start-up.

The terminal is constructed to allow installation with standard metal hanging straps. Optional hanger brackets for use with all-thread support rods or wire hangers are also available.

VALUE AND SECURITY

Quality. All metal components are fabricated from galvanized steel. Unlike most manufacturers' terminals, the TSL is capable of withstanding a 125 hour salt spray test without showing any evidence of red rust.

Energy Efficiency. In addition to quiet and accurate temperature control, the building owner will benefit from lower operating costs. The highly amplified velocity pressure signal from the FlowStar™ inlet sensor allows precise airflow control at low air velocities.

The FlowStar™ sensor's airfoil shape provides minimal pressure drop across the terminal. This allows the central fan to run at a lower pressure and with less brake horsepower.

Agency Certification. Model TSL terminals with electronic controls and/or electric heat are listed with ETL as an assembly, and bear the ETL label.

TSL terminals and accessories are wired in compliance with all applicable NEC requirements and tested in accordance with ARI Standard 880.

Maintenance and Service. TSL terminals require no periodic maintenance and provide trouble-free operation. Controls are located on the outside of the unit casing for easy access by maintenance personnel.

CONTROLS

Model TSL terminals are available with analog electronic, consignment DDC, Pneumatic controls, and Johnson Controls DDC for BACnet, Lon or N2. Johnson Controls manufactures a complete line of analog controls specifically designed for use with TSL terminals. These controls are designed to accommodate a multitude of control schemes.

From the most basic to the most sophisticated sequence of operation, the controls are designed by experts in VAV single duct terminal operation. Refer to the Electronic Controls Selection Guide, and the Pneumatic Controls Selection Guide for a complete description of the sequences and schematic drawings that are available.

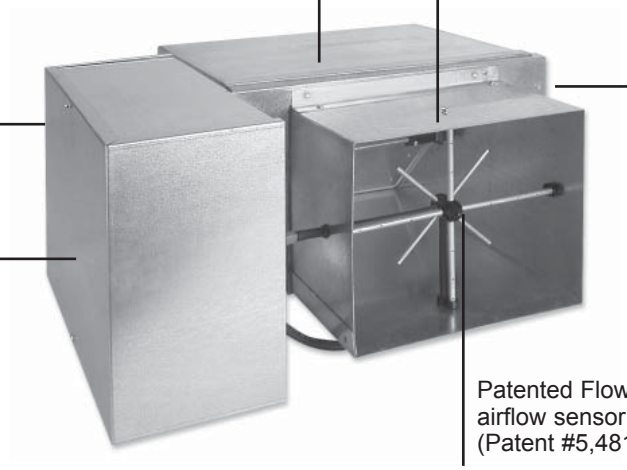
Available Control Types:
- Analog Electronic (shown)
- Pneumatic
- Factory mounted consignment DDC
- Johnson Controls DDC

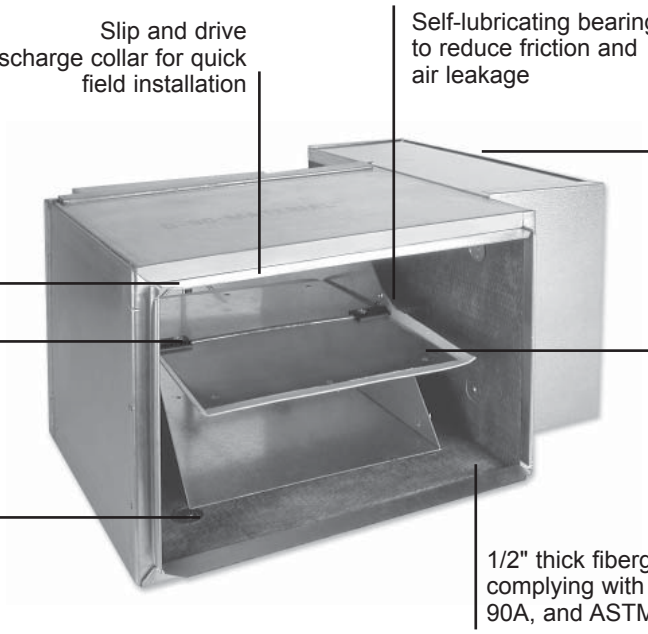
Standard Features of Electronic Controls Include:
- Patented FlowStar™ Airflow Sensor
- ETL Listing
- NEMA 1 Enclosure
- 24 Volt Control Transformer
- Floating Modulating Actuator
- Balancing Tees and Plenum Rated Tubing

CONSTRUCTION FEATURES

MODEL TSL

The TSL terminal incorporates many standard features that are expensive options for other manufacturers.





OPTIONAL CONSTRUCTION FEATURES

- Mounting brackets (not shown) to accept all-thread hanging rods or wire hangers
- Double wall construction
- Scrim reinforced foil faced insulation meeting ASTM C1136 for mold, mildew, and humidity resistance
- Elastomeric closed cell foam insulation
- Hot water (TSL-WC) or electric heat (TSL-EH) coils
- Discharge sound attenuator (TSL-SA)
- Factory controls including analog electronic, DDC electronic and pneumatic
- Factory piping packages.

STANDARD AND OPTIONAL FEATURES

STANDARD FEATURES

Construction
- ARI 880 certified and labeled
- 20 gauge galvanized steel construction
- 1/2" thick fiberglass insulation, mechanically fastened for added security
- Unit is invertible and may be installed with controls on left or right

Primary Air Valve
- 18 gauge galvanized steel construction
- Low thermal conductance damper shaft
- Position indicator on end of damper shaft
- Mechanical stops for open and closed position
- FlowStar™ center averaging airflow sensor
- Balancing tees
- Plenum rated sensor tubing

Hot Water Coils
- Designed and manufactured by Johnson Controls
- ARI 410 certified and labeled
- 1, 2, 3 or 4 rows
- Left or right hand connections
- Tested at a minimum of 450 PSIG under water and rated at 300 PSIG working pressure at 200°F

Electrical
- cETL listed for safety compliance with UL 1995
- NEMA 1 wiring enclosure

Electric Heat
- Unit is invertible and may be installed with controls on left or right, except with mercury contactor option
- Designed and manufactured by Johnson Controls
- cETL listed as an assembly for safety compliance
- Automatic reset primary and back-up secondary thermal limits
- Airflow switch
- Single point power connection
- Hinged electrical enclosure door
- Fusing per NEC

OPTIONAL FEATURES

Construction
- Foil faced scrim backed insulation
- Elastomeric closed cell foam insulation
- Double wall construction with 22 gauge liner

Hot Water Coil
- Coil access plate for cleaning coil

Electrical
- Toggle disconnect switch
- Primary and secondary transformer fusing

Electric Heat
- Proportional SSR heater control
- Mercury contactors (may not be inverted)
- Door interlocking disconnect switches

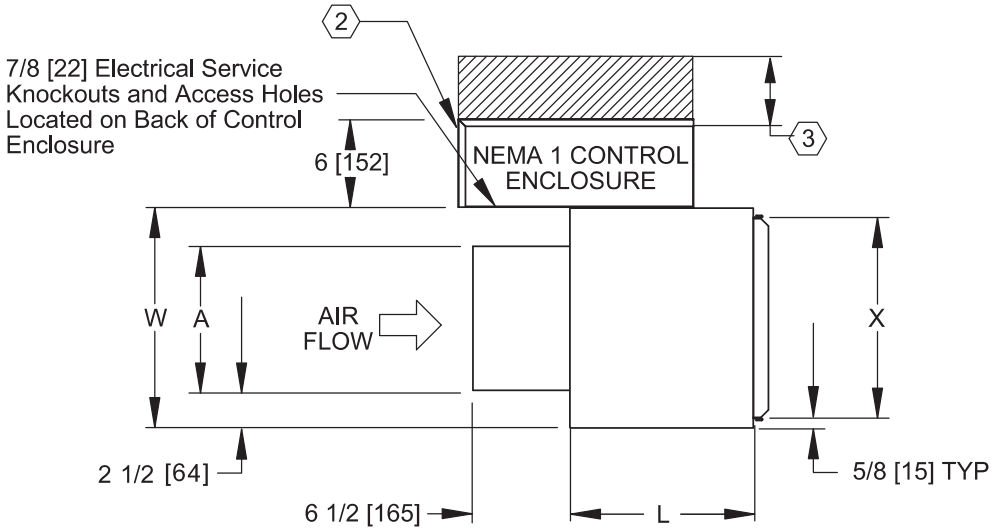
Controls
- Factory provided controls include:
  - Analog electronic
  - Pneumatic
  - Johnson Controls DDC
- Consignment DDC controls (factory mount and wire controls provided by others)

Piping Packages
- Factory assembled – shipped loose for field installation
- 1/2" and 3/4", 2 way, normally closed, two position electric motorized valves
- Isolation ball valves with memory stop
- Fixed and adjustable flow control devices
- Unions and P/T ports
- Floating point modulating control valves
- High pressure close-off actuators

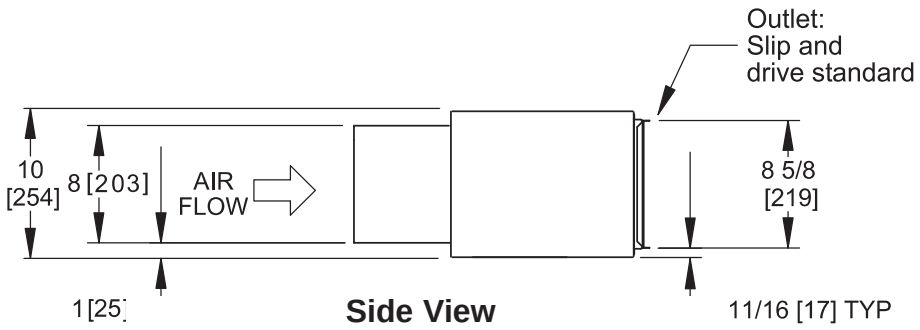
DIMENSIONAL & WEIGHT DATA

MODEL TSL

Drawings are not to scale and not for submittal or installation purposes.



Top View



Side View

See Model TSS catalog for dimensional data of unit sizes 4, 5, 6, and 8.

UNIT SIZE	DIMENSIONS				WEIGHTS	
	A	W	L	X	Single Wall	Double Wall
10	10 [254]	15 [381]	12 1/2 [318]	13 3/4 [349]	26 [12]	30 [14]
12	14 [356]	19 [483]	12 1/2 [318]	17 3/4 [451]	28 [13]	35 [16]
14	20 [508]	25 [635]	16 1/2 [419]	23 3/4 [603]	39 [18]	47 [21]
16	26 [660]	31 [787]	16 1/2 [419]	29 3/4 [756]	45 [20]	55 [25]

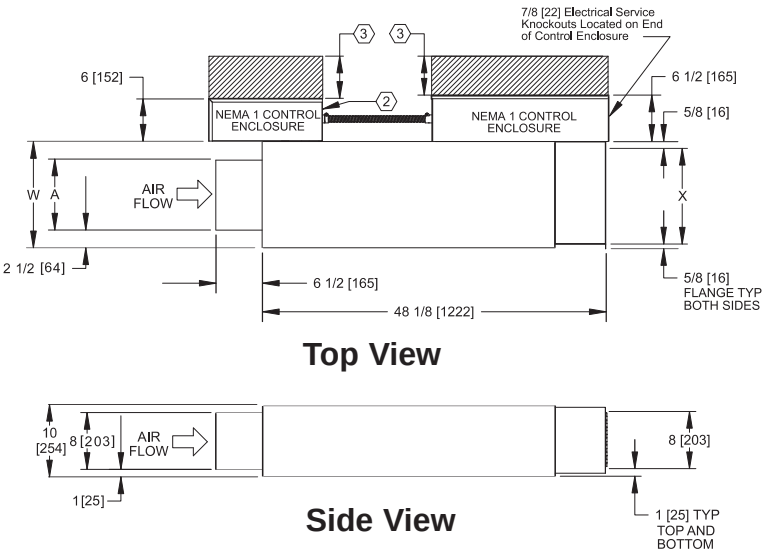
NOTES:

1. All dimensions are in inches [mm] with a tolerance of ±1/8" [3mm]. Weights are in pounds [kg]. Weights are for basic unit with indicated option and control enclosure. Actual weight will vary based on project specific requirements for unit options, appurtenances, and controls.
2. Control enclosure is standard with factory mounted electronic controls.
3. Check all national and local codes for required clearances.

DIMENSIONAL & WEIGHT DATA

MODEL TSL-EH (ELECTRIC HEAT)

Drawings are not to scale and not for submittal or installation purposes.



See Model TSS catalog for dimensional data of unit sizes 4, 5, 6, and 8.

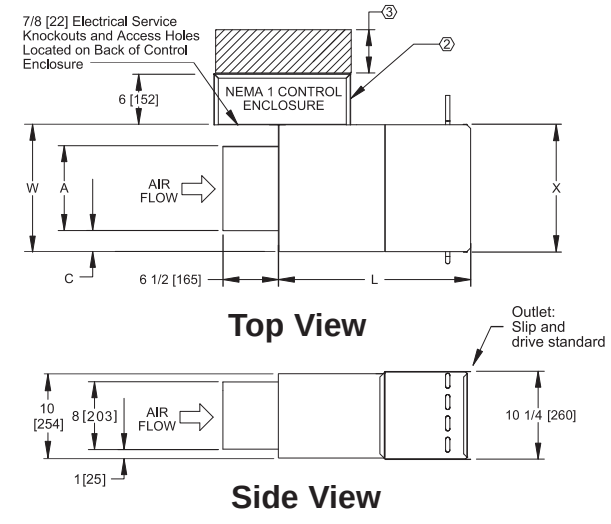
UNIT SIZE	A	W	X	TOTAL WEIGHT	
				Single Wall	Double Wall
10	10 [254]	15 [381]	13 3/4 [349]	62 [28]	77 [35]
12	14 [356]	19 [483]	17 3/4 [451]	74 [34]	93 [42]
14	20 [508]	25 [635]	23 3/4 [603]	90 [41]	110 [50]
16	26 [660]	31 [787]	29 3/4 [756]	103 [47]	126 [57]

NOTES:

1. All dimensions are in inches [mm]. Weights are in pounds [kg]. Weights are for basic unit with indicated option and control enclosure. Actual weight will vary based on project specific requirements for unit options, appurtenances, and controls.
2. Control enclosure is standard with factory mounted electronic controls.
3. Check all national and local codes for required clearances.

MODEL TSL-WC (HOT WATER COIL)

Drawings are not to scale and not for submittal or installation purposes.



See Model TSS catalog for dimensional data of unit sizes 4, 5, 6, and 8.

UNIT SIZE	A	C	W	LENGTH L		X	COIL WEIGHTS (ADD TO SDL UNIT WEIGHT)							
				1,2,3 ROW COIL	4 ROW COIL		1 ROW		2 ROW		3 ROW		4 ROW	
							DRY	WET	DRY	WET	DRY	WET	DRY	WET
10	10 [254]	6 1/2 [165]	19 [483]	18 1/2 [470]	19 1/2 [495]	18 3/4 [476]	8 [4]	9 [4]	10 [5]	12 [6]	12 [5]	15 [7]	14 [6]	18 [8]
12	14 [356]	8 1/2 [216]	25 [635]	18 1/2 [470]	19 1/2 [495]	24 3/4 [629]	10 [4]	11 [5]	12 [5]	15 [7]	15 [7]	19 [9]	17 [8]	23 [10]
14	20 [508]	8 1/2 [216]	31 [787]	22 1/2 [572]	23 1/2 [597]	30 3/4 [781]	11 [5]	13 [6]	14 [6]	18 [8]	17 [8]	22 [10]	20 [9]	27 [12]
16	26 [660]	7 5/8 [194]	38 [965]	22 1/2 [572]	23 1/2 [597]	37 3/4 [959]	13 [6]	15 [7]	17 [8]	21 [9]	20 [9]	27 [12]	24 [11]	32 [15]

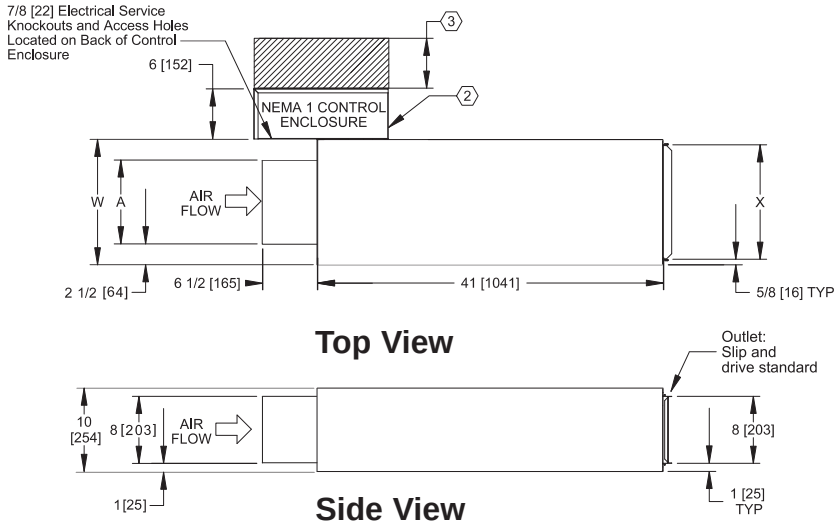
NOTES:

1. All dimensions are in inches [mm]. Weights are in pounds [kg]. Weights are for basic unit with indicated option and control enclosure. Actual weight will vary based on project specific requirements for unit options, appurtenances, and controls.
2. Control enclosure is standard with factory mounted electronic controls.
3. Check all national and local codes for required clearances.

DIMENSIONAL & WEIGHT DATA

MODEL TSL-SA (SOUND ATTENUATOR)

Drawings are not to scale and not for submittal or installation purposes.



See Model TSS catalog for dimensional data of unit sizes 4, 5, 6, and 8.

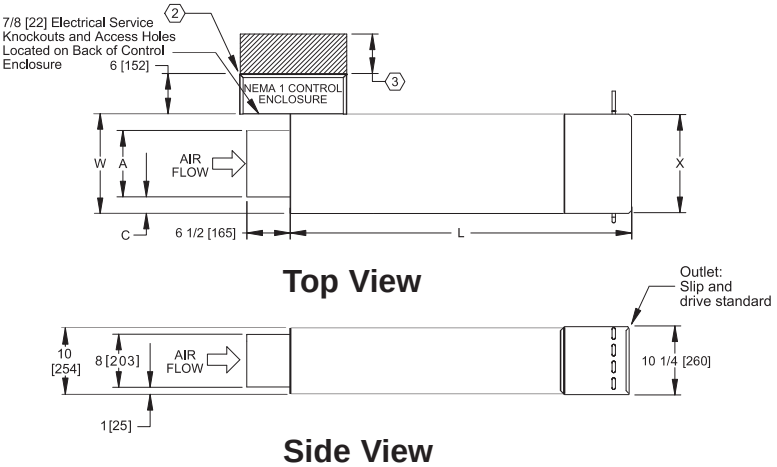
UNIT SIZE	A	W	X	TOTAL WEIGHT	
				Single Wall	Double Wall
10	10 [254]	15 [381]	13 3/4 [349]	43 [19]	58 [26]
12	14 [356]	19 [483]	17 3/4 [451]	49 [22]	68 [31]
14	20 [508]	25 [635]	23 3/4 [603]	62 [28]	82 [37]
16	26 [660]	31 [787]	29 3/4 [756]	73 [33]	96 [44]

NOTES:

1. All dimensions are in inches [mm]. Weights are in pounds [kg]. Weights are for basic unit with indicated option and control enclosure. Actual weight will vary based on project specific requirements for unit options, appurtenances, and controls.
2. Control enclosure is standard with factory mounted electronic controls.
3. Check all national and local codes for required clearances.

MODEL TSL-SA-WC (SOUND ATTENUATOR & HOT WATER COIL)

Drawings are not to scale and not for submittal or installation purposes.



See Model TSS catalog for dimensional data of unit sizes 4, 5, 6, and 8.

UNIT SIZE	A	C	W	LENGTH L		X	TOTAL WEIGHT (Wet Coils)		
				1,2,3 ROW COIL	4 ROW COIL		Coil Rows	Single Wall	Double Wall
10	10 [254]	6 1/2 [165]	19 [483]	47 [1194]	48 [1221]	18 3/4 [476]	1	52 [24]	67 [30]
							2	55 [25]	70 [32]
							3	58 [26]	73 [33]
							4	61 [28]	76 [34]
12	14 [356]	8 1/2 [216]	25 [635]	47 [1194]	48 [1221]	24 3/4 [629]	1	60 [27]	79 [36]
							2	64 [29]	83 [38]
							3	68 [31]	87 [39]
							4	72 [33]	91 [41]
14	20 [508]	8 1/2 [216]	31 [787]	47 [1194]	48 [1221]	30 3/4 [781]	1	75 [34]	95 [43]
							2	80 [36]	100 [45]
							3	84 [38]	104 [47]
							4	89 [40]	109 [49]
16	26 [660]	7 5/8 [194]	38 [965]	47 [1194]	48 [1221]	37 3/4 [959]	1	88 [40]	111 [50]
							2	94 [43]	117 [53]
							3	100 [45]	123 [56]
							4	105 [48]	128 [58]

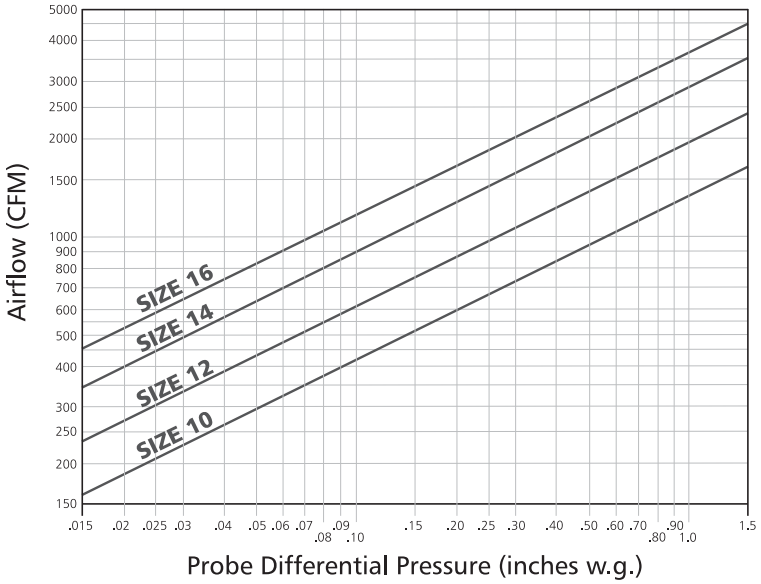
NOTES:

1. All dimensions are in inches [mm]. Weights are in pounds [kg]. Weights are for basic unit with indicated option and control enclosure. Actual weight will vary based on project specific requirements for unit options, appurtenances, and controls.
2. Control enclosure is standard with factory mounted electronic controls.
3. Check all national and local codes for required clearances.
4. For TSL-SA-WC weights with dry coil, add dry coil weights from TSL-WC table to TSL-SA unit weights.

AIRLFLOW CALIBRATION, ARI RATINGS

FLOWSTAR™ CALIBRATION CHART

(For dead-end differential pressure transducers)



See the Model TSS catalog for primary airflow calibration and ARI Ratings for unit sizes 4, 5, 6, and 8 (also 10" in height).

NOTE: Maximum and minimum CFM limits are dependent on the type of controls that are utilized. Refer to the table below for specific values. When DDC controls are furnished by others, the CFM limits are dependent on the specific control vendor that is employed. After obtaining the differential pressure range from the control vendor, the maximum and minimum CFM limits can be obtained from the chart above (many controllers are capable of controlling minimum setpoint down to .015" w.g.).

AIRFLOW RANGES (CFM)

UNIT SIZE	400 SERIES (PNEUMATIC) STANDARD CONTROLLER		7000 SERIES ANALOG ELECTRONIC		DDC CONSIGNMENT CONTROLS (See Notes Below)				
					MIN.			MAX.	
	MIN.	MAX.	MIN.	MAX.	Min. transducer differential pressure (in. w.g.)			Max. transducer differential pressure (in. w.g.)	
					0.015	0.03	0.05	1.0	≥1.5
10	235	1545	170	1600	170	235	305	1370	1600
12	340	2250	240	2300	240	340	435	1955	2300
14	495	3100	350	3100	350	495	640	2855	3100
16	660	4100	465	4100	465	660	850	3800	4100

NOTES:

1. Minimum and maximum airflow limits are dependent on the specific DDC controller supplied. Contact the control vendor to obtain the minimum and maximum differential pressure limits (inches W.G.) of the transducer utilized with the DDC controller.
2. Maximum CFM is limited to value shown in General Selection Data.

ARI STANDARD RATINGS

SIZE	RATED AIRFLOW CFM	MINIMUM OPERATING PRESSURE (IN. W.G.)	STANDARD RATINGS - SOUND POWER LEVEL, dB RE: 1 X 10^{-12} WATTS											
			RADIATED @ 1.5" WATER STATIC PRESSURE						DISCHARGE @ 1.5" WATER STATIC PRESSURE					
			Hz Octave Band Center Frequency						Hz Octave Band Center Frequency					
			125	250	500	1000	2000	4000	125	250	500	1000	2000	4000
10	1100	0.01	60	57	49	44	40	37	63	66	61	61	61	55
12	1600	0.01	65	59	54	49	43	34	66	66	64	62	61	56
14	2100	0.01	66	58	51	45	41	38	68	67	64	62	61	56
16	2800	0.02	65	58	52	45	39	38	69	69	65	63	61	56

NOTE: Rated in accordance with ARI Standard 880.

GENERAL SELECTION DATA

See Model TSS catalog for dimensional data of unit sizes 4, 5, 6, and 8.

TERMINAL SIZE	CFM	MINIMUM ΔPs				DISCHARGE NOISE CRITERIA (NC)						RADIATED NOISE CRITERIA (NC)		
		Model TSL / TSL-SA	Model TSL-EH	Model TSL-WC 1 Row	Model TSL-WC 2 Row	0.5" ΔPs		1.0" ΔPs		3.0" ΔPs		0.5" ΔPs	1.0" ΔPs	3.0" ΔPs
						Model TSL	Model TSL-SA	Model TSL	Model TSL-SA	Model TSL	Model TSL-SA	Model TSL & TSL-SA	Model TSL & TSL-SA	Model TSL & TSL-SA
10	600	0.01	0.03	0.07	0.14	--	--	--	--	25	20	--	--	24
	800	0.01	0.06	0.11	0.22	--	--	--	--	26	22	--	--	27
	1000	0.01	0.10	0.16	0.31	--	--	--	--	27	24	--	22	30
	1200	0.01	0.15	0.21	0.41	--	--	21	--	31	26	--	25	32
	1400	0.01	0.21	0.27	0.53	--	--	23	20	31	28	22	26	33
	1600	0.02	0.29	0.34	0.67	20	20	25	22	32	29	25	28	35
12	800	0.01	0.04	0.07	0.14	--	--	--	--	26	22	--	--	30
	1100	0.01	0.07	0.12	0.23	--	--	--	--	26	24	--	20	32
	1400	0.01	0.12	0.17	0.34	--	--	--	--	27	27	20	23	35
	1700	0.01	0.19	0.24	0.46	--	--	20	--	29	29	24	26	37
	2000	0.01	0.26	0.31	0.60	--	--	22	22	31	30	28	30	38
	2300	0.02	0.36	0.39	0.76	21	21	24	24	33	32	32	33	40
14	1100	0.01	0.04	0.08	0.16	--	--	--	--	25	23	--	20	30
	1500	0.01	0.08	0.14	0.27	--	--	--	--	30	30	--	22	31
	1900	0.01	0.13	0.20	0.39	--	--	--	--	32	32	--	23	36
	2300	0.01	0.19	0.27	0.53	--	--	21	--	33	32	20	26	40
	2700	0.02	0.27	0.35	0.69	--	--	23	20	34	33	25	30	45
	3100	0.02	0.36	0.44	0.87	23	20	26	22	36	33	28	30	46
16	1600	0.01	0.05	0.11	0.21	--	--	--	--	30	30	--	20	32
	2100	0.01	0.10	0.17	0.33	--	--	--	--	33	33	--	22	36
	2600	0.02	0.16	0.24	0.47	--	--	21	--	35	35	--	25	40
	3100	0.02	0.23	0.32	0.62	--	--	22	20	36	35	22	26	43
	3600	0.03	0.32	0.41	0.79	21	--	24	21	37	36	25	28	45
	4100	0.04	0.42	0.51	0.98	25	22	26	23	37	35	31	31	46

NOTES:
- Min. ΔPs is the static pressure difference between the terminal inlet and discharge with the damper wide open.
- Performance data obtained from tests conducted in accordance with ARI Standard 880.
- Dash (-) indicates NC level less than 20.
- NC values calculated based upon the 2002 Addendum to ARI Standard 885 Appendix E Typical Sound Attenuation Values (shown below), using Ceiling Type 2 for calculating Radiated NC.
- NC (sound pressure) levels predicted by subtracting appropriate values below from published sound power levels (following pages).

DISCHARGE ATTENUATION VALUES	OCTAVE BAND					
	2	3	4	5	6	7
Small Box (< 300 CFM)	24	28	39	53	59	40
Medium Box (300-700 CFM)	27	29	40	51	53	39
Large Box (> 700 CFM)	29	30	41	51	52	39

RADIATED ATTENUATION VALUES	OCTAVE BAND					
	2	3	4	5	6	7
Type 2 - Mineral Fiber Ceiling	18	19	20	26	31	36

SOUND POWER DATA

DISCHARGE SOUND POWER DATA – MODEL TSL

See the Model TSS catalog for Sound Power Data for unit sizes 4, 5, 6, and 8 (also 10" in height)

TERMINAL SIZE	CFM	OCTAVE BAND NUMBERS																	
		0.5"ΔPs						1.0"ΔPs						3.0"ΔPs					
		2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
10	600	51	53	47	45	42	38	55	59	54	53	51	46	60	64	64	67	66	62
	800	54	55	50	47	45	38	58	61	55	54	53	48	63	67	66	67	68	63
	1000	56	57	52	49	47	41	60	63	57	56	55	50	66	69	68	67	68	64
	1200	58	59	56	51	49	43	62	64	59	57	56	50	69	72	70	70	72	68
	1400	61	62	60	53	51	47	64	66	61	59	57	52	70	72	70	69	72	67
	1600	63	64	62	55	53	48	66	67	63	60	59	53	72	73	71	70	73	68
12	800	52	53	49	46	44	39	58	59	57	54	52	48	62	64	64	71	67	62
	1100	55	55	51	48	47	41	60	60	58	55	54	49	66	67	69	71	67	62
	1400	58	57	54	50	49	44	62	62	59	56	55	51	68	69	70	70	68	63
	1700	60	59	56	52	50	46	64	64	62	58	57	52	70	71	71	70	69	64
	2000	64	62	59	55	52	47	65	65	63	59	58	53	72	72	72	71	70	65
	2300	66	64	62	57	54	50	67	67	65	61	60	55	74	74	73	72	71	66
14	1100	53	52	49	47	44	38	59	59	57	53	51	47	63	66	67	69	65	62
	1500	55	55	51	48	46	41	61	61	57	55	53	49	68	71	69	71	66	63
	1900	58	57	54	51	48	42	63	62	59	56	55	50	72	73	70	73	67	64
	2300	61	60	57	53	49	43	66	64	62	58	57	51	75	74	72	70	68	65
	2700	64	63	61	55	51	46	67	66	64	60	58	53	77	75	73	70	70	66
	3100	66	65	63	59	54	49	69	68	66	62	59	54	78	76	74	71	71	68
16	1600	55	54	52	49	45	41	61	61	57	55	52	47	69	71	69	69	65	60
	2100	58	56	55	51	47	42	63	62	59	56	54	49	72	74	71	69	66	61
	2600	59	58	57	52	48	43	65	64	61	59	56	50	75	75	72	69	68	62
	3100	62	61	60	54	50	45	66	65	64	60	58	52	76	76	73	70	69	64
	3600	64	64	63	56	53	47	67	67	65	62	59	53	78	77	75	71	71	65
	4100	66	67	67	60	56	50	70	68	67	63	60	54	79	78	75	73	72	66

RADIATED SOUND POWER DATA – MODEL TSL

TERMINAL SIZE	CFM	OCTAVE BAND NUMBERS																	
		0.5"ΔPs						1.0"ΔPs						3.0"ΔPs					
		2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
10	600	47	43	37	34	32	31	51	49	42	38	35	32	56	53	50	50	46	42
	800	51	45	39	35	33	31	54	51	43	39	36	33	59	57	53	51	47	43
	1000	54	48	41	37	33	31	56	54	45	40	36	34	61	60	55	52	48	43
	1200	55	50	45	38	33	31	59	56	47	42	37	34	64	62	56	53	48	44
	1400	57	52	48	40	34	31	61	57	49	43	37	33	65	63	58	53	48	44
	1600	59	54	51	44	36	32	62	59	51	45	38	34	67	64	57	53	47	43
12	800	48	41	37	34	33	30	54	49	44	40	36	31	59	59	55	53	48	38
	1100	52	45	41	36	33	31	57	52	46	42	37	31	62	62	57	56	51	41
	1400	55	49	46	37	33	31	60	54	49	43	38	32	65	64	60	57	51	41
	1700	59	54	50	40	35	31	63	57	52	44	39	32	68	65	62	57	52	42
	2000	63	57	54	43	37	32	66	59	55	46	41	33	70	67	63	58	53	43
	2300	64	60	57	47	38	33	67	62	58	49	42	34	73	69	64	59	54	45
14	1100	52	45	39	36	35	36	58	50	45	38	35	35	65	58	55	50	43	41
	1500	54	46	40	37	34	35	60	52	45	40	36	35	67	61	56	52	43	41
	1900	57	49	44	40	36	35	61	54	47	40	36	36	71	64	57	52	44	42
	2300	58	51	46	42	39	36	63	56	49	44	41	37	74	65	58	52	46	43
	2700	62	55	50	45	41	37	66	57	51	46	44	39	78	67	59	53	48	45
	3100	63	59	53	47	44	39	66	59	53	47	45	42	79	67	60	53	49	47
16	1600	51	45	40	37	34	34	57	52	45	39	35	34	67	62	56	52	44	41
	2100	54	47	42	38	34	34	60	53	46	41	37	35	71	64	57	52	45	42
	2600	56	50	45	38	35	35	62	55	48	42	37	36	74	65	58	52	45	42
	3100	59	53	48	40	36	37	63	56	50	44	38	37	77	66	59	53	46	43
	3600	61	56	51	42	38	38	65	58	53	46	40	38	78	67	60	54	48	43
	4100	62	58	56	45	39	38	67	59	55	47	41	39	79	67	61	55	49	44

- Performance data obtained from tests conducted in accordance with ARI Standard 880.
- Sound levels are expressed in decibels, dB re: 1 x 10^{-12} watts.

SOUND POWER DATA

DISCHARGE SOUND POWER DATA – MODEL TSL-SA

See the Model TSS catalog for Sound Power Data for unit sizes 4, 5, 6, and 8 (also 10" in height)

TERMINAL SIZE	CFM	OCTAVE BAND NUMBERS																	
		0.5"ΔPs						1.0"ΔPs						3.0"ΔPs					
		2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
10	600	51	50	46	43	36	36	55	56	52	49	42	38	60	63	61	61	51	48
	800	53	52	48	44	36	36	57	58	53	50	44	39	64	65	63	62	55	49
	1000	54	54	50	45	36	35	59	60	55	51	45	40	66	67	65	63	57	50
	1200	58	58	54	47	41	38	61	61	56	52	45	40	68	68	66	63	57	51
	1400	60	60	57	49	43	39	64	63	58	53	46	41	70	70	67	63	58	52
	1600	61	63	60	51	45	40	64	65	60	54	48	42	71	71	68	64	58	53
12	800	51	52	48	44	36	37	57	58	54	51	42	39	61	65	64	64	54	51
	1100	52	53	49	45	38	37	58	59	55	52	44	39	64	67	66	65	56	51
	1400	56	56	53	47	41	38	61	61	58	54	46	41	67	69	68	66	57	51
	1700	60	59	56	49	45	39	62	62	60	55	48	41	70	71	69	66	58	52
	2000	61	61	59	52	48	41	64	65	62	57	50	42	72	72	70	68	60	53
	2300	64	64	61	55	51	43	67	67	64	58	54	47	73	73	71	68	61	54
14	1100	52	50	46	42	35	33	59	58	54	48	41	38	63	66	61	60	50	45
	1500	54	52	49	44	35	33	60	59	54	49	44	39	67	71	66	65	56	51
	1900	57	55	52	46	39	35	62	60	57	51	46	41	71	73	68	65	57	52
	2300	60	58	55	48	44	37	64	62	59	54	48	42	75	73	69	65	58	53
	2700	62	61	58	51	47	41	65	63	61	55	50	43	77	74	70	65	60	54
	3100	64	63	61	54	50	43	68	65	63	57	53	47	77	74	71	66	61	56
16	1600	54	52	49	44	37	35	61	60	54	49	43	39	69	71	63	60	49	43
	2100	56	54	52	46	38	35	62	60	56	51	44	39	71	74	69	63	56	49
	2600	58	56	55	48	40	36	63	62	59	53	47	41	74	75	69	61	58	50
	3100	61	59	57	50	45	36	65	63	61	56	49	42	76	75	70	65	59	52
	3600	62	62	60	52	49	42	66	64	62	56	51	43	78	76	72	66	61	53
	4100	64	65	64	55	52	45	69	66	64	58	53	46	78	75	72	68	62	55

RADIATED SOUND POWER DATA – MODEL TSL-SA

TERMINAL SIZE	CFM	OCTAVE BAND NUMBERS																	
		0.5"ΔPs						1.0"ΔPs						3.0"ΔPs					
		2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	6	7
10	600	47	43	37	34	32	31	51	49	42	38	35	32	56	53	50	50	46	42
	800	51	45	39	35	33	31	54	51	43	39	36	33	59	57	53	51	47	43
	1000	54	48	41	37	33	31	56	54	45	40	36	34	61	60	55	52	48	43
	1200	55	50	45	38	33	31	59	56	47	42	37	34	64	62	56	53	48	44
	1400	57	52	48	40	34	31	61	57	49	43	37	33	65	63	58	53	48	44
	1600	59	54	51	44	36	32	62	59	51	45	38	34	67	64	57	53	47	43
12	800	48	41	37	34	33	30	54	49	44	40	36	31	59	59	55	53	48	38
	1100	52	45	41	36	33	31	57	52	46	42	37	31	62	62	57	56	51	41
	1400	55	49	46	37	33	31	60	54	49	43	38	32	65	64	60	57	51	41
	1700	59	54	50	40	35	31	63	57	52	44	39	32	68	65	62	57	52	42
	2000	63	57	54	43	37	32	66	59	55	46	41	33	70	67	63	58	53	43
	2300	64	60	57	47	38	33	67	62	58	49	42	34	73	69	64	59	54	45
14	1100	52	45	39	36	35	36	58	50	45	38	35	35	65	58	55	50	43	41
	1500	54	46	40	37	34	35	60	52	45	40	36	35	67	61	56	52	43	41
	1900	57	49	44	40	36	35	61	54	47	40	36	36	71	64	57	52	44	42
	2300	58	51	46	42	39	36	63	56	49	44	41	37	74	65	58	52	46	43
	2700	62	55	50	45	41	37	66	57	51	46	44	39	78	67	59	53	48	45
	3100	63	59	53	47	44	39	66	59	53	47	45	42	79	67	60	53	49	47
16	1600	51	45	40	37	34	34	57	52	45	39	35	34	67	62	56	52	44	41
	2100	54	47	42	38	34	34	60	53	46	41	37	35	71	64	57	52	45	42
	2600	56	50	45	38	35	35	62	55	48	42	37	36	74	65	58	52	45	42
	3100	59	53	48	40	36	37	63	56	50	44	38	37	77	66	59	53	46	43
	3600	61	56	51	42	38	38	65	58	53	46	40	38	78	67	60	54	48	43
	4100	62	58	56	45	39	38	67	59	55	47	41	39	79	67	61	55	49	44

- Performance data obtained from tests conducted in accordance with ARI Standard 880.
- Sound levels are expressed in decibels, dB re: 1 x 10^{-12} watts.

ELECTRIC HEAT

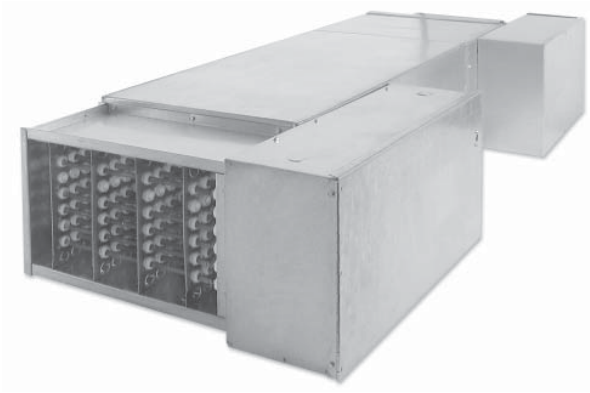
MODEL TSL-EH

STANDARD FEATURES

- Designed, manufactured, and tested by Johnson Controls
- Unit is invertible (may be installed with controls on left or right, except with mercury contactor option)
- cETL listed as an assembly
- Single point power connection
- Primary auto-reset high limit
- Secondary high limit
- Airflow switch
- Hinged control panel
- Ni-Chrome elements
- Primary/secondary power terminations
- Fusing per NEC
- Wiring diagram and ETL label
- Available kW increments are as follows: 0.5 to 12.0 kW – .50 kW; 12.0 to 26.0 kW – 1.0 kW; above 26.0 – 2.0 kW.

OPTIONAL FEATURES

- Disconnect (toggle or door interlocking)
- PE switches
- Mercury and magnetic contactors
- Manual reset secondary limit
- Proportional control (SSR)
- 24 V control transformer



SELECTION PROCEDURE

With standard heater elements, the maximum capacity (kW) is obtained by dividing the heating (minimum) SCFM by 70. In other words, the terminal must have at least 70 SCFM per kW. In addition, each size terminal has a maximum allowable kW based upon the specific heater element configuration (i.e. voltage, phase, number of steps, etc.). Contact your Johnson Controls representative for design assistance.

Heaters require a minimum of 0.07" w.g. downstream static pressure to ensure proper operation.

Selection Equations

$$kW = \frac{SCFM \times \Delta T \times 1.085^*}{3413}$$

$$SCFM = \frac{kW \times 3413}{\Delta T \times 1.085^*}$$

$$\Delta T = \frac{kW \times 3413}{SCFM \times 1.085^*}$$

** Air density at sea level - reduce by 0.036 for each 1000 feet of altitude above sea level.*

Calculating Line Amperage

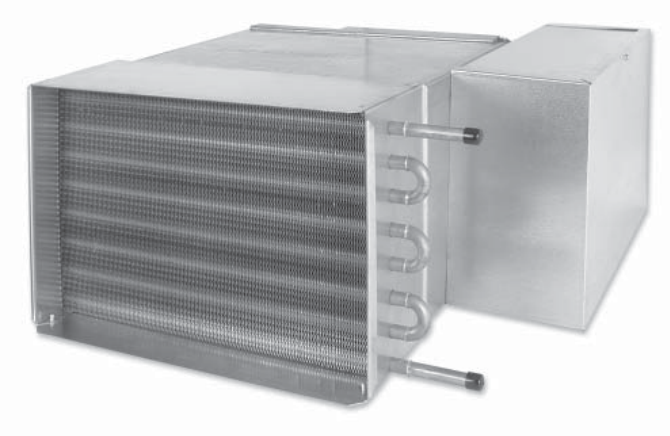
$$\text{Single Phase Amps} = \frac{kW \times 1000}{Volts}$$

$$\text{Three Phase Amps} = \frac{kW \times 1000}{Volts \times 1.73}$$

UNIT VOLTAGE AND PHASE		ELECTRIC HEAT KW LIMITS							
		Unit Size							
		10		12		14		16	
		Min	Max	Min	Max	Min	Max	Min	Max
1 Phase	115/120	0.5	5.5	0.5	5.5	0.5	5.5	0.5	5.5
	208	0.5	9.5	0.5	9.5	0.5	9.5	0.5	9.5
	230/240	0.5	11	0.5	11	0.5	11	0.5	11
	277	0.5	13	0.5	13	0.5	13	0.5	13
	347	0.5	16	0.5	16	0.5	16	0.5	16
	460	0.5	20	0.5	22	0.5	22	0.5	22
	480	0.5	20	0.5	23	0.5	23	0.5	23
3 Phase	208	1	17	1	17	1	17	1	17
	240	1	19	1	19	1	19	1	19
	460/480	1	20	1	28	1	38	1	38

HOT WATER COIL DATA

MODEL TSL-WC



STANDARD FEATURES

- Designed, manufactured, and tested by Johnson Controls
- Aluminum fin construction with die-formed spacer collars for uniform spacing
- Mechanically expanded copper tubes leak tested to 450 PSIG air pressure and rated at 300 PSIG working pressure at 200°F
- Male sweat type water connections
- 1, 2, 3 and 4 row configurations

OPTIONAL FEATURES

- Coil circuiting options for reduced water pressure drop
- Right or left hand water connections
- Bottom and top access plates for cleaning
- Steam coils

DEFINITION OF TERMS

EAT	Entering Air Temperature (°F)
EWT	Entering Water Temperature (°F)
LWT	Leaving Water Temperature (°F)
LAT	Leaving Air Temperature
CFM	Air Volume (Cubic Feet per Minute)
GPM	Water Capacity (Gallons per Minute)
MBH	1,000 BTUH
BTUH	Coil Heating Capacity (British Thermal Units per Hour)

SELECTION PROCEDURE

TSL-WC Hot Water Coil Performance Tables are based upon a temperature difference of 125°F between the entering water and the entering air. If this ΔT is suitable, proceed directly to the tables for selection. All pertinent performance data is tabulated. **For Variable Air Volume Applications, the static pressure drop must be based on the maximum air volume.**

ENTERING WATER - AIR TEMPERATURE DIFFERENTIAL (ΔT) CORRECTION FACTORS															
ΔT	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
FACTOR	0.15	0.19	0.23	0.27	0.31	0.35	0.39	0.43	0.47	0.51	0.55	0.59	0.63	0.67	0.71
ΔT	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165
FACTOR	0.75	0.79	0.83	0.88	0.92	0.96	1.00	1.04	1.08	1.13	1.17	1.21	1.25	1.29	1.33

The table above gives correction factors for various entering ΔT's (difference between EWT and EAT). Multiply MBH values obtained from selection tables by the appropriate correction factor above to obtain the actual MBH value. Air and water pressure drop can be read directly from the selection tables. The LAT and LWT can be calculated from the following fundamental formulas:

$$LAT = EAT + \frac{BTUH}{1.085 \times CFM} \qquad LWT = EWT - \frac{BTUH}{500 \times GPM}$$

HOT WATER COIL DATA

MODEL TSL-WC SIZE 10: STANDARD CIRCUITING

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN.W.G.)		Rate (GPM)	Water PD (FT.W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
250	1 Row	0.02	0.5	0.42	0.15	96.6	112.1	134.0	117.0	11.3	15.5
	2 Row	0.03	1.0	1.31	0.50	104.5	126.5	152.5	140.4	13.4	19.4
			2.0	4.60	1.60	109.8	135.9	164.8	157.5	14.8	21.9
			4.0	16.30	5.73	113.0	141.5	171.9	168.0	15.7	23.4
400	1 Row	0.03	0.5	0.42	0.15	85.7	96.5	125.7	106.9	13.3	18.0
	2 Row	0.07	1.0	1.31	0.50	93.2	110.5	146.1	130.9	16.5	24.0
			2.0	4.60	1.60	98.5	121.0	160.7	150.7	18.8	28.6
			4.0	16.30	5.73	101.8	127.7	169.6	163.8	20.3	31.5
550	1 Row	0.06	0.5	0.42	0.15	79.5	87.6	120.5	101.1	14.6	19.4
	2 Row	0.11	1.0	1.31	0.50	86.4	100.5	141.8	124.8	18.7	27.1
			2.0	4.60	1.60	91.4	110.9	157.7	145.9	21.7	33.3
			4.0	16.30	5.73	94.7	118.0	167.8	160.7	23.7	37.5
700	1 Row	0.08	0.5	0.42	0.15	75.5	81.9	116.7	97.1	15.6	20.4
	2 Row	0.17	1.0	1.31	0.50	81.8	93.6	138.5	120.4	20.3	29.3
			2.0	4.60	1.60	86.6	103.8	155.4	142.2	24.0	37.0
			4.0	16.30	5.73	89.8	110.9	166.4	158.3	26.4	42.4
850	1 Row	0.12	0.5	0.42	0.15	72.7	77.9	113.7	94.3	16.3	21.1
	2 Row	0.23	1.0	1.31	0.50	78.5	88.6	135.8	116.9	21.6	31.0
			2.0	4.60	1.60	83.1	98.4	153.5	139.2	25.9	39.9
			4.0	16.30	5.73	86.2	105.5	165.2	156.2	28.8	46.5
1000	1 Row	0.15	0.5	0.42	0.15	70.6	75.0	111.4	92.1	16.9	21.7
	2 Row	0.30	1.0	1.31	0.50	76.0	84.8	133.5	114.2	22.8	32.3
			2.0	4.60	1.60	80.4	94.2	151.8	136.7	27.5	42.4
			4.0	16.30	5.73	83.4	101.2	164.2	154.4	30.8	50.0
1150	1 Row	0.19	0.5	0.42	0.15	68.9	72.7	109.4	90.4	17.4	22.1
	2 Row	0.38	1.0	1.31	0.50	74.0	81.8	131.6	112.0	23.7	33.4
			2.0	4.60	1.60	78.2	90.7	150.4	134.5	28.9	44.5
			4.0	16.30	5.73	81.2	97.6	163.3	152.8	32.6	53.1
1300	1 Row	0.23	0.5	0.42	0.15	67.6	70.9	107.8	88.9	17.8	22.5
	2 Row	0.46	1.0	1.31	0.50	72.4	79.4	130.0	110.1	24.5	34.4
			2.0	4.60	1.60	76.5	87.9	149.1	132.7	30.2	46.4
			4.0	16.30	5.73	79.3	94.7	162.4	151.4	34.2	55.9

MODEL TSL-WC SIZE 10: MULTI-CIRCUITING

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN.W.G.)		Rate (GPM)	Water PD (FT.W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
250	1 Row	0.02	0.5	0.09	0.04	93.0	106.1	138.0	123.5	10.3	13.9
	2 Row	0.03	1.0	0.30	0.16	101.6	121.1	154.2	143.4	12.6	17.9
			2.0	1.01	0.60	107.7	132.1	165.3	158.6	14.3	20.9
			4.0	3.70	2.16	111.6	139.0	172.1	168.3	15.3	22.8
400	1 Row	0.03	0.5	0.09	0.04	82.6	91.5	131.3	115.7	11.9	15.8
	2 Row	0.07	1.0	0.30	0.16	90.3	105.2	148.7	135.5	15.3	21.8
			2.0	1.01	0.60	96.3	116.8	161.6	152.6	17.9	26.8
			4.0	3.70	2.16	100.4	124.8	169.9	164.5	19.7	30.2
550	1 Row	0.06	0.5	0.09	0.04	76.8	83.4	127.1	111.1	13.0	16.9
	2 Row	0.11	1.0	0.30	0.16	83.7	95.6	145.0	130.6	17.1	24.2
			2.0	1.01	0.60	89.4	106.7	159.0	148.5	20.5	30.8
			4.0	3.70	2.16	93.3	114.9	168.3	161.7	22.8	35.7
700	1 Row	0.08	0.5	0.09	0.04	73.1	78.3	124.1	108.1	13.7	17.7
	2 Row	0.17	1.0	0.30	0.16	79.4	89.2	142.2	127.1	18.5	25.9
			2.0	1.01	0.60	84.7	99.7	156.9	145.3	22.5	33.9
			4.0	3.70	2.16	88.4	107.8	167.0	159.5	25.4	40.1
850	1 Row	0.12	0.5	0.09	0.04	70.5	74.8	121.8	105.9	14.3	18.2
	2 Row	0.23	1.0	0.30	0.16	76.2	84.6	140.0	124.4	19.6	27.3
			2.0	1.01	0.60	81.2	94.5	155.3	142.9	24.1	36.3
			4.0	3.70	2.16	84.9	102.4	165.9	157.6	27.5	43.7
1000	1 Row	0.15	0.5	0.09	0.04	68.6	72.2	120.0	104.2	14.7	18.6
	2 Row	0.30	1.0	0.30	0.16	73.9	81.1	138.2	122.3	20.4	28.3
			2.0	1.01	0.60	78.6	90.4	153.8	140.8	25.5	38.3
			4.0	3.70	2.16	82.1	98.2	164.9	156.0	29.4	46.8
1150	1 Row	0.19	0.5	0.09	0.04	67.1	70.2	118.5	102.9	15.1	19.0
	2 Row	0.38	1.0	0.30	0.16	72.0	78.4	136.7	120.6	21.2	29.2
			2.0	1.01	0.60	76.5	87.2	152.6	139.1	26.8	40.1
			4.0	3.70	2.16	79.9	94.7	164.1	154.7	31.0	49.4
1300	1 Row	0.23	0.5	0.09	0.04	65.9	68.7	117.3	101.7	15.4	19.3
	2 Row	0.46	1.0	0.30	0.16	70.5	76.2	135.4	119.1	21.8	29.9
			2.0	1.01	0.60	74.8	84.5	151.5	137.6	27.8	41.5
			4.0	3.70	2.16	78.1	91.8	163.3	153.5	32.5	51.8

Data is based on 180°F entering water and 55°F entering air at sea level. See selection procedure for other conditions.

HOT WATER COIL DATA

MODEL TSL-WC SIZE 12: STANDARD CIRCUITING

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN.W.G.)		Rate (GPM)	Water PD (FT.W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
300	1 Row	0.01	0.5	0.09	0.16	93.0	110.6	129.6	106.5	12.4	18.1
	2 Row	0.03	1.0	0.32	0.54	102.5	126.5	148.4	132.5	15.4	23.2
			2.0	1.07	1.73	109.3	137.2	161.9	152.6	17.6	26.7
			4.0	3.92	6.17	113.6	143.4	170.2	165.3	19.1	28.7
500	1 Row	0.03	0.5	0.09	0.16	81.5	93.5	121.5	95.4	14.4	20.9
	2 Row	0.06	1.0	0.32	0.54	89.7	108.4	141.5	121.0	18.8	28.9
			2.0	1.07	1.73	96.2	120.1	157.1	144.0	22.3	35.2
			4.0	3.92	6.17	100.6	127.5	167.3	159.9	24.7	39.3
700	1 Row	0.05	0.5	0.09	0.16	75.6	84.6	116.3	89.0	15.6	22.4
	2 Row	0.11	1.0	0.32	0.54	83.0	98.1	136.6	113.5	21.2	32.7
			2.0	1.07	1.73	89.2	109.8	153.4	137.6	25.9	41.5
			4.0	3.92	6.17	93.5	117.8	165.0	155.6	29.2	47.6
900	1 Row	0.08	0.5	0.09	0.16	71.9	79.0	112.9	85.2	16.5	23.4
	2 Row	0.16	1.0	0.32	0.54	78.5	91.1	133.2	108.5	22.9	35.2
			2.0	1.07	1.73	84.2	102.2	150.8	133.0	28.5	46.0
			4.0	3.92	6.17	88.4	110.3	163.3	152.4	32.6	54.0
1100	1 Row	0.11	0.5	0.09	0.16	69.4	75.2	110.4	82.5	17.1	24.1
	2 Row	0.22	1.0	0.32	0.54	75.3	86.1	130.6	104.8	24.2	37.0
			2.0	1.07	1.73	80.7	96.6	148.7	129.4	30.6	49.6
			4.0	3.92	6.17	84.7	104.7	161.8	149.7	35.4	59.2
1300	1 Row	0.15	0.5	0.09	0.16	67.5	72.4	108.4	80.5	17.6	24.6
	2 Row	0.29	1.0	0.32	0.54	72.9	82.3	128.5	101.9	25.3	38.4
			2.0	1.07	1.73	78.0	92.3	146.9	126.4	32.4	52.5
			4.0	3.92	6.17	81.9	100.2	160.6	147.4	37.8	63.6
1500	1 Row	0.19	0.5	0.09	0.16	66.1	70.4	106.8	78.9	18.0	25.0
	2 Row	0.37	1.0	0.32	0.54	71.1	79.4	126.7	99.6	26.2	39.6
			2.0	1.07	1.73	75.9	88.8	145.3	124.0	33.9	55.0
			4.0	3.92	6.17	79.6	96.5	159.5	145.5	39.9	67.5
1700	1 Row	0.23	0.5	0.09	0.16	65.0	68.7	105.4	77.7	18.3	25.3
	2 Row	0.45	1.0	0.32	0.54	69.6	77.0	125.1	97.6	26.9	40.6
			2.0	1.07	1.73	74.1	86.0	144.0	121.8	35.2	57.1
			4.0	3.92	6.17	77.7	93.5	158.6	143.7	41.8	70.9

MODEL TSL-WC SIZE 12: MULTI-CIRCUITING

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN.W.G.)		Rate (GPM)	Water PD (FT.W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
300	1 Row	0.01	0.5	0.04	0.04	88.4	105.4	135.6	113.4	10.9	16.4
	2 Row	0.03	1.0	0.14	0.17	98.3	121.6	151.2	135.8	14.1	21.6
			2.0	0.51	0.62	106.1	133.6	163.0	153.8	16.6	25.5
			4.0	1.90	2.22	111.5	141.1	170.6	165.6	18.4	28.0
500	1 Row	0.03	0.5	0.04	0.04	77.8	89.4	129.5	104.3	12.4	18.6
	2 Row	0.06	1.0	0.14	0.17	86.0	103.8	145.6	126.1	16.8	26.4
			2.0	0.51	0.62	93.1	116.1	158.8	146.1	20.7	33.1
			4.0	1.90	2.22	98.4	124.8	167.9	160.6	23.5	37.8
700	1 Row	0.05	0.5	0.04	0.04	72.5	81.2	125.8	99.2	13.3	19.9
	2 Row	0.11	1.0	0.14	0.17	79.6	93.9	141.8	120.0	18.7	29.5
			2.0	0.51	0.62	86.2	105.8	155.7	140.6	23.7	38.5
			4.0	1.90	2.22	91.3	114.9	165.9	156.7	27.6	45.4
900	1 Row	0.08	0.5	0.04	0.04	69.3	76.2	123.3	96.0	13.9	20.7
	2 Row	0.16	1.0	0.14	0.17	75.5	87.3	139.2	116.0	19.9	31.5
			2.0	0.51	0.62	81.5	98.4	153.6	136.8	25.8	42.3
			4.0	1.90	2.22	86.3	107.4	164.3	153.8	30.5	51.1
1100	1 Row	0.11	0.5	0.04	0.04	67.0	72.8	121.5	93.8	14.3	21.2
	2 Row	0.22	1.0	0.14	0.17	72.6	82.6	137.3	113.0	20.9	32.9
			2.0	0.51	0.62	78.1	93.0	151.8	133.7	27.5	45.3
			4.0	1.90	2.22	82.7	101.7	163.1	151.5	33.0	55.7
1300	1 Row	0.15	0.5	0.04	0.04	65.4	70.4	120.1	92.1	14.7	21.7
	2 Row	0.29	1.0	0.14	0.17	70.4	79.2	135.7	110.6	21.7	34.1
			2.0	0.51	0.62	75.5	88.9	150.4	131.3	28.9	47.7
			4.0	1.90	2.22	79.9	97.3	162.0	149.5	35.0	59.6
1500	1 Row	0.19	0.5	0.04	0.04	64.2	68.5	119.0	90.8	15.0	22.0
	2 Row	0.37	1.0	0.14	0.17	68.8	76.6	134.4	108.8	22.3	35.0
			2.0	0.51	0.62	73.5	85.6	149.2	129.3	30.1	49.7
			4.0	1.90	2.22	77.7	93.7	161.1	147.8	36.8	62.9
1700	1 Row	0.23	0.5	0.04	0.04	63.3	67.1	118.0	89.7	15.2	22.3
	2 Row	0.45	1.0	0.14	0.17	67.4	74.4	133.2	107.2	22.9	35.8
			2.0	0.51	0.62	71.9	82.9	148.1	127.5	31.2	51.5
			4.0	1.90	2.22	75.9	90.8	160.3	146.3	38.4	65.9

Data is based on 180°F entering water and 55°F entering air at sea level. See selection procedure for other conditions.

HOT WATER COIL DATA

MODEL TSL-WC SIZE 14: STANDARD CIRCUITING

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN.W.G.)		Rate (GPM)	Water PD (FT.W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
800	1 Row	0.05	0.5	0.10	0.18	75.3	83.1	108.5	81.4	17.6	24.3
	2 Row	0.09	1.0	0.35	0.60	83.0	97.1	130.5	105.8	24.3	36.5
			2.0	1.15	1.89	89.6	109.6	149.3	131.7	29.9	47.3
			4.0	4.15	6.67	94.2	118.3	162.6	151.9	34.0	54.9
1000	1 Row	0.07	0.5	0.10	0.18	71.9	78.2	105.4	78.2	18.4	25.1
	2 Row	0.13	1.0	0.35	0.60	78.9	90.8	127.2	101.3	25.9	38.8
			2.0	1.15	1.89	85.0	102.7	146.7	127.3	32.5	51.7
			4.0	4.15	6.67	89.5	111.5	160.8	148.7	37.4	61.2
1200	1 Row	0.09	0.5	0.10	0.18	69.6	74.8	103.0	76.0	19.0	25.7
	2 Row	0.18	1.0	0.35	0.60	75.9	86.1	124.6	97.8	27.2	40.5
			2.0	1.15	1.89	81.7	97.5	144.5	123.7	34.7	55.2
			4.0	4.15	6.67	86.0	106.1	159.4	146.0	40.3	66.5
1400	1 Row	0.12	0.5	0.10	0.18	67.8	72.2	101.1	74.3	19.4	26.1
	2 Row	0.23	1.0	0.35	0.60	73.6	82.6	122.5	95.1	28.2	41.8
			2.0	1.15	1.89	79.0	93.3	142.7	120.8	36.5	58.1
			4.0	4.15	6.67	83.2	101.8	158.1	143.7	42.7	71.0
1600	1 Row	0.14	0.5	0.10	0.18	66.5	70.3	98.9	72.5	20.0	26.6
	2 Row	0.29	1.0	0.35	0.60	72.0	80.0	119.9	92.2	29.5	43.3
			2.0	1.15	1.89	77.3	90.4	140.4	117.5	38.7	61.4
			4.0	4.15	6.67	81.5	99.0	156.5	141.0	45.9	76.3
1800	1 Row	0.18	0.5	0.10	0.18	65.4	68.8	97.6	71.5	20.3	26.8
	2 Row	0.35	1.0	0.35	0.60	70.5	77.7	118.3	90.3	30.3	44.2
			2.0	1.15	1.89	75.6	87.6	139.0	115.3	40.1	63.6
			4.0	4.15	6.67	79.6	96.0	155.4	139.1	48.0	80.0
2000	1 Row	0.21	0.5	0.10	0.18	64.5	67.5	96.5	70.6	20.6	27.1
	2 Row	0.42	1.0	0.35	0.60	69.3	75.8	116.9	88.7	31.0	45.0
			2.0	1.15	1.89	74.1	85.2	137.7	113.4	41.4	65.5
			4.0	4.15	6.67	78.0	93.4	154.4	137.5	49.9	83.3
2200	1 Row	0.24	0.5	0.10	0.18	63.7	66.4	95.5	69.8	20.8	27.2
	2 Row	0.49	1.0	0.35	0.60	68.3	74.2	115.7	87.3	31.6	45.7
			2.0	1.15	1.89	72.9	83.2	136.5	111.7	42.6	67.2
			4.0	4.15	6.67	76.7	91.2	153.6	136.0	51.6	86.2

MODEL TSL-WC SIZE 14: MULTI-CIRCUITING

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN.W.G.)		Rate (GPM)	Water PD (FT.W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
800	1 Row	0.05	0.5	0.04	0.05	72.5	80.4	118.2	90.8	15.2	22.0
	2 Row	0.09	1.0	0.14	0.18	79.9	93.4	136.0	112.3	21.6	33.3
			2.0	0.52	0.64	86.8	106.0	151.8	134.9	27.5	44.2
			4.0	1.93	2.29	92.1	115.5	163.5	153.1	32.2	52.5
1000	1 Row	0.07	0.5	0.04	0.05	69.5	75.9	115.8	88.1	15.8	22.7
	2 Row	0.13	1.0	0.14	0.18	76.1	87.4	133.4	108.5	22.8	35.1
			2.0	0.52	0.64	82.4	99.2	149.6	131.1	29.7	47.9
			4.0	1.93	2.29	87.5	108.7	162.0	150.2	35.2	58.2
1200	1 Row	0.09	0.5	0.04	0.05	67.5	72.8	114.0	86.1	16.2	23.2
	2 Row	0.18	1.0	0.14	0.18	73.3	83.1	131.4	105.7	23.8	36.6
			2.0	0.52	0.64	79.2	94.2	147.8	128.1	31.4	50.9
			4.0	1.93	2.29	84.0	103.4	160.7	147.8	37.7	62.9
1400	1 Row	0.12	0.5	0.04	0.05	65.9	70.5	112.6	84.5	16.6	23.6
	2 Row	0.23	1.0	0.14	0.18	71.2	79.8	129.8	103.4	24.6	37.7
			2.0	0.52	0.64	76.7	90.2	146.3	125.6	32.9	53.3
			4.0	1.93	2.29	81.3	99.1	159.5	145.8	39.9	66.9
1600	1 Row	0.14	0.5	0.04	0.05	64.8	68.8	111.1	83.0	16.9	23.9
	2 Row	0.29	1.0	0.14	0.18	69.7	77.4	127.9	101.1	25.5	38.9
			2.0	0.52	0.64	75.0	87.4	144.5	122.9	34.7	56.1
			4.0	1.93	2.29	79.6	96.3	158.1	143.4	42.6	71.6
1800	1 Row	0.18	0.5	0.04	0.05	63.8	67.4	110.2	82.0	17.2	24.2
	2 Row	0.35	1.0	0.14	0.18	68.4	75.3	126.7	99.5	26.1	39.6
			2.0	0.52	0.64	73.4	84.7	143.4	121.0	35.8	57.9
			4.0	1.93	2.29	77.8	93.3	157.2	141.8	44.4	74.8
2000	1 Row	0.21	0.5	0.04	0.05	63.0	66.3	109.3	81.2	17.4	24.4
	2 Row	0.42	1.0	0.14	0.18	67.3	73.6	125.7	98.2	26.6	40.3
			2.0	0.52	0.64	72.0	82.4	142.3	119.4	36.8	59.5
			4.0	1.93	2.29	76.2	90.8	156.4	140.3	46.0	77.6
2200	1 Row	0.24	0.5	0.04	0.05	62.4	65.3	108.6	80.5	17.6	24.6
	2 Row	0.49	1.0	0.14	0.18	66.4	72.1	124.7	97.0	27.1	40.9
			2.0	0.52	0.64	70.8	80.5	141.4	118.0	37.7	60.9
			4.0	1.93	2.29	74.9	88.6	155.7	139.0	47.4	80.2

Data is based on 180°F entering water and 55°F entering air at sea level. See selection procedure for other conditions.

HOT WATER COIL DATA

MODEL TSL-WC SIZE 16: STANDARD CIRCUITING

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN.W.G.)		Rate (GPM)	Water PD (FT.W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
1600	1 Row	0.10	0.5	0.11	0.12	67.4	70.9	93.0	68.3	21.4	27.6
	2 Row	0.21	1.0	0.37	0.66	73.4	81.4	114.9	87.1	32.0	45.8
			2.0	1.23	2.07	79.3	92.9	137.0	113.2	42.1	65.6
			4.0	4.42	7.25	83.8	102.2	154.4	138.2	50.0	81.9
1800	1 Row	0.12	0.5	0.11	0.12	66.2	69.3	91.6	67.3	21.8	27.9
	2 Row	0.25	1.0	0.37	0.66	71.8	79.0	113.2	85.3	32.8	46.7
			2.0	1.23	2.07	77.4	89.8	135.4	110.9	43.7	67.9
			4.0	4.42	7.25	81.8	99.0	153.2	136.2	52.2	85.8
2000	1 Row	0.15	0.5	0.11	0.12	65.2	68.0	90.4	66.5	22.1	28.1
	2 Row	0.30	1.0	0.37	0.66	70.5	76.9	111.7	83.7	33.6	47.5
			2.0	1.23	2.07	75.8	87.3	134.0	108.9	45.1	69.9
			4.0	4.42	7.25	80.1	96.3	152.2	134.4	54.3	89.4
2200	1 Row	0.17	0.5	0.11	0.12	64.4	66.9	89.4	65.8	22.3	28.2
	2 Row	0.34	1.0	0.37	0.66	69.4	75.2	110.4	82.3	34.2	48.2
			2.0	1.23	2.07	74.4	85.1	132.7	107.1	46.3	71.7
			4.0	4.42	7.25	78.6	93.8	151.2	132.8	56.2	92.6
2400	1 Row	0.20	0.5	0.11	0.12	63.7	65.9	88.5	65.2	22.6	28.4
	2 Row	0.40	1.0	0.37	0.66	68.4	73.8	109.2	81.1	34.8	48.8
			2.0	1.23	2.07	73.2	83.2	131.6	105.5	47.4	73.3
			4.0	4.42	7.25	77.3	91.7	150.4	131.3	57.9	95.5
2600	1 Row	0.23	0.5	0.11	0.12	63.1	65.1	87.7	64.7	22.8	28.5
	2 Row	0.45	1.0	0.37	0.66	67.5	72.5	108.2	80.1	35.3	49.3
			2.0	1.23	2.07	72.2	81.5	130.5	104.1	48.5	74.7
			4.0	4.42	7.25	76.1	89.8	149.6	129.9	59.5	98.1
2800	1 Row	0.25	0.5	0.11	0.12	62.6	64.4	87.0	64.3	22.9	28.6
	2 Row	0.51	1.0	0.37	0.66	66.8	71.4	107.2	79.2	35.8	49.8
			2.0	1.23	2.07	71.3	80.1	129.6	102.8	49.4	76.0
			4.0	4.42	7.25	75.1	88.2	148.8	128.7	60.9	100.6
3000	1 Row	0.28	0.5	0.11	0.12	62.1	63.8	86.3	63.9	23.1	28.7
	2 Row	0.57	1.0	0.37	0.66	66.1	70.5	106.4	78.3	36.2	50.2
			2.0	1.23	2.07	70.5	78.8	128.7	101.6	50.3	77.2
			4.0	4.42	7.25	74.2	86.6	148.1	127.6	62.3	102.8

MODEL TSL-WC SIZE 16: MULTI-CIRCUITING

AIRFLOW			WATER FLOW			LAT (°F)		LWT (°F)		CAPACITY (MBH)	
Rate (CFM)	Air PD (IN.W.G.)		Rate (GPM)	Water PD (FT.W.G.)							
				1 Row	2 Row	1 Row	2 Row	1 Row	2 Row	1 Row	2 Row
1600	1 Row	0.10	0.5	0.04	0.05	65.7	69.7	104.5	77.2	18.6	25.4
	2 Row	0.21	1.0	0.33	0.42	71.2	79.1	122.6	95.2	28.1	41.8
			2.0	0.54	0.68	77.0	90.0	141.0	118.3	38.2	60.6
			4.0	1.97	2.38	82.0	99.7	156.0	140.4	46.8	77.4
1800	1 Row	0.12	0.5	0.04	0.05	64.7	68.2	103.4	76.2	18.8	25.6
	2 Row	0.25	1.0	0.33	0.42	69.8	76.8	121.3	93.6	28.8	42.6
			2.0	0.54	0.68	75.2	87.1	139.7	116.3	39.5	62.6
			4.0	1.97	2.38	80.0	96.5	155.0	138.7	48.7	80.9
2000	1 Row	0.15	0.5	0.04	0.05	63.8	66.9	102.5	75.4	19.1	25.9
	2 Row	0.30	1.0	0.33	0.42	68.6	75.0	120.2	92.2	29.4	43.3
			2.0	0.54	0.68	73.7	84.7	138.5	114.6	40.6	64.3
			4.0	1.97	2.38	78.3	93.8	154.1	137.1	50.5	84.0
2200	1 Row	0.17	0.5	0.04	0.05	63.1	65.9	101.7	74.7	19.3	26.0
	2 Row	0.34	1.0	0.33	0.42	67.5	73.4	119.1	91.0	29.9	43.9
			2.0	0.54	0.68	72.5	82.6	137.5	113.0	41.6	65.8
			4.0	1.97	2.38	76.9	91.4	153.3	135.7	52.1	86.8
2400	1 Row	0.20	0.5	0.04	0.05	62.5	65.1	101.0	74.1	19.4	26.2
	2 Row	0.40	1.0	0.33	0.42	66.7	72.1	118.2	90.0	30.3	44.4
			2.0	0.54	0.68	71.4	80.8	136.6	111.7	42.5	67.2
			4.0	1.97	2.38	75.6	89.4	152.6	134.4	53.6	89.4
2600	1 Row	0.23	0.5	0.04	0.05	62.0	64.3	100.4	73.5	19.6	26.3
	2 Row	0.45	1.0	0.33	0.42	65.9	70.9	117.4	89.1	30.7	44.8
			2.0	0.54	0.68	70.4	79.3	135.7	110.5	43.3	68.4
			4.0	1.97	2.38	74.5	87.6	151.9	133.2	54.9	91.7
2800	1 Row	0.25	0.5	0.04	0.05	61.5	63.7	99.8	73.1	19.7	26.4
	2 Row	0.51	1.0	0.33	0.42	65.2	69.9	116.7	88.3	31.1	45.2
			2.0	0.54	0.68	69.5	77.9	135.0	109.4	44.1	69.4
			4.0	1.97	2.38	73.5	85.9	151.2	132.1	56.2	93.8
3000	1 Row	0.28	0.5	0.04	0.05	61.1	63.2	99.3	72.7	19.9	26.5
	2 Row	0.57	1.0	0.33	0.42	64.7	69.0	116.0	87.5	31.4	45.6
			2.0	0.54	0.68	68.8	76.7	134.3	108.4	44.8	70.4
			4.0	1.97	2.38	72.7	84.5	150.6	131.1	57.4	95.8

Data is based on 180°F entering water and 55°F entering air at sea level. See selection procedure for other conditions.

GUIDE SPECIFICATIONS

GENERAL

Furnish and install Johnson Controls Model TSL Single Duct Low Height Variable Air Volume Terminal Units of the sizes and capacities as scheduled. Terminals shall be certified by ARI and bear the ARI 880 seal.

CONSTRUCTION

Terminals shall be constructed of not less than 20 gauge galvanized steel, able to withstand a 125 hour salt spray test per ASTM B-117. Stainless steel casings, or galvannealed steel casings with a baked enamel paint finish, may be used as an alternative. The terminal casing shall be mechanically assembled (spot-welded casings are not acceptable).

Casing shall be internally lined with 1/2" thick fiberglass insulation, rated for a maximum air velocity of 5000 f.p.m. Maximum thermal conductivity shall be .24 (BTU • in) / (hr • ft^2 • °F). Insulation must meet all requirements of ASTM C1071 (including C665), UL 181 for erosion, and carry a 25/50 rating for flame spread/ smoke developed per ASTM E-84, UL 723 and NFPA 90A. Raw insulation edges on the discharge of the unit must be covered with metal liner to eliminate flaking of insulation during field duct connections. Simple “buttering” of raw edges with an approved sealant is not acceptable.

All appurtenances including control assemblies, control enclosures, hot water heating coils, and electric heating coils shall not extend beyond the top and bottom of the unit casing. At an inlet velocity of 2000 f.p.m., the static pressure drop across the basic terminal or basic terminal with a sound attenuator shall not exceed 0.02" W.G. for all unit sizes.

PRIMARY AIR VALVE

Rectangular shaped primary air valves shall consist of minimum 18 gauge galvanized steel. Cylindrically shaped primary air valves shall consist of minimum 22 gauge galvanized steel and include embossment rings for rigidity. The damper blade shall be connected to a solid shaft by means of an integral molded sleeve which does not require screw or bolt fasteners. The shaft shall be manufactured of a low thermal conducting composite material, and include a molded damper position indicator visible from the exterior of the unit. The damper shall pivot in self lubricating bearings. The damper actuator shall be mounted on the exterior of the terminal for ease of service. The valve assembly shall include internal mechanical stops for both full open and closed positions. The damper blade seal shall be secured without use of adhesives. The air valve leakage shall not exceed 2% of maximum inlet rated airflow at 3" W.G. inlet pressure.

PRIMARY AIRFLOW SENSOR

Differential pressure airflow sensor shall traverse the duct along two perpendicular diameters. Single axis sensor shall not be acceptable for duct diameters 6" or larger. A minimum of 12 total pressure sensing points shall be utilized. The total pressure inputs shall be averaged using a pressure chamber located at the center of the sensor. A sensor that delivers the differential pressure signal from one end of the sensor is not acceptable. The sensor shall output an amplified differential pressure signal that is at least 2.5 times the equivalent velocity pressure signal obtained from a conventional pitot tube. The sensor shall develop a differential pressure of 0.03" w.g. at an air velocity of < 450 FPM. Documentation shall be submitted which substantiates this requirement. Balancing taps and airflow calibration charts shall be provided for field airflow measurements.

HOT WATER COIL

Single duct terminal shall include an integral hot water coil where indicated on the plans. The coil shall be manufactured by the terminal unit manufacturer and shall have a minimum 22 gauge galvanized sheet metal casing. Stainless steel casings, or galvannealed steel casings with a baked enamel paint finish, may be used as an alternative. Coil to be constructed of pure aluminum fins with full fin collars to assure accurate fin spacing and maximum tube contact. Fins shall be spaced with a minimum of 10 per inch and mechanically fixed to seamless copper tubes for maximum heat transfer.

Each coil shall be hydrostatically tested at 450 PSIG under water, and rated for a maximum 300 PSIG working pressure at 200°F.

ELECTRIC HEATERS

Terminal shall include an integral electric heater where indicated on the plans. Heater shall be manufactured by the terminal unit manufacturer, and shall be cETL listed as an assembly. Listing for heater only is not acceptable. Terminals without mercury contactors shall be invertible, allowing the control enclosure to be on the left or right side without field modification.

The heater cabinet shall be constructed of not less than 20 gauge galvanized steel. Stainless steel cabinets,

or galvannealed steel casings with a baked enamel paint finish, may be used as an alternative. Heater shall have a hinged access panel for entry to the controls.

A power disconnect shall be furnished to render the heater non-operational. Heater shall be furnished with all controls necessary for safe operation and full compliance with UL 1996 and National Electric Code requirements.

Heater shall have a single point electrical connection. It shall include a primary disc-type automatic reset high temperature limit, secondary high limit(s), airflow switch, Ni-Chrome elements, and fusing per UL and NEC. Heater shall have complete wiring diagram and label indicating power requirement and kW output.

SOUND ATTENUATOR

Sound attenuator shall be provided where scheduled to meet acoustical performance requirements. Unit length shall be minimum 41 inches. Attenuator casing shall be constructed as specified for the base terminal.

OPTIONS

Foil Faced Insulation
Insulation shall be covered with scrim backed foil facing. All insulation edges shall be covered with foil or metal nosing. In addition to the basic requirements, insulation shall meet ASTM C1136 for insulation facings, and ASTM C1338 for mold, mildew and humidity resistance.

Elastomeric Closed Cell Foam Insulation
Provide Elastomeric Closed Cell Foam Insulation in lieu of standard. Insulation shall conform to UL 181 for erosion and NFPA 90A for fire, smoke and melting, and comply with a 25/50 Flame Spread and Smoke Developed Index per ASTM E-84 or UL 723. Additionally, insulation shall comply with Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21. Polyethylene insulation is not acceptable.

Double Wall Construction
The terminal casing shall be double wall construction using a 22 gauge galvanized metal liner covering all insulation.

Piping Packages
Provide a standard factory assembled non-insulated valve piping package to consist of a 2 way, on/off, motorized electric control valve and two ball isolation valves. Control valves are piped normally closed to the coil. Maximum entering water temperature on the control valve shall be 200°F. The maximum close-off pressure is 40 PSIG (1/2") or 20 PSIG (3/4"). Maximum operating pressure shall be 300 PSIG.

Option: Provide 3-wire floating point modulating control valve (fail-in-place) in lieu of standard 2-position control valve with factory assembled valve piping package.

Option: Provide high pressure close-off actuators for 2-way, on/off control valves. Maximum close-off pressure is 50 PSIG (1/2") or 25 PSIG (3/4)".

Option: Provide either a fixed or adjustable flow control device for each piping package.

Option: Provide unions and/or pressure-temperature ports for each piping package.

Piping package shall be completely factory assembled, including interconnecting pipe, and shipped separate from the unit for field installation on the coil, so as to minimize the risk of freight damage.

CONTROLS

Analog Electronics Controls
Furnish and install Series 7000 Pressure Independent Analog Electronic Control System where indicated on the plans and in the specifications. The complete system shall be fully operational and include the following:

- Single duct, dual duct, and/or fan powered terminal units
- Pressure independent Series 7000 analog electronic zone controllers with integral differential pressure transducer
- Analog electronic wall thermostat
- Electronic air valve actuator
- 24 VAC control transformers
- Air pressure switches as required
- Electronic duct temperature sensors as required

Pneumatic Controls
Units shall be controlled by a pneumatic differential pressure reset volume controller. Controller shall be capable of pressure independent operation down to 0.03 inches W.G. differential pressure and shall be factory set to the specified airflow (CFM). Controller shall not exceed 11.5 scim (Standard Cubic Inches per Minute) air consumption @ 20 PSIG.

Unit primary air valve shall modulate in response to the room mounted thermostat and shall maintain airflow in relation to thermostat pressure regardless of system

static pressure changes. An airflow (CFM) curve shall be affixed to the terminal unit expressing differential pressure vs. CFM. Pressure taps shall be provided for field use and ease of balancing.

Terminal unit manufacturer shall supply and manufacture a 5 to 10 PSIG pneumatic actuator capable of a minimum of 45 in. lbs. of torque.

Actual sequence of operation is shown on the contract drawings. Terminal unit manufacturer shall coordinate, where necessary, with the Temperature Control Contractor.

JOHNSON CONTROLS DDC CONTROL

N2

Each VAV terminal unit shall be bundled with a digital controller. The controller shall be compatible with a Johnson Controls N2 system network. A unique Johnson Controls N2 network address shall be assigned to each controller, and referenced to the tagging system used on the drawings and in the schedules provided by the Project Engineer. All controllers shall be factory mounted and wired, with the controller's hardware address set, and all of the individual terminal's data pre-loaded into the controller. The terminal's data shall include, but not be limited to the Max CFM, Min CFM, Heating CFM, and terminal K factor. Heating system operating data shall also be factory installed for all terminals with heat. Communication with the digital controller shall be accomplished through the Johnson Controls N2 network. The digital controller shall have hardware input and output connections to facilitate the specified sequence of operation in either the network mode, or on a stand-alone basis. The terminal unit manufacturer shall coordinate, where necessary, with the Temperature Control Contractor.

MS/TP

Each VAV terminal unit shall be bundled with a digital controller. The controller shall be compatible with a MS/TP BACnet system network. A unique network address and a BACnet site address shall be assigned to each controller, and referenced to the tagging system used on the drawings and in the schedules provided by the Project Engineer. All controllers shall be factory mounted and wired, with the controller's hardware address set, and all of the individual terminal's data pre-loaded into the controller. The terminal's data shall include, but not be limited to Max CFM, Min CFM, Heating CFM, and terminal K factor. Heating system operating data shall also be factory installed for all terminals with heat. Communications with the digital controller shall be accomplished through the MS/TP BACnet network or through a Bluetooth connector. The digital controller shall have hardware input and output connections to facilitate the specified sequence of operation in either the network mode, or on a stand-alone basis. The terminal unit manufacturer shall coordinate, where necessary, with the Temperature Control Contractor.

LON

Each VAV terminal unit shall be bundled with a digital controller. The controller shall be compatible with a LON system network. A unique network address shall be assigned to each controller and referenced to the tagging system used on the drawings and in the schedules provided by the Project Engineer. All controllers shall be factory mounted and wired, and all of the individual terminal's data pre-loaded into the LNS database for the project. The terminal's data shall include, but not be limited to Max CFM, Min CFM, Heating CFM, and terminal K factor. Heating system operating data shall also be factory installed for all terminals with heat. Communication with the digital controller shall be accomplished through the LON network. The digital controller shall have hardware input and output connections to facilitate the specified sequence of operation in either the network mode, or on a stand-alone basis. The terminal unit manufacturer shall coordinate, where necessary, with the Temperature Control Contractor.

NOTES

NOTES

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Johnson Controls