CONTROLLED AIR, INC. 12009 Tramway Drive • Cincinnati, Ohio 45241

PROJECT:	**Kroger Headquarters** **First Floor Rnovation**
LOCATION:	**Cincinnati, OH**
CUSTOMER:	**Bachman's Inc.**
ENGINEER:	**Elevar Design Group**
EQUIPMENT:	**Titus Air Terminal Units**
SUBMITTED BY:	**ANDY TEPE** **CONTROLLED AIR INC.** **12009 TRAMWAY DRIVE** **CINCINNATI, OH 45241**
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DATE:	**7/18/2022**

Single Duct Terminal Unit Sche

KROGER 1ST FLOOR

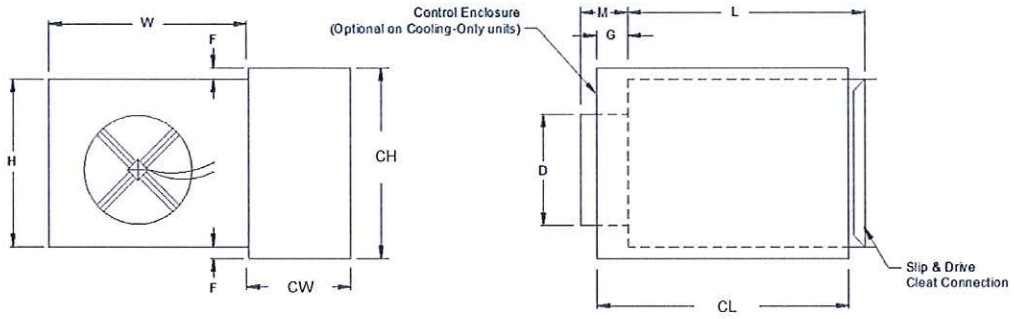
Tag	AHU Tag	Room	Model	Size		CFM		Static Pressure			NC Levels		Hot Water Heat Coil											Unit Information
				Unit	Outlet	Max	Min	Inlet	Down	Min	Rad	Dis	CFM	MBH	EAT	EWT	LAT	APd	GPM	LWT	WPd	Rows	FPI	Hand
VAV-01			DESV	14	20x17.5	2200	660	1	0.25	0.38	19	22	1100	32.8	55	160	82.5	0.34	1.4	112.1	0.13	2-LH	10	LH
VAV-02			DESV	10	14x12.5	1000	300	1	0.25	0.3	19	27	500	17.9	55	160	87.9	0.29	1.1	126.8	0.14	2-RH	10	RH
VAV-03			DESV	12	16x15	1000	300	1	0.25	0.28	15	23	1000	54.1	55	160	104.9	0.27	3.7	130.1	0.68	3-LH	10	LH
VAV-04			DESV	14	20x17.5	2100	630	1	0.25	0.35	18	20	1050	32.4	55	160	83.4	0.31	1.4	112.8	0.13	2-LH	10	LH
VAV-05			DESV	12	16x15	1250	375	1	0.25	0.26	18	24	625	30	55	160	99.2	0.25	2.7	137.3	0.57	2-RH	10	RH
VAV-06			DESV	10	14x12.5	1000	300	1	0.25	0.3	19	27	880	23.4	55	160	79.5	0.29	1.3	123.2	0.18	2-RH	10	RH
VAV-07			DESV	08	12x10	700	210	1	0.25	0.32	19	28	350	15.9	55	160	96.9	0.3	1.6	139.7	0.38	2-LH	10	LH
VAV-08			DESV	06	12x8	250	75	1	0.25	0.1	14	24	125	5	55	160	91.8	0.05	1.7	154	1.2	1-LH	10	LH
VAV-09			DESV	10	14x12.5	800	240	1	0.25	0.21	18	24	640	26	55	160	92.4	0.2	2.4	137.9	0.39	2-LH	10	LH
VAV-10			DESV	14	20x17.5	2200	660	1	0.25	0.38	19	22	1100	32.8	55	160	82.5	0.34	1.4	112.1	0.13	2-LH	10	LH
VAV-11			DESV	08	12x10	700	210	1	0.25	0.17	20	29	350	10	55	160	81.3	0.15	3.3	153.8	5.46	1-RH	10	RH

Notes:
1. Selections are based on Titus as Manufacturer.
2. All performance based on tests conducted in accordance with ASHRAE 130-2008 and AHRI 880-2011.
3. All NC levels determined using AHRI 885-2008 Appendix E.
4. All airflow, pressure losses and heating performance values have been corrected for altitude.
5. Units of measure: dimensions (in), airflow (cfm), water flow (gpm), air pressure (in wg), water head losses (ft) and temperatures (degF).
6. Water pressure drop (WPd) units is in ft. water.

ESV

Single Duct Terminal Unit
Digital, Analog or Electric Control, Pressure Independent

☐ Digital Control, DESV ☐ Analog Control, AESV ☐ Electric Control, EESV



Right hand unit shown. All dimensions are in inches.

Size	CFM Range	D (H x W)	F	G	H	L	M	W	CH	CL	CW
4	0-225	3 7/8	2 1/8	7 3/8	8	15 1/2	5 3/8	12	12 1/4	18	6 1/2
5	0-350	4 7/8	2 1/8	7 3/8	8	15 1/2	5 3/8	12	12 1/4	18	6 1/2
6	0-500	5 7/8	2 1/8	7 3/8	8	15 1/2	3 3/8	12	12 1/4	18	6 1/2
7	0-650	6 7/8	1 1/8	7 3/8	10	15 1/2	3 3/8	12	12 1/4	18	6 1/2
8	0-900	7 7/8	1 1/8	7 3/8	10	15 1/2	3 3/8	12	12 1/4	18	6 1/2
9	0-1050	8 7/8	-	5 3/8	12 1/2	15 1/2	3 3/8	14	12 1/4	18	6 1/2
10	0-1400	9 7/8	-	5 3/8	12 1/2	15 1/2	3 3/8	14	12 1/4	18	6 1/2
12	0-2000	11 7/8	-	5 3/8	15	15 1/2	3 3/8	16	12 1/4	18	6 1/2
14	0-3000	13 7/8	-	3 3/8	17 1/2	15 1/2	3 3/8	20	12 1/4	18	6 1/2
16	0-4000	15 7/8	-	3 3/8	18	15 1/2	3 3/8	24	12 1/4	18	6 1/2
20	0-2000	7 1/2 x 12 1/4	1/4	3	10	15 1/2	3 3/8	16	10 1/4	15 1/4	6 1/2
30	0-4000	7 1/2 x 23 3/4	1/4	3	10	15 1/2	3 3/8	27 1/4	10 1/4	15 1/4	6 1/2
40	0-8000	23 7/8 x 15 7/8	1 1/8	5 3/8	18	15	3 3/8	38	12 1/4	18	6 1/2
5E	0-350	4 7/8	2 1/8	7 3/8	10	15 1/2	3 3/8	12	12 1/4	18	6 1/2
6E	0-500	5 7/8	2 1/8	7 3/8	10	15 1/2	3 3/8	12	12 1/4	18	6 1/2
7E	0-650	6 7/8	1 1/8	5 3/8	12 1/2	15 1/2	3 3/8	14	12 1/4	18	6 1/2
8E	0-900	7 7/8	1 1/8	5 3/8	12 1/2	15 1/2	3 3/8	14	12 1/4	18	6 1/2
1E	0-1400	9 7/8	-	5 3/8	15	15 1/2	3 3/8	16	12 1/4	18	6 1/2
2E	0-2000	11 7/8	-	3 3/8	17 1/2	15 1/2	3 3/8	20	12 1/4	18	6 1/2
4E	0-3000	13 7/8	-	3 3/8	18	15 1/2	3 3/8	24	12 1/4	18	6 1/2

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.

General Description

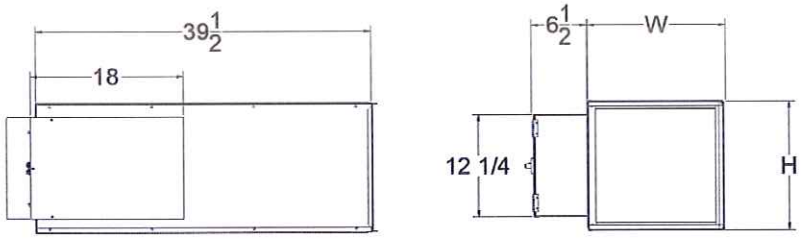
- Heavy gauge steel housing. Mechanically sealed and gasketed, leak resistant construction. Less than 2% of nominal cfm at 1.5" sp wg.
- Dual density internal insulation, treated to resist air erosion. Meets requirements of NFPA 90A and UL 181.
- Units equipped with the Titus II velocity controller can either be direct acting or reverse acting, with the damper either normally open or normally closed. Controller maintains constant span and start point. (Span and start point are adjustable.)
- Rectangular discharge opening is designed for slip and drive cleat duct connection.
- Multipoint center averaging inlet velocity sensor.
- Control packages can be factory mounted by Titus.
- Choice of right hand or left hand control location.
- Units equipped with the Titus I velocity controller are available in both direct acting / normally open and reverse acting / normally closed operating modes.
- 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 and pneumatic controls approved for seismic installation.

Accessories (Optional)

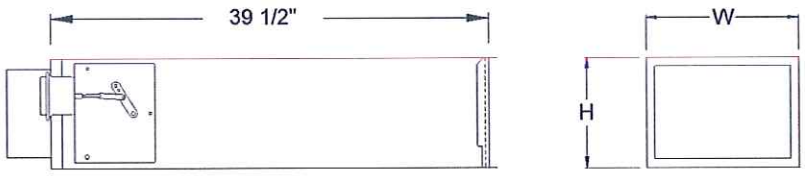
Check ☑ if provided.

- ☐ 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
- ☑ _____

☐ Integral Sound Attenuator



DESV, AESV, EESV



PESV

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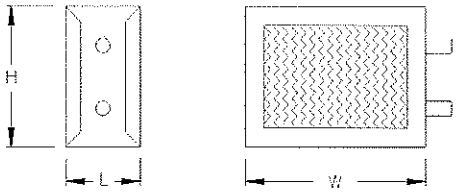
Accessories (Optional)

☑ Hot Water Coil Section

- Aluminum ripple fins, 10 per inch
- Coil pipe connections are male, sweat, type "L" copper. Connection sizes on unit sizes 04-08 are $^{1}/_{2}$" OD for 1 row coil and $^{5}/_{8}$" on 2 row coils. 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.
- Coils rated and certified to AHRI Standard 410

☑ 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.

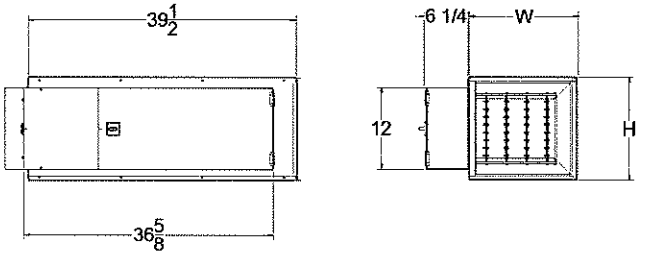
Options

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

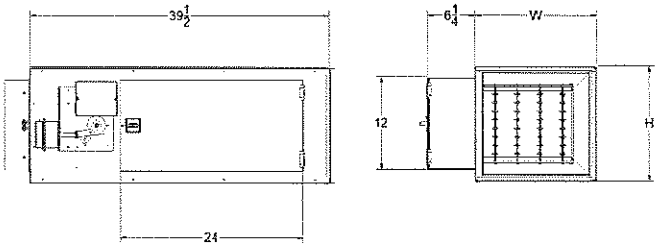
Supply Voltage

☐ 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)

DESV, AESV, EESV



PESV



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
20	10	16	5	7 1/4
30	10	27 1/4	5	7 1/4
40	18	38	5	7 1/4

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

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1" EcoShield Insulation (Foil Face)

Insulation Characteristics

Material:	Foil Face Natural Fiber Duct Liner
Thickness:	1 inch
R-Value:	4.0 ft^2 °F h/Btu @ 75°F
Density:	1.5 lbs/ft^3
Flame Spread:	less than 25
Smoke Density:	less than 50
Mold Growth:	None

Code Compliances

NFPA 90A & 90B	Appliances
NFPA 255	Flame / Smoke Spread (25/50)
UL 723	Flame / Smoke Spread (25/50)
ASTM C 411	Operating Temperature Limits
ASTM E84	Flame / Smoke Spread (25/50)
ASTM C 1071	Maximum Air Velocity
ASTM C 739	Corrosion Resistance
ASTM G 21	Fungi Resistance
ASTM G 22	Bacteria Resistance

Acoustical Performance

Correction factors to standard liner catalog data are shown below.

ESV Basic Units

Band	2	3	4	5	6	7	NC
HZ	125	250	500	1000	2000	4000	Impact
Discharge	0	0	0	0	0	0	0
Radiated	-2	-6	-7	-8	-9	-10	-3

ESV Attenuator Units (Average Correction Factor - Actual correction factor is dependent on unit size.)

Band	2	3	4	5	6	7	NC
HZ	125	250	500	1000	2000	4000	Impact
Discharge	0	-1	-2	-3	-3	-2	-2
Radiated	-2	-6	-7	-8	-9	-10	-3

Fan Powered Terminals

Band	2	3	4	5	6	7	NC
HZ	125	250	500	1000	2000	4000	Impact
Discharge	0	0	0	0	0	0	0
Radiated	+2	+3	+6	+11	+10	+3	+4

AeroCross™ K-Factors

AeroCross Sensor - Calibration Curves

Inlet Sensor Applications (All Units Except QCV)

Unit Size	Duct Area	K-Factor		Sensor	
	SQ FT	CFM	FPM	Qty.	Size
04	0.087	273	3138	1	4/5
05	0.136	390	2647	1	4/5
06	0.196	448	2286	1	6
07	0.267	667	2498	1	7
08	0.349	904	2590	1	8
09	0.442	1167	2640	1	9
10	0.545	1436	2635	1	10
12	0.785	1891	2409	1	12
14	1.069	3015	2820	1	14
16	1.395	3839	2752	1	16
20	0.778	2106	2707	1	8
22	0.778	2106	2707	1	8
26	1.000	2498	2498	1	8
40	2.667	7176	2691	2	14

Discharge Sensor Applications (For Dual Ducts)

Unit Size	Duct Area	K-Factor		Sensor	
	SQ FT	CFM	FPM	Qty.	Size
04	0.098	240	2444	1	4/5
05	0.157	384	2444	1	6
06	0.222	538	2423	1	7
07	0.292	733	2509	1	8
08	0.395	997	2525	1	9
09	0.625	1254	2007	1	12
10	0.773	1640	2122	1	12
12	1.003	2619	2611	1	14
14	1.401	3808	2718	1	16
16	1.680	4810	2863	1	16

Inlet Sensor Applications (For QCV's)

Unit Size	Damper	K-Factor		Sensor	
	SQ FT	CFM	FPM	Quantity	Size
A	0.174	320	1837	1	4/5
B	0.250	477	1908	1	4/5
C	0.333	629	1890	1	4/5
D	0.555	1047	1886	1	8
E	0.778	1539	1978	1	8
F	0.750	1472	1962	2	4/5
G	0.833	1676	2012	1	10
H	1.250	2619	2095	2	10
J	1.500	3036	2024	1	12
K	1.944	4385	2256	1	16
L	2.500	5582	2233	2	12
M	2.444	5847	2392	1	16
N	3.000	7413	2471	1	16
P	4.167	11224	2693	2	16
R	5.555	16496	2970	2	16

Equations:

$$CFM = K\sqrt{\Delta P}$$

$$\Delta P = \left(\frac{CFM}{K}\right)^2$$

ΔP = Differential Pressure On AeroCross, IN WG

K = Flow Required To Produce A 1.0 IN WG Differential Pressure On AeroCross, CFM

Single Duct VAV Terminals

Receiving Inspection

After unpacking the terminal, check it for shipping damage. If any shipping damage is found, report it immediately to the delivering carrier. Store units in a clean, dry location prior to installation.

Caution: Do not use the flow sensor, connecting tubing, or damper shaft linkage as a handle to lift or move assembly. Damage to the flow sensor or controls may result.

Supporting the Assembly

Many basic single duct terminals are light enough to be supported by the duct work itself. Where heavier accessory modules, such as DDC controls, coils, attenuators, or multiple outlets are included, the terminal should be supported directly. Straps screwed directly into the side of the terminal, threaded rod through the opti onal hanger brackets (see Figure 1), or the method prescribed for the rect angular duct on the job specifications may be used.

Important: If equipped with pneumatic controls, the terminal must be mounted right side up. It must be level within + or - 10 degrees of horizontal, both parallel to the air flow and at the right angle of air flow. The control side of the terminal is labeled with an arrow indicating UP. The first letter of the model number (P) indicates pneumatic controls. Most electronic units (A- analog controls and D-digital controls) can be installed in any orientation. Check with the local TITUS representative for verification.

Duct Connections

Slip each inlet duct over the inlet collar of the terminal. Fasten and seal the connection by the method prescri bed by the job specification.

The diameter of the inlet duct "D" in inches must be equal to the listed size of the terminal; e.g. a duct that actually measures 8 inches must be fitted to a size 8 terminal. The inlet collar of the terminal is made 1/8 inch smaller than listed size in order to fit inside the duct (see Figure 1).

Note: Do not insert duct work inside the inlet collar of the assembly. Inlet duct should be installed in accordance with SMACNA guidelines.

The outlet end of the terminal is designed for use with slip and drive duct connections. A rectangular duct the size of the terminal outlet should be attached.

If single-point electronic velocity sensor is used, 3 to 5 inlet duct diameters of straight duct should be provided at the terminal inlet; for specific guidelines, consult the manufacturer's installation material. Sensor(s) may be attached to the inside of control enclosure for protection during shipping. Sensor must be inserted in inlet duct of terminal before operation. Remove any protective plastic devices from tip of sensor before installation.

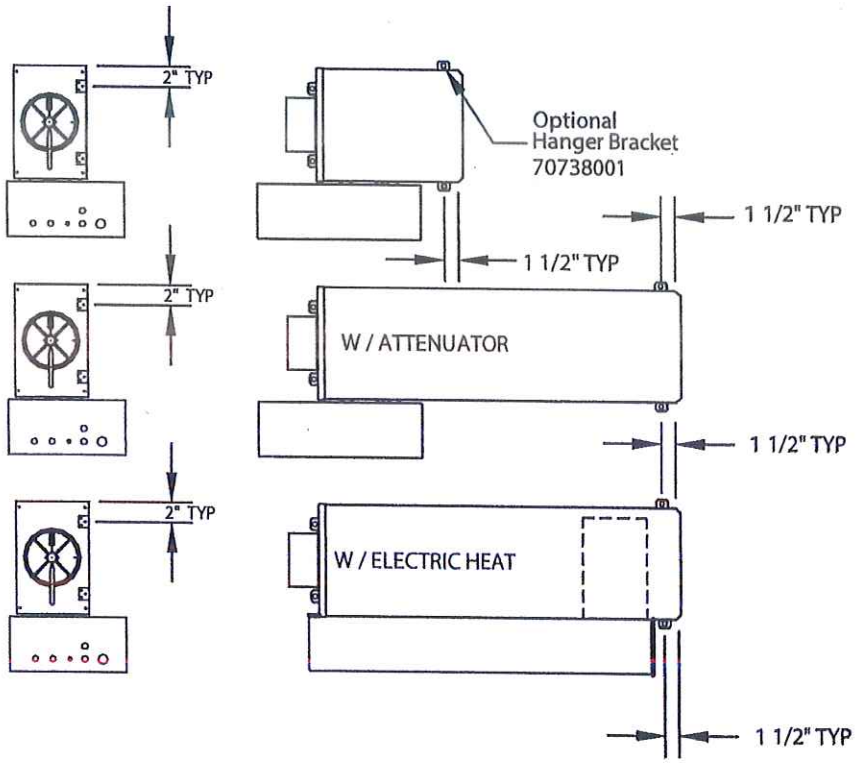

Figure 1. Single Duct Recommended Hanger Bracket Locations

Field Wiring

All field wiring must comply with the local codes and with the National Electrical Code (ANSI/NFPA 70-1981). Electrical, control and piping diagrams are shown on the exterior labeling or on the diagram on the inside of control enclosure cover. All electric heaters if provided by TITUS are balanced by kW per stage. The installing electrician should rotate these heater stages by phase in order to help balance the building electric load.

Control Start-up, Operation

Detailed information regarding power, accessory and communications connections, start-up and operating procedures for the controls provided by TITUS are available from your local TITUS representative. For specific information on controls by other manufacturers, contact that manufacturer's local branch or dealer.

Important: Units with digital controllers may incorporate specific communication addresses based on Building Management Systems Architecture, and original engineering drawings. Installing the terminal in a different location than noted on unit label may result in excessive start-up labor.

Calibration Instructions

For Pneumatic Controls, see PNEU-IOM: Operations Manual for Pneumatic Controls.

For Analog Controls: Titus TA1, see ANA-IOM: Analog Controller Calibration.

For Digital Controls: see control manufacturer's manual

Replacement Parts

Description	Part Number
Primary Damper Assembly	
Size 4-5-6"	31171301
Size 7"	31171302
Size 8"	31171303
Size 9"	31171304
Size 10"	31171305
Size 12"	31171306
Size 14"	31171307
Size 16"	31171308
Damper Shaft Extension	
Short Stub all sizes	70300301
Long Ext. Sz. 4-6, 14, 16	70300302
Long Ext. Sz. 7-12	70300303
Shaft Bearing - All	70324901
Control Tube	
Red Stripe 1/4" O.D.	61510035
Green Stripe 1/4" O.D.	61510234
Red Stripe 3/8" O.D.	61510279
Green Stripe 3/8" O.D.	61510280
Yellow Stripe 1/4" O.D.	61510260
White Stripe 1/4" O.D.	61510261
Blue Stripe 1/4" O.D.	61510262
Tees for sensor taps	
Plastic 1/4"	42150011
Plastic 3/8"	42150020
Plugs for tees	
1/4"	42160081
3/8"	10015601
AeroCross™ Multipoint Velocity Sensors	
Size 4"	3151520001
Size 5"	3151520001
Size 6"	3151520002
Size 7"	3151520003
Size 8"	3151520004
Size 9"	3151520005
Size 10"	3151520006
Size 12"	3151520007
Size 14"	3151520008
Size 16"	3151520009
Size 24" x 16"	3151520009