



FLO-CROSS® AIR FLOW SENSOR





APPLICATION

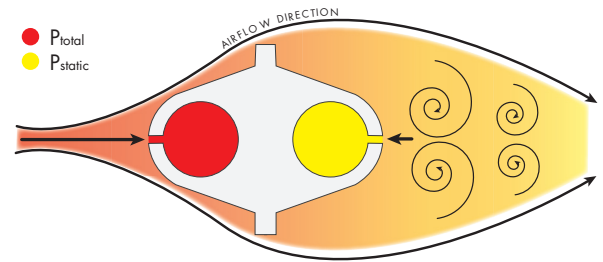
The Flo-Cross® is an original Barber-Colman design (former Barcol-Air) and is a multi-point averaging air flow sensor and is used to exactly measure the pressure difference inside a VAV/CAV terminal to determine the air flow rate going through the unit and/or air flow measuring station.

The Flo-Cross sensor amplifies the air differential pressure signal linearly with an amplification factor of at least 2.0. The sensor always contains at least 2x12 sensing points, which are arranged in two perpendicular axis. The sensing holes are arranged in such a way that each four points in a ring sense the air pressure across concentric circles of equal area in a round duct. The signal is then averaged and measured from the centre of the Flo-Cross. This can result in an accuracy of the signal better than 2,5% even with irregular duct approach.

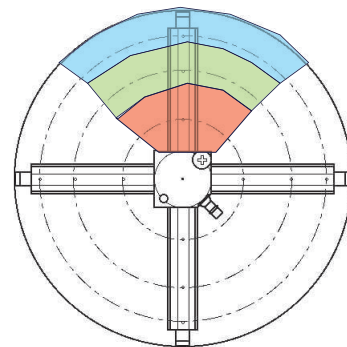
Specific for low air speed circumstances, the Flo-Cross® Low Velocity is available. This version provides a higher pressure difference at an equivalent air volume, making it more suitable for these specific air speed conditions.

BENEFITS

- Multiple test points (at least 2 x 12 points) equally distributed in the duct area.
- Only 1 diameter installations space required.
- High accuracy
- Centre averaged signal
- Linear amplified
- Available in different sizes



Special shaped wings provide a "Linear Amplification"



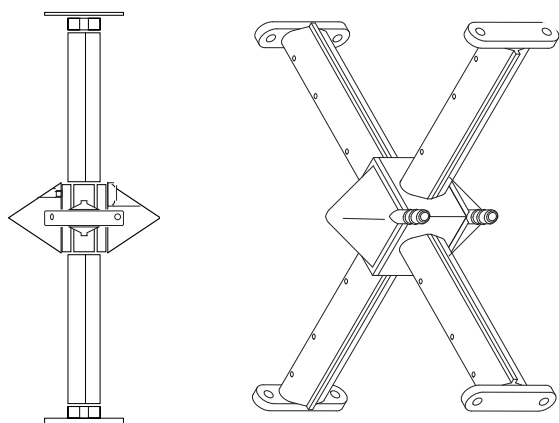
Test point locations according to the "Equal Area" method. Insensitive to air flow pattern!



CFD Presentation

WORKING PRINCIPLE

Flo-Cross® air flow sensor



Air flow calculation

For different types of VAV terminals with a Flo-Cross® air flow sensor, it is possible to calculate the air flow rate based on differential pressure through a special factor which is the Kv-value. The Kv-value is the air volume at a differential pressure of 1 Pascal.

Meaning of the different symbols in the formula:

- Q = Flow rate (l/s)
- Kv = Kv-value in (l/s/1Pa)
- ΔP = Flo-Cross® differential pressure (Pa)

Formula:

Air volume Q (l/s) = Kv x √ΔP

Example:

- Model Flo-Cross® = 200
- Kv-value = 23.73 l/s/1Pa
- Pressure difference ΔP = 100 Pa
- Flow rate Q = 23.73 x √100 = 237 l/s

To calculate the differential pressure at a given air flow rate, the following formula can be used:

Measuring signal ΔP = (Q / Kv)²

Example:

- Model Flo-Cross® = 125
- Kv-value = 8.11 l/s/1Pa
- Flow rate Q = 81 l/s
- Measuring signal ΔP = (81/8.11)² = 100Pa

Flo-Cross® pressure difference in Pa and air flow rate in l/s - SI unities for the standard Flo-Cross® models.

Model	Ø	100	125	160	200	250	315	355	400
Kv-values	l/s/Pa	5,37	8,11	14,39	23,73	35,28	59,68	73,91	92,23
Flo-Cross Δp	Pa	Air flow m³/h							
ca. 2.5 m/s	2	27	41	73	121	180	304	376	470
	4	39	58	104	171	254	430	532	664
	6	47	72	127	209	311	526	652	813
	8	55	83	147	242	359	608	753	939
	10	61	92	164	270	402	679	841	1050
	12	67	101	179	296	440	744	922	1150
	14	72	109	194	320	475	804	996	1242
	16	77	117	207	342	508	859	1064	1328
	18	82	124	220	362	539	912	1129	1409
	20	86	131	232	382	568	961	1190	1485
	25	97	146	259	427	635	1074	1330	1660
	30	106	160	284	468	696	1177	1457	1819
	35	114	173	306	505	751	1271	1574	1964
	40	122	185	328	540	803	1359	1683	2100
	45	130	196	348	573	852	1441	1785	2227
	50	137	206	366	604	898	1519	1881	2348
	55	143	217	384	634	942	1593	1973	2462
	60	150	226	401	662	984	1664	2061	2572
	65	156	235	418	689	1024	1732	2145	2677
	70	162	244	433	715	1063	1798	2226	2778
	75	167	253	449	740	1100	1861	2304	2875
	80	173	261	463	764	1136	1922	2380	2970
	85	178	269	478	788	1171	1981	2453	3061
	90	183	277	491	810	1205	2038	2524	3150
	95	188	285	505	833	1238	2094	2593	3236
	100	193	292	518	854	1270	2148	2661	3320
	110	203	306	543	896	1332	2253	2791	3482
	120	212	320	567	936	1391	2354	2915	3637
	130	220	333	591	974	1448	2450	3034	3786
	140	229	345	613	1011	1503	2542	3148	3929
	150	237	358	634	1046	1556	2631	3259	4066
	160	245	369	655	1081	1607	2718	3366	4200
	170	252	381	675	1114	1656	2801	3469	4329
	180	259	392	695	1146	1704	2882	3570	4455
	190	266	402	714	1178	1751	2961	3668	4577
	200	273	413	733	1208	1796	3038	3763	4696
	210	280	423	751	1238	1841	3113	3856	4812
	220	287	433	768	1267	1884	3187	3947	4925
	230	293	443	786	1296	1926	3258	4035	5035
	240	299	452	803	1323	1968	3328	4122	5144
ca. 12 m/s	250	306	462	819	1351	2008	3397	4207	5250
	300	335	506	897	1480	2200	3721	4609	5751
	350	362	546	969	1598	2376	4019	4978	6212
	400	387	584	1036	1709	2540	4297	5322	6641
	450	410	619	1099	1812	2694	4558	5644	7043
	500	432	653	1158	1910	2840	4804	5950	7424

The Kv-value is set according to the specific mass of air of 1,2 kg/m³.

Flo-Cross® Low Velocity pressure difference in Pa and air flow rate in l/s - SI unities for the standard Flo-Cross® Low Velocity models.

Model 3193	Ø	100	125	160	200	250	315	355
Kv-values	l/s/Pa	4,56	6,28	12,09	19,96	29,04	55,34	73,57
Flo-Cross Δp	Pa	Air flow m ³ /h						
	2	23	32	62	102	148	282	375
	4	33	45	87	144	209	398	530
	6	40	55	107	176	256	488	649
	8	46	64	123	203	296	563	749
	10	52	71	138	227	331	630	838
ca. 2.5 m/s	12	57	78	151	249	362	690	917
	14	61	85	163	269	391	745	991
	16	66	90	174	287	418	797	1059
	18	70	96	185	305	444	845	1124
	20	73	101	195	321	468	891	1184
	25	82	113	218	359	523	996	1324
	30	90	124	238	394	573	1091	1451
	35	97	134	257	425	618	1179	1567
	40	104	143	275	454	661	1260	1675
	45	110	152	292	482	701	1336	1777
	50	116	160	308	508	739	1409	1873
	55	122	168	323	533	775	1477	1964
	60	127	175	337	557	810	1543	2052
	65	132	182	351	579	843	1606	2135
	70	137	189	364	601	875	1667	2216
	75	142	196	377	622	905	1725	2294
	80	147	202	389	643	935	1782	2369
	85	151	208	401	662	964	1837	2442
	90	156	214	413	682	992	1890	2513
	95	160	220	424	700	1019	1942	2581
	100	164	226	435	719	1045	1992	2649
	110	172	237	456	754	1096	2089	2778
	120	180	248	477	787	1145	2182	2901
	130	187	258	496	819	1192	2272	3020
	140	194	268	515	850	1237	2357	3134
	150	201	277	533	880	1280	2440	3244
	160	208	286	551	909	1322	2520	3350
	170	214	295	567	937	1363	2598	3453
	180	220	303	584	964	1403	2673	3553
	190	226	312	600	990	1441	2746	3651
	200	232	320	616	1016	1478	2817	3746
	210	238	328	631	1041	1515	2887	3838
	220	243	335	646	1066	1551	2955	3928
	230	249	343	660	1090	1585	3021	4017
	240	254	350	674	1113	1620	3086	4103
ca. 12 m/s	250	260	357	688	1136	1653	3150	4188
	300	284	392	754	1245	1811	3451	4587
	350	307	423	814	1344	1956	3727	4955
	400	328	452	870	1437	2091	3984	5297
	450	348	480	923	1524	2218	4226	5618
	500	367	506	973	1607	2338	4455	5922

The Kv-value is set according to the specific mass of air of 1,2 kg/m³.

ACCURACY

Based on many years of experience and lots of measurements carried out in our test laboratory and also at different project sites, we herewith present an overview of the air flow rate accuracy in different installations. The accuracy depends on the following parameters.

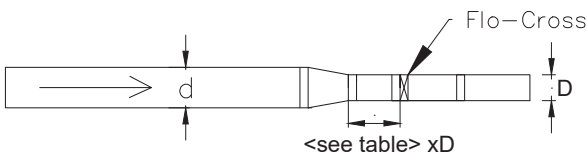
- Duct diameter/size (generally bigger size diameter will result in better accuracy)
- Straight installation length expressed in $x \cdot D$ (generally the longer straight installation length, the better accuracy)
- Air velocity (generally the higher velocity will result in better accuracy)
- Installation type (different for different type installation)

Straight duct approach after a progression to a smaller diameter (1 size)

0 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	2,5%	< 2,5%	< 2,5%
> 2.0 m/s	2,5%	< 2,5%	< 2,5%

1 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	2,5%	< 2,5%	< 2,5%
> 2.0 m/s	2,5%	< 2,5%	< 2,5%

2 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	< 2,5%	< 2,5%	< 2,5%
> 2.0 m/s	< 2,5%	< 2,5%	< 2,5%

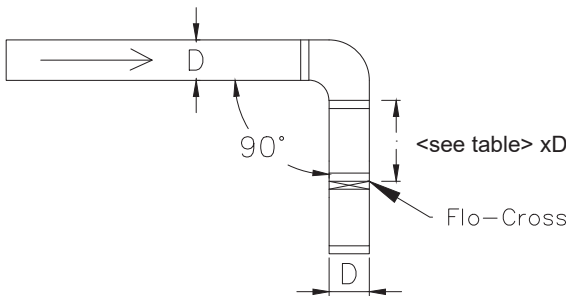


After a 90 degree bend

0 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	5,0%	5,0%	5,0%
> 2.0 m/s	3,5%	4,5%	3,0%

1 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	4,0%	3,5%	2,5%
> 2.0 m/s	2,5%	4,0%	< 2,5%

2 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	3,0%	< 2,5%	< 2,5%
> 2.0 m/s	< 2,5%	2,5%	< 2,5%

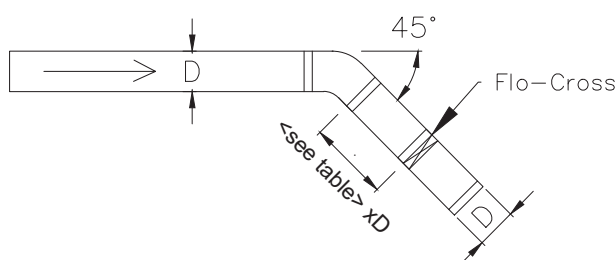


After a 45 degree bend

0 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	5,0%	5,0%	5,0%
> 2.0 m/s	2,5%	2,5%	< 2,5%

1 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	3,0%	3,5%	3,0%
> 2.0 m/s	< 2,5%	3,0%	< 2,5%

2 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	< 2,5%	< 2,5%	< 2,5%
> 2.0 m/s	< 2,5%	< 2,5%	< 2,5%



After a T-junction with a 90 degree branch into the same diameter

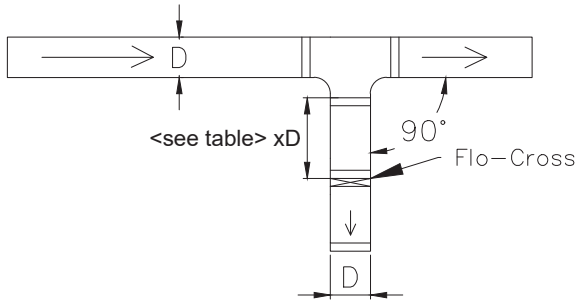
0 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	5,0%	13,5%	12,0%
> 2.0 m/s	3,0%	13,0%	12,0%

1 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	3,0%	7,0%	5,0%
> 2.0 m/s	7,0%	5,0%	2,5%

2 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	8,0%	< 2,5%	< 2,5%
> 2.0 m/s	7,5%	2,5%	2,5%

3 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	7,0%	3,0%	< 2,5%
> 2.0 m/s	6,0%	3,0%	< 2,5%

4 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	2,5%	< 2,5%	< 2,5%
> 2.0 m/s	3,5%	< 2,5%	< 2,5%



After a T-junction with a 90 degree branch into a smaller diameter (2 sizes)

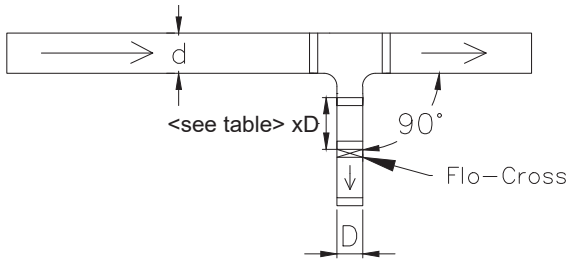
0 x D	200 -> 125	250 -> 160
1.0 - 2.0 m/s	13,0%	3,0%
> 2.0 m/s	22,5%	4,0%

1 x D	200 -> 125	250 -> 160
1.0 - 2.0 m/s	10,5%	3,0%
> 2.0 m/s	19,0%	3,0%

2 x D	200 -> 125	250 -> 160
1.0 - 2.0 m/s	5,0%	< 2,5%
> 2.0 m/s	7,0%	2,5%

3 x D	200 -> 125	250 -> 160
1.0 - 2.0 m/s	3,5%	< 2,5%
> 2.0 m/s	4,0%	2,5%

4 x D	200 -> 125	250 -> 160
1.0 - 2.0 m/s	< 2,5%	< 2,5%
> 2.0 m/s	3,5%	< 2,5%

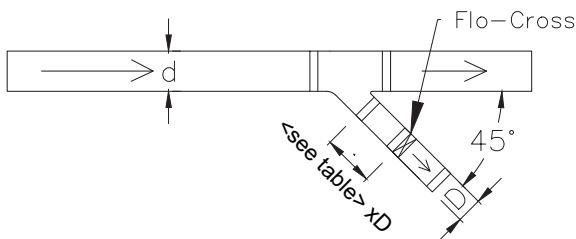


After a T-junction with a 45 degree branch into a smaller diameter (2 sizes)

0 x D	200 -> 125	250 -> 160
1.0 - 2.0 m/s	2,5%	3,0%
> 2.0 m/s	< 2,5%	< 2,5%

1 x D	200 -> 125	250 -> 160
1.0 - 2.0 m/s	2,5%	2,5%
> 2.0 m/s	< 2,5%	< 2,5%

2 x D	200 -> 125	250 -> 160
1.0 - 2.0 m/s	< 2,5%	< 2,5%
> 2.0 m/s	< 2,5%	< 2,5%





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