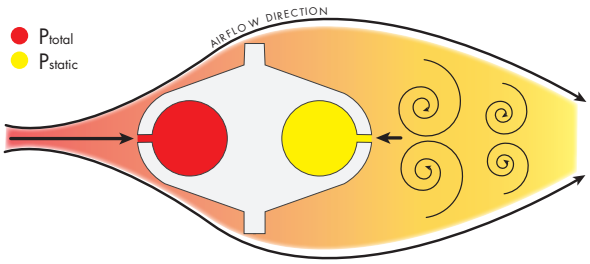
FLO-CROSS® AIR FLOW SENSOR

BARCOL-AIR
AIR DISTRIBUTION & CONTROLS



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.

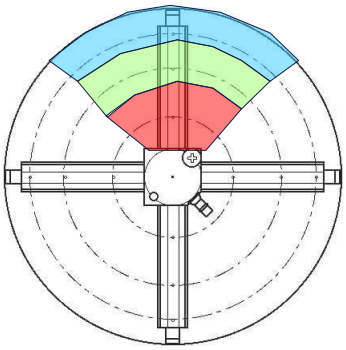
The Flo-Cross sensor amplifies the air differential pressure signal linearly with an amplification factor of at least 2.0. The sensor always contains at least 2x12 sensing points, which are arranged in two perpendicular axis. The sensing holes are arranged in such a way that each four points in a ring sense the air pressure across concentric circles of equal area in a round duct. The signal is than 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”

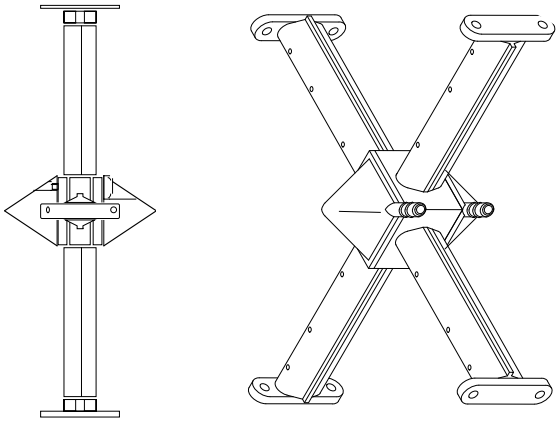


Test point locations according to the “Equal Area” method. Insensitive to air flow pattern!

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 l/s							
	2	8	11	20	34	50	84	105	130
	4	11	16	29	47	71	119	148	184
	6	13	20	35	58	86	146	181	226
	8	15	23	41	67	100	169	209	261
ca. 2.5 m/s	10	17	26	46	75	112	189	234	292
	12	19	28	50	82	122	207	256	319
	14	20	30	54	89	132	223	277	345
	16	21	32	58	95	141	239	296	369
	18	23	34	61	101	150	253	314	391
	20	24	36	64	106	158	267	331	412
	25	27	41	72	119	176	298	370	461
	30	29	44	79	130	193	327	405	505
	35	32	48	85	140	209	353	437	545
	40	34	51	91	150	223	377	467	583
	45	36	54	97	159	237	400	496	618
	50	38	57	102	168	249	422	523	652
	55	40	60	107	176	262	443	548	684
	60	42	63	111	184	273	462	573	714
	65	43	65	116	191	284	481	596	743
	70	45	68	120	199	295	499	618	771
	75	47	70	125	206	306	517	640	798
	80	48	73	129	212	316	534	661	825
	85	50	75	133	219	325	550	681	850
	90	51	77	137	225	335	566	701	875
	95	52	79	140	231	344	582	720	899
	100	54	81	144	237	353	597	739	922
	110	56	85	151	249	370	626	775	967
	120	59	89	158	260	386	654	810	1010
	130	61	92	164	271	402	680	843	1051
	140	64	96	170	281	417	706	875	1091
	150	66	99	176	291	432	731	905	1129
	160	68	103	182	300	446	755	935	1166
	170	70	106	188	309	460	778	964	1202
	180	72	109	193	318	473	801	992	1237
	190	74	112	198	327	486	823	1019	1271
	200	76	115	204	336	499	844	1045	1304
	210	78	118	209	344	511	865	1071	1336
	220	80	120	213	352	523	885	1096	1368
	230	81	123	218	360	535	905	1121	1398
	240	83	126	223	368	547	925	1145	1428
ca. 12 m/s	250	85	128	228	375	558	944	1169	1458
	300	93	140	249	411	611	1034	1280	1597
	350	100	152	269	444	660	1117	1383	1725
	400	107	162	288	475	706	1194	1478	1844
	450	114	172	305	503	748	1266	1568	1956
	500	120	181	322	531	789	1334	1653	2062

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 l/s						
	2	6	9	17	28	41	78	104
	4	9	13	24	40	58	111	147
	6	11	15	30	49	71	136	180
	8	13	18	34	56	82	157	208
	10	14	20	38	63	92	175	233
	12	16	22	42	69	101	192	255
ca. 2.5 m/s	14	17	23	45	75	109	207	275
	16	18	25	48	80	116	221	294
	18	19	27	51	85	123	235	312
	20	20	28	54	89	130	247	329
	25	23	31	60	100	145	277	368
	30	25	34	66	109	159	303	403
	35	27	37	72	118	172	327	435
	40	29	40	76	126	184	350	465
	45	31	42	81	134	195	371	494
	50	32	44	85	141	205	391	520
	55	34	47	90	148	215	410	546
	60	35	49	94	155	225	429	570
	65	37	51	97	161	234	446	593
	70	38	53	101	167	243	463	616
	75	39	54	105	173	251	479	637
	80	41	56	108	179	260	495	658
	85	42	58	111	184	268	510	678
	90	43	60	115	189	275	525	698
	95	44	61	118	195	283	539	717
	100	46	63	121	200	290	553	736
	110	48	66	127	209	305	580	772
	120	50	69	132	219	318	606	806
	130	52	72	138	228	331	631	839
	140	54	74	143	236	344	655	870
	150	56	77	148	244	356	678	901
	160	58	79	153	252	367	700	931
	170	59	82	158	260	379	722	959
	180	61	84	162	268	390	742	987
	190	63	87	167	275	400	763	1014
	200	64	89	171	282	411	783	1040
	210	66	91	175	289	421	802	1066
	220	68	93	179	296	431	821	1091
	230	69	95	183	303	440	839	1116
	240	71	97	187	309	450	857	1140
	250	72	99	191	316	459	875	1163
	300	79	109	209	346	503	959	1274
ca. 12 m/s	350	85	117	226	373	543	1035	1376
	400	91	126	242	399	581	1107	1471
	450	97	133	256	423	616	1174	1561
	500	102	140	270	446	649	1237	1645

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 caried 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.

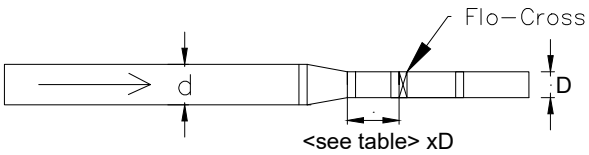
- Duct diameter/size (generally bigger size diameter will result in better accuracy)
- Straight installation length expressed in x * D (generally the longer straight installation length, the better accuracy)
- Air velocity (generally the higher velocity will result in better accuracy)
- Installation 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%

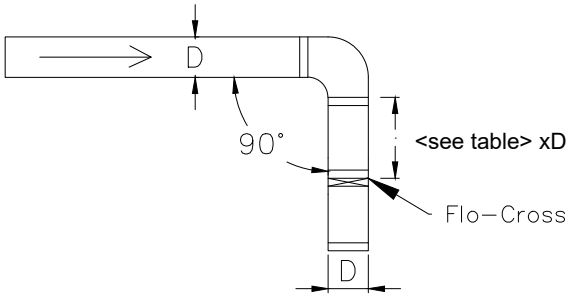


After a 90 degree bend

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%

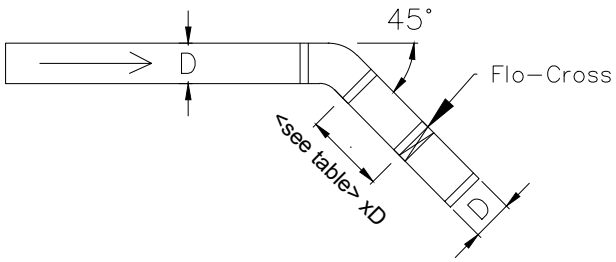


After a 45 degree bend

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

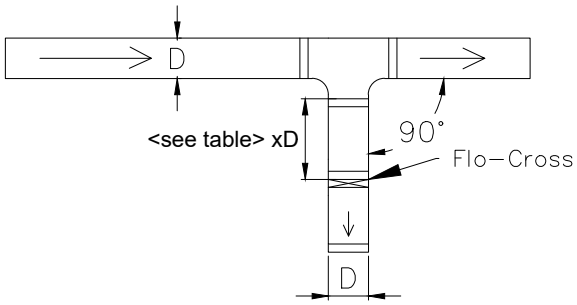
0 x D	100/125	160/200	>=250
1.0 - 2.0 m/s	5,0%	13,5%	12,0%
> 2.0 m/s	3,0%	13,0%	12,0%

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)

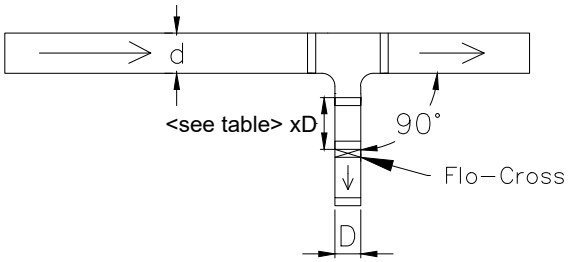
0 x D	200 -> 125	250 -> 160
1.0 - 2.0 m/s	13,0%	3,0%
> 2.0 m/s	22,5%	4,0%

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%

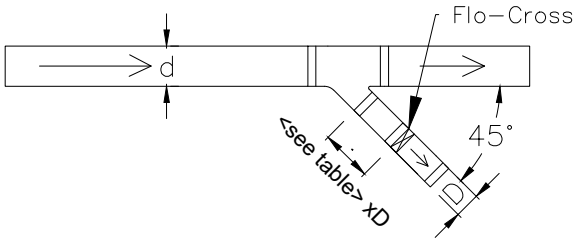


After a T-junction with a 45 degree branch into a smaller diameter (2 sizes)

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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