SECTION 4

AIR DISTRIBUTION SYSTEMS

DUCT SIZING METHODS

General

The objective is to size the ductwork so that the total pressure loss along each flow path provides the correct air quantity through the network at each terminal without generating unacceptable noise.

A number of methods are used to size air conditioning ductwork and include:-

1. Velocity reduction method.
2. Constant pressure gradient method.
3. Balanced pressure drop method.
4. Static regain method.

Velocity reduction method

Each duct segment is sized on a specified velocity. The velocity is selected on the basis of experience and is reduced along the duct run.

Constant pressure gradient method

Each segment of the ductwork system is sized on the basis of a selected fixed pressure gradient. The pressure gradient is expressed in terms of unit length of straight duct, a value of 1.00 Pa/m is typical. This method is often termed the equal friction method.

Balanced pressure drop method

This is essentially a resizing method. Duct sizes initially sized by some other method or combination of methods are adjusted such that there is an equal pressure drop along all air flow paths, from the fan to each terminal. This will minimise the amount of pressure required to be taken up by balancing devices in the network. From the initial sizing calculations the path with the greatest pressure loss (the index run) is determined. The size of the segments in all other paths are then adjusted such that all paths have the same pressure drop as the index run.

Static regain method

This method is applicable to supply air duct systems only.

The static regain method sizes the ductwork system so that the pressure recovery due to decrease in velocity at each branch or velocity fitting just offsets the friction loss in the succeeding section of duct. The static pressure will then in theory be the same at each terminal and at each branch throughout the system.

Note: -

For full and detailed information on the design of duct systems including the calculation of system total pressure and fan selection, reference should be made to:-

AIRAH Application Manual DA3 - Ductwork for Air Conditioning and

AIRAH Application Manual DA13 - Fans - Selection and Application.

DUCT SYSTEM PRESSURE LOSSES

The total system resistance loss in a duct system is a combination of friction and dynamic losses.

Straight Ducts - In straight parallel ducts, dynamic loss is insignificant so the total loss is assumed as all friction. This value may be obtained from the following duct friction chart or if using the Constant Pressure Gradient Method of sizing a value for friction loss is assumed, e.g., 1.00 Pa/m.

Duct Fittings - For duct fittings both dynamic and friction losses are significant. Data for fittings are given in the following tables in terms of total loss, expressed as a Loss Coefficient K_T. The total pressure loss for a duct fitting is an expression of pressure loss in terms of velocity pressure or velocity pressure difference multiplied by the loss coefficient. Values of velocity pressure may be obtained from the following chart.

Total pressure loss of a fitting is given by:-

$$P_T = K_T P_V$$

where:-

P_T = total pressure loss through fitting (Pa)

K_T = loss coefficient

P_V = velocity pressure (Pa)

Velocity pressure is given by:-

$$P_V = 0.50 \rho V^2$$

$$= 0.60 V^2 \text{ for air at } 20°C.$$

where:-

V = velocity of the air stream (m/s)

For a circular duct,

V = 1273 x (Flow, L/s) / (diameter, mm)^2 (m/s)

ρ = density of air (kg/m^3)

Values of velocity pressure may be read from the following table.

VELOCITY PRESSURE - AIR (P_V)

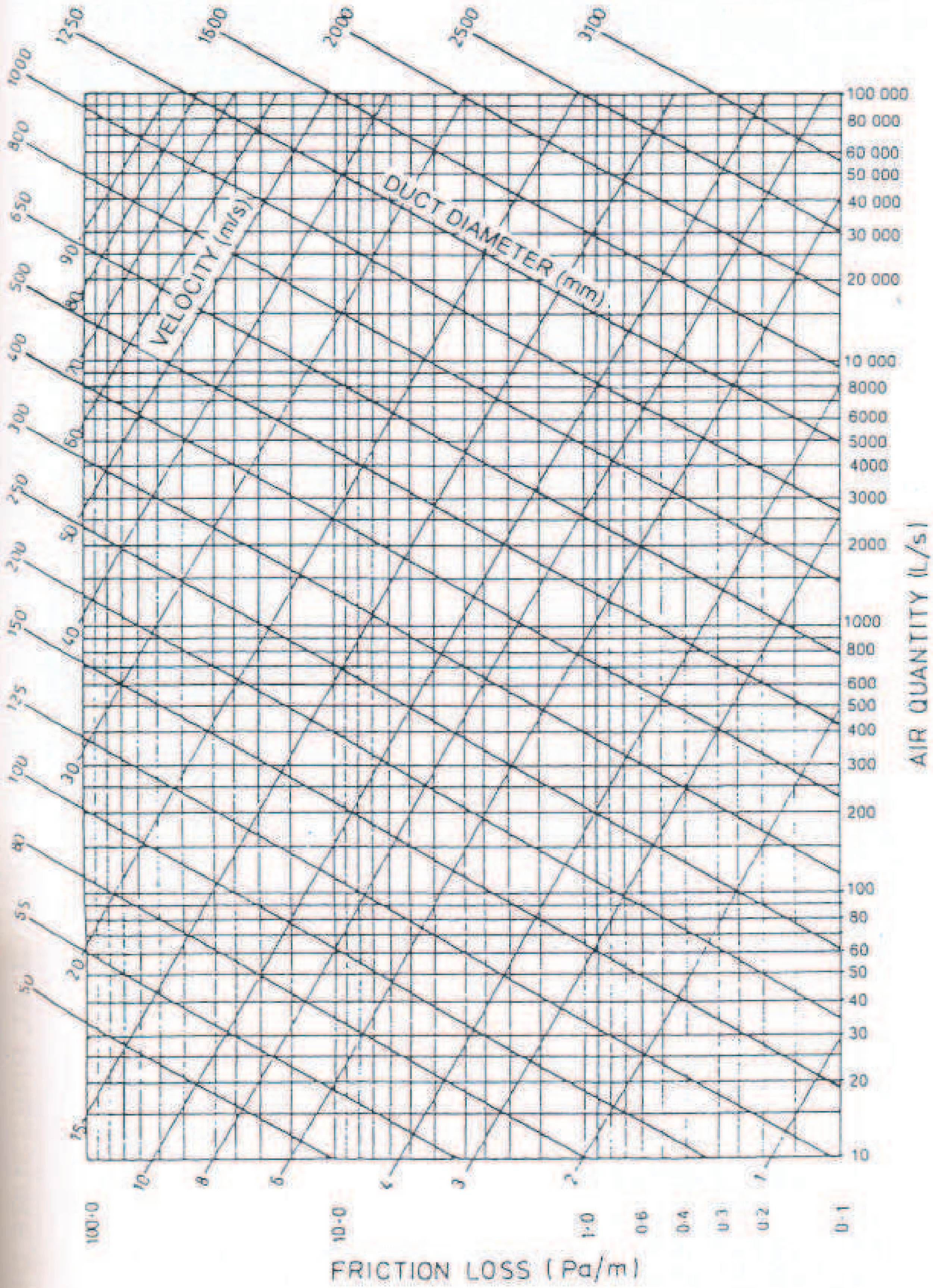
Velocity (m/s)	Velocity pressure (Pa)
1.00	0.60
1.25	0.94
1.50	1.35
1.75	1.84
2.00	2.40
2.25	3.04
2.50	3.75
2.75	4.54
3.00	5.40
3.25	6.34
3.50	7.35
3.75	8.44
4.00	9.6
4.25	10.8
4.50	12.2
4.75	13.5
5.00	15.0
5.25	16.5
5.50	18.2
5.75	19.8
6.00	21.6
6.25	23.4
6.50	25.4
6.75	27.3
7.00	29.4

Velocity (m/s)	Velocity pressure (Pa)
7.25	32
7.50	34
7.75	36
8.00	38
8.25	41
8.50	43
8.75	46
9.00	49
9.25	51
9.50	54
9.75	57
10.0	60
12.5	94
15.0	135
17.5	184
20.0	240
22.5	304
25.0	375
27.5	454
30.0	540
35.0	735
40.0	960
45.0	1215
50.0	1500

$P_v = 0.5\ \rho V^2 = 0.60\ V^2$ Pa for air at 20°C

PRESSURE LOSS - CIRCULAR METAL DUCT

DRY AIR at 20°C and 101.325kPa



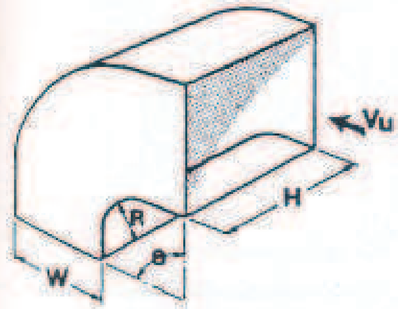
CIRCULAR EQUIVALENT OF RECTANGULAR DUCTS FOR EQUAL PRESSURE DROP

Refer: Eqn. 3-110e of AIRAH DA3

	Rectangular Duct Side, mm																													
Rectangular Duct Side, mm	100	125	150	175	200	225	250	275	300	350	400	450	500	550	600	650	700	750	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
100	109																													
125	122	137																												
150	133	150	164																											
175	143	161	177	191																										
200	152	172	189	204	219																									
225	161	181	200	216	232	246																								
250	169	190	210	228	244	259	273																							
275	179	199	220	238	256	272	287	301																						
300	183	207	229	248	266	283	299	314	328																					
350	195	222	245	267	286	305	322	339	354	383																				
400	207	235	260	283	305	325	343	361	378	409	437																			
450	217	247	274	299	321	343	363	382	400	433	464	492																		
500	227	258	287	313	337	360	381	401	420	455	488	518	547																	
550	236	269	299	326	352	375	398	419	439	477	511	543	573	601																
600	245	279	310	339	365	390	414	436	457	496	533	567	598	628	656															
650	253	289	321	351	378	404	429	452	474	515	553	589	622	653	683	711														
700	261	298	331	362	391	418	443	467	490	533	573	610	644	677	708	737	765													
750	268	306	341	373	402	430	457	482	506	550	592	630	666	700	732	763	792	820												
800	275	314	350	383	414	442	470	492	520	567	609	649	687	722	755	787	818	847	875											
900	289	330	367	402	435	465	494	522	548	597	643	686	726	763	799	833	866	897	927	984										
1000	301	344	384	420	454	486	517	546	574	626	674	719	762	802	840	876	911	944	976	1037	1093									
1100	313	358	399	437	473	506	538	569	598	652	703	751	795	838	878	916	953	988	1022	1086	1146	1202								
1200	324	370	413	453	490	525	558	590	620	677	731	780	827	872	914	954	993	1030	1066	1133	1196	1256	1312							
1300	334	382	426	468	506	543	577	610	642	701	757	808	857	904	948	990	1031	1069	1107	1177	1244	1306	1365	1421						
1400	344	394	439	482	522	559	595	629	662	724	781	835	886	934	980	1024	1066	1107	1146	1220	1289	1354	1416	1475	1530					
1500	353	404	452	495	536	575	612	648	681	745	805	860	913	963	1011	1057	1100	1143	1183	1260	1332	1400	1464	1526	1584	1640				
1600	362	415	463	508	551	591	629	665	700	766	827	885	939	991	1041	1088	1133	1177	1219	1298	1373	1444	1511	1574	1675	1693	1749			
1700	371	425	475	521	564	605	644	682	718	785	849	908	964	1018	1069	1118	1164	1209	1253	1335	1413	1486	1555	1621	1684	1745	1803	1858		
1800		434	485	533	577	619	660	698	735	804	869	930	988	1043	1096	1146	1195	1241	1286	1371	1451	1527	1598	1667	1732	1794	1854	1912	1968	
1900			496	544	590	633	674	713	751	823	889	952	1012	1068	1122	1174	1224	1271	1318	1405	1488	1566	1640	1710	1778	1842	1904	1964	2021	2077
2000				555	602	646	688	728	767	840	908	973	1034	1092	1147	1200	1252	1301	1348	1438	1523	1604	1680	1753	1822	1889	1952	2014	2073	2131
2100					614	659	702	743	782	857	927	993	1055	1115	1172	1226	1279	1329	1378	1470	1558	1640	1719	1793	1865	1933	1999	2063	2124	2183
2200						671	715	757	797	874	945	1013	1076	1137	1195	1251	1305	1356	1406	1501	1591	1676	1756	1833	1906	1977	2044	2110	2173	2233
2300							728	771	812	890	963	1031	1097	1159	1218	1275	1330	1383	1434	1532	1623	1710	1793	1871	1947	2013	2088	2155	2220	2283
2400								784	826	905	980	1050	1116	1180	1241	1299	1355	1409	1461	1561	1655	1744	1828	1909	1986	2060	2131	2200	2266	2330
2500									840	920	996	1068	1136	1200	1283	1322	1379	1434	1488	1589	1685	1776	1862	1945	2024	2100	2173	2243	2311	2377
2600										935	1012	1085	1154	1220	1285	1344	1402	1459	1513	1617	1715	1809	1896	1980	2061	2139	2213	2285	2355	2422
2700											1028	1102	1173	1240	1304	1366	1425	1483	1538	1644	1744	1839	1929	2015	2097	2177	2253	2327	2398	2466
2800												1119	1190	1259	1324	1387	1447	1506	1562	1670	1772	1869	1961	2048	2133	2214	2292	2367	2439	2510
2900													1208	1277	1344	1403	1469	1529	1586	1696	1800	1898	1992	2081	2167	2250	2329	2406	2480	2552

BENDS

FITTING No. 001 RECTANGULAR RADIUSED BEND



R = throat radius

ASPECT RATIO H/W	RADIUS RATIO R/W			
	0.25	0.5	1.0	1.5
0.25	0.57	0.27	0.22	0.20
0.5	0.52	0.25	0.20	0.18
0.75	0.48	0.23	0.19	0.16
1.0	0.44	0.21	0.17	0.15
1.5	0.40	0.19	0.15	0.14
2.0	0.39	0.18	0.14	0.13
3.0	0.39	0.18	0.14	0.13
4.0	0.40	0.19	0.15	0.14
5.0	0.42	0.20	0.16	0.14
6.0	0.43	0.21	0.17	0.15
8.0	0.44	0.21	0.17	0.15

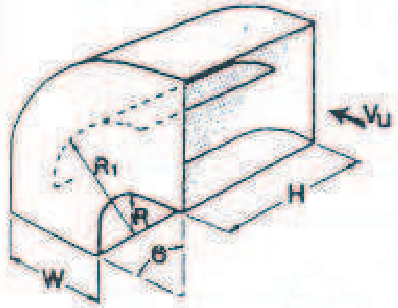
BEND ANGLE θ°	BEND ANGLE CORRECTION
20	0.31
30	0.45
45	0.60
60	0.78
75	0.90
90	1.00
110	1.13
130	1.20
150	1.28
180	1.40

IHVE-HVRA

$k_T = k'_T \times k_{Re}$ k_{Re} = Reynolds No. correction.

$R_e \times 10^{-4}$	1.0	2.0	3.0	4.0	6.0	8.0	10.0	14.0	≥ 20.0
k_{Re}	2.0	1.77	1.64	1.56	1.46	1.38	1.30	1.15	1.0

FITTING No. 002 RECTANGULAR RADIUSED BEND WITH 1 SPLITTER

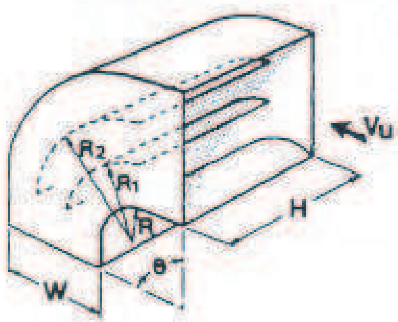


RADIUS RATIO R/W	ASPECT RATIO H/W										
	0.25	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0
0.05	0.52	0.40	0.43	0.49	0.55	0.66	0.75	0.84	0.93	1.0	1.1
0.10	0.36	0.27	0.25	0.28	0.30	0.35	0.39	0.42	0.46	0.49	0.52
0.15	0.28	0.21	0.18	0.19	0.20	0.22	0.25	0.26	0.28	0.30	0.32
0.20	0.22	0.16	0.14	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21
0.25	0.18	0.13	0.11	0.11	0.11	0.12	0.13	0.14	0.14	0.15	0.15
0.30	0.15	0.11	0.09	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.12
0.35	0.13	0.09	0.08	0.07	0.07	0.08	0.08	0.08	0.08	0.09	0.09
0.40	0.11	0.08	0.07	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07
0.45	0.10	0.07	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06
0.50	0.09	0.06	0.05	0.05	0.04	0.04	0.04	0.05	0.05	0.05	0.05

ASHRAE85

R = throat radius
R_1 = splitter vane radius = R/CR
Bend Angle correction as for Fitting No. 001

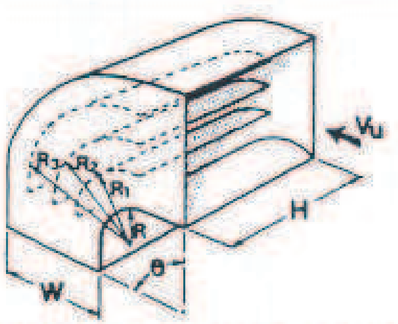
FITTING No. 004 RECTANGULAR RADIUSED BEND WITH 2 SPLITTERS



RADIUS RATIO R/W	ASPECT RATIO H/W										
	0.25	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0
0.05	0.26	0.20	0.22	0.25	0.28	0.33	0.37	0.41	0.45	0.48	0.51
0.10	0.17	0.13	0.11	0.12	0.13	0.15	0.16	0.17	0.19	0.20	0.21
0.15	0.12	0.09	0.08	0.08	0.08	0.09	0.10	0.10	0.11	0.11	0.11
0.20	0.09	0.07	0.06	0.05	0.06	0.06	0.06	0.06	0.07	0.07	0.07
0.25	0.08	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05
0.30	0.06	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04

R = throat radius
R_1 = splitter #1 radius = R/CR R_2 = splitter #2 radius = R/CR^2
Bend Angle correction as for Fitting No. 001

FITTING No. 006 RECTANGULAR RADIUSED BEND WITH 3 SPLITTERS



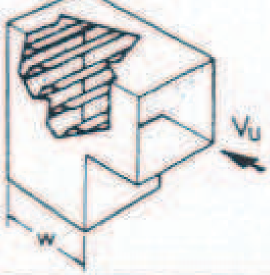
RADIUS RATIO R/W	ASPECT RATIO H/W										
	0.25	0.5	1.0	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0
0.05	0.11	0.10	0.12	0.13	0.14	0.16	0.18	0.19	0.21	0.22	0.23
0.10	0.07	0.05	0.06	0.06	0.06	0.07	0.07	0.08	0.08	0.08	0.09

R = throat radius
R_1 = splitter #1 radius = R/CR, R_2 = splitter #2 radius = R/CR^2,
R_3 = splitter #3 radius = R/CR^3,
Bend Angle correction as for Fitting No. 001

Total Loss Coefficients for Duct Fittings (k_T based on V_D)

BENDS (cont.)

FITTING No. 003 RECTANGULAR MITRE BEND WITH SINGLE SKIN TURNING VANES



SPACING (mm)	k_T
40	0.12
50	0.15
80	0.18
100	0.25
> 100	0.30

ASHRAE85/HVRA

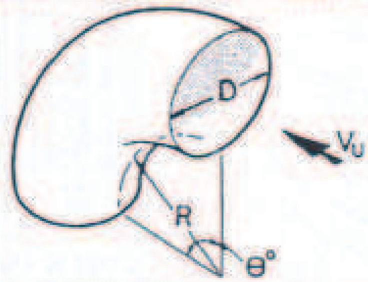
FITTING No. 005 RECTANGULAR MITRE BEND WITH SINGLE SKIN TURNING VANE PLUS TRAILING EDGE EXTENSION

Pressure drop as for Fitting No. 003
but no interaction on next fitting

FITTING No. 007 RECTANGULAR MITRE BEND WITH DOUBLE SKIN TURNING VANES (EMBOSSED VANE RUNNER)

Pressure drop as for Fitting No. 003
but no interaction on next fitting

FITTING No. 011 CIRCULAR RADIUSED BEND

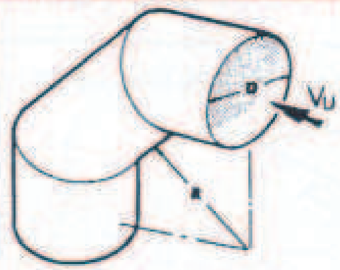


RADIUS RATIO R/D	k_T
0.25	0.45
0.50	0.34
1.0	0.24
1.5	0.23
2.5	0.22

Bend Angle correction
as for Fitting No. 001

IHVE

FITTING No. 012 CIRCULAR THREE PIECE BEND

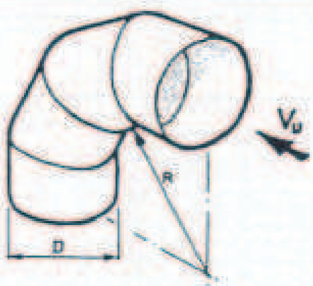


RADIUS RATIO R/D	k_T
0.25	0.58
0.50	0.46
1.0	0.40
1.5	0.42
2.5	0.46

Bend Angle correction
as for Fitting No. 001

IHVE

FITTING No. 013 CIRCULAR FOUR PIECE BEND

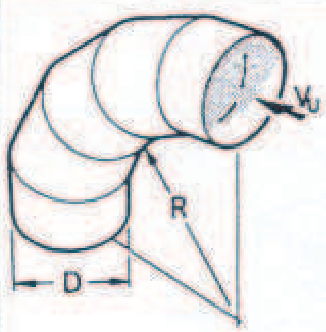


RADIUS RATIO R/D	k_T
0.25	0.56
0.5	0.42
1.0	0.34
1.5	0.32
2.5	0.34

Bend Angle correction
as for Fitting No. 001

IHVE

FITTING No. 014 CIRCULAR FIVE PIECE BEND

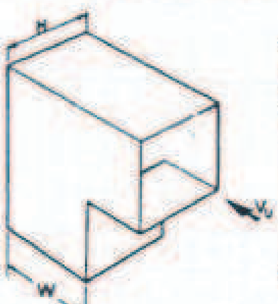


RADIUS RATIO R/D	k_T
0.25	0.50
0.5	0.36
1.0	0.30
1.5	0.26
2.5	0.26

Bend Angle correction
as for Fitting No. 001

IHVE

FITTING No. 021 RECTANGULAR MITRE BEND WITHOUT BUFFER



ASPECT RATIO H/W	k_T
0.25	1.30
0.5	1.27
1.0	1.19
2.0	1.07
4.0	0.92
6.0	0.85
8.0	0.81

U.S.A.E.C.

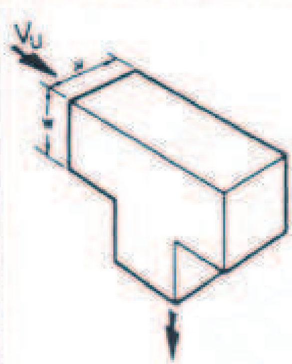
BEND ANGLE	CORRECTION
90	1.0
75	0.67
60	0.46
45	0.28
30	0.13
20	0.06

ASHRAE85

$k_T = k_T \times k_{Re}$ k_{Re} = Reynolds No. correction

$R_e \times 10^{-4}$	1.0	2.0	3.0	4.0	6.0	8.0	10.0	≥14.0
k_{Re}	1.40	1.26	1.19	1.14	1.09	1.06	1.04	1.0

FITTING No. 022 RECTANGULAR MITRE BEND WITH BUFFER



ASPECT RATIO H/W	k_T
0.25	1.57
0.5	1.52
1.0	1.43
2.0	1.29
4.0	1.10
6.0	1.02
8.0	0.98

U.S.A.E.C.

Fitting Angle connection
as for Fitting No. 021

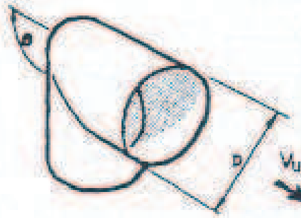
$k_T = k'_T \times k_{Re}$ k_{Re} = Reynolds No. correction

$R_e \times 10^{-4}$	1.0	2.0	3.0	4.0	6.0	8.0	10.0	≥14.0
k_{Re}	1.40	1.26	1.19	1.14	1.09	1.06	1.04	1.0

Total Loss Coefficients for Duct Fittings (k_T based on V_0)

BENDS AND TEES

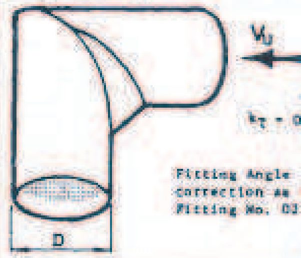
FITTING No. 023 CIRCULAR MITRE BEND



ANGLE θ	k_T
90	1.2
75	0.81
60	0.55
45	0.34
30	0.16
20	0.08

ASHRAE85

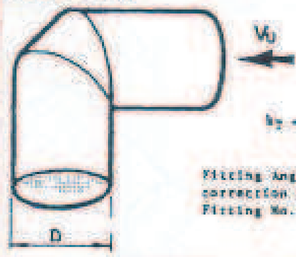
FITTING No. 024 CIRCULAR MITRE BEND WITH THROAT CORE



$k_T = 0.86$

Fitting Angle correction as for Fitting No. 023

FITTING No. 025 CIRCULAR MITRE BEND WITH HEEL CORE



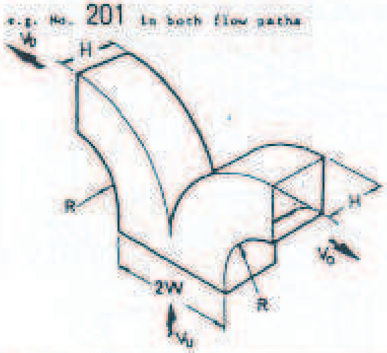
$k_T = 1.05$

Fitting Angle correction as for Fitting No. 023

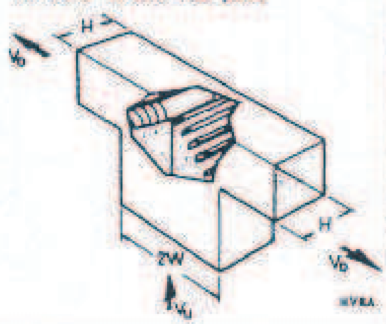
FITTING No. 1ab TEES OR 2ab TEES WITH SPLITTER DAMPERS

'ab' denotes bend number in flow path being considered. Loss coefficient k_T is as for single bend when $V_U = V_D$. If splitter damper included, add loss coefficient for single blade damper fully open ($k_{TD} = 0.08$).

e.g. No. 201 in both flow paths

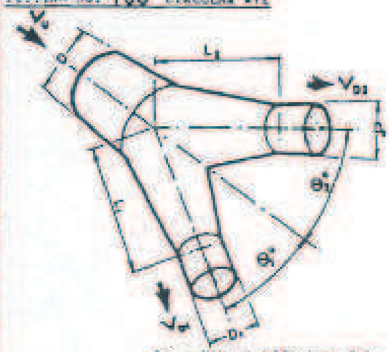


No. 203 in both flow paths



HVRA

FITTING No. 100 CIRCULAR WYE



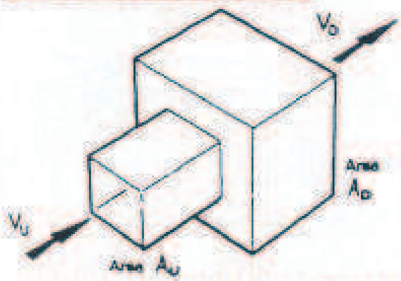
k_T = loss coefficient for circular radiused bend with radius ratio of

$$\frac{R_1}{D_1} = \frac{1}{2}\left(\frac{L_1}{\tan(\theta_1/2)} - 1\right)$$

HVRA

EXPANSIONS & CONTRACTIONS

FITTING No. 301 ABRUPT EXPANSION



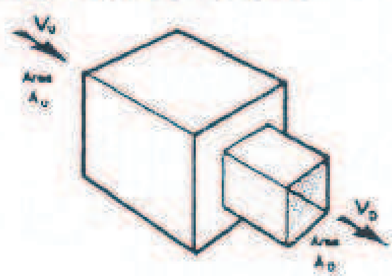
Note: For short length of downstream duct $k_T = 1.0$

k_T based on V_U

AREA RATIO A_U/A_D	k_T
0.2	0.64
0.25	0.56
0.3	0.49
0.35	0.43
0.4	0.36
0.45	0.30
0.5	0.25
0.55	0.20
0.6	0.16
0.65	0.12
0.7	0.09
0.75	0.06

ASHRAE

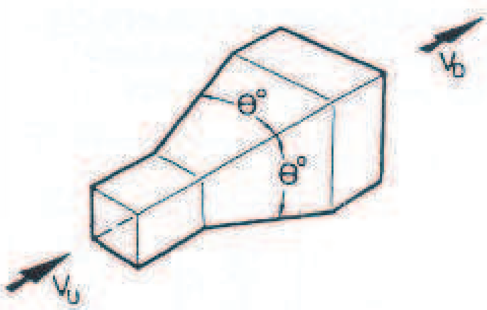
FITTING No. 302 ABRUPT CONTRACTION



AREA RATIO A_U/A_D	k_T
1.0	0
1.25	0.05
1.5	0.12
1.75	0.18
2.0	0.22
2.5	0.28
3.0	0.32
3.5	0.34
4.0	0.37
6.0	0.42
10.0	0.46

IHVE

FITTING No. 303 GRADUAL RECTANGULAR EXPANSION AND FITTING No. 304 GRADUAL ECCENTRIC (ONE SIDED) RECTANGULAR EXPANSION



k_T based on V_U

θ°	$V_D:V_U$				
	0.2	0.3	0.4	0.5	0.6
10	0.20	0.15	0.12	0.08	0.06
20	0.39	0.30	0.22	0.15	0.10
30	0.52	0.40	0.29	0.20	0.13
40	0.67	0.51	0.38	0.26	0.17
50	0.70	0.54	0.40	0.28	0.18

Values assume long downstream duct.
For assymetrical configurations take θ as the mean angle.
For 1 in 7 expansion θ = 16° for concentric expansion and 8° for eccentric expansion.

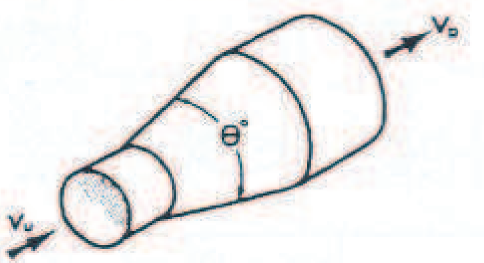
θ°	CORRECTION MULTIPLIER FOR ECC. EXPANSION
5	1.23
10	1.69
15	2.23
20	2.00
25	1.61
30	1.31
35	1.25
40	1.20
45	1.10

HVRA-IHVE

Total Loss Coefficients for Duct Fittings (k_T based on V_D except for expansions where K_T based on V_U)

EXPANSIONS & CONTRACTIONS

FITTING No. 305 GRADUAL CIRCULAR EXPANSION AND FITTING No. 306 GRADUAL ECCENTRIC CIRCULAR EXPANSION



k_T based on V_U

θ°	V_D:V_U				
	0.2	0.3	0.4	0.5	0.6
10	0.18	0.13	0.11	0.08	0.06
20	0.31	0.25	0.18	0.13	0.09
30	0.41	0.31	0.23	0.16	0.10
40	0.52	0.40	0.33	0.23	0.15
50	0.70	0.52	0.39	0.27	0.18

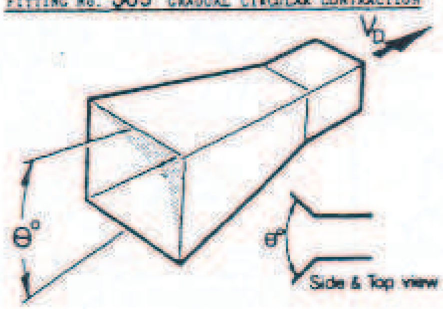
Values assume long downstream duct.
For 1 in 7 expansion θ = 16° for concentric expansion and 8° for eccentric expansion.

θ°	CORRECTION MULTIPLIER FOR ECC. EXPANSION
5	1.23
10	1.69
15	2.23
20	2.00
25	1.61
30	1.31
35	1.25
40	1.20
45	1.10

HVRA-IHVE

FITTING No. 307 GRADUAL RECTANGULAR CONTRACTION AND

FITTING No. 309 GRADUAL CIRCULAR CONTRACTION



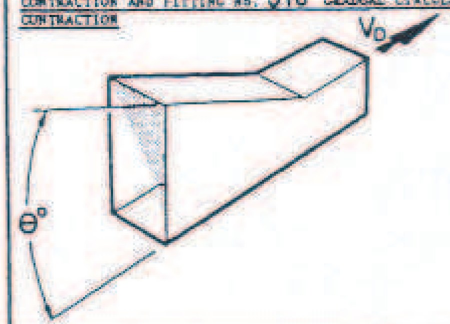
θ°	k_T
15	0.008
30	0.02
45	0.04
60	0.07

For assymetrical configurations take θ as the mean angle.

For 1 in 4 contraction θ = 28°

HVRA

FITTING No. 308 GRADUAL RECTANGULAR ECCENTRIC (ONE SIDED) CONTRACTION AND FITTING No. 310 GRADUAL CIRCULAR ECCENTRIC CONTRACTION



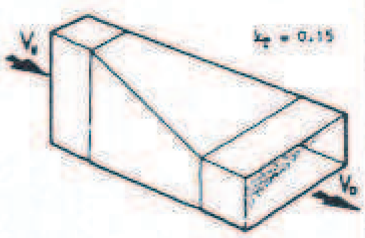
θ°	k_T
15	0.014
30	0.07
45	0.20
60	0.40

For 1 in 4 contraction θ = 14°

HVRA

AREA TRANSITIONS

FITTING No. 311 CONSTANT VELOCITY AREA TRANSITION

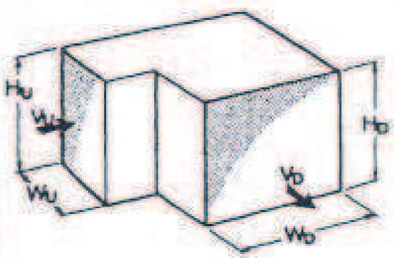


k_T = 0.15

Conditions $V_D = V_U$ θ ≤ 15°

ASHRAE

FITTING No. 312 BEND WITH EXPANDING OR CONTRACTING FLOW



H_U/W_U	W_D/W_U					
	0.6	0.8	1.2	1.4	1.6	2.0
0.25	1.8	1.4	1.1	1.1	1.1	1.1
1.0	1.7	1.4	1.0	0.95	0.90	0.84
4.0	1.5	1.1	0.81	0.76	0.72	0.66
6.0	1.5	1.0	0.69	0.63	0.60	0.55

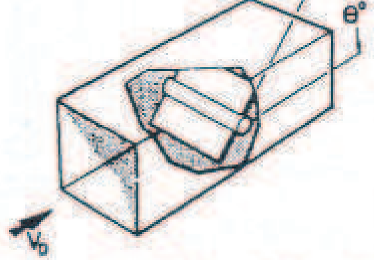
$k_T = k_T \times k_{Ba}$

k_{Ba} as for Fitting No. 021

DAMPERS

FITTING No. 321 SINGLE BLADE BUTTERFLY DAMPER

FITTING No. 324 SINGLE BLADE FIRE DAMPER



APPROXIMATE ANGLE OF BLADE	k_T
0	0.08
10	0.28
15	0.54
20	0.90
30	2.8
40	7.0
50	20.0

FITTING No. 322 OPPOSED MULTI-BLADE DAMPER

FITTING No. 323 PARALLEL MULTI-BLADE DAMPERS

FITTING No. 325 MULTI-BLADE FIRE DAMPERS

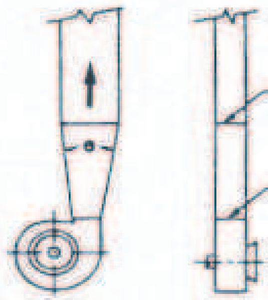
APPROXIMATE ANGLE OF BLADE	k_T (No. 323)	k_T (No. 322 & 325)
0	0.23	0.23
10	0.52	0.66
15	0.75	1.1
20	1.2	1.85
30	1.75	4.7
40	3.2	11.6
50	5.0	33.0

HVRA

Total Loss Coefficients for Duct Fittings (k_T based on V_D except for expansions where K_T based on V_U)

FAN DISCHARGES

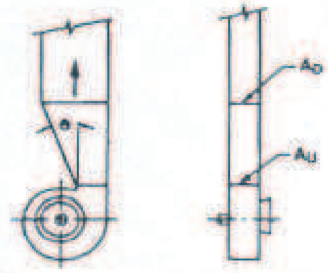
FITTING No. 331 PLANE SYMMETRIC DIFFUSER AT FAN DISCHARGE



θ deg	AREA RATIO A_O/A_U					
	1.5	2.0	2.5	3.0	3.5	4.0
10	0.05	0.07	0.09	0.10	0.11	0.11
15	0.06	0.09	0.11	0.13	0.13	0.14
20	0.07	0.10	0.13	0.15	0.16	0.16
25	0.08	0.13	0.16	0.19	0.21	0.23
30	0.16	0.24	0.29	0.32	0.34	0.35
35	0.24	0.34	0.39	0.44	0.48	0.50

ASHRAE85

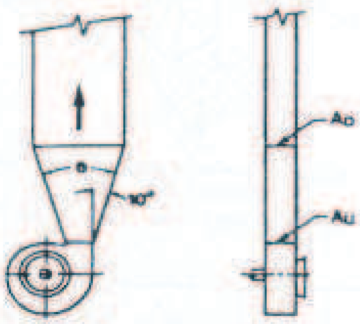
FITTING No. 332 PLANE ASYMMETRIC DIFFUSER AT FAN DISCHARGE



θ deg	AREA RATIO A_O/A_U					
	1.5	2.0	2.5	3.0	3.5	4.0
10	0.08	0.09	0.10	0.10	0.11	0.11
15	0.10	0.11	0.12	0.13	0.14	0.15
20	0.12	0.14	0.15	0.16	0.17	0.18
25	0.15	0.18	0.21	0.23	0.25	0.26
30	0.18	0.25	0.30	0.33	0.35	0.35
35	0.21	0.31	0.38	0.41	0.43	0.44

ASHRAE85

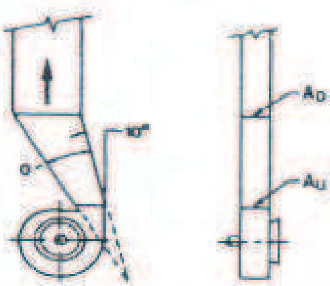
FITTING No. 333 ECCENTRIC PLANE ASYMMETRIC DIFFUSER AT FAN DISCHARGE



θ deg	AREA RATIO A_O/A_U					
	1.5	2.0	2.5	3.0	3.5	4.0
10	0.05	0.08	0.11	0.13	0.13	0.14
15	0.06	0.10	0.12	0.14	0.15	0.15
20	0.07	0.11	0.14	0.15	0.16	0.16
25	0.09	0.14	0.18	0.20	0.21	0.22
30	0.13	0.18	0.23	0.26	0.28	0.29
35	0.15	0.23	0.28	0.33	0.35	0.36

ASHRAE85

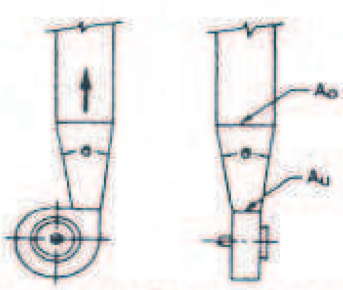
FITTING No. 334 OFFSET PLANE DIFFUSER AT FAN DISCHARGE



θ deg	AREA RATIO A_O/A_U					
	1.5	2.0	2.5	3.0	3.5	4.0
10	0.25	0.32	0.14	0.14	0.14	0.14
15	0.29	0.60	0.16	0.17	0.18	0.18
20	0.43	0.88	0.24	0.26	0.28	0.30
25	0.65	1.28	0.35	0.37	0.39	0.40
30	0.81	1.68	0.46	0.49	0.51	0.51
35	1.00	2.16	0.61	0.64	0.66	0.66

ASHRAE85

FITTING No. 335 PYRAMIDAL DIFFUSER AT FAN DISCHARGE



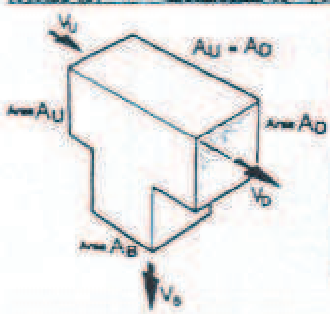
θ deg	AREA RATIO A_O/A_U					
	1.5	2.0	2.5	3.0	3.5	4.0
10	0.10	0.18	0.21	0.23	0.24	0.25
15	0.23	0.33	0.38	0.40	0.42	0.44
20	0.31	0.43	0.48	0.53	0.56	0.58
25	0.36	0.49	0.55	0.58	0.62	0.64
30	0.42	0.53	0.59	0.64	0.67	0.69

ASHRAE85

Total Loss Coefficients for Duct Fittings (k_T based on V_0)

DIVIDED FLOW FITTINGS

FITTING No. 401 RECTANGULAR 90° TAKE-OFF OR FITTING No. 411 CIRCULAR 90° TAKE-OFF



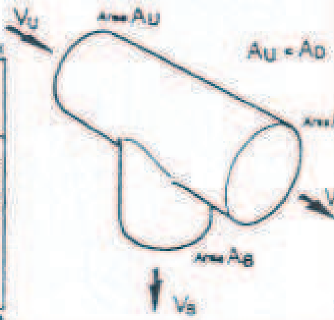
BRANCH PATH

VELOCITY RATIO V_B/V_U	AREA RATIO $A_B:A_D$				
	0.2	0.3	0.5	0.7	1.0
0.4	9.69	8.75	6.88	5.94	5.31
0.6	4.58	4.31	3.33	2.64	2.5
0.8	3.13	2.81	2.03	1.72	1.72
1.0	2.40	2.00	1.40	1.25	1.25
1.2	1.88	1.74	1.11	0.97	-
1.5	1.56	1.56	0.84	-	-
2.0	1.50	1.50	0.88	-	-
2.5	1.28	1.44	-	-	-

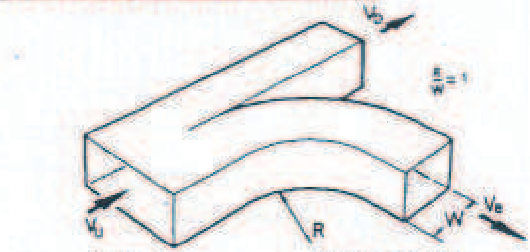
STRAIGHT THROUGH

VELOCITY RATIO V_D/V_U	k_T
0.4	0.12
0.5	0.09
0.6	0.06
0.7	0.03
0.8-1.0	0

HVRA



FITTING No. 402 RECTANGULAR SWEEP TAKE-OFF



BRANCH PATH

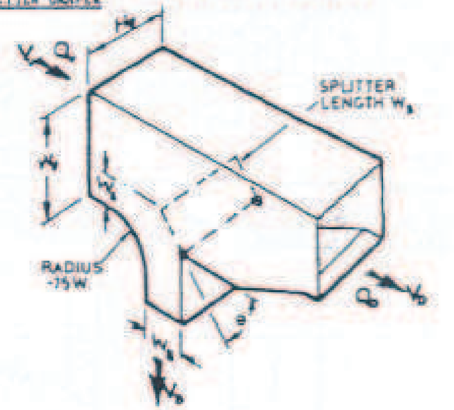
VELOCITY RATIO V_B/V_U	k_B
0.6	1.70
0.7	0.90
0.8	0.50
0.9	0.35
1.0	0.26
1.1	0.25
1.2	0.30

STRAIGHT THROUGH

VELOCITY RATIO V_D/V_U	k_T
0.6	0.78
0.7	0.41
0.8	0.20
0.9	0.12
1.0	0.08
1.1	0.05
1.2	0.03

HVRA

FITTING No. 403 RECTANGULAR RADIUSED 90° TAKE-OFF WITH SPLITTER DAMPER

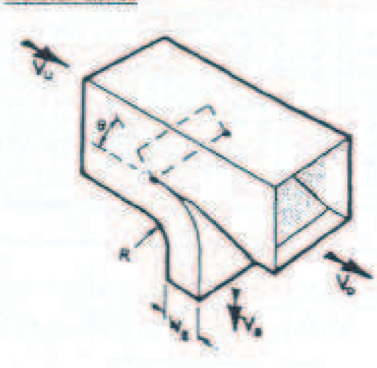


BRANCH : Take as equivalent to 90° rectangular take-off with 45° haunch.

STRAIGHT THROUGH : As for Fitting Nos. 405 & 406

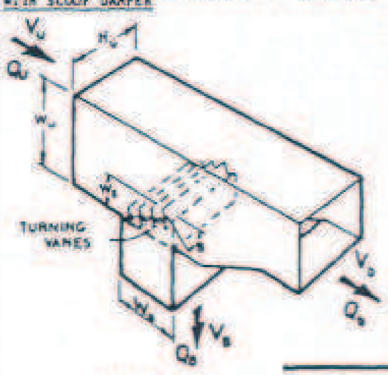
ASHRAE85

FITTING No. 404 RECTANGULAR SWEEP WITH SPLITTER DAMPER

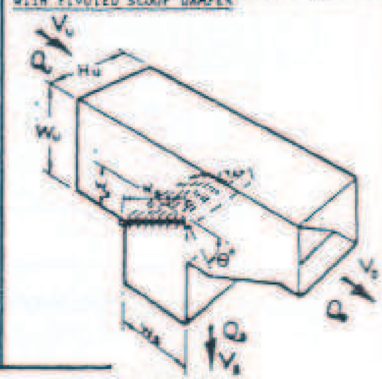


For both the branch and the straight through path take as equivalent to loss coefficient of sweep take-off (fitting no. 402) plus loss coefficient of single blade damper fully open (0.08). If the splitter damper is used for balancing (not recommended) then the pressure drop absorbed by the splitter is added to the fitting loss in the path in which the damper restricts the flow.

FITTING No. 405 RECTANGULAR 90° TAKE-OFF WITH SCOOP DAMPER



FITTING No. 406 RECTANGULAR 90° TAKE-OFF WITH PIVOTED SCOOP DAMPER



BRANCH PATH

VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_D		
	0.2	0.3	0.5
0.4	3.75	3.94	4.30
0.6	2.08	2.19	2.28
0.8	1.66	1.63	1.41
1.0	1.12	1.41	1.21
1.2	0.95	1.03	1.14
1.4	0.87	1.03	1.26
1.6	0.96	0.92	1.27
1.8	0.95	0.95	1.27

Note that for this Fitting the Velocity Ratio is V_B/V_U

STRAIGHT THROUGH

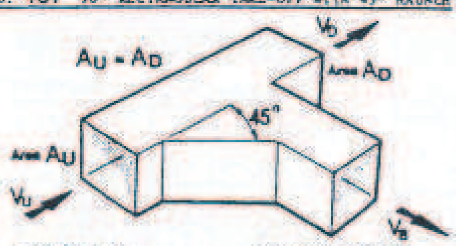
VELOCITY RATIO V_D/V_U	k_T
0.2	0.03
0.4	0.04
0.6	0.07
0.8	0.17
1.0	0.13
1.2	0.14
1.4	0.27
1.6	0.30
1.8	0.25

ASHRAE85

Total Loss Coefficients for Duct Fittings (Branch path k_T based on V_B, straight through on V_D)

DIVIDED FLOW FITTINGS (cont.)

FITTING No. 407 90° RECTANGULAR TAKE-OFF WITH 45° HAUNCH



BRANCH PATH

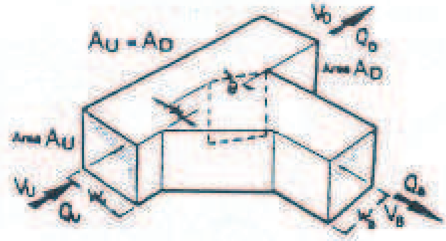
VELOCITY RATIO V_B/V_U	k_T
0.4	4.4
0.5	2.5
0.6	1.6
0.7	1.0
0.8	0.78
0.9	0.62
1.0	0.55

STRAIGHT THROUGH

VELOCITY RATIO V_D/V_U	k_T
0.4	2.30
0.5	1.00
0.6	0.44
0.7	0.20
0.8	0.09
0.9	0.06
1.0	0.04

HVRA

FITTING No. 408 90° RECTANGULAR TAKE-OFF WITH 45° HAUNCH AND SPLITTER DAMPER

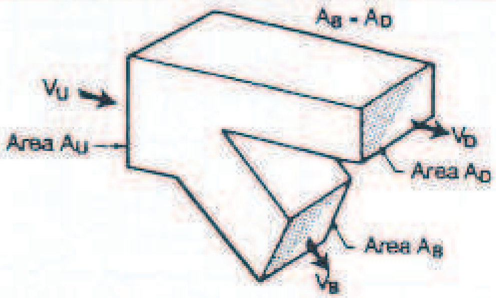


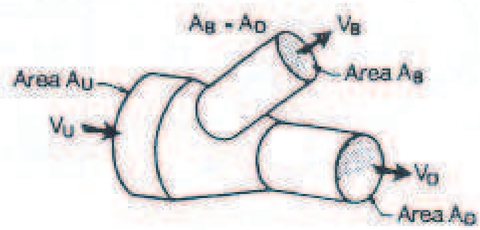
BRANCH : Take as equivalent to 45° circular take-off.

STRAIGHT THROUGH : As for Fitting Nos. 405 & 406.

ASHRAE85

FITTING No. 409 RECTANGULAR DIVERGING WYE OR FITTING No. 419 CIRCULAR DIVERGING WYE





30° TAKE-OFF

VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_U				
	0.2	0.3	0.5	0.7	0.8
0.4	–	3.10	2.36	2.44	2.35
0.5	1.60	1.66	1.34	1.22	1.12
0.6	1.03	0.93	0.72	1.66	0.62
0.7	0.70	0.56	0.46	0.38	0.37
0.8	0.49	0.41	0.30	0.28	0.24
0.9	0.36	0.31	0.23	0.19	0.19
1.0	0.26	0.24	0.18	0.16	0.16
1.5	0.26	0.25	0.18	–	–
2.0	0.33	0.33	–	–	–

45° TAKE-OFF

VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_U				
	0.2	0.3	0.5	0.7	0.8
0.4	–	3.90	3.23	3.09	2.95
0.5	2.24	2.28	1.86	1.70	1.60
0.6	1.56	1.43	1.14	1.03	0.98
0.7	1.14	0.99	0.81	0.70	0.66
0.8	0.88	0.78	0.59	0.51	0.49
0.9	0.69	0.63	0.48	0.41	0.40
1.0	0.56	0.52	0.40	0.35	0.35
1.5	0.44	0.30	–	–	–
2.0	0.45	0.45	–	–	–

60° TAKE-OFF

VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_U				
	0.2	0.3	0.5	0.7	0.8
0.4	–	4.94	4.13	3.90	3.80
0.5	3.08	3.10	2.54	2.36	2.24
0.6	2.24	2.11	1.69	1.54	1.47
0.7	1.73	1.56	1.26	1.11	1.04
0.8	1.38	1.24	0.97	0.84	0.85
0.9	1.14	1.05	0.80	0.69	0.67
1.0	0.96	0.89	0.68	0.60	0.60
1.5	0.71	0.67	0.44	–	–
2.0	0.83	0.65	–	–	–

90° TAKE-OFF

VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_U				
	0.2	0.3	0.5	0.7	0.8
0.4	–	7.23	6.23	5.93	5.76
0.5	8.13	4.60	4.20	3.86	3.72
0.6	3.94	3.72	3.00	2.73	2.61
0.7	3.14	2.94	2.35	2.04	1.93
0.8	2.59	2.44	1.88	1.66	1.52
0.9	2.20	2.12	1.60	1.40	1.38
1.0	1.90	1.80	1.40	1.20	1.20
1.5	1.29	–	–	–	–
2.0	–	–	–	–	–

STRAIGHT THROUGH

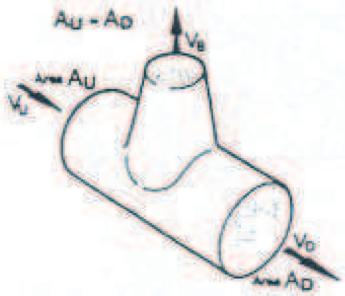
VELOCITY RATIO V_D/V_U	0.3	0.4	0.5	0.6	0.8	1.0
k_T	1.89	0.81	0.36	0.17	0.03	0.0

ASHRAE85

otal Loss Coefficients for Duct Fittings (Branch path k_T based on V_B, straight through on V_D)

DIVIDED FLOW FITTINGS (cont.)

FITTING No. 412 CIRCULAR LONG CONE TAKE-OFF



BRANCH PATH

VELOCITY RATIO V_B/V_U	k_T
0.4	5.2
0.5	3.1
0.6	1.9
0.7	1.3
0.8	0.89
0.9	0.64
1.0	0.48
1.2	0.32
1.4	0.25
2.0	0.25

STRAIGHT THROUGH

VELOCITY RATIO V_D/V_U	k_T
0.4	0.12
0.5	0.09
0.6	0.06
0.7	0.03
0.8–1.0	0

ASHRAE

FITTING No. 413 CIRCULAR SHORT CONE TAKE-OFF

BRANCH PATH

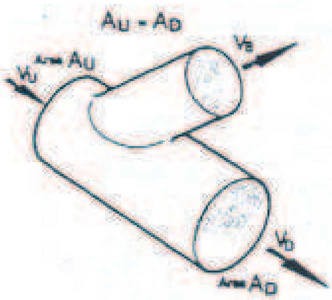
VELOCITY RATIO V_B/V_U	k_T
0.4	5.0
0.5	3.0
0.6	2.0
0.7	1.5
0.8	1.2
0.9	1.0
1.0	0.8
1.2	0.6
1.6	0.3
2.0	0.3

STRAIGHT THROUGH

VELOCITY RATIO V_D/V_U	k_T
0.4	0.12
0.5	0.09
0.6	0.06
0.7	0.03
0.8–1.0	0

HVRA–ASHRAE

FITTING No. 414 ANGLED CIRCULAR BRANCH TAKE-OFF



45° TAKE-OFF

BRANCH PATH

VELOCITY RATIO V_B/V_U	k_T
0.4	4.0
0.5	2.2
0.6	1.5
0.7	1.0
0.8	0.7
0.9	0.55
1.0	0.4

STRAIGHT THROUGH

VELOCITY RATIO V_D/V_U	k_T
0.4	0.12
0.5	0.09
0.6	0.06
0.7	0.03
0.8–1.0	0

HVRA

60° TAKE-OFF

BRANCH PATH

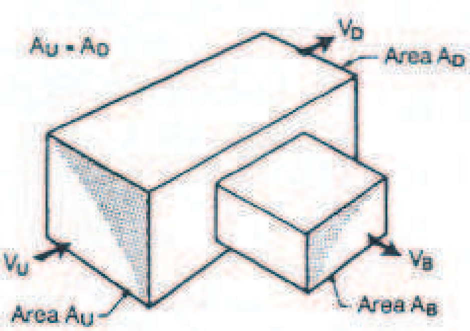
VELOCITY RATIO V_B/V_U	k_T
0.4	4.2
0.5	2.6
0.6	1.9
0.7	1.4
0.8	1.1
0.9	0.82
1.0	0.65
1.2	0.56
1.6	0.50
2.0	0.49

STRAIGHT THROUGH

VELOCITY RATIO V_D/V_U	k_T
0.4	0.12
0.5	0.09
0.6	0.06
0.7	0.03
0.8–1.0	0

ASHRAE

FITTING No. 421 90° RECTANGULAR MAIN AND TAP



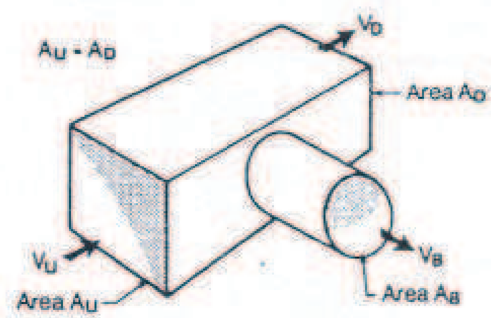
BRANCH PATH

VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_D			
	0.2	0.3	0.4	0.5
0.4	6.60	6.46	6.39	6.31
0.6	3.03	2.92	2.89	2.92
0.8	1.86	1.86	1.81	1.75
1.0	1.80	1.30	1.36	1.27
1.2	1.14	1.26	1.09	1.15
1.4	0.98	1.18	1.14	0.99
1.6	0.88	1.14	0.99	0.86
1.8	0.90	1.12	0.69	0.79

ASHRAE85

STRAIGHT THROUGH :
As for Fitting Nos. 401 & 411 HVRA

FITTING No. 422 90° RECTANGULAR MAIN WITH CIRCULAR TAP



BRANCH PATH

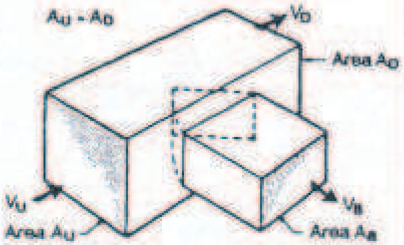
VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_D			
	0.2	0.3	0.4	0.5
0.4	6.24	6.39	6.34	6.69
0.6	3.14	3.08	3.03	3.00
0.8	1.97	1.93	1.75	1.77
1.0	1.38	1.20	1.23	1.26
1.2	1.06	0.95	0.95	1.03
1.4	0.83	0.76	0.82	0.87
1.6	0.77	0.68	0.69	0.73
1.8	0.67	0.63	0.61	0.64

STRAIGHT THROUGH :
As for Fitting Nos. 401 & 411
HVRA

Total Loss Coefficients for Duct Fittings (Branch path k_T based on V_B, straight through on V_D)

DIVIDED FLOW FITTINGS (cont.)

FITTING No. 423 90° RECTANGULAR MAIN AND TAP WITH DAMPER



BRANCH PATH

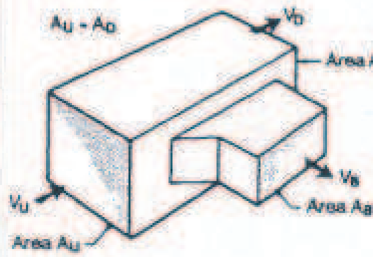
VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_D			
	0.2	0.3	0.4	0.5
0.4	2.69	3.06	3.44	3.81
0.6	1.23	1.35	1.43	1.50
0.8	0.65	0.79	0.94	0.83
1.0	0.37	0.77	0.73	0.68
1.2	0.50	0.64	0.73	0.58
1.4	0.35	0.61	0.73	0.60
1.6	0.50	0.63	0.77	0.57
1.8	0.88	0.65	0.82	0.59

STRAIGHT THROUGH :

As for Fitting Nos. 403 & 406

ASHRAE85

FITTING No. 427 90° RECTANGULAR MAIN AND TAP WITH 45° HAUNCH



BRANCH PATH

VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_D			
	0.2	0.3	0.4	0.5
0.4	5.06	5.04	5.03	4.94
0.6	2.12	2.03	1.97	1.94
0.8	1.17	1.12	1.07	1.03
1.0	0.98	0.85	0.79	0.74
1.2	0.78	0.84	0.74	0.60
1.4	0.64	0.68	0.70	0.47
1.6	0.61	0.63	0.56	0.43
1.8	0.54	0.47	0.49	0.36

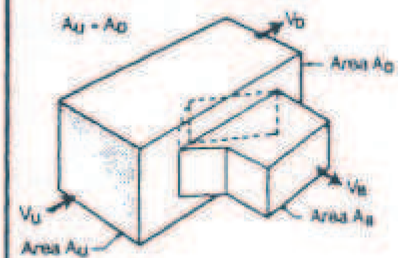
ASHRAE85

STRAIGHT THROUGH :

As for Fitting Nos. 401 & 411

HVRA

FITTING No. 428 90° RECTANGULAR MAIN AND TAP WITH 45° HAUNCH PLUS DAMPER



BRANCH PATH

VELOCITY RATIO V_B/V_U	AREA RATIO A_B/A_D			
	0.2	0.3	0.4	0.5
0.4	2.69	3.06	3.44	3.81
0.6	1.23	1.35	1.43	1.50
0.8	0.65	0.79	0.94	0.83
1.0	0.37	0.77	0.73	0.68
1.2	0.50	0.64	0.73	0.58
1.4	0.50	0.63	0.73	0.60
1.6	0.50	0.63	0.77	0.57
1.8	0.58	0.65	0.82	0.59

ASHRAE85

STRAIGHT THROUGH :

As for Fitting Nos. 405 & 406

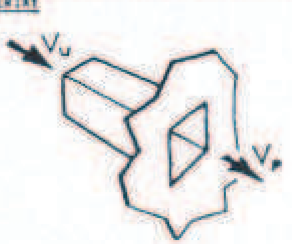
ASHRAE85

PLENUM FITTINGS

PLENUM ENTRIES

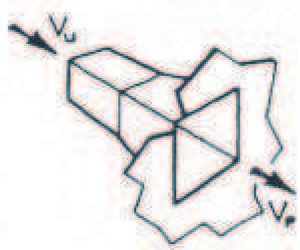
$k_T = k_1$ x loss coefficient for abrupt expansion with velocity ratio V_P/V_U where k_1 = loss coefficient of equivalent duct discharge k_T based on V_U.

FITTING No. 501 RECTANGULAR OR CIRCULAR ABRUPT ENTRY



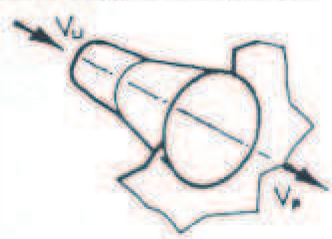
$k_1 = 1.0$

FITTING No. 502 RECTANGULAR FLARED ENTRY



k_1 = value for rectangular flared duct discharge

FITTING No. 503 CIRCULAR FLARED ENTRY

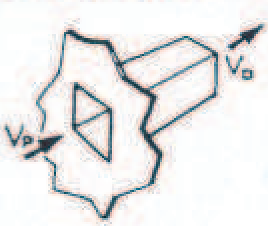


k_1 = value for circular flared duct discharge

PLENUM EXITS

$k_T = (k_1/0.5)$ x loss coefficient for abrupt contraction with velocity ratio V_D/V_P where k_1 = loss coefficient of equivalent duct entry

FITTING No. 511 RECTANGULAR OR CIRCULAR ABRUPT EXIT

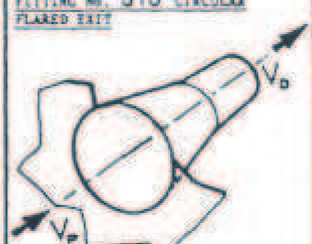


$k_1 = 0.5$

FITTING No. 512 RECTANGULAR FLARED EXIT

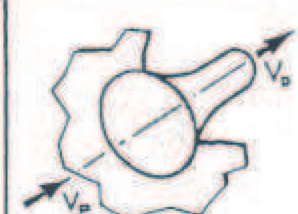
k_1 = value for rectangular flared duct entry

FITTING No. 513 CIRCULAR FLARED EXIT



k_1 = value for circular flared duct entry

FITTING No. 514 BELLMOUTH EXIT

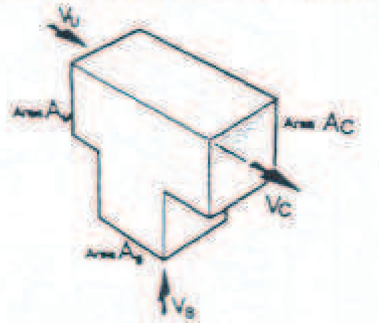


k_1 = value for bellmouth duct entry

Total Loss Coefficients for Duct Fittings (Branch path k_T based on V_B, straight through on V_D)

COMBINED FLOW FITTINGS

FITTING No. 601 RECTANGULAR COMBINED FLOW



BRANCH PATH

VELOCITY RATIO V_B/V_C	AREA RATIO A_B/A_C 0.2	0.3	0.5	0.7	1.0
0.4	0.15	0.2	0.27	0.35	0.45
0.6	0.20	0.27	0.40	0.48	0.52
0.8	0.25	0.35	0.50	0.56	0.54
1.0	0.30	0.42	0.60	0.63	0.55
1.2	0.35	0.50	0.67	0.67	-
1.5	0.45	0.60	0.77	-	-
2.0	0.60	0.75	0.90	-	-
2.5	0.70	0.90	-	-	-

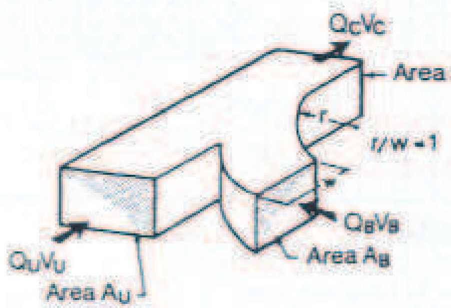
HVRA

STRAIGHT THROUGH

VELOCITY RATIO V_U/V_C	K_T
0.4	0.12
0.5	0.09
0.6	0.06
0.7	0.03
0.8-1.0	0

HVRA

FITTING No. 602 RADIUSED RECTANGULAR COMBINED FLOW



BRANCH PATH

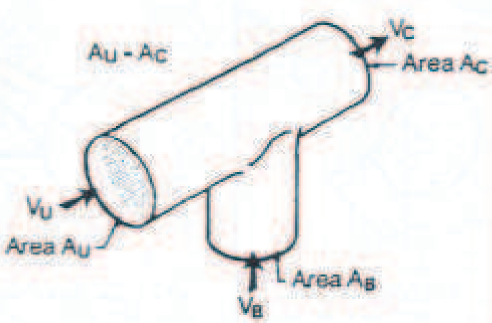
VELOCITY RATIO V_B/V_C	AREA RATIOS A_B/A_U	0.25	0.33	0.50	0.67	1.0	1.0	1.33	2.0
	A_B/A_C	0.25	0.25	0.50	0.50	0.50	1.0	1.0	1.0
0.2				-0.50	-1.0	-2.2	-0.30	-0.80	-1.40
0.4		-0.50	-1.20	-0.20	-0.60	-1.5	-0.40	-0.20	-0.50
0.6		-0.25	-0.80	0	-0.20	-0.95	0.21	0.16	0
0.8		0	-0.40	0.25	0.10	-0.50	0.36	0.32	0.25
1.0		0.25	0	0.45	0.30	0	0.48	0.44	0.35
1.4		0.85	1.00	1.00	1.00	0.80	-	-	-
1.8		1.70	2.30	2.00	2.00	1.90	-	-	-
2.0		2.20	3.00	-	-	-	-	-	-
2.4		3.70	4.80	-	-	-	-	-	-

STRAIGHT THROUGH

VELOCITY RATIO V_B/V_C	AREA RATIOS A_U/A_C	0.75	1.0	0.75	0.5	1.0	0.75	0.5
	A_B/A_C	0.25	0.5	0.5	0.5	1.0	1.0	1.0
0.2		0.22	0.17	0.27	1.20	0.24	0.36	0.87
0.4		0.30	0.16	0.35	1.10	0.26	0.35	0.68
0.6		0.33	0.10	0.32	0.90	0.18	0.18	0.40
0.8		0.30	0	0.25	0.65	0	-0.08	0.08
1.0		0.26	-0.08	0.12	0.35	-0.24	-0.36	-0.17
1.4		0.06	-0.27	-0.23	-0.40	-	-	-
1.8		-0.28	-0.46	-0.38	-1.30	-	-	-
2.0		-0.45	-	-	-	-	-	-
2.4		-0.92	-	-	-	-	-	-

ASHRAE85

FITTING No. 611 CIRCULAR 90° COMBINED FLOW WITH NO AREA CHANGE



BRANCH PATH

VELOCITY RATIO V_B/V_C	AREA RATIO A_B/A_C 0.1	0.2	0.3	0.4	0.6	0.8	1.0
0.4	-0.04	-0.5	-0.17	-0.20	0	0.11	0.32
0.5	-0.03	-0.37	-0.11	-0.02	0.21	0.40	0.42
0.6	-0.02	-0.13	0.03	0.16	0.41	0.47	0.57
0.7	0	0.07	0.25	0.35	0.56	0.61	0.72
0.8	0.12	0.28	0.50	0.54	0.64	0.77	0.86
0.9	0.26	0.50	0.75	0.74	0.76	0.92	0.99
1.0	0.40	0.72	1.0	0.94	0.92	1.1	1.1
1.5	2.1	2.3	2.7	1.6	1.8	-	-
2.0	3.8	4.3	4.7	2.7	-	-	-
2.5	6.3	6.8	7.1	4.0	-	-	-
3.0	9.2	9.7	9.7	-	-	-	-
4.0	16.0	17.0	-	-	-	-	-
5.0	26.0	26.0	-	-	-	-	-

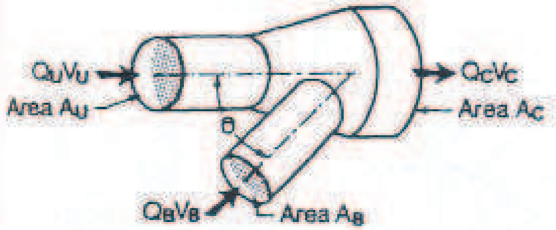
STRAIGHT THROUGH

VELOCITY RATIO V_U/V_C	K_T
0.1	0.59
0.2	0.60
0.3	0.59
0.4	0.57
0.5	0.53
0.6	0.46
0.7	0.38
0.8	0.27
0.9	0.16

ASHRAE85

Total Loss Coefficients for Duct Fittings (K_T based on V_C for both paths)

FITTING No. 612 ANGLED CONICAL COMBINED FLOW



θ - 30°

Area Ratios A_U/A_C	A_B/A_C	Branch Path 0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	Straight Through 0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
		Air Flow Ratio Q_B/Q_U																			
0.3	0.2	-2.4	-.11	1.8	3.6	4.8	6.0	7.1	8.0	8.9	9.7	4.5	2.8	1.5	0.56	-.17	-.74	-1.2	-.16	-1.9	-2.1
	0.3	-2.8	-1.3	0.14	0.72	1.4	2.0	2.4	2.8	3.2	3.5	4.8	3.1	2.0	1.2	0.37	0.08	-.30	-.67	-.89	-1.1
0.4	0.2	-1.4	0.61	2.3	3.8	5.2	6.3	7.3	8.3	9.1	9.8	1.6	0.85	0.16	-.43	-.92	-1.3	-1.7	-1.9	-2.2	-2.4
	0.3	-1.8	-.54	0.42	1.2	1.8	2.3	2.7	3.1	3.4	3.7	1.7	1.1	0.58	0.13	-.24	-.56	-.82	-1.1	-1.3	-1.4
	0.4	-1.9	-.89	-.17	0.36	0.76	1.1	1.3	1.5	1.7	1.9	1.8	1.3	0.80	0.42	0.11	-.15	-.37	-.55	-.72	-.86
0.5	0.2	-.82	0.97	2.6	4.0	5.3	6.4	7.4	8.3	9.1	9.9	0.67	0.18	-.33	-.79	-1.2	-1.5	-1.8	-2.1	-2.3	-2.5
	0.3	-1.2	-.19	0.71	1.4	2.0	2.5	2.9	3.3	3.6	3.9	0.75	0.42	0.07	-.25	-.54	-.80	-1.0	-1.2	-1.4	-1.5
	0.4	-1.4	-.54	0.06	0.50	0.85	1.1	1.3	1.5	1.7	1.8	0.80	0.55	0.28	0.03	-.20	-.40	-.57	-.73	-.86	-.98
	0.5	-1.4	-.66	-.15	0.21	0.48	0.68	0.84	0.97	1.1	1.2	0.82	0.62	0.41	0.20	0.02	-.15	-.29	-.42	-.53	-.63
0.6	0.2	-.32	1.2	2.7	4.1	5.3	6.4	7.4	8.3	9.1	9.9	0.26	-.11	-.54	-.95	-1.3	-1.6	-1.9	-2.1	-2.4	-2.5
	0.3	-.93	0.06	0.85	1.5	2.1	2.6	3.0	3.4	3.7	4.0	0.34	0.13	-.14	-.42	-.67	-.90	-1.1	-1.3	-1.4	-1.6
	0.4	-1.1	-.37	0.16	0.55	0.86	1.1	1.3	1.5	1.6	1.8	0.39	0.25	0.06	-.14	-.33	-.51	-.66	-.80	-.93	-1.0
	0.5	-1.1	-.49	-.06	0.25	0.48	0.66	0.79	0.90	1.0	1.1	0.41	0.32	0.18	0.03	-1.2	-.26	-.38	-.50	-.60	-.69
	0.6	-1.2	-.55	-.15	0.12	0.31	0.45	0.56	0.65	0.71	0.77	0.43	0.37	0.26	0.14	0.02	-.09	-.19	-.29	-.37	-.45
0.8	0.2	-.27	1.3	2.7	4.0	5.2	6.3	7.3	8.2	9.0	9.7	-.01	-.30	-.67	-1.1	-1.4	-1.7	-2.0	-2.2	-2.4	-2.6
	0.3	-.67	0.18	0.90	1.5	2.0	2.5	2.9	3.3	3.6	4.0	0.07	-.07	-.29	-.38	-.76	-.97	-1.2	-1.3	-1.5	-1.6
	0.4	-.85	-.27	0.16	0.49	0.75	0.97	1.2	1.3	1.4	1.6	0.11	0.05	-.09	-.26	-.42	-.58	-.72	-.85	-.97	-1.1
	0.5	-.90	-.40	-.07	0.18	0.36	0.50	0.61	0.70	0.78	0.84	0.14	0.12	0.03	-.09	-.21	-.34	-.45	-.55	-.66	-.73
	0.6	-.92	-.46	-.16	0.04	0.18	0.29	0.37	0.44	0.49	0.53	0.15	0.17	0.11	0.02	-.07	-.17	-.26	-.36	-.42	-.49
	0.7	-.93	-.49	-.21	-.03	0.10	0.19	0.25	0.30	0.34	0.37	0.17	0.21	0.17	0.11	0.03	-.05	-.12	-.19	-.26	-.32
	0.8	-.93	-.50	-.24	-.07	0.05	0.13	0.19	0.23	0.27	0.29	0.17	0.23	0.22	0.17	0.11	0.05	-.02	-.07	-.13	-.18
1.0	0.2	-.26	1.2	2.6	3.9	5.1	6.1	7.1	8.0	8.8	9.5	-.05	-.33	-.70	-1.1	-1.4	-1.7	-2.0	-2.2	-2.4	-2.6
	0.3	-.65	0.12	0.79	1.4	1.9	2.4	2.8	3.1	3.5	3.8	0.03	-.10	-.31	-.55	-.78	-.98	-1.2	-1.3	-1.5	-1.6
	0.4	-.83	-.34	0.04	0.33	0.58	0.78	0.95	1.1	1.2	1.3	0.07	0.02	-.12	-.28	-.44	-.59	-.73	-.86	-.98	-1.1
	0.5	-.89	-.48	-.20	0	0.15	0.27	0.37	0.45	0.51	0.57	0.09	0.09	0.01	-.11	-.23	-.35	-.46	-.56	-.65	-.74
	0.6	-.91	-.54	-.31	-.14	-.03	0.06	0.12	0.18	0.22	0.25	0.11	0.14	0.09	0	-.09	-.18	-.27	-.35	-.43	-.50
	0.8	-.93	-.59	-.38	-.25	-.16	-.10	-.06	-.03	-.01	0.01	0.13	0.20	0.19	0.15	0.09	0.03	-.03	-.08	-.14	-.19
	1.0	-.93	-.60	-.40	-.28	-.20	-.14	-.11	-.08	-.07	-.06	0.14	0.24	0.25	0.24	0.20	0.16	0.12	0.08	0.04	0

θ - 45°

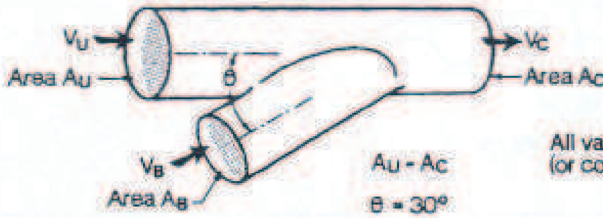
Area Ratios A_U/A_C	A_B/A_C	Branch Path 0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	Straight Through 0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
		Air Flow Ratio Q_B/Q_U																			
0.3	0.2	-2.6	-.01	2.0	3.8	5.3	6.6	7.8	8.9	9.8	11.0	5.3	-.01	2.0	1.1	0.34	-.20	-.61	-.93	-1.2	-1.4
	0.3	-2.8	-1.2	0.12	1.1	1.9	2.6	3.2	3.7	4.2	4.6	5.4	3.7	2.5	1.6	1.0	0.53	0.16	-.14	-.38	-.56
0.4	0.2	-1.2	0.93	2.8	4.5	5.9	7.2	8.4	9.5	10.0	11.0	1.9	1.1	0.46	-.07	-.49	-.83	-1.1	-1.3	-1.5	-1.7
	0.3	-1.6	-.27	0.81	1.7	2.4	3.0	3.6	4.1	4.5	4.9	2.0	1.4	0.81	0.42	0.08	-.20	-.43	-.62	-.78	-.92
	0.4	-1.8	-.72	0.07	0.66	1.1	1.5	1.8	2.1	2.3	2.5	2.0	1.5	1.0	0.60	0.39	0.16	-.04	-.21	-.35	-.47
0.5	0.2	-.46	1.5	3.3	4.9	6.4	7.7	8.8	9.9	11.0	12.0	0.77	0.34	-.09	-.48	-.81	-1.1	1.3	-1.5	-1.7	-1.8
	0.3	-.94	0.25	1.2	2.0	2.7	3.3	3.8	4.2	4.7	5.0	0.83	0.56	0.25	-.03	-.27	-.48	-.67	-.82	-.96	-1.1
	0.4	-1.1	-.24	0.42	0.92	1.3	1.6	1.9	2.1	2.3	2.5	0.88	0.66	0.43	0.21	0.02	-.15	-.30	-.43	-.54	-.64
	0.5	-1.2	-.38	0.18	0.58	0.88	1.1	1.3	1.5	1.6	1.7	0.91	0.73	0.54	0.36	0.21	0.06	-.06	-.17	-.26	-.35
0.6	0.2	-.55	1.3	3.1	4.7	6.1	7.4	8.6	9.6	11.0	12.0	0.30	0	-.34	-.67	-.96	-1.2	-1.4	-1.6	-1.8	-1.9
	0.3	-1.1	0	0.88	1.6	2.3	2.8	3.3	3.7	4.1	4.5	0.37	0.21	-.02	-.26	-.44	-.63	-.79	-.93	-1.1	-1.2
	0.4	-1.2	-.48	0.10	0.54	0.89	1.2	1.6	1.6	1.8	2.0	0.40	0.31	0.16	-0.1	-.36	-.30	-.43	-.56	-.64	-.73
	0.5	-1.3	-.62	-.14	0.21	0.47	0.68	0.85	0.99	1.1	1.2	0.43	0.37	0.26	0.14	0.02	-.09	-.20	-.29	-.37	-.45
	0.6	-1.3	-.69	-.26	0.06	0.26	0.42	0.57	0.66	0.75	0.82	0.44	0.41	0.33	0.24	0.14	0.05	-.03	-.11	-.18	-.25
0.8	0.2	0.06	1.8	3.5	5.1	6.5	7.8	8.9	10.0	11.0	12.0	-.06	-.27	-.57	-.86	-1.1	-1.4	-1.6	-1.7	-1.9	-2.0
	0.3	-.52	0.35	1.1	1.7	2.3	2.8	3.2	3.6	3.9	4.2	0	-.08	-.25	-.43	-.62	-.78	-.93	-1.1	-1.2	-1.3
	0.4	-.67	-.05	0.43	0.80	1.1	1.4	1.6	1.8	1.9	2.1	0.04	0.02	-.08	-.21	-.34	-.46	-.57	-.67	-.77	-.85
	0.6	-.75	-.27	0.05	0.28	0.45	0.58	0.68	0.76	0.81	0.88	0.07	0.12	0.09	0.03	-.04	-.11	-.18	-.25	-.31	-.37
	0.7	-.77	-.31	-.02	0.18	0.32	0.43	0.50	0.56	0.61	0.63	0.08	0.13	0.14	0.10	0.05	-.01	-.07	-.12	-.17	-.22
	0.8	-.78	-.34	-.07	0.12	0.24	0.33	0.39	0.44	0.47	0.50	0.09	0.17	0.18	0.16	0.11	0.07	0.02	-.02	-.07	-.11
1.0	0.2	0.40	2.1	3.7	5.2	6.6	7.8	9.0	11.0	11.0	12.0	-.19	-.39	-.67	-.96	-1.2	-1.5	-1.6	-1.8	-2.0	-2.1
	0.3	-.21	0.54	1.2	1.8	2.3	2.7	3.1	3.7	3.7	4.0	-.12	-.19	-.35	-.54	-.71	-.87	-1.0	-1.2	-1.3	-1.4
	0.4	-.33	0.21	0.62	0.96	1.2	1.5	1.7	2.0	2.0	2.1	-.09	-.10	-.19	-.31	-.43	-.55	-.66	-.77	-.86	-.94
	0.5	-.38	0.05	0.37	0.60	0.79	0.93	1.1	1.2	1.2	1.3	-.07	-.04	-.09	-.17	-.26	-.35	-.44	-.52	-.59	-.66
	0.6	-.41	-.02	0.23	0.42	0.55	0.66	0.73	0.80	0.85	0.89	-.06	0	-.03	-.07	-.16	-.21	-.28	-.36	-.40	-.46
	0.8	-.44	-.10	0.11	0.24	0.33	0.39	0.43	0.46	0.47	0.48	-.04	0.06	0.07	0.05	0.02	-.03	-.07	-.12	-.16	-.20
	1.2	-.46	-.14	0.05	0.16	0.23	0.27	0.29	0.30	0.30	0.29	-.03	0.09	0.13	0.13	0.11	0.08	0.06	0.03	-.01	-.03

ASHRAE85

Total Loss Coefficients for Duct Fittings (K_T based on V_C for both paths)

COMBINED FLOW FITTINGS (cont.)

FITTING No. 613 ANGLED CIRCULAR COMBINED FLOW WITH NO AREA CHANGE



$A_U = A_C$

θ = 30°

All values based on downstream (or combined) Velocity V_C

θ = 30° BRANCH PATH

VELOCITY RATIO V_B/V_C	AREA RATIO A_B/A_C						
	0.1	0.2	0.3	0.4	0.6	0.8	1.0
0.4	-0.52	-0.37	-0.48	-0.44	-0.19	-0.03	0.16
0.5	-0.41	-0.46	-0.35	-0.20	-0.05	0.18	0.27
0.6	-0.27	-0.29	-0.19	-0.04	0.16	0.32	0.33
0.7	-0.15	-0.13	-0.02	0.12	0.30	0.41	0.40
0.8	-0.03	0.04	0.12	0.28	0.40	0.48	0.45
0.9	0.10	0.20	0.33	0.43	0.52	0.51	0.40
1.0	0.21	0.37	0.50	0.59	0.66	0.53	0.27
1.5	1.7	1.5	1.5	1.4	0.89	-	-
2.0	3.1	3.0	2.6	2.1	-	-	-
2.5	5.4	4.6	3.8	2.9	-	-	-
3.0	7.6	6.4	5.3	-	-	-	-
4.0	14.0	12.0	-	-	-	-	-
5.0	21.0	17.0	-	-	-	-	-

θ = 30° STRAIGHT THROUGH

VELOCITY RATIO V_B/V_C	AREA RATIO A_B/A_C						
	0.1	0.2	0.3	0.4	0.6	0.8	1.0
0.4	0.01	0.09	0.13	0.17	0.23	0.29	0.36
0.5	0.01	0.11	0.13	0.19	0.22	0.26	0.32
0.6	0.01	0.09	0.13	0.15	0.19	0.22	0.25
0.7	0.01	0.07	0.12	0.12	0.14	0.13	0.10
0.8	0.02	0.05	0.07	0.07	0.03	-0.02	-0.15
0.9	0.02	0.03	0.03	0.01	-0.10	-0.09	-0.45
1.0	0.02	0.01	-0.01	-0.05	-0.20	-0.43	-0.75
1.5	-0.16	-0.25	-0.50	-0.70	-1.4	-	-
2.0	-0.33	-0.75	-1.3	-1.8	-	-	-
2.5	-0.72	-1.4	-2.4	-3.4	-	-	-
3.0	-1.1	-2.6	-3.7	-	-	-	-
4.0	-2.2	-4.8	-	-	-	-	-
5.0	-3.6	-7.7	-	-	-	-	-

θ = 45° BRANCH PATH

VELOCITY RATIO V_B/V_C	AREA RATIO A_B/A_C						
	0.1	0.2	0.3	0.4	0.6	0.8	1.0
0.4	-0.56	-0.44	-0.35	-0.28	-0.15	-0.04	0.05
0.5	-0.48	-0.37	-0.28	-0.21	-0.09	0.02	0.11
0.6	-0.38	-0.27	-0.19	-0.12	0	0.10	0.18
0.7	-0.26	-0.16	-0.08	-0.01	0.10	0.20	0.28
0.8	-0.21	-0.02	0.05	0.12	0.23	0.32	0.40
0.9	0.09	0.13	0.21	0.27	0.37	0.46	0.53
1.0	0.22	0.31	0.38	0.44	0.53	0.62	0.69
1.5	1.4	1.5	1.5	1.6	1.7	1.7	1.8
2.0	3.1	3.2	3.2	3.2	3.3	3.3	3.3
2.5	5.3	5.3	5.3	5.4	5.4	5.4	5.4
3.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

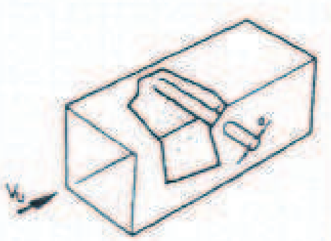
θ = 45° STRAIGHT THROUGH

VELOCITY RATIO V_U/V_C	AREA RATIO A_B/A_C						
	0.1	0.2	0.3	0.4	0.6	0.8	1.0
0.1	-8.6	-4.1	-2.5	-1.7	-0.97	-0.58	-0.34
0.2	-6.7	-3.1	-1.9	-1.3	-0.67	-0.36	-0.18
0.3	-5.0	-2.2	-1.3	-0.88	-0.42	-0.19	-0.05
0.4	-3.5	-1.5	-0.88	-0.55	-0.21	-0.05	0.05
0.5	-2.3	-0.95	-0.51	-0.28	-0.06	0.06	0.13
0.6	-1.3	-0.50	-0.22	-0.09	0.05	0.12	0.17
0.7	-0.63	-0.18	-0.03	0.04	0.12	0.16	0.18
0.8	-0.18	0.01	0.07	0.10	0.13	0.15	0.17
0.9	0.03	0.07	0.08	0.09	0.10	0.11	0.13
1.0	-0.01	0	0	0.10	0.02	0.04	0.05

ASHRAE 85

DUCT PENETRATIONS & ELIMINATORS

PIPE THROUGH CIRCULAR OR RECTANGULAR DUCT



K_1

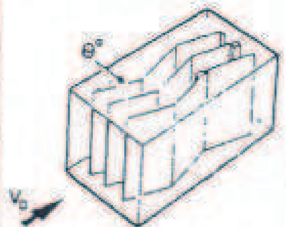
d:D or d:H	H	D
0.01	0.01	0.02
0.05	0.08	0.11
0.12	0.23	0.34
0.14	0.30	0.44
0.16	0.37	0.56
0.18	0.45	0.69
0.20	0.54	0.85
0.25	0.82	1.40

$K_T = K_1 \times K_2$

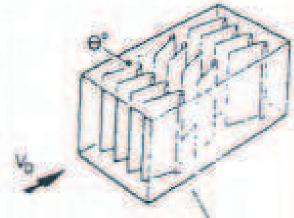
y:D or y:H	0	0.05	0.1	0.15	0.2	0.25
K_2	1.0	0.97	0.93	0.88	0.84	0.80

SMNA

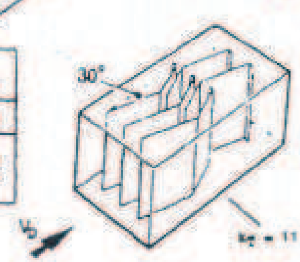
ELIMINATORS



θ°	Number of Rows	
	2	3
30 45	4 9	9 18



θ°	K_T
30 45	8.0 17.0



$K_T = 11$

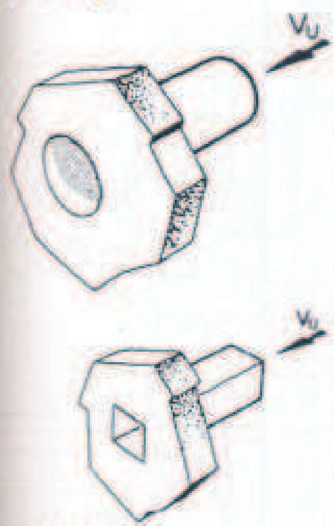
SMNA

Total Loss Coefficients for Duct Fittings (K_T based on V_C for both paths)

DISCHARGES

ABRUPT DUCT DISCHARGE

K_T based on V_U

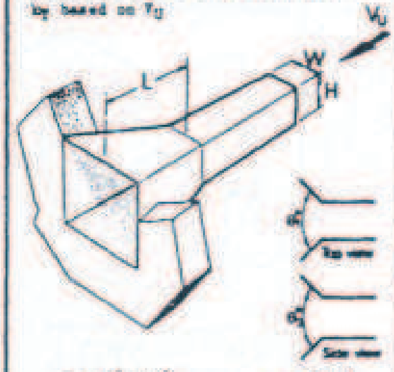


$K_T = 1.0$

HVRA

RECTANGULAR FLARED DUCT DISCHARGE

K_T based on V_U



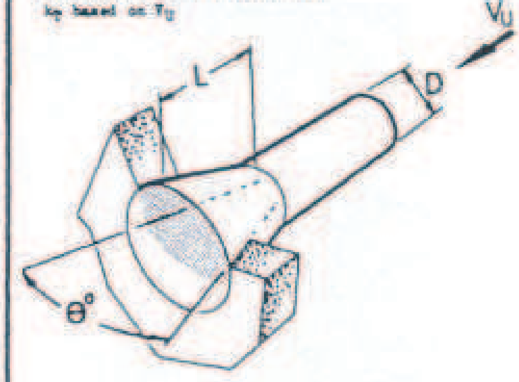
$\theta^\circ = \frac{\theta_1^\circ + \theta_2^\circ}{2}$ $D = \frac{2(H \times W)}{H + W}$

θ°	L:D				
	1	2	3	4	6
10	0.75	0.59	0.48	0.41	0.32
20	0.58	0.42	0.36	0.32	0.30
30	0.52	0.42	0.40	0.40	0.44
40	0.51	0.50	0.54	0.58	0.65

HVRA

CIRCULAR FLARED DUCT DISCHARGE

K_T based on V_U

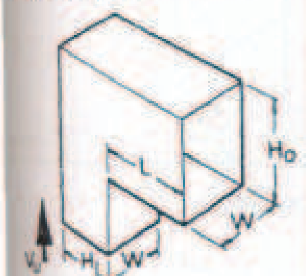


θ°	L:D				
	1	2	3	4	6
10	1.00	0.83	0.62	0.51	0.38
20	0.84	0.57	0.47	0.40	0.35
30	0.74	0.57	0.52	0.50	0.55
40	0.74	0.57	0.70	0.72	0.77

HVRA

RECTANGULAR BEND DISCHARGE

K_T based on V_U



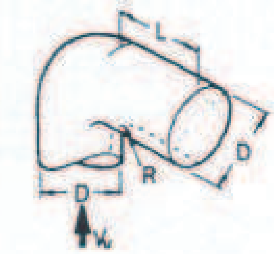
$\frac{1}{4} \leq \frac{H_1}{W} \leq 4$

$\frac{L}{H_1}$	$H_O:H_1$		
	1.0	1.4	2.0
0	3.0	2.5	1.5
1.0	2.0	2.0	1.6
10.0	1.5	1.4	1.1

HVRA

CIRCULAR BEND DISCHARGE

K_T based on V_U

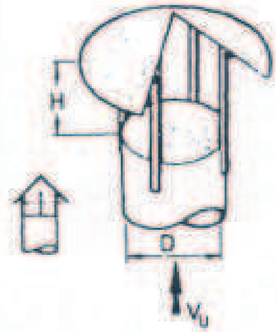


$\frac{R}{D}$	L:D		
	0	2	10
0	3.0	2.7	2.0
0.2	2.2	1.7	1.5
0.5	1.8	1.3	1.2
1.0	1.5	1.1	1.1

HVRA

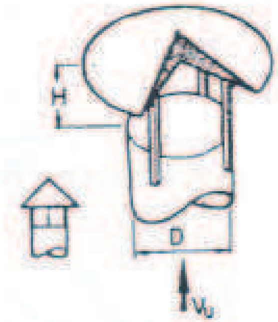
EXHAUST HOOD

K_T based on V_U



$\frac{H}{D}$	K_T
0.1	4.0
0.2	2.3
0.4	1.4
0.6	1.1
1.0	1.0

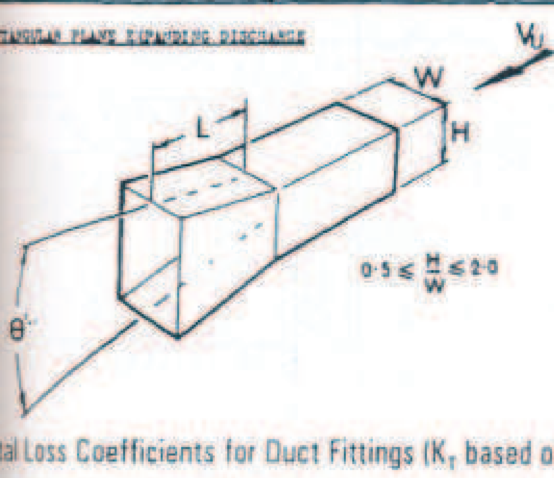
HVRA



$\frac{H}{D}$	K_T
0.25	3.4
0.3	2.6
0.4	1.7
0.6	1.2
1.0	1.0

HVRA

RECTANGULAR PLANE EXPANDING DISCHARGE



$0.5 \leq \frac{H}{W} \leq 2.0$

K_T based on V_U

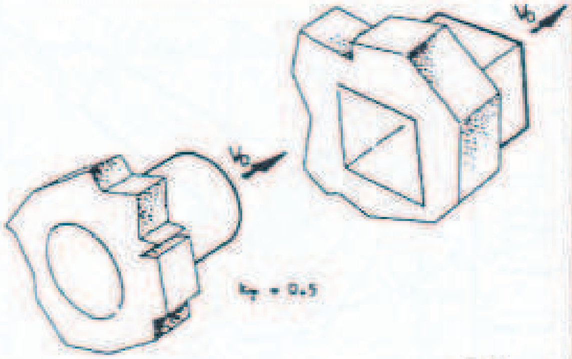
θ°	L:H				
	1	2	3	4	6
10	1.00	0.83	0.62	0.51	0.38
20	0.84	0.57	0.47	0.40	0.35
30	0.74	0.57	0.52	0.50	0.55
40	0.74	0.57	0.70	0.72	0.77

HVRA

Total Loss Coefficients for Duct Fittings (K_T based on V_U)

INTAKES

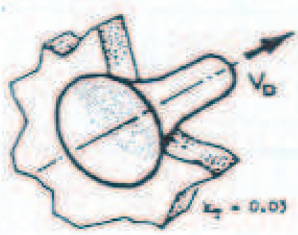
ABRUPT DUCT ENTRY CIRCULAR OR RECTANGULAR



$K_T = 0.5$

HVRA

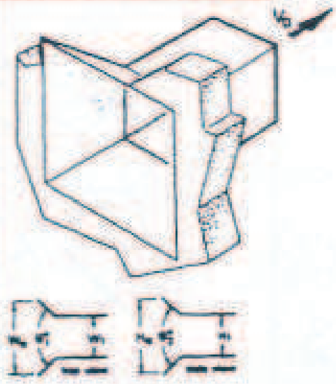
CIRCULAR BELLMOUTH ENTRY



$K_T = 0.05$

ASHRAE

RECTANGULAR FLARED DUCT ENTRY



Take θ° as the mean of θ_1° and θ_2°

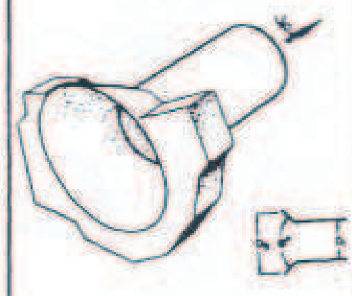
$$D_0 = \frac{2(H_0 \times W_0)}{H_0 + W_0}$$

$$D_1 = \frac{2(H_1 \times W_1)}{H_1 + W_1}$$

$\frac{D_0}{D_1}$	K_T		
	θ°		
	60	90	120
1.1	0.25	0.32	0.40
1.2	0.17	0.25	0.35
1.4	0.12	0.21	0.31
1.6	0.12	0.20	0.30

HVRA

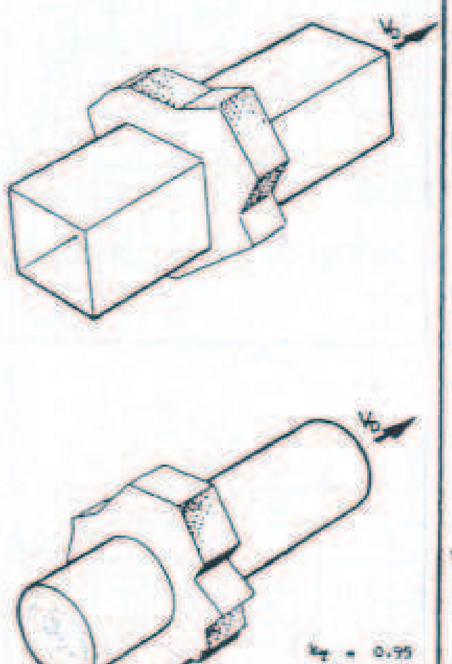
CIRCULAR FLARED DUCT ENTRY



[illegible]	K_T		
	θ°		
	60	90	120
1.1	0.25	0.32	0.40
1.2	0.17	0.25	0.35
1.4	0.12	0.21	0.31
1.6	0.12	0.20	0.30

HVRA

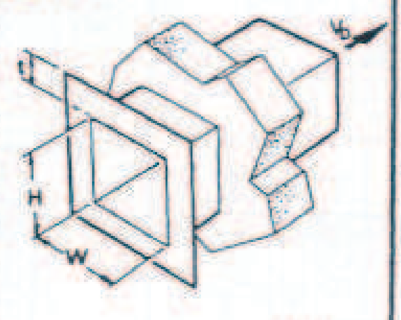
PROJECTING RECTANGULAR OR CIRCULAR DUCT ENTRIES



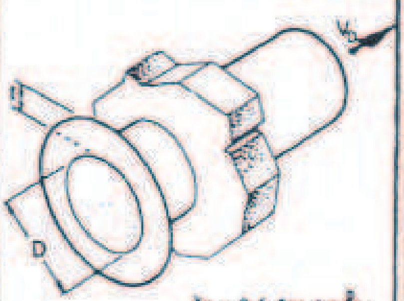
$K_T = 0.95$

HVRA

FLANGED RECTANGULAR OR CIRCULAR DUCT ENTRIES



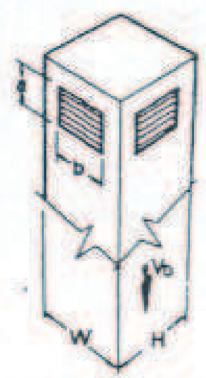
$$D = \frac{2(H \times W)}{H + W}$$



$K_T = 0.5$ for $t \geq \frac{D}{25}$

HVRA

LOUVRED DUCT ENTRY



$$JR = \frac{\text{Number of inlets} \times a \times b}{W \times H}$$

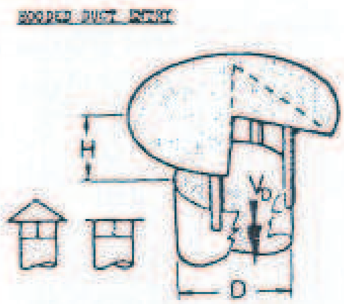
JR	Without Louvre	Louvre vane angle 30°	Louvre vane angle 45°
0.4	13.7	19.5	–
0.6	7.5	12.5	21.0
0.8	4.5	7.5	14.0
1.0	3.0	4.5	8.5
1.2	2.0	3.5	5.5
1.4	1.5	3.0	4.5
1.6	1.2	2.5	4.0
1.8	1.2	2.5	4.0

HVRA

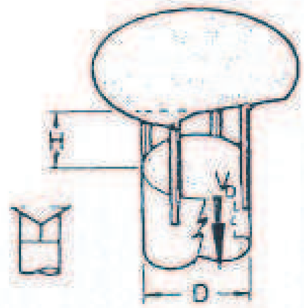
Total Loss Coefficients for Duct Fittings (K_T based on V_0)

INTAKES (cont.)

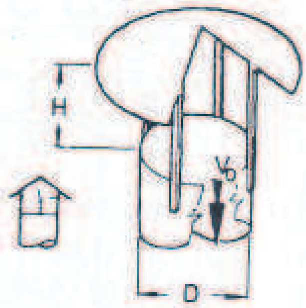
HOODED DUCT ENTRY



H/D	0.2	0.4	0.6	0.8	1.0
k_T	4.4	1.8	1.4	1.2	1.1



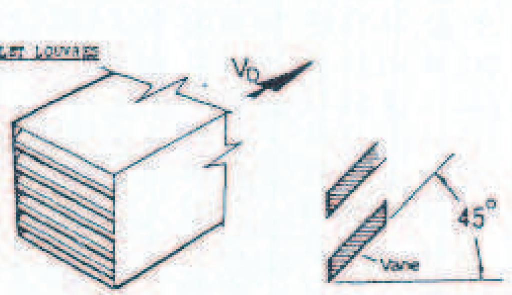
H/D	0.2	0.4	0.6	0.8	1.0
k_T	4.8	2.7	1.5	1.2	1.1



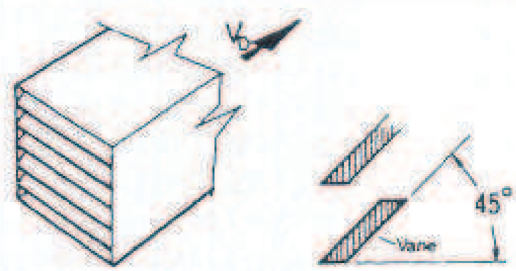
H/D	0.2	0.4	0.6	0.8	1.0
k_T	1.6	1.4	1.2	1.1	1.1

HVRA

INLET LOUVRES



Free area ratio	0.4	0.5	0.6	0.7	0.8
k_T	10.5	6.0	3.6	2.35	1.6

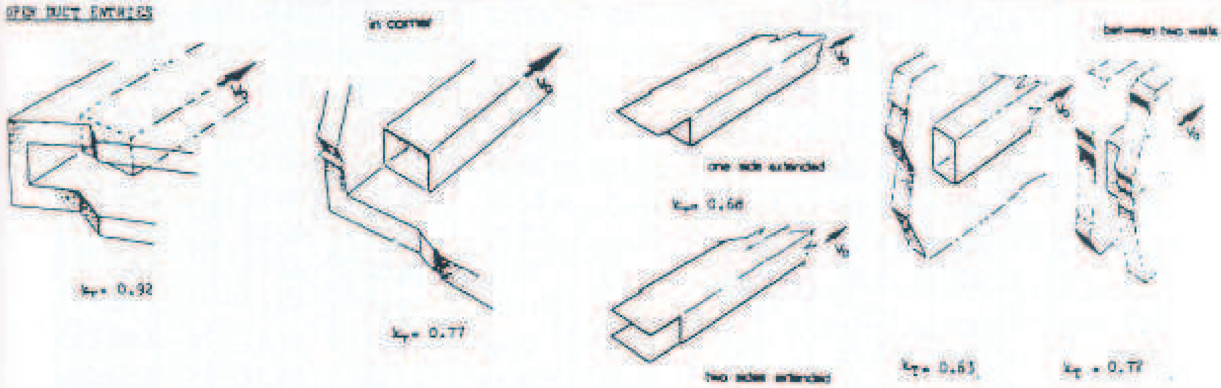


Free area ratio	0.4	0.5	0.6	0.7	0.8
k_T	6.3	3.6	2.2	1.4	0.9

Free area ratio = Open area of duct/Total area of duct.

HVRA

OPEN DUCT ENTRIES



k_T = 0.92

k_T = 0.77

k_T = 0.68

k_T = 0.82

k_T = 0.63

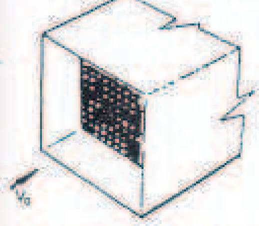
k_T = 0.77

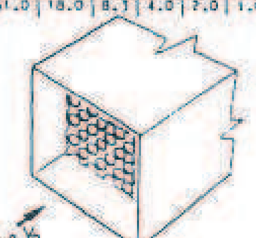
HVRA

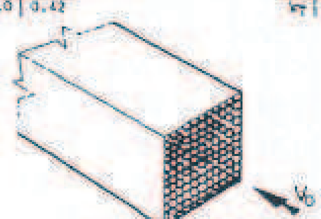
SCREENS

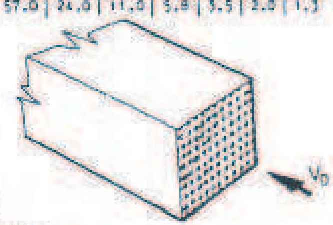
F	0.2	0.3	0.4	0.5	0.6	0.7	0.8
k_T	51.0	18.0	8.3	4.0	2.0	1.0	0.42

F	0.2	0.3	0.4	0.5	0.6	0.7	0.8
k_T	57.0	24.0	11.0	5.8	3.5	2.0	1.3









F	0.2	0.3	0.4	0.5	0.6	0.7	0.8
k_T	17.0	6.2	3.0	1.7	1.0	0.6	0.32

F	0.2	0.3	0.4	0.5	0.6	0.7	0.8
k_T	18.0	7.2	4.0	2.7	2.0	1.6	1.3

HVRA

Total Loss Coefficients for Duct Fittings (k_T based on V_0)

WEIGHTS & AREAS OF RECTANGULAR GALVANISED STEEL DUCT

Width plus Height (mm)	Metal Thickness (mm)							Area (m²) per lin m
	0.5	0.6	0.8	1.0	1.2	1.6	2.0	
250	2.28	2.90	3.66	4.59	5.80	7.32	9.20	0.50
275	2.53	3.19	4.03	5.05	6.38	8.06	10.11	0.55
300	2.76	3.48	4.39	5.51	6.96	8.79	11.03	0.60
325	2.99	3.77	4.76	5.97	7.54	9.52	11.96	0.65
350	3.22	4.06	5.13	6.43	8.12	10.25	12.88	0.70
375	3.45	4.35	5.49	6.89	8.70	10.99	13.80	0.75
400	3.68	4.64	5.86	7.35	9.28	11.72	14.71	0.80
425	3.91	4.93	6.23	7.81	9.80	12.45	15.63	0.85
450	4.14	5.22	6.59	8.27	10.44	13.18	16.56	0.90
475	4.37	5.51	6.96	8.79	11.02	13.91	17.48	0.95
500	4.60	5.80	7.32	9.19	11.60	14.65	18.40	1.00
525	4.83	6.09	7.69	9.65	12.18	15.38	19.31	1.05
550	5.06	6.38	8.06	10.11	12.76	16.11	20.23	1.10
575	5.29	6.67	8.42	10.56	13.34	16.84	21.16	1.15
600	5.51	6.96	8.79	11.02	13.92	17.58	22.08	1.20
650	5.97	7.54	9.52	11.94	15.08	19.04	23.92	1.30
700	6.43	8.12	10.25	12.86	16.24	20.51	25.76	1.40
750	6.89	8.70	10.99	13.78	17.40	21.27	27.60	1.50
800	7.35	9.28	11.72	14.70	18.56	23.43	29.44	1.60
850	7.81	9.86	12.45	15.62	19.72	24.90	31.27	1.70
900	8.27	10.44	13.18	16.54	20.88	26.37	33.11	1.80
950	8.73	11.03	13.91	17.45	22.04	27.83	34.95	1.90
1000	9.19	11.61	14.65	18.37	23.20	29.29	36.79	2.00
1050	9.95	12.19	15.38	19.29	24.36	30.76	38.63	2.10
1100	10.11	12.77	16.11	20.21	25.52	32.22	40.47	2.20
1150	10.57	13.35	16.84	21.18	26.68	33.69	42.31	2.30
1200	11.03	13.93	17.58	22.05	27.84	35.15	44.15	2.40
1250	11.49	14.51	18.31	22.97	29.00	36.62	45.99	2.50
1300	11.95	15.09	19.04	23.89	30.16	38.08	47.83	2.60
1350	12.41	15.67	19.77	24.80	31.32	39.55	49.67	2.70
1400	12.87	16.25	20.51	25.72	32.48	41.01	51.51	2.80
1450	13.33	16.83	21.24	26.64	33.64	42.48	53.35	2.90
1500	13.79	17.41	21.97	27.56	34.80	43.94	55.19	3.00
1550	14.25	17.99	22.70	28.48	35.96	45.51	57.03	3.10
1600	14.71	18.57	23.44	29.40	37.12	46.87	58.87	3.20
1650	15.17	19.15	24.17	30.32	38.28	48.34	60.71	3.30
1700	15.68	19.73	24.90	31.24	39.44	49.80	62.55	3.40
1750	16.09	20.31	25.63	32.15	40.60	51.27	64.39	3.50
1800	16.54	20.89	26.37	33.07	41.76	52.73	66.23	3.60
1850	17.00	21.47	27.10	33.99	42.92	54.20	68.07	3.70
1900	17.46	22.05	27.83	34.91	44.08	55.66	69.91	3.80
1950	17.92	22.63	28.56	35.83	45.24	57.12	71.75	3.90
2000	18.38	23.21	29.29	36.75	46.40	58.59	73.59	4.00
	kg per linear metre							

Weights include 20% allowance for bracing, hangers, waste and seams.

WEIGHTS & AREAS OF CIRCULAR GALVANISED STEEL DUCT

Diameter	Metal Thickness (mm)							Area (m²)
(mm)	0.5	0.6	0.8	1.0	1.2	1.6	2.0	per lin m
100	1.44	1.82	2.30	2.89	3.64	4.60	5.78	0.31
125	1.80	2.28	2.88	3.61	4.56	5.75	7.22	0.39
150	2.17	2.73	3.45	4.38	5.47	6.90	8.67	0.47
175	2.53	3.19	4.03	5.05	6.38	8.05	10.11	0.55
200	2.89	3.65	4.60	5.77	7.29	9.20	11.56	0.63
225	3.25	4.10	5.18	6.49	8.20	10.35	13.00	0.71
250	3.61	4.56	5.75	7.22	9.11	11.50	14.45	0.79
275	3.97	5.01	6.33	7.94	10.02	12.65	15.89	0.86
300	4.33	5.47	6.90	8.66	10.93	13.80	17.34	0.94
325	4.69	5.92	7.48	9.38	11.84	14.95	18.78	1.02
350	5.05	6.38	8.05	10.10	12.76	16.11	20.23	1.10
375	5.41	6.84	8.63	10.82	13.67	17.26	21.67	1.18
400	5.78	7.29	9.20	11.54	14.58	18.41	23.12	1.26
425	6.14	7.75	9.78	12.27	15.49	19.56	24.56	1.33
450	6.50	8.20	10.35	12.99	16.40	20.71	26.01	1.40
475	6.86	8.66	10.92	13.71	17.31	21.86	27.45	1.49
500	7.22	9.11	11.50	14.43	18.22	23.01	28.90	1.57
525	7.58	9.57	12.08	15.15	19.13	24.16	30.34	1.65
550	7.94	10.08	12.65	15.87	20.04	25.31	31.79	1.73
575	8.30	10.48	13.28	16.59	20.96	26.46	33.23	1.80
600	8.66	10.94	13.80	17.32	21.87	27.61	34.68	1.88
625	9.02	11.39	14.38	18.04	22.78	28.76	36.12	1.96
650	9.38	11.85	14.96	18.76	23.69	29.91	37.57	2.04
675	9.75	12.30	15.53	19.48	24.60	31.06	39.01	2.12
700	10.11	12.76	16.11	20.20	25.51	32.31	40.46	2.20
725	10.47	13.22	16.68	20.92	26.42	33.36	41.90	2.28
750	10.83	13.67	17.26	21.65	27.33	34.51	43.35	2.36
775	11.19	14.13	17.83	22.37	28.24	35.66	44.79	2.43
800	11.55	14.58	18.41	23.09	29.15	36.81	46.24	2.51
825	11.91	15.04	18.98	23.81	30.07	37.96	47.68	2.59
850	12.27	15.49	19.56	24.53	30.98	39.11	49.13	2.67
875	12.63	15.95	20.13	25.25	31.89	40.26	50.57	2.75
900	12.99	16.41	20.71	25.97	32.80	41.41	52.01	2.83
925	13.35	16.86	21.28	26.70	33.71	42.56	53.46	2.91
950	13.72	17.32	21.86	27.42	34.62	43.71	54.90	2.98
975	14.08	17.77	22.43	28.14	35.53	44.85	56.36	3.06
1000	14.44	18.23	23.01	28.86	36.44	46.01	57.79	3.14
	kg per linear metre							

Weights include 20% allowance for bracing, hangers, waste and seams.