EUROVENT 2/10-96

CATALOGUE OF
ENERGY LOSS COEFFICIENTS
OF
AIR HANDLING COMPONENTS

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FOREWORD

Mechanical energy loss coefficients of various components of an air distribution system are required in order to establish a correct design of an air conditioning or ventilating installation. If errors are made in estimating these coefficients it can lead to :

a) larger sizes of ductwork than are strictly necessary,
b) an inappropriate fan, and
c) a poorly balanced installation.

For more than 60 years a great deal of experimental work has been done to establish energy loss coefficients for different components. Several well known catalogues or guides have been published using data from various researchers. However, a comparison between these catalogues shows that there are several serious problems outlined as follows :

- For an identical component the energy loss coefficient values given by different catalogues can sometimes vary widely. For exemple, in the case of a 90° segmented bend the values found in catalogues vary from 0.37 to 0.92.

- For some components all catalogues give exactly the same value. Unfortunately, this is due to the fact that there is only one original data source and the given value may not be correct.

- The influence of Reynolds number may be significant for some components but this effect is generally neglected.

- It has been often observed that the energy loss coefficient of a component depends on the upstream and downstream flow conditions. For example, the energy loss from two bends installed close to each other is not equal to the sum of the individuel energy losses. Moreover, in a real installation the components are rarely isolated from each other by a long straight duct.

Therefore a standard method for experimental determination of mechanical energy loss coefficients with a strictly specified test installation was clearly needed. The Bureau Communautaire de Référence (BCR) at the European Commission realised that Europe needed a new catalogue of loss coefficient and an important programme of testing and evaluation started in 1985.

A standard method was proposed and then experimentally evaluated by four laboratories (CETIAT Orsay, NEL East Kilbride, University of Louvain-la-Neuve and Fachhochschule in Mannheim). Comparison of test results obtained by these laboratories on two components allowed to improve the first proposal and to finalise a test method which produces very similar results in different laboratories. The EUROVENT document 2/9 reproduces this method which has also been presented as a draft European Standard to the CEN/TC 156..

After approval of the method, BCR funded an extensive experimental work which was carried out in all four involved laboratories. More than 500 different components were tested, which is the largest single contribution in this field ever done.

The present document givers a condensed version of obtained results. The full report (printed or on computer diskette) may be obtained from EUROVENT.

It should be emphasised that this catalogue presents exclusively test results, no compilation from existing catalogues was included.

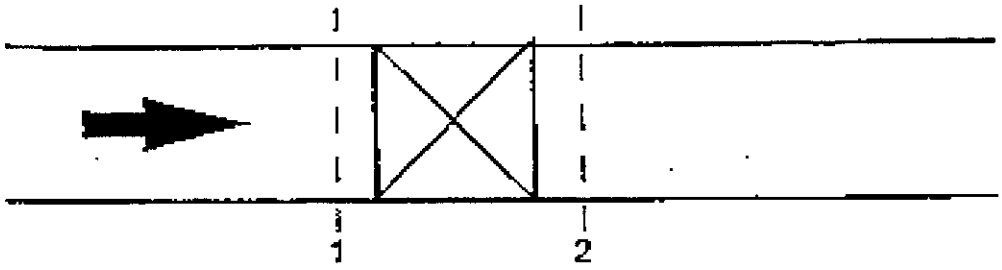
CONTENTS

1. DEFINITIONS

All definitions may be taken out from the EUROVENT 2/1 and the relevant standards under preparation by the CEN/TC 156.

2. GENERAL TEST METHOD - PRINCIPLE

In principle it is possible to give a very rigorous definition of energy loss produced by a component of air distribution systems.



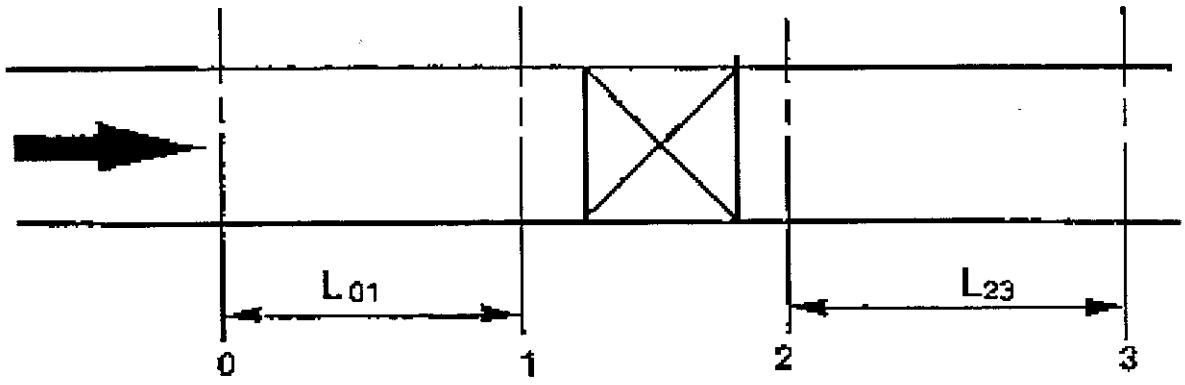
The mechanical energy loss in the flow within the component is equal to the difference between the energy entering the component through Section 1 and the energy leaving the component through Section 2. By applying the generalised Bernoulli formula which takes into account the fact that the air is compressible (its density varies through the component and that it is a real fluid, (the velocity distribution in a section is not uniform) the energy loss by unit mass (J/kg) is expressed as :

$$[\Delta y]_1^2 = \frac{p_1 - p_2}{p_{12}} + \alpha_{A1} \frac{Vm^2_1}{2} - \alpha_{A12} \frac{Vm^2_2}{2} + g(Z_1 - Z_2)$$

p	absolute pressure
Vm	mean flow velocity
Z	altitude
ρ_{12}	fluid density
g	free fall acceleration
α_A	kinetic energy factor

The kinetic energy factor α_A can be found by Pitot-tube exploration in the cross section under consideration. The density p12 depends on the flow variation through the component.

In practice the mere presence of an air handling component in a duct system modifies the flow structure upstream and downstream of the component. For this reason the practical determination of the mechanical energy losses in generally made on the following test installation :



A straight duct of the length L_{01} is installed upstream of the component and a straight duct of the length L_{23} downstream. The measurement sections (0 upstream and 3 downstream) are consequently distant from the component. From the test values obtained in these sections the characteristics of flow are calculated for the sections I and 2 and then used in the generalised Bernoulli formula to obtain the mechanical energy loss.

The choice of lengths L_{01} and L_{23} and the assumptions concerning the flow through these duct sections can cause differences in the final results. Therefore an agreement on the choice of lengths must be established before the start of the experimental work.

There is no intrinsic value of energy loss coefficient for an air handling component. For each upstream flow condition a different value will be found. Consequently the use of a long straight duct upstream of the component is just one of many possible conditions. However the different lengths of this duct and different entry conditions can product variations in the flow pattern.

Therefore, it is important to specify in detail all characteristics of the installation upstream of the component. According to this standard the upstream straight duct has a length equal to 20D and a specified perforated plate at the entrance. The measuring section is located at a distance 5D from the component.

The downstream flow pattern depends on the component under test. Usually a very long straight duct is used and the measuring section is a distance away in order to allow for the correct measurement. The energy loss of the ducting must be taken into account in the calculation of the energy loss coefficient of the component under test. For the same length of straight duct this energy loss may be very different depending on the flow pattern (essentially in the presence or in the absence of swirl).

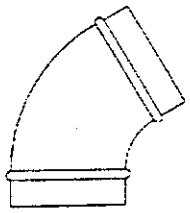
As the actual loss is not known the conventional energy loss corresponding to the fully established flow without swirl is normally used.

According to this standard instead of a very long duct (it may be as long as 40D) a specified flow straightener (as used for fan performance testing now applied in the ISO Standard and in many countries) is installed immediately downstream of the component under test. The correct measurement of the pressure is therefore possible whereas the loss on the straightener and associated ducting is taken into account conventionally.

An important advantage of this method is the elimination of the necessity to measure the kinetic energy factor α_A in the upstream section as well as in the downstream section. It is assumed that α_A is equal to one. If a particular component produces a very strong swirling flow with an irregular velocity distribution, the energy loss in the straightener will be far greater than the conventional value used for the calculation. The energy loss coefficient of the component under test will appear higher.

It is considered that this is the correct way to present these characteristics because in practice the rotational energy in fluid flow will be lost anyway and this loss is produced by the component (though not in the component itself). It may be noted that in usual methods (a long straight duct downstream) this assumption is also applied but the measurement is more difficult and the scatter of results obtained in different laboratories may be important.

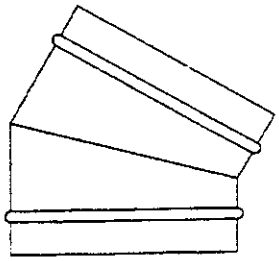
The EUROVENT 2/9 (and the equivalent European Standard under preparation in the CEN/TC 156) gives the detailed information concerning determination of loss coefficients for all practical configurations.



3.1 - ELBOWS

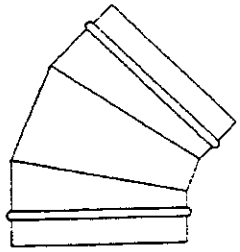
SMOOTH ELBOW

D (mm)	250	250	150
α (°)	45	60	90
$r/_D$	1.0	1.0	1.0
ζ	0.09	0.16	0.24



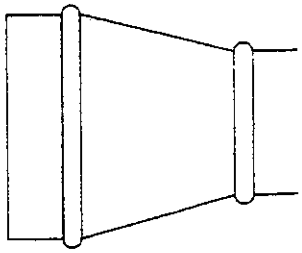
SHARP ELBOW

D (mm)	250	400	250	250
α (°)	30	30	45	90
$r/_D$	1.0	1.0	1.0	1.0
ζ	0.08	0.03	0.16	0.14



SEGMENTED ELBOW

D(mm)	250	400	250	400	250	400	250	400	250	400	250	400
α (°)	45	45	60	60	90	90	90	90	90	90	90	90
$r/_D$	1.0	1.0	1.0	1.0	1.0	10.	0.7	1.5	2.0	2.5	3.0	5.0
ζ	0.10	0.07	0.16	0.13	0.25	0.28	0.41	0.18	0.18	0.18	0.24	0.27

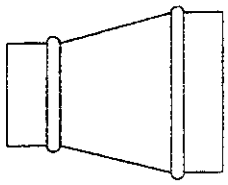


3.2 - CONVERGING SECTIONS

CONVERGING SECTIONS

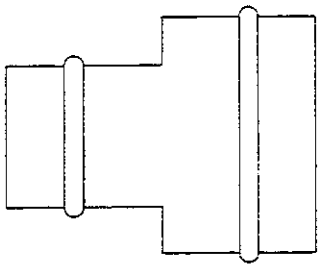
D1 (mm)	250	250	250
D2 (mm)	160	160	160
β (°)	15	30	45
ζ	0.21	0.17	0.25

3.3 - DIVERGING SECTIONS



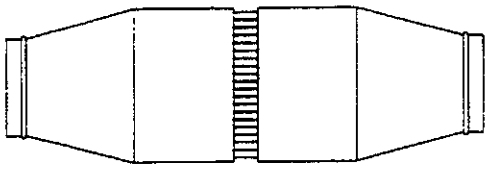
PROGRESSIVE DIFFUSER

D1 (mm)	160	160	160
D2 (mm)	250	250	250
β (°)	15	30	45
ζ	0.16	0.28	0.35



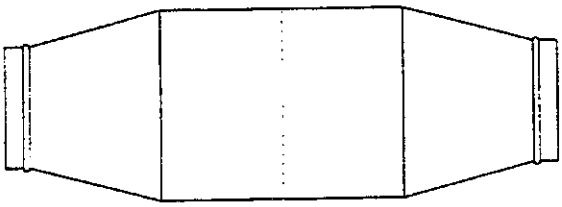
ABRUPT DIFFUSER

D1 (mm)	150	150	150
D2 (mm)	250	250	250
β (°)	90 centric	90 interm.	90 perip.
ζ	0.49	0.52	0.49



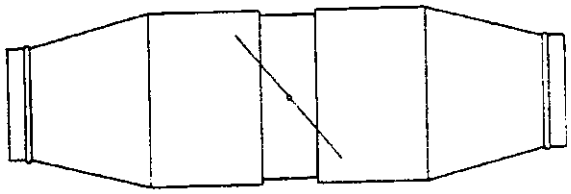
3.4 - HEATING COIL - L 400-100-400

D1 (mm)	400	400	400
D2 (mm)	630	630	630
β (°)	15	30	45
ζ	0.62	0.80	0.85



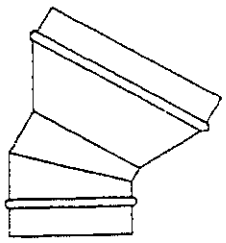
3.5 - PERFORATED PLATE - L 400-400

D1 (mm)	400	400	400
D2 (mm)	630	630	630
β (°)	15	30	45
ζ	1.0	1.23	1.33



3.6 - VALVE - L 400-200-400

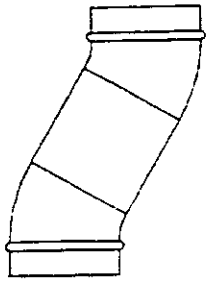
D1 (mm)	400	400	400
D2 (mm)	630	630	630
α (°)	50	50	50
β (°)	15	30	45
ζ	1.51	1.86	2.12



3.7 - ELBOW & DIVERGING SECTION

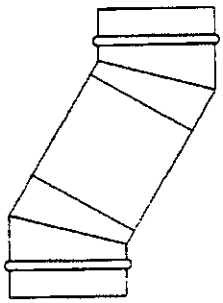
D1 (mm)	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
D2 (mm)	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
α (°)	30	30	30	30	45	45	45	45	60	60	60	60	90	90	90	90
β (°)	15	30	45	90	13	50	45	90	15	30	45	90	13	30	45	90
ζ	0.80	0.82	0.87	0.93	0.64	0.81	0.83	0.93	0.66	0.89	1.00	10.8	0.55	0.72	0.78	0.83

3.8 - COMBINATION OF ELBOWS



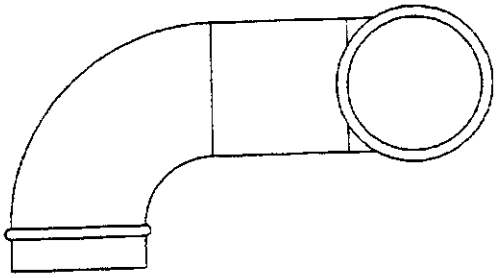
SMOOTH ELBOWS IN PLANE

D (mm)	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
α (°)	30	30	30	45	45	45	60	60	60	75	75	75	90	90	90
L/D	1	3	5	1	3	5	1	3	5	1	3	5	1	3	5
ζ	0.10	0.15	0.19	0.18	0.23	0.27	0.33	0.34	0.38	0.50	0.48	0.50	0.52	0.55	0.61



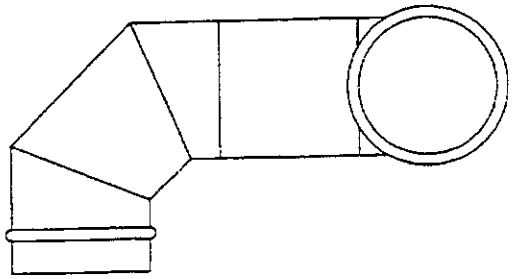
SHARP ELBOWS IN PLANE

D (mm)	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
α (°)	30	30	30	45	45	45	60	60	60	75	75	75	90	90	90
L/D	1	3	5	1	3	5	1	3	5	1	3	5	1	3	5
ζ	0.21	0.24	0.27	0.25	0.27	0.31	0.45	0.45	0.50	0.39	0.42	0.45	0.58	0.59	0.64



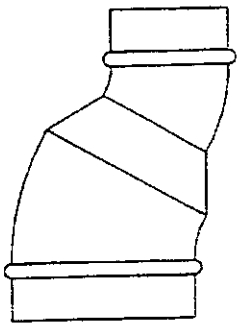
SMOOTH ELBOWS OUT OF PLANE

D (mm)	250	250	250
α (°)	90	90	90
L/D	1	3	5
ζ	0.46	0.52	0.55



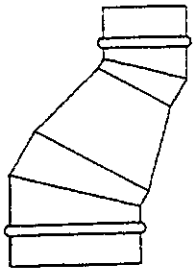
SEGMENTED ELBOWS OUT OF PLANE

D (mm)	250	250	250
α (°)	90	90	90
L/D	1	3	5
ζ	0.52	0.58	0.64



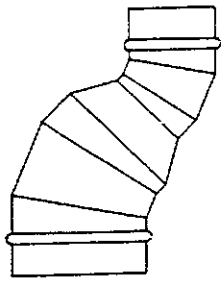
SMOOTH ELBOWS IN PLANE

D1 (mm)	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
D2 (mm)	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
α (°)	30	30	30	45	45	45	60	60	60	75	75	75	90	90	90
β (°)	15	30	45	15	30	45	15	30	45	15	30	45	15	30	45
ζ	0.57	0.55	0.58	0.88	0.83	0.85	1.20	0.17	0.16	1.62	1.63	1.66	1.97	1.97	2.03



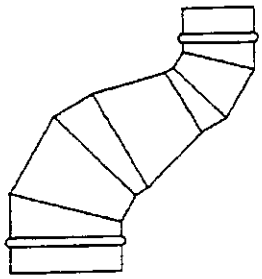
SHARP ELBOWS IN PLANE

D1 (mm)	400	400	400
D2 (mm)	250	250	250
α (°)	30	30	30
β (°)	15	30	45
ζ	0.85	0.95	0.90



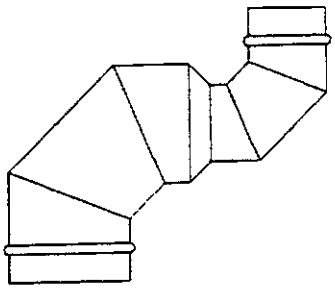
SEGMENTED ELBOWS IN PLANE

D1 (mm)	400	400	400	400	400	400
D2 (mm)	250	250	250	250	250	250
α (°)	45	45	45	60	60	60
β (°)	15	30	45	15	30	45
ζ	0.84	0.90	1.01	1.50	1.60	1.68



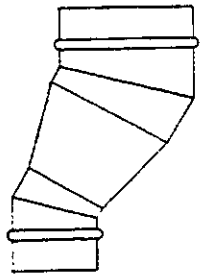
SEGMENTED ELBOWS IN PLANE WITH CONVERGING SECTION

D1 (mm)	250	250	250	250	250	250	400	400	400	400	400	400
D2 (mm)	160	160	160	160	160	160	250	250	250	250	250	250
α (°)	60	60	60	90	90	90	75	75	75	90	90	90
β (°)	15	30	45	15	30	45	15	30	45	13	30	45
ζ	1.77	0.63	0.71	2.95	2.83	2.88	1.57	1.70	1.75	2.22	2.31	2.44



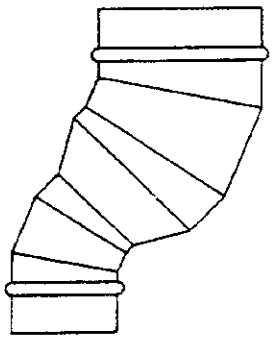
SMOOTH ELBOWS IN PLANE WITH DIVERGING SECTION

D1 (mm)	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
D2 (mm)	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
α (°)	30	30	30	45	45	45	60	60	60	75	75	75	90	90	90
β (°)	15	30	45	15	30	45	15	30	45	15	30	45	15	30	45
ζ	0.50	0.50	0.53	0.48	0.68	0.74	0.37	0.58	0.76	0.44	0.50	0.68	0.42	0.59	0.67



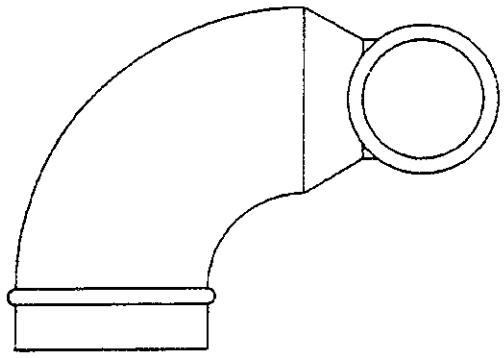
SHARP ELBOWS IN PLANE WITH DIVERGING SECTION

D1 (mm)	250	250	250
D2 (mm)	400	400	400
α (°)	30	30	30
β (°)	15	30	45
ζ	0.73	0.73	0.74



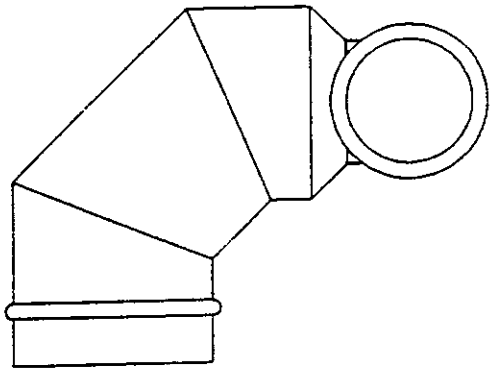
SEGMENTED ELBOWS IN PLANE WITH DIVERGING SECTION

D1 (mm)	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**250**	**160**	**160**	**160**	**160**	**160**	**160**
D2 (mm)	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**250**	**250**	**250**	**250**	**250**	**250**
α (°)	45	45	45	60	60	60	75	75	75	90	90	90	60	60	60	90	90	90
β (°)	15	30	45	15	30	45	15	30	45	15	30	45	15	30	45	15	30	45
ζ	0.73	0.84	1.12	0.73	1.00	1.11	0.54	0.77	0.81	0.65	0.84	0.96	0.85	0.71	0.82	0.74	0.82	0.88



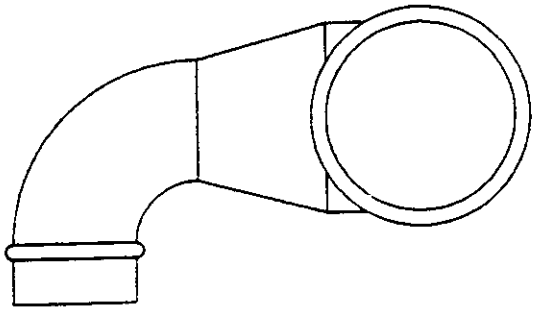
SMOOTH ELBOWS OUT OF PLANE WITH CONVERGING SECTION

D1 (mm)	**250**	**250**	**250**
D2 (mm)	**160**	**160**	**160**
α (°)	90	90	90
β (°)	15	30	45
ζ	1.82	1.79	1.79



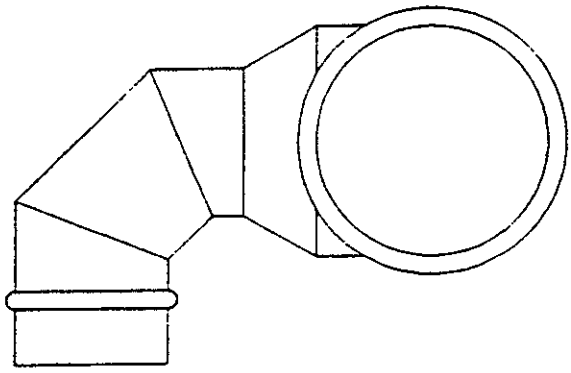
SEGMENTED ELBOWS OUT OF PLANE WITH CONVERGING SECTION

D1 (mm)	400	400	400	250	250	250
D2 (mm)	250	250	250	160	160	160
α (°)	90	90	90	90	90	90
β (°)	15	30	45	15	30	45
ζ	2.56	2.20	2.30	2.75	2.69	2.72



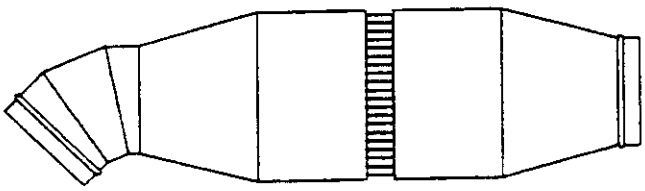
SMOOTH ELBOWS OUT OF PLANE WITH DIVERGING SECTION

D1 (mm)	160	160	160
D2 (mm)	250	250	250
α (°)	90	90	90
β (°)	15	30	45
ζ	0.42	0.54	0.67



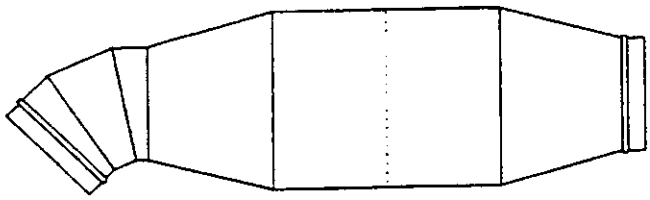
SEGMENTED ELBOWS OUT OF PLANE WITH DIVERGING SECTION

D1 (mm)	250	250	250	160	160	160
D2 (mm)	400	400	400	250	250	250
α (°)	90	90	90	90	90	90
β (°)	15	30	45	15	30	45
ζ	0.62	0.80	0.95	0.71	0.76	0.81



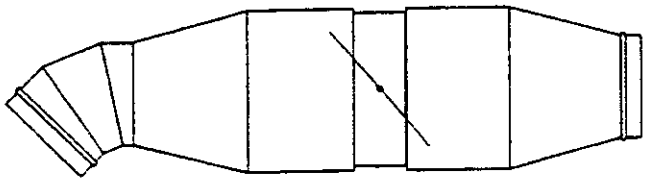
SEGMENTED ELBOWS HEATING COIL - L 400-100-400

D1 (mm)	400	400	400	400	400	400	400	400	400	400	400	400
D2 (mm)	630	630	630	630	630	630	630	630	630	630	630	630
α (°)	30	30	30	45	45	45	60	60	60	90	90	90
β (°)	15	30	45	15	30	45	15	30	45	15	30	45
ζ	0.65	0.82	0.88	0.68	0.86	0.93	0.76	0.94	1.01	0.95	1.14	1.29



SEGMENTED ELBOWS PERFORATED PLATE - L 400-400

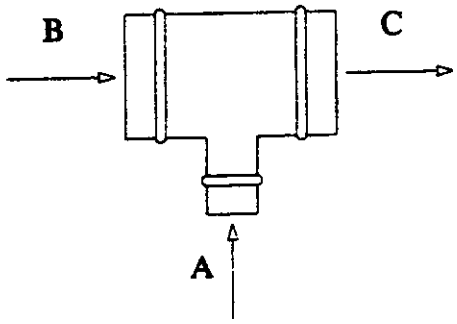
D1 (mm)	400	400	400	400	400	400	400	400	400	400	400	400
D2 (mm)	630	630	630	630	630	630	630	630	630	630	630	630
α (°)	30	30	30	45	45	45	60	60	60	90	90	90
β (°)	15	30	45	15	30	45	15	30	45	15	30	45
ζ	1.03	1.29	1.43	1.04	1.30	1.43	1.13	1.39	1.53	1.34	1.58	1.70



SEGMENTED ELBOWS VALVE - L 400-200-400

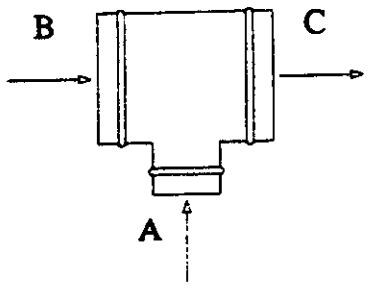
D1 (mm)	400	400	400	400	400	400	400	400	400	400	400	400
D2 (mm)	630	630	630	630	630	630	630	630	630	630	630	630
α (°)	30	30	30	45	45	45	60	60	60	90	90	90
β (°)	15	30	45	15	30	45	15	30	45	15	30	45
ζ	1.60	1.93	2.16	1.78	1.96	2.17	1.76	2.03	2.21	1.92	2.17	2.52

3.9 - CONVERGING T-PIECES



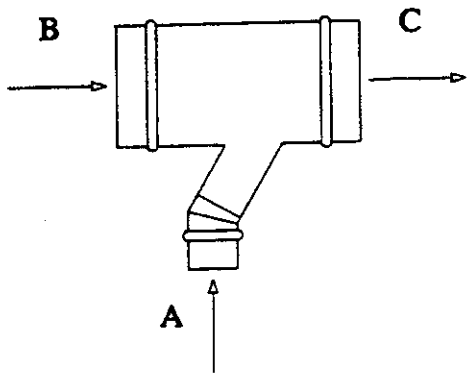
CONVERGING 90° SEGM. ELBOW 0°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	-0.98	0.02
			0.3	3.25	0.55
			0.5	10.4	1.09
			0.7	22.5	1.53
			1.3	46.7	1.40
250	150	250	0	-0.94	0.03
			0.3	0.66	0.47
			0.5	1.90	0.67
			0.7	3.90	0.93
			1.0	7.8	1.22
250	200	250	0	-0.93	0.04
			0.3	0.28	0.42
			0.5	0.82	0.57
			0.7	1.40	0.68
			1.0	2.61	0.89
250	250	250	0	-0.91	0.06
			0.3	0.15	0.43
			0.5	0.55	0.55
			0.7	0.76	0.66
			1.0	1.25	0.72



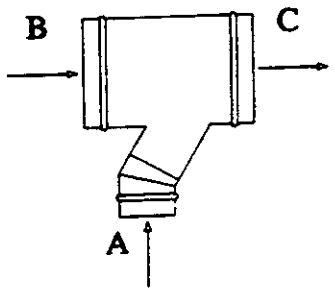
CONVERGING T-PIECES 90° SEGM. ELBOW 0°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	-1.08	-0.05
			0.1	2.00	0.10
			0.2	8.05	0.20
			0.3	18.0	0.40
			0.4	37.0	0.88
			0.5	69.8	1.22
			0.8	159	0.72
			1.0	282	0.28
400	150	400	0	-1.06	-0.05
			0.1	0.05	0.13
			0.2	0.80	0.18
			0.3	3.50	0.30
			0.4	5.53	0.38
			0.5	10.0	0.70
			0.7	21.0	1.44
			1.0	49.08	1.84
400	200	400	0	-1.08	-0.05
			0.2	0.55	0.26
			0.3	0.55	0.27
			0.4	1.62	0.36
			0.5	3.30	0.50
			0.7	8.23	1.00
			0.8	8.33	1.01
			1.0	14.65	0.96
400	250	400	0	-1.03	-0.03
			0.2	0.04	0.22
			0.3	0.05	0.22
			0.5	1.30	0.33
			0.7	3.27	0.47
			0.8	3.35	0.60
			1.0	5.97	0.79



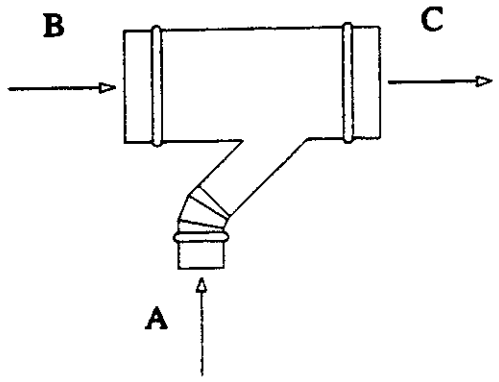
CONVERGING T-PIECES 60° SEGM. ELBOW 30°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	-0.94	0.03
			0.3	3.30	-0.20
			0.5	10.8	-0.77
			0.7	22.6	-1.14
			1.0	42.8	-4.06
250	150	250	0	-0.94	0.03
			0.3	0.57	0.17
			0.5	1.83	-0.12
			0.7	3.92	-0.56
			1.0	8.31	-1.47
250	200	250	0	-0.93	0.05
			0.3	0.12	0.29
			0.5	0.58	0.21
			0.7	1.02	-0.02
			1.0	1.98	-0.52
250	250	250	0	-0.94	0.07
			0.3	0.01	0.33
			0.5	0.33	0.33
			0.6	0.45	0.25
			1.0	0.78	-0.10



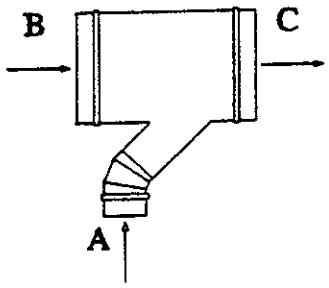
CONVERGING T-PIECES 60° SEGM. ELBOW 30°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	-1.05	-0.05
			0.1	4.50	-0.15
			0.2	13.0	-0.36
			0.3	27.0	-0.75
			0.4	49.8	-0.67
			0.5	88.6	-2.25
			0.6	133	-3.41
			0.8	252	-8.53
			1.0	428	-14.91
400	150	400	0	-1.07	-0.05
			0.1	0.26	0.04
			0.2	0.89	-0.00
			0.3	4.50	-0.50
			0.4	7.64	-0.61
			0.5	15.3	-0.75
			0.7	28.5	-2.00
			0.8	35.9	-3.17
			1.0	64.7	-6.26
400	200	400	0	-1.08	-0.05
			0.2	0.55	0.05
			0.3	0.57	0.05
			0.4	1.87	-0.17
			0.5	3.56	-0.48
			0.6	5.03	-0.59
			0.7	10.0	-0.82
			0.8	10.1	-0.80
			1.0	17.7	-2.65
400	250	400	0	-1.07	-0.49
			0.2	-0.01	0.13
			0.3	-0.00	0.12
			0.5	1.10	-0.14
			0.7	2.99	-0.60
			0.8	3.03	-0.62
			1.0	5.99	-136



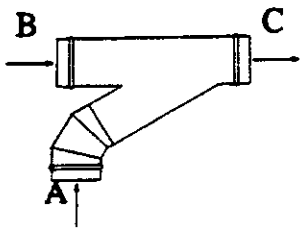
CONVERGING T-PIECES 45° SEGM. ELBOW 45°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	-0.93	0.03
			0.3	3.97	-0.43
			0.5	12.3	-1.30
			0.7	24.9	-2.52
			1.0	46.4	-6.14
250	150	250	0	-0.91	0.04
			0.3	0.53	0.05
			0.5	1.71	-0.42
			0.7	3.52	-1.13
			1.0	7.06	-2.56
250	200	250	0	-0.94	0.06
			0.3	0.05	0.21
			0.5	0.50	0.03
			0.7	0.89	-0.03
			1.0	1.53	-1.24
250	250	250	0	-0.91	0.07
			0.3	-0.05	0.28
			0.5	0.23	0.22
			0.6	0.29	0.07
			1.0	0.57	-0.42



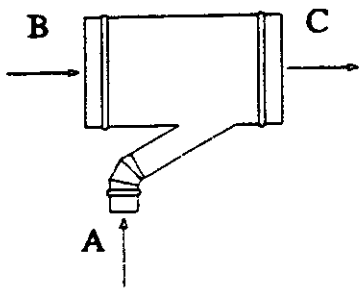
CONVERGING T-PIECES 45°SEGM. ELBOW 45°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	-1.06	-0.05
			0.1	5.58	-0.20
			0.2	8.87	-0.45
			0.3	24	-8.85
			0.4	66.0	-2.58
			0.5	106.9	-4.8
			0.8	217.9	-11.0
			1.0	374.9	-19.5
400	150	400	0	-1.06	-0.04
			0.1	0.18	-0.01
			0.2	0.86	-0.09
			0.3	3.1	-0.50
			0.4	7.9	-0.95
			0.5	14.6	-1.50
			0.7	26.7	-3.04
			0.8	34.9	-4.57
			1.0	61	-8.95
400	200	400	0	-1.07	-0.05
			0.2	0.52	-0.07
			0.3	0.60	-0.08
			0.4	2.59	-0.61
			0.5	3.80	-0.88
			0.6	5.69	-1.20
			0.7	9.80	-1.79
			0.8	10.0	-1.8
			1.0	17.05	-4.27
400	250	400	0	-1.08	-0.03
			0.2	-0.03	-0.07
			0.3	-0.02	-0.07
			0.5	1.13	-0.40
			0.7	2.85	-1.28
			0.8	2.91	-1.29
			1.0	5.50	-2.48



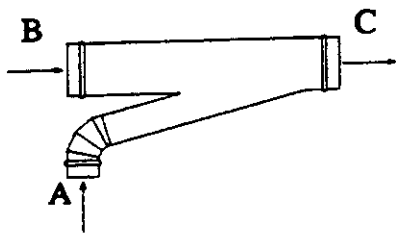
CONVERGING T-PIECES 30° SEGM. ELBOW 60°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	-0.93	0.05
			0.3	4.12	-0.56
			0.5	12.04	-1.79
			0.7	23.11	-3.70
			1.0	45.47	-9.34
250	150	250	0	-0.92	0.06
			0.3	0.52	-0.01
			0.5	1.80	-0.59
			0.7	3.20	-1.69
			1.0	6.17	-3.74
250	200	250	0	-0.92	0.07
			0.3	0.05	0.16
			0.5	0.52	-0.09
			0.7	0.92	-0.63
			1.0	1.47	-1.86
250	250	250	0	-0.88	0.11
			0.3	-0.11	0.22
			0.5	0.18	0.11
			0.6	0.24	-0.10
			1.0	0.46	-0.72



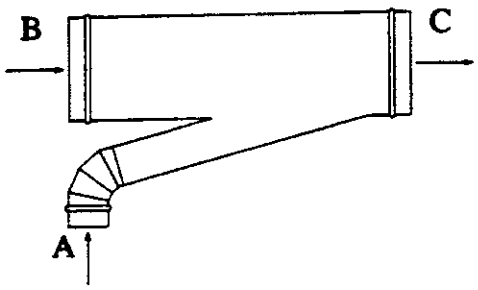
CONVERGING T-PIECES 30° SEGM. ELBOW 60°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	-1.07	-0.05
			0.1	2.44	-0.15
			0.2	14.47	-0.81
			0.3	32.35	-1.39
			0.4	55.27	-2.02
			0.5	78.43	-3.51
			0.6	129.3	-5.68
			0.8	227.10	-14.41
			1.0	388.45	-26.36
400	150	400	0	-1.07	-0.04
			0.1	0.36	-0.06
			0.2	1.14	-0.15
			0.3	6.49	-1.08
			0.4	8.31	-1.38
			0.5	15.11	-2.28
			0.7	27.61	-4.37
			1.0	60.25	-11.98
400	200	400	0	-1.07	-0.04
			0.2	0.63	-0.13
			0.3	0.66	-0.14
			0.4	2.09	-0.59
			0.5	3.95	-1.24
			0.7	9.10	-2.93
			1.0	15.73	-6.01
400	250	400	0	-1.07	-0.02
			0.2	-0.01	-0.00
			0.3	-0.00	0.01
			0.5	1.30	-0.50
			0.7	2.99	-1.77
			0.8	3.09	-1.81
			1.0	5.36	-3.51



CONVERGING T-PIECES 15° SEGM. ELBOW 75°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	-0.94	0.06
			0.3	4.70	-0.42
			0.5	13.1	-2.18
			0.7	25.8	-5.03
			1.0	48.13	-11.21
250	150	250	0	-0.91	0.09
			0.3	0.53	-0.00
			0.5	1.90	-0.59
			0.7	3.39	-1.81
			1.0	5.99	-4.42
250	200	250	0	-0.88	0.12
			0.3	0.08	0.16
			0.5	0.64	-0.09
			0.7	1.12	-0.62
			1.0	1.70	-1.99
250	250	250	0	-0.80	0.19
			0.3	-0.09	0.23
			0.5	0.20	0.11
			0.6	0.30	-0.10
			1.0	0.53	-0.69

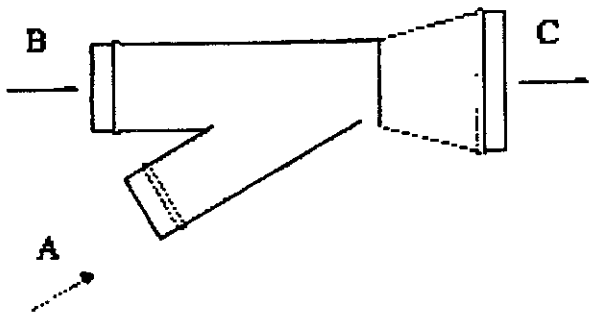


CONVERGING T-PIECES 15° SEGM. ELBOW 75°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	-1.06	-0.03
			0.1	1.95	-0.12
			0.2	10.5	-0.60
			0.3	25.7	-1.52
			0.4	63.7	-4.84
			0.5	104.4	-8.65
			0.6	115.2	-9.45
			0.8	233.1	-19.7
			1.0	375.4	-31.6
400	150	400	0	-1.08	-0.03
			0.1	0.36	-0.06
			0.2	1.31	-0.17
			0.3	6.33	-1.03
			0.4	7.78	-1.36
			0.5	14.0	-2.83
			0.7	25.3	-5.44
			0.8	32.8	-7.36
			1.0	57.5	-13.5
400	200	400	0	-1.06	-0.01
			0.2	0.66	-0.13
			0.3	0.67	-0.14
			0.5	3.84	-1.26
			0.7	8.49	-3.48
			0.8	8.59	-3.50
			1.0	14.6	-6.91
400	250	400	0	-1.05	-0.00
			0.2	-0.01	0.01
			0.3	0.00	0.01
			0.5	1.31	-0.58
			0.7	2.78	-1.99
			0.8	2.78	-2.01
			1.0	4.51	-4.05

CONVERGING T-PIECES WITH DIVERGING SECTION

D_A	D_B	D_C	δ	β	q_{ma}/q_{mc}	ζAC	ζBC
250	200	250	30	15	0.0	0.00	1.61
					0.3	1.24	2.74
					0.5	2.95	0.23
					0.7	6.23	-1.69
250	200	250	30	30	0.0	0.00	2.35
					0.3	1.58	3.09
					0.5	4.37	1.44
					0.7	6.94	-1.17
250	200	250	30	45	0.0	0.00	2.96
					0.3	1.89	3.36
					0.5	4.55	1.71
					0.7	7.44	-0.72
250	200	250	45	15	0.0	0.00	1.53
					0.3	1.58	3.20
					0.5	4.05	1.86
					0.7	7.71	-0.05
250	200	200	45	30	0.0	0.00	2.19
					0.3	2.60	4.13
					0.5	5.38	3.54
					0.7	9.33	1.88
250	200	250	45	45	0	0.00	2.90
					0.3	2.79	4.45
					0.5	5.08	2.87
					0.7	9.76	2.33
250	200	250	60	15	0	0.00	1.43
					0.3	2.89	4.51
					0.5	6.12	4.46
					0.7	9.45	2.85
250	200	250	60	30	0	0.00	2.17
					0.3	4.41	5.98
					0.5	8.03	6.42
					0.7	11.5	5.03
250	200	250	60	45	0	0.00	2.82
					0.3	5.20	6.76
					0.5	8.76	7.06
					0.7	12.4	5.72
250	200	250	90	15	0	0.00	1.45
					0.3	3.41	5.19
					0.5	6.87	5.45
					0.7	9.91	5.65



CONVERGING T-PIECES WITH DIVERGING SECTION

D_A	D_B	D_C	δ	β	q_{ma}/q_{mc}	ζ_{AC}	ζ_{BC}
250	250	250	30	15	0	0.00	1.86
					0.3	1.26	3.65
					0.5	2.90	2.78
					0.7	4.33	1.73
					1.0	5.31	0.00
250	250	250	30	30	0	0.00	2.65
					0.3	1.71	4.15
					0.5	3.57	3.51
					0.7	5.17	2.59
					1.0	6.42	0.00
250	250	250	30	45	0	0.00	3.24
					0.3	1.95	4.41
					0.5	3.82	4.10
					0.7	5.88	3.31
					1.0	6.93	0.00
250	250	250	45	15	0	0.00	1.78
					0.3	1.68	3.87
					0.5	3.89	3.77
					0.7	5.67	3.27
					1.0	6.26	0.00

CONVERGING T-PIECES WITH DIVERGING SECTION

D_A	D_B	D_C	δ	β	q_{ma}/q_{mc}	ζAC	ζBC
250	250	250	45	30	0	0.00	2.33
					0.3	2.78	5.00
					0.5	5.60	5.48
					0.7	7.34	4.97
					1.0	8.14	0.00
250	250	250	45	45	0	0.00	3.00
					0.3	3.24	5.39
					0.5	6.04	5.88
					0.7	7.88	5.28
					1.0	9.10	0.00
250	250	250	60	15	0	0.00	1.69
					0.3	4.24	6.38
					0.5	6.88	6.91
					0.7	8.76	6.68
					1.0	9.53	0.00
250	250	250	60	30	0	0.00	2.26
					0.3	5.21	7.30
					0.5	7.86	7.93
					0.7	9.97	7.90
					1.0	11.38	0.00
250	250	250	60	45	0	0.00	2.90
					0.3	5.5	7.65
					0.5	8.03	8.08
					0.7	10.2	8.11
					1.0	12.2	0.00

CONVERGING T-PIECES WITH DIVERGING SECTION

D_A	D_B	D_C	δ	β	q_{ma}/q_{mc}	ζ_{AC}	ζ_{BC}
160	100	160	90	15	0	0.00	1.49
					0.3	5.40	4.29
					0.5	11.2	4.60
					0.7	20.7	5.50
					1.0	45.5	0.00
160	100	160	90	30	0	0.00	1.94
					0.3	6.35	5.36
					0.5	12.1	5.80
					0.7	21.5	6.35
					1.0	46.9	0.00
160	100	160	90	45	0	0.00	2.28
					0.3	6.19	5.70
					0.5	13.0	6.49
					0.7	23.0	7.52
					1.0	47.3	0.00
160	160	160	90	15	0	0.00	1.72
					0.3	2.14	4.62
					0.5	5.02	5.02
					0.7	6.73	5.11
					1.0	8.84	0.00
160	160	160	90	30	0	0.00	2.21
					0.3	2.95	5.40
					0.5	5.92	5.93
					0.7	7.74	6.13
					1.0	9.62	0.00
160	160	160	90	45	0	0.00	2.26
					0.3	3.49	5.91
					0.5	6.64	6.66
					0.7	8.62	7.07
					1.0	10	0
250	250	250	90	15	0	0.00	1.43
					0.3	2.41	4.78
					0.5	4.95	5.22
					0.7	6.74	5.42
					1.0	8.78	0.00
250	250	250	90	30	0	0.00	2.26
					0.3	3.87	6.17
					0.5	6.64	6.92
					0.7	8.80	7.34
					1.0	10.8	0.00

CONVERGING T-PIECES WITH DIVERGING SECTION

D_A	D_B	D_C	δ	β	q_{ma}/q_{mc}	ζAC	ζBC
250	250	250	90	45	0	0.00	2.86
					0.3	4.28	6.65
					0.5	7.44	7.66
					0.7	9.46	8.07
					1.0	11.13	0.00
160	100	160	60	15	0	0.00	1.69
					0.3	5.74	3.35
					0.5	13.19	2.04
					0.7	25.73	0.19
					1.0	54.6	0.00
160	100	160	60	30	0	0.00	2.03
					0.3	6.65	4.29
					0.5	13.9	2.82
					0.7	26.6	0.90
					1.0	56.2	0.00
160	100	1600	60	45	0	0.00	2.39
					0.3	6.41	4.73
					0.5	14.03	3.03
					0.7	26.62	1.32
					1.0	57.0	0.00

CONVERGING T-PIECES WITH DIVERGING SECTION

D_A	D_B	D_C	δ	β	q_{ma}/q_{mc}	ζAC	ζBC
160	160	160	60	15	0	0.00	1.70
					0.3	0.95	3.23
					0.5	3.11	2.88
					0.7	4.55	2.17
					1.0	6.47	0.00
160	160	160	60	30	0	0.00	2.33
					0.3	1.40	3.73
					0.5	3.82	3.71
					0.7	5.57	3.23
					1.0	7.14	0.00
160	160	160	60	45	0.	0.00	2.60
					0.3	1.56	3.77
					0.5	3.65	3.48
					0.7	5.26	2.92
					1.0	7.77	0.00
250	250	250	60	15	0	0.00	1.59
					0.3	3.70	5.88
					0.5	6.39	6.52
					0.7	8.26	6.22
					1.0	9.29	0.00
250	250	250	60	30	0	0.00	2.32
					0.3	5.14	7.28
					0.5	7.67	7.81
					0.7	9.75	7.64
					1.0	11.28	0.00
250	250	250	6.	45	0	0.00	2.95
					0.3	5.55	7.68
					0.5	7.95	8.02
					0.7	9.91	7.81
					1.00	1.88	0.00
160	100	160	45	15	0	0.00	0.53
					0.3	4.52	1.59
					0.5	12.44	-0.65
					0.7	23.89	-3.88
					1.0	51.5	0.00
160	100	160	45	30	0	0.00	2.23
					0.3	4.92	2.10
					0.5	12.5	0.19
					0.7	23.3	-3.62
					1.0	50.55	0.00
160	100	160	45	45	0	0.00	2.56
					0.3	5.24	2.39
					0.5	12.6	0.43
					0.7	23.8	-3.18
					1.0	51.5	0.00

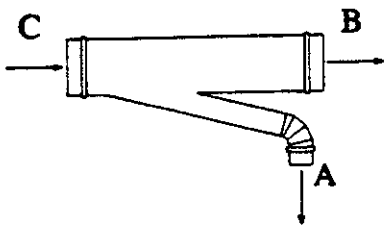
CONVERGING T-PIECES WITH DIVERGING SECTION

D_A	D_B	D_C	δ	β	q_{ma}/q_{mc}	ζAC	ζBC
160	160	160	45	15	0	0.00	2.22
					0.3	1.07	3.47
					0.5	2.73	2.50
					0.7	3.73	1.25
					1.0	4.91	0.00
160	160	160	45	30	0	0.00	2.64
					0.3	1.23	3.63
					0.5	3.06	2.84
					0.7	4.23	1.75
					1.0	5.36	0.00
160	160	160	45	45	0	0.00	2.95
					0.3	1.53	3.91
					0.5	3.52	3.31
					0.7	5.55	2.01
					1.0	5.90	0.00
250	250	250	45	15	0	0.00	1.71
					0.3	1.27	3.49
					0.5	2.84	2.88
					0.7	4.75	2.18
					1.0	5.74	0.00
250	250	250	45	30	0	0.00	2.33
					0.3	2.51	4.75
					0.5	4.90	4.88
					0.7	6.97	4.43
					1.0	7.33	0.00
250	250	250	45	45	0	0.00	3.12
					0.3	1.70	4.00
					0.5	3.47	3.46
					0.7	6.96	4.56
					1.0	7.45	0.00
160	100	160	30	15	0	0.00	1.81
					0.3	3.96	0.83
					0.5	11.4	-1.35
					0.7	21.84	-6.15
					1.0	44.86	0.00
160	100	160	30	30	0	0.00	2.31
					0.3	4.69	1.63
					0.5	12.3	-0.65
					0.7	23.2	-5.11
					1.0	46.7	0.00
160	100	160	30	45	0	0.00	2.58
					0.3	4.57	2.11
					0.5	12.6	-0.51
					0.7	23.4	-4.88
					1.0	47.97	0.00

CONVERGING T-PIECES WITH DIVERGING SECTION

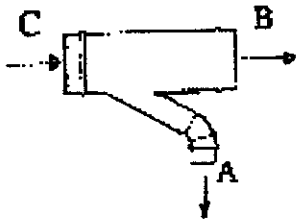
D_A	D_B	D_C	δ	β	q_{ma}/q_{mc}	ζAC	ζBC
160	160	160	30	15	0	0.00	1.95
					0.3	0.74	3.00
					0.5	2.26	1.95
					0.7	3.38	-0.06
					1.0	4.38	0.00
160	160	160	30	30	0.0	0.00	2.50
					0.3	0.97	3.30
					0.5	2.76	2.48
					0.7	3.99	0.50
					1.0	4.64	0.00
160	160	160	30	45	0	0.00	2.79
					0.3	1.10	3.48
					0.5	2.76	2.70
					0.7	4.18	0.96
					1.0	4.94	0.00
250	250	250	30	15	0	0.00	1.87
					0.3	1.22	3.64
					0.5	2.70	2.54
					0.7	3.98	1.08
					1.0	5.30	0.00
250	250	250	30	30	0	0.00	2.63
					0.3	1.71	4.06
					0.5	3.35	3.21
					0.6	4.10	1.81
					0.7	4.60	1.77
					1.0	6.12	0.00
250	250	250	30	45	0	0.00	3.24
					0.3	1.92	4.38
					0.5	3.35	3.21
					0.7	4.63	1.69
					1.0	6.89	0.00

3.10 - DIVERGING T-PIECES



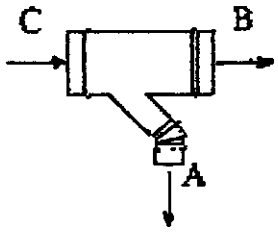
DIVERGING T-PIECES 15° SEGM. ELBOW 75°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	0.59	0.15
			0.3	3.93	0.00
			0.5	12.2	0.03
			0.7	26.4	0.17
			1.0	63.5	0.29
250	150	250	0	0.57	0.20
			0.3	0.38	0.01
			0.5	1.45	0.03
			0.7	3.69	3.13
			1.0	8.83	0.27
250	200	250	0	0.52	0.25
			0.3	0.26	0.00
			0.5	0.36	0.02
			0.7	0.99	0.09
			1.0	2.55	0.22
250	250	250	0	0.50	0.36
			0.3	0.35	-0.05
			0.5	0.21	0.01
			0.7	0.23	0.12
			1.0	0.63	0.22



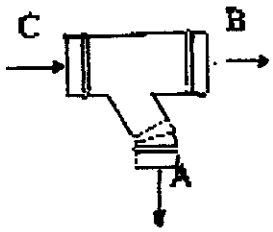
DIVERGING T-PIECES 30° SEGM. ELBOW 60°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	0.94	0.12
			0.3	2.82	0.01
			0.5	9.48	0.05
			0.7	20.5	0.14
			0.9	37.4	0.25
			1.0	57.2	0.30
250	150	250	0	0.93	0.13
			0.3	0.39	0.04
			0.5	1.41	0.03
			0.7	3.26	0.13
			0.9	6.85	0.29
			1.0	7.90	0.35
250	200	250	0	0.93	0.16
			0.3	0.49	-0.00
			0.5	0.43	0.02
			0.7	0.74	0.13
			1.0	2.08	0.27
			1.2	2.09	0.28
250	250	250	0	0.91	0.19
			0.3	0.62	0.00
			0.5	0.40	0.03
			0.7	0.34	0.14
			1.0	0.62	0.31



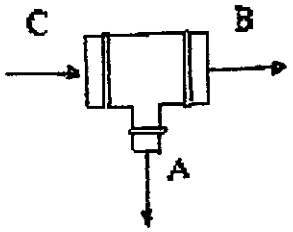
DIVERGING T-PIECES 45° SEGM. ELBOW 45°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	1.0	0.10
			0.3	2.36	0.00
			0.5	6.92	0.05
			0.7	14.8	0.20
			0.9	29.1	0.37
			1.0	34.6	0.31
250	150	250	0	0.97	0.10
			0.3	0.54	-0.00
			0.5	1.17	0.08
			0.7	2.58	0.16
			1.0	6.52	0.36
250	200	250	0	0.96	0.13
			0.3	0.60	-0.00
			0.5	0.46	0.03
			0.7	0.66	0.13
			1.0	1.65	0.33
250	250	250	0	0.96	0.16
			0.3	0.71	-0.00
			0.5	0.49	0.06
			0.7	0.37	0.15
			1.0	0.50	0.28



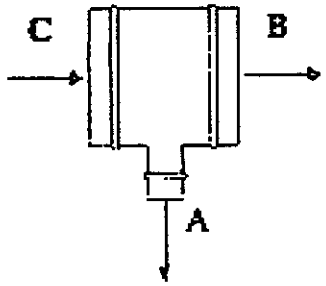
DIVERGING T-PIECES 60° SEGM. ELBOW 30°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	0.99	0.09
			0.3	2.08	0.00
			0.5	6.34	0.06
			0.7	13.7	0.20
			1.0	32.4	0.40
			1.4	30.4	0.39
250	150	250	0	0.96	0.09
			0.3	0.71	0.00
			0.5	1.13	0.09
			0.7	2.32	0.18
			1.0	5.24	0.30
250	200	250	0	0.98	0.11
			0.3	0.77	-0.00
			0.5	0.65	0.03
			0.7	0.77	0.13
			1.0	1.41	0.29
250	250	250	0	1.01	0.13
			0.3	0.81	-0.01
			0.5	0.66	0.06
			0.7	0.56	0.15
			1.0	0.67	0.35



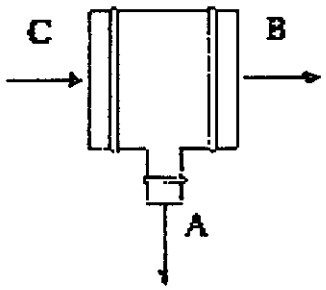
DIVERGING T-PIECES 90° SEGM. ELBOW 0°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
250	100	250	0	0.98	0.09
			0.3	3.03	0.00
			0.5	5.67	0.07
			0.7	9.64	0.19
			0.9	17.46	0.25
			1.0	21.0	0.35
250	150	250	0	0.99	0.10
			0.3	1.48	0.02
			0.5	2.17	0.09
			0.7	3.01	0.17
			1.0	4.75	0.29
250	200	250	0	0.96	0.11
			0.3	0.99	-0.01
			0.5	1.01	0.01
			0.7	1.36	0.14
			1.0	1.86	0.28
250	250	250	0	1.01	0.12
			0.3	0.94	-0.02
			0.5	0.94	0.04
			0.7	0.98	0.12
			1.0	1.20	0.27



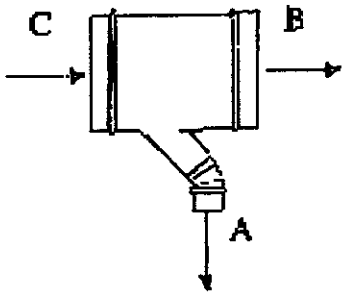
DIVERGING T-PIECES 90° SEGM. ELBOW 0°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	1.09	-0.04
			0.1	1.90	-0.05
			0.2	2.32	-0.04
			0.3	2.43	-0.07
			0.4	4.70	-0.08
			0.5	4.17	-0.12
			0.8	11.7	-0.52
			1.0	-20.79	-0.26
400	150	400	0	1.04	-0.02
			0.1	1.07	-0.02
			0.2	1.35	-0.02
			0.3	1.50	-0.01
			0.4	2.08	0.01
			0.5	2.92	0.05
			0.6	3.39	0.09
			0.8	4.72	0.19
			1.0	6.63	0.24
400	200	400	0	1.01	-0.04
			0.2	1.31	-0.03
			0.3	1.41	-0.03
			0.4	1.47	0.01
			0.5	1.54	0.04
			0.6	1.81	0.13
			0.7	2.36	0.22
			0.8	2.04	0.18
			1.0	2.63	0.27
400	250	400	0	1.02	-0.03
			0.2	0.97	-0.03
			0.3	0.94	-0.02
			0.5	1.06	0.04
			0.7	1.06	0.19
			0.8	1.09	0.21
			1.0	1.49	0.31



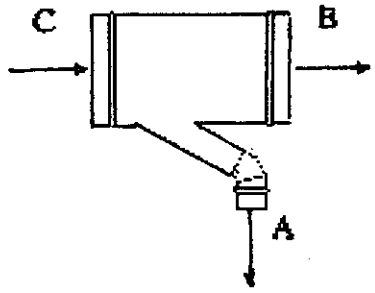
DIVERGING T-PIECES 60° SEGM. ELBOW 30°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	1.04	-0.06
			0.1	2.32	-0.06
			0.2	4.98	-0.05
			0.3	11.9	-0.07
			0.4	30.2	-0.14
			0.5	36.4	-0.21
			0.8	114.5	-0.33
			1.0	156.6	-0.71
400	150	400	0	1.02	-0.02
			0.1	0.89	-0.03
			0.2	1.17	-0.02
			0.3	1.99	-0.02
			0.4	4.68	-0.00
			0.5	11.5	0.05
			0.7	20.1	0.13
			1.0	42.08	0.16
400	200	400	0	1.02	-0.04
			0.2	0.65	-0.02
			0.3	0.66	-0.01
			0.4	1.20	0.02
			0.5	1.77	0.05
			0.6	3.26	0.12
			0.7	4.78	0.19
			0.8	6.14	0.23
			1.0	9.48	0.29
400	250	400	0	1.01	-0.02
			0.2	0.70	-0.02
			0.3	0.70	-0.01
			0.5	0.76	0.05
			0.7	1.73	0.19
			0.8	1.77	0.21
			1.0	3.46	0.30



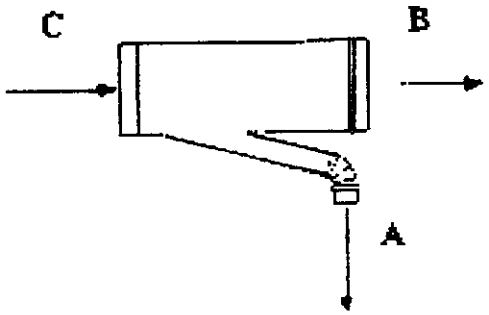
DIVERGING T-PIECES 45° SEGM. ELBOW 45°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	1.01	-0.06
			0.1	1.64	-0.05
			0.2	3.90	-0.04
			0.3	21.5	-0.12
			0.4	32.5	-0.13
			0.5	42.6	-0.19
			0.8	129.5	-0.45
			1.0	169.7	-0.75
400	150	400	0	1.04	-0.03
			0.1	0.63	-0.03
			0.2	1.29	-0.03
			0.3	2.18	-0.02
			0.4	5.01	-0.00
			0.5	11.0	-0.01
			0.6	11.8	-0.05
			0.7	26.2	0.10
			0.8	20.1	0.13
			1.0	42.8	0.17
400	200	400	0	1.00	-0.03
			0.2	0.52	-0.02
			0.3	0.74	-0.01
			0.4	1.52	0.01
			0.5	2.41	0.04
			0.6	4.39	0.11
			0.7	4.76	0.13
			0.8	8.78	0.23
			1.0	13.45	0.22
400	250	400	0	0.98	-0.02
			0.2	0.50	-0.01
			0.3	0.51	-0.01
			0.5	0.67	0.05
			0.7	1.77	0.19
			0.8	1.82	0.20
			1.0	3.77	0.31



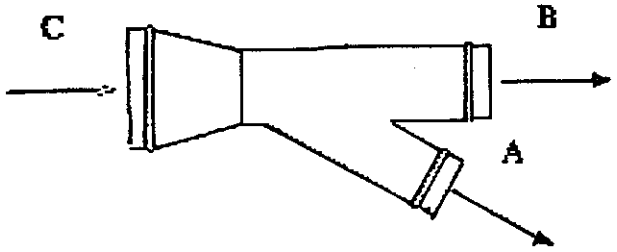
DIVERGING T-PIECES 30° SEGM. ELBOW 60°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	0.94	-0.05
			0.1	1.86	-0.05
			0.2	4.84	-0.04
			0.3	23.7	-0.12
			0.4	38.4	-0.15
			0.5	43.0	-0.16
			0.8	158.1	-0.29
			1.0	187.3	-0.80
400	150	400	0	0.96	-0.02
			0.1	0.74	-0.04
			0.2	1.94	-0.05
			0.3	3.10	-0.02
			0.4	7.29	-0.01
			0.5	13.6	0.03
			0.6	15.9	0.05
			0.7	30.2	0.08
			0.8	21.0	0.13
			1.0	57.6	0.16
400	200	400	0	0.94	-0.01
			0.2	0.54	-0.02
			0.3	0.80	-0.01
			0.4	1.77	0.00
			0.5	2.72	0.04
			0.6	4.90	0.10
			0.8	7.45	0.18
			0.9	9.48	0.22
			1.0	14.07	0.25
400	250	400	0	0.96	-0.04
			0.2	0.43	-0.03
			0.3	0.41	-0.03
			0.5	0.96	0.02
			0.7	2.62	0.16
			0.8	2.72	0.17
			1.0	4.94	0.27



DIVERGING T-PIECES 15° SEGM. ELBOW 75°

D_A	D_B	D_C	q_{ma}/q_{mc}	ζAC	ζBC
400	100	400	0	0.64	-0.02
			0.1	2.59	-0.03
			0.2	6.68	-0.05
			0.3	13.6	-0.06
			0.4	17.1	-0.10
			0.5	30.0	-0.16
			0.8	141.4	-0.40
			1.0	-72.3	-0.60
400	150	400	0	0.56	0.01
			0.1	0.51	-0.02
			0.2	2.96	-0.01
			0.3	2.99	-0.01
			0.4	6.83	0.02
			0.5	14.4	0.04
			0.6	15.9	0.07
			0.7	30.2	0.12
			0.8	22.1	0.13
			1.0	59.8	0.15
400	200	400	0	0.58	0.01
			0.2	0.33	-0.02
			0.3	0.43	-0.01
			0.4	1.63	0.00
			0.5	2.76	0.03
			0.6	4.89	0.08
			0.7	7.60	0.13
			0.8	9.90	0.18
			1.0	15.05	0.21
400	250	400	0	0.47	0.03
			0.2	0.29	-0.02
			0.3	0.27	-0.03
			0.5	0.87	0.02
			0.7	2.75	0.16
			0.8	2.68	0.16
			1.0	5.1	0.26



DIVERGING T-PIECES WITH CONVERGING SECTION

D_A	D_B	D_C	δ		β	q_{ma}/q_{mc}	ζAC	ζBC
250	200	250	30		15	0	0.00	0.67
						0.3	3.03	0.44
						0.4	2.10	0.50
						0.5	1.96	0.63
						0.7	2.31	1.32
						1.0	7.07	0.00
250	200	250	30		30	0.0	0.00	0.72
						0.3	3.02	0.44
						0.4	2.50	0.65
						0.5	1.96	0.62
						0.6	2.13	1.03
						0.7	2.53	1.22
						1.0	7.04	0.00
250	200	250	30		45	0	0.00	0.75
						0.3	3.09	0.43
						0.4	2.20	0.66
						0.5	2.03	0.55
						0.6	2.23	1.15
						0.7	2.49	1.51
						1.0	7.11	0.00
250	200	250	45		15	0	0.00	0.52
						0.3	3.80	0.38
						0.4	2.93	0.57
						0.5	2.64	0.67
						0.6	2.52	1.22
						0.7	2.84	1.45
						1.0	6.61	0.00
250	200	250	45		30	0	0.00	0.59
						0.3	3.83	0.39
						0.4	2.91	0.50
						0.5	2.62	0.52
						0.6	2.63	1.17
						0.7	2.84	1.27
						1.0	6.87	0.00
250	200	250	45		45	0	0.00	0.58
						0.3	3.85	0.39
						0.4	3.01	0.62
						0.5	2.66	0.61
						0.6	2.49	1.28
						0.7	2.82	1.49
						1.0	6.82	0.00
250	200	250	60		15	0	0.00	0.46
						0.3	5.12	0.29
						0.5	4.07	0.52
						0.7	3.94	1.43
						1.0	6.62	0.00

DIVERGING T-PIECES WITH CONVERGING SECTION

D_A	D_B	D_C	δ	α	β	q_{ma}/q_{mc}	ζAC	ζBC
250	200	250	60		30	0	0.00	0.42
						0.3	5.10	0.28
						0.5	4.02	0.52
						0.7	3.92	1.43
						1.0	6.49	0.00
250	200	250	60		45	0	0.00	0.49
						0.3	5.03	0.32
						0.5	4.12	0.60
						0.7	3.91	1.49
						1.0	6.34	0.00
250	200	250	90		15	0	0.00	0.39
						0.3	6.70	0.31
						0.4	6.69	0.45
						0.5	6.75	0.56
						0.6	7.30	1.18
						0.7	7.67	1.29
						1.0	10.01	0.00
250	200	250	90		30	0	0.00	0.46
						0.3	6.65	0.31
						0.4	6.77	0.47
						0.5	6.78	0.61
						0.6	7.20	1.23
						0.7	7.57	1.37
						1.0	9.90	0.00
250	200	250	90	0	45	0	0.00	0.47
						0.3	6.70	0.30
						0.4	6.84	0.47
						0.5	6.70	0.52
						0.7	7.59	1.31
						1.0	9.74	0.00
250	200	250	60	30	15	0	0.00	0.44
						0.3	4.86	0.34
						0.4	4.25	0.43
						0.5	3.87	0.55
						0.7	4.19	1.39
						1.0	8.23	0.00
250	200	250	60	30	30	0	0.00	0.52
						0.3	4.78	0.40
						0.5	3.86	0.65
						0.7	4.23	1.42
						1.0	8.07	0.00
250	200	250	60	30	45	0	0.00	0.55
						0.3	4.86	0.42
						0.4	4.25	0.68
						0.5	3.96	0.59
						0.7	4.33	1.49
						1.0	8.04	0.00

DIVERGING T-PIECES WITH CONVERGING SECTION

D_A	D_B	D_C	δ	α	β	q_{ma}/q_{mc}	ζAC	ζBC
250	200	250	45	45	15	0	0.00	0.61
						0.3	3.80	0.27
						0.5	3.06	0.52
						0.7	4.41	1.41
						1.0	10.2	0.00
250	200	250	45	45	30	0	0.00	0.60
						0.3	3.84	0.40
						0.5	3.13	0.63
						0.7	4.50	1.36
						0.8	5.66	1.64
						1.0	10.4	0.00
250	200	250	45	45	45	0	0.00	0.61
						0.3	3.97	0.43
						0.4	3.25	0.64
						0.5	3.13	0.60
						0.6	3.78	1.07
						0.7	4.33	1.29
						1.0	10.4	0.00
250	200	250	30	60	15	0	0.00	0.67
						0.3	3.25	0.37
						0.4	3.02	0.50
						0.5	2.85	0.58
						0.6	3.95	1.02
						0.7	4.71	1.26
						1.0	12.4	0.00
250	200	250	30	60	30	0	0.00	0.69
						0.3	3.77	0.44
						0.4	3.00	0.61
						0.5	2.85	0.58
						0.6	3.87	1.04
						0.7	4.62	1.17
						1.0	12.4	0.00
250	200	250	30	60	45	0	0.00	0.76
						0.3	3.31	0.43
						0.4	3.03	0.52
						0.5	2.95	0.64
						0.6	3.89	1.12
						0.7	4.69	1.29
						1.0	12.56	0.00
250	250	250	30	0	15	0	0.00	0.93
						0.3	4.27	0.38
						0.5	2.86	0.61
						0.7	2.13	1.31
						1.0	3.04	0.00

DIVERGING T-PIECES WITH CONVERGING SECTION

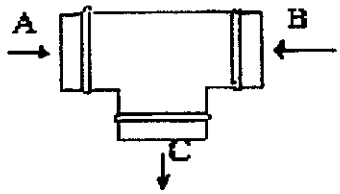
D_A	D_B	D_C	δ	α	β	q_{ma}/q_{mc}	ζ_{AC}	ζ_{BC}
250	250	250	30	0	30	0	0.00	1.05
						0.3	4.16	0.35
						0.4	3.24	0.46
						0.5	2.86	0.63
						0.7	2.25	1.25
						1.0	3.11	0.00
250	250	250	30	0	45	0	0.00	1.20
						0.3	4.36	0.38
						0.5	2.96	0.54
						0.7	2.29	1.29
						1.0	3.31	0.00
250	250	250	45	0	15	0	0.00	0.61
						0.3	4.42	0.33
						0.5	3.29	0.64
						0.7	2.44	1.39
						1.0	3.07	0.00
250	250	250	45	0	30	0	0.00	0.64
						0.3	4.50	0.35
						0.5	3.22	0.57
						0.7	2.40	1.36
						1.0	3.02	0.00
250	250	250	45	0	45	0	0.00	0.93
						0.3	4.63	0.41
						0.5	3.32	0.58
						0.7	2.47	1.40
						1.0	3.03	0.00
250	250	250	60	0	15	0	0.00	0.19
						0.3	5.47	0.28
						0.5	4.42	0.50
						0.7	3.90	1.73
						1.0	4.07	0.00
250	250	250	60	0	30	0	0.00	0.49
						0.3	5.45	0.27
						0.5	4.42	0.67
						0.7	3.88	1.61
						1.0	4.03	0.00
250	250	250	60	0	45	0	0.00	0.54
						0.3	5.48	0.33
						0.4	4.76	0.63
						0.5	4.51	0.62
						0.7	3.93	1.66
						1.0	4.20	0.00
250	250	250	90	0	15	0	0.00	0.50
						0.3	5.94	0.25
						0.5	5.59	0.59
						0.7	5.86	1.52
						1.0	6.31	0.00

DIVERGING T-PIECES WITH CONVERGING SECTION

D_A	D_B	D_C	δ	α	β	q_{ma}/q_{mc}	ζAC	ζBC
250	250	250	90	0	30	0	0.00	0.62
						0.3	5.97	0.28
						0.4	5.72	0.25
						0.5	5.60	0.47
						0.7	5.69	1.30
						1.0	6.16	0.00
250	250	250	90	0	45	0	0.00	0.46
						0.3	5.93	0.34
						0.4	5.68	0.47
						0.5	5.61	0.62
						0.7	5.71	1.45
						1.0	6.23	0.00
250	250	250	60	30	15	0	0.00	0.48
						0.3	5.24	0.27
						0.5	4.40	0.64
						0.7	3.93	1.52
						1.0	4.58	0.00
250	250	250	60	30	30	0.	0.00	0.43
						0.3	5.28	0.28
						0.5	4.39	0.66
						0.7	3.96	1.63
						1.0	4.45	0.00
250	250	250	60	30	45	0	0.00	0.55
						0.3	5.39	0.33
						0.4	4.64	0.53
						0.5	4.55	0.64
						0.7	3.96	1.60
						1.0	4.58	0.00
250	250	250	45	45	15	0	0.00	0.64
						0.3	4.50	0.41
						0.5	3.33	0.54
						0.7	2.79	1.36
						1.0	4.01	0.00
250	250	250	45	45	30	0	0.00	0.53
						0.3	4.47	0.33
						0.5	3.31	0.63
						0.7	2.75	1.41
						1.0	3.94	0.00
250	250	250	45	45	45	0	0.00	0.59
						0.3	4.55	0.48
						0.5	3.35	0.68
						0.7	2.79	1.40
						1.0	3.98	0.00

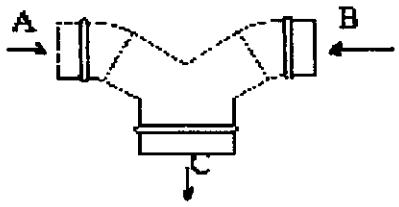
DIVERGING T-PIECES WITH CONVERGING SECTION

D_A	D_B	D_C	δ	α	β	q_{ma}/q_{mc}	ζAC	ζBC
250	250	250	30	60	15	0	0.00	1.0
						0.3	4.38	0.39
						0.5	3.35	0.70
						0.7	3.23	1.40
						1.0	5.30	0.00
250	250	250	30	60	30	0	0.00	1.06
						0.3	4.41	0.40
						0.5	3.35	0.59
						0.7	3.32	1.27
						1.0	5.39	0.00
250	250	250	30	60	45	0	0.00	1.13
						0.3	4.46	0.43
						0.5	3.51	0.63
						0.7	3.44	1.46
						1.0	5.39	0.00



3.11 - CONVERGING Y-PIECES

D_A	D_B	D_C	δ	α	q_{ma}/q_{mc}	ζAC	ζBC
250	100	100	180	0	0	0.00	37.5
					0.3	6.34	17.67
					0.5	8.16	10.4
					0.7	17.62	8.76
					1.0	39.0	0.00
250	160	160	180	0	0	0.00	4.94
					0.3	0.80	2.14
					0.5	1.14	1.07
					0.7	2.02	0.78
					1.0	4.68	0.00
250	200	200	180	0	0	0.00	1.89
					0.3	0.31	0.90
					0.5	0.50	0.51
					0.7	0.90	0.27
					1.0	1.79	0.00



CONVERGING Y-PIECES 2 ELBOWS

250	100	100	120	30	0	0.00	39.9
					0.3	4.52	17.3
					0.5	7.89	7.05
					0.7	17.67	4.18
					1.0	41.71	0.00
250	160	160	120	30	0	0.00	4.49
					0.3	-0.12	1.96
					0.5	1.0	1.04
					0.7	1.97	-0.09
					1.0	4.40	0.00
250	200	200	120	30	0	0.00	1.28
					0.3	0.03	0.66
					0.5	0.34	0.38
					0.7	0.68	-0.01
					1.0	1.21	0.00
250	100	100	90	45	0	0.00	35.8
					0.3	2.59	17.7
					0.5	9.14	9.07
					0.7	16.9	1.93
					1.0	34.15	0.00

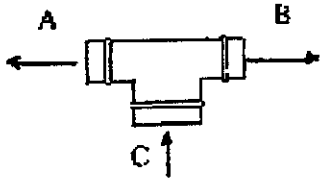
CONVERGING Y-PIECES 2 ELBOWS

D_A	D_B	D_C	δ	α	q_{ma}/q_{mc}	ζAC	ζBC
250	160	160	90	45	0	0.00	4.72
					0.3	-0.28	1.68
					0.5	0.93	1.04
					0.7	1.73	-0.33
					1.0	4.64	0.00
250	200	200	90	45	0	0.00	1.54
					0.3	-0.12	0.51
					0.5	0.23	0.20
					0.7	0.55	-0.18
					1.0	1.36	0.00
250	100	100	60	60	0	0.00	33.5
					0.3	1.24	16.8
					0.5	7.37	8.14
					0.7	15.5	1.48
					1.0	31.6	0.00
250	160	160	60	60	0	0.0	3.07
					0.3	-0.41	1.63
					0.5	0.57	0.56
					0.7	1.64	-0.43
					1.0	4.04	0.00
250	200	200	60	60	0	0.00	1.41
					0.3	-0.20	0.51
					0.5	0.15	0.19
					0.6	0.57	-0.07
					0.7	0.49	-0.19
					1.0	1.26	0.00
400	200	200	120	30	0	2.09	15.0
					0.2	1.29	7.26
					0.3	1.25	7.08
					0.5	1.78	2.14
					0.7	7.42	1.19
					0.8	7.76	1.22
					1.0	15.88	1.90
400	250	250	120	30	0	0.31	5.16
					0.3	0.13	1.98
					0.5	0.43	0.37
					0.7	1.78	0.17
					0.8	1.88	0.15
					1.0	4.90	0.45
400	315	315	120	30	0	-0.52	1.53
					0.2	-0.08	0.75
					0.3	-0.10	0.75
					0.5	0.23	0.30
					0.7	0.60	-0.10
					0.8	0.60	-0.08
					1.0	1.31	-0.57

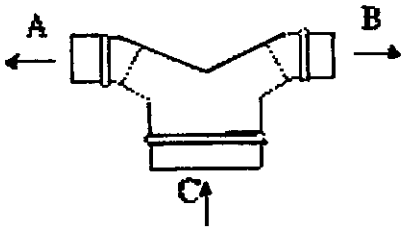
CONVERGING Y-PIECES 2 ELBOWS

D_A	D_B	D_C	δ	α	q_{ma}/q_{mc}	ζAC	ζBC
400	200	200	90	45	0	0.27	16.7
					0.2	0.33	8.17
					0.3	0.34	8.08
					0.5	1.79	2.36
					0.7	7.85	0.28
					0.8	7.92	0.23
					1.0	16.4	0.48
400	250	250	90	45	0	-0.82	5.92
					0.2	-0.48	2.42
					0.3	-0.43	2.34
					0.5	0.40	0.39
					0.7	2.32	-0.70
					0.8	2.37	-0.51
					1.0	5.87	-1.00
400	315	315	90	45	0	-0.82	1.10
					0.2	-0.25	0.40
					0.3	-0.25	0.37
					0.5	0.08	0.09
					0.7	0.28	-0.22
					0.8	0.28	-0.26
					1.0	0.98	-0.86
400	200	200	60	60	0	-2.97	18.3
					0.2	-1.37	9.15
					0.3	-1.38	9.05
					0.5	2.40	2.51
					0.7	8.79	-1.29
					0.8	9.05	-1.39
					1.0	17.9	-2.49
400	250	250	60	60	0	-2.62	5.63
					0.2	-1.14	2.38
					0.3	-1.15	2.27
					0.5	0.45	0.48
					0.7	2.29	-1.14
					0.8	2.32	-1.16
					1.00	5.44	-2.50
400	315	315	60	60	0	-1.51	1.15
					0.2	-0.47	0.47
					0.3	-0.49	0.45
					0.5	0.06	0.08
					0.7	0.32	-0.49
					0.8	0.33	-0.50
					1.00	0.98	-1.45

3.12 - DIVERGING Y-PIECES



D_A	D_B	D_C	δ	α	q_{ma}/q_{mc}	ζAC	ζBC
250	100	100	180	0	0	0.00	10.20
					0.3	1.55	4.90
					0.5	3.43	2.99
					0.7	6.64	1.18
					1.0	12.9	0.00
250	160	160	180	0	0	0.00	3.22
					0.3	0.51	1.49
					0.5	0.89	0.87
					0.7	1.53	0.50
					1.0	3.23	0.00
250	200	200	180	0	0	0.00	1.85
					0.3	0.47	0.91
					0.5	0.63	0.58
					0.7	1.0	0.48
					1.0	2.12	0.00



DIVERGING Y 2 ELBOWS

250	100	100	120	30	0	0.00	9.05
					0.3	0.89	4.28
					0.5	1.92	2.32
					0.7	3.53	1.02
					1.0	7.91	0.00
250	160	160	120	30	0	0.00	1.16
					0.3	0.45	0.66
					0.5	0.52	0.48
					0.7	0.68	0.39
					1.0	1.24	0.00
250	200	200	120	30	0	0.00	0.83
					0.3	0.38	0.44
					0.5	0.41	0.40
					0.7	0.49	0.44
					1.00	0.94	0.00
250	100	100	90	45	0	0.00	9.53
					0.3	1.36	4.63
					0.5	2.90	2.37
					0.7	5.58	0.97
					1.0	10.5	0.00
250	160	160	90	45	0	0.00	1.21
					0.3	0.31	0.54
					0.5	0.31	0.30
					0.7	0.47	0.32
					1.0	1.19	0.00

DIVERGING Y-PIECES 2 ELBOWS

D_A	D_B	D_C	δ	α	q_{ma}/q_{mc}	ζAC	ζBC
250	200	200	90	45	0	0.00	0.79
					0.3	0.36	0.35
					0.5	0.30	0.30
					0.7	0.42	0.42
					1.0	0.89	0.00
250	100	100	60	60	0	0.00	9.68
					0.3	1.45	4.26
					0.5	3.42	2.10
					0.7	6.35	0.93
					1.0	12.8	0.00
250	160	160	60	60	0	0.00	1.50
					0.3	0.23	0.64
					0.5	0.33	0.33
					0.7	0.66	0.24
					1.0	1.48	0.00
250	200	200	60	60	0	0.00	0.97
					0.3	0.30	0.39
					0.5	0.20	0.23
					0.7	0.37	0.35
					1.0	1.04	0.00
400	200	200	120	30	0	0.28	-0.13
					0.2	0.18	0.16
					0.3	0.25	0.16
					0.5	0.35	0.09
					0.7	0.12	0.15
					1.0	0.17	0.27
400	250	250	120	30	0	0.38	0.83
					0.2	0.28	0.44
					0.3	0.24	0.46
					0.5	0.21	0.36
					0.7	0.39	0.26
					0.8	0.35	0.25
					1.0	0.69	0.38
400	315	315	120	30	0	0.43	0.92
					0.2	0.37	0.56
					0.3	0.36	0.54
					0.5	0.33	0.43
					0.7	0.45	0.37
					0.8	0.46	0.39
					1.0	0.71	0.42
400	200	200	90	45	0	0.30	0.54
					0.2	0.14	0.56
					0.3	0.22	0.46
					0.5	0.27	0.51
					0.8	0.67	0.11
					1.0	1.17	0.31

D_A	D_B	D_C	δ	α	q_{ma}/q_{mc}	ζAC	ζBC
400	250	250	90	45	0	0.39	0.90
					0.2	0.20	0.43
					0.3	0.17	0.45
					0.5	0.17	0.27
					0.7	0.39	0.18
					0.8	0.38	0.17
					1.0	0.79	0.40
400	315	315	90	45	0	0.45	0.64
					0.2	0.32	0.28
					0.3	0.80	0.32
					0.5	0.16	0.25
					0.7	0.20	0.33
					0.8	0.19	0.33
					1.0	0.42	0.45
400	200	200	60	60	0	0.32	1.05
					0.2	0.13	0.97
					0.3	0.18	0.92
					0.5	0.43	0.59
					0.7	0.98	0.09
					0.8	1.00	0.10
					1.0	1.40	0.33
400	250	250	60	60	0	0.48	1.14
					0.2	0.21	0.48
					0.3	0.21	0.49
					0.5	0.19	0.35
					0.7	0.38	0.21
					0.8	0.37	0.21
					1.0	1.13	0.44
400	315	315	60	60	0	0.50	0.88
					0.2	0.31	0.37
					0.3	0.32	0.35
					0.5	0.15	0.19
					0.7	0.24	0.32
					0.8	0.25	0.32
					1.0	0.63	0.50

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