Lindab®

DUCTWORK TURNS FULL CIRCLE

A designer's guide to the benefits of selecting a circular ductwork system

A booklet produced by SCANDIACONSULT, Box 35, S-164 93 Kista, Sweden
at the request of Lindab Ventilation AB.

Economical and technical aspects of the selection of duct systems

Traditionally, ventilation and air conditioning ducts have been manufactured with rectangular cross sections. The rectangular duct can easily be adapted, e.g. to restricted ceiling voids and plant rooms, however, often at the cost of efficient airflow design and possible cost savings. A circular duct system normally performs better and offers a more economical solution, which is the reason why it always pays to study and compare the ductwork design before selecting which type is to be used for a specific application.

This booklet summarises various aspects found when ductwork systems of different design are compared:

Emphasis has been made to keep the presentation on a factual and objective level. All research material has been documented and filed for referral.

In all cost comparisons made, the pre-sealed push-fit circular system has been used.

The current Scandinavian market prices have been used for all calculations.

1. Circular ducts are more air-tight than rectangular

It is of utmost importance that the air within a ventilation system is delivered to the designed outlet points and that leakage through the duct system is minimised.

The present Eurovent and the future CEN standards define three leakage classes:

A: the lowest class.

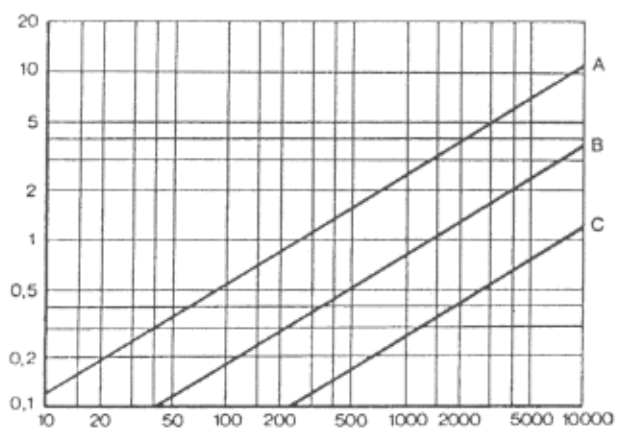
Leakage factor: 1.320 litres/(s,m^2) at 400 Pa (= 0.260 cfm/sqft at 8.4 lb/sqft)

B: the medium class.

Leakage factor: 0.440 litres/(s,m^2) at 400 Pa (= 0.087 cfm/sqft at 8.4 lb/sqft)

C: the highest class.

Leakage factor: 0.15 litres/(s,m^2) at 400 Pa (= 0.029 cfm/sqft at 8.4 lb/sqft)



Class C is thus three times tighter than Class B and nine times tighter than Class A.

It is far simpler and more economical to connect various parts of a circular duct system than that of a rectangular:

- Connecting two circular spiral wound ducts only requires one fitting, whereas rectangular ducts are connected by use of a complete separate flanging system.
- The perimeter, that has to be sealed, is shorter on a circular duct:

  For the same free cross sectional area, a square duct has 13% longer perimeter than the circular one, for a rectangular duct with side ratio 1:2, the perimeter is 20% longer, 1:3 30%, 1:4 41% and 1:5 51%.

Ducts with a high degree of air-tightness are increasingly in demand for many reasons:

- Rising energy prices - the cost for filtering, heating, cooling and distributing air is rising rapidly.
- Good indoor air quality (IAQ) has to be guaranteed today. An increasing number of existing buildings are being classified as "Sick Buildings". One of the remedies to this is to increase the amount of fresh air intake. With circular "air-tight" ducts it is often easier and more economical to fulfill these increasingly stricter demands.

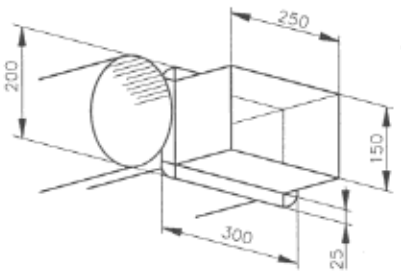


Fig 1
A rectangular duct 250 x 150 mm can, without any increase in pressure drop, be replaced by a circular duct of 200 mm diameter within the same space.
The in-situ cost for the circular duct is approximately 50% of the cost for the rectangular duct.

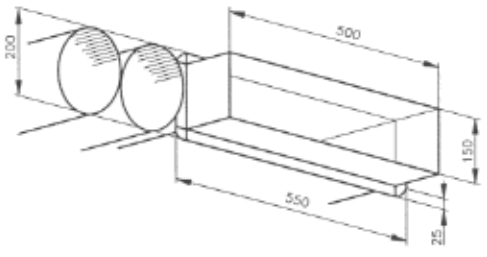


Fig 2
Flat rectangular ducts can often be replaced by several circular ducts without any need for extra space.
The in-situ cost is lower as shown in Fig 4
The use of two or more circular ducts instead of one rectangular gives beneficial advantages with better airflow control, simplified air balancing and more flexible fire zone sectioning.

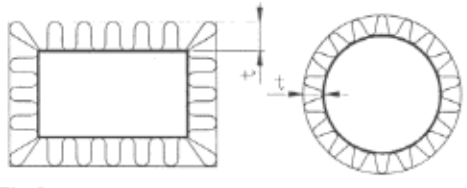


Fig 3
Circular ducts are approved with thinner layers of outside fire insulation material than the equivalent rectangular ducts.
Fire insulation of ventilation ducts, minimum demands as specified by Swedish standards. The outer temperature must not exeed 140°C during the time (15,30 or 60 minutes) the fire is ongoing inside of the duct with a fire curve as defined by ISO 834.

Insulation Type	Insulation Thickness t_{mm}			
	Outer		Inner	
	ø	□	ø	□
net matting	30	40	–	–
A15: sheet	30	30	30	30
net matting	50	70	–	–
A30: sheet	50	60	50	50
net matting	100	140	–	–
A60: sheet	100	120	100	100

2. The installation cost is lower

The overall cost of a duct system built with circular ducts is distinctly lower than one with rectangular ducts.

The installation is simpler to carry out and the air tightness properties are better than when rectangular and flat oval ducts are used.

One circular duct is always installed at a lower overall cost than a rectangular of the same equivalent diameter. Fig. 1.

Using two circular ducts instead of one rectangular also results in a lower overall cost. Fig 2.

In some cases even several circular ducts can result in a lower cost when replacing one rectangular duct.

There are several reasons for the lower cost of the circular duct system:

- It consists of a limited number of standardised components and sizes.
- Manufacturing of the ducts and fittings is highly automated and subject to advanced quality control.
- In some cases, the installation time for a circular duct system is only a third of that for a similar rectangular system.
- The cost for insulating is lower due to several reasons such as:

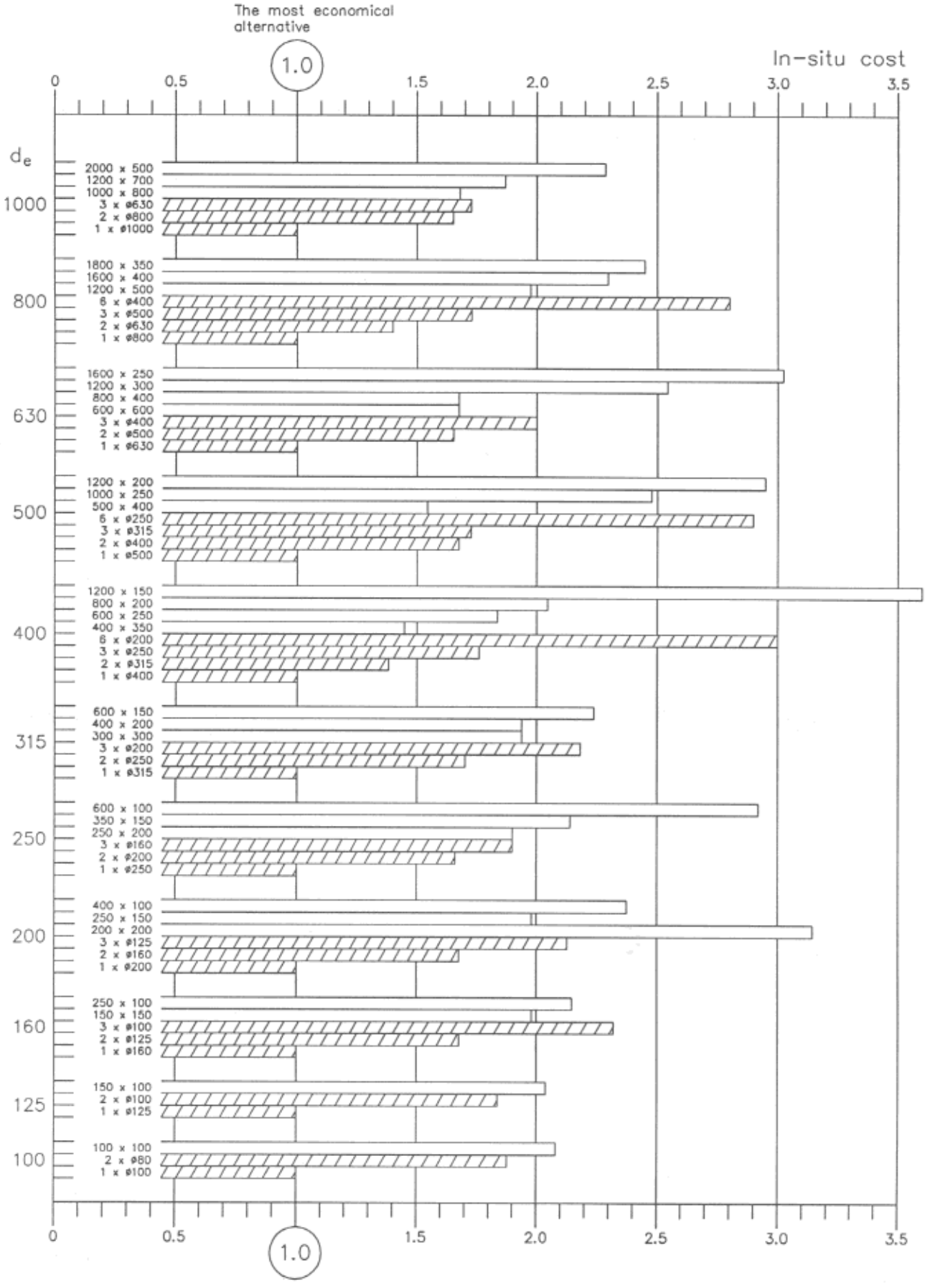
  The amount of insulating material is reduced due to the shorter perimeter of the circular duct compared with the rectangular one.

  Circular ducts are in some markets approved with thinner layers of outside fire insulation than the equivalent rectangular ducts. Fig 3. It is in all cases a fact that the same heat loss is achieved by using a thinner layer of insulation for circular ducts than for rectangular.

  It is more accessible and therefore easier to lag. The attenuating properties of a circular system are superior due mainly to a higher degree of rigidity. See section 9.
- An example shows that a circular duct, Diam. 500 mm, requires approximately 13% less insulation material than the equivalent rectangular duct, 500 x 400 mm.
- The in-situ cost (inclusive of transportation, packaging, waste, etc.,) is considerably lower for circular ducts than for rectangular with the same equivalent diameter. As shown in Fig 5-9.
- The number and dimensions of duct hangers is reduced. The space between two hangers is 2.5 m for a rectangular duct but 3.0 m for a circular one, thus reducing the required number of hangers and the cost and installation time needed by some 20%.
- Circular ducts often result in an improved control of the air flow distribution.

Fig 4

The In-situ cost (inclusive of transportation, packaging and waste), for ducts with the same equivalent diameter.



In the bar chart the cost of, e.g. 3 ducts of ø 315 mm diameter (used as shown in Fig 2), is compared to that of a rectangular duct 1000 x 250 mm dimension.

One circular duct with the same equivalent diameter as the rectangular duct has been used as a base - this is always the most economical alternative.

The drawings below, Fig 6 - 9, give circular alternatives to the rectangular system shown in Fig 5 at the top. All systems are calculated for the flow of 0.5 m^3/s. The highest and lowest pressure drop is shown for all systems as is the maximum velocity. To the right of each drawing the in-situ costs for the systems are shown in relation to that of the rectangular system.

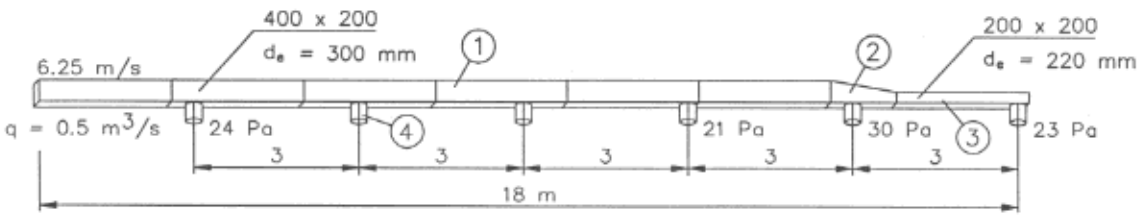


Fig 5

System A

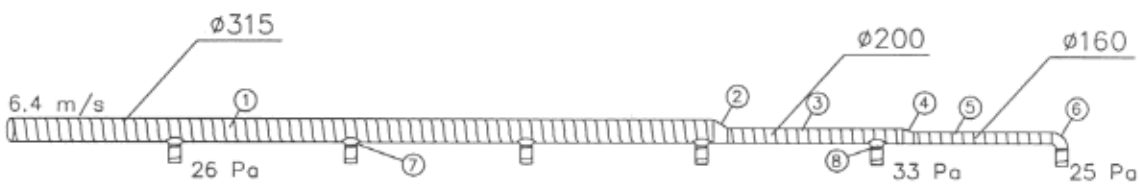


Fig 6

System B

Cost for B = 0.24 A

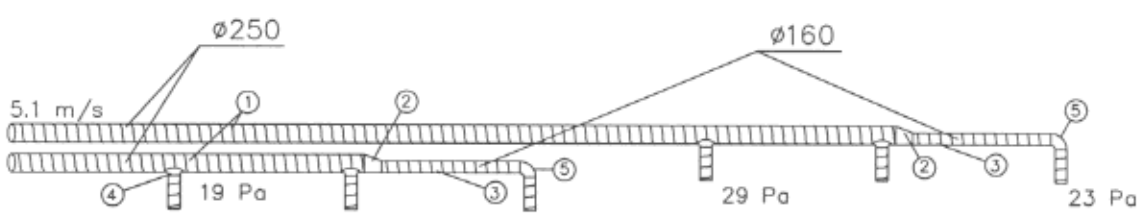


Fig 7

System C

Cost for C = 0.27 A

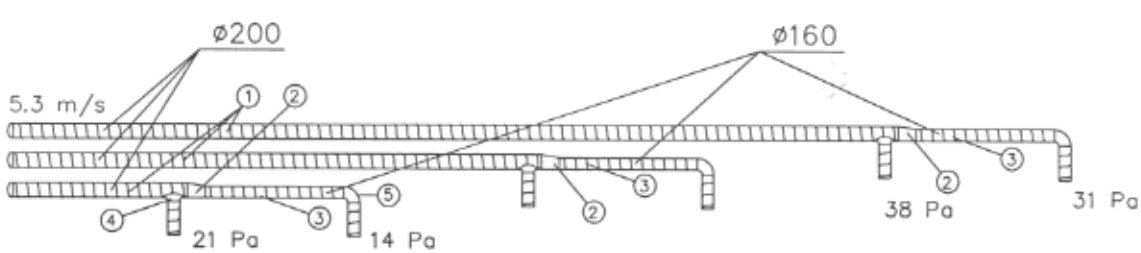


Fig 8

System D

Cost for D = 0.31 A

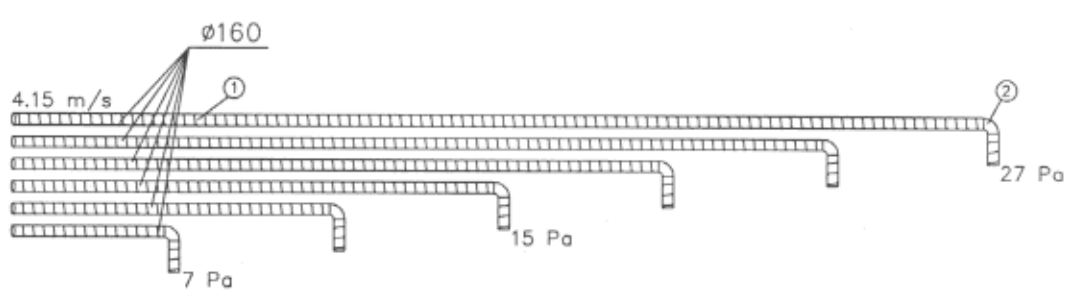


Fig 9

System E

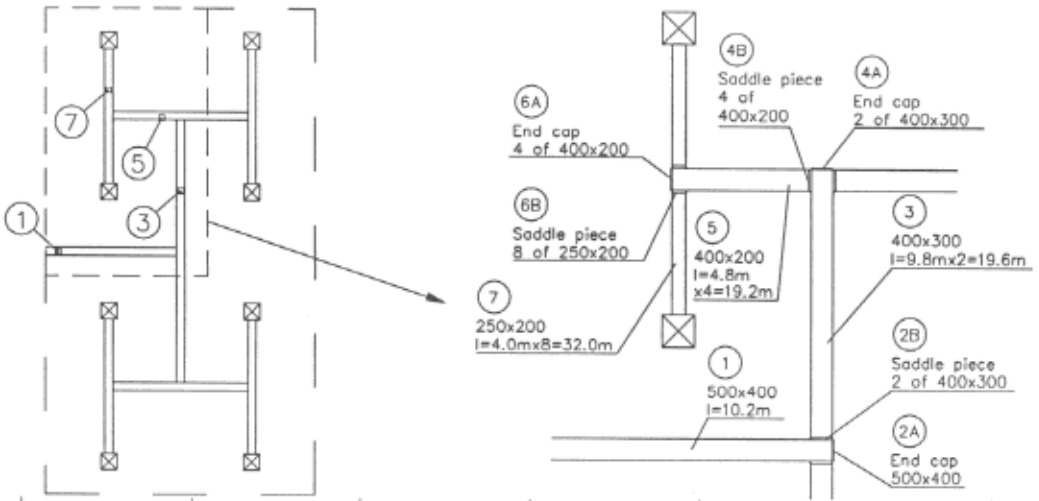
Cost for E = 0.50 A

When the total air flow into a large room is to be supplied equally through a number of supply air registers, the design shown in the two examples below results in the same duct pressure drop through all the registers – the air passes through the same duct length and through the same number of bends on its way to each register. Also here, the cost is considerably lower and approximately halved, when using circular ducts.

Installation with Rectangular Ducts

Fig 10

System R



No.	Air Flow (l/s)	Duct Dim. (mm)	Air Veloc. (m/s)	Duct lgth (m)	Nos. off	Pressure	
						Drop ea.	tot. (Pa)
1	2,400	500x400	12.0	10.2	1	2.8	28.0
2A	–	500x400	–	–	1	–	–
2B	2,400/1,200	500x400/ /400x300	12.0/ /10.0	–	2	–	45.0
3	1,200	400x300	10.0	9.8x2=19.6	2	2.8	27.4
4A	–	400x300	–	–	2	–	–
4B	1,200/600	400x300/ /400x200	10.0/ /7..5	–	4	–	36.0
5	600	400x200	7.5	4.8x4=19.2	4	2.5	12.0
6A	–	400x200	–	–	4	–	–
6B	600/300	400x200/ /250x200	7.5/ /6.0	–	8	–	9.0
7	300	250x200	6.0	4.0x8=32.0	8	2.0	8.0

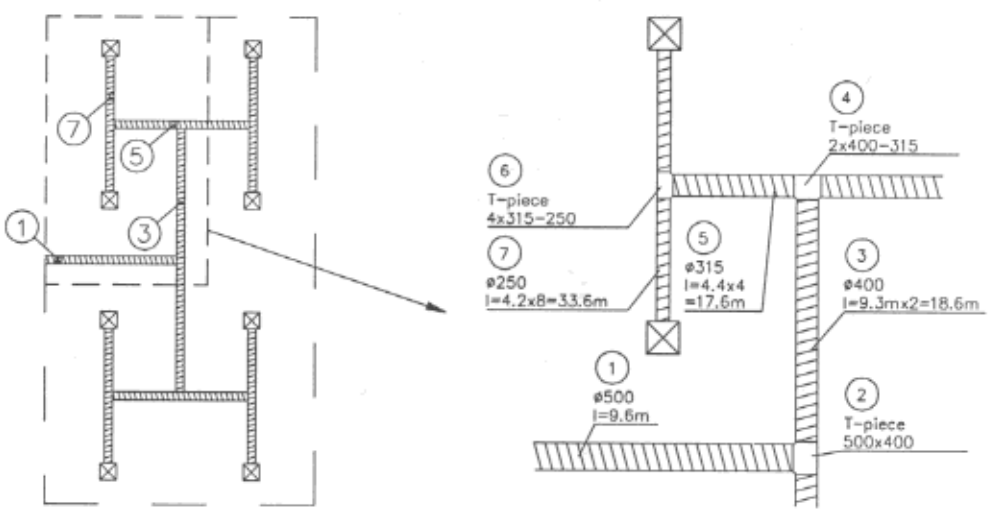
Total Pressure Drop (Pa) 165.4

Total Installation Cost: R

Installation with Circular Ducts

Fig 11

System S



No.	Air Flow (l/s)	Duct Dim. (mm)	Air Veloc. (m/s)	Duct lgth (m)	Nos. off	Pressure	
						Drop ea.	tot. (Pa)
1	2 400	ø500	12.2	9.6	1	2.2	21.1
2	2 400/1 200	ø500/ø400	12.2/9.5	–	1	–	44.0
3	1 200	ø400	9.5	9.3x2=18.6	2	1.9	17.7
4	1 200/600	ø400/ø315	9.5/7.7	–	2	–	32.0
5	600	ø315	7.7	4.4x4=17.6	4	1.9	8.4
6	600/300	ø315/ø250	7.7/6.1	–	4	–	21.0
7	300	ø250	6.1	4.2x8=33.6	8	1.6	6.7

Total Pressure Drop (Pa) 150.0

Total Installation Cost: S=0.51 R

Ducts with external fire insulation – comparisons between rectangular and circular ducts

(Mineralwool covered with Aluminium foil)

Duct	Peri-meter	Thickness (mm)			Insulation Material Volume (l/m duct)			Relative Installation costs (cost/meter duct)		
		Fire class			Fire class			Fire class		
		A15	A30	A60	A15	A30	A60	A15	A30	A60
Circular Duct ⌀250	.785	30	50	100	24	39	78			
Relation Circular/Rectangular	.87	.75	.71	.71	.67	.62	.62	.92	.85	.60
Rectangular Duct 250x200	.900	40	70	140	36	.63	126			

3. The delivery time is shorter

Circular ducts and fittings are stock items and can be delivered quickly which facilitates fast track building programmes.

Due to standardisation of sizes, a comprehensive range of fittings and ducts can be kept in stock. The duct diameters for the standard sizes follow a geometrical progression of cross sectional area with an approximate increase of the diameter of 25% over each step. The metric dimensions which are included in the coming CEN standard are shown in the table below.

Nominal Internal Diameter mm	Perimeter area per metre length in m^2	Nominal Internal Diameter mm	Perimeter area per metre length in m^2
63	0.198	500	1.571
80	0.251	560	1.760
100	0.314	630	1.979
125	0.393	710	2.229
160	0.502	800	2.512
200	0.628	900	2.826
250	0.785	1000	3.142
315	0.990	1120	3.517
355	1.115	1250	3.927
400	1.257	1400	4.400
450	1.413	1600	5.030

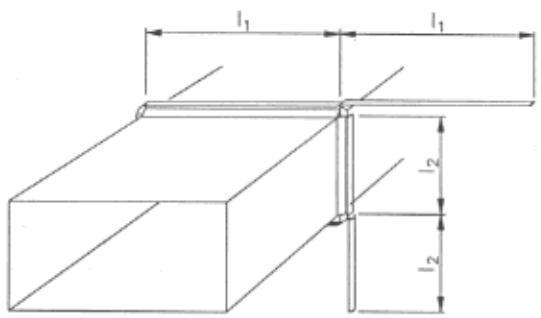
Rectangular and flat oval ducts must always be manufactured tailor made for every individual installation, the variations are here practically infinite as both widths and heights vary, a bend can either turn around the flat or the high side, etc., the alternatives are thus too many to admit any batch production and automation of the manufacturing process.

The circular ducts can easily be cut to exact length on site and are thus much more flexible to alterations etc. The rectangular ducts have to be made exactly to measure, any site alteration and adjustment is impossible and ducts of incorrect length have to be scrapped and replaced.

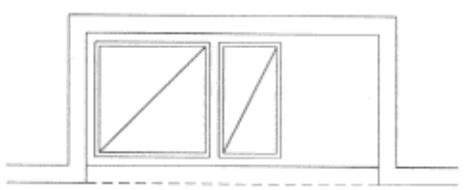
4. Less space is needed for the duct system

The space required for installing a circular duct is often less than that of a rectangular with similar pressure drop since rectangular ducts are joined by slip joints pushed onto the standing-seam joints, fitted on the ducts. Protrusions made by these flanges add to the space needed.

Low Medium High



As these slip joints cover the duct width, they require an available space of the same order on either side of the duct.
Often, when space is restricted, e.g. when ducts are installed above the false ceiling in an office corridor or in a duct shaft and the ducts are only accessible from one side/end, severe problems arise due to the impossibility of applying mastic or tape to the inwards facing joint sections.

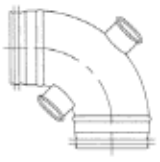


This will not only raise the costs of the installation and prolong the time needed for the job, but also reduce the air-tightness qualities of the ducts.

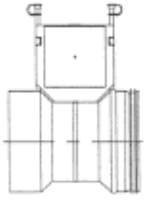
5. Air flow measurements made the easy way

It is easier to measure the air flow passing through a circular than a rectangular duct. There are many flow measurement units especially designed for circular ducts available on the market.

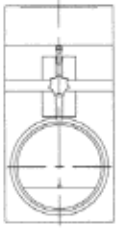
Measuring Bend
MBU



Flow Measuring Unit
FMU

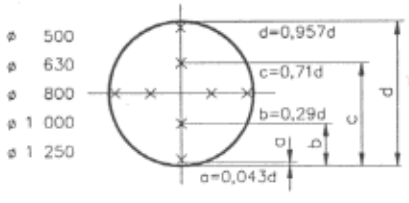


Blastgate Damper
SKMU

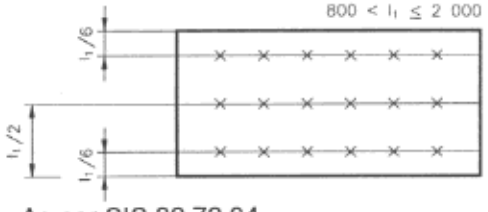


With these accurate but inexpensive devices the ventilation systems can be equipped with fixed measuring units, a low cost method which enables regular check-ups or continuous monitoring.
A decreasing air flow has often been found to be the reason for a sound building turning "sick" - A fact that has been stressed on many air quality conferences during the last few years.

Also when making site measurements for control purposes, the circular ducts are easier to work with. When using the classic Prandtl-method the circular duct, regardless of size, has to be measured through two holes at right angles. The rectangular duct will have to be measured through several test holes, the larger the duct, the higher the number of holes for collecting the data needed to get the same measuring accuracy as for the circular duct.



As per SIS 82 72 06



As per SIS 82 72 04

6. Installation work, handling and transportation is simplified

The weight and bulk of a circular duct system is less than that of a rectangular, this influences the cost level and makes it easier to install.

One individual is able to install circular duct systems up to diam. 200 single handed, whilst two people are always needed to install rectangular of any size.
For the same free cross sectional area the circular duct is not only less material consuming, due to its shorter perimeter and simpler connections, but the steel gauge can be reduced for the smaller and most frequently used duct dimensions due to the more rigid construction of a spiral wound circular duct.

This is shown in the following Swedish standard specification for spiral wound ducts BFS 1988:18, chapter 4:13 for new buildings:

	Diameter mm				
	0-80	(80)-160	(160)-315	(315)-800	(800)-1250
Thickness mm	0,4	0,5	0,6	0,8	0,9

However the HVCA DW/142 specification for sheet metal ductwork specifies the following gauges for spirally wound ducts:

	Maximum diameter mm			
	205	762	1020	1525
Thickness mm	0,6	0,8	1,0	1,2

The complete weight for a typical system comprising a normal combination of straight ducts, bends and diffusers, is between 30 and 40 % higher for a rectangular system than for a circular duct system.

7. Pressure drop is reduced

The pressure drop for a typical system comprising a normal combination of straight ducts, bends, and diffusers, is often lower for a circular duct system than for a rectangular.

This will lead to higher operation costs for the rectangular system, the required power from the fan is directly related to the pressure drop, and so also of course to the consumed electric energy.

8. Inside cleaning of ducts

Some investigations of ventilation systems in buildings that have been classified as sick have shown that dust, fungus, etc., collected in supply and return air ducts have added to the emission load and thus to the sick building problem. The need for clean supply air ducts has been stressed on several international healthy building conferences. New building regulations in some countries, e.g. Sweden, also require regular inspection of the ductwork and internal cleaning when needed.

The cleaning methods (dry or wet) and cleaning tools (rotating brushes connected to heavy duty vacuum cleaners) used for internal duct cleaning are easier and cheaper to apply to circular than to rectangular ducts, due e.g. to the standard diameters of the circular ducts.

9. Flat oval

When limited ceiling void restricts the use of a circular duct system and a multiple system of circular ducts is impractical, a flat oval duct system offers an interesting alternative.

Flat oval ducts are manufactured from spirally wound circular ducts which have been formed into an elliptic shape in specially designed machines. See fig 12.

Some of the basic advantages of spirally wound circular ductwork permeate through to the flat oval system such as:

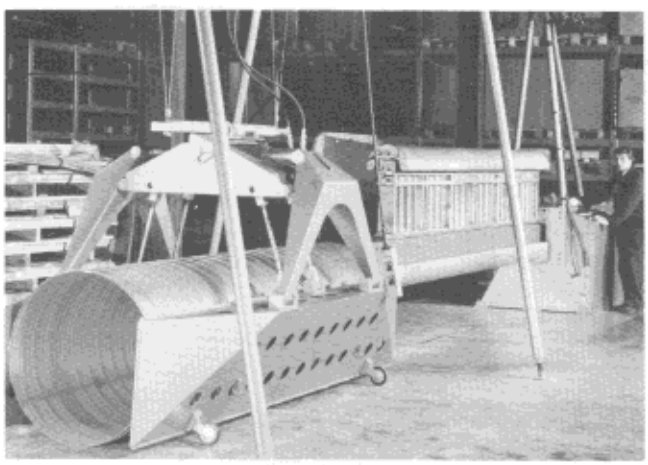
- More rigid than rectangular since it is manufactured from the seamed spiral duct.
- Elliptic shape with round corners gives a lower contact area for a given cross section than rectangular resulting in superior air flow.
- The rigidity reduces reverberation and noise penetration.
- The duct system is joined together with slip joints without any need for fitting and bolting separate flanges onto the ducts and fittings.
- An aesthetic appearance well suited for exposed applications.

Compared with circular ducts, the flat oval shows some of the drawbacks which apply to the rectangular system such as:

- An endless variety of widths and heights which makes standardisation, batch production and ex-stock deliveries impossible.
- The manufacturing is more labour intensive and skill demanding.

It is assumed that the total in-situ cost level is approximately the same as fore rectangular.

Fig 12



10. Silent spirals and noise problems

Modern ductwork design incorporating high velocity variable air volume (VAV) and constant air volume (CAV) systems have inherent features which are known to present serious noise difficulties. In all cases it is low frequency noise which constitutes the most intractable problem since it easily breaks through the duct walls of rectangular cross-sectioned ductwork into the ceiling.

The problem with noise break-out can to a large extent be avoided by using circular ductwork which is far stiffer than rectangular and hence reduces the level of penetration through the duct wall.

Where the air flow requires a ductwork diameter too large to fit into the false ceiling area, several smaller diameter ducts should be used or as second best, flat oval ducting, since in noise terms it is false economy to use the conventional rectangular type of ductwork resulting in noise problems at the commissioning stage.

11. Pre-sealed circular duct systems of push-fit type

Another great advantage with circular ductwork is the possibility of manufacturing all fittings and components of push-fit type, a pre-sealed system that simplifies installation and guaranties a low leakage system.

Some of these systems such as LindabSafe, Lindab's double gasketted system, have been available since the early seventies. This system is Type Approved, certificated and guaranteed to withstand leakage class C requirements, see test report in Fig 14, for all components included.

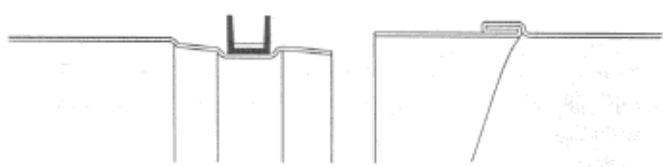
The high quality systems are provided with seals made from EPDM age resistant rubber which is impervious to deterioration when inserted between duct and fitting wall outside of the airstream.

Recommended air temperatures are -30°C to +100°C continuously and -50°C to +120°C intermittently. Gaskets made from oil-resistant silicone rubber are used for higher temperatures.

Construction

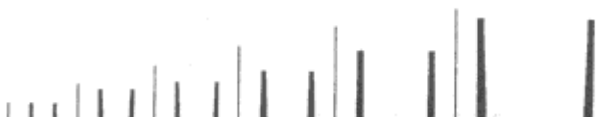
The LindabSafe sealing gasket is designed in the form of a U-profile of homogeneous rubber. The rubber gasket is located in a groove at the end of the fitting and is securely attached by a steel band.

Fig 13



When the fitting is connected to the duct, the flange of the U-shaped strip will be folded back. The gasket will thus be better able to withstand negative pressure than positive, since negative pressure will tend to press the gasket lips harder against the inside of the duct. The system withstands positive pressure up to 3000 Pa (300 mm WG) and negative pressure down to 5000 Pa (500 mm WG).

Under British and European standards, there is a greater tolerance range between duct and fitting as the diameters increase. In order to obtain the maximum seal for all dimensions, successively heavier rubber gaskets are used for increasing duct dimensions in accordance with the group divisions in the table below.



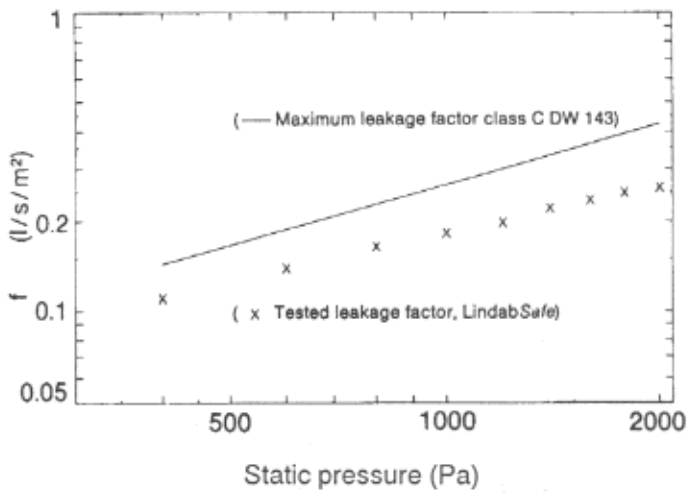
Type	7	9	11	14	20	30
Diameter	83 - 180	200 - 280	300 - 500	560 - 900	1000 - 1400	1500 - 1600
Tolerance-range	0,7 - 1,9	0,7 - 2,3	0,7 - 2,9	0,7- 3,8	0,7 - 6,0	0,7 - 6,6

The advantages the push-fit system has to offer are of great importance mainly regarding installation time and savings on commissioning and it has therefore replaced the conventional slip joint system in countries such as Sweden, Denmark, Norway, Finland and is gradually spreading into other markets on the European continent.

Leakage classification test

All ductwork and fittings fitted with the LindabSafe system, are included in the type approval certificate of leakage up to and including class C.

The leakage factor in (l/s) /m^2 gives the flow of air that leaks out of or into the system in l/s relative to the surface area of the ductwork in m^2.



Total pressure on test Pa	Total system leakage flowrate l/s	Total system leakage received (l/s)/m^2	Maximum leakage class C (l/s)/m^2	Relationship received against class C %
400	3.11	0.112	0.147	76.2
600	3.94	0.140	0.192	72.9
800	4.61	0.165	0.231	71.4
1000	5.16	0.184	0.267	68.9
1200	5.69	0.202	0.301	67.1
1400	6.19	0.222	0.333	66.7
1600	6.58	0.236	0.363	65.0
1800	6.94	0.249	0.392	63.5
2000	7.36	0.262	0.420	62.4

Uncertainty of flow measurement is within ± 3%.

Testing and classification

The type approval certificate (Type approval no. 1358/88) was obtained by the National Testing Institute of Sweden, an independent government testing authority, carrying out a leakage classification test on the LindabSafe system.

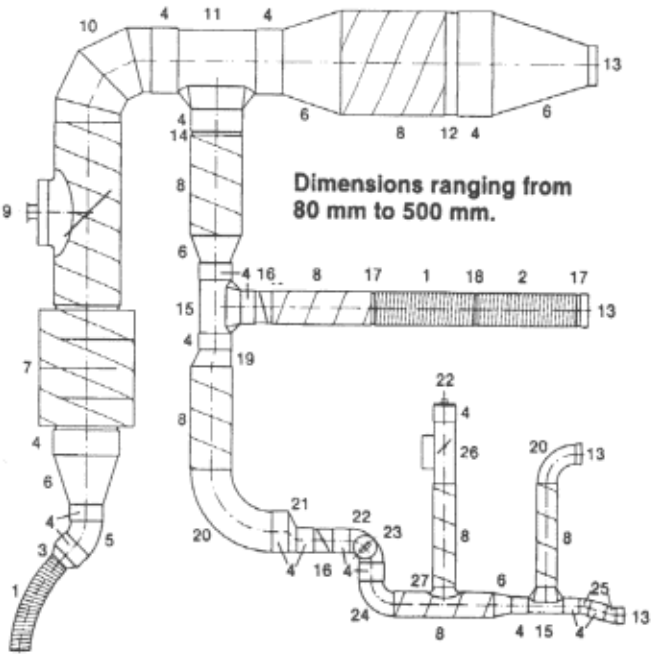
The test was carried out in accordance with Eurovent 2/2 (Air leakage rate in sheet metal air distribution systems).

The graph illustrated below shows the leakage limits for classification C along with the received leakage readings of the test.

Figure 14 shows the components and the layout of the system tested, constructed entirely of LindabSafe fittings, accessories and Lindab spirally wound ducting. No other forms of sealing agent were used.

The joint length of the system was 41.8 metres. The perimeter area was calculated to be 27.9 m^2.

Fig 14



1	SRFA	Flexible aluminium duct	16	DRU	Regulating damper
2	SRFG	Flexible galvanized duct	17	SNPU	Male coupler for flexible ducts
3	RCU	Pressed concentric reducer	18	SMF	Female coupler for flexible ducts
4	MF	Female coupler	19	RLU	Eccentric elongated reducer
5	BU	Pressed bend 45°, radius 1.0xd	20	BSU	Pressed bend 90°, radius 1.5xd
6	RCLU	Elongated concentric reducer	21	RU	Eccentric short reducer
7	SLU	Sound attenuator 3005	22	ESU	Male end cap
8	SR	Spiral duct	23	BKCU	90° pressed bend with clean-out section
9	PSDRU	Clean-out damper	24	BU	Pressed bend 90° radius 1.0xd
10	BFU	Segmented bend 90°, radius 1.0xd	25	BU	Pressed bend 15° 1.0xd
11	TU	Eccentric tee-piece 90°	26	KLU	Constant flow unit
12	NPEU	Expandible connector	27	PSUU	90° collar saddle with gasket
13	EPF	Female end cap			
14	NPU	Male coupler			
15	TCU	Concentric tee-piece 90°			

Manufacturers assume responsibility

When a product has been certificated there is an important shift of responsibility towards the manufacturer. When supplying pre-sealed ductwork on the Scandinavian market, the specialist manufacturers guarantee the leakage performance of their tested and approved products.

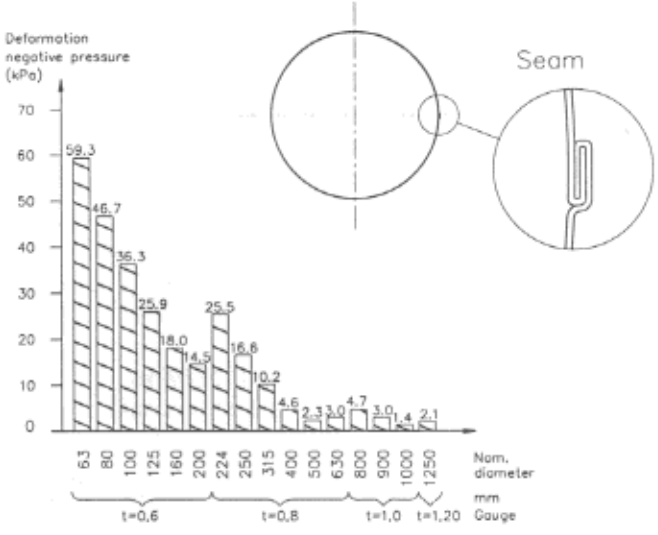
Since the onus of product performance falls on the manufacturers, the contractors only have to install in accordance with given recommendations to be safe-guarded against failure.

12. Strength

Circular ducts are normally made from a 137 mm wide steel strip which is seamed and formed into a perfect circular cross section (see illustration bellow). The technique employed gives each duct a rigidity that reduces the need of additional stiffeners.

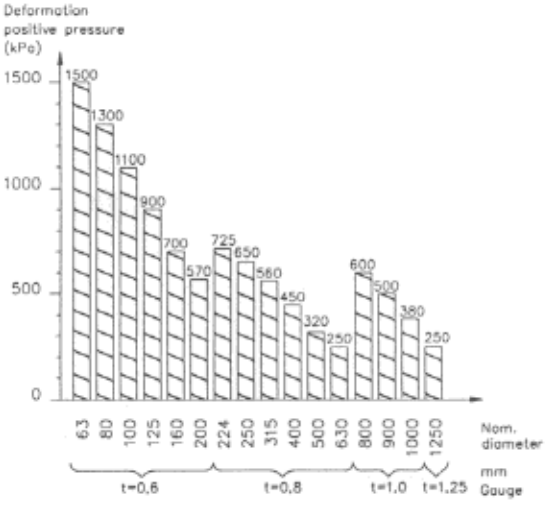
Negative pressure

In installations in which pressure is very low in relation to the atmosphere, there is a risk that ventilation ducts will collapse. This phenomenon is known as buckling and occurs whithout warning at the weakest point in the system. The buckling spreads along the duct and as negative pressure increases it becomes completely flattened. The weakest point is often a "transit dent" in the duct. The bar-chart shows the maximum negative pressure an undamaged spirally wound duct can withstand without collapsing.



Positive pressure

The risk of ventilation pipes bursting as a result of positive pressure is considerably less than that of collapse caused by low negative pressure. At a given positive pressure it is also probable there will be ruptures in the joint between the ducts long before the duct splits apart at the seam. If however the connections can be well fixed, the duct will burst along the seam. The bar-chart shows the maximum positive pressure an undamaged duct can withstand without bursting.



13. Summary

The benefits of circular ductwork are many and influential which has caused and is causing changes to traditional work patterns throughout Europe.

This can be illustrated by a study of the Scandinavian countries where the following development has taken place:

1. 1960 and before

   Ductwork contractors manufactured and installed all equipment in square and rectangular form.

2. 1961 - 1970

   Some specialist companies started batch production of circular ducts and fittings.
   The ductwork contractors started buying circular which they installed alongside the rectangular made in their own work shops.

3. 1971 - 1991

   A total change of behaviour took place during which specialist manufacturers intensified their level of automation, research and development.

   During this period the ductwork contractors started sourcing more materials from specialist suppliers at lower cost than by producing in-house. The contractors gradually concentrated their resources on installing standardised prefabricated items which were readily available at short notice.

   These changes were made possible through the contractors' ability to adapt their work patterns around the system that provides the greatest competitive edge. Consulting Engineers changed their designs and specifications from tailor made design of specially constructed ductwork for every building's specific needs to designs built around a standardised concept.

   An international comparison gives the following picture of the actual market share of circular ductwork and the way this has developed:

% of total ductwork market

	1960	1965	1970	1975	1980	1985	1990
Scandinavia	5	15	40	60	70	80	85
Germany	5	5	10	15	20	25	30
France	5	10	20	30	40	50	60
Great Britain	5	10	15	20	25	35	45

Sweden
Lindab Ventilation AB
Förslövsvägen, Grevie
269 82 Båstad
Phone +46 431 85000
Telefax +46 431 85310

Lindab Nord AB
Box 66
936 21 Boliden
Phone +46 910 580000
Telefax +46 910 581500

Czech Republic
Lindab s.r.o.
Zdebradská 56
251 01 Ricany - Jazlovice
Phone +420 204637416
Telefax +420 204637463

Denmark
Lindab A/S
Comfort Division
Lucernemarken 17
3520 Farum
Phone +45 42 951233
Telefax +45 42 951261

Duct Division
Langkaer 20
6100 Haderslev
Phone +45 74 226222
Telefax +45 74 530159

Finland
Oy Lindab Ab
Kopplingsvägen 47
007 70 Helsingfors
Phone +358 9 3508340
Telefax +358 9 3896761

France
Lindab S.A.
Parc d'Activités
01 120 Montluel
Phone +33 43772804
Telefax +33 43772806

Germany
Lindab GmbH
Postfach 1355
22935 Bargteheide
Phone +49 4532 28590
Telefax +49 4532 5666

Great Britain
Lindab Ltd.
45 Caswell Road,
Brackmills
Northampton NN4 0PW
Phone +44 1604 702141
Telefax +44 1604 709441

Hungary
Lindab Kft.
Àllomás. ut. 1/A
2051 Biatorbàgy
Phone +36 23 310700/1
Telefax +36 23 310703

Italy
Lindab S.r.l.
Via Cravero 17/2 A
100 88 Volpiano (TO)
Phone +39 11 995 20 99
Telefax +39 11 995 24 99

Malaysia
Lindab International AB
Lindab Far East Regional Office
1 st floor, Bangunan Universal
44 Jalan Penchala
46050 Petaling Jaya, Selangor
Phone +603 794 8040
Telefax +603 794 8048

Norway
Lindab A/S
Postboks 175 Leirdal
1009 Oslo 10
Phone +47 22 793600
Telefax +47 22 325740

Poland
Lindab Sp. z o.o.
ul. Kolejowa 7, Sadowa
05-092 Lomianki
Phone +48 22 7518890
Telefax +48 22 7519667

Switzerland
Spiro International S.A.
Industriestrasse 49
3178 Boesingen
Phone +41 31 7403100
Telefax +41 31 7403131

USA
Lindab Inc.
Two Stamford Landing
Stamford, CT 06902
Phone +1 203 325 4666
Telefax +1 203 325 2111

Halmstad Tryckeri AB 104309