COMMISSION DIRECTIVE

of 11 July 1985

adapting to technical progress Council Directive 84/533/EEC on the approximation of the laws of the Member States relating to the permissible sound power level of compressors

(85/406/EEC)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community,

Having regard to Council Directive 84/533/EEC of 17 September 1984 on the approximation of the laws of the Member States relating to the permissible sound power level of compressors (1) and in particular Article 7 thereof,

Whereas, in view of experience gained and of the state of the art, it is now necessary to match the requirements of Annex I and Annex II of Directive 84/533/EEC to the actual test conditions;

Whereas the measures provided for in this Directive are in accordance with the opinion of the Committee on the Adaptation to Technical Progress of the Directive on the Determination of the Noise Emission of Construction Plant and Equipment,

HAS ADOPTED THIS DIRECTIVE:

Article 1

Annex I and Annex II to Directive 84/533/EEC are hereby amended in accordance with the Annex to this Directive.

Article 2

The Member States shall, by 26 March 1986, adopt and publish the provisions required to comply with this Directive and shall forthwith inform the Commission thereof.

Article 3

This Directive is addressed to the Member States.

Done at Brussels, 11 July 1985.

For the Commission

Stanley CLINTON DAVIS

Member of the Commission

(1) OJ No L 300, 19. 11. 1984, p. 123.

ANNEX

AMENDMENTS TO ANNEX I TO DIRECTIVE 84/533/EEC

6.2. **Operation of the sound source during measurement**

The last paragraph of point 6.2.2 shall be reworded as follows:

In these operating conditions, the air flow shall be checked as laid down in point 12 of Annex I.

6.3. **Measuring site**

The measuring site must be flat and horizontal. This site, up to and including the vertical projection of the microphone positions, shall be of concrete or non-porous asphalt. Skid-mounted compressors shall be placed on supports 0,40 m high unless otherwise required by the manufacturer's conditions of installation.

6.4.1. *Measuring surface, measuring distance*

Point 6.4.1 shall be reworded as follows:

The measuring surface to be used for the test shall be a hemisphere.

The radius shall be:

— 4 m, where the greatest dimension of the compressor to be tested is not more than 1,5 m,

— 10 m, where the greatest dimension of the compressor to be tested is more than 1,5 m but not more than 4 m,

— 16 m, where the greatest dimension of the compressor to be tested is more than 4 m.

6.4.2.1. General

Point 6.4.2.1 shall be reworded as follows:

For measurements there shall be six measuring points, i.e. point 2, 4, 6, 8, 10 and 12, arranged as defined in section 6.4.2.2 of Annex I to Directive 79/113/EEC.

For testing the compressor, the geometric centre of the compressor shall be positioned vertically above the centre of the hemisphere.

The x axis of the set of coordinates, in relation to which the positions of the measuring points are fixed, shall be parallel to the main axis of the compressor.

A new point 12 shall be added, worded as follows:

12. A METHOD FOR MEASURING THE AIR VOLUME FLOW RATE OF AIR COMPRESSORS BY MEANS OF CIRCULAR ARC VENTURI NOZZLES UNDER CRITICAL FLOW CONDITIONS

12.1. **General**

The purpose of this Annex is to provide a simple, quick and economical method for measuring the flow rate of air compressors.

This method has an accuracy of ± 2,5 %.

12.2. **Test arrangement**

The nozzle diameter is to be chosen so as to ensure that the pressure ratio across the nozzle produces sonic velocity in the throat.

The nozzle is to be inserted in a pipe with a diameter equal to or greater than four times the nozzle throat diameter. Upstream of the nozzle shall be a length of pipe equal to at least two pipe diameters, in the wall of which are fitted means for measuring the pressure and temperature of the air flowing through the pipe. At the upstream end of this pipe, a flow straightener shall be fitted consisting of two perforated plates mounted one pipe diameter apart. See Figures 1 and 2.

Downstream of the nozzle a pipe and silencer can be fitted provided the pressure drop across this downstream piping does not invalidate the critical flow conditions across the nozzle.

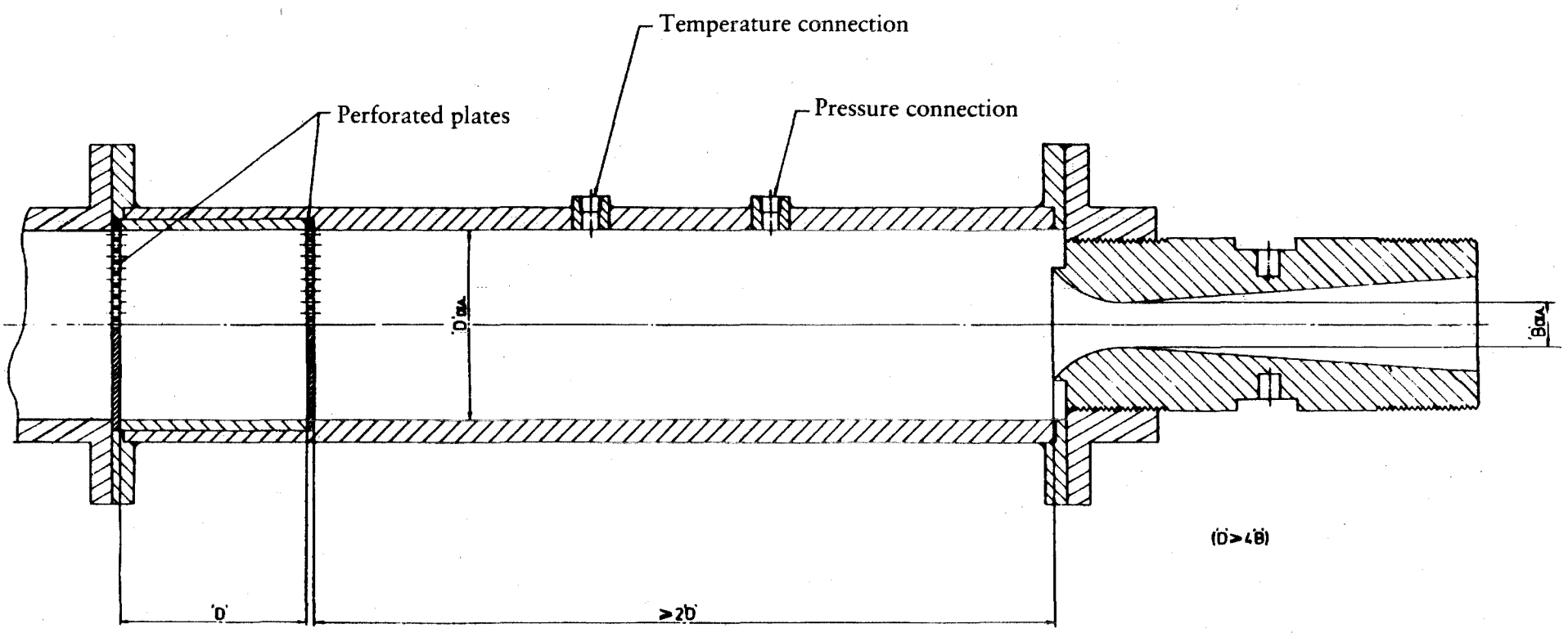

Figure 1 – **Measuring pipe**

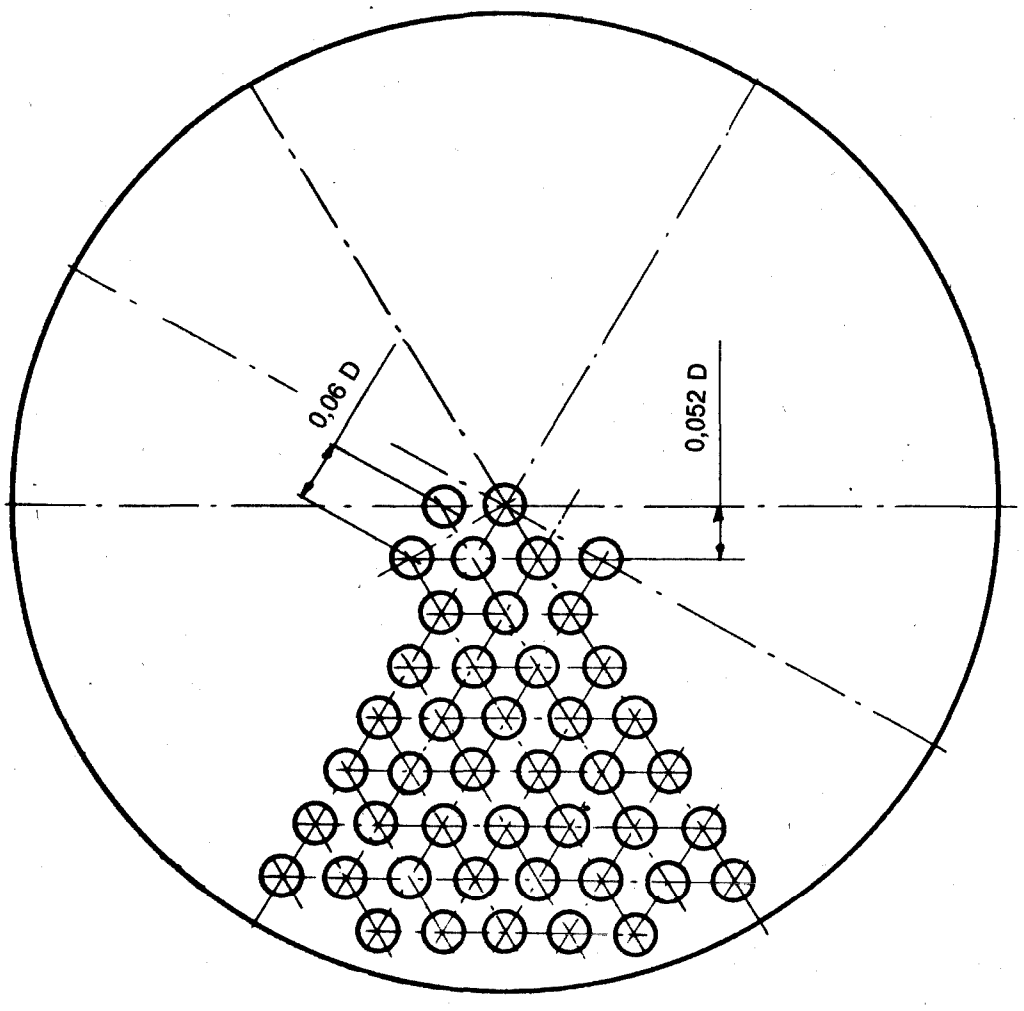

Figure 2 – **Perforated plate for flow straightener**

d = 0,04 D
t = d
where d is the hole diameter
D is the pipe diameter
t is the thickness of the plate

12.3. **Circular arc venturi**

The design shall be as shown in Figure 3, the internal surfaces shall be polished and the throat diameter measured accurately. Suggested dimensions are given in Table 1.

12.4. **Pressure and temperature readings**

The pressure shall be read with an accuracy of 0,5 % and the temperature with an accuracy of ± 1K.

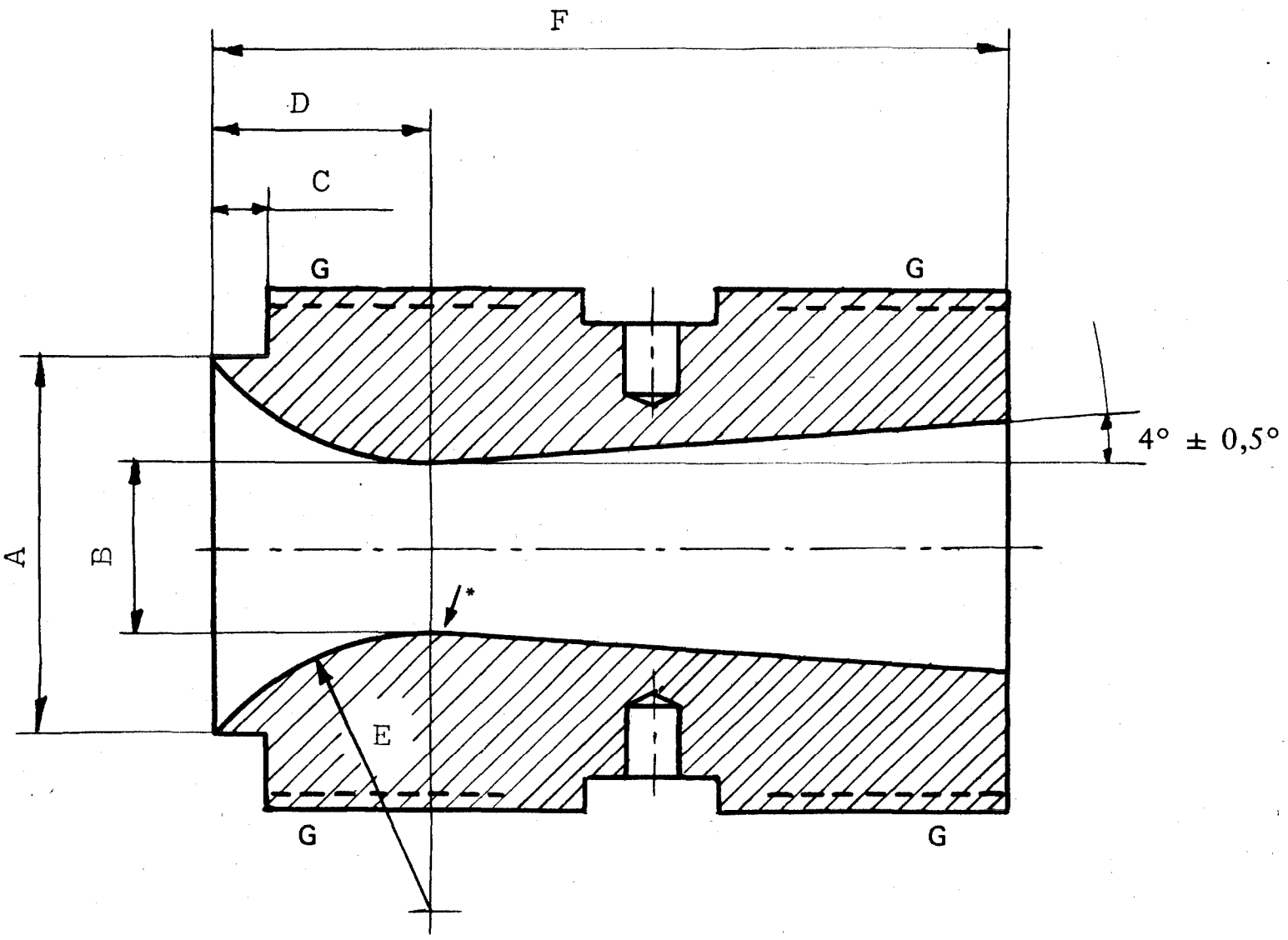

Figure 3 – **Circular arc venturi nozzle**

(*) = Taper tangential to radius
G = Taper thread both ends
Internal surface finish 0,4 µm C.L.A.

Table 1

Nozzle dimensions

Flow rate in l/s	A mm	B mm	C mm	D mm	E mm	F mm	G Denomination
12 – 40	16,00	6,350	2,40	9,93	12,70	60,5	R 1,0
24 – 90	24,00	9,525	3,60	14,86	19,05	91,0	R 1,5
50 – 160	32,00	12,700	4,60	19,81	25,40	121,5	R 2,0
100 – 360	48,00	19,050	7,10	29,72	38,10	182,0	R 2,5
180 – 650	64,00	25,400	9,60	39,65	50,80	243,0	R 3,0
280 – 1000	80,00	31,750	12,00	49,53	63,50	303,5	R 3,5
400 – 1500	95,00	38,100	14,20	59,44	76,20	364,0	R 4,0

12.5. **The test**

When steady flow conditions have been reached the following readings shall be taken:

barometric pressure (P_b)
nozzle upstream pressure (P_N)
nozzle upstream temperature (t_n)
temperature and pressure at which volume flow rate is required (t_o, P_o)

12.6. **Volume rate of flow calculations**

$$q_m = 0{,}1 \cdot \pi \cdot B^2 \cdot C_D \cdot C^* \cdot P_N/[4 \cdot (R \cdot T_N)^{1/2}]$$

Where

q_m is the mass flow rate in kg/s
B is the nozzle diameter in mm
C_D is the discharge coefficient
C^* is the critical flow factor
P_N is the absolute pressure upstream of the nozzle in bar
T_N is the absolute temperature upstream of the nozzle in K
R is the gas constant in J/(kg·K) (for air R = 287,1)

$$C^* = 0{,}684858 + (3{,}70575 - 4{,}76902 \cdot 10^{-2} \cdot t_N + 2{,}63019 \cdot 10^{-4} \cdot t_N 2) \cdot p_N \cdot 10^{-4}$$

Where

t_N = temperature upstream of the nozzle in °C. On the basis of test results and for the accuracy stipulated, C_D = 0,9888.

When used at the discharge of portable or packaged air compressors, t_n will vary from 20 °C to 70 °C and P_N from 2 to 8 bar. C^* will therefore vary from 0,6871 to 0,6852 and an average value of 0,6862 can be used. Under these conditions the equation can be simplified to:

$$q_m = 0{,}1 \cdot \pi \cdot B^2 \cdot 0{,}9888 \cdot 0{,}6862 \cdot P_N/[4 \cdot (287{,}1 \cdot T_N)^{1/2}]$$
$$= 3{,}143 \cdot 10^{-3} \cdot B^2 \cdot P_N/T_N{}^{1/2} \text{ kg/s}$$

or converted to volume flow rate (q_v) under the reference conditions:

$$q_v = 9 \cdot 10^{-3} \cdot B^2 \cdot P_N \cdot T_o/(P_o \cdot T_N{}^{1/2}) \text{ l/s}$$

where

P_o = is the absolute reference pressure in bar
T_o = is the absolute reference temperature in K.

AMENDMENTS TO ANNEX II TO DIRECTIVE 84/533/EEC

3. **Operating conditions**

3.1.4. *Motor power*

The text in brackets 'DIN 6270B' shall be replaced by 'Council Directive 80/1269/EEC'.

3.2.4. *Nominal air flow*

The words 'ISO 1217' shall be replaced by 'Point 12 of Annex I'.