Incorporating Amendment No. 1

Electrical apparatus for use in the presence of combustible dust —

Part 2-1: Test methods — Methods of determining minimum ignition temperatures

The European Standard EN 50281-2-1:1998 has the status of a British Standard

ICS 29.260.20

National foreword

This British Standard is the English language version of EN 50281-2-1:1998, including Corrigendum August 1999.

The UK participation in its preparation was entrusted by Technical Committee GEL/31, Electrical apparatus for explosive atmospheres, to Subcommittee GEL/31/20, Apparatus for use in the presence of ignitable dust, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Summary of pages

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English version

Electrical apparatus for use in the presence of combustible dust — Part 2-1: Test methods — Methods of determining minimum ignition temperatures

Matériels électriques destinés à être utilisés en présence de poussières combustibles
Partie 2-1: Méthodes d'essai
Méthodes de détermination de la température minimale d'inflammation de la poussière

Elektrische Betriebsmittel zur Verwendung in Bereichen mit brennbarem Staub
Teil 1-2: Untersuchungsverfahren
Verfahren zur Bestimmung der Mindestzündtemperatur von Staub

This European Standard was approved by CENELEC on 1998-09-01.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Ref. No. 50281-2-1:1998 E

Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres. The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC EN 50281-2-1 on 1998-09-01.

This European Standard was prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and supports the essential health and safety requirements of the EC Directive 94/9/EC.

The following dates have been fixed:

— latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop) 1999-09-01
— latest date by which national standards conflicting with the EN have to be withdrawn	(dow) 2003-06-30

Annexes designated "normative" are part of the body of the standard.

In this standard, annexes A and B are normative.

Contents

Introduction

This European Standard describes methods for determining the minimum ignition temperature of dust for the purpose of selecting electrical apparatus. These are:

— Method A: Dust layer on a heated surface at a constant temperature (clause **4**);

— Method B: Dust cloud in a furnace at a constant temperature (clause **5**).

Method A determines the minimum ignition temperature of a dust layer on a prescribed heated surface.

Method B determines the minimum ignition temperature of a dust cloud within a prescribed heated furnace.

The test methods are of a general nature, and may be used for purposes of comparison, but in certain industrial situations further tests may be necessary.

The methods for determining the minimum ignition temperatures are not suitable for use with recognized explosives, for example, gunpowder, dynamite, or mixtures of substances which may, under some circumstances, behave similarly.

Where there is doubt, an indication of the existence of a hazard due to explosive properties may be obtained by testing a very small quantity of the dust on a surface at 400 °C or higher, located remotely from the operator.

1 Scope

This European Standard specifies two test methods for determining the minimum ignition temperatures of dust for the purpose of selecting electrical apparatus for use in the presence of combustible dust in accordance with EN 50281-1-2:1998 and constructed in accordance with EN 50281-1-1:1998.

These methods are not suitable for use with substances having explosive properties.

Method A (clause **4**) is applicable to the determination of the minimum temperature of a prescribed hot surface which will result in the decomposition and/or ignition of a layer of dust of a specified thickness deposited on it. The method is particularly relevant to industrial equipment with which dusts are present on hot surfaces in thin layers exposed to the atmosphere.

Method B (clause **5**) is applicable to the determination of the minimum temperature of a prescribed hot surface which will result in the ignition of a cloud of given sample of dust or other particulate solid. The test is intended to be carried out as a complementary test after determining the minimum ignition temperature of a dust layer by method A of this European Standard.

NOTE 1 Concerning method B: because the method of operation of the furnace gives short residence times for dust particles within it, this method of test is applicable to industrial equipment where dust is present as a cloud for a short time. This method of test is of small scale and the results are not necessarily representative of all industrial conditions.

NOTE 2 Concerning method B: the method is not applicable to dusts which may, over a longer period of time than provided for in the test method, produce gasses from deposits generated during pyrolysis or smouldering.

2 Normative references

EN 50281-1-1, *Electrical apparatus for use in the presence of combustible dust — Part 1-1: Electrical apparatus protected by enclosures — Construction and testing.*

EN 50281-1-2, *Electrical apparatus for use in the presence of combustible dust — Part 1-2: Electrical apparatus protected by enclosures — Selection, installation and maintenance.*

ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings.*

ISO 4225, *Air Quality — General aspects — Vocabulary.*

3 Definitions

For the purpose of this European Standard the following definitions apply.

3.1

dust

small solid particles that settle out under their own weight but that may remain suspended in air for some time in the atmosphere (includes dust and grit as defined in ISO 4225)

3.2

ignition of a dust layer

ignition shall be considered to have occurred if glowing or flaming is initiated in the material, or a temperature of 450 °C or more, or a temperature rise of 250 K or more above the temperature of the prescribed hot surface, is measured in the test

3.3

minimum ignition temperature of a dust layer

the lowest temperature of a hot surface at which ignition occurs in a dust layer of specified thickness on this hot surface

NOTE 1 Because of the wide range of processes in industry, the ignition of dust layers may be dependent upon local conditions. This method of test is not necessarily representative of all industrial conditions, where account may need to be taken of such factors as the presence of thick layers of dust and of the distribution of temperature in the environment.

NOTE 2 When carrying out this test, it is essential that all necessary precautions be taken to safeguard the health of personnel, for example, against the risk of fire, explosion, inhalation of smoke and any toxic products of combustion.

3.4

ignition of a dust cloud

the initiation of an explosion by the transfer of energy to a dust cloud in air

3.5

ignition temperature of a dust cloud

the lowest temperature of the hot inner wall of a furnace at which ignition occurs in a dust cloud in air contained therein

NOTE When carrying out this test, it is essential that all necessary precautions be taken to safeguard the health of personnel, for example, against the risk of fire, explosion, inhalation of smoke and any toxic products of combustion.

4 Method A: dust layer on a heated surface at a constant temperature

4.1 Preparation of dust sample

The sample shall be prepared so as to be homogeneous and representative of the dust received for consideration.

The dust sample to be tested shall, in general, be able to pass through a woven metal wire cloth or a square hole perforated plate test sieve with a nominal size of aperture of 200 µm (supplementary sizes, ISO 565). If it is necessary to test a coarser dust, passing a test sieve with a nominal size of aperture up to 500 µm, the fact shall be stated in the report of the test.

Any apparent changes noted in the properties of the dust during preparation of the sample, for example, by sieving or owing to temperature or humidity conditions, shall be stated in the report of the test.

4.2 Test apparatus

The apparatus is shown schematically in Figure A.1. Essential details and performance requirements are given in the following clauses. Methods of construction to enable these requirements to be met are described in annex A.

4.2.1 *Heated surface*

The heated surface shall consist of a metal plate and shall provide a working area of at least 200 mm in diameter, and be not less than 20 mm in thickness. The plate shall be heated electrically and its temperature shall be controlled by a device for which the sensing element is a thermocouple mounted in the plate near the centre and with its junction within 1 ± 0,5 mm of the upper surface and in good thermal contact with the plate.

A similar thermocouple shall be mounted near the control thermocouple in a similar manner, and shall be connected to a temperature recorder to record the temperature of the surface during a test. The heated surface and its control device shall satisfy the following performance requirements:

a) The heated surface shall be capable of attaining a maximum temperature of 400 °C without a dust layer in position.

b) The temperature of the heated surface shall be constant to within ±5 K throughout the period of a test.

c) When the heated surface has reached a steady state, the temperature across the surface shall be uniform to within ±5 K when measured across two diameters at right angles, by the procedure in annex A. This requirement shall be satisfied at nominal surface temperatures of 200 °C and 350 °C.

d) The temperature control shall be such that the recorded surface temperature does not change by more than ±5 K during the placing of the dust layer, and it shall be restored to within ±2 K of the previous value within 5 min of placing the dust layer.

e) Temperature control and measurement devices shall be calibrated and shall have limits of inaccuracy of ±3 K.

4.2.2 *Dust layer thermocouple*

A fine thermocouple (0,20 mm to 0,25 mm diameter) of chromel-alumel or other suitable material shall be stretched across the heated surface, and parallel to it, at a height of between 2 mm and 3 mm from it with the junction over the centre of the plate. This thermocouple shall be connected to a temperature recorder in order to determine the behaviour of the dust layer during the test.

4.2.3 *Temperature measurements*

Temperature measurements using thermocouples shall be made either relative to a fixed reference junction or with automatic cold junction compensation. In either case, calibration shall satisfy the requirements of **4.2.1**e).

4.2.4 *Ambient temperature measurements*

The ambient temperature shall be measured by a thermometer placed not more than 1 m from the heated surface, but shielded from heat convection and radiation from the surface. The ambient temperatures shall be within the range 15 °C to 35 °C.

4.2.5 *Dust layers*

Dust layers shall be prepared by filling the cavity formed by placing a metal ring of appropriate height on the heated surface and levelling the layer to the top of the ring. The ring shall have an internal diameter of nominally 100 mm and shall have slots at opposite ends of a diameter to clear the test thermocouple (Figure A.2). The ring shall be left in place during a test.

A given dust shall be tested in a layer of 5,0 mm ± 0,1 mm depth.

NOTE For predictive purposes (see **4.6**) a second depth (such as 12,5 mm ± 0,1 mm or 15,0 mm ± 1 mm) is useful. Rings of appropriate height will be required.

4.2.6 ***Formation of dust layer***

The dust layer shall be formed without compressing it unduly. That is to say, the dust shall be put into the ring with a spatula and distributed mainly with sideways movement of the spatula until the ring is slightly overfilled. The layer shall then be levelled by drawing a straight edge across the top of the ring. Any excess should be swept away.

For each dust, a layer shall be formed in the above manner on a sheet of paper whose weight is known and weighed. The density shall be calculated from the mass of the dust and the filled volume of the ring, and shall be reported.

4.3 Procedure

4.3.1 ***General***

NOTE 1 The occurrence of ignition in a layer of dust on a surface at a given temperature depends critically on the balance between the rate of heat generation ("self-heating") in the layer and the rate of heat loss to the surroundings. The temperature at which ignition of a given material occurs depends, therefore, on the thickness of the layer. Values determined for two or more thickness of a given dust may be used for predictive purposes (see **4.6**).

Following the recommended procedure, ignition shall be considered to have occurred if:

a) visible glowing or flaming is observed (Figure 3A); or

b) a temperature of 450 °C is measured; or

c) a temperature rise of 250 K above the temperature of the heated plate (Figure 3C), is measured.

With regards to items b) and c) above, ignition shall not be considered to have occurred if it can be shown that the reaction does not propagate to glowing or flaming. The temperature shall be measured by thermocouple (see **4.2.2**). It will usually be found that, provided the temperature of the heated surface is high enough, the temperature in the layer will slowly increase to a maximum value which may be in excess of the temperature of the heated surface and then slowly fall to a steady value below the temperature of the heated surface (Figure 3B).

NOTE 2 Some materials exhibit more than one stage of self-heating, and it may sometimes be necessary to prolong the test in order to fully explore this possibility.

With organic dusts, combustion will usually take the form of charring followed by the appearance of smouldering with glowing which will progress through the layer and leave a residue of ash.

With dust layers composed of certain divided metals, ignition may be characterised by the relatively sudden appearance of highly incandescent smouldering combustion progressing rapidly through the layer.

In the determination of the minimum ignition temperature for a layer of given thickness, repeated trials shall be carried out, using a fresh layer of dust each time and with up-and-down adjustments to the temperature of the heated surface until a temperature is found which is high enough to cause ignition in the layer but which is no more than 10 K higher than a temperature which fails to cause ignition. The highest temperature at which ignition fails to occur shall be confirmed by continuing the test long enough to establish that any self-heating is decreasing in rate; that is, the temperature at the point of measurement in the layer is decreasing to a steady value lower than the temperature of the heated surface.

4.3.2 ***Method***

The apparatus shall be set up in a position free from draughts, and preferably under a hood capable of extracting smoke and fumes.

The temperature of the heated surface shall be adjusted to the desired value and shall be allowed to become steady within the prescribed limits of **4.2.1**b). A metal ring of the required height shall be placed centrally on the heated surface and this ring shall be filled with the dust to be tested and leveled off within a period of 2 min. The recorder for the dust layer thermocouple shall then be started.

The test shall be continued until it is ascertained either that the layer has ignited, either visually or by the thermocouple record, or has self-heated without igniting and is subsequently cooling down.

If, after a period of 30 min, no self-heating is apparent the test shall be terminated and repeated at a higher temperature. If ignition or self-heating occurs the test shall be repeated at a lower temperature, if necessary, prolonging the test beyond 30 min. Testing is continued until a temperature is found which is high enough to cause ignition or self-heating in the layer, but which is no more than 10 K higher than a temperature which fails to cause ignition or self-heating.

4.3.3 ***Results***

Tests shall be repeated with fresh layers of dust until a minimum ignition temperature has been determined. This shall be the lowest temperature, rounded down to the nearest integral multiple of 10 °C, at which ignition occurs in a layer of given thickness. Where ignition has been deemed to occur, from readings of the test thermocouple (**4.3.1**), the minimum ignition temperature shall be the lowest such temperature, rounded down to the nearest integral multiple of 10 °C, less 10 K.

The highest value of temperature at which ignition does not occur, or is deemed not to occur, shall also be recorded. This temperature shall not be more than 10 K lower than the minimum temperature at which ignition does occur, or is deemed to occur, and it shall be confirmed by at least three tests.

For the purposes of this European Standard, the tests shall be discontinued if ignition of a dust layer does not occur below a heated surface temperature of 400 °C. This fact shall be reported as the result of the test.

Times to obtain ignition, or times to the maximum temperature reached in the case of no ignition, shall be measured to the nearest 5 min from the time of placing the dust layer on to the heated surface, and shall be reported.

Where a dust layer fails to ignite at a temperature of less than 400 °C, the maximum duration shall be reported.

4.4 Test acceptance criteria

Results obtained by the same operator on different days and results obtained in different laboratories shall be considered unsatisfactory if they give ignition temperatures differing by more than 10 K in either case.

Where validity of test results may sometimes be poor for reasons associated with the physical nature of the dusts and the behaviour of layers during test. This shall be reported (see **4.5**) and all results shall be accepted as equally valid.

The test report shall then include a brief description of the nature of the combustion following ignition, noting especially behaviour such as unusually rapid combustion or violent decomposition. Factors likely to affect the significance of the results shall also be reported; these include difficulties in the preparation of layers, distortion of layers during heating, decrepitation, melting, and evidence of flammable gas generated during heating of the dust.

4.5 Reporting of results

The test report shall include the name, source and description (if not implicit in the name) of the material tested, the date and identification of the test, the ambient temperature and the density of the material as tested (**4.2.6**).

The report shall state that the determination of minimum ignition temperature of the dust layer has been carried out in accordance with this European Standard.

The ignition tests shall be reported in the manner shown in the following table (showing results in descending order of surface temperature rather than in the order in which tests were performed).

The ignition temperature shall be recorded in accordance with **4.3.3** for each depth of layer.

Tests in which the heated surface temperature differed by more than ±20 K from the recorded minimum ignition temperature need not be reported.

Depth of mm	Surface temperature °C	Result of test	Time to ignition or to reach the highest layer value of temperature without ignition min
	180	Ignition	16
	170	Ignition	36
5	160	No ignition	40
	160	No ignition	38
	160	No ignition	42
	150	No ignition	62

NOTE In the example given in the above table the minimum ignition temperature for the 5 mm layer would be recorded as 170 °C.

The ignition temperature shall be recorded in accordance with **4.3.3** for each depth of layer.

Tests in which the heated surface temperature differed by more than ±20 K from the recorded minimum ignition temperature need not be reported.

4.6 Application of results

The values of minimum ignition temperature determined in accordance with method A of this European Standard apply to layers having the thicknesses used in the tests. Although for some materials it is possible to estimate the minimum temperatures of a heated surface for the ignition of layers of a given dust of intermediate or greater thickness, by linear interpolation or extrapolation of the test results plotted as the logarithm of the thickness versus the reciprocal of the minimum ignition temperature in kelvins, it is preferable to test with the required thickness.

NOTE 1 The above is the simplest predictive procedure which has some theoretical justification. More elaborate treatment based on thermal explosion theory will permit estimates for ignition of layers in other configurations, such as layers on curved surfaces. However, if it is desired to make accurate predictions for ignition under widely different conditions of exposure, in particular exposure to a symmetrical high temperature environment rather than to an unsymmetrical environment as on a hot plate, it is preferable to use results obtained for an experimental procedure matching the different environment more closely – such as ignition in an oven.

NOTE 2 When extensive prediction is intended, it is desirable to determine ignition temperatures for more than two thicknesses of layer and with an emphasis on thicker layers.

5 Method B: dust cloud in a furnace at a constant temperature

5.1 Preparation of dust sample

The sample shall be prepared so as to be homogeneous and representative of the dust received for consideration.

The dust sample to be tested shall, in general, be able to pass through a woven metal wire cloth or a square hole perforated plate test sieve with a nominal size of aperture of 71 µm (supplementary sizes, ISO 565). If it is necessary to test a coarser dust, passing a test sieve with a nominal size of aperture up to 500 µm, the fact shall be stated in the report of the test.

Any apparent changes noted in the properties of the dust during preparation of the sample, for example, by sieving or owing to temperature or humidity conditions, shall be stated in the report of the test.

5.2 Test apparatus

Details of construction of the test apparatus are shown in Figures B.1 to B.10, and in Table B.1. The heated silica tube of the furnace is vertical, and is open to atmosphere at its lower end. The upper end connects, by a glass adaptor, to the dust holder. Dust is dispersed into the furnace by opening a solenoid valve, which releases compressed air from the reservoir. The furnace is mounted on a stand, enabling the lower end of the furnace tube to be readily observed.

A mirror is placed below the tube to enable the interior of the furnace tube to be viewed.

The thermocouples used are calibrated on a regular basis so as to maintain temperature measurements above 500 °C to ±1 %, and measurements below 300 °C ± 3%.

After assembly of the test apparatus, its accuracy shall be compared with results obtained elsewhere for a powder such as lycopodium.

5.3 Procedure

5.3.1 *Setting up*

The apparatus shall be set up in an enclosure from which dust and fumes can be extracted and which is free from draughts.

5.3.2 Determination of minimum ignition temperature shall be as follows.

Place approximately 0,1 g of the dust in the dust holder; set the temperature of the furnace to 500 °C, and the pressure of the air in the reservoir to 10 kPa (0,1 bar) above atmospheric. Disperse the dust into the furnace. If ignition does not occur, repeat the test with fresh dust, having increased the temperature in steps of 50 K until ignition is obtained, or until a furnace temperature of 1 000 °C is reached.

Once ignition is obtained, vary the mass of dust and the dispersion pressure of the air until the most vigorous ignition is apparent. Then, using the same mass and dispersion pressure, carry out further tests with the temperature reduced in steps of 20 K until no ignition is obtained in 10 attempts.

If ignition still occurs at 300 °C, reduce the temperature in steps of 10 K.

When no ignition is obtained, using this temperature reduction procedure, test again with the next lower temperature using lower and higher values of mass of dust and dispersion air pressure. If necessary, the temperature is reduced further until no ignition is again obtained in 10 attempts.

5.3.3 *Mass of dust*

The values of the mass of dust shall be selected from the following, with a tolerance of ±5 %:

0,01, 0,02, 0,03, 0,05, 0,10, 0,20, 0,30, 0,50, 1,0, ... g.

5.4 Air pressure

The values for the pressure of air in the reservoir, above atmospheric, for dispersion of the dust shall be selected from the following, with a tolerance of ±5 %:

2,0, 3,0, 5,0, 10, 20, 30 and 50 kPa, or alternatively,

0,02, 0,03, 0,05, 0,10, 0,20, 0,30, and 0,50 bar.

5.5 Criterion for ignition

Ignition shall be considered to have occurred when a burst of flame is seen beyond the lower end of the furnace tube. A delay in time for ignition is acceptable. Sparks without flames do not constitute ignition.

5.6 Minimum ignition temperature of a dust cloud

The minimum ignition temperature shall be recorded as the lowest temperature of the furnace at which ignition was obtained using the stated procedures, minus 20 K for furnace temperatures above 300 °C, and minus 10 K for furnace temperatures at or below 300 °C.

If no ignition is obtained even when the furnace temperature is at 1 000 °C, this fact shall be stated in the report of the test.

5.7 Reporting of results

The test report shall include the name, source and description (if not implicit in the name) of the material tested, the moisture content of the dust if it has been measured, the date and the identification of the test.

The report shall state that the determination of minimum ignition temperature of the dust cloud has been carried out in accordance with this European Standard.

The ignition temperature shall be recorded in accordance with **5.5**.

Annex A (normative)

Method A: Construction of a heated surface and measurement of temperature distribution on the surface

Provided the requirements of **4.2.1** are satisfied, the detailed construction of the heated surface is not critical. As an example, it may consist of a circular plate of suitable metal such as aluminium or stainless steel, provided with a "skirt" (Figure A.1) and it may be mounted on any suitable electrically heated boiling plate commercially available.

There are two ways of achieving a sufficiently uniform temperature distribution across the heated plate, the choice of which depends primarily on the heating device available. If the heater consists, for example, of exposed coiled filaments intended to run at red heat, there should be an air gap of about 10 mm between the heater and the plate so that heat transfer occurs by radiation and convection. If, however, the heater is designed for direct contact, so that heat transfer occurs mainly by conduction, the plate needs to be much thicker if hot spots are to be avoided. A thickness of not less than 20 mm is specified in **4.2.1**.

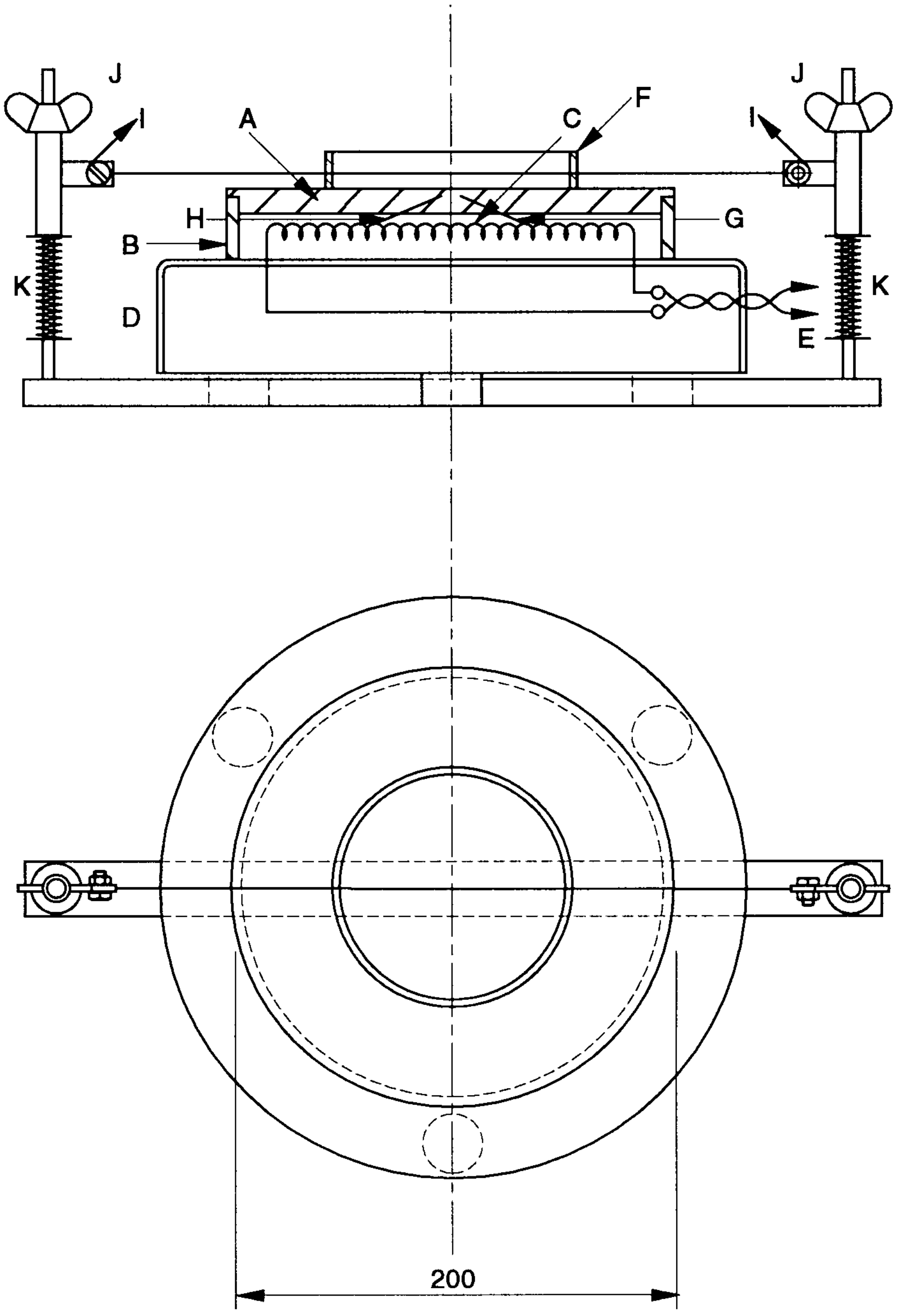
The general arrangement shown in Figure A.1 is self-explanatory. Although the indicating and controlling thermocouples may be inserted into the hot plate as shown in G and H in Figure A.1, it is preferable to insert them in holes drilled radially from the edge of the plate and parallel to the surface, at a suitable depth for the junctions to be 1 mm ± 0,5 mm below the surface, as specified in **4.2.1**. The base of the heated plate should be provided with feet in order to clear the support for the thermocouple stretched across the surface. This thermocouple is mounted between spring-loaded carriers on threaded vertical rods. The height of the thermocouple can be adjusted by means of nuts.

A suitable apparatus for measuring the temperature distribution across the heated surface is illustrated in Figure A.4.

The measuring element consists of a fine thermocouple with the junction flattened and brazed to a disc of copper or brass foil, 5 mm in nominal diameter. This is placed at a measuring point, covered with a piece of suitable thermal insulating material, 5 mm in thickness and 10 mm to 15 mm in diameter and held by a vertical glass rod which moves freely in a tubular guide and to which a fixed load is applied.

Temperature measurements are made along two diameters at right angles and at points 20 mm apart, and recorded as in Figure A.5. The thermocouple shall be allowed to reach a steady temperature at each point.

The measured surface temperature will usually be less than the surface temperature of the plate as set, to an extent which will depend on the detailed construction of the thermocouple. This difference is immaterial and can be ignored. The essential requirement is an accurate measurement of temperature differences rather than of actual values of temperature.



(drawing not to scale)

A Heated plate
B Skirt
C Heater
D Heater base
E Heater connection to power supply and controller
F Ring for dust layer
G Plate thermocouple to controller
H Plate thermocouple to recorder
I Dust layer thermocouple to recorder
J Screw adjustment for thermocouple height
K Coil spring

Figure A.1 — Diagram of hot plate (method A)

Dimensions in millimetres

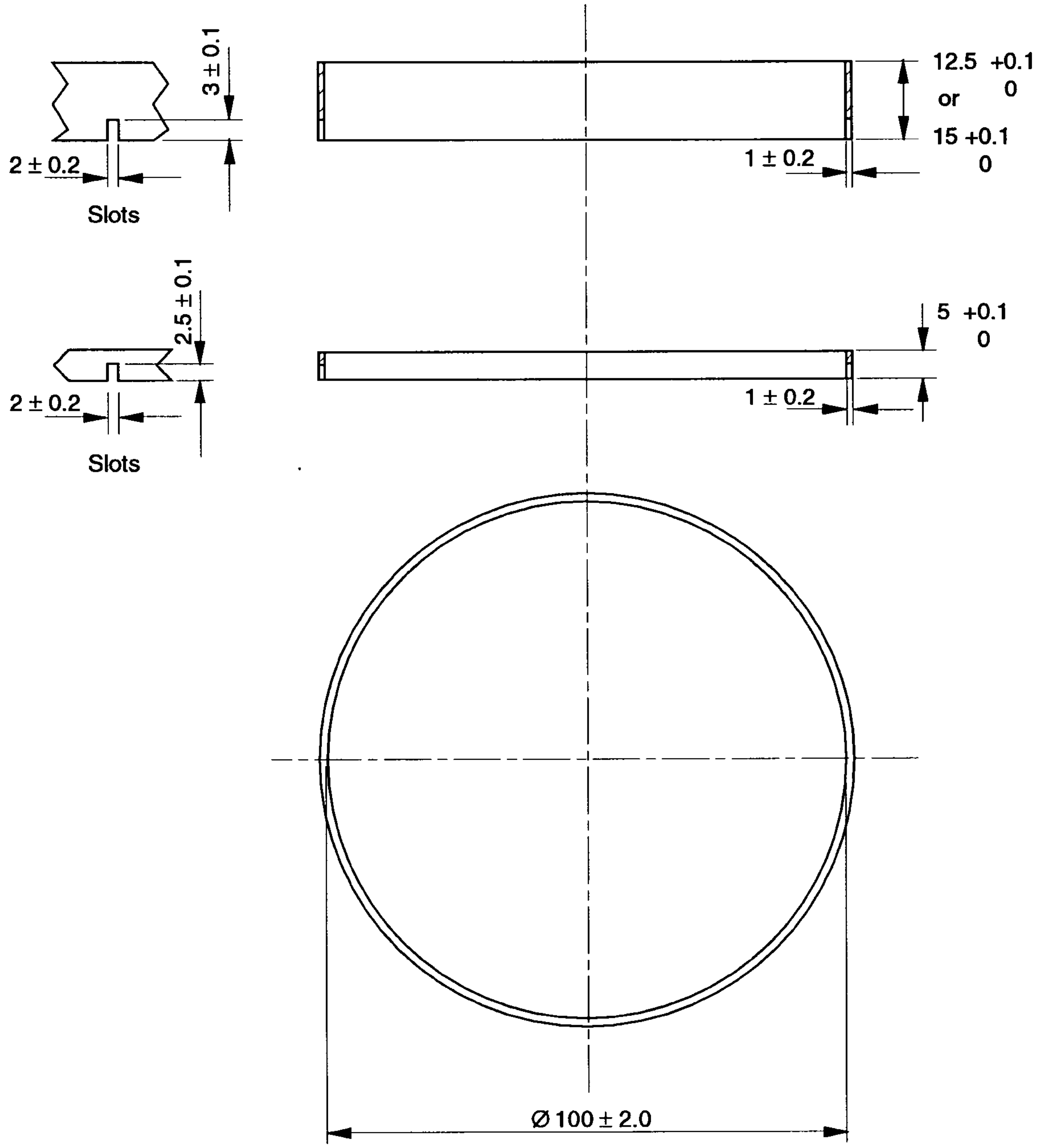


Figure A.2 — Rings for forming dust layers (method A)

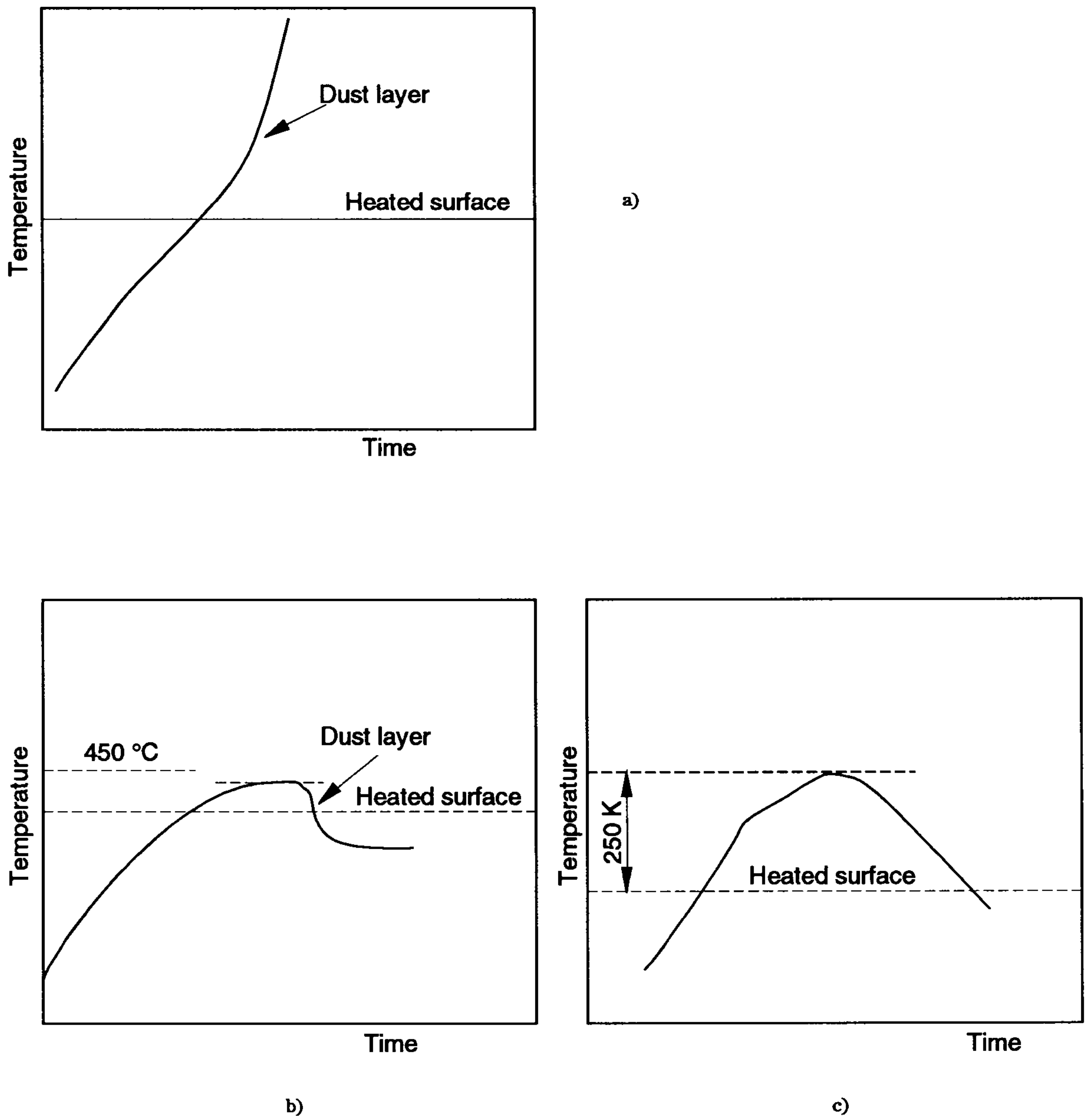


Figure A.3 — Typical temperature/time curves for ignition of dust layer on heated surface (method A)

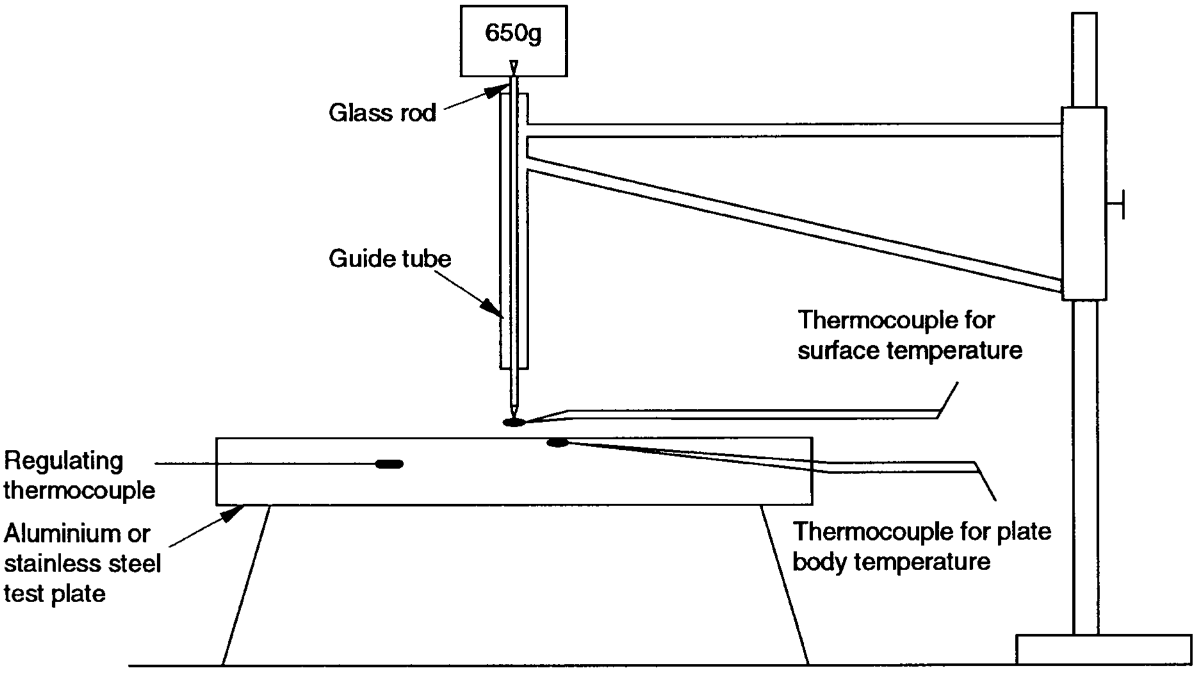
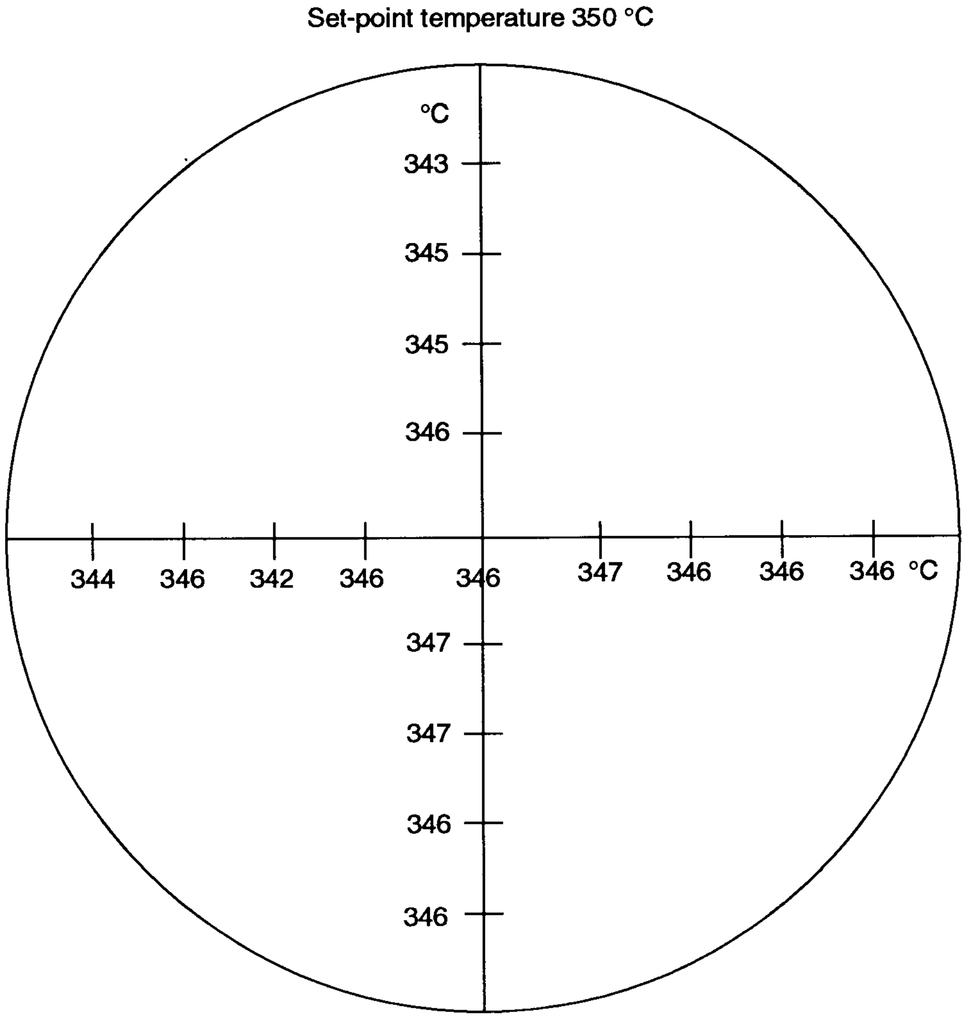


Figure A.4 — Measurement of surface temperature (method A)



Maximum temperature difference over the whole plate 5 K

(Maximum deviation from set-point temperature 8 K)

Figure A.5 — Typical surface temperature distribution (method A)

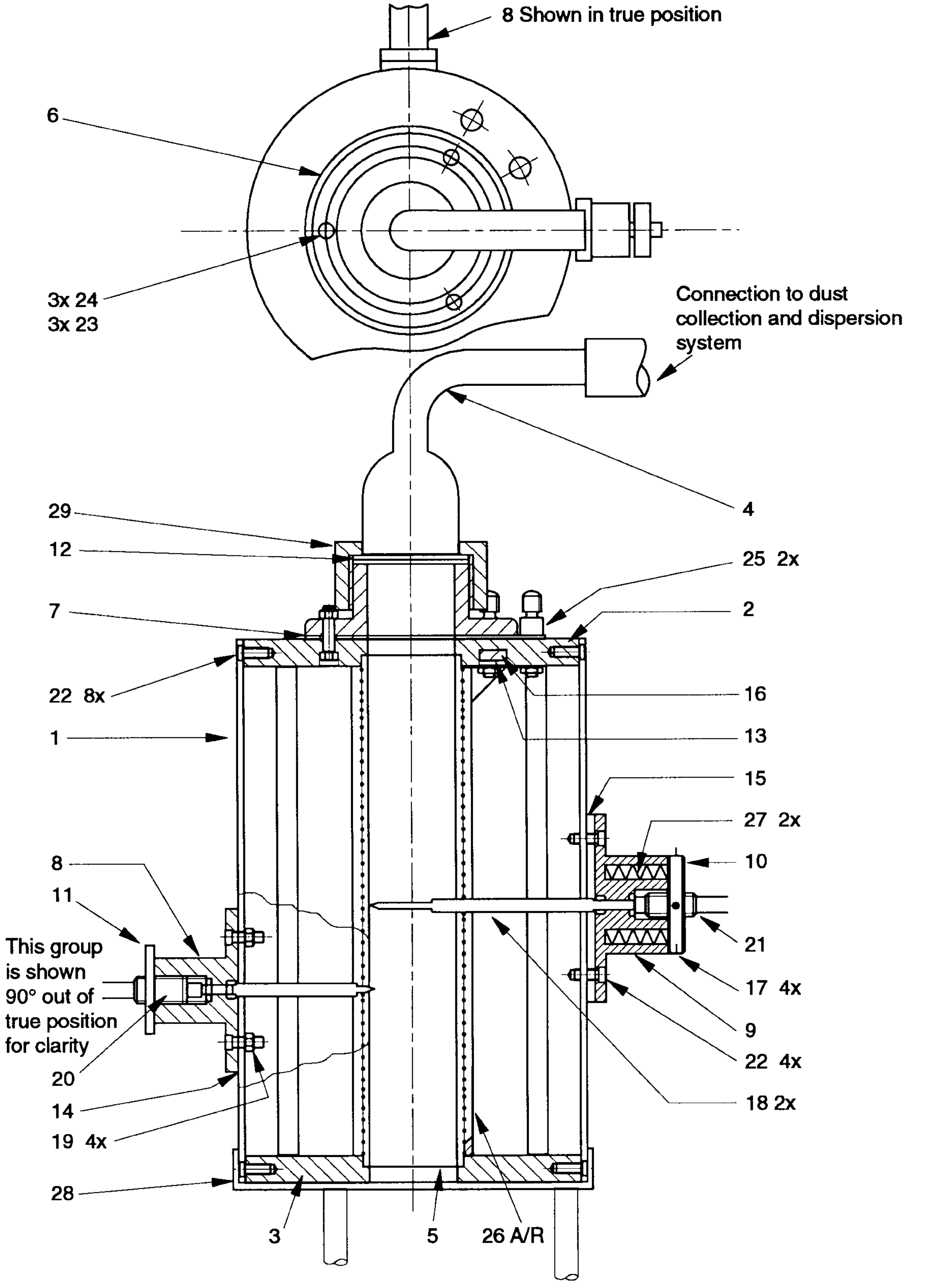
Annex B (normative)
Construction of a constant temperature furnace

Table B.1 — Components of the apparatus (method B)
(see Figures B.1 to B.10)

Item	Description	Material	Section mm	Length mm	Number
1	Furnace housing	Stainless steel	0,9 thick	228	1
2	Top cover	Mineral fibre	∅ 150	12	1
3	Bottom cover	Mineral fibre	∅ 150	12	1
4	Adaptor	Glass	—	—	1
5	Tube	Silica	∅ 44	216	1
6	Collar	Stainless steel	∅ 90	8	1
7	Washer	Mineral fibre	∅ 90	2 thick	1
8	Thermocouple mounting	Stainless steel	20 × 40	26	1
9	Thermocouple mounting	Stainless steel	30 × 50	23	1
10	Knob	Stainless steel	∅ 25	6	1
11	Knob	Stainless steel	∅ 18	4	1
12	Washer	Mineral fibre	∅ 45	2 thick	1
13	Washer	Mineral fibre	∅ 80	2 thick	1
14	Washer	Mineral fibre	20 × 40	2 thick	1
15	Washer	Mineral fibre	30 × 50	2 thick	1
16	Support ring	Stainless steel	∅ 80	4 thick	1
17	Pin	Silver steel	∅ 1,5	6	4
18	Sleeve	Alumina	∅ 4 outside	60	2
19	Rivet nut M4	—	∅ 2,4 inside	—	4
20	Thermocouple	*	—	90	1
21	Thermocouple	*	—	126	1
22	Screw M4 × 10 countersunk head	Stainless steel	—	—	12
23	Nut M4 domehead	Stainless steel	—	—	3
24	Washer	Stainless steel	—	—	3
25	Terminal	—	—	—	2
26	Wire Kanthal A	**	—	—	As required
27	Spring, tension	Steel	∅ 3,18 outside	12,7	2
28	Furnace stand	Stainless steel	—	—	1
29	Securing ring	Stainless steel	∅ 60	28	1
30	Dust holder	Stainless steel	—	—	1

* Nickel chrome/chrome alumel

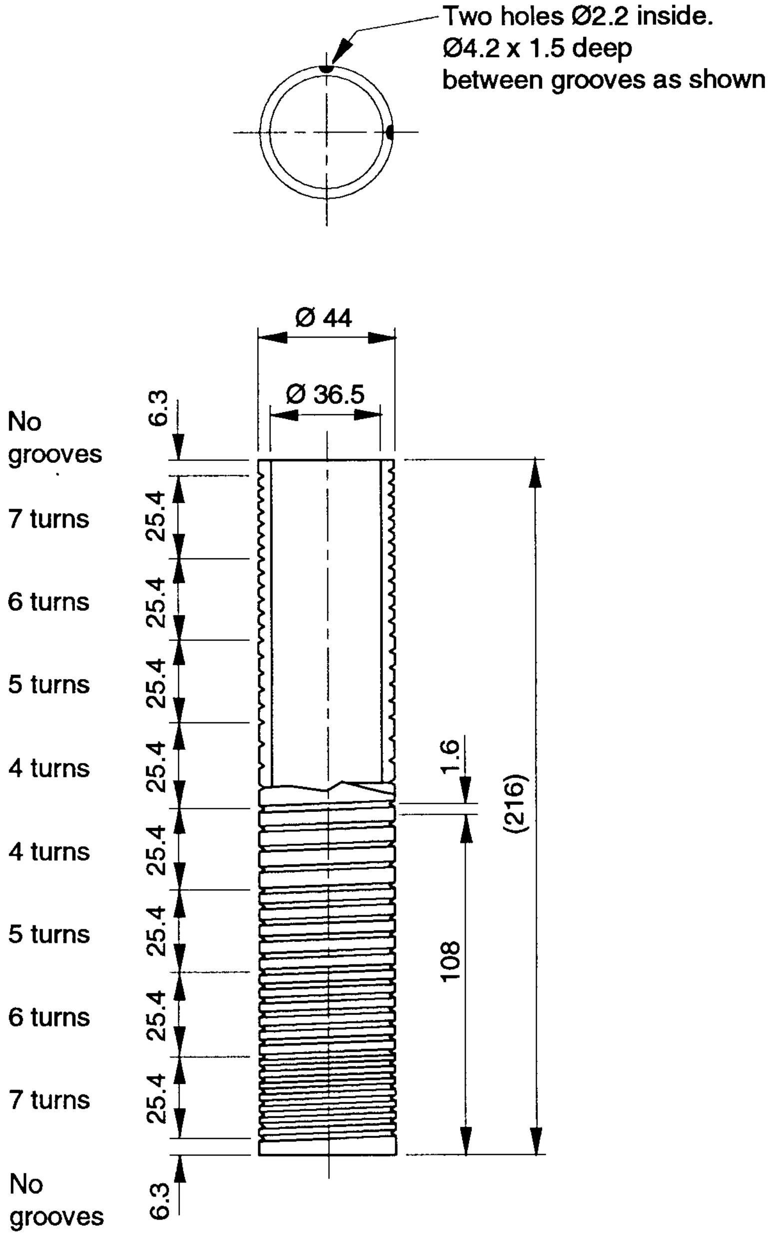
** Iron alloy containing aluminium, cobalt and chromium.



For details of numbered items, refer to Table B.1
Insulation — from item 5
5 mm thick aluminous cement
25 mm thick mineral fibre
10 mm thick aluminous cement
Remainder to be kieselguhr

Figure B.1 — Furnace apparatus assembly (method B)

Dimensions in millimetres

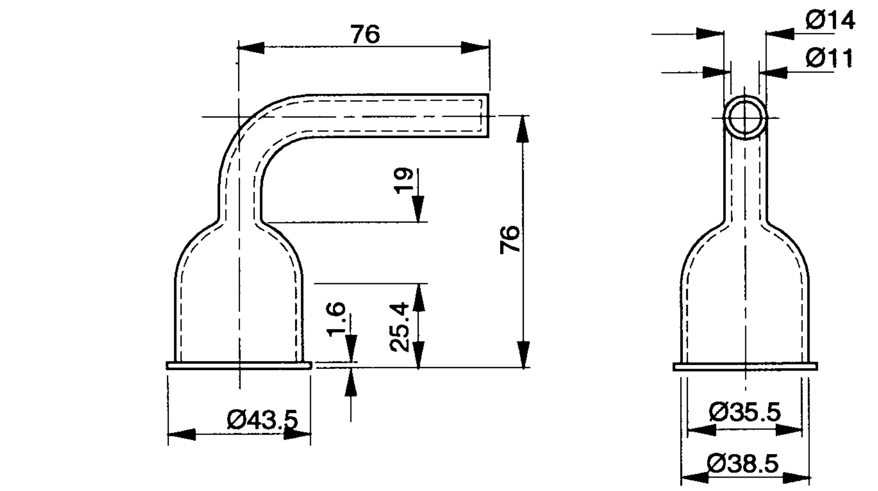


5 Silica tube with spiral groove on external surface

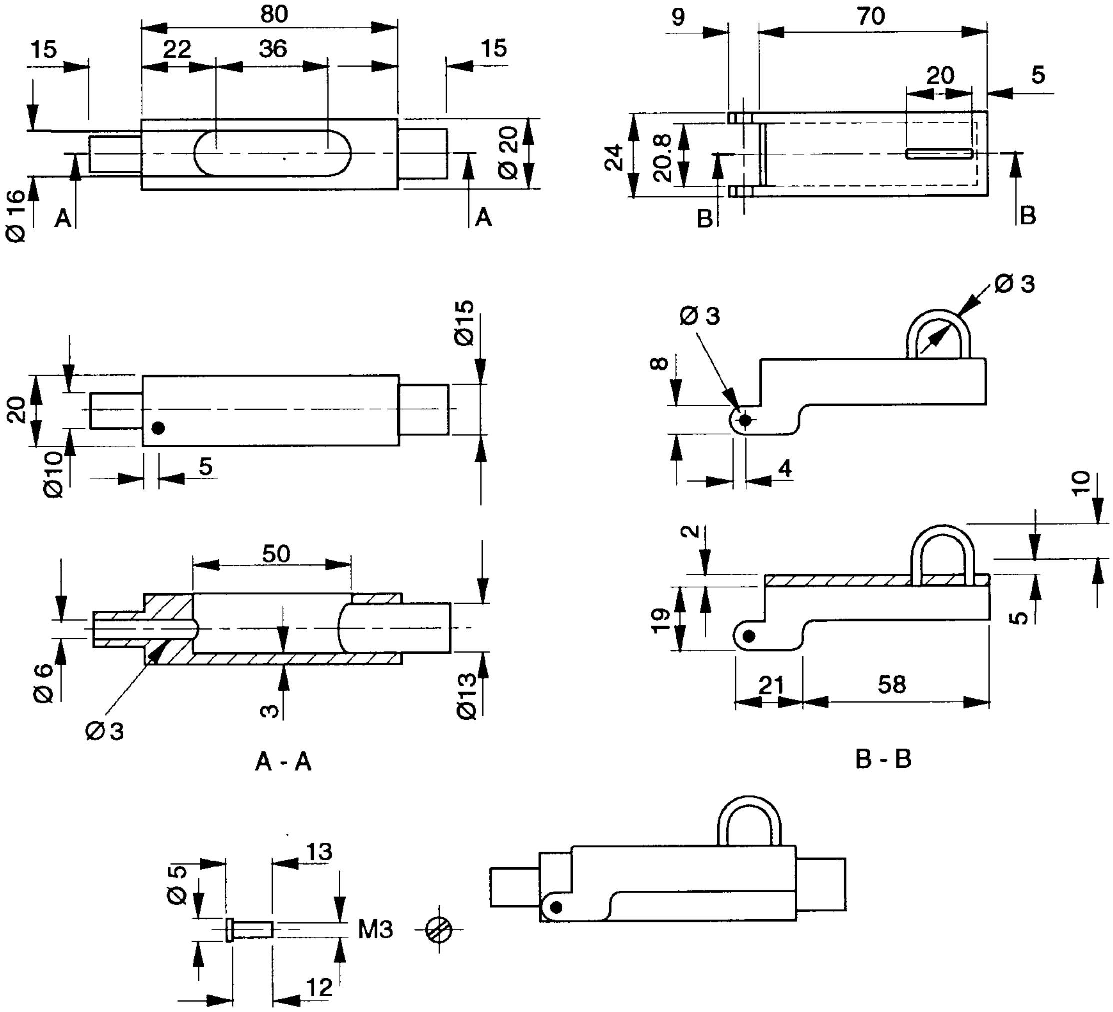
Groove to take heating element of Kanthal "A" wire 20 SWG, total resistance 13 Ω

Figure B.2 — Silica tube (method B)

Dimensions in millimetres



4 Glass adaptor



30 Stainless steel dust holder

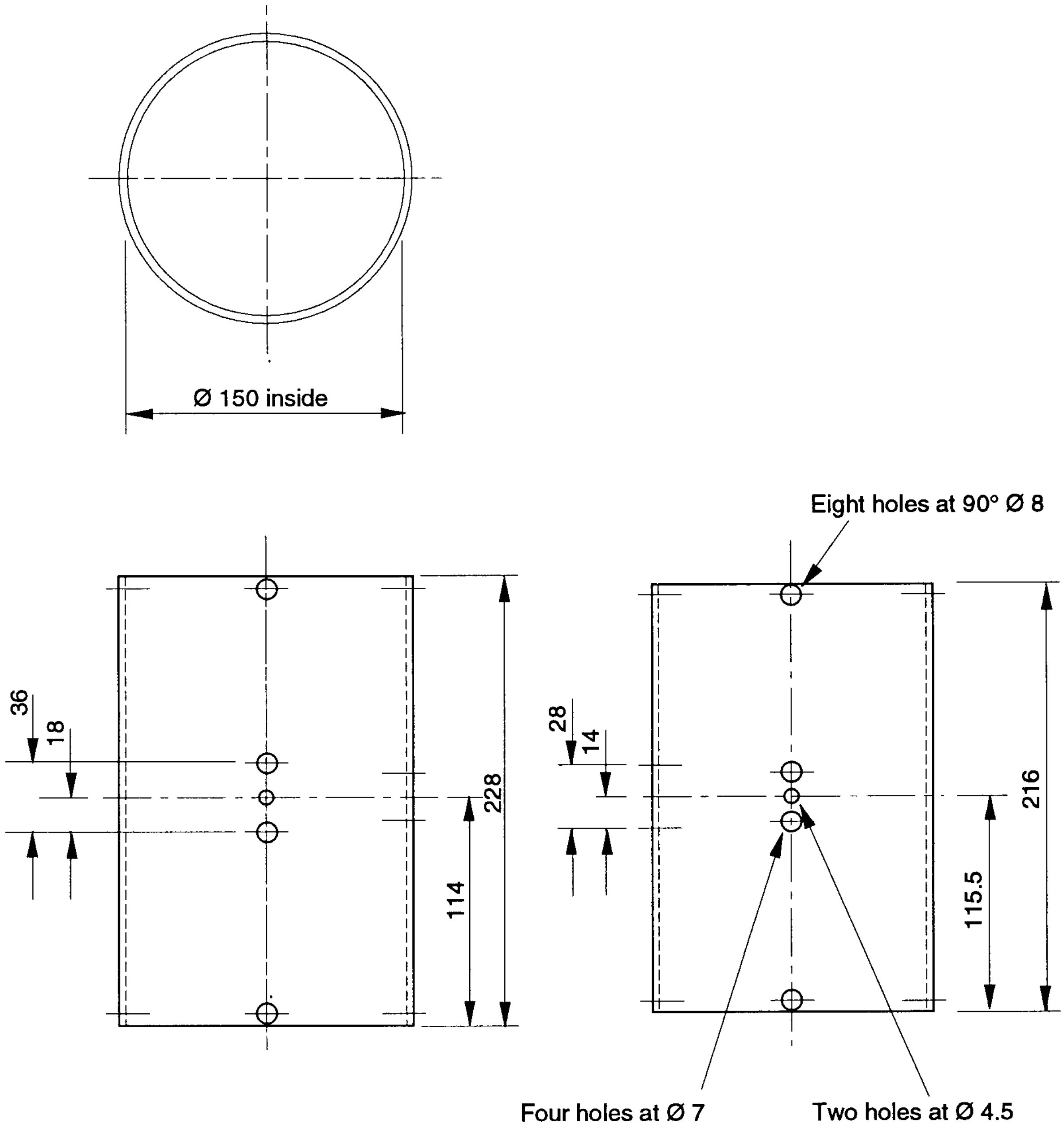
For details of numbered items, refer to Table B.1

NOTE — Cover to be a close fit to body

— Hinge pins to be press-fit

Figure B.3 — Glass adaptor and dust holder (method B)

Dimensions in millimetres

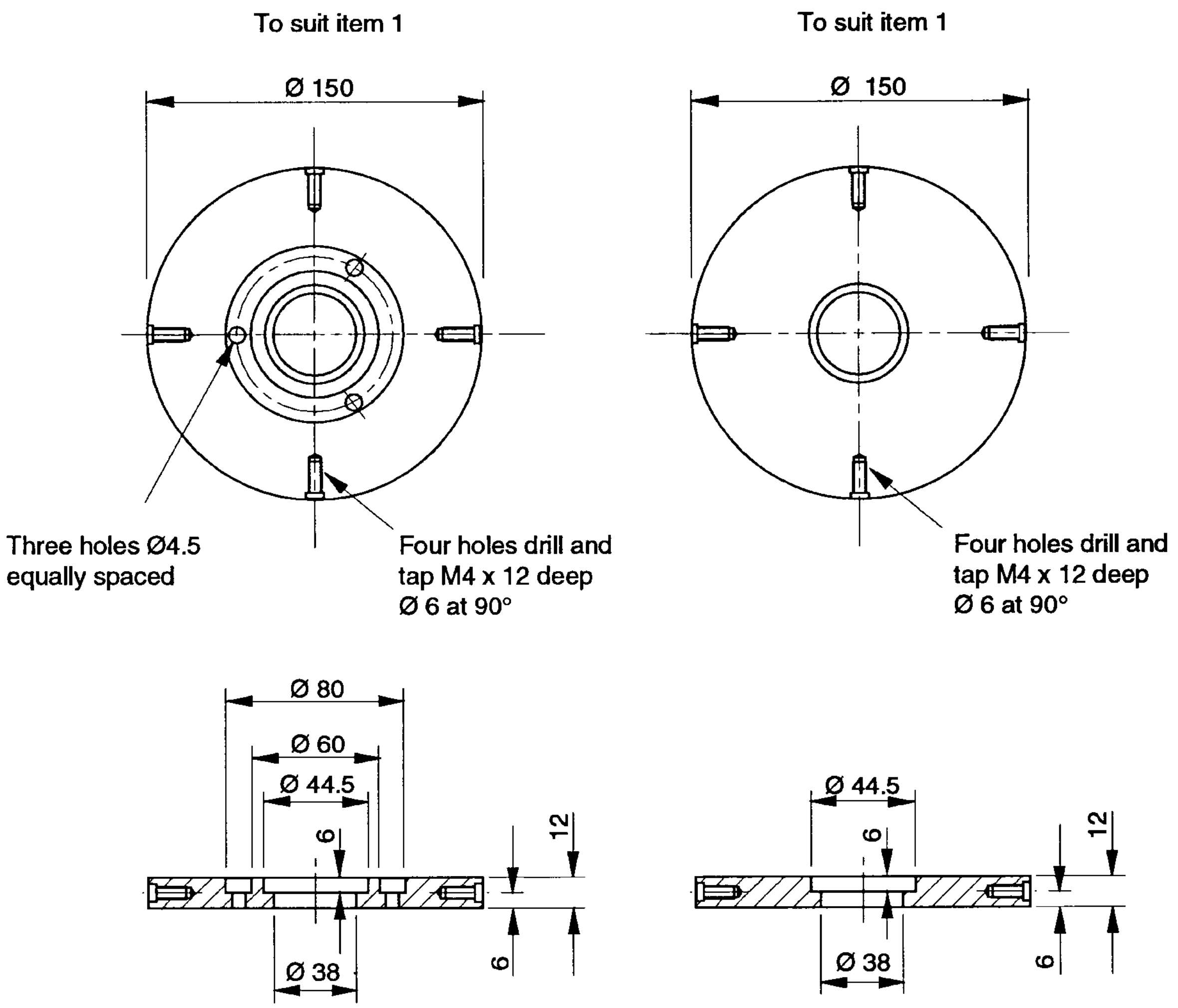


1 Furnace housing 20 SWG stainless steel seamless (method B)

For details of numbered items, refer to Table B.1

Figure B.4 — Furnace housing 20 SWG stainless steel seamless (method B)

Dimensions in millimetres



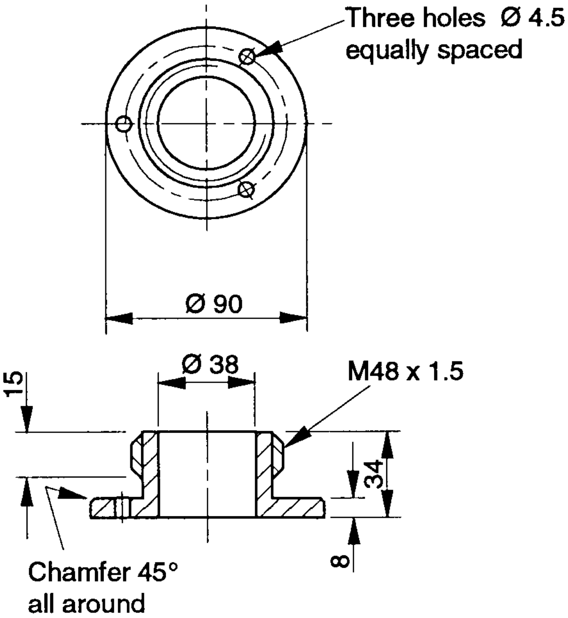
2 Top cover of mineral fibre, 1 piece

3 Bottom cover of mineral fibre, 1 piece

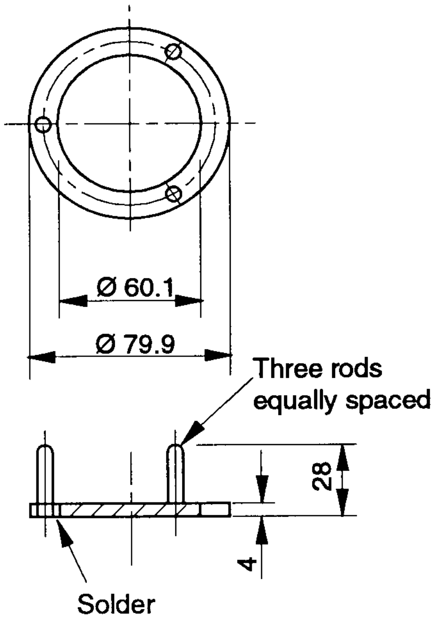
For details of numbered items, refer to Table B.1

Figure B.5 – Top and bottom covers (method B)

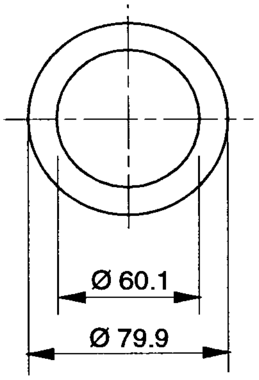
Dimensions in millimetres



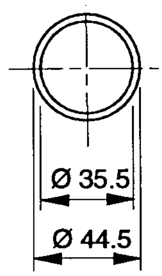
6 Stainless steel collar, 1 piece



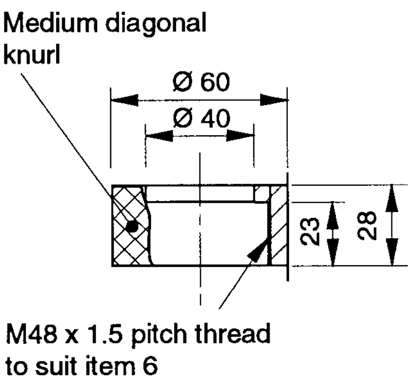
16 Stainless steel support ring, 1 piece



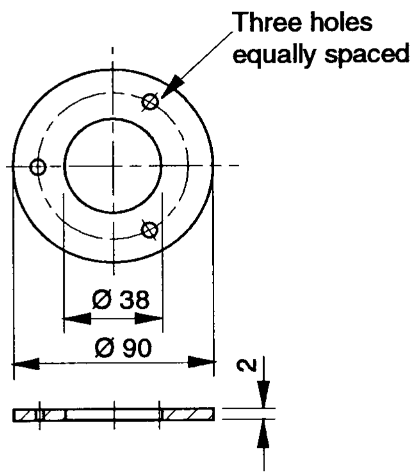
13 Mineral fibre washer 2 mm thick, 1 piece



12 Mineral fibre washer 2 mm thick, 1 piece



29 Stainless steel securing ring, 1 piece

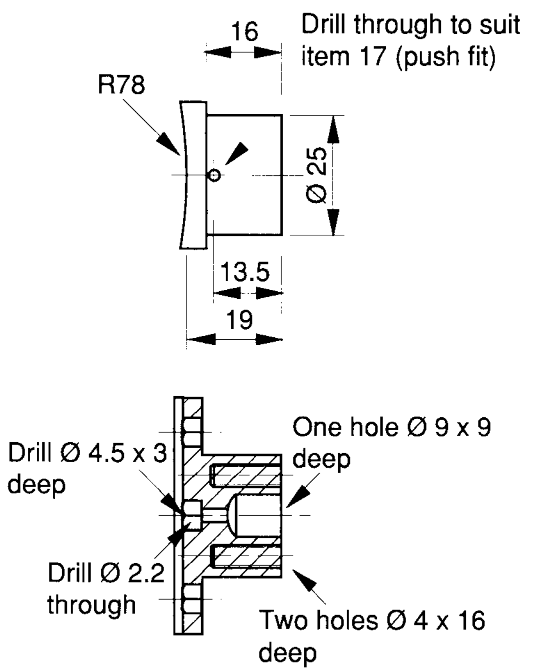


7 Mineral fibre washer, 1 piece

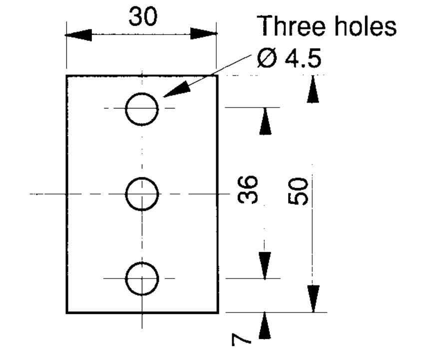
For details of numbered items, refer to Table B.1

Figure B.6

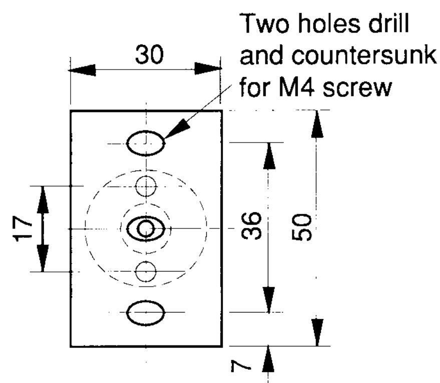
Dimensions in millimetres

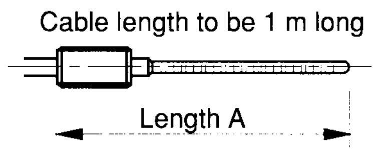


9 Stainless steel thermocouple mounting, 1 piece



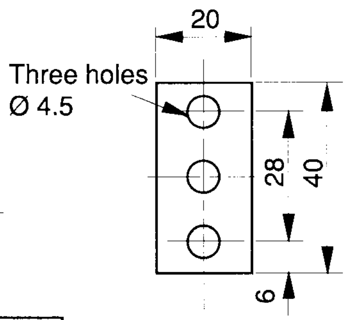
15 Mineral fibre washer 2 mm thick, 1 piece



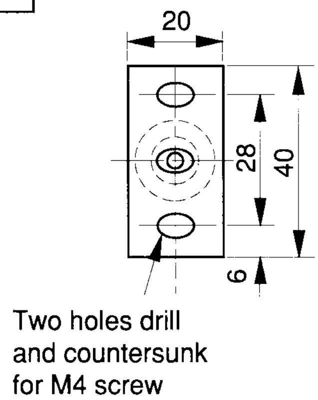


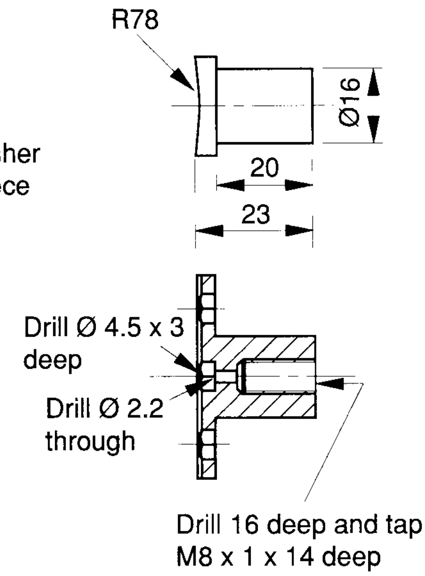
Element	Length A	No. off
20	90	1
21	124	1

20 and 21 Thermocouple



14 Mineral fibre washer 2 mm thick, 1 piece



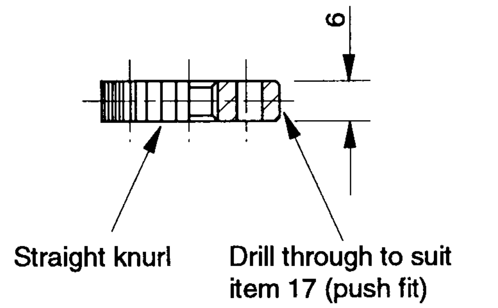


8 Stainless steel thermocouple mounting, 1 piece

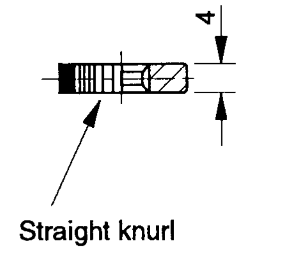
For details of numbered items, refer to Table B.1

Figure B.7

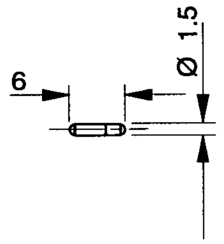
Dimensions in millimetres



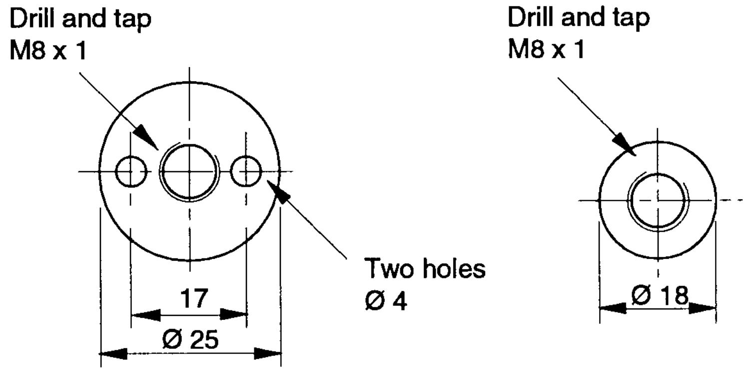
10 Knob — stainless steel, 1 piece



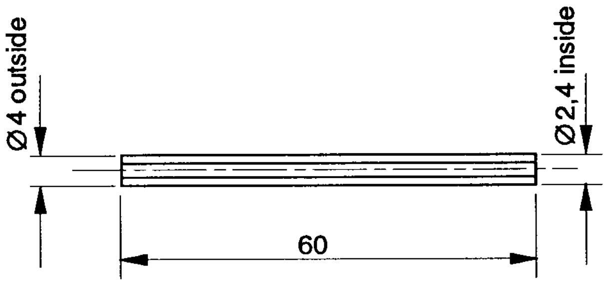
11 Knob — stainless steel, 1 piece



17 Pin — Silver steel, 4 pieces



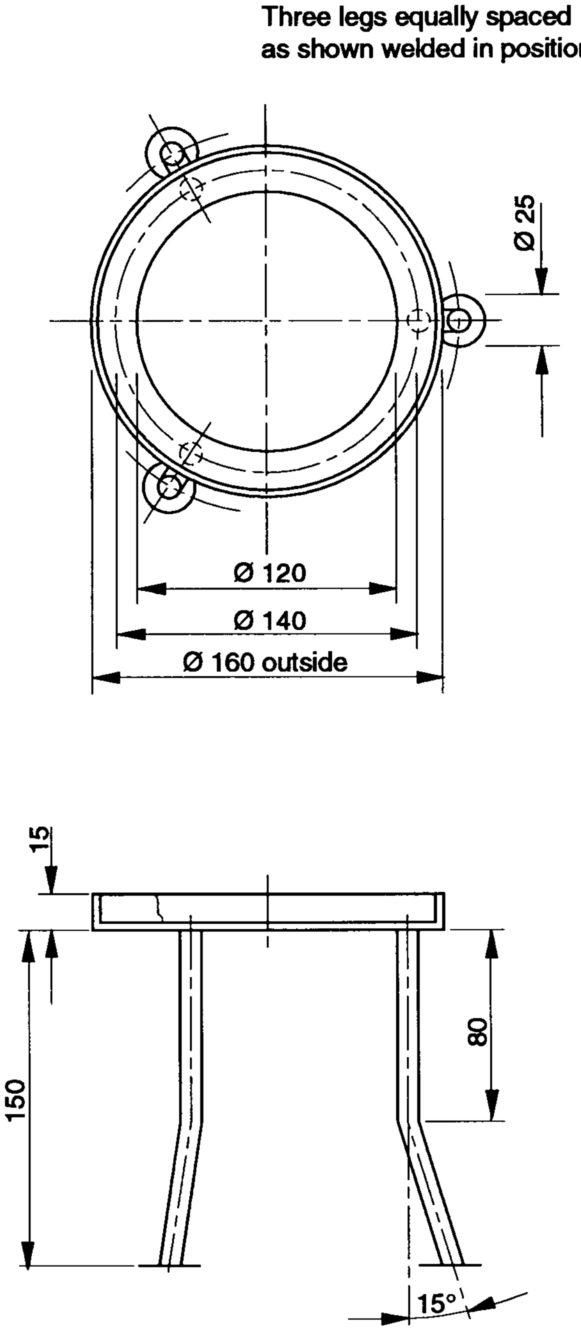
18 Sleeve — alumina, 2 pieces



For details of numbered items, refer to Table B.1

Figure B.8

Dimensions in millimetres



28 Upper circular section stainless steel 16 SWG,
legs ∅ 10 outside stainless steel tube,
feet ∅ 25 stainless steel 16 SWG welded on to legs

For details of numbered items, refer to Table B.1

Figure B.9 — Furnace stand base (method B)

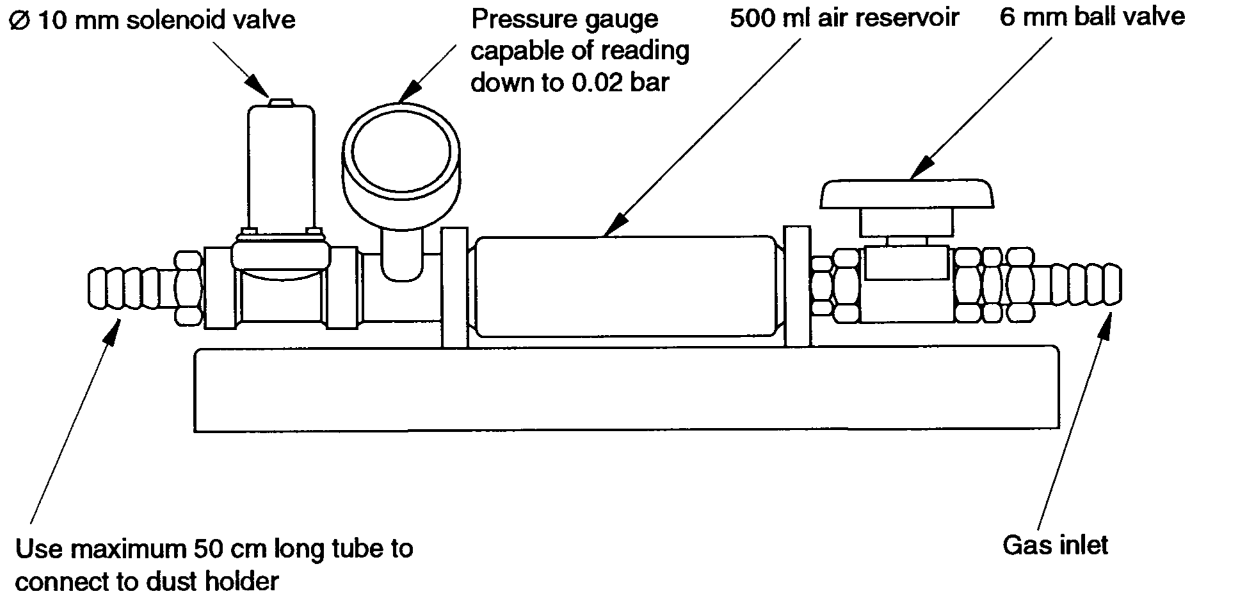


Figure B.10 — Dust dispersion system (method B)

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