BRITISH STANDARD

BS EN
1363-2:1999

Fire resistance tests —

Part 2: Alternative and additional procedures

The European Standard EN 1363-2:1999 has the status of a British Standard

ICS 13.220.50

National foreword

This British Standard is the English language version of EN 1363-2:1999.

The UK participation in its preparation was entrusted by Technical Committee FSH/22, Fire resistance tests, to Subcommittee FSH/22/1, General aspects of fire resistance testing, 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 subcommittee can be obtained on request to its secretary.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 16, an inside back cover and a back cover.

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English version

Fire resistance tests – Part 2: Alternative and additional procedures

Essais de résistance au feu – Partie 2: Modes opératoires de substitution ou additionnels

Feuerwiderstandsprüfungen – Teil 2: Alternative und ergänzende Verfahren

This European Standard was approved by CEN on 18 February 1999.

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Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 127 "Fire safety in buildings", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2001, and conflicting national standards shall be withdrawn at the latest by March 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the Construction Products Directive.

EN 1363 ‘Fire resistance tests’ consists of the following

Part 1: General requirements

Part 2: Alternative and additional procedures

Part 3: Verification of furnace performance (published as an ENV)

Introduction

The general requirements for fire resistance testing are given in EN 1363-1. However, in practice it is possible to identify conditions or scenarios where the standard conditions, given in EN 1363-1, are inappropriate or where additional factors need to be considered. This may be because of the nature of a product, construction or assembly, together with its intended use; or because of a regulatory requirement in a particular member state.

This Part of EN 1363 addresses those additional, supplementary or alternative procedures that may need to be employed.

Three areas are addressed in this document, alternative heating regimes, an impact test and the measurement of radiation from the unexposed face of separating elements.

Caution

The attention of all persons concerned with managing and carrying out alternative and additional procedures in conjunction with the fire resistance test, EN 1363-1 and EN 1363-2 is drawn to the fact that fire testing may be hazardous and that there is a possibility that toxic and/or harmful smoke and gases may be evolved during the test. Mechanical and operational hazards may also arise during the construction of the test elements or structures, their testing and disposal of test residues.

An assessment of all potential hazards and risks to health shall be made and safety precautions shall be identified and provided. Written safety instructions shall be issued. Appropriate training shall be given to relevant personnel. Laboratory personnel shall ensure that they follow written safety instructions at all times.

1 Scope

This part of EN 1363 specifies alternative heating conditions and other procedures that may need to be adopted under special circumstances. This standard shall be read in conjunction with EN 1363-1.

Details of the alternative hydrocarbon, slow heating and external fire exposure heating curves and the additional impact test and measurement of radiation procedures are included within this standard. Within the appropriate clause for each procedure is given an explanation as to why it may be necessary.

Unless one of the alternative heating regimes is specifically required, the standard temperature-time curve given in EN 1363-1 shall be used. Similarly, the impact test and measurement of radiation shall only be undertaken when they are specifically requested.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1363-1	Fire resistance tests Part 1 General requirements
EN 1364-1	Fire resistance tests for non loadbearing elements Part 1 Walls
EN 1365-1	Fire resistance tests for loadbearing elements Part 1 Walls
prEN ISO 13943	Fire safety - Vocabulary (ISO/DIS 13943:1998)

3 Definitions

For the purposes of this part of EN1363, the definitions given in EN 1363-1 and prEN ISO 13943, together with the following, apply.

3.1 heat flux: The quantity of heat energy per unit area incident on the target of the measuring device. It includes heat transferred by convection as well as that due to radiation.

4 Hydrocarbon curve

4.1 General

EN 1363-1 defines the heating conditions, in terms of a specified temperature-time relationship, for the determination of fire resistance.

It is recognized that, whilst the heating conditions specified are related to those occurring in real fires, it is not the intent to define an 'average' fire for universal application. In some practical cases it is possible to identify scenarios where significant variation from the standard conditions could exist.

One such example is in the petrochemical and offshore oil industries where there is a threat of exposure to very intense fires such as liquid pool fires. Such fires are characterized by higher temperatures and a rapid rate of growth.

Where there is an identified requirement for such a fire exposure, the following hydrocarbon curve shall be used.

4.2 Expression of temperature-time curve

A temperature-time curve to be designated as the hydrocarbon curve shall be defined by the following expression

$$T = 1080\ [1 - 0{,}325\ e^{-0{,}167t} - 0.675\ e^{-2.5t}] + 20$$

where t is the time from start of test in minutes;
T is the average required furnace temperature in ^{o}C

See figure 1.

4.3 Tolerances

The percentage deviation (d_e) in the area of the curve of the average temperature recorded by the specified furnace thermocouples versus time from the area of the specified temperature-time curve shall be within

a) 15% for $5 < t \leq 10$

b) $(15 - 0{,}5\ (t-10))\%$ for $10 < t \leq 30$

c) $(5 - 0{,}083\ (t-30))\%$ for $30 < t \leq 60$

d) 2.5% for $t > 60$

where

$$d_e = \frac{A - A_s}{A_s} \times 100$$

d_e is the percentage deviation

A is the area under the actual furnace temperature-time curve

A_s is the area under the specified temperature-time curve

t is the time in minutes

All areas shall be computed by the same method, i.e. by the summation of areas at intervals not exceeding one minute and shall be calculated from time zero.

At any time after the first 10 min of test, the temperature recorded by any thermocouple in the furnace shall not differ from the corresponding temperature of the specified temperature-time curve by more than 100 °C.

For test specimens which burn rapidly, a deviation in excess of 100 °C above the specified temperature/time curve may be exceeded for a period not in excess of 10 min provided that such excess deviation is clearly identified as being associated with the sudden ignition of significant quantities of combustible materials increasing the gas temperature in the furnace.

5 External fire exposure curve

5.1 General

EN 1363-1 defines the heating conditions, in terms of a specified temperature-time relationship, for the determination of fire resistance.

In some cases elements may be exposed to conditions which are less severe than when the element or structure is exposed to a compartment fire. Examples of this are walls at the perimeter of a building which may be exposed to an external fire or flames coming out of windows. There is also a need to ensure that the nature of fire protection is such that the re-entry of the fire into the building is prevented. Because of the nature of external fire with the additional possibilities for heat dissipation, a lower level of heat exposure is given.

This exposure condition is only relevant to the assessment of the fire resistance of separating elements. Other evaluation techniques exist for the evaluation of beams and columns and for measuring external fire spread.

Where there is an identified requirement for such a fire exposure, the following external fire exposure curve shall be used.

5.2 Expression of temperature-time curve

A temperature-time curve to be designated as the external fire exposure curve shall be defined by the following expression.

$$T = 660\ [1 - 0{,}687\ e^{-0{,}32t} - 0{,}313\ e^{-3{,}8t}]\ +\ 20$$

where t is the time from start of test, in minutes;
T is the average required furnace temperature in °C

See figure 1.

5.3 Tolerances

The percentage deviation, d_e, in the area of the curve of the average temperature recorded by the specified furnace thermocouples versus time from the area of the specified temperature-time curve shall be within

a) 15% for $5 < t \leq 10$

b) (15 - 0,5 (t-10))% for $10 < t \leq 30$

c) (5 - 0,083 (t-30))% for $30 < t \leq 60$

d) 2,5% for $t > 60$

where

$$d_e = \frac{A - A_s}{A_s} \times 100$$

d_e is the percentage deviation

A is the area under the actual furnace temperature-time curve

A_s is the area under the specified temperature-time curve

t is the time in minutes

All areas shall be computed by the same method, i.e by the summation of areas at intervals not exceeding one min and shall be calculated from time zero.

At any time after the first 10 min of test, the temperature recorded by any thermocouple in the furnace shall not differ from the corresponding temperature of the specified temperature-time curve by more than 100 °C.

For test specimens which burn rapidly, a deviation in excess of 100 °C above the specified temperature/time curve may be exceeded for a period not in excess of 10 min provided that such excess deviation is clearly identified as being associated with the sudden ignition of significant quantities of combustible materials increasing the gas temperature in the furnace.

6 Slow heating curve

6.1 General

EN 1363-1 defines the heating conditions, in terms of a specified temperature-time relationship, for the determination of fire resistance.

The fire resistance of some products determined using the standard temperature-time curve, as specified in EN 1363-1, may be substantially reduced in a slowly growing fire. Examples are products which are reactive under the influence of heat. For this reason a slow growing temperature-time curve is proposed.

Where there is an identified requirement for such a fire exposure, the following slow heating curve shall be used.

6.2 Expression of temperature-time curve

A temperature-time curve to be designated as the slow heating curve shall be defined by the following expression:

for $0 < t \leq 21$

$T = 154t^{0,25} + 20$

for $t > 21$

$T = 345 \log_{10} (8 (t - 20) + 1) + 20$

where t is the time from start of test, in minutes;
T is the average required furnace temperature in °C

See figure 1.

6.3 Tolerances

The percentage deviation, d_e, in the area of the curve of the average temperature recorded by the specified furnace thermocouples versus time from the area of the specified temperature-time curve shall be within

a)	15%	for	$5 < t \leq 10$
b)	(15 - 0,5 (t-10))%	for	$10 < t \leq 30$
c)	(5 - 0,083 (t-30))%	for	$30 < t \leq 60$
d)	2,5%	for	$t > 60$

where

$$d_e = \frac{A - A_s}{A_s} \times 100$$

d_e is the percentage deviation

A is the area under the actual furnace temperature-time curve

A_s is the area under the specified temperature-time curve

t is the time in minutes

All areas shall be computed by the same method, i.e. by the summation of areas at intervals not exceeding 1 min and shall be calculated from time zero.

At any time after the first 10 min of test, the temperature recorded by any thermocouple in the furnace shall not differ from the corresponding temperature of the specified temperature-time curve by more than 100 °C.

For test specimens which burn rapidly, a deviation in excess of 100 °C above the specified temperature/time curve, as specified in EN 1363-1, may be exceeded for a period not in excess of 10 min provided that such excess deviation is clearly identified as being associated with the sudden ignition of significant quantities of combustible materials increasing the gas temperature in the furnace.

6.4 Assessment of performance

Performance shall be assessed by comparing the behaviour of samples tested using the slow heating curve with that obtained using the standard temperature-time curve, as specified in EN 1363-1. The samples shall be identical for each exposure condition, but they need not necessarily be the element to be classified. The samples are defined in the appropriate test method.

6.5 Criteria

The periods for compliance with the classification criteria, when evaluated using the slow heating curve, shall be equivalent to those achieved with the standard temperature/time curve, as specified in EN 1363-1, plus 20 minutes. If the times during which the criteria are satisfied are not equivalent, then the element shall be classified for the shorter duration as specified above.

7 Impact test

7.1 General

The fire resistance of specific classes of walls with a fire separating function can be influenced by impacts arising from the failure of other components or objects exposed to fire. A method is described to define a reference impact procedure which, if required, can be applied to loadbearing or non-loadbearing fire resisting walls.

7.2 Apparatus

In addition to the test equipment specified in EN 1363-1, and if applicable EN 1364-1 and EN 1365-1, the following is required:

The impact device shall be suspended from a rigid support or frame constructed so as not to interfere with deformations of the test specimen under fire test conditions.

The impact energy is obtained by the pendular fall of a spheroconical bag (figure 2) filled with lead shot.

The impact body consists of a double sheet sack which has the dimensions 650 mm × 1200 mm when empty. It is filled with bags each containing 10 kg of lead shot of diameter 2 mm to 3 mm and closed by a steel band.

The filled sack is surrounded by a steel wire net with a basic area of 1200 mm × 1200 mm, mesh 50 mm × 50 mm, diameter of steel wire 5 mm. The total mass of the impact body is 200 kg.

The impact body is suspended by its ring to a steel cable attached to a fixed point on the test apparatus (see figure 2) and arranged so that when in the resting position it is just touching the building element at the predicted point of impact with a length of the pendulum from the fixing point to the centre of the bag of (2750 ± 50) mm. The predicted point of impact shall be the centre of the largest panel near to the centre of the test specimen.

7.3 Application of impact

The impact body is brought to its starting position by raising it pendularly by a suitable lifting device. For this purpose a steel band consisting of two wires of 6 mm diameter shall be wrapped tightly around the centre of the sack and equipped with a ring for the fixing of the lifting device.

The drop height 1.5 m is the difference in the level of a clearly marked horizontal line around the middle of the bag (see figure 3) determined with a tolerance of ± 50 mm. This represents an impact energy of 3000 Nm.

7.4 Procedure

Three impacts shall be applied to the test specimen within five minutes after the end of the classification period. For loadbearing walls the first two impacts shall be applied while the specimen is still loaded. The third impact shall be applied after removal of the test load.

In each case, observations and measurements with regard to the performance criteria shall be made within 2 min after the third impact, the heating being continued until the observations are completed.

7.5 Test report

The report shall state that the test has been carried out in accordance with EN 1363-2. It shall contain information on the result of impact testing including a description of the points of impact and the resulting measurements and observations with respect to damage and deformation.

8 Measurement of radiation

8.1 General

This clause describes a method of measuring radiation in a fire resistance test following EN 1363-1. The hazard presented by radiation is evaluated in the test by measuring total heat flux. However, as the convected heat transfer is neglible the measurement is reported as radiation in this Standard. It considers the measurement of radiation in a plane parallel to and at a distance of 1,0 m from the unexposed face of the test specimen. It includes the concept of both an average value, measured opposite the centre of the specimen, and the maximum value, which will be greater than or equal to the average value if the specimen is not a uniform radiator.

Guidance is provided on the determination of the maximum value.

There is no requirement to measure the radiation from a surface with a temperature below 300°C because the radiation emitted from such a surface is low (typically 6 kW/m² - even with an emissivity of 1,0).

8.2 Apparatus

In addition to the test equipment specified in EN 1363-1, heat flux meters complying with the following specification are required:

Target	:	The target of the instrument shall not be shielded by a window or subject to a gas purge i.e. it shall be subject to convection as well as radiation.
Suggested range:	:	0 to 50 kW/m²
Accuracy	:	± 5% of maximum in range
Time constant (time to reach 64% of target value)	:	< 10 s
View angle	:	180 ± 5º

8.3 Procedure

8.3.1 Positioning

8.3.1.1 General

Each heat flux meter shall be positioned 1,0 m from the unexposed surface of the test specimen.

At the start of the test the target of each heat flux meter shall be parallel (± 5 degrees) to the plane of the unexposed surface of the test specimen. The target shall be pointing towards the unexposed surface of the test specimen.

There shall be no significant radiating surfaces other than the specimen within the field of view. The flux meter shall not be shielded or masked so that the field of view is restricted.

8.3.1.2 Specific locations

Measurements shall be taken at the following locations:

a) Opposite the geometric centre of the specimen, this is referred to as the average radiation level.

b) At the point at which the maximum heat flux can be expected. Often this follows logically or can be calculated from the geometry of the specimen. If the specimen is symmetrical about its centre and a uniform radiator this will coincide with position a).

   If the specimen has areas of differing insulation and/or transmission then it may be difficult to predict the point of maximum intensity with any degree or certainty. In these cases the following procedure shall be used:

   i) Identify all areas where it is anticipated that the temperature will exceed 300°C and that also have an area in excess of 0,1 m². Measure the radiation opposite the notional centre of each such area.

   ii) Two or more identical adjacent parts of the specimen having the same height or width, separated by less than 0,1 m, may be treated jointly together as single radiation surface.

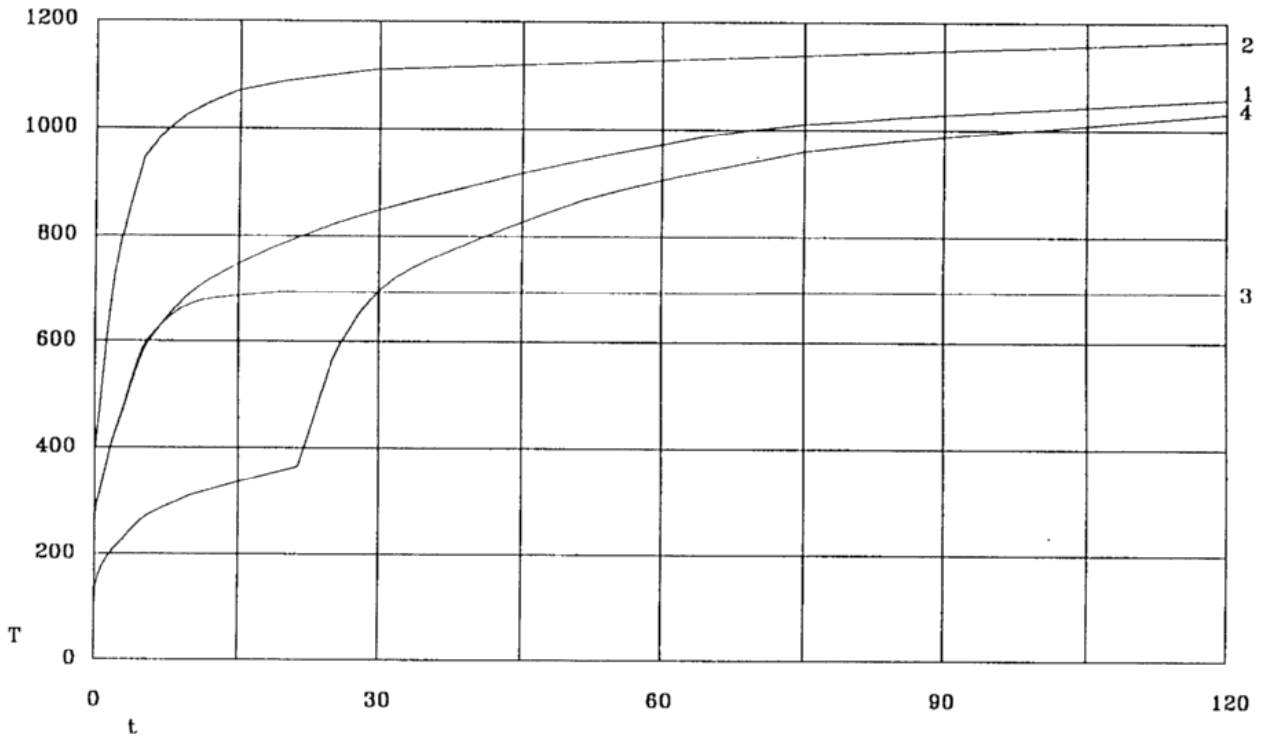
   iii) If the area, or sub areas, of the specimen that is expected to remain below 300°C is less than 10% of the total areas, or sub-area, under consideration, then that area, or sub-area, can be treated as a single radiating surface. This allows for breaks such as glazing bars.

8.3.2 Measurement

Measurements taken at each of the locations described in 8.3.1 shall be recorded throughout the test at intervals not exceeding one minute.

8.4 Test report

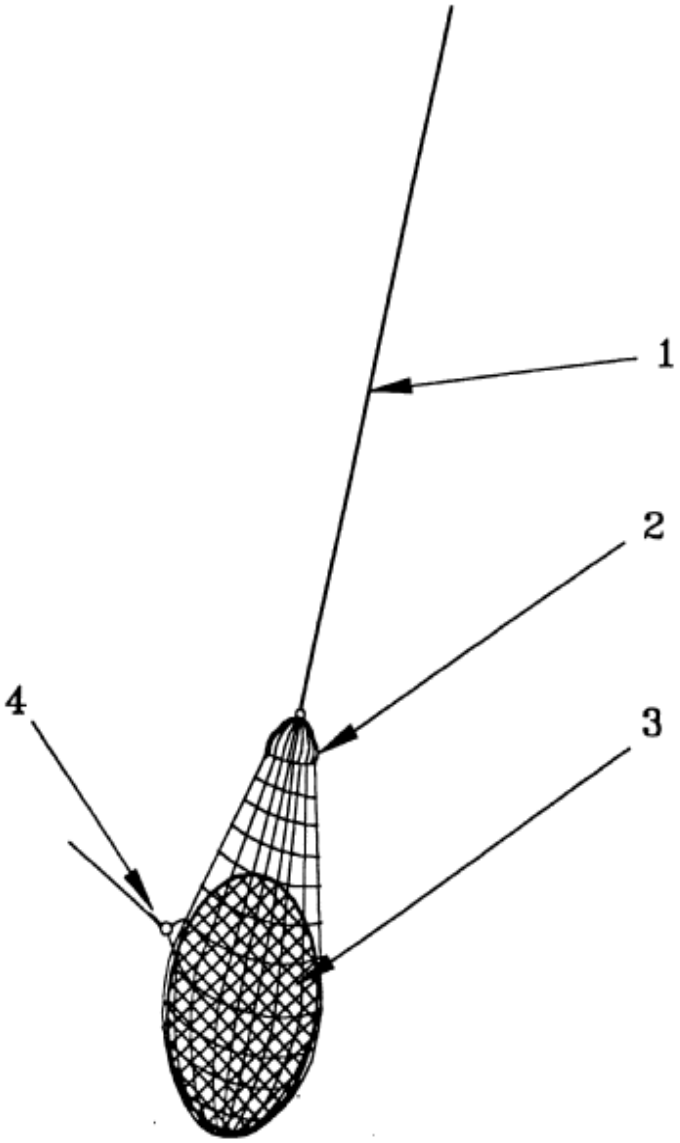
At each specific measurement location, the time for the measured radiation to exceed the value of 5, 10, 15, 20 and 25 kW/m² shall be reported. A clear statement should be made as to whether this is on the basis of average or maximum levels.



T temperature °C
t time minutes

1 standard
2 hydrocarbon
3 external
4 slow heating

Figure 1 Temperature/ time curves

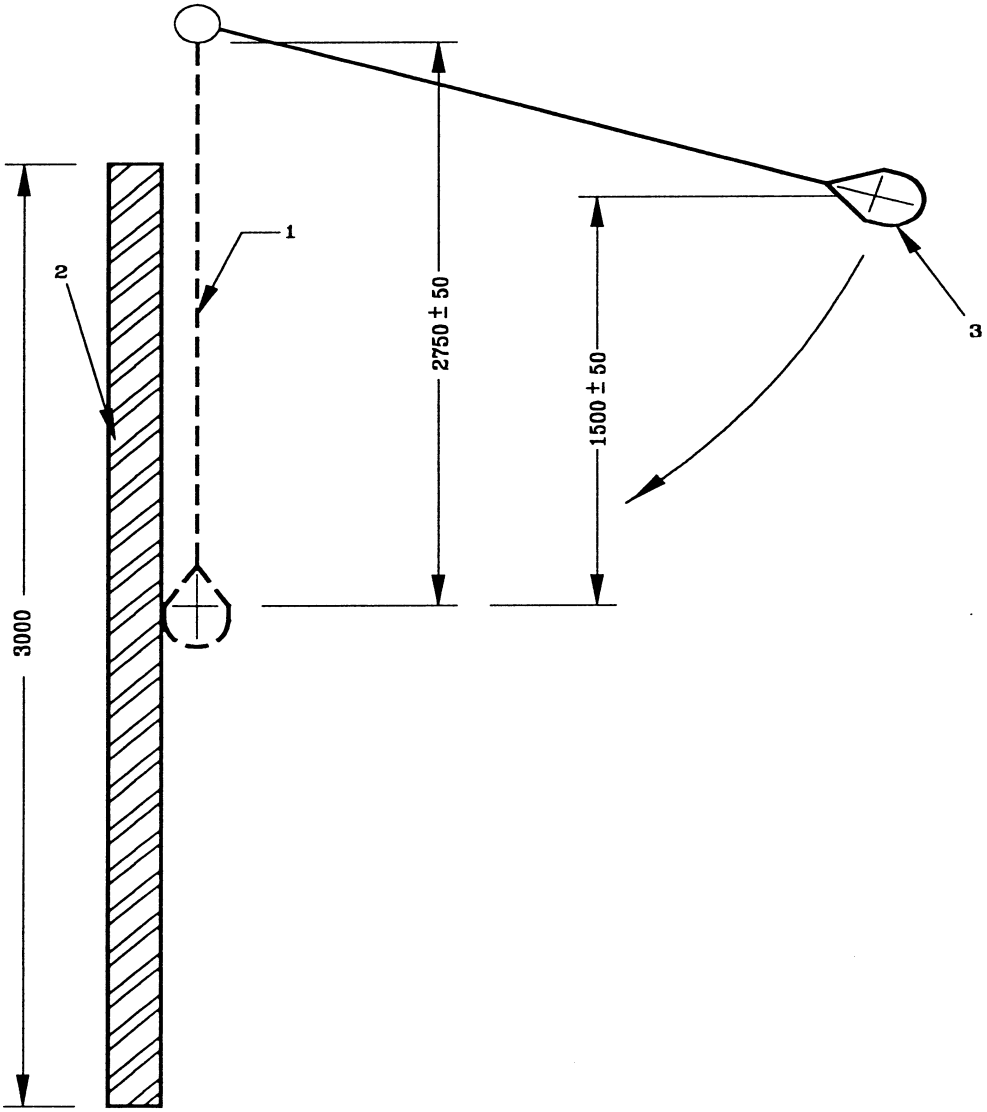


1 steel cable ∅ 10
2 steel cable ∅ 5
3 sack filled with lead shot
4 steel cable ∅ 6

weight 200 kg

Dimensions in mm

Figure 2 Impact body



1 steel wire ∅ 10
2 specimen
3 impact body (see figure 2)

Dimensions in mm

Figure 3 Test apparatus, impact resistance test

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