ISTITUTO GIORDANO s.p.a.

CENTRO POLITECNICO DI RICERCHE E CERTIFICAZIONI

Via Rossini, 2
47814 BELLARIA (RN) Italy
Tel. ++39/0541 343030 (10 linee)
Telefax ++39/0541 345540

e-mail: istitutogiordano@giordano.it
web site: www.giordano.it

Cod. Fisc./Part. IVA: 00 549 540 409
R.E.A. c/o C.C.I.A.A. (RN) 156766
Registro Imprese Rimini n. 00549540409
Cap. Soc. € 516.000,00 i.v.

TEST REPORT N. 180125/2599RF

Place and date of emission: Bellaria, 12/03/2004

Commissioner: BROFER S.r.l. – Via Pio X – Località Fratte – 35010 SANTA GIUSTINA IN COLLE (PD)

Date of test: 27/01/2004

Subject of the test: Determine the fire damper according to the circular n. 91 of the Minister of the Interior – General Management of Fire-prevention Services dated 14/09/1961.

Test site: Giordano Institute S.p.A. – Blocco 3 – Via Verga, 19 _ 47030 Gatteo (FO)

Sample origin: provided by the Commissioner.

Generalities.

At the experimental oven of the Fire Damper laboratory in this Institute a test was carried out according to the prescriptions of Circular n. 91 of the Minister of the Interior – General management of Fire-prevention Services dated 14/09/1961, on n. 3 fire barrier gates called "MTF/30", "BTS/30" and "BTT/30", not subjected to loading, produced and presented by Brofer S.r.l. – Via Pio X, 9 – Località Fratte – 35010 Santa Giustina in Colle (PD).

IRIDE SERVIZI Aggiornamento documentale

N. 3359

ISTITUTO GIORDANO - RICERCHE DI FISICA * BELLARIA - ITALY * LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE

Test purpose.

The purpose of the test is to verify the time the sample being examined conserves the stability "R", the seal "E" and the thermic insulation "I" defined by Minister's Decree 30/11/1983 paragraph 1.11.

Description of the sample*.

The sample subjected to testing consists of n. 3 fire barrier gates called MTF/30", "BTS/30" and "BTT/30", made up of a tunnel, which a foil shutter on a horizontal axis rotates around, moved by a control mechanism and with the dimensions reported in the following table.

Fire barrier gate	Shape of the section	Internal nominal dimension* (mm)	Nominal depth
MTF/30	Square	400 x 400	300
BTS/30	Square	500 x 500	300
BTT/30	Square	400	300

(*) section for the fire barrier gate is squared and the diameter for the fire barrier gate is circular.

Fire barrier gate "MTF/30".

The fire barrier gate "MTF/30" consists of:

- a tunnel made by a square section hull in galvanized steel sheet, 1.5 mm thick, folded frontally at both ends in such a way as to form flanges that are 40-mm long each;
- Ledge for the shutter in a closed position made of a plaster of Paris listel, 40 x 15 mm in cross section and 850 kg/m3 in density, fastened to the upper horizontal wall inside the tunnel by means of n. 2 steel rivets;

ISTITUTO GIORDANO - RICERCHE DI FISICA * BELLARIA - ITALY * LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE

(*) According to customer's declarations and controls of this Istitute.

- Foil shutter, total thickness 30 mm, formed by n. 3 fibrosilicate cementite-based plates, each one 9.5 mm thick and 1100 kg/m3 dense, glued together and covered with a ceramic bonding agent for a total thickness of 1.5 mm for the various layers and assembled by means of n. 2 containment profiles in galvanized steel shaped like a " L ", 280 mm long, overall section is 33 x 30 mm and 1.5 mm thick, fastened together by means of a couple of steel screws; the shutter moves by means of n. 2 steel rotational pins, fastened to the containment profiles described above, and they rotate inside the proper brass ferrules fastened by pressure to the vertical walls of the tunnel;
- Graphite-based thermoexpanding gasket, 30 x 3.5 mm cross section, placed inside the tunnel opposite the perimeter edge of the shutter when the shutter is in a closed position;
- Control device consisting of:
    - o steel return spring, placed outside the tunnel and attached to one of the rotational pins described above;
    - o steel lever for manual recocking, placed outside the tunnel and attached directly to the same rotational pin the return spring is attached to;
    - o galvanized steel blocking device;
    - o recockable circuit breaker starting from a thermic fuse in alloy located inside the tunnel;
    - o covering carter in galvanized steel plate;

  when the thermic fuse melts the circuit breaker is freed which enables the release of the lever and the action of the spring and the closing of the shutter; the fire barrier gate is recocked manually by means of the lever.

Fire barrier gate "BTS/30".

The fire barrier gate "BTS/30" consists of:

- a tunnel made by a square section hull in fibrosilicate plate, with a base of silicates, cement and additives, 20 mm thick and 850 kg/m3 dense, fastened together by means of screwed-on galvanized steel angular profiles, 30 x 30 mm cross section and 1.5 mm thick, covered in galvanized steel sheet on the outside, 1.5 mm thick, and provided with connecting flanges at the ends in galvanized steel sheet, 40 mm wide and 1.5 mm thick;

- Ledge for the shutter in a closed position made of fibrosilicate cement-based listel, 40 x 15 mm in cross section and 1100kg/m3 in density, fastened to the upper horizontal wall inside the tunnel by means of n. 4 steel clips;
- Foil shutter, total thickness 30 mm, formed by n. 3 fibrosilicate cementite-based plates, each one 9.5 mm thick and 1100 kg/m3 dense, glued together and covered with a ceramic bonding agent for a total thickness of 1.5 mm for the various layers and assembled by means of n. 2 containment profiles in galvanized steel shaped like a " ⊏ ", 400 mm long, overall section is 33 x 30 mm and 1.5 mm thick, fastened together by means of a couple of steel screws; the shutter moves by means of n. 2 steel rotational pins, fastened to the containment profiles described above, and they rotate inside the proper brass ferrules fastened by pressure to the vertical walls of the tunnel;
- Graphite-based thermoexpanding gasket, 30 x 3.5 mm cross section, placed inside the tunnel opposite the perimeter edge of the shutter when the shutter is in a closed position;
- Control device consisting of:
    - steel return spring, placed outside the tunnel and attached to one of the rotational pins described above;
    - steel lever for manual recocking, placed outside the tunnel and attached directly to the same rotational pin the return spring is attached to;
    - galvanized steel blocking device;
    - recockable circuit breaker starting from a thermic fuse in alloy located inside the tunnel;
    - covering carter in galvanized steel plate;

when the thermic fuse melts the circuit breaker is freed which enables the release of the lever and the action of the spring and the closing of the shutter; the fire barrier gate is recocked manually by means of the lever.

ISTITUTO GIORDANO - RICERCHE DI FISICA * BELLARIA - ITALY * LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE

Fire barrier gate "BTT/30".

The fire barrier gate "BTT/30" consists of:

- a tunnel made by a circular section hull in galvanized steel sheet, 1.5 mm thick;
- n. 2 ledges for the shutter in a closed position made of galvanized steel angular profiles, 40 x 15 mm in cross section and 1.5 mm thick, welded to the internal tunnel wall;
- Foil shutter, total thickness 30 mm, formed by n. 3 fibrosilicate cementite-based plates, each one 9.5 mm thick and 1100 kg/m3 dense, glued together and covered with a ceramic bonding agent for a total thickness of 1.5 mm for the various layers and assembled by means of n. 2 angular profiles in galvanized steel, 1.5 mm thick, fastened by means of steel screws; the shutter moves by means of n. 2 steel rotational pins, fastened to the containment profiles described above, and they rotate inside the proper brass ferrules fastened by pressure to the vertical walls of the tunnel;
- Graphite-based thermoexpanding gasket, 30 x 3.0 mm cross section, placed inside the tunnel opposite the perimeter edge of the shutter when the shutter is in a closed position;
- Control device consisting of:
    - o steel return spring, placed outside the tunnel and attached to one of the rotational pins described above;
    - o steel lever for manual recocking, placed outside the tunnel and attached directly to the same rotational pin the return spring is attached to;
    - o galvanized steel blocking device;
    - o recockable circuit breaker starting from a thermic fuse in alloy located inside the tunnel;
    - o covering carter in galvanized steel plate;

when the thermic fuse melts the circuit breaker is freed which enables the release of the lever and the action of the spring and the closing of the shutter; the fire barrier gate is recocked manually by means of the lever.

ISTITUTO GIORDANO - RICERCHE DI FISICA * BELLARIA - ITALY * LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE

The schematic drawings of the sample subjected to testing are reported below.

KEY

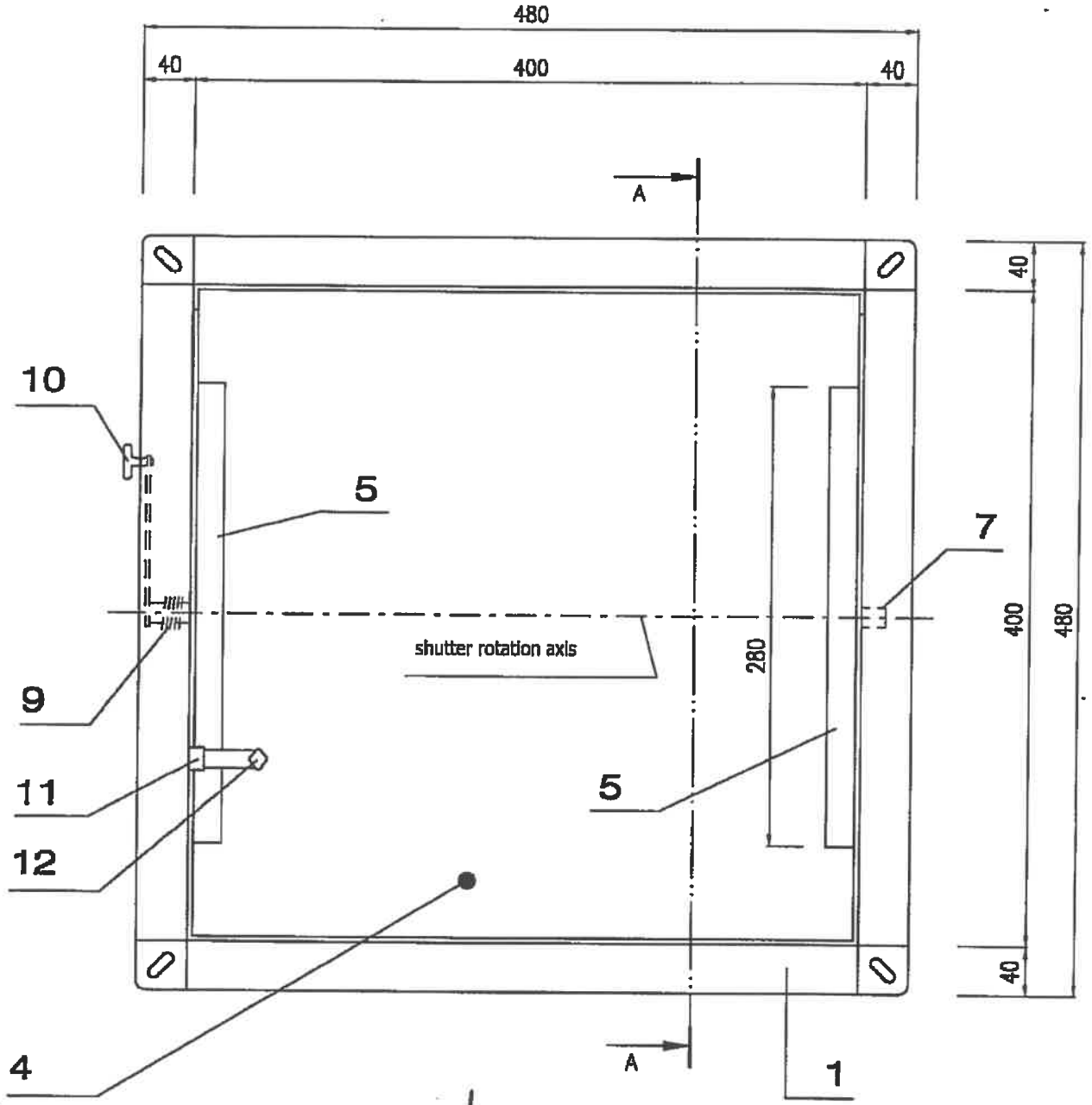
Symbol	Description
	Fire barrier gate "MTF/30"
1	Tunnel: galvanized steel sheet, 1.5 mm thick, connecting flanges at the ends, 40 mm thick
2	Ledge for the shutter in a closed position; plaster of Paris listel, 40 x 15 mm cross section and 850 kg/m3 dense
3	Steel rivet
4	Foil ledge, total thickness 30 mm, formed by n. 3 plates in cement-based fibrosilicate, 9.5 mm thick and 1100 kg/m3 dense each, glued together and covered with a ceramic bonding agent for a total thickness of 1.5 mm for the various layers
5	Galvanized steel containment profile shaped like a " ⌐ ", 280 mm long, overall cross section 33 x 30 mm and 1.5 mm thick
6	Steel screws
7	Steel rotational pins
8	Graphite-based thermoexpanding gasket, cross section 30 x 3.5 mm
9	Control device: steel return spring
10	Control device: steel lever for manual recocking
11	Control device: recockable circuit breaker
12	Control device. Thermic fuse in alloy
	Fire barrier gate "BTS/30"
13	Tunnel: fibrosilicate plate based on silicates, cement and additives, 20 mm thick and 850 kg/m3 dense
14	Tunnel: external covering in galvanized steel sheet, 1.5 mm thick
15	Tunnel: connecting flanges in galvanized steel sheet, 40 mm wide and 1.5 mm thick
16	Ledge for the shutter in a closed position: cementite-based fibrosilicate listel, cross section 40 x 15 mm and 1100 kg/m3 dense
17	Steel clip

ISTITUTO GIORDANO - RICERCHE DI FISICA
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
BELLARIA - ITALY

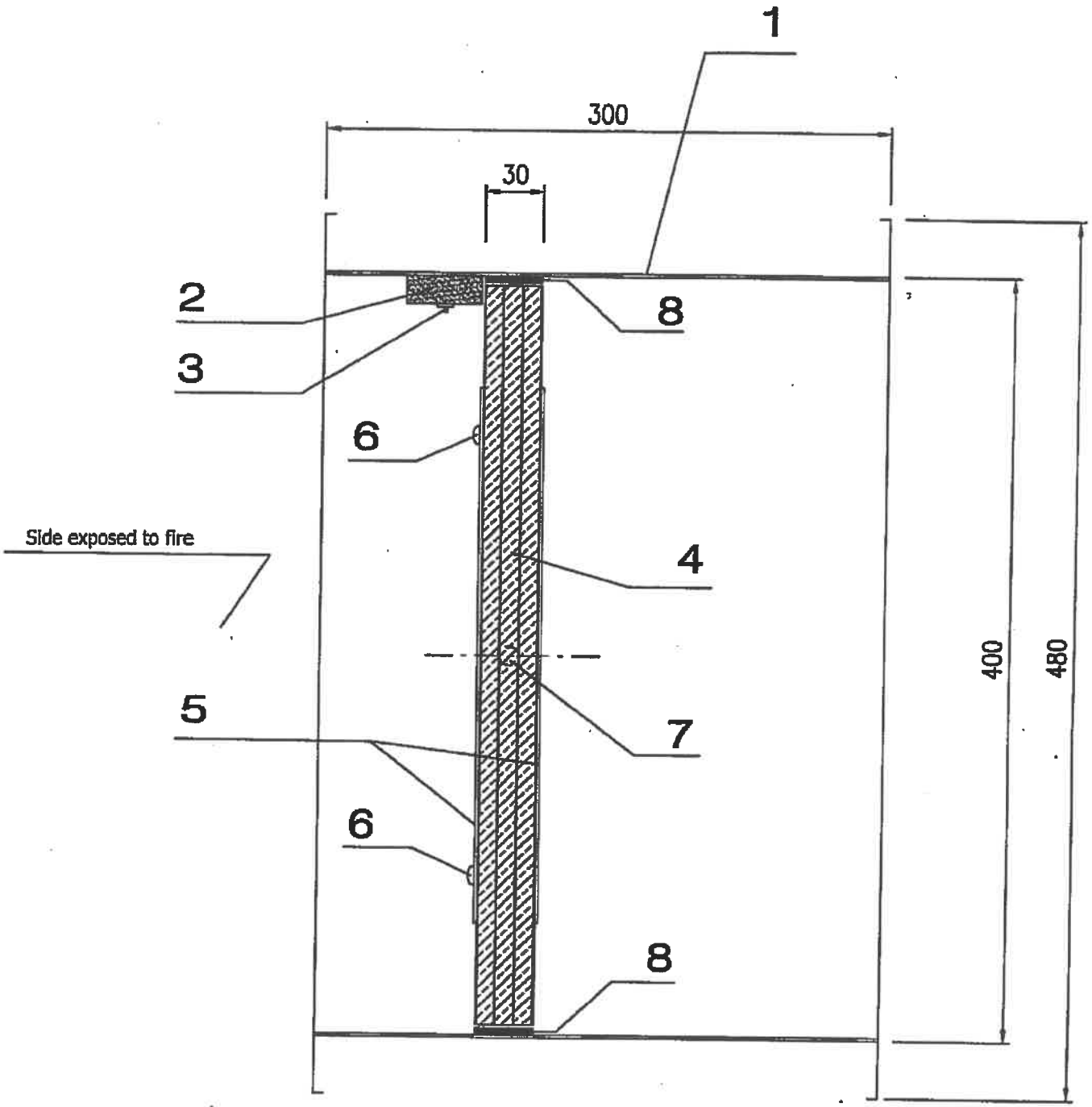
Symbol	Description
18	Foil ledge, total thickness 30 mm, formed by n. 3 plates in cementite-based fibrosilicate, 9.5 mm thick and 1100 kg/m3 dense each, glued together and covered with a ceramic bonding agent for a total thickness of 1.5 mm for the various layers
19	Containment profile in galvanized steel shaped like a " ⊏ ", 400 mm long, overall cross section 33 x 30 mm and 1.5 mm thick
20	Steel screws
21	Steel rotational pins
22	Graphite-based thermoexpanding gasket, cross section 30 x 3.5 mm
23	Control device: steel return spring
24	Control device: steel lever for manual recocking
25	Control device: recockable circuit breaker
26	Control device. Thermic fuse in alloy
	Fire barrier gate "BTT/30"
27	Tunnel: galvanized steel sheet, 1.5 mm thick
28	Ledge for shutter in closed position: galvanized steel angular profile, cross section 25 x 25 mm and 1.5 mm thick
29	Foil ledge, total thickness 30 mm, formed by n. 3 plates in cement-based fibrosilicate, 9.5 mm thick and 1100 kg/m3 dense each, glued together and covered with a ceramic bonding agent for a total thickness of 1.5 mm for the various layers
30	Angular profile in galvanized steel, 1.5 mm thick
31	Steel screws
32	Steel rotational pins
33	Graphite-based thermoexpanding gasket, cross section 30 x 3.5 mm
34	Control device: steel return spring
35	Control device: steel lever for manual recocking
36	Control device: recockable circuit breaker
37	Control device. Thermic fuse in alloy

ISTITUTO GIORDANO - RICERCHE DI FISICA * BELLARIA - ITALY * LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE

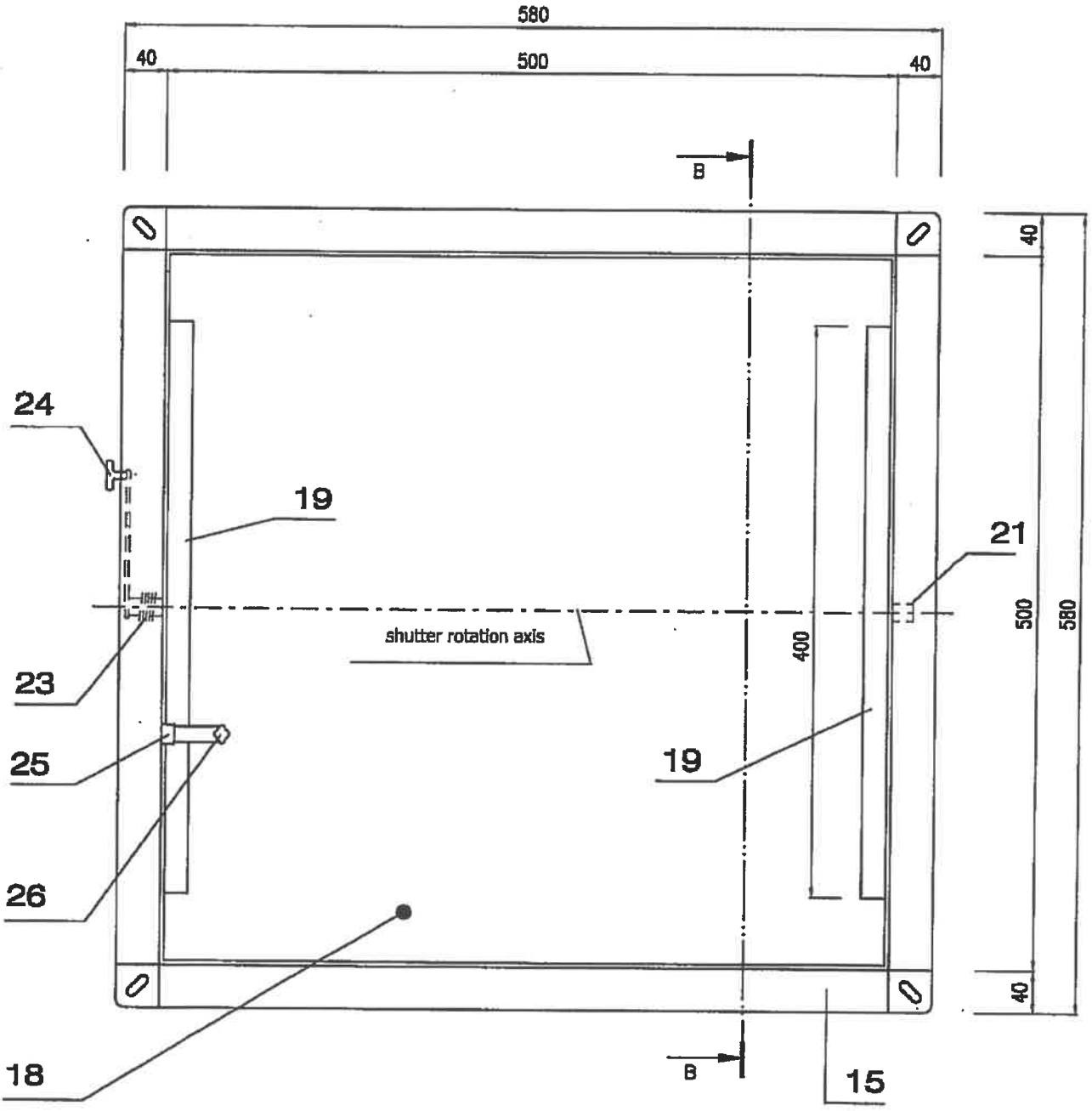
VIEW OF THE "MTF/30" FIRE BARRIER GATE WITH SHUTTER IN CLOSED POSITION



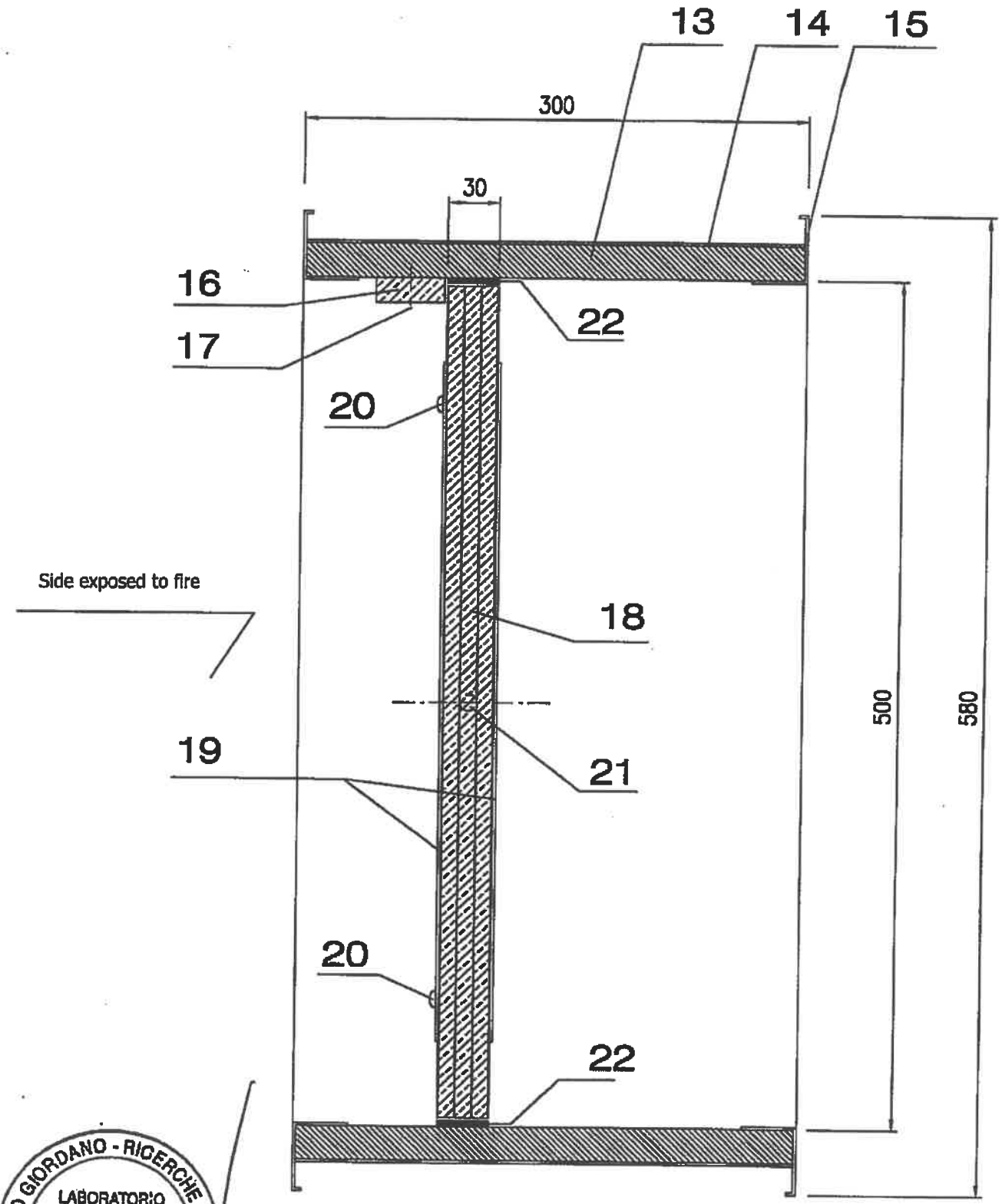
SECTION A: A OF THE "MTF/30" FIRE BARRIER GATE



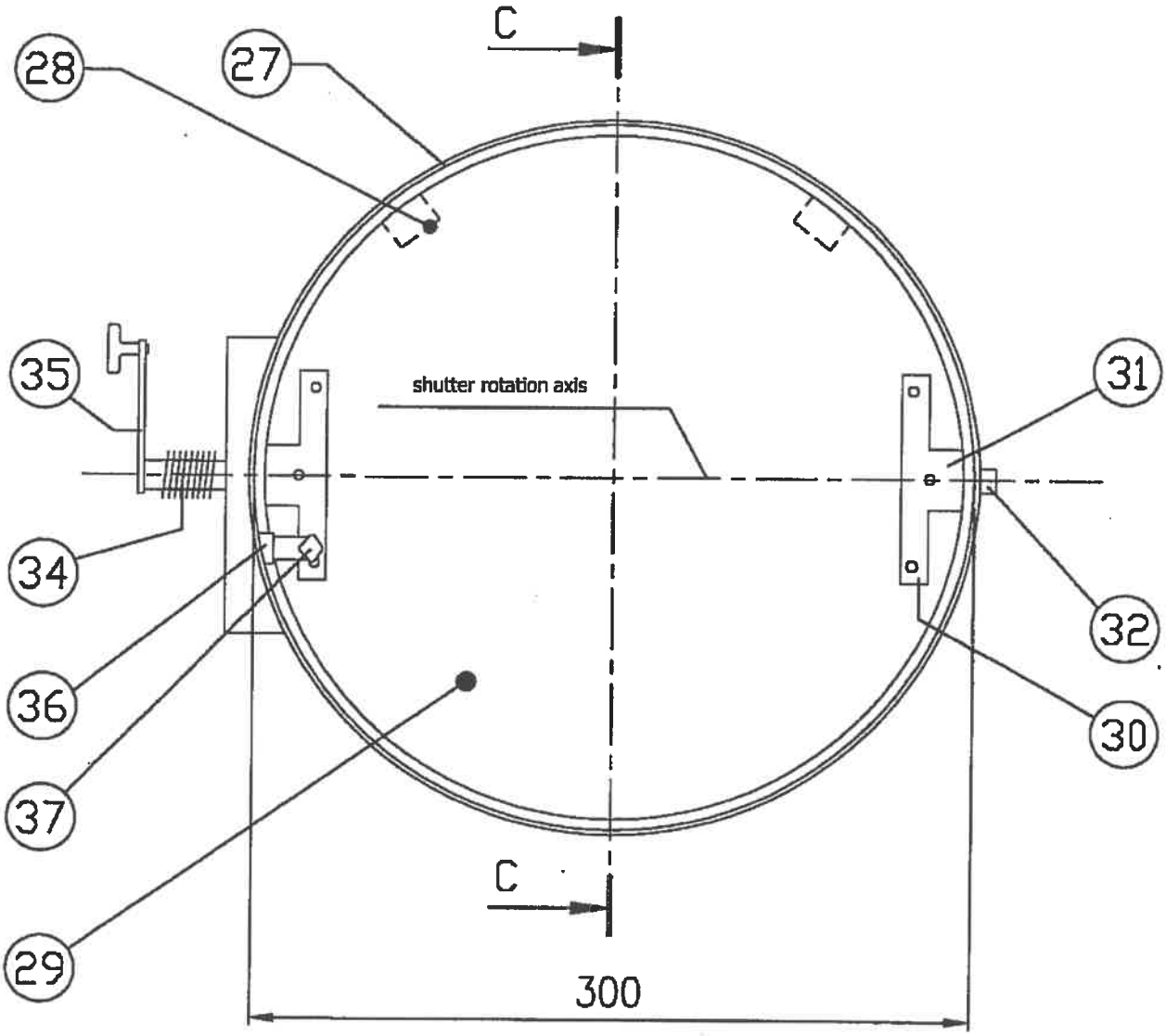
VIEW OF THE "BTS/30" FIRE BARRIER GATE WITH SHUTTER IN CLOSED POSITION



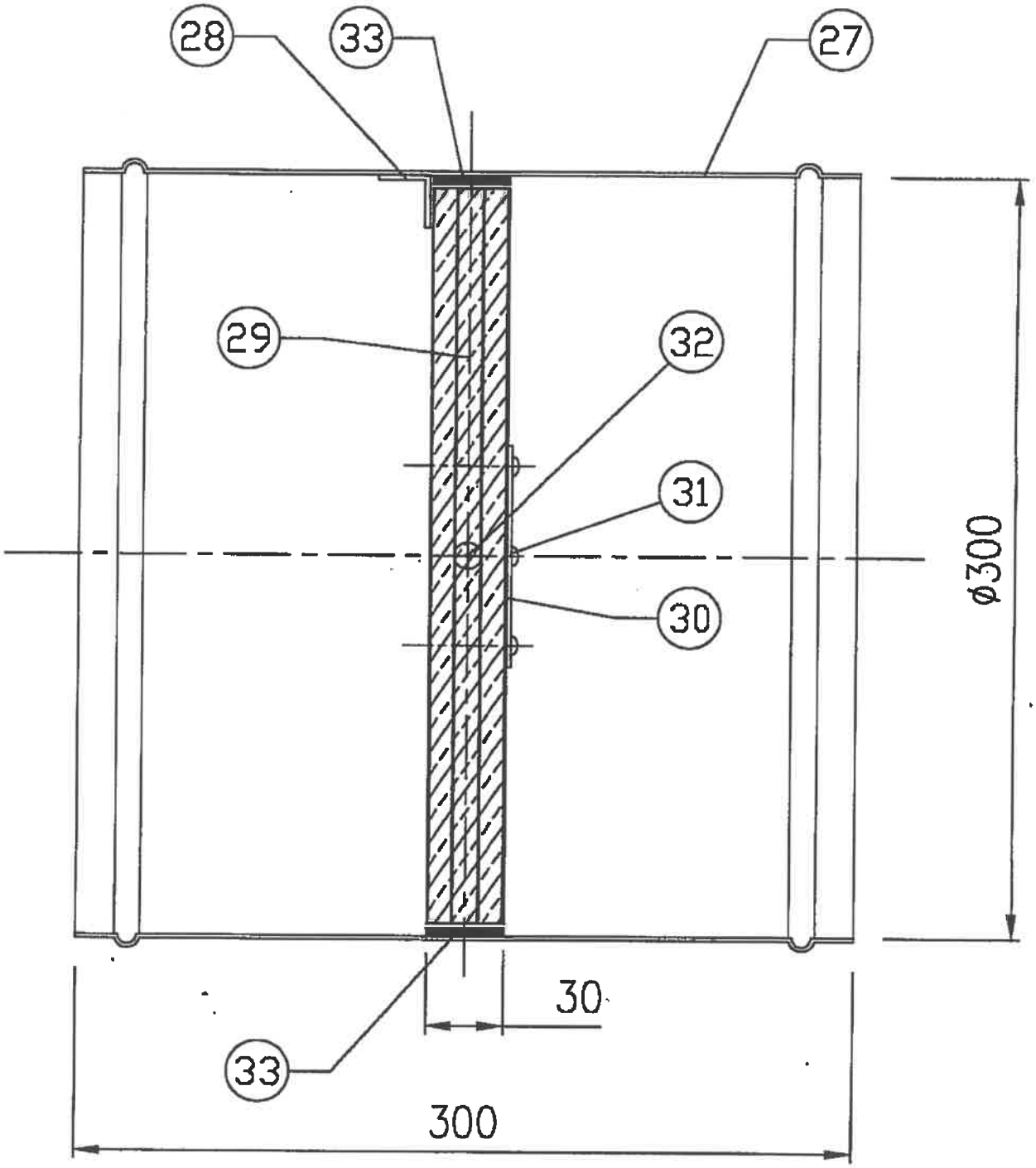
SECTION B: B OF THE "BTS/30" FIRE BARRIER GATE



VIEW OF THE "BTT/30" FIRE BARRIER GATE WITH SHUTTER IN CLOSED POSITION



SECTION C: C OF THE "BTT/30" FIRE BARRIER GATE



Normative references.

The test was carried out according to the prescriptions of the Circular n. 91 of the Minister of the Interior – General Management of Fire-prevention Services dated 14/09/1961 "Safety norms for protection against fire in steel-structured buildings for civil use."

Testing equipment.

The following equipment was used to carry out the test:

- experimental oven with opening on the vertical side (oven opening provided with:
  - dual-flame burners fed by gasoline;
  - n. 2 chimneys placed separately, with electronically controlled variation valves on the outlet section;
  - pressure detectors placed at ⅔ of the height of the oven opening, connected by an automatic detecting system;
- data acquisition system consisting of:
  - accessory cases placed on the vertical sides of the oven to detect the temperature inside the oven;
  - manual pressure reading system placed on a wall of the oven near its opening;
  - type "K" wire thermocouples connected to a mobile case that is connected to a reader that transforms the potential difference of the thermocouples themselves into temperature
- electronic calculator and management software

ISTITUTO GIORDANO - RICERCHE DI FISICA * LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE * BELLARIA - ITALY *

Test modality.

The fire barrier gates with the relative shutter in the closed position were assembled on the same support element consisting of a drilled lateriz or "Poroton"-type block wall, 150 mm thick, incorporated on the inside by a shape-retaining perimeter frame in reinforced concrete, 2300 kg/m3 dense; the support element was then installed on the experimental oven opening in such a way as to create a closed combustion chamber, where a façade of the fire barrier gate was exposed to the fire so that the respective control devices remained on the opposite side.

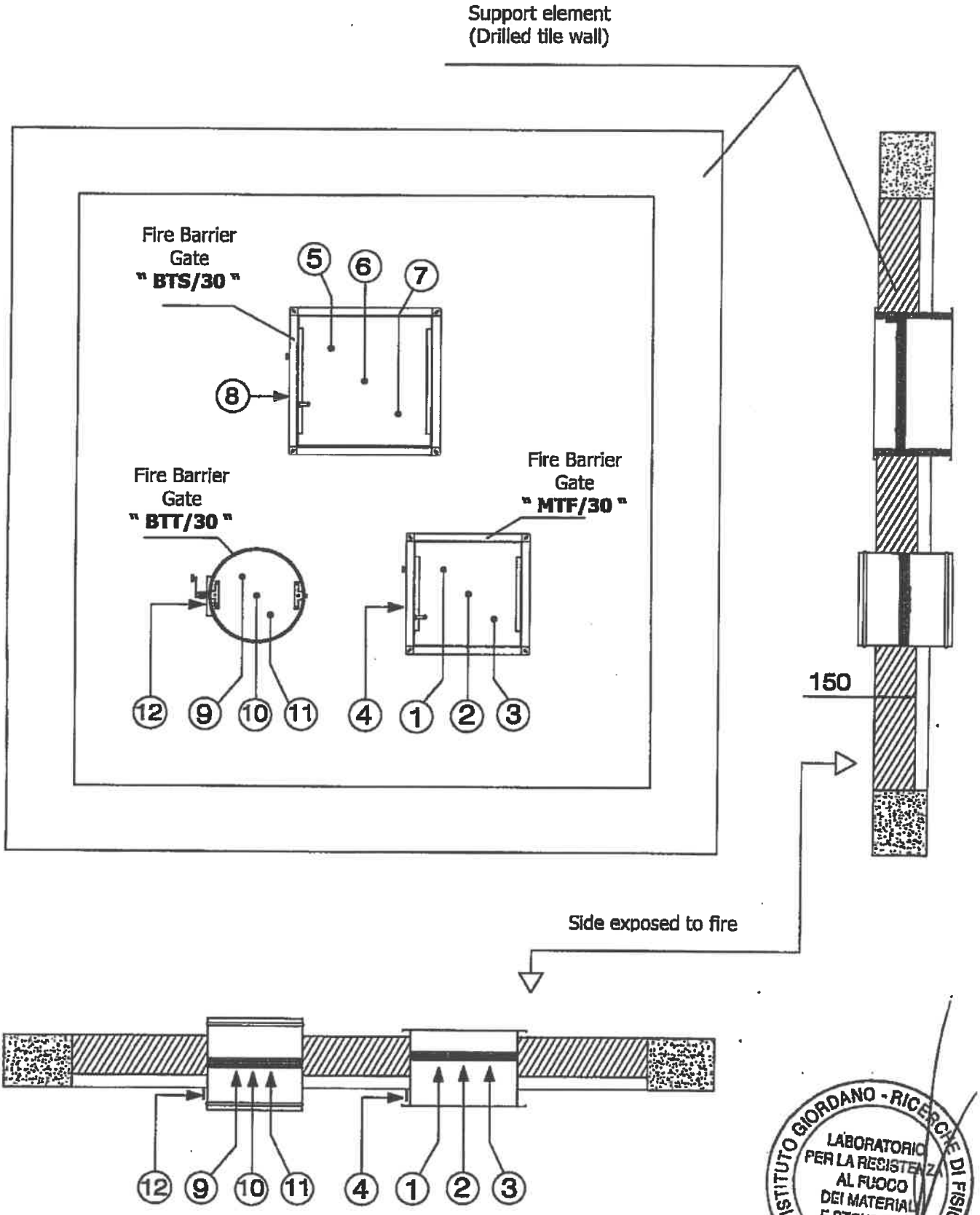
N. 12 thermocouples (thermocouples from n. 1 to n. 12) were put on the surface of the fire barrier gate that was not exposed to the fire as shown in the following drawing.

Once the measuring and control equipment was set up the burners were turned on, heating the experimental oven according to the temperature/time curve foreseen by Circular n. 91 of the Minister of the Interior – General Management of Fire-prevention Services dated 14/09/1961 and according to the prescribed tolerances.

The test was carried out by pressurizing the experimental oven to start from the tenth minute to the end, at a value of 10 ± 2 Pa.

ISTITUTO GIORDANO - RICERCHE DI FISICA
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
BELLARIA - ITALY

TEST MODALITY AND AVAILABILITY OF THERMOCOUPLES ON THE SURFACE OF THE FIRE BARRIER GATE NOT EXPOSED TO FIRE



(1)...(12) THERMOCOUPLE ATTACHMENT POINTS

Test results.

During the course of the test the significant phenomena reported in the following table were verified.

Minutes of testing	Observations
12	Watery steam started to come out on the surface of the fire barrier gate "BTT/30" that was not exposed to the fire, corresponding to the perimeter edge of the shutter
15	Watery steam started to come out on the surface of the fire barrier gates "MTF/30" and BTS/30" that was not exposed to the fire, corresponding to the perimeter edge of the relative shutters
70	The surfaces of the fire barrier gates not exposed to the fire started to blacken, corresponding to the perimeter edges of the relative shutters with particular accentuation near the corners
123	The "BTT/30" fire barrier gate loss thermic insulation due to the exceeding of 150° C by the average temperature recorded by the three thermocouples of the shutter placed on the surface not exposed to the fire (thermocouples from n. 1 to n. 3)
127	The "BTS/30" fire barrier gate loss thermic insulation due to the exceeding of 150° C by the average temperature recorded by the three thermocouples of the shutter placed on the surface not exposed to the fire (thermocouples from n. 1 to n. 3)
132	The "MTF/30" fire barrier gate loss thermic insulation due to the exceeding of 150° C by the average temperature recorded by the three thermocouples of the shutter placed on the surface not exposed to the fire (thermocouples from n. 1 to n. 3)
184	Interruption of the test without having verified further significant phenomena in the meantime

In the moment thermic insulation was lost the temperatures recorded by the thermocouples on the fire barrier gates being tested had reached the values reported in the following summary.

Room temperature = 10° C

Measuring point		Instant (min)	Thermocouple (n.)	Temperature (°C)
Along a diagonal of the shutter of the "MTF/30" fire barrier gate	Average	132	1 ÷ 3	153
	Maximum	132	1 ÷ 3	175
On the side of the tunnel of the "MTF/30" fire barrier gate, 50 mm from the support element		132	4	138

ISTITUTO GIORDANO - RICERCHE DI FISICA
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
BELLARIA - ITALY

Measuring point		Instant (min)	Thermocouple (n.)	Temperature (°C)
Along a diagonal of the shutter of the fire barrier gate "BTS/30"	Average	127	5 ÷ 7	151
	Maximum	127	5 ÷ 7	176
On the side of the tunnel of the "BTS/30" fire barrier gate, 50 mm from the support element		127	8	125
Along a diagonal of the shutter of the fire barrier gate "BTT/30"	Average	123	9 ÷ 11	152
	Maximum	123	9 ÷ 11	173
On the side of the tunnel of the "BTT/30" fire barrier gate, 50 mm from the support element		123	12	170

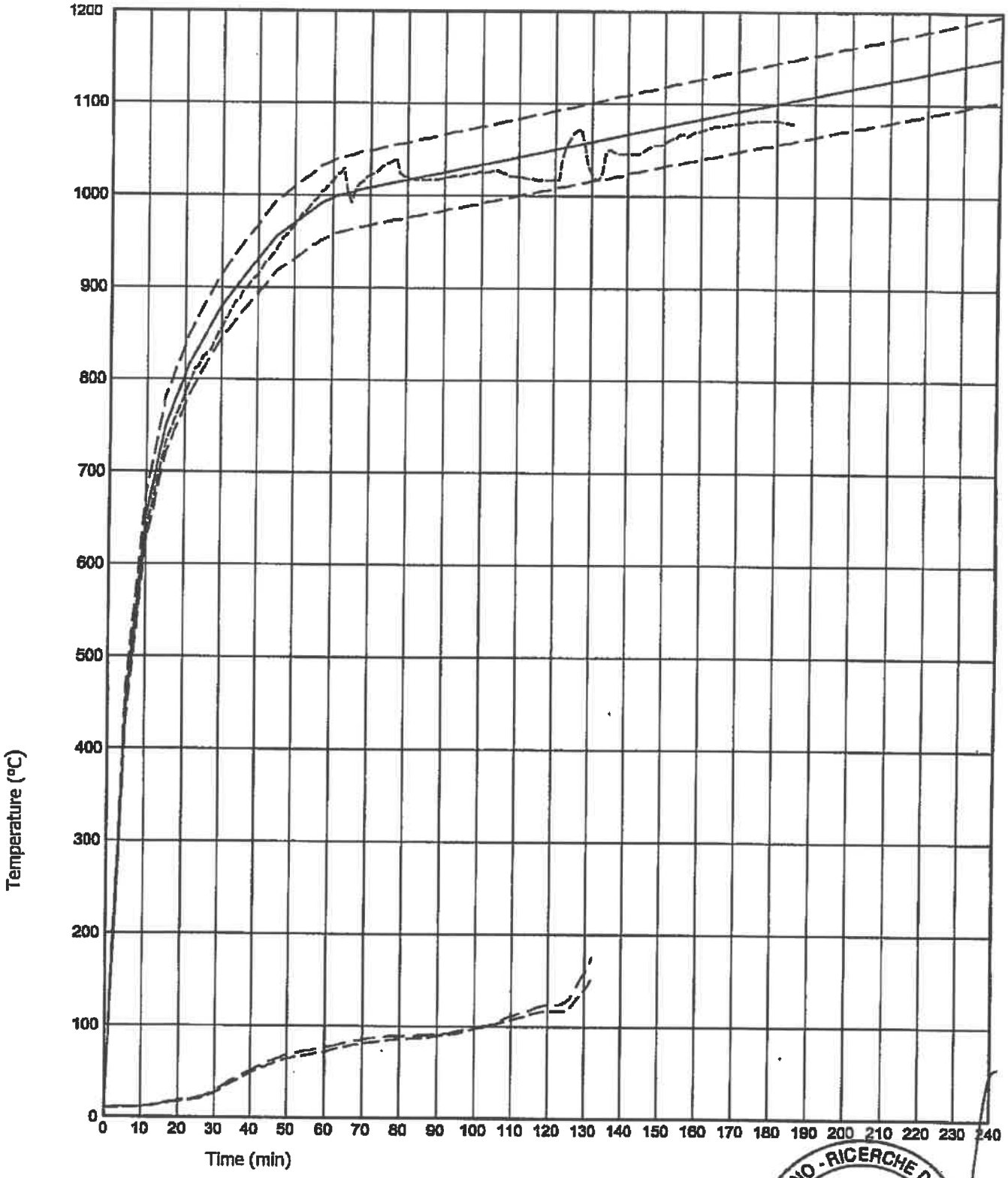
Repeated controls carried out according to the prescriptions of the norm UNI EN 1363-1:2001 on the surface of the fire barrier gate being tested not exposed to the fire did not show that it was less fire-proof.

On the following sheets we have reported:

- the diagrams with the temperature/time curves recorded by the thermocouple put on the sample being tested together with the theoretical curve of the oven heating and what was effectively done during the course of the test;
- the photographs of the sample being tested before and after the test.

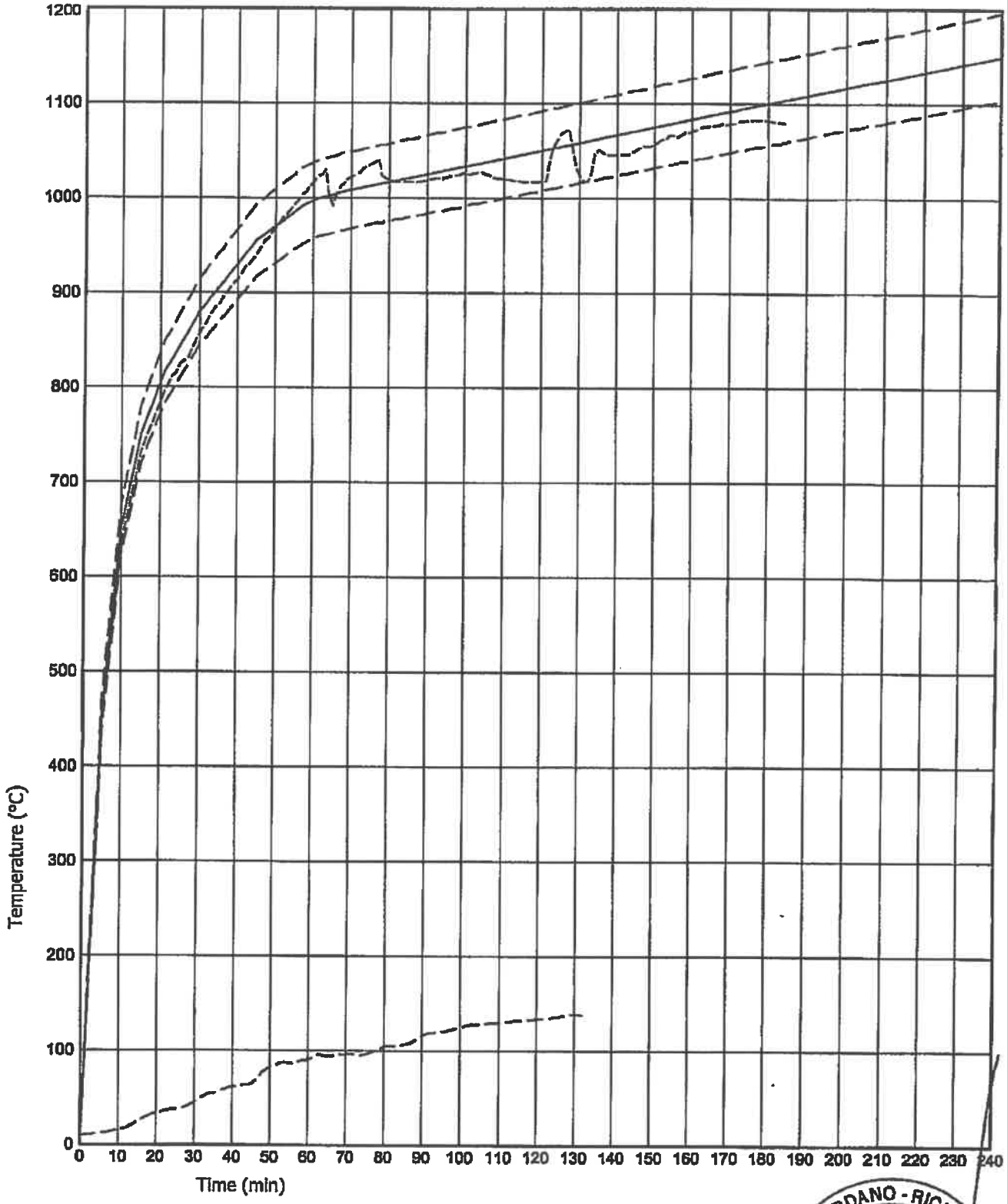
ISTITUTO GIORDANO - RICERCHE DI FISICA * BELLARIA - ITALY * LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE

TEMPERATURE/TIME DIAGRAM N. 1



ISTITUTO GIORDANO - RICERCHE DI FISICA
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
* BELLARIA - ITALY *

TEMPERATURE/TIME DIAGRAM N. 2



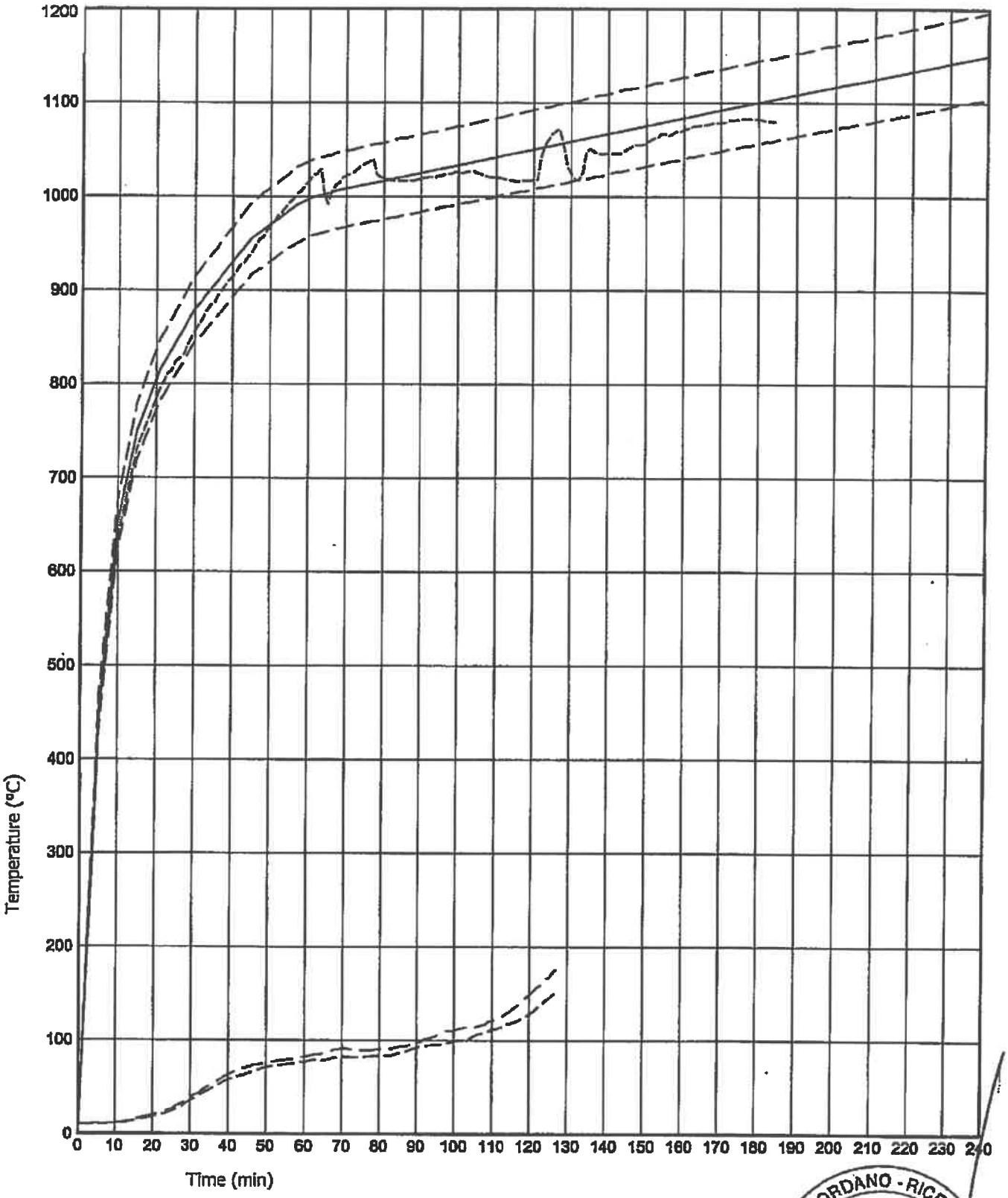
Theoretical oven heating temperature and tolerance limits

Experimental oven heating temperature

Average temperature on the shutter of the "MTF/30" fire barrier gate (T4)

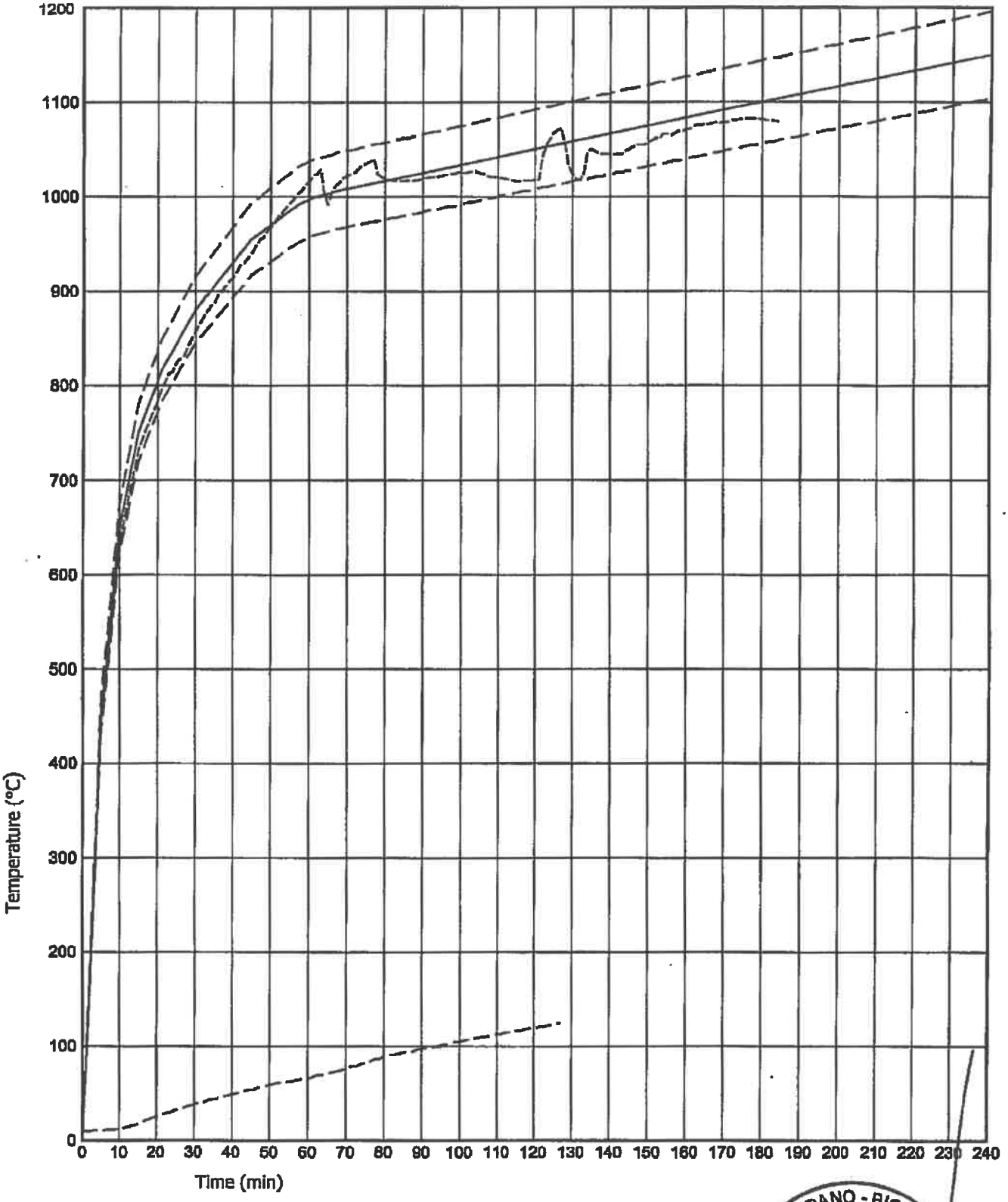
ISTITUTO GIORDANO - RICERCHE DI FISICA
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
BELLARIA - ITALY

TEMPERATURE/TIME DIAGRAM N. 3



ISTITUTO GIORDANO - RICERCHE DI FISICA
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
BELLARIA - ITALY

TEMPERATURE/TIME DIAGRAM N. 4



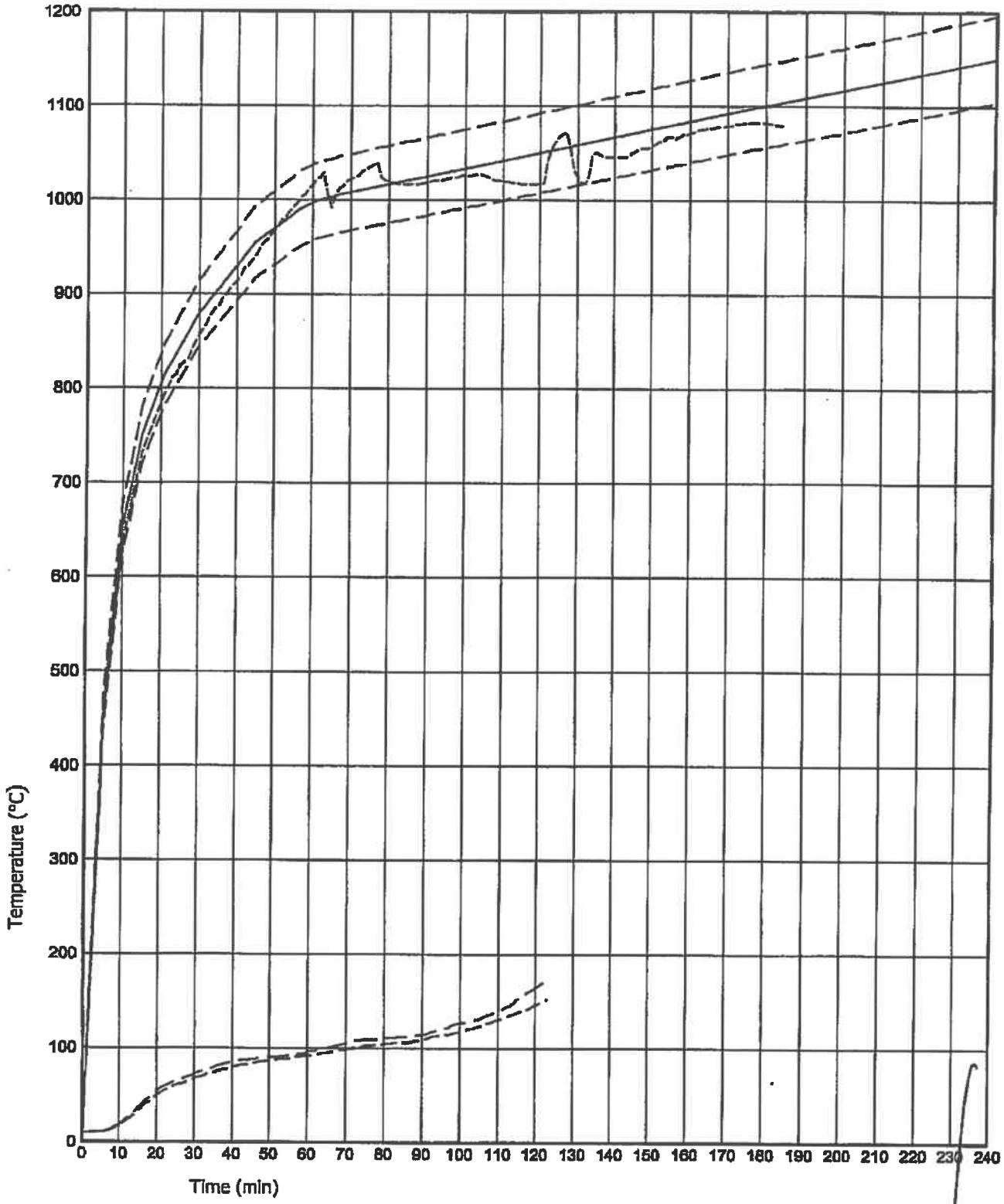
Theoretical oven heating temperature and tolerance limits

Experimental oven heating temperature

Average temperature on the shutter of the "BTS/30" fire barrier gate (T8)

ISTITUTO GIORDANO - RICERCHE TECNOLOGICHE
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
BELLARIA - ITALY

TEMPERATURE/TIME DIAGRAM N. 5



Theoretical oven heating temperature and tolerance limits

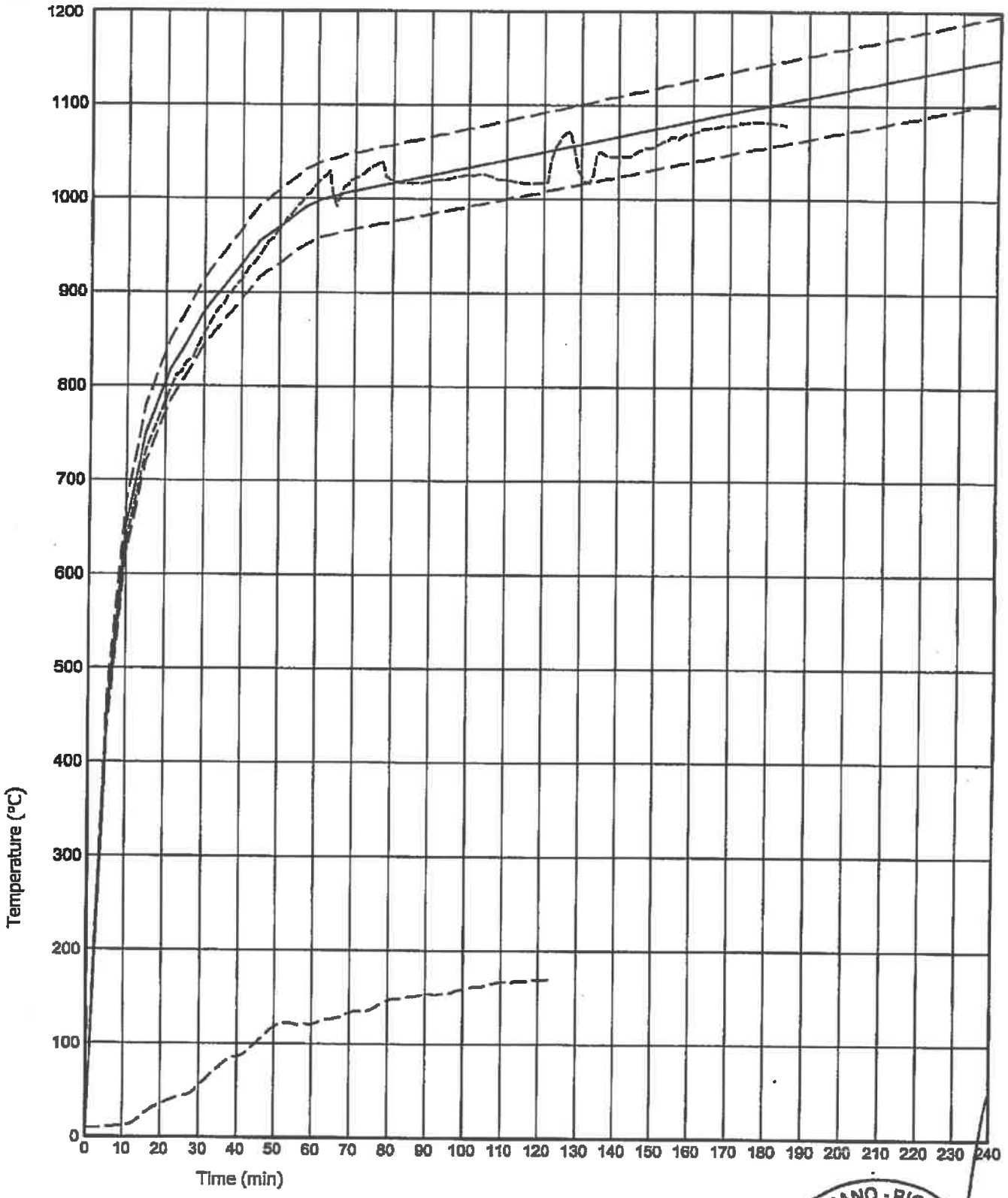
Experimental oven heating temperature

Average temperature on the shutter of the "BTT/30" fire barrier gate (T9-T11)

Maximum temperature on the shutter of the "BTT/30" fire barrier gate (T9-T11)

ISTITUTO GIORDANO - RICERCHE TECNOLOGICHE E FISICA
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
BELLARIA - ITALY

TEMPERATURE/TIME DIAGRAM N. 6



Theoretical oven heating temperature and tolerance limits

Experimental oven heating temperature

Average temperature on the shutter of the "BTT/30" fire barrier gate (T12)

ISTITUTO GIORDANO - RICERCHE DI FISICA
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
* SELLARIA - ITALY *

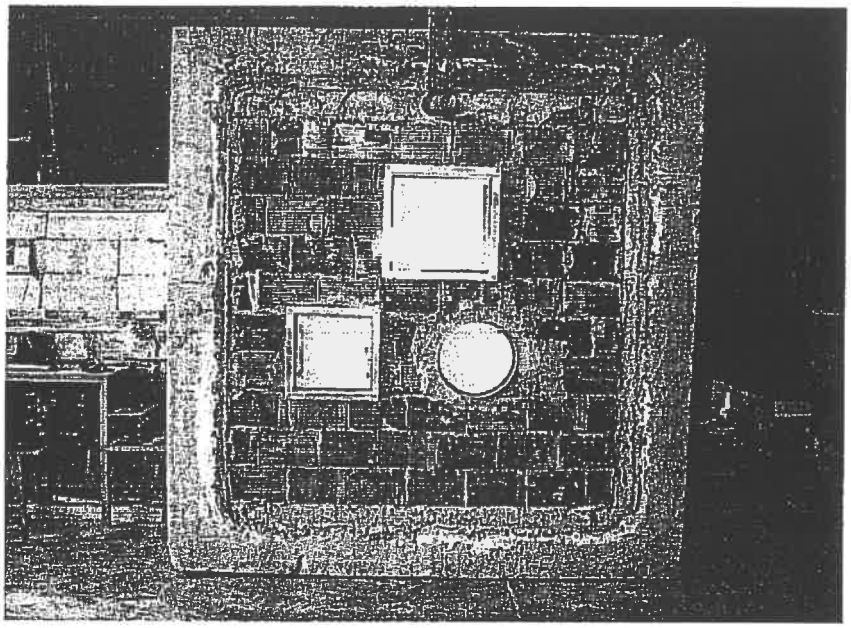


Photo of the surface of the sample exposed to fire before testing

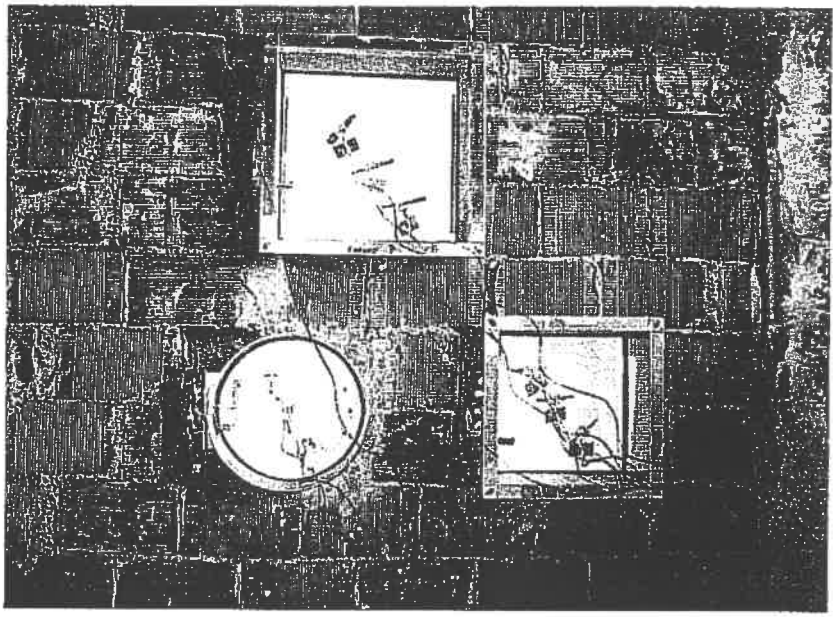


Photo of the surface of the sample not exposed to fire before testing

ISTITUTO GIORDANO - RICERCHE DI FISICA * BELLARIA - ITALY * LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE

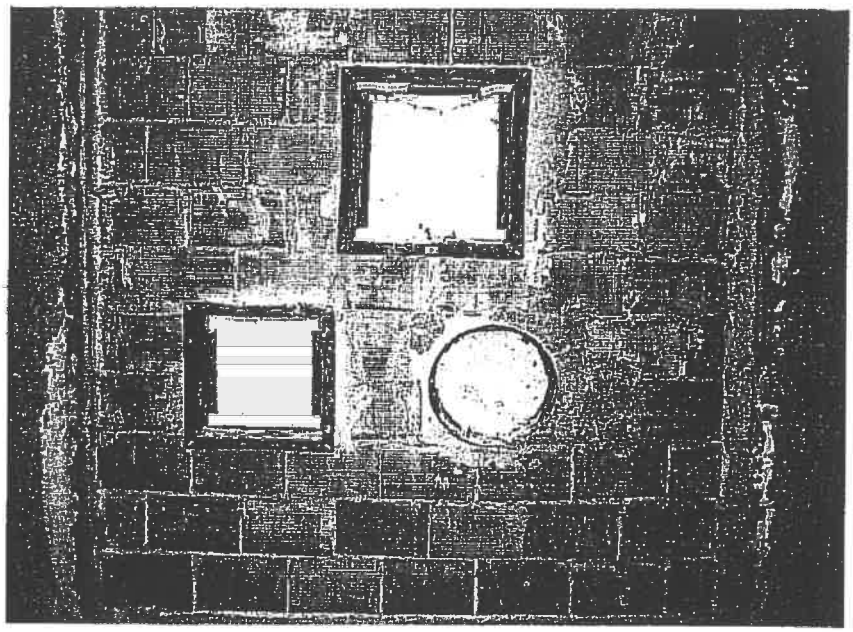


Photo of the surface of the sample exposed to fire after testing

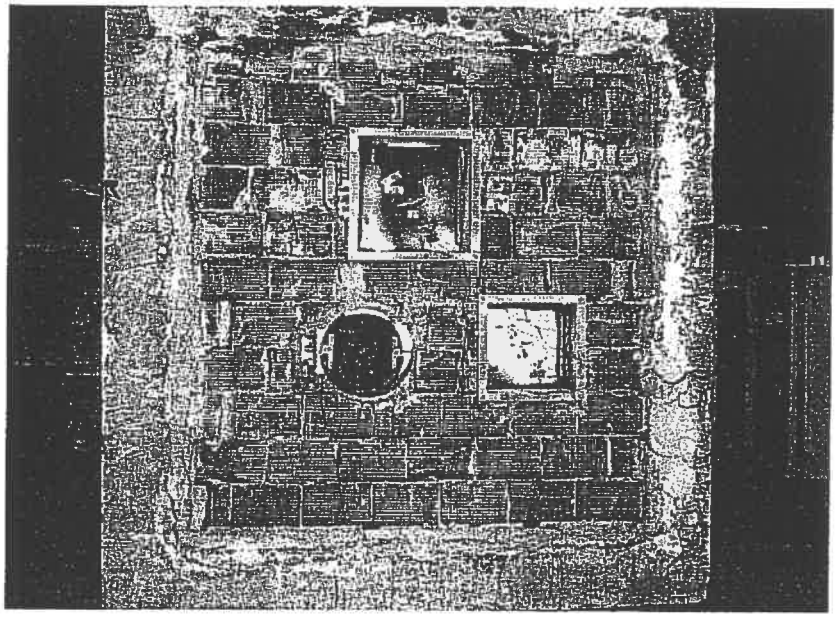


Photo of the surface of the sample not exposed to fire when the test was interrupted

ISTITUTO GIORDANO - RICERCHE DI FISICA
LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE
BELLARIA - ITALY

Classification.

From the examination of the results from the test carried out on n. 3 fire barrier gates called "MTF/30", "BTS/30" and "BTT/30", described above, produced and presented by the company Brofer S.r.l. – Via Pio X, 9 – Località Fratte – 35010 Santa Giustina in Colle (PD) we can deduce that:

- the duration of the fire damping of the fire barrier gate "BTT/30" was 123 minutes compared to parameter "I" and over 180 minutes compared to parameters "R" and "E";
- the duration of fire damping of the fire barrier gate "BTS/30" was 127 minutes compared to parameter "I" and over 180 minutes compared to parameters "R" and "E".
- the duration of fire damping of the fire barrier gate "MTF/30" was 132 minutes compared to parameter "I" and over 180 minutes compared to parameters "R" and "E".

Therefore, according to what is stated in the Circular n. 91 of the Minister of the Interior – General Management of Fire-prevention dated 14/09/1961 and in the Minister's Decree dated 30/11/1983, the sample tested is classified as

REI 120 and RE 180

And therefore the sample itself can be used in fire-prevention compartments not higher than REI 120 and RE 180.

Bellaria, 12/02/2004

ISTITUTO GIORDANO - RICERCHE DI FISICA - LABORATORIO PER LA RESISTENZA AL FUOCO DEI MATERIALI E STRUTTURE - BELLARIA - ITALY

Il Direttore del Laboratorio
di Resistenza al Fuoco
(Dott. Ing. Stefano Vasini)

Il Presidente o
l'Amministratore Delegato
Dott. Ing. Vincenzo Iommi