ATRIUM ROOF CONSTRUCTION:
FIRE RESISTANCE

Key words: Testing, fire resistance, atrium roof

1 SCOPE
The test method comprises two independent parts, a low temperature phase test and a high temperature phase test. If a construction is to be evaluated according to either part, the two temperature phases may be combined into one test.

2. FIELD OF APPLICATION
This test method is applicable to atrium roof construction with respect to the structure, joints, fixing details, roof covering materials etc.

The low temperature phase of the test represents a situation where the temperature in the smoke layer is expected to be not more than 300 °C. If other temperature levels are more likely in a certain case then the test can be used but with a different constant temperature level.

The high temperature phase represents a situation where flames are reaching the roof. If the purpose of the test is to evaluate the structure for a fire of a certain duration then the roof must be covered with panels that will keep the furnace covered for at least that period of time.

3. REFERENCES
ISO 3261, Fire tests - Vocabulary
ISO 834, Fire-resistance tests - Elements of building construction
ISO 3009, Fire-resistance tests - Glazed elements

4. DEFINITIONS
4.1 Roof construction
The construction includes the main structure, panes of glass or other roof covering products, fixing details, etc.

4.2 Low temperature phase
The temperatures expected in a large volume equipped with sprinklers or extraction hoods. The normally expected temperatures in the smoke layer are not above 300 °C.

4.3 High temperature phase
Temperatures expected in a flame that reaches the roof. Normally simulated by temperatures according to ISO 834.

5. METHOD OF TEST
5.1 Principles
This test comprises fire tests representing two different scenarios. The first scenario comprises relatively low temperatures as when the fire is on the floor of an atrium and the height up to the roof is relatively large or when the area is ventilated or equipped with sprinklers. The second scenario comprises high temperatures as when the fire is close to the roof construction e.g. atriums of small height or when flames are coming out from a window just below the roof.

The low temperature and the high temperature scenario can be simulated in one test or separated into two separate tests.

5.2 Apparatus
5.2.1 Main apparatus
The tests are performed in a horizontal furnace capable of tests according to ISO 834.

5.2.2 Furnace thermocouples
The furnace temperature shall be measured in accordance with ISO 834 and 100 mm from the exposed surface of the roof construction.

5.2.3 Surface thermocouples
Surface thermocouples on the unexposed side are only needed if there is a requirement for insulation. The type of thermocouples should then be with copper disc and covering
5.3 Preparation of test specimen

5.3.1 Erection of test specimen
The tested roof construction shall be of full size or as large as possible. If the construction is made up of main structure and fields covered by panes of glass at least one field with representative connections with surrounding fields shall be exposed to the fire. The mounting of the construction e.g. the structure and the panes of glass shall be the same as in practice. If the slope of the roof is not known it shall be mounted at 10°, in order to study the risk of the panes of glass sliding out of the structure, see Fig. 1.

5.3.2 Conditioning
Before test the specimen shall be conditioned in accordance with ISO 834.

5.4 Procedure

5.4.1 Combined fire test
The furnace temperature is controlled according to the time-temperature curve given in Fig. 2. The heating period is started as the standard fire according to ISO 834 but interrupted when the temperature is 300 °C which then is kept constant for a period of 30 minutes (low temperature phase). After this period the standard-curve is continued (high temperature phase).

5.4.2 Low temperature test
The furnace temperature is controlled according to the time-temperature curve given in Fig. 2. The heating period is started as the standard fire according to ISO 834 but interrupted when the temperature is 300 °C which is then kept constant for a period of 30 minutes.

5.4.3 High temperature test
The furnace temperature is controlled according to the standard time-temperature curve in ISO 834.

5.4.4 Furnace pressure
The pressure condition shall be in accordance with ISO 834.

5.4.5 Observations
During the test the following observations shall be made:
- time when cracks or other damage occur
- deflection of the structure
- time when the integrity according to ISO 834 fails e.g. when the cotton pad ignites, flames occur on the unexposed side or when panes of glass falls down
- surface time-temperature curve for each thermocouple and mean values according to ISO 834

6 PERFORMANCE CRITERIA

6.1 Low temperature exposure
Roof material may not fail down during the first 10 minutes of the test.
Roof material may not fall down except in very small pieces during the first 30 minutes.
6.2 High temperature exposure
The roof construction may not lose its stability during the period of time which corresponds to the requirements of the Authorities.

6.3 Insulation and integrity at high temperature exposure (only when required by the Authorities)
The mean temperature rise on the unexposed side, according to thermocouples described in ISO 834, may not exceed 140 °C.
The temperature rise on the unexposed side, according to thermocouples described in ISO 834, may not at any point exceed 180 °C.
Failure of the integrity is deemed to occur when cotton pad is ignited or when sustained flames have longer duration than 10 s (see also ISO 834).

7 TEST REPORT
The test report shall contain the following information:

a) Name and address of the testing laboratory
b) Date and identification number of the report
c) Name and address of the client
d) Purpose of the test
e) Method of sampling
f) Name of manufacturer or supplier of the product
g) Name or other identification marks and description of the product
h) Date of supply of the product
i) Date of test
j) Description of the test specimen including relevant properties of the material, mounting details etc.
k) Conditioning of the specimen
l) Test method
m) When not identified in the test method, equipment and instruments used
n) Deviations from the test method if any
o) Test results:
furnace time-temperature plot
furnace time-pressure plot
surface time-temperature plot (if requested)
deflection of structure
integrity observations
other observations of interest, see par. 5.4.5.