

FIRE INVESTIGATIONS **ON** **FIRE PROTECTION DOORS**

Submitted to
M/S. Astral windoors Pvt Ltd
Bengaluru



BUILDING FIRE RESEARCH CENTRE
N.I.E., MYSURU, INDIA

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FOREWORD

Different parts of buildings are separated from each other into compartments by fire resisting walls, partitions, etc., in which openings are closed by doors, which have precise functions to full fill in case of a fire. The first and most important function of a door assembly is to check the passage of excess amount of gases and smoke which can interfere with the safe use of escape routes. Secondly it should maintain the effectiveness as a fire barrier of the wall in which it is installed.

The fire door is constructed in such a way so that it can withstand the severity of fire for a specified time period.

The Building Fire Research Centre (BFRC), Mysuru has provided facilities for fire resistance evaluations of doors, according to IS 3614-1992 (Part 2).

I hope this report would be useful to M/S. Astral windows Pvt.Ltd. Bengaluru, in getting the correct appraisal of the doors manufactured by them and would be beneficial to building and industrial sectors in reducing loss of life and property.

MYSORE
April 2016

Dr. N. SURESH
Head



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PROJECT TEAM

Dr. N. Suresh Project Leader

Dr. Y.M. Manjunath Project Associate

Dr.K.C. Manjunath Project Associate

M.S. Guruprasad Member

M.N. Manjunath Member

Members Present

Mr.Dilip Bafna

**Managing Director
M/s. Astral windoors Pvt Ltd**

**Mr.Mohammad Imran
Ltd**

M/s. Astral windoors Pvt

Client

**M/s. Astral windoors Pvt.Ltd.
Bengaluru**



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1.0 SUMMARY

A Single Leaf Door with view panel was evaluated in a wall furnace (ANNEXURE 1) regulated according to standard heating condition as specified in IS 3614 Part 2, 1992.

2.0 OBJECTIVES

A special investigation of Single Leaf Door with view panel to assess its performance for fire resistance was undertaken. The fire door was subjected to standard heating conditions as specified in IS 3614, 1992, Part 2 in a wall furnace for classifying, fire resistance rating depending upon its performance.

3.0 CONSTRUCTION

The fire door is constructed to give maximum fire resistance, minimum heat and smoke transfer from one side to another by M/S. Astral windoors Pvt.Ltd.

Bengaluru, The details of fire door is shown in Fig.1.



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4.0 TEST PROCEDURE

4.1 General

The fire door was evaluated separately in a wall furnace regulated according to IS 3614, 1992, Part 2 for obtaining standard conditions of fire severity. The furnace has five flat flame burners positioned in a way to produce even heating over the exposed face of the specimen. For measuring temperature of the furnace five bare wire thermocouples are provided. (The details of door furnace are given in ANNEXURE-1).

The variation of furnace temperature with time during the evaluations of the door has been shown separately in Table 1 with standard temperature, and the time-temperature curves are plotted in Figure 2. The door was installed in a fixed fire brick wall which forms one side of the wall furnace before each evaluation.

4.2 Furnace Control

The specimen was heated as specified in a furnace which produced a positive pressure. For maintaining standard heating conditions, the temperature of the furnace was controlled to vary with time as closely as possible in accordance with the following relationship:

$$T - T_0 = 345 \text{ Log}_{10}(8t + 1)$$

Where, t = time of test in minutes

T = furnace temperature in °C at time t, and

T₀ = initial furnace temperature in °C

The temperature rise in the furnace computed using the above formula is as shown below.



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Time Minutes	Temperature rise in furnace (T – To)
5	556
10	659
15	718
30	821
60	925
90	986
120	1029

The accuracy of furnace control should be such that:

- (i) During the first ten minutes of test the area under the curve of mean furnace temperature does not vary by more than $\pm 15\%$ of the area under the standard curve.
- (ii) During the first half-hour of test the area under the curve of mean furnace temperature does not vary by more than $\pm 10\%$ of the area under the standard curve.
- (iii) For any period after the first half hour of the test the area under the curve of mean furnace temperature does not vary by more than $\pm 5\%$ of the area under the standard curve.
- (iv) At any time after the first ten minutes the mean furnace temperature does not differ from the standard temperature by more than $\pm 100^\circ\text{C}$.

4.3 Single Leaf Metal Door (Opening outside).

The door was installed in a fire brick wall of the wall furnace opening outside. Evaluation was carried out in the month of April 2016. The door remained unlocked during the evaluation period. The temperature recorded at five positions on exposed face is given in Table 1 and unexposed face temperature is shown in Table 2. Positions of thermocouples on exposed face are shown in Fig 3.



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5. OBSERVATIONS

The observations were made during evaluation of the door for fire resistance. A specimen is considered fire resistant for a particular period for which it satisfies certain criteria with respect to stability, integrity and thermal insulation.

Stability

For stability, following considerations were observed:

- (i) The deformation of test specimen; extent of separation of door frame from wall; extent of separation of door panel from the frame.
- (ii) Temperature and radiation from steel / steel plates.
- (iii) Detachment of any locking part.
- (iv) Time of occurrence of collapse; if any. (v) Any other factor which could affect stability.

Integrity

Presence of cracks or other openings developed either in the door panel or between door and door frame were observed. Observation for stability and integrity for single leaf door opening outside is given in Table 2.

Insulation

The average temperature of the unexposed face of the specimen shall not increase above the initial temperature by more than 140⁰C. The maximum temperature at any point of unexposed face shall not exceed the initial temperature by more than 180⁰C, and shall not exceed 220⁰C irrespective of the initial temperature.



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6.0 RESULTS

One Single Leaf Door with view panel of M/S. Astral windows Pvt.Ltd. Bengaluru was evaluated for fire resistance in the wall furnace as described in earlier paragraphs of the report. The time for which the door stood against a standard fire was obtained after evaluating.

6.1 Single Leaf Metal Door (Opening outside)

The door complied with standard heating & pressure conditions of the furnace. There were no cracks or openings developed during the evaluation. Hence there is no failure in stability & Integrity.

6.2 Insulation

The average temperature of the unexposed face of the specimen has not increased above the initial temperature by more than 140⁰C. The maximum temperature at any point of the face has also not exceeded the initial temperature by more than 180⁰C. Hence there is no failure of door due to insulation.

7.0 CONCLUSION

SINGLE LEAF DOOR WITH VIEW PANEL OF M/S. ASTRAL WINDOWS PVT.LTD, BENGALURU CAN BE ASSIGNED FOR TWO HOURS (120 MINUTES) FIRE RESISTANCE RATING.



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Table 1. SINGLE LEAF FIRE DOOR M/S. ASTRAL WINDOORS PVT.LTD. (OPENING OUTSIDE)

FURNACE AND EXPOSED FACE TEMPERATURES

Time (min)	Furnace Temperature °C (T – To)		Exposed Face Temperature °C				
	Standard	Actual	T1	T2	T3	T4	T5
05	556	621	550	556	730	690	580
15	718	698	630	620	787	714	738
30	821	785	790	740	768	774	852
60	925	879	860	830	865	858	979
90	986	955	950	890	900	1021	1016
120	1029	1011	1000	974	982	1052	1046

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Head,
,BFRC,NIE, Mysuru.



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Table 2. EVALUATION OBSERVATIONS OF SINGLE LEAF METAL DOOR (OPENING OUTSIDE)

Time (in min.)	Observations
0	Furnace was started.
05	Smoke observed at the edges of the view panel bedding.
10	Smoke disappeared.
70	Paint peeled off at the edges of the view panel bedding.
120	Furnace was stopped.

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Head,
BFRC, NIE, Mysuru.



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Table 3. SINGLE LEAF FIRE DOOR M/S. ASTRAL WINDOORS PVT.LTD (OPENING OUTSIDE)

FURNACE AND UNEXPOSED FACE TEMPERATURES

Time (min)	Un-Exposed Face Temperature °C					
	Average	T1	T2	T3	T4	T5
05	29.94	30.5	30.2	30	29.5	29.5
10	31.5	33	32.8	30	31.5	30.2
15	33.52	34	34.6	32.8	32.5	33.7
30	56.92	55	55.6	59.2	58.3	56.5
60	86.2	85	88	85.5	86.5	86
90	98.22	98	98.6	96.8	99.3	98.4
120	108.24	106.5	105.3	108.5	110.4	110.5

Dr. N. SURESH
Head,

BFRC, NIE, Mysuru.



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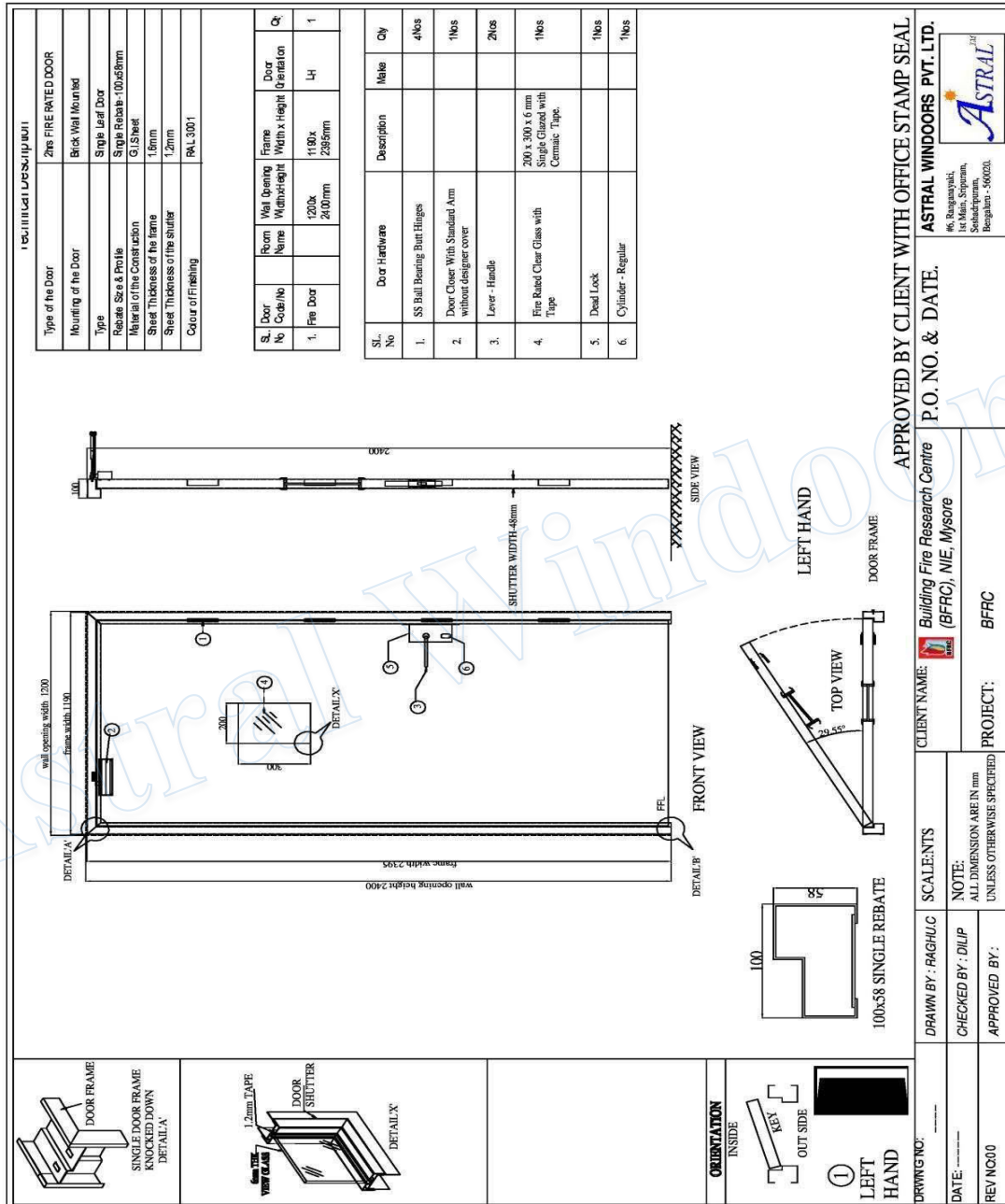


Fig.1. The construction details of single leaf fire door.



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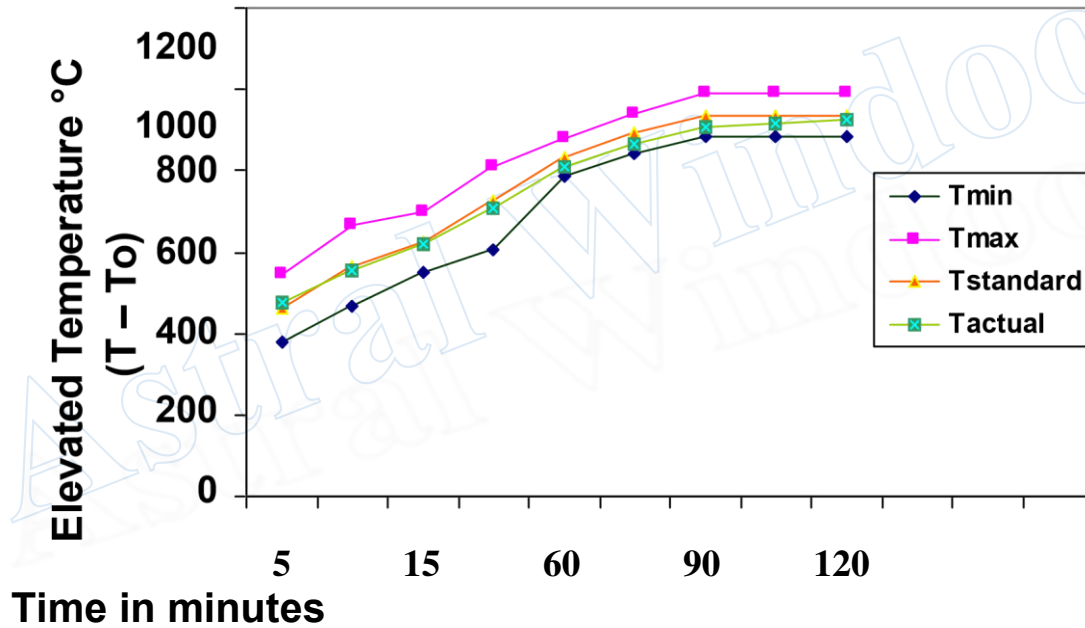


Fig. 2 .Furnace Time-Temperature curve for single leaf fire door

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Head,
BFRC,NIE, Mysuru.



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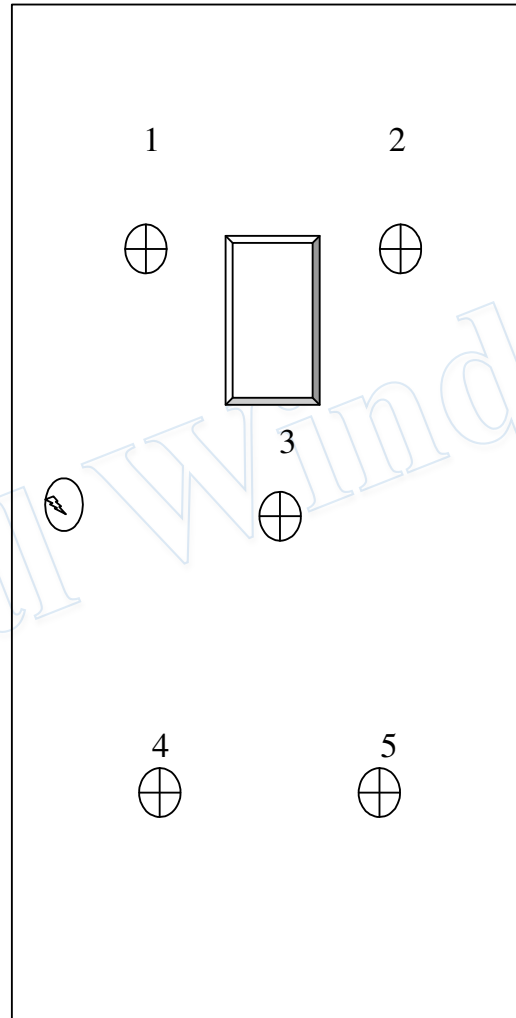


Fig. 3. Position of Thermocouples

⊕ → Thermocouples

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Head,
BFRC,NIE, Mysuru.



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ANNEXURE 1 MULTIPURPOSE FIRE TEST RIG

The wall furnace is a rectangular chamber in construction. The casing is made out of steel. The refractory lining consists of front layer of glass wool. The complete furnace assembly consists of a stationery wall which is a specimen itself.

The furnace is fired by 5 rows of burners each located at different levels. Each row of burners is complete with the necessary pressure regulator and pressure gauges and manually controlled valves.

The products of combustion escape through the flue duct which is located at the top of the furnace.

The pressure in the furnace is controlled by a damper drive located in the passage of the flue gases.

The induced draft chimney system is connected to the flue gas to allow the necessary draft for the movement of gases.

There are peep holes to observe condition of the specimen during the course of the test. The specimen is held in place by a frame called the test rig.

**Dr. N. SURESH
Head,
BFRC, NIE, Mysuru.**



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PHOTOGRAPHS

