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

Submitted to
M/S. Doorwin Technologies.
Hyderabad



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. Doorwin Technologies, Hyderabad, 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
October, 2016

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Head



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PROJECT TEAM

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1.0 SUMMARY

A Double leaf door 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 double leaf door to assess its performance for fire resistance was undertaken. The fire door was subjected to standard heating conditions as specified in IS 3614 (Part 2): 1992, 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. Doorwin Technologies, Hyderabad, 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:

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

Where, t = time of test in minutes

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

T_0 = 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 – T ₀)
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 Double 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 October, 2016. The temperature recorded at five positions on exposed face is given in Table 1. 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.

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 double leaf door opening outside is given in Table 2.



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6.0 RESULTS

One double leaf door of M/S. Doorwin Technologies, Hyderabad 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 Double 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.

7.0 CONCLUSION

**DOUBLE LEAF DOOR OF M/S. DOORWIN TECHNOLOGIES.,
HYDERABAD CAN BE ASSIGNED FOR TWO HOURS (120 MINUTES)
FIRE RESISTANCE RATING AS PER IS 3614-1992 (PART-II)**

THIS CERTIFICATE IS VALID FOR 1YEAR



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Table 1. DOUBLE LEAF FIRE DOOR M/S. DOORWIN TECHNOLOGIES. (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	554	600	588	548	511	523
15	718	703	752	850	806	556	550
30	821	854	781	810	896	895	890
60	925	955	1036	912	926	940	960
90	986	996	1050	1050	998	925	956
120	1029	1007	1036	1040	990	980	990

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

Time (in min.)	Observations
0	Furnace was started.
05	Smoke observed between top edge of door & hinges.
20	Smoke disappeared.
120	Furnace was stopped.

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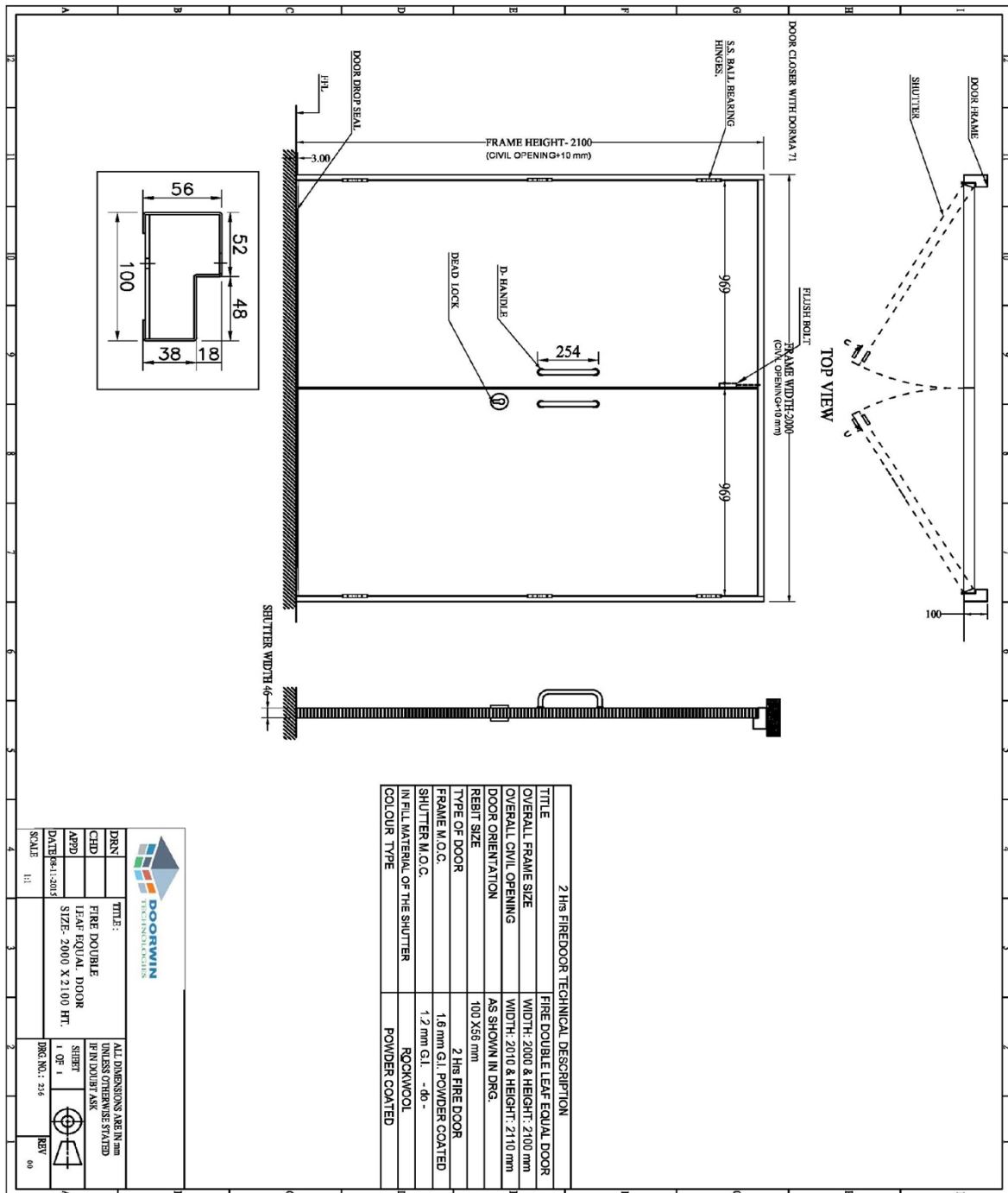


Fig.1. The construction details of Double leaf fire door.



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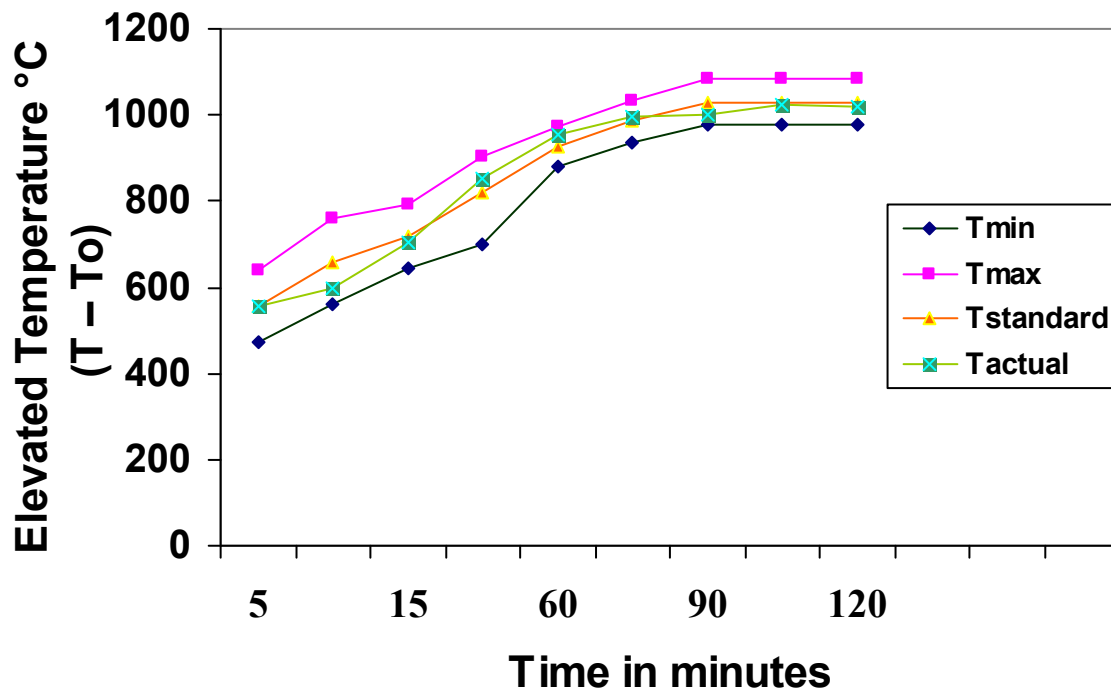


Fig. 2 .Furnace Time-Temperature curve
for Double leaf fire door

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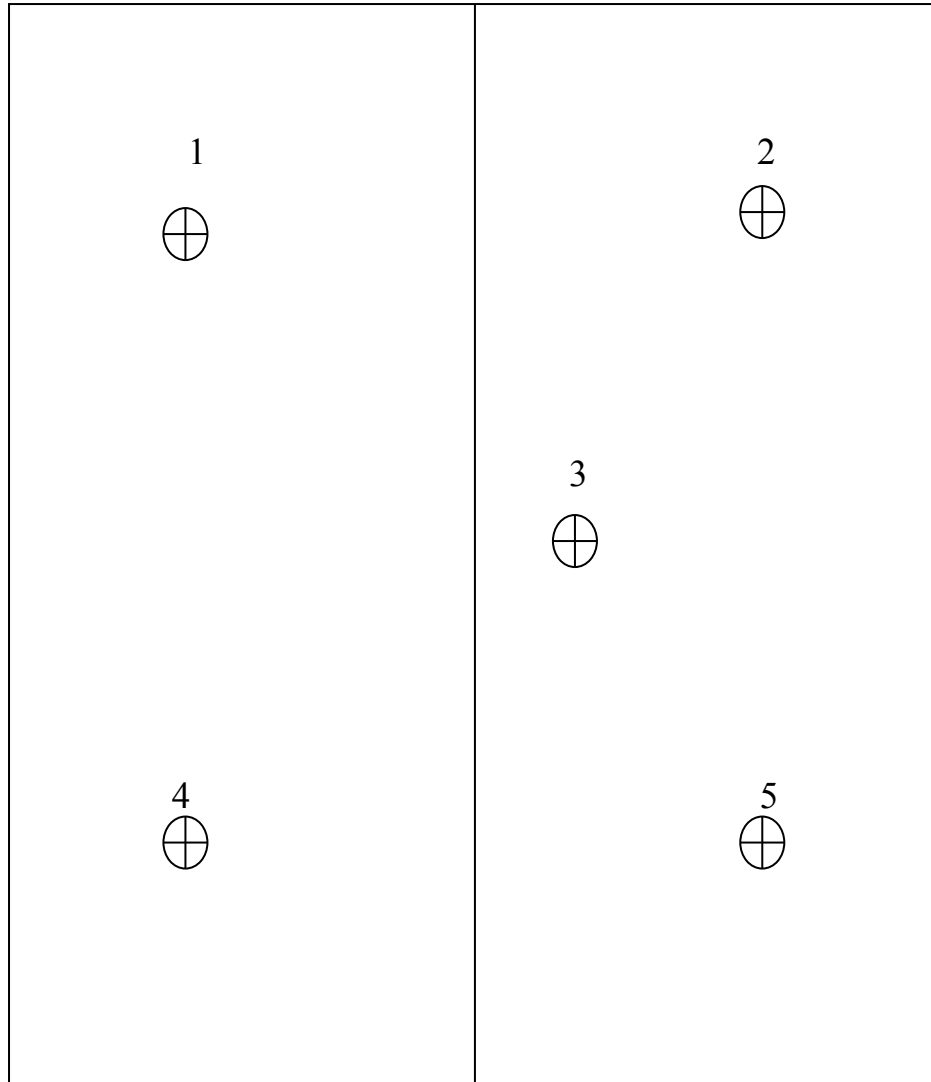


Fig. 3. Position of Thermocouples

⊕ → Thermocouples

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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.

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PHOTOGRAPHS



At the time of fire exposure