FORTE
TESTING AND CONSULTANTS CO., LTD.

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HKAS
HOKLAS 191
TEST

FIRE RESISTANCE TEST REPORT

DOUBLE-LEAF COMPOSITE TIMBER DOOR with METAL CLADDING, A GLAZED ELEMENT AND A GLAZED SIDE PANEL

in accordance with ***BS EN 1634-1: 2008***

Test Sponsor: **Garish Crown Fire Engineering & Consultancy**
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Report Number: IT16-132

Date of Issue: 2016-06-21

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HOKLAS Approved Signatory:
Ir. Dr Chan Yuk Kit

1. Scope of Test

This report was a record of a fire resistance test conducted by Forte Testing and Consultants Company Limited, in conformity with requirements in *BS EN 1634-1: 2008 "Fire resistance and smoke control tests for door, shutter and openable window assemblies and elements of building hardware Part 1: Fire resistance tests for doors, shutters and openable windows"* and particular requirements in *BS EN 1363-1: 1999 "Fire resistance tests – Part 1: General requirements"*.

The test subject was a single acting double-leaf composite timber door with metal cladding, a glazed element and a glazed side panel. The specimen was supplied for test by Well Favour Woodworks Limited and Garish Crown Fire Engineering & Consultancy, the Sponsors.

The specimen achieved the following fire resistance:

INTEGRITY	**(E)**		**INSULATION**	**(I)**		
Sustained Flaming	57	Minutes	Door Frame	Max. Temp. Rise (I_1)	60	Minutes
Gap Gauge	60	Minutes	Door Leaves	Average Temp. Rise	60	Minutes
Cotton Pad	57	Minutes		Max. Temp. Rise(I_1)	54	Minutes
			Glazed Element	Average Temp. Rise	60	Minutes
				Max. Temp. Rise(I_1)	60	Minutes
			Glazed Side Panel	Average Temp. Rise	60	Minutes
				Max. Temp. Rise(I_1)	60	Minutes

2. Test Information

Test Laboratory:	FORTE Testing and Consultants Company Limited
Test Location:	West Side of Huan Xiang Shan, Xin Yu Road, Shajin, Baoan District, Shenzhen, Guangdong Province, China.
Test Sponsors:	Well Favour Woodworks Limited Garish Crown Fire Engineering & Consultancy
Specimen Supplier:	Well Favour Woodworks Limited
ID no. of the Specimen:	QT15-081A
Date Received:	2015-09-07
Test Number:	QT15-081 * A total of two sets of report (Report no. IT15-058 and IT16-132) with identical content had issued at request of the sponsors.
Date Tested:	2015-09-17 **Start Time:** 11:01
Approved Test Operator from FORTE:	Ms. Cheng San Mei, Sammi
Witness of the Test:	Mr. Bill Wan and Mr. Zeta Wan – Official Delegates of the Sponsor
Report Issue Record:	Version 1 – 2016-06-21

3. Construction Details of Specimen

3.1 Specimen Description

3.1.1 Door Frame

The mono timber door frame overall sized 2764 mm (**w**idth) x 2475 mm (**h**eight). The sectional dimension of the door frame was 47 mm (w) x 100 mm (**t**hick) with 20 mm rebate.

The specimen comprised of a share mullion with an overall sectional dimension of 47 mm (w) x 100 mm (t).

The sub-frame was made with film plywood sized 75 mm (w) x 9 mm (t). The sub-frame was fixed into the door frame by pressure nails.

The door frame was fixed into the concrete supporting frame by M6 x 103 mm nylon door frame anchor bolts at maximum 820 mm centre to centre. There were 4 numbers of fixings on each jamb and 3 numbers of fixing on the head of door frame.

Timber architraves sized 50 mm (w) x 12 mm (t) were fixed over the door frame and on the share mullion on both fire exposed side and unexposed side. They were fixed by pressure nails or sealant.

A 30 mm (w) x 4 mm (t) intumescent seal was fitted into the groove along the head and jambs of door frame at 10 mm away from the rebate corner. The seal was partially interrupted at the hinged positions.

A 12 mm x 12 mm smoke seal was fitted along the rebate of the door frame.

The space between door frame and sub-frame was filled with ceramic fibre and lined up with fire sealant.

3.1.2 Door Leaves

The specimen comprised of two unequal width door leaf: the active door leaf sized 1150 mm (w) x 2440 mm (h) and the inactive door leaf sized 350 mm (w) x 2440 mm (h), each door leaf was nominal 56 mm thick.

The stiles and rails were made of 3 numbers of 45 mm (w) x 38 mm (t) timber slabs, whereas the mid-rails were made of 1 number of 45 mm (w) x 38 mm (t) timber slabs. The stiles and rails were fixed together by steel staples. The space between stiles and rails were filled with 38 mm (t) perlite core. Both sides of the core were covered by a layer of 5 mm (t) fire board sub-facing and 3 mm (t) medium density fibreboard (MDF) on both sides. The sub-facing was fixed onto the stiles and rails by screws; the facing was fixed onto the sub-facing by glue. A 1 mm (t) stainless steel facing was fixed on both sides of the door leaf with angle return into the groove for intumescent seals.

The door lippings were made of wooden strips.

The specimen comprised unequal rebated meeting edge.

A 30 mm (w) x 4 mm (t) intumescent seal was fitted into the groove along the top and hinged edges of the door leaf.

A 20 mm (w) x 4 mm (t) intumescent seal was fitted into the grooves along the meeting edge on both the active and inactive door leaf.

A 10 mm (w) x 4 mm (t) intumescent seal was fitted into the grooves along bottom edge of each door leaf at 3 mm away the unexposed side.

A 12 mm x 12 mm smoke seal was fitted along the rebate corner of meeting edge along the inactive door leaf.

3.1.3 Glazed Element

The specimen comprised of a glazed element on the active door leaf visually sized 160 mm (w) x 1750 mm (h) and it was installed 350 mm away from the top edge and 470 mm away from the meeting edge of the door leaf.

The glazed element consisted of a piece of nominal 25 mm (t) interlayered glass pane. The glass pane was lined with 2 mm (t) intumescent pad and set on a 5 mm (t) fire board then clamped by 1 mm (t) steel angle and timber glazing beads sized 25 mm (width, parallel to the glass) x 20 mm (thick, perpendicular to the glass). A 1 mm (t) stainless steel facing was glue fixed on the timber glazing beads.

The timber glazing beads were fixed onto the door leaf by pressure nails at maximum 100 mm centre to centre.

3.1.4 Glazed Side Panel

The specimen comprised of a glazed side panel visually sized 1113 mm (w) x 2345 mm (h).

The glazed element consisted of a piece of nominal 25 mm (t) interlayered glass pane. The glass pane was set on a 5 mm (t) fire board and it was sandwiched by 2 (t) ceramic fibre tape, 17 mm x 25 mm x 1 mm (t) steel angles and timber glazing beads sized 20 mm (width, parallel to the glass) x 37.5 mm (thick, perpendicular to the glass) with 3 mm x 3 mm groove. The steel angels were fixed onto the door leaf by M3 x 25 mm wood screws; the timber glazing beads were fixed onto the door leaf by pressure nails at approximate 100 mm to 180 mm centre to centre.

3.1.5 Ironmongeries

The active door leaf was supported onto the door frame by 4 numbers of butt hinge. The top and bottom hinge on the active door leaf was 160 mm and 200 mm away from the top rim and the bottom of the door leaf respectively. The maximum distance between hinges was 910 mm.

The inactive door leaf was supported onto the door frame by 3 numbers of butt hinge. The top and bottom hinge on the active door leaf was 250 mm away from the top rim and the bottom of the door leaf respectively. The maximum distance between hinges was 970 mm.

A mortise lock with handle set was installed 1000 mm above the bottom edge of the door leaf.

A door coordinator was mounted on the head of door frame near the meeting edges of the door leaf on unexposed side.

A surface mounted door closer was installed at the top edge of the each door leaf on the fire exposed side.

A flush bolt was installed into the groove at the top and bottom of the meeting edge on the inactive door leaf.

A conceal bottom drop seal was fitted into the groove along the bottom edge of each door leaf.

Intumescent material was applied to mortised area for ironmongeries.

3.2 Material Schedule

Parts specifications were summarized in the following tables.

A star mark "*" indicates those not verified by FORTE.

Door Frame

Supplier:	Well Favour Woodworks Limited
Material:	Timber (Hardwood *)
Overall Sizes:	2764 mm x 2475 mm
Rebate:	20 mm
Dimensions:	47 mm x 100 mm
Density:	350 - 400 kg/m^3 *
Connection Method of Head to Jamb:	By Tongue and Groove Joint and Fixed by Ø5 mm x 50 mm Screws or Nails
Fixing Method to Sub-frame:	By Pressure Nails at Approximate 50mm to 100 mm Centre to Centre
Gap Filling between Door Frame and Sub-frame:	Ceramic Fibre and Lined Up with Fire Sealant

Sub-Frame

Supplier:	Well Favour Woodworks Limited
Material:	Film Plywood
Sizes:	75 mm x 9 mm
Density:	350 - 400 kg/m^3 *
Fixing method to Concrete Supporting Frame:	By M6 x 103 mm Nylon Door Frame Anchor Bolts at Maximum 820 mm Centre to Centre

Architraves

Supplier:	Well Favour Woodworks Limited
Material:	Timber (Hardwood *)
Sizes:	50 mm x 12 mm
Density:	550 - 700 kg/m^3 *
Fixing Method:	By Wood Nails of Pressure Nails at Approximate 200 mm - 350 mm Centre to Centre

Intumescent Seal - Door Frame

Supplier:		Garish Crown Fire Engineering & Consultancy
Brands:		Ying Mu*
Head & Jambs	Model:	YM3004 *
	Sizes:	30 mm x 4 mm

Smoke Seal

Supplier:	Garish Crown Fire Engineering & Consultancy
Brands:	Ying Mu*
Model:	YM1212 *
Sizes:	12 mm x 12 mm
Location Applied:	Along the Rebate Corner of Door Frame and Meeting Edge of Inactive Door Leaf

Door Leaves

Supplier:		Well Favour Woodworks Limited
Overall Sizes:		(1150+350) mm x 2440 mm
Nominal Thickness:		56 mm
Measured Thickness:		58.04 mm
Stiles and Rails	Material:	Timber (Softwood*)
	Width:	Main Stiles and Rails – 3 x 45 mm Mid Rails – 45 mm
	Thickness:	38 mm
	Density:	350 - 400 kg/m^3 *
	Moisture Content:	12 – 17 % *
Core	Material:	Perlite
	Brand:	Perfect Material *
	Thickness:	38 mm
	Density:	380 kg/m^3 *
	Moisture Content:	12 – 17 % *

Door Leaf Lipping

Supplier:	Well Favour Woodworks Limited
Material:	Timber (Hardwood *)
Thickness:	8 mm
Density:	550 - 700 kg/m^3 *

Fire Board

Supplier:	Perfect Material Company *
Brand:	Perfect Material *
Thickness:	5 mm
Density:	950 - 1050 kg/m^3 *
Location Applied:	Door Leaf Sub-facing and Glazed Element Setting Block

Door Leaf Sub-facing

Supplier:	Well Favour Woodworks Limited
Material:	Medium Density Fibreboard (MDF)
Thickness:	3 mm
Density:	450 - 550 kg/m^3 *

Door Leaf Facing

Supplier:	Well Favour Woodworks Limited
Material:	Stainless Steel
Thickness:	1 mm

Intumescent Seal - Door Leaves

Supplier:		Garish Crown Fire Engineering & Consultancy
Brands:		Ying Mu *
Top and Hinged Edges	Model:	YM3004 *
	Sizes:	30 mm x 4 mm
Meeting Edge of Door Leaf	Model:	YM2004 *
	Sizes:	20 mm x 4 mm
Bottom Edge of Door Leaf	Model:	YM1004 *
	Sizes:	10 mm x 4 mm

Glazing Elements

Supplier:	Shenzhen Zhongxinchang Technology Company Limited	
Brand:	ZXC *	
Combination of the Glass Pane:	5±0.05 mm Clear Glass + 15±0.05 mm Gel + 5±0.05 mm Clear Glass	
Nominal Thickness:	25 mm	
Measured Thickness:	25.17 mm	
Full Sizes:	200 mm x 1790 mm	1153 mm x 2385 mm
Visual Sizes:	160 mm x 1750 mm	1113 mm x 2345 mm
Glass Edge Covering Depth:	20 mm	
Fixing Method:	Lined with Intumescent Pad and Set on Fire Board; Clamped by Steel Angle and Timber Glazing Beads	

Glazing Bead

Supplier:	Well Favour Woodworks Limited
Material:	Timber (Hardwood *)
Sizes:	Glazed Element on Door Leaf- 25 mm x 20 mm Glazed Side Panel - 20 mm x 37.5 mm
Density:	550 - 700 kg/m^3 *
Fixing Method:	By Pressure Nails At Maximum 100 mm Centre to Centre

Glazed Element - Fixing Angle

Supplier:	Well Favour Woodworks Limited	
Material:	Stainless Steel	
Sizes:	17 mm x 25 mm x 1 mm	17 mm x 15 mm x 1 mm
Fixing Method:	Self-tapping Screws at Maximum 200 mm Centre to Centre	

Butt Hinge

Supplier:	ABS Building Product Company Limited	Not Provided
Brand:	ABS	Weber
Model:	H102A *	Not Provided
Material:	Stainless Steel *	
Sizes:	102 mm x 102 mm x 3 mm	

Mortise Lock

Supplier:	ABS Building Product Company Limited
Brand:	ABS *
Model:	11206/60 Sash Lock*
Material:	Stainless Steel *
Sizes:	Body: 166 mm x 75 mm * Forend: 28 mm x 200 mm * Backset: 60 mm *

Handle Set

Supplier:	ABS Building Product Company Limited	
Brand:	ABS	
Material:	Forged Brass *	
Model:	Not Provided	Not Provided
Location Applied:	Fire Exposed Side	Fire Unexposed Side

Door Closer

Supplier:	ABS Building Product Company Limited
Brand:	ABS
Model:	7300 EN2-4 *
Material:	Precise Cast Aluminum Body & Steel Arm *

Door Coordinator

Supplier:	ABS Building Product Company Limited
Brand:	ABS
Model:	DC280 *
Material:	Stainless Steel *
Sizes:	Swing Arm: 280 mm

Flush Bolt

Supplier:	ABS Building Product Company Limited
Brand:	ABS
Material:	Stainless Steel *
Model:	BFB *
Sizes:	200 mm

Conceal Bottom Drop Seal

Supplier:	Garish Crown Fire Engineering & Consultancy
Brand:	Ying Mu
Model:	Not Provided
Material:	Aluminum *

Fire Sealant

Supplier:	Everbuild Building Products Limited
Brand:	Everbuild
Model:	Fire Mate *
Location Applied:	Between the Gap along the Door Frame and Test Frame

Glue

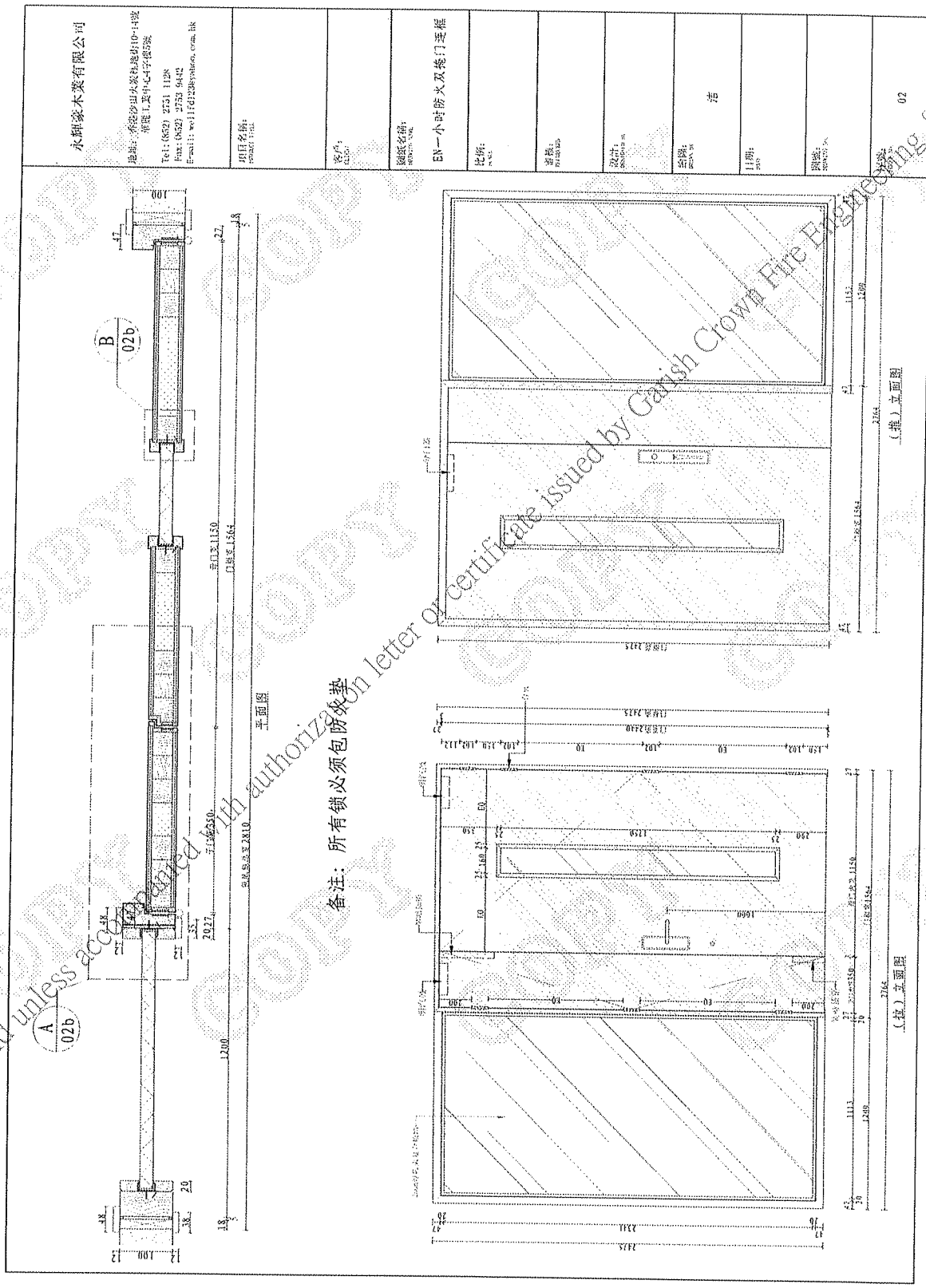
Supplier:	Well Favour Woodworks Limited *
Type:	木膠粉 *

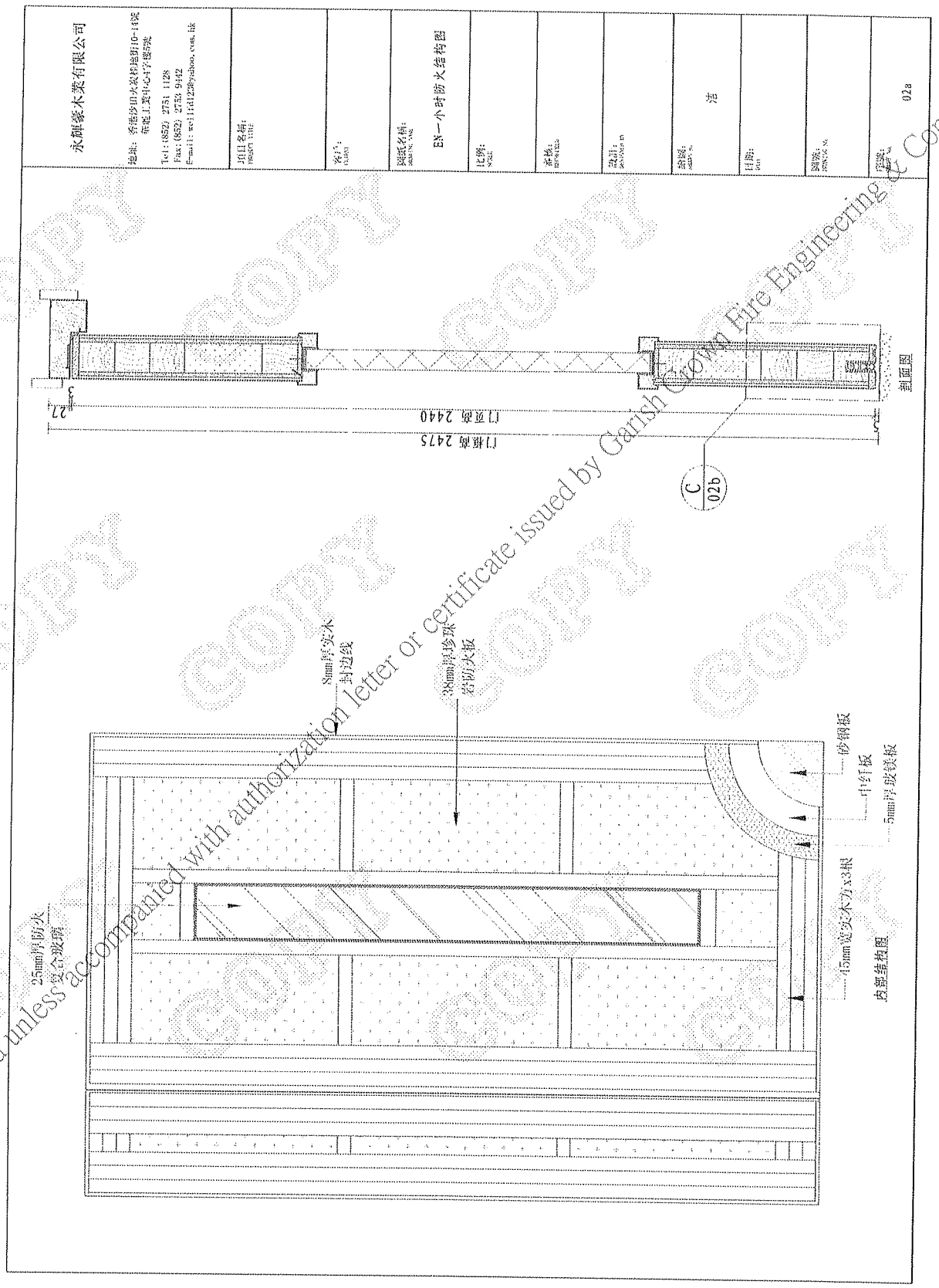
Intumescent Pad

Supplier:	Garish Crown Fire Engineering & Consultancy
Brand:	Ying Mu
Model:	YM100 *
Thickness:	2 mm
Location Applied:	At the Concealed Faces of the Ironmongeries and Underneath the Intumescent Seals

3.3 Drawings on the Specimen provided by the Sponsor (Total 3 pages)

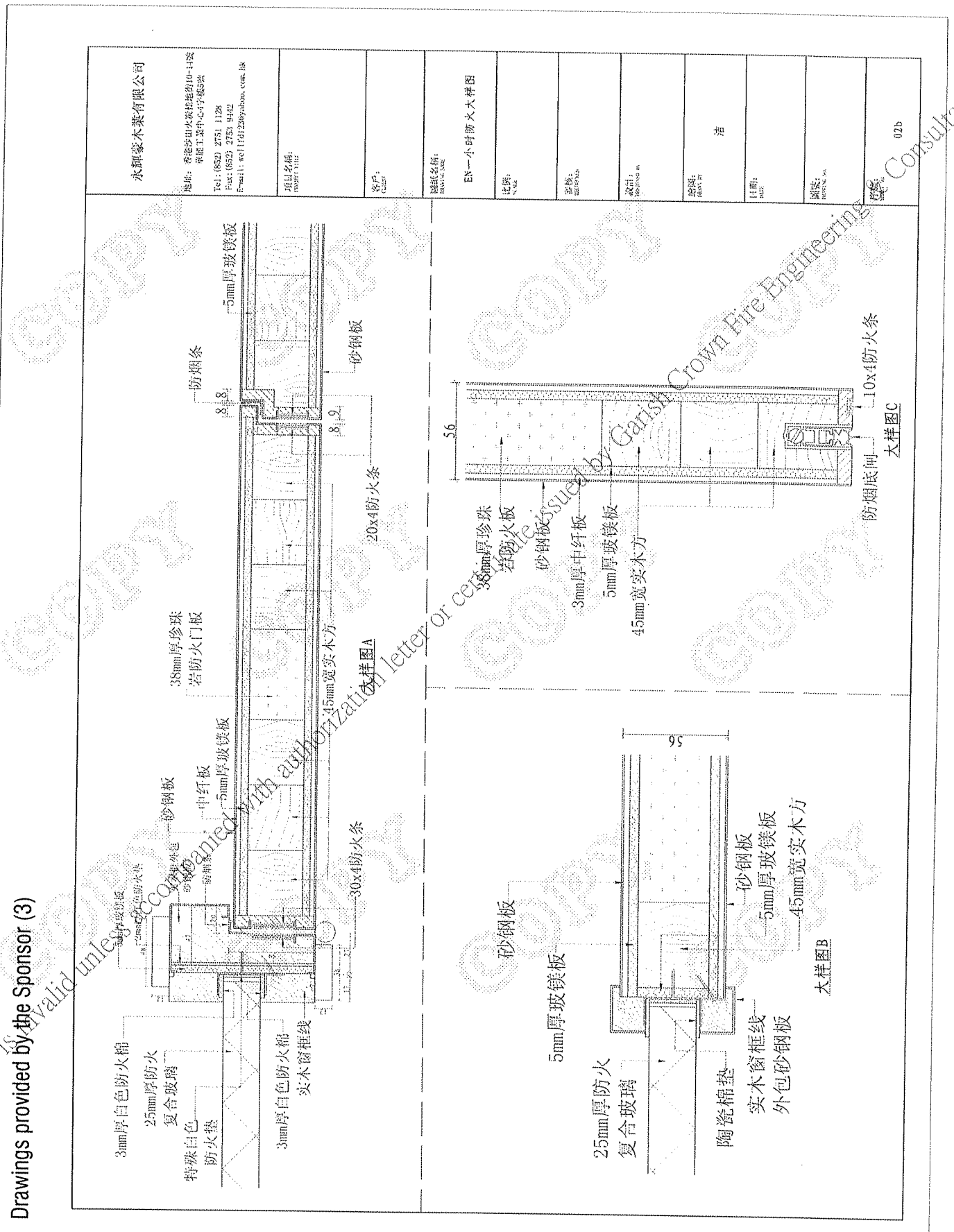
Drawings provided by the Sponsor (1)





Drawings provided by the Sponsor (2)

Drawings provided by the Sponsor (3)



4. Condition

4.1 Selection of the Specimen

The specimen was submitted by the sponsor to the Test Location, and selected by FORTE.

All the components of the test specimen were supplied by the Sponsor.

4.2 Verification of the Specimen

The specimen was transferred to the Test Location on 2015-09-07 by the Sponsor.

Parts of the manufacturing process were over seen by FORTE delegates.

In *section 3.2* of this report, items which had been verified by FORTE was clearly identified and distinguished from those relying on Sponsor's declaration.

4.3 Supporting Construction

The specimen was fixed into a supporting construction made of fully cured reinforced normal density concrete slabs provided by FORTE. The concrete slabs formed a structural opening 2787 mm (w) x 2496 mm (h).

4.4 Installation of the Specimen

The specimen was assembled and installed by workers delegated by the Sponsor on 2015-09-07 to 2015-09-15.

4.5 Specimen Conditioning

The specimen was stored in the Test Location from 2015-09-07, the date which specimen was received, to 2015-09-17, the date which fire resistance test performed.

The average environment parameters in the Test Location within this period were:

Ambient Temperature (°C)	Relative Humidity (%)
30 ± 5	70 ± 10

4.6 Direction of Fire Side and Others

The Sponsor designated and installed that door leaves on specimen could only be swung inwards the furnace.

The door lock was UNLOCKED and UNLATCHED; the flush bolts were UNBOLTED during the test.

5. Test Method

5.1 Pre-test Conditioning

The pre-test conditioning of the specimen was carried out on 2015-09-15 prior to the fire test with reference to *BS EN 1634-1: 2008* and *clause 5.1.1.1 and 5.1.1.3, BS EN 14600: 2005.*

Operability test of the specimen:

The specimen should been tested for operability in the fire test frame by operating from fully closed to fully open at 90 degrees for 25 cycles.

Self-closing for doorset without coordinating devices:

The specimen had each leaf opened to 10° ± 2° and held for 20s ± 2s and then without shock and allowed to closed at the speed between one-tenth of the leaf width per second up to a maximum leading edge speed of 300 mm/s.

5.2 Ambient Temperature

The ambient temperature was measured by mineral insulated metal sheathed type K thermocouple. The measuring junction was screened by two concentric plastic pipes from radiated heat and draught, at a position approximate 1500 mm away the test construction.

5.3 Heating Condition

The average temperature inside the furnace was monitored and controlled throughout the test according to the standard heating curve stated in *BS EN 1363-1:1999* given by the equation:

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

Where,

T is the average furnace temperature, in degree Celsius

t is the time, in minutes

The temperature inside the furnace was measured in conformity with *BS EN 1363-1: 1999* by 9 numbers of plate thermometers. These thermometers were evenly distributed over a vertical plane approximately 100 mm from the exposed surface of the test construction.

The positions of furnace thermocouple were shown in *Figure 1*.

5.4 Unexposed Surface Temperature

The unexposed surface temperatures of the specimen were measured by 41 numbers of type K thermocouples.

The temperature rise was calculated by subtracting the initial average temperature from the unexposed temperature measured.

The specimen was evaluated against the maximum temperature rise criterion given by supplementary procedure – Classification I_1 at the request of the Sponsor.

These thermocouples were positioned and fixed on unexposed surface of the test specimen in conformity with *BS EN 1634-1: 2008*.

The positions of unexposed surface temperature measurement point were shown in *Figure 3*. The locations of thermocouple were explained in the following table.

Thermocouple	Area	Description
U1—U5	Door Leaves	For average and maximum unexposed surface temperature rise
U6—U13; U30—U37	Door Leaves	For maximum unexposed surface temperature rise **(Supplementary Procedure, I_1)**
U14—U21	Door Frame	For maximum unexposed surface temperature rise
U25—U29	Glazed Side Panel	For average and maximum unexposed surface temperature rise
U38—U41	Glazed Side Panel	For maximum unexposed surface temperature rise
U22, U24	Glazed Element	For average and maximum unexposed surface temperature rise
U23	Glazed Element	For maximum unexposed surface temperature rise

5.5 Pressure Condition

The pressure inside the furnace was continuously monitored in compliance with *BS EN 1363-1: 1999* during the whole test. The pressure at a point 500 mm above the notional floor level was to be maintained 0 ± 5 Pa by five minutes from commencement of the test and 0 ± 3 Pa that from ten minutes onwards with respect to the atmosphere.

5.6 Deflection Measurements

Measurements of the deflection of the test specimen were taken with a steel rule from cross line laser across the top, mid-height and bottom of the specimen.

The positions of deflection measurement point were shown in *Figure 4*.

Figure 1. Positions of thermocouple and pressure measuring probe inside the furnace.

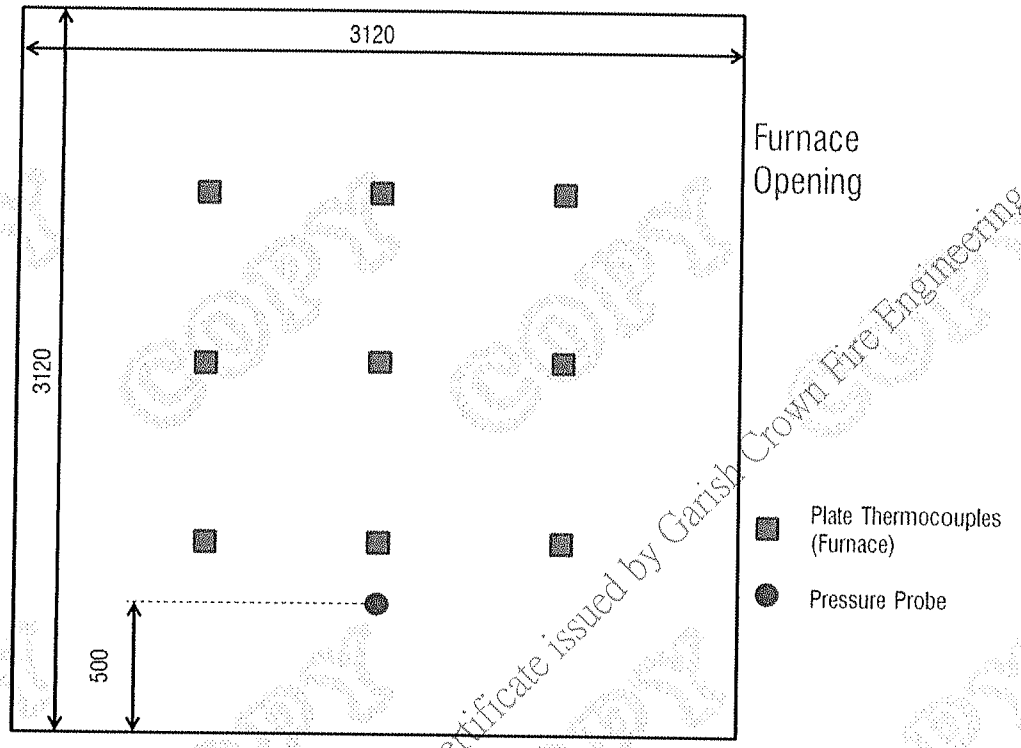


Figure 2. Primary gaps measurement positions of the specimen.

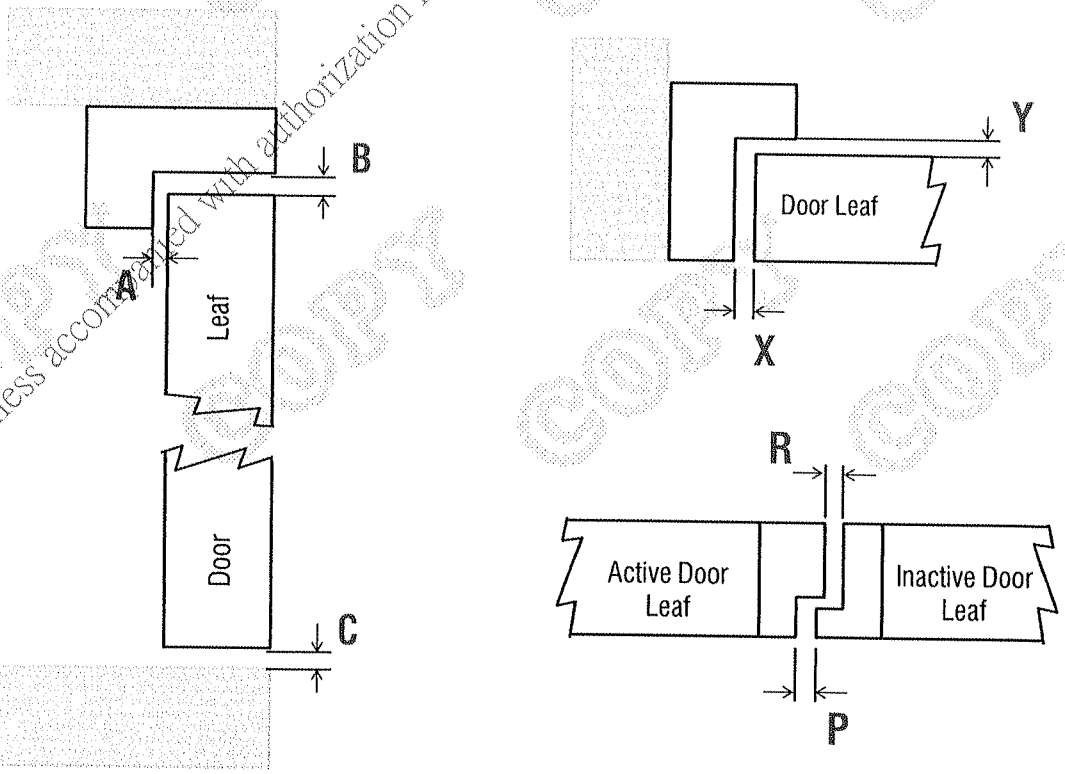


Figure 3. Positions of fixed surface thermocouple (U) on the specimen.

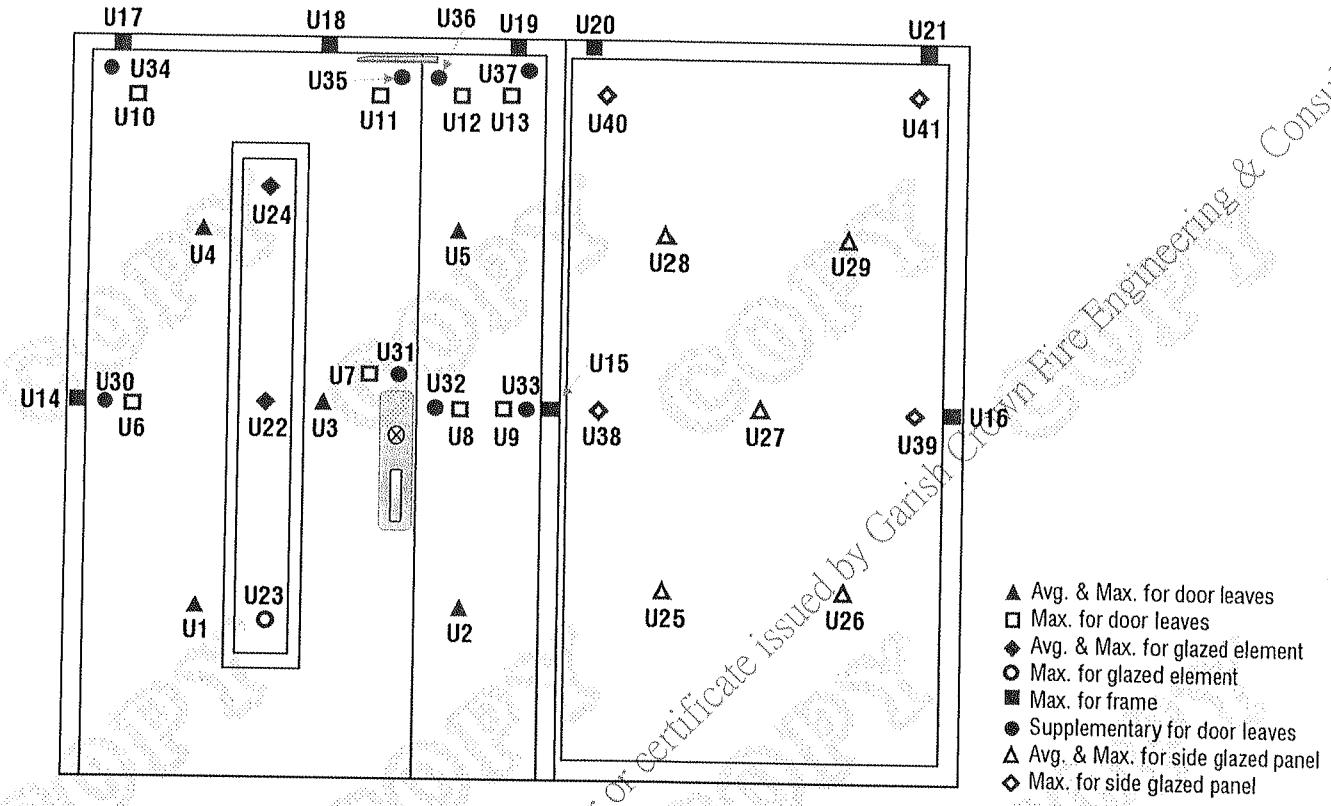
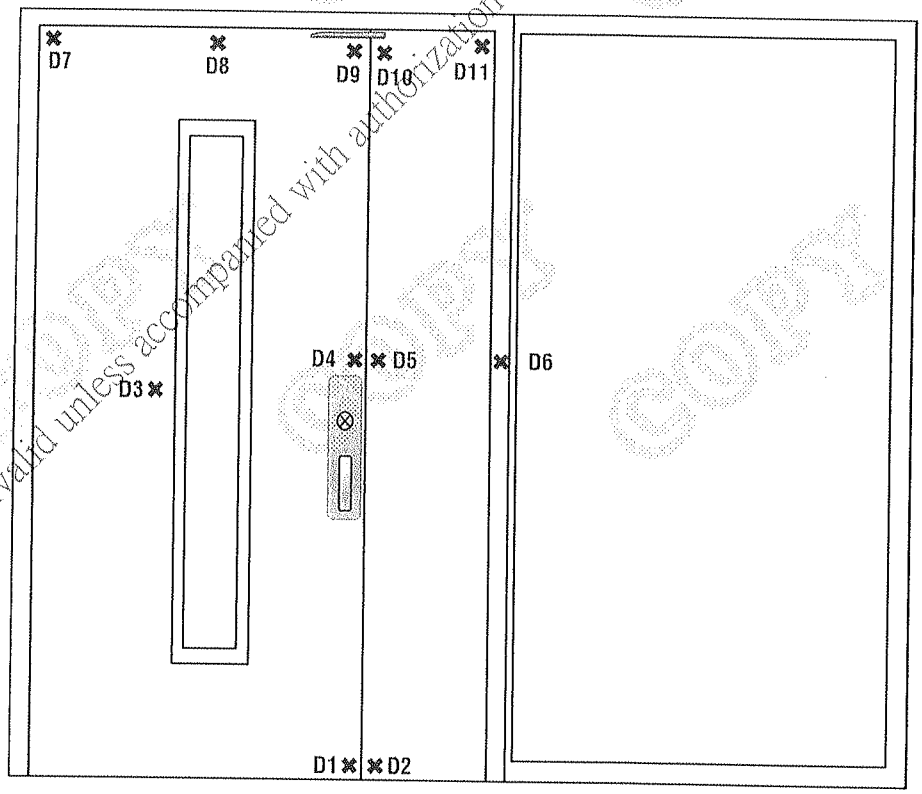


Figure 4.Positions of deflection measurement point (D) on the specimen.



6. Test Data

6.1 Retention Forces and Pre-Conditioning of the Specimen

The retention forces on each door leaf of the specimen for each direction of opening were determined. The respective highest gauge measurements were summarized in the following table.

Leaf	Push	Pull
Active	75.5 N	84.0 N
Inactive	183.6 N	191.4 N

Operability test of the specimen:

The specimen had been tested for operability in the fire test frame by operating from fully closed to fully open at 10 degrees for 25 cycles.

Closing speed of the specimen without coordinating devices:

Leaf	Leading Edge Speed (mm/s)
Active	127.0
Inactive	83.7

6.2 Gaps Measurement

Primary gaps of the specimen were measured and summarized in the following table.

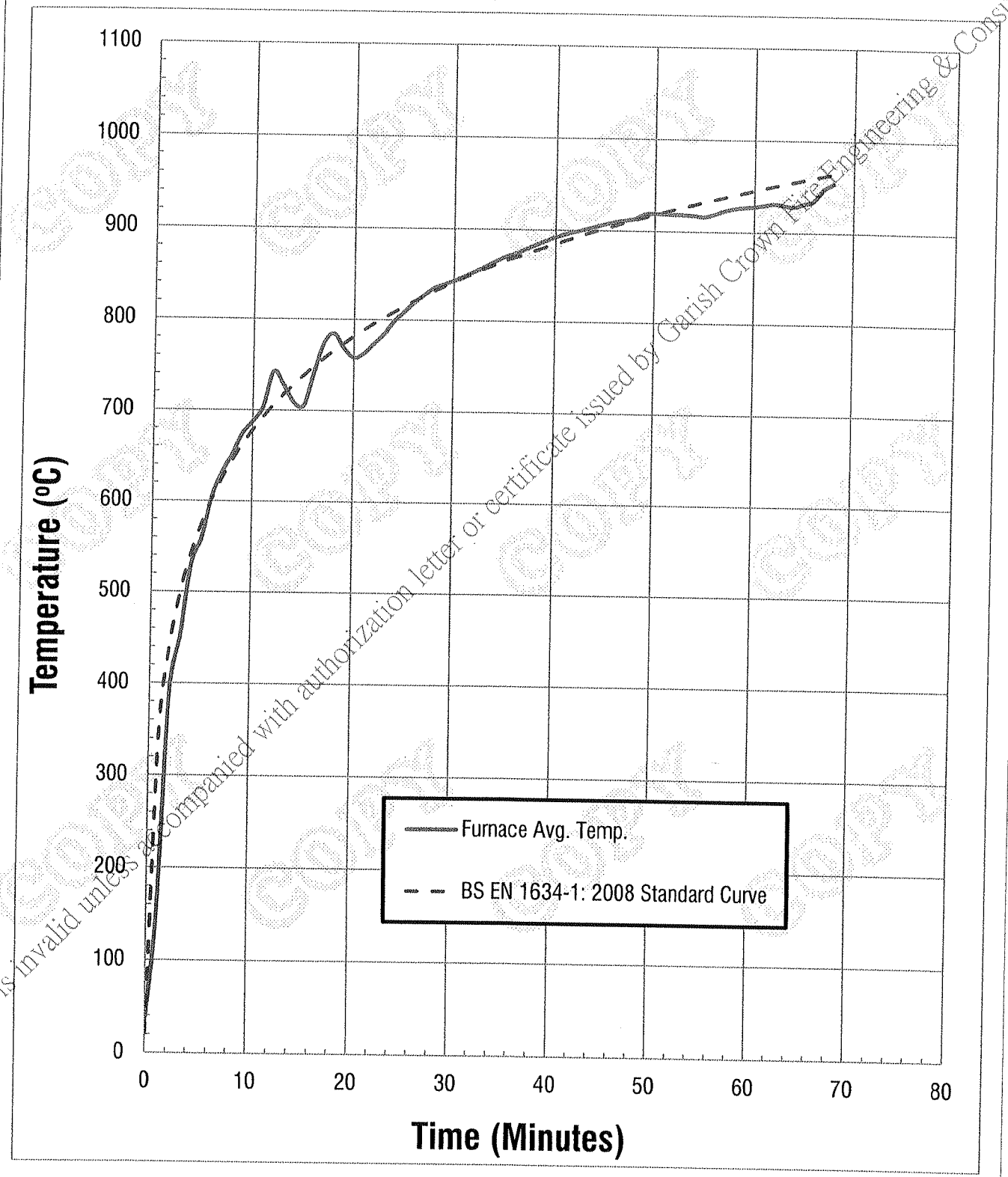
Measurements were taken in mm.

Gap	Measured		
	Minimum	Maximum	Average
A	1.1	3.9	2.2
B	1.5	2.3	1.8
C	1.5	6.5	3.6
P	1.5	3.8	2.8
R	2.4	2.9	2.7
X	1.5	4.5	3.2
Y	1.5	2.1	1.7

6.3 Furnace Temperature

The furnace average temperature over the test period was shown in *Figure 5*.

Figure 5. Furnace average temperature over the test period.



6.4 Unexposed Surface Temperature Rise

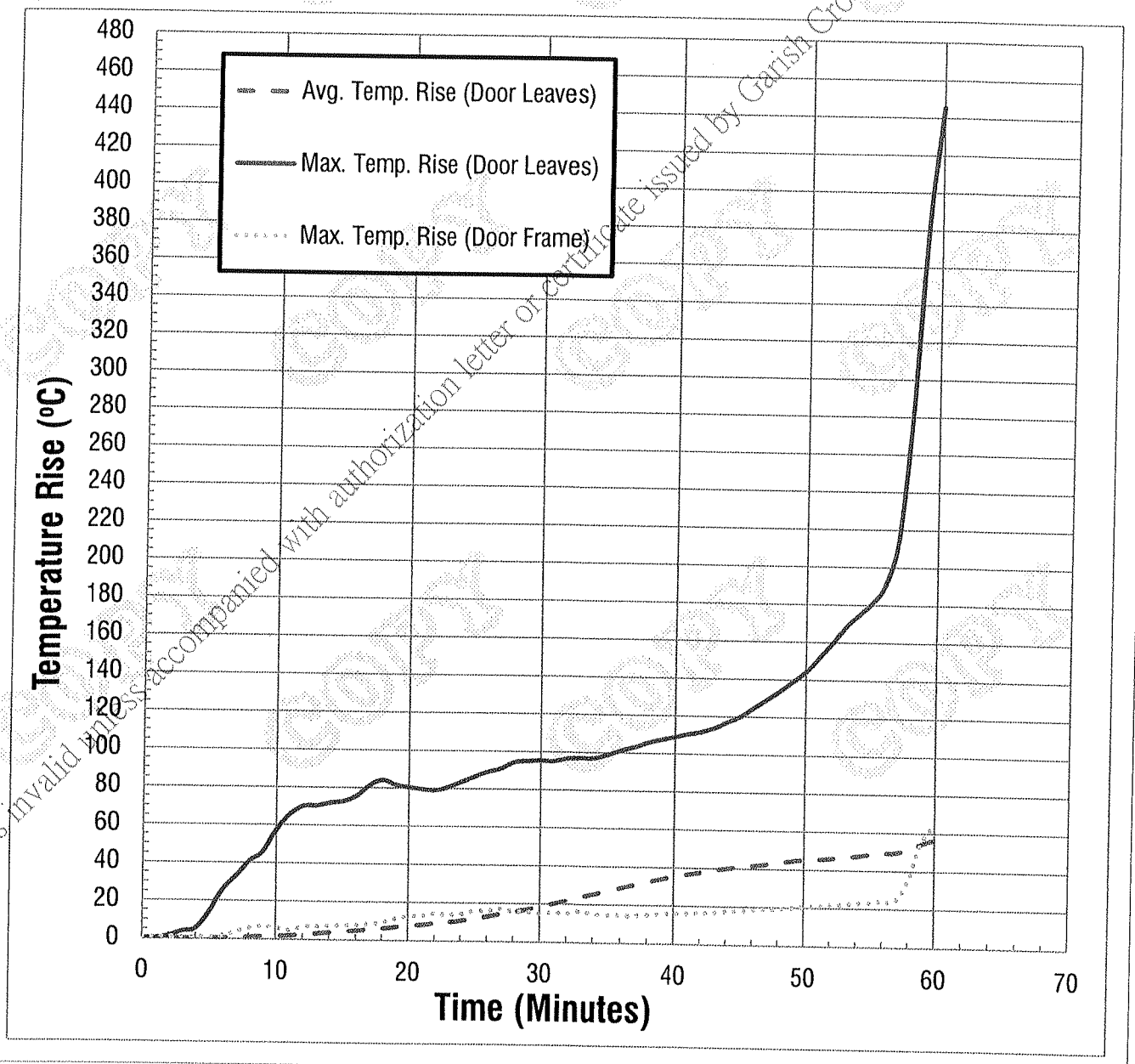
6.4.1 Fixed Surface Thermocouples – Door Leaves and Door Frame

The temperature rises of unexposed surface on door leaves and door frame measured by fixed surface thermocouples over the test period were shown in *Figure 6.*

The maximum temperature rise of door leaves measured at 54.9 minute of test at U36 was 180.2°C which was in excess of 180°C limit.

A fire board was covered onto the top of meeting edges at 60 minute during the test at requrst of the Sponsor. Due to safety reason, water was spray onto the door leaves, therefore the data captured from the thermocouples on door leaves after 60 minute was discarded.

Figure 6. Average and maximum temperature rise on door leaf and door frame over the test period.

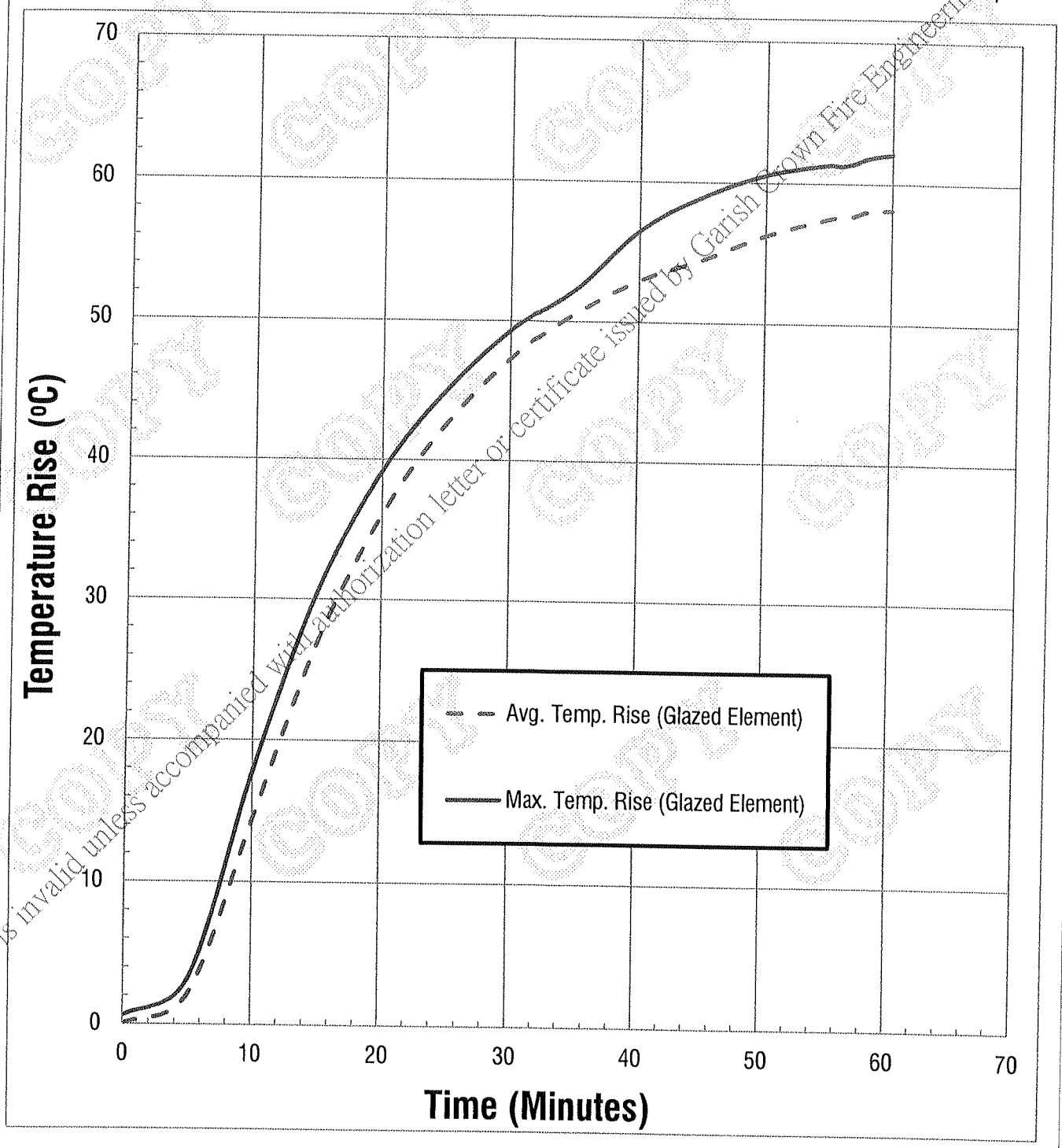


6.4.2 Fixed Surface Thermocouples – Glazed Element

The temperature rises of unexposed surface of glazed element of the specimen measured by fixed surface thermocouples over the test period were shown in Figure 7.

Due to safety reason, water was spray onto the door leaves, therefore the data captured from the thermocouples on door leaves after 60 minute was discarded.

Figure 7. Average and maximum temperature rise on the glazed element of the specimen over the test period.

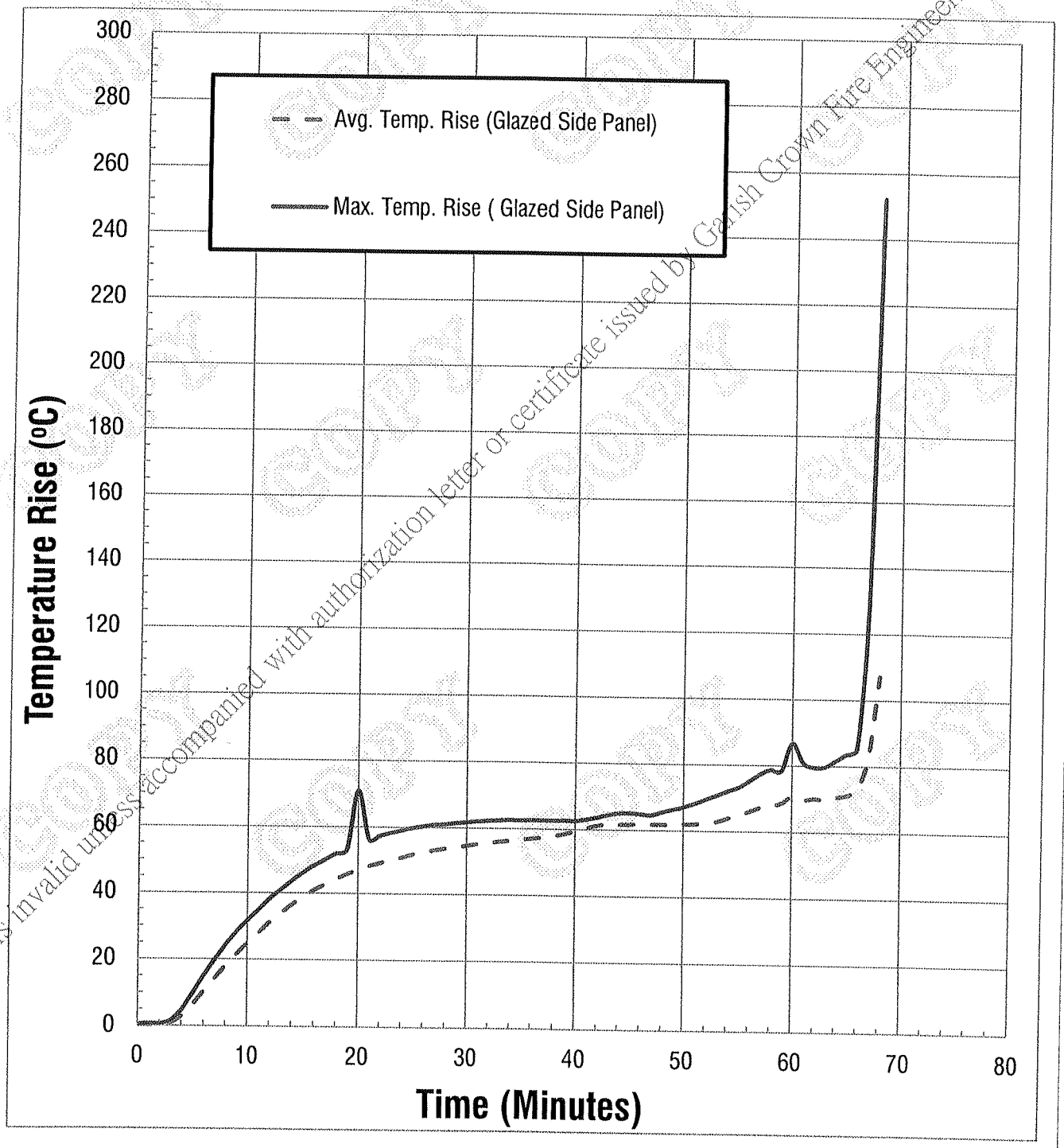


6.4.3 Fixed Surface Thermocouples – Glazed Side Panel

The temperature rises of unexposed surface on glazed side panel measured by fixed surface thermocouples over the test period were shown in *Figure 8.*

The maximum temperature rise of glazed side panel at 67.5 minute of test at U26 was 182.0°C which was in excess of 180°C limit.

Figure 8. Average and maximum temperature rise on fixed glazed side panel over the test period.



6.4.4 Fixed Surface Thermocouples – Detailed Temperature Records

The outputs of the unexposed surface thermocouples on the specimen were summarized in the following tables. Measurements were taken in °C.

A fire board was covered onto the top of meeting edges at 60 minute during the test at requrst of the Sponsor. Due to safety reason, water was spray onto the door leaves, therefore the data captured from the thermocouples on door leaves after 60 minute was discarded.

Temperature outputs from unexposed surface temperature U1 to U11

Time (min)	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11
0	29.0	28.9	28.9	29.2	29.1	28.9	28.3	27.9	29.0	28.7	28.8
5	29.3	29.2	29.0	29.5	29.9	29.3	28.5	28.1	29.1	29.5	34.4
10	29.4	30.2	29.0	29.7	35.1	30.5	28.6	29.7	29.8	31.6	65.4
15	29.9	34.3	31.6	30.3	40.3	33.2	31.3	33.6	32.0	35.8	92.2
20	31.9	37.1	34.7	33.2	46.0	35.5	35.1	36.7	34.6	39.4	75.7
25	36.3	40.7	38.8	37.9	50.3	38.1	40.2	40.6	38.6	44.0	67.7
30	46.1	45.4	46.0	46.3	53.7	41.8	46.5	45.4	44.3	51.4	65.9
35	58.7	50.4	58.3	57.2	56.5	47.3	54.8	51.5	50.8	58.2	67.1
40	69.0	55.7	70.3	66.5	60.3	54.6	62.1	58.4	57.6	67.0	70.4
45	74.7	62.0	76.2	72.2	64.7	61.2	67.3	64.6	64.1	80.3	74.4
50	77.8	69.3	78.5	75.7	70.4	67.6	72.8	70.7	69.9	84.7	79.7
55	79.1	78.0	77.7	73.6	79.3	73.1	80.3	76.3	74.9	94.0	90.7
56	79.1	79.8	77.7	73.8	81.2	74.9	83.5	77.2	75.2	94.5	94.9
57	79.6	81.3	77.0	73.8	81.5	76.3	88.1	78.1	76.2	94.6	98.8
58	79.5	82.6	77.1	73.9	88.7	77.8	92.0	78.9	77.4	95.0	103.9
59	79.1	84.0	77.2	74.7	102.1	79.1	93.9	80.0	78.8	95.1	116.1
60	79.0	85.2	77.2	75.9	111.4	80.4	95.0	81.1	82.1	95.3	134.9

Temperature outputs from unexposed surface temperature U12 to U22

Time (min)	U12	U13	U14	U15	U16	U17	U18	U19	U20	U21	U22
0	29.2	29.3	29.4	29.8	28.5	28.9	29.0	29.0	29.3	29.6	29.3
5	29.9	29.9	29.7	30.1	28.7	29.4	29.8	29.2	29.6	29.8	31.3
10	35.1	32.8	29.8	30.3	28.9	30.8	35.2	31.1	31.0	31.5	43.8
15	44.1	40.9	30.4	30.8	29.2	32.0	36.6	35.0	33.1	33.6	56.4
20	50.3	46.0	31.1	31.6	29.6	33.8	41.8	37.7	35.3	35.3	65.5
25	55.7	51.5	31.9	32.7	29.7	36.9	44.9	39.3	36.7	36.5	72.3
30	63.3	57.1	32.9	34.2	30.0	40.1	44.1	40.9	37.8	37.7	77.0
35	69.3	62.4	33.9	35.9	30.3	43.0	43.7	42.2	39.3	39.1	80.4
40	76.7	69.1	35.3	37.9	30.6	45.1	44.0	44.1	41.4	40.2	83.0
45	83.9	77.4	36.5	40.1	30.9	47.1	45.5	46.6	43.6	41.2	84.1
50	93.2	86.7	37.8	42.1	31.8	49.6	47.6	49.6	46.5	42.4	85.6
55	106.6	89.7	39.4	44.6	33.5	52.2	52.1	52.3	49.4	44.5	86.6
56	109.1	90.7	39.6	45.3	33.9	52.7	53.3	53.1	50.1	45.0	86.7
57	110.4	91.3	40.0	45.7	34.3	53.1	52.7	53.4	50.7	45.5	86.8
58	113.0	92.3	40.3	46.2	35.0	53.5	64.4	55.7	51.3	45.9	87.0
59	119.9	93.5	40.9	47.0	35.8	54.1	84.3	56.7	52.1	46.6	87.1
60	128.9	94.6	41.2	47.3	36.3	54.7	93.9	57.6	52.6	47.5	87.1

Temperature outputs from unexposed surface temperature U23, U24 to U30 to U37

Time (min)	U23	U24	U30	U31	U32	U33	U34	U35	U36	U37
0	28.8	28.1	28.6	28.3	28.2	28.7	28.3	28.9	29.0	29.0
5	31.8	30.2	33.3	29.0	28.7	30.0	36.8	43.0	34.7	37.6
10	46.5	42.3	43.7	30.7	44.5	35.6	55.6	86.3	67.3	55.9
15	59.3	54.9	53.8	37.5	56.0	47.5	63.4	101.9	93.8	80.8
20	67.8	63.9	55.8	43.6	62.8	52.6	72.6	109.6	106.5	83.5
25	73.7	70.2	60.0	49.4	67.0	58.2	84.9	106.9	115.5	82.0
30	78.0	74.9	64.0	57.0	73.2	64.1	92.8	107.1	124.4	82.9
35	81.0	78.0	69.0	68.0	82.6	71.9	92.5	110.2	128.0	86.0
40	85.2	80.3	78.4	72.5	95.2	82.6	100.7	117.0	137.9	94.3
45	87.6	82.3	87.3	78.7	102.2	99.7	104.8	129.3	149.1	100.4
50	89.2	84.3	100.2	85.8	111.2	113.6	109.3	151.1	173.4	104.5
55	90.0	85.7	112.3	92.0	117.9	125.9	116.8	202.6	210.0	111.1
56	89.9	85.9	115.8	93.2	119.0	127.9	118.8	219.5	214.8	112.8
57	90.1	86.0	118.5	94.4	119.9	129.9	120.3	243.2	218.9	114.6
58	90.5	86.4	122.0	96.4	121.3	132.1	122.8	311.0	256.9	117.0
59	90.7	86.5	125.5	96.7	123.1	134.3	124.9	410.5	307.7	120.1
60	90.8	86.5	128.4	97.5	124.3	136.8	127.5	474.8	373.1	124.0

Temperature outputs from unexposed surface temperature U25 to U29 and U38 to U41

Time (min)	U25	U26	U27	U28	U29	U38	U39	U40	U41
0	29.1	29.7	29.8	29.9	30.0	29.3	28.9	28.1	29.9
5	35.0	35.4	35.6	36.2	37.2	34.2	36.1	36.7	39.3
10	53.0	54.8	54.4	53.5	56.5	51.7	56.8	56.5	61.3
15	67.2	67.6	69.3	67.6	71.0	64.9	71.1	72.1	75.7
20	76.3	74.0	79.0	75.1	79.8	72.9	79.6	81.5	100.6
25	80.9	78.1	84.5	79.0	85.1	77.2	84.2	85.8	89.5
30	82.5	81.2	87.8	82.5	87.8	79.9	87.0	88.4	91.4
35	84.3	83.2	89.3	85.3	89.7	81.3	88.2	89.8	92.2
40	86.6	86.9	89.9	91.2	90.8	82.6	88.5	90.7	92.2
45	87.2	90.3	91.1	93.4	94.8	83.3	89.0	91.2	92.1
50	87.9	91.5	91.9	92.5	94.5	84.3	90.0	93.1	96.8
55	89.6	93.1	93.1	95.5	102.1	85.5	91.2	94.6	102.9
60	90.3	116.4	93.0	97.6	104.8	84.8	91.7	96.4	106.6
64	92.7	108.1	98.1	99.1	103.7	84.4	91.7	96.0	111.3
65	92.5	107.5	98.4	101.3	104.6	85.3	92.7	96.2	113.3
66	92.8	114.9	98.4	103.4	104.9	85.4	94.9	97.2	115.1
67	92.6	159.6	98.4	105.0	104.6	84.7	98.6	97.0	117.1
68	93.0	281.9	98.5	107.5	103.8	84.5	100.3	96.9	118.6

6.4.4.1 Fixed Surface Thermocouples – Detailed Temperature Records

The unexposed surface thermocouples of those reach the insulation criteria at the shortest elapsed time were summarized in the following tables. Measurements were taken in °C.

Temperature outputs from unexposed surface temperature U26, U35 and U36

Time (min)	U26
58	97.8
59	102.4
60	116.4
61	110.7
62	109.2
63	106.7
64	108.1
65	107.5
66	114.9
67	159.6
68	281.9

Time (min)	U35
50	151.1
51	158.4
52	167.9
53	178.0
54	189.9
55	202.6
56	219.5
57	243.2
58	311.0
59	410.5
60	474.8

Time (min)	U36
49	168.0
50	173.4
51	180.8
52	188.4
53	197.1
54	203.5
55	210.0
56	214.8
57	218.9
58	256.9
59	307.7

6.5 Pressure

The furnace pressure differential with respect to the atmosphere at 500 mm above notional floor level over the test period was summarized in the following table.

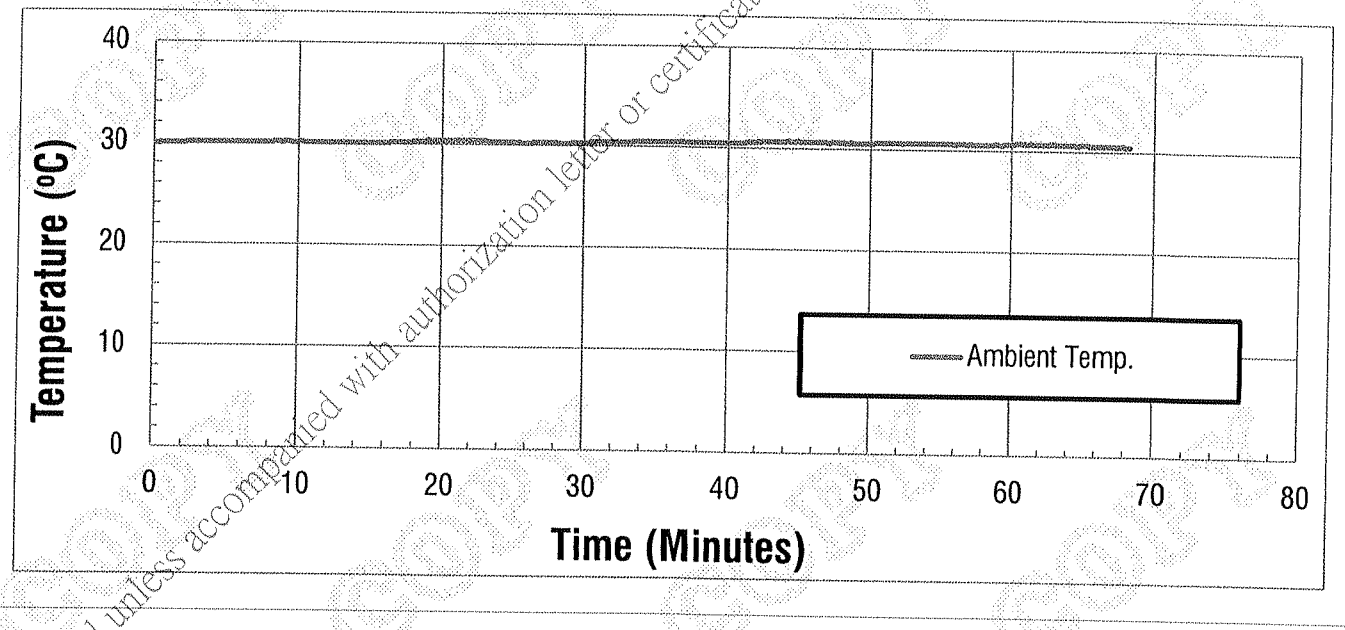
Time (min)	Pressure (Pa)	Time (min)	Pressure (Pa)
6	-0.3	40	1.4
10	-1.2	45	0.6
15	-0.5	50	-2.2
20	-2.2	55	-0.2
25	2.1	60	0.0
30	-0.9	65	-0.4
35	-1.4	68	0.0

6.6 Ambient Temperature

The ambient temperature over the test period was recorded and shown in *Figure 9*.

The ambient temperature at the commencement of test was 29.9°C.

Figure 9. Ambient temperature over the test period.



6.7 Lateral Deflections

Measured lateral deflections over the test period were summarized in the following table. A positive measurement indicates a movement towards into the furnace and vice versa.

Measurements were taken in mm.

Due to the safety reason, there was no deflection measurements data recording after 55 minute of test.

Maximum deflection on the specimen was BOLDED in the following table.

Time (min) / Positions	0	10	20	30	40	50	55
D1	+0	+5	+8	+8	+8	+8	+8
D2	+0	+5	+3	+2	+3	+2	-4
D3	+0	+14	+7	+7	+4	+10	+12
D4	+0	+12	+7	+7	+4	+10	+17
D5	+0	+12	+4	+4	-1	-1	+7
D6	+0	+8	+3	+3	+2	+6	+9
D7	+0	+6	+5	+5	+5	+10	+13
D8	+0	+0	+1	+3	+8	+5	+10
D9	+0	+9	+13	+14	+17	+29	+39
D10	+0	+2	+4	+5	+18	+12	+16
D11	+0	+4	+7	+7	+10	+17	+20

6.8 Observations

Significant behaviours of the specimen during the test period were summarized in the following table.

Photos taken during the test period were also attached.

Time (min. sec)	Observation (from unexposed side)
00.00	Test Started.
01.48	Crackle sound was heard from the specimen.
01.56	The interlayer of glass pane on the active door leaf started to react.
03.04	The interlayer of glass pane on the glazed side panel started react.
03.44	The interlayer of glass pane on the active door leaf fully reacted and its color turned yellowish brown.
03.49	A little amount of smoke released from the top edges of each door leaf and the upper half portion of hinged edge of active door leaf.
05.20	Smoke released from the upper half portion of meeting edges.
05.37	A little amount of smoke released from the key hole.
05.47	The interlayer of glass pane on the glazed side panel fully reacted and its color turned yellowish brown.
08.12	Smoke release from the top of meeting edges increased.
09.23	Some interlayer of glass panes turned milky.
12.50	Smoke release from the upper half portion of meeting edges decreased.
17.13	Brown staining mark was observed at the top of meeting edges.
19.09	Smoke release at the middle top edge of active door leaf increased.
20.27	Staining mark was observed at the middle top edge of active door leaf.
21.55	The interlayer of glass panes turned milky.
23.30	Dark mark was observed at the top of meeting edges and the middle top edge of active door leaf.
25.01	Cotton fibre pad test was carried out at the top of meeting edges. No flaming or glowing on the cotton pad was observed.
26.49	A little amount of smoke released at the meeting edges near the lock position.
28.03	Smoke release at the middle top edge of active door leaf decreased.
28.08	Cotton fibre pad test was carried out at the top of meeting edges. No flaming or glowing on the cotton pad was observed.
30.00	**No integrity failure had occurred.**
31.18	A little amount of smoke released at the top left corner of active door leaf.
32.08	Brown liquid mark was observed along the top edges of each door leaf.
33.21	Smoke release at the meeting edges near the lock increased.
33.35	Dark mark was observed at the top left corner of active door leaf.
37.59	The area of dark mark at the top of meeting edges enlarged.

Time (min. sec)	Observation Cont'd (from unexposed side)
40.15	Dark mark was observed at the bottom right corner of inactive door leaf.
43.19	Glowing spot was observed in the upper half portion of glass pane on active door leaf.
43.53	Cotton fibre pad test was carried out at the middle of meeting edges. No flaming or glowing on the cotton pad was observed.
43.54	The area of dark mark at the top left corner of active door leaf increased.
44.44	Cotton fibre pad test was carried out at the top left corner of active door leaf. No flaming or glowing on the cotton pad was observed.
47.30	Some interlayers turned to grey spots were observed in the glass pane on the glazed side panel.
51.06	Dark mark was observed along the top edge of inactive door leaf.
52.03	The middle and the top edges of door leave bended inwards the furnace.
53.43	Cotton fibre pad test was carried out at the top left corner of active door leaf. No flaming and glowing on the cotton pad was observed.
54.14	Glowing spot was observed at the top of meeting edges.
54.33	A glowing spot was observed in the glass pane at near the bottom right portion.
57.06	Cotton fibre pad test was carried out at the middle of meeting edges. No flaming or glowing on the cotton pad was observed.
57.39	Sustain flaming appeared at the top of meeting edges. **INTEGRITY FAILURE OCCURRED.**
57.41	Cotton fibre pad test was carried out at the top of meeting edges. Flaming on the cotton pad was observed.
58.19	Glowing spots were observed in the lower half portion of glass pane on the glazed side panel.
60.22	Fire board was fixed on the top of meeting edges at the request of the Sponsor. **FIRE RESISTANCE EVALUATION ON THE SPECIMEN CEASED.**
60.52	Glowing spots were observed in the lower half portion of glass pane on the glazed side panel.
61.49	A little amount of smoke released from the upper half part perimeter of glass pane on active door leaf.
62.35	The top edges of each door leaf further bended inwards the furnace.
63.27	About 90% of the glass pane interlayer on glazed side panel turned milky white.
64.49	Glowing spots were observed in the glass pane near bottom right portion and the upper portion of glass pane on glazed side panel.
67.25	Smoke release from the upper half perimeter of glass pane on active door leaf increased.
67.42	A dark spot was observed in the glass pane near bottom right portion on the glazed side panel.
68.23	**Test was terminated at request of the Sponsor.**

6.9 Photos

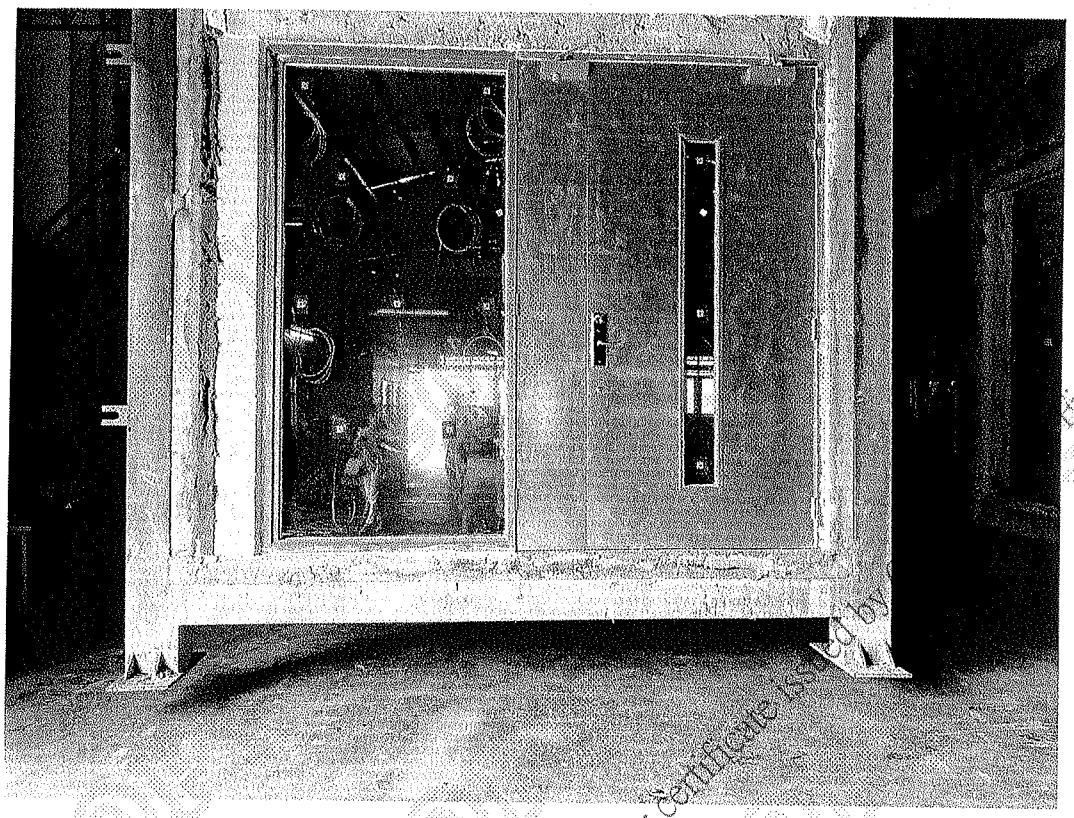


Photo 1. Exposed surface of the specimen before test.

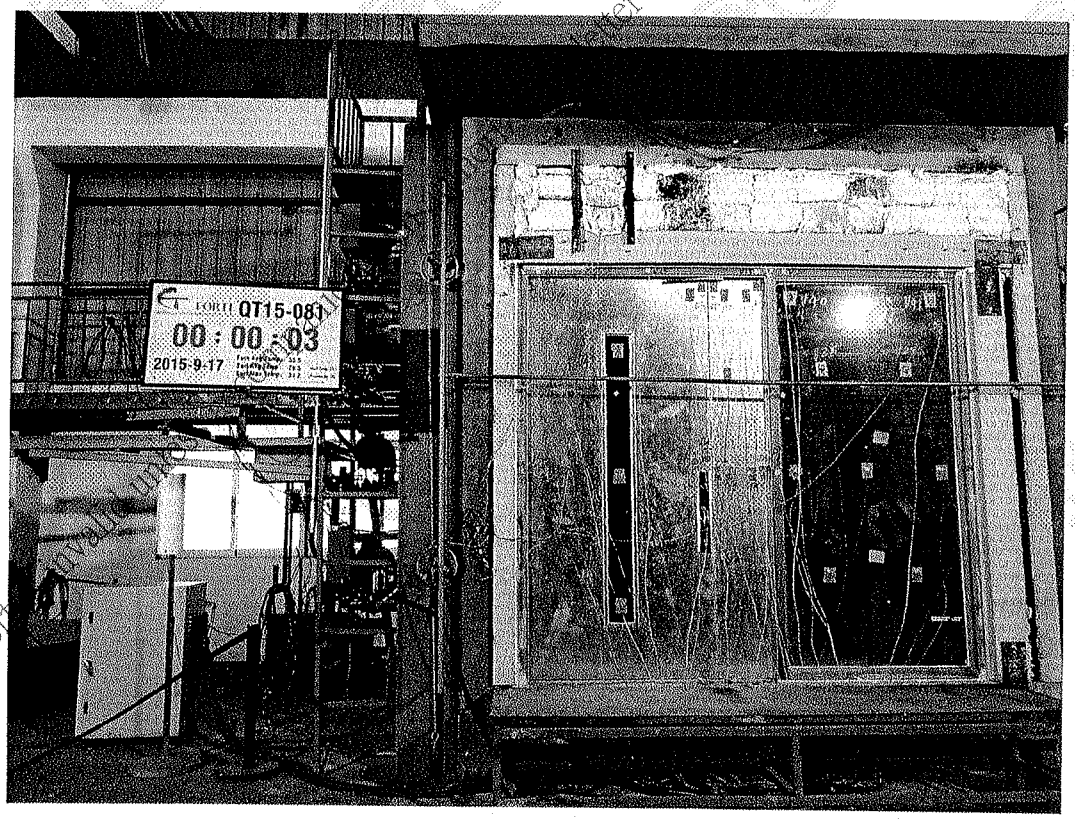


Photo 2. Unexposed surface of the specimen just after the commencement of test.

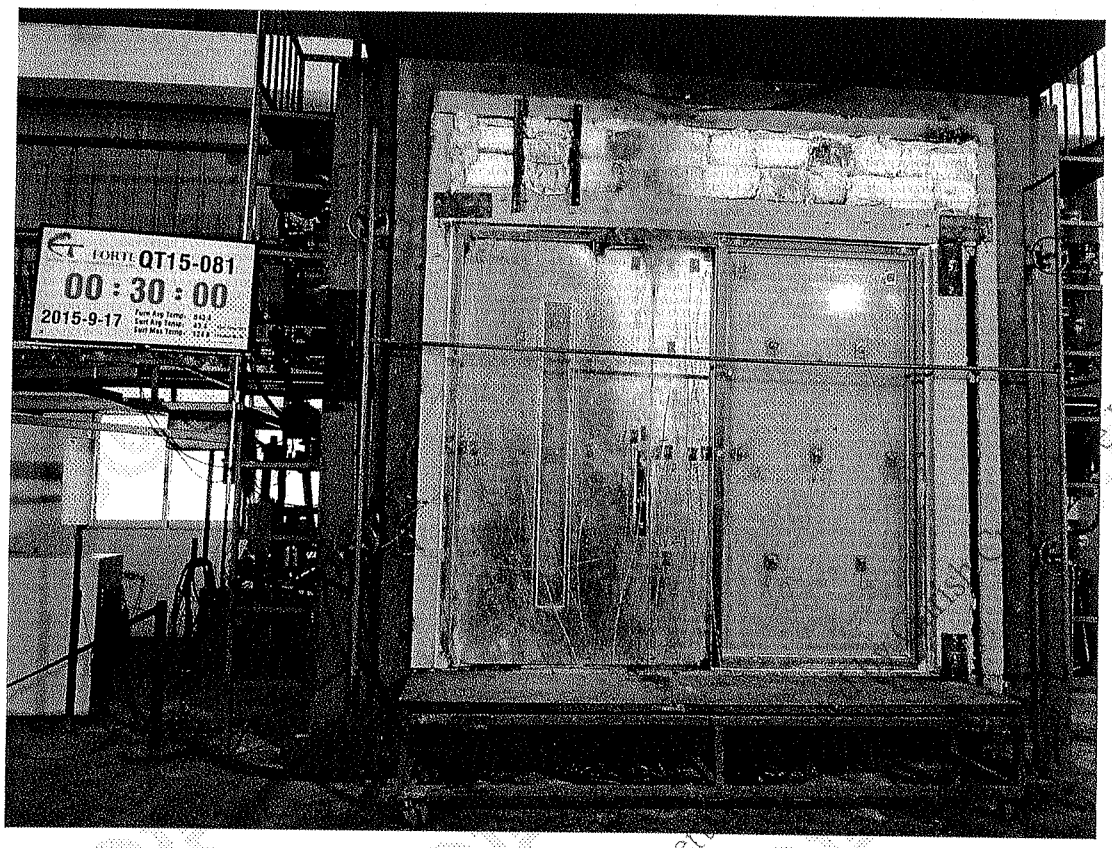


Photo 3. Unexposed surface of the specimen at 30 minute of test.

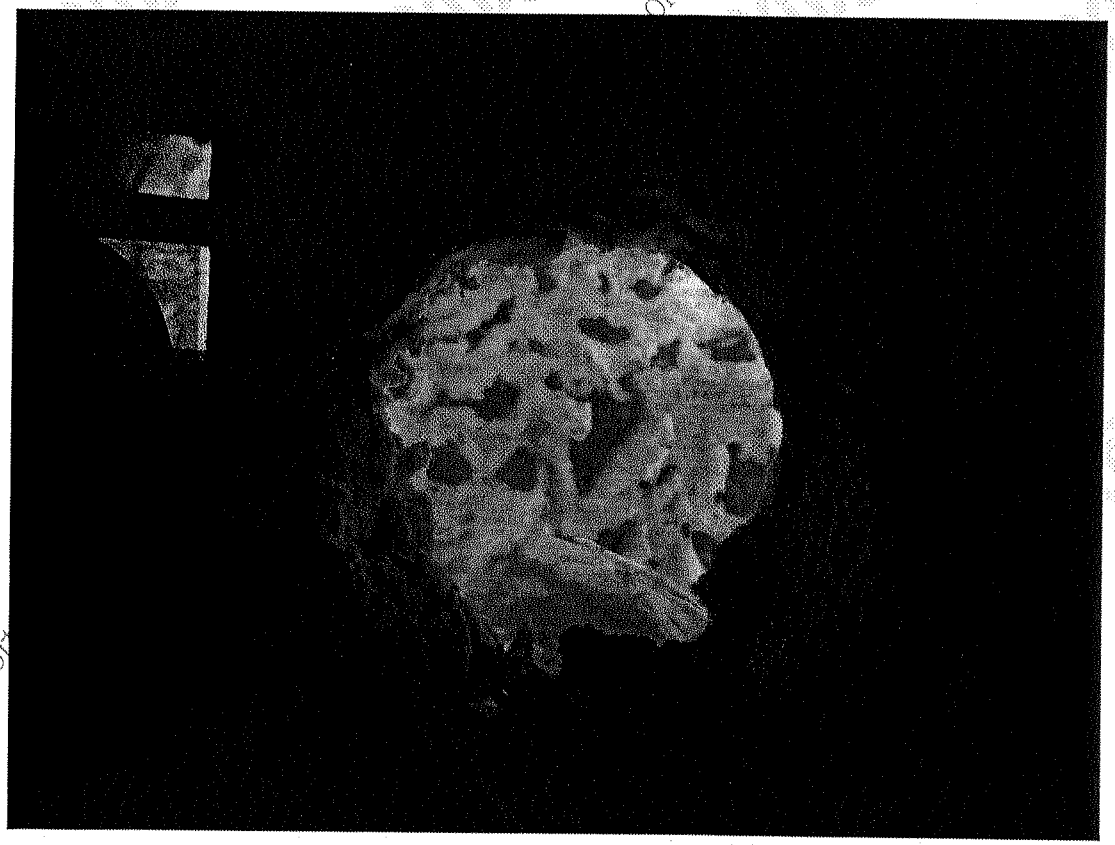


Photo 4. Exposed surface of the glass pane on fixed side panel at 42 minute of test.

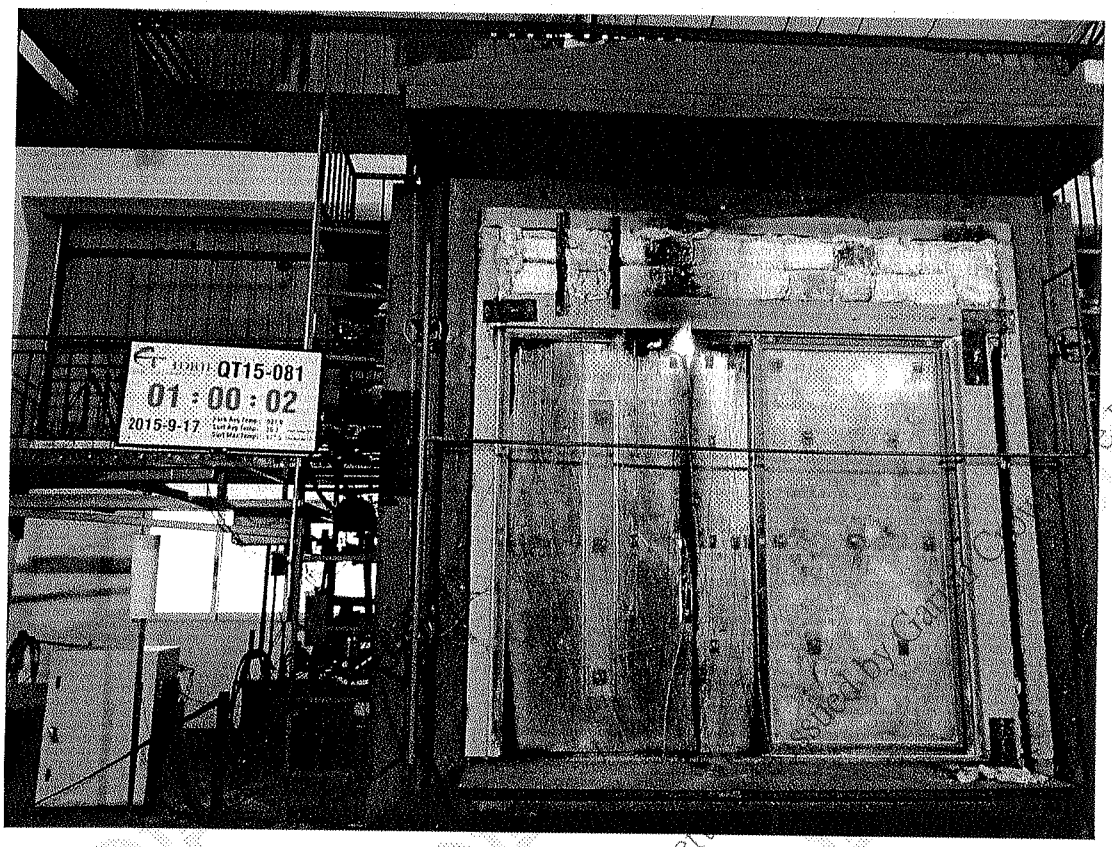


Photo 5. Unexposed surface of the specimen at 60 minute of test.

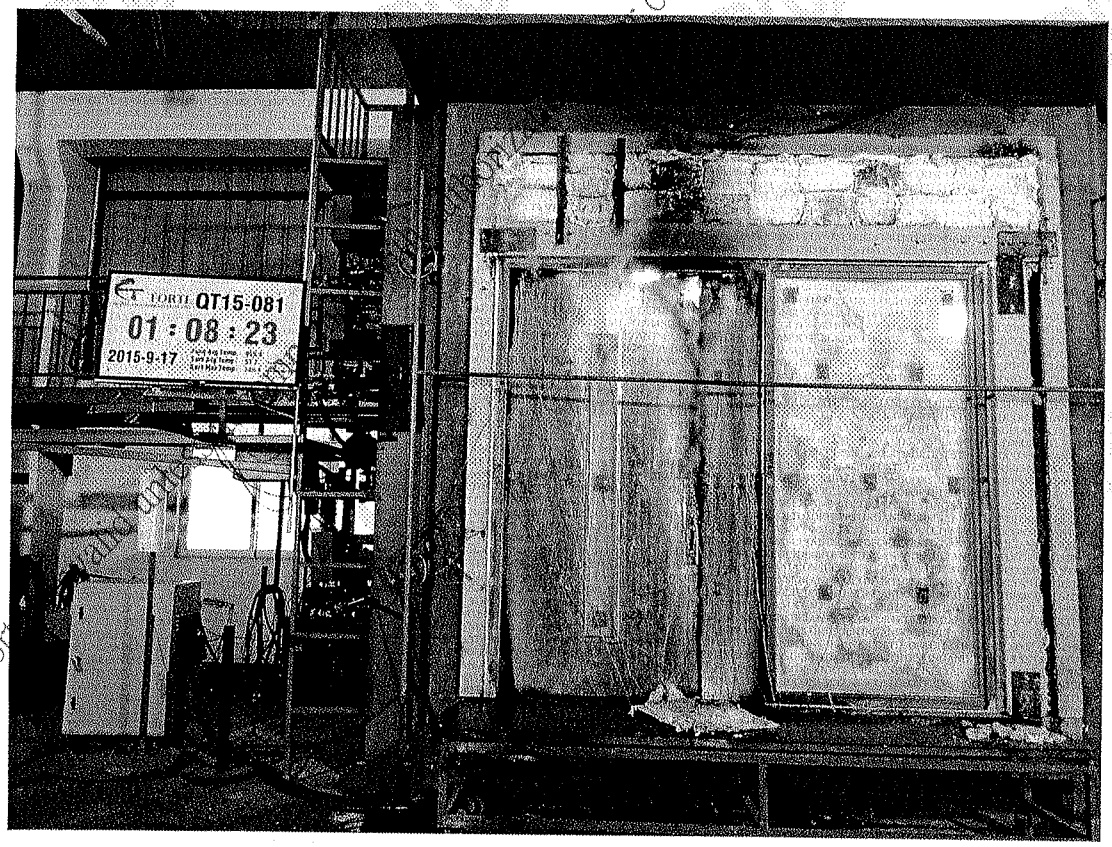


Photo 6. Unexposed surface of the specimen at the end of test.

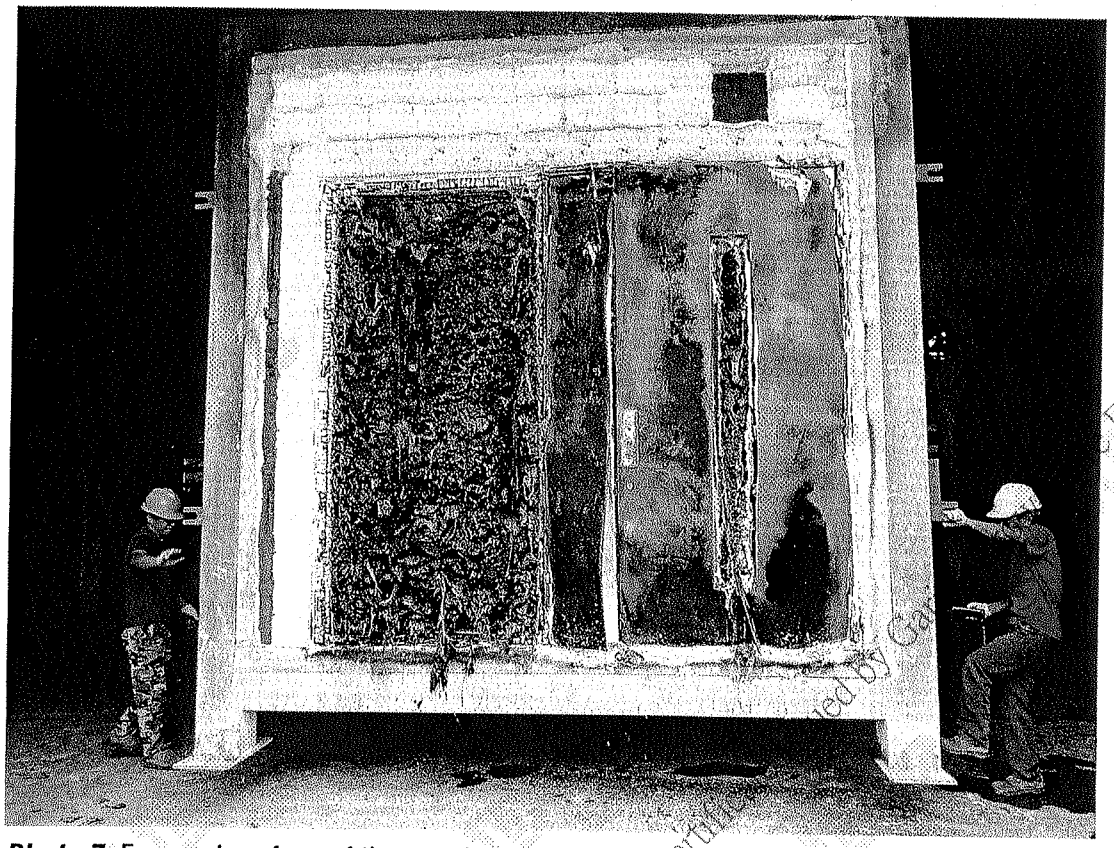


Photo 7. Exposed surface of the specimen after the test.

7. Test Results

The fire resistance evaluation on specimen was ceased at 60 minute of test because fire board was fixed on the top of meeting edges at request of the Sponsor.

The test data obtained from the fire resistance test was assessed against performance criteria given in *BS EN 1634-1: 2008*. The test results were summarized in the following table.

Performance Criteria **Integrity (E)**			
Criteria of Failure		**Description**	**Elapsed Time before Failure Occurrence**
Sustained Flaming		Continuous flaming for a period of time greater than 10 seconds on unexposed surface	57 minutes
Gap Gauge	Ø6 mm	Penetration of the gauge into the furnace through the specimen and movable along a	60 minutes (No Failure)
	Ø25 mm	Penetration of the gauge into the furnace through the specimen	
Cotton Pad		Ignition of the cotton pad	57 minutes

Performance Criteria **Insulation (I)**			
Criteria of Failure		**Description**	**Elapsed Time before Failure Occurrence**
Integrity Failure		The performance criterion "insulation" shall automatically be assumed not to be satisfied when the "integrity" criterion ceases to be satisfied	57 minutes
Average Temperature Rise		An increase of the average temperature of unexposed surface of the specimen above the initial average temperature by more than 140°C	[Door Leaves] 60 minutes (No Failure)
			[Glazed Side Panel] 60 minutes (No Failure)
			[Glazed Element] 60 minutes (No Failure)
Maximum Temperature Rise **[Supplementary, I_1]**		An increase of temperature at any other point of the specimen above the initial average temperature by more than 180 °C	[Door Leaves] 54 minutes
			[Door Frame] 60 minutes (No Failure)
			[Glazed Element] 60 minutes (No Failure)
			[Glazed Side Panel] 60 minutes (No Failure)

8. Limitations

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in *BS EN 1363-1*, and where appropriate *BS EN 1363-2*. Any significant deviation with respect to size, construction details, loads, stresses, and edge or end conditions other than those allowed under the field of direct application in the relevant test method was not covered by this report.

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it was not possible to provide a stated degree of accuracy of the result.

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9. Field of Direct Application

The field of direct application defines the allowable changes to the test specimen following a successful fire resistance test. These variations can be introduced automatically without the need for the sponsor to seek additional evaluation, calculation or approval.

The series of rules and guidelines were defined in *Clause 13 Field of direct application of test results, BS EN 1634-1: 2008* and relevant clauses and annexes. Permitted variations away from the test specimen include 1) materials and construction, 2) size variations, 3) coverage of asymmetrical doorsets and 4) supporting constructions.

The field of direct applications may only be defined following the identification of classification(s). The field of direct and, where applicable, extended application will be included in classification relevant documents.

END OF REPORT