#### Test Report No. 7191251620-MEC21-LHK dated 09 APR 2021



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#### SUBJECT:

Fire resistance test on an insulated single leaf composite doorset consisted of asymmetrical Internal timber edge stiles and rails, Brand "KNS" and Model "KNS 30 minutes" with vision pane installed within drywall partition submitted by KNS Holdings Pte Ltd.

#### **TESTED FOR:**

KNS HOLDINGS PTE LTD 1C Jalan Haji Salam Singapore 468743

#### DATE SUBMITTED:

06 Jan 2021

#### DATE OF TEST:

15 Jan 2021

#### **PURPOSE OF TEST:**

1. To determine the fire resistance performance of the specimen when tested in accordance with SS332: 2018 – Annex B Fire resistance tests: Requirements and test methods- BS EN 1634-1.





Laboratory: TÜV SÜD PSB Pte. Ltd. 15 International Business Park TÜV SÜD @ IBP Singapore 609937



LA-2007-0380-A LA-2007-0386-C LA-2007-0381-F LA-2010-0464-D LA-2007-0382-B LA-2018-0702-B LA-2007-0384-G LA-2018-0703-G LA-2007-0385-E LA-2020-0747-L The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council. Inspections/Calibrations/Tests marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our inspection body/laboratory.

Phone : +65-6778 7777 E-mail: info.sg@tuvsud.com https://www.tuvsud.com/en-sg Co. Reg : 199002667R Regional Head Office: TÜV SÜD Asia Pacific Pte. Ltd. 15 International Business Park TÜV SÜD @ IBP Singapore 609937 **TUV**®



# TEST PROCEDURE

- 2. At the commencement of test, the ambient air temperature in the general vicinity of the specimen construction was ensured to be 10°C to 40°C and was monitored at a distance between 1m and 3m horizontally away from the unexposed face under condition such that the sensor is not affected by thermal radiation from the test construction and/or furnace.
- 3. During the test, the temperature in the laboratory shall not decrease more than 5°C or increase more than 20°C for all insulated separating elements while they are still satisfying the insulation criterion. With commencement of heating of the specimen, the furnace temperature and pressure were controlled to comply with the requirements specified in BS EN 1363-1: 2012: Part 1: General requirements: Clause 5.1 and Clause 5.2 respectively. The pressure was controlled such that a linear pressure gradient of 8.5 Pa per 1000mm height exist above a neutral pressure axis at a height of approximately 500mm above the notional floor level. The furnace shall be operated so that the nominal pressure of the furnace at the top of a vertical test construction shall not exceed 20Pa.
- 4. Nine plate thermocouples were distributed over a plane 100mm from the surface of the test specimen. The furnace was controlled so that its average temperature complied with requirements of BS EN 1363-1 Clause 9.1.
- 5. Throughout the heating period, measurements and observations were recorded for compliance with the relevant performance criteria stated in Clause 10.4 of BS EN 1363-1: 2012: Fire resistance tests Part 1: General requirements...
- 6. For insulated specimen, the average and maximum temperatures on the unexposed face of doorset were measured by thermocouples of the type specified in BS EN 1363-1. The positioning relates to the part of each door leaf visible from the unexposed side and are as stated in Clause 9.1.2 of BS EN 1634-1: 2014+ A1: 2018: Part 1: Fire resistance test for doors, shutters and openable windows.
- 7. Observations, on the behaviour of the test specimen throughout the heating period, were made and recorded. As appropriate, cotton wool pads, gap gauges and roving thermocouple were used to establish the occurrence of failure.
- 8. The test was terminated when one or more failures as stated in the performance criteria occurred, or otherwise at a time agreed between the sponsor of test and the test laboratory.

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### **PERFORMANCE CRITERIA:**

9. The specimen is assessed against the following test criteria:

#### 9.1 Integrity

Failure shall be deemed to have occurred when one of the following occurs on the unexposed face of the specimen: -

- Glowing or flaming of the cotton wool pad during its application, for a maximum of 30 seconds, to all surfaces of the specimen, where either flames or hot gases from a discontinuity, a crack or a gap are present.
- Where the 6mm gap gauge can be passed through the specimen such that the gauge projects into the furnace, and can be moved a distance of 150mm along the gap
- Where the 25mm gap gauge can be passed through the specimen such that the gauge projects into the furnace
- Continuous (sustained) flaming for more than 10 seconds on the unexposed surface
- 9.2 Insulation (normal procedure, BS EN 1634-1: 2014+A1:2018 Clause 9.1.2.2 & 9.1.2.3)

Failure shall be deemed to have occurred when one of the following occurs:

- the average temperature rise on the unexposed face of the specimen increases by more than 140°C above its initial average temperature
- the maximum temperature rises as recorded of at any position on the unexposed face of the specimen is in excess of 180°C above its initial average temperature.
- the maximum temperature rises for any perimeter frame member, for a doorset, on the unexposed face of the specimen is in excess of 360°C above the initial average temperature.
- When integrity failures occur.



#### **DESCRIPTION OF TEST SPECIMEN:**

- 10. A set of a single leaf insulated composite doorset consisted of asymmetrical Internal timber edge stiles and rails with vision pane installed within a 3000mm (wide) x 3000mm (height) drywall partition system, vertical free edge clearance of approximately 25mm wide filled with ceramic wool was provided along two vertical sides of the drywall partition system, the drywall partition was constructed in accordance with the test report no. BRE 208818. Overall timber door frame dimension of 1000mm (width) x 2700mm (height) and nominal thickness of the door leaf was 50mm thick and the size of the door leaf was 934mm (W) x 2665mm (H). The test assembly was erected with a surrounding abutting masonry wall thickness of 220mm with fire bricks of nominal size of 220mm x 105mm x 70mm, surrounding it. The test frame was mounted onto test furnace (PSB Asset No: 20009077). The test was conducted at TÜV SÜD PSB Pte Ltd fire test laboratory located at No. 10 Tuas Ave 10, Singapore 639134.
- 11. The doorset was mounted with the door leaf opening towards the furnace. This was taken as representing a more severe fire exposure, as the door leaf perimeter were not protected from the fire exposure by the rebated jamb of the door frame.
- 12. An inspection on the doorset and its assembly was conducted by a TÜV SÜD PSB staff to verify on its dimensions and designs. Detailed drawings of the doorset are shown in the page no. 21 to 22 of this test report, provided by sponsor of test.
- 13. Erection of the test assembly onto the test furnace was arranged and carried out by KNS Holdings Pte Ltd.
- 14. The clearances between the door leaf and frame were as follows:
- 14.1 Door frame to leaf edge (exposed side)

14.2

Top side	:	5.0 mm
Hinge side	:	1.0 mm to 3.0 mm
Door face to frame stop	o (unex	posed side)
Top side	:	0.5 mm to 1.5 mm
Hinge side	:	0.5 mm to 3.0 mm

14.4 Threshold gap : 5.0 mm



## TEST RESULTS:

- 15. Operability test of 25 manual cycles was completed on the leaf in accordance with BS EN 16034.
- 16. Specimen self-closing test from 10° was measured to be 1.42 seconds on the door leaf in accordance with BS EN 16034 respectively.
- 17. In accordance with BS EN 1634-1, the closer forces on the door leaf were measured to be 19.2 N.
- 18. Final setting of the specimen was conducted in accordance with BS EN 1634-1.
- 19. Table 1 shows the temperature rise for the furnace and the standard curve. In addition, the table shows the percentage difference between the area under the standard curve and the area under the furnace curve compared with the percentage tolerance allowable within the standards.
- 20. Figure 1 shows the actual time-temperature curve of furnace in relation to the specified time-temperature curve.
- 21. Figure 2 shows the furnace pressure recorded at the tapping point 2500mm above the furnace floor with a computed value of 15.3pa. The test specimen was constructed 200mm above the furnace floor.
- 22. Table 2 shows the average unexposed face temperature rise above the initial temperature of the door leaf.
- 23. Table 3 and 4 show the maximum unexposed face temperature rise above the initial average temperature of 100mm and 25mm from the edges of the door leaf respectively.
- 24. Table 5 shows the maximum unexposed face temperature rise above the initial temperature of the door frame.
- 25. Table 6 shows the maximum unexposed face temperature rise above the initial temperature of the vision glass.
- 26. Table 7 shows the maximum unexposed face temperature rise above the initial temperature of the drywall partition.
- 27. Table 8 to 10 show the deflection measurement points at top, mid-height and bottom of doorset.
- 28. Figure 3 shows the thermocouple locations and deflection measurement points on the test specimen.





- 29. Photographs of the test are shown in Plates 1 to 8.
- 30. Observations were made during the test on the unexposed face of the test specimen and these are given in Appendix 1 of this report.
- 31. Appendix 2 shows the Schedule of Components.

#### **CONCLUSION:**

 The specimen satisfied the requirements of the SS332: 2018 Annex B Fire resistance tests: Requirements and test methods- BS EN 1634-1. for the periods stated below: -

Integrity	18	
-Sustained flaming		37 minutes
-Gap gauge	:	37 minutes
-Cotton pad	1	37 minutes
Insulation	:	37 minutes (normal procedure)

#### REMARKS:

32. Integrity

At 37 minutes and 20 seconds of test, continuous flaming was observed at top edge around concealed door closer area for more than 10 seconds and still persistence, therefore, the integrity of the specimen, meets the standard for 37 minutes.

#### 33. Insulation

At 37 minutes of test, the maximum mean temperature rise and maximum temperature rise above the initial temperature on the unexposed face of specimen were 51.2°C and 66.2°C respectively.

The maximum temperature rise of the door frame above initial temperature was 21.5°C. (<360°C)

The maximum temperature rises of the door leaf (100mm from edge) above initial temperature was 74.9°C. (<180°C)

Therefore, the insulation of the specimen meets the standard for 37 minutes



#### LIMITATIONS:

- 34. 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, constructional details, loads, stresses and edge or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report.
- 35. Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.
- 36. The results only relate to the behaviour of the specimen of the element of construction under the particular conditions of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the actual behaviour in fires

#### WITNESSES:

37. The test was witnessed by the following representatives: -

KNS Holdings Pte Ltd

Mr. Eric Wee

Igloohome Company

Mr. Louis Tay

Lim Hee Kim Senior Associate Engineer

<del>u T</del>oa Assistant Vice President

Assistant Vice Preside Fire Testing Mechanical Centre



# Table 1: Comparison of area under the curve

Time	Temperature rise (°C)		Area uno (°C	der curve min)	Percentage difference	Standard tolerance
(min)	Standard	Furnace	Standard	Furnace	(%)	±%
10	658.4	654.8	5402.7	5865.9	8.6	15.0
15	718.6	716.4	3602.1	3586.5	-0.4	12.5
30	821.8	821.6	15692.6	15664.2	-0.2	5.0
35	844.8	844.3	4317.9	4318.0	0.0	4.6
40	864.7	864.3	8742.8	8741.8	0.0	4.2



#### FIGURE 1: FURNACE AVERAGE TEMPERATURE

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Table 2: Unexposed face temperature of the door lea	<u>af</u>
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Time	Thermocouple no.				Mean temp	Above initia	l mean temp C)	
(min)	T-01	T-02	T-03	T-04	T-05	(°C)	Mean temp	Max. temp
0	30.5	30.5	30.3	30.6	30.4	30.5	-	-
10	45.1	41.8	42.6	31.6	32.4	38.7	8.2	14.6
20	78.6	68.5	71.5	52.8	57.9	65.9	35.4	48.2
30	91.6	76.2	78.3	72.3	71.2	77.9	47.5	61.2
36	95.3	77.2	82.1	76.3	73.7	80.9	50.5	64.8
37	96.7	77.4	83.0	77.4	74.0	81.7	51.2	66.2

Note: Mean temperature is based on the thermocouple point No.01 to 05

# Table 3: Maximum temperature on unexposed face of door leaf (100mm from edge)

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Time	Thermocouple no.					
(min)	T-15	T-16	T-17	T-18	rise	
0	31.0	30.1	30.5	30.8	-	
10	37.6	43.0	47.3	35.9	16.9	
20	76.5	81.6	75.4	63.7	51.5	
30	75.2	88.8	93.8	74.7	63.3	
36	80.2	83.2	104.1	77.3	73.7	
37	82.1	83.6	105.4	78.0	74.9	

#### Table 4: Maximum temperature on unexposed face of door leaf (Supplementary Procedure - 25mm from edge)

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Time	Thermocouple no.					
(min)	T-11	T-12	T-13	T-14	rise	
0	32.2	29.8	31.4	31.3	-	
10	57.0	67.9	94.6	59.1	63.2	
20	86.6	116.0	155.7	67.7	124.3	
30	77.7	118.6	175.6	79.1	144.2	
36	95.8	127.1	192.8	79.7	161.4	
37	104.1	129.6	213.9	80.7	182.5	



Time		T				
(Min)	T-06	T-07	T-08	T-09	T-10	Max. temp rise
0	30.1	29.7	28.7	29.8	29.9	-
10	30.4	33.2	31.3	39.2	30.6	9.4
20	30.9	39.6	35.4	45.9	32.2	16.1
30	31.7	40.8	39.3	47.9	35.3	18.1
36	32.0	43.0	41.5	50.0	36.1	20.2
37	32.2	43.5	42.0	51.4	36.4	21.5

# Table 5: Maximum temperature on unexposed face of door frame

# Table 6: Additional unexposed face temperature of vision glass (for information only)

Time	Thermoco	Max tamp rise $(^{\circ}C)$	
(Min)	T-19	T-20	Max. temp rise (°C)
0	34.8	35.3	-
10	552.5	548.6	517.7
20	618.9	613.4	584.1
30	686.6	675.7	651.9
36	719.1	707.6	684.3
37	722.2	710.3	687.4

# Table 7: Maximum temperature on unexposed face of drywall partition

Time		Max, tamp rise $(^{\circ}C)$			
(Min)	T-21	T-22	T-23	T-24	Max. temp rise (°C)
0	29.3	29.9	30.7	29.7	-
10	29.8	30.3	31.5	30.1	0.8
20	31.4	31.9	31.9	31.5	2.1
30	36.3	36.8	35.2	36.6	7.0
36	40.5	41.5	36.1	40.6	11.6
37	41.4	42.4	35.5	41.5	12.5

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## Table 8: Deflection measurement at top of doorset

Time	Measurement of deflection (mm)				
(min)	A	В	С	D	
10	5	7	5	5	
20	5	13	5	5	
30	5	10	5	5	

# Table 9: Deflection measurement at mid-height and mid-width of door leaf

Time	Measu	rement of deflection (mm)	
(min)		E	
10		16	
20		25	
30		30	

# Table 10: Deflection measurement at bottom of doorset

Time	Measurement of deflection (mm)	
(min)	F	G
10	4	2
20		1
30	0 0000	0

#### Notes:

The thermocouple locations and deflection measuring points are indicated in figure 3 on page 20 of this report.

A negative value indicates deflection away from the furnace.



# Figure 2: Pressure at 2500mm tapping point

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# Photographs of test



Plate 1: The unexposed face of specimen before the test.



Plate 2: At about 20 minutes of test.

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# Photographs of test (cont'd)



# Plate 3: At about 30 minutes of test.



Plate 4: Close-up view flaming at about 37 minutes and 20 seconds of test





# Photographs of test (cont'd)



Plate 5: At about 38 minutes of test.



Plate 6: The exposed face of specimen after the test.

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# **APPENDIX 1**

Time (min:sec)	Observations on the unexposed face
00:00	Test commenced.
00:30	Smoke was emitted at doorset.
01:10	Large volume of smoke was emitted at doorset.
02:30	Blackening was observed at top edge of doorset.
03:00	Water vapour was observed at top of door panel surface and side edges area.
04:00	Emission of smoke reduced.
05:00	Smoke was emitted at top half of both side edges.
06:30	Large volume of smoke was emitted at top half of both side edges and lockset area.
08:00	Dark black was observed at top half of both side edges.
12:00	Surface mounted digital lockset cover on keypad area was deformed.
15:00	Charring was observed at top & centre hinge areas, lockset area, both top corners and along top half of left edge (lockset side).
16:00	Large volume of smoke was continued emitted at top half of both side edges and top edge area.
20:00	Large volume of smoke was emitted at right edge (hinge side), top half of left edge (lockset side), top edge and lockset area.
24:40	Large volume of smoke was emitted at top edge area, top two corners, and lockset area.
30:00	No significant changed were observed on drywall partition area.
35:00	Glowing was observed at top right corner concealed door closer area.
36:00	Glowing area mentioned at 35 minutes of test was expanded wider.
37:20	Continuous flaming was observed at top edge area at around concealed door closer area for more than 10 seconds and still persistence.
40:00	Glowing was observed at lockset latch area.
40:70	Lockset cover was observed deformed.
41:00	Charring was observed on top bead of vision pane.
44:10	Continuous flaming was observed at side edge at around lockset latch area.
45:00	Continuous flaming was observed at top hinge area.
46:00	No significant changed were observed on drywall partition.
50:00	Continuous flaming was observed at top left corner for more than 10 seconds and still persistence.
54:00	Test was terminated.

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# APPENDIX 2 Schedule of Components

(With reference to page no.21 & 22 of this test report)

All materials, components and hardware used for the construction of the doorset were declared / provided by the sponsor of test as follows:

ITEM NO.	ITEM	DESCRIPTION	
Hardwar	Hardware		
1.	Hinges	Said to be "Hafele" 921, size 127 x 89 x 3mm stainless steel 2BB butt hinge, 3 nos of hinges were installed on side edge of door leaf.	
2.	Lockcase	Said to be "Igloohome" E-MECHA-90 mortise lockcase body dimensions 73.2mm(W) x 101.4mm (Depth) x 22.6mm (Thick), with a 66.5mm backset and latch size 12mm x 12mm and 12mm throw, deadbolt size 25mm x 14.8mm x 20.2mm (throw).	
3.	Cylinder	Said to be "Igloohome" M5000-KC cylinder for lock.	
4.	Lever Handle	Said to be "Igloohome" Smart mortise 2 lever handle & knob furniture, overall body dimension was 352mm(L) x 80mm(W) x 24mm (thick) come with spring loaded handle of length 144mm and touch screen keypad installed facing on exposed to fire side.	
5.	Door Closer	Said to be "Dorma" ITS 915 EN4 concealed door closer with power size and no backcheck, come with sliding arm, body dimension 265mm (L) x 36 mm (W) x 57mm (H) was mounted at the top edge of the door leaf. It has 4mm thick calcium silicate board was placed surround the door closer.	

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# APPENDIX 2 (Cont'd)

Schedule of Components (With reference to page no.21 & 22 of this test report)

ITEM NO.	ITEM	DESCRIPTION	
Door De	Door Details & Materials		
6.	Door Frame	<ul> <li>Overall hardwood door frame size 1000mm (W) x 2700mm (H), single rebated x-section profile 145mm x 45mm (W). Architrave 25mm and rebates was 53mm x 20mm, it has said to be: <ul> <li>a) Calcium silicate board was glued onto the rebate and architrave of door frame by using adhesive said to be "MasterGrip" MGrip 7009.</li> <li>b) 4mm thick was glued onto the architrave and rebate door stop and 8mm thick was glued onto the rebate face.</li> <li>c) 2 nos and 2 rows of intumescent fire seal said to be "Lorient" of size 10 x 4mm with casing was placed together face to face and was installed apart at 10mm on the reveal face of the rebate.</li> <li>d) the density of door frame timber was found to be 826kg/m<sup>3</sup>.</li> <li>e) Additional timber of size 92mm x 18mm thick was glued on the top jamb of door frame as extended door stop.</li> <li>f) 0.8mm thick wood veneer was glued all round of door frame and covered all materials and fire seal.</li> <li>g) Door frame was secured onto the square hollow mild steel of size 100 x 100mm of the drywall partition by 4 nos of fishtails of size 25mm(w) x 1.0mm thick @ 700 c/c on side jamb and top without square hollow steel.</li> </ul> </li> </ul>	
7.	Door Panel	Overall single composite door leaf of size 934(W) x 2665mm(H) x 50mm(T), with clear glass vision pane of clear view size 140mm (W) x 690mm (H).	
8.	Core Board	Said to be KNS Board consisted of Pyrolite material, thickness 38mm, length of the board was step jointed by 2 piece of board, longer board was 2290mm and shortest board was 280mm, the jointing step was 19mm depth x 18mm x 19mm, bulk density of the board was found to be 493kg/m <sup>3</sup> .	



# APPENDIX 2 (Cont'd)

Schedule of Components (With reference to page no.21 & 22 of this test report)

ITEM NO.	ITEM	DESCRIPTION
Door De	etails & Materia	ls
9.	Internal timber edge stiles and rails	Internal edge timber stile & rail said to be KS Edge Strip of thickness 35mm, width of the timber was 25mm for side and bottom and 100mm for top, the bulk density of the KS Edge Strip was found to be 782kg/m <sup>3</sup> . There was a 4mm thick calcium silicate board was glued and screwed onto one face of the timber @ 200 ~ 350 c/c, it was faced on the expose to fire side.
10.	Calcium Silicate Board	Promat "Supalux" calcium silicate board was used on one face of timber stile & rail which was faced to the exposed to fire side, on reveal face of door frame rebate and architrave, and on the vision pane glass support block on both faces, the density of the "Supalux" calcium silicate board was said to be 950kg/m <sup>3</sup> .
11.	Vision Pane	Vision pane overall clear view dimension 140mm(W) x 690mm(H), height of the vision pane measured from the bottom edge of the door leaf to the bottom edge of the vision glass was 900mm and 225mm away from the door edge, vision glass used said to be 6mm thick "Schott" Pyran <sup>®</sup> S was installed, vision panes edge support framing used said to be 12mm x 12mm "Supalux" calcium silicate board were placed on edge of both faces of vision glass with timber beading and screwed onto the door leaf core, together with said to be 10 x 2mm thick "Lorient" intumescent fire seal was placed inbetween. The timber beading was placed on both sides of door face and was covered up the "Supalux" calcium silicate board edge support framing and screwed onto the door core by 3 nos of screw on vertical and 2 nos on horizontal.
12.	External Laminate	Said to be 0.8mm thick laminate finish was glued onto the external face of the plywood and door frame by using adhesive said to be "MGrip "MG 7009".

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# APPENDIX 2 (Cont'd) Schedule of Components (With reference to page no.21 & 22 of this test report)

ITEM NO.	ITEM	DESCRIPTION
Door Details & Materials		
13.	Intumescent Seal	Intumescent fire seal used said to be "Lorient" 10 x 4mm thick with casing was placed on the reveal face of door frame rebate and on both faces of the vision pane glass.
14.	External Facing	Said to be 5mm thick plywood facing with 0.8mm thick laminate finish was glued onto the face of the internal core and timber framing by using adhesive said to be "MGrip" MG 7009.
15.	Adhesive	Adhesive used said to be "MGrip" MG 7009.







# Figure 3: General arrangement of the doorset on unexposed face

 TCs for mean and max temp rise
 TCs for max temp rise on door frame
 TCs for max temp rise, 100mm from door edge
 TCs for max temp rise, 25mm from door edge
 Deflection measurement point



# Test Report No. 7191256120-MEC21-LHK dated 09 APR 2021





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