Technical presentation of Fire test

1. Introduction

Fire resistance requirements for a PV module intended for building applications are defined in local or national building codes. PV modules as building product – i.e. serving as roof covering materials, elements for building integration or that are mounted on buildings – are subject to specific safety requirements originating from national building codes.

The equipment confirm to IEC 61730-(Part 1&2): 2004, IEC 61730:2016 (Part 1&2, MST23) and referenced by UL 1703:2015, UL790 and ASTM E108-04, ENV 1187-1-4 , ISO 13501-5:2005, ISO 5657, ISO 834-3, ISO 834-1, Annex B of IEC 61730-2 , NBC –BIS: 2016 standards.

2. Component

The system could be showed as follow figure 1:

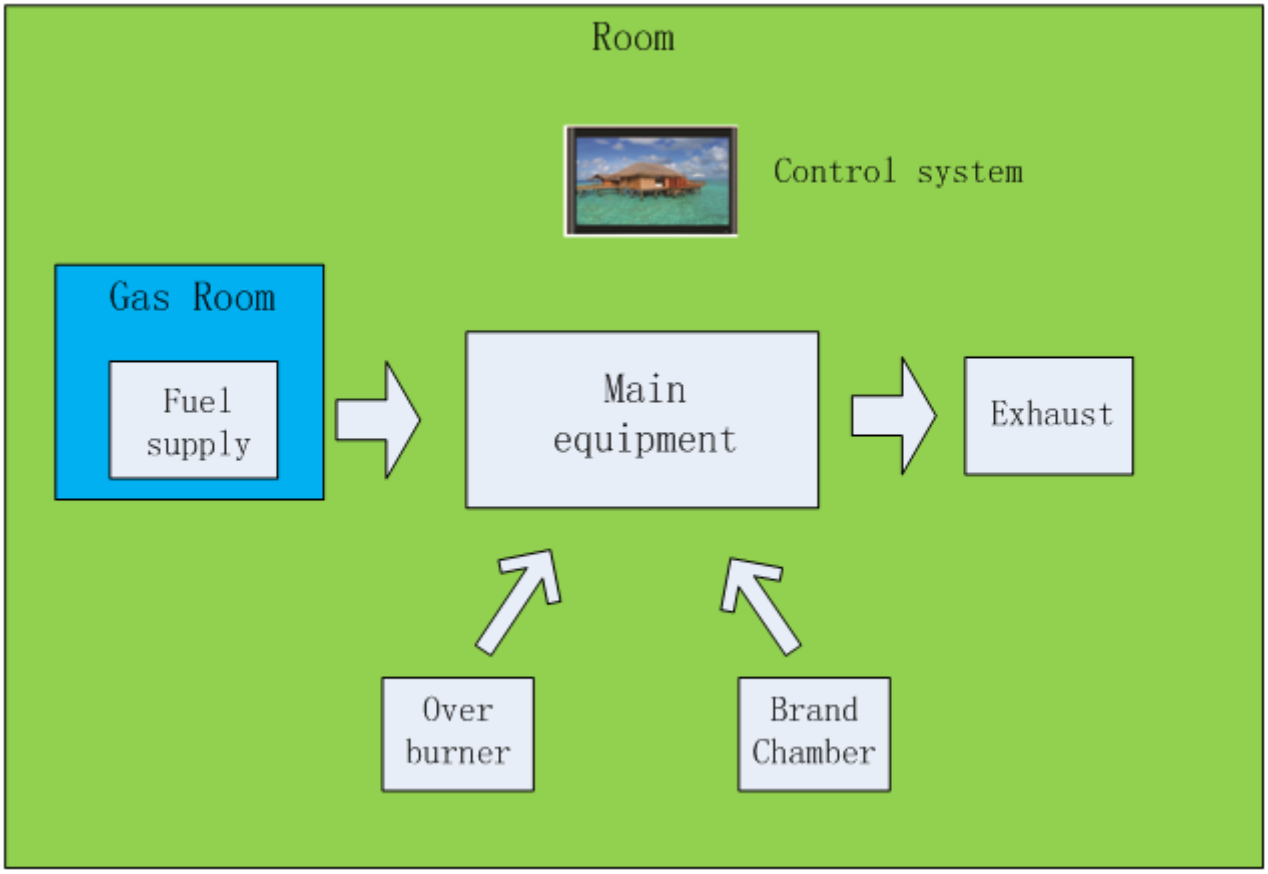

Figure 1

The system constructed with Main equipment, Fuel supply, Gas room, Exhaust, Over burner, Control system and Room.

2.1 Main equipment

Note: The requirement for the client is high light.

Main equipment could be represented in the table 1.

Table 1

S. No	Component	Function	Parameter
1	Blower and air duct	Input the out room air	✓ Adjustable fins mounted inside the air duct to straighten the air stream and

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<table>
<tr><td></td><td></td><td></td><td>reduce turbulence;
✓ To make wind speed with 3point average at 5.3 ± 0.2 m/s.</td></tr>
<tr><td>2</td><td>Wind Tunnel</td><td>Generate a uniform wind speed</td><td>✓ Wind tunnel material: Steel;
✓ Wind tunnel height from ground: 1111 ± 100 mm;
✓ Wind tunnel hole diameter: 2133.6 ± 100 mm * 762mm;
✓ Wind tunnel length: To make wind speed with 3point at 5.3 ± 0.2 m/s.</td></tr>
<tr><td>3</td><td>Nozzle burner</td><td>Produce flame</td><td>✓ Burner specs: Refer IEC 61730-2:2016, Annexure B;
✓ Length of nozzle burner: 1,120mm ± 0.1 mm;
✓ Diameter of nozzle: Nominal 50.9 mm± 0.1 mm (60.3 ± 0.1 mm OD);
✓ Burner slot: (12.7 ± 0.1) mm X (910.0 ± 1.5) mm (Length X Wide);
✓ Both ends: nominal 25± 0.13 mm (33.4 ± 0.13 mm OD);
✓ Fire specification:
<table>
<tr><td>Fire Resistance Class</td><td>Flame Temp(Ideal)</td><td>Flame Length(Ideal)</td></tr>
<tr><td>A</td><td>(760±28)℃</td><td>＜1.82m</td></tr>
<tr><td>A</td><td>(760±28)℃</td><td>＜2.4m</td></tr>
<tr><td>A</td><td>(704±28)℃</td><td>＜3.9m</td></tr>
</table></td></tr>
<tr><td>4</td><td>Rack/deck/platform</td><td>Place the module</td><td>✓ Test mounting Rack should be made of fire resistant material;
✓ Test mounting Rack can adjust angle of module for ±30 Degree from horizontal, with minimum inclined scale of 0.01 degree, where 22.62 degree is marked.
✓ Manual adjustment shall be allowable by gear change
✓ Platform with side mark 2.5 m and 4.2 m location on both side of edges
✓ Platform should be equipped with a steel tray to collect burning waste
✓ Tilting frame shall be assembled and removable on test deck</td></tr>
</table>

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5	Baffle	Prevent backfiring and test subject sliding	✓ Should be mounted on the back edge of the test deck
6	Angle indicator	Test the angle of the rack	✓ Angle marking: within 22～23°, resolution 0.01° ✓ Material: Heat resistant 800 °C without deformation and non-flammable material
7	Thermocouple	Test burning temperature above flame	✓ Type: K; ✓ Response time: < 1 second

2.2 Fuel supply

Fuel supply could be represented in the table 2.

Table 2

S. No	Component	Function	Parameter
1	Steel cylinder(**offered by the customer**) 4pcs	Store the gas	✓ Suitable for propane; ✓ About 40L(just suggest);
2	Vaporizer	Vaporize the liquid gas	✓ The gas press of the nozzle end is at least 1Mpa; ✓ The diameter of the tube is 25mm; ✓ Depending on the distance between the gas room and the nozzle burner.
3	Gas tube	Transfer the gas to the nozzle burner	
4	Gas flow meter	Control the gas flow	✓ 21,000 Btu/min ~ 22,000 Btu/min (369 kWh ~387 kWh) with respect to (760 ± 28) °C. ✓ 18,000 Btu/min ~ 19,000 Btu/min (316 kWh ~334 kWh) with respect to (704 ± 28) °C.
5	Gas supply auto switch	switch to another gas supply automatically at low gas pressure.	✓ With gas pressure monitor.
6	Gas room(**offered by the customer, figure 1 as reference**)	Separate the gas supply with the burning place.	✓ Two separate room, one for vaporizing and one for propane. ✓ The Propane room is at least 3m*3m*3m(L*W*H); ✓ The Propane room is well-ventilated at least $1m^3$/min; ✓ The vaporizer room is at least 3m*3m*3m(L*W*H); ✓ The vaporizer room is well-ventilated at least $1m^3$/min; ✓ The distance between vaporizer room and nozzle burner is less than 10m;
7	Back flash arrestor	Avoid the flash go back	✓

2.3 Exhaust

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Exhaust could be represented in the table 3.

Table 3

S. No	Component	Function	Parameter
1	Exhausted gas analysis system(offered by the customer)	Inspect the gas component	✓ According to the local law(CO and CO_2 are detected and CO could be ignored.
2	Toxic gas treatment system(offered by the customer)	Treat Toxic gas	✓ According to the local law
3	Extraction Blower(offered by the customer)	Extract out the gas from the room	✓ Decide by the room(referenced 400m^3 /min for figure 1 room size).

2.4 Oven burner

Oven burner could be represented in the table 4.

Table 4

S. No	**Component**	**Function**	**Parameter**
1	Oven container	Burning the brand	✓ Size: 40 cm X 40 cm (Length X Wide) ✓ Oven burner container size: 50 cm X 50 cm X 50 cm (Length X Wide X Height); ✓ Container material: Steel, temperature resistance up to 1,000 ℃.
2	Thermal resistance heater	Control flame temperature	✓ (888 ± 28) ℃ @ 58.7 mm above the top of the burner
3	Brand holder	Hold the brand	✓ 3 kg minimum weight allowance ✓ brands shall be enveloped in the flame
4	Brand clip	Rotate and remove burning brands	✓ High temperature resistance.
5	Brand	For burning-brand test	✓ Brands mass: 10 g to 2,000 gram; ✓ Brand type: kiln dried Douglas fir lumber free from knots and pitch pockets; ✓ Brand Size (mm): 300X300X57 for Class A, 150X150X57 for Class B, 38.1X38.1X19.8 for Class C;

2.5 Brand chamber

Brand chamber could be represented in the table 5.

Table 5

S. No	**Component**	**Function**	**Parameter**
1	Brand Chamber	Store brand	✓ Temperature: RT+10～60℃; ✓ Size: 50 cm X 50 cm X 50 cm (Length X Wide X Height);

2.6 Control system

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Control system could be represented in the table 6

Table 6

S. No	Component	Function	Parameter
1	Visual Monitor System	Observe the state	✓ 3 cameras are installed under, above and one side of the test deck
2	Burning temperature monitor	Monitor the temperature of the flame	✓ Temperature data are collected every 10 second ✓ Average latest 2 minutes data to obtain required temperature ✓ Gas flow tuned automatically to retain burning heat
3	Wind speed monitor	Air velocity monitor and control	✓ air flow is tuned automatically to retain velocity at (5.3 ± 0.2) m/s (1 minute average)
4	Auto ignition control	Ignite the gas	✓ ignite small amount of fuel and then control fuel and air flow by program
5	Air duct temperature monitor	Monitor the temperature of Air duct	✓ collect air duct temperature every 10 seconds after ignition
6	Emergency stop button	Shut down power and air supply	✓
7	Gas leakage monitor	Monitor the gas leakage and send information to the PC to Shut down power and air supply	✓
8	Gas flow monitor	Gas flow monitor & control	✓ Adjust to meet the flame temperature and burning heat.
9	Gas pressure monitor	Gas pressure monitor & valve control	✓ Switch automatically the gas supply.
10	Screen	Display the visual monitor and datasheet	✓ 40'' LCD

2.7 Room(figure 1 as reference)

Room for the test could be represented in the table 7

Table 7

S. No	Component	Function	Parameter
1	Wall of the Room		✓ should be fire resistance Coating; ✓ Tiles on all wall of room and floor of room with necessary fire protection arrangement.
2	Structure		✓ The combustor room is at least 10m*5m*5m(L*W*H); ✓ Should be fire resistance Coating(according to the local law);

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			✓ Tiles on all wall of room and floor of room with necessary fire protection arrangement(according to the local law); ✓ There is a hole on the wall with the size at least 2.5m*1m(W*H). And the hole is about 1.1m high from the ground. Also, there should be nothing outside the hole in at least 10m distance; ✓ The structure of the room is according to the local law.
3	Electrical Power		✓ Inlet Blower: 415V, Φ3, 8.5kW ✓ Control Parts: 220V, Φ1, 6kW ✓ Extraction Blower: Depending on the power of the extraction blower.(Referenced 415V, Φ3, 7.5kW for figure 1 room size)

3. Others

Others are present in table 8

Table 8

S. No	Items	Presentation
1	Accessories	✓ All required accessories are to be provided. ✓ Cable, duct and pipe material must be fire-resistance. ✓ Motoring accessories (ex: thermocouple wire…) must be fire-resistance.
2	Drawings/ Documents	✓ Provide for all related drawings / Bill of material for test building and utilities.
3	Safety device(**offered by the customer**)	✓ Provide necessary arrangement to stop the fire in device under test according to the local law.

Reference of the room

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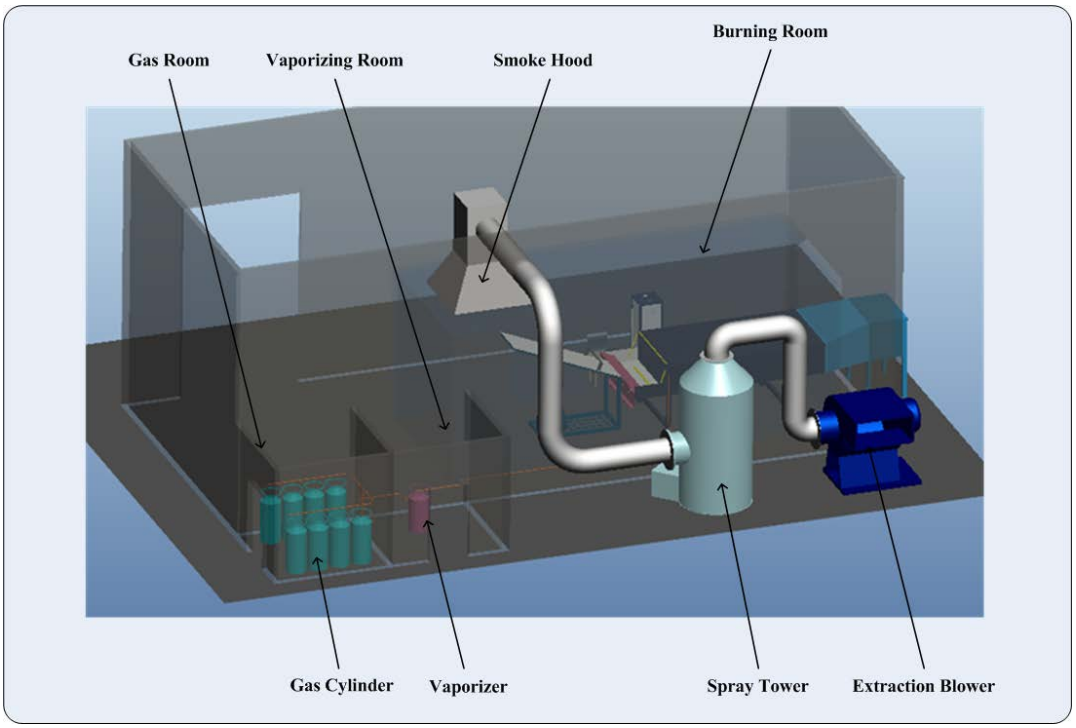

Figure 1

4. Reference picture

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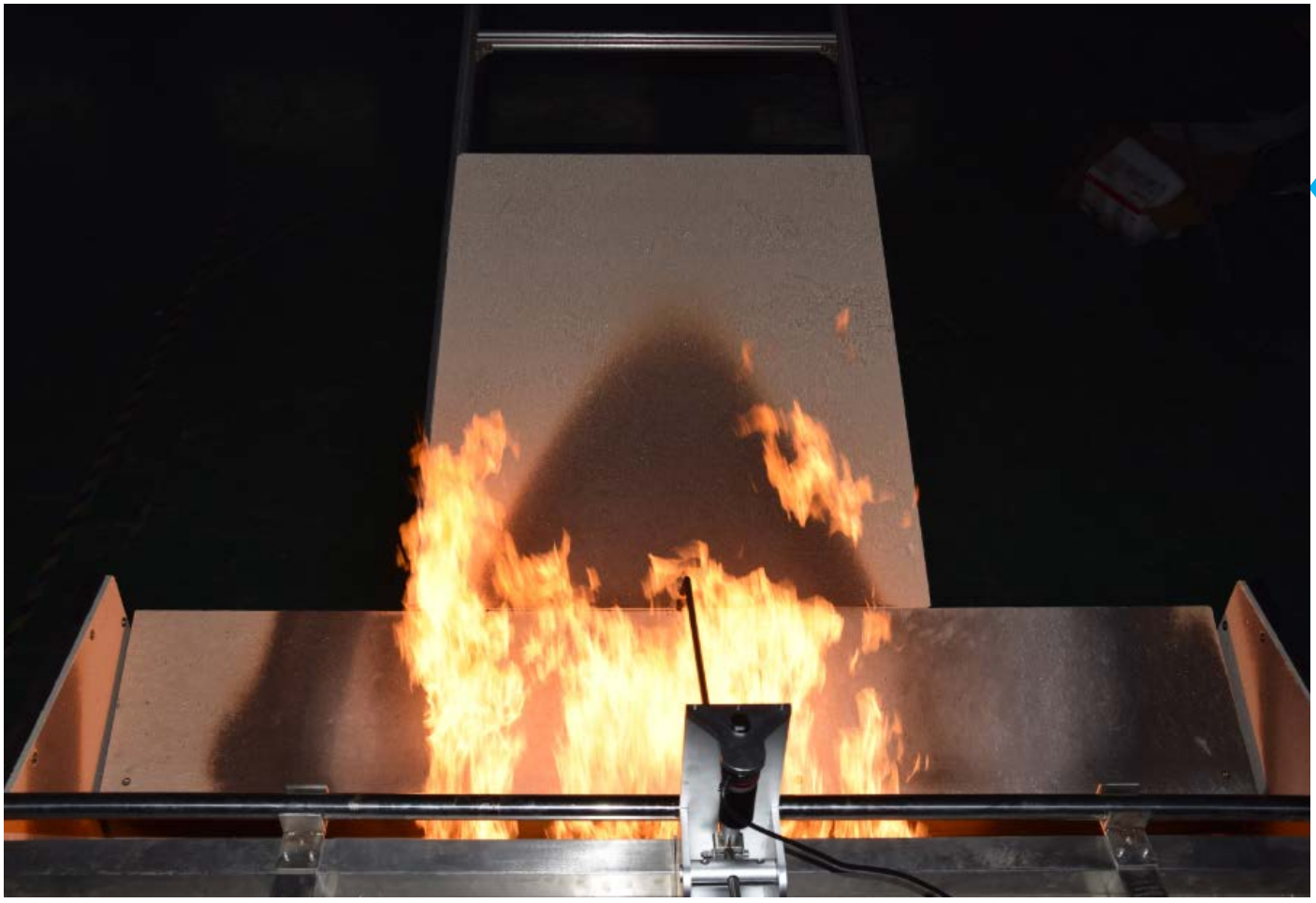

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