PRODUCT DATASHEET

Solar Facade

MITREX™

BUILDING-INTEGRATED SOLAR TECHNOLOGY

יבואן בלעדי:

יוניקיט אנרגיה

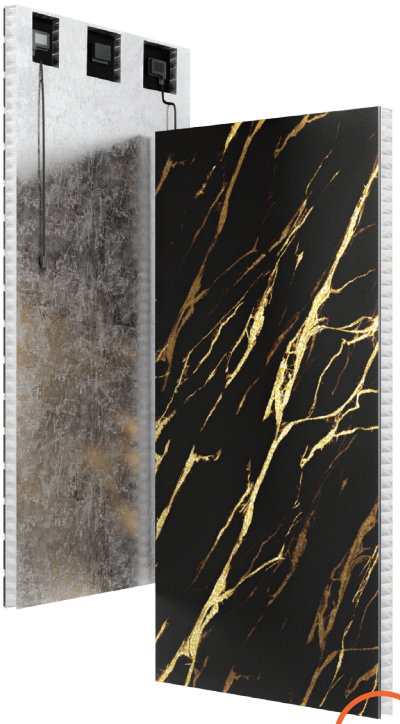
073-7969732

PRODUCT OVERVIEW

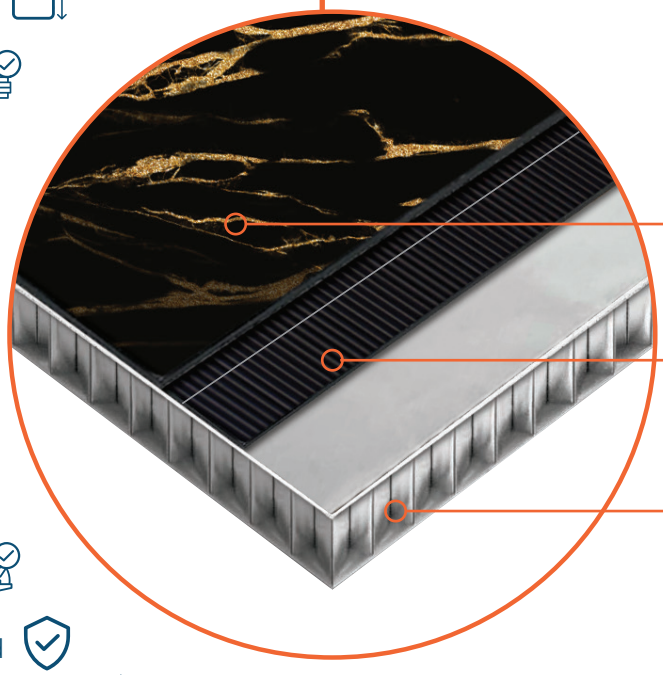
Mitrex Solar Facades use the power of the sun to produce clean electricity. In addition, these products feature various backing systems, allowing for lightweight, high-strength panels.

Mounted on top is a layer of solar cells fixed with a customizable facing, recreating any pattern or color while allowing for energy generation. These panels also provide thermal resistance in addition to exterior noise control while ensuring durability and safety.

Mitrex cladding panels are an energy-efficient solution for both existing and also new facades. Particularly from design and building perspectives, Mitrex BIPV systems have limitless applications. Furthermore, these panels transform typical, single-purpose building materials into multi-purpose cladding that acts as an energy generating building envelope.



- Versatile, integrated panel components
- Customizable facings, materials & shapes
- Various panel size options
- Cost-effective
- Strong & durable panels
- Lightweight system
- Any application
- Rapid fabrication
- Easy to install
- Safety-tested
- Fire proof

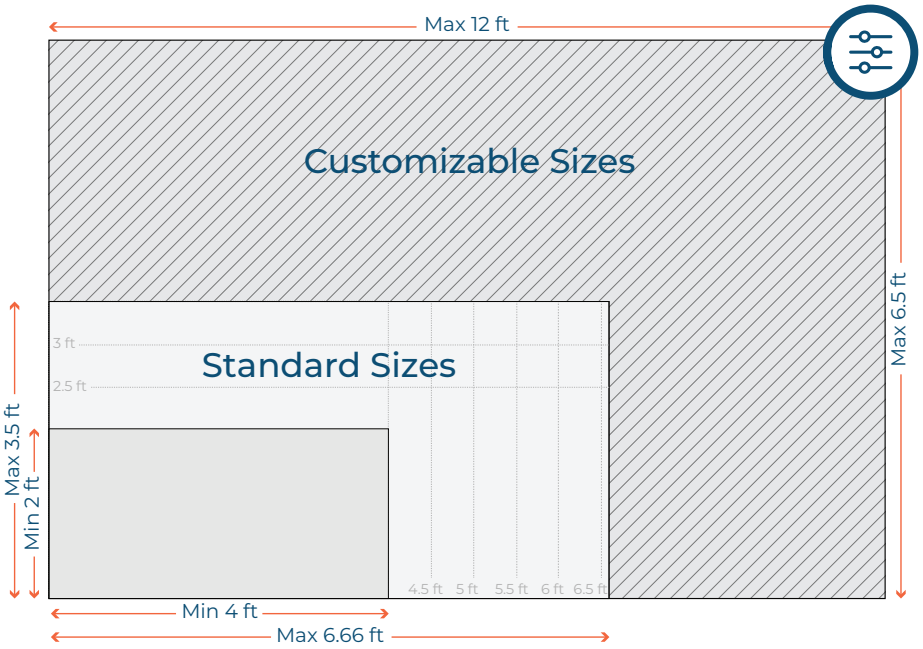


ENERGY GENERATION

SOLAR FACADE PANEL DATA

SPECIFICATIONS	SOLAR FACADE
Cell Type	Mono-crystalline
Standard Panel Dimensions	40” x 80” (1016mm x 2032mm)
Maximum Panel Dimensions	78” x 144” (1981mm x 3658mm)
Front Cover	(Min) 3.2 mm Ultra Clear Advanced Low Iron Glass
Average Weight	3.2 Pounds / SQFT (15.6 kg / SQFM)
Back Support	Smart Core Aluminum Honeycomb
Overall Thickness	1” +/- 1/16” (25.4mm +/- 1.6mm) With Customizable Options Up to 8” (203mm)
Aluminum Honeycomb Thickness	3/4” (19mm) With Customizable Options Up to 8” (203mm) Depending on Application
Tolerances (Length, Width &, Squareness)	+/- 1/8” (+- 3.2mm) Refer to Mitrex.com for More Information

PANEL DIMENSIONS



A major limitation of most solar panels is that they are restricted to a standard panel size or colour (black) because of technology, design, supply chain, or manufacturing constraints. Consequently, restrictions in panel size and constructibility hamper the ability of architects to design buildings with complete creative freedom.

In contrast, Mitrex Solar Facade panels overcome this problem because they can vary both in size and shape, adapting to the needs of architects as required. Mitrex can manufacture solar cladding in many different sizes, including multiple panels with minute differences, based on architectural design needs.

SOLAR FACADE PANEL LATERAL LOAD CAPACITY

Based upon 15/16 in. panel thickness & L/240 deflection limit (ASTM C393)

Uniform Load (psf)	24	42	50	66	102
Span (Inches)	48	36	32	24	16

For Mitrex: 1 in. = 25.4 mm, 1 psf = 47.99 Pa.
Maximum vertical spacing of panel attachments to the support is 24 in. for rainscreen systems with 1 in. honeycomb.

HONEYCOMB PROPERTIES

Aluminium honeycomb can be used as deflector for laminar flow-ventilation, and as crash-absorber for kinetic energy.

Thickness of non-expanded blocks: 1000mm standard, the diameter of the cells from 3 to 25 mm. The density of the honeycomb depends on the thickness of the foil and the diameter of the cells.

Thickness of expanded section from 3mm to 60 / 200mm approx. (depending on the cell diameter). Honeycomb density (from 20 to 163 kg/m3) depends on foil's thickness and on cell size.

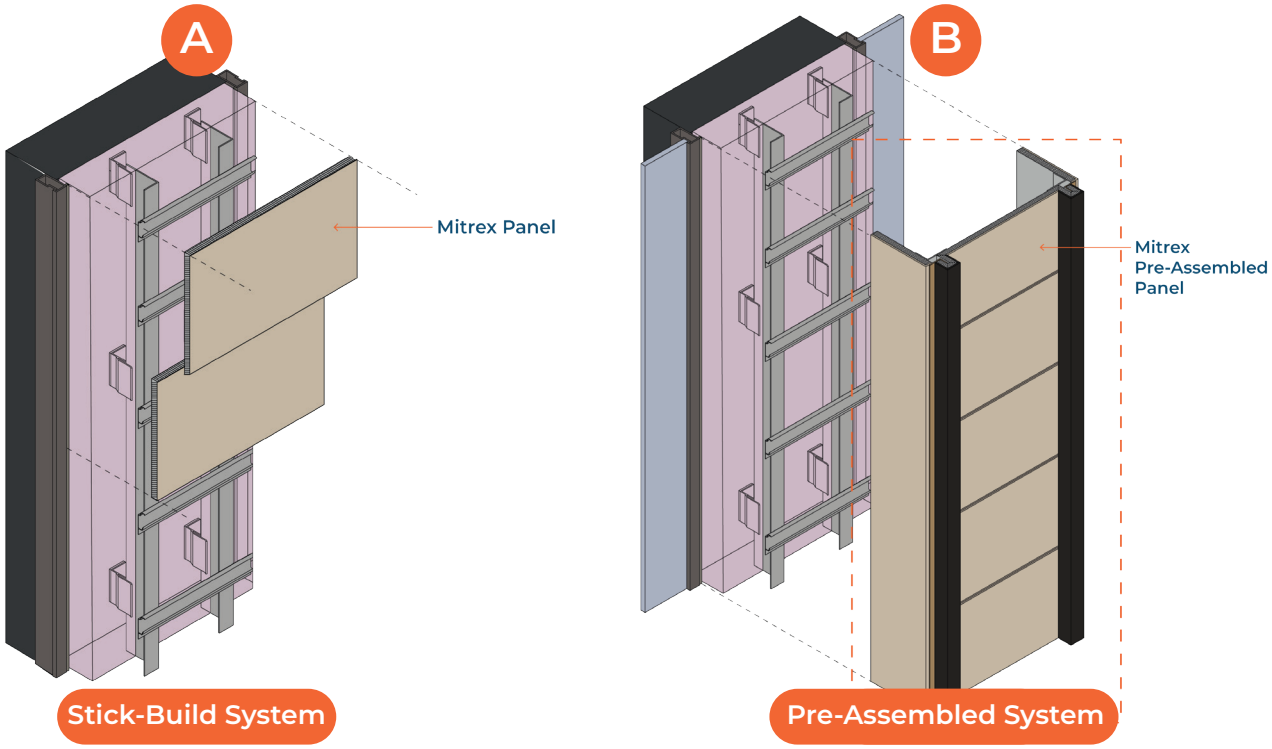
HONEYCOMB CORE'S PROPERTIES	50 MICRONS				
Aluminum Alloy Series 3000	3003 / 3005 / 3103 / 3104				
Ø Honeycomb in mm ca	3,8	6	9	12	19
Ø Honeycomb in inches	1/8"	1/4"	3/8"	1/2"	3/4"
Density kg/m^3	112	56 - 59	39 - 40	29 - 30	20 - 21
Compressive Stabilized Strength MPa	6,8	3,0 - 3,5	1,4 - 1,95	0,8 - 0,95	0,4 - 0,6
Thinckness' Tolerance mm	± 0,1 (±, 0,05 on Request)				
Dimension's Tolerance mm	± 30				
Maximum Use Temperature °C	180°				

INSTALLATION SYSTEMS

Mitrex offers panelling wall system solutions that enhance design appeal and flexibility for any building need.
The panels are connected to the back wall via any attachment system desired.

- ☑ Panel or Preassembled Options
- ☑ Design Flexibility
- ☑ Limitless Applications

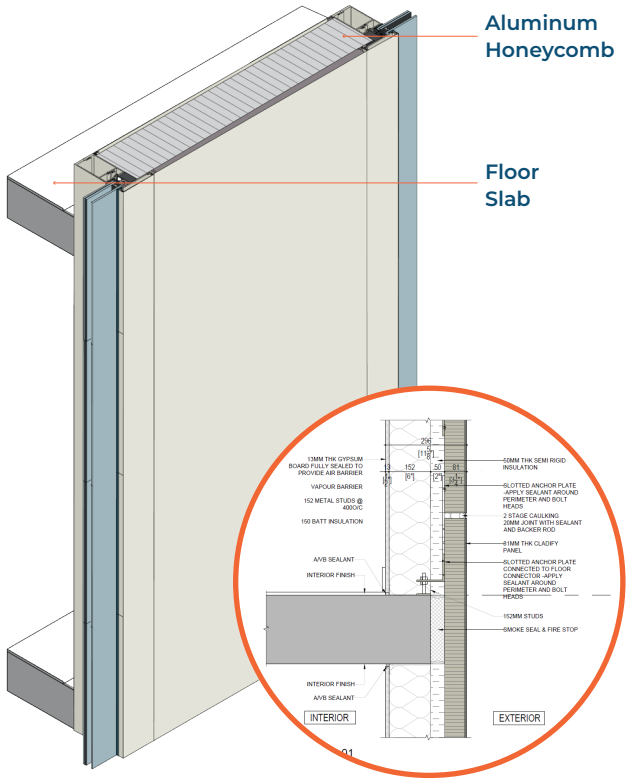
RAINSCREEN SYSTEM
Installation System



An air pressurized cavity wall system designed to eliminate water penetration and allow ventilation.
This system consists of two options: **stick-build cladding** where installation is panel by panel, and **pre-assembled cladding** where the panels are prefabricated and installed as a single unit. This results in faster installation and minimizes connection points to substrate. Panels can span floor to floor and be attached to slabs only.

- ☑ Air pressurized cavity wall system.
- ☑ Continuous insulation and AWB.
- ☑ Achieves irregular designs.
- ☑ Precise installation.
- ☑ Stick-build requires a backup wall, whereas preassembles requires structural slabs only.

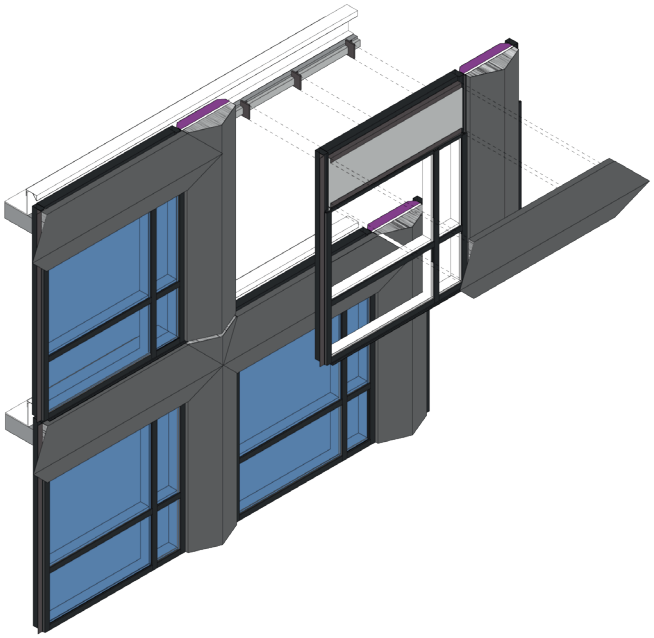
PRE-PANELIZED SYSTEM
Installation System



The system is a hybrid of window wall and precast architectural wall panels, spanning slab to slab and transferring all the component loads to the building structure.

- ☑ Rapid, year-round installation.
- ☑ Slab to slab panel sizes.
- ☑ Installation from inside.
- ☑ Reduced costs for design, transportation & installation.
- ☑ No need for structural backup of the wall.
- ☑ Lightweight panel system.
- ☑ No tower crane needed.

UNITIZED FACADE INTEGRATION TO OTHER ASSEMBLIES
Installation System

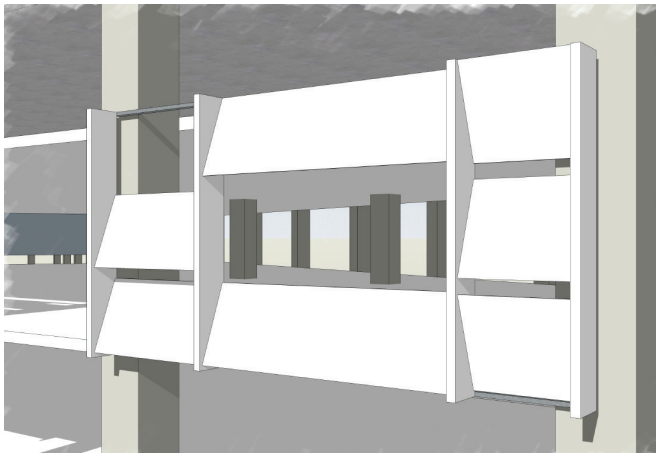


Integration into window walls, curtain walls, mega-panels, modular systems, etc by working with other service providers. This allows for a uniform installation system for the entire building based on prefabricated wall assemblies.

- ☑ Preassembled solution for entire building envelope including window walls, curtain walls, mega-panels, modular systems, etc.
- ☑ Prefabricated units contain supporting structure and exterior wall panels.
- ☑ Quick installation done all at once.
- ☑ Large panel sizes (12’ x 25’) and slab to slab connections.
- ☑ Lightweight panel system.
- ☑ Prefabricated units made and sent to site.

CUSTOMIZABLE INTEGRATIONS & SPECIAL PROJECTS

Installation System



Our active and non-active cladding panels can be incorporated into any pre-set custom framing system or a new system can be developed as per any requirement.

- ☑ Custom shape are achieved through prefabricated panel assemblies.
- ☑ Compatible with manual or automated movable panel system, which can be an added benefit considering optimized solar efficiency due to desirable orientation.
- ☑ With the combination of active, non-active panels & voids in between, the essence of perforated facade can be captured.

CERTIFIED IEC 61730 | CERTIFIED IEC 61215 | UL 61730 | UL 61215 | CSA 61730 | CSA 61215

SOLAR CLADDING

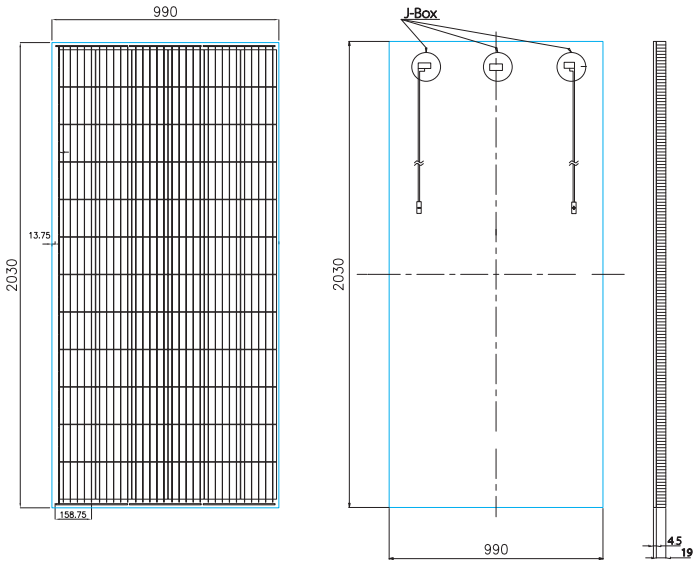
Orbit Facing With Aluminum Honeycomb

High Efficiency Mono Module

340W

1000V

ENGINEERING DRAWING (mm)



ELECTRICAL DATA | STC*

SPECIFICATIONS	SOLAR CLADDING ORBIT
Nominal Max. Power (Pmax)	340W
MPP Operating Voltage (Vmp)	42.3V
MPP Operating Current (Imp)	8.04A
Open Circuit Voltage (Voc)	48.2V
Short Circuit Current (Isc)	8.97A
Cell Efficiency	22% - 22.5%
Operating Temperature	-40°C ~ +85°C
Max. System Voltage	1000V (IEC/UL)
Max. Series Fuse Rating	20A
Application Classification	Class A

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m2, spectrum AM 1.5 and cell temperature of 25°C.

MECHANICAL DATA

SPECIFICATIONS	SOLAR CLADDING ORBIT
Cell Type	Mono-crystalline
Cell Arrangement	72 (12x6)
Dimensions	2030x990mm
Front Cover	3.2 mm tempered glass
Weight	29kg
Back Support	Aluminum Honeycomb
J-Box	IP68, 3 bypass diodes
Cable	4mm², 12 AWG (UL)
Cable Length (Including Connector)	500mm, 1000mm, 1200mm
Connector	MC4

TEMPERATURE CHARACTERISTICS

SPECIFICATIONS	SOLAR CLADDING ORBIT
Temperature Coefficient Pmax	-0.36% / °C
Temperature Coefficient Voc	-0.30% / °C
Temperature Coefficient Isc	0.046% / °C
Nominal Module Operating Temperature	42 ± 3°C

SOLAR CLADDING

Oracolo Facing With Aluminum Honeycomb

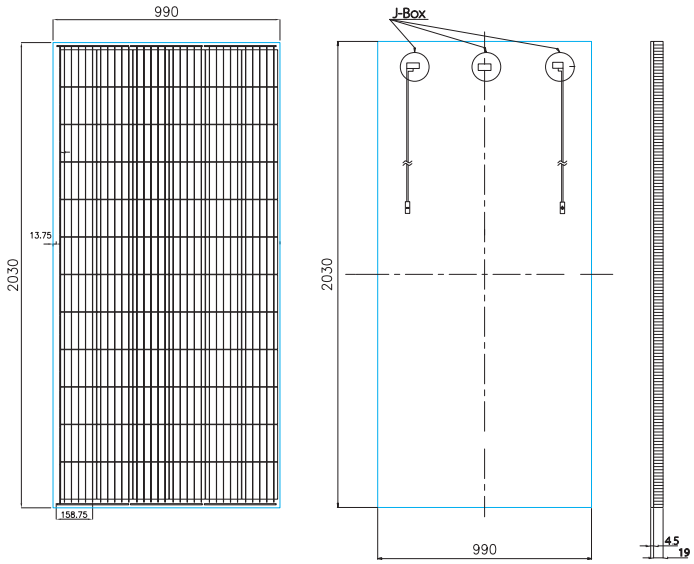
High Efficiency Mono Module

175W

1000V

CERTIFIED IEC 61730 | CERTIFIED IEC 61215 | UL 61730 | UL 61215 | CSA 61730 | CSA 61215

ENGINEERING DRAWING (mm)



ELECTRICAL DATA | STC*

SPECIFICATIONS	SOLAR CLADDING ORACOLO
Nominal Max. Power (Pmax)	175W
MPP Operating Voltage (Vmp)	43.0V
MPP Operating Current (Imp)	4.07A
Open Circuit Voltage (Voc)	48.2V
Short Circuit Current (Isc)	4.36A
Cell Efficiency	22% - 22.5%
Operating Temperature	-40°C ~ +85°C
Max. System Voltage	1000V (IEC/UL)
Max. Series Fuse Rating	20A
Application Classification	Class A

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m2, spectrum AM 1.5 and cell temperature of 25°C.

MECHANICAL DATA

SPECIFICATIONS	SOLAR CLADDING ORACOLO
Cell Type	Mono-crystalline
Cell Arrangement	72 (12x6)
Dimensions	2030x990mm
Front Cover	3.2 mm tempered glass
Weight	29kg
Back Support	Aluminum Honeycomb
J-Box	IP68, 3 bypass diodes
Cable	4mm², 12 AWG (UL)
Cable Length (Including Connector)	500mm, 1000mm, 1200mm
Connector	MC4

TEMPERATURE CHARACTERISTICS

SPECIFICATIONS	SOLAR CLADDING ORACOLO
Temperature Coefficient Pmax	-0.36% / °C
Temperature Coefficient Voc	-0.30% / °C
Temperature Coefficient Isc	0.046% / °C
Nominal Module Operating Temperature	42 ± 3°C

TESTING DETAILS

GENERAL TESTING SUMMARY

TEST	SPECIFICATION	METHODOLOGY	RESULT
Salt Spray Resistance	ASTM B117-16	1000 Hours of exposure	No deleterious effects
Density of Sandwich Core	ASTM C271/C271M-16	12'' X 12'' X 0.6''	327 kg/m3 (20.42 lbm/ft3)
Shear Stress and Shear Modulus	ASTM C273/C273M-18	Compressive force applied until rupture	Ultimate Core shear Strength = 1.01 MPa (147 psi) Core shear Modulus = 10.9 MPa (1583 psi)
Flatwise Tensile Bond Strength	ASTM C297/C297M-16	Load was applied to the top and bottom layers of the composite panel	1.52 MPa (220 psi)
Edgewise Compressive Strength	ASTM C364/C364M-16	Compressive load was applied at a rate of 0.02 in/min	Ultimate Compressive Strength = 37.85 MPa (5490 psi)
Flatwise Tensile Bond Strength	ASTM C365	Load was applied to the top and bottom layers of the composite panel	1.52 MPa (220 psi)
Shear Strength by Beam Flexure	ASTM C393/C393M-16	Loaded in flexure with facing side in tension at a cross head speed of 0.025 in/min.	Maximum Core Shear Strength = 0.94 MPa (137 psi) Facing Bending Stress = 8.14 MPa (1180 psi)
Flexure Creep Evaluation	ASTM C480/C480M-16	Midspan loading setup was used with facing side in tension at a cross head speed of 0.025 in/min. until achieved.	Net Creep (in/day) Facing - 0.029.
Laboratory Aging of Sandwich Construction	ASTM C481-99 (Reapproved 2016)	Procedure A, for six repetitions of following load cycle is applied: Immerse in water at 50 °C for 1h Spray with steam at 95 °C for 3h Store at -12 °C for 20h Heated at 100 °C for 3h Spray with steam at 95 °C for 3h Heat in dry air at 100 °C for 18h	ASTM C273; C297; C364; C393 tests were reconducted after aging: the variation was +1.36 %, -5.90%; +2.55%; -7.95% Note: Positive variation indicates no decrease in strength after aging.
Resistance to Rapid Freezing and Thawing	ASTM C666/C666M-15	200 cycles of rapid freeze and thaw (4 °C to - 18 °C)	No visible change to facing, aluminum, or adhesive
Flexural Strength	ASTM C880/C880M-15	Tested a Composite panel with Mitrex panel	22.83 MPa (3311.21 psi)
Tensile Properties of Adhesive Bond	ASTM C897-08 (2016)	The adhesive bond never failed	No Failure
Screw Withdrawal Test	ASTM D1761	Testing Speed: 2.5 mm/min	2124 N
Damage Resistance Testing of Sandwich Constructions	ASTM D7766/D7766M-16	Load was applied at the specimen midpoint through a 0.5 in. diameter hemispherical steel indenter at a constant rate of 0.01 in/min until a drop-in load was observed.	No panel deformation
Air Leakage Resistance	ASTM E283-04 (2012)	Air infiltration and exfiltration tests were performed using test pressure of 75 Pa (1.57 psf). The maximum air leakage rate was calculated and compared to the allowable air leakage.	Passed the test infiltration rate = 0.00 L/s.m2 (0 cfm/ft2) & exfiltration rate = 0.01 L/s.m2 (0.002 cfm/ft2) at 75 Pa test pressure
Static Pressure	ASTM E330-00 (2016)	The test specimen was also tested to failure with both positive and negative loads. The specimen only showed a permanent deflection of 0.10 mm with a test load of + 5760 Pa (120 psf). The specimen failed at -5006 Pa, the rivets at the backside of the specimen failed.	All the panels tested met or exceeded requirements
Uniform Static Deflection	ASTM E330-02	The test specimen was tested to ±3840 Pa (80.2 spf) to examine the deflection of 2440 mm panel, the specimen showed a maximum net deflection of 4.14 mm under positive test pressure and 4.93 mm under negative load.	No failure or permanent damage

GENERAL TESTING SUMMARY

TEST	SPECIFICATION	METHODOLOGY	RESULT
Large Missile Impact Test	ASTM E1996-14a	Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.	Passed the test. A weighted 2×4 was fired at the Mitrex panel at 50 fps.
Fluorescent Ultraviolet Radiation Exposure	ASTM G154 -16	2000 hours of UV exposure	No visible change to Glass, aluminum, or adhesive
Thermal Resistance	ASTM 1363-11	Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus	0.20 m2 oC/W (1.12 hr-ft2-oF/BTU)
Cyclic Pressure Loading	ASTM E1886-13a	Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials	Passed the test. Over 3,500 positive and negative pressure cycles were applied at ± 2880 Pa (60 psf), equivalent wind load of 165 mph.
Water Penetration Resistance	ASTM E331-00(2016)	During the 15-minute test period, using a pressure differential of 720 Pa (15.0 psf), there was no water leakage observed.	No water leakage

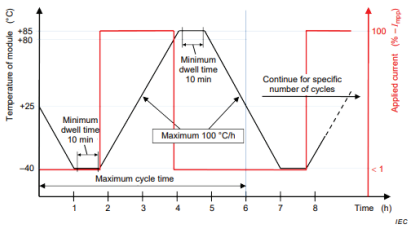
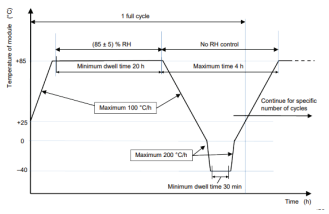
FIRE TESTING SUMMARY

TEST	SPECIFICATION	RESULT
Tunnel Test	ASTM E84	Sample passed the test with Flame Spread Index = 0; smoke developed index = 0.
Surface Burning Characteristics of Building Materials	CAN/ULC S102	The panel received the Flame Spread Rating = 0 & Smoke Developed Classification = 40. As the Flame Spread Index was 0, the lab technicians from the Intertek and we are assuming the smoke developed (smoke developed Index = 40) was because of moisture.
Non-Combustibility in Building Materials	CAN/ULC S114	Component material testing. Mitrex sample passed the test requirements. There was no visible smoke or flame. The sample did not have a maximum temperature rise of more than 36°C on the indicating thermocouple. The samples did not loose more than 20% of their original mass.
Multi-Story Fire Test	CAN/ULC S134	Passed.
Fire Endurance Tests of Building Construction and Materials	CAN/ULC S101	1 hr Fire Exposure - The Mitrex Material did not affect the fire rated wall assembly.

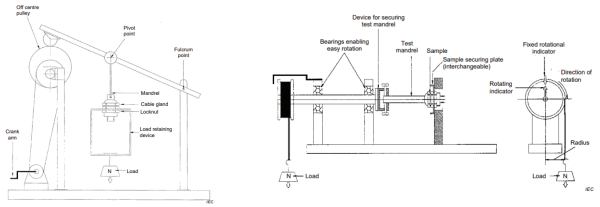
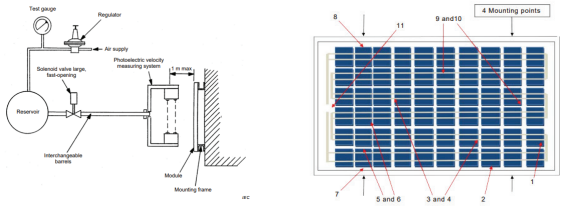
MITREX SOLAR QUALITY TESTING IEC 61215

TEST	SPECIFICATION
MQT 01 Visual Inspection	To detect any visual defects in module: · Broken, cracked, or torn external surfaces. · Bent or misaligned external surfaces, including superstrates, substrates, frames and juntion boxes to the extent that the operation of the PV module would be impaired. · Bubbles or delaminations forming a continuous path between electric circuit and the edge of the module. · If the mechanical integrity depends on lamination or other means of adhesion, the sum of the area of all bubbles shall not exceed 1% of the total module area. · Evidence of any molten or burned encapsulant, backsheet, front sheet, diode or active PV component.

MITREX SOLAR QUALITY TESTING IEC 61215

TEST	SPECIFICATION
MQT 01 Visual Inspection	· Loss of mechanical integrity to the extent that the installation and operation of the moule would be impaired. · Cracked/broken cells which can remove more than 10% of the cell's photovoltaic active area from the electrical circuit of the PV module. · Voids in, or visible corrosion of any of the layers of the active (live circuitry of the module extending over more than 10% of any cell. · Broken interconnections, joints or terminals. · Any short-circuited live parts or exposed live electrical parts. · Module markings (label) are no longer attached, or the information is unreadable.
MQT 02 Maximum Power Determination	Checking the functionality of module and maximum power by checking the I-V curve.
MQT 03 Insulation Test	HiPot test with voltage of 3000V for PV modules with voltage system of 1000V for 1 min. again another HiPot test for 2 min with 1000V (system voltage).
MQT 04 Measurement of Temperature Coefficients	Determining temperature coefficients of current, voltage and peak power from module measurement.
MQT 05 Measurement of Nominal Module Operating Temperature (NMOT)	Determining the solar module characteristics (Voc, Isc and Pmax) in 800 W/m2, 20 degree and wind speed of 1m/s.
MQT 06 Performance at STC and NMOT	Checking the short circuit current (Isc) and open circuit voltage (Voc) and IV-curve and comparing with the rating with tolerances for both STC (1000 W/m2 , 25 degree and AM = 1.5) and NMOT (800 W/m2, 20 degree and wind speed of 1 m/s) conditions.
MQT 07 Performance at Low Irradiance	Determining the current-voltage characteristics of module at 25 degree and low irradiance of 200 W/m2 and having IV curve result.
MQT 08 Outdoor Exposure Test	Installing the module outdoor with load around its maximum power for at least 60 kWh/m2. No defect should be found.
MQT 09 Hot-Spot Endurance Test	Determining ability of module against hot-spot effects like solder melting or deterioration caused by faulty cells, mismatched cells, shadowing, or soiling. Using I-V curve tracer and IR scan to check the hot-spot by making shadow for every single cell.
MQT 10 UV Preconditioning Test	Install the module in a chamber with only UV light (between 280nm to 320 wavelength and 320 to 400nm) with maximum 50W/m2 and short-circuited module (or with load in maximum power) at the 60 degree temperature. Subject the module to total UV irradiance of at least 15kWh/m2 in the wavelength range between 280 to 400nm.
MQT 11 Thermal Cycling Test	Testing the module by changing the temperature repeatedly. Module to be installed in the chamber with temperature sensor attached to its middle. The temperature should change with no more than 100 degree per hour and stay at -40 and 85 for at least 10 min. during the test, module will carry the current when temperature increasing from -40 to 80 degree only. Below process will be taken 50 or 200 times. 
MQT 12 Humidity Freeze Test	Testing the module in high temperature and humidity followed by sub-zero temperature. Temperature will arise to 85 degree at maximum 100 degree per hour and keep the module for 20h in humidity of RH 85%. Then cool down to zero and then -40 degree by the speed of max 100 and 200 degree per hour. And keep for 30 min. do this process for 10 cycles. 

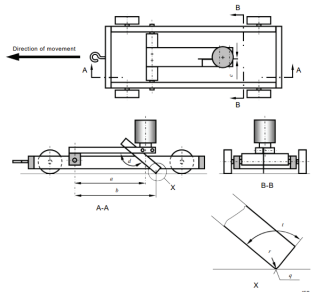
MITREX SOLAR QUALITY TESTING IEC 61215

TEST	SPECIFICATION
MQT 13 Damp Heat Test	Testing the ability of module for long term humid environment. The module will be at 85-degree temperature and 85 percent relative humidity and keep it there for 1000 h (or 200 h for another test) and no defect should be found.
MQT 14 Robustness of Terminations	Checking capability of withstanding of cables and termination attachments against stresses. Force of 40N for 10s in different direction will be applied to junction box to test its retention on module surface. Cable will be pulled 50 times for 1s in the direction or the axis and then torque test will be applied for 1 min. 
MQT 15 Wet Leakage Current Test	Putting module in the tank of required solution to a depth sufficient to cover all surfaces (except junction box not designed for immersion). Then doing HiPot test for 2 min at system voltage (1000V).
MQT 16 Static Mechanical Load Test	Testing ability of withstanding with minimum static load. During the test electrical continuity of internal circuit should be monitored. Fixing the module on mounting base and applying 1 hour of 1.5 times of design load (per manufacturer) in front and back of the module respectively for three cycles.
MQT 17 Hail Test	Testing the effect of hitting hail on the module surface (different location). Module will be installed on 90 degree tilt and room temperature. 11 hail ball at the diameter of minimum 25mm and speed of minimum 23 m/s will be fired through launcher. No major defect should be found. 
MQT 18 Bypass Diode Testing	Checking the forward voltage of diode with short circuit current in 30, 50, 70 and 90 degree Celsius, then keep the current 100% and 125% of short circuit current for one hour and check the forward voltage at 75 degree. Then checking the functionality of diode after test. It could be done by successive IV-Curve tracer at maximum power by having shaded the strings to turn the diode ON or connecting the IV-Curve tracer in reverse polarity to turn the diode ON.
MQT 19 Stabilization	Checking the power of module to make sure it is stabilized electrically. The power testing on three consecutive should follow below relation: (Pmax – Pmin) / Paverage < x Stabilization will be done in the beginning to check the label of each module and at the end of test to make sure degradation did not affect on the modules. IEC classified the tests in few categories just to have better view on all tests as follow: · Environmental stress tests (MST 51, MST 52, MST 53, MST 54, MST 55, MST 56) · General inspection tests (MST 01, MST 02, MST 03, MST 04, MST 05, MST 06, MST 07) · Electrical shock hazard tests (MST 11, MST 12, MST 13, MST 14, MST 16, MST 17, MST 42) · Fire hazard tests (MST 21, MST 22, MST 23, MST 24, MST 25, MST 26) · Mechanical stress tests (MST 32, MST 33, MST 34, MST 35, MST 36, MST 37, MST 42)

MITREX SOLAR SAFETY TESTING IEC 61730

TEST	SPECIFICATION
MST 01 Visual Inspection	Checking any visual defect or change in the module; (marking, sharp edge, bubbles, crack, delamination, bent, mechanical integrity, ...)
MST 02 Performance at STC	Checking the short circuit current (Isc) and open circuit voltage (Voc) and comparing with the rating with tolerances (same as MQT 06)

MITREX SOLAR SAFETY TESTING IEC 61730

TEST	SPECIFICATION
MST 03 Maximum Power Determination	Checking the functionality of module and maximum power by checking the I-V curve (same as MQT 02)
MST 04 Insulation Thickness Test	Checking the thickness of insulation thin layers (backsheet) in three points as worst cases at solder connection, edge of farmeless PV modules, laminator membrane indents. The measurement should be bigger than requirement (0.15mm+tolerance%)
MST 01 Visual Inspection	Checking any visual defect or change in the module; (marking, sharp edge, bubbles, crack, delamination, bent, mechanical integrity, ...)
MST 02 Performance at STC	Checking the short circuit current (Isc) and open circuit voltage (Voc) and comparing with the rating with tolerances (same as MQT 06)
MST 03 Maximum Power Determination	Checking the functionality of module and maximum power by checking the I-V curve (same as MQT 02)
MST 04 Insulation Thickness Test	Checking the thickness of insulation thin layers (backsheet) in three points as worst cases at solder connection, edge of farmeless PV modules, laminator membrane indents. The measurement should be bigger than requirement (0.15mm+tolerance%)
MST 05 Durability of Marking	Checking durability and legibility of markings on the solar panels with medium pressure 15 second by hand and cloth soaked with water and again with petroleum spirits.
MST 06 Sharp Edge Test	Accessible part of solar modules should be smooth and free from sharp edges, burrs, ...
MST 07 Bypass Diode Functionality Test	Checking the functionality of diode after test. It could be done by successive IV-Curve tracer at maximum power by having shaded the strings to turn the diode ON or connecting the IV-Curve tracer in reverse polarity to turn the diode ON. (same as MQT 18.2)
MST 11 Accessibility Test	Checking the insulation resistance off all part of module that may be accessible to the live part by cylindrical test fixture at the pressure of 10N and at all time the resistance should be higher than 1MΩ.
MST 12 Cut susceptibility Test	Testing withstanding of polymeric material surface of module with specific fixture with force of 9N. 
MST 13 Continuity Test of Equipotential Bonding	Verifying continuous path between accessible conductive parts. Applying 2.5 times of maximum protective device current (for example 15A x 2.5) and checking the voltage for different conductive parts. Resistive should be less than 0.1Ω.
MST 14 Impulse Voltage Test	Testing capability of insulation of PV module against overvolage (from atmosphere like impulse and switching of low-voltage equipment). Module will be covered by conductive metal foil and surge voltage will be applied to module. Dielectric should not breakdown.
MST 16 Insulation Test	HiPot test with voltage of 6000V for PV modules with voltage system of 1000V. (same as MQT 03)
MST 17 Wet Leakage Current Test	Putting module in the tank of required solution to a depth sufficient to cover all surfaces (except junction box not designed for immersion). Then doing HiPot test for 2 min at system voltage (1000V). (same as MQT 15)
MST 21 Temperature Test	Putting module on black painted wooden platform and checking the temperature of different location of module (normalised by changing of ambient temperature) in maximum power and no wind. Normalized temperature should not reach TI/RTE/RTI. (for example 90 degree)
MST 22 Hot-Spot Endurance	Determining ability of module against hot-spot effects like solder melting or deterioration caused by faulty cells, mismatched cells, shadowing, or soiling. Using I-V curve tracer and IR scan to check the hot-spot by making shadow for every single cell. (same as MQT 09)

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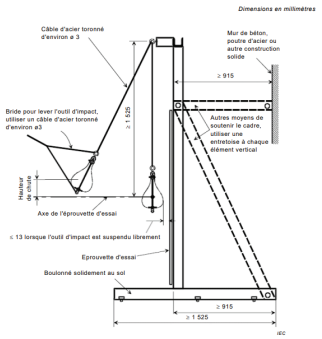
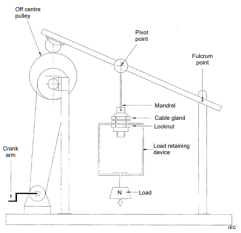
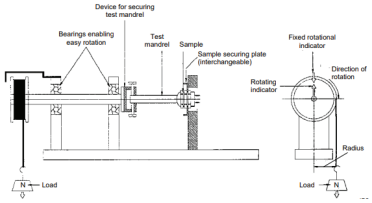
TEST	SPECIFICATION
MST 03 Maximum Power Determination	Checking the functionality of module and maximum power by checking the I-V curve (same as MQT 02)
MST 23 Fire Test	Fundamental requirements for fire safety are not internationally harmonised. Fire resistance requirements for a PV module intended for building applications are defined in local or national building codes.
MST 24 Ignitability Test	Testing ignitability of vertical mounted PV by direct small flame under zero irradiance by external heat source. All exposed combustible material will be tested (but junction boxes, cables, and connectors). Flame will be applied at least 40mm above the bottom edge of the sample for 15s.
MST 25 Bypass Diode thermal test	Checking the forward voltage of diode with short circuit current in 30, 50, 70 and 90 degree Celsius, then keep the current 100% and 125% of short circuit current for one hour and check the forward voltage at 75 degree. Then following MST 07 for checking the functionality of diode. (same as MQT 18)
MST 26 Reverse CurrentOverload Test	Checking the risk of fire or ignition in reverse current situation. Putting module facedown to the mounting and covered by white tissue paper. Back of module should be covered by single layer of white tissue paper. With no irradiance, 1.35 times of maximum fuse size should apply to the module in reverse direction. No glass break or flaming should happen.
MST 32 Module Breakage Test	The weight of bag is around 45.5kg. Module should be mount on the frame and bag should be max 13mm far from surface and max 50mm from the centre of module. Drop height should be 300mm, and release after stabilizing. 
MST 33 Screw Connections Test	Testing screws and nuts in completely loosening and tightening (to the specified torque) for five times.
MST 34 Static Mechanical Load	Testing ability of withstanding with minimum static load. During the test electrical continuity of internal circuit should be monitored. Fixing the module on mounting base and applying 1 hour of 1.5 times of design load (per manufacturer) in front and back of the module respectively for three cycles. (same as MQT 16)
MST 35 Peel Test	This test is only for cemented joint. Not sure this test is applicable to our product (based on the tables 3 and 4 of IEC 61730-1). But include tensile test in some adhesion part between encapsulant and back-sheet. Module should be unframed.
MST 36 Lap Shear Strength Test	Same as MST 35 but for glass/glass module tensile test.
MST 37 Material Creep Test	Checking the adhesive between different part of module (frontsheet and backsheet, FS or BS to mounting system, JB to BS) will be done in this test. Putting the module in chamber on mounting base and increasing temperature to 105 degree for 200 hours.
MST 42 Robustness of Termination Test	Checking capability of withstanding of cables and termination attachments against stresses. Force of 40N for 10s in different direction will be applied to junction box to test its retention on module surface. Cable will be pulled 50 times for 1s in the direction or the axis and then torque test will be applied for 1 min. (same as MQT 14)  

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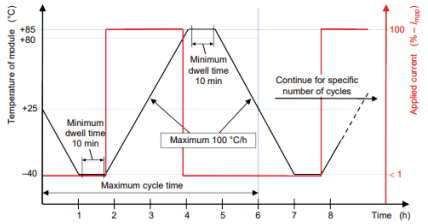
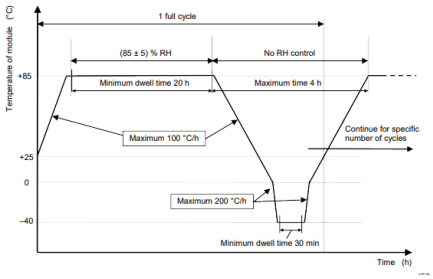
TEST	SPECIFICATION
MST 03 Maximum Power Determination	Checking the functionality of module and maximum power by checking the I-V curve (same as MQT 02)
MST 51 Thermal Cycling Test	Testing the module by changing the temperature repeatedly. Module to be installed in the chamber with temperature sensor attached to its middle. The temperature should change with no more than 100 degree per hour and stay at -40 and 85 for at least 10 min. during the test, module will carry the current when temperature increasing from -40 to 80 degree only. Below process will be taken 50 or 200 times. (same as MQT 11) 
MST 52 Humidity Freeze Test	Testing the module in high temperature and humidity followed by sub-zero temperature. Temperature will arise to 85 degree at maximum 100 degree per hour and keep the module for 20h in humidity of RH 85%. Then cool down to zero and then -40 degree by the speed of max 100 and 200 degree per hour. And keep for 30 min. do this process for 10 cycles. (same as MQT 12) 
MST 53 Damp Heat Test	Testing the ability of module for long term humid environment. The module will be at 85-degree temperature and 85 percent relative humidity and keep it there for 1000 h (or 200 h for another test) and no defect should be found. (same as MQT 13)
MST 54 UV Test	Install the module in a chamber with only UV light (between 280nm to 320 wavelength and 320 to 400nm) with maximum 250W/m2 and shortcircuited module (or with load in maximum power) at the 60 degree temperature. Subject the module to total UV irradiance of at least 15kWh/m2 or 60kWh/m2 in the wavelength range between 280 to 400nm. (same as MQT 10 for 15kWh/m2)
MST 55 Cold Conditioning	Install the module in a chamber with temperature sensor and keep it there for 48 h with -40 degree. No defect should be found.
MST 56 Dry Heat Conditioning	Install the module in a chamber with temperature sensor. Keep the module in a chamber with 105 degree and less than 50% relative humidity for 200 h. No defect should be found.

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