CÔNG TY CỔ PHẦN THIẾT KẾ XÂY DỰNG KIẾN NHẬT - KNC

KIEN NHAT CONSTRUCTION DESIGN JOINT STOCK COMPANY - KNC

A2 Le Thi Kinh - Phuoc Kien - Nha Be District, HCMC

Tel - (028) 62894.999 - Hotline - 0919 396 368

Web - www.kncfacade.com

ETFE

vectorfoiltec

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SECTION

SECTION 1 GENERAL

1.1 DESCRIPTION OF SYSTEM

1.1.1 This Particular Technical Specification describes complete ETFE roof system along XXXXX Consultant to provide details

1.1.2 Extent of works involve fabrication installation and maintenance of ETFE to XXXXXXX Consultant to provide details.

1.2 BASIC MATERIALS

1.2.1 The following basic materials used for metal works in this Part of the PTS shall comply with the corresponding requirement specified in the following Parts of the Particular Technical Specification:

Basic Material Used in This Part of the PTS and Stated in Clause 1.2, 1.3, 1.4, 1.5 and 1.6	Comply with Specification in Other Parts of the PTS and Sections of the GMWS	
	(No.)	(Title)
Polyurethane steel system paints	GMWS Section 22	Steelwork
Aluminium anodizing	A06	Paints, Coatings, Renderings & Plastering
Stainless steel surface finishes	A06	Paints, Coatings, Renderings & Plastering
PVF2/Powder coating	A06	Paints, Coatings, Renderings & Plastering
Paint for mild steel	A06	Paints, Coatings, Renderings & Plastering
Sealant	A03	Plastics, Composites and Sealants

1.2.2 **ETFE MEMBRANE:**

- The following tables indicate the Ethylene-Tetra-Flouro-Ehtylene (hereafter referred to as ETFE) film properties. Thickness and heat treatment listed herein are indicative only. All ETFE must meet technical requirements outlined in this specification: -

ITEM	**REQUIREMENT**	**REMARK**
Density	1.65 – 1.75 g/cm^3	DIN 53479 at 32°C
Thickness (minimum)	Minimum 100 µm	Throughout
	Minimum 200 µm	External surfaces
U – Value 2 layers 3 layers	 <2.95 Wm^{-2}K <2.00 Wm^{-2}K	
Melting Point	>270°C	
Ultimate Tensile Strength	50 N/mm^2 min.	DIN-EN-ISO-527-3
Tensile Strain at break	300% min	DIN-EN-ISO-527-3
Tensile Strength at 10% strain	18 N/mm^2 min	DIN-EN-ISO-527-3
Tear Strength	400 N/mm min	DIN-EN-ISO-527-3
Cold Fracture Temperature	-180°C	DIN 53372

- For type of cushions (foils) selection, the specialist contractor shall conform to Employer's specified requirements and submission process.

1.2.3 Allow for connections to Facade Secondary Framing System

1.3 INTERFACES

1.3.1 The Contractor shall take fully into account the following interfacing and related elements:

Interfacing works	Refer Other Parts of Specification	
	(No.)	(Title)
Roofing	A24	Standing Seam Roof
External Cladding	A25	Facade and External Glazing
Structural parameters	AA	

SECTION 2 DESIGN AND PERFORMANCE CRITERIA

2.1 **CONTRACTOR'S DESIGN** Complete full Design and Calculations necessary for installation for the following:

(a) Integrity and stability of ETFE Roofing system and supporting Structure.

(b) Typical junctional details and bespoke junction details for ETFE Roofing system and Structure.

(c) Incorporation of Fall Arrest system and Access and Maintenance system along the ETFE structure.

(d) Allow for movement of existing to new structure with new movement joint.

(e) Demonstrate Structural Integrity, Fire, Acoustic, Thermal and Interstitial Condensation pass minimum requirements of the specification.

2.1.2 Detailed design of the ETFE cushion roofing and associated features to meet the requirements of this specification and associated tender drawings.

2.1.3 Related works: Coordinate with supporting structure and interfaces in detailed design.

2.1.4 For the avoidance of doubt, the Contractor shall design the full ETFE roof, gutters and cladding to provide a complete system including any fixings, lugs, cleats, stiffeners etc as necessary to connect to the Employer's steelwork.

2.1.5 The cushion system must be certified as a class B non-Fragile Roof Assembly in accordance with ACR(M)001:2000-Test for Fragility of roofing assemblies

2.1.6 Pressure-inflated ETFE 'cushions' fixed to aluminium perimeter framing with sealed edge clamps. The fixing of individual cushions shall be designed to allow cushions to be replaced without disturbing adjacent cushions.

2.1.7 The number and thickness of the foil layers and the inflation pressures of the foil cushions shall be determined by ETFE Specialist Installer to comply with the specified performance requirements.

2.1.8 Cushion pattern design, nesting and layout will be arranged to allow the most economical usage of the raw ETFE material roll unless otherwise advised in the Tender drawings.

2.1.9 The cushions and their associated framing and accessories shall be designed, fabricated and installed to provide a smooth free-draining surface, with pressure caps flush to the cushions to prevent ponding, and weather-sealed to the adjacent construction.

2.1.10 The extrusions carrying the cushions shall incorporate a secondary drainage system that drains to an appropriate point.

2.1.11 Inflation shall be by an inflation system comprising one or more units each incorporating 2 fans, any one of which is capable of servicing the designated inflation

zone. The control system shall be designed such that, at any one time, one fan is operational with the other fan on ‘stand-by’ to be used in the event of fan failure. The control system shall be designed to ensure that should the operational unit fail than the stand by unit will cut in automatically.

2.1.12 The inflation units shall be supplied with external air or if not available air from a low humidity source.

2.2 LOADING

2.2.1 Refer to Structural Engineers documentation for full Structural parameters.

2.3 INTEGRITY:

2.3.1 Determine the thickness of foil layers and sizes of the panels/facings, types and locations of framing, fixings and supports, and the inflation pressures of the foil cushions to ensure that the membrane roofing will resist all wind loads, dead loads and design live loads, and accommodate all deflections and movements without damage.

2.3.2 The canopies are to be designed for wind loads conforming to the current relevant standards as defined by the Building Authority.

2.3.3 The ETFE Specialist must ensure that the ETFE Cushions do not have water ponding in the case of deflation as it is not acceptable to assume the cushions will always be inflated. The ETFE Specialist is to provide a 3D model of each cushion in the deflated state to prove no water-ponding occurs either by passive drainage or by other mechanical means such as valves. In addition, the rise of the ETFE Cushion shall be limited to 10% of the maximum width to help mitigate water ponding concerns.

2.4 STRUCTURAL PERFORMANCE

2.4.1 Independent Checking Engineer:

The Contractor must employ his own Independent Checking Engineer (ICE) to endorse all ETFE and structure submissions where structural calculations are required.

2.5 GENERAL MOVEMENT:

2.5.1 The membrane roofing must accommodate anticipated building movements as follows:

The dead load deflection of horizontal members shall be limited to Span/360, unless agreed with Consultant Team. The aggregate effects of all loads shall not allow interlocking members to bear against each other.

The deflection of structural frames shall be limited to the limits stated above, or as required to avoid ponding of water or accumulation of dirt, whichever is more stringent.

2.6 PERFORMANCE REQUIREMENTS

2.6.1 Allowance shall be made for all structural deflections and other movements.

2.6.2 Foil cushions:

(a) Outer layers: thickness to be calculated by ETFE Specialist with supporting calculations and models. Minimum 200µm.
(b) Inner layers: thickness to be calculated by ETFE Specialist with supporting calculations and models. Minimum 100µm.

2.6.3 Aluminium Extrusions:

(a) Material: Aluminium alloys as clauses 3.1

(b) Finish: Anodized

(c) ALL Aluminium framing to have fully welded nodes for both base extrusions and top caps. No sealant joints at the node allowed.

2.6.4 Light Transmission:

The tender drawings detail the print pattern required which is a Dot Hexagon Pattern using 9mm hexagonal dots covering 92% of the surface area and will be located on the inside face of the top layer of ETFE. This print must have a 10-year warranty to ensure no delamination and print must have 10-year track record.

The following light transmission values are specified:

		Value
Visible Light Transmission	%	12
UV Light Transmission	%	9
G Value		0.16 minimum
Visible Light Reflectance	%	54

2.6.5

G-Value, U-Value, Light Transmission, Light Reflectance and Shading Coefficient

Solar Heat Gain Performance

(a) Solar heat gain coefficient/G-value required: G value of not more than 0.16. Full calculations to be provided to confirm the performance.

2.6.6 Thermal properties:

(a) U-Value: A U-Value of not more than 1.5 W/m2K. Full calculations to be provided to confirm the performance.

2.6.7 Fire Performance:

(a) The ETFE specialist contractor must provide current Test Certificates in their company name from Singapore PSB (or Accredited Laboratory, except China) proving their ETFE meets Test Standards EN 13501 – 1:2007/A1:2009.
(b) The Performance of the ETFE must be B-s1, d0 (B = Fire behaviour, s1 = Smoke production, d0 = Flaming droplets or debris).

2.6.8 Water penetration:

(a) Requirement: Under site exposure conditions, water must not penetrate onto internal surfaces or into cavities not designed to be wetted.

2.6.9 Interstitial Condensation:

(a) Determine: Interstitial condensation risk of roof construction as recommended in BS 5250,

(b) Vapour control layer: Provide a suitable membrane so that damage and nuisance from interstitial condensation do not occur.

2.7 FALL ARREST/ ACCESS AND MAINTENANCE SYSTEM:

2.7.1 Design of Fall Arrest/ Access and Maintenance System: In accordance with:

(a) Class A/Class C Man Safe Protection System: BS EN795:
(b) General standards refer to Part A10 Fall Arrest, and A02 Architectural Metalwork.

2.8 DURABILITY AND SERVICE LIFE

2.8.1 The works shall be selected for durability in relation to conditions of use and shall meet the minimum requirements of BS 7543:1992 Table 2 and or BS EN 1996-3.

2.8.2 Service life shall be a minimum of 15 years.

SECTION 3 MATERIALS AND WORKMANSHIP

3.1 ALUMINIUM ALLOY FRAMING SECTIONS:

(a) To BS 1474, alloys 6060 & 6063 and suitable for the specified finish.

(b) Structural members to comply with BS 8118.

3.1.1 ALUMINIUM ALLOY SHEET:

(a) To BS EN 485, BS EN 515 and BS EN 573 in an alloy, temper and thickness suitable for the application and specified finish.

(b) Specific requirements:

i. Aluminium sheet for flat panels and copings shall be not less than 1.6mm thick.

ii. Aluminium sheet for flashings shall be not less than 1.6m thick.

3.1.2 MILD STEEL FRAMING SECTIONS/REINFORCEMENT:

To the relevant parts of BS 7668, BS EN 10029, BS EN 10113, BS EN 10137, BS EN 10155 and BS EN 10210, in a thickness suitable for the application, and for galvanizing or other protective coating.

3.1.3 MILD STEEL SHEET:

To the relevant parts of BS 1449-1, BS EN 10048, BS EN 10051, BS EN 10111, BS EN 10131, BS EN 10139, BS EN 10140, BS EN 10149, BS EN 10209 and BS EN 10268 in a grade and thickness suitable for the application, and suitable for galvanizing or other protective coating.

3.1.4 STAINLESS STEEL SHEET:

To the relevant parts of BS EN 10029, BS EN 10048, BS EN 10051, BS EN 10095, BS EN 10258, BS EN 10259 and to BS EN 10088-2, austenitic, grade 1.4301 (304) generally, grade 1.4401 (316) when used externally or in severely corrosive environments, and in a thickness suitable for the application.

3.1.5 MECHANICAL FIXINGS:

Stainless steel to BS EN ISO 3506-1 and 2, grade A4, or

(a) Mild steel to BS 4190 and suitable for galvanizing or other protective coating, or

(b) Aluminium complying with BS 1474 for brackets, rivets and shear pins.

3.1.6 ADHESIVES:

Must not be degradable by moisture or water vapour, and are protein free anti-fungal/ non-acidic and UV resistant. General standards as Part A03 Plastics, Composites, Sealants, Waterproofing & Fireproofing.

3.1.7 GASKETS:

(a) Non-cellular rubber to BS 4255-1
(b) Cellular rubber to ASTM-C509.
(c) All gaskets must be resistant to oxidation, ozone and UV degradation.

3.1.8 WEATHER STRIPPING of opening units:

(a) Non-cellular rubber to BS 4255-1
(b) Cellular rubber to ASTM-C509
(c) Weather stripping must be fixed in undercut grooves in framing sections

3.1.9 GENERAL SEALANTS:

(a) Must be stable and compatible with all contact products and finishes and be selected in accordance with BS 6213 from:
(b) Silicone to BS 5889
(c) One part polysulfide to BS 5215
(d) Two part polysulfide to BS 4254
(e) One or two part polyurethane.

3.1.10 INSULATION:

(a) Durable, rot and vermin proof and not degradable by moisture or water vapour.
(b) Attached to or supported within the system so as not to bulge, sag, delaminate or detach during installation or in situ during the life of the system
(c) Insulation materials exposed to the external environment shall have a suitable textile-reinforced weathering membrane on the external face.
(d) To comply with all relevant BS and be BBE certified.

3.2 MANUFACTURED TOLERANCES

3.2.1 INFILL PANELS/FACINGS AND PERIMETER ACCESSORIES must be:

(a) Manufactured and finished to not more than ± 5 mm deviation in size, ± 5 mm deviation in flatness from the plane per 2 m length.
(b) Adequately rigid to comply with all design/performance requirements.

3.3 FABRICATION AND INSTALLATION

3.3.1 Roof coverings: Secure, free draining and weathertight.

3.3.2 Fabricate and install membrane roofing in accordance with this specification and the final detailed drawings.

3.3.3 Fabricators and installers must employ competent operatives. Records of their experience are to be provided to the Project Manager on request.

3.3.4 Select and align all products to ensure uniformity of appearance.

3.3.5 Joints must only occur at positions indicated on final detailed drawings.

3.3.6 Isolate dissimilar metals to prevent electrolytic corrosion.

3.3.7 All fixings must be concealed unless indicated on final detailed drawings. Where

exposed they must match the material and finish of the products fixed.

3.3.8 Machine cut and drill all products in the workshop wherever possible.

3.3.9 Mark or tag all products to facilitate identification during assembly, handling, storage and installation. Do not mark surfaces visible in the complete installation.

3.4 ASSEMBLY:

3.4.1 Carry out as much assembly as possible in the workshop.

3.4.2 Joints, other than movement joints, must be rigidly secured, reinforced where necessary and fixed with hairline abutments.

3.4.3 Take precautions to prevent displacement of components in assembled units.

3.4.4 Obtain approval for any reassembly on site.

3.5 SUITABILITY OF STRUCTURE:

3.5.1 It is understood and acknowledged that the Texlon ETFE installation will have to fabricated prior to erection of the steel support structure.

3.5.2 The main contractor will forward not less than 15 days before commencement of membrane roofing installation a 3D geometric survey of the supporting building structure, checking line, level and fixing points. Prior to starting on site report immediately to the Project Manager if structure will not allow the required accuracy or security of erection.

3.6 MEMBRANE ROOFING INSTALLATION:

3.6.1 Set out straight, parallel and truly aligned.

3.6.2 Secure to fixing anchors through holes formed during fabrication only.

3.6.3 Tighten all mechanical fixings to manufacturer's recommended torque figures. Do not over-tighten fixings intended to permit differential movement.

3.6.4 Remove protective coverings only where necessary to facilitate installation and from surfaces which will be inaccessible on completion.

3.7 IN SITU WELDING:

3.7.1 In situ welding is permitted, subject to completion of a 'hot work permit' form and compliance with its requirements.

3.8 INTERFACES:

3.8.1 Ensure that flashings, closers, etc. are located correctly and neatly overlap the membrane roofing to form a weathertight junction.

3.9 HANDLING AND STORAGE:

3.9.1 Do not deliver to site any membrane roofing products and units which cannot be installed immediately or unloaded into a suitable well protected storage area.

3.9.2 Store products and units on level bearers clear of the ground and separate with resilient spacers.

3.10 TYPHOON CONDITIONS

In the event of an imminent typhoon, the following precautions shall be taken:

3.9.2 All unused material not fully secured to the roofing system shall be removed, whenever it is practical. Otherwise, the unsecured material shall be strapped down with nylon ratchet straps or ropes as appropriate.

3.9.2 The Contractor shall prepare a typhoon preparedness plan and implement all measures necessary to ensure that, at all stages of construction, no material can be blown from the site and all partially complete work is secured and safe.

3.11 STEELWORK INSTALLATION TOLERANCES

In order to ensure the successful installation of the ETFE System the steel support structures, specifically the steel T-Brackets, are to installed to the following tolerances: -

3.11.1. Maximum 'in line planar' tolerance between each of the 'T' brackets +/- 2mm. Specifically, this means that the top surface of all 'T' brackets must be level and in plane with all adjacent brackets. The reason for this is that the aluminium extrusion profiles are fixed down with bolts to the 'T' brackets. These bolts do not allow for shimming, in order to retain their structural performance. Similarly, at nodes it is important that the 'T' brackets line through at the same height. Height discrepancies need to be less than 2mm and ideally within 1mm.

3.11.2 Max tolerance bracket to bracket: +/-2mm xyz

3.11.3 Max tolerance along cushion (i.e over 6m long): +/- 10mm

3.11.4 Max angular deviation from cushion plane: 3°

3.11.5 The ETFE Specialist during the detailed design stages (before any steelwork is fabricated) will overlay the exact T Bracket set-out over the main supporting steelwork 3D Model to ensure full coordination by ETFE specialist and steelwork contractor. These coordinated 3D models must be used for the steelwork fabrication drawings to ensure coordinated set-out and maximum tolerances of the T Bracket are followed.

3.11.6 The main contractor will issue to the ETFE Specialist not less than 7 days before commencement of the ETFE installation a 3D geometric survey of the supporting steel structure, checking line, level and fixing points to prove the steelwork is within tolerance. There will be a handover of the canopy steelwork to the ETFE specialist before commencement of ETFE System to confirm and agree all tolerances have been met.

SECTION 4 SUBMISSIONS

4.1 GENERAL

4.1.1 COMPANY EXPERIENCE:

(a) Provide Detailed List of Completed Projects totalling over 50,000m2 of ETFE in Asia Pacific over the past ten years demonstrating ability to design, supply, fabricate, install and maintain each project. Include Project Name, Client & Consultant Details, Photos of Projects, ETFE Area and ETFE Value.

(b) Provide Detailed List of Completed Projects totalling over 10,000m2 of ETFE in South East Asia over the past five years demonstrating ability to design, supply, fabricate, install and maintain each project. Project Letters of Award (LOAs) must be in the Specialist Contractor's name.

(c) Provide details of Full Time Employees in the region providing support in design, engineering, project management and maintenance.

(d) Provide details of Installation and Maintenance Teams demonstrating their ability to use specialist equipment and work at height.

(e) Provide details of where 'spares' are kept in the region and demonstrate how emergency call-outs and regular maintenance will be administered and operated.

4.2 INFORMATION TO BE PROVIDED WITH TENDER:

4.2.1 Submit for Project Manager to review a list of Contractor's Drawings and their intended submission dates. This shall include, but not limited to the Contractor's Drawings listed in this Part of the PTS. Submit additional Contractor's Drawings when requested by the Project Manager for review.

4.2.2 Submit a method statement detailing how the proposal will achieve the specified tolerances. Demonstrate a clear understanding of the construction programme, the effects on the supporting structure, the erection and the fabrication method of the ETFE roof system.

4.2.3 Contractor's Drawings shall include elevations, floor and roof plans, sections and full size details. Contractor's Drawings shall include the following information:

(a) Assembly of works containing thermal and moisture protection;

(b) Comprehensive and fully coordinated and dimensioned details at scales of no less than 1:100 and 1:20, and 1:2 and 1:5 details, showing geometry, disposition and setting outs of including, but not limited to, support framework, incorporation of building services penetrations and interfaces, clearly showing all sub-frames, supports, all interface conditions with adjacent elements and works (as listed under 1.3) by other subcontractors and installers and provisions for tolerances and setting out, and any temporary arrangements required during construction of the ETFE roof system;

(c) Construction details elaborating typical and special conditions identified in the above drawings, of ETFE roof system including those at angles,

corners, abutments, construction joints, pipe penetrations, interface with adjoining elements, and the like, without limitation;

(d) Details of the source, type and properties of the materials proposed; and

(e) Arrangement of the component parts, illustrated in 3-dimensional diagrams.

4.2.4 Seek Manufacturer's written approval for bespoke (non-standard manufacturer's) details and provide evidence of such.

4.2.5 Submit a detailed list of tolerances within the requirements of the Specification for the overall geometry to which are fabricated. As a minimum statement of tolerances shall include the following:

(a) Position on plan;

(b) Level;

(c) Alignment;

(d) Joints between panels;

(e) Diagonal;

(f) Eccentricity; and

(g) Inclination.

4.2.6 Submit to the PMR the following cushion roofing particulars:

(a) Technical information and certification demonstrating compliance, with the specification, of proposed incorporated products and finishes.

(b) Certification, reports and calculations demonstrating compliance with the specification of the proposed membrane roofing.

(c) Singapore PSB (or equivalent) Conformity Certificate of ETFE Materials.

(d) Detailed Thermal Calculations proving the G-Value, U-Value, Light Transmission, Light Reflectance and Shading Coefficient of ETFE System proposed.

(e) Proposals for connections to and support from the building structure and building components.

(f) Proposals for any amendments to the Employer designed steelwork and for any additional secondary supporting structure.

(g) Schedule of builder's work, special provisions and special attendance by others.

(h) Examples of standard documentation from which the project quality plan will be prepared.

(i) Preliminary fabrication and installation method statements and programme.

(j) Proposals for replacing damaged or failed products.

(k) Areas of non-compliance with the specification.

(l) Typical detailed drawings at suitable scale.

4.3 INFORMATION TO BE PROVIDED AFTER ACCEPTANCE OF TENDER:

4.3.1 Submit to the PMR in accordance with the tender programme.

(a) A schedule of detailed drawings and dates for submission for comment.

(b) A schedule of loads that will be transmitted from the membrane roofing to the structure.

(c) Proposed fixing anchor details relevant to structural design and construction.

(d) A detailed fabrication and installation programme in compliance with the tender programme.

4.4 INFORMATION TO BE PROVIDED BEFORE COMMENCEMENT OF WORK:

4.4.1 Submit to the PMR before fabrication the following particulars:

(a) Detailed drawings to adequately describe fabrication and installation.

(b) Detailed information to prove compliance with all design/performance requirements.

(c) Project specific handling and installation method statements.

4.5 PRODUCT SAMPLES:

4.5.1 To be provided in accordance with the contractual requirement ETFE Cushion Material, Printed Patterns, Aluminium Perimeter Extrusions with Gaskets & Plenum Pipes.

4.5.2 SAMPLES OF FIXINGS:

At an agreed stage during detailed design work provide the Project Manager with identified samples of each type of fixing anchor including casting-in restraints and shims, together with manufacturers' recommended torque figures.

4.5.3 FABRICATION SAMPLES:

(a) At an agreed stage during detailed design work provide the PMR with samples of:

i. 1.0m x 1.0m complete ETFE Cushion with Aluminium Perimeter Frame & Caskets.

4.5.4 Obtain "Reviewed without Objection" status of sample appearance before

proceeding.

4.6 PROTOTYPES

4.6.1 Submit Contractor's Drawings detailing the prototype for review by Project Manager one month prior to commencement of work.

4.6.2 Fabricate and erect a Prototype for Project Manager Review including:

a) Construct one complete, standard bay for Visual quality and Complete testing: Agree location with Project Manager.
b) Prototypes that demonstrate how the Contract requirements are met, including details proposed, and interfaces with relevant trades.

Prototypes shall be constructed in strict accordance with reviewed prototype drawings. Any deviations from or additions to details shown on prototype drawings shall be submitted to the Project Manager for review without objection.

4.7 BENCHMARKS

4.7.1 Benchmarks shall be part of the works and constructed at the final location of the works.

4.7.2 Following receipt of no objection from the Project Manager of relevant samples and prototype, construct and establish benchmarks. Upon a notice of no objection the benchmarks shall become the agreed standard to which all subsequent architectural metalwork shall conform.

4.7.3 In the event the Project Manager does not issue a notice of no objection for the benchmark, the Contractor shall demolish and remove the reviewed benchmark and construct a new benchmark.

4.7.4 The extent of the benchmarks shall be as follows:

(a) Construct 1 complete, standard bays complete with Access & Maintenance/ Fall Arrest system and complete all accessories.

SECTION 5 INSPECTION, TESTING AND COMMISSIONING

5.1 INSPECTION:

5.1.1 All fabrications and assembled units must be carefully inspected for match with approved samples and for compliance with this specification and the final detailed drawings before dispatch to site.

5.1.2 Give adequate notice of inspection arrangements to enable the Project Manager and/or other affected parties to be present.

5.2 TESTING OF FABRIC

5.2.1 Standard: To relevant parts of BS EN ISO 1421.

5.2.2 Timing of test (s): Agree with Project Manager.

5.2.3 Test results: Submit on completion of testing.

5.3 PROTECTION:

5.3.1 All fabrications and assembled units must be protected against damage, corrosion and disfigurement during handling, and installation.

5.3.2 Protective coverings must be applied before dispatch to site and must not be detrimental to membrane roofing products, finishes or installation procedures.

5.3.3 On completion of the installation of the Texlon ETFE cushions comply with Manufacturer's/ Installer's recommendations for protection.

5.3.4 Protect from onward trades.

5.4 COMPLETION

5.4.1 Cables: Not damaged, crushed or kinked.

Fabric:
- Colour and translucency: Consistent, free from discontinuities and discolouration.
- Required Cushion Pressure: Verified.
- Surfaces: Clean and smooth, fully sealed, weathertight and free draining.
- Rainwater outlets: Clear.

Completed coverings: Protected against damage from adjacent or high level working.

SECTION 6 OPERATION AND MAINTENANCE

6.1 CLEANING:

6.1.1 The roof shall be supplied in a clean condition. Note. Should the roof require a builders clean prior to the overall project practical completion / PMR handover, cleaning agents for the purpose must be approved by the specialist roofing contractor.

6.2 OPERATION & MAINTENANCE:

6.2.1 Prepare a maintenance manual. Unless otherwise instructed or agreed the manual must be completed and handed over to the Project Manager at Completion.

6.2.2 Certification for all incorporated components manufactured by others confirming their suitability for all locations in the membrane roofing.

6.2.3 Recommendations for spare parts for future repairs or replacements.

6.2.4 Recommendations for safe dismantling and recycling or disposal of all products.

END OF SECTION