

**SECTION 00 01 05**  
**TABLE OF CONTENTS**

| <u>SECTION</u>     | <u>DESCRIPTION</u>   | <u>DATE</u>                                      |
|--------------------|--|--|
| <b>VOLUME ONE</b>  |  |  |
| <b>DIVISION 00</b> | <b>PROCUREMENT AND CONTRACTING REQUIREMENTS</b>                  |  |
| 00 01 01           | Project Title Page   | 08-December-2017                                 |
| 00 01 05           | Table of Contents  | <del>13-April-2018</del><br><u>25-April-2018</u> |
| 00 01 08           | Seals Page   | 13-April-2018                                    |
| 00 01 17           | RFI and Addendum Matrix  | 08-December-2017                                 |
| <b>DIVISION 01</b> | <b>GENERAL REQUIREMENTS</b>                                      |  |
| 01 11 00           | Summary of Work  | 08-December-2017                                 |
| 01 14 19           | Use of Site  | 08-December-2017                                 |
| 01 18 16           | Protection of Existing Underground Utilities and Cables          | 08-December-2017                                 |
| 01 18 16.13        | DFW Airport Utility Location Sign-off Sheet                      | 08-December-2017                                 |
| 01 25 13           | Product Substitution Procedures                                  | 08-December-2017                                 |
| 01 29 00           | Payment Procedures   | 08-December-2017                                 |
| 01 29 85           | Wage Rate Requirements   | 08-December-2017                                 |
| 01 29 85.13        | Wage Determination Schedule                                      | 08-December-2017                                 |
| 01 31 19           | Project Meetings   | 08-December-2017                                 |
| 01 32 16           | Construction Progress Schedule                                   | 08-December-2017                                 |
| 01 33 23           | Shop Drawings, Product Data, and Samples                         | 08-December-2017                                 |
| 01 35 13           | Minimum Standards for Construction and Maintenance<br>On the AOA | 08-December-2017                                 |
| 01 41 00           | Regulatory Requirements  | 08-December-2017                                 |
| 01 42 13           | Abbreviations, Acronyms and Definitions                          | 08-December-2017                                 |
| 01 42 19           | Reference Standards  | 08-December-2017                                 |
| 01 45 16.13        | Contractor Quality Control                                       | 08-December-2017                                 |
| 01 45 23           | Testing And Inspecting Services                                  | 08-December-2017                                 |
| 01 50 00           | Temporary Facilities and Controls                                | 08-December-2017                                 |
| 01 52 00           | Contractors Construction Area                                    | 08-December-2017                                 |
| 01 55 26           | Traffic Control  | 08-December-2017                                 |
| 01 55 29           | Staging Area   | 08-December-2017                                 |
| 01 56 23           | Temporary Barricades   | 08-December-2017                                 |
| 01 56 26           | Temporary Construction Fencing                                   | 08-December-2017                                 |
| 01 57 13           | Temporary Erosion and Sediment Control                           | 08-December-2017                                 |
| 01 57 19.13        | Spill Response   | 08-December-2017                                 |
| 01 57 19.14        | Spil Response Plan   | 08-December-2017                                 |
| 01 57 19.23        | Construction Site Spill Prevention                               | 08-December-2017                                 |
| 01 57 23           | Temporary Storm Water Pollution Control                          | 08-December-2017                                 |
| 01 58 00           | Project Identification   | 08-December-2017                                 |
| 01 61 16           | Materials and Equipment  | 08-December-2017                                 |
| 01 62 00           | Product Options  | 08-December-2017                                 |
| 01 66 00           | Product Storage and Handling Requirements                        | 08-December-2017                                 |
| 01 71 13           | Mobilization   | 08-December-2017                                 |
| 01 71 14           | Land Use Requirements  | 08-December-2017                                 |
| 01 71 33           | Protection of Adjacent Construction                              | 08-December-2017                                 |

|                    |  |   |
|--------------------|--|---|
| 01 73 29           | Cutting And Patching                       | 08-December-2017                          |
| 01 74 13           | Progress Cleaning                          | 08-December-2017                          |
| 01 74 19           | Construction Waste Management and Disposal | 08-December-2017                          |
| 01 74 19.13        | Waste Characterization                     | 08-December-2017                          |
| 01 74 23           | Final Cleaning                             | 08-December-2017                          |
| 01 76 00           | Protecting Installed Construction          | 08-December-2017                          |
| 01 77 00           | Closeout Procedures                        | 08-December-2017                          |
| 01 78 23           | Operation and Maintenance Data             | 08-December-2017                          |
| 01 78 33           | Bonds and Warranties                       | 08-December-2017                          |
| 01 78 39           | Project Record Documents                   | 08-December-2017                          |
| 01 79 00           | Demonstration and Training                 | 08-December-2017                          |
| 01 91 00           | Commissioning                              | 08-December-2017                          |
| <br>               |  |   |
| <b>DIVISION 02</b> | <b>EXISTING CONDITIONS</b>                 |   |
| 02 41 13           | Selective Site Demolition                  | 08-December-2017                          |
| <br>               |  |   |
| <b>DIVISION 13</b> | <b>SPECIAL CONSTRUCTION</b>                |   |
| 13 31 00           | Parking Canopy Improvements                | <del>25-April-2018</del> 13-April-2018    |
| 13 31 01           | Tensile Membrane Structures - PTFE         | <del>25-April-2018</del> 08-December-2017 |
| 13 31 03           | Tensile Membrane Structures – HDPE         | <del>25-April-2018</del> 13-April-2018    |
| 13 31 23           | Pre-Engineered Fabric Structures           | 13-April-2018                             |

**- END OF SECTION -**

## SECTION 13 31 00

### PARKING CANOPY IMPROVEMENTS

#### PART 1 GENERAL

##### 1.1 DESCRIPTION

- A. This work includes, cleaning of canopies, repair/replacement of damaged canopies, rust removal and resurfacing with anti-rust materials on canopy structures, and replacement of light fixtures, as needed.

##### 1.2 MATERIALS

- A. Construction materials.

- Spec. Item 13 31 01 – Tensile Membrane Structures - PTFE
- Spec. Item 13 31 03 – Tensile Membrane Structures - HDPE
- Spec. Item 13 31 23 – Pre-Engineered Fabric Structures

##### 1.3 EQUIPMENT

- A. Provide equipment necessary to complete the work.
- B. Attendant Station with Utilities
1. Contractor shall be required to provide an attendant station with utilities, such as power, heater, air conditioner, and nearby sani-hut for the temporary attendant station. Attendant station will be paid for on a per each basis. Sani-hut is required, regardless of whether or not they are present at the existing attendant stations.

##### 1.4 WORK METHODS

Each work site is unique so at each location identified within the contract documents the Contractor shall perform a site visit prior to beginning work at each site and prepare a work sequencing schedule that identifies major work elements.

##### A. ALL SITES

1. Contractor shall provide temporary fencing to designate the work and staging areas.
2. Contractor shall provide erosion control measures at existing drainage structures prior to commencing work.
3. Contractor shall contain power washing spray for proper disposal (see section 01 74 19).
4. Contractor shall put forth best effort to clean canopy fabric, final product will be subject to approval of the OAR.

##### B. NORTH REMOTE PARKING LOT

###### B.1 IMPROVEMENTS:

1. Remove rust (sand to bare metal) on structures, re-tension

retainers (as necessary).

2. Prime and repaint per specification section 13 31 23.
3. Replace fabric (PTFE) at phase sequence area 3.

B.2 LIGHTING:

1. Replace any non-functional lighting fixtures.
2. Lighting fixtures to match existing (KIM Model AFL 10/175MH277/WH-P/HDS).

C. EXPRESS NORTH PARKING LOT

C.1 IMPROVEMENTS:

1. Remove rust (sand to bare metal) and chalking paint from base plate covers in replacement areas, then repaint.
2. Remove rust (sand to bare metal) from structure, remove "old style" bar retainer strips, and prime and repaint per specification section 13 31 23.
3. Replace bent end plates at east end of Row 17/18.
4. Re-tension cable x-braces as required at each canopy replacement location.
5. Install securely fixed fabric doublers at each arm end to prevent abrasion and fabric failure.
6. Replace fabric (~~PTFE~~HDPE for vehicle parking canopies and HDPE~~PTFE~~ for vehicle and bus entry canopies).
7. Provide temporary attendant station – coordinate with OAR.

C.2 LIGHTING:

1. Replace non-functional lighting fixtures.
2. Lighting fixtures to match existing (WideLite SPS-150-480-LMP).

D. EXPRESS SOUTH PARKING LOT

D.1 IMPROVEMENTS:

1. Remove rust (sand to bare metal) on structures, re-tension retainers (as necessary).
2. Prime and repaint per specification section 13 31 23.
3. Replace fabric (PTFE).
4. Provide temporary attendant station – coordinate with OAR.

E. DPS STATION #1/AIRPORT OPERATIONS CENTER

E.1 IMPROVEMENTS:

1. Remove rust (sand to bare metal) on structures, re-tension retainers (as necessary).
2. Prime and repaint per specification section 13 31 23.
3. Replace fabric (HDPE).

F. SOUTH REMOTE PARKING LOT

F.1 IMPROVEMENTS:

1. Remove rust (sand to bare metal) on structures, re-tension retainers (as necessary).
2. Prime and repaint per specification section 13 31 23.
3. Replace fabric (PTFE) on vehicle canopy.
4. Clean/Power wash fabric (PTFE) for bus canopy.

F.2 LIGHTING

1. Replace any non-functional lighting fixtures.

2. Lighting fixtures to match existing (KIM Model AFL 10/175MH277/WH-P/HDS)

## G. TERMINAL A CANOPY

### G.1 IMPROVEMENTS:

1. Check tension at high section to prevent fabric touching structure in heavy wind conditions (winds greater than 30 mph). Re-tension if necessary.
2. Power wash fabric (PTFE) and structures, existing painted finishes must be free of weathered residue.
3. Remove rust (sand to bare metal) on structures, re-tension retainers (as necessary).
4. Prime and repaint per specification section 13 31 23.
5. Remove column wrap signs and replace after painting and inspection/approval by OAR.
6. Remove rust (sand to bare metal) on horizontal members to source of rust stains then treat per specification 13 31 23.
7. Thoroughly clean galvanized or cad-plated bolts prior to priming and paint application.

### G.2 LIGHTING

1. Replace any non-functional lighting fixtures.
2. Tandem lighting fixtures to match existing (ELLIPTIPAR M152-0150-X-02-277-VXX).
3. Cluster lighting fixtures to match existing (ELLIPTIPAR M454-0400-F-02-277-VO-O).

## H. TERMINAL B CANOPY

### H.1 IMPROVEMENTS:

1. Check tension on high section to prevent fabric touching structure in heavy wind conditions (winds greater than 30 mph). Re-tension if necessary.
2. Power wash fabric (PTFE) and structures, existing painted finishes must be free of weathered residue.
3. Remove rust (sand to bare metal) on structures, re-tension retainers (as necessary).
4. Prime and repaint per specification section 13 31 23.
5. Remove column wrap signs and replace after painting and inspection/approval by OAR.
6. Remove rust (sand to bare metal) on horizontal members to source of rust stains then treat per specification 13 31 23.
7. Thoroughly clean galvanized or cad-plated bolts prior to priming and paint application.

### H.2 LIGHTING

1. Replace any non-functional lighting fixtures
2. Tandem lighting fixtures to match existing (ELLIPTIPAR M152-0150-X-02-277-VXX).
3. Cluster lighting fixtures to match existing (ELLIPTIPAR M454-0400-F-02-277-VO-O).

## I. TERMINAL C CANOPY

### I.1 IMPROVEMENTS:

1. Check tension on high section to prevent fabric touching structure in heavy wind conditions (winds greater than 30 mph). Re-tension if necessary.

2. Power wash fabric (PTFE) and structures, existing painted finishes must be free of weathered residue.
3. Remove rust (sand to bare metal) on structures, re-tension retainers (as necessary).
4. Prime and repaint per specification section 13 31 23.
5. Remove column wrap signs and replace after painting and inspection/approval by OAR.
6. Remove rust (sand to bare metal) on horizontal members to source of rust stains then treat per specification 13 31 23.
7. Thoroughly clean galvanized or cad-plated bolts prior to priming and paint application.

#### I.2 LIGHTING

1. Replace any non-functional lighting fixtures.
2. Tandem lighting fixtures to match existing (ELLIPTIPAR M152-0150-X-02-277-VXX).
3. Cluster lighting fixtures to match existing (ELLIPTIPAR M454-0400-F-02-277-VO-O).

### J. TERMINAL D CANOPY

#### J.1 IMPROVEMENTS:

1. Remove rust (sand to bare metal) from all exposed anchors, turnbuckles and fittings.
2. Prime and repaint per specification section 13 31 23.
3. Install fabric covers over degraded valley cable sleeves, clean cable ends and remove frayed wraps.
4. "Down" tension cables must be repositioned in several valleys due to movement and staining.
5. Touch up metal capture strips where flaking/paint white to match.
6. Power wash fabric (PTFE) and structures, existing painted finishes must be free of weathered residue.
7. Remove rust (sand to bare metal) from "down" cable tension tubes and weatherproof tubes to prevent holding water.
8. Replace any missing, defective or badly deformed cotter pins as determined by OAR.
  - a. If Contractor discovers defective cotter pins during work on Terminal D improvements, He/She shall notify OAR for concurrence on defectiveness. If directed by OAR, Contractor shall replace defective cotter pins with stainless steel hairpin cotter pins (also referred to as hitch pin clips) of like size.
  - b. Contractor shall assume for basis of bid that replacement cotter pins shall be 6 inches in length with a nominal diameter of 0.25 inches.
9. Remove rust (sand to bare metal) from large anchor fittings/prime and repaint.
10. Remove rust (sand to bare metal), dirt, and grease from "high" anchors at garage.

### K. TERMINAL E CANOPY

#### K.1 IMPROVEMENTS:

1. Check tension on high section to prevent fabric touching structure in heavy wind conditions (winds greater than 30 mph). Re-tension if necessary.

2. Power wash fabric (PTFE) and structures, existing painted finishes must be free of weathered residue.
3. Remove rust (sand to bare metal) on structures, re-tension retainers (as necessary).
4. Prime and repaint per specification section 13 31 23.
5. Remove column wrap signs and replace after painting and inspection/approval by OAR.
6. Remove rust (sand to bare metal) on horizontal members to source of rust stains then treat per specification 13 31 23.
7. Thoroughly clean galvanized or cad-plated bolts prior to priming and paint application.
8. Install new fabric (PTFE) at North Entry (Feature Canopy).
9. Replace first canopy (PTFE) at North Entry sidewalk due to contamination damage.

#### K.2 LIGHTING

1. Replace any non-functional lighting fixtures.
2. Tandem lighting fixtures to match existing (ELLIPTIPAR M152-0150-X-02-277-VXX).
3. Cluster lighting fixtures to match existing (ELLIPTIPAR M454-0400-F-02-277-VO-O).

## PART 2 MEASUREMENT AND PAYMENT

### 2.1 METHOD OF MEASUREMENT

Each Item will be measured as follows:

- A. The quantity of NORTH REMOTE PARKING LOT IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner. The quantity of LIGHTING to be paid shall be per each installed in accordance with the specification and accept by the Owner.
- B. The quantity of EXPRESS NORTH PARKING LOT IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner. The quantity of LIGHTING to be paid shall be per each installed in accordance with the specification and accept by the Owner.
- C. The quantity of EXPRESS SOUTH PARKING LOT IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner.
- D. The quantity of DPS STATION #1/AIRPORT OPERATIONS CENTER IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner.
- E. The quantity of SOUTH REMOTE PARKING LOT IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner. The quantity of LIGHTING to be paid shall be per each installed in accordance with the specification and accept by the Owner.
- F. The quantity of TERMINAL A CANOPY IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner. The quantity of LIGHTING (CLUSTER) / (TANDEM) to be paid shall be per each



installed in accordance with the specification and accept by the Owner.

- G. The quantity of TERMINAL B CANOPY IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner. The quantity of LIGHTING (CLUSTER) / (TANDEM) to be paid shall be per each installed in accordance with the specification and accept by the Owner.
- H. The quantity of TERMINAL C CANOPY IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner. The quantity of LIGHTING (CLUSTER) / (TANDEM) to be paid shall be per each installed in accordance with the specification and accept by the Owner.
- I. The quantity of TERMINAL D CANOPY IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner.
- J. The quantity of TERMINAL E CANOPY IMPROVEMENTS to be paid shall be per lump sum performed in accordance with the specifications and accepted by the Owner. The quantity of LIGHTING (CLUSTER) / (TANDEM) to be paid shall be per each installed in accordance with the specification and accept by the Owner.
- K. The quantity of ATTENDANT STATION WITH UTILITIES to be paid shall be per each installed in accordance with the specifications, accepted by the Owner, and shall be full compensation for all structures, preparation, maintenance, delivery, labor, furnished equipment, tools, power, heater, air conditioner, sani-hut, and incidentals necessary to complete this item.
- L. The quantity of COTTER PINS to be paid shall be per each installed in accordance with the specifications, accepted by the Owner.

## 2.2 BASIS OF PAYMENT

- A. Payment shall be made for the improvements at the respective contract unit price per lump sum at each site. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Partial payments will be made to the Contractor once each month as the work progresses. Said payments will be based upon estimates, prepared by the Contractor and approved by the Owner, of the value of the work performed and materials complete and in place, in accordance with the contract, plans, and specifications. No partial payment will be made when the amount due to the Contractor since the last estimate amounts to less than five hundred dollars.

It is understood and agreed that the Contractor shall not be entitled to demand or receive partial payment based on quantities of work in excess of those provided in the proposal or covered by approved change orders or supplemental agreements, except when such excess quantities have been determined by the Owner to be a part of the final quantity for the item of work in question.

Payment shall be made for the lighting at the respective contract unit price per each. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.



Payment will be made under:

Pay Item 13 31 00.1 NORTH REMOTE PARKING LOT: IMPROVEMENTS – per lump sum  
Pay Item 13 31 00.2 EXPRESS NORTH PARKING LOT: IMPROVEMENTS – per lump sum  
Pay Item 13 31 00.3 EXPRESS SOUTH PARKING LOT: IMPROVEMENTS – per lump sum  
Pay Item 13 31 00.4 DPS STATION #1/AIRPORT OPERATIONS CENTER: IMPROVEMENTS – per lump sum  
Pay Item 13 31 00.5 SOUTH REMOTE PARKING LOT: IMPROVEMENTS: – per lump sum  
Pay Item 13 31 00.6 TERMINAL A CANOPY: IMPROVEMENTS – per lump sum  
Pay Item 13 31 00.7 TERMINAL B CANOPY: IMPROVEMENTS – per lump sum  
Pay Item 13 31 00.8 TERMINAL C CANOPY: IMPROVEMENTS – per lump sum  
Pay Item 13 31 00.9 TERMINAL D CANOPY: IMPROVEMENTS – per lump sum  
Pay Item 13 31 00.10 TERMINAL E CANOPY: IMPROVEMENTS – per lump sum  
Pay Item 13 31 00.11 NORTH REMOTE PARKING LOT: LIGHTING – per each  
Pay Item 13 31 00.12 EXPRESS NORTH PARKING LOT: LIGHTING – per each  
Pay Item 13 31 00.13 SOUTH REMOTE PARKING LOT: LIGHTING – per each  
Pay Item 13 31 00.14 TERMINAL A CANOPY: LIGHTING (CLUSTER) – per each  
Pay Item 13 31 00.15 TERMINAL A CANOPY: LIGHTING (TANDEM) – per each  
Pay Item 13 31 00.16 TERMINAL B CANOPY: LIGHTING (CLUSTER) – per each  
Pay Item 13 31 00.17 TERMINAL B CANOPY: LIGHTING (TANDEM) – per each  
Pay Item 13 31 00.18 TERMINAL C CANOPY: LIGHTING (CLUSTER) – per each  
Pay Item 13 31 00.19 TERMINAL C CANOPY: LIGHTING (TANDEM) – per each  
Pay Item 13 31 00.20 TERMINAL E CANOPY: LIGHTING (CLUSTER) – per each  
Pay Item 13 31 00.21 TERMINAL E CANOPY: LIGHTING (TANDEM) – per each  
Pay Item 13 31 00.22 ATTENDANT STATION WITH UTILITIES – per each  
Pay Item 13 31 00.23 COTTER PINS – per each

**END OF ITEM 13 31 00**

THIS PAGE INTENTIONALLY LEFT BLANK

## SECTION 13 31 01

### TENSILE MEMBRANE STRUCTURES - PTFE

#### PART 1 – GENERAL

##### 1.1 SUMMARY

- A. This section includes an exterior architectural tensile membrane roof structure system.
- B. The Contractor shall be responsible for the structural design, detailing, fabrication, supply, and installation of the work specified herein, some or all of which may be contracted by Contractor to others meeting the qualification requirements of Section 1.5. The intent of this specification is to establish in the first instance an undivided, single-source responsibility of the Contractor for all of the foregoing functions.
- C. Contractor's work shall include, but not necessarily be limited to, the structural design, supply, fabrication, shipment, and erection of the following principal items:
  - 1. The architectural membrane as indicated on the drawings and in these specifications.
  - 2. Cables and end fittings.
  - 3. Perimeter, catenary, and sectionalized aluminum clamping system.
  - 4. Structural steel, including masts, trusses, struts, beams, and / or weldments, as indicated on the drawings.
  - 5. Fasteners and gasketing.
- D. The architectural membrane used in these structures shall be polytetrafluoroethylene ("PTFE", such as Teflon® coated woven fiberglass). All references to "membrane" in this section, without exception, and whether singular, plural, capitalized or not, are to such architectural membrane.

##### 1.2 REFERENCES

- A. General: Except as otherwise shown or noted, all work shall comply with the requirements of the following codes and standards:
  - 1. American Institute of Steel Construction (AISC).
    - a. Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings
    - b. Code of Standard Practice for Steel Buildings and Bridges
    - c. Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design
    - d. Specification for Allowable Stress Design of Single-Angle Members
    - e. Seismic Provisions for Structural Steel Buildings

2. American Society of Civil Engineers (ASCE)
  - a. ASCE 19: Structural Applications of Steel Cables for Buildings
  - b. ASCE 7: Minimum Design Loads for Buildings and Other Structures
3. American Society of Testing and Materials (ASTM)
  - a. ASTM A 586: Standard Specification for Zinc-Coated Steel Structural Strand
  - b. ASTM A 603: Standard Specification for Zinc-Coated Steel Structural Wire Rope
  - c. ASTM A 780: Zinc Rich Paint Repairs
  - d. ASTM A 153: Hot Dip Galvanizing
  - e. ASTM D 4851-88: Standard Test Methods for Coated and Laminated Fabrics for Architectural Use
  - f. ASTM A 36: Carbon Steel
  - g. ASTM A 307: Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
  - h. ASTM E 84: Standard Test Method and Surface Burning Characteristics of Building Materials
  - i. ASTM 108: Standard Test Methods for Fire Tests of Roof Coverings
  - j. ASTM 136: Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750° C
  - k. ASTM C 423: Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - l. ASTM E 424: Standard Test Method for Solar Energy Transmittance and Reflectance of Sheet Materials
  - m. ASTM D 1117: Testing Non-Woven Fabrics
  - n. ASTM B 221-08: Standard Aluminum and Aluminum Alloy Extruded Bars
  - o. ASTM B 209: Standard Specification for Aluminum Sheet
4. American Welding Society (AWS)
  - a. AWS D1.1: Structural Welding Code
  - b. AWS 2.4: Symbols for Welding and Nondestructive Testing
5. Aluminum Association
  - a. Specifications for Aluminum Structures
6. National Fire Protection Association (NFPA)
  - a. NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
7. Steel Structures Painting Council (SSPC)
  - a. Steel Structures Painting Manual, Volumes 1 and 2

### 1.3 SYSTEM REQUIREMENTS

- A. General: Provide a structural tensile membrane system that complies with requirements specified herein by testing the Contractor's corresponding membrane system in accordance with the indicated test methods.

- B. Building Code Criteria: The tensile membrane structure shall comply with the International Building Code, 2015 edition.
  - 1. Roof Live Load: 12 psf
  - 2. Basic Wind Load: 115 mph
  - 3. Wind Exposure Category: C
- C. DFW Design Criteria Manual.
- D. Life Safety: All tensile membrane structures shall be detailed so that no life safety issue is created in the event of a loss of a part of the membrane. The tensile membrane structure shall not rely on the membrane for structural stability.
- E. Design of fabric canopies are to withstand the most critical effects of load factors and load calculations.
- F. Fire Performance: Range of characteristics required of membranes:
  - 1. Burning Characteristics (ASTM E 84)
    - a. Flame Spread 5 max.
    - b. Smoke Generation (Tunnel Test) 20 max.
  - 2. Fire Resistance of Roof Coverings (ASTM E 108)
    - a. Burning Brand Class A
  - 3. Incombustibility of Substrates (ASTM E136)
    - a. Substrate Noncombustible Pass
  - 4. Flame Resistance (NFPA 701 Small Scale, UL 94)
    - a. Flame Out 1 sec. after
    - b. Char Length 0.25-inch max.

#### 1.4 QUALITY ASSURANCE

- A. The Contractor shall submit a Corporate Quality Control Manual describing the company's complete quality assurance program.

#### 1.5 SUBMITTALS

- A. Submit under provision of Section 01 33 23 – Shop Drawings, Product Data, and Samples.
- B. Must submit a letter that the Contractor is certified as a design/ engineer, fabricator, installer and post service provider approved by the membrane supplier.
- C. General: Notwithstanding any provisions of these specifications that may appear to be to the contrary, any and all submittals by the Contractor shall be subject to review, approval, and adoption by the Architect/Engineer as part of the overall project design and engineering, and shall not create a contractual or other professional design relationship between the Contractor and either the Architect/Engineer or the Owner.

- D. Product Data: Include manufacturer's specifications for materials, fabrication, color options, installation, and recommendations for maintenance. Include test reports showing compliance with project requirements where test method is indicated. Final color choice to be approved by OAR.
- E. Design Drawings: Contractor shall submit tensile membrane structure drawings defining the completed structure, anchorage, and connection details, interfaces with building construction and general membrane seam arrangements. Design Drawings are to be signed and sealed by a Professional Engineer in the State of Texas.
- F. Design Calculations: Contractor shall submit complete calculations for the tensile membrane structure, as one package with the design drawings, signed and sealed by a Professional Engineer licensed in the State of Texas. Structural calculations shall include all required loading cases and load combinations used in the design and resulting member forces, reactions, deflections and drift. The magnitude of maximum reactions on the supporting structures from all critical load combinations shall be separately tabulated. Critical load conditions used in the final sizing of the members shall be emphasized. The design analysis shall include the name and office phone number of the designer to answer questions during the design drawing review.
- G. Quality Assurance Submittals
1. Test Reports: Provide test reports from a qualified testing laboratory that show compliance of the Contractor's PTFE-coated woven fiberglass tensile membrane system with specification requirements, as follows:
    - a. Physical test data of the actual fabric roll goods to be used in the project confirming conformance with specifications for the membrane.
  2. Certificates: Product certificates signed by the Contractor certifying materials comply with specified characteristics, criteria, and physical requirements.
- G. See Section – 01 77 00 – Close-out Procedures: Submit the following items:
1. Warranty: Project Warranty documents as described herein.
  2. Record Documents: Project record documents for installed materials in accordance with Contract Conditions and Division 1 Submittal Procedures Section.
  3. Maintenance Manual: Submit one (1) copy of a maintenance manual for the tensile membrane structure to the owner. The manual shall include a schedule for routine inspection, and inspection checklist, instructions for emergency repair and use of emergency repair materials, and warranty. During the system erection period, the owner shall provide maintenance personnel to be trained in the use of repair materials.

## 1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. See Section – 01 66 00 – Product Storage and Handling Requirements.
- B. Materials shall be packed, loaded, shipped, unloaded, stored and protected in a manner that will avoid abuse, damage, and defacement.

## 1.7 WARRANTY

- A. The Contractor shall furnish the Owner with a written warranty, which warrants the membrane, its perimeter attachment system, and the structural support system as supplied by the Contractor have been installed in accordance with the project specifications and will be free from defects in materials and workmanship that will impair their normal use of service. The beginning of each warranty will be established by the date of Final Acceptance pursuant to Section 01 78 33 – Bonds and Warrants.
- B. One (1) year workmanship warranty on installed products  
One (1) year warranty on paint system  
Manufacturer’s standard pass thru warranty on fabric

## PART 2 – MATERIALS

### ~~2.1 QUALIFIED CONTRACTOR~~

~~A. *FabriTec Structures LLC*  
ATTN: Michael Lair  
1011 Regal Row  
Dallas, TX 75247  
Tel: 972.740.1810  
Email: mlair@fabriTecllc.com~~

~~B. Or approved equal.~~

~~C. Approved bidders must meet all qualifications in Section 1.5 – Quality Assurance and show written proof for each item listed to become an approved equal.~~

### 2.2 ARCHITECTURAL MEMBRANE

- A. General: The membrane used in these structures shall be polytetrafluoroethylene (“PTFE”, such as Teflon®) coated woven fiberglass. All references to “membrane” in this section, without exception, and whether singular, plural, or capitalized or not, are to such architectural membrane.



- B. The membrane shall meet the following general requirements:
1. Source Quality Control: The primary materials shall be obtained from a single manufacturer. Secondary materials shall be those recommended by the primary manufacturer.
  2. Physical Characteristics: The following indicates a range of physical property types for PTFE architectural membranes. The determination of specific characteristics and selection of a membrane shall be derived from analysis and calculations carried out by the Professional Engineer for this project.
    - a. Coated Fabric Weight (oz/sq. yd)                      24-45.5 nom. (ASTM 4851)
    - b. Thickness (mils)    18 – 36 nom. (ASTM 4851)
    - c. Strip Tensile (lbs./in., avg.)
      - 1) Dry, Warp (ASTM 4851)                                      520 min. – 975 min. avg.
      - 2) Dry, Fill (ASTM 4851)                                      380 min. – 900 min. avg.
    - d. Tensile after Flexfold (lbs/in., avg.)
      - 1) Dry, Warp (ASTM 4851)                                      375 min. – 760 min. avg.
      - 2) Dry, Fill (ASTM 4851)                                      350 min. – 735 min. avg.
    - e. Trapezoidal Tear (lbs. avg.)
      - 1) Warp (ASTM 4851)    35 min. – 95 min. avg.
      - 2) Fill (ASTM 4851)    35 min. – 120 min. avg.
    - f. Solar Transmission (%) (ASTM 424)                      7 – 22 nom.
    - g. Solar Reflectance (%) (ASTM 424)                      70 – 75 nom.

C. Materials

1. Base Fabric: The yarns used shall be of the highest commercial quality, essentially free of broken fibers and fully suitable for coating. The fabric shall be woven with uniform tension and crimp in the warp and fill yarns and free of defects deleterious to the coating process.
2. Fluorocarbon Coatings: The coating materials shall be fluorocarbon resins formulated specifically for architectural applications. These materials shall be applied to form a weatherized barrier between the fiberglass yarns and the environment. The bulk of the coating shall be formulated dispersions of PTFE fluoropolymer resin and additives to enhance abrasion and tear resistance, impart pigmentation or modify solar transmission. The additives shall not constitute more than 20 percent by weight of the total coating or 25 percent by weight of any individual layer. The surface shall be totally a fluoroethylenepropylene (“FEP”) resin to facilitate heat welding.
3. After weaving, the base fabric shall be cleaned and primed to achieve optimum mechanical properties of the coated membrane. The coating, described above, shall be virtually free of mud cracks and pinholes. The coating shall be applied evenly to both sides of the fabric and the FEP fluorocarbon resin topcoat shall be of sufficient thickness to permit proper heat fusion of joints with the recommended die pressure and temperature.

## 2.3 CABLE AND END FITTINGS

### A. Materials

1. All structural wire rope cables shall conform to the latest revision of ASTM A 603.
2. All structural strand cables shall conform to the latest revision of ASTM A 586.
3. All cables shall be coated to "Class A" zinc coating throughout.
4. All cables in contact with the membrane shall be white PVC coated. All other cables may be galvanized only.

### B. Fabrication

1. Cable fabricator shall provide effective quality control over all fabrication activities. Inspection of the place of fabrication may occur at any time to verify proper quality control. This inspection does not relieve the fabricator from meeting the requirements of this specification.
2. Cables that are designated to be pre-stretched shall be pre-stretched per ASTM A 603 for wire rope and ASTM A 586 for structural strand. Cables of the same type shall have the same modulus of elasticity.
3. All cables shall be manufactured to the following length tolerances at 70° Fahrenheit (23° Celsius):

|  |                  |
|--|------------------|
| a. Length < 70 feet (213 meters)               | ¼ inch (6.4mm)   |
| b. Length 70 to 270 feet (32.3 to 82.3 meters) | 0.03% of length  |
| c. Length > 270 feet (82.3 meters)             | 1 inch (25.4 mm) |
4. Cables shall have a continuous longitudinal paint stripe (1/8 inch wide max.) along their top surface unless noted otherwise.
5. Index markings shown shall be a circumferential paint stripe (1/8 inch wide max.).
6. All cables and end fittings shall be delivered clean and dry.
7. All swaged and speltered fittings shall be designed and attached to develop the full breaking strength of the cable. Thimble end fittings shall develop a minimum of 90 percent of the cable breaking strength.
8. Swaged end fittings, pins, nuts, and washers shall be electro-galvanized. Any damage to the zinc coating shall be cleaned and painted with gray zinc-rich paint per ASTM A 780.
9. Speltered end fittings shall be hot dip galvanized per ASTM A 153. Any damage to the zinc coating shall be cleaned and painted with a gray zinc-rich paint per ASTM A 780.

## 2.4 ALUMINUM CLAMPING SYSTEM

### A. Materials

1. All structural aluminum clamping systems shall be ASTM alloy 6061-T6.
2. Bent Plates shall be formed from ASTM B 221-08 alloy 6061 and then heat-treated to T6.
3. All structural "U straps" shall be ASTM B 221-08 Aluminum Alloy 6063, heat-treated to T5.

4. All structural aluminum clamping shall have the following finish:
  - a. Polyester thermosetting powder coating with a tri-glycidyl di-isocyanurate (i.e. TGDI) curing agent/hardener per American Architectural Manufacturers Association (AAMA) 603 to a thickness of 3 mils, whit in color
  - OR*
  - b. Clear anodized per MIL-A 8625C, Type 2, Class 1.
5. Structural sheet aluminum shall be ASTM B 209 alloy 5052-H32.
6. Non-structural sheet aluminum shall be ASTM B 209 alloy 1100 series.

**B. Fabrication**

1. Aluminum fabricator shall provide effective quality control over all fabrication activities. Inspection of the place of fabrication may occur any time to verify proper quality control. This inspection does not relieve the fabricator from meeting requirements of this specification.
2. Fabricated aluminum shall have no sharp edges.
3. Stamp all parts with the appropriate mark number.
4. All fabricated aluminum shall be free of oil, grease, and machining chips.
5. Tolerances shall be as follows:
  - a. Cross sectional dimensions +/- 10%, 0.03 in. (0.8 mm) max.
  - b. Bolt hold locations +/- 1/32 in. (0.8 mm)
  - c. Overall length +/- 1/16 in. (1.6 mm)
6. All welded joints shall conform to AWS D1.2.

## 2.5 STRUCTURAL STEEL

- A. General: The structural steel fabrication shall comply with the latest revision of all applicable codes, standards and regulations including the following:
  1. ASTM (as referenced)
  2. AISC: "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" and "Code of Standard Practice for Steel Buildings and Bridges"
  3. SSPC: "Steel Structures Painting Manual, Volumes 1 and 2"
  4. Research Council on Riveted and Bolted Structural Joints: "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts"
  5. AWS D1.1 and AWS A2.4
  
- B. In the event of conflict between pertinent codes and regulations and the requirements of the references standards or these specifications, the provisions of the more stringent shall govern.
  
- C. Submittals
  1. General: Submit the following under provisions of Section 01 33 23 – Shop Drawings, Product Data, and Samples.
  2. Shop Drawings:
    - a. The structural steel fabricator shall submit shop drawings to the Contractor for approval.

- b. The drawings shall show all shop and erection details including cuts, copes, connection holes, threaded fasteners, bolts, stands and spacing, etc.
- c. The drawings shall show all welds, both shop and field, by the currently recommended symbols of the AWS.
- d. A welding procedure must be submitted to the Contractor for approval of welds that are not pre-qualified.
- e. Shop drawings shall be carefully checked before being submitted for approval, and shall be submitted in the order in which they are needed for the executive of the work, well in advance and not all at one time. Submitted drawings shall show all structural steel required for the work, whether or not indicated on the drawings.
- f. The fabricator shall not fabricate any material until after receipt of approved shop drawings.
- g. The fabricator shall immediately make all corrections to his drawings as required by the Contractor and shall keep a satisfactory history of all changes by separately numbered and dated revision block on a convenient portion of each drawing affected.
- h. Certification of material conformance that includes chemical and physical properties for all structural elements shall be submitted to the Contractor.
- i. All shop drawings are to be signed and sealed by a Professional Engineer in the State of Texas

#### D. Materials

- 1. Structural steel for plates and bars shall conform to the requirements of ASTM A 36 or ASTM A 572, Grade 50, unless noted otherwise.
- 2. Structural pipe shall conform to ASTM A 53, Types E or S, Grade B.
- 3. Structural tubing shall conform to ASTM A 50, Grade B or C.
- 4. Structural bolts
  - a. High strength bolts: ASTM A 325, unless noted otherwise
  - b. Common bolts and nuts: ASTM A 307
  - c. Threaded rods: ASTM A 36, unless noted otherwise
- 5. Other materials: All other materials, not specifically described but required for a complete and proper installation of structural steel, shall be provided and shall be new, free from rust, first quality of their respective kinds, and subject to the approval of the Contractor.

#### E. Accessories

- 1. Base Plates and Anchor Bolts
  - a. Base plates supported on concrete, whether shop attached or shipped loose, shall be furnished and set on shims or leveling plates. Grouting shall be by the General Contractor.
  - b. Anchor bolt locations shall be furnished by the Contractor and used by the General Contractor to set the bolts. The General Contractor is to check carefully the setting of the bolts to their proper position prior to pouring of

concrete. Anchor bolts, provided by the General Contractor, shall have two (2) nuts and washers. Damaged threads shall be repaired or be cut to permit full tightening of nuts.

#### F. Fabrication

1. Workmanship: All members when finished shall be true and free of twists, bends, and open joints between the components parts. Members shall be thoroughly straightened in the shop by methods that will not injure them, before being worked on in any way.
  - a. Properly mark materials, and match-mark when directed by the Contractor, for field assembly.
2. Connections:
  - a. Connections shall be as indicated on the drawings. When details are not shown the connections shall conform to the requirements of the AISC.
  - b. Provide high-strength threaded fasteners for all structural steel bolted connections, unless noted otherwise.
  - c. Combination of bolts and welds in the same connection are not permitted, unless otherwise detailed.
  - d. Welded Connections
    - 1) Definitions: All terms herein relating to the welds, welding and oxygen cutting shall be construed in accordance with the latest revision of "Standard Definitions of Welding Terms and Master Chart of Welding Processes" of the AWS.
    - 2) Operators: only operators who have been previously qualified by tests, as prescribed in AWS D1.1 to perform the type of work required shall make Welds.
    - 3) Welding equipment shall be of sufficient capacity and maintained in good working condition, capable of adjustment in full range of current settings. Welding cables shall be adequate size for the currents involved and ground methods shall be such as to insure proper machine operation.
    - 4) No welding shall begin until joint elements are clamped in proper alignment and adjusted to dimensions shown on the drawings and allowance for any weld shrinkage that is expected. No members are to be spliced without prior approval.
    - 5) All welding shall be done in accordance with the reference specifications, with the following modifications and additions:
      - a) All field welding shall be done by manual shielded metal-arc welding.
      - b) All groove welds shall have complete penetration, unless otherwise specified on the drawings.
      - c) The minimum preheat and inter-pass temperature requirements shall be as required per AWS D1.1.
    - 6) Welding Sequence: Heavy sections and those having a high degree of restraint must be welded in a sequence with the proper preheat and post-

weld heat treatment such that no permanent distortion occurs. Submit a welding sequence for approval for these types of connections.

- 7) Oxygen Cutting: Manual oxygen cutting shall be done only with a mechanically guided torch. Alternatively, an unguided torch may be used provided the cut is not within ½ inch of the finished dimension and the final removal is completed by chipping or grinding to produce a surface quality equal to that of the base metal edges. The use of oxygen-cut holes for bolted connections will under no circumstances be permitted and violation of this clause will be sufficient cause for the rejection of any pieces in which oxygen-cut holes exist.
3. Tolerances: All tolerances shall be as per the AISC “Code of Standard Practice for Steel Buildings and Bridges”.
4. Paint System, Two-Part: See Specification 13 31 23 – Pre-Engineered Fabric Structures, Section 2.F.

G. Source Quality Control:

1. Testing
  - a. An independent testing laboratory paid for by the owner shall perform testing and inspection of the structural steel and welding. All welds shall be tested by visual, dye penetrant, magnetic particle methods in accordance with instructions from the Contractor.
  - b. The Contractor and the testing laboratory inspector shall be permitted to inspect the work in the shop or field throughout fabrication and erection.
  - c. The inspector shall check for workmanship of steel, both in the shop and field, and check general compliance with the contract documents and steel shop drawings. The inspector shall record types and locations of all defects found in the work and measures required and performed to correct such defects.
  - d. The steel fabricator shall make all repairs to defective work to the satisfaction of the inspector and at no additional cost to the Contractor.
  - e. The inspector shall submit reports of his inspection and test findings to the Contractor. He shall record all defects found with the subsequent repair operations and submit reports to the Contractor.
  - f. The work of the independent inspector shall in no way relieve the steel fabricator of his responsibility to comply with all requirements of the contract documents.

H. Product Handling and Protection: Use all means necessary to protect structural steel before, during, and after installation, and to protect the installed work and materials of all other trades.

I. Rejection and Replacement:

1. In the event of damage to the steel, immediately make all repairs and replacements necessary to the approval of, and at no additional cost, to the Contractor.
2. Any materials or welding rejected through inspection either in the shop, mill, or field must be promptly replaced to the satisfaction of, and at no additional cost to, the Contractor.

## 2.6 FASTENERS

- A. General: Provide fasteners used to secure clamp systems to curbs and cables, assemblage of clamp systems, and other fasteners as required to complete the work specified herein.
- B. Materials:
  1. All work shall comply with the latest edition of ASTM standards and American Iron and Steel Institute (AISI), as referenced herein.
  2. Fasteners used in membrane clamping systems shall be stainless steel. Bolts and studs shall conform to ASTM F 593, type 304. Nuts shall conform to ASTM F 594, Type 316. Washers shall be plain, narrow, and conform to AISI Type 18-8.
  3. All clamping systems subjected to relative movement between clamping and curb shall receive a split-ring lock washer conforming to AISI Type 18-8.
  4. Unless otherwise specified on the drawings, all other bolts and nuts shall conform to ASTM A 307-76B, zinc plated to conform to ASTM B 633 Class FE/ZN 8 type III.
- C. Source Quality Control: The manufacturer shall certify that all fasteners comply with the above referenced specifications.

## 2.7 GASKETING

- A. General: All work shall comply with the latest edition of ASTM standards, as referenced herein.
- B. Sponge Neoprene Gasketing:
  1. Material
    - a. All sponge neoprene shall be of a cellular elastomeric compound of a firm grade, which has been manufactured in pre-formed shapes for use as gasket and sealing material, as specified in ASTM specification C 509.
    - b. Cellular elastomeric materials furnished to this specification shall be manufactured from natural or synthetic rubber, or mixtures of these, with added compounds of such nature and quality that, with proper curing, the finished product will comply with this specification.



- c. The cured compounds shall be suitable for use where resistance to sunlight, weathering oxidation and permanent deformation under load are of prime importance.
- d. The manufacturing process shall be such as will ensure a homogeneous cellular material free of defects that may affect serviceability.
- e. The physical characteristics of the neoprene must meet or excess ASTM C 509, "Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Materials."
- f. Certification of material shall be provided that conforms to ASTM C 509.

C. Dense Neoprene Gasketing:

- 1. All neoprene material shall conform to ASTM D 2000M hardness Grade 60. The material shall be homogenous, free from defects and shall be compounded and cured to meet the requirements specified herein.
- 2. All neoprene shall be non-staining formulation and shall consist of at least 50 percent by weight of basic rubber hydrocarbon. Material shall not contain crude or reclaimed rubber.
- 3. The physical characteristics of the neoprene must meet or exceed the following physical test requirements when tested using the standard ASTM test slab can compression set plug (or approved equal):

| PROPERTY  | ASTM METHOD                                     | UNITS                    |
|---|---|--------------------------|
| a. Shore A Durometer                            | D2240   | 55-65                    |
| b. Tensile Strength (Min.)                      | D 412   | 1,100 psi                |
| c. Percent Elongation (Min.)                    | D 412   | 300%                     |
| d. Percent Compression Set (Max.)               | D395, Method B, 22hrs at 212° F                 | 35%                      |
| e. Heat Aging, Change from original properties: |   |                          |
| • Hardness Change (Max.)                        | +15 Points Shore A                              |                          |
| • Tensile Strength (Max.)                       |   | -15%                     |
| • Elongation Change (Max.)                      | -40%  |                          |
| f. Flame Resistance                             |   | Must not propogate flame |
| g. Temperature Range                            |   | -30°C to -100°C          |
| h. Ozone Resistance                             | D1171, Method A, 72 hrs @ 38°C and 50 mPa Ozone |                          |
| i. Resistance to Oil Aging:                     | D471, 70hrs @ 212°F Immersion in ASTM Oil No.3  |                          |
| • Tensile Strength (Max.)                       |   | -70%                     |
| • Elongation (Max.)                             |   | -55%                     |
| • Volume Change (Max.)                          |   | +120%                    |

## 2.8 MAINTENANCE KIT

A. Architectural Membrane Maintenance Kit: The owner shall be supplied with the following materials for emergency repair or maintenance. The materials shall be neatly packaged into a maintenance kit for storage by the owner.

| QUANTITY     | DESCRIPTION                                       |
|--------------|---|
| • 6          | 12-inch diameter patch with FEP sheets            |
| • 12         | 5-inch diameter patch with FEP sheets             |
| • 12         | 4-inch x 8-inch rectangular patch with FEP sheets |
| • 6 sq. yds. | Outer Membrane                                    |
| • 200 ft.    | FEP tape, 3 inches wide                           |
| • 1          | Soldering iron, 500W with wedge tip               |
| • 1          | Tacking sealer, 3-inch x 5-inch die               |
| • 2          | Insulating bearing blocks                         |
| • 1          | 5/8-inch hole punch                               |
| • 1          | Utility knife                                     |
| • 50         | Repair clips                                      |
| • 1          | Spool of No. 36 nylon twine                       |
| • 36 yds.    | Comar B29/4 x 15 Kevlar® thread                   |
| • 1          | Hand awl  |
| • 1 pkg.     | C-29 needles                                      |
| • 1          | Repair Manual                                     |

## PART 3 – FABRICATION AND ERECTION

### 3.1 FABRICATION OF MEMBRANE PANELS

#### A. General

1. Membrane assembly design drawings shall include all information necessary for the fabrication by the Contractor of the tensile membrane structure. They shall include size and shape of envelope, type and location of shop and field connections, size, type and extent of all heat-welded seams.
2. The Contractor shall take necessary care to plan and assemble the fabricated sections such that the assembly has not shop patches. Splices, if any, shall be patterned into a symmetrical and repetitive geometric arrangement within the assembly, shown on the design drawings and, where feasible, hidden by structural members.
3. All fabricated joints shall have a minimum of 90 percent of the total strength of the coated membrane in strip tensile testing. All structural joints shall be fused in accordance with industry standards and shall maintain the integrity of the coating. PTFE-coated woven fiberglass membranes shall be heat-sealed only.
4. Biaxial Test: At least one (1) representative sample of the outer membrane shall be biaxially test loaded. Membrane compensation in patterning shall be based upon results of the biaxial test loading.

### 3.2 ERECTION OF MEMBRANE ASSEMBLIES

- A. Prior installation of the membrane assemblies, the Contractor shall meet with the General Contractor to review the erection procedure and scheduling. The Contractor shall coordinate all work with other trades.
- B. No trade shall have access to, or work from the membrane, unless authorized by the Contractor in writing.
- C. Erection of structural steel
  - 1. The Contractor shall employ a competent foreman to supervise all work of steel erection. This foreman shall be present at all times during the Contractor's scope of work.
  - 2. All precautions shall be taken to ensure an accurately located and completely safe and stable structure at all times. Adequate guy cables shall be used throughout the work and all erection bolts shall be drawn up tight.
  - 3. All steel shall be accurately aligned before permanent connections are made.
  - 4. Temporary bracing shall be left in place as long as may be required for safety. The bracing shall be located so it does not interfere with the erection for the tensile membrane structure, and can be removed as required during construction.
    - a. The structure is to be self-supporting and stable after the structure is fully completed. It is the Contractor's sole responsibility to determine the erection procedure and sequence and to ensure the safety of the structure and its component parts during erection. This includes the additional of whatever temporary bracing, guys or tie-downs that may be necessary. Such materials shall be removed by the Contractor and remain his property after completion of the property.
  - 5. Erection tolerances shall be specified in the AISC "Code of Standard Practice for Steel Buildings and Bridges", unless otherwise noted.

### 3.3 CLEANING

- A. Protect work from damage and deterioration during installation.
- B. Upon completion of tensile membrane structure installation:
  - 1. The Contractor shall clean all surfaces of the system's components in conformance with the membrane manufacturer's recommendations.
  - 2. Inspect the system and repair membrane panels that become damaged. Repairs shall be executed in such a way that they are visually acceptable.
- C. Repairs:
  - 1. Inspect the system and repair membrane panels that have become damaged.

2. Repairs shall be neatly made and shall not exceed 12 inches in diameter. Repairs shall be limited to one of each 3,000 square feet of fabric and no more than 10 repairs for the entire shade structure system.

D. Steel Cleaning:

1. Cleaning and touchup steel finishes field welds, bolted connections and abraded areas shall be completed per the manufacturer's field repair recommendations.

**PART 4 – MEASUREMENT AND PAYMENT**

4.01 MEASUREMENT

- A. The work performed and the materials furnished for this item shall be considered subsidiary to other pay items.

4.02 PAYMENT

- A. The work performed for this item shall not be paid separately but shall be considered incidental to other pay items.

**END OF SECTION 13 31 01**

## SECTION 13 31 03

### TENSILE MEMBRANE STRUCTURES - HDPE

#### PART 1 – GENERAL

##### 1.1 SUMMARY

- A. This section includes an exterior architectural tensile membrane roof structure system.
- B. The Contractor shall be responsible for the structural design, detailing, fabrication, supply, and installation of the work specified herein, some or all of which may be contracted by others meeting the qualification requirements of Section 1.5. The intent of this specification is to establish in the first instance an undivided, single-source responsibility of the Contractor for all of the foregoing functions.
- C. Contractor's work shall include, but not necessarily be limited to, the structural design, supply, fabrication, shipment, and erection of the following principal items:
  - 1. The architectural membrane as indicated on the drawings and in these specifications.
  - 2. Cables and end fittings.
  - 3. Perimeter, catenary, and sectionalized aluminum clamping system.
  - 4. Structural steel, including masts, trusses, struts, beams, and / or weldments, as indicated on the drawings.
  - 5. Fasteners and gasketing.
- D. The architectural membrane used in these structures shall be high-density polyethylene (HDPE). All references to "membrane" in this section, without exception, and whether singular, plural, capitalized or not, are to such architectural membrane.

##### 1.2 REFERENCES

- A. General: Except as otherwise shown or noted, all work shall comply with the requirements of the following codes and standards:
  - 1. ASTM A 500 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
  - 2. ASTM A 513 – Standard Specification for Electric-Resistance-Welded and Seamless Carbon Steel Structural Tubing.
  - 3. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 4. AWI – AWS D1.1 – Structural Welding Code - Steel
  - 5. AISC – Specifications for the Design of Cold-Formed Steel Structural Members

6. ASCE-7 – American Society of Civil Engineers, Minimum Design Loads for Buildings and other structures
7. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials
8. NFPA 701 – Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
9. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials

### 1.3 SYSTEM REQUIREMENTS

- A. General: Provide a structural tensile membrane system that complies with requirements specified herein by testing the Contractor’s corresponding membrane system in accordance with the indicated test methods.
- B. Building Code Criteria: The tensile membrane structure shall comply with the International Building Code, 2015 edition.
  1. Roof Live Load: 12 psf
  2. Basic Wind Load: 115 mph
  3. Wind Exposure Category: C
- C. DFW Design Criteria Manual.
- D. Life Safety: All tensile membrane structures shall be detailed so that no life safety issue is created in the event of a loss of a part of the membrane. The tensile membrane structure shall not rely on the membrane for structural stability.
- E. Fire Performance: Range of characteristics required of membranes:
  1. Burning Characteristics (NFPA 701)
 

|                                  |              |
|----------------------------------|--------------|
| a. Flame Spread (After Flame)    | Class C PASS |
| b. Flame Spread (Residual Flame) | Class C PASS |
| c. Char length                   | Class C PASS |
  2. Fire Resistance of Roof Coverings (ASTM E 108)
 

|                                |              |
|--------------------------------|--------------|
| a. Burning Brand – Small Scale | Class C PASS |
| b. Intermittent Flame          | Class C PASS |

### 1.4 QUALITY ASSURANCE

- A. The Contractor shall submit a Corporate Quality Control Manual describing the company’s complete quality assurance program.

### 1.5 SUBMITTALS

- A. Submit under provision of Section 01 33 23 – Shop Drawings, Product Data, and Samples.
- B. General: Notwithstanding any provisions of these specifications that may appear to be to the contrary, any and all submittals by the Contractor shall be subject to review, approval, and adoption by the Architect/Engineer as part of the overall project design and engineering, and shall not create a contractual or other professional design relationship between the Contractor and either the Architect/Engineer or the Owner.
- C. Product Data: Include manufacturer's specifications for materials, fabrication, color options, installation, and recommendations for maintenance. Include test reports showing compliance with project requirements where test method is indicated. Final color choice to be approved by OAR.
- D. Design Drawings: Contractor shall submit tensile membrane structure drawings defining the completed structure, anchorage, and connection details, interfaces with building construction and general membrane seam arrangements. Design Drawings are to be signed and sealed by a Professional Engineer in the State of Texas.
- E. Design Calculations: Contractor shall submit complete calculations for the tensile membrane structure, as one package with the design drawings, signed and sealed by a Professional Engineer licensed in the State of Texas. Structural calculations shall include all required loading cases and load combinations used in the design and resulting member forces, reactions, deflections and drift. The magnitude of maximum reactions on the supporting structures from all critical load combinations shall be separately tabulated. Critical load conditions used in the final sizing of the members shall be emphasized. The design analysis shall include the name and office phone number of the designer to answer questions during the design drawing review.
- F. Quality Assurance Submittals
  - 1. Test Reports: Provide test reports from a qualified testing laboratory that show compliance of the Contractor's HDPE-coated polyester tensile membrane system with specification requirements, as follows:
    - a. Physical test data of the actual fabric roll goods to be used in the project confirming conformance with specifications for the membrane.
  - 2. Certificates: Product certificates signed by the Contractor certifying materials comply with specified characteristics, criteria, and physical requirements.
- G. See Section – 01 77 00 – Close-out Procedures: Submit the following items:
  - 1. Warranty: Project Warranty documents as described herein.
  - 2. Record Documents: Project record documents for installed materials in accordance with Contract Conditions and Division 1 Submittal Procedures Section.



3. Maintenance Manual: Submit one (1) copy of a maintenance manual for the tensile membrane structure to the owner. The manual shall include a schedule for routine inspection, and inspection checklist, instructions for emergency repair and use of emergency repair materials, and warranty. During the system erection period, the owner shall provide maintenance personnel to be trained in the use of repair materials.

## 1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. See Section – 01 66 00 – Product Storage and Handling Requirements.
- B. Materials shall be packed, loaded, shipped, unloaded, stored, and protected in a manner that will avoid abuse, damage, and defacement.

## 1.7 WARRANTY

- A. The Contractor shall furnish the Owner with a written warranty, which warrants the membrane, its perimeter attachment system, and the structural support system as supplied by the Contractor have been installed in accordance with the project specifications and will be free from defects in materials and workmanship that will impair their normal use of service. The beginning of each warranty will be established by the date of Final Acceptance pursuant to Section 01 78 33 – Bonds and Warranties.
- B. One (1) year workmanship warranty on installed products  
Ten (10) year structural warranty on structural steel and cables  
One (1) year warranty on paint system  
Manufacturer's standard pass thru warranty on fabric

## PART 2 – MATERIALS

### ~~2.1 QUALIFIED CONTRACTOR~~

#### ~~A. Sun Ports~~

~~ATTEN: Gary Haymann~~

~~Andre Marks~~

~~Mike Martin~~

~~8505 Chancellor Row~~

~~Dallas, TX 75247~~

~~1 (800) 966-5005~~

#### ~~B. Or approved equal.~~

## 2.2 ARCHITECTURAL MEMBRANE

- A. General: The membrane used in these structures shall be high density polyethylene (HDPE) fabric with ultraviolet blocking additives. All references to “membrane” in this section, without exception, and whether singular, plural, or capitalized or not, are to such architectural membrane.
- B. The membrane shall meet the following general requirements:
1. Source Quality Control: The primary materials shall be obtained from a single manufacturer. Secondary materials shall be those recommended by the primary manufacturer.
  2. Physical Characteristics: The following indicates a range of physical property types for HDPE architectural membranes. The determination of specific characteristics and selection of a membrane shall be derived from analysis and calculations carried out by the Professional Engineer for this project.
    - a. Construction: HDPE top coated Polyester with ultraviolet blocking additives
    - b. Burst Strength: 33-38 psi
    - c. Fabric Mass: 195 to 200 grams per square meter
    - d. Tear Strength:
      - 1) Weft: 183 lbs (83 kg)
      - 2) Warp: 220 lbs. (100kg)
    - e. Fire Rating:
      - 1) ASTM E 84: Class 1, Flame spread 15, smoke developed 15
      - 2) NFPA 701 Test Method 2 test standards: Pass
    - f. Shade percentage: 60 percent to 95 percent
    - g. UVB Block: 85 percent to 98 percent
    - h. Color: To be approved by OAR

## 2.3 CABLE FASTENING AND TENSIONING MATERIALS

- A. Fastening and tensioning system:
1. Fastening and tensioning system shall be designed and provided by system manufacturer, and be covered under standard warranty.
- B. Cable and end fittings: Design cables with a minimum safety factor of 2 on breaking strength
1. Wire rope shall conform to AISI Steel Cable Manual requirements with a Class A galvanized coating or approved substitute. Cable shall be IWRC improved plow steel.
  2. Cable terminations and connectors shall be hot-dipped galvanized for corrosion protection.

3. Swaged and splattered fittings shall be designed and attached to develop the full breaking strength of the cable. Thimble end fittings shall develop a minimum of 100 percent of the cable breaking strength.
4. Swaged end fittings, nuts, and washers shall be electric-galvanized. Splattered end fittings shall be hot-dip galvanized.

## 2.4 FRAMING MATERIALS

- A. Structural steel members: ASTM A36/A36M, hot-dip galvanized.
- B. Structural tubing: Tubing conforming to ASTM A500, Grade B, hot-dip galvanized and treated.
- C. Plate or bar stock: ASTM A529/A529M, hot-dip galvanized.
- D. Anchor bolts: ASTM A307, galvanized.
- E. Bolts, nuts, and washers: ASTM A 325 or ASTM A490 and A315 stainless steel.
- F. Welding materials: AWS D1.1; type required for materials being welded.
- G. Concrete anchor bolts shall conform to A307, hot-dip galvanized, or A316 stainless steel anchors as specified.

## 2.5 FABRICATION

- A. Steel Components: Fabrication of steel components shall be in accordance with guidelines set forth in the AISC steel design manual and the AWS code of structural welding.
  1. All welds shall be in accordance with manufacturer's design, and performed prior to shipping. No welding shall be performed in the field.
  2. Structural members shall be fabricated in as large segments as possible to minimize field joints.
  3. Grind all corners and sharp edges.
  4. Steel will require abrasive blasting and primer before application of the polyester powder paint finish.
  5. Steel shall be polyester powder painted to a minimum thickness of three (3) mils.
  6. Cables shall be tensioned to double the design load before length is cut.
  
- B. Frame colors: To match existing.
  
- C. Fabric cover: Fabric cover fabricated with UV-resistant thread. Fabric connection points to be triple-reinforced and heat-sealed with vinyl interfacing inserted and sewn between layers of reinforcement. Fabric shall be pre-stressed prior to fabrication.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify foundation and placed anchors are in correct position.
- C. If substrate preparation is the responsibility of another installer, notify General Contractor of unsatisfactory preparation before proceeding.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Construct foundations in accordance with local codes and best practices for specific structure and site conditions.
  - 1. Direct embedment: Column shall be embedded in a concrete footing in bare soil as indicated on the approved shop drawings. Contractor shall coordinate anchor bolt placement per manufacturers.
  - 2. Integrated shade: Install in accordance with manufacturer's instructions.
- C. Fabric: Prior to start of installation; check all surfaces of framing members and other rigid construction elements to be in contact with fabric, to ensure that all edges are smooth and well-rounded. Remove any potential causes for snagging or tearing of the fabric. Install all connections and provide all materials and equipment required for the erection and stressing of the fabric. Unroll the fabric in such a manner as to avoid snagging or dragging the fabric over sharp objects during installation. Appearance of the fabric membrane roof shall be smooth and wrinkle free. Creasing or folding the fabric around sharp corners shall be avoided at all times.
- D. Fabric tensioning system: Cables shall be free of all kinks and bends. Care shall be taken not to damage the cables during installation. Bolt holes shall be 1/8 inch larger than the bolt, unless noted otherwise.

### 3.3 ADJUSTING AND CLEANING

- A. Clean all surfaces and restore any marred or abraded surfaces to original conditions as approved by the Architect.
- B. Adjust all cables and fabric as required to produce a smooth, uniform appearance.
- C. Clean canopies of dirt, dust, and debris.

### 3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products prior to Substantial Completion.

**PART 4 – MEASUREMENT AND PAYMENT**

4.01 MEASUREMENT

- A. The work performed and the materials furnished for this item shall be considered subsidiary to other pay items.

4.02 PAYMENT

- A. The work performed for this item shall not be paid separately but shall be considered incidental to other pay items.

**END OF SECTION 13 31 03**