

ALUMINUM DOME SPECIFICATION

Wastewater Applications for Fixed Roof Anaerobic Digester (Pressurized Tanks)

1. GENERAL

This specification includes the design, fabrication, and erection of the aluminum dome roof structure(s) for circular wastewater anaerobic digesters with appurtenances as shown on the contract drawings and specified herein.

2. SCOPE OF WORK

The dome fabricator/erector shall furnish all labor, materials and equipment required to design, fabricate, deliver, and erect the aluminum dome roof(s).

3. DESIGN

- A. The roof shall be a dome structure(s) conforming to the specified dimensions of the tank. The structural frame of the domes shall consist of a fully triangulated, aluminum space truss that shall be clear-span and self supporting from the periphery structure; primary horizontal thrust shall be contained by an integral tension ring. Provisions shall be made to allow for thermal expansion of the dome and it's parts over a temperature range of -40°F to +140°F.
- B. The dome surface paneling shall consist of non-corrugated aluminum closure panels that shall be designed as a gas-tight system under all design load and temperature conditions. All raw edges of the aluminum panels shall be covered, sealed, and firmly clamped with batten bars in an interlocking manner to prevent slipping or disengagement under design load and temperature changes.
- C. The dead weight of the dome structure shall not exceed 3.5 pounds per square foot of surface area.
- D. The roof framing system shall be designed as a three dimensional truss with moment-resisting joints. The design must consider the increased minor axis bending and compression induced in the framing members due to tension in the roof panels.
- E. The structural analysis shall be performed using stiffness analysis models. The structural computer models shall include the effect of geometry irregularities such as perimeter support members and appurtenance openings.

Aluminum Dome Specification Fixed Roof Anaerobic Digester Pressurized Tanks

- F. Connection forces shall be transferred through gusset plates connected to the top and bottom flanges of the beam-struts. The connections shall be designed as moment connections; a minimum of four Huck lockbolts shall be used to connect the gusset plate to each strut flange.
- G. All dome fasteners shall be designed with a safety factor of 2.34 on ultimate strength and 1.65 on yield strength.
- H. The design of welded components shall be done in accordance with the Aluminum Structural Welding Code ANSI/AWS D1.1/D1.2.
- I. The vertical loads transferred from the roof to the tank shall be in line with the tank support wall. The transfer of horizontal loads to the tank shall be minimized by means of low friction slide supports. Radial forces applied to the tank shall not exceed 10% of the vertical reactions.
- J. Dissimilar materials which are not compatible shall be isolated by an insulator to prevent galvanic corrosion. Passivated 300 series Stainless Steel is compatible to Aluminum.

4. MATERIALS

- A. Triangulated dome frame struts: 6061-T6 aluminum.
- B. Structural frame gussets: 0.375" nominal thickness, 6061-T6 aluminum.
- C. Triangular closure panels: 0.050" nominal thickness 3003-H16 aluminum Sheet.
- D. Perimeter tension/compression ring: 6061-T6 aluminum.
- E. Fasteners: 7075-T73 anodized aluminum or austenitic series 300 stainless steel as required by the manufacturers design.
- F. Sealant: Silicone, conforming to Federal Specification TT-S-00230 as manufactured by Pecora 864 or equal.
- G. Gaskets: Silicone, conforming to Federal Specification ZZ-R-765, Class 2, Grade 50 as manufactured by General Electric SE-44/88 or equal.
- H. Anchor Bolts: austenitic series 300 stainless steel.

Aluminum Dome Specification Fixed Roof Anaerobic Digester Pressurized Tanks

- I. Hatches and nozzles: 6061-T6, 5086-H34 or 5052-H36 aluminum, 0.090" nominal thickness.

5. ALLOWABLE STRESSES

Aluminum structural members and their connections shall be designed in accordance with the Aluminum Association's Specifications for Aluminum Structures and the following additions and clarifications.

A. Aluminum Structural Members

For members subjected to axial forces and bending moments due to load eccentricity or lateral loads, the combined member stresses shall be determined by adding the stress component due to axial load to the stress components due to bending in both the major and minor axis.

B. Snap-Through Buckling

General shell buckling shall be determined in accordance with the following formula:

$$w = \frac{2258 \times 10^6 \sqrt{I_x A}}{(SF) R^2 L}$$

1

Where:

- w = Allowable load [pressure psf].
- I_x = Moment of inertia of strut about the strong axis [in⁴].
- A = Cross sectional area of strut [in²].
- R = Spherical radius of dome [in].
- L = Average member length [in].
- SF = Safety factor (1.65).

The allowable buckling pressure shall be compared to the maximum intensities of symmetrical and nonsymmetrical load conditions.

6. DESIGN LOADS

Aluminum Dome Specification Fixed Roof Anaerobic Digester Pressurized Tanks

A. Dome Design Loads

The dome frame and skin shall be designed in accordance with the most recent edition of "Specifications for Aluminum Structures" as published by the Aluminum Association and designed for full dead load plus live or snow load in accordance with ASCE 7-95 and/or applicable local codes.

1. Basic Live Load [psf]:
2. Ground Snow Load [psf]:
3. Internal Pressure/Vacuum [wc]:

B. Panel Design Loads (not acting simultaneously with the above loads)

The aluminum panels shall be secured to the dome frame to withstand the following vertical loads:

1. Two concentrated loads of 250 pounds each, applied simultaneously on two separate one square foot areas of the panel or 60 psf distributed over the total panel area.
2. A distributed load equal to the ground snow load (item A.2) or 60 pounds per square foot over the total panel, whichever is greater.

C. Wind Loads:

The wind load shall be based on the local building code but the minimum shall be the load resulting from a wind velocity of 70 mph unless otherwise specified by the purchaser. Wind pressures and their distribution may be based on certified wind tunnel tests.

D. Seismic Loads:

The roof shall be designed for the seismic loading as specified in local building codes.

7. SHOP DRAWINGS, DESIGN CALCULATIONS AND SUBMITTALS

- A. Before executing any of the work in this section, calculations and prints or drawings shall be submitted to the consulting engineer showing dimensions, sizes, thickness, gauges, materials, finishes, joint attachments and erection procedures. These

Aluminum Dome Specification Fixed Roof Anaerobic Digester Pressurized Tanks

calculations and prints or drawings shall be reviewed and sealed by a Professional Engineer registered and licensed in the state in which the installation is to be made.

- B. All work shall be fabricated and erected in accordance with the approved drawings.
- C. Certification that the specified material alloys, sizes and quantities have been furnished shall be submitted by the manufacturer upon completion of the project.
- D. The manufacturer shall submit, as part of its submittal package, documentation from a qualified, independent third party testing laboratory that certifies that the manufacturer has built and tested a dome of similar design to the proposed pressure dome cover and the performance met the following conditions:
 - 1. The unit was pressurized to a minimum of the proposed operating pressure or a maximum of 24 inches water column (wc) pressure and it held leak free.
 - 2. During the test all seams shall be tested with a soapy water solution of sufficient strength to cause bubbling at an air seep of as little as one (1) cubic foot per hour. In addition, pressure readings shall be used to verify that the specified pressures were maintained.

8. FABRICATION AND ERECTION

- A. The contractor shall perform the work described herein with mechanics skilled and experienced in the fabrication and erection of aluminum dome roof structures. All field work shall be directed by a qualified supervisor who will remain on the job site until the dome construction is completed.
- B. Field re-fabrication of structural components or panels will not be accepted. Forcing of the structure to achieve fit-up during construction is expressly forbidden and not acceptable. Any indication of improper fit-up of parts shall be immediately reported to the dome fabricator.
- C. All sealant joints shall be tooled slightly concave after sealant is installed. Care shall be taken to keep sealant confined to joint area, and any outside of the joint shall be removed so that the panels will be free from misplaced sealant. All gasket materials shall be continuous; splices will not be allowed.

Aluminum Dome Specification Fixed Roof Anaerobic Digester Pressurized Tanks

- D. Upon completion of erection and curing of sealant, a leak test of all seams shall be made with a soapy water solution of sufficient strength to cause bubbling at an air seep of as little as one (1) cubic foot per hour. In addition, pressure readings shall be used to verify that the specified pressures were maintained.

9. QUALIFICATIONS TO BID

- A. The dome fabricator/erector must have installed at least one clear-span aluminum dome similar to the unit(s) specified that has been operating satisfactorily for a minimum period of two (2) years under design pressures of not less than 8" (203mm) w.c. Evidence of such experience shall be submitted with his bid proposal and/or pre-bid submittal.
- B. The experience requirement will be waived if the manufacturer provides a five-year Performance Bond in lieu of evidence of experience and operation. Proof of the ability to provide said bond shall be submitted with his bid proposal and/or pre-bid submittal. The bond shall guarantee satisfactory leak free operation as defined by the technical specifications, and it shall state that the manufacturer will, in case of unsatisfactory service, remedy any problem(s) within thirty (30) days after written notification, or, at the Owner's option, replace the domes or forfeit the bond. The bonding period shall commence upon written acceptance by the Owner of the installed equipment and all appurtenances and final acceptance of the General Contract.
- C. The dome shall be manufactured by TEMCOR of Gardena, California, (Phone 310-523-2322 or 800-421-2263).

10. GUARANTEE

The dome(s) shall be guaranteed for a period of one (1) year against defective materials and workmanship.

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