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STORAGE TANK EQUIPMENT
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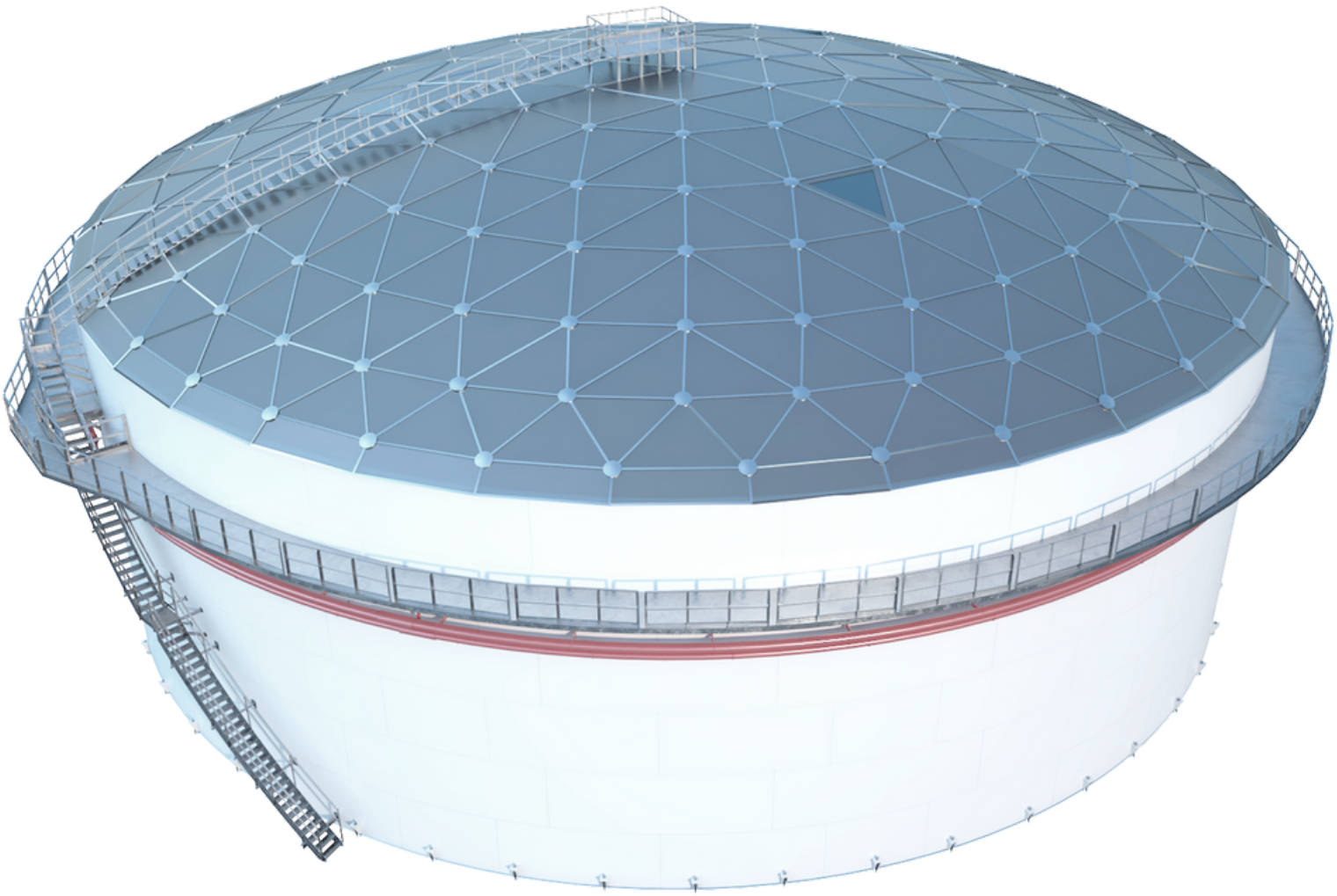
CATALOG 2023

Benefits of
Aluminum Dome Roof



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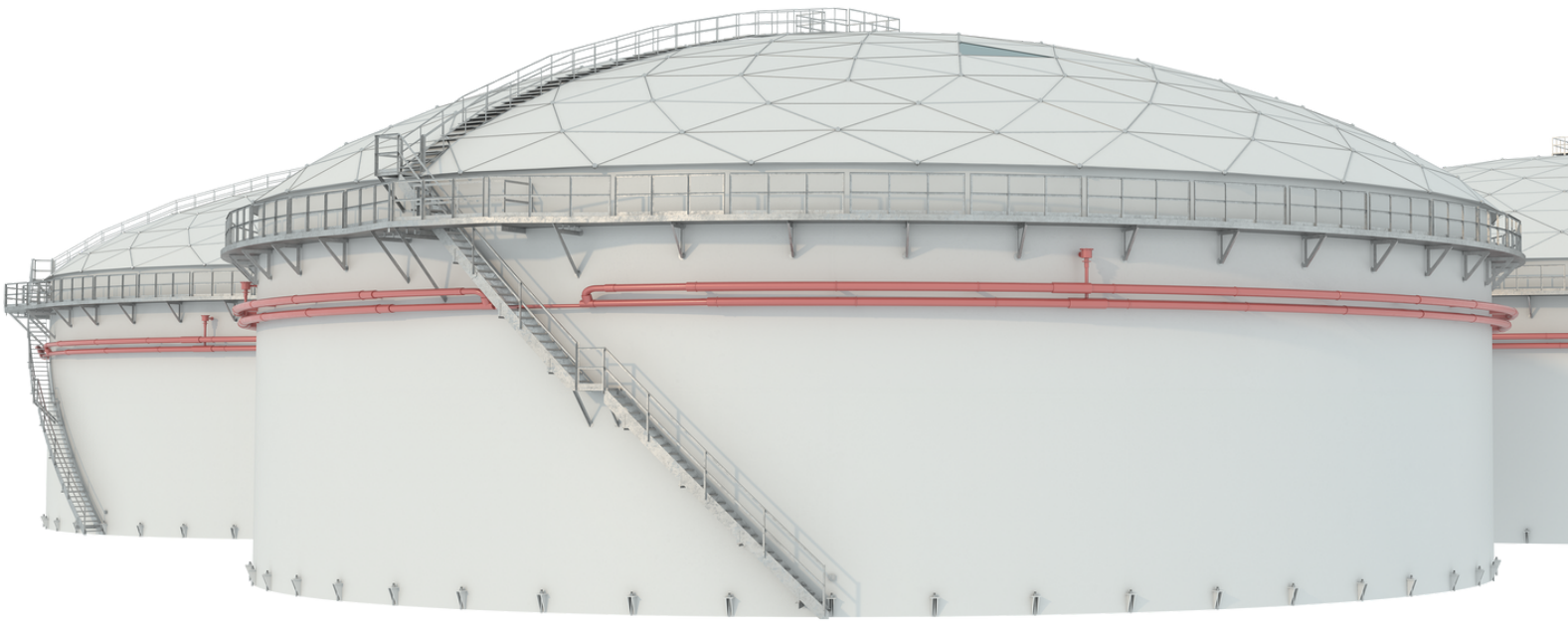
Introduction

Aluminum made tremendous advances as a structural construction material in the last thirty years. To understand the reasons why it is necessary to develop an appreciation for the basic fundamentals that make it so well suited for many construction applications.

The Aluminium Geodesic Dome Roof is an innovative modular free-spanning, a self-supporting structure that perfectly complements modular bolted containment and storage solutions. The design of the Geodesic Dome is such that it will fit onto both new and existing tanks, often without the need for the tank to be reinforced. They are a fast and easy solution to install with the low weight of the aluminum structure giving decisive cost advantages when compared to other roof types. The solution is elegant and gives maximum durability with minimal ongoing maintenance whilst providing environmental protection and a suitable means of odor control from the contents of a tank.

The Domed Roof can be used on very large diameter tanks without the requirement for intermediate supports. The roof design offers excellent resistance to atmospheric conditions and is designed to withstand very high wind and snow loads which makes them an effective choice for weather protection. Utilising an intelligent sealing system the design allows rapid and reliable construction in all types of construction conditions.



Benefits of Aluminum Structure

Non-Rusting

“Rust” means iron(*2) oxide formed by the oxidation of iron, or steel containing the element, iron (Fe). Since, aluminum(*1) products do not include iron, they will never “rust”.

Aluminum will oxidize forming an Aluminum oxide film on the surface. As a matter of fact, the oxidation action is similar, but the results are totally different. Iron oxide (rust) is very porous, allowing moisture to penetrate the film of rust and thus permitting additional rusting until over time, structural failure results.

Aluminum oxide is a dense, tight film covering that effectively forms a barrier to moisture, resulting in the protection of the metal underneath against further oxidation.

Thus, the oxidation rate of aluminum decreases as the film builds. An actual bare aluminum roof installation exposed to salt air with no applied barrier coating or maintenance had an oxide penetration of only 0.05 mm in 40 years. At this rate, it would require 500 years to penetrate at 0.5 mm sheet of aluminum.

Penetration Tests

Results of exposure tests for aluminum by the American Society for Testing Materials, in nine locations (including industrial, seacoast, and rural) indicated an average penetration of only **0,000508mm per year.**

Surface Marking

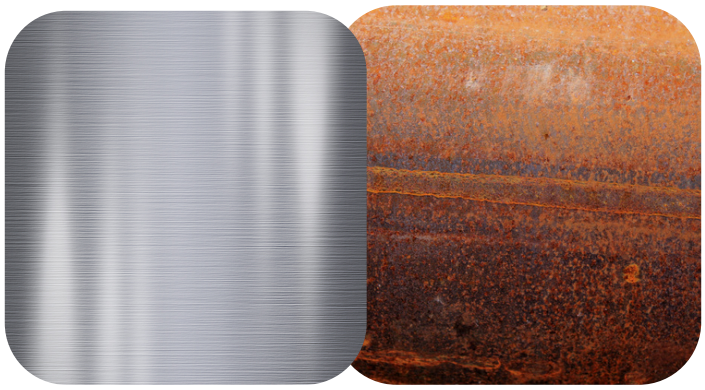
Shearing, bundling, shipping, fabrication, and erection of any building products are bound to produce a certain amount of surface marking. It is difficult to erect galvanized roofing without scratching, chipping, breaking, or peeling off some of the galvanizing, exposing the underlying metal to moisture, which causes rust.

Fastener holes are a good point to starting point for rust. Deformation here is particularly harmful to the roofing, siding, and flashing.

Aluminum, however, being a homogeneous material, has no protective coating to come off. Any scratches that may be produced are quickly protected by the **natural protective coating of aluminum oxide**. Fastener holes similarly provide their own protection. Thus, holes in aluminum are no weak points for deterioration.

Immune to Most Chemicals

Aluminum is unaffected by **many chemicals and acids that seriously attack galvanized steel and iron.** Sulfur fumes that necessitate the replacement of ordinary galvanized roofing every few months have no effect whatever on aluminum roofing which has withstood years of use in the same plant.



1.Aluminum 2.Iron

Watermarking

Pure water allowed to pond on aluminum does not produce a water spot. However, it is an unfortunate fact that most water (even moisture condensing from the atmosphere) contains some chemicals, enough to react with aluminum, and its alloying elements, to form gray or white salts.

These salts will mark the surface of the aluminum. It should be emphasized that this attack is superficial, hardly being enough to mark the top layer.

However, these spots or streaks may be unsightly. Such marks are easily removed by mechanically abrading the surface with a power-driven wire brush or using some cleaner.

No Painting

Aluminum manufacturers recommend the use of bare untreated aluminum for all sorts of building products including roofing and siding of many different types. **Painting is not necessary to protect aluminum.**

Easy to Handle … Lighter Roof Loads

Competition says, “The difference in weight is not considered important in roofing”. While it may not be important to the man selling steel roofing, it is important to the warehouser, applicator, and user of roofing sheet. To say that a reduction of nearly 90,72kg. for every 45,36kg. of aluminum used is unimportant is just plain distortion of fact. Labor involved in application is a definite and large factor in cost of a roof. **The favorable difference in weight of aluminum can be important in reducing the installed cost.**

Comparison of Weights

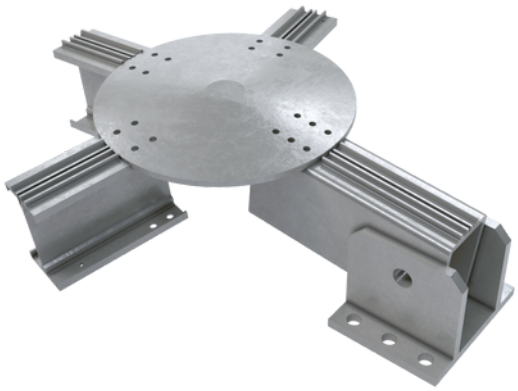
3 meters sheet of galvanized weight 7,6 kg. 3 meters sheet of aluminum 0,5 thick (35% thicker than the galvanized) weighs only 2,83 kg. This great weight of galvanized accounts for the sagging roofs readily found in many installations.

This great weight of galvanized accounts for the sagging roofs readily found in many installations. A sagging roof distorts and leaks. To say that a lighter roof load is unimportant completely disregards the importance of leaks.

Comparison of Density

Material	Density (Lb/inch³)- **(g/cm³)**
AL 3003 H16 AND H14 Used in dome panels	0,0986 – **2,729**
AL 6061 T6 Used in dome struts	0,0975 – **2,698**
Steel A 36 & A 283	0,284 – **7,861**

In average Steel density is 2.9 greater than aluminum density.

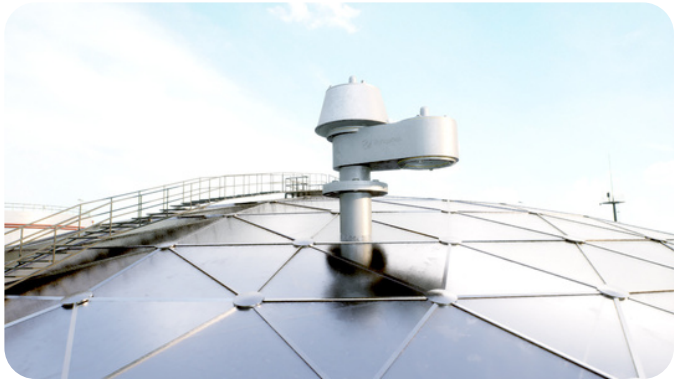


Heat Reflectivity (Cooler Buildings)

Aluminum is much superior to other metals in its ability to reflect the infrared or heat rays of the sun. And this high reflectivity (up to 95%) is reduced only very slightly as the aluminum weathers and loses its brilliance.

Remember that light reflectivity (up to 85% for aluminum) has little relation to heat reflectivity. On the other hand, galvanized steel rapidly loses its heat reflectivity as it weathers.

	When Bright	When Weathered
Aluminum	90-95%	85-94%
Galvanized steel	92%	55-65%
Carbon steel	50%	20%



Aluminum is far superior, especially in heat reflectivity, the factor that makes for cooler buildings. *Tests have shown an aluminum roof will often reduce inside temperatures by as much as 15º F (9,5°C).*

Emissivity

On the other hand, aluminum has lower emissivity than other metals including galvanized steel.

Emissivity means heat radiating power, the ability to dissipate heat by radiation. If two solid blocks of metal, of the same size, one of aluminum, and the other of galvanized steel, are both heated to the same temperature and allowed to stand, the aluminum will stay hot longer because it radiates less heat.

But radiation of heat through the roof and sidewalls of a building is not the way to cool any building. It is much better to reflect the heat off the roof and prevent the building from getting hot in the first place. That's what an aluminum roof does, it prevents it from getting hot.

Fire Protection

Steel has an advantage over aluminum; aluminum melts at about 660 °C., steel at about 1482 °C. Also, aluminum is more combustible than steel. But both statements are misleading.

Any fire that melts aluminum (660 °C. approx.) will also damage the galvanizing (or painted steel) that the galvanized steel will be worthless because the zinc coating melts at 420°C.

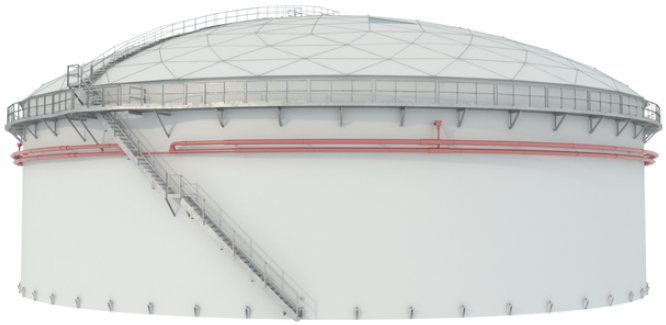
During a fire in a continuous tank is more likely that the steel roof reaches the melting point first than the aluminum.

The reasons for that are:

a) Reflectivity: Most of the radiation heat will be reflected by the aluminum (95% to 85%)

b) The heat conductivity: for aluminum is on average 3 times larger than steel, therefore when exposed to fire it takes much longer to heat aluminum to its limit temperature than it does steel (the heat is concentrated rapidly in one spot). This property is especially important with respect to the fire safety of the roof structural frame.

Material	Heat Conductivity (BTU-inch/hr-ft²-°F)- **(W/m²°C)**
AL 3003 H16 & H14	1100 – **6246,1**
AL 6061 T6	1160 – **6586,7**
Steel A 36 & A 283	360 – **2044,2**



c) The specific heat: of aluminum is almost twice as great as that of steel. The specific heat is the amount of heat required to raise 1 kg of metal 1 °C. Thus a kilogram of aluminum will absorb almost twice as much heat as a kilogram of steel for a given rise of temperature.

Material	Heat Conductivity (BTU-inch/hr-ft²-°F)- **(W/m²°C)**
AL 3003 H16 AND H14	0,213 – **0,891**
AL 6061 T6	0,214 – **0,896**
Steel A 36 & A 283	0,116 – **0,485**

Combustibility of aluminum vs. steel is unimportant because neither will burn unless in finely divided powder form. Even the thinnest aluminum foil can not be made to burn, it simply melts.

Strength at high temperature: Aluminum maintains at high degree of strength at high temperature. If the metal is held at 204 °C for one hour its tensile strength will drop approximately 5%. If it is held at 204°C for 16 hours its tensile strength will drop approximately 10%. Niether of these reductions in strength will be critical to the Aluminum dome since the dead weight of the structure (approximately 14,65 kg/m²) is about 17.5 of its live load design capacity (97,65 kg/m²). It is also a fact that aluminum return to almost 100% of its original strength, this fact is not true for steel. This property is also especially important with respect to the fire safety of the roof structural frame.

Initial Cost: Cost comparisons disregard the economies possible from the use of aluminum, its lightweight and ease of application, substantially reducing erection costs; its immunity to rust assuring longer life and less maintenance; the complete elimination of any need for painting or repainting, etc.

Standards and Norms

- **API 650 App. G** - Welded Tanks for Oil Storage – Structurally Supported Aluminum Dome Roofs .
- **API 2000** - Venting Atmospheric and Low-pressure Storage Tank
- **AWWA D108** – Aluminum Dome Roofs for water storage Facilities
- **AWWA D103** – Factory Coated bolted Steel Tanks for Water Storage
- **AWWA D100** - Carbon Steel Tanks for Water Storage
- **NFPA 22** - Standard for Water Tanks for Private Fire Protection
- **NFPA 30** - Flammable and Combustible Liquids Code
- **ASCE 7**- Minimum Design Loads for Buildings and Other Structures
- **ADM 2020** – Aluminum Design Manual
- **IS 875** – Code of Practice for Design Loads
- **EuroCodes**

Results and Evaluation

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They are a fast and easy solution to install with the low weight of the aluminum structure giving decisive cost advantages when compared to other roof types.

The solution is elegant and gives maximum durability with minimal ongoing maintenance whilst providing environmental protection and a suitable means of emission control from the contents of a tank.

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