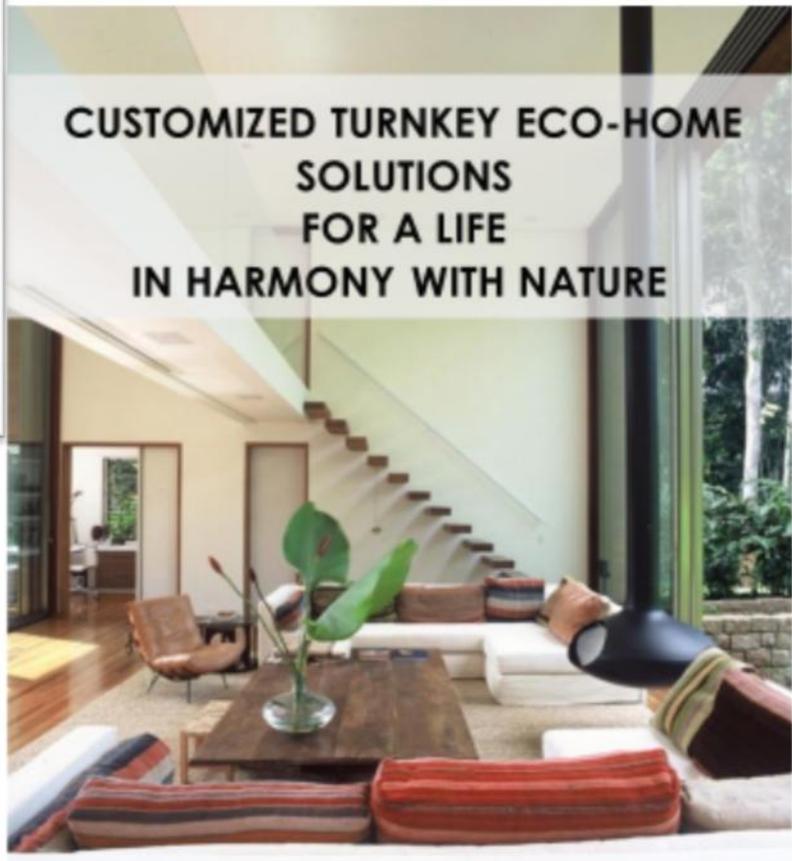




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for your peace of mind

MAGNESIUM OXIDE (MgO) BOARDS AND ALUMINUM HONEYCOMB ADVANTAGES AND PROPERTIES



TECHNICAL DETAILS

MgO BOARDS

HISTORY

Magnesium Oxide (MgO) or Magnesia has been used to construct “The Great Wall of China” and “The Brooklyn Bridge” in New York City. USA.



Magnesium based cements are some of the oldest building materials in the world, first used around the same time as gypsum. Unlike gypsum plasters though, magnesium phosphate cement is very strong, impervious to the weather and was used as mortar by the Romans, in the Great Wall of China, to build Stupas in India, to protect wood structures like the Forbidden City, and

in 800 year old timber buildings in Europe.

About sixty years after Joseph Aspdin invented Portland cement in 1824, Stanislaus Sorel rediscovered magnesium based cements and they have continued to be used for specialty applications like high temperature kiln linings, patching cement for airport runways and bridges, oil well mud, and hospital and institutional floors to name a few.

Around forty years ago, Vance Steyner reverse-engineered mortar from the Great Wall of China and from this the MgO board was developed in China where it has become a popular construction material for buildings.

For the Beijing Olympics, MgO boards were used extensively as the premier material to make the games more ecological and environmentally sustainable.

Taipei 101, the world’s tallest Platinum LEED building, uses it extensively on walls and ceilings, inside and out for decoration and fire proofing. In some places in Europe it is replacing OSB as the sheathing of choice due to its strength, durability, and ease of use.

MGO (Magnesium Oxide)

INTRODUCTION

WHAT IS MgO MADE OF?

Pure magnesium is a silvery metal element (it is shown in the chemistry Periodic Table) and is a solid at room temperature (unlike mercury, also a metal, which is liquid at room temperature). Magnesium is somewhat like aluminum, but lighter.

Pure magnesium, in raw form, is not stable—it burns—they make flares and fireworks from it. MgO, however, is the exact opposite. It is completely non-flammable and used for fireproofing and as furnace liners. Oxygen, when combined with magnesium under heat and pressure can produce a stone-like material: MgO.

MgO exists in gigantic deposits as raw “rock” and is mined like other minerals. It is ground up into a powder, which is then combined with water to make a cement-like (adhesive) material. About 70 percent of the world’s MgO is in Asia. Other deposits are located elsewhere around the globe, but not all have the correct quality for making sheathing. There is sufficient mine-able MgO spread around the world to make enough “MgO drywall” for centuries. MgO board also contains other magnesium-based components, but MgO is the main one.

AVAILABLE IN VARIOUS THICKNESSES AND IN A 8 FT X 4 FT SIZE

MgO COMPOSITION

In addition to the base material of MgO, other types of magnesium 'cements', wood flour, and various additives are included to improve manufacturing and enhance various properties. Most MgO boards have some type of fibrous reinforcement within the core and/or on the face. Often this takes the form of glass mesh, fibers, or a fine screed. MgO boards also contain other additives to enhance flexibility and weather-ability. In other words, there are various types of MgO boards, but most are essentially the same in terms of their basic composition.

MgO boards are made as individual pieces that are cut to length as they are poured onto a casting tray. The initial set occurs horizontally, but the final cure occurs vertically or with spacers between the sheets. The MgO is cast in a liquid slurry-like form (a mixture of MgO powder, and other additives and water) and sets up by chemical reaction - much like Portland cement does in stucco or concrete. The cast boards are then cured at ambient temperature. MgO boards do not contain asbestos.



MgO board is a “low tech” and “energy-friendly” product. MgO production is simple, energy efficient, and produces NO “greenhouse” gases. This aspect of MgO, from the standpoint of being a ‘green’/eco-friendly product, would indicate that MgO based products have a bright future.

MAGNESIUM OXIDE BENEFITS

Magnesium Oxide (MGO) is a versatile mineral that is used in building as an alternative to traditional Portland cement. The foundations, panels and internal walls of our domes are made with an MGO composite which makes the structures fire resistant, mold resistant, thermally insulated, termite proof and strong enough to withstand most natural disasters. It is an environmentally friendly, non-toxic building material providing both strength and insulation due to strong bonds formed between the magnesium and oxygen atoms that create the MGO molecule.

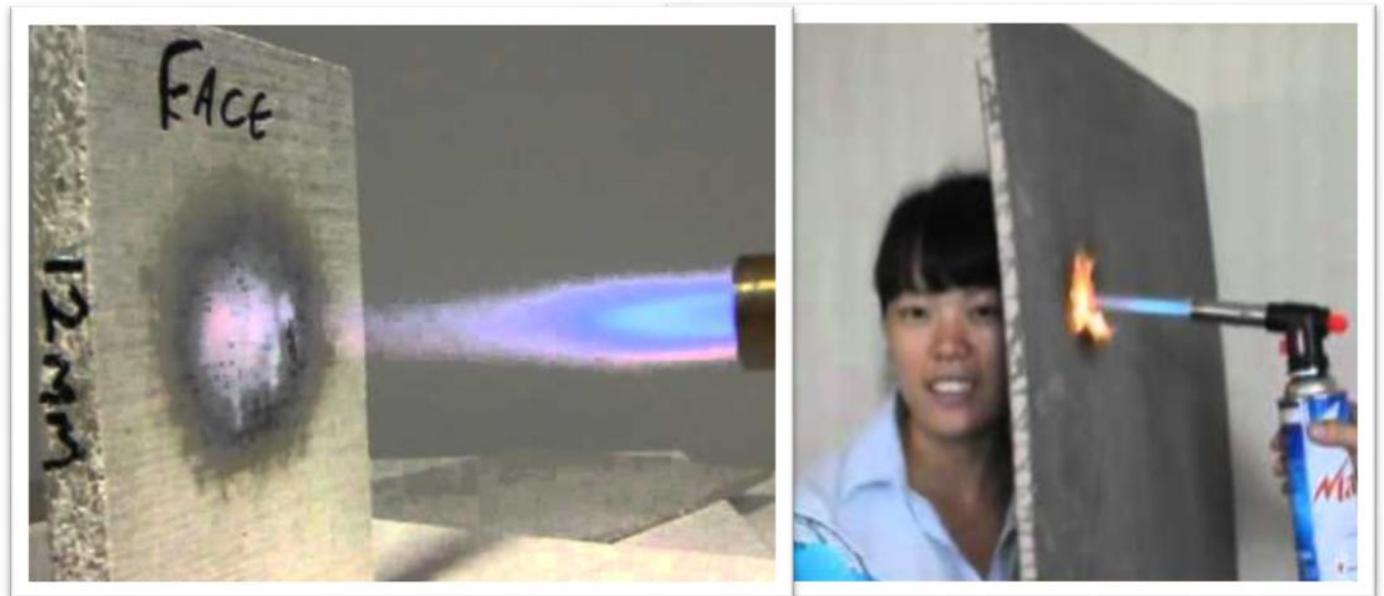
- **Mold, Fungus & Bug Free (Non-nutrient to mold, fungus & insects ASTM G-21).**
- **Fire-Proof (UL 055 and ASTM-Tested and A-Rated).**
- **Water-Proof (Freeze/Thaw-Tested for 36 months).**
- **Impact Resistant (ASTM D-5628).**
- **NYC Approved (MEA # 359-02-M).**
- **Silica & Asbestos Free.**
- **Resistant to EMF (Electro-Magnetic Frequencies)**
- **Ideal for Flooring (3/4" = 2 1/2" poured concrete!).**
- **Florida Hurricane Tested.**
- **STC-Rated 53-54**

| QUALITY | EXAMPLE OF APPLICATION | THEY REPALCE |
|-----------------------|---|---------------------------------------|
| fireproof category A1 | universal application in interiors and also exteriors | OSB boards |
| water resistant | fireproof walls and partitions | plasterboards |
| very strong | moist and wet environment of bathrooms, kitchens, wellness, ... | plaster fiber boards |
| shock resistant | groundwork under tiles | cement-chip boards |
| freeze resistant | soffits | cement-fiber boards |
| sound insulating | ventilated facades | water resistant boards |
| resistant to molds | wood constructions | boards with enhanced mech. resistance |
| environment friendly | exterior circumferential jacketing | |
| health friendly | groundwork under facades | |
| resistant to rodents | | |

MgO PROPERTIES

FIRE RESISTANT AND RETARDANT

MgO boards are officially certified by Slovak and Czech testing laboratories as absolutely noncombustible – category A1 - and are completely resistant to fire up to temperature of 800°C. In case of fire they do not create any smoke nor any other exhalation products.



Magnesium Oxide Board is non-combustible and can achieve fire ratings as high as 6 hours given the correct installation.

It can be used for sound studios, schools, public areas, movie theatre's, train and bus partitioning, boat partitioning, shopping centers and any area where the fireproof function is necessary.

When Magnesium Oxide Board is used in conjunction with Light Steel Framing or MgO Honeycomb boards are used as frameless structures there are two very significant advantages.

1. Light steel framing being non-combustible, when fire burns through the linings it will not spread within the framing cavity in steel framing, whereas this is a major cause of hidden fire spread in timber framing. Thus light metal frames are much stronger and safer than wooden frames



2. Steel Framing does not increase the fire load. Timber is combustible and there is at least 20kg of timber per square meter of floor area in a timber framed house. This is 75% of the design fire load of a houses content, which means that a timber framed house is carrying at least 1.75 times the fire load of a steel framed house. The higher the fire load, the more severe the fire.

3. If constructed as per SIP's method where the Aluminum Honeycomb panel structure is the frame itself, the entire structure is fire retardant.

| Item | Index | Unit |
|-----------------|--|--|
| Fire Resistance | A2-s1, d0 based on BS EN 13501 -1 +A1:2010 Classification | Does not burn, emit smoke with an open fire. |

SHOCK & IMPACT RESISTANT

A strong net made from glass fibers forms part of boards in two layers that causes that they very effectively resist to impacts and strokes.

Smooth surface resistant to scratches

MgO boards have smooth surface and high mechanical resistance. Blow, impact, or scratch have almost no or only very small influence on the surface of boards.

NON TOXIC AND ZERO GAS OR FUMES EMISSION

MgO boards are 100% FREE of asbestos, radiation and formaldehyde. They do not create any organic substances nor vapors that are harmful to human organism.



EXCELLENT FOR EXTREME WEATHER

Provides Thermal and acoustic insulation

The application of this material in current low energy buildings helps by its composition of peripheral jacket and partitions to increase the significance of low energy house in the saving of energy used for heating. At the same time MgO boards efficiently absorb sound. They thereby exhibit excellent thermal, acoustic and insulation properties.

MOISTURE AND WATER RESISTANT

Resistance to moisture

Progressive and special manufacturing processes and regulations introduce MgO boards as a material that is not expanding, de-scaling individual layers, not deformed even when immersed in water. Thanks to above properties this material can be used also in spaces that are strained by humidity, e.g. bathrooms, toilets, kitchens, wellness centers, broader areas of swimming pools, etc.

OPTIONS OF FINISHING

MgO boards can be painted, it is possible to glue on them tiles or wallpapers, final paintings, to be used under them interior or exterior plasters.

Flexibility: MgO boards are ideal for applications with demands on flexibility and elasticity

ANTI MOLD, MILDEW, ALGAE, FUNGUS AND BACTERIA

Magnesium Oxide due to its molecular structure naturally repels humidity and thereby repels mold, mildew, algae, fungus and bacteria.

SURFACE OF MGO BOARDS



MgO board can have on one side a smooth surface – suitable in interior, on the other reverse side can have a rough surface – suitable for Exterior Paints and wall cladding

The surface of MgO boards is basic (alkaline) that means that the adhesiveness of surface is very good and enables to adjust their surface by various types of paint, paste on them various tiles (ceramic, synthetic, natural stone, etc.).

SUMMARY

- Non-combustible Class A Building Material
- Breathable and porous for strong coating and adhesive bond
- For ALL Residential, Commercial, Industrial and Institutional Construction
- Excellent acoustic dampening material with higher density and elasticity
- Refractory material for infrared radiation (heat) assisting to reduce loss of energy when heating or cooling by reducing conductivity.
- Non-hazardous, natural, non-toxic and disposable as crushable clean fill.
- Stronger and more rigid to allow thinner material to do the same job
- Easier to work with using all types of hand tools and wood working equipment but also can be cut with quick score and snap faster than drywall

TESTING

Magnesium Oxide (MgO) Board is a light weight energy-saving building panel with non-asbestos fiber that is treated by high temperature and a high pressure autoclave process, according to ISO 9001.

- Ratings and testing:
- Fire-resistant (UL 055 and ASTM-Tested and A-Rated)
- Waterproof (Freeze/Thaw-Tested for 36 months)
- Mold/fungus/bug free (non-nutritious to mold, fungus, insects ASTM G-21)
- Impact-resistant (ASTM D-5628)
- Silica/asbestos free
- STC-Rated 53-54

PHYSICAL PROPERTIES

| | | | |
|------------------------------|-------------|--------------------------------|------------|
| Density (kg/m ³) | 1.12 x 1000 | Heat conductivity W/m/K | 0.15 |
| Moisture absorption rate | 11 | Combustion -Resistance Class 1 | Above 3 mm |
| Swelling % | 0.34 | Flexibility | Good |
| Bending strength | 15.4 MPa | Sound resistance | 40 dB |
| Compressive stress | 3.98 MPa | Mold and insect | Resistant |

ALUMINUM HONEYCOMB

If it's good enough for aerospace... It's great for you. It is the material that the aerospace industry relies heavily upon.

When applications require a lightweight, high strength composite panel, aluminum honeycomb panels are often the best solution. The cell size, grade of aluminum, depth of the material, and thickness of the cell wall are all variables that can be specified to create a honeycomb panel with the best properties for your application.

ALUMINUM HONEYCOMB STRENGTHS

As a general rule, these panels have the following attributes:

- Extremely Low Weight
- Excellent Strength
- High Resistance to Moisture and Water
- High Resistance to Corrosion



- Excellent Thermal Conductivity
- Weatherproof
- Great Insulation properties against extreme weather
- Great insulation against sound
- Fire Retardant and Noncombustible
- High Resistance to Fungi, Algae, Mold and Bacteria
- Termite and Insect proof

| | Solid Metal Sheet | Sandwich Construction | Thicker Sandwich |
|--------------------|-------------------|------------------------------|------------------------------|
| Relative Stiffness | 100 | 700 7 times more rigid | 3700 37 times more rigid! |
| Relative Strength | 100 | 350 3.5 times as strong | 925 9.25 times as strong! |
| Relative Weight | 100 | 103 3% increase in weight | 106 6% increase in weight |

A striking example of how honeycomb stiffens a structure without materially increasing its weight. **As a guide to selecting honeycomb core best suited for particular applications.**

ALUMINUM HONEYCOMB ADVANTAGES

- Relatively low cost
- Best for energy absorption
- Greatest strength/weight
- Thinnest cell walls
- Smooth cell walls
- Conductive heat transfer
- Electrical shielding
- Machinability

ALUMINUM HONEYCOMB COMPOSITE PANEL

- Aluminum Honeycomb Composite Panel is composed of multi-layer aluminum foil; honeycomb is formed after the expansion.
- Aluminum Honeycomb core panel has sharp and clear whole surface, and it is suitable for adhering to high grade plate as well as other purposes.
- Aluminum Honeycomb Composite Panel is made from aluminum honeycomb core expanded into a hexagonal structure sandwiched by the various types of facings as per the applications which are then bonded together by a layer of aircraft grade adhesives and our proprietary developed joineries.
- These panels are lightweight, high strength structures that are very rigid and leak-proof.
- Aluminum Honeycomb Composite Panel have the best strength to weight ratio compared to any conventional construction technologies available currently.
- Aluminum Honeycomb Composite Panel is the Original Equipment Manufacturer choice in the Aviation (Boeing) and Aerospace, Automotive (Truck Bodies), Marine, Rail, Elevators, Exhibitions and Showrooms.
- Aluminum Honeycomb Composite Panels are now being used in countless commercial applications where strength, flatness and lightweight are needed.
- Aluminum Honeycomb Composite Panels are specified wherever high strength-to-weight ratio, energy absorption or directional qualities are desired.
- Aluminum Honeycomb Composite Panels are manufactured and offered in different configurations of cell diameters, thicknesses and densities.
- Wherever there's a requirement for greater structural strength with less weight, you will find Azulverde Aluminum Honeycomb Composite Panel to be the product of choice.

FEATURES & BENEFITS OF ALUMINUM HONEYCOMB

- Thermal Protection with ~ 0.44 (W/mK)
- Termite proof
- Easy insulation
- High Strength to weight ratio
- High Thermal & Sound insulation properties.
- Impervious to Fire / Water / Insects / Mold / Mildew.
- High mechanical properties
- Light weight
- Superior Flatness
- Light Weight
- Unparalleled Rigidity
- Fire & Water Resistant
- Sound and Heat Insulation
- Corrosion Resistant
- Environmentally Friendly
- Wide Selection of Finishes and Dimensions

MgO ALUMINUM HONEYCOMB SANDWICH PANELS

Aluminum sandwich construction has been recognized as a promising concept for structural design of lightweight transportation systems such as aircraft, high-speed trains and fast ships.

Aluminum Honeycomb Sandwich Panels consist of thin two facing layers separated by a core material. Potential materials for sandwich facings are aluminum alloys, high tensile steels, titanium and composites depending on the specific mission requirement.

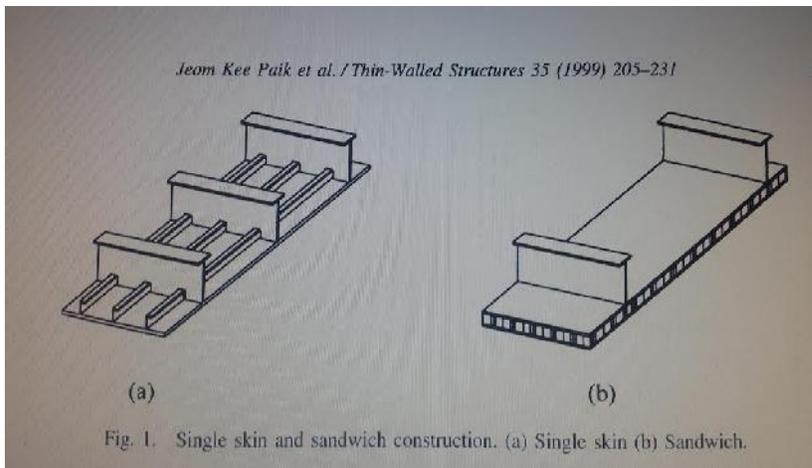
Several types of core shapes and core material have been applied to the construction of sandwich structures. Among them, the honeycomb core that consists of very thin foils in the form of hexagonal cells perpendicular to the facings is the most popular.

A sandwich construction provides excellent structural efficiency, i.e., with high ratio of strength to weight.

Other advantages offered by sandwich construction are elimination of welding, superior insulating qualities and design versatility

JOINING METHODS

More weld seams also mean a greater number of fatigue initiation locations as well. Meanwhile, a MgO aluminum honeycomb sandwich construction, see figure which a



honeycomb core is sandwiched by two outer facing skins is better able to cope with such difficulties.

Two methods, namely brazing and adhesive bonding, are currently being used for joining aluminum alloy facing material and honeycomb core. In these methods,

brazing sheets or adhesive films are inserted between the core and facing skins, and the panel is heated in a furnace resulting in bonding. Such panels have certain advantages due to their comparatively low cost, high strength to weight ratio and good energy absorbing capabilities. In using aluminum honeycomb sandwich panels for construction of a

structure, no stiffeners are welded to plates, and also connections of the main support frames are simplified, both of which greatly reduce the need for complicated welding. A reduced amount of weld seams and the higher rigidity of the panels both lessen weld distortions. Frame spacing can be increased due to the higher rigidity of the sandwich panels, thus providing added structural weight savings in the structure.

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It is for these reasons that the sandwich construction has been widely adopted for large weight critical structures. Honeycomb-cored sandwich panels have been used as strength members of satellites or aircraft, thus efficiently reducing their structural weight. In the railroad industry, passenger coaches of high-speed trains such as the TGV in France and Shinkansen in Japan have been designed and fabricated using aluminum honeycomb sandwich panels. Recently, MgO aluminum honeycomb sandwich panels were as strength members of high-speed vessel hulls.

SPECIFICATIONS OF ALUMINIUM HONEYCOMB SANDWICH PANELS

ISO9001:2000

Width:950mm/1040mm/1150mm

Length: on customers' needs

Thickness: 50mm-150mm

Heat conductivity 0.03W/m. K

Rock wool Density: 20-200kg/m³

Fire-protection rating: A

Upper and lower plate: stainless steel sheet/color steel sheet/galvanized sheet

ADVANTAGES OF MGO ALUMINUM HONEYCOMB SANDWICH PANELS

- 1) Lower price and best quality
- 2) Waterproof
- 3) Anti-seismic and impact resistance
- 4) Fast and convenient installation
- 5) Different colors for option
- 6) High strength
- 7) Durable
- 8) Heat insulation and Sound insulation
- 9) Energy-saving and most area-saving
- 10) Environmental friendly. Raw materials do not include harmful substances. It is highly recommended by the government
- 11) Aluminum Honeycomb Sandwich Panels have the best strength to weight ratio of any construction material available.
- 12) Lightweight, stiff, resistant to fire, compression and corrosion proof, this wonder of modern technology can be used for Architectural applications like interior walls, floors, ceilings, doors, partitions, facades, elevator panels, store graphic display panels, tables, shelving, etc.

Aluminum Honeycomb Sandwich Panels are made from aluminum honeycomb core expanded into a hexagonal structure sandwiched by the aluminum facings which are then bonded together by a layer of adhesive.

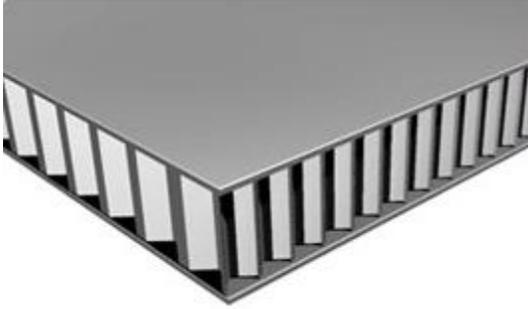
SUPER STRONG LIGHTWEIGHT

MgO Aluminum Honeycomb Sandwich Panels offer ease of installation due to their flatness, strength, rigidity and increased safety due to the aluminum panel's light weight. They are resistant to fatigue and shock, resistant to chemical weathering, corrosion and fire, recyclable and used for thermal and acoustic insulation too!

MgO Aluminum Honeycomb Sandwich Panels being one of the most versatile materials available, has applications that are numerous and in very different sectors. The product is mainly used as structural reinforcement for the nautical sector, rail, automotive, military and aerospace.

In the construction sector, these are used as a core for sandwich panels: floors, ceilings, doors, partitions, facades, etc.

ALUMINUM ON ALUMINUM PANELS



When the application requires a flat, rigid and lightweight work surfaces, aluminum honeycomb panels with aluminum facings offer flat, wear resistant surfaces that can be custom machined. Panels can have open edges or be closed out.

Standard Construction

Face: .032" Aluminum

Core: Aluminum honeycomb

Back: .032" Aluminum

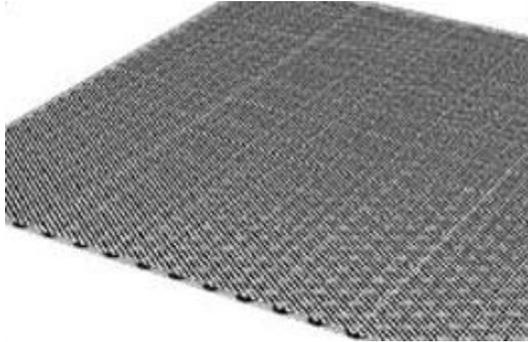
Features

- Light weight
- Corrosion resistant
- High strength and excellent durability
- Flat tolerances
- Non-combustible

Applications:

- Work surfaces and tables
- Wall panels
- Platens
- Machine enclosures
- Machining surfaces
- Furniture
- Custom table systems
- Fixtures

PERFORATED ALUMINUM PANELS



Aluminum ceiling panels can act as a means of straightening and directing air in free atmosphere and ducts. Perforations on both sides of a ceiling panel provide a flow-through design for both air and lighting.

Standard Construction

Face: .040" Perforated aluminum sheet

Core: Aluminum honeycomb (1/2" cell)

Back: .040" Perforated aluminum sheet

Features

- Light weight
- Corrosion resistant
- High strength and excellent durability
- Flat tolerances
- Non-combustible

Applications:

- Airport ceilings
- Convention centers
- Air returns
- Art deco walls

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