

# The Doorway

A Publication of The Gill Corporation

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# AIRBUS A320



ANTIMICROBIAL TREATED



It has been nearly four decades since Airbus Industrie launched the A320, its first twin-engine, single-aisle aircraft for the medium-range market. Considered by some analysts to be Airbus' greatest contribution to commercial aviation, the A320 introduced a series of technical innovations including fly-by-wire, side stick controls, flight envelope protection, and cockpit commonality. These technologies garnered the interest of airlines worldwide and helped advance Airbus' position to one of the world's leading commercial airframe manufacturers. Today, the A320 has evolved into a family of aircraft that includes the stretched A321, the smaller A319 and A318, and the upgraded A319/A320/A321neo (new engine option).

In 1988, the same year the A320 entered service, The Gill Corporation (TGC) qualified its first proprietary floor panel design with Airbus. Since then, our portfolio of qualified products has expanded to include a full complement of cabin and cargo floor panels, cargo lining panels and laminates, h-profiles, cargo repair patches, and honeycombs. While our honeycombs are sold to Airbus Tier 1 suppliers for OEM production, TGC floor panels and cargo lining products are currently qualified exclusively for the airline aftermarket. All OEM cabin and cargo floor panels and cargo liners are produced within the Airbus group of companies and feature a different panel construction and manufacturing process.

While OEM specifications typically delineate the product construction to be qualified, the Airbus aftermarket specifications presented a unique opportunity for TGC to qualify proprietary designs that are markedly different from OEM constructions. These designs go beyond the minimum specification requirements to deliver maximum in-service durability. TGC's commitment to supporting the aftermarket extends beyond OEM qualified panels to include innovative designs approved under Supplemental Type Certificate (STC). When it comes to product design, we rely on feedback from our most valued resource – our customers.



## OEM VS. TGC AFTERMARKET DESIGNS

TGC products are Form, Fit and Function equivalent to Airbus OEM products. There are two important distinctions when comparing the Airbus OEM panels with TGC's qualified aftermarket designs.

The Airbus Technical Specification establishes the *minimum* performance requirements for each panel Type. Within this framework, the panel manufacturer determines the product construction. This has resulted in significant differences between OEM, competitor, and Gill-proprietary designs.

*Example: The OEM BCC2 bulk cargo panel has an eight-millimeter thick aluminum top sheet. In contrast, Gillfab® 4223, features glass-reinforced facings that exceed the Airbus strength requirements without the addition of an aluminum overlay.*

The Airbus OEM floor panels and cargo liner panels are produced to a specific part configuration at the time of manufacture. Gillfab® panels are manufactured as semi-finished sheet stock, providing airlines and MRO's the flexibility and cost savings potential to fabricate replacement floor panels and cargo liners in-house. TGC Report No. IRM 9701 and AIM 2001 provide detailed instructions for the fabrication of replacement floor panels, cargo liners, and decompression panels including cutting, routing, edge sealing and hardware installation.

## MEETING THE DEMANDS OF THE CARGO ENVIRONMENT

The in-service conditions of a cargo compartment can vary significantly depending on the aircraft configuration (e.g. bulk, containerized, freighter), number of cycles, loading system, type of cargo, and climatic conditions. While OEM designs rely on 'baseline' in-service conditions with a focus on cost and weight, actual in-service conditions often exceed the strength of the original floor panel and cargo liner designs. Consequently, airlines commonly look to upgrade OEM materials to improve in-service durability and reduce maintenance costs.





## BULK CARGO FLOOR PANELS - GILLFAB® 4223 AND 4523

Bulk cargo compartments represent one of the most demanding environments due to the repetitive loading and unloading of baggage and freight. Bulk compartments are standard for single-aisle aircraft that typically support shorter, quick-turn routes, resulting in a comparatively high number of cycles. Depending on the loading system, repositioning cargo within the confines of the compartment typically involves baggage handlers tossing or sliding baggage across the floor panels. Accordingly, bulk cargo panels must be sufficiently robust to resist dynamic loads and provide superior impact and abrasion resistance.

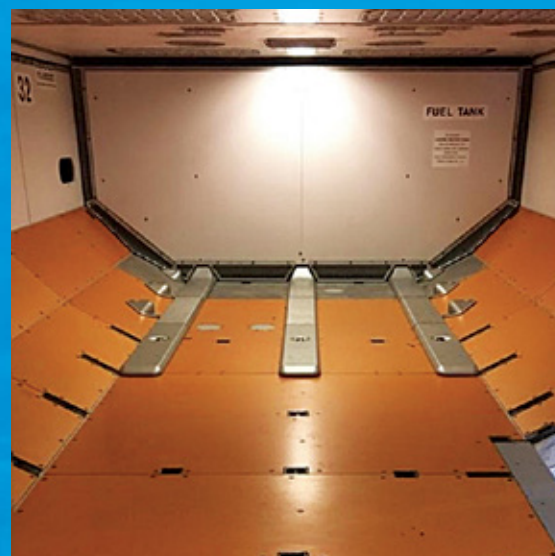
TGC's longstanding history designing bulk cargo floor panels has yielded a variety of designs using different resin matrices, types and amounts of fiber reinforcement, and honeycomb cores to withstand the most rigorous in-service environments. Our bulk cargo floor panel designs are typically asymmetrical constructions that deliver localized strength to the top facing, without the added cost and weight of a balanced construction.

**Gillfab® 4223**, qualified to Airbus Technical Specification 5360 M1M 000500, Type BCC2, features .050/.020" woven S-glass reinforced phenolic facings bonded to a 9.0 pcf meta-aramid honeycomb core. Gillfab® 4223 has 2X the impact resistance of the Airbus BCC1 panel and exceeds the impact strength of both the BCC2 and BCCS6 panels.

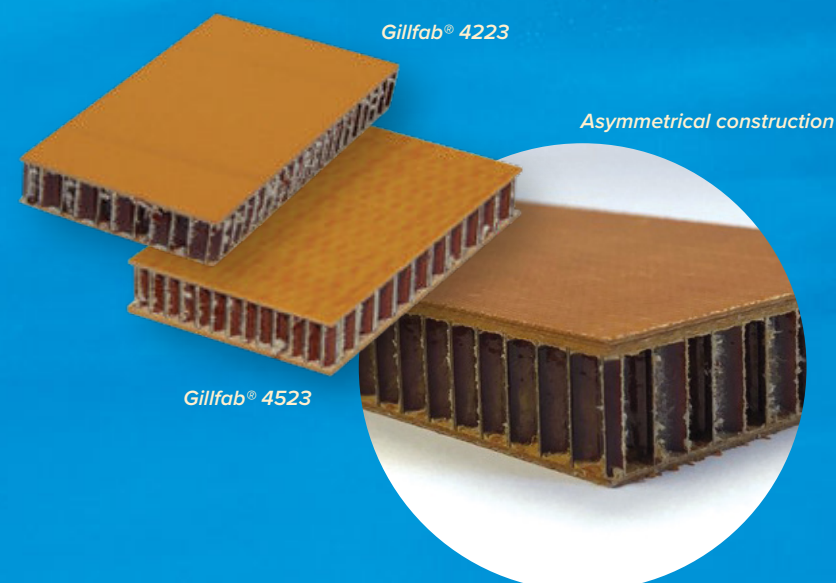
**Gillfab® 4523**, qualified to Airbus Technical Specification 5360 M1M 000500, Type BCC3, features .060/.025" facings that are a combination of unidirectional and woven S-glass reinforced phenolic, bonded to a 9.0 pcf meta-aramid honeycomb core. Gillfab® 4523 yields a 20% higher impact strength compared to the OEM BCCS8 panel.

## BULK CARGO FLOOR PANELS - DESIGNS APPROVED BY STC

In 2004, TGC was contacted by several domestic airline customers seeking the support of our R&D group to develop an improved alternative to the OEM BCC2 panel. Our objective was to design a panel that would have superior impact resistance and load bearing properties, while optimizing weight and cost.



TGC floor and sidewall panels installed on an Airbus A320 aircraft. Photo courtesy of Aeroco Group



**Gillfab® 4321** is designed using a combination of unidirectional E and S-glass reinforcement with a TGC proprietary epoxy resin matrix to achieve superior impact and abrasion resistance. The .060/.020" facings are bonded to 6.0 pcf meta-aramid honeycomb core. Gillfab® 4321 delivers 60% higher impact strength than the OEM BCC2 panel, without an aluminum overlay. This panel was qualified under a STC in 2005 and has a proven history of in-service durability.

In 2015, this STC was amended to include Gillfab® 4623, an improved alternative to the OEM BCCS8 panel.

**Gillfab® 4623** is based on the proven design of Gillfab® 4321 but with additional plies on the top surface to achieve a 40% higher impact strength as compared to the OEM BCCS8 panel.

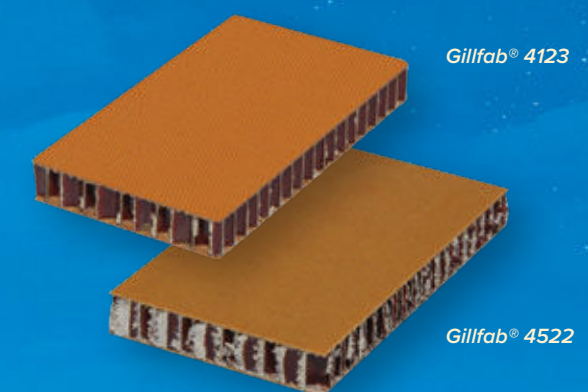
## CONTAINERIZED AND MAIN DECK (FREIGHTER) FLOOR PANELS – GILLFAB® 4522 AND 4123

Containerized Cargo and Main Deck Floor Panels utilize specially fitted Unit Load Devices (ULDs) that store and restrain cargo during flight. Baggage and freight are loaded into the ULDs prior to stowage on the aircraft. The ULD is then loaded into the aircraft by means of a specially designed roller floor system. Hence, there is no direct contact between the floor panels and cargo. While containerized cargo panels must meet all applicable strength and flammability requirements of the airframe design, the in-service conditions generally allow for use of light to medium duty panels to optimize strength, weight and cost.

**Gillfab® 4522**, qualified to Airbus Technical Specification 5360 M1M 000500, Type CCC1, is used in containerized cargo floors.

**Gillfab® 4123**, qualified to Airbus Specification 5360 M1M 000500, MDC2, is used in main deck cargo floors.

Gillfab® 4522 and 4123 feature woven glass reinforced phenolic facings bonded to meta-aramid honeycomb core.





CARGO LINER PANELS AND LAMINATES - GILLFAB® 4422 AND 1369A

Throughout its history, TGC has been designing cargo liners that meet the most stringent strength, weight, and flammability characteristics. Installed on the sidewalls, ceilings, and partition walls of cargo holds, cargo liner is designed to:

- ◆ Prevent a fire originating in the cargo compartment from spreading to other areas of the aircraft before it can be contained by the fire suppression system.
- ◆ Maintain a sealed environment to prevent hazardous quantities of smoke, flames, or extinguishing agent from reaching areas occupied by crew or passengers.
- ◆ Protect equipment within the cargo compartment from damage by loading, unloading, or shifting of cargo.

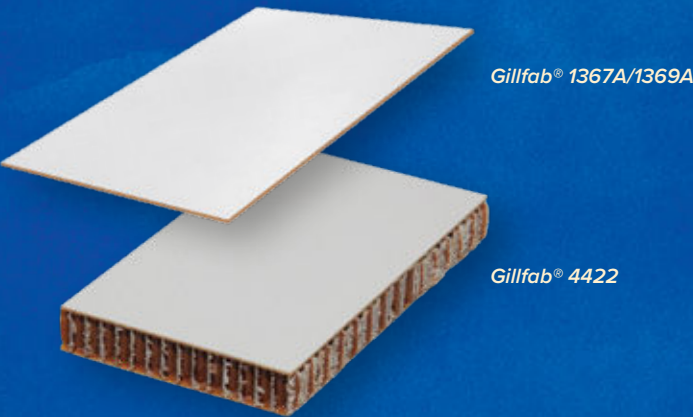
Although classified as a passive fire protection, the cargo liner design must not only meet the requisite flammability characteristics, but also be compatible with the operational environment.

In 2000, TGC qualified Gillfab® 4422 and Gillfab® 1367A (now Gillfab® 1369A) to Airbus Technical Specification 2550 M1M 0008 00. At the time of qualification, Gillfab® 1367A, had already been in-service with other major OEM programs for more than a decade. Hence, TGC had the advantage of incorporating proven technology into our Gillfab® 4422 sandwich panel design.

Gillfab® 1367A/1369A, constructed using a combination of woven E and S-glass reinforcement with a TGC proprietary resin formulation, deliver some of the highest impact resistance of any phenolic cargo liner.

Gillfab® 4422 features 1367A/1369A style facings bonded to meta-aramid honeycomb core.

During qualification testing, the impact resistance of Gillfab® 4422 was so high in comparison to the minimum specification requirements, our R&D department had to request Airbus’ permission to increase the weight of the impactor to measure the ultimate impact strength of the TGC material. Using this more stringent test condition, the lowest impact value recorded was still more than 20 times higher than the minimum Airbus requirement.



In 2005, Airbus upgraded the OEM cargo liner design in the single-aisle family, replacing E-glass with S-glass reinforcement to increase impact resistance. Although this change increased the minimum impact strength requirements of Airbus Technical Specification 2550 M1M 0008 00, no changes were required to the TGC design. Our original Gillfab® 4422 design exceeds the newest requirements by a factor greater than 3X. As the world’s leading pioneer of cargo liner design, our customers have come to expect superior durability and at TGC, we remain steadfast in our commitment to deliver it.



Impact testing

DECOMPRESSION PANEL PROFILE - GILLFAB® 3072 h-PROFILE

Decompression panels serve an important role in commercial aircraft design. Their function is to help equalize pressure between different compartments of the fuselage (e.g. passenger cabin and cargo hold). In the event of a sudden loss of pressure, decompression panels will pull away or ‘blow out’ to help equalize pressure and prevent damage to the fuselage structure.

Gillfab® 4422 and Gillfab® 3072 are qualified to Airbus Technical Specification 2550 M1M 0008 00 and 2550 M1M 000400 for use in the repair or replacement of decompression panels.

Gillfab® 3072 is a woven glass reinforced phenolic channel that is installed around the edges of the decompression panel to create a frame. Under specific conditions, this profile is designed to break, thus enabling the decompression panel to ‘blow out’.



Gillfab® 3072 h-Profile

CARGO LINER REPAIR - GILLPATCH® III 6306

Since first introduced more than 60 years ago, Gillpatch® designs have continued to evolve, incorporating new materials and technologies to meet increasingly stringent flammability requirements. For cargo liner damage that is within the allowable limits of repair, Gillpatch® III and Gillpatch® III WR, qualified to AIMS 08-07-001 and ABS5665, enable operators to perform quick, in situ repairs using our ‘peel and stick’ application. Although there are a variety of Airbus approved repair techniques that are generically referred to as ‘speedpatches’, the Gillpatch® III design offers a distinct advantage. While most patches only restore flammability resistance, Gillpatch® III also restores impact resistance equivalent to a 0.070” (1.8 mm) thick cargo liner, making it a true repair.



Gillpatch® repair patch



## PASSENGER COMPARTMENT FLOOR PANELS - GILLFAB® 4505 AND 4605

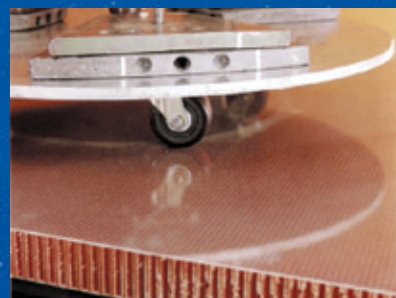
In 1995, Airbus released a series of new floor panel specifications aimed at increasing panel strengths, optimizing weight, and standardizing floor panel specifications across the single-aisle and long-range aircraft families.

Gillfab® 4505 and 4605 are qualified to Airbus Technical Specification 5360 M1M 000600, feature unidirectional carbon-reinforced phenolic facings, with meta-aramid honeycomb core. The outer panel surfaces include a lightweight woven glass isolation barrier to protect against galvanic corrosion.

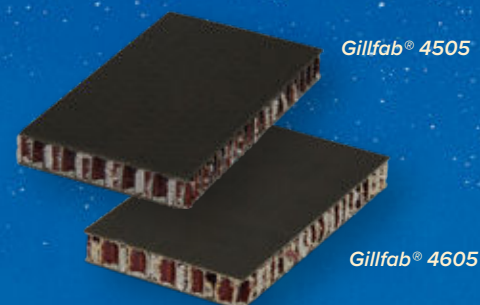
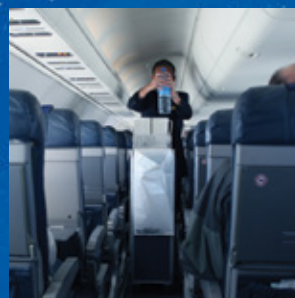
**Gillfab® 4505**, qualified to Type PC3, is designed for use in high-traffic areas.

**Gillfab® 4605**, qualified to Type PC1, is designed for under seat areas.

There are a variety of test methods used to measure the strength of a floor panel. One of the most rigorous and predictive tests of a main-aisle floor panel is the roller cart test. Designed to simulate the in-service conditions associated with galley carts, the roller cart test measures the fatigue resistance of the floor panel under repetitive loading. During qualification, Gillfab® 4505 was subjected to 120,000 cycles at 127.5 lbs. per wheel and 35,000 cycles at an increased weight of 165.3 lbs. per wheel. Although not required by the Airbus Specification, but to further test durability, the qualification test panels were subjected to an additional 120,000 cycles at an increased weight of 250 lbs/wheel with no reported damage.



Roller cart test



## A320/A321 PASSENGER TO FREIGHTER CONVERSIONS

In 2019, TGC expanded its support of the A320 aftermarket to include passenger to freighter conversions. The A320 freighter is the first single-aisle aircraft to offer a fully containerized lower deck. The A320-200 accommodates 10 containers plus 1 pallet on the main deck with capacity for an additional 7 smaller containers on the lower deck. The A321 accommodates 14 containers on the main deck with the option of up to 10 smaller containers on the lower deck. According to a recent Airbus forecast, 1000 single-aisle converted freighters will be required over the next 20 years.

The A320 conversion programs supported by TGC include A320-200 and A321-200 with multiple STC holders. TGC products supplied to these programs include floor panels, cargo liners, and interior panels used in the manufacture of galleys and lavatories.

## HONEYCOMB

In 2013, TGC began manufacturing engine nacelle details for the A320neo. TGC's special processing capabilities allow us to cut, shape, mill, form, bond and combine different core densities to support multiple components of the engine nacelle structure. Such components include; inner fixed structures for thrust reversers, translating sleeves for thrust reversers, inlet cowls, fan cowls, and blocker doors.

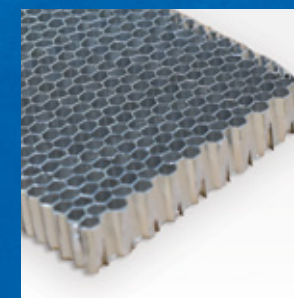
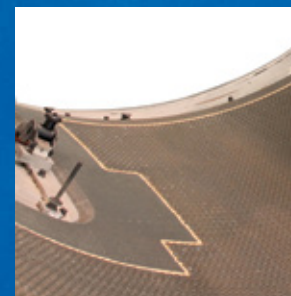
TGC packages the A320neo finished details into complete kits that are ready for immediate bonding at our customers' facilities without further cleaning or processing needed.

**Gillcore® HD**, qualified to AIMS 11-01-001 / ABS5035, is a meta-aramid fiber reinforced honeycomb coated with heat resistant phenolic resin to solve most structural design challenges in composite aerostructures when non-metallic honeycomb is preferred.

**Gillcore® HK**, qualified to AIMS 11-01-004 / ABS5341, is a para-aramid fiber reinforced honeycomb coated with heat resistant phenolic resin for moisture resistance and is suitable for applications requiring a high degree of forming. It's 25% lighter than meta-aramid with enhanced performance characteristics including strength, stiffness and fatigue. Gillcore HK® offers exceptional performance/weight ratio for all applications.

**Dura-Core®**, qualified to AIMS 11-02-002, is a high performance aluminum honeycomb core that solves light weight structural design challenges and exhibits excellent corrosion resistance in hostile environments, especially salt fog.

**PAA-Core®**, qualified to multiple customers' specifications including engine nacelle suppliers, is the ultimate aluminum honeycomb core. Our Phosphoric Acid Anodized (PAA) foil treatment process yields unsurpassed corrosion resistance with excellent bonding properties and allows for the bonding of carbon skins without the risk of galvanic corrosion. One of its distinctions is a high strength-to-weight ratio. It's been proven over the years to provide critical bond durability between core and skins, critical to long part life, and for this, PAA-Core® has no equal.





## HONEYCOMB

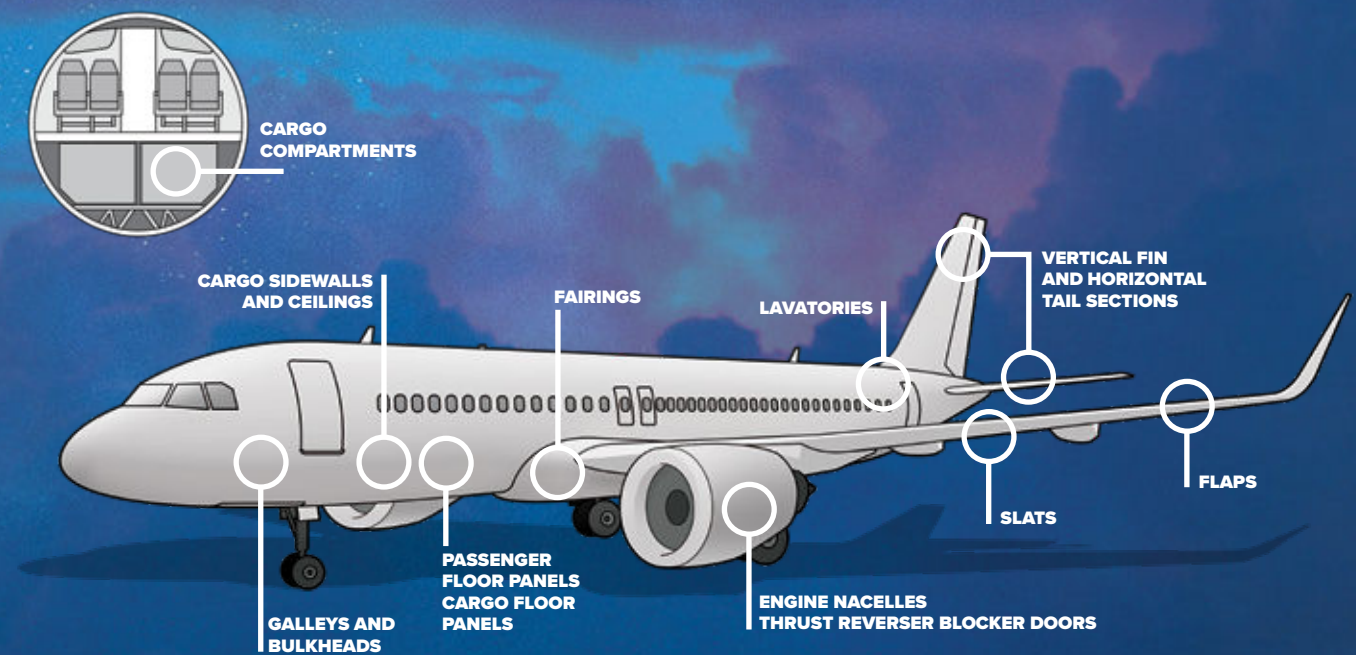
| PRODUCT                 | DESCRIPTION  | APPLICATION   | SPECIFICATION              |
|-------------------------|--|---|----------------------------|
| Gillcore® HD            | Meta-aramid fiber reinforced honeycomb which is coated with heat resistant phenolic resin.                                   | Interior aircraft panels including flooring, sidewalls, ceilings, galleys and lavatories. Exterior aircraft panels including trailing and leading edges, flaps, ailerons, fairings, helicopter blades, access panels and doors. | AIMS 11-01-001<br>ABS5035  |
| Gillcore® HK            | Para-aramaid fiber reinforced honeycomb which is coated with heat resistant phenolic resin. High shear strength and modulus. | Interior aircraft panels including flooring, sidewalls, ceilings, galleys and lavatories. Exterior aircraft panels including trailing and leading edges, flaps, ailerons, fairings, helicopter blades, access panels and doors. | AIMS 11-01-004<br>ABS5341  |
| Dura-Core® 5052         | Aluminium honeycomb that has excellent corrosion resistance and mechanical strength.   | Core for sandwich structures of the control surfaces, such as trailing edge of slats.   | AIMS 11-02-002             |
| PAA-Core® 5052 and 5056 | Ultimate aluminium honeycomb that has excellent corrosion resistance and maximum mechanical strength.                        | Core for sandwich structures of control surfaces and nacelle structures.  | Per customer specification |

## CARGO LINERS, h-PROFILES & REPAIR PATCHES

| PRODUCT                 | DESCRIPTION   | APPLICATION  | SPECIFICATION                |
|-------------------------|---|--|------------------------------|
| Gillfab® 1367A/1369A    | Woven glass reinforced phenolic laminate with a white PVF film on the face side.  | Cargo compartment lining. Backing material for non-textile floor mats used in wet areas of cabin interiors (without PVF film overlay). | 2550 M1M 000800<br>Type 1-5  |
| Gillfab® 4422           | Woven glass reinforced phenolic facings bonded to meta-aramid honeycomb. Panel facings have white PVF film both sides.  | Cargo compartment lining in sidewalls, ceilings, partition walls, and decompression panels in the lower cargo hold.                    | 2550 M1M 000800<br>Type A-N  |
| Gillfab® 3072 h-Profile | Woven glass reinforced phenolic h-profile with a white PVF film on the face side.   | Used to produce the frame around the periphery of the decompression panels installed in the lower cargo hold.                          | 2550 M1M 000400<br>Types A-D |
| Gillpatch® III 6306     | Woven glass reinforced phenolic with layer of intumescent fire barrier. White PVF film on the face side; pressure-sensitive adhesive on the back side.  | Cargo lining repair patch.   | AIMS 08-07-001<br>ABS5665    |
| Gillpatch® III 6306 WR  | Woven glass reinforced phenolic with layer of intumescent fire barrier. White PVF film on the face side; pressure-sensitive adhesive on the back side. Includes rivets for ceiling application. | Cargo lining repair patch.   | AIMS 08-07-001<br>ABS5665    |

## FLOOR PANELS

| PRODUCT       | DESCRIPTION   | APPLICATION  | SPECIFICATION                |
|---------------|---|--|------------------------------|
| Gillfab® 4505 | Unidirectional carbon reinforced phenolic facings bonded to meta-aramid honeycomb core with a lightweight woven glass scrim outer surfaces. | Passenger flooring - main aisle, galley areas and flight compartments. | 5360 M1M 0006000<br>Type PC3 |
| Gillfab® 4605 | Unidirectional carbon reinforced phenolic facings bonded to meta-aramid honeycomb core with a lightweight woven glass scrim outer surfaces. | Passenger compartment flooring - underseat.                            | 5360 M1M 000600<br>Type PC1  |
| Gillfab® 4123 | Woven glass reinforced phenolic facings bonded to meta-aramid honeycomb core.   | Main deck cargo flooring (freighter).                                  | 5360 M1M 000500<br>Type MDC2 |
| Gillfab® 4223 | Woven glass reinforced phenolic facings bonded to meta-aramid honeycomb core.   | Bulk cargo compartment flooring.                                       | 5360 M1M 000500<br>Type BCC2 |
| Gillfab® 4523 | Unidirectional and woven glass reinforced phenolic facings bonded to meta-aramid honeycomb core.  | Bulk cargo compartment flooring.                                       | 5360 M1M 000500<br>Type BCC3 |
| Gillfab® 4522 | Woven glass reinforced phenolic facings bonded to meta-aramid honeycomb core.   | Containerized cargo compartment flooring.                              | 5360 M1M 000500<br>Type CCC1 |



This is not an inclusive list of where TGC products are used. TGC metallic and non-metallic honeycomb cores are sold to customers around the world for use in many applications across the Airbus A320 aircraft.





# Quotables

A real executive goes around with a worried look on his direct reports.

—**Unknown**

Standing in the middle of the road is very dangerous; you get knocked down by the traffic from both sides.

—**Margaret Thatcher, Politician**

Tough times never last, but tough people do.

—**Robert H. Schuller, Religious Leader**

There's nothing worse than energizing incompetents.

—**Bill Brooks, Vistage Speaker**

The optimist proclaims that we live in the best of all possible worlds, and the pessimist fears this is true.

—**James Branch Cabell, Author**

There's only one big event left after you retire.

—**Bobby Bowden, Football Coach**

Eagles may soar, but weasels don't get sucked into jet engines.

—**John Benfield, Businessman**

Do the best you can in every task, no matter how unimportant it may seem at the time. No one learns more about a problem than the person at the bottom.

—**Sandra Day O'Connor, first woman appointed to U.S. Supreme Court**

If everyone agrees with you they probably don't mean it.

—**Unknown**

The greatest problem in the world today is intolerance. Everyone is so intolerant of each other.

—**Princess Diana**

After all is said and done, more is said than done.

—**Amy K. Hutchens, Vistage Speaker**

When trying to resolve a problem, don't ask, "How did that happen?" Instead ask yourself, "How would I do that?"

—**Stephen Gill**



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