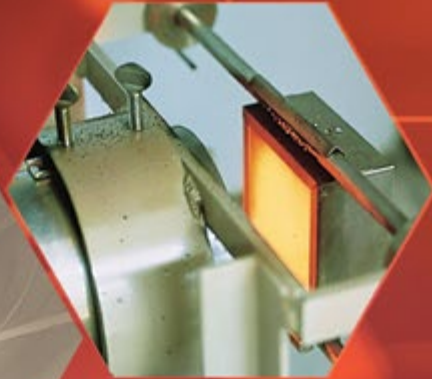


# The Doorway

A Publication of The Gill Corporation

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## TESTING OF LAMINATES



ANTIMICROBIAL TREATED



For nearly eight decades, The Gill Corporation (TGC) has been recognized as a trailblazer in materials science, particularly known for its leadership in developing advanced high-performance composites for aerospace applications.

TGC pioneered the use of protective laminates in the cargo compartments of the Douglas DC-6, representing a major leap forward in aerospace materials. Innovations continued by incorporating pre-impregnated (prepreg) fiber reinforcements with custom designed resin systems to significantly boost the resilience and flexibility of plastics, alongside proprietary manufacturing techniques, setting a new standard for materials with superior mechanical, physical and flame-resistant properties.

TGC performs extensive testing during both the development and production phases to ensure products not only meet but often surpass the stringent engineering and quality standards set by the aerospace industry.

Beyond specialty laminates, TGC also provides composite sandwich panels, honeycomb cores, bonded assemblies, and fully finished components for a wide range of aircraft, spacecraft, and various non-aerospace sectors.

## TYPES OF AEROSPACE LAMINATES

Aerospace laminates generally comprise a matrix material, like epoxy, reinforced with fibers such as carbon, glass, or aramid. These fibers are layered, or plied, to create the laminate. The predominant categories of aerospace laminates are:

- 1. Carbon Fiber Reinforced Polymers (CFRPs):** Known for their superior strength-to-weight ratio, CFRPs are widely utilized in both primary and secondary aircraft structures, and incorporated in TGC's state-of-the-art sandwich panels. CFRPs resistance to fatigue and corrosion makes them ideal for critical components.
- 2. Glass Fiber Reinforced Polymers (GFRPs):** While not as robust as CFRPs, GFRPs offer substantial strength and flexibility at a more economical price. They are commonly found in less-critical components and secondary structures.
- 3. Aramid Fiber Reinforced Polymers (AFRPs):** A hybrid combination of GFRPs with metal layers that can offer damage tolerance with fire resistance, although with a higher areal weight.
- 4. Glass Reinforced Laminate (GLARE):** A hybrid combination of GFRPs with metal layers that can offer damage tolerance with fire resistance, although with a higher areal weight.

TGC laminates act as protective barriers in cargo holds, shielding hydraulic lines, electrical wiring, structural elements, and the aircraft's exterior from the movement of cargo. These laminates block flame and smoke spread in case of fires and comply with rigorous high-impact and abrasion resistance standards.



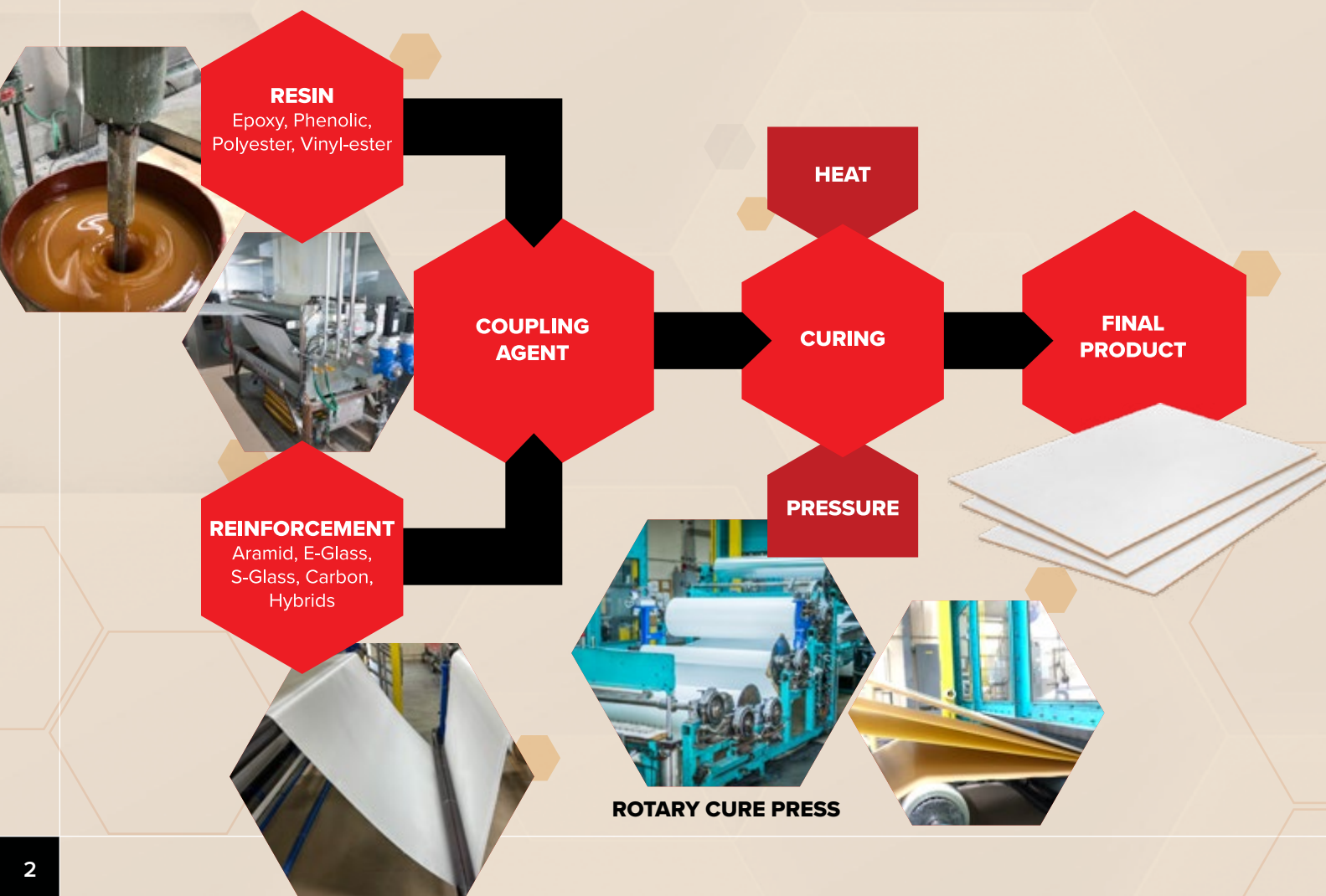
Cargo Compartment (Bulk)



Cargo Compartment (Containerized)  
Sidewalls are capable of enduring wear and tear after extensive use.



Aircraft Interiors



ROTARY CURE PRESS



## MECHANICAL TESTING

**Tensile Testing:** This test measures the tensile strength and modulus of the laminate by applying a uniaxial tensile load until failure. It helps determine the material's ability to withstand axial loads.

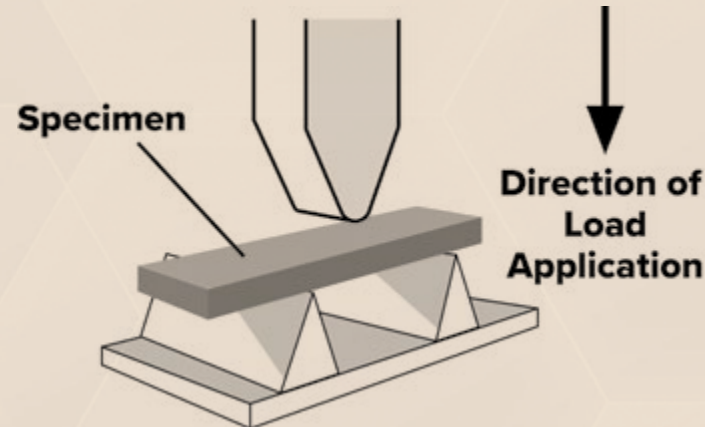
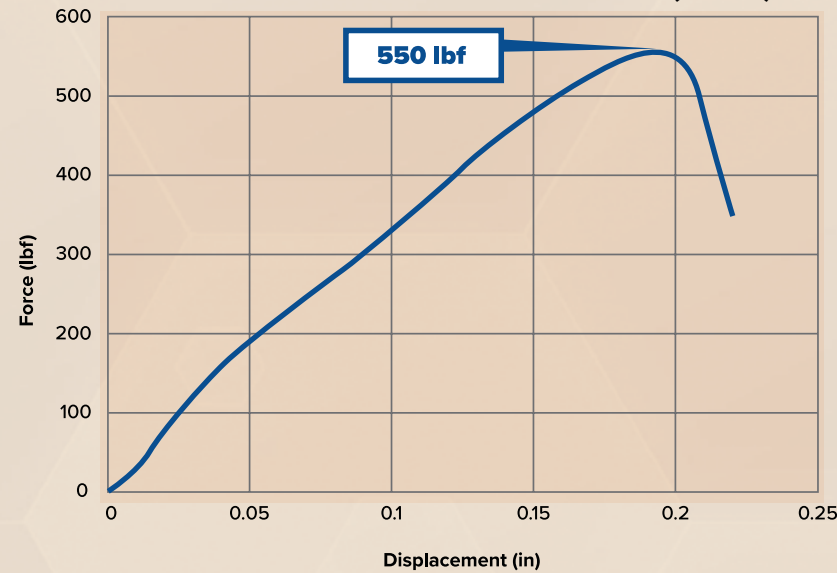
**Edge Bearing Test:** This test assesses the performance and integrity of machined holes where laminated composite materials are mechanically fastened with bolts. It ensures that fastening locations in composite laminates can withstand the required loads and maintain structural integrity.

**Flexural Testing:** This test assesses the laminate's bending strength and stiffness by applying a load at the center of a supported span until failure.



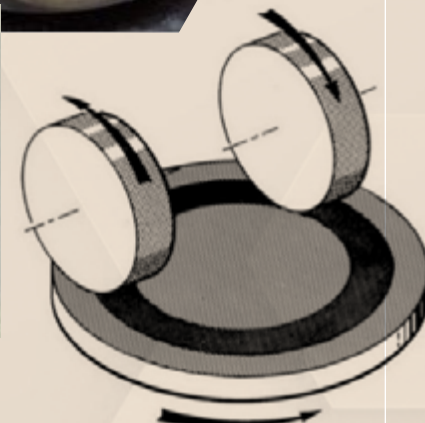
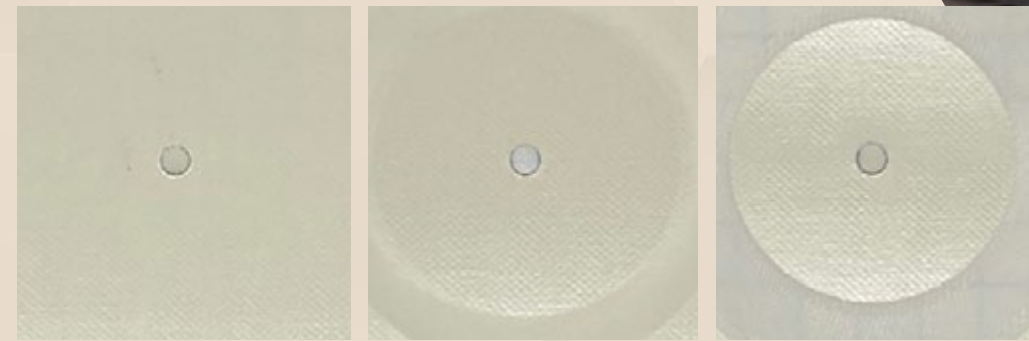
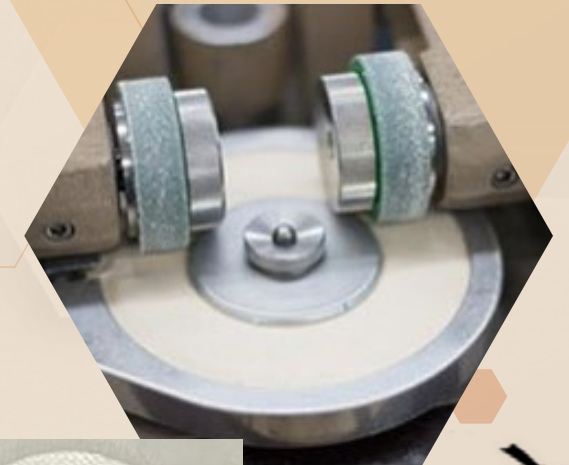
Tensile Strength Testing

TENSILE STRENGTH OF GILLINER® 1567A (0.013")



## FATIGUE TESTING

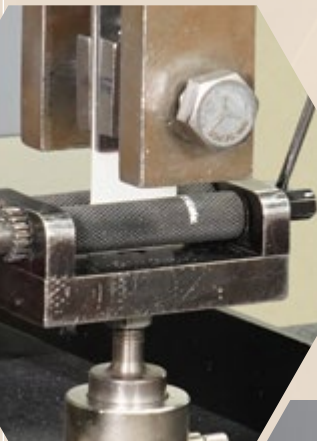
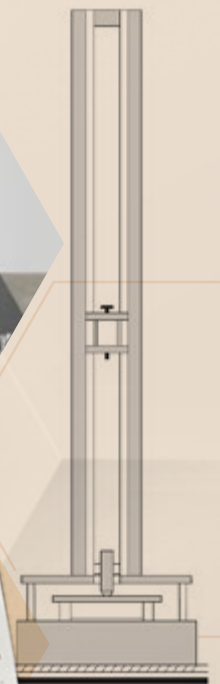
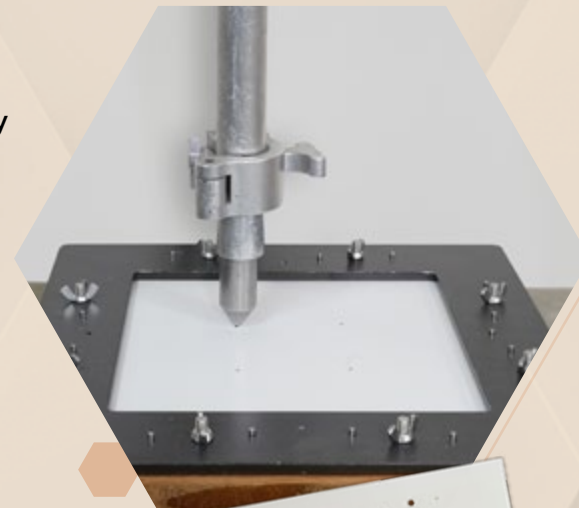
**Abrasion Testing:** This test assesses the capacity of the laminates to endure repeated movement of cargo over the lining surface without wearing through. This feature is crucial for cargo liners, especially in bulk cargo compartments, where the sloping area of the lower sidewall at the ribs or attachment points is particularly prone to wear-through. Variations in wheels, loading weight, or the number of cycles can increase the test's difficulty.



## IMPACT (PUNCTURE) TESTING

**Low-Velocity Impact Testing:** This test evaluates a laminate's resistance to low-velocity impacts, such as tool drops or bird strikes, to determine its impact strength and damage tolerance. The results can show a cargo liner's ability to withstand penetration, preventing exposure of the aircraft's interior wiring, cables, and ducting. Additionally, a hole could allow smoke and toxic fumes to escape during a fire in the cargo compartment.

**High-Velocity Impact Testing:** It simulates conditions like hailstorms or debris strikes, assessing the laminate's ability to withstand high-speed impacts without catastrophic failure.



Edge Bearing Testing



Flexural Testing





## ENVIRONMENTAL TESTING

**Elevated Temperature Exposure Testing:** This test evaluates the performance and durability of laminate materials under elevated temperatures and extended exposure time. These tests can evaluate if the laminates can perform outside the normal operating conditions of the aircraft.

**Humidity and Moisture Testing:** This test exposes the laminate to high humidity and moisture conditions to assess its resistance to moisture absorption, which can degrade mechanical properties and cause swelling or delamination.

**Ultraviolet (UV) Exposure:** This test evaluates the laminate's resistance to UV radiation, which can cause degradation and loss of mechanical properties over time.

## FLAMMABILITY TESTING

**Vertical Burn Testing:** This test evaluates the laminate's resistance to ignition and flame spread. In a vertical burn test, a sample is held vertically and exposed to a flame for a specified period, after which the flame source is removed, and the material's ability to self-extinguish is observed.

**Heat Release Rate Testing:** This test measures the amount of heat energy released by the laminate when it burns, which is critical for assessing fire hazard and compliance with aviation safety standards.



### FIRE

Minimize the intensity and spread of a fire.



### SMOKE

Minimize the amount the amount of smoke particles generated.



### TOXICITY

Minimize the quantity of harmful gases emitted during a fire.



**Smoke Density Testing:** The amount of smoke generated during combustion is measured to determine the laminate's smoke production rate, as excessive smoke can hinder visibility and evacuation during an emergency.

**Toxic Gas Emission Testing:** This test analyzes the types and quantities of toxic gases released when the laminate burns. Limiting toxic emissions is crucial for ensuring passenger safety in the event of a fire.

## PASSENGER SAFETY

The Federal Aviation Regulations (FAA) specify the airworthiness standards for cargo liners in Title 14 of the Code of Federal Regulations, Part 25, Subpart D (Design and Construction).

**Section 25.857:** Establishes the classification of the cargo compartment based on the aircraft's configuration.

**Section 25.855:** Defines the flammability requirements of the liner material based on the specific classification.

Aerospace laminates are crucial in the building of modern aircraft, providing a blend of high strength, low weight, durability, and safety. To ensure their reliability and performance, TGC laminates undergo comprehensive testing for mechanical properties, fatigue resistance, impact strength, environmental conditions, fire resistance, and nondestructive evaluations. TGC is committed to staying ahead by continuously improving its laminate materials through research and development, and testing methodologies to meet or surpass the evolving standards of the aerospace industry.



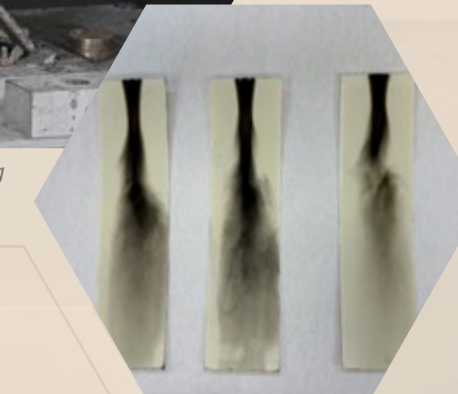
Smoke Density Testing



Heat Release Rate Testing\*



Vertical Burn Testing



\*Photo courtesy of Aeroblaze Laboratory

# Fun Facts

*The human eye is so sensitive that if the Earth were flat and it was a dark night, a candle's flame could be seen from 30 miles away.*

*When Space Invaders was created, Tomohiro Nishikado left in the lag caused by more invaders on the screen in order to create greater difficulty in the games.*

*The color red doesn't really make bulls angry; they are color-blind.*

*65% of autistic kids are left-handed, and only 10% of people, in general, are left-handed.*

*In 2007, Scotland spent £125,000 devising a new national slogan. The winning entry was: "Welcome to Scotland."*

*Until 2016, the "Happy Birthday" song was not for public use. Meaning that prior to 2016, the song was copyrighted, and you had to pay a license to use it.*

*When mice live in the wild, they typically only live for about six months. This is mostly due to the fact that they're a good source of food for other animals. However, in a controlled environment, like being kept as a pet, they can live up to two years.*

*There is a punctuation mark used to signify irony or sarcasm that looks like a backward question mark.*

*Researchers have found that flossing your teeth can help your memory. Flossing prevents gum disease, which prevents stiff blood vessels, which cause memory issues.*

*A cluster of bananas is called a "hand." Along that theme, a single banana is called a "finger."*

*The Hobbit has been published in two editions. In the first edition, Gollum willingly bet on his ring in the riddle game.*

*Lettuce is a member of the sunflower family.*

*For nearly 60 years, Texas didn't have an official state flag between 1879 & 1933. During that time, the Lone Star flag was active, but the unofficial flag.*

*A wildlife technician, Richard Thomas, took the famous tongue twister, "how much wood would a woodchuck chuck if a woodchuck could chuck wood" and calculated a rough estimate of what the answer would actually be. It came out to be around 700 pounds.*

*Red Solo cups are a common souvenir to bring back from the United States. The novelty comes from the cups being used in many party scenes in movies.*

*Swedish meatballs originated from a recipe King Charles XII brought back from Turkey in the early 1800s.*

*Saint Lucia is the only country in the world named after a woman. The country was named after Saint Lucy of Syracuse by the French.*



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