

Bringing Composites

TO SUBMERSIBLE APPLICATIONS

**FLEXIBLE, HIGH-STRENGTH &
HIGHLY ELASTIC MATERIALS**



Executive Summary

With a desire to improve the performance of the missile tube muzzle hatch gasket material (Mil-G-15624F Type III Buna-N Rubber), the U.S. Navy sought out to find a suitable replacement that met stringent physical and dimensional requirements. For almost 2 years, Globe developed "Composite #1200-60A", which underwent extensive testing until ultimately landing on a polymer formulation and a process that produces a tensile strength 158% higher yet yields an elasticity 23% greater and a compression set 53% lower than Buna-N rubber.

Globe Composite Solutions manufactures a variety of gaskets for U.S. nuclear submarines, ranging as large as 139 inches in diameter. Over the past ten years, the performance of Globe Composite #1200-60A has been flawless. In fact, not a single gasket made with this compound material has failed while in service due to physical or mechanical error.



When failure equates to millions of dollars' worth of damage, how do you find a solution to improve performance?

With composites - that's how.

Background

In the mid-1990's, the United States Navy discovered an increase of fraying and/or extrusion damage on the edges of the missile tube muzzle hatch gaskets within the Ohio-class SSBN nuclear submarine fleet. This issue was flagged as a major concern since a high incidence of failure would cause leaking or flooding inside the missile tubes.



At this time, the gaskets were being manufactured using Mil-G-15624F Type III Buna-N rubber material (a copolymer of butadiene-styrene). After stringently testing 64 samples of the faulty gaskets, it was discovered that the Type III Buna-N rubber material was prone to degrade over time - failing to meet the physical specifications and dimensional requirements for successful application.

In pursuit of a resolution, alternative materials were investigated as a solution to this critical performance issue. A polyurethane-based material, with an outstanding track-record of use on the Seawolf-class submarines, was selected for its superior survivability in ocean environments. After a series of Mil-G-15624F tests, researchers concluded that 'Globe Composite #1200-60A', a high performance polyurethane compound material, contained the ideal combination of properties best suited to address the limitations associated with Buna-N materials.

From this point on, Globe Composite Solutions has served as the primary supplier of polyurethane gaskets for the U.S. Navy and its contractors according to the EB-4224(1) specifications that were established between Globe and General Dynamics Electric Boat.

Development of Composite # 1200-60A

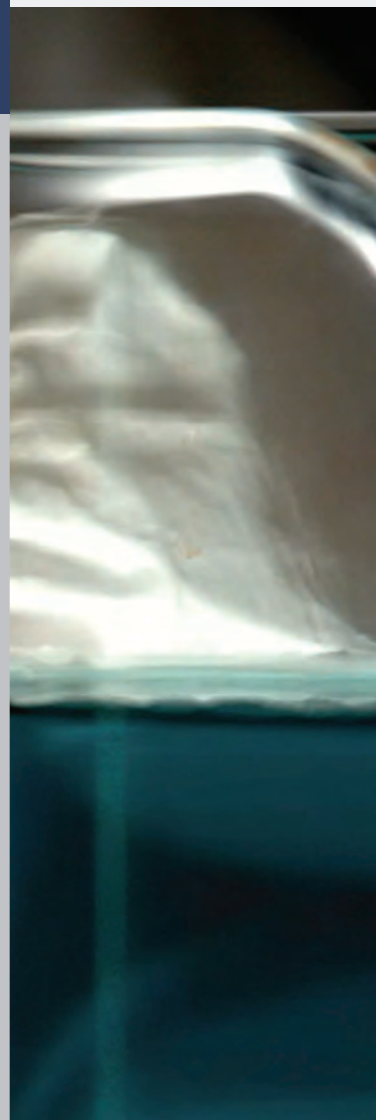
Once the U.S. Navy identified the damage potential associated with Type III Buna-N rubber gaskets, Globe Composite Solutions expertly identified more than twenty materials candidates to meet the strict physical requirements. Initially developed in 1997, Composite #1200-60A is a liquid castable, high-strength material that is durable enough to withstand critical defense applications, yet flexible enough to conform to the desired shape and assure a tight-fitting seal at various operating depths.



Following the thorough material selection stage, Globe Composite produced and presented several prototype parts for final acceptance testing. Six full-sized Globe Composite #1200-60A gaskets were installed on the Ohio-class submarine SSBN 743 (Louisiana) for a series of sea trials. The second set of sea trials, conducted after making minor physical dimension modifications, demonstrated that the missile tube muzzle hatches fitted with Composite #1200-60A gaskets functioned properly. Additionally, the static compression load for these gaskets, as measured in a laboratory fixture, was significantly better than the original Buna-N gasket.



Composite #1200-60A - At A Glance

- ▶ Certified for use in missile tube muzzle hatch and other applications
 - ▶ Based on MDI polyether chemistry
 - ▶ High Tensile Strength up to 4000 psi
 - ▶ Outstanding Elasticity up to 500%
 - ▶ Excellent resistance to seawater, oils, chemicals, & UV degradation
 - ▶ Ideal for thrust bearing isolation mounts and other vibration and shock absorption applications
 - ▶ Can be adhered to metallic components, including stainless steel and titanium
- 

Additional supporting tests were performed in the following areas:

- ▶ Hydrostatic Pressure Sealing
- ▶ Static Load vs. Deflection
- ▶ Cyclic Loading
- ▶ ASTM D 624: Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
- ▶ ASTM D 471, Rubber properties: Effects of Liquids

Composite #1200-60A Physical Properties

Globe Composite was tasked with not only developing a material that would avoid costly damage to critical military systems, but also had to adhere to the rigorous performance criteria defined by the U.S. Navy. In order to meet these requirements, Composite #1200-60A was custom blended to guarantee that the high-strength gaskets will perform as expected, each and every time.

When compared to Mil-G-15624F Type III Buna-N rubber material, this composite polymer has superior tensile strength and elongation properties and a significantly lower specific gravity - ideal for situations where weight consideration or part handling is a factor.

Chemically, Buna-N or nitrile rubber material is a copolymer of butadiene and acrylonitrile. Acrylonitrile content in commercial products varies between 18% to 48%. As the nitrile content rises, there is an increased resistance to petroleum-based oils and hydrocarbon fuels, but a decrease in low temperature flexibility. Table 2 offers a list of Mil-G-15624F Type III Buna-N rubber(2) specifications in comparison to those of Globe Composite #1200-60A, a polyurethane compound material:

Table 1: Summary of Composite1200-60A
Physical Properties Properties ASTM Method Units Typical Value

PROPERTIES	ASTM METHOD	UNITS	TYPICAL VALUE
Specific Gravity	ASTM D 792	sp gr 23/238C	1,08
Shore Hardness	ASTM D 2240	A Scale	65
Young's Modulus	ASTM D 412	PSI	172,000
Tensile Strength	ASTM D 412	PSI	4,000
Elongation at Break	ASTM D 412	%	492
Tear Strength	ASTM D 624	lb/inch	225
Compression Set	ASTM D 395	%	14
Temperature Range	--	--	-20°F-200°F

Table 2: Mil-G-15624F Type III Buna-N Rubber vs. Composite1200-60A

PROPERTIES	MIL-G-15624F TYPE III BUNA-N RUBBER	1200-60A	COMPARISON
Tensil Strength (psi min)	1,550	4000	158% greater
Ultimate Elongation (% min)	400	492	23% greater
Shore A Hardness (max)	50	64	32% harder
Specific Gravity (max)	1.400	1.083	22% lighter
Compression Set (% max)	30	14	53% lower

Applications

Due to its versatile and liquid-castable property, Globe Composite #1200-60A can be used to produce components of almost any size or geometry with significantly lower tooling costs compared to traditional compression molded rubber products. Globe employs a unique processing method that drastically reduces the presence of voids, while increasing the uniformity of the material. One-piece gaskets or seals can be made in virtually any size or shape without the risk of compromising strength along knit-lines or compression zones.

Need Something Special?

Globe Composite #1200-60A can be modified to increase or decrease certain physical properties such as tensile strength, rebound, durometer, or elongation to best fit performance needs.

Defense applications aside, this mold-resistance, high-performance polymer naturally lends itself to marine, agricultural, tropical, and water/sewage treatment applications available in both FDA and non-FDA approved grades.



Table 3: General Property Comparison of 1200-60A & Buna-N Rubber

PROPERTY	1200-60A	BUNA-N RUBBER
Tensile Strength	Excellent	Good
Tear Resistance	Outstanding	Fair
Abrasion Resistance	Outstanding	Good
Compression Set	Good	Good
Elongation	Excellent	Good
Weight/Specific Gravity	Excellent	Good
Ozone Resistance	Outstanding	Fair
UV Resistance	Outstanding	Poor
Hydrolytic Stability	Excellent	Excellent
Durability/Weathering	Excellent	Fair
Low Temperature Resistance	Outstanding	Excellent
Moldability	Excellent	Fair
Mold/Fungi Resistance	Outstanding	Poor
Rebound	Excellent	Good
Durometer Range	Outstanding	Good
Higher Temperature Service	Fair	Good
Diesel/Gasoline Resistance	Fair/Good	Outstanding

Composite 1200-60A is designed to excel in a range of agricultural, marine, and submersible applications including:

- ▶ Custom-molded shapes
- ▶ Diaphragms
- ▶ Access hatch gaskets & seals
- ▶ Water pump gaskets & seals
- ▶ Vibration and shock mounts
- ▶ Deep-sea gaskets & seals
- ▶ Marine gaskets & seals
- ▶ Mooring Systems

Shock and Vibration Mounts

Globe can design and manufacture isolation mounts and vibration dampeners for a variety of applications using our advanced, low-durometer, high-strength Composite #1200-60A dampening material. This material has superior bonding strength when cast or bonded to metallic (i.e., stainless steel, INCONEL, titanium, etc.) and non-metallic (including ultra-high molecular weight polyethylene) structures or casements. With low durometer, yet high tensile and shear strength, this material can withstand repetitive stress and vibration.

Mooring Systems

Globe Composite #1200-60A has superior strength and resiliency capabilities in submersible applications which makes it ideal for surface and bottom mounts, buoys, tethers and other mooring system components.

Conclusion

Originally founded in 1890 as a sheet rubber company, Globe Composite has evolved to solve the demanding performance challenges faced by some of the largest and most complex industries. The defense industry, specifically submersibles, comes with its own set of unique requirements from design to production, and all of the critical testing in between.

For the past two decades, Globe has tirelessly advanced polyurethane processing technologies, while consistently providing high-quality, performance-driven composite components. Throughout their engagement, Globe Composite has provided the U.S. Navy and its contractors with thousands of Globe Composite #1200-60A polyurethane gaskets - all without a single incidence of in-service physical or mechanical failure.

Looking to improve your company's
demanding operational and
performance requirements?

TALK TO AN EXPERT

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