QUIET BUNKS

Today's sailors are asked to perform ever-increasing tasks and thus need to be at peak performance. Restful sleep is essential to achieving this peak performance, yet the close working quarters inside submarines can be detrimental to sleep cycles. Therefore, the use of materials to bolster the natural sleep cycle for more restorative rest is desired. Additionally, sound damping materials can be used to reduce mechanical or other noises onboard Navy submarine and surface ship platforms.

Texas Research Institute Austin, Inc. (TRI Austin), developed a noise control material (Figure 1) that possesses the required physical and environmental properties for internal shipboard applications while meeting the stringent fire, smoke, and toxicity (FST) requirements of MIL-STD-2031 entitled "Fire and Toxicity Test Methods and Qualification Procedure for Composite Materials Used In Hull, Machinery, and Structural Applications Inside Naval Submarines", see Table 1 below.

MIL-STD-2031 Fire and Toxicity Test Methods and Qualification Procedure for Composite Material Systems Used in Hull, Machinery, and Structural Applications Inside Naval Submarines

Fire Test/Characteristic	Requirement	Test Method	*Test Results for TRI07525*
Oxygen-temperature index	Minimum	ASTM D-2863-2013	
% oxygen at 25°C	35	2013 Modified	60.29
% oxygen at 75°C	30		62.59
% oxygen at 300°C	21		70.39
Flame-spread index	20 (maximum)	ASTM E-162	5
Ignitibility(s)	Minimum		
100 kW/m^2 irradiance	60		82
75 kW/m^2 irradiance	90	ASTM E-1354-16a	142.7
50 kW/m^2 irradiance	150		No Ignition
25 kW/m^2 irradiance	300		No Ignition
Heat release rate (kW/m^2)	Maximum		
100 kW/m^2 irradiance, peak	150		35.71
Average for 300 s	120		22.41
75 kW/m^2 irradiance, peak	100		33.03
Average for 300 s	100	ASTM E-1354-16a	16.4
50 kW/m^2 irradiance, peak	65		0
Average for 300 s	50		0
25 kW/m^2 irradiance, peak	50		0
Average for 300 s	50		0
Smoke obscuration	Maximum		
D_s during 300 s	100	ASTM E-662	0.7
D_{max}	200		3.9
Combustion gas generation	CO=200 ppm		No Ignition
(25 kW/m^2)	CO_2 = 40000 ppm	ASTM E-1354	No Ignition
	HCN = 30 ppm		No Ignition
	HCl = 100 ppm		No Ignition

Table 1. MIL-STD-2031 Test Results for TRI Austin's Sound Damping Material

The material system was tested for Sound Transmission Loss at ETS-Lindgren Acoustic Research Laboratory in Cedar Park, TX (a NVLAP-accredited laboratory, Scope of Accreditation under Lab Code 100286-0). At one inch thickness, the material achieved an excellent Sound Transmission Class (STC) of 35 (per ASTM E413) and Outdoor/Indoor Transmission Class (OITC) 31 (per ASTM E1332) in Sound Transmission Loss testing (per ASTM E90). Figure 2 and Figure 3 on the following page show the test results of the bare material.

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Quiet Bunks

Figure 1. Quiet Bunks Sound Damping Material that meets MIL-STD-2031 "Fire and Toxicity Test Methods and Qualification Procedure for Composite Materials Used In Hull, Machinery, and Structural Applications Inside Naval Submarines"

Table 2. Mechanical Properties

Tensile Strength, *TS*	753	psi
Tensile Modulus, *E*	314,511	psi
Poisson's Ratio, *v*	0.23	
Compressive Strength, *CS*	3,114	psi
Compressive Modulus, *E*	48,676	psi
Shear Strength, τ_S	2,209	psi
Shear Modulus, *G*	143,791	psi
Density, ρ	0.033	lb/in^3

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Figure 2. Sound Transmission Loss Test Results (ASTM E90)

ETS-LINDGREN ACOUSTIC RESEARCH LABORATORY SOUND TRANSMISSION LOSS (ASTM E90) TEST RESULTS

RESULTS SUMMARY TABLE

Test Number:	**TL7845A**
Client:	**TRI Austin**
Specimen Description:	**1015 PSF Bare Panel**

1/3 Octave Band Mid-band Freq (Hz)	Transmission Loss (dB)	Uncertainty (+/- dB)	Notes	Octave Band TL (dB)
50	8		[d][f]	
63	15		[d][f]	12
80	27	4.7	[b][d]	
100	21	1.9	[c]	
125	23	2.2	[c]	23
160	26	1.4		
200	29	0.6	[c]	
250	31	0.4	[c]	30
315	31	0.4	[c]	
400	30	0.3		
500	32	0.3		31
630	33	0.2		
800	34	0.2		
1000	34	0.2		34
1250	33	0.2		
1600	35	0.2		
2000	37	0.2		37
2500	39	0.2		
3150	41	0.2		
4000	43	0.2		42
5000	43	0.2		
6300	42	0.3		
8000	42	0.4	[c]	42
10000	43	0.4	[c]	
STC	**35**			
OITC	**31**			
Rw	**35**			

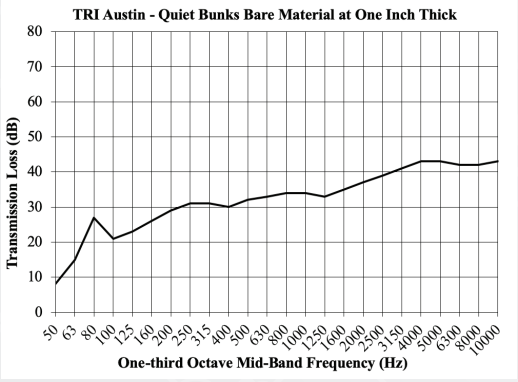

Figure 3. Sound Transmission Loss Test Results (ASTM E90)

Our new sound damping material is cost effective and easy to use. This new material can be clad/co-cured in metal or composite skins. Low temperature cure (200° F) enables the material to be fabricated in place on a submarines and surface ships.

The material's low density lends itself to weight-sensitive applications. The material properties and density are shown in Table 2. Applications include aerospace, maritime, automotive, and architectural products.

We are evaluating various commercial markets for this material including: construction in apartments, office spaces, and industrial applications. For example, sound damping screens in welding areas that would also have FST properties are straightforward applications where roll-in screens can be used to reduce sound and risk of fire.

NOTES

[b] - Specimen TL within 10 dB of facility flanking limits. No correction applied. Value represents lower bound of specimen TL in this band.
[c] - Specimen TL corrected for sound transmission through laboratory filler wall per ASTM E90-09 (2016) Section 7.3.1.6
[d] - Specimen TL too close to laboratory filler wall. Specimen TL corrected per ASTM E90-09 (2016) Section 7.3.1.7. Value represents lower bound for TL in this band.
[e] - Uncertainty in this band exceeds limits of ASTM E90-09 (2016) Section A2.2.

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TO LEARN IF QUIET BUNKS CAN HELP YOU WITH YOUR APPLICATION, CONTACT:

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