

HEADQUARTERS
AIR FORCE SECURITY FORCES CENTER
LACKLAND AIR FORCE BASE, TEXAS



**BALLISTIC PERFORMANCE TEST OF
THE TROY SYSTEM AND TROY ACOUSTIC PANELS**

16 NOVEMBER 2009

PREPARED BY

HQ AFSFC/SFXW

**BALLISTIC PERFORMANCE TEST OF
THE TROY SYSTEM AND TROY ACOUSTIC PANELS
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Section 1 - GENERAL

1.1. Project Title: Ballistic Performance Test of the Troy System and Troy Acoustic Panels.

1.2. Project Number: 09-01

1.3. Project Officers: Mr. Rolland Roth, HQ AFSFC/SFXW, and Mr. Jeffrey Nielsen, HQ AFCESA/CEOA.

1.4. Background: Mr. Roth requested assistance from US Air Force Gunsmith Shop (AFGSS), 575 CBSS/GBLC, personnel and use of their test tunnels at Bldg 5584, Lackland AFB, Texas to test the ballistic performance of sound absorbing range covering materials produced by Troy Acoustics Corporation. These materials are intended to replace plywood and other facial materials currently used on AF small arms ranges to contain bullet splash back and mitigate potential ricochets from bullets impacting range walls, ceilings and baffles. The added benefit of the Troy Acoustics material is sound absorption and noise abatement. Additionally, the manufacturer states that this material is impervious to water, mold, mildew and humidity damage and is non-combustible.

1.4.1. This test was not developed to evaluate any of these additional qualities and was focused solely on evaluating the performance of the material in retaining bullet splash-back and mitigating ricochets, as compared to standard plywood covering.

1.4.2. Two AF bases, Wright-Patterson AFB and Maxwell AFB, have requested use of the Troy System on their ongoing range renovation projects. The Wright-Patterson range is closed due to excessive sounds levels.

Section 2 - TEST PLAN

2.1. Test Plan: Troy Acoustics developed the initial test plan and Mr. Roth and Mr. Nielsen reviewed and modified the plan to meet AF requirements. The plan is included at **Attachment 1**.

3.1.1. The test plan consisted of placing samples of both type materials (Troy System and plywood), constructed in the same manner as that used on small arms ranges, at 1 meter from the muzzle of several types of small arms and firing various type rounds at the test panel to evaluate the ability of both materials to contain bullet splash-back and mitigate ricochets. The panels would be attached to a test jig and the jig would be placed at a 15 degree angle from the bore of each type weapon.

3.1.2. Mr. Roth selected the small arms and munitions included in Table 1.1. to evaluate the test materials. Mr. Nielsen agreed with the ammunition selected.

Table 1.1. Small Arms and Munitions Used

Small Arm	Caliber	Ammunition Types
M9 Pistol	9mm	M882 Ball and 9mm Frangible
M-16 Rifle	5.56mm	M855 Ball and 5.56mm Frangible
M-14 Rifle	7.62mm	M80 Ball and M62 Tracer

2.2. Resources: The AFSFC provided the munitions for the test and the AFGSS provided the small arms, test facility and technicians to perform the test. Troy Acoustics provided the test materials and constructed the test samples and jig.

Section 3 - SCOPE

3.1. Scope: TSgt Brendan McGloin and SSgt Mark Fitzgerald from the AFGSS conducted the test on 13 Nov 09 at Lackland AFB, Bldg 5584, Small Arms Test Tunnels. TSgt Brendan and SSgt Fitzgerald set-up the facility for the test and placed the test jigs in position. SSgt Fitzgerald fired all weapons during the test. TSgt McGloin supervised all firing operations and verified loading and clearing of all weapons. Mr. Roth and Mr. Nielsen oversaw the test and guided all actions to ensure validity and objectiveness. Mr. Bill Bergiadis from Troy Acoustics and Mr. Ken Lewis assisted with setup and teardown of test materials.

3.1.1. At approximately 0915, AFGSS and Troy Acoustics personnel placed the test samples in the test tunnels. They placed the handgun jig in the left tunnel and the rifle jig in the right tunnel. **Note:** The inside diameter of the left tunnel was too small to allow placement of the handgun panel within 1 meter of the pistol muzzle. This necessitated placement of the jig 1.42 meters (55.75 inches) from the muzzle. Mr. Roth and Mr. Nielsen agreed to this modification.

Figure 3.1. Rifle Test Setup



Figure 3.2. Handgun Test Setup



3.1.2. Rifle test on Troy System material.

3.1.2.1. When personnel had all equipment, test materials and personal protective equipment in place, SSgt Fitzgerald fired three rounds of 5.56mm ball ammunition with an M-16A2 rifle into top left portion of the Troy Acoustics test material. He then reloaded the rifle with three rounds of 5.56mm frangible ammunition and fired those into the top right portion of the test panel. For the next phase, he loaded three more rounds of 5.56mm ball ammunition and fired those rounds into the bottom right portion of the test panel to hit the Troy Board support bracket.

3.1.2.2. Sergeant Fitzgerald then cleared the M-16A2 and retrieved an M-14 rifle. He loaded the rifle with three rounds of 7.62mm tracer ammunition and fired the rounds into the center of the test panel. SSgt Fitzgerald cleared the M-14 and moved to the left tunnel to begin the M9 phase of the test.

Figure 3.3. M-16A2 (5.56mm) Test



Figure 3.4. M-14 (7.62mm) Test



3.1.3. M9 pistol test on Troy System material.

3.1.3.1. SSgt Fitzgerald retrieved an M9 pistol and loaded with three rounds of 9mm ball ammunition. He fired the rounds into the top right portion of the test panel. It was necessary for Sergeant Fitzgerald to fire an additional round of 9mm ball to ensure hits were not spaced too closely together (hits from two previously fired rounds appeared to be less than a half inch apart).

3.1.3.2. He then loaded the weapon with three rounds of 9mm frangible ammunition and fired the rounds into the bottom left area of the panel. Sergeant Fitzgerald cleared the pistol. This concluded the test phase for the Troy Acoustic material. AFGSS and Troy Acoustics personnel removed the test jigs from the tunnels.

Figure 3.5. M9 (9mm) Test



3.1.4. Mr. Lewis disassembled the test panels (Troy System mounted on front of steel plate and plywood mounted on back); Mr. Roth and Mr. Nielsen evaluated the results.

Figure 3.6. Rifle Impacts Front Troy



Figure 3.7. Rifle Impacts Rear Troy



Figure 3.8. Rifle Troy Wool



Figure 3.9. Rifle Steel Plate Troy



Figure 3.10. Handgun Impacts Front Troy

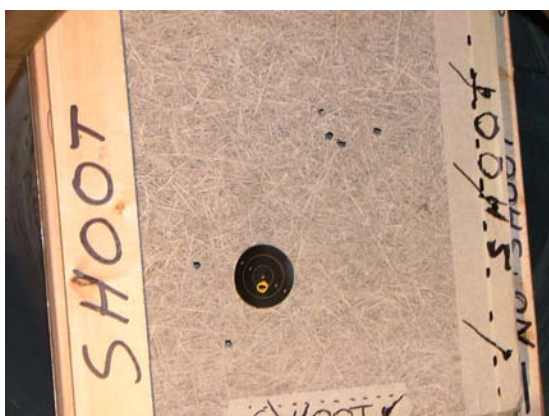


Figure 3.11. Handgun Impacts Rear Troy



Figure 3.12. Handgun Troy Wool



Figure 3.13. Handgun Steel Plate Troy



3.1.5. Mr. Lewis assembled the test panels for the plywood test; AFGSS and Troy Acoustics personnel placed the test jigs back in the tunnels in the same positions as the previous phase of the test.

3.1.6. Rifle and pistol test on plywood material.

3.1.7.1. Individuals repeated the same steps used to test the Troy System to evaluate the plywood design.

3.1.7.2. After all weapons were cleared, AFGSS and Troy Acoustics personnel removed the test jigs from the tunnels.

3.1.7.3. Mr. Lewis removed the plywood from the steel plates on the test panels; Mr. Roth and Mr. Nielsen inspected the panels to determine performance.

Figure 3.14. Rifle Impacts Front Plywood



Figure 3.15. Rifle Impacts Rear Plywood



Figure 3.16. 5.56mm Ball Steel Plywood

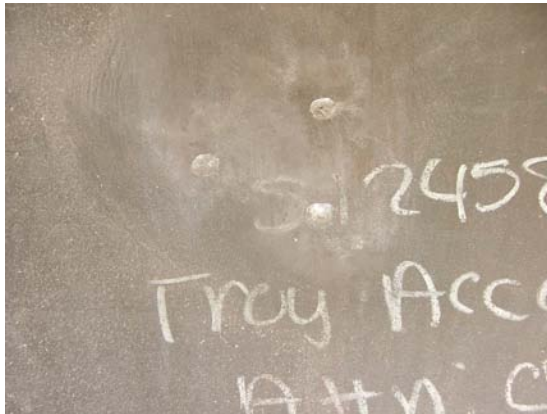


Figure 3.17. 7.62mm Tracer Steel Plywood

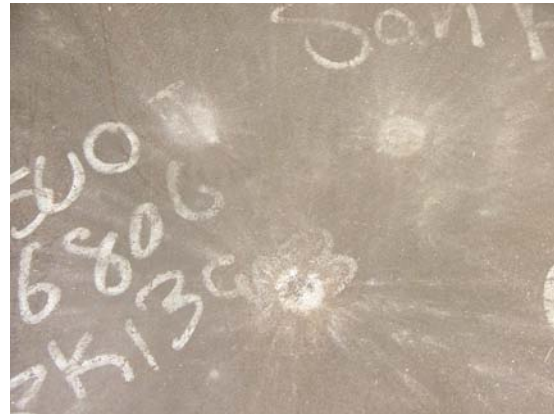


Figure 3.18. 9mm Hits Front Plywood



Figure 3.19. 9mm Hits Rear Plywood



Figure 3.20. 9mm Ball Steel Plywood

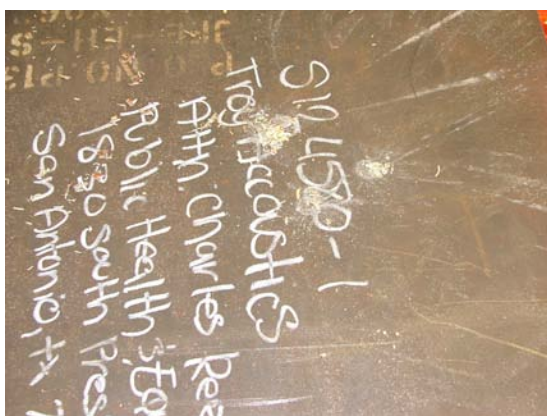
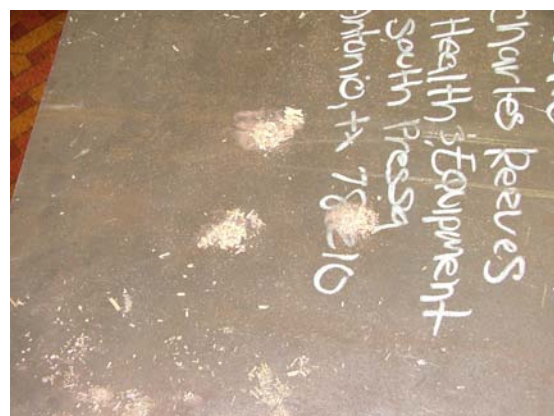


Figure 3.21. 9mm Frangible Steel Plywood



3.2. Completion of Test: This concluded the test and evaluation of both range covering materials. The AFGSS and Troy Acoustics personnel cleaned the facility and removed all test material.

Section 4 - RESULTS/FINDINGS

4.1. Results: Mr. Roth and Mr. Nielsen examined all test materials to determine their effectiveness.

4.1.1. Bullet holes in the exterior of the material were uniform and not significantly larger than the outside diameter of the bullets. No excessive damage was evident.

4.1.2. There was no evidence of bullets or fragments escaping from the material.

4.1.3. Damage to the interior side of the Troy Board, although distinct, was not excessive and captured bullet fragments were evident.

4.1.4. The Troy Wool, behind the Troy Board, showed significant damage and although it would not affect splash-back retention performance, it may impact sound absorption effectiveness.

4.1.5. Evaluation of performance with tracer rounds was inconclusive, as the bullets disintegrated and the tracer compound did not burn long enough to have an impact on the material. The tracer compound did ignite and did not have any effect on the test material.

4.1.6. Mr. Roth expressed concern with potential lead dust accumulation on the Troy Board because of the porous surface of the material and the potential challenges and cost of decontamination. Mr. Bergiadis explained that after installation, the boards are easily cleaned with a High Efficiency Particulate Air (HEPA) vacuum. Mr. Roth requested contact information from several range managers at ranges where the product has been in use for at least a year. Mr. Roth will interview these individuals to identify any problems with lead contamination or clean up.

4.2. Findings: After close inspection of all materials in each type of construction, Mr. Roth and Mr. Nielsen determined that the Troy System performed as well or better than plywood at containing bullet fragments, splash-back and mitigating ricochets.

Section 5 - CONCLUSION

5.1. Based on the performance of the Troy System at containing bullet splash-back and the limited damage caused by bullet impacts, this design will perform more than adequately on AF small arms range surfaces as a replacement for plywood. With the sound attenuation qualities and other benefits of this material, we endorse its use and recommend HQ AFCESA/CEOA approve this material for use on AF small arms ranges.

ROLLAND H. ROTH, JR., DAF
Program Manager, USAF Combat Arms

Attachment:
Test Plan

Test Method

for

**Ballistic Performance of
Engineering Technical Letter (ETL) 08-11: Small Arms Range Design and
Construction,
Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction
as Compared to
The Troy System and Troy Acoustic Panels Attached to Same Substructures
(TEST)**

Presented to

**United States of America
Department of the Air Force
Headquarters Air Force Civil Engineer Support Agency**

for consideration

Prepared by

**Troy Acoustics Corporation
USA**

**Test Method
for
Ballistic Performance of
Engineering Technical Letter (ETL) 08-11: Small Arms Range Design and
Construction,
Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction
as Compared to
The Troy System and Troy Acoustic Panels Attached to Same Substructures
(TEST)**

INTRODUCTION

The TEST methods presented herein have been developed and are presented to serve the distinct purpose of complying with the Department of the Air Force Headquarters Air Force Civil Engineer Support Agency (AFCESA) minimum design criteria necessary for achieving a safe small arms range design, and ensure the range is operationally safe. The TEST methods are divided into two parts, Part A and B, depending on the nature of the material tested. These tests and results are intended to be suitable for current Air Force standards, Unified Facilities Criteria general building requirements, safety, health and environmental standards and applicable to both permanent and portable ranges. To this end is offered a standard TEST method to conform to the ETL, specifically Section 7.5 *Ballistic Safety Structures*, subsection 7.5.4 *Baffle Construction*.

Part A. General Test Method for Evaluating the Ballistic Performance of Ballistic Performance of ETL 08-11, Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction. Resultant data from Part A are for use in obtaining basic performance properties suitable for comparison studies with other materials of construction in this TEST.

Part B. General Test Method for Evaluating the Ballistic Performance of The Troy System. This particular TEST method is conformity to adapt the intended criteria of the ETL, and use emerging technologies and commercially available products, specifically, The Troy System. Resultant data from Part B are for performance measures specified by confinement to their particular use.

1. Location

Lackland Air Force Base, Texas as an approved testing facility to carry out this initial TEST.

2. Reference Documents

Air Force Instruction 32-1023, *Design and Construction Standards and Execution of Facility Construction Projects*, available at <http://www.af.mil/shared/media/epubs/AFI32-1032.pdf>

Test Method for Ballistic Performance of Engineering Technical Letter (ETL) 08-11: Small Arms Range Design and Construction, Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction as Compared to The Troy System and Troy Acoustic Panels Attached to Same Substructures (TEST) ©
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Air Force Instruction 36-2226, *Combat Arms Program*, available at <http://www.e-publishing.af.mil>
Air Force Instruction 90-901, *Operational Risk Management*, available at <http://www.e-publishing.af.mil>
Air Force Pamphlet (AFPAM) 90-902, *Operational Risk Management (ORM)*, available at <http://www.e-publishing.af.mil>
Department of Defense Directive 5100.76-M, *Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives*, available at <http://www.dtic.mil/whs/directives/corres/html/510076m.htm>
Guidelines and Tools, available at <http://www.e-publishing.af.mil>
Engineering Technical Letter (ETL) 08-11: *Small Arms Range Design and Construction*, available at www.wbdg.org/ccb/AF/AFETL/etl_08_11.pdf
Technical Order 11W3-3-5-1, *Operator's Maintenance Manual, Pistol, Semiautomatic, 9mm, M9 (Army Technical Manual 9-1005-317-10)*
Technical Order 11W3-55-41, *Operator's Manual for Rifle, 5.56 MM [series M16/M4]*
Technical Manual 9-1005-223-12P, *Operator and Organizational Maintenance Rifle..., 7.62MM, M14 (M)*
Technical Manual 43-0001-27, *Army Ammunition Data Sheets, Small Caliber Ammunition*
Troy Acoustics Document, Z.USAF.SRIN.090901.0335.T001.APDX A. *Troy System Design Criteria*
Troy Acoustics Document, Z.USAF.SRIN.090901.0335.T001.APDX A. *Troy Military Report*
Troy Acoustics Document, Z.USAF.SRIN.090901.0335.T001.APDX A. *Troy Army Report*
Troy Acoustics Document, Z.USAF.SRIN.090901.0335.T001.APDX A. *Troy Range Reverberation & Testing*
Troy Acoustics Document, Z.USAF.SRIN.090901.0335.T001.TEST.APDX B. *In-Situ TEST Shop Drawings*
Troy Acoustics Document, Z.USAF.SRIN.090901.0335.T001.APDX B. *Troy Tactical Plan Set*
Unified Facilities Criteria 1-200-01, *General Building Requirements*, available at http://www.wbdg.org/ccb/browse_cat.php?o=29&c=4

3. Scope

Using standard US Air Force service weapons, fire rounds at a 75 degree angle, measured one (1) meter* from the muzzle for each munitions listed at a sample panel covering a steel plate specified in paragraph 9. *All 9mm firing will be fired at 55 1/2" from the muzzle due to facility constraints.

4. Significance And Use

The Troy System proprietary acoustic assembly is principally designed to provide superior reduction in both noise and reverberation on indoor and outdoor firing ranges, meeting the criteria established in ETL 08-11, 7.2.9. The assembly provides an additional benefit wherein it is designed to safely encapsulate direct and indirect, missed or inadvertent, fired rounds during live fire training, tactical and fixed, shooting exercises. Data from The Troy System TEST will facilitate comparative analysis of this emerging technology with the existing standards and Air Force Instruction (AFI) 32-1023, AFI 36-2226 and the current ETL guidelines. Because The Troy System is specified by range designers and installed by contractors in the United States and abroad, proofs of the TEST and acceptance by HQ USAF will give design professionals immediate access to a system guaranteed to deliver the highest acoustical performance as well as fragmentation protection. Service personnel using these properly designed facilities will receive the maximum protection available from environmental health hazards (noise and fragmentation) incurred when operating in the live fire envelope.

**Test Method for Ballistic Performance of Engineering Technical Letter (ETL) 08-11: Small Arms Range Design and Construction, Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction as Compared to The Troy System and Troy Acoustic Panels Attached to Same Substructures (TEST) ©
TAC Designation: Z.USAF.SRIN.090901.0335.T001©**

5. Facility Selection Parameters

TEST facility (firing range) must provide for operational safety and environmental security submitted as requirements to fulfill the events of the TEST. The facility envelope must allow for isolation and unpredictable ricochet containment for all firing configurations.

6. Controlling Authority in Charge (CAC) and Personnel for TEST

Headquarters Air Force Security Forces Center (HQ AFSFC) shall be the Controlling Authority in Charge. To minimize exposure to hazards, personnel shall be limited to the fullest extent possible. The TEST agent representative or designated lead in charge of TEST procurement shall be the DTPA.

7. Environmental Controls

The approved facility should be a stable environment for the duration of the TEST. Extreme variations in ambient temperature and relative humidity during the TEST period should be brought into consideration and evaluated for detrimental affects to TEST. If extreme environmental conditions develop during the course of the TEST, continuing the work of the TEST will be at the discretion of the DTPA.

8. Safety Orders and Measures of Operation

Follow the Cardinal Rules of Firearms Safety:

- 8.1. Treat ALL firearms as loaded.
- 8.2. Point the muzzle in a safe direction.
- 8.3. Keep your finger outside the trigger guard until you are on target and decided to fire.
- 8.4. Be sure of your target and what's around and beyond it.
- 8.5. Condition Check Rule - When you pick up a firearm (even for an instant) that has been out of your direct control, open the action to determine whether or not it is loaded. (As a corollary to this rule, a firearm you hand to or accept from someone else shall be condition-checked first, and handed unloaded and with the action open.) When possible have someone else double check you. Areas to safely point firearms shall be established. Use these areas.
- 8.6. All firing shall be done from a horizontal rest (bench or prone) position.
- 8.7. Operational Risk Management (ORM) shall be applied to all sequences. Ensure the risk of the TEST is worth the data received. There is NO acceptable level of injury during this procedure; notwithstanding weapons firing is inherently dangerous. At no time will life of limb be jeopardized.
- 8.8. Range personnel will establish communications prior to commencing live-fire and ensure communications are maintained throughout the test. Communication must be available to summon emergency medical personnel in the event of injury to personnel. Emergency contact information will be obtained for all non DOD personnel prior to initiation of any live-fire.
- 8.9. All one (1) meter firing may be by remote trigger with all personnel protected from a direct hit by fragmentation.
- 8.10. STEEL TARGET SAFETY RULES (edited)
 - 8.10.1. Always obey the Firearms Safety Rules listed above

Test Method for Ballistic Performance of Engineering Technical Letter (ETL) 08-11: Small Arms Range Design and Construction, Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction as Compared to The Troy System and Troy Acoustic Panels Attached to Same Substructures (TEST) ©
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- 8.10.2. Always wear hearing protection and wrap-around shatter resistant eye protection
- 8.10.3. Always stand at least 10 yards from the target when using handgun calibers.
- 8.10.4. Always stand at least 50 yards from the target when using rifle calibers like .223 (5.56MM) and .308 (7.62MM).
- 8.10.5. Never use ammunition that exceeds 3,000 feet per second at the muzzle.
- 8.10.6. Never shoot on steel that is cratered, pitted, or damaged in any way.
- 8.10.7. Hard ground surfaces under the target shall be covered with plywood or boxed pea gravel.
- 8.10.8. Use only non-toxic paint on steel targets.
- 8.10.9. Inspect all targets before using for damage, functionality, etc.
- 8.10.10. Shooters and observers must wear long pants (no shorts), long sleeve shirts, a cap or hat with a brim, and closed toed shoes.
- 8.10.11. If using frangible ammunition, make sure it is designed to disintegrate into powder on impact. The same velocity rules apply to frangible ammunition as well.

A Local Fire Department shall be informed of the tracer firing requirement. Tracer firing procedures are estimated at less than two (2) hours in time duration.

9. TEST Specimens

The plywood system shall be in situ (situated naturally as intended for use) specimen samples assembled as specified in the ETL, specifically Section 7. *Design Criteria*, Table 3. *Construction Materials for Canopy and Overhead Baffles*. The Troy System is a two part set; the wool and the board, and shall be installed as specified in Troy documents, X.USAF.SRIN.090901.0335.T001.TEST.Troy Tactical Plan Set, with channel metal furring or wooden furring. Each system shall be applied to a BRINELL HARDNESS (BNL) 500 steel plate of 10 mm (0.375 in) mounted as drawn (Appendix A) or in a jig to represent actual facility conditions.

A jig shall hold all media in place and be capable of holding steel and/or concrete with plywood or The Troy System at a 75 degree angle.

10. TEST Duration

The estimated TEST duration is two duty-days; including TEST set-up, TEST procedures and TEST clean-up.

11. Apparatus and Equipment

- 11.1. USAF weapons fired by USAF personnel or by mechanical means.
- 11.2. Air Force approved ammunition, as specified in this document.
- 11.3. Level IV personal protective vests and ballistic helmets shall be worn, or a suitable alternate protection shall be chosen.

**Test Method for Ballistic Performance of Engineering Technical Letter (ETL) 08-11: Small Arms Range Design and Construction, Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction as Compared to The Troy System and Troy Acoustic Panels Attached to Same Substructures (TEST) ©
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- 11.4. Minimum personal protective equipment required for all personnel present are ANZI/OSHA/AFOSH approved eye protection, covered toe shoes, OSHA/AFOSH approved hearing protection, long pants and long sleeves are recommended.
- 11.5. TEST jig and mechanical fasteners for various sample subjects presented for Testing built according to TEST shop drawings, X.USAF.SRIN.090901.0335.T001.TEST.In-Situ TEST Shop Drawings.
- 11.6. TEST specimen samples as configured.
- 11.7. Visual Recording Equipment.
- 11.8. Fire Extinguisher.
- 11.9. First Aid Kit.

Part A. – General Test Method for Evaluating the Ballistic Performance of ETL 08-11, Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction.

12. TEST Procedure Methodology: Plywood

- 12.1. Using US Air Force service weapons, fire rounds at a 75 degree angle, measured one (1) meter* from the muzzle for each munitions listed at a 11/32” CDX and 17mm Marine Grade plywood panel covering a steel plate specified in paragraph 9. *All 9mm firing will be fired at 55 1/2” from the muzzle due to facility constraints.

Caliber	DODIC	Nomenclature
5.56MM	A059	M855 Ball
5.56MM	AA40	Frangible
7.62MM	A171	M852 Ball
9MM	A363	M882 Ball
9MM	AA16	Frangible

- 12.2. TEST format shall represent “splash-back” ricochets on small arms range Sidewalls and Overhead Baffles. This includes Side Containment Walls, Continuous Walls, and Discontinuous Sidewall Baffles. Shoot this configuration at a 75 degree angle, with muzzle of weapon one (1) meter* from baffle material. *All 9mm firing will be fired at 55 1/2” from the muzzle due to facility constraints.
- 12.3. A quantity of three (3) rounds of each caliber and type of round shall be fired into a designated four (4) inch by four (4) inch area on each Ballistic Safety Structure and Substructure listed above, covered with plywood. A separate area will be designated for each caliber and type of ammunition. Do not intentionally attempt to hit the same hole twice.
- 12.4. Material Safety Data Sheets representing the plywood involved in the TEST shall be submitted with report.

**Test Method for Ballistic Performance of Engineering Technical Letter (ETL) 08-11: Small Arms Range Design and Construction, Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction as Compared to The Troy System and Troy Acoustic Panels Attached to Same Substructures (TEST) ©
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12.5. A typical plywood installation shop drawings as a representation of any such firing range installation shall be submitted with report.

13. Quality Controls, Quality Assurance, and TEST Data Report

- 13.1. The Data Log and Report shall include, and may not be limited to, the following:
 - 13.1.1. Complete identification
 - 13.1.2. Personnel present
 - 13.1.3. History log of set-up and events
 - 13.1.4. Environmental Conditions Statement
 - 13.1.5. Confirmation of in situ specimen features and measurements
 - 13.1.6. Confirmation of jig and apparatus
 - 13.1.7. Systematic Testing sequence and conditions
 - 13.1.8. Data log of events and findings

Part B. – General Test Method for Evaluating the Ballistic Performance of The Troy System.

14. TEST Procedure Methodology: The Troy System

14.1. Using US Air Force service weapons, fire rounds at a 75 degree angle, measured one (1) meter* from the muzzle for each munitions listed at The Troy System panel covering a steel plate specified in paragraph 9. *All 9mm firing will be fired at 55 1/2” from the muzzle due to facility constraints.

Caliber	DODIC	Nomenclature
5.56MM	A059	M855 Ball
5.56MM	AA40	Frangible
7.62MM	A124	M62 Tracer
9MM	A363	M882 Ball
9MM	AA16	Frangible

- 14.2. TEST format shall represent “splash-back” ricochets on small arms range Sidewalls and Overhead Baffles. This includes Side Containment Walls, Continuous Walls, and Discontinuous Sidewall Baffles. Shoot this configuration at a 75 degree angle, with muzzle of weapon one (1) meter from baffle material. *All 9mm firing will be fired at 55 1/2” from the muzzle due to facility constraints.
- 14.3. A quantity of three (3) rounds of each caliber and type of round shall be fired into a designated four (4) inch by four (4) inch area on each Ballistic Safety Structure and Substructure listed above, covered with The Troy System. A separate area will be designated for each caliber and type of ammunition. Do not intentionally attempt to hit the same hole twice.

**Test Method for Ballistic Performance of Engineering Technical Letter (ETL) 08-11: Small Arms Range Design and Construction, Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction as Compared to The Troy System and Troy Acoustic Panels Attached to Same Substructures (TEST) ©
TAC Designation: Z.USAF.SRIN.090901.0335.T001©**

- 14.4. A quantity of three (3) rounds of 5.56mm ball shall be precision targeted fired into each Ballistic Safety Structure and Substructure listed above, covered with The Troy System at steel furring panel butt joints and panel end joints. Do your best to hit the joints, but do not intentionally attempt to hit the same hole twice.
- 14.5. Material Safety Data Sheets representing The Troy System involved in the TEST shall be submitted with report.
- 14.6. A typical Troy System installation shop drawing showing proposed location of sound absorbing materials. Wright Patterson Range AFB, Ohio represents any such firing range configuration shall be submitted with report.
- 14.7. Other Troy System support and test data shall be submitted with report.

15. Quality Controls, Quality Assurance, and TEST Data Reports

- 15.1. The Data Log and Report shall include, and may not be limited to, the following:
 - 15.1.1. Complete identification
 - 15.1.2. Personnel present
 - 15.1.3. History log of set-up and events
 - 15.1.4. Environmental Conditions Statement
 - 15.1.5. Confirmation of in situ specimen features and measurements
 - 15.1.6. Confirmation of jig and apparatus
 - 15.1.7. Systematic Testing sequence and conditions
 - 15.1.8. Data log of events/findings

16. Final Reporting

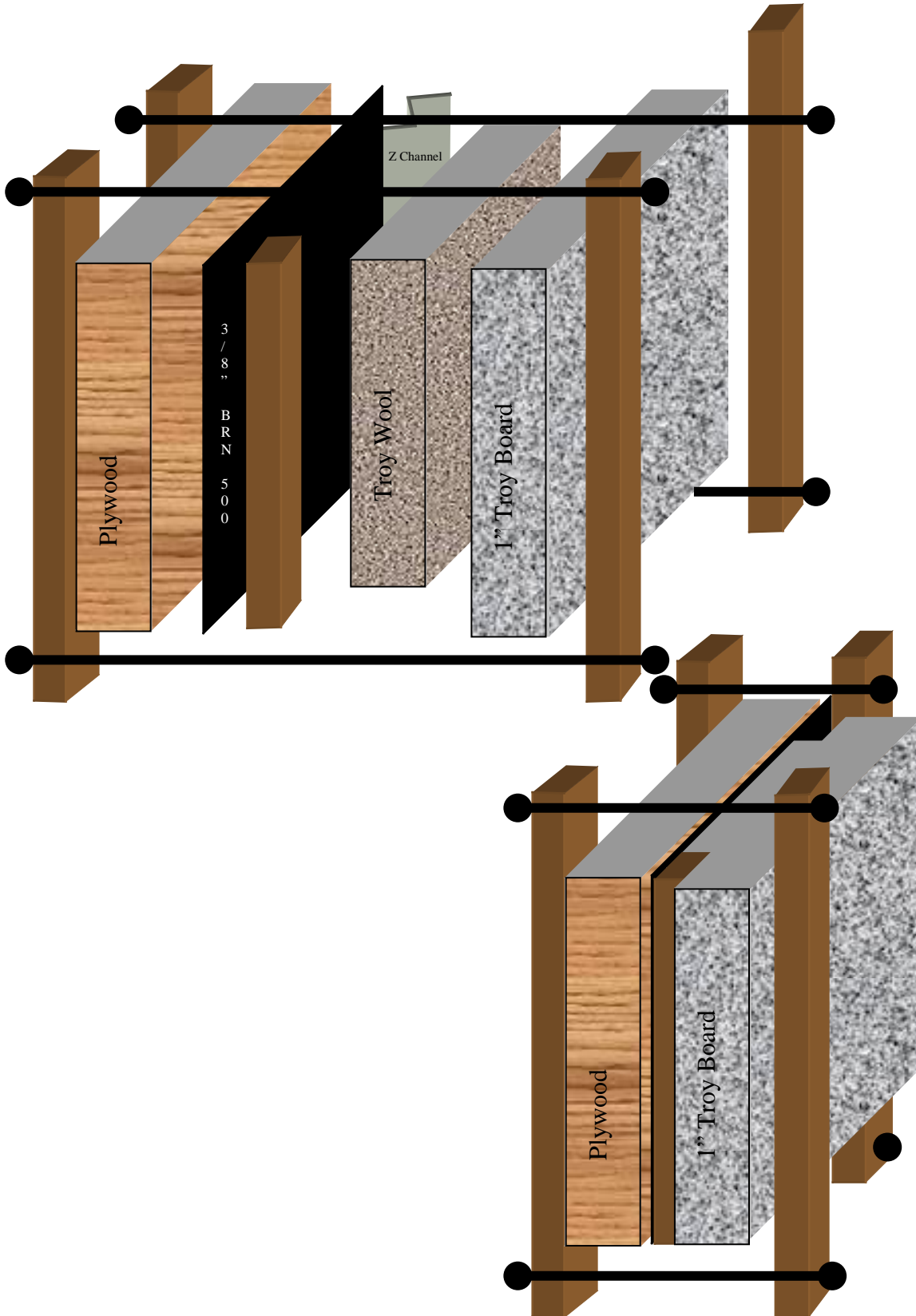
- 16.1. Final Reporting shall be extracurricular to TEST and follow the report template *X.USAF.SRIN.090901.0335.T001.RPT.Final Report Template* and submitted to:

ROLLAND H. ROTH, JR., YC-02, DAF
Program Manager, USAF Combat Arms
HQ AFSFC/SFXW
1517 Billy Mitchell Blvd
Lackland AFB TX 78236-0119
EMAIL: Rolland.Roth@lackland.af.mil

no later than three calendar days from a final TEST data log entry.

Appendix A

Test Method for Ballistic Performance of Engineering Technical Letter (ETL) 08-11: Small Arms Range Design and Construction, Section 7.5 Ballistic Safety Structures, subsection 7.5.4 Baffle Construction as Compared to The Troy System and Troy Acoustic Panels Attached to Same Substructures (TEST) © TAC Designation: Z.USAF.SRIN.090901.0335.T001©



1. Product and Company Identification

Material name	WOOD AND WOOD PRODUCTS
Product use	Building Materials - Structural, Industrial or Decorative
Product List	See Product List found in Section 16
Synonym(s)	Softwood Plywood * Oriented Strand Board (OSB) * Hardboard (Standard, Tempered, Perforated, Paneling) * Lumber Products * Engineered Lumber (LVL, Wood-I-Joists, Rimboard)
Chemical description	Solid wood, such as lumber and wood products, such as softwood plywood, hardboard, oriented strand board and engineered wood products bonded with resin (phenol, phenol resorcinol, melamine formaldehyde-based, or polyvinyl acetate).
Manufacturer information	Georgia-Pacific Wood Products LLC 133 Peachtree Street, NE Atlanta, GA 30303 MSDS Request 404.652.5119 Technical Information 800.284.5347 Chemtrec - Emergency 800.424.9300

2. Hazards Identification

Emergency overview	Sawing, sanding or machining wood or wood products can generate dust. Wood dust may ignite or form explosive mixture with air. Product dust may be irritating to eyes, skin or respiratory system.
Target organs	Eyes, skin and respiratory system
Potential health effects	
Eyes	Dust or splinters may cause irritation or injury to the eyes.
Skin	Contact with skin may cause irritation.
Inhalation	Dusts of this product may cause irritation to the nose, throat, or respiratory tract.
Ingestion	Due to material form and application, ingestion is considered unlikely. May result in irritation of the digestive tract.

3. Composition / Information on Ingredients

Components	CAS #	Percent
Wood/Wood Dust	Not Assigned	60 - 100
Composition comments	Some lumber products may be sprayed with sap stain control coatings. The lumber is air or kiln dried. No chemical residue is left on the surface of the board. Wood products are bonded with phenol, phenol resorcinol, melamine formaldehyde-based, or polyvinyl acetate resin. Some wood products may be coated with finishes, sealants and or overlays.	

4. First Aid Measures

First aid procedures	
Eye contact	In case of contact, immediately flush eyes with large amounts of water, continuing to flush for 15 minutes. Do not rub the eyes. Get medical attention immediately.
Skin contact	If irritation develops, wash with soap and water. Get medical attention if irritation persists.
Inhalation	Remove from area of exposure. If the affected person is not breathing, apply artificial respiration. If persistent irritation, severe coughing or breathing difficulty occurs, get medical attention.
Ingestion	If wood or wood dust is swallowed, get immediate medical attention or advice -- Do not induce vomiting.

5. Fire Fighting Measures

General fire hazards	Wood is combustible when exposed to heat or flame. Wood dusts may form explosive mixtures with air in the presence of an ignition source. An airborne dust concentration of 40 g/m ³ of air is often used as the lower explosion limit (LEL) for wood dust. Avoid breathing dust or decomposition products.
Extinguishing media	
Suitable extinguishing media	Use methods for the surrounding fire.
Protection of firefighters	
Protective equipment and precautions for firefighters	Firefighters should wear full protective clothing including self contained breathing apparatus. Partially burned dust is especially hazardous if dispersed into the air. Wet down to reduce likelihood of ignition or dispersion. Remove burned or wet dust to open, secure area after fire is extinguished.
Explosion data	
Sensitivity to static discharge	Not available
Sensitivity to mechanical impact	Not available
Hazardous combustion products	Hazardous decomposition products may include irritating fumes or gases including carbon monoxide, aldehydes or organic acids.

6. Accidental Release Measures

Personal precautions	Wear appropriate protective equipment and clothing during clean-up. Ensure adequate ventilation. Avoid inhalation of dust during clean up.
Methods for cleaning up	Vacuum or wet sweep small pieces and dust; place in appropriate container for disposal. Gather larger pieces by an appropriate method. Reduce airborne dust and prevent scattering by moistening with water.

7. Handling and Storage

Handling	Dust can form an explosive mixture in air. Provide appropriate exhaust ventilation at machinery and at places where dust can be generated. Use personal protective equipment as required. Avoid frequent or prolonged inhalation of wood dust. Avoid contact with skin, eyes and clothing. Wash hands thoroughly after handling. Keep away from heat and sources of ignition. Keep formation of airborne dusts to a minimum.
Storage	Store flat, supported and protected from direct contact with the ground. Keep in a well-ventilated place away from incompatible materials. Store in a cool dry place.

8. Exposure Controls / Personal Protection

Exposure guidelines	Georgia-Pacific Wood Products LLC voluntarily elects to adhere to exposure limits contained in OSHA's 1989 Air Contaminants Standard although certain limits were vacated in 1992. The present OSHA exposure limits governing wood dust is 15 mg/m ³ (Total Dust) and 5 mg/m ³ (Respirable Fraction).
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Wood/Wood Dust (CAS # Not Assigned)

	TWA	STEL	Ceiling
ACGIH	1 mg/m ³ TWA (Inhalable)	Not established	Not established
OSHA	5 mg/m ³ TWA (Total Dust) (Vacated)	10 mg/m ³ (Vacated)	Not established

Engineering controls	Due to the explosive potential of dust when suspended in air, precautions should be taken when sawing, sanding, or machining wood or wood products to prevent sparks or other ignition sources in ventilation equipment. Local exhaust ventilation is recommended when sawing, sanding, or machining this product. General dilution ventilation is recommended in processing and storage areas. Use wet methods, if appropriate, to reduce generation of dust.
Personal protective equipment	
Eye / face protection	Safety glasses or goggles are recommended when using product. Ensure compliance with OSHA's PPE standard (29 CFR 1910.132 and .133) for eye and face protection.

Skin protection	Impervious protective clothing and gloves recommended to prevent drying or irritation of hands. Ensure compliance with OSHA's PPE standards (29 CFR 1910.132 (general) and 138 (hand protection)). Safety shower/eye wash fountain is recommended in the workplace area (29 CFR 1910.151 (c)).
Respiratory protection	A NIOSH approved dust mask or filtering facepiece is recommended in poorly ventilated areas or when permissible exposure limits may be exceeded. Respirators should be selected by and used under the direction of a trained health and safety professional following requirements found in OSHA's respirator standard (29 CFR 1910.134) and ANSI's standard for respiratory protection (Z88.2)

9. Physical & Chemical Properties

Appearance	Rigid boards or panels
Color	Various
Odor	Resinous wood
Odor threshold	Not available
Physical state	Solid.
pH	Not applicable
Melting point	Not applicable
Freezing point	Not applicable
Boiling point	Not applicable
Flash point	Not applicable
Evaporation rate	Not applicable
Flammability	Combustible
Flammability limits in air, upper, % by volume	Not available
Flammability limits in air, lower, % by volume	40 g/cm ³ for wood dust
Vapor pressure	Not applicable
Vapor density	Not applicable
Specific gravity	Variable
Relative density	Not available
Solubility (water)	Insoluble
Partition coefficient (n-octanol/water)	Not applicable
Auto-ignition temperature	399.2 - 500 °F (204.4 - 260 °C) for wood
Decomposition temperature	Not available
Bulk density	Not applicable

10. Chemical Stability & Reactivity Information

Chemical stability	Stable at normal conditions.
Conditions to avoid	Contact with incompatible materials. High temperatures. Heat, flames and sparks. Dust may form explosive mixture in air.
Conditions of Reactivity	None known.
Incompatible materials	Strong acids, alkalis, oxidizing agents and drying oils.
Hazardous decomposition products	Thermal decomposition may emit irritating fumes or gases of carbon monoxide, carbon dioxide, aldehydes, or organic acids.
Possibility of hazardous reactions	Will not occur.

11. Toxicological Information

Toxicological information	No toxicological data available for this product. Toxicological information for components of this product is listed below.	
	Repeated inhalation of dust from this product may result in respiratory irritation.	
	WOOD DUST. Wood dust may cause dryness, irritation, coughing or sinusitis. IARC and NTP classify wood dust as a carcinogen. This classification is based on the increased occurrence of adenocarcinomas of the nasal cavities and paranasal sinuses associated with exposure to wood dust. The evaluation noted insufficient evidence to associate cancer of the oropharynx, hypopharynx, lung, lymphatic and hematopoietic systems, stomach, colon or rectum with exposure to wood dust.	
Irritancy	Product dust may cause irritation to eyes, skin and/or lungs.	
Sensitization	Not applicable for softwoods.	
Carcinogenicity		
	Wood/Wood Dust (CAS # Not Assigned)	
	IARC - Group 1 (Carcinogenic to Humans)	Monograph 62 [1995]
	NTP (National Toxicology Program) - Report on Carcinogens - Known Human Carcinogens	Known Human Carcinogen
	U.S. - OSHA - Hazard Communication Carcinogens	Present
Mutagenicity	Not available.	
Reproductive effects	Not available.	
Teratogenicity	Not available.	
Synergistic materials	Not applicable.	

12. Ecological Information

Ecotoxicity	Not available.
Environmental effects	Not available.

13. Disposal Considerations

Disposal instructions	Under RCRA, it is the responsibility of the user of the product to determine, at the time of disposal, whether the product meets RCRA criteria for hazardous waste. Dispose of material according to Local, State, Federal, and Provincial Environmental Regulations.
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14. Transport Information

Department of Transportation (DOT) Requirements

This product is not regulated as a hazardous material by the United States (DOT) transportation regulations

Canadian Transportation of Dangerous Goods (TDG) Requirements

Not regulated as dangerous goods.

15. Regulatory Information

US federal regulations	Wood and wood products are considered manufactured articles and are exempt under OSHA's Hazard Communication Standard 29 CFR 1910.1200. Wood dust, a by-product generated from sawing, sanding or machining wood and wood products, is considered hazardous and is regulated under the Hazard Communication Standard 29 CFR 1910.1200.
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Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - No Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No
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Section 302 extremely hazardous substance No

Section 311 hazardous chemical No

Section 313 hazardous chemical No

Inventory status

Country(s) or region	Inventory name	Compliant w/inventory requirements (yes/no)
Canada	Domestic Substances List (DSL) / Non-Domestic Substances List (NDSL)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes
Canadian regulations	This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.	

16. Other Information

Product list

Engineered Lumber Wood I Beam™ Joists and Broadspan™ I-Joists, GP Lam® LVL and Broadspan™ LVL, Fiberstrong® Rim Board

Lumber Sta-Strait™ Finger-Jointed Southern Yellow Pine Lumber, Solid Sawn Wood

Plywood Plytanium® Plywood, Plytanium® DryPly® Plywood, Sanded Pine Plywood, Cargo Panel Plywood, Plywood Sturd-I-Floor®, Plywood Rated Sheathing, Plywood Exterior Siding, Ply-Bead® Panels, Sanded Plywood Project Panels, PlyFrame® Panels, Plywood Underlayment, CDX Plywood; Plyform, T1-11 Textured Plywood Siding, Craftsman® Primer/Sealer Plywood Siding, Craftsman® Sanded Plywood

Oriented Strand Board (OSB) Oriented Strand Board (OSB), OSB Sturd-I-Floor®, OSB Rated Sheathing, Home Advantage® OSB Sturd-I-Floor®, DryGuard® OSB Sturd-I-Floor, Nautilus™ Wall Sheathing, Thermostat® OSB Radiant Barrier Roof Sheathing

Engineered Boards Hardboard, Hushboard® Sound Deadening Board, Coreboard, Uncoated Container Pack, Table Pad Substrate, Jubilee® RTP and White Ice Beadboard Paneling, Lionite® Tileboard Paneling, SuperWood® Industrial Panels, Mark-R Board, Chalk Board, Clutter Cutter™ Panels, UltraStrate® Industrial Panels

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HMIS® ratings

Health: 1*
Flammability: 1
Physical hazard: 0

NFPA ratings

Health: 1
Flammability: 1
Instability: 0

Disclaimer

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Prepared by

Georgia-Pacific LLC
404.652.5119