

NAVAL SEA SYSTEMS COMMAND

What's New in Nonskid?



Mega Rust

Norfolk, VA

June 2017

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TSN Technical Requirements Being Developed

**TSN Fielding
Vital to Amphibious Ships
& Fleet Operations**

Material

Installation Process /Qualifications

In-service

**CURRENT
EPOXY
NONSKID:**

Military specification MIL-PRF-24667C for epoxy nonskid
2 Sep 2009

FY-18, Change 1 Standard Item 009-32
7 Mar 2017

Naval Ships Technical Manual Chapter 634
1 Jan 2009

MRC (Multiple) for Nonskid Inspection and Repair by Ship's Force

**NEW
TSN:**

New military specification MIL-PRF-32577 for TSN wire material.

FY-18 **New** NAVSEA Standard Item 009-BB

Update current MIL-STD-1687A to Technical Publication 1687

Update Naval Ships Technical Manual Chapter 634 to Include TSN

Update MRC for TSN Inspection and Repair by Ship's Force

STATUS: Signed out on 9 Jun 2017

Delivered to CNRMC on 25 Jan 2017

Signed out on 9 Jun 2017

PDS for FY-18 Task

Developmental based on current changes to MRC to reduce risk of nonskid undercutting and forming chips

New TSN Standard Item 009-BB Defines TSN Installation Process

Plan: Publish new Standard Item 009-BB, "Thermal Spray Nonskid Application; accomplish" defines the twin-wire arc spray process & equipment as demonstrated on LHA/LHD.

Process Summary: New Standard Item 009-BB defines requirements starting with required Al_2O_3 aggregate to prepare SSPC-SP 5 "white metal" cleanliness through to final color topping and deck marking.



STATUS: [TSN Standard Item 009-BB released to CNRMC on 25 Jan 2017 to be finalized at July 2017 SSRAC Meeting.](#)

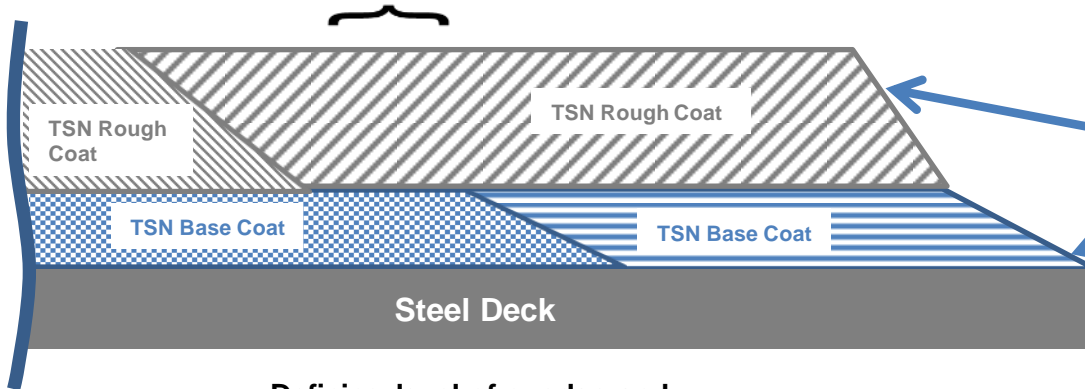
New TSN Standard Item 009-BB Process Requirements to Define Coats

ISSUE: New Standard Item 009-BB uses similar approach with text and Table/Lines to Standard Item 009-32 to show how layers of thermal spray are to be applied to create corrosion-resistant, rough, nonskid system.

Footprint One

Footprint Two

≈5-inch overlap
between layers to
reduce corrosion
risk and distribute
shrinkage stress



Rastering robotic
spray of base coat

Thicker robotic spray of
rough coat

Defining level of overlap and
specific robotic spray set-up
crucial to TSN in-service
performance.

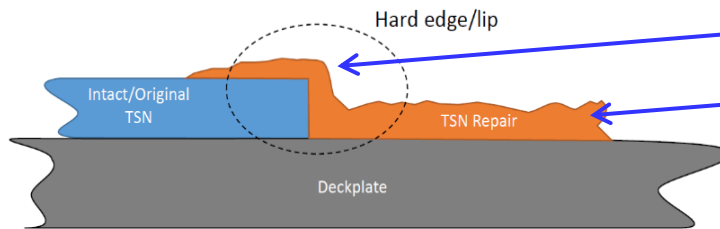
[Standard Item 009-BB defines detailed process, with G-points, to ensure successful application of TSN nonskid coatings.](#)

New TSN Standard Item 009-BB

Appearance of Lip or Edge Around Repairs

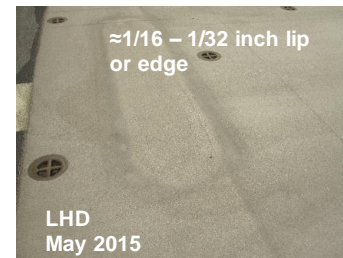
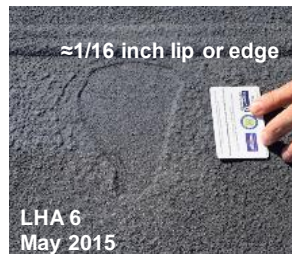
ISSUE: Concern expressed about appearance of lip or edge in Thermal Spray Nonskid (TSN) repairs adversely affecting deck service life.

- Hard lip or edge visible because aluminum-based TSN does not cut smoothly enough to be “feathered” like conventional paints.
- Repair areas less than 8-foot wide are conducted with manual spray because the robotic, rastering system inherently cannot apply TSN to small or irregularly shaped areas.
- Manual thermal spray inherently applies less TSN thickness in repair area to minimize risk of flaking at lip or hard edge.



BACKGROUND: Manual TSN repairs in service on all ships with TSN.

Repairs on all TSN systems still in service.



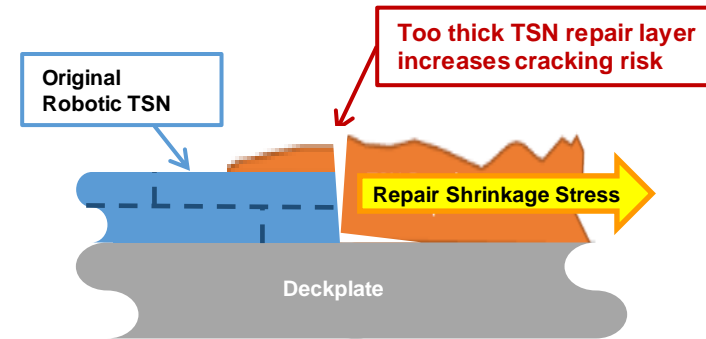
Localized repair creates inconsistent appearance with visible lip/edge. Standard Item 009-BB must establish requirements.

New TSN Standard Item 009-BB

TSN Repair Performance

TSN REPAIR PERFORMANCE CHARACTERISTICS:

- Corrosion Control / Adhesion
- TSN applied to deck as liquid metal droplets that shrink as they cool. Increased layer thickness increases stress and risk of edge cracking/delamination.
 - Robot applies TSN in overlapping, staggered layers to resist cracking.
 - Corrosion testing of scribed TSN-coated steel panels shows >10 mils of TSN resists 1,000 hrs of salt fog exposure and maintains >2,000 psi adhesion (as per new MIL-PRF-32577).
 - New, DRAFT Standard Item 009-BB on TSN application cites thickness range at 25 -150 mils to account for manual repair and robotic application.



Layer Thickness: 4.1 mils
Adhesion: 5,187 psi



Layer Thickness: 12.7 mils
Adhesion: 3,375 psi



Layer Thickness: 24.5 mils
Adhesion: 2,519 psi

Proposed Standard Item 009-BB to require 10 mils of TSN in first coat and 15 mils in second coat.

New TSN Standard Item 009-BB

Update Requirements to Reduce Adhesion Risk on Welds

ISSUE: Small crack observed in TSN after installation.



Crack inspected and found no loose material. Most likely related to inadequate surface profile on weld.

Cut edges of crack away with small rotary power tool. Aluminum-based TSN does not feather effectively.

5 in² weld exposed and applied epoxy primer to seal area.

No other areas with cracks or blisters observed visually and by sounding the deck (i.e., tapping with 5-in-1 tool).

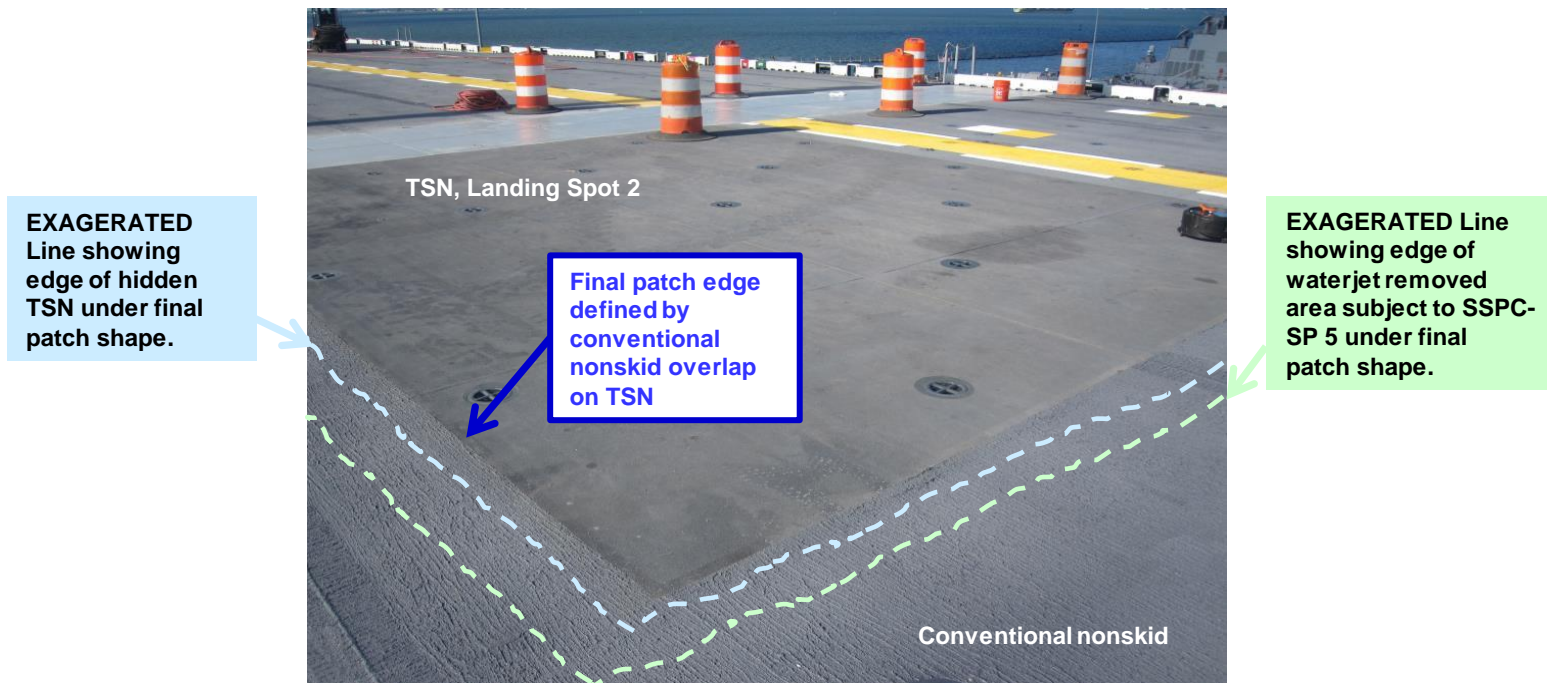
[Plan to discuss the issue at July 2017 SSRAC meeting to obtain NAVSEA, NRL, and industry comments.](#)

New TSN Standard Item 009-BB

Patch Location Process

ISSUE: Thermal spray nonskid (TSN) installations inherently exhibit an irregular edge due to blasting and robot start/stop points. Final patch shape defined by overlapping edge of conventional epoxy nonskid.

- TSN work area is oversized by 12-18 inches of waterjet cleaning and SSPC-SP 5 “white metal” abrasive blasting. TSN patches are oversized by 6-12 inches to allow overlap.
- TSN without color topping is adequately rough for direct application of liquid nonskid primer (i.e., no additional blasting required).
- Overlap ensures any water penetration under the conventional nonskid hits TSN and not the steel deck.



New TSN Material Specification MIL-PRF-32577 Defines Thermal Spray Wire Requirements

Plan: Create new MIL-PRF-32577 "COATING SYSTEM, NONSKID, METALLIC THERMAL SPRAY APPLICATION" to define the wire material used with twin-wire arc spray process & equipment to apply TSN to LHA/LHD flight decks.

Key Material Specification Provisions:

Wires based on aluminum alloys to withstand operational requirements.

Multiple coats of TSN acceptable to build final coating system.

Wire material Type/Class to specify allowable levels of hazardous heavy metals.

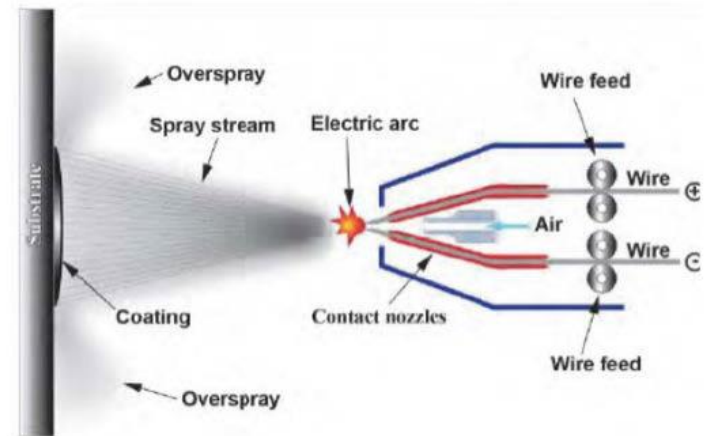
Wire material Type/Class to define whether wire is solid or cored.

Qualification Tests:

Conformance tests (e.g., metals levels, lubricants, packaging) to be conducted on wire feed stock.

Coating conformance tests to exclude silicate color topping (need to prepare a color top specification).

Qualification testing on coating with application parameters demonstrated on LHD and LHA.



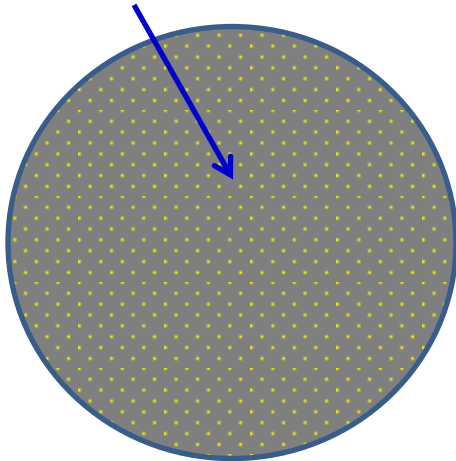
4-Head Robot In Operation

[STATUS: New military specification coordinated through SEA 05S process and in final SEA 05 review.](#)

New TSN Material Specification MIL-PRF-32577 Wire Type

- LHA 6 TSN installed using solid wire that is 97% Al / 3% Ti.
- LHD 1 and LHD 5 TSN installed using cored wire that is 5054 Al jacket / aluminum oxide (400 grit) core.

Cross Section: solid core aluminum wire
with elemental Ti.

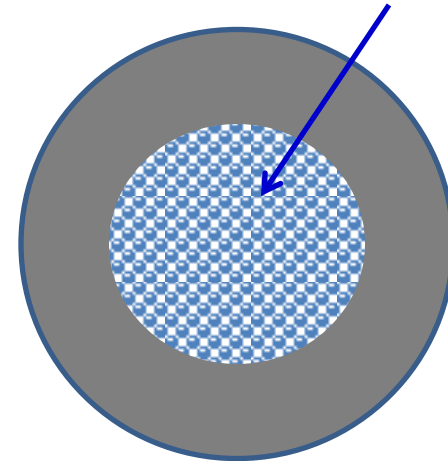


Transfer Efficiency: 68%

Application Rate: 84 - 112 ft²/hour

No reportable chromium on MSDS.

Cross Section: hollow core aluminum alloy wire
with discrete aluminum oxide particles.



Transfer Efficiency: 57%

Application Rate: 84 - 112 ft²/hour

Chromium reported as 0.15 – 0.35%

[New MIL-PRF-32577 to address Types or Class for both solid and cored TSN wire.](#)

Update to MIL-STD-1687A on Process Qualifications Requirements for TSN Applicator Training, Certification & Qualification

Plan: Update MIL-STD-1687A to Technical Publication 1687, "THERMAL SPRAY PROCESSES FOR NAVAL SHIP MACHINERY APPLICATION," to include requirements for personnel training and process qualification to apply TSN wire material with the twin-wire arc spray process and equipment, as-demonstrated by NRL on LHA/LHD.

Key Update Provisions:

- Defines required applicator training.
- Outlines safety requirements.
- Defines applicator qualification process and audit For Quality Assurance.
- Explains to applicator the entire process.



[Updated MIL-STD-1687 to Technical Publication 1687 and change was signed out on 9 Jun 2017.](#)

Action Item - New TSN Standard Item

New Process Creates New Environmental Challenges

Plan: Standard Item 009-01 may need updates to address provisions for HEPA filters and air emission controls to satisfy San Diego, CA Air Quality Management District requirements.



Enclosure Access Door

Enclosure and Support Equipment



Overview of Enclosure



Support Equipment

Status: Presented slides at SSRAC in Aug. 2016.

[Key question is whether Standard Item 009-01 will ensure environmentally compliant application of TSN nonskid coatings.](#)

New Specification Development TSN and Nonskid Color Topping

Plan: Create new specification for color toppings used on TSN and conventional nonskid. Qualified products required to reduce the risk of inadequate markings adversely affecting aviation certification.

Key New Specification Provisions:

- Color toppings must withstand short-term exposure to temperatures above 1,000°F.
- Durability adequate to support full deployment.
- Define color / gloss requirements.
- Measure influence on Coefficient of Friction.

Status:

New start proposal for FY-18.



Development of color topping performance requirements will support competition and define new product types.