

NAVISTAR, INC.		
Material, Parts, and Process Specifications (MPAPS)		NUMBER: MPAPS F-1069
		<i>Former Designation: TMS-1069</i>
TITLE: Steel Tubing for Engine Exhaust Systems	CURRENT REV No: 1711	DATE: Nov. 2017
WRITTEN/EDITED BY: J. Goldschmidt	APPROVED BY: R. Goluch	SUPERSEDES: Rev 1702– Feb. 2017
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<i>This specification may involve hazardous materials, equipment, and procedures. This specification does not purport to address all of the safety issues associated with its use. The user is responsible to consult appropriate safety and health practices and to determine the applicability of regulatory limits prior to use.</i>		

1.0 APPLICATION

This specification covers single wall steel tubing used in exhaust systems with formed, beaded, or straight ends, and applies to tubing 1.625 to 7.00 inches in diameter.

2.0 SCOPE

This specification covers construction, material, finish requirements, welding, design guidelines, tolerances, workmanship standards, and quality control and source approval for different types of exhaust tubing.

2.1 THIS SPECIFICATION SHOULD BE REFERENCED IN PLACE OF MPAPS F-1058 FOR NEW EXHAUST SYSTEMS. Existing parts with drawings that reference TMS-1058 should refer to MPAPS F-1058 for requirements where there are differences, but, if the part/ drawing is revised, then MPAPS F-1069 shall be applied.

2.2 Restricted Chemical Substances

Effective JANUARY 1, 2007, all product supplied to the requirements of this specification must comply with the requirements of MPAPS B-50.

3.0 REFERENCE DOCUMENTS

Unless otherwise specified*, the latest issue of all referenced standards applies. The following specifications, standards, and regulations are referenced herein.

Quality System Standard ISO 9001 or TS-16949
 CFR Title 29, Part 1910 – Occupational Safety and Health Standards
 CFR Title 40, Part 205 – Transportation Equipment Noise Emission Controls
 NAVISTAR D-13 – Supplier Packing and shipping Standard
 NAVISTAR MPAPS A-6, Part II – Low Carbon Steel, Flat Rolled and Structural Shapes - Part II.
 METALLIC COATED SHEET AND STRIP
 NAVISTAR MPAPS A-10, Part I – Mechanical Steel Tubing Part I - Electric Resistance Welded Mechanical Steel Tubing
 NAVISTAR MPAPS A-37 – Stainless/Heat Resistant Steels and Finish Requirements
 NAVISTAR MPAPS B-50 – Restricted Chemical Substances
 NAVISTAR MPAPS F-2 – Fluid System Cleanliness Requirements
 NAVISTAR MPAPS F-1050 – Flexible Steel Hose
 NAVISTAR MPAPS F-1058 – Steel Tubing for Engine Air/Fluid Systems
 NAVISTAR MPAPS F-1068 – Bellows Flexible Pipe
 NAVISTAR MPAPS G-19 Part I – Decorative Copper/Nickel/Chromium and Nickel/Chromium Plating

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NAVISTAR MPAPS G-9015 – Painted Metal Parts for High-Heat Resistance
 NAVISTAR MPAPS L-6614 – Exhaust Piping Insulation
 NAVISTAR MPAPS P-9516 – Quality Requirements for Resistance Spot Welds
 ANSI/AWS A2.4 – Standard Symbols for Welding, Brazing, and Nondestructive Examination
 ANSI/AWS D1.1 – Structural Welding Code - Steel
 ANSI/AWS D1.3 – Structural Welding Code - Sheet Steel
 ANSI/AWS D1.6 – Structural Welding Code-Stainless Steel
 ANSI AWS D8.8 – Specification for Automotive Weld Quality - Arc Welding of Steel
 ASME Y14.5M-1994* – Mathematical Definition of Dimensioning and Tolerancing Principles

**Conformance to the 1994 version of ASME Y14.5M is required*

4.0 GENERAL REQUIREMENTS

4.1 Welding

Required welding will be specified on the engineering drawing, and will be consistent with the applicable AWS or Navistar welding standard (e.g., AWS D1.1, D1.3 and D1.6 for structural plate/shapes, structural sheet and stainless steel respectively, D8.8 for general welding, and MPAPS P-9516 for spot welding, etc.), unless otherwise specified. Weld symbols shall be in accordance with ANSI/AWS A2.4. Sizes of fillet/groove welds shown on the engineering drawing are **minimum** values.

4.1.1 External weld seams on aluminized tubing shall be metalized with an aluminum coating. The thickness of the remetalized layer should be equivalent to the thickness of the aluminum coating on the base metal to provide equivalent corrosion resistance. The minimum thickness of the remetalized layer shall be 0.00025 inch as measured microscopically on cross sections taken perpendicular to the weld seam. Other methods of measurement of the metalized layer may be used by agreement.

4.1.2 Welds on fabricated tube shall be continuous with a minimum of weld spatter. No weld spatter is permitted on flange sealing surfaces.

4.1.2.1 Aluminized tubing: All weld areas on fabricated **aluminized** tubing, along with uncoated attachments, shall be painted with an aluminum-colored high-temperature paint conforming to the requirements of MPAPS G-9015.

4.1.2.2 Leakage: Welds on fabricated pipes/tubing shall show no leakage when pressure-tested at 25 psi (minimum) pressure. Welds on fabricated pipes/tubing bellows assemblies' maximum leakage rate shall be less than 0.03 Standard Cubic Feet of air per Minute at 10 psig.

4.1.3 Weld filler metal: When welding exhaust tubing specified to this spec, the weld filler metals specified in Figure 9 must be used, unless otherwise agreed upon by NAVISTAR Engineering.

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4.2 Workmanship

4.2.1 Dimensional Tolerances: Unless otherwise specified, the dimensional tolerances shown in Figures 1 through 11 shall apply, and the standard dimensional tolerances shown in the title block of the engineering drawing are not applicable. Dimensioning and tolerancing shown in these figures is in accordance with ASME Y14.5M-1994. Cylindricity of tubing shall not exceed 1.5% of the nominal tube diameter. For parts specified to have **tube ends** sized, cylindricity at the ends shall be within the indicated diameter tolerance as shown in Figures 2 thru 7.

4.2.2 Wrinkles in or adjacent to bends shall not exceed 0.040-inch depth.

4.2.3 Reduction of the OD in bend areas shall conform to limits shown in chart #1 and Figure 1.

4.2.4 Quality: There shall be no severe scratches or tool marks on the pipe/tube. All product supplied to the requirements of this specification shall be free of rust, stains, oil, dirt, metal chips, grease, etc., and shall be clean and dry to the touch. When specified on the engineering drawing, the pipe(s) shall meet the applicable cleanliness requirements of MPAPS F-2, and when so specified, the ends of the pipe shall be capped, or otherwise protected so as to prevent contamination in shipment and/or storage. Parts provided for service, to individual users or to Parts Storage facilities, are generally required to be individually end-capped.

4.3 Construction

Engineering design is generally based upon single piece construction, rather than cut and weld construction. The welding process adds extra cost and introduces distortion, which reduces the consistency and accuracy of alignment at the tube ends. Use of cut and weld construction is permissible when bend radius and straight between bends are outside the limits shown in Chart #1 (see Section A.4 for additional discussion).

4.3.1 In many cases, tubing and any other parts of the exhaust systems that gas passes through are parts of the truck system which are required to meet Federal Noise Regulations (CFR Title 40, Section 205). All such applications shall be so indicated on the engineering drawing, and in these applications no deviations in construction and/or material outside the allowance of Section 4.3 shall be permitted without prior Engineering approval.

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4.4 **Material and Finish**

Unless otherwise specified, tubing supplied will meet requirements for the Type as indicted below.

4.4.1 **Tubing Types:**

Type I	<i>This type is no longer used, and is superseded by Type VI below. (Aluminized steel tubing would be replaced with Type VIA.)</i>
Type II	<u>409 Ferritic Stainless Steel</u> : Uncoated Type 409 (UNS S40900) per MPAPS A-37
Type III	<u>439 Ferritic Stainless Steel</u> : Uncoated Type 439 (UNS S43035 or UNS S43932) per MPAPS A-37
Type IV	<u>304 Austenitic Stainless Steel</u> : Uncoated Type 304 (UNS S30400) per MPAPS A-37
Type V	<u>201 Austenitic Stainless Steel</u> : Uncoated Type 201 (UNS S20100) per MPAPS A-37
Type VI	<u>Low carbon steel tubing</u> : Uncoated 1008/1010 steel tubing, Grade H-F, per MPAPS A-10, Part I (20 ksi min yield strength)

4.4.2 **Suffix Requirements for Tubing Types:**

Bare tubing of the type specified will be supplied unless one of the following suffixes is added to the tubing type on the drawing (e.g., Type IIA, Type IIC, Type V-EP, etc.):

Suffix	Description
A	Aluminized Coating Tubing will be supplied with an aluminized coating per MPAPS A-6 Part II, Grade 1A, Class T1-75 or T1-120, except minimum aluminized coating weight will be 60 g/m ² (single spot test).
C	Chromium Plated Stainless steel tubing will be supplied with chromium plating per MPAPS G-19 Pt I. Chromium plating on carbon steel tubing must meet MPAPS G-19 Part I, Class SC-4.
EP	Electropolish and Chrome Flash Stainless steel tubing will be electropolished, followed by a chrome flash, to meet the finish requirements of MPAPS A-37 Type 3.

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4.5 Tubing Wall Thickness

Tubing wall thickness shall be shown on the engineering drawing.

5.0 THERMAL MANAGEMENT

For exhaust insulation and its application, see MPAPS L-6614.

6.0 SOURCE APPROVAL AND QUALITY CONTROL

6.1 Supplier Requirements

All suppliers to NAVISTAR are required to be registered to ISO 9001 Quality System Requirements. NAVISTAR will also accept TS-16949 registration as long as the supplier can also fulfill all AIAG PPAP (Production Part Approval Process) documentation and approval requirements. Suppliers must maintain their certification with an accredited registrar and must furnish copies of registration certificates to their Corporate Buyer upon request.

6.2 Approval

Parts supplied against contracts or purchase orders citing this specification shall be equivalent in all respects to those samples which were approved by the purchaser. No changes in formulation or processing practices are permitted without approval. In the event that changes in material, properties, processing practices, construction, color, or labeling of the product are required, the supplier shall notify Materials Engineering and Purchasing and Supplier Development of the proposed change(s). Test data indicating conformance to all requirements of this specification, test samples, and new or amended or updated Material Safety Data Sheet(s) (MSDS), in accordance with CFR Title 29, Part 1910 shall be submitted with the request for change.

6.3 Process Control

The supplier shall either perform and report results of tests on specific lots of parts produced using ISO 9001 or TS-16949 guidelines, or provide statistical evidence of the lot having been produced in a state of statistical control and with a process capable of providing all required properties. The part supplier and the quality control manager of the using NAVISTAR plant may determine testing and reporting requirements on specific products.

7.0 SHIPPING, PACKING AND IDENTIFICATION

Loading, packing and identification shall be in accordance with Navistar Supplier Packing and Shipping Standard D-13.

7.1 Color Marking

A special identification-color marking shall be applied to those specific exhaust-turbo pipes as identified on the Engineering drawing. The color marking shall be applied to the engine end of the tube. The color of the marking shall be either red or black as indicated, and shall be of a uniform shape. The size of the color marking shall not be less than $\frac{1}{2}$ inch², nor greater than 3 inch². The marking must have sufficient durability to be maintained through packaging, shipping, handling, and all manufacturing assembly operations. The specific color marking process used by the supplier must be approved by the Quality Department(s) of the using NAVISTAR Assembly Plant(s). No changes to the (approved) marking process shall be made without the approval of the using

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8.0 DESIGNATION ON DRAWINGS

8.1 Material

For part drawings, the following UG stamp (#S77) should be used, with the material type specified in the blank:

FOR PIPE FINISH, MATERIAL SPEC,
WORKMANSHIP & WELDING SEE MPAPS F-1069
TYPE _____

(Refer to Section 4.4 for applicable tubing types and suffixes to use in this stamp.)

8.2 Exhaust assemblies

The same note/stamp used above should also be used on assembly drawings, but the last line (Type ____) should be deleted (i.e., tubing type will not be specified on an assembly drawing).

Optional drawing notes:

For designs involving welding of aluminized tubing, the following note may be added to the drawing in:

“Finish per MPAPS F-1069, Section 4.1.2.1, after welding.”

8.3 Exhaust Connection Description

Drawing must designate exhaust connection type per any pipe end treatments listed in this document.

9.0 TECHNICAL INFORMATION

For further information related to the technical content of this specification, contact:	Suppliers may purchase controlled copies of this specification by contacting:
Materials Engineering and Technology Dept. 10400 W. North Avenue Melrose Park, IL 60160 E-mail: MaterialsEngineering@Navistar.com	IHS Markit Inc. 15 Inverness Way East Englewood CO 80112-5776 Phone: 1-800-854-7179 E-mail: Automotive@IHS.com Website: http://global.ihs.com

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A.0 GENERAL INFORMATION (NOT A REQUIREMENT)

In order to obtain maximum life for pipe/tubing systems, to standardize designs and minimize costs, procedures described herein should be followed. This is particularly important with regard to bend radii and bend locations relative to each other.

A.1 Design Procedure for Engineering Reference

A more effective and efficient method for the design of tubular products used in engine air/fluid systems has been developed. This method involves the simple use of a line drawing (center line) and XYZ coordinate table. An example of this method is shown in Figure 10. All radii are specified to the center line of the pipe and all dimensions are given from the centerline and intersecting points. Provision of coordinates is via the XYZ-Tubing program available within the UNIGRAPHIC GRIP Program system. All dimensions are basic except radii to be .5 (12.7).

A.1.1 The use of this design method facilitates transfer of data from the engineering drawing to manufacturing operations. The data can be transferred directly from the drawing into CNC controlled tube benders and/or coordinate measuring systems to permit manufacturing/inspection without the need for intermediate manufacturing drawings and/or checking/testing templates or fixtures. The elimination of these steps improves efficiency/economy of operations.

A.2 Manufacturing Methods and Design Procedure

"Press" (compression) bends generally have higher production rates and hence lower costs than "Mandrel" bends and should be used whenever space permits their larger radii and lesser degree of bend. The supplier should be consulted for the preferred bend radius and availability of tooling before release of the drawing. The minimum bend radii shown in Chart #1 should only be used in applications where critical spatial restraints justify the smaller radii.

A.2.1 Avoid **bends** that are too close together and the use of "bends-within-bends." They are difficult to fabricate, require non-standard tooling, and add significantly to the cost of the product. In many cases, rotating the bends will achieve the same result while permitting the use of standard tooling and reducing the costs. Use Chart #1 as a design guide to maintain adequate distance between bends.

A.2.2 All radii on pipes/tubes should be the same to minimize tool changes and set-up time. The exception to this rule is the special case where bends smaller than those shown in Chart #1 are necessary at one or two points and space permits the use of larger bend radii (as shown in Chart #1) at other points. The tubing fabricator/supplier should be consulted for guidance in these cases.

A.2.3 Flex Pipe: See MPAPS F-1050 for data on spiral wound flex. See MPAPS F-1068 for data on Bellows flex.

A.3 Recommended Wall Thickness

Pipe Application	Non-SST Material	SST Material
Flared / turbo connection	0.083 – 0.112 in.	0.083 – 0.112 in.
Flared / non-turbo connection	0.083 in.	0.071 in. MIN
Non-Flared	0.065 in.	0.065 in.

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