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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------------------------------|
| <b>NAVISTAR, INC.</b>                                                                                                                                                                                                                                                                                                                   |                                  |                                              |
| <b>Material, Parts, and Process Specifications<br/>(MPAPS)</b>                                                                                                                                                                                                                                                                          |                                  | NUMBER:<br><b>MPAPS- F-1050</b>              |
|                                                                                                                                                                                                                                                                                                                                         |                                  | Former Designation: <b>TMS-1050</b>          |
| TITLE:<br><br><b>Flexible Steel Hose</b>                                                                                                                                                                                                                                                                                                |                                  | CURRENT REV No.:<br><b>1604</b>              |
|                                                                                                                                                                                                                                                                                                                                         |                                  | DATE:<br><b>April 2016</b>                   |
| WRITTEN/EDITED BY:<br><b>W. Cook</b>                                                                                                                                                                                                                                                                                                    | APPROVED BY:<br><b>R. Goluch</b> | SUPERSEDES:<br><b>Rev. 0904 – April 2009</b> |
| <b>PRINTED COPIES OF THIS DOCUMENT MUST BE VERIFIED FOR CURRENT REVISION</b>                                                                                                                                                                                                                                                            |                                  |                                              |
| <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> |                                  |                                              |
| <b>Change Notice: Released in MPAPS Format; Increased allowable thickness range and add 304L as material option for 4" OD and larger hose ( 4.1.1); Added restriction weld start/ stop point (4.10.1); Editorial changes</b>                                                                                                            |                                  |                                              |

## 1.0 APPLICATION

This specification covers two types of flexible steel pipe/hose used for making connections between pipes used in the exhaust system. The pipe described in this document is not to be used when raw fuel is present in the exhaust gas traveling through the piping; bellows per MPAPAS F-1068 should be specified when this is the case.

## 2.0 SCOPE

This specification covers requirements for the material, construction, dimensions, quality, leakage, installation, design guidance, source approval and quality control, for both types of hose.

TYPE I - ID Controlled

TYPE II - OD Controlled

**THIS SPECIFICATION REPLACES ENGINEERING DRAWING AM-76710.**

References on existing drawings to AM-76710 for materials, construction, dimensions, Installation, etc..., are superseded by this specification.

## 2.1 Restricted Chemical Substances

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

## 3.0 REFERENCE DOCUMENTS

Unless otherwise specified the latest issue of all referenced standards shall apply. The following specifications and standards are referenced in this specification.

Quality System Standard ISO 9001 or TS-16949  
NAVISTAR Engineering Design Std A-16  
NAVISTAR Manufacturing Std MS-D-13  
CFR Title 29, Part 1910  
CFR Title 40, Part 205  
NAVISTAR Engineering Dwg. AM-76710

NAVISTAR Engineering Dwg. AM-82853  
NAVISTAR Engineering Dwg. WCL-7400  
NAVISTAR Engineering Drawing AD-6955  
NAVISTAR MPAPS B-50  
NAVISTAR MPAPS F-1068  
NAVISTAR MPAPS A-37

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| NUMBER:<br><b>MPAPS F-1050</b> | TITLE<br><b><i>Flexible Steel Hose</i></b> | REVISION:<br><b>1604</b> |
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## **4.0 REQUIREMENTS**

### **4.1 Material**

**4.1.1** For 4-inch O.D. hose or larger: Type 302, Type 304, 304L or Type 321 stainless steel per MPAPS A-37, cold rolled stainless steel strip 0.015-0.020 inch thick, Finish No. 2D, 2B, or Bright Annealed.

**4.1.2** For hose greater than 2.5" O.D. and less than 4" O.D.: Type 409 or 300 series Stainless Steel per MPAPS A-37. Exception: Pulling force for a 15% min extension shall be a **maximum** of 45 pounds (see Construction Requirement, Section 4.2).

**4.1.3** For 2.5" O.D. hose: 300 series stainless steel per MPAPS A-37 (Optional: Type 439 stainless steel)

### **4.2 Construction**

Hose shall be constructed of an interlocked series of metal convolutions tightly wound about an axis so as to require a **maximum** pulling force of 35 pounds\* to achieve an extension of 15% from the compressed length. Extension shall be 2.5 inches per foot minimum from the compressed position. Hose may be provided unpacked or packing with copper or stainless steel wire is permissible; asbestos packing shall not be used. End coils shall be tack-welded (both ends) after cutting to length (refer to Section A.1.1). Both ends shall have all burrs removed.

\* Note: There is a direct correlation between the **minimum** allowable pulling force to achieve a 15% extension and the maximum allowable leakage rate. The max allowable leakage rate constrains the minimum pulling force.

### **4.3 Leakage Rate**

Maximum leakage rate of hose in the one-half extended position shall be two standard cubic feet of air per minute per foot of hose at 4 psig. (Note: This requirement is necessary in order to meet 80dB pass-by noise testing; reference CFR Title 40, Part 205.)

### **4.4 Dimensions**

#### **Bore Diameter - Type I only**

| <b><u>ID</u></b>   |                  | <b><u>Tolerance</u></b> |                  |
|--------------------|------------------|-------------------------|------------------|
| <b><u>Inch</u></b> | <b><u>mm</u></b> | <b><u>inch</u></b>      | <b><u>mm</u></b> |
| 1.50               | 38.0             | +0.030/-0.000           | +0.75/-0.000     |
| 2.00               | 50.0             | +0.030/-0.000           | +0.75/-0.000     |
| 2.25               | 57.0             | +0.030/-0.000           | +0.75/-0.000     |
| 2.50               | 65.0             | +0.030/-0.000           | +0.75/-0.000     |
| 2.75               | 70.0             | +0.030/-0.000           | +0.75/-0.000     |
| 3.00               | 75.0             | +0.030/-0.000           | +0.75/-0.000     |
| 3.25               | 82.0             | +0.030/-0.000           | +0.75/-0.000     |
| 3.50               | 90.0             | +0.030/-0.000           | +0.75/-0.000     |
| 4.00               | 100.0            | +0.030/-0.000           | +0.75/-0.000     |
| 5.00               | 125.0            | +0.030/-0.000           | +0.75/-0.000     |

Bore ovality tolerance will not exceed the total applicable ID tolerance

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| NUMBER:<br><b>MPAPS F-1050</b> | TITLE<br><b>Flexible Steel Hose</b> | REVISION:<br><b>1604</b> |
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### **Outer Diameter - Type II only**

| <b><u>OD</u></b>   |                  | <b><u>Tolerance</u></b> |                  |
|--------------------|------------------|-------------------------|------------------|
| <b><u>inch</u></b> | <b><u>Mm</u></b> | <b><u>Inch</u></b>      | <b><u>mm</u></b> |
| 2.50               | 65               | +0.020/-0.010           | +0.50/-0.25      |
| 2.75               | 70               | +0.020/-0.010           | +0.50/-0.25      |
| 3.0                | 75               | +0.020/-0.010           | +0.50/-0.25      |
| 3.5                | 90               | +0.020/-0.010           | +0.50/-0.25      |
| 4.0                | 100              | +0.020/-0.010           | +0.50/-0.25      |
| 5.0                | 125              | +0.020/-0.010           | +0.50/-0.25      |

Outer diameter ovality tolerance will not exceed the total applicable OD tolerance.

#### **4.5 Length** - applies to both Type I and Type II

Specific requirements for cut lengths of hose for each part number are shown on the Engineering Tabulation drawings. Tolerance for compressed (solid) length is +0.050/-0.000 inch (+1.25/-0.00 mm). Cut lengths of hose shall be furnished in an extended length which is approximately midway between the compressed length and full extension (see engineering tabulations for specific requirements); tolerance for furnished length is +0.25/-0.00 inch (+6.5/-0.00 mm).

#### **4.6 Straightness** - applies to both Type I and Type II

Cut lengths of hose shall be straight within 0.25 inch/foot (20 mm/m).

#### **4.7 Installation**

Install hose in the 10 %, partially extended position, normally one-half of the total extension.

#### **4.8 Bending Radius**

The minimum inside bend radius for flex pipe connections is shown below:

**Note:** Installation of the flex pipe in a bent condition may significantly reduce the service life of the flex pipe because opposite sides of the flex pipe will be either extended or compressed beyond the recommended half extended length. If the flex pipe is installed in a bent condition, any further extension or compression may cause yielding of the coils within the bend.

| <b><u>Flex Pipe Diameter (inch)</u></b> | <b><u>Min Inside Bend Radius (inch)</u></b> |
|-----------------------------------------|---------------------------------------------|
| 3.0                                     | 10.5                                        |
| 3.5                                     | 12.5                                        |
| 4.0                                     | 13.5                                        |
| 5.0                                     | 15.5                                        |

#### **4.9 Flow Direction Labeling**

The hose construction as an interlocked series of metal convolutions wound about an axis provides a preferential direction of gas flow through the hose/pipe as indicated in Figure 1. The flex hose shall be marked on the outside diameter of the hose to indicate the preferred direction of flow. The method of marking and frequency of the markings shall be agreed upon between Engineering, the Quality Department of the receiving NAVISTAR Plant(s), and the supplier. Upon agreement, no changes in the marking procedure/process will be made without the prior approval of Engineering and the Plant Quality Department(s). An example of an approved marking is shown in Figure 2. NAVISTAR engineering assembly drawings should specify the flow direction when flex pipe is used in the assembly.

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