

INCH-POUND

MIL-PRF-62099C(AT)

27 May 1996

SUPERSEDING

MIL-T-62099B(AT)

4 October 1972

## PERFORMANCE SPECIFICATION

### TRANSMISSION, HYDRAULIC: MODIFIED AUTOMATIC TX-100-1

This specification is approved for use by the U.S. Army Tank-automotive and Armaments Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This specification covers one type of Modified Commerical Hydraulic Transmission assembly for use in military vehicles.

#### 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A

FSC 2520

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

## SPECIFICATIONS

## DEPARTMENT OF DEFENSE

- |             |   |
|-------------|---|
| MIL-L-2104  | - Lubricating Oil, Internal-Combustion Engine, Combat/Tactical Service.   |
| MIL-L-21260 | - Lubricating Oil, Internal-Combustion Engine, Preservative and Break-In. |
| MIL-L-46167 | - Lubricating Oil, Internal-Combustion Engine, Arctic.                    |

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Bldg. 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

## DRAWING

- |         |                 |
|---------|-----------------|
| 8355951 | - Transmission. |
|---------|-----------------|

(Copies of these drawings are available from the U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SAE AS478 - Identification Marking Methods (DoD Adopted).

(Application for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings for Iron and Steel Products (AASHTO M111) (DoD Adopted).

(Application for copies should be addressed to the American Society for Testing and Materials, 100 Barr Harbor Drive, W. Conshohocken, PA 19428-2959.)

GENERAL MOTORS CORP., (GM)

GM 9540P -Accelerated Corrosion Test.

(Application for copies should be addressed to General Motors Corp., c/o Global Engineering, 15 Inverness Way, Englewood, CO 80112.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

3.1 Materials. Materials specified herein and in referenced drawings, specifications, and standards shall be free from all defects and imperfections that might affect the serviceability and function of the finished product (see 4.4).

3.1.1 Oil. Oil conforming to Grade 1 of MIL-L-21260 shall be used during each transmission evaluation sequence. After the transmission is installed in its intended vehicle, oil conforming to MIL-L-46167 shall be used when the transmission is operated in ambient temperature below 0 degrees Fahrenheit (°F). Oil conforming to grade 10 of MIL-L-2104 shall be used when the transmission is operated in ambient temperature above 0°F (see 4.4).

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3.2 Construction. The transmission construction and assembly shall be in accordance with Drawing 8355951. All parts requiring identification shall be marked in accordance with ANSI/SAE AS478 (see 4.4 and 4.5).

### 3.3 Performance.

3.3.1 Temperature range. The transmission converter out oil temperature shall not exceed 300°F during each transmission evaluation sequence and production runs (see 4.4).

3.3.2 Warm-up. During the warm-up period the transmission shall show no evidence of mechanical malfunction and shall maintain an oil sump temperature of between 160 and 200°F (see 4.3.1).

3.3.3 Functional pressure and flow requirements. With the transmission operating as indicated in table I, the transmission shall meet the functional pressure and flow requirements indicated therein (see 4.3.2).

TABLE I. Functional pressure and flow requirements

Item	Reverse operation	Forward operation
Throttle valve (TV) lever position	Full on	Full on
Range selector lever position	Rev	1-3
Input speed, revolutions per minute (rpm)	2180 - 2220	2980 - 3020
Output torque, pound-feet (lb-ft)	No Load	No Load
Main oil pressure, pounds per square inch (psi)	275 to 340	
Lockup clutch oil pressure, psi	0	120 to 150
Cooler "out" oil pressure, psi		10 to 30

3.3.4 Automatic range upshift at detent position (TV). The automatic upshifts shall occur as specified in table II with the TV lever at the detent position and the range selector lever in the selected range. Lockup clutch pressure shall drop momentarily during the shift and rise again when shift is completed (see 4.3.3).

TABLE II. Automatic range upshift.

Item	Input speed, rpm	
Range selector lever 1-3 position	Min.	Max.
1-2 shift	3400	3600
2-3 shift	3400	3600

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3.3.5 Closed TV stop. With the TV fully closed, the TV lever shall be between 30.5 and 31.5 degrees from the detent position (see 4.3.4).

3.3.6 Automatic range upshifts input speed limits (through detent). The transmission shall not automatically upshift at input speeds less than 3700 rpm with the TV lever at full-on position and with the range selector in 1-3 position (see 4.3.5).

3.3.7 Drive range automatic downshift. The transmission shall produce an automatic 2-1 downshift between 775 and 985 rpm output speed (see 4.3.6).

3.3.8 Drive range converter stall capacity. With the output shaft stalled by the dynamometer and with the range selector lever in the 1-3 range position and with TV lever in the full-on position, the converter input stall speed and output torque shall conform to the requirements of table III. Cooler oil flow shall be 7.5 gallons per minute (gal/min) (see 4.3.7).

TABLE III. Converter stall capacity

Item	Min.	Max.
Input speed, rpm	2000	2350
Input torque, lb-ft	240	260
Output torque, lb-ft	2500	

3.3.9 Shift inhibitor allowance. The shift inhibitor shall control the downshift as indicated in table IV when the selector lever is manually shifted from the 3-2 position to the 1-2 position and from the 1-2 position to the 1 position (see 4.3.8).

TABLE IV. Shift inhibitor allowances.

Item	Input speed, rpm	
	Min.	Max.
3-2 Downshift	2000	2350
2-1 Downshift	2000	2300

3.3.10 Leakage. During any evaluation sequence or at completion of all evaluations, transmission leakage shall be limited to weep or seep (see 4.3.9, 4.5, and 6.3).

3.3.11 Submersion. The transmission, pressurized internally with 3 to 7 psi air, shall show no evidence of leakage when immersed in a water bath (see 4.3.10).

3.4 Exterior surface treatment. Unless otherwise specified in the applicable drawings, all exposed exterior surfaces of the transmission and its components shall be painted in accordance with the manufacturer's standard practice (see 4.5). All external component materials shall have corrosion resistance equal to or exceeding that provided by hot-dip galvanized 1020 steel, with

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coating thickness in accordance with ASTM A123 (or minimum coating thickness of 0.75 mil on pre-galvanized sheet 0.063 in. or less), with zinc phosphate pre-treatment. A proposed alternate design shall be compared to a galvanized sample (as described above) using the Accelerated Corrosion Test GM 9540P Method B 120 cycles, or until prior failure of one of the items with defects such as extensive corrosion at scribe or significant penetration of base material.

3.5 **Reliability.** The transmission shall require no repair or maintenance, other than oil and oil filter changes and oil additions, during 5000 miles of normal vehicle operation (see 4.5).

#### 4. VERIFICATION

4.1 **Examinations.** Visual, dimensional, and primary functional examinations shall consist of examination for defects listed in table V.

TABLE V. Classification of defects.

Category	Defects	Method of examination
<u>Major:</u>		
101	Dimensions not as specified, affecting interchangeability of major components (see 3.2).	Visual/SIE <u>1</u> /
102	Control levers and valves malfunction (see 3.3).	Functional/Visual
103	Installation of hydraulic lines and fittings improper (see 3.2).	Functional/Visual
104	Dirt or foreign matter plugging oil filter lines or screens (see 3.5).	Functional/Visual
105	Marking improper or not legible (see 3.2).	Visual
106	Scratched, chipped, pitted, or burned (see 3.4).	Visual
107	Paint not as specified (see 3.4).	Visual
108	Leak or drip (weep or seep permissible) (see 3.3.10).	Visual

1/ SIE = Standard Inspection Equipment.

4.1.1 **Failure.** The occurrence of any defect listed in table V, failure to pass any specified test of table VI, or examinations specified in 4.4 or 4.5 shall be cause for rejection of that transmission.

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TABLE VI. Cross reference.

Title	Requirement	Test
Warm-up	3.3.2	4.3.1
Functional pressure and flow requirements	3.3.3	4.3.2
Automatic shift	3.3.4	4.3.3
Closed TV stop	3.3.5	4.3.4
Automatic range upshift, full-on TV lever position	3.3.6	4.3.5
Drive range load	3.3.7	4.3.6
Drive range converter stall capacity	3.3.8	4.3.7
Shift inhibitor allowance	3.3.9	4.3.8.1, 4.3.8.2
Leakage	3.3.10	4.3.9
Submersion	3.3.11	4.3.10

4.2. Test conditions. The transmission shall be installed on an absorption dynamometer test stand with provisions for connecting the drive cover studs to an input power supply, linkage controls, and external hydraulic system. The engine used for input power supply shall be the same type as used in vehicle installation or a suitable equivalent power source. Separate linkage controls shall be provided for the engine throttle, transmission TV lever, and range selector shift lever. The external hydraulic circuit, which includes all oil lines, oil filter, and flowmeter, shall have a pressure drop between the transmission to oil cooler “outlet” connection point and the oil cooler to transmission “inlet” connection point that is in accordance with figure 1. Tests shall be made at ambient room temperatures and oil level shall be in accordance with 4.2.1.

4.2.1 Transmission oil level. The design oil level shall be determined using one of the following options:

- a. Option I. When testing with the sump oil pan installed, fill the transmission with approximately twenty (20) quarts of oil. The oil level shall be at the “Full” mark on the dipstick, as the installation drawing (see 2.2.2) directs, while running in neutral range at 1500 rpm input speed, with output shaft stalled, and with the oil at operating temperature of 160 to 200°F. Adjust the level if necessary by adding or removing oil.
- b. Option II. When testing with the sump pan removed, the bottom of the transmission normally enclosed by the sump oil pan shall be submerged in an oil reservoir to a level approximately one inch below the sump pan splitline. The temperature of the oil in the reservoir shall be maintained in the range of 160 to 200°F.

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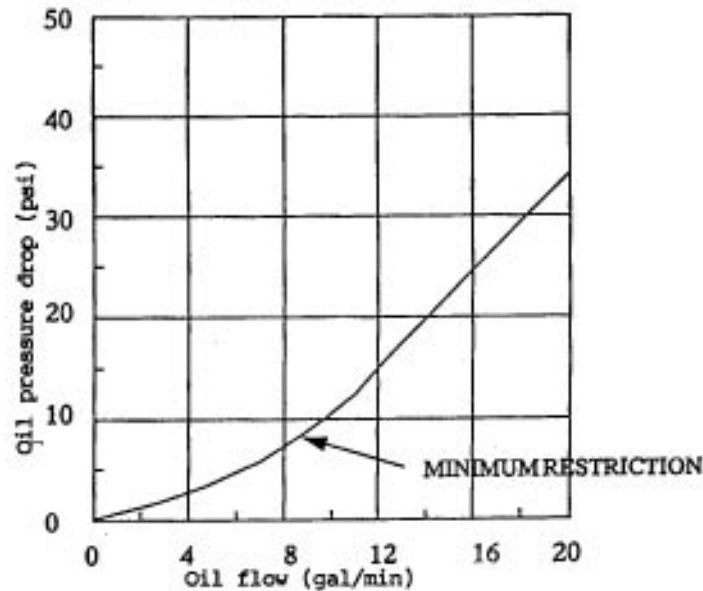


Figure 1. External Hydraulic system oil pressure drop.

#### 4.3 Performance tests.

4.3.1 Warm-up check. To determine conformance to 3.3.2, with the transmission filled with lubricant (see 4.2.1), the following test shall be performed:

- Place the range selector lever in the reverse range gear shift position with the transmission TV lever in the full-on position and the output shaft stalled.
- Increase input speed to  $1000 \pm 50$  rpm and run at this speed until oil pressures stabilize.
- Release the output load on dynamometer, increase the input speed to  $2200 \pm 20$  rpm, and run until all air is evacuated from the converter cooler circuit and sump oil temperatures are stabilized.
- Note reverse function (output rotation opposite input rotation).

4.3.2 Functional pressure and flow test. To determine conformance to 3.3.3, the following test shall be performed:

- Place the range selector shift lever in the reverse position with the TV lever in the "full-on" position and no dynamometer load on the output shaft.
- Increase the input speed to 2200 rpm.
- Determine main oil pressure.
- Reduce input speed to 1000 rpm.



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- e. Place the range selector shift lever in the “1-3” range position and the TV lever in a “full-on” position with no dynamometer load on the output shaft.
- f. Increase the input speed to  $3000 \pm 20$  rpm.
- g. Determine the lockup clutch apply pressure, cooler out oil pressure, and cooler oil flow.

4.3.3 Automatic shift test. To determine conformance to 3.3.4, the following test shall be performed:

- a. Place the range selector shift lever in the “1-3” range position and the TV lever in a “partial-on” position.
- b. Increase the input speed as required to obtain the automatic “1-2” and “2-3” range upshifts.
- c. By adjustment of the TV lever during “2-3” and “3-2” cycle shifts establish the TV lever position that produces a “2-3” range automatic upshift. This position is defined to be the “at detent” position for the TV lever.
- d. Place a light dynamometer load on the output shaft with the TV lever at the “at detent” position.
- e. With the range shift selector lever in the proper range position and with full engine throttle, adjust the output load to obtain all automatic shift points.
- f. Determine the input speed at which each automatic upshift occurs.

4.3.4 TV lever closed-stop adjustment check. To determine conformance to 3.3.5, at completion of the automatic shift test, the input power supply shall be stopped. From the TV lever position established for the “at detent” position, the TV adjustment screw and nut shall be positioned and locked.

4.3.5 “Full-On” TV lever position - automatic range upshift tests. To determine conformance to 3.3.6, the following test shall be performed:

- a. Place the range selector lever in the 1-3 position and the TV lever in the “full-on” position with no dynamometer load on the output shaft.
- b. Increase the input speed.
- c. By adjustment of the TV lever and output load, allow the transmission to upshift “1-2” and “2-3”.
- d. Determine that shifts do not occur before specified minimum input speeds.

4.3.6 Drive range load test. To determine conformance to 3.3.7, the following test shall be performed:

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- a. Place the TV lever in the full-on position.
- b. Increase the output shaft load to produce a “3-2” and “2-1” automatic range downshift.
- c. Determine the output speed at which the automatic “2-1” downshift occurs.

4.3.7 Drive range converter stall test. To determine conformance to 3.3.8, the following test shall be performed:

- a. Stall the output shaft with the dynamometer.
- b. Place the range selector shift lever in the “1-3” range position and the TV lever in the “full-on” position.
- c. Increase the input speed until input torque is within the limits of 240 to 260 lb-ft.
- d. Determine the input speed and output torque in accordance with table III.

#### 4.3.8 Shift inhibitor test.

4.3.8.1 “3-2” shift inhibitor test. To determine conformance to 3.3.9, the following test shall be performed:

- a. With the transmission in “1-3” position and no TV, disconnect transmission output shaft from absorption dynamometer and adjust the engine throttle to obtain approximately 3000 rpm input speed. Check that lockup clutch is engaged.
- b. Manually shift to “1-2” position and slowly decrease input speed to produce a “3-2” automatic range downshift.
- c. Determine the input speed at which the automatic downshift occurs in accordance with table IV.

4.3.8.2 “2-1” shift inhibitor test. To determine conformance to 3.3.9, the following test shall be performed:

- a. With the transmission in “1-2” position and no TV, disconnect transmission output shaft from absorption dynamometer and adjust the engine throttle to obtain approximately 3000 rpm input speed.
- b. Manually shift to “1” position and slowly decrease input speed to produce a “2-1” automatic range downshift.
- c. Determine the input speed at which the automatic downshift occurs, in accordance with table IV.

4.3.9 Leak check. To determine conformance to 3.3.10, visually inspect transmission at various points during test operation and thoroughly at the end of test operation for indications of oil leaks.

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4.3.10 Submersion test. To determine conformance to 3.3.11, when tested in accordance with option II of 4.2.1, one transmission from every ten produced (with sump pan installed) shall be further tested by plugging all holes, pressurizing internally with 3-7 psi air and immersing unit in water bath for visual inspection for leaks. No leaks are permissible. A continuous stream of air bubbles, regardless of size, shall be considered a leak.

4.4 Materials and construction. Conformance to 3.1, 3.1.1, 3.2, and 3.3.1 shall be determined by inspection of contractor records providing proof or certification that materials and construction conform to requirements. Applicable records shall include drawings, specifications, design data, receiving inspection records, processing and quality control standards, test reports, and rating data.

4.5 Defects. Conformance to 3.2, 3.3.10, 3.4, and 3.5 shall be determined by examination for the defects listed in table V and inspection of contractor records as specified in 4.4.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. The transmissions covered by this specification are intended for production use, as spares, or as replacements in military combat and tactical vehicles. Initial application of the transmission was for the M113 family of tracked vehicles.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).

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- c. Packaging requirements (see 5.1).

6.3 Definitions. The following definitions are established as a guide in determining conformance with the leakage requirements of this specification.

- a. Weep - Any evidence of fluid beyond a seal or splitline.
- b. Seep - Any evidence of fluid beyond a seal or splitline that does not result in the formation of a droplet.
- c. Leak - Any evidence of fluid beyond a seal or splitline that results in the formation of a droplet.
- d. Drip - Any evidence of fluid beyond a seal or splitline where droplets form and fall.

### 6.4 Subject term (key word) listing.

Converter, drive range  
Inhibitor, shift  
Lever, throttle valve

6.5 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodian:  
Army - AT

Preparing Activity:  
Army - AT

(Project 2520-0005)

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

<b>I RECOMMEND A CHANGE:</b>		<b>1. DOCUMENT NUMBER</b> MIL-PRF-62099C(AT)	<b>2. DOCUMENT DATE (YYMMDD)</b> 960527
<b>3. DOCUMENT TITLE</b> Transmission, Hydraulic: Modified Automatic TX-100-1			
<b>4. NATURE OF CHANGE</b> (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
<b>5. REASON FOR RECOMMENDATION</b>			
<b>6. SUBMITTER</b>			
<b>a. NAME</b> (Last, First, Middle Initial)		<b>b. ORGANIZATION</b>	
<b>c. ADDRESS</b> (Include Zip Code)		<b>d. TELEPHONE</b> (Include Area Code) (1) Commercial (2) AUTOVON (if applicable)	<b>7. DATE SUBMITTED</b> (YYMMDD)
<b>8. PREPARING ACTIVITY</b>			
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<b>c. ADDRESS</b> (Include Zip Code) Commander U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-TR-E/BLUE, Warren, MI 48397-5000		(810) 574-8745 786-8745	
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