



DEXRON® - IX Automatic Transmission Fluid

1 Scope

1.1 Material Description. This specification covers DEXRON® - IX Automatic Transmission Fluid (ATF) primarily for use in General Motors automatic transmissions. This specification describes, in terms of laboratory and simulated service test results, the requirements for a minimum-performance fluid. The primary requirement is satisfactory performance in normally functioning transmissions under normal and severe conditions.

1.2 Symbols. Not applicable.

1.3 Applicability. This lubricant is to be used in GM Automatic Transmissions and other specified applications.

1.4 Remarks. This specification may involve hazardous materials, operations, and equipment. This specification does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this specification to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use

1.4.1 This specification uses the International System of Units (SI) as standard per Institute of Electrical and Electronics Engineers (IEEE)/ASTM International (ASTM) SI 10 (IEEE/ASTM SI 10), except for certain components, which are commercially available on in American conventional units.

1.4.2 This specification use the Rounding-Off Method per ASTM E29 for signification figures to determine conformance to specification requirements.

1.4.3 Unless otherwise noted, part numbers in this specification refer to those of GM Engine/Transmission Hardware Engineering.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ASTM D92	ASTM D1748	ASTM D5133	ASTM D7896
ASTM D130	ASTM D2240	ASTM D5185	ASTM E29
ASTM D412	ASTM D2270	ASTM D5293	CEC L-45-99
ASTM D445	ASTM D2624	ASTM D5800	CEC L-48-A-00
ASTM D471	ASTM D2983	ASTM D5949	CEC L-084-02
ASTM D665	ASTM D4052	ASTM D6082	DIN 51819 T3
ASTM D892	ASTM D4629	ASTM D6304	FED-STD-791
ASTM D1169	ASTM D4683	ASTM D6443	IEEE/ASTM SI 10
ASTM D1418	ASTM D4927	ASTM D6922	JASO M349
ASTM D1500	ASTM D4951	ASTM D7043	SAE J2643

2.2 GM Standards/Specifications.

GMW3059

2.3 Additional References.

- Afton HiTec 34900. See DEXRON® Committee for current friction materials and plate information
- BorgWarner Friction Material information per www2.borgwarner.com/en/transmission/products/Literature/TS%20-%20Trans%20friction%20products.pdf
- Donaldson Duramax Part Number; P165354, P169310
- FVA-2/IV (Pitting Test Procedure) - Forschungsvereinigung Antriebstechnik (Germany)
- GM Customer Care and Aftersales (CCA) Part Number; 24214202, 24219551, 24223118
- GM Part Number; 9986605
- GM Engine/Transmission Hardware Engineering Part Number; GMPT-0506
- GM Engine/Transmission Hardware Engineering Procedure Matrix
- ITT Standard Company Part Number; SN5-160-02-008-002
- Luk, WFP6300. See DEXRON® Committee for current friction materials and plate information
- Morgan, C., Cummings, J.M., Fewkes, R., Jackson, J.M. A New Method of Measuring Aeration and Deaeration of Fluids, SAE Paper 2004-01-2914. See Statement of Requirements (SOR) Appendix K.
- Morgan, C., Fewkes, R., McCombs, T., Tersigni, S.H., Jackson, J.M. Low-Speed Carbon Fiber Torque Capacity and Frictional Properties Test for ATFs, SAE Paper 2004-01-3026
- Part drawings, including material specifications, are available from Southwest Research Institute (San Antonio, Texas), see Appendix H.
- SAE No. 2 Friction Test Machine available at greeninginc.com/products-and-services/test-equipment/sae-no-2-machine/
- SOR Appendix K
- VWR (laboratory supply company) Grade 417, 25.0 cm Diameter, Part Number 28313-160

2.3.1 Test Method Sources.

- ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, Pennsylvania, 19428-2959, U.S.A. (Available at: www.enterprise.astm.org.)
- EHDPROC_11 is available from Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas U.S.A.
- MERCON SP Procedure 3.14 Specification. Ford Motor Company, ATF Committee, 36200 Plymouth Road, Livonia, Michigan, 48150, U.S.A.
- Test Methods CEC L-45-99 Coordinating European Council, Madou Plaza, 25th Floor, Place Madou 1, B-1030 Brussels, Belgium. (Available at: www.cectests.org)
- VW PV 1454 (Volkswagen test procedure), www.swri.org/sites/default/files/brochures/tribology-research-and-evaluations.pdf

2.3.2 Forms.

- A spreadsheet is available from the GM ATF Committee that contains all report formats, see Appendix H
- All GM DEXRON® testing forms, including Form A, are available from the Team Leader for Service Parts Engineering and DEXRON® Licensing or the GM ATF and Gear Oil Committee Chairman, via GM Supply Power. Folders/ENGINEERING/Powertrain Product Engineering/Transmission.
(gmsupplypower.covisint.com/c/document_library/get_file?p_l_id=4211828&folderId=4501165&name=DLF+E-188908.docx).

3 Requirements

3.1 All materials supplied to this standard must comply with GMW3059, **Restricted and Reportable Substances**, including the requirement to obtain a GM-approved International Material Data System (IMDS) submission.

3.2 Test Requirements. Form A, (see 2.3.2) is required for testing to be started on ATF pursuing DEXRON® - IX approval.

3.3 Mechanical Requirements. Test procedures shall be conducted as specified, with no deviation, unless express written authorization is obtained from the General Motors ATF and Gear Oil Committee. Test transmissions and parts are to be used as received. Replacement or modification of any part shall be made only if directed in this specification or to replace damaged parts. The laboratory must target to the mean of the specified test conditions.

3.4 Physical Requirements. Fluids qualified under this specification shall conform to the test methods and requirements as listed in Table 1.

3.5 Approved Additive Chemistries.

3.5.1 Fluids meeting this specification shall be manufactured using additive chemistries listed in Table 2.

3.6 Requirements for New DEXRON® - IX Additive Chemistry Combinations.

3.6.1 Successful completion of a complete DEXRON® - IX Qualification Program (Table 1).

3.6.2 Successful completion of a complete DEXRON® - IX Qualification Program (Table 1) using the following fluid blends from a to d.

- a. Seventy-Five Percent (75%) Candidate, 25% Reference Fluid.
- b. Fifty Percent (50%) Candidate, 50% Reference Fluid.
- c. Twenty-Five Percent (25%) Candidate, 75% Reference Fluid.
- d. If applicable, 50% Candidate, 50% any previously approved chemistry other than the Reference Fluid.

3.6.3 Successful completion of tests listed in Table 3.

3.6.4 Successful completion of a 241 400 km (150 000 mi) fleet test using the new candidate chemistry and blends of fluids from 3.5.2. A proposal for the fleet test shall be submitted to and approved by the GM ATF and Gear Oil Committee before commencing the fleet test.

3.6.5 Any additional testing as directed by the GM ATF and Gear Oil Committee.

3.7 Additional Requirements.

3.7.1 The test requirements given in this specification are minimum or maximum acceptance limits for valid tests. No adjustments for test precision are to be applied as test variability was taken into account in the determination of the requirements.

3.7.2 The General Motors ATF and Gear Oil Committee reserves the right to require any additional tests that may be deemed necessary to ensure satisfactory performance of fluids submitted for qualification as DEXRON® - IX ATFs.

Table 1: DEXRON® - IX Test Methods and Requirements

TEST	METHOD	REQUIREMENT
Color	ASTM D1500	6.0 to 8.0
Elemental Analysis	ASTM D5185 or ASTM D4951	Report, parts per million (ppm): Ag, Al, B, Ba, Ca, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, Si, Sn, Ti, V, Zn
	ASTM D6443	Report, parts per million (ppm): Cl
	ASTM D4629	Report, parts per million (ppm): N
	ASTM D4927	Report, parts per million (ppm): S
Fluid Profile	Proprietary GM Test	Report
Miscibility and Homogeneity	ASTM D6922	No separation or color change at end of test using Reference Fluid
FED-STD-791	3430-Compatibility	Pass
	3440-Storage Solubility	Pass
Water Content	ASTM D6304	0.1% weight (maximum)
Density	ASTM D4052: 15 °C	Report
Kinematic Viscosity (KV)	ASTM D445	32 cSt at 40 °C (maximum)
		6.4 cSt at 100 °C (maximum)
		Report at 150 °C
		4.5 cSt at 100 °C (minimum) for base oil blend
Viscosity Index	ASTM D2270	145 (minimum)
Flash Point	ASTM D92	180 °C (minimum)
Fire Point	ASTM D92	195 °C (minimum)
Pour Point	ASTM D5949	-45 °C (maximum)
Brookfield Viscosity	ASTM D2983	Report, cP at -10 °C
		1500 maximum at -20 °C
		5000 maximum at -30 °C
		15000 maximum at -40 °C
Scanning Brookfield	ASTM D5133	Run and Record (R&R) -5 °C to -40 °C
Copper Strip Corrosion Test	ASTM D130, Modified: 3 h, 150 °C	1B minimum (see ASTM D130)
Corrosion Test	ASTM D665, Procedure A; 4 h	Pass
Rust Protection Test	ASTM D1748	No rust or corrosion on any test surface

Wear Test	ASTM D7043, Modified:80 °C ± 3 °C 6.9 MPa 11.356 L (3 gal) Conestoga pump parts	5 mg weight loss (maximum)
Bearing Test	DIN 51819 T3, Bearing: Aßmann bearing TBA/TBB Wear: 100 kN/7.5 rpm/80 °C/80 h Pitting: 60 kN/500 rpm/100 °C/200 h	R&R milligram (mg) wear
		R&R in hours (h) pitting
Thermal Conductivity	Run fresh and used oil after Deutscher Koordinierungsausschuss (DKA) (ASTM D7896)	R&R: 40 °C, 70 °C, 100 °C, 130 °C, 170 °C
Electrical Conductivity	ASTM D2624, Modified, Run fresh and used fluid, after Aluminum Beaker Oxidation Test (ABOT)	R&R: 22 °C, 30 °C, 40 °C, 50 °C, 60 °C, 70 °C, 100 °C, 120 °C, 150 °C
Cold Crank Simulation	ASTM D5293: -30 °C	3200 cP (maximum)
	ASTM D5293: -35 °C	Record cP (maximum)
High Temperature, High Shear	ASTM D4683: 150 °C	2.00 cP (minimum)
Noack Evaporation	ASTM D5800	10% evaporation (maximum) 1 h at 200 °C
Film Thickness	EHDPROC_11 at Imperial College	60 °C, Report, Committee Decision
		80 °C, Report, Committee Decision
		100 °C, Report, Committee Decision
		120 °C, Report, Committee Decision
Tapered Roller Bearing Shear 40 h	CEC L-45-99 Modified:3.48 Mrevs, approximately 40 h at 100 °C	Not applicable Viscosity at start of test (SOT)
		5.5 cSt, KV100, (minimum) at End of Test (EOT)
		10% decrease (maximum) at EOT
		5 (Base Oil Viscosity (BOV) + End of Test Viscosity (EOTV))/2 > 5.0 cSt at 100 °C
Tapered Roller Bearing Shear 100 h	CEC L-45-99 Modified: 8.7 Mrevs, approximately 100 h at 100 °C	R&R at EOT
		R&R % decrease (maximum) at EOT
Base Oil Viscosity (BOV)	ASTM D445	45 (minimum)
Heat Capacity	ASTM D7896	Measure to -40 °C to 120 °C

Foam Test	Appendix A ASTM D892 Modified	Fresh Fluid:
		Sequence I, II, III: ASTM D892; 50/0 (maximum)
		Sequence IV, ASTM D6082; 50/0 (maximum)
		After cycling test filtered fluid:
		Sequence I, II, III: ASTM D892; 50/0 (maximum)
		Sequence IV, ASTM D6082; 150/0 (maximum)
		After Thermal Aging at 135 °C for 100 h
		Sequence I, II, III: ASTM D892; 50/0 (maximum)
		Sequence IV, ASTM D6082; 50/0 (maximum)
		After Thermal Aging at 150 °C for 100 h
Report results for all four (4) sequences		
Seal Test Original and New Chemistry Only	Elastomer: Fluid Interaction Phase I Validation (Appendix B, Table B2, Schedule 1 and Schedule 2)	Report and Pass
Forschungstelle Fur Zahnrad und Getriebebau (FZG) - Pitting	Forschungsvereinigung Antriebstechnik (FVA) Number 2/IV: PT-C/9/90, Run three (3) times and report all data	Committee decision
Forschungstelle Fur Zahnrad und Getriebebau (FZG) - Scuffing	CEC L-084-02	Six (6) load stage. A10/16.6R/90C
Plate Friction Test	Appendix C See DEXRON® Committee for current friction materials	Satisfactory operation for 200 h
		No unusual wear or flaking on test parts
		Between 10 h and 200 h of operation:
		Midpoint dynamic torque between 80 Nm and 105 Nm
		Maximum Torque > 90 Nm
		Delta Torque < 30 Nm
		Stop Time between 0.85 s and 1.05 s
		Report End Torque, Newton meters (Nm)
Report Shift Energy, kilojoules (kJ)		

Low-Speed Friction Test SAE No. 2 Friction Test Machine (see 2.3)	Appendix G	BW6100 (see 2.3) fresh fluid	R&R
		BW6100 used fluid (cycling test)	R&R
		WFP6300 fresh fluid	R&R
DEXRON® SAE No. 2 Anti-Shudder Durability (ASD) Use BW6100 friction material, on SAE No. 2, unless otherwise specified.	Appendix F See DEXRON® Committee for current friction materials	> 200 h	
Low Velocity Friction Apparatus (LVFA) Run with fresh and used fluids after Aluminum Beaker Oxidation Test (ABOT) Run at the Additive Supplier Run for New Chemistry	JASO M349 See DEXRON® Committee for current friction materials and plate information	Report	
Aluminum Beaker Oxidation Test	Appendix D	Report	
DKA Oxidation Stability Test	CEC L-48-A-00, 175 °C for 192 h, Method B, See DEXRON® Committee	- Delta Kinematic Viscosity (KV) 40%, 13 maximum. - Delta KV 100%, 12 maximum. - Peak Area Increase (PAI) (units), Report. - Delta Total Acid Number (TAN) (mg KOH/g fluid), Report (typical one (1) to typical three (3)). - Sludge rating of flask, maximum 1.0. Blotter, report with photo.	
Cycling Test	See DEXRON® Committee for test method	See DEXRON® Committee for requirements	
Achsial-Rillen-Kugal-Lager (ARKL)	VW PV 1454 (see 2.3.2)	Report in Degrees Celsius (C)	
Aeration Test Factory fill DEXRON® - IX fluid reference shall be run before every candidate fluid	Appendix H	New fluid must have the following limits: < 3% above reference; Aeration percent 60 °C < 3% above reference; Aeration percent 90 °C < 3% above reference; Aeration percent 120 °C < 5 s above reference; Deaeration 60 °C < 5 s above reference; Deaeration 90 °C < 5 s above reference; Deaeration 120 °C	

		Report result for used fluid after cycling test.
Electrical Resistivity After Cycling Test	ASTM D1169	Report
GM 3-day Wear Test - Using BW6100 and 0% water - Using WFP6300 and 0% water - Using BW6100 with (1000 ppm H₂O) 0.1% - Using WFP6300 with (1000 ppm H₂O) 0.1% specification	Appendix E	
		Average slope at break-in between 10 rpm to 30 rpm (0.06 m/s to 0.37 m/s) should be ≥ 0 s/m. Average slope between 20 rpm to 100 rpm (0.26 m/s to 1.22 m/s) should be ≥ -0.003 s/m at 90 °C sump at EOT for all pressures. Static $\mu = \geq 0.06$.

Note: cP = Centipoise, cSt = Centistoke(s), KV100 = Kinematic Viscosity at 100 °C.

Table 2: DEXRON® - IX Approved Chemistry Combinations

Company	Chemistry Name	Treat Rate Weight Percentage (wt%)	Part Number
Afton	HiTec 34900	15.75	9986605

Table 3: DEXRON® - IX Additional Test Methods and Requirements for New Chemistries

Test	Method	Requirement
3A. Pitting	FVA-2/IV (Pitting Test Procedure)	Equal to or better than reference fluid
3B. Carbon Fiber Durability	MERCON SP Procedure 3.14 Modified: 1) Low Speed Carbon Fiber plates	Equal to or better than reference fluid
3C. Fleet Test	See DEXRON® Committee	See DEXRON® Committee

4 Manufacturing Process

Not applicable.

5 Rules and Regulations

5.1 Legal Regulations. All materials must satisfy applicable laws, rules, regulations and recommendations valid in the country of usage.

5.2 Language. In the event of conflict between the English and domestic language, the English language shall take precedence.

5.3 Inspection and Rejection. All shipments of material or parts under contract or purchase order manufactured to this specification shall be equivalent in every respect to the initial samples approved by Engineering. There shall be no changes in either formulation or manufacturing processes permitted without prior notification and approval by Engineering. Lack of notification by the supplier constitutes grounds for rejection of any shipment. While samples may be taken from incoming shipments and checked for conformance to this specification, the supplier shall accept the responsibility for incoming shipments meeting this specification without dependence upon purchaser's inspection.

The series of tests used to approve each batch of product along with acceptance limits will be agreed upon by the purchaser and seller. The laboratory providing the certificate of analysis must also participate in a proficiency testing program (round robin) that is approved by the Fuels, Fluids, and Lubricants Global Subsystem Leadership

Team (GSSLT) or designate. The Fuels, Fluids, and Lubricants GSSLT or designate must receive copies of the proficiency testing reports directly from the test program administrator.

5.4 Initial Source Approval. No shipment shall be made by any supplier until representative initial production samples have been approved by the Fuels, Fluids, and Lubricants Global Subsystem Leadership Team or designees meeting the requirements of this specification.

5.5 Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS). For new product submissions, or when a change in chemical composition of an existing product has occurred, a complete copy of the Material Safety Data Sheet/Safety Data Sheet must be submitted in compliance with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) requirements or other country-specific MSDS/SDS requirements.

5.6 Trademark Licensing.

5.6.1 Licenses to use the trademark DEXRON® and related "J" identification numbers are issued for fluids which have been tested by an independent laboratory and/or by General Motors and subsequently approved by the General Motors ATF and Gear Oil Committee.

Note: For information on qualification of service replacement fluids for use in General Motors axles, contact, the Team Leader for Service Parts Engineering and DEXRON® Licensing or the GM ATF and Gear Oil Committee Chairman, via GM Supply Power. Folders/ENGINEERING/Powertrain Product Engineering/Transmission. (gmsupplypower.covisint.com/c/document_library/get_file?p_l_id=4211828&folderId=4501165&name=DLFE-188908.docx).

6 Approved Sources

Materials supplied to this specification must be approved by General Motors.

The appropriate GM Materials Engineering department(s) must confirm material as meeting the requirements of this specification. Any test data sheets of material submitted to General Motors for such confirmation (e.g., during Production Part Approval Process (PPAP)) under this material specification must list all properties and must apply corresponding test methods of this material specification.

For other GM locations, the responsible engineering group should be contacted to obtain the approved source in that individual country.

7 Notes

7.1 Glossary.

I/P: The 'I' stands for current, (an 'E' would stand for Voltage) and the 'P' stands for pressure. So, an I/P is an electronic device that converts electric current into a known output pressure

T_{avg}: Average Torque.

VTi An electronically controlled Continuously Variable Transmission (CVT)

7.2 Acronyms, Abbreviations, and Symbols.

%	percent(age)
μ	coefficient of friction
μv	microvolt(s)
Φ	Pressure angle of cam profile
°C	degrees Celsius
ABOT	Aluminum Beaker Oxidation Test
ACM	Acrylic Monomer
ACN	Acrylonitrile
AEM	Ethylene Acrylate Elastomer
ARDL	Akron Rubber Development Laboratory
ARKL	Achsial-Rillen-Kugal-Lager
ASD	Anti Shudder Durability

ASTM	ASTM International
ATC	Air-To-Close
ATF	Automatic Transmission Fluid
BOV	Base Oil Viscosity
CCA	Customer Care and Aftersales
CEC	Coordinating European Council
cP	Centipoise
cSt	Centistoke(s)
CVT	Continuously Variable Transmission
DAS	Data Acquisition System
DC	Direct Current
DKA	Deutscher Koordinierungsausschuss
ECCC	Electronically Controlled Capacity Clutch
EOT	End of Test
EOTV	End of Test Viscosity
ES	Elastomers Standard
FED	Federal
FKM	Fluorocarbon
FVA	Forschungsvereinigung Antriebstechnik (Germany Company)
FVC	Frequency to Voltage Converter
FZG	Forschungstelle Fur Zahnrad und Getriebebau
GHS	Globally Harmonized System of Classification and Labeling of Chemicals
GSSLT	Global Subsystem Leadership Team
h	hour(s)
HNBR	Highly Saturated Nitrile Halogenated Acrylonitrile Butadiene
ID	Inside Diameter
IEEE	Institute of Electrical and Electronics Engineers
IMDS	International Material Data System
J	Joule(s)
kJ	kilojoule(s)
kPa	kilopascal(s)
KV	Kinematic Viscosity
KV100	Kinematic Viscosity at 100 °C
LVFA	Low Velocity Friction Apparatus
m/s	meter(s) per second
m²	meter squared, or square meter(s)
mg	milligram(s)
MJ	Megajoule(s)
mm	millimeter(s)
MPa	megapascal(s)
ms	millisecond(s)
MSDS	Material Safety Data Sheet
N	Newton(s)
NBR	Nitrile Butadiene Rubber

NEC	North East Corner
No.	Number
Nm	Newton meter(s)
OD	Outside Diameter
Pa	pascal(s)
PAI	Peak Area Interval
PPAP	Production Part Approval Process
ppm	Parts per Million
PTFE	Polytetrafluoroethylen
R&R	Run and Record
rpm	rotations per minute
s	second(s)
SDS	Safety Data Sheet
SI	International System of Units
SOR	Statement of Requirements
SOT	Start of Test
SRE	Standard Reference Elastomer
STD	Standard
Std. Dev.	Standard Deviation
TAN	Total Acid Number
TBA	standard bearing type and size
TBB	standard bearing type and size
Temp	Temperature
Tp	Plate Temperature
VWR	VWR is the name of a laboratory supply company
W/s	Watts per Second

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Material per GMW18208

9 Release and Revisions

This standard was originated in August 2019. It was first approved by Materials – Fuels, Fluids and Lubricants Global Subsystem Leadership Team (GSSLT) in January 2020. It was first published in January 2020.

Issue	Publication Date	Description (Organization)
1	JAN 2020	Initial publication.

Appendix A: Foam Test

A1 Objective

A1.1 To determine the foaming characteristics of new and used automatic transmission fluid.

A2 Test Equipment

A2.1 Standardized Foam Test Equipment.

A2.1.1 ASTM D892 Equipment.

A2.1.2 Automated Oven. Lawler, Model Number 323-4.

A2.1.3 Mott Diffuser.

A2.2 Used Cycling Test Fluid Filtration.

A2.2.1 Filtering Flask. Erlenmeyer style, Borosilicate glass, 4 L capacity.

A2.2.2 Buchner Funnel. Coors Ceramics U.S.A. Model Number 60248, 253 mm diameter, or equivalent.

A2.2.3 Filter Paper. VWR (laboratory supply Company) Grade 417, 25.0 cm Diameter, Part Number 28313-160.

A2.2.4 Rubber Stopper Adaptor. Rubber stopper with hole to adapt Buchner funnel to filter flask.

A3 Procedure

A3.1 ASTM D892 shall be followed exactly as written, with the following points included.

A3.1.1 As indicated in Note 4 of ASTM D892, only liquid baths (i.e., silicone oil) shall be used for Sequences I, II, and III.

A3.2 Run ASTM D6082.

A3.3 Repeat A3.1 thru A3.2 for ATF taken from the end of the Cycling Test. This step should be performed within 24 h of completion of the GM Aeration Test. The fluid is to be filtered through the filtration system described in A2.2 before testing commences.

A4 Test Results

A4.1 Report the foaming tendency (in milliliters (mm)) at the end of the 5 minute blowing period.

A4.2 Report the foam stability (in mm) at the end of the 10 minute settling period.

A5 Test Criteria

A5.1 New Fluid.

A5.1.1 Candidate fluid results for new fluid shall meet the test limits in Table A1.

A5.2 Used Fluid.

A5.2.1 Candidate fluid results for the fluid after the GM Cycling Test and filtration shall meet the limits in Table A2.

Table A1: New Fluid Limits

Test	Tendency (mm)	Stability (mm)
ASTM D892, Sequence I, II, III	50	0
ASTM D6082, Sequence IV	50	0

Table A2: Used Fluid Limits

Test	Tendency (milliliters)	Stability (milliliters)
ASTM D892, Sequence I, II, III	50	0
ASTM D6082, Sequence IV	150	0

Appendix B: Elastomers Test

B1 Elastomer; Fluid Interaction, Phase I Validation Objective

B1.1 Determine the effects of ATF on elastomeric seal materials.

B1.2 The fluid defined under this standard shall demonstrate limited effects on the Standard Reference Elastomers (SRE) under definite conditions of temperature and time when tested in accordance to ASTM D471.

B2 Test Equipment

B2.1 Refer to ASTM D471.

B2.2 Reference Fluids. As defined under the current reference fluids standard.

B2.3 Elastomeric Compounds and Specimens.

B2.3.1 Use SAE J2643 defined SRE listed in Table B1.

B2.3.2 Except as otherwise specified in the applicable specifications, specimens shall be prepared in accordance with the requirements of ASTM Practices ASTM D3182 and ASTM D3183. Order ASTM standard testing slabs from Akron Rubber Development Laboratory (ARDL) Incorporated, the only SAE International (SAE) approved organization for SAE J2643 SRE.

Table B1: Standard Reference Elastomers (SRE)

GM Number	SAE J2643	ASTM D1418	Compounds
ES-1	FKM-2	FKM Type 1	DuPont, A401C, Tg -16 C
ES-2	FKM-3	FKM Type 2	DuPont, GBL 6005, Tg -17 C
ES-7	AEM-2	AEM	DuPont VAMAC G
ES-10	ACM-1	ACM	ZEON HYTEMP 4052
ES-11	ACM-2		ZEON HYTEMP AR12
ES-12	NBR-1	NBR	ZEON NIPOL DN2850, 28% ACN
ES-14	HNBR-1	HNBR	ZEON ZEPTOL 2010, 36% ACN

Note: SAE J2643-2013. Approved facility; Akron Rubber Development Laboratory (ARDL), 2887 Gilchrist Road, Akron, Ohio 44305.

Note: ACM = Alkyl Acrylate Copolymer, ACN = Acrylonitrile, AEM = Ethylene Acrylic Elastomers, ES = Elastomer Standard, FKM = Fluoroelastomer, HNBR = Hydrogenated Nitrile Butadiene Rubber, NBR = Nitrile Butadiene Rubber.

B3 Tests Procedure

B3.1 Refer to ASTM D471 and references therein for test details.

B3.2 Requirements.

B3.2.1 When tested with the designated standard reference elastomers, the effects of the fluid to the elastomers shall meet the requirements specified in Table B2 after the exposure defined therein.

Table B2: Elastomer Impact Tests

Materials/Parameters	Test Method	Unit	Limits
SRE SAE J2643 ACM-1	ASTM D471		
Schedule 1	150 °C, 168 h		
Change in Durometer Hardness	ASTM D2240	Points	± 5
Change in Tensile Strength	ASTM D412	%	± 30
Change in Ultimate Elongation	ASTM D412	%	± 30
Change in Stress at 50% Elongation	ASTM D412	%	Report
Volume Swell	ASTM D471	%	± 5
180 degree Bend Test Note 1	Note 1	Not applicable	Pass
SRE SAE J2643 ACM-2	ASTM D471		
Schedule 1	150 °C, 168 h		
Change in Durometer Hardness	ASTM D2240	Points	± 10
Change in Tensile Strength	ASTM D412	%	± 30
Change in Ultimate Elongation	ASTM D412	%	-35 to 10
Change in Stress at 50% Elongation	ASTM D412	%	Report
Volume Swell	ASTM D471	%	0 to 15
180 degree Bend Test Note 1	Note 1	Not applicable	Pass
Schedule 2	150 °C, 1008 h		
Change in Durometer Hardness	ASTM D2240	Points	-10 to +15
Change in Tensile Strength	ASTM D412	%	± 50
Change in Ultimate Elongation	ASTM D412	%	± 50
Change in Stress at 50% Elongation	ASTM D412	%	Report
Volume Swell	ASTM D471	%	0 to 15
180 degree Bend Test Note 1	Note 1	Not applicable	Pass
SRE SAE J2643 AEM-2	ASTM D471		
Schedule 1	150 °C, 168 h		
Change in Durometer Hardness	ASTM D2240	Points	-15 to +5
Change in Tensile Strength	ASTM D412	%	≥ -30
Change in Ultimate Elongation	ASTM D412	%	≥ -35
Change in Stress at 50% Elongation	ASTM D412	%	Report
Volume Swell	ASTM D471	%	0 to 20
180 degree Bend Test Note 1	Note 1	Not applicable	Pass

Schedule 2	150 °C, 1008 h		
Change in Durometer Hardness	ASTM D2240	Points	-15 to +5
Change in Tensile Strength	ASTM D412	%	≥ -45
Change in Ultimate Elongation	ASTM D412	%	≥ -45
Change in Stress at 50% Elongation	ASTM D412	%	Report
Volume Swell	ASTM D471	%	0 to 20
180 degree Bend Test Note 1	Note 1	Not applicable	Pass
SRE SAE J2643 FKM-2	ASTM D471		
Schedule 1	150 °C, 168 h		
Change in Durometer Hardness	ASTM D2240	Points	± 5
Change in Tensile Strength	ASTM D412	%	≥ -55
Change in Ultimate Elongation	ASTM D412	%	≥ -60
Change in Stress at 50% Elongation	ASTM D412	%	Report
Volume Swell	ASTM D471	%	± 5
180 degree Bend Test Note 1	Note 1	Not applicable	Pass
Schedule 2	150 °C, 1008 h		
Change in Durometer Hardness	ASTM D2240	Points	-5 to +10
Change in Tensile Strength	ASTM D412	%	≥ -65
Change in Ultimate Elongation	ASTM D412	%	≥ -70
Change in Stress at 50% Elongation	ASTM D412	%	Report
Volume Swell	ASTM D471	%	-5 to 10
180 degree Bend Test Note 1	Note 1	Not applicable	Report
SRE SAE J2643 FKM-3	ASTM D471		
Schedule 1	150 °C, 168 h		
Change in Durometer Hardness	ASTM D2240	Points	± 5
Change in Tensile Strength	ASTM D412	%	≥ -50
Change in Ultimate Elongation	ASTM D412	%	≥ -50
Change in Stress at 50% Elongation	ASTM D412	%	Report
Volume Swell	ASTM D471	%	± 5
180 degree Bend Test Note 1	Note 1	Not applicable	Pass