

The following procedures cover Allison C-4**Chemical Analysis****Specifications**

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to record significant chemical characteristics of C-4 candidate fluids in order to obtain a chemical fingerprint. This fingerprint is used as a reference baseline for checking blend values against analytically defined blend limits. Four separate evaluations are performed:

- (A) Additive Metals Content – Emission Spectroscopy: ICP
- (B) Non-metals Content
 - 1. Chlorine – ASTM D 808
 - 2. Nitrogen – ASTM D 3228
 - 3. Sulfur – ASTM D 129, D 1552, D 2622, D 4294
- (C) Acidity and Base
 - 1. Acid Number – ASTM D 664
 - 2. Base Number – ASTM D 2896, D 4739
- (D) Infrared Spectra
 - 1. Carbonyl Absorbance – ASTM E 168
 - 2. Infrared Spectrum – ASTM E 168

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmission when operating under the conditions specified by the manufacturer.

Procedure parts evaluated

The procedure fluid is evaluated.

Viscosity Characteristics**Specifications**

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine viscosity of procedure fluid in the following manners:

- (A) Kinematic Viscosity at 40°C, ASTM D 445
- (B) Kinematic Viscosity at 100°C, ASTM D 445
- (C) Stable Pour Point, FTM 203
- (D) Brookfield Viscosity, GM 6137-M
- (E) Apparent Viscosity, ASTM D 2602

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmissions when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires equipment specified in Procedures.

Procedure parameters

The procedure parameters are specified in Procedures.

Procedure parts evaluated

The procedure fluid is evaluated.

Pass/fail criteria

The pass/fail criteria are as follows:

<u>Type of Fluid</u>	<u>Limits</u>
Heavy-duty Engine Oils	MIL-L-2104
Passenger Car ATFs	Report
All Others	SAE J-300 June 86

Physical Properties

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine flash and fire points of procedure fluid by ASTM designation D 92.

Field service simulated

This procedure simulates typical transmission operating temperatures plus a liberal safety factor.

Procedure fixture

Performance of this procedure requires equipment as specified in Procedure.

Procedure parameters

The procedure parameters are as specified in Procedure.

Procedure parts evaluated

The procedure fluid is evaluated.

Pass/fail criteria

The pass/fail criteria are as follows:

- (A) Flash Point, 160°C (minimum)
- (B) Fire Point, 175°C (minimum)

Anti-Foaming Properties

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine anti-foaming characteristics in Hydra-matic Division foam procedureer per GM 6137-M, Procedure G.

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmissions when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires a pump, circulating system, heater, and agitating device.

Procedure parameters

Fill apparatus with procedure fluid. Turn on agitator and heater, regulating pressure at 275 kPa. Make foam observations at 95°C. Restart procedure rig and heat to 135°C. Record height of foam and break time.

Procedure parts evaluated

The procedure fluid is evaluated.

Pass/fail criteria

The pass/fail criteria require that there be no foam at 95°C.

There should be no more than 10 mm of foam at 135°C and it should not take more than 23 seconds for the foam to break.

Copper Strip Procedure

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine copper strip corrosion by ASTM designation D 130.

Field service simulated

This procedure simulates satisfactory performance in a normally functioning transmission under service conditions.

Procedure fixture

Performance of this procedure requires 125 ml bottle, heating oven or bath, and metal specimen conforming to ASTM D 130.

Procedure parameters

Place copper strip in bottle and cover two-thirds with procedure fluid. Heat to 150°C for 3 hours.

Procedure parts evaluated

The copper strip is evaluated.

Pass/fail criteria

The pass/fail criteria require that there be no blackening with flaking.

Noncorrosion and Nonrusting

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine corrosion and rusting by ASTM designation D 665.

Field service simulated

This procedure simulates satisfactory performance in a normally functioning transmission under service conditions.

Procedure fixture

Performance of this procedure requires an oil bath, 400 ml beaker, beaker cover, stirrer, grinding and polishing equipment.

Procedure parameters

Polish specimens as per procedure. Fill beaker with 300 ml of procedure fluid and 20 ml of distilled water. Insert procedure specimen and spin at 1000 rpm for 24 hours. Remove and rate.

Procedure parts evaluated

The procedure specimens (pins) are evaluated.

Pass/fail criteria

The pass/fail criteria require that there be no rust on procedure pins.

Oxidation Procedure

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine fluid oxidation resistance, thermal stability, and corrosion protection characteristics.

Field service simulated

This procedure simulates satisfactory operation of a commercial hydraulic transmission when operating under the conditions specified by the manufacturer.

Procedure fixture

A Hydra-matic 4L60 automatic transmission is driven by an electric motor. The motor-driven converter has the stator installed in the reverse position. The components are mounted on a procedure stand capable of controlling temperatures and pressures. The input pump hub seal is replaced with a Viton[®] elastomer seal.

Procedure parameters

The transmission is driven at 1755 rpm under no load at 163°C converter-out temperature for 300 hours, with air introduced at 30 cc per minute, and a fluid flow rate of 0.086 ± 0.003 L/s.

Procedure parts evaluation

All of the internal transmission parts are rated for sludge, varnish, deterioration, wear, or abnormal conditions.

Used lubricant analysis

Used lubricant analysis consists of viscosity at 40°C and 100°C, Brookfield viscosity at 0, -10, and -20°F, TAN, carbonyl group absorbance, and metals (iron, copper, lead, tin, aluminum).

Pass/fail criteria

The pass/fail criteria are as follows:

- No varnish or sludge shall accumulate on drums, piston, valves, case, screen or pan components used for evaluation.
- No blackening or flaking of copper or copper alloys shall have occurred.
- The oil cannot gain more than 15% viscosity at 100°C.
- The TAN difference between the 300-hour and the 0-hour sample shall not be greater than 7.
- The increase in carbonyl group absorbency (as measured by differential infrared) in the final sample may not exceed 0.9 over that of the 0-hour sample.
- Transmission part condition shall be equal to or better than that obtained with reference fluids.

Elastomer Seals Compatibility (Nitrile – Total Immersion Procedure)

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine the procedure fluid's effect on seal elastomers.

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmissions when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires ASTM D 471 equipment, oil bath, procedure tubes, reflux condensers, balance, three beakers, wetting agent, ASTM D 676 equipment, durometer, reference fluids, and seal material (nitrile).

Procedure parameters

Determine volume and durometer reading of seal material. Immerse seal material in 100 ml of procedure fluid. Heat to 150°C for 70 hours. Determine volume and durometer change.

Procedure parts evaluated

The seal material is evaluated.

Pass/fail criteria

The pass/fail criteria are dependent on elastomer batch.

Elastomer Seals Compatibility (Fluoroelastomer – Total Immersion Procedure)

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine the procedure fluid's effect on seal elastomers.

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmissions when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires ASTM D 471 equipment, oil bath, procedure tubes, reflux condensers, balance, three beakers, wetting agent, ASTM D 676 equipment, durometer, reference fluids, and seal material.

Procedure parameters

Determine volume and durometer reading of seal material. Immerse seal material in 100 ml of procedure fluid. Heat to 150°C for 70 hours. Determine volume and durometer change.

Procedure parts evaluated

The seal material is evaluated.

Pass/fail criteria

The pass/fail criteria are dependent on elastomer batch.

Elastomer Seals Compatibility (Ethylene Acrylic – Total Immersion Procedure)

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine the procedure fluid's effect on seal elastomers.

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmissions when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires ASTM D 471 equipment, oil bath, procedure tubes, reflux condensers, balance, three beakers, wetting agent, ASTM D 676 equipment, durometer, reference fluids, and seal material.

Procedure parameters

Determine volume and durometer reading of seal material. Immerse seal material in 100 ml of procedure fluid. Heat to 150°C for 70 hours. Determine volume and durometer change.

Procedure parts evaluated

The seal material is evaluated.

Pass/fail criteria

The pass/fail criteria are dependent on elastomer batch.

Elastomer Seals Compatibility (Polyacrylate – Dip Cycle Procedure)

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine the procedure fluid's effect on seal elastomers.

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmissions when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires ASTM D 676 equipment, oil bath, dip cycle equipment, durometer, procedure tubes, reflux condenser, balance, beakers, reference fluids, and seal material (polyacrylate).

Procedure parameters

Determine original volume and durometer reading of polyacrylate seal material. Heat 100 ml of procedure fluid to 150°C. Run 70 hours of dip cycle (15 minutes in fluid followed by 120 minutes suspended above fluid). At end of procedure determine volume change and durometer change.

Procedure parts evaluated

The seal material (polyacrylate) is evaluated.

Pass/fail criteria

The pass/fail criteria are dependent on elastomer batch.

Elastomer Seals Compatibility (Silicone – Tip Cycle Procedure)

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine the procedure fluid's effect on seal elastomers.

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmissions when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires ASTM D 676 equipment durometer, tip cycle equipment, air circulating oven, balance, beakers, reference fluids, and seal material (silicone).

Procedure parameters

Determine volume and hardness readings on seal material. Put 100 ml of procedure fluid in tip cycle cups. Put in oven and heat to 175°C fluid temperature. Rotate tip cycle cups 360 degrees every 2 hours. After 8 total hours remove from oven and cool at room temperature for 12 hours. Determine final hardness and durometer readings.

Procedure parts evaluated

The seal material is evaluated.

Pass/fail criteria

The procedure criteria are dependent on elastomer batch.

Rust Protection

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine rusting by ASTM designation D 1748.

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmission when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires a humidity cabinet, air circulating supply, specimen holders, and temperature controls and readouts.

Procedure parameters

Prepare procedure panels. Heat procedure oil to 23.3°C. Dip procedure panel in procedure fluid for 10 seconds. Place panel in humidity cabinet for 50 hours. Cabinet temperature is 38°C. Remove at 50 hours and rate.

Procedure parts evaluated

The procedure specimens (panels) are evaluated.

Pass/fail criteria

The pass/fail criteria require that there be no rust* or corrosion on procedure panels.

* No rust is defined as "no more than 3 spots of rust greater than 1 mm at least 6 mm away from the edge of procedure panel".

Friction Retention Procedure (Graphite – Composite Clutches)

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine fluid friction retention characteristics.

Field service simulated

This procedure simulates satisfactory operation of commercial hydraulic transmission when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires the SAE No. 2 friction procedure machine.

Procedure parameters

After 1000 cycles of a lower energy level, 4500 cycles of 15 seconds duration at a higher energy level are required. Clutches are engaged once each cycle, absorbing 18,710 joules of total energy. Fluid temperature is maintained at $93.3 \pm 3^{\circ}\text{C}$ for the first phase and $112.7 \pm 3^{\circ}\text{C}$ for second phase.

Procedure parts evaluated

The procedure fluid is evaluated.

Pass/fail criteria

The pass/fail criteria are dependent on plate batch.

Friction Retention Procedure (Paper – Composite Clutches)

Specifications

This procedure covers Allison Transmission Division Type C-4 Hydraulic Transmission Powershift Fluid.

Objective

The objective is to determine fluid friction retention characteristics.

Field service simulated

This procedure simulates satisfactory operation of a commercial hydraulic transmission when operating under the conditions specified by the manufacturer.

Procedure fixture

Performance of this procedure requires the SAE No. 2 friction procedure machine.

Procedure parameters

The system provides 18.70 ± 0.40 KJ for 10,000 cycles of testing. Fluid temperature is maintained at $93.3 \pm 3^{\circ}\text{C}$.

Procedure parts evaluated

The procedure fluid is evaluated.

Pass/fail criteria

The pass/fail criteria are dependent on plate batch.

JASO T904:2006

Specifications

This procedure covers JASO T904:2006. It is modified to run using a 750-ml test charge.

Objective

The objective is to determine the friction characteristics and durability of the tested fluid.

Field service simulated

This procedure simulates satisfactory performance in normally functioning transmission under service conditions.

Procedure fixture

Performance of this procedure requires the SAE # 2 friction machine.

Procedure parameters

5,000 cycles, each 30 seconds duration, are required. Clutches are engaged once each cycle and absorb 24,500 Joules of total energy. Fluid temperature is maintained at 100 degrees C.

Procedure parts evaluated

The steel and composition plates are evaluated for wear. Indices for dynamic friction, static friction, and stop time are also determined.