Tractor Hydraulic Fluids Evaluations

- Tractor Hydraulic Fluids Field Procedure
- JDQ-84 Saver-Danfoss Dynamic Corrosion Procedure
- JDQ-95 Spiral Bevel and Final Drive Gear Wear
- JDQ-94 PST Clutch Procedure
- John Deere JDQ-96 Performed Using 1400 Series Axle
- John Deere 6000 Series Brake Procedure
- John Deere Synchromesh
- Ford 8340 16x16 Transmission Driveline Stall Procedure
- Noise and Performance Procedure for Transmission Oil
- Ford 3000 Gear Wear
- Modified Ford 8340 16x16 High-Energy Clutch Procedure
- New Holland Jenkins Cycle Procedure
- New Holland 16x16 Transmission, 400-Cycle Stall Procedure
- Massey-Ferguson Foursquare Gear Wear Procedure
- Massey-Ferguson Brake Chatter Procedure
- Massey-Ferguson IPTO Clutch Procedure

Tractor Hydraulic Fluids Field Procedure

Field testing of tractor hydraulic fluids has been a continual activity at SwRI since the mid 60's.

SwRI personnel monitor tractors operating with procedure oils in all sections of the United States. Techniques for evaluating filter plugging and performance in the field have been developed.

Lubricant-related testing is conducted on New Holland, John Deere, Massey-Ferguson, and Case IH tractors.

JDQ-84 Sauer-Danfoss Dynamic Corrosion Procedure

Specifications
This procedure covers John Deere J20C and J20D.

Objective
The objective of this procedure is to identify oils that, when contaminated with limited amounts of water, can still serve as a suitable fluid for hydrostatic transmissions and hydraulic pumps found on agricultural and industrial off-highway equipment.

Procedure fixture
A Sauer-Danfoss Series 22 or Series 90 axial piston pump is driven by a 6-cylinder engine. Associated relief valves, heat exchangers, and a reservoir provide substantial flexibility for various operating conditions.

Procedure parameters
Procedure duration is 225 hours. 1% water is added at 25 hours. The pump is run at 34,475 kPa (5,000 psi), 1.51 liters per second (24 gpm), and main loop temperature of 82°C (180°F).

JDQ-95 Spiral Bevel and Final Drive Gear Wear

Specifications
This procedure covers John Deere JDM J20 and JDM J27.

Objective
Performance of a procedure oil is compared to a reference oil with respect to the scoring of the spiral bevel ring/pinion gears. The wear and surface distress of sun pinion gears are also evaluated.

Procedure fixture
The procedure fixture is a final-drive axle assembly powered by a six-cylinder diesel engine through a powershift transmission. A special low-speed/high-torque brake dynamometer absorbs the axle output power.

Procedure parameters
Output speeds vary from 24 to 14 axle rpm with axle torques of 23,730 Nm (17,400 lb-ft). Oil temperature is 121°C (250°F). Procedure duration is 50 hours.

JDQ-94 PST Clutch Procedure

Specifications
This procedure covers John Deere J20 and JDM J27.

Objective
The objective of this procedure is to assess the effect of transmission/hydraulic oils on powershift transmission (PST) clutch stall time, dynamic friction coefficient, and clutch disc wear.

Procedure fixture
A modified John Deere transmission that is powered by a six-cylinder diesel engine serves as a procedure apparatus. A dynamometer coupled to the output shaft of the transmission provides the loading.

Procedure parameters
A typical cycle consists of a partial engagement in which the clutches absorb 1,100 kJ of energy followed by a cool-down period in which the clutches are fully engaged. This cycle is repeated every 28.5 seconds for a total of 2,000 cycles. Lube oil temperature is controlled at 50°C (122°F).

John Deere JDQ-96 Performed Using 1400 Series Axle

Specifications
This procedure covers John Deere JDM J20 and JDM J27.

Objective
The objective of this procedure is to assess the effect of the procedure oil on brake noise and brake capacity compared to that demonstrated with a reference.

Procedure fixture
A modified, full-sized John Deere agricultural tractor powers a John Deere industrial axle in the laboratory. The sun pinion shaft is equipped with strain gages in order to measure dynamic torque changes as the brakes are applied over a wide range of axle speeds and loads.

Procedure parameters
Chatter is evaluated at 32, 49, 60, and 71°C (90, 120, 140, and 160°F) oil temperature. Brake chatter is measured at different brake apply pressures and wheel speeds.

John Deere 6000 Series Brake Procedure

Specifications
This procedure is not required by any published specifications. John Deere Werke Mannheim requests it.

Objective
A series of six procedures are performed in order to evaluate the effect of different formulations of tractor hydraulic fluid (THF) on the brakes and PTO and MFWD clutches of a John Deere 6000 series tractor. The candidate fluid's performance is compared to that of the reference oil. Normal as well as unusual field usage is simulated. Torque, pressure, and friction coefficients are measured and compared to those produced by the reference oil under similar circumstances.

Procedure fixture
A John Deere 6000 series tractor is used to perform these procedures. Numerous fixtures are used to measure PTO, MFWD, and braking torque.

Procedure parameters
Oil Influence on Service Brake Friction Coefficient – A procedure designed to compare the friction coefficient of the brakes with candidate and reference oil. The procedure consists of slow and fast brake application cycles. The torque at 5 bar and 25 bar of brake application pressure is measured. The torques are compared to infer differences in friction coefficient.

Lag of Brake Reaction – Some brake disk lining materials in combination with certain oils undergo undefined changes resulting in braking torque having a non-linear relationship versus braking pressure. When an oil creates a lag of brake reaction, the torque is significantly lower than the "normal" case, up to a certain pressure. At higher pressure the torque rises rapidly until it intercepts the torque that would be produced by the normal oil. From this point the offending oil behaves in a normal fashion. This procedure is performed to detect this phenomenon.

Effect of Transmission Oil on Chatter Characteristics of Foot Brakes – The procedure is performed to determine the effect of oil on chatter characteristics of the foot brakes.

John Deere 6000 *(cont'd)*

This procedure consists of two parts. The first part is a chatter evaluation while driving the tractor, applying the brakes against the engine. The second part of the procedure involves braking one wheel to a standstill while the tractor is mounted on the universal tractor axle stand. During this part of the procedure, the braking force and torque variation can be measured.

Oil Performance Under High Load and High Speed Braking – This procedure is designed to simulate critical load conditions for the service brake components. These conditions are occasionally found when tractors are used to pull heavy trailers with poorly adjusted brakes or no brakes whatsoever.

The procedure consists of braking one wheel at a time against the engine. The tractor is operated in a high gear, and the brake is applied until it loads the engine down to 1800 rpm from a high idle. Four 4-second engagements are performed 30 seconds apart. Lastly, a 13-second engagement is performed. After the procedure is complete, the brake disks are inspected.

Effect of Transmission Oil on Frictional Characteristics of the PTO Clutch – The procedure is performed to determine the effect of oil on frictional characteristics of the PTO clutch.

Twenty PTO slip cycles are performed using the 540-rpm and 1000-rpm PTO. During each slip cycle, PTO pressure and PTO torque are measured. The torque/pressure ratio is calculated and compared to the reference oil. The torque/pressure ratio is used to infer friction coefficient.

In order to evaluate PTO chatter, a series of PTO stall procedures are performed using the 540- and 1000-rpm PTO. The operator listens for noise, and the chart traces are interpreted for torque variation.

Effect of Transmission Oil on Friction Characteristics of the MFWD Clutch – The procedure is performed to determine the effect of oil on frictional characteristics of the MFWD clutch. The procedure consists of a measurement of breakaway and slipping torque, and a comparison of the two.

Ten cycles were conducted where the MFWD clutch was slipped while the transmission clutch was engaged. Torque was measured during the midpoint of the engagement.

Five cycles were conducted where the traction clutch was used to "break-away" the MFWD clutch. The breakaway torque was measured. All MFWD clutch procedures were conducted at 1 meter/second slip speed of the friction material.

John Deere Synchromesh

Specifications
This procedure is not required by any published specifications. John Deere Werke Mannheim requests it. It is being considered for addition to John Deere JDM J20.

Objective
This procedure is designed to measure the effect of lubricant on the synchronizers. Some of the expected effects of various lubricants are shorter or longer shift times, and wear of the synchronizer cones. Once the synchronizers become worn, they will no longer provide an effective friction coupling with the cone on the gear. The synchronizer will no longer function, and gear clashes will be heard.

Procedure fixture
The synchronizer procedure was built around a John Deere Synchro-Plus® transmission used in the 6410 tractor, which is more or less common to the new 10 series of tractors. These tractors are built in Mannheim, Germany, and are sold worldwide.

The transmission is powered from both ends. The input to the clutch housing, which is normally powered by the engine, is powered by an electric motor. The electric motor provides power that runs the transmission oil pump and spins the outside of the clutch. The clutch is disengaged throughout the procedure.

The transmission's spiral bevel pinion gear has been machined to accept a drive shaft hub. The hub is connected to a drive shaft; the drive shaft is connected to a flywheel and a variable-speed electric motor. During the procedure the flywheel and spiral bevel pinion is spun by the electric motor at a speed similar to the speed it would be spinning at while an actual tractor is being driven in the particular gear and range being tested.

An air cylinder moves the shift linkage. The load cell is used to measure shift force. Shift force is adjusted by adjusting air pressure to the regulator.

Procedure parameters
The procedure should result in satisfactory performance of the synchronizers comparable to the reference oil. The synchronizer cones are measured before and after the procedure to quantify wear. The shift times and shift forces required are recorded throughout the procedure.

Ford 8340 16x16 Transmission Driveline Stall Procedure

Details of this procedure are confidential to New Holland.

Noise and Performance Procedure for Transmission Oil

Specifications
This procedure covers New Holland ESN-M2C-134D oil, lubricating – driveline – wet brakes – hydraulic tractor – VI improved.

Objective
The objective of this procedure is to assess the effect of the procedure oil on brake noise and brake capacity (deceleration rate) as compared to that demonstrated with a reference or factory-fill oil.

Procedure fixture
Performance of this procedure requires a Ford 6610 or New Holland 8340 agricultural tractor equipped with a fifth-wheel, brake force transducer, a sound level meter, and a remotely mounted microphone near the brakes.

Procedure parameters
Procedure parameters are performed in the following order. Brakes are applied under varying conditions. Noise level and deceleration rates are recorded. A series of spin turns are performed. The tractor is towed with the brakes applied for 1000 meters (fade procedure). The final procedure is a subjective noise evaluation.

Ford 3000 Gear Wear*

Specifications
This procedure covers New Holland ESN-M2C134-D oil lubricating – driveline – wet brakes – hydraulic tractor – VI improved.

Objective
This is an initial screening procedure to assess ability of procedure oil to protect the final drive ring gear and pinion gear. Results with procedure oil are compared to a reference oil.

Procedure fixture
A complete Ford 3000 series tractor operates on special low-speed high-torque chassis dynamometer.

Procedure parameters
Procedure duration is 100 hours. Oil temperature is maintained at 91°C (195°F). Tractor is loaded to 22,240N (5,000 lb) of drawbar pull.

* This procedure is useful for screening oils which are designed to other New Holland specifications.

Modified Ford 8340 16x16 High-Energy Clutch Procedure

Details of this procedure are confidential to New Holland.

New Holland Jenkins Cycle Procedure

Details of this procedure are confidential to New Holland.

New Holland 16x16 Transmission, 400-Cycle Stall Procedure

Details of this procedure are confidential to New Holland.

Massey-Ferguson Foursquare Gear Wear Procedure

Specifications
This procedure covers CMS 1135 and CMS 1139.

Objective
The objective is to assess a fluid's ability to protect final drive gears from wear and surface distress.

Procedure fixture
A pair of tractor transmissions and rear axles are mounted to a steel frame so that the inputs are facing each other. The "wheels" are connected by chain loops. The two transmission's inputs are rotated relative to each other so that they are in a bind; one axle is providing load for the other axle. An electric motor rotates both axles simultaneously.

Procedure parameters
The procedure is successful if the gears run with the candidate oil in one end of the rig compare favorably to the reference oil gears in the other end.

Massey-Ferguson Brake Chatter Procedure

Specifications
This procedure covers a Massey-Ferguson CMS 1135 and CMS 1139.

Objective
The objective is to assess a fluid's ability to suppress wet brake noises.

Procedure fixture
A relatively unmodified Massey-Ferguson 383 is used as a procedure vehicle. A trained operator drives the tractor with reference oil in the transmission. He makes numerous stops in different operating conditions and notes the severity of brake noise that he hears. Then the candidate oil is installed in the tractor and the same operator goes through the same stops.

Procedure parameters
The operator makes a comparison of the two oils' brake noise characteristics. Less or equal noise is desirable.

Massey-Ferguson IPTO Clutch Procedure

Specifications
This procedure covers Massey-Ferguson CMS 1135 and CMS 1139.

Objective
The objective is to assess a fluid's effect on the tractor's independent power take off (IPTO) clutches. The fluid must provide a high enough coefficient of friction for the clutch to engage properly.

Procedure fixture
A Massey-Ferguson IPTO clutch is loaded with the inertial force of a flywheel 1000 times. A computer records IPTO torque, IPTO pressure, and stall times. The computer calculates friction coefficients and sequences the engagements.

Procedure parameters
The high-speed and low-speed coefficients of friction must be above 0.06 for the procedure to be successful.