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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1890

REAF. AUG2000

Issued 1988-06
Reaffirmed 2000-08

Superseding J1890 MAR1995

Submitted for recognition as an American National Standard

Performance Assurance of Remanufactured, Hydraulically-Operated Rack and Pinion Steering Gears

***Foreword*—**This Reaffirmed Document has been changed only to reflect the new SAE Technical Standards Board Format. Definitions changed to Section 3. All other section numbers have changed accordingly.

***1. Scope*—**In order to insure that the remanufactured and/or rebuilt steering gear has and maintains the reliability and performance associated with a new OEM steering gear, it is essential that the following procedures be followed; if in-house engineering capabilities are limited, it may be necessary to consult with an outside laboratory to insure all testing methods used meet with the requirements outlined in this paper.

***2. References*—**There are no referenced publications specified herein.

3. Definitions

3.1 Remanufacturing—A process in which worn units are completely taken apart and all components inspected prior to reassembly. Components within specs are reused; components out of spec are either repaired or replaced with new components.

4. Performance Specifications

4.1 In order to perform a functional and valid test of the rack and pinion steering gear, and to determine its performance characteristics, it is essential that the testing apparatus is capable of maintaining:

4.1.1 CONSTANT TEMPERATURE—43 to 49 °C (110 to 120 °F).

4.1.2 CONSTANT PRESSURE—84.6 to 105.7 kg/cm^2 (1200 to 1500 psi).

4.1.3 CONSTANT FLOW—6.0 to 7.9 L/m (1.6 to 2.1 gpm).

Although the required specifications may vary, the apparatus should have the capability of maintaining relief valve pressure of approximately 84.6 to 105.7 kg/cm^2 (1200 to 1500 psi), fluid temperature of 43 to 49 °C (110 to 120 °F), and flow in the range of 6.0 to 7.9 L/m (1.6 to 2.1 gpm).

In addition to checking hydraulic flow, the apparatus must be capable of rotating the unit to be tested by the input shaft at a specific rate. A normally accepted range is 15 to 25 rpm rotation of input shaft while resistance to this movement is measured in in-lb, as well as moving the unit by the rack, pushing the rack at a rate of 2.54 to 3.80 cm/s (1 to 1.5 in/s).

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Further, measure oil flow from gear when valve is shut off in increments of 0.38 L/m (0.1 gpm).

It is important that all readings be consistent, taken at the same, predetermined points.

4.2 **Functional Data—**To obtain functional data, OEM service manuals should be consulted first. If detailed test data is not available, a comparative test database can be developed by testing approximately 10 to 12 new, like rack and pinion units, maintaining constant temperature, flow and pressure as stated in 4.1.1, 4.1.2, and 4.1.3 in order to obtain high and low limits for that specific unit.

5. Functional Testing

5.1 In order to establish a test database by testing new gears, and upon completion of the final assembly process, the finished gear must pass a series of functional tests to insure the performance and reliability of the steering gear. These tests include wet mesh, dry mesh, wet returnability, dry returnability, internal leakage, external leakage, and valve balance. A description of each of these tests follows:

5.2 **Wet Mesh/Dry Mesh—**These two tests are similar in nature; the only difference is whether the gear is charged (wet) with hydraulic fluid or drained (dry) of hydraulic fluid.

In performing this test, the gear is driven by the input shaft through its entire travel at a specified rate and the resistance to rotation of the input shaft must be measured.

a. Typical Readings

1. Wet mesh 5.8 to 28.8 kg·cm (5 to 25 in-lb) (resistance to rotation)
2. Dry mesh 5.8 to 28.8 kg·cm (5 to 25 in-lb) (resistance to rotation)

The resistance measured must be smooth and cannot exceed 10 in-lb in variation.

5.3 **Wet Returnability/Dry Returnability—**The wet and dry configuration of these tests is the same as previously mentioned in the mesh test. In performing the test, the gear is driven through its entire travel by the rack at a specified rate and the resistance to this travel is measured.

a. Typical Readings

1. Wet returnability 45.4 to 68.0 kg (100 to 150 lb)
2. Dry returnability 45.4 to 68.0 kg (100 to 150 lb)

Resistance to travel must be smooth and cannot exceed 50 lb variation.

Failure to meet mesh (5.2) and returnability (5.3) requirements could be caused by:

5.3.1 Incorrect tolerance stack-up due to parts mix.

5.3.2 When applicable (not required on certain type gears), steel sleeve in pinion housing is not installed straight or causes pinion (valve) assembly to bind or bend.

5.3.3 Straight ahead (forward) position—wear of one tooth resulting in some clearance when gear (car) is in straight forward position.

5.3.4 Housing bent—not visible to the eye but enough to detect binding when rack is moving.

5.3.5 The rack itself is slightly bent.

5.3.6 “T” Bar loose in valve effect flow control of fluid—can impair returnability.

5.3.7 Loose spool.

5.3.8 Contamination in valve.

5.4 Valve Balance—In order to determine the balance of the valve, the input shaft torque (in-lb) must be measured in relation to a specified inlet pressure. The input shaft torque must not vary from left to right when outlet pressure is the same on right and left turn.

Typical readings could be taken at 21.1 kg/cm^2 (300 psi). At that reading, the torque read-out difference is not to exceed 6.9 kg·cm (6 in-lb).

Failure to meet requirements could be caused by:

5.4.1 "T" Bar pinned in wrong spot.

5.4.2 Loose spool, loose pin.

5.4.3 Restricted pressure line.

5.4.4 Contamination in valve.

5.5 Internal Leakage—Internal leakage is determined by rotating the input shaft (with gear against each stop) until relief pressure is reached in the inlet line. At this point, the flow of oil from the return line of the gear must be within a range of 0 to 1.1 L/m (0 to 0.3 gpm).

5.5.1 Damaged or missing valve seals.

5.5.2 Damaged or missing piston seal.

5.5.3 Porous casting.

5.5.4 Fluid leaking behind steel sleeve in valve tower (only on gears where valve bore has been repaired by sleeving).

5.6 External Leakage—There should be no external leakage of the gear assembly. Wipe unit dry and observe:

5.6.1 UPPER PINION SEAL.

5.6.2 LOWER PINION SEAL.

5.6.3 RACK BULKHEAD.

5.6.4 INNER RACK SEAL.

5.6.5 ALL FITTINGS.

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