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LOW-TEMPERATURE TORQUE OF GREASE

GM9078P

1 SCOPE. This method of test determines the extent to which a grease retards the rotation of a spring loaded automotive front wheel bearing assembly when lubricated with a test grease and subjected to sub-zero temperatures. The method was developed employing greases giving torques of less than 34 N·m at temperatures from 0 to −55 C. Unless otherwise specified, the test shall be run at 1 rpm at −40 C.

2 DEFINITIONS.

2.1 Low Temperature Torque. The torque is N·m required to restrain the spindle of an automotive front wheel assembly when the hub and bearings, lubricated with the test grease, are rotated at the specified speed and temperature. Two values are obtained:

2.1.1 Breakaway Torque. The maximum torque measured at the start of rotation.

2.1.2 Running Torque. The average value of the torque integrated over the first 3 min. of rotation.

3 APPARATUS. A suitable torque test apparatus and its components are described in the following paragraphs.

3.1 Test Machine. The test machine (NOTE 1) consists of a 0.37kW hp electric motor, a 600:1 gear reducer (NOTE 2), suitable pulleys, and timing belt, and a load cell pedestal mounted on a base plate. Torque is measured with a strain-gauge load cell and recorded on a strip-chart potentiometer.

NOTE 1: Details of one approved version of the test apparatus are available from Research Laboratories, GM Corporation, Warren, MI 48090.

NOTE 2: The gear reducer sump should be filled to the recommended level with a low viscosity (100 SUS at 38 C) gear lubricant such as CITGO CBL-741.

3.2 Test Units. The test units consist of modified Chevy II (Nova) production parts and specially manufactured parts (NOTE 1) as follows:

a. One steering knuckle (spindle): Part No. 3790426

b. One hub: Part No. 3790279

c. One inner bearing and cone: Part No. 7451080

d. One outer bearing and cone: Part No. 7451077

e. One washer, tanged: Part No. 6255552

NOTE: The inner races of the bearings shall be slotted and suitable keys or pins provided to prevent rotation of the races at high torques and permit ready removal of the bearings from the test unit assembly. The spindle should be drilled and tapped for the installation of a 3.2 mm dia shielded copper-constantan thermocouple. The thermocouple junction is located midway between the bearings.

f. One spring guide.

g. One calibrated spring having a rate of approximately 14.9 N/m.

h. One spring cup having an inner depth equal to the height of the spring at 445 N (NOTE 3).

i. One spring cap.

j. One washer.

k. One adjusting nut.

NOTE 3: Each spring and spring cup should be color-coded to prevent mismatching.

3.3 Instrumentation.

a. One thermocouple, 3.2 mm dia shielded copper-constantan with fitting and connector for each test unit.

b. One potentiometer capable of measuring temperatures within ±0.3 C through the range of −55 to 70 C.

c. One strain-gauge load cell capable of measuring force up to 1335 N with a sensitivity of 2 N (NOTE 4).

d. One recording potentiometer having multiple ranges between the ranges of 0 to 2 and 0 to 25 mV.

e. One matching network consisting of a DC power supply and bridge balance circuit (NOTE 5).

f. Two torque wrenches, 0 to 8.5 and 0 to 34 N·m.

g. One dial indicator and magnetic-base stand having a range of 0.75 mm in 0.02 mm increments.

h. One planimeter.

i. One low-temperature box having minimum interior dimensions of 710 x 610 x 610 mm and capable of maintaining the test temperature within ±0.5 C over the range of −55 to −17 C.

j. One ultrasonic cleaning bath of about 4 L capacity operating at a power input of approximately 150W.

k. One bearing packer suitable for packing grease into 0.688 and 1.062 bore tapered roller bearings and equipped with a standard hydraulic grease fitting.

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l. Several hand operated grease guns equipped with "snap-over" grease couplings.

NOTE 4: Although of a nominal 220 N capacity, a LeBow Associates, Inc., Model 3108-50 load cell has been satisfactorily used at loads up to 1335 N.

NOTE 5: A suitable matching network will vary with the selection of the load cell and recording potentiometer.

4 PROCEDURES.

4.1 Cleaning. Wipe excess grease from the exterior of the test bearings. Place the bearings in the ultrasonic cleaner tank half filled with technical grade chloroform (NOTE 6). After approximately 20 min. of operation, place the bearings in a stainless steel beaker containing about 500 mL of clean, filtered chloroform. Place beaker containing the bearings into the ultrasonic tank and operate for 5 minutes. Remove bearings and place in a stainless steel or baked enamel tray to dry (NOTE 7). Permit the bearings to cool to room temperature before proceeding.

NOTE 6: Chloroform vapors are a health hazard, therefore, provide adequate ventilation, preferably a fume hood. When the use of chloroform is impractical, nontoxic, nonflammable solvents such as Freon TF may be used, but the time required for cleaning will be longer.

NOTE 7: Clean, dry bearings must not be rotated or air blown. Do not touch the rollers with bare hands. Bearings may be handled with tongs or by inserting a finger in the bore.

4.2 Packing. Apply a thin film of test grease on the bearing races which have been previously installed in the hub. Fill a clean grease gun with the test grease. Install an inner test bearing in the clean bearing packer and fill the bearing with the test grease using the grease gun (NOTE 8). Remove the bearing, and with a small spatula scrape the excess grease from the bore. Using fingers, pack grease into all visible voids and coat outside of the bearing with a layer of grease approximately 0.75 mm thick. Remove excess grease from both ends of the bearing with the spatula. While holding the bearing race and cage together with thumb and forefinger to prevent rotation, install the bearing on the spindle, aligning the bearing slot with the key or pin.

NOTE 8: The grease gun and bearing packer must be clean and dry before installing the test grease. Cleaning can be accomplished by disassembly and using the ultrasonic cleaner as described under procedures for cleaning the test bearings. Flushing out the old grease with a new test grease is not satisfactory.

4.2.1 Fill the outer bearing with the test grease as described in the preceding paragraph, and install the bearing in the hub without rotating the rollers. Place the tanged washer on the outer bearing, keeping slots or keyways in alignment. Once grease is packed into the bearings they must not be rotated until the torque measurements are taken.

4.3 Assembly. Place the spindle together with the inner bearing in an upright position in a mechanics vise. Holding the hub flange with the fingers of both hands while holding the outer bearing and tanged washer with the thumbs will prevent bearing rotation as the hub is slipped over the spindle. Bearing slots and keys or pins, as well as the washer tang and spindle groove, must be kept aligned to permit seating the bearings without rotation.

4.3.1 Install the spring cup over the end of the spindle. Screw on the spring guide and tighten. Place the matching calibrated spring in the cup, and install the spring cap, washer, and adjusting nut.

4.3.2 Compress the spring by turning the adjusting nut until the face of the spring cap lightly contacts the lip of the spring cup. Contact can be felt as a sudden increase in torque as the adjusting nut is slowly turned in.

4.3.3 Place the magnetic-base stand on the flange of the hub such that the dial indicator contacts the upper surface of the cap. Establish a reference reading on the dial indicator by backing-off and screwing-in the adjusting nut while observing contact between the cap and cup. Back off the adjusting nut until the indicator shows a +0.25 and −0.013 mm clearance between the cup lip and cap face.

4.3.4 If more than one unit is used, assemble all the other units before proceeding (NOTE 9).

NOTE 9: The number of test units that can be handled at one time depends on the dimensions and cooling capacity of the low-temperature box. Generally, four units can be satisfactorily handled at once.

4.3.5 Preheat the oven to 70 ± 3 C. Place the assembled units in the oven and heat at this temperature for 1 h ± 5 minutes.

4.3.6 Precool the low-temperature box containing the test machine to the test temperature ±0.5 C. (The normal test temperature is −40 C but other temperatures between −55 and −17 C may be specified.) Remove the test units from the oven, and place them in the cold box. Without rotating the bearings, bolt one unit to the test machine and place the other units on the floor of the cold box. Connect the thermocouple of the first unit to the potentiometer. Cold soak the test units at the test temperature for 16 to 18 h before measuring the torque.

4.4 Calibration. Construct calibration curves of torque as a function of pen displacement (output in mV) in the following manner. Remove the thermocouple and the fitting cap but leave the fitting body in the spindle. Electrically null the load cell and recording potentiometer using the adjusting potentiometer of the matching network. Adjust the electrical

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