



SURFACE VEHICLE RECOMMENDED PRACTICE

J2985™

DEC2024

Issued 2014-02
Reaffirmed 2024-12

Superseding J2985 JUL2019

Definition and Measurement of Transfer Case Speed-Dependent Parasitic Loss

RATIONALE

New government regulations that raise automotive fuel economy requirements and change the methods by which vehicle level fuel economy is measured drive the need for improved methods to measure component level parasitic loss. The intent of this standard is to provide the means to generate consistent component level parasitic loss data in support of modeling and analysis of vehicle-level emissions and fuel economy.

SAE J2985 has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

This SAE Recommended Practice covers transfer cases used in passenger car and light truck applications. Transfer cases are of the chain, geared, manually and electronically shifted types although other configurations are possible. The operating points (speeds, temperatures, etc.) were chosen to mirror those of the United States Environmental Protection Agency Vehicle Chassis Dynamometer Driving Schedules (DDS).

1.1 Purpose

To provide a common means to consistently measure and quantify the speed-dependent parasitic loss ("spin loss") characteristics of transfer cases.

2. REFERENCES

2.1 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J1952 All Wheel Drive Systems Classification

SAE J2059 All-Wheel-Drive Drivetrain Schematic Symbol Standards

SAE J2263 Road Load Measurement Using Onboard Anamometry and Coastdown Techniques

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2.1.2 Other Publications

United States Code of Federal Regulations, Title 40 - Protection of Environment [40 CFR], Part 86 - Control of Emissions from New and In-Use Highway Vehicles and Engines [40 CFR 86]

United States Environmental Protection Agency, Emission Standards Reference Guide

3. DEFINITIONS

3.1 Transfer Case

In a longitudinal mounted drivetrain based vehicle, this term refers to the drive mechanism that distributes power to the front and rear axles. The transfer case may also contain torque management devices. Externally the transfer case is mechanically connected to the transmission, which provides its input power, and to the front and rear axles via drive shafts, which distribute its output power (as shown schematically in Figure 1). Internally, the transfer case mechanically connects the front and rear outputs via chain or gears. Depending on the design, the transfer case may be electronically or manually shifted between two wheel drive (2WD) and all-wheel drive (AWD) modes or it may only have an AWD mode. Transfer cases may be single or multi-speed depending on the design and application.

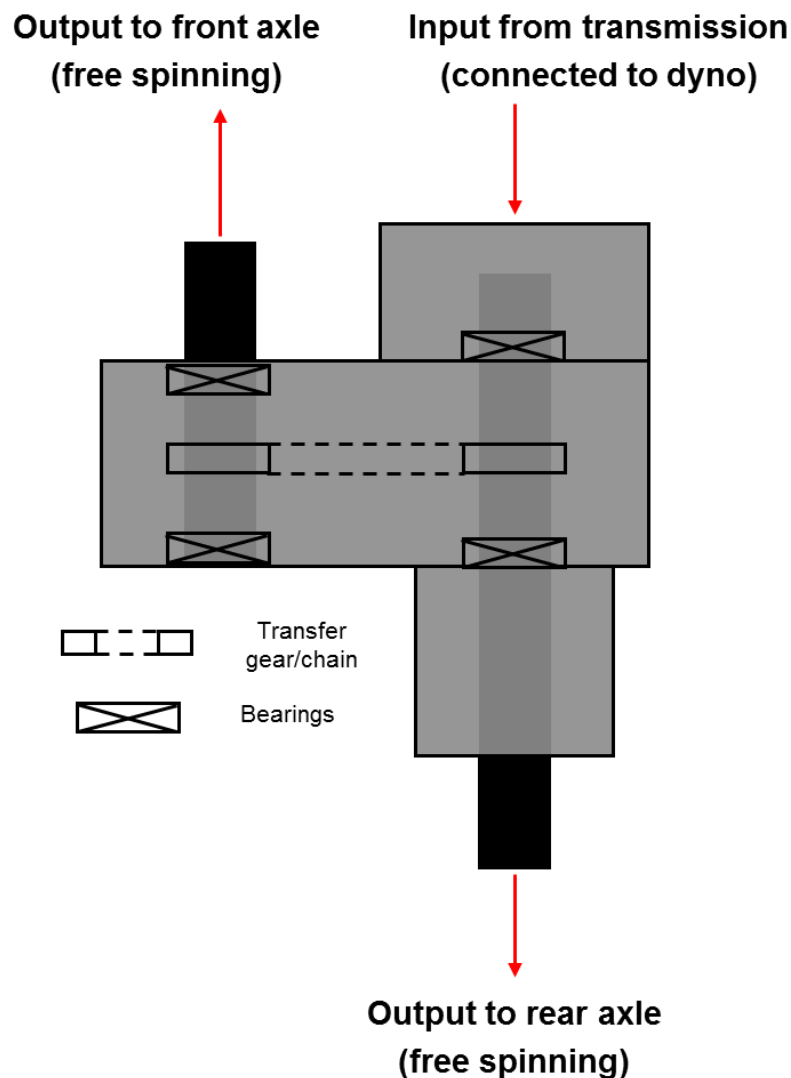


FIGURE 1 - TRANSFER CASE SCHEMATIC (SHOWN WITH REFERENCES TO VEHICLE POSITION)

3.2 Unit Under Test (UUT)

This term and its associated acronym is used to describe the test article (transfer case) undergoing the tests outlined herein.

3.3 Average Skin Temperature (AST)

To accurately represent the temperature of the unit under test (UUT), a metric has been developed using the average of multiple thermocouples. This method has been demonstrated to accurately represent the internal / overall ('core') temperature of the UUT and is based on a detailed study using an array of internal and external thermocouples. The thermocouples should be 'soldered tip' type (i.e., exposed wires/tip) and adhered to the unit using a thermally conductive adhesive to be most representative of the metal temperature. The AST measurement is composed of the arithmetic average readings of seven (7) thermocouples located as follows:

1-4) As close to the outer race of the input and output shaft support bearings as possible (4 total thermocouples)

5) As close to the vent as possible, but not inside the vent

6) Top of transfer case housing (center/middle of main input shaft)

7) Top of transfer case above torque multiplying gear set (for multi-speed units; for single speed, as close as possible to the 'transfer gear' - belt/chain/gear - which drives the front output shaft)

A pictorial example of sample locations is shown in Figure 2.

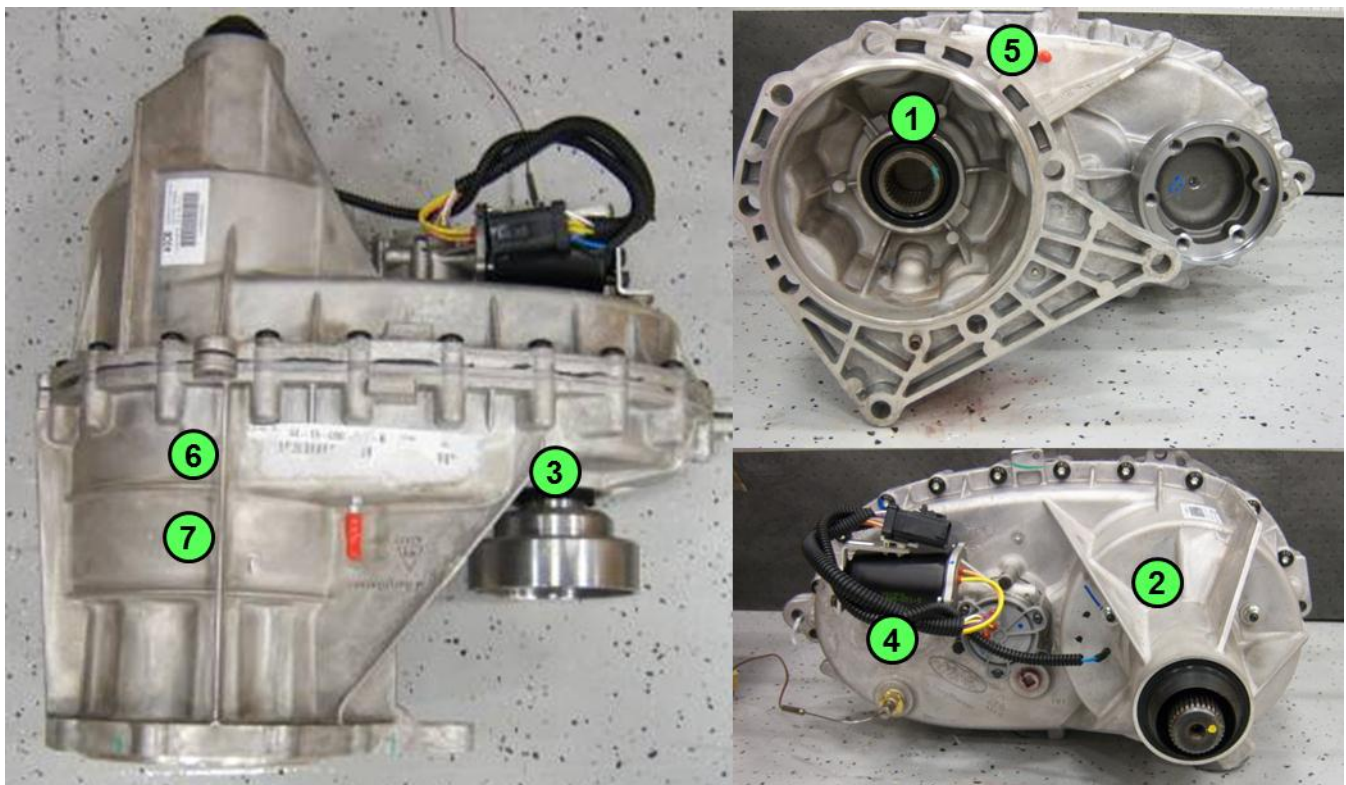


FIGURE 2 - AVERAGE SKIN TEMPERATURE SAMPLE LOCATIONS

1= Input Shaft; 2 = Prim. Shaft Rear; 3 = Sec. Shaft Front; 4 = Sec. Shaft Rear; 5 = Vent; 6 = Top/Mid, 7 = Ring Gear/Top

3.4 Sump Temperature

A thermocouple is installed in the drain plug (as shown in Figure 3) of the UUT to record the temperature of the oil within the test unit. This temperature is used in conjunction with the AST to establish the temperature state of the UUT. (NOTE: Sump temperature is not included in the AST calculation/definition defined above in Section 3.3.)

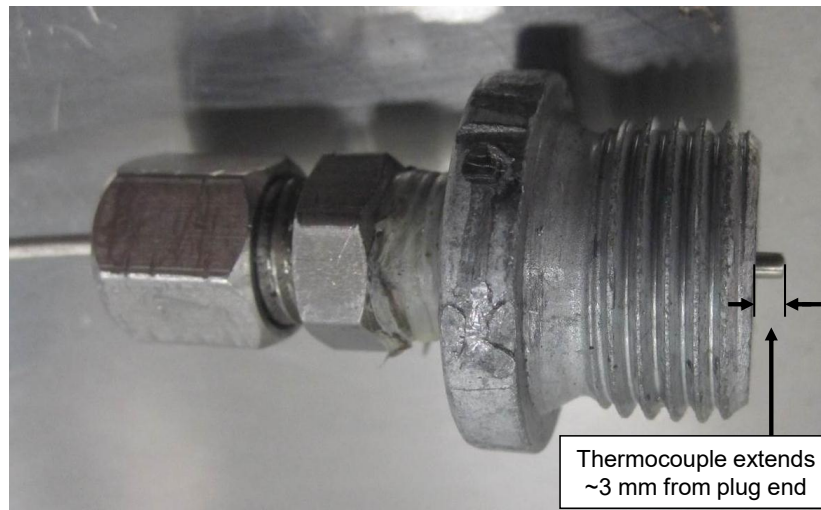


FIGURE 3 - SUMP TEMPERATURE VIA DRAIN PLUG

3.5 Temperature-Controlled Chamber

In order to conduct the testing outlined in Section 4, a suitable temperature-controlled chamber must be used. The chamber should be capable of controlling the transfer case temperature without directly conditioning the oil inside the transfer case (i.e., via convection). The method used should minimize the creation of localized hot or cold spots on the transfer case (a heat gun blowing directly on the UUT, for example). The chamber should be capable of achieving an average skin temperature (AST) in the range of -7°C (20°F) to $+65^{\circ}\text{C}$ (150°F), $\pm 1^{\circ}\text{C}$. Note, to achieve this range it is likely the chamber will need to be capable of achieving temperatures slightly above and below these target temperatures. Specific design of the chamber is beyond the scope of this specification; however, during the development of this specification, liquid nitrogen (LN_2) was utilized to achieve the lower range (-7°C) of the specification. If liquid nitrogen is used, care should be taken to ensure no liquid nitrogen is spilled or splashed directly on the UUT as it could damage the unit. A schematic of the chamber used is shown below in Figure 4 and a photograph of the chamber used is shown in Figure 5.

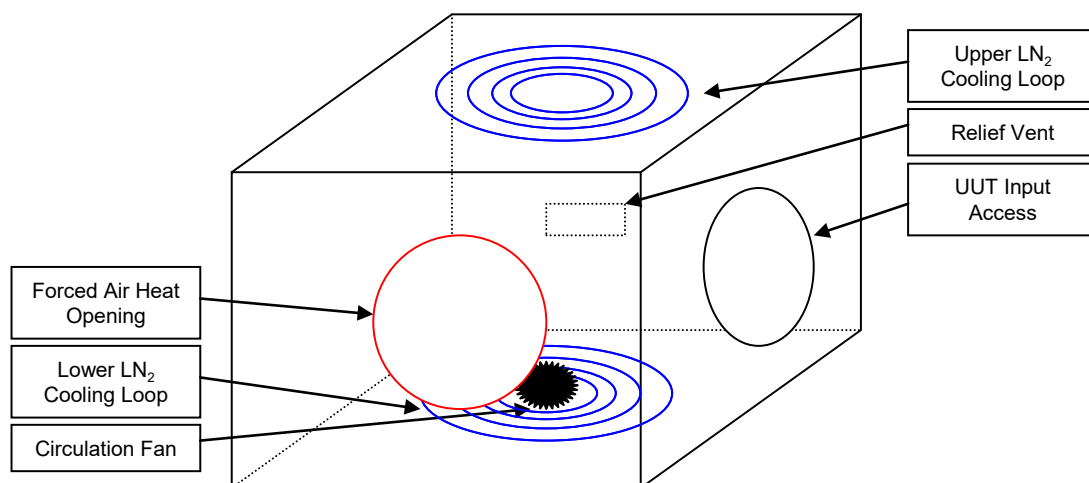


FIGURE 4 - SCHEMATIC OF TEMPERATURE-CONTROLLED CHAMBER