- CONFIDENTIAL -

MITSUBISHI MOTORS CORPORATION
1-21, Shibaura 3-chome, Minato-ku, Tokyo 108-8410 Japan

June 2, 2022
22VCE-A022

Mr. Linc Wehrly, Director
Light Duty Vehicle Compliance
Office of Transportation and Air Quality
U. S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, Michigan 48105

Dear Mr. Wehrly:

Subject: Application for GHG Off-Cycle Credit of Active Transmission Warm-Up

Mitsubishi Motors Corporation (MMC) submits this application for off-cycle credit of active transmission warm-up under the alternative methodology in accordance with 40 CFR 86.1869-12(d).

Per 40 CFR §86.1869-12, vehicle manufacturers may obtain GHG off-cycle credits for certain CO_2 reduction technologies where this benefit is not adequately captured on existing test cycles. This application is submitted in accordance with 40 CFR §86.1869-12(d), which allows manufacturers to earn credits by demonstrating that the applicable technology provides GHG reduction benefits via an alternative EPA-approved methodology.

MMC also states that the active transmission warm-up technology covered by this application is not a safety-related technology and is not subject to the exclusions listed in 40 CFR §86.1869-12(a).

If you have any questions or comments, please contact Andy Mabutol (714-514-2102) at MRDA.

Sincerely,

Mineyuki Kojima, General Manager
Certification and Regulation Compliance Department
Mitsubishi Motors Corporation

Enclosures: (3)

cc: Mr. Stephane Thiriez / Mr. Andy Mabutol MRDA

Introduction:

Pursuant to 40 CFR §86.1869-12, EPA allows manufacturers to generate credits for certain CO_2-reduction technologies where the benefit is not adequately captured on existing test cycles. Mitsubishi Motors Corporation (MMC) is hereby applying to receive credits for active transmission warm-up as described in paragraph (b)(1)(vi) of this section. Active transmission warm-up means a system that uses waste heat from the vehicle to quickly warm the transmission fluid to an operating temperature range using a heat exchanger. This increases the overall transmission efficiency by reducing parasitic losses associated with the transmission fluid, such as losses related to friction and fluid viscosity.

Description of Mitsubishi System:

MMC utilizes a heat exchanger in the coolant circuit of several vehicle models. Figure 1 shows the representative coolant circuit for MMC vehicles with transmission heat exchanger technology. The heat exchanger is incorporated in the coolant circuit and transfers heat between the transmission oil and the coolant. By implementing a heat exchanger approach, the transmission oil warms early and the oil viscosity falls, resulting in reduced transmission friction.

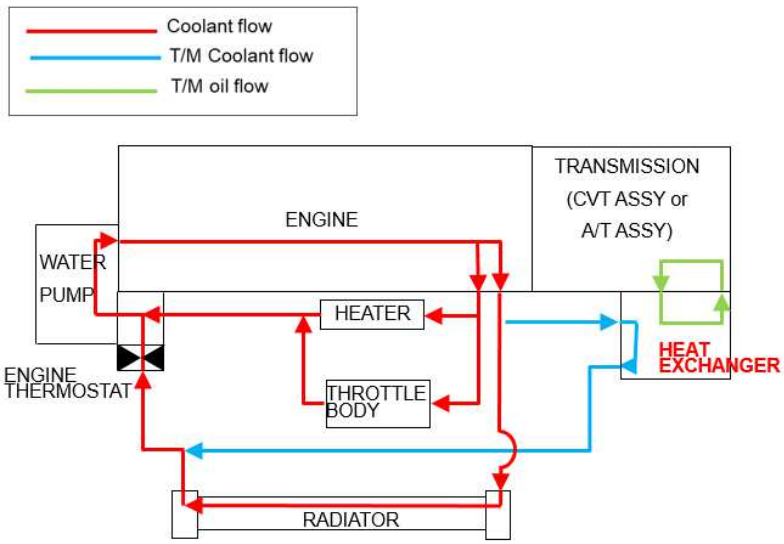
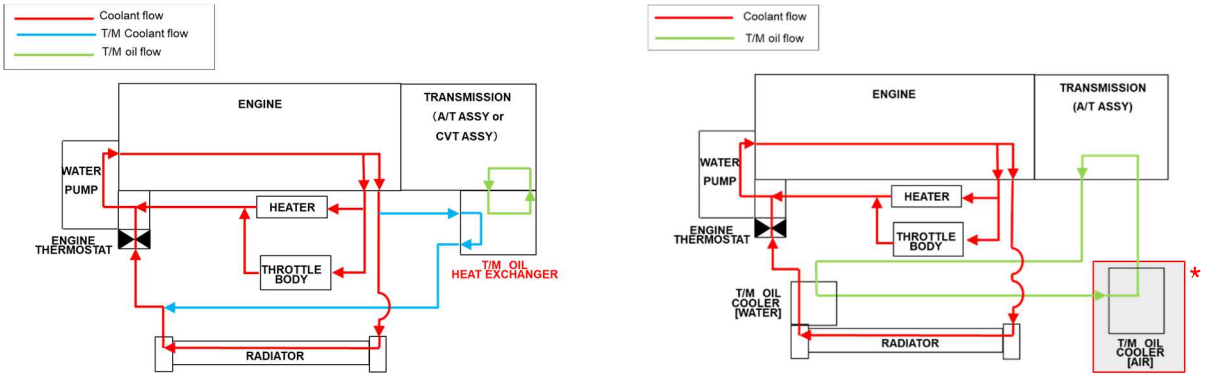


Figure 1 Representative coolant circuit for Mitsubishi vehicles

MMC used simulation to evaluate the transmission warm-up effect of the system with transmission heat exchanger. The model coolant circuits are shown in Figure 2. MMC calculated engine coolant water temperature and transmission oil temperature using the simulation, which were conducted with ambient temperature conditions of -7 degrees C and 20 degrees C to capture the off-cycle benefit.



(a) With T/M OIL HEAT EXCHANGER

(b) Without T/M OIL HEAT EXCHANGER
(Until 2006 Mitsubishi Outlander)

Figure 2 Coolant circuit for simulation

The circuit (a) represents the system with transmission heat exchanger and the circuit (b) represents the system without transmission heat exchanger. The circuit (b) system was installed in MMC vehicles sold in the North American market in the past (i.e. Outlander, sold in US until 2006). The transmission oil air cooler (*) left out from the baseline simulation model is shaded with gray hatching on the circuit (b) in the Figure 2.
Figure 3 shows the result of the simulation comparing transmission oil temperatures between the system with transmission heat exchanger, circuit (a), and the system without transmission heat exchanger, circuit (b).

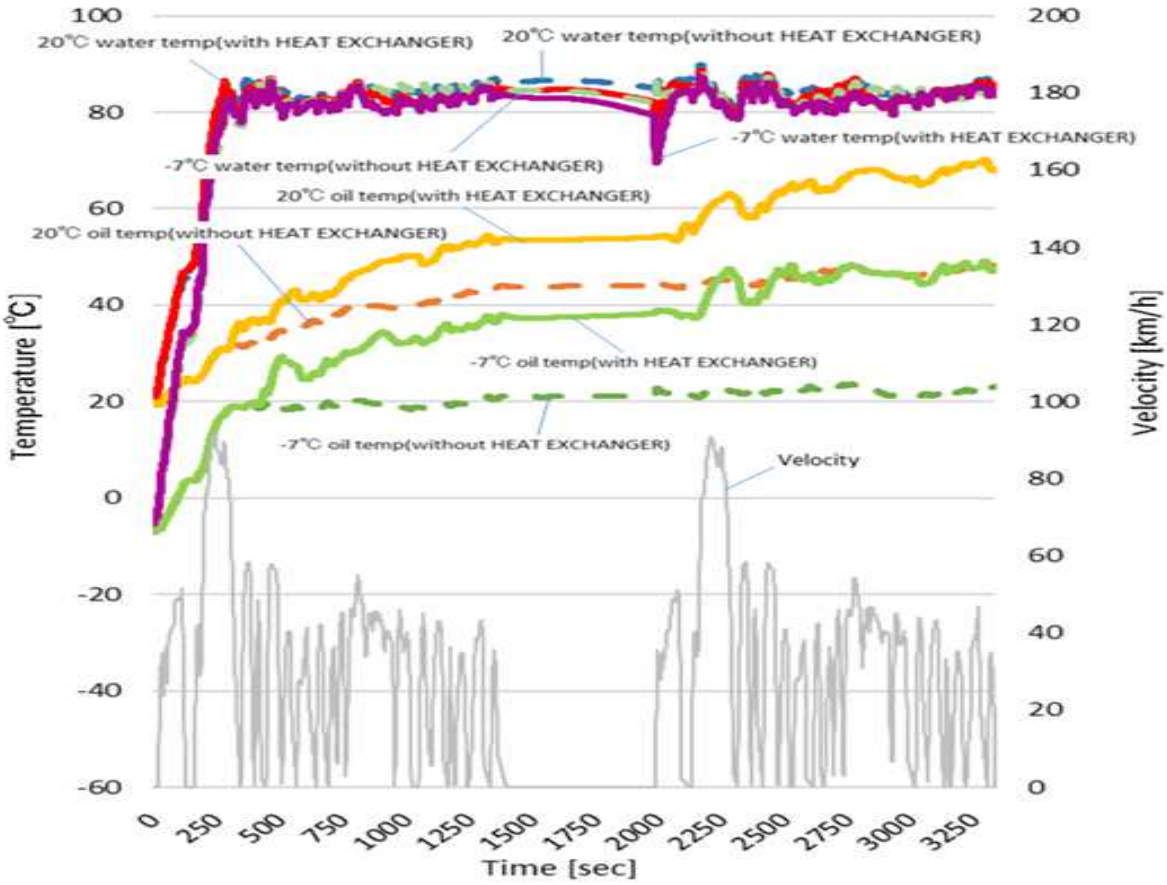


Figure 3 Simulation results (Measurement pattern: UDDS)

The circuit (a) shows early transmission oil temperature rise compared to that of the circuit (b) in both 20 degrees C and -7 degrees C ambient temperature conditions. Therefore earlier transmission friction decrease is expected. The data indicates the system with transmission warm-up technology has a fuel economy benefit in 20 degrees C and -7 degrees C conditions due to the warm-up technology, applied to both A/T and CVT transmission designs. The simulation predicts that the fuel economy of the entire vehicle increases in both 20 degrees C and -7 degrees C conditions.

The circuit (b) is equipped with the transmission oil water cooler to satisfy transmission cooling. But the transmission oil water cooler works only for heat radiation and inhibits temperature rise of transmission oil. The circuit (a), on the other hand, secures transmission cooling performance while raising transmission oil temperature early, because the transmission heat exchanger technology contributes both heat radiation to and heat absorption from the coolant.

Circuit (b), without the heat exchanger, uses heat radiation as the cooling mechanism and is not effective in causing temperature rise of the transmission oil. Circuit (a) on the other hand, which incorporates the heat exchanger and is used in select Mitsubishi vehicles, results in transmission cooling while raising the transmission oil temperature, by employing the two mechanisms of heat radiation AND heat absorption from the coolant. For this reason, MMC believes that the MMC vehicles with this transmission warm-up technology are eligible for active transmission warm-up credit.

Mitsubishi Methodology:

MMC intends to apply the pre-defined credit per the methodology described in the EPA and NHTSA Joint Technical Support Document[1] regarding credit determination. The credits are listed in 40 CFR §86.1869-12(b)(1)(vi) for each active transmission warm-up application per vehicle type (car/truck).

(A) The passenger automobile credit is 1.5 grams per mile.
(B) The light truck credit is 3.2 grams per mile.

The fleet credit will be calculated based on credit for each type of vehicle, vehicle lifetime miles, and U.S. sales volume for the applicable model year products.

Durability

Based on MMC's engineering analysis, the active transmission warm-up technology is expected to meet EPA requirements for in-use durability over the full useful life of the vehicle.

[1] EPA-420-R-12-901, August 2012