- CONFIDENTIAL -

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

June 2, 2022
22VCE-A021

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 High-Efficiency Alternator

Mitsubishi Motors Corporation (MMC) submits this application for off-cycle credit of high-efficiency alternator under the alternative methodology in accordance with 40 CFR §86.1869-12(d). MMC requests approval to use a GHG credit value of 0.16 gram/mile CO_2 per 1% efficiency improvement above a baseline efficiency level of 67% VDA.

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 high-efficiency alternator 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: (4)

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. MMC is hereby applying to receive credits for high efficiency alternator as described in paragraph (b)(1)(ix) of this section. High efficiency alternator means an alternator where the ratio of the alternator output power to the power supplied to the alternator is greater than 67 percent, as measured using the Verband der Automobilindustrie (VDA) efficiency measurement methodology.

Description of Mitsubishi System:

High efficiency alternator means a power generation technology that, when installed on the vehicle, is expected to reduce the CO_2 from the generation system when compared to conventional generation systems.

The baseline alternator efficiency is based on Verband der Automobilindustrie (VDA) efficiency of 67% as defined in EPA's Memorandum to Docket EPA-HQ OAR-2018-0283 ("Potential Off-cycle Menu Credit Levels and Definitions for High Efficiency Alternators and Advanced Air Conditioning Compressors")[1]. The VDA efficiency is the accepted industry standard for measuring alternator efficiency. Therefore, high efficiency alternator means an alternator where the ratio of the alternator output power to the power supplied to the alternator is greater than 67 percent, as measured using the VDA efficiency measurement methodology.

With a high efficiency alternator, the load torque is kept low when generating the same output current. Thus, a high efficiency alternator can reduce CO_2 by suppressing the fuel injection rate in the engine, keeping the drive source for the alternator to a low level.

[1] EPA-HQ-OAR-2018-0283-0706, August 2018

Mitsubishi Methodology:

MMC intends to apply the credit value per the assessment described in the EPA's Memorandum to Docket EPA-HQ-OAR-2018-0283 ("Potential Off-cycle Menu Credit Levels and Definitions for High Efficiency Alternators and Advanced Air Conditioning Compressors"). EPA assesses that, for alternators with an efficiency higher than the 67% baseline level, a conservative off-cycle credit is 0.16 grams/mile CO_2 per % improvement. To calculate high efficiency alternator credit for each applicable vehicle models, MMC will use the following equation described in to §86.1869-12 (b)(1)(ix).

> (ix) High efficiency alternator. The credit for a high efficiency alternator for passenger automobiles and light trucks shall be calculated using the following equation, and rounded to the nearest 0.1 grams/mile:
>
> $$Credit\left(\frac{}{i\ e}\right. = (VDA_{HEA} - 67) \times 0.16$$
>
> Where:
> VDA_{HEA} is the ratio of the alternator output power to the power supplied to the alternator, as measured using the Verband der Automobilindustrie (VDA) efficiency measurement methodology and expressed as a whole number percentage from 68 to 100.

Since the VDA efficiency of the applicable alternator is 70%, MMC intends to apply for 0.5 grams per mile credit per vehicle. 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.

Electrical loads under 2-cycle driving conditions:

In granting off-cycle credits for high-efficiency alternators, EPA has accepted a large body electrical load data for LDV and LDT models operated under on-road driving conditions and 2-cycle test pattern driving conditions[2]. Ford's data demonstrated a credit basis of 297 Watts for 2-cycle test electrical load and 588 Watts for on-road driving conditions[3]. That data was used to determine electrical saving values resulting from the use of high efficiency alternator. The EPA-accepted unified on-road saving value is 41 Watts, and the EPA-accepted unified 2-cycle saving value is 21 Watts[3]. Toyota conducted 2-cycle test electrical load testing of additional models. That testing showed electrical load under 2-cycle test conditions that is similar to Ford's 2-cycle test data[4]. EPA has accepted that a demonstration of comparable 2-cycle test electrical loads can obviate the need for additional on-road data[4]. That is, if 2-cycle electrical loads are similar, on-road electrical loads can be considered similar. On the basis of these Agency approved submissions and other information, the Agency concluded *"…GHG emissions benefits for high efficiency alternators were fairly consistent across manufacturers, conditions and vehicle types" and "…could serve as the basis for a [generalized] menu credit for high efficiency alternators*"[5].

Mitsubishi has conducted 2-cycle testing on Mitsubishi models equipped with high-efficiency alternator technology. The data is shown in below table and comparable to Ford, Toyota, GM, Nissan and VW that have been accepted by EPA.

Table 1 Electrical loads values under 2-cycle test procedure

Manufacturer	Model	Electrical load [W]	Average electrical load [W]
Mitsubishi	Outlander 2.4L CVT	175	183
	Outlander Sport 2.0L	188	
	Outlander Sport 2.4L	186	
Ford	Fusion	275	297
	F-150	318	
Toyota	RAV4 with engine-stop function	252	308
	RAV4 without engine-stop function	364	
General Motors	Impala	233	276
	Sierra	319	
Nissan	Rogue	309	295
	Altima	281	
VW	Q5	342	307
	Jetta	272	

[2] "EPA Decision Document: Off-Cycle Credits for BMW Group, Ford Motor Company, and Hyundai Motor Company" EPA-420-R-17-010, December 2017

[3] "Ford Motor Company Application for High-Efficiency Alternator Off-Cycle GHG Credit", EPA-HQ-OAR2017-0189-006, June 21, 2016

[4] "EPA Decision Document: Off-Cycle Credits for Fiat Automobiles and Toyota Motor Corporation" EPA-420R-18-015, June 2018

[5] EPA-OTAQ memorandum to docket EPA-HQ-OAR-2018-0283 entitled "Potential Off-Cycle Credit Levels for High Efficiency Alternators…" dated August 1, 2018

Application for Mitsubishi Vehicles:

MMC has implemented high efficiency alternator technology on certain vehicles (Table 2). High efficiency alternator technology is standard on these vehicles. MMC will calculate earned credits based on actual sales of these vehicles.

Table 2 2014-2020MY Mitsubishi vehicles with high efficiency alternator technology.

Vehicle Model	Engine	MY							VDA Efficiency [%]
		2014	2015	2016	2017	2018	2019	2020	
[redacted]									70
									70
									70

Notes: X= Standard / = No production

Durability

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