

State of California  
AIR RESOURCES BOARD

EXECUTIVE ORDER D-715

Relating to Exemptions under  
Section 27156 of the Vehicle Code

Hydrogen Power Systems, Inc.  
On-Demand Hydrogen Enhanced Combustion System

Pursuant to the authority vested in the Air Resources Board by Section 27156 of the Vehicle Code; and

Pursuant to the authority vested in the undersigned by Sections 39515 and 39516 of the Health and Safety Code and Executive Order G-02-003;

IT IS ORDERED AND RESOLVED: That installation of the On-Demand Hydrogen Enhanced Combustion System device, manufactured by Hydrogen Power Systems, Inc. (1120 Simpson Way, Escondido, California 92029), has been found not to reduce the effectiveness of the applicable vehicle pollution control systems, and therefore, the On-Demand Hydrogen Enhanced Combustion System device is exempt from the prohibitions in Section 27156 of the Vehicle Code for all 1960-2009 model year light/medium/heavy heavy-duty on-road diesel engines between 5.0 liters to 16.2 liters.

The On-Demand Hydrogen Enhanced Combustion System device consists of a metal/plastic case containing an 8-quart water reservoir, an electrolysis generator cell, various electrical components, electrical wiring and connectors, an electrolyte, and plastic supply hose for the hydrogen gas.

This Executive Order is based on emission test results using Heavy-Duty Federal Test Procedure Transient Cycle test submitted by Hydrogen Power Systems, Inc. with the On-Demand Hydrogen Enhanced Combustion System device.

If evidence provides the Air Resources Board with reasons to suspect that the On-Demand Hydrogen Enhanced Combustion System device will affect the durability of the emission control system, Hydrogen Power Systems, Inc. shall be required to submit durability data to show that the durability of the vehicle emission control system is not, in fact, affected and/or that the add-on or modified parts demonstrate adequate durability.

This Executive Order is valid provided that installation instructions for the On-Demand Hydrogen Enhanced Combustion System device do not recommend tuning the vehicles to specifications different from those of the vehicle manufacturer.

Changes made to the design or operating conditions of the On-Demand Hydrogen Enhanced Combustion System device, as exempt by the Air Resources Board, which adversely affect the performance of the vehicle's emission control system, shall invalidate this Executive Order.

Marketing of the On-Demand Hydrogen Enhanced Combustion System device using identification other than that shown in this Executive Order or for an application other than that listed in this Executive Order shall be prohibited unless prior approval is obtained from the Air Resources Board.

Exemption of the On-Demand Hydrogen Enhanced Combustion System device shall not be construed as exemption to sell, offer for sale, or advertise any component of the kit as an individual device.

This Executive Order shall not apply to any On-Demand Hydrogen Enhanced Combustion System device advertised, offered for sale, sold with, or installed on a motor vehicle prior to or concurrent with transfer to an ultimate purchaser.

This Executive Order does not constitute any opinion as to the effect the use of the On-Demand Hydrogen Enhanced Combustion System device may have on any warranty either expressed or implied by the vehicle manufacturer.

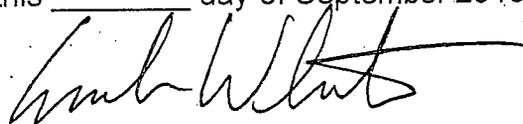
No claim of any kind, such as "Approved by the Air Resources Board," may be made with respect to the action taken herein in any advertising or other oral or written communication.

In addition to the foregoing, the Air Resources Board reserves the right in the future to review this Executive Order and the exemption provided herein to assure that the exempted add-on or modified part continues to meet the standards and procedures of California Code of Regulations, Title 13, Section 2222, et seq.

THIS EXECUTIVE ORDER DOES NOT CONSTITUTE A CERTIFICATION, ACCREDITATION, APPROVAL, OR ANY OTHER TYPE OF ENDORSEMENT BY THE AIR RESOURCES BOARD OF ANY CLAIMS OF THE APPLICANT CONCERNING ANTI-POLLUTION BENEFITS OR ANY ALLEGED BENEFITS OF HYDROGEN POWER SYSTEMS, INC.'S ON-DEMAND HYDROGEN ENHANCED COMBUSTION SYSTEM DEVICE.

Violation of any of the above conditions shall be grounds for revocation of this Executive Order. The Executive Order may be revoked only after a ten day written notice of intention to revoke the Executive Order, in which period the holder of the Executive Order may request in writing a hearing to contest the proposed revocation. If a hearing is requested, it shall be held within ten days of receipt of the request, and the Executive Order may not be revoked until a determination is made after the hearing that grounds for revocation exist.

Executed at El Monte, California, this 5<sup>th</sup> day of September 2013.



Erik White, Chief  
Mobile Source Operations Division

## EVALUATION SUMMARY

Manufacturer Name: Hydrogen Power Systems, Inc.

Name of Device: On-Demand Hydrogen Enhanced Combustion System

Background:

Hydrogen Power Systems, Inc. of 1120 Simpson Way, Escondido, California 92029 has applied for exemption from the prohibitions in Section 27156 of the California Vehicle Code for its On-Demand Hydrogen Enhanced Combustion System device. The device is designed for all 1960-2009 model year (MY) light/medium/heavy heavy-duty on-road diesel engines between 5.0 liters to 16.2 liters.

Recommendation:

Grant exemption to Hydrogen Power Systems, Inc. as requested and issue Executive Order D-715.

Device Description:

The On-Demand Hydrogen Enhanced Combustion System device produces hydrogen through an electrolysis process by supplying water from a reservoir containing distilled water and an activator (potassium hydroxide) to an electrolysis dry cell containing titanium plates that are supplied electricity from the vehicle's battery. The device consists of a 8-quart water reservoir, an electrolysis dry cell (which contains the positive, negative, and neutral stainless steel plates), various electrical components, electrical wiring and connectors, and a EDPM rubber supply hose for the hydrogen gas. The device is connected to the vehicle's battery through a power controller so that hydrogen gas is only produced when the engine is operating.

Discussion/Basis for the Recommendation:

This exemption is based on the following emission tests conducted on two heavy-duty diesel engines with Hydrogen Power Systems, Inc.'s On-Demand Hydrogen Enhanced Combustion System device installed:

1. FTP transient cycle test on a 1999 MY Mack E7 Series 11.9 liter diesel engine.
2. FTP transient cycle, Euro III ESC 13-mode steady-state, and NTE tests on a 2007 MY Caterpillar C15 Series 11.9 liter diesel engine.

The emission test results are shown below:

Hot-Start FTP Transient Cycle Emission Test  
1999 MY Mack E7 Series 11.9 liter Diesel Engine  
Engine Family XMKXH11.9E54

	FTP Transient Cycle Emissions (grams/bhp-hr)			
	HC	NOx	CO	PM
FTP baseline results for engine	0.188	4.08	0.77	0.075
FTP results w/ On-Demand Hydrogen Enhanced Combustion System installed	0.177	4.29	0.71	0.070
Percentage change	-5.9%	+5.1%	-7.8%	-6.7%

Hot-Start FTP Transient Cycle Emission Test  
2007 MY Caterpillar C15 Series 11.9 liter Diesel Engine  
Engine Family 7CPXH0928E1K

	FTP Transient Cycle Emissions (grams/bhp-hr)				
	NMHC	NOx	NMHC+NOx	CO	PM
FTP baseline results for engine	0.01	1.38	1.39	0.25	0.0037
FTP results w/ On-Demand Hydrogen Enhanced Combustion System installed	0.01	1.35	1.36	0.28	0.0037
Percentage change	0%	-2.2%	-2.2%	+12.0%	0%

Euro III ESC 13-Mode Steady-State Emission Test  
2007 MY Caterpillar C15 Series 11.9 liter Diesel Engine  
Engine Family 7CPXH0928E1K

	Euro III ESC Emissions (grams/bhp-hr)				
	NMHC	NOx	NMHC+NOx	CO	PM
ESC Emission Standards	0.14	1.16	1.3	15.5	0.01
ESC Test Results w/ On-Demand Hydrogen Enhanced Combustion System Installed	0.01	0.91	0.92	0.09	0.0039
Pass/Fail	Pass	Pass	Pass	Pass	Pass

NTE Emission Test  
2007 MY Caterpillar C15 Series 11.9 liter Diesel Engine  
Engine Family 7CPXH0928E1K

	NTE Emissions (grams/bhp-hr)				
	NMHC	NOx	NMHC+NOx	CO	PM
NTE Emission Standards	0.21	1.74	2.0	19.4	0.02
Point 1 NTE Test Results w/ On-Demand Hydrogen Enhanced Combustion System Installed	0.01	0.70	0.71	0.05	0.0038
Point 2 NTE Test Results w/ On-Demand Hydrogen Enhanced Combustion System Installed	0.00	0.89	0.89	0.05	0.0024
Point 3 NTE Test Results w/ On-Demand Hydrogen Enhanced Combustion System Installed	0.00	0.69	0.69	0.05	0.0011
Pass/Fail	Pass	Pass	Pass	Pass	Pass

Notes: 1. NTE Point 1 is 50% Torque/90% RPM  
NTE Point 2 is 85% Torque/80% RPM  
NTE Point 3 is 65% Torque/70% RPM

2. All testing was conducted at Olson-EcoLogic Engine Testing Laboratories in Fullerton, California

FTP transient cycle testing on the 1999 MY Mack E7 Series engine and 2007 MY Caterpillar C15 Series engine modified with the On-Demand Hydrogen Enhanced Combustion System device did not cause emissions to exceed baseline by more than the allowed limits of 10 percent for HC, NMHC, and NOx and 15 percent on CO and PM which is acceptable for exemption. EURO III ESC and NTE emission testing on the 2007 MY Caterpillar C15 Series engine modified with the On-Demand Hydrogen Enhanced Combustion System device showed that the modified engine met the exhaust emission standards. Similar results are expected when Hydrogen Power Systems, Inc.'s On-Demand Hydrogen Enhanced Combustion System device is used on the 1960-2009 MY light/medium/heavy heavy-duty on-road diesel engines between 5.0 liters to 16.2 liters as stated in this application.