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Putting 2010 Emissions Compliant Vehicles to the Test

Results of Third-Party TMC Type IV Testing Commissioned by Navistar

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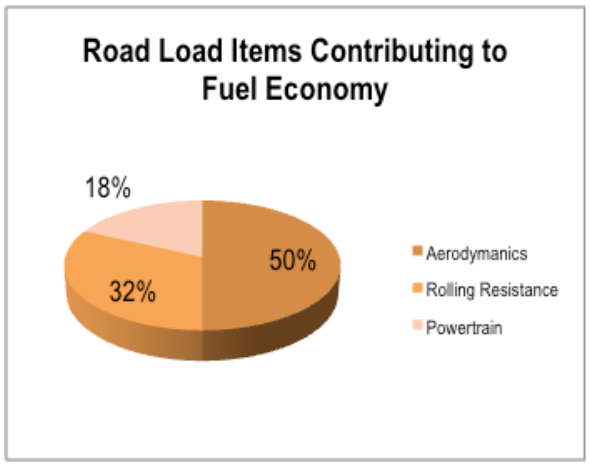
Abstract

The purpose of this initiative was to conduct third-party testing among class 8 vehicles to validate claims relative to fluid economy (diesel + liquid urea SCR consumed). International Truck commissioned Transportation Research Center (TRC) to conduct over-the-road testing utilizing TMC Type IV standards of the International® ProStar®+ with MaxxForce® Advanced EGR, Freightliner Cascadia® and Kenworth T660, both with liquid urea SCR. Findings proved the International ProStar+ had nearly 1% - 2.5% advantage on fluid economy. The following document outlines testing methodology and detailed results.

Background

Navistar commissioned a head-to-head fluid economy comparison of three 2010 emissions-compliant trucks: ProStar®+ with MaxxForce 13 Advanced EGR, Freightliner Cascadia® with DD15 and Kenworth T660 with Cummins ISX to provide their customers information needed to make informed decisions in their upcoming truck purchases.

The intent of this testing was to provide clarity of competing claims in the marketplace. Liquid urea SCR-powered manufacturers made claims of 3%, 5%, and up to 10% better fuel economy. Some claims are compared to their own 2007 emissions-compliant engines, whereas others are compared to all engines within the industry. Navistar felt a more accurate measurement of performance is not engine-to-engine, but truck and engine working together because aerodynamics contributes 50% to fuel economy and rolling resistance 32% and powertrain the smallest factor at 18% of road load items contributing to fuel economy.



And with 2010 emissions, the rules changed and measurement needed to be revisited. Until 2010, comparisons of Class 8 trucks began with fuel economy. But in 2010, different trucks offered different solutions for 2010 emissions, and fuel economy didn't tell the whole story. The competitors' trucks require a liquid urea SCR solution to operate the vehicle, and like diesel fuel, liquid urea costs money. That's why fluid economy was introduced as the new standard measurement for truck comparison. Fluid economy is a measurement of diesel fuel plus liquid urea consumed. This measurement provides a more accurate representation of fluid economy and customers' operating costs.

Objective/Hypothesis

The goal of this initiative was to contract a third party to conduct testing that utilizes TMC Type IV practices to measure and compare fluid economy for competitive 2010 emissions compliant class 8 vehicles. The production vehicles measured were as similarly spec'ed to what each manufacturer was positioning as their most fuel efficient:

Specifications		International ProStar+	Freightliner Cascadia	Kenworth T660
Wheel Base		231"	237"	236"
Rails		5/16"x3.58"x10.125"	11/32" x 3.5x 10.187	5/16"x3.5x 10.625
Front Axle		Meritor 12.0k	Steertek 12.5K	DANA 12K
Front Susp		12k Taperleaf	12K Taperleaf	13.2K Air
Brakes		Bendix FWWCS	Wabco 6S/6M ABS	Bendix 6S/6M
		AD-IS Dyer	AD-9 Dryer	AD-IS
		21.0 CPRSR	15.9CFM CPRSR	18.7 CFM CPRSR
Steering		Std Sheppard HD-94	Std TRW THP-60	Std TRW TAS-65
Driveline		SPL 250XL	18T Merritor	SPL 250XL
Exhaust		Single Ver TP	Single Ver TP	Single Ver TP
		RSM	RSM	RSM
		N/A Blue Tank	23 Gal Blue Tank	20 Gal Blue Tank
Alternator		200 AMP	275 amp	160 AMP
Front End		Opt for Prostar +122	Std for Cascadia	Std for T-660
Fifth Wheel		6.75"	6.75"	6.75"
Clutch		Eaton 15.5"	Eaton 15.5"	Eaton 15.5"
Engine		MaxxForce 13L	DD15 14.8L	Cummins ISX 15L
		430 HP @ 1900 RPM	455 HP @ 1800 RPM	435 HP @ 1700 RPM
		1550 LB/FT @ 1100	1550 LB/FT @ 1100	1450 LB/FT @ 1200
Transmission		Eaton FRO-16210C	Eaton FRO-1521	Eaton FRO - 1621
		10 spd w/OD	10 spd w/OD	10 spd w/OD
Rear Axle		RT40-145 40k Tandem	RT40 40K Tandem	DANA DSP 40
		3.42 Ratio	3.58 Ratio	3.55 Ratio
Rear Susp		40k Air Susp	40K Air Susp	40K Air Susp
		52" Spacing	51" Spacing	52" Spacing
Fuel Tanks		Lt Tank 125 Gal	Dual 120 Gal	Dual 120 Gal
		Rt Tank 150 Gal		
Cab		73" Sleeper	72" Sleeper	72" Sleeper
Tires	Front	Goodyear G395 295/75R22.5	Goodyear G395 295/75R22.5	Goodyear G395 295/75R22.5
	Rear	Goodyear G372A 295/75R22.5	Goodyear G372A 295/75R22.5	Goodyear G372A 295/75R22.5

Hypothesis

To date, no claims have been proven through third party testing, showing which truck/engine performance lead on fluid consumption, until this testing. We believed International ProStar+, when compared to other 2010 emissions compliant class 8 highway tractors, was the most efficient in fluid economy.

Methodology/Procedures

When fluid economy testing under TMC Type IV practices is conducted, numerous measures* are taken to ensure stable testing controls and statistically reliable results.

a.) A complete test = a minimum of three valid test runs.

b.) Test Run = a test run can vary from a minimum of 200 miles to a maximum of 500 miles

c.) Data Point = the ratio of fluid burned during a test run divided by the fluid burned during a control run.

d.) Mid-Point = a site designated as a driver/trailer switching or fueling facility located within plus or minus five percent of halfway point of the test run course.

e.) Valid Test Run/Valid Test = a test run resulting in a valid data point. A valid data point is a ratio within two percent of two other data points. Three valid data points comprise a valid test.

Test Preparation

a.) Test Route Selection- a frequently used four-lane, limited-access, divided highway that is representative of route system terrain. A test route start point must be established which includes provisions for fueling. At the test route mid-point, a facility must be designated which will accommodate a switch of tractors or drivers. The end point must have fueling facilities.

b.) Test Speed Selection- the test speed should be representative of fleet operation

c.) Test Vehicle Specification and Configuration- test vehicles must be identical down to tire design, air pressure and tread remaining. The only variable should be the item being evaluated. When testing new vehicles with odometer mileage between 2,500 - 10,000, the odometer readings of both vehicles should be within 1,000 miles of each other. When trailers are swapped and load weight is not a consideration, the gross weight of each vehicle may be within five percent of the other. If straight trucks are being tested, drivers must switch at the mid-point and load weight must be equal.

d.) Drivers- drivers who start the test must complete the test, and substitution is not permitted.

e.) Observers- if observers are used, they should have a contributing function and avoid distracting the driver.

f.) Weather Measurement- complete test summaries include environmental conditions-temperature, wind speed and direction, and relative humidity.

g.) Truck Fuel System- only one fuel tank should be used. All other fuel tanks must be isolated by disconnecting and plugging-off or capping-off crossover lines.

Vehicle Preparation

To minimize variability, all vehicles tested must be in similar mechanical condition, representative of the fleet's vehicles, and have the following:

a.) CB radios- enables drivers to keep vehicle conditions exactly the same.

b.) Each engine governor or electronically programmable drivetrain parameter set to manufacturer's recommendation or fleet standard and verification of electronic engine program settings.

c.) New fuel filters in all cases and new air cleaner elements.

d.) Each vehicle clean and free of damage and missing body parts.

e.) Sliding fifth wheels must be set to give equal trailer gap unless trailer gap is the test parameter.

g.) Cab side window openings the same in each vehicle at all times.

h.) Accessory load for-each vehicle as consistent as possible.

i.) Trailer free of damage affecting aerodynamic drag.

j.) Truck/tractor and axles checked for proper alignment.

k.) Each vehicle properly lubricated prior to test and fluid levels checked for prescribed levels.

l.) Temperature controlled fan drives and shutters in the same operating mode throughout the test.

m.) Cold tire pressures measured and inflated to standard.

n.) Stall checks performed on vehicles equipped with automatic transmissions and torque converters.

o.) Exhaust system back pressure below engine manufacturer's maximum recommended limit.

p.) Proper brake adjustment. Either disarm automatic slack adjusters or check for brake drag before, at mid-point and after each test run.

q.) When comparing straight trucks, the freight loaded in each truck should be equal. If this is the case, load weights or axle weights cannot be changed until three valid data points have been completed.

Test Procedure

a.) Warm-up– during the warm-up, drivers familiarize themselves with the vehicles, note speedometer and tachometer accuracy, and practice speed management using visual and voice contact.

b.) Fueling Before Test Run- at the end of the warm-up period, both vehicles are filled with fuel to the point that fuel just touches the tank's filler neck or to a specific level as noted on a free swinging dip stick resting on top of the tank filler neck. Fuel temperature must be measured with tank full and recorded.

c.) Test Run- both vehicles must leave the fueling station together. The lead driver establishes and maintains test speed; the following driver establishes and maintains the distance between vehicles. The gap, or interval, should always be between 1/4-3/4 mile or 15-45 seconds.

d.) Mid-point Switching- at the test run mid-point facility, driver/trailer switching takes place to limit any effect drivers and trailers might have on results.

e.) Test Run After Mid-point Switch- when leaving the mid-point switch facility, the driver that led the first half of the test run leads the second half. The following driver maintains the same gap between vehicles.

f.) Measurement of Fuel Consumed- fuel consumption by each truck must be measured at the end of each test run by recording the meter reading on a commercial diesel pump after having pumped fuel into the truck's supply tank, bringing the fuel level in the tank to the predetermined point on the filler neck of the tank or a free-swinging dipstick scale. After filling the tank to the predetermined point and waiting for temperature stabilization, fuel temperature is measured and recorded.

Results/Discussion

Fluid economy testing of select 2010 emissions compliant class 8 vehicles took place in June and July 2010 and the results were in favor of International ProStar®+. ProStar+ had nearly 1% better fluid economy over Freightliner Cascadia and nearly 2.5% improvement over Kenworth's T660.

Testing Data Variables	ProStar+ with MaxxForce 13 Advanced EGR	Freightliner Cascadia with Detroit Diesel 15	ProStar+ with MaxxForce 13 Advanced EGR	Kenworth T660 with Cummins ISX
Miles Driven (per test run)	444	444	444	444
Total Liquid Consumed	194.4	196.2	199.0	204.0
Fluid Economy Advantage	Baseline	-0.90%	Baseline	-2.50%

On diesel consumption alone, the International ProStar+ with MaxxForce Advanced EGR was nearly equal to the other trucks tested, with a slight variance of +/- 1% versus the competitive liquid urea SCR vehicles tested. However, the more accurate measurement based on 2010 emissions-compliant vehicles is fluid economy, where ProStar+ excelled nearly 1% - 2.5% over the competitive liquid urea SCR models tested.

Moving forward, when making comparisons with 2010 emissions-compliant truck/engines, one must look at overall fluid economy, not just diesel. And when fluid economy is measured, there is a clear leader: International ProStar+ with MaxxForce Advanced EGR.

For further information on this fluid economy initiative, go to InternationalTrucks.com/results.