
GET THE FACTS ON MEDIUM
DUTY FLUID ECONOMY TESTING
INTERNATIONAL
A NAVISTAR COMPANY
DURAStar
POWERED BY MAXXFORCE

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CHAPTER ONE:
EXECUTIVE SUMMARY

Get the Facts on Medium Duty Fluid Economy Testing

Hino issued a press release on March 7, 2011 stating the results of their third-party validated testing of Hino 268A vs. International® DuraStar® using SAE Type III fuel economy testing procedures. The release claimed Hino's 268A had a 19.8% fuel efficiency advantage over International's DuraStar. Hino provided specific detail of the testing upon International's request, and after close evaluation, there was evidence of numerous violations to SAE Type III testing procedures and methodology in calculating results. Navistar conducted its own testing of the International DuraStar vs. Hino 268A, and the outcome produced very different results.

HINO'S FUEL ECONOMY CLAIMS PROVEN FALSE

1 HINO'S SPECS WERE INCONSISTENT

VEHICLE SPECIFICATIONS FROM HINO'S TESTING WERE INCONSISTENT

	Hino 268A	INTERNATIONAL® DURASTAR®
Vehicle Mileage	29,624	5,852
Transmission	Allison 2200 HS Automatic OD (6 speed)	Allison 2200 HS Automatic OD (5 speed)
Axle Ratios	5.57	5.29
Weight Savings	Aluminum wheels	Steel wheels
Tires	Bridgestone	Hankook
Mirrors	Side	Side, hood
Engine	J08E-VC	MaxxForce® DT (NOTE: Hino uses MxF7 in all comparisons except this test)

2 HINO DIDN'T CALCULATE RESULTS CORRECTLY

- Hino's testing runs do not constitute as a valid test run according to Type III standards. A valid test run = a ratio within two percent of the other valid test runs. Three valid test runs comprise a valid test, and the ratio between Hino's test runs was 7 percent.

3 HINO'S TESTING DIDN'T FOLLOW SAE GUIDELINES

- Traffic conditions varied each route: Traffic standstills and traffic lights were reported
- Used a "pace truck" to negate the effects of wind, which alters aerodynamic loading
- Driver swap not performed correctly: Drivers swapped after each test run results in driver variation that affect test results
- DEF consumption not reported

TESTING PROCEDURES COMPARISON

	Hino Testing	Navistar Testing
Repeatability	**3 runs within 7% of one another**	**3 runs within 2% ratio of one another (per TMC Type IV testing guidelines)**
Route	**Variable traffic conditions and speed**	**Steady state, 55 mph**
Pace truck	**Used, which negates the effects of wind**	**Not used**
Driver swap	**Rotated at the end of each test run**	**At half-way point for each run (per TMC Type IV testing guidelines)**
Calculations	**Liquid Urea not reported**	**Reported liquid urea consumption**

4 NAVISTAR'S TESTING FOLLOWED PROPER PROCEDURES

- We source or purchase test vehicles to ensure consistency in specifications. The specifications for both vehicles are as identical as possible. Since the measure is fluid economy, we spec'ed the powertrain that optimized fuel consumption, the MaxxForce® 7. With the industry's most advanced fuel system with high pressure common rail with piezo electric injectors, MaxxForce 7 provides unmatched fuel economy and performance.
- Navistar has a strong history of vehicle testing, and we leveraged our learnings from the on-highway business for this fluid economy test. Our testing is thorough and because it's conducted by the Transportation Research Center Inc.,® experts in the field, our results are credible. To date, no competitor has challenged our testing.

5 RESULTS SHOW DURASTAR ON PAR WITH HINO 268A

- The outcome of Navistar's testing was very different than Hino's testing. The results varied by duty cycle, but overall DuraStar's fluid economy performance was within +/- 2% of Hino's 268A. The largest variance was the on-highway test where the DuraStar proved to be nearly 3% more fluid efficient than the 268A.

6 SPEC'ING DURASTAR FOR MAXIMUM FLUID EFFICIENCY

- Spec'ing an International DuraStar for optimal fluid economy will vary based on the vehicle's application. For pickup and delivery, the most common use, these specifications are recommended:

2011 INTERNATIONAL® DURASTAR®	
Model	DuraStar
Model Year	2011
GVWR	25,500
Engine Make/Model	MaxxForce 7
Engine Disp	389 Cubic Inch 6.4L
HP @ RPM	220 at 2600
Transmission	Allison
Trans Model	2200 HS Automatic OD 6spd
Axle Ratio	5.29
Tire Size	11 R 22.5
Body MFG	Morgan Corp.

2011 INTERNATIONAL® DURASTAR®	
Certified Weight Loaded	20,400
Front Tire Pressure	100 PSI cold
Front Tire Diameter	L- 41 1/4" R- 41 1/4"
Rear Tire Brand Name	Goodyear
Rear Tire Model	G182
Rear Tire Pressures	100 PSI cold
Rear Right Tire Diameter	RRO- 41 1/4" RRI- 41 1/4"
Rear Left Tire Diameter	LRO- 41 1/4" LRI- 41 1/4"
Tank Capacity	70 Gallon
Body MFG	Morgan Corp.
Body Model Number	GVSD09722FT
Body Type	Box
Body	No
Body Length	22' 6"
Body Height to Ground	12'
Body Width	102'
Bumper to Ground Height	18"
Lube Trans	Allison Factory Specified
Lube Rear End	Factory Specified

CHAPTER TWO:
FREQUENTLY ASKED QUESTIONS

Why is there such a wide variance between Hino's and Navistar's testing?

When analyzing the detail of Hino's testing, there were numerous violations between their testing procedures and the methodology per the guidelines outlined by SAE for Type III testing.

Why did Navistar utilize Type IV testing methodology when Hino used Type III? Would that variance skew results?

It shouldn't skew results. The overall testing procedures and methodology are similar with the key differences being the length of testing run and the method of how the fluid consumption is measured. Navistar chose to utilize Type IV testing because it more closely resembles real world situations.

Powertrain is listed as a reason for variance in the testing. What engines were spec'ed for the testing and why?

Hino spec'ed a DuraStar with MaxxForce DT for their testing, whereas Navistar utilized a MaxxForce 7 for fluid economy testing. The MaxxForce 7 and MaxxForce DT were both developed with performance top of mind. The MaxxForce DT sets the standard for residual value because of durability, long life, and rebuildability, while offering excellent performance and fluid economy. MaxxForce 7 incorporates the industry's most advanced fuel system, high pressure common rail with piezo electric injectors, to provide unmatched fuel economy and performance. MaxxForce 7 durability is assured with the mid-range diesel industry's first Compacted Graphite Iron cylinder block with ductile iron main bearing bedplate.

What testing route did Navistar utilize for their testing?

Pick-up and Delivery Route: From testing with a range of customers, we've developed a route that reflects a pick-up and delivery type cycle which consists of multiple stops and runs up to 50 mph. On-highway Route: Constant speed highway at 55 mph with one stop mid-way to switch drivers.

Where can I find the exact product specifications used in the testing?

Refer to the white paper section in this document.

Did Navistar utilize a third party to validate test results?

Navistar commissioned Transportation Research Center Inc. (TRC Inc.) to conduct the testing on their behalf and validate the results. TRC Inc. had been a long standing partner of Navistar's through the numerous tests they've conducted on ProStar® and ProStar®+ to demonstrate superiority in fuel/fluid economy. TRC Inc. is a well known, credible partner specializing in vehicle research and performance measurement.

You tested International DuraStar vs. Hino 268A. Is there any testing underway against other products?

Ongoing testing and validation of our products is a part of Navistar's DNA in order to deliver value to our customers. As results of additional tests become available, they will be shared across the enterprise.

What should I tell my customers?

As anticipated, the International DuraStar is NOT 19.8% worse in fuel economy when compared to Hino 268A as claimed in their press release earlier this year. In fact, fluid economy performance is nearly equal. The results of Navistar's testing varied by duty cycle, but overall DuraStar's fluid economy performance was within +/- 2% of Hino's 268A. The largest variance was the on-highway test where the DuraStar proved to be nearly 3% more fluid efficient than the 268A.

How can I help my customers spec their DuraStar to optimize fluid economy?

Spec'ing an International DuraStar for optimal fluid economy will vary based on the vehicle's application. For pick-up and delivery, the most common use, the specifications are outlined within the white paper published in conjunction with this FAQ.

CHAPTER THREE:
WHITE PAPER TESTING DETAIL

Abstract

The purpose of this initiative was to conduct third-party testing among International® DuraStar® and Hino 268A vehicles to validate claims relative to fluid economy (diesel + liquid urea SCR consumed). Navistar commissioned Transportation Research Center Inc. (TRC Inc.) to conduct over-the-road testing utilizing TMC Type IV standards of the International® DuraStar® with MaxxForce® Advanced EGR, and the Hino 268A with liquid urea SCR.

The results of Navistar's testing varied by duty cycle, but overall DuraStar's fluid economy performance was within +/- 2% of Hino's 268A. The largest variance was the on-highway test where the DuraStar proved to be nearly 3% more fluid efficient than the 268A.

Background

Hino issued a press release on March 7, 2011 stating the results of their third-party validated testing of Hino 268A vs. International DuraStar using SAE Type III fuel economy testing procedures. The release claimed Hino's 268A had a 19.8% fuel efficiency advantage over International's DuraStar. Hino provided specific details of the testing upon Navistar's request, and after close evaluation, there was evidence of numerous violations to SAE Type III testing procedures.

The intent of Navistar's testing was to provide clarity of fluid economy among International DuraStar and Hino 268A, and to make known flaws in Hino's testing that impacted results. For example, Hino did not include the consumption of liquid urea, and with 2010 emissions, the rules changed and measurement needed to be revisited. Until 2010, comparisons of commercial 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 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.

Hino also used the MaxxForce DT within their fuel economy testing. However, when spec'ing a DuraStar to optimize fluid efficiency, the MaxxForce 7 is recommended. The MaxxForce 7 and MaxxForce DT were both developed with performance top of mind, but it is important to understand the positioning and value each engine delivers to customers. The MaxxForce DT sets the standard for residual value because of durability, long life, and rebuildability while offering excellent performance and fuel economy. MaxxForce 7 incorporates the industry's most advanced fuel system, high pressure common rail with piezo electric injectors, to provide unmatched fuel economy and performance. MaxxForce 7 durability is assured with the mid-range diesel industry's first Compacted Graphite Iron cylinder block with ductile iron main bearing bedplate. It is important to also note that when Hino directly compares their 268A to an International DuraStar, they use MaxxForce 7 within the comparison.

Objective/Hypothesis

Navistar contracted Transportation Research Center Inc., a third party, to conduct testing that utilized industry recognized TMC Type IV practices to measure and compare fluid economy for competitive 2010 emissions compliant vehicles. The production vehicles measured were spec'ed as similar as possible to what each manufacturer positioned as their most fuel efficient.

	2011 HINO 268A	2011 INTERNATIONAL DURASTAR
Vehicle #	2011 Red	2011 White
Model	268A	DuraStar
Date of Manufacture	Sep-10	16-Aug-10
Model Year	2011	2011
GVWR	25,950	25,500
Mileage	11,682	9,739
Hours	NA	308
Owner	NA	NA
Engine Make/Model	HINO J08E-VC	MaxxForce 7
Engine Disp	469 Cubic Inch 7.8L	389 Cubic Inch 6.4L
HP @ RPM	220 at 2500	220 at 2600
Torque @ RPM	520 at 1500	560 at 1400
Emissions	DPF/DEF	EGR
Transmission	Allison	Allison
Trans Model	2200 HS Automatic OD 6spd	2200 HS Automatic OD 6spd
Axle Ratio	5.29	5.29
Suspension	Spring	Spring
Tire Size	11 R 22.5	11 R 22.5
Front Tire Brand Name	Goodyear	Goodyear
Front Tire Model	G662	G662
Front Tire Pressure	100 PSI cold	100 PSI cold
Front Tire Tread Depth	L- 12/32nd's R- 13/32nd's	L- 13/32nd's R- 14/32nd's
Front Tire Diameter	L- 41 1/4" R- 41 1/4"	L- 41 1/4" R- 41 1/4"

Navistar believed the 2010 emissions compliant International DuraStar, when compared to Hino's 268A, was comparable in fluid economy, and therefore made the investment to prove Hino's claims from their March 7, 2011 press release inaccurate.

	2011 HINO 268A	2011 INTERNATIONAL DURASTAR
Rear Tire Brand Name	Goodyear	Goodyear
Rear Tire Model	G182	G182
Rear Tire Pressures	100 PSI cold	100 PSI cold
Rear Right Tire Tread Depth	23/32nd's 22/32nd's	24/32nd's 25/32nd's
Rear Right Tire Diameter	RRO- 41 1/4" RRI- 41 1/4"	RRO- 41 1/4" RRI- 41 1/4"
Rear Left Tire Diameter	LRO- 41 1/4" LRI- 41 1/4"	LRO- 41 1/4" LRI- 41 1/4"
Rear Left Tire Tread Depth	22/32nd's 23/32nd's	24/32nd's 24/32nd's
Tank Capacity	52 Gallon	70 Gallon
Body MFG	Morgan Corp.	Morgan Corp.
Body Model Number	GVSD09722FT	GVSD09722FT
Body Type	Box	Box
Body Liftgate	No	No
Body Length	22' 6"	22' 6"
Body Height to Ground	12'	12'
Body Width	102"	102"
Bumper to Ground Height	20"	18"
Last PM	5,147 Miles (odo)	2,772 Miles (odo)
Lube Trans	Allison Factory Specified	Allison Factory Specified
Lube Rear End	Factory Specified	Factory Specified
Certified Weight Empty	(delivered to TRC Inc. loaded)	(delivered to TRC Inc. loaded)
Certified Weight Loaded	20,190 lbs.	20,400 lbs.
Driver Average Weight Ballast	175 lbs.	175 lbs.
Ballast	sand bags	sand bags

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 – Navistar's test for both the pickup and delivery and on-highway routes were 150 miles which better aligned with a typical route for this duty cycle.
c. Data Point – the ratio of fuel burned by the test truck divided by the fuel burned by the control truck.
d. Mid-Point – a site designated as a driver switching or fueling facility located within plus or minus five percent of half-way 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 – TMC recommends a frequently used four-lane, limited-access, divided highway that is representative of route system terrain or a closed-course test track. 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.
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.

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. Cab side window openings the same in each vehicle at all times.
f. Accessory load for each vehicle as consistent as possible.
g. Truck and axles checked for proper alignment.
h. Each vehicle properly lubricated prior to test and fluid levels checked for prescribed levels.
i. Temperature controlled fan drives in the same operating mode throughout the test.
j. Cold tire pressures measured and inflated to standard.
k. Automatic transmissions and torque converters were checked.
l. Proper brake adjustment. Either disarm automatic slack adjusters or check for brake drag before and after each test run.
m. 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 approximately 1 mile or 60 seconds.
d. Mid-point Switching – at the test run mid-point facility, driver 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 dip-stick scale. After filling the tank to the predetermined point and waiting for temperature stabilization, fuel temperature is measured and recorded.

Results/Discussion

The outcome of Navistar's testing was very different than Hino's testing. The results varied by duty cycle, but overall DuraStar's fluid economy performance was within +/- 2% of Hino's 268A. The largest variance was the on-highway test where the DuraStar proved to be nearly 3% more fluid efficient than the 268A.

TYPE IV TEST RESULTS HIGHWAY	HINO 268 SERIES WITH J08E-TV/ SCR	DURASTAR 4300 SERIES WITH MAXXFORCE 7 ADVANCED EGR
Miles Driven (per test run)	**150**	**150**
Total Liquid Consumed	**44.1**	**42.9**
Fluid Economy Advantage	**NA**	**+2.9%**