

Appendix E

Handbook 130 – Uniform Regulation Engine Fuels and Automotive Lubricants Regulation

Items:

- Item 237-2:** 1.1.3. Minimum Antiknock Index (AKI),
2.1.4. Minimum Motor Octane Number, and
3.2.5. Prohibition of Terms – Table 1

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January 21, 2013 ¶

¶
To the Members of the National Council of Weights and Measures: ¶

¶
Ballot (Form 15) to modify U.S. Gasoline Octane Specifications in Handbook 130 ¶

¶
The purpose of this letter is to state the official position of Mercury Marine regarding the minimum octane rating of pump fuels available in the United States. ¶

¶
Mercury Marine produces marine propulsion engines for use in a wide variety of recreational, commercial, and government applications. These engines employ a range of technologies. Many products make use of electronic engine controls featuring fuel injection (both port and direct), pressure charging, and knock control systems. All of Mercury Marine's products are designed to be operated on gasoline with a minimum rating of 87 AKI or higher. As such, these engines are calibrated to achieve maximum performance at all operating loads on this fuel. On engines with knock control systems, the use of lower grades of gasoline will reduce performance. The use of lower grades of gasoline in engines without knock control could cause increased levels of knock, potentially damaging internal engine components. ¶

¶
The fuel specification in Mercury Marine's owner's manuals includes a minimum octane rating of 87 AKI, regardless of operating altitude. Further, the manuals state that the use of improper fuels can cause engine damage, and that damage caused by the use of improper fuels may not be covered by the engine warranty. ¶

¶
Mercury Marine strongly encourages the National Council of Weights and Measures to amend the U.S. Octane Specification to require a minimum octane rating of 87 AKI, regardless of altitude. ¶

Respectfully, ¶

¶
Jeff Broman ¶

Technical Specialist -- Engine Thermodynamics ¶

Product Development & Engineering ¶

Mercury Marine ¶

¶

Mercury Marine Marine Products and Services

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Aston Martin • Ferrari • Honda • Hyundai • Isuzu • Kia • Mahindra
Maserati • McLaren • Nissan • Peugeot • Subaru • Suzuki • Toyota

January 24, 2013

National Conference of Weights & Measures
1135 M Street, Suite 110
Lincoln, NE 68508

Re: Amendments to Handbook 130 Regarding Minimum Octane of 87 AKI for Gasoline

Dear Sir or Madam:

The Association of Global Automakers represents international motor vehicle manufacturers, original equipment suppliers, and other automotive-related trade associations.¹ Global Automakers works with industry leaders, legislators, regulators, and other stakeholders in the United States to create public policies that improve motor vehicle safety, encourage technological innovation and protect our planet. Our goal is to foster an open and competitive automotive marketplace that encourages investment, job growth, and development of vehicles that can enhance Americans' quality of life.

We understand that the NCWM will be meeting on January 27-30, 2013 and, among other business, will be considering proposed amendments to Handbook 130. The purpose of this letter is to advise you of our support for amendments to Handbook 130 to set minimum octane requirements for gasoline at 87 AKI (anti-knock index) for gasoline sold throughout the United States. All Global Automakers' members and, in fact, all auto manufacturers selling vehicles in the U.S., stipulate minimum octane levels for their products in their owner's manuals for current vehicles at 87 octane AKI throughout the entirety of the U.S. Some higher performance models may require higher octane levels. We are working with the ASTM D02 committee (Petroleum Products and Lubricants) to effect the same amendments in the ASTM D4814 Standard Specification for Automotive Spark-Ignition Engine Fuel. We fully support these amendments to Handbook 130 as soon as possible.

Consumers' investments in their vehicles are usually second only to the investments they make in their homes. Using off-specification gasoline from that recommended by the vehicle manufacturer puts these investments at risk, increases emissions, and erodes fuel economy. It is in the best interests of the motoring public and the public interest to set minimum specifications in Handbook 130 which are consistent with the fuels recommended by auto manufacturers.

¹ Our members include American Honda Motor Co., American Suzuki Motor Corp., Aston Martin Lagonda of North America, Inc., Ferrari North America, Inc., Hyundai Motor America, Isuzu Motors America, Inc., Kia Motors America, Inc., Mahindra & Mahindra Ltd., Maserati North America, Inc., McLaren Automotive Ltd., Nissan North America, Inc. Peugeot Motors of America, Subaru of America, Inc. and Toyota Motor North America, Inc. For more information, visit www.globalautomakers.org.



Thank you for your consideration and support of this request. Please direct any questions to John Cabaniss, Director, Environment & Energy, (202) 650-5562 or jcabaniss@globalautomakers.org.

Sincerely,

A handwritten signature in black ink that reads "Michael J. Stanton".

Michael J. Stanton
President & CEO

National Council of Weights and Measures
Interim Meeting
January 27, 2013
Charleston, South Carolina

**Alliance of Automobile Manufacturers Statement
Re: Gasoline Octane De-rating for High Altitudes**

My name is Valerie Ughetta, and I am Director for Automotive Fuels at the Alliance of Automobile Manufacturers. The Alliance is the leading advocacy group for the auto industry, representing 77% of all car and light truck sales in the United States. Members include BMW Group, Chrysler Group LLC, Ford Motor Company, General Motors Company, Jaguar Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi Motors, Porsche, Toyota, Volkswagen Group of America, and Volvo Cars North America. Our website can be found at www.autoalliance.org.

Alliance Members strongly support a review of national consensus standards with regard to provisions that allow so-called Octane De-rating for Altitude. Without exception, all automakers specify the use of gasoline with a minimum octane rating of 87 AKI (Antiknock Index) in their vehicle owner's manuals. Today, post- MY 1984 vehicles are designed, calibrated, and durability-tested to run on 87 AKI or higher fuel.

A gasoline's octane rating is the number one fuel property affecting a vehicle's performance. Fuel is not merely a customer commodity, but an integral part of the vehicle system as a whole. Highly advanced fuel delivery, engine control and exhaust after-treatment systems are designed to run in a precisely engineered and optimized manner to meet challenging new environmental, fuel economy, and vehicle performance specifications. Engineering to protect against the potential use of a low octane fuel in a vehicle developed for 87 AKI or higher reduces the optimized functional capabilities of the vehicle. In short, consumers *already* need, and will continue to need nationally consistent supplies of minimum 87 AKI and higher rated octane fuels.

Efforts at ASTM and NCWM to review their gasoline specifications and standards are important and time-sensitive. States neighboring the ASTM High Altitude designated geographic areas are faced with supply, marketing, and competitive issues because of the disparity in fuel grades from high altitude states and counties, because they get their gasoline from the same limited refinery and pipeline sources. This has been playing out in South Dakota over the past year. A uniform, national minimum octane grade is warranted by the refinements in vehicle technology and is far preferable for consumers to a patchwork of state laws.

Thank you for the opportunity to comment.

For further information please contact:
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202 326 5549

My name is Win Gardner, Fuels Quality Manager for ExxonMobil in the US. We consider the proposal to amend Section 2.1.4 to eliminate the altitude adjustments for octanes to be premature at this time and recommend that the item remain informational.

ASTM is also addressing this issue and a ballot to remove the discussion regarding altitude adjustments was issued last fall and addressed at the December meeting. There were a number of negatives submitted for a variety of reasons, but predominantly because there was almost no pertinent data presented that the octane requirement adjustment for altitude was invalid. It was decided to withdraw the ballot and, instead, move forward with some scientifically designed experiments to elucidate the subject.

Let's take a look at what data is available. There are two types of data that should be considered. There's the sort of data developed via designed experiments, exemplified by CRC studies which have been used traditionally to guide the specification setting process at ASTM. While there have been no recent CRC studies on the subject of octane requirement needs of vehicles at higher altitudes, there are a number of peer reviewed scientific studies that have been published using vehicles produced during the 1990s and 2000s which confirm that an altitude adjustment for octane is still justified. These studies were conducted with many vehicles employing altitude compensation. So the data that is available, while not conducted on the most recent model years, does conclude that vehicles operating at high altitudes require a lower octane than vehicles operating at sea level.

But there's another type of data that's available, empirical data, or that type of data developed over time from practical experience. As a general rule, I prefer the data that's generated via scientific experiments. But empirical data isn't automatically invalid and one shouldn't discount it especially when there's a wealth of it available. Gasoline with octanes at 85 or 85.5 has been sold in the mountain states of Montana, Idaho, Wyoming, Utah, Colorado and South Dakota for many decades. Consumers express their satisfaction with those grades by purchasing it overwhelmingly compared with the other octane grades available. The majority of the gasoline sold in the mountain states is Regular 85 or 85.5. We are a major marketer of these gasolines and have received no complaints from our customers about the octane over the years. And, to our knowledge, the auto manufacturers have not incurred octane-related warranty issues on vehicles from this region.

While most of the sales in the mountain states are the Regular 85 grade, ExxonMobil and other companies do offer higher grades of 87 and 91 octane. So, if the auto companies choose to introduce more vehicles with turbo chargers or other technologies which require higher octane levels, those fuels are readily available at the same services stations.

I need to mention one other aspect of this issue. Octane isn't free.

I'm sure you've noticed that Premium gasoline costs more at the pump than does Regular. In my area of the country the differential is about 50 cents. A refinery, given their crude mix and processing capabilities, has a limited octane "pool" to disburse among its gasoline products. Raising the octane of a product that represents the majority of production is not easy, nor cheap. MSAT (Mobile Source Air Toxics) II recently was implemented nationwide. This EPA program required that the levels of benzene be lowered in gasolines. Benzene has high octane so removing it from the gasoline pool reduced the ability to maintain octane. Fortunately, the rapid increase in ethanol blending counteracted that decrease due to MSAT II. If a significant increase in octane is mandated in the mountain states, we expect that refineries will have to invest many millions of dollars to modify their processing units. Those modifications take several years to plan, permit and construct, so any rapid change to regulated octanes is likely to drive supply shortage issues and pressures on the cost structure. Do you really want to saddle the mountain state consumers with increased gasoline costs with essentially no data driven reason for their sacrifice?

Thank you for the opportunity to provide this testimony today. I recommend this item be maintained as informational pending ASTM action.

National Council of Weights and Measures
Interim Meeting
January 27, 2013
Charleston, South Carolina

Ford Motor Company Statement
Re: Gasoline Octane De-rating for High Altitudes

Ford Motor Company supports the review of industry gasoline standards that allow marketers to sell fuel with an octane rating below $87 (R+M)/2$ as “REGULAR GRADE”. The industry practice of de-rating the octane of fuels in altitude regions is not consistent with minimum octane requirements of vehicles manufactured by Ford that are designed and calibrated to operate on $87 (R+M)/2$ minimum octane at both sea level and higher altitudes.

The recommendation given in Ford’s vehicle owner guides specifies that “Fuels with octane levels below 87 are not recommended.” In addition, the use of such fuels may result in loss of vehicle performance and possible engine damage that may void warranty claims for related repairs.

In the mid 90’s, Ford raised concerns at industry meetings and held discussions with oil companies regarding a higher rate of warranty claims that were experienced by vehicle owners in altitude regions of western states, including, the Denver area. The rate of warranty claims related to spark knock complaints in Ford trucks were significantly higher in the altitude regions as compared to areas at sea level. Also, studies conducted by the Coordinating Research Council and findings reported in SAE papers in late 80’s confirmed that Ford vehicles and others had the same octane requirement, regardless of altitude.

The discussions at NCWM to review the octane issue and develop a consensus on a minimum octane standard where “REGULAR GRADE” is defined as $87 (R+M)/2$ would help the auto industry meet national standards for emission, fuel economy and GHG. A consensus on a minimum octane standard that is applicable to all regions of each state will also promote improved customer satisfaction for vehicle owners as it relates to vehicle performance and durability.

If you require further information, please feel free to contact me.

Peter W. Misangyi, Supv., Fuels and Lubricants
Ford Motor Company
pmisangy@ford.com
Phone: 313-322-3543

General Motors, Bill Studzinski (presentation), January 27 - 31, 2013

2013 NCWM Interim Meeting

January 27 - 31 – Charleston, SC

L&R Item 237-2

Ballot (Form-15) to modify U.S. Gasoline Octane Specifications in Handbook 130

Applicable L&R Sections

Section 2.1.4. Minimum Antiknock Index (AKI)

Section 2.1.5. Minimum Motor Octane Number

Table 1. Minimum Antiknock Index Pump Labeling Requirements

Bill Studzinski – General Motors

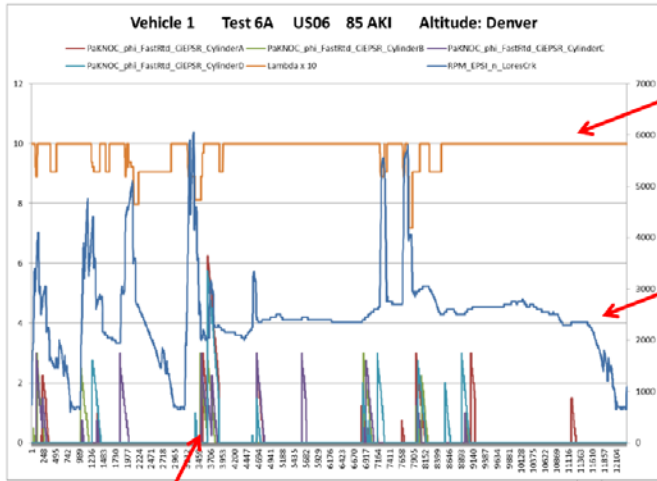
1

Background and Data Supporting Item 237-2 – U.S. Gasoline Octane

- 85 and 86 Pump Octane levels were developed when carbureted cars without computer controls were predominantly in the market and subject to altitude de-rating of octane
 - Modern computer controlled cars will optimize performance to utilize the gasoline octane rating stated in the vehicle owner's manual at all altitudes
- Vehicle owners should use the gasoline octane rating stated in their owner's manual
 - All U.S. vehicles require 87 Pump Octane or greater
 - A vehicle's octane requirement is set during development to balance engine power, torque, emissions, fuel economy, durability, and emissions compliance
- Knock sensors and computer controls prevent engine damage if mild autoignition (knock) occurs but can not protect against engine damaging severe autoignition
 - Consumers most likely won't be able to hear or feel the reduced performance of mild knock
- Scoping Tests: Vehicle Octane Testing on High Altitude Emission Chassis Dyno
 - 2 vehicles instrumented with Engine Computer Module data acquisition and exhaust inlet temperature thermocouples
 - Standardized US06 Emissions Test Cycles in A-B-A pattern
 - Two fuels: 85 and 87 AKI E0 Gasoline
 - Two Altitudes: 5,400 ft and 0 ft (Sea Level)
 - Results from 85 Octane...
 - Reduced fuel economy – more significant at Sea Level
 - Increased engine load
 - Increased thermal loading on the engine and exhaust reduction components

2

Comparison of US06 Emissions Test Cycle Results Vehicle 1, Denver Altitude, 85 and 87 Pump Octane

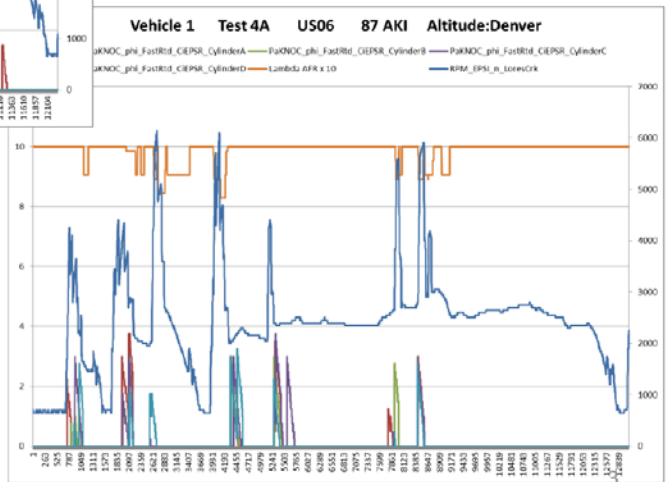


Lambda Air to Fuel Ratio x 10
 (1.0 is stoichiometric, < 1 is fuel rich)

Engine RPM

“Spark Retard” for each Cylinder
 (Reason for higher Exhaust Temps.)

Next Slide quantifies the 85
 Octane effects at Altitude.



Low Octane Causes Inefficient Vehicle Operation

Vehicle Performance Benefits of 87 Pump Octane¹ Relative to 85 Octane in Standardized US06² Emissions Tests

Vehicle Description	Vehicle 1		Vehicle 2	
	2012 Passenger Car (4 Cyl., PFI, NA ³)		2010 Passenger Car (6 Cyl., PFI, NA ³)	
Altitude	Sea Level (0 ft.)	Denver (5,400 ft)	Sea Level (0 ft.)	Denver (5,400 ft)
Fuel Economy Change from 87 AKI to 85 AKI in MPG	29.04 – 27.10 = 1.94	28.65 – 27.07 = 1.58	23.22 – 22.14 = 1.08	22.85 – 22.36 = 0.49
Fuel Economy Change (%)	7.2 %	5.8 %	4.9 %	2.2 %

Notes: 1. Pump Octane = (RON + MON)/2
 2. The US06 Standard Vehicle Emissions test requires a driver to follow a specified vehicle speed pattern so vehicles tested in many different emissions labs can be compared. Test can generate a Fuel Economy number from the Emissions data.
 3. Vehicle Information: Cyl = Cylinder, PFI = Port Fuel Injected, NA = Naturally Aspirated (Common in today's marketplace.)

Vehicle 1: A Closer Look at 85 and 87 Pump Octane Effects on Engine Fueling, Vehicle Load Factor, and Catalyst Temperature

US06 Comparison at Sea Level

Vehicle 1				
Test Identification No.	5A	3A	Change Relative to 85 AKI	Benefit of 87 AKI
Altitude	Sea Level	Sea Level	---	
Octane	85 AKI	87 AKI	---	
Lambda	0.9748	0.9836	0.90%	Leaner Fuel Amount
Load %	30.19	29.79	-1.32%	Lighter Engine Load
Throttle %	17.51	17.00	-2.91%	Better Fuel Use
Pre-Cat Temp. (Deg C)	729.59	727.31	-2.28	Lower Catalyst Temp.

US06 Comparison at Altitude

Vehicle 1				
Test Identification No.	6A	4A	Change Relative to 85 AKI	Benefit of 87 AKI
Altitude	Denver	Denver	---	
Octane	85 AKI	87 AKI	---	
Lambda	0.9786	0.9849	0.64%	Leaner Fuel Amount
Load %	29.43	27.93	-5.10%	Lighter Engine Load
Throttle %	21.32	19.63	-7.93%	Better Fuel Use
Pre-Cat Temp (deg. C)	728.5	713.5	-15.0	Lower Catalyst Temp.

Low Octane Causes Inefficient Vehicle Operation

Vehicle Performance Benefits of 87 Pump Octane ¹ Relative to 85 Octane in Standardized US06 ² Emissions Tests				
	Vehicle 1		Vehicle 2	
Vehicle Description	2012 Passenger Car (4 Cyl., PFI, NA ³)		2010 Passenger Car (6 Cyl., PFI, NA ³)	
Altitude	Sea Level (0 ft.)	Denver (5,400 ft)	Sea Level (0 ft.)	Denver (5,400 ft)
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Vehicle 1: A Closer Look at 85 and 87 Pump Octane Effects on Engine Fueling, Vehicle Load Factor, and Catalyst Temperature

US06 Comparison at Sea Level

Vehicle 1				
Test Identification No.	5A	3A	Change Relative to 85 AKI	Benefit of 87 AKI
Altitude	Sea Level	Sea Level	---	
Octane	85 AKI	87 AKI	---	
Lambda	0.9748	0.9836	0.90%	Leaner Fuel Amount
Load %	30.19	29.79	-1.32%	Lighter Engine Load
Throttle %	17.51	17.00	-2.91%	Better Fuel Use
Pre-Cat Temp. (Deg C)	729.59	727.31	-2.28	Lower Catalyst Temp.

US06 Comparison at Altitude

Vehicle 1				
Test Identification No.	6A	4A	Change Relative to 85 AKI	Benefit of 87 AKI
Altitude	Denver	Denver	---	
Octane	85 AKI	87 AKI	---	
Lambda	0.9786	0.9849	0.64%	Leaner Fuel Amount
Load %	29.43	27.93	-5.10%	Lighter Engine Load
Throttle %	21.32	19.63	-7.93%	Better Fuel Use
Pre-Cat Temp (deg. C)	728.5	713.5	-15.0	Lower Catalyst Temp.

ASTM D02 Subcommittee A: Gasoline Octane Work Group Plan

- Follow-up to Dec. 2012 ASTM Workgroup Meeting
 - Evaluate Vehicle Octane Rating Technique developed by Sasol Oil (S. Africa)
 - Define test program to study octane effects on vehicle performance at altitude
 - Modeled after initial two vehicle scoping tests?
 - GM High Altitude Emissions Chamber Program – Minimize test variation
 - Metrics – FE, Emissions, Load %, Enrichment, Pre-cat Inlet Temperature
 - 4 to 6 instrumented vehicles – PFI vs GDI, N.A. vs Boosted
 - Matched E10 fuel pair – equivalent heating value, composition, H/C ratio, etc...
 - Test Cycles – A-B-A Format (85 – 87 – 85) LA92 and US06 Emissions Cycles
 - Reduce variation: One Test driver; Evaluate Engine RPM traces for each cycle
 - Timing: by mid-April

NCWM Item 237-2 Ballot

- New business item presented to each of the 4 regions – Fall, 2012
- Form 15 author wishes to see this item move forward as a voting item to the 2013 Annual Mtg
 - Form 15 HB 130 language shown on next slide

Handbook 130 – Proposed Gasoline Octane Content

2.1. Gasoline and Gasoline-Oxygenate Blends.

2.1.4. Minimum Antiknock Index (AKI). – The AKI of gasoline and gasoline-oxygenate blends shall not be less than 87. The AKI shall not be less than the AKI posted on the product dispenser or as certified on the invoice, bill of lading, shipping paper, or other documentation;

2.1.5. Minimum Motor Octane Number. – The minimum motor octane number shall not be less than 82. ~~for gasoline with an AKI of 87 or greater;~~

3.2. Automotive Gasoline and Automotive Gasoline-Oxygenate Blends.

3.2.5. Prohibition of Terms. – It is prohibited to use specific terms to describe a grade of gasoline or gasoline-oxygenate blend unless it meets the minimum antiknock index requirement shown in Table 1. Minimum Antiknock Index Requirements.

Table 1. Minimum Antiknock Index Requirements

Term	Minimum Antiknock Index	
	ASTM-D4814 Altitude Reduction Areas IV and V	All Other ASTM-D4814 Areas
Premium, Super, Supreme, High Test	90	91
Midgrade, Plus	87	89
Regular-Leaded	86	88
Regular, Unleaded	85	87
Economy	--	86