OCTAMATIC
ELECTRONIC SYSTEMS DESIGN
A Business Unit of The Protectoseal Company

On-Line & Laboratory Analyzers for the Determination of Octane Number Using the Falling Level Method

(Conforming to ASTM Standards: D2699, D2700 & D2885)

ON-LINE SYSTEM

OCTANE DETERMINATIONS

Electronic Systems Design (ESD), formerly based in Palatine, Illinois, has been an industry leader for almost 50 years, focusing on innovative solutions for determining the octane ratings of fuels.

ESD is well-known for supplying On-Line and Laboratory Analyzers and for pioneering the use of the Falling Level Method (Dynamic Fuel Level) for octane number determination. Installation, parts and service are available throughout the world.

Conforms to ASTM Standards

ESD Representatives have been active participants in the development and maintenance of industry standards. All equipment meets or exceeds the requirements outlined in: ASTM D2699 Research Method, ASTM D2700 Motor Method and ASTM D2885 Test Method for Determining Octane Number of Spark-Ignition Fuels by On-Line Direct Comparison Technique.

LAB SYSTEM

PROTECTOSEAL

On November 13, 2012, The Protectoseal Company became the parent company of Electronic Systems Design. ESD will operate as a separate business unit of The Protectoseal Company

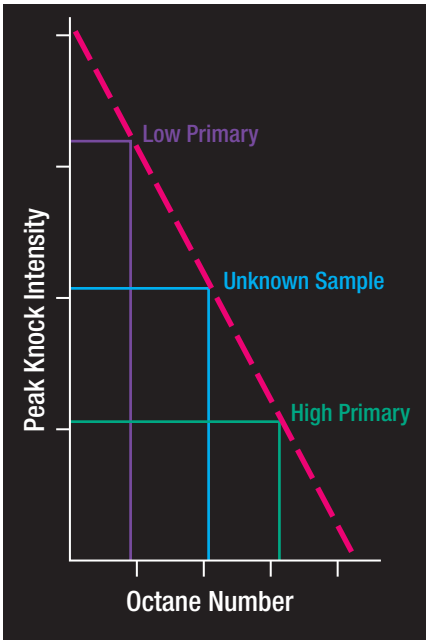
WHAT IS THE FALLING LEVEL METHOD?

The ESD Octane Analyzer Systems employ the well-known and proven Falling Level (Dynamic Fuel Level) Method for determining the octane number of a fuel sample. This method is documented in ASTM D2699 - Standard Method for Research Octane Number of Spark Ignition Engine Fuel (Procedure B), ASTM D2700 - Standard Test Method for Motor Octane Number of Spark-Ignition Engine Fuel (Procedure B) and, by reference, in ASTM D2885 - Determination of Octane Number of Spark-Ignition Engine Fuels by On-Line Direct Comparison Technique.

With the Falling Level Method, a specifically designed and calibrated fuel supply bowl is filled and is allowed to empty as the CFR test engine runs. The bowl design is such that a test cycle on any fuel sample can be completed in a reasonable amount of time while ensuring that a consistent and repeatable range of fuel mixtures are delivered to the engine without the need for intervention by the operator.

As the liquid level in the supply bowl falls, the rate of fuel supplied to the engine decreases and the fuel / air ratio changes. The knock intensity of the engine is measured continuously over the range of fuel / air ratios. In a properly calibrated system, this is characterized by a light knock condition, through a peak knock measurement and then back to a light knock.

The peak knock intensity levels of fuels with known octane numbers higher and lower than the sample fuel are plotted in a straight-line graph. The sample's octane number can then be determined by the position of its measured peak knock intensity along this plotted curve. The Falling Level Method has been statistically proven and accepted by the ASTM as a valid octane number determination procedure.



By comparing peak knock intensity with known reference fuels, a simple straight-line interpolation reveals the octane number of the unknown fuel.

SYSTEM OVERVIEW

The Octamatic Octane Analyzer Systems are based on the Falling Level Method of measuring octane rating in fuel. This is a variant of the standard Bracketing Method (Procedure B) used by laboratories and refineries.

Determination of the proper fuel air ratio is far more accurate than that obtained by manual methods. Unlike manual methods, the operator is out of the control loop which determines peak fuel / air ratio. Errors in recording, transcribing and calculating octane numbers are eliminated.

There are two versions of the ESD Octamatic Analyzer: The ON-LINE SYSTEM and the LABORATORY SYSTEM. Both systems use the same high precision methods as described in ASTM D2699, ASTM D2700 and ASTM D2885.

Economy

One computer (plus one backup computer for on-line systems) can be used for the entire test lab. Incremental costs for additional engines beyond the first engine are small. The database generated by the system is tailored to each installation, at no additional charge. Reports are also customized and can be displayed, printed or sent to other systems. Data is stored permanently and can be transmitted to removable media, remote computer systems and/or networks.

The ability to produce consistently at a specific octane number is extremely critical. The value of an octane barrel makes controlled production capability a moneymaker, not an expense. As competitive pressures mount and consumption declines, the need to make octane qualities of fuels as near to "zero giveaway" as possible increases significantly.

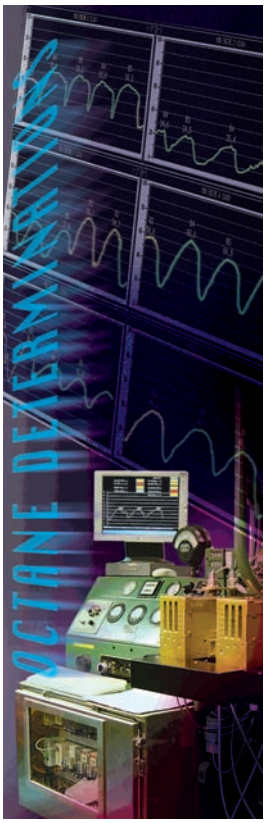
Whatever octane determination method is used, ESD Analyzers enable the on-line blending and laboratory testing of octane quality to move into an area of precision that insures minimum of octane giveaway. Lower operating and maintenance costs are also realized.

Ease of Operation

Operators with previous experience on CFR engines quickly adapt to these new analyzers. The ESD "Falling Level" Octane Analyzer Systems are being utilized by many refineries and testing laboratories, because of the short amount of time it takes a technician to become proficient in producing quality octane numbers.

In laboratories where it is required that many individuals product octane ratings, the ESD "Falling Level" Systems bring their "site precision" close to the "method repeatability", as cited in the applicable ASTM Standards.

The population of experienced technicians in the field of octane ratings is on a worldwide decline. Some have turned to spectroscopy to bridge this gap only to find that you must have precise octane data to make the spectroscopy models work. These models must be maintained due to the nature of the complexity of motor gasoline. With an ESD Octane Analyzer System installed on a well maintained CFR test engine you will have the real octane number, not a guess.



FEATURES & BENEFITS

General:

- Economical with a fast pay back on investment. Can run tests on multiple engines simultaneously and the system precision reduces octane "giveaway".
- Is compliant with ASTM Standards: D2699 Research Method, D2700 Motor Method and D2885 Test Method for Determining Octane Number of Spark-Ignition Fuels by On-Line Direct Comparison Techniques.
- Very precise system eliminating manual data calculation and recording. Frees operator from continually adjusting fuel / air ratio.
- Always finds the fuel / air mixture resulting in maximum engine knock. Fuel / air ratio is adjusted automatically by the falling level of the fuel bowl.
- Features a UNIX operating system insuring a cost effective capability that is stable, reliable and expandable.
- Far superior testing of octane than manual means.
- Minimizes operator transcription errors (all data is handled by computer).
- Runs test on multiple engines simultaneously. ESD has installed systems with up to 14 engines.
- With properly maintained engines, a standard deviation of 0.06 (RON) and 0.08 (MON) can be reasonably expected.
- Includes automatic temperature control based on digital temperatures input monitoring for air intake and mixture temperatures for all engines.
- No moving parts, increasing reliability.
- Minimal maintenance; can be accomplished by in-house personnel.
- Water-cooled aluminum block brings fuel temperature down to ASTM requirements.
- Top cover on bowl reduces evaporative losses.
- Delivers customized hardware and software.

Software & Programming:

- An interactive screen program through which the operator enters the variables of the blend to be analyzed, i.e. type of fuel to be made, and the blend size. All other factors are stored in the system and can only be changed under a supervisory menu. Examples: proto fuel to be used, blend name or sample ID. This reduces the probability that the operator will enter something in error.
- A menu which lists the supervisory programs. These include, but are not limited to, features that are not normally available to the operator, such as performing spread calibration, proto rating, ASTM qualification, NEG rating, proto tank record maintenance, system parameter settings, system calibrations, records management, and running historical reports (ASTM checkout, proto rating, blend files, spread cal runs, NEG history, SQC history). The system keeps a complete history of all activities listed above that have been performed since installation.

FEATURES & BENEFITS (continued)

- Application programs written in DecisionPlus and C++ to operate the system at each engine.
- A continuously running scanner program to read all the analog and digital signals at high speed. A moving average is maintained on all variables, resulting in precise, noise-free data acquisition.

Hardware:

- Includes UNIX-based system for high reliability, reduced costs and ease of expansion.
- 300 gigabyte RAID hard drives for program and data reliability.
- Color printer for reports.
- Uninterruptible power supply for entire system.

Engineering & Installation:

- Professional installation and startup will be performed by Electronic Systems Design field engineer(s). Optionally, a software engineer may also be on-site, if needed, during startup and commissioning. (This will be determined on a site-by-site basis.)
- Operator and supervisory training is included, which will be done during the installation phase. Our policy is to stay on-site until the project is complete and the customer is satisfied that all training has been done and everything is working properly. If there is a problem during the first twelve (12) months that your staff cannot resolve, we will make a return trip at no charge.

ENGINE PARAMETERS

ESD Octamatic Systems typically monitor the engine parameters shown below and are delivered with alarm and warning limits consistent with the relevant ASTM specification. These limits are easily changeable by the customer.

ON-LINE SYSTEM

Engine Parameters:

- Oil pressure
- Air refrigerant temperature
- Intake air temperature
- Mixture temperature (MON)
- Fuel refrigerant temperature
- Oil temperature
- Proto and product fuel temperatures
- Knock intensity (K.I.)

Some optional measurements that are often specified:

- Humidity
- Barometric pressure
- Oil pressure (switch)
- Water pressure (switch)
- Water level (switch)
- Product pressure (switch)
- Condenser temperature

SEMI-AUTOMATIC LAB SYSTEM

Engine Parameters:

- Engine coolant temperature
- Intake air temperature
- Mixture temperature (MON)
- Fuel refrigerant temperature
- Oil temperature
- Fuel temperature
- Knock intensity (K.I.)

Some optional measurements that are often specified:

- Oil pressure
- Humidity
- Barometric pressure
- Oil pressure (switch)
- Water pressure (switch)
- Water level (switch)
- Condenser temperature

MANUAL LAB SYSTEM

Engine Parameters:

- Intake air temperature
- Mixture temperature (MON)
- Knock intensity (K.I.)

Some optional measurements that are often specified:

- Engine coolant temperature
- Oil pressure
- Fuel refrigerant temperature
- Oil temperature
- Fuel temperature
- Humidity
- Barometric pressure
- Oil pressure (switch)
- Water pressure (switch)
- Water level (switch)
- Condenser temperature

ALARMS & WARNING LIMITS

Alarms are considered more serious than warnings; the occurrence of an alarm requires corrective action before measurements can continue. Alarms and warnings are displayed to the operator and must be cleared by the operator. In addition, some alarms act as a backup to the safety systems provided by the engine manufacturer.

ON-LINE SYSTEM

Alarms & Warning Limits:

The following engine conditions will trigger engine shutdown:

- Coolant temperature over 220° F.
- Oil pressure under 20 PSI
- Low oil pressure switch (optional)
- Low water pressure switch (optional)
- Low water level switch (optional)
- QC bowl became full during blending (indicates level sensor failure)

Other warning conditions:

- Excessive proto drift from previous proto measurement
- Any temperature out of operating limits
- Rate of change of delta O.N. too large
- Out of fuel warning
- Delta octane out of user-specified range
- Product pressure low (optional)

Other alarm conditions:

- Oil pressure out of operating range
- Product O.N. out of range
- No peak K.I. found after two attempts
- Proto K.I. over 80 or under 20
- Product K.I. over 99 or under 10
- Any abnormal exit from blending screen

SEMI-AUTOMATIC LAB SYSTEM

Alarms & Warning Limits:

The following engine conditions will trigger engine shutdown:

- Coolant temperature over 220° F.
- Oil pressure under 20 PSI
- Low oil pressure switch (optional)
- Low water pressure switch (optional)
- Low water level switch (optional)

Other warning conditions:

- Any temperature out of operating limits
- Out of fuel warning

Other alarm conditions:

- Oil pressure out of operating range
- No peak K.I. found after two attempts
- K.I. over 99 or under 10

MANUAL LAB SYSTEM

Alarms & Warning Limits:

The following engine conditions will trigger engine shutdown:

- Coolant temperature over 220° F. (optional)
- Oil pressure under 20 PSI (optional)
- Low oil pressure switch (optional)
- Low water pressure switch (optional)
- Low water level switch (optional)

Other warning conditions:

- Any temperature out of operating limits
- Out of fuel warning

Other alarm conditions:

- Oil pressure out of operating range (optional)
- No peak K.I. found after two attempts
- K.I. over 99 or under 10

COMPREHENSIVE REPORT GENERATION

ON-LINE SYSTEM

- Blend History Report
  - Detailed record of each blend
  - Graphs of blend results: delta O.N., Proto K.I.
- System Configuration Reports
  - Customer-changeable parameters, their current values and ranges
  - Sensor calibration and alarm / warning limits
- Proto Tank Definitions Report
  - O.N., ID, tank #, correlation to reference fuel used to rate, etc.
- Pre-Blend Checkout Report
  - Pre-blend (SQC) runs, with details
- ASTM Checkout Report
- Proto Rating Report
- Historical Pre-Blend Checkout Report
  - Archived SQC reports associated with proto fuels no longer used
- Current Spread Table
- Spread Run Report
- Historical ASTM Checkout, Proto Rating and Spread Run Reports
- NEG Exchange Fuel Rating Report
- Graphs of Blend Results
- Alarm Log Report per Engine
- Detailed Log of Internal System Operations

Report data may be optionally exported to readable media (CD/DVD-ROM, USB Memory Stick)

LABORATORY SYSTEMS

- Measurement Results Report
  - Report may be optionally printed (user-selectable) at the conclusion of each test
  - Historical reports of all ratings made by system are available for the life of the system
- Summary Results Report, sorted by date or ID
  - Provides summary of all tests performed over a given date range, including re-tests
- Detailed Summary Results Report, sorted by date or ID
  - Same as above but with additional details and measurement parameters
- Sensor Calibration and Alarm / Warning Limits Report

Report data may be optionally exported to readable media (CD/DVD-ROM, USB Memory Stick)

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