F1/F2 Octane Rating System
with XCP Technology

Providing value and confidence in global fuel quality.

The CFR® F1/F2 Octane Rating Unit is the globally accepted standard for determining and certifying the anti-knock characteristics of motor fuels – whether gasoline, fuel constituents, or alternative fuels. Since the release of the first CFR unit in 1929, CFR has been at the forefront of establishing test methods for rating fuels. Working hand-in-hand with the automotive and petroleum industries, we continue to enhance the CFR product line to help fuel producers and engine manufacturers develop products that perform together more effectively.

The CFR F1/F2 is the specified equipment for testing fuels according to:

ASTM D2699: Standard Test Method for Research Octane Number of Spark-Ignition Engine Fuel

ASTM D2700: Standard Test Method for Motor Octane Number of Spark-Ignition Engine Fuel

IP 236: Determination of Knock Characteristics of Motor and Aviation Fuels - Motor Method

IP 237: Determination of Knock Characteristics of Motor Fuels - Research Method

EN ISO 5163: Determination of Knock Characteristics of Motor and Aviation Fuels - Motor Method

EN ISO 5164: Determination of Knock Characteristics of Motor Fuels - Research Method

Features & Benefits

Confidence in a Fully Integrated Fuel Testing System

A complete CFR Engines Inc. octane fuel testing system includes four main elements, each designed to seamlessly integrate and deliver trusted results. With the Engine Air Control System, the F1/F2 engine unit, XCP™ Technology, and a CFR® exhaust surge tank; each critical parameter of a successful octane test is controlled. Whether working with a complete unit, an upgrade/conversion kit, or a genuine CFR service part; the product has been designed, manufactured, and fully tested by CFR to work as an integrated solution for your operation. Confidence in the CFR system to do its job, allows users to focus less on making the system work and focus more on what else they need to do.

Data Integrity with XCP Technology

With the XCP Digital Control Panel, critical information for each rating is automatically captured and presented in a ready-to-use Excel-based report, minimizing manual data recording and calculating errors. The standard report of XCP includes KI values, Octane Numbers, environmental data (temperatures, pressures, barometer, and EACS humidity), and KI vs fuel level curves. The XCP is also capable of being integrated into a Laboratory Information Management System (LIMS). Automatic capture and processing of test data, gives the accountability needed to defend ratings without challenge.

Reliability of Proven Design

Since 1929, thousands of users have relied on the proven service of CFR Engines Inc. products. This reliability has been consistently maintained through a long series of well-designed system upgrades and product enhancements. CFR systems and components are built to deliver unsurpassed operating life, such as the robust engine crankcase and cylinder, or the industrial grade Engine Air Control System. With basic maintenance and upkeep, a user can expect CFR products to consistently withstand the demands of today's fuel testing environment with a true engine-based octane test.

Precision through Modern Instrument Control

The CFR F1/F2 with XCP Technology uses digital instrumentation to record and process critical aspects of system operation and performance. On-board barometric pressure adjustments, increased automation, broad octane meter range, no adjustments for "spread", and even control of engine intake air are some of the many advantages of the CFR fully integrated instrument system. More accurate measurements, controlled by and intuitive interface lead to better overall precision.

Cost Savings with One System Flexibility

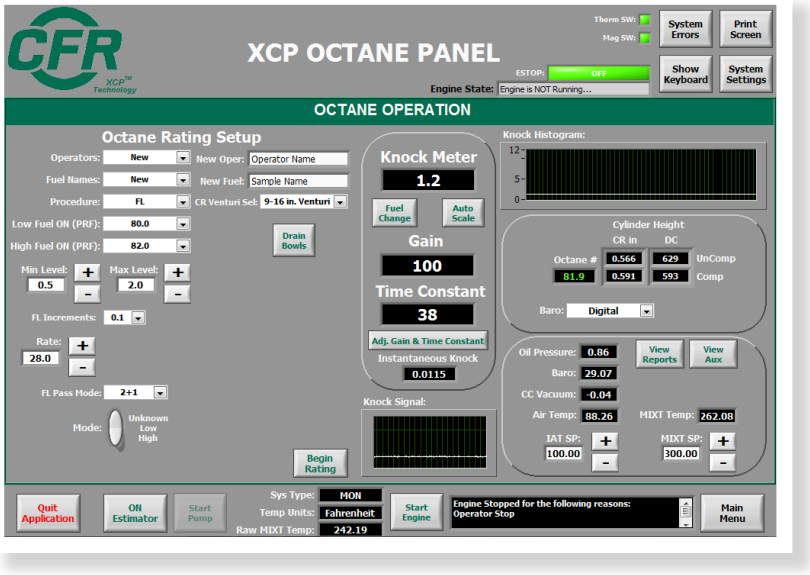
With standard product offerings, a CFR F1/F2 Octane Rating System provides the user unmatched flexibility and cost savings. With a few simple component changes and push button control, users can easily switch between any of the four test procedures in ASTM Methods D2699 or D2700. Cost savings are realized in greater utilization of resources, quicker test changes, reduced operator training, and improved repeatability with a single system.

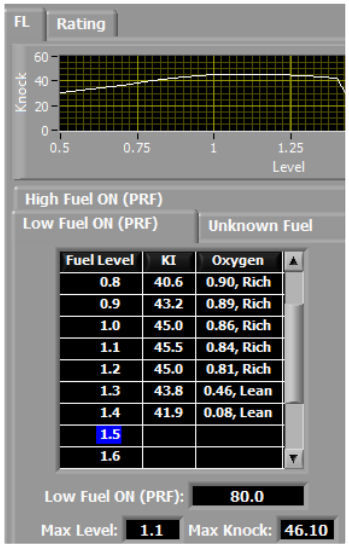
XCP Technology

XCP™ Technology remains the modern instrumentation of choice for octane testing. CFR continues to apply advances in design, measurement, and control to its XCP Technology platform.

Intuitive and Complete Interface:

- Clearly displayed visual Knock Meter
- Knock trending chart/histogram
- Adjust intake air or mixture temperature
- Monitor basic engine parameters
- View error codes and status messages
- Automatically look up octane number of compensated cylinder height
- Select any octane rating procedure
- Flexible pass quantity (1, 2, 2+1, 3)
- Set sight glass minimum and maximum levels, as well as the fuel flow rate



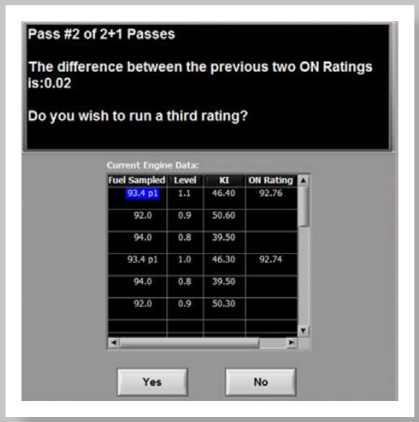


Real Time Data Recording:

- Automatic recording of data
- KI vs fuel level chart that is updated in real time
- Easily see when maximum knock is achieved
- “Next Fuel” function enables users to manually advance to the next fuel/air sweep
- Software prompts for appropriate fuel testing sequence (unknown, high, low, etc.)

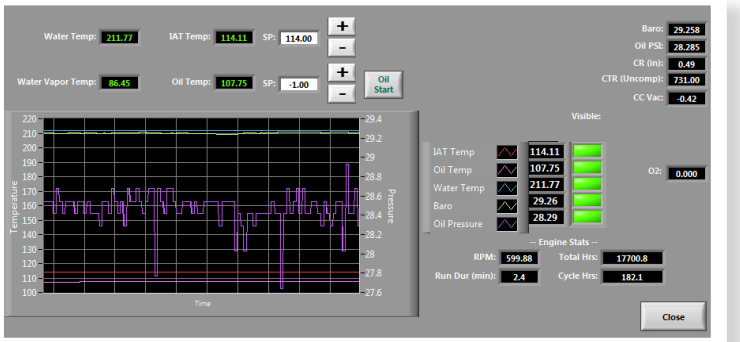
Clearly Defined Results:

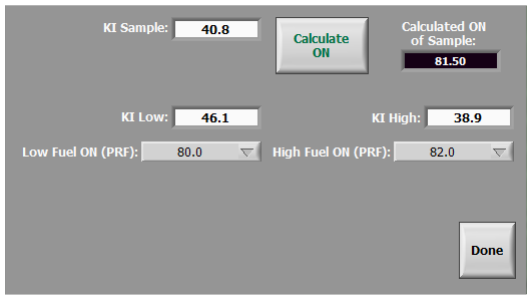
- Easy to ready summary at end of test
- Calculations and rounding per ASTM Method
- Critical results for each sweep and pass
- User remains in control of next actions



Full Engine Monitoring:

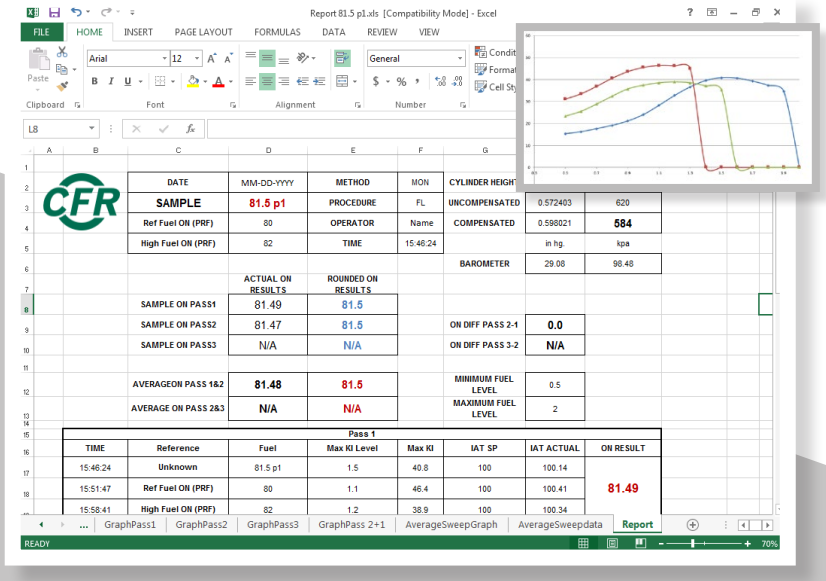
- Auxiliary screen provides clear oversight
- Real time control of basic parameters
- Isolate data logs for closer monitoring
- Turn-on and set the oil heater
- Engine and cylinder operating hours





Convenient Octane Estimator Tool:

- Perform quick estimations of unknown samples
- A full fuel/air sweep is run on unknown sample
- Existing KI and bracket information used to calculate an estimated octane number for unknown sample
- Users then determine the brackets to be used to properly rate the unknown sample
- Max KI of the unknown sample does not have to fall between the KI's of the bracket fuels in order to use the octane estimator tool



Detailed and Traceable Reports:

- All engines and test data automatically recorded in onboard database
- Timestamped record of test procedure
- Report automatically generated in Excel
- Data exportable to LIMS systems
- Graphs of each pass automatically generated

Octane Analyzer (OA) Option:

Add-on upgrade to XCP Technology for capability to perform the Auto-Dy procedure of ASTM Methods D2699 and D2700.

- Automatically complete passes
- Allows for broader range of Octane Number
- Reduced testing time
- Reduced test fuel consumption

Trusted Design, Reliable Results

The core design around which the CFR® engine is built has been tested and proven through rigorous and continued usage by customers around the world over many decades. Even as automotive designs have changed and fuel performance has improved, the CFR F1/F2 continues to be the gold standard for determining the octane number of liquid spark-ignition engine fuels.

Variable Compression Ratio Cylinder

At the heart of the CFR engine lies the variable compression cylinder and sleeve assembly. Varying the compression ratio by adjusting the cylinder height during engine operation makes it possible to compare unknown fuels to reference fuels with known octane values. Cylinder height is correlated to a compression ratio that can then be directly correlated to a specific octane value as per ASTM method specifications.

Four-Bowl Falling Level Carburetor

The CFR F1/F2 Octane Rating Unit is equipped with a four-bowl, variable-level carburetor that includes a falling level mode. With the falling level mode, the CFR carburetor gives the operator the flexibility to utilize any of the four test procedures in ASTM Methods D2699 and D2700.

Engine Air Control System

Precise management of the temperature and humidity of intake air is critical to a successful test. The CFR Engine Air Control System integrates fully with XCP Technology to deliver improved test reliability and accuracy.

CFR Crankcase

The CFR crankcase is a heavy-duty cast design that provides both strength and rigidity for the loads produced by various types of fuels, and will provide long service life when operated and maintained properly. Removable side doors allow for easy access to critical internal components for inspection, maintenance, and repair.

Exhaust Surge Tank System

The F1/F2 is equipped with a surge or expansion tank that eliminates the resonant pulsations and back pressure that occur in the CFR rating unit's exhaust lines during operation. Eliminating these variables in the testing process ensures consistent and accurate octane ratings.

XCP Technology

The fully integrated control, data capture, and reporting of XCP™ Technology directly supports the accountability and traceability needs of today's testing environments.

Specifications

Model: CFR F1/F2 Octane Rating System
Test methods: ASTM D2699, ASTM D2700, IP 236, IP 237, EN ISO 5164, EN ISO 5163
Octane number range: 40-120

Standard CFR F1/F2 System Inclusions:

- Engine unit mounted to rigid base
- Synchronous motor mounted to slide base (220/380/440 V; 3 Ph; 50/60 Hz)
- Variable compression ration cylinder
- Compression ratio change motor
- XCP™ panel with touchscreen PC (120V, 1 Ph, 50/60Hz)
- Electronic integrated barometer
- Laser sensor for measuring cylinder height
- Four-bowl “falling level” carburetor with one water-cooled bowl
- Exhaust surge tank system
- Water cooled exhaust manifold
- Desk with keyboard and mouse

Optional Equipment:

- Engine Air Control System (220V, 1Ph, 50/60 Hz)
- Octane Analyzer for automatic falling level test per Procedure D of ASTM Methods D2699 and D2700
- Ice Tower Assembly

Dimensions & Weight:

- Approximately 1.58 x 1.49 x 0.96m (H x W x D), 909 kg; (62 x 58 ½ x 37 ⅞ in, 2000 lbs)
- Including concrete base: approximate height 1.96 m (77 in), weight 1818 kg (4000 lbs)
- With exhaust surge tank: approximate depth 1.4 m (55 ⅛ in)

Operating Conditions:

	Motor Method (ASTM D2700)	Research Method (ASTM D2699)
RPM	900 +/- 1%	600 +/- 1%
Timing	Variable based on cylinder height	13° BTDC
Water jacket temperature	100 °C +/- 1.5 °C (212 °F +/- 3 °F)	100 °C +/- 1.5 °C (212 °F +/- 3 °F)
Oil temperature	57 °C +/- 8 °C (135 +/- 15 °F)	57 °C +/- 8 °C (135 +/- 15 °F)
Oil pressure	172 kPa-207 kPa (25 psi-30 psi)	172 kPa-207 kPa (25 psi-30 psi)
Vacuum	25-150 mm H_2O (1-6 in H_2O)	25-150 mm H_2O (1-6 in H_2O)
Intake temperature	38 °C +/- 2.8 °C (100 °F +/- 5 °F)	Barometrically Controlled Temperature +/- 4.4 °C (+/- 40 °F)
Mixture temperature	Standard 149 °C (300 °F); Tunable Range 141-163 °C (285-325 °F)	N/A
Intake humidity	0.00356 kg-0.00712 kg H2O/kg dry air (25-50 grains H20 / lb dry air)	0.00356 kg-0.00712 kg H2O/kg dry air (25-50 grains H20 / lb dry air)

CFR Engines, Inc.
N8 W22577 Johnson Drive
Pewaukee, WI 53186

E: info@cfrengines.com
T: +1 262 501 5998
www.cfrengines.com

Form C625