

F1/F2 Octane Rating System with XCP® TECHNOLOGY

CFR Engines Inc.

Providing Value and Confidence in Global Fuel Quality

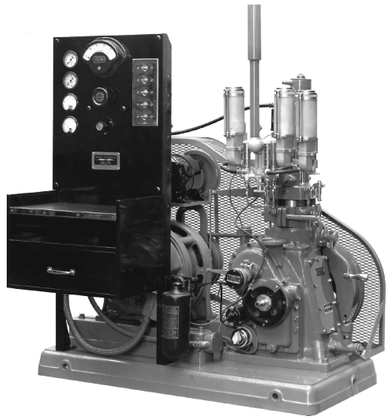
CFR® F1/F2 Octane Rating System with XCP® TECHNOLOGY

Combination Research & Motor Method

The CFR F1/F2 Octane Rating System 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.



Historical unit, first released in 1929



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 237:** Determination of Knock Characteristics of Motor Fuels - Research Method
- **IP 236:** Determination of Knock Characteristics of Motor and Aviation Fuels - Motor Method
- **EN ISO 5164:** Determination of Knock Characteristics of Motor Fuels - Research Method
- **EN ISO 5163:** Determination of Knock Characteristics of Motor and Aviation Fuels - Motor Method



Features & Benefits

Providing value and confidence in global fuel quality

Whether working with a complete unit, an upgrade/conversion kit, or a CFR genuine part; the product has been designed, manufactured, and fully tested by the CFR team to work as an integrated solution for your operation.

Confidence in a Fully Integrated Fuel Testing System

A complete CFR octane fuel testing system includes four main elements, each is designed to seamlessly integrate and deliver trusted results. With the EACS, the CFR F1/F2 Octane Rating System, XCP® TECHNOLOGY, and a CFR exhaust surge tank; each critical parameter of a successful octane test is controlled.

Suitable Data Integrity with XCP® TECHNOLOGY

The XCP Digital Control Panel routinely captures critical information for each rating and presents it in a ready-to-use Excel-based report, minimizing calculation errors and the need to manually record data. The XCP standard report includes KI values, Octane Numbers, environmental data (temperatures, pressures, barometer, and EACS humidity), and KI vs fuel level curves. The XCP can also integrate with LIMS. The added benefit of capturing and processing your test data automatically gives the accountability to defend your ratings without challenge.

Reliability of Proven Design

Since 1929, thousands of users have relied on the proven service of CFR 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 EACS. 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

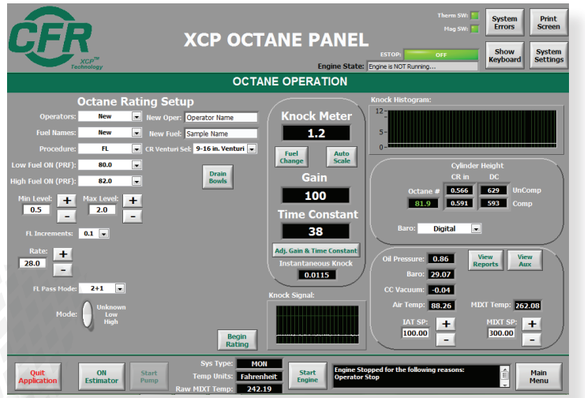
The CFR F1/F2 with XCP TECHNOLOGY uses digital instrumentation to record and process critical aspects of system operation and performance. On-board barometric pressure adjustments, increased automation, broad octane meter range, no adjustments for "spread", and even control of engine intake air are some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

Cost Savings with One System Flexibility

With standard product offerings, a CFR F1/F2 engine unit 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 all within 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.

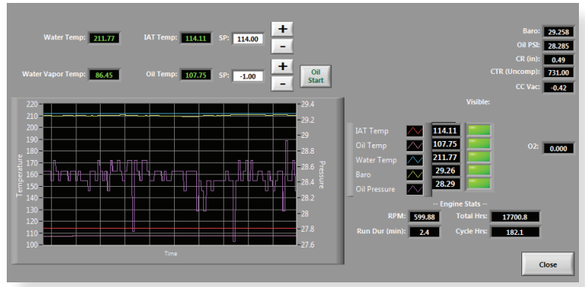


Intuitive & Complete Interface:

- 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

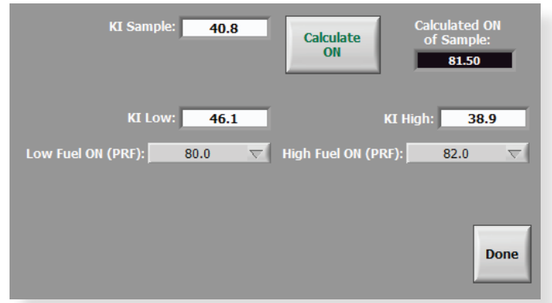
Full Engine Monitoring:

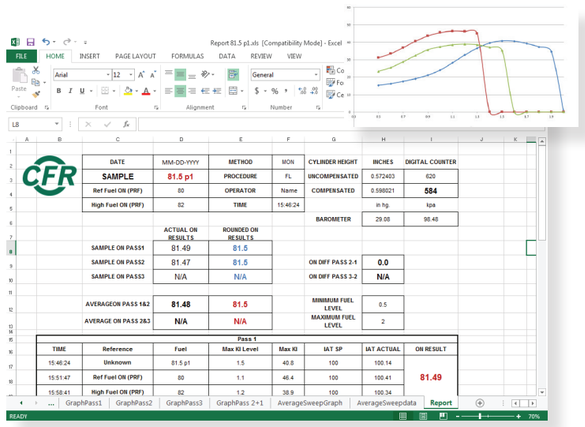
- Auxiliary screen provides clear oversight
- Real-time control of basic parameters
- Isolate data logs for closer monitoring
- Turn-on and set the oil heater
- Engine and cylinder operating hours



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 of the bracket fuels in order to use the octane estimator tool



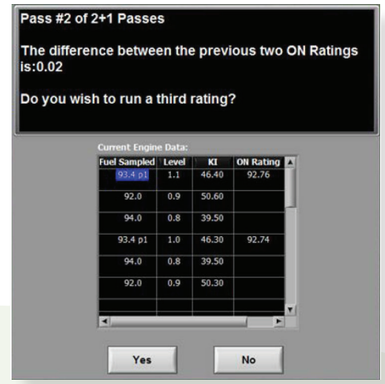


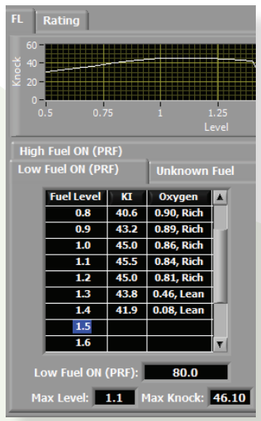
Detailed & Traceable Reports:

- 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

Clearly Defined Results:

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





Intuitive & Complete Interface:

- 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.)





Octane Analyzer (OA) Option:

Add-on upgrade to XCP TECHNOLOGY for capability to perform the Auto-Dry 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 CFR F1/F2 remains the gold standard for determining the octane number of liquid spark-ignition engine fuels. Even as automotive designs have changed and fuel performance has improved, the CFR engine has kept with the times and continues to be innovative. The core design around which the CFR engine is built has been tested and proven through rigorous and consistent usage by customers around the world over many decades.

Variable Compression Ration 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.



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.

Engine Air Control System (EACS)

Precise management of the temperature and humidity of intake air is critical to a successful test. The EACS 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. Removeable side doors allow for easy access to critical internal components for inspection, maintenance, and repair.

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.



Configurations and Specifications

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 ratio cylinder
- Compression ratio change motor
- XCP panel with touchscreen PC (120V, 1 Ph, 50/60 Hz)
- 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 (EACS), 200 - 220 VAC, 1 Ph, 20 Amp dedicated circuit for 50 Hz and 208-230 VAC, 1 Ph, 20 Amp dedicated circuit for 60 Hz
- XCP® TECHNOLOGY Octane Analyzer (OA) 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)



Operation 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 H2O (1-6 in H2O)	25-150 mm H2O (1-6 in H2O)
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)

Scan to learn more about the F1/F2 Octane Rating System →

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Form C625, Revision B