

VERSATILITY IN PROCESS CONTROL & FUEL ANALYSIS USING ATR FLOW CELL & FT-IR

Michael Collier

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REFINERY PROCESS CONTROL & FUEL ANALYSIS

**PROBLEM
CHALLENGE
SOLUTION**

Problem Identified



- **TIME is \$\$\$\$\$\$**
- **Traditional means of fuel analysis by standard laboratory practice can involve time delay and labor cost in return of test results.**



Problem Identified



- **Delay can result in disruption of refinery processing and even off specification products which have to be recycled or sent to disposal.**



Problem Identified



- **Enormous waste in time and material for refinery process economics.**



Challenge Posed



- **Develop a means to provide test results to process and blending engineers in real time**
- **Caveat 1: The means must provide reliable test results.**
- **Caveat 2: The means must provide economic advantage to the process.**

Solutions



- **Some refinery operations have satellite labs which have dedicated testing services focused for that portion of the process, which can provide results from traditional tests in less time and more frequent than the main laboratory.**
- **Still requires traditional standard test time and labor cost.**



Better Solution



Analytical Laboratory



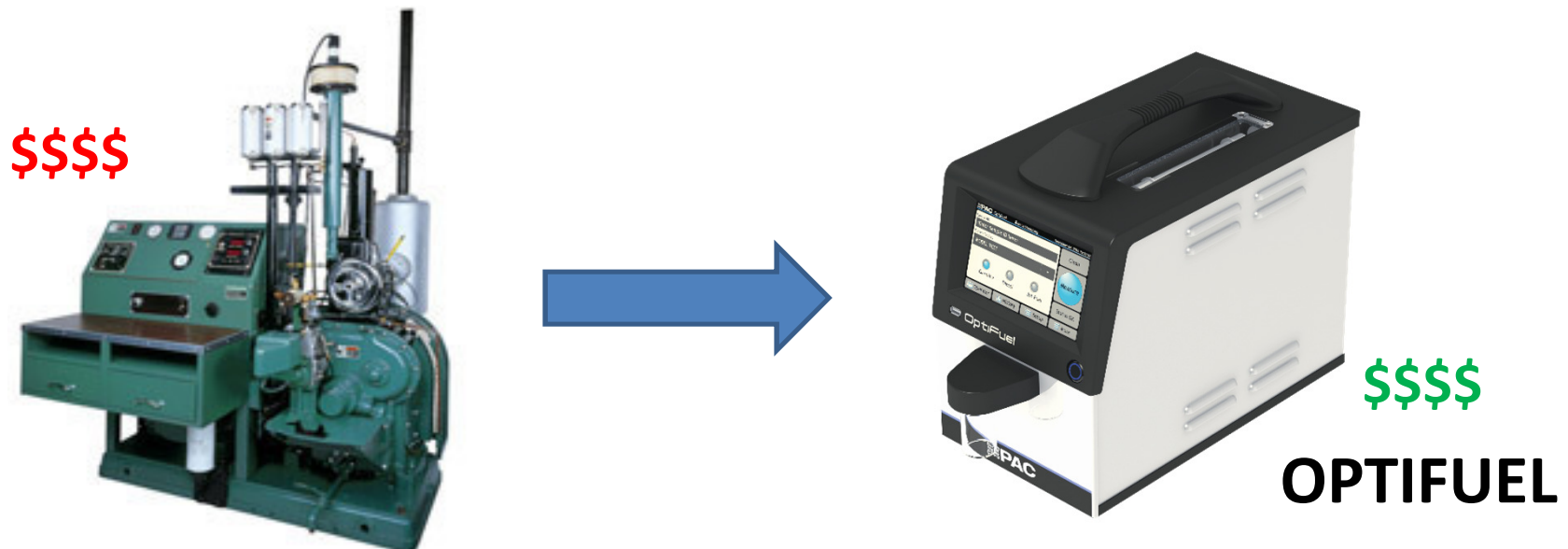
OPTIFUEL



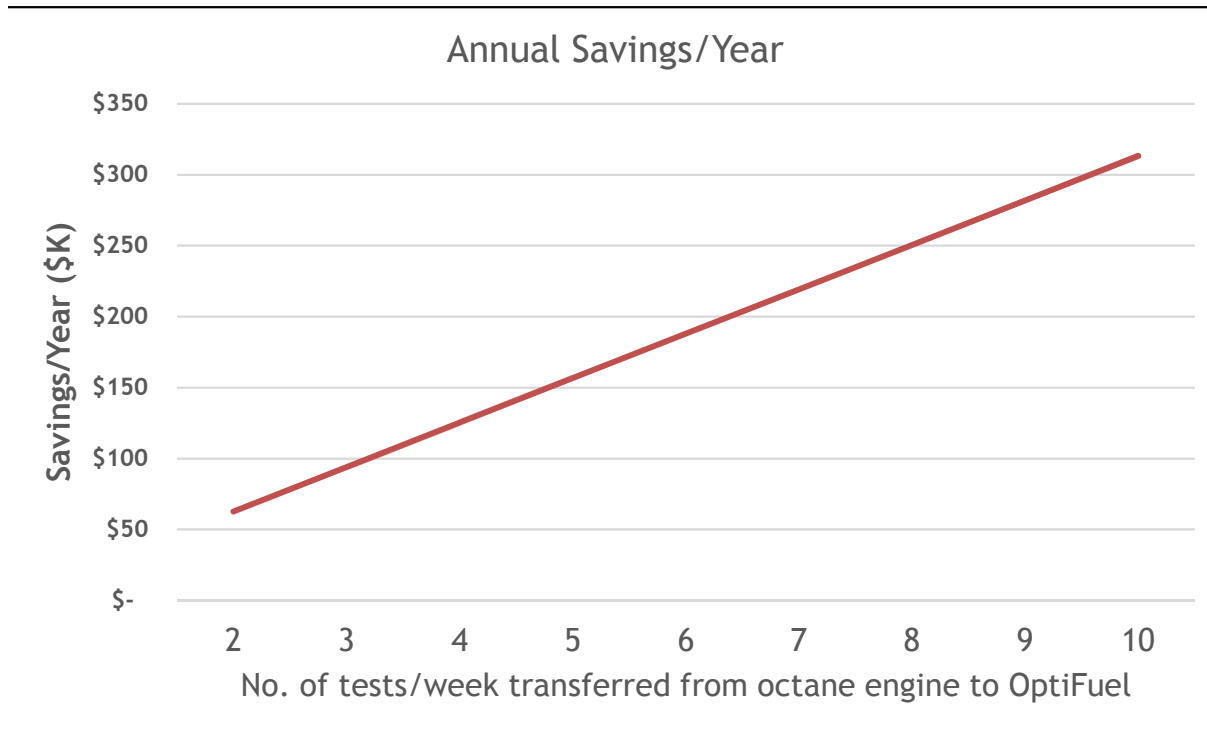
Better Solution > OptiFuel



- One 20 second scan can provide a single customized report of 50+ properties from built-in models in less than 2 minutes.
- Results transmitted direct to LIMS and sent to network printer.
- Enormous reduction of time and \$\$\$\$.



Refinery Process Control Economics

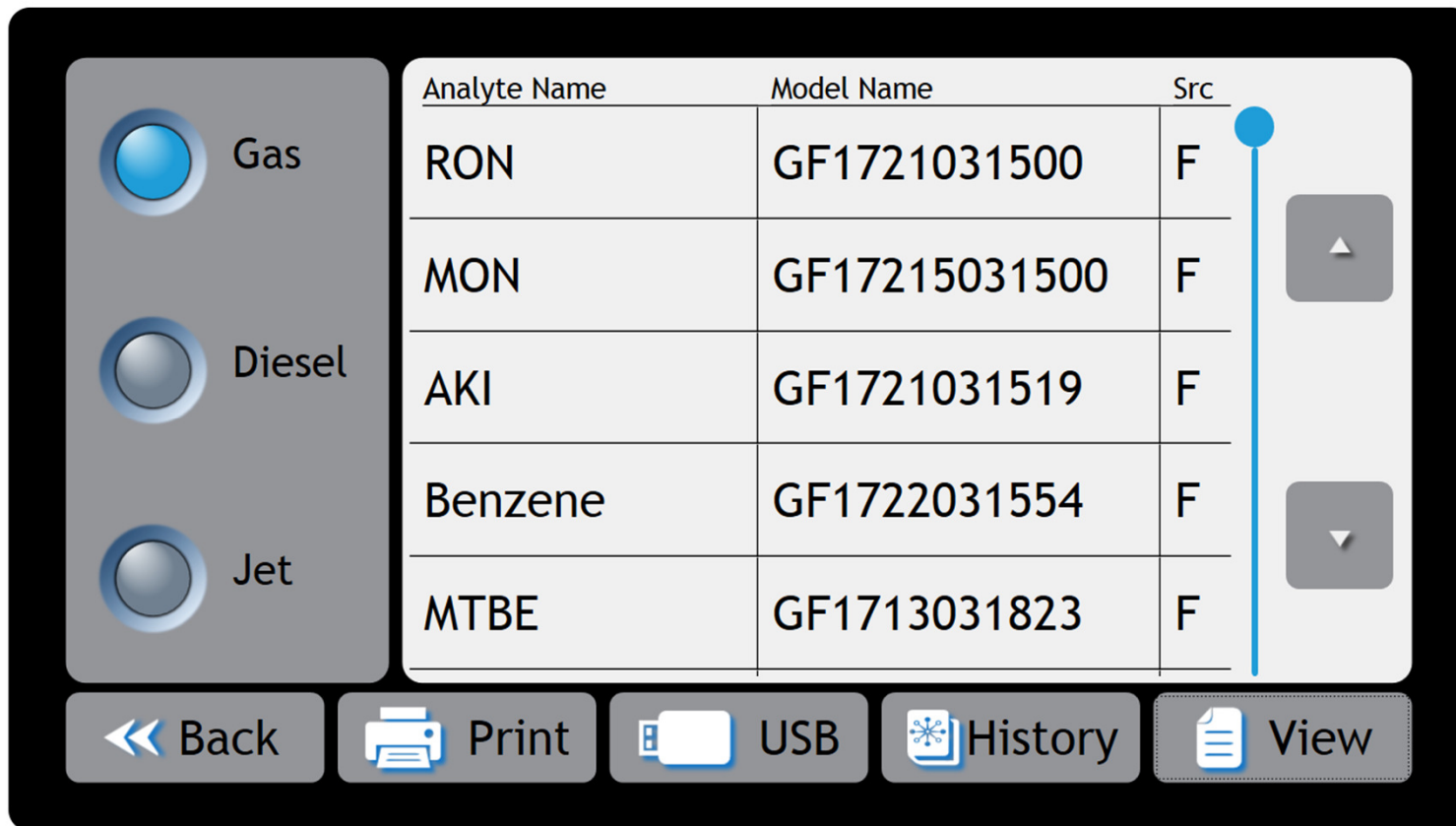


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No. of Tests/Week on OptiFuel	Payback Period (Months)
2	9.19
3	6.13
4	4.60
5	3.68
6	3.06
7	2.63
8	2.30
9	2.04
10	1.84

\$\$\$\$\$\$\$\$

OptiFuel has Factory Models for 50+ Properties



The screenshot displays the OptiFuel interface. On the left, there are three radio buttons for fuel types: Gas (selected), Diesel, and Jet. The main area contains a table with the following data:

Analyte Name	Model Name	Src
RON	GF1721031500	F
MON	GF17215031500	F
AKI	GF1721031519	F
Benzene	GF1722031554	F
MTBE	GF1713031823	F

At the bottom, there are five buttons: Back, Print, USB, History, and View. A vertical slider on the right side of the table is currently positioned at the top, with an upward arrow button above it and a downward arrow button below it.

ASTM D7777 Density Meter U-Tube

An ASTM compliant u-tube density module, capable of measuring from 0.5 g/cm^3 to 2.0 g/cm^3 , is integrated in each OptiFuel to provide direct density reading. Per ASTM D1250-04 algorithm, densities of hydrocarbon samples can be reported at 15° from 0.6 to 1.200 g/cm^3 . This eliminates the need for an external density meter.



Typical Laboratory Tests



	Sample	ASTM	EN
Benzene	Gasoline	D6277	
Oxygenates (Methanol, Ethanol. Etc.)	Gasoline	D5845	
FAME	Diesel	D7371	
Density	All	D7777	
RON	Gasoline	D2699	ISO 5164
MON	Gasoline	D2700	ISO 5163
Anti Knock Index	Gasoline		
Vapor Pressure (DVPE 37.8°C)	Gasoline	D5191	ISO 13016/1
Distillation Points	Gasoline	D86	ISO 3405
Evaporation Points	Gasoline	D86	ISO 3405
Driveability Index	Gasoline	D4814	
Vapor Lock Index	Gasoline	Correlated to calculated value	
VOC Emission	Gasoline	Correlated to calculated value (US samples only)	
Total Olefins	Gasoline	D6839	ISO 22854
Aromatics (Total, C7, C8)	Gasoline	D6839	ISO 22854
Manganese	Gasoline	SGS M2533	
Cetane Number	Diesel	D613	ISO 5165
Cetane Index	Diesel	D4737A	ISO 4264
Distillation/Evaporation Points	Diesel	D86	ISO 3405
Cetane Improver (2-EHN)	Diesel	SGS M2522	
FAME	Jet Fuel		

Better Solution



20 ml Sample Jar

OptiFuel



Dimensions:
8.5" x 14" x 16"

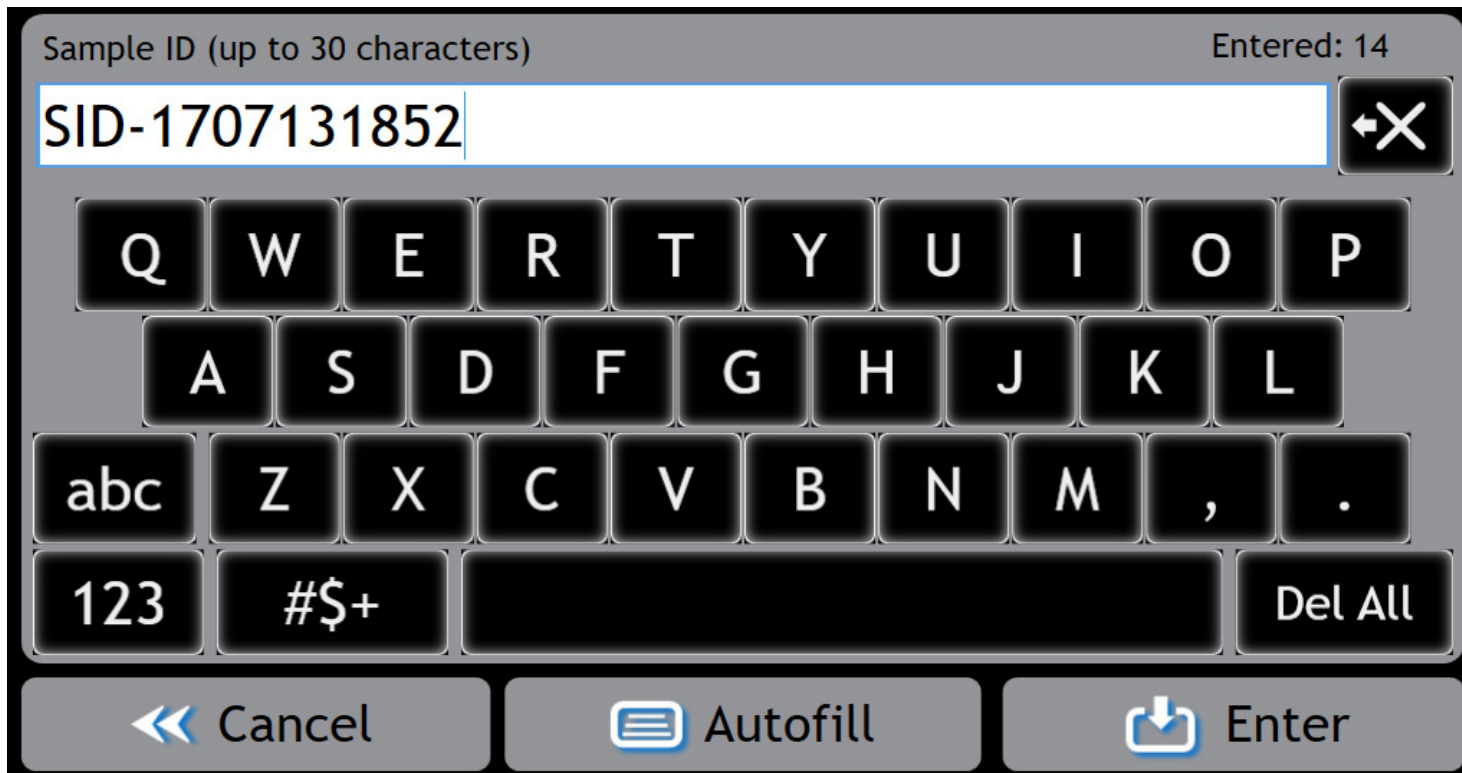
Operational Principle



7" Color Touchscreen



Sample ID Autofill Feature



OptiFuel Profile List



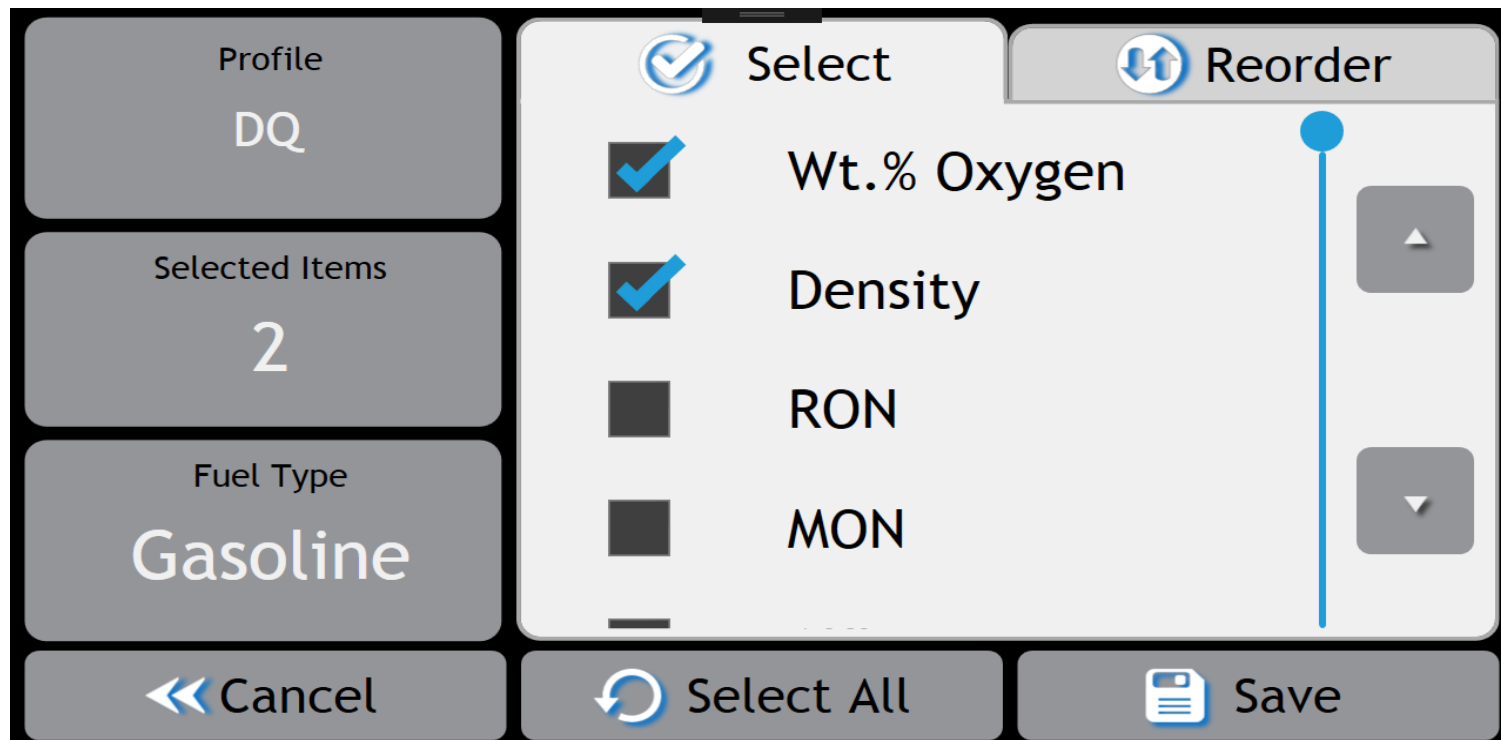
Sample Profile Drop Down

The screenshot displays a user interface for managing fuel profiles. At the top left, it shows "Active Profile: Super Unleaded TK". To the right of this is an "Activate" button with a circular refresh icon. Below the active profile information is a vertical stack of three buttons labeled "Gas", "Dsl", and "Jet". The "Gas" button is currently selected and highlighted in blue. To the right of these buttons is a dropdown menu that is open, showing a list of profile names: "SystemProfile_Gas" (highlighted), "Super Unleaded TK", "aaaaaaa", "BBBBB", and "CCCCCC". To the right of the dropdown list are two square buttons with upward and downward arrow icons. At the bottom of the interface is a navigation bar with five buttons: "Back" (with a left-pointing arrow), "Options" (with a gear icon), "Add" (with a plus sign icon), "Delete" (with a minus sign icon), and "View" (with a document icon).

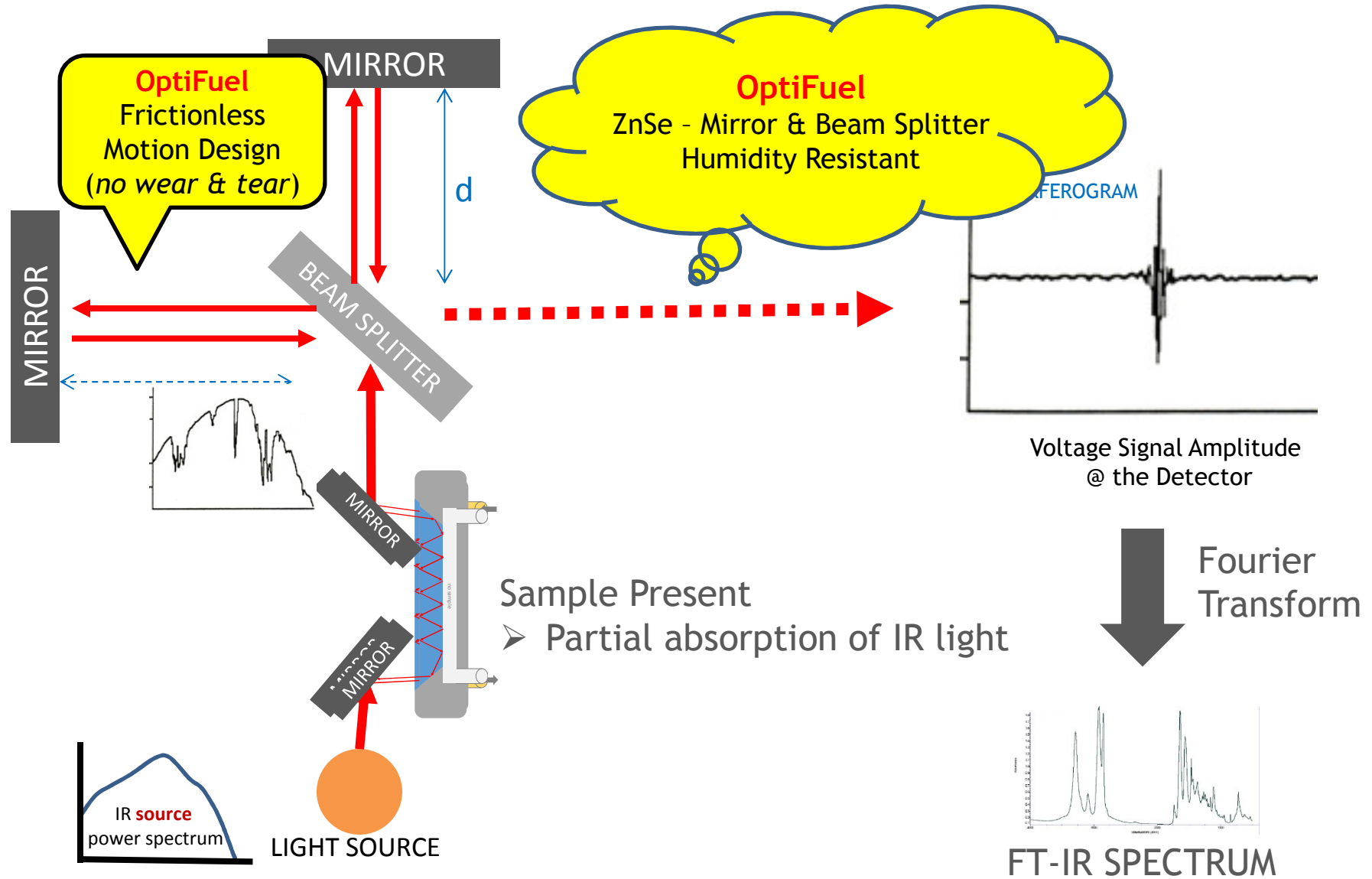
Profile Properties



Profile Editing Screen

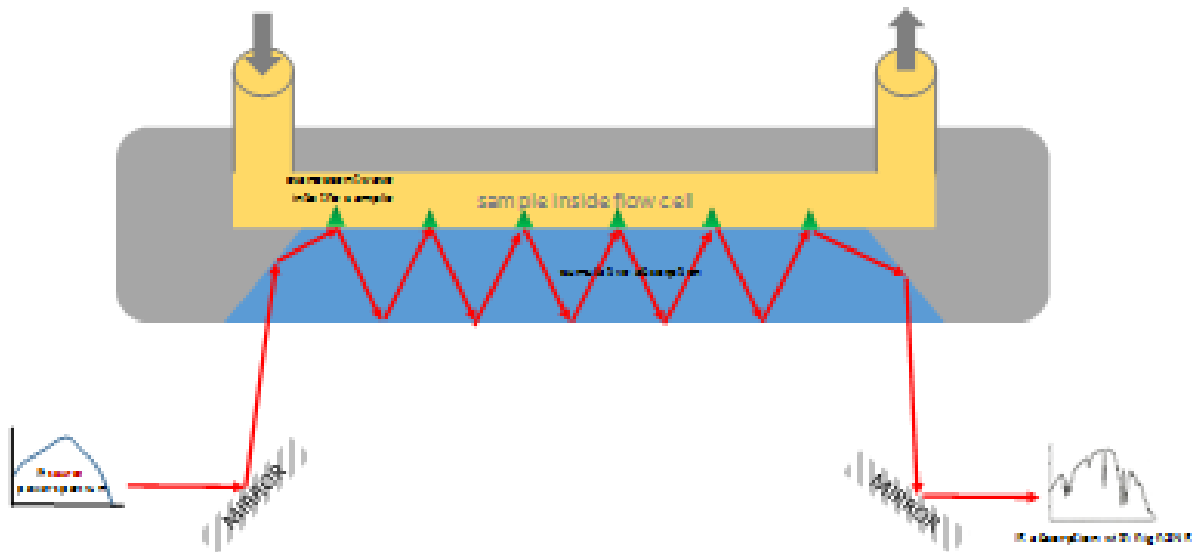


How Interferometer Works



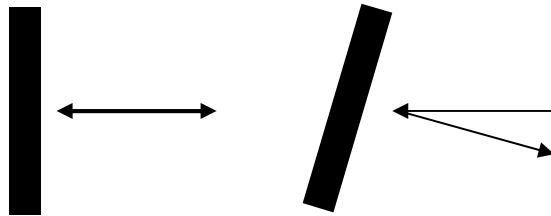
OptiFuel Single ATR Flow Cell

Attenuated Total Reflectance Flow Cell
Wide Range High Resolution Analysis (2 cm^{-1}) for all sample types

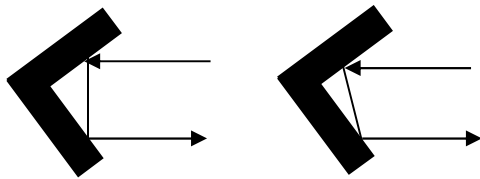


**ONE cell for all Gasoline, Diesel, Jet Fuel
no moving part !!!**

Cube Corner Mirrors in OptiFuel

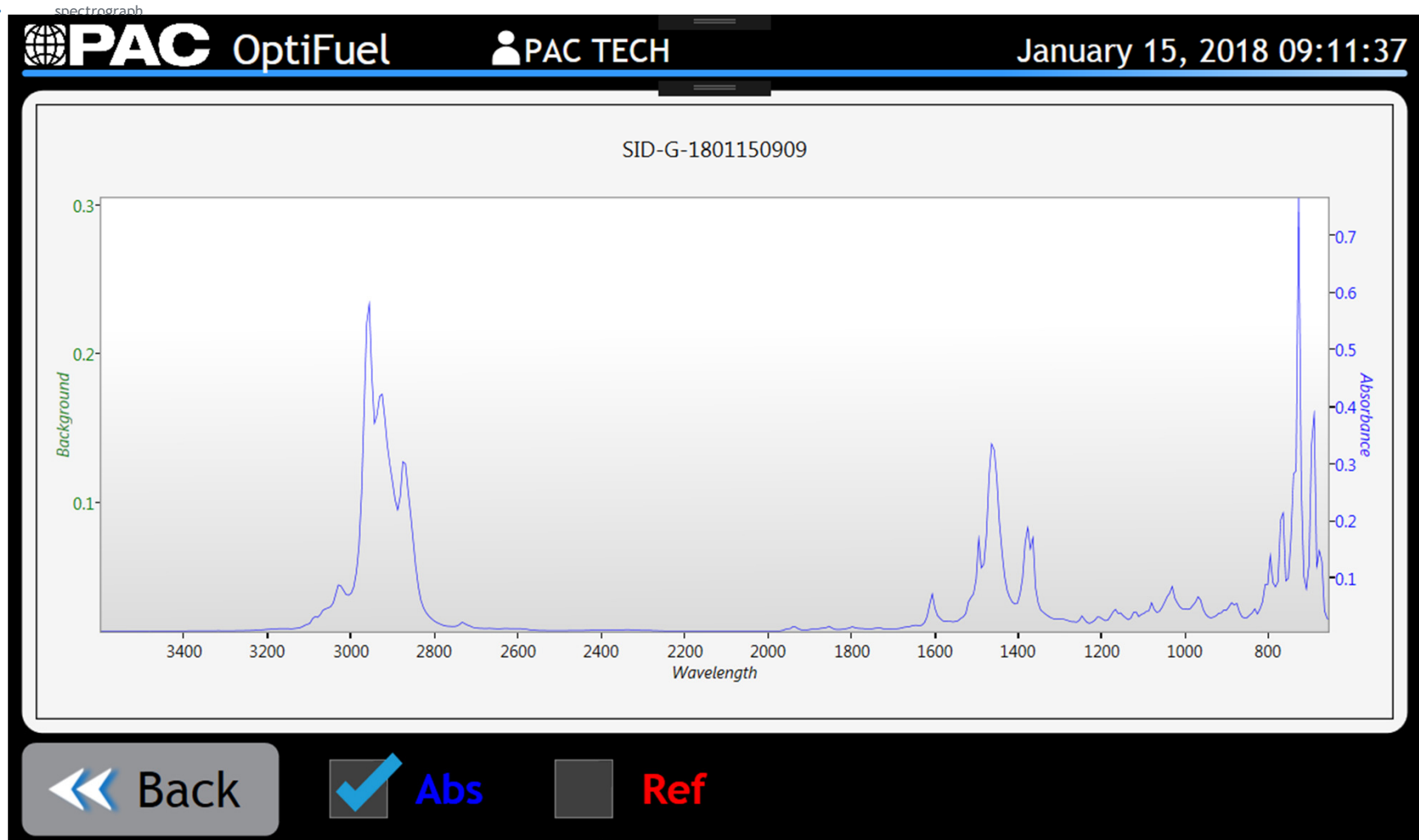


- Flat mirror
- Prone to misalignment of output beam due to vibration

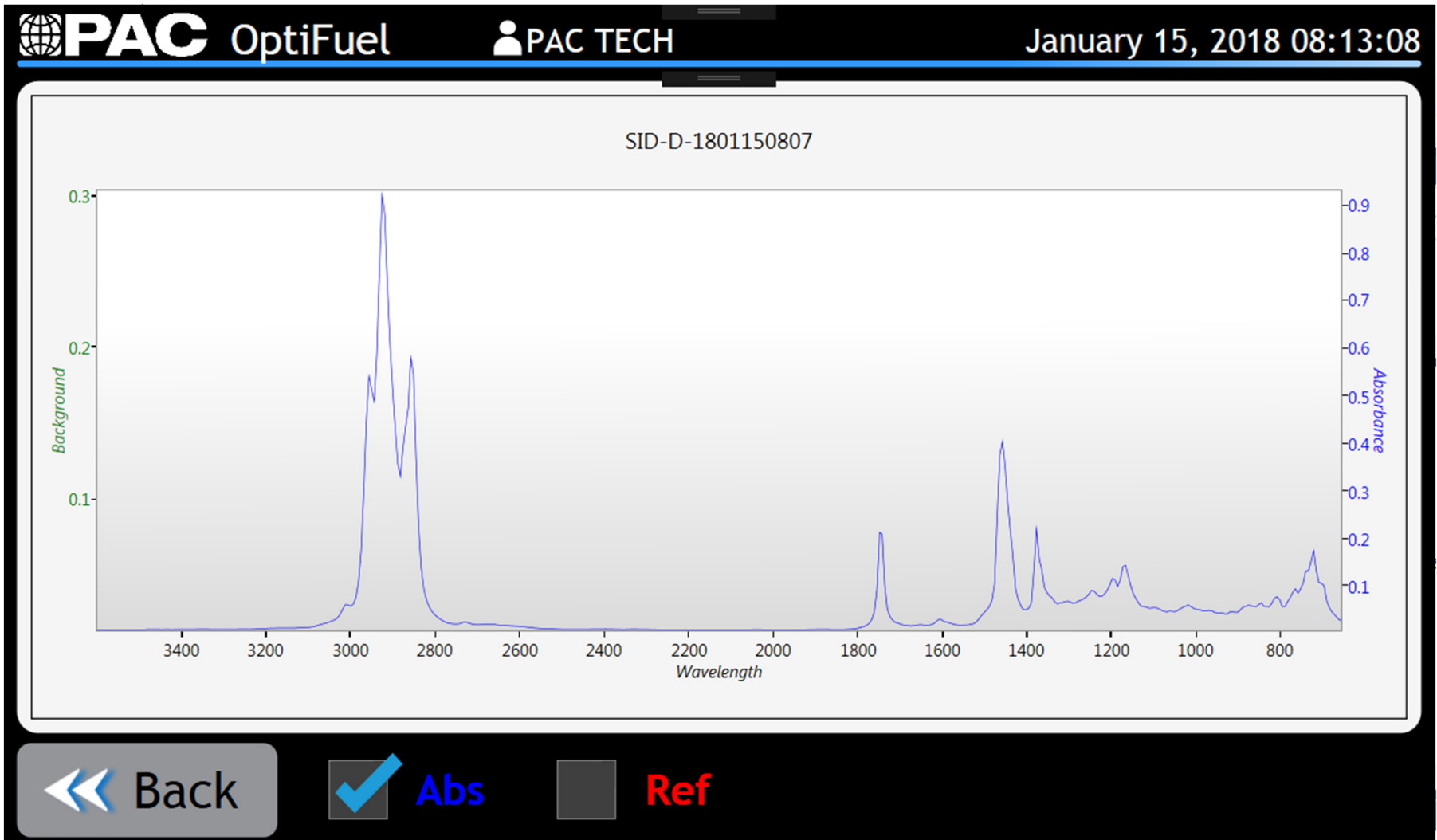


- ✓ Cube corner mirror
- ✓ Vibration resistant

Gasoline Spectrum



Diesel Spectrum



OptiFuel Test Report History



Searchable Measurement History

Date/Time	Sample ID	Fuel
July 17 2017 15:56	SID-G-1707171556	Gas
July 17 2017 15:48	SID-G-1707171547	Gas
July 17 2017 15:24	SID-G-1707171523	Gas
July 17 2017 15:13	SID-G-1707171512	Gas
July 17 2017 14:56	SID-G-1707171455	Gas

Navigation bar: Home, Search, USB, Print, View

OptiFuel Test Report

Company Name SkillSoft, Inc
 Company 210 Dream Dr, Hope City, TX, 77459
 Operator Name PAC TECH
 Sample ID German-G-1712181553
 Test Date/Time 12.18.2017 15:54
 Fuel Type Gasoline
 Instrument SN NA
 LIMS ID NA
 Notes

Analyte Name	Result	Units	Expected Range	Model
RON	92.7		[89.9 : 102.7]	GF1710161500
MON	84.3		[80.9 : 92.7]	GF1710161500
AKI	88.5			-
Benzene	0.00	%m		GC171207031006
MTBE	0.69	%m		GF1709181823
ETBE	0.00	%m		GF1710311822
TAME	0.90	%m		GF1709181423
DIPE	0.18	%m		GF1709181922
Ethanol	5.31	%m		GF1711071423
Methanol	0.00	%m		GF1709201812
TBA	0.00	%m		GF1709181925
Olefins	4.6	%v		GF1709191502
Total Aromatics	13.2	%v		GF1709191553
C7 Aromatics	3.5	%v		GF1709181554
C8 Aromatics	2.7	%v		GF1709181554
Saturates	74.3	%v	[0 : 94.7]	-
DVPE	84.7	kPa		GF1709191556
MMT	604	ppm		GF1710061554
Manganese	152	ppm		-
IBP	79.7	°F		GF1709191554
T10	105.6	°F		GF1709191554
T50	169.4	°F		GF1709181554
T90	331.5	°F		GF1709181554
FBP	439.1*	°F		GF1709191554
E70	47.1	%v		GF1709191554
E100	63.3	%v		GF1709181554
E150	84.1	%v		GF1709191554
E180	94.3	%v		GF1709191554
E200	64.9	%v		-

* - out of model range

OptiFuel Report (cont.)



OptiFuel Test Report

Page 2 of 2

Instrument SN SN-DEV1

Print Time: 12.21.2017 17:06

German-G-1712181553



Analyte Name	Result	Units	Expected Range	Model
E300	82.5	%v		-
Driveability Idx	1012			-
Vapor Lock Idx	1177			-
Wt.% Oxygen	2.14	%		-
Density	30.621	API		-

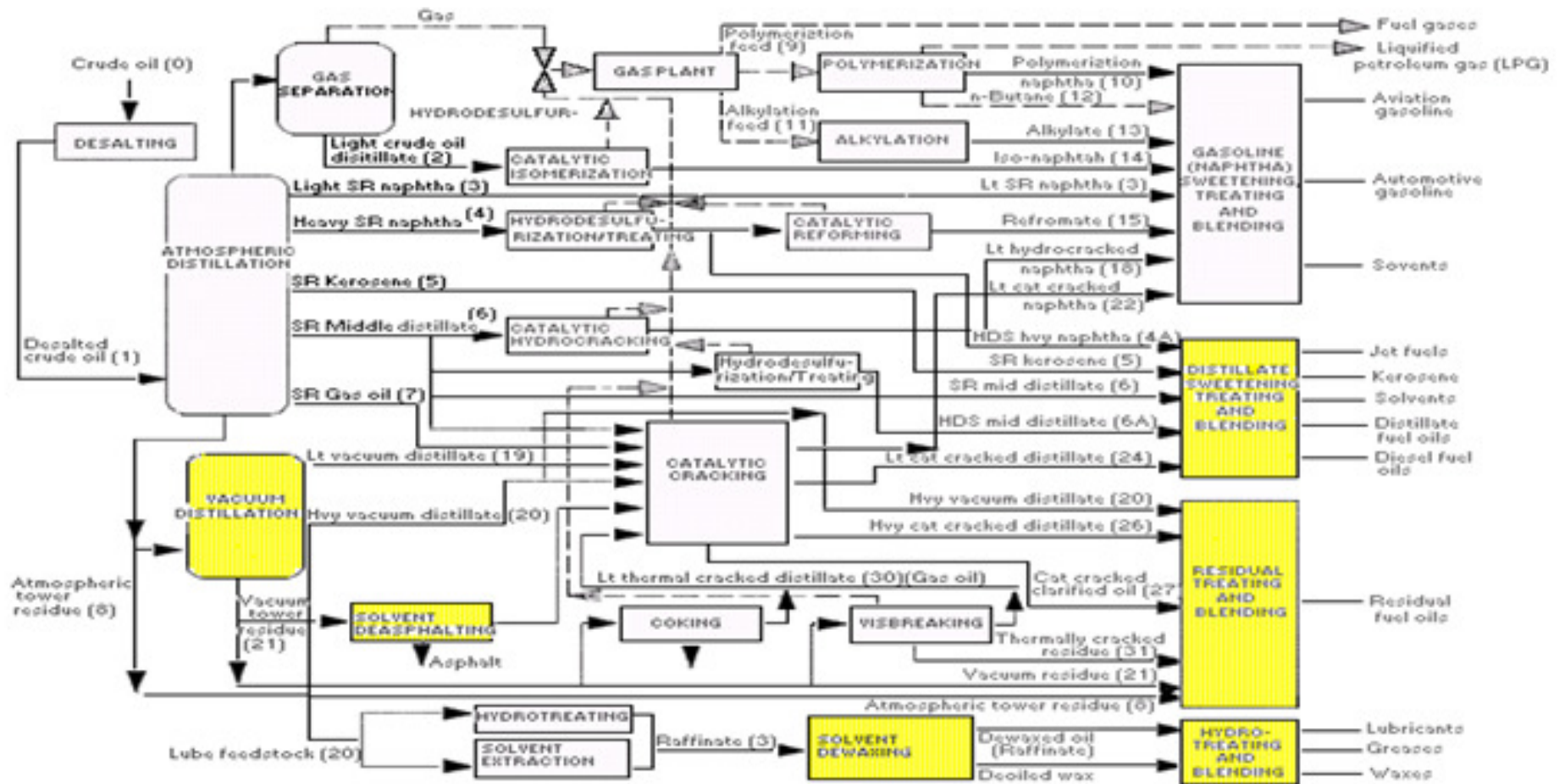
* - out of model range

Signature: _____

Best Solution ??



Refinery Process Control Needs Test Results Faster! \$\$\$\$\$\$



Best Solution



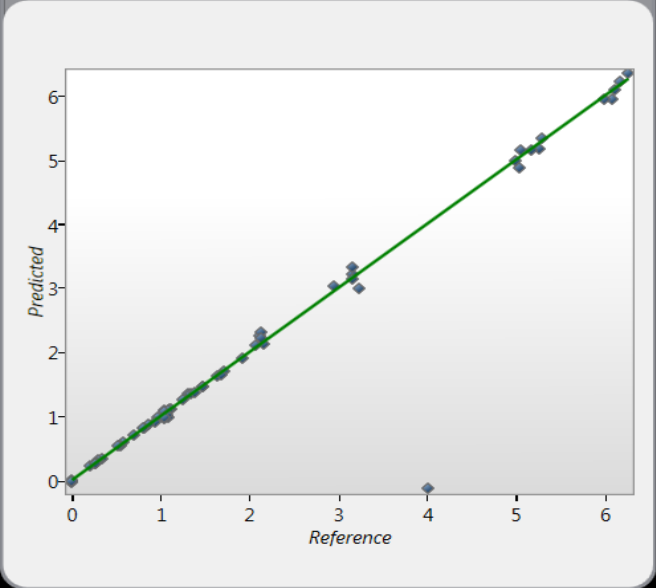
- Dedicate **OPTIFUEL** to your satellite process control lab and let them control in real time!



OPTIFUEL \$\$\$\$\$

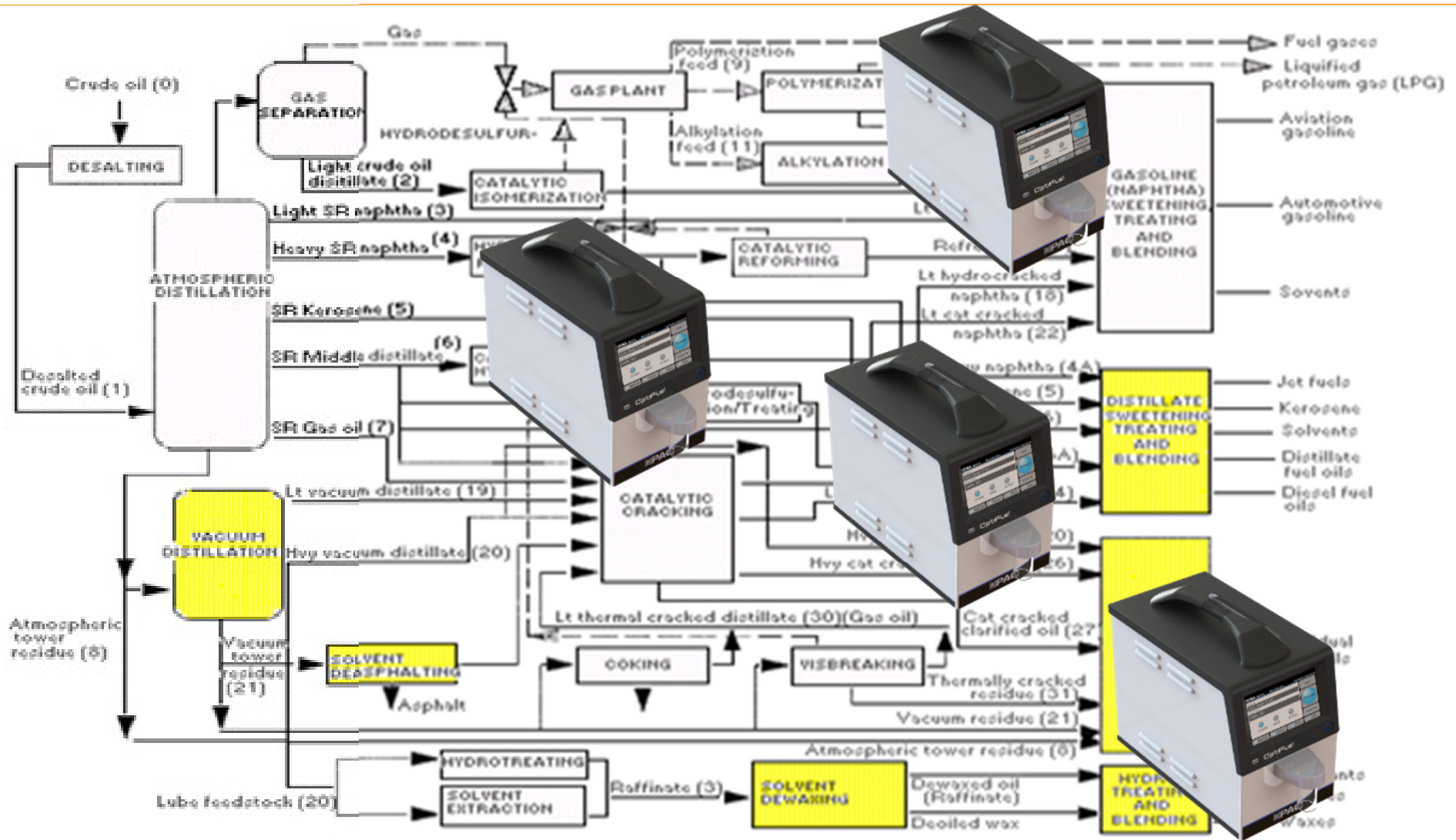
OptiFuel Model Editing Screen

Model	GC171207031006
Analyte	Benzene
Fuel	Gasoline
Source	Custom
Created	12.07.2017
Range	[0 : 6.25] %m
Samples	2



Navigation buttons: Back, Factory, Change, Export

Best Solution !!



Best Solution

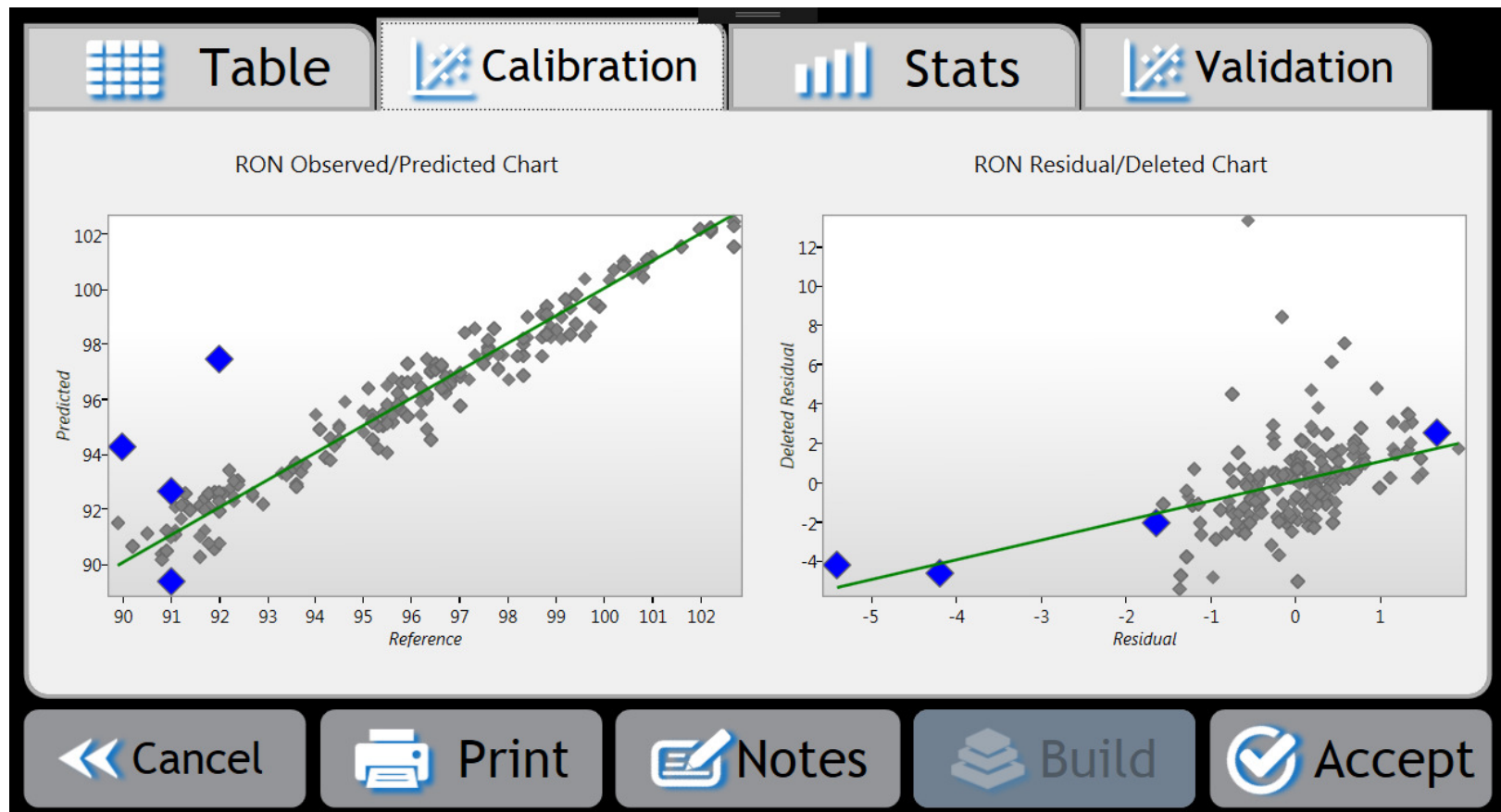


- **OptiFuel in main lab, satellite process control labs, and terminal operations provide for reliable and real time analysis on 50 + properties.**
- **OptiFuel is delivered with factory models from actual refinery products & properties.**
- **2 Year System Warranty**
- **5 Year IR Light Source Warranty**
- **10 Year Optics Warranty**

Best Solution



- **Process specific models and final product models can be created or tuned using statistical analysis.**



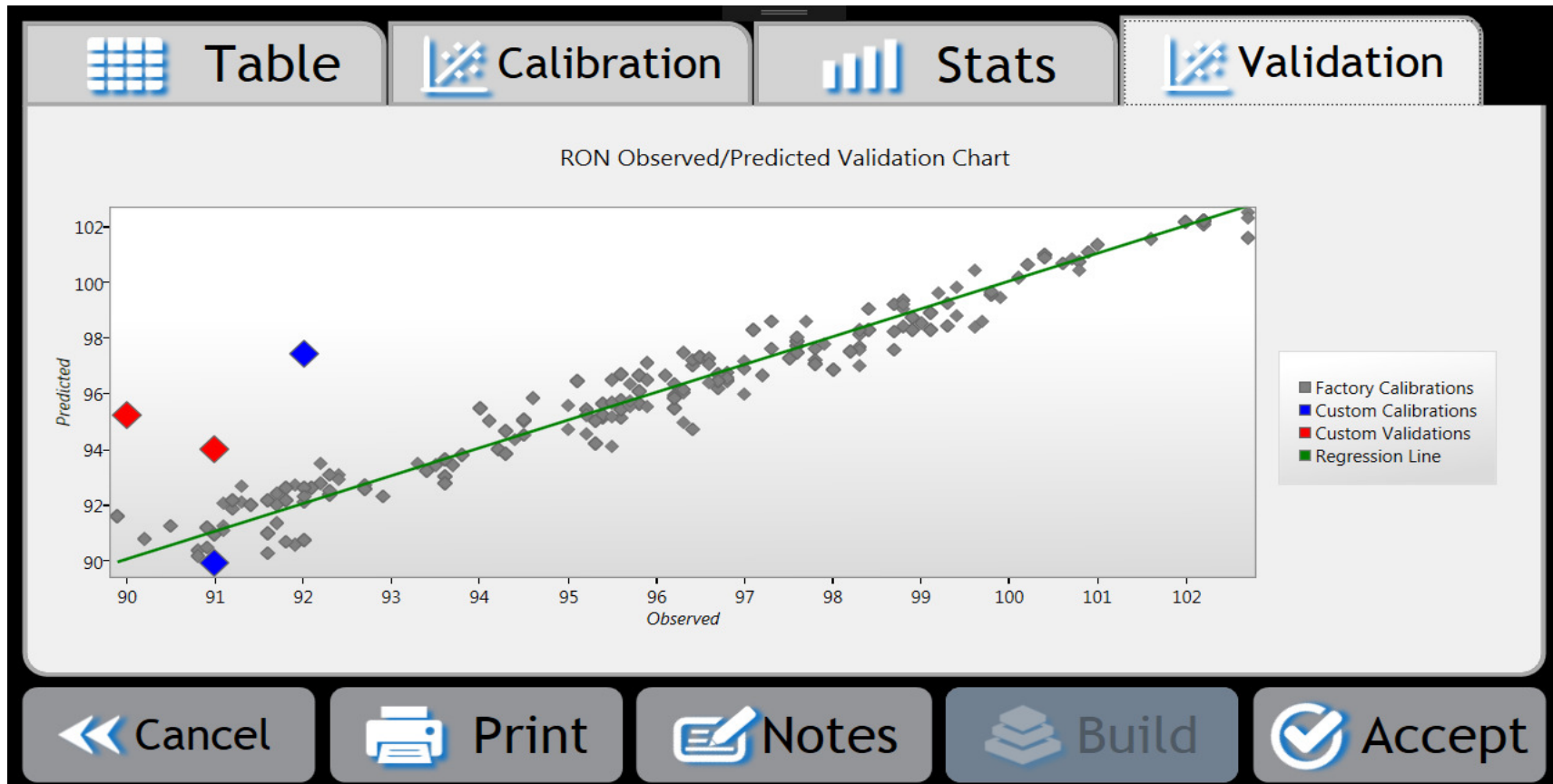
Import Reference Sample



Reference Sample Import Table

	A	B	C	D	E	F	G	H	I
1		RON	Mar	MON	AKI	Benzene	MTBE	ETBE	TA
2	German-031	92.7	83.2	83.2	87.9	0.53	0.52	0	
3	German-075	90	82	82	86		0.2	0	
4	German-076	92	82	82	87	0.2	0		
5	German-080	102		90	96	0.1	0.7	0	
6	German-081			90	95	0	0.5	0	
7	G-08888			90	95	0	0.5	0	
8									
9									

Validation Chart



OptiFuel Statistics Screens



Table Calibration Stats Validation

RON: New Model Statistics

RMSEP	R ²	SE	SSR	SST	PRESS
0.779	0.941	0.796	116.53	1990.955	35635.371

Cancel Print Notes Build Accept

Table Calibration Stats Validation

Calibr	Valid	Sample ID	Standard	Predict	Residual	DeletedR
<input checked="" type="checkbox"/>	<input type="checkbox"/>	German-031	92.00	97.40	-5.40	-4.30
<input type="checkbox"/>	<input checked="" type="checkbox"/>	German-078	91.00	92.64	-1.64	-2.14
<input type="checkbox"/>	<input checked="" type="checkbox"/>	VOC1	90.00	94.20	-4.20	-4.66
<input checked="" type="checkbox"/>	<input type="checkbox"/>	German-048	91.00	89.34	1.66	2.51

Cancel Print Notes Build Accept

Clone Your Optifuel Property Models



Additional OptiFuel Uses



Terminals/Pipelines



BIOFUELS

Additional OptiFuel Uses



Regulatory Conformance



Additional OptiFuel Uses



Mobile Laboratory



Battery Pack Option



5 Hour Continuous Power

OptiFuel Key Features



- Rugged design > shock and vibration tested (ASTM/MilSpec)
- High resolution ATR flow cell and interferometer 2 cm⁻¹ wavenumber
- Single wide range high resolution cell 20 second scan
- One sample, one scan for all properties, no sample preparation needed
- Vibration free/humidity resistant cube corner mirrors
- Built-in product models> 50 plus
- Built in U-tube density module ASTM D7777 compliant
- ASTM D6277 Benzene, D7371 FAME, D5845 Oxygenates > compliant
- 10 year optics warranty
- Touchscreen navigation 7 inch color display
- Statistical calibration modeling/model importing/expandable models
- Unlimited additional properties/models capable
- Small footprint/portable
- Battery package available for mobile apps, 5 Hour continuous power.
- Pressurized sample introduction/Small 8 ml sample volume for scan
- Built-in fume sensor, leak test, filter change calendar
- Up to 100k test result storage
- On button touch Cloning capable

Summary/Conclusion



- **OPTIFUEL** is YOUR BEST SOLUTION
- Bring the **ECONOMIC ADVANTAGE** to your process



QUESTIONS ??

BOOTH #329