

## 4IR Process NMR AI-60 Analyzer Performance Specification for H+ Applications

### Features and Benefits

The Process NMR Analyzer provides the following benefits:

- Real-time, continuous flow-through stream analysis: Reduces Process response time and allows tighter control
- Provides chemical and physical analysis in dense and opaque materials: Linear spectral response across a broad range of materials (models can be extrapolated)
- Analyzes multiple properties
- Replaces conventional analyzers and provides faster results
- Simple sample conditioning: Requires no water removal and limited filtering, to protect valve seats
- Minimal maintenance: No moving parts in sensor



4IR Process NMR Analyzer

## Applications

The following table lists typical processes and sample variables that the Analyzer can continuously measure online:

Material	Calibration Models
Gasoline	RON, MON, D86, T10, T50, T90, benzene, total
	Point, Cetane No., API gravity, viscosity, sulfur*
Reformate	RON, MON, benzene, RVP
Gasoline	RON, MON, D86, T10, T50, T90, benzene, total
	Aromatics, RVP
Crude distillation, light naphtha	D86, T5, T95, RVP, API
Crude distillation, medium naphtha	D86, T90
Crude distillation, heavy naphtha	D86, T5, T95, sulfur*
Crude distillation, kerosene	D86, T5, T95, flash point, freeze point
Crude distillation, light gas oil	D86, T5, T85, T90, T95, cloud, pour, flash, API
	Sulfur*
Crude distillation, heavy gas oil	T95, cloud, pour, flash, API, sulfur*
Crude analysis	TBP, water, API gravity

## Device Labeling

 <p>4IR Solutions Process NMR System</p>
<p>4IR Solutions Ltd. 42 Pinchas Rozen St. Herzlia Israel 4659057 Tel: +972-54-4300058 Model: AI-60-EX</p>
<p>REF: 70002100 SN: PROC-NMR-CEXXX YYYY-MM</p>
<p>3N ~ 380-415[V] 25 [A] .50/60 [Hz] Maximum Power: 9.5 [KW] Minimum Purge Flow Rate :80 [l/min] Minimum Purge Flow Time :25 [min] Leakage Rate: &lt; 20 liter @ 2 mbar Minimum Over Pressure :0.8 [mbar] Maximum Over Pressure :3 [mbar] Minimum Supply Pressure :4.5 [bar] Maximum Supply Pressure :6 [bar] Overall Internal Free Volume :700 [L] Maximum Sample Inlet Pressure :20 [Bar]</p>
<p> WARNING PRESSURIZED ENCLOSURE DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT POWER SHALL NOT BE RESTORED AFTER ENCLOSURE HAS BEEN OPENED UNTIL ENCLOSURE HAS BEEN PURGED FOR 25 MINUTES AT A FLOW RATE OF 80 l/min</p>
<p>II 3 (1) G Ex db pzc (Ia Ga) (op is Ga) IIC T4 Gc 0°C ≤ Ta ≤ 40°C Certification Number ITS17ATEX101916X</p>


## Standard System Performance Specifications

Material	Calibration Models	
Observe nuclei	<sup>1</sup> H+	
Operating frequency	60 ±1 MHz	
Standard Process probe	8mm OD (up to 10mm) ambient temperature probes are designed to accept flowing sample streams.	
Proton resolution	Un-shimmed	Less than 500 Hz at half height and less than 1000 Hz at tenth height.
	Shimmed	Less than 6 Hz at half height and less than 24 Hz at tenth height.
Proton line shapes	Line width at the average peak height of the C13 satellites (0.55%) shall be: <90Hz	
Proton sensitivity	Single pulse sufficient to observe the largest peak of a 10% ethyl-benzene quartet with a signal to average noise ratio of 25:1, 1 pulse acquisition.	
Proton signal averaging	Sufficient to observe the largest peak of a 10% ethyl-benzene quartet with a signal to average noise ratio of 125:1, 25 pulse acquisitions.	
Frequency Stability	Change of ambient temperature of ±3°C frequency drift will not exceed ±1000 Hz at H1 observed frequency	
Pulse width	Transmitter pulse width of a 90° flip angle at 7-watt RF power shall be less than 30 microseconds.	
Integral ratios	For the total of the three (3) groups in the spectrum of a 10% by volume solution of ethyl-benzene:	

	Accuracy	The mean value of the ratio between the two groups of ethyl benzene (The benzene ring to CH <sub>2</sub> +CH <sub>3</sub> ) is 1:1 ±0.05
	Precision	Standard deviation of ten successive integrals shall not exceed 0.01

## Magnet System

Material	Calibration Models
System temperature	Stabilized self-condensed-field permanent magnet including computer-controlled magnet field gradient coils.
Field strength	At 45C° - 1.42 tesla
Fringe field	On external magnet enclosure less than 1 gauss.
Clear bore size	30 millimeters diameter

## Characteristics

Item	Description
Measurement method	Nuclear Magnetic Resonance spectroscopy
Calibration method	Chemo-metrics
Sample conditioning	Application dependant
Wetted materials	Process compatible cell body, Ceramic pipe and approved seal materials. Optional Hastelloy C, Monel, PVDF and other materials
Communication	Modbus over RS485, Modbus over Ethernet, TCP/IP over Ethernet

## Physical and Environmental Specifications

Item	Value
Dimensions	System Cabinet 196 x 75 x113 cm
Weight	450 kg
Power Consumption	3 Ø 380 - 415 VAC 25 A (Uninterruptable)
Operating temperature	20°C to 25° with temperature fluctuation less than ±3°C
Relative humidity	30-70% (non-condensing)
Storage temperature	0°C to +55°C
Relative humidity	Maximum 95%, non-condensing

## Probe Specification

Item	Description
Unloaded Q of H1 coil	> 180
Impedance matching to 50Ω	> 20 dB
Maximum pressure	<25 Bar
Maximum temperature	<100°C
Inner diameter	5.6mm

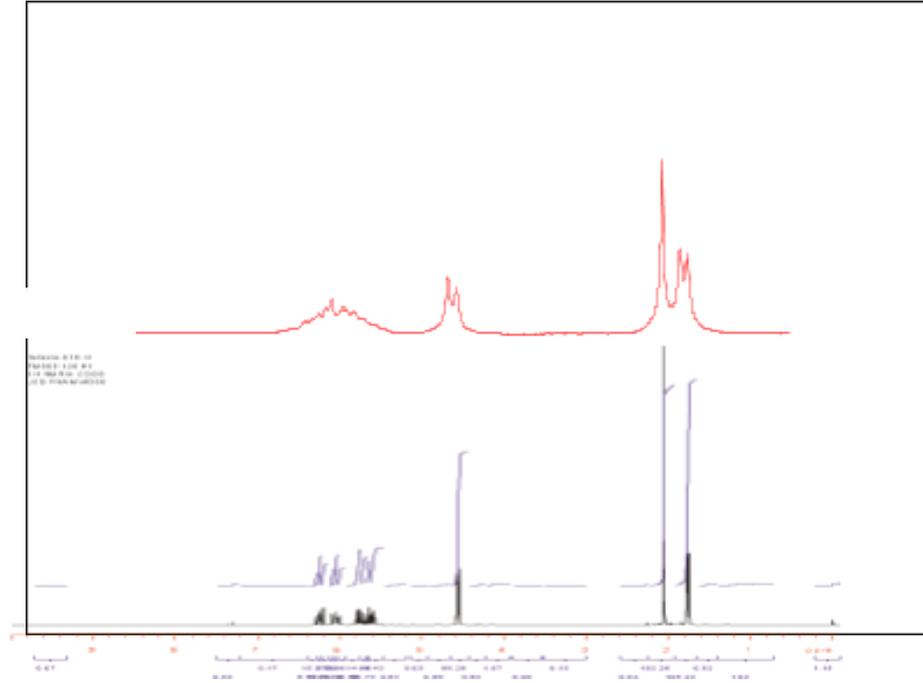
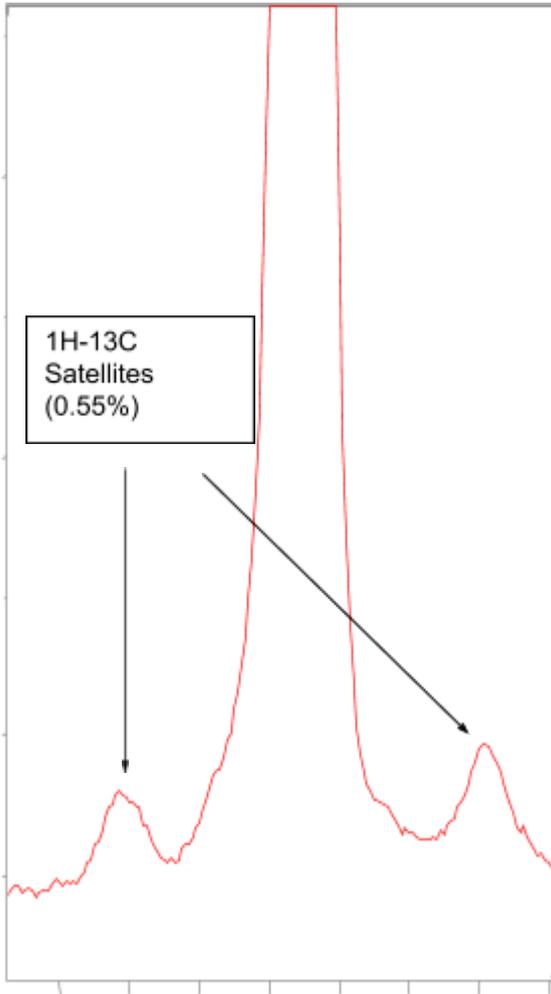
# $^1\text{H}$ Spectra

Cyclohexane in standard process NMR probe TMS.

(Non-Spinning)

Varian samples (black) in deuterated chloroform with

Aspect samples (red) run neat and non-spinning.



## Key Software Features

4IR NMR Software has four principle functions:

1. Control and Interface to NMR Hardware Functions and System diagnostics
2. NMR data acquisition
3. NMR data processing
4. NMR communications

The Lab Client software supports the following features:

Multiple clients on a single machine

Client can select which channel to receive FID from

Configuration selectable channel for shim, RF calibration and frequency lock

In addition, the software supports the following advanced sequences (using graphical editor):

Multi Tx

Multi Rx

Support of tables

Support of shape tables

Simultaneous/overlapping events