



HarbourDom

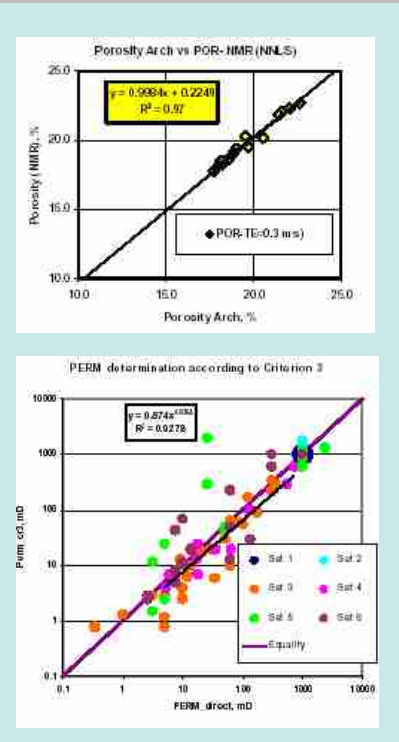
# Magnetic Resonance measurements for Mud Logging (MR – ML™)

New NMR-based approach for evaluating reservoir parameters in real time while drilling

## MR-ML



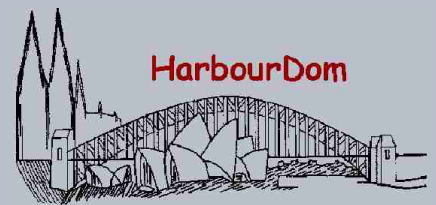
The MR-ML™ Instrument is a compact system with magnet and electronics in a single case



## Overview:

The approach is based on Low Field Nuclear Magnetic Resonance (NMR) measurements and is intended for faster and more reliable identification of hydrocarbon-bearing reservoirs while drilling a well (mud logging). Drill cuttings and micro-samples of hydrocarbons delivered to the surface can be subjected to further detailed petrophysical parameter determination.

The new NMR application provides better results when used in conjunction with conventional techniques.



## MR-ML™

### **Magnetic Resonance** measurements for **Mud Logging (MR – ML™)**

*New NMR-based approach for evaluating reservoir parameters in real time while drilling* KMS Technologies – KJT Enterprises Inc.

and their alliance partner NMR Plus Inc. of Canada have developed new technology to evaluate rock and fluid properties in real time while drilling. The hardware development was done by KMS Technologies' sensor experts while the applications come from NMR Plus Inc.

### **Overview**

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### **Benefits**

- Formation evaluation parameters during mud logging
- NMR log calibration parameters
- Low cost NMR log substitution
- Competitive NMR device and software prices

### **Hardware**

The core of this technology is the new generation magnetic resonance spectrometers that combine the basic specifications of a laboratory low-field relaxometers with some unique features, making the tool (MR-ML™ Instrument) adaptable to a variety of on-site measurements.

*The MR-ML™ Instrument is a compact system with magnet and electronics in a single case*

### **Software, Control, and Interface**

- Windows-based interface
- User friendly
- NMR simulator
- Calibration and Tune Functions



- Bi-modal mode
- Multiple measurement set-up and execution
- Automated measurement sequence

Specification Sheet	MR-ML Instrument
Minimum Time to First Sampling Point on NMR Relaxation Curve, ms	0.16
Maximum Number of Sampling Points on NMR Relaxation Curve	5000
Maximum Duty Cycle of RF Transmitter	10 %
Wait Time, ms	50-40000
NMR Frequency (MHz)	1.5-2
Maximum Sample Size, inches	1.5
S/N, Full Size Water Sample	> 100
Maximum Warm-Up Time, min	< 20
Line Input Power	120 V, 6 A
Operating System	Windows 98, NT, XP
Communications	Parallel Port
Dimensions (can be mounted in 19" cabinets/racks), inches	Width-19, Height/Depth - 10,5
Weight, lb	50

We benchmarked the instruments to verify the estimation errors. The error of estimating the total NMR signal amplitude  $A_s$  depends upon the properties of the rock under study and the accepted measurement mode. The relative error of  $A_s$  for routine measurements is not greater than  $\pm 1.5\%$ . Accuracy of the total porosity (left) and permeability (right) measurements can be seen from the figures, which compare porosity and permeability values obtained by NMR measurements with those resulting from conventional laboratory experiments. Fully water-saturated rock cuttings provide the most preferable condition for evaluating permeability the NMR measurements. The figures demonstrate high coefficients of correlation of MR-ML™ measurements with a conventional method of the porosity and permeability estimations.

