

# Mud Watcher

## Transforming Mud Monitoring



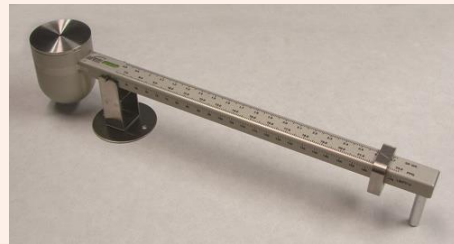
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# Current Situation

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Drilling Fluid Density is manually monitored using a mud balance

- ◆ Periodic testing (15 to 30 minute intervals)
- ◆ Time consuming
- ◆ Requires manual sampling, open to error
- ◆ Data recorded manually
- ◆ No quality assurance



Drilling Fluid Viscosity is determined with a Marsh Funnel

- ◆ Method developed by H.N. Marsh (1931)
- ◆ Indirect viscosity measurement, as volume flowed over time
- ◆ Periodic testing (15 to 30 minute Intervals)
- ◆ Requires manual sampling, open to error
- ◆ Data recorded manually
- ◆ No quality assurance



# Hi Spec and Hi Rate Drilling Needs

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- ◆ To generate frequent measurements of key drilling mud parameters.
- ◆ Identify trends over time is one of stability or change.
- ◆ Provide early warning of changes, e.g., that may indicate developing bore-hole or drilling mud problems that warrant further examination.`

# Mud Watcher – Capability

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- ◆ Continuous monitoring of drilling fluid density and viscosity
- ◆ Monitor at hazardous locations
- ◆ Data is exported as an intrinsically safe analog signal to the rig data acquisition system, mud logging unit, or a dedicated data acquisition system
- ◆ Reduces rig crew exposure to noise and fumes within the shaker house
- ◆ Accurate, reliable, and easy to operate and maintain
- ◆ No requirement for dedicated / specialist service engineers. Operated and maintained by existing rig crews.
- ◆ Releases rig crews for more productive tasks

# Standard Mud Watcher Readings

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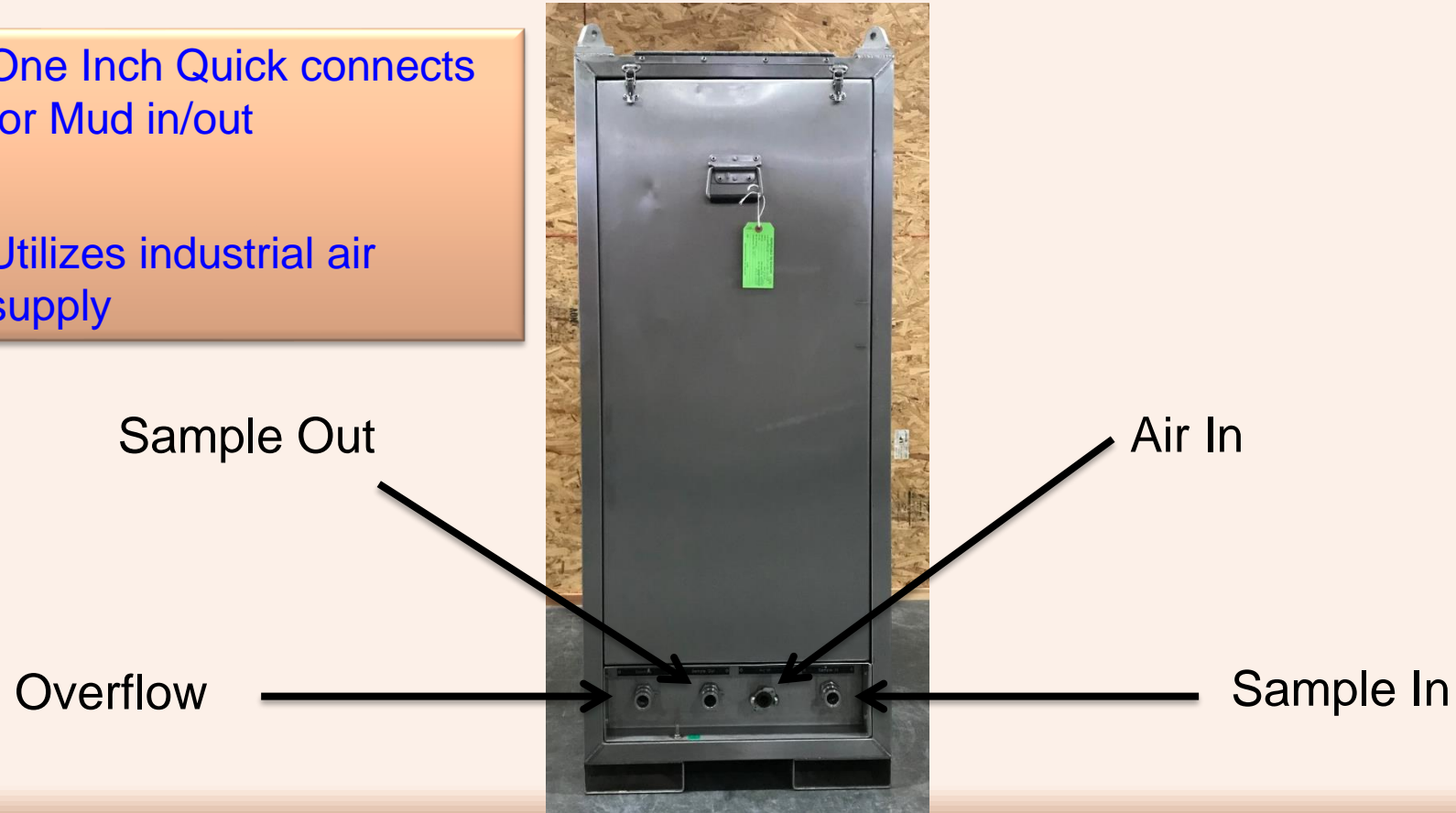
- ◆ Density is an absolute reading which can be displayed in any desired units.
- ◆ Viscosity reading is a dynamic value normally measured in centistokes and is a function of the shear-rate in the sample chamber.
- ◆ Viscosity can be reported as centipoise or centistokes, or in “Funnel Viscosity” equivalent seconds.

# Installation Schematic

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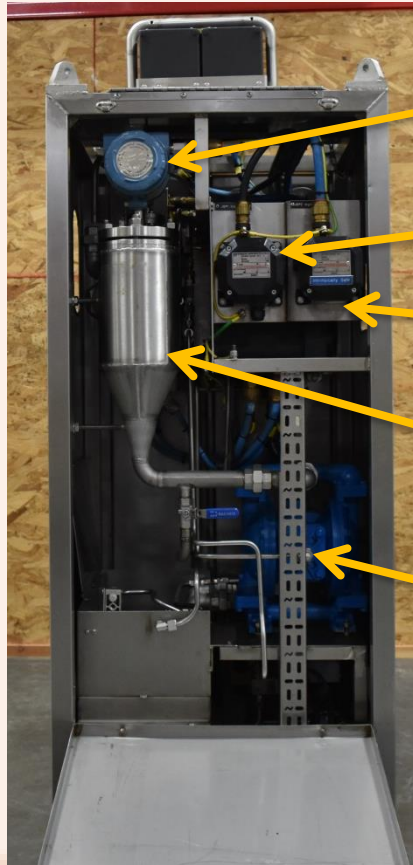
One Inch Quick connects  
for Mud in/out

Utilizes industrial air  
supply



# Mud Watcher Rear View

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Density / Viscosity Instrument

Explosion Proof Power Supply

Digital Data Signal Box

Sample Chamber

Air Diaphragm Pump(s)

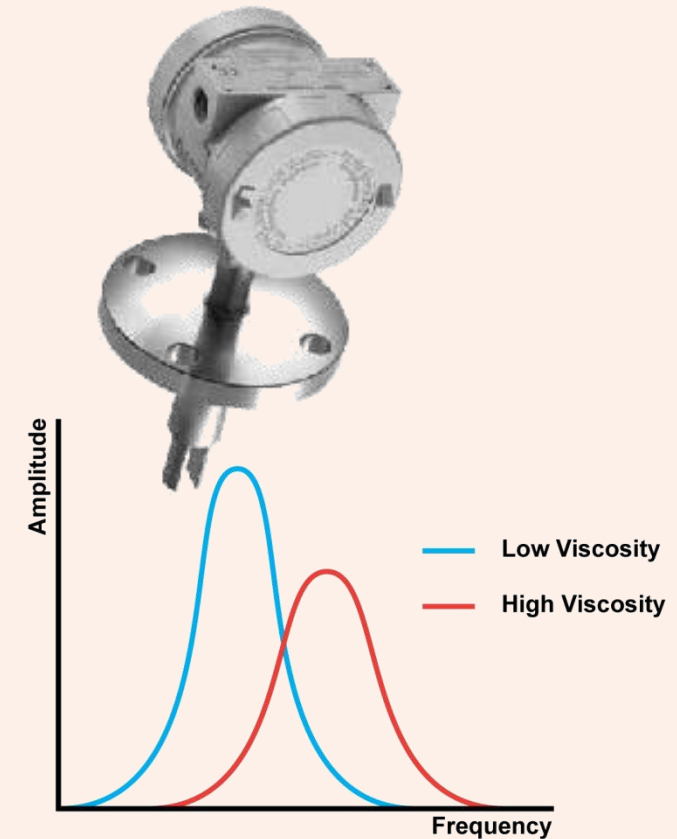


# Mud Watcher Instrumentation

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## ◆ Principle of Operation

- The sensor is a simple tuning fork maintained in vibration electronically.
- The density is a function of the resonant frequency.
- Viscosity is a function of the bandwidth.





# Left and Right Side Access Ports

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Calibration  
Potentiometers



Back Pressure  
Choke Valve

# Mud Watcher Display

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- ◆ Back-lit display ensures high visibility even from a distance
- ◆ Intrinsically-safe, rugged design
- ◆ Folds into mud watcher unit for transportation
- ◆ Remote mounting capability



# UKCS Operation – 12¼” Section

Operation		Drilling from 3,317 ft to 6,373 ft						
Date		1/30/2010		1/31/2010			2/1/2010	
Time		13:30	20:00	02:00	12:30	20:00	02:00	13:00
Depth		3,364	3,750	3,953	4,487	5,021	5,483	6,325
Sample		Pit 3	Pit 3	Pit 3	Pit 3	Pit 3	Pit 3	Pit 3
Manual M.Weight (ppg)		12.6	12.6	12.5	12.5	12.5	12.5	12.5
M.Watcher M.Weight (ppg)	Max	12.6	12.6	12.6	12.5	12.6	12.5	12.5
	Min	12.5	12.6	12.5	12.5	12.6	12.5	12.5
	Avg	12.6	12.6	12.6	12.5	12.6	12.5	12.5
Manual F.Vis (secs)		71	71	66	65	65	58	57
M.Watcher F.Vis (secs)	Max	70	76	81	63	69	62	62
	Min	68	67	64	63	62	62	61
	Avg	69	71	68	63	65	62	61

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# UKCS Operation – 12¼” Section

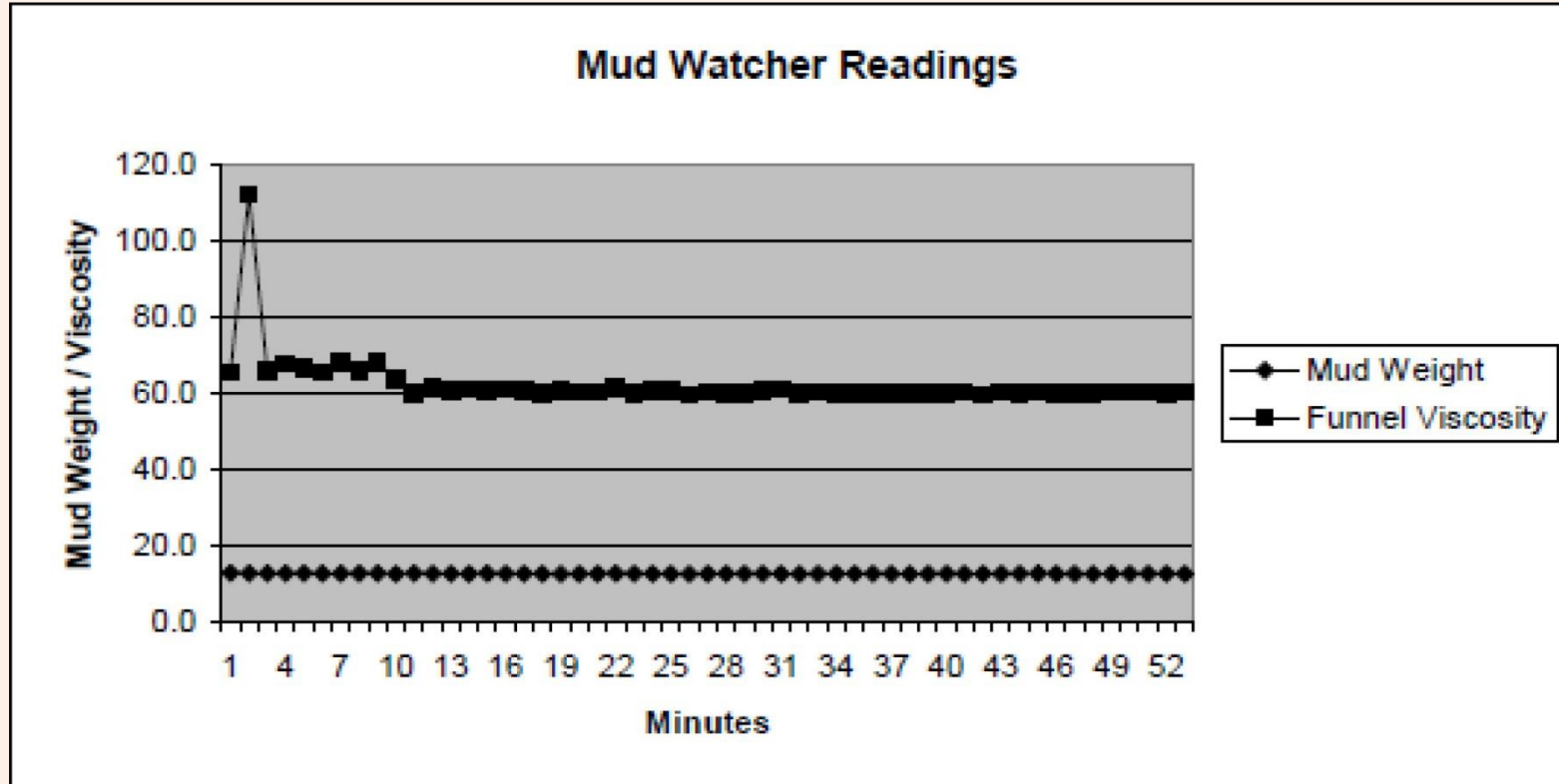
Operation		Drilling from 6,373 ft to 11,291 ft							
Date		2/6/2010		2/7/2010			2/8/2010		
Time		12:30	21:00	02:30	12:30	21:30	04:00	14:30	21:45
Depth		6,989	7,896	8,358	9,488	9,488	10,496	11,045	11,272
Sample		F.Line	F.Line	F.Line	F.Line	F.Line	F.Line	F.Line	F.Line
Manual M.Weight (ppg)		12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
M.Watcher M.Weight (ppg)	Max	12.6	12.6	12.7	12.7	12.5	12.6	12.5	12.6
	Min	12.6	12.5	12.7	12.6	12.5	12.5	12.5	12.5
	Avg	12.6	12.5	12.7	12.6	12.5	12.6	12.5	12.5
Manual F.Vis (secs)		62	63	63	61	62	63	63	63
M.Watcher F.Vis (secs)	Max	62	61	64	67	62	64	63	64
	Min	62	60	63	60	62	63	62	61
	Avg	62	61	64	64	62	63	63	62

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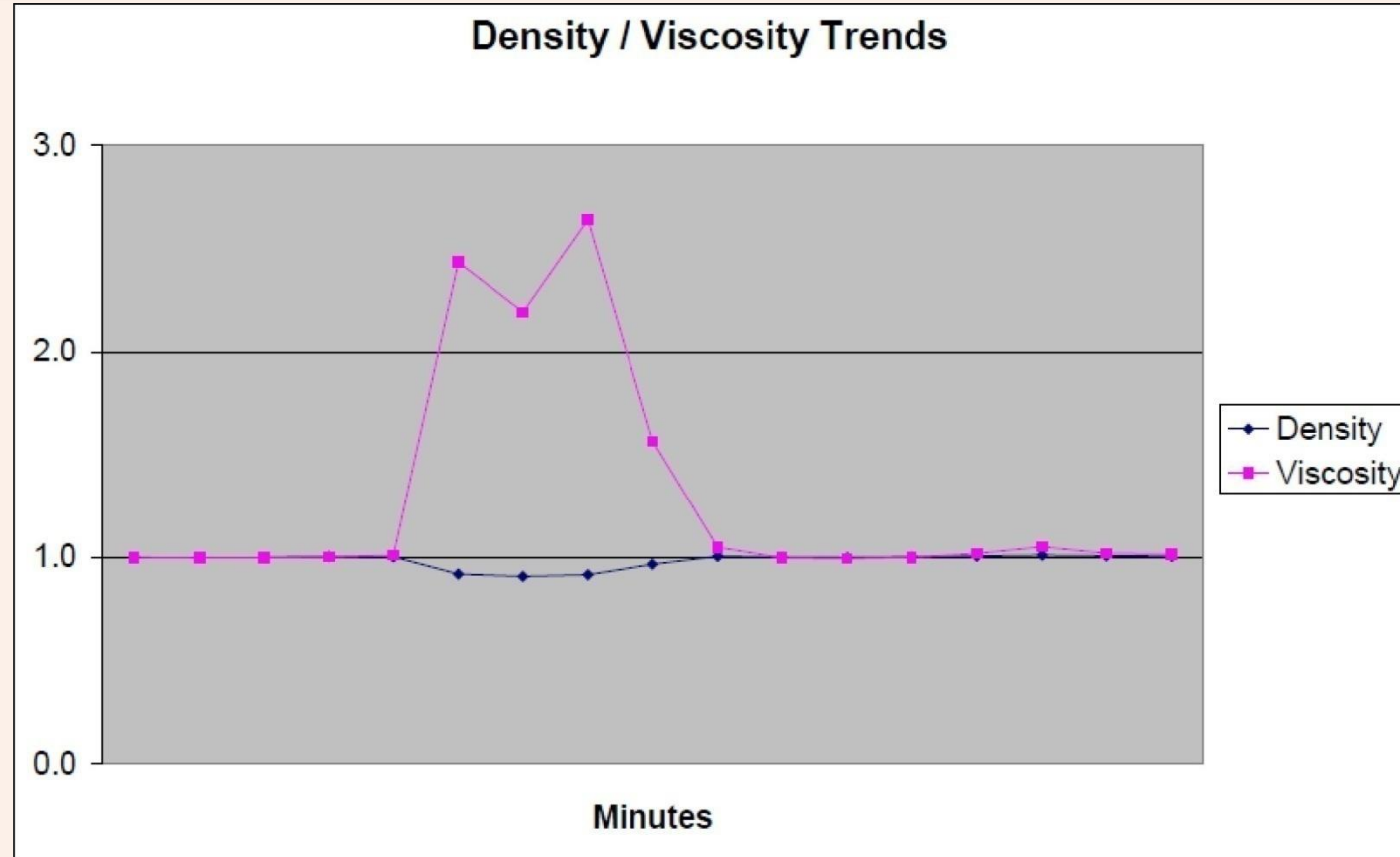


# Drilling Connection Signature

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# Drilling Fluid Treatment Event



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# Specifications / Utilities

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- ◆ Certified for Zone 1 operating environment
- ◆ 85 / 264 Volt, 50 / 60 Hz electrical supply, 2 Amp current
- ◆ 100 – 120 PSI (690 – 872 kPa) rig air supply, 20 – 50 scf/m
- ◆ Flexible or hard piped 1” suction and discharge hoses
- ◆ Back-flushing facility to clear a plugged suction hose



# Specifications / Utilities

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- ◆ Weight: ~ 326 lb (148 kg) – Dry Weight
- ◆ Dimensions: 25" (62 cm) x 25" (62 cm) footprint, 42"/ 60 (107/150 cm) high
- ◆ Maneuvered with forklift or block and tackle

# Correlation to Funnel Viscosity

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- ◆ The correlation between centistokes and Funnel Viscosity is non-linear, so that the reading has to be initially calibrated to match the known measurement using a standard marsh funnel.
- ◆ Further calibration is only required if the drilling fluid properties change substantially, e.g. significantly increasing the density or a major conditioning treatment is carried out.

# Field Experience

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# Field Experience Highlights

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- ◆ Statoil – Brage platform
  - 12 months of continuous use
  - No maintenance call-outs after initial installation period
- ◆ ConocoPhillips – Eldfisk A
  - 10 months of continuous use
  - Hard-piped for multiple sample collection
  - New order placed for Eldfisk B
- ◆ PetroCanada & Maersk Oil & Gas
  - Continuous data capture through mud logging units

# Field Experience Highlights

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- ◆ PetroCanada & Maersk Oil & Gas
  - Continuous data capture through mud logging units
- ◆ ConocoPhillips – Ekofisk M
  - Development of remote operational capabilities for cuttings slurry monitoring
- ◆ GeoDynamics – Australia
  - Additional measurement of WBM pH and conductivity

# Contact Information

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