

# Setting Up Mechanical Specific Energy (MSE)

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Technology

Deployed

Simply



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*Any questions regarding this document or others should be forwarded to the following:*

*Pason Systems Corp.*

*6130 – 3rd Street S.E.*

*Calgary, Alberta T2H 1K4*

*Canada*

*Phone: 1-403-301-3400*

*Fax: 1-403-301-3499*

*Email: [info@pason.com](mailto:info@pason.com)*

*Website: [www.pason.com](http://www.pason.com)*

*For 24-hour support, phone Pason Technical Support toll free: 1-877-255-3158*

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# 1 Overview

This document describes the mechanical specific energy (MSE) setup procedures for rig managers and drillers using Pason's Electronic Drilling Recorder (EDR).

On a drilling rig, MSE refers to the amount of energy required to drill through a volume of rock. There are two types of MSE:

- Actual MSE (MSE)
- Relative MSE (rMSE)

Because it is displayed in specific units (ksi) that are usable in other calculations, engineers and geologists prefer actual MSE. You should always set up an actual MSE trace whenever torque values are available in N m or ft-lbs. Nevertheless, relative MSE (which the EDR displays without a unit of measurement) is still valuable as a trending tool.

You can set up the EDR to calculate an MSE value and display it as a trace. A drilling engineer, driller, or geologist can analyze MSE trends from this trace to identify possible inefficiencies and make adjustments to drilling parameters.

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**Note:**

MSE is not a hands-off trace—if you want the EDR to display MSE, you must perform one of the setup procedures in this document.

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The EDR uses the following values to calculate MSE:

- Torque
- Weight on bit (WOB)
- Rate of penetration (ROP). Instantaneous ROP and Overall ROP are not used in MSE calculations.
- Revolutions per minute (RPM)
- Bit diameter
- Total RPM (mud motor RPM + rotary RPM), if a mud motor is in use

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**Important:**

You *must* maintain accurate calibration of torque and WOB at all times and enter changes to bit diameter and mud motor specifications in the EDR. Failure to do so results in inaccurate MSE values.

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## 2 The Importance of Torque Calibration in MSE

Torque is a critical part of how the EDR calculates MSE. Simply put, your MSE value is only as good as your torque value—actual torque is needed for actual MSE, and relative torque is needed for relative MSE.

On rigs not using a mud motor, there are three ways to measure torque:

- A Pason sensor supplies *relative* torque measurements (in psi for hydraulic drives, or in amps for electric drives) to the EDR. A Pason torque sensor can only measure relative torque.
- A Pason sensor supplies *relative* torque measurements to the EDR, which is calibrated to a non-Pason sensor measuring *actual* torque (in N m or ft-lb).
- A third-party sensor supplies *actual* torque measurements (in N m or ft-lb) directly to the EDR.

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**Important:**

When configuring torque, ensure that the units you select in the EDR match the units of the data from the torque sensor. If those units are not available for selection, you must convert them into units that the EDR supports.

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On rigs using a mud motor, the EDR also uses the motor specifications to calculate MSE. Because this can be confusing, the next section, [Determining the Right Setup Procedure](#), provides you a simple way to choose your MSE setup.

## 3 Determining the Right Setup Procedure

Find the set of statements in the table below that best describes your situation, then use the indicated procedure to set up MSE on your rig.

If...	...use this procedure to set up MSE
1. My rig uses a mud motor. 2. I know the mud motor's <ul style="list-style-type: none"> <li>· maximum differential pressure</li> <li>· maximum torque</li> <li>· speed-to-flow ratio</li> </ul>	<a href="#">Procedure 1</a>
1. My rig uses a mud motor. 2. I only know the mud motor's speed-to-flow ratio. 3. Torque is calibrated in psi or amps.	<a href="#">Procedure 2</a>
1. My rig uses a mud motor. 2. I do not know the mud motor's specifications.	The EDR cannot calculate MSE or rMSE. Use <a href="#">Procedure 5</a> to disable MSE in the EDR.
1. My rig does not use a mud motor 2. Torque is calibrated in N m or ft-lb	<a href="#">Procedure 3</a>
1. My rig does not use a mud motor 2. Torque is calibrated in psi or amps	<a href="#">Procedure 4</a>

Table 1: Factors for determining your MSE setup procedure

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**Tip:**

You can obtain the mud motor's speed-to-flow ratio, maximum rated torque, and maximum rated differential pressure from the mud motor's specifications, or from the mud motor's supplier.

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### 3.1 Recommended ROP Setting for MSE

The EDR's MSE calculations use the rate of penetration (ROP) trace, which has an averaging window that you can adjust. When using MSE, Pason recommends setting the ROP averaging window to Automatic. Before you configure MSE, check ROP settings: on the DHC or on a Rig Display in Drilling mode, make sure the averaging window is set to Automatic under **Menu > Setup > Calibrate > ROP**.

## 4 Procedure 1: When Using a Mud Motor and All Mud Motor Specifications are Known

Follow the procedure below on the DHC or Rig Display to set up actual MSE:

1. On the main screen, add the MSE trace to your trace order, then select it. The MSE settings window opens.

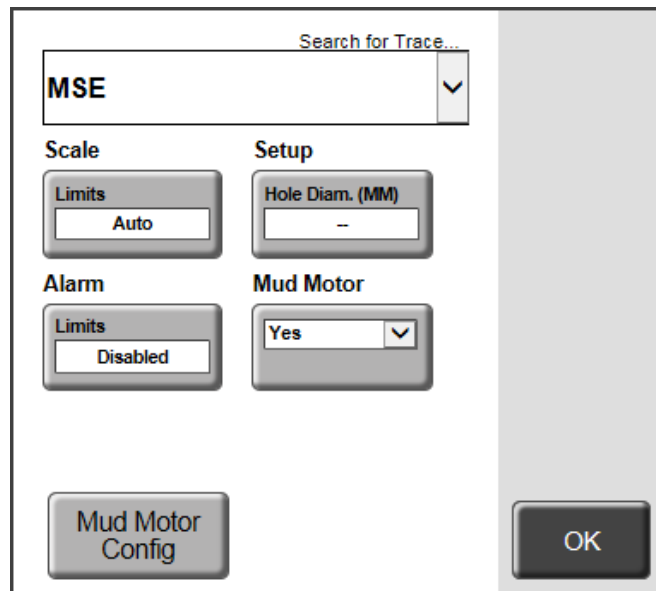


Figure 1: MSE settings window

2. Select the **Hole Diam** button, enter the hole diameter, then press **OK**.

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**Tip:**

Normally, the hole diameter is the same as the current bit diameter.

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3. Select the **Mud Motor** button, then select Yes to confirm that you are using a mud motor.
4. Select **Mud Motor Config**. The Mud Motor screen opens.

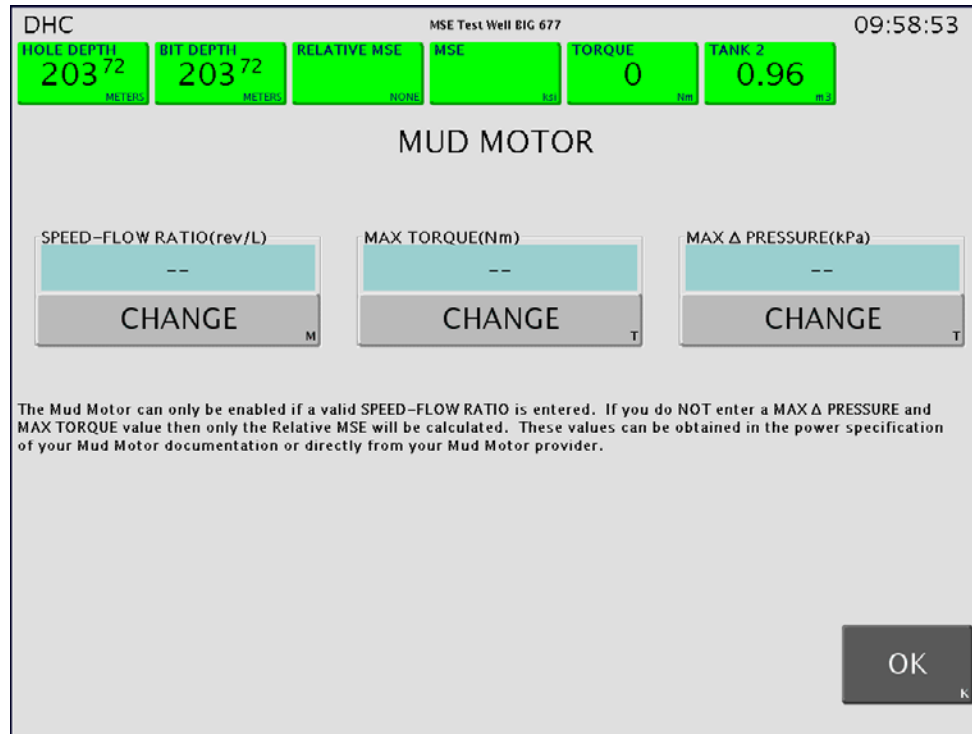


Figure 2: Mud Motor screen

5. Under Speed-Flow Ratio, select **Change**. Enter the mud motor's speed-flow ratio in rev/L (rev/gal). Press **OK** to confirm.
6. Under Max Torque, select **Change**. Enter the mud motor's maximum torque in Nm (ft-lbs). Press **OK** to confirm.
7. Under Max  $\Delta$  Pressure, select **Change**. Enter the mud motor's maximum differential pressure in kPa (psi). Press **OK** to confirm.
8. Select **OK** to return to the main screen. The EDR calculates actual MSE and displays it in the MSE current reading box in ksi units.

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**Note:**

This setup doesn't require calibrated torque, but if you calibrate torque in relative units, the EDR will show a calculated value for rMSE as well as MSE. If you calibrate torque in actual units, the EDR will only show 0.0 in the rMSE reading box.

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## 5 Procedure 2: When Using a Mud Motor and Only the Mud Motor's Speed-to-Flow Ratio is Known

Follow the procedure below on the DHC or Rig Display to set up relative MSE:

1. Ensure that actual or relative torque measurements are being sent to the EDR, and that torque is properly calibrated in Nm or ft-lbs (for actual torque), or in psi or amps (for relative torque).
2. On the main screen, add the MSE trace to your trace order, then select it. The MSE settings window opens ([Figure 1](#)).
3. Select the **Hole Diam** button, enter the hole diameter, then press **OK**.

---

**Tip:**

Normally, the hole diameter is the same as the current bit diameter.

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4. Select the **Mud Motor** button, then select Yes to confirm that you are using a mud motor.
5. Select **Mud Motor Config**. The Mud Motor screen opens ([Figure 2](#)).
6. Under Speed-Flow Ratio, select **Change**. Enter the mud motor's speed-flow ratio in rev/L (rev/gal). Press **OK** to confirm.

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**Note:**

The Max Torque and Max  $\Delta$  Pressure displays must read -- or 0 in this setup. If they do not, press the **Change** button under Max Torque and Max  $\Delta$  Pressure and enter 0.

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7. Press **OK** to return to the main screen. The EDR calculates relative MSE, and displays it in the Relative MSE trace box in generic units.

## 6 Procedure 3: When *Not* Using a Mud Motor and Torque is Calibrated in Actual Units

Follow the procedure below on the DHC or Rig Display to set up actual MSE:

1. Ensure that non-Pason sensors are measuring actual torque, and that torque is properly calibrated in Nm or ft-lbs, or that the non-Pason sensor is wired directly to the EDR system.
2. On the main screen, add the MSE trace to your trace order, then select it. The MSE settings window opens ([Figure 1](#)).
3. Select the **Hole Diam** button, enter the hole diameter, then press **OK**.

---

**Tip:**

Normally, the hole diameter is the same as the current bit diameter.

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4. Select the **Mud Motor** button, then select No to confirm that you are not using a mud motor.
5. Select **OK** to return to the main screen. The EDR calculates actual MSE, and displays it in the MSE trace box in ksi units.

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**Note:**

In this setup, the EDR shows a calculated value in the MSE reading box and 0.0 in the rMSE reading box.

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## 7 Procedure 4: When *Not* Using a Mud Motor and Torque is Calibrated in Relative Units

Follow the procedure below on the DHC or Rig Display to set up relative MSE:

1. Ensure that Pason sensors are sending relative torque measurements to the EDR, and that torque is properly calibrated in psi for hydraulic drives, or in amps for electric drives.
2. On the main screen, add the MSE trace to your trace order, then select it. The MSE settings window opens ([Figure 1](#)).
3. Select the **Hole Diam** button, enter the hole diameter, then press **OK**.

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**Tip:**

Normally, the hole diameter is the same as the current bit diameter.

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4. Select the **Mud Motor** button, then select No to confirm that you are not using a mud motor.
5. Select **OK** to return to the main screen. The EDR calculates relative MSE, and displays it in the Relative MSE trace box in generic units.

## 8 Procedure 5: Disabling MSE

Follow the procedure below on the DHC or Rig Display to disable the MSE calculation.

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**Tip:**

When conditions on the rig change, or if you are not confident in your calibrations, it is a good idea to disable MSE until you sort out the situation. If not, others monitoring the EDR will see an inaccurate MSE value.

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1. Select the **MSE** current reading box. The MSE settings window opens ([Figure 1](#)).
2. Select the **Hole Diam** button, enter a value of 0, then press **OK**.
3. Select **OK** to return to the main screen. The EDR stops displaying all MSE values