

GEK 100814

Instructions

PowerDrill 2000
Rig Drive System

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OPERATING PROCEDURES

The procedures outlined below are for normal, day-to-day operation of the PowerDrill 2000 rig drive system, including rig start up, operation, and shut down.

These procedures assume a rig drive system with typical options installed. Your system may have some of the controls or indicators mentioned. In addition, rig drive systems vary in the number of generators, generator controls, power control panels, and motors. Disregard any steps that do not apply to your rig drive system.

RIG START UP

This procedure describes how to start up a typical PD2000 rig drive system, assuming that the rig, drive system, generators, and engines have been properly installed and checked out.

1. Preliminary steps:
 - a. Ensure that the power plant shutdown and emergency stop switches on the driller's console are pulled out.
 - b. Position the battery module power switch on the ON position.
 - c. Ensure that the engine control switch for the generator being started is in the IDLE position.
2. Start the desired engine and follow the manufacturer's recommended warm up procedures before continuing with the following steps. (The following steps assume that generator 1 is being brought on line first, followed by generator 2.)
3. Set the synchronizing switch to GEN 1.
4. Set the generator 1 engine control switch to RUN. No faults should be displayed by the generator 1 engine/generator regulator (EGR). Check that the generator voltmeter for generator 1 reads 600 volts.
5. Set the frequency switch on the synchronizing control to GEN 1. Push the speed INCR or DECR buttons on the EGR until the frequency meter reads 60 Hertz.
6. Set the generator 1 engine control switch to LOAD.
7. Charge the generator breaker and press the breaker close switch to bring the generator on line to the AC thru bus. The GEN ON light should come on.
8. Close the lighting transformer circuit breaker and the motor control center circuit breaker. Start the essential motors (i.e., air compressors, fuel pumps, radiator fans, etc.) from the motor control center.
9. Start the generator 2 engine according to the instructions in steps 1 through 6 above. Check the generator voltmeter for generator 2 and make sure it reads 600 volts.
10. You will now use the synchroscope to synchronize the output frequency of the two generators before you bring generator 2 on line. The synchroscope indicates whether the output frequency of the generator selected by the synchronizing switch is higher or lower than the output frequency of the generator already on line. Set the synchronizing switch on the synchronizing panel to GEN 2. Increase or decrease the speed on the generator 2 engine/generator regulator until the synchroscope needle is rotating slowly in a clockwise direction (about one revolution every 15 seconds).
11. Charge the main generator breaker for generator 2.
12. Watch the synchroscope and press the breaker close switch just before the rotating needle reaches the twelve o'clock position. This brings generator 2 on line to the AC bus. The GEN ON light should come on.
13. The meters on the generator 2 engine/generator control panel will now indicate Generator 2 voltage, current, and power. The values on these meters should be the same for all other on-line generators.
14. If your rig uses three or more generators, repeat steps 9 through 13 for the additional engine/generator sets.

15. Check that the AC disconnect switch on the front of each power control panel is closed to provide AC power to the SCRs and control logic. At this point, the display on the drive should not be indicating any faults and the SCRs ready to be selected.

16. Energize the appropriate auxiliary motor starters from the motor control center. These would include drill motor blowers, mud pump oiler motors, and so forth. These motors will start automatically when the drilling motor assignments are made from the driller's console. Drilling motor cut-out switches must be un-pinned before the drive will operate.

The rig drive system is now ready for operation.

RIG OPERATION

Once the rig drive system has been started, the drilling motors are controlled from the driller's console and mud pump console. The operator will seldom need to concern himself with the control equipment.

Most operations can be broken down into four types of activities:

- Making motor selections(including alternate assignments)
- Controlling motor speed and direction
- Monitoring rig operation
- Correcting operating problems

These activities are described below. As we describe each activity, refer to Figure 1 and Figure 2.

MAKING MOTOR SELECTIONS AND CONTROLLING MOTOR SPEED/DIRECTION

The selection pushbuttons on the driller's console are used to enable SCR power converters for various drilling functions and directions. Each selection button represents a specific drilling function; for example, mud pump #1, the drawworks, or the rotary table.

Alternate Assignment (Optional)

If your rig contains the alternate assignment feature, there will be an alternate assignment pushbutton on the driller's console. The alternate assignment option allows the driller to use a single power conversion panel for more than one drilling function. The most common alternate assignment is to use the drawworks "B" power conversion panel to power the drawworks "B" motor(normal) or the rotary table motor (alternate assignment).

Using the drawworks "B" alternate assignment option described above as an example, a typical alternate assignment operation is as follows. In the normal mode, the drawworks "B" power conversion panel will supply power to the drawworks "B" motor. In the alternate assignment mode, the drawworks "B" power conversion panel will supply power to the rotary table and the drawworks "B" motor will be disabled. The mode of operation is selected using the alternate assignment pushbutton on the driller's console. After selection of alternate assignment all controls, indicators, and auxiliaries will operate normally for the alternate motor.

CONTROLLING MOTOR SPEED AND DIRECTION

The driller's console is the main control center for all rig motors. The driller can control both motor speed and direction with the motor INC/DEC pushbuttons and selection pushbuttons.

Mud Pump

The driller selects a mud pump by pushing the proper mode and motor selection pushbuttons. The pump is then controlled using the corresponding speed control pushbuttons. If the rig has an optional mud pump console, the driller can transfer control of the mud pump to that console by pressing the REM pushbutton. With the remote light on, the in control light on the mud pump console will light. The mud pumps are ready to run from the remote console.

Under normal operating conditions, two motors on the mud pump share the pumping load. If one-motor operation is required, the motor not in use should be de-selected. When this is done, the drive system will automatically recalibrate the current limit on the remaining motor, allowing that motor to supply more power than it would under two-motor operation.

Drawworks

The drawworks are controlled from the driller's console only. The driller controls the drawworks using the selection pushbutton and speed control. The selection and direction pushbuttons enable operation of the motor in either the forward (FWD) or reverse (REV) direction. The FWD direction is default and enables regenerative braking of the drawworks motors. Regenerative braking is a method of slowing down a motor by pumping its energy back into the AC power system, thus allowing the motor to decelerate more rapidly.

Drawworks motor speed is controlled by either a pushbutton or foot throttle at the driller's console. Usually, cathead speed is set with the pushbutton speed control and hoist speed is controlled with the foot throttle. Deselection of a drawworks motor can be done at the driller's console.

Rotary Table

The rotary table is driven by its own motor, which is controlled by a selection pushbutton and INC/DEC speed control on the driller's console. The rotary table torque limit control is used to limit the torque applied to the drill string. This torque limit also limits cathead torque. This system allows the driller to control cathead torque.

The rotary table may be chain-driven and clutched off the drawworks motors. In this cases, the driller uses the drawwork selection pushbutton and speed control to control the rotary table. Clutching determines the correct current limit value for drawworks or rotary table operation. Whenever the drawworks is unclutched, the rotary table torque limit controls cathead and rotary torque.

MONITORING RIG OPERATION

These are three displays on the console that can be monitored during rig operation.

Make a habit of occasionally scanning the console display to ensure proper rig operation and early detection of problems.

Should any system problem occur, the audible alarm will sound, unless the alarm silence pushbutton light is ON. Leave the silence pushbutton OFF unless you need to silence an active alarm while you fix a problem.

Before starting a drilling operation or making a function change, the driller should check the following things:

1. Are the correct number of generators on line?
2. Are all selections made properly and are the correct motor select lights on?
3. Is the rotary table torque limit control set according to the drill pipe grade and diameter?
4. Is the drawworks selected in the correct direction (REV)?

CORRECTING OPERATING PROBLEMS

Two common operating problems are described below along with suggestions for correcting them:

Insufficient Rig Power - If the speed of all DC motors decreases and the high load alarm goes off, there are not enough engines/generators on-line to support the heavy drilling load. Should this occur, the load must be reduced or an additional generator brought on line.

Insufficient RT Torque - If only the rotary table's speed decreases, the torque limit set by the rotary table torque limit control has been reached. Ensure that the limit control is set properly for the type of pipe being used. If the setting is correct, you must reduce the torque requirements. There may be too much weight on the bit or the wrong gear may have been selected.

RIG SHUT DOWN

This procedure describes how to completely shut down the PowerDrill, 2000 rig drive system in preparation for power off maintenance or moving of the rig.

1. Stop all motors from the driller's console. De-select all motors.
2. Stop all non-essential loads.
3. Turn the engine control switch on the EGR to the RUN position. This unloads the engine. Turn the generator circuit breaker to the OFF position. Repeat this step for each generator.
4. Turn the engine control switch on each EGR to the IDLE position. After the manufacturer's recommended idle time, turn the engine control switch to the OFF position.
5. Turn the battery module power switch to the OFF position.
If permissives are met, 'Mode' key lights will be flashing to indicate ready state.

INTELLIGENT DRILLER'S CONSOLE (IDC) FUNCTIONS**To Select Mud Pump /Super Charger Combination:**

- Push a MP 'Mode' key:
 - 'Mode' key light will light to indicate which MP is selected.
 - 'Super Chgr' keys will begin to flash to indicate which ones are ready for selection.
- Push desired 'Super Chgr'key(s):
 - 'Super Chgr' key will light.
 - Selected Super Charger will now start and stop with selected Mud Pump.
 - If a Super Charger is already selected to run with a certain MP, its key light will not be flashing when the other MP 'Mode' key is lit.

To Select a Drive/Motor combination:

- Push 'Mode' key:
 - 'Mode' key light will light to indicate mode is selected.
 - 'Mtr' keys will begin to flash to indicate they are ready for selection.
- Push desired 'Mtr' key(s):
 - 'Mtr' key will light.
 - Selected drive will start auxiliaries and blower, energize motor field, etc.
 - When all permissives are satisfied. The 'Opr' keys will begin to flash to indicate drive is ready to run.
 - Diagnostic Display will show drive reference setpoint.

To run motor(s):

- Push 'INC' to increase drive reference.
- Push 'DEC' to decrease drive reference.

To stop motor(s):

- Select desired motor set by pushing 'Mode' key.
- Push 'Stop' Function key to reduce reference to zero.

To reverse motor:

- Motor must be stopped and drives deselected. If not, complete 'Stop' and 'De-selection' procedure.
- 'REV' key light should be flashing to indicate okay to reverse. Push 'REV' key. Key light will go on.
- Push 'Mtr' Function key(s) to select motor(s) for reverse operation.

To De-select a Drive/Motor combination:

- Motor must be stopped. If not, complete 'Stop' procedure.
- Push 'Mode' key:
 - 'Mode' key light will light to indicate mode is selected.
 - Selected 'Mtr' key(s) will be lit to indicate motor(s) presently selected.
- Push the lighted 'Mtr' key(s):
 - SCR drive will De-select by stopping auxiliary and blower, de-energizing motor field, etc.
 - 'Mtr' key(s) will begin to flash to indicate they are ready for selection.

To De-Select Mud Pump /Super Charger Combination:

- Push MP 'Mode' key:
 - 'Mode' key light will light to indicate which MP is selected.
 - Selected 'Super Chgr' keys will be lit to indicate which ones are presently selected.
- Push desired 'Super Chgr' key(s):
 - 'Super Chgr' key will light will begin to flash.
 - This Super Charger is now free to be selected to either Mud Pump.

To Set Rotary Current Limit:

- Push 'Rotor Cur Limit' key.
 - 'Rotor Cur Limit' key light will go on.
 - Diagnostic Readout will display Rotary Current Limit Value of (0 to 100 %LMT).
- Press 'INC' key to increase current limit.
- Press 'DEC' key to decrease current limit.
 - Selecting a different 'Mode' key will cause the 'Rotor Cur Limit' key light to go out.

System Alarm Indication:

- If a fault occurs, 'Alarm' light will come on.
- Press 'System Alarm' key, then small 'Escape/clear' key, then small 'Enter/select' key, then small 'Inc' key to scroll through fault messages on the diagnostic display.
- To leave diagnostic mode, press 'Escape/clear' twice and 'Enter/select' once. Display will show drive references again.

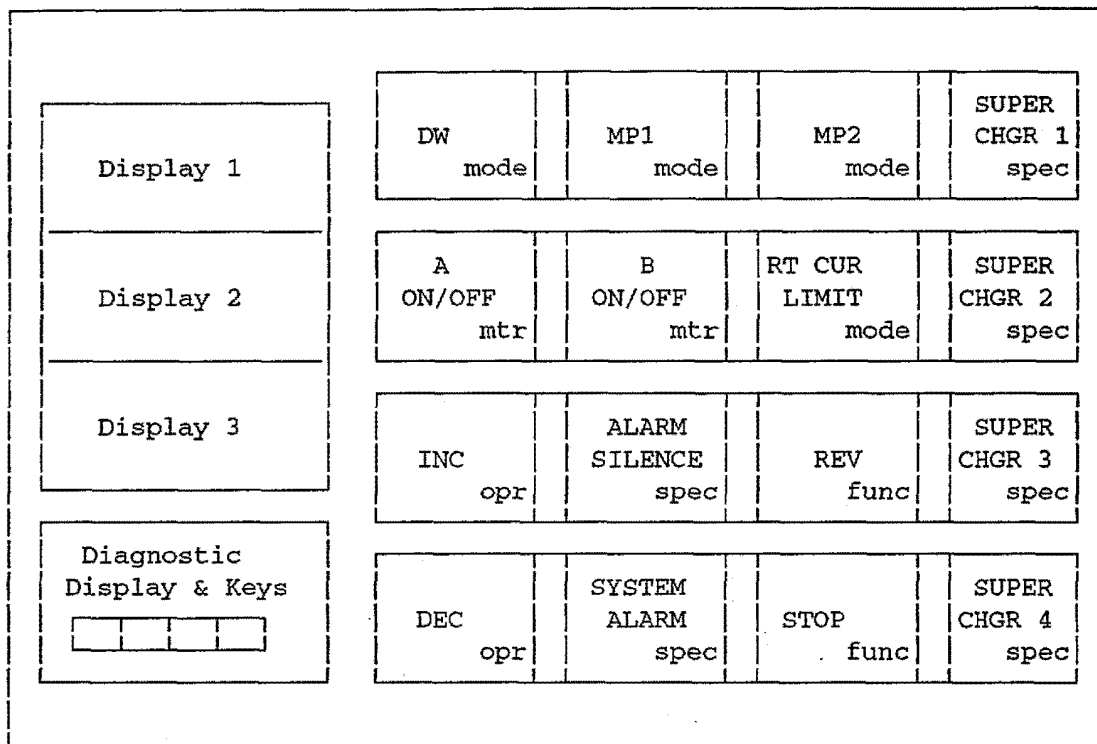


Figure 1. Intelligent Driller's Console (IDC).

Mode Keys:

DW Drawworks
 MP1 Mudpump 1
 MP2 Mudpump 2
 RT CUR LIMIT Rotary Current Limit

Mtr (motor selection) Keys:

A ON/OFF Selects motor A to run for the present 'Mode'
 B ON/OFF Selects motor B to run for the present 'Mode'

Func (function) Keys:

Reverse Selects reverse direction for the present 'Mode'
 Stop Stops motor(s) for the present 'Mode'

Spec (special function) Keys:

Super Chgr 1 Assigns Super Charger 1 to either MP1 or MP2
 Super Chgr 2 Assigns Super Charger 2 to either MP1 or MP2
 Super Chgr 3 Assigns Super Charger 3 to either MP1 or MP2
 Super Chgr 4 Assigns Super Charger 4 to either MP1 or MP2

Alarm Indicates a problem has occurred in system
 Alarm Silence Button will silence Alarm horn

Opr (operation) Keys:

Inc Increase Reference or Current Limit
 Dec Decrease Reference or Current Limit

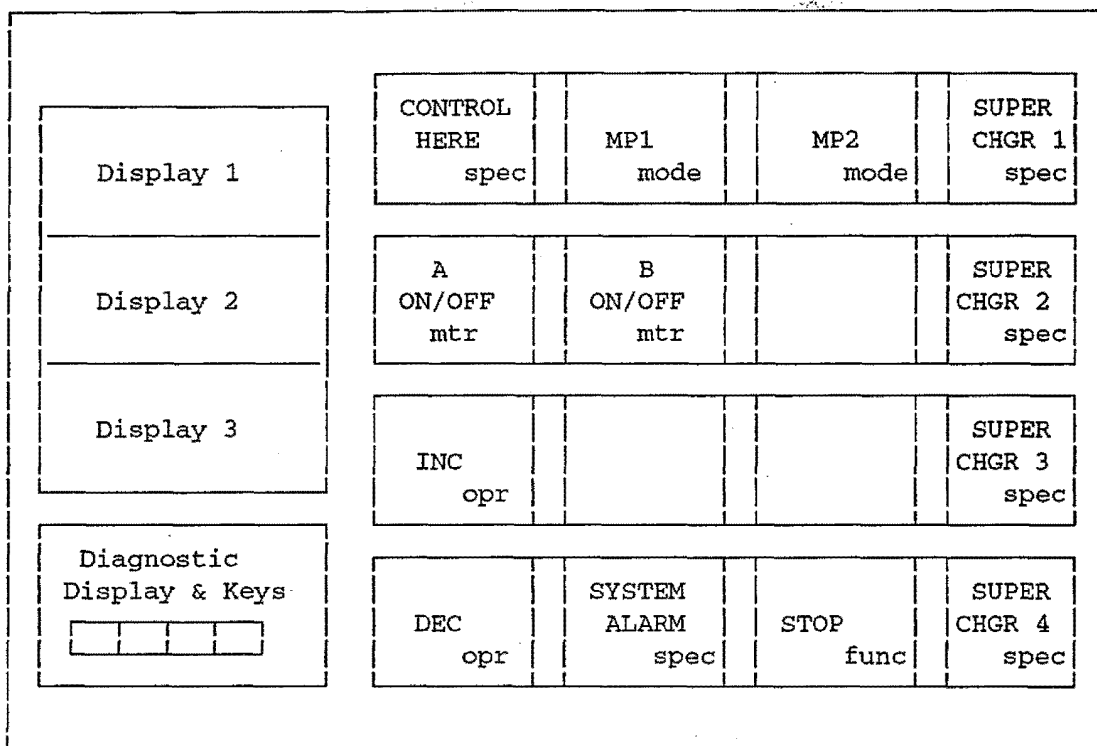


Figure 2. Mud Pump Console.

Mode Keys:

MP1 Mudpump 1
MP2 Mudpump 2

Mtr (motor selection) Keys:

A ON/OFF Selects motor A to run for the present 'Mode'
B ON/OFF Selects motor B to run for the present 'Mode'

Func (function) Keys:

Stop Stops motor(s) for the present 'Mode'

Spec (special function) Keys:

Super Chgr 1 Assigns Super Charger 1 to either MP1 or MP2
Super Chgr 2 Assigns Super Charger 2 to either MP1 or MP2
Super Chgr 3 Assigns Super Charger 3 to either MP1 or MP2
Super Chgr 4 Assigns Super Charger 4 to either MP1 or MP2

Control Here Enables Mud Pump Console operation of MP's

System Alarm Indicates a problem has occurred in system

Opr (operation) Keys:

Inc Increase Reference or Current Limit
Dec Decrease Reference or Current Limit

INTELLIGENT MUD PUMP CONSOLE (MPC) FUNCTION

If permissives are met, 'Mode' key lights will be flashing to indicate ready state.

To Enable Mud Pump Console:

Caution: This function will take control of Mud Pumps away from Driller's Console. Be sure Driller is informed before using this function.

- Push 'Control Here' key.
 - 'Control Here' key will light to indicate Mud Pump Console in control of Mud Pump operation.
 - 'Mode' keys should now be flashing.

To Disable Mud Pump Console:

- Push 'Control Here' key.
 - 'Control Here' key light will go off indicate that Driller's Console is in control of Mud Pump operation.
 - 'Mode' keys should now be off.

To Select Mud Pump /Super Charger Combination:

- Push 'Mode' key:
 - 'Mode' key light will light to indicate which MP is selected.
 - 'Super Chgr' keys will begin to flash to indicate which ones are ready for selection.
- Push desired 'Super Chgr' key(s):
 - 'Super Chgr' key will light.
 - Selected Super Charger will now start and stop with selected Mud Pump.
 - If a Super Charger is already selected to run with a certain MP, its key light will not be flashing when the other MP 'Mode' key is lit.

To Select a Drive/Motor combination:

- Push 'Mode' key:
 - 'Mode' key light will light to indicate mode is selected.
 - 'Mtr' keys will begin to flash to indicate they are ready for selection.
- Push desired 'Mtr' key(s):
 - 'Mtr' key will light.
 - Selected drive will start auxiliaries and blower, energize motor field, etc.
 - When all permissives are satisfied. The 'Opr' keys will begin to flash to indicate drive is ready to run.
 - Diagnostic Display will show drive reference setpoint.

To run motor(s):

- Push 'INC' to increase drive reference.
- Push 'DEC' to decrease drive reference.

To stop motor(s):

- Select desired motor set by pushing 'Mode' key.
- Push 'Stop' Function key to reduce reference to zero.

To De-select a Drive/Motor combination:

- Motor must be stopped. If not, complete 'Stop' procedure.
- Push 'Mode' key:
 - 'Mode' key light will light to indicate mode is selected.
 - Selected 'Mtr' key(s) will be lit to indicate motor(s) presently selected.
- Push the lighted 'Mtr' key(s):
 - SCR drive will De-select by stopping auxiliary and blower, de-energizing motor field, etc.
 - 'Mtr' key(s) will begin to flash to indicate they are ready for selection.

To De-Select Mud Pump /Super Charger combination:

- Push 'Mode' key:
 - 'Mode' key light will light to indicate which MP is selected.
 - Selected 'Super Chgr' keys will be lit to indicate which ones are presently selected.
- Push desired 'Super Chgr' key(s):
 - 'Super Chgr' key will light will begin to flash.
 - This Super Charger is now free to be selected to either Mud Pump.

System Alarm Indication:

- If a fault occurs, 'Alarm' light will come on.
- Press 'System Alarm' key, then small 'Escape/clear' key, then small 'Enter/select' key, then small 'Inc' key to scroll through fault messages on the diagnostic display.
- To leave diagnostic mode, press 'Escape/clear' twice and 'Enter/select' once. Display will show drive references again.