



SECTION 3: OPERATING INSTRUCTIONS

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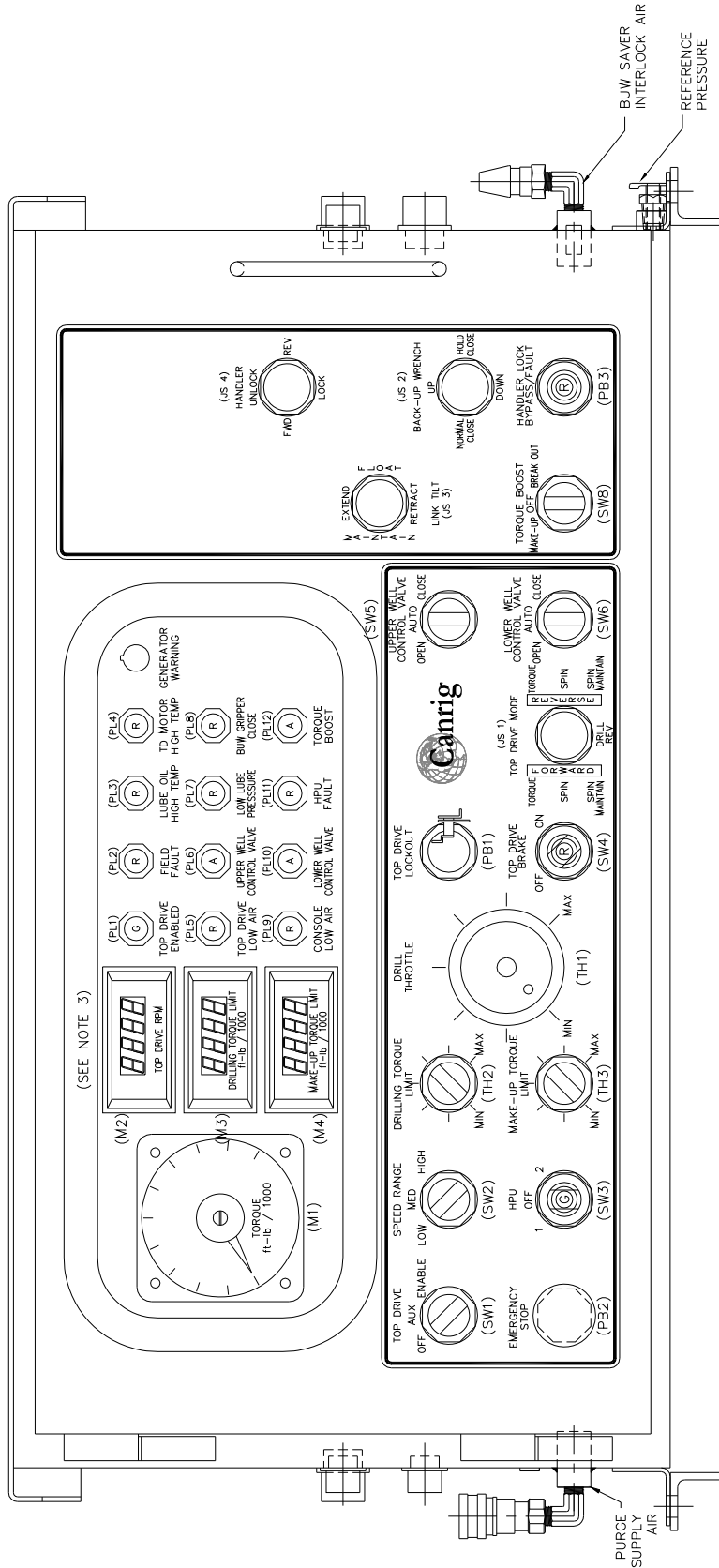
Canrig Model 1250AC-681 Top Drive

SUBSECTION 3A: TOP DRIVE OPERATION

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Typical Control Console

Figure 3.1



Top Drive Console Operating Instructions

Canrig Model 1250AC-681 Top Drive

With GE B20 AC Motor

Refer to Top Drive Console Illustration, Figure 3.1

TOP DRIVE LOCKOUT SWITCH (PB 1)	
DEPRESSED	<ul style="list-style-type: none">Shuts off all electrical power to the top drive and disables all Top Drive functions.
RELEASED	<ul style="list-style-type: none">Normal Top Drive operation.

EMERGENCY STOP SWITCH (PB 2)	
DEPRESSED	Shuts off all electrical power to the top drive and disables all Top Drive functions by: <ul style="list-style-type: none">tripping the VFD (Variable Frequency Drive) breaker on Canrig supplied VFD unitstripping the feeder breaker at the CIP panel or Transfer panel.
PULLED - OUT	<ul style="list-style-type: none">Normal Top Drive operation.

Canrig Model 1250AC-681 Top Drive

OFF - AUX - ENABLE (SW 1)	
OFF	<ul style="list-style-type: none"> Disables operation of the Top Drive.
AUX	<ul style="list-style-type: none"> Power is supplied to the Top Drive for auxiliary functions but no power is available to the Top Drive motor. There is a 5 second alarm test sequence when AUX is first selected. This position is normally used for tripping operations.
ENABLE	<ul style="list-style-type: none"> The VFD (Variable Frequency Drive) is enabled making power available to the Top Drive motor. Power is available for auxiliary functions. There is a 5 second alarm test sequence when ENABLE is selected. The Top Drive blower will start when the internal motor temperature reaches 30 ° C and remain on as long as the internal motor temperature is above 20 ° C. If the internal motor temperature drops below 20 ° C, the blower will shut off. The Top Drive lube pump will start. The Top Drive lube cooler will start after a 30 minute delay. If the Top Drive has been OFF for less than 120 minutes, the cooler will start when the top drive is ENABLED. (When applicable) The TOP DRIVE ENABLE light will be continuously lit when the FVD is properly enabled. The TOP DRIVE ENABLE light will flash under the following conditions: <ul style="list-style-type: none"> FVD not properly enabled.
RT (Optional)	<ul style="list-style-type: none"> Power is supplied to the rotary table. Power is supplied to the Top Drive for auxiliary functions but no power is available to the Top Drive motor.

NOTE: The Top Drive will automatically shut down under the following conditions:

- Low air flow detected while the Top Drive is in ENABLE and the motor temperature exceeds 30 ° C.
- Loss of the Top Drive Lube Pump Running status.
- If the drilling motor temperature reaches 356° F (180° C). The throttle can be zeroed and the top drive restarted ONE TIME. If the high temp continues for 10 minutes the top drive will shut down and cannot be restarted until the temperature reaches 310° F (155° C).

A Torque Unwind sequence is performed before shut-down to slowly remove the torque from the drill string.

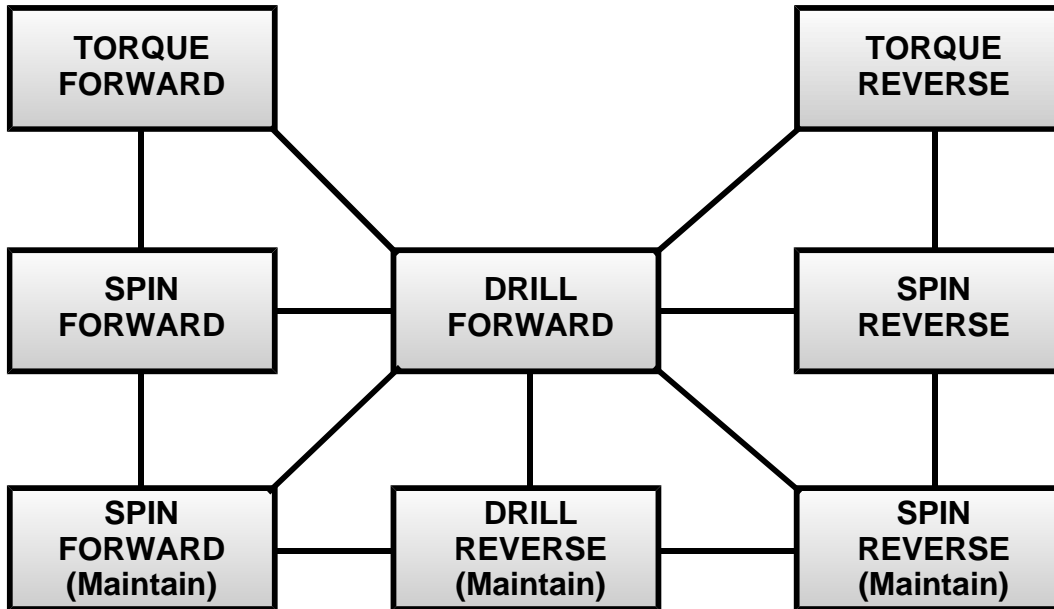
Subsection 3A: Top Drive Operation

TOP DRIVE MODE JOYSTICK (JS 1)	
<ul style="list-style-type: none"> • Refer also to the Top Drive Mode Joystick Function summary page 8. • Refer also to the DRILL-SPIN-TORQUE Control Summary (Table 1) on page 9 	
DRILL Forward & Reverse	<ul style="list-style-type: none"> • The speed is controlled with the hand throttle wheel (TH1). • The torque is limited by the DRILLING TORQUE LIMIT which is displayed in units of ft-lb on the DRILL TORQUE LIMIT meter (M3) and can be adjusted with the DRILLING TORQUE LIMIT dial (TH2). • The maximum continuous torque is limited by the Torque - Speed Limitations shown on the torque curves in section 2 of this manual.
SPIN Forward & Reverse	<ul style="list-style-type: none"> • The speed is preset at approximately 30 RPM. • The torque is limited to 3 000 ft-lb (4 000 Nm). • Note that there are two spin joystick positions for each direction. One is maintained and the other will spring return to neutral.
TORQUE Forward**	<ul style="list-style-type: none"> • The maximum torque is limited by the MAKE-UP TORQUE LIMIT which is displayed in units of ft-lb on the MAKE-UP TORQUE LIMIT meter (M4) and can be adjusted with the MAKE-UP TORQUE LIMIT dial (TH3). • The maximum Make-Up torque is 90 000 ft-lb (122 000 Nm) which is the limited electric motor torque of 66 000 ft-lb (89 500 Nm) plus the maximum Torque Boost Make-Up torque of 24 000 ft-lb (32 500 Nm). • The torque will ramp up to the MAKE-UP TORQUE LIMIT, hold for 1.5 seconds and ramp down. • Currents above the continuous rating will be time limited by the PLC to 5-85 seconds depending on the current level. •
TORQUE Reverse	<ul style="list-style-type: none"> • The maximum Break Out torque is 90 000 ft-lb (122 000 Nm) which is the limited electric motor torque of 52 500 ft-lb (71 200 Nm) plus the maximum Torque Boost Break Out torque of 37 500 ft-lb (50 800 Nm). • Currents above the continuous rating will be time limited by the PLC.

** See Torque Boost Disclaimer at the end of Section 3

IMPORTANT: Do NOT rotate the top drive with drill string weight in the elevators. Serious damage to the rotary manifold may result.

Top Drive Mode Joystick Functions



Note: All positions are spring returned except where "Maintain" is noted.

Subsection 3A: Top Drive Operation

Table 1

DRILL - SPIN - TORQUE CONTROL SUMMARY
Canrig Model 1250AC-681 Top Drive
With GE B20 AC Motor

	DRILL	SPIN	TORQUE – FWD (Make-Up)	TORQUE – REV (Break Out)
Speed Control	Handwheel (TH1)	Fixed 30 RPM	Fixed	Fixed
Torque Limit	Adjustable	Fixed 3 000 ft-lb (4 000 Nm)	Adjustable	Fixed
Torque Limit Display	Drilling Torque Limit Meter (M3)	N/A	Make-up Torque Limit Meter (M4)	N/A
Torque Limit Adjustment	Drilling Torque Limit Dial (TH3)	N/A	Make-Up Torque Limit Dial (TH2)	N/A
Continuous Current Limitation	N/A	N/A	N/A	N/A
Continuous Torque Limitation	51 400 ft-lb (69 700 Nm)	3 000 ft-lb (4 000 Nm)	N/A	N/A
Intermittent Current Limitation	N/A	N/A	N/A	N/A
Intermittent Torque Limitation Motor Only	71 000 ft-lb (96 300 Nm)	N/A	71 000 ft-lb (96 300 Nm)	71 000 ft-lb (96 300 Nm)
Intermittent Torque Limitation with Torque Boost*	N/A	N/A	90 000 ft-lb (122 000 Nm)	90 000 ft-lb (122 000 Nm)
Intermittent Current Time Limitation		N/A	150% for 10 seconds	

* See Torque Boost Disclaimer at the end of Section 3

Canrig Model 1250AC-681 Top Drive

TOP DRIVE DRILL THROTTLE HANDWHEEL (TH1)

- Active only in DRILL mode.
- De-activated in SPIN and TORQUE modes.
- De-activated if the Torque Boost is ENGAGED.

CLOCKWISE	<ul style="list-style-type: none">• Increases the Top Drive rotary speed.
COUNTER-CLOCKWISE	<ul style="list-style-type: none">• Decreases the Top Drive rotary speed.

DRILLING TORQUE LIMIT DIAL (TH 2)

- Adjusts the torque limit of the Top Drive in DRILL mode.
- Turn the dial clockwise to increase the torque limit.
- The drilling torque limit is displayed on the DRILLING TORQUE LIMIT meter (M4).

MAKE-UP TORQUE LIMIT DIAL (TH 3)

- Adjusts the Make-Up Torque Limit of the Top Drive in TORQUE mode.
- Turn the dial clockwise to increase the torque limit.
- The Make-Up Torque Limit is displayed on the MAKE-UP TORQUE LIMIT meter (M4).
- If the Torque Boost and electric motor are used together, set the Make-Up Torque Limit at the desired torque minus 24 000 ft-lb (32 500 Nm).**

** See Torque Boost Disclaimer at the end of Section 3

Subsection 3A: Top Drive Operation

HYDRAULIC POWER UNIT SWITCH (SW 3)	
<ul style="list-style-type: none"> • The Hydraulic Power Unit (HPU) supplies hydraulic pressure to the auxiliary functions. • The unit has two pumps; only one runs at any given time. • The pumps can run continuously or can be turned off if no auxiliary functions are being used. 	
HPU 1	<ul style="list-style-type: none"> • HPU No. 1 will start. • The HYDRAULIC UNIT indicator light will be on if the HPU is running properly. • The HYDRAULIC UNIT indicator light and the HPU FAULT lamp will flash if an HPU fault is detected: <ul style="list-style-type: none"> • Motor not running. • Low hydraulic oil level. • High hydraulic oil temperature. • UWCV actuation or BUW Gripper opening prevented by the HPU not running.
OFF	<ul style="list-style-type: none"> • Both units will stop.
HPU 2	<ul style="list-style-type: none"> • Same as HPU 1 above except HPU 2.

TOP DRIVE BRAKE SWITCH (SW 4)	
<ul style="list-style-type: none"> • The brake should NOT be used for dynamic braking. It can be used for static operation only. • The brake is a hydraulic caliper disc type mounted on the top of the motor. 	
OFF	<ul style="list-style-type: none"> • The Top Drive can rotate freely.
ON	<ul style="list-style-type: none"> • The Top Drive brake is applied. • The BRAKE indicator light will turn on. • The Hydraulic Power Unit must be running for brake operation, e.g. for directional drilling. • If the brake is turned on for more that 2 seconds while the throttle is ON, the horn will sound and the BRAKE indicator light will flash. • The brake will not apply if in SPIN or TORQUE mode. The horn will sound and the BRAKE indicator light will flash.

Canrig Model 1250AC-681 Top Drive

UPPER WELL CONTROL VALVE SWITCH (SW 5) (* Optional)

- This hydraulically actuated valve is mounted on the mud inlet, above the Top Drive.
- It is used as a mud saver and for well control.

OPEN	<ul style="list-style-type: none">• The valve will open, regardless of the mud pump status.
AUTO	<ul style="list-style-type: none">• The valve closes automatically whenever the mud pump(s) are stopped and the standpipe pressure is less than 250 psi (1725 KPa).• The valve opens automatically whenever the mud pump(s) are started.
CLOSE	<ul style="list-style-type: none">• The valve will close, regardless of the mud pump status.• The UWCV CLOSED indicator light will turn on.

NOTE: The UWCV CLOSED light will turn on if the valve closing is activated either by the AUTO or CLOSE switch selection.

The UWCV CLOSED light will flash and the horn will sound if valve actuation (OPEN or CLOSE) is prevented because the HPU is not running.

LOWER WELL CONTROL VALVE SWITCH (SW 6) (* Optional)

- This air or hydraulic actuated valve is mounted on the quill, below the Top Drive.

OPEN	<ul style="list-style-type: none">• The valve will open, regardless of the mud pump status.
AUTO	<ul style="list-style-type: none">• The valve closes automatically whenever the mud pump(s) are stopped and the standpipe pressure is less than 250 psi (1725 KPa).• The valve opens automatically whenever the mud pump(s) are started.
CLOSE	<ul style="list-style-type: none">• The valve will close, regardless of the mud pump status.• The LWCV CLOSED indicator light will turn on.

NOTE: The LWCV CLOSED light will turn on if the valve closing is activated either by the AUTO or CLOSE switch selection.

Subsection 3A: Top Drive Operation

TORQUE BOOST SWITCH (SW 8)	
	<ul style="list-style-type: none">• The Torque Boost is a high-torque, low speed hydraulic drive for connection make-up or break out.• The Torque Boost clutch is automatically engaged when the Make-Up or Break Out function is selected.• The Torque Boost clutch is automatically disengaged when the Make-Up or Break Out function is released, then every 10 minutes thereafter to ensure that it does not inadvertently creep engaged.• The Torque Boost will not engage if:<ul style="list-style-type: none">• the Throttle is not at zero• the Top Drive is turning• the Back-Up Wrench Gripper is closed and the Handler is not locked
MAKE-UP	<ul style="list-style-type: none">• The Top Drive quill will hydraulically rotate forward with a maximum torque of 24 000 ft-lb (32 500 Nm).• Select TORQUE FORWARD mode (using JS1) to provide up to 66 000 ft-lb (89 500 Nm) of additional electric motor torque, for a total of 90 000 ft-lb (122 000 Nm) combined.**
OFF	<ul style="list-style-type: none">• Torque Boost rotation will stop. The Torque Boost clutch will disengage.
BREAK OUT	<ul style="list-style-type: none">• The Top Drive quill will hydraulically rotate in reverse with a maximum torque of 37 500 ft-lb (50 800 Nm).• Select TORQUE REVERSE mode (using JS1) to provide up to 52 500 ft-lb (71 200 Nm) of additional electric motor torque, for a total of 90 000 ft-lb (122 000 Nm) combined.

IMPORTANT: When using the Torque Boost and electric motor together, the Torque Boost torque must be applied first. The Torque Boost clutch cannot engage while the Top Drive is turning.

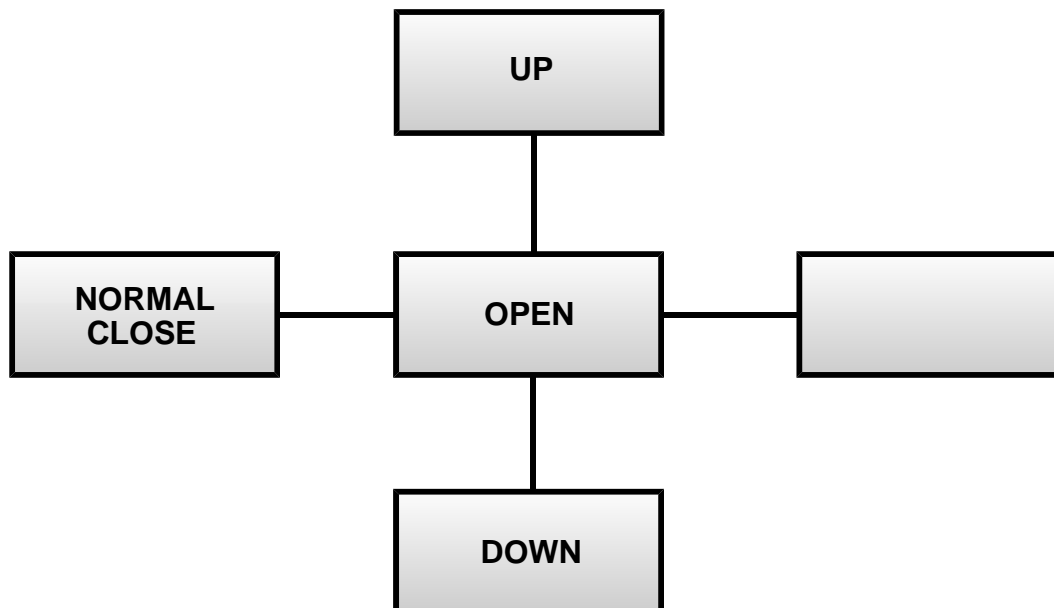
** See Torque Boost Disclaimer at the end of Section 3

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BACK-UP WRENCH (BUW) JOYSTICK (JS 2)	
UP	<ul style="list-style-type: none">• Raise the BUW Gripper assembly.
DOWN	<ul style="list-style-type: none">• Lower the BUW Gripper assembly.
OPEN (Neutral)	<ul style="list-style-type: none">• Open the BUW Gripper to allow normal Top Drive rotation.• Maintain the BUW gripper at its current height.
NORMAL CLOSE	<ul style="list-style-type: none">• Close the BUW Gripper on the tubular.• This position is spring returned. Normally use this position to close the Gripper to avoid inadvertent hoisting with the Gripper closed.• If the handler is locked and the top drive is not rotating, the BUW Gripper will hold the tubular for make-up or break out operations.• The BACK-UP WRENCH CLOSED indicator light will flash when the Gripper is closed. This is a warning to avoid hoisting with the BUW Gripper closed.

IMPORTANT: Neither electric motor torque nor Torque Boost torque are permitted if the BUW Gripper is closed and the Handler is unlocked. In that condition the bails could swing unexpectedly causing severe damage, injury, or death.

Back-Up Wrench Joystick Functions



Note: All positions are spring returned

BACK-UP WRENCH SAVER

- The BUW Gripper is interlocked to the drawworks clutch. This prevents damage to the wrench assembly when the Top Drive is inadvertently hoisted with the BUW Gripper closed. The Gripper will open if either drawworks clutch is engaged, regardless of the joystick position.

IMPORTANT: After breaking out of a joint, remember to open the Back-Up Wrench before hoisting to avoid damage to the wrench.

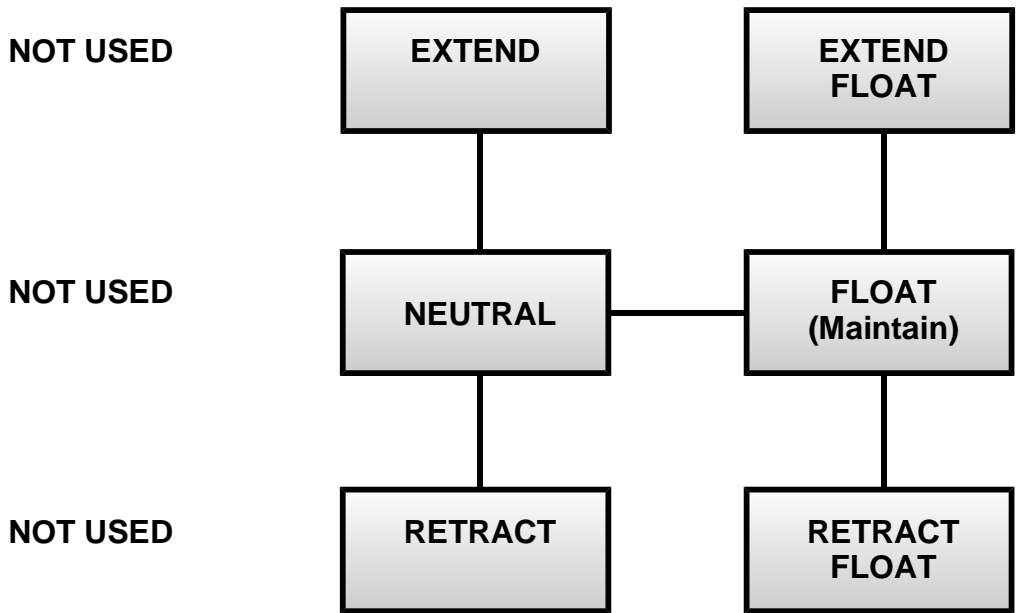
WARNING: Be careful in using the gripper to hold up a sub or stabilizer for handling. If a drawworks clutch is engaged, the HPU is turned off, or if the Top Drive switch (SW1) is moved to the OFF position, the Back-Up Wrench Saver will open the Gripper and drop the sub.

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LINK TILT JOYSTICK (JS 3)	
EXTEND (UP)	<ul style="list-style-type: none"> Extends the Link Tilt hydraulic cylinder rods. This will push the bails toward the latch side of the elevators.
RETRACT (DOWN)	<ul style="list-style-type: none"> Retracts the Link Tilt hydraulic cylinder rods. This will pull the bails toward the hinge side of the elevators.
MAINTAIN (CENTER)	<ul style="list-style-type: none"> If neither EXTEND nor RETRACT are selected, the Link Tilt will remain in its current position.
FLOAT (RIGHT)	<ul style="list-style-type: none"> If neither EXTEND nor RETRACT are selected the Link Tilt will float as influenced by gravity or may be moved by hand.

IMPORTANT: The elevator must be installed with the handles on the OPPOSITE side from the link tilt cylinders. See Figure 3.2.

Link Tilt Joystick Functions

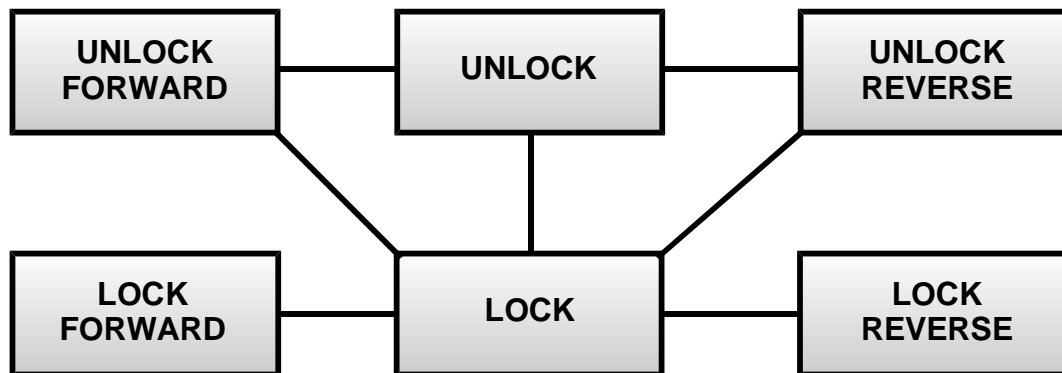


Note: All positions are spring returned except where "Maintain" is noted.

Subsection 3A: Top Drive Operation

HANDLER JOYSTICK (JS 4)	
UNLOCK	<ul style="list-style-type: none"> Disengages the lock dog from the handler rotate gear.
UNLOCK FORWARD	<ul style="list-style-type: none"> The lock dog disengages and the entire pipe handler assembly rotates in a clockwise direction.
UNLOCK REVERSE	<ul style="list-style-type: none"> The lock dog disengages and the entire pipe handler assembly rotates in a counter-clockwise direction.
LOCK	<ul style="list-style-type: none"> Engages the lock dog in the current position.
LOCK FORWARD	<ul style="list-style-type: none"> It may be necessary to rotate the pipe handler in a clockwise direction in order to line up the lock dog with the teeth of the handler rotate gear. When they align, the handler will lock into place.
LOCK REVERSE	<ul style="list-style-type: none"> It may be necessary to rotate the pipe handler in a counter-clockwise direction in order to line up the lock dog with the teeth of the handler rotate gear. When they align, the handler will lock into place.

Handler Joystick Functions



NOT USED

NOT USED

NOT USED

CAUTION: To avoid injury due to accidental rotation of the pipe handler, the handler should be locked most of the time.

Visually verify that the handler is locked.

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HANDLER LOCK FAULT LIGHT (on PB 3)		
OFF	<ul style="list-style-type: none"> • Handler is locked. • Handler is being held unlocked with the Handler Lock joystick. 	
ON	<ul style="list-style-type: none"> • Handler Lock Bypass is in progress which creates a 30 second window for applying torque without handler lock confirmation. 	<i>3 second Horn Burst every 15 seconds</i>
FAST FLASH	<ul style="list-style-type: none"> • Handler is not locked and the Handler Lock joystick is in the LOCK position. 	<i>3 second Horn Burst every 15 seconds</i>

HANDLER LOCK BYPASS SWITCH (PB 3)		
PUSH	<ul style="list-style-type: none"> • Starts a timer which creates a 30 second window where Make-Up or Break Out torque is permitted even if the system cannot determine that the handler is positively locked. Normally this feature would only be used in the event of a handler lock sensor failure. • The HANDLER LOCK FAULT indicator light will turn on for 30 seconds. 	
RELEASED	<ul style="list-style-type: none"> • Normal handler lock operation (after 30 second bypass time.) 	

CAUTION: Always visually confirm that the handler is locked before applying torque to make-up or break out of a connection.

BRAKE LIGHT (on SW 4)		
OFF	<ul style="list-style-type: none"> • Brake off. 	
ON	<ul style="list-style-type: none"> • Brake on. 	
FLASHING	<ul style="list-style-type: none"> • Brake on with the Throttle on for more than 2 seconds. • Attempt to apply the brake while in SPIN mode. • Attempt to apply the brake while in TORQUE mode. 	Horn Burst

Subsection 3A: Top Drive Operation

TOP DRIVE ENABLED LIGHT (PL 1)		
OFF	<ul style="list-style-type: none"> • Top Drive ENABLE not selected. • Top Drive LOCKOUT switch depressed. • EMERGENCY STOP switch depressed. 	
ON	<ul style="list-style-type: none"> • Normal operating status - FVD properly enabled. 	
SLOW FLASH	<ul style="list-style-type: none"> • FVD bay not properly enabled. 	
RAPID FLASH	<ul style="list-style-type: none"> • Stalled motor. 	Repeated Horn

LUBE OIL HIGH TEMPERATURE LIGHT (PL 3)		
OFF	<ul style="list-style-type: none"> • Normal operating status - Lube oil temperature less than 175°F (80°C). • Top Drive not enabled. 	
FLASHING	<ul style="list-style-type: none"> • Lube oil temperature greater than 175°F (80°C). 	Horn Burst

TOP DRIVE MOTOR HIGH TEMPERATURE LIGHT (PL 4)		
OFF	<ul style="list-style-type: none"> • Normal operating status - motor temperature less than 275°F (135°C). • Top Drive not enabled. 	
FLASHING	<ul style="list-style-type: none"> • Motor temperature greater than 275°F (135°C). • If the drilling motor temperature reaches 302° F (150° C), the motor will shut down. The throttle can be zeroed and the top drive restarted ONE TIME. If the high temp continues for 10 minutes the top drive will shut down and cannot be restarted until the temperature reaches 275° F (135° C). 	Horn Burst

TOP DRIVE LOW AIR LIGHT (PL 5)		
OFF	<ul style="list-style-type: none"> • Normal operating status - adequate air pressure and flow at the Top Drive motor. • Top Drive not enabled. 	
SLOW FLASH	<ul style="list-style-type: none"> • Motor contactor is OFF and the Low Air Pressure Switch is ON 	
FAST FLASH	<ul style="list-style-type: none"> • Insufficient air pressure or flow at the Top Drive motor. Check the blower and ducting. 	Horn Burst (Repeated after 30 sec.)

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UWCV CLOSED LIGHT (PL 6) (* Optional)		
OFF	<ul style="list-style-type: none"> Upper Well Control Valve OPEN selected. 	
ON	<ul style="list-style-type: none"> Upper Well Control Valve closing is activated either by the AUTO or CLOSE switch selection. 	
FLASHING	<ul style="list-style-type: none"> Actuation of the valve (either OPEN or CLOSE) prevented by the HPU not running. UWCV CLOSE selection with the mud pumps running or with more than 250 psi (1725 KPa) standpipe pressure. 	Horn Burst

LOW LUBE PRESSURE LIGHT (PL7)		
OFF	<ul style="list-style-type: none"> Normal operating status - Top Drive lubrication OK. Top Drive not enabled. 	
FLASHING	<ul style="list-style-type: none"> Top Drive lubrication pressure is less than 15 psi. Check the lube pressure gauge on the Top Drive. Check the Top Drive lube system. Top Drive enabled but the lube pump motor is not running. Check the motor starter and motor. Motor contactor is OFF and the Low Lube Pressure Switch is ON 	Horn Burst

BACK-UP WRENCH GRIPPER CLOSED LIGHT (PL 8)		
OFF	<ul style="list-style-type: none"> Back-Up Wrench Gripper is open. 	
FLASHING	<ul style="list-style-type: none"> Back-Up Wrench Gripper is closed. 	
FLASHING	<ul style="list-style-type: none"> Engaging either drawworks clutch with the BUW gripper closed. Opening of the Back-up Wrench Gripper prevented by the HPU not running. Attempting to close the BUW gripper while the Top Drive is rotating. 	Horn Burst

IMPORTANT: After breaking out of a joint, remember to open the Back-Up Wrench before hoisting to avoid damage to the wrench.

CONSOLE LOW AIR LIGHT (PL 9)		
OFF	<ul style="list-style-type: none"> Normal operating status. Adequate purge air pressure at the Top Drive console. 	
FLASHING	<ul style="list-style-type: none"> Insufficient purge air pressure at the Top Drive console. Check the air supply, regulator and console sealing. 	Horn Burst

Subsection 3A: Top Drive Operation

LWCV CLOSED LIGHT (PL 10) (* Optional)		
OFF	<ul style="list-style-type: none"> Lower Well Control Valve OPEN selected. 	
ON	<ul style="list-style-type: none"> Lower Well Control Valve closing is activated either by the AUTO or CLOSE switch selection. 	
FLASHING	<ul style="list-style-type: none"> LWCV selection with the mud pumps running or with more than 250 psi (1725 KPa) standpipe pressure. 	Horn Burst

HPU FAULT LIGHT (PL 11)		
OFF	<ul style="list-style-type: none"> Hydraulic Unit not selected. Selected Hydraulic Unit running properly. 	
FLASHING	<ul style="list-style-type: none"> Selected Hydraulic Unit not running. Low hydraulic oil level. High hydraulic oil temperature (> 75° C). UWCV actuation or BUW Gripper opening prevented by the HPU not running. 	Horn Burst

TORQUE BOOST ENGAGED LIGHT (PL 12)		
OFF	<ul style="list-style-type: none"> Torque Boost is disengaged. 	
ON	<ul style="list-style-type: none"> Torque Boost is engaged. 	
FLASHING	<ul style="list-style-type: none"> Attempt to engage the Torque Boost with the throttle on. Attempt to engage the Torque Boost while in SPIN mode. Attempt to engage the Torque Boost while in TORQUE mode. Electrical torque may be applied after the Torque Boost clutch has engaged. 	Horn Burst

GENERATOR WARNING LIGHT (PL 13) (* Optional)		
OFF	<ul style="list-style-type: none"> No Engine alarms. 	
FLASHING	<ul style="list-style-type: none"> An indication that one of the Engine alarms has activated. Check Engine for High Temp Alarm, Low Lube Alarm or Low Water Alarm. 	

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TORQUE METER (M 1)

- Analog display of the torque output of the Top Drive, in thousands of ft-lb.
- If the Torque Boost is used together with the electric motor for make-up, the output of the Top Drive will be 24 000 ft-lb (32 500 Nm) higher than the Torque Meter reading.
- If the Torque Boost is used together with the electric motor for break out, the output of the Top Drive will be 37 500 ft-lb (50 800 Nm) higher than the Torque Meter reading.

TOP DRIVE RPM METER (M 2)

- Digital display of the Top Drive rotary speed in revolutions per minute.

DRILLING TORQUE LIMIT METER (M 3)

- Digital display of the torque limit of the Top Drive in DRILL mode, in thousands of ft-lb.
- The drilling torque limit can be adjusted with the DRILLING TORQUE LIMIT dial (TH2).

MAKE-UP TORQUE LIMIT METER (M 4)

- Digital display of the make-up torque limit of the Top Drive in TORQUE mode, in thousands of ft-lb.
- The make-up torque limit can be adjusted with the MAKE-UP TORQUE LIMIT dial (TH3).
- When torquing with the Torque Boost and the electric motor together, set the Make-Up Torque Limit at the desired torque minus 24 000 ft-lb (32 500 Nm).**

** See Torque Boost Disclaimer at the end of Section 3

STALLED MOTOR DURING DRILLING

During the drilling process, the Top Drive motor can stall if the drilling torque reaches the torque limit setting. To perform a controlled release of torque on the drillstring:

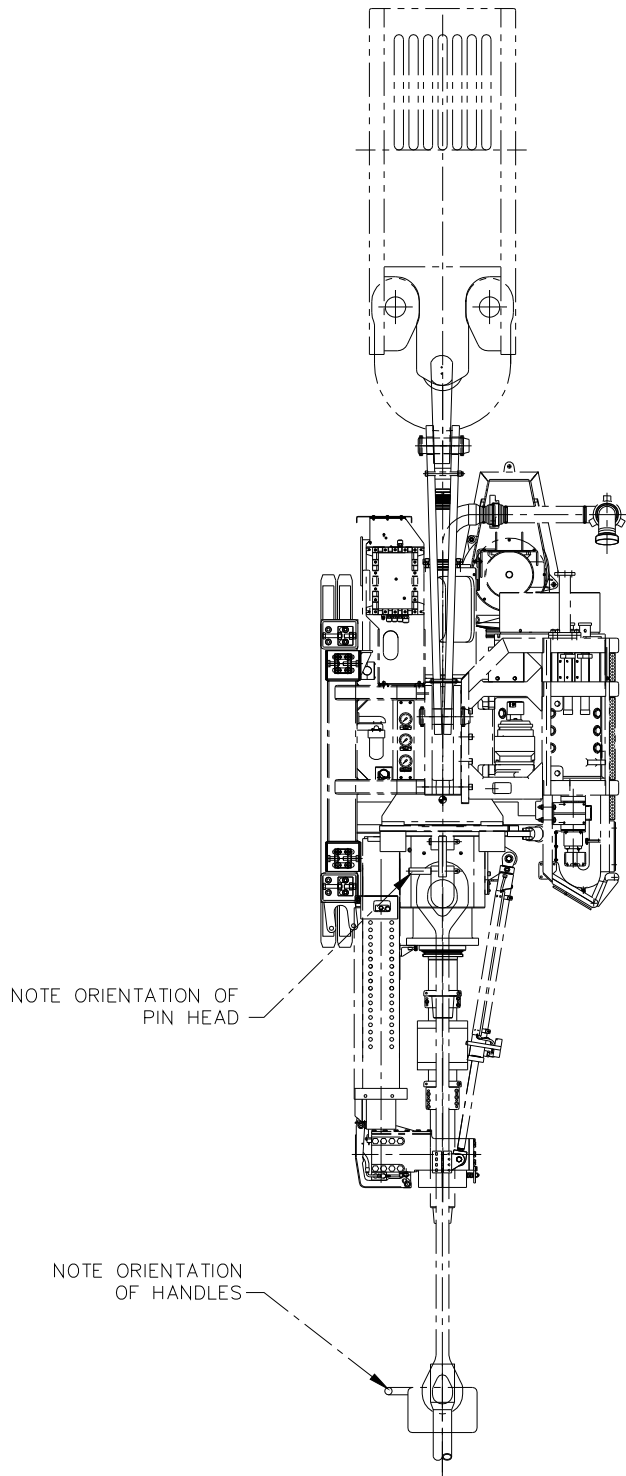
- Slowly reduce the Drilling Torque Limit while leaving the Throttle in its last position.
- When the pipe has unwound or the Torque Limit has reached zero, the throttle can be reduced to zero.
- Reset the Drilling Torque Limit.
- Hoist off bottom and resume the drilling operation.

Subsection 3A: Top Drive Operation

HORN	
OFF	<ul style="list-style-type: none"> • Normal operating status.
SHORT REPEATING	<ul style="list-style-type: none"> • Back-Up Wrench Gripper closed. <i>Remember to open it before hoisting.</i>
LONG REPEATING	<ul style="list-style-type: none"> • Handler UNLOCKED. • Handler not in safe position to TORQUE.
SHORT BURST ON NEW ALARM	<ul style="list-style-type: none"> • Alarm test for 5 seconds when ENABLE is first selected. • Low lube pressure. • Lube pump not running with Top Drive Enable switch on. • High lube temperature. • Low Top Drive cooling air pressure or flow. • Blower not running with Top Drive Enable switch on. • High motor temperature. • Brake on with the throttle on for more than 2 seconds. • Attempt to apply the brake while in SPIN or TORQUE mode. • HPU #1 or #2 selected but not running. • High hydraulic oil temperature – greater than 175°F (80°C). • Low hydraulic oil level. • Attempt to close LWCV with mud pumps running. • Attempt to close LWCV with high mud pressure. • Opening the Back-Up Wrench Gripper prevented by HPU not running. • Attempt to switch to SPIN or TORQUE Modes with quill speed greater than or equal 1 RPM. • Initiating Torque Boost Make-Up/Break Out. • Attempt to engage the Torque Boost with the Drill Throttle on or while in SPIN or TORQUE mode. • Attempt to close the Back-Up Wrench Gripper with the Handler UNLOCKED. • Releasing the Torque Boost first when applying electric motor torque and Torque Boost torque together. • Attempt to Torque Boost Make-Up/Break Out with Torque Boost disengaged. • Attempt to use the electric motor in addition to the Torque Boost with improper matching of the rotation directions (eg. Torque Boost MAKE-UP and Top Drive REVERSE). • Attempt to switch between forward and reverse with the Throttle on or while in SPIN or TORQUE modes. • Engagement of either drawworks clutch / hoisting with the Back-Up Wrench Gripper closed. • Attempt to close the BUW Gripper while the Top Drive is rotating.

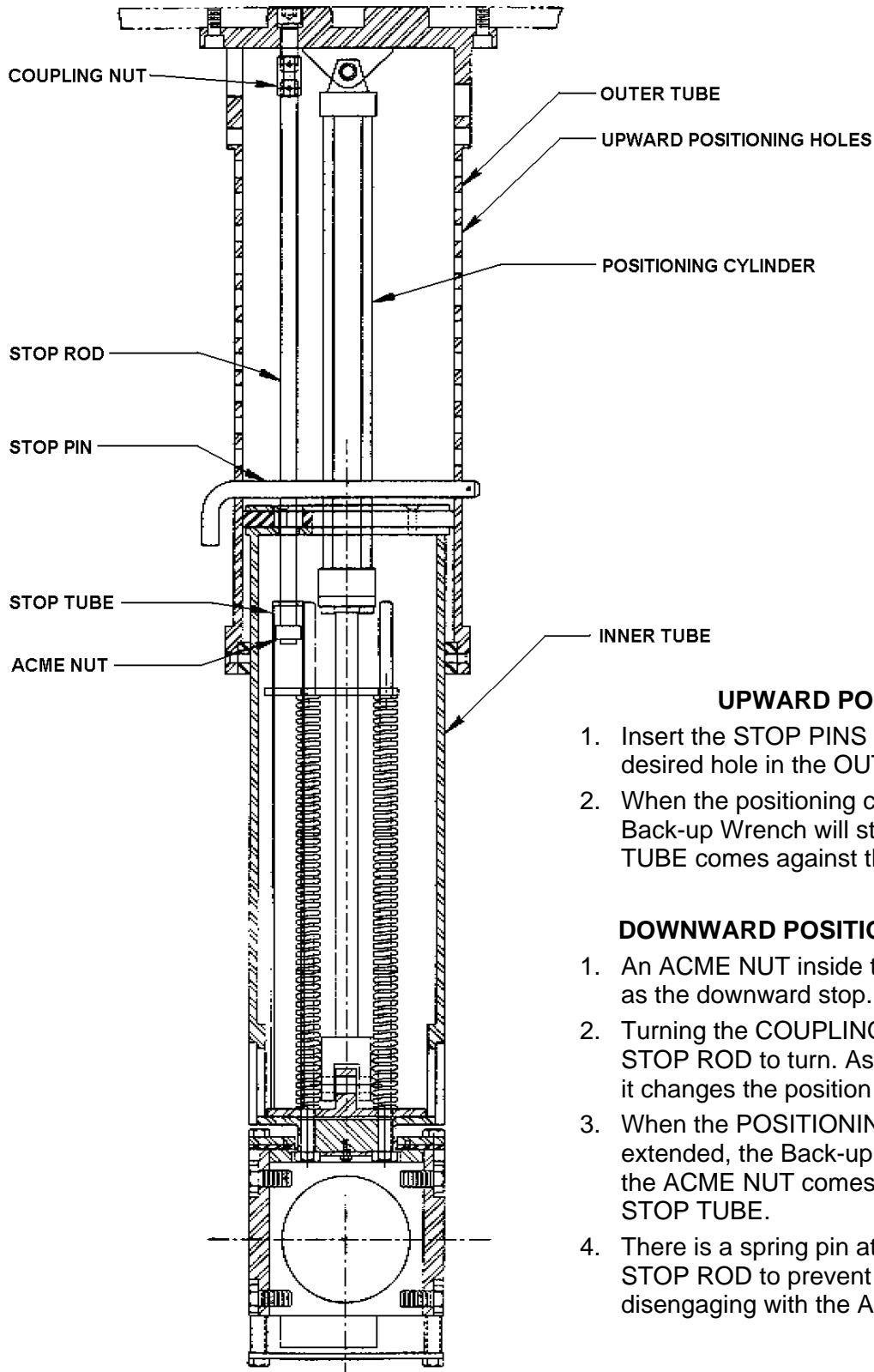
Elevator Arrangement

Figure 3.2



Back-Up Wrench Positioning

Drawing Number: M-7-101-01



UPWARD POSITIONING

1. Insert the STOP PINS (Qty:2) through the desired hole in the OUTER TUBE.
2. When the positioning cylinder is retracted the Back-up Wrench will stop when the INNER TUBE comes against the STOP PINS.

DOWNWARD POSITIONING (OPTIONAL)

1. An ACME NUT inside the STOP TUBE acts as the downward stop.
2. Turning the COUPLING NUT will cause the STOP ROD to turn. As the STOP ROD turns, it changes the position of the ACME NUT.
3. When the POSITIONING CYLINDER is extended, the Back-up Wrench will stop when the ACME NUT comes against the top of the STOP TUBE.
4. There is a spring pin at the bottom of the STOP ROD to prevent the STOP ROD from disengaging with the ACME NUT.

Drilling Connection Sequence

1. Drill down the joint of pipe, bringing the Top Drive as close to the floor as possible by retracting the Back-Up Wrench and elevator Link Tilt to the over-drill position (70 degrees toward the hinge side of the elevators). For safety, keep the elevators as close to the floor as possible and keep personnel from standing below retracted elevators. See "Pipe Handler – Care and Usage".
2. Raise the pipe off bottom and set the slips.
3. Stop circulation and close the Upper Well Control Valve (LWCV, remotely activated from the Top Drive console).
4. Lower the Back-Up Wrench (BUW) over the pipe tool joint and close the BUW Gripper.
5. Break out and spin out of the pipe using Torque Reverse and Spin Reverse functions. Open the BUW Gripper.
6. Option A, B, or C (detailed on the following page).
7. Move the link tilt back to center using the FLOAT setting. Use Extend/Retract feature for minor adjustments.
8. Continue to hoist the Top Drive until the pin of the pipe to be added is above the box of the pipe in the slips.
9. Lower the Top Drive to stab the pipe into the drill string at the floor. Activate Spin Maintain. Continue to lower to stab the Top Drive saver sub into the box of the pipe being added. Lower the BUW fully for this operation to provide a stabbing guide.
10. After stabbing, continue to lower approximately 6 inches. This will allow the floating quill to compensate for the thread advance.
11. Use a back-up tong on the pipe in the slips if there is insufficient string weight for the slips to hold the make-up torque.
12. Spin in and make-up both connections simultaneously using the Top Drive. The torque can be pre-set at the Top Drive console. Raise the BUW Gripper to its highest position.
13. Open the Mud Saver Valve or LWCV if used as a Mud Saver.
14. Commence circulation, hoist to allow removal of the slips, lower to bottom and proceed to drill.
15. The elevators may be optionally opened and the link tilt retracted slightly while drilling.

OPTION A

Connection of a Racked Stand

- 6A i) Hoist the Top Drive to the racking board elevation.
- 6A ii) Extend the link tilt in the same manner as tripping into the hole.
- 6A iii) The derrickman positions a stand of drill pipe and closes the elevators in the same manner as tripping into the hole. (Power elevators are optional.)

(Procedure continues on the following page.)

OPTION B

Mousehole Single Connection

- 6B i) Latch the elevators around the single in the mousehole with the link tilt in the retracted position (open side of the elevators facing well center). The link tilt can be used to close the elevators.
- 6B ii) Hoist to raise the single out of the mousehole.

(Procedure continues on the following page.)

OPTION C

Mousehole Double Connection

- 6C i) Complete the Mousehole Single Connection procedure as above.
- 6C ii) Position another single in the mousehole.
- 6C iii) Lower the Top Drive to stab the first single into the second single.
- 6C iv) Spin in and snug up the connection using a Pipe Spinner.
- 6C v) Hoist to raise the double out of the mousehole.

(Procedure continues on the following page.)

Drilling Surface Holes with Collars

1. Put a collar in the mousehole, install a Drill-Through Pick-Up sub (DTPU sub) and torque as required with the tongs. Pick up the collar in the elevators and stab it into the collar in the table. Stab in the Top Drive and make-up both connections to the limit of the saver sub connection. Torque the floor connection to the required torque with tongs.

If the drill collar is too large for the mousehole, then install the DTPU sub and pick it out of the V-door ramp with the elevators.

Canrig Casing Nubbin

- Machined from one piece of 4145H material, eliminating welds and areas for potential failure.
- Has a urethane guide mounted on the pin end to assist in stabbing casing and help prevent threads from making contact during stabbing.
- Designed with a shoulder that faces up to the casing collar when at the hand-tight position. This allows the casing to be rotated by the Top Drive during casing run and creates a seal for filling or circulating the casing.
- With the Nubbin properly installed in the casing, the Top Drive can be used to hoist the casing.
- The Nubbins allow the weight of the Top Drive to be applied to the casing when tight spots are encountered downhole.
- The casing thread of the Nubbin will usually exceed the performance of the actual casing thread due to superior metallurgical properties and a thicker wall at the Nubbin pin.

All Nubbins are load rated and code stamped for traceability.

Tripping Sequence: Into Hole

1. Tripping procedures are essentially conventional unless tight hole is encountered.
2. Lower the drill string with the elevators and set the slips.
3. Open the elevators, retract Link Tilt slightly and hoist the Top Drive to the racking board position.
4. Extend the link tilt. Keep the pipe handler at the desired orientation to tilt the links to the desired pipe presentation point at the racking board. Pipe handler orientation is controlled at the Top Drive console. Maximum link tilt angle is pre-set to avoid any possibility of the elevators hitting the racking board.
5. The derrickman positions a stand of drill pipe and closes the elevators. This step is approximately the same as conventional non-Top Drive tripping except that the links are tilted toward the racking board, which reduces derrickman effort and improves safety. Power elevators are optional.
6. Move the link tilt back to center using the FLOAT setting.
7. Continue to hoist the Top Drive until the pin of the pipe being added is above the box of the pipe in the slips.
8. Lower the Top Drive to stab the pipe at the floor.
9. Spin in and make-up the connection using the floor handling tools.
10. Hoist the drill string and open the slips.
11. Lower the drill string into the hole and repeat the procedure.

<p>NOTE: If tight hole is encountered at any time, set the pipe in the slips and lower the Top Drive, spin in and make-up to the connection on top of the pipe. Use the Back-Up Wrench on the pipe tool joint if there is insufficient string weight to restrain the torque in the slips. Initiate circulation and rotation. Ream as required.</p>

Tripping Sequence: Out of Hole

1. Suitable elevators should be installed on the Top Drive.
2. Latch the elevators around the drill string and hoist (opening slips) to the racking board elevation. The link tilt can be used to latch the elevators.
3. Set the slips while gently lowering the string until all weight of the drill string is in the slips.
4. Break out the stand in the elevators from the string using the floor handling tools.
5. Hoist to “un-stab” the stand.
6. Extend the link tilt.
7. Position the pin end of the stand at the pipe set-back and lower the Top Drive to set the stand down.
8. The derrickman opens the elevator and racks back the top end of the stand. The link tilt reduces the required derrickman effort.
9. Lower the Top Drive. Ensure the pipe is clear of the Top Drive. Retract the link tilt in preparation to latch the elevators onto the next stand.
10. Repeat the procedure.

<p>NOTE: If tight hole is encountered at any time, set the pipe in the slips and lower the Top Drive, spin in and make-up to the connection on top of the pipe. Use the Back-Up Wrench on the pipe tool joint if there is insufficient string weight to restrain the torque in the slips. Initiate circulation and rotation. Ream as required.</p>

11. After a stand is reamed out, set the slips. Close the Back-Up Wrench on the drill pipe and reverse Torque to break the connection. Break the stand at the floor and rack back using the elevators.

Running Casing Using Side Door Elevators

1. Retract the link tilt and close the casing elevators around a joint of casing lying in the V-door. The elevators approach the casing from the top side.
 2. Hoist the Top Drive and casing joint to clear the coupling in the slips. Select the FLOAT position for the link tilt.
 3. Stab the casing.
 4. Align the casing using the link tilt and pipe handler rotation. No man is required on the stabbing board.
 5. Make-up the casing with a power tong in the usual manner.
 6. Hoist the casing string and open the slips.
 7. Lower the casing string into the hole, set the slips and open the elevators.
 8. Repeat the above procedure.
- The Top Drive can be equipped with a Canrig casing nubbin attached to the quill during the entire casing job. It will allow you to screw into casing at any time. You can then:
 - Fill the casing with no spills
 - Circulate the casing string
 - Rotate the casing string
 - Reciprocate the casing string
 - Push down on the casing string with the weight of the Top Drive and blocks.
 - Any combination of the above.

<p>NOTE: Casing nubbins incorporate a urethane stabbing guide for thread protection and make-up shoulder. Various sizes and thread types are available.</p>
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Jarring

DISCUSSION: It is imperative that Top Drive users exercise *care and caution* when using a Top Drive during and after a jarring operation.

RECOMMENDATION:

- Due to the changing parameters of jarring operations (depth of hole, drill string, free point, type of jars, etc.), it is impossible to establish firm limits or guidelines for jarring with the Top Drive. Every situation will have to be evaluated on individual merits with due consideration of the costs of abandoning a well.
- The use of an Accelerator® tool or a similar device in conjunction with drilling or fishing jars can greatly reduce the jarring forces at the top drive. It can absorb shock waves that are generated while jarring and protect the pipe and top drive from damage.
- Canrig advises against using surface jars whenever possible, as the risk of damage to the Top Drive will increase.
- After any jarring operation, the Top Drive should be thoroughly inspected according to the following guidelines:
 - Perform a thorough visual examination of the Top Drive looking for any signs of damage.
 - Visually inspect the mud inlet piping.
 - Check all wire locked bolts for damage or broken wires. If broken wires are detected, re-torque the bolts according to the Capscrew Torque Values information in Subsection 4D of this manual and rewire. Replace damaged wires.
 - Check all external bolts and nuts that are not wired for tightness. Any bolts found to be loose should be removed, coated with Loctite 242 Threadlocker, reinstalled and re-torqued according to the Capscrew Torque Values information.
 - Check all guards, vents and covers for tightness.
 - Ensure that all safety cables are properly and securely attached.
 - Visually examine the inside of the junction box(es) for loose components.
 - Open the motor brush access cover and check that all bolts are tight and all brushes are correctly positioned. Also ensure that the condensation heater is secure.
 - Check that all electrical plugs are properly engaged and secured.
 - Check the seals at the bottom of the rotary manifold to ensure that they are properly in place.
- The Top Drive load path is designed according to API Specification 8C; it can be treated in much the same manner as any API hoisting equipment. The main difference is that

Subsection 3A: Top Drive Operation

the Top Drive has many accessories bolted on; these should be checked for loose bolts, etc. as described above.

- Jarring operations can be done with the load connected either to the quill or the elevators.

Helpful Items

- Connection make-up torques may be limited by the saver sub or lower well control valve connection.
- If a drill collar is to be torqued higher than the saver sub limit then the rig tongs must be used.
- Ensure that the BUW is opened after breaking out of the tool joint. If you pick up the Top Drive with the Gripper closed, you could damage the Back-Up Wrench.
- You can cut continuous 90' (30m) cores.
- To slip and cut line:
 - a) Screw a joint of pipe or drill collar to the quill.
 - b) Set the Top Drive unit in the slips.
 - c) The traveling block must be laterally restrained. This can be done by retaining the block to the mast or Torque Guide or by using the block guides (if system is equipped with this feature).
- When drilling singles, a single should be put in the mousehole immediately before drilling down because the Top Drive may be blocking access to the mousehole when near the floor.
- If there is a failure with the handler rotate, the BUW can be closed on the saver sub and the torque boost can be used to rotate the pipe handler. Ensure that the handler is unlocked during rotation.
- To break the quill cross-over sub 6 5/8 REG connection, grip the Lower Well Control Valve (LWCV) with BUW and ensure that the uppermost tool joint clamp (x/o to LWCV) is tightened fully. Refer to Upper Drill String Assembly in Section 6B of the *Drawings and Parts List* book for your Top Drive System.

Pipe Handler

Care and Usage

Proper use of the Handler Lock system and the Link Tilt system can greatly reduce the chances of an accident or personal injury.

- All elevators must be installed with the handles on the OPPOSITE side from the link tilt cylinders (refer to Figure 3.2).
 - The link tilt is designed such that at the fully extended position, the elevators clear the racking board. It is recommended that this clearance be verified by passing the top drive slowly past the racking board with the links extended. There should be a minimum 2" of clearance between the elevator handles and the racking board.
 - If there is insufficient clearance, position the link tilt clamps lower on the links to increase the clearance.
 - The link tilt overdrill position (retracted) is used for drilling as low as possible before connections, allowing for maximum bit clearance off bottom when making a connection.
- When torquing against the Back-Up Wrench (BUW), the Handler Lock prevents rotation of the handler assembly due to the applied torque. It is important to avoid the hazard of inadvertent handler rotation with the elevator links retracted.
- When the links and elevators are retracted (in the overdrill position), keep personnel from standing below the elevators or in the path of elevator travel.
- When torquing against the BUW, always keep personnel clear of the swing radius of the links and elevators in case of inadvertent handler rotation.
- The driller should keep the links and elevators as close to center as possible when torquing against the BUW. This will minimize the swing radius of the elevators.
- The lock pin or locking dog mechanism should be magnetic particle inspected annually.
- The lock alarm should be tested daily. A fault can be simulated on a lock dog by closing the dog on a 1/8" dia. rod or making tooth tip to tooth tip contact when closing.

IMPORTANT: Do NOT rotate the top drive with drill string weight in the elevators. Serious damage to the rotary manifold may result.

Torque Boost Disclaimer

The Torque Boost values shown throughout the specifications and instructions are based on the pressure settings (+/- 10%) shown on the hydraulic schematic for this circuit @ 75°F (24°C). Any change in oil viscosity and/or wear on the hydraulic and mechanical components could cause reduced torque output. An increase in circuit back pressure will reduce differential pressure across the motor and cause a decrease in torque output.

Procedure For Field Testing the Torque Boost Output

The following procedure should be used when it is required to measure or verify the torque being generated by the Torque Boost. This procedure is intended to minimize possible mechanical damages to the torque boost hydraulic motor that may result from back-spinning the Torque Boost. Uncontrolled back-spin may cause cavitation and failure of the motor.

It will be assumed for the purpose of writing this procedure that rig tongs are being used, however the procedure will still be the same if a torque cell or some other load sensing device is being used.

Note: Proper Canrig and Rig safety procedures must be followed and a JSA held to reduce the risk of injuries on the rig floor from any 'kick back' of the rig tongs or movement of the Top Drive when the torque is released.

- Ensure that the traction motor is disabled by either setting the Top Drive control switch on the Driller's Console to 'Aux' or otherwise locking out the power to the motor. This is critical on AC drive systems since the drive would attempt to keep the quill from turning and would interfere with the torque measurements.
- Configure the rig tongs or other device to resist the quill movement.
- Engage and hold the Torque Boost in make-up.
- Once the torque measurement reading has stabilized, engage the Top Drive brakes.
- Release the Torque Boost.
- Engage and hold the Torque Boost 'break-out' function.
- Release the Top Drive brakes and then release the Torque Boost as soon as the torque measurement approaches zero.

Note: The time between releasing the brakes and the torque measurement approaching zero may be fairly short if only a LWCV and a saver sub is used at the end of the quill. In this case, the Torque Boost will need to be released almost immediately after the brakes are released to keep the tongs from rotating backwards (if the tongs don't release properly). If a length of drill pipe is being used at the end of the quill, the time before releasing the Torque Boost will be somewhat longer.

