



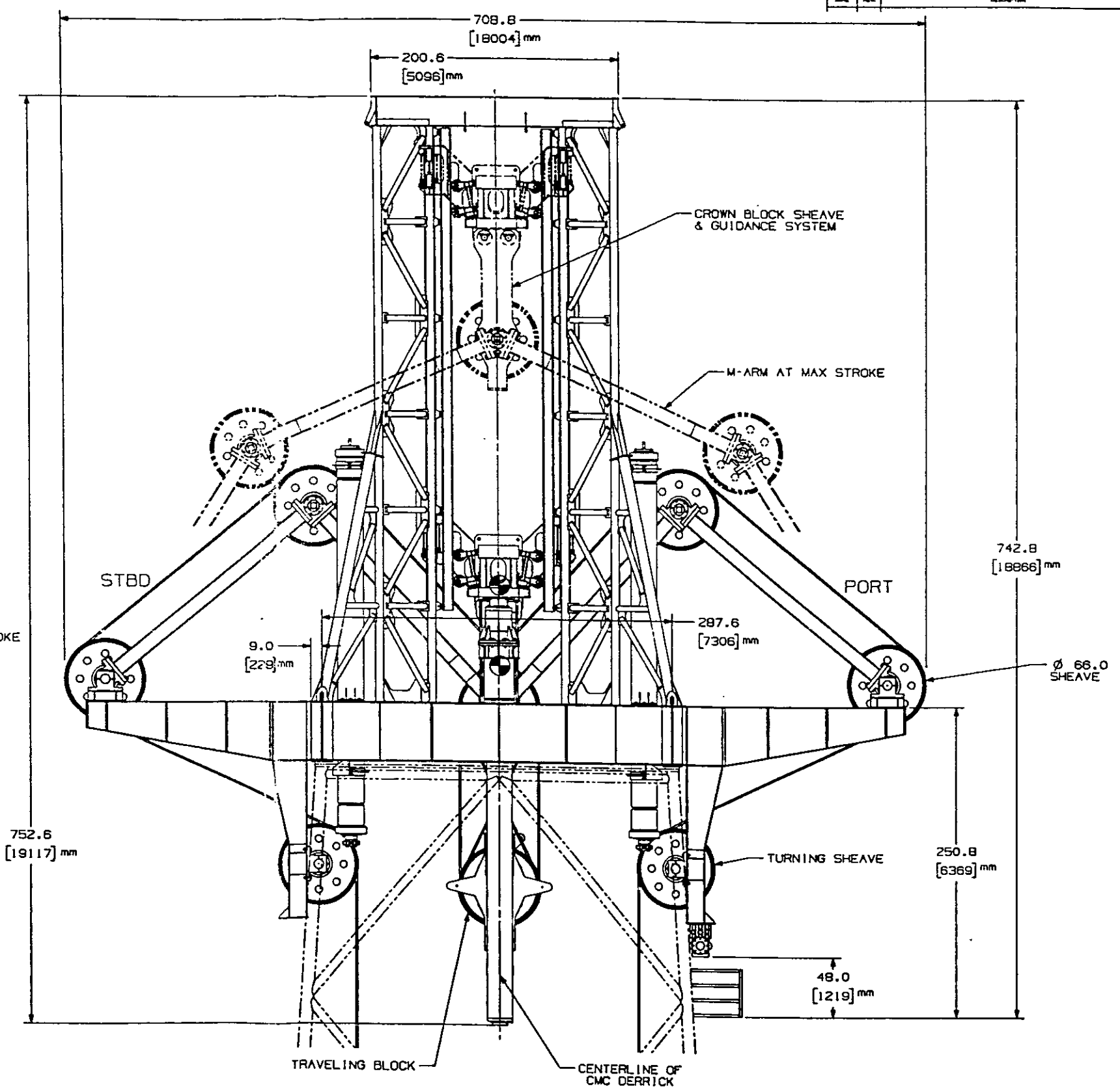
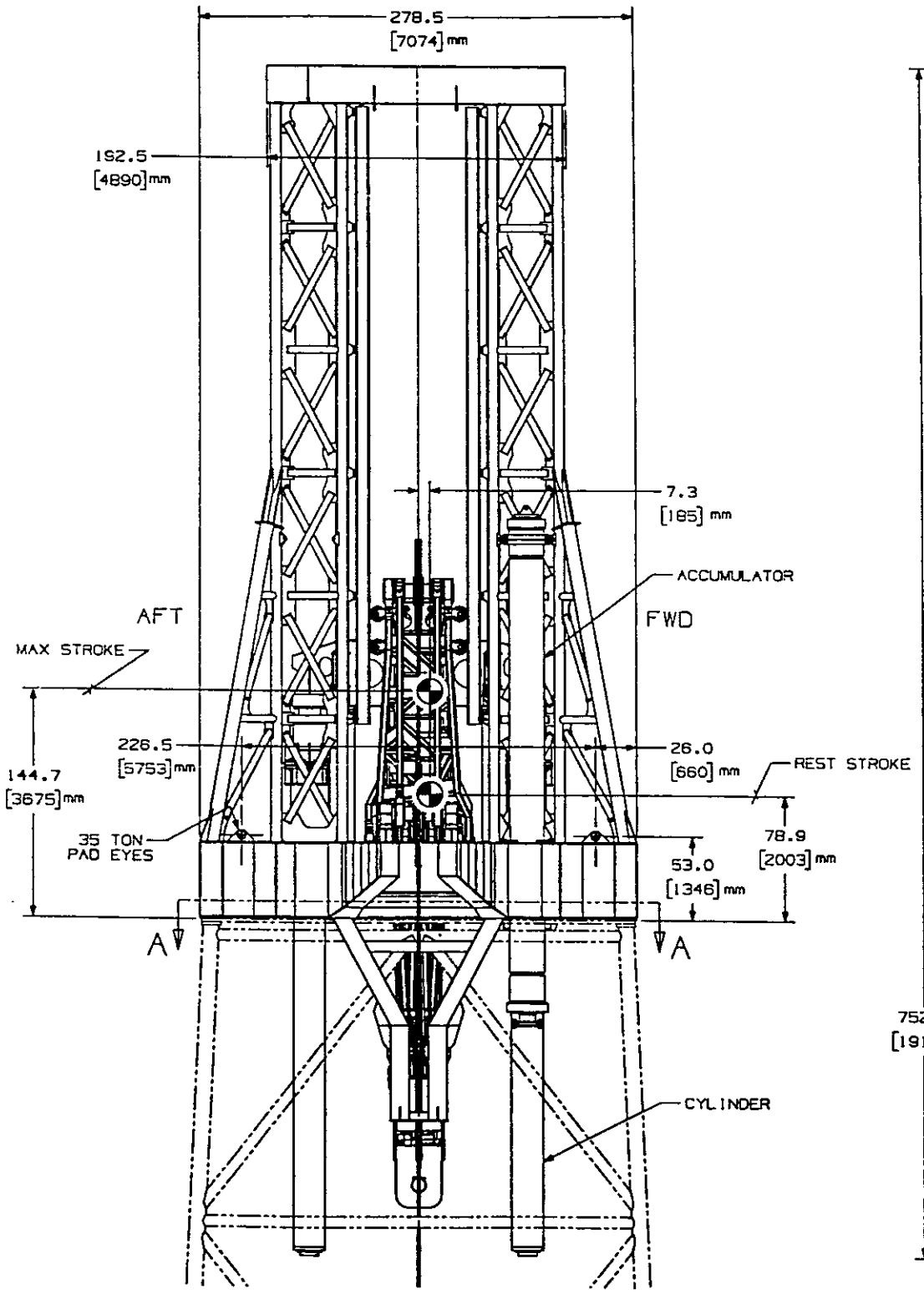
HEAVE COMPENSATORS

Introduction


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DWG NO. 2007381		REV. 1	
REV.	REV.	DESCRIPTION	DATE



NOTES: UNLESS OTHERWISE SPECIFIED
1. LADDERS, GRATING, LIFE RAILS OMITTED FOR CLARITY.

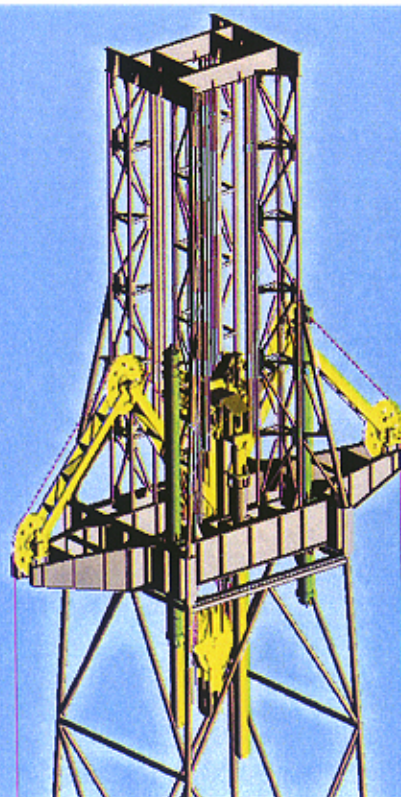
APPLICATION		EXCEPT AS NOTED	INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5	
TOP ASSY	SALES ORDER			
2007331	31750/MC	ALL DIMENSIONS ARE IN INCHES MACHINED DIMENSION TOLERANCES: ANGULAR ± .03° LINEAR .005 JCT ± .005 JCT ± .005 CASTING AND FAB TOLERANCES: F 1/16 ± .005 F 3/16 ± .005 F 1/2 ± .005 F 3/4 ± .005 F 1 ± .005 F 1 1/2 ± .005 F 2 ± .005 F 3 ± .005 F 4 ± .005 F 6 ± .005 F 8 ± .005 F 10 ± .005 F 12 ± .005 F 14 ± .005 F 16 ± .005 F 18 ± .005 F 20 ± .005 F 24 ± .005 F 30 ± .005 F 36 ± .005 F 42 ± .005 F 48 ± .005 F 54 ± .005 F 60 ± .005 F 72 ± .005 F 84 ± .005 F 96 ± .005 F 108 ± .005 F 120 ± .005 F 144 ± .005 F 168 ± .005 F 192 ± .005 F 216 ± .005 F 240 ± .005 F 264 ± .005 F 288 ± .005 F 312 ± .005 F 336 ± .005 F 360 ± .005 F 384 ± .005 F 408 ± .005 F 432 ± .005 F 456 ± .005 F 480 ± .005 F 504 ± .005 F 528 ± .005 F 552 ± .005 F 576 ± .005 F 600 ± .005 F 624 ± .005 F 648 ± .005 F 672 ± .005 F 696 ± .005 F 720 ± .005 F 744 ± .005 F 768 ± .005 F 792 ± .005 F 816 ± .005 F 840 ± .005 F 864 ± .005 F 888 ± .005 F 912 ± .005 F 936 ± .005 F 960 ± .005 F 984 ± .005 F 1008 ± .005 F 1032 ± 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CONTROL FLOW, INC./HMD
Crown Block Compensator
(600K - 1,000K Systems)

Fully Extended

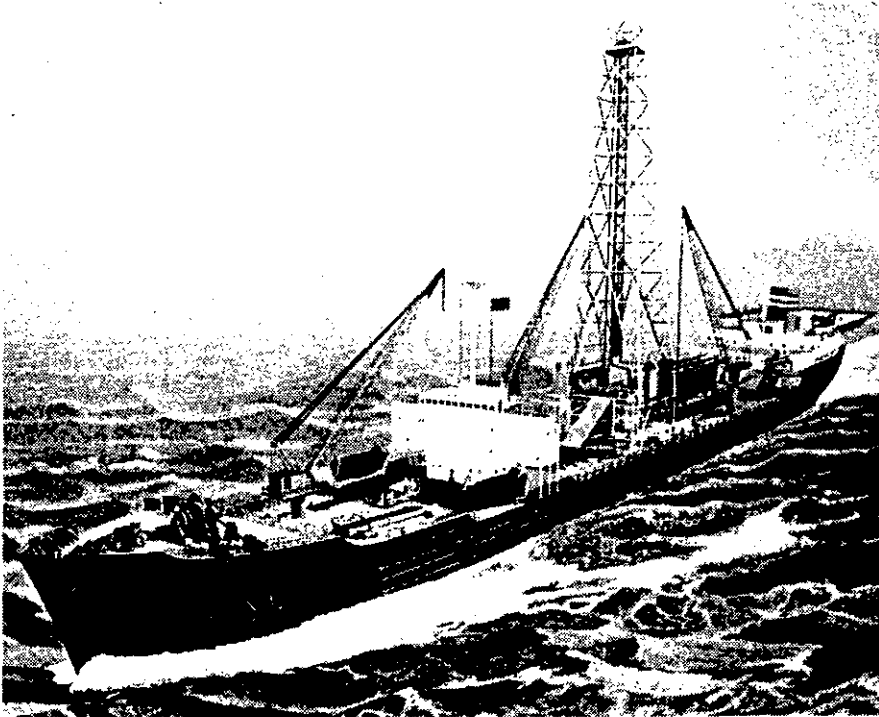
Mid Stroke

Fully Retracted

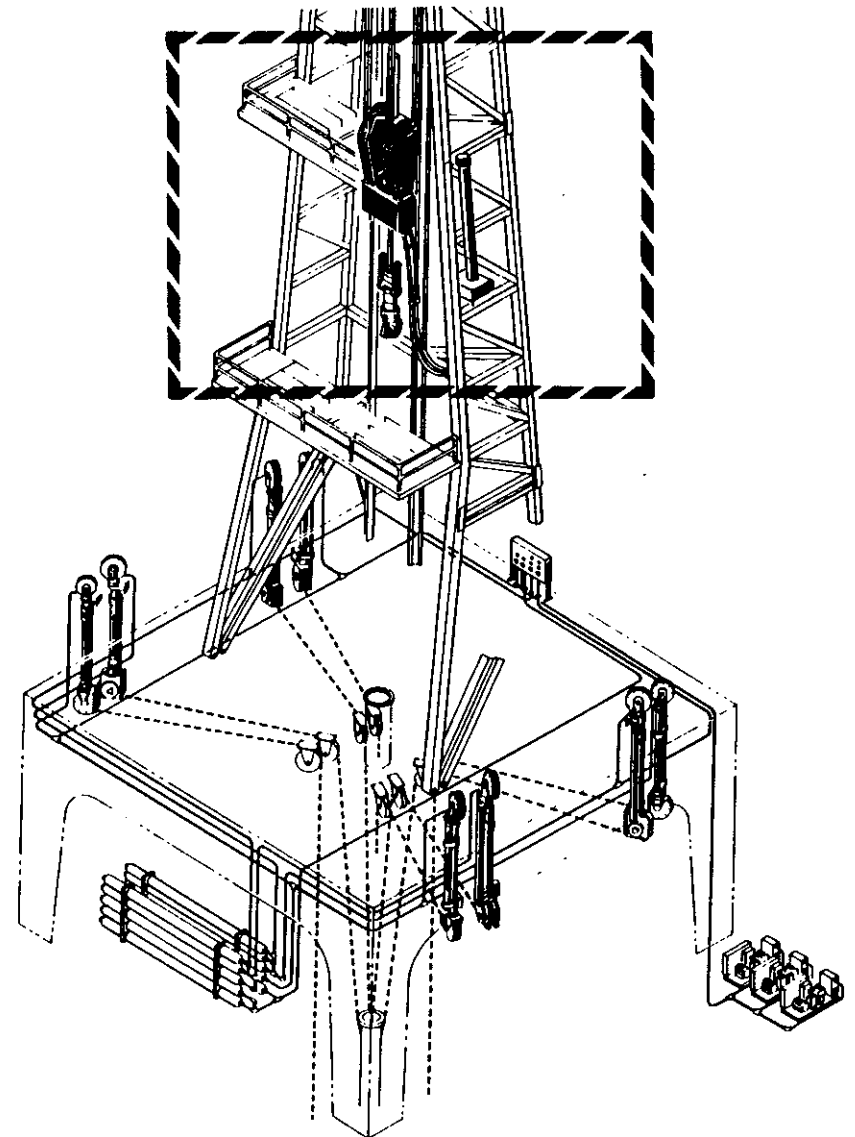


STROKE RANGE
(18 FT. - 25 FT.)

HEAVE COMPENSATOR



- A MECHANICAL SYSTEM TO RELIEVE THE HEAVE MOTION IMPACT OF A FLOATING DRILLING PLATFORM ON THE DRILL BIT.



PRODUCTIVITY FEATURES

REDUCED OPERATING COST

HIGH MECHANICAL EFFICIENCY

LIGHT TRAVELING BLOCK REDUCES WIRE ROPE WEAR

HYDRAULIC LOCK PERMITS FAST ADDING OF SINGLES

= POTENTIAL
COST SAVINGS

RELIABILITY

DURABLE CONSTRUCTION

MANUAL CONTROLS

SINGLE CYLINDER IN LINE WITH LOAD

= REDUCTION OF RISK
ELEMENTS INCREASES
COMPENSATOR LIFE

REDUCED SPACE

SHORT TRAVELING BLOCK LENGTH

EASY TO PENETRATE CROWN BLOCK WITH SINGLE CYLINDER

= MORE AVAILABLE
DERRICK SPACE

SAFETY FEATURES

SIMPLE LOAD PATH

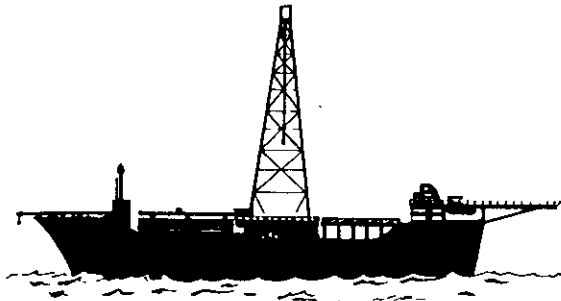
HIGH STATIC LOAD RATING

HANDLES DRILL PIPE FAILURE

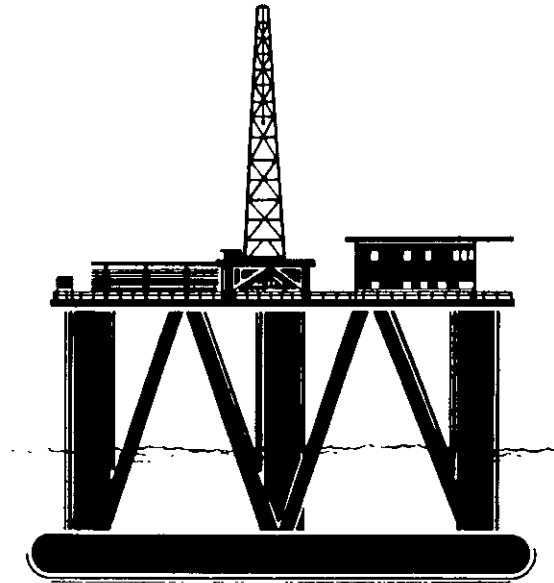
= RISK
REDUCTION

HEAVE COMPENSATOR APPLICATIONS

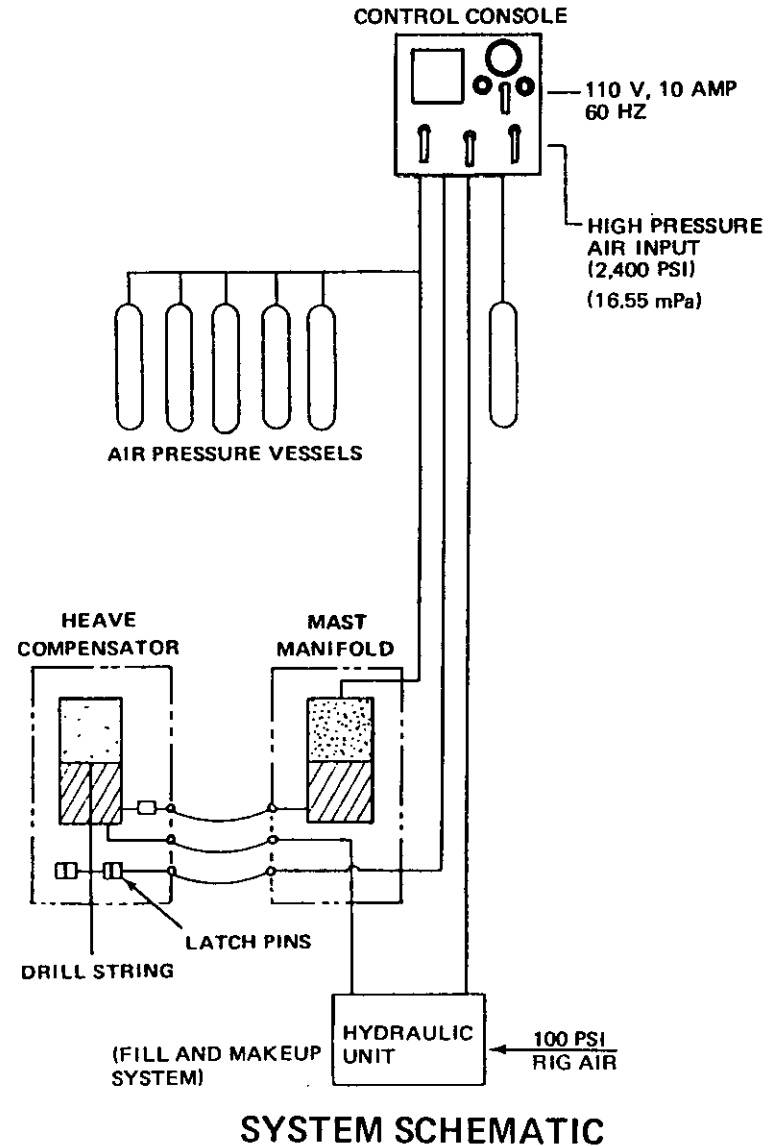
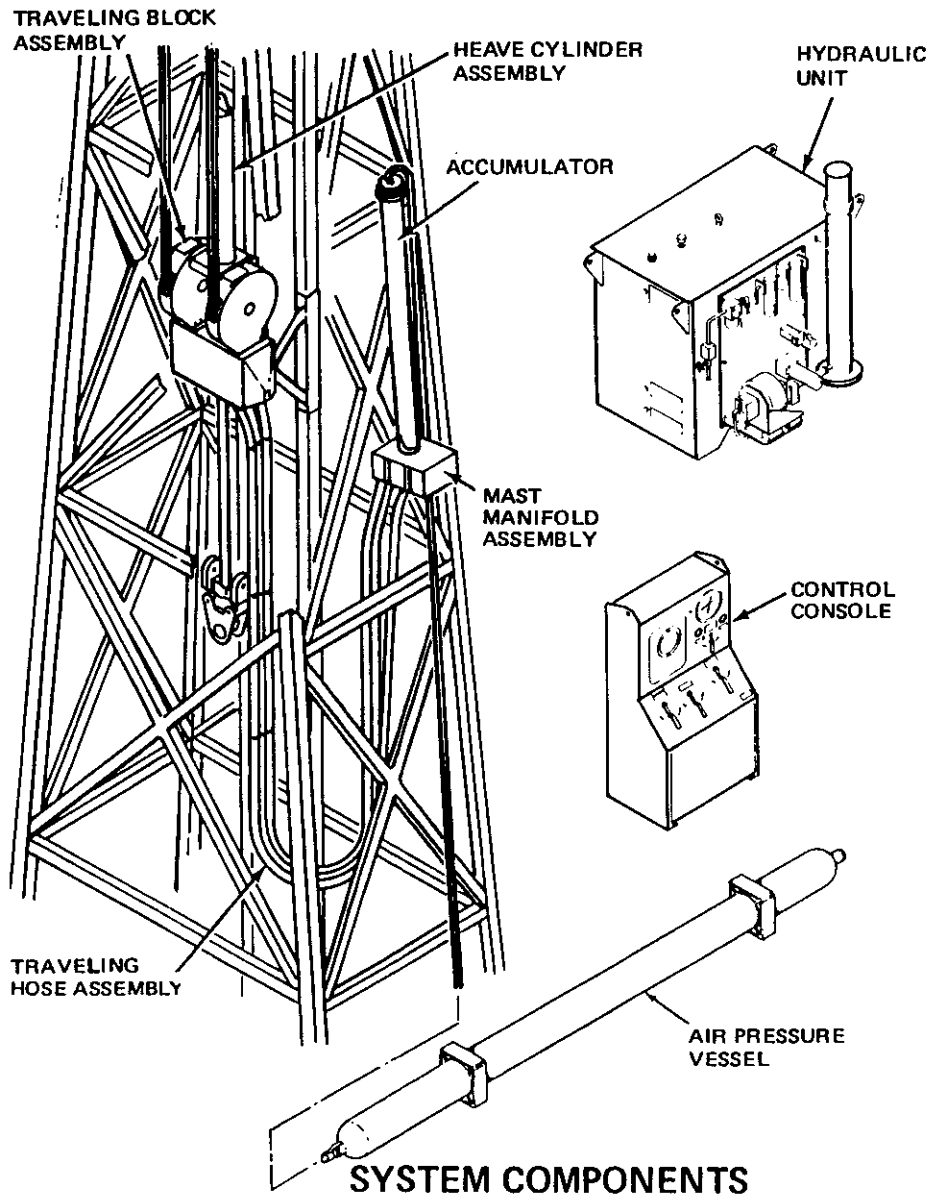
DRILLSHIPS



SEMI-SUBMERSIBLES



HEAVE COMPENSATOR SYSTEM

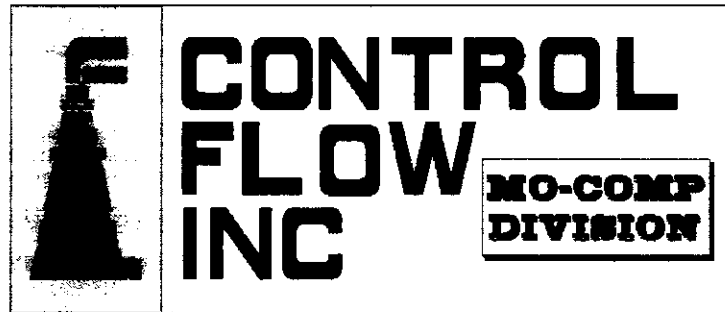


SPECIFICATIONS — 400K HEAVE COMPENSATORS

MODEL	HC-400-16-20C	HC-400-16-25C
LIFTING CAPACITY IN COMPENSATING MODE ROD END UP AND LATCHED	400,000 POUNDS (1,779 kN) 1,200,000 POUNDS (5,338 kN)	
ACCUMULATOR MAXIMUM PRESSURE	2,400 PSI (16.55 mPa)	
ACCUMULATOR VOLUME	23 CUBIC FEET (0.651 CUBIC METERS)	29.0 CUBIC FEET (.821 CUBIC METERS)
HEAVE CYLINDER STROKE MAXIMUM WORKING PRESSURE	20 FEET (6.1 METERS) 2,400 PSI (16.55 mPa)	25 FEET (7.62 METERS) 2,400 PSI (16.55 mPa)
HOSE ASSEMBLY	(2) 4 INCH I.D., 90 FEET 10.16 CM I.D., 27.43 METERS	
RESERVOIR OVERFLOW CAPACITY	467 GALLONS (1768 LITERS)	
AIR PRESSURE VESSEL MAXIMUM OPERATING PRESSURE SAFETY VALVE	2411 PSI (16.55 mPa) COMBINATION 3200 PSI (22.06 mPa) FRANGIBLE DISC & 208°F (98°C) FUSIBLE PLUG.	

SPECIFICATIONS — 650K HEAVE COMPENSATORS

MODEL	HC650-20-20	HC650-20-25
LIFTING CAPACITY IN COMPENSATING MODE ROD END UP AND LATCHED	650,000 POUNDS (2,891 kN) 1,600,000 POUNDS (7,177 kN)	
ACCUMULATOR MAXIMUM PRESSURE	2,400 PSI (16.6 mPa)	
ACCUMULATOR VOLUME	35.3 CUBIC FEET (1.0 CUBIC METER)	46.2 CUBIC FEET (1.30 CUBIC METERS)
HEAVE CYLINDER STROKE MAXIMUM WORKING PRESSURE	20 FEET (6.096 METERS) 2,400 PSI (16.55 mPa)	25 FEET (7.62 METERS) 2,400 PSI (16.55 mPa)
HOSE ASSEMBLY	(2) 5 INCH I.D., 90 FEET (12.7 CM I.D., 27.43 METERS)	
RESERVOIR OVERFLOW CAPACITY	685 GALLONS (2593 LITERS)	
AIR PRESSURE VESSEL MAXIMUM OPERATING PRESSURE SAFETY VALVE SETTING	2411 PSI (16.6 mPa) COMBINATION 3200 PSI (22.06 mPa) FRANGIBLE DISC & 208°F (98°C) FUSIBLE PLUG	

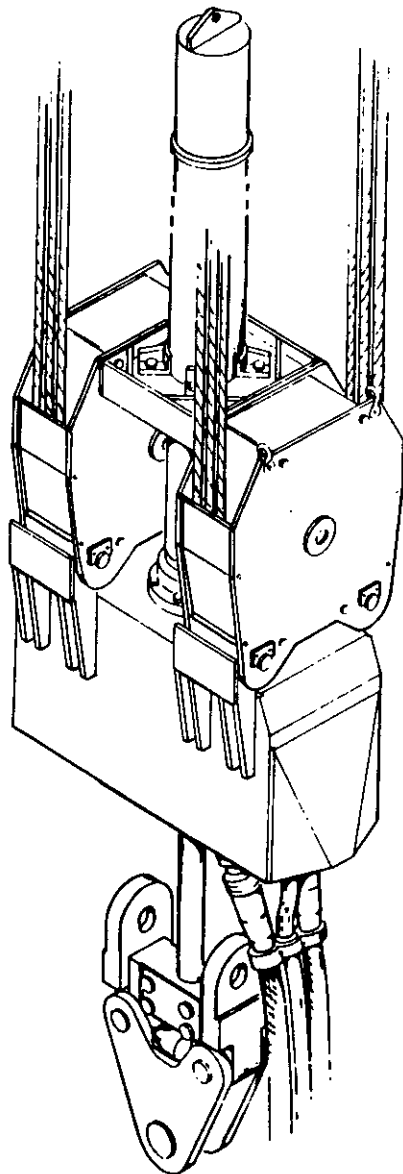


HEAVE COMPENSATORS

Mechanical Features

400K HEAVE COMPENSATOR TRAVELING BLOCK

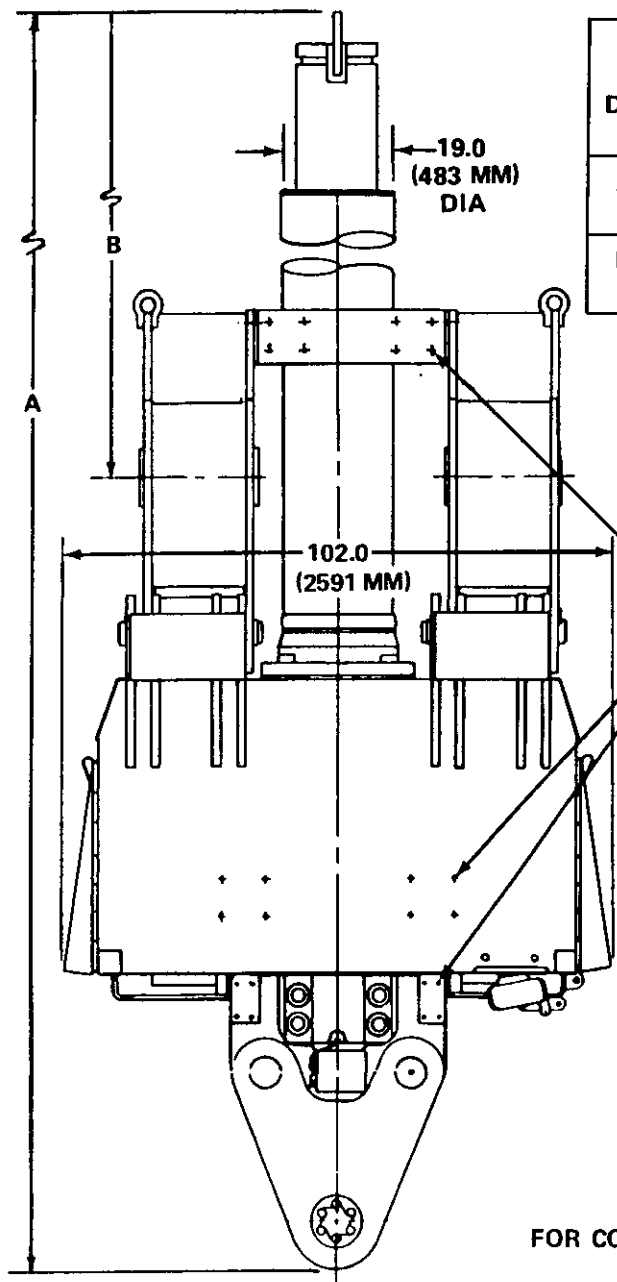
(WITH ACCUMULATOR ON MAST)



- SINGLE HYDRAULIC CYLINDER
- 2,400 PSI (16.55 mPa) SYSTEM
- WEIGHT OF UNIT INCLUDING SHEAVE BLOCK AND ROD END AND FLUID
 - MODEL HC400-16-20C 46000 LBS (20865 KG)
 - MODEL HC400-16-25C 48600 LBS (22045 KG)
- WORKING CAPACITY 400,000 LBS (1,779 kN)
- MAX STATIC LOAD 1,200,000 LBS (5,338 kN)
- SPLIT TRAVELING BLOCK
- TWO (2) 4" (10.16 CM) HYDRAULIC SUPPLY LINES
- SHUTOFF SAFETY VALVE FOR HOSE OR DRILL STRING FAILURE OR USE AS BLOCKING VALVE FOR CHANGING SINGLES
- SHEAVES INCLUDED
- WIRE ROPE SIZE (STANDARD) – 1.50 DIA (38.0 MM)
- CAPABLE OF REEVING FOR 8, 10 OR 12 PART LINE

400K TRAVELING BLOCK INSTALLATION

(WITH ACCUMULATOR ON MAST)



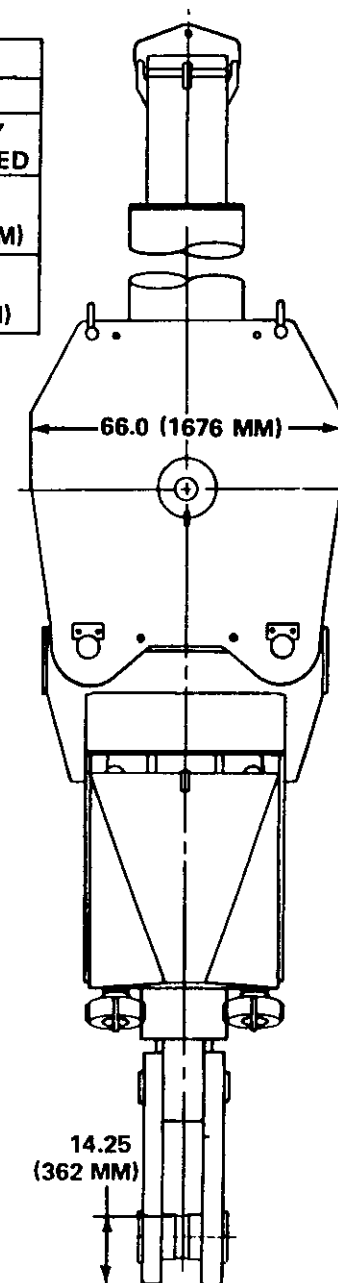
DIM	MODEL			
	HC400-16-20C		HC400-16-25C	
	FULLY RETRACTED	FULLY EXTENDED	FULLY RETRACTED	FULLY EXTENDED
A	372.50 (9462 MM)	612.50 (15558 MM)	432.50 (10986 MM)	732.50 (18606 MM)
B	225.5 (5728 MM)	225.5 (5728 MM)	285.5 (7251 MM)	285.5 (7251 MM)

MOUNTING HOLES FOR
CUSTOMER FURNISHED
GUIDE ROLLERS

NOTES:

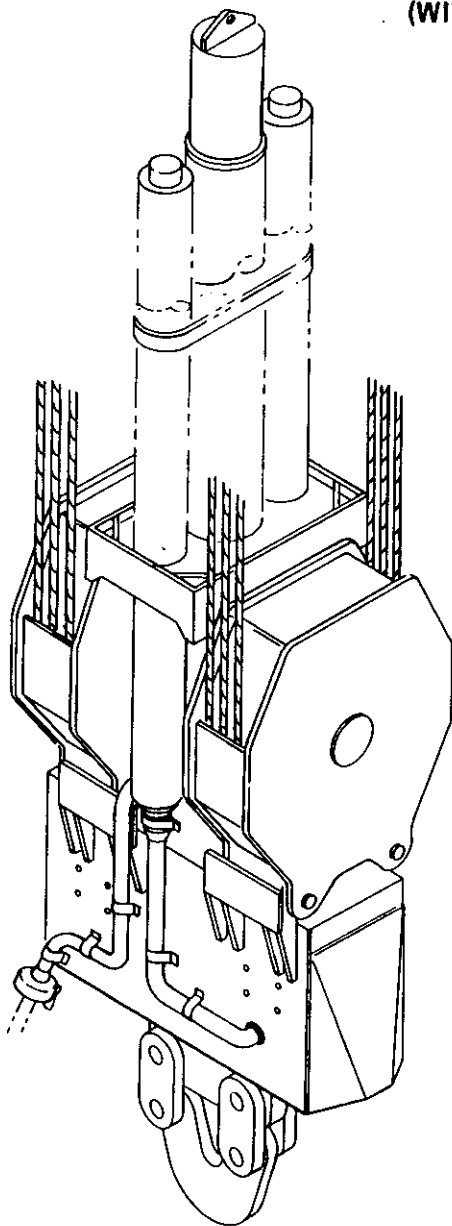
1. CAPABLE OF 8, 10, & 12
PART LINE OPERATION
2. DESIGNED FOR 1-1/2 INCH
(38 MM) WIRE ROPE (STANDARD)

FOR COMPLETE DETAILS REQUEST INSTALLATION DRAWINGS



400K HEAVE COMPENSATOR TRAVELING BLOCK

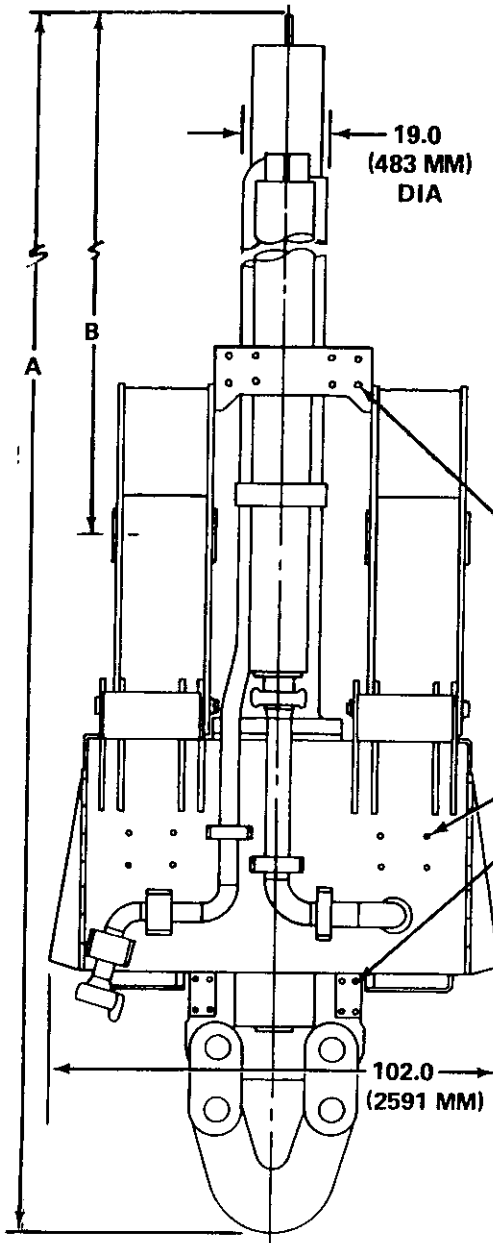
(WITH ACCUMULATORS ON TRAVELING BLOCK)



- SINGLE HYDRAULIC CYLINDER
- 2,400 PSI (16.55 mPa) SYSTEM
- WEIGHT OF UNIT INCLUDING SHEAVE BLOCK AND ROD END AND FLUID
 - MODEL HC400-16-20C 53,400 LBS (24,218 KG)
 - MODEL HC400-16-25C 57,600 LBS (26,122 KG)
- WORKING CAPACITY 400,000 LBS (1,779 kN)
- MAX STATIC LOAD 1,200,000 LBS (5,338 kN)
- SPLIT TRAVELING BLOCK
- TWO (2) 3.5" (8.89 CM) AIR SUPPLY LINES
- SHUTOFF SAFETY VALVE FOR HOSE OR DRILL STRING FAILURE OR USE AS BLOCKING VALVE FOR CHANGING SINGLES
- SHEAVES INCLUDED
- WIRE ROPE SIZE (STANDARD) – 1.50 DIA (38.0 MM)
- CAPABLE OF REEVING FOR 8, 10 OR 12 PART LINE

400K TRAVELING BLOCK INSTALLATION

(WITH ACCUMULATORS ON TRAVELING BLOCK)

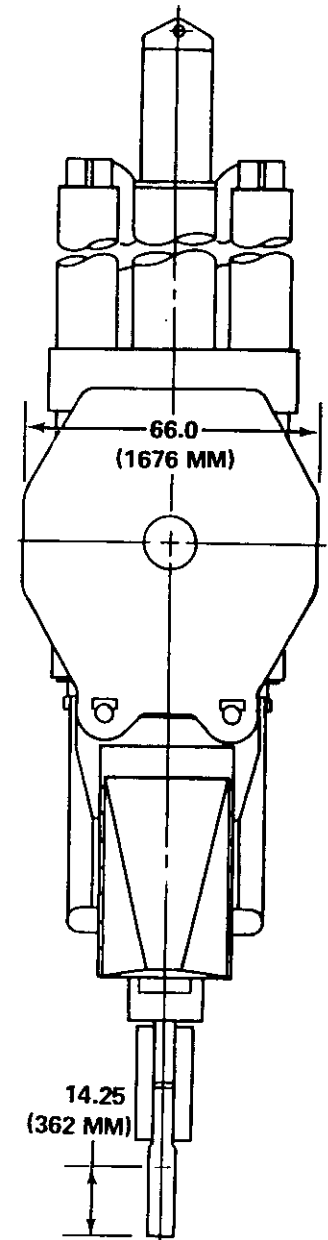


DIM	MODEL			
	HC400-16-20C		HC400-16-25C	
	FULLY RETRACTED	FULLY EXTENDED	FULLY RETRACTED	FULLY EXTENDED
A	372.50 (9462 MM)	612.50 (15558 MM)	432.50 (10986 MM)	732.50 (18606 MM)
B	225.5 (5728 MM)	225.5 (5728 MM)	285.5 (7251 MM)	285.5 (7251 MM)

MOUNTING HOLES FOR
CUSTOMER FURNISHED
GUIDE ROLLERS

NOTES:

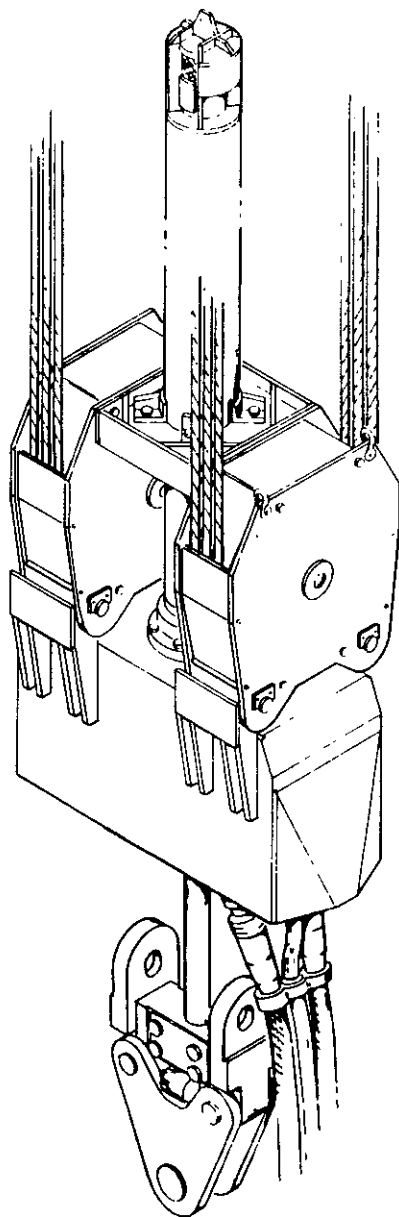
1. CAPABLE OF 8, 10, & 12
PART LINE OPERATION
2. DESIGNED FOR 1-1/2 INCH
(38 MM) WIRE ROPE (STANDARD)



FOR COMPLETE DETAILS REQUEST INSTALLATION DRAWINGS

650K HEAVE COMPENSATOR TRAVELING BLOCK

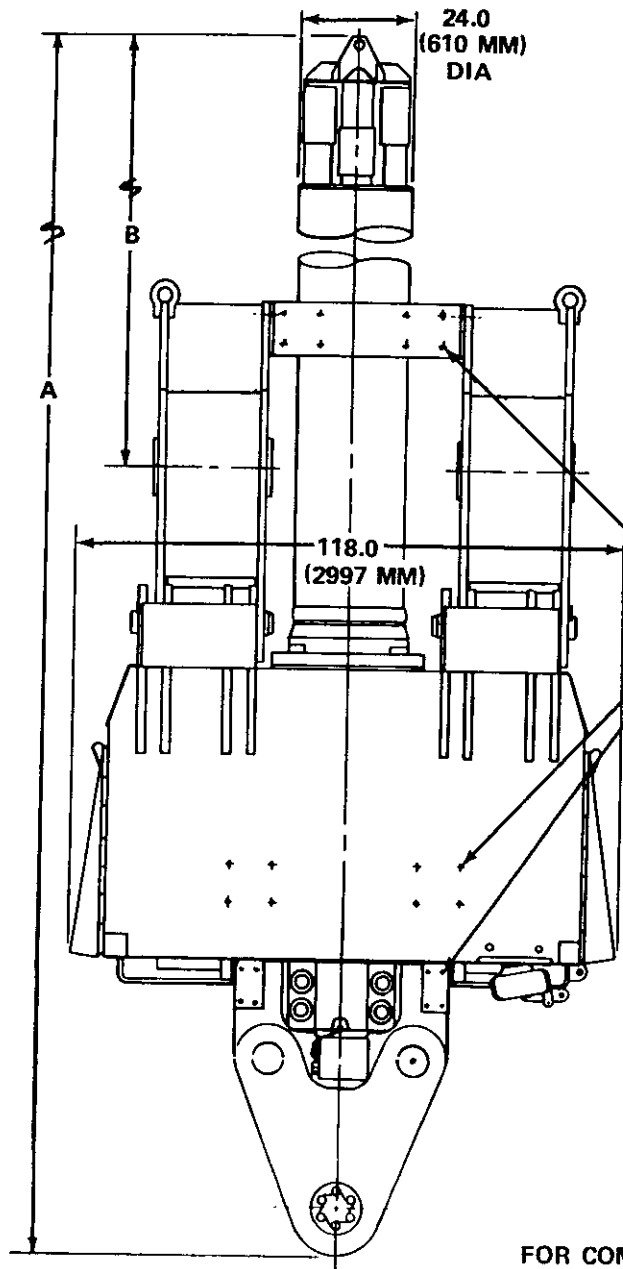
(WITH ACCUMULATOR ON MAST)



- SINGLE HYDRAULIC CYLINDER
- 2,400 PSI (16.55 mPa) SYSTEM
- WEIGHT OF UNIT INCLUDING SHEAVE BLOCK ASSY, ROD END AND FLUID
 - MODEL HC650-20-20 67000 LBS (30390 KG)
 - MODEL HC650-20-25 70600 LBS (32024 KG)
- WORKING CAPACITY 650,000 LBS (2891 kN)
- MAX STATIC LOAD 1,600,000 LBS (7177 kN)
- SPLIT TRAVELING BLOCK
- TWO (2) 5" (12.7 CM) HYDRAULIC SUPPLY LINES
- SHUTOFF SAFETY VALVE FOR HOSE OR DRILL STRING FAILURE OR USE AS BLOCKING VALVE FOR CHANGING SINGLES
- SHEAVES INCLUDED
- WIRE ROPE SIZE (STANDARD) – 1.75 DIA (44.5 MM)
- CAPABLE OF REEVING FOR 8, 10 OR 12 PART LINE

650K TRAVELING BLOCK INSTALLATION

(WITH ACCUMULATOR ON MAST)



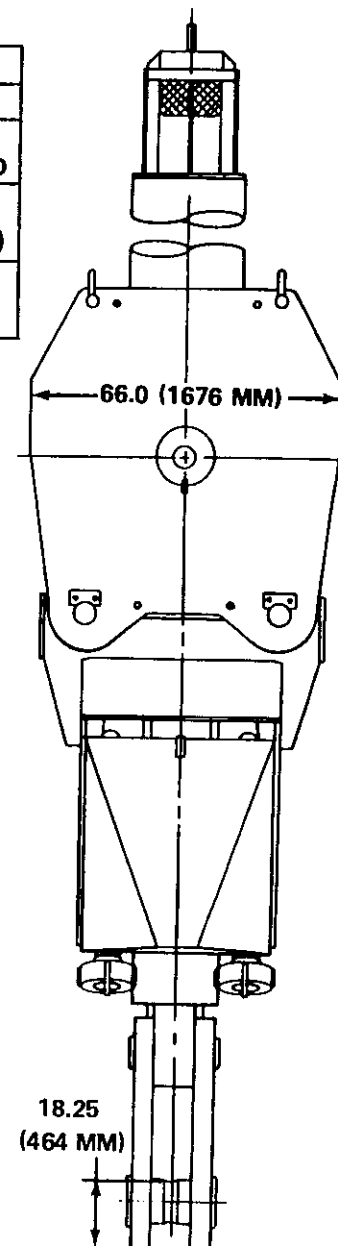
DIM	MODEL			
	HC650-20-20		HC650-20-25	
	FULLY RETRACTED	FULLY EXTENDED	FULLY RETRACTED	FULLY EXTENDED
A	399.5 (10147 MM)	639.5 (16243 MM)	459.5 (11671 MM)	759.5 (19291 MM)
B	221.0 (5613 MM)	221.0 (5613 MM)	281.0 (7137 MM)	281.0 (7137 MM)

MOUNTING HOLES FOR
CUSTOMER FURNISHED
GUIDE ROLLERS

NOTES:

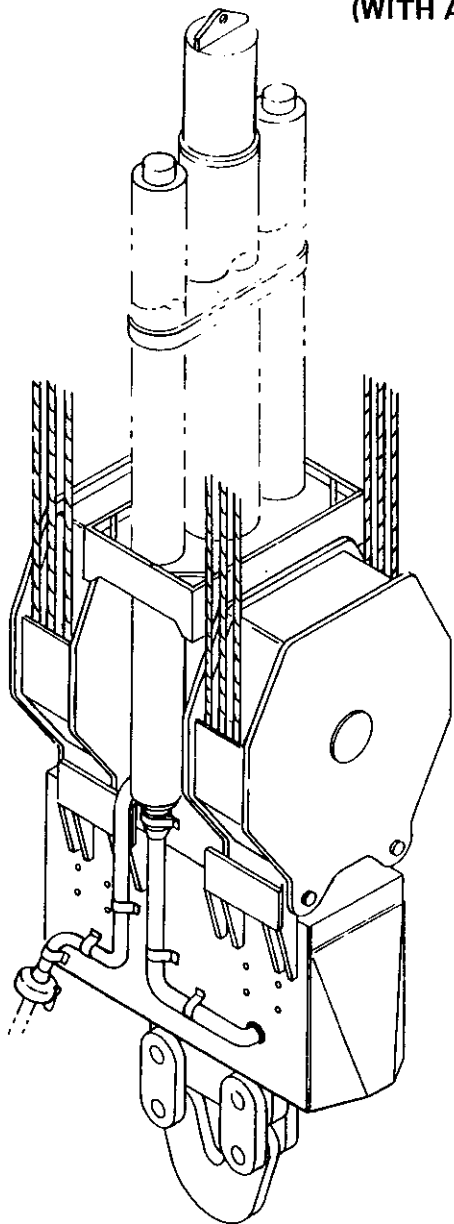
1. CAPABLE OF 8, 10 & 12
PART LINE OPERATION
2. DESIGNED FOR 1.75 INCH
(44.5 MM) WIRE ROPE

FOR COMPLETE DETAILS REQUEST INSTALLATION DRAWINGS



650K HEAVE COMPENSATOR TRAVELING BLOCK

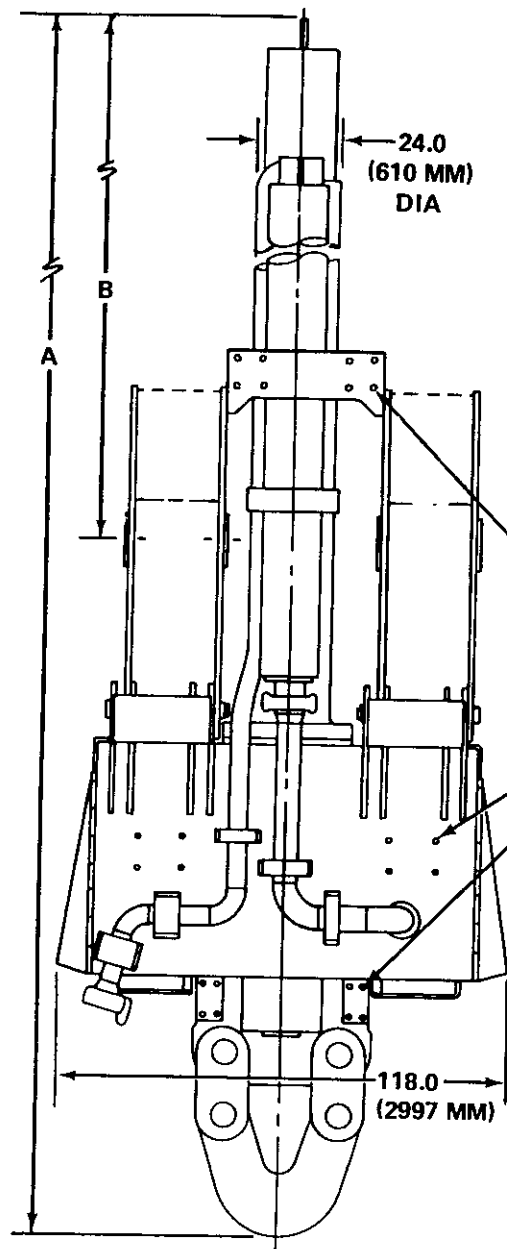
(WITH ACCUMULATOR ON TRAVELING BLOCK)



- SINGLE HYDRAULIC CYLINDER
- 2,400 PSI (16.55 mPa) SYSTEM
- WEIGHT OF UNIT INCLUDING SHEAVE BLOCK ASSY, ROD END AND FLUID
 - MODEL HC650-20-20 78,200 LBS (35,465 KG)
 - MODEL HC650-20-25 84,500 LBS (38,322 KG)
- WORKING CAPACITY 650,000 LBS (2891 kN)
- MAX STATIC LOAD 1,600,000 LBS (7177 kN)
- SPLIT TRAVELING BLOCK
- TWO (2) 4" (10.16 CM) AIR SUPPLY LINES
- SHUTOFF SAFETY VALVE FOR HOSE OR DRILL STRING FAILURE OR USE AS BLOCKING VALVE FOR CHANGING SINGLES
- SHEAVES INCLUDED
- WIRE ROPE SIZE (STANDARD) – 1.75 DIA (44.5 MM)
- CAPABLE OF REEVING FOR 8, 10 OR 12 PART LINE

650K TRAVELING BLOCK INSTALLATION

(WITH ACCUMULATOR ON TRAVELING BLOCK)

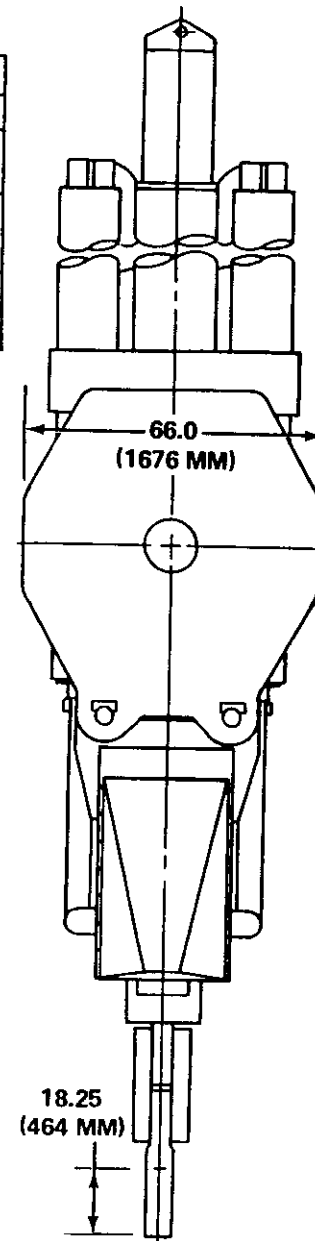


DIM	MODEL			
	HC650-20-20		HC650-20-25	
	FULLY RETRACTED	FULLY EXTENDED	FULLY RETRACTED	FULLY EXTENDED
A	399.50 (10147 MM)	639.5 (16243 MM)	459.5 (11671 MM)	759.50 (19291 MM)
B	221.0 (5613 MM)	221.0 (5613 MM)	281.0 (7137 MM)	281.0 (7137 MM)

MOUNTING HOLES FOR
CUSTOMER FURNISHED
GUIDE ROLLERS

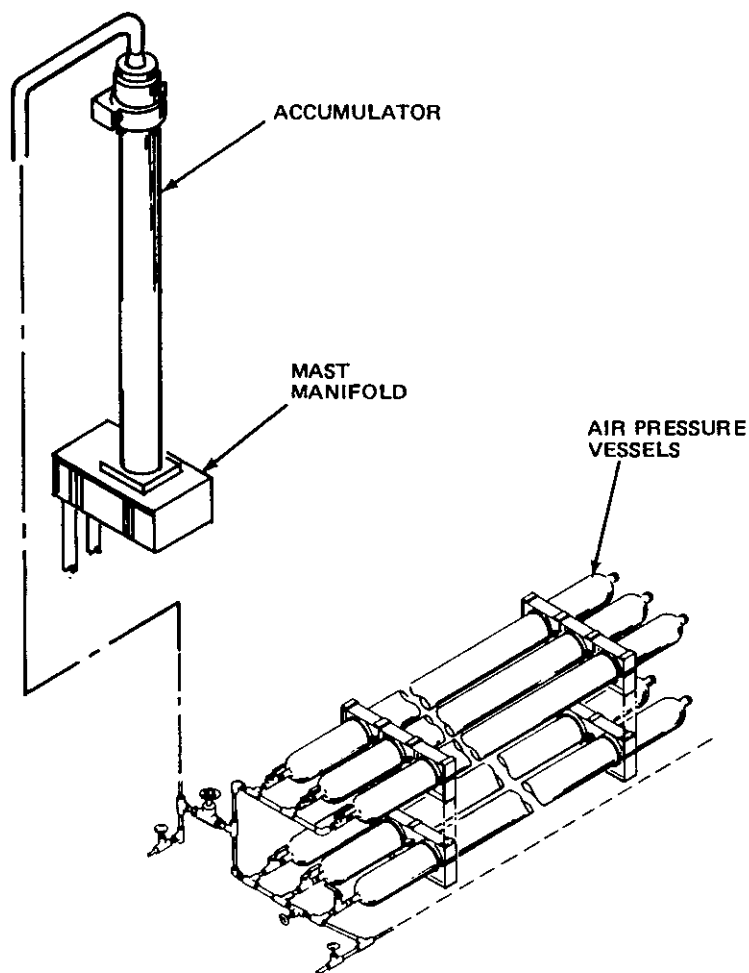
NOTES:

1. CAPABLE OF 8, 10 & 12
PART LINE OPERATION
2. DESIGNED FOR 1.75 INCH
(44.5 MM) WIRE ROPE



FOR COMPLETE DETAILS REQUEST INSTALLATION DRAWINGS

AIR PRESSURE SYSTEM

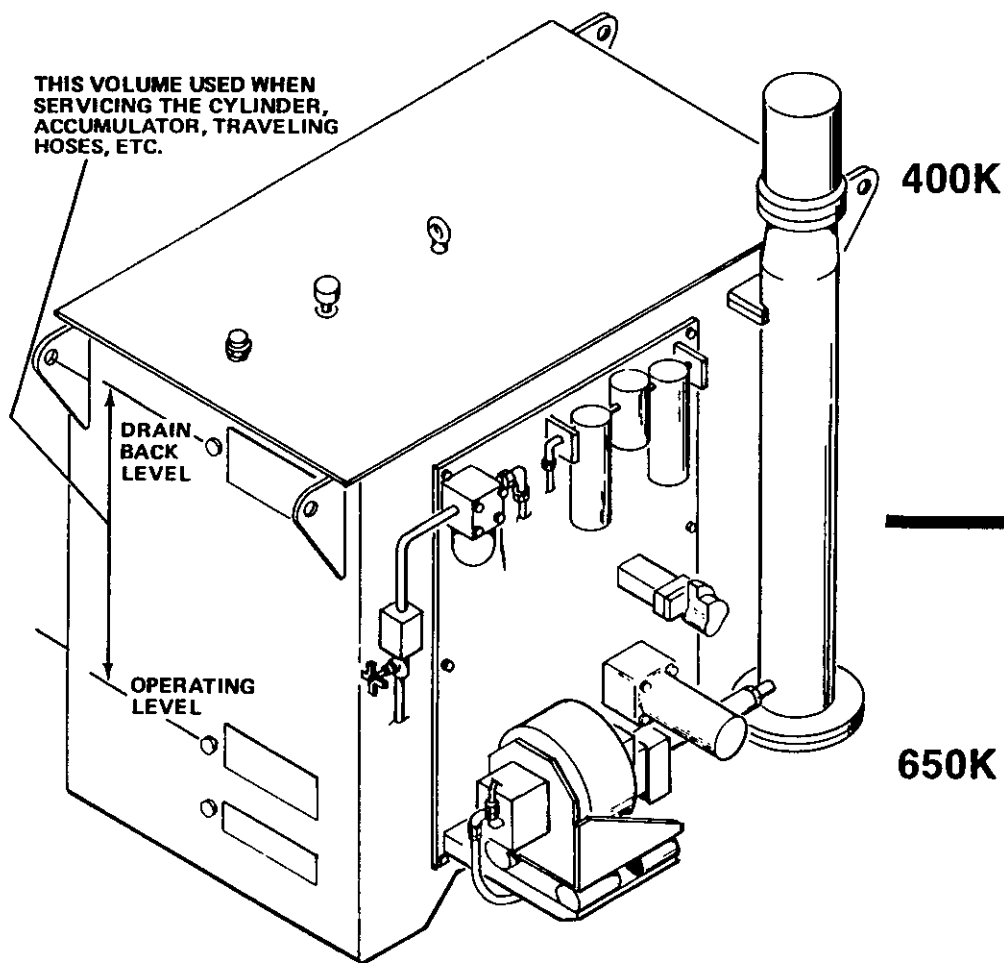


- 2,400 PSI (16.55 mPa) SYSTEM
- EACH VESSEL CONTAINS 37 CU. FT. (1047 LITERS)
- ACCUMULATOR CONTAINS OIL TO AIR INTERFACE
- MAST MANIFOLD PLUMBS INTO TWO (2) HYDRAULIC LINES TO HEAVE COMPENSATOR
- INTERCONNECTING PIPING TO APV'S FURNISHED BY CUSTOMER
- NUMBER OF APV'S

HEAVE COMP MODEL	NUMBER OF APV'S		TOTAL WEIGHT OF APV'S
	ACTIVE	STANDBY	
HC400-16-20C	5	1	32100 LBS (14568 KG)
HC400-16-25C	6	1	37450 LBS (16996 KG)
HC650-20-20	8	2	53500 LBS (24280 KG)
HC650-20-25	9	2	58850 LBS (26708 KG)

FOR COMPLETE DETAILS, REQUEST INSTALLATION DRAWINGS

HYDRAULIC UNIT

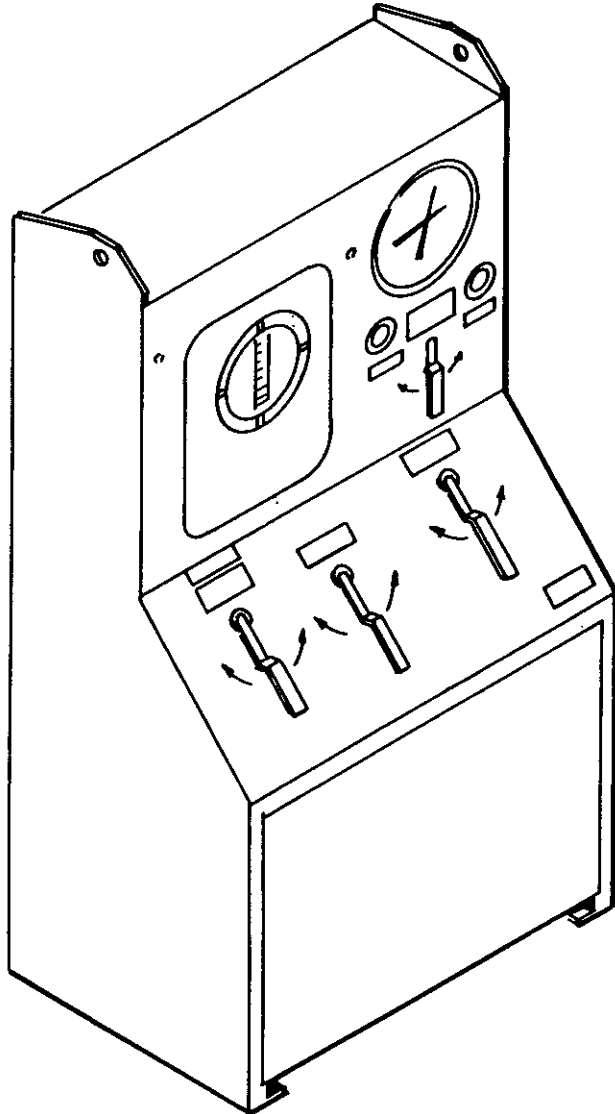


FOR COMPLETE DETAILS, REQUEST INSTALLATION DRAWINGS

- COMPLETE PNEUMATIC OPERATION
- RUGGED CONSTRUCTION
- PUMPING CAPACITY— 1.75 GPM (6.6 LITERS/MIN) AT 2400 PSI (16.55 mPa)
6 GPM (22.7 LITERS/MIN) AT 200 PSI (1379 kPa)
- TANK CAPACITY— 467 GALLONS (1768 LITERS)
SIZE 60 x 75 x 75.5 INCHES (1.52 x 1.90 x 1.92 METERS)
- WEIGHT: DRY— 2400 LBS (1089 KG)
WET— 5950 LBS (2699 KG)
(OVERFLOW CONDITION)
- AIR REQUIREMENT FOR AIR MOTOR — 200 SCFM AT 100 PSIG (95 LITERS/SEC AT 690 kPa)

- COMPLETE PNEUMATIC OPERATION
- RUGGED CONSTRUCTION
- PUMPING CAPACITY— 3 GPM (12 LITERS/MIN) AT 2400 PSI (16.55 mPa)
15 GPM (57 LITERS/MIN) AT 200 1379 kPa)
- TANK CAPACITY— 685 GALLONS (2593 LITERS)
- SIZE 68.5 x 87.12 x 75 INCHES (1.74 x 2.21 x 1.91 METERS)
- WEIGHT: DRY— 3208 LBS (1455 KG)
WET— 8500 LBS (3855 KG)
(OVERFLOW CONDITION)
- AIR REQUIREMENT FOR AIR MOTOR — 300 SCFM AT 100 PSIG (140 LITERS/SEC AT 690 kPa)

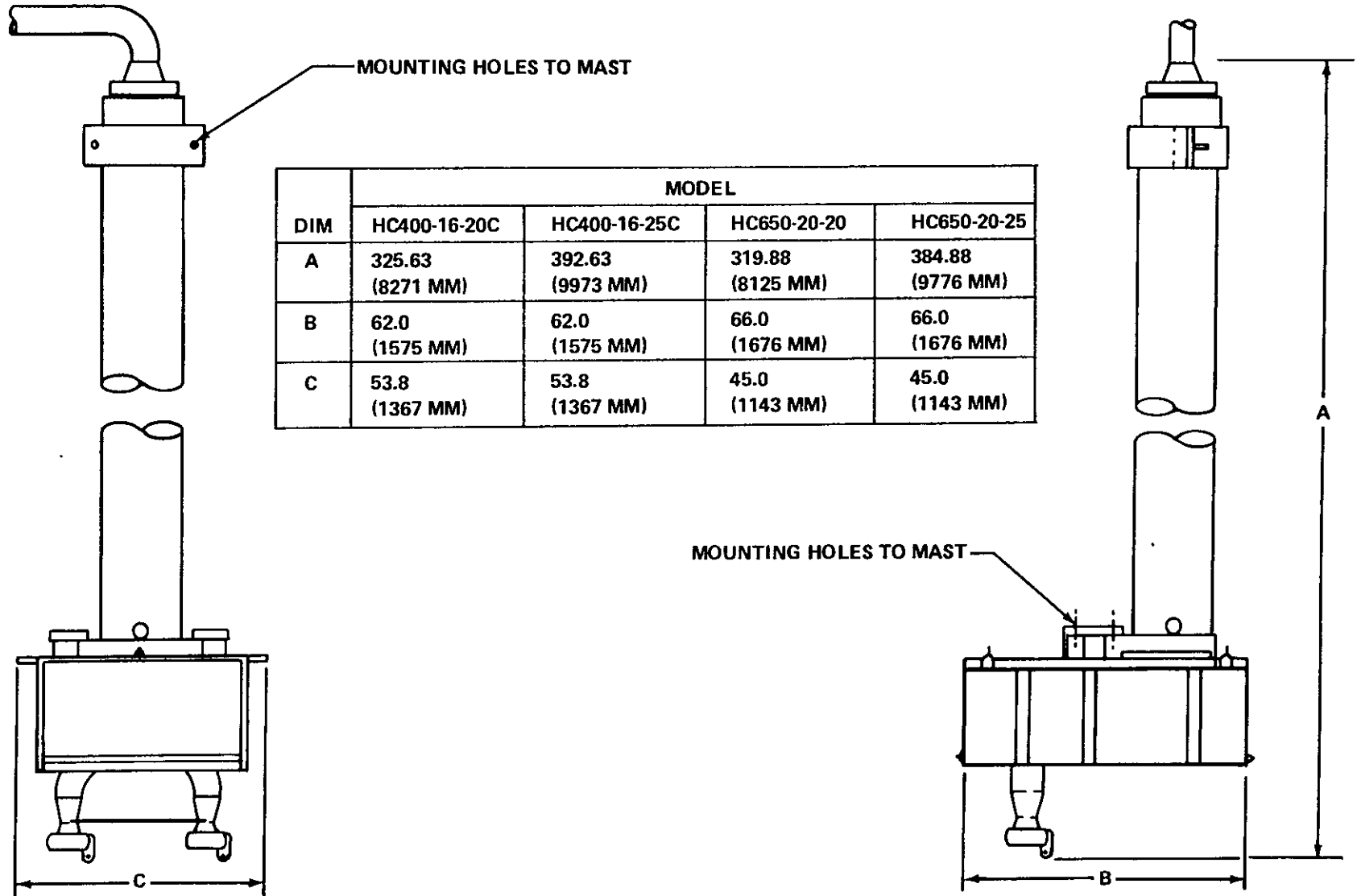
RIG FLOOR CONTROL CONSOLE



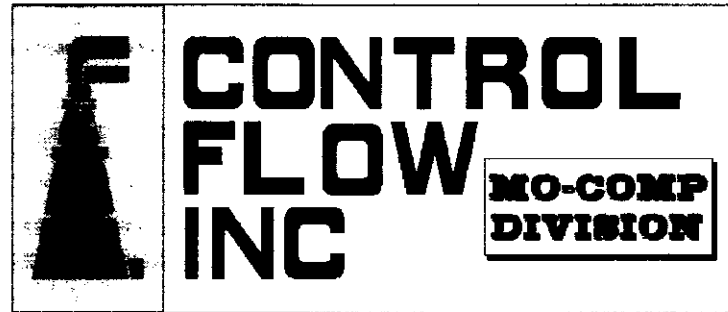
- STROKE INDICATOR (NON-CONTACTING SONAR DESIGN)
- RUGGED CONSTRUCTION
- STANDBY AIR PRESSURE GAGE AND ACTIVE AIR/HYD PRESSURE (DUPLEX) GAGE
- OPERATION CONTROL VALVES ACCOMPANIED BY ON-OFF LIGHTS
- ALL ELECTRIC COMPONENTS IN EXPLOSION PROOF ENCLOSURE
- SMALL IN SIZE 24.5 x 37 x 63.2 INCHES (.62 x .94 x 1.6 METERS)
- WEIGHT = 700 POUNDS (318 KG)

FOR COMPLETE DETAILS, REQUEST INSTALLATION DRAWINGS

MAST MANIFOLD INSTALLATION



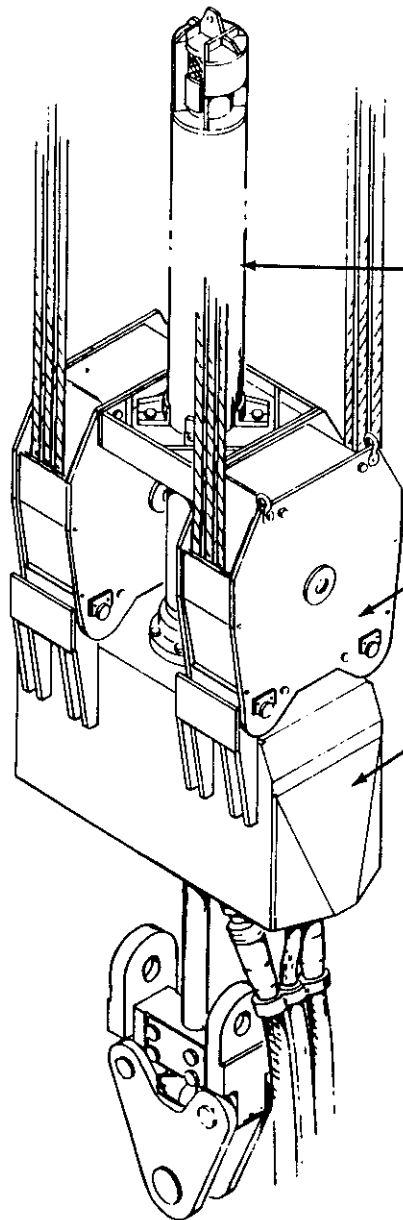
FOR COMPLETE DETAILS, REQUEST INSTALLATION DRAWINGS



HEAVE COMPENSATORS

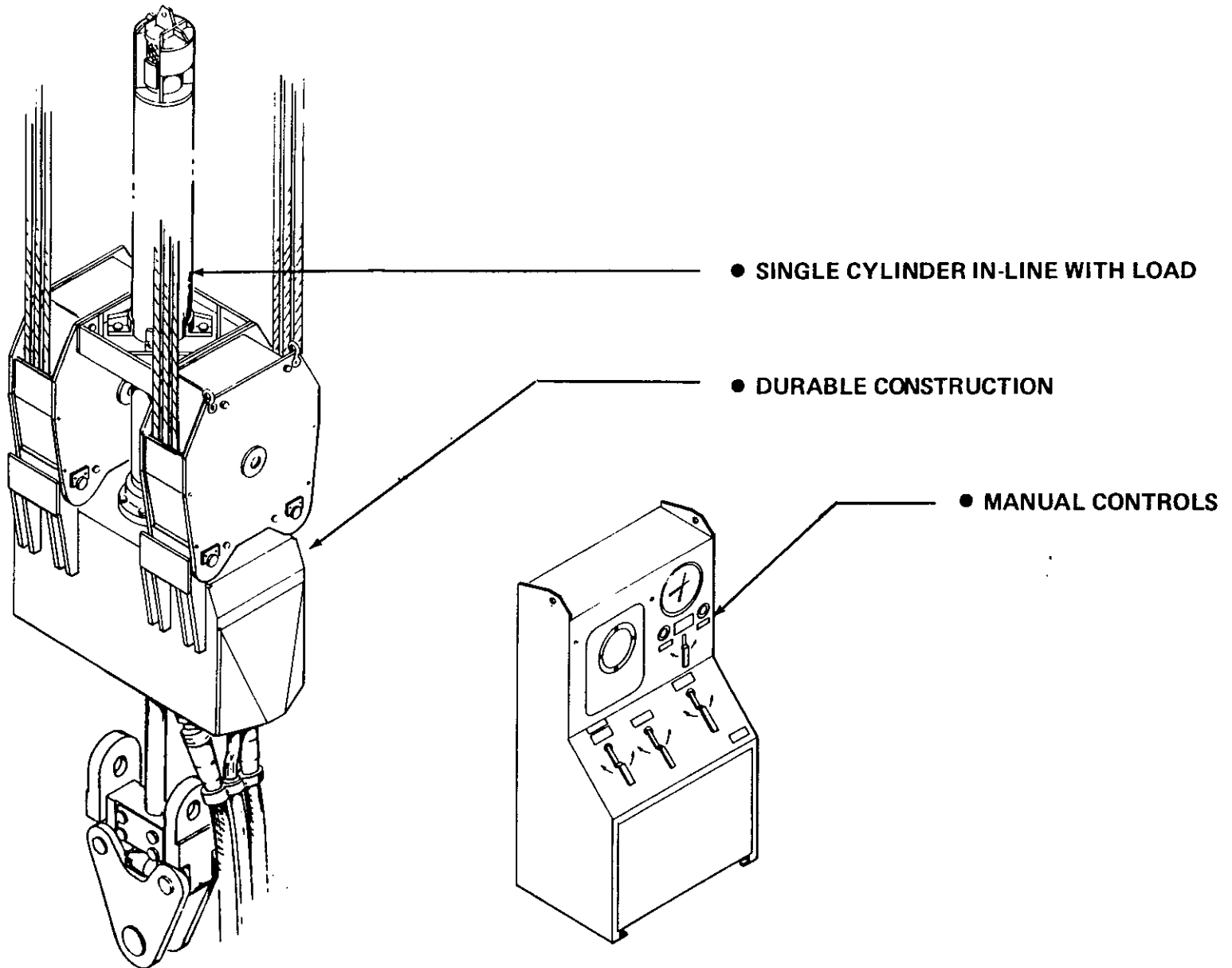
High Productivity Features

REDUCED OPERATING COST

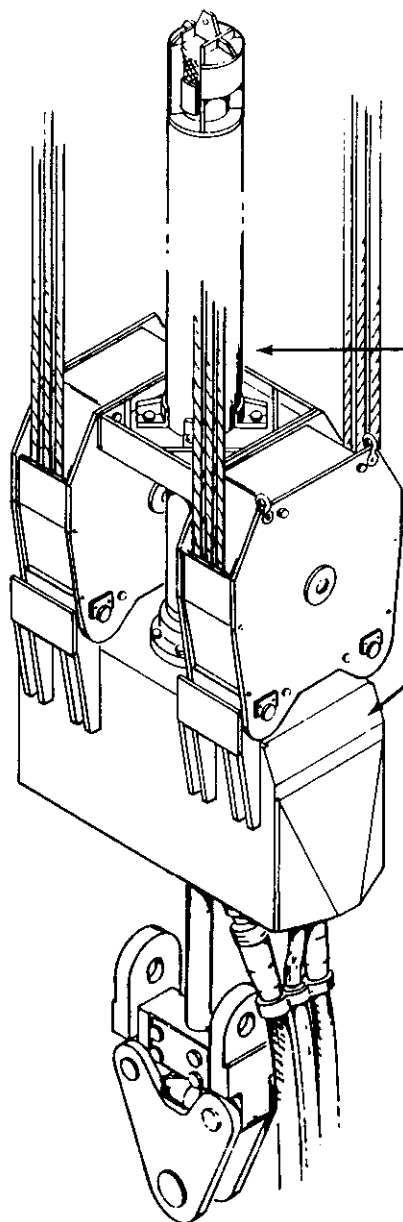


- HIGH MECHANICAL EFFICIENCY IN AIR BACKED HYDRAULIC SYSTEM
- LIGHT WEIGHT TRAVELING BLOCK REDUCES WIRE ROPE WEAR
- HYDRAULIC VALVE PERMITS THE SYSTEM TO BE LOCKED AT ANY STROKE POSITION. DO NOT HAVE TO FULLY RETRACT PISTON ROD AND MECHANICALLY LOCK, THUS SAVING TIME WHEN ADDING A SINGLE FOR DRILLING.

REDUCTION OF RISK ELEMENTS



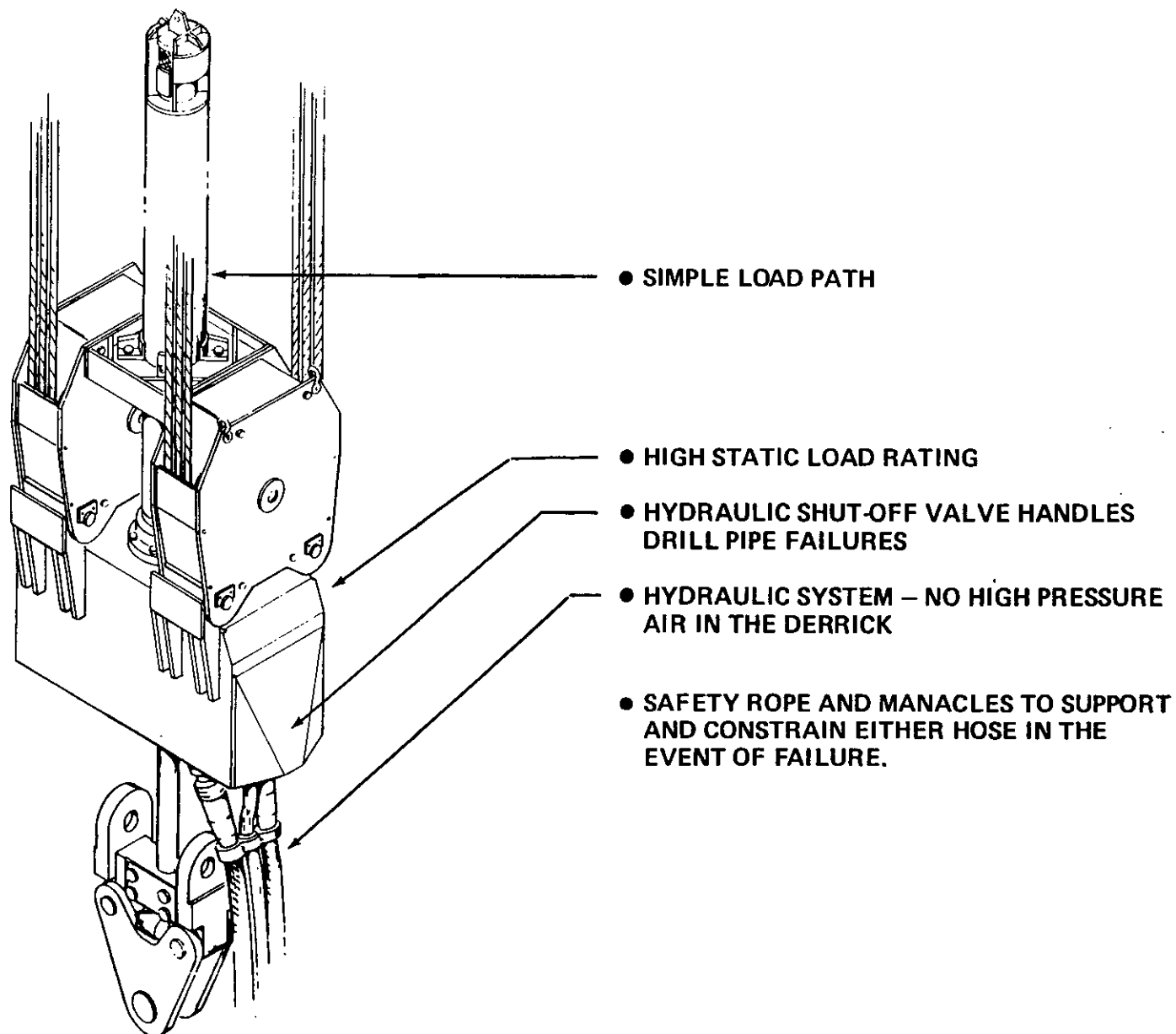
COMPACT SIZE



- EASY TO PENETRATE CROWN BLOCK WITH SINGLE CYLINDER

- SHORT TRAVELING BLOCK LENGTH – MORE AVAILABLE DERRICK SPACE

SAFETY FEATURES



CHAPTER 1

SYSTEM INFORMATION

SECTION I

GENERAL INFORMATION

1-1.1. SCOPE AND ARRANGEMENT OF MANUAL.

1-1.1.1 SCOPE. This manual provides installation, operation, maintenance, and parts list information for the Heave Compensator System, Model HC600-21.5-25 manufactured by WesTech/HMD.

1-1.1.2. ARRANGEMENT. This manual is composed of several chapters, each chapter being further divided into sections. Chapter 1 provides system-oriented information including system description, interconnection of equipment, operation, troubleshooting, and maintenance information. Subsequent chapters pertain to a specific item of equipment, and each is divided into sections providing description, installation, troubleshooting, and maintenance information.

1-1.1.3. An abridged table of contents for the entire manual is contained in the front of the manual. A comprehensive table of contents for each chapter begins on the first page of each chapter. Refer to the table of contents for the manual to determine which chapter contains the information needed, then refer to table of contents for that chapter to find the specific paragraph, figure, or table number and the corresponding page number.

1-1.2. PURPOSE OF EQUIPMENT.

1-1.2.1. The heave compensator system provides a means of controlling drilling force on a drill string suspended from a floating drill ship or semi-submersible drilling rig. It virtually eliminates wave induced vertical motion of the drill string. The heave compensator system (see figure 1-1) is composed of seven subsystems: (1) the traveling block assembly, (2) the mast manifold assembly, (3) the control console assembly, (4) the air pressure vessels, (5) a traveling hose assembly, (6) the power unit assembly, and (7) a high pressure air source (not shown).

1-1.3. EQUIPMENT SUPPLIED.

1-1.3.1. Table 1-1 lists the equipment supplied for the heave compensator system and gives the approximate weight and dimensions for each item. Table 1-2 contains a reference data for the overall heave compensator system. Detailed data for individual equipment items is presented in the chapter pertaining to the item.

1-1.4. SYSTEM FUNCTION.

1-1.4.1. The heave compensator has two basic modes of operation: the compensating mode and the lifting mode. In the compensating mode, it operates like a loaded compression spring with a variable spring constant; this is accomplished by a closed hydraulic circuit that is pressurized by an air-on-fluid accumulator (see figure 1-2). The hydraulic circuit can be blocked at any time, thus stabilizing the heave compensator cylinder rod at any chosen position, and the compensator then has a maximum lifting capability of 600,000 pounds. In the lifting mode, the rod is fully retracted and latched and the compensator has a static design capability of 1,600,000 pounds (see figure 1-3). The lifting mode should be used for tripping or when other heavy loads are to be lifted. The unit also has a capacity of 1,600,000 pounds with rod fully extended. The accumulator piston (mast manifold assembly) applies the pressure to the hydraulic circuit, which is then capable of exerting enough force to support all or any part of the drill string weight. The unsupported portion of the weight is the drilling force.

1-1.4.2. As shown in figure 1-1, the heave compensator cylinder is an integral part of the traveling block assembly but the drill string hook is connected to the heave compensator cylinder rod end. In the compensating mode, the hydraulic line between heave compensator cylinder lower (lift) chamber and accumulator chamber is not blocked, so fluid can flow freely. As the floating

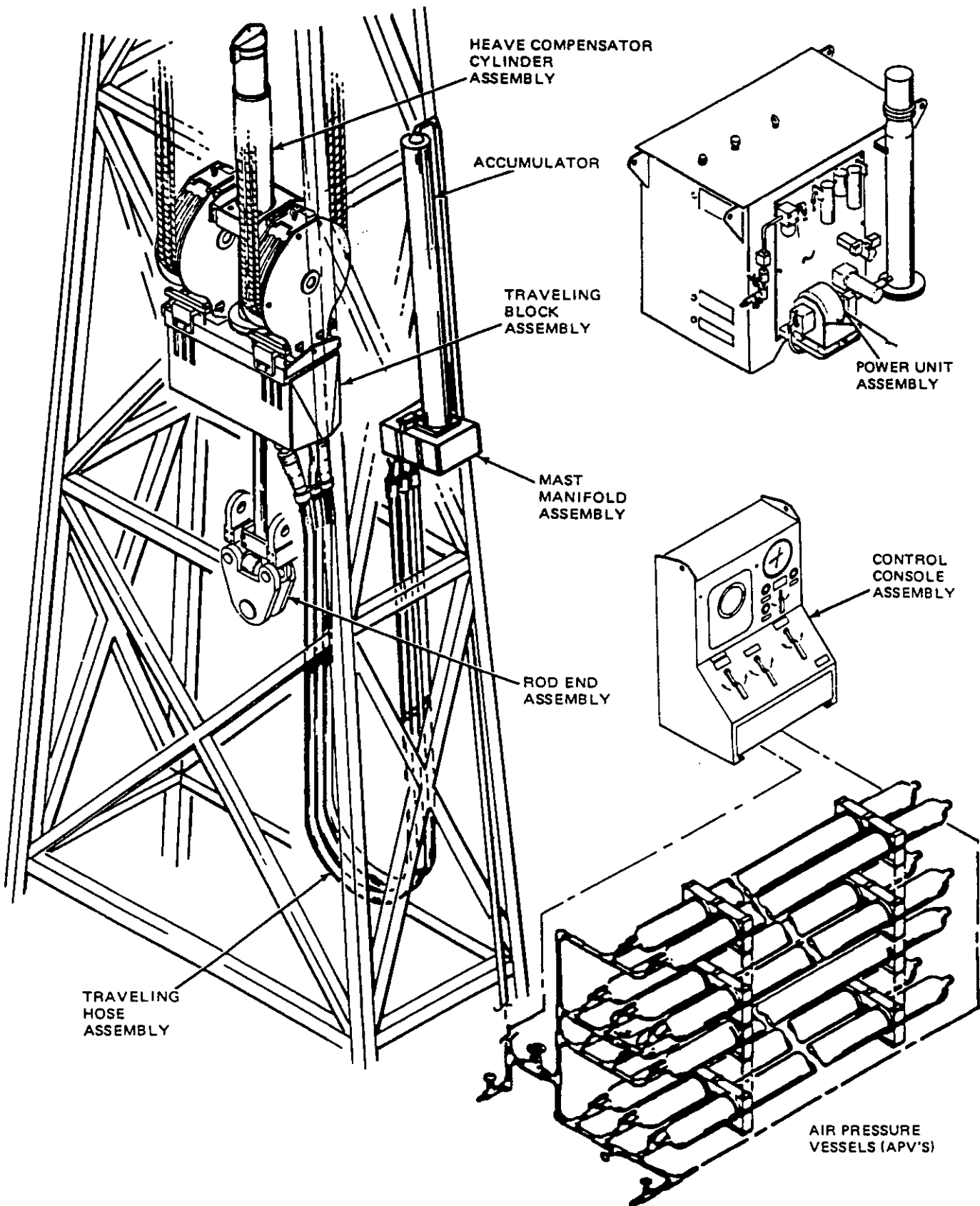


Figure 1-1. Heave Compensator System

drill rig rises and falls, the derrick, traveling block, and heave compensator cylinder will move with it, but the heave compensator cylinder rod and the drill string will not. Drilling force will vary slightly because the entrapped resilient pressurizing air is allowed to expand with the fall, and is compressed with the rising of the rig.

1-1.4.3. The heave compensator has an isolation valve in the traveling block that prevents uncontrolled heave compensator cylinder rod/drill string reaction in case of a drill string failure or a burst hydraulic hose. The valve does not affect normal operation but it will close automatically under adverse conditions and block the hydraulic line at the heave compensator cylinder; console-mounted CONTROL VALVE and indicator lights provide for manual operation and monitoring (see figure 1-4).

1-1.4.4. Two pneumatically-operated latching pins are provided in the traveling block. They are controlled by the manual COMPENSATOR LATCHES valve mounted on the control console. Indicators on the console panel signify pin status. The locking pins engage elongated holes in the rod end assembly, whereby the heave compensator cylinder rod can be moved one inch despite the locking pins being engaged. Without sufficient hydraulic pressure to support the load, the rod end assembly will be pulled downward and open the RETRACTED indicator lamp circuit, thus signifying that the latching pins must not be retracted.

1-1.4.5. The duplex gage (see figure 1-4) embodies a black pointer for indicating hydraulic pressure in the heave compensator cylinder and a red pointer for indicating air pressure in the accumulator. The dial is calibrated in pounds per square inch and in corresponding thousand-pound increments of weight. In the lifting mode, with the hydraulic line blocked and the drill string suspended, the dual gage black pointer will display drill string weight and the red pointer will indicate the *theoretical* portion of that weight that the compensator will support when the line is opened.

In the compensating mode, the black and red pointers indicate the lifting force being applied with no difference between the two.

1-1.4.6. The power unit assembly (see figure 1-1) provides hydraulic fluid to the heave compensator cylinder to control drilling force and pressure for lifting. The control console mounted HYDRAULIC FLUID valve controls operation of the power unit and the duplex gage monitors pressure.

1-1.4.7. The mast manifold assembly supports the accumulator. The accumulator accepts hydraulic fluid from the heave compensator cylinder at the bottom and applies air pressure to the fluid from above. The accumulator piston separates the air/fluid.

1-1.4.8. Operating air pressure is provided by a bank of air pressure vessels. An additional, standby air pressure vessel(s) is connected directly to the air compressor system. A pressure switch in the compressor/air dryer system automatically maintains pressure in the standby air pressure vessel. The console-mounted ACCUMULATOR AIR valve admits air into the air bank vessels from the standby air pressure vessel(s) and the compressor or it blocks off the standby air pressure vessel(s) and compressor while reducing air bank pressure to the desired level. The duplex gage monitors system pressure. The standby air pressure gage monitors the standby air pressure vessel(s) and the active air pressure gage monitors the active air pressure vessels.

1-1.4.9. Complete control of the heave compensator system is accomplished at a centralized control console. This console enables a single operator to start up, set operation, monitor, and shut down the complete system.

1-1.4.10. The electrical indicating functions (see figure 1-4) provide operator information for ram position, latch position, and isolation valve condition. For electrical definition, refer to drawings D322079 and D321968.

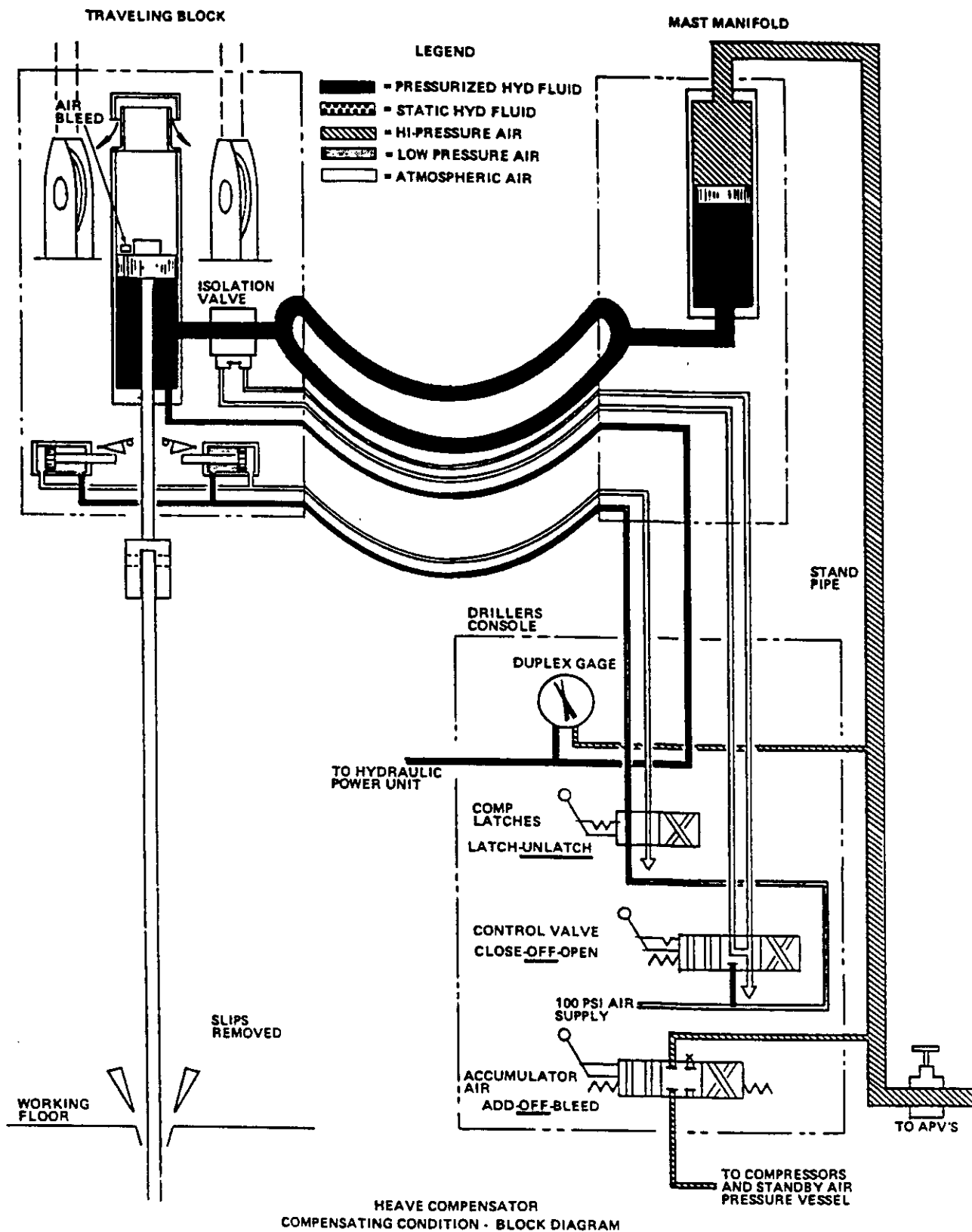


Figure 1-2. Compensating Condition Block Diagram

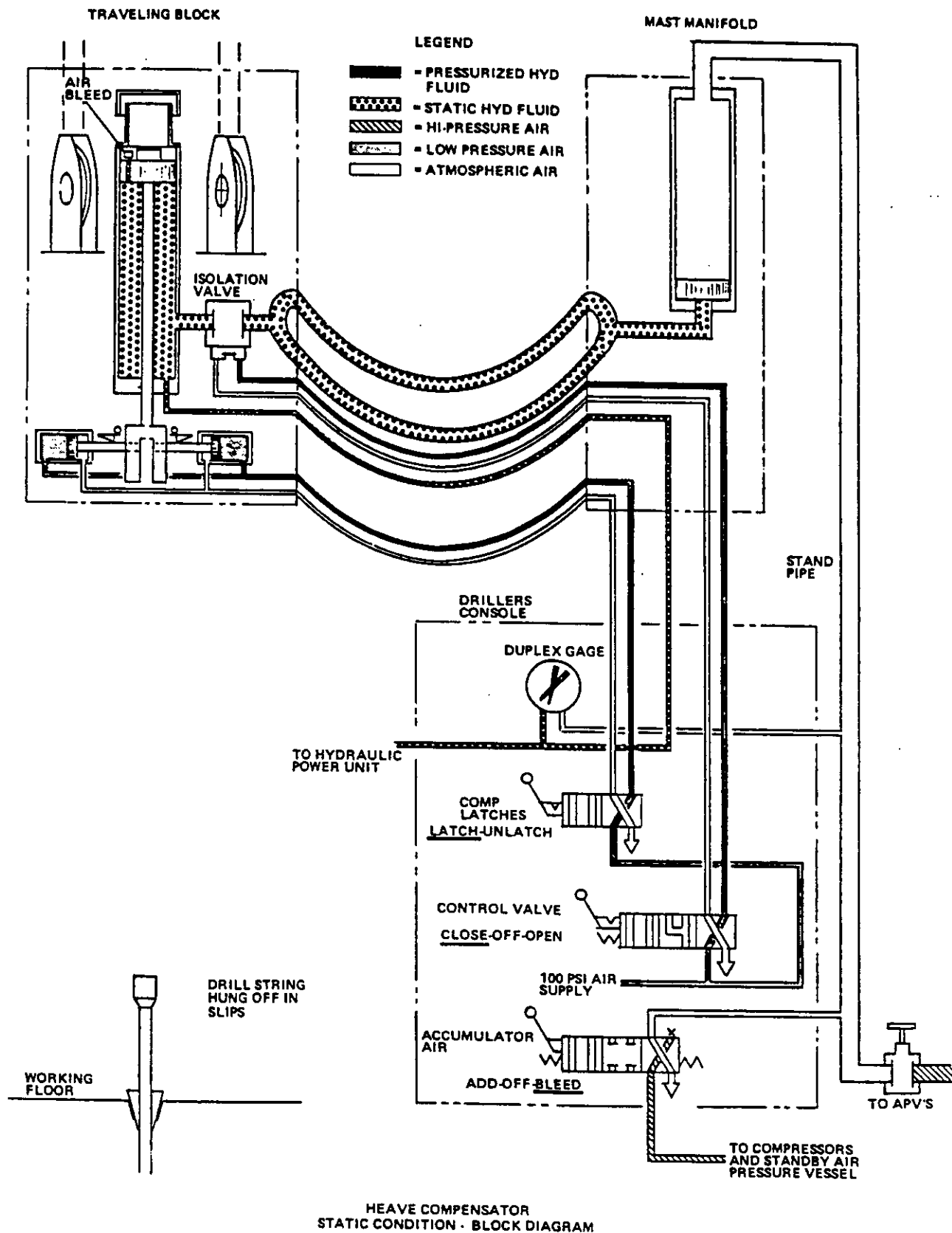


Figure 1-3. Static Condition Block Diagram

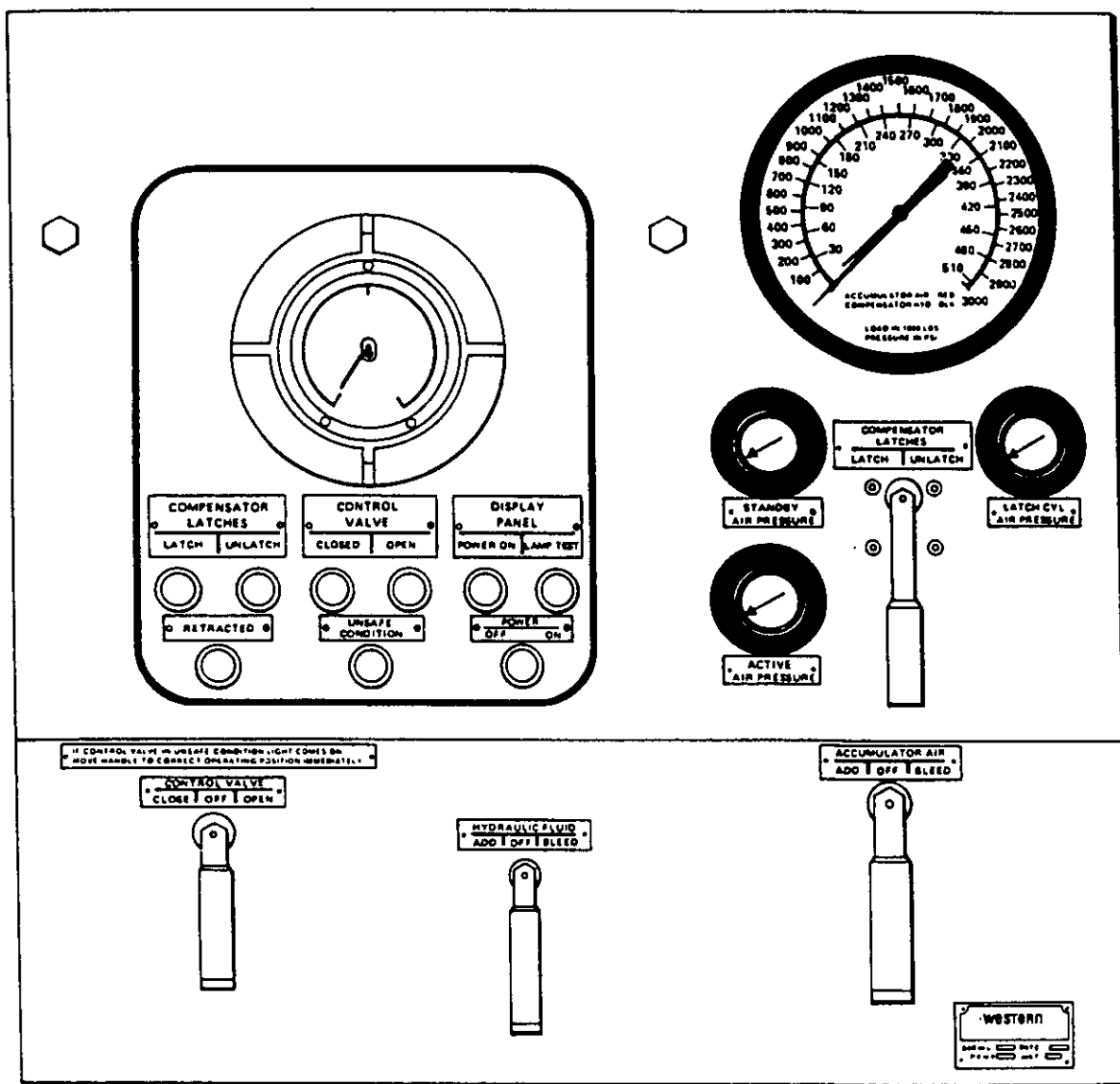


Figure 1-4. Console Panel Controls and Indicators

GREEN INDICATOR: LIGHTED WHEN BOTH LATCHING PINS ARE FULLY EXTENDED. IF NOT LIGHTED, ONE OR BOTH PINS NOT FULLY EXTENDED AND ROD END CANNOT BE CONSIDERED LATCHED.

AMBER INDICATOR: LIGHTED WHEN BOTH LATCHING PINS ARE FULLY RETRACTED. IF NOT LIGHTED, ONE OR BOTH PINS ARE NOT FULLY RETRACTED AND ROD END MAY STILL BE PARTIALLY LATCHED.

AMBER INDICATOR: LIGHTED WHEN FULLY RETRACTED HEAVE CYLINDER ROD HAS OPERATED ITS LIMIT SWITCH TO A CLOSED POSITION. WHEN NOT LIT, ROD IS EITHER IN USE, OR IF LATCHED, ROD END ASSEMBLY AND LOAD IS RESTING ON PINS AND PINS MUST NOT BE UNLATCHED.

GREEN INDICATOR: WHEN LIT, ISOLATION VALVE IS CLOSED.

AMBER INDICATOR: WHEN LIT, ISOLATION VALVE IS OPEN. MUST BE LIT FOR SAFETY VALVE FUNCTION OF ISOLATION VALVE.

RED INDICATOR: WHEN CONTROL VALVE IS TURNED TO CLOSE AND THEN TO OFF, THE INDICATOR WILL LIGHT WHEN THERE IS A LOSS OF CONTROL PRESSURE TO THE VALVE. THE INDICATOR WILL ALSO LIGHT WHEN THE CONTROL VALVE IS TURNED TO OPEN AND THEN TO OFF.

THREE-POSITION, DETENTED CLOSE, SPRING CENTERED, AND OPEN, MANUAL ROTARY VALVE: AT OPEN POSITION, OPENS ISOLATION VALVE. RETURN TO OFF POSITION WHEN CONTROL VALVE-OPEN INDICATOR LIGHTS AT CLOSE POSITION, CLOSES ISOLATION VALVE. LEAVE IN CLOSE POSITION TO KEEP VALVE CLOSED. NORMAL OPERATION IS IN OFF POSITION WITH ISOLATION VALVE OPEN.

THREE-POSITION, SPRING CENTERED, MANUAL ROTARY VALVE: AT ADD POSITION, ADMITS PUMP OUTPUT TO HEAVE CYLINDER CIRCUIT; AT BLEED POSITION, RELEASES FLUID TO MAIN TANK; AT OFF POSITION, ADD AND BLEED FUNCTIONS BLOCKED. MONITOR FLUID PRESSURE ON DUPLEX GAGE.

THREE-POSITION, SPRING CENTERED, MANUAL ROTARY VALVE: AT ADD POSITION, ADMITS STANDBY AIR PRESSURE VESSEL AIR TO TOP OF ACCUMULATOR AND TO THE THREE OPERATING PRESSURE VESSELS. AT BLEED POSITION, RELEASES AIR TO ATMOSPHERE. AT OFF POSITION, ADD AND BLEED FUNCTIONS BLOCKED. MONITOR AIR PRESSURE ON DUPLEX GAGE.

GREEN INDICATOR: WHEN LIT, POWER IS ON AND AVAILABLE TO THE SYSTEM.

TWO-POLE, SINGLE-THROW ROTARY SWITCH: IN ON POSITION, CONNECTS AC POWER TO THE CONTROL CONSOLE. IN OFF POSITION, DISCONNECTS AC POWER TO THE CONTROL CONSOLE.

LAMP TEST: NORMALLY OPEN MOMENTARY PUSHBUTTON SWITCH. WHEN DEPRESSED, ENERGIZES RELAY 2CR AND 3CR TO LIGHT ALL LAMPS EXCEPT POWER ON INDICATOR.

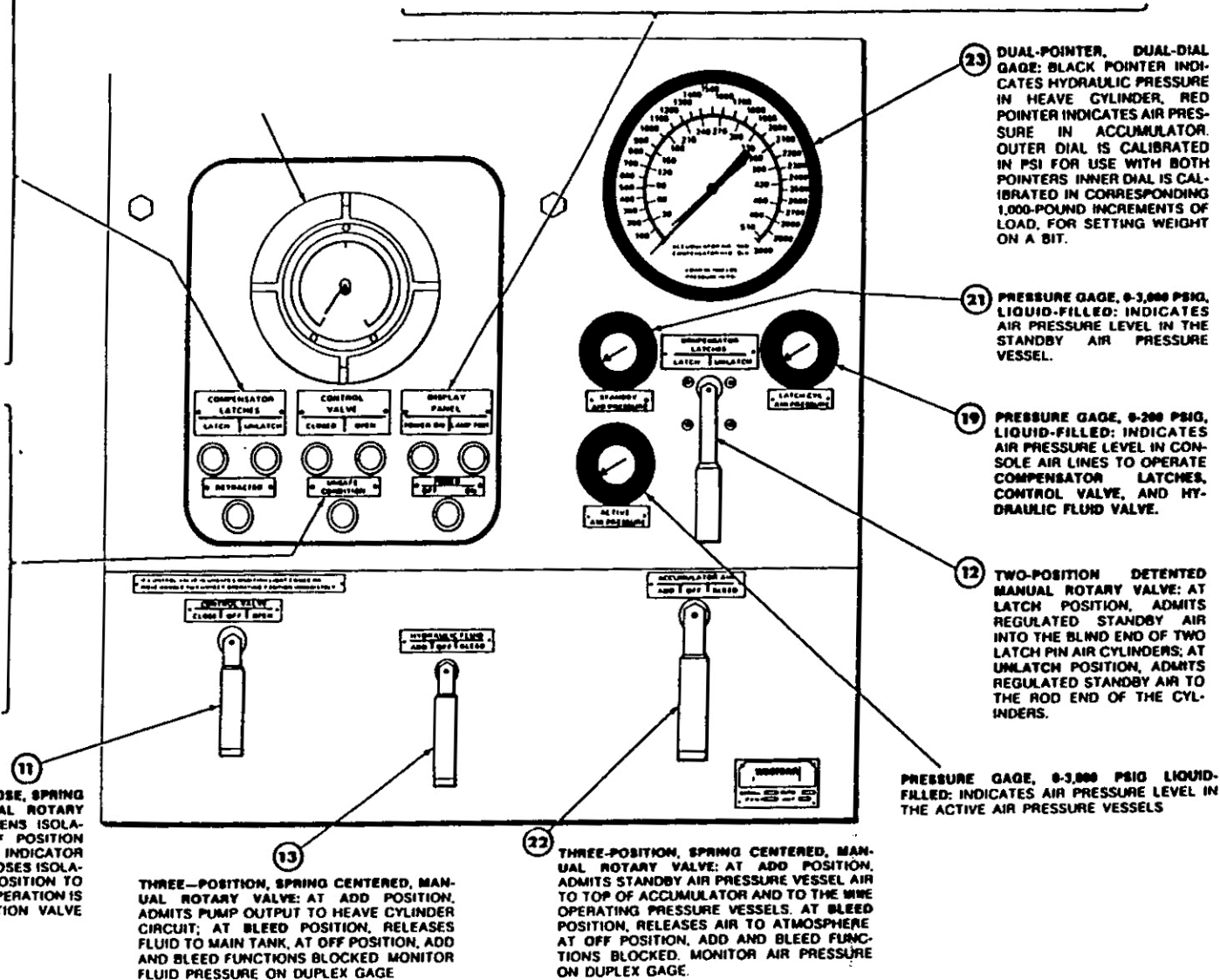
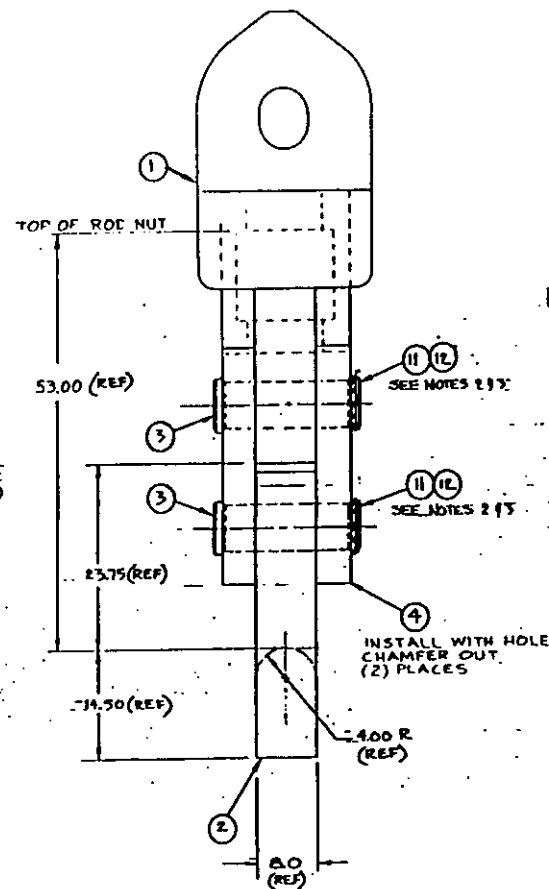
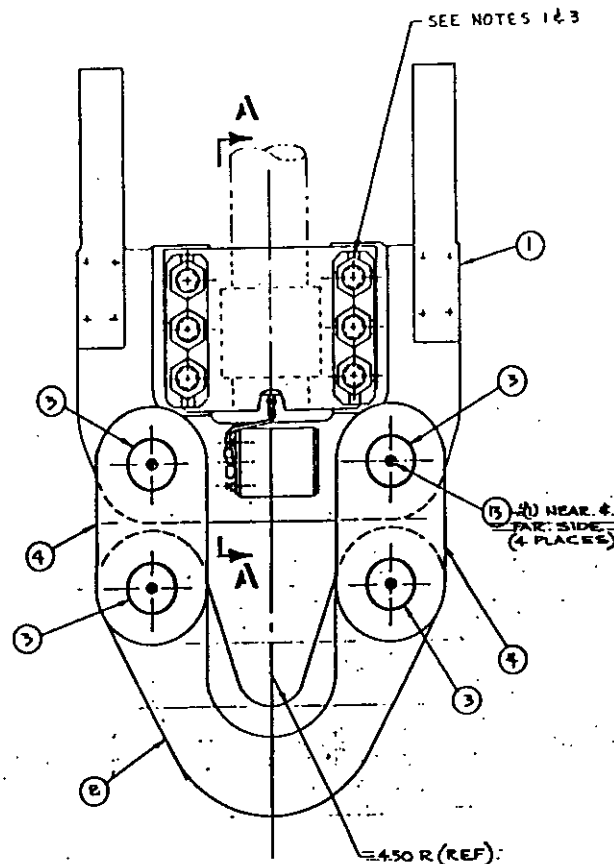


Figure 4-1. Control Console Assembly - "How It Works"

WESTERN HEAVY CORPORATION <small>A Subsidiary of Western Machine Inc.</small>		Western Gear Machinery Co. Everett, Washington <small>A Subsidiary of Western Gear Corporation</small>	
CYLINDER ASSEMBLY HEAVE COMPENSATOR MODEL HC 600-215-25			
SIZE D	PCPN NO 16603	D321967	REV A

ALL DIMENSIONS ARE UNLESS OTHERWISE SPECIFIED TO BE IN INCHES
FRACTIONS ARE TO BE IN 16THS OF AN INCH
ALL DIMENSIONS ARE TO BE TAKEN TO THE CENTER OF THE HOLE UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE TO BE TAKEN TO THE CENTER OF THE HOLE UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE TO BE TAKEN TO THE CENTER OF THE HOLE UNLESS OTHERWISE SPECIFIED

REVISIONS			
DATE	BY	DESCRIPTION	APPROVED



NOTES:

- TORQUE TO 2000/2400 FT/LB. BEND RETAINER FIRMLY AGAINST NUT.
- SET NUT UP FIRMLY AGAINST SHOULDER WITH A SPANNER OR PUNCH & BEND LOCKWASHER FINGER INTO APPROPRIATE NOTCH.
- APPLY LATEX BASE CAULKING COMPOUND TO EXPOSED THREADS.
- USE WITH BJ-9500 OR BJ-9750 DYNAPLEX HOOK, STANDARD DAIL.

MAX. LOAD: 1,600,000.

SIMILAR TO 0518096

DATE	BY	DESCRIPTION	APPROVED

DATE	BY	DESCRIPTION	APPROVED

DATE	BY	DESCRIPTION	APPROVED

DATE	BY	DESCRIPTION	APPROVED

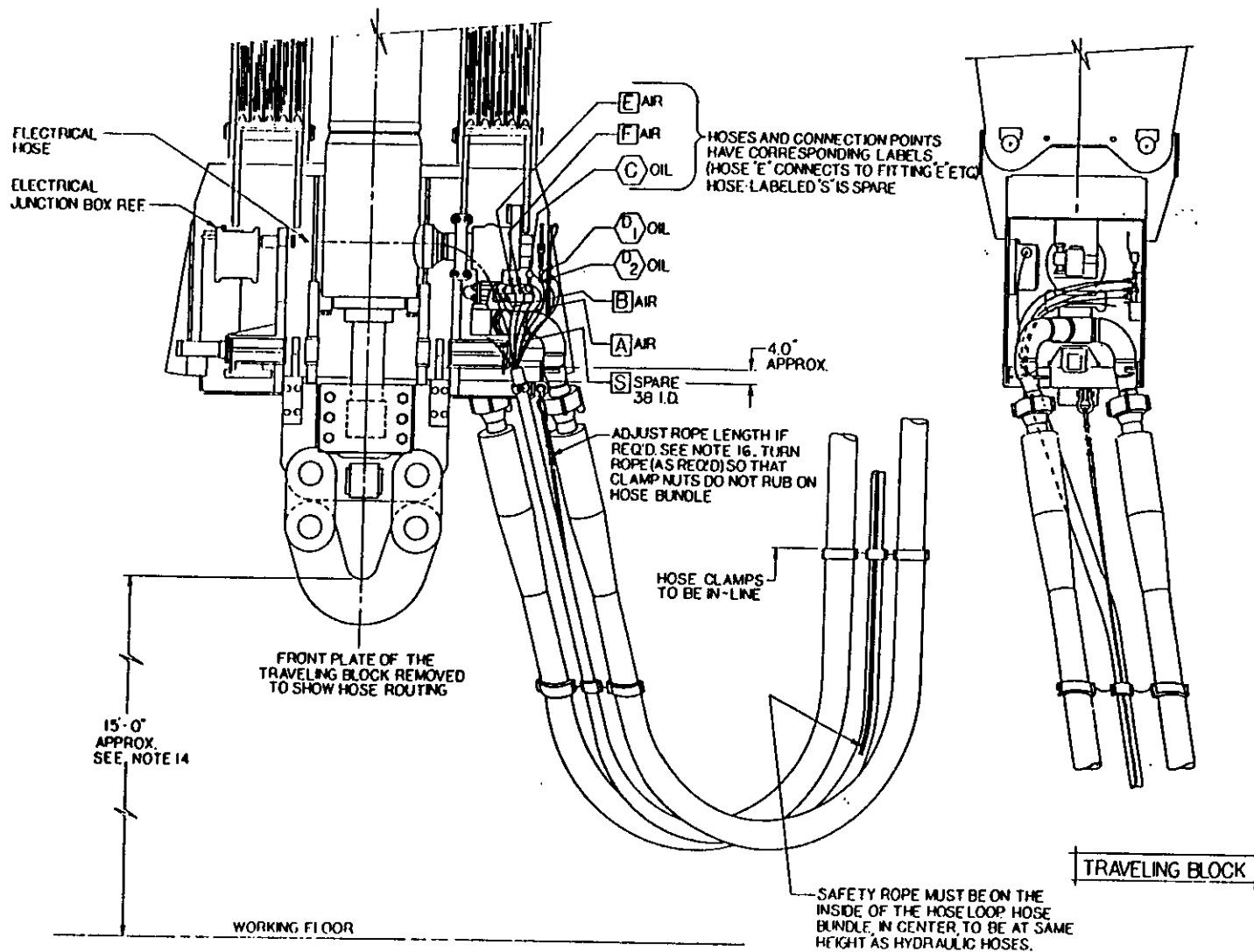
western HEAVY MACHINERY
DIVISION
1000 W. 10TH AVENUE
DENVER, COLORADO 80202

ROD END
ASSY

D 16603 D321949

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REVISIONS		DATE	APPROVED
AS	A	ADDED VIEW A-A	11-85 RMR



NOTES:

- HANDLE THE TRAVELING HOSE ASSEMBLY CAREFULLY WHEN OPERATING AND INSTALLING IT TO AVOID MOST OR HOSE COVER DAMAGE. DO NOT KICK THE SMALL HOSES EXTENDING FROM THE CENTER HOSE BUNDLE.
- MAINTAINING CLEARANCE OF THE HOSES WHEN THEY ARE INSTALLED IS ALSO IMPORTANT. DIRT, GRIT, OR WATER IN THE HOSES WILL IMPAIR THE CONVEYANCE.
- LEAVE THE 5" NUTS AND BUSHING PLUGS, PLUS THE SMALL HOSE PLUGS, IN PLACE UNTIL EACH CONNECTION IS MADE UP OTHER PRELIME AND STORE THESE PARTS FOR FUTURE USE.
- REMOVE THE HOSE ASSY FROM THE CRANE BY LIFTING ABOUT 30 FT IN FROM ONE END WITH A SLING ON EACH OF THE 427 5" COUPLINGS. USE A SHOCK ROPE TO AVOID HOSE TWIST.
- IF, DURING INSTALLATION, IT BECOMES NECESSARY TO PICK UP THE HOSE ASSEMBLY AT MID-POINT, USE MORE THAN ONE SHOCK SLING TO AVOID OVER-STRESSING THE 5" HYD. HOSES.
- DO NOT HOSE INTO THE CRANES OR THE HOSE CLAMPS.
- EACH END OF THE HOSES IN THE HOSE BUNDLE ARE LABELED AS SHOWN IN ASSEMBLY DIAGRAM. HOSE LABELED "S" IS SPARE.
- HOSE CONNECTION POINTS ON THE TRAVELING BLOCK AND ON THE FIRST PIVOTPOINT HAVE CORRESPONDING LABELS. THIS HOSE "A" CONNECTS TO FITTING "A" AND HOSE "B" TO FITTING "B", ETC.
- CONNECT THE HOSE ASSY TO THE FIRST PIVOTPOINT FIRST. THEN PICK UP THE OTHER END AND MAKE CONNECTIONS AT THE TRAVELING BLOCK WHILE THE POWERED UP AND END IS APPROX. 15 FT. OFF THE FLOOR.
- THE SAFETY ROPE MUST BE IN THE INSIDE OF THE HOSE LOOP.
- REMOVE THE SHIPPING STRAPS.
- WITH POWER CONNECTION AT EACH END:
 - POSITION THE HOSE BUNDLE AND MOVE THE INDIVIDUAL HOSES APPROPRIATELY.
 - MAKE UP THE 427 5" COUPLINGS. PREVENT ROTATION OF EACH HOSE AS THE COUPLING IS TIGHTENED.
 - PICK UP THE HOSE BUNDLE NEARBY AND INSTALL THE SAFETY ROPE SHOCKLE.
 - TIGHTEN THE CLAMP AT THE EXTREME END OF THE HOSE BUNDLE JACKET.
 - MAKE UP THE SMALL HOSE CONNECTIONS.
 - THE ELECTRICAL CONNECTIONS AT EACH END SHOULD BE MADE UP WITH THE CRANABLE POWER POWERED OFF.
- IF NECESSARY, ADJUST THE LENGTH OF THE SAFETY ROPE SO THAT THE LOOP IN THE HOSE BUNDLE IS THE SAME HEIGHT AS THE LOOP IN THE 5" HYD. HOSES. BETWEEN THE CLAMP AT THE EXTREME END OF THE HOSE BUNDLE AND VERIFY THAT THE SMALL HOSES ARE STILL SUPPORTED PROPERLY.
- NOTE: THE FIRST SPLIT CLAMP (WITH CARBIDES) AT EACH END OF THE HOSE BUNDLE MUST CARRY THE BUNDLE WEIGHT. EACH GROUP OF THREE SPLIT CLAMPS SHOULD BE IN A STRAIGHT LINE WHEN THE 5" HYD. HOSES ARE UNPRESSURIZED.
- INSTALL A RIDING LINE TO CRANE, WITHING OF THE TRAVELING HOSES. CONNECT IT TO ONE OF THE 5" HYD. HOSES.

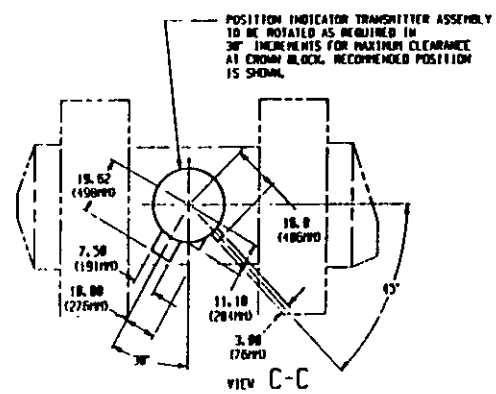
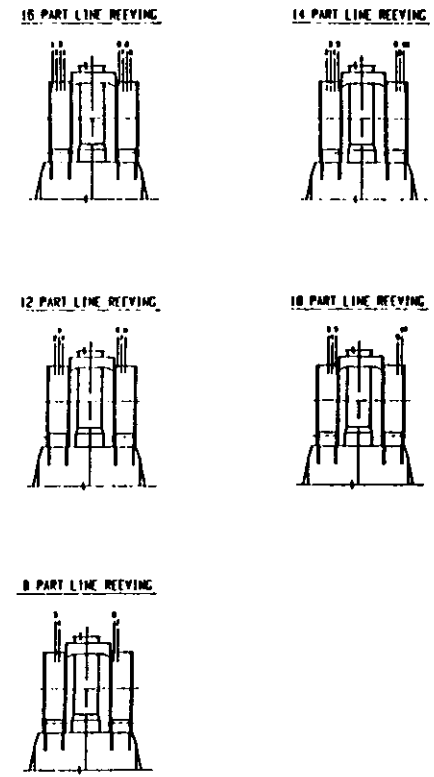
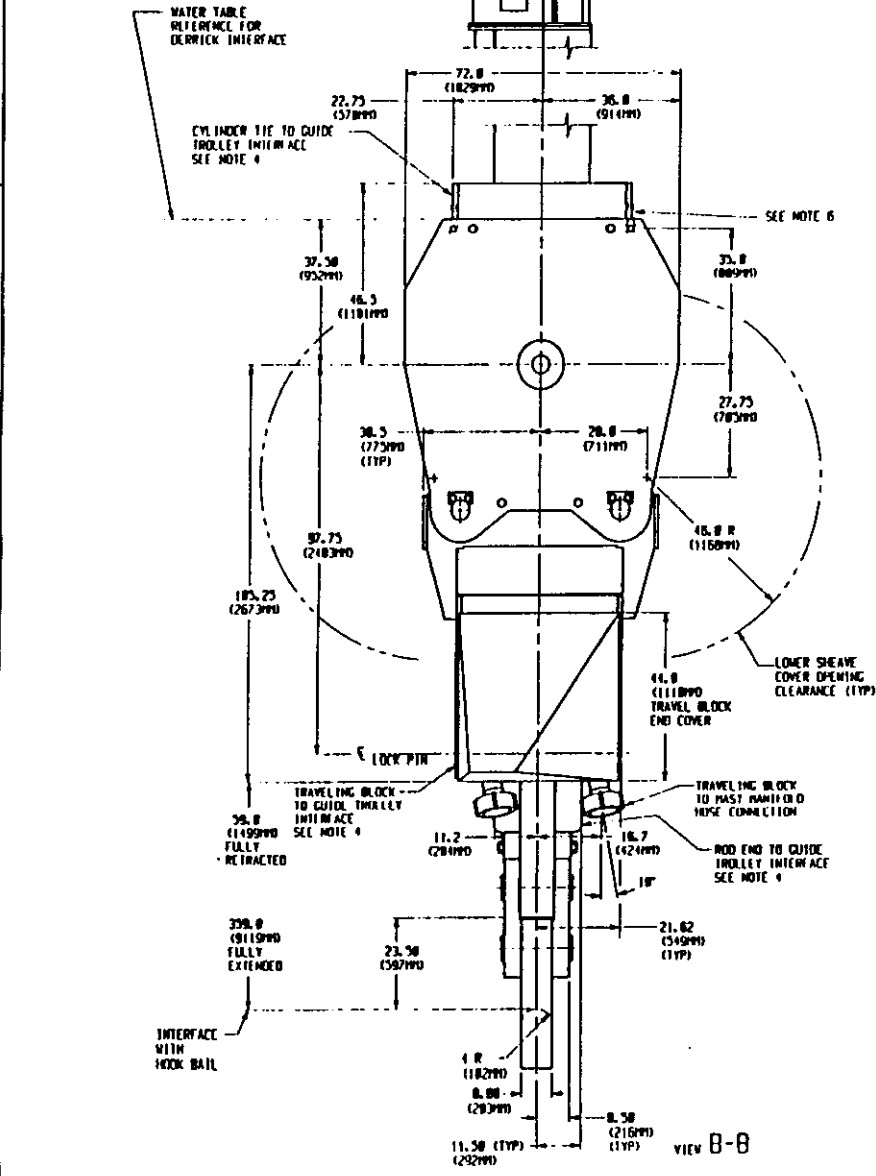
VIEW A-A

SIZE	FRACNO.	DATE	REV
D	16603	D 322040	A
SCALE	1/4" = 1'	NO. SHEET	OF 4

REVISION STATUS				
SHI	1	2		
REV	0	0		

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REVISIONS				DATE		BY	
NO.	REV.	DESCRIPTION	DATE	BY	CHKD.	APP.	DATE
11	A	ADDED VIEW C-C	11-8-80				
12	B	15' WAS 15' REVISED NOTES 3, 4 AND 6. P. 11	12-1-80				

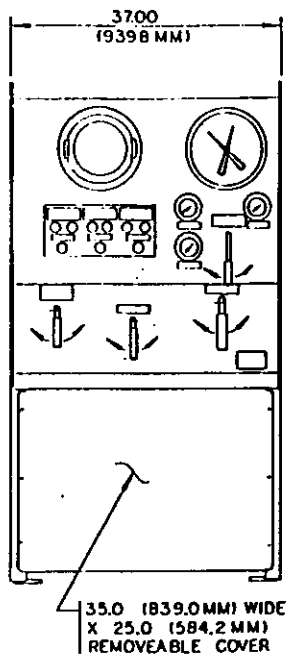
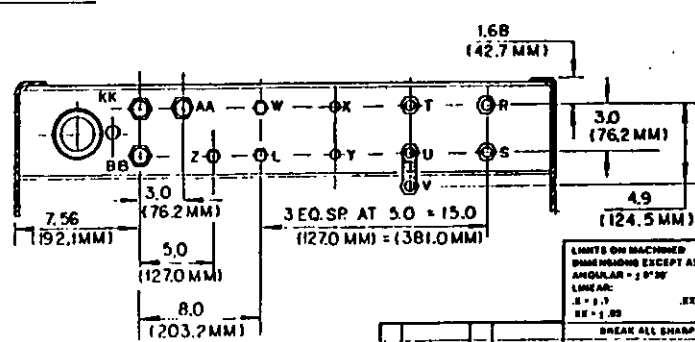
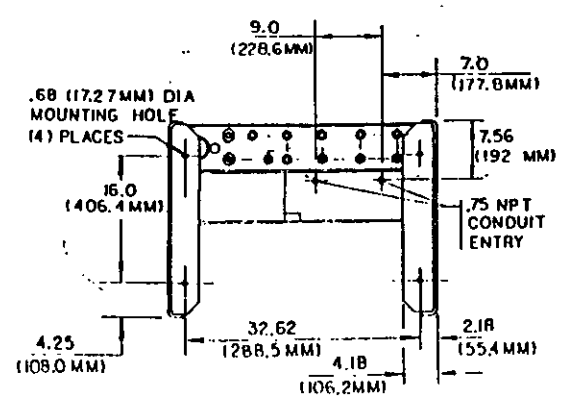
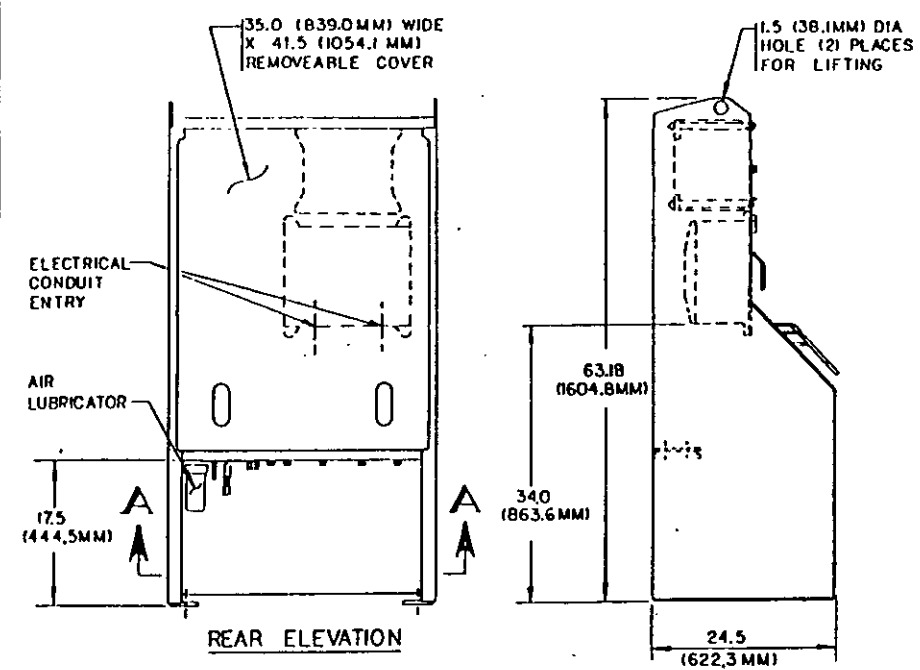


NOTES:

- REFERENCE DRAWINGS:
TRAVELING BLOCK ASSEMBLY _____ 0321910
ROD END ASSEMBLY _____ 0321940
CYLINDER ASSEMBLY _____ 0321967
LOWER SHEAVE ASSEMBLY _____ 0321930
AIR-HYDRAULIC SYSTEM SCHEMATIC _____ 0321903
WIRING DIAGRAM _____ 0321969
- TRAVELING BLOCK ASSEMBLY SHEAVE DATA
A. GROOVED FOR 1.75 (43mm) DIA WIRE ROPE.
B. SHEAVE OUTSIDE DIA - 66.8 (1676mm).
- THE ROD END ASSEMBLY IS TO BE USED WITH A 0.52750 DYNAPLEX HOOK WITH STANDARD BALL.
- PROVIDE 1.0 (25mm) MIN. SHIM ALLOWANCE AT ALL GUIDE DOLLY TO TRAVELING BLOCK INTERFACES TO ALLOW TRAVELING BLOCK AND ROD END ASSEMBLIES TO BE PROPERLY ALIGNED WITH GUIDE DOLLY SUCH THAT NO SIDE LOADS ARE IMPOSED ON CYLINDER OR ROD END ASSEMBLY WHEN BOLTED TO GUIDE DOLLY. HEAVE COMPENSATOR CYLINDER TO BE ALIGNED DIRECTLY OVER WELL CENTERLINE WITHIN ±.50. THIS ALIGNMENT TO BE HELD THROUGHOUT THE TRAVEL OF THE TRAVELING BLOCK AND THE STROKE OF THE HEAVE COMPENSATOR CYLINDER. RECOMMEND LAMINATED SHIMS FURNISHED BY SHIPYARD.
- TRAVELING BLOCK END COVERS MAY BE OPENED FROM EITHER SIDE.
- LIFTING SHACKLES USED FOR LIFTING TRAVELING BLOCK ARE TO BE FURNISHED BY SHIPYARD. RECOMMEND ANCHOR SHACKLE, CROSBY LAMARIN C-713-1, 50 (117 TONS) OR EQUIV.
- CYLINDER END CAP LIFTING MOLE IS TO BE USED ONLY FOR SERVICING CYLINDER. THIS LIFTING MOLE IS NOT TO BE USED FOR LIFTING TRAVELING BLOCK ASSEMBLY.
- CENTERS OF GRAVITY AND HEIGHT ARE CALCULATED VALUES WHICH MAY VARY SLIGHTLY FROM ACTUAL MACHINERY. CENTER OF GRAVITY VALUES GIVEN ARE WITH THE CYLINDER FULL OF HYDRAULIC FLUID AND RETRACTED.
TRAVELING BLOCK AND ROD END ASSEMBLY NET WEIGHT: 85,100 LBS (NET)
81,827 LBS (GROSS)

SIZE	FSM NO	REV
D	16603	0321881
SCALE	1/16" = 1'	LD SHEET 2 OF 2

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REVISIONS			
NO.	DATE	DESCRIPTION	APPROVED
1	8/85	REVISED NOTE 5, ADDED RECOMMENDED USING 4 CMG PORT 1" TO .75 NPT SIZE. REVISED PICTURE TO SHOW 2 ELECTRICAL ENCLOSURES INSTEAD OF 1. .75 NPT CONDUIT ENTRY WAS 1.00 NPT & CHANGED THEIR LOCATION.	2/f

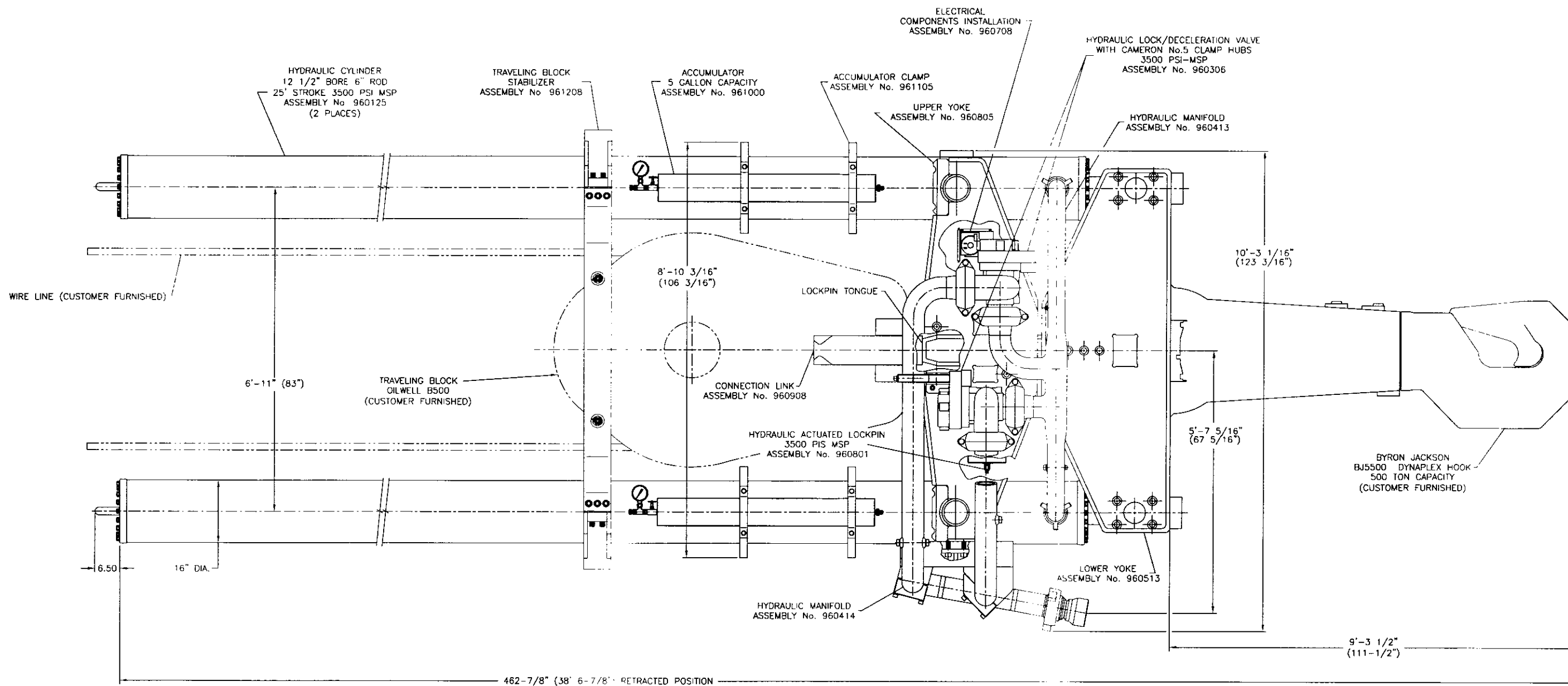
NOTES:

- REFERENCE DRAWINGS -
 CONTROL CONSOLE ASSEMBLY 0321795
 AIR HYDRAULIC SCHEMATIC 0321791
 ELECTRICAL GENERAL ARRANGEMENT 0327070
 POWER UNIT ASSEMBLY 0321788
 HAST MANIFOLD ASSEMBLY 0327073
 AIR PRESSURE VESSEL ASSEMBLY 0323903
- INSTALLATION, FABRICATION AND CLEANLINESS OF ALL INTERCONNECTING PIPING OR TUBING SHALL BE PER VISC. INC. APPROVED FABRICATION, CLEANING, TESTING AND INSTALLATION FOR INTERCONNECTING PIPING OF WESTERN GEAR MACHINERY CO. SUPPLIED EQUIPMENT.
- INTERCONNECTING PIPING AND FITTINGS CONNECTING PORTS AA, BB, CC, EE, LL, R, S, T, U, V, W, X, Y, Z ON CONSOLE TO POWER UNIT, HAST MANIFOLD AND AIR PRESSURE VESSELS SHALL BE FURNISHED AND INSTALLED BY SHIPYARD.
 RECOMMENDED PORTING IS STAINLESS STEEL PER ASTM A264 TYPE 304 OR TYPE 316 ANNEALED. PORT CONNECTIONS ON THE CONSOLE ARE SAE J1913 3/4" ANGLE TUBE FITTING ENDS, BEARING 3/4" FLARED TUBE END, 1/2" UNF, AND 1/2" SLEEVE PER EACH PORT CONNECTION. THE FOLLOWING TABLE LISTS RECOMMENDED TUBE SIZE AND PORTER MANIFOLD HOT AND SLEEVE PART NUMBERS FOR EACH CONSOLE PORT.

PORT	PORTER-MANIFOLD PART NUMBER	TUBE SIZE
AA	1221-CA-1212-C	1/2" SAE
BB	1221-CA-1212-C	1/2" SAE
CC	1221-CA-1212-C	1/2" SAE
EE	1221-CA-1212-C	1/2" SAE
LL	1221-CA-1212-C	1/2" SAE
R	1221-CA-1212-C	1/2" SAE
S	1221-CA-1212-C	1/2" SAE
T	1221-CA-1212-C	1/2" SAE
U	1221-CA-1212-C	1/2" SAE
V	1221-CA-1212-C	1/2" SAE
W	1221-CA-1212-C	1/2" SAE
X	1221-CA-1212-C	1/2" SAE
Y	1221-CA-1212-C	1/2" SAE
Z	1221-CA-1212-C	1/2" SAE

- BEFORE OPERATION FILL AIR LUBRICATOR WITH 0.02 (20% WGT) OF PETROLEUM LUBRICANT OF 200 SSV (AT 200°F) OR LESS. DO NOT USE OILS COMPOUNDED WITH ADDITIVES, SOLVENTS, CARBIDE, OR METALS ON SYNTHETIC OILS.
- INTERCONNECTING WIRING AND CONDUIT FURNISHED BY SHIPYARD. SCHEDULE 40 CONDUIT IS RECOMMENDED.

LIMITS ON MACHINED SURFACES
 UNLESS SPECIFIED OTHERWISE, ALL DIMENSIONS ARE TO BE HOLD.
 FINISH: 125 RMS
 BREAK ALL SHARP EDGES
 TAP TOLERANCES:
 OVER 1/4" 1/4"
 1/4" TO 1/2" 1/16"
 1/2" TO 1" 1/8"
 1" TO 2" 1/4"
 2" TO 4" 3/8"
 4" TO 6" 1/2"
 6" TO 12" 3/4"
 12" TO 24" 1"
 24" TO 48" 1 1/4"
 48" TO 96" 1 1/2"
 96" TO 192" 1 3/4"
 192" TO 384" 2"
 384" TO 768" 2 1/4"
 768" TO 1536" 2 1/2"
 1536" TO 3072" 2 3/4"
 3072" TO 6144" 3"
 6144" TO 12288" 3 1/4"
 12288" TO 24576" 3 1/2"
 24576" TO 49152" 3 3/4"
 49152" TO 98304" 4"
 98304" TO 196608" 4 1/4"
 196608" TO 393216" 4 1/2"
 393216" TO 786432" 4 3/4"
 786432" TO 1572864" 5"
 1572864" TO 3145728" 5 1/4"
 3145728" TO 6291456" 5 1/2"
 6291456" TO 12582912" 5 3/4"
 12582912" TO 25165824" 6"
 25165824" TO 50331648" 6 1/4"
 50331648" TO 100663296" 6 1/2"
 100663296" TO 201326592" 6 3/4"
 201326592" TO 402653184" 7"
 402653184" TO 805306368" 7 1/4"
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 1610612736" TO 3221225472" 7 3/4"
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CONTROL FLOW INC. <small>HYDRAULIC EQUIPMENT DIVISION</small> <small>1000 W. 10th St. - Tulsa, Okla. 74103</small>		ASSEMBLY: MOTION COMPENSATOR MC 600-250, DUAL HYDRAULIC CYLINDERS, 3500 PSI-MSP 600,000 LBS. DYNAMIC LOAD CAPACITY, WITH 25" STROKE HAS OILWELL B500 TRAVELING BLOCK AND BYRON JACKSON BJ5500 DYNAPLEX HOOK		UNLESS OTHERWISE SPEC. ALL DIMS IN INCHES DECIMAL: .001 FRACTIONS: 1/16, 1/8, 1/4, 1/2, 3/4, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 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