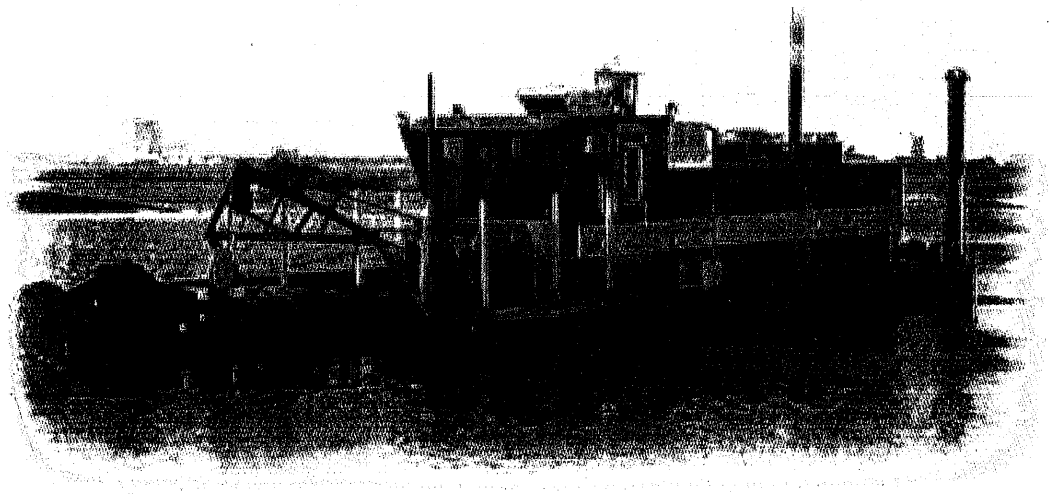
BADGER CLASS 8" X 8" CUTTERHEAD DREDGE With Caterpillar Engine OPERATOR'S MANUAL



BADGER

BY DSC DREDGE, LLC

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NEW EQUIPMENT WARRANTY

DSC Dredge, LLC ("DSC") warrants that it will convey good title to the Equipment, free of all security interests therein except as may be agreed between the Purchaser and DSC, and for a period of one (1) year from the date of arrival of the Equipment at Purchaser's facilities and that the Equipment is free from defects in workmanship and materials under normal use, subject to the following provisions:

The Purchaser shall notify DSC in writing within ten (10) days of the Purchaser's first knowledge of any facts, which may lead to any warranty claim. DSC shall not have any further responsibility if this notice to DSC is not given.

DSC provides no warranty for any part, which may be damaged or rendered inoperative or less efficient due to lack of maintenance by the Purchaser. Any warranty of DSC shall be voided if the Purchaser has altered, misused, neglected, overloaded, improperly operated or in any way subjected the equipment to mistreatment outside of its expected operating range.

DSC does not warrant any component part of the Equipment manufactured by any other party. DSC will provide to the Purchaser any warranty or other material, manuals and/or specifications provided to DSC by such manufacturer. THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER FOR ANY FAILURE, DEFECT OR OTHER CLAIMS RELATIVE TO SUCH COMPONENTS SHALL BE TO PURSUE ANY WARRANTY OR OTHER CLAIM DIRECTLY AGAINST THE COMPONENT MANUFACTURER AND NOT DSC.

Should it become necessary to replace any removable part manufactured by DSC, the Purchaser must return the part, transportation pre-paid to DSC. If the part is warranted by DSC, DSC will replace the part and deliver the part to Purchaser Ex-Works DSC's facility, and reimburse to the Purchaser the cost of the transportation to [and from] DSC. DSC shall have no obligation to repair or replace any part at the site of the Equipment. Should damaged, defective or inoperable part not be removable, at the Purchaser's pre-paid expense, DSC will send a representative to the Equipment site to inspect the part. If the part is covered by the DSC warranty, DSC will replace and deliver it Ex-Works DSC's facility. DSC does not warrant any labor or travel cost for removal or installation of any part.

THE PURCHASER WAIVES ANY CLAIMS OF REDHIBITION AS THAT TERM IS DEFINED IN THE CIVIL CODE OF LO. 2496 AND ACKNOWLEDGES THAT THE SOLE WARRANTY RESPONSIBILITY OF DSC SHALL BE AS SET OUT HEREIN. THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

No officer, employee or agent of DSC or any other party has authority to promise, extend, or warrant other than as set out herein or as may be expressly agreed to by DSC in writing signed by the President of DSC. Under no circumstances whatsoever, does DSC warrant or will be responsible of any claim of lost profits, downtime, consequential damages, punitive damages or attorney fees arising out of the operation or non-operation of the equipment.

(continued)

Should any provision of this warranty be found to be invalid for any reason, it shall not void this limited warranty but all other provisions hereof shall be deemed to be in effect.

Should the Purchaser sell the Equipment during the term of this warranty, the Purchaser shall be responsible to provide a copy of this warranty to the new purchaser.

The sole and exclusive jurisdiction and venue for any claim arising out of the sale of the equipment, including any warranty claim against DSC, shall be the courts of the Parish of Saint John the Baptist, State of Louisiana. The laws of the State of Louisiana shall govern this warranty.

THIS IS ABSOLUTELY THE SOLE AND EXCLUSIVE WARRANTY OF DSC RELATIVE TO EQUIPMENT SOLD BY DSC AND PROVIDES THE SOLE RESPONSIBILITY OF DSC FOR THE EQUIPMENT UPON ARRIVAL.

DSC Dredge LLC

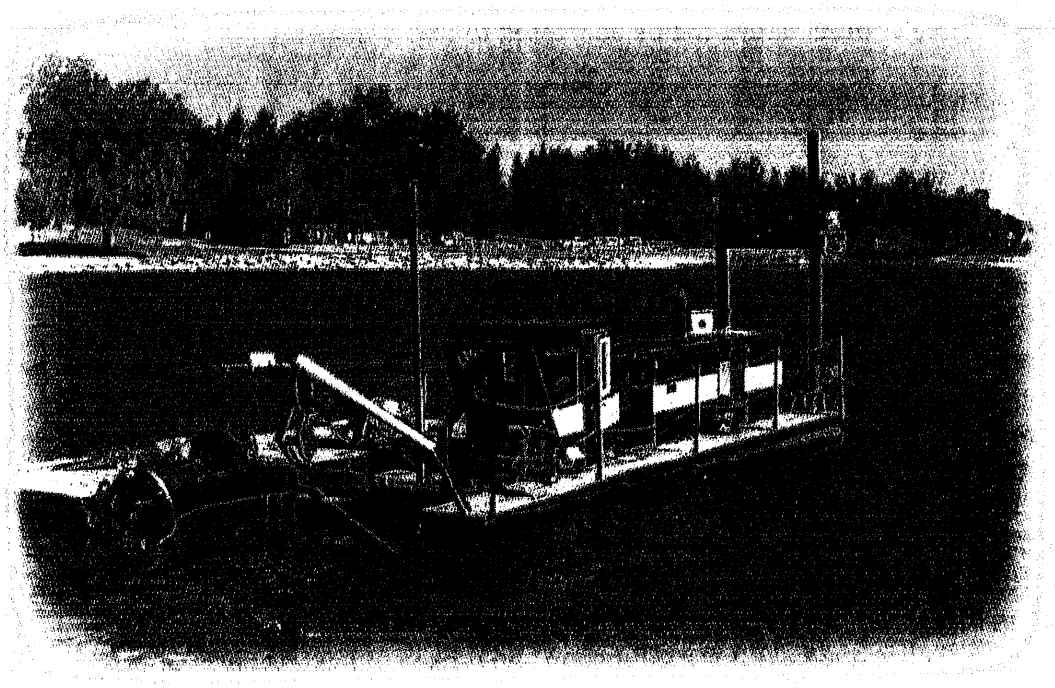
BADGER

BY DSC DREDGE, LLC

INTRODUCTION

This 8" dredge was designed, manufactured, and tested using state of the art technology and rigorous building codes. The dredge provides a portable floating platform that offers all of the features of a conventional contractor's dredge.

The following pages of this manual will serve to familiarize and assist the operator with assembly, operation, and maintenance procedures necessary to successfully operate the dredge.



SAFETY RECOMMENDATIONS

⚠ CAUTION

THIS DREDGE IS DESIGNED FOR ONE MAN OPERATION, BUT A MINIMUM OF TWO QUALIFIED PERSONNEL SHOULD BE ON SITE NEAR THIS DREDGE AT ALL TIMES WHEN OPERATION AND MAINTENANCE IS BEING PERFORMED. TRANSPORTATION FOR PERSONNEL TO AND FROM SHORE WITH A RELIABLE MEANS OF COMMUNICATION WITH SHORE/ EMERGENCY PERSONNEL MUST BE IMMEDIATELY AVAILABLE.

DO NOT OPERATE THE DREDGE IN WATERS WHERE THE WAVES OR SWELLS CAN EXCEED 0.5 FEET (0.15M) OR IN CURRENTS THAT EXCEED 1 KNOT (1.7 FPS)

A primary concern to all equipment operators and service personnel must be safety. The responsibility of the user is conformance to any active safety recommendations, practices or regulations. The user has the most control over a dredge's application, operation, inspection, and maintenance or the varying and numerous regulations governing safety requirements. It is reasonable to presume that by knowing and following the guidelines given in the following pages, a safer working environment for yourself, those around you, and the dredge's operation will be maintained.

Questions about safety or other issues can be addressed to DSC Dredge LLC.

SAFETY RECOMMENDATIONS:

1. ***DO NOT*** operate the dredge or its machinery unless authorized to do so.
2. ***NEVER*** carry unauthorized passengers on or to and from the dredge.
3. ***ALWAYS WEAR*** a personal flotation device whenever working on the deck, the ladder, or moving to and from shore.
4. ***ALWAYS WEAR*** or utilize the proper safety equipment necessary for personal protection.
5. ***REVIEW*** your company's arc flash program and abide by all requirements and recommendations of this program before energizing any electrical equipment on the dredge.
6. ***READ and UNDERSTAND*** all the manuals for the dredge including the component equipment's instruction manuals before operating or performing any maintenance or service procedures for the dredge.
7. ***ALWAYS*** get some qualified help if you are not qualified to perform the procedure needed.
8. ***MAKE SURE*** that any petroleum based substances or foreign materials are cleaned from the steps, handrails, and walkways to reduce the danger of slipping.
9. ***INSPECT*** the dredge and have any malfunction and broken or missing parts corrected before operating.
10. ***ALWAYS*** use caution and be observant when working in close quarters or in congested areas
11. ***LOOK*** in all directions before changing the dredge's position.
12. ***DO NOT*** leave the dredge running and unattended; shut it down.
13. ***DO NOT*** service or clean the dredge with the engine running.

⚠ CAUTION

WHEN IT IS NECESSARY TO SERVICE THE DREDGE WITH THE ENGINE RUNNING, USE EXTREME CAUTION AND FOLLOW ALL SAFETY PROCEDURES NECESSARY TO INSURE PERSONNEL AND EQUIPMENT SAFETY.

⚠ WARNING

DO NOT SERVICE OR CLEAN THE DREDGE WITHOUT FOLLOWING YOUR COMPANY'S WRITTEN LOCK-OUT PROGRAM!

14. As all batteries are potentially hazardous, due to their emitting flammable gases, injury or damage could result unless caution and the proper procedures are ***ALWAYS*** used to minimize arcing when jump-starting. (refer to your motor operator's manual)
15. ***ALWAYS*** secure the dredge ladder with safety cables or chains BEFORE providing service or maintenance to the dredge.
16. ***ALWAYS*** use the appropriate lifesaving and firefighting equipment in accordance with regulatory laws having jurisdiction in your working area.
17. ***ALWAYS*** use the proper contaminant free material handling and dispensing equipment when adding or changing systems fluids.
18. ***ALWAYS*** wear the proper hand protection when handling wire rope.
19. ***FOLLOW*** the procedures in the instruction manual for start-up, shut-down, maintenance, and service. ***IF IN DOUBT, CHECK!***
20. ***OPERATING CREW*** must know where the firefighting equipment is and how to use it.
21. ***OBSERVE*** all safety signs and labels on the dredge.
22. Any hydraulic leaks or electrical wire chaffing should be promptly ***REPAIRED***.
23. ***ALWAYS*** check that the dredge has safe clearance under any overhead electric transmission wires.
24. ***ALWAYS*** think first and use good common sense when operating or working on the dredge.
25. ***NEVER*** exceed the maximum load limit of any crane or hoist.
26. ***PROVIDE*** life rings at appropriate places on the deck.

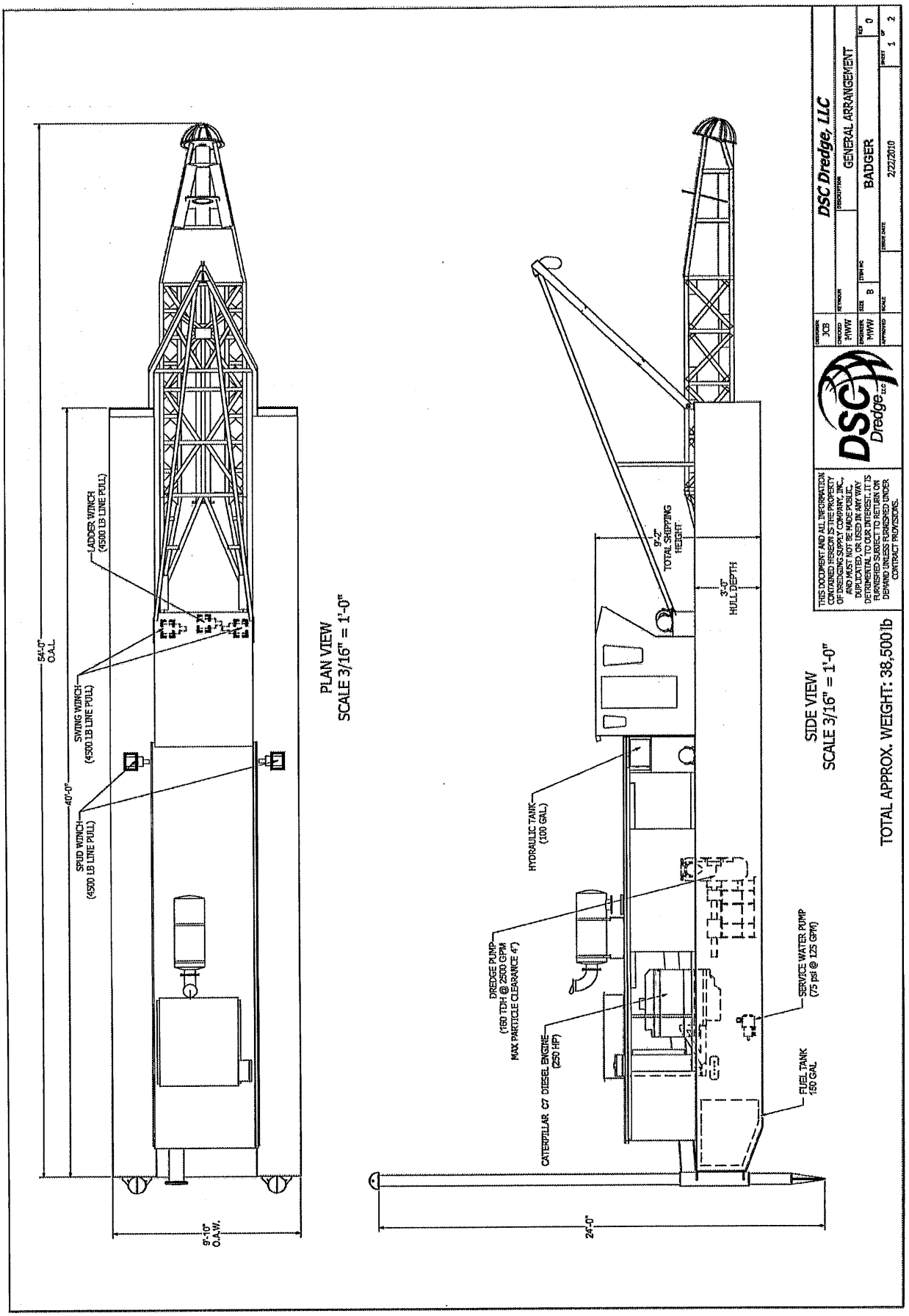
⚠ CAUTION

DO NOT ALLOW UNTRAINED OR INEXPERIENCED PERSONNEL TO LAUNCH, OPERATE OR PERFORM MAINTENANCE ON THIS EQUIPMENT.

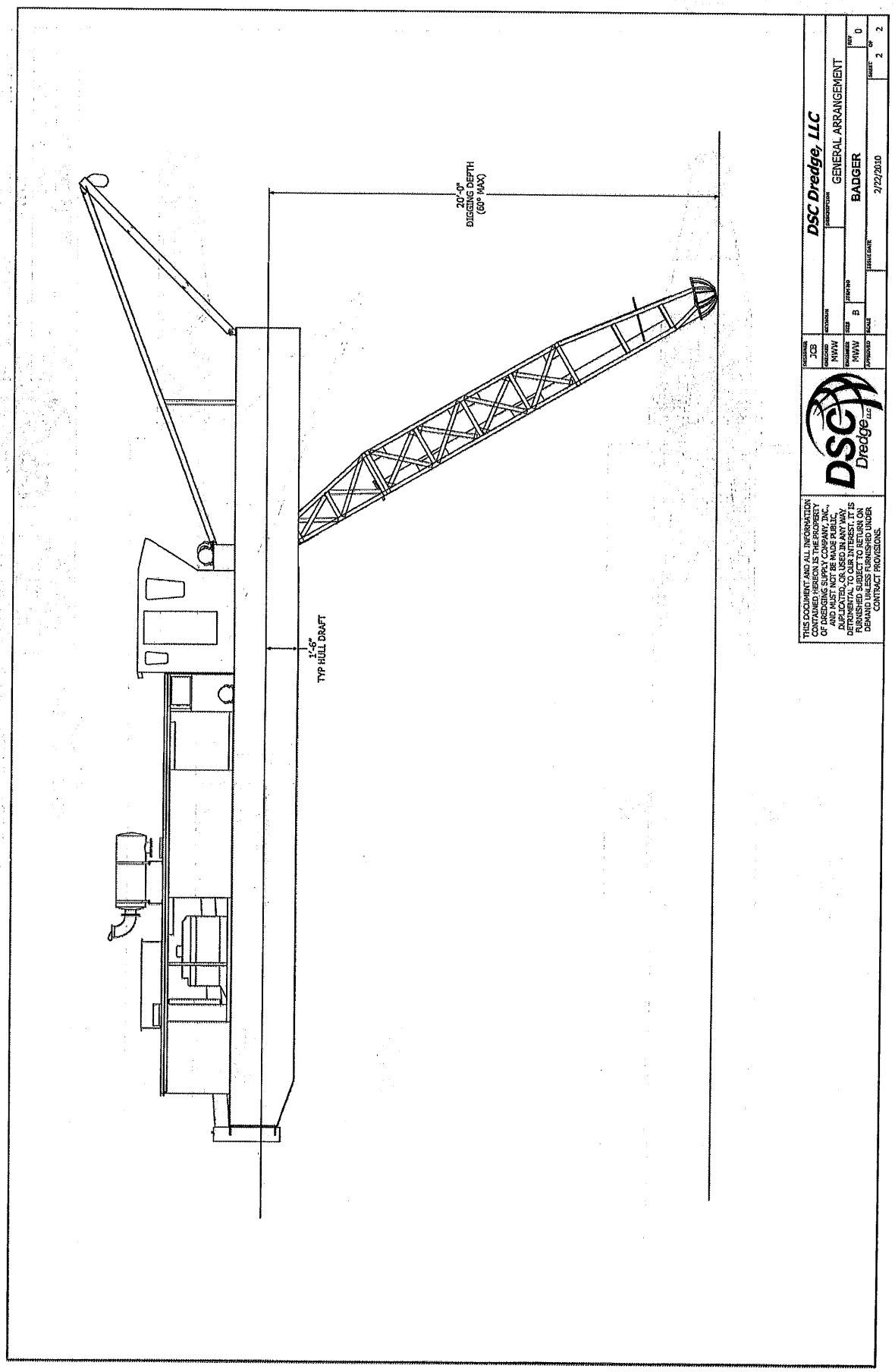
DO NOT UNDERCUT HIGH BANKS! CAVE-INS CAN CAUSE INJURY TO PERSONNEL AND COULD DAMAGE OR SINK THE DREDGE. ALWAYS BENCH CUT THE DEPOSIT TO AVOID BANK HEIGHTS IN EXCESS OF 6 FEET.

ALWAYS BE ALERT; CAREFUL OPERATIONS AND SERVICE PERSONNEL ARE THE BEST INSURANCE AGAINST ACCIDENTS.

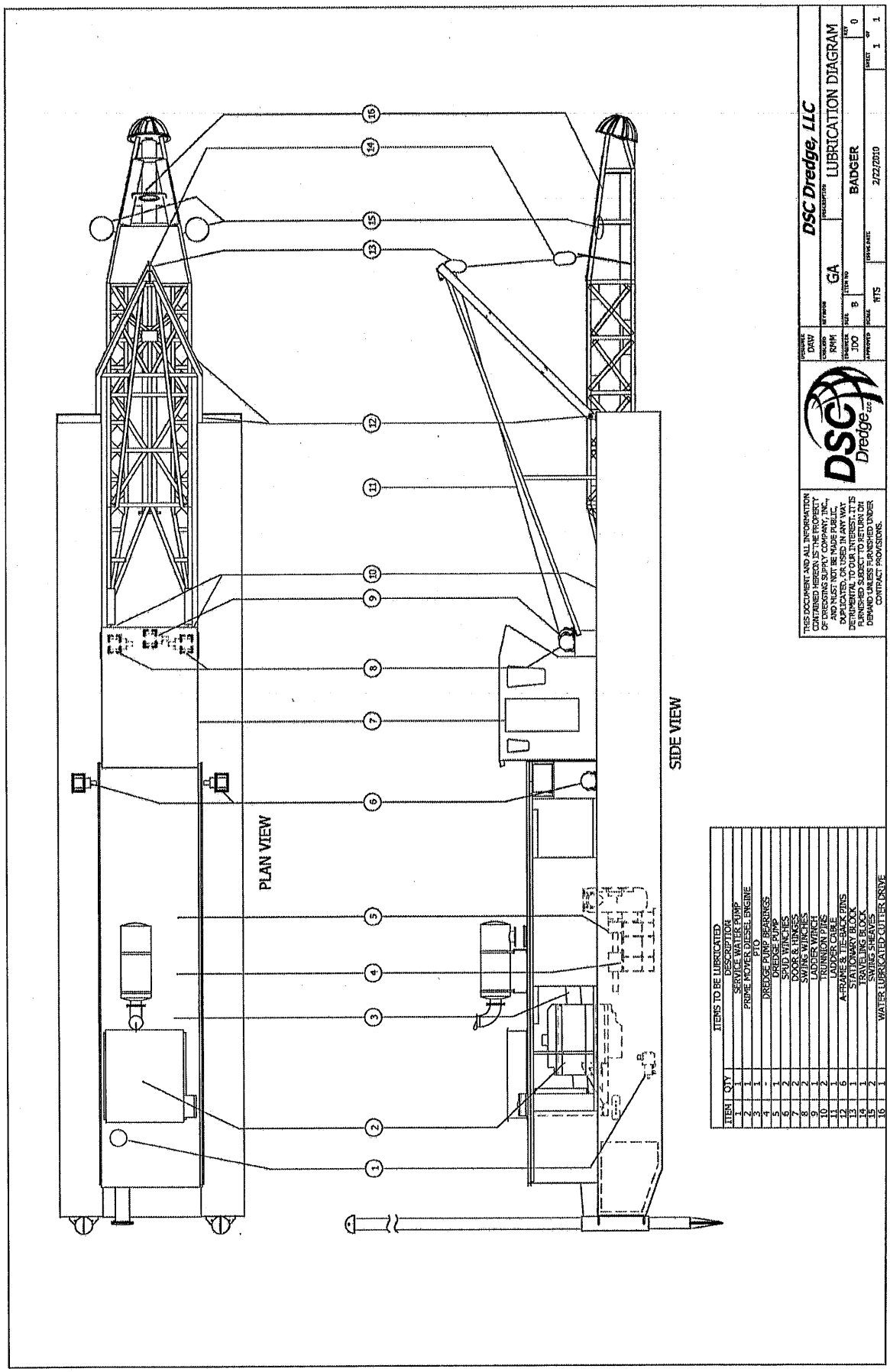
GENERAL ARRANGEMENT



DIGGING DEPTH DIAGRAM



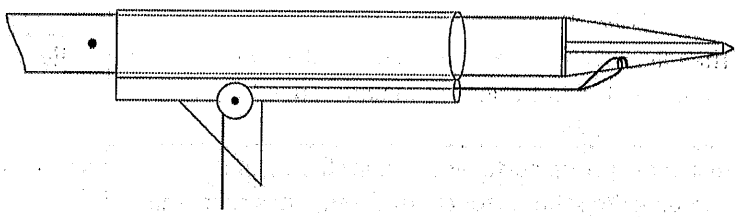
LUBRICATION DIAGRAM



LUBRICATION SCHEDULE		
DESCRIPTION	**LUBRICANT**	**SCHEDULE**
SWING LINE PULLEY	CHEVRON RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPOSE)	Grease every shift change or 8 hours of dredge operation.
A-FRAME & LADDER PULLEY BLOCK	CHEVRON RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPOSE)	Grease every shift change or 8 hours of dredge operation.
SPUD WELL PULLEY	GREASE EVERY SHIFT CHANGE OR 8 HOURS OF DREDGE OPERATION.	Grease daily
CONTROL HOUSE DOOR HINGES & LATCHES	LIGHT MULTI-PURPOSE OIL	Clean and lubricate as needed
SERVICE WATER PUMP BEARINGS	CHEVRON RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPOSE)	Refer to grease fitting panel. Grease every 24 hours of dredge operation. Refer to the manufacturer's manual for other lubrication specifications.
METSO H24 THOMAS SIMPLICITY PUMP	CHEVRON 6EP OIL SAE30; GREASE EP-1 (REFER TO METSO INSTALLATION AND OPERATIONS MANUAL FOR FURTHER INFORMATION)	Check oil level on "sight gauge" several times daily. Lubrication depends on the environment of pump operation. Lubricate once or twice per week in favorable environment; every 2 hours in hostile environment. If dust, water & corrosive vapor or high speeds are present it is necessary to lubricate the bearings frequently
HYDRAULIC OIL TANK	PROGUARD HYDRAULIC OIL AW 46* **DO NOT MIX OIL TYPES**	Proper oil level should be at or above the center of the sight glass. Servicing should only be required if a leak is present. Check and maintain the oil level daily. Milky color indicates contamination with water in the system; change oil immediately; check lines & fittings for leaks. Change filter every 1,000 hours of operation or when they are contaminated.
DREDGE POWER TAKE-OFF	CHEVRON RPM HEAVY DUTY LC GREASE EP NLG 2 (MULTIPURPose)	A grease fitting panel for the (2) pilot bearings is provided. Grease every 24 hours of dredge operation
CATERPILLAR DIESEL ENGINE C7 (Prime mover)	CATERPILLAR DEO SAE 15W40 OR CHEVRON DELO 400 ESI MULTIGRADE 15W-40	Change oil and filter every 500 hours of operation. Engine fuel filters should also be changed at this interval. Send in a sample to CAT. S.O.S. oil analysis program **every 250 hours of operation.** Check oil level every 8 hour shift. (See Caterpillar Manual)(Approx. refill capacity is 6.5 gallons, or 25 liters)
WINCHES-ROTZLER	CHEVRON SAE 90 GRADE OIL (REFER TO WINCH OPERATING & SERVICE MANUALS FOR PROPER VOLUMES AND PROCEDURES.	Oil should be initially changed after first 50 to 100 hours of operation, after which the oil should be changed annually or after each 500 hours of operation

COMPONENT INSPECTION SCHEDULE		
DESCRIPTION	**INSPECT/REPAIR/REPLACE**	**SCHEDULE**
SPUD WINCH CABLES	Replace Cables worn due to abrasion, fatigue, excessive strain, or damage caused by cable jumping off pulley or fatigued from bending over too small a radius	Inspect Daily
LADDER CABLE	Replace cable worn due to abrasion, fatigue, excessive strain or damage caused by cable jumping off pulley	Inspect Daily
HYDRAULIC HOSES	Replace worn or broken hydraulic lines with a hose having the same length, diameter, fittings and bend characteristics.	Inspect daily for leaks. Monitor hydraulic gauges. The sight glass will let you know there is a leak
DREDGE PUMP	Inspect pump impeller and side cover. Inspect pump packing gland for excessive leakage	When practical daily
LADDER HINGE PINS	Inspect ladder hinge pins/retainers for stress cracks and pin wear	Each 8 hour shift
HAND VALVE CONTROLS	Inspect hand valve controls to set and/or readjust hydraulic pressure	Daily
CUTTERHEAD DRIVE SYSTEM	The cutterhead drive bearings are lubricated by the fresh water pump. The cutterhead motor is internally lubricated by the hydraulic oil	Monitor fresh water pump gauge and cutterhead pressure gauge located in the control house
CUTTERHEAD	Inspect cutterhead brass wear plates & lock collar assembly for wear	Daily
ELECTRICAL SYSTEM	The electrical system consists of a full 24 volt breaker panel and the batteries are maintenance-free. Inspect connections	Daily
PREPARATION & PAINT	Inspect exposed surfaces for paint fading and/or chipping. Repaint or touch up these areas to increase dredge longevity	Annually or as needed

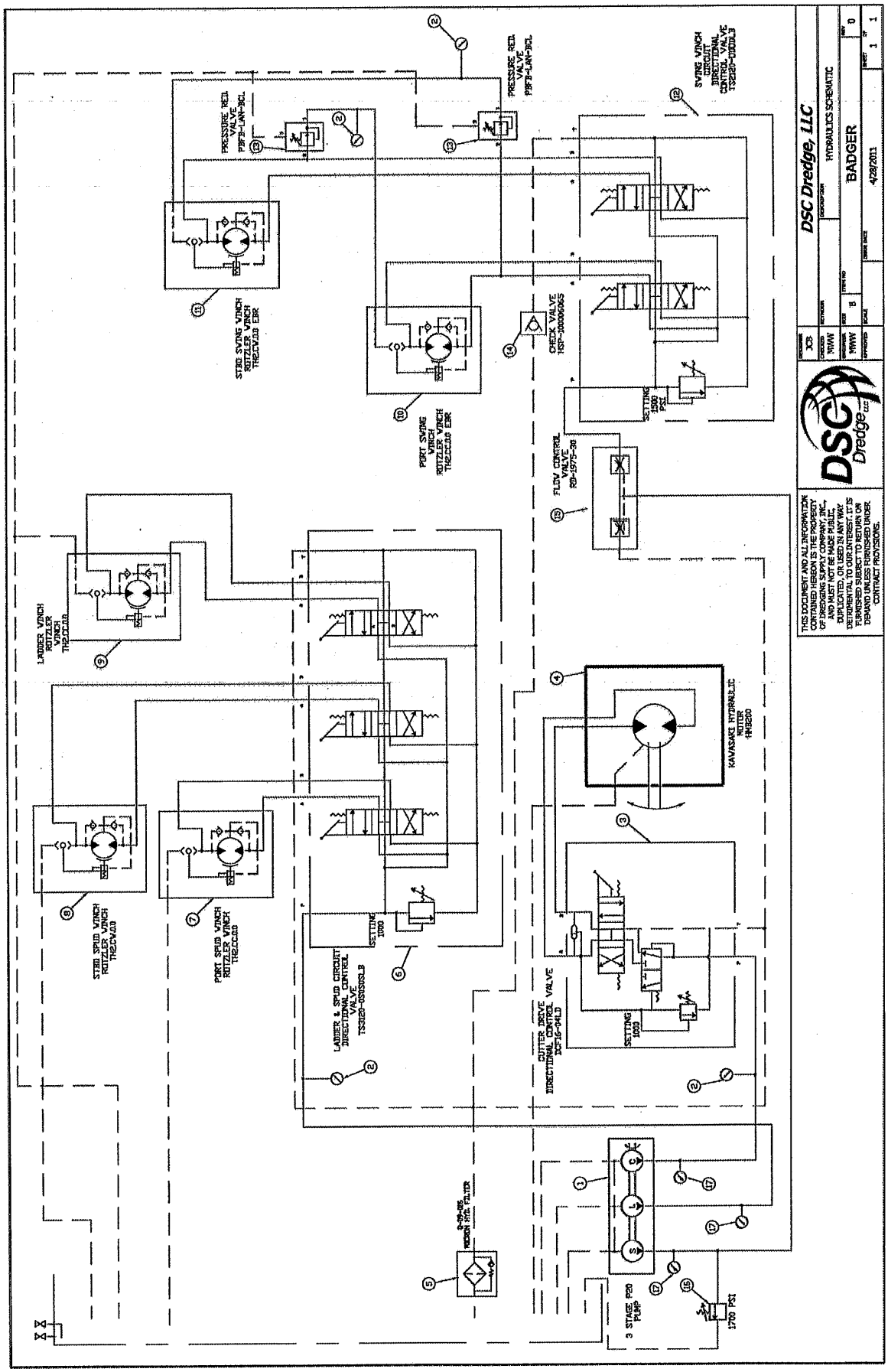
SPUD REEVING DIAGRAM



DRAWN BY: DAW	DSC Dredge, LLC						
CHECKED BY: MWW	APPROVED	DESCRIPTION	SPUD REAVING DIAGRAM				
ENGINEER: MWW	SIZE: B	ITEM # ID:	BADGER				REV: 0
APPROVED:	SCALE: NTS	SUPERSEDES:	8/10/2011				SHEET: 1 OF 1

THIS DOCUMENT AND ALL INFORMATION CONTAINED HEREIN IS THE PROPERTY OF DREDGING SUPPLY COMPANY, INC., AND MUST NOT BE MADE PUBLIC, DUPLICATED, OR USED IN ANY WAY DETRIMENTAL TO OUR INTEREST. IT IS FURNISHED SUBJECT TO RETURN ON DEMAND AND IS LOANED UNDER CONTRACT PROVISIONS.

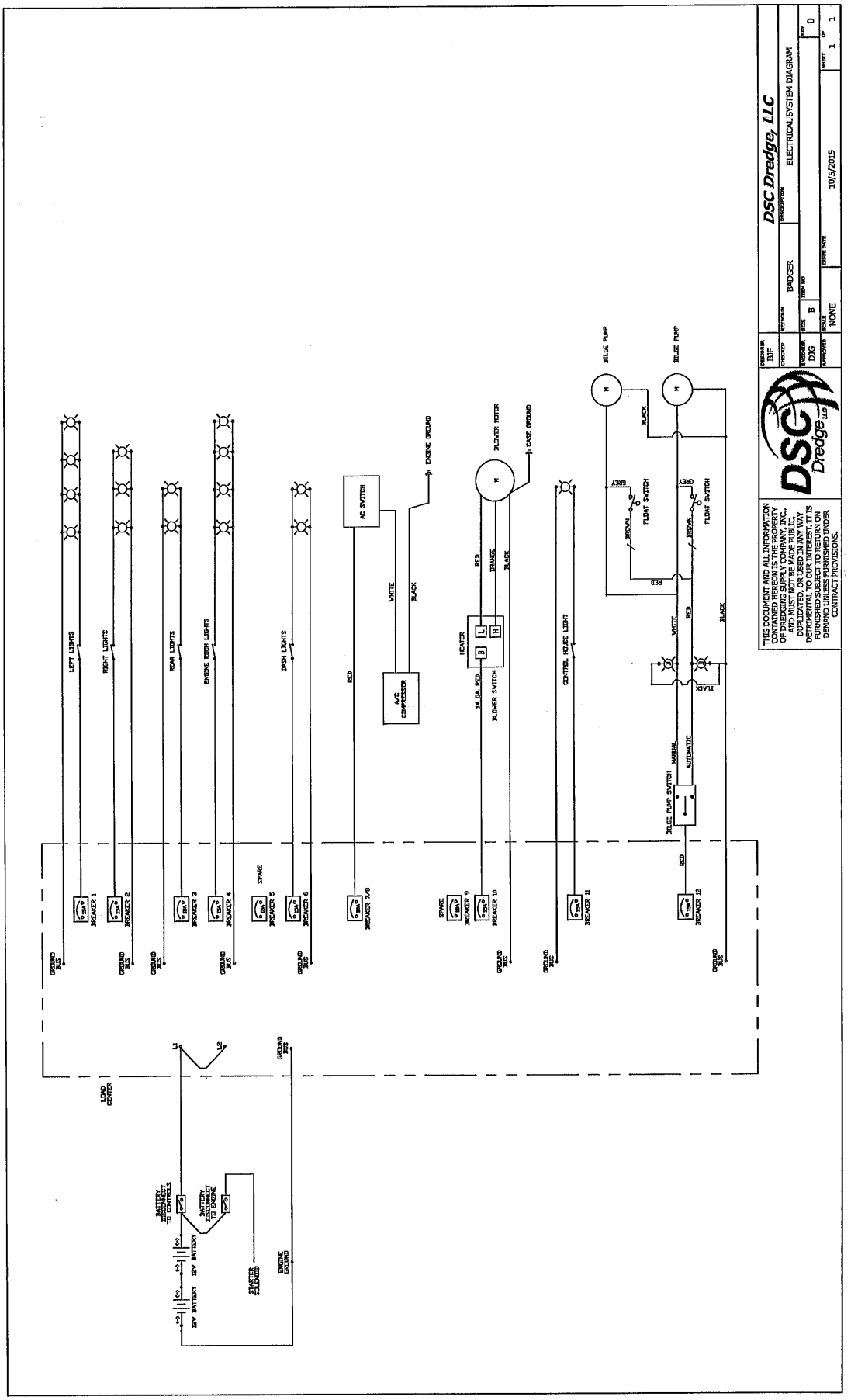
HYDRAULIC SCHEMATIC



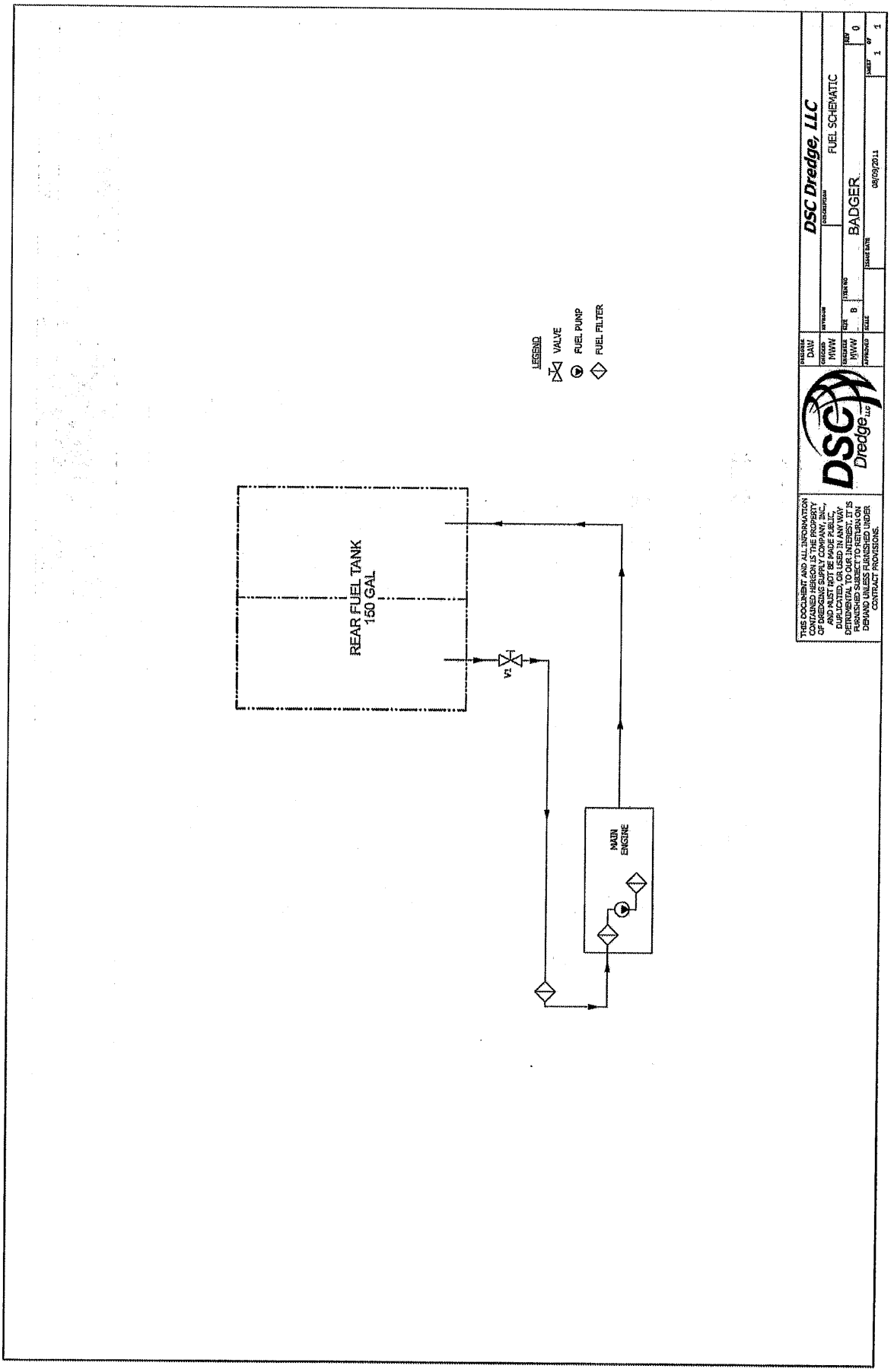
HYDRAULIC SCHEMATIC LEGEND

ITEM #	ITEM	QTY	DESCRIPTION
		CUTTER DRIVE CIRCUIT	
1	HYDRAULIC PUMP	1	3 STAGE P20 PUMP (PGP020B542BYAH17-43DAG12-1DAG12-1
2	PRESSURE GAUGE	4	WIKA 4.0" 0-2000 PSI GAUGE
3	DIRECTIONAL CONTROL VALVE	1	DCF16-04LD DIRECTIONAL CONTROL VALVE
4	CUTTER MOTOR	1	KAWASAKI HYDRAULIC MOTOR (HMB100)
		LADDER/SPUD CIRCUIT	
5	HYDRAULIC FILTER	1	MICRON HYD. FILTER SF-120-25-00
6	DIRECTIONAL CONTROL VALVE	1	TS3120-0S0S0SLB DIRECTIONAL CONTROL VALVE
7	PORT SPUD WINCH	1	ROTZLER TH2.CC.0.0
8	STBD SPUD WINCH	1	ROTZLER TH2.CW.0.0
9	LADDER WINCH	1	ROTZLER TH2.CC.0.0
		SWING WINCH CIRCUIT	
10	PORT SWING WINCH	1	ROTZLER TH2.CC.0.0-EBR
11	STBD SWING WINCH	1	ROTZLER TH2.CW.0.0 EBR
12	DIRECTIONAL CONTOL VALVE	2	TS2120-0D0DLB DIRECTIONAL CONTROL VALVE
13	PRESSURE REDUCING VALVE	1	PBDB-LBN-ECI SUN VALVE ASSY
14	CHECK VALVE	1	HSP-10000-6-65 DYNAMIC CHECK VALVE
15	FLOW CONTROL VALVE	1	RD-1975-30 PRINCE FLOW CONTROL VALVE
16	PRESSURE RELIEF CONTROL VALVE	1	1VR150P-12T-20-S
17	PRESSURE GAUGE	3	TRERICE 2.5" 0-2000 PSI GAUGE

ELECTRICAL SCHEMATIC



FUEL SCHEMATIC



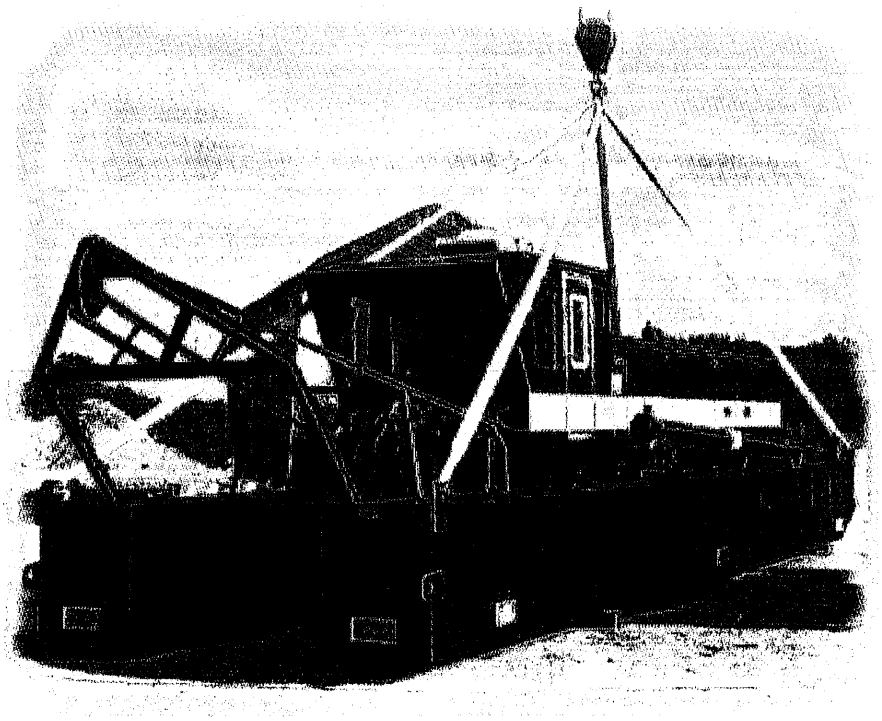
Assembly Instructions

This 8 inch dredge was designed for easy disassembly, transport, and assembly. It has been completely assembled, and shop tested at our facility to ensure its satisfactory operation. Due to height restrictions, the spuds are shipped lying on the side pontoons.

The dredge hull consists of multi-compartment sections to aid in flood resistance. It provides flotation and serves as a foundation for both the excavating and conveying machinery. The hull has a total of four lifting eyes and four drag eyes (two each located in the front and rear of the dredge). The lifting eyes are used to lift the dredge from the trailer and the drag eyes are used to drag the dredge into the launch area. If a crane with the capability to reach the water with the dredge after lifting from the truck is used, then direct launching is possible.

When direct launching, the spuds may be installed before or after launching. When direct launching is not possible, the dredge should be positioned with the stern facing the water and launched on greased timbers that extend into the water on a slight slope. The spuds are raised and pinned prior to launch. The dredge will require water's depth of a least 48" (122 cm) for easy launching.

Once the dredge is in the water and prior to engine start-up, open all **three (3) of the hydraulic tank valves located beneath the hydraulic tank.** Open the service water pump's seacock valve located on the back starboard side inside the engine room. Connect the discharge pipeline, attach and set the swing anchors, start the engine and prepare to begin dredging.



SPECIFICATIONS

General Information

Hull Length	40'	12.2 meters
Overall Length (with ladder)	54'	16.5 meters
Hull Depth	3'	.91 meters
Hull Width	9'-10"	3.0 meters
Hull Draft (approx)	1'-6"	0.5 meters
Overall Height (trucking)	9'-2"	2.8 meters
Total Dry Weight (approx)	38,500 lb.	17,464 kg
Diesel Fuel Capacity	150 gal.	568 liters

OPERATING CONDITIONS

Minimum	4 feet
Maximum	20 feet

CUTTING WIDTH

At Minimum Depth	50 feet
At Maximum Depth	70 feet

PRIME MOVER

Manufacturer	Caterpillar
Model Number	C7 ACERT
Power	250 HP @2200 RPM

CUTTERHEAD

Cutterhead Type, 5 Cast Steel Blades	Smooth Edge
Cutterhead Diameter (inside)	22 inches
Cutterhead Diameter (outside)	30 inches
Shaft Diameter (nominal)	2 1/2 inch
Cutterhead Rating	17HP
Cutterhead Speed Variable	0- 70 RPM

CUTTERHEAD HYDRAULIC MOTOR

Manufacturer	Kawasaki Motors
Model	HMB-100

SWING WINCHES

Manufacturer	Hydra Works
Models:	Rotzler
Starboard Side	TH2.CW.0.0 EBR
Port Side	TH2.CC.0.0 EBR
Line Pull (mean)	4,500 lb.
Wire Size	3/8" 6x37
Drum Capacity	150 ft.

SPECIFICATIONS (CONT.)

SPUD WINCHES

Manufacturer	Hydra Works
Models:	Rotzler
Starboard Side	TH2.CC.0.0
Port Side	TH2.CW.0.0
Line Pull - Bare Drum	1,400 lb.
Wire Size	1/2" 6x37
Drum Capacity	65 ft.

LADDER WINCH

Manufacturer	Hydra Works
Models:	Rotzler – TH2.CC.0.0
Line Pull - Bare Drum	1,400 lb.
Wire Size	1/2" 6x37
Drum Capacity	110 ft.

DREDGE PUMP

Manufacturer	Metso Minerals
Series	Thomas Simplicity
Model	H24
Suction	8 inch
Discharge	8 inch
Impeller Diameter	24 inch
Rating	160'TDH @ 2500 GPM
Particle Clearance (max.)	4 inch

MAIN ENINE/ PUMP PTO

Manufacturer	Twin Disc
Model	SP214P1

HYDRAULICS

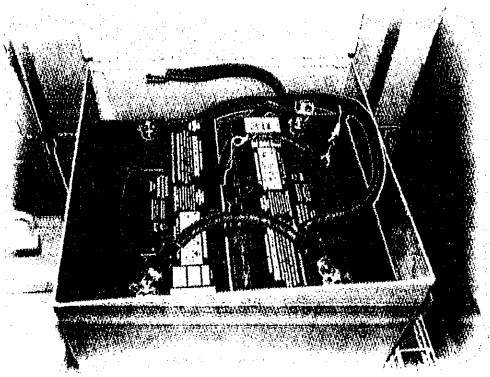
The dredge hydraulic pump is a 3-section pump that provides service to the cutterhead motor, swing winches, spud winches and ladder winch. The hydraulic system is protected by relief valves and the system has replaceable inline filters. The hydraulic system has an approximate capacity of 100 gallons (379 liters).

ELECTRICAL SPECIFICATIONS

Voltage	24 Volt
Battery	(2) 1000 CCA

CAPACITIES

Fuel	150 gal.
Hydraulic Oil	100 gal.

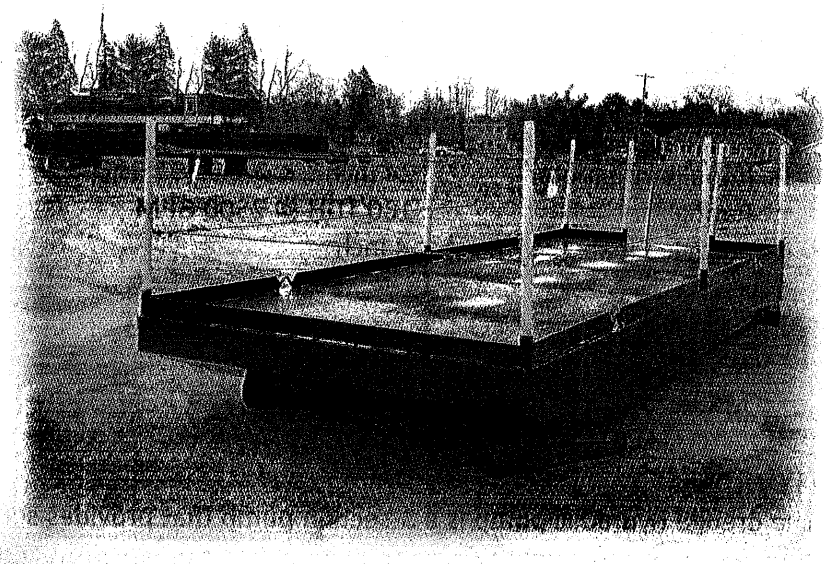


STANDARD FEATURES

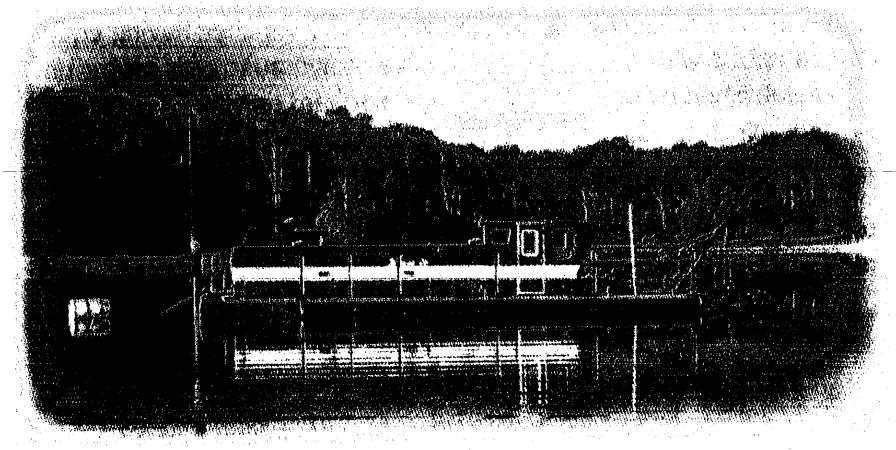
- Control cab insulated against sound and temperature, finished with wood paneling, equipped with Captain's chair and fire extinguisher
- All glass is of unbreakable gray tinted polycarbonate with makrolon
- All identification tags are in Spanish and English
- Safety hand rails and machinery guards
- Hatch covers for easy access to fuel tanks and filters
- Cabin and engine room lights
- Outside flood lights for night operation
- Digging depth gauge
- Fresh water service pump system
- 2000 gal 24V bilge pump. Galvanized cables on all winches. Special paint for greater salt water resistance, and to inhibit marine growth
- Dredge wash down system
- Roof Mount A/C Unit

OPTIONAL FEATURES

- Pump Packing
- Caterpillar Engine Filters
- Hydraulic Filters
- Cutterhead Teeth
- Discharge Hose with Flange (8"x10'L)
- Zinc Anodes
- Ladder Recovery Winch
- Tool Package
- Work barge - (20'long x 8'wide x 18"deep)



Work barge



DESCRIPTION OF EQUIPMENT

This 8" dredge is a self-powered pump system constructed to excavate and transport materials such as mud, silt, sand, gravel, and clay from the bottom of a shallow body of water (up to 20 feet deep) through a pipeline to a disposal site some distance away from the dredge.

The following paragraphs describe the functions of the various pieces of machinery located on the dredge. It is suggested that the reader refer to the machinery operating manuals and drawings which are enclosed while reading these sections.

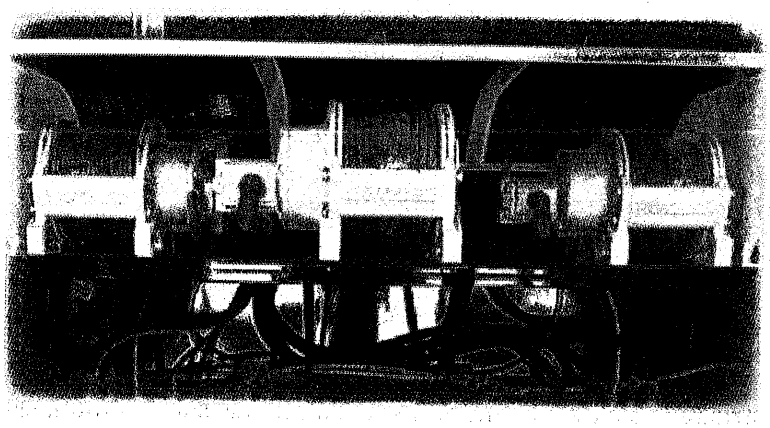
DREDGE LADDER

The dredge ladder consists of a structural steel frame which houses the dredge suction pipe, the cutterhead, and the cutter drive shaft and bearings. The ladder is supported at its aft end by hinge pins mounted on the bulk head. Near the end of the ladder are the swing pulleys. Wire rope passes from the swing winches through the swing pulleys to anchors located at either side of the channel to be dredged. The dredge cutterhead is driven by a hydraulic

motor with cutlass bearings. The ladder suction pipe is used to carry the mixture of solids and water to the dredge pump. A bolt-on flexible rubber hose connects the dredge ladder suction pipe to the hull suction pipe to permit ladder up and down movement.

WINCHES

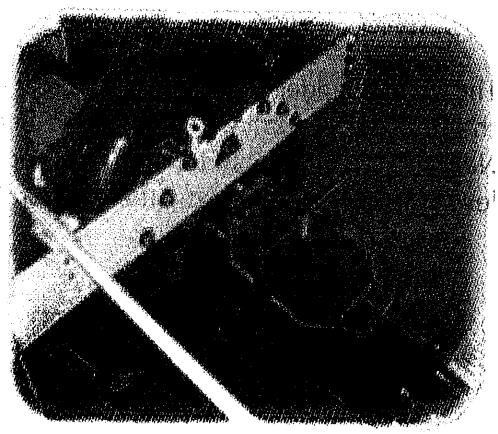
The swing winches are high performance, high efficiency planetary winches having equal speeds in forward and reverse directions and is equipped with a speed control valve. A hydraulic gear motor powers the swing winches and the reduction ratio is established by one planetary stage. Forward motion of the winch lever's are regulated to allow movement of the right winch to reel in while the left winch reels out. Backward motion of the winch levers are regulated to allow movement of the left winch to reel in while the right winch reels out. The opposite winch spools cable off against the brake at an operator-adjusted tension. All moving parts of these winches are totally enclosed and run in an oil bath. Anti-friction bearings are used on all turning components, assuring a long trouble-free service with a minimum requirement for maintenance.



Winch Assembly

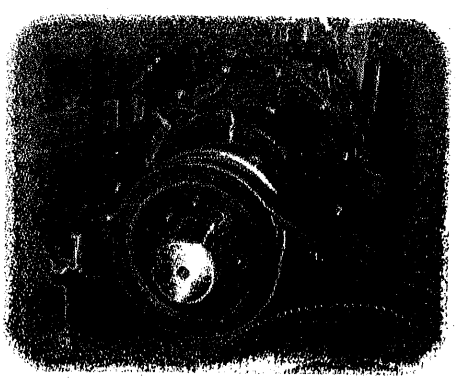
DREDGE PUMP

The dredge pump, which is driven by the main engine power take off through a belt reduction drive, consists of a rotating impeller enclosed in a pump shell which causes a low pressure area near the inlet and a high pressure area throughout the shell to the outlet. Atmospheric pressure and the water column above the pump forces material and water into the low-pressure inlet and the pump pushes this material around the shell to the outlet and down the pipeline. For a more detailed description of the dredge pump, refer to the pump operating manual.



PUMP BELT DRIVE

The dredge pump reduction is a belt drive. The main engine power take off has a 14MX-56S-68 sprocket/pulley with a 3525 x 3 1/2" bushing. The main pump shaft has a 14MX-140S-68 sprocket/pulley with a 4030 x 3 7/16" bushing. The drive belt is a 14MGT-2520-68 polychain. The pump located in the engine room can be engaged manually from the control house by using the clutch lever to engage the power take off.



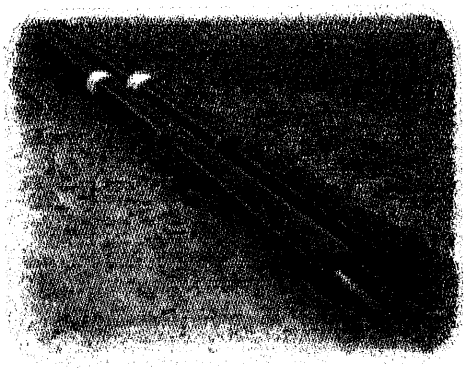
The prime mover is a Caterpillar model C7 ACERT diesel engine rated 250 hp (186 kW). The engine is attached to a Twin Disc clutch. For more information on the engine system refer to the Caterpillar manual.

Suction Piping

The dredge ladder suction piping is a straight length of 8" pipe. The dredge hull pipe consists of a welded piece of pipe piercing the hull. There is a Dresser coupling and a suction cleanout at the dredge pump. The welded piece of pipe serves as the transition barrier between the suction hose and the hull interior. The Dresser coupling is used to absorb vibration and to allow the cleanout to be removed for pump servicing. The cleanout serves as a convenient access for pump cleaning and inspection of wear. The dredge discharge pipe consists of a standard 8" elbow with an extended end, a Dresser coupling, and a straight piece of flanged pipe.

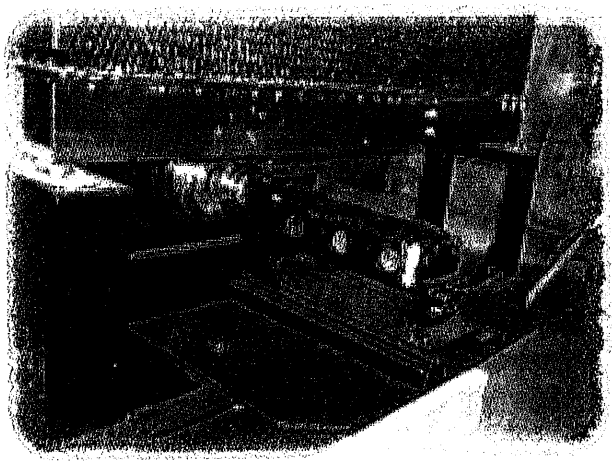
Spud System

The dredge spud system consists of two 8" pipe digging spuds located on the rear of the dredge. These spuds are used, one at a time, to hold the dredge steady in its cut and to provide a point for the dredge to rotate about. By alternating between the two spuds the dredge can be made to move forward or backward. The spuds are raised and lowered in a power-up, power-down fashion; care must be taken by the operator to stop the spud winch once the spud penetrates the bottom to prevent excess cable from being spooled off and causing a tangle. The spuds can be raised or lowered to any depth without resetting pins, pulleys, etc. There are yellow and red caution strips on and around the spuds to identify the position of spud. The operator can view the spuds and winches by using the side mirrors.



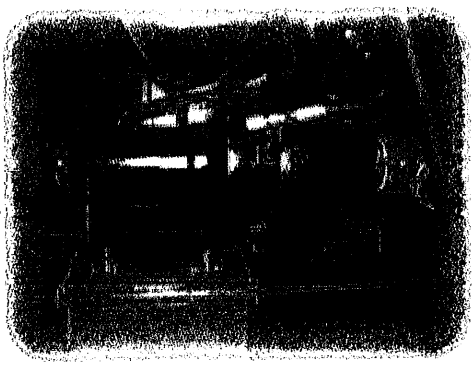
Hydraulic Pump

Most of the dredge's auxiliary functions are hydraulically powered by a three stage pump mounted at the stern of the engine. These auxiliary functions include the dredge cutterhead, swing winches, ladder winch, and spud winches. The hydraulic pump is divided into three sections to give individual operation to the cutterhead, ladder, swing winches and spud winches. The hydraulic system is protected from dirt and contamination by a tank return filter. All hydraulic circuits have pressure gauges and relief valves to protect from spikes and large hydraulic loads. The hydraulic tank also has a sight gauge and thermometer to indicate poor operating conditions.



Fresh Water Pump

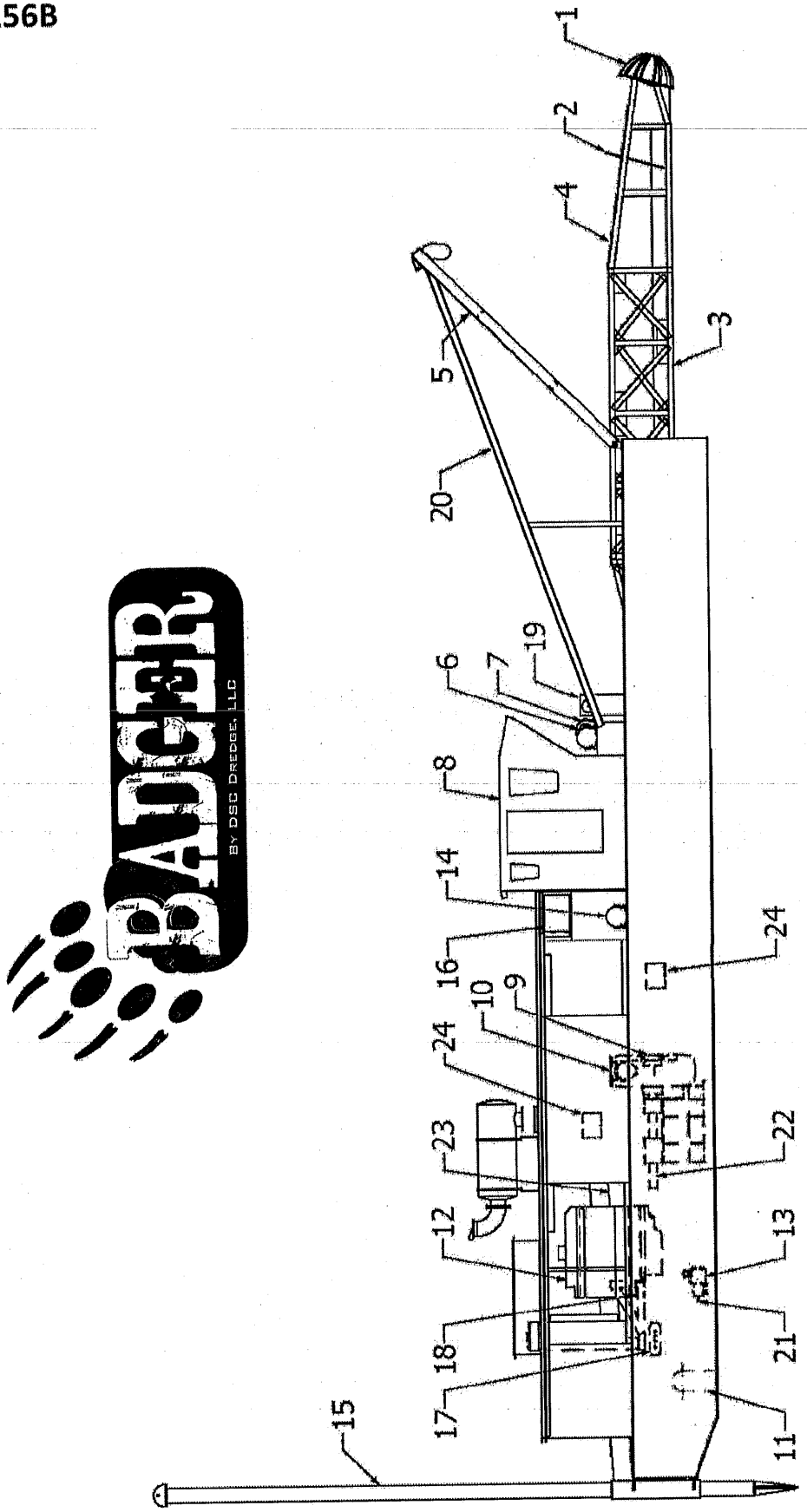
The water required for the dredge pump-packing gland is provided by a belt driven service water pump located at the stern on the starboard side of the fresh water pump water well. Fresh water enters the pump through screened seacock located on the starboard side. Water then flows through the gate valve into the service water pump and from the service water pump to the main pump-packing gland. A wash down faucet is located on the starboard side of the engine room.



MAJOR COMPONENTS LIST
DRAWING - #9156B
(REF PAGE. 25)

ITEM #	DESCRIPTION	MANUFACTURER	PART NO.	MODEL #
1	Cutterhead	In-House Fab	----	30"
2	Cutterhead drive motor	Kawasaki	42-030	HMB-100
3	Dredge ladder	In-House Fab	----	24'
4	Swing line pulleys	McMaster/Carr	60-005	3175T68
5	A-Frame	In-House Fab	----	----
6	Swingline winches	Hydra Works	Port 30-003 Stbd 30-004	Rotzler-TH2.CW.0.0 EBR & TH2.CC.0.0 EBR
7	Ladder winch	Hydra Works	30-001	Rotzler – TH2.CC.0.0
8	Control House	In-House Fab	----	----
9	Cleanout	In-House Fab	----	8"
10	Main Pump	Metso Minerals	20-013	----
11	Fresh Water Well	In-House Fab	----	----
12	Main Engine	Caterpillar Diesel	10-003	C7 ACERT
13	Service water pump	Burks	20-010	GNB 2-1/2 x 2
14	Spud winches	Hydra Works	Port 30-001 Stbd 30-002	Rotzler – TH2.CC.0.0 & TH2.CW.0.0
15	Spuds	In-House Fab	--------	8" x 20'
16	Hydraulic tank	In-House Fab		100 gals
17	Hydraulic pump	Parker	20-009	PGP020B542BYAH17-43DAG12-1DAG12-1
18	Engine stack shims	In-House Fab	----	----
19	Roller assembly	In-House Fab	----	----
20	A-Frame braces	In-House Fab	----	----
21	Service water belt	Gates	50-147	8MGT-2000-36
22	Dredge pump belts	Gates	50-146	14MGT-2520-68
23	PTO	Twin Disc	12-020	SP214P1
24	Dressers	Dresser	90-010	8" IPS ¼" x 5"

MAJOR COMPONENTS
DRAWING - #9156B
REF PAGE 24



Dredge Operation

Dredge Controls

The dredge has operator cab mounted controls for all of the dredging functions of the dredge.

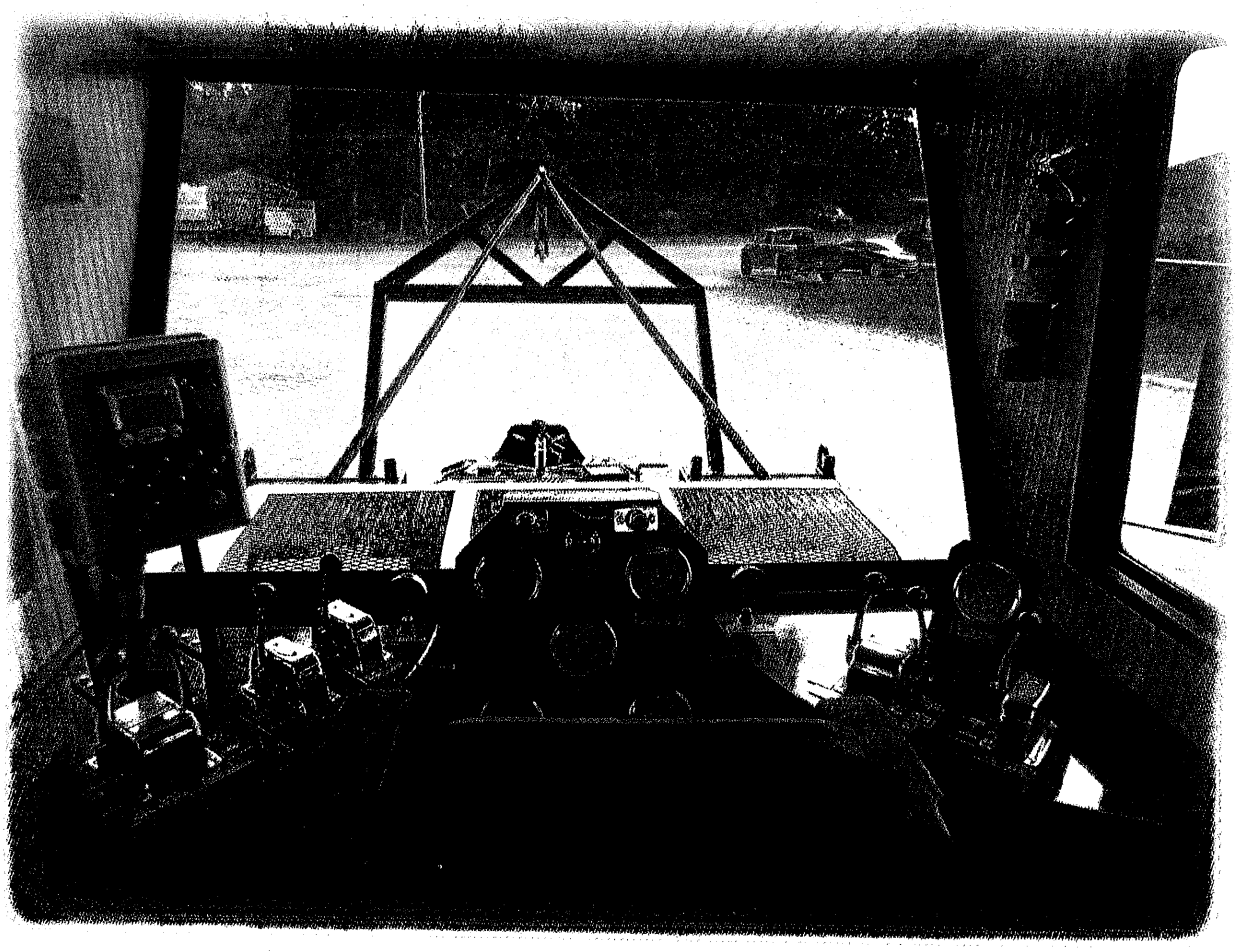
Ladder & Swing Winch Controls

The swing and ladder control levers are on the cab right side console. The swing winch's brake pressure gauge, one on each side for each winch, and the cutter pressure gauge are also on this console.

Both sets of controls are off when the lever is in the center position. When in the off position the swing winch's drag brakes are set and the ladder winch brake is set.

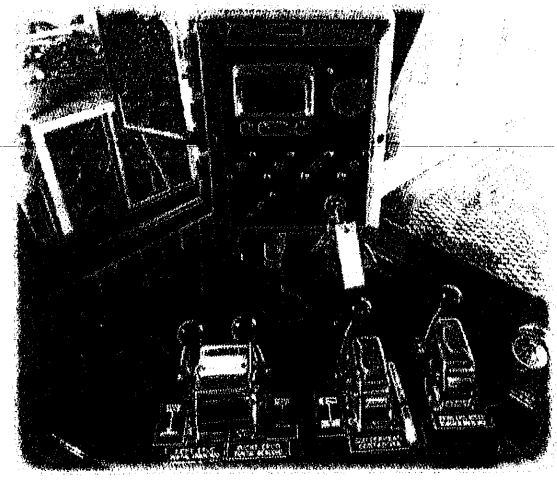
The ladder winch is power down and power up. Pulling the ladder lever back raises the ladder and pushing it forward lowers the ladder. The swing winches are controlled with the duel bank of levers on the left side of the right side console. The left lever controls the port (left) swing winch and the right lever controls the starboard (right) swing winch. When the swing winches control lever is moved forward wire rope will payout and hoist. The swing speed is controlled with first lever on the right of the left lever console.

The cutterhead pressure gauge is a display of the pressure to turn the cutter. This pressure will change with different materials dredged and with the speed of swinging the dredge



Spud and Cutterhead Controls and Swing Speed Control

The left lever console has four levers, the bilge pump switch, and the heater switch. The first lever set on the left is the port (left) spud lever and the next lever is for the starboard (right) spud. The spuds are power up and power down, pushing the spud lever forward will lower the spud, and pulling it back will raise it.



Cutterhead Rotation

The cutter lever is the third from the left. Push it forward to rotate the cutter counterclockwise and pull it back for clockwise rotation.

Swing Speed

The swing speed lever, the last lever on the right side of the console, controls the speed that the swing winches operate. The speed is increased as the lever is moved forward and speed decreases as it is moved back.

Engine Ignition

The key engine switch, murphy display, ignition switch, engine throttle and engine breakers are mounted behind the levers on the left side of the control console in the elevated control box. The display panel on the left side of this console is a display of the engine status.

Control Room Gauge Panel

The gauges on the gauge panel are the following:

A: Discharge pressure.

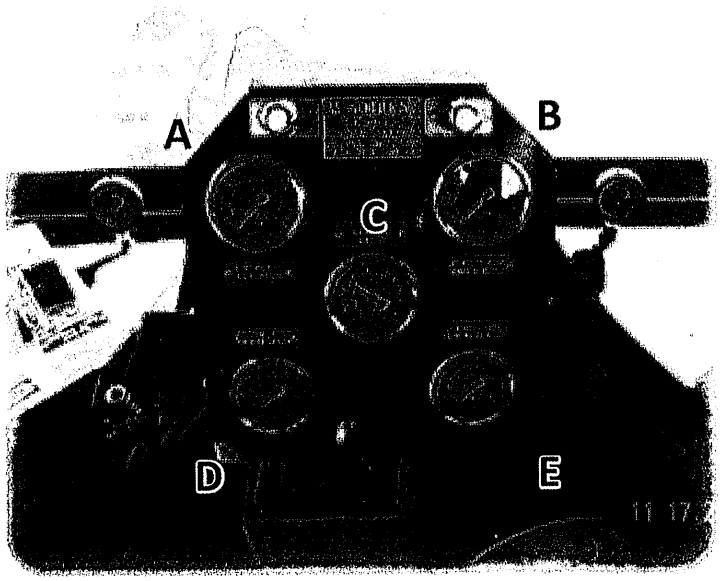
B: Service Water pressure. (5 to 19 lbs. above the discharge pressure)

C: Suction Vacuum. (Normal clear water 2 to 4 inches Hg)

D: Spuds & Ladder Hydraulic Pressure. (In use ladder or spud shown)

E: Swing winches hydraulic pressure (pressure of pulling winch)

The panel has two night lights on the top of it for night operation.



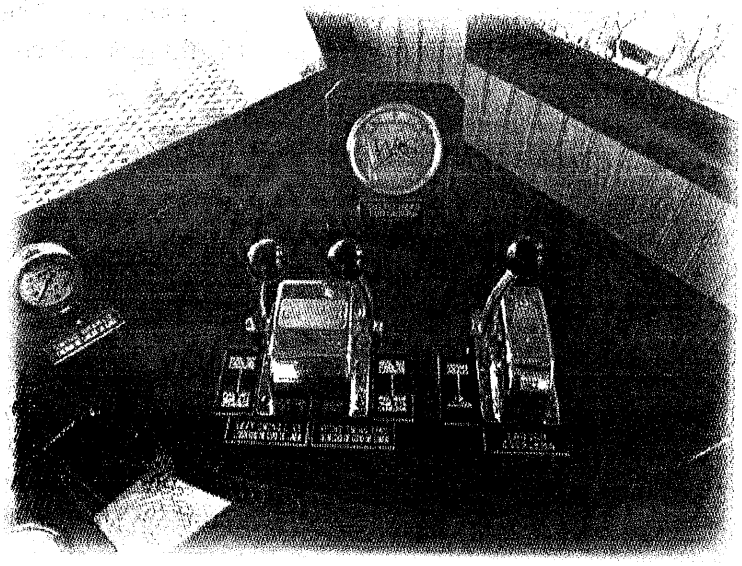
STARTING THE DREDGE

Prior to attempting to start the engine, the fuel tank should be completely filled with fuel that meets the specifications in the "Caterpillar Diesel Operations Manual". The Fuel Shut-Off Valve, which is a 3/4" ball valve, will need to be opened. It is located on the bottom of the fuel tank in the stern of the dredge. The only time the Fuel Shut-Off Valve should be closed is for inspection or cleaning of the fuel tank or when the dredge is being transported. There is a dip stick on the port stern of the dredge to check engine fuel level. The hydraulic tank has a sight glass on it and the proper oil level is half way up the gauge when the oil is cold. Check the oil level before every shift.

All machinery should be checked to see that it is properly lubricated, adjusted, fastened, and in good working order. Instruction manuals are furnished on the majority of the equipment in this dredge and they should be thoroughly studied prior to operating the dredge. The dredging area should be inspected for possible obstacles and debris.

The service water well should be opened to allow water to flow to the service water pump. Check that all console controls are in their neutral or off positions, including the engine throttle.

Turn engine key to the "start" position. Allow the engine to run at idle for several minutes. While the engine is at idle, check the machinery compartment for any leaks, loose belts or screws, etc. Engage the dredge pump and increase the engine speed to 1200 RPM. The service water gauge on the console should indicate service water pressure.



SWING AND LADDER CONTROLS

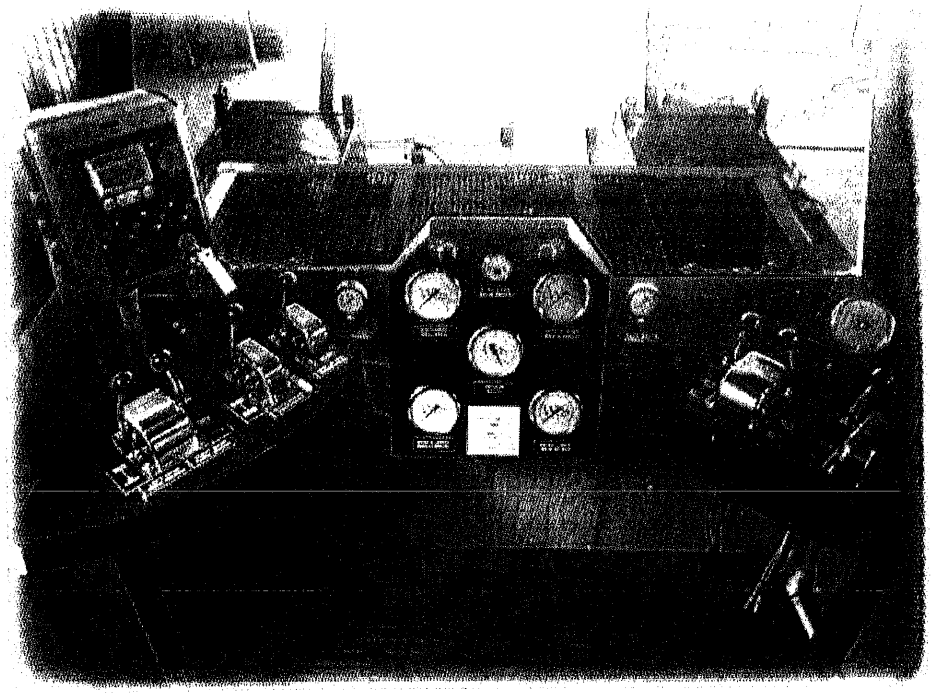
Lower the dredge ladder down into the water (the cutterhead should be just below the surface) and bring the engine speed to 1600 RPM. Open the air bleeder line located on the discharge pipe and when the vacuum gauge reading becomes a steady (3 to 4 in HG) and the discharge pressure gauge indicates a steady pressure, the pump is primed, close the air bleeder valve.

If the pump is slow to prime raise and lower the ladder rapidly between depths of 5 feet and 15 feet with the pump engaged to assist with priming. Close the air bleeder valve when the dredge is primed. The engine speed can now be varied up or down as necessary.

Swing And Spud Operation

Spuds provide the dredge a stable point to rotate about which is ideal when compacted material is encountered or when it is critical to leave a well-shaped bottom. Operation of the spuds is quite simple after the geometry of moving forward is fully understood. The two spuds located on the stern of this 8" dredge are used for two different tasks. The starboard spud is the **STEPPING** or **SETTING SPUD** and the port spud is referred to as the **DIGGING SPUD**. Most of the dredging cycle is spent on the **DIGGING SPUD** while the stepping spud is used primarily for locomotion.

It is imperative that at no time is the dredge swung to either side with both spuds down in order to prevent spud and spud well damage; there is no safety device other than good operation to prevent this.

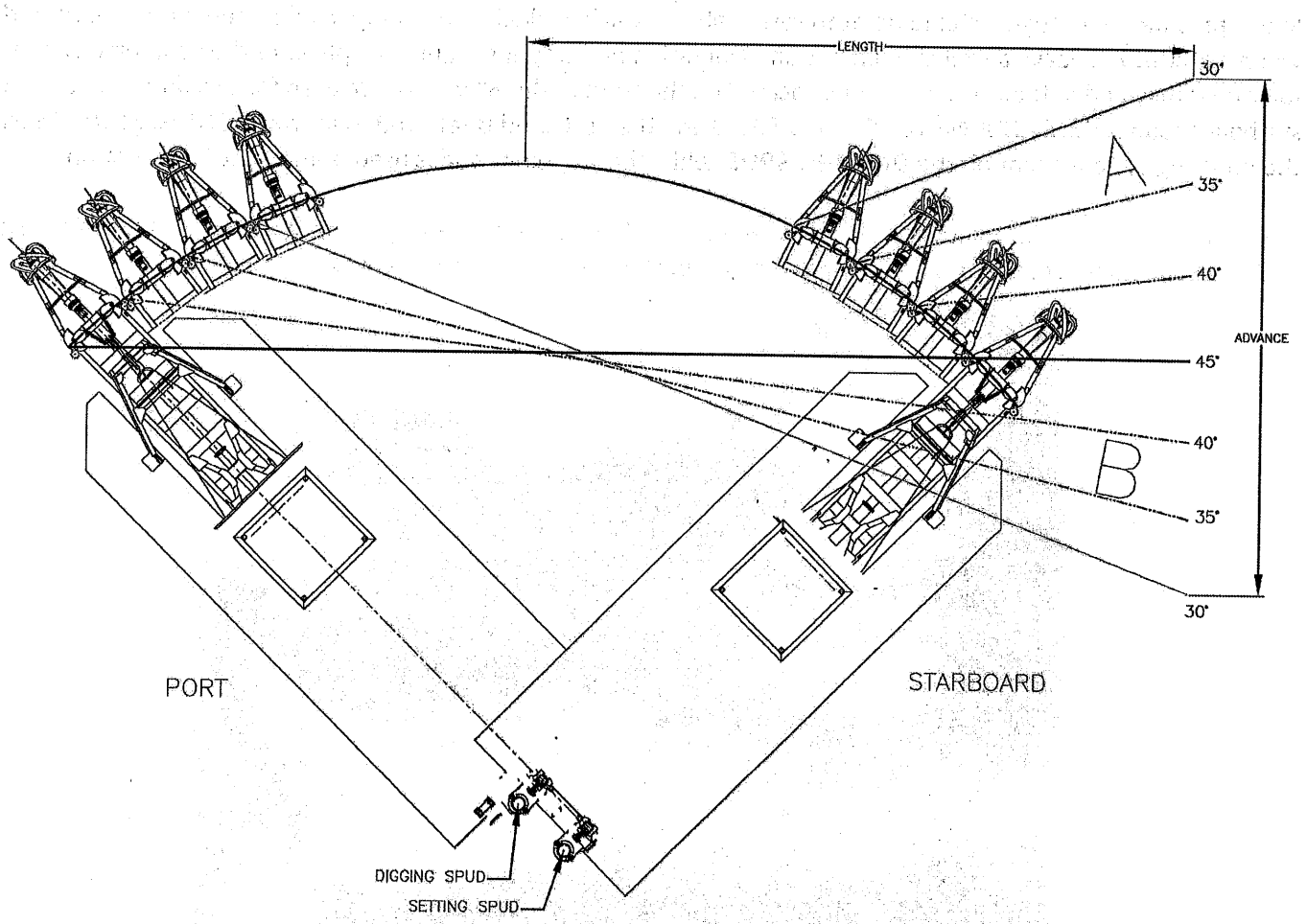


Control House Console

⚠ CAUTION

NEVER TRY TO SWING THE DREDGE WITH BOTH OF THE SPUDS SET IN THE BOTTOM

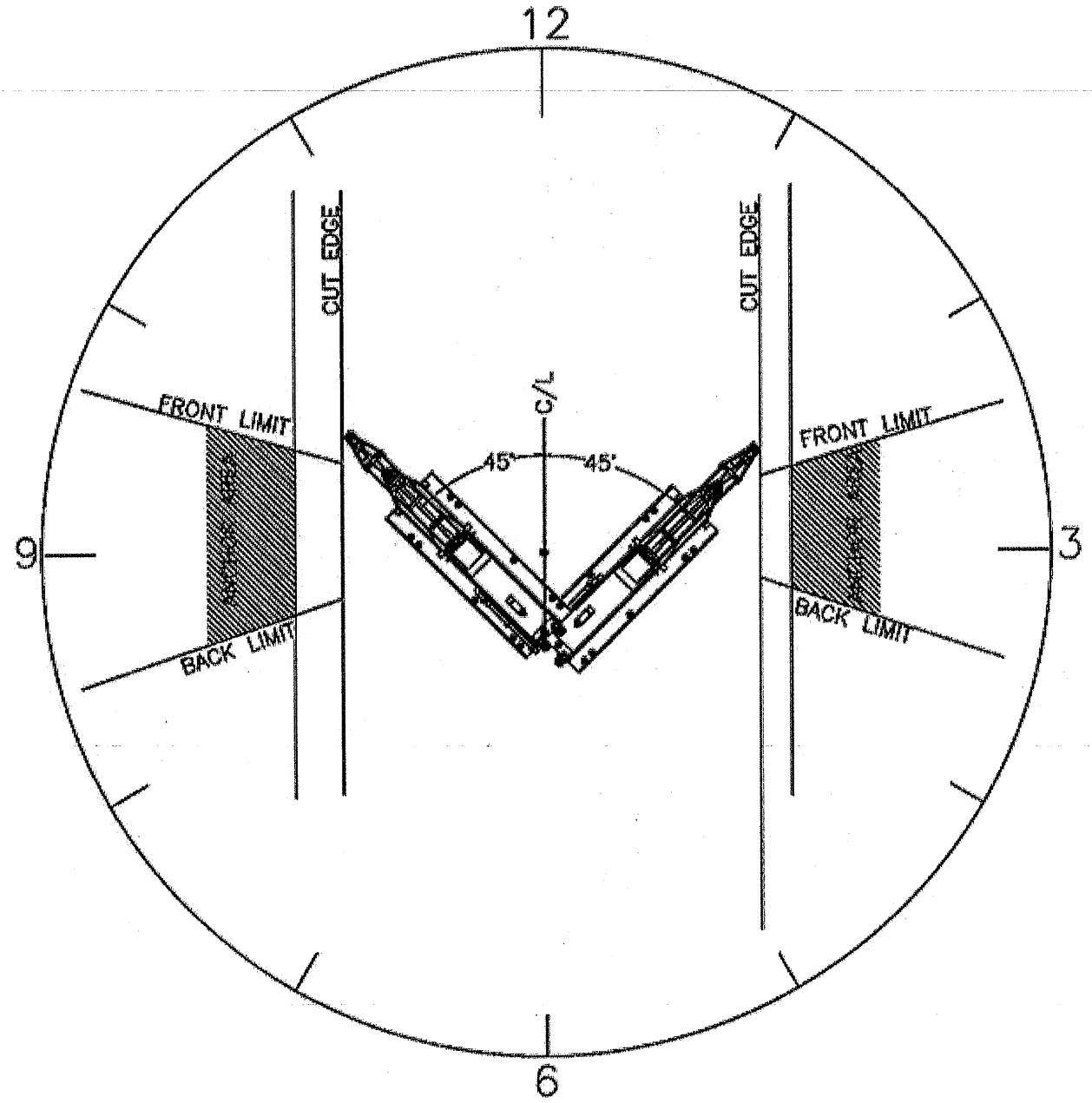
TECHNICAL ANCHOR PLACEMENT DIAGRAM



TECHNICAL ANCHOR PLACEMENT

To be able to fully load the cutterhead and swing winches and not overload the dredge spud system, the swing anchors should be placed according to the TECHNICAL ANCHOR PLACEMENT DIAGRAM as shown above. For example, if the dredge is to be swung thirty-five degrees to each side and the length is 100 feet (length is the perpendicular distance from the cut centerline to the anchor location). Then the anchor would be initially set on the 35-degree line marked **A**. The dredge would step forward as described in the next paragraph until the anchor lies on the 35-degree line marked **B**. As shown on the TECHNICAL ANCHOR PLACEMENT DIAGRAM, this advance or step forward would be equal to the length times the ratio for 35 degrees or 100 x 0.353 which is approximately 35'-3". It should be noted that as the length increases the available advance increases as well.
(SEE APPROXIMATE ANCHOR LIMITS DIAGRAM ON FOLLOWING PAGES).

APPROXIMATE LIMITS FOR ANCHOR PLACEMENT DIAGRAM



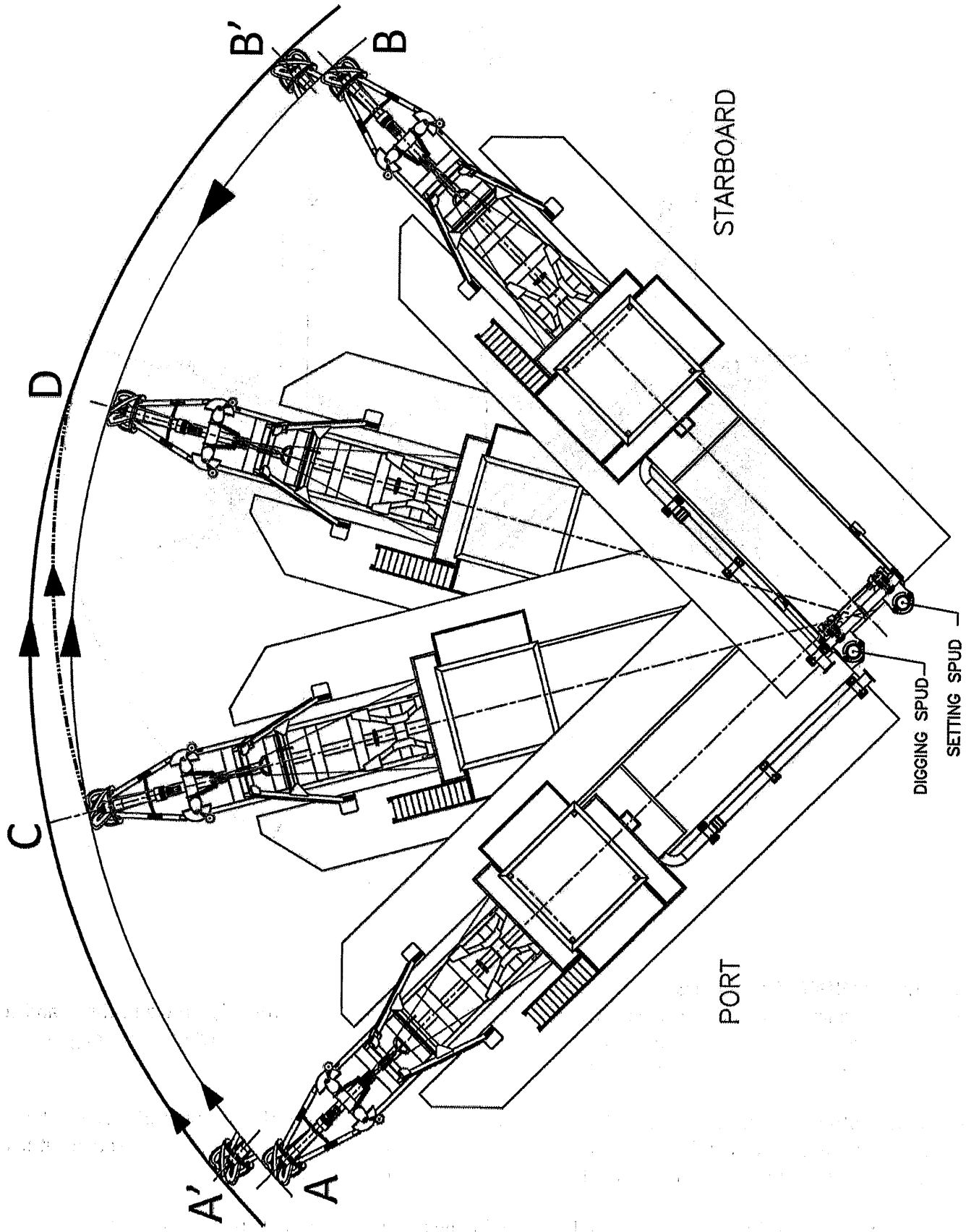
MOVING SWING ANCHORS

The swinging anchors should be moved when they get behind the dredge roughly between three and four o'clock on the starboard side and between eight and nine o'clock on the port side when the dredge is in the center of the cut looking from the operator room.

The appropriate anchor move forward should be roughly between two o'clock and three o'clock on the starboard side and nine o'clock and ten o'clock on the port side. Both anchors are set out of the dredge cut taking care to leave enough wire rope on the winches to reach across the dredge cut.

NOTE: The further out the anchor is placed the more dredge advance is available per anchor move.

SWING & ADVANCE DIAGRAM



DREDGING SWING & ADVANCE

The maximum allowable swing angle to either side of the centerline is forty-five (45) degrees for normal dredging; it should be noted that at forty-five degrees, the swing anchors should be advanced forward each set to prevent cutterhead stalling, swing winch stalling, or spud failure.

To begin dredging the swing anchors should be placed in suitable locations as mentioned above and the dredge swung to its port side to position **A** in the Swing & Advance drawing. Activate the cutterhead making sure the direction of rotation when viewed from the control house is clockwise. With the dredge pump primed and pumping water, lower the dredge ladder to the bottom at position **A**. Upon contact with the bottom the cutterhead pressure gauge should show an increased pressure and the dredge pump vacuum and discharge pressure gauges may reflect a change.

Using the swing winch controls and swing speed control, swing the dredge across the dredge cut to position **B**. Each cut across from **A** to **B** is called a digging cut since the direction of swing opposes the cutterhead rotation. Lower the ladder and swing back to position **A**. This swing is known as the clean up cut because the cutterhead does not efficiently excavate new material when swung in this direction.

When the required depth is reached swing the dredge to position **C** and stop, lower the stepping spud into the bottom, and then raise the digging spud. Swing to the starboard until position **D** is reached. Stop at position **D** and lower the digging spud, and then raise the stepping spud. This completes the advancement step. As shown on the Swing & Advance drawing the dredge has now moved ahead in a straight line.

Position **C** and **D** are relative to how far ahead the dredge is to be advanced. It is normal to step ahead one cutterhead length (approximately 24 inches) for most bottom conditions. For a 25 + inch step, positions **C** and **D** are located 7 degrees off of the advance center line. (See Swing & Advance Diagram)

The process of swinging from **A** to **B** and back to **A** and lowering the ladder can be repeated as necessary without advancing to achieve the proper depth. It is common to excavate more material than the dredge can move into the suction mouth during the digging cut to allow for better production during the clean up cut.

DREDGING EXAMPLE

(Refer to Swing and Advance Diagram on Page 32)

This hypothetical dredging work consists of maintenance dredging a boat slip 200 ft. long by 75 ft. bottom width and 20 ft. deep with the last 50 ft. a new extension. The material is silt and sand. The first 100 ft. has 2 ft. of material sloping up to 6 ft. The next 50 ft. slopes up to virgin bank that is 4 ft out of the water for the remaining 50 ft.

The virgin bank has 5 ft. of humus silt and fine sand. The spoil area is at the start of the boat slip 200 ft. to the left of the entrance. There are no land structures on either side for 200+ft. The water edge is approximately 70 ft. on either side of the slip bottom. The virgin material has maintained an after dredging slope of 1 on .5 (60 degrees).

1. **SET DREDGE UP** at the starting point with discharge in the spoil area and the swing anchors on either side out of the cut area.
2. **PERFORM THE START UP** procedure described in the dredge manual.
3. **LOWER THE PORT SPUD** into the bottom and raise the starboard spud.
4. **ENGAGE AND PRIME THE DREDGE PUMP** and start the cutter.
5. **SWING TO THE PORT** cut edge. (**A**)
6. **NOTE THE CLEAR WATER VACUUM** and adjust the engine speed to have 2" to 4 "Hg on the vacuum gauge.
7. **TAKE NOTE OF THE CUTTER HYDRAULIC PRESSURE** with it freewheeling.
8. **LOWER THE CUTTER** into the material to be dredged, noting the cutter pressure change, and the vacuum & discharge pressure change.
9. **SWING THE DREDGE** across the cut to the starboard limit (**B**) adjusting the speed of the swing by the gauge readings.
10. **ADJUST THE SWING SPEED** to get the maximum vacuum and discharge and cutter pressure without over loading the system.
11. **CONTINUE TO SWING** between the port and starboard cut limits until the required depth is reached and the vacuum is close to the clear water vacuum reading.
12. **LEAVE THE CUTTER AT THE FINAL DEPTH** and swing the dredge to the advance starting point (**C**).
13. **RAISE THE CUTTER** as needed to start the new swing. (at least 1 ft. to 2 ft.).
14. **LOWER THE STARBOARD (STEPPING) SPUD** and raise the port (Digging) spud.
15. **SWING TO THE ADVANCE FINISH POINT (D)** and lower the digging spud into the bottom.
16. **RAISE THE STARBOARD SPUD** and swing to the port cut limit (**A**) and repeat steps 8 through 16.

When the dredge is advancing into the dredging area, the height of the bank to be dredged increases the distance the ladder is raised. Near the end of the cut, in the virgin material the cutter may have to be raised to 4 ft.+ deep to undercut the bank. Repeat swinging the dredge from (**A**) to (**B**) and lowering the ladder until the required depth is produced. Then advance the dredge (steps 12 through 16). Once the dredging has reached the last 50 ft. of this slip under cutting the virgin bank may be necessary to finish the slip. Under cutting is accomplished by picking the cutter up until it is just deep enough to not suck air (+ 4 ft.) and advancing the dredge into the bank. Then swing between the cut side limits and lowering the ladder in steps until the required depth is reached. Some of the material may fall behind the cutter and will require backing up the dredge to clean up this material.

NOTE: THE SWING ANCHORS MUST BE ADVANCED TO STAY IN THE PROPER CONFIGURATION FOR DREDGING

A smooth operation will be the most productive. The speed of the swinging and the depth of the cutting should be adjusted to keep the maximum amount of material flowing through the discharge without having to stop and start swinging or over loading the cutter.

SWING CHART

BADGER SWING CHART			
Ladder Length(plus cutter)	23.8	Trunnion center to end of cutter	
Spud to Trunnion	31.2	Center of digging spud to center of trunnions	
Spud Width	7.4	Distance between spuds center to center	
Trunnion Height above Water	0.0		
Ladder Depths	**Angle**	**Length**	
4	10	54	Ladder depth is in feet from the top of water to bottom of the cutter. Ladder Angle & Dredge Length is computed automatically for ladder depth. The ladder depth is variable
10	25	52	
15	40	49	
20	58	43	

STEPPING CHART		
Total Set Degress	**Advance**	**Remarks**
5	0.3	Set Degrees are the total degrees for the set. This is from the point that the setting spud is set to the point that the digging spud is set. EXAMPLE: STOP 10 DEGREES TO ONE SIDE OF THE CENTERLINE, SET THE STEPPING SPUD AND RAISE THE DIGGING SPUD. SWING THE DREDGE TO 10 DEGREES TO THE OPPOSITE SIDE OF THE CENTERLINE, SET THE DIGGING SPUD AND RAISE THE STEPPING SPUD. THIS IS A 20 DEGREE SET = 3.0 FEET OF ADVANCE
10	1.3	
14	1.8	
20	2.6	
25	3.2	
30	3.8	
35	4.7	
40	5.1	
45	5.7	

SWING CHART					
DEPTH	4 (10°)	10 (25°)	15(40°)	20(58°)	
TOTAL DEGREES SWING	**WIDTH**	**WIDTH**	**WIDTH**	**WIDTH**	
10	7.4	8	8	9	
20	18	17	16	14	
30	22	24	26	27	
40	29	33	34	36	
45	32	36	41	40	
50	36	40	42	44	
55	39	44	46	48	
60	42	48	50	52	
65	45	51	55	56	
70	60	58	55	49	
75	64	62	58	52	
80	67	65	61	54	
85	71	67	64	57	
90	75	72	67	60	

The total degrees Swing are variable but are usually limited to 45 degrees either side which = 90 degrees total swing.

DREDGING TECHNIQUE

Effective dredge operation requires that the operator be both knowledgeable and comfortable with the dredge system and its operation. Very few projects rely so heavily on one person as does dredging. This section is intended to familiarize the operator with some frequently encountered dredging operations, the dredging gauges and what they are measuring, and some simple short cuts for every day operation.

In the daily routine of dredging, there are two basic types of situations that will be encountered; maintenance or deepening and excavating virgin land. When beginning a deepening operation, the dredge must slowly cut a slope down to the final depth; this must be done to keep the dredge ladder from dragging along the bottom. To dredge this slope the operator should progressively dig deeper with more passes as the dredge advances forward. Once the dredge has reached the final depth, the operator can excavate the entire depth on each advance. If the dredge is dredging high banks of stiff material the ladder may have to be raised to near the material top or water surface and then dredged down to the required depth after each advance.

Since the dredge pump must remain primed during the excavating operation, the removal of elevated virgin material may seem to present problems. Actually this operation can be performed easily by undercutting the bank. To do this, the operator should advance the dredge into the bank with the cutterhead just below the water level, then cut into the bank face at this level, and proceed downward. When the dredge has reached the final depth, the ladder should again be raised and advanced just below the surface. As this is continued, the above water material will begin to cave in behind the cutterhead. The operator may have to move the dredge backward to pick up this loose material.

Although the bottom being excavated is usually not readily visible, the dredge is equipped with an array of gauges to inform the operator about what is happening beneath the water and in the pipeline.

The dredge pump vacuum gauge is the single most important dredging gauge on the operator's console for this gauge indicates conditions in the dredge suction pipe as they occur. A dredge pump relies on atmospheric pressure to push water and material into its case; the dredge vacuum gauge indicates the effectiveness of the use of this pressure. Three vacuum gauge readings are of importance to the operator:

Indicated Vacuum - the vacuum reading directly from the gauge.
Clear Water Vacuum - the vacuum reading when pumping only water.
Effective Vacuum - the indicated reading minus the clear water reading.

The clear water reading is a measurement of the inefficiencies built into the dredge suction at a given flow rate. Since atmospheric pressure is limited (approximately 30" of Hg) the clear water vacuum should be kept as low as possible and still allow adequate velocity for conveying material; the clear water vacuum can be regulated by the pump speed. The effective vacuum, unlike the clear water vacuum, is a measurement of the suction losses due to conveying material. It is therefore favorable to maintain as high an effective vacuum as possible without causing cavitations or pipeline plugging.

The dredge pump's discharge pressure gauge measures the losses in the discharge line due to friction, elevation changes, and the conveying of solids. The discharge pressure gauge gives a good indication of what is happening in the discharge line behind the dredge. Soon after the dredge vacuum rises due to the movement of solids, the discharge pressure gauge rises to indicate greater restriction in the pipeline. While the discharge pressure gauge reacts with increasing solids, as does the vacuum gauge, its primary purpose is to prevent plugging in the pipeline. Pumping a mixture at a lower velocity decreases the power required as well as the wear; by watching the discharge gauge, the operator can get a feel for the proper discharge velocity. If plugging does begin to occur, the discharge pressure gauge will begin to rise sharply; the vacuum gauge may begin to fall. It is up to the operator to quickly raise the dredging ladder and increase the pump speed until the conditions have stabilized.

The cutterhead pressure gauge gives the operator an indication of both, the strength of the bottom material, and the rate at which it is being removed. The swing pressure gauge gives the operator an indication of strength of the bottom and the rate of the swing. If the dredge ladder is digging properly and not plowing into the material, the swing and cutterhead pressures should react similarly.

The engine tachometer serves as a useful measurement of the pump speed. The pump speed is approximately 45% of the engine speed. The engine speed should be adjusted to the length of the discharge line. Normally on this dredge a water vacuum of 3 in. to 4 in. will set the speed properly.

In addition to the use of gauges to increase production, clever manipulation of the dredge can also aid in production. The dredge cutterhead is manufactured with five smooth blades and 1" steel bars spaced at 4" intervals, which may help production by preventing intake of large stones and sticks causing the loss of suction power and pump prime. There are, however, bottom conditions that do not allow the cutterhead to work properly such as large amounts of trash or small twigs and vines. The cutterhead is designed to cut in a clockwise direction. However, a counter clockwise direction can be selected from the control house. By reversing the cutterhead direction several times the material trapped within or tangled about the cutterhead can often be shaken loose.

DO NOT REVERSE DIRECTIONS OF THE CUTTERHEAD WITHOUT ALLOWING IT TO STOP BETWEEN CHANGES IN DIRECTION.

During dredge operation, the dredge advance direction can be adjusted to suit curves in the channel. The operator alternates spuds on the clean up cut at differing angles to step at angles. The dredge can be advanced faster by alternating spuds at the end of each swing; the dredge can be moved backwards in the opposite manor as described earlier.

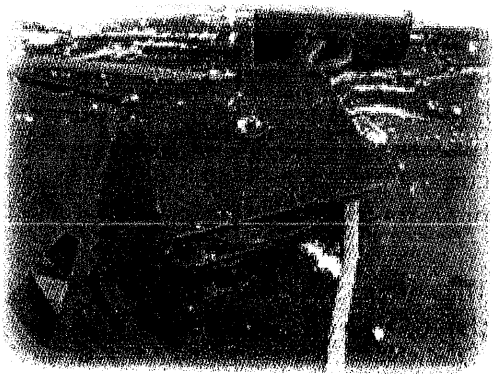
The final dredge technique to be discussed is the clearing of all solid material from the discharge line before stopping the dredge. The operator should raise the ladder and pump only to water level for several minutes until clear water is spewing from the pipeline at the spoil area. This ensures a clean pipeline whenever dredging operations resume.

Maintenance Schedule

Lubrication

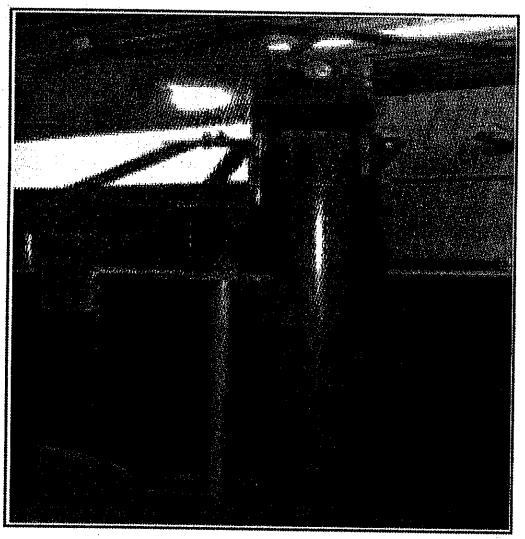
Swing Line Pulley

The pulleys are submerged and subjected to a very contaminated environment. They require lubrication every shift change or 8 hours, whichever comes first.



A-Frame & Ladder

Grease pulleys located on the mid-deck of the ladder and top of the A-Frame at every shift change or 8 hours, whichever comes first.



Spud Wells

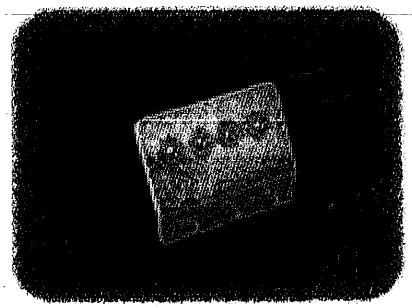
The pulley located on the top of the spud wells should be lubricated with acceptable grease on a daily basis to insure smooth operation.

Control House

There are no fittings located on the door hinges; however, the hinges should be lubricated as needed. The door latches should also be greased as needed.

Lubrication Specifications And Replacement Schedules

All lubrication levels should be checked in accordance with the following schedules. Failure to do so could cause serious damage to equipment.

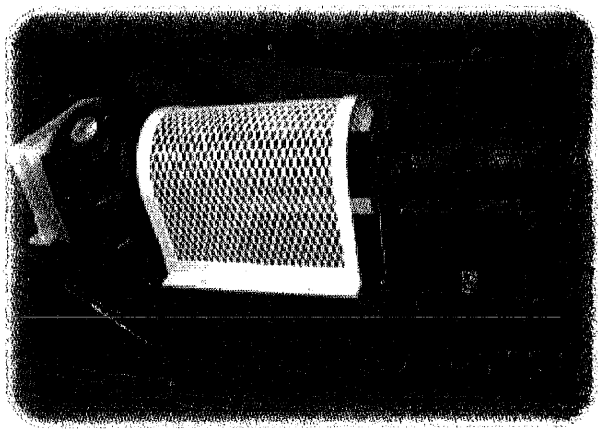


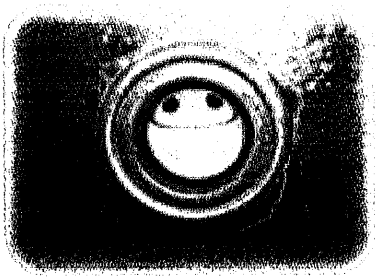
Service Water Pump & Power Take-Off

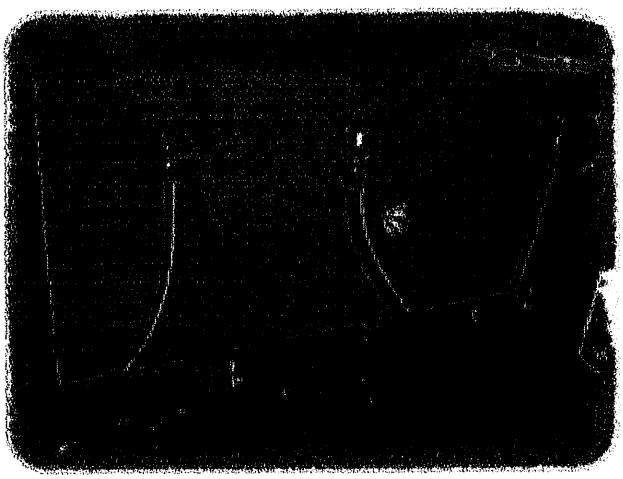
A grease fitting panel, shown at left, has two (2) fittings for the Burks Pump bearings on the service water pump and (2) for the PTO (Power Take-Off) pilot bearings. Grease every 24 hrs. of use with multipurpose grease. Refer to the manufacturer's manual for other lubrication specifications.

Dredge Pump Bearings

Observe the oil level in the Metso pump **SIGHT GAUGE** several times daily. Make sure the air vent in the gauge is open. The temperature of the thrust bearing normally runs at 140 degrees to 180 degrees Fahrenheit. The recommended lubricant is high quality lithium-soap grease, free of resin and acid, not liable to crumble and with good rust-preventive characteristics. The lubrication schedule depends on the environment the pump operates, but normally varies from once or twice per week in a favorable environment, to as often as once every two hours of operation in an extremely hostile environment. If the bearings are operated in the presence of dust, water, and corrosive vapor or at high speeds, more frequent lubrication is necessary. Refer to METSO "Installation and Operations" manual for further information.







Hydraulic Oil Tank

The hydraulic tank is located on the back of the control house cab. Proper oil level should be at or above the center of the sight glass located on the tank. Servicing should only be required if a leak is present. Check all lines and fittings for security and leaks. The hydraulic oil filters, located on the port stern side of the pump hole, should be changed every 1000 hours of operation or when dirt indicators on filters show contamination is present.

Wear Components

Spud Winch Cables

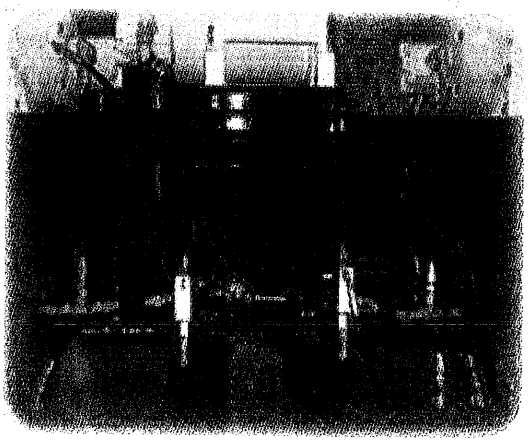
Visual inspection of the winch cables should be performed daily. Replace any cables worn due to abrasion, fatigue, excessive strain, or has been damaged by jumping off pulley or fatigued from bending over too small of a radius.

Ladder Cable

Visually check the ladder cable for any damage or wear. Replace cable as needed.

Hydraulic Hoses

Visually inspect hydraulic lines daily for leaks. Replace any worn or broken hydraulic lines with a hose having the same length, diameter, fittings, and bend characteristics.



⚠ CAUTION

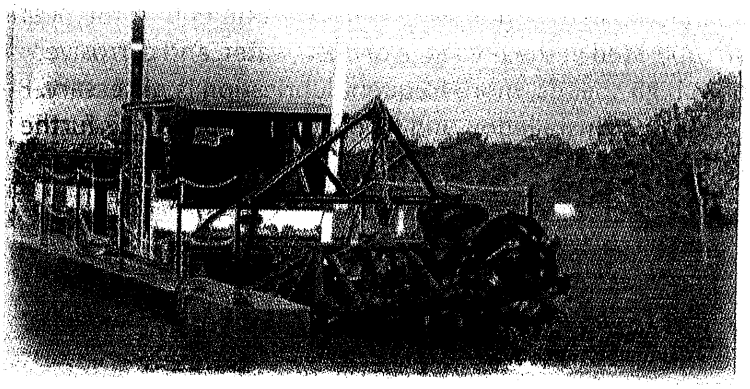
HYDRAULIC OIL ESCAPING UNDER PRESSURE CAN CAUSE SEVERE INJURY OR DEATH.

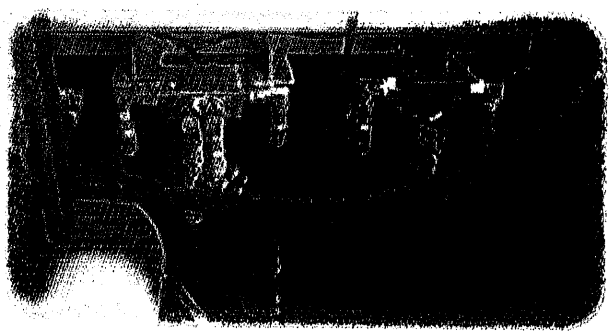
Dredge Pump

The pump impeller and side cover should be checked as often as practical. The pump-packing gland should be checked on a daily basis. Refer to the Metso pump service manual for proper adjustment and recommendations.

Ladder Hinge Pins

Due to the high forces generated by the dredge cutterhead and swing winches, the ladder hinge pins and their retainers should be checked each shift to insure that they are fastened and wearing properly. If a hinge retainer should come loose, it should be promptly secured. Likewise, if the hinge pins become worn, they should be replaced promptly.



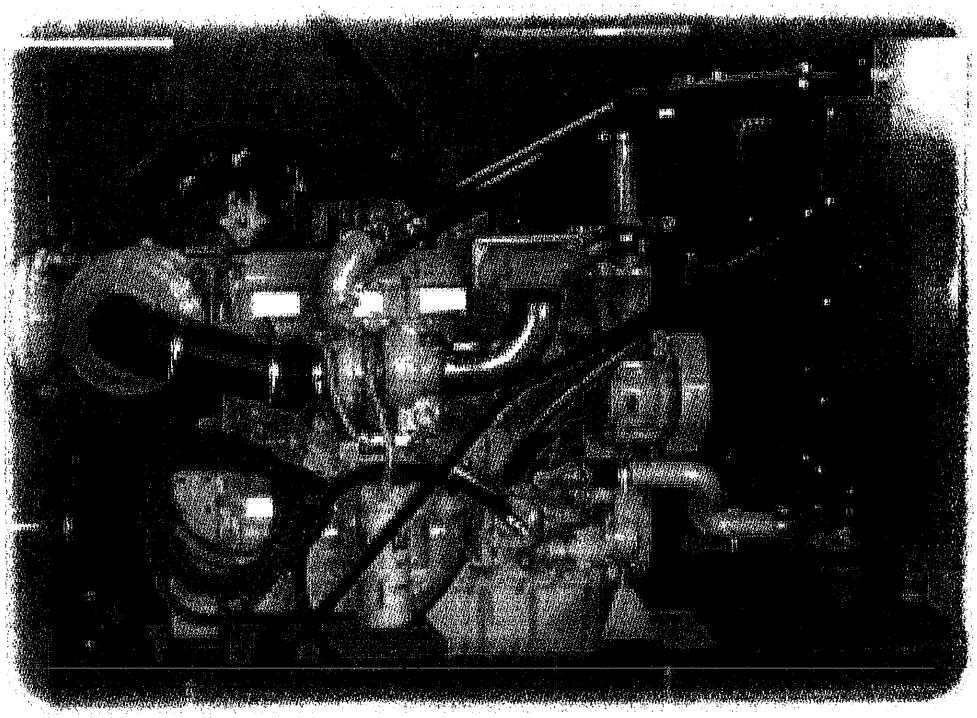


Hand Valve Controls

The hand valve controls are located under the control house for easy access to set and/or readjust the cutterhead and swing line pressure. Daily inspection of the hose fittings for leaks is recommended.

PRIME MOVER MAIN ENGINE

The Caterpillar Diesel engine requires engine oil and filter replacement as well as an engine oil sample every 500 hours of operation; engine fuel filters should also be changed at this interval. Caterpillar Diesel recommends an SAE 15W40 to operate in ambient temperatures of 5 to 122 degrees Fahrenheit. The engine is ready for normal operation; however, extra care during the first 100 hours of operation will result in more satisfactory long-term engine performance and life. DO NOT exceed 100 hours of operation with break-in oil. Check engine oil level more frequently during the engine break-in period. See "Caterpillar Diesel Operator's Manual" for further details.



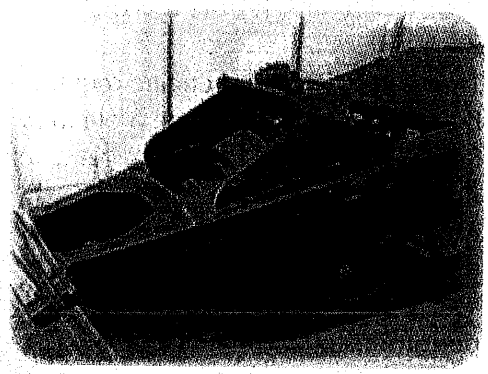
WINCHES

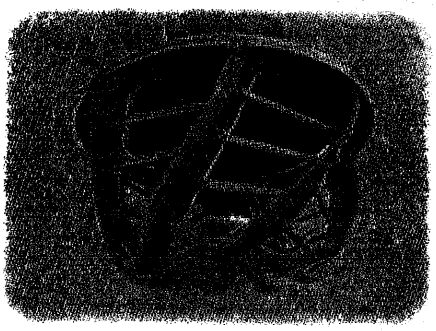
The planetary reduction gear that sets inside the winches requires an oil bath using SAE 90 lubricating oil. The winches are shipped fully serviced and should only be checked if a leak occurs or after oil change is required. The oil should be initially drained after first 50 to 100 hours of operation, after which the oil should be changed annually or after each 500 hours of operation, whichever occurs first. Replace using SAE 90 grade oil. Refer to winch operating & service manuals for proper volumes and procedures.

WEAR COMPONENTS (CONT.)

CUTTERHEAD DRIVE SYSTEM

The cutterhead drive bearings are two Cord Cutlass bearings and are lubricated by the fresh water pump from the water well. The cutterhead motor is internally lubricated by the hydraulic oil.





STANDARD CUTTERHEAD

CUTTERHEAD

The cutterhead and shaft are assembled as one unit. The brass wear plates and lock collar should be checked periodically for wear. Replaceable Hensley cutterhead teeth can be added as an option.

CUTTERHEAD W/HENSLEY TEETH

ELECTRICAL SYSTEM

The electrical system consists of a 24-volt 95-amp alternator and (2) 1000 CCA maintenance free batteries. The wiring is a complete circuit with one wire to ground through a full breaker panel. The lighting consists of nine (9) flood lights that are mounted on the outside of the dredge. Lighting is also provided in the engine/pump compartment, on the instrument panel and overhead in the control house.

PREPARATION AND PAINT

All exposed hull and control house surfaces, as well as the inside of the hull structure are sandblasted before the primer coats are applied. The hull is painted with coal-tar epoxy. The superstructure is painted blue with a white strip using epoxy paint.

STARTUP CHECK LIST

- Notify all involved personnel of the pending startup.
- Visually check the dredged location and trim as you approach it.
- Visually check the pipeline for breaks or missing floats, etc.
- Board the dredge and check the bilge, and pump out when needed.
- Check the fuel equalizing valves, assuring that they are open.
- Check the fuel level in the tank, and arrange to not operate with less than ¼ of the full tank level
- Check the cutterhead and check and grease the swing pulleys.
- Check the ladder hinge pins; to assure they are in place.
- Put all of the levers in the neutral position
- Go into the pump room; grease the pump in accordance with the pump manufacturers recommendations. Open the service water pump suction valve and its discharge valve to main pump packing.
- Go to the engine and check the oil. Then check the cooling fluid level. Check the belts and look for lose bolts, etc.
- Open all three (3) Hydraulic Tank Valves; check the HYDRAULIC oil level in the tank.
- Start the Caterpillar Diesel Engine as per the instructions in the Caterpillar Diesel Operation Manual.
- Ensure that only one spud is down.
- Check the hydraulic hoses and grease the spud well pulley on both spuds.
- Open the discharge air bleeding line. Make sure the workboat is not under it.
- After the engine has warmed, lower the ladder into the water.
- Engage the pumps and increase the engine speed to 1600 RPM and prime the pump.
- Close the bleeder valve and start dredging.

SUMMARY OF STARTUP PROCEDURES

- CHECK DREDGE
- CHECK FUEL
- CHECK FLUID LEVELS, OIL AND WATER, ETC.
- GREASE DREDGE AS NEEDED
- OPEN SERVICE WATER VALVES
- START THE ENGINE
- LOWER LADDER INTO WATER
- RAISE ONE SPUD
- OPEN THE DISCHARGE AIR BLEEDING VALVE
- PRIME THE DREDGE
- CLOSE THE DISCHARGE AIR BLEEDER VALVE
- NOTIFY ALL EFFECTED PERSONNEL THE DREDGE IS STARTING
- START DREDGING

SUMMARY OF SHUT DOWN PROCEDURE

- NOTIFY ALL EFFECTED PERSONNEL THE DREDGE IS STOPPING
- WASHOUT THE DISCHARGE LINE ALL THE WAY TO THE END.
- REDUCE THE SPEED OF THE ENGINE TO 1000 RPM.
- CHECK FOR ANY LEAKS OR LOSE BELTS, ETC.
- CHECK THE MAIN PUMP PACKING TO ENSURE IT IS NOT LEAKING TOO MUCH.
- PUT ENGINE AT IDLE AND DISENGAGE THE PUMPS
- CLOSE THE SUCTION VALVE TO THE SERVICE WATER PUMP
- RAISE THE LADDER
- REVERSE CABLE OFF THE SWING WINCHES TO ACCOMMODATE CHANGES IN WATER ELEVATION WHILE THE DREDGE IS NOT WORKING
- RAISE ONE SPUD OFF THE BOTTOM AND LEAVE ENOUGH SLACK IN THE DOWN SPUD CABLE TO ACCOMMODATE CHANGES IN WATER ELEVATION WHILE THE DREDGE IS NOT WORKING
- STOP THE CATERPILLAR DIESEL ENGINE AND LISTEN FOR ANY UNUSUAL SOUNDS.
- CLOSE THE PUMP HOUSE AND CONTROL HOUSE.

⚠ CAUTION

DO NOT LEAVE BOTH SPUDS DOWN FOR ANY EXTENDED PERIOD OF TIME.

NEVER TRY TO SWING THE DREDGE WITH BOTH OF THE SPUDS SET IN THE BOTTOM

TROUBLESHOOTING

Due to the different nature of sediments and water conditions, problems often occur during the dredging procedure. Some of the more common problems and some solutions are mentioned in the following pages.

ENGINE FAILS TO TURN

Check to see that the battery connections are tight and tighten as needed. Check that the batteries are in good working order; charge or replace as needed.

ENGINE TURNS BUT FAILS TO START

Check the fuel level in the tank; fill fuel tank. Verify that the fuel valve is open. Check the fuel filter and fuel pressure gauge. Refer to the engine-operating manual.

SERVICE PUMP FAILS TO PRIME

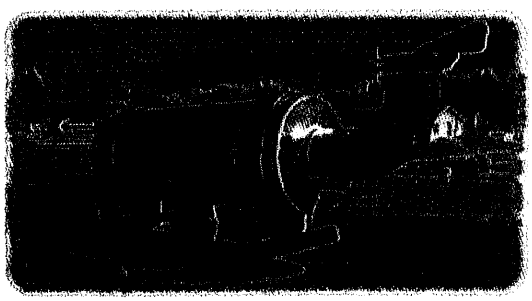
Check the service water pump drive for slipping; tighten pump belts. The pump may have trapped air in it; open pump petcock and bleed the air out. Shut fresh water valve off before checking the fresh water well screen for blockage, such as, sticks, mud and other debris.

DREDGE PUMP FAILS TO PRIME

Check the procedure used to prime the pump with the procedure listed in this manual. Check that the suction pipe is below the waterline - lower the dredging ladder. Check that the service water pump is operating and primed. Check around the flexible suction hose and cleanout trap for leaks or blockage. Tighten bolts on dresser coupling and/or pump.

ENGINE OVERHEATS OR HIGH EXHAUST STACK TEMPERATURE

Engine speed must be reduced as the dredge pipeline shortens. Operating the engine at a high speed on short discharge lines causes the dredge pump to convey greater volumes of mixture which greatly increases the horsepower demand of the pump. Check to see if there is a large leak or break in the discharge line and repair any found. Engine speed should be operated where the clear water vacuum does not exceed 4" of mercury.



ENGINE MUFFLER

SWING WINCHES DO NOT OPERATE SMOOTHLY

Check the swing brake controls in front of the control house under the winch assembly; adjust the brake controls until operation is smooth. Refer to the winch service manual

CLEANOUT TRAP

HIGH DREDGE PUMP VACUUM, LOW DISCHARGE PRESSURE

Decrease engine speed until flow rate is equal to or below 17 feet per second. Engine speed should be operated where the clear water vacuum does not exceed 4" of mercury. Check dredge cutterhead assembly - clean debris from in the suction and from around suction inlet. Inspect dredge pump interior through cleanout trap; remove any foreign material lodged in pump impeller or cleanout trap.

HIGH DREDGE PUMP DISCHARGE PRESSURE, LOW VACUUM

This condition is normal when the discharge pipe is long or highly elevated. This condition is normal for very long pipelines where discharge velocity is low. Check dredge discharge pipe and elbow; remove elbow and clean it. Check pipelines for unusual sounds or plugging; jar obstruction loose by striking pipe with hammer.

LOW DREDGE PUMP DISCHARGE PRESSURE AND VACUUM

Check that the pump is primed; follow priming procedure and prime pump. Check the dredge pump interior through the cleanout trap; remove any foreign material lodged in the pump impeller.

VIBRATION IN DREDGE PUMP

This condition can be caused from trapped gas being released from the bottom into the suction pipe. This condition will be most prevalent in areas where decayed vegetation exists. Check the dredge pump interior through the cleanout trap; remove any foreign material lodged in the dredge pump. This condition can also indicate cavitations in the pump; lower the percentage of material that the dredge is excavating or lower the dredge discharge velocity as needed.

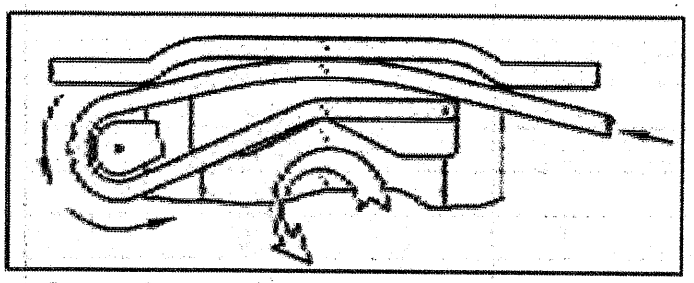
Check the swing brake controls in front of the control house under the winch assembly; adjust the brake controls until operation is smooth. Refer to the winch service manual

TORQUE SPECIFICATIONS (FT./LBS)

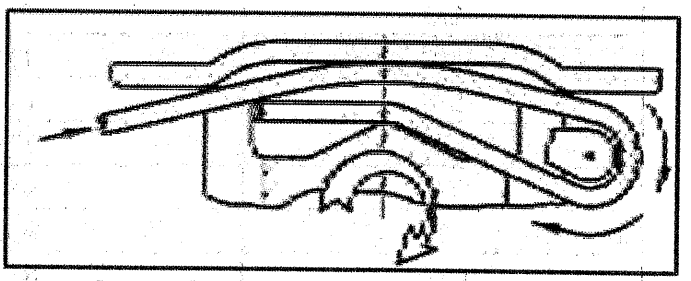
GRADE 5 HEX HEAD CAP SCREWS- COURSE THREAD		
TYPE OF LUBRICANT USED:	DRY	MOLY PASTE
BOLT DIAMETER		
1/4	9	5
5/16	18	10
3/8	32	17
7/16	52	27
1/2	79	41
9/16	113	58
5/8	156	80
3/4	275	141
7/8	442	225
1	662	336
1 1/8	817	416
1 1/4	1145	577
1 3/8	1507	764
1 1/2	1990	1000
1 3/4	3144	1584
2	4721	2373

Rotzler Swing Winch Reeving Procedure

- Raise the ladder on the dredge and push the dredge towards the bank.
- Verify the wire rope is the correct diameter according to the DSC Operations Manual
- Unspool the wire rope and stretch it out on land.
- Remove the old wire rope and discard properly.
- Reeve the wire rope to the winch through its respective swing block as seen below. (Color may vary)
- Install the cable through the wedge according to the Rotzler Installation instructions as seen below. The tag on the winch part number will tell you the rotation of the winch. (CC: Counter clockwise, CW: Clockwise)
- Push the loose end of the cable through the slot until it is even with the opening. Do not let it protrude from the Drum barrel.



Cable Connection for Counter-Clockwise Hoisting Winch



Cable Connection for Clockwise Hoisting Winch

- Hook the opposite end to a piece of mobile equipment and place it in neutral with the brake engaged (a boat will not work).
- Ideally the operator would like to see about 1500 PSI (103 Bar) on the Swing Winch gauge.
- With constant tension on the cable begin hoisting the respective winch, ensuring each wrap is tight on the drum with no gap as the next wrap is laid.
- Once a complete drum is spooled, allow the cable to climb on top of the last wrap closest to the drum flange.
- Then continue to keep the wraps close to the previous wrap until enough slack is available to hook up the anchor or anchor point using the given cable clamps.
- Repeat for next winch.
- Once both winches are spooled and anchors attached, place the anchors in the proper dredging position as per DSC Operations Manual.

External Brake Release Setting Procedure

Tools Needed:

- 9/16" Wrench
- 5/32" Allen Wrench (Hex Key)
- PBDBLBN Pressure Reducing Valve (290 PSI/Turn)

- According to Sun Hydraulics, the pressure reducing valve comes factory set around 200 PSI (14 BAR) using the tools above loosen the locking nut and screw IN the adjustment 1 full turn. This should put you around 490-500 PSI (34-35 BAR).

- Start up the dredge and verify no leaks are present.

- Once the anchors are in position swing the dredge to the Port (Left) side and record the pressure on the Swing Break gage located on the Starboard (Right) dash. Adjust the brake IN (1/4 turn increments) until the "drag" on the starboard winch is tight enough it doesn't pull the anchors up and/or you experience backlash or birds nest from the cable on the drum.

- Repeat the last step with the Starboard (Right) side.

Note: Rotzler Winches External Brake Release is fully open at 800-1000 PSI (55-70 BAR). Applying higher pressure is not only useless but could deem harmful to the winches longevity.

PUMP PACKING INSTALLATION

- Remove all of the used pump packing rings and the lantern ring. Thoroughly clean and inspect the stuffing box. Replace worn shaft sleeve if needed.

- Coat each new packing ring with Grease, Go-Jo or some type of liquid soap. Never use Anti-Seize or any metallic based compound on the pump packing!

- Stagger the joints of each packing ring 90 degrees, beginning at twelve o'clock, three o'clock, six o'clock, and then nine o'clock.

- Install each packing ring individually, carefully seating each packing ring in the bottom of the stuffing box. Use a split bushing or a tamping tool. NEVER use a screwdriver or a sharp tool. It is important to seat the packing rings toward the bottom of the box because of radial expansion. (When the packing rings are properly seated, more packing rings in the set are used to create the seal, leading to longer packing life.)

- Make sure the lantern ring is properly located. This is done by inserting a small object through the flush port and feeling the lantern ring.

- After the proper amount of rings have been installed, install the gland follower and run the gland nuts up finger tight only.

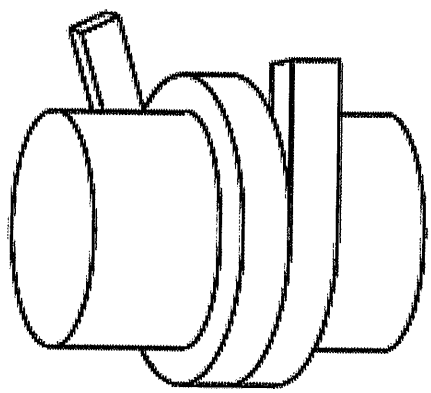
- Install the proper flush set-up (Pressure Gauge and Valve for regulating flow) It is important to start the flush before pumping slurry with the pump.

- Start the pump and allow the packing to leak freely at start-up. During the break-in period, adjustments should be made gradually (adding one flat at a time), allowing 5 to 10 minutes between adjustments. Remember, extra consideration during break-in will result in longer packing life.

- After the break-in period, the leakage rate can be controlled to 10 to 12 drops per minute per inch of shaft sleeve diameter.

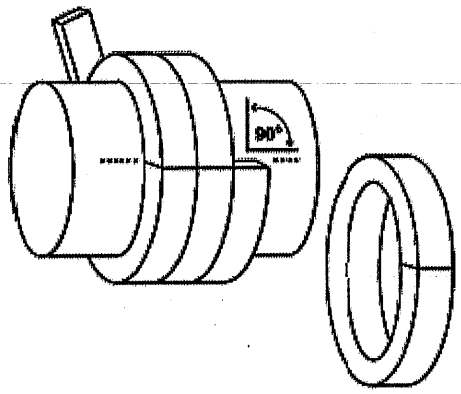
PROPER PACKING CUTTING INSTRUCTIONS

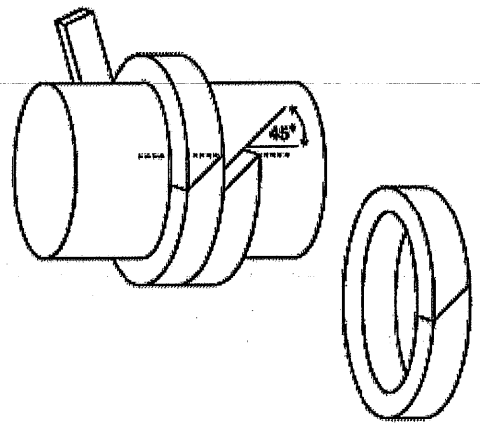
Hold the packing tightly on the packing sleeve, but do not stretch excessively. Cut the ring(s).



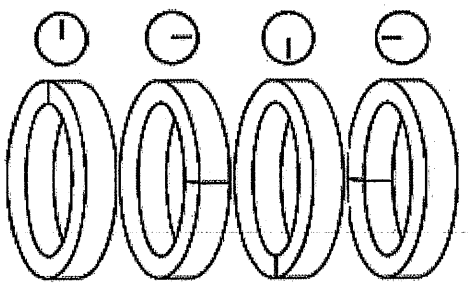
PROPER PACKING CUTTING INSTRUCTIONS (CONT.)

Multiple rings can be Butt Cut / 90° (square).

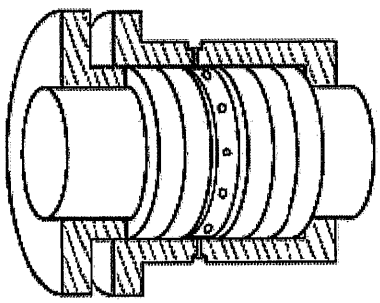




Individual rings can be Skive Cut at 45° (diagonally). The best way to cut packing rings is to cut them on a mandrel with the same diameter as the shaft in the stuffing box. If there is no sleeve wear, rings can be cut on the shaft sleeve outside the stuffing box.



Joints of successive packing should be staggered at 90°. When enough rings have been installed so the nose of the gland will reach them, individual tamping should be supplemented by using the gland.

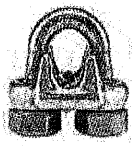


If the stuffing box has a lantern ring, make sure that the lantern ring, as installed, is slightly behind the fluid inlet so that it will move under the inlet as the follower pressure is applied.

CROSBY CABLE CLAMP INSTRUCTIONS

CROSBY® CLIPS WARNINGS AND APPLICATION INSTRUCTIONS

G-450
(Red-U-Bolt®)



SS-450
(316 Stainless Steel)

⚠ WARNING

- **Failure to read, understand, and follow these instructions may cause death or serious injury.**
- **Read and understand these instructions before using clips.**
- **Match the same size clip to the same size wire rope.**
- **Prepare wire rope end termination only as instructed.**
- **Do not use with plastic coated wire rope.**
- **Apply first load to test the assembly. This load should be of equal or greater weight than loads expected in use. Next, check and retighten nuts to recommended torque (See Table 1).**

Efficiency ratings for wire rope end terminations are based upon the minimum breaking force of wire rope. The efficiency rating of a properly prepared loop or thimble-eye termination for clip sizes 1/8" through 7/8" is 80%, and for sizes 1" through 3-1/2" is 90%.

The number of clips shown (see Table 1) is based upon using RRL or RLL wire rope, 6 x 19 or 6 x 36 Class, FC or IWRC; IPS or XIP, XXIP. If Seale construction or similar large outer wire type construction in the 6 x 19 Class is to be used for sizes 1 inch and larger, add one additional clip. If a pulley (sheave) is used for turning back the wire rope, add one additional clip.

The number of clips shown also applies to rotation-resistant RRL wire rope, 8 x 19 Class, IPS, XIP, XXIP sizes 1-1/2 inch and smaller; and to rotation-resistant RRL wire rope, 19 x 7 Class, IPS, XIP, XXIP sizes 1-3/4 inch and smaller.

For other classes of wire rope not mentioned above, we recommend contacting Crosby Engineering to ensure the desired efficiency rating.

For elevator, personnel hoist, and scaffold applications, refer to ANSI A17.1 and ANSI A10.4. These standards do not recommend U-Bolt style wire rope clip terminations. The style wire rope termination used for any application is the obligation of the user.

For OSHA (Construction) applications, see OSHA 1926.251.

1. Refer to Table 1 in following these instructions. Turn back specified amount of rope from thimble or loop.

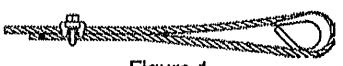


Figure 1

Apply first clip one base width from dead end of rope. Apply U-Bolt over dead end of wire rope – live end rests in saddle (Never saddle a dead horse!). Use torque wrench to tighten nuts evenly, alternate from one nut to the other until reaching the recommended torque. (See Figure 1)

2. When two clips are required, apply the second clip as near the loop or thimble as possible. Use torque wrench to tighten nuts evenly, alternating until reaching the recommended torque. When more than two clips are required, apply the second clip as near the loop or thimble as possible, turn nuts on second clip firmly, but do not tighten. (See Figure 2)

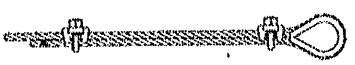


Figure 2

3. When three or more clips are required, space additional clips equally between first two – take up rope slack – use torque wrench to tighten nuts on each U-Bolt evenly, alternating from one nut to the other until reaching recommended torque. (See Figure 3)

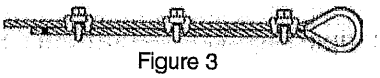


Figure 3

4. If a pulley (sheave) is used in place of a thimble, add one additional clip. Clip spacing should be as shown. (See Figure 4)

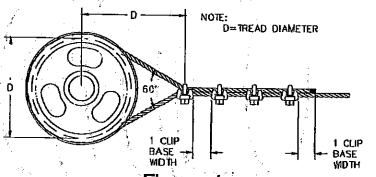


Figure 4

5. WIRE ROPE SPLICING PROCEDURES:

The preferred method of splicing two wire ropes together is to use inter-locking turnback eyes with thimbles using the recommended number of clips on each eye (See Figure 5).

Figure 5

An alternate method is to use twice the number of clips as used for a turnback termination. The rope ends are placed parallel to each other, overlapping by twice the turnback amount shown in the application instructions. The minimum number of clips should be installed on each dead end (See Figure 6). Spacing, installation torque, and other instructions still apply.

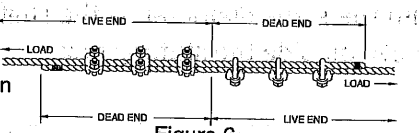


Figure 6

6. IMPORTANT

Apply first load to test the assembly. This load should be of equal or greater weight than loads expected in use. Next, check and use torque wrench to retighten nuts to recommended torque. In accordance with good rigging and maintenance practices, the wire rope end termination should be inspected periodically for wear, abuse, and general adequacy.

Table 1

Clip Size (in.)	Rope Size (in.)	Minimum No. of Clips	Amount of Rope to Turn Back in Inches	Torque in Ft-Lbs*
1/8	1/8	2	3-1/4	4.5
3/16	3/16	2	3-3/4	7.5
1/4	1/4	2	4-3/4	15
5/16	5/16	2	5-1/4	30
3/8	3/8	2	6-1/2	45
7/16	7/16	2	7	65
1/2	1/2	3	11-1/2	65
9/16	9/16	3	12	95
5/8	5/8	3	12	95
3/4	3/4	4	18	130
7/8	7/8	4	19	225
1	1	5	26	225
1-1/8	1-1/8	6	34	225
1-1/4	1-1/4	7	44	360
1-3/8	1-3/8	7	44	360
1-1/2	1-1/2	8	54	360
1-5/8	1-5/8	8	58	430
1-3/4	1-3/4	8	61	590
2	2	8	71	750
2-1/4	2-1/4	8	73	750
2-1/2	2-1/2	9	84	750
2-3/4	2-3/4	10	100	750
3	3	10	106	1200
3-1/2	3-1/2	12	149	1200

If a pulley (sheave) is used for turning back the wire rope, add one additional clip. See Figure 4.

If a greater number of clips are used than shown in the table, the amount of turnback should be increased proportionately.

*The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.

CONTACTING DSC IN MICHIGAN

This DSC Dredge, LLC facility is located at

4957 Main Street
Greenbush, Michigan 48738

Our facility is near the shores of the second largest of the Great Lakes, Lake Huron. This is a small DSC fabrication facility with a staff of twelve at this location. Normal working hours are 7:00 AM to 5:30 PM Eastern Standard time Monday through Friday.

We can be contacted toll free within the USA at **800-845-1078 or at (989) 724-5463**. Facsimiles can be sent to **(989) 724-9963** and emails delivered to dredge@dscdredge.com or direct contact with the Director of Operations, Rose Koenig at rmkoenig@dscdredge.com

This operations manual is for our Badger Class 8x8 dredge, our smallest dredge. This facility also manufactures a larger unit known as our Wolverine Class 10x10 dredge. On an average, our Michigan facility manufactures 5 to 6 dredges per year. It is our ultimate goal with such a small staff to produce 7 units per year.