TECHNICAL MANUAL

UNIT, INTERMEDIATE DIRECT SUPPORT AND

INTERMEDIATE GENERAL SUPPORT MAINTENANCE MANUAL

DRILLING SYSTEM, WELL, ROTARY, TRUCK MOUNTED, AIR TRANSPORTABLE, 600 FEET CAPACITY

MODEL LP-12

NSN 3820-01-246-4276

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and content requirements normally associated with Army technical manuals. This technical manual does, however, contain all essential information required to operate and maintain the equipment.

Approved for public release; distribution is unlimited.

HEADQUARTERS, DEPARTMENTOF THE ARMY

8 MAY1989

CHANGE

NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 July 1995

Technical Manual

Unit, Intermediate Direct Support and
Intermediate General Support Maintenance Manual

DRILLING SYSTEM, WELL, ROTARY,
TRUCK MOUNTED, AIR TRANSPORTABLE,
600 FEET CAPACITY
MODEL LP-165F299
NSN 3820-01-246-4276

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited

TM 5-3820-256-24-6, 8 May 1989, is changed as follows:

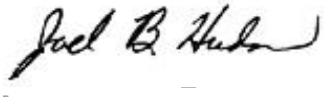
1. **Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.**

Remove pages	**Insert pages**
A-9 and A-10	**A-9 and A-10**
A-25 and A-26	**A-25 and A-26**

2. **Retain this sheet in front of manual for reference purposes.**

By Order of the Secretary of the Army:

Official:



JOEL B. HUDSON
Acting Administrative Assistant to the
Secretary of the Army
00598

DENNIS J. REIMER
General, United States Army
Chief of Staff

DISTRIBUTION:

To be distributed in accordance with DA Form 12-25-E, block no. 4845, requirements for TM 5-3820-256-24-6.

CHANGE
NO 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 26 February 1993

UNIT, INTERMEDIATE DIRECT SUPPORT AND
INTERMEDIATE GENERAL SUPPORT MAINTENANCE MANUAL

DRILLING SYSTEM, WELL, ROTARY
TRUCK MOUNTED, AIR TRANSPORTABLE,
600 FEET CAPACITY

MODEL LP-165F299
NSN 3820-01-246-4276

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

TM 5-3820-256-24-6, 8 May 1989, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
A-9 and A-10	A-9 and A-10
A-25 and A-26	A-25 and A-26

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
03505

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25-E, block no. 4845, requirements for TM 5-3820-256-24-6.

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 10 October 1989

UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE MANUAL

DRILLING SYSTEM, WELL, ROTARY TRUCK MOUNTED, AIR TRANSPORTABLE, 600 FEET CAPACITY

MODEL LP-165F299
NSN 3820-01-246-4276

Approved for public release; distribution is unlimited.

TM 5-3820-256-24-6, 8 May 1989 is changed as follows.

1. Title is changed as shown above.

2. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove Pages	Insert Pages
----------	C-1 and C-2

3. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

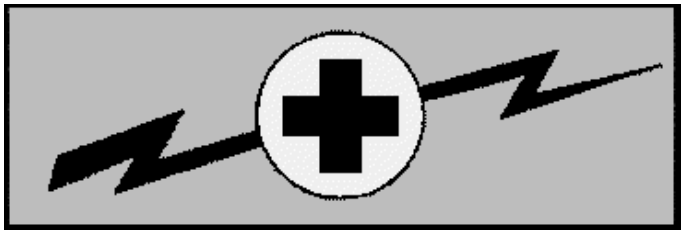
CARL E. VUONO
General United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN, II
Brigadier General United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A, Unit, Direct Support and General Support Maintenance requirements for Drilling Machine, Well, Combination Rotary/Percussion, Semitrailer Mounted Diesel, 1500 Ft. Model CF-15-S

WARNING



ELECTRIC POWER LINES CAN KILL

Never raise mast or crane, or operate drill unit with less than 25 feet working clearance to any electrical power line.

Do not touch live electrical parts.

Check for buried utility lines before drilling.

WARNING

Crane and drilling operations have inherent hazards that cannot be mechanically safe guarded. Operator and maintenance personnel are required to wear hard hats and safety shoes.

Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psig. Eye protection required.

Never operate engine in enclosed areas. Exhaust gases, particularly carbon monoxide, may build up. These gases are harmful and potentially lethal.

Cleaning solvent (PD-680, Type II) is toxic to skin, eyes and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate.

Welding operations produce heat, highly toxic fumes, injurious radiation, metal slag and airborne particles. Protection equipment consisting of welding goggles with proper tinted lenses, apron or jacket, and welder's boots required. Good general ventilation is normally adequate.

Exercise care when using sharp or pointed tools to prevent injury to personnel.

Personnel will be trained in safe climbing practices. Climbing devices will be used on mast at all times. Safety climbing devices will be inspected prior to each use to insure good working order.

For Artificial Respiration, refer to FM 21-11.

WARNING

NOISE HAZARD

exist for all personnel within 15 Feet of an operating drilling unit. Personnel must wear approved ear protection equipment. Failure to do so may result in impairment or loss of hearing.

b

INTRODUCTION

1. SCOPE

This manual covers the 600 Feet Capacity Well Drilling System, Model LP-12, NSN 3820-01-246-4276. This manual consists of six volumes.

2. DRILLING SYSTEM

The Drilling System consists of three main components; a well drilling machine; a support vehicle (rig tender); and a well completion kit. Government furnished (GFE) incorporated as part of the system include a trailer mounted power unit and 3,000 gallon, collapsible, fabric water tank.

3. DRILLING MACHINE - VOLUME 1

The drilling machine is a truck mounted rotary well drilling machine consisting of a 32 foot mast, three drum drawworks assembly, rotary table, mud pump and air compressor. The components of the drilling machine are powered by the truck engine.

4. SUPPORT VEHICLE - VOLUME 2

The support vehicle is a truck mounted vehicle consisting of a 1,000 gallon water tank, hydraulically driven water pump, an electric fuel pump and fuel dispensing nozzle, a welder-generator assembly, and an electro-hydraulic crane. The support vehicle also provides a storage area for transport of drill pipe, collars, hand tools, operating and accessory equipment for the drilling machine, and the well completion equipment.

5. TRUCKS - VOLUMES 3, 4 and 5

The drilling machine and support vehicle are mounted on truck chassis of the same model. The drilling machine truck has a special design low profile cab. The truck is a diesel engine powered, 6x6 vehicle with a transfer case to transfer engine power to truck mounted components.

6. WELL COMPLETION - VOLUME 6

The well completion kit consists of equipment necessary for completion of a 600-ft. water well.

7. OPERATION INSTRUCTIONS

Refer to TM5-3820-256-10 for Operation, Preventive Maintenance and Lubrication of the Well Drilling System.

8. REPAIR PARTS

For repair parts refer to TM5-3820-256-24P, Repair Parts and Special Tools List.

9. APPENDIXES - VOLUME 6

Maintenance Allocation Chart is contained in Appendix A; Torque Requirements are contained in Appendix B.

TABLE OF CONTENTS

VOLUME I

TABLE OF CONTENTS - Continued

VOLUME 2

VOLUME 3

TABLE OF CONTENTS

VOLUME 6

LIST OF ILLUSTRATIONS - Volume 1

LIST OF ILLUSTRATIONS - Volume 1 (Contd)

LIST OF TABLES - Volume 1

LIST OF ILLUSTRATIONS - Volume 2

LIST OF TABLES - Volume 2

LIST OF ILLUSTRATIONS - Volume 3

LIST OF TABLES - Volume 3

CHAPTER 1

GENERAL INFORMNATION

1-1. INTRODUCTION

1-1.1 Scope. This manual volume covers operations performed following the drilling of a water well. Information is arranged as follows:

Chapter 1 - General Information

Chapter 2 - Logging Wells

Chapter 3 - Well Casing

Chapter 4 - Water Production

1-1.2 Requirements. Instructions in this manual are used in conjunction with the following equipment:

a. Electric Logging System, p/n 149F923 (CAGE 21363). This equipment is used following drilling to determine the types and locations of formations in the well borehole.

b. Kit, Well Completion, p/n 165F004 (CAGE 21363), NSN 3820-01-178-4981. This kit contains components necessary to complete a water well to a depth of 600 feet, and for water production. Components of the kit are listed in Department of the Army Supply Catalog, SC 3820-97-CL-E.

c. Well Sounder, p/n 149F924 (CAGE 21363). This instrument is used to determine water levels.

d. Dart Valve Bailer, p/n 149F917 (CAGE 21363). This equipment is used to remove accumulations of sand or mud from well.

1-2 DEFINITIONS

1-2.1 Casing. Pipe constructed of PVC material used to form a 'wall' for a well.

1-2.2 Draw-Down. The distance water recedes from static (standing) level to pumping level.

1-2.3 Overburden. A soft ground formation above a rock layer.

CHAPTER 2

All information in chapter 2 is contained in TM 5-3820-256-10.

2-4 TROUBLESHOOTING

2-4.1 Introduction. A "test set" is provided so that you can check the instrument's operation independent of the cable assembly. If the instrument reads the correct value for the test set, then the instrument itself is functioning properly and the trouble is somewhere other than in the electronics of the instrument. To use the test set, plug it into the instrument as described under "Test Set", paragraph 2-1.5, then follow the operating instructions in paragraph 2-2. The electrode selector switch must be in one of the normal logging positions.

2-4.2 Checking Batteries. With the test set plugged into the instrument, turn the function switch to the CAL position and try to calibrate the instrument:

1. If the instrument can be calibrated, then turn the function switch to CUR and check the current by throwing the current switch; if the current flowing is less than 8 ma. (full scale on meter = 25 ma.) then the complete set of six, 9 volt batteries should be replaced.

2. If the instrument cannot be calibrated, the complete set of six, 9 volt batteries should be replaced. (Figure 2-1 A).

NOTE
Refer to battery voltage checking procedure to check the batteries with a voltmeter.

2-4.3 Troubleshooting Procedures. Commonly encountered troubles are listed below along with the corrective procedures.

1. Unable to Calibrate Instrument: Most often caused by insufficient or no current flowing in the ground circuit.

   a. Check conditions of batteries, replace if necessary.

   b. Check all lines and plugs for bad connections.

   c. Sometimes insufficient current is the result of high resistance at the steel surface current electrode. If the galvanometer shows less than 9 ma. and it cannot be increased by rotating the cal adjust knob, then the contact resistance at the steel stake is too high. Reduce the resistance by driving it deeper or pour water around it or double stake until an excess of 8 ma. can be obtained.

      If at least 8 ma. cannot be obtained, the ground circuit is too highly resistive (a situation encountered in areas having a thick cover of dry sand or where there is frost on the ground) and obtaining a log in these situations requires the use of the lateral arrangement of electrodes with the CUR wires connected to the well casing.

2. Fluctuation SP: Galvanometer needle fluctuates uncontrollably when function switch is in the log position.

a. Check surface potential reference (lead oxide flag) to make sure it is buried in moist soil and that the wire from it is not frayed or broken.

b. If SP fluctuates badly, stray ground potentials are the cause; this is a situation encountered in highly industrialized areas. To remedy this situation, use the lateral arrangement of electrodes.

3. Unable to Zero the Meter with Self-Potential Potentiometer:

   a. Be sure you have tried reversing the SP polarity switch. To zero the galvanometer the injected voltage must be of proper polarity. Note that the polarity of the SP may change during the logging.

   b. Check the voltage of the 1 1/2 volt "C" battery. Replace it if necessary.

4. No Meter Response to Self-Potential Potentiometer:

   a. Check all plug-in connections and surface lines, in particular, the potential surface line where it is connected to the lead flag.

   b. Check the SP shut-off switch. Occasionally if the instrument has not been used for some time, this switch may have become stuck in the off position (depressed). Pushing the button up and down with your finger a couple of times will release the switch.

5. Meter Deflection with no Connections to Instrument:

   a. This condition will be present when water has entered the current switch thereby maintaining an electrical connection within the switch without the switch being activated. When this happens, the switch needs only to be dried with the application of some heat to the switch. Should this happen frequently, a rubber boot should be installed on the switch.

   b. NOTE: Although this condition is not normal, if proper calibration and operation of the unit can be effected with the test set, then the instrument will operate properly when the current switch is activated.

2-4.4 Battery Voltage Check Using a Voltmeter

NOTE
The following checks are made with the test set connected.

a. Single 9 Volt Battery: With voltmeter function switch at +DC volts and range switch at full scale reading closest to, but no lower than 10 volts, connect Red (+) lead to positive terminal (male) and Black (-) lead to the opposite (female) terminal of the battery. Record this open circuit voltage. Place function switch in CUR or CAL mode, energize the current switch, and record the battery voltage under load. The voltage should remain at or slightly below the open circuit voltage. If the voltage should continue to change value when the current switch is energized, the battery is defective (weak) and should be replaced.

b. Five 9 Volt Batteries: With function switch at +DC volts and range switch at full scale reading closest to, but not lower than 50 volts, connect Red (+) lead to exposed positive terminal (male) and Black (-) lead to exposed negative terminal (female) of battery string. Record this open circuit voltage.

Place function switch in CUR or CAL mode, energize the current switch, and record the battery voltage under load.

The voltage should remain at or slightly below the open circuit voltage. If the level should continue to change value when the current switch is energized, the batteries are defective and should be replaced.

All five batteries should be replaced if any are defective.

Although a transistor radio battery (Leclanche' type) will work satisfactorily under most conditions, the alkaline type (Mallory MN 1604 or equivalent) should be installed when the unit is used in adverse weather conditions of cold ambient temperatures as they exhibit better voltage-current characteristics.

2-5 MAINTENANCE

2-5.1 Introduction. Of first importance is that all plugs, panel connections, etc., be kept clean and dry. Moisture on the panel plugs or cable plug can cause current leakage and result in improper operation of the gear. The same is true of the cable and reel. Upon pulling the cable out of the well make sure it is wiped clean.

2-5.2 Maintenance of Resistively Instrument

a. The only maintenance other than cleaning required is the changing of batteries. The test set will tell you when the 9 volt batteries need replacement. The 1 1/2 volt cell should be replaced every two months. Access to the batteries is by lifting the instrument panel. The battery box will be seen in the bottom of the case (see figure 2-1A).

b. In operating the instrument, care should be exercised so that the Ohmmeter and Self-Potential Potentiometer dials are not slammed against their zero stops. When turned all the way counterclockwise, they both should read exactly zero. If they do not, loosen the two set screws set 900 apart with the small hex wrench which is taped onto the potentiometers. Reset the knob to zero.

2-5.3 Maintenance of Cable and Reel. In handling the cable, care must be exercised so that damage to the insulation will not occur. The cable should always be wiped clean and when storing, it should be kept in a dry place until such time that the cable is judged to be thoroughly dry.

2-6 INTERPRETATION OF ELECTRICAL LOGS

2-6.1 Preparation of the Log.

a. Basic to a proper interpretation of the electrical log data is the preparation of the graphical log. Any suitable graph paper may be used.

b. In preparing the log, the 0.25 foot reading, normal, arrangement should be plotted at the depth as read from the marked cable and the 2.5 ft readings about one foot above this point. This is because the cable markings have been measured from the current electrode. For the lateral arrangement, the values are plotted just as is the case for the normal arrangement. If the 10 ft normal is used, its reading should be plotted about 5 ft above the marked cable reading.

2-6.2 Significance of 0.25 ft Spacing. The reading obtained with the 0.25 ft spacing is heavily influenced by the fluid in the well bore and hence it reads only some fraction of the formation resistively. However, the short spacing enables you to see changes in resistively with greater detail. With this electrode spacing, formations having a thickness of about 6 inches or greater can be detected. Because of this ability to see small detail, the 0.25 ft curve should be used to "pick" formation boundaries.

2-6.3 Significance of 2.5 ft Spacing. The 2.5 ft electrode spacing provides you with very nearly the true formation resistively for wells having diameters up to about 16 inches and for formations thicker than about 5 ft. For larger diameter wells or thinner formations, the measured resistively will depart somewhat from the true. For qualitative interpretation this departure is not significant. Because the 2.5 ft curve provides you with the formation resistively, it is used to identify the type of material penetrated.

2-6.4 Significance of the Lateral Log. The lateral log obtained with the equipment is made by a combination of either the 0.25 or 2.5 ft electrode with the 10 ft. electrode. Because the 10 ft electrode is at a distance fairly large compared with either of the other two, the interpretation is essentially the same as for the normal log after using the appropriate correction factors.

a. For the 0.25 lateral log, the meter factor is 1.025.

b. For the 2.50 lateral log, the meter factor is 13.33.

2-6.5 Interpretation of Resistively Values.

a. In interpreting the resistively values obtained, clays and shales will be low resistive and sands, gravels, sandstones and limestones will be high resistive. Igneous and metamorphic rocks (such as granites and gneisses) will most generally be extremely high resistive.

b. The exact range of numerical values will depend upon the:

1. Type of earth material making up the formation.

2. Degree of cementation of the formation.

3. Water quality of the formation water.

4. Porosity of the formation.

5. Diameter of the well bore.

6. Resistively of the fluid in the well bore.

c. In interpretation, the unknowns will generally be 1, 2, 3 and 4. Granular materials will be high resistive compared to fines such as silt and clay; crystalline materials (such as limestone or granite) will be high resistive compared to the granular materials.

d. The quality of the formation water will greatly affect the measured resistively.

In general, the resistively of a formation will vary in an inverse proportion to the total dissolved solids. For example, all other conditions remaining the same, if the total solid content increases, the formation resistively will decrease. Hence a clean sand filled with salty water may actually be extremely low resistive.

e. Porosity of the formation also has an effect on the resistively. It is not as pronounced as the effect from water quality. In the logging of chemical precipitates, such as limestone, changes in porosity may enable you to detect the water producing zones. Increased porosity will lower the formation resistively and hence in such material a low resistive zone (where no shale is present) is indicative of increased porosity. This is then indicative of possible water production.

f. The exact range of values for clean sand, gravel, or sandstone is something which you learn by experience in your own particular area. In the midwest United States, clean sand and gravel generally exhibit resistively values in the range of from 350 to 1000 ohmft. The lower values apply to formations having water quality in the range of 300 to 400 ppm total solids and the upper values apply for formation waters having 100 to 150 ppm total solids. The above remarks are, of course, very general and are included for guidance only.

2-6.6 Selecting Formation Contact. In "picking" the formation boundaries, the 0.25 ft curve should be used wherever possible. The inflection point (the point midway between changes in curvature of the resistively curve) of the resistively curve is used to mark the contact between different formations.

2-6.7 Correlation by Electrical Logs.

a. A useful application of the electrical logs is in correlating formation thickness' and depths from one well to another. For example, two wells within a few feet of each other invariably will give identical electrical logs. When the wells are farther apart, the correlation will still be recognizable and the changes which do occur, as for example thickening or thinning of beds, are exactly the information needed to guide further exploration.

b. Correlation is commonly possible to considerable distances in bedrock formation, in the order of thousands of feet. Because of the variable nature of unconsolidated glacial and alluvial deposits, do not expect such distances except in special cases of a single, widespread type of deposit.

2-6.8 The Effect of Metal on the Resistively Log.

a. Because metal is such a good conductor, its presence in the zone of measurement, as for example air lines which have dropped to the bottom of the well, will cause a major decrease in the resistively and make the log unusable, in so far as determining formation type. This effect, however, may be used to locate such steel in the well.

b. In making the log, the bottom of the well casing will be detected when the probe enters it. The effect on the curves will be that both fall off to extremely low values, 5 to 20 ohmft, and then remain fairly constant. Where the casing is seated into very low resistive shale, it may be rather difficult to determine the exact position of the casing by this method.

2-6.9 The SP Curve.

a. The spontaneous potentials measured in a borehole are of great value in deep oil wells where saline waters are encountered. For these situations the SP curve exhibits a great deal of character and can be related to relative changes in formation permeability.

b. When logging in fresh water horizons, the SP curve will usually be featureless and provide little or no useful information.

CHAPTER 3

All information in Chapter 3 is contained in TM 5-3820-256-10.

3-1/(3-2 Blank)

CHAPTER 4

WATER PRODUCTION

4-1 SUBMERSIBLE PUMP

4-1.1 Setting the Pump.

a. Check to see that the end of the drop hose is cut square. Use a sharp knife or hacksaw to cut the hose if required.

b. Install the hose coupling into the end of the drop hose. (Refer to figure 4-1).

NOTE

If insertion of the coupling is difficult, a small slit (maximum 1 inch) may be made in the end of the hose. DO NOT use any form of lubrication on hose or coupling.

c. Push the hose fully on shank of coupling. The end of coupling may be tapped lightly on a wood surface if necessary.

d. Use a sharp knife and cut away about 6 inches of the cable ridge from the hose. File any upstanding part of the ridge until flush with hose cover.

NOTE

The coupling clamp contains a grooved portion on the inside. The grooved portion should be located toward the coupling.

e. Assemble the coupling clamp onto hose and install the screws. Tighten the screws evenly then, using a torque wrench, tighten screws to 4.4 ft.-lbs.

NOTE

The clamp halves may not close completely. A maximum gap of 1/32 inch is acceptable. If halves close completely before screws are tight, loosen screws and reposition clamp higher on coupling taper.

f. Install nipple in check valve, then check valve to hose coupling. Attach hose assembly to submersible pump.

g. Loosen both nuts of the hose elevator clamp and move the swing bolt aside. Position the clamp half with the lifting loop to the side of drop hose opposite the cable ridge.

h. Close the hose elevator clamp on hose and reposition swing bolt. Tighten both nuts finger tight. Be sure the hose is square and centered in the clamp.

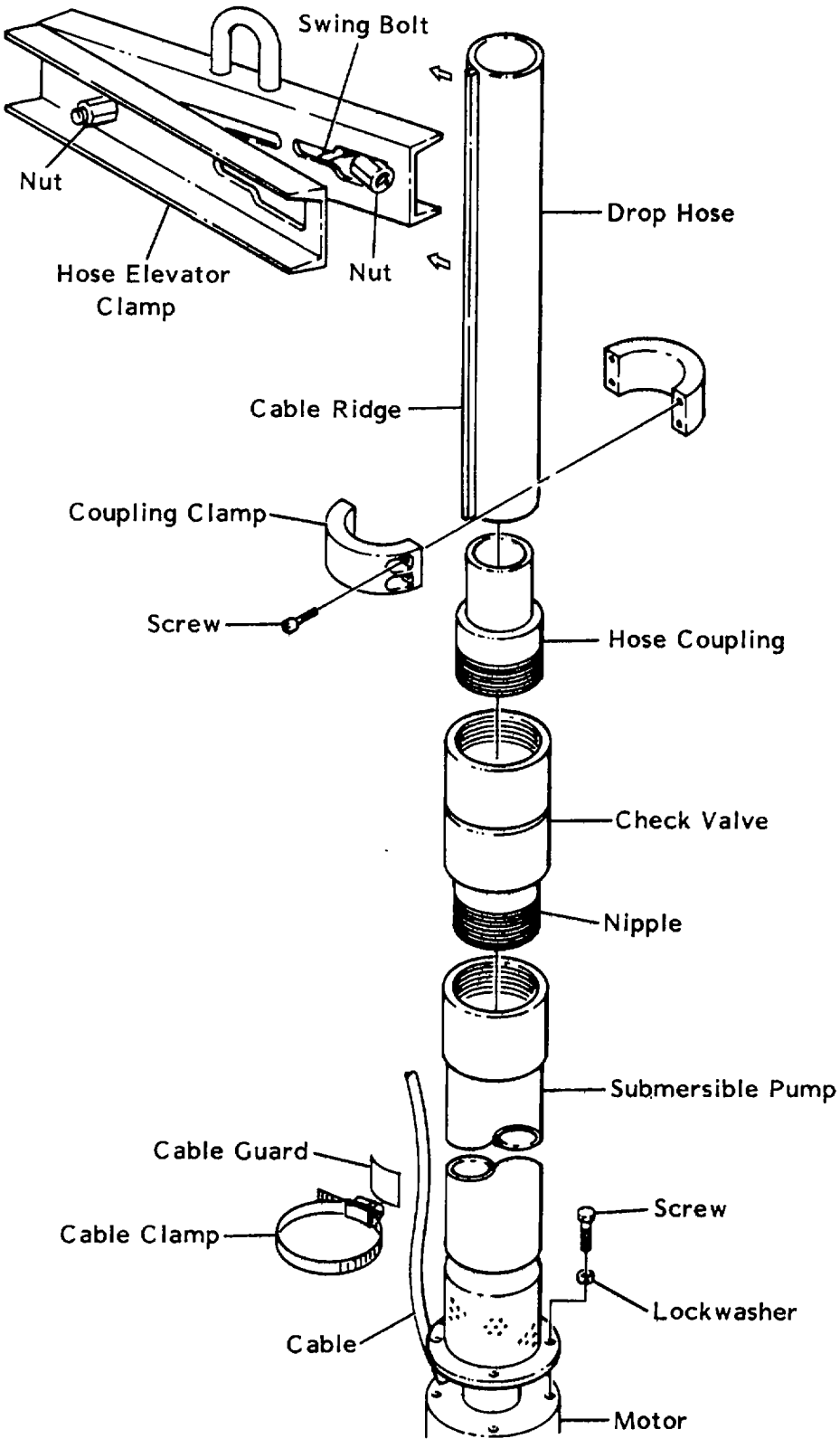


Figure 4-1. Setting the Pump

i. Tighten both nuts equally to a torque of 40 ft.-lbs., ensuring clamp faces remain parallel.

j. Attach the auxiliary drum line to the hose elevator clamp. Operate the auxiliary drum to lift the hose, with attached submersible pump.

k. Position the pump motor upright on a block of wood and maneuver the pump directly above the motor.

l. Slowly lower the pump, guiding by hand until the pump coupling is over the motor shaft. Rotate the pump to line up coupling slots with key in motor shaft.

m. Slowly lower the pump until very close to contact with motor then install screws and lockwashers.

NOTE

The hardware attaching pump to motor is stainless steel. No other material may be substituted.

n. Check that pump and motor are properly aligned and tighten screws.

o. Follow instructions in paragraph 4-1.2 and splice power cable to motor leads.

p. Attach the power cable to the submersible pump using the cable guard and cable clamp.

q. Position the pump and motor over the hole and slowly lower the pump into the hole until hose elevator clamp is resting atop casing.

r. Install the wellhead roller above the well with the hose positioned over the roller. Refer to figure 4-2.

s. Anchor the wellhead roller to the rig using anchor chains or cable.

t. Using the crane of the support vehicle, pick up the roll of drop hose and position such that the hose lays across the truck cab. Slowly back the support vehicle away from the hole, unrolling hose along ground, 50 feet or more.

u. Attach another hose elevator clamp (refer to steps g. through i.) and anchor the clamp to the front of support vehicle.

v. Roll the power cable out along the drop hose. Attach the cable to the hose using cable straps as shown in figure 4-3. Straps should be inserted at 6 ft. intervals. Allow slack in cable between straps, as in figure 4-3, to allow for extension of drop hose under service. The cable should be approximately 2% longer than hose length.

w. Reverse the support vehicle enough to raise clamp at well sufficiently for clamp to be removed.

x. Slowly drive support vehicle toward well, lowering pump and motor into well. When vehicle is near wellhead roller, stop and re-install hose elevator clamp at

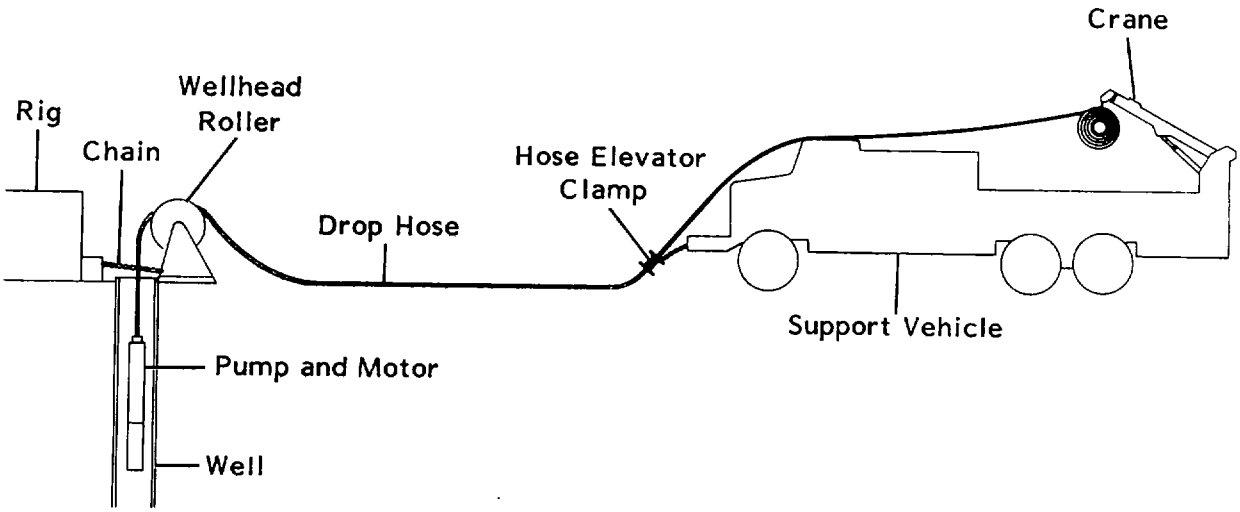


Figure 4-2. Installing Submersible Pump and Motor

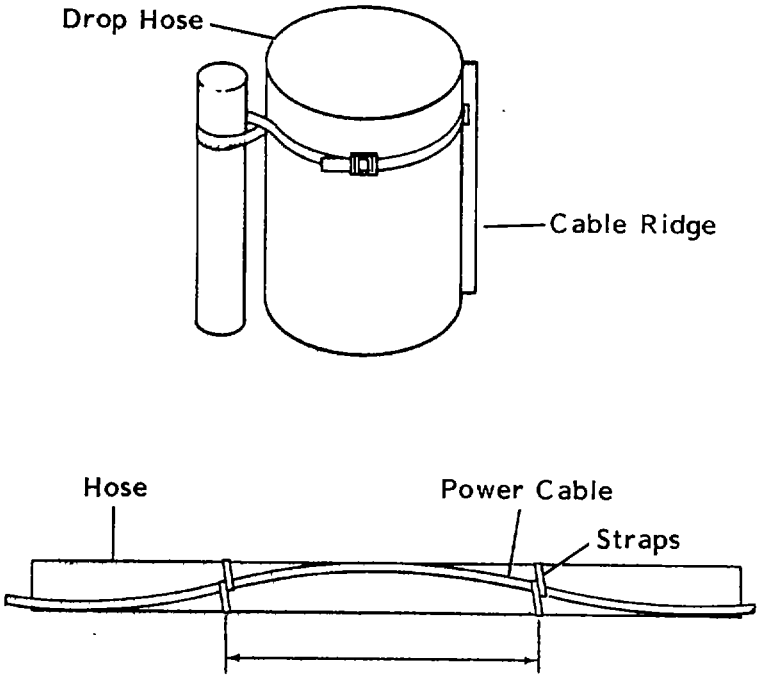


Figure 4-3. Strapping Cable to Hose

top of well, then move vehicle forward enough to support the pump and motor with clamp at well.

y. Remove the hose elevator clamp at support vehicle and reverse vehicle, unrolling more hose as needed. Attach power cable and anchor hose to support vehicle as before.

z. Repeat above procedure as many times as necessary to lower the pump and motor to 4 to 5 feet from bottom of the well.

aa. Assemble a clamp to hose at top of well casing, relieve tension on clamp at support vehicle, then cut drop hose squarely with a sharp knife or hacksaw 10 to 12 inches above clamp at well. (Refer to figure 4-4).

ab. Install the hose coupling in hose and assemble coupling clamp in the same manner as other hose end. (Refer to steps a. through e.) ac. Unroll power cable to length necessary to reach starter panel and cut power cable. Insert power cable through the smaller hole in well seal.

ad. Assemble nipples to elbow and insert one nipple through well seal. Connect the nipple to hose with pipe coupling. Install gate valve on other nipple.

ae. Attach the auxiliary drum line to the elbow and lift assembly to raise clamp from atop well casing. Remove clamp from hose.

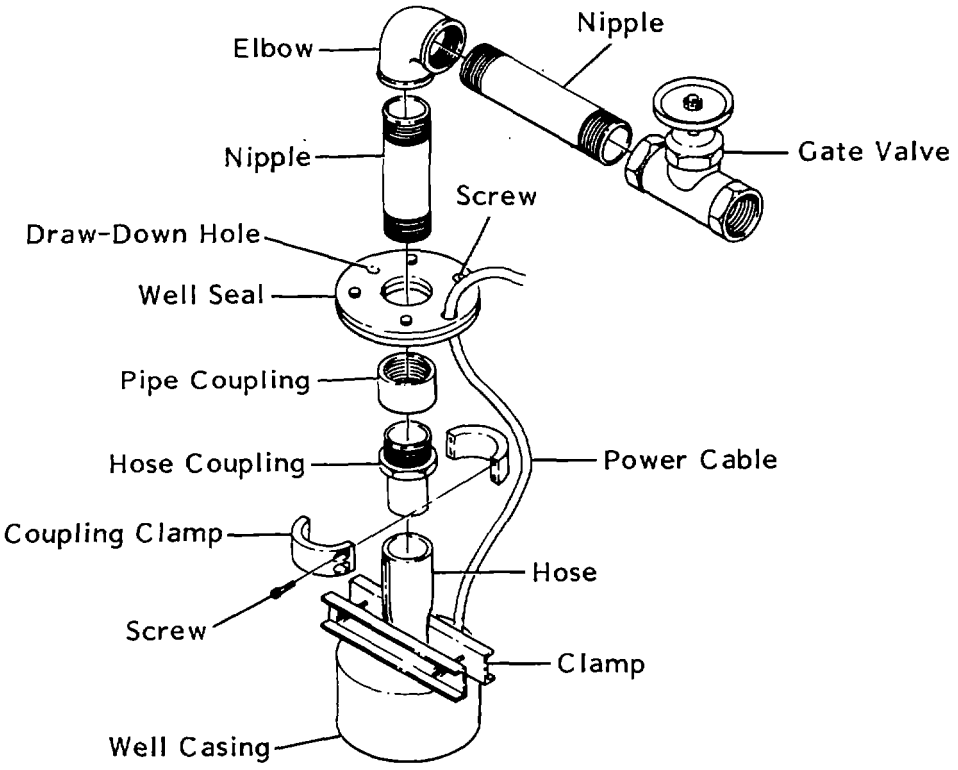


Figure 4-4. Sealing Well

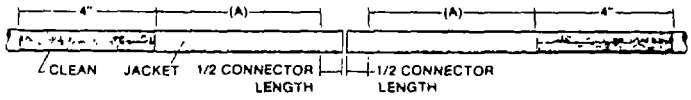
af. Lower the assembly into the well, guiding the well seal into the casing. Tighten the screws on the well seal to compress and expand the seal's rubber center. Remove auxiliary line.

4-1.2 Splicing Submersible Cable. Use the following steps to splice the power cable to submersible motor cable. An illustrated example follows each narrative step.

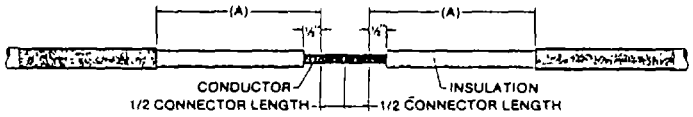
NOTE

When power cable and motor leads are not the same size, select connector for larger size cable. Strands of copper wire should be used together with smaller cable to fill connector.

a. Cut motor lead and power cable so that ends will butt squarely. Thoroughly clean cable jacket for 4 inches beyond dimension (A) with non conductive abrasive cloth from cable splicing kit.

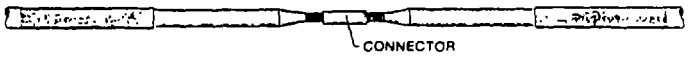


b. Remove cable jackets for distance (A), plus one half connector length. Do not cut into cable insulation. If jacket is bonded to insulation, do not remove, and treat it as insulation. Remove cable insulation and strand shielding from end of conductors for 1/2 inch plus one-half length of connector. Do not nick conductor.



c. Pencil (taper) insulation for distance (B) and smooth with non-conductive abrasive cloth from splice kit.

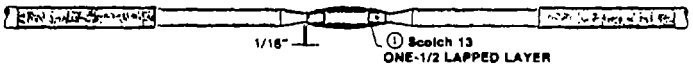
d. Join conductors using crimp connector. Clean entire area of prepared splice by wiping with a solvent saturated cloth from kit.



CAUTION

Area must be absolutely dry and free of all solvent residue (especially in conductor strands) before applying any tapes.

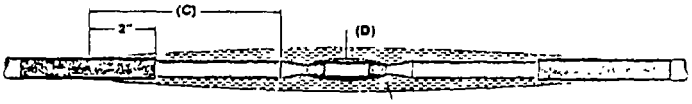
e. Fill any connector indents with small pieces of semi-conducting tape. Tightly level wind tape across connector area, overlapping 1/16 inch onto each edge of the penciled insulation. Form smooth concentric buildup, as shown.



f. Tightly half-lap splicing tape across connector area, building up to dimension (D) with a smooth taper along distance (C), reaching maximum diameter over penciled insulation.

NOTE

Highly stretch and exactly half-lap tape to produce a void-free, uniform buildup.



g. Tightly half-lap two layers of vinyl plastic electrical tape over entire splice, extending for one (1) inch onto each cable jacket.

4-2 WATER PRODUCTION

4-2.1 Pump Starter Panel. (Figure 4-5)

a. Attach starter panel to panel stands, using screws, lockwashers and nuts that are stored on panel standfoot.

b. Stabilize the panel by placing sandbags on the stand feet or by driving stakes into the ground at holes in stand feet.

c. Turn the door locking screws one-half turn to disengage door locks. Open panel door.

d. Cut outer insulation back on pump cable about twelve inches. Strip insulation

on each lead to expose approximately 3/4 inch of wire.

e. Insert the pump leads through the hole in bottom of panel.

f. Connect the leads as follows: black to T1, red to T2, yellow to T3, and green to ground.

g. Strip away approximately six inches of outer insulation from power source cable and strip away approximately 3/4 inch of insulation from each lead.

h. Insert the power source cable through hole in side of panel and connect leads at Line 1, Line 2, Line 3 and Ground.

i. Close panel door and turn door locking screws to engage door locks.

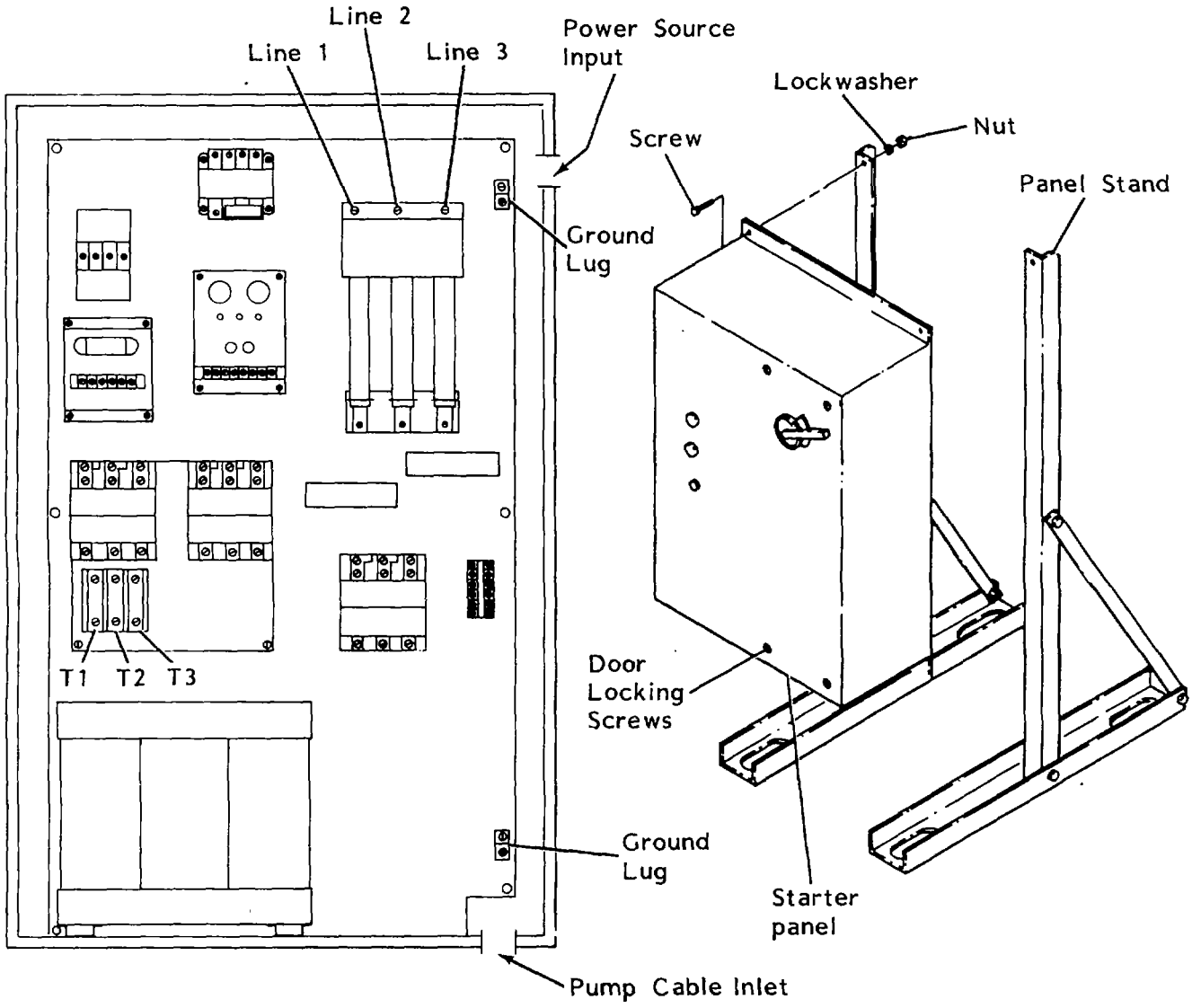


Figure 4-5. Starter Panel Installation

e. Allow concrete to cure, then remove forms.

4-4 TROUBLESHOOTING

4-4.1 Table 4-1 describes some problems which may occur with the submersible pump, with their possible cause, procedure for checking, and method for correction.

Table 4-1. Troubleshooting

CAUSE OF TROUBLE	CHECKING PROCEDURE	CORRECTION
FUSES BLOW WHEN MOTOR STARTS		
A. Incorrect voltage	Using a voltmeter check the line terminals. Voltage must be within plus or minus 10% of nominal.	Check power source if voltage is incorrect.
B. Incorrect fuses	Check fuses for recommended size and check for loose, dirty or corroded connections in the fuse receptacle.	Replace with proper fuses.
C. Defective pressure switch	Check voltage at contact points. Improper contact of switch points can cause voltage less than line voltage.	Replace pressure switch or clean points.
D. Control box malfunction	Check wiring against diagram in control box. Check for loose connections. Control box-motor	Correct wrong wiring circuits. Press prong connectors to assure
1. Wrong connections	must match and be same as supply voltage.	contact. Correct short circuit.
2. Defective relay	Check relay coil with ohmmeter. No movement of needle, if capacitor is good, indicates defective relay point corntact.	Replace relay.
3. Defective capacitor	Check resistance across capacitor terminals with ohmmeter. Ohmmeter needle should jump at once when contact is made then move up slowly. An open capacitor or no current to the capacitor is indicated when no movement occurs. A shorted capacitor will not give resistance reading.	Replace capacitor.
E. Bound pump	Locked rotor conditions can result from misalignment between pump	Sand bound pump can sometimes be corrected

Table 4-1. Troubleshooting Cont'd.

CAUSE OF TROUBLE	CHECKING PROCEDURE	CORRECTION
E. Bound Pump - con't.	and motor caused by wedging in a crooked well or rough handling at installation. Locked rotor readings can also indicate a sand bound pump. Amp readings 3 to 6 times higher than normal will be indicated.	by temporarily reversing black and red leads in control box then returning to normal. If pump does not rotate freely it must be pulled and cleaned or realigned and the well condition corrected.
F. Defective cable or motor windind	Attach one ohmmeter lead to the drop pipe or well casing and touch the other lead to each motor lead. If the needle moves appreciably a ground is indicated in either the motor or the drop cable.	The pump must be pulled and the cable disconnected and inspected. Damaged cable should be correctly spliced or replaced. If cable is good, the motor winding is grounded.
1. Shorted or open	Disconnect motor leads from control box, note length and size of drop cable and use ohmmeter to check resistance. Low ohms may indicate shorted motor winding. High resistance (no movement of needle) can mean an open circuit in winding or broken but not exposed lead cable conductor.	The pump must be pulled and motor or drop cable repaired or replaced.
MOTOR DOES NOT START -- FUSES DO NOT BLOW		
A. No power	Check fuses or circuit breaker.	Replace fuses or reset breaker.
B. Defective pressure switch	Check voltage across pressure switch with contact closed. If voltage drop is equal to line voltage the switch is not making contact.	Clean contact points or replace switch.
C. Defective wiring	Check for loose or corroded connections. Check motor lead terminals with voltmeter for power.	Correct faulty wiring or connections.
PUMP RUNS BUT DELIVERS LITTLE OR NO WATER		
A. Air locked pump	Pump can be heard running but no water noise is detected.	Normal delivery may resume if pump is started and stopped at one minute intervals.

Table 4-1. Troubleshooting Cont'd.

CAUSE OF TROUBLE	CHECKING PROCEDURE	CORRECTION
B. Low water level in well	Water delivery good on start up but diminishes. Pump capacity too great for well production. Pump may be set in sand.	Throttle pump delivery through restricting valve. Lower pump setting if depth of well is adequate.
C. Pump rotation wrong	Lower water delivery or low pressure may indicate pump operating in wrong direction.	Rotation can be corrected by properly connecting 10 3-wire units or by interchanging two leads of 30 units.
D. Check valve stuck or installed improperly	No water will be delivered if valve is installed with flow arrow in wrong direction.	Valve must be reversed.
	If drop pipe is screwed into the pump check valve too deeply it may be jammed in the closed position.	Cut off a portion of the threads on the drop pipe.
E. Leak in drop pipe	Although water is being supplied to tank the pump may not deliver sufficient pressure to shut off the system. The "on" portion of the cycle increases.	Raise pipe, check for leak and replace damaged section.
F. Pump screen blocked	Restricted flow may indicate a clogged intake screen on pump. Pump may be installed in mud or sand.	Clean screen and reset at less depth. It may be necessary to clean well.
G. Worn pump	Symptoms of worn pump are similar to those of drop pipe leak or low water level in well. pressure switch setting, if pump shuts off worn parts may be at fault. Sand is usually present in tank.	Pull pump and replace worn impellers, casing Reduce or other close fitting parts.
H. Loose or broken motor shaft	No water will be delivered if coupling between motor and pump shaft is loose or if a jammed pump has caused the motor shaft to sheer off.	Check for damaged shafts if coupling is loose and replace worn or defective units.

Table 4-1. Troubleshooting Cont'd.

CAUSE OF TROUBLE	CHECKING PROCEDURE	CORRECTION
PUMP KEEPS RUNNING		
A. Pressure switch	Switch points may be "welded" in closed position.	Clean points or replace switch.
B. Low level well	Pump may exceed well capacity. Shut off pump, recover. Check static level from well head.	Throttle pump output wait for well to or reset pump to lower level. Do not lower if sand may clog pump.
C. Leak in system	Check pipe one unit at a time for leak.	Replace damaged section.
D. Worn pump	Abrasives in water may indicate wear. Reduce pressure setting of switch until pump shuts off. If pressure is insufficient unit must be replaced.	Pull pump and replace.
PUMP STARTS TOO OFTEN		
A. Pressure switch	Check setting on pressure switch and examine for defects.	Reset limit or replace switch.
B. Leak in system	Tank may be leaking air above water level. Delivery pipe into house or hiddle lines.	Repair or replace tank or pipes.
C. Check valve	Damaged or defective check valve will not hold pressure.	Remove and replace if defective.
D. Air supply (waterlogged tank)	Check air volume control or snifter valve for improper operation.	Clean or replace. Drain and recharge tank.

APPENDIX A

MAINTENANCE ALLOCATION CHART

SECTION I

INTRODUCTION

A-1 General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

b. The Maintenance Allocation Chart (MAC) in section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

A-2 Maintenance functions. Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e. g., by sight, sound, or feel).

b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i. e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. Aline. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and is shown as the 3d position code of the SMR code.

i. Repair. The application of maintenance services, including fault location/troubleshooting, removal/installation, and disassembly/assembly procedures, and maintenance actions to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i. e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

A-3 Explanation of Columns in the MAC, Section II

a. Column 1, Group Number. Column 1 lists functions group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00".

b. Column 2, Component/Assembly. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Function. Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, see paragraph A-2.)

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate work time figures will be shown for each category. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific

tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance categories are as follows:

C	Operator or crew
O	Organizational maintenance
F	Direct Support Maintenance
H	General Support Maintenance
D	Depot maintenance/Specialized Repair Activity (SRA)

e. Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

f. Column 6, Remarks. This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in Section IV.

A-4 Explanation of Columns in Tool and Test Equipment Requirements, Section III.

a. Column 1, Reference Code. The tool and test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

b. Column 2, Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.

c. Column 3, Nomenclature. Name or identification of the tool or test equipment.

d. Column 4, National Stock Number. The national stock number of the tool or test equipment.

e. Column 5, Tool Number. The manufacturer's part number.

A-5 Explanation of Columns in Remarks, Section IV

a. Column 1, Reference Code. The code recorded in column 6, Section II.

b. Column 2, Remarks. This column lists information pertinent to the maintenance funtion being performed as indicated in the MAC, Section II.

SECTION II. MAINTENANCE ALLOCATION CHART
FOR
DRILLING SYSYEM, WELL, ROTARY,
TRUCK MOUNTED, AIR TRANSPORTABLE,
600 FEET CAPACITY

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
00	Well Drilling System	Repair					80.0		
01	Well Drilling Rig	Inspect	14.4						
		Service	9.0	0.1					
		Replace	2.8	46.2	112.0				
		Repair	10.6	72.4	141.0	202.5			
0101	Lighting, Mast	Inspect	0.1						
		Replace		4.0					
		Repair		6.0					
0102	Piping Assy, Discharge	Inspect	0.1						
		Replace		1.5					
		Repair	0.1	1.5					
010201	Valve, Shear Relief	Replace	0.5						
		Repair	0.1	1.0					
010202	Valve, Ball	Replace	1.5						
		Repair		0.5					
0103	Mast Assy	Inspect	1.0						
		Service	0.6						A,B
		Replace			15.0				
		Repair			13.0	8.0		1,5,6	
010301	Block Assy, Crown	Inspect	0.2						
		Replace		2.0					
		Repair		2.0					
010302	Sprocket Assy, Chain Feed	Inspect	0.2						
		Replace		2.0					
		Repair		1.0					
010303	Pulldown Assy, Chain	Inspect	0.2						
		Replace		2.0					
		Repair		1.5					
0104	Cylinder, Mast Raising	Inspect	0.1						
		Service	0.1						B
		Replace		1.5					
		Repair			3.0			1,5,6	
0105	Drive Assy, Mud Pump	Inspect	0.1						
		Service	0.2						B,C
		Replace			2.0				
		Repair			5.0	1.0		1,5,6	
010501	Clutch	Replace			3.0				
		Repair			2.0				
0106	Mud Pump Assy	Inspect	0.2						
		Service	0.2						B,C
		Replace			2.0				
		Repair	8.0		18.0			1,5,6,9,10	
0107	Air Compressor Drive	Inspect	0.5						
		Test	0.5						
		Replace			8.0				
		Repair				2.0	5.0	1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
010701	Compressor Assy, Air	Replace			3.0				
		Repair				2.0	5.0		
01070101	Seal Assy, Shaft	Inspect	0.2						
		Replace			3.0				
		Repair				2.0			
01070102	Clutch Assy	Replace			3.0				
		Repair			3.0				
01070103	Compressor, Air	Replace			3.0				
		Repair					5.0		
010702	0il Cooler Assy	Inspect	0.2						
		Replace			3.0				
		Repair		1.0					
01070201	Filter, Oil	Inspect	0.1						
		Replace		1.0					
		Repair		0.5					
01070202	Motor, Hydraulic	Inspect	0.2						
		Replace		1.0					
		Repair			2.0				
01070203	Valve, Thermostatic Bypass	Replace		1.0					
		Repair			1.5				
010703	Air Cleaner Assy	Inspect	0.1						
		Replace		1.0					
		Repair	0.2						
010704	Separator Assy, Air/Oil	Inspect	0.2						
		Replace			3.0				
		Repair			1.5				
0108	Sub Drive Assy	Inspect	0.5						
		Service	0.5						B, C
		Replace			6.0				
		Repair		5.0	10.0	20.0		1,5,6	
010801	Driveshaft, Drive	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.5					
010802	Driveshaft, Mud Pump	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.5					
010803	Power Take-Off Assy	Service	0.3						
		Adjust			0.3				
		Replace			2.0				
		Repair			10.0				

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
010804	Pump, Hydraulic Gear	Inspect	0.1						
		Replace			1.0				
		Repair				4.0			
010805	Pump, Displacement	Inspect	0.1						
		Replace			3.0				
		Repair				10.0			
010806	Pump, Hydraulic	Inspect	0.1						
		Replace			2.5				
		Repair				6.0			
0109	Drawworks	Inspect	0.8						
		Service	1.5						B
		Replace			4.0				
		Repair		35.0	30.0	20.0		1.5,6	
010901	Driveshaft	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.5					
010902	Bevel Gear Box Assy	Inspect	0.1						
		Service	0.3						C
		Replace		2.5					
		Repair				4.0			
010903	Brake Assy, Hoist/Aux	Inspect	0.2						
		Adjust			0.5				
		Replace			1.5				
		Repair			1.0				
01090301	Band, Brake	Replace			1.0				
		Repair			1.0				
010904	Brake Assy, Third Drum	Inspect	0.2						
		Adjust			0.5				
		Replace			1.5				
		Repair			1.0				
01090401	Band, Brake	Replace			1.0				
		Repair			1.0				
010905	Control, Third Drum Clutch	Inspect	0.1						
		Adjust		0.5					
		Replace			1.0				
		Repair			1.0				
010906	Drum Assy, Hoist & Aux	Inspect	0.2						
		Replace			2.0				
		Repair			3.0				
01090601	Rotorseal Assy	Replace		0.5					
		Repair			1.0				
01090602	Clutch Assy	Replace			2.5				
		Repair			2.0				

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
010907	Third Drum Assy	Inspect	0.2						
		Replace			2.0				
		Repair			3.0				
01090701	Clutch Assy	Replace			2.5				
		Repair			3.0				
0110	Piping Assy, Hydraulic	Inspect	0.5						
		Replace			4.0				
		Repair		1.0	2.0			1,5,6	
011001	Filter Assy, Hyd. Oil	Inspect	0.1						
		Replace		0.5					
		Repair		0.5					
011002	Valve, Relief	Replace			0.5				
		Repair				1.0			
011003	Valve, Flow Control	Replace			0.5				
		Repair				1.0			
0111	Injection Assy, Water & Foam	Inspect	0.5						
		Service	0.5						
		Replace			4.0				
		Repair			6.0	8.0		1,5,6	
011101	Motor, Hydraulic	Inspect	0.5						
		Replace			1.0				
		Repair				8.0			
011102	Pump, Water Injection	Inspect	0.2						
		Service	0.5						C
		Replace			1.0				
		Repair			2.0				
011103	Pump, Pulse Foam	Inspect	0.2						
		Replace			1.0				
		Repair			1.5				
0112	Lubricator Assy	Inspect	0.1						
		Replace		2.0					
		Repair			2.5	4.0		1,5,6	
011201	Lubricator	Inspect	0.2						
		Service	0.2						C
		Adjust	0.1						
		Replace		0.5					
		Repair			2.5	4.0			
01120101	Pump Assy	Replace		0.3					
		Repair				1.0			
01120102	Drive Assy	Replace		0.5					
		Repair			1.0				
0113	Tong Assy, Breakout	Inspect	0.1						
		Replace	1.0						
		Repair	1.0					1,5,6	
0114	Breakout Assy, Hydraulic	Inspect	0.2						
		Replace		1.5					
		Repair		2.0		1.0		1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
011401	Cylinder, Hydraulic	Inspect	0.1						
		Replace		1.0					
		Repair				1.0			
0115	Drive Assy, Rotary Table	Inspect	0.2						
		Service	0.5						B, C
		Replace			4.0				
		Repair		2.0		20.0		1,5,6	
011501	Linkage Assy, Shift	Inspect	0.1						
		Adjust		0.5					
		Replace		1.0					
011501	Motor, Fixed Displace-ment	Inspect	0.2						
		Replace			1.0				
		Repair				10.0			
011503	Transmission, Rot. Table	Inspect	0.2						
		Service	0.5						C
		Replace			1.0				
		Repair				10.0			
011504	Driveshaft	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.0					
0116	Deflector, Dust	Inspect	0.1						
		Replace	0.5						
		Repair	0.5					1,5,6	
0117	Cylinder, Table Transfer	Inspect	0.1						
		Replace		1.0					
		Repair				1.5		1,5,6	
0118	Table Assy, Rotary	Inspect	0.2						
		Service	0.5						B, C
		Replace		3.0					
		Repair					10.0	1,5,6	
0119	Base Assy, Rotary Table	Inspect	0.3						
		Replace		2.0					
		Repair		2.0				1,5,6	
0120	Control Assy, Pulldown Trans.	Inspect	0.2						
		Adjust		0.4					
		Replace		0.5					
		Repair		0.5				1,5,6	
0121	Drive Assy, Chain Feed	Inspect	0.4						
		Service	0.5						B, C
		Replace			5.0				
		Repair			3.0	16.0		1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
012101	Motor, Hydraulic	Inspect	0.1						
		Replace			1.5				
		Repair				6.0			
012102	Transmission, Pulldown	Inspect	0.2						
		Service	0.5						C
		Replace			1.5				
		Repair				10.0			
0122	Panel Assy, Instrument	Insect	0.1						
		Replace			3.0				
		Repair			5.0			1,5,6	
012201	Panel , Compartment	Inspect	0.1						
		Replace			3.0				
		Repair			5.0				
0123	Air Piping Assy	Inspect	03						
		Service	03						
		Replace			8.0				
		Repair			12.0			1,5,6	
012301	Valve, Controlair	Inspect	0.1						
		Replace		0.5					
		Repair			1.0				
012302	Valve, Pilotair	Inspect	0.1						
		Replace		05					
		Repair			1.0				
012303	Unit, Air Line Condition	Inspect	0.2						
		Replace			1.0				
		Repair			2.0				
01230301	Filter, Air Line	Replace		0.3					
		Repair		0.3					
01230302	Regulator, Air	Replace		0.3					
		Repair		0.3					
01230303	Lubricator, Air Line	Adjust		0.2					
		Replace		0.3					
		Repair		0.3					
0124	Control Throttle	Inspect	0.2						
		Adjust		0.2					
		Replace		1.0					
		Repair		0.5				1,5,6	
0125	Lighting Assy, Frame	Inspect	0.1						
		Replace		1.0					
		Repair	0.1		2.0			15,6	
0126	Mud Flap Assy	Inspect	0.1						
		Replace	0.5						
		Repair	0.5					1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
0127	Platform Assy, Drill's	Inspect	0.1						
		Replace	0.3						
		Repair	0.3						
0128	Jacks & Mtg. Assy	Inspect	0.2						
		Replace		1.5					
		Repair				6.0		1,5,6	
012801	Jack, Front Hydraulic	Inspect	0.1						
		Replace		0.5					
		Repair				1.5			
012802	Jack, Rear Hydraulic	Inspect	0.1						
		Replace		0.5					
		Repair				1.5			
0129	Frame Assy, Drill	Inspect	0.4						
		Replace				6.0			
		Repair		0.5				1,5,6	D
0130	Winch Amy, Front Mtd.	Inspect	0.1						E
		Service	0.5						C
		Replace		4.0					
		Repair			4.0			1,5,6	
0131	Motor, Hydraulic, Winch	Inspect	0.1						
		Replace			0.5				
		Repair				2.0		1,5,6	
0132	Valve Amy, Control	Inspect	0.1						
		Replace			1.0			1,5,6	
0133	Power Take-Off	Replace			1.0				
		Repair				2.0		1,5,6	
0134	Pump, Hydraulic, Winch	Inspect	0.1						
		Replace			1.0				
		Repair				2.0		1,5,6	
0135	Jack, Hand, 20 Ton	Inspect	0.1						
		Service		0.1					C
		Replace	0.1						
0136	Hand Tools Assembly	Repair		0.1					K
0137	Operating Equipment	Repair		0.1					K
0138	Accessory Kit	Repair		0.1					K
013801	Hoisting Plugs	Repair		05				1	
0139	Life-Lie, Self	Inspect	0.1						
	Retracting	Replace		0.2					
		Repair							L

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
02	Truck, Rig	Inspect	5.5	0.1					
		Service	3.1						
		Replace		35.7	91.7	21.0			
		Repair		22.5	74.0	83.0			
0201	Cab/Body Group	Inspect	0.1						
		Replace				10.0			
		Repair				6.0			
020101	Cab Trim, Exterior	Inspect	0.1						
		Replace			1.0				
		Repair			1.0			1,5,6	
020102	Cab Trim, Interior	Inspect	0.1						
		Replace			1.0				
		Repair			1.0			1,5,6	
020103	Windshield Wiper Assy	Inspect	0.2						
		Replace	1.0						
		Repair			1.0			1,5,6	
020104	Heater/Defroster Connections	Inspect	0.1						
		Replace	2.0						
		Repair			1.5			1,5,6	
0202	Seat Assy, Driver	Inspect	0.1						
		Replace		1.0					
		Repair			1.0			1,5,6	
0203	Brake Pedal Assy	Inspect	0.1						
		Replace			0.5				
		Repair			1.0				
0204	Clutch Pedal Assy	Inspect	0.1						
		Adjust		0.2					
		Replace		0.5					
		Repair		1.0					
0205	Accelerator Pedal Assy	Inspect	0.1						
		Replace		0.5					
		Repair		1.0					
0206	Shift Lever Assy	Inspect	0.1						
		Replace		0.5					
		Repair		1.0					
0207	Steering Group	Inspect	0.2						
	Service		0.5						B
		Replace			4.0				
		Repair			2.0			1,5,6,33, 34,52	
0208	Electrical Components, Cab	Inspect	0.2						
		Replace			2.5				
		Repair			1.5			1,5,6	
0209	Steering Gear	Inspect	0.2						
		Service	0.1						C
		Replace			2.5				
		Repair				4.0		1,5,6,45, 46,47	
0210	Engine Cover Assy	Inspect	0.2						
		Replace		2.0					
		Repair		1.0				1,5,6	

(1)	(2)	(3)	(4) Maintenance Category					(5)	(6)
Group Number	Component/ Assembly	Maintenance Function	C	O	F	H	D	Tools and Equipment	Remarks
0211	Exhaust System	Inspect	0.1						
		Replace		1.5					
		Repair		1.0				1,2	
0212	Radiator	Inspect	0.2						
		Test			0.5				
		Service	0.3						
		Replace		3.0					
		Repair			3.0			1,5,6,49, 50,51	
021201	Hoses	Inspect	0.1						
		Replace		0.3					
0213	Steering Pump	Inspect	0.1						
		Service	0.1						C
		Replace		1.5					
		Repair			3.0			1,5,6	
0214	Alternator Assy	Inspect	0.1						
		Test			0.5				
		Replace		1.0					
		Repair			2.0			1,5,6,7,8	F
021401	Belts	Inspect	0.1						
		Adjust		0.2					
		Replace		0.4					
0215	Starting Motor Assy	Inspect	0.1						
		Test			0.5				
		Replace		1.5					
		Repair			3.0			1,5,6,7,8	
021501	Solenoid, Starter	Inspect	0.1						
		Test		0.5					
		Replace		1.0					,5,6
0216	Engine Assy, Diesel	Inspect	0.2						
		Service	0.5						C
		Replace			10.0				
		Repair		2.0	15.0	25.0			
021601	Air Cleaner Assy	Inspect	0.2						
		Service	0.2						
		Replace		0.5					
		Repair		1.0				1,5,6	
021602	Turbocharger	Replace			1.5				
		Repair			2.0			1,5,6	
021603	Fuel Lines & Filter	Inspect	0.2						
		Replace		1.5					
		Repair		1.5				1,5,6	
021604	Injection Pump, Fuel	Inspect	0.2						
		Test				2.0			
		Calibrate				2.0			
		Replace			2.0				
		Repair				4.0		1,5,6, F 26 thru 32	
021605	Governor	Inspect	0.1						
		Replace			2.5				
		Repair				4.0		1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
021606	Air Compressor	Inspect	0.1						
		Replace			3.0				
		Repair			2.5			1,5,6	
021607	Water Pump	Inspect	0.1						
		Replace			3.0				
		Repair			1.5			1,5,6	
021608	Oil Cooler 6 Filter	Inspect	0.1						
		Replace		1.0					
		Repair			2.0			1,5,6	
021609	Fuel Filter a Mounting	Inspect	0.1						
		Replace		1.0					
		Repair		1.0				1,5,6	
021610	Manifolds, Intake a Exhaust	Inspect	0.1						
		Replace			2.0				
		Repair			1.0			1,5,6	
021611	Pan, Oil	Inspect		0.1					
		Replace			4.0				
		Repair			1.0			1,5,6	
021612	Oil Pump Assy	Replace			4.0				
		Repair			1.0			1,5,6	
021613	Cover, Engine Front	Inspect	0.1						
		Replace			3.0				
		Repair			1.0			1,5,6	
021614	Cylinder Head Group	Inspect	0.1						
		Replace			2.0				
		Repair			4.0			1,5,6,13, 14,15,38	
021615	Camshaft Group	Replace				2.0			
		Repair				1.5		1,5,6,16	
021616	Piston & Conn. Rod	Replace				2.0			
		Repair				4.0		1,5,6 & 17 thru 23, 38	
021617	Crankshaft Group	Replace				5.0			
		Repair				3.5		1,5,6,24, 25,39	
021618	Crankcase Group	Replace				2.0			
		Repair				5.0		1,5,6	
0217	Transmission	Inspect	0.2						
		Service	0.2						C
		Replace			6.0				
		Repair				16.0		1,5,6	
0218	Driveshaft, Transfer Case	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.0				1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
0219	Driveshaft, Front Axle	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.0					1,5,6
0220	Transfer Case	Inspect	0.1						
		Service	0.1						C
		Replace			5.0				
		Repair				10.0		1,5,6	
0221	Clutch Assy	Replace			4.2				
		Repair			1.0			1,5,6	
0222	Brake Chambers, Air	Inspect	0.1						G
		Replace			1.0				
		Repair			2.5			1,5,6	
0223	Hub & Drum, Front	Replace		1.0					
		Repair		1.0	1.0			1,5,6	
022301	Hub, Wheel	Replace		1.0					
		Repair		1.0					
022302	Drum, Brake	Replace			1.0				
		Repair		1.0					
0224	Hub & Drum, Rear	Replace		2.0					
		Repair		1.0	1.0			1,5,6	
022401	Hub, Wheel	Replace		1.0					
		Repair		1.0					
022402	Drum Brake	Replace		1.0					
		Repair			1.0				
0225	Brake Assy, Front	Replace		2.0					
		Repair		1.0				1,5,6	
0226	Brake Assy, Rear	Replace		2.0					
		Repair		1.0				1,5,6	
0227	Driveshaft, Rear Axle	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.0				1,5,6	
0228	Driveshaft, Interaxle	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.0				1,5,6	
0229	Rear Axle Group	Replace			7.0				
		Repair			8.0			1,5,6	
022901	Front Rear Axle	Inspect	0.1						
		Service	0.1						C
		Replace			7.0				
		Repair			4.0			1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
022902	Rear Rear Axle	Inspect	0.1						
		Service	0.1						C
		Replace			7.0				
		Repair			4.0			1,5,6	
0230	Front Axle Assy	Inspect	0.1						
		Service	0.1						B
		Adjust			1.5				
		Replace			5.0				
		Repair			2.5			1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
03	Rig Tender Vehicle	Inspect	3.5						
		Service	4.5						
		Replace	0.6	6.9	37.25	17.5			
		Repair	1.0	5.4	34.0	80.0			
0301	Crane Assy	Inspect	0.1						E
		Service	0.2						A,B
		Replace			8.0				
		Repair			10.0	15.0		1,5,6	
030101	Boom Assy, Extension	Inspect	0.2						
		Service	0.2						B
		Replace			1.5				
		Repair			2.0				
030102	Boom Assy, Main	Inspect	0.2						
		Service	0.2						B
		Replace			2.0				
		Repair			2.0	1.0			
03010201	Cylinder. Extension	Inspect	0.2						
		Replace			1.0				
		Repair				1.0			
030103	Turret Assy, Crane	Inspect	0.1						
		Replace				6.0			
		Repair				4.0			
03010301	Cylinder, Main	Inspect	0.1						
		Service	0.1						B
		Replace			1.0				
		Repair				2.0			
03010302	Motor, Hydraulic	Inspect	0.1						
		Replace			1.0				
		Repair				6.0			
03010303	Winch Assy, Crane	Inspect	0.1						E
		Service	0.2						C
		Replace			1.0				
		Repair			2.0				
030104	Base Assy, Crane	Inspect	0.1						
		Service	0.2						A,B
		Replace				2.0			
		Repair				6.0			
03010401	Control Valve	Inspect		0.1					
		Replace			3.0				
		Repair				1.0			
03010402	Motor, Hydraulic	Inspect	0.1						
		Replace			1.0				
		Repair				6.0			
030105	Control Assy, Remote	Inspect	0.1						
		Replace	0.1						
		Repair		0.5					
0302	Welder/Generator	Inspect	0.1						
		Service	0.5						H
		Replace		1.0					
		Repair		1.5	1.5	2.0		1,5,6	J

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
030201	Panel, Front	Inspect	0.1						
		Replace			1.0				
		Repair			1.5			1,5,6	
030202	Generator Assy	Replace			1.5				
		Repair			1.0	3.0		1,5,6	
030203	Engine, Diesel	Inspect	0.1						
		Service	0.2						H
		Replace			2.5				
		Repair			1.0	3.0		1,5,6	G
03020301	Air Cleaner	Inspect	0.1						
		Service	0.5						
		Replace		1.0					
		Repair		1.0				1,5,6	
03020302	Alternator	Inspect		0.1					
		Test		1.0					
		Replace		0.5					
		Repair			2.0			1,5,6	F
03020303	Exhaust Group	Inspect	0.1						
		Replace		0.5					
		Repair		0.2				1,5,6	
03020304	Starting Motor	Inspect	0.1						
		Test		0.5					
		Replace		1.0					
		Repair			2.0			1,5,6	
03020305	Injection Pump	Replace			2.0				
		Repair				2.0		1,5,6	
03020306	Cylinder Head & Valves	Adjust			0.5				
		Replace				2.0			
		Repair				2.0		1,5,6	
03020307	Camshaft	Replace				2.0			
		Repair				1.0		1,5,6	
03020308	Piston & Connecting Rod	Replace				2.5			
		Repair				1.0		1,5,6	
03020309	Crankshaft	Replace				3.0			
		Repair				1.0		1.5,6	
0303	Flood Light Assy	Replace		0.3					
		Repair		0.2					
0304	Cabinet Assy								
030401	Fuel Transfer Pump	Inspect	0.1						
		Replace			1.0				
		Repair			1.5			1,5,6	
030402	Nozzle, Fuel	Inspect	0.1						
		Replace	0.5						
		Repair	1.0					1,5,6	
030403	Heating Torch Assy	Inspect	0.1						
		Replace		1.0					
		Repair		1.0				1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
0305	Water Pump Assy	Inspect	0.1						
		Replace			1.5				
		Repair			1.5	4.5			
030501	Water Pump	Inspect	0.1						
		Replace			1.5				
		Repair			3.0			1,5,6	
030502	Hydraulic Motor	Inspect	0.1						
		Replace			1.5				
		Repair				2.0		1,5,6	
0306	Reservoir Assy, Hydraulic	Inspect	0.1						
		Service	0.2						C
		Replace		1.0					
		Repair			1.0			1,5,6	
030601	Valve Assy, Control	Inspect	0.2						
		Replace		1.0					
		Repair				1.5		1,5,6	
030602	Filter Assy	Replace		0.1					
		Repair		1.0					
0307	Winch Assy	Inspect	0.1						E
		Service	0.1						C
		Replace			1.0				
		Repair			1.0	1.0		1,5,6	
030701	Winch	Inspect	0.1						
		Service	0.1						C
		Replace			1.0				
		Repair			2.0				
030702	Motor, Hydraulic	Inspect	0.1						
		Replace			1.0				
		Repair				6.0			
0308	Pump/PTO Assy	Inspect	0.1						
		Replace			1.5				
		Repair				4.0			
030801	Hydraulic Pump	Inspect	0.1						
		Replace			0.75				
		Repair				2.0		1,5,6	
030802	Power Take-Off	Replace			1.0				
		Repair				2.0		1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
04	Truck, Rig Tender	Inspect	5.3	0.1					
		Service	3.1						
		Replace		35.7	91.7	21.0			
		Repair		22.5	74.0	83.0			
0401	Front Sheet Metal Group	Inspect	0.1						
		Replace			2.0				
		Repair			1.0			1,5,6	
0402	Cab Group	Inspect	0.1						
		Replace				10.0			
		Repair				6.0		1,5,6	
040201	Door Assy	Inspect	0.1						
		Replace			1.0				
		Repair			1.0			1,5,6	
040202	Fan, Defroster	Inspect	0.1						
		Replace		0.5					
		Repair		0.5				1,5,6	
040203	Windshield Wiper/Washer	Inspect	0.2						
		Service	0.2						
		Replace		1.0					
		Repair		1.0				1,5,6	
040204	Heater Assy	Inspect	0.1						
		Replace			2.0				
		Repair			1.5			1,5,6	
040205	Seat Assy, Driver	Inspect	0.1						
		Replace		1.0					
		Repair			1.0			1,5,6	
0403	Brake Pedal Assy	Inspect	0.1						
		Replace			0.5				
		Repair			1.0				
0404	Clutch Pedal Assy	Inspect	0.1						
		Adjust		0.2					
		Replace		0.5					
		Repair		1.0					
0405	Accelerator Pedal Assy	Inspect	0.1						
		Replace		0.5					
		Repair		1.0					
0406	Shift Lever Assy	Inspect	0.1						
		Replace		0.5					
		Repair		1.0					
0407	Steering Group	Inspect	0.2						
		Service	0.5						B
		Replace			4.0				
		Repair			2.0			1,5,6,33, 34,52	
0408	Electrical Components, Cab	Inspect	0.2						
		Replace			2.5				
		Repair			1.5			1,5,6	
0409	Steering Gear	Inspect	0.2						
		Service	0.1						C
		Replace			2.5				
		Repair					4.0	1,5,6,45, 46,4 7	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
0410	Exhaust System	Inspect	0.1						
		Replace		1.5					
		Repair		1.0				1,2	
0411	Radiator	Inspect	0.2						
		Test			0.5				
		Service	0.3						
		Replace		3.0					
		Repair			3.0			1,5,6	
041101	Hoses	Inspect	0.1						
		Replace		0.3					
0412	Steering Pump	Inspect	0.1						
		Service	0.1						C
		Replace		1.5					
		Repair			3.0			1,5,6,49, 50,51	
0413	Alternator Assy	Inspect	0.1						
		Test			0.5				
		Replace		1.0					
		Repair			2.0			1,5,6,7,8	F
041301	Belts	Inspect	0.1						
		Adjust		0.2					
		Replace		0.4					
0414	Starting Motor Assy	Inspect	0.1						
		Test			0.5				
		Replace		1.5					
		Repair			3.0			1,5,6,7,8	
041401	Solenoid, Starter	Inspect	0.1						
		Test		0.5					
		Replace		1.0					
0415	Engine Assy, Diesel	Inspect	0.2						
		Service	0.5						C
		Replace			10.0				
		Repair		2.0	15.0	25.0			
041501	Air Cleaner Assy	Inspect	0.2						
		Service	0.2						
		Replace		0.5					
		Repair		1.0				1,5,6	
041502	Turbocharger	Replace			1.5				
		Repair			3.0			1,5,6	
041103	Fuel Lines & Filter	Inspect	0.2						
		Replace		1.5					
		Repair		1.5				1,5,6	
041504	Injection Pump, Fuel	Inspect	0.2						
		Test				2.0			
		Calibrate				2.0			
		Replace			2.0				
		Repair				4.0		1,5,6, & 26 thru 32	
041505	Governor	Inspect	0.1						
		Replace			2.5				
		Repair				4.0		1.,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
041506	Air Compressor	Inspect	0.1						
		Replace			3.0				
		Repair			2.5			1,5,6	
041507	Water Pump	Inspect	0.1						
		Replace			3.0				
		Repair			1.5			1,5,6	
041508	Oil Cooler & Filter	Inspect	0.1						
		Replace		1.0					
		Repair		2.0				1,5,6	
041509	Fuel Filter & Mounting	Inspect	0.1						
		Replace		1.0					
		Repair		1.0				1,5,6	
0411510	Manifolds, Intake & Exhaust	Inspect	0.1						
		Replace			2.0				
		Repair			1.0			1,5,6	
041511	Pan, Oil	Inspect	0.1						
		Replace			4.0				
		Repair			1.0			1,5,6	
041512	Oil Pump Assy	Replace			4.0				
		Repair			1.0			1,5,6	
041513	Cover, Engine Front	Inspect	0.1						
		Replace			3.0				
		Repair			1.0			1,5,6	
041514	Cylinder Head Group	Inspect	0.1						
		Replace			2.0				
		Repair			4.0			1,5,6,13, 14,15,38	
041515	Camshaft Group	Replace				2.0			
		Repair				1.5		1,5,6,16	
041516	Piston & Conn. Rod	Replace				2.0			
		Repair				4.0		1,5,6 &17, thru 23,38	
041517	Crankshaft Group	Replace				5.0			
		Repair				3.5		1,5,6,24, 25,39	
041518	Crankcase Group	Replace				2.0			
		Repair				5.0		1,5,6	
0416	Transmission	Inspect	0.2						
		Service	0.2						C
		Replace				6.0			
		Repair				16.0		1,5,6	
0417	Driveshaft, Transfer Case	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.0				1,5,6	
0418	Driveshaft, Front Axle	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.0				1,5,6	

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment	(6) Remarks
0419	Transfer Case	Inspect	0.1						
		Service	0.1						C
		Replace			5.0				
		Repair				10.0		1,5,6	
0420	Clutch Assy	Replace			4.2				
		Repair			1.0			1,5,6	
0421	Brake Chambers, Air	Inspect	0.1						G
		Replace			1.0				
		Repair			2.5			1,5,6	
0422	Hub & Drum, Front	Replace		1.0					
		Repair		1.0	1.0			1,5,6	
042201	Hub, Wheel	Replace		1.0					
		Repair		1.0					
042202	Drum, Brake	Replace		1.0					
		Repair			1.0				
0423	Hub & Drum, Rear	Replace		2.0					
		Repair		1.0	1.0			1,5,6	
042301	Hub, Wheel	Replace		1.0					
		Repair		1.0					
042302	Drum Brake	Replace		1.0					
		Repair			1.0				
0424	Brake Assy, Front	Replace		2.0					
		Repair		1.0				1,5,6	
0425	Brake Assy, Rear	Replace		2.0					
		Repair		1.0				1,5,6	
0426	Driveshaft, Rear Axle	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.0				1,5,6	
0427	Driveshaft, Interaxle	Inspect	0.1						
		Service	0.2						B
		Replace		1.0					
		Repair		1.0				1,5,6	
0428	Rear Axle Group	Replace			7.0				
		Repair			8.0			1,5,6	
042801	Front Rear Axle	Inspect	0.1						
		Service	0.1						C
		Replace			7.0				
		Repair			4.0			1,5,6	
042802	Rear Rear Axle	Inspect	0.1						
		Service	0.1						C
		Replace			7.0				
		Repair			4.0			1,5,6	
0429	Front Axle Assy	Inspect	0.1						
		Service	0.1						B
		Adjust			1.5				
		Replace			5.0				
		Repair			2.5			1,5,6	

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
DRILLING SYSTEM, WELL, ROTARY,
TRUCK MOUNTED, AIR TRANSPORTABLE,
600 FEET CAPACITY

(1) Tool or Test Equipment Ref Code	(2) Maintenance Category	(3) Nomenclature	(4) National/ NATO Stock Number	(5) Tool Number
1	0	TOOL KIT, GENERAL MECHANICS: AUTOMOTIVE	5180-00-177-7033	
2	0	SHOP EQUIPMENT, AUTO MAINT, 2ND ECHELON, COMMON #1	4910-00-754-0654	
3	0	SHOP EQUIPMENT, AUTO MAINT, 2ND ECHELON, COMMON #1, LESS POWER	4910-00-754-0653	
4	0	SHOP EQUIPMENT, AUTO MAINT, 2ND ECHELON, COMMON #2, LESS POWER	4910-00-754-0650	
5	F	SHOP EQUIPMENT, AUTO MAINT AND REPAIR: FLD. MAINT., BASIC	4910-00-754-0705	
6	F	SHOP EQUIPMENT, AUTO MAINT AND REPAIR: FLD. MAINT., SUPPLEMENTAL	4910-00-754-0706	
7	F	SHOP EQUIPMENT, FUEL AND ELECTRIC MAINT. AND REPAIR, FIELD MAINTENANCE	4910-00-754-0714	
8	F	SHOP EQUIPMENT, FUEL AND ELECTRIC MAINT. AND REPAIR, FIELD MAINTENANCE, SUPPLEMENTAL, NO. 1	4910-01-028-9849	
9	0	PULLER ASSY, MUD PUMP LINER		(21363) F-942
10	0	PULLER ASSY, MUD PUMP VALVE SEAT		(21363) F-908
11	F	NOZZLE SLEEVE PULLER ADAPTER		SE-2587
12	F	NOZZLE SLEEVE INSTALLING TOOL		SE-2534
13	F	VALVE GUIDE REMOVER		SE-1722
14	F	VALVE GUIDE INSTALLER		SE-1943
15	F	VALVE SPRING TESTER		SE-2241
16	H	CAMSHAFT BEARING SERVICE SET		SE-2893
17	H	UNIVERSAL WET SLEEVE PULLER		SE-2536
18	H	PISTON RING COMPRESSOR		SE-1680
19	H	PISTON GROOVE WEAR GAUGE PINS		J-29511
20	H	PISTON RING CLEARANCE FIXTURE		SE-2206
21	H	COUNTER BORE DEPTH GAUGE		SE-2515
22	H	COUNTER BORING TOOL		SE-2514
23	H	OIL LEAK DETECTOR		SE-1632

(1) Tool or Test Equipment Ref Code	(2) Maintenance Category	(3) Nomenclature	(4) National/ NATO Stock Number	(5) Tool Number
24	H	LIFTING SLING		SE-2722
25	H	PULLER (FOR THREE-HOLE VIBRATION DAMPER)		SE-1368
26	H	EXCESS FUEL DEVICE SUPPORT BAR		SE-2755
27	H	PRESSURE TEST KIT		SE-2239
28	H	TORQUE CAM ANGLE GAUGE		SE-2755
29	H	TORQUE CAM FULCRUM SUPPORT BLOCK		SE-2755
30	H	NOZZLE TEST PUMP		SE-2002
31	H	NOZZLE TUBE ASSEMBLY		SE-2004-13
32	H	90 DEGREE ADAPTER		SE-2757
33	F	TORQUE INDICATOR WRENCH (100-600 lb.-ft.)		SE-2189
34	F	TORQUE INDICATOR WRENCH (0-150 lb.-ft.)		SE-2221
35	F	EQUALIZER BEAM BUSHING SERVICE SET H		SE-2725
36	F	TORQUE INDICATOR WRENCH (0-100 lb.-ft.)		SE-2005
37	F	VALVE CAGE TOOL		SE-2613
38	H	PISTON INSTALLER		SE-4006
39	H	DIAL INDICATOR SET		SE-1848
40	F	TORQUE INDICATOR WRENCH (in. lbs.)		SE-1919
41	F	RACK PISTON ARBOR TOOL		SE-2277
42	F	ADJUSTER PLUG SPANNER WRENCH		SE-2279
43	F	REMOVER AND INSTALLER, ADJUSTER PLUG BEARING		SE-2280
44	F	INSTALLER, OIL, SEAL, ADJUSTER PLUG		SE-2281
45	H	INSTALLER, PITMAN SHAFT NEEDLE BEARING		SE-2817
46	H	REMOVER, PITMAN SHAFT NEEDLE BEARING		SE-2818
47	H	INSTALLER, PITMAN SHAFT OIL SEAL		SE-2819
48	F	POWER STEERING SYSTEM ANALYZER		SE-2780

(1) Tool or Test Equipment Ref Code	(2) Maintenance Category	(3) Nomenclature	(4) National/ NATO Stock Number	(5) Tool Number
49	F	POWER STEERING PUMP RETAINER RING SPANNER WRENCH		SE-2838
50	F	POWER STEERING PUMP SHAFT OIL SEAL REMOVER		SE-2839
51	F	POWER STEERING PUMP SHAFT OIL SEAL INSTALLER		SE-2840
52	F	PULLER		SE-1821

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	Lubricate all hinge points.
B	Lubricate grease fittings.
C	Fill with appropriate lubricant
D	Repair of frames will be in accordance with TB9-2300-247-40.
E	Service/Inspection of Winch/Hoist wire cables will be in accordance with TB9-43-0142 and TB9-0352.
F	Repair of Alternator/Generator will be in accordance with TM9-2920-225-34.
G	Inspection of brake lines will be in accordance with TB9-230-405-14.
H	Fill fuel reservoir with diesel fuel.
J	Repair of batteries will be in accordance with TM9-6140-200-14 and DA Pamphlet 750-34.
K	Repair by replacing components.
L	Repair is at Special Repair Activity (SRA). SRA is the manufacturer.

APPENDIX B. TORQUE REQUIREMENTS

Grade 5 Socket and Hexagon Head Capscrews

SIZE	TENSILE STRENGTH (Min. PSI)	PROOF LOAD (PSI)	CLAMP LOAD P(lb)	TORQUE DRY K=0.20
				lb-in
4-40	120,000	85,000	380	8
4-48	120,000	85,000	420	9
6-32	120,000	85,000	580	16
6-40	120,000	85,000	640	18
8-32	120,000	85,000	900	30
8-36	120,000	85,000	940	31
10-24	120,000	85,000	1,120	43
10-32	120,000	85,000	1,285	49
1/4 - 20	120,000	85,000	2,020	96
1/4 - 28	120,000	85,000	2,320	120
				lb-ft
5/16-18	120,000	85,000	3,340	17
5/16-24	120,000	85,000	3,700	19
3/8-16	120,000	85,000	4,940	30
3/8-24	120,000	85,000	5,600	35
7/16-14	120,000	85,000	6,800	50
7/16-20	120,000	85,000	7,550	55
1/2-13	120,000	85,000	9,050	75
1/2-20	120,000	85,000	10,700	90
9/16-12	120,000	85,000	11,600	110
9/16-18	120,000	85,000	12,950	120
5/8-11	120,000	85,000	14,400	150
5/8-18	120,000	85,000	16,950	180
3/4-10	120,000	85,000	21,300	260
3/4-16	120,000	85,000	23,800	300
7/8-9	115,000	78,000	27,000	400
7/8-14	115,000	78,000	29,800	440
1-8	115,000	78,000	35,500	580
1-12	115,000	78,000	38,800	640
1 1/18-7	105,000	74,000	42,300	800
1 1/8-12	105,000	74,000	47,300	880
1 1/4-7	105,000	74,000	53,300	1,120
1 1/4-12	105,000	74,000	59,600	1,240
1 3/8-6	105,000	74,000	64,100	1,460
1 3/8-12	105,000	74,000	73,000	1,680
1 1/2-6	105,000	74,000	78,000	1,940
1 1/2-12	105,000	74,000	87,700	2,200

APPENDIX C

EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

C-1. SCOPE

This appendix lists expendable supplies and materials you will need to operate and maintain the Well Drilling System. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-970, Expendable Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items), or CTA 8-100, Army Medical Department Expendable/ Durable Items.

C-2. EXPLANATION OF COLUMNS

a. Column (1) Item number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, App. D").

b. Column (2) Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator / Crew
O - Unit Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column (3) National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column (4) Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by the part number.

e. Column (5) Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE / DURABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	O		COMPOUND, JOINT (29204) 949-002-15	LB
2	O		GAA (MIL-G-10924C)	LB
3	O		GO-85/140 (MIL-L-2105G) SAE 30	GAL.
4	O		GO-85/140 (MIL-L-2105C) SAE 50-60	GAL.
5	O		MOBIL RARUS SHC 924 (19135)	GAL.
6	O		MOBIL RARUS SHC 926 (19135)	GAL.
7	O		LUBRICATING OIL (MIL-L-2104D) OE/HDO 10, 20, 30, 40	GAL.
8	O		GO-80/90 (MIL-L-2105C) OE/HDO 10, 30	GAL.
9	O		GO-85/140 (MI L-L-2105C) OE/HDO 10, 30	GAL.
10	O		LUBRICATING OIL (MIL-L-2104D) OE/HDO 15/40	GAL.
11	O		LUBRICATING OIL (MIL-L-2104C) OE/HDO 10, 15/40	GAL.
12	O	9150-00-142-	ROCK DRILL OIL 9320	GAL.
13	O		GO-85/140 (MIL-L-2105C) SAE 140 EP	GAL.
14	O		GRAPHITE, COLLOIDAL (MI L-L-2431B)	GAL.
15	O		LUBRICATING OIL, OEA (MI L-L-46167A)	GAL.

☆U.S. Government Printing Office:1989-654-030/00356
PIN: 066267-001

By Order of the Secretary of the Army:

CARL E. VUONO
General. United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN, II
Brigadier General. United States Army
The Adjutant General

DISTRIBUTION:

To be distributed in accordance with DA Form 12-25A, Unit and Intermediate Direct Support and Intermediate General Support Maintenance requirements for Drilling Machine, Well, Combination Rotary/Percussion, Semitrailer Mounted, Diesel, 1500 Ft. Model CF-15-S

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 066267-000