USGS DEEP LOGGING WINCH

Operations and Maintenance Manual

September 17, 2019

U.S. Ice Drilling Program
University of Wisconsin-Madison Space Science & Engineering Center

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1.0 PURPOSE

The objective of this document is to provide the operator with a working knowledge of how the USGS Deep Logging Winch is assembled and operated. This document outlines winch components, setup, basic operation, preventative maintenance and troubleshooting. The final appendix, added by IDP personnel, is a safety guide for working with the winch.

2.0 SCOPE

This Operations Manual applies to the USGS Deep Logging Winch maintained and operated by the U.S. Ice Drilling Program.

3.0 REFERENCES

Clow, G.D. (2008): USGS polar temperature logging system, description and measurement uncertainties, USGS Techniques and Methods 2–E3, 24 pp., http://pubs.usgs.gov/tm/02e03.

4.0 DEFINITIONS

IDP – U.S. Ice Drilling Program, formerly IDDO.

QAS – Quality Assurance and Safety group.

SSEC – University of Wisconsin-Madison, Space Science and Engineering Center.

USGS – United States Geological Survey.

5.0 RESPONSIBILITIES

IDP Management is responsible for ensuring that operators run the USGS Deep Logging Winch in accordance with this Operations Manual.

SSEC QAS is responsible for ensuring that this document is created, reviewed, approved, maintained and updated per appropriate procedures.

IDP Engineering is responsible for ensuring that the content of this document is correct and up-to-date.

USGS Deep Logging Winch operators are responsible for ensuring this manual is followed.

6.0 INTRODUCTION

The USGS Polar Logging Winch is a semi-custom AC-powered winch that has been successfully used at GISP2, GRIP, NGRIP, and NEEM in Greenland and at Siple Dome and WAIS Divide in Antarctica. Thus far, it has been used to acquire high-precision temperature logs, optical logs, sonic logs, acoustic televiewer logs, and for vertical seismic profiling. The winch utilizes a steel 4-conductor teflon-insulated logging cable allowing both digital and analog measurements. A high-quality slip-ring connector provides electrical continuity between the logging cable and the surface electronics. Cable tension provided by a strain-gauge force transducer is displayed on a separate monitor. Rather than use a traditional level-wind system, cable spooling is accomplished using a 'fleet-angle compensator'. This device, which is reputed to be more trouble-free than a traditional level-wind system, allows the winch to be run in two modes: 1) the logging cable can be run directly off the winch into a borehole without the use of a separate tower, or 2) the winch can be set some distance from a borehole and the cable run to a sheave mounted on an existing tower over the borehole. The uncertainty of the depth measuring system depends on specific borehole conditions and the temperature near the winch during logging operations and thus must be treated on a case-by-case basis. However, recent experience indicates that when logging conditions are favorable, the 4.4-km logging system is capable of producing depths with a standard uncertainty (u_z) on the order of 0.2mm to 0.25mm per meter of depth.

Table 1. Basic winch specifications.

maximum logging depth	~ 4400 m
electrical conductors	4
drive motor	2 HP, 208–230 VAC
logging speed	4–20 cm/s
weight	1936 kg (4260 lbs)
setup dimensions - logging mode 1	4.78 m × 1.17 m × 2.70 m
setup dimensions - logging mode 2	3.76 m × 1.17 m × 1.68 m

7.0 WINCH COMPONENTS

7.1 Basic Mechanical Model

The heart of the logging winch is a surplus drum found on the USGS backlot years ago. The drum is 24 inches long with a 12-inch diameter core and 24-inch diameter flanges. With these flanges, logging cable can be stacked 6 inches deep on the core. J & J Manufacturing (Longbeach, CA) built a custom two-piece winch frame to accommodate this drum. The lower piece of the frame has 8-inch wide skids to allow the winch to be dragged on snow; the winch was successfully dragged behind a Tucker Sno-Cat between GISP2 and GRIP in the mid-1990s, a distance of about 30 km. The upper piece of the frame sits on large screws that allow the working part of the winch to be leveled on uneven or sloping surfaces. For braking, J & J Manufacturing equipped the winch with a simple mechanical drum brake (Fig. 1). This has proved sufficient over the years.

Winch power is provided by a 2 HP, 208–230 VAC, single-phase, 1750 rpm motor. The motor assembly consists of the main unit, a varidrive module, and a syncrogear module. The varidrive sitting between the main motor unit and the syncrogear provides a speed range of 10:1. The syncrogear for the original motor (presently mounted on the winch) has a 57:1 gear ratio. The lowest speed at the output shaft is 12 rpm. A spare motor assembly has a 71.6:1 syncrogear ratio, offering slightly slower logging speeds.

The motor assembly is coupled to the transmission using an EPDM ‘sure-flex’ coupling (Fig. 2). This type of coupling offers some mechanical compliance but its alignment is fairly critical. The transmission is a simple gearbox with a 2:1 gear ratio, plus neutral. An earlier 2-speed version of this transmission with a reverse gear proved problematic. Rather than use a reverse gear, the direction of the motor is reversed with an electrical switch when ascent within the borehole is desired. The transmission is coupled to an 11 tooth drive sprocket through another sure-flex coupling. This sprocket, connected to the 34 tooth drum sprocket through a large drive chain, yields a further 3.09:1 gear reduction.

Cable spooling is accomplished using a fleet angle compensator built by Kennelly Research & Development. This device allows the winch to be run in two modes. In the first mode, cable can be spooled vertically into a borehole if the winch can be placed near to the borehole casing (Fig. 3). In the second mode, the logging cable comes off the winch more or less horizontally. This mode is useful when the winch must be placed some distance from the borehole (Fig. 4).

Figure 1. Photo showing the drum, hand brake, and motor assembly. Logging speed is controlled by the dial on the varidrive unit.

Figure 2. Power created by the motor passes through a sure-flex coupling, the transmission, another sure-flex coupling, and into the drive sprocket (blue housing, lower left).

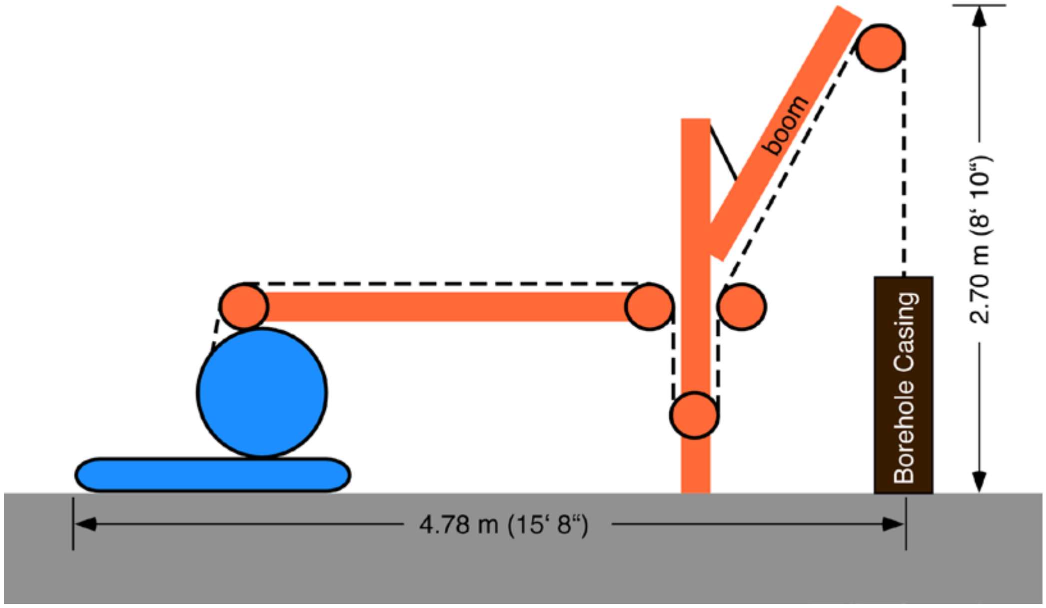

Figure 3. Logging Mode 1. This mode allows the cable to be spooled directly into the borehole casing.

Table 2. Mechanical system.

component	manufacturer	part no.	comments
drum	unknown	—	length = 24 in, core diam = 12 in
frame	J & J Manufacturing	—	modified by USGS
brake	J & J Manufacturing	—	mechanical drum brake
motor	US Motor		
main	”	E516, type TMP	2 HP, 1750 rpm
syncrogear	”	E461, type GWBP	gear ratio 57:1, 71.6:1
varidrive	”	E740, type VAM	
varidrive belt	”	Varibelt No. 6-1	
sure-flex couplings	TB Wood’s		
sleeves	”	9JE EPDM	
motor flange	”	9S × 1.5 inch	
transmission flanges	”	9S × 1.375 inch	
transmission	Turner Uni-Drive	X5M1-20 LR	manual, 1 speed, gear ratio 2:1
chain	—	—	
fleet-angle compensator	Kennelly R&D	SN 981	

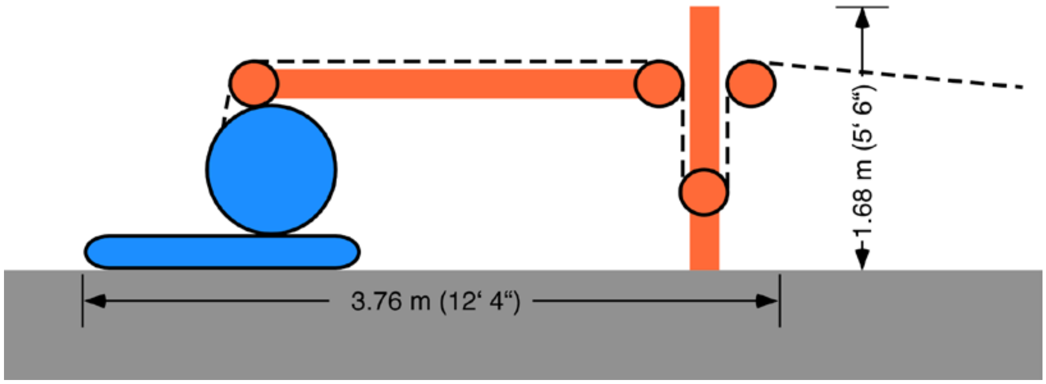

Figure 4. Logging Mode 2. With the removal of the fleet angle boom, the logging cable can be directed towards sheaves used to guide the cable into a distant borehole.

7.2 Signal Path

The signal path consists of a steel 4-conductor logging cable with a 1-inch Gearhart Owen cable head on one end and a high-quality slip-ring connector on the other. The cable is a steel 3/16-inch (4.72 mm) oil-patch logging cable with teflon insulation to allow its use in a wide variety of drilling fluids, including n-butyl acetate. Its weight in air is 92 kg/km, maximum temperature 260°C, minimum breaking strength 14.7 kN (3300 lbf), working load 5.9 kN (1300 lbf), bend diameter 25 cm (10 in), elongation 1.15 m/(km kN), conductor wire gauge #24, voltage rating 400 Vdc, insulation resistance 15,000 MΩ/km, dc conductor resistance 85.3 Ω/km, dc armor resistance 23.0 Ω/km, capacitance 157 pF/m (at 1 kHz), and velocity of propagation 69%. The cable was 4572 m (15,000 ft) long when purchased in 1994. Since the cable has been re-headed a couple of times since then, its exact length is currently unknown. Although it has seen many field seasons, the cable still appears to be in excellent condition. As the oil industry has moved to 7-conductor logging cables, it may be difficult to replace this cable when the time comes.

The cable head is also is an oil industry standard, known as a 1-inch O.D. Gearhart-Owen 4-conductor cable head for 3/16-inch wireline. The original supplier for the cable head is no longer in business so it's not clear where replacement parts can be purchased. Mount Sopris Instruments (Denver, CO) is a possible supplier. There are two o-rings that provide a seal between the cable head and a logging tool. These 2-014 (1/2-inch ID, 5/8-inch OD, 1/16-inch cross section) o-rings should be changed frequently when logging deep boreholes. If a logging tool becomes stuck downhole, the cable head is designed to separate from the logging cable when the cable tension exceeds 1100 lbf. In this way, at least the cable can be retrieved.

The slip-ring connector is a high quality 6-conductor connector built by IEC Corporation for the USGS (they maintain the drawings under part no. BXSN-6-MS8-USGS). The ring material is solid coin silver, the brush springs are beryllium copper, and the brush contacts are 80% silver - 20% graphite. Only four of the conductors are utilized with the 4-conductor logging cable. This unit has proved to be electrically quiet. To connect to the slip-ring connector, the user will need a cable with an Amphenol circular MIL spec connector, part # MS3106E-18-8S (Fig. 7).

Figure 5. Cable head with protective cap in place. Before every deep logging run, arctic grease (or equivalent) should be injected into the cable head by replacing the set screw in the middle of the narrow section with a zerk fitting. A special tool is needed to remove the spring (right side) from the cable head.

Table 3. Signal path.

component	manufacturer	part no.	comments
logging cable	Rochester Corporation	4-H-181K (A240188)	3/16-inch, teflon
head	Gearhart-Owen	1-inch GO 4-conductor cable	
o-rings	Rocket Seals	head 2-014	insulation use EPR or
slip-ring connector	IEC Corporation	BXSN-6-MS8-USGS	

Figure 6. End view of the cable head. O-rings are just barely visible under threaded shell. Logging tools need to be compatible with this cable head.

Figure 7. Example of cable needed to connect the logging instruments to the slip-ring connector.

7.3 Depth Measurement

Depths can be measured using the precision counting wheel mounted on top of the fleet angle compensator (Fig. 8). This is done using an optical encoder on the right side of the wheel (as viewed from the operator's location). A mechanical counter mounted on the left side provides an easily visible backup in case of a power failure. As the counting wheel is steel, the standard protocol is to periodically record the temperature of the wheel so the effect of thermal expansion/contraction on the measured depths can be accounted for. A complete description of the depth measurement system and related depth uncertainties can be found in Clow (2008). For best performance, the depth measurement system should be recalibrated at every deep logging site to account for local conditions and the aging of the cable.

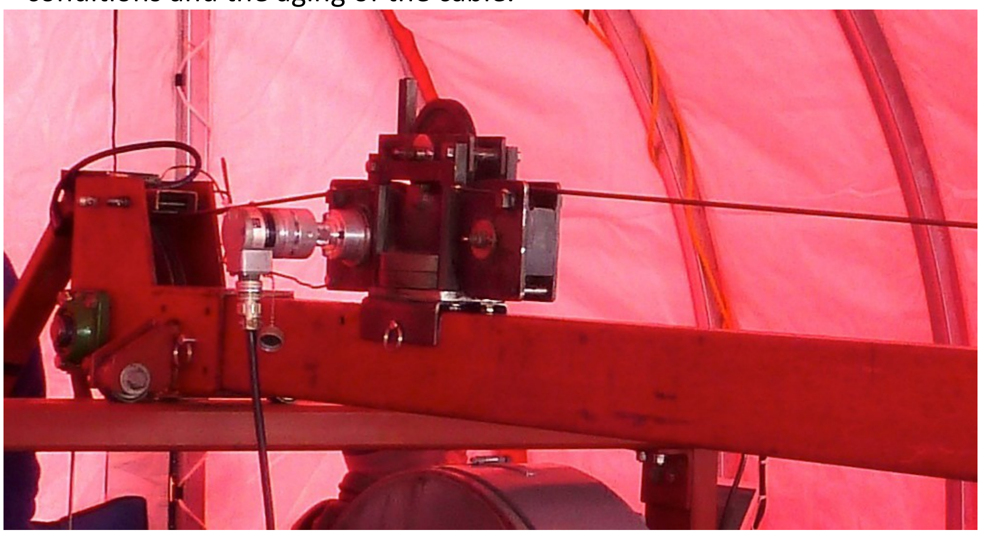

Figure 8. Depth measurement assembly.

7.4 Cable Tension

Cable tension is monitored using a sealed S-type load cell attached to one of the sheaves in the fleet angle compensator (Fig. 9). The resulting value is displayed on a digital readout near the front of the winch (Fig. 10). The readout also serves as a controller, stopping the winch should the line tension exceed a user selected preset value.

Figure 9. Load cell used for measuring cable tension.

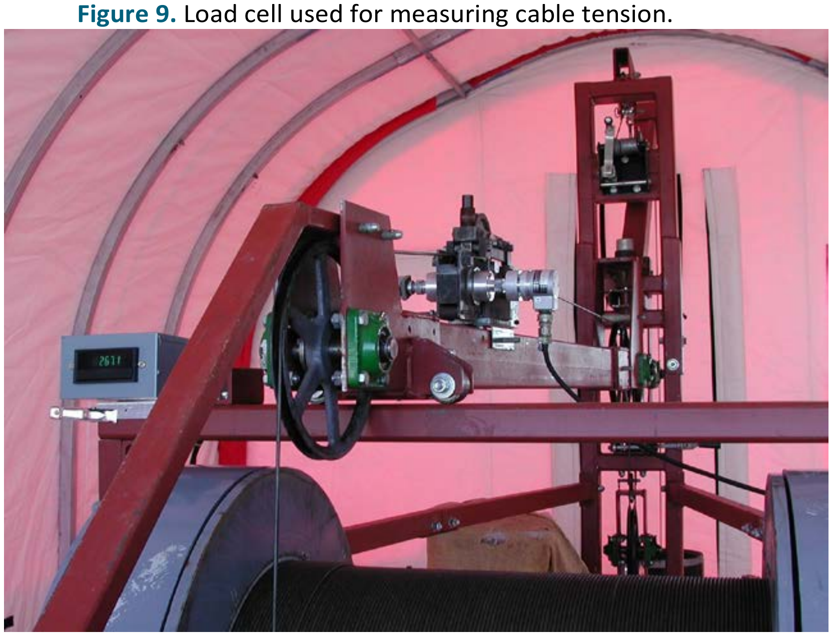

Figure 10. Digital readout showing cable tension is on the left.

Table 4. Cable tension.

component	manufacturer	part no.	comments
load cell	Interface Advanced Force Measurement	SSM-AF-3000	3000 lbf capacity
digital readout	Analogic	AN2401	

8.0 WINCH SETUP

8.1 Mechanical

Deep logging projects generally take 2–4 weeks to complete. To prevent snow from building up on the logging cable and sheaves, it's best to operate the winch from inside the special-purpose logging WeatherPort. Two of these WeatherPorts exist, one in Greenland and one in Antarctica. Given the difficulty of moving the winch into the WeatherPort, it's usually best to set the winch in place and then build the WeatherPort around it. The standard assembly procedure is:

- Determine where the winch will be located relative to the borehole.
- Set an Air Force (AF) pallet on the snow to provide a stable level surface for the winch frame.
- Cover the AF pallet with plywood to protect the pallet and provide a no-slip surface.
- Place the winch-frame box on the pallet.
- Setup the WeatherPort.
- Remove the box protecting the winch frame (remove the side panel and then slide the rest of the box off).
- Level the winch with the four adjustment screws.
- Install the breather in the winch transmission.
- Place a small piece of plywood on the snow in front of the AF pallet to support the fleet angle compensator tower.
- Attach bottom crossbar to lower tower section.
- Attach leveling feet to the crossbar.
- Attach lower horizontal supports to tower (the tower should now stand on its own).
- Loosely attach lower horizontal supports to the winch frame.
- Level the tower in both axes and center it with respect to the winch frame.
- Attach upper horizontal supports to the winch frame and tower.
- Carefully and incrementally tighten the bolts securing the horizontal supports.
- Lower the upper tower section into place on top of the lower tower section.
- Mount the fleet angle fulcrum pulley on the tower.
- Attach the fleet angle beam to the fulcrum pulley.
- Mount the drum pulley on the fleet angle beam.
- Install the tiller.
- Mount the load cell pulley.
- Install the load cell.
- Install the depth measurement assembly. Remove the 2 bolts from the assembly and lift the upper pulley of this assembly away.
- For Winch Mode 1:
    - Mount the boom winch on the upper tower.
    - Mount the boom support pulley.
    - Install the boom.

    - Attach the boom hoist.
    - Mount the boom end pulley.
- Carefully feed the logging cable through the entire winch path.
- Reinstall the upper pulley of the depth measurement assembly.
- Mount the cable tension display on the winch.
- Make all electrical connections for the load cell and display.
- Attach mechanical counter and optical encoder to depth measurement assembly.
- Install thermocouple used to monitor temperature of the measuring wheel.
- Install drip pans.
- Install deadman anchors behind the winch. Use chains to attach them to the winch frame.
- Attach slip-ring connector.

8.2 Electrical

The winch motor is designed for 208–230 VAC, 60 Hz, single-phase power. The manufacturer confirms that it can also be used at 230 VAC, 50 Hz as is commonly found in Danish camps. At full load, this motor needs 9.3 amps (2.4 kW). Starting the motor takes three times the full-load power, or 7.0 kW. The estimated generator power needed to run this winch is then 10.5 kW (at sea level), assuming a 25% generator derating for the cold and an additional 25% margin. A 56 ft long extension cable is included with the winch to connect it to a generator or local power, whichever is available. The plug is a 20 amp, 250 V, Hubble Twist-Lock part # 231A.

Some of the winch accessories such as the cable tension readout require 115 VAC. This is available through the winch's electrical panel so a separate 115 VAC line to the winch is not required. Once winch power is available, the standard procedure is:

- Test power to the motor.
- Test that the motor and everything in the drive-train is functioning normally, including reverse.
- Test the load cell and display.
- Test that the temperature display for the depth-measuring wheel is working.

9.0 PREVENTATIVE MAINTENANCE

The preventative maintenance schedule is as follows:

9.1 Beginning of Every Logging Season:

- Check the alignment of the sure-flex couplings and the tightness of the Allen screws in the sure-flex flanges.
- Check fluid levels in the transmission and motor.
- Lubricate bearings using zerk fittings as needed.
- Check the condition of the Varidrive belt.

9.2 Before Every Logging Run:

- Pump a small amount of arctic grease into the cable head.
- Inspect the cable head o-rings and replace as necessary. Apply a thin film of arctic grease to the o-rings before attaching a logging tool.
- Check alignment of sure-flex couplings and tightness of Allen screws.
- Check tightness of the slip-ring connector.
- Check that the winch is still level.

10.0 BASIC OPERATION

Once the winch is setup, it's very easy to operate. The motor has a simple on-off switch. To start moving downhole, turn the motor on and set the speed with the Varidrive unit (**Note:** Always have the motor going when adjusting the speed). When you want to stop the winch, turn the motor off and then set the brake. Setting the brake before turning the motor off will break the gears inside the transmission (this has happened before). When the logging tool touches the bottom of the borehole, you'll see the cable tension drop. The fleet angle compensator will do a nice job automatically respooling the cable. The one caveat is that it typically needs a little nudge when respooling cable near the side flanges.

11.0 POSSIBLE PROBLEMS

There are a few things to watch out for when running this winch.

- Safety. There are a lot of exposed parts on this winch. It's critical for everyone to keep body parts and loose clothing away from the moving parts while the winch is running.
- Like all deep drills and winches, there is considerable line tension when a tool is downhole. Should something break in the drive-train, the logging tool and cable can start moving downhole very quickly. If the drum rotation is not brought to a halt within a few seconds with the hand brake, it's probably best to just walk away from the winch.
- Two situations have led to a drive-train failure in the past. (1) The gears in the transmission are straight-cut gears. Thus, it's difficult to bring the transmission out of neutral and into gear if the there's a lot of stress on the transmission. It's critical to make sure the transmission is fully in gear when it is running. It is recommended to keep a block under the gear handle to make sure the transmission does not inadvertently slip into neutral while running. (2) One of the gears shattered in the transmission when an operator set the brake before turning the motor off. The logging tool then screamed downhole and was barely caught in time.

- Sure-flex couplings can fail when they become too worn. The symptom is that the EPDM sleeve begins to slip within the sure-flex flanges resulting in a loud popping sound. This is not a catastrophic problem. But, it is time to replace the sure-flex sleeve before venturing further downhole where the stresses will be higher. This has not been a problem since the system was upgraded to larger sure-flex couplings. Still, at some point, the current sleeves will become worn enough that they should be replaced.
- Sometimes a logging tool will hang on a small ledge while logging downhole. If this is not noticed soon enough, it is possible for all the logging cable that is continuing to be spooled into the hole to build a 'bird's nest'. At this point, everything may be irretrievably stuck downhole. This can be avoided by diligently watching the cable tension to confirm the tool is advancing downhole. If the tool has indeed hung on a ledge, it's usually possible to 'fish' the tool past by bringing the tool back up above the ledge and trying again.
- If the motor inexplicitly stops while logging, it's almost always because the load cell has tripped the motor power. This will happen if the trip point in the cable tension readout is set too low. It can also happen if someone uses a radio too close to the load cell; this sends a spurious high tension value to the readout which then trips the power. Vehicle radios have tripped the load cell in the past, but handheld radios don't seem to be a problem. Just something to be aware of.
- The centralizers on some logging tools may cause the tool to spin when going down or up hole. This can twist all the wires inside the cable head causing it to fail. When this happens, the cable head will need to be rebuilt in the field.

The following spare parts and lubricants should be brought to the field to handle the most likely problems:

- Varidrive belt
- Sure-flex couplings
- Cable head o-rings
- Cable head
- Slip-ring connector
- Arctic grease (or equivalent)
- Transmission fluid
- Motor fluid

Depending on the situation, it might also be worth having a spare motor assembly and transmission available on-site.

12.0 AN2401 Cable Tension Readout

The readout is generally in the Normal Display Mode. To check or change the Setpoint load value:

- Enter the Display Menu by pressing D.
- Press D repeatedly to scroll through the Display Menu until Setpoint 1 is reached.

- Once Setpoint 1 is reached, use the > ^ arrows to select and increment digits.
- Continue to select until the rightmost digit is selected.
- Press E to enter value.
- Press X to exit menu.

To manually reset a Tripped Relay:

- The relay will trip if the load exceeds Setpoint 1. It will remain tripped until manually reset.
- Enter A to reset the tripped relay.
- Note that the relay will not untrip unless the load has dropped to less than Setpoint 1 - Hysteresis 1. For example, if S1 = 400 lbs and H1 = 40 lbs, the load must drop to 360 lbs to untrip.

13.0 CONTACTS

IEC Corporation
3100 Longhorn Blvd.
Austin, TX 78758
www.ieccorporation.com
512-836-0547

Interface Advanced Force Measurement
7401 E. Butherus Dr.
Scottsdale, AZ 85260
www.interfaceforce.com
480-948-5555

J & J Manufacturing
701 West 15th St
Long Beach, CA 90813
562-437-2131

Kennelly Research & Development
PO Box 2541
315 Peninsula Dr
Lake Almanor, CA 96137
530-596-4435

Mount Sopris Instruments
4975 East 41st Ave.
Denver, CO 80216
http://mountsopris.com
303-279-3211

Rochester Corporation
9450 Clarewood
Houston, TX 77036
www.rochestercables.com
713-981-8293

Rocket Seals
1297 South Lipan St.
Denver, CO 80223
www.rocketseals.com
303-777-7024

Turner Uni-Drive
3434 Terrace Street
Kansas City, MO 64111
www.turnerunidrive.com
800-637-7736

14.0 APPENDIX A

This section includes other potentially useful diagrams, including:

- Winch frame dimensions (Fig. 11).
- Logging Mode 1 schematic (Fig. 12).
- Logging Mode 2 schematic (Fig. 13).
- Logging cable specifications (Fig. 14).
- Electrical controls that shutoff the motor in the event of logging cable over-tension (Fig. 15).

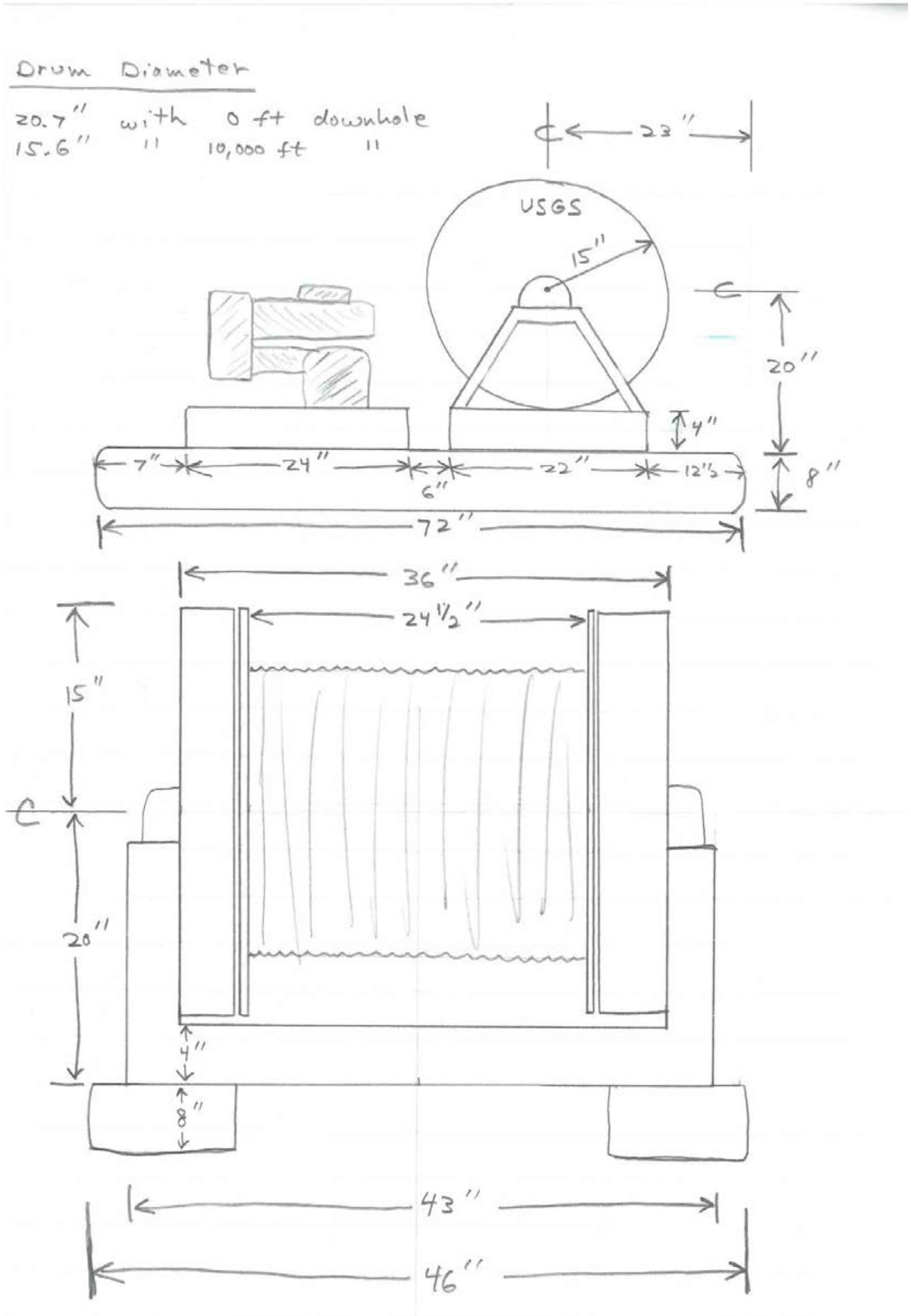

Figure 11. Frame dimensions.

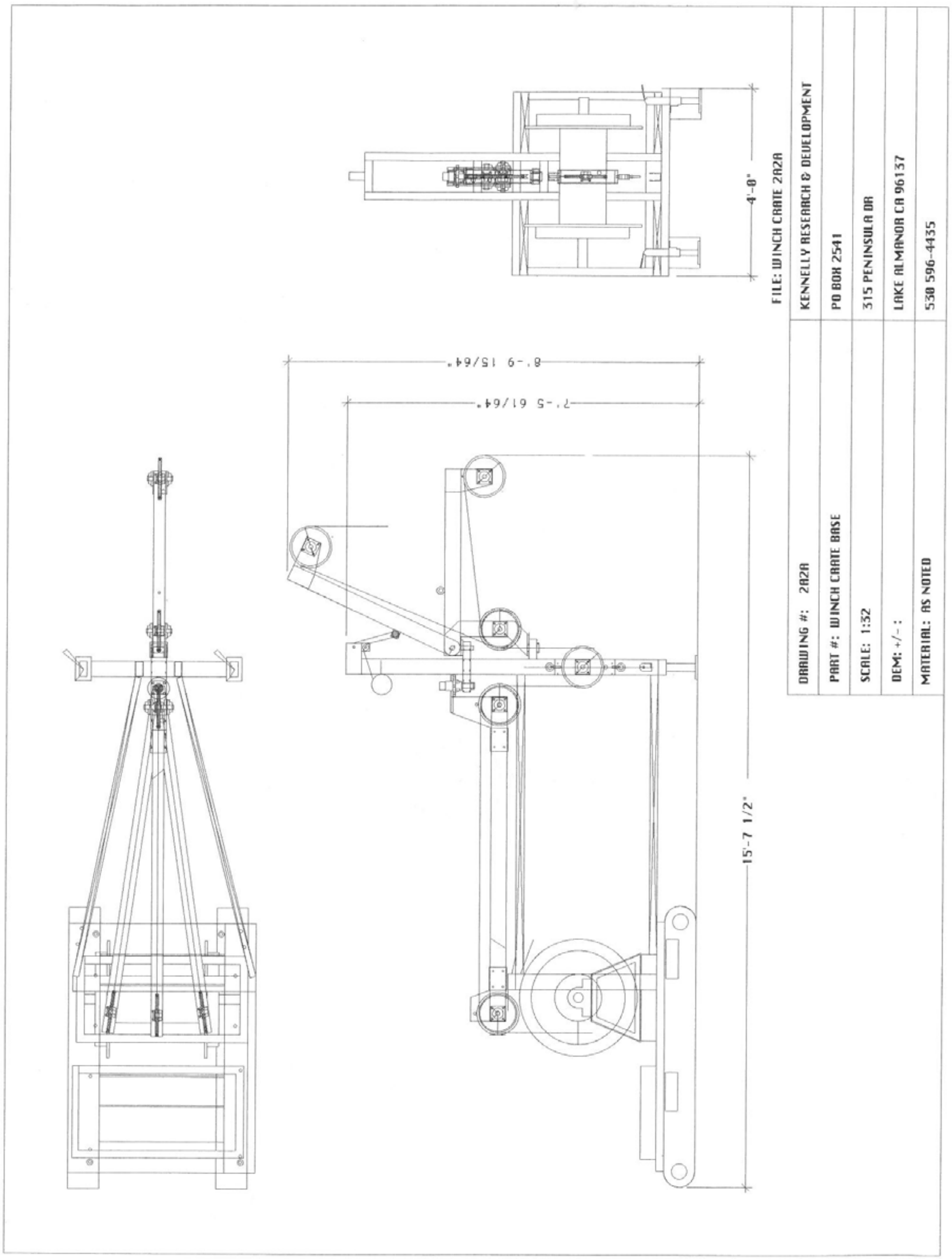

Figure 12. Logging Mode 1 schematic.

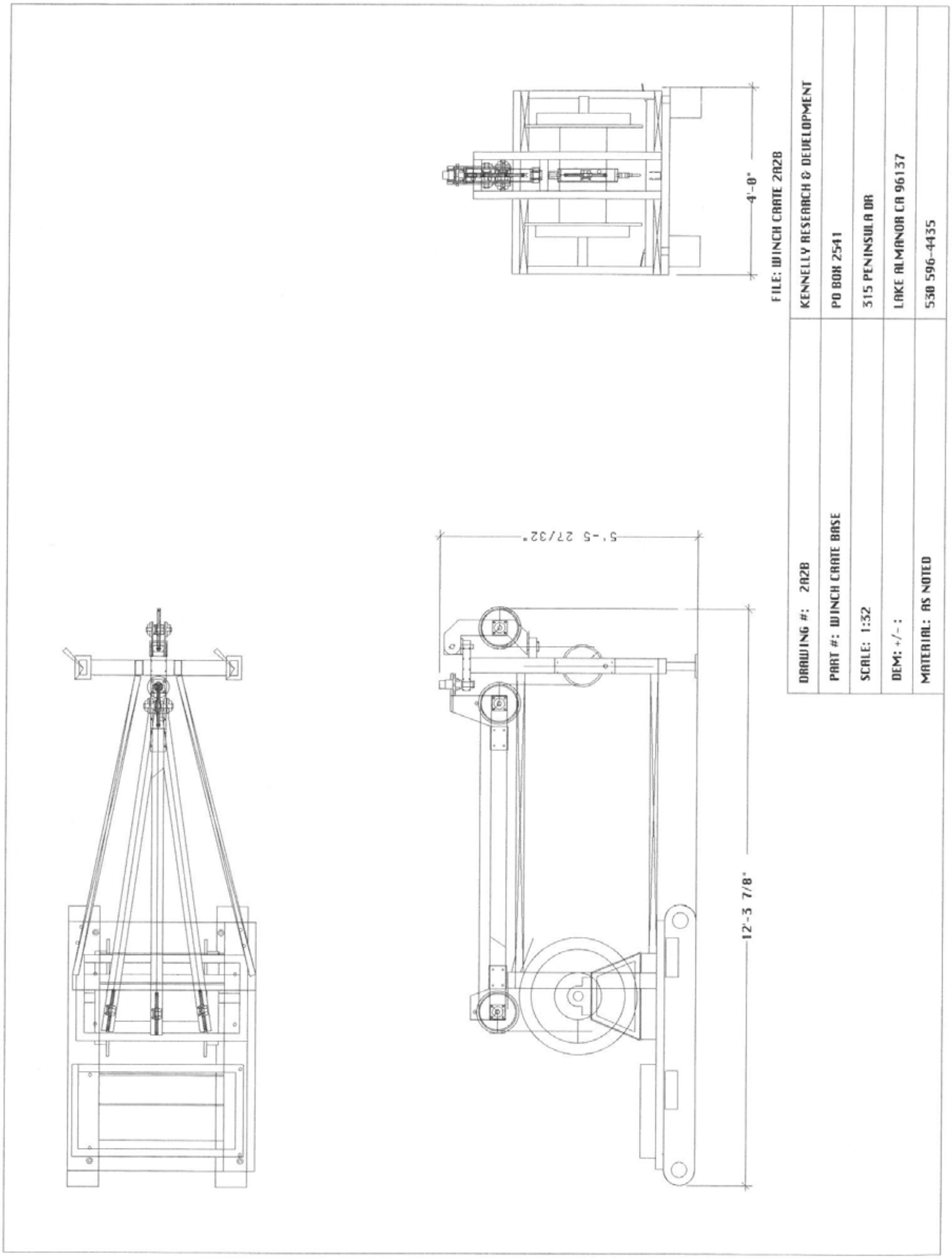

Figure 13. Logging Mode 2 schematic.

the ROCHESTER corporation

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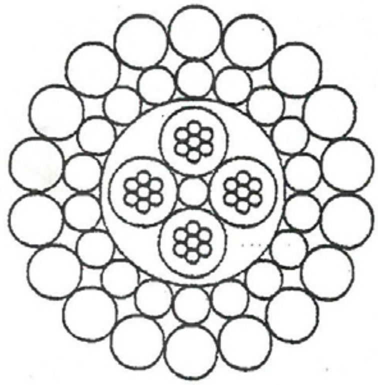
POST OFFICE BOX 312
CULPEPER, VIRGINIA 22701 U.S.A.

DATALINE

TELEPHONE 703/825-2111
TWX 710-839-3439



	(mm)	(in)
CONDUCTORS (4) #24 AWG, 7/.008" BCu	.61	.024
INSULATION .008" Wall PFA teflon	1.02	.040
CORE 4 insulated cdrs twisted with fillers as necessary. Protective bedding over core.	2.49	.098
ARMOR: Spec. Galv. IPS		
inner: 18/.0185" wire	3.43	.135
outer: 18/.0255" wire	4.72	.186

CHARACTERISTICS (All Values Nominal)	METRIC	ENGLISH
PHYSICAL		
Overall Dimensions	4.72 mm	.186"
Wt. in Air	92 kg/km	62 lb/kft
Wt. in Fresh Water	76 kg/km	51 lb/kft
Maximum Temperature	260 degrees C	500 degrees F
MECHANICAL		
Breaking Strength (minimum)	14.7 kN	3300 lbf
Working Load	5.9 kN	1300 lbf
Bend Diameter	25 cm	10 inches
Elongation (approx)	m/km/kN	ft/kft/klbf
	1.15	5.1
ELECTRICAL		
Voltage Rating	400 Vdc	400 Vdc
Insulation Resistance	Megohms.km	Megohms.kft
	15,000	50,000
dc Resistance @ 68 degrees F	Ohms/km	Ohms/kft
cdr	85.3	26.0
armor	23.0	7.0
Capacitance @ 1 kHz		
cdr-armor	157 pF/m	48 pF/ft
Velocity of Propagation @ 1 MHz	69%	69%

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CULPEPER, VIRGINIA 22701

TITLE: ROCHESTER STOCK TYPE 4-H-181K

DATE	SHEET	REVISION	NUMBER
03-27-87	1		A240188

TRC 206-3

Figure 14. Logging cable specifications.

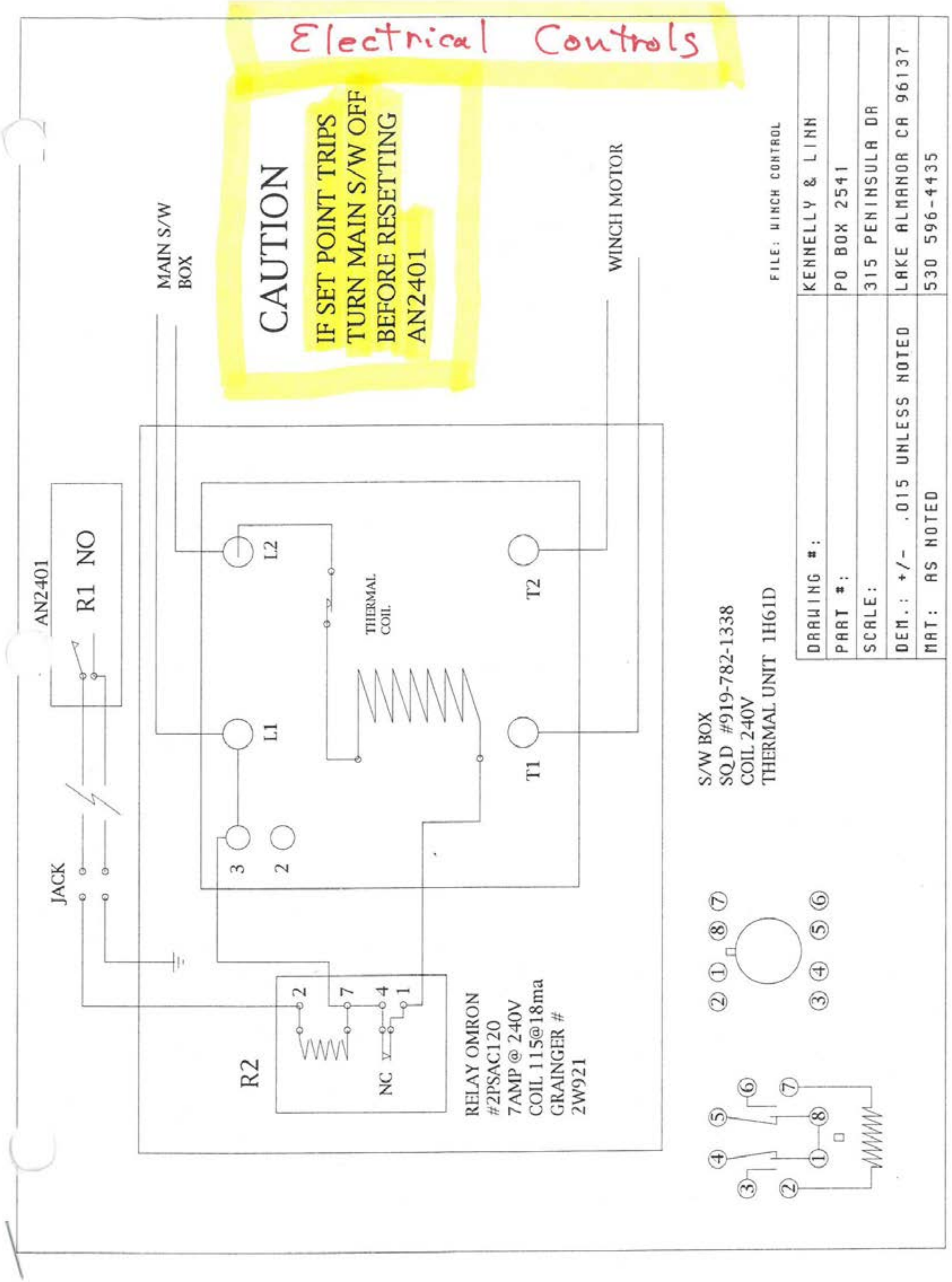

Figure 15. Schematic of the electrical controls that shut the motor off when the line tension exceeds a user preset value in the AN2401 cable tension readout

15.0 APPENDIX B

USGS Deep Logging Winch Safety Guide

All operators of the USGS Deep Logging Winch should read and understand the *USGS Deep Logging Winch Operations Manual* prior to operating this equipment and should understand the safety precautions described below.

A winch operator's primary duty is to ensure the safety of themselves and bystanders during winch operation.

Personal Protective Equipment (PPE)

- Skin PPE – Personnel will likely be working on snow-covered terrain that reflects much of the sun's rays. In many instances, field sites will experience 24 hours of daylight during the field season. Sunscreen should be used on any exposed skin and applied liberally and repeatedly throughout the day.
- Eyes PPE – Keep eyes covered with safety glasses that provide protection against UV light to prevent snow blindness or decline of eyesight.
- General PPE – Operators shall wear safety gloves and eye protection whenever there is the potential for injury while operating, handling or repairing any equipment.
- Cold weather PPE – When working in extreme cold, be aware of any exposed skin and the potential for frost bite. When handling fluids like alcohols or fuels, be aware that evaporative cooling will greatly exacerbate heat loss from skin and may result in instantaneous freezing of the skin and long term skin damage. Operators shall wear appropriate cold weather gear to protect skin from the environment.
- Back PPE – Lifting of cargo pieces on uneven, sloped, and soft surfaces may increase the chances for injury. Take time to place your footing solidly. Take time to move cargo slowly, carefully, and with good posture.

Mechanical Safety

- Make the working area around the winch assembly, where you will be standing and walking, safe by eliminating hazards such as uneven or inclined surfaces and by keeping all objects not related to the winch operations out of the immediate area; the operator must be able to remain comfortably within reach of the controls and must remain attentive any time the winch parts are in motion.
- There are several exposed moving parts on the winch. It is critical that all body parts and loose clothing are kept away from moving parts while the winch is in motion. Operators shall heed all warnings presented on safety labels affixed to the winch, Fig. 16.

Fig 16. USGS Logging Winch, Front/Right Side View.

Remain clear of all pinch points. Most likely locations are noted by safety labels, though care should be taken to avoid all moving or rotating parts.

Electrical Safety

- The USGS Logging Winch is an electro-mechanical system that uses 208-230 VAC, 50-60 Hz, single phase power. This system contains several electrical components, including, but not limited to a main power electrical box, a direction toggle switch box, a fuse box, and a dual power receptacle. These components are not waterproof and should be kept dry at all times. Operators shall heed all warnings presented on safety labels affixed to the winch.
- In most cases, the winch's electrical system is powered by an external generator. Operators shall abide by operational guidelines specific to the model and type of generator used.
- Ensure system grounding by using the 3-prong (grounded) plug to connect the winch to the source of electric power (generator, wall receptacle, etc.) at all times. There are opportunities for the human body to become part of the electrical circuit even without the presence of an electrical ground. Glacier ice and melt water are good electrical insulators, that is, they are poor conductors of electricity; this is because of the high degree of purity of the ice and water. This being the case, establishing a true electrical ground is not possible.
- Normally, all electrical conductors are protected from exposure to prevent accidental contact. However, when servicing any part of the electrical circuitry, you must first unplug the winch from the power supply (e.g. generator or wall outlet).

Always lock out and tag out any electrical components before servicing them.

Chemical and Fire Safety

- Drilling/anti-freeze fluid hazard – If the winch will come into contact with alcohols or drilling fluids during operations, operators should be aware of the potential hazards, including, but not limited to fluid volatility and buildup of fumes that may create a fire hazard. CAUTION: alcohol fires burn invisibly; handle alcohol away from any ignition source, such as electrical switches. Evaporation of alcohol from skin can expedite frostbite, thus extreme care should be taken when handling alcohols.
- Gasoline hazard – Keep gasoline away from ignition sources. Always shut off the generator before fueling it. Promptly clean up any spills before re-starting or allow time for evaporation. Take care to keep gasoline off of your clothing; some of the volatile components can absorb through your skin and can be a skin irritant.