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STILETTO MAST SYSTEM
INSTALLATION, OPERATION & MAINTENANCE MANUAL

INCLUDING THE FOLLOWING OPTIONS:

INTERMEDIATE SENSING KIT

And
HAND-HELD REMOTE CONTROL

And
90° GEAR DRIVE

And
STILETTO CONTROL
P/N 4086801

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SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

SHOCK HAZARD

Observe general safety precautions for handling equipment using high voltage. Always disconnect power before performing repair or test operations.

HEALTH AND SAFETY HAZARD

Solvent used to clean parts is potentially dangerous. Avoid inhalation of fumes and also prolonged contact to skin.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery, United States Navy.

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⚠ WARNING

A WARNING is used to call your attention to a potentially hazardous situation, which, if not avoided could result in death or serious injury.

⚠ CAUTION

A CAUTION is used to call your attention to a potentially hazardous situation, which, if not avoided, may result in minor to moderate injury and/or property damage.

The following warnings appear in the text and are repeated here for emphasis.

⚠ WARNING

Do not operate the mast system until you have made certain that the area of operation is free of overhead power lines and other unwanted sources of electricity.

⚠ WARNING

Death or serious injury could occur if alcohol is not handled carefully. Use it in a well-ventilated area away from open flame, arcing equipment, ignition sources, heaters or excessive heat. Always store alcohol in a properly marked container. Do not smoke.

⚠ WARNING

Do not move the mast while it is being raised. This applies especially to vehicle mounted masts.

⚠ WARNING

Do not move the mast once it has been extended. This applies especially to vehicle mounted masts.

⚠ WARNING

Make sure there is adequate clearance above the mast system before applying power and operating the system.

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⚠ WARNING

At all times prior to system operation you should insure that:

- The mast extension path is free of personnel and mechanical obstruction.
- All electrical cables are undamaged and properly terminated.
- The control is receiving proper voltage and current.
- The payload is properly installed.
- Any transit tie-downs on the payload have been removed.
- The mast base is not moving.
- The area above the mast is free of mechanical obstructions. Striking an overhead obstruction can damage the mast and leave it partially extended. It can also damage the payload.
- Ensure the area above the mast is free of electrical wires. Operator death may occur by extending the mast into power lines.
- Coaxial and payload control cables are not tangled and that they are free to pay out as the mast is extended.

⚠ WARNING

Deviation from standard operating conditions could cause mast failure.

⚠ WARNING

Use care when manually extending or retracting the mast tubes because the normal stops and protections are being bypassed.

⚠ WARNING

Voltage may be present which can cause severe electrical shock. Always ensure that all electrical circuits to the mast are de-energized and properly tagged during manual operation.

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⚠ WARNING

This Stiletto Mast System is supplied with a friction slip clutch to prevent serious damage to the mast in the event of a jam. There is no way to detect the action of the slip clutch other than operator observation. When the clutch begins to slip, that is, when the motor is running and the mast is neither extending nor retracting, release the extend/retract toggle switch immediately to avoid overheating the clutch.

⚠ WARNING

Always turn off power before servicing the mast system.

⚠ WARNING

Make sure all personnel stay clear of the mast and the direction of travel in which it is pointed.

⚠ CAUTION

Only trained and qualified personnel should install, use and service this equipment.

⚠ CAUTION

Before performing maintenance or repair, make sure that the Stiletto Mast System is level and secure. Injury to personnel or damage to equipment could occur if the Stiletto Mast System tips over.

⚠ CAUTION

Any attempt to electrically energize the Stiletto Mast System when manually operating the mast may result in injury. Always ensure that all electrical circuits to the mast are de-energized and properly tagged to prevent injury during manual operations.

⚠ CAUTION

An external 15 Amp Time Delay fuse (FNM-15) must be installed must be installed between the control box and the customers power supply. Excessive current can damage the control box. Reversed polarity power leads will damage the control box.

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INTRODUCTION

SAFETY PRECAUTIONS

Refer to the Safety Summary for precautions to be observed while operating or servicing this equipment.

INTRODUCTION

This manual covers the operation, maintenance, troubleshooting and installation instructions for the Stiletto Mast System. The Stiletto Mast System consists of a control system, telescoping mast, 28 VDC drive unit, support bracket assembly, assorted cables, hardware, an intermediate height readout option, a handheld remote control option and a 90° gear drive option.

DESCRIPTION

1.3.1 Control System

The control system combines customer input, power input, sensor input and power output to allow the customer to raise and lower the mast without running past sensor limits. It also keeps track of cycles to aid in preventative maintenance, and has some self-diagnosing capability. It is housed in a NEMA 4X box. The control system also includes fully extended and nested sensors that mount on the mast. It includes an eight digit, IR secure, green LED display which displays status, error codes and intermediate heights.

1.3.2 Telescoping Mast

The telescoping mast provides the structure that supports the payload. It consists of (9) concentric carbon epoxy composite tubes. Each tube has two internal keys that match with keyways on the adjacent tube to establish azimuth integrity.

1.3.3 28 VDC Drive Unit

The Screw Drive Stiletto Mast has an ACME screw located in the center of the telescoping mast. As the screw rotates it sequentially lifts up the mast sections. Each moving mast section (all but the base tube) has an ACME nut attached to its bottom. The drive unit extends and retracts the telescoping mast in response to either input from the control system, or by manually cranking the drive. Under powered operation the motor is dynamically braked for a short period of time at the end of each motion. The system has sufficient internal friction to keep the mast extended at any desired height when not powered.

1.3.4 Support Bracket Assembly

The support bracket assembly attaches to the telescoping mast and to the customer's vehicle or structure. Along with the mounting holes in the base of the drive it is an essential part of the mounting of the Stiletto Mast System.

1.3.5 Assorted Cables

Two cables, one for power and one for signals, are permanently attached to the 28 VDC Drive Unit. They have a length of 3 meters, and have MS screw type connectors to attach to the bottom of the control system box.

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1.3.6 Hardware

Hardware includes nuts and bolts for the support bracket assembly, a grease gun and a manual crank handle.

1.3.7 Intermediate Height Readout

The intermediate height readout utilizes a proximity sensor that reads the drive sprocket and converts the reading into an extension height of the mast. The readout (in either feet or meters) is incorporated into the control system display. When the mast is fully extended the control box display will read, “DEPLOYED”, and when the mast is nested the control box will read, “NESTED”.

1.3.8 90° Gear Drive Variant

The Will-Burt Company offers variants of its standard models with a 90° gear drive installed on the manual crank point. This allows the user to access the manual crank point from the side or the rear rather than from above. The 90° gear drive should only be used for manual extension and retraction in the event of an electrical power loss. Damage to the 90° gear drive could result from trying to input too much torque by hand, such as breaking through ice, or other similar high torque applications.

1.3.9 Hand Held Remote Control Option

This option consists of a small NEMA 4X box containing a switch that will raise and lower the mast. It includes an extension cable with a MS screw connector that screws into the bottom of the control box. In addition to the control switch there are three indicator lights that indicate the status of the Stiletto Mast System; nested, partially deployed and deployed.

1.3.10 PC Interface

A Personal Computer Interface is an option for controlling the mast height. Standard functions include controls for raising, lowering, stowing and stopping the mast. Additional operational functions include the ability to move the mast to a desired height and to monitor the various mast parameters and limit switch inputs in real time.

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REFERENCE DATA

Reference data for the Stiletto Mast System is given in Table 1-1.

Table 1-1 Reference Data

Functional Characteristic	4 Meter	6 Meter	10 Meter	15 Meter
Mast System Weight (mast control box, cables, bracket)	190 lbs	203 lbs.	246 lbs.	300 lbs
Fully Nested Height	39”, +1, -0	46”, +1, -0	67”, +1, -0	94.5”, +1, -0
Fully Extended Height	165”, +2, -0	228”, +2, -0	394”, +2, -0	590.5”, +4, -0
Maximum Payload	200 lbs.	200 lbs.	175 lbs.	125 lbs.
Extension Time (28 VDC)	<90 sec.	<120 sec.	<200 sec.	<330 sec.
Extension Time (18.1 VDC)	<135 sec.	<180 sec.	<300 sec.	<500 sec.
Operating Voltage Range	18.1-33 VDC	18.1-33 VDC	18.1-33 VDC	18.1-33 VDC
Max Tilt from Vertical	10°	10°	10°	5°
Operational Wind Speed	Consult Factory	Consult Factory	Consult Factory	Consult Factory
Survival Wind Speed	Consult Factory	Consult Factory	Consult Factory	Consult Factory
*Current Draw, 125 lb Payload at 28 V	10A	10A	10A	10A
Inrush Current	120A	120A	120A	120A
Typical Ice Breaking Operating Current	30A-40A	30A-40A	30A-40A	30A-40A

* For proper operation under full load conditions, power supply must maintain 18.1 Volts at control, at up to 60 Amps for 2 second intervals and 40 Amps continuous. If voltage drops below 5 Volts at any time, damage to the control may occur.

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CHAPTER 2-INSTALLATION

2.1 INTRODUCTION

This section provides instructions for installing the Stiletto Mast System.

2.2 INSTALLATION

2.2.1 Mast

2.2.1.1 Refer to the top level assembly drawing supplied with your mast. Match holes for the base of the mast and for the support bracket, and create mounting places in the host site. The mast should be as plumb as possible. Make sure the installation site does not interfere with the cables.

2.2.1.2 Note that there are (14) drain holes (3/8" diameter, quantity 13; 7/16" diameter, quantity 1) on the bottom of the mast to drain off rain water and condensation. Refer to drawing B-54878, Stiletto Drain Hole Locations, in your reference drawings. The surface to which the base of the mast bolts must allow for drainage.

2.2.1.3 Bolt the mast into place. Mount the support bracket using customer supplied 3/8 inch diameter or M10 stainless steel fasteners with a stainless steel flat washer and means to prevent loosening. Secure the base of the mast with customer supplied ½ inch diameter or M12 stainless steel fasteners with a heavy duty extra thick (MS 15795-819) stainless steel flat washer and means to prevent loosening.

2.2.2 Controls

2.2.2.1 Refer to Drawing 40868 located in Section 5.2, Reference Drawings, for the hole pattern of the control. Use either ¼ inch diameter or M6 stainless steel fasteners and means to prevent loosening.

2.2.2.2 Refer to Drawing 40868, sheet 1 and 3, located in Section 5, Reference Drawings for the location of the connector for the user supplied power. This mast system is designed to operate on 28 VDC power per MIL-STD 1275. The mast system does NOT have a master power switch. If such a switch is desired the integrator must provide it with the supplied power. An external 15 Amp Time Delay (FNM-15) fuse must be installed by the customer.

2.2.3 Power Cable Requirements

2.2.3.1 The unit requires a customer supplied 12 gauge power cable. With long cable runs, a heavier gauge wire may be needed. Power is applied through a supplied MS3106E20-16S connector or equivalent.

2.2.3.2 The control has three handshaking features detailed in section 3.2.1.5. They are:

1. A precondition contact closure,
2. A fully nested enable circuit,
3. A full extended enable circuit.

These circuits use the power connector 000013-409-001 to connect with the world. Of immediate concern is the precondition contact closure. For the mast to operate this closure must be made either with a purposeful switch OR WITH A JUMPER. See Sheet 3 of Drawing 40868, Stiletto Control Box. Any jumper must be part of the cable because the control box is sealed for warranty purposes.

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CHAPTER 3- OPERATING THE MAST

3.1 INTRODUCTION

This chapter of the Stiletto Mast System manual will cover the following topics:

a. A description of the control with reference to its workings and capabilities.

b. A discussion of the Human-Machine interface with the controls, describing the up/down switch and the display.

c. A discussion of the optional Intermediate Height Readout and the optional Hand Held Remote Control.

d. Instructions in the normal (powered) operation of the mast system.

e. Instructions in manual operation of the mast system using the hand crank. Included is a discussion of the 90° Gear Drive variant.

f. A review of the ERROR MESSAGES of Table 3-1 available in the control.

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3.2 DISCUSSION ON THE CONTROL

⚠ WARNING

At all times prior to system operation you should insure that:

- The mast extension path is free of personnel and mechanical obstruction.
- All electrical cables are undamaged and properly terminated.
- The control is receiving proper voltage and current.
- The payload is properly installed.
- Any transit tie-downs on the payload have been removed.
- The mast is not moving.
- The area above the mast is free of mechanical obstructions. Striking an overhead obstruction can damage the mast and leave it partially extended. It can also damage the payload.
- Ensure the area above the mast is free of electrical wires. Operator death may occur by extending the mast into power lines.
- Coaxial and payload control cables are not tangled and that they are free to pay out as the mast is extended.

3.2.1 Description of Controls

3.2.1.1 Enclosure - The controls are contained in an aluminum NEMA 4X box. Please refer to drawings 40868 in the reference section for its size and for the location of the mounting holes. The box contains the screw bulkhead connectors for the signal and power cables from the mast, for the cable for the optional hand held remote, and for the customer-supplied power and handshake signals. It also contains an up/down switch and an 8-character alphanumeric display.

⚠ WARNING

Deviation from standard operating conditions could cause mast failure.

3.2.1.2 MOSFETS – The control box uses MOSFETS for electrical switching purposes. The main function of the control is to manage motor direction and to dynamically brake the motor for a short period of time at the end of each motion. The motor draws about 10 Amperes continuously and about 120 Amperes on start-up under “normal” conditions (See Table 1-1). However, to ensure proper operation under high load and/or icing conditions, a minimum 18.1 Volt supply voltage must be maintained at the control at up to 60 Amps for 2 second intervals and 40 Amps continuous.

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⚠ CAUTION

Damage to the controls may occur if voltage drops below 5 Volts during operation of the mast.

3.2.1.3 Sensors - The control relies upon two limit sensors attached to the mast. The fully nested sensor is a mechanical limit switch, which is triggered when a probe attached to the bottom of the center tube hits the lever on the switch. The full extension sensor is a reed switch attached to the outside of the base tube which detects the approach of a permanent magnet attached to the bottom of the largest moving tube. A proximity sensor is used to determine the height readout of the mast sections during deployment and retraction. The mast height is displayed on the control box.

3.2.1.4 Capabilities - The control allows for the powered extension and retraction of the Stiletto Mast System. It uses the input from two extreme limit switches to prevent the user from over-extending or over-nesting the mast. When a directional command is terminated, the control automatically shorts the motor leads to dynamically brake the motor for a short period of time. The control is wired for an optional handheld remote control. The alphanumeric display shows status of the mast (nested, intermediate height readout and fully deployed), the number of cycles on the mast and any error messages.

3.2.1.5 Handshaking - The control (see drawing 40868) has three handshake signals. The first is an input for a hatch switch or other pre-condition contact closure. An open circuit will cause the control to display its software revision and will inhibit extension. This input must be driven by an isolated contact closure capable of handling 20 milliamperes at 28 volts. The second signal is for a remote enable output. This is an isolated relay contact that closes when the mast is fully nested. This could be used to prevent an external operation unless the mast is fully nested. The third signal is an isolated relay contact that closes when the mast is fully extended. These contacts are rated for 1 Ampere at 28 VDC.

3.2.1.6 Intermediate Height Readout - This mast is supplied with intermediate height readout. It consists of a proximity sensor that reads the drive sprocket and converts the reading into an extension height of the mast. The readout in the control display window is zeroed out at the nested height. If the mast is never nested, because of a saddle type mounting system, then the displayed height will compound in error the more times the mast is extended. In metric mode the display reads “XX.XX M” where XX.XX is the extension of the mast in meters. The resolution is .01 meters and the accuracy is ± .02 meters. In English mode the display reads “XX.XX F” where XX.XX is the extension of the mast in feet. The resolution is .01 feet and the accuracy is ± .05 feet. As the mast extends, the display shows the extension rather than enunciating “PARTIAL”. Remember, extended height equals extension PLUS the nested height.

3.2.2 Human-Machine Interface

3.2.2.1 On the side of the main control box is an SPDT (Mom-Off-Mom) toggle switch that is used by the operator for raising or lowering the mast. The switch is protected by a switch guard and a waterproof boot.

3.2.2.2 On front of the control box is an eight character green LED alphanumeric display. This shows the status of the mast, either NESTED, intermediate height, or fully DEPLOYED. With the intermediate height readout gives the extension of the mast in at a height above the nested height. It can also give the number of cycles on the mast, and a variety of error messages.

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⚠ WARNING

At all times prior to system operation insure that:

- The mast area is free of personnel and mechanical obstruction.
- All electrical cables are undamaged and properly terminated.
- A power source capable of delivering specified system voltage and current has been properly connected to the Control Enclosure.

3.2.3 Options

3.2.3.1 Hand Held Remote - This mast may be supplied with a hand held remote control (See Drawing B-3766). It consists of a small NEMA 4X box that contains an SPDT (Mom-Off-Mom) toggle switch that is used by the operator for raising or lowering the mast. This switch is protected by a switch guard and a waterproof boot. It also has three red LED indicators that light appropriately when the mast is fully nested, partially extended or fully deployed. They backlight appropriate text to enunciate these messages. The hand held remote does NOT have an alphanumeric readout displaying extended height. The hand held remote control attaches via an extension cable to a bulkhead connector on the bottom of the control box.

3.3 POWERED OPERATION

3.3.1 Turn System On

The mast control does not have a master power switch. The operator powers up the system at the level of the vehicle or shelter by supplying power to the proper contacts on the control box connector. If desired, the integrator can provide a master power switch upstream from the mast system. The control will generate a sign-on message of “STILETTO” at power up for a short period of time, and finally will display NESTED, intermediate height, DEPLOYED or some error code as appropriate.

3.3.2 Raise the Mast (Standard)

Place the Mast UP / DOWN switch in the UP position. As long as the switch is held in the UP position the mast will raise. If the switch is engaged long enough, the mast will automatically stop when the full extension limit switch is made. At that point the alphanumeric display will say DEPLOYED. If the UP / DOWN switch is released before the maximum extension the mast will quickly stop, and the alphanumeric display will say display the intermediate height.

3.3.3 Lower the Mast (Standard)

Place the Mast UP / DOWN switch in the DOWN position. As long as the switch is held in the DOWN position the mast will continue to lower. If the switch is engaged long enough the mast will automatically stop when the full nested limit switch is made. At that point the alphanumeric display will say NESTED. If the UP / DOWN switch is released before nesting the mast will quickly stop, and the alphanumeric display will display the intermediate height.

3.3.4 Access the Number of Cycles

When the mast is nested releasing the toggle switch and then reapplying the toggle switch in the DOWN direction will cause the control to display the number of cycles on the mast.

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3.4 MANUAL OPERATION

3.4.1 Normal Operations

This mast may be raised or lowered manually. Refer to your top level assembly drawing to find the square end shaft on the drive unit that is the manual input point. Use the hand crank provided to raise (clockwise) or to lower (counter-clockwise) the mast. When the mast is not powered the motor leads are not shorted together thus disabling dynamic braking. The normal limit switches are not in effect during manual operation. There are mechanical hard stops just beyond both the upper and lower limit switch locations that will stop the mast safely. Nevertheless, it is good practice to stop the mast at the normal positions.

3.4.2 The 90° Gear Drive Option

The manual input point can normally only be accessed from above. The Will-Burt Company offers a 90 degree gear box variant which bolts onto the manual input point and provides an identical ½ inch square interface to the hand crank. This variant can be oriented either to the side or to the rear per customer instruction. The operation is identical to 3.4.1. The 90° gear drive should only be used for manual extension and retraction in the event of an electrical power loss. Damage to the 90° gear drive could result from trying to input too much torque by hand, such as breaking through ice, or other similar high torque applications.

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3.5 ERROR MESSAGES

There are two error messages. Error messages and their meaning are shown in Table 3-1.

Table 3-1 Error Messages

Code	Meaning
“CONFLICT”	Conflicting requests between the local UP / DOWN and the remote UP / DOWN switches have occurred. The mast will come to a stop, and normal operation will resume when at least one of the switches is returned to the “OFF” position.
“L.S. ERR”	Both the Upper and Lower limit switches are open, indicating the impossible state of being fully extended and fully nested at the same time. The fault can only be cleared by turning off the control and correcting the problem. This will most often mean that there is a broken wire connection, one of the limit switches is defective, or the sensor cable is disconnected.

3.6 OPERATOR MAINTENANCE

Specific to the control system, only nominal routine maintenance is required. Refer to the mast operations manual for detailed mechanical maintenance requirements. On a routine basis—WEEKLY—perform the following:

a. Insure that all mounting fasteners are tight, particularly on the motor.
b. Insure that all cable connections are snug.
c. Inspect all cables for frayed and damaged wiring.
d. Using a soft, non-abrasive cloth, wipe the bezel clean on the alphanumeric display.
e. Refrain from applying a stream or high pressure water directly to the control box.

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CHAPTER 4- MAINTENANCE AND SERVICE INSTRUCTIONS

4.1 GENERAL

Preventive Maintenance Checks and Services (PMCS) means systematic care, inspection and servicing of equipment to keep the system in good condition and to prevent breakdowns. When received for maintenance, the assembly has been removed from the site on which it was mounted and is otherwise fully assembled. Removal typically requires disconnecting the power and signal cables from the mast control box, removal of the mast payload, removal of the mast support bracket assembly and removal of the mounting screws from the base plate. Consult vehicle manual for specific installation details. All procedures must be performed by trained personnel only. The Will-Burt Company recommends that the owner create and maintain a maintenance log for each mast.

4.1.1 Schedule.

4.1.1.1 The Preventative Maintenance Schedule provided in Table 4-1 lists inspections and care required to keep the Stiletto Mast System in good operating condition.

4.1.1.2 The Interval column specifies when to do a certain check or service.

4.1.1.3 The Procedure column specifies how to do the required checks or services or refers to a specific procedure. Follow these instructions carefully.

4.1.1.4 The Not Fully Mission Capable If: column lists when the Stiletto Mast System is non-mission capable and why it cannot be used.

4.1.1.5 If the Stiletto Mast System does not perform as required, see section 4.3 Troubleshooting.

4.1.1.6 If anything looks wrong and cannot be diagnosed and/or fixed, the Mast System should be taken to the next higher level maintenance facility or returned to the Will-Burt Company for disposition.

4.1.1.7 Record all inspection and maintenance activities in the mast system's maintenance record log. When doing PMCS, several soft, clean rags will always be required. The following are common procedures and checks:

a. Keep it clean. Dirt, grease, oil and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use denatured alcohol on all metal surfaces. Use water when cleaning rubber or plastic material. Use soap and water when cleaning the mast tube's exterior surfaces.

b. Rust and Corrosion. Check for rust and corrosion. If any bare metal or corrosion exists, remove it with a wire brush and repair with touchup paint.

c. Bolts, Nuts and Screws. Check for obvious looseness, missing, bent or broken condition. It is not practical to check all hardware installation torques, but look for chipped paint, bare metal or rust around bolt heads. If you find a bolt, nut or screw that is loose, tighten it.

d. Electric Wires and Connectors. Look for cracked, frayed or broken insulation, bare wires and loose or broken connectors. Replace as required. Tighten loose connectors.

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Table 4-1 Preventive Maintenance Schedule

Item No.	Interval	Location/Item to Check	Procedure	Not Fully Mission Capable if:
1	During operation	Base of Mast Tube Assemblies	During extension and retraction of the mast and antenna, observe the outer surface of the tubes for damage and accumulation of foreign material.	Tubes are damaged
2	Weekly	Mast Exterior Surfaces	Visually check for foreign material, damage or obstructions. Remove any foreign material or obstructions as necessary.	
3	Weekly	Mast Exterior Coating	Check condition of coating. Coating shall be in good condition with no bare metal or composite material exposed.	
4	Weekly	Mast Exterior Fasteners	Visually check that all fasteners are tight. Pay special attention to those attaching the Stiletto Mast System to the site, the mast to the drive unit, the motor to the drive unit, and the payload to the mast.	Loose fasteners joining major components cannot be tightened.
5	Weekly	Mast Exterior Operation	During extension and retraction of the mast, observe the mast operation for evidence of binding.	Binding is observed.
6	Weekly	Cycle Counter	Check that counter is operating properly by noting that during initial cycle of the mast the counter increases by one. Refer to paragraph 3.3.6 for cycle counter operation.	
7	Weekly	Cables and Bulkhead Connectors	Check that connectors are clean, pins are undamaged, and threads are in good condition. Check for looseness and damage to insulation.	Connector is damaged too severely to mate with corresponding cables.
8	Weekly	Mast Top Mounting Adapter	Check that plate is firmly attached to top tube assembly, threaded holes are in good condition, and no damage has penetrated anodization. Replace damaged adapter plate or tighten to composite top tube as required.	Plate is loose or threaded inserts are missing or damaged.
9	Weekly	Mast Exterior Surfaces	Check all visible surfaces of the mast for damage, especially cracking. Pay particular attention to the base of the mast.	Cracks are visible in mast composite material.
10	250 Cycles	Lube port on side of mast	See paragraph 4.2.2 “Lubricating the ACME Screw”	Mast will not work.
11	500 Cycles	Base of Mast Drive Unit	See paragraph 4.2.1 “External Lubrication”	Mast will not work.
12	2500 Cycles	Replacement of Nuts	Special Training Requirements. Contact Will-Burt Co. for details about factory training and/or factory rebuild.	Mast will not work.
13	10,000 Cycles	Mast	Return for complete factory overall and rebuild.	N. A.

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4.1.2 Expendable and Durable Items Required. Table 4-2 lists the expendable and durable items required to perform preventive maintenance on the Stiletto Mast System.

Table 4-2 Expendable and Durable Items Required

Item No.	Item Name, Description, Part Number	U/M
1	Alcohol, denatured	OZ
2	Lubricant, Drive Screw, Will-Burt P/N 912542	OZ
3	Oil, engine, SAE 30 (preferred) or 15W40	QT
4	Rags, wiping, clean	EA

4.2 MAINTENANCE INSTRUCTIONS

4.2.1.1 External Lubrication

Refer to Table 4-1 and perform the following procedure every 500 cycles.

a. Remove protective cap over manual drive shaft. (See Figure 4-1-1)

b. Using an oil can or eye dropper, apply 3 to 5 drops of SAE 30 (preferred) or 15W40 engine oil (Item 3, Table 4.2) to bushing supporting the manual drive shaft.

c. Wipe off excess oil. Replace protective cap.

4.2.1.2 External Lubrication – 90 degree Manual Crank Input Gear Box (if Applicable-Optional)

Refer to Table 4-1 and perform the following procedure every 500 cycles.

a. Remove the four #8-32 X ¾ SHCS, SSTL bolts attaching the 90 degree gear box to the upper tension slider. (see Figure 4-1-2 and 4-1-3)
b. Remove the 90 degree gear box from the upper tension slider. (see Figure 4-1-3)
c. Use a clean screw driver or punch to pack drive screw lubricant part number 912542 into the driven hollow shaft. Fill the cavity between the driven hollow shaft and the bearing plug with lubricant completely. (see Figure 4-1-3)
d. Wipe off excess lubricant before assembly, and ensure that the hollow shaft keyway is not packed with lubricant to allow clearance for the 90 degree gear box shaft to fit.
e. Replace the 90 degree gear box onto the upper tension slider, and check for alignment of the bolt holes. Also, check that the gear motor keyway is aligned in the driven hollow shaft. (see Figure 4-1-3)
f. Apply Loctite 242 and tighten the four #8-32 X ¾ bolts.

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Figure 4-1-1 Lubrication Point on Mast Drive

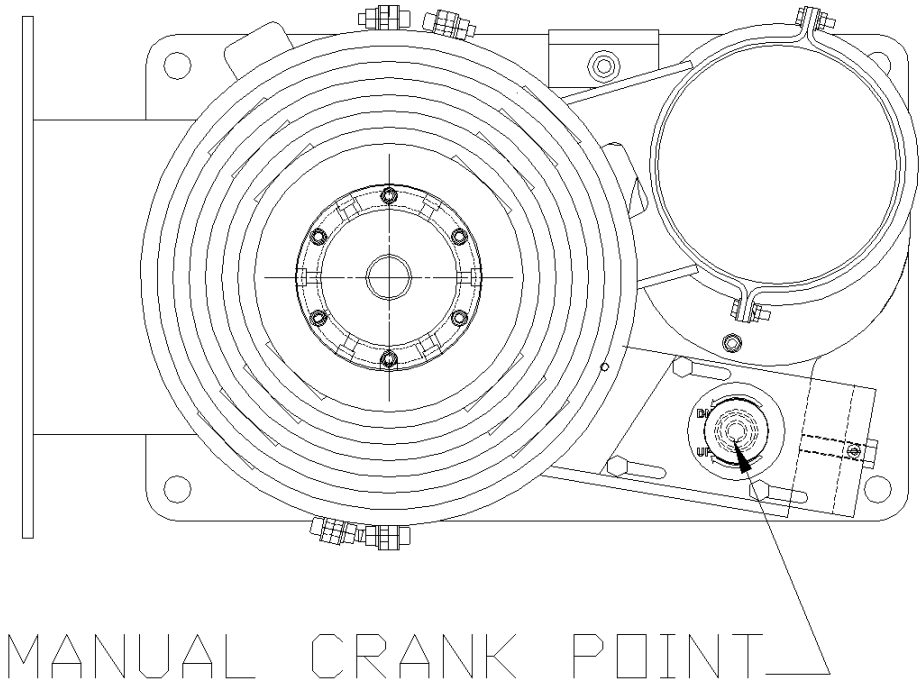
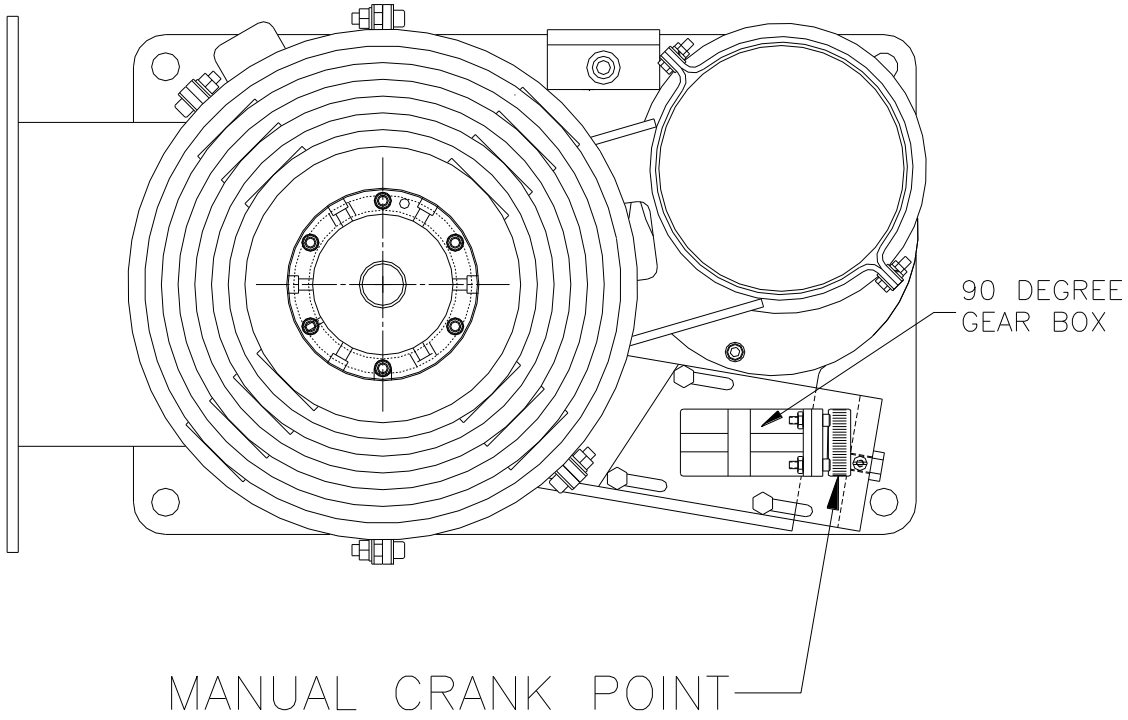
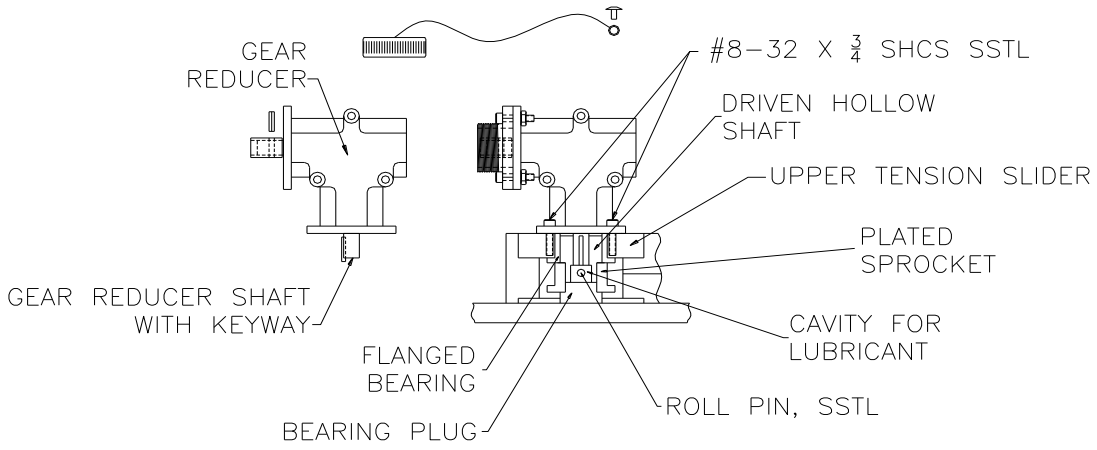


Figure 4-1-2 Lubrication Point on Mast Drive-90 degree Manual Crank Input Gear Box (if Applicable)



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Figure 4-1-3, Manual Crank Input Gear Box Assembly



4.2.2 Lubricating the ACME Screw. Refer to Figure 4.2 and perform the following procedure every 250 cycles.

a. Charge the Grease Gun Assembly (Item No. 912541), supplied with each mast, with a cartridge of Drive Screw Lubricant, Will-Burt part number 912542, ordered separately.

⚠ CAUTION

Do not substitute any grease for the Will-Burt Drive Screw Lubricant, 912542. This is a super-premium aerospace grade product, and is required for specified performance and life.

⚠ WARNING

Before performing maintenance or repair, make sure that the Stiletto Mast System is level and secure. Injury to personnel or damage to equipment could occur if the Stiletto Mast System tips over.

b. Extend the mast completely.

c. Remove the hex shaped plug from the grease port about 16 inches up on the side of the mast base tube. See Figure 4-2.

d. Remove the hydraulic coupling (cap) from the output tube of the grease gun assembly. Insert the tube through the access hole and apply a generous dab of grease onto the screw. Jog the mast about ½ inch (one half revolution of the screw) and apply another generous dab.

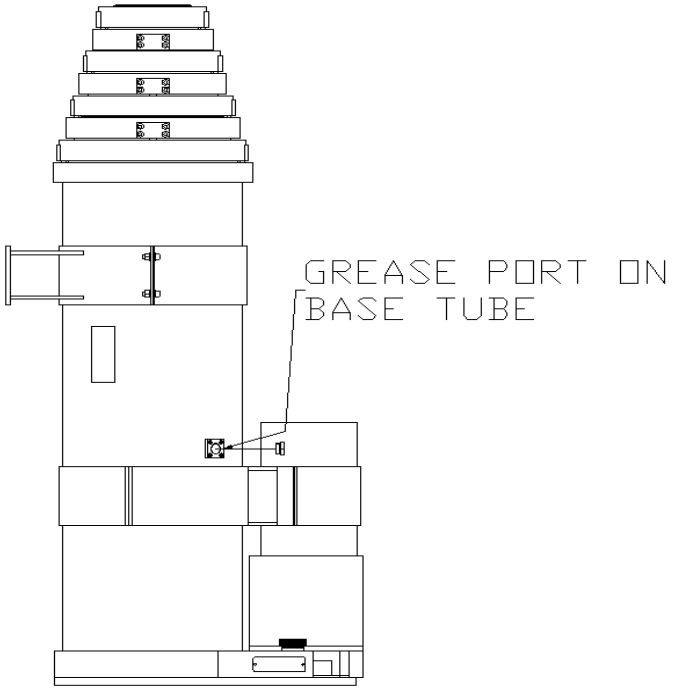
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e. Replace the access plug into the access plate. Screw the hydraulic coupling (cap) back onto the output tube of the grease gun.

f. Retract the mast completely, extend it completely and retract it completely to distribute the grease over all the nuts and the complete screw.

g. Record the date, cycle count and procedure in the mast's maintenance record.

Figure 4-2 Lubricating the ACME Screw



4.3 TROUBLESHOOTING

The following pages show many of the more probable error conditions. Where more than one probable cause can explain an error condition, they are listed in an "indented" fashion, with specific corrective actions for each situation further indented. Causes are listed in order of probability from highest to lowest. It should be noted that some "errors" are more aptly called "states", and do not necessarily indicate improper operation.

4.3.1 Pre-Condition Contact Closure Condition

Provisions have been made (see paragraph 3.2.1.4) for a pre-condition contact "handshake" circuit. If the circuit is open the operation of the mast is prevented and the software revision level is displayed on the alphanumeric display. This feature is normally disabled by a jumper installed across the connector pins. The typical application of this capability is a sensor on a hatch above the mast. Correcting the condition will clear this error.

a. Pre-condition is not present (i.e. the hatch is closed).

Corrective Action: Establish the proper pre-condition (i.e. open the hatch).

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b. Damaged/inoperative pre-condition switch.

Corrective Action: Check the switch for continuity and replace if necessary.

c. Missing connector wire (no handshaking used). (There is no hatch.)

Corrective Action: Refer to drawing 40868, and replace a jumper between the two appropriate contacts.

d. Malfunctioning mast control panel.

Corrective Action: Contact authorized service center for evaluation and possible return for repair.

4.3.2 The Mast Has Stopped Moving Upward or Is Moving Very Slowly.

⚠ WARNING

This Stiletto Mast System is supplied with a friction slip clutch to prevent serious damage to the mast in the event of a jam. There is no way to detect the action of the slip clutch other than operator observation. When the clutch begins to slip, that is, when the motor is running and the mast is neither extending nor retracting, release the UP / DOWN toggle switch immediately to avoid overheating the clutch.

a. Interference to mast.

Corrective Action: Inspect and remove obstructions, tangled payload cables or lighten the payload.

b. Damaged motor cable.

Corrective Action: Disconnect the motor cable from the mast. Inspect the cable for continuity and shorts. Replace faulty cable.

c. Damaged/inoperative motor.

Corrective Action: Replace the motor.

d. Malfunctioning mast control panel.

Corrective Action: Contact authorized service center for evaluation and possible return for repair.

e. ACME nuts fail to synchronize with ACME drive screw.

Corrective Action: Try retracting the mast three inches and approach that region again. If this does not work the nuts may be worn out and will need to be replaced.

Corrective Action: Try raising the mast with the hand crank. There may be a burr on the nut, and action with the hand crank, which is not limited by the torque limits on the friction safety clutch set at the factory, may power through it. If this does not work the nuts may be worn out and will need to be replaced.

f. Clutch is out of adjustment.

Corrective Action: The clutch may be in need of tightening. Contact authorized service center for evaluation and possible return for repair.

4.3.3 The Mast Has Stopped Moving Downward.

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⚠ WARNING

This Stiletto Mast System is supplied with a friction slip clutch to prevent serious damage to the mast in the event of a jam. Detection of the clutch slipping is when the tube section does not extend/retract when electrical power is applied via the UP/DOWN toggle switch. Release the switch to avoid overheating the clutch.

a. Damaged motor cable.

Corrective Action: Disconnect the motor cable from the mast. Inspect the cable for continuity and shorts. Replace faulty cable.

b. Damaged/inoperative motor.

Corrective Action: Replace the motor.

c. Malfunctioning mast control panel.

Corrective Action: Contact authorized service center for evaluation and possible return for repair.

d. ACME nuts fail to synchronize with ACME drive screw.

Corrective Action: Try raising the mast three inches and approach that region again. If this does not work the nuts may be worn out and will need to be replaced.

Corrective Action: Try lowering the mast with the hand crank. There may be a burr on the nut, and action with the hand crank, which is not limited by the torque limits on the friction safety clutch set at the factory, may power through it. If this does not work the nuts may be worn out and will need to be replaced.

e. Clutch out of adjustment.

Corrective Action: The clutch may be in need of tightening. Contact authorized service center for evaluation and possible return for repair.

4.3.4 Nothing Works and the Display does not illuminate.

a. Power to the mast is interrupted at the shelter or vehicle level.

Corrective Action: Refer to shelter or vehicle level maintenance procedures.

b. Fuse Blown

Corrective Action: Replace external 15 Amp Fuse (Slow Blow FNM-15)

c. The control box has been damaged.

Corrective Action: Contact Authorized Service facility for repair disposition.

4.3.5 Mast prematurely stops upward travel and control box indicates “DEPLOYED.”

a. A heavy object struck the mast during deployment causing the “DEPLOYED” limit switch to falsely activate.

Corrective Action: Look over mast for damage and secure any loose objects.

Corrective Action: Lower the mast using the toggle switch for 3 (three) seconds until the Control Box display no longer reads “DEPLOYED”. Use the toggle switch again, for 3 (three) seconds, to raise the mast to full deployment height.

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4.3.6 Control Box display reads “NESTED” when mast is partially extended.

a. Misinterpreted Electronic Limit Switch Status

Corrective Action: Motor needs to be operated continuously for 3 (three) seconds, for display to change from “NESTED” to intermediate height status.

4.3.7 After Power cycle (switching main power off, then back on), the display does not read correct “NESTED/ACTUAL INTERMEDIATE HEIGHT/DEPLOYED” status.

a. Must fully nest mast to re-zero height readout

b. Misinterpreted Electronic Limit Switch Status

Corrective Action: Motor needs to be operated continuously for 3 (three) seconds, for display to change from “NESTED” to “PARTIAL” status.

4.3.8 Mast does not move up/down when switch is activated and control box display goes blank or restarts.

a. Insufficient voltage at control under load

Corrective Action: Check supply voltage and power cabling.

4.4 SPECIAL INSTRUCTIONS FOR CLEARING HEAVY ICE BUILDUP

During periods of heavy precipitation and high ice buildup on the mast there is a chance of jamming during retraction of a deployed mast. This high ice buildup on the collar sections (horizontal surfaces) of the mast could cause the tube locks mechanisms to become “out of time” and cause internal damage. This ice buildup must be cleared away during retraction just before the individual tube and collars contact each other. Shown on Page 20 are the areas to clear the ice away from the tubes and collars prior to nesting. For instruction on how to remove ice from a jammed lock assembly refer to Step 5.

The order of operations concerning the ice removal is as follows:

Note: Only retract the mast with electrical power, do not attempt to use the manual crank input. Internal damage may occur using the manual crank during high torque applications.

Step 1. Attempt to retract the mast with electrical power only. If the mast begins to break the ice on its own, proceed to Step 4. If the mast stalls and does not retract then proceed to Step 2. Do not continue to labor the motor with a stalled tube set; because this will cause wear on the slip-clutch.

Step 2. Begin clearing away the ice on horizontal surfaces (collar) closest to the operator. Utilizing non-piercing tools, begin by breaking the ice bond and using a striking motion away from the tube (tangent to the tube). Continue to do this ice clearing around the collar. Then remove the remaining ice from the vertical lock post on the collar. Next, begin to remove the ice buildup on the “nesting” tube. Use extreme caution when removing ice from the circumference of the tube, only 1-2 vertical inches of ice will need to be removed. Use a tangential clearing motion to keep from piercing the tube. Proceed to Step 3.

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Step 3. Attempt to retract the mast electrically again. If the tube set is still stalled and will not retract, then ice has built up internally and the unit will need to be thawed in order to regain functionality. Do not continue to labor the motor with a stalled tube set; save the slip-clutch. If the mast does retract, proceed to Step 4.

Step 4. Continue to retract the tube until it is a few inches from nesting and contacting the lower collar. Begin clearing away the ice on horizontal surfaces (collar) closest to the operator. Utilizing non-piercing tools, begin by breaking the ice bond and using a striking motion away from the tube (tangent to the tube). Continue to do this ice clearing around the collar. Next, remove the remaining ice from the vertical lock post on the collar. Then operate the mast until the collars contact and the next tube begins to retract. At this point repeat Step 1 and 4.

Step 5. If the mast will continue to break ice during retraction but experiences trouble only near a locking transition, then ice has frozen inside the lock body. This ice in the lock body is interfering with the normal unlocking of the interfaces. To clear the ice, use a small, hard tool to reach inside the opening at the bottom of the housing. Manually chip and clear the ice from the internal parts, then set the latch to the proper “Locked” orientation, as illustrated on Page 21. Attempt to retract the mast again under electrical power.

Utilizing non-piercing tools, remove the ice buildup from the indicated areas:

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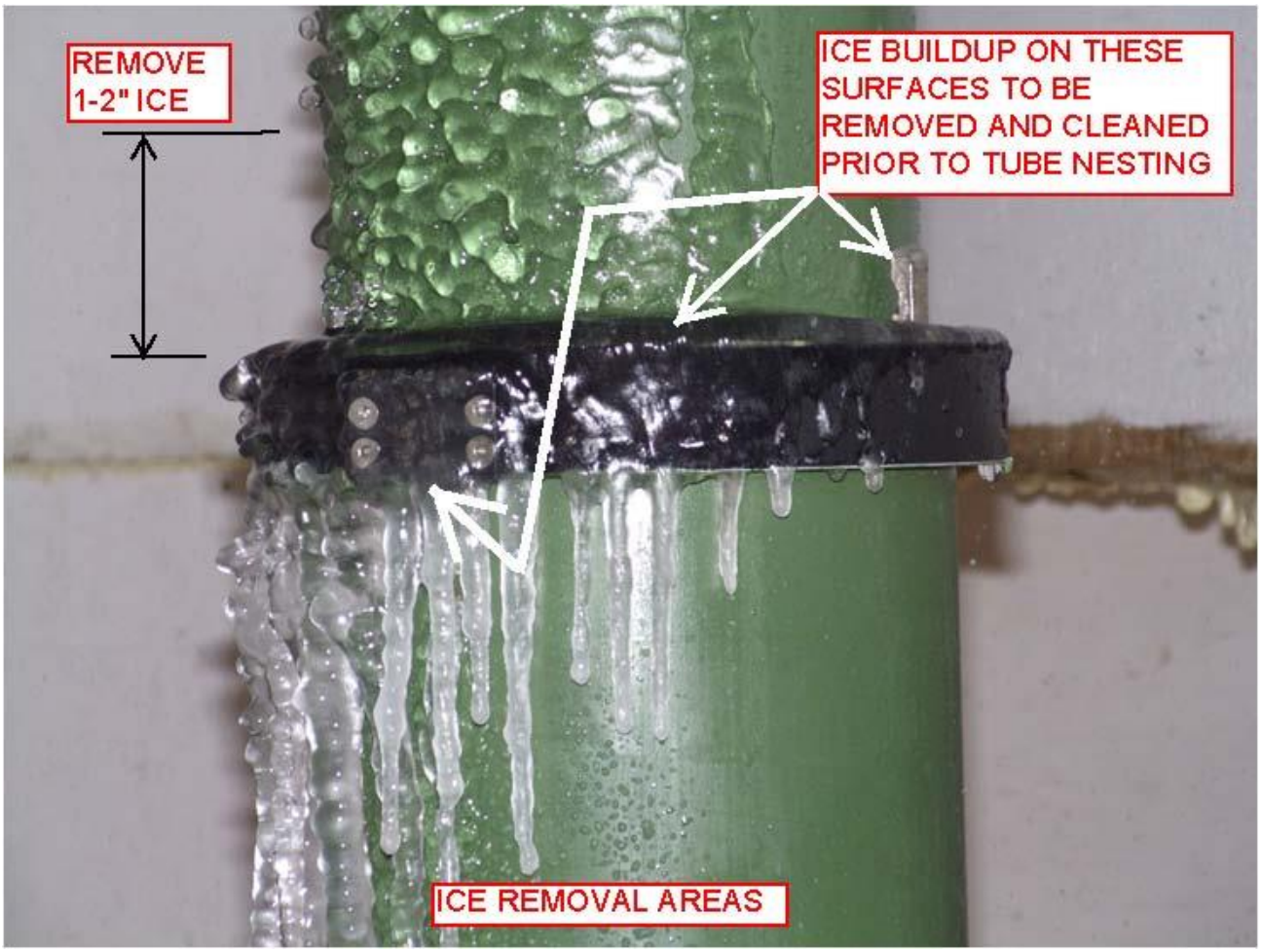


Figure 4-3, Ice Removal Areas

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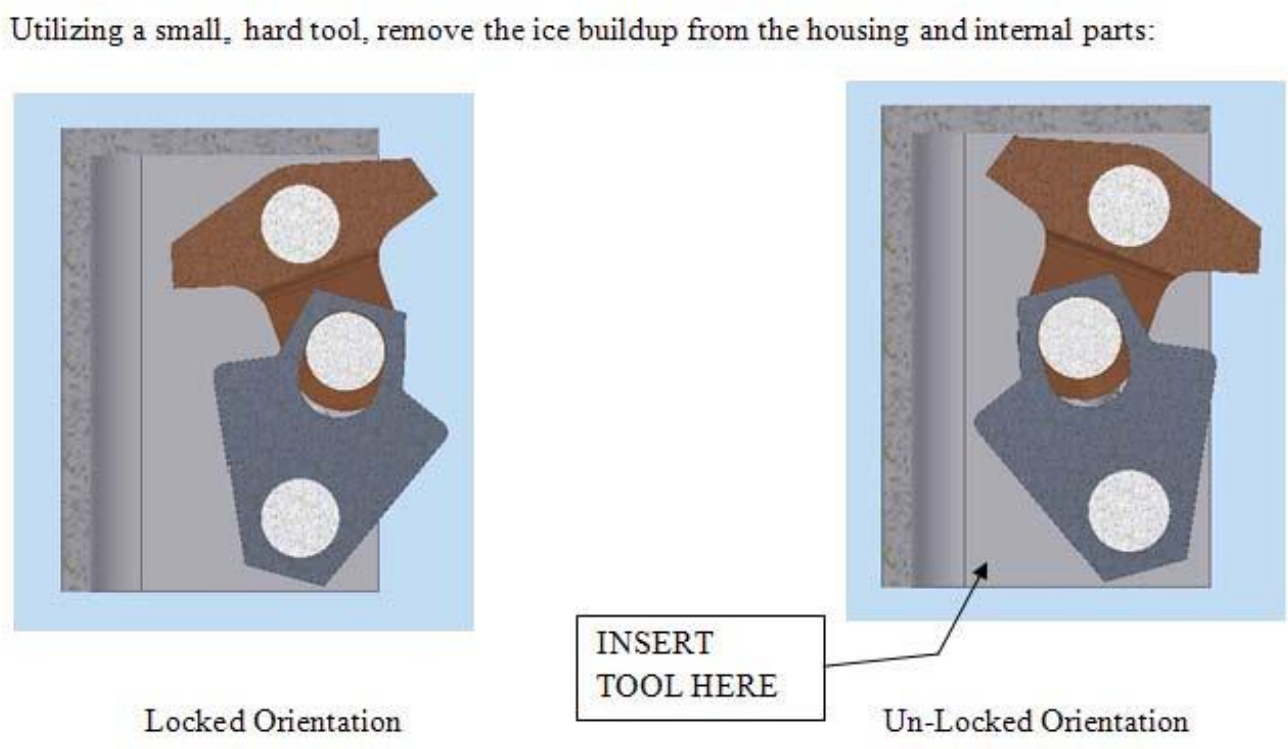


Figure 4-4, Lock Housing Ice Removal

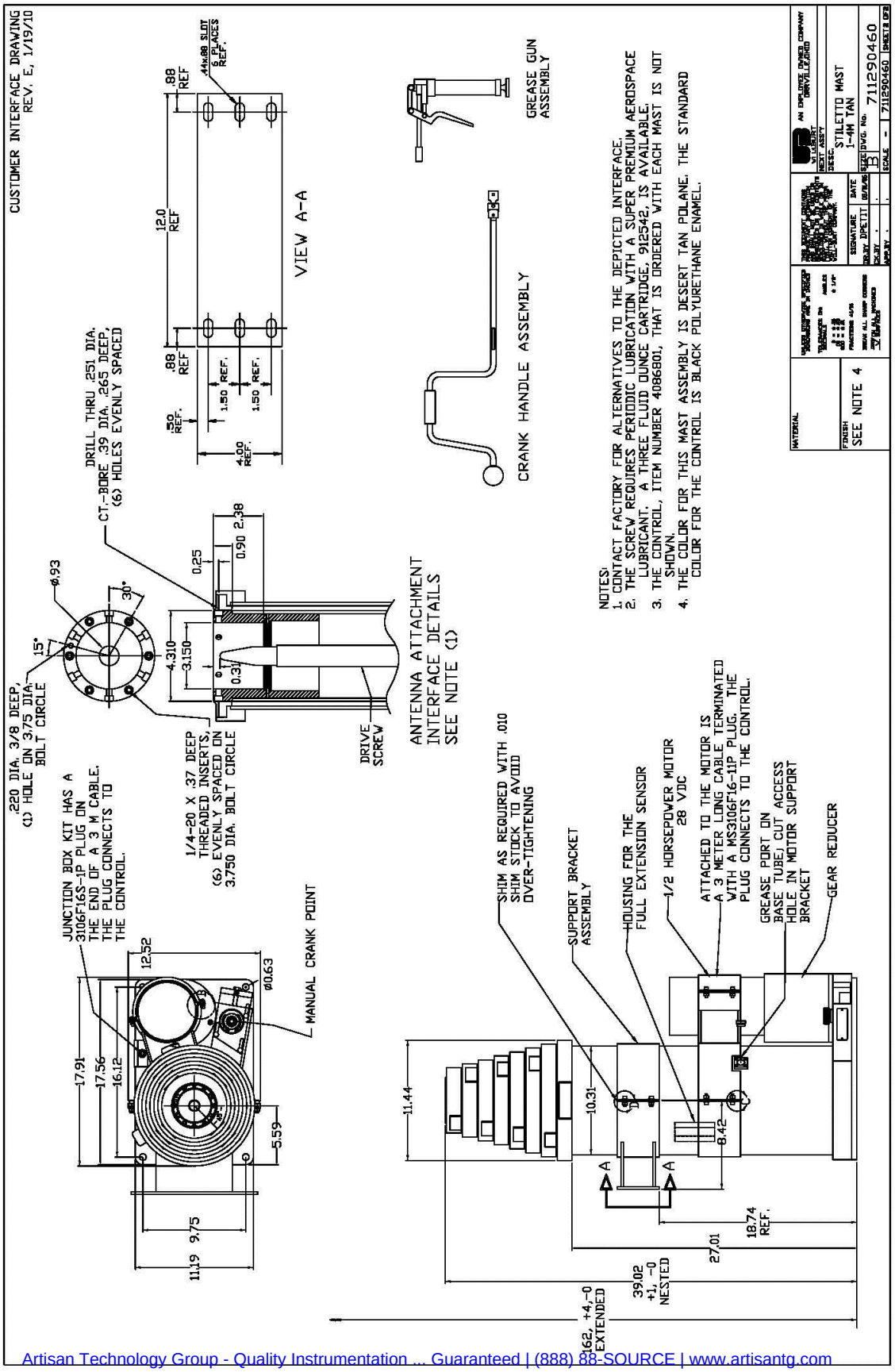
Once the internal ice is cleared away, observe the orientation of the lock mechanism. If it is witnessed to be in the "Un-locked" position then push on the rocker to trip it back to the "Locked" position. When the mast operator has clear access to the internal parts of the lock housing, the orientation should only be "Locked." Under no circumstance should the locks be simultaneously set in the "Un-locked" orientation, while the mast is being operated.

CHAPTER 5- REFERENCE DRAWINGS

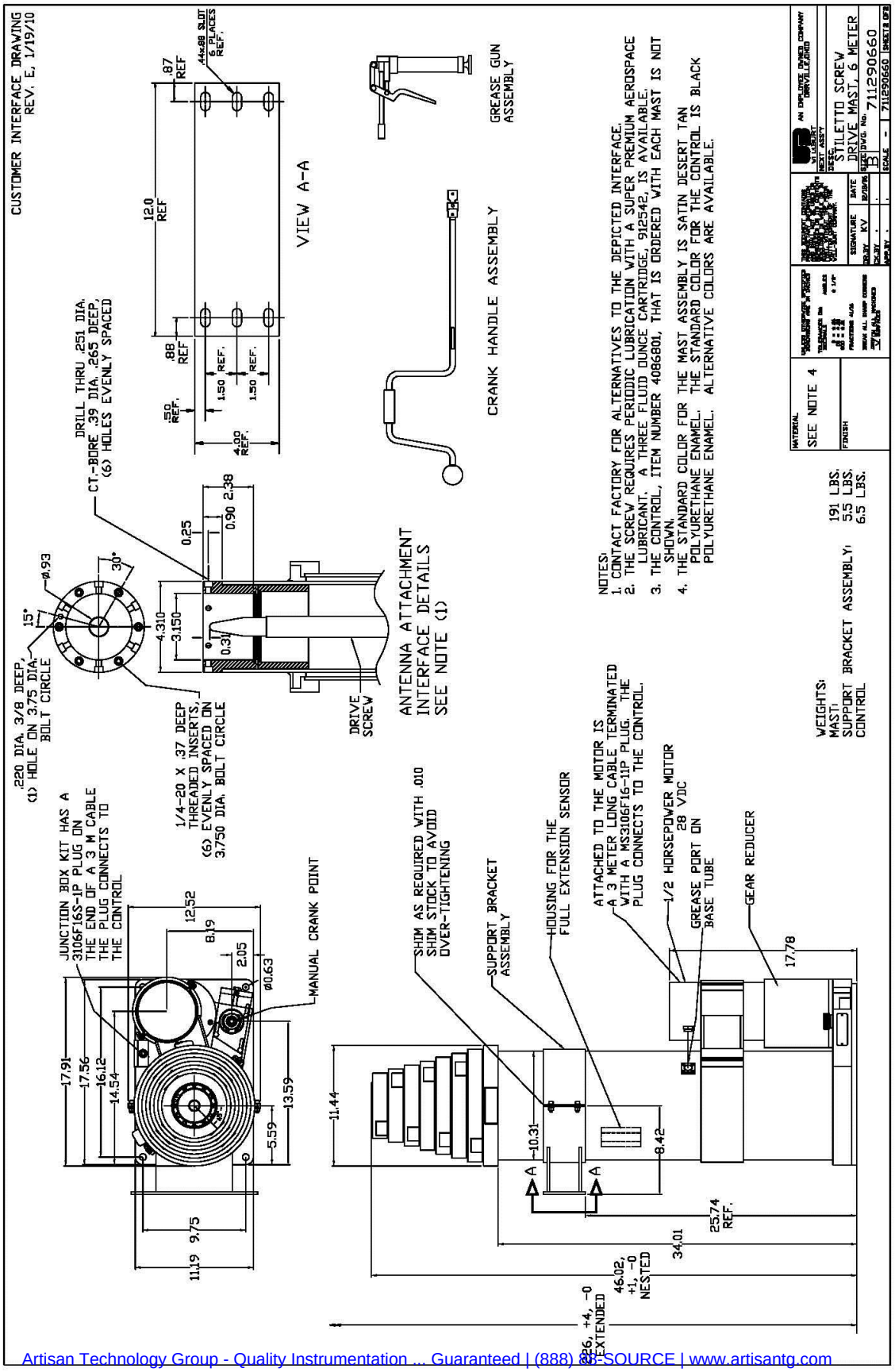
5.1 INTRODUCTION

This section provides reference drawings and photographs for use with the Stiletto Mast System.

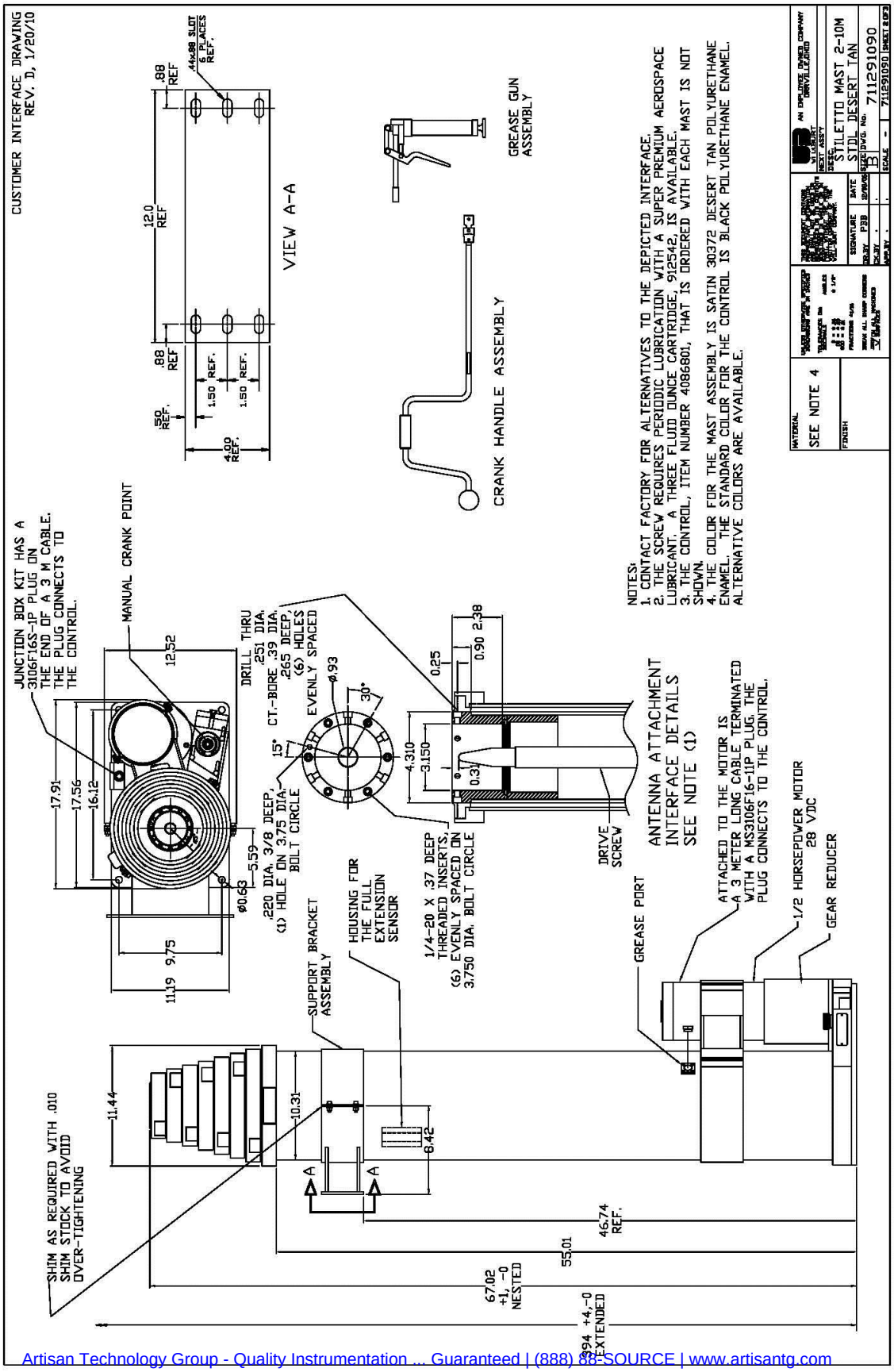
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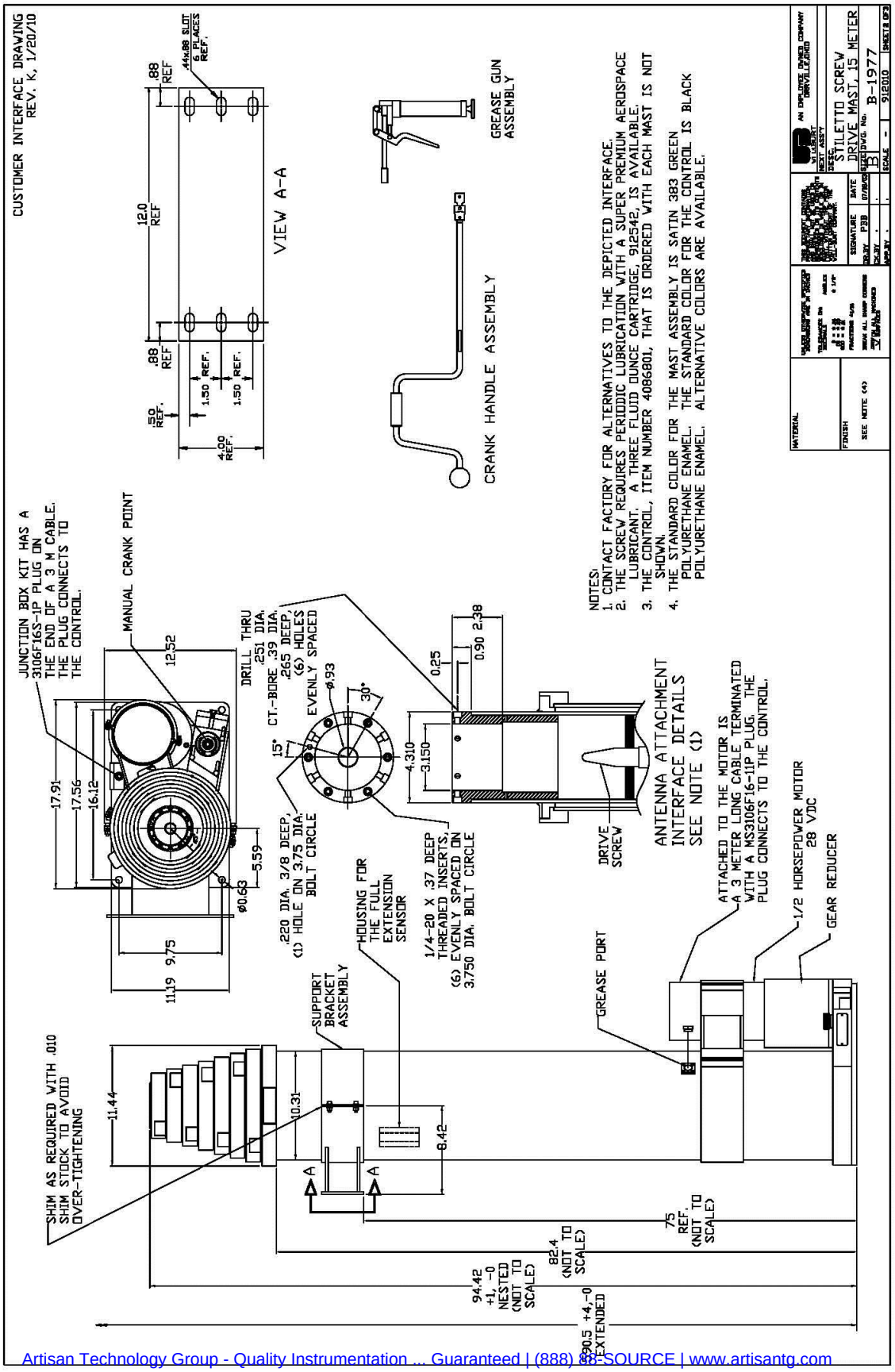
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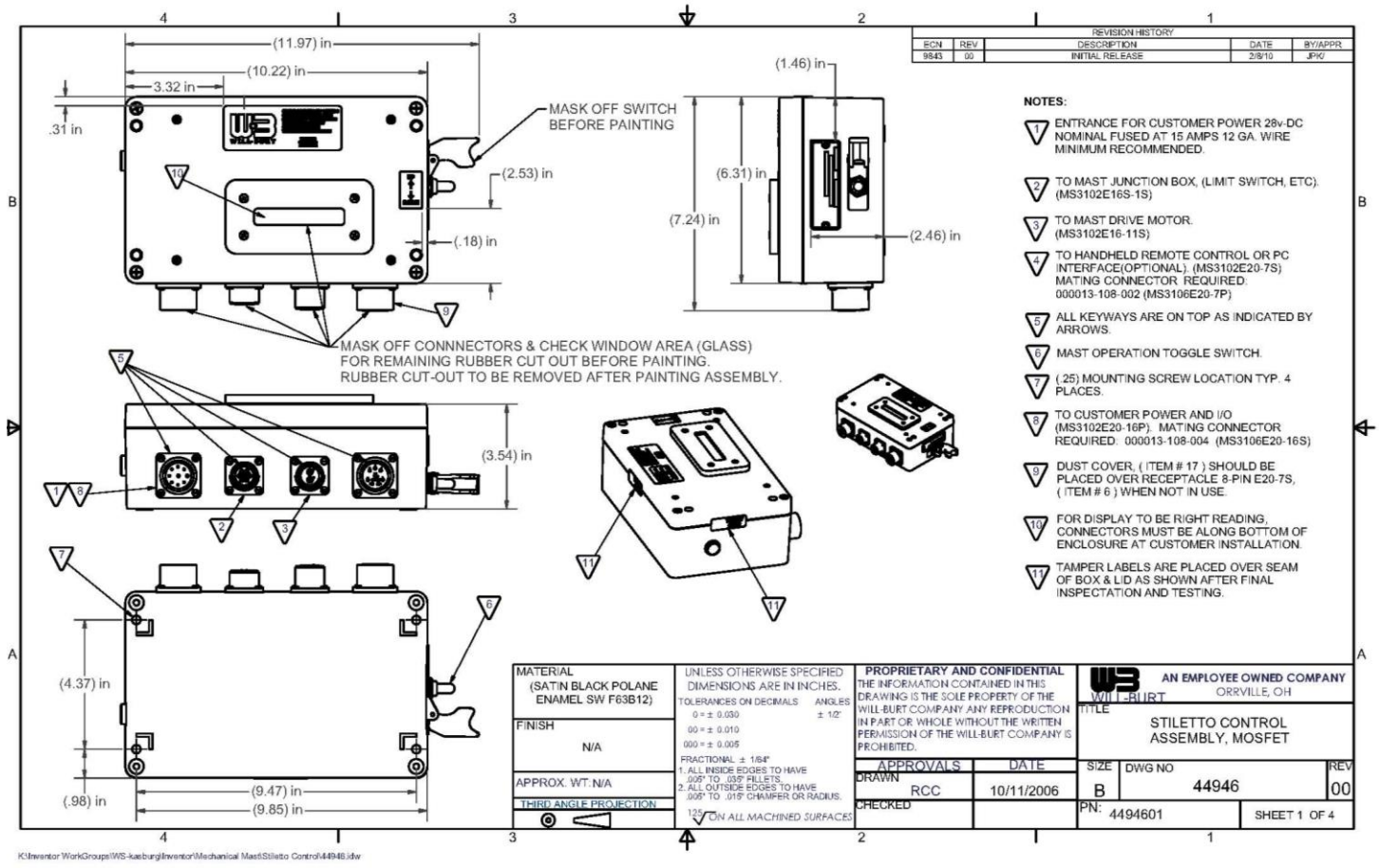
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