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INUKTUN VERSATRAX 300™

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About This Manual

This manual has been prepared to assist you in the operation and maintenance of your Eddyfi Technologies Inuktun equipment. Correct and prudent operation rests with the operator who must thoroughly understand the operation, maintenance, service and job requirements. The specifications and information in this manual are current at the time of printing.

This product is continually being updated and improved. Therefore, this manual is meant to explain and define the functionality of the product. Furthermore, schematics or pictorials and detailed functionality may differ slightly from what is described in this manual.

Eddyfi Technologies reserves the right to change and/or amend these specifications at any time without notice. Customers will be notified of any changes to their equipment.

Information in this manual does not necessarily replace specific regulations, codes, standards, or requirements of others such as government regulations.

Specifications

Tether Length	2,130 m (7,000 ft)
Chassis Configuration	Tandem Parallel Chassis
Vehicle Weight	104 kg (230 lb) with full configuration)
Power Requirements	
Winch	120VAC, dedicated 15 Amp circuit
Control Computer	120VAC, standard 15 Amp circuit
Power Supply	120VAC, dedicated 25 Amp circuit, L5-30 type plug
Pipe Diameter Range	
12in to 24in	Camera Centered
Up to 56in	Camera Centered with Extensions
56in to Flat	Continuous Adjustment
Operating Temperature	0 º -50 ºC (32 º -122 ºF) * *Dependent on operating conditions. Ask your sales expert for more information.

Front Facing Camera	Spectrum 90™ Optional: Spectrum 120HD™ high definition camera main camera, middle and/or rear-facing camera
Rear & Auxiliary Camera	Crystal Cam®
Minimum Vehicle Dimensions	1651 x 371 x 434 mm (65 x 14.6 x 17.1 in)
Nominal Pulling Capacity	200lb
Max Speed	9 m (30 ft) per minute
Depth Rating	60 m (200 ft)
Conditions	All vehicle hardware can be used in dry, dusty conditions or underwater in dirty, muddy conditions

Safety

- All personnel operating or maintaining this equipment must read and understand the operations and maintenance manual prior to system operation.
- All personnel operating or maintaining this equipment must be competently trained.
- Appropriate personal protective equipment (PPE) must be worn while operating and maintaining the equipment.
- Under no circumstances should this equipment be used in a potentially explosive atmosphere.
- If the equipment is powered from a source other than an Eddyfi provided controller, the power supplied to the product must have reinforced isolation from the mains with no reference to earth ground.

Caution: Disconnect the power source before servicing the product; otherwise, damage may result.

Caution: **Pinching Hazard** - There is a pinching hazard around the chassis “X” hinges and the camera swivel mount. Do not lift or handle the vehicle from these areas. Use the handles provided for safe handling.

Warning: **Shock Hazard.** 420 Volts DC. Turn off the power before servicing, connecting, or disconnecting any of these components: power control rack, deck cable, winch, tether, vehicle telemetry can.

Personnel Safety

Personal Safety Equipment

Observe all safety regulations required by law in your place of work. These will typically include:

- Traffic safety protocols
- Standard Personal Safety Equipment including:
  - Steel toed boots
  - Safety vests
  - Hard hats
  - Gloves
- Heavy lifting procedures.
- Overhead lifting protocols.

Operational Safety

Your personal safety is the most important of all. Here are a few things to watch out for:

- Take care when using cranes or overhead equipment for vehicle deployment. Watch for overhead cables and take appropriate safety precautions (hard hats, steel-toed boots, gloves, etc.)
- Never stand on the tether. The vehicle and winch are strong enough to pull it out from under you and cause you to fall. Standing on the tether can also damage the tether.
- The tether carries 420 VDC for vehicle power. Keep the tether termination power connector capped when not plugged into the vehicle. Follow the guidelines for preventing tether damage. Do not operate the system with a damaged tether.
- The LED lights are very bright. Do not look directly into the lights.

Warning: **Shock Hazard! 420 Volts DC ⎓ Turn off the power before servicing, connecting, or disconnecting any of these components:**

- Interface box
- Deck cable
- Winch
- Tether
- Vehicle telemetry can
-

Warning: High Intensity lights. Do not look directly into the lights. Use a welding filter (shade #8) to observe the light elements.

Equipment Safety

Some precautions should be taken to protect the Versatrax 300™ system from damage:

- Repair any damaged wires before operating the vehicle. A short circuit may damage the telemetry can, cameras, or any attached equipment.
- Never drop the vehicle. Although built tough, the vehicle is heavy and can suffer structural damage when dropped.

System Setup

Working Environment

Controller – The controller is a rack-mount industrial computer system intended to be used in a **dry, covered** environment only. The controller connectors are not waterproof. Keep all cords and cables away from water. Recommended controller operating temperature is between 0 º and 50 ºC (32 º-122 °F)

Power Supply – The high voltage power supplies must be kept under cover and dry at all times.

Tether & Wiring Harnesses – The tether and vehicle wiring harnesses are depth rated to 100 feet (30m) of water. Keep the power connector capped with a dummy plug when the tether is not connected to the vehicle.

Winch – The winch is splash resistant only. Refer to the winch manual.

Vehicle – The Minitracs™, vehicle wiring harnesses and chassis are designed to work underwater up to 100 feet deep. The tracks are tolerant toward sandy and muddy conditions, although this decreases seal life. The vehicle may also be operated in dry or dusty environments in the recommended operating temperature range of 0 º -50 ºC (32 º to 122 ºF).

Storage – Allowable system storage temperatures are between -20 º and +70 ºC (0 º - 150 ºF).

Typical Installation

The following describes a typical installation scenario recommended by us.

A representative set up for a pipe inspection system is based on a covered two-ton or larger box truck. The truck carries the power source (generator) and houses the power supply and control system in a dry, covered environment. The computer / control console and recording equipment are placed in an office-like room built into the truck. The rear wall of the truck should open completely. A hoisting winch must be installed to lift the vehicle during deployment. The winch, crane and other equipment can be mounted at the back of the truck box near the door for easy deployment. The truck should also contain the maintenance shop, ample bench space for maintaining and configuring the vehicle and system wash down equipment.

The vehicle should be operated by a crew of at least two. Most importantly, a person should always be available to tend the tether. This person may also play a role in vehicle inspection and deployment. A second person drives the vehicle and operates the recording equipment.

The operations crew should be able to communicate quickly with each other to allow fast response in case of an emergency such as a tether hang up. It is recommended that a signal system be set up so that the operators may work efficiently and safely as a team. It is always advantageous for both operators to be aware of full system status.

Personnel Requirements

A typical pipe inspection van operation requires a minimum of two people. A third person is often needed to aid in vehicle deployment and tether handling.

Console Operator – This person is responsible for driving the vehicle, watching the pipe and making notes and comments about location and pipe situation. It is also the operator's responsibility to assess whether a pipe is in condition for safe passage of the vehicle or risk getting stuck. The operator may also assist in general site setup (cones/ warning signs), vehicle maintenance and configuration.

Deployment / Tether Handler / Field Maintenance – This person has several tasks;

- Configure the vehicle for the current pipe
- Lower the vehicle into and out of the manhole
- Watch the tether as the vehicle enters and exits the pipe
- Operate the winch

Assistant / Winch Handler – This person assists with maintenance, lifting and winch operation. When deploying the vehicle one person is need at the console, one to handle the tether and a third to operate the cable hoist.

Power Requirements

This system requires two power circuits.

- **Winch** – 120VAC, standard 15 Amp circuit. It is recommended that the winch operate from its own circuit independent of the control computer. The input voltage for the winch can be switched to 240VAC by configuring the Penta Drive. See the winch manual for instructions on how to do this. The Auto Level Wind supports 100-250VAC.
- **Rack Mounted Control System** – The rack mounted control system consists of the Control Computer, Interface Box (Power Supplies), Fiber Interface Box and, the monitor and keyboard tray. All rack mounted devices except the Interface Box (Power Supply) are connected to a Rack Mounted Power Bar. The power cables for the Interface Box and the Power Bar are bundled together and then joined to a single 120V 15A North American NEMA 5-15P plug. This plug must only be connected to 120VAC mains.
    - **Control Computer** – 120-240VAC, standard 15 Amp circuit. A surge protected UPS is recommended to protect the computer from power failures. We also recommend that this circuit be dedicated to the computer and monitors only.

- **Interface Box (Power Supply)** – 120VAC, 25 Amp circuit; L5-30 type locking plug. This circuit must be dedicated to the vehicle.
- **Fiber Interface Box** – 100-250VAC, 3.15A.
- **Monitor and Keyboard Tray** – 100-240VAC.
- **Rack Mounted Power Bar** – 120VAC, standard 15 Amp circuit; NEMA 5-15P plug.

Input Voltage Transformer

Voltage Transformer – In order to support system operation around the world, a voltage transformer is included with the system. Both the Rack Mounted Power Bar and the Interface Box must be connected to this voltage transformer whenever the system is to be powered from 200-240VAC. The Interface Box (Power Supply) and the Rack Mounted Power Bar cords are bundled together and joined to a single NEMA 5-15P plug which can be plugged directly into the voltage transformer.

Note: The voltage selection jumper on the back of the voltage transformer must be set to the appropriate mains voltage which the voltage transformer will be connected to.

Warning: The VT300 system may be damaged if the voltage selection jumper on the back of the input system voltage transformer is set incorrectly.

Unpacking the System

The system is packed into two wooden crates for shipping and storage. Remove the Phillips-head screws at the bottom of the crates to lift off the covers. One crate contains the winch and the other contains the vehicle and control computer.

An overhead crane or engine hoist will be needed to move the winch from the crate base to its installed position.

Note: The crates are for shipping and storage only – not for system deployment.

Note: If the system is to be shipped or stored for any length of time, we recommend that it be packed into its original shipping crate.

Power Supply Rack Installation

Mount the power supplies and interface box on a standard 19in rack-mount rail. The power supplies are air cooled and require open circulation. The rack must be an open-face type with no front or back cover to allow unimpeded cooling circulation. The power supplies draw air from the front and blow it out from the back.

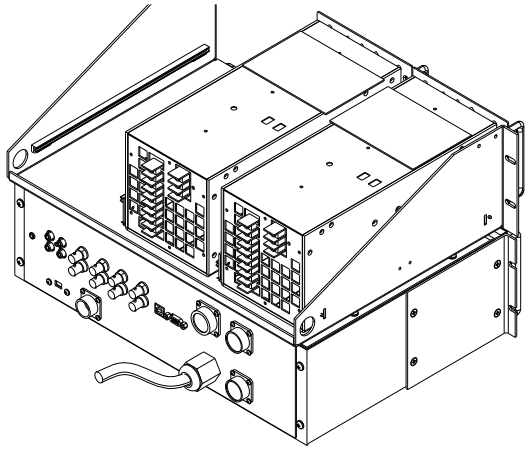


FIGURE 1: RACK-MOUNT POWER SUPPLIES & INTERFACE BOX

Warning: Failure to provide for enough air circulation will cause overheating and system malfunction. Do not mount the power supplies in a closed-front rack.

Computer Cable Hookup

The VT300™ control system consists of the computer, power interface box, fibre interface box and power supply rack. The interface boxes provide a common connection point for vehicle power supplies, PC controls, and communication for the system. The power interface box is also the main power input for the vehicle and provides ground fault protection.

Use the following check list for cable hook-up, with reference to the Control Cable Hook-Up illustration below.

1. Ensure the AC power cords are plugged into the internal power bar.
2. Vehicle Power L5-30 power plug to wall or generator.
3. PS1 and PS2 connected to interface box. The order of these plugs does not matter.
4. Connect the deck cables from the winch to the interface box.
    a. Deck Cable 1 from winch to Interface Box.
    b. Deck Cable 2 from winch to Interface Box.
    c. HD-SDI fibre from winch to Fibre Interface Box (yellow patch cord).

d. COMMS fibre from winch to Fibre Interface Box (yellow patch cord).

5. Vehicle COMMS to USB2 on the computer.
6. USB connection between fibre interface box and computer.
7. RS-232 between fibre interface box and USB2 on computer.
8. Ethernet connection between fibre interface box and computer.
9. SD video (auxiliary cameras) connected to the 8-Y-IN plug on the octopus connector.
10. HD-SDI video coax to the middle coax connector on the computer.
11. Optional second monitor connection.
12. Tray keyboard to USB
13. Tray trackpad to USB
14. Tray monitor to upper HDMI connector.
15. Tray speaker to the green audio connector.
16. Hermes RTL dongle
17. StreamPix dongle
18. Winch encoder USB connection to computer.

(Refer to image on next page)

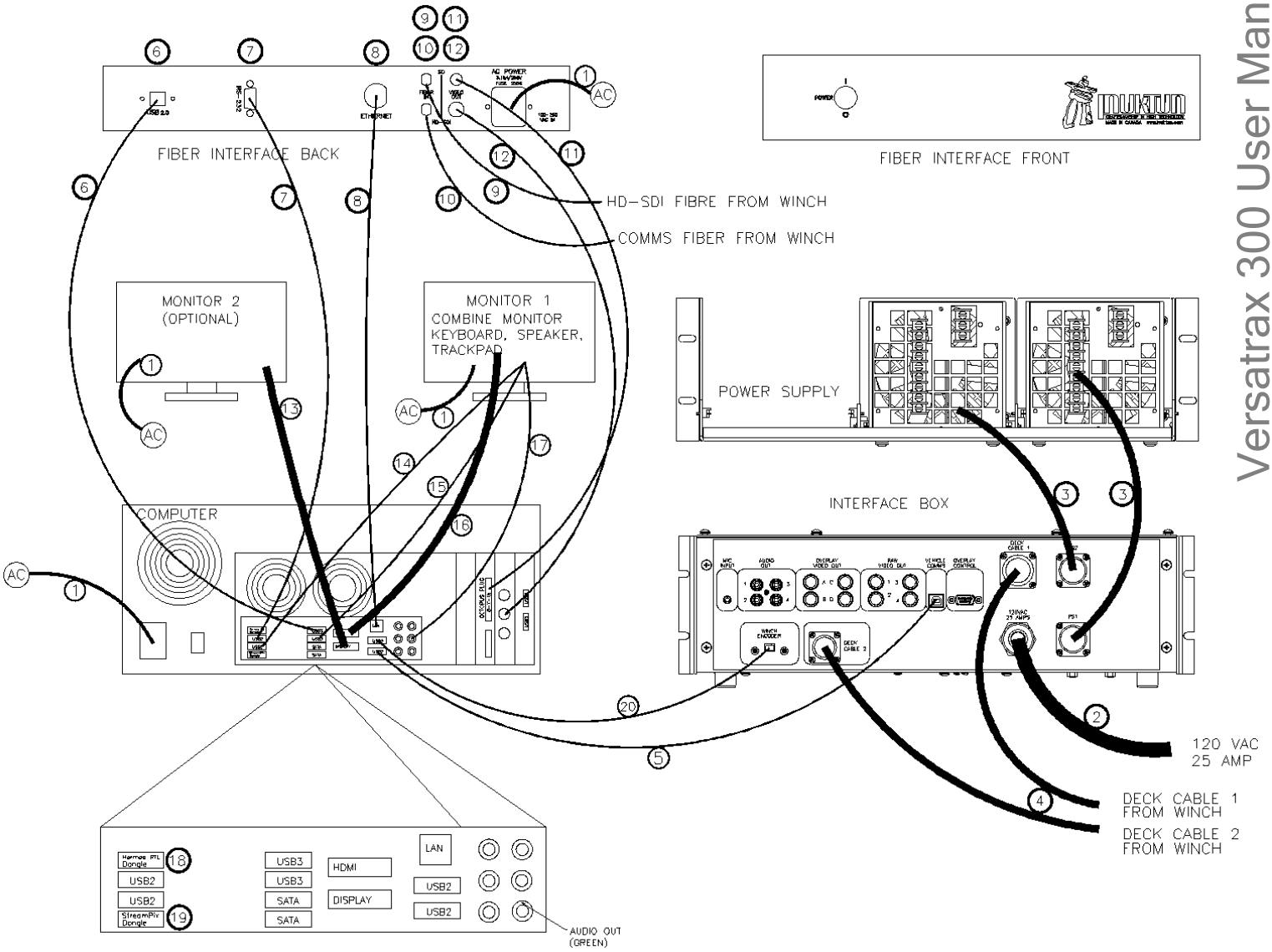


FIGURE 2: CONTROL CABLE HOOK-UP

Winch Installation

Working Environment

The winch is intended for use in a dry covered environment. It is splash resistant and can withstand some water spray. The drum is sealed so the tether can be wound on wet. Keep the winch out of standing water. Working temperature range: 0 º - 50 °C (32 º - 122 °F). Storage temperature -20 º to 60 °C (0 º - 140 °F).

Power Requirements

The winch connects to a standard 110VAC 60Hz. Power source fused at 15 Amps. A ground fault protected (GFI) outlet is recommended.

The input voltage for the winch can be switched to 240VAC by configuring the Penta Drive. See the winch manual for instructions on how to do this. The Auto Level Wind supports 100-250VAC.

If an inverter is used, ISL recommends a minimum of 1200 watts rating.

Bolt Down

The winch must be bolted down prior to use. Peak loads may be strong enough to pull an unsecured winch out of the van. The figure below shows the bolt pattern for use with 3/8in bolts and large washers.

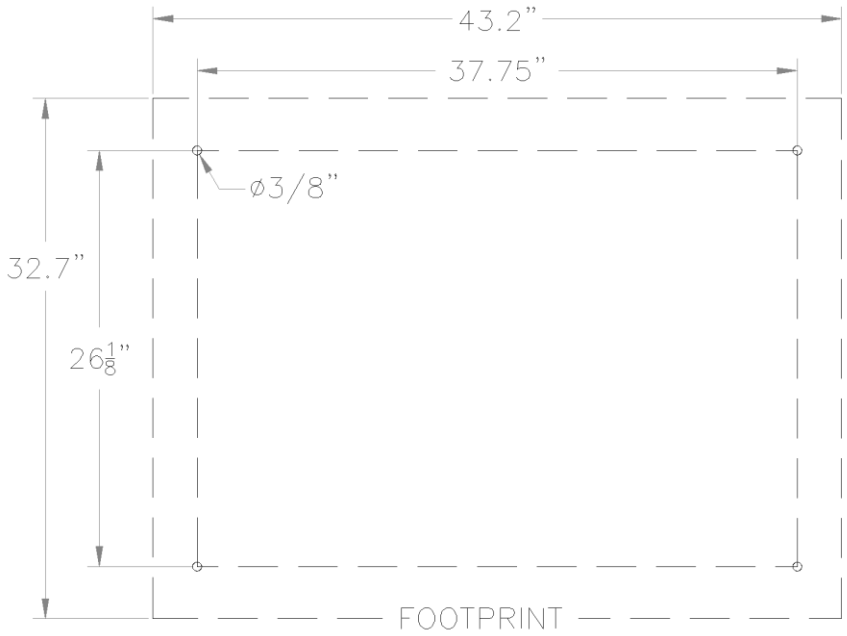


FIGURE 3: WINCH BOLT-DOWN PATTERN

Vehicle Handling Equipment

Boom Arm & Cable Hoist

Because the vehicle is heavy some handling equipment is recommended with the system installation.

- The first of these is a swinging overhead boom for vehicle deployment which must hold the pay-out sheave axle at least 9 feet above ground level. The capacity of the arm needs to be at least ½-tonne at full extension – enough for full vehicle weight plus full winch power.
- The pay-out sheave diameter should be at least 10in diameter to help prevent tether fatigue.
- An electric cable hoisting winch with at least ½-tonne load capacity is necessary to raise and lower the vehicle. The cable on this hoist needs to be long enough for the deepest expected deployment.

Configuration

Configuration Bench

You will need a dedicated work bench for vehicle configuration and maintenance. Ideally this is at least 30in x 60in and is accessible from both sides. The lower portions of the bench may be equipped with racks or drawers where tools, spare parts and fasteners are kept.

A configuration fixture is provided with the VT300. This is a system of wooden stands and support blocks used for installing the tracks, side weights and track extension plates.

Parallel Vehicle Configuration

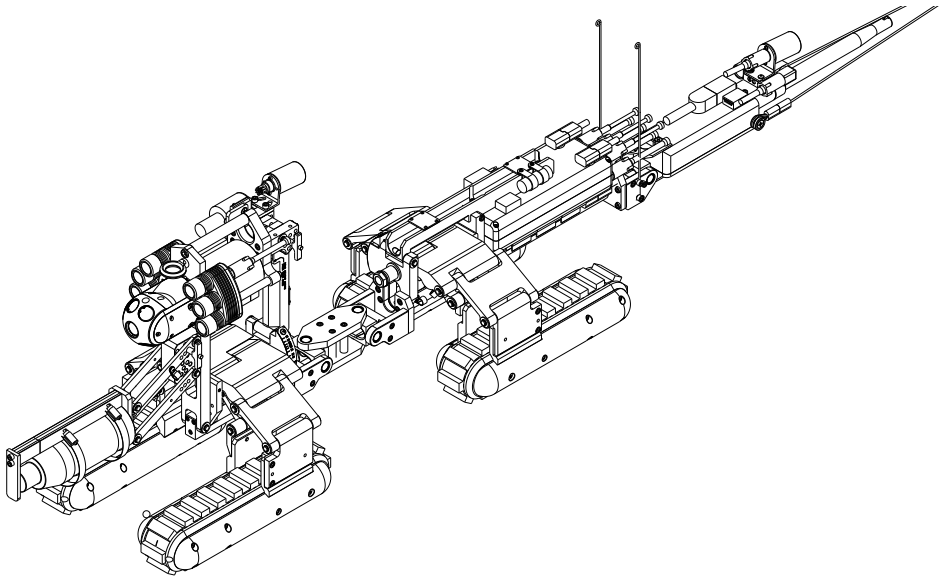


FIGURE 4: VT300 FOUR-TRACK CHASSIS

Minitrac™ Installation & Removal

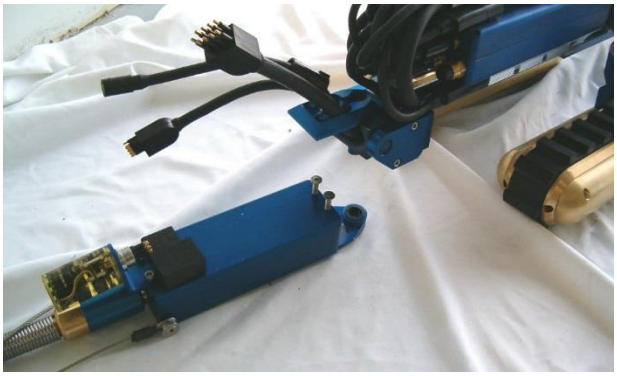
1. The chassis must be in the flat configuration for installation of the tracks.
2. Use the track installation stand provided with the vehicle to hold the chassis while installing the tracks. Place the jack blocks onto the stand and set the chassis on top. The tapered end of the stand is at the back of the vehicle.
3. Place the tracks in position around the vehicle.
4. Place the 2x4 spacing blocks under the tracks if you are not using the track extension brackets.
5. Install the outside flanges first using ¼-20 x 5/8in socket cap screws. Leave the screws slightly loose until the inside bracket bolts are installed (step 7).
6. Plug in all four connector whips.
7. Bolt on the inside brackets using ¼-20 x 1¼in socket cap screws. The inside bolts may be difficult to align. You may need to jiggle or lift up on the chassis to find the bolt alignment.

Tether Hook-Up

The photo sequence below shows the procedure for hooking up the tether.

1. The bottom flange remains with the tether termination can; the top flange remains with the vehicle. The harness whips remain installed through the top flange as shown. It is best to keep the mounting screws with the can.
2. Mount the can onto the back swivel and screw on the top flange. Make sure top and bottom screws are tightened.
3. Plug in the connectors, including the Crystal Cam® connector. Make sure connectors are seated all the way.
4. Install the rear camera bracket
5. Check that the tow cable is securely attached to the termination can.

1



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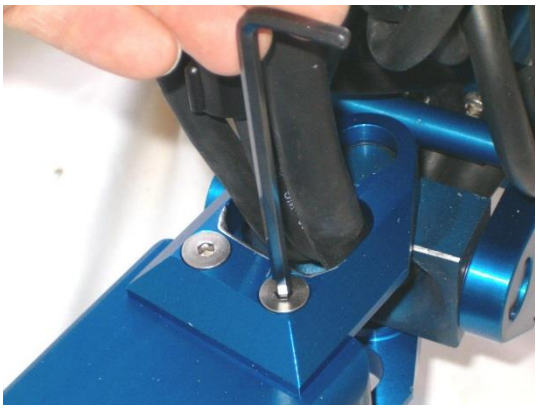

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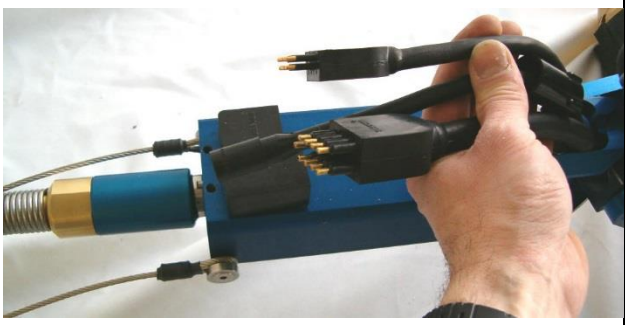

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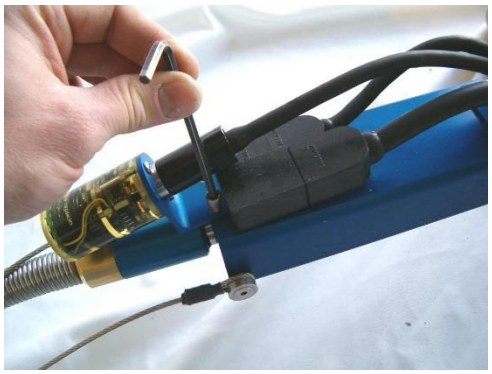

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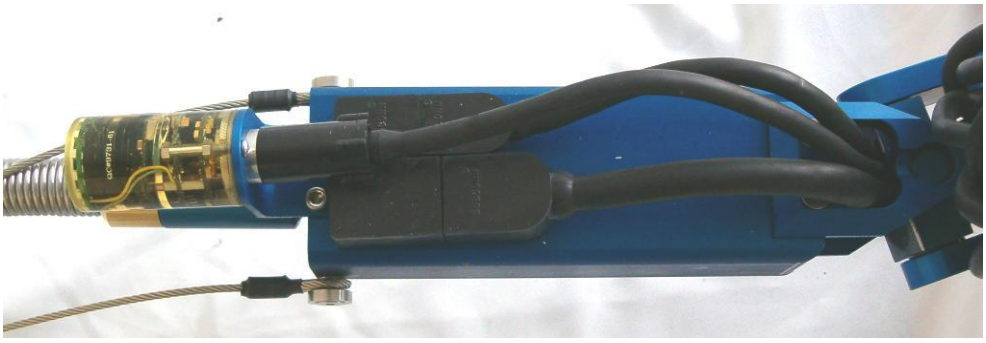


FIGURE 5: TETHER HOOK-UP & REMOVAL

Camera Installation

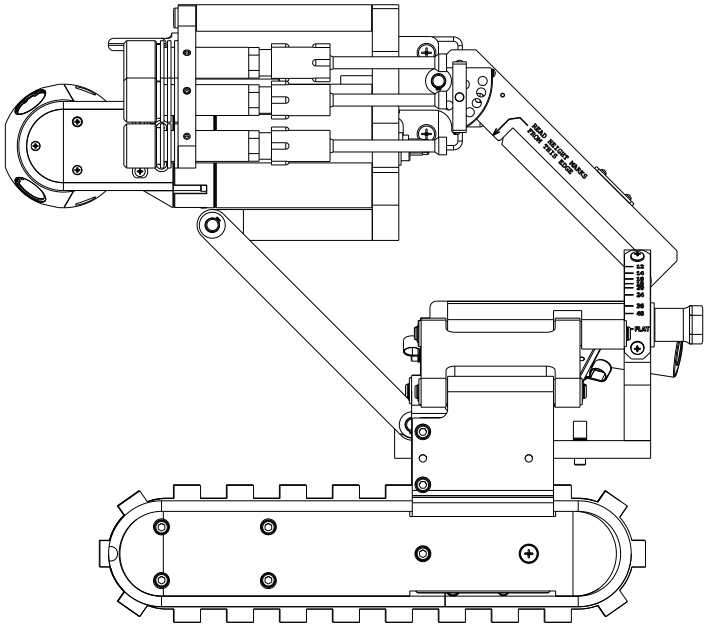


FIGURE 6: PREFERRED RAISE POSITION FOR CAMERA INSTALLATION

1. Adjust the Camera Raise Mechanism to the position shown in Figure 6. This will enable access to the camera installation screws.

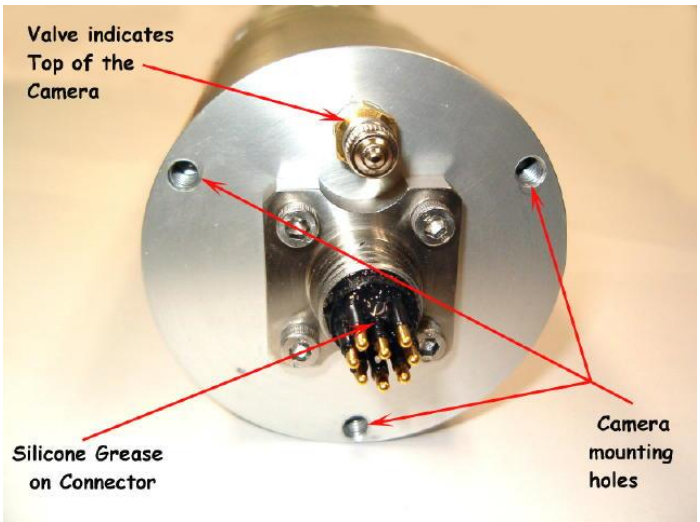


FIGURE 7: CAMERA MOUNTING HOLES

2. The brass valve indicates the top of the camera, as illustrated in Figure 7. Mount the camera as shown with the valve on top.

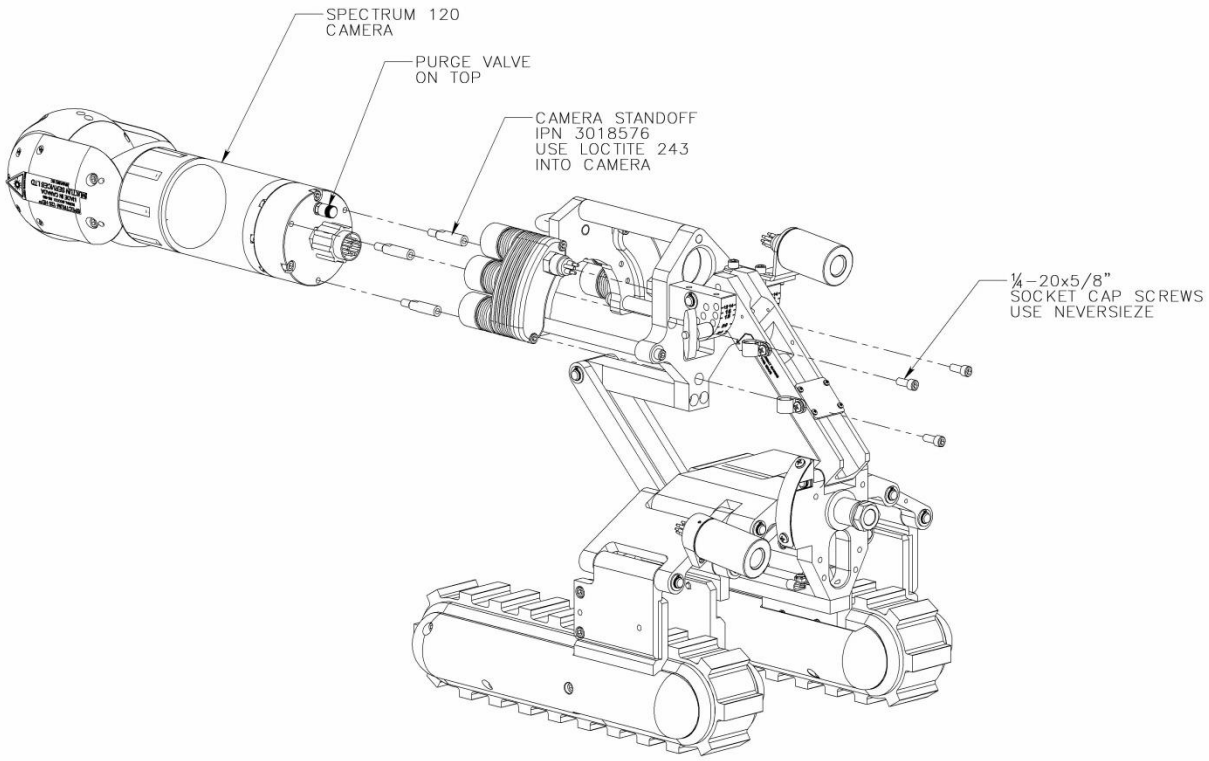


FIGURE 8: MOUNTING THE CAMERA

3. Ensure the camera standoffs (IPN 3018576) are installed onto the back of the SP120™ camera.
4. Slide the camera into position from the front of the light mount.
5. Install the connector while the camera is part way in. Ensure that there is enough Silicone grease on the connector and the female mate (in the pin holes). Push the whip connector onto the camera *all* the way. Screw the locking collar onto the bulkhead connector. Finger tight is good.
6. Move the camera into position against the mounting plate. Clear the connector into the square opening. Using three ¼-20 x 7/8in screws, fasten the camera to the rear plate. Use a 9/64in Ball end Allen key. Do not over tighten screws.

Auxiliary Light Installation

Auxiliary lights mount onto the back of the front face plate using ¼-20 x 5/8in socket cap bolts. The two light assemblies are identical and can be swapped from side to side. Plug the light connector all the way in and install the locking collar – finger tight only.

Warning: Cap unused light whips with dummy plugs. Open whips may short out the light driver circuit.

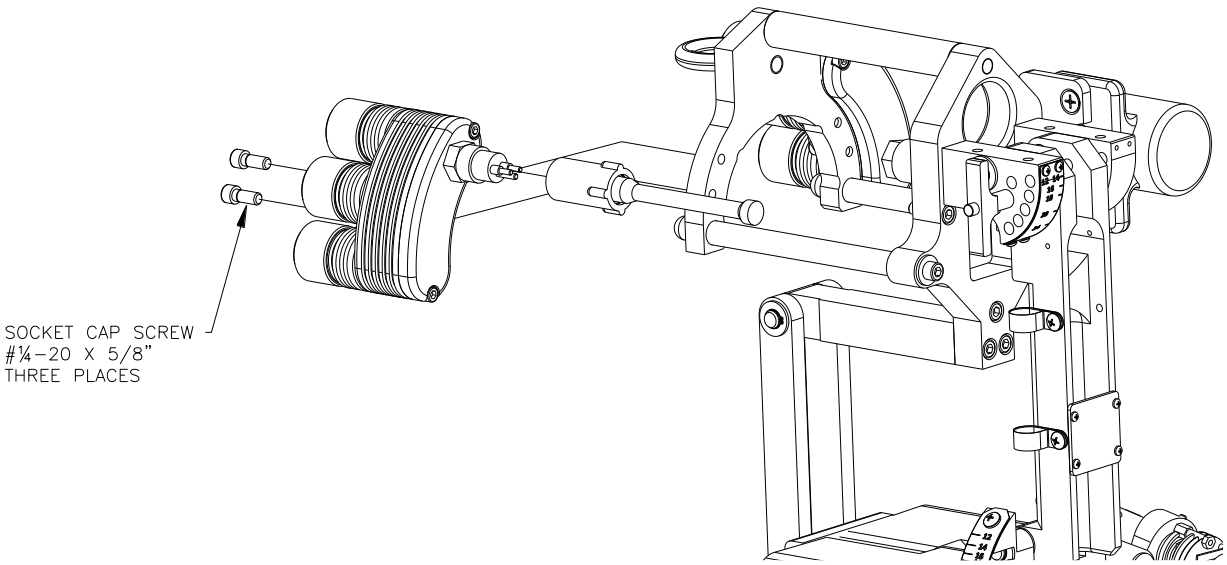


FIGURE 9: LIGHT INSTALLATION & ADJUSTMENT

Rear Camera Installation

The Versatrax 300™ system can accept one auxiliary 72V Crystal Cam® camera, which is designated as the rear facing camera for tether observation. As illustrated below, the mounting bracket is located on the back of the tether termination can.

Warning: The plug-in whip is supplied with 48 VDC. This whip must be capped with a dummy plug whenever the Crystal Cam® is removed. Electric shock or system damage may otherwise result. Never operate the system with this connector open.

Warning: The Versatrax Crystal Cam is different from a standard Crystal Cam. It uses a higher voltage and different connector than the standard Crystal Cam (eight and six-pin, respectively). You cannot use a standard Crystal Cam® with the Versatrax system. Attempts to install the standard Crystal Cam® will *destroy* the camera.

Installation:

1. Remove the cable clamp holding the camera whip.
2. Install the camera bracket as shown using two #10-24 x ½in pan head screws.
3. Install the camera using two #6-32 x ¾in pan head screws. Note the camera orientation marked "TOP" seen on the label inside the epoxy.
4. Apply a small amount of silicone grease to the camera connector pins.
5. Secure the locking collar after plugging in the camera.

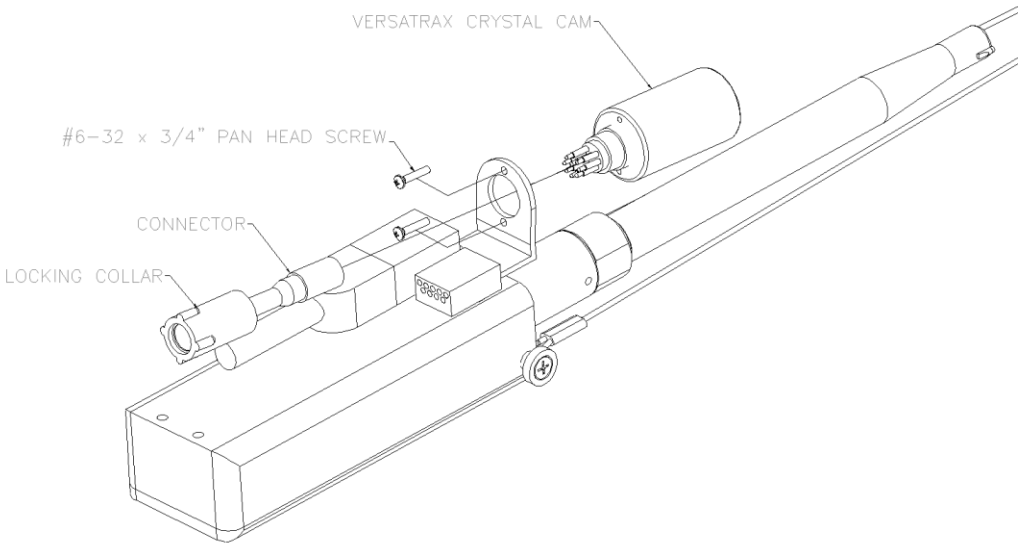


FIGURE 10: REAR CAMERA INSTALLATION

Auxiliary Camera Installation

An auxiliary camera can be mounted in one of three positions:

1. Track Level Position – In this position the camera is mounted on a special bracket on the track articulation mechanism. This is the recommended position if the vehicle is to be used in 12in pipe. The camera may be mounted on either the right or left-hand side of the vehicle.

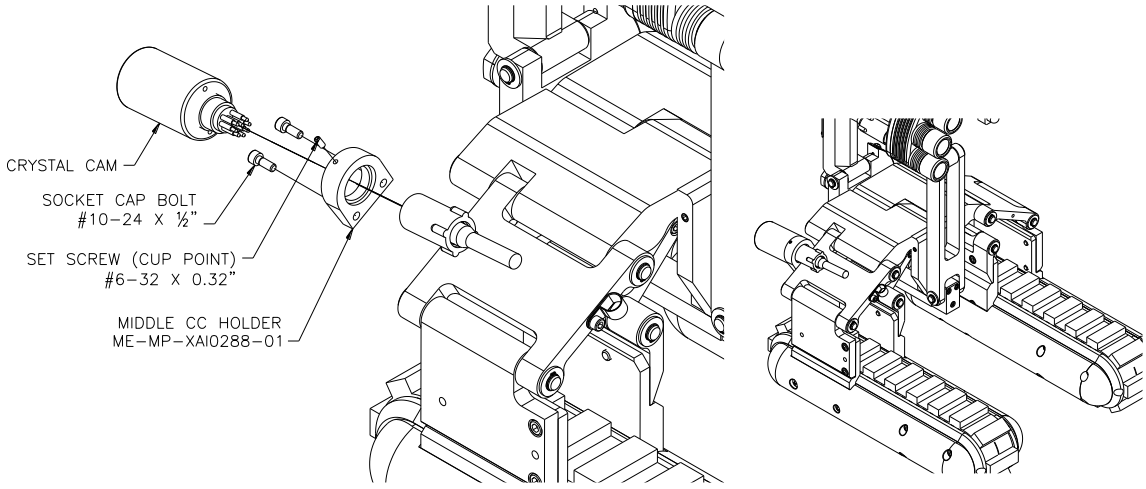


FIGURE 11: AUX CAMERA INSTALLATION – POSITION #1

2. Camera Raise Arm – In this position the camera is mounted behind the main camera on top of the camera raise arm. This is the recommended position for best view where pipe size allows.

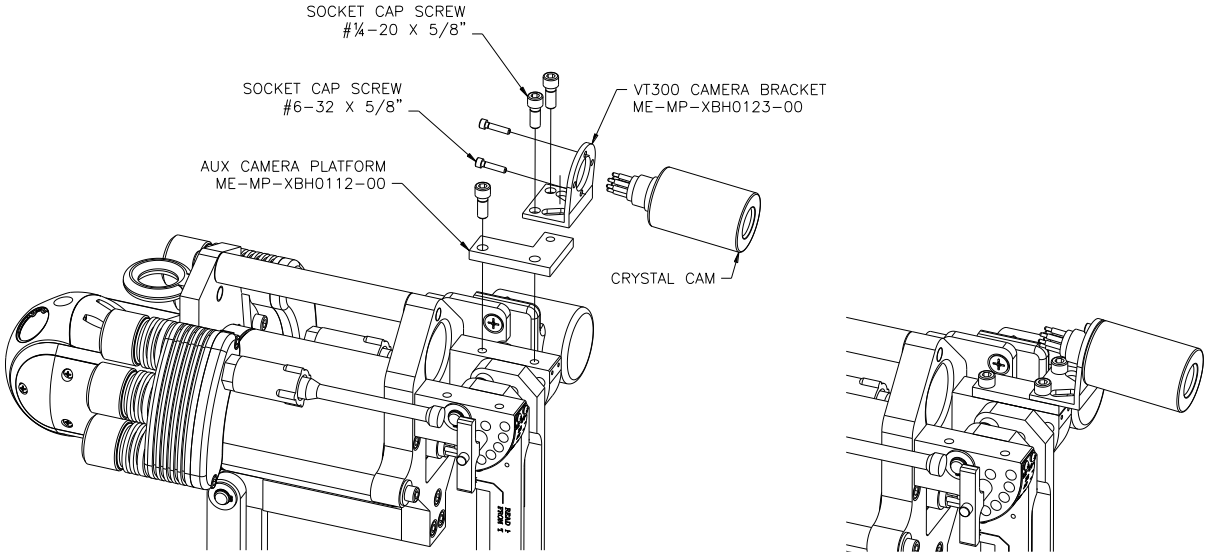


FIGURE 12: AUX CAMERA INSTALLATION – POSITION #2

3. Camera Raise Extension – In this position the camera is mounted to the side of the camera raise extension. Note that the camera mounting bracket can be swiveled up or down for best field of view and mounted on either the right or left-hand side of the bracket.

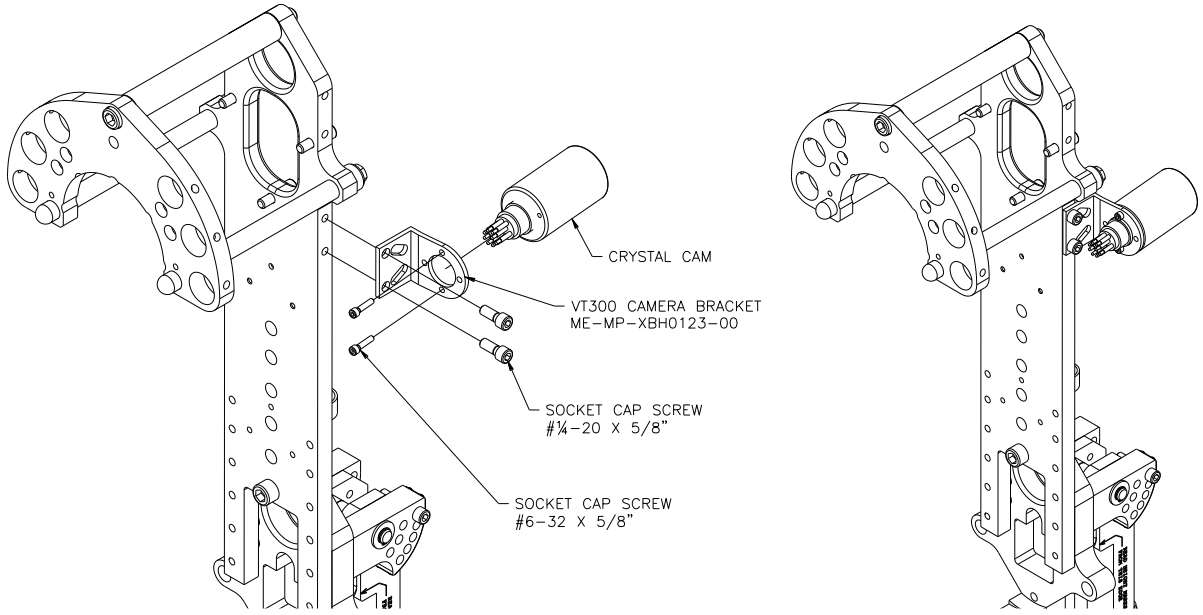


FIGURE 13: AUX CAMERA INSTALLATION – POSITION #3

Sonar Installation

The Imagenex 831A-P profiling sonar is the standard sonar for the VT300™ system. It is held in front of the tracks and camera by a bar which provide an unobstructed view of the pipe. The bar bolts on underneath the camera mount, and the sonar is clamped onto the bar using 4-inch stainless-steel hose clamps. The sonar is then raised up and down with the camera mount. When the camera extension plate is used, the sonar can be mounted on top of the bar for greater height.

If a full 360° view is required, the bumper portion on the front of the sonar bracket can be removed by undoing the two screws at the very front.

Note that other sonar makes may appear different or be held by different brackets.

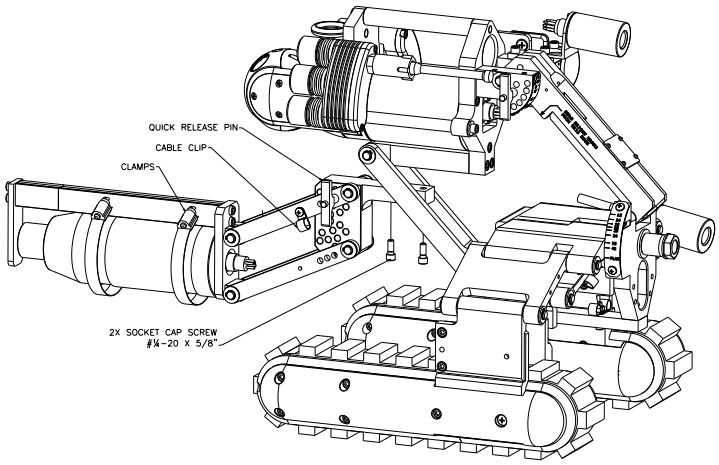


FIGURE 14: STANDARD SONAR MOUNT

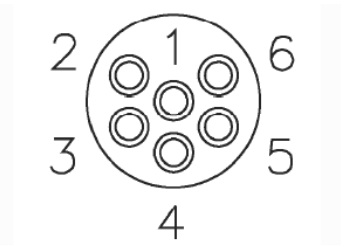
Ethernet

A 6-pin Subconn connector provides a connection for an Ethernet device to be installed on the vehicle. ±15VDC is also provided on this connector to power the Ethernet device. The connection is 100BASE-T however the maximum data throughput is 10Mbps.

Refer to Section “Fiber Interface Box” for Ethernet connection to a PC or laptop.

Pinout for MCBH6F Subconn Bulkhead - Ethernet

Conductor Name	Pin
Ethernet A(+)	1
Ethernet A(-)	2
Ethernet B(+)	3
Ethernet B(-)	4
15VDC	5
-15VDC	6



Female Bulkhead
Face View

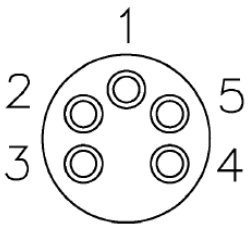
RS-232

A 5-pin Subconn connector provides a connection for an RS-232 device to be installed on the vehicle. 5VDC is also provided on this connector to power the RS-232 device. This port is compatible with signal voltage levels from TTL to ±25V.

Refer to Section “Fiber Interface Box” for RS-232 connection to a PC or laptop.

Pinout for MCBH5F Subconn Bulkhead – RS232

Conductor Name	Pin
5VDC	1
5V GND	2
RS232 (Rx)	3
RS232 (Tx)	4
Not connected	5



Female Bulkhead
Face View

Size Configuration 12in – 36in – Flat

Warning: Pinching hazard. Keep your fingers out of the mechanism while changing size.

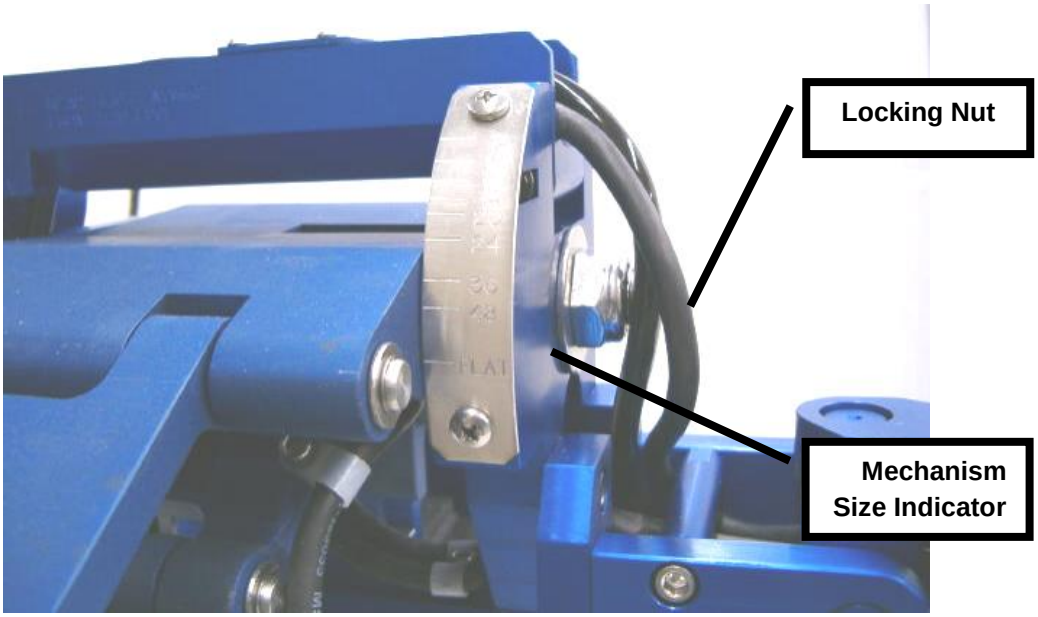


FIGURE 15: VEHICLE CONFIGURATION SIZE INDICATOR

Track angle adjustment for pipe sizes has been made relatively simple. A large mechanism locking nut is located at the rear of the vehicle (Figure 16).

To change configurations, back the nut off until loose. Take hold of the left and right tracks and pivot them in or out. It takes only a bit of practice to do. Both tracks will pivot at the same time. Read the current configuration size from the indicator strip shown. At the desired readout, hold the track in place and tighten the locking nut. Sometimes it will be helpful to have a little tension on the nut to be able to fine tune the mechanism and then fully tighten.

Note: If track extensions are installed the indicated pipe sizes will no longer read correctly. In this case use the following chart to find the correct indicator readings:

Track Extensions – Chassis Mark Conversion Chart

Nominal Pipe Size	Chassis Mark	Camera Platform Mark
16 in	Does Not Fit	Does Not Fit
18 in	13 in (Not Recommended)	Not Centered (use Full Down)
20 in	15 in	14 in (Full Down)
24 in	19 in	18½ in
36 in	34 in	Full Up
48 in	47 in	Not Centered (use Full Up)

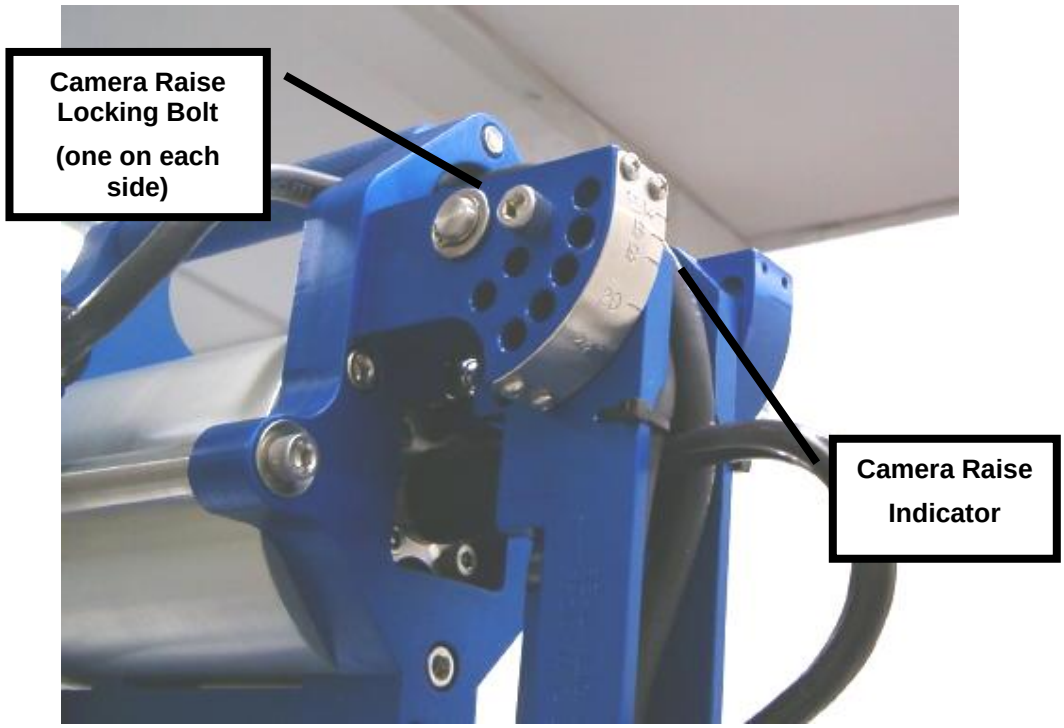


FIGURE 16: CAMERA RAISE CONFIGURATION INDICATOR

1. On the camera raise mechanism note the various hole positions for the locking screw. Remove the locking screws on both sides and raise the camera to the nominal pipe size indicated on the Camera Raise Indicator (Figure 17). Replace the locking screws.
2. The indicator sizes are suggested settings. Note that there are more possible positions than those indicated. At any time, the settings may be varied to suit conditions.

Traction Weights

The vehicle is equipped with a set of weights to add a total of 50 pounds to the four-track vehicle and 25 pounds to the two-track vehicle for extra traction. The weights are placed on the sides of the Minitracs™ to help keep the center of gravity as low as possible. They are shaped to maintain maximum track clearance.

It is recommended the weights be installed for operations over 3000 feet and left off for shorter distances for easier handling. Because the outside weights are easiest to install, they should be put on first. Install the inside weights only if the extra traction is required.

Refer to Drawing ADBH007493 SHEET 2.

Installing Exterior Weights – The exterior weights are all the same and can be installed on the right or left-hand side. Use #¼-20 x 5/8in socket cap bolts in the first five positions and a ¼-20 x ½in Pan Head screw for the rear position.

Installing Interior Weights – The interior weights have a right and a left-hand side. Note that because the front and rear chassis point in opposite directions that the right-left weights are swapped on the back.

When installing the inside weights, notice that the track whip is routed through a cut-out in the whip, as in Figure 19. The whip exits though the top side of the weight next to the linkage. Be careful when installing not to pinch the wires.

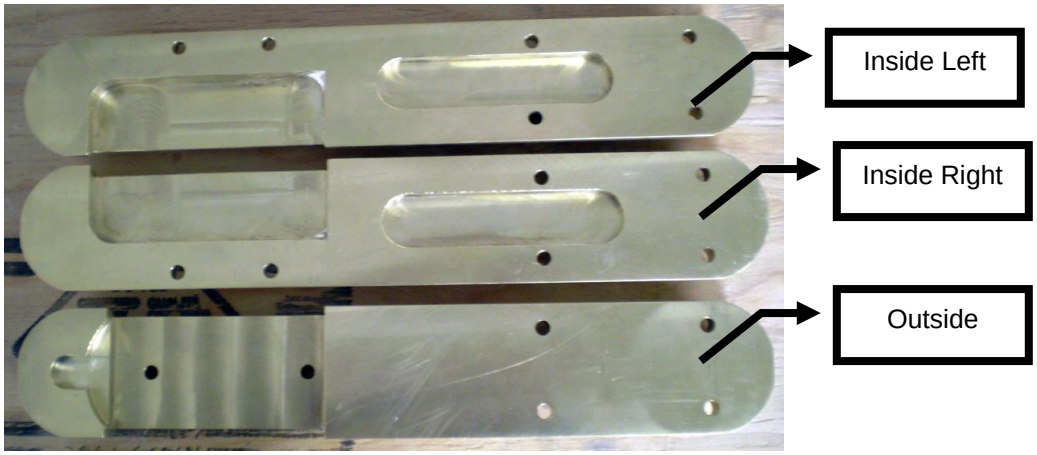


FIGURE 17: TRACK WEIGHTS

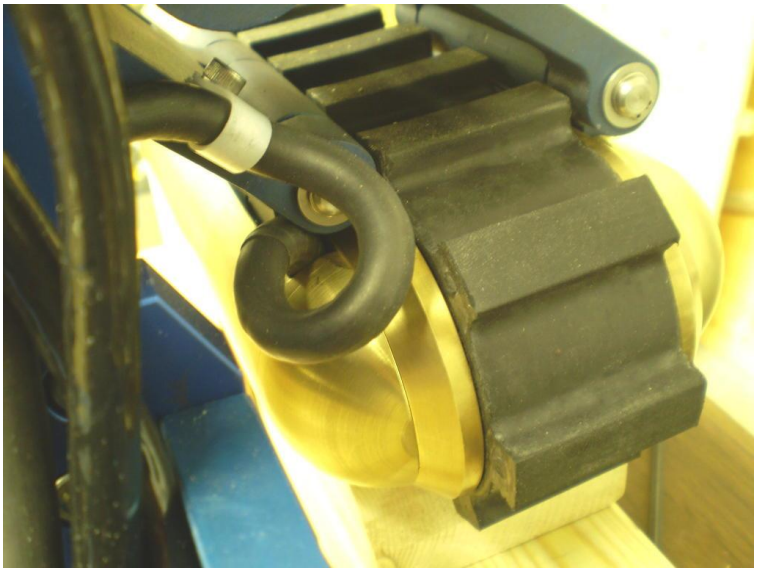


FIGURE 18: INSIDE TRACK WEIGHT - WIRE ROUTING

Camera Raise Extension

The Camera Raise Extension is an optional bolt-on bracket which raises the camera by 14 inches. To install the bracket, refer to DWG ADAI0030:

1. Remove the camera, handle and bumpers from the vehicle and install them on the extension bracket. The top of the extension bracket is made the same profile as the original camera mount.
2. Bolt the extension bracket onto the original camera mount using two ¼-20 x 1in socket cap bolts from the back and one 3/8-16 x 1¼in bolt from the front. The height of the bracket can be adjusted to six different positions.
3. Mount the camera and lights as usual on the raise bracket.
4. Install the supplied wiring harness extension to the camera. Whips for the sonar and lights have already been made long enough to accommodate the camera extension.
5. The auxiliary camera can be mounted to either side of the extension as shown. The curved slots in the camera mounting bracket enable the camera to tilt up or down for best viewing angle. See the section above for camera installation.

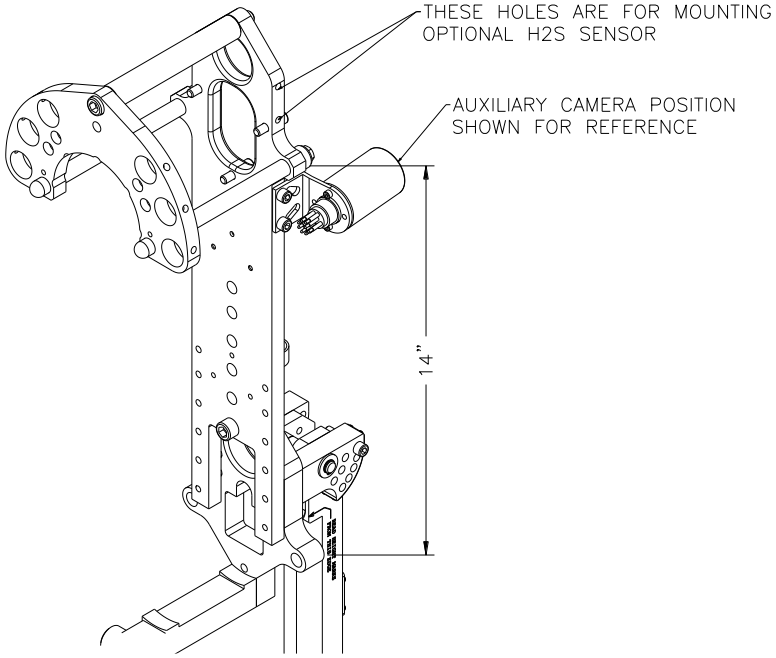


FIGURE 19: CAMERA RAISE EXTENSION

Track Extensions

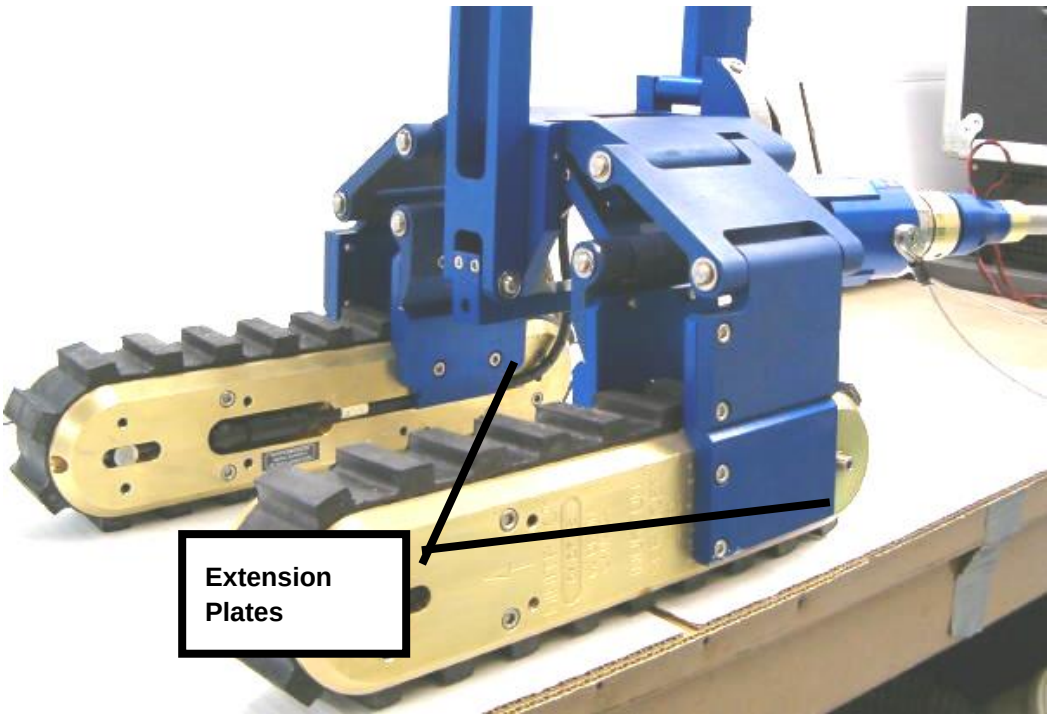


FIGURE 20: TRACK EXTENSIONS

VT300 Chassis Track Extensions – Refer to assembly drawing ADBH007493.

The above photo shows a chassis with the track extension plates installed. The plates simply bolt onto the mechanism brackets using #¼-20 x 5/8in socket cap screws. The tracks then bolt onto the extension plates as they normally would on the chassis. The extension plates raise the vehicle 2.7” for greater ground clearance.

Please note that with extensions the indicated pipe sizes no longer read correctly and the conversion table mentioned in this manual must be used.

Wire Harness Routing

There are numerous different configurations and accessories which must be accommodated by the VT300™ chassis. In turn the wiring harness must be similarly flexible. Of equal importance is protection of the cables from stretching, twisting, chafing and getting caught in the pipe. To accomplish this the harness is composed of individual component whips and routed via a special cable pathway though the length of the vehicle. This is illustrated in the two figures below.

Starting from the back of the vehicle and working forward:

- Two telemetry cables connect the tether termination can with the telemetry can. These are routed through the rear hinge pass-through and connect on the top of the telemetry can.
- The rear camera whip follows the same route through the rear hinge and plugs into the connector face. This same whip will plug into the Sonde/camera unit whenever it is installed.
- All remaining whips for vehicle functions connect to the back face of the telemetry can, bend (around the top) and enter the rear cable trough.
- The illustration below shows the connector locations on the telemetry can.
- All connectors are equipped with a locking collar which must be screwed down finger-tight.
- A tie-wrap is placed at the trough exit to hold the cable bundle down. The tie-wrap can be anchored around the top row of connectors.

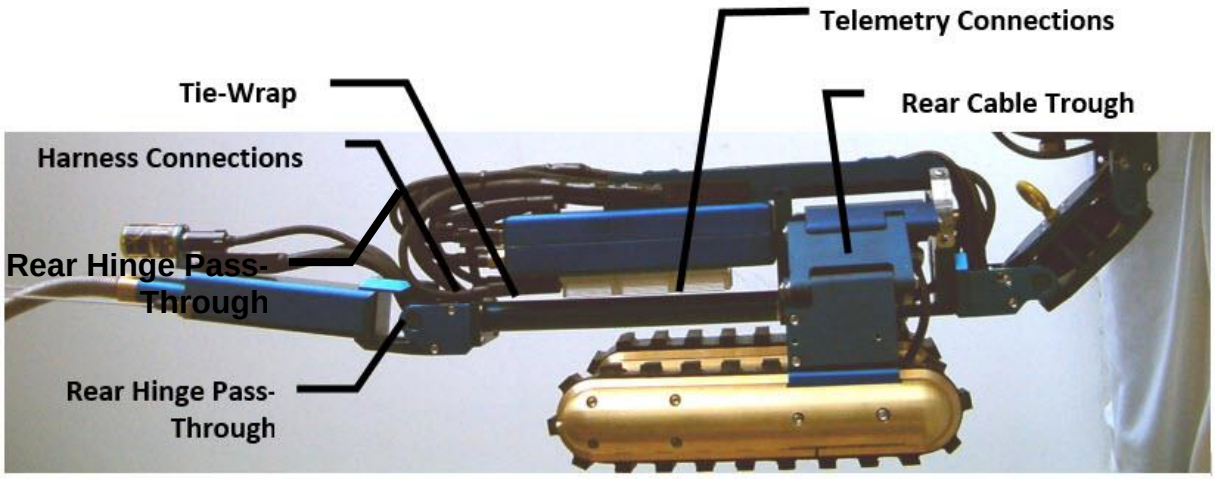


FIGURE 21: REAR WIRE ROUTING

- At the other end of the cable trough the wires plunge down into the middle hinge and reemerge at the front chassis. The two cables for the rear tracks branch off before the hinge and enter the rear chassis.
- The two cables for the front tracks branch off after the mid-hinge and enter the front chassis.
- Figure 22 illustrates how the track whips are routed and constrained inside the chassis. In (1) the bottom support bar is removed to show the cable loop. The cables enter the chassis from the harness bundle, make a complete upwards loop and attach to the butterfly hinges with cable clips before entering the tracks. In (2) another set of clips are used to secure the bottom of the loop. An extra coil (3) may be used to accommodate the extra track length needed for the track extensions.
- Cables for the main camera, lights and sonar enter the front cable guide and exit behind the camera.

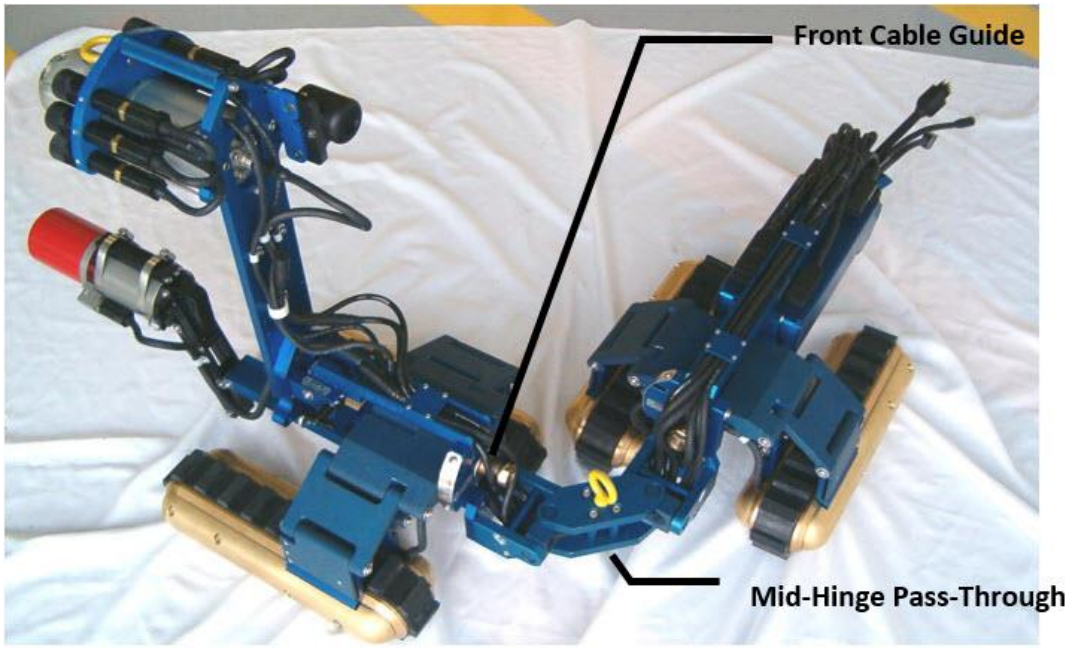
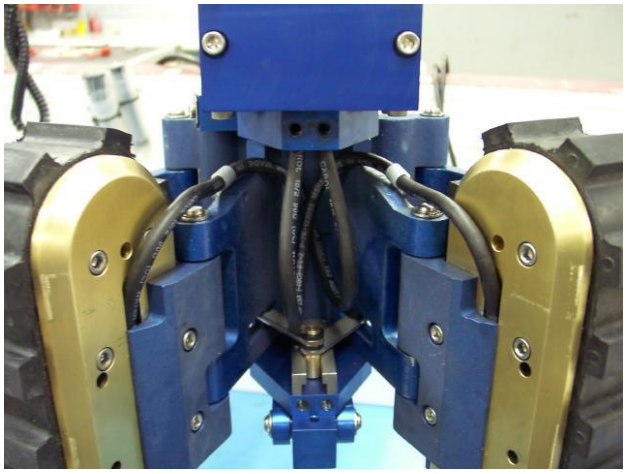
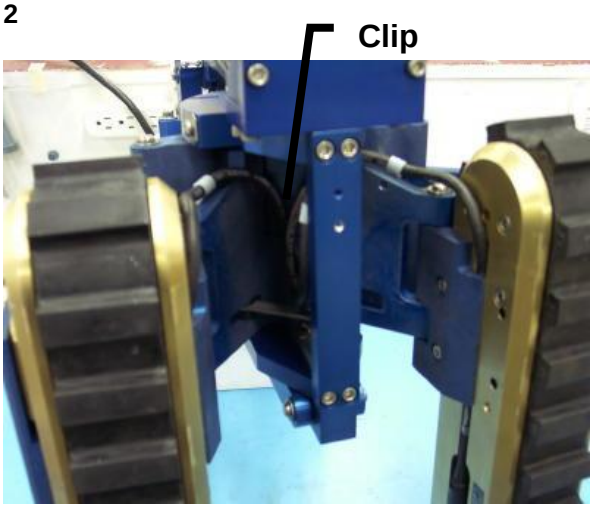


FIGURE 22: CHASSIS CABLE ROUTING

1



2



3

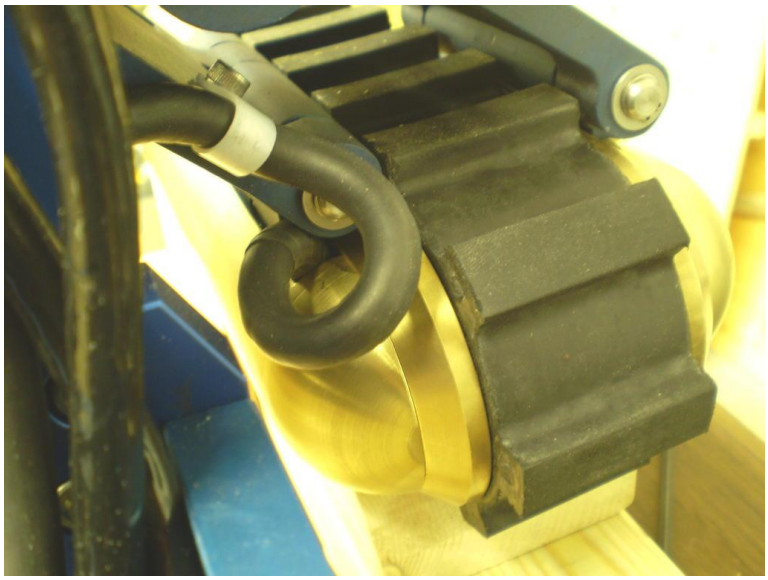


FIGURE 23: TRACK WIRE CONSTRAINT LOOP

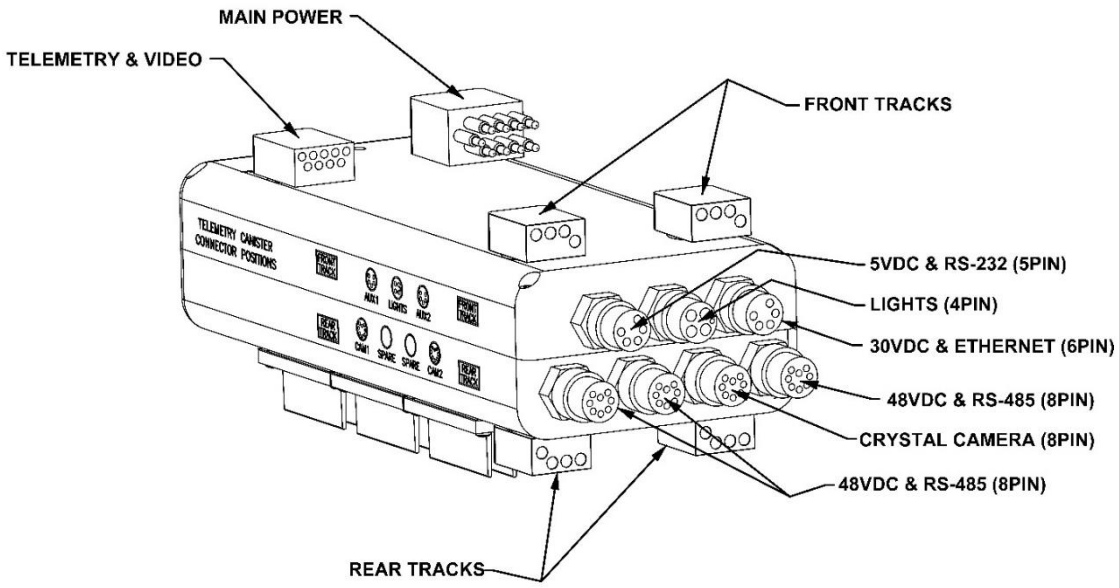


FIGURE 24: CONNECTOR ASSIGNMENTS

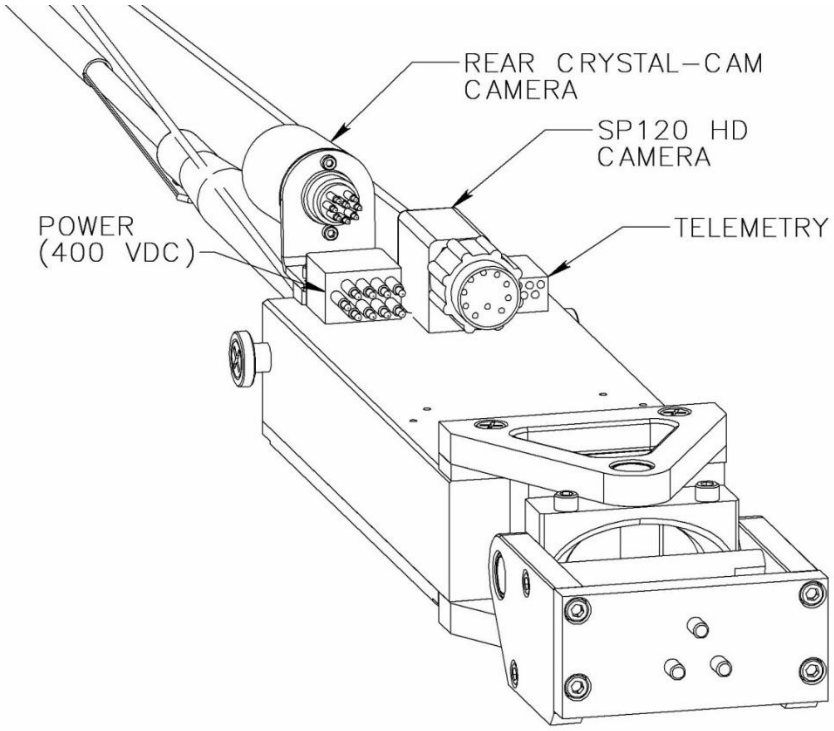


FIGURE 25: TERMINATION CAN CONNECTORS

FIGURE 26: EXTENSION BRACKET WIRE ROUTING

When the camera raise extension, bracket is installed:

- Route the sonar cable through the original camera mounting plate.
- Install a camera extension whip onto the Spectrum 90™ cable.
- Install the light extension whips onto the light cables.
- Wires can be tied down to the extension plate using cable clips as shown in Figure 26 above.

Inline Vehicle Configuration (6-8-10-12)

Installing the Tracks

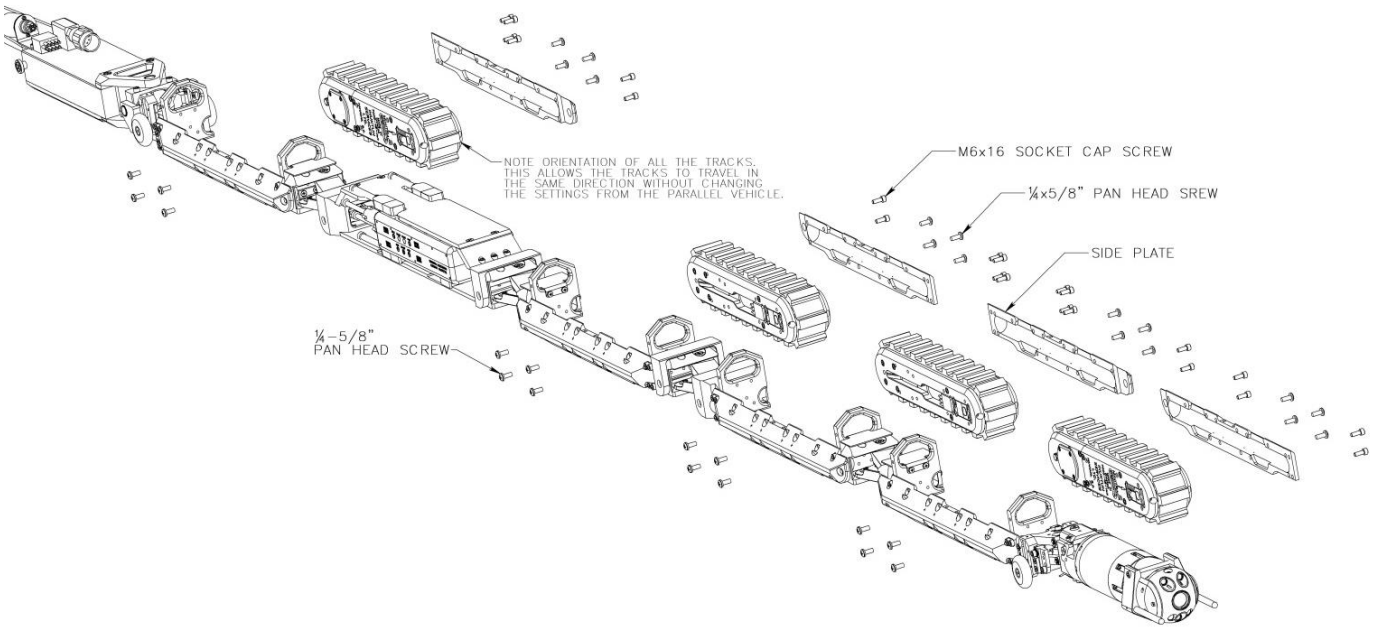


FIGURE 27: INLINE TRACK MOUNTING SCREWS

Tools required to install the tracks and side plates onto the inline chassis: 5 mm T-Handle Allen wrench; Large Phillips screwdriver.

***Warning*: Pinching Hazard.** Keep your fingers and hands out of the X-Hinge. Do not hold or lift the vehicle by the X-Hinge. Severe pinching and hand injury may result. Always use the handles for lifting.

1. The in-line vehicle shares all the modular components with the parallel vehicle. These components must be removed for installation onto the in-line chassis:
    - 4x Tracks
    - Main Spectrum camera and auxiliary crystal cameras.
    - Telemetry Can
    - Tether Termination can with brackets.
2. The wiring harness is not transferrable. Cabling for the in-line vehicle is much longer. The in-line chassis has its own dedicated set of cables which can remain installed in the chassis.
3. The heat sink fins must be removed from the telemetry can.
2. Place the vehicle on a suitably long work bench (minimum 15' or 450 cm) with the tracks in the orientation shown. In this way the tracks will both operate in the forward direction as they do for the parallel configuration (no track reversal settings necessary in the controller). The far side plates may remain attached to the handles and hinges as shown.

3. Attach the tracks to the far side plates using ¼-20 x 5/8-inch pan head screws. Ensure both track connectors are fully secured.
4. Attach the free side plates using M6x16 socket cap screws.
5. Install the remaining ¼-20 x 5/8-inch track screws.

Details for installing the telemetry can are illustrated below.

6. Ensure the heat sinks are removed from the telemetry can. Remove the carrier plates – not the fins from the plates.
7. Cabling is routed underneath the telemetry can as seen in Figure 28. It is best to turn the vehicle upside down to rout the cabling.
    a. Remove the bottom plate (35).
    b. Position the telemetry can on the top plate.
    c. Plug in the cables and install dummy plugs on un-used connectors
    d. Rout wires underneath the telemetry can as shown in Figure 2.
    e. Install the bottom plate.
8. Heat transfer paste may be added between the telemetry can and the top plate.

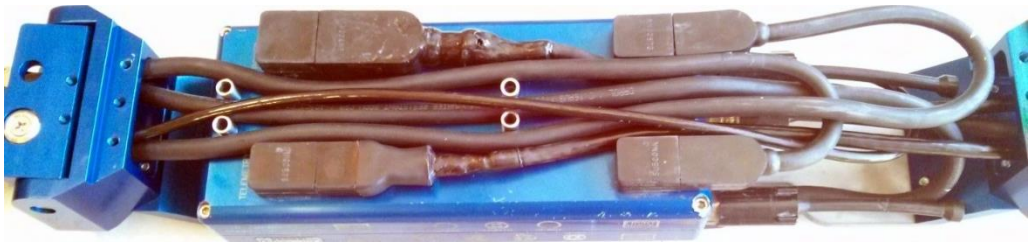
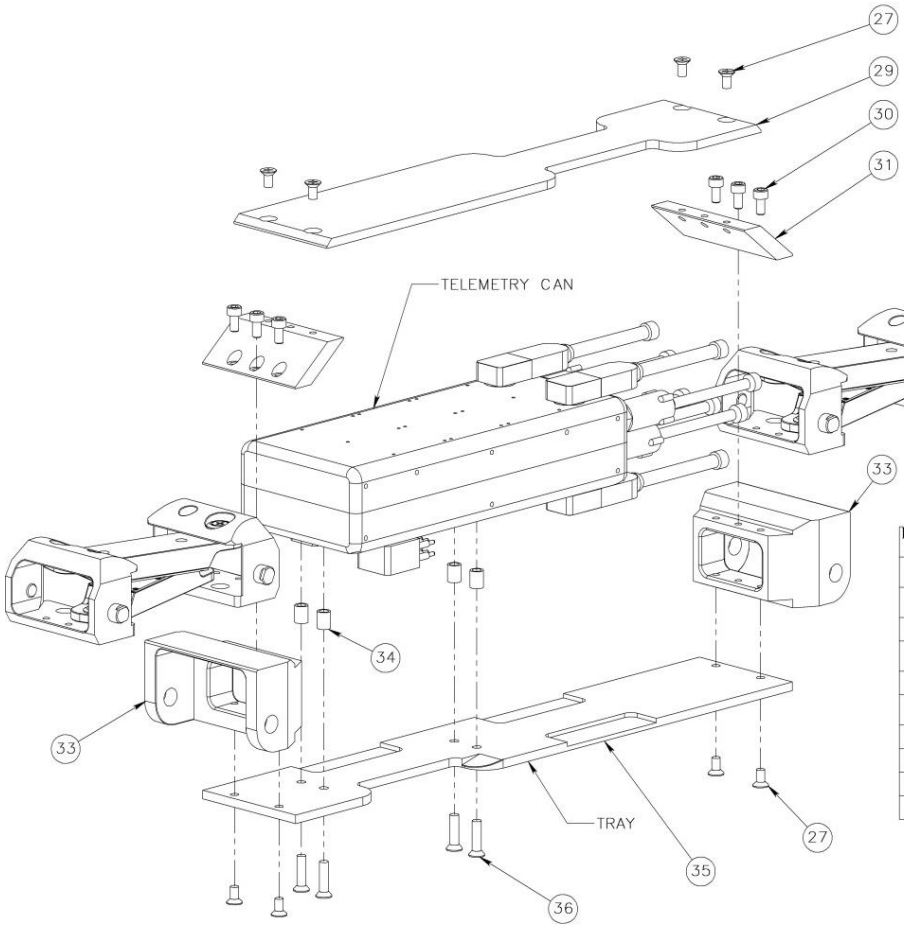


FIGURE 28: TELEMETRY CAN CABLING



ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY
27	4034553	FHMS, M5x10mm, SS316, PH, Recessed, B18.6.7M	SS316	4
27	4085542	FHMS, M6x12mm, SS316, PH, Recessed, B18.6.7M	SS316	8
29	3052142	Cover, Telemetry, VT300, In-Line	AL6061-T6	1
30	4062173	SHCScrew, M6x12mm, SS316, Hex, 12mm Thread, B18.3.1M	SS316	6
31	3052139	Bracket, Telemetry, VT300, In-Line	AL6061-T6	2
32	3035445	Sticker, Safety, Pinch Hazard, 1.5 X 3.15	PLASTIC	4
33	3052133	Telemetry Coupler, VT300, In-Line	AL6061-T6	2
34	3052145	Spacer, Telemetry, VT300, In-Line	SS316	4
35	3052136	Tray, Telemetry, VT300, In-Line	AL6061-T6	1
36	4010226	FHMS, 0.25-20x1x1, SS316, 1/4-20	SS316	6

FIGURE 29: INLINE TELEMETRY CAN INSTALLATION

Installing The Spectrum 90™ Camera

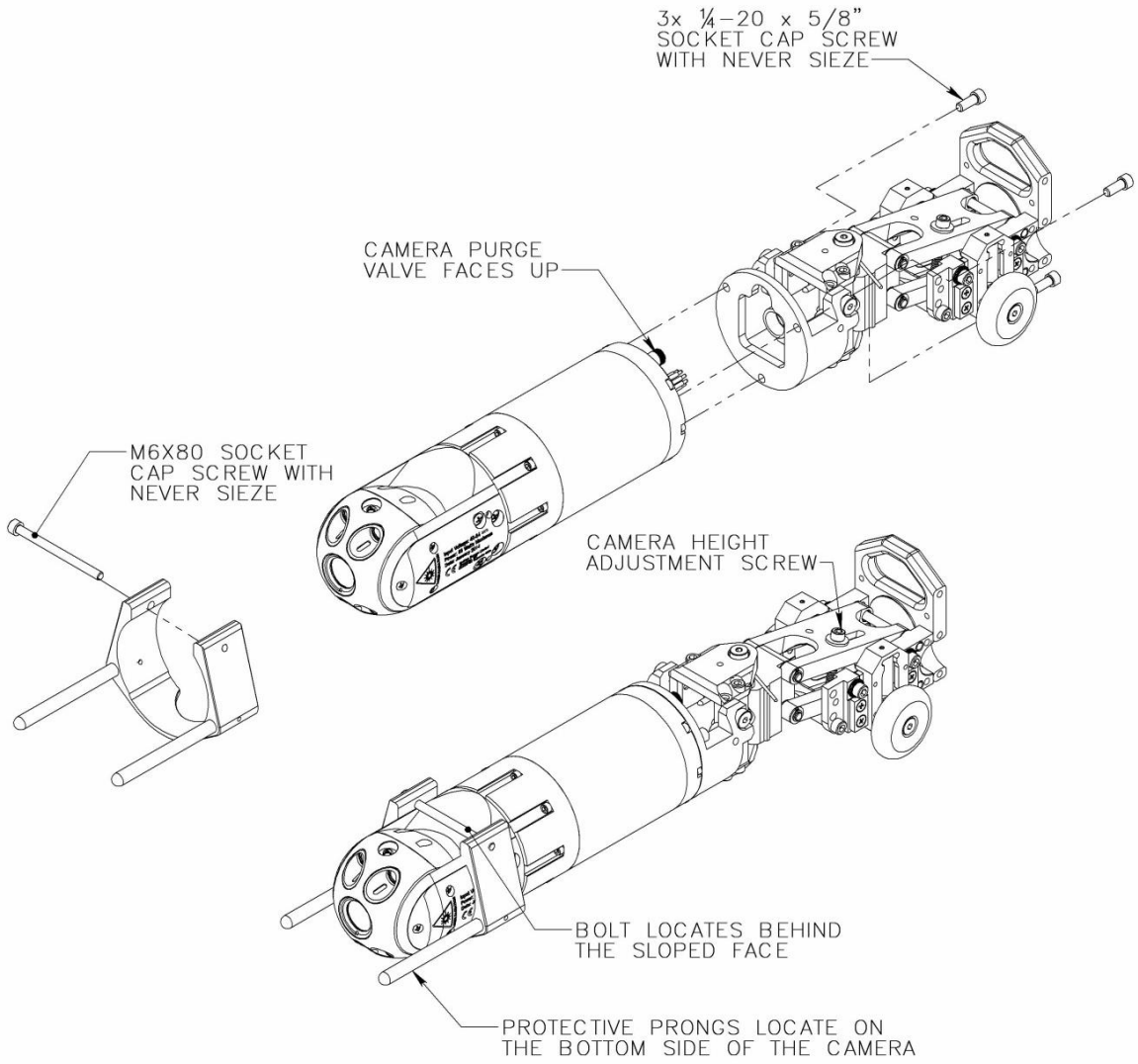


FIGURE 30: INLINE CAMERA INSTALLATION

Install the Spectrum™ camera on to the front of the vehicle using three ¼-20 X 5/8-inch socket cap screws and a ball end Allen wrench. Orient the camera with the purge valve facing up.

The protective prongs are optionally installed over the rotating portion of the camera. Fully remove the M6x80 socket cap screw and slide the holder over the camera head to the position shown above. For best camera protection, orient the prongs near the bottom of the camera. Push the holder back until the bolt contacts the sloped face behind the camera head. Lightly snug the bolt in place.

Camera Height / Guide Wheel Adjustment

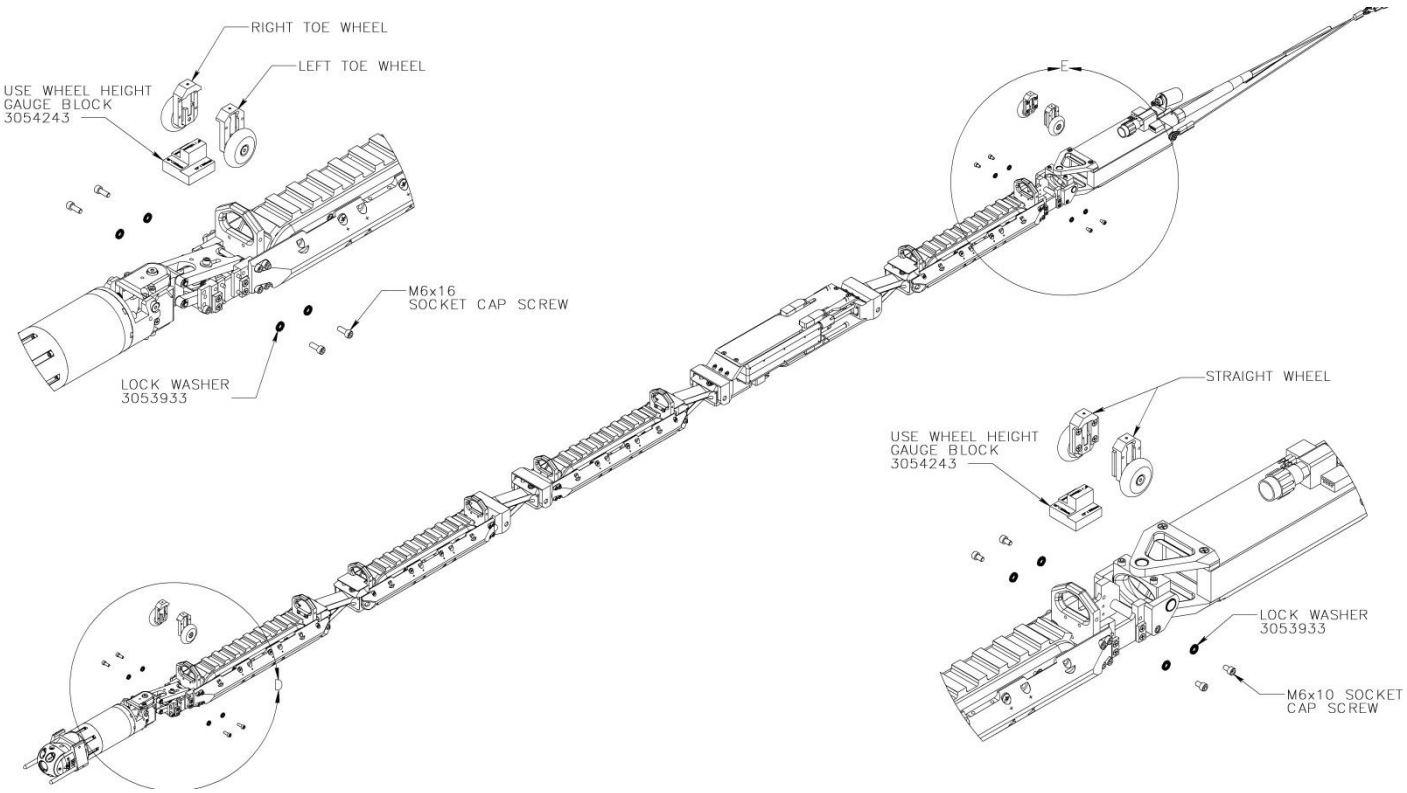


FIGURE 31: CAMERA HEIGHT / GUIDE WHEEL ADJUSTMENT

For proper operation and stability, the chassis must be adjusted for the target pipe size.

Camera Adjustment: There are four sizes of camera height brackets for 6, 8, 10- and 12-inch pipe (150, 200, 250, 300mm). Install the bracket that best centers the camera in the target pipe size.

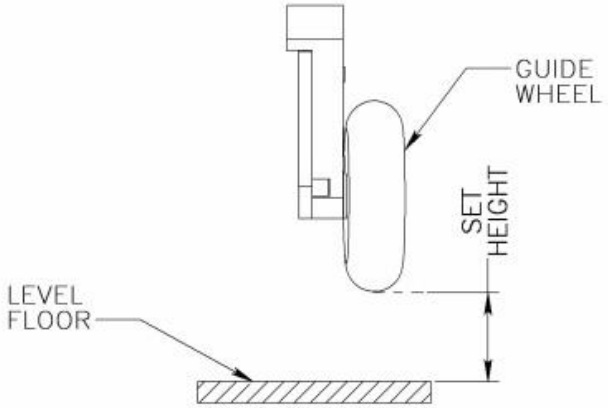
Rear Camera: The rear camera must be removed for 6-inch pipe but may remain in place for 8-12-inch pipe.

Guide Wheel Adjustment: First, ensure the guide wheels are located correctly on the vehicle. As illustrated above, the front guide wheels must be toed outward from the vehicle by 2½°. An incorrect installation (toed in) will result in vehicle instability. The rear guide wheels are straight.

Set the wheel height to suit the target pipe. The wheels should be just lightly touching the pipe. The chart below outlines approximate wheel heights for standard pipe sizes. A guide wheel height gauge (3054243) is also provided with the system for generic pipe sizes.

Recommended wheel height from flat surface:

Pipe Size	Wheel Height
6	28 mm (1 1/8 in)
8	16 mm (5/8 in)
10	13 mm (½ in)
12	11 mm (7/16 in)



Rear Camera Installation (In-line)

The rear camera mounts to the tether termination block in the same way as it does for the parallel configuration. See “Rear Camera Installation.”

Traction Enhancement (In-Line)

There are two kinds of traction enhancement devices which can be attached to the VT300™ In-Line vehicle. The first uses an active drive belt which borrows power from the Minitrac. This traction enhancement is intended for use in 8-12” (200-300 mm) pipe. The second type of traction enhancement uses a passive press wheel which also mounts on top of the track and presses up on the roof of the pipe. It is intended for use in 7-9” (175-230 mm) pipe. Traction enhancement can be added to tracks individually.

To install the active traction enhancement:

1. Referring to the illustration above, install parts 3037551 and 3037554 onto the chassis side plates using M6x25mm Socket Cap Screws. Note: Assemble all fasteners using Loctite 243 (blue).
2. Spacers are added so the top belt is driven by the track by pressing against the top of the lugs. Note in the situation the lugs do not necessarily mesh. If the belts are placed too close, they may

jam. Bolt the mechanism onto the mounting arms using M6x30mm socket cap screws. The length of these screws may be adjusted as necessary depending on how many spacers are used.

3. Assemble the tension arms as shown onto the chassis.
4. Insert the springs into the tension arm slots and stretch the spring over the grooved spring mounts.

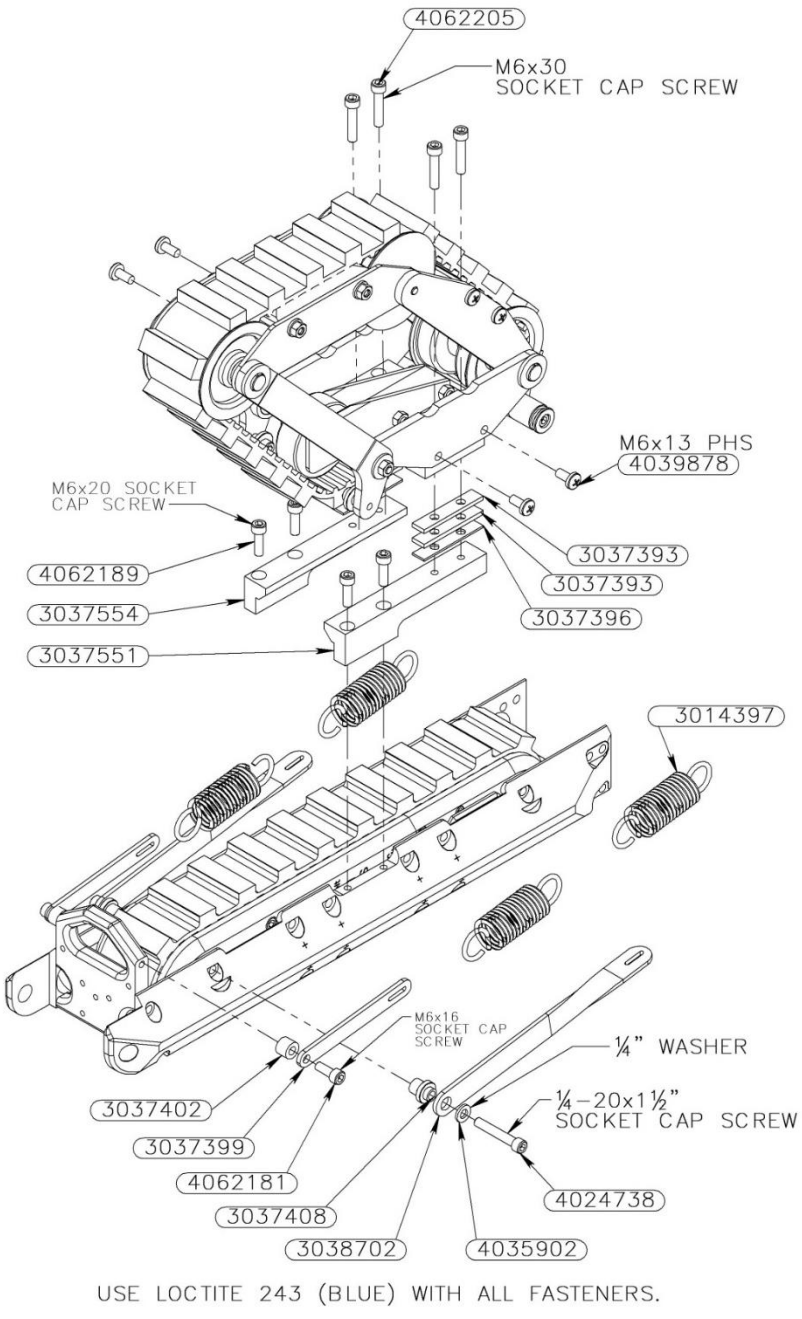


FIGURE 32: 8-12" ACTIVE TRACTION ENHANCEMENT

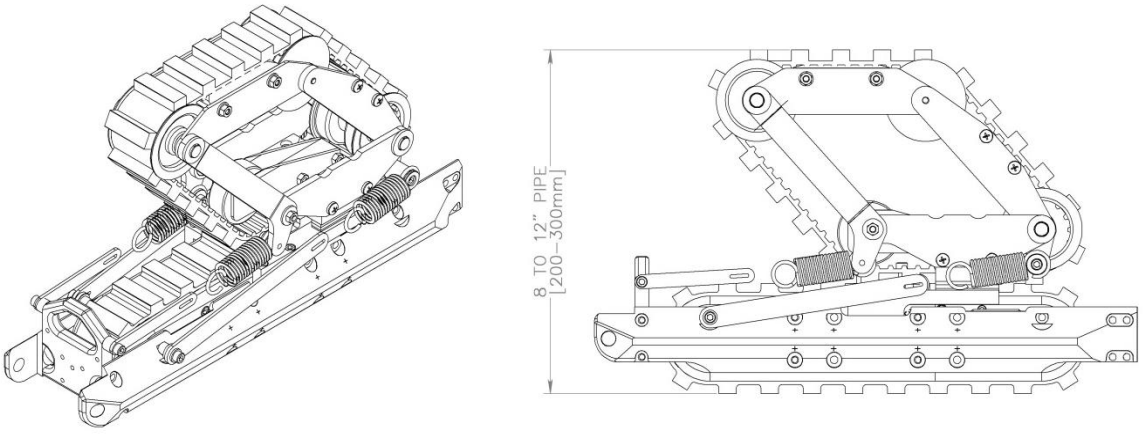


FIGURE 33: 8-12" ACTIVE TRACTION ENHANCEMENT AS INSTALLED

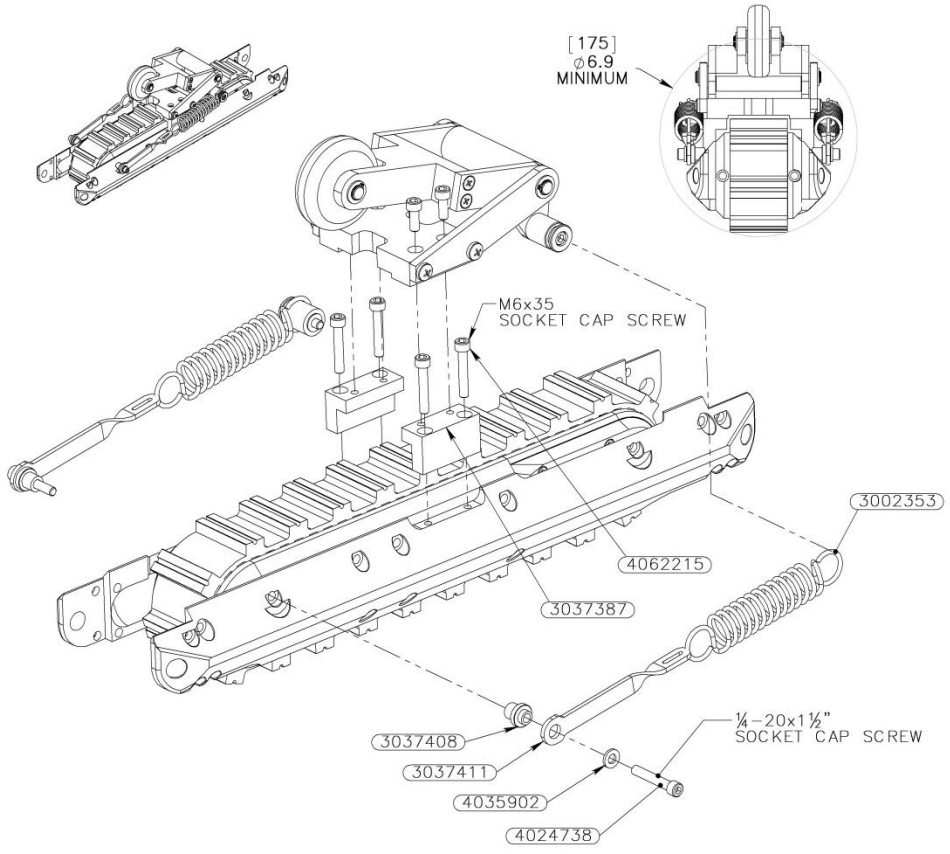


FIGURE 34: 7" PRESS-WHEEL TRACTION ENHANCEMENT

Operation

Communication

Establish a good channel of communication between the operator and deployment personnel: whether this be a system of signals, PA system or audio headsets. Good communication can avoid accidents and damage to the equipment. The person deploying the vehicle and watching the tether must be able to quickly tell the operator to stop the vehicle when something goes wrong. Because he is situated in the office-like van, the operator is often provided with a CCTV system or view port so he can see directly what is happening at the manhole.

Tether Handling

The tether should be considered the most important part of the vehicle system. It feeds power and control signals to the vehicle and returns data from the sensors. If the tether becomes damaged from improper use, poor handling or an accident, the vehicle may become crippled or inoperable. This is a serious situation because of the cost for tether repairs, as well as significant downtime and loss of production. For maximum tether life and reliability, ISL offers the following tether handling tips:

Never step on the tether. Trampling the tether may crush conductors, leading to premature failure. Trampling is also abrasive to the tether jacket. Trampling fosters the wrong attitude toward the tether. Remember, this is an expensive multi-conductor tether, not a common electrical extension cord.

Never allow vehicles, trucks, cars, etc. to drive over the tether. This will do concentrated, immediate and permanent damage. Set up cones or blockades to keep vehicles away.

Do not bend the tether beyond its minimum bend diameter. The VT300™ fiber-optic tether has a minimum bend diameter of 16in. If the tether has difficulty bending, you have bent it too far. If the tether is bent beyond its minimum diameter on pulleys or around corners wire fatigue will be accelerated. It is important that any pulleys or tackle support the tether at or beyond its minimum bend diameter. For an extended fatigue life, the minimum bend diameter should be considered larger.

Never kink the tether. A kink will permanently break the fibers and disable the vehicle. A broken fiber cannot be repaired except by cutting the tether at the break and re-terminating. Take precautions to never allow the tether to kink. Kink situations may occur when there is slack tether with closing loops, or when coils slip off a full drum.

Do not snap load the tether. Your tether has a maximum safe working load of 300 lb tension. Loads may peak at a very high value when the tether snaps taut. Snap loading may easily occur when a slack tether is reeled onto a motorized spool, or when the vehicle is suspended from a swinging deployment crane.

Avoid loading the tether unnecessarily. Unnecessary large loads will only shorten the fatigue life of the tether.

Always use the Kellems grip strain relief on the vehicle. The VT300™ is powerful and can generate a lot of pulling force. Even though the tether termination is designed to withstand tension in an emergency, it is best to protect it with a strain relief.

Never fully un-spool the tether. The surface end of the tether is anchored to the spool drum. If the spool is turned past the anchor point, the tether will be instantly broken and require re-termination. To help prevent this a band of tape has been wrapped around the last few coils to act as a visible and audible warning that the tether is fully paid out.

Connector Handling

With regards to system reliability, connectors come next after the tether in terms of importance, though not quite as expensive to replace as a whole tether, a damaged connector can still represent significant cost in downtime and re-termination which could easily have been prevented. To this end, we recommend the following steps to help prevent damage to connectors.

1. When plugging in a connector:
    a. Inspect for dirt in both sides of the connectors. Do not plug in a dirty or damaged connector.
    b. Inspect for bent or burnt pins.
    c. Visually align the key-way or locating pin first before plugging in. Do NOT blindly jam and twist!
    d. Fully tighten or engage a connector. Never use a connector partly plugged or screwed in. Contacts left partly open may be subject to leaking, arcing or burn-out.
    e. Use locking collars where available. In general, locking collars need only be screwed on finger tight.
2. In general, all connectors on the vehicle are wet pluggable; apart from the H_2S gas sensor.
3. Install dummy plugs on unused connectors.
4. Regularly apply silicone grease to the connectors to keep them from seizing.

Power Interface Box

Power Indicators & Alarms

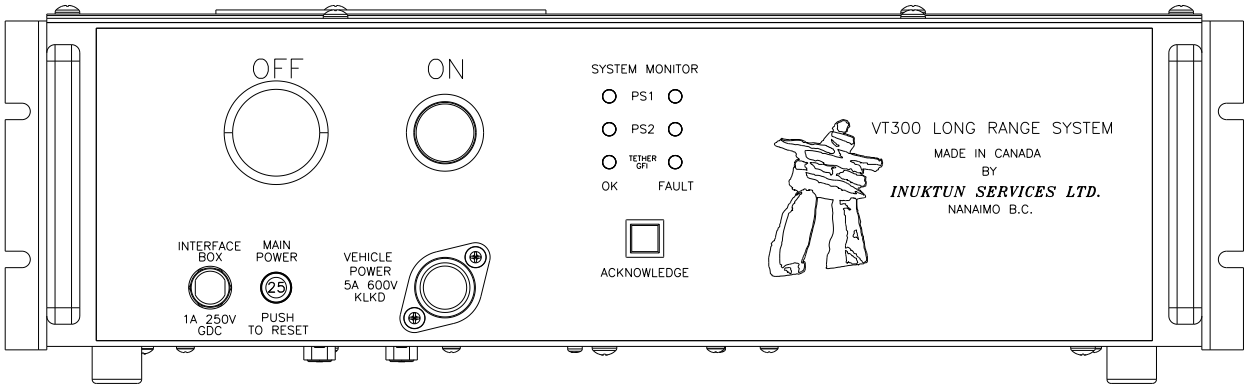


FIGURE 35: VT300 POWER INTERFACE BOX

Power Interface Box

The VT300™ Interface Box is the connection point for vehicle power supplies, PC control, and tether deck cables. The Interface Box is also the main power input for the system and provides fusing and handling of system alarms.

The Interface Box is a 120VAC unit and requires a power feed rated for at least 25A. The power cord has been fitted with a 30A rated circular L5-30P locking plug.

Controls and Indicators

ON Button – When powering up the **ON** button must be held for approximately two seconds (buzzer will beep). The ON button will illuminate whenever power is on. If a fault is detected causing the main power supplies to automatically shut down the **ON** button will flash to indicate a problem.

OFF Button – The **OFF** button will cut power to the power supplies, vehicle, and Interface Box. The **OFF** button may be used as an emergency stop but during normal operation the vehicle should be brought to a full stop with lights off before turning the system off.

Note: Pressing the **OFF** button while the vehicle is in full operation is hard on both vehicle electronics and power supplies and may reduce the overall life of components.

System Monitor – The system monitor is used to indicate the status of the power supplies and the 420 Volt ground fault detector.

- **PS1 / PS2 Fault –** The power supply units have individual short circuit and over-temperature protection. Should one of the power units turn itself off or otherwise fail a fault will be indicated here. The Interface Box will then disable both power supplies to protect against overload.

- **GFI Fault** – This indicates that the 420V ground fault detector has tripped. This may be an indication of a safety risk. Examine the system carefully and proceed with caution when restarting. See below for more information.
- **Acknowledge Button** – Lights when a fault is detected. Pushing the acknowledge button will silence the system alarm.

System Alarms – In the event of a fault the Interface Box will enter alarm mode. The status lights on the front panel will change to indicate the source of the fault and the power supplies will automatically turn off. The **ON** button will flash.

During an alarm a buzzer will sound and the acknowledge button will be lit. Pressing the acknowledge button will silence the alarm but once a fault has been detected it can only be cleared by turning off the Interface Box.

Warning: If an alarm trips during operation the system should be turned off and carefully examined before attempting to restart. The alarm could be an indication of a safety risk or damaged equipment.

Power Fuses

Fuses are located on the front panel of the Interface Box. Recommended replacements are listed in this manual. Fuses must only be replaced with ones of the same type and rating.

Interface Box Fuse

1 Amp replaceable fuse. This fuse provides protection for the Interface Box's internal electronics as well as the power supply for the fiber optic receivers in the tether reel. If triggered this fuse will disable data and video receivers, all Interface Box functions, and the power relays feeding the 420V supplies.

Vehicle Power Fuse

5 Amp, 600V replaceable fuse. This fuse is located in-line to the 420VDC output to the tether. If triggered this fuse will disable the 420VDC output but not the power supplies themselves. *This is a high voltage fuse and must only be replaced with an identically rated fuse type.*

Main Power Breaker

25 Amp resettable breaker. This breaker provides 120VAC to the main power supplies. If tripped this breaker will cut power to the supplies and, as a result, any power delivery to the vehicle. A tripped main power breaker is a sign of a significant and sustained short-circuit either at the power supplies or within the Interface Box. This equipment should be carefully evaluated before attempting to re-power.

Ground Fault Detection

The Interface Box contains ground fault detection for the 420VDC vehicle power supply. Should internal wiring or the tether itself become damaged in such a way to provides electrical connection between the 420VDC feed / return lines and earth ground the fault detector will trip and cause the power supplies to shut down.

This detector monitors the high voltage DC power feed only and is not a replacement for a proper GFCI protected AC power outlet.

A detected ground fault may be the result of damage anywhere in the system, but the most likely source is a cut or crushed tether. Other possible causes may include water intrusion into the vehicle's Telemetry or Termination canisters, damaged deck cables, or water within the drum of the tether reel.

Warning: If a ground fault alarm trips during operation the system should be turned off and carefully examined. The alarm could be an indication of a safety risk.

Power Up / Power Down

The VT300™ system is powered in four independent blocks:

Control Computer – This is an industrial PC running Windows 7. Boot as normal for a Windows computer. The user account is "Operator Admin". There is no password.

Warning: Always shut the computer down by pressing the Windows START button and selecting "Shut Down"

If you disconnect the power without a proper shut-down sequence you risk corrupting the hard drive and losing data.

Fiber Interface Box – This contains the fiber transceiver equipment. This interface box must be turned on in order to communicate with the vehicle and receive video from the vehicle.

Winch – The winch is normally ON whenever plugged in. Winch power can be cut by pressing the Emergency STOP button on the side of the frame. Power can be restored by resetting the STOP button with a twist. The motor controller has a power interlock to prevent unintended movement when power is turned on or restored. The level wind cannot run unless the winch power is ON. Refer to the winch manual for controller details.

Vehicle – The 420VDC vehicle power is controlled from the Interface Box mounted below the high-voltage power supplies. Press the green **ON** button to power up the vehicle and the red **STOP** button to power down. Power is relay latched and in the event of a power failure the unit will remain **OFF** when the mains power is restored.

Power-ON Notes

The **ON** button must be held for approximately two seconds to allow the power relays time to latch on. This also helps to prevent an accidental startup as it requires a deliberate action by the operator to turn on. Upon start-up the alarm buzzer will sound briefly, and the system monitor lights will flash as the system powers up. The **ON** button will be illuminated whenever the power supplies are on.

If the **ON** button is only briefly pushed the power relays will not latch. The panel will display a fault on PS1, and the ON light will be off. If this happens press the **OFF** button and retry.

Power-OFF Notes

The OFF button will immediately cut power to the power supplies, vehicle, and Interface Box. The OFF button may also be used as an emergency stop. During normal operation the vehicle should be brought to a full stop with lights down before turning off the system power.

Pressing the OFF button while the vehicle is in full operation is hard on both vehicle electronics and power supplies and may reduce the overall life of components.

Fiber Interface Box

The Fiber Interface rackmount box has been designed to support Ethernet and RS232 communication to the Versatrax 300™ crawler.

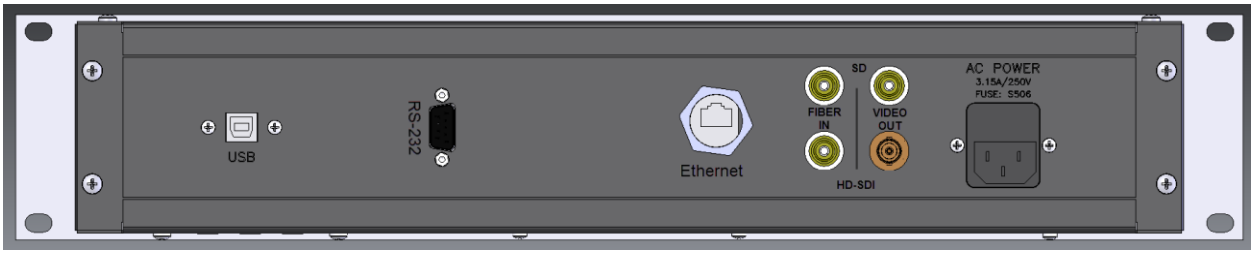


FIGURE 36 - FIBER INTERFACE REAR PANEL

Note: Default factory setup includes routing RS-232 and Ethernet to the control PC from the back panel of the Fiber Interface Box. RS-232 is converted to USB using FTDI (Future Technology Devices International Ltd) model UT232R-200 Adapter Cable.

The UT232R adaptor drivers are available for download from: www.ftdichip.com

FIGURE 37 - UT232R-200 ADAPTER CABLE

Pre / Post Operations Check

A Pre / Post Operations check list is included in Annex B. The check list may be photocopied for regular use. Operators are encouraged to use the check list to help prevent error and maximize equipment reliability to ensure a successful mission.

Note: Ensuring the Versatrax 300™ is always stored in good working condition will minimize deployment time for future inspections.

Vehicle Deployment

The VT300 vehicle must be deployed into a manhole using a cable hoist. While the tether can carry the weight of the vehicle, unnecessary loading of the termination is discouraged.

1. Check that the vehicle is fully configured and ready for the mission (see Pre / Post Operations Check above).
2. Hook the cable hoist onto the shackle between the Kellems grip and the tow cable.
3. Attach a tag line to the yellow eye-hook at the front of the vehicle – in such a way that the line can be disengaged from the surface once the vehicle is deployed. The easiest way to do this is to thread the line down and back up so you have both ends of the line in your hand – no knot involved.
4. Hoist the vehicle overtop the manhole, using the tag line to keep swing and rotation under control.
5. Lower the vehicle until the front end is near the floor. Pull up on the tag line to tilt the front section up so that the tracks are the first to touch the bottom. The center hinge of the vehicle can bend 90° upward to negotiate into the pipe.
6. After touchdown of the front section, remove the tag line.
7. Begin driving the vehicle slowly forward and lower the rest of the vehicle behind.
8. When the vehicle is fully seated in the pipe put a down-hole sheave in place to protect the tether around the bottom corner.
9. The vehicle is now ready for its mission through the pipe.

Vehicle Recovery

The VT300 vehicle is designed for quick, efficient recovery by using the winch to tow it out of the pipe. Just how quickly recovery can proceed will depend on the condition of the pipe and how far the vehicle has traveled. Some factors may slow down recovery, such as distant travel into the pipe, bends and corners.

1. Begin retrieval by activating the “Start Retrieval” function in the user interface. This will disengage the track drive clutches and lock out the forward controls; you will be able to control the tracks in reverse but not forward.
2. If the vehicle has gone a long distance down the pipe it may require an excessive force on the tether from the winch to tow the vehicle. To prevent this, begin by driving the vehicle in reverse, hence taking the load of the vehicle off the tether.
3. Carefully watch the rear facing camera whenever the vehicle is in reverse. Ensure the tether is towed from behind the vehicle. Accidentally driving over the tether runs a high risk of breaking the fibers and even jamming the vehicle.

4. If the tether tension does not seem excessive, and you know (from the inspection) that the pipe is clear, you can tow the vehicle out with the winch. The winch will tow the vehicle at between 60 and 100 feet per minute, depending on how full the drum is.

Warning: Driving forward while the vehicle is being towed backwards by the winch may destroy the track motor drivers. Always engage the **Start Retrieval** button before towing.

1. When the vehicle arrives at the deployment hole stop towing and resume driving the vehicle. As the vehicle comes under the opening the tow cable and back of the vehicle will begin to lift. At this point stop and attach the lifting hoist.
2. Use the extendable hooking pole to attach the cable hoist to the large shackle between the Kellems grip and the tow cable.
3. When the cable is attached lift away the pole and hoist the vehicle out of the hole.

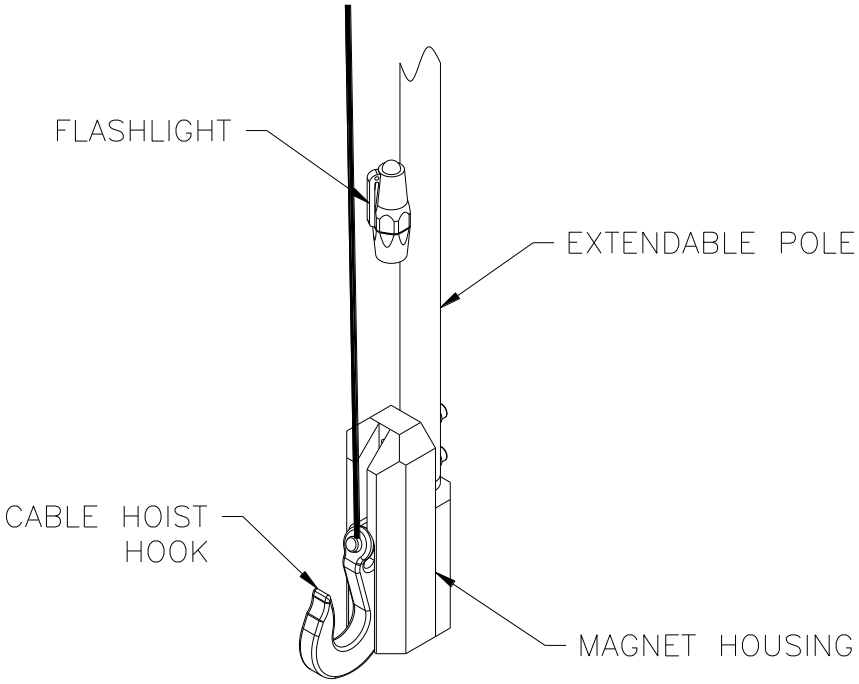


FIGURE 38: RETRIEVAL HOOK

Winch Operation

Winch Safety

Note: The Winch System is equipped with an **EMERGENCY STOP** button located beside the level wind. Depending on configuration, the button can appear on the left or right-hand side. Power to the drum motor will be cut immediately. Twist the button to reset.

Warning: Turn motor control off before resetting the Emergency STOP button.

Warning: Never apply the spring bolt drum lock while the drum is turning.

1. Lock the drum with the spring bolt whenever the winch is not in use.
2. The tether reel can generate very strong pulling forces. The winch must be securely bolted down, or it can drag itself out of the van!
3. Always make sure the van brake is engaged when running the winch.
4. Keep hands and loose clothing away from the reel while it is operating.
5. Be alert about getting any clothing caught in the chain, gear drive or level wind.
6. Do not place any objects on top of the winch frame which could fall into the mechanism.
7. The winch is not hermetically sealed. Keep it under cover out of the rain. Do not operate the winch in the rain.
8. It is strongly recommended that the winch be powered through a GFI protected outlet.

Pre-Operations Inspection

1. Check power and deck cable connections.
2. Check that nothing will block movement of the level wind shuttle.
3. Check that no objects, tools, etc., have fallen into the winch mechanism around the chain and drum.
4. Check that the tether has no loose, dangling coils. Dangling coils can propagate as the drum rotates and have the potential to jump the drum. Take care of these before deploying the tether.
5. Check that the drum lock is disengaged and latched open.
6. Power up the winch and test the drum motor.
7. Check that the level wind is following the spool – and in the right direction.
8. Ensure that the drive clutch moves freely and is operational.

Winch Operation

1. Operation of the winch is the most important job of the vehicle operations team. It is the responsibility of this person to ensure that the tether is not damaged during operation. Therefore, anyone operating the winch must be familiar with and understand these operating instructions.
2. Keep in mind that the spool is capable of reeling and unreeling at a maximum rate up to three times faster than the vehicle.

3. The winch is equipped with a reversible variable speed control (see manufacturers literature, KBPC-240D) and automatic level wind mechanism.
4. Proper level winding of the tether is important for both the tether life and capacity of the reel.
5. When paying out tether, disengage the drive clutch to allow the vehicle to pull tether directly off the drum.

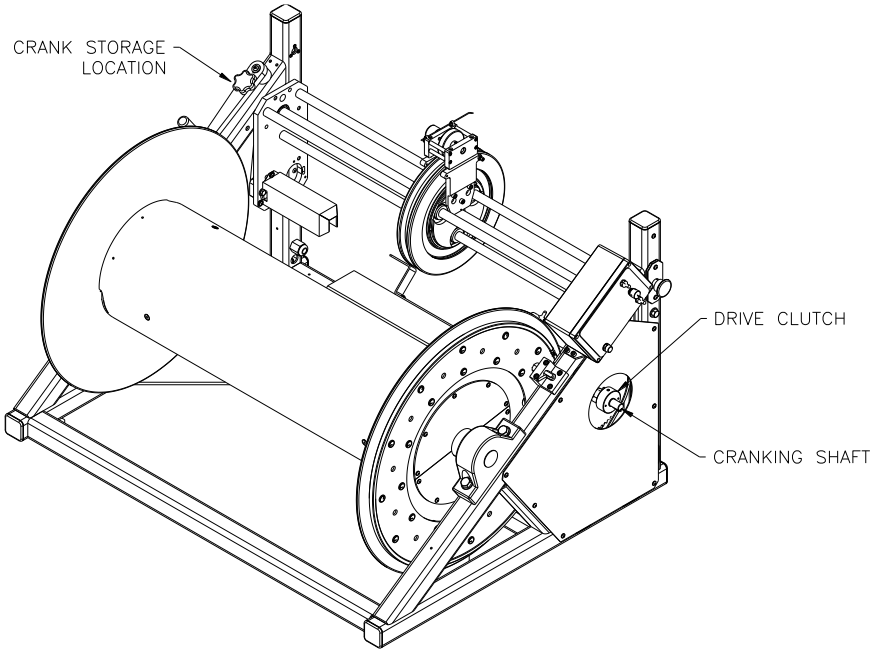


FIGURE 39: WINCH DRIVE CLUTCH LOCATION

Un-spooling The Tether

1. The first phase of the vehicle's journey is the initial deployment. Make sure that the tether is not snap loaded or kinked during the initial deployment.
2. As the vehicle travels, it may pull tether directly off the spool as needed. Ensure that the Drive Clutch is disengaged.
3. Ensure that the winch is powered on. The winch must be powered for the level wind shuttle to operate.
4. Make sure the level wind shuttle is moving with the tether as it unspools. Adjust shuttle speed or direction as necessary. This will prevent any sharp bends while coming off the spool.
5. Always keep some tension on the tether to keep the coils tight on the drum.
6. Do not let slack winds build up on the spool. Such slack winds may get tangled and cause a kink. They may also fall off the end of the drum and jam.
7. Never fully unspool the tether. The surface end of the tether is anchored to the spool drum. If the spool is turned past the anchor point, the tether will be broken and require re-termination. Stop the tether at least one turn before the end and no further. Tape is usually wrapped around the first five turns as a warning.
8. The winch operator must be in communication with the vehicle operator to co-ordinate stopping and starting.

Spooling The Tether

1. Spooling the tether is a special operation because the vehicle is backing up and the motive force for the tether must come from the winch. The tether tension must be kept just great enough to pull the tether out from behind the vehicle and keep the tether spooling, but the operator must be on a constant watch for sharp rises in tension. The winch operator must co-ordinate with the vehicle operator to safely back up the vehicle.
2. Alternatively, the winch can be used to pull the vehicle out directly at up to twice the vehicle's maximum speed. The Minitrac™ clutches on the vehicle must be disengaged before pulling the vehicle with the winch. Refer to the Versatrax™ manual; clutch operation.
3. Always keep tension on the tether to keep the coils tight on the drum.
4. When spooling the tether, watch the tether for damage. At the same, time brush off debris from the tether and wipe it dry.
5. The VT300 vehicle is equipped with a rear facing camera. We recommend a monitor and feed be available to the winch operator to watch the tether at the vehicle.

Automatic Level Wind

Control Box

This winch is equipped with an automatic powered level wind. It works by matching the shuttle speed with the drum using a rotary encoder on the drum and a pre-programmed calibration for the tether diameter.

The level wind controller is factory mounted to the side of the tether reel. For convenience it comes with a long cable and can be hand-held or mounted in the van.

Operation

The level wind will monitor the rotation of the reel and adjusts the movement of the level wind shuttle to match the drum speed. The level wind is active whenever the reel is powered on allowing it to be used while turning the reel by hand or when feeding cable out manually with the winch clutch released.

Note: In order for the level wind to operate the level-wind clutch must be engaged/ pushed in. See Figure 40 below.

When rapidly pulling out tether by hand, it is possible to outrun the level wind. If this occurs slow down the pay-out until it catches up. During a long retrieval occasional rate adjustment may be necessary to ensure an even wind, particularly at the edges of the drum. It is strongly recommended that the controller remain close to the reel to allow the operator to monitor and adjust as required.

Level Wind Controls

Direction switch – Changes the direction of the level wind shuttle. Normally the level wind will retain the last shuttle direction when the winch is powered down. If the shuttle is traveling in the wrong direction, simply hit the direction switch.

Jog switch – Moves the shuttle left or right at full speed.

Trim knob – Allows small increases or decreases in the level wind speed.

Limit switches – These are buttons mounted in the frame at each side of the reel. When the level wind hits a limit switch the shuttle will change direction and continue winding back along the drum. If both buttons are pushed at the same time the level wind will stop until one is released. This is a protection against one of the buttons becoming jammed.

Clutch – The level wind motor may be disengaged by pulling out on the clutch wheel located at the end of the level wind drive shaft. Once disengaged this wheel can be spun by hand to manually advance the level wind. The motor is reengaged by lining up the clutch pins and pushing inward to lock the wheel in place.

Level Wind Calibration

The level wind is calibrated at the factory and should require no further adjustment. Should recalibration be necessary instructions can be found in the winch manual.

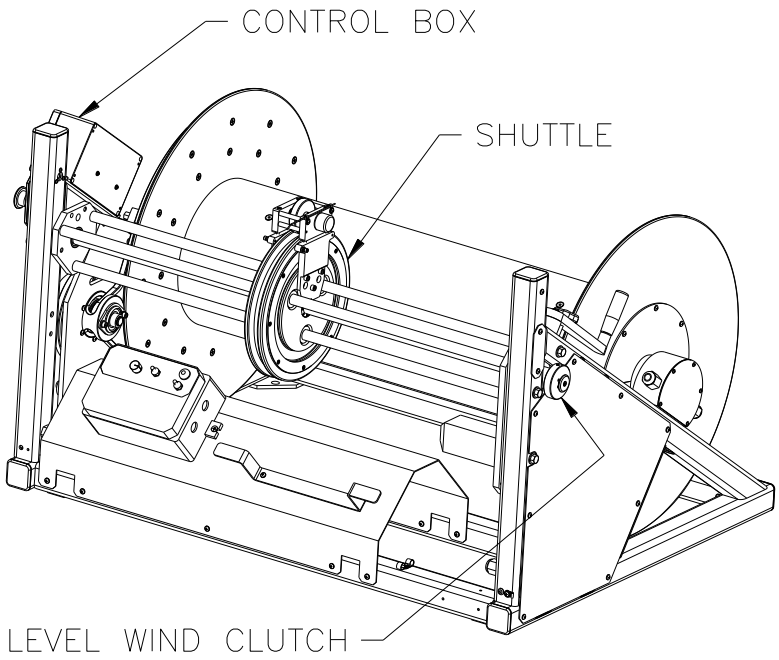


FIGURE 40: LEVEL WIND COMPONENTS

Free-Wheeling Spool

In many situations, the vehicle may pull the tether directly off the drum. Disengage the drum drive clutch to reduce the back tension.

Drum Brake

The drum is equipped with a spring bolt on the main drive sprocket intended for storage and transport only. Lock the drum with the spring bolt whenever the winch is not in use.

Warning: Never apply the spring bolt drum lock while the drum is turning.

Manual Cranking

If the winch becomes disabled, or more pulling force is needed than the drive motor can provide, the winch may be manually cranked.

1. Disengage the drive clutch.
2. Insert the manual crank handle.

Warning: The crank gives you a mechanical advantage of 10:1. A tether pulling force of up to 500 pounds can be generated.

Dealing with Obstacles

The operator will invariably encounter a range of obstacles in a pipe. Each time the operator must decide if the vehicle can safely pass or if there is risk of getting stuck. Common obstacles include:

- Crushed pipe
- Sand
- Rocks / Debris
- Roots
- Intersecting service pipes
- Animals and their nests

The VT300™ vehicle naturally straddles the debris at the very bottom of a pipe. If the debris is high you may try installing the track extension brackets to give the chassis more clearance. Additionally, the inside track weights may be removed to increase center clearance.

If the operator is unsure about pipe navigability, he should consult with the site supervisor before moving forward.

Inspection Guidelines

The objective of an inspection is to obtain a recording of video and other data for review by the customer or pipe owner. If a recording is lost, fails to record, or is of poor quality the inspection will likely have to be re-done at the operators' expense. It is therefore in the operators' best interest to verify vehicle operation, video quality and recorder function before beginning each inspection. A set of video-overlay comments and data are usually required depending on the contract or client. Initial comments will usually include the

location, pipe number and date. During the inspection the contractor may require certain pipe features or faults to be pointed out along with the distance from the manhole.

Conduct a complete inspection of pipe features and faults. For any feature or situation of interest, stop the vehicle and make a complete video survey using the continuous pan feature of the camera. Ultimately, the inspection is conducted for the benefit of the client who is reviewing the footage later.

Maintenance

Fuse Replacement

Fuses must only be replaced with ones of equivalent type and rating.

Interface Box Fuse – 1 Amp, 250VAC 5x20mm fuse (Bussmann GDC Series, part# BK/GDC-1A).

Vehicle Power Fuse – 5 Amp, 600AC fuse (Littelfuse KLKD [Midget] Series, part# KLKD005).

Main Power Breaker – 25 Amp resettable breaker.

Minitrac™ Maintenance

Refer to the 7000-Series Minitrac™ manual for track maintenance instructions.

Camera Maintenance

Refer to your Spectrum 90™ camera manual for operation and maintenance instructions.

701 LED-Bulb Replacement

If an LED light board requires replacement, the pre-built board can be obtained from us. To install the board, refer to DWG: ADAJ001375 “Light, 703/704, LED”.

1. Unscrew the light retainer from the front of the unit.
2. Remove the window and O-ring underneath it.
3. Pull the light reflector straight off.
4. Lift the circuit board off its silpad seat and unsolder.
5. Check that the edges of the new circuit board are sanded smooth.
6. Solder the two wires onto the new circuit board, following polarity on the drawing. Note: if the polarity is incorrect the light will not work.
7. Check that the O-rings are clean; if they are dirty or more than a year old replace with new O-rings. Clean the seating surfaces.
8. Line up with the LEDs and push the light reflector straight on.
9. Replace the retainer with window and O-ring. Snug down finger tight only.

Warning: Do not twist on the reflector – the LED lights will break.

Tether Re-termination

Tether termination is a specialized service beyond the scope of this manual. Contact us if the fiber-optic tether is damaged or requires re-termination.

Troubleshooting

Camera Control Problems

1. Not all the camera lights are on.
   - The Spectrum™ cameras allow the lights to be controlled independently. Refer to the user interface manual.
2. Camera tilt does not function in one or both directions.
   - Check that the camera is not jammed.
   - Re-calibrate the camera tilt limits as explained in section Refer to the user interface manual.
3. Camera is moving very slowly.
   - Check the pan & tilt speed settings in the advanced camera control window. Refer to the user interface manual.
   - Check the auto pan/tilt speed setting in the advanced camera control window. Refer to the user interface manual.
4. Camera does not stop moving.
   - Re-zero the camera pan & tilt calibration using the camera calibration dialog box. Refer to the user interface manual.
5. Cannot adjust camera pan & tilt speed
   - Pan and tilt max speed may not be manually set while in auto pan/tilt mode. Turn off auto pan/tilt mode. See settings in the advanced camera control window. Refer to the user interface manual.
6. Zoom is too slow or too fast
   - Zoom speed may be set in the advanced camera control window.
7. Camera Pitch or Roll angle is not displaying correctly
   - Re-calibrate the inclinometer. An inclinometer error of up to ±2½° is normal.

Video Problems

1. No video (black or blue background)
   - Fiber interface box is not turned on.
   - Video cables are not hooked up between interface box and computer.
   - Camera is not plugged in on vehicle (turn power off first before plugging in camera).
   - Check that the camera harness whip is plugged into the correct socket on the telemetry can.
   - Check monitor input settings.
   - Vehicle power is not on.
   - Check for problems with other video components between the computer and monitor.
   - Try a different monitor. Whole days have been spent on field maintenance trips only to discover a faulty monitor.

2. Picture is very dark or very bright.
   - Check the light levels of both the camera and main lights.
   - Check camera exposure settings. See settings in the advanced camera control window.
3. Intermittent picture.
   - Check and replace the video cables.
   - Check the monitor is working properly.
   - Check that the camera is fully plugged in.
   - Check for intermittent breaks in the camera harness cable.
   - Check the tether connectors at both controller and vehicle.
   - Check for tether or slip ring damage by testing tether continuity.
4. Picture is blurry or has poor color.
   - This may be a dirty camera view port.
   - Try manually focusing the camera.
5. No Rear Video
   - Verify the video connection from the interface box to the computer.
   - Check that the camera is fully plugged in.
   - Check that the rear camera whip is plugged into the correct socket on the telemetry can.

Vehicle Problems

1. Vehicle won't steer or vehicle runs backward.
   - Tracks set to the wrong positions.
   - Track reverse setting incorrect in control software.
   - Node ID conflict between one or more devices on the vehicle.
2. Tracks will not run.
   - Check the current meters.
     - If current is at 100% and the vehicle doesn't move, then the tracks may be stalled. They could be wedged on an object or jammed with sand. Try reversing the tracks to clear any debris. If a jam will not clear you will have to recover the vehicle by pulling it out with the tether.
     - If no current is registered, then power or communication is not getting to the tracks. Check all the cable connections.
   - Try power cycling the system.
   - Try changing tracks.
     i. Note that changing tracks may require reprogramming their node ID's.
   - Inspect the vehicle wiring for damage.
   - Check all the system connectors.
   - Check that the tracks are all assigned their own unique Node ID positions.
   - Listen for the track motors. If the motors run but the track doesn't turn suspect a broken pin in the drive train. Refer to the assembly diagram in the Minitrac™ manual.
3. Main lights don't function even when set to maximum.
   - Check all the cable connections.
   - Inspect for blown LEDs.

Note: LEDs are very bright and must not be viewed directly. Inspect the LEDs only through a piece of smoked welding glass.

Warning: High Intensity. Do not look directly into the lights. Use a welding filter (shade #8) to observe the light elements.

Winch Problems

1. Tether distance does not read correctly.
   - Check that the pressure wheel is applying proper pressure to the payout sheave.
   - Check that the units are set properly in the graphical overlay.
   - Recalibrate distance encoder.
   - Ensure that the correct COM port is selected in the control software.
2. Winch is very noisy.
   - First stage chain is too tight. This chain must run with some slack. Refer to the winch manual.
3. Winch does not run.
   - Check that the winch has AC power.
   - Check that the Emergency STOP button has not been pressed. (Twist to reset).
   - After a power failure the run/stop switch must be reset.
   - If there are no lights on the controller, check the fuse in the motor control box. Refer to the winch manual.
4. Intermittent problems with vehicle or camera, when winch is running.
   - Slip ring may be damaged. Use a multi-meter or oscilloscope to check continuity of the tether with the winch drum turning.
5. Level wind does not run.
   - Check the fuse in the level wind controller.
   - Check that the level wind clutch is engaged.
   - If the drum is being turned manually, check that the winch still has power.
   - Verify both limit switch buttons are free (push them by hand).

Vehicle Recovery

In the event the vehicle becomes disabled while on a mission in a pipe provision has been made for recovery of the vehicle by pulling it out with the tether. Recovering the vehicle by pulling is a serious operation and can put great demand on the tether system. Listed below are three scenarios in which vehicle may need to be recovered. Loading the tether beyond its maximum safe capacity of 300 pounds is to be considered only as a last resort.

Note: Prevention is always the best policy. When traveling through a pipe or in any unknown area, carefully watch your monitor.

The vehicle may become stuck if it is traveling through a damaged pipe section or improperly steered around a corner. If the vehicle does become stuck;

1. Determine if it is the vehicle or the tether which is stuck. Look back at the tether with the camera if possible. If the vehicle can back up but the tether will not reel in, the tether is caught on something. Try to identify and fix the cause of the catch before putting any more strain on the tether. The operator should use any dexterity available first to free the vehicle without resorting to force.
2. Determine if the vehicle can drive forward to a favorable extraction point, allowing the tether to be removed alone.
3. If the vehicle cannot work itself free from a snag, try using light tether tension and tractor power simultaneously.
4. If still stuck, try a stronger tether tension. The winch is capable of pulling up to 500 lb of force. The tether will handle this as a temporary load.

If the vehicle seems to be permanently stuck in the pipe, the supervisor must decide whether to sacrifice the tether in an attempt to pull harder (over 500 pounds), or to dig the vehicle out.

Annex B

Date: _____
Location: _____
Operator: _____

Pre-Operation Check

- ☐ 1) Check safety equipment set-up – cones, traffic control & personal safety equipment as per site regulations.
- ☐ 2) Verify the vehicle is in the correct configuration for the job.
- ☐ 3) Check launch equipment set-up – crane, hoist, tether sheaves, etc.
- ☐ 4) Check for vehicle mechanical damage. Visually inspect the vehicle and Minitracs™ to ensure that the moving parts are free of debris and are functional. Check that the track belts are free to rotate.
- ☐ 5) Check wiring harness for good routing / damage / proper tie-downs and restraints.
- ☐ 6) Check Kellems grip and tow cable attachment.
- ☐ 7) Check for dummy plugs in unused whips and connectors.
- ☐ 8) Check winch for obstructions and mechanical damage.
- ☐ 9) Check winch power and operation.
- ☐ 10) Check controller & power supply connections.
- ☐ 11) Start Generator / Check for stable 25 Amp 120VAC power source
- ☐ 12) Launch control interface.

☐ 13) Power up the VT300 System. Check:
- ☐ No Alarms
- ☐ Telemetry Current OK
- ☐ Telemetry Temp OK
- ☐ Telemetry Canister Humidity OK.
- ☐ Telemetry Pitch / Roll feedback OK.

☐ 14) Check front video OK; Check rear & auxiliary video Ok. Check camera windows are clean.

☐ 15) Check camera control; Pan, Tilt, Home, Lights, Zoom

☐ 16) Check all tracks:
- ☐ Current OK
- ☐ Temp OK
- ☐ Humidity OK.
- ☐ Control Function

☐ 17) Check Aux lights.

☐ 18) Check front camera video record & playback.

☐ 19) Check rear video record & playback.

☐ 20) Check sonar software launch & sonar comms.

Post-Operation Check

- ☐ 1) Clean off the tether as it reels in & check for damage.
- ☐ 2) Wash down vehicle as necessary.
- ☐ 3) Check vehicle for mechanical damage and wear.
- ☐ 4) Check lights & camera operation.
- ☐ 5) Check track operation.
- ☐ 6) Power down.
- ☐ 7) Vehicle stored securely for transport or next use.
- ☐ 8) Video files uploaded to a server.

Comments:

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Parts and Repairs

Ordering Parts/Customer Service

Spare and/or replacement parts are available for your product and can be ordered directly from your local office.

When ordering parts, always make sure to quote the sales order acknowledgement (SOA) number and/or the serial number of the system component in question.

Inuktun Services Ltd. (Canadian Headquarters and Manufacturing Location)
2569 Kenworth Road, Suite C
Nanaimo, BC, V9T 3M4
CANADA
TF 1.877.468.5886
T +1.250.729.8080
info@eddyfi.com
www.eddyfitechnologies.com

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812 W 13th Street
Deer Park, TX, 77536
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www.eddyfitechnologies.com

Warranty Repairs

Warranty conditions are specified in the Warranty section. Should any conditions of the manufacturer's warranty be breached, the warranty may be considered void. All returned items must be sent prepaid to Eddyfi Technologies at the above address.

Factory Returns to Canada

Some sub-assemblies of your Eddyfi Technologies product are not field-serviceable and may need to return to the factory for repair. Warranty claims must return to the factory for evaluation.

To return an item for evaluation or repair, first contact Eddyfi Technologies at our toll-free number or e-mail address. Eddyfi Technologies will supply a Return Merchandise Authorization (RMA) number with detailed shipping and customs instructions. Items shipped without an RMA number will be held at Eddyfi

Technologies until the correct paperwork is completed. If cross-border shipments are not labelled as per the instructions, the items may be held by customs and issued additional fees.

All returned items must be sent prepaid unless other specific arrangements have been made.

When the product or system is being shipped anywhere by courier or shipping company, it must be packaged in the original packaging it was received in. This measure greatly reduces the consequences of rough handling and subsequent shipping damage.

Eddyfi Technologies cannot be held responsible for damages due to improper packaging. Shipping damage may have significant impact on repair turnaround times.

Product/System Drawing Package Availability

Mechanical assembly and electrical wiring diagram drawing packages for your equipment are available in PDF format upon request. Printed copies may also be purchased from Eddyfi Technologies. Contact your local sales contact for more information.

Limited Warranty Policy

Eddyfi Technologies will repair or replace, at its expense and at its option, any system or component, subject to the limitations and / or exclusions specified herein, which in normal use has proven to be defective in workmanship or material provided that, within one (1) year of the purchase date, the original purchaser returns the product prepaid, accompanied by proof of purchase, from a sales agent authorized by Eddyfi Technologies, and provides Eddyfi Technologies with reasonable opportunity to verify the alleged defect by inspection.

Warranty Limitations and/or Exclusions:

1. This warranty does not apply to light bulbs.
2. Batteries, fuses, transistors, integrated circuit modules (IC's), voltage regulating devices and electrical plugs and / or connectors are warranted to be free from defects in material and workmanship for a period of ninety (90) days from the date of shipment to the original purchaser.
3. Any article purchased from, but not manufactured by, Eddyfi Technologies is sold with only such warranties as are made by the manufacturer therein. Eddyfi Technologies only warrants that it has title thereto, free of all liens or encumbrances.
4. This warranty does not apply to units which are damaged by connection to improperly wired AC receptacles.
5. Track belts, tethers, view ports and other components subject to wear through abrasion are warranted to be free from defects in material and workmanship for a period of ninety (90) days from the date of shipment to the original purchaser.
6. Any damage caused by failure to observe proper packing or to observe instructions for operation and maintenance as contained in the Instruction Manual furnished with the equipment, by accident in transit or elsewhere, will not be covered by the warranty.
7. Repairs are warranted for 90 days.

Eddyfi Technologies may require that certain components may be returned, prepaid, to a manufacturer's authorized station for inspection and repair or replacement.

Eddyfi Technologies will not be responsible for any asserted defect which has resulted from Acts of God, normal wear, misuse, abuse, improper configuration, repair, or alteration made, or specifically authorized by, anyone other than a representative of Eddyfi Technologies authorized to do so. The giving of, or failure to give, any advice or recommendation by Eddyfi Technologies shall not constitute any warranty by, or impose any liability on, Eddyfi Technologies.

The foregoing constitutes the sole and exclusive remedy of the purchaser and the exclusive liability of Eddyfi Technologies and is in lieu of any and all other warranties, express, implied or statutory as to merchantability, fitness for purpose sold, description, quality productiveness, or any other matter. Under no circumstances shall Eddyfi Technologies be liable for special, incidental or consequential damages, or for delay in performance of this warranty.