



INUKTUN VERSATRAX 150™ ANALOG

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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.

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Description and Specifications

The Inuktun Versatrax 150™ Analog pipe inspection system is a Minitrac™ based vehicle used for navigating pipelines ranging from 6 inch to 36-inch diameters (camera centered). The track mechanism is further adjustable beyond 36 inches to very large diameters.

The system is made with the hazards and demands of pipe inspection in mind. The rugged dual tractors permit pipe penetration up to 1500 feet. A minimized vehicle profile provides maximum clearance for passage of service intrusions in the pipe.

All Versatrax hardware can be used underwater and in dirty, muddy conditions. The rugged design ensures a long service life and helps protect the vehicle from damage during normal use.

Typical applications include inspection of:

- Sewer and storm drains
- Hydroelectric pipe and infrastructure
- Steam headers
- Tanks and pressure vessels
- Oil & gas refineries and pipelines
- Pulp and paper mills

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Specifications

Pipe Size Range	Minimum: 12in/ 300mm Maximum: Flat Camera Centered: 16in-24in/ 400mm – 610mm
Operating Temperature	0 ° – 50 °C (32 ° - 122 °F) Dependant on operating conditions. Ask your sales expert for more information
Storage Temperature	-20 ° – 60 °C (-4 °– 140 °F)
Depth Rating	VT150 Chassis, Tracks, Cameras and Lights: 60 m (200 ft)
Vehicle Weight	40 kg (88 lb) <i>Weight may vary depending on configuration</i>
Power Input	Switchable between 120VAC/ 60Hz and 220VAC/ 50/60Hz

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.
- Observe all traffic safety requirements in effect in your municipality.
- Wear steel toed boots when working with the VT150 Vehicle.
- Wear protective gloves while deploying the vehicle.
- 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 also increases wear and tear.
- The tether carries 120 VAC for the main lights. Always keep unused light whips capped. Follow the guidelines for preventing tether damage. Do not operate with damaged light whips.
- Repair any damaged wires before operating the vehicle. A short circuit may damage the controller, cameras, or any attached equipment.
- Never drop the vehicle. Although built tough, the vehicle is heavy, increasing the chance of structural damage when dropped.
- 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.

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- **Overhead Lifting / Hoisting:** 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.)
- **Heavy Lifting:** Use safe lifting practices according to your work-site regulations when handling the vehicle and its components.
- **Pinching Hazard:** There is a possibility that a person's fingers could be drawn into the tracks should they be activated when the vehicle is being handled. To avoid this hazard do not connect the tether to the portable controller until the vehicle is configured, placed and ready to use. If the vehicle is being tested, do not connect the tether until handling of the vehicle is complete. If the vehicle is permanently installed into a van or trailer and the tether cannot be disconnected, turn off the power instead.

Safe lifting recommendations:

- Two people are recommended to lift and carry the tether container because of its awkward size and weight.
- Know your own strengths and limits. Assess whether the object is too heavy for you before attempting to lift.
- Lift with your knees – not your back.

System Setup

Working Environment

Controller

The controller is 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 temperatures are between 0° and 50° Celsius.

Tether and Wiring Harnesses

The tether and vehicle wiring harnesses are depth rated to 200 feet (60m) of water. However, the main connector may only be exposed to water when it is plugged in. Keep it capped with a dummy plug when not connected to the vehicle.

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 200 feet. 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° to 50° C.

Allowable system storage temperatures are between -20° and +60° C.

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Typical Installation

The following describes a typical installation scenario recommended by us.

A typical 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. 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 be available to tend the tether at all times. 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.

Vehicle Handling Equipment

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 payout 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 payout sheave diameter should be at least 10-inch 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.

We recommend a dedicated work bench for vehicle configuration and maintenance. Ideally this is at least 30 inches by 60 inches 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.

Personnel Requirements

A typical pipe inspection van operation usually requires two people for operations.

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:

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- 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 and wind the tether during recovery.

Power Requirements

Line Voltage – When installing the system in a new location always check the line voltage selection switch located next to the AC power cord on the controller. This switch may be set for 110VAC or 220VAC power input and must match the line voltage of the power source. Incorrectly setting this switch will damage the controller.

If your system includes a powered cable winch refer to the winch manual for instructions on setting its input voltage. An incorrect voltage at the winch will damage the motor controller.

Power Requirement – The following figures are for a 1500-foot system and take component efficiency and tether power loss into account.

Vehicle and Controller = 800W; Winch = 1000W, Total system = 1800W peak load.

With no winch the system can operate comfortably on a 1000W supply or inverter. With a full system we recommend a minimum of 2000W supply or inverter. Remember to account for the power used by your monitors and video recorders.

The Versatrax™ controller is designed to support our tracks, cameras, and lights. Powering other devices or equipment off the Versatrax controller is not recommended.

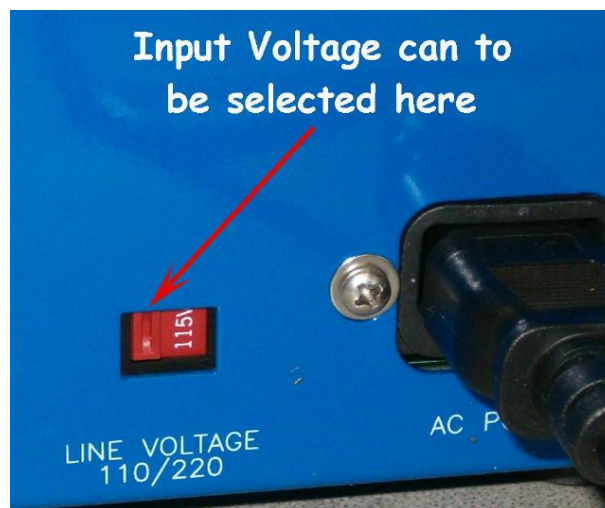


FIGURE 1: LINE VOLTAGE SELECT SWITCH

Video Hook-Up

The external video connectors on your Versatrax system use RCA style video jacks similar to most monitors and video equipment. An RCA style video cable has been supplied with the controller. Some industrial monitors may use a BNC style video jack. An RCA to BNC adapter has been supplied for this purpose.

Video from your Versatrax™ controller may be connected directly to the video input of a television, VCR, or other recording device. Please refer to your television or recording device owner's manual.

Winch Installation

If your system includes an AC powered winch, refer to the winch manual for installation instructions.

Avoiding Tether Damage

The tether is the most vulnerable part of the Versatrax system. Tether damage is a serious matter but is generally avoidable through proper handling. Re-termination means lost time, and tether replacement is a significant cost. As a precaution we recommend that anyone using or handling the Versatrax system read and understand this manual before working with the system.

Vehicle Cable Connections

It is very important to properly connect the tether and strain relief to the vehicle. Improper connection may result in costly tether damage. See the figures below.

1. The tow cable must be securely attached to the harness block.
2. The other end of the tow cable clips to the Kellems Grip strain relief. Ensure the Kellems Grip is adjusted properly to allow some tether slack as shown.
3. Plug the connector all the way in. It is important for the longevity of the connector that it be kept free of dirt, have good o-rings and be mated carefully.
4. It is important to adjust the Kellems grip to allow slack in the tether connection, no matter what angle the tether approaches the vehicle.
5. Tether connection to the parallel and in-line vehicles are identical.
6. When the tether is not plugged in, it should be capped to prevent dirt and moisture from entering the pins.



FIGURE 2: TETHER AND TOW CABLE CONNECTION

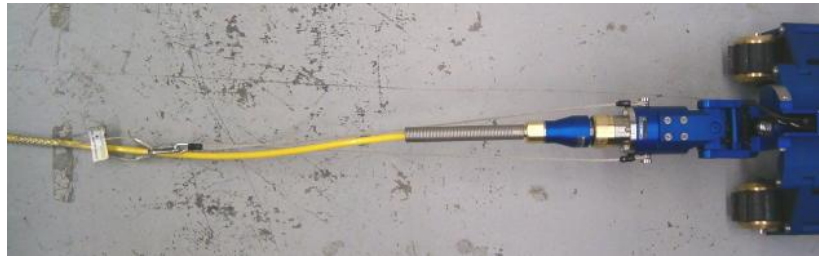


FIGURE 3: KELLEMS GRIP HOOK-UP

Auxiliary Device

There is provision in the Versatrax™ system to allow add-on devices such as a rear facing camera, sonar, or other vehicle electronics. A twisted pair in the tether is reserved for telemetry from this device. The controller must be configured by setting a dip switch on the main control PCB (see Figure 4 below). The standard configuration is to use this twisted pair for the rear camera.

- If vehicle has a second camera, set the auxiliary dip switch to the position marked “rear video”. This is the default position shipped from the factory. The switch must be in this position in order to receive video from a secondary camera.
- If the spare conductors are to be used by other devices, such as sonar or on-board sensors, the switch must be set to the position marked “spare cond.” This will route the signals to the “Desktop Controller” connector on the controller.

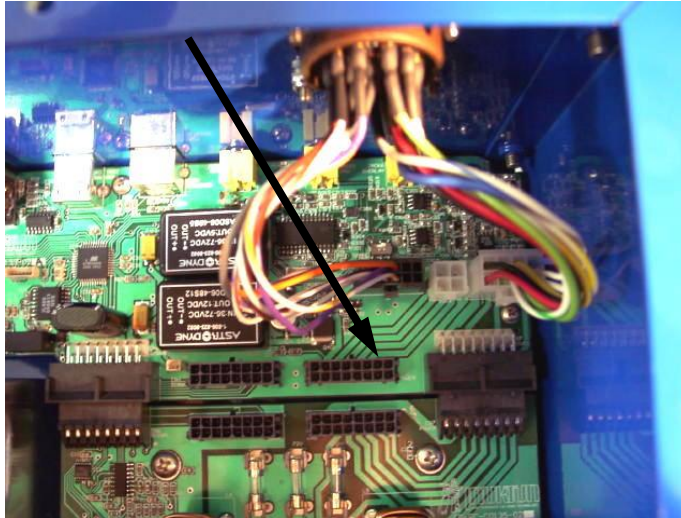


FIGURE 4: AUXILIARY DIP SWITCH

Camera Installation

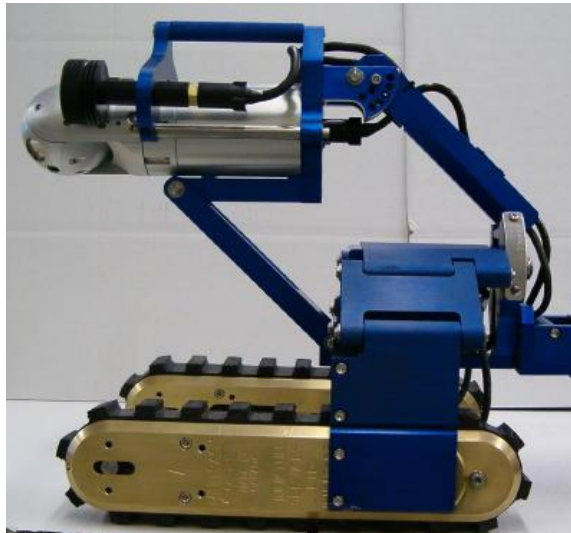


FIGURE 5: PREFERRED RAISE POSITION FOR CAMERA INSTALLATION

1. Adjust the Camera Raise Mechanism to the position shown in Figure 5. This will allow access to the camera mounting screws.

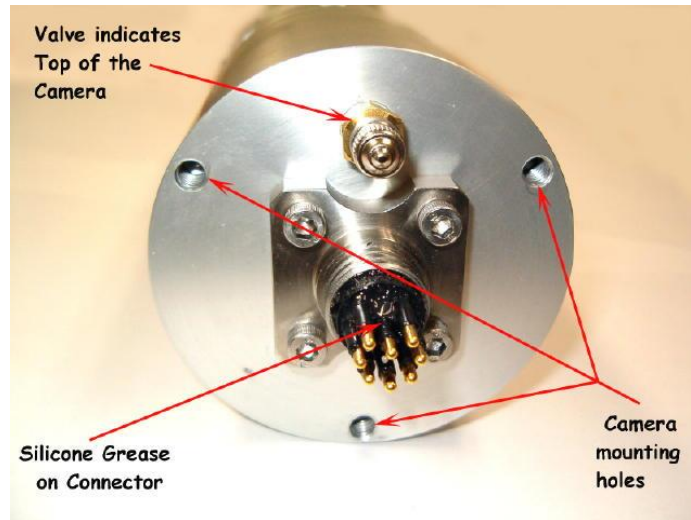


FIGURE 6: CAMERA MOUNTING HOLES

2. The purge valve indicates the top of the camera, as in Figure 6. Mount the camera with the valve on top.

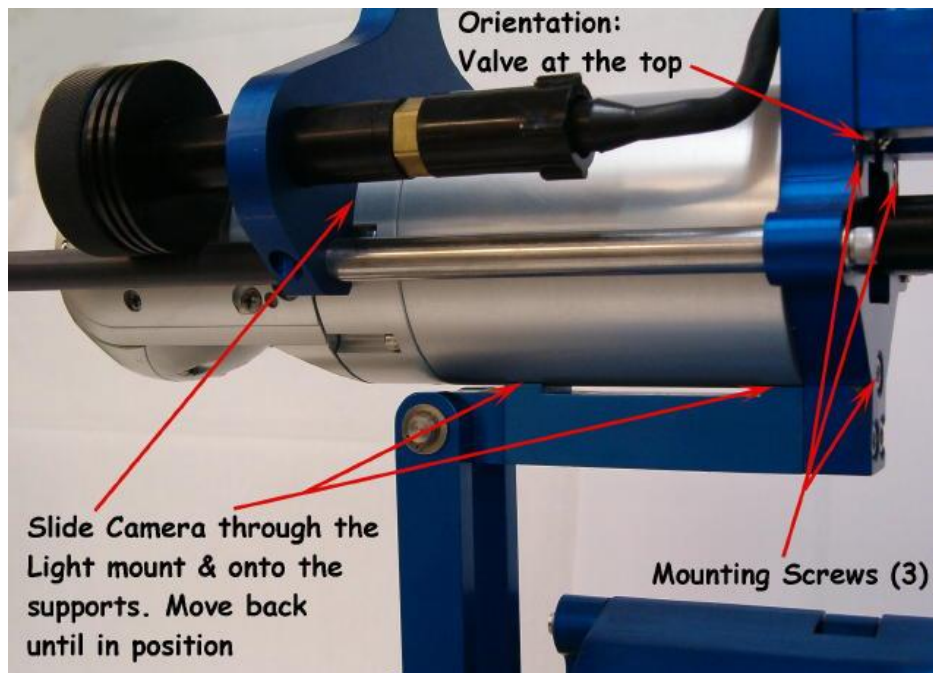


FIGURE 7: MOUNTING THE CAMERA

3. Slide the camera into position from the front of the light mount.
4. 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.

5. Move the camera all the way to the rear. Clear the connector into the square opening. Using three ¼-20 x 5/8-inch screws fasten the camera to the rear plate. Use a 9/64-inch ball end Allen key.

101 Auxiliary Lights Installation

Light installation is easy and intuitive. After the nylon tipped set screw has been installed, it does not need to be taken out anymore. Just loosen to install/remove or adjust the light fore/aft and re-tighten. Finger tight is generally enough. Refer to figures below.

Warning: The 101 lights are powered by 110VAC. To prevent shock and equipment damage, the light whips must be capped with dummy plugs whenever the lights are not in use.



FIGURE 8: INSERT 101 LIGHT

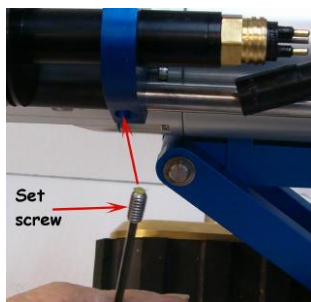


FIGURE 9: INSTALL NYLON
TIPPED SET SCREW



FIGURE 10: POSITION LIGHT
AND TIGHTEN



FIGURE 11: LUBRICATE AND
PUSH ON CONNECTOR

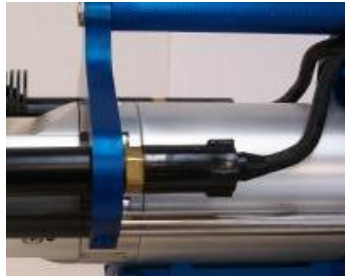


FIGURE 12: SCREW ON
LOCKING COLLAR

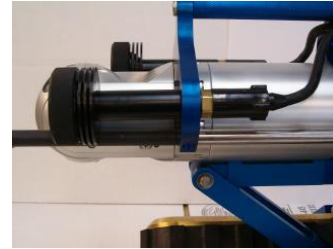


FIGURE 13: LIGHTS ARE
FULLY ADJUSTABLE
FORWARD AND BACK



FIGURE 14: LIGHT INSTALLATION AND ADJUSTMENT

Bumper Rods

For convenience the operator has a choice of two lengths of bumper bars. The long bumper bars depicted below provide the most protection for the camera when the vehicle is being lowered down a manhole. The long bars will block a portion of the view to the side. As an alternative the short bars allow an unobstructed view beside the camera but offer no mechanical protection. In general, bars act to stabilize the frame and chassis. Do not operate the vehicle without at least the short bars installed.



FIGURE 15: ALTERNATIVE LONG BUMPER RODS

Minitrac™ Installation and Removal

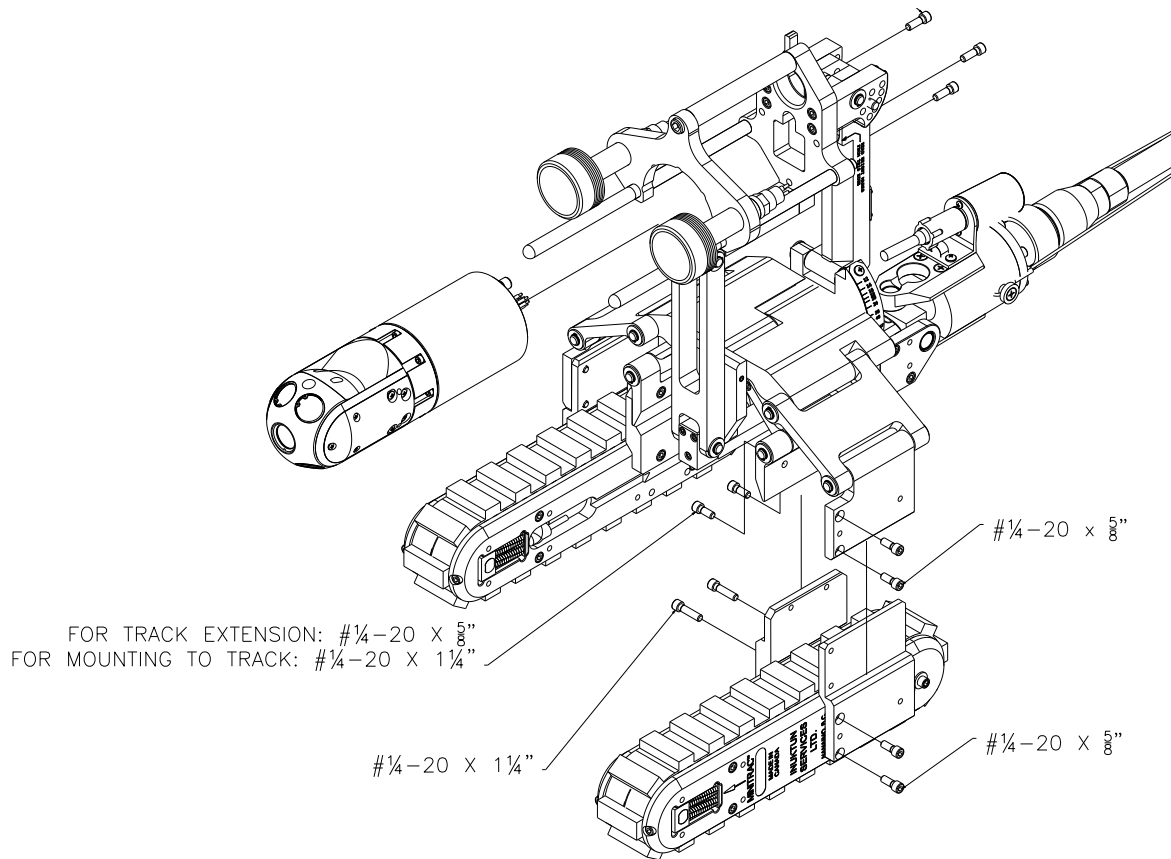


FIGURE 16: TRACK MOUNTING BOLTS

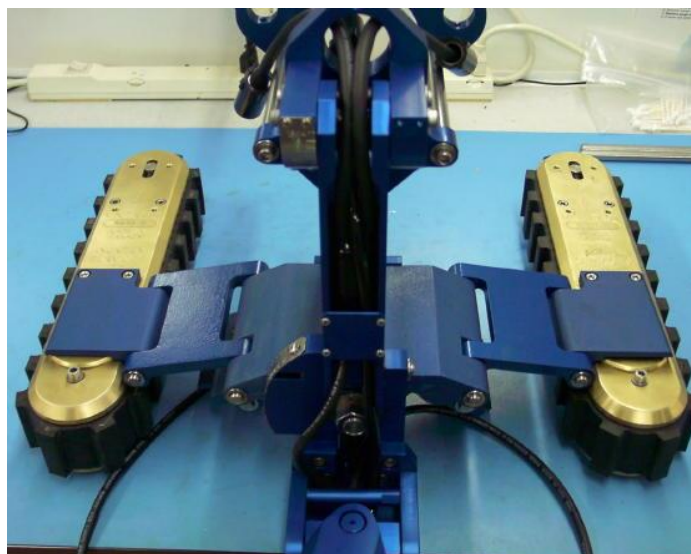


FIGURE 17: TRACKS FLAT ON BENCH – OUTER BRACKETS

To install the Minitracs™ onto the parallel chassis, do the following:

1. Loosen the linkage adjustment bolt off so that the mechanism can actuate freely.
2. Figure 17 shows the preferred starting point for track installation. Lay the tracks out on the bench as shown with the chassis straddled between them. Bolt the two-outside links in place using ¼-20 x 5/8-inch socket cap screws.

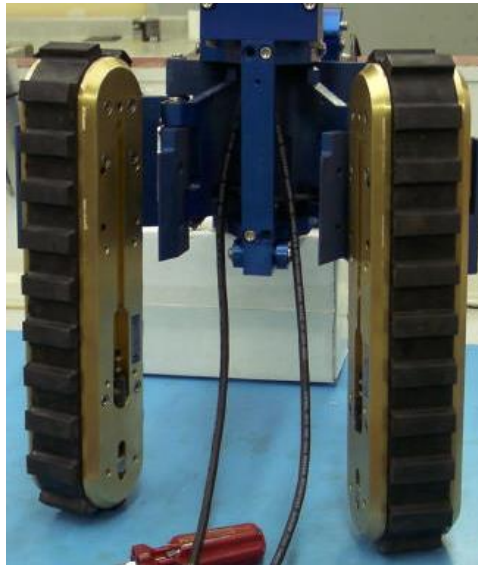


FIGURE 18: VEHICLE STOOD ON END – INNER BRACKETS

3. Tip the vehicle forward so that it is resting on the front of the tracks and the front of the camera. Use a piece of foam to rest the camera on to prevent damage. Alternatively, the camera can be removed altogether.

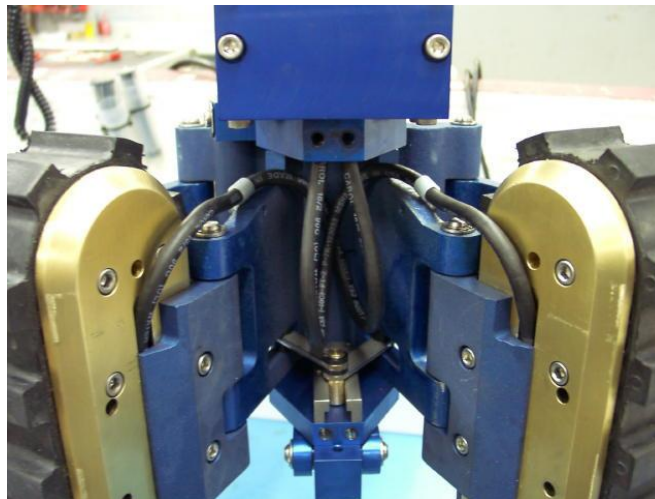


FIGURE 19: TRACKS PLUGGED IN

4. Install the track connectors onto the tracks. Lay the connector cable into the slot in the Minitrac™ side plate and swing the inside link overtop as shown in Figure 19. Bolt these down using ¼-20 x 1¼ inch socket cap screws.
5. Reverse the procedure to remove the tracks.

Note also in Figure 19 that there are two white plastic clips holding the connector whips to the frame. These always remain on to maintain proper whip routing. If they are missing, they must be replaced. In addition, Figure 20 below shows an interior wire constraint which must be present to confine the wiring harness.

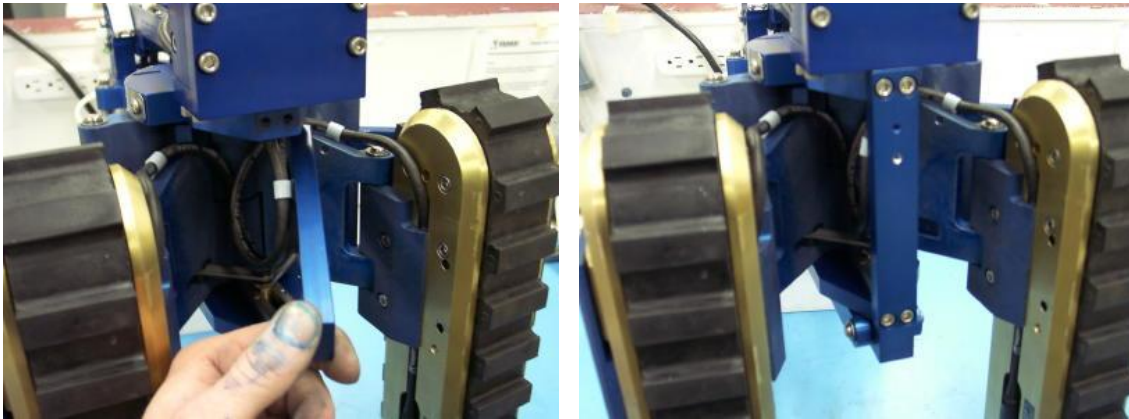


FIGURE 20: WIRE CONSTRAINTS

Parallel Configurations 12 inch – 36 inch – Flat

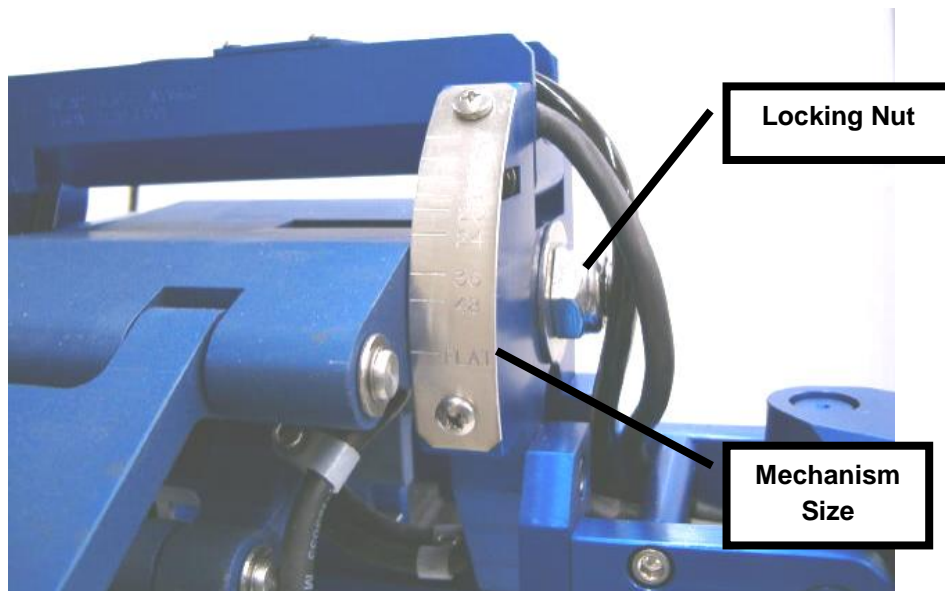


FIGURE 21: VEHICLE CONFIGURATION SIZE INDICATOR

1. Adjusting the various configurations has been made relatively simple. A large mechanism locking nut is located at the rear of the vehicle (see Figure 21). 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 in Figure 21 above.
2. 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.

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

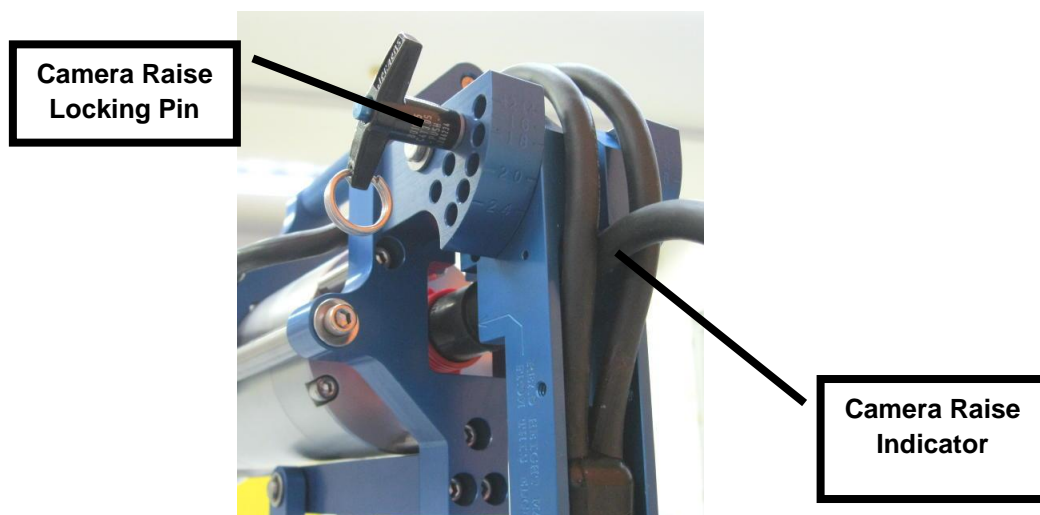


FIGURE 22: CAMERA RAISE CONFIGURATION INDICATOR

3. On the camera raise mechanism, note the various hole positions for the locking pin. Remove the locking pin and raise the camera to the nominal pipe size indicated on the camera raise indicator; the size reading is taken from the bottom edge of the camera raise arm. Replace the locking pin into the nearest through hole that matches the size.
4. 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.

Track Extensions

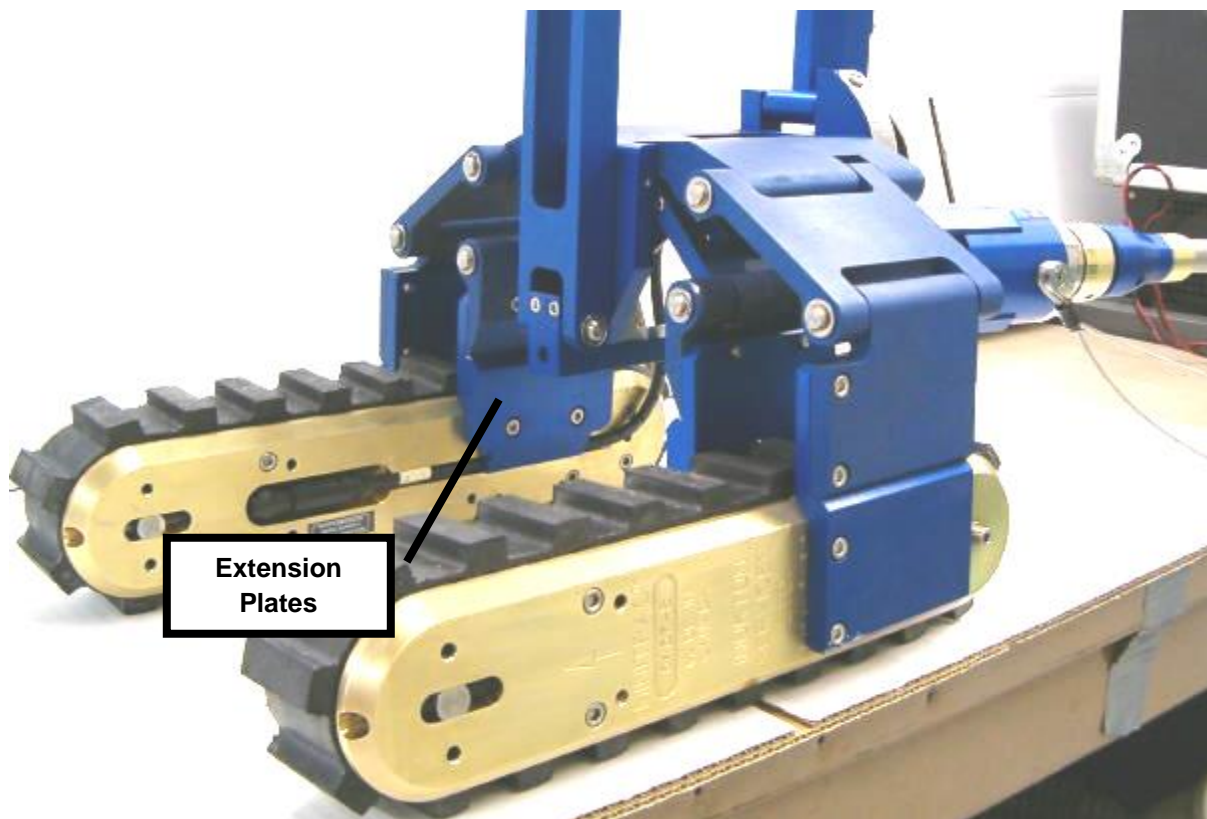


FIGURE 23: TRACK EXTENSIONS

The above photo shows the parallel chassis with the optional extension plates installed. The plates simply bolt onto the mechanism brackets using #¼-20 x 5/8-inch 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 inches for greater ground clearance. Please note that with extensions the indicated pipe sizes are no longer accurate.

Camera Height Extension

The optional camera raise extension is a bolt-on bracket which raises the camera by 14 inches.

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 with the same profile as the original camera mount.
2. Bolt the extension bracket onto the original camera mount using two ¼-20 x 1-inch socket cap bolts from the back and one 3/8-16 x 1¼ inch bolt from the front (for a total of three screws). 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.

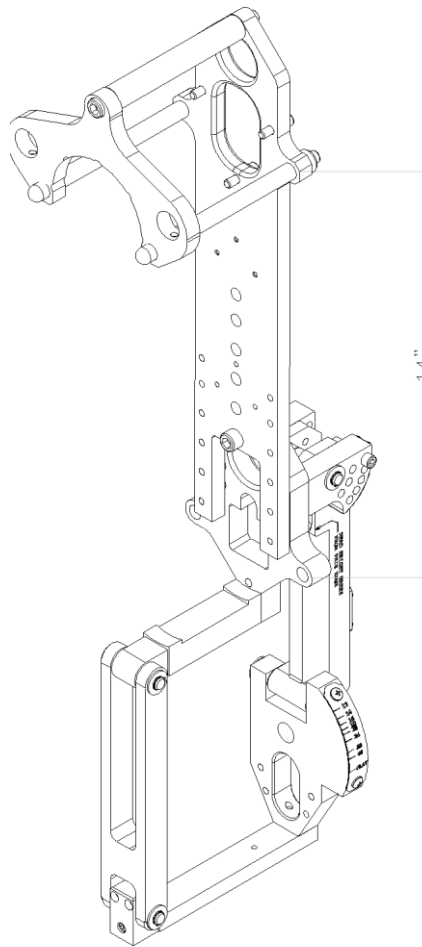


FIGURE 24: CAMERA RAISE EXTENSION

Motorized Camera Raise

A motorized camera raise mechanism is available for the VT150™ chassis which replaces the manual raise mechanism. Installation of the motorized raise is done at the factory. The illustration below shows the major parts. First, the mounting points are the same as for the manual raise making any chassis with a manual raise fully upgradeable to the motorized raise. Second, the raise motor contains its own driver circuitry and plug into a special rear camera harness extension. Whenever the system is switch on, the mechanism must be lowered to its auto-stop point for calibration.

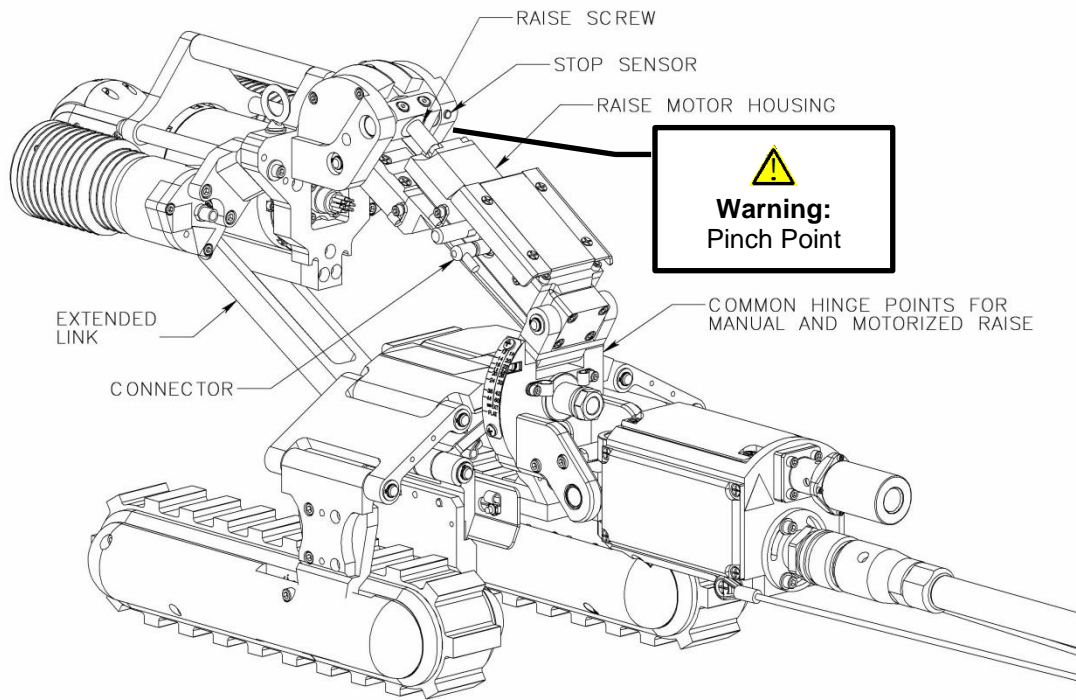


FIGURE 25: MOTORIZED CAMERA RAISE



Warning: Pinch Point: There is a pinch point between the raise motor housing and raise nut. Serious injury or loss of fingers may result if the mechanism is activated while being held.

Inline Configuration (6-8-10-12)

Installing the Tracks

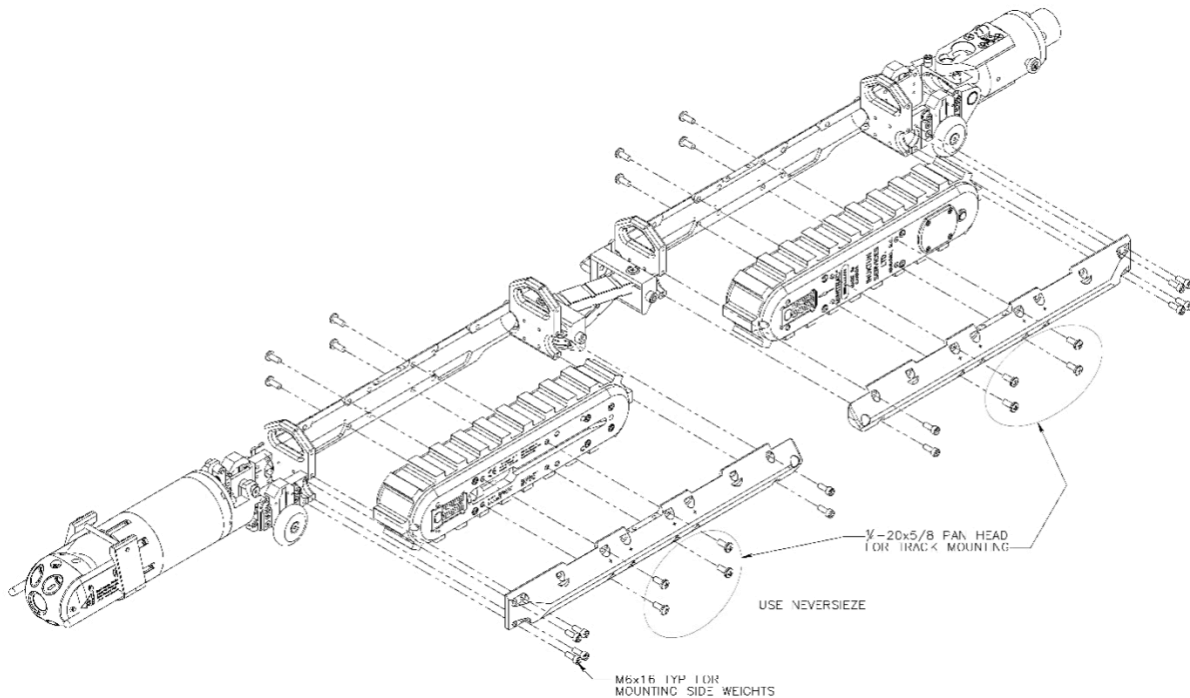


FIGURE 26: INLINE TRACK MOUNTING SCREWS

Installation of the tracks and side plates into the in-line configuration is accomplished using a 5mm T-Handle Allen wrench and a large Phillips screwdriver.

Safety – When handling the in-line chassis, hold it by the handles. Do not grasp or lift the chassis by the centre X-Hinge as this is a severe pinching hazard.

1. Lay the vehicle on the work bench 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.
2. 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.
3. Attach the free side plates using M6x16 socket cap screws.
4. Install the remaining ¼-20 x 5/8-inch track screws.

Warning: Pinching Hazard. Keep your fingers and hands out of the X-Hinge. Do not hold or lift the vehicle by the X-Hinge. Hand injury or loss of fingers may result. Only use the handles for lifting.

Note: The Minitrac™ and camera mounts with *imperial* ¼-20 x 5/8-inch screws, while the chassis screws are *metric* (mostly M6x16).

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Installing The Spectrum 90™ Camera

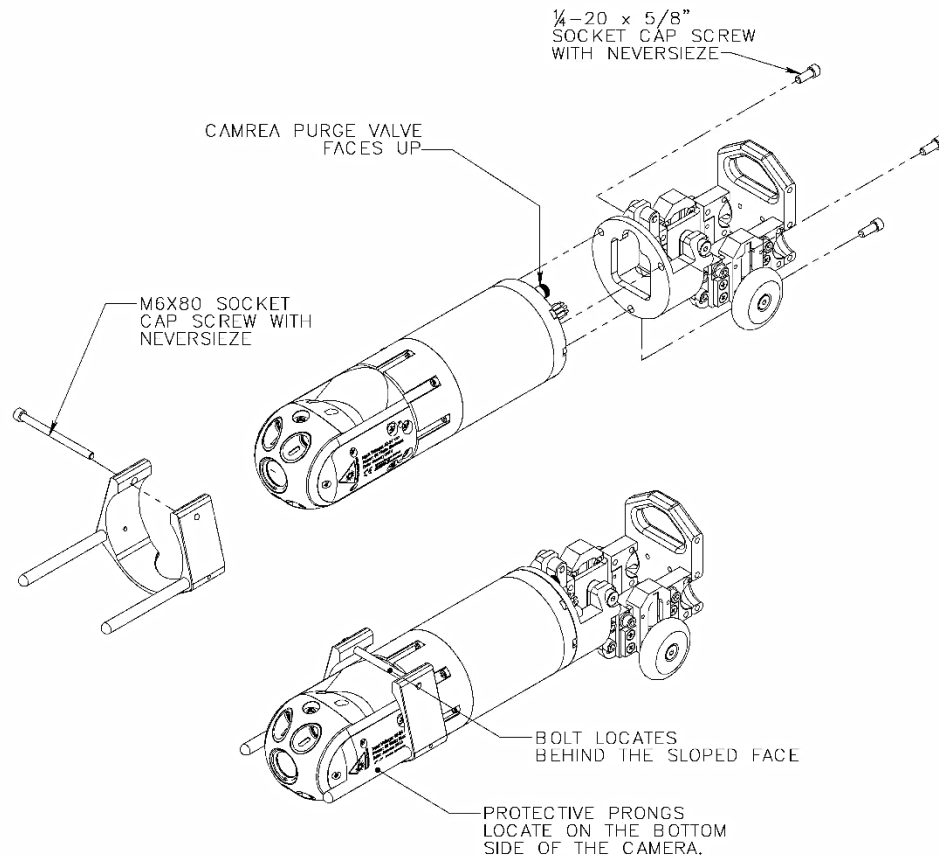


FIGURE 27: CAMERA INSTALLATION

Install the Spectrum camera on to the front of the vehicle using three 1/4-20 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.

Warning: Pinching Hazard. Keep your fingers and hands out of the X-Hinge. Do not hold or lift the vehicle by the X-Hinge. Hand injury or loss of fingers may result. Only use the handles for lifting.

Note: The Minitrac and camera mounts with *imperial* 1/4-20 x 5/8-inch screws, while the chasses screws are *metric* (mostly M6x16).

Camera Height / Guide Wheel Adjustment

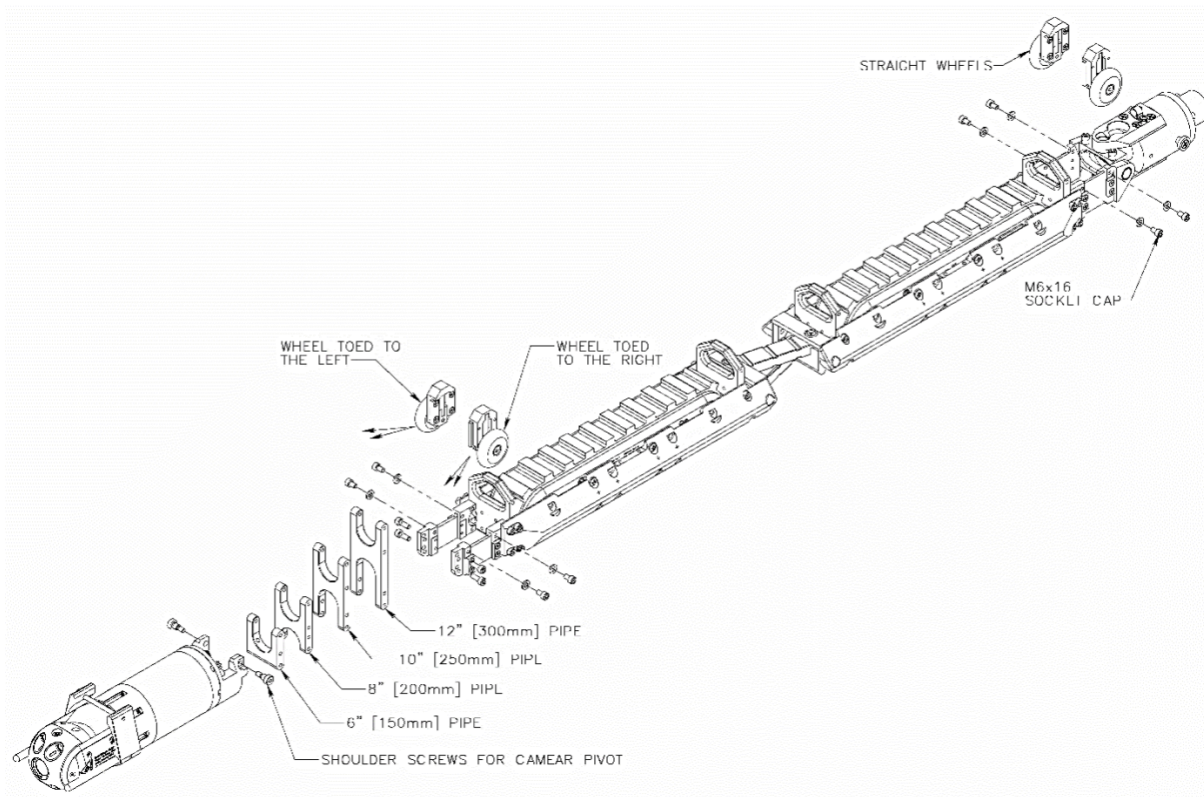


FIGURE 28: CAMERA HEIGHT / GUIDE WHEEL ADJUSTMENT

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.

Guide Wheel Adjustment: First, ensure the guide wheels are located correctly on the vehicle. As illustrated above, the front guide wheels must be arranged with the toe facing outward from the vehicle. The toe angle is small, 2.5 degrees, but can be easily seen. An incorrect installation (toed in) will result in vehicle instability. The rear guide wheels are straight.

Set the height wheels 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.

Recommended wheel height from flat surface:

Pipe Size	Wheel Height
6	1 1/8in / 28mm
8	5/8in / 16mm
10	1/2in / 13mm
12	7/16in / 11mm

Rear Camera Installation

The Versatrax™ system comes ready to accept a rear facing 72V Crystal Cam® camera with built-in Sonde locator. The plug-in whip is included with the harness block at the back of the vehicle. The 72V Crystal Cam® will come supplied with a mounting bracket and installation hardware. Note that in-line configurations for pipe below 10 inches diameter may not have enough clearance for the rear camera.

Warning: The plug-in whip is supplied 72 VDC. This whip must be capped with a dummy plug whenever the Crystal Cam® is removed. Shock or system damage may otherwise result. Never operate the system with this connector open.

Warning: The 72 Volt Crystal Cam® uses a higher voltage and different pin-out than the standard Crystal Cam®. 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 ½ inch pan head screws.
3. Install the camera using two #6-32 x ¾ inch 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.

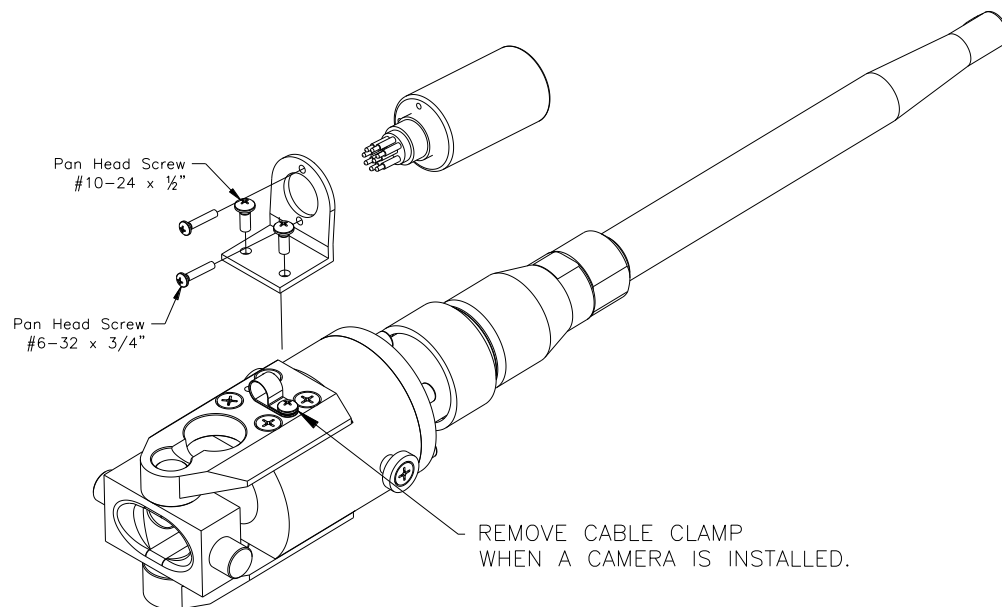


FIGURE 29: REAR CAMERA INSTALLATION

System Operation

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.

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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 110 VAC for light power. 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: 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™ 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.

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, we offer 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.

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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. 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 bend a cable and may break a wire internally. 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 350-pound 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 VT150™ is powerful and can generate a lot of pulling force. Even though the tether termination is designed to withstand tension, 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 may be 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.

When plugging in a connector:

- Inspect for dirt in both sides of the connectors. Do not plug in a dirty or damaged connector.
- Inspect for bent or burnt pins.
- Visually align the key-way or locating pin first before plugging in. Do *not* blindly jam and twist.
- 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.
- Use locking collars where available. In general, locking collars need only be screwed on finger tight.
- In general, all connectors on the vehicle are wet pluggable except for the main tether connector.
- Install dummy plugs on unused connectors.

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- Regularly apply silicone grease to the connectors to keep them from seizing.

Power Up / Power Down

This system is powered in three independent blocks:

1. **Control Computer** – This is an industrial PC running Microsoft Windows. Boot as normal for a Windows computer. The computer is configured by us to boot directly into a single user account.

Caution: To protect data integrity always shut the computer down by pressing the Windows START button and selecting “Turn Off Computer...”

2. **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.
3. **Versatrax™ Controller** – Refer to your Versatrax controller manual.

Pre-Operations Check

Before each deployment of the Versatrax system use the following checklist:

- ☐ Check that the work area has been safely set up.
- ☐ Check that the line voltage available at the worksite matches the equipment setup.
- ☐ Check that power and deck cable connections are correct.
- ☐ Check the vehicle for the following:
 - ☐ Check that the vehicle is in the correct configuration for the deployment.
 - ☐ Check the vehicle for mechanical damage to the chassis or cable harnesses which could affect its operation.
 - ☐ Ensure that all fasteners are in place and secure. In particular, check the fasteners holding on cameras, lights, tracks and tow cable.
 - ☐ Visually inspect the vehicle and Minitracs to ensure that the moving parts are free of debris and are functional. Make sure the track belt is free of debris and turns freely.
 - ☐ Ensure camera viewports are clean.
- ☐ Check the winch for the following:
 - ☐ Check that nothing will block movement of the level wind shuttle.
 - ☐ Check that no objects, tools, etc., have fallen into the winch mechanism around the chain and drum.
 - ☐ 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.
 - ☐ Check that the drum lock is disengaged and latched open.
 - ☐ Ensure that the drive clutch moves freely and is operational.
- ☐ Power up the system and check the following:

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- Check for sufficient SSD drive space for recording.
- Check record directories are set.
- Check video quality and camera control functions.
- Test video recording.
- Test main lights.
- Test track control.

Post-Operations Check

A post-ops inspection should be carried out after every deployment:

- ☐ Inspect the tether for damage as it is reeled in.
- ☐ Visually inspect vehicle for entrained debris or mechanical damage.
- ☐ Test each function to ensure proper operation.
- ☐ Clean the system by hosing it down with water at regular line pressure. Do not pressure wash. The tracks may be cleaned off by hosing them down while running. If the system has been used in salt water, thoroughly rinse the vehicle with fresh water right away.
- ☐ Take time to pack the system properly for transport away from the worksite.
- ☐ Store the system in a dry environment.

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

Warning: Use regular water line pressure to rinse. Do not use a pressure washer. This will cause water damage since high pressure water can push past the seals.

Vehicle Deployment

The Versatrax 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 using the pre/post-operations checklists provided in this manual.
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.

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The vehicle is now ready for its mission through the pipe.

Vehicle Recovery

The Versatrax™ 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 driving backwards a very short distance. This will disengage the track drive clutches for towing with the winch.
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 while simultaneously running the winch, 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 tether or 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 damage the Minitracs.

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.

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 Versatrax™ 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/she should consult with the site supervisor before moving forward.

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Sonde Locating Device

A Sonde transponder can be optionally installed in-line with the rear camera. Independent “bullet” shaped Sondes may also be obtained and attached to the system (www.prototek.net).

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 operator's expense. It is therefore in the operator's 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 on.

Vehicle Problems

1. In-line tracks don't run in the same direction.
 - Crawler / Chassis type is set incorrectly. See the Versatrax controller manual to set the crawler/chassis type.
 - One or more track reversals are set. See the Minitrac manual to set the correct track reversal.
2. Parallel vehicle won't steer or runs backward.
 - Crawler / Chassis type is set incorrectly. See the Versatrax controller manual to set the crawler/chassis type.
 - One or more track reversals are set. See the Minitrac manual to set the correct track reversal.
3. Tracks are running too fast or too slow.
 - Re-zero the joystick calibration. See the Versatrax controller manual to re-zero the joystick calibration.
 - Verify tether resistance settings. See the Versatrax controller manual to verify tether resistance settings.
 - Verify crawler type. See the Versatrax controller manual to verify crawler type.
4. Tracks running or creeping even with joystick centered.
 - Re-zero the joystick calibration. See the Versatrax controller manual to re-zero the joystick calibration.
 - Tether resistance is set incorrectly. See the Versatrax controller manual to verify tether resistance settings.
5. Tracks slow down excessively when under load.
 - Tether resistance is set incorrectly. See the Versatrax controller manual to verify tether resistance settings.
6. Tracks run out of control or speed up when under load.
 - Tether resistance is set incorrectly. See the Versatrax controller manual to verify tether resistance settings.
7. Tracks will not run.
 - Check the current meters.
 - If current is at 100% 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 is not getting to the tracks. Check all the cable connections.
 - Try changing tracks.
 - Inspect the vehicle wiring for damage.
 - Check all the system connectors.
 - Listen for the track motors. If the motors run but the track doesn't turn, suspect a broken pin in the drivetrain. Refer to the assembly diagram in the Minitrac manual.
8. Main lights don't function even when dial is turned to maximum.
 - Check all the cable connections.
 - Inspect for blown bulbs. Follow the instructions for Changing a Bulb in this manual.
 - Ensure there is no water in the lights. This can cause the light fuse to blow.
 - Check the light fuse on the front panel.

- Verify the light whips are plugged in fully and any unused whips are fitted with dummy plugs.
- Check for tether or slip ring damage by testing tether continuity.

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 360 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 look for 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. If the vehicle cannot work itself free from a snag, try using light tether tension and tractor power simultaneously.
 - a. If still stuck, try a stronger tether tension. When cranked by hand the winch can pull up to 500 pounds of force. The tether will handle this as a temporary load.
3. 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.

Maintenance

Fuse Replacement

The Versatrax™ controller contains both internal and panel mount fuses. These fuses are for the safety of the operators as well as to protect the equipment from damage. Fuse values have been carefully selected for their application.

If a fuse blows, stop and look for possible causes. These might include cable damage, water incursion or improper connections.

Replace fuses with the same type and rating only.

Front Panel Fuses

Main Light Output Fuse: 1 Amp slow blow (5x20mm). This fuse is placed directly on the main vehicle light feed and is unrelated to the camera lights. This fuse may occasionally trigger when a main light bulb blows. This is normal. Do not install a larger fuse. Installing a larger fuse will risk damage to the winch slip rings.

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72V Fuse: 3 Amp slow blow (5x20mm). This is the 72V feed down the tether. This circuit powers the cameras and any vehicle electronics. Inspect all connections and dummy plugs before replacing this fuse. Also inspect any cameras and vehicle electronics for signs of water leakage.

Internal Fuses (Board Mount)

Line Fuse: 10 Amp GDC time delay fuse (5x20mm). This is the main live-side AC power fuse. Failure of this fuse is a sign of catastrophic failure. Carefully evaluate the system before replacing this fuse.

Neutral Fuse: 10 Amp GDC time delay fuse (5x20mm). This is the main neutral-side AC power fuse. Failure of this fuse is a sign of catastrophic failure. Carefully evaluate the system before replacing this fuse.

Light Input Fuse: 3.15 Amp GDC time delay fuse (5x20mm). This fuse protects the main vehicle light circuits inside the controller. There is a separate output fuse located on the front panel. This fuse is unrelated to the camera lights.

Note: A printing error on some early circuit boards incorrectly labeled this fuse as 2A.

Track Fuses: 3 Amp slow blow (2AG). Failure of the left or right track fuse may indicate a problem with a driver module or the filter board.

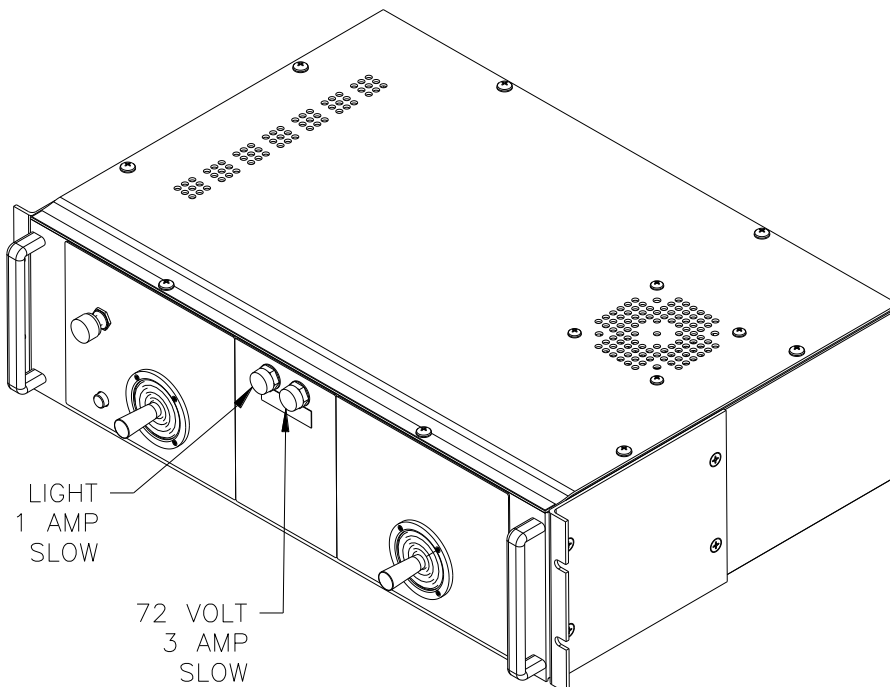


FIGURE 30: FRONT PANEL FUSES

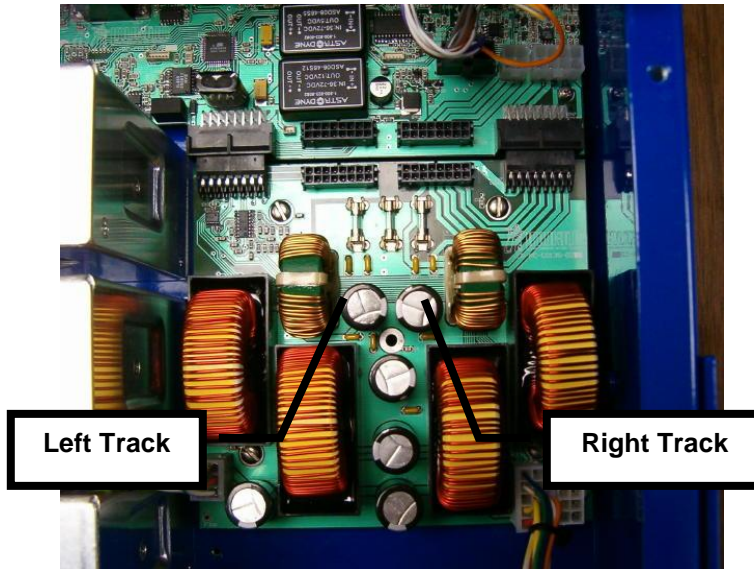


FIGURE 31: TRACK AND CAMERA FUSES

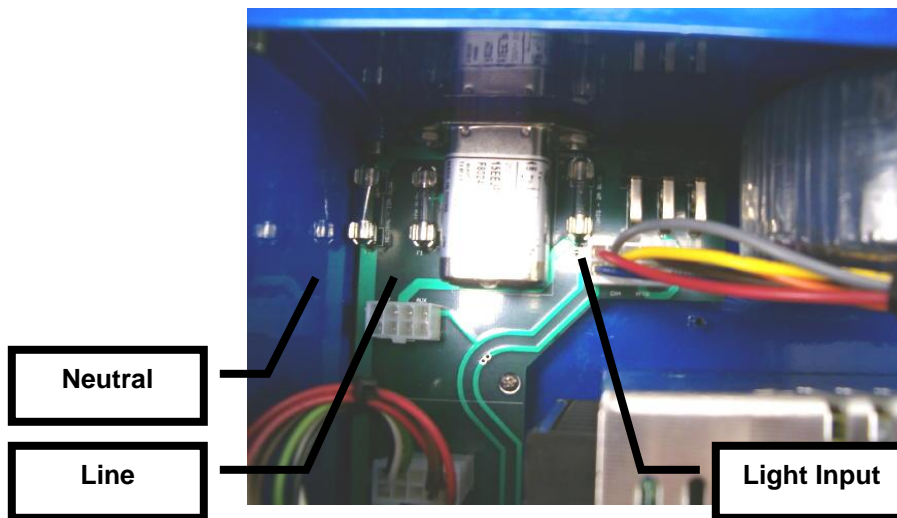


FIGURE 32: LINE AND LIGHT INPUT FUSES

Changing a Bulb (101 Lights)

Unscrew the light dome assembly from the tube to access the bulb. The window port should not need to be removed. Replace with Eddyfi supplied frosted bulbs (120V 50W). Substituted light bulbs may not be durable and may cast an inefficient light pattern.

Tether Re-termination

Contact your Eddyfi agent if the tether requires re-termination.

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.

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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.

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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.

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