

## Cameras

### **Orion 3 Zoom**

<b>Pan &amp; Tilt Zoom Camera (Color) (Orion 3)</b>
Camera maximum resolution shall be no less than 1920 x 1080 pixels. Systems that have resolution lower than 1920 x 1080 pixels will be deemed unacceptable.
Camera must have 360 degrees of continuous rotation.
Camera shall have a digital, 3x zoom in Standard Definition and 32x in High Definition.
Camera photosensitivity shall be no more than 0.05 lux. Cameras that have a higher LUX will be deemed unacceptable.
Camera aperture angle / FOV shall be no less than 90 degrees diagonal
Camera total diameter not to exceed 2.5 inches
Camera total length is not to exceed 4 inches
Camera must be able to operate in a minimum 4" diameter pipeline.
Camera must weigh less than 1.25 lbs.
Camera shall have automatic iris that adjusts light sensitivity based on pipeline conditions and the ability to manually set the iris level via a joystick.
The camera housing must be pressurized to a minimum of 1 bar to avoid water ingress that could cause damage.  A low-pressure situation will alert the operator with an <u>audible tone</u> and <u>text message</u> on the camera controller's diagnostic display. Systems that do not have both on screen pressure display and audible alarm will be deemed unacceptable.
Camera shall have built-in white LED lights to illuminate the interior of the pipeline. Light groups must be connected in parallel so that the failure of 1 LED does not affect other LEDs
Camera must have auto upright picture control to ensure video image is correctly displayed on the monitor with the top of the pipe always at the top of the video monitor screen.
Camera shall have a zero (home) position where the camera views straight ahead and the upright picture control automatically enables
Camera must display viewing direction on screen while operating. The display shall appear as a clock allowing the operator to clearly and quickly indicate viewing direction.
Camera rotation must be on the horizontal axis of the main connector with a slipring through the geometric center of the camera to reduce unnecessary strain on moving parts and connectors during operation.
Camera rotation must be controllable must be variable based on operator input.
All fasteners used on the camera must be recessed so that no protruding fasteners to catch during operations
Camera housing must be constructed of hard-anodized high strength aluminum with a documented testing of shock resistance of 1 kg / height of fall 27.5".

Camera light housing must be constructed of high strength polycarbonate with a documented testing of shock resistance of 1 kg / height of fall 15.75”
Camera lens protective front window shall be constructed of a special scratch resistant glass with a documented testing of shock resistance of 1 kg / height of fall 15.75”
Camera protection class shall meet a minimum of an IP68 to IEC 529 rating
All electronic PCBs shall be connected to one another without the need of soldering for ease of service and repair. Any camera with PCB’s that require soldering will be deemed unacceptable.
A tool and spares kit, and storage transport case must be provided.

**Orpheus HD Pan, Tilt and Zoom Camera**

<b>Pan &amp; Tilt Zoom High Definition Camera (Color) (Orpheus HD)</b>
Camera maximum resolution shall be no less than 1920 x 1080 pixels. Systems that have resolution lower than 1920 x 1080 pixels will be deemed unacceptable.
Camera must have pan & tilt function with motorized controls to allow the operator to change the viewing angle from the camera controller.
Camera must have a 160x zoom comprised of a 10x optical and 16x digital zoom.
Camera shall have automatic focus that will focus to the pipe will without user intervention. The focus must also have remote focus controls that can be changed from the camera controller.
Camera shall have automatic iris and manual iris that adjust light sensitivity based on pipeline conditions.
Graphical warning labels must be affixed to warn of laser light and identify the laser classification.
The camera housing must be pressurized to a minimum of 1 bar to avoid water ingress from damage. A low-pressure situation will alert the operator with an audible tone and text message on the camera controller’s diagnostic display. Systems that do not alert the operator of low-pressure VIA both audible and visual alerts will be deemed unacceptable.
The camera must be pressurized with dry air supplied by a supplied pressure test set/air pump. (see attached specification for Pressure Test Set/Air Pump)
The pressurization valve must be located on the rear of the camera housing with a protective plastic cap.
Camera shall have built-in a minimum 12 high intensity white LED lights to illuminate the interior of the pipeline up to a minimum of 120” in diameter. Cameras or systems that require additional lighting to completely illuminate a 120” diameter pipeline will be deemed unacceptable.
Camera shall have 2 high intensity white LEDs that can be independently controlled and specifically designed to illuminate the space between joints in pipeline segments.
The camera lens assembly must be designed and built in a manner to eliminate all blossoming of video image from reflections and mirrored light.
Camera must have always-upright picture that will automatically rotate the imaging chip while panning and tilting to ensure the image is always upright. Example: When panned to 90 degrees

and looking directly parallel to the pipe wall, the camera must have an upright picture when viewing the pipe wall from 7 o'clock to 12 o'clock and also while viewing 1 o'clock to 6 o'clock.
Camera CCD imaging chip must have a minimum of 2,073,600 pixels
Camera aperture angle / FOV shall be no more than 58 degrees diagonal on the wide view and no more than 6.5 degrees diagonal on the telephoto view.
Camera photosensitivity shall be no more than 1.0 lux
Camera resolution shall be no less than 1920 horizontal x 1080 vertical
Camera must have 360 degrees of continuous rotation.
Camera rotation must be on the horizontal axis of the main connector with a slip ring through the geometric center of the camera to reduce unnecessary strain on moving parts and connectors during operation.
Camera must have 240 degrees of total pan
Camera rotation and tilting must be controllable with varying speeds to aid in camera alignment while camera optics is zoomed. Pan and/or rotation speed shall increase as more force is applied to the control joystick.
Camera must have automatic joint panning operated from a single button press
Camera must have pre-programmed panning positions at multiple clock positions for simple quick operation.
Camera lens window must be a minimum of 1.25" in diameter to allow maximum lighting through the lens to the imaging chip.
Camera must have removable side covers to allow ease of maintenance and repairs. The side covers shall have o-ring sealing and be fixed with a minimum of 8 fasteners per side.
Camera must be able to operate in a minimum 6" diameter pipeline and be no longer than 8" in overall
Camera shall have a zero (home) position where the camera views straight ahead and the upright picture control automatically enables.
Camera housing must be cylindrical in design with long radius edges and no protruding surfaces to catch on during operations.
All fasteners used on the camera must be recessed so that there are no protruding fasteners to catch during operations
Camera must provide a clock position graphical overlay on screen to provide information on viewing angle.
Camera must have a pipe size overlay to measure pipe diameter sizes.
Camera connection must be no greater than .650 inches in diameter.
Camera housing must be constructed of hard-anodized high strength aluminum with a documented testing of shock resistance of 1 kg / height of fall 27.5".
Camera light housing must be constructed of high strength polycarbonate with a documented testing of shock resistance of 1 kg / height of fall 15.75"
Camera lens protective front window shall be constructed of a special glass with a documented testing of shock resistance of 1 kg / height of fall 15.75"
Camera protection class shall meet a minimum of an IP68 to IEC 529 rating

All electronic PCBs shall be connected to one another without the need of soldering for ease of service and repair. Any camera with PCB's that require soldering will be deemed unacceptable.
A tool and spares kit, protective connector cap, and watertight plastic storage transport case must be provided.

**Retrus for HD Systems**

<b>Rear-Viewing Camera for HD Systems (Retrus)</b>
Camera shall have the ability to be installed to provide a rear view, from the HD camera tractor, allowing monitoring of objects, defects and other items of interest while navigating in reverse.
Camera shall have built-in high-power white LED lights to illuminate the interior of the pipeline.
Camera shall be constructed to install quickly in-between the mainline camera cable and the rear connector of the HD camera tractor.
Camera body shall be made without sharp edges which will help prevent catching on debris, offset joints or other internal pipeline features.
Camera body shall be coated to prevent corrosion.
Camera body shall be manufactured out of non-corrosive materials such as stainless steel and aluminum.
The system shall have the ability to automatically switch the displayed video to the Retrus (rear) view when the system moves backward.
Camera shall be pressurized to prevent water ingress, none pressurized cameras may be deemed unacceptable.

**Tractors**

**T66.1 HD**

<b>Robotic Tractor (Small) (T66 HD)</b>
Tractor must be able to operate in a minimum 4" diameter pipeline with enough clearance to negotiate offsets and debris.
Tractor shall be designed utilizing wheels / tires as the mode of propulsion. Tracked crawlers or other modes of propulsion will be deemed unacceptable.
Tractors shall be four-wheel drive.
Tractor must be steerable with each side able to be independently operated to provide skid-steer style of turning. Tractor must have two internal motors for this operation.
Tractor must be able to operate 5 different front camera mounts
Tractor must be able to operate standard CCTV, CCTV 3D, HD and HD 3D cameras.
Tractor must be able to have an external over-turn projection system installed on it.
Tractor must be no longer than 14 inches in length. Any tractors longer than 14 inches will be deemed unacceptable.
Tractor must have a dual swivel cable connector allowing for both X & Y axis to pivot.
Must be able to be fitted with multiple camera connection configurations. Configuration shall include: <ul style="list-style-type: none"> <li>✓ Fixed position connection</li> </ul>

<ul style="list-style-type: none"> <li>✓ Movable connection to assist in positioning in confined areas and providing camera protection during impact with objects</li> <li>✓ Connection that allows the addition of an auxiliary light ring</li> <li>✓ Adjustable lift for large diameter pipelines</li> </ul> <p>Each optional connector must accept a minimum of five (5) camera options without the need for additional, ancillary or auxiliary adaptors.</p>
<p>Tractor must have continuously adjustable speed with speed set (cruise control).</p>
<p>Tractor must have ATC (anti tilt compensation) that will automatically steer the tractor so that it does not ride up on the pipe wall and capsizes.</p> <ul style="list-style-type: none"> <li>✓ The anti-tilt compensation shall maintain the tractor on a level plane within the pipeline during operation without operator input.</li> <li>✓ The anti-tilt compensation shall operate in both forwards and reverse.</li> </ul> <p>Any tractors without ATC (anti tilt compensation) or require operator input to maintain a level plane will be deemed unacceptable.</p>
<p>The tractor housing must be pressurized to a minimum of 1 bar to avoid water egress from damage.</p> <ul style="list-style-type: none"> <li>✓ A low-pressure situation will alert the operator with an <u>audible tone</u> and <u>text message</u> on the controller's diagnostic display.</li> </ul> <p>Systems that do not have both on screen pressure display and audible alarm will be deemed unacceptable.</p>
<p>The tractor may be supplemented with various wheel sets, a tractor height extension, additional weights, and auxiliary LED lighting.</p>
<p>The tractor may be outfitted with an optional inclinometer module to monitor and log the pitch and roll of the tractor in the pipeline.</p> <ul style="list-style-type: none"> <li>✓ Grade must be displayed on screen during operation</li> <li>✓ Must be able to work with approved software's to produce usable reports and graphical view of the pitch or grade of the pipeline.</li> </ul>
<p>Tractor body must be manufactured from solid brass for weight and coated with a chrome finish to resist tarnishing and facilitate cleaning.</p>
<p>All fasteners must be manufactured from a non-corrosive material such as stainless steel or aluminum.</p>
<p>Tractor must have lowering hooks mounted to work in connection with a claw to enable insertion and extraction out of manholes with minimal risk to equipment</p>
<p>The tractor shall include wheel sets for 4", 6" and 8" diameter pipe.</p>
<p>Tractor protection class shall meet a minimum of an IP68 to IEC 529 rating</p>
<p>A tool and spares kit must be provided for maintenance of the tractor.</p>

**T76 HD**

<p><b>High Definition Robotic Tractor (Medium) (T76 HD)</b></p>
<p>Tractor must be able to operate in a minimum 6" diameter pipeline with enough clearance to negotiate offsets and debris.</p>
<p>Tractor shall be designed utilizing wheels / tires as its mode of propulsion. Tracked crawlers or other modes of propulsion will be deemed unacceptable.</p>

Tractor must be four (4) wheel drive, Tractors that utilize more than four (4) wheels will be deemed unacceptable
Tractor must be steerable with each side able to be independently operated to provide skid-steer style of turning. Tractor must have two internal motors for this operation.
Tractor must be no longer than 22 inches in length. Any tractors longer than 22 inches will be deemed unacceptable.
Tractor must weigh a minimum of 44 pounds without any wheels attached.
Tractor must have a dual swivel cable connector, allowing both X & Y axis to pivot.
Tractor must have continuously adjustable speed with speed set.
Tractor shall have a front moveable camera connector, referred to as a base module, which will fold upwards to assist during insertion in confined areas.
The base module must be removable through utilization of a recessed connector.
Tractor must have the ability to remove the base module and have the ability to add a lateral launching module to convert the tractor to a fully operational lateral launch robot.
Tractor must have anti tilt compensation that will automatically steer the tractor so that it does not ride up on the pipe wall and capsize. The anti-tilt compensation shall maintain the tractor in a level plane within the pipeline during operation. Any tractors without anti tilt compensation will be deemed unacceptable.
The tractor housing must be pressurized to a minimum of 1 bar to avoid water egress from damage. A low-pressure situation will alert the operator with an audible tone and text message on the camera controller's diagnostic display.
Tractor body must be manufactured from solid brass for weight and coated with a chrome finish to resist tarnishing and facilitate cleaning.
All fasteners must be manufactured from a non-corrosive material such as stainless steel or aluminum.
Tractor must have a remotely operated motorized camera-elevating device that allows the camera to be raised and lowered inside of pipeline during operation. Manual elevating of camera will be deemed unacceptable.
Motorized camera elevator must be able to raise the camera vertically a minimum of 8.25"
Motorized camera elevator must have the ability to display the height of operation in percentage on the main control panel.
Motorized camera elevator must be pressurized to a minimum of 1 bar to avoid water egress from damage. A low-pressure situation will alert the operator with an <u>audible tone</u> and <u>text message</u> on the controller's diagnostic display. Systems that do not have both on screen pressure display and audible alarm will be deemed unacceptable.
Tractor must have the ability to be operated without the use of a motorized camera-elevating device for smaller diameter pipelines. Protective caps and all hardware must be supplied for this mode of operation.
Appropriate graphical warning stickers shall be affixed to warn of any potential pinch points on elevating device.
Tractor must have a milled sloped hook system with a lowering claw to quickly and efficiently insert and extract the tractor from manholes.
The tractor may be supplemented with various wheel sets, additional weights
Tractor must have ability to accept and function with High Definition Camera

All fasteners used on the tractor must be recessed so that no protruding fasteners catch during operations
All electronic PCBs shall be connected to one another without the need of soldering for ease of service and repair. Any tractor with PCB's that require soldering will be deemed unacceptable.
All electronic PCBs must be located in a single location on the tractor with a single access cover, o-ring sealed, and secured with a minimum of 6 fasteners for protection and ease of service and repair.
All gearing and motors must be accessible from a single location on the tractor with a single access cover, o-ring sealed, and secured with a minimum of 8 fasteners for protection and ease of service and repair.
The tractor may be outfitted with an inclinometer module to monitor and log the pitch and roll of the tractor in the pipeline.
The tractor shall include wheel sets for 6", 8", and 10" diameter pipe.
Tractor protection class shall meet a minimum of an IP68 to IEC 529 rating
A tool and spares kit must be provided for maintenance of the tractor.

### Computer System

#### **19" Industrial PC Package**

<b>Computer</b>
Rugged Intel Based Motherboard <ul style="list-style-type: none"> <li>✓ Includes on-board RS-232 Port</li> <li>✓ Includes on-board 2 DVI video outputs</li> <li>✓ Includes minimum of 2 full size PCI expansion slots</li> </ul>
Intel Quad Core Processor > 3GHz
16 GB RAM Minimum
256 GB SSD for Applications / OS
2 TB Hard Drive for data
DVD-R/CD-RW drive
Washable Anti-Microbial Keyboard <ul style="list-style-type: none"> <li>✓ Washable keyboard offering antimicrobial protection</li> <li>✓ Treated antimicrobial coating provides added defense against the growth of mold, mildew, and fungi</li> </ul>
Anti-Microbial Mouse <ul style="list-style-type: none"> <li>✓ Antimicrobial protection of the mouse surface</li> <li>✓ Dishwasher Safe</li> </ul>
Rugged industrial grade rack mount enclosure <ul style="list-style-type: none"> <li>✓ Includes shock mounted hard drive carriage</li> <li>✓ Includes minimum of 2 front mounted USB ports</li> </ul>
Windows 10 Professional 64-bit operating system
Professional Grade 17" Monitor <ul style="list-style-type: none"> <li>✓ High 1280 x 1024 SXGA resolution or similar</li> <li>✓ Optical Glass Protective Cover over LCD Screen</li> <li>✓ Anti-Burn-in technology</li> <li>✓ Versatile connectivity (BNC in/out x2, S-Video, VGA, DVI, Audio in/out)</li> </ul>

- ✓ Selectable aspect ratio for ultimate image: Native, Overscan, Underscan
- ✓ Input Signal VGA, DVI, CVBS, S-Video

## Controllers

### **BS7 Controller**

Power Supply / Controller (BS 7)
Power supply controller must be able to operate both digital scanners and analog CCTV inspection equipment.
Power supply controller must have removable power supply card situated on a bus to easy diagnostics or replacement without removal from the rack.
Power supply controller shall be rack mount design with remote control station and keyboard handling camera power and controls, tractor power and controls, text generation, diagnostics, and cable winch controls. Camera systems that require more than one mounted component will be deemed unacceptable.
Remote Control Station must have a minimum 6” diagonal, full-color adaptive touch screen for selecting options and controlling system functions.
Remote Control Station shall give a diagnostic readout of component pressure and issue an audible warning when pressure is low.
Remote Control Station shall display the current draw of both the lighthoods and each motor in the tractor by view of a bar graph representing percentage.
Remote Control Station shall allow for adjustment of brightness / intensity of both auxiliary light rings and camera lights, as well as be able to switch off individual light banks on the auxiliary lighthouse.
Power supply controller must have a graphic-oriented on-screen display generator to allow the operator to: <ul style="list-style-type: none"> <li>✓ Type on-screen text</li> <li>✓ Display distance counter</li> <li>✓ Tractor inclination</li> <li>✓ Display date and time</li> <li>✓ Display camera viewing angle</li> <li>✓ Display tractor speed in numeric value or in a graphic with color indicators of Green, Yellow and Red keeping the operator within correct speed limits.</li> </ul> Each of the OSD (On Screen Display) objects shall be positioned to any portion of the viewing screen based on systems owner’s requirements. Systems that do not allow for all OSD items to be displayed or repositioned will be deemed unacceptable
On-screen text must have a minimum of 16 lines of text with a minimum of 53 characters per line.
The controller must be capable accepting inputs for a minimum of 2 distance counters and switchable between meters and feet.
The controller must be able to delete all text from the screen with the press of a single key.
The power supply controller shall allow for a minimum of 10 color variations of overlay text to contrast on different backgrounds.



<p>The on-screen text generator must have a header field that will continuously display text at the desired location.</p>
<p>The power supply controller shall allow the user to position each system field anywhere on the visible screen to prevent obstruction of view.</p>
<p>The power supply controller must automatically identify which camera, tractor, and cable winch is connected to the system.</p>
<p>The power supply controller must have a minimum of 4 video output, 1 composite video input</p>
<p>The power supply controller shall be able to operate:</p> <p>push cameras</p> <ul style="list-style-type: none"> <li>✓ Minimum of 10 different cameras</li> <li>✓ Small medium &amp; large tractors</li> <li>✓ Lateral launch systems</li> <li>✓ PANORAMO mainline scanner</li> <li>✓ PANORAMO SI manhole scanner</li> </ul> <p>Should an upgrade be desired in the future, systems should not require additional controller modules to allow for additional or enhanced inspection capabilities.</p>
<p>Tractor functions shall be operated from a single joystick.</p> <ul style="list-style-type: none"> <li>✓ Tractor speed</li> <li>✓ Speed set</li> <li>✓ Direction</li> <li>✓ Steering</li> </ul> <p>All to be operated from a multi-axis, multi-function joystick to be mounted in the desktop area.</p> <ul style="list-style-type: none"> <li>✓ Forward and reverse must be controlled by an up or down motion</li> <li>✓ Drift or incremental steering by side-to-side motion</li> <li>✓ Skid steering via rotation of the joystick.</li> <li>✓ In addition, two function buttons must be supplied on the top of the joystick, one to set the speed and stop the tractor, the other to switch between cameras on a lateral launch.</li> </ul>
<p>Camera functions shall be operated from a single joystick.</p> <ul style="list-style-type: none"> <li>✓ Camera pan &amp; tilt operations</li> <li>✓ Auto-home</li> <li>✓ Aris, and focus</li> </ul> <p>All to be operated from a multi-axis, multi-function joystick to be mounted in the desktop area.</p> <ul style="list-style-type: none"> <li>✓ Camera rotation must be controlled by side-to-side movement of the joystick</li> <li>✓ Tilting by up and down movement of the joystick</li> <li>✓ Focus and iris controlled by rotation of the joystick.</li> <li>✓ In addition, two function buttons must be supplied on the top of the joystick, one to return the camera to the home position, the other to switch between iris controls.</li> </ul>
<p>Joystick functions should automatically change based on power supply controller's recognition of the attached tractor or camera.</p>
<p>Joystick must have proportionate directional controls so that the speed of the tractor varies by the percentage from home to max.</p>
<p>Power supply controller must have the capability to switch between right hand and left-hand joystick configurations.</p>
<p>Power supply controller must have a 360 degrees joint inspection function that will automatically turn the camera to an upright position and then slowly scan 360 degrees.</p>

Remote Control Station must allow the operator the ability to electronically and remotely switch the radio sonde transmitter in the camera head off and on.
Remote Control Station must allow the operator the ability to electronically and remotely switch off and on the upright picture control of the camera head.
When used with corresponding equipment, the power Remote Control Station must allow the operator the ability to electronically and remotely switch off and on the laser diodes, auto-focus, and control the zoom of the camera head.
The Remote-Control Station must allow the operator the ability to electronically and remotely switch off and on the automatic tilt compensation of the tractor.
Remote Control Station must have an emergency stop button to remove all power to the downhole equipment.
Power supply controller shall weigh no more than 10 lbs. for ease of installation and shipping.
On-screen text entry and menu navigation shall be done on a standard QWERTY PS2/AT keyboard.
Controller must have a serial communications port using a DB9 connection for interface with various types of computer software.
The power supply controller must be able to be restarted without removing power to other components and via menu selection from the Remote-Control Station.
The power supply controller shall have a master power switch on the front of the unit.
Power supply controller must have on-board help menus to aid in new user operation.
Power supply controller menu system shall come standard with a minimum of 12 unique language settings.
Power supply controller must be able to be reset to factory defaults by a maximum of 3 key presses.
The power supply controller must have a function to calibrate the tractor mounted inclination meter and be able to calibrate within a minimum of +/- 5%.
The power supply controller must be constructed from lightweight, extruded aluminum with a minimum of 4 sides with over 80% of the surface area ventilated.
The system must utilize a RS485 communication protocol. Systems utilizing a CAN communication protocol will be deemed unacceptable.

## Reels

### **KW505 HD 4K Synchronized Power Reel**

<b>Powered Cable Reel (KW505 4K)</b>
The cable winch shall be stationary mounted and hold up to 2000 linear feet of camera cable.
Cable winch must be compatible with digital pipe inspection / HD/4K pipe inspection equipment as well as analog CCTV pipe inspection equipment transferring data over a dual fiber optic cable.
Cable reel must operate with a 48-volt DC power source.
The cable winch must have an electromagnetic clutch to engage and disengage the cable winch.
The cable winch's clutch must be electronically switchable on and off using a push button switch with a LED status indicator light.
The cable winch must have an automatic level wind guide.

The cable winch shall have a cable equalization amplifier for video picture processing.
There shall be a cable distance-measuring device built into the boom and integrated pulley.
Cable winch must have an integrated traction-regulating device that ensures optimum performance of the tractor in all operating conditions. <ul style="list-style-type: none"> <li>✓ This system assists in paying out cable dependent on tractor speed.</li> </ul>
Cable winch must have an integrated lowering winch to lift, lower, and position the tractor from the truck into the manholes. <ul style="list-style-type: none"> <li>✓ Systems that do not have integrated lowering devices and utilize 3<sup>rd</sup> party cranes to lower equipment will be deemed unacceptable.</li> </ul>
The cable reel integrated lowering winch must be capable of lifting a minimum of 175 lbs.
Cable Reel must have a foldable boom that will have multiple locks allowing it to position at various angles to enhance setup capabilities.
Cable Reels foldable boom must be able to support a minimum of 175 lbs.
The cable reel shall be equipped with an emergency brake that will lock the reel if power is lost to the system to prevent uncontrollable unreeling of camera cable. <ul style="list-style-type: none"> <li>✓ Emergency brake must be equipped with a manual override and hand crank.</li> </ul>
Cable winch must have a remote-control pendant with the following controls: <ul style="list-style-type: none"> <li>✓ Tractor direction</li> <li>✓ Tractor speed</li> <li>✓ Tractor stop</li> <li>✓ Control cable winch</li> <li>✓ Operate lowering winch</li> <li>✓ Switch between internal and external controls</li> <li>✓ Turn winch on and off</li> <li>✓ Removal of slack from the cable</li> <li>✓ Retract lateral launch cable if attached.</li> </ul>
Cable reel must have an emergency stop button on both <ul style="list-style-type: none"> <li>✓ Drum/Reel</li> <li>✓ Pendant controller</li> </ul>
Emergency stops shall remove all power to the downhole equipment.
Cable Reel must have a minimum of 3 status indicators, power and circuit breaker states.
Cable Reel must have a digital distance counter
Cable Reel must have a button used to reset the digital distance counter to zero position. <ul style="list-style-type: none"> <li>✓ Digital distance counter must operate independently from the footage counter in the office.</li> </ul>
Cable Reel must have a removable drip tray that will catch and retain water and debris from main cable drum.
Camera cable must be 1640 feet of dual fiber optic, maximum of 0.405” diameter with 2000 lb. rating and Kevlar fiber armored.
Cable winch must be able to operate with an optional foot-controlled switch for hands-free raising and lowering of the camera / tractor with the lowering winch.

## Cable Protection

### **Downhole Roller**

<b>Cable Protection (Downhole Roller)</b>
Downhole roller to protect the cable at the invert Downhole roller must be designed to spin freely to aid in reducing friction aiding in longer range inspections <ul style="list-style-type: none"> <li>• Must be able to be secured to rope or lowering winch</li> <li>• Frame of roller must be constructed of aluminum</li> <li>• Shall use minimum of 2 lock pins to keep cable in the roller track</li> </ul>
Use of poles for lowering and locking the manhole roller into place is not acceptable for safety
Roller must have the preferred radius that will aid in encouraging longer life of the inspection cable and reduce wear.
Recommendation of a “tiger tail” or similar will not be accepted

### **Remote Inspection Reel Guide Roller**

<b>Cable Protection 305/505 Roller</b>
Roller must connect to the cable reel to allow reel to maintain proper cable geometry when performing remote inspections.
Roller must have the preferred radius that will aid in encouraging longer life of the inspection cable and reduce wear.
Roller must be of constructed of a steel frame and a nylon composite roller
Must be attached via a single locking pin
Rollers that attach with hardware that requires tools will be deemed unacceptable
Roller must be able to be disengaged when not in use, and not require removal when not doing remote inspections.

## Accessories

### **Pressure Test Set**

Manual pump with pressure gauge utilized with all cameras and tractors to pressurize them to the recommended safe pressure. The pressurization is monitored for each component by the controller. The controller will alert the operator in event of a low-pressure situation. This feature is a major benefit to system owners aiding in protecting it from potential water ingress.
Pressure test set must have pressure relief blow off valve integrated to ensure that the system cannot be accidentally over charged.
Air pump/Pressure test set must have an integrated and replaceable desiccant canister to remove moisture from the air.
Pressure test set must have a dial type gauge that is clear and easy to read.
Pressure test set must actively pump air in both directions (Pull & Push)
Systems that require gas canisters to pressurize the components will be deemed unacceptable.

### **Cable Cleaning Brush**

Must attach to cable reel boom
Must have replaceable brushes

**Foot Switch for Lowering Winch**

Must connect to cable reel
Foot switch to allow operator to control up and down functions of lowering winch

**8HD-10HD Adapter**

Must allow ORION 3 HD to operate on T76 HD Tractor
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**Additional Accessories**

Top manhole roller
36" manhole hook
18' of fiberglass lowering poles and mounting bracket
3" Tiger tail
Vivax-Metrotech VLOC3 Locator with Carry Bag
POSM HD video capture card

**Chassis and Conversion****Chassis**

Ford E-450 Cutaway – Ford E-450 Cutaway - vendor must deliver chassis to 2 <sup>nd</sup> stage manufacture within 60 days of receipt of PO. Vin numbers must be supplied to verify availability
176" WB
7.3L V8 Premium Rated Engine
6-Speed Automatic Transmission with Overdrive w/ Tow-Haul Mode
Remote Keyless Entry
40-Gallon Fuel Tank
Grey Vinyl Seats and Flooring
Cruise Control
Power Group
Air Conditioning
AM/FM Stereo

**Box Conversion**

16' Commercial FRP Constructed Box
16' Commercial FRP Box,
Dimensions: 16'x8'x6'6"
Dual swing open rear doors
Rear backup camera
Walk-thru design with partition wall and door
Glass viewing window in bulkhead wall
12v LED lighting
Aluminum plank flooring for easy cleaning and improved grip when wet
Roof Air
Exterior shore power package with extension cord
Auxiliary battery and charging system

Carpeted walls in Studio
Laminated base cabinetry
Laminate countertops in studio
Vibration resistant electronics cabinet with rear door access to outside of truck for easy installation and troubleshooting
Bench seat over battery bank storage
Mounted high-quality monitor in office
Heavy-duty, 5 drawer toolbox
High-quality monitor in workspace for monitoring camera operation
14 Gallon pressurized wash down system
Butcher block workbench
Aluminum storage shelves
Overhead laminate cabinets with easy-open hardware
Directional arrow board at front and rear of roof
Strobe light mounted on front and rear of roof
LED strobe lights mounted in grill of chassis
LED side markers on box
Dual PREMIUM LED rear work light package mounted on rear of vehicle
Bathroom addition installed between chassis cab and studio
Cabinet with sink in bathroom area
5000W Victron Energy Inverter system with (4) 300amp hour LifePO4 batteries. Controller and charging system
Wall Mounted Electric Heater - Installed under desk or in work area
Powered Rear Canopy - Push button
Fold-down Steps (rear)