

CONTROL UNIT

The system controls must be contained in damage resistant housing.

The CCU shall include circuit protection for individual electronic components. This is to be incorporated in case of power interruption, surges, component malfunction or inadvertent mis-operation of the system.

The Camera Control Unit and Pendant Shall contain:

- 100mm monochrome LCD to view system status soft key control area via LCD
- Power on/off switch
- Connectors for external video signal
- Forward/Reverse, Left/Right tractor control joystick
- Variable tractor speed control
- Camera controls for focus
- Adjustable lighting controls
- AC power receptacle
- Control cable receptacle
- Adequate circuit breakers and fuse protection
- Hour meter
- Camera "home" control
- RS232 Connector for Software Link
- On/off of digital zoom function
- On/off of auto shutter speed control
- On/off of rear viewing camera
- Control of remote camera lift
- Auto lateral left camera positioning button
- Auto lateral right camera positioning button
- Auto circumferential joint camera positioning button
- 250mm colour video LCD

The proposed system shall have all electronic controls for the CCU mounted on modular slide out cards for easy repair/replacement.

The CCU shall operate larger, medium, and smaller crawlers with no need for additional control unit or cable upgrades.

Control unit must run off of a CAN-BUS control protocol to allow for future upgrades to all components.

PAN & TILT COLOR ZOOM CAMERA

When connected to any crawler there cannot be external wires, connectors, clamps or tie-downs

The camera will pan a full 360 degrees and tilt (+/- 135°) allowing for full view of laterals and joints. Camera will have the ability to view behind crawlers to inspect upstream lateral rubber seal on gravity flow PVC pipes.

Camera must have 10X optical 4X digital zoom capability for viewing up laterals and magnifying observations.

Camera construction shall include all solid-state circuitry designed to withstand shocks and vibrations while being pushed, pulled or propelled through the pipe.

All camera electronics shall be of modular construction for ease of exchange and repair, and shall be designed to facilitate future upgrades.

The front of the camera housing shall have a windshield made of impact resistant, distortion-free material.

The housing shall be fully sealed and waterproof (IP68) to withstand external pressure up to 10 bar without damage or leaking.

The camera power supply shall be provided from a solid-state power source and the camera input shall be 12 volts DC. The lighting for the camera shall be supplied through an isolated power supply and shall regulate the light voltage up to a nominal 36 volts DC.

Pan/Tilt Motor power 12V/3Watt

Camera shall attach to the front of the crawler by turning a slotted locking mechanism on the top of the camera which drives 4 stainless bearings into the rotate shaft of the crawler and have the ability to maintain a 10 bar waterproof seal.

Camera illumination must be provided with a minimum of 28 field-replaceable LED's that have a 50 degree lighting angle and provide 45000mcd/piece to light pipes up to 60" diameter

Camera shall have a valve for purge and pressurization of camera-body. Pressurization prevents the ingress of water during an accident and provides a dry air internal environment to prevent fogging of inner lens during changing external temperatures.

Camera will pan and tilt at the same time to increase speed of inspection and home position placement when continuing forward. Cameras that require a two-step process by having to pan and then separately tilt will be deemed unacceptable.

Camera must not weigh more than 1.7kg

Camera must have a maximum size of (85mm x 80mm x 80mm) in order to fit into a diameter of 88mm.

Side stainless plates must be a minimum of 13mm for increased durability when inserting the camera in a manhole

Rotation axle must be made of a minimum of 15mm stainless steel

Pan and tilt must have integrated clutch for pan and tilt motor

LIGHTWEIGHT TRANSMISSION CABLE

500m of 6 wire continuous length multi-conductor cable shall be provided.

The cable must be Kevlar reinforced and have a minimum breaking strength of 450kgs.

The cable shall be no greater than 6mm inches in diameter.

Cable shall not weigh more than 4.5kg for every 100 m of cable to allow for portability, long tractor runs and easy handling

A connector strain relief fixture must be internal to the cable and cable connector.

Cable and connectors must be waterproof up to 10 bar

Cable must have tough outer jacket to resist tears and scrapes

Outer jacket must be smooth to reduce friction

Crawler connect end must have a minimum of 200mm steel armored jacket to prevent cable damage while going around pipe bends and during entry.

Crawler connect end must have solid stainless steel screw on connector that locks with two turns and engages a locking spring loaded pin on the rear of the crawler to secure the cable and provide strain relief. Connections that require tools or screws will be deemed unacceptable.

Crawler connect end must have connector that has electrical keyway for proper alignment of cable to camera or crawler connector without damaging electrical pins

Cable must be able to be directly reterminated and then sealed and strain-relieved with a 2-ton quick-dry epoxy. Procedure shall not take more than ½ hour to complete. Scotch cast style units that require cure times beyond an hour will be deemed unacceptable.

Cable must be able to be used with fully automatic cable reel, manual cable reel and cable reel with auto-assist motors for easy management.

MEDIUM 150mm – 600 mm PIPE DIAMETER STEERABLE MOTORIZED CRAWLER

The cable must be able to connect to the following directly without any modification

- 100mm minimum ID Pipe capable crawler
- 150mm minimum ID Pipe capable crawler
- 250mm Minimum ID Pipe capable crawler

The system shall include a gear driven; all wheel drive tractor to carry the camera for rapid remote inspection of pipes that range from 150 to 600mm for travel and camera centering and over 1.6m for viewing and lighting capability.

The tractor shall provide sufficient traction, under suitable conditions, to tow 500m of transmission cable. Such traction shall be provided by six gear driven wheels with tapered tyres. Tractors propelled by chains, belts or continuous tracks will not be acceptable.

The tractor shall have proportional left/right steering, forward, reverse, along with a clutch release mechanism capability via a joystick and other controls via the operator pendants attached to the CCU and the cable reel.

The tractor shall have a maximum size of 315mm long by 120mm High by 110mm wide to allow for proper clearance in 150mm and lined pipes.

A minimum of 2-50 watt DC motors shall power the tractor.

The crawler shall have an integral remotely operated lift that can raise the camera a minimum of 125mm from its lowest position.

The lift mechanism shall have an integrated rear viewing color camera to assist with avoiding debris and cable management. Rear and forward view cameras can be toggled between one another via the operators pendant.

Raising and lowering of the camera lift mechanism shall be generated by a combination of pressurized struts and motors to ensure reliable and precise control in a small size.

Camera shall attach to the front of the crawler by turning a slotted locking mechanism on the top of the camera which drives 4 stainless bearings into the rotate shaft of the crawler and have the ability to maintain a 10 bar waterproof seal.

Camera and crawler rotate shaft shall have a keyway to allow for proper alignment of electrical pins without bending or breaking them.

Cable shall attach to rear of crawler with 2 turns of the outer stainless housing on the end of the cable. A spring loaded pin on the crawler body shall lock into the end of cable housing to secure cable connection and provide a pulling strength that is beyond the 450 kg rated break strength of the cable.

To allow for performance in soft sediment and debris and ease of use the tractor shall weigh a minimum of 14kg.

Crawler shall have a maximum speed of 23 m per minute

The tractor shall be no longer than 315mm in order to easily navigate through 90-degree inverts without rolling.

In order to prevent leaking and bending due to torque and stress generated by a small steerable crawler, the tractor chassis shall be a single piece of machined stainless steel with only a top plate to access the control boards, a bottom plate to access the motors and two side cover plates to access the gears. Bronze or brass bodies or soft metals will not be acceptable for body chassis.

All wheels to have tapered edges to conform to pipe sidewall

The tractor shall have machined key fitting on all 6 axles to facilitate easy use and ensure an exact fit with all wheels. Machined axle key must be able to be replaced in the field without having to replace the axle. Crawlers without keyways or keyway fittings that can be replaced in the field without removal of the axle will be deemed unacceptable

Crawler shall have ability to be outfitted with an integral 33 kHz, 512 Hz or 612 Hz sonde

Crawler shall be controlled via PipeBus software technology to allow for precision control, diagnostic monitoring and future upgradeability.

The tractor shall include 3 wheel sizes and spacers suitable to accommodate pipe inspection in 150mm through 600mm pipes. Spacers and wheels sizes shall attach with a keyway and single screw. No plates or spacer-bars will be accepted.

Tractor shall work with the following standard and optional wheel sets

Included

Set of 4 common 36mm dia by 20mm wide spacers

(6) 86mm dia rubber wheels

(4) 110mm dia grooved rubber wheels

(4) 110mm dia soft composite grease wheels with traction grit impregnation

(4) 135mm dia grooved rubber wheels

Optional

(6) 86mm dia soft composite grease wheels with traction grit impregnation

(4) 135mm dia soft composite grease wheels with traction grit impregnation

(4) 135mm dia pointed carbide wheels

(4) 135mm dia by 66mm wide sediment rubber wheels

The tractor must have a single waterproof connection port for additional upwardly angled large pipe lighting located behind the center area of the crawler.

The tractor shall have the ability to add triple LED low profile auxiliary lighting that is remotely controlled via a controller on the operator pendant.

Crawler must fit in 200mm diameter pipe with dual auxiliary lighting attached

The tractor shall have a tilting rear cable connector that points vertically when deploying the system into a manhole but can tilt into a horizontal position during operation in order to protect cable and connector during deployment.

Strain relief must be provided internal to the cable and then maintained by the strength of the locking mechanism of the stainless steel connector.

Crawler and cable stainless connectors must have a lifetime warranty

The tractor shall allow for a 512, 33 and 612 Hz integral sonde to facilitate locating crawler location with a receiver.

The tractor shall have a standard inclinometer for tracking and electronically outputting pipe rise and fall (grade) and integrate data with database inspection software.

Crawler shall have an additional roll sensor to avoid flipping the crawler. Sensor shall sound an audible or visible onscreen alarm when crawler center of gravity is pitched in a way that it will soon roll over.

250 – 1500mm PIPE DIAMETER STEERABLE MOTORIZED CRAWLER

The system shall include a gear driven; all wheel drive tractor to carry the camera for rapid remote inspection of pipes that range from 250mm to 1200 mm for travel and camera centering and over 1500mm for viewing and lighting capability.

The tractor shall provide sufficient traction, under suitable conditions, to tow 500m of transmission cable. Such traction shall be provided by six gear driven wheels with tapered tires. Tractors propelled by chains, belts or continuous tracks will not be acceptable.

The tractor shall have proportional left/right steering, forward, reverse, along with a clutch release mechanism capability via a joystick and other controls via the operator pendants attached to the CCU and the cable reel.

The tractor shall be no longer than 635mm without pan and tilt camera and 765mm with the pan-tilt-zoom camera in order to easily navigate through 90-degree inverts without rolling.

Tractor shall have a minimum weight of 18 kg. with camera

The tractor shall be powered by dual 75 Watt DC motors.

The crawler shall have an integral remotely operated lift that can raise the camera a minimum of 250mm from its lowest position.

The lift mechanism shall have an integrated rear viewing color camera to assist with avoiding debris and cable management. Rear and forward view cameras can be toggled between one another via the operators pendant.

Camera shall attach to the front of the crawler by turning a slotted locking mechanism on the top of the camera which drives 4 stainless bearings into the rotate shaft of the crawler and have the ability to maintain a 10 bar waterproof seal.

Camera and crawler rotate shaft shall have a keyway to allow for proper alignment.

Cable shall attach to rear of crawler with 2 turns of the outer stainless housing on the end of the cable. A spring loaded pin on the crawler body shall lock into the end of cable housing to secure cable connection and provide a pulling strength that is beyond the 450kg rated break strength of the cable.

In order to prevent leaking and bending due to torque and stress generated by a small steerable crawler, the tractor chassis shall be a single piece of machined aluminum with only a top plate to access the control boards, a bottom plate to access the motors and two side cover plates to access the gears. Bronze or brass bodies or soft metals will not be acceptable for body chassis.

All wheels to have tapered edges to conform to pipe sidewall

The tractor shall have machined key fitting on all 6 axles to facilitate easy use and ensure an exact fit with all wheels. Machined axle key must be able to be replaced in the field without having to replace the axle. Crawlers without keyways or keyway fittings that can be replaced in the field without removal of the axle will be deemed unacceptable

Crawler shall have ability to be outfitted with an integral 33 kHz, 512 Hz or 612 Hz sonde.

Crawler shall be controlled via PipeBus software technology to allow for precision control, diagnostic monitoring and future upgradeability. Single conductor or multi conductor systems with more than 6 wires within the cable will be deemed unacceptable.

The tractor shall include 3 wheel sizes and spacers suitable to accommodate pipe inspection in 250mm through 1500mm pipes. Spacers and wheels sizes shall attach with a keyway and single screw. No plates or spacer-bars will be accepted.

The tractor shall have dual large pipe Xenon and LED lighting that can be manually moved to view in an upward or downward angle to cover a variety of inspection requirements. Lighting will illuminate target areas of interest up to 2.5m away.

The tractor shall have a tilting rear cable connector that points vertically when deploying the system into a manhole but can tilt into a horizontal position during operation in order to protect cable and connector during deployment.

Strain relief must be provided internal to the cable and then maintained by the strength of the locking mechanism of the stainless steel connector.

Crawler and cable stainless connectors must have a lifetime warranty

The tractor shall allow for one of the following sondes to be added (512, 33 or 612 Hz integral sonde) to facilitate locating crawler location with a receiver.

The tractor shall have a standard inclinometer for tracking and electronically outputting pipe rise and fall (grade) and integrate data with database inspection software.

Crawler shall have an additional roll sensor to avoid flipping the crawler. Sensor shall sound an audible or visible onscreen alarm when crawler center of gravity is pitched in a way that it will soon roll over.

The tractor shall come with an internal temperature and pressure sensor that is able to read at the control unit

MOTORIZED CABLE DRUM

A cable drum shall be provided to contain the cable for camera and tractor operation.

The hub of the cable drum shall be equipped with a continuous contact slip-ring assembly to allow the cable to be dispensed and retrieved while the camera and tractor are operational.

The slip ring contacts shall be of an alloy of gold and rhodium and must be housed in an environmentally sealed housing.

Cable feed out and retrieval must happen automatically via a motorized system with sensors that correspond with the movement of the crawler. Cable reels that require operator control while the crawler is in use will be deemed unacceptable.

The cable drum must have an emergency stop switch.

The cable drum must be able to operate in both automatic and manual modes.

The cable drum must have speed and torque controls to adjust for different pipe conditions and user preferences.

The cable reel shall not weigh more than 85kg. With 500m of cable 105 kg.

Cable drum must come with stationary mounting plate where cable drum remains secure, but can easily be removed for maintenance, shipping or portable use without the use of any tools or loose hardware.

Cable reel must have remote pendant to allow operator to have access to camera, crawler, crane and cable reel controls while setting up the system away from the control unit.

METER COUNTER

The system shall include a meter counter attached to the counter arm assembly which extends from the cable drum.

The meter counter assembly shall be constructed of machined aluminum parts and shall include the necessary guide wheels to maintain cable tension.

The Meter counter shall measure passage of the cable from the wheel graduated in 0.01m steps up to 500m

The meter counter shall function electronically and transmit meter data for monitor display and video recording.