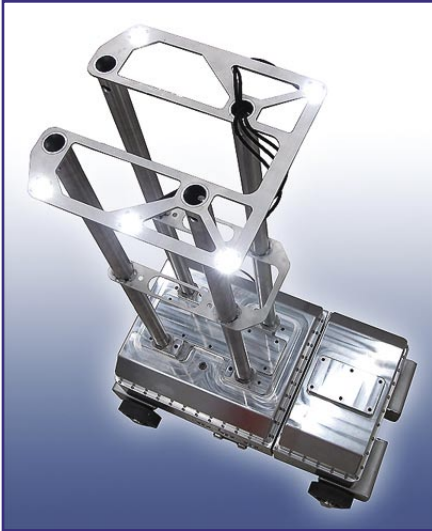


Inspector Underwater In-Tank Inspection Robot



Mast-top mounted LED lights enable the precision navigation “god’s-eye” camera, mounted on a pole inside the tank hatch, to track the robot. The mast height keeps the LEDs above any sediment and turbidity in the bottom of the tank.



This view of the underside shows the enclosed port (center) for the downward-looking laser scanner and video camera, as well as the four independently powered and steerable drive wheel pods.

Equipment Mounting Options:

- Front end mounting bar with multi-functional holes extending port and starboard to allow for mounting of sensors, optional tank bottom cleaner or other devices.
- Low-slung, arm-mounted equipment plate on starboard side
- Top deck can accommodate additional sensor mounting.
- Additional options include tank bottom cleaner, specialized sensors, environmental mapping and robotic arms.



The Inspector is a highly maneuverable robotic platform and system designed to locate and map tank bottom defects with +/- 1/8 inch accuracy in water-filled or dry storage units as large as 50 feet (15 m) in diameter. The Inspector system is composed of the robot, an in-tank, hatch-mounted “god’s-eye” camera and the operator’s console.

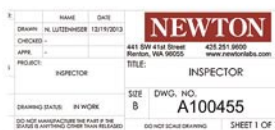
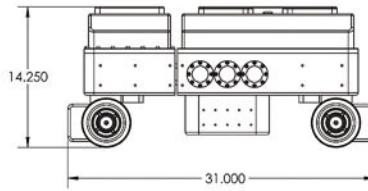
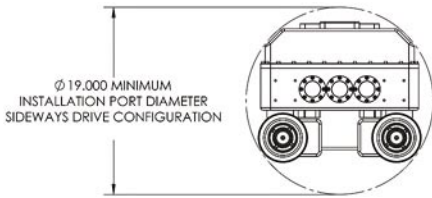
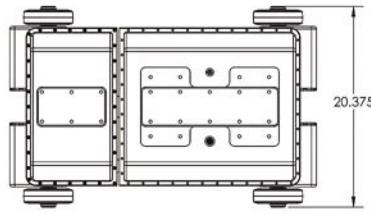
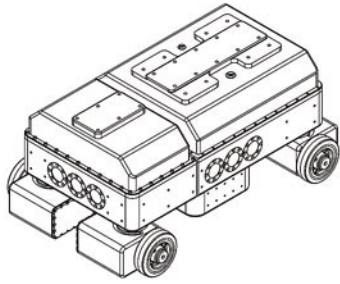
The features of the Inspector system include:

- 360° peripheral video imaging
- Five on-board color video cameras
- Overhead precision navigation system
- On-board down-looking video capture
- Highly maneuverable four-wheel steering
- Four wheel independent drive motor system
- On-board downward-facing 3D laser scanner
- Virtual view User Interface enables precise navigation
- Split chassis design provides constant all-wheel contact
- Laser range finders on all four side for precise positioning

The Inspector robot is designed to fit through the most narrow tank top access hatch, a diameter of 19 in. (48 cm).

Maneuverability:

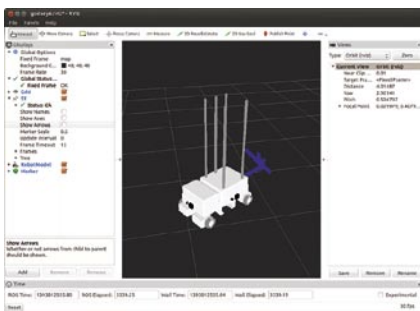
As a delivery platform, the Inspector is exceptionally maneuverable thanks to an independent, steerable drive wheel system and a split, pivoting chassis design. Each wheel pod can rotate 193° and each wheel drive motor is independently variable. Steering and drive motors are software coordinated, enabling a full range of motion: forward/backward, side-to-side, spin on central axis, diagonal or “crabbing” and radius turns. The top speed of the Inspector is in excess of 6 in. (15,2 cm) per second. The split chassis design allows the Inspector to maintain ground contact with all four wheels when moving across surfaces with different elevations. ●●●



Inspector System Specifications

Elements	Details
Length:	31 in. (78,7 cm)
Width:	20.38 in. (15.75 in. for tank insertion) (52 cm & 40 cm)
Height (chassis):	14.25 in. (36 cm)
Height (overall with mast):	50.25 in. (127,6 cm)
Mast length:	36 in. (91,4 cm)
Weight (in air):	245 lbs. (111 kg)
Weight (in water):	100 lbs. (45 kg)
Construction (chassis):	Machined from solid billets of 6061-T6 aluminum stock
Video cameras:	5 ea. on-board high-resolution color 1 ea. "god's eye" high-resolution monochrome
Scanning laser power:	35 MW
Scanning laser resolution:	0.01 in. (0,3 mm)
Range finder laser power:	7 MW ea.
LED arrays	4 ea. on chassis perimeter at 705 lumens ea. 4 ea in bottom video port totaling 2,800 lumens 5 ea on mast at 235 lumens ea. (1,175 lumens total)
Power input voltage to control unit:	100 to 240 VAC 50 to 60 cycles
Underwater temperature range:	32° to 122° F (0° to 50° C)
Top speed (omni-directional):	In excess of 6 in. (15,2 cm) per second

Precise In-Tank Navigation and Positioning



The Inspector is precisely positioned using a combination of inputs: the vertical video view from the "god's eye" camera at the top of the tank, as well as the forward, rearward, lateral and down-looking views from five on-board cameras. The information from these sources, in addition to direction, speed and position inputs from sensors in the drive motors and wheel pods, is combined by the software to create a virtual tank environment and robot avatar (screenshot at left). ●●●

Inspector Deployment Example

The Inspector is designed to be deployed through the smallest tank top hatch, a circular diameter of 19 in. (48 cm). Many hatches have larger diameters. The following is a description of a deployment through the smallest diameter hatch:

- The robot chassis, without mast, is checked out at ground level and configured into the insertion mode.
- The robot is lifted atop the tank.
- A tripod lifting rig is erected over an access hatch holding two winches with cables.
- The robot is attached at the rear with Lifting Cable #1, then hoisted, front end down, and lowered through the hatch. The data cable/umbilical has no tension on it.
- Once inside the hatch, a spring-loaded arm with Lifting cable #2 attached is fastened to the top deck of the chassis.
- Cable #2 is tensioned and Cable #1 is slackened, the robot pivots to horizontal.
- Cable #1 is removed and measuring instruments or tools are installed.
- The LED mast is lowered and fastened to the top deck of the robot. The power cable for the LEDs is plugged in.
- The robot is lowered to the floor of the tank with no tension on the data cable.
- Once on the tank floor, Lifting Cable #2 is slackened and the spring-loaded arm folds backward onto the chassis.
- The "god's eye" camera is clamped to the edge of the hatch, facing downward, and is calibrated into the system software.
- The robot begins its initial mapping of the tank bottom guided by an operator at the control console, or autonomously via preprogramming.
- Recovery from the tank involves driving the robot to below the hatch and reversing the deployment sequence. ●●●

For more information on the Inspector in-tank robot please contact:
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