Point & Continuous Level Control Technologies

including
Innovations in 3D Inventory Management Systems

Why Use Level Controls?

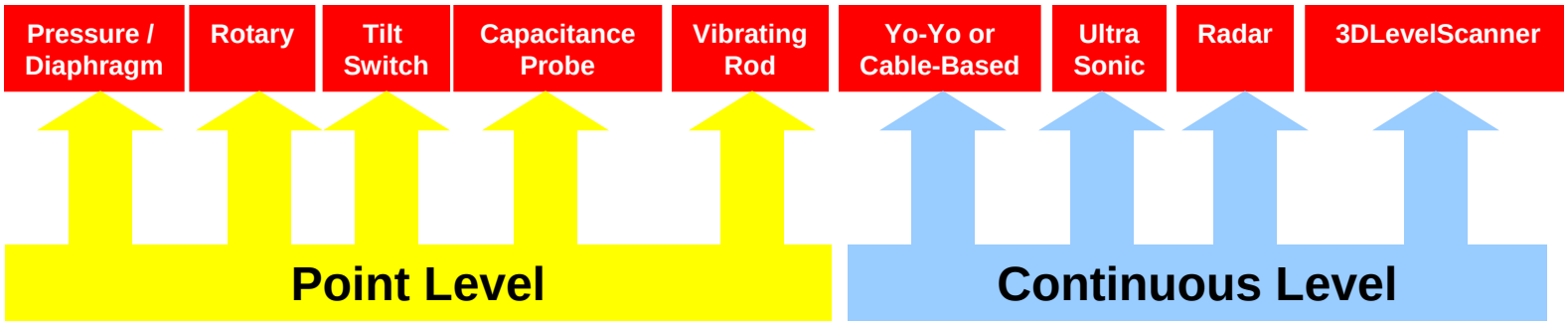
- Enhance safety
  - No need for climbing bins to check levels
- Save time
  - Monitor multiple bins from a central location
- Simple operation
  - Easy to install and operate, minimal maintenance
- Requires less staff
  - Manage more bins with fewer people
- Improves inventory management
  - Better accuracy, just-in-time replenishment, reduce shut downs
- Prevent bin overflows
  - Eliminate material waste, costly spills and down time
- Optimize storage capacity
  - Timely filling without overfilling, eliminate empty conditions
- Highly cost effective
  - Saves labor and time, while consuming little power and requiring minimal maintenance

Level Controls Make the Job Easier

Level Controls are used in Most Every Industry

- Suitable for pellets, granulars, powders and most other bulk solids
  - Grain, seed & feed
  - Chemical processing
  - Aggregates & cement
  - Bioenergy
  - Pulp & paper
  - Petrochemicals
  - Plastics manufacturing
  - Mining operations

Types of Level Controls



- Point Level Indicators
  - Detect when solid material reaches a certain “point” in the bin and sends an alert that the bin is empty or full
  - Primarily used as a high or low level alert to prevent overfilling or running out of material
- Continuous Level Indicators
  - Measure the bin level and at predetermined time intervals and send data to a console or PC
  - Used for inventory management and process control

It’s a harsh world
Here’s how you measure it

Diaphragm Switch
"How It Works"

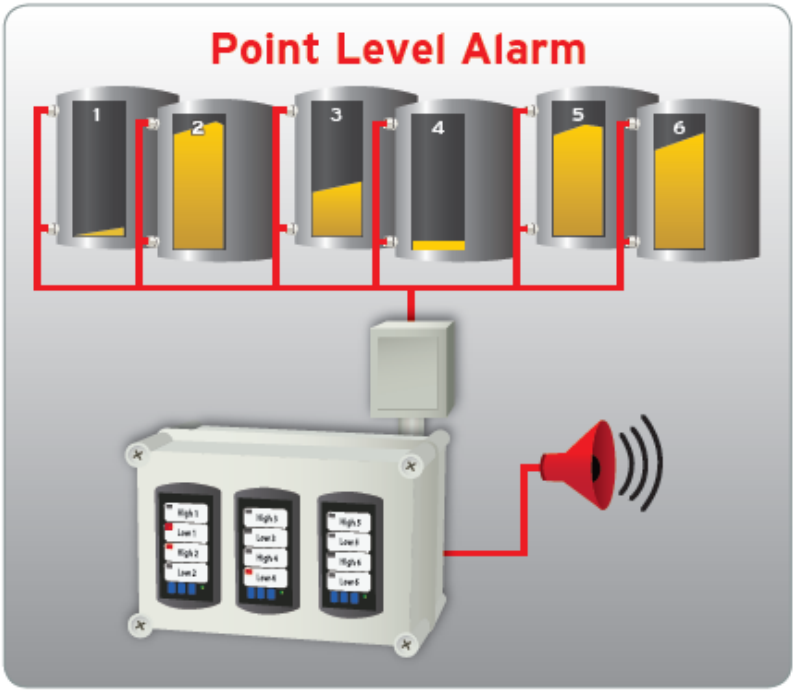
- Works in free flowing dry granular and pelleted materials
- Internal or external mounted units are installed in the bin
- Operates by sensing material pressing against a switch as the bin fills
- When material comes into contact with the pressure switch, it activates a sensitive micro switch which can be wired to a visual alarm, such as a light or an audible alarm, such as a horn.
- It can also be wired to stop or start a process when materials reach a desired level.

Most common device for high level detection

Activates an alert to an alarm panel, light or horn

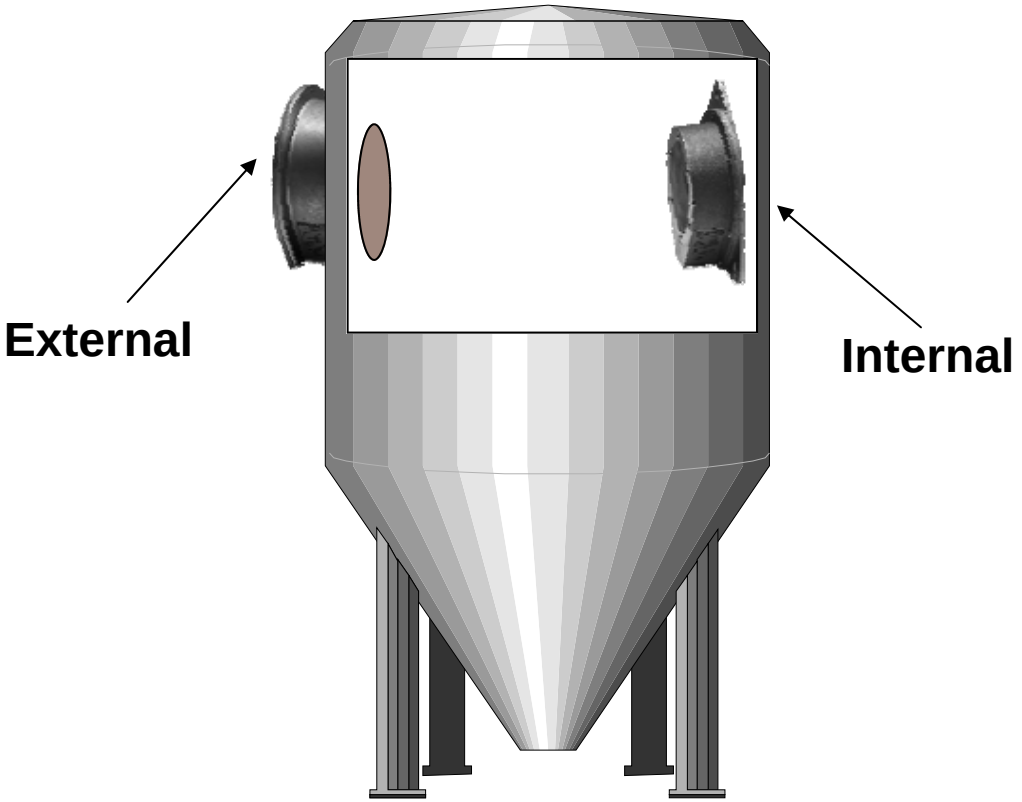
Point Level Alarm Panel
Alerts to High / Low Levels

- Can be used with a variety of level indicators including diaphragm switches, rotary paddles, tilt switches, capacitance probes and vibrating rods
- Monitors full, partially full, or empty status from four to 24 level indicator stations and sends alerts to operators via a blinking LED light and audible alarm
- Easy-to-read LED panel features high and low bin level alarms, power status and acknowledge button
- NEMA 4X enclosure is suitable for harsh environments and outdoor locations



Diaphragm Switch Features

- Internal or external mounting options
  - Internally mounted models are easy to install
  - Externally mounted permits mounting of the entire unit outside the bin, making the operation mechanism easily accessible.
- Diaphragm cover materials for different applications
  - Heavy duty neoprene, neoprene with nylon mesh and silicone
- Models for non-hazardous locations or with hazardous locations certification
  - Listed by U/L for Class II, Groups E, F and G
- Proven, long lasting and economical



Rotary Level Indicator
"How It Works"

- As a high level control, the paddle rotates continuously when material is not present.
  - When material reaches the paddle, the resistance causes the motor to "de-energize" and sends an alert or automatically shuts-off a process system.
- As a low level control, the paddle is stopped and the motor is "de-energized" when material is present.
  - When material drops below the paddle, the motor "energizes" and the paddle starts rotating. This will send an alert to a change in status or automatically start-up a process system.

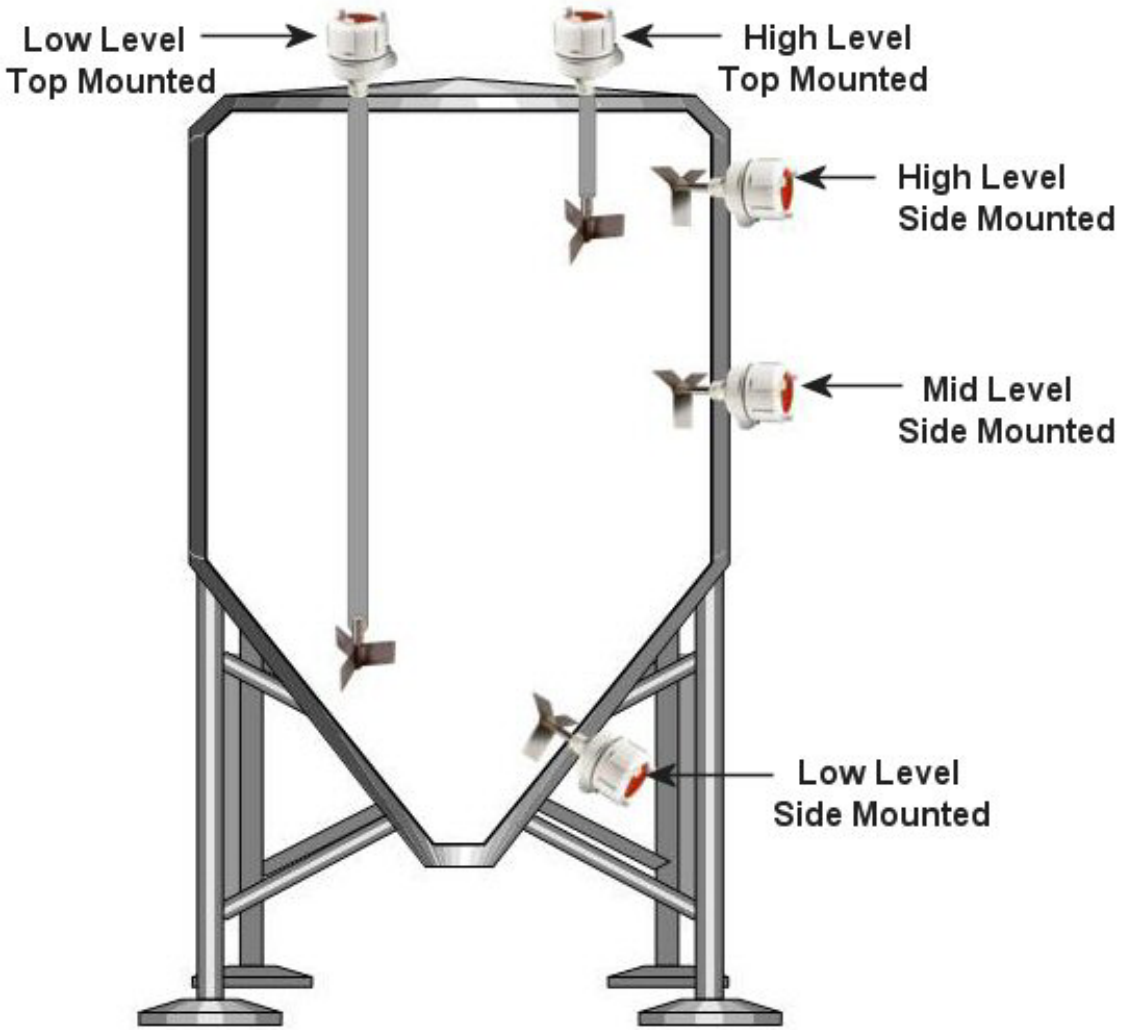
Rotary Features and Options

- "De-energized" motor for long life
- Explosion proof housing
- Hazardous location approvals
- Dual conduit entrances
- Screw-off cover for easy access
- Switch-selectable high/low failsafe switch
- Models with LED light provide local visual indication of operating status
- Extensions for top mount installations

Extended rotary with collapsible paddle

Rotary Mounting Options

- Mounted on top or side of bin
- Can be mounted intermittently for high, mid and low level detection
- Extensions can be customized to specific lengths for top mount, high level applications

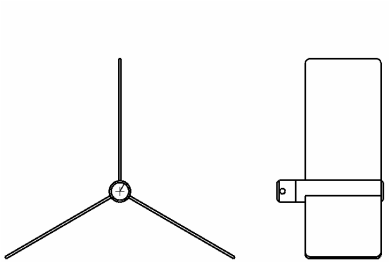


Rotary Paddles

3-Vane Paddles

Most popular stainless steel paddles used for both very light and heavy materials.

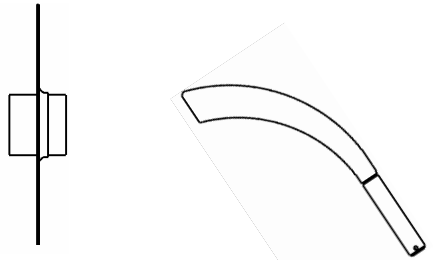
The paddle size based on bulk density of the material. The lighter the material the larger the paddle. Thus, the heavier the material the smaller and stronger the paddle.



Insertable Paddles

Eliminates cutting any large hole in the vessel.

Insertable steel paddles used for both very light and heavy materials. These paddles can be inserted directly through a 1¼" coupling welded to the vessel with the rotary indicator attached.

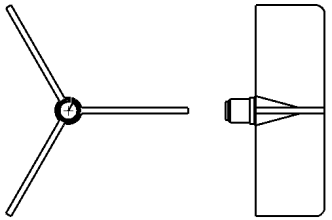


Plastic Paddles

Popular with lighter materials.

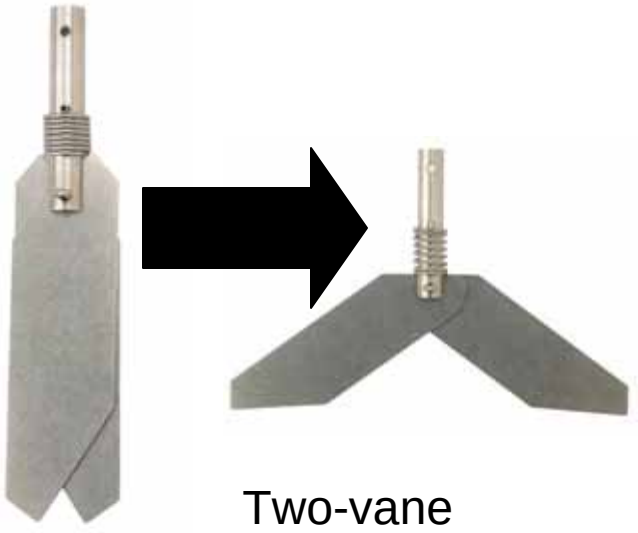
Economical 3-vane polyethylene paddles.

Generally available in 5" and 7" diameter.



Insertable, Collapsible Paddles Simplify Installation of Rotaries

- Paddles collapse to fit through a standard 1-1/4" coupling
- Saves time and work, eliminates the need to cut larger holes in bin or install mounting plates
- No need to go into the bin to install or remove the paddle from the bottom of the rotary
- Available with new rotary level indicators or retrofit onto existing rotaries
- 2-paddle and single paddle models for light/medium or heavy/dense materials



Two-vane

Single-vane

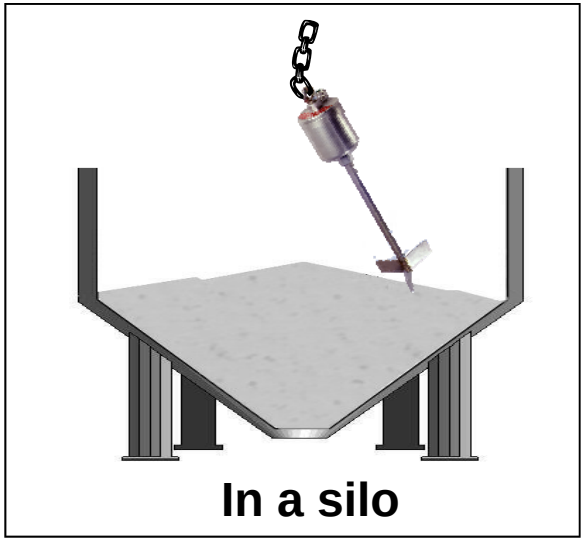
Tilt Switch
"How It Works"

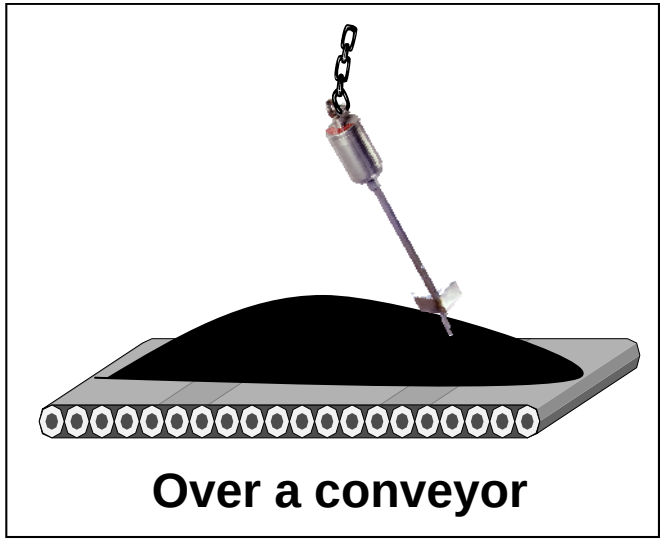
- The Tilt Switch is suspended over a control point with wire rope, chain, or flexible hanger.
- When the material comes in contact with the paddle the unit will begin to tilt.
- When tilted to 15°, a large steel ball inside the unit shifts position, actuating a micro switch.

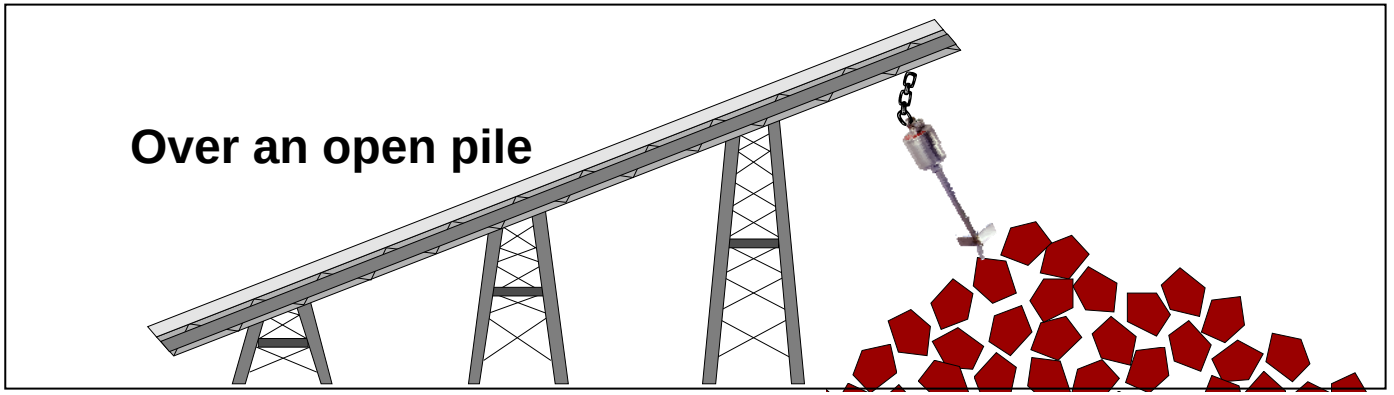
A Tilt Switch with an 18" stainless steel shaft and 316 Stainless Steel paddle is used in rock, aggregate and bulk solid material over 30 lb./cu. ft.

A Tilt Switch with the 18" 316 Stainless Steel shaft and plastic sphere is used in light powder and bulk solids under 30 lb./cu. ft.

Tilt Switch Mounting Options







Capacitance Probe
"How It Works"

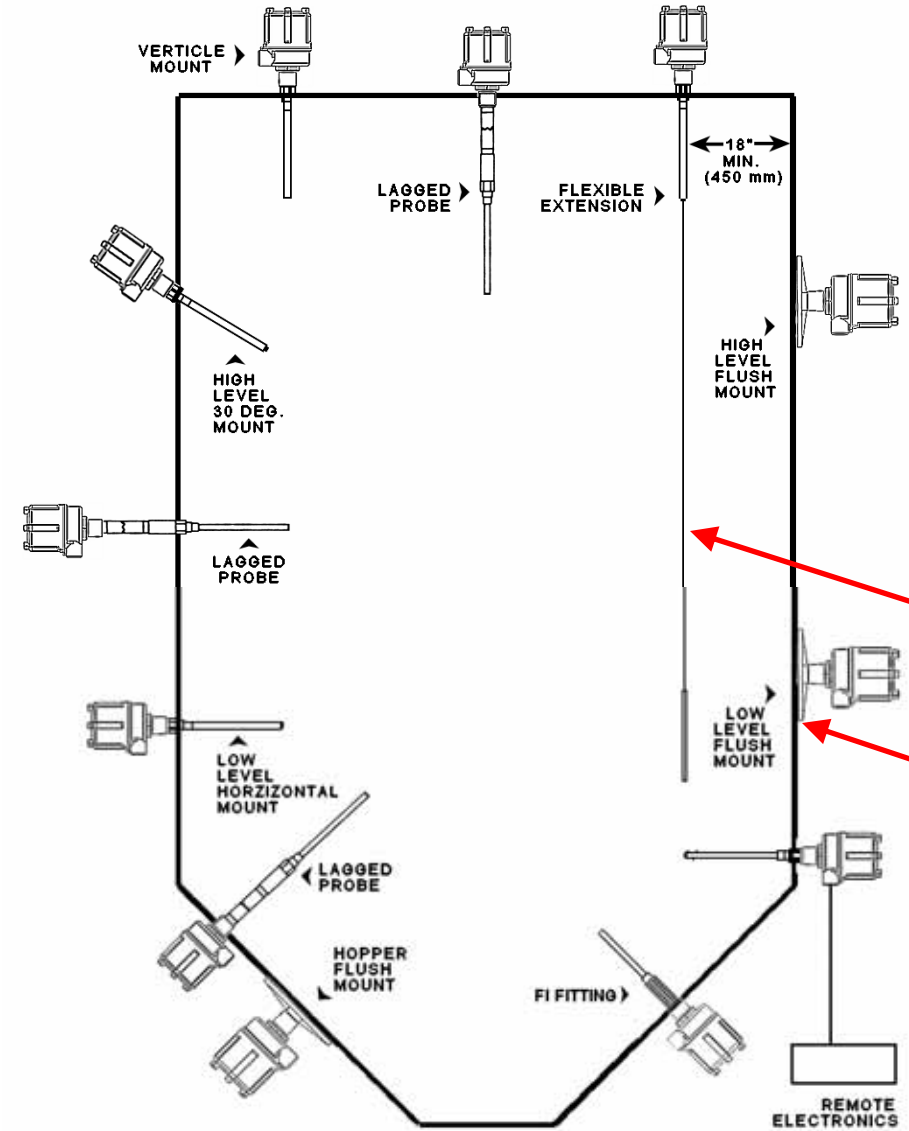
- A sensor detects the presence or absence of material in contact with the probe by sensing a change in the capacitance caused by the difference in the dielectric constant of the vessel material and air.

Capacitance Probe Features

- Operates at approximately 6 KHz, below the RF level
- Fail-safe protection eliminates process accidents caused by a power failure
- A guard to prevent false readings from build-up on the probe
- Time delay option to minimize false signals

Types of Capacitance Probes

- Extended
  - Flexible probe up to 35’
- Sanitary
  - For food and pharmaceutical
- Flush Mount
  - For space constrained areas or materials that might damage probes
- Remote Electronics
  - For high temperature or vibration environments
- Explosion Proof
  - For hazardous locations
- Compact
  - For small bins and tight spaces



Capacitance Probe Mounting Options

- Can be used for high, mid and low level indication
- May be mounted vertically, horizontally, or on a 30° angle
- Flexible extensions can be used for top mount applications in lengths up to 35 feet
- Flush mount probes are ideal for space constrained areas or where material flow or bridging may damage standard probes

Vibrating Rod
"How It Works"

- A piezoelectric device has a single rod-shaped vibrating element.
- The rod of the sensor vibrates if there is no material covering the active rod.
- When the rod is covered with material, the vibration is dampened and the electronic circuit forces a relay to switch and sends an alert.
- When the rod is uncovered, the vibration will restart and the relay will switch back.

Types of Vibrating Rods

Standard Vibrating Rod

Insertion length of around 7”.

Suitable for both top and side mount applications.

Mounts to the vessel with a 1-1/2” mounting socket.

Mini Vibrating Rod

Designed for use in small bins and hoppers.

Use in constrained spaces.

Overall insertion length is 6”.

High Temperature Vibrating Rod

Built specifically for higher process temperatures up to 482°F (250°C).

Standard insertion length of 7.24”.

Can be extended into a vessel from 13” to 13’ with a rigid pipe extension.

Rigid or Flexible Extended Vibrating Rods

Intended for top mount applications.

Rigid 1” pipe extension made with galvanized or stainless steel available in lengths up to 13’.

Flexible models use a steel rope reinforced cable and allows insertion lengths of up to 19’.

Yo-Yo or Cable-Based Inventory Measurement Systems

- Proven technology in existence for more than 25 years
- Virtually maintenance-free
- Work in vessels up to 180 feet
- Trouble-free mounting
- Minimal contact with stored materials
- Easily scalable communication options
- Consoles or PC software for data access
- No field calibration or adjustment

Cable-Based Sensor
"How It Works"

Measuring carbon black in a rubber belt plant

Measuring polystyrene in a polymer plant

- The sensor, located at the top of the silo, is prompted to take a measurement.
- The motor releases a strong stainless steel aircraft cable from the supply pulley and a weight sensor probe descends to the surface of the material.
- During the descent, the sensor measures the cable dispensed. A microcontroller counts the pulses from an internal encoder that produces 80 pulses per foot.
- When the sensor probe touches the material surface, measurement information is transmitted and pulse generation is momentarily stopped.
- The absence of these pulses immediately causes the motor to reverse and retract the sensor probe.

Measuring coal in bunker under tripper belt at a power plant

Measuring sawdust at a wood products plant

Features and Options of a Cable-Based System

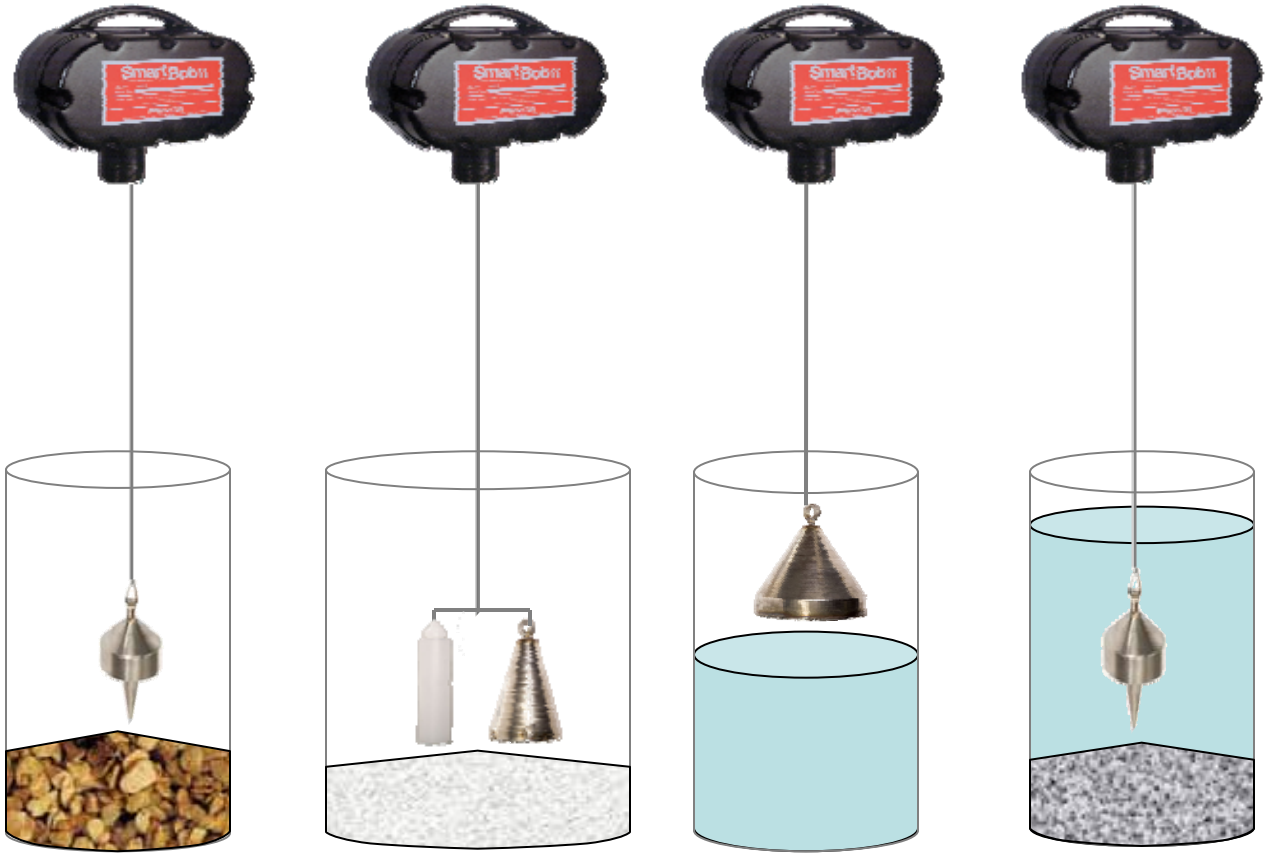
High Temp Option
includes Standpipe

Wireless Application

- RS-485 communications network
- Sends data to a Windows-based software program or push button console
- Certified for hazardous Class II locations
- Wireless options to reduce installation costs
- High temperature configuration for applications between 240° and 500°F
- Can be configured for use with submersed solids, such as brine tanks

Brine Tank
measuring
Submersed Solids

Sensor Probe Options



Stainless steel spike for bulk solids greater than 20 lb./cu. ft.

Digestible bottle or 4” stainless steel inverted cone for light solids & powders

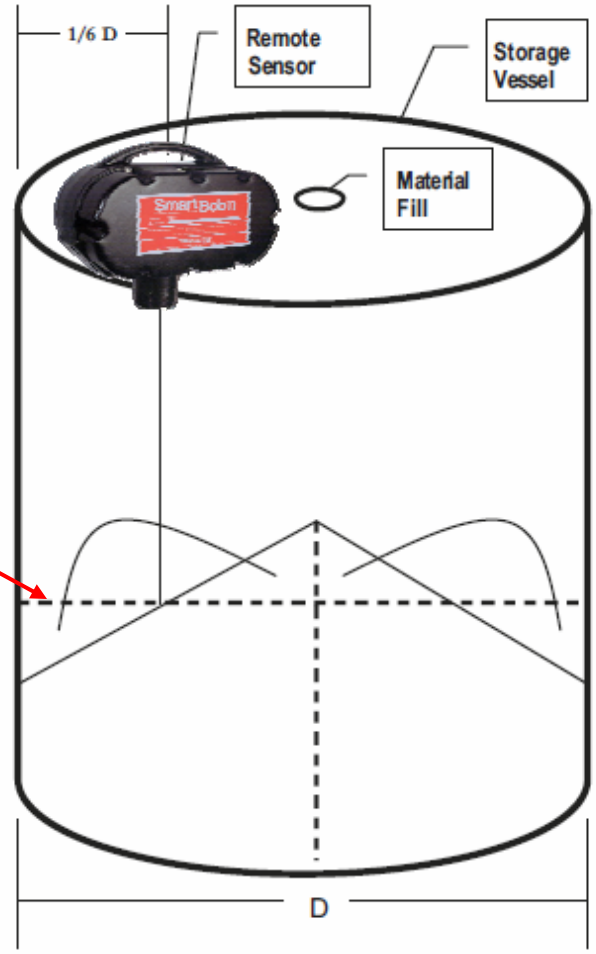
6” stainless steel inverted cone designed for use in liquids

Stainless steel spike used to torpedo through liquid to detect submersed solids

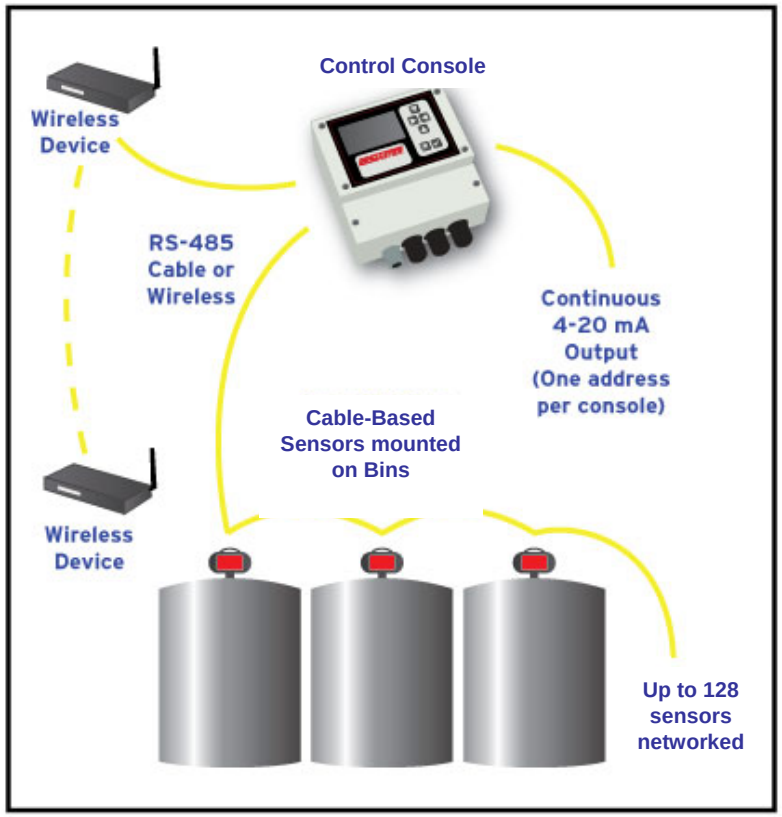
Locating the Sensor for Optimal Accuracy on a Center Filled Vessel

- Mounting location is one-sixth of the vessel diameter in from the outside edge
- This approximates the average level when considering the material's angle of repose
- Note the horizontal line drawn where the sensor probe comes into contact with material surface
  - There is a peak at the center and voids at the side
  - If you take out peaks and fill in voids it will flatten out the angle of repose and provide the most accurate level reading

When properly located, cable-based sensors are very accurate.



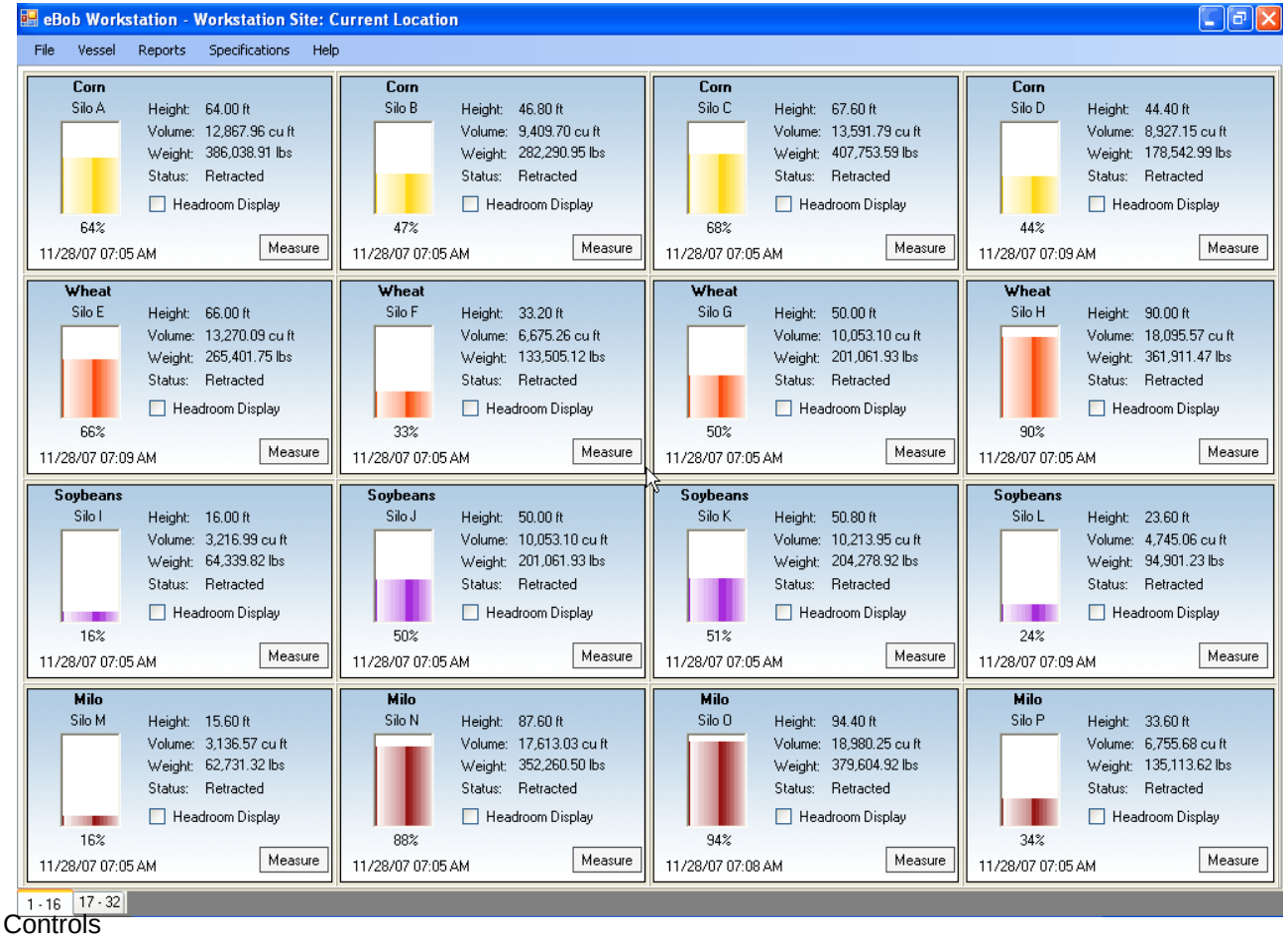
Control Console to Easily View Measurements from Multiple Sensors



- Compact, push button console provides fast measurement readings
- Provides basic, local control and monitoring of a single sensor or a network of up to 128 sensors at a single site
- Can be used in hardwired or wireless applications

Software Allows Viewing of Multiple Bins

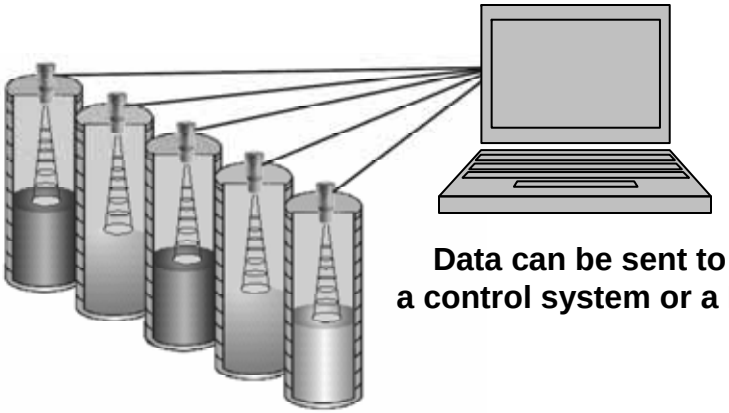
Set for “Distance” or “Headroom”



Ultrasonic
"How It Works"

- Continuous, non-contact, single-point level measuring and monitoring of liquids and solids
- Generates an ultrasonic pulse that is sent in the direction of the product
- Pulse reflects off product and returns to the sensor
  - Does not perform reliably in high dust environments
- Sends a 4-20 mA analog output to the control system or sends data to a PC running a data logging program using RS-485 communications
- Optional display units can also be used

Ultrasonic devices are often used in liquids for continuous level detection

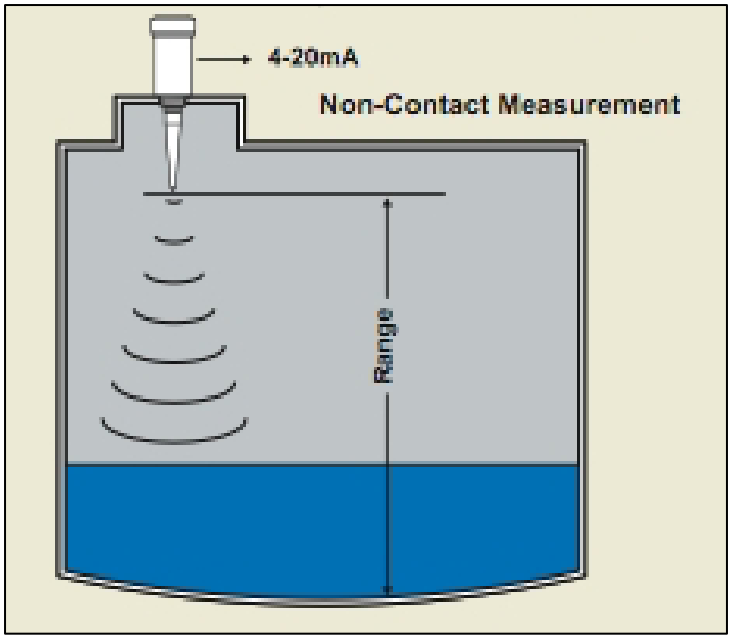


Data can be sent to a control system or a PC

Radar
"How It Works"

Radar can be problematic in dusty environments

- Continuous, non-contact, single-point level measurement for liquids and solids
- Generates an electromagnetic pulse that travels to the material surface and is reflected off the surface back to the sensor
- Sends a 4-20 mA signal directly to an existing control system or sends data to a PC
- Optional display consoles are available



Radar is often used in liquids, where the material level is even within the bin

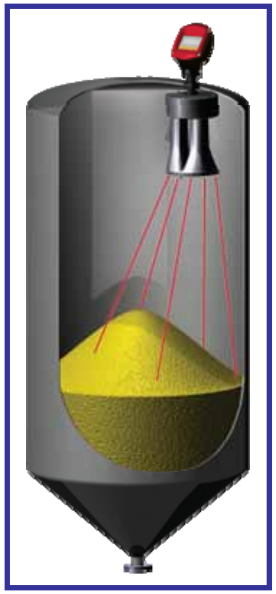
3DLevelScanner™

Multiple-Point, Dust-Penetrating, Non-Contact Bin Level Measurement

Measures level, volume and mass of materials in bins with 3-D mapping of contents.

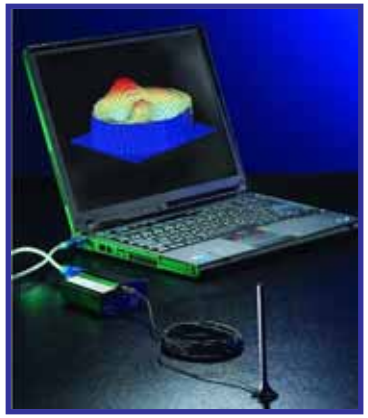
3DLevelScanner Overview

Scanner mounts on top of bin



Scanner takes multiple measurements

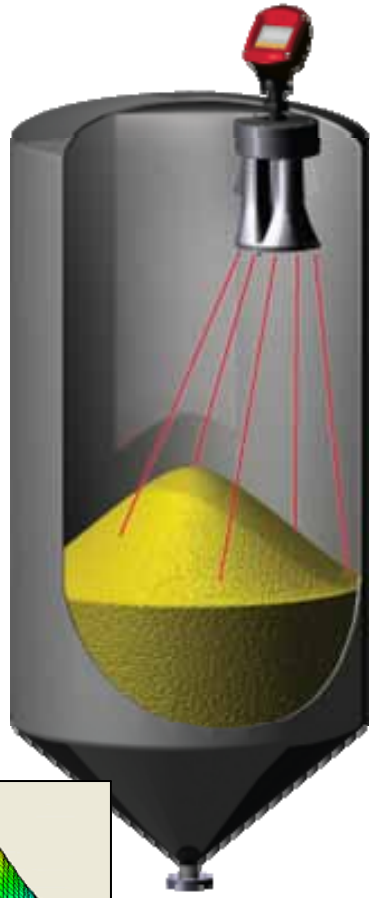
Data is sent to remote PC

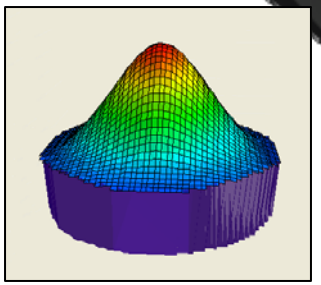


Software generates data and 3-D map of contents & calculates level, volume and mass

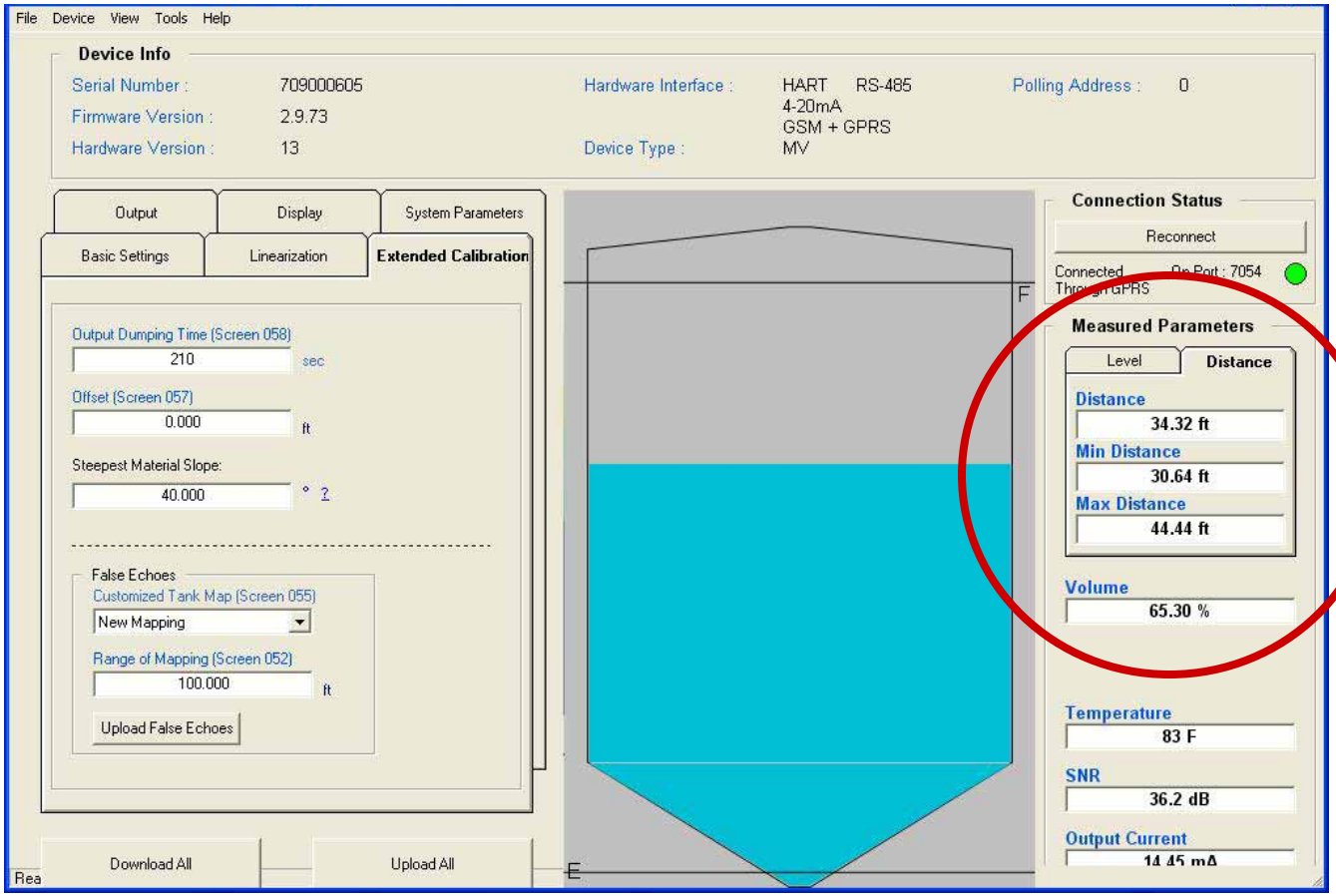
3DLevelScanner
"How It Works"

- Acoustics-based technology works by collecting all echoes bounced from the material surface and detects:
  - The distance to the material (time of flight for each echo)
  - The location of every returning echo at the surface area (multiple points within the bin)
- The echoes are converted to mapping points and construct the 3D image of the surface area using 3DLevelManager software.





3DLevel Manager Software

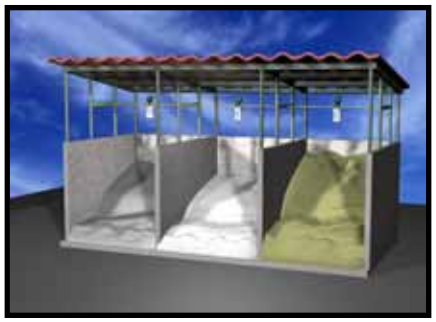


Main display screen shows Average, Minimum and Maximum Distances and Volume %.

Multiple-Point Accuracy

- Eliminates guesswork
- Improves accuracy of readings versus competitive technologies
- Maps uneven topography that randomly forms inside bins
- Accounts for sidewall build-up
- Detects irregular surfaces caused by bridging or multiple fill or empty sites
- Calculates absolute surface level values, volume and mass inside a bin or storage area

Appropriate for bins up to 200 feet with multiple fill or empty sites, sidewall build-up or uneven material.



Penetrates Dust

- Low frequency, acoustics-based technology penetrates dust
- Works where ultrasonic and radar have failed
- Self-cleaning sensors perform reliably over time

Covered with dust at a flour mill.

The outside of the unit is coated with dust. The sensors inside the unit are clean and fully functional.

Proven to perform in dust where other technologies fail.

Approved for Hazardous Locations

Actual application showing Scanner mounted using existing opening and cover.

Actual application showing Scanner mounted on existing flange using adapter plate (1/6 in from silo diameter).

ATEX & FM approved for Intrinsic Safety in Hazardous Locations.

3D Visualization During Empty Cycle

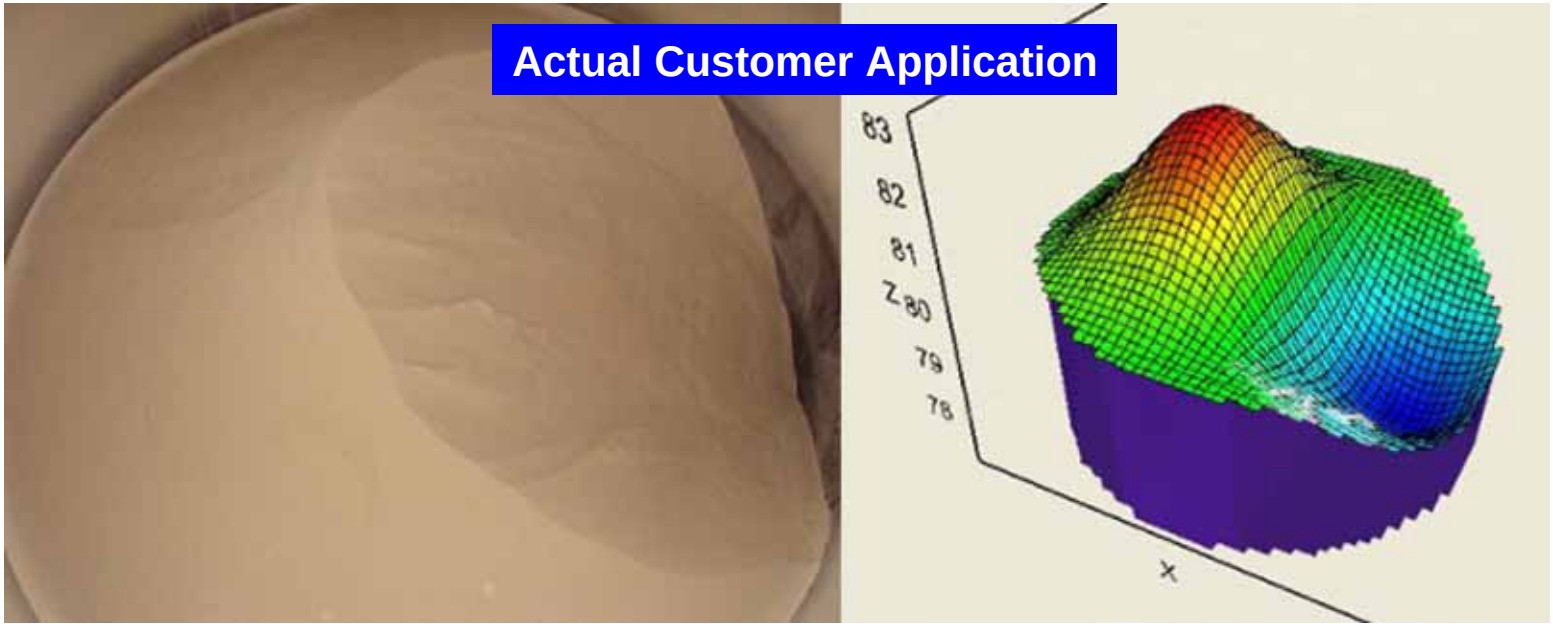


Photo on left shows bin contents higher on left than right at time of measurement.

Single point measurement devices would not account for irregularity in material surface.

3D Visualization Accounting for Bridging

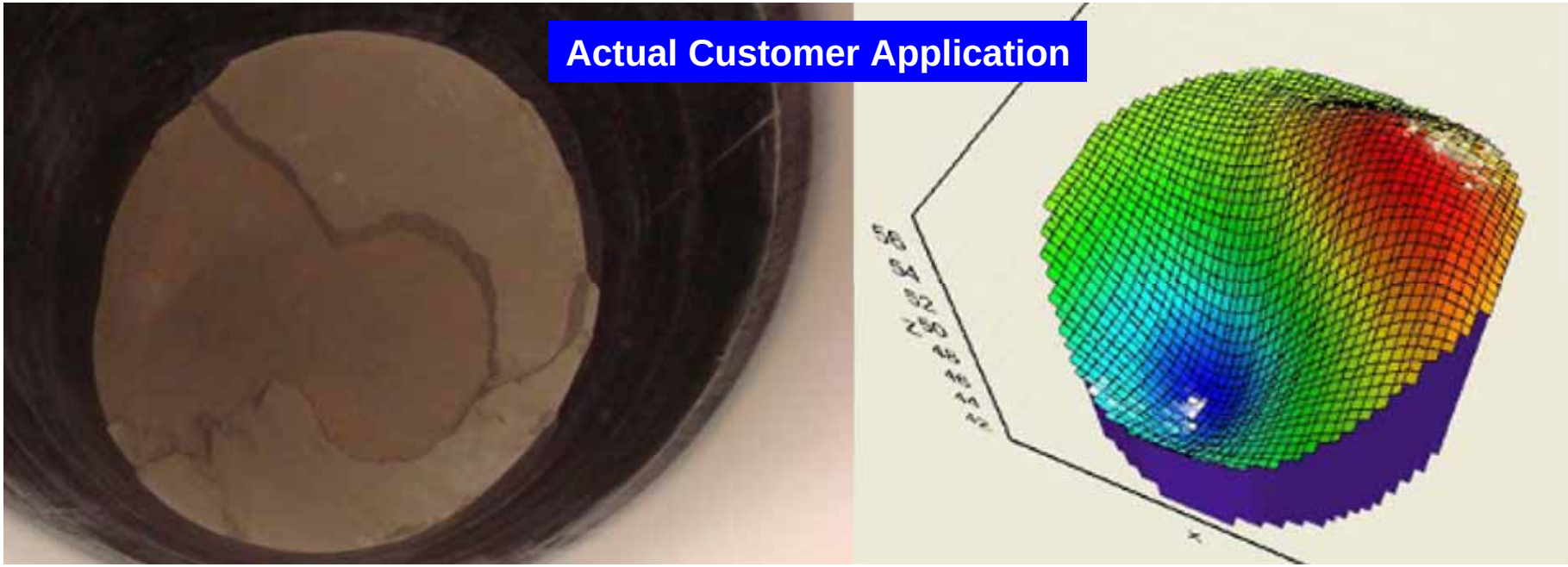


Photo on left shows significant bridging of material.

3D visualization on right detects and depicts 10 foot difference in distance to product.

Proven Installations & Configurations

Wisconsin Corn Bins

- RS-485
- 4 - 20
- HART
- TCP/IP
- Modbus

Nebraska Food Processing Plant

Texas Food Processing Plant

Nebraska Ethanol Plant

**Each site is custom configured to work within an existing system.
Hard-wired or wireless communications are available.**

Thank You!