



Measurements Division

X96 Series

NON-CONTACT MEASUREMENTS



LEVEL • DENSITY • WEIGHT



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X96 Series

Ronan Engineering, a privately held California corporation founded in 1959, has enjoyed continuous growth over years based on innovative products, advanced research and development, and unsurpassed customer support.

Our domestic and internationally based engineering and manufacturing capabilities allow us to quickly service our customers' requirements with a large variety of standard products and customized systems at the most economical terms. Proven product reliability, consistent after-sales service, and our willingness to apply corporate resources to solve problems, have given us nuclear measurement recognition in the process and steel industries. Starting with ionization chamber detectors, we made the obvious technological progression by manufacturing a new generation of detectors using advanced scintillating material for efficient radiation detection in conjunction with state-of-the-art microprocessor based electronics for precision gauging.

In keeping up with the rapidly changing customer needs in radiation measurement technology, Ronan pioneered a low radiation level scintillation detector with low cost of ownership and sensitive measurement capability that set the new standards in the nuclear measurement industry.

Continuous research and development, and our constant involvement with customers in numerous applications, have added *Geiger-Mueller Tube Detectors, Ion Chamber Detectors, Scintillation Detectors, Curved Scintillation Detectors, and Flexible Scintillation Detectors* to the Ronan measurement line.

Advancements in source holder design enables Ronan to offer a variety of source sizes suitable for most common applications. Our RLL Series of source holders are mechanically small in size and weight, offer relaxed regulatory requirements, are ideal for density and weight scale applications, and some level applications in various industries.

Continuous Level Measurement

The Ronan X96 Continuous Level Measurement System is ideally suited for continuous level measurement of liquids and solids contained in a vessel without making contact with the process material. Since all system components are not wetted to the process, the continuous on-line level measurement can be made regardless of such conditions as extreme temperature, high pressure, and corrosive, toxic or abrasive materials within the vessel.

Each system consists of a gamma source, detector, and microprocessor. The gamma source, typically mounted external to the vessel, emits energy through the vessel walls collimated in a direction towards a detector, mounted on the opposite side of the vessel. The gamma energy reaches the detector when the vessel is empty. As the process level rises in the vessel, the gamma energy reaching the detector will decrease in an inversely proportional relationship to level. The detector measures this changing gamma field and sends a proportional signal to the microprocessor. The X96 microprocessor linearizes, filters, and correlates this signal to a level measurement. A graphic LCD display and outputs are then generated to meet the application requirements.

FEATURES

- Non-contact Measurement of Liquids or Solids
- Unaffected by:
 - Extreme Temperature
 - Extreme Pressures
 - Corrosive, Abrasive, or Toxic Materials
 - Dust or Moisture
- Gamma Energy is Absorbed Inversely Proportional to Level
- Point or Strip Sources
- Straight, Curved, or Flexible Detectors
- Optional Vapor Density Compensation for Vessels with Changing Vapor Density
- Optional Multi-point Autocalibration Points
- Optional Radiation Discrimination for Indication and Latching of Outputs when Incidental Radiation may Affect Measurement Readings

SPECIFICATIONS

Detectors:

- Scintillation Detectors Active Lengths up to 15 Feet*
- Ion Chamber Detectors Active Length up to 20 Feet*
- Flexible Scintillation Detectors Active Lengths up to 20 Feet*
- Detectors Available in Explosion Proof, NEMA-4X, NEMA-4, and I.S. Configurations

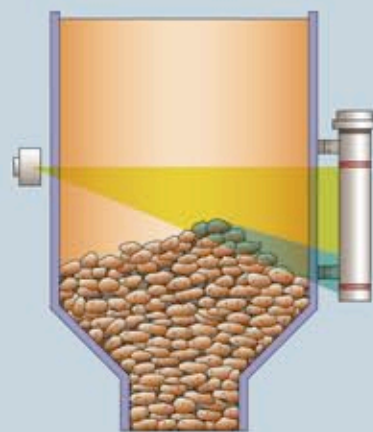
Microprocessors:

- Remote to Detector or Integral in Head of Detector
- LCD Graphic Back-lit Display
- HART Communications
- Three Analog Outputs
- Four Relay Outputs
- Four Solid State Outputs

Source Holders:

- Sealed Housing Made of Ductile Iron, Stainless Steel, or PVC Coated with an Internal Rotary Shutter
- Point and Strip Sources
- Low Level Gamma Source Holder

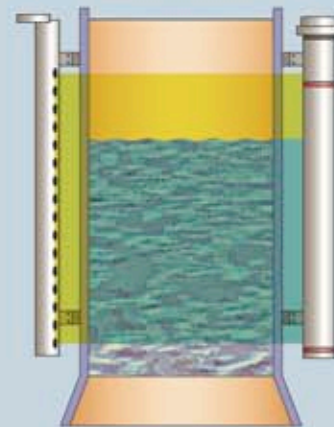
*Consult Factory for Longer Lengths



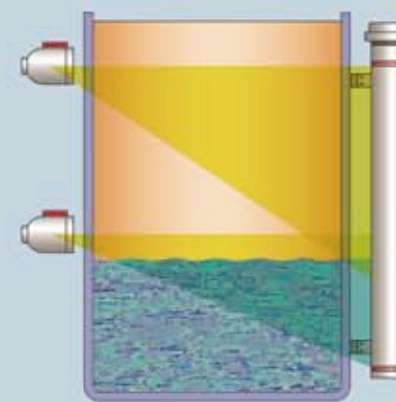
Solids Continuous Level Measurement with Source and Detector Mounted Externally on the Vessel



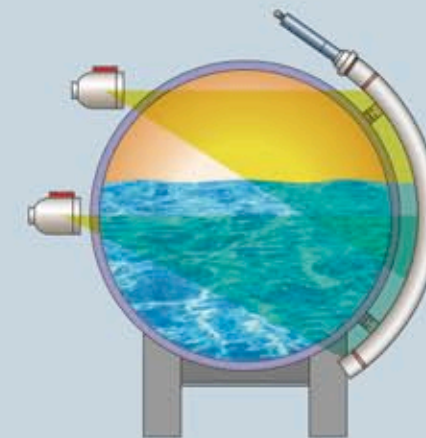
Liquid Continuous Level Measurement with Source and Detector Mounted Externally on the Vessel



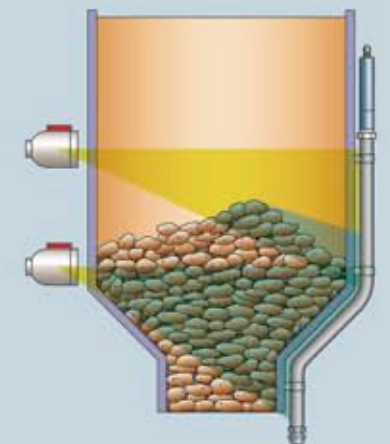
Strip Source Holder and Detector for Narrow Vessel Configurations



Continuous Level System Using Two Source Holders and One Detector



Two Source Holders and One Detector Contoured to the Vessel Diameter



Two Source Holders and One Flexible Detector to be Contoured in the Field

Density/Mass flow Measurement

The Ronan X96 Density/Mass Flow Measurement System is ideally suited for continuous density measurement of liquids, slurries, and solids contained in a pipe or vessel without making contact with the process material. Since all system components are not wetted to the process such conditions as extreme temperature, high pressure, sterile, corrosive, toxic, or abrasive materials within the pipe do not affect the continuous on-line density measurement.

Each density system consists of a gamma source, detector, and microprocessor. A mass flow system includes an input from a flow meter into the density microprocessor for mass flow calculations. The gamma source, typically mounted external to a pipe, emits energy through the pipe walls collimated in a direction towards a detector, mounted on the opposite side of the pipe. The pipe needs to be kept full of process to hold process volume constant. As the process density increases, the gamma energy reaching the detector will decrease in an inversely proportional relationship to density. The detector measures this changing gamma field and sends a proportional signal to the microprocessor. The X96 microprocessor linearizes, filters, and correlates this signal to a density measurement. A graphic LCD display and outputs are then generated to meet the application requirements.

FEATURES

- Non-contact Measurement of Liquids, Slurries, or Solids
- Unaffected by:
 - Extreme Temperature
 - Extreme Pressures
 - Corrosive, Abrasive, or Toxic Materials
 - Dust or Moisture
- Gamma Energy is Absorbed Inversely Proportional to Density
- Dynamic Tracking of Process Fluctuations
- Empty Pipe Alarm/Protection
- Linearization: Logarithmic or Segmented
- Automatic Source Decay Compensation
- Automatic Re-standardization Prompt
- HART Communications

SPECIFICATIONS

Detectors:

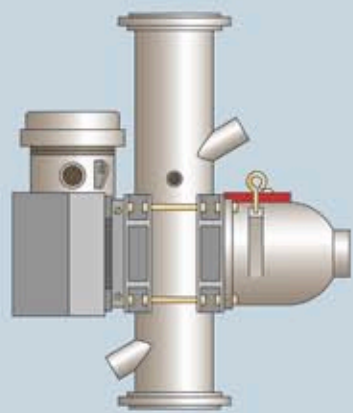
- Scintillation Detectors Using Various Size Crystals
- Scintillation Crystals of PVT or NaI
- Ion Chamber Detectors Low Voltage Chamber
- Detectors Available in Explosion Proof, NEMA-4X, NEMA-4, and I.S. Configurations

Microprocessors:

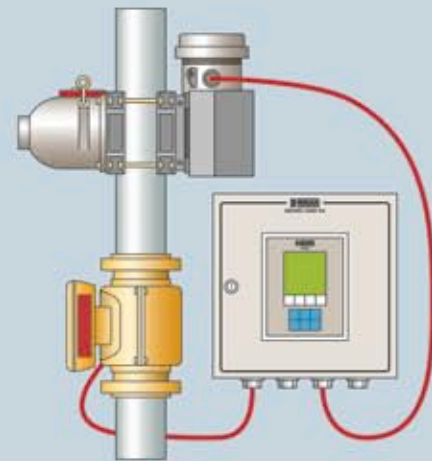
- Remote to Detector or Integral in Head of Detector
- LCD Graphic Back-lit Display
- HART Communications
- Three Isolated Analog Outputs
- Four Relay Outputs
- Four Solid State Outputs

Source Holders:

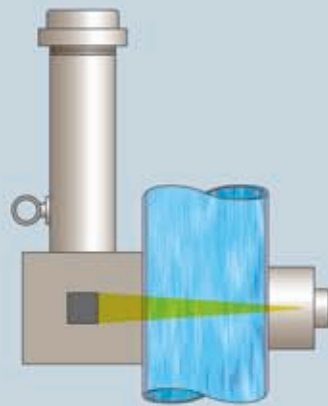
- Sealed Housing Made of Ductile Iron, Stainless Steel, or PVC Coated with Internal Rotary Shutter
- Point and Strip Sources
- Low Level Gamma Source Holder



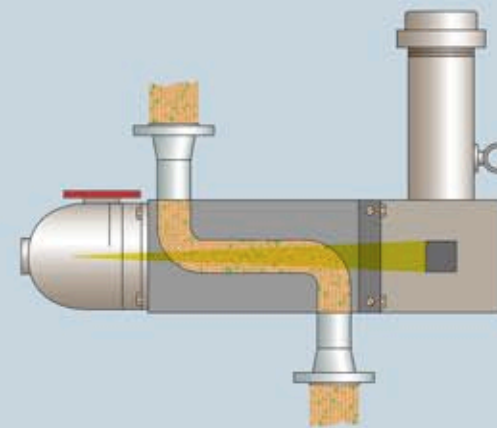
Density Measurement Clamped to Outside of Spool Piece Piping



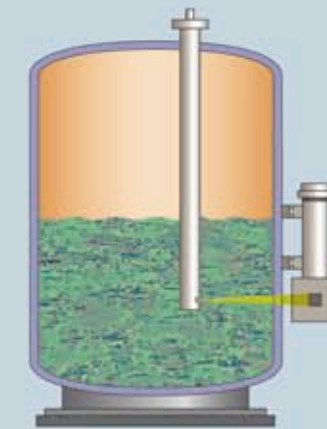
Mass Flow Measurement Including Ronan Density Meter, Customer's Flow Meter, and Ronan X96S Microprocessor



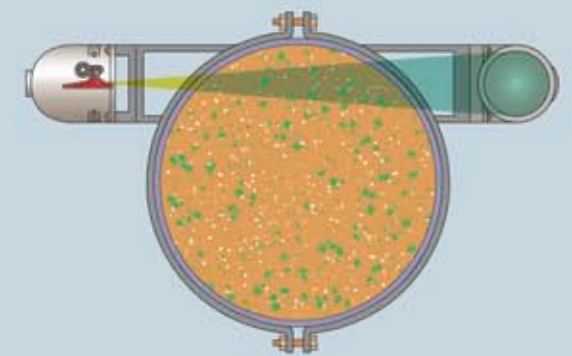
Density Measurement (Cutaway View) Clamped to Outside of Pipe



Narrow Span Density Measurement Using Axial Section

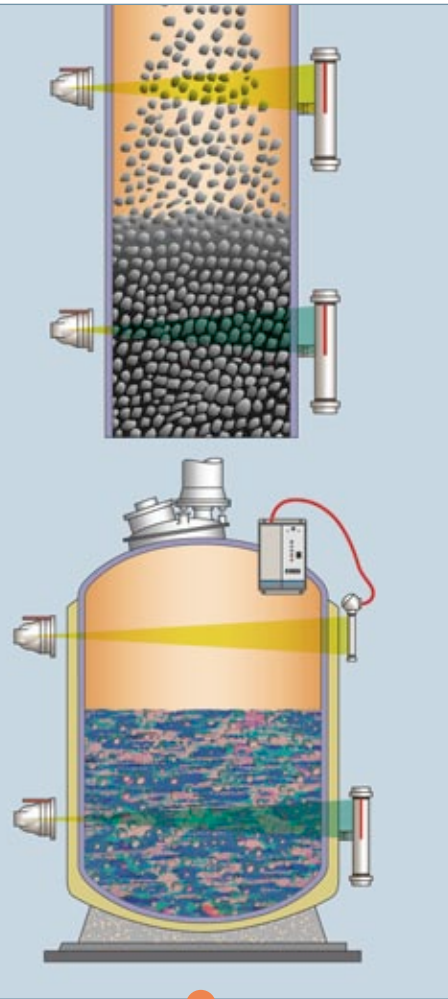


Internal Source Well Used in Density Applications on Large Vessels



Density Measurement Made on a Chord for Large Pipe Applications

Point Level Monitor



Liquid or Solid Point Level Measurement with Integral or Remote Electronics

FEATURES

- Non-contact Measurement
- Easy and Quick Installation – No Mechanical Maintenance
- Unaffected by:
 - High Temperature and Pressure
 - Corrosive, Abrasive and Toxic Materials
 - Dust, Moisture or Chemical Properties
- Suitable for Hazardous Locations
- NEMA Standard Enclosures for Indoor/Outdoor Installations
- Integral Local or Remote Electronic Module Installation
- Multi-point Chassis with Plug-in Type Modules
- SPDT Relays, Indicators for Normal and Alarm States
- Push-button Referencing

The Ronan Series X90 Point Level Monitor detects and indicates the presence of material relative to a pre-selected level in a process. The instrument provides solutions to process problems, where abrasive and corrosive conditions or high temperatures and pressures prohibit effective use of contact devices. All components of the system are easily installed external to the tanks, hoppers, chutes or vessels. The X90 Point Level Monitor System provides alarms for high or low level. It also detects the presence or absence of bulk material in hoppers or the flow of powder/bulk solids in chutes.

The system consists of two basic parts – the small radioisotope source in a source holder, and the detector, which receive energy at a level depending on the presence or absence of the process. A beam of gamma radiation passes through the process enclosure to be monitored. As the process material level passes above or below the detector, the changing amount of energy sensed by a detector provides the input to the integral or remote switch electronics. The electronics feature a single-pole/double-throw contact output, LED status indication, and as an option, system failure indication. The electronics are microprocessor based and pre-calibrated at the factory. Only an empty vessel reference is required in the field. This reference is achieved by a single push button on the face of the electronics. Detailed field setup and calibration can be achieved using a Ronan hand held programmer.

SPECIFICATIONS

Detectors:

- Geiger-Mueller Tube Detectors:
 - Standard and Extra-sensitive
 - Integral or Remote Electronics
 - Explosion Proof or NEMA-4X Housing
- Scintillation Detectors:
 - Works on Low Radiation Fields
 - Explosion Proof or NEMA-4X Housings

Microprocessors:

- Integral or Remote to Detector
- 24 VDC, 115 VAC, or 220 VAC Power
- Two 10 Amp Relay Outputs
- Programmable Hand Held Programmer

Source Holders:

- Sealed Housing Made of Ductile Iron, Stainless Steel, or PVC Coated with Internal Rotary Shutter
- Point and Strip Sources
- Low Level Gamma Source Holder

Interface Level/Density Measurement

The Ronan Interface Level/Density Measurement System is ideally suited for measurement of multiple stratified layered processes. The system locates the interface level of multiple layers, and produces a density reading of each layer. Measurement is achieved through the use of non-contact gamma-ray transmission, where the gamma field is inversely proportional to the process density. The system has multiple settings that include vessel profile, process level profile, rag layer scan, density seek, and manual control.

Components of the system include a gamma source, scintillation detector, motor drive assembly, and control micro-processor. The motor drive assembly moves the gamma source and scintillation detector in a vertical plane through guide wells, often located inside a vessel. The control microprocessor controls the movement of the source and detector, continuously monitoring their elevation. A density value is calculated in the microprocessor by evaluating the output of the scintillation detector. These two values are then outputted and displayed. Depending on the mode of operation selected, this information offers assistance to process control. Level measurement often achieves +/- .2 inch and density repeatability of +/- .005 specific gravity .



Field Mounted Controls Remote Microprocessor

FEATURES

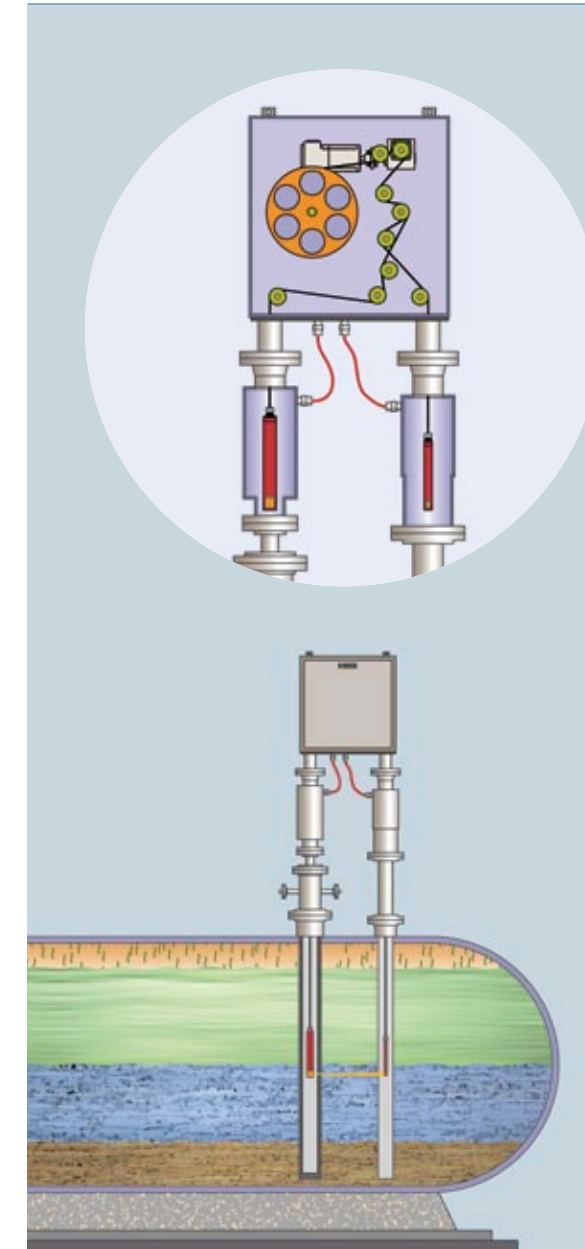
- Non-contact Measurement of Liquids or Solids
- Gamma Energy is Absorbed Inversely Proportional to Density
- Setup Performed by Remote Microprocessor
- Analog Outputs for Level and Density Values
- Multiple Customizable Alarm Outputs
- Remote Control Available

SPECIFICATIONS

- 90 to 250 VAC Power
- -30° C to 80° C
- NEMA-4/IP-65 Housing
- Seven Relay Outputs
- Level: 0-20 mA/0-10 V Analog Output
- Density: 0-20 mA/0-10 V Analog Output
- Explosion Proof with Nitrogen Purge

Modes of Operation:

- Vessel Profile
- Continuous Scan
- Density Seek
- Manual Up
- Manual Down
- Rag Layer Interface Track

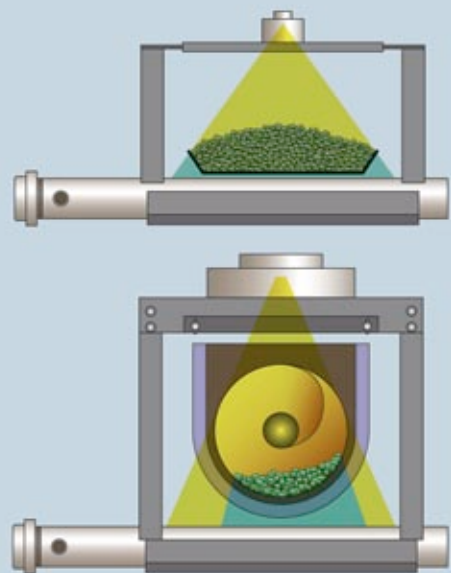


Interface Level Measurement: Source and Detector Traverse Inside Wells Measuring Process Density

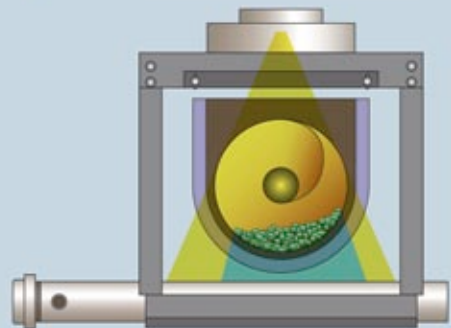
Continuous Weight Scale Measurement

The X96 Continuous Weight Scale Measurement System is ideally suited for weighing materials on belt conveyors, screw conveyors, drag chain conveyors, and metal plate conveyors. Measurements of the processes are made without making contact with the process material. Since all system components never contact the process; extreme temperature, corrosive, toxic, or abrasive materials do not affect the continuous on-line weight measurement. The non-contact gamma weight scale is not affected by belt misalignment, changes in belt tension, or hostile conditions.

Each system consists of a gamma source, detector, microprocessor, and a frame assembly for mounting the system around a conveyor. The gamma source, typically mounted over the top of the conveyor, emits energy through the process collimated in a direction towards a detector, mounted under the conveyor. The maximum possible gamma energy reaches the detector when the conveyor is empty. As the weight of the process increases on the conveyor, the gamma energy reaching the detector will decrease in an inversely proportional relationship to weight. The detector measures this changing gamma field and sends a proportional signal to the microprocessor. The X96 microprocessor linearizes, filters, and correlates this signal to a weight measurement. A graphic LCD display and outputs are then generated to meet the application requirements, typically including weight, rate, and speed. If the conveyor speed varies, a tachometer is attached to the shaft of the conveyor and its signal is inputted into the X96 microprocessor for speed calculation. The X96 can also accept 4-20 mA or 0-10 VDC speed input, or a dry contact signal for run/stop input for constant speed conditions.



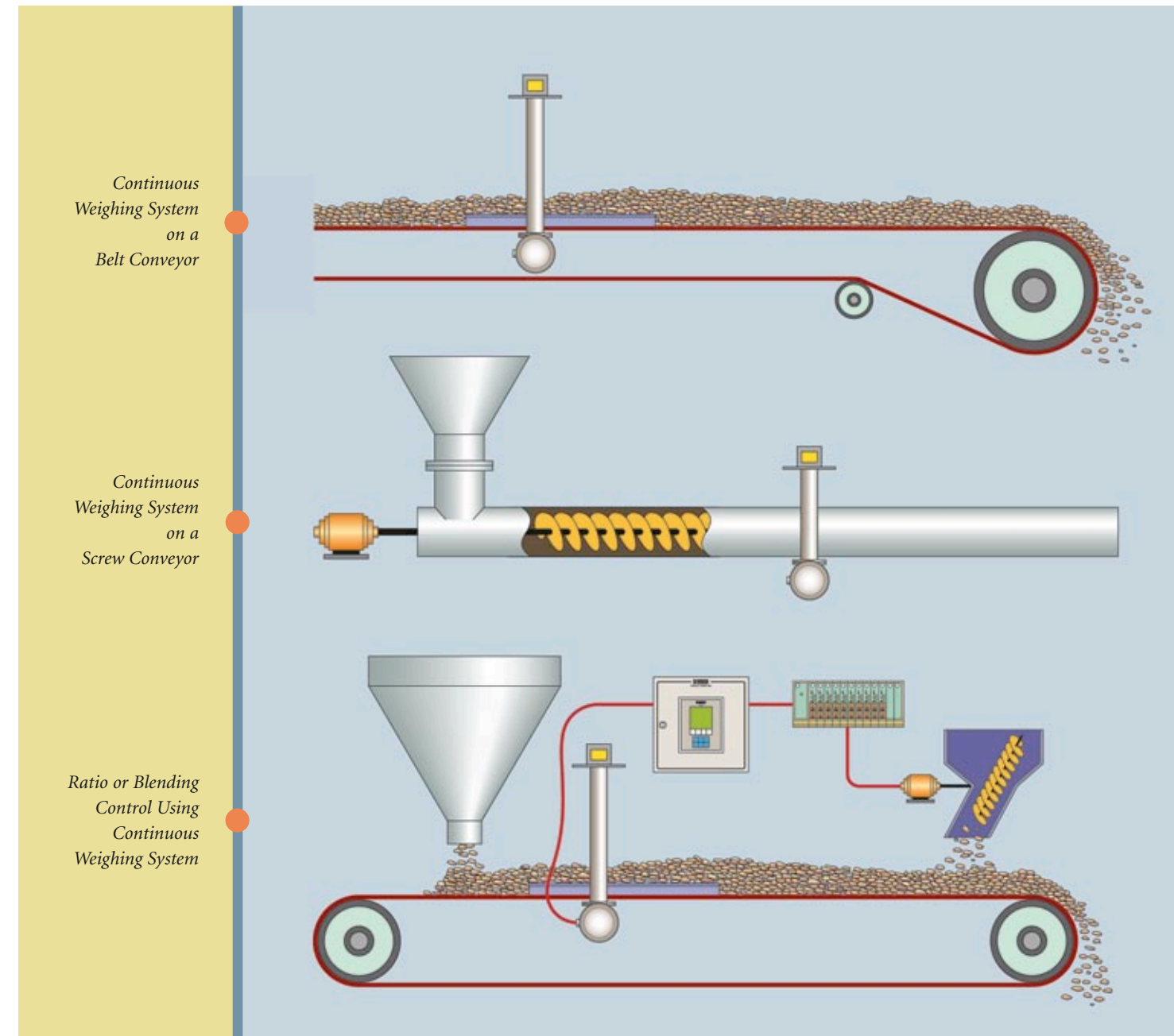
Flat or Troughed
Belt Conveyor
Measurement



Screw Conveyor
Measurement

FEATURES

- Non-contact Measurement
- Suited for:
 - Belt Conveyors
 - Screw Conveyors
 - Drag Chain Conveyors
 - Metal Conveyor
- Gamma Energy is Absorbed Inversely Proportional to Weight
- Little to No Conveyor Modifications
- Unaffected by:
 - Extreme Temperature
 - Abrasives
 - Corrosives or Toxic Materials
 - Sterile Environment
 - Dust or Moisture



SPECIFICATIONS

Detectors:

- Scintillation Detectors Active Lengths up to 15 Feet
- Ion Chamber Detectors Active Length up to 20 Feet
- Detectors Available in Explosion Proof, NEMA-4X, NEMA-4, and I.S. Configurations

Microprocessors:

- Remote to Detector or Integral in Head of Detector
- LCD Graphic Back-lit Display
- HART Communications
- Three Analog Outputs
- Four Relay Outputs
- Four Solid State Outputs

Source Holders:

- Sealed Housing Made of Ductile Iron, Stainless Steel, or PVC Coated with Internal Rotary Shutter
- Point and Strip Sources
- Low Level Gamma Source Holder

Source Holders



RLL-1 Point or Strip Source Holders with Shipping Shields

Safest Gamma Gage on the Market – Ronan pioneered the development of ultra-low level sources, to greatly improve safety, and eliminate the requirement for surveys, wipe tests, inspections and much of the documentation. They are so safe the NRC permits their removal and installation without a licensed person being present, translating into significant cost savings for the user.

The RLL-1 ultra low source utilizes very small quantities of radioactive materials. The RLL-1 is permitted to contain a maximum of 900 microcuries (mCi) of cesium-137 (Cs-137) or 200 microcuries (mCi) of cobalt-60 (Co-60). The radioactive material is completely encapsulated in a stainless steel capsule, which is then heli-arc or laser welded closed. Due to high structural integrity, these source capsules qualify as special form material.

Ronan understands that installation costs of instrumentation is a major factor when choosing a technology or vendor. To minimize the need to make changes to your existing installation, Ronan offers a wide variety of source holder designs. In addition to external sources, we manufacture small physical sizes for those with space constraints and insertion types for existing wells.

Whatever the installation requirements, Ronan can work with you to install the safest source for the application.

FEATURES

- Source Material
 - Cesium-137
 - Cobalt-60
 - Americium-241
- Source Sized to Each Application
- Source Holder Options
 - Ultra Shielded with Internal Rotary Shutter
 - Lighter with Safety Shielding
 - Insertion Styles
 - Various Shutter Designs
 - Internal Rotary Shutters
 - External Shipping Shields



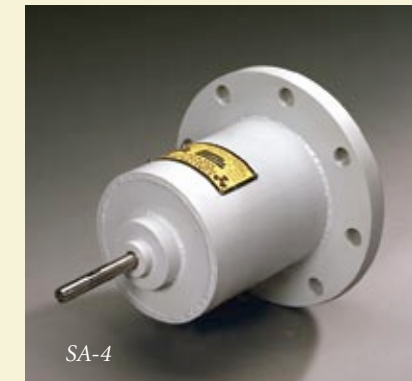
GS-200/300 Point or Strip Source Holder with Internal Rotary Shutter



SA-1 Ductile Iron Point Source Holder with Internal Rotary Shutter



SA-15



SA-4



SA-10

Point or Strip Source Holders for Insertion of Sources into Wells Located Inside Vessels



SPECIFICATIONS

- All Source Holders have Governmental Approval
- Shielding Standardly Meets International Standards Producing a Radiation Field Not Greater than 5mR/hr at 12 Inches from any Accessible Surface. (Greater Shielding Available for Tighter Standards)
- Materials of Construction Include Ductile Iron, Carbon Steel, Stainless Steel, and PVC Coated Protection
- Sealed Source Holders are Available for Extreme Heat Applications
- Standard Manual Shutter with Position Indicator
- Remote Actuated Shutters Available

Measurement Detectors



Each system must not only contain a radiation source, but must also contain a detector to measure the gamma radiation energy. The Ronan Measurement Systems can be furnished with either an ion chamber detector or a scintillation detector.

The ion chamber detector contains parallel plates stacked in an alternating polarity arrangement sealed in a pressurized chamber. A signal is generated when the radiation field enters the chamber and ionizes in the pressured chamber, creating a current across the parallel plates. This design produces a very rugged detector able to withstand heavy shock and vibration. It uses an ultra stable low bias voltage that is amplified within the detector, easily transmitted to remotely mounted electronics.

The scintillation detector consists of the scintillation crystal, photo-multiplier tube, and associated electronics. A signal is generated when the radiation field enters the crystal causing the crystal to scintillate with photon energy, proportional to the incident radiation striking it. This photon energy is converted to electrical pulses in the photo-multiplier tube. The detector

uses a low voltage supplied from the microprocessor, and can transmit its output over great lengths. Ronan offers many types of scintillation crystal formed in many custom shapes and sizes.



Explosion Proof Detector Housings



Ionization Chamber Detector



Scintillation Detector



The Flexible detector utilizes a patented non-hazardous, non-flammable scintillating fill-fluid, which is doubly encapsulated and protected by an outer sheath of armored conduit. This newest flexible design offers unique advantages in reliability and sensitivity, while the lightweight construction eliminates the need to employ cranes and rigging for installation. This design is ideal for horizontal or spherical vessels, irregular contours, or parts of the vessels where space is limited.

The flexible detector is available in lengths up to 23 feet (7 meters). For longer level measurements, multiple detectors can be summed in the X96S computer.

FEATURES

- High Detector Efficiency, Excellent Sensitivity – Able to Provide Measurements with Lower Intensity Radiation Source
- Active Length Up to 23 Feet (7 Meters) – Limits the Need for Multiple Detectors, Reduces Cost
- Spring Tension of PM Tube – Maintains Integrity of the Signal Path Under Vibration and when Detector is Mounted Inverted
- Lightweight and Easy to Install – 1.1 lbs/ft (0.5 kg) vs. 15 lbs/ft (6.8 kg) for Solid Crystal
- Can be Shipped via UPS or Other Carriers ...No Need to Ship by Truck – Significant Savings on Freight Cost
- Flexible 12-Inch (0.3 Meter) Radius to Fit Around the Contour of Irregular Vessels
- Fill Fluid: Non-hazardous, Non-flammable
- Improved Linearization Over the Entire Range of Active Length
- Lowest Cost per Foot
- Ronan Quality Manufacturing – Backed by a Three Year Limited Warranty

SPECIFICATIONS

- Construction:
 - Electronics – Stainless Steel
 - Housing – Aluminum as Standard; (304 Stainless Steel Optional)
 - PVC Body – PVC Sheathed Aluminum Armored Flexible Conduit
- Fill Fluid: Non-hazardous, Non-flammable
- System Accuracy: +/- 1% Span (Typical)
- Active Length: Up to 23 Feet (7 Meters)
- Power Requirements: 24 VDC @ .035 A
- Ratings:
 - UL, Cenelec/Atex
 - Class I, Division 1
 - NEMA-4, NEMA-4X
- Weight: Detector Electronics – 10 lb. (4.6 kg), Body – 1.1 lb (0.5 kg) per Active Foot
- Operating Temperature: 14° to 140° F (-10° to +60° C), Low and High Temperature Options Available

Flexible Scintillation Detector in a NEMA-4X Enclosure with I.S. Electronics

Process Measurement Computers

The X96S Series of Process Measurement Computers offer calibration and configuration in a simplified format. It provides flexibility and inherent stability of digital processing to process measurements. The diversity of the design enables the customer to choose from a self-contained unit mounted remotely from the measurement, a blind transmitter with various communication options, or any combination in between.

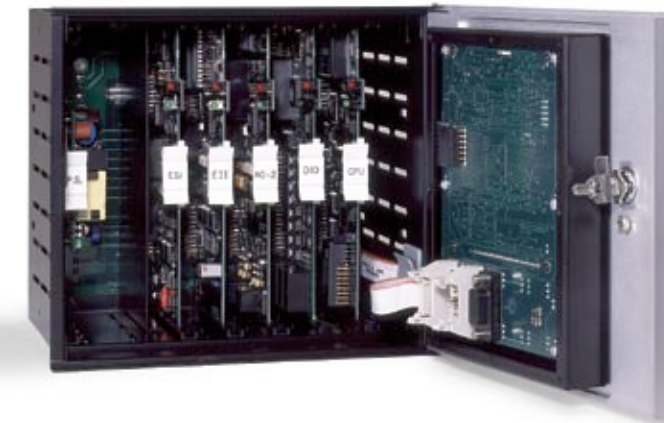
The X96S Series Computers are modular in design, enabling the measurement computer to be tailored to the application requirements. Push-button programming is obtained through the LCD Graphic Display. All programming prompts are in English, with help screens available almost eliminating the need for a manual. Various board configurations accept multiple digital or analog inputs from ion chambers or scintillation detectors, as well as analog or discrete inputs and outputs. Serial communication is available in multiple formats including the HART® format.

X96S Blind Microprocessor in a Surface Mount Chassis Enclosed in a NEMA-4 Enclosure with a Panel Mounted Programmer in the Door



X96S Panel Mount Microprocessor Shown Sitting on Top of X96S Rack Mount Microprocessors with Panel Mounted Programmers in the Doors

X96S Surface Mount Microprocessor



X96S Panel Mount Microprocessor

SPECIFICATIONS

- 90 to 240 VAC or 24 VDC
- HART/4 to 20 mA Current Loop
- Detector Inputs for Ion Chamber or Scintillator
- Four Form "C" Relay Outputs
- Four Solid State Outputs with Capacity of 4.5 to 30 VDC
- Eight Digital Inputs
- Three Analog Outputs
- Temperature Inputs: RTD or Analog
- Analog Inputs of 4 to 20 mA or 0 to 10 V
- RS232/RS485 Communications
- Standard Surface Mount Enclosure is NEMA-4
- Optional Enclosures of Stainless Steel (NEMA-4X) or Explosion Proof
- Optional Panel or Rack Mounting

FEATURES

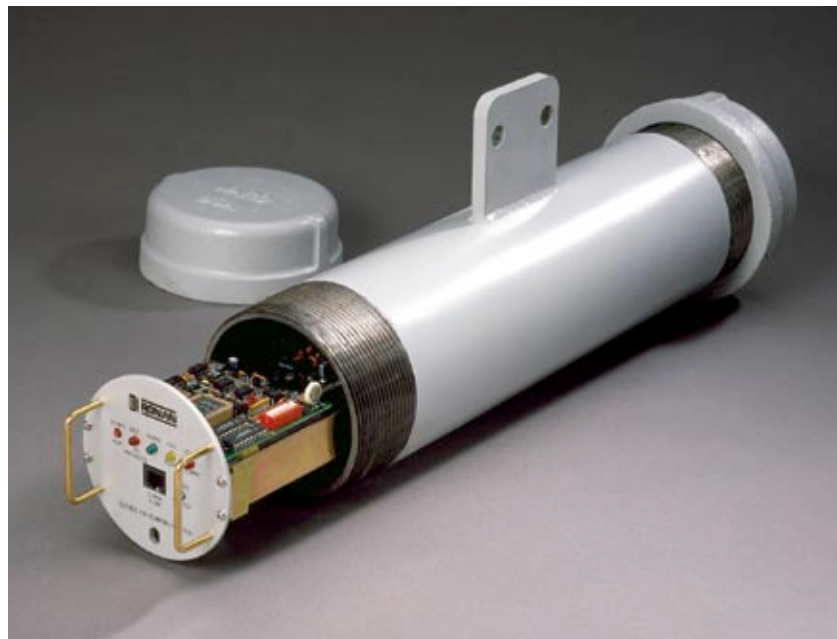
- Menu Driven Configuration
- LCD Graphic Backlit Display
- Automatic Source Decay Compensation
- Multiple Point Linearization
- HART Communications
- Dynamic Process Tracking and Filtering
- Isolated Analog Outputs
- Modular Design
- Serial Communications
- Multiple Configurations Include:
 - Full Featured Microprocessor Mounted Remote to Detector
 - Blind Microprocessor Mounted in Detector Head



Point Level Electronics

The Ronan X90 Series of Process Measurement Electronics offers microprocessor-based electronics for point level measurement. These systems offer a simplified push-button field calibration and/or versatility for customization through the use of a hand held programmer. A standard system consists of a gamma radiation source, Geiger-Mueller tube or scintillation detector, and X90 electronics. The gamma source is located in a source holder, which is described earlier in this brochure. Ronan offers various detector designs depending on the application requirements. The Geiger-Mueller tube detector requires a larger radiation field than required by a scintillation detector, but typically is the least expensive choice. The detector measures the gamma field and transmits this signal strength to the X90 electronics where the point level alarm's status is indicated and outputted. The X90 triggers an alarm when the detector signal changes by a percentage, which is set up in the software custom to your application. This percent change calculation requires only a single point field calibration on an empty condition, simplifying the field start-up and calibration.

Broad packaging options of the X90 Series offer systems that meet most any requirement. Enclosure options are available for explosion proof, water tight, wash down, and general purpose. The X90 electronics is packaged integral or remotely to the detector, or to meet any custom requirements.



X90 Integral Point Level Switch

FEATURES

- Push-button Calibration
- Process and Watchdog Alarms
- Modular Design
- LED Alarm Indication
- Field Customization through Menu Driven Configuration
- Serial Communications
- Integral or Remote Electronics

FIELD DETECTORS



GM Tube Detectors



General Purpose Scintillation Detector



Remote Electronics



Remote Hand Held Programmer



Scintillation Detector/Housing

SPECIFICATIONS

Detectors:

- Geiger-Mueller Tube Detectors:
 - Standard Tubes Sensitivity of .2 mR/hr.
 - Extra Sensitive Tubes Sensitivity of .1 mR/hr.
 - Temperature Resistant up to 212° F
 - Explosion Proof or NEMA-4X Housing

Scintillation Detectors:

- Standard Sensitivity of .01 mR/hr.
- Temperature Resistant up to 160° F
- Explosion Proof or NEMA-4X Housings

Microprocessors:

- Integral or Remote to Detector
- Power: 24 VDC, 115 VAC, or 220 VAC
- Two 10 Amp Relay Outputs
- Single or Multi-point Chassis
- Programmable with a Ronan Hand Held Programmer with Push-button Calibration
- LED Indication of Alarm Conditions
- Process and Watchdog Alarms
- Temperature Resistant up to 165° F
- NEMA-4, NEMA-4X, or Explosion Proof Enclosures

WARRANTY

Ronan warrants equipment of its own manufacture to be free from defects in material and workmanship, under normal conditions of use and service, and will repair or replace any electronics found to be defective, on its return, transportation charges prepaid, within three (3) years of its original purchase. This warranty carries no liability, either expressed or implied, beyond our obligations to replace the unit which carries the warranty.



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