TR Electronic
@ Oktoberfest 2015
Presents…….

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. . . Passionate about Sensors.

Ultrasonic Sensors – Lab /Talk

Introduction

Steve Cecchini

-Experience spanning two decades implementing sensor and feedback solutions in a multitude of different industries across North America .

-Currently the Regional Sales Manager of the Midwest.

Introduction

Tristan Pawluch

-13+ years implementing, troubleshooting, piloting and retrofitting solutions for power generation and positioning feedback applications across North America.

-Currently the Applications and Training Supervisor for North America.

Agenda

- TR Electronic Overview
- What Is Ultrasonic?
- What Are Ultrasonic Sensors?
- Why Use Ultrasonic Sensors?
- Choosing Your Sensor
- Different Ultrasonic Modes
- Ultrasonic Filters
- Applications
- Questions

TR Electronic Overview

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Who is TR?

***TR* Electronic** is a:

Designer – Developer – Manufacturer – Distributor
….Of Rotary, Linear, Laser Measurement and Presence Detection Devices.

Providing Measurement and Automation Solutions for the Manufacturing Industry for over 25 years!

TR Electronic is also proud to have a dedicated Training and Technical Service Center for **all** Industrial Positioning and Sensing Solutions.

Providing our Customers with ***OUTSTANDING*** Customer Service and Support

"Thank you for assisting today. My guys were impressed with your knowledge and ability to assist further than originally expected. The great level of service is what separates the great companies that will gain return business from the "Also-rans". " - Line Manager, Plant Engineering - Electrical

Who is TR?

***TR* Electronic** – Your exclusive North American source for:

TR Electronic, SENSEable, di-soric, Microsonic, and PowerGap

Unmatched Technical Support and Customer Service 24 /7, 365 Days of the year!

Let us earn your business – Our Goal, is Your Success

TR Germany

What is Ultrasonic?

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What Is Ultrasonic?

Sound:

- is the sensation in the human brain produced when mechanical waves between 16Hz and 20kHz strike the ear.
- In the natural sciences and engineering, the term sound is extended to include the mechanical vibrations below 16 Hz and above 20 kHz.
- These forms of mechanical waves are called sound waves or acoustic sound.

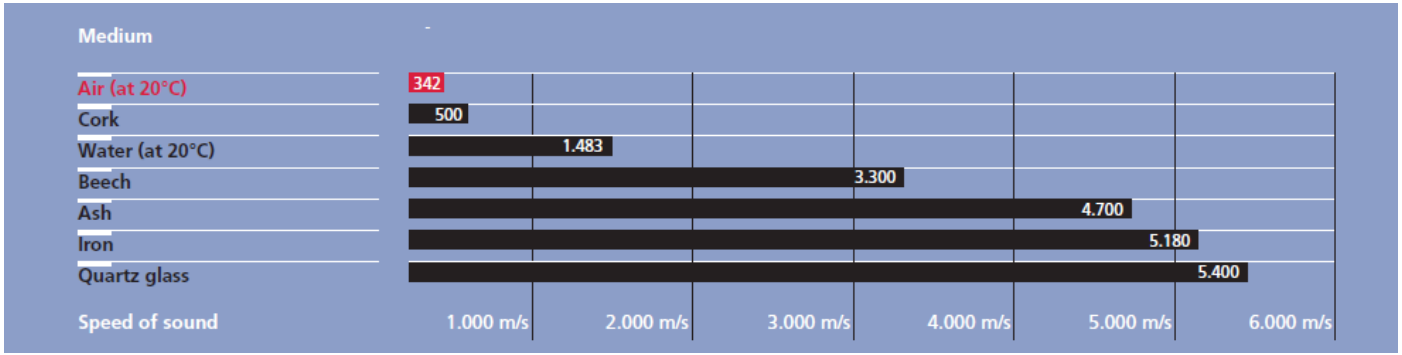
Ultrasonic:

- is the termed used to describe mechanical vibrations between 20kHz and 1GHz.
- These vibrations (or ultrasonic waves) are beyond the range of the human ear.

Infrasound: Sound waves < 16 Hz	- Earthquakes - Rocket lift offs
Ultrasound: Sound waves > 20 kHz	- Medical Equipment - Bats /Dolphins
Hypersound: Sound waves > 1 GHz	

Propagation:

- Sound can travel through solids, liquids and gases, as well as pass from one medium to another.
- Sound cannot travel (propagate) in a vacuum.



What Are Ultrasonic Sensors?

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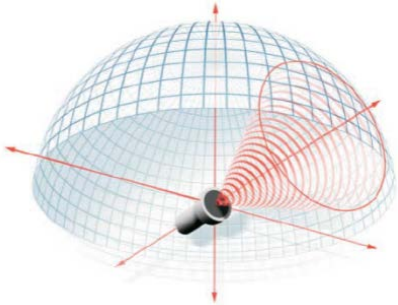
What Are Ultrasonic Sensors?

Propagation of sound:

Fans in Lambeau Field cannot be heard by people on the streets 50 blocks away.



Speaking:

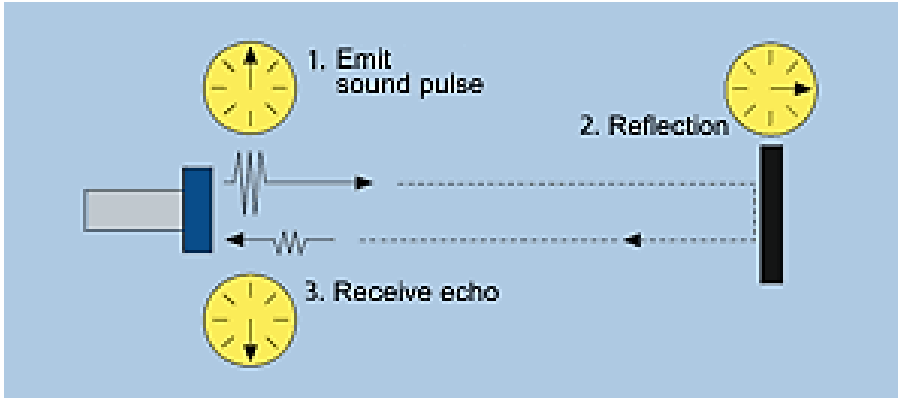
- Produces spherical waves.

Ultrasonic sensors:

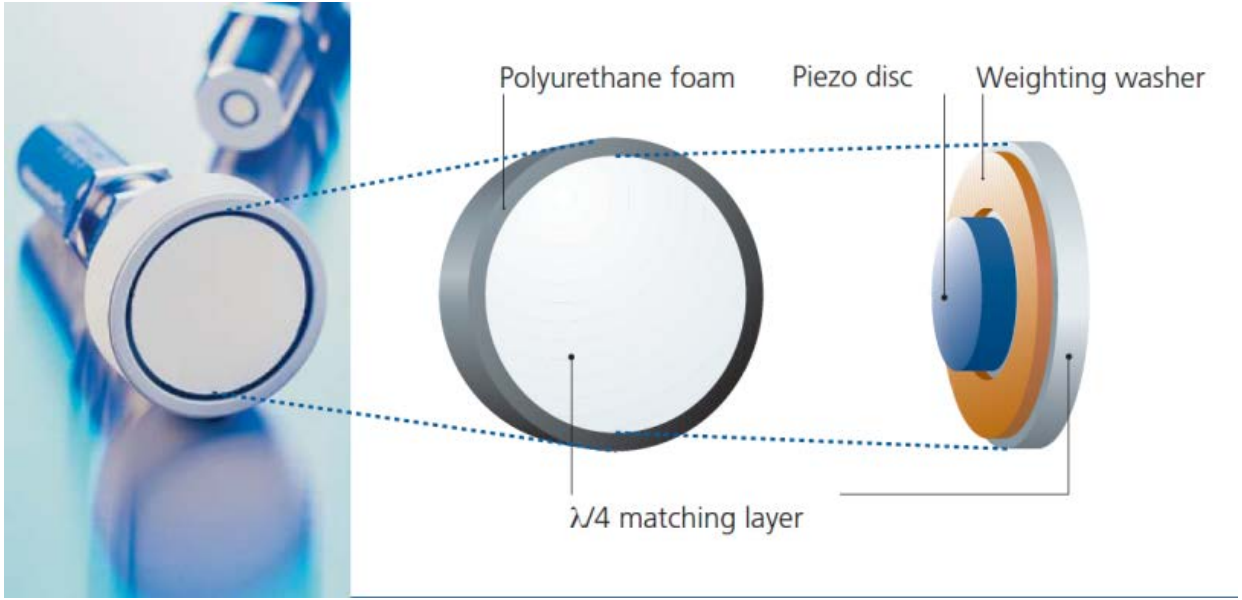
- Radiate what approximates to a section of a sphere.
- The sound field is divergent.
- With increasing distance away, the sound energy per unit area reduces.

Ultrasonic sensors:

- Emit a sound pulse.
- The same sound pulse reflects off of an object back toward the sensor.
- The sensor receives the echo and computes the distance based on the time between emitting the pulse and receiving the echo.



A closer look:



Why Use Ultrasonic?

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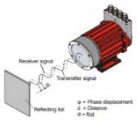
Why Use Ultrasonic Sensors?

Object Detection:

Objects come in all shapes, sizes and materials. Choosing the right sensor for the right job is imperative for operational success.

- Dark vs. Bright: The darker the object, the more light tends to be absorbed. (sound is unaffected by color)
- Rough vs. Smooth: Rough objects tend to reflect light away from sensing heads. Ultrasonic's can have a wider detection beam emitted.
- Removable vs. Immovable: Sometimes a reflector is not possible as an object enters and leaves a sensing field.




Why Use Ultrasonic Sensors?

Good Sonically Reflective Materials:

- Water
- Paint/Vanish
- Wood
- Metal
- Plastic
- Stone/Concrete
- Glass
- Hard foam rubber (Styrofoam)

Poor Sonically Reflective Materials:

- Cotton wool
- Soft carpet
- Soft coverings (eg. Mohair)
- Soap /Waste water /Beer foam
- Powders with high air content
- Soft foam rubber

Why Use Ultrasonic Sensors?

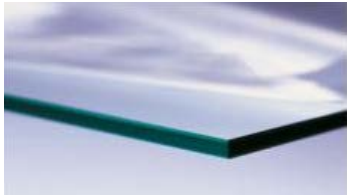
Clear Water or Black Coffee

Velvet and Leather?

Ruby Red, Steel Blue, Lemon Yellow

White on White or Black on Black?

Sheets of glass and skin-thin foils?



Coarse Grains, chips, or fine sand?

Choosing Your Sensor

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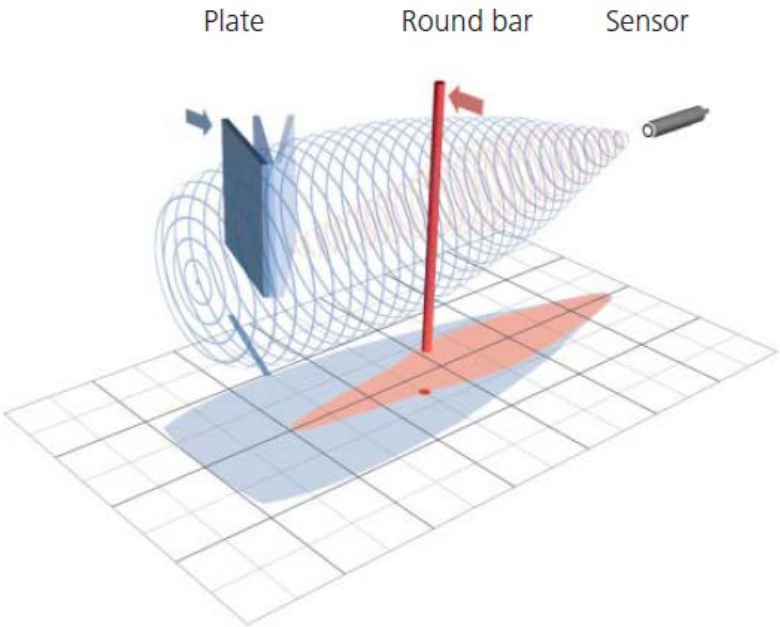
Choosing Your Sensor

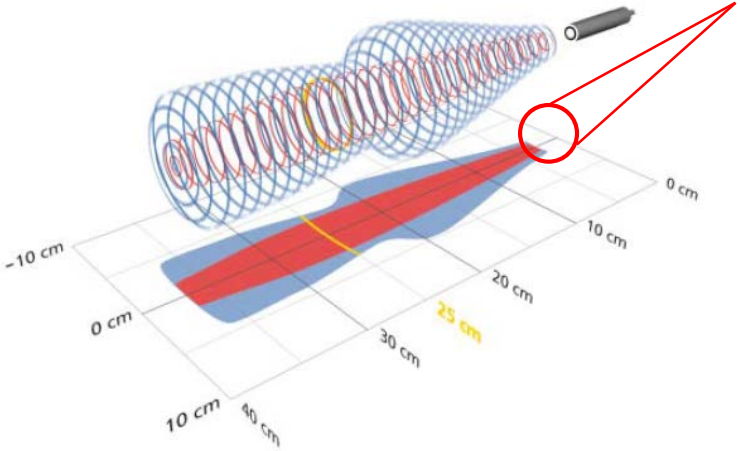
Detection Zone:

- **Red Area:** Determined with a thin round bar (10 or 27mm in diameter depending on the type of sensor).
- Indicates the typical operating range of the sensor.
- **Blue Area:** A plate (500mm x 500mm) is introduced into the beam from the side.
- The optimum angle between the plate and the sensor is always employed.
- This indicates the maximum detection zone of the sensor.



Detection Zone:

- **Yellow: Recommended operating range.**



Blind Zone

30mm

Detection Zones Specifications

Temperature: 20°C

Relative Humidity: 50%

Pressure: Normal (101.375 kPa)

Environmental Concerns:

Accuracy: The speed of sound is temperature dependant.

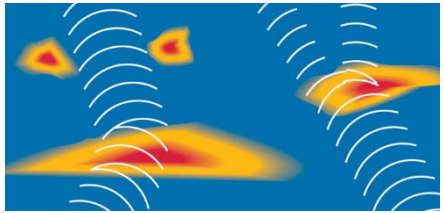
ie. Sound travels slower in warmer temperatures.

Range: The attenuation of sound is dependant upon air temperature and relative humidity.

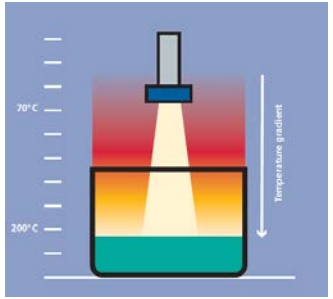
ie. Sound travels shorter in higher humidity and warmer temperatures.

Non-Homogenous Temperatures: Hot air mixed with cold air.

A refraction of sound waves occurs.



Temperature Gradient Measurement:



-Several ultrasonic measurements required.

Different Ultrasonic Modes

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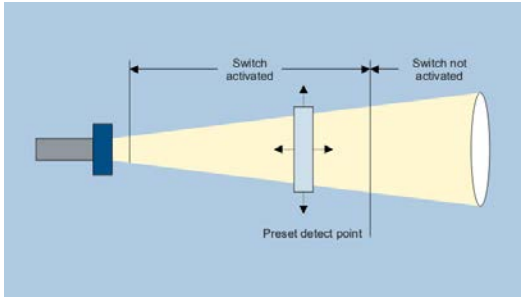
Different Ultrasonic Modes

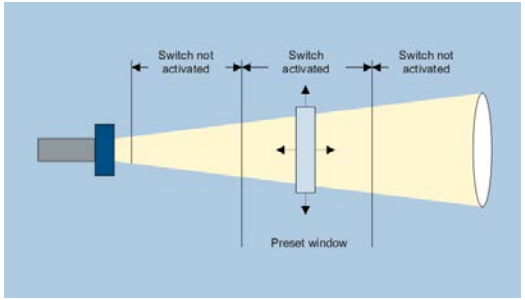
- Reflective Mode (Proximity Switch)
- Window Mode
- Two Way or Retro-Reflective
- Foreground Suppression
- Analog (Position Measurement)
- Through-Beam (Double Sheet)

Reflective Mode



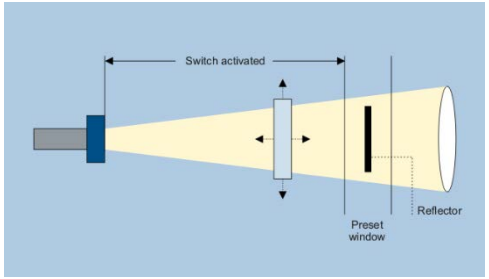
- Part / Proximity detection
- Output is active when object is inside of the detection range

Window Mode



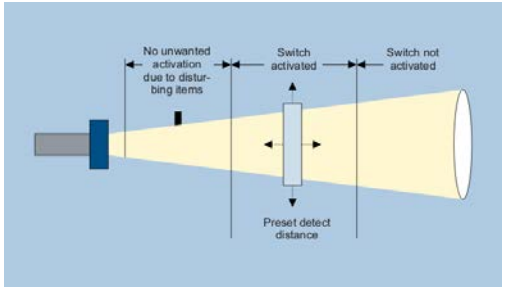
- Zone / Window detection
- Output is active when object is inside the defined window

Two Way / Retro-Reflective Mode



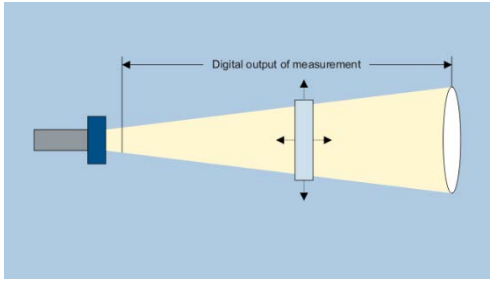
- Similar to Photo-Retro-Reflective
- Output is active when object is blocking reflector

Foreground Suppression



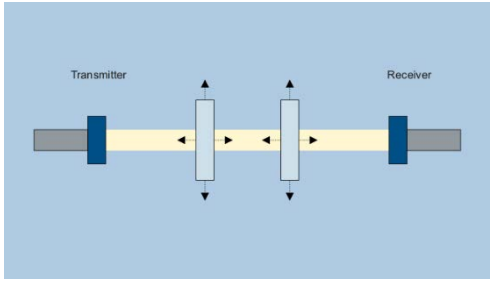
- Similar to Window detection
- Ignores signals which protrude into foreground

Analog / BUS Output



- Position Measurement
- Value is given as an Analog value or communicated on BUS

Through-Beam (Double Sheet)



- One-way sound barrier
- Output is active when 2+ sheets are present / No sheet detection

Ultrasonic Filters

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Ultrasonic Filters

- The distance values established by the echo runtime measurements between the ultrasonic sensor and the object are internally checked for plausibility and, if necessary, subjected to a measurement value attenuation.
- The filter strength can be adjusted within 10 levels.
- Additionally, the software filters can be deactivated.

Ultrasonic Filters

- **F00**: no filter activated, each distance measurement is passed unfiltered.
- **F01**: standard filter
- **F02**: averaging filter
- **F03**: foreground filter
- **F04**: background filter
- **P00-P09**: filter strength adjustable on a scale of 10

F00: No filter, each measuring value is transmitted to the output unfiltered. Neither a plausibility check nor a measuring-value attenuation is performed.

F01: Standard filter

- The position alteration of the object is continuously assessed between the first and second as well as between the second and third measurement. The sensor, at known measuring cycle time and established position alteration, internally calculates the relative velocity of the object towards the sensor.

-Looks for anomalies in the measured value.

-Spikes of velocity v ≤ 2 m/s are handled without issue.

-Spikes of velocity > of 2 m/s, the last transmitted distance value will be maintained and continue to be transmitted to the output.

-The time period for which the last transmitted distance value is maintained depends on the selected filter strength.

Filter F01 ideally takes into account the physical characteristics of the ultrasonic principles. It bridges the sporadic loss of the echo signal.

F02: Averaging filter

-The distance values respectively verified for plausibility are subjected to a continuous averaging process according to the FIFO principle.
-The filter strength set via P00 to P09 determines how intensive the averaging is performed.
-The dwell time of filter F02 is significant shorter than of filter F01 and will not be further increased as of filter strength P02.
-The bridging of measurement outliers is here limited to a maximum of 5 measurement cycles.

F03: Foreground filter

-Contrary to the filters F01 and F02, the velocity of the object is not considered at the filter F03. All detected distance values are further processed.

A) Distance values that are in the close vicinity of the sensor (in the foreground)
B) Distance values that are beyond the close vicinity of the sensor (in the background)

-The foreground filter F03 calculates the average from all distance values of group A.
-The filter strength set via P00 to P09 determines how intensive this averaging is.

-The filter F03 is named foreground filter because from all distance measurements found the filter calculates the average only with the **sensor-close** values.

F04: Background filter

-Contrary to the filters F01 and F02, the velocity of the object is not considered at the filter F04. All detected distance values are further processed.

A) Distance values that are in the close vicinity of the sensor (in the foreground)
B) Distance values that are beyond the close vicinity of the sensor (in the background)

-The foreground filter F04 calculates the average from all distance values of group A.
-The filter strength set via P00 to P09 determines how intensive this averaging is.
-The filter F04 is named background filter because from all distance measurements found the filter calculates the average only with the **sensor-far** values

NOTE If there is no longer an object within the measuring range of the sensor, the sensor will, after expiry of a certain dwell time dependent of the set filter strength, output the maximum value (maximum range).

Applications

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Applications

- Printing & Paper Industry
- Office and Information Technology
- Agricultural Machines and Tractors
- Rubber and Plastics Machines
- Woodworking Machines
- Food Processing Machines
- Commercial Vehicles
- Packaging Machines
- Construction and Construction Material Machines
- Balances
- Textile Machines
- Conveying Handling Systems
- Assembly Technology and Robotics

- Elevator Tracking On a Potato Hopper.

  Mic-35/D/M

- Tractor Autopilot

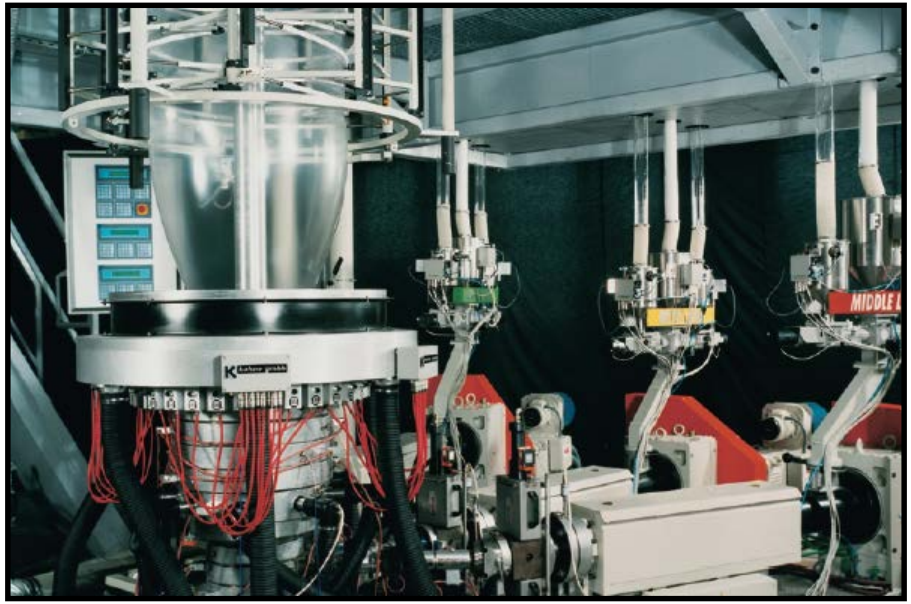
  4 x WMS-130 /RT /M30

- Double Sheet Detection

  dbk sensor

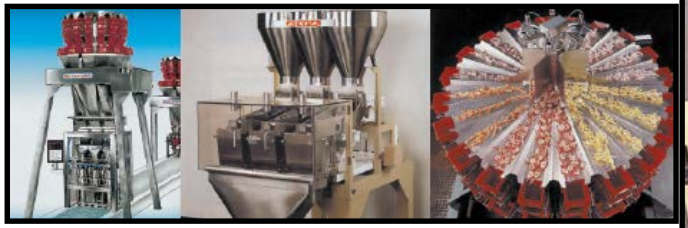
- Controls Film Extruder

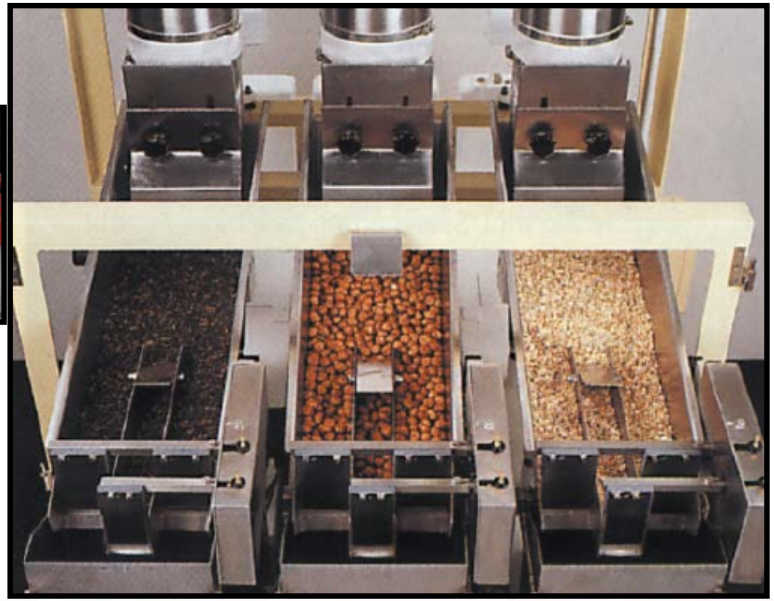
  Mic +130 /IU /TC



- Automatic Scales (Volume Flow)

  Mic+130 /IU /TC /E



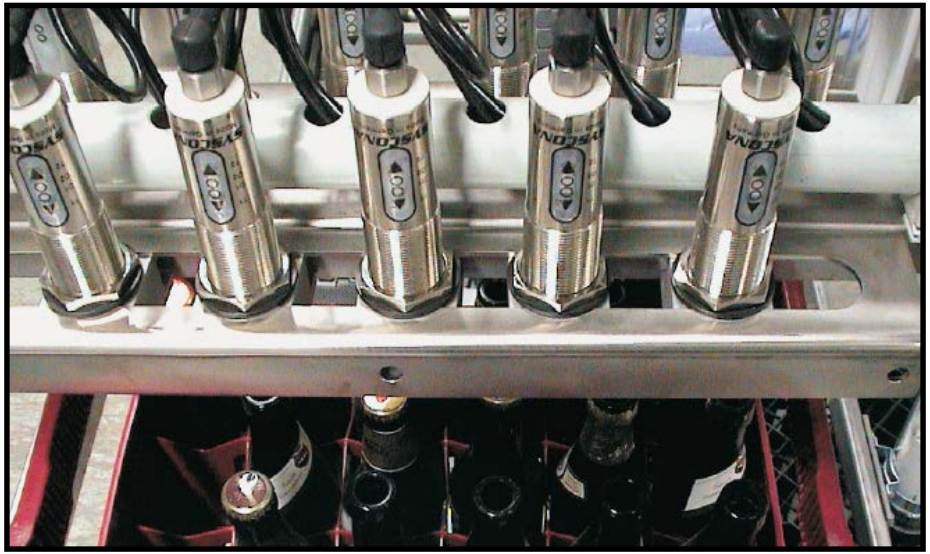


- Printing Press: Sheet Presence

  dbk-4 /CD /O /M18 E+S

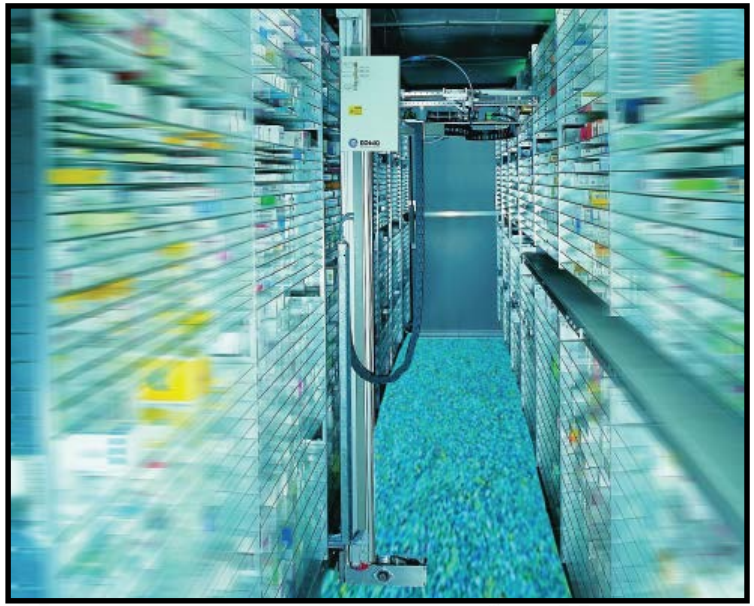
- Drink Industry: Looks for empty crates.

  Mic+25 /UI /TC (Synchronization)



- Automated Pharmacy Warehouse

  zws-15 /CD /RWA



- Ramp Approach Aid

  wms-800 /RT

QUESTIONS?

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TR Electronic CUSTOMERS FIRST Program

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