Applus RTD Group
International Presence

- Applus RTD: 4500+ Employees Worldwide
- Presence in 5 Continents
- Presence in 40 Countries
- Corporate Office in Rotterdam, The Netherlands
- Strong Organic Growth
- In Business since 1937
- Currently supports Oxy at many locations
Applus RTD USA Inspection Solutions

- INCOTEST (Insulated Component Testing)
- Shear Wave (UT)
- Phased Array / TOFD (UT)
- Digital Radiography
- Rayscan (RTR Weld Inspection)
- Guided Wave (GUL)
- Eddy Current
- EMAT
- Thermography
- MFL Floorscanning
- Certified Weld Inspectors (CWI)
- API Inspections (510, 570, 653)
On-stream inspection plan required to monitor deficiency until permanent repair is executed...critical when dealing with internal corrosion.

For smaller diameter piping (<12”), X-ray is effective.

For larger diameter pipe, X-ray may not be feasible.

Most ultrasonic methods (shear wave, phased array, & straight beam) cannot penetrate the composite or can only scan the edge of the repair area.

Guided wave (GUL) technique can be used, but not able to quantify damage and accurately monitor increasing corrosion other than boundary of damaged areas.
Based on Eddy Current Principle
Screening Tool (General Corrosion)
Data Digitally Stored
Detection of Remaining Average Wall Thickness (AWT)
No Contact Needed for Measurement
No Special Surface Preparation Needed
Measurement Through Insulation, Fireproofing, and Concrete
RTD-INCOTEST® System Theory

- Measures Decay Time of Eddy Current Induced in Carbon Steel Object.
- Eddy Current Induced by DC Current Through Probe Sending Coils (Creates Stable Magnetic Field)
- When Current is Stopped, Coils Stop Generating the Magnetic Field.
- During This Transient, Eddy Current is Induced in the Ferromagnetic Object.
- Eddy Current Circulates and Generates a Variable Magnetic Field During its Decay.
- The Generated Magnetic Field Lines Migrate Through the Receiving Coils and Induce a Current.
- RTD-INCOTEST Measures the Resulting Voltage With Time.
The RTD-INCOTEST Application Range Depends on Different Parameters:

- Material Type
- Wall Thickness
- Insulation Thickness
- Sheeting Type
- Object Temperature
- Object Dimension
- Vibration
- External Interferences
- Sensor Type
RTD-INCOTEST® Application Range

- Base Material Requirements:
  - Carbon Steel (or Low Alloy Carbon Steel)
  - No Material Properties Deviation (Homogeneous)

- Stainless Steel Insulation Sheeting is “Transparent” to Technique

- Wall Thickness Range is 6-65mm

- RTD-INCOTEST Can Inspect Through All Non-Magnetic and Non-Conductive Insulation Types:
  - Polyurethane
  - Ice
  - Foam
  - Concrete
  - Etc…

- Insulation Thickness (Lift Off) Maximum of 200mm
RTD-INCOTEST® Advantages

- In-Service Inspection
- No Surface Preparation
- Saves Time, Costs, and Risk
- Single Measurement: 2 – 10 Seconds
- Multiple Power Sources (Permitting)
- Data Digitally Stored
- Results Reported Daily
- Upwards of 1000 readings/day
- Application Development in Cooperation with Client
RTD-INCOTEST® Limitations

- Carbon Steel (Ferromagnetic)
- Wall thickness 6-65 mm (1/4 – 2.5”)
- Insulation Thickness <200 mm (7.75”)
- Aluminum or Stainless Steel Sheeting
- Temp. -150°C to 500°C (-240° – 930°F)
- Minimum pipe diameter 2” (50mm)
- Accuracy +/- 5% for general thinning – will not quantify localized thinning such as deep pit
- Repeatability 2%
**AWT versus minimum wall thickness**

*General wall loss*

*Irregular wall loss (like corrosion under insulation)*

*Very localised corrosion (like pitting)*
Application range with Standard probes
Detection
- Defect Area at least bigger than 1/3 of sensor footprint size
- Defect volume at least 10% smaller than footprint volume

Footprint with area: $A$
Volume: $V = A \cdot d$
Corrosion with area: $a$
Volume: $v$

$a > \frac{1}{3} \% A$
$v > 10 \% V$
Footprint (activated area)

- Depends on the probe size
- Increase linearly with the lift-off
- From 50mm up to 300mm in diameter
RTD-INCOTEST® Applications

- Composite Wraps (On-stream Monitoring)
- Sphere Legs
- Distillation Columns
- Tower Skirts
- Pressure Vessels
- Insulated Piping
- Heat Exchanger Shells
- Insulated Tanks
- Structural Members (Corrosion Under Fireproofing)
Composite Wrap With Internal Corrosion Radiography vs. RTD-INCOTEST®

- On-stream Monitoring Solutions
  - Digital Radiography
  - INCOTEST (Pulsed Eddy Current)

- Baseline Test Required for both RT & PEC

- Inspection Speed
  - Advantage: Equal

- Operator Dependence
  - Advantage: Equal

- Licensing Requirements
  - Advantage: INCOTEST

- Equipment Mobilization to Jobsite
  - Advantage: INCOTEST

- Safe Zone Area Requirements
  - Advantage: INCOTEST

- Inspection Results
  - AWL vs. Profile Shots

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Object Type
- 8” x 0.322” CS Pipe

Sheeting Type
- Epoxy Composite Wrap

Insulation Thickness
- 0.5” Approximately

Object Temperature
- Ambient

Applied Probes
- PO.25 (Footprint)
**Oxy Sample Pipe A - Blind Assessment**

- Three Holes Detected:
  - Left # Area - 1” Diameter
  - Center # Area - 1.5” Diameter
  - Right # Area – 2” Diameter
### Oxy Sample Pipe A - Largest Defect (Blind Assessment)

**Average Wall Thickness**

Largest Defect

Measurements in Average Wall Thickness

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**Defect Wall Thickness**

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**Colors legend in %**

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- 60-64
- 65-69
- 70-74
- 75-79
- 80-84
- 85-89
- 90-94
- 95-99
- 100-104
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Oxy Pipe Sample Demonstration
RTD-INCOTEST®

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#### Incremental steps at H4
- 4.25: 18
- 4.5: 17, 19, 16
- 4.75: 15, 16, 17, 17

#### Colors legend in %
- 45-49
- 50-54
- 55-59
- 60-64
- 65-69
- 70-74
- 75-79
- 80-84
- 85-89
- 90-94
- 95-99
- 100-104
- >104
Through Wall Defect Assessments

RTD-INCOTEST®

8 Though Wall Holes Machined into Pipe:

- Smallest – 1” in Diameter
- Largest – 8” in Diameter
Corrosion on the OD allows System to Detect Difference in Lift-off

- As Lift-off Increases, Field Generated in Pipe Wall Decreases
- Lift-off will not vary if Corrosion is on the ID

*Figure 2.36*: ideal coil (orange colour) surrounded by its magnetic field (green colour).

*Figure 2.37*: eddy current (yellow colour) generated within the conductive material (gray colour).
Through Wall Defect Assessments

Reference Point

Center of 5” Hole
Through Wall Defect Assessments

RTD-INCOTEST®

Through Wall Defect Assessments

Average Wall Loss Display

Lift-Off Display
Criteria for Either Detection of Wall Thickness or Wall Loss Will Vary with Change in:

- Pipe Diameter
- Variable Shape of Corrosion Cell

The Ability to Precisely Size a Through-Wall Hole was not Conclusive

- Too Many Variables
- Self Induction of Probe Coil May Give Indication of Low Amplitude Signal

Repeatability of Test was within +/- 2% Threshold

- Baseline Data
- Allows System Operator the Ability to Monitor Corrosion Growth with High Confidence
Use within OOG for Monitoring of Composite Wrapped Piping

- Based on initial tests and evaluation of INCOTEST & Shell PEC…
  - Can use to monitor progressing internal corrosion when baseline inspection at time of composite wrap installation
  - General thinning and localized thinning
  - Inspection results will be qualitative
  - Not able to verify through wall defects under composite repair with certainty, but can identify suspect areas that can support risk assessment for continued operation and mitigation plans
- Not effective for localized pitting

- Baseline inspection should be as detailed as practical. Corrosion mapping with AUT is preferred over UT grid, but not required. Use what is available within response window.

- This technique is a good option when RT is not feasible, typically with large diameter piping (12” and greater) or where operational/safety constraints won’t allow use of radiography

- Not effective with smaller diameter pipe.
Excess Lift-off

Intrados of Short Radius Elbows

Obstructions

Electro Magnetic Noise (Potential)
  - Pump Motors
  - Welding Machines

Galvanized Sheeting

Incotest Operator Experience
Questions?
As a Proprietary Non-Intrusive Screening Technology, Applus RTD Trains and Certifies Technicians in Accordance with:

- Applus RTD Written Practice NA-WP-01
- Conforms to SNT TC-1A and/or ISO-9712 Certification

Only Advanced/Multi-Disciplined Technicians are Selected

Training Course Required (80 Hours)

Examination

- Theoretical
- Practical

800 Hours of Field Experience Required for Certification