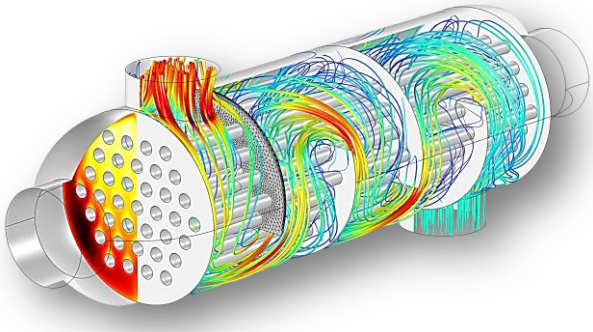
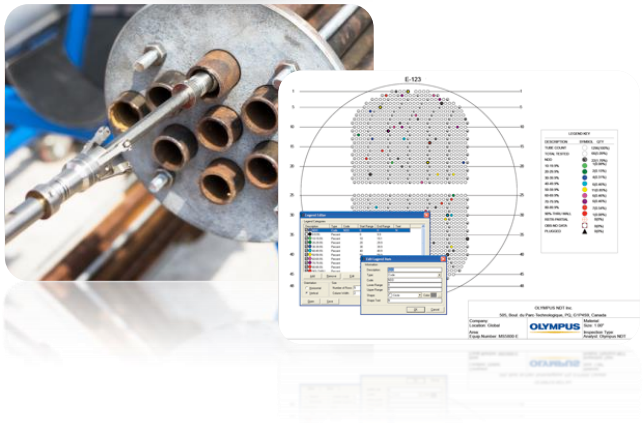
DNT INSPECTION SERVICE CO., LTD.

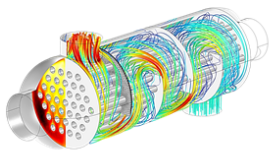
TUBE INSPECTION & EDDY SURFACE





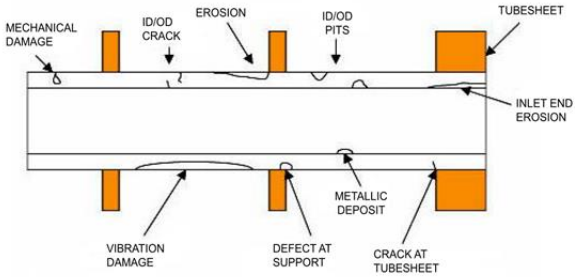
- HX are used to transfer heat from one medium to another medium
- Widely used in industries
- HX are designed to maximize the surface area of contact between the wall of the two mediums and minimizing the resistance to fluid flow.
- Performance of HX can also be increased by adding fins or support plates.

❖ Shell and Tube Heat Exchanger

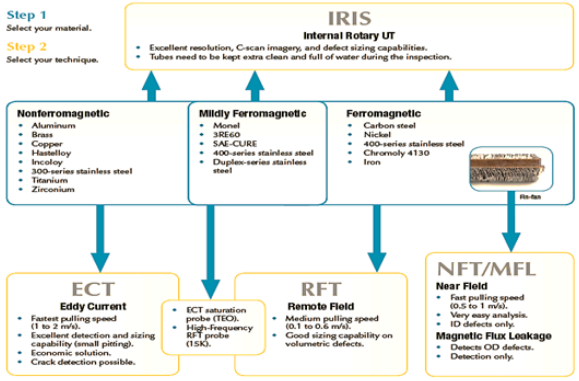


- Most Common type used in Oil and Gas industry.
- Consist of Shell and a number of tubes
- Can be horizontal or Vertical type
- May consist of several tube plates or baffles
- Can either be straight tubes with or U tubes
- May have external or internal fins

TYPICAL TUBE DEFECT



METHOD FOR SUPPORT



❖ Suitability According to Material

Material/Tech		ECT	ECA	IRIS	RFT	NFT	MFL	PSEC
Non-ferromagnetic	Tube	🟢	🟢	🟢	🔴	🔴	🔴	🔴
	Finned tube	🟢	🟢	🟢	🔴	🔴	🔴	🔴
Low ferromagnetic	Tube	🔴	🔴	🟢	🟢	🟢	🟢	🟢
	Finned tube	🔴	🔴	🟢	🟢	🟢	🟢	🟢
Ferromagnetic	Tube	🔴	🔴	🟢	🟢	🟢	🟢	🟢
	Integral finned tube	🔴	🔴	🟡	🟢	🟢	🟢	🟢
	Aluminum finned tube	🔴	🔴	🟢	🔴	🟢	🟢	🟢

❖ Detection Capabilities According to Defect Type

Defect/Tech	ECT	ECA	IRIS	RFT	NFT	MFL	PSEC
ID pitting	🟢	🟢	🟢	🟡	🟡	🟢	🟢
OD pitting	🟢	🟢	🟢	🟡	🔴	🟡	🟡
Axial cracking	🟡	🟢	🔴	🟡	🟡	🔴	🟡
Circumferential cracking	🟡	🟢	🔴	🔴	🔴	🟡	🟡
ID corrosion	🟢	🟢	🟢	🟢	🟢	🟢	🟢
OD corrosion	🟢	🟢	🟢	🟢	🔴	🟡	🟡
At tubesheet	🟡	🟢	🟢	🟡	🔴	🟡	🟡

🟢 Excellent 🟡 Acceptable, but limited 🔴 Not suitable

❖ Sizing Capabilities According to Defect Type

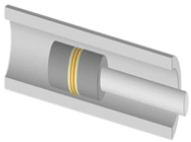
Defect/Tech	ECT	ECA	IRIS	RFT	NFT	MFL	PSEC
ID pitting	🟡	🟢	🟢	🟡	🔴	🔴	🔴
OD pitting	🟢	🟢	🟢	🟡	🔴	🔴	🔴
Axial cracking	🟡	🟢	🔴	🔴	🔴	🔴	🔴
Circumferential cracking	🔴	🟢	🔴	🔴	🔴	🔴	🔴
ID corrosion	🟡	🟢	🟢	🟢	🔴	🔴	🔴
OD corrosion	🟢	🟢	🟢	🟢	🔴	🔴	🔴
At tubesheet	🟡	🟡	🟢	🔴	🔴	🔴	🔴

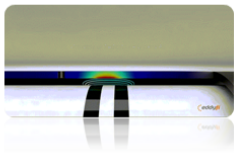
🟢 Excellent 🟡 Good 🔴 Not suitable

THEORY

❖ The Eddy Current technique

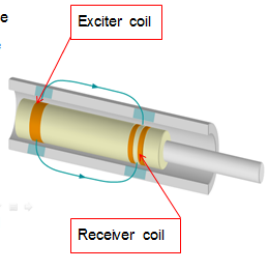
- Internal axial probe with coils are introduce inside tube.
- Two coils are excited with an electrical current, producing a magnetic field around them.
- The magnetic fields expand to materials and generate opposing alternating currents in the material. These currents are called eddy currents.
- Defects change the eddy current flow and also change the impedance of the coils in the probe.
- The impedance of the coils change are used to detect defects in the tube.





❖ RFT General Concept

- RFT is a through-wall transmission technique where the magnetic field travels through the tube wall twice; once at the exciter location and once at the receiver location.
- Any defect located at the exciter and/or receiver location will have an effect on the magnetic field sensed by the receiver coils.
- The receiver-coil measurements correspond to the total material thickness that the magnetic field has gone through.

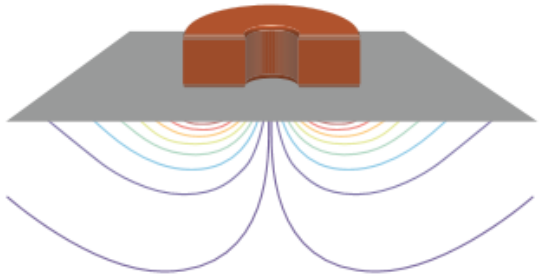


❖ IRIS General Concept

- A transducer located inside a turbine generates an ultrasonic pulse along the axis of the tube.
- The ultrasound is reflected on a 45° mirror and oriented toward the tube wall
- The ultrasound is partially reflected by the tube ID, then transmitted through the wall, and finally reflected by the tube OD.
- The ultrasonic velocity of the tube material allows the wall thickness to be calculated by using the time-of-flight difference between the OD and ID echoes.

EDDY SURFACE

Demystifying the Technology

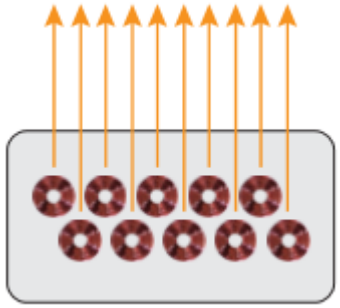


Eddy current technologies take advantage of a physical phenomenon referred to as electromagnetic induction, where an alternating current flowing through a wire coil — generally copper — generates an oscillating magnetic field. When this magnetic field nears another electrically conductive material, a circular flow of electrons appears in the material, which is known as an eddy current. An eddy current generates, in turn, a magnetic field that interacts with the coil and its magnetic field. Defects such as cracks in the electrically conductive materials disrupt the flow of eddy current and its magnetic field, modifying the electrical impedance of the coil, which make it possible to identify and characterize the defects.

Eddy Current Testing

Usually referred to as ECT, this is the best method for inspecting non-ferrous components, such as stainless-steel welds, for defects. ECT makes it possible to reliably detect corrosion and surface cracking, for example. Such defects cause variations in the phase and magnitude of the eddy current generated by a transmitter coil, which are monitored by a receiver coil or by measuring the variations in the current flowing through the transmitter. This is the core of standard, single-element ECT.

Eddy Current Array



Eddy current array (ECA) probes use several individual coils, grouped together in one probe. The coils are excited sequentially to eliminate interference from mutual inductance (a process referred to as channel multiplexing; see below). To optimize performance, ECA probes can be flexible or shaped to match the specific geometry of the part to inspect for simplified, one-pass inspections. Data from ECA probes can be encoded and it is transmitted directly to software for graphical display (C-scan), record keeping, and reporting.

ECA probes can replace a number of traditional NDT inspection methods like magnetic particle testing (MT), liquid penetrant testing (PT), and single-element ECT (above) through shorter inspection times, better flaw detection, and complete inspection records.