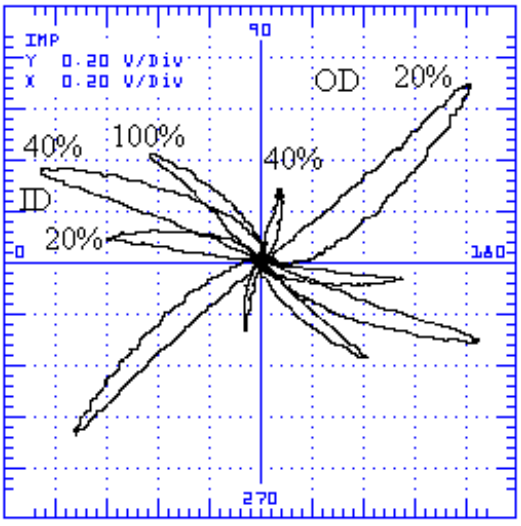
How Accurate Is
Percent Of Wall Loss Eddy Current Testing
And Why Does T.E.C.C.I.S. Report In Divisions?

Percent of wall loss testing can be very deceiving if not fully understood by all parties involved in the eddy current test. Not given all of the facts, someone could assume, <20% means that a defect is < 20% through the tube wall. Actually < 20% means the defect is < 20% through the tube wall as compared to a calibration standard. These percentages have many variables. Eddy Current Companies report percent of tube wall using a calibration standard containing any number of flat bottom holes and notches at varying depths. The depth of discontinuities is primarily shown by the phase angel of the eddy current signals they produce. *Illustration 1* depicts a .035" wall finned copper tube calibration standard with 20% and 40 % ID notches, a 100% through wall hole, a 40% flat bottom OD hole and 20% OD notch.

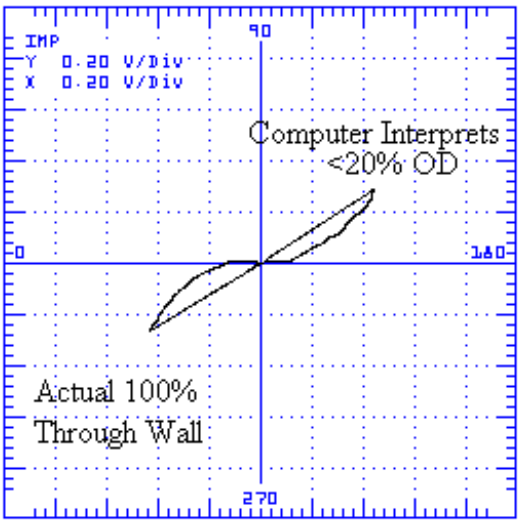
Illustration 1 Calibration Standard



Calibration Standard: Defect reference signals used to establish a calibration curve for computer interpretation.

Illustration 2 depicts a defect signal in a .035" wall finned copper tube. This defect signal was interpreted, by computer software, as being < 20% of the tube wall originating on the tubes OD. The defect depicted in illustration 2 is actually 100% through wall.

Illustration 2 Defect Signal



Computer uses calibration curve established in illustration 1 and interprets defect signal as < 20% OD. Actual defect is 100% through wall.

The reason the percent of wall loss method failed is because the actual shape of the defect is not similar to the shape of the calibration standard discontinuities. The shape of calibration standard discontinuities as compared to actual defects is critical for accurate percent of wall loss reporting. Another factor affecting percent of wall loss testing is the tubes wall thickness. Many tubes used in today's air conditioners have a .028" wall That's .028" $\pm$ .003". The $\pm$ .003" can allow for up to a 20% variance in the tube wall. This wall variance does not take into consideration tube finning or internal rifling. A major problem in air conditioner tubing is ID Pitting. ID Pits are not normally flat bottom in shape and can be elongated in the direction of water flow. In addition ID Pits may be under iron oxide deposits. It should be remembered anything that affects continuity will affect defect signal response, thus affecting percent of wall loss interpretation. Percent of wall loss is normally done in accordance with ASME Section V Article 8. T.E.C.C.I.S. normally reports loss of mass in air conditioner tubing based on amplitude as compared to a calibration standard. We are often asked, what is a division? The impedance plane is divided into squares; we call each square a division. Each division is divided into fifths. For 1" OD or less tubing, the test instrument gain and phasing are set so that a .093" diameter through wall hole will display 4/5 of 1 division amplitude deflection. This is done at a frequency were a less than 20% through wall OD discontinuity is phased at 270º and there is a ID to OD phase lag of 45º. *Illustration 3*

Not given all of the facts, someone could assume that 2/5 division loss means that 3/5 of the tube wall remains. Actually 2/5 division loss means that the tube wall has lost enough mass to deflect the eddy current test signal 2/5 of 1 division amplitude.

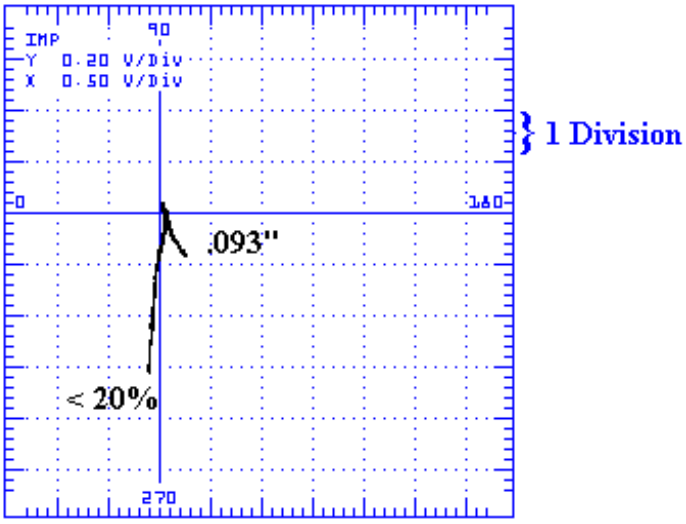


Illustration 3

As can be seen in these examples, 2/5 of a division is always 2/5 of a division. Reporting in divisions eliminates the need to explain to chiller owners why < 20% is 100% through wall.

Our eddy current test has been designed to detect defects normally encountered in industrial air conditioning. Some of the common types of defects noted are ID and OD pitting, corrosion, erosion, support wear, bulges, longitudinal and radial cracks. Our recommendations are based on defect type, any wear patterns in a bundle and how progressive any wear patterns or defects may be. T.E.C.C.I.S. reports loss of mass in amplitude in accordance with ASTM E 690. If you have any questions concerning eddy current testing amplitude analysis or our other test methods please feel free to call us.