



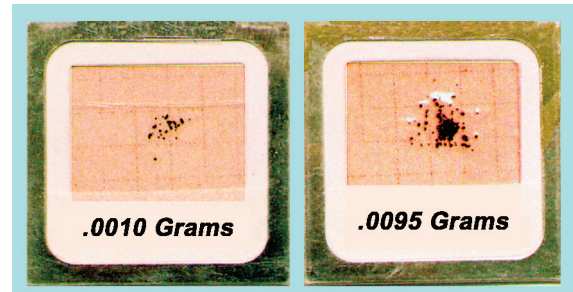
Detecting Ferrous Inclusions in Nonferrous Tube

MultiMac® Eddy Current Equipment



Ferrous inclusions in nonferrous tube

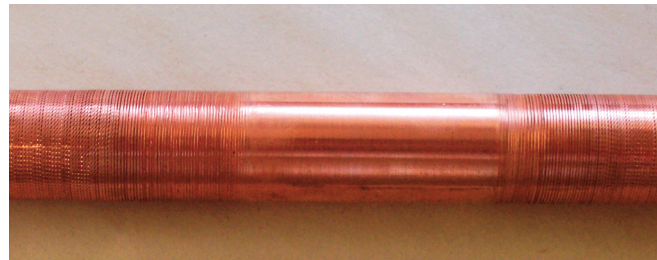
To detect ferrous inclusions such as metal filings from finning tools that are introduced into a tubular product during processing, the Magnetic Analysis Corporation MultiMac® instrumentation is particularly effective. A stable DC magnetic field is established using a saturation coil platform. The test coil detects changes in the flux field caused by the ferrous inclusion.



.0010 gram size filings at left. .0095 gram size filings at right. Both are typical of ferrous inclusions from finning operations. Inclusions as small as .0084 grams have been detected in copper tube and .00035 grams in titanium.

Finned Tube Without Transitional (land) Zones

Experience in testing titanium tubes without transitional land zones shows that inclusions as small as .00035 grams can be detected at production line speeds using the MultiMac at a range from 1 foot per minute up to several thousand.



Finned Copper Tube with Transitional Land Zone in the center

Finned Tube with Transitional (land) Zones

For finned copper tubing with transitional “land” zones, (the area on the tube where there are no fins to allow the tube to rest on tube supports when installed in a heat exchanger or similar application) the signal for the inclusion is usually greater than the signals from the beginning and end of the transitional land zones, thereby permitting detection of the inclusion.

However, as the throughput speed of the test increases, the signals from the transitional land zones increase at a faster rate than the signals generated by ferrous inclusions, making it difficult to detect the inclusion.



Ferrous filings are embedded in paraffin wax, shown above at left, then inserted in a hollowed out cork to create a calibration standard that can be inserted in the tube to be tested.

Experience in mill applications has shown that keeping the maximum throughput speed in the range of 250 to 300 fpm allows the inclusions to be detected. Above these speeds, detection is not reliable.

Calibration Standards

Ferrous filings are so small, it is difficult to create a calibration standard. This problem can be solved by embedding a sample of the ferrous filings you wish to detect in a small amount of paraffin wax, then inserting this into a hollowed out cork.