

Eddy Current Testing of Wires < 2 mm Ø with CIRCOGRAPH

The FOERSTER CIRCOGRAPH Rotating Head Ro 20 covers a diameter range from 2 to 20 mm in its standard configuration.

A mutual influence of the sensors mounted in the vis à vis position increases the noise when closing the test heads to the test position for wires less than 2 mm in diameter.

1. Design Aspects

Mechanically the test heads can be set to a minimum test position for a 1 mm wire.

A change of the test head design minimises the mutual influence and then allows the test of wire diameters smaller than 2 mm down to approximately 1.0 mm.

The smallest sensors from FOERSTER were used and mounted in the test heads in a displaced position as far as the geometry allows it.

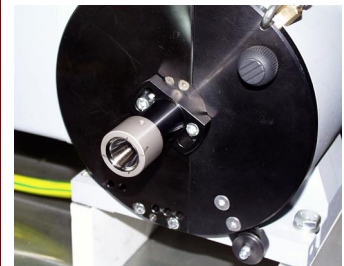
The use of the precision guide is recommended to provide an optimum guidance for such thin wires. Drawing cores (dies) with corresponding diameters have to be used as inserts of the precision guide.

2. Trials

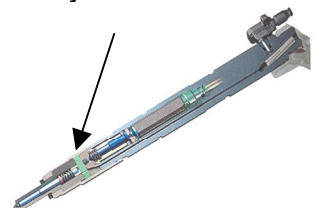
Trials are made with only one active test head and in comparison with two active test heads to investigate how the mutual influence could be reduced by the design alteration.

3. Wires

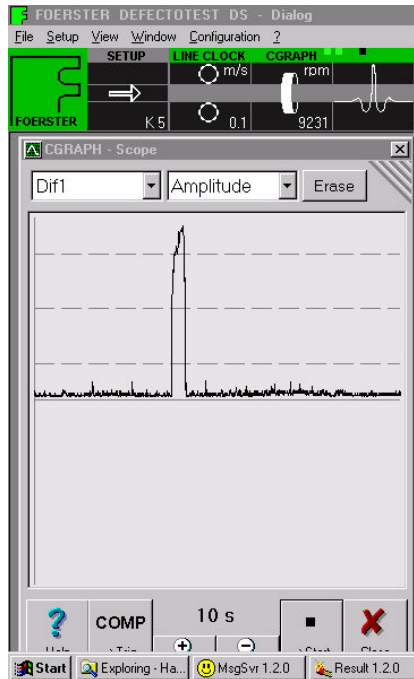
- Ferrous oil tempered spring wire type OT, 1.05 mm, 1.3 mm and 1.5 mm Ø
- Stainless spring wire type GARBA 177, 1.7 mm Ø



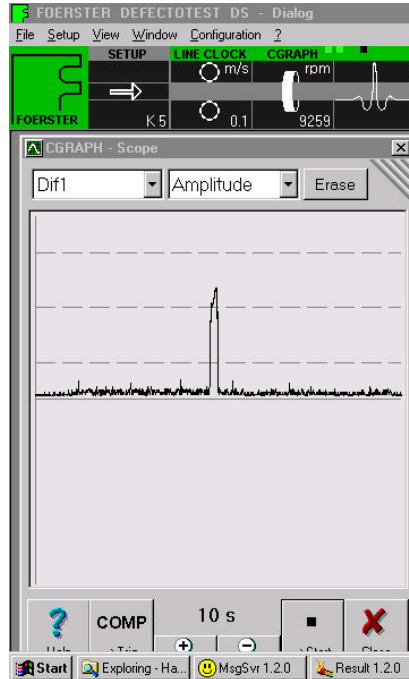
Austenitic springs for fuel injection



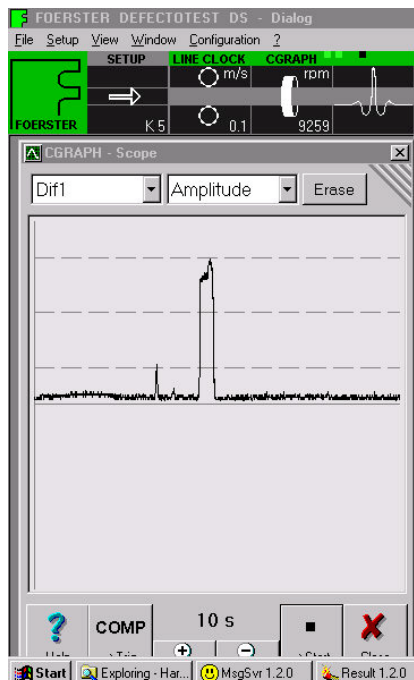
4. Test Results for Ferrous OT Wire



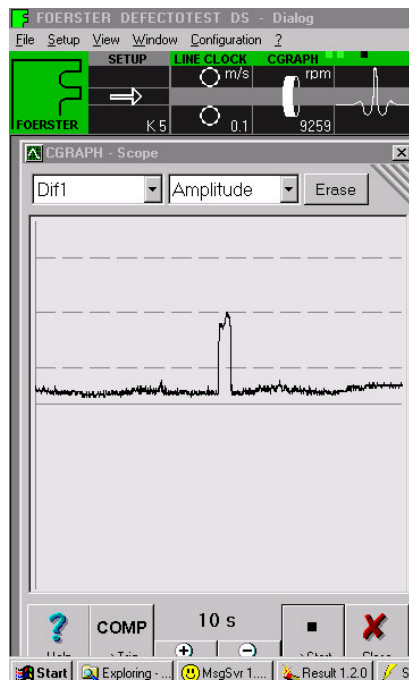
1 Test head
S/N \approx 16 (24.5 dB)



2 Test heads
S/N \approx 10 (20.0 dB)



1 Test head
S/N \approx 13 (22.0 dB)



2 Test heads
S/N \approx 7 (17.0 dB)

CIRCOGRAPH DS + Ro 20

Artificial longitudinal crack

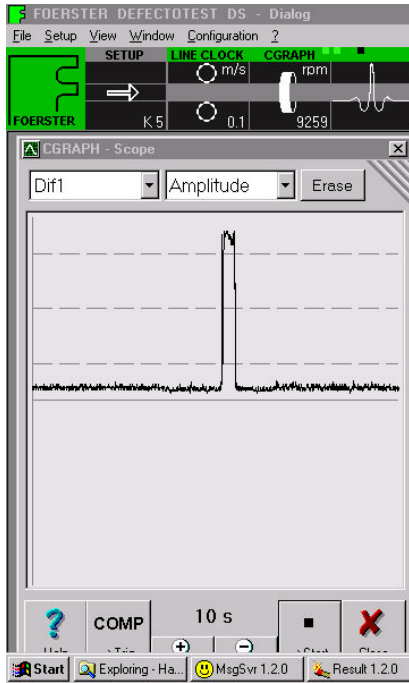
**70 μ m deep,
0.1 mm wide
10 mm long**

OT Wire \varnothing 1.05 mm

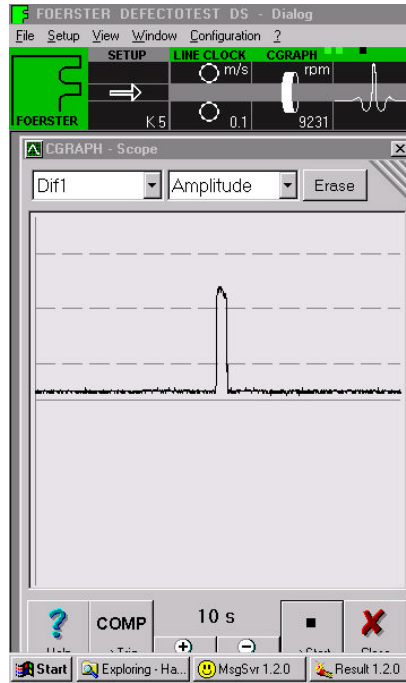
**Sensitivity reduction
approx. 7.5 dB when using
2 test heads**

OT Wire \varnothing 1.3 mm

**Sensitivity reduction
approx. 7 dB when using 2
test heads**



1 Test head
S/N \approx 13 (22.0 dB)



2 Test heads
S/N \approx 10 (20.0 dB)

Summary:

When using two test heads the absolute sensitivity is reduced depending on the wire diameter.
The Signal/Noise – Ratio decreases a little bit as well, but is still very good with approx. 10:1 !

CIRCOGRAPH DS + Ro 20

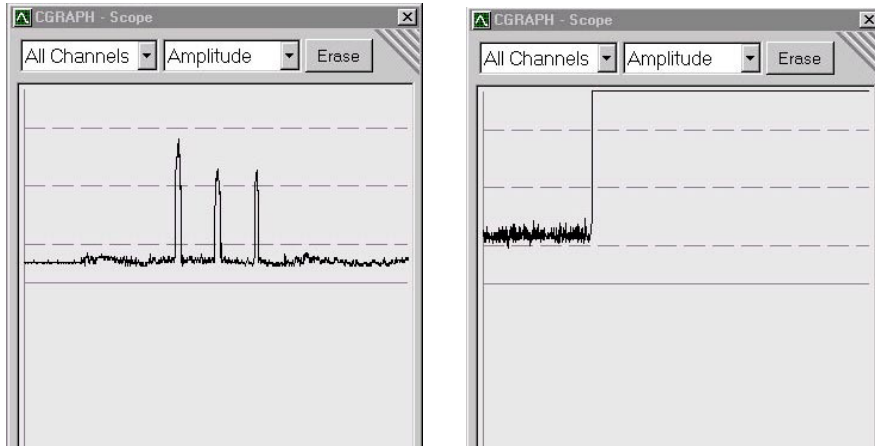
Artificial longitudinal crack

70 μ m deep,
0.1 mm wide
10 mm long

OT Wire \varnothing 1.50 mm

Sensitivity reduction
approx. 3.5 dB when using
2 test heads

5. Test Results for Stainless Wire



GARBA Wire \varnothing 1.70mm

Left:
3 Artificial longitudinal cracks
0.1 mm wide
5 mm long
approx. 100 μ m deep

right:
High amplitude of Natural Tension Crack

CIRCOGRAPH DS + Ro 20
2 Test heads, displaced

Summary:

The test of stainless non magnetic wire less than 2 mm is also possible by this test head arrangement. Above screenshots show pretty well the good achievable S/N ratios for artificial cracks and for a natural tension crack.

6. Résumé

FOERSTER is able to provide a CIRCOGRAPH system for diameters less than 2 mm, starting with 1 mm.

Special test heads are necessary to minimise the mutual influence of the 2 sensors.

Sensors with small track width (0.8 mm) are used and frequency is optimised to 3 MHz.

A testing speed of 0.3 m/s results by calculational assumptions of a scanning track of 0.8 mm per revolution according to the track width of one probe and a maximum rotational speed of 18 000 rpm.

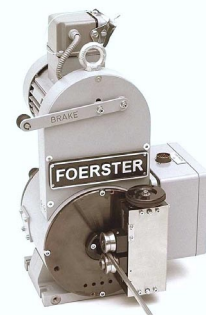
This is a theoretical value for a real gapless test with CIRCOGRAPH. But please have in mind that the big advantage of CIRCOGRAPH is the detection of longitudinal cracks. Therefore if e.g. a minimum reproducible defect length of 2.4 mm is accepted, a test speed of approx. 1 m/s can be achieved. Short and transverse defects are the domain of encircling coils with DEFECTOMAT.

In summary this leads to our suggestion to use a combination of CIRCOGRAPH + Ro 20 and DEFECTOMAT + encircling coil simultaneously as it is usual for the larger valve spring wires.

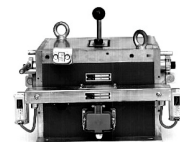
When testing ferrous wire a DC magnetisation is necessary for the DEFECTOMAT by using P 12 (permanent yoke) and for high tensile strength wire by using M 40 (electromagnetic yoke with variable and higher DC field).



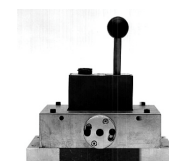
Special test head set:
6.460.51-2008 V
6.460.51-2008 H



Ro 20



M 40



P 12