

Eddy Current Testing of Valve Spring Wire

For years Eddy Current Testing of round valve spring wire has been a standard at the leading manufacturers all over the world by using a combination of CIRCOGRAPH (rotating sensors) and DEFECTOMAT (encircling through type coil).

Today **CIRCOGRAPH DS** including a **DEFECTOMAT** channel in combination with the sensor systems **Ro 20** and **M 40** or **P 12** is the state-of-the-art equipment.

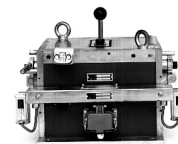


1. Testing of round wires:

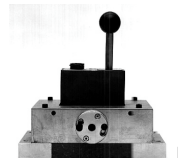
By the rotating sensors longitudinal cracks with a depth $\geq 40 \mu\text{m}$ can be detected in case of round wires. Some of our customers claim to be better, down to $30 \mu\text{m}$ or even more. This cannot be guaranteed by FOERSTER, because other factors as smooth guiding and surface quality etc. influence the detectability as well.



Ro 20

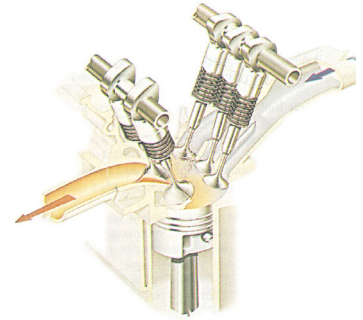
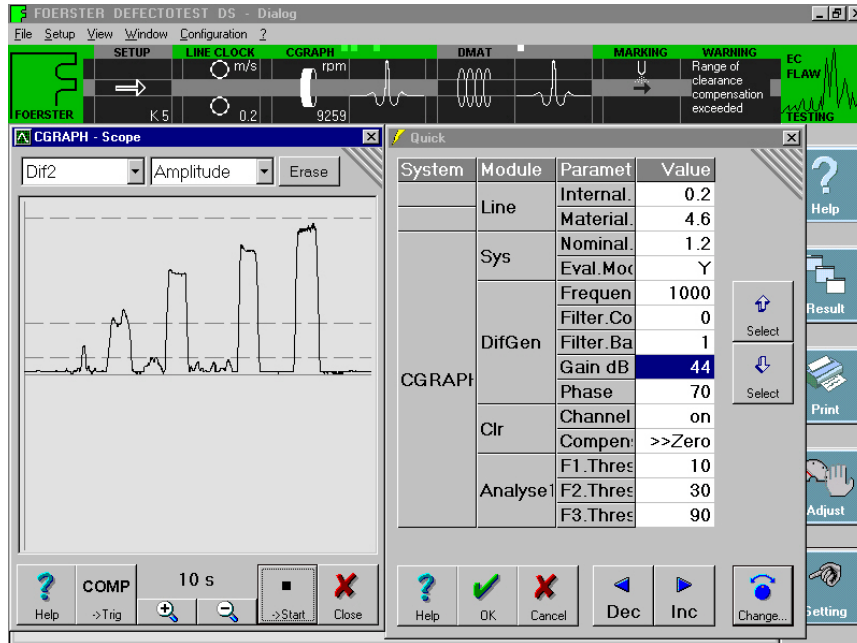


M 40



P 12

The Example below shows that artificial longitudinal defects with a depth of 40 µm /60 µm /120 µm /160 µm are detectable with a very good S/N ratio.



The encircling coils detect short and transverse defects. Whether M 40 or P 12 is adequate depends on the material's grade and hardness. DC magnetisation is very important for a good S/N ratio.

2. Testing of non round wires for longitudinal defects

For some years wire with non round cross section have been manufactured. They are either ovate, lemon shaped or egg shaped and they improve spring behaviour and save weight.

Of course high testing quality is also required for non round wire. FOERSTER developed algorithms for the CIRCOGRAPH with rotating sensors with the following specifications:

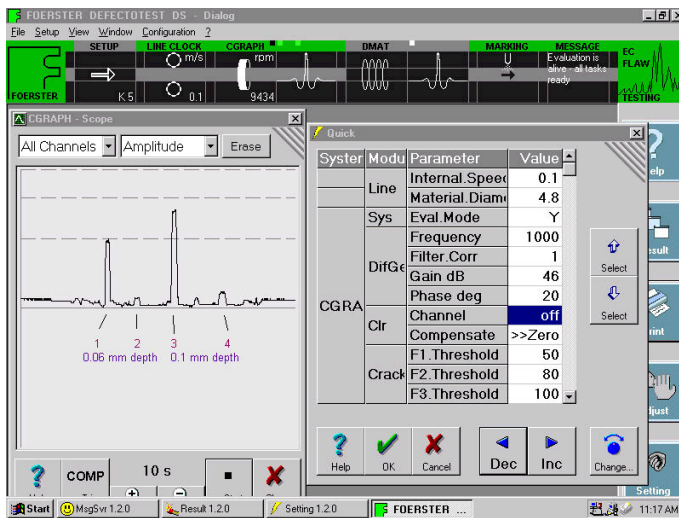
- Non round wires can be tested by the Rotating Head Ro 20 if the maximum diameter is not larger than 1 mm as the minimum diameter.
- Special test heads 6.450.01-2901 with 5 mm track width have to be used together with the electronic clearance compensation. They are able to provide same sensitivity over the whole circumference.
- The rotational speed is limited to 12 000 rpm.

Results:

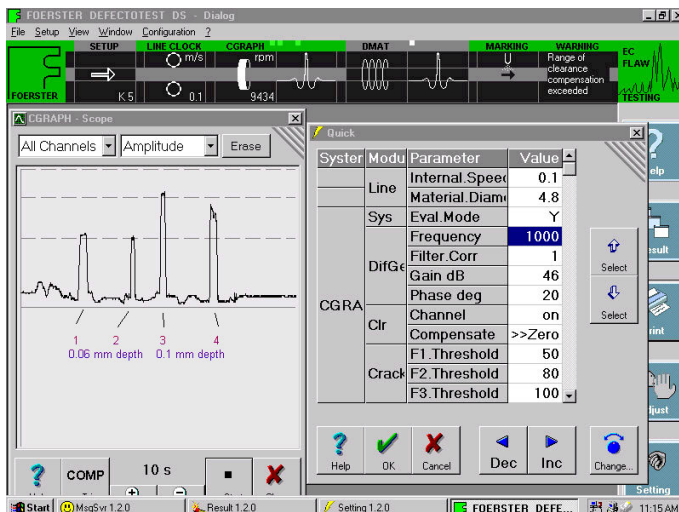
Longitudinal cracks with a depth $\geq 70 \mu\text{m}$ can be detected in case of non round wire within the a.m. limitations of the cross section.

The example below shows the detectability for artificial longitudinal cracks with a depth of even $60 \mu\text{m}$ and $100 \mu\text{m}$ at the minimum and maximum diameter

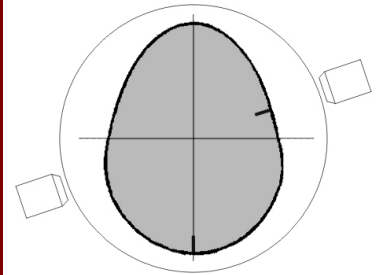
Without clearance compensation for non round wire



With clearance compensation for non round wire



Furthermore the use of drawing dies profiled as the wire is necessary as nozzles for the Rotating Head. An exact shape oriented feeding of the wire into the Rotating head is then also required.



Y evaluation is recommended to suppress signals caused by the shape variation at the top of the cross section

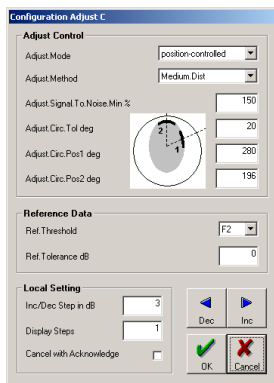


drawing dies used as nozzle inserts



The latest release of the ECT Software V 1.30 for DEFECTOTEST DS 2000 offers an improved and now very easy adjustment procedure for the clearance compensation for ovate wires. Please compare to our **TS product news No 14 from August 2003** describing the adjustment procedure.

A quick impression on the improvement is shown below by a screen shot of the procedure.



Step 1: Configuration of Adjust C:

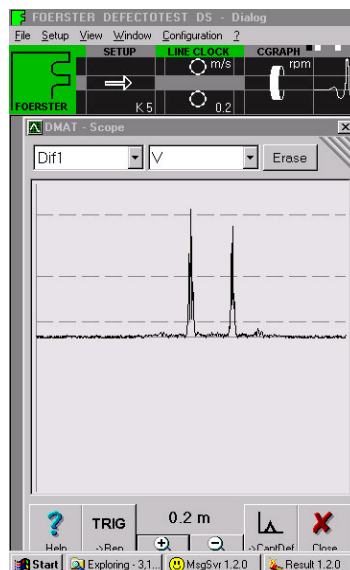
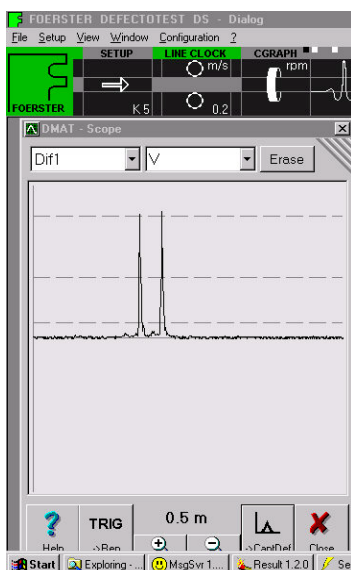
Select position-controlled
In the menu
"Configuration Adjust C"

Step 2: Zero Compensation:
Perform the zero compensation as usual.

3. Testing of non round wires for transverse defects

Besides the requirement to provide a test possibility with CIRCOGRAPH for ovate wires with adequate sensitivity for longitudinal cracks another requirement came up to improve the sensitivity for the DEFECTOMAT test with encircling through type coils by adapting the coil shape to the wire profile.

The following examples show the comparison of test results by applying either shaped or round coils for artificial flat bottom holes with 0.8 mm \emptyset and 0.1 mm depth at the minimum and maximum diameter of the wire.

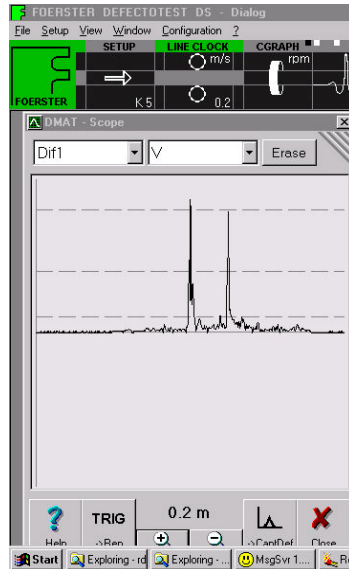
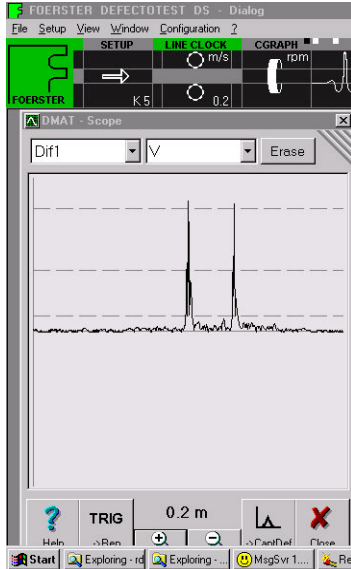


Example:

Ovate wire 3.80 x 4.77 mm

Left:
Ovate coil 4.30 x 5.27 mm

Right:
Round coil 5.2 mm \emptyset



Example:

Ovate wire 3.25 x 3.90 mm

Left:
Ovate coil 3.75 x 4.40mm

Right:
Round coil 4.6 mm Ø

Profiled nozzles and a proper profile oriented feeding of the wire is necessary when using shape adapted coils.

Result:

An absolute sensitivity gain of some dB is achieved when using shape adapted coils.

The most important point is that the sensitivity is equal round the circumference of the wire if the coil profile is consequently adapted to the wire shape.

4. Résumé:

FOERSTER offers now for both Eddy Current Systems CIRCOGRAPH and DEFECTOMAT tools to improve the testing quality for non round valve spring wire. This is another real step for improving product quality.

FOERSTER 's goal is to provide individual assistance to achieve the best customised solution according to our slogan

Test with the Best