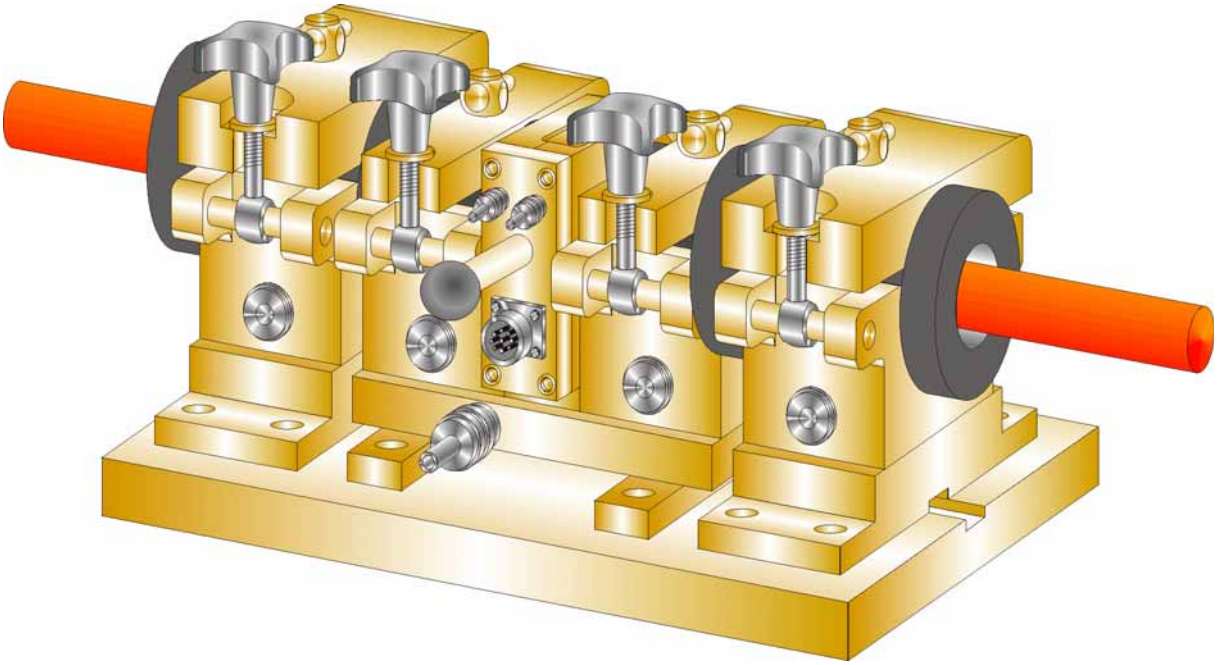
DEFECTOTHERM®

Sensor system T 60 2.863



Sensor system T 60 with guide units

- ✓ Sensor system for hot wire testing up to +1200 °C
- ✓ For wire or rod diameters from around 5 to 60 mm
- ✓ Coil carrier T 60 for water-cooled LMD-Therm coils
- ✓ Online testing directly in the rolling line
- ✓ Designed for maximum production speeds
- ✓ Fast dimension change in the line
- ✓ Fast conversion for line operation “Without testing”
- ✓ Full functionality without sliding table
- ✓ Operator control end can be adapted locally without special tools

Application

The sensor system T 60 has been optimized for testing rolled wire and rods with material temperatures of up to +1200 °C in the production line. The sensor system T 60 operates in accordance with the eddy current method in conformity with EN 12084.

For many years now, non-destructive testing of wire with eddy current during production has been a recognized means of ensuring the quality of the wire and of optimizing the production process.

The eddy current method can also be employed under extreme conditions: material speed up to 150 m/s and wire temperature in excess of 1000 °C – the material temperature of ferromagnetic materials must be safely above the Curie point to rule out disturbances from permeability fluctuations. Modern wire lines produce coils with wire lengths of up to 12 km. This is why analysis and interpretation of the test signals has priority over the localization of individual flaws. The aims of analysis:

- Determining and logging the delivery quality of the individual wire coil and/or of an entire order
- Determining changes and irregularities in the production process to be able to intervene in good time

Signal evaluation is based on a distinction according to signal amplitude, separate counting of signals and depiction of the frequency distribution over the wire length and over several wires for a trend analysis. The test units can be integrated into quality and production data acquisition systems.

Water-cooled eddy current differential coils are used for signal generation. The reliability – signal stability and useful life – of the coil systems is crucially important.

Qualified assistance in the choice of the optimum installation location and in definition of the right coil diameter can be expected from an experienced system supplier. Useful test signals can only be expected if we succeed in adapting the coil system properly to the conditions of the roll mill.

To arrive at optimum test results, the wire must be guided through the test coil centrically and without vibrations. Radial wire movement depends on the choice of test location and on the overall conditions of the rolling line. The coil carrier features entry and exit guide nozzles that are adapted to the diameter of the test coils so as to largely prevent any damage to them.

Therefore, if conditions in the rolling line are good, a guide unit with adapted guide nozzle **before** the coil carrier frequently suffices to arrive at good test results.

Under unfavorable conditions it may be necessary to install a further guide unit **after** the coil carrier or even to work with roller guides instead of the nozzle guide. (Roller guides are generally offered by roll mill manufacturers, e.g. the Morgardshammar company offers suitable roller guides.)

The eddy current differential coil is used in conjunction with DEFECTOMAT® test and evaluation equipment operated in a through-type mode of operation.

The electronic circuitry of the device is designed for testing speeds up to 150 m/s so as to reliably cover all rolling speeds.

Test coils with nominal diameters from 7 to 65 mm are available.

Figure 1: Sensor system T 60, installed in a hot wire line

Structure

Coil carrier

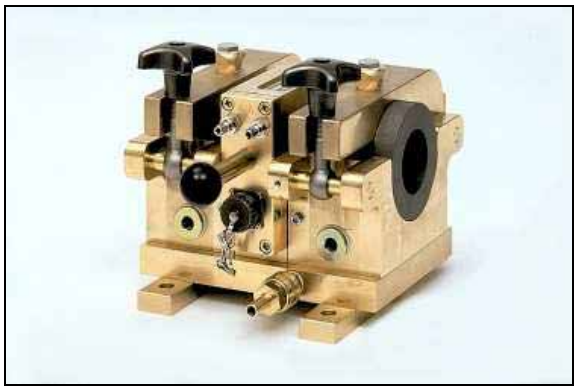


Figure 2: Coil carrier, operating side

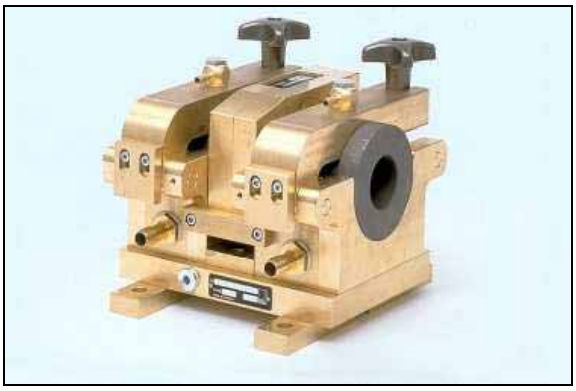


Figure 3: Coil carrier, ports for cooling media

The Coil carrier accommodates the test coil and the nozzles.

The test coil and the nozzles for coil protection are inserted in the coil carrier from above. Without the need for tools, the coil carrier can be retooled within the shortest of times:

- Undo cable and cooling medium ⇔ coil coupling.
- Undo the toggle screw.
- Tilt up the stirrup.
- Remove the nozzles and coil.
- Insert the new coil and nozzles – or NT (Not-Test) guide tube if testing is not to take place.
- Close and lock the stirrup.

The owner generally provides a guide tube with an adapted geometry.

The operating side and the connection ports for the cooling media and the compressed air can be adapted to the respective on-site situation.

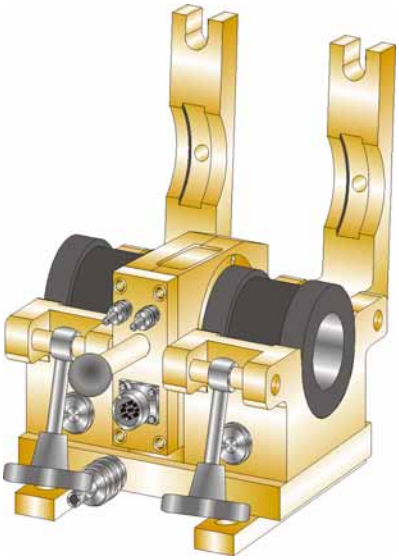


Figure 4: Coil carrier open

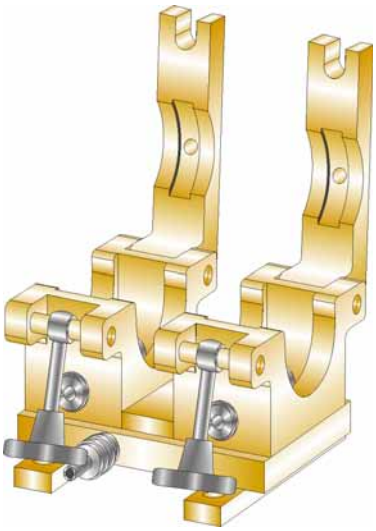


Figure 5: Coil carrier without coil and nozzles

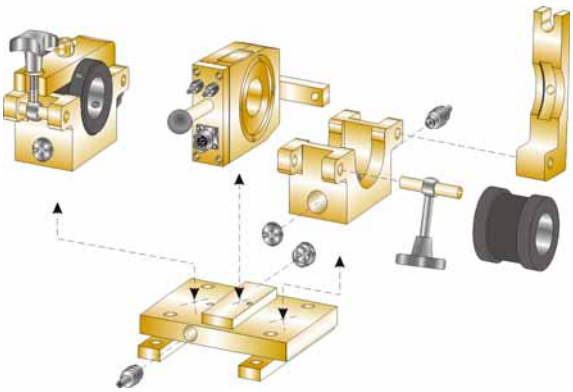


Figure 6: Coil carrier, adapting operating side

Test coils

Figure 7: Test coils size I

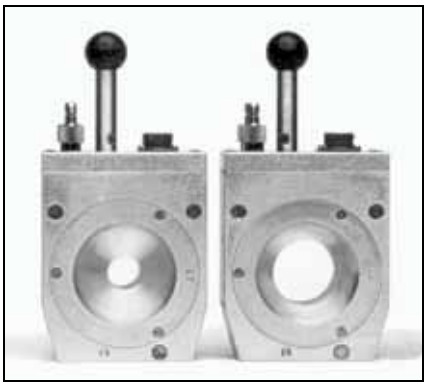


Figure 8: Test coils size II

Hot wire testing is realized with the proven LMD-Therm coils, sizes I + II, selected for the tested material diameter.

I: (7), 8, 9, 10, 11, 12, 13, 15, 17, 20, 23 mm

II: 26, 29, 32, 35, 38, 41, 44, 47, 50, 53, 56, 59, 62, 65 mm

(Please inquire about intermediate dimensions)

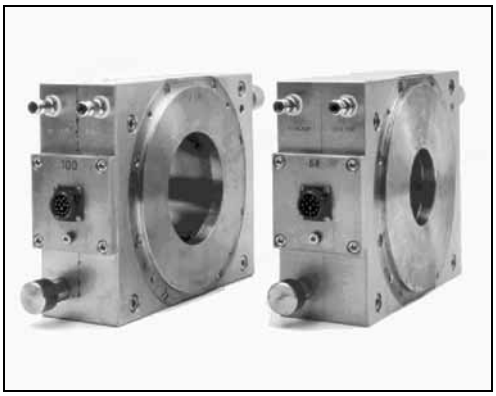


Figure 9: Test coils size III (special application)

Special application:

In some cases, eddy current testing is also used to test hot pipes and rods. A coil holder III for the use of Therm coil sizes III – 65 to 125 mm – and corresponding nozzles are available for this purpose.

The connection sockets for the coil cable and the two plug-in connectors for water cooling are mounted on the coil cover.

LMD-Therm coils can be repaired by the customer. Service instructions are provided for this purpose.

Therm coils in the size I series are inserted in the coil carrier T 60 with the “Therm coils size I coil adapter”.

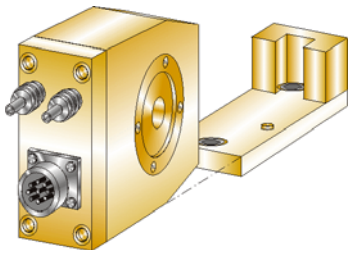


Figure 11: Coil adapter Therm coil size I, see Figure 10 for details of installation

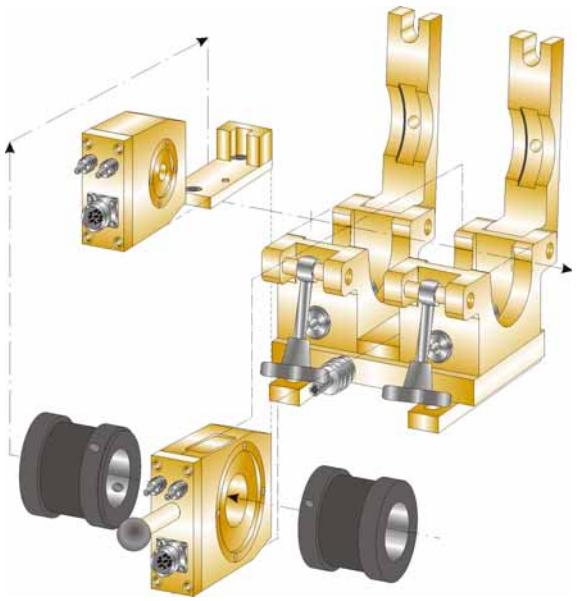


Figure 10: Nozzle-coil centring adapter

Entry and exit nozzles

The diameters of the surface-hardened entry and exit nozzles are adapted to the test coils.

Standard recommendation: Ø entry and exit nozzle 1 mm less than the Therm coil.

By means of centering adapters, nozzles and the test coil are centered in the coil carrier and they are fixed in position by hinged stirrups.

Compressed air for the removal of deposits can be blown into the entry nozzle through three radially entering holes offset at 120°. As air is always fed to at least one radial hole, the nozzles can be rotated to prolong the operating time if wear has occurred owing to contact with the wire.

The compressed air supply is located on the operation end of the coil holder. It can optionally be displaced on the opposite side.

Entry nozzles are not suitable for catching the wire coming from the rolling line. This is why either a guide unit or a special, extended entry nozzle with a large funnel must be used before the entry nozzle.

Nozzle selection recommendation: same nominal diameter for the entry and exit, but 1mm less than the nominal dimension of the Therm coil.

Same nominal dimension for guide nozzles and the Therm coil.

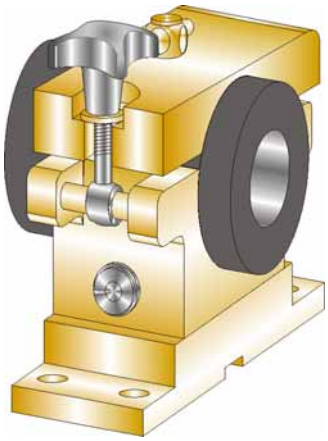


Figure 12: Guide unit with guide nozzle

Guide unit

In the T 60 test system, centricity can be improved and vibration of the test material can be reduced by means of additional, identical guide units before and if necessary after the coil carrier.

Guide nozzles

The guide nozzles with one-sided funnels are harmonized to the entry nozzles. The mount for the guide nozzles (guide unit) is basically similar to the coil carrier, but air port is not necessary.

The nozzles are inserted in the mount from above and are fixed in place with a stirrup.

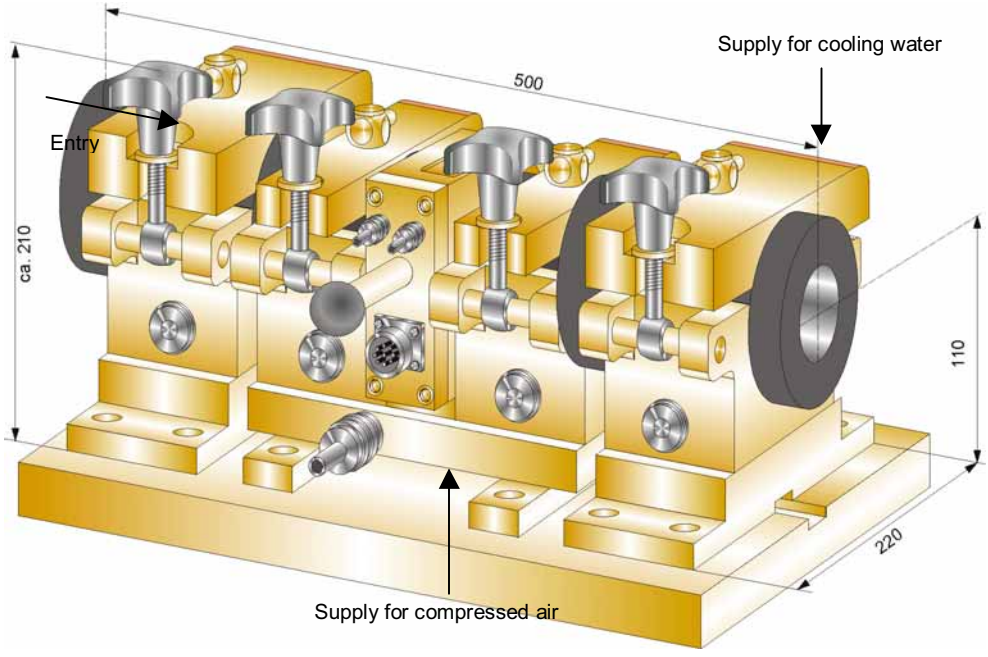


Figure 13: Coil carrier with two optional nozzle guide units, optional mounting plate

Alternative guides

Roller guide

As already mentioned, under unfavorable conditions there may be a need to use roller guides instead of nozzle guide units because these enable optimum wire guidance and largely avoid surface damage. As roller guides depend directly on the rolled products, on the rolling line and on the operating and maintenance personnel, however, it is advisable to plan these in direct coordination with the respective roll mill outfitter; for example, a modified version of the SR series from Morgardshammar is shown.

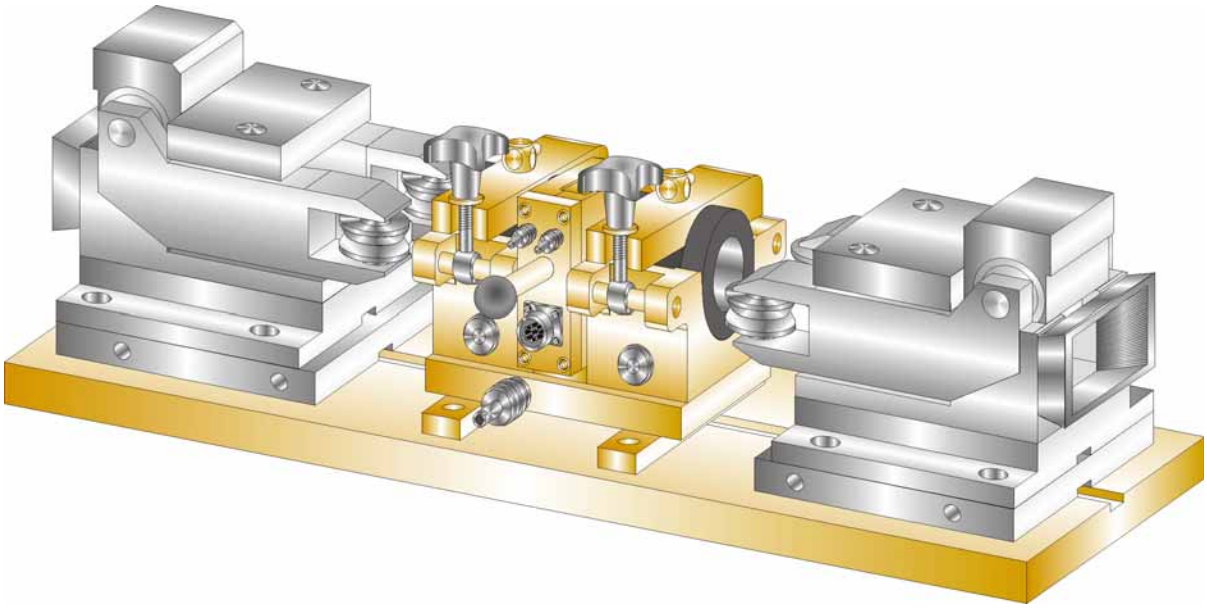


Figure 14: Coil carrier with roller guide, planned by the roll mill outfitter

NT guide tubes (No-Test)

In the event that testing is not to take place in the roll mill, NT guide tubes are available for bridging the coil carrier without the coil and one or two guide units (substitute for a sliding table).

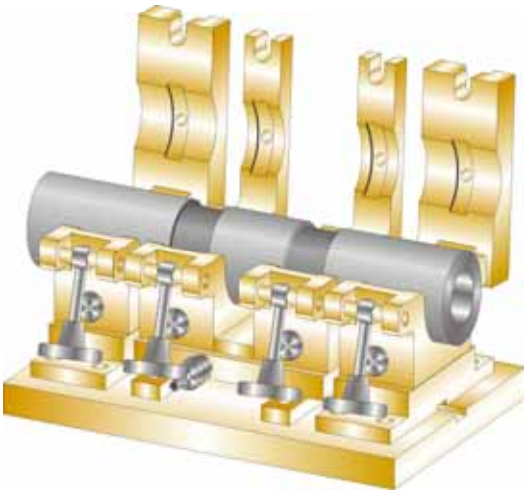


Figure 15: NT guide tube in the coil carrier with two guide units

Coil dummy

The minimum possible nominal dimension for a wire with specified diameter can be determined with a coil dummy that has the nominal dimension of the coil and which is inserted in the coil carrier.

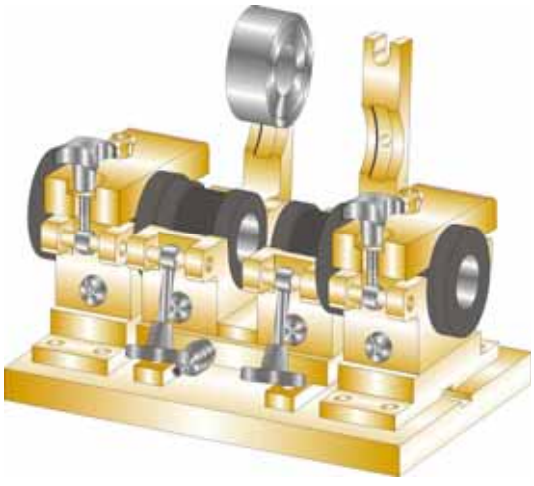


Figure 16: NT coil dummy in the coil carrier

Cooling water accessories

To avoid thermal damage on the sensor system during hot wire testing, the test coil and the nozzles are cooled with water.

With the aid of plug-in hoses, the coil, the coil carrier, and, if applicable, the guide unit(s) are joined together in a cooling system.

It is imperative to use purified industrial water as the cooling water. The system must not be deactivated automatically in the event of an average. It is also urgently advisable to provide a cleaning filter on the entry side of the coil cooling water circuit and a flow monitor on the exit side.

The optionally available cooling water accessories include the cleaning filter, the flow monitor, a distributor and shut-off unit and hoses.

Thus, an adapted coolant installation can be set up on site.

If cooling water accessories and installation are realized on-site, attention must be paid to ensuring that the cooling water quantity and the pressure in the cooling system do not exceed the specified values.

To reduce material deposits such as scale in the test coil, compressed air can be introduced into the entry nozzle via a compressed air port on the coil carrier.

During pauses in testing (wire gaps), a previously connected valve (to be provided by the customer) can be used to shut off the air.

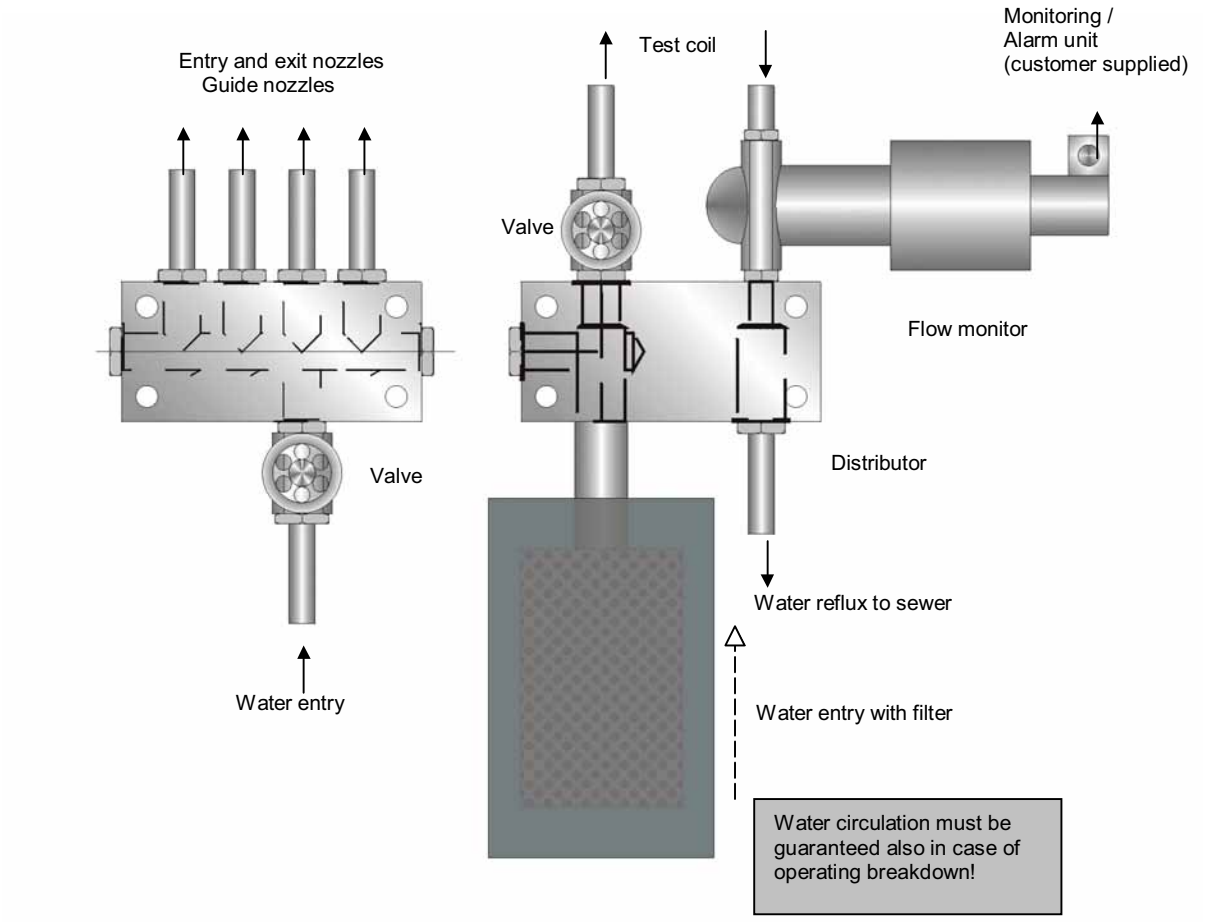


Figure 17: Cooling water accessories

Test piece sensor

Controlled by an infrared test piece sensor fitted before the sensor system T 60, the dynamic signal lock of the electronic testing unit suppresses the start and end signals.

The infrared test piece sensor is installed in any position up to 10 m ahead of the test coil with a direct line of sight to the test piece.

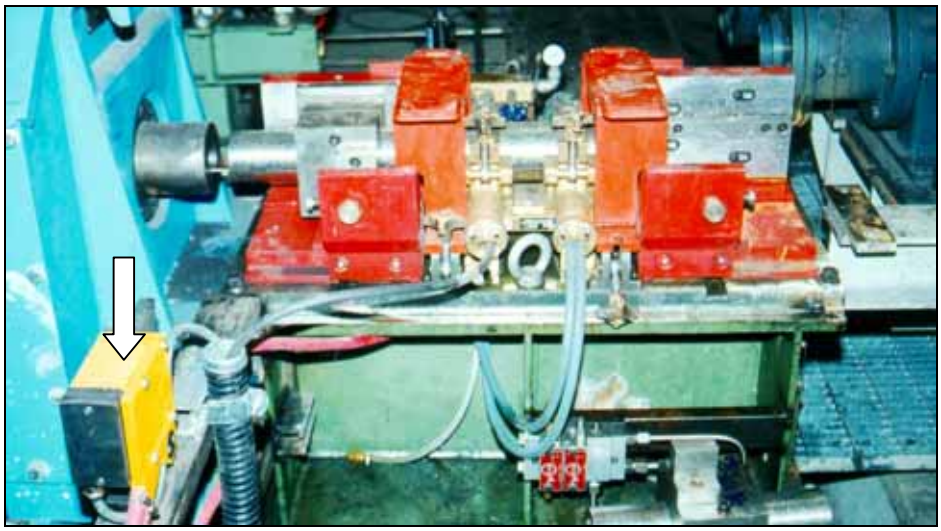


Figure 18: Test piece sensor

Powder marking unit

On warm test material, flaws are marked with a powder marking unit, if necessary. Flaw markings are possible up to test speeds of around 15 m/s. Attention must be paid to the fact that the intensity of paint application decreases as speed increases. The essential function units consist of a powder receptacle featuring an atomizer head, a pneumatic service unit and an electropneumatical control unit.

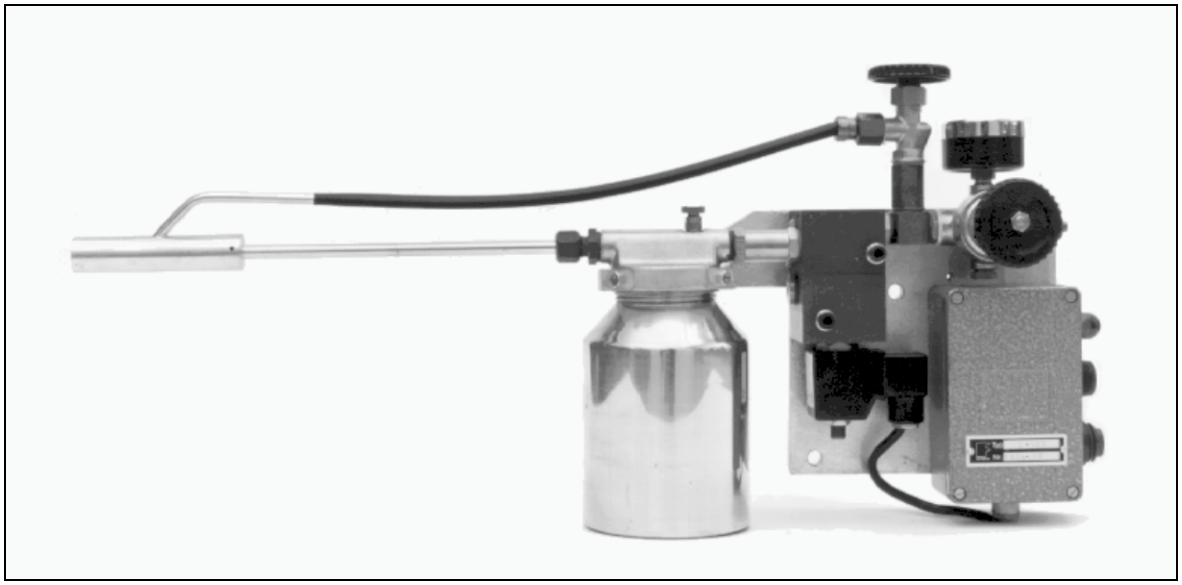


Figure 19: Powder marking unit

Electronic testing unit

- DEFECTOMAT DS (see Leaflet DEFECTOMAT® DS 2.815)

Connecting cables

Connecting cables as detailed in the cable overview diagram are needed to establish the electrical connection between the testing and evaluation unit and the sensor system with the test piece sensor and marking unit. Figure 21 shows the layout that is recommended. As the electronic test unit does not feature any operator controls whatever, it can be accommodated in a protective housing in the proximity of the testing location and will only require accessibility for servicing.

The advantage of this arrangement is the short length of diverse cables, particularly of the coil cable, with resulting low interference (EMC). The distance from the operation unit, which is typically set up in the control platform, can be several hundred meters. The connection between test electronics and operation unit is realized with an Ethernet cable. If distances are more than 100 m the use of glass fiber cable is recommended.

Test pieces – Test equipment

To determine the sensitivity setting for selected artificial test flaws and to check functioning, use is generally made of “cold” test pieces in a test equipment (rods featuring test flaws in a separate coil and nozzle arrangement) which correspond to the “hot” test material in terms of their eddy current properties. The test pieces are moved manually in the test equipment so as to ensure that the test flaws in the test coil generate flaw signals. Communication between the test equipment and the operation unit at the control platform for setting the suitable test parameters can be established with a second monitor or via FOERSTERnet with a second operation unit which even can be connected temporary. Alternatively, a radio telephone connection can be established between the control platform and the operator of the test equipment.

The test equipment consists of a separate coil holder T 60 with a pair of plastic protective nozzles per test piece and a short additional coil cable. For good reproducibility of signal acquisition, the nozzle diameter is adapted closely to the test piece diameter.

The parameter settings determined with the artificial test flaws, in particular the test sensitivity, serve only as guide values for the results that can be achieved online. These largely depend on the surface quality of the test material; the resulting interference level and the vibrations of the wire running at high speeds.

Line holder (option)

Protective facilities can be attached to the coil mount to protect connectors and coupling during conversion.

Fastening accessories (option)

Clamping claws for provisional fastening of the coil mount and guide units. Simple position correction during trial operation

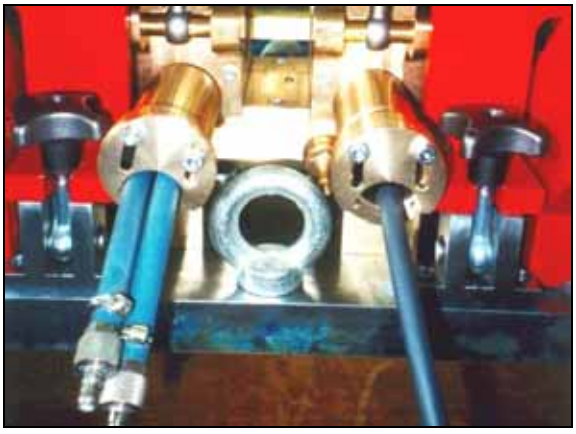


Figure 20: Protective facility for connectors

Technical data

Nominal diameter range (clear inner diameter)	7 to 65 mm	
Diameter of test material	5 to 60 mm	
Test frequencies for LMD-Therm coils	1 to 100 kHz	Nominal diameter < 29 mm
	1 to 30 kHz	Nominal diameter > 29 mm
Test object temperature	up to +1200 °C [1]	
Testable material	Fe, NFe, Aust.	
Cooling water requirement (purified industrial water)	Coil size I	> 1,5 l/min
	Coil size II	> 2,5 l/min
	per nozzle	approx. 2 l/min
Permissible temperature of the cooling water at the outlet of test coil	+60 °C	
Permissible pressure of the cooling water at the outlet	preferably pressureless, max. 0,5 bar	
Compressed air connection port	2 to 6 bar	
Quality of the compressed air	no special requirements	
Testing speed	up to 150 m/s	
Test piece sensor	Infrared-Sensor	
Test piece sensor ⇔ test coil distance	max. 10 m The test piece must already have the nominal dimension at the location of the test piece sensor	
Sensor system mounting level	horizontally or slightly inclined, according to rolling mill. Mounting flange always down! (If it is mounted other than in the permissible way, there is a risk of air bubbles forming in the cooling water circuit)	
Dimensions of sensor systems	see Figures 22 to 24	
Mass of coil holder without nozzles and coil	approx. 22 kg	

[1] Ferromagnetic material and material containing ferromagnetic components only at temperatures above the Curie point (cold points must be avoided)

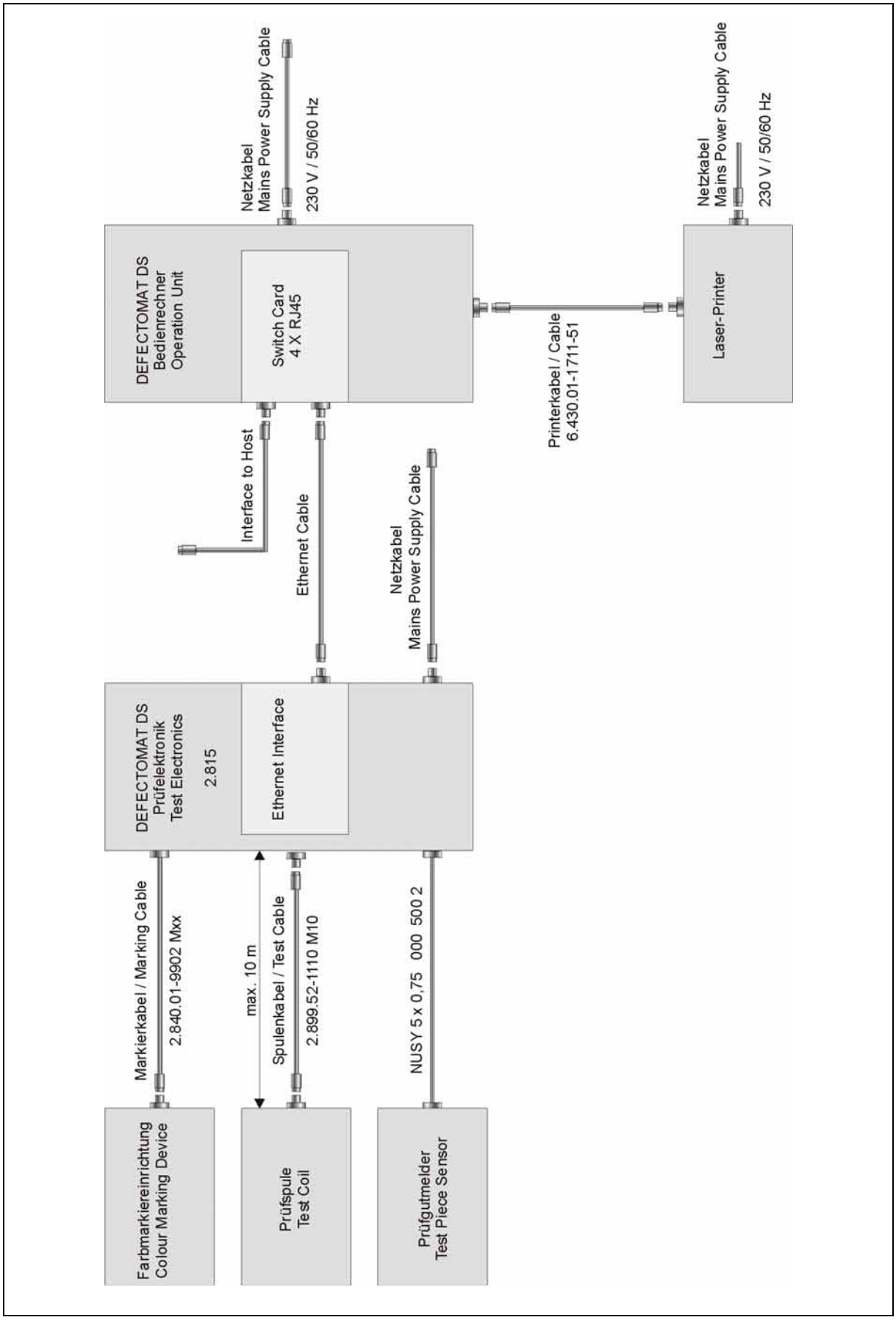


Figure 21: General cable diagram DEFECTOMAT DS 2.815

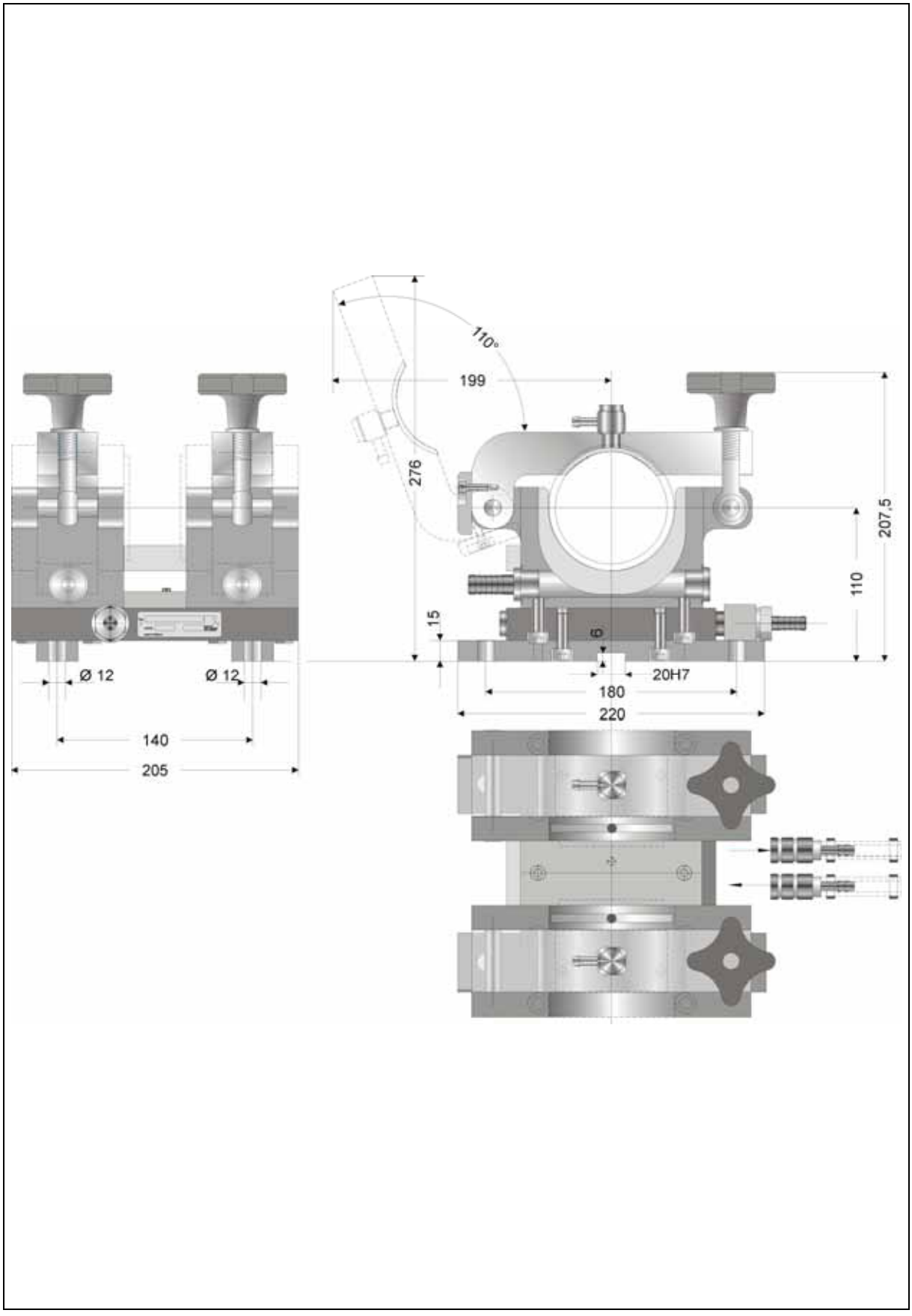


Figure 22: Dimensions Coil carrier

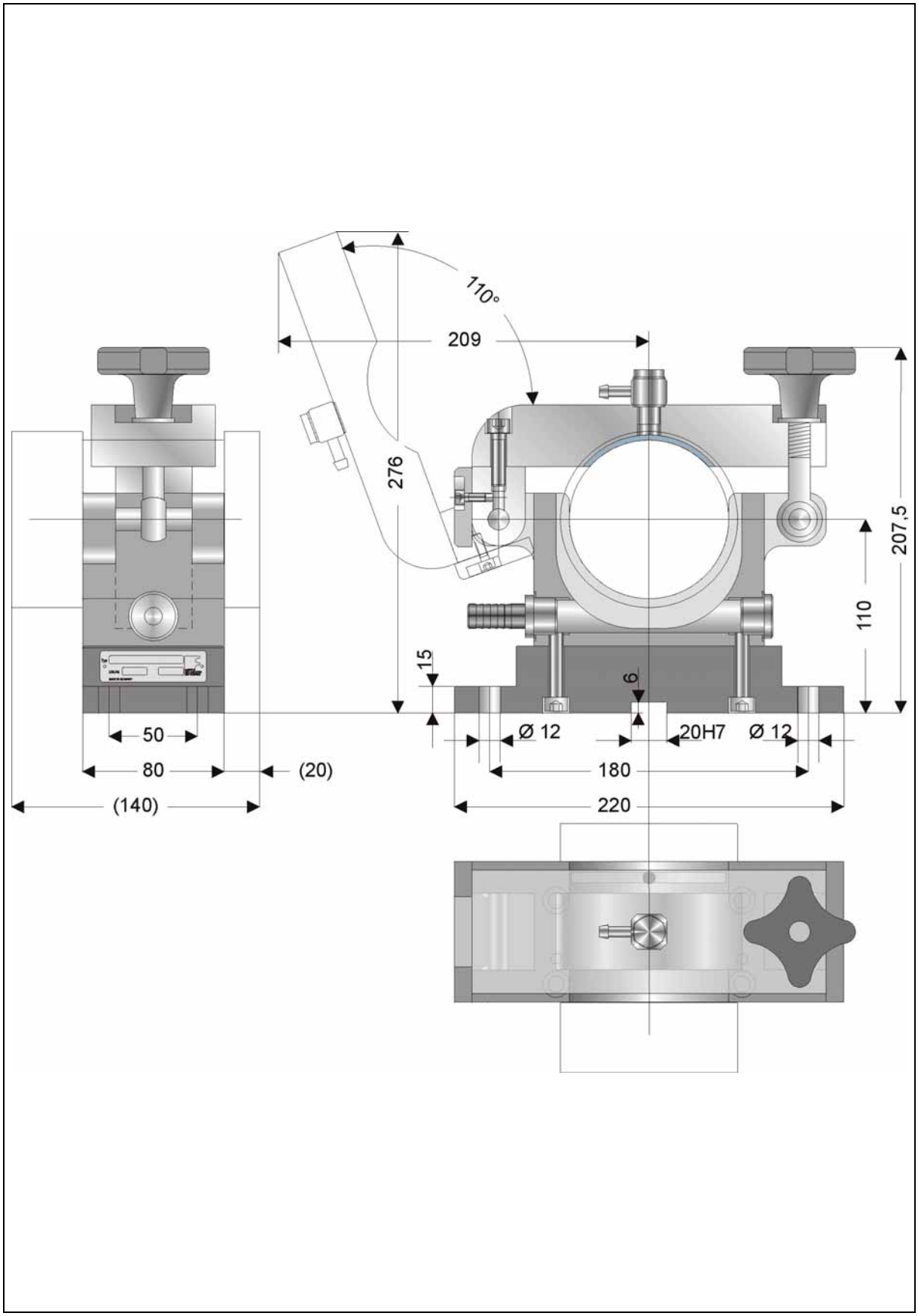


Figure 23: Dimensions Guide unit

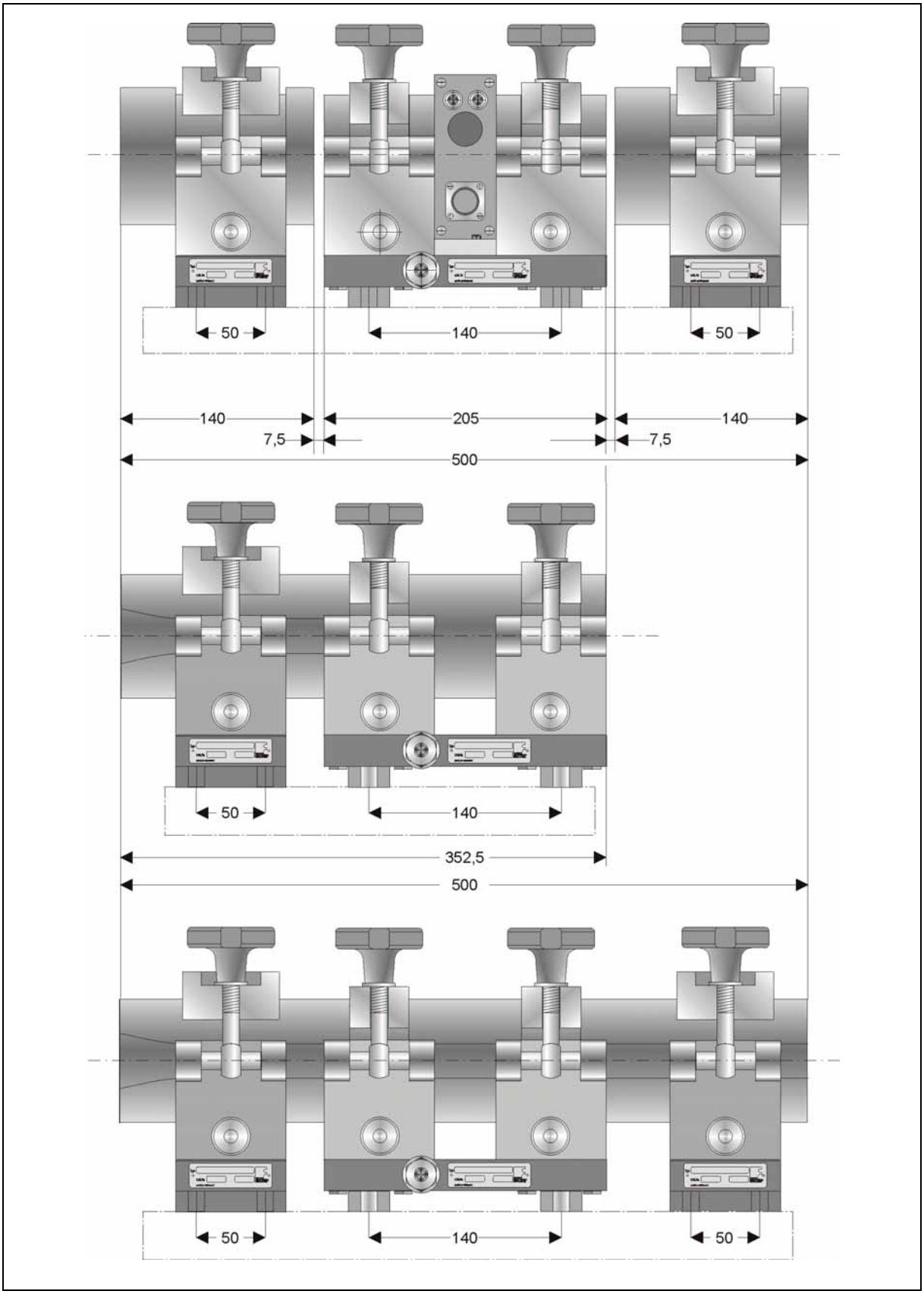


Figure 24: Dimensions
above: Coil carrier with two Guide units and coil
mid: Coil carrier with one Guide unit
below: Coil carrier with two Guide unit and NT-Guide tube

Should you have any special problems please contact:

Institut Dr. Foerster GmbH & Co. KG
Division TS Semi-finished Product Testing
In Laisen 70
72766 REUTLINGEN
GERMANY
Phone +49 7121 140-270
Fax +49 7121 140-459
ts@foerstergroup.de
www.foerstergroup.de

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Author Haditsch