The basic model of the time-proven FOERSTER® CIRCOGRAPH family unites the advantages of a low-cost, single-channel compact instrument with the scope of performance of modern computer technology - configurable, application-oriented functionality, high level of operating convenience, problem-oriented signal and result evaluation and the option of integration in a comprehensive quality system.

Reasonably priced, high-performance eddy current testing system for automatic, high-resolution on-line flaw testing with rotating sensor systems.

Processor-controlled compact unit for non-destructive flaw testing on wires, rods and pipes made of ferrous, non-ferrous and austenitic material.

Evaluation of the test results adaptable to the automatic sequences for piece test, wire test, continuous test and continuous test with subsequent cropping.

Evaluating the test results for marking, logging in various stages (test piece, section, wire, test order) and, if necessary, sorting.

Registered trade-mark
Characteristics

Display and operating concept
- TFT color display
- Clear basic display with all information relevant to test operation: signal characteristic, event messages, selected operating parameters and test results
- Modern windowing and non-confusable operating controls
- Fast and reliable selection of the optimum instrument setting:
  - the filters are set automatically
  - the setting window offers precisely the parameters which you need
  - the setting parameters can be optimized very easily with the aid of the signal display over one revolution (ROTSYNC) and the display in the X/Y impedance plane
- Dialog language either German, English, French, Italian or Spanish, other dialog languages on request
- Multi-position key-operated switch for preselecting the operable scope of functions

Signal evaluation
- Discrimination between small and large flaws with two independently settable trigger thresholds
- Connectable evaluation of minor flaws in accordance with the Copper Tube Standard EN 1971* (option)
- Switchable evaluation methods for „Pieces“, „Cutting“, „Continuous“ and „Wire“.
  - In „Pieces“ and „Cutting“ evaluation modes, the parts are assessed on the basis of the number of small and large flaws. The limit values can be set.
  - In „Continuous“ and „Wire“ evaluation modes, the material under test is subdivided into sections of adjustable length. These are assessed either on the basis of the number or on the basis of the density of small and large flaws; the evaluation mode can be selected by means of a switch.
  - An overall assessment is formed for wires on the basis of the number of defective sections.
- A flaw position list can be printed out after the trailing edge of the test piece when evaluating the number of flaws
- Double logging of the test results, in the form of long-term and short-term log, can be used for lot and shift or for individual part and overall order
- Two-class marking, three-class sorting

Signal processing
- Differential channel with adjustable test frequencies 30/100/300/1000/3000 kHz
- Automatic setting of the high-pass and low-pass filters; both filters may also be adjusted manually
- High-slope (120dB/Dec) high-pass filter adapted specifically for rotating applications

* For details see Institute Report No. 371
Tried-and-tested instrument settings can be saved and recalled when required.

Unlimited storing possibilities via Remote interface on an external computer.

Internal RAM for quick access to often used settings with a capacity for 24 settings.

Printer interface
- For output of the screen contents as a hard copy,
- for printing out the short-term or long-term log,
- output of the flaw position list
- for synchronous output of fault messages in clear text and
- for system printouts for servicing purposes

Library of instruments settings
- Tried-and-tested instrument settings can be saved and recalled when required.
- Unlimited storing possibilities via Remote interface on an external computer.
- Internal RAM for quick access to often used settings with a capacity for 24 settings.

Computer interface for transfer of:
- instrument settings
- control commands
- test results

Printer interface
- For output of the screen contents as a hard copy,
- for printing out the short-term or long-term log,
- output of the flaw position list
- for synchronous output of fault messages in clear text and
- for system printouts for servicing purposes

Fig. 3 Test sequence „Piece testing“
Flaw statistics and evaluation per test piece

Fig. 4 Test sequence „Wire“
Flaw statistics and evaluation per section; remaining section at end of coil and statistics

Fig. 5 Test sequence „Continuous“
Flaw statistics and evaluation per section; no remaining section, statistics

Fig. 6 Test sequence „Crosscut“
Flaw events are buffered; flaw statistics and evaluation after cropping per cropped section
Application

- Non-destructive test of ferromagnetic, austenitic and non-ferromagnetic circular material (wires, rods, pipes) for surface flaws with scanning coils (particularly longitudinal flaws) using the eddy current method (DIN 54140)

- Material surface free of scale, bright if possible

- With sensor system:
  - Ro 20  2 to 20 mm
  - Ro 35  2 to 35 mm
  - Ro 65  5 to 65 mm

- An additional module in the rotating head electronic circuitry interconnects two probes from opposite test heads. The aggregate signal formed from the two measurement signals is supplied to the test electronics. Adjustment to the same test sensitivity of the two probes is also carried out simultaneously. The additional module is a part of the „CP-Ro accessories“ 6.412.01-9901

- Complete testing in continuous throughput
  - when using the Ro 20 with 2 probes and Motor control MOC E test speed 1.5 m/s, optionally with Motor control EV 3 m/s
  - when using the Ro 35, restriction to 2 test heads, so that 1.5 m/s is obtained as the maximum test speed
  - when using the Ro 65, restriction to 1 probe per test head, so that 2.0 m/s is obtained as the maximum test speed

- Flaw resolution from 30 µm

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Fig. 7 Examples of a steel bar test:
- with rotating head Ro 20
- with rotating head Ro 35
- with rotating head Ro 65

* Referred to the maximum rotational speed of 9000rpm
** Referred to the maximum rotational speed of 6000rpm
Function

The **eddy current rotating probe** rotates at a high speed around the longitudinally moved test material and scans its surface in a helical manner. In doing so, the rotating probe, which operates in a "punctiform" manner, senses only a small part of the material surface. In other words, during the test it concentrates on a very small part of the overall circumferential surface. This means that even a very small material flaw represents a major fault in terms of percentage to this relatively small material surface scanned by the probe.

The rotating probe reliably shows up very small material flaws with extremely high resolution. An additional advantage of the rotating probe method is that elongated material flaws are shown up in their entire length. The rotating probe runs over the flaw in every revolution, giving a signal every time. Extremely small flaws must be reliably indicated on the material surfaces in the case of high-quality semi-finished products, for example quenched spring steel wires, valve spring wires, forge quality bars, copper, austenite or titanium pipes. Only the rotating probe method can achieve this extremely high flaw resolution.

Constructions and technical data

**CIRCOGRAPH CP TEST INSTRUMENT 6.412.80**

**Housing**

Rugged metal housing for use under rough industrial conditions. Enclosed design with heat-sink cooling and rugged sealed keypad, enclosure IP 63. Compact 19" bench-top unit which can also be incorporated in a 19" equipment cabinet using a screw-on mounting bracket.

**Signal evaluation**

Signal evaluation is performed in several stages: the individual flaws are subdivided into flaw classes F1 and F2 on the basis of two trigger thresholds which can be set mutually independently.

The minor flaws of threshold A can also be evaluated in accordance with the Copper Tube Standard EN 1971 (option). The rest of the evaluation process depends upon the type of material and test: In the case of separate-item (piece) testing and long material which is cropped after testing, the individual pieces are subdivided into the result classes RO (flawless), R1 (defective class 1) and R2 (defective class 2). A part is defective R1 (or R2) if the number of flaws F1 (F2) has reached an adjustable limit value F1 (F2). This assessment also determines how the material is sorted.

In the case of evaluation in accordance with EN 1971, transgression of the limit values for F1/F2 is signalled as early as during the test itself in order to allow early intervention in the ongoing process. In the case of continuous material and wire, sections of adjustable lengths are assessed, whereby you can switch over between assessment on the basis of the "number of flaws" in the case of separate items (pieces) and cropping and assessment on the basis of the "flaw density". The flaw density is the quotient of flaw length per section and section length. This assessment is particularly suitable for applications in which high flaw rates are anticipated, e.g. if it is intended to detect an increased surface roughness as F1 owing to fluctuations relating to production conditions. By contrast, assessment on the basis of the number of flaws is suitable for applications in which relatively low flaw rates are anticipated.
Screen and signal display

The **basic display** is matched precisely to the information required in Test operating mode.

- The event field contains a number of „Event lamps“ which signal important statuses and events in the test sequence.
- The signal area offers a real **new feature**: *You have your entire testing line in view!*
The position of the transmitter (D, Figure 11) is shown at the left-hand edge of the screen. The signals move to the right in synchronism with the pass of the material under test from the transmitter. Marking guns (M) and, if applicable, the cutter are shown in the correct position.
  In evaluation modes „Continuous“ and „Wire“, markings for the section limits also move along with the signal.
- The parameter area shows selected parameters of the current instrument setting.
- The result area shows the counts of the test report, whereby you can switch over between display of the short-term report and display of the long-term report.

All other information is displayed only if it is required. This is carried out in the form of windows which are displayed individually: Faults which occur open the messages window which shows the cause in clear text. The relevant input window is displayed at the press of a key for data entry.

Fig. 9 The basic display
Logging

The instrument records both a short-term and a long-term report. These reports contain the same statistical evaluations but can be started mutually independently. This permits batch and shift reports to be kept simultaneously for instance.

Fig. 10 Example of a report printout for piece testing

1 You can freely define these texts. Example: Two-line company header and field with order data. Using the external keyboard, you can both enter general fields of designations and enter the current order data before each printout. If you do not have an external keyboard, you can have the field designations entered at the works and you can enter the current order data by hand in the printouts.

2 Parameter field as in the basic display on the screen

3 Result field as in the basic display on the screen

Fig. 11 The result field, at left in „Continuous“ with flaw number report and, at the right in „Wire“ with flaw density report. Q0, Q1, Q2 in the case of „Wire“= Number of wire on the basis of quality classes
Front-panel keypad

Sealed keypad with menu, entry and special function keys. Only a small number of operating controls is required thanks to the cleverly designed operating concept. These operating elements are clearly arranged and have a clear, unequivocal function:

✓ Each menu key calls a specific input window. Key RUN closes an open window and returns you to the basic menu.

✓ The entry keys change parameter settings and trigger functions. Precisely one function is assigned to each pair of keys in each input window, e.g.:

![Image of keypad with menu keys and entry keys]

Operating structure

- The operating method is based entirely on modern windowing techniques: Calling a specific input window with the appropriate menu key and changing the parameter or triggering a function with the related entry keys.

- All operating functions are structured ergonomically in line with user requirements

- The configuration window covers all parameters of the current instrument setting, subdivided into several pages on the basis of functional units. It is not generally required a great deal after commissioning.

- The setting window is available for adapting the instrument setting to changing testing tasks. It includes targeted selection from the entire set of configuration parameters. You can modify the works preselection individually if you require.

![Image of setting window with parameter selection]

Fig. 12 The setting window, standard assignment on instruments without absolute channel

Fig. 13 The front keypad

1 Entry keys, in pairs
2 Menu keys
3 COPY: Print screen contents
   SPCL: Can be defined individually
All required functions can be operated with the keys on the front keypad. In addition, the external full-complement keyboard offers the option of free text entries for designating instrument settings and for configuring the test log. It also provides qualified users with access to the instrument’s entire database.

The key-operated switch is used to preselect one of five hierarchically structured interlock levels. Each level enables a specific scope of functions for operation.

Advantages:
- Protection against unintentional modification or deletion of data.
- Targeted enabling of the scope of operating functions depending upon qualification of the operating staff.
- Protection of the data against unauthorized access.

Dialog language

One language is included in the scope of delivery, either:
- German
- English
- French
- Italian
- Spanish
- Additional dialog languages available on Memory Cards (one language per Memory Card)

Advantages:
- Protection against unintentional modification or deletion of data.
- Targeted enabling of the scope of operating functions depending upon qualification of the operating staff.
- Protection of the data against unauthorized access.
Monitoring

Important instrument functions are monitored automatically. These include all internal supply voltages and various functions of the test sequence. All fault signals and event signals and messages are subdivided into seven categories on the basis of urgency, from information on the test sequence through to malfunctions resulting from defects. Signals and messages as of a configurable category can trip an external alarm. An FIFO with capacity for 30 messages stores the clear-text messages and outputs them on a connected printer.

Internal Library

Internal SRAM with buffer battery for storing maximal 24 instrument settings. This permits instrument settings to be optimized once for a specific testing task and then reloaded for testing subsequent series.

All entries are clearly identifiable: You can enter a clear-text designation on an external keyboard. The time of archiving is entered as the identification automatically if no entry is made.

Advantages:
- Avoidance of incorrect settings, reliable reproduction of the instrument setting
- Verifiable reproducibility of the test results determined
- No need for extensive manual logging
- Changes of instrument settings can be implemented within a very short time.

Individual software installation

Specific basic settings of the instrument can be adapted to meet individual requirements. It is also possible to define so-called option commands. These are commands or sequences which are triggered automatically if a specific event occurs, e.g. if the instrument is switched on or if the SPCL key is pressed. These settings can be implemented at the works if required. If you are appropriately qualified, you yourself can enter these settings using the external keyboard.
Connections on the rear panel of the instrument:

**X1 Mains connection**
115/230 V +10/-15 %, 50 - 60 Hz, 220 VA

**X2 PRINTER**
Socket DB 25 S, serial interface RS 232 C for text and bitmap graphic printouts.

**X3 REMOTE**
Socket DB 25 S, serial interface RS 232 C for remote control of the instrument in asynchronous full-duplex data transfer mode by a master control computer. Universal mode of operation owing to free read and write access to the instrument’s entire database.

**X4 ANALOG**
Socket DB 25 S for connection for a recorder, if applicable with interconnection of an external pulse expander or for servicing purposes.

**X5 TEST COIL**
For connection at sensor system, 15-pin instrument socket PT 02 A 14-15 S.

**Eingänge INPUTS**
Control signals from the testing line
Terminal strip with strain relief and bus with earthing contact
Ten inputs with optocouplers

**Ausgänge OUTPUTS**
Control signals to the testing line, flaw and fault signals for external monitoring
Terminal strip with strain relief and bus with earthing contact, ten outputs

**PCs and software for remote control**
The instrument has a remote serial RS 232 C interface for linking to other computers. This interface offers the option of remotely controlling all functions on the CIRCOGRAPH CP. Instrument settings can be managed and all evaluation data can be retrieved. Ready-to-use systems with PCs and appropriate software are available for specific applications.
MEMORY CARD

128 kByte SRAM with battery. The battery has a service life of five years. The battery must then be replaced.

The standard scope of delivery includes 1 Memory Card. It contains the installation data set valid for the individual instrument, i.e. all project-specific non-recurrent settings, installation data for inputs and outputs and so forth and all menu texts in the selected dialog language.

Additional Memory Cards can be used for the following purposes:
- Loading changing dialog languages e.g. output of the test report in the language of the end user.
- Saving the entire database as a backup for transfer to a standby instrument or for downloading after servicing work.

Options for the test instrument

FUNCTION MODULE EN 1971

This software option allows flaw evaluation in accordance with the stipulations in the Copper Tube Standard EN 1971.

KEYBOARD EXTERNAL

Keyboard complete with 1 m connecting cable
- Full alphanumeric keyboard
- Permits all functions as with the front keypad
- Also enables text inputs for the designation of instrument settings and for designing the descriptive part of the test report
- Allows, too, the access to the complete database of the instrument for servicing and programming work

19" INSTRUMENT HOUSING, 12 HU

for accommodating the instrument, the external keyboard and the printer, see separate leaflet, Order-No. 145 001 8

Printer and printer accessories

MATRIX NEEDLE PRINTER

- For setting up separately
- Graphics-capable matrix printer with serial interface RS 232 C
- Can be switched over to 20mA current interface active or passive (female, 25-pole)

PERIPHERY CABLE 2.5 m, Order No. 119 150 0

Male plug, 25-pole on both sides
For connecting the CIRCOGRAPH CP with the matrix needle printer

* Height unit, 1 HU = 44.5 mm
Cable when using a CIRCOGRAPH sensor system

Connections between rotating head and CIRCOGRAPH CP

Accessories CP-Ro, Order No. 148 504 0

Consisting of:
- Test cable 6.412.01-9911
- Control cable 6.412.01-9912
- Interface 6.412.01-9920

Motor controls with cable
- Motor control MOC E Order No. 163 825 4 0.75 kW / 400 V
- Motor control MOC EV, Order No. 163 826 2 0.75 kW / 400 V, only together with Ro 20
- Motor control MOC S, Order No. 163 827 0 0.75 kW / 400 V, two rotational speeds
- Motor control MOC SB, Order No. 163 828 9 2.2 kW / 400 V, two rotational speeds, electrically braking device

Fig. 17 Cable overview CIRCOGRAPH CP, motor control, rotating head
**Motor control MOC E**

Fixed speed of 9.000 rpm, 50 Hz mains connection, hand brake device.

**Motor control MOC EV**

Variable speed of up to 18.000 rpm, a frequency converter is used.

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**Components for the testing line**

**MARKING CABLE 10M, Order No. 134 973 2**
- Clamped at the instrument, plugged at the marking gun
- One cable is required per marking gun

**PULSE WHEEL CABLE 10 M, Order No. 137 858 9**
Clamped at the instrument, plugged at the pulse wheel

**TEST PIECE SENSOR, Order No. 135 965 7**
Reflex light barrier with reflector for measuring the test piece speed.

**STAND, Order No. 102 119 2**
For holding the displacement transducer with stepless height preadjustment

**MOTION TRANSDUCER, Order No. 104 550 4**
For generating displacement-proportional timing pulses (1 pulse per mm) independent from the test speed. Runner circumference 500 mm

**LIFT-OFF DEVICE, Order No. 104 558 0**
Pneumatic/electrical, for automatically placing down and lifting the displacement transducer. Must be controlled by the external feeding conveyor controller.
### Technical data

**Rotating heads**
- Ro 20, Ro 35 P and L, Ro 65

**Test frequency**
- 30, 100, 300, 1000 and 3000 kHz

**Excitation voltage**
- 10 Vrms, output resistance 7.5 Ω

**Signal coupling**
- dynamic

**High-pass filter**
- 25-stage

**Low-pass filter**
- 25-stage

**Gain**
- dynamic range from 0.0 to 71.9 dB in 0.1 dB steps

**Phase setting**
- 0 to 359°, 1° increments

**Evaluation mode**
- instantaneous value evaluation of the vector or of the Y component, switchable

**Trigger thresholds**
- 2 thresholds, can be set between 10 and 100% in 5 % steps, additionally fixed 100% allround threshold in the case of Y-component evaluation

**Display**
- **Monitor**
  - TFT VGA color display
- **Signal displays**
  - motion-synchronous display in Recorded mode,
  - Signal display in the impedance plain, and over one revolution
  - scale of motion-synchronous display can be set between 0.6 and 18000 m in steps of 1.2/1.8/3.0/4.5/6.0/9.0 per decade (the low scale values are possible only at low test speeds)
  - Size of impedance memory adjustable from 0.1 to 12 m

**Signal evaluation**
- **Evaluation methods**
  - Pieces, Wire, Continuous and Cutting, switchable
- **Statistics**
  - in Pieces and Cutting modes, on the basis of number of flaws per part,
  - in Wire and Continuous mode, on the basis of number of flaws or flaw density per section, switchable
  - optional flaw evaluation in accordance with EN 1971

**Marking**
- 2 marking classes

**Sorting**
- 3 sorting classes

**Test speed**
- adapted to testing without omission depending on the sensor system

**Interfaces**
- RS 232 C for printer
- RS 232 C for master control computer
- control signals from and to the testing line via terminals, analog output for external signal recording, input for external keyboard

**Housing**
- **Dimensions**
  - 19", 4 HU, H x W x D = 187 x 437 x 501 mm
- **Enclosure**
  - IP 63, complying with IEC 529/ DIN 40 050/52/5

**Farbe**
- RAL 7001

**Mains connection**
- 115/230 V +10/-15 %,
- 50 - 60 Hz, 220 VA

**Mass**
- 28 kg

**Permitted ambient temperature**
- +5 to +40 °C
### ORDERING INSTRUCTIONS

#### STANDARD FUNCTIONAL SETS

<table>
<thead>
<tr>
<th>Designation</th>
<th>Part No.</th>
<th>Order No.</th>
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<tbody>
<tr>
<td>CIRCOGRAPH CP</td>
<td>6.412.80</td>
<td>1485032</td>
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<tr>
<td>consisting of:</td>
<td></td>
<td></td>
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<tr>
<td>BASISGERAET CIRCOGRAPH CP</td>
<td>6.412.01-1001</td>
<td>1539604</td>
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<tr>
<td>HF-SECTION, F=1...3000KHZ</td>
<td>2.842.01-1001-14</td>
<td>1452754</td>
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<td>LF-SECTION, HP F. ROT. ANWEND.</td>
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<td>1496093</td>
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<td>TEST LINE INTERFACE</td>
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<td>CPU</td>
<td>2.842.01-1001-18</td>
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<td>GRAPHIC</td>
<td>2.842.01-1001-19</td>
<td>1481525</td>
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<tr>
<td>OUTPUT MODULE, RELAIS</td>
<td>2.842.01-1001-17</td>
<td>1451189</td>
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<tr>
<td>OPERATING INSTRUCTIONS GERMAN, CIRCOGRAPH CP</td>
<td>6.412 DMCP1.2 UA06/DE1522744</td>
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<tr>
<td>OPERATING INSTRUCTIONS ENGL., CIRCOGRAPH CP</td>
<td>6.412 DMCP1.2 UA06/EN1522752</td>
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| MOTOR CONTROL E, WITH CABLE | 6.412.84 | 1551183 |
| consisting of: | | |
| MOTOR CONTROL E, 0,75KW 400V F. RO14 | 6.415.01-3010 | 1485512 |
| MAINS CABLE 10M | 6.410.01-9905 | 1306847 |
| ZUBEHOER CP-RO, PRUEF-STEUERKABEL + ANPASSUNG | 6.412.01-9901 | 1485040 |

| MOTOR CONTROL, VARI. SPEED, WITH CABLES | 6.412.89 | 1585436 |
| consisting of: | | |
| MOTOR CONTROL V, VARIABEL 2.2KW 400V IM GEHAUSE | 6.410.01-3050 | 1585428 |
| ZUBEHOER CP-RO, PRUEF-STEUERKABEL + ANPASSUNG | 6.412.01-9901 | 1485040 |
| EARTHING CABLE 10M | 1.175 -0061 | 1554034 |
| MOTOR CABLE 10M | 6.410.01-9913 | 1371487 |
| CONTROL CABLE 10M, F. ELEKTRIK | 6.410.01-9914 | 1371509 |
| MAINS CABLE 10M | 6.420.21-9905 | 1330837 |
| ADAPTION CP-RO | 6.412.01-9901 | 1485040 |

| TEST PIECE SENSOR, FOR TERMINAL CONNECTION | 2.840.01-9001 | 1359657 |
| TEST PIECE SENSOR CABLE 10M, ONE-SIDE CLAMP-TYPE CONNECTION | 2.840.01-9901 | 1349716 |
| MARKING CABLE 10M, ONE-SIDE CLAMP-TYPE CONNECTION | 2.840.01-9902 | 1349732 |

| MOTION TRANSDUCER | 2.899.01-3101 | 1045504 |
| PULSE WHEEL CABLE 10M | 2.840.01-9904 | 1378589 |
| STAND | 2.870.01-7001 | 1021192 |
| LIFT-OFF DEVICE | 2.899.01-3151 | 1045580 |

| CALIBRATION | 6.412 KAL | 1522256 |

| LEAFLET GERMAN | 6.412 UA01/DE | 1522280 |
| LEAFLET ENGLISH | 6.412 UA01/EN | 1522663 |
| OPERATING INSTRUCTIONS GERMAN | 6.412 DMCP1.2 UA06/DE1522744 |
| OPERATING INSTRUCTIONS ENGL. | 6.412 DMCP1.2 UA06/EN1522752 |
| REMOTE CONTROL INSTRUCT. ENGL., DEFECTOMAT CP | 2.842 SW1.1 UA6C/E | 1033379 |
The order documents below for the color marking device 1.176 represent an extract from product group 58. Please also refer to product brochure „Color marking“ with the Order No. 137 714 0.

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<tr>
<td>COLOR MARKING DEVICE 2 CH. WITHOUT CABLE</td>
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<td>1330667</td>
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