POROSCOPE® HV5, HV20, HV40
Porosity Test Using High Voltage
Test Method

The test method is based on the fact that all electrically insulating coating materials have a much higher disruptive strength than air.

At the POROSCOPE the suitable test voltage is set according to the disruptive strength and thickness of the coating. Alternatively, a test standard can be selected and a coating thickness can be set. The POROSCOPE then adjusts the appropriate high voltage automatically. The specimen is grounded and the electrode is moved slowly across the surface to be measured. The voltage drops briefly when the electrode passes a defective spot, a sparkover as well as an optical and acoustical signal indicating the pore.

Safety

The POROSCOPE was developed with extreme care regarding safety. The safety requirements of the ISO 2746 are fulfilled in all points through the following design characteristics:

• The high voltage is directly generated in probe head. Thus, a high voltage cable is not necessary, which would store additional charge of electricity. This additional charge would lead to a higher discharge current in the case of an electrical shock.
• The high voltage is switched off automatically, if the instrument is overloaded for a longer period of time.
• Insulated and earthed hand piece, therefore no electrostatic charging of the operator.
• Protective resistor that limits to the current to a safe level.
• Push button for switching on the high voltage. Only as long as the button is depressed, the high voltage is generated.

Applications

In order to protect objects, which are made of steel or metal, they are coated with corrosion resistant materials such as rubber, synthetics or enamel. The protective coatings must be tight, that is, free of pores, cracks or embedded foreign objects, to keep aggressive materials from the carrier material that is in danger of corrosion. Fine pores or cracks cannot be entirely avoided in any coating process.

Fine pores or cracks cannot be entirely avoided in any coating process. With the POROSCOPE®, even pores and cracks, not visible to the eye, can be discovered and counted in electrically non-conducting protective coatings.

The POROSCOPE is used for quick and reliable pore tests on coated metals. Typical applications:

• Enamel- or plastic-coated mineral oil tanks, agitator kettles, pipelines, boilers and heat exchangers
• Plastic-coated food packages
• Corrosion protection coatings on offshore installations

Measurement Method, Features

Features

• Robust instruments for harsh use on construction sites or in manufacturing
• Three instrument versions with different test voltage ranges:
  HV5: 0.8 – 5 kV
  HV20: 4 – 20 kV
  HV40: 8 – 40 kV
• Maximum safety through high voltage generation in the test head
• Intuitive operation with menu navigation, rotary button and illuminated display in the operator’s field of vision
• Extensive electrode selection
• Continuously adjustable test voltage
• Electronic test voltage monitoring and display of the test voltage that is present directly at the electrode
• Optical and acoustical pore indication on the test head
• Adjustable detection sensitivity
• Also suitable for testing electrostatically chargeable materials
• Battery operation by means of a Li-ion battery with smart battery technology, a controller monitors the battery state permanently and avoids deep discharge

Standards

Testing in accordance with AS 3894.1, ASTM D4787, ASTM D5162, ASTM G62, EN 14430, NACE SP0188, NACE SP0490, NACE SP0274
Technical Data, Standard Content of Shipment, Ordering Information

Technical Data
- Voltage supply: 100 – 240 V~
- Battery operation:
  - at 40 kV: approx. 8 h continuous operation
  - at 20 kV: approx. 20 h continuous operation
- Battery monitoring by means of smart battery technology
- Test voltage:
  - continuously adjustable:
    - HV5: 0.8 – 5 kV, in compliance with standard 1 – 5 kV
    - HV20: 4 – 20 kV
    - HV40: 8 – 40 kV
- Dimensions [mm]:
  - Supply unit: approx. 200 x 125 x 50
  - Test head max. Ø approx. 120
  - Test head length: HV5: approx. 320
    - HV20: approx. 340
    - HV40: approx. 380
- Weight [kg]:
  - Supply unit: HV5: approx. 0.9
    - HV20: approx. 0.94
    - HV40: approx. 1
  - Test head: HV5: approx. 0.9
    - HV20: approx. 0.94
    - HV40: approx. 1
- Test voltage display: OLED graphic display
- Test voltage display error: ≤ 5 %

Pore indication:
- acoustical: alarm signal at test head
- optical: red LED at test head, pore symbol with current pore counter reading on the display of the test head
- Pore detection sensitivity: detection threshold settable to a voltage drop of 10, 20, 30 or 50 %, porosity detector switchable between static and dynamic threshold
- Test voltage monitoring: green LED; turns off, if the nominal voltage decreases by more than 5 %
- Environmental conditions during operation:
  - 0 – 40 °C (32 – 104 °F)
  - 0 – 60 % RH, no condensation on test surface
- Storage temperature: 0 – 60 °C (32 – 140 °F)
- Compliant with ISO 2746

Ordering Information

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>POROSCOPE® HV5</td>
<td>Portable pore test instrument with continuously adjustable test voltage 0.8 – 5 kV</td>
<td>604-959</td>
</tr>
<tr>
<td>POROSCOPE® HV20</td>
<td>Portable pore test instrument with continuously adjustable test voltage 4 – 20 kV</td>
<td>604-958</td>
</tr>
<tr>
<td>POROSCOPE® HV40</td>
<td>Portable pore test instrument with continuously adjustable test voltage 8 – 40 kV</td>
<td>604-521</td>
</tr>
</tbody>
</table>

Please find the electrode selection and the respective accessories on the subsequent pages.

Standard Content of Shipment
The POROSCOPE® is delivered in a sturdy transporta-

<table>
<thead>
<tr>
<th>Electrode Type</th>
<th>Weight [g]</th>
<th>Dimensions [mm]</th>
<th>Remarks</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweeper electrodes</td>
<td>200</td>
<td>150</td>
<td>Fan-like arrangement of trimming</td>
<td>600-695</td>
</tr>
<tr>
<td>Roller electrode</td>
<td>400</td>
<td>273</td>
<td>Comb-like wire trimming, can be pivoted and secured on all sides using a ball joint</td>
<td>600-697</td>
</tr>
<tr>
<td>Circ. ring electrodes</td>
<td>200</td>
<td>108</td>
<td>Pipe ID [mm]</td>
<td>600-736</td>
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<td></td>
<td>220</td>
<td>133</td>
<td></td>
<td>600-737</td>
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<td>250</td>
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<td>600-738</td>
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<td>300</td>
<td>159</td>
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<td>600-739</td>
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<td>400</td>
<td>220</td>
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<td>600-740</td>
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<td></td>
<td>600</td>
<td>324</td>
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<td>600-741</td>
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</table>

Electrodes, Selection Table

Sweeper electrodes: Pore testing of large-area enamel, rubber and synthetic coatings.
- Flat electrode with replaceable rubber tongue: Pore testing of paint coatings.
- Roller electrode: Pore testing of foils.
- Circular ring electrodes: Pore testing of exterior pipe walls. The circular ring electrodes swing open for easy placement around a pipe.

Rotating electrodes: Pore testing of interior pipe walls. Up to an inside diameter of 125, the rotating electrodes look like bottlebrushes. The brush bristles in the center are made of fine bronze spring wire; the nylon bristles in the front and back help to center the brush in the pipe.

Tests on the inside of pipes up to a length of 12 m (47”) are possible using suitable rod systems. Rod pieces coated with synthetic material are combined to the desired lengths. Inserting centering devices prevents sagging of the rod. The rod system together with the inserted centering devices is also used for the voltage supply of the rotating electrode.

Selection table for flat, sweeper, circular ring and roller electrodes

<table>
<thead>
<tr>
<th>Electrode Type</th>
<th>Weight [g]</th>
<th>Oper. width [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZH10a</td>
<td>406,6</td>
<td>150</td>
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<tr>
<td>ZH10b</td>
<td>2000</td>
<td>400</td>
</tr>
</tbody>
</table>

Overview of the various electrodes:
- a) Sweeper electrode
- b) Flat electrode
- c) Roller electrode
- d) Rotating electrodes for tests inside pipes
- e) Circular ring electrode for tests on the outside walls of pipes
### Rotating Electrodes, Selection Table

#### Pipe ID < 13 mm

<table>
<thead>
<tr>
<th>Pipe Φ inside [mm]</th>
<th>Rotation electrodes</th>
<th>Thread reducer</th>
<th>Order no.</th>
<th>Type</th>
<th>Weight [g]</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 (0.31&quot;)</td>
<td>ZH3y</td>
<td>M8/M4</td>
<td>600.713</td>
<td>8</td>
<td>600.714</td>
<td></td>
</tr>
<tr>
<td>10 (0.39&quot;)</td>
<td>ZH3z</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.12 (0.43-0.47&quot;)</td>
<td>ZH3a</td>
<td>M8/M5</td>
<td>600.721</td>
<td>10</td>
<td>600.699</td>
<td></td>
</tr>
<tr>
<td>13.14 (0.51-0.55&quot;)</td>
<td>ZH3b</td>
<td></td>
<td></td>
<td>30</td>
<td>600.700</td>
<td></td>
</tr>
<tr>
<td>15-16 (0.59-0.63&quot;)</td>
<td>ZH3c</td>
<td></td>
<td></td>
<td>40</td>
<td>600.701</td>
<td></td>
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<tr>
<td>22-23 (0.87-0.98&quot;)</td>
<td>ZH3c</td>
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<tr>
<td>28-30 (1.01-1.18&quot;)</td>
<td>ZH3c</td>
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<tr>
<td>33.40 (1.30-1.57&quot;)</td>
<td>ZH3d</td>
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</tr>
<tr>
<td>50-65 (1.97-2.56&quot;)</td>
<td>ZH3e</td>
<td></td>
<td></td>
<td>60</td>
<td>600.710</td>
<td></td>
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</tbody>
</table>

#### Pipe ID ≥ 13 mm

<table>
<thead>
<tr>
<th>Pipe Φ inside [mm]</th>
<th>Rod system</th>
<th>Centering device</th>
<th>Order no.</th>
<th>Type</th>
<th>Weight [g]</th>
<th>ID [mm]</th>
<th>Order no.</th>
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</thead>
<tbody>
<tr>
<td>100 (3.94&quot;)</td>
<td>ZH3a, ..., k</td>
<td></td>
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<td></td>
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<tr>
<td>115 (4.92&quot;)</td>
<td>ZH3f1</td>
<td>220</td>
<td>600.705</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>150 (5.91&quot;)</td>
<td>ZH3f2</td>
<td>350</td>
<td>600.706</td>
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<tr>
<td>200 (7.87&quot;)</td>
<td>ZH3g</td>
<td>1300</td>
<td>600.707</td>
<td></td>
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<tr>
<td>250 (9.84&quot;)</td>
<td>ZH3h</td>
<td>1600</td>
<td>600.708</td>
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<tr>
<td>300 (11.81&quot;)</td>
<td>ZH3i</td>
<td>1800</td>
<td>600.709</td>
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<tr>
<td>350 (13.78&quot;)</td>
<td>ZH3k</td>
<td>2000</td>
<td>600.710</td>
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</table>

### Elastic Spacers

<table>
<thead>
<tr>
<th>Type</th>
<th>Weight [g]</th>
<th>Length [mm]</th>
<th>Description</th>
<th>Order no.</th>
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</thead>
<tbody>
<tr>
<td>ZH9</td>
<td>145</td>
<td>1806[3&quot;]</td>
<td>Avoids tilting when inserting into greater pipe depths</td>
<td>600.720</td>
</tr>
</tbody>
</table>

### Ordering Examples

**Example 1:**
- Test system for testing enamel coatings
- Test instrument POROSCOPE® HV40
- Sweeper electrode ZH6b
- Order no.: 600.996

**Example 2:**
- Test system for testing interior pipe walls
- Test instrument POROSCOPE® HV40
- Sweeper electrode ZH6b
- Order no.: 600.720
- 2 x Rod system ZH18b
- Centering device ZH4a
- Thread reducer M8/M12
- Rotating electrode ZH3e1
- Order no.: 600.703