Water is a common contaminant in industrial oils. Water contamination deteriorates the performance of the oil, be it used for lubrication, cooling, insulation or other purposes. High moisture content increases the risk of corrosion, overheating, machine malfunction and other problems and can ultimately lead to costly failure and unscheduled downtime. Monitoring the oil for moisture is a simple way of improving the reliability of industrial machinery and equipment. With time, substantial savings in maintenance costs can be achieved.

**Free Water Formation – the Critical Point**

Water can dissolve in oil. When the water content of the oil increases, it eventually reaches the saturation point of the oil. Once the fluid has reached its saturation point, any additional water introduced will separate out as free water by forming a distinct layer. Alternatively, the oil can form dispersion with water, which turns the oil cloudy. Since most oils are less dense than water, the water layer will usually settle below the oil with time.

Free water formation is critical in terms of problems related to water in oil. When water is no longer dissolved in the oil, corrosion and wearing of equipment increase rapidly. Therefore it is important to keep the moisture content safely below the saturation point.

The ability of oil to hold dissolved water depends on the type and age of the oil as well as its additives. Two major factors have an effect on the saturation point as the oil ages: temperature fluctuations and changes in the chemical make-up due to the formation of new substances as by-products of the chemical reactions.

**Water Activity (a_w) – a Direct Measure of Oil Quality**

The conventional measure for water content in oil is ppm (parts per million), which describes the absolute amount of water in the oil. Ppm measurement has, however, a major limitation. It does not account for any variations in the oil’s saturation point. In other words, ppm measurement provides no indication of how close the moisture level is to the saturation point in a dynamic system with fluctuating saturation point. By measuring water activity instead of ppm, the risk of actually exceeding the saturation point can be avoided.

**Unique Benefits of HUMICAP in Oil Moisture Measurements**

- Fast. Online, real-time detection of moisture in oil without sampling
- Reliable. Tells the true margin to water saturation point in all changing conditions, taking into account e.g. temperature changes and aging of oil
- Highly stable. Excellent pressure and temperature tolerance
- Easy to install through ball valve – no need to shut down the process
- Enables predictive maintenance work. Trends can be quickly identified.
Water activity measurement indicates directly whether there is a risk of free water formation. With a relative scale from 0 (no water present) to 1 (the oil is saturated with water) it gives a reliable indication of how close the saturation point of water is. In contrast to traditional measurement techniques, water activity measurement is independent of oil type. Regardless of the saturation point of the fluid, water activity measurement always provides a true indication for the risk of free water formation, even when the saturation point is increasing or decreasing. In its simplicity, water activity value is understandable at a glance. Trends can be quickly identified.

Vaisala HUMICAP® for Measuring Water Activity
The Vaisala transmitters used for measuring moisture in oil feature the HUMICAP® sensor, a capacitive thin-film polymer sensor especially developed for demanding moisture measurements in liquid hydrocarbons.

The HUMICAP sensor consists of four functional layers: glass substrate, lower electrode, water-active polymer layer, and porous upper electrode. The thin-film polymer either absorbs or releases water as the surrounding moisture level changes. Water molecules move to/from the polymer layer until there is moisture equilibrium between the polymer and the oil. The dielectric properties of the polymer depend on the moisture level. As the moisture level changes, the dielectric properties of the polymer film change, and so does the capacitance of the sensor. The instrument’s electronics measure the capacitance of the sensor and convert it into water activity.

Oil molecules or additives do not penetrate the electrode. Thus the sensor output is independent of the oil type.

On-line Measurement
On-line water activity measurement ensures reliable performance of equipment at all times. Time-consuming sampling and laboratory analysis are no longer needed. This not only reduces the risk of human induced error but also provides cost savings in equipment and chemicals.

Typical Applications for Moisture in Oil Measurement
Moisture is an important factor determining the condition of both lubricating and transformer oils. With on-line information on the quality of the oil, preventive actions can be taken and the maintenance costs cut substantially.

HUMICAP in Brief
- A capacitive thin-film polymer sensor
- Water activity (a_w) measurement within range 0...1
- Accurate to +/- 0.02 (a_w)
- 15 years of experience in measuring moisture in oil

Structure of the HUMICAP sensor.
The Vaisala HUMICAP® Moisture and Temperature Transmitter Series for Oil MMT330 enables the fast and reliable detection of moisture in oil. MMT330 series transmitters can be used in online moisture monitoring and as control devices, allowing separators and oil driers to be started only when needed. Proper monitoring saves both oil and the environment. With the MMT330 series it is easy and economical to monitor the changes of moisture in oil.

Reliable Vaisala HUMICAP® Technology

The MMT330 series incorporates the latest-generation Vaisala HUMICAP® sensor, which is the result of over 15 years of field experience. It was developed for demanding moisture measurement in liquid hydrocarbons.

The sensor’s excellent chemical tolerance provides accurate and reliable measurement over a wide measurement range.

For Diverse Applications and Demanding Conditions

With a wide variety of probes, the transmitter can be used in lubrication systems, hydraulic systems, and transformers.

Indicates the Margin to Water Saturation

The MMT330 measures moisture in oil in terms of the water activity (aw) and temperature (T). Water activity indicates directly whether there is a risk of free-water formation. The measurement is independent of oil type and age.

Features/Benefits

- Continuous online measurement of moisture in oil
- Ball-valve installation – no need to shut down the process or drain the oil
- Proven Vaisala HUMICAP® sensor, used for over 15 years in oil applications
- Easy field calibration and maintenance – compatible with Vaisala HUMICAP® Hand-Held Moisture Meter for Oil MM70
- NIST traceable calibration (certificate included)
- Analog outputs, RS232/485, WLAN/LAN
- MODBUS protocol support (RTU/TCP)
- Approved for installation in MAN Diesel & Turbo Two-Stroke Diesel Engines lubrication systems

The MMT330 transmitter family offers reliable performance for the demanding measurement of moisture in oil.
Water Content as ppm Conversion
In addition to water activity, the MMT330 can output ppm, the average mass concentration of water in oil. Vaisala has this conversion readily available for mineral transformer oil. For other oils, the oil-specific conversion coefficients can be programmed into the transmitter if the water solubility of the oil is known.

Graphical Display of Measurement Data and Trends for Convenient Operation
The MMT330 features a large numerical and graphical display with a multilingual menu and keypad. It allows users to easily monitor operational data, measurement trends, and access measurement history for the past 12 months. The optional data logger, with real-time clock, makes it possible to generate over four years of measurement history and zoom in on any desired time or time frame.

The display alarm allows any measured parameter to be tracked, with freely configurable low and high limits.

Versatile Outputs and Data Collection
The MMT330 can support up to three analog outputs; an isolated galvanic power supply and relay outputs are also available. For serial interface the USB connection, RS232, and RS485 can be used. MMT330 is also capable of applying the MODBUS communication protocol and, together with an appropriate connection option, provides either MODBUS RTU (RS485) or MODBUS TCP/IP (Ethernet) communication. The data logger, with real-time clock and battery backup, guarantees reliable logging of measurement data for over four years. The recorded data can be viewed on the local display or transferred to a PC with Microsoft Windows® software. The transmitter can also be connected to a network with an optional (W)LAN interface, which enables a (wireless) Ethernet connection. A USB service cable makes it easy to connect the MMT330 to a PC via the service port.

Easy Installation
MMT330 transmitters have several options for transmitter mounting. They are delivered installation-ready, pre-configured with all settings.

Mounting Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting with Wall</td>
<td>Mounting Kit</td>
</tr>
<tr>
<td>Pole Installation with Installation Kit</td>
<td>for Pole or Pipeline</td>
</tr>
<tr>
<td>Mounting with DIN Rail Installation Kit</td>
<td></td>
</tr>
<tr>
<td>Mounting Rain Shield with Installation Kit</td>
<td></td>
</tr>
</tbody>
</table>

Dimensions

<table>
<thead>
<tr>
<th>Type</th>
<th>Dimensions in mm (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMT330</td>
<td>Width 71.5 (2.80)</td>
</tr>
</tbody>
</table>

HUMICAP® is a registered trademark of Vaisala.
The MMT332 probe is installed using a flange. It is designed for high-pressure applications.

### Installation Options

**MMT332 for High Pressure Installations**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure range</td>
<td>0 ... 250 bar / 0 ... 3625 psia</td>
</tr>
<tr>
<td>Probe diameter</td>
<td>12 mm / 0.5&quot;</td>
</tr>
<tr>
<td>Installation</td>
<td>Flange 36 mm / 1.4&quot;</td>
</tr>
<tr>
<td>Temperature</td>
<td>-40 ... +180 °C (-40 ... 356 °F)</td>
</tr>
</tbody>
</table>

### Dimensions

Dimensions in mm (inches)

![Dimensions Image](image1.png)

The MMT337 probe, with optional Swagelok® connector, is ideal for tight spaces with a thread connection. The small probe is designed for integration into small diameter lines.

### Installation Options

**MMT337 with Small-Sized Probe**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure range</td>
<td>0 ... 10 bar / 0 ... 145 psia</td>
</tr>
<tr>
<td>Probe diameter</td>
<td>12 mm / 0.5&quot;</td>
</tr>
<tr>
<td>Installation</td>
<td>Fitting body R 3/8&quot; ISO, Fitting body 1/2&quot; ISO, Fitting body NPT 1/2&quot;</td>
</tr>
<tr>
<td>Temperature</td>
<td>-40 ... +180 °C (-40 ... 356 °F)</td>
</tr>
</tbody>
</table>

### Dimensions

Dimensions in mm (inches)

![Dimensions Image](image2.png)

The MMT338 is ideal for installation into pressurized processes where the probe needs to be able to be removed while the process is running. The probe depth is adjustable.

### Installation Options

**MMT338 with Probe for Pipeline Installations**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure range</td>
<td>0 ... 40 bar / 0 ... 580 psia up to 120 °C (248 °F) and 40 bar</td>
</tr>
<tr>
<td>Adjustable length</td>
<td>35 ... 157/379 mm / 1.37 ... 6.2 /14.9&quot;</td>
</tr>
<tr>
<td>Installation</td>
<td>Fitting body R1/2&quot; ISO, Fitting body NPT 1/2&quot;, Ball-valve set BALLVALVE-1, Sampling cell DMT242SC2</td>
</tr>
<tr>
<td>Temperature</td>
<td>-40 ... +180 °C (-40 ... 356 °F)</td>
</tr>
</tbody>
</table>

### Dimensions

Dimensions in mm (inches)

![Dimensions Image](image3.png)
## Technical Data

### Measured Values

**WATER ACTIVITY**
- **Measurement range** $a_w$: 0 ... 1
- **Accuracy** (including non-linearity, hysteresis and repeatability)
  - 0 ... 0.9: ±0.02
  - 0.9 ... 1.0: ±0.03
- **Response time** (90%) at +20 °C in still oil (with stainless steel filter): 10 min.
- **Sensor**: HUMICAP® 180,2

### Performance

**TEMPERATURE**
- **Measurement range**
  - MMT332: -40 ... +180 °C (-40 ... +356 °F)
  - MMT337: -40 ... +180 °C (-40 ... +356 °F)
  - MMT338: -40 ... +180 °C (-40 ... +356 °F)
- **Accuracy at +20 °C (+68 °F)** ± 0.2 °C (0.36 °F)
- **Electromagnetic compatibility**: Complies with EMC standard EN61326-1, Industrial environment
- **Note**: Transmitter with display test impedance of 40 ohm is used in IEC61000-4-5 (Surge immunity)

### Operating Environment

**Operating temperature**
- for probes: same as measurement ranges
- for transmitter body: -40 ... +60 °C (-40 ... +140 °F)
- with display: 0 ... +60 °C (+32 ... +140 °F)
- **Pressure range for probes**: see probe specifications

### Inputs and Outputs

**Operating voltage**: 10 ... 35 VDC, 24 VAC ± 20%
- with optional power supply module: 100 ... 240 VAC 50/60 Hz
- **Power consumption @ 20 °C ($U_{in}$ 24VDC)**
  - RS232: max. 25 mA
  - $U_{in}$ 2 x 0...1V / 0...5V / 0...10V: max. 25 mA
  - $I_{in}$ 2 x 0...20 mA: max. 60 mA
  - display and backlight: + 20 mA
- **Analog outputs (2 standard, 3rd optional)**
  - **current output**: 0 ... 20 mA, 4 ... 20 mA
  - **voltage output**: 0 ... 1 V, 0 ... 5 V, 0 ... 10 V
- **Accuracy of analog outputs at 20 °C**: ± 0.05% full scale
- **Temperature dependence of the analog outputs**: ± 0.005%/°C full scale
- **External loads**
  - **current outputs**: $R_i < 500$ ohm
  - **0 ... 1V output**: $R_i > 2$ kohm
  - **0 ... 5V and 0 ... 10V outputs**: $R_i > 10$ kohm
- **Max. wire size**: 0.5 mm² (AWG 20) stranded wires recommended
- **Digital outputs**: RS232, RS485 (optional)

### Protocols
- ASCII commands, MODBUS RTU

### Service connection
- RS232, USB

### Relay outputs
- 0.5 A, 250 VAC, SPDT, potential-free (optional)

### Ethernet interface (optional)
- **Supported standards**: 10BASE-T, 100BASE-TX
- **Connector**: RJ45
- **IPv4 address assignment**: DHCP (automatic), static
- **Protocols**: Telnet, MODBUS TCP/IP

### WLAN interface (optional)
- **Supported standards**: 802.11b
- **Antenna connector type**: RP-SMA
- **IPv4 address assignment**: DHCP (automatic), static
- **Protocols**: Telnet, MODBUS TCP/IP
- **Security**: WEP 64/128, WPA

### Authentication / Encryption
- **Open / no encryption**
- **Open / WEP**
- **WPA Pre-shared key / TKIP**
- **WPA Pre-shared key / CCMP (a.k.a. WPA2)**

### Optional data logger with real-time clock
- **Logged parameters**: max. four with trend/min/max values
- **Logging interval**: 10 sec. (fixed)
- **Max. logging period**: 4 years, 5 months
- **Logged points**: 13.7 million points per parameter
- **Battery lifetime**: min. 5 years
- **Display**: LCD with backlight, graphical trend display of any parameter
- **Menu languages**: English, Chinese, Finnish, French, German, Japanese, Russian, Spanish, Swedish

### Mechanics
- **Cable bushing**: M20x1.5 for cable diameter 8 ... 11mm/0.31 ... 0.43”
- **Conduit fitting**: 1/2” NPT
- **Interface cable connector (optional)**: M12 series 8-pin (male)
  - option 1: female plug with 5 m black cable
  - option 2: female plug with screw terminals
- **USB-RJ45 Serial Connection Cable**: (incl. Mi70 Link software)
  - 2 m, 5 m or 10 m
- **Probe cable diameter**: 5.5 mm
- **Standard probe cable lengths**: 2 m, 5 m or 10 m
- **Housing material**: G-AlSi 10 Mg (DIN 1725)
- **Housing classification**: IP 66
- **IP65 (NEMA4X) with local display**
- **Weight**: depending on selected probe, cable and modules 1.0 - 3.0 kgs
- **Sensor protection**: Stainless steel grid standard filter, Stainless steel grid filter for high flow rates (>1 m/s)

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The Vaisala HUMICAP® Moisture and Temperature Transmitter Series for Oil MMT310 is a fast and reliable on-line detector for moisture in oil.

Reliable Vaisala HUMICAP® Technology

The MMT310 series incorporates the latest generation of the Vaisala HUMICAP® Sensor, developed for demanding moisture measurement in liquid hydrocarbons. The sensor’s excellent chemical tolerance provides accurate and reliable measurement over the wide measurement range.

Measuring Water Activity

The MMT310 series measures moisture in oil in terms of the water activity (aw) and temperature (T). Water activity directly indicates if there is a risk of free water formation. The measurement is independent of oil type, age, and temperature.

Water Content as PPM Calculation for Transformer Oils

PPM units are traditionally used in transformer applications. They indicate the average mass concentration of water in oil. The ppm calculation for mineral oil based transformer oil is optional in the MMT310 series.

Diverse Applications and Demanding Conditions

The MMT310 series can be used in lubrication and hydraulic systems as well as in transformers. It can be used for on-line moisture monitoring and as a control function, allowing separators and oil purifiers to be started only when necessary.

Installation Options

The MMT318 has two adjustable probe lengths. The transmitter can be ordered with a ball valve set that enables the insertion and removal of the moisture probe for calibration, without the need to empty the oil system.

The MMT317 has a small pressure-tight probe with optional Swagelok fittings.

Several Outputs, One Connector

The MMT310 series has two analog outputs and an RS-232 serial output. The output signals and the supply power travel in the same cable, the only cable connected to the unit.

Features/Benefits

- Continuous measurement of moisture in oil
- Proven Vaisala HUMICAP® Sensor, 15 years in oil applications
- Measurements in lubrication, hydraulic and transformer oils
- Excellent pressure and temperature tolerance
- Measuring water activity - ppm calculation for transformer oil
- Small size, easy to integrate
- NIST traceable calibration
- Applications: e.g. monitoring of transformer oil and of lubrication systems in marine and paper industry

Two probe options: MMT317 and MMT318
### Measured Values

**WATER ACTIVITY**
Measurement range $a_w$ 0 ... 1
Accuracy (including non-linearity, hysteresis and repeatability)
- 0 ... 0.9 ±0.02
- 0.9 ... 1.0 ±0.03
Response time (90 %) at +20 °C in still oil (with stainless steel filter) 10 min

**TEMPERATURE**
Measurement range -40 ... +180 °C (-40 ... +356 °F)
Typical accuracy at +20 °C ±0.1 °C (±0.18 °F)
Typical temperature dependence of electronics ±0.05 °C/°C (±0.005 °F/°F)
Sensor Vaisala HUMICAP®

**Electrical Connections**
Two analog outputs, selectable and scalable 0 ... 20 mA or 4 ... 20 mA
Typical accuracy of analog output at +20 °C ±0.05 % full scale
Typical temperature dependence of analog output 0.005 %/°C (0.003 %/°F)
Serial output RS-232C
Connections 8-pole connector with RS-232C, current outputs (two channels) and $U_{in}$
Operating voltage $U_{in}$ 24 VDC (10 ... 35 VDC)
Minimum operating voltage $U_{in}$ with RS-232C 10 VDC
$I_{out}$ 0 ... 20 mA, 4 ... 20 mA 11 VDC + (R_{load}/60) VDC
Power consumption at +20 °C, $U_{in}$ = 24 VDC with RS-232C 20 mA
$I_{out}$ 2 x 0 ... 20 mA 60 mA

**Dimensions**
Dimensions in mm (inches)

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### General

**OPERATING TEMPERATURE RANGE**
-40 ... +60 °C (-40 ... +140 °F)
**STORAGE TEMPERATURE**
-55 ... +80 °C (-67 ... +176 °F)
**PRESSURE RANGE**
-**PRESSURE RANGE FOR MMT318 WITH BALL VALVE** up to 120 °C 0 ... 40 bar
- **PRESSURE RANGE FOR MMT317** 0 ... 10 bar
**EXTERNAL LOAD**
$R_{<500 Ohm}$
**MATERIAL**
- **TRANSMITTER HOUSING** G-AlSi 10 Mg
- **TRANSMITTER BASE** ABS/PC
**HOUSING CLASSIFICATION** IP65
**CABLE FED BY** to be protected from direct rain
**CABLE FEED THROUGH ALTERNATIVES** 8-pole connector with 5 m cable, female 8-pin connector screw joint for cable diameter 4 ... 8 mm
**SENSOR PROTECTION** stainless steel grid standard filter
**SHEATH PROTECTION** stainless steel grid filter for high flow rates (>1 m/s)
**PROBE CABLE LENGTH**
- **MMT317** 0.5, 2, 5 or 10 meters
- **MMT318** 2, 5 or 10 meters
**PROBE INSTALLATION MMT317**
- Swagelok® NPT 1/2", ISO 3/8" or ISO 1/2"
**PROBE INSTALLATION MMT318**
- Fitting bodies ISO 1/2", NPT 1/2"
- Ball Valve Set BALLVALVE-1
**COMPATIBILITY** Complies with EMC standard EN61326-1, Industrial environment

Note: When using the current output, the RF field susceptibility level according to standard EN61000-4-3 with a frequency band of 110 ... 165 MHz, is only 3 V/m (generic environment) with the specified accuracy.

HUMICAP® is a registered trademark of Vaisala.

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**Dimensions**

![MMT317 probe](image)

![MMT318 probe](image)
MMT162 Compact Moisture in Oil and Temperature Transmitter for OEM Applications

The MMT162 enables on-line moisture monitoring in oils even in the most demanding applications.

**Features/Benefits**
- Continuous measurement of moisture in oil
- Measures in lubrication, hydraulic and transformer oils
- Excellent pressure and temperature tolerance
- Proven Vaisala HUMICAP® Sensor, 15 years in oil applications
- Measures water activity - ppm-calculation available for transformer oil
- Small size, easy to integrate
- NIST traceable calibration (certificate included)

The Vaisala HUMICAP® Moisture and Temperature Transmitter for Oil MMT162 is an excellent economical solution for reliable on-line detection of moisture in oil.

**Reliable Vaisala HUMICAP® Technology**
The MMT162 incorporates the latest generation of the Vaisala HUMICAP® Sensor. The sensor is developed for demanding moisture measurement in liquid hydrocarbons and has been successfully used in oil applications for over a decade. The sensor’s excellent chemical tolerance provides accurate and reliable measurement over the measurement range.

**Water Activity Measurement**
The MMT162 measures moisture in oil in terms of the water activity (aw) and temperature (T). Water activity directly indicates whether there is a risk of free water formation. The measurement is independent of oil type, age and temperature. The ppm calculation for mineral oil based transformer oil is optional in the MMT162.

**Several Outputs - One Connector**
The MMT162 has two analog outputs that can be scaled and the measurement ranges changed. Additionally, the transmitter has an RS-485 serial output. The signals and the unit power travel in the same cable.

An optional LED-cable enables a visual alarm.

**Compact, Rugged and Intelligent**
Due to its compact size, the MMT162 is quickly and easily installed in tight spaces. Units are delivered fully assembled, however, you can re-configure them to suit your needs.

**MM70**
In combination with an MM70 indicator, the MMT162 provides an ideal tool for on-site calibration. The MM70 indicator can be used as a display, communication, and data-logging device for the MMT162.
### Measured Values

**WATER ACTIVITY**
- **Measurement range**: 0 ... 1 aw
- **Accuracy** (including non-linearity, hysteresis and repeatability)
  - 0 ... 0.9
  - ± 0.02
  - 0.9 ... 1.0
  - ± 0.03
- **Response time**: in oil flow (typical) <1 min (dry-wet)

**MOISTURE**
- Calculated moisture content in ppm for mineral transformer oil

**TEMPERATURE**
- **Accuracy at +20 °C (+68 °F)** ± 0.2 °C (0.36 °F)

### Operating Environment

**Operating temperature**
- -40 ... +60 °C (-40 ... +140 °F)

**Oil temperature**
- -40 ... +80 °C (-40 ... +176 °F)

**Pressure range**
- metal version up to 200 bar
- plastic version up to 40 bar

**Oil flow**
- some flow recommended

### Outputs

**Analog outputs (two channels)**
- **current output**: 0 ... 20 mA, 4 ... 20 mA
- **voltage output**: 0 ... 5 V, 0 ... 10 V

**Alarm level indication by analog signal**
- user selectable

**Digital outputs**
- RS-485

### General

**Sensor**
- HUMICAP®

**Cable connections (2 ports)**
- M8, 4 pin

**Minimum operating voltage with**
- RS-485 output: 14 ... 28 VDC
- voltage output: 16 ... 28 VDC
- current output: 22 ... 28 VDC

**Supply current**
- normal measurement: 20 mA + load current

**External load for**
- voltage output: min. 10 kOhm
- current output: max. 500 Ohm

**Housing material**
- metal: AISI 316L
- plastic: PPS + 40% GF

**Mechanical connections with bonded seal ring (washer)**
- metal version: G 1/2” ISO or NPT 1/2”
- plastic version: G 1/2” ISO

**Housing classification**
- IP65 (NEMA 4)

**Storage temperature range**
- -40 ... +176 °F

**Weight**
- with plastic housing: 65 g (2.3 oz)
- with metal housing: 200 g (7 oz)

### Options and Accessories

**Stainless steel filter (standard)**
- 225356SP

**Stainless steel filter for high flow (>1 m/s)**
- 221494SP

**Connection cable for MM70 hand-held meter**
- 219980

**USB serial interface cable**
- 219690

**Sealing ring set (U-seal) ISO G1/2, 3 pcs**
- 221525SP

**Sealing ring set (copper) ISO G1/2, 3 pcs**
- 221524SP

**ISO 1/2” plug**
- 218773

**NPT 1/2” plug**
- 222507

**Sampling cell**
- DMT242SC

**Sampling cell w. Swagelok connectors**
- DMT242SC2

**Connection cable**
- 2 m (6.5 ft), M8 snap-on: 211598
- 0.32 m (1 ft) Shielded, M8 threaded: HMP50Z032
- 3.0 m (9.8 ft), Shielded, M8 threaded: HMP50Z300SP
- 5.0 m (16.4 ft), Shielded, M8 threaded: HMP50Z500SP
- 10 m (32.8 ft), Shielded, M8 threaded: HMP50Z1000SP
- 3 m, connector 90° angle: 221739
- 5 m, connector 90° angle: 221740
- M8 threaded, Ch1 signal + Ch2 LED: MP300LEDCL

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**Dimensions**

Dimensions in mm (inches)

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The Vaisala HUMICAP® Hand-held Moisture Meter for Oil MM70 enables reliable detection of moisture in oil.

In-Line Process Checking Through Ball Valve
The probe can be inserted directly into the process pipe through a ball valve without draining the oil in the system.

Water Activity Measurement
The MM70 measures moisture in oil in terms of the water activity (aw) and temperature (T). Water activity directly indicates whether there is a risk of free water formation. The measurement is independent of oil type, age and temperature.

PPM Calculation Included
The MM70 has an embedded model for expressing moisture as ppm in mineral transformer oil. The customer can enter up to three other oil models into the meter’s memory.

Numerical and Graphical Display
The MM70 features a multilingual, menu-based user interface and a backlit LCD display. The measurement parameters can be numerically and graphically displayed and logged into the meter’s memory at the same time. An analog output option is also available.

Connection to PC
The optional MI70 Link Windows® software in combination with a USB connection cable is used to transfer logged data and real time measurement data from the MM70 to a PC.

Proven Vaisala HUMICAP® Technology
The MM70 incorporates the latest generation of the Vaisala HUMICAP® Sensor, developed for demanding moisture measurements in liquid hydrocarbons. The sensor’s excellent chemical tolerance provides accurate and reliable measurement over the measurement range.

Speedy Service - Once a Year
The meter can be recalibrated by sending the probe to Vaisala Service, or customers can calibrate the instrument themselves using a standard relative humidity calibration.

Multi-Probe Operation
One or two probes can be connected simultaneously. Maintenance teams can use additional Vaisala dew point or relative humidity probes for other tasks. For example, a dew point probe is ideal for checking the moisture inside washed and dried oil tanks.

Features/Benefits
- Measurement independent of oil type, age and temperature
- In-line process checking through ball valve, no need to drain the oil
- Rugged and reliable construction
- Excellent pressure and temperature tolerance
- Data can be logged and transferred to a PC
- Proven Vaisala HUMICAP® Sensor, 15 years in oil applications.
- Compatible with Vaisala’s fixed oil moisture instruments
- No reference oil needed for recalibration
- NIST traceable (certificate included)
### Technical Data

#### Performance

**WATER ACTIVITY**

Measurement range $a_w$ 0 ... 1

Accuracy (including nonlinearity, hysteresis and repeatability)

When calibrated against salt solutions (ASTM E104-85):

- 0 ... 0.9 ±0.02
- 0.9 ... 1.0 ±0.03

Maximum achievable accuracy when calibrated against high-quality, certified humidity standards:

- 0 ... 0.9 ±0.01
- 0.9 ... 1.0 ±0.02

Response time (90%) at +20 °C (+68 °F)

- in still oil (with stainless steel filter) 10 min.
- Sensor Vaisala HUMICAP® 180,2

Recommended recalibration interval 1 year

**TEMPERATURE**

Measurement range -40 ... +100 °C (-40 ... +212 °F)

Typical accuracy at +20 °C ±0.2 °C (±0.36 °F)

Typical temperature dependence of electronics ±0.005 °C/°C (±0.005 °F/°F)

Sensor Pt100 RTD Class F0.1 IEC 60751

Typical long-term stability better than 0.01 aw / year

#### Operating Environment

**PROBE**

Operating temperature range for electronics -40 ... +60 °C (-40 ... +140 °F)

Operating pressure range max. 20 bar

during installation through ball valve max. 10 bar

Oil flow range max. 1 m/s

**INDICATOR**

Operating temperature range -10 ... +40 °C (+14 ... +104 °F)

Operating humidity range non-condensing

#### Electromagnetic Compatibility

Complies with EMC standard EN61326-1, Electrical equipment for measurement, control and laboratory use - EMC requirements; Portable equipment.

#### Inputs and Outputs

**Display**

- LCD with backlight, graphic trend display of any parameter, character height up to 16 mm

**Analog output**

- 0 ... 1 VDC

**Output resolution**

- 0.6 mV

**PC interface**

- MI70 Link software with USB or serial port cable

**Data logging capacity**

- 2700 points

**Alarm**

- Audible alarm function

#### Options and Accessories

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#### Dimensions

Dimensions in mm (inches)

HUMICAP® is a registered trademark of Vaisala.

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Please contact us at [www.vaisala.com/requestinfo](http://www.vaisala.com/requestinfo)