Accessories

Contamination Monitoring Products

RDU 2.0
ICM-USBi
ICM-ETHi
ICM-FC1
SK0040

FLUID SAMPLING BOTTLES
PRESSURE & WASTE HOSES

444.009000
## Contamination management

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HYDRAULIC FLUIDS

The fluid is the vector that transmits power, energy within an oleodynamic circuit. In addition to transmitting energy through the circuit, it also performs additional functions such as lubrication, protection and cooling of the surfaces. The classification of fluids used in hydraulic systems is coded in many regulatory references, different Standards.

The most popular classification criterion divides them into the following families:
- MINERAL OILS
  Commonly used oil deriving fluids.
- FIRE RESISTANT FLUIDS
  Fluids with intrinsic characteristics of incendibility or high flash point.
- SYNTHETIC FLUIDS
  Modified chemical products to obtain specific optimized features.
- ECOLOGICAL FLUIDS
  Synthetic or vegetable origin fluids with high biodegradability characteristics.

The choice of fluid for an hydraulic system must take into account several parameters. These parameters can adversely affect the performance of an hydraulic system, causing delay in the controls, pump cavitation, excessive absorption, excessive temperature rise, efficiency reduction, increased drainage, wear, jam/block or air intake in the plant.

The main properties that characterize hydraulic fluids and affect their choice are:
- DYNAMIC VISCOSITY
  It identifies the fluid’s resistance to sliding due to the impact of the particles forming it.
- KINEMATIC VISCOSITY
  It is a widespread formal dimension in the hydraulic field. It is calculated with the ratio between the dynamic viscosity and the fluid density. Kinematic viscosity varies with temperature and pressure variations.
- VISCOSITY INDEX
  This value expresses the ability of a fluid to maintain viscosity when the temperature changes. A high viscosity index indicates the fluid’s ability to limit viscosity variations by varying the temperature.
- FILTERABILITY INDEX
  It is the value that indicates the ability of a fluid to cross the filter materials. A low filterability index could cause premature clogging of the filter material.
- WORKING TEMPERATURE
  Working temperature affects the fundamental characteristics of the fluid. As already seen, some fluid characteristics, such as cinematic viscosity, vary with the temperature variation. When choosing a hydraulic oil, must therefore be taken into account of the environmental conditions in which the machine will operate.
- COMPRESSIBILITY MODULE
  Every fluid subjected to a pressure contracts, increasing its density. The compressibility module identifies the increase in pressure required to cause a corresponding increase in density.
- HYDROLYTIC STABILITY
  It is the characteristic that prevents galvanic pairs that can cause wear in the plant/system.

FLUID CONTAMINATION

Whatever the nature and properties of fluids, they are inevitably subject to contamination. Fluid contamination can have two origins:
- INITIAL CONTAMINATION
  Caused by the introduction of contaminated fluid into the circuit, or by incorrect storage, transport or transfer operations.
- PROGRESSIVE CONTAMINATION
  Caused by factors related to the operation of the system, such as metal surface wear, sealing wear, oxidation or degradation of the fluid, the introduction of contaminants during maintenance, corrosion due to chemical or electrochemical action between fluid and components, cavitation. The contamination of hydraulic systems can be of different nature:
- SOLID CONTAMINATION
  For example rust, slag, metal particles, fibers, rubber particles, paint particles or additives
- LIQUID CONTAMINATION
  For example, the presence of water due to condensation or external infiltration or acids
- GASEOUS CONTAMINATION
  For example, the presence of air due to inadequate oil level in the tank, drainage in suction ducts, incorrect sizing of tubes or tanks.

EFFECTS OF CONTAMINATION ON HYDRAULIC COMPONENTS

Solid contamination is recognized as the main cause of malfunction, failure and early degradation in hydraulic systems. It is impossible to delete it completely, but it can be effectively controlled by appropriate devices.

Solid contamination mainly causes surface damage and component wear.
CONTAMINATION MANAGEMENT

- **SURFACE EROSION**
  Cause of leakage through mechanical seals, reduction of system performance, variation in adjustment of control components, failures.

- **ADHESION OF MOVING PARTS**
  Cause of failure due to lack of lubrication.

- **DAMAGES DUE TO FATIGUE**
  Cause of breakdowns and components breakdown.

- **MODIFICATION OF FLUID PROPERTIES**
  (COMPRRESSIBILITY MODULE, DENSITY, VISCOSITY)
  Cause of system’s reduction of efficiency and of control.

  It is easy to understand how a system without proper contamination management is subject to higher costs than a system that is provided.

- **MAINTENANCE**
  Maintenance activities, spare parts, machine stop costs

- **ENERGY AND EFFICIENCY**
  Efficiency and performance reduction due to friction, drainage, cavitation.

**4. MEASURING THE SOLID CONTAMINATION LEVEL**

The level of contamination of a system identifies the amount of contaminant contained in a fluid.

This parameter refers to a unit volume of fluid.

The level of contamination may be different at different points in the system.

From the information in the previous paragraphs it is also apparent that the level of contamination is heavily influenced by the working conditions of the system, by its working years and by the environmental conditions.

What is the size of the contaminating particles that we must handle in our hydraulic circuit?

Liquid contamination mainly results in decay of lubrication performance and protection of fluid surfaces.

**DISSOLVED WATER**

- **INCREASING FLUID ACIDITY**
  Cause of surface corrosion and premature fluid oxidation

- **GALVANIC COUPLE AT HIGH TEMPERATURES**
  Cause of corrosion

**FREE WATER - ADDITIONAL EFFECTS**

- **DECAY OF LUBRICANT PERFORMANCE**
  Cause of rust and sludge formation, metal corrosion and increased solid contamination

- **BATTERY COLONY CREATION**
  Cause of worsening in the filterability feature

- **ICE CREATION AT LOW TEMPERATURES**
  Cause damage to the surface

- **ADDITIVE DEPLETION**
  Free water retains polar additives

Gaseous contamination mainly results in decay of system performance.

- **ABRASION**
- **ADHESION**
- **EROSION**
- **FATIGUE**

Contamination level analysis is significant only if performed with a uniform and repeatable method, conducted with standard test methods and suitably calibrated equipment.

To this end, ISO has issued a set of standards that allow tests to be conducted and express the measured values in the following ways.

- **GRAVIMETRIC LEVEL - ISO 4405**

  Contamination level analysis is significant only if performed with a uniform and repeatable method, conducted with standard test methods and suitably calibrated equipment.

  To this end, ISO has issued a set of standards that allow tests to be conducted and express the measured values in the following ways.

  - **HUMAN HAIR**
    - (75 µm)
  - **MINIMUM DIMENSION VISIBLE WITH HUMAN EYES**
    - (40 µm)
  - **TYPICAL CONTAMINANT DIMENSION IN A HYDRAULIC CIRCUIT**
    - (4-14 µm)

  The level of contamination is defined by checking the weight of particles collected by a laboratory membrane. The membrane must be cleaned, dried and desiccated, with fluid and conditions defined by the Standard.

  The volume of fluid is filtered through the membrane by using a suitable suction system. The weight of the contaminant is determined by checking the weight of the membrane before and after the fluid filtration.

  - **CLEAN MEMBRANE**
  - **CONTAMINATED MEMBRANE**
The level of contamination is defined by counting the number of particles of certain dimensions per unit of volume of fluid. Measurement is performed by Automatic Particle Counters (APC). Following the count, the contamination classes are determined, corresponding to the number of particles detected in the unit of fluid. The most common classification methods follow ISO 4406 and SAE AS 4059 (Aerospace Sector) regulations. NAS 1638 is still used although obsolete.

Classification example according to ISO 4406
The International Standards Organisation standard ISO 4406 is the preferred method of quoting the number of solid contaminant particles in a sample. The code is constructed from the combination of three scale numbers selected from the following table. The first number represents the number of particles that are larger than 4 μm(c). The second number represents the number of particles larger than 6 μm(c). The third scale number represents the number of particles in a millilitre sample of the fluid that are larger than 14 μm(c).

ISO 4406 - Allocation of Scale Numbers

<table>
<thead>
<tr>
<th>Class</th>
<th>Number of particles per ml</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over</td>
</tr>
<tr>
<td>28</td>
<td>1 300 000</td>
</tr>
<tr>
<td>27</td>
<td>640 000</td>
</tr>
<tr>
<td>26</td>
<td>320 000</td>
</tr>
<tr>
<td>25</td>
<td>160 000</td>
</tr>
<tr>
<td>24</td>
<td>80 000</td>
</tr>
<tr>
<td>23</td>
<td>40 000</td>
</tr>
<tr>
<td>22</td>
<td>20 000</td>
</tr>
<tr>
<td>21</td>
<td>10 000</td>
</tr>
<tr>
<td>20</td>
<td>5 000</td>
</tr>
<tr>
<td>19</td>
<td>2 500</td>
</tr>
<tr>
<td>18</td>
<td>1 300</td>
</tr>
<tr>
<td>17</td>
<td>640</td>
</tr>
<tr>
<td>16</td>
<td>320</td>
</tr>
<tr>
<td>15</td>
<td>160</td>
</tr>
<tr>
<td>14</td>
<td>80</td>
</tr>
<tr>
<td>13</td>
<td>40</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>2.5</td>
</tr>
<tr>
<td>8</td>
<td>1.3</td>
</tr>
<tr>
<td>7</td>
<td>0.64</td>
</tr>
<tr>
<td>6</td>
<td>0.32</td>
</tr>
<tr>
<td>5</td>
<td>0.16</td>
</tr>
<tr>
<td>4</td>
<td>0.08</td>
</tr>
<tr>
<td>3</td>
<td>0.04</td>
</tr>
<tr>
<td>2</td>
<td>0.02</td>
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<tr>
<td>1</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

ISO 4406 Cleanliness Code System
Microscope counting examines the particles differently to APCs and the code is given with two scale numbers only. These are at 5 μm and 15 μm equivalent to the 6 μm(c) and 14 μm(c) of APCs.
It can be made a differential measurement (Table 1) or a cumulative measurement (Table 2).

**Classification example according to SAE AS4059 - Rev. E and SAE AS4059-2 - REV. F**

The code, prepared for the aerospace industry, is based on the size, quantity, and particle spacing in a 100 ml fluid sample. The contamination classes are defined by numeric codes, the size of the contaminant is identified by letters (A-F).

### Table 1 - Class for differential measurement

<table>
<thead>
<tr>
<th>Class</th>
<th>Dimension of contaminant</th>
<th>Maximum Contamination Limits per 100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-14 µm (c)</td>
<td>14-21 µm (c)</td>
<td>21-38 µm (c)</td>
</tr>
<tr>
<td>00</td>
<td>125</td>
<td>22</td>
</tr>
<tr>
<td>0</td>
<td>250</td>
<td>44</td>
</tr>
<tr>
<td>1</td>
<td>1 000</td>
<td>178</td>
</tr>
<tr>
<td>2</td>
<td>2 000</td>
<td>356</td>
</tr>
<tr>
<td>3</td>
<td>4 000</td>
<td>712</td>
</tr>
<tr>
<td>4</td>
<td>8 000</td>
<td>1 425</td>
</tr>
<tr>
<td>5</td>
<td>16 000</td>
<td>2 850</td>
</tr>
<tr>
<td>6</td>
<td>32 000</td>
<td>5 700</td>
</tr>
<tr>
<td>7</td>
<td>64 000</td>
<td>11 400</td>
</tr>
<tr>
<td>8</td>
<td>128 000</td>
<td>22 900</td>
</tr>
<tr>
<td>9</td>
<td>256 000</td>
<td>45 600</td>
</tr>
<tr>
<td>10</td>
<td>512 000</td>
<td>91 200</td>
</tr>
<tr>
<td>12</td>
<td>1 024 000</td>
<td>182 400</td>
</tr>
</tbody>
</table>

**SAE AS4059 - REV. F**

It can be made a differential measurement (Table 1) or a cumulative measurement (Table 2).

### Table 2 - Class for cumulative measurement

<table>
<thead>
<tr>
<th>Class</th>
<th>Dimension of contaminant</th>
<th>Maximum Contamination Limits per 100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;4 µm (c)</td>
<td>&gt;6 µm (c)</td>
<td>&gt;14 µm (c)</td>
</tr>
<tr>
<td>000</td>
<td>195</td>
<td>76</td>
</tr>
<tr>
<td>0</td>
<td>390</td>
<td>152</td>
</tr>
<tr>
<td>0</td>
<td>780</td>
<td>304</td>
</tr>
<tr>
<td>1</td>
<td>1 560</td>
<td>608</td>
</tr>
<tr>
<td>2</td>
<td>3 120</td>
<td>1 217</td>
</tr>
<tr>
<td>3</td>
<td>6 250</td>
<td>2 432</td>
</tr>
<tr>
<td>4</td>
<td>12 500</td>
<td>4 864</td>
</tr>
<tr>
<td>5</td>
<td>25 000</td>
<td>9 731</td>
</tr>
<tr>
<td>6</td>
<td>50 000</td>
<td>19 462</td>
</tr>
<tr>
<td>7</td>
<td>100 000</td>
<td>38 924</td>
</tr>
<tr>
<td>8</td>
<td>200 000</td>
<td>77 849</td>
</tr>
<tr>
<td>9</td>
<td>400 000</td>
<td>155 698</td>
</tr>
<tr>
<td>10</td>
<td>800 000</td>
<td>311 396</td>
</tr>
<tr>
<td>11</td>
<td>1 600 000</td>
<td>622 792</td>
</tr>
<tr>
<td>12</td>
<td>3 200 000</td>
<td>1 245 584</td>
</tr>
</tbody>
</table>

**SAE AS4059 REV F**

cpc* Class 6 6/6/5/5/4/2

The information reproduced on this page is a brief extract from SAE-AS4059 Rev.E, revised in May 2005. For further details and explanations refer to the full Standard.
- CLASSES OF CONTAMINATION ACCORDING TO NAS 1638 (January 1964)

The NAS system was originally developed in 1964 to define contamination classes for the contamination contained within aircraft components. The application of this standard was extended to industrial hydraulic systems simply because nothing else existed at the time. The coding system defines the maximum numbers permitted of 100 ml volume at various size intervals (differential counts) rather than using cumulative counts as in ISO 4406. Although there is no guidance given in the standard on how to quote the levels, most industrial users quote a single code which is the highest recorded in all sizes and this convention is used on MP Filtri APC’s.

The contamination classes are defined by a number (from 00 to 12) which indicates the maximum number of particles per 100 ml, counted on a differential basis, in a given size bracket.

### Maximum Contamination Limits per 100 ml

<table>
<thead>
<tr>
<th>Size Range Classes (in microns)</th>
<th>Maximum Contamination Limits per 100 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class</strong></td>
<td><strong>5-15</strong></td>
</tr>
<tr>
<td>00</td>
<td>125</td>
</tr>
<tr>
<td>0</td>
<td>250</td>
</tr>
<tr>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>2</td>
<td>1,000</td>
</tr>
<tr>
<td>3</td>
<td>2,000</td>
</tr>
<tr>
<td>4</td>
<td>4,000</td>
</tr>
<tr>
<td>5</td>
<td>8,000</td>
</tr>
<tr>
<td>6</td>
<td>16,000</td>
</tr>
<tr>
<td>7</td>
<td>32,000</td>
</tr>
<tr>
<td>8</td>
<td>64,000</td>
</tr>
<tr>
<td>9</td>
<td>128,000</td>
</tr>
<tr>
<td>NAS 1638</td>
<td>256,000</td>
</tr>
<tr>
<td>10</td>
<td>512,000</td>
</tr>
<tr>
<td>11</td>
<td>1,024,000</td>
</tr>
</tbody>
</table>

- CUMULATIVE DISTRIBUTION OF THE PARTICLES SIZE - ISO 4407

The level of contamination is defined by counting the number of particles collected by a laboratory membrane per unit volume. The measurement is done by a microscope. The membrane must be cleaned, dried and desiccated, with fluid and conditions defined by the Standard. The fluid volume is filtered through the membrane, using a suitable suction system. The level of contamination is identified by dividing the membrane into a predefined number of areas and by counting the contaminant particles using a suitable laboratory microscope.

**MICROSCOPE CONTROL AND MEASUREMENT**

**COMPARISON PHOTOGRAPH’S**

Example figure 1and 2

ISO 4406
SAE AS4059E Table 1 Class 16/14/11 Class 22/20/17
SAE AS4059E Table 2 Class 5 Class 11
NAS 1638 Class 5 Class 11

For other comparison photographs for contamination classes see the “Fluid Condition and Filtration Handbook”.

- CLEANLINESS CODE COMPARISON

Although ISO 4406 standard is being used extensively within the hydraulics industry other standards are occasionally required and a comparison may be requested. The table below gives a very general comparison but often no direct comparison is possible due to the different classes and sizes involved.

<table>
<thead>
<tr>
<th>ISO 4406</th>
<th>SAE AS4059 Table 2</th>
<th>SAE AS4059 Table 1</th>
<th>NAS 1638</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 4 µm(c)</td>
<td>&gt; 4 µm(c)</td>
<td>4-6</td>
<td>5-15</td>
</tr>
<tr>
<td>6 µm(c)</td>
<td>6 µm(c)</td>
<td>14-21</td>
<td>15-25</td>
</tr>
<tr>
<td>14 µm(c)</td>
<td>14 µm(c)</td>
<td>21-38</td>
<td>25-50</td>
</tr>
<tr>
<td>&gt;70</td>
<td>&gt;70</td>
<td>&gt;70</td>
<td>&gt;100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>&lt; 3 µm</th>
<th>1 graduation = 10µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2200 particles</td>
</tr>
<tr>
<td>5 µm(c)</td>
<td>6400 particles</td>
</tr>
<tr>
<td>10 µm(c)</td>
<td>12,800 particles</td>
</tr>
<tr>
<td>20 µm(c)</td>
<td>25,600 particles</td>
</tr>
<tr>
<td>50 µm(c)</td>
<td>64,000 particles</td>
</tr>
<tr>
<td>100 µm(c)</td>
<td>128,000 particles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5 µm(c)</th>
<th>6 µm(c)</th>
<th>14 µm(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>356</td>
<td>63</td>
<td>11</td>
</tr>
<tr>
<td>712</td>
<td>126</td>
<td>22</td>
</tr>
<tr>
<td>1,420</td>
<td>256</td>
<td>45</td>
</tr>
<tr>
<td>2,850</td>
<td>506</td>
<td>90</td>
</tr>
<tr>
<td>5,700</td>
<td>1,012</td>
<td>180</td>
</tr>
<tr>
<td>11,400</td>
<td>2,025</td>
<td>360</td>
</tr>
<tr>
<td>22,800</td>
<td>4,040</td>
<td>720</td>
</tr>
<tr>
<td>51,200</td>
<td>10,240</td>
<td>1,440</td>
</tr>
</tbody>
</table>

5 RECOMMENDED CONTAMINATION CLASSES

The table below gives a selection of maximum contamination levels that are typically issued by component manufacturer. These relate to the use of the correct viscosity mineral fluid. An even cleaner level may be needed if the operation is severe, such as high frequency fluctuations in loading, high temperature or high failure risk.

- Piston pumps with fixed flow rate
- Piston pumps with variable flow rate
- Vane pumps with fixed flow rate
- Vane pumps with variable flow
- Engineers
- Hydraulic cylinders
- Actuators
- Test benches
- Check valve
- Directional valves
- Flow regulating valves
- Proportional valves
- Servo-valves
- Flat bearings
- Ball bearings
- ISO 4406 CODE
- Recommended filtration B20(c) > 1000 B15(c) > 1000 B10(c) > 1000 B7(c) > 1000 B5(c) > 1000
WATER IN HYDRAULIC AND LUBRICATING FLUIDS

Water Content

In mineral oils and non aqueous resistant fluids water is undesirable. Mineral oil usually has a water content of 50-300 ppm (at 40°C) which it can support without adverse consequences. Once the water content exceeds about 300 ppm the oil starts to appear hazy. Above this level there is a danger of free water accumulating in the system in areas of low flow. This can lead to corrosion and accelerated wear. Similarly, fire resistant fluids have a natural water which may be different to mineral oil.

Saturation Levels

Since the effects of free (also emulsified) water is more harmful than those of dissolved water, water levels should remain well below the saturation point. However, even water in solution can cause damage and therefore every reasonable effort should be made to keep saturation levels as low as possible. There is no such thing as too little water. As a guideline, we recommend maintaining saturation levels below 50% in all equipment.

TYPICAL WATER SATURATION LEVEL FOR NEW OILS

Examples:
- Hydraulic oil @ 30°C = 200 ppm = 100% saturation
- Hydraulic oil @ 65°C = 500 ppm = 100% saturation

W - Water and Temperature Sensing

“W” option, in MP Filtri Contamination Monitoring Products, indicates water content as a percentage of saturation and oil temperature in degrees centigrade. 100% RH corresponds to the point at which free water can exist in the fluid. i.e. the fluid is no longer able to hold the water in a dissolved solution. The sensor can help provide early indication of costly failure due to free water, including but not exclusive to corrosion, metal surface fatigue e.g. bearing failure, reduced lubrication & load carrying characteristics.

Different oils have different saturation levels and therefore RH (relative humidity) % is the best and most practical measurement.

Water absorber

Water is present everywhere, during storage, handling and servicing. MP Filtri filter elements feature an absorbent media which protects hydraulic systems from both particulate and water contamination. MP Filtri’s filter element technology is available with inorganic microfiber media with a filtration rating 25 μm (therefore identified with media designation WA025, providing absolute filtration of solid particles to \( \theta_{(dc)} = 1000 \)). Absorbent media is made by water absorbent fibres which increase in size during the absorption process. Free water is thus bonded to the filter media and completely removed from the system (it cannot even be squeezed out).

By removing water from your fluid power system, you can prevent such key problems as:
- corrosion (metal etching)
- loss of lubricant power
- accelerated abrasive wear in hydraulic components
- valve-locking
- bearing fatigue
- viscosity variance (reduction in lubricating properties)
- additive precipitation and oil oxidation
- increase in acidity level
- increased electrical conductivity (loss of dielectric strength)
- slow/weak response of control systems

Product availability - UFM Series:
- UFM 041 - UFM 051 - UFM 091 - UFM 181 - UFM 919

Fabric that absorbs water
The Filter Media has absorbed water

Microfibre filtration technology

By removing water from your fluid power system, you can prevent such key problems as:
- corrosion (metal etching)
- loss of lubricant power
- accelerated abrasive wear in hydraulic components
- valve-locking
- bearing fatigue
- viscosity variance (reduction in lubricating properties)
- additive precipitation and oil oxidation
- increase in acidity level
- increased electrical conductivity (loss of dielectric strength)
- slow/weak response of control systems

Product availability - UFM Series:
- UFM 041 - UFM 051 - UFM 091 - UFM 181 - UFM 919
Remote Display Unit
Depending on your application, access and visibility of particle counting equipment can sometimes be an issue. The ICM-RDU has specially been developed to dovetail with its parent ICM 2.0. So you have the option to control and monitor the ICM 2.0 remotely. Supplied with a 10m cable as standard.

**Features & Benefits**
- Large backlit display
- Keypad interface
- Robust die-cast aluminium construction

**Scope of Supply**
1 x ICM-RDU 2.0
1 x 10m Twisted Pair Cable Assembly
1 x Digital copy of user guides/software/drivers

**Status LED**
All RDU 2.0 versions have a multicolour indicator on the front panel, which is used to indicate the status or alarm state. RDU-K versions also have a screen that changes colour. The alarm thresholds can be set from LPA-View via the serial interface.

**Screen and multicolor indicators**
- Green indicates that the test result passed, i.e. none of the alarm thresholds were exceeded
- Yellow indicates that the lower cleanliness limit was exceeded, but not the upper one
- Red indicates that the upper cleanliness limit was exceeded
- Blue indicates that the upper water content limit was exceeded
- Red/Blue Alternating indicates both cleanliness and water content upper limits exceeded
- Violet indicates that the upper temperature limit was exceeded

**Dimensions**

**Designation & Ordering code**

<table>
<thead>
<tr>
<th>RDU 2.0</th>
<th>Configuration:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>iCM RDU 2.0</td>
</tr>
</tbody>
</table>
Electric Vacuum Pump
MP Filtri’s Patch Imaging Kit is available with an optional electric pump (spares number: 444.009000). The pump is available with power options for the UK, EU, US, AUS/CN.

Used with PIK

Flow Control Valve
The FC1 is a pressure compensated flow control valve which can operate across a range of fluid types and is compatible with the ICM where flow rate exceeds operating parameters. Max pressure rating 400 bar at normal hydraulic system temperatures.

Features & Benefits
- Pressure compensated
- Regulates flow to within ICM specification
- Various connection options
- Viscosity independent
- Hexagonal form for ease of installation

Dimensions

ICM-FC1

Contamination Monitoring Products
Auxiliary Communication Options
We offer four auxiliary communication devices to operate with the ICM 2.0:

ICM-USBi:
Two auxiliary communication devices are available to order with the ICM. A USB interface which allows for communication via a laptop (RS485 to RS232 converter) & an ethernet device for remote access via a network hub.

ICM-ETHi:
An ethernet device enables remote access via a network hub via Com Port redirection software.

Both devices can transmit power to the ICM/RDU electrical circuit using a DC power adapter.
The USBi has the additional benefit of supplying power via the USB cable directly. Both devices come with a DC Power adapter and 3m twisted pair cable as standard.

Features & Benefits
- Compact
- Off the shelf solution
- Robust aluminium construction

Plug and play technology
- Robust aluminium construction
- Compact
- Provided with a twisted cable conductors 8, length 3m.
- All devices can transmit power to the ICM/RDU electrical circuit using the supplied DC power adapter.
ICM-USBi & ICM-ETHi

Dimensions

ICM-USBi

ICM-ETHi

Designation & Ordering code

ICM-USBi & ICM-ETHi

Configuration: ICM  USBi  ICM  ETHi
Description

Screen Filter
The SK0040 coarse screen filter adapter is designed to limit the ingress of large particles into MP Filtri’s range of Contamination Monitoring Products (CMP).

Features & Benefits
- Part number: SK0040
- Inlet connection: M16x2 male test point
- Outlet connection: M16x2 female thread form
- Pressure rating: 400 bar
- Mesh rating: 600 µm

Dimensions

Designation & Ordering code

<table>
<thead>
<tr>
<th>Configuration</th>
<th>SK0040</th>
</tr>
</thead>
</table>
Description

**Features & Benefits**

We supply laboratory standard and certified clean sampling bottles. 100 ml, 210 ml and 500 ml bottle sizes are available and are easily incorporated into our range of bottle samplers.

Designation & Ordering code

**BS110 - BS500**

For Ordering Codes see page 88-91

**PRESSURE & WASTE HOSES**

Description

**Features & Benefits**

Replacement hoses.

**Pressure Hose**

M16x2 Micro bore pressure hose by length (various available) long

Plated steel (alternative material options available)

Pressure hoses are able to connect MP Filtri products directly to your hydraulic systems.

<table>
<thead>
<tr>
<th>- LPA3</th>
<th>- LPA2</th>
<th>- CML2</th>
<th>- CML4</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS110</td>
<td>BS500</td>
<td>ICM 2.0</td>
<td></td>
</tr>
</tbody>
</table>

**Waste Hose**

Length: 2000 mm

OD: 8 mm

ID: 5 mm

Standard material: Polyurethane*

Fitting type: Quick release coupling (brass as standard)

*Other versions available to suit the M, N and S versions of CMP

Designation & Ordering code

**HOSES**

For Ordering Codes see page 88-91