In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. The liquid is both a lubricant and a power-transmitting medium.

The presence of solid contaminant particles in the liquid interferes with the ability of the hydraulic fluid to lubricate and causes wear to the components. The extent of contamination in the fluid has a direct bearing on the performance and reliability of the system and it is necessary to control solid contaminant particles to levels that are considered appropriate for the system concerned.

A quantitative determination of particulate contamination requires precision in obtaining the sample and in determining the extent of contamination. Liquid Automatic Particle Counters (APC) (MP Filtri Products), work on the light-extinction principle. This has become an accepted means of determining the extent of contamination. The accuracy of particle count data can be affected by the techniques used to obtain such data.

The NAS 1638 reporting format was developed for use where the principle means of counting particles was the optical microscope, with particles sized by the longest dimension per ARP598. When APC’s came in to use this provided a method of analysing a sample much faster than the ARP598 method. A method of calibrating APC’s was developed, although they measured area and not length, such that comparable results to that of ARP598 could be obtained from the same sample. Now, APC’s are the primary method used to count particles and the projected area of a particle determines size. Because of the way particles are sized with the two methods, APC’s and optical microscopes do not always provide the same results. **NAS 1638 has now been made inactive for new design and has been revised to indicate it does not apply to use of APC’s.**

Prior to ISO 11171, the previous APC calibration method most widely utilised was ISO 4402, which used Air Cleaner Fine Test Dust (ACFTD) as the reference calibration material. ACFTD is no longer manufactured and the ISO 4402 method using this dust has been made obsolete. The industry developed the method ISO 11171, which supersedes ISO 4402, with a calibration standard based on NIST-certified samples of ISO 12103-1 A3 medium test dust suspended in hydraulic oil. There is a difference between the particle measurements by ISO 4402 and ISO 11171. To retain the same cleanliness measure, calibrations using ISO 11171 are conducted to a corrected particle count scale. For example, particles reported as 5 um with the ISO 4402 method are reported as 6 um (c) by the ISO 11171 method. In fact 5 um corresponds to 6.4 um (c), and some round off was conducted for simplification.
**Particle size analysis**

Several methods and instruments based on different physical principles are used to determine the size distribution of the particles suspended in aeronautical fluids. The numbers of particles found in the different size ranges characterize this distribution. A single particle therefore has as many equivalent diameters as the number of counting methods used.

Figure 1 shows the size given to the particle being analysed (shading) by a microscope as its longest chord and an APC calibrated in accordance with ISO 11171 using the Standard Reference Material NIST SRM 2806 sized by the equivalent projected area.

**Differences between NAS 1638 and AS4059E.**

AS4059E was developed as a replacement/equivalent to the obsolete NAS 1638 format, where table 2 relates to the old AS4059D standard and table 1 is the equivalent NAS1638 standard. However, there are differences. Particularly in Table 2, (Cumulative Particle Counts).

**Counting of Smaller Particles.**

AS4059E allows the analysis and reporting of smaller particle sizes than NAS 1638.

**Counting Large Particles and Fibres.**

In some samples, it has been observed that many of the particles larger than 100 micrometers are fibres. However, APC’s size particles based on projected area rather than longest dimension and do not differentiate between fibres and particles. Therefore, fibres will be reported as particles with dimensions considerably less than the length of the fibres. A problem with fibres is that they may not be present in fluid in the system but rather have been introduced as the result of poor sampling techniques or poor handling during analysis.

**Determining AS4059E Class Using Differential Particle Counts:**

This method is applicable to those currently using NAS 1638 classes and desiring to maintain the methods/format, and results equivalent to those specified in NAS 1638.

Table 1 applies to acceptance criteria based on differential particle counts, and provides a definition of particulate limits for Classes 00 through 12. A class shall be determined for each particle size range. The reported class of the sample is the highest class in any given particle range size.

**NOTE:** The classes and particle count limits in Table 1 are identical to NAS 1638. Measurements of particle counts are allowed by use of an automatic particle counter (calibrated per ISO 11171 or ISO 4402:1991), or an optical or electron microscope. The size ranges measured and reported should be determined from Table 1 based on the measurement method.
Determining AS4059E Class Using Cumulative Particle Counts:

This method is applicable to those using the methods of previous revisions of AS4059 and/or cumulative particle counts. The cleanliness levels for this method shall be specified by the appropriate class from Table 2. To provide versatility, the applicable cleanliness class can be identified in the following ways:

a. Basing the class on the highest class of multiple size ranges.
b. Total number of particles larger than a specific size.
c. Designating a class for each size range.

Designating a Class for Each Size Range:

APC's can count the number of particles in several size ranges. Today, a different class of cleanliness is often desired for each of several size ranges. Requirements can be stated and cleanliness can easily be reported for a number of size ranges. A class may be designated for each size from A through F*. An example is provided below:

7B/6C/5D is a numeric-alpha representation in which the number designates the cleanliness class and the alphabetical letter designates the particle size range to which the class applies. It also indicates that the number of particles for each size range do not exceed the following maximum number of particles:

Size B: 38,924 per 100 ml
Size C: 3462 per 100 ml
Size D: 306 per 100 ml

*Please check standard for definition of size/classes

Sampling procedures are defined in ISO4021. Extraction of fluid samples from lines of an operating system. Receptacles should be cleaned in accordance with DIN/1505884. The degree of cleanliness should be verified to ISO3722.
Methods of taking sample from hydraulic applications, using appropriate recepticles

Methods One & Two

**Method One – Preferred method**
(Using a suitable sampling valve with PTFE seating method)

- Install sampling valve in pressure or return line (in closed condition) at an appropriate point under constant flow or turbulent conditions
- Operate system for at least 30 minutes before taking a sample
- Clean outside of sampling valve
- Open the sampling valve to give appropriate flow rate and flush at least one litre of fluid through the valve
  **Do Not Close Valve After Flushing**
- Remove cap from sampling bottle. Ensure cap is retained in hand face downwards
- Place bottle under sampling valve. Fill bottle to neck. Cap bottle & wipe.
- Close the sampling valve
- Label the bottle with the necessary information for analysis e.g. Oil type, running hours, system description etc.

**Method Two – Preferred method**
(Using an unspecified sampling valve)

- Install valve in return line or an appropriate point where flow is constant and does not exceed 14 bar
- Operate system for at least 30 minutes before taking a sample
- Flush sampling valve by passing at least 45 litres through valve back to reservoir
- Disconnect line from valve to reservoir with valve open and fluid flowing

Methods Three & Four

**Method Three - Reservoir sampling**
(Use only if methods One & Two cannot be used)

- Operate system for at least one hour before taking a sample
- Thoroughly clean area around the point of entry to the reservoir
- Attach sample bottle to the sampling device
- Carefully insert sampling hose into the midway point of the reservoir. Try not to touch sides or baffles within the reservoir
- Extract sample using the vacuum pump and fill to approx 75% volume
- Release vacuum, disconnect bottle and discard fluid
- **Repeat the above three steps three times to ensure flushing of the equipment**
- Attach ultra cleaned sample bottle to sampling device – collect final fluid sample
- Remove bottle from sampling device & cap - label with appropriate information
- Label the bottle with the necessary information for analysis e.g. Oil type, running hours, system description etc.

**Method Four - Bottle Dipping**
(Least preferred method due to possible high ingression of contamination)

- Operate system for at least one hour before taking a sample
- Thoroughly clean area around the point of entry to the reservoir where sample bottle is to be inserted
- Clean outside of ultra clean sample bottle using filtered solvent, allow to evaporate dry
- Dip sample bottle into reservoir, cap and wipe
- Re-seal reservoir access
- Label the bottle with the necessary information for analysis e.g. Oil type, running hours, system description etc.
Cleanliness Reporting Formats

ISO 4406:1999 Cleanliness Code System

The International Standards Organisation standard ISO 4406:1999 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** scale number represents the number of particles in a millilitre sample of the fluid that are larger than 4 μm(c).

The **second** number represents the number of particles larger than 6 μm(c).

The **third** number represents the number of particles that are larger than 14 μm(c).

<table>
<thead>
<tr>
<th>Scale No.</th>
<th>Number of Particles per mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>More than 2.5M</td>
</tr>
<tr>
<td>27</td>
<td>Up to and including 1.3M</td>
</tr>
<tr>
<td>26</td>
<td>640k</td>
</tr>
<tr>
<td>25</td>
<td>320k</td>
</tr>
<tr>
<td>24</td>
<td>160k</td>
</tr>
<tr>
<td>23</td>
<td>80k</td>
</tr>
<tr>
<td>22</td>
<td>40k</td>
</tr>
<tr>
<td>21</td>
<td>10k</td>
</tr>
<tr>
<td>20</td>
<td>5000</td>
</tr>
<tr>
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<td>2500</td>
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<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>0.15</td>
</tr>
<tr>
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<td>0.08</td>
</tr>
<tr>
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<td>0.04</td>
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<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 5 - ISO 4406 Allocation of Scale Numbers

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 the APCs.
Cleanliness Reporting Formats

Classes of Contamination According to NAS 1638

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 100ml volume at various size intervals (differential counts) rather than using cumulative counts as in ISO 4406:1999.

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’s APC’s.

CONTAMINATION LEVEL CLASSES according to NAS 1638 (January 1964)

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.
Cleanliness Reporting Formats

SAE AS 4059 REV.E**
Cleanliness Classification for Hydraulic Fluids (SAE Aerospace Standard)

This SAE Aerospace Standard (AS) defines cleanliness levels for particulate contamination of hydraulic fluids and includes methods of reporting data relating to the contamination levels.

Tables 1 and 2 below provide differential and cumulative particle counts respectively for counts obtained by an automatic particle counter, e.g., LPA2.

** The information reproduced on this and the previous page is a brief extract from SAE AS4059 Rev.E, revised in May 2005. For further details and explanations refer to the full Standard.
How BIG are the particles we have to control

Micron Rating Size Comparisons

1 Micron* = 0.001mm
25.4 Micron* = 0.001 inch
(* correct designation = Micrometre)

<table>
<thead>
<tr>
<th>Substance</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEACH SAND</td>
<td>100</td>
<td>2,000</td>
</tr>
<tr>
<td>LIMESTONE DUST</td>
<td>10</td>
<td>1,000</td>
</tr>
<tr>
<td>CARBON BLACK</td>
<td>5</td>
<td>500</td>
</tr>
<tr>
<td>HUMAN HAIR (diameter)</td>
<td>40</td>
<td>150</td>
</tr>
<tr>
<td>CARBON DUST</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>CEMENT DUST</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>TALC DUST</td>
<td>5</td>
<td>60</td>
</tr>
<tr>
<td>BACTERIA</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>PIGMENTS</td>
<td>0,1</td>
<td>7</td>
</tr>
<tr>
<td>TOBACCO SMOKE</td>
<td>0,01</td>
<td>1</td>
</tr>
</tbody>
</table>

For all practical purposes particles of 1 micron size and smaller are permanently suspended in air.

100µm Dust Particle (Dead Skin)
75µm Human Hair
40µm Pollen (Smallest particle human eye can see)

4 - 14µm Typical particles in a hydraulic system
ISO 4406:1999  
Class 14/12/9  
SAE AS4059E Table 1  
Class 3  
NAS 1638  
Class 3  
SAE AS4059E Table 2  
Class 4A/3B/3C

1 graduation = 10 µm

ISO 4406:1999  
Class 15/13/10  
SAE AS4059E Table 1  
Class 4  
NAS 1638  
Class 4  
SAE AS4059E Table 2  
Class 5A/4B/4C

1 graduation = 10 µm
### Comparison Photograph's for Contamination Classes

<table>
<thead>
<tr>
<th>Standard</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 4406:1999</td>
<td>16/14/11</td>
</tr>
<tr>
<td>SAE AS4059E Table 1</td>
<td>Class 5</td>
</tr>
<tr>
<td>NAS 1638</td>
<td>Class 5</td>
</tr>
<tr>
<td>SAE AS4059E Table 2</td>
<td>6A/5B/5C</td>
</tr>
</tbody>
</table>

1 graduation = 10 µm

<table>
<thead>
<tr>
<th>Standard</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 4406:1999</td>
<td>17/15/12</td>
</tr>
<tr>
<td>SAE AS4059E Table 1</td>
<td>Class 6</td>
</tr>
<tr>
<td>NAS 1638</td>
<td>Class 6</td>
</tr>
<tr>
<td>SAE AS4059E Table 2</td>
<td>7A/6B/6C</td>
</tr>
</tbody>
</table>

1 graduation = 10 µm
Comparison Photograph's for Contamination Classes

ISO 4406:1999  Class 18/16/13
SAE AS4059E Table 1  Class 7
NAS 1638  Class 7
SAE AS4059E Table 2  Class 8A/7B/7C

1 graduation= 10 µm

ISO 4406:1999  Class 19/17/14
SAE AS4059E Table 1  Class 8
NAS 1638  Class 8
SAE AS4059E Table 2  Class 9A/8B/8C

1 graduation= 10 µm
### ISO 4406:1999

<table>
<thead>
<tr>
<th>Standard</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE AS4059E Table 1</td>
<td>Class 9</td>
</tr>
<tr>
<td>NAS 1638</td>
<td>Class 9</td>
</tr>
<tr>
<td>SAE AS4059E Table 2</td>
<td>Class 10A/9B/9C</td>
</tr>
</tbody>
</table>

1 graduation = 10 µm

### Comparison Photograph's for Contamination Classes

#### ISO 4406:1999

<table>
<thead>
<tr>
<th>Standard</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE AS4059E Table 1</td>
<td>Class 10</td>
</tr>
<tr>
<td>NAS 1638</td>
<td>Class 10</td>
</tr>
<tr>
<td>SAE AS4059E Table 2</td>
<td>Class 11A/10B/10C</td>
</tr>
</tbody>
</table>

1 graduation = 10 µm
ISO 4406:1999 Class 22/20/17
SAE AS4059E Table 1 Class 11
NAS 1638 Class 11
SAE AS4059E Table 2 Class 12A/11B/11C

1 graduation = 10 µm

ISO 4406:1999 Class 23/21/18
SAE AS4059E Table 1 Class 12
NAS 1638 Class 12
SAE AS4059E Table 2 Class 13A/12B/12C

1 graduation = 10 µm

Comparison Photograph's for Contamination Classes
Contamination Classes

**NAS 12**
**ISO 23/21/18**
Typically New Oil as delivered in new certified mild steel 250 ltr barrels

**NAS 7**
**ISO 18/15/13**
Typically New Oil as delivered in new certified mini containers

**NAS 9**
**ISO 21/18/15**
Typically New Oil as delivered in oil tankers

**NAS 6**
**ISO 17/15/12**
Typically Required for most modern hydraulic systems
Most component manufacturers know the proportionate effect that increased dirt level has on the performance of their components and issue maximum permissible contamination levels. They state that operating components on fluids which are cleaner than those stated will increase life.

However, the diversity of hydraulic systems in terms of pressure, duty cycles, environments, lubrication required, contaminant types, etc, makes it almost impossible to predict the components service life over and above that which can be reasonably expected.

Furthermore, without the benefits of significant research material and the existence of standard contaminant sensitivity tests, manufacturers who publish recommendations that are cleaner than competitors may be viewed as having a more sensitive product.

Hence there may be a possible source of conflicting information when comparing cleanliness levels recommended from different sources.

The table opposite 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.
Hydraulic System
Target Cleanliness Levels****

Where a hydraulic system user has been able to check cleanliness levels over a considerable period, the acceptability, or otherwise, of those levels can be verified. Thus if no failures have occurred, the average level measured may well be one which could be made a benchmark. However, such a level may have to be modified if the conditions change, or if specific contaminant-sensitive components are added to the system. The demand for greater reliability may also necessitate an improved cleanliness level.

The level of acceptability depends on three features

- the contamination sensitivity of the components
- the operational conditions of the system
- the required reliability and life expectancy

<table>
<thead>
<tr>
<th>Contamination codes ISO 4406</th>
<th>Correspondent codes NAS 1638</th>
<th>Recommended filtration degree</th>
<th>Typical applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>4μm(c) 6μm(c) 14μm(c)</td>
<td></td>
<td>3, 6, 10-12</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>12</td>
<td>9</td>
<td>B x ≥1000</td>
</tr>
<tr>
<td>17</td>
<td>15</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>16</td>
<td>13</td>
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<td></td>
</tr>
<tr>
<td>25</td>
<td>25</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Filter Element Beta Ratio
Information

Filter Beta Ratios

The Beta Ratio equals the ratio of the number of particles of a maximum given size upstream of the filter to the number of particles of the same size and larger found downstream. Simply put, the higher the Beta Ratio the higher the capture efficiency of the filter.

\[
\beta_{5.1} = \frac{4000}{4} = 1000\]

Beta Ratio - value \( \beta_{5.1} \) > 1000  Absolute Filtration
Technical Information on Reynolds Numbers

The flow of fluids (either laminar or turbulent) is determined by evaluating the Reynolds number of the flow. The Reynolds number, based on studies of Osborn Reynolds, is a dimensionless number comprised of the physical characteristics of the flow.

For practical purposes, if the Reynolds number is less than 2000, the flow is laminar. If it is greater than 3500, the flow is turbulent. Flows with Reynolds numbers between 2000 and 3500 are sometimes referred to as transitional flows.

In practice for hydraulic/lubrication systems turbulent flow is achieved when the Reynolds number is greater than 4000 (Re > 4000).

Reynolds number is given by (Re) = \( \frac{21220 \times Q}{\pi \times d_i \times \nu} \)

Where:

- \( Q \) = Volumetric Flow Rate (litres/min)
- \( d_i \) = Inside diameter or equivalent diameter of largest flow gallery (mm)
- \( \nu \) = Viscosity of the flushing fluid at normal flushing temperature (Cst)

Flushing Information for Various Pipe Diameters

Component cleaning/flushing systems can only be effective if Turbulent Flow is achieved.

The following guideline is with a fluid having a 86 - kg/m³ fluid density (typical mineral oils) and 30 cst viscosity.

<table>
<thead>
<tr>
<th>Pipe size nom</th>
<th>Core inches</th>
<th>Core mm</th>
<th>Flow for Re = 4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4”</td>
<td>0.451</td>
<td>11.5</td>
<td>65 l/min</td>
</tr>
<tr>
<td>1/2”</td>
<td>0.734</td>
<td>18.6</td>
<td>105 l/min</td>
</tr>
<tr>
<td>1”</td>
<td>1.193</td>
<td>30.3</td>
<td>171 l/min</td>
</tr>
<tr>
<td>1 1/4”</td>
<td>1.534</td>
<td>39.0</td>
<td>220 l/min</td>
</tr>
<tr>
<td>1 1/2”</td>
<td>1.766</td>
<td>44.9</td>
<td>254 l/min</td>
</tr>
<tr>
<td>2”</td>
<td>2.231</td>
<td>56.7</td>
<td>320 l/min</td>
</tr>
</tbody>
</table>

Pressure Changes

Evaluation of differential pressure versus flow characteristics

Increasing a pressure in a hydraulic system means

- Increasing compressibility of oil
- Increasing viscosity of oil

<table>
<thead>
<tr>
<th>ISO VG</th>
<th>Pressure bar</th>
<th>50</th>
<th>100</th>
<th>200</th>
<th>300</th>
<th>400</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Viscosity Increase</td>
<td></td>
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<tr>
<td>32</td>
<td>35</td>
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<td>349</td>
<td>380</td>
<td>458</td>
<td>534</td>
<td>655</td>
<td></td>
</tr>
</tbody>
</table>

\[ \Delta p \text{ complete} = \Delta p \text{ body} + \Delta p \text{ element} \]

- \( \Delta p \text{ body} \) FHP 135 3  0,65 bar
- \( \Delta p \text{ element} \) HP 135 3 A 10
- Q 150 \times \Theta 0,00338 \times ( V_2 77 / V_1 30 ) 1,3 bar

\[ \Delta p \text{ complete} = \Delta p \text{ body} 0,65 + \Delta p \text{ element} 1,3 =1,95 \text{ bar} \]

\[ \Delta p \text{ complete at pressure} < 50 \text{ bar} = 1,43 \text{ bar} \]

\[ \Delta p \text{ complete at pressure} 300\text{ bar} = 1,95 \text{ bar} \]
### Cleanliness Code Comparison

The table above gives a very general comparison but often no direct comparison is possible due to the different classes and sizes involved. 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 above gives a very general comparison.

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

Viscosity Conversion Chart

STD grades against temperature

Viscosity (cSt)
In mineral oils and non-aqueous fire resistant fluids water is undesirable. Mineral oil usually has a water content of 50-300ppm which it can support without adverse consequences. Once the water content exceeds about 500ppm 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 content which may be different to mineral oil. (From North Notts Fluid Power Centre)

**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.
Contamination Monitoring Products

BS110 & BS250 – Bottle Samplers
The BS110 & BS250 bottle samplers are suitable for off line and laboratory applications where fluid sampling at point of use is in-accessible or impractical. A fluid de-aeration facility comes as standard.

PML2 – Permanently Mounted Laser Particle Analyser
The PML2 is a pressure dependant in-line product intended for on-site and industrial applications. It can automatically measure and display particulate contamination, moisture and temperature levels in various hydraulic fluids.

ICM - Inline Contamination Monitor
The ICM automatically measures and displays particulate contamination, moisture and temperature levels in various hydraulic fluids. It is designed specifically to be mounted directly to systems, where ongoing measurement or analysis is required, and where space and costs are limited.

VPAF – 100
A simple way to check the fluid used in hydraulic applications is to verify the contamination of solid particles; the KIT “VPAF – 100” is suitable for checking these contaminants.

LPA2 – Twin Laser Particle Analyser
The LPA2 is a highly precise, lightweight & fully portable instrument suitable for on-site and laboratory applications. It can automatically measure and display particulate contamination, moisture and temperature levels in various hydraulic fluids.

CML2 – Compact Laser Particle Analyser
The CML2 is a compact, super lightweight mains operated unit for on-site and laboratory applications. It can automatically measure and display particulate contamination, moisture and temperature levels in various hydraulic fluids.

www.mpfiltri.co.uk  Condition Monitoring Division
www.mpfiltri.com  Group Headquarters
The complete range of Contamination Monitoring Products

Don’t let Contamination Create a Crisis!

70–80% of all failures on hydraulic systems + up to 45% of all bearing failures are due to contaminants in the hydraulic fluid.

When contamination is the problem, we have the solution.

The Complete Hydraulic Filtration & Accessory Range

When contamination is the problem, we have the solution.