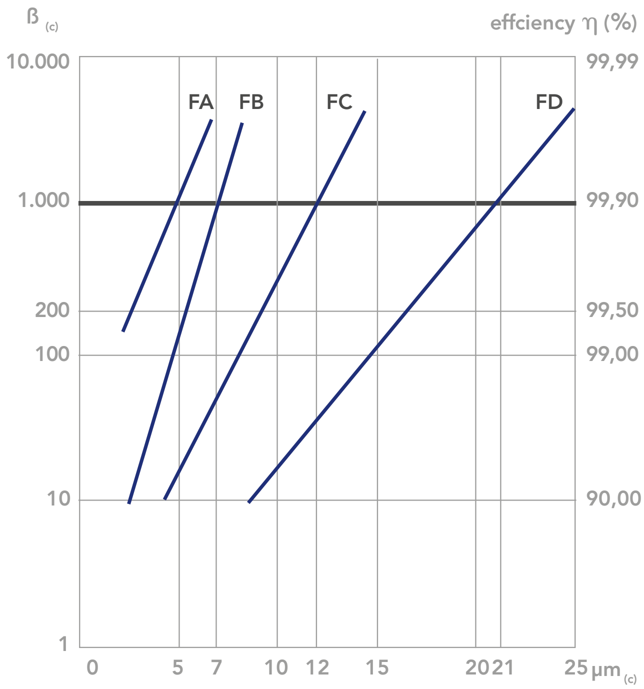
# FILTRATION IN BRIEF

The actual retention capacity behaviour is described in the graph here below:




## REFERENCES FOR THE "BETA" RATIO

The standard ISO 16889 has replaced the former ISO 4572 concerning the Multi-Pass test, stating the Beta value of a filter element, since 1999. The current standard prescribes the test dust ISO MTD instead of the formerly used ACFTD, both in Multi-Pass test rigs as well as the calibration of the automatic particle counters.

According to the ISO 16889 the particles sizes are measured with a different method than according to the ISO 4572.
To avoid any confusion, when microns are measured according to the current specification, they are identified as µm(c).

## REAL FLOW RATE THROUGH THE FILTER

In order to properly size the filter, it is essential to calculate the REAL flow rate of the oil passing through it:

- In SUCTION AND PRESSURE FILTERS the flow rate is usually the same as the pump delivery (with the exception of the FPD01 and 12 series, where the flow rate is just the one required by the pilot valve)
- In RETURN FILTERS it is necessary to calculate the maximum possible flow rate, taking into account any potential additional return line, cylinder and accumulator. If such data are unknown, as a good rule a flow rate at least 2 ÷ 2,5 times the pump delivery should be considered.

Filter element life is significantly affected by the pollution level at the machine location and by the maintenance level of the machine. Considering these parameters the actual flow rate should be multiplied by the following "Environmental Factor".

## ENVIRONMENTAL FACTOR

| System maintenance level | Environment contamination level LOW | MEDIUM | HIGH |
|---|---|---|---|
| • tank with good protection, efficient air breathers<br>• few actuators, with very good protection from contaminant ingression<br>• frequent monitoring of filter conditions | 1 | 1 | 1,3 |
| • tank with protection, good air breathers<br>• many actuators, with good protection from contaminant ingression<br>• scheduled monitoring of filter conditions | 1 | 1,5 | 1,7 |
| • tank with poor protection<br>• many actuators, with low protection from contaminant ingressions<br>• random monitoring of filter conditions | 1,3 | 2 | 2,3 |
| | F. i. system located in climatized room | F. i. system located in industrial building | F. i. system located in hostile environment (foudry, wood workingmachines, mobile machines) |

## FILTER SIZING AND PRESSURE DROP (ΔP)

The filter sizing is based on the total pressure drop, that depends on the application, the selected filter media, in order to obtain the required oil cleanliness level, and the REAL flow rate.
The pressure drop calculation (“assembly Δp) is performed by adding together the value of the housing ((Δp filter housing) with the value of the filter element (Δp filter element) and should respect the following guidelines:

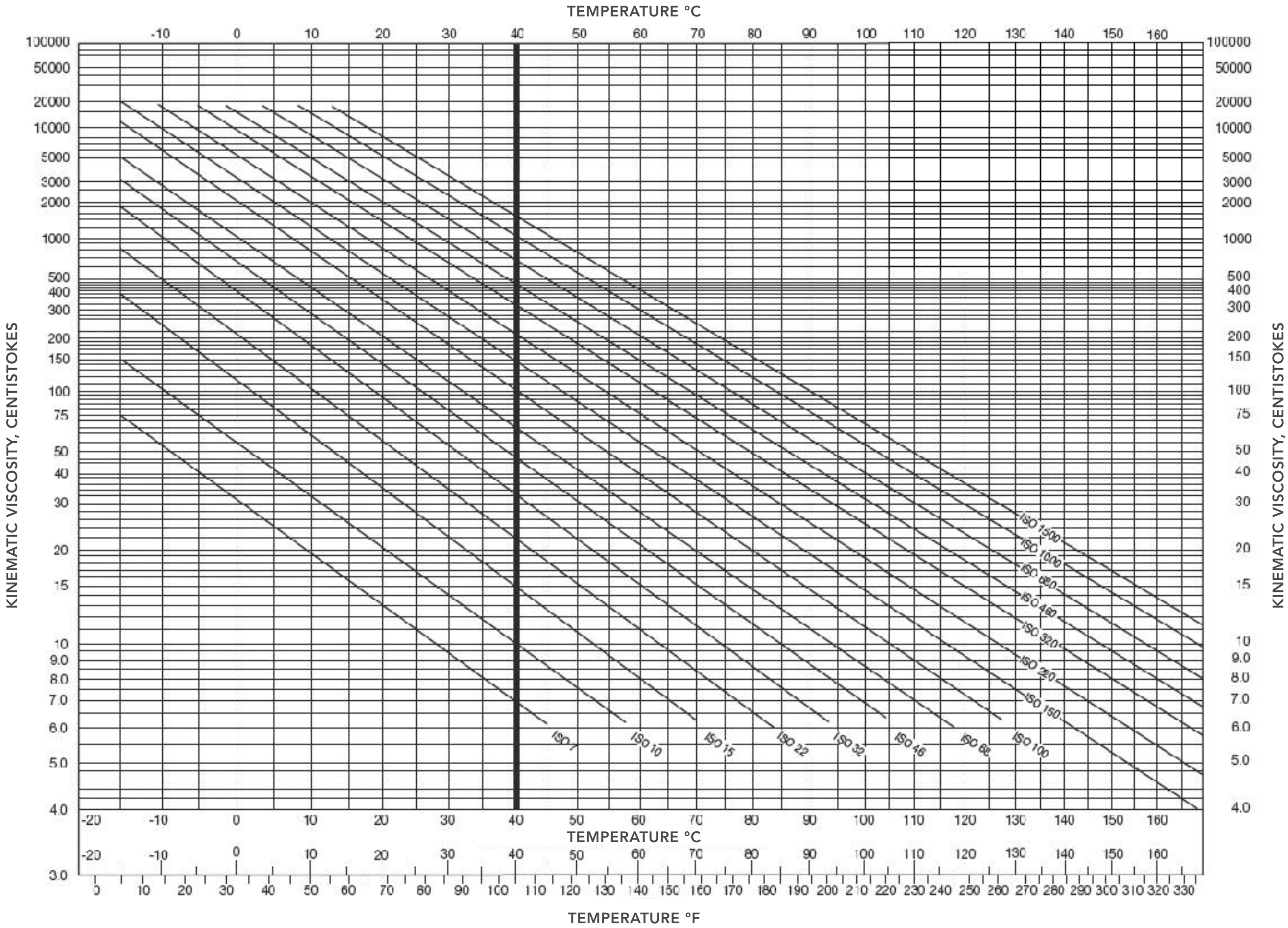
· **3 kPa** (0,03 bar) max for suction filters
· **35 ÷ 50 kPa** (0,35 ÷ 0,5 bar) max for return filters
· **35 ÷ 50 kPa** (0,35 ÷ 0,5 bar) max for pressure filters < 11 MPa (110 bar)
· **80 ÷120 kPa** (0,80 ÷1,2 bar) max for pressure filters > 11 MPa (110 bar)

Lower initial pressure drop provides better filter efficiency and longer filter element service life.

N.B. The flow rate values given in the tables are referred to mineral oil with kinematic viscosity “V” of 30 cSt and density “ps” = 0,86 Kg/dm³.
When using oils with different features, the following correction factors must be applied at the $\Delta p_0$ values obtained on the curves:
FILTER HOUSING
the pressure drop is directly proportional to the oil density “ps”, so in case you have $ps_1 \neq 0,86$ ► $\Delta p_1 = (\Delta p_0 \times ps_1) : 0,86$
FILTER ELEMENT
the pressure drop through the filter element varies in function of the kinematic oil viscosity, so in case you have a kinematic viscosity $V_1$ (cSt) different from cSt:
· for kinematic oil viscosity ≤ 150 cSt ► $\Delta p_1 = \Delta p_0 \times (V_1 : 30)$
· for kinematic oil viscosity > 150 cSt ► $\Delta p_1 = \Delta p_0 \times [V_1 : 30 + \sqrt{(V_1 : 30)}] : 2$
(for more details about kinematic oil viscosity see the diagram on the next page)
Some fluids have filterability problems (difficulty in passing through a “multilayer” (glassfiber) filter media).
In such cases a correction factor must be considered when sizing the filter: this factor must be verified with the filter manufacturing, specifying all the features of the fluid.
It is a good rule, when sizing the filter, to consider also the max recommended fluid speed:
in suction lines 0,1< v < 1 m/s | in return lines 1,5< v < 4 m/s | in pressure lines 5< v < 10 m/s

# FILTRATION IN BRIEF

## VISCOSITY VS TEMPERATURE




Lines shown refer to oils of ISO preferred grades and V.I. = 100.
Lower V.I. oils will show steeper slopes.
Higher V.I. oils will show flatter slopes.

## ISO FLUIDS CLASSIFICATION AND COMPATIBILITY WITH MATERIALS

The below table resume some general indication of fluid classification (ref. ISO 6743) and their compatibility; we recommend to verify the exact features of the fluid with the supplier.

| ISO ref. | Type of fluid | Features | Compatibility (10th digit in ordering pn) |
|---|---|---|---|
| HH | Mineral base fluid | No additives | N |
| HL | Mineral base fluid | Anticorrosion, antioxidation add. | N |
| HM | Mineral base fluid | Antiwear additives | N |
| HV | Mineral base fluid | Viscosity improver additives | N |
| HFA | Fire extinguishing fluid | Oil in water emulsion (water >90%) | G (aluminum and zinc not compatible) |
| HFB | Fire extinguishing fluid | Water in oil emulsion (water >40%) | G (aluminum and zinc not compatible) |
| HFC | Fire extinguishing fluid | Water glycol | G (aluminum and zinc not compatible) |
| HFD | Fire extinguishing fluid | Synthetic fluid (phosforic ester) | F (NBR not compatible) |
| HTG | Environmentally accepted fluid | Vegetal base fluid | N |
| HPG | Environmentally accepted fluid | Glycol base synthetic fluid | G (aluminum and zinc not compatible) |
| HE | Environmentally accepted fluid | Esther base synthetic fluid | F (NBR not compatible) |

## FILTERS AND FILTER MEDIA

All the hydraulic systems have an initial solid contamination, tending to increase during operation due to component wear, ingression from the external environment, etc. For this reason it is necessary to use filters that retain the contaminant and allow the fluid to reach and maintain the required contamination class.
Depending on their location into the system, the most common filter types are:

- RETURN LINE FILTERS, downstream from all the components, filtering the oil before it returns into the tank. Their function is keeping the required contamination level inside the tank (indirect protection of the components) and must be sized to have a high dirt holding capacity (i.e. a long life). They usually have filter elements by glassfiber (absolute filtration, $\beta x \geq 75$) or by cellulose (nominal filtration, $\beta x \geq 2$).

- PRESSURE FILTERS, on the pressure line, protecting directly one or more components, ensuring they are fed with oil with the proper contamination class. They usually have filter elements made from glassfiber (absolute filtration, $\beta x \geq 75$) or sometimes from cellulose (nominal filtration, $\beta x \geq 2$).

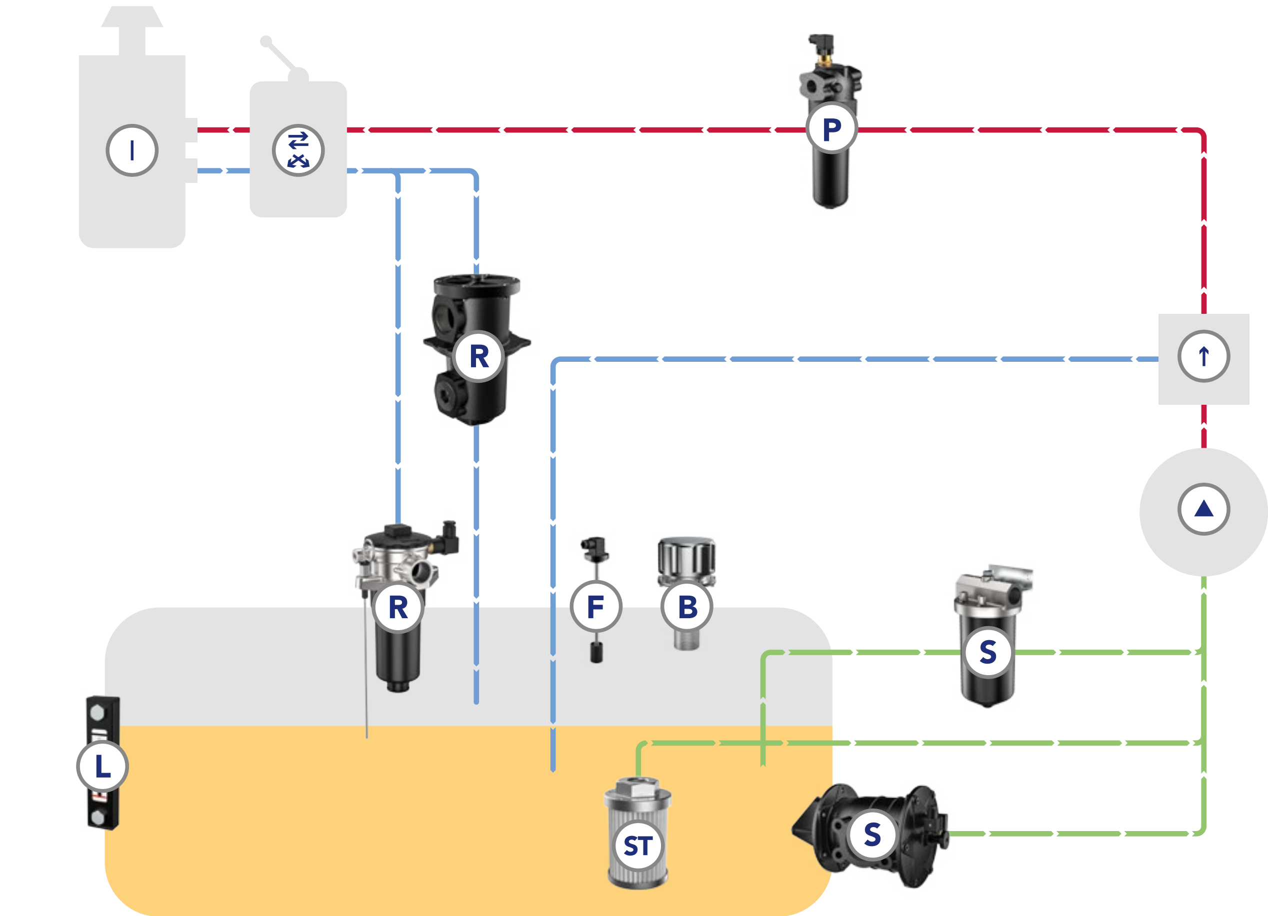
- SUCTION FILTERS, on the suction line, protecting the pump from possible coarse contamination. They usually have filter elements by metal wire mesh (geometric filtration) and must be sized properly, to avoid any possible pump cavitation.

- OFF-LINE FILTERS, generally used when a very low contamination class is required (i.e. very good cleanliness). These filters operate with constant flow rate and pressure, thus resulting in the highest filtration efficiency. Even fresh oil presents a certain contamination, so it is a good rule to make any filling or refilling of the system using an OFF-LINE FILTRATION UNIT.

- AIR FILTERS (breathers), filtering the air drawn into the tank when the oil goes to the actuators, must be used to avoid contaminant ingression from the environment.

# FILTRATION IN BRIEF

## *HYDRAULIC CIRCUIT*




## *KEY*

**L** Level indicator

**R** Return filter

**F** Float switch

**B** Breather

**ST** Suction strainer

**P** Pressure filter

**S** Suction filter

▲ Pump

↑ Pressure regulator

⇄ Directional control valve

I Double acting cylinder

— Suction

— Return

— Pressure

● Oil

## FILTER MEDIA AND CONTAMINATION CLASSES

Each hydraulic component manufacturer specifies the contamination class required for the best performance and life of their components.

To achieve the required contamination class, the proper UFI filter media must be chosen according to this table:

| **Typical application** | Aeronautic, test rigs. | Aeronautic, ind. Robotics | Ind. robotics, precision machine tools | High reliability ind. machines, Hydrostatic transmissions | Industrial machines, earth moving machines | Mobile machines | Machines for heavy industry | Machines for agriculture systems not continuos service |
|---|---|---|---|---|---|---|---|---|
| **Pumps and/or motors** | - | Piston, variable > 21 Mpa | Piston, variable < 21 MPa Vane, variable > 14 Mpa | Pist./vane, variable < 14 MPa Pist./vane, fIxed > 14 Mpa | Pistons, fixed < 14 Mpa Vane, fixed > 14 Mpa | Vane, fixed gear > 14 Mpa | Vane, fixed gear < 14 Mpa | Vane, fixed gear < 14 Mpa |
| **Valves** | Servovalves > 21 Mpa | Servovalves < 21 MPa Proportional > 21 Mpa | Proportional < 21 MPa Cartridge > 14 Mpa | Cartridge < 14 Mpa | Solenoid > 21 Mpa | Solenoid < 21 Mpa | Solenoid > 14 Mpa | Solenoid > 14 Mpa |
| **Contamination class ISO 4406** | 15/13/10 | 16/14/11 | 17/15/12 | 18/16/13 | 19/17/14 | 20/18/15 | 21/19/16 | 22/20/17 |
| **Recommended UFI filter media** | **FA** $\beta_{5(c)} > 1.000$ | **FA - FB** $\beta_{5(c)} > 1.000$ $\beta_{7(c)} > 1.000$ | **FB** $\beta_{7(c)} > 1.000$ | **FB - FC** $\beta_{7(c)} > 1.000$ $\beta_{12(c)} > 1.000$ | **FC - FD** $\beta_{12(c)} > 1.000$ $\beta_{21(c)} > 1.000$ | **FD** $\beta_{21(c)} > 1.000$ | **FD - CC** $\beta_{21(c)} > 1.000$ $\beta_{10} > 2$ | **CC** $\beta_{10} > 2$ |

N.B. NAS 1638 is officially inactive for new designs after May 30, 2001.