Pipeline Products for all Industries

Product Information

TECHNICAL APPENDIX

STAUFF FILTRATION TECHNOLOGY

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Choice of filters

Choice of a suitable micron rating

Generally, the type of components incorporated in the hydraulic system will determine the micron rating required. It has been clearly demonstrated that system components will operate reliably for years if a specific minimum oil cleanliness grade is maintained. Frequently the choice will be determined by the most sensitive component in the system.

a) Operating filter

The following chart is a general guide but the final result should be checked by oil analysis. Apart from the specific flow rate (l/min per cm² of filter area), other factors such as operating environment and condition of seals and breathers can have an effect on the cleanliness grade which can actually be achieved.

Oil cleanliness grade as per ISO 4406	Micron rating	Area of Application
13/10	3 µm	servo valve hydraulics
16/13	5 µm	proportional hydraulics
18/15	10 µm	standard hydraulics >100 bar
19/16	20 µm	standard hydraulics <100 bar

b) Protective filter

Occasionally, protective filters are fitted downstream of major components, eg., the pump, to collect the debris in case of a catastrophic failure. This avoids total stripping and flushing of the system. For economic reasons, protective filters are normally one grade coarser than the operating filters since they do not significantly contribute to the cleaning of the system and this extends filter service intervals.

Choice of the optimum filter

In selecting the filter, the following information must be considered:

- maximum flow volume (Q_{max}) through the filter including surge flows
- kinematic viscosity (υ) of the fluid in mm²/s (cSt) at cold start temperature and operating temperature
- density ρ of the fluid
- micron rating (µm): see table
- filter material

The aim is to choose a filter whose total differential pressure (Δp) is no greater than Δp_{max} = 1,0 bar (for pressure filters) or Δp_{max} = 0,5 bar (for return line filters), in a clean state at the normal operating temperature. These values have been proven in practice to give the optimum service life for the element.

The nominal flow volume of the filter is the obvious reference value for pre-selection and this should be larger than the flow to be filtered.

$$Q_{nom} > Q_{max}$$

Calculations based on the filter data will verify whether the pre-selected filter meets the requirements, at operating temperatures:

$\Delta p_{max} \leq$ 1,0 bar (for pressure filter)
$\Delta p_{max} \leq$ 0,5 bar (for return line filter)

The total differential pressure of the assembly Δp_{Assy} is calculated by adding the differential pressure of the housing Δp_{Hous} and that of the element Δp_{Elem}. Both the kinematic viscosity and density of the operating medium should be considered for the selection, as the flow curves on the pages following have been determined with a kinematic viscosity of υ = 30 cSt and a density of ρ = 0,86 kg/dm³. The values of the pressure drops for the Δp_{Hous} and the Δp_{Elem} can be read from the flow curves on the pages following. The values for the kinematic viscosity in cSt and the density in kg/dm³ should be inserted into the following formula.

$$\Delta p_{total} = \frac{\rho}{0{,}86} \cdot \Delta p_{Hous} + \frac{\rho}{0{,}86} \cdot \frac{\upsilon}{30} \cdot \Delta p_{Elem}$$

The filter size is suitable if the $\Delta p_{total} < \Delta p_{max}$.
If the calculated Δp_{total} is greater than Δp_{max}, select the next larger filter size and re-calculate until a satisfactory solution is found.

The following two examples explain the procedure.

Examples of Calculation

Example 1: Selection of a pressure filter

System Information. A pressure filter with an inorganic glass fibre element is required immediately after the pump. The system has standard components and is operating at presures up to 200 bar. The filter shall be fitted with a bypass valve and a visual clogging indicator.

Data given: Q_{max} = 160 l/min
$\upsilon_{operating}$ = 46 cSt
ρ = 0,86 kg/dm^3
Micron rating 10 µm (see table on page 16)

First Step

Pre-selection: Size SF 070, $Q_{nominal}$ = 240 l/min > Q_{max}

Pressure drop values (at viscosity of 30 mm^2/s) from the flow characteristics:

Δp_{Hous} = 0,22 bar (SF 070 ..., see page 18)
Δp_{Elem} = 0,79 bar (SE 070 G 10 B, see page 20)

Determination of the correction factor (see page 16)

$$\Delta p_{total} = \frac{0{,}86}{0{,}86} \cdot 0{,}22\ \text{bar} + \frac{0{,}86}{0{,}86} \cdot \frac{46}{30} \cdot 0{,}79\ \text{bar} \qquad \Delta p_{total} = 1{,}43\ \text{bar} > \Delta p_{max} = 1{,}0\ \text{bar}$$

Since the actual pressure drop is larger than the allowed pressure drop, a larger filter has to be chosen.

Second Step

Selection of the next larger filter size; SF 090, $Q_{nominal}$ = 330 l/min > Q_{max}

Δp_{Hous} = 0,13 bar (SF 090 ..., see page 18)
Δp_{Elem} = 0,54 bar (SE 090 G 10 B, see page 20)

$$\Delta p_{total} = \frac{0{,}86}{0{,}86} \cdot 0{,}13\ \text{bar} + \frac{0{,}86}{0{,}86} \cdot \frac{46}{30} \cdot 0{,}54\ \text{bar} \qquad \Delta p_{total} = 0{,}96\ \text{bar} \leq \Delta p_{max} = 1{,}0\ \text{bar}$$

In a clean state, this filter fulfills the requirements and is suitable for the application.
The correct filter designation is:

SF090G10B-TB/BV

Example 2: Selection of a return line filter

System Information. A return line filter with a paper element is required to clean the oil. No clogging indicator is required.

N. B. If the system incorporates either accumulators or cy linders, the return flow can dramatically exceed pump flow and the maximum surge flow should be the flow used to calculate the pressure drop through the filter.

Data given: Q_{max} = 90 l/min
$\upsilon_{operating}$ = 32 cSt
ρ = 0,86 kg/dm^3
Micron rating 20 µm (see table page 16)

First Step

Pre-selection: Size RF 030, $Q_{nominal}$ = 110 l/min > Q_{max}

Pressure drop values (at viscosity of 30 mm^2/s) from the flow characteristics:

Δp_{Hous} = 0,27 bar (RF 030..., see page 21)
Δp_{Elem} = 0,04 bar (RE 030 N 20 B, see page 21)

$$\Delta p_{total} = \frac{0{,}86}{0{,}86} \cdot 0{,}27\ \text{bar} + \frac{0{,}86}{0{,}86} \cdot \frac{32}{30} \cdot 0{,}04\ \text{bar} \qquad \Delta p_{total} = 0{,}31\ \text{bar} < \Delta p_{max} = 0{,}5\ \text{bar}$$

Determination of the correction factor (see page 16)

In a clean state, this filter fulfills the requirements and is suitable for the application. No further calculation is necessary.
The correct filter designation is:

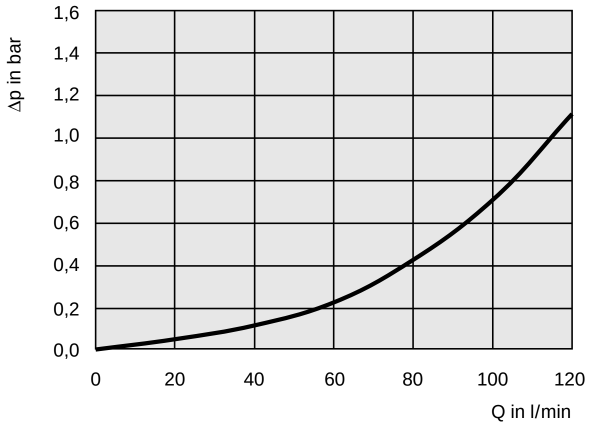
RF030N20B/B

Flow Characteristics of Pressure Filters

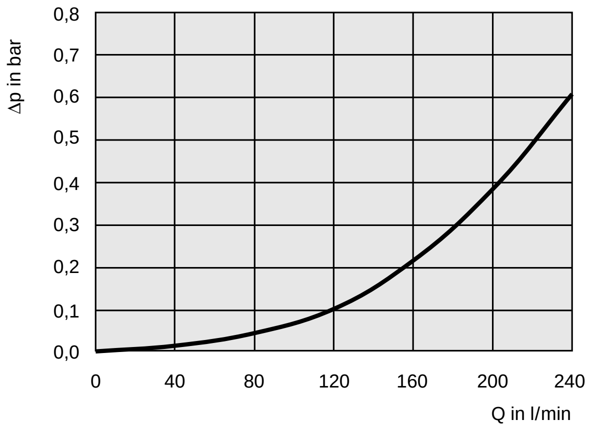
The following flow characteristics are valid for mineral oils with a density of 0,85 kg/dm³ and the kinematic viscosity of 30 mm²/s. The characteristics have been determined in accordance to ISO 3968.

Housing Characteristics SF Filter Size

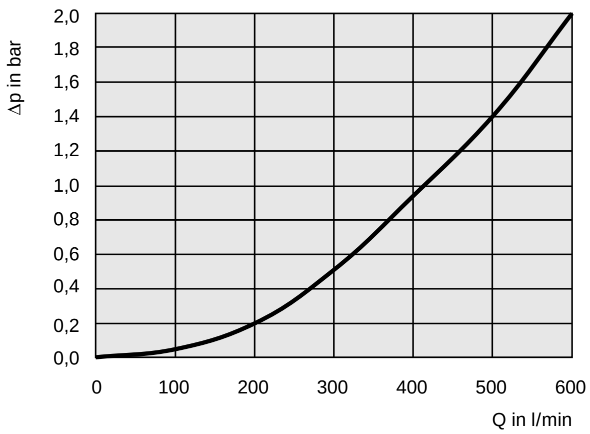
Housing Filter Size SF 014/030



Housing Filter Size SF 045/070



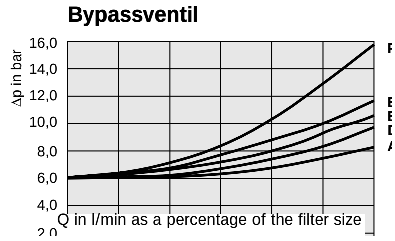
Housing Filter Size SF 090/160



Bypass Valve Flow Characteristics

(incl. housing resistance, without element)

Bypass Valve

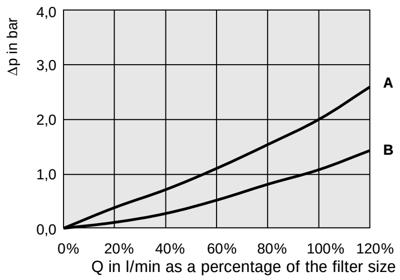


Filter Size SF 014: A
Filter Size SF 030: B
Filter Size SF 045: C
Filter Size SF 070: D
Filter Size SF 090: E
Filter Size SF 160: F

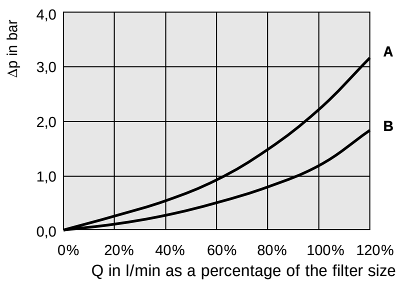
Characteristics of the multi-function valve are approximately 5 % higher than those of the bypass valve

Reverse Flow Valve

Flow Direction A –> B



Flow Direction B –> A



A: Filter Size SF 030 / SF 070 / SF 160
B: Filter Size SF 014 / SF 045 / SF 090

Characteristics of the multi-function valve are approximately 15% higher than those of the bypass valve.

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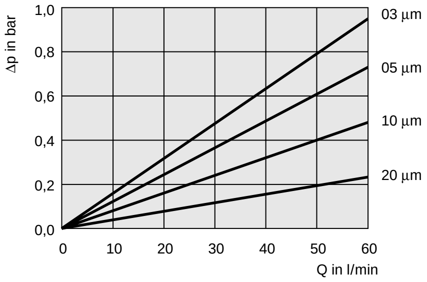
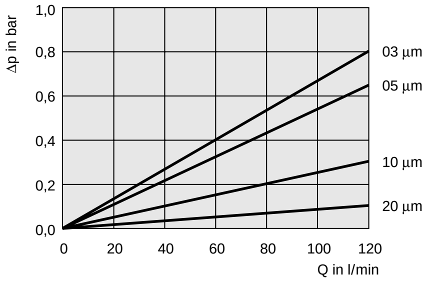
Element Flow Characteristics

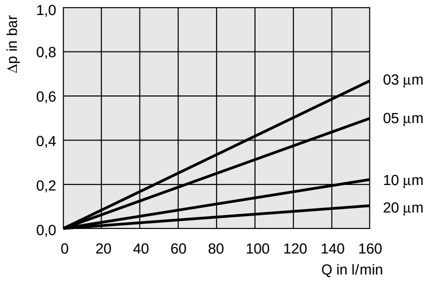
SE 014 A



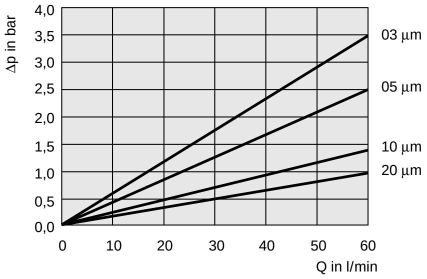
SE 030 A



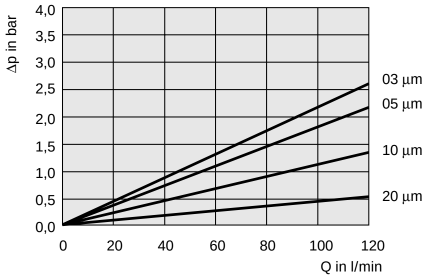
SE 045 A



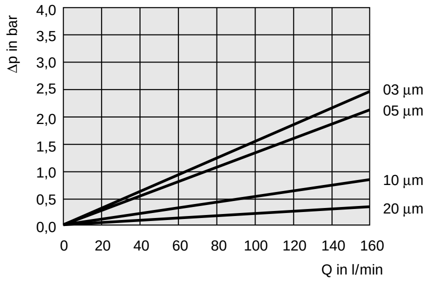
SE 014 C



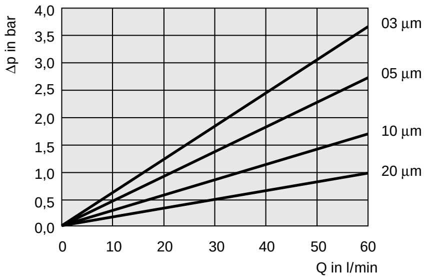
SE 030 C



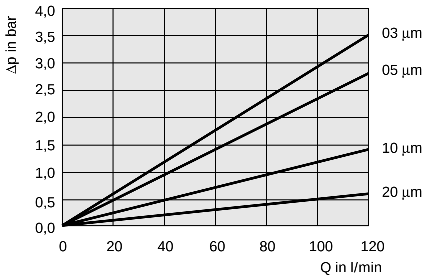
SE 045 C



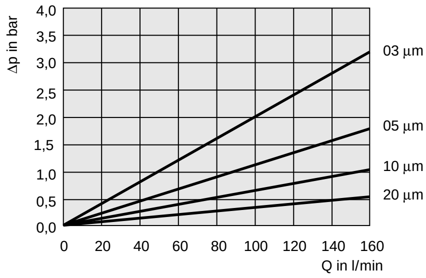
SE 014 G



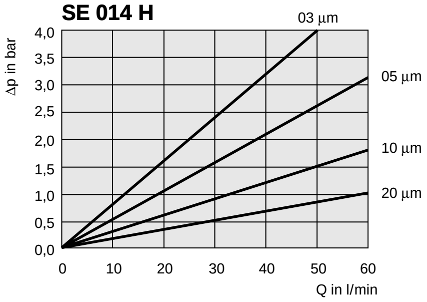
SE 030 G



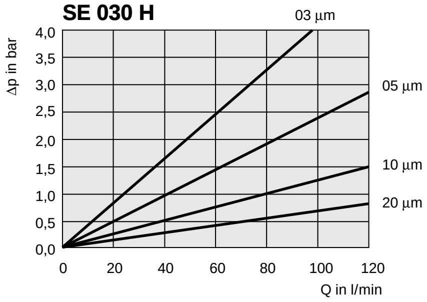
SE 045 G



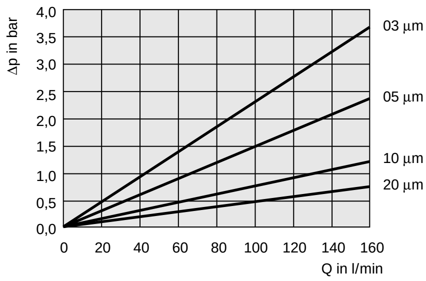
SE 014 H



SE 030 H

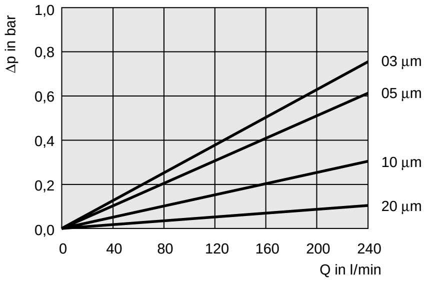


SE 045 H

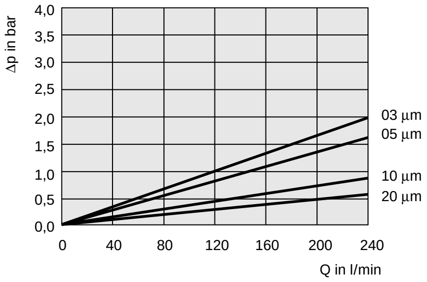


Element Flow Characteristics

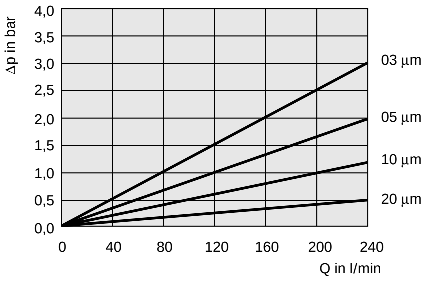
SE 070 A



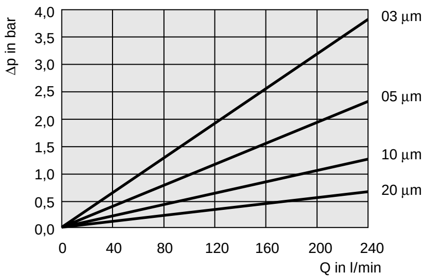
SE 070 C



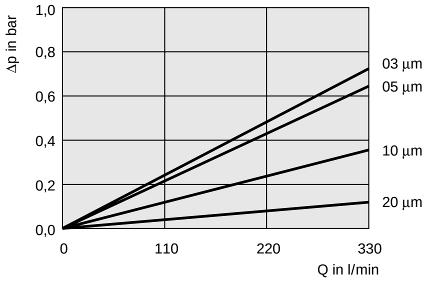
SE 070 G



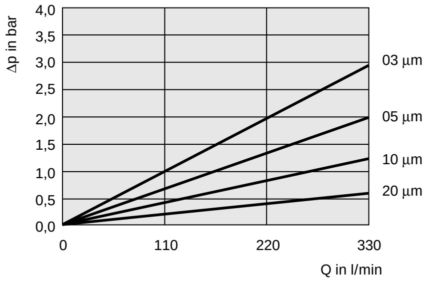
SE 070 H



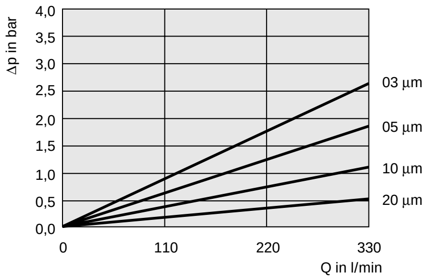
SE 090 A



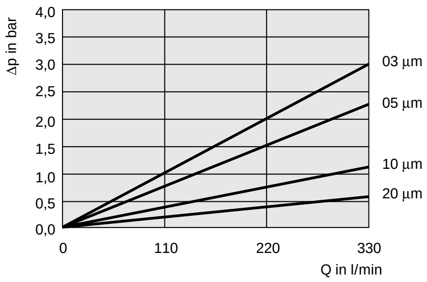
SE 090 C



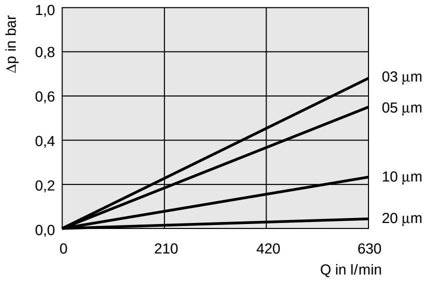
SE 090 G



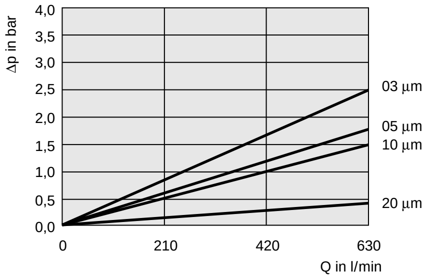
SE 090 H



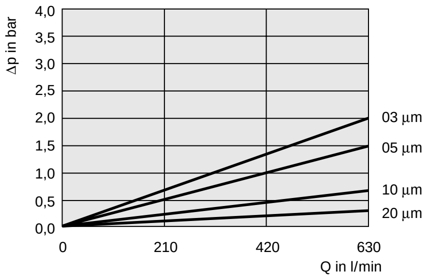
SE 160 A



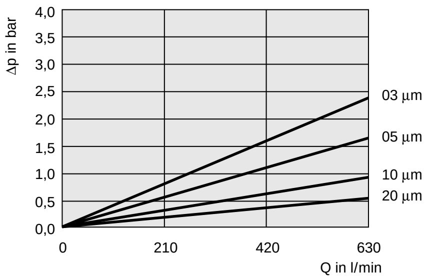
SE 160 C



SE 160 G

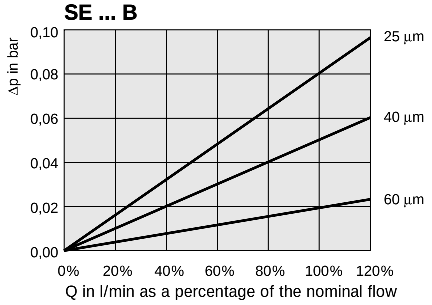


SE 160 H



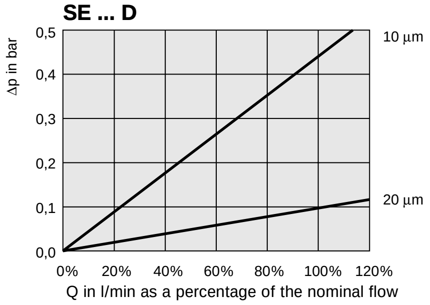
Pressure Filter Elements with Filter Material „B“

SE ... B



Pressure Filter Elements with Filter Material „D“

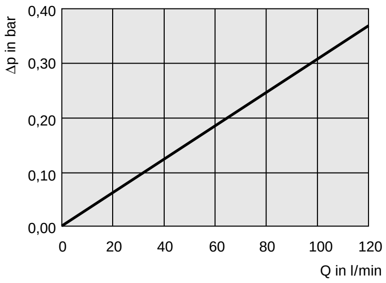
SE ... D



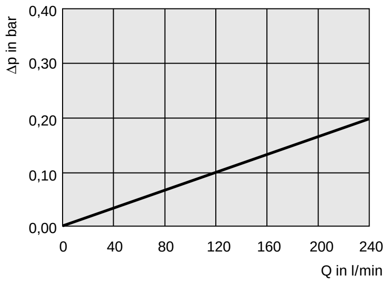
Flow Characteristics of Return Line Filters

The following flow characteristics are valid for mineral oils with a density of 0,85 kg/dm³ and the kinematic viscosity of 30 mm²/s. The characteristics have been determined in accordance to ISO 3968.

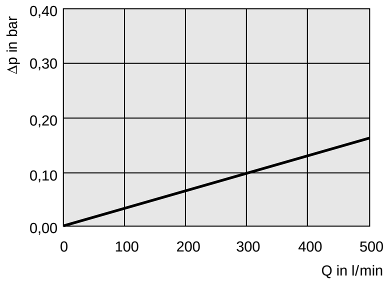
Housing Filter Size RF 014/030



Housing Filter Size RF 045/070

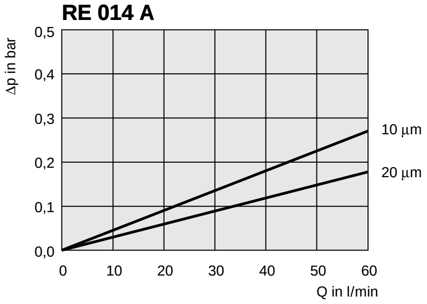


Housing Filter Size RF 090/130

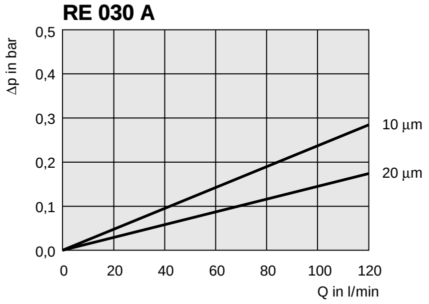


Element Flow Characteristics

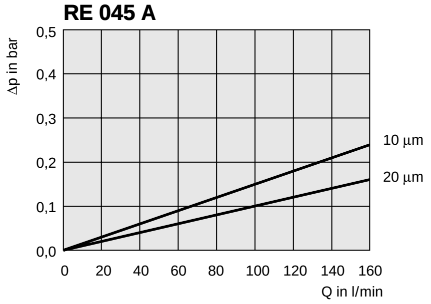
RE 014 A



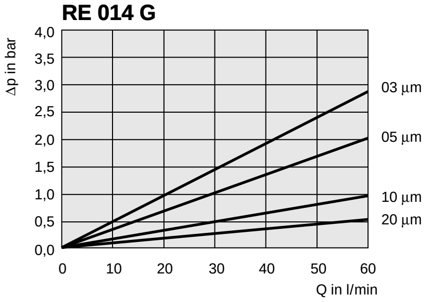
RE 030 A



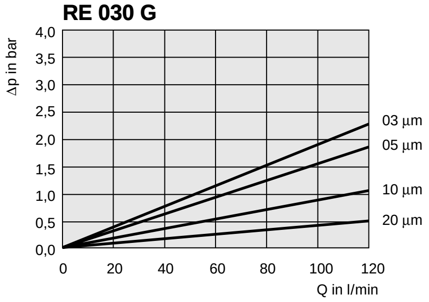
RE 045 A



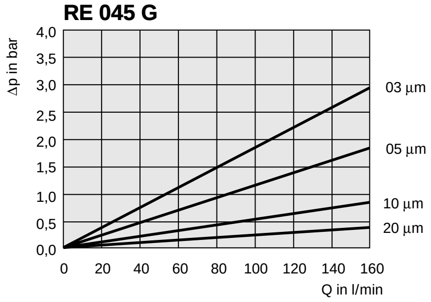
RE 014 G



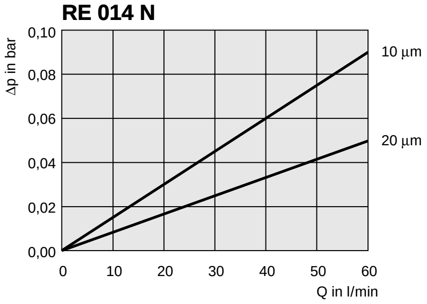
RE 030 G



RE 045 G



RE 014 N



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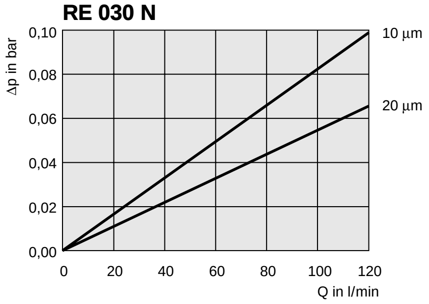

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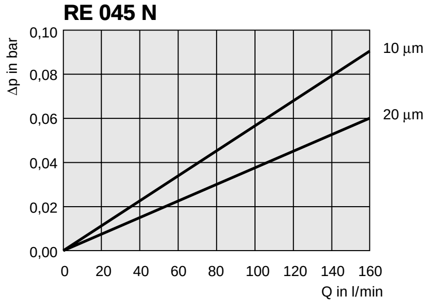
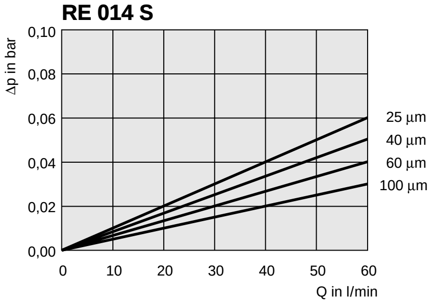
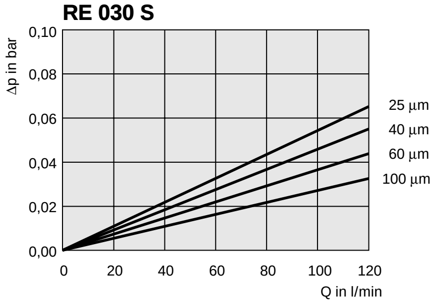


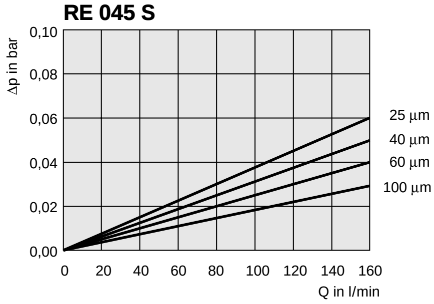
RE 014 S



RE 030 S

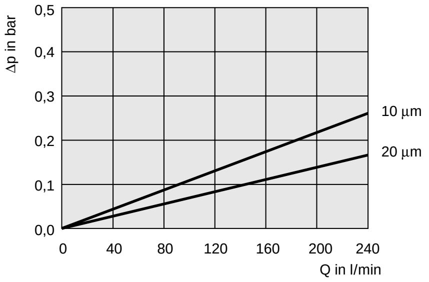


RE 045 S

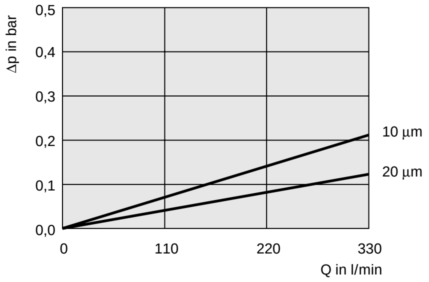


Element Flow Characteristics

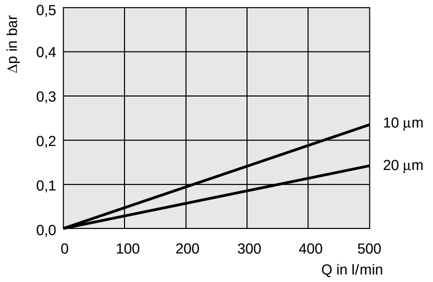
RE 070 A



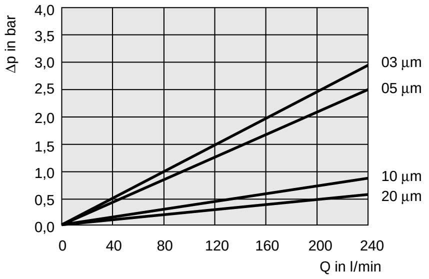
RE 090 A



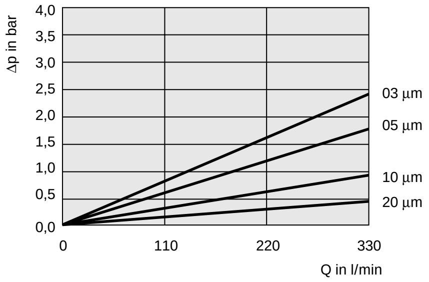
RE 130 A



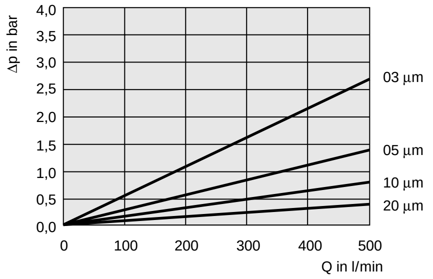
RE 070 G



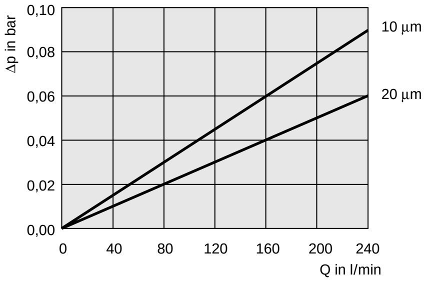
RE 090 G



RE 130 G



RE 070 N



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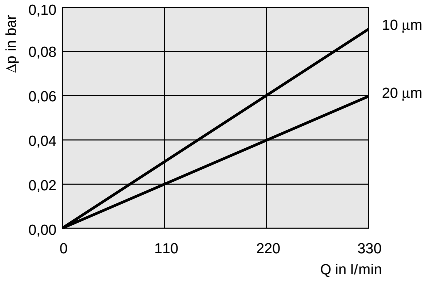

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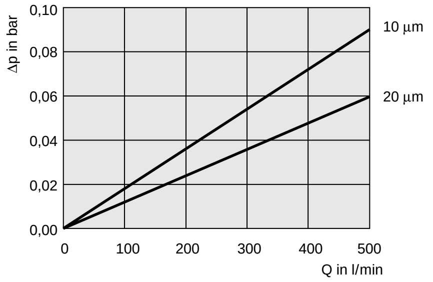

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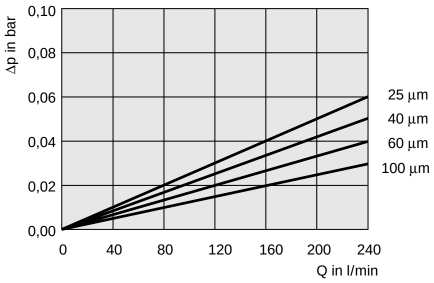

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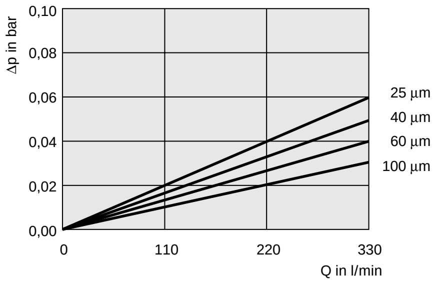

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