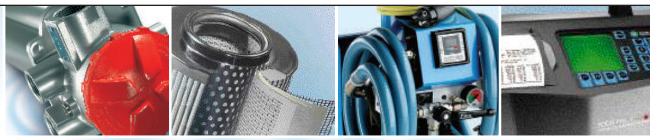
ARGO HYTOS

Filtration & Fluid Management • Sensors & Measurement



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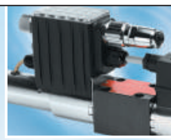
Company Profile

A strong brand in fluid technology

ARGO-HYTOS s.r.o, Vrchlabí, Czech Republic

ARGO-HYTOS Pvt. Ltd., Coimbatore, India

A strong brand in fluid technology

ARGO-HYTOS GMBH, Kraichtal, Germany

As a components and system supplier **ARGO-HYTOS** is an essential part in the supply chain of the world market leaders when it comes to mobile working machinery and mechanical engineering. **ARGO-HYTOS** has established an international network of production and distribution companies to provide the full support our successful global customers are accustomed to. We offer customer-oriented added value and expertise at the customers' location. With modern technical challenges becoming more complex as time goes on, it is vital to find system partners who can offer an integrated approach supported by outstanding experience, which they can contribute to projects and offer solutions for fluid power technology.

Christian H. Kienzle,
President

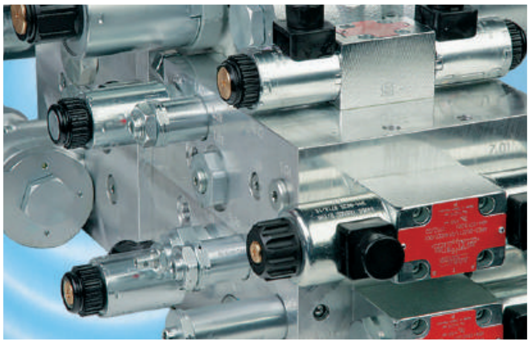
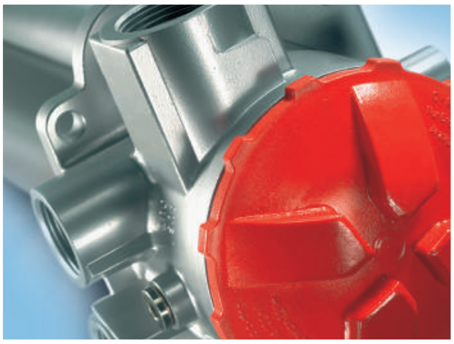
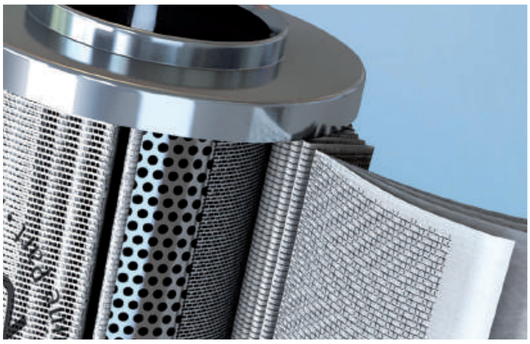
We view ourselves as an international partner implementing innovative and individually designed system solutions together with our customers. The basis for this is a wide modular product range which can be flexibly expanded to customized solutions. Thereby we draw on our entire wealth of know-how and give new impetus to modern fluid power technology, time and again. **ARGO-HYTOS** owns a number of patents and in many cases has set new standards in its industry.

With production companies in Germany, Czech Republic, India and China as well as numerous own distribution and assembly companies the **ARGO-HYTOS** Group is active worldwide. Furthermore we are cooperating with a network of professional service partners.

As a medium-sized family business with more than 1300 employees **ARGO-HYTOS** has more than 65 years experience in Fluid & Motion Control and Filtration technology in mobile and industrial hydraulics. Especially in the mobile hydraulics sector **ARGO-HYTOS** has developed into one of the innovation leaders.

ARGO-HYTOS aims to make a substantial contribution to improve customer products and sustainably ensure significant customer benefit.

The product range of ARGO-HYTOS

Fluid and Motion Control

ARGO-HYTOS' expertise in control technology is the fruit of more than 60 years' experience. We focus here on a wide range of valves, power units and integrated manifolds featuring all commonly used design features and functions, together with proportional valves and the associated control electronics:

- **directly operated directional valves in CETOP 02 to CETOP 05 and pilot operated directional valves in CETOP 07 and CETOP 08**
- **valves sub-plate and sandwich type – flow control, pressure and check valves in CETOP 02 to CETOP 05**
- **cartridge valves**
- **directly activated proportional valves with compensator sandwich valve, in CETOP 02 to CETOP 05**
- **analog and digital control electronics – on-board, or for installation in control cabinets**
- **power pack assembly kits**
- **customized control blocks**

We focus especially on developing customized solutions based on tried-and-tested fundamental technologies, specifically adapted to the requirement profiles in each individual case.

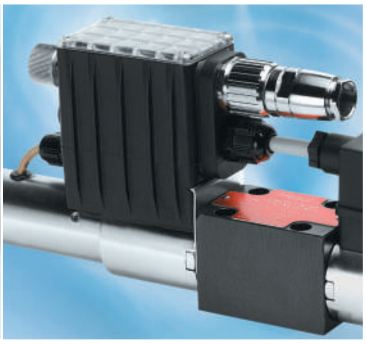
Filtration

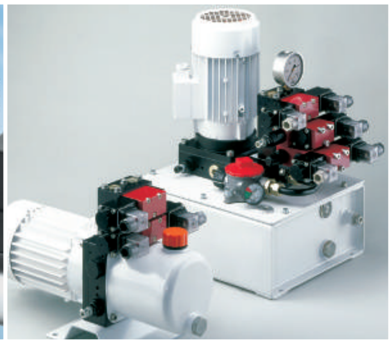
ARGO-HYTOS produces sophisticated filter solutions together with hydraulic and lubrication systems. The range of solutions we have implemented extends from fixed-position industrial plants to mobile applications.

As well as customized developments, exactly adjusted to the individual requirements of the customer, ARGO-HYTOS offers a comprehensive range of innovative standard solutions for a wide variety of applications:

- **suction filters**
- **return-suction filters and return filters**
- **pressure and high-pressure filters**
- **filling and ventilating filters**
- **filter accessories**

The product range of ARGO-HYTOS





Fluid Management

As well as reducing maintenance and servicing costs, effective fluid management is also a key factor in boosting the reliability, productivity and cost-effectiveness of the operation.

ARGO-HYTOS supplies application-oriented products for manual and automatic cleaning of hydraulic fluids:

- **Off-line filters**
- **Off-line filter units**
- **Filter cooling systems**
- **Oil service units**
- **Dewatering systems**

Sensors and Measurement

Systems that provide reliable assessment of the condition of hydraulic fluids are the key feature of continuous fluid monitoring.

Sensors and measurement technology from ARGO-HYTOS precisely target this range of tasks. Our fluid monitoring products comprise equipment and system solutions to enable online monitoring during continuous operation as well as analysis of bottled samples under laboratory conditions.

- **Portable oil diagnosis equipment**
- **Stationary and portable particle monitor**
- **Oil condition sensors**
- **Software to evaluate data and analyze trends**

A commitment to quality

Constant quality is the basis for high-caliber products that precisely meet the defined requirements to ensure smooth operation. But quality is more than a matter of systems and processes. First and foremost, it has to govern the thinking of everyone involved, not only in production, but also in administrative areas, development work and marketing activities.

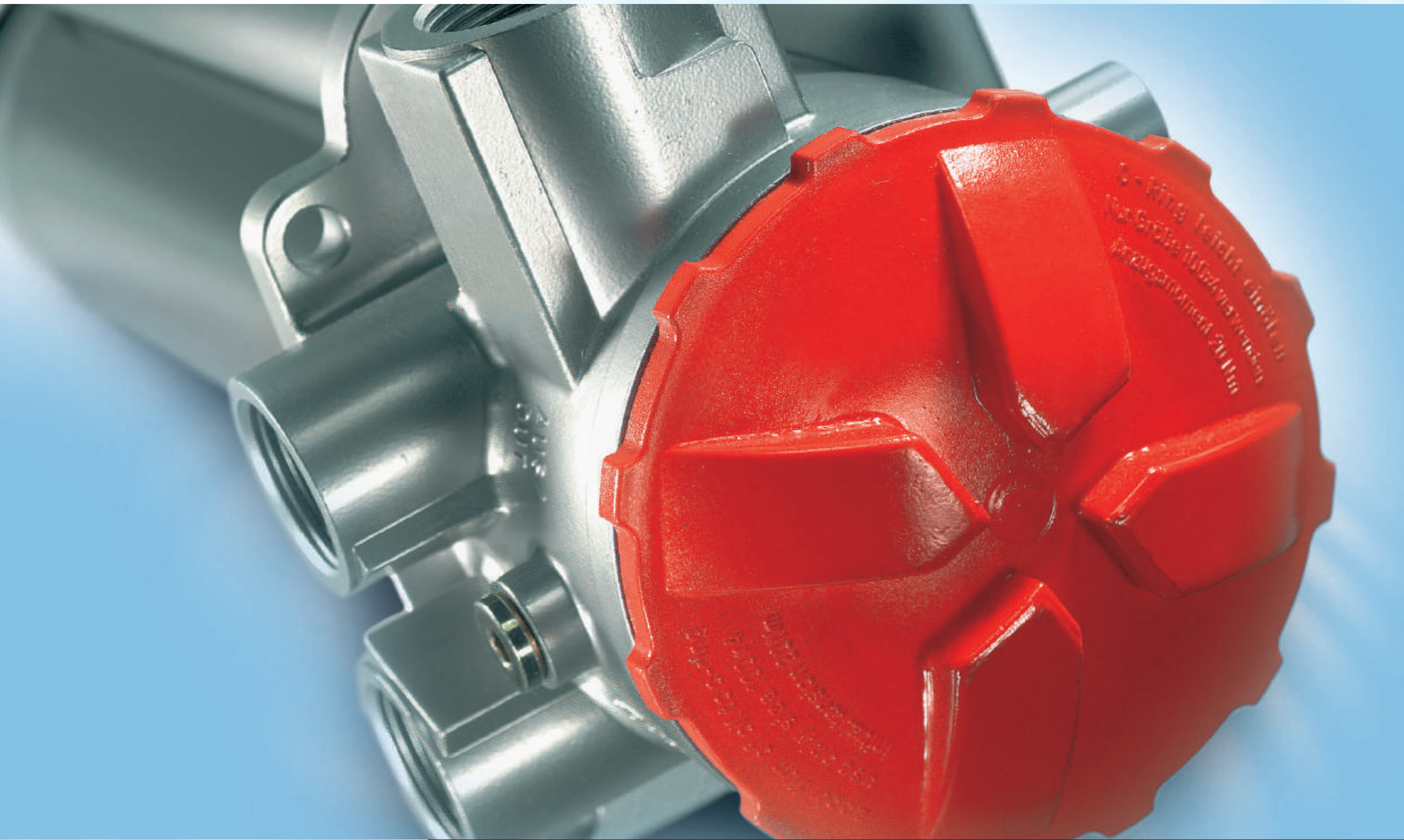
This is the approach that makes ARGO-HYTOS a dependable partner: quality is an integral element of our corporate philosophy, firmly rooted in the minds of our employees, a source of fresh inspiration day after day.

By maximizing production depth at its manufacturing facilities, ARGO-HYTOS can directly influence all the decisive processes, ensuring optim al control over all the quality criteria. This is supported by universal and continuous quality management certified to DIN EN ISO 9001, covering not only production but all other areas of the company.

The Automotive Production Division is also certified to ISO/TS 16949 meaning that it operates in conformance with the globally recognized quality standards for the automobile industry.

ARGO-HYTOS places great emphasis on environmental awareness, as attested by the certified environmental management system according to DIN EN ISO 14001.

ARGO HYTOS



Guidelines

Tips and information
on how to select the
optimal hydraulic filter

Following the revision of several of the most important standards on assessing the performance of hydraulic filters and classifying oil cleanliness (ISO 4572 and ISO 4406), many users are now faced with the same question: what practical effects will these changes have?

Let us answer this question immediately: in the future as in the past, the same filters in the same hydraulic systems will achieve the same levels of oil cleanliness.

The changes only affect the presentation of the results from measurements.

This new edition of the ARGO-HYTOS Guidelines on Selecting Hydraulic Filters includes many new features linked to the revision of the standards mentioned above.

Detailed attention is also given to two filter concepts which are becoming increasingly important: return-suction filters and off-line filters.

The technical requirements for the hydraulic components and the operating pressure have to be considered when the oil cleanliness required for a hydraulic system is being determined, but the user's expectations regarding the availability, safety and lifetime of a machine are playing an ever greater part.

The revised ARGO-HYTOS filter selection procedure also takes these aspects into account.

More than ever before, the ARGO-HYTOS Guidelines offer useful advice on selecting technically and economically ideal filter concepts for hydraulic systems, and experts will also find that they contain important information.

Did you know…

…fresh oil can often contain 10 times more dirt particles than are acceptable for hydraulic systems of high technical quality?

…if the operating pressure is increased by only 50 %, the number of dirt particles in the oil must be reduced by a factor of 3 to avoid a deterioration in the lifetime of the components?

…even a filtration quotient of $\beta = 75$ corresponds to filtration efficiency of 98,7 % for all dirt particles that are larger than the specified size, and a β-value of only 5 still corresponds to 80 % efficiency?

…even oil sample bottles declared as clean can contain considerably more dirt particles than the examined oil, if it comes from hydraulic systems with good filtration?

…a lifetime of 1.000 service hours for a hydraulic filter corresponds to a mileage of about 60.000 km of a passenger car?

…only an online count can determine the actual values for cleanliness classes < 10 (ISO 4406)?

…standard ISO 4572 on assessing fiter performance data has been completey revised; this has produced some majorchanges to measure ment results, but the actual performance data for filters have not changed?

Our know-how – your benefit

At ARGO-HYTOS, the focus is consistently on the customer – and a major element of our development work is to implement customer-specific solutions for filters and systems.

Continuous improvement of our filter elements is another major goal of our development work: for example, this includes increasing the dirt capacity while keeping the installed volume as small as possible. This optimization goal is excellently achieved by our range of standard return-suction filters – just one example of many.

Our sales engineers are just as reliable as our filters themselves. They are trained and experienced filter specialists who speak YOUR language. We believe that before the actual sales discussion there should be the best possible technical advice and assistance with planning if requested. This is the only way to ensure that our customers make the right purchase.

Another benefit from ARGO-HYTOS:

Spare parts can be delivered from our factories in the shortest possible time – and what is more, our subsidiaries in all important industrial countries and representatives all over the world always keep minimum stocks available.

This ensures you rapid access to our know-how and our products.

The key feature of the entire hydraulics sector is that – for understandable reasons – users are setting demanding (and ever increasing) requirements for the quality and efficiency of the filters that are used. The testing technology used to develop filters must also meet these requirements.

And this is where the difference between "filters" and ARGO-HYTOS filters emerges very clearly!

ARGO-HYTOS operates testing rigs that are equipped with ultra-modern technology, enabling fast test sequences, extended testing procedures and accurate documentation of all the parameters:

- Multi-Pass test rig
- Collapse/burst pressure test rig
- Test rig to determine pressure drop
- Test rig to prove the flow-fatigue resistance characteristics
- Pressure pulse test rig to confirm fatigue strength

The ARGO-HYTOS Test Department is highly equipped with efficient testing equipment and human resources, and it plays a major part in the development of new technologies.

Practical requirements can already be taken into account during filter trials in the test laboratory. Individual customer requirements are incorporated into the development process in the form of load tests which reflect practical conditions.

The performance parameters of the test rigs we have installed allow us to test all filters throughout their performance ranges.

The state-of-the-art **Multi-Pass test rig** enables us to determine filter efficiency data according to ISO 16889.

The **collapse/burst pressure test rig** (for testing according to ISO 2941) is used to determine the specified permissible differential pressure; if this pressuredifference is exceeded, the element would be damaged.

Multi-Pass test rig

Collapse/burst pressure test rig

Test rig to determine pressure drop

The **test rig to determine pressure drop** in filters and their components (such as housings, filter elements and valves) is based on ISO 3968. It is suitable for testing the pressure loss in relation to the flow rate, and in relation to the kinematic viscosity. This also makes it possible to determine the pressure loss in a filter for unfavourable operating conditions – for example, at a cold start.

Here at ARGO-HYTOS, the **flow fatigue resistance characteristics** of filter elements are determined on the test rig according to ISO 23181, in such a way that a Multi-Pass test can be carried out afterwards. After the fatigue test, this means that the filter characteristics can be compared with the values of a new filter. Tests carried out on this rig are very important as they regard extending the intervals between filter element changes. Long-term loads of 1 million cycles or more may occur during practical use: these can be simulated within a short time on the test rig using a testing frequency of 1 Hz.

The **pressure pulse test rig** is used to validate filter casings to maximum pressure for lifetime, up to 10 million times, in order to test fatigue strength – and this can be done up to 600 bar.

Alongside the laboratory tests, "field trials" are carried out at customers' applications. The filters are put to the test in practice, under tough operating conditions. Thanks to these "field trials" which can often go on for months, even the smallest weak point is sure to be discovered.

The result: ARGO-HYTOS offers tested quality and safety from A–Z.

The ARGO-HYTOS Mobile laboratory and measuring van

Oil cleanliness requirements are becoming stricter as time goes on. Filters are now expected to offer service lifetimes of 1.000 hours or more. Oils that stay clean not only extend the usual intervals between oil changes – they also prevent faults during operation, and they substantially extend the lifetimes of all the hydraulic components. Only in rare instances do we know how clean or dirty the pressure fluid in a hydraulic system really is. In many cases, the medium is only examined when a failure occurs or when damage is noticed. ARGO-HYTOS has developed its mobile customer service so that potential risks can be identified. The ARGO-HYTOS Test Mobile – with laboratory and measuring facilities – can travel to you whenever you need it. Oil samples can be analyzed on the spot, and we can determine the type and size of the dirt particles in the pressure fluid just a short time after the samples have been taken. This means that we can make appropriate suggestions about improving or redesigning the filtration in your hydraulic system while we are still on site. Furthermore, the ARGO-HYTOS Test Mobile plays a vital part in our development work. We can follow through field tests, enabling us to obtain, evaluate and document practical data on the spot.

The ARGO-HYTOS Test Mobile in action

Oil diagnostic systems

Portable oil diagnostic systems make it possible for you, the user, to carry out oil analyses yourself on your own systems – at any time.

This instrument can be used in two different ways:

- **Analysis of samples in bottles**

  Small quantities of oil are taken from a suitable location in the system; the samples are filled in bottles and examined. Maximum cleanliness must be ensured both for the sampling process and the bottles themselves, so that the results of the measurements are not unintentionally affected by dirt from external sources.

- **Online analysis**

  Online analysis is based on continuous sampling with the help of a measuring hose – so external influences on the measured results can be virtually ruled out in this case. Depending on the sampling location, the oil diagnostic equipment must also be able to withstand the maximum system pressure, as well as to provide reliable measurements at low pressures.

PODS Pro – the Portable Oil Diagnostic System

The most important benefit of portable oil diagnostic systems is that the results are always available after just a few minutes, so that information is quickly available about the condition of the system. This means that any action that is needed can be initiated as quickly as possible. Convenient evaluation and documentation of the results is provided thanks to a PC interface and appropriate software, making it easy to identify any changes and trends.

It is possible to monitor the cleaning procedure by using oil diagnostic equipment in combination with mobile off-line filter systems. As soon as the desired level of oil cleanliness has been reached, the filtration process is stopped. This also makes it possible to fill systems with oil that has a defined level of cleanliness.

Permanently installed equipment for online oil cleanliness monitoring is ideal for cyclical monitoring of oil cleanliness in hydraulic and lubrication systems, and it also offers benefits in terms of preventive maintenance and early detection of damage in large systems. Suitable interfaces can be used to provide a direct link to the machine control system, with programming either via the system software or from an integrated keyboard.

The ARGO-HYTOS procedure for selecting a filter

The selection procedure described below makes it easy for you to select the right filters for hydraulic systems.

To simplify matters, the procedure is broken down into these steps:

- determine the right filter type
- determine the filter fineness that is needed
- determine the filter size that is needed
- other considerations

This filter selection procedure is based on many years of practical experience with countless mobile and industrial hydraulic systems that are equipped with correctly chosen ARGO-HYTOS filters.

Suction filters

Return filters

Pressure filters

High-Pressure filters

How to determine the proper filter type

Unfortunately, there is no generally applicable concept which dictates the proper type of filter for each of the different hydraulic systems. To a large extent, the decision on whether to use suction, return, pressure or high-pressure filters – or a combination of these types – depends on these factors:

- the contamination sensitivity of the components in the existing or planned system
- the priority given to protect the function of the component, or to prevent wear
- design or requirements of pumps, motors and valves, which may result in specified requirements from the compone manufacturer
- the way dirt is generated, the locations where it occurs and the possibility of ingression from outside

Depending on these factors, the criteria detailed below should be taken into account when you are choosing from possible types of filters. A basic distinction can be made here between protective filters that protect the function of components, and working filters that attain a specified level of cleanliness for the pressure fluid.

Suction filters

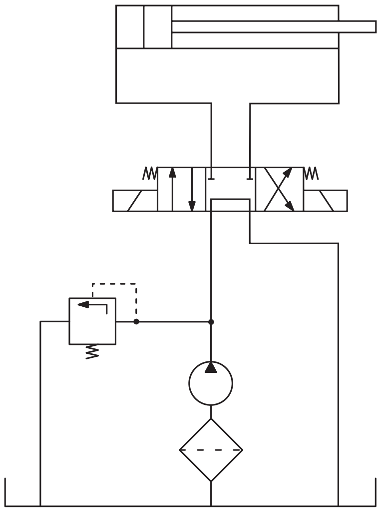
Hydraulic systems have to be fitted with a suction filter if there is a particularly high risk of damage to the pump from coarse contamination.

Typical applications of this sort include:

- systems with a common oil reservoir for working hydraulics and gear transmissions.
- units with oil tanks of large dimensions and/or complex shapes, or those which are welded or casted. Experience shows that 100 % cleaning of the tank prior to assembly is impossible under these circumstances.
- systems that are filled under difficult conditions in the field.

Often relatively coarse suction filters (e.g. screen filter elements with a mesh size of 40 - 125 µm) are planned that can only guarantee functional protection for the pump. In this case, the required protection against wear on the hydraulic components must be ensured by a finer filter at another location.

Specialized literature and company publications sometimes advance the opinion that the use of finer suction filters with paper or glassfiber elements is either impractical or inadvisable: however, this view is not tenable. Positive field experience – even with filter finenesses of 16 µm abs. – in hydraulic systems (especially in the mobile sector) have demonstrated that these objections are not justified.



Hydraulic system with suction filter

ARGO-HYTOS suction filter ES

However, it is essential to consider the following criteria when designing a hydraulic system with a suction filter:

- low pressure drop on the clean filter, due to optimal design of the filter element and housing, also taking account of high start viscosities
- filter monitoring with a vacuum switch or vacuum manometer
- the filter element must be easily accessible and simple to replace for maintenance purposes
- the suction pipe should be designed with the lowest possible pressure drop, i.e. large nominal width (inner diameter), few and/or constant changes of direction (bent pipe instead of 90° fittings) and shortest possible length
- the oil tank should be positioned higher than the pump (gravitation drop)
- the system should be designed so that the planned operating temperature is reached as soon as possible after a cold start (tank volume should not be too large, oil cooler should be bypassed during the cold start phase)
- the hydraulic oils used should have the lowest permitted viscosity and a low increase in viscosity if the temperature drops (high viscosity index)
- the pump types used should not be very sensitive to cavitation (e.g. gear pumps).

ARGO-HYTOS's ES filter line offers a range of easy-to-maintain tank-mounted suction filters that have proven their excellence, especially in hydrostatic transmissions on mobile equipment.

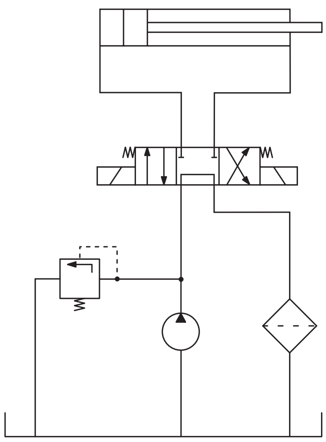
Return filters

It is particularly beneficial to use filters that are mounted on the tank or integrated in it, because this method allows filtering of the entire oil flow (full flow filtration) at low cost and with low space requirements.

Full flow filtration in the return flow protects the pumps against dirt which penetrates the system from outside (especially via hydraulic cylinders) or which is generated by abrasion.

When selecting the right filter size, it is essential to consider the maximum possible flow rate. Depending on the area ratio between the piston and piston rod side of the hydraulic cylinder, this is larger than the flow rate for the pump(s).

Full flow filtering in the return may be problematic, and is therefore inadvisable. If the maximum flow rate is very high in relation to the pump flow rate (for example due to a large area ratio for the cylinders, and/or due to the emptying of hydro-accumulators).



Hydraulic system with return filter

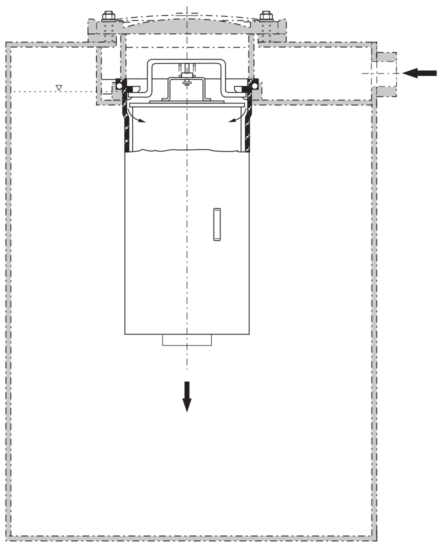
The maximum pressure build-up (mainly determined by the actuating pressure and characteristic curve of the bypass valve) should be considered on the basis of these conditions:

- if drain lines for pumps and/or hydro-motors are connected to the return filter system, the maximum pressure build-up specified for these components by the manufacturer must not be exceeded. (The limitation is usually on the sealing rings of the input/output shafts).
- in certain cases where several components are connected in a system, high pressure build-up can trigger uncontrolled functions – for example, the hydraulic cylinders may be moved out unintentionally.

To prevent oil foaming in the tank, it is essential to ensure that the oil out et is always below the oil level under all operating conditions. The distance from the tank bottom should be 2 to 3 x the diameter of the outlet (extension pipe diameter), in order to avoid swirling particles which have already settled on the bottom.

At a very early stage, ARGO-HYTOS pushed the consistent introduction of return filters for mobile units mounted below the tank surface, in a separate oil return chamber.

As long ago as 1971, ARGO-HYTOS was the first manufacturer to launch tankmounted return filters on the market, with integrated tank ventilating filter within the filter head (see fig., right).



E 440 ... E 700 return filters for installation in tanks

E 103 return filter for tank installation, with integrated tank ventilating filter

Return-Suction filters

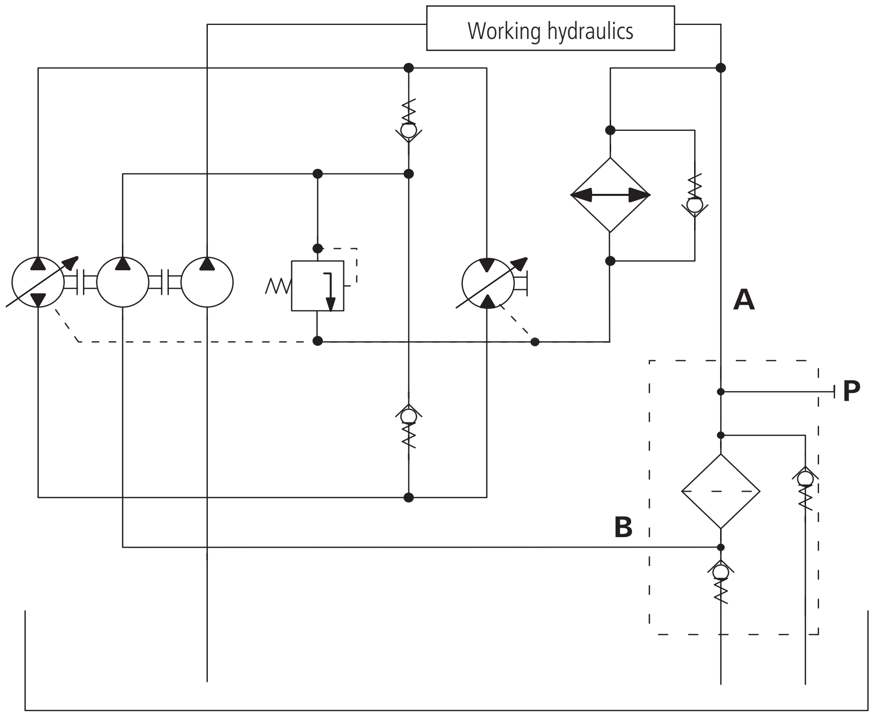
ARGO-HYTOS first developed its return suction filters in the mid-1980's. On equipment with a hydrostatic drive and combined working hydraulics, these filters replace the suction and/or pressure filters that were previously required for the filling pump of the closed hydrostatic drive, and in an open circuit they replace the return filter for the working hydraulics.

The benefit of these filters is that filtered oil is fed to the filling pump at an overpressure of 0,5 bar, avoiding the risk of cavitation in the filling pump so that excellent cold start characteristics are possible.

In order to maintain a boost pressure of approx. 0,5 bar at the connection to the filling pump, a surplus between the return and suction flow is required under all operating conditions.

A pressure relief valve is used to feed the oil directly into the tank starting from a Δp of 2,5 bar (so no bypass for the closed circuit!).

If the drain oil from the hydrostatic drive is fed through the filter as well as the flow in the open circuit, remember that – in order to protect the radial shaft seals – the permissible drainline pressure must not be exceeded (taking account of the pressure drop in the drain lines, the oil cooler and the pressure relief valve on the filter).



Hydraulic system with return-suction filter

ARGO-HYTOS return-suction filters

Pressure and high-pressure filters

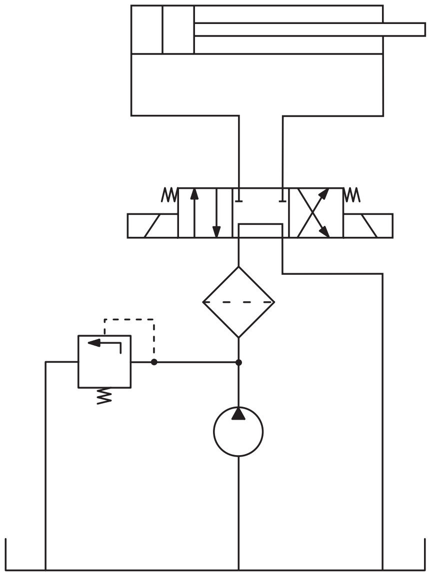
The main function of this type of filter is to ensure that the functions of downstream hydraulic components are protected. For this reason, these filters are installed directly upstream of the components if .

Taking account of the risks of dirt penetrating the system from outside and the possibility of pump abrasion, the following aspects can be particularly decisive for the use of a pressure or high-pressure filter:

- the components are particularly sensitive to dirt (such as servo valves) and/or they are integral to the functioning of a complex system
- the components are particularly expensive (such as large cylinders, servo valves, hydromotors) and they are extremely important for the safety of the equipment (such as hydraulic steering, transmission or brake systems)
- exceptionally high costs are possible if a system is shut down due to malfunctions or damage to a hydraulic component caused by contamination.

High pressure filters must withstand the maximum system pressure, and in many cases the fatigue strength must also be guaranteed because there are frequent pressure peaks in the system.

ARGO-HYTOS is convinced that safety is very important. For example, casings must undergo a fatigue strength test with more than 10 million pressure pulses before they are released for series production, and leakage tests are performed regularly during production.



Hydraulic system with high-pressure filter

ARGO-HYTOS high-pressure filter

In many cases, high-pressure filters carry out their function by filtering only part of the flow or only relatively coarse particles. In these cases, the filter basically operates as a safety filter. Under these conditions, a fine filter should be positioned at another point in the system so as to take account of the requirements for protection against wear.

High-pressure filters that mainly work as safety filters should preferably be equipped with a differential pressure switch that monitors the contamination of the filter element. Only high-pressure filters without a bypass valve should be fitted upstream of particularly critical components. Those filter types must be fitted with a high collapse filter element that itself is able to withstand higher differential pressure loads without damage.

In this case, a decisive influence on the maximum differential pressure is the ratio between startup viscosity ν_2 and operating viscosity ν_1.

Assuming that the filter element is changed when the differential pressure indicator responds, the following formula can be used to determine the highest possible differential pressure that will occur on the element:

$$\Delta p_2 = \frac{\nu_2}{\nu_1} \times \Delta p_1$$

ν_1 = operating viscosity

ν_2 = start viscosity

Δp_1 = max. differential pressure when the differential pressure switch responds at operating viscosity ν_1

Δp_2 = max. differential pressure at start viscosity ν_2

Example of calculation:

- operating viscosity $\nu_1 = 35$ mm²/s
- start viscosity $\nu_2 = 700$ mm²/s
- switching pressure of differential pressure switch = 5 ± 0,5 bar
- max. differential pressure $\Delta p_1 = 5{,}5$ bar

$$\Delta p_2 = \frac{700}{35} \times 5{,}5 \text{ bar} = 110 \text{ bar}$$

The differential pressure which occurs here would be 110 bar. ARGO-HYTOS's EXAPOR®MAX 2-elements, with a collapse pressure of 160 bar, have been specially developed to meet these demanding requirements.

The EXAPOR®MAX 2-filter elements that are used in ARGO-HYTOS high-pressure filters without a bypass valve have a collapse pressure of 160 bar and they are stable in response to differential pressure, so they satisfy the highest safety requirements:

- damage to the filter layer up to the specified differential pressure of 160 bar is impossible thanks to the exceptional support offered by the filter medium, together with its high intrinsic stability.
- there is consistent monitoring of the manufacturing process for filter elements, with continuous checks on production quality to ISO 2942.

Clogging indicators

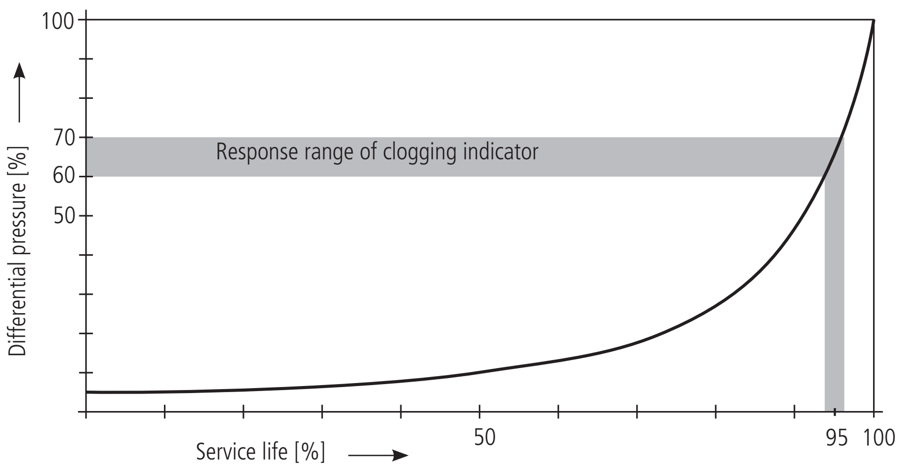
As the duration of use of the filter element increases, the level of contamination and therefore the pressure drop will increase. This causes pressure build-up and/or differential pressure, which is monitored by the clogging indicator. When a preset value is reached, electrical and/or optical signals are given.

The following points should be noted here: the pressure drop on the filter element increases with the flow rate, the contamination and the kinematic viscosity of the pressure fluid.

For these reasons, a filter element is only regarded as contaminated and in need of replacement when the contamination indicator responds at the operating temperature of the hydraulic system, and when the signal remains on continuously.

Effects of delaying the replacement of a filter element:

- on filters with a bypass valve: the more heavily the filter element is contaminated, the more frequently the bypass valve will respond, and part of the hydraulic fluid will not be filtered.
- on filters without a bypass valve: the pressure drop on the filter element, and hence the loss of efficiency in the system, will increase continuously: this can lead to impermissible heating of the hydraulic oil.



Typical progression of contamination of a filter element throughout its service life

Differential pressure indicators

Pressure switches and manometers

Ventilating filters

Temperature changes, together with the use of cylinders and/or pressure accumulators, cause the oil level in the tanks of hydraulic systems to have constant fluctuations.

These create a difference in pressure with the surrounding environment, which is compensated by an exchange of air that can allow dirt to penetrate the tank.

A ventilating filter can prevent dirt from entering. Ideally, it should have at least the same fineness as the system filters in the hydraulic circuit.

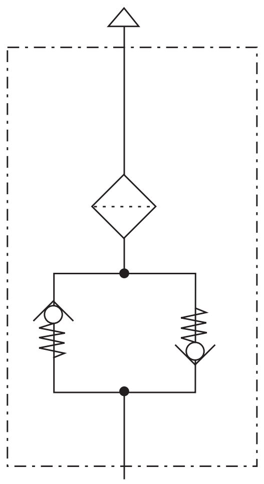
Ventilating filters with double check valves can be used to achieve a major reduction in the exchange of air between the tank and the environment, so that the entry of dirt and dust is minimized and the service life of the ventilating filter element can be prolonged.

An important factor here is that the air volume in the tank and the valve cracking pressure must be optimally coordinated with the specific design of the system.

With the specified air volume in the tank, higher response pressures tend to cause a reduction in the exchange of air. The air exchange at the defined response pressure of the ventilating filter can be reduced by increasing the air volume.

With a suitable design, a defined pressure level can be generated in the tank in order to improve the suction conditions for the pump(s).

ARGO-HYTOS ventilating filters



Circuit diagram for ventilating filters with double check valve

ARGO-HYTOS Vandalism-Proof ventilating filters

A special feature: ARGO-HYTOS ventilating filters in the patented Vandalism-Proof version.

These ventilating filters can only be dismantled with a special spanner which is supplied with the product. This makes it considerably more difficult to remove the ventilating filter, or to pour dirt in through the filling/ventilation opening.

Off-line filters

Increasingly, additional off-line filters are being used in systems that are subject to high stress in order to prevent the build-up of superfine particles. Unlike main flow filters, off-line filters only filter part of the total flow in the system. Depending on the influence of the environment (incidence of dirt) and the selected filter fineness, the partial flow (in l/min) should be approx. 2 to 10 % of the tank volume (in l).

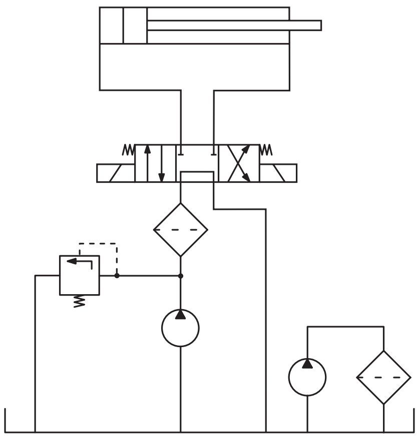
In combination with superfine filter elements, outstanding levels of oil cleanliness can be achieved by continuous filtration, independently of the machine's working cycle. Furthermore, the load on the main filters is reduced, so that intervals between replacements can be extended.

Off-line filter systems should be used in addition to main flow filters; in this case, the latter can be designed as protective filters, i.e. they do not filter so finely.

A distinction is usually made between two different concepts:

- **Off-line filters with a flow control valve**
  From the pressure circuit of the system, the required quantity of oil initially flows via an integrated flow control valve and then it is fed into the tank via the offline filter. The small installation effort for this concept makes it especially suitable for retrofitting systems.

- **Off-line filter units,**
  on the other hand, having an integrated motor/pump unit. This makes the energy consumption economical more favorable than off-line filters with a flow control valve. Separate filter-cooler circuits can be implemented in combination with an oil cooler.



Hydraulic system with high-pressure filter and off-line filter unit

Filter units

To guarantee the required level of oil cleanliness when a system is filled for the first time or refilled, the operating medium should be cleaned using filter units with superfine filter elements.

Mobile filter units are also suitable for cyclical cleaning of hydraulic or lubrication systems where no provision was made for off-line filters when the systems were equipped for the first time, and it is impossible to install them at a later stage.

Optimal results can be achieved if the cleaning and/or filling processes are monitored by an oil diagnosis system such as particle counters.

Off-line filter unit with motor and pump

Mobile filter unit with oil diagnostic system

Definition of the filter fineness

The Multi-Pass test according to ISO 16889:1999 (previously ISO 4572:1981) is used to determine the number of particles upstream and downstream of a filter, in relation to specified particle sizes. This makes it possible to calculate the respective beta value (the filtration ratio) which is the quotient of the numbers of particles upstream and downstream of the filter.

$$\text{Beta value } \beta = \frac{\text{number of particles upstream of filter}}{\text{number of particles downstream of filter}}$$

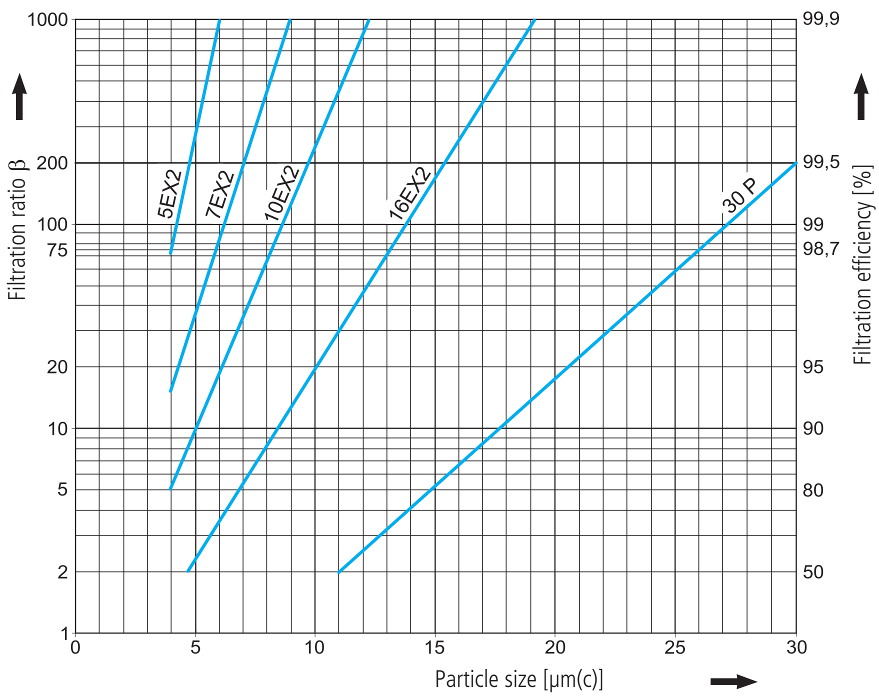
The filtration level (or filtration efficiency) can be calculated analogously.

$$\text{Filtration efficiency} = \frac{\text{no. of particles upstream of filter} - \text{no. of particles downstream of filter}}{\text{no. of particles upstream of filter}} \times 100\ \%$$

The following relation exists between the two values:

$$\text{Filtration efficiency (in \%)} = (1 - \frac{1}{\beta}) \times 100\ \%$$

The following table provides some numerical values.



ARGO-HYTOS filter fineness:
filtration ratio β and filtration efficiency in relation to particle size to ISO 16889

Beta value β	1	1,5	2	5	10	20	50	75	100	200	1000	10000
Filtration efficiency	0,00 %	33,33 %	50,00 %	80,00 %	90,00 %	95,00 %	98,00 %	98,67 %	99,00 %	99,50 %	99,90 %	99,99 %

Relation between filtration efficiency and beta value

ARGO-HYTOS filter fineness is based on the mean beta value 200 ($\beta_{x(c)} = 200$ according to ISO 16889:1999), corresponding to a filtration efficiency of 99,5 %. The relevant characteristic filtration curves are shown in the chart.

This makes it easy to read the filtration ratio β and the filtration efficiency in percent for various particle sizes, clearly showing the relationship between the various levels of fineness. The characteristics of the individual curves ultimately determine the level of cleanliness for the pressure fluid that can be achieved in practice.

Oil cleanliness classification

The classification systems ISO 4406 and NAS 1638 are most widespread. Both systems are used to describe the distribution of solid particles in hydraulic fluids according to number and size.

This is done by assigning the number of particles of a specific size to a code number or class. Each time the oil cleanliness deteriorates by a class, the number of particles is doubled.

This relationship is shown in the table, using ISO 4406 as the example. NAS 1638 uses different particle size ranges to describe the distribution of particles, whereas ISO 4406:1987 indicates codes for the numbers of particles > 5 µm and > 15 µm.

Analogously, current standard ISO 4406:1999 indicates the number of particles > 6 µm(c) or > 14 µm(c) as codes. In addition, this standard incorporates a code for particles > 4 µm(c), represented by a dash if determination is impossible.

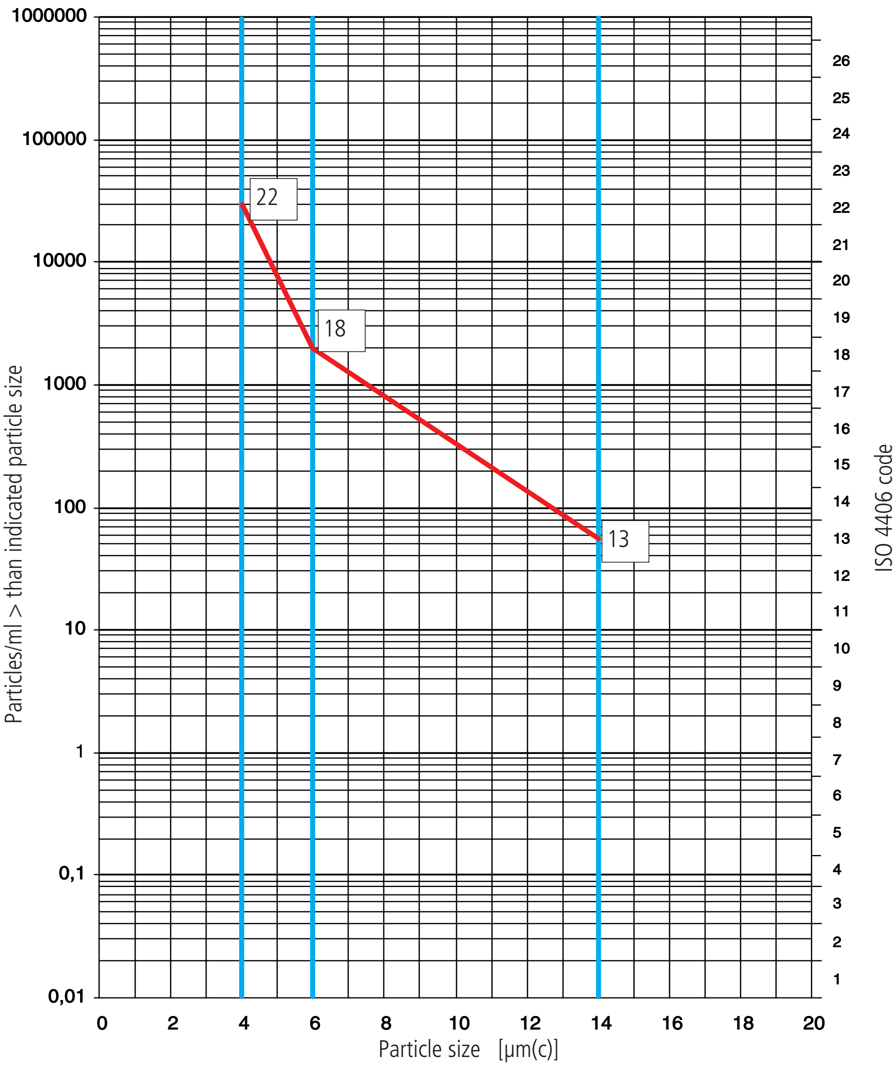
Due to the changes between ISO 4406:1987 and ISO 4406:1999, shifts in cleanliness classes between the old and current standards may occur when comparing analytical results from the same oil sample.

For example, an oil sample may have cleanliness class 16/13 (> 5 µm / > 15 µm) according to ISO 4406:1987, but according to ISO 4406:1999 it may be between -/16/13 and -/17/13 (> 4 µm(c) / > 6 µm(c) / > 14 µm(c)).

The following chart shows the evaluation of an oil sample according to ISO 4406:1999.

No. of particles per 1 ml		Code number
from	up	
80.000	160.000	24
40.000	80.000	23
20.000	40.000	22
10.000	20.000	21
5.000	10.000	20
2.500	5.000	19
1.300	2.500	18
640	1.300	17
320	640	16
160	320	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2,5	5	9
1,3	2,5	8
0,64	1,3	7
0,32	0,64	6
0,16	0,32	5
0,08	0,16	4
0,04	0,08	3
0,02	0,04	2
0,01	0,02	1

Extract from ISO 4406:1987 or ISO 4406:1999



Evaluation of an oil sample to ISO 4406:1999

Required oil cleanliness

The oil cleanliness required in the system is determined by the component which is most sensitive to dirt. If the component manufacturer does not provide any specific information about the required oil cleanliness or filter fineness, it is advisable to determine the oil cleanliness on the basis of the tables shown below.

The listed reference values for normal components refer to a basic pressure range of 160 ... 210 bar.

If the operating pressure is increased in a system, it is necessary to improve the oil cleanliness in order to achieve the same wear lifetime for the components.

The following table lists the required change in oil cleanliness when the operating pressure increases in relation to the basic pressure range of 160 ... 210 bar.

Using an example, we will now explain the influence of the operating pressure on the required oil cleanliness, and hence on the filter fineness.

In a system with gear pump and proportional valves, oil cleanliness of 20/17/14 to ISO 4406 is required for an operating pressure of up to 210 bar. If the operating pressure is raised to 250 bar, the table shows that the oil cleanliness must be improved by 1 class to 19/16/13.

The required oil cleanliness is determined by other influencing variables as well as the operating pressure:

- expected lifetime of the machine
- costs of repairs / spare parts
- interruption costs due to shutdown times
- requirements for the safety of the system (these are not only influenced by the cleanliness of the oil!)

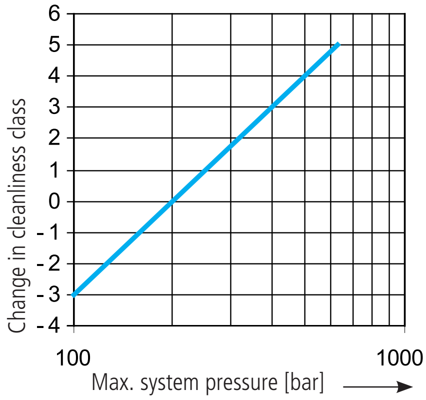
If one of these aspects is especially important, the required oil cleanliness should be improved by one class. If two or more criteria apply, the required oil cleanliness must be up-graded by two classes.

In the example given above, if high-grade cylinders are used as well, and if high interruption costs can be expected due to a system shutdown, 17/14/11 should be recommended as the oil cleanliness class instead of 19/16/13 (2 classes better).

Operating pressure	Change in oil cleanliness
0 ... 100 bar	3 classes worse
100 ... 160 bar	1 class worse
160 ... 210 bar	none
210 ... 250 bar	1 classe better
250 ... 315 bar	2 classes better
315 ... 420 bar	3 classes better
420 ... 500 bar	4 classes better
500 ... 630 bar	5 classes better

Pumps	
Axial piston pumps	21 / 18 / 15
Radial piston pumps	21 / 18 / 15
Gear pumps	21 / 18 / 15
Vane pumps	20 / 17 / 14
Motors	
Axial piston motors	21 / 18 / 15
Radial piston motors	21 / 18 / 15
Gear motors	21 / 18 / 15
Vane motors	20 / 17 / 14
Valves	
Directional control valves (solenoid valves)	21 / 18 / 15
Pressure valves	21 / 18 / 15
Flow control valves	21 / 18 / 15
Check valves	21 / 18 / 15
Proportional valves	20 / 17 / 14
Servo valves	17 / 14 / 11
Cylinders	21 / 18 / 15

Oil cleanliness levels required
for hydraulic components (160 ... 210 bar)



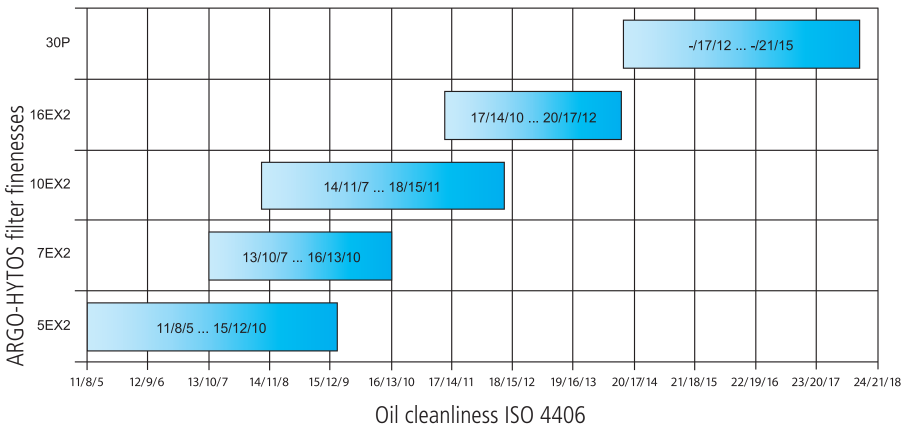
Influence of operating pressure on required oil cleanliness

Required ARGO-HYTOS filter fineness

Continuous evaluation of oil samples for several decades has shown which level of oil cleanliness can be achieved with which filter fineness under specified system conditions. For full flow filtration under the least favorable conditions, cleanliness levels to ISO 4406:1999 can be achieved with ARGO-HYTOS filter finenesses as follows:

Depending on the influence of one or more of the criteria mentioned above, the oil cleanliness levels that are achieved will be at the left end of the bandwidths shown (in favorable cases) or at the right end (in unfavorable cases).

In the calculation example cited previously, an oil cleanliness level of 19/16/13 was required. Now we shall determine which ARGO-HYTOS filter fineness is required to achieve this.



Attainable oil cleanliness levels

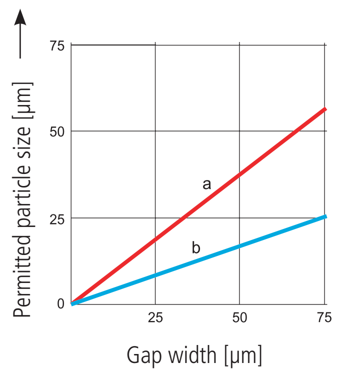
However, significantly better levels of oil cleanliness can be achieved depending on the environmental conditions and the specific circumstances of the system. Conditions that may have a positive influence on the cleanliness level include:

- design features that reduce the penetration of dirt from outside (high-quality packing seals in hydraulic cylinders, good shaft sealing rings)
- tank ventilating filters with fine filter elements
- uniform flow instead of pulsation (caused by variable displacement pumps, for example)
- low pressure drop, e.g. when suction filters or off-line filters are used

According to the chart, filter fineness 16EX2 can be used to achieve oil cleanliness of 17/14/10 in the most favorable case. But under unfavorable conditions, it will only be possible to attain class 20/17/12. On the other hand, filter fineness 10EX2 can achieve the required oil cleanliness of 19/16/13 even under the most unfavorable conditions.

Fineness required to prevent gap blockage

Typical phenomena that cause functional failures on hydraulic components include blockage of gaps and nozzles. Flow control valves, restrictor valves and servo valves are particularly susceptible to this problem. If the relative movement of the gap surfaces is small, there is a greater risk that the gap will clog up when the size of the dirt particles exceeds 1/3 of the smallest gap height (characteristic b in the chart below). Bearing the possibility of blockage in mind, this means that the absolute filter fineness must be at least equal to the given value, or better less than this value. The following chart shows how the gap width and the permitted particle size are related.



Permitted particle size in relation to gap width with (a) large and (b) small relative movement of the gap surfaces.

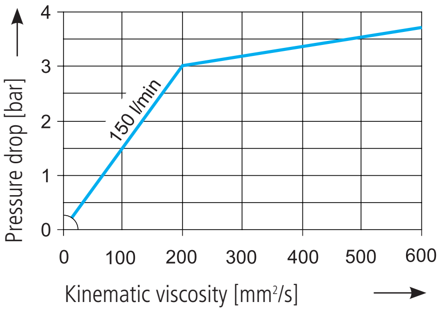
Nominal flow rate

The correct choice of filter size, taking account of application-specific operating conditions, is the only way to ensure that:

- economically acceptable filter lifetimes are achieved
- even with higher starting viscosity, 100 % filtering guarantees the best possible functional protection for the hydraulic components, with pressure drops in the system kept to a minimum.

These important criteria must be taken into account when the nominal flow of a hydraulic filter is determined.

- in practical operating conditions, the filter service life must be at least 1.000 operating hours (for this purpose, ARGO-HYTOS's operational experience shows that a specific dirt accumulation of at least 0,07 g per l/min flow rate has to be taken as a basis).
- at nominal flow rate, the bypass valve of the filter must remain closed during first startup (new filter element) up to a starting viscosity of 200 mm²/s (see the following chart). This corresponds to a temperature of approx. 15 °C with an ISO VG 46 or HLP 46 hydraulic oil.



Pressure drop of a filter in relation to the kinematic viscosity

Given that the pressure drop on superfine filter elements is more or less proportional to the kinematic viscosity, the approximate permitted flow rate on a filter for pressure fluids that vary from ISO VG 46 can be determined as follows:

$$Q_{max} = Q_N \times \frac{\nu_1}{\nu_2}$$

Q_{max} = permitted maximum flow with a pressure fluid that varies from ISO VG 46

Q_N = nominal flow rate based on ISO VG 46

ν_1 = kinematic viscosity of the ISO VG 46 pressure fluid at 15 °C (corresponds to 200 mm²/s)

ν_2 = kinematic viscosity of the variant pressure fluid at 15 °C

When using hydraulic oils of higher viscosity, a lower flow rate is permitted as compared with the nominal flow rate. For media of lower vis-cosity, on the other hand, a higher flow rate is possible as compared with the nominal flow rate. The below listed flow rates have to be adhered to.

When hydraulic oils of different viscosity classes are used, this results in the following factors for QN:

ISO viscosity class	Factor for Q_N
22	2,60
32	1,60
46	1,00
68	0,60
100	0,38
150	0,23
220	0,14
320	0,09

- suction line: 1,5 m/s
- return line: 4,5 m/s
- pressure line up to 100 bar: 6 m/s
- pressure / high-pressure line up to 250 bar: 8 m/s
- high-pressure line up to 600 bar: 12 m/s

All nominal flow rates indicated by ARGO-HYTOS are based on the criteria listed before, which have been fully tried and tested in practice.

How to determine the required dirt capacity

In many cases, the user indicates either the required filter lifetime in operating hours (Bh in the formulas) or the dirt capacity in grams of ISO MTD.

If the lifetime is specified (usually it is identical to the intervals between replacements according to the operating and maintenance instructions), a safety factor of 1,2 to 2,0 should be applied in order to calculate the required ISO MTD capacity of the filter element.

The safety factor is based on the importance or weighting of criteria such as:

- nature of influences from the environment (dust, moisture, temperature)
- following the maintenance instructions (original spare parts, oil quality, intervals between replacements)
- filter monitoring by electrical / optical indicators
- preventive replacement of filter elements

The required setpoint dirt capacity in grams ISO MTD is calculated according to this formula:

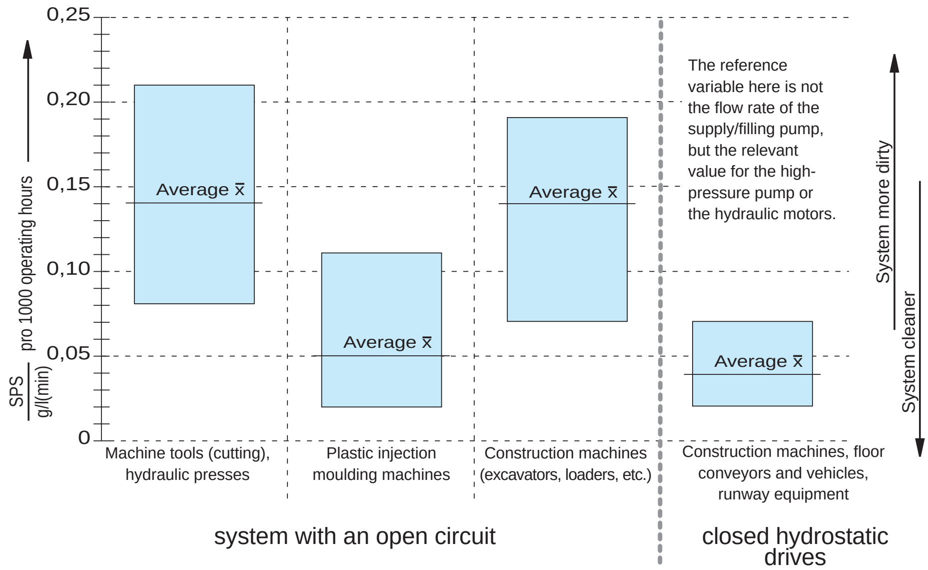
$$\text{Dirt capacity}_{setpoint} = \frac{\text{Specified lifetime}}{1.000\ \text{Bh}} \text{ x S x SPS x Q}$$

Specified lifetime = desired filter lifetime in operating hours (Bh)

S = safety factor (1,2 ... 2,0)

SPS = specific dirt ingression in g/l/min (also see the experience-based values shown below)

Q = pumped flow rate of the working pump in l/min



SPS values for typical hydraulic systems

SPS-values

SPS = specific dirt ingression, indicated in g/l/min pumping flow in 1.000 operating hours.

In the Multi-Pass test, the dirt capacity of a filter is determined with the help of a test dust whose chemical and physical characteristics cannot be compared to those of dirt that occurs in practice. The filter lifetimes that can actually be achieved in various hydraulic systems under practical conditions can only be determined by extensive investigations in the field. The SPS value represents the relationship between the dirt capacity determined in the Multi-Pass test and the filter lifetime that can be achieved in practice. SPS values for commonly used hydraulic systems are shown in the chart.

These experience-based values refer to a machine concept with a well-protected hydraulic cylinder and highly efficient tank ventilating filters.

For systems and equipment that are not included in this list, please consult ARGO-HYTOS for the relevant SPS value.

How to determine the lifetime

The calculated dirt capacity should now be compared with the ISO MTD values shown in the ARGO-HYTOS data sheets, taking account of the filter fineness that has already been determined, and the nominal flow rate.

If the selection table shows that the dirt capacity of the selected filter varies substantially from the calculated value, it may be necessary to select the next largest type. If the variance is insignificant, the decision is ultimately up to the user. The lifetime in hours can then be determined as follows:

$$\text{Lifetime}_{actual} = \frac{\text{Dirt capacity}_{actual}}{\text{S x SPS x Q}} \text{ x1.000 Bh}$$

If the result varies substantially from the specified lifetime, you should again verify the initial data and safety factors, and check whether the system has been classified in the correct machine group based on the SPS value.

Before you finally determine the hydraulic filter that is suitable, you should also clarify these points:

Design-related factors:

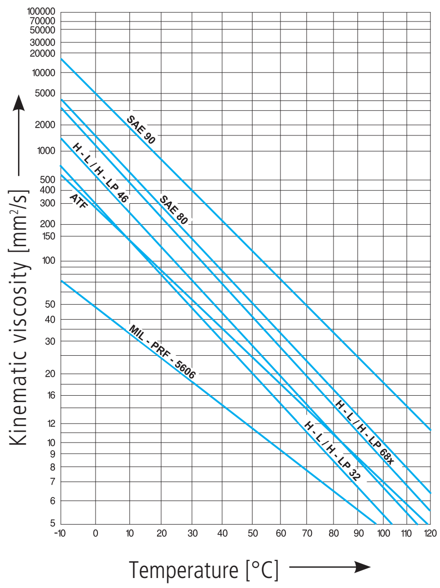
- accessibility for changing the filter element
- type of clogging indicator
- positioning / dimensions of the oil tank
- level differences / angles
- connection threads / flanges

Clogging indicators

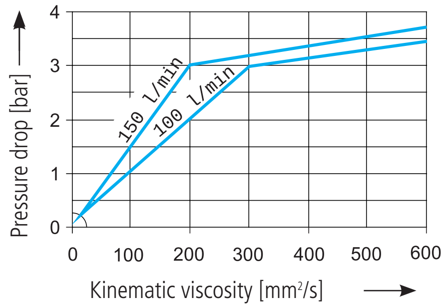
High-pressure filters with flanged/threaded connection

Hydraulic factors:

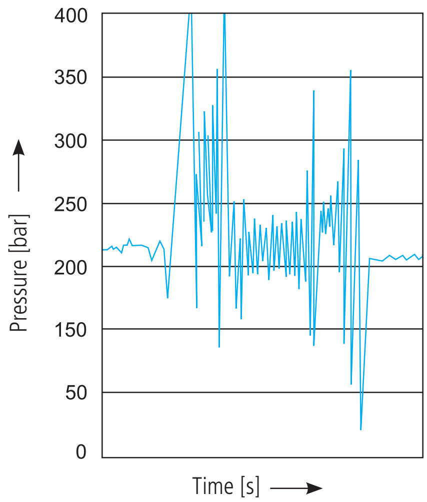
- type of fluid
- level / number of possible pressure peaks
- pressure drop at nominal flow
- viscosity
- bypass valve required / allowed



Viscosity



Pressure drop



Pressure peaks

We are certain that these "Guidelines" have provided you with some important information and that they will help you to reach a descision.

However, the "Guidelines" cannot be a substitute for personal advice from our qualified filter specialists, nor are they intended as such.

Flow chart filter selection procedure

Determine the correct type of filter → **Determine the required filter fineness** → **Determine the required filter size** → **Further considerations**

Determine the correct type of filter
- Suction filter
- Return filter
- Return-Suction filter
- Pressure filter
- High-Pressure filter
- Off-line filter
- Ventilating filter
- Clogging indicator

Determine the required filter fineness
- Determine the required level of oil cleanliness
- Assign the required filter fineness
- Check filter fineness for prevention of gap blockage

Determine the required filter size
- Select size based on nominal flow rate
- Determine the required dirt cappacity
- Determine lifetime

Further considerations
- Design-related factors
- Hydraulic factors

ARGO-HYTOS Service

Rental Units, Calibration, Oil Analysis and Further Services

Our Services for You

The ARGO-HYTOS corporate philosophy focuses on integrated service for our costumers. Our process starts when we devise practical solutions, continue with product development and manufacturing, and extend through to our comprehensive after-sales service.

Today's global market environment calls for all-encompassing service concepts that are precisely tailored to the customer's requirements, so that unrestricted product benefit can be guaranteed.

For this reason, ARGO-HYTOS maintains its own distribution companies in key markets and cooperates with a network of professional service partners. The result: We are a globally active partner, present in all the world's decisive business regions and able to offer our customers the fullest possible service.

Rental Units

Should you need one of our instruments only for a certain time, we may supply you with a demo unit from our stock. This enables you to receive a replacement unit during maintenance work or to assure yourself of the quality of our products. We offer you e.g. oil service units, dewatering systems, oil particle counters and airborne particle counters. On the next page you will see our available units.

Comprehensive Service

Beginning with the planning, over the installation up to the maintenance of your individual Condition Monitoring Systems, we provide customized solutions from one source.

Do you have any questions? Please contact us:

Condition Monitoring Service Team
Industriestraße 9
76703 Kraichtal, Germany

Phone: +49 7250 76-522
Fax: +49 7250 76-475
Email: service@argo-hytos.com

Consulting

Are you interested in the topic Condition Monitoring and would like to equip your system with Sensors & Measurement technology respectively but you are short on experience? We will be pleased to support you with your measurement tasks and advise you regarding system integration and connection to your control system.
Benefit from our experience in various applications.

Installation Service

Do you need support with the installation of your Condition Monitoring System in your unit? We would like to support you. We will carry out mechanical installation, cabling, system integration, tests and initial operation.
If desired we will install a remote control system (e.g. GSM/Ethernet) and will take over the regular data recording and analysis.

Calibration

If you wish to certify your quality management according to ISO 9001ff, your measurement equipment has to be calibrated regularly. For this we offer a calibration service for our sensors including a corresponding certificate.
For operational testing of your particle counter (PODS Pro), we provide a set of two certified reference suspensions, in order to test the measuring quality of your equipment at any time.

Repair Service

We will be pleased to check your equipment for errors and if needed we will make an estimate of the repairing costs. For fast and professional service we only use original spare parts.

Laboratory Analysis

The ARGO-HYTOS oil analysis includes the standard laboratory analysis as well as the extended condition analysis with the help of special electrical transducers. The condition of the oil may be analyzed more precisely. Please see the offered test methods on the following page.

Analysis Technique / Rental Units

Standard Laboratory Analysis consisting of:
Kinematic viscosity at 40 °C and 100 °C (ISO 51562)
Slope m (DIN 51563)
Cleanliness level (ISO 4406:1999)
Neutralisation value (DIN 51558)
para. Determination of the water content (DIN EN ISO 12937) according to Karl Fischer

Analysis with ARGO-HYTOS Condition Sensors consisting of:
SAW dynamic viscosity
Slope m (DIN 51563)
Relative permittivity
Conductivity
Temperature range of the relative permittivity
Temperature range of the conductivity
Relative water content
Cleanliness level (ISO 4406:1999)

Spectroscopy constisting of:
UV/VIS/NIR-spectroscopy

Rental Units	Application
PODS Pro	Portable particle counter with data storage and printer
OPCom portable	Portable particle monitor with data storage
OPCom II[1)]	Stationary particle counter
LubCos H_2O*plus* II[1)]	Oil condition sensor
LubCos Level[1)]	Combined oil condition and filling level sensor
LubCos Vis*plus*[1)]	Oil viscosity sensor
LubCos H_2O[1)]	Combined water and temperature sensor
FA 016 / FAPC 016[2)]	Compact oil service unit for easy filling or cleaning of hydraulic and lubricating systems
UM 045 / UMPC 045 / UMP 045[3)]	Efficient oil service units for easy filling or cleaning of hydraulic and lubricating systems
COPS 010	Compact dewatering system for fast dewatering and filtering of oils
HHPC-6	Airborne particle counter: mobile solution for particle monitoring

[1)] Optionally with display and storage unit LubMon Visu
[2)] Optionally with integrated particle monitor
[3)] Optionally with integrated particle monitor or programmable oil diagnostic system

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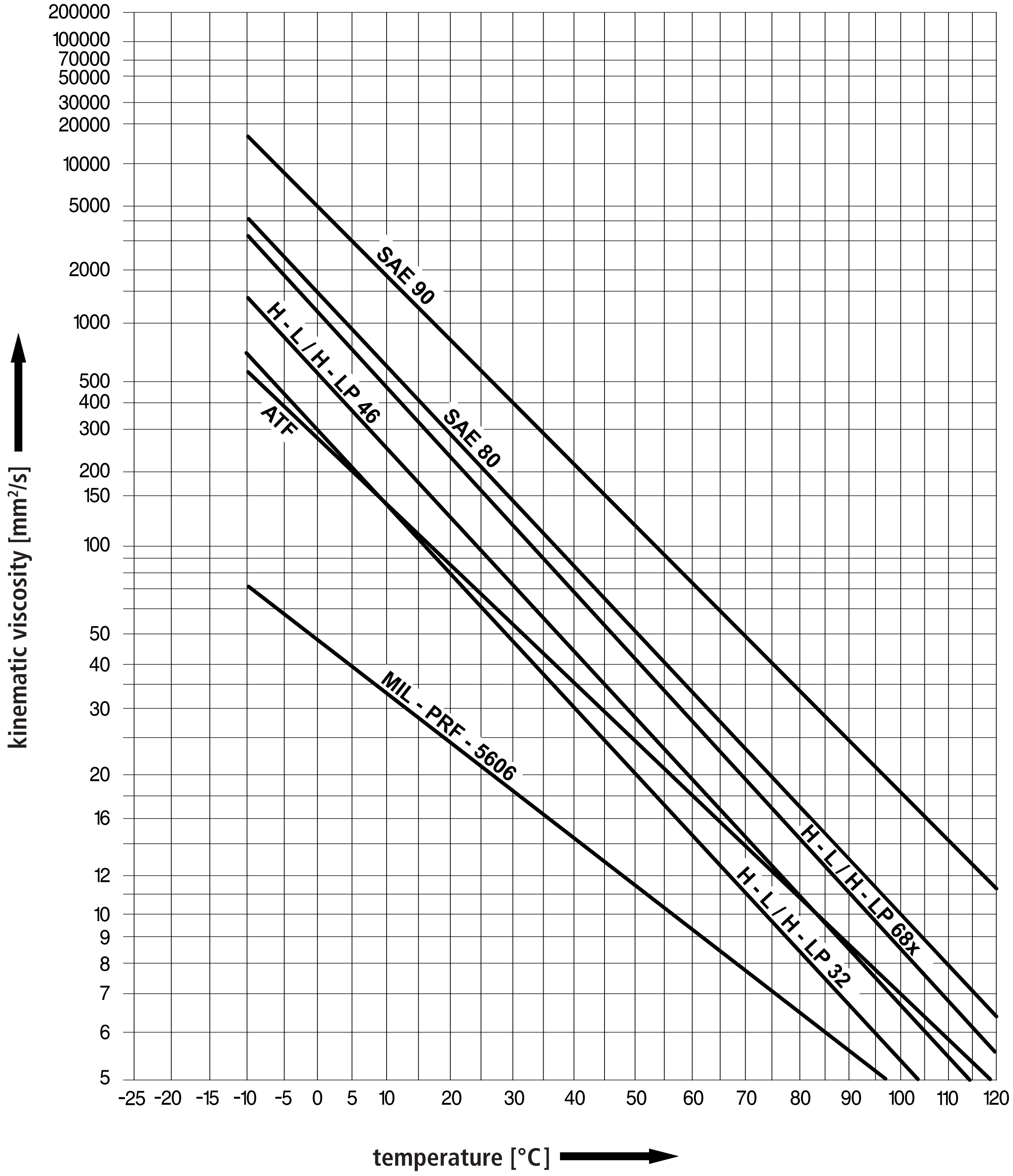
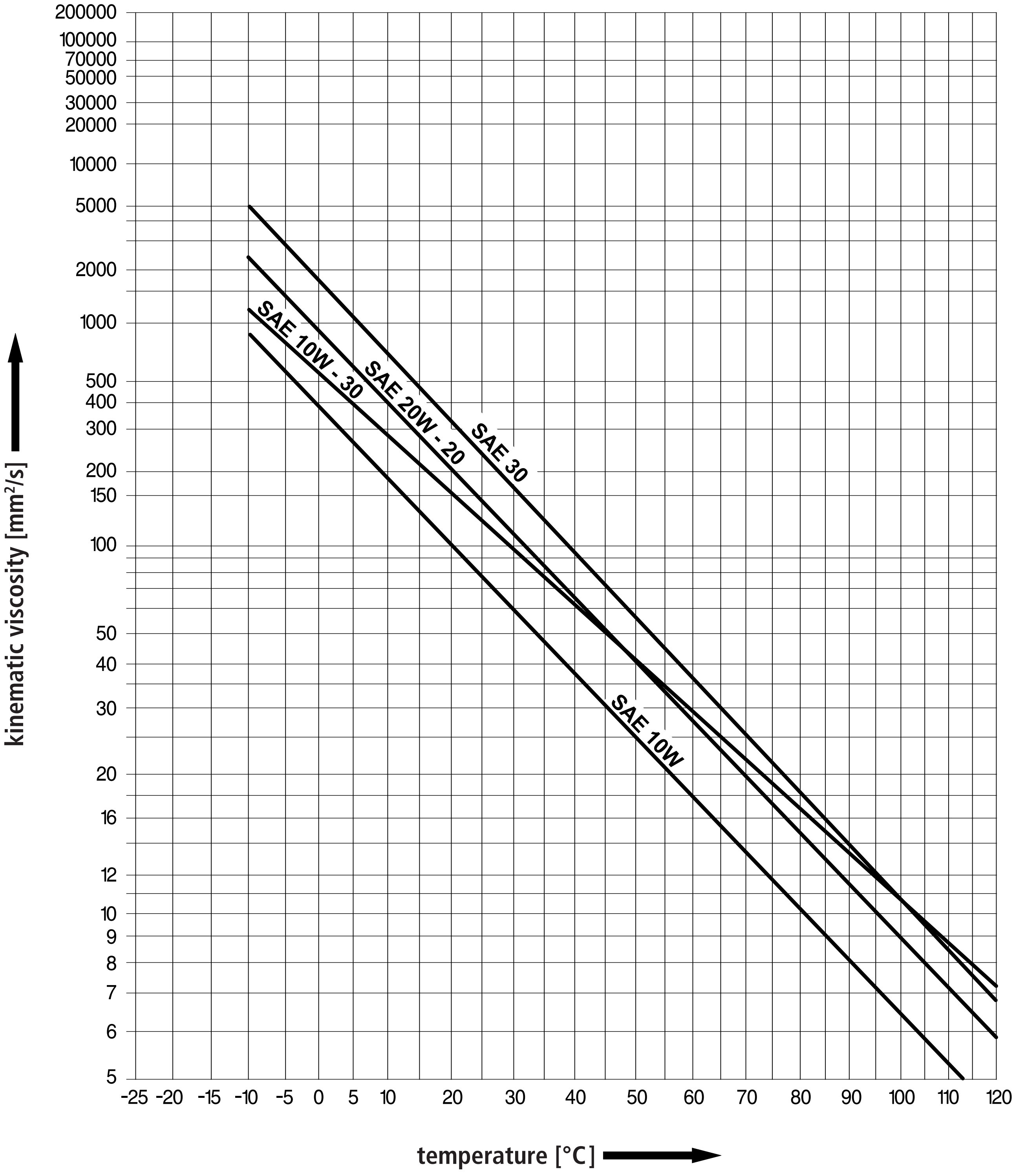
Viscosity Temperature Diagram

Hydraulic Oils, Motor Vehicle Transmission Oils,
ATF (Automatic Transmission Fluid) Oils and MIL-PRF-5606



Motor Oils



Remarks:

- The actual viscosity-temperature behaviour may vary from the characteristic curves for average values which are indicated here. For a precise determination, the information from the respective oil manufacturer should be used.
- On request we will send you a file (MS Excel) with the viscosity curves of common hydraulic media.

Use of Components in Systems with Environmentally Sound Hydraulic Fluids

Technical Recommendations

Environmentally sound hydraulic fluids

At present, three groups of environmentally sound[1] or environmentally compatible[1] hydraulic fluids are used:

- Native esters (HETG), e.g., rapeseed oil
- Synthetic esters (HEES), e.g., dicarboxylic acid ester
- Polyalkylene glycols (HEPG), e.g., polyethylene glycol

Chemical resistance tests

The chemical resistance of ARGO-HYTOS products is currently tested with typical representatives of the groups native esters (HETG), synthetic esters (HEES) and mineral oils (HL, HLP, HLPV).

Ventilating Filters, Filling and Ventilating Filters, Accessories for Filters and Tanks

Native esters (vegetable oils)
The current level of knowledge shows that the above mentioned components can be used in vegetable oils without any problems, provided that the vegetable oils are kept free of water during operation.
If water is allowed to enter, the sealing materials (as well as metal components) may corrode due to hydrolytic[2] separation of the rapeseed oils.

Synthetic esters
The current level of knowledge shows that the above mentioned components can be used in synthetic esters without any problems.

Hydraulic Filters

Native esters and synthetic esters
The current level of knowledge shows that ARGO-HYTOS filters can be used without any problems in fluids of these groups. For the components no chemical resistance problems occur in case of no other sealing materials than NBR[3] is specified by the fluid manufacturer and provided that the subsequent recommendations are observed.

Polyalkylene glycols
If you intend to use the hydraulic filters for fluids of the polyalkylene glycol type (HEPG), it is essential that you first consult ARGO-HYTOS.

Required Replacement Intervals for ARGO-HYTOS Filter Elements

Initial fill of hydraulic systems
Hydraulic components are normally tested with mineral oil. Rapeseed oil-based hydraulic fluids and synthetic esters can both be mixed with mineral oils.

With native esters (vegetable oils)

- First filter element change after running-in period, but not later than after 50 operating hours.
- Second filter element change after 500 operating hours, together with hydraulic fluid.

Subsequent filter element changes every 1.000 operating hours and/or always together with hydraulic fluid change, but at least once a year. The hydraulic fluid should be tested by the supplier/manufacturer in all cases after 1.000 operating hours, and thereafter at intervals of 300 operating hours, owing to the risk of hydrolysis[2] if water[4] enters.

With synthetic esters

- First filter element change after running-in period, but not later than after 50 operating hours.
- Second filter element change after 500 operating hours, together with hydraulic fluid.

Subsequent filter element changes every 1.000 operating hours and/or always together with hydraulic fluid change, but at least once a year.

Changing the oil type of hydraulic systems to native or synthetic esters
After filling with vegetable oil or synthetic ester for the first time, and using new filter elements, the entire hydraulic system should be flushed. All hydraulic functions should be operated several times to ensure that any residue of used oil is flushed out of the entire system. After this first flushing process, a full oil change should be carried out, whereby the filter elements should also be replaced with new ones.
As both vegetable oils and synthetic esters have good dirt-removing[5] properties, the

- first filter element change should be made approx. 10 … 20 operating hours after changing the oil type. All subsequent filter element changes should be carried out at the same intervals as for initial fill of hydraulic systems (see above).

[1] The terms "environmentally sound" and "environmentally compatible" should be regarded in relation to mineral oil-based hydraulic oils (fluids). The term "environmentally friendly" should not be used in connection with hydraulic fluids.

[2] Separation into glycerine and fatty acid

[3] In oil hydraulics NBR sealing materials are standard. If in the technical datasheet of the used oil a higher quality sealing material than NBR is recommended, ARGO-HYTOS should be consulted.

[4] e.g. condensation water

[5] Deposits which have built up during operation with mineral oil are loosened.

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Taking Oil Samples from Hydraulic Systems

ARGO HYTOS

Technical Recommendations

Basic requirements

Particle counting
and oil sample analyzing
Counting the particles contained in an oil sample and analyzing the oil condition is a complex task. The information value of the analysis exclusively depends on whether the particle distribution of the oil sample is representative to the oil situation of the hydraulic system. Therefore we ask you to observe the following instructions and to exercise special care when taking samples.

Sampling points
When selecting sampling points make sure that representative samples are withdrawn from the system (for more information see Adequate Sampling Points).

Sampling time
Samples must be taken at machine operating temperature.

Sampling bottles
The sampling bottles supplied by us are thoroughly cleaned. They may only be taken out of the plastic bag right before sampling.

Sampling conditions
On mobile hydraulic systems preparation of the oil sampling as well as the oil sampling itself should be carried out at locations where external contamination through airborne particles is prevented. Samples taken under windy or rainy conditions cause special problems (water makes any particle counting worthless).

Adequate sampling points

Systems with in-line filters, pressure filters or high-pressure filters
Sampling downstream of the filter
- by means of a special sampling valve or
- by means of a micro port and hose

Systems equipped with tank-mounted return filters
Sampling upstream of the filter
- by means of a special sampling valve or
- by means of a micro port and hose

Systems equipped with suction filters
Sampling
- by means of a special sampling valve or
- by means of a micro port and hose connected to the pressure line or
- from the oil tank, using special equipment, if no other method is possible.

Sampling

Before an oil sample has been withdrawn from a hydraulic system (when the operating temperature has been reached) the hydraulic fluid should be re-circulated at maximum flow rate for at least 5 to 10 minutes. All machine movements should be actuated several times.

Sampling by means of a special sampling valve or a micro port and hose
This is the most reliable method for obtaining reproducible results as secondary contamination will effectively be prevented. Furthermore, the sample will be directly taken from the oil flow. On hydraulic systems operated on a fixed location, sampling is possible without shutting down the system.
When taking a sample you are requested to proceed as follows:

1) While the pump is operating (max. flow rate) open the sampling valve and drain a sufficient quantity of fluid (approx. 2 l) into a separate container in order to flush the sampling valve and dead volumes in the area of the sampling port. Never take a sample right after opening the sampling valve.
2) Open the plastic bag, take the sampling bottle, remove the screw cap and hold it without touching its inner surface.
3) Place the bottle directly under the fluid stream and fill it up to at least 50 %, max. up to 80 %.
   Please note: Reduce the bottled quantity instantly in case the prescribed maximum has been exceeded.[1]
4) Seal the bottle with the screw cap immediately, close the sampling valve afterwards.
5) Label one of the self-sticking tags (to be found in the plastic bag) and stick it to the outward-cleaned bottle.

Operating hours: ....
Type: ....
No.: ....
Date: ....
Company: ....

6) Fill in the data sheet. Please answer the questions accurately.
7) Send us the oil samples together with the data sheet.

Sampling from the tank
This sampling method should only be applied in exceptional cases. Please contact our research department if there is no other possibility to sample. They will advise you.

Remark:
In case the oil sampling will be carried out together with an element change, please label the element and send it to us together with the filled in data sheet.

[1] To prepare the sample in our laboratory (homogenization) a volume of min. 130 ml and max. 200 ml will be required (by using 250 ml sampling bottles provided by ARGO-HYTOS).

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Subject to change
00.300-1e ·0714

Datasheet for oil sampling ☐
filter element change ☐

ARGO HYTOS

Company ______________________ Industry ______________________
Address ______________________ Phone ______________________

Machine/Application ______________________ Manufacturer ______________________
Type/Model ______________________ Chassis/Machine No. ______________________
Operating hours ____________ h Year of manufacture ____________ Power ________ kW (__________) HP

Oil sampling/element change date ______________ by ______________ from Company ______________
Operating hours of oil ______________ h Designation/Type of oil ______________________

Circulation time through filter before sampling ______________ ☐min. / ☐hrs.
Operating hours of element __________ h Tank volume ______________ l Max. operation temperature ____________°C

Filter type ______________________ Manufacturer ______________________
Filter identification ____
Element fineness ____________ µm ☐nom. ☐abs. Clogging indicator ☐no ☐visual ☐electr. ☐electr./vis.

Sampling location ☐Upstream Filter ☐Downstream Filter ☐Tank
☐Other ____

Sampling through ☐System Valve ☐Minimess ☐Vacuum bottle
☐Other ____

Hydraulic circuit ☐Open ☐Closed
Tank breather filter Type ______________________ Manufacturer ______________________

Hydraulic pump ☐Variable displacement ☐Fixed displacement Design ______________________
Type ______________________ Manufacturer ______________________
Capacity ______________ l/min Operating pressure max. ____________ bar

Field of application ☐Construction site equipment ☐Machine tool ☐Hydraulic press ☐Injection molding machine
☐Other ____

Maintenance
Last hydraulic fluid change at ______________ Operating hours at ______________
Recommended fluid change interval ______________ Operating hours resp. ________ Months
Last element change/cleaning at ______________ Operating hours at ______________
Recommended element change interval ______________ Operating hours resp. ________ Months

Repairs ☐No
☐Yes, at ________ Operating hours Kind of repair ______________________

Contact person ______________ Phone ______________ E-mail ______________

Confirmation:
We hereby confirm that the oil sample(s) in question does (do) not contain PCB (polychlorinated biphenyl) nor PCT (polychlorinated terphenyl).

Place ______________ Date ______________ ______________________
Stamp and signature

Maintenance of Hydraulic and Ventilating Filters

Technical Recommendations

General

The task of a filter is to remove solid particles from hydraulic and lubrication systems. As a result the filter contaminates itself.

Ventilating filters contaminate due to the dusty ambient air.

To avoid malfunctions in the system, the maintenance intervals recommended by the manufacturer should be observed.

In filtration we differentiate between 2 filtration principles:

- Depth filters with chaotically arranged fibres
  (e.g. glass fibres, polyester fibres)
- Surface filters with geometrically defined gaps
  (e.g. filter mesh of metal or plastic wires)

With **depth filters** open pores or gaps in the filter material are clogged by different sized dirt particles and thus the differential pressure continuously increases. **Cleaning such a filter is not possible.**

Surface filters hold back all particles which are larger than the mesh size. Particularly strainers with a mesh size smaller 60 µm might be completely clogged at high contamination. **These filters are cleanable.**

Ventilating filters

ARGO-HYTOS ventilating filters are depth filters. These filters cannot be cleaned.
For operational safety reasons and to simplify maintenance, the housings cannot be separated. Changing the filter element is therefore not possible.

ARGO-HYTOS recommends changing the ventilating filters every 1000 operating hours, at least once a year.
This applies to the operation of filters with the nominal volume flow rates specified by ARGO-HYTOS.

Ventilating filters

Hydraulic Filters

Maintaining filters with clogging indicator

By the use of a clogging indicator the pending filter maintenance is indicated and this results in an optimum utilization of the dirt holding capacity.

Clogging of the filter element and thus the differential pressure increase with growing lifetime.

The clogging indicator monitors the differential pressure and generates an electrical and / or optical signal as soon as the preset value is reached.

It should be noted that:
The differential pressure at the filter element increases with the volume flow, the clogging and the kinematic viscosity of the hydraulic fluid.

A filter element is not regarded as contaminated and has to be replaced before the clogging indicator responds at operating temperature of the hydraulic system, causing a continuous signal.

Then the filter element should be changed as soon as possible.

Maintaining filters without clogging indicator

Depth filters

Should the ARGO-HYTOS filters be operated with the volume flow rates indicated in the catalogue with a medium dirt ingress of 0,07 g per l/min, **a maintenance interval of 1000 operating hours, at least once a year** is recommended.

Taking into account the specific operating conditions, the maintenance interval may differ from this indication.

Depth filter (**EXAPOR®MAX 2** filter element)

Surface filters

Due to their filter fineness, normally larger than 60 µm, surface filters cannot produce a sufficient oil cleanliness and are therefore used to protect the system.

The robust design allows the use in many applications throughout the entire lifetime, provided that visual inspections are regularly performed and that the filter elements are cleaned if necessary.

For cleaning we recommend:

- Cleaning in ultrasonic bath for a few minutes.
  As an alternative, put filter in cleaning agent for approx.
  15 minutes and remove dirt from the outside using a brush.

- Then flush with fresh cleaning fluid from the inside to the outside.

- Blow out with compressed air from the inside to the outside.

In any case be careful that no dirt enters the inner side (clean oil side) of the suction filter.

This kind of **cleaning can be performed up to 3 times,** then the filter has to be replaced.

Exceptions

Suction filter without sealing point to the surrounding

To guarantee lowest differential pressures in the suction line, a fixed maintenance interval is advisable.

The ARGO-HYTOS suction filters of series AS are surface filters and have a robust design with end caps, inner frame and metal filter mesh, so that **cleaning as above described is possible.**

Suction filter
without sealing point to the surrounding

Suction filter with sealing point to the surrounding

The operational reliability of seals reduces with increasing lifetime. Thus suction filters as e.g. products of the ARGO-HYTOS series S0 have to be replaced regularly, preferably in connection with the change of the hydraulic fluid

It is recommended to install a new filter every **2000 operating hours, at least every 2 years.** In this case be careful that no dirt enters the inner side (clean oil side) of the suction filter.

Suction filters with synthetic fabric should not be cleaned but replaced.

Suction filter with sealing point to the surrounding

High pressure safety filter

Due to their design it is not economical to replace filter elements of high pressure safety filters, so that a new filter has to be installed when servicing.
Servicing should always be performed when the system is repaired as a result of a larger damage.

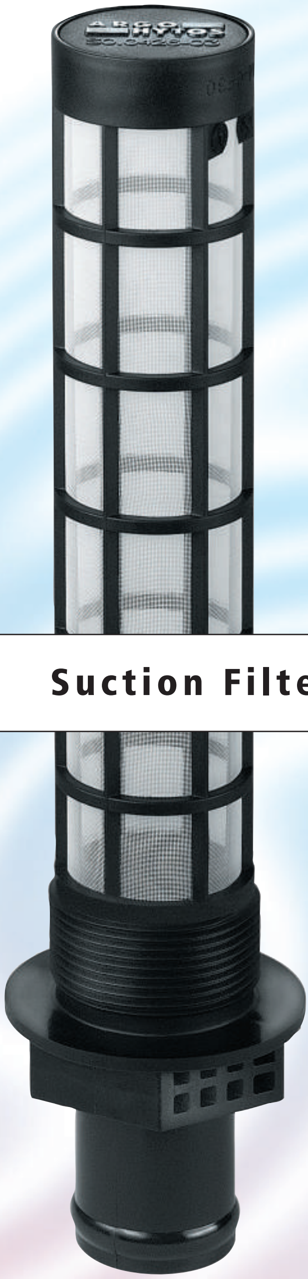
High pressure safety filters

Additional information

ARGO-HYTOS recommends to check the seals with each filter maintenance and replace them if necessary.
Maintenance kits consisting e.g. of filter element, housing seal and maintenance instructions can be put together individually.

All by ARGO-HYTOS announced functionalities of the complete filters as well as the excellent characteristics of the filter element can only be guaranteed when using original ARGO-HYTOS spare parts.

Content



Suction Filters

S0.0426 · S0.0638

- In Tank mounting
- Hose connection up to DN 60
- Nominal flow rate up to 160 l/min

10.05-2e

Description

Application
In the suction line of pumps of hydraulic or lubricating circuits.

Performance features
Protection against malfunction: By full-flow filtration in the suction line, particularly the pumps are protected from coarse dirt particles that have remained in the system after manufacture or repair, or enter the system when it is filled with oil.

Special features
The robust construction with hose fittings, corpus out of reinforced plastics and embedded mesh screen material offers the following advantages:
- High reliability at low dead weight
- Enormous shock and vibration resistance
- Easy mounting

Construction
Flow direction from outside to centre. By using optimized filter material, pressure drops are kept down.
The suction filters operate without by-pass valves. This guarantees continuous full flow filtration.

Filter maintenance
These suction filters have to be replaced on regular basis, e. g. together with the replacement of the hydraulic fluid. It is recommended to change the filter every 2 years or every 2.000 operating hours, depending on what occurs first.
When replacing, it is inevitable to prevent any dirt from entering the inner side (clean oil side) of the filter.
Please refrain from cleaning these suction filters.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness	Filter surface	Connection B	Connection M	Diameter D_1	Diameter D_2	Length L_1	Length L_2	Dimension K	Symbol	Weight	Remarks
	l/min		µm	cm²	mm		mm	mm	mm	mm	mm		kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
S0.0426-02	30	**D1**/1	135	115	32,0	M42 x 2	60	39	251	198	AF50	1	0,09	-
S0.0426-13	60	**D1**/2	280	115	32,0	M42 x 2	60	39	251	198	AF50	1	0,09	-
S0.0638-01	80	**D1**/3	135	320	60,5	M64 x 2	85	55	370	290	AF65	1	0,17	-
S0.0638-03	160	**D1**/4	280	320	60,5	M64 x 2	85	55	370	290	AF65	1	0,17	-

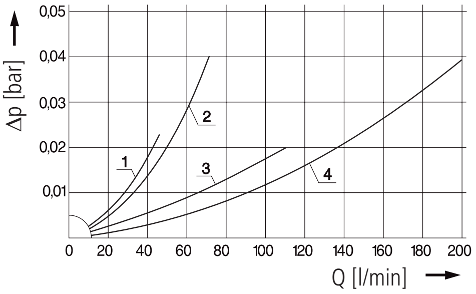
Remarks:
The filters listed in this chart are standard filters. If modifications are required we kindly ask for your request.

Diagrams

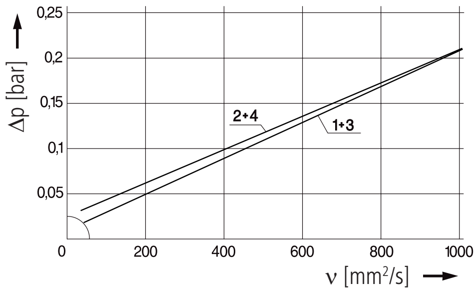
Δp-curves for filters in Selection Chart, column 3

D1

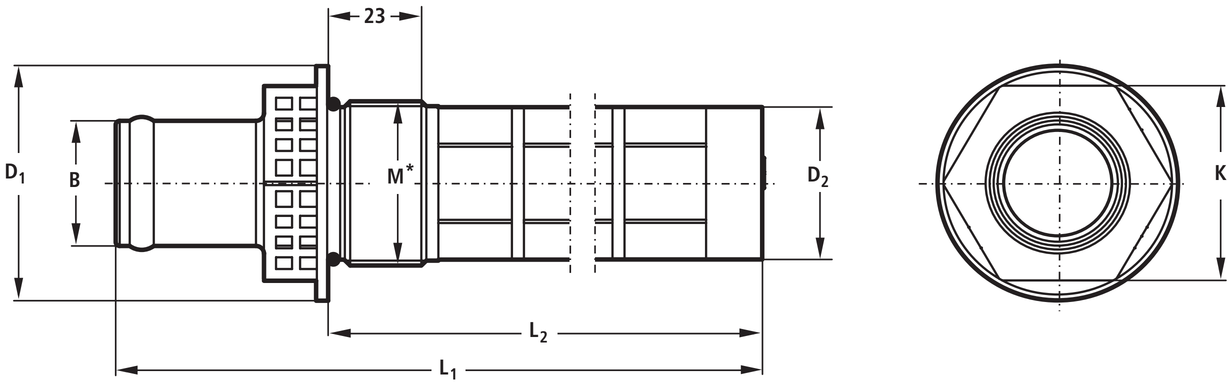
Pressure drop as a function of the **flow volume** at ν = 35 mm²/s



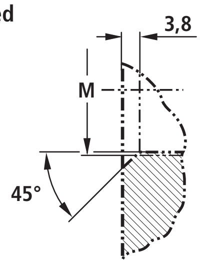
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Dimensions



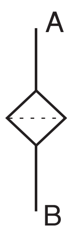
Recommended port sizes



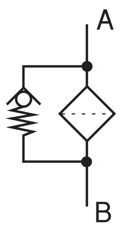
* The thread dimensions do not exactly conform to the DIN ISO standard thread (functioning with the DIN ISO standard thread is guaranteed)

Symbols

1



2



Characteristics

Nominal flow rate
Up to 160 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- Pressure drop $\Delta p < 0{,}035$ bar at $\nu = 35$ mm²/s
- Pressure drop $\Delta p \leq 0{,}25$ bar at $^1/_3$ of the nominal flow rate and $\nu = 4.000$ mm²/s (~ HLP 46 at -20 °C)
- flow velocity in the connection lines ≤ 1,5 m/s

Connection
Fittings for hoses up to DN 60. Sizes see Selection Chart, column 6 (other port threads on request).

Filter fineness
135 µm, 280 µm

Hydraulic fluids
Mineral oil and biodegradable fluids (HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +80 °C (temporary -40 °C ... +100 °C)

Materials

Corpus:	Polyamide, GF reinforced
Cap:	Polyamide, GF reinforced
Seal:	NBR (FPM on request)
Filter mesh:	Polyester

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- start-up viscosity: ν_{max} equivalent to the permitted pump inlet pressure (refer to diagram D), Δp to be determined as a function of the viscosity (take pressure loss in connection lines into account!)

Mounting position
Optional, preferably in horizontal position.
Under all operating conditions (min. oil level, max. inclination) the suction must occur under the oil level.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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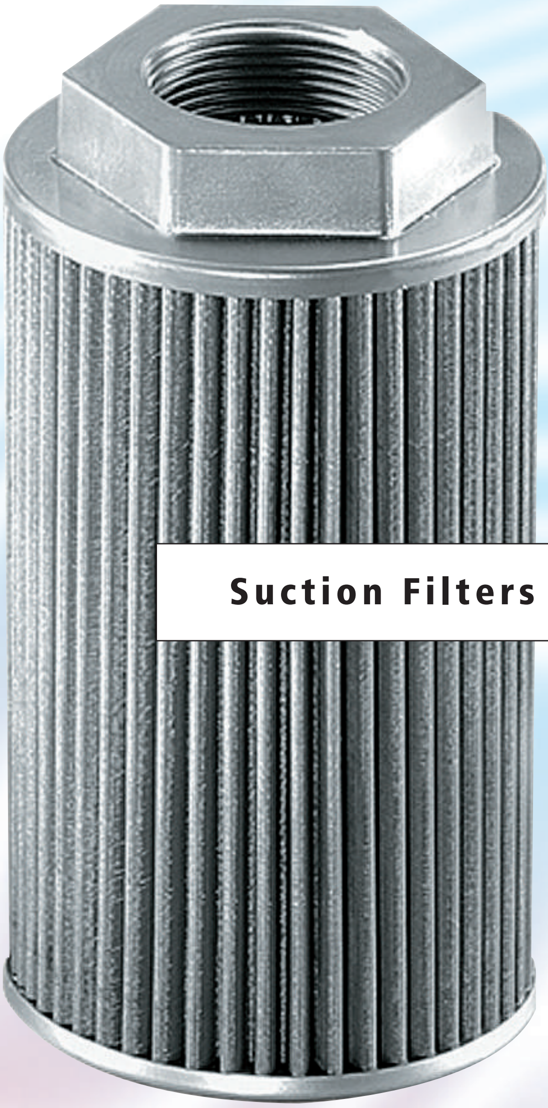
ARGO HYTOS



Suction Filters

AS 010 · AS 025 · AS 040 AS 060 · AS 080 · AS 100 AS 150

- In Tank mounting
- Connection up to G2½
- Nominal flow rate up to 350 l/min

10.10-3e

Description

Application
In the suction line of pumps of hydraulic or lubricating circuits.

Performance features
Protection against malfunction: By full-flow filtration in the suction line, particularly the pumps are protected from coarse dirt particles that have remained in the system after manufacture or repair, or enter the system when it is filled with oil.

Special features
The robust construction with end caps, inner core, and mesh screen material, all out of metal, offers the following advantages:
- Maximum reliability at increased operating temperatures
- Enormous shock and vibration resistance

Construction
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- long service life

Filter maintenance
- Cleaning in ultrasonic bath for a few minutes. As an alternative, put suction filter in cleaning agent for approx. 15 minutes and remove dirt from the outside using a brush.
- Then flush with fresh cleaning fluid from the inside to the outside.
- Blow out with compressed air from the inside to the outside.

In any case, be careful that no dirt enters the inner side (clean oil side) of the suction filter.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness	Filter surface	Cracking pressure of by-pass	Connection B	Diameter D	Length L_1	Length L_2	Dimension K	Symbol	Weight	Remarks
	l/min		µm	cm²	bar		mm	mm	mm	mm		kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
AS 010-00	15	**D1**/1	100	155	-	G½	45	82	60	AF 27	1	0,13	-
AS 025-01	35	**D1**/2	100	420	-	G¾	69,5	91	75	AF 36	1	0,24	-
AS 040-01	60	**D1**/4	100	650	-	G1	69,5	133	117	AF 41	1	0,30	-
AS 040-71	60	**D1**/3	100	650	- 0,3	G1	69,5	133	117	AF 41	2	0,30	-
AS 060-01	90	**D2**/1	100	1030	-	G1¼	70	205	185	AF 50	1	0,42	-
AS 080-01	120	**D2**/2	100	1280	-	G1½	100	182	165	AF 70	1	0,50	-
AS 080-81	120	**D2**/2	100	1400	- 0,3	G1½	100	182	165	AF 70	2	0,50	-
AS 100-01	200	**D2**/4	100	2300	-	G2	100	213	196	AF 70	1	0,60	-
AS 100-81	150	**D2**/3	100	1750	- 0,3	G2	100	213	196	AF 70	2	0,60	-
AS 150-01	350	**D2**/5	100	2300	-	G2½	150	191	165	Ø 82	1	1,40	-

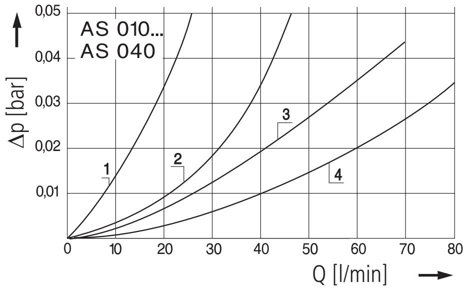
Remarks:
The filters listed in this chart are standard filters. Other designs, e.g. other filter finenesses, available on request.

Diagrams

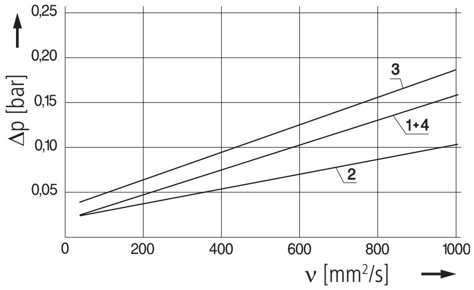
Δp-curves for filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm^2/s

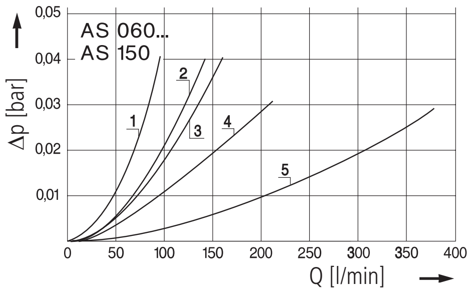


Pressure drop as a function of the **kinematic viscosity** at nominal flow

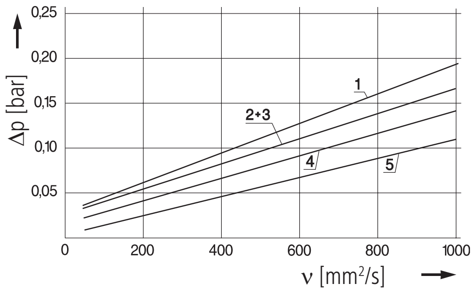


D2

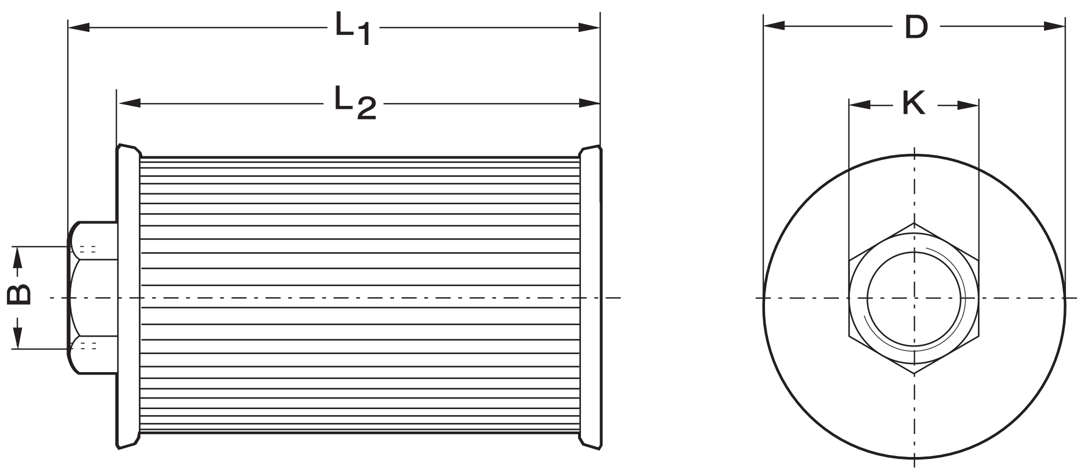
Pressure drop as a function of the **flow volume** at ν = 35 mm^2/s



Pressure drop as a function of the **kinematic viscosity** at nominal flow



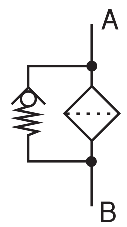
Dimensions



Symbols

1

2



Characteristics

Nominal flow rate
Up to 350 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- Pressure drop $\Delta p < 0{,}035$ bar at $\nu = 35$ mm²/s
- closed by-pass valve at $\nu \leq 200$ mm²/s
- flow velocity in the connection lines $\leq 1{,}5$ m/s

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 7 (other port threads on request).

Filter fineness
100 µm

Hydraulic fluids
Mineral oil and biodegradable fluids (HEES and HETG, see info-sheet 00.20)

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Materials
- AS 010-00 / AS 025-01 / AS 040-01 / AS 060-01 / AS 150-01
  End caps out of steel,
  support mesh out of steel, zinc plated,
  filter mesh out of stainless steel (1.4301)
- AS 080-01 / AS 100-01
  End cap with hexagon out of aluminum,
  bottom end cap out of steel,
  support mesh out of steel, zinc plated,
  filter mesh out of stainless steel (1.4301)
- AS 040-71
  End caps out of steel,
  filter mesh out of stainless steel (1.4301)
- AS 080-81 / AS 100-81
  End cap with hexagon out of aluminum,
  bottom end cap out of steel,
  filter mesh out of stainless steel (1.4301)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- start-up viscosity: ν_{max} equivalent to the permitted pump inlet pressure (refer to diagram D), Δp to be determined as a function of the viscosity (take pressure loss in connection lines into account!)

Mounting position
Optional; versions equipped with bypass valve preferably in horizontal position. Under all operating conditions (min. oil level, max. inclination) the suction must occur under the oil level.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
ARGO-HYTOS GMBH · Industriestraße 9 · 76703 Kraichtal-Menzingen · Germany
Phone: +49 7250 76-0 · Fax: +49 7250 76-199 · info@argo-hytos.com · www.argo-hytos.com

Suction Filters

LS 025 · LS 035

- In-line mounting
- Connection up to G¾
- Nominal flow rate up to 33 l/min

10.20-2e

Description

Application
To be installed in the suction line of the pumps of hydraulic systems resp. upstream of the charge pumps of hydrostatic drives.

Performance features

Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Filter elements
Flow direction from outside to center. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Aluminium alloy
Filter bowl:	Polyamide, GF reinforced
Seals:	NBR (FPM on request)
Filter media:	Paper-cellulose web, impregnated with resin

Accessories
Electrical and optical clogging indicators are available.
Dimensions and technical data see catalogue sheet 60.20.

Characteristics

Nominal flow rate
Up to 33 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines $\leq$ 1,5 m/s
  If units not equipped with a bypass valve are used in hydrostatic drives, the recommendations regarding their technical application given on catalogue sheet 10.310 should be observed.

Connection
Threaded ports according to ISO 228 or DIN 13. Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
50 µm(c)
ß-values according ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- start-up viscosity: determine ν_{max}, observing the permissible pressure at the pump inlet according to diagram D; determine Δp as a function of the viscosity (take into account the pressure loss in the connecting lines!)
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

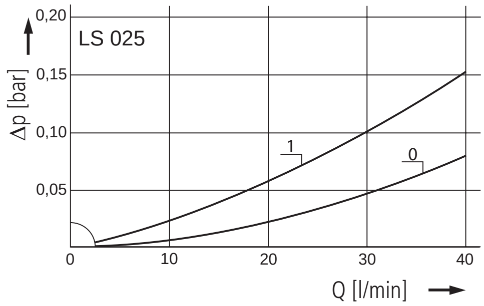
Mounting position
Vertical mounting to be preferred, filter head on top.

Diagrams

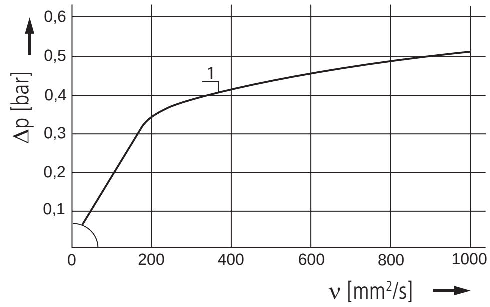
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at $\nu = 35\ mm^2/s$ (0 = casing empty)

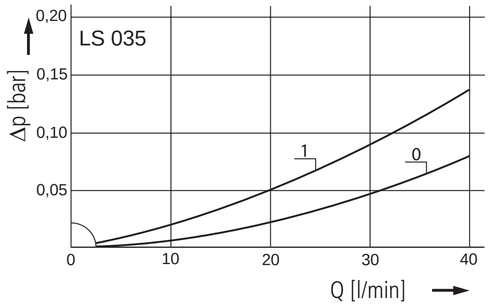


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

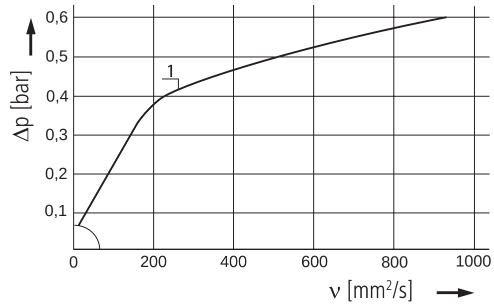


D2

Pressure drop as a function of the **flow volume**
at $\nu = 35\ mm^2/s$ (0 = casing empty)



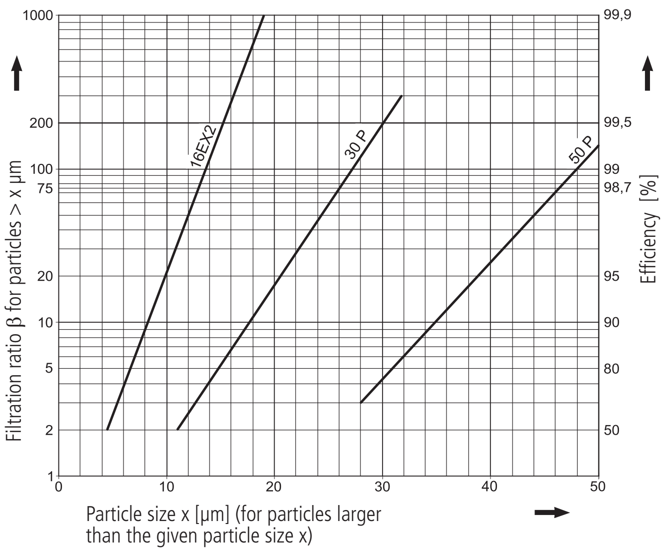
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

16EX2 = $\overline{\beta}_{16\,(c)} = 200$ EXAPOR®MAX 2
30P = $\overline{\beta}_{30\,(c)} = 200$ Paper
50P = $\overline{\beta}_{50\,(c)} = 200$ Paper

Based on the structure of the filter media of the 30P and 50P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

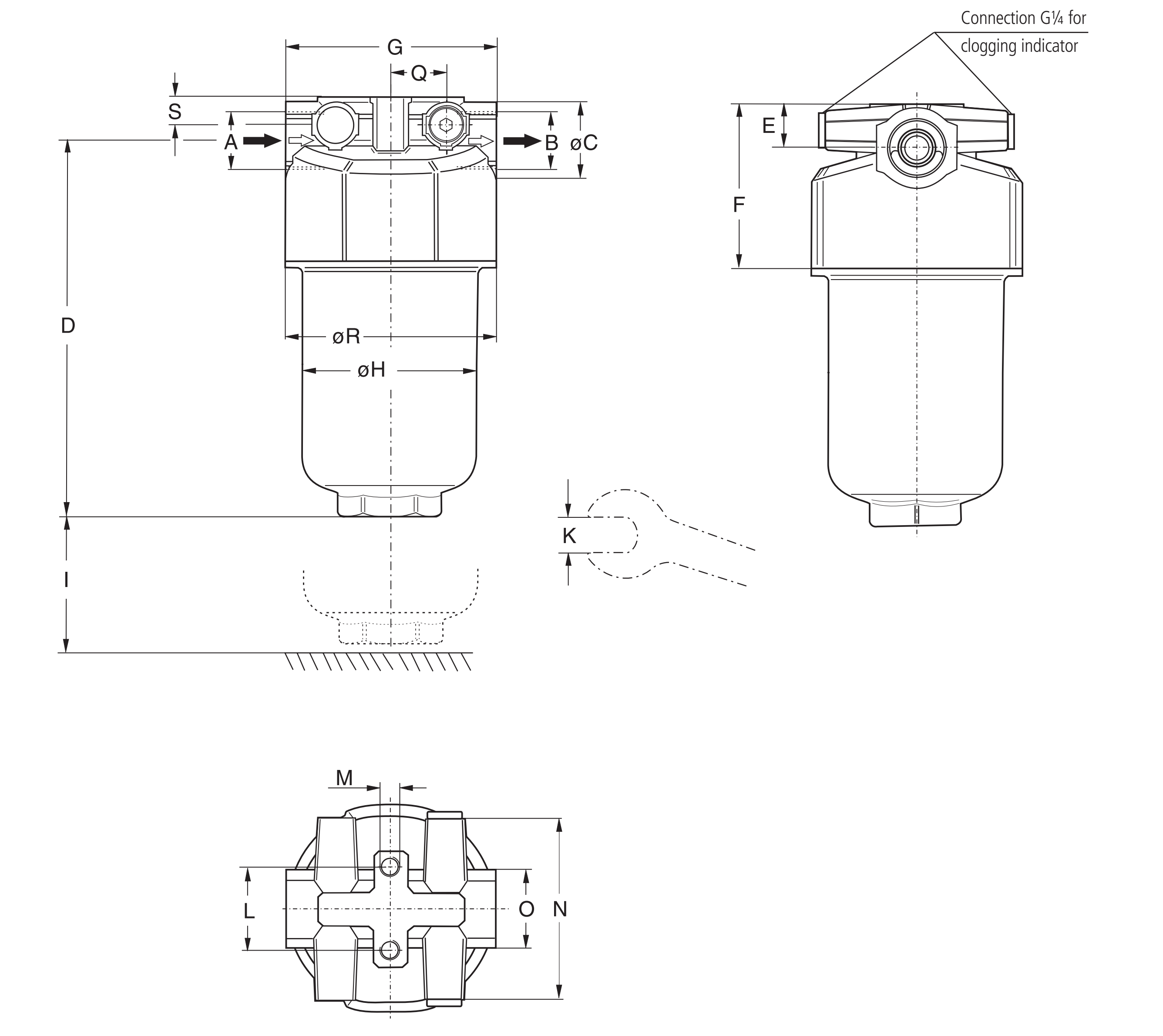
Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity Filter surface in ( )	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Remarks
	l/min			g		bar			kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
LS 025-152	25	**D1**/1	50P	15	G¾	-0,3	2	P3.0714-02	0,9	-
LS 035-152	33	**D2**/1	50P	19	G¾	-0,3	2	P3.0717-02	1,0	-

All filters are delivered with a plugged clogging indicator connection G¼. As clogging indicators either manometers or vacuum switches can be used.

For the appropriate clogging indicator see catalogue sheet 60.20.

Remarks:
- The start of the red area respectively the actuating pressure of the vacuum switch has always to be higher than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs available on request.

Dimensions

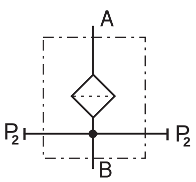


Measurements

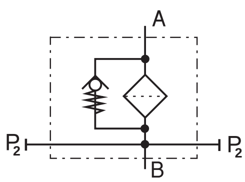
Type	A	B	C	D	E	F	G	H	I	K	L	M Ø/depth	N	O	Q	R	S
LS 025	G¾	G¾	35	178	20	74	95	80	40	AF 41	38,1	M8/15	82	AF 36	25	95	12
LS 035	G¾	G¾	35	212	20	74	95	80	40	AF 41	38,1	M8/15	82	AF 36	25	95	12

Symbols

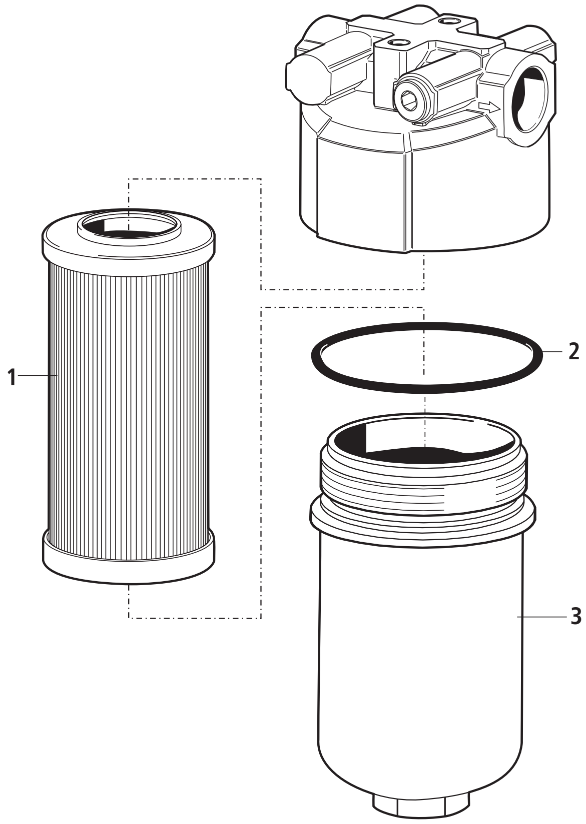
1



2



Spare Parts



Pos.	Designation	Part No.
1	Filter element	see Chart/ col. 9
2	O-ring 82,14 x 3,53	N007.0824
3	Filter bowl LS 025	E 068.0101
3	Filter bowl LS 035	E 068.0102

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

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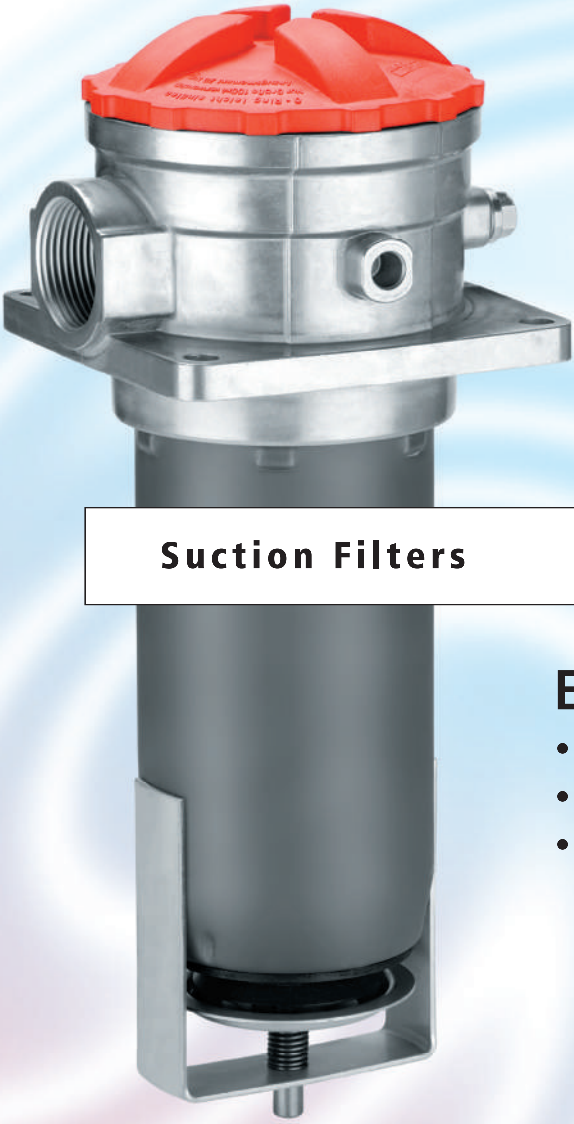


Suction Filters

ES 074 · ES 094

- Tank top mounting
- Connection up to G1¼
- Nominal flow rate up to 80 l/min

10.30-4e

Description

Application
To be installed in the suction line of the pumps of hydraulic systems resp. upstream of the charge pumps of hydrostatic drives.

Performance features
Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Special features
By-pass valve: The location close to the suction inlet prevents dirt particles retained by the filter element from entering into the clean oil side.

Filter element locking valve: Ensures that dirt accumulated in the filter element is removed together with the element and cannot return to the tank.

Foot valve: When the screw-on cap is removed for maintenance, the foot valve closes automatically. This makes it possible to service the filter even if it is submerged below the oil level in a full tank.

Filter elements
Flow direction from centre to outside. The star-shaped pleating of the filter material results in:
• large filter surfaces
• low pressure drop
• high dirt-holding capacities
• long service life
In filters with a magnetic system, the ferromagnetic particles in the fluid pass first through a strong magnetic field and are separated.

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Screw-on cap:	Polyester, GF reinforced
Filter head:	Aluminium alloy
Filter bowl:	Steel
Seals:	NBR (FPM on request)
	EXAPOR®MAX 2 - inorganic microfibre web
Filter media:	Paper – cellulose web, impregnated with resin
	Stainless steel wire mesh (1.4301)

Accessories
Electrical and optical clogging indicators are available on request. Dimensions and technical data see catalogue sheet 60.20.

Characteristics

Nominal flow rate
Up to 80 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines ≤ 1,5 m/s
  If units not equipped with a bypass valve are used in hydrostatic drives, the recommendations regarding their technical application given on catalogue sheet 10.310 should be observed.

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
16 µm(c) ... 60 µm(c)
β-values according ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- start-up viscosity: determine ν_{max}, observing the permissible pressure at the pump inlet according to diagram D; determine Δp as a function of the viscosity (take pressure loss in connection lines into account!)
- at initial operation of units equipped with a bypass valve: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

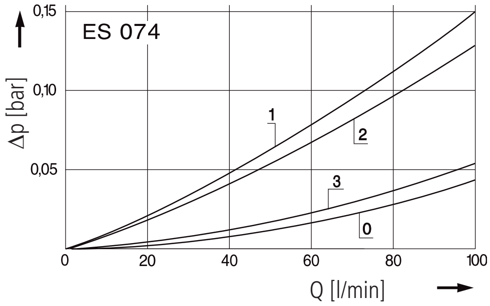
Mounting position
Vertical mounting to be preferred, suction opening pointing downwards, versions equipped with foot valve for horizontal mounting also.

Diagrams

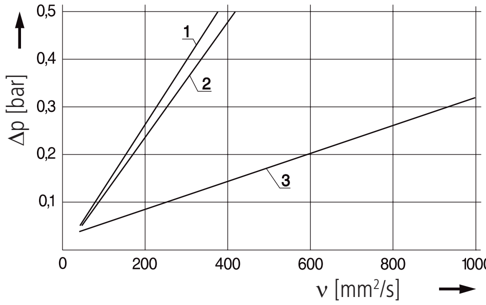
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at $\nu = 35$ mm²/s (0 = casing empty)

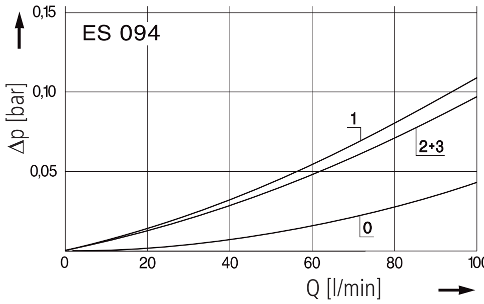


Pressure drop as a function of the **kinematic viscosity** at nominal flow

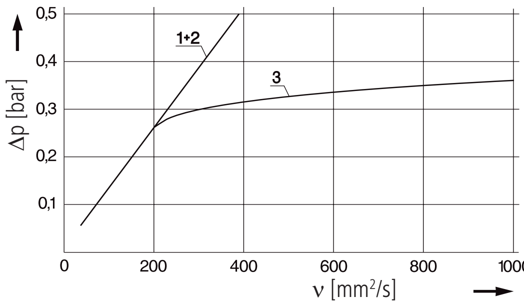


D2

Pressure drop as a function of the **flow volume** at $\nu = 35$ mm²/s (0 = casing empty)



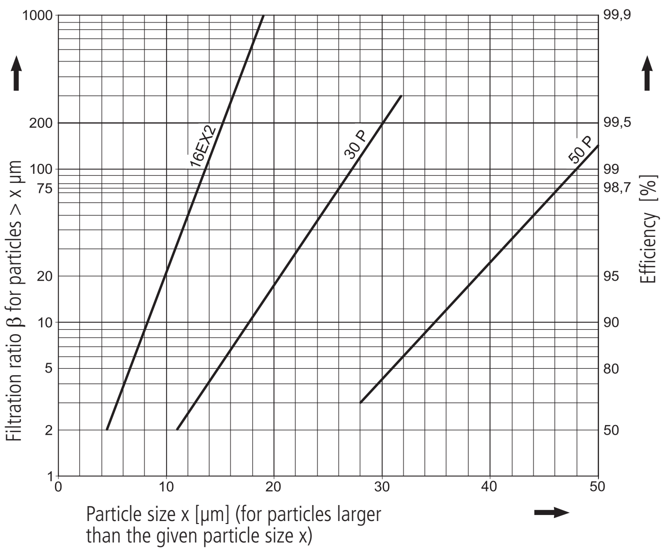
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

16EX2 = $\bar{\beta}_{16\,(c)} = 200$ EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)} = 200$ Paper
50P = $\bar{\beta}_{50\,(c)} = 200$ Paper

Based on the structure of the filter media of the 30 P and 50 P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity Filter surface in ( )	Connection B	Cracking pressure of by-pass	Foot valve	Symbol	Replacement filter element Part No.	Weight	Remarks
	l/min			g		bar				kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
ES 074-6801	40[1]	**D1**/1	16EX2	26	G1¼	-	•	2	V2.0923-07	2,4	-
ES 074-6110	45[1]	**D1**/2	30P	23	G1	-	-	1	P2.0923-01	2,2	-
ES 074-6120	45[1]	**D1**/2	30P	23	G1¼	-	-	1	P2.0923-01	2,2	-
ES 074-6121	45[1]	**D1**/2	30P	23	G1	-	•	2	P2.0923-01	2,4	-
ES 074-6141	45[1]	**D1**/2	30P	23	G1¼	-	•	2	P2.0923-01	2,4	-
ES 074-0001	80	**D1**/3	60S	(1540 cm^2)	G1¼	-0,25	•	6	S2.0920-10	2,4	with magnetic system
ES 094-6801	60[1]	**D2**/1	16EX2	40	G1¼	-	•	2	V2.0933-08	3,2	-
ES 094-6110	70[1]	**D2**/2	30P	34	G1¼	-	-	1	P2.0933-01	3,0	-
ES 094-6111	70[1]	**D2**/2	30P	34	G1¼	-	•	2	P2.0933-01	3,2	-
ES 094-6121	70	**D2**/3	30P	34	G1¼	-0,25	•	4	P2.0933-01	3,2	-

All filters are delivered with a plugged clogging indicator connection G¼. As clogging indicators either manometers or vacuum switches can be used. Optional extension pipes adapt the filter length to various tank depths. For ordering of accessories please use the below mentioned codes.

Order example: The filter ES 074-6110 has to be supplied with an extension pipe (EV) for a mounting depth of 400 mm.

Order description: **ES 074-6110 / EV 400**

Part No. (Basic unit) — ES 074-6110

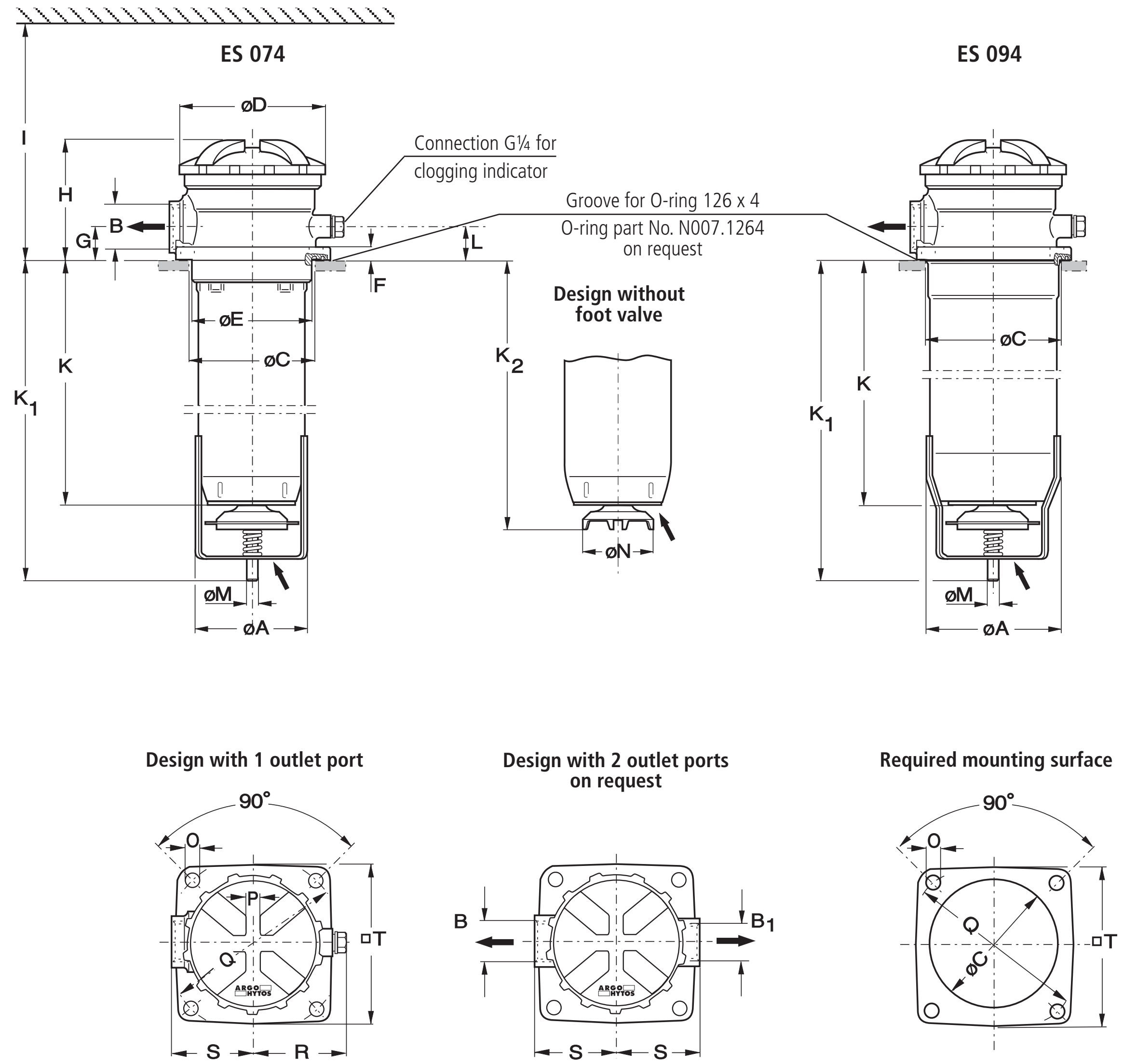
Extension pipe[2] (2 lengths are available) — EV 400
EV = 400 / 500 mm (see dimensions and measurements)

For the appropriate clogging indicator see catalogue sheet 60.20.

Remarks:
- The start of the red area respectively the actuating pressure of the vacuum switch has always to be higher than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs available on request.

[1] Those values apply when used in hydrostatic drives and instructions in catalogue sheet 10.310 have to be observed [2] For designs without foot valve

Dimensions



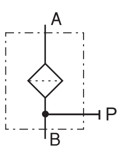
For calculation of dimension EV see selection chart

Measurements

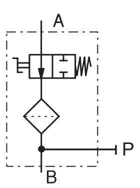
Type	A	B	C min./max.	D	E	F	G	H	I	K	K_1	K_2	L	M	N	O	P
ES 074	100	G1, G1¼	111/121	126,5	110	11,5	32	106	400	198	256	218	35	10	62,5	11	13
ES 094	115	G1¼	119/121	126,5	-	11,5	32	106	525	305	364	325	35	10	62,5	11	13
Type	**Q**	**R**	**S**	**T**													
ES 074	165	82,5	76	141													
ES 094	165	76,5	76	141													

Symbols

1



2



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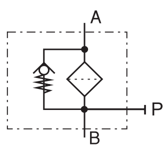

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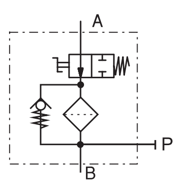

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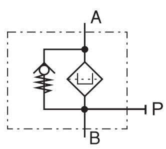
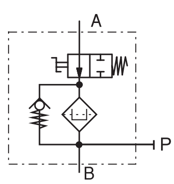
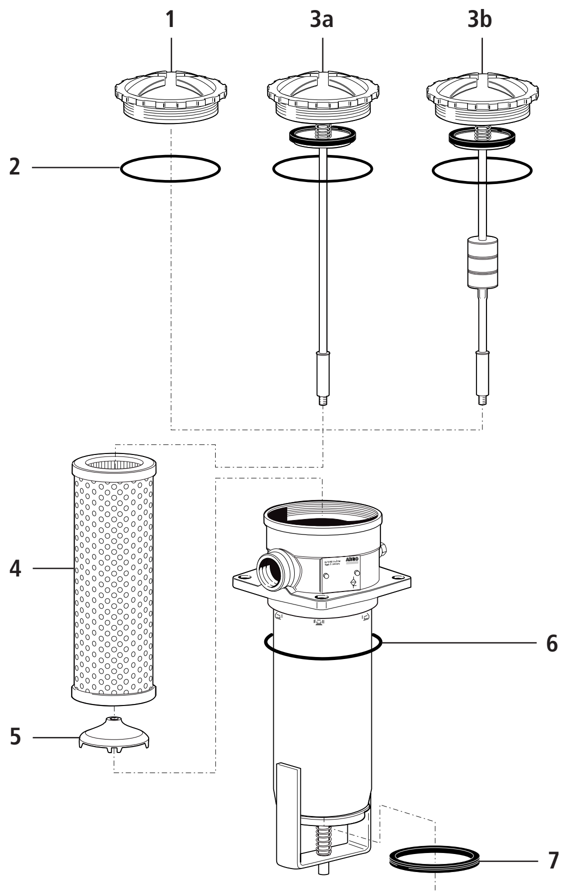


6



Spare Parts



Pos.	Designation	Part No.
1	Screw-on cap with Pos. 2	ES 074.1212
2	O-ring 100 x 4	N007.1004
3a	Screw-on cap with Pos. 2 for ES 074 (without by-pass) for ES 094 (without by-pass) for ES 094 (with by-pass)	 ES 074.1213 ES 094.1212 ES 094.1213
3b	Screw-on cap with Pos. 2 including magnetic system for ES 074 (with by-pass)	 ES 074.1205
4	Filter element	see Chart / col. 10
5	Valve cone	ES 074.0202
6	O-ring 126 x 4 *	N007.1264
7	Rubber ring	N042.7401

* not included in basic equipment

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

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ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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We produce fluid power solutions

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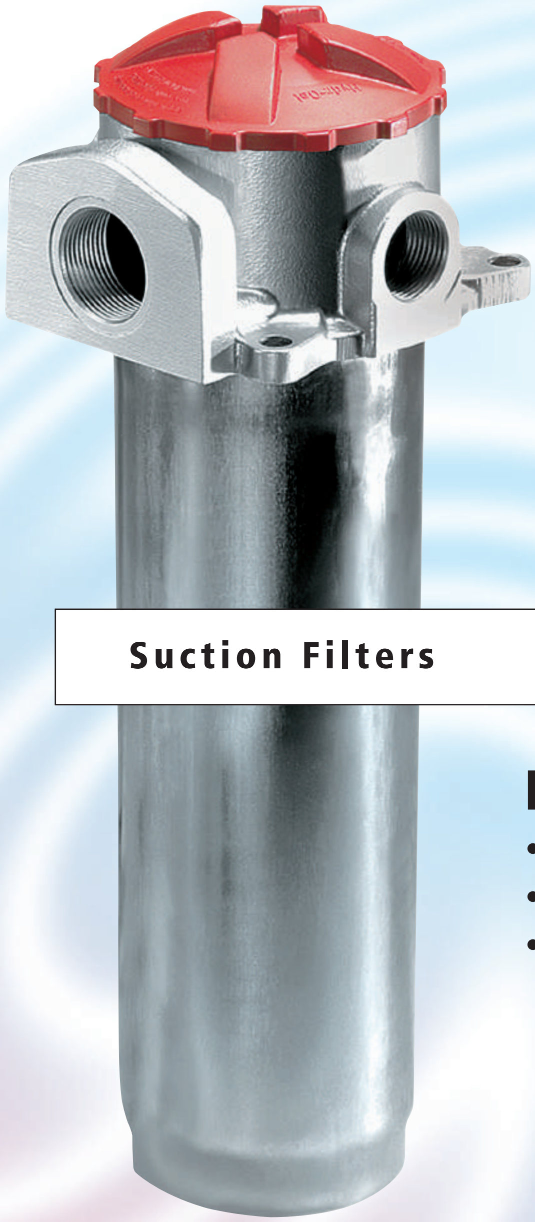
Suction Filters



ES 134 · ES 144

- Tank top mounting
- Connection up to SAE 1 1/2
- Nominal flow rate up to 130 l/min

10.50-3e

Description

Application
To be installed in the suction line of the pumps of hydraulic systems resp. upstream of the charge pumps of hydrostatic drives.

Performance features
Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Special features
By-pass valve: The location close to the suction inlet prevents dirt particles retained by the filter element from entering into the clean oil side.

Filter element locking valve: Ensures that dirt accumulated in the filter element is removed together with the element and cannot return to the tank.

Foot valve: When the screw-on cap is removed for maintenance, the foot valve closes automatically. This makes it possible to service the filter even if it is submerged below the oil level in a full tank.

Filter elements
Flow direction from centre to outside. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

In filters with a magnetic system, the ferromagnetic particles in the fluid pass first through a strong magnetic field and are separated.

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Screw-on cap:	Polyester, GF reinforced
Filter head:	Aluminium alloy
Filter bowl:	Steel
Seals:	NBR (FPM on request)
Filter media:	Paper – cellulose web, impregnated with resin Stainless steel wire mesh (1.4301)

Accessories
Electrical and optical clogging indicators are available on request. Dimensions and technical data see catalogue sheet 60.20.

Characteristics

Nominal flow rate
Up to 130 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines ≤ 1,5 m/s
  If units not equipped with a bypass valve are used in hydrostatic drives, the recommendations regarding their technical application given on catalogue sheet 10.310 should be observed.

Connection
Threaded ports according to ISO 228 or DIN 13 or SAE-flanges (3.000 psi). Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
30 µm(c) ... 60 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- start-up viscosity: determine ν_{max}, observing the permissible pressure at the pump inlet according to diagram D; determine Δp as a function of the viscosity (take pressure loss in connection lines into account!)
- at initial operation of units equipped with a bypass valve: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

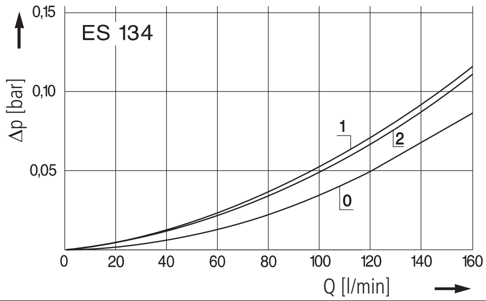
Mounting position
Vertical mounting to be preferred, suction opening pointing downwards, versions equipped with foot valve for horizontal mounting also.

Diagrams

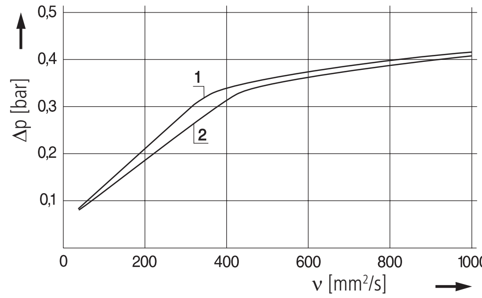
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at $\nu = 35\ mm^2/s$ (0 = casing empty)

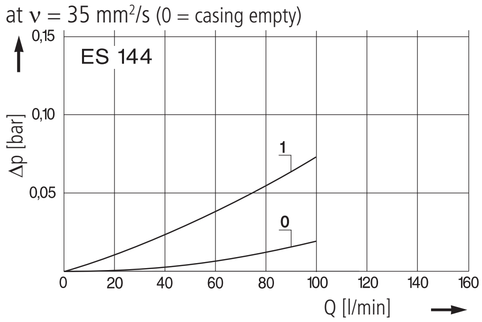


Pressure drop as a function of the **kinematic viscosity** at nominal flow

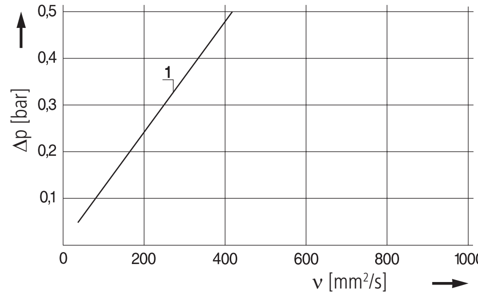


D2

Pressure drop as a function of the **flow volume** at $\nu = 35\ mm^2/s$ (0 = casing empty)



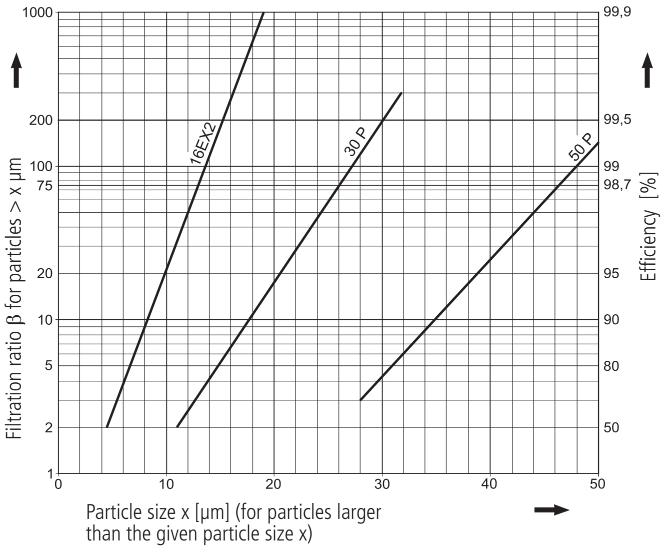
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

16EX2 = $\overline{\beta}_{16\,(c)} = 200$ EXAPOR®MAX 2
30P = $\overline{\beta}_{30\,(c)} = 200$ Paper
50P = $\overline{\beta}_{50\,(c)} = 200$ Paper

Based on the structure of the filter media of the 30 P and 50 P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity Filter surface in ( )	Connection B	Cracking pressure of by-pass	Foot valve	Symbol	Replacement filter element Part No.	Weight	Remarks
	l/min			g		bar				kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
ES 134-0501	130	**D1**/1	40S	(1540 cm^2)	SAE 1½	-0,25	•	6	S2.0920-05	3,0	with magnetic system
ES 134-0001	130	**D1**/2	60S	(1540 cm^2)	SAE 1½	-0,25	•	6	S2.0920-10	3,0	with magnetic system
ES 144-6110	70[1]	**D2**/1	30P	34	2 x G1 + G1¼	-	-	1	P2.0933-01	3,5	-

All filters are delivered with a plugged clogging indicator connection G¼. As clogging indicators either manometers or vacuum switches can be used. Optional extension pipes adapt the filter length to various tank depths. For ordering of accessories please use the below mentioned codes.

Order example: The filter ES 144-6110 has to be supplied with an extension pipe (EV) for a mounting depth of 400 mm.

Order description: **ES 144-6110 / EV 400**

Part No. (Basic unit) — ES 144-6110

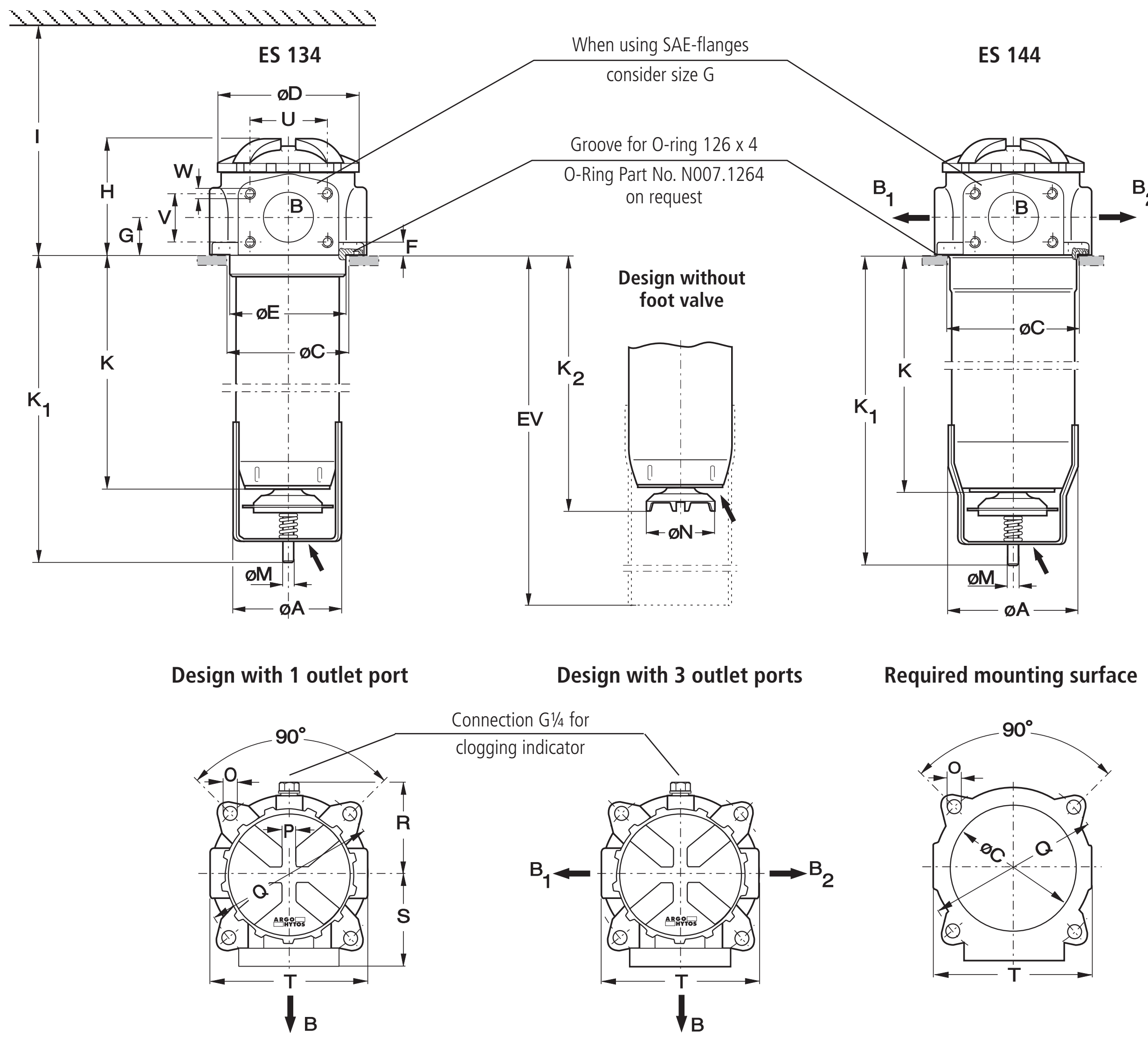
Extension pipe[2] (2 lengths are available) — EV 400
EV = 400 / 500 mm (see section dimensions and measurements)

For the appropriate clogging indicator see catalogue sheet 60.20.

Remarks:
- The start of the red area respectively the actuating pressure of the vacuum switch has always to be higher than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs available on request.

[1] Those values apply when used in hydrostatic drives and instructions in catalogue sheet 10.310 have to be observed. [2] For designs without foot valve

Dimensions



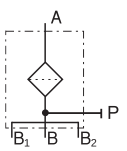
For calculation of dimension EV see selection chart

Measurements

Type	A	B	B1	B2	C min./max.	D	E	F	G	H	I	K	K1	K2	L	M	N
ES 134	100	SAE 1½	-	-	111/121	126,5	110	12	32	106	400	198	256	218	-	10	62,5
ES 144	115	G1¼	G1	G1	119/121	126,5	-	12	32	106	525	305	364	325	-	10	62,5
Type	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**								
ES 134	11,5	13	165	81	82	144	69,8	35,7	M 12								
ES 144	11,5	13	165	81	82	144	69,8	35,7	M 12								

Symbols

1



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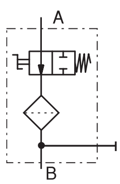

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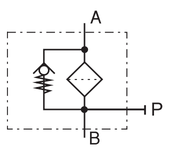

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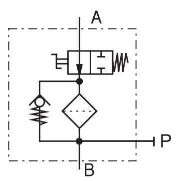

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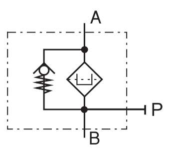

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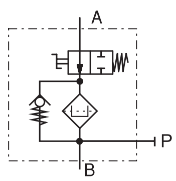
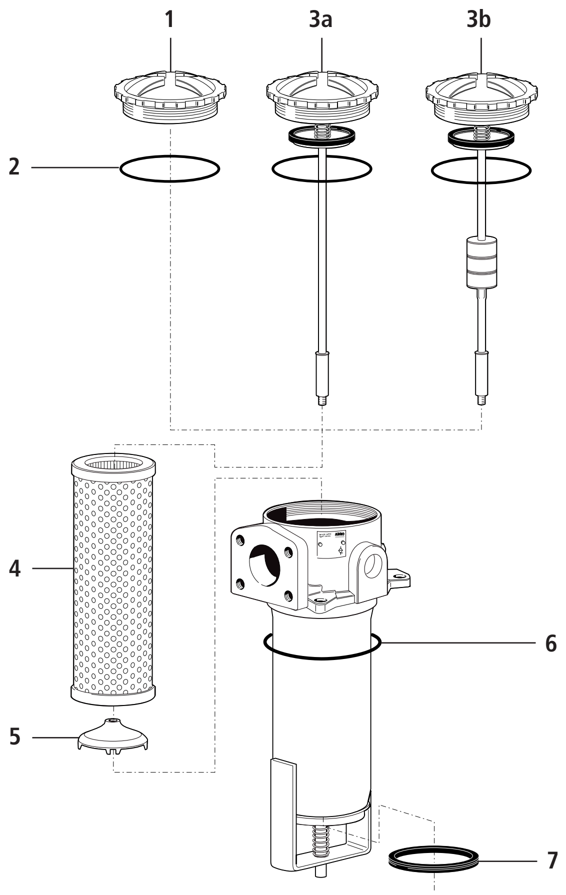


Spare Parts



Pos.	Designation	Part No.
1	Screw-on cap with Pos. 2	ES 074.1212
2	O-ring 100 x 4	N007.1004
3a	Screw-on cap with Pos. 2 for ES 134 (without by-pass) for ES 144 (without by-pass)	 ES 074.1213 ES 094.1212
3b	Screw-on cap with Pos. 2 including magnetic system for ES 134 (with by-pass)	 ES 074.1205
4	Filter element	see Chart / col. 10
5	Valve cone	ES 074.0202
6	O-ring 126 x 4 *	N007.1264
7	Rubber ring	N042.7401

* not included in basic equipment

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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Built-in Suction Filters

Type series ES, application in hydrostatic gears

Technical Recommendations

Certain versions of our built-in suction filters in the ES series are designed for use in front of filler pumps of hydrostatic gears.
Particular attention has been paid to the specific requirements of the manufacturers of these gears regarding filter fineness and pressure drop.
These filters have no bypass-valve, so that unfiltered oil cannot enter the circulation.
Versions without a foot-valve are intended for vertical installation, in which case particular attention must be paid to the oil-level:

at max. oil-level: **sufficient safety-clearance below the filter cover must be maintained.**

at min. oil-level: **sufficient level of oil above the filter inlet must be maintained.**

Suction filters designed for installation below the oil-level are fitted with a foot-valve. The oil-feed to the filter casing is cut off automatically when the filter cover is opened.

Some gear manufacturers insist that filters be designed to handle double the maximum output of the filler pump. Our filters already conform to this requirement.
The flow-data for the filters shown in the tables are based on the following assumptions:

1. The use of ATF oils with approx. 26 to 28 mm²/s at 50 °C or hydraulic oils with a viscosity and viscosity temperature characteristic corresponding to standard ATF oils (also see info-sheet 00.003).

2. Under normal operating conditions an operating viscosity of $\leq$ 35 mm²/s should be reached within 15 minutes of commencement of operation.

3. Effective oil capacity in litres should be about 0,5 to 1 x the maximum output of the filler pump.

4. A pressure drop Δp between filter outlet and filler pump inlet of $\leq$ 0,05 bar at viscosity of 35 mm²/s.

Should operationg conditions differ from the above, please contact us for further information.

Details of pressure gradients for individual filters are given on the specification sheets of the respective filters, chapter diagrams.

Suction filter, type series ES

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Content

ARGO HYTOS

Return Filters

D 090 · D 100

- In-line mounting
- Connection up to G¾
- Nominal flow rate up to 110 l/min

20.05-2e

Description

Application
In the return line circuits of hydraulic systems.

Performance features

Protection against wear: By means of filter elements that, in full-flow filtration meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Aluminium alloy
Filter bowl:	Polyamide, GF reinforced
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

Accessories
Electrical and optical clogging indicators are available. Dimensions and technical data see cataologue sheet 60.20.

Characteristics

Nominal flow rate
Up to 110 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines ≤ 4,5 m/s

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
10 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20)

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

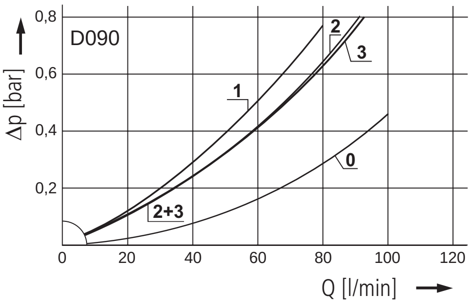
Mounting position
Preferably vertical, filter head on top.

Diagrams

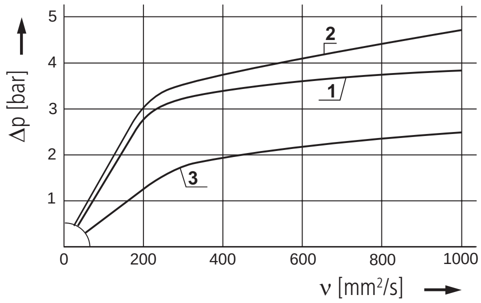
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)

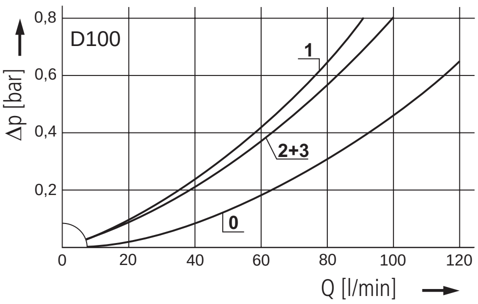


Pressure drop as a function of the **kinematic viscosity** at nominal flow

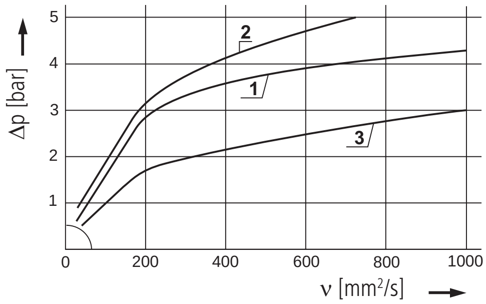


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)



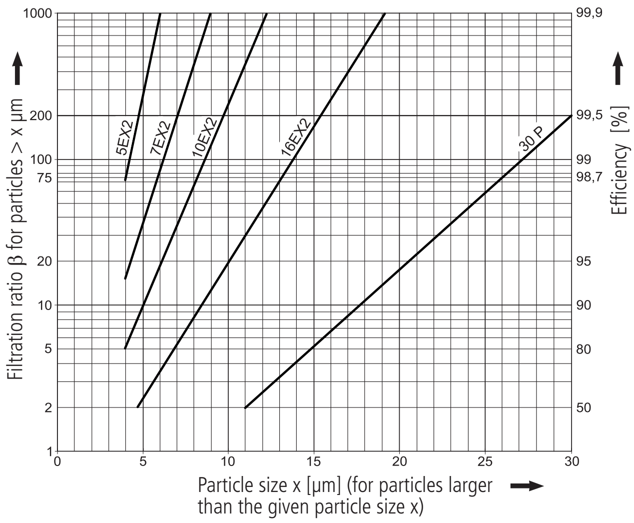
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2	=	$\bar{\beta}_{5\,(c)} = 200$	EXAPOR®MAX 2
7EX2	=	$\bar{\beta}_{7\,(c)} = 200$	EXAPOR®MAX 2
10EX2	=	$\bar{\beta}_{10\,(c)} = 200$	EXAPOR®MAX 2
16EX2	=	$\bar{\beta}_{16\,(c)} = 200$	EXAPOR®MAX 2
30P	=	$\bar{\beta}_{30\,(c)} = 200$	Paper

For screen elements:

40S	=	screen material with mesh size	40 µm
60S	=	screen material with mesh size	60 µm
100S	=	screen material with mesh size	100 µm

Tolerances for mesh size accordung to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

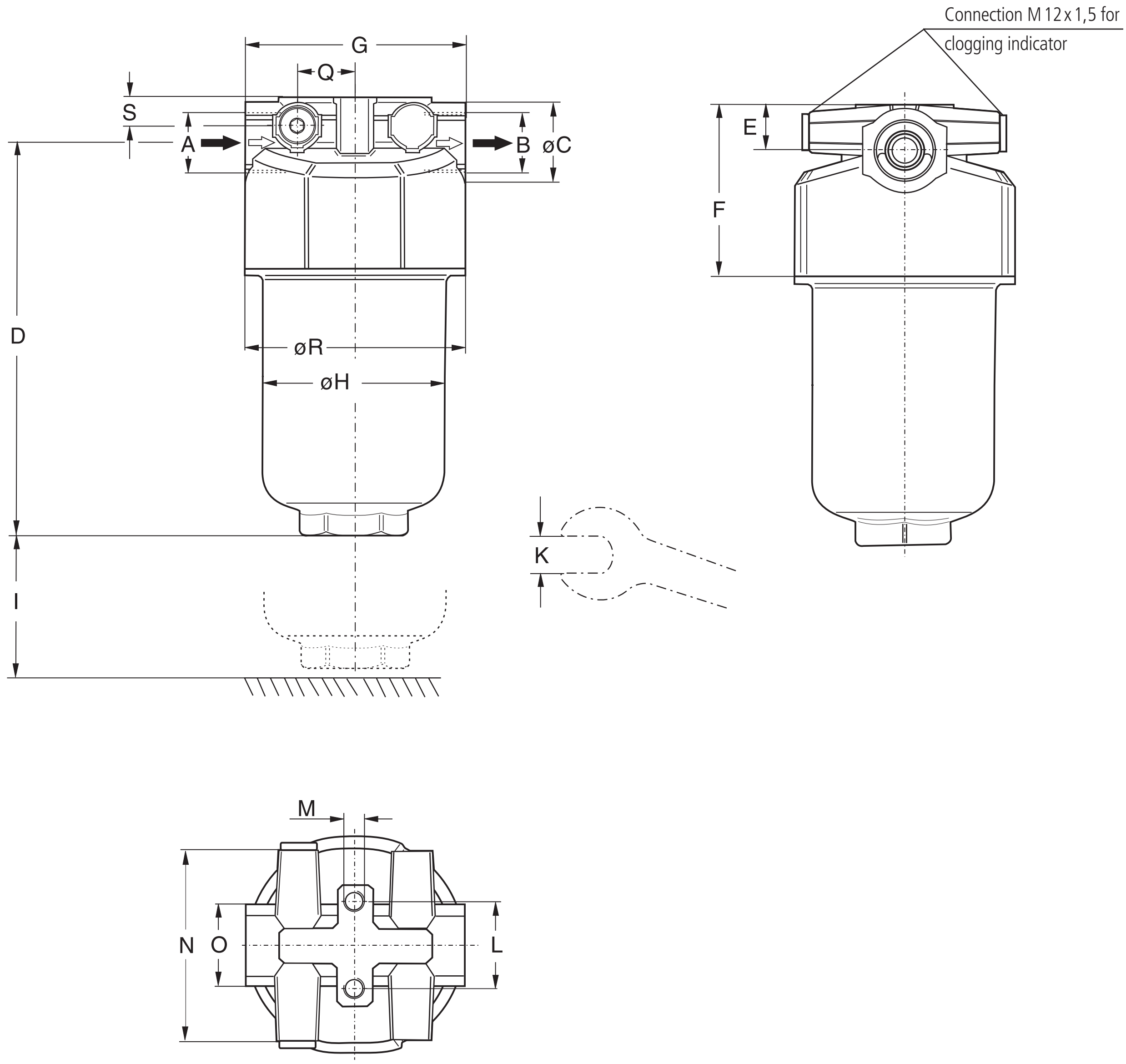
Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement element Part No.	Weight	Remarks
	l/min			g		bar			kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
D 090-156	60	**D1**/1	10EX2	17	G¾	2,5	2	V3.0714-06	0,9	-
D 090-158	85	**D1**/2	16EX2	17	G¾	2,5	2	V3.0714-08	0,9	-
D 090-151	50	**D1**/3	30P	7,3	G¾	1,5	2	P3.0714-01	0,9	-
D 100-156	75	**D2**/1	10EX2	22	G¾	2,5	2	V3.0717-06	1,0	-
D 100-158	110	**D2**/2	16EX2	22	G¾	2,5	2	V3.0717-08	1,0	-
D 100-151	70	**D2**/3	30P	9,4	G¾	1,5	2	P3.0717-01	1,0	-

All filters are delivered with a plugged clogging indicator connection M12 x 1,5. As clogging indicators either manometers or electrical pressure switches can be used.

For the appropriate clogging indicator please see catalogue sheet 60.20.

Remarks:
- The switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs available on request.

Dimensions

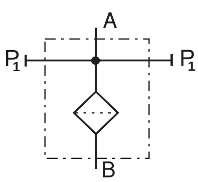


Measurements

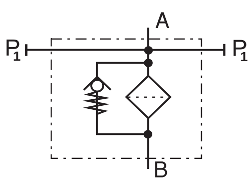
Type	A	B	C	D	E	F	G	H	I	K	L	M Ø/depth	N	O	Q	R	S
D 090	G¾	G¾	35	178	20	74	95	80	40	AF 41	38,1	M8/15	82	AF 36	25	95	12
D 100	G¾	G¾	35	212	20	74	95	80	40	AF 41	38,1	M8/15	82	AF 36	25	95	12

Symbols

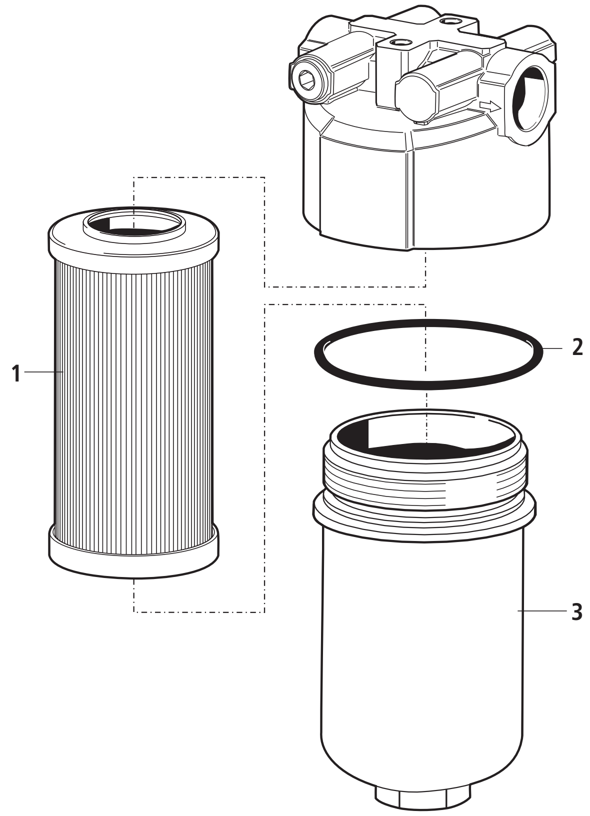
1



2



Spare Parts



Pos.	Designation	Part No.
1	Filter element	see Chart / col. 9
2	O-ring 82,14 x 3,53	N007.0824
3	Filter bowl D 090	E 068.0101
3	Filter bowl D 100	E 068.0102

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

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Return Filters

E 043 · E 072

- Tank top mounting
- Connection up to G¾
- Nominal flow rate up to 70 l/min

20.20-6e

Description

Application
In the return line circuits of hydraulic systems.

Performance features
Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Special features
By-pass valve: The location close to the inlet port prevents dirt particles retained by the filter element from entering into the clean oil side.

Oil separator: Prevents oil splashing through the breather on mobile application.

Removable bowl: In case of maintenance the filter bowl is removed together with the filter element – therefore dirt particles are not flushed back into the tank.

Extension pipe: A correct extension pipe length ensures oil outlet below minimum oil level and prevents foaming.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Ventilating filter
Ventilation of the reservoir by an integral star-shape pleated filter element:
- removable (replace annually!)
- splash-proof
- fineness 2 µm

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Screw-on cap:	Polyester, GF reinforced
Filter head:	Aluminium alloy
Filter bowl:	Polyamide, CF reinforced, electrically conducting
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

Accessories
Electrical and optical clogging indicators are available on request. Dimensions and technical data see catalogue sheet 60.20.

An optional oil separator (Part No. E 043.1701) is available on request.

Extension pipes on the bowl outlet are available in several lengths on request.
A self-assembly system for installation of extension pipes can be ordered. For detailed information please see catalogue sheet 20.390.

Characteristics

Nominal flow rate
Up to 70 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines ≤ 4,5 m/s

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
5 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).
With high filling conditions we recommend an electrical conductivity ≥ 500 pS/m at 20 °C.

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

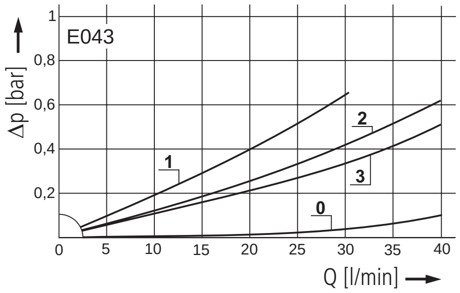
Mounting position
Preferably vertical, outlet downwards

Diagrams

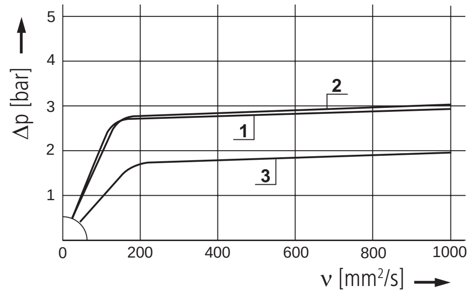
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)

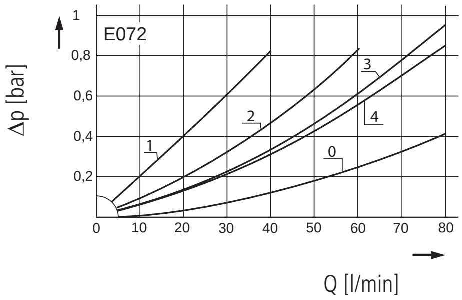


Pressure drop as a function of the **kinematic viscosity** at nominal flow

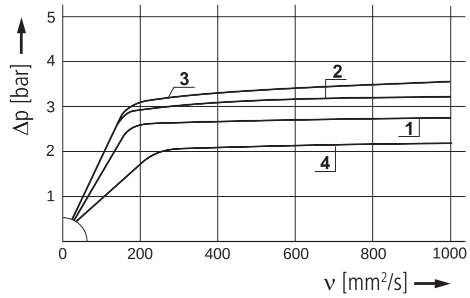


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)



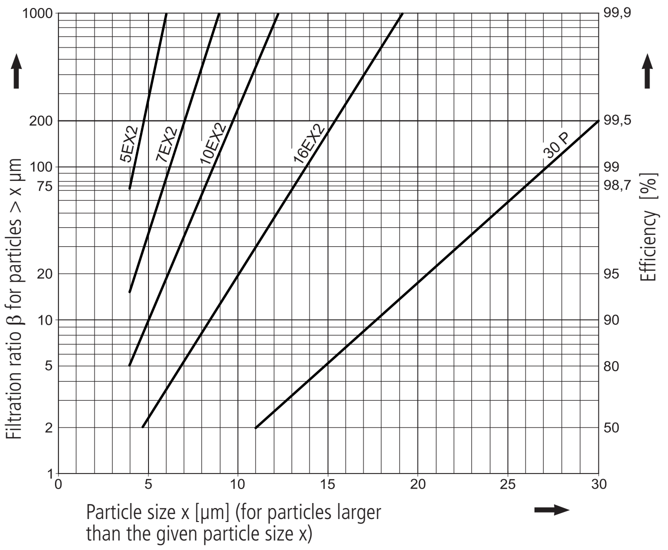
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\overline{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\overline{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\overline{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\overline{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\overline{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 μm
60S = screen material with mesh size 60 μm
100S = screen material with mesh size 100 μm

Tolerances for mesh size accordung to DIN 4189

For ventilating filter elements:

2CL = 99,5 % efficiency for particles of size 2 μm

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A	Cracking pressure of by-pass	Symbol	Replacement element Part No.	Weight	Replacement ventilating filter Part No. (Filter fineness see diagrams)	Remarks
	l/min			g		bar			kg		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
E 043-156	25	**D1**/1	10EX2	6,1	G$^{1}/_{2}$	2,5	2	V3.0510-56	0,6	L1.0403-01 (2CL)	-
E 043-166	25	**D1**/1	10EX2	6,1	G$^{1}/_{2}$	2,5	1	V3.0510-56	0,6	-	-
E 043-158	35	**D1**/2	16EX2	6,1	G$^{1}/_{2}$	2,5	2	V3.0510-58	0,6	L1.0403-01 (2CL)	-
E 043-168	35	**D1**/2	16EX2	6,1	G$^{1}/_{2}$	2,5	1	V3.0510-58	0,6	-	-
E 043-151	30	**D1**/3	30P	4,0	G$^{1}/_{2}$	1,5	2	P3.0510-51	0,6	L1.0403-01 (2CL)	-
E 043-161	30	**D1**/3	30P	4,0	G$^{1}/_{2}$	1,5	1	P3.0510-51	0,6	-	-
E 072-153	25	**D2**/1	5EX2	7,7	G$^{3}/_{4}$	2,5	2	V3.0520-53	0,8	L1.0403-01 (2CL)	-
E 072-163	25	**D2**/1	5EX2	7,7	G$^{3}/_{4}$	2,5	1	V3.0520-53	0,8	-	-
E 072-156	50	**D2**/2	10EX2	13	G$^{3}/_{4}$	2,5	2	V3.0520-56	0,8	L1.0403-01 (2CL)	-
E 072-166	50	**D2**/2	10EX2	13	G$^{3}/_{4}$	2,5	1	V3.0520-56	0,8	-	-
E 072-158	70	**D2**/3	16EX2	13	G$^{3}/_{4}$	2,5	2	V3.0520-58	0,8	L1.0403-01 (2CL)	-
E 072-168	70	**D2**/3	16EX2	13	G$^{3}/_{4}$	2,5	1	V3.0520-58	0,8	-	-
E 072-151	50	**D2**/4	30P	6,6	G$^{3}/_{4}$	1,5	2	P3.0520-51*	0,8	L1.0403-01 (2CL)	-
E 072-161	50	**D2**/4	30P	6,6	G$^{3}/_{4}$	1,5	1	P3.0520-51*	0,8	-	-

All filters are delivered with a plugged clogging indicator connection M12 x 1,5. As clogging indicators either manometers or electrical pressure switches can be used. Optional extension pipes adapt the filter length to various tank depths. For ordering of accessories please use the below mentioned codes.

Order example: The filter E 072-156 has to be supplied with an extension pipe for a mounting depth of 500 mm.

Order description: **E 072-156** **EV 500**

Part No. (Basic unit)

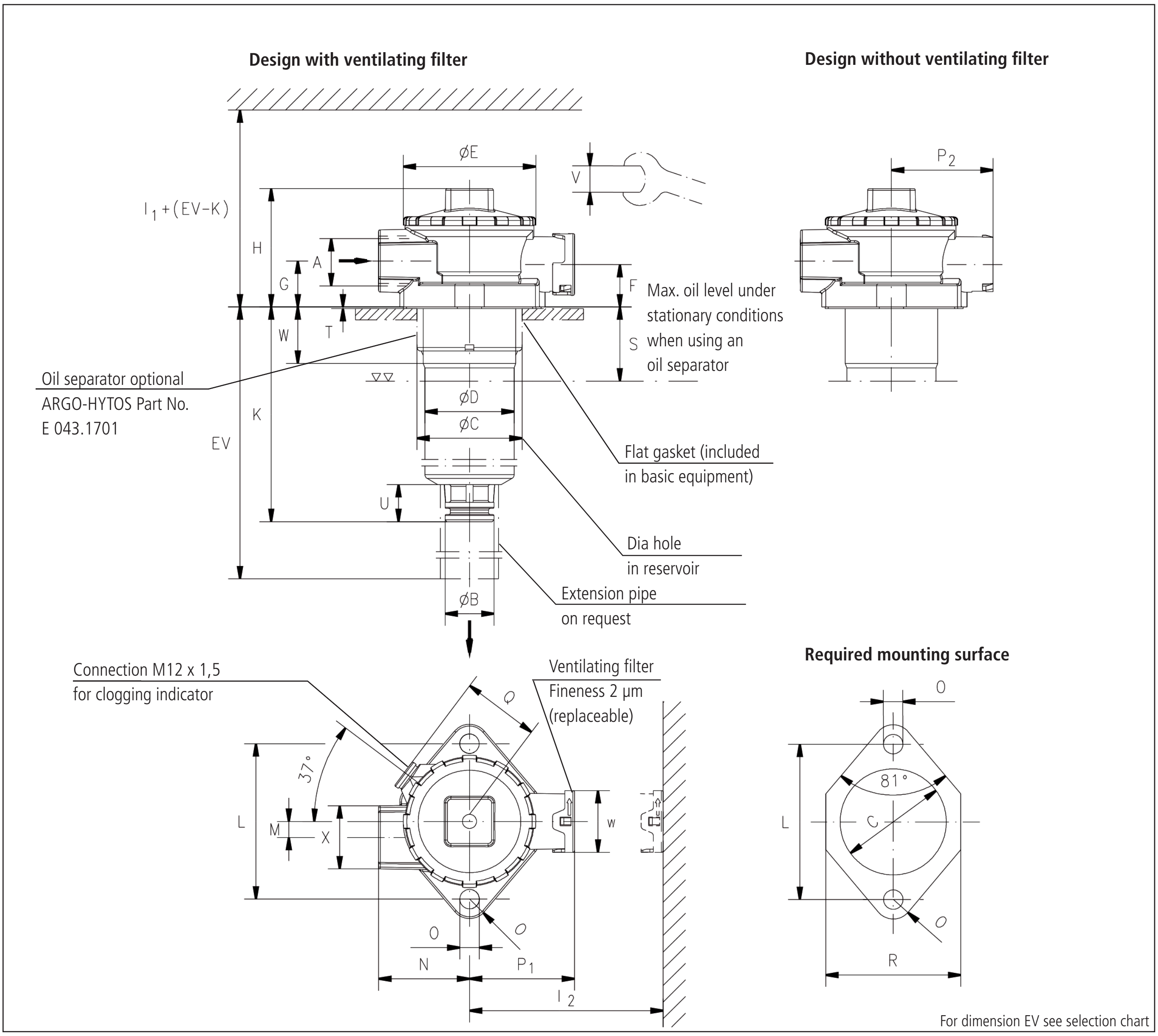
Mounted extension pipe (5 various lengths are available on request)
E 043: EV 150, EV 200, EV 300, EV 400, EV 500
E 072: EV 250, EV 300, EV 400, EV 500, EV 600

For the appropriate clogging indicators see catalogue sheet 60.20.

Remarks:
- The switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs available on request.

* Paper media supported with metal gauze

Dimensions

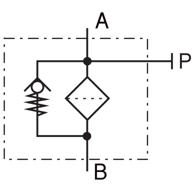


Measurements

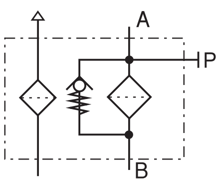
Type	A	B	C min./max.	D	E	F	G	H	I_1	I_2	K	L	M	N	O	P_1	P_2	Q	R	S
E 043	$G^{1}/_{2}$	75	60/63	51	27,8	24	26	67	175	110	83	88	9	51	11	59,5	57,5	46	79	42
E 072	$G^{3}/_{4}$	75	60/63	51	27,8	24	26	67	270	110	180	88	9	51	11	59,5	57,5	46	79	42
Type	**T**	**U**	**V**	**W**	**X**															
E 043	2	21	AF 27	35	AF 36															
E 072	2	21	AF 27	35	AF 36															

Symbols

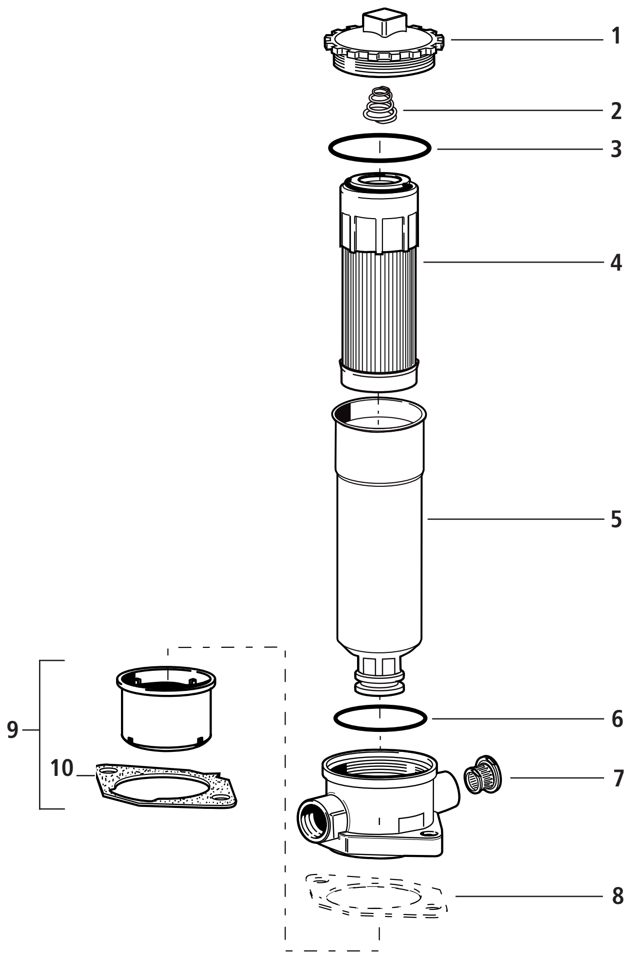
1



2



Spare Parts



Pos.	Designation	Part No.
1	Screw-on cap	FR 043.0201
2	Compression spring	N015.1606
3	O-ring 57 x 3	N007.0573
4	Filter element	see Chart / col. 9
5	Filter bowl E043 *	FR 043.0107
5	Filter bowl E072 *	FR 072.0104
6	O-ring 50 x 2	N007.0501
7	Ventilating filter	L1.0403-01
8	Flat gasket (for versions without oil separator)	D 043.0113
9	Oil separator with Pos. 10	E 043.1701
10	Flat gasket (for versions with oil separator)	D 043.0118

* Specify mounting depth (EV) in mm

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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ARGO HYTOS

Return Filters

FR 043 · FR 072

- Tank top mounting
- Hose connection up to ID 19 mm
- Nominal flow rate up to 70 l/min

20.15-5e

Description

Application

In the return line circuits of hydraulic systems.

Performance features

Protection against wear:	By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.
Protection against malfunction:	By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Special features

Connection:	Hose nipple
By-pass valve:	The location close to the inlet port prevents dirt particles retained by the filter element from entering into the clean oil side.
Removable bowl:	In case of maintenance the filter bowl is removed together with the filter element - therefore dirt particles are not flushed back into the tank.
Oil separator:	Prevents oil splashing through the breather on mobile application.
Extension pipe:	A correct extension pipe length ensures oil outlet below minimum oil level and prevents foaming.

Filter elements

Flow direction from outside to centre. The star-shaped pleating of the filter material results in:

- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Ventilating Filter

Ventilation of the reservoir by an integral star-shape pleated filter element:

- removable (replace annually!)
- splash-proof
- fineness 2 µm

Filter maintenance

By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Screw-on cap:	Polyester, GF reinforced
Housing:	Polyamide, CF reinforced, electrically conducting
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

Accessories

Electrical and optical clogging indicators are available on request. Dimensions and technical data see catalogue sheet 60.20.

Recommended hose clamps according to DIN 3017 Part 2 or equivalent for hose OD 23 mm or 26 mm. For orders use ARGO-HYTOS Part No. 332 70 03 or 332 70 04.

Extension pipes on the bowl outlet are available in several lengths on request.

A self-assembly system for installation of extension pipes can be ordered. For detailed information please see catalogue sheet 20.390.

Characteristics

Nominal flow rate

Up to 70 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines ≤ 4,5 m/s

Connection

Hose nipple for hose up to ID 19 mm.
Sizes see Selection Chart, column 6 (other connections on request).

Filter fineness

10 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity

Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids

Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).With high filling conditions we recommend
an electrical conductivity ≥ 500 pS/m at 20 °C.

Temperature range

-30 °C ... +80 °C (short intervals to +100 °C)

Viscosity at nominal flow rate

• at operating temperature:	$\nu < 60$ mm²/s
• as starting viscosity:	$\nu_{max} = 1.200$ mm²/s
• at initial operation:	The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure

Max. 6 bar

Mounting position

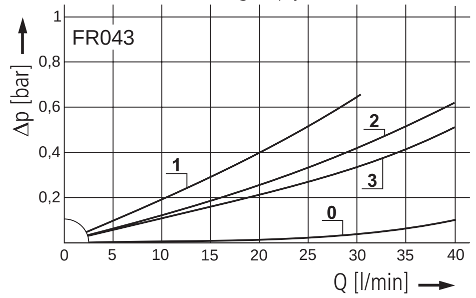
Preferably vertical, outlet downwards

Diagrams

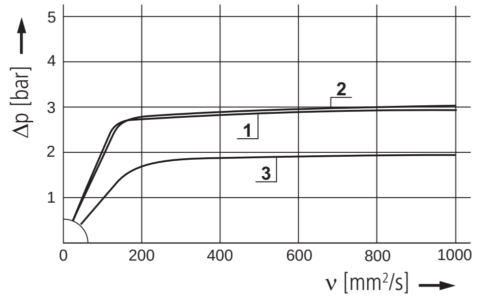
∆p-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)

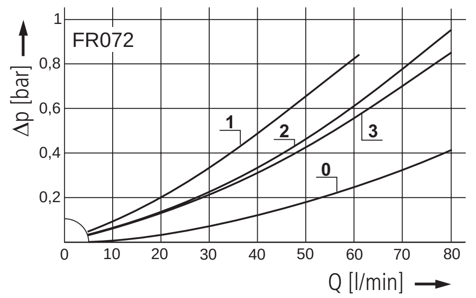


Pressure drop as a function of the **kinematic viscosity** at nominal flow

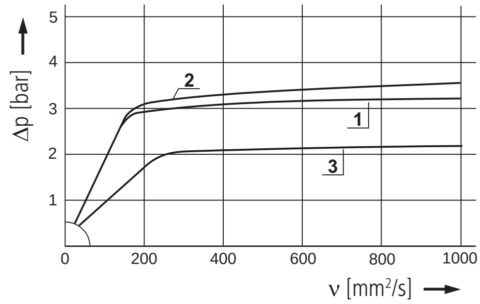


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)



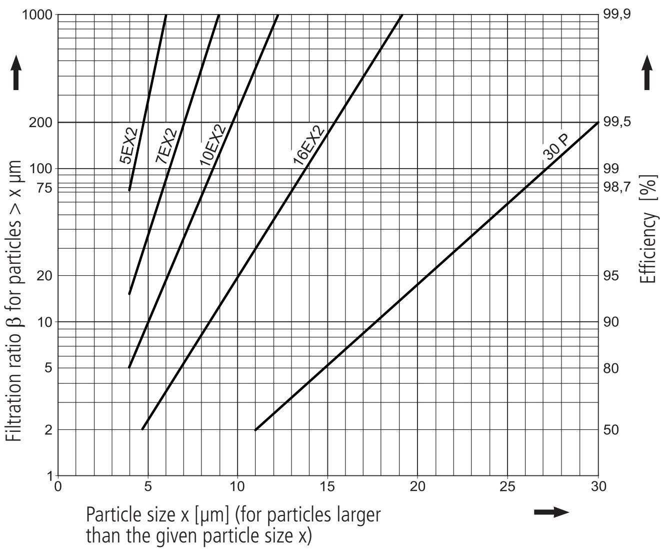
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189

For ventilating filter elements:

2CL = 99,5 % filter efficiency for particles of size 2 µm

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Replacement ventilating filter Part No. (Filter fineness, see diagrams)	Remarks
	l/min			g		bar			kg		
1	2	3	4	5	6	7	8	9	10	11	12
FR 043-156	25	**D1**/1	10EX2	6,1	17,5	2,5	1	V3.0510-56	0,42	-	-
FR 043-166	25	**D1**/1	10EX2	6,1	17,5	2,5	2	V3.0510-56	0,42	L1.0403-51 (2CL)	M12 x 1,5 for indicator
FR 043-158	35	**D1**/2	16EX2	6,1	17,5	2,5	1	V3.0510-58	0,42	-	-
FR 043-178	35	**D1**/2	16EX2	6,1	17,5	2,5	2	V3.0510-58	0,42	L1.0403-51 (2CL)	M12 x 1,5 for indicator
FR 043-151	30	**D1**/3	30P	4,0	17,5	1,5	1	P3.0510-51	0,42	-	-
FR 043-161	30	**D1**/3	30P	4,0	17,5	1,5	2	P3.0510-51	0,42	L1.0403-51 (2CL)	M12 x 1,5 for indicator
FR 072-156	50	**D2**/1	10EX2	13	20,5	2,5	1	V3.0520-56	0,58	-	-
FR 072-166	50	**D2**/1	10EX2	13	20,5	2,5	2	V3.0520-56	0,58	L1.0403-51 (2CL)	M12 x 1,5 for indicator
FR 072-158	70	**D2**/2	16EX2	13	20,5	2,5	1	V3.0520-58	0,58	-	-
FR 072-168	70	**D2**/2	16EX2	13	20,5	2,5	2	V3.0520-58	0,58	L1.0403-51 (2CL)	M12 x 1,5 for indicator
FR 072-151	50	**D2**/3	30P	6,6	20,5	1,5	1	P3.0520-51*	0,58	-	-
FR 072-171	50	**D2**/3	30P	6,6	20,5	1,5	2	P3.0520-51*	0,58	L1.0403-51 (2CL)	M12 x 1,5 for indicator

As clogging indicators either manometers or electrical pressure switches can be used. Optional extension pipes adapt the filter length to various tank depths. For ordering of accessories please use the below mentioned codes.

Order example: The filter FR 072-156 has to be supplied with an extension pipe for a mounting depth of 500 mm.

Order description: **E 072-156** **EV 500**

Part No. (Basic unit) — E 072-156

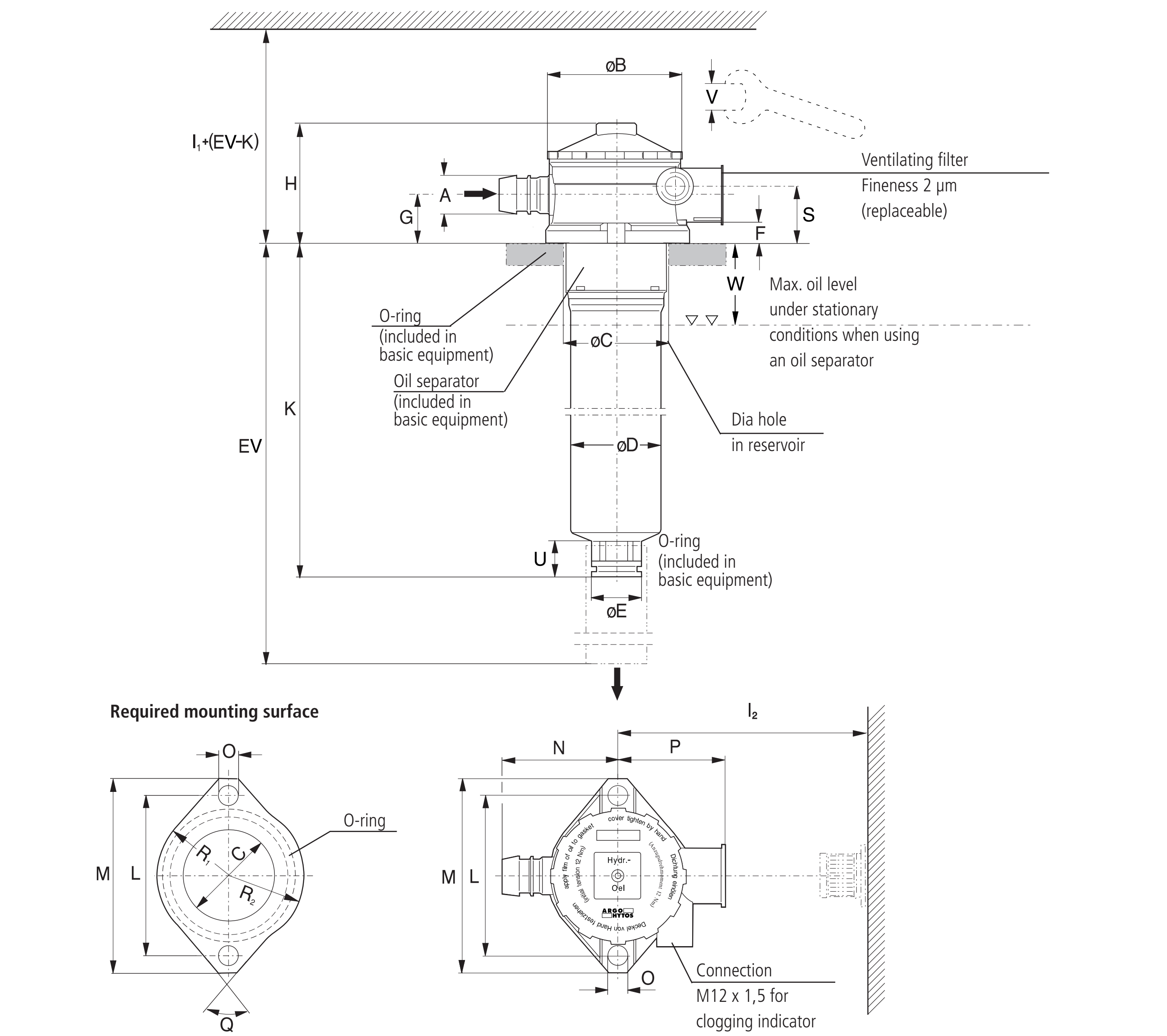
Mounted extension pipe (5 various lengths are available on request) — EV 500
FR 043: EV 150, EV 200, EV 300, EV 400, EV 500
FR 072: EV 250, EV 300, EV 400, EV 500, EV 600

For the appropriate clogging indicator see data sheet 60.20.
When using pressure switches of series DG 813 sealing by means of an O-ring (order no. N007.0103, to be ordered separately) has to be guaranteed (torque 4 Nm). When using manometers of series DG 200 variants with preformed sealing ring are to be used.

Remarks:
- The switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- For fastening the filter the enclosed spring washers have to be used. Assembly torque 15^{+5} Nm.
- The filters listed in this chart are standard filters. Other designs available on request.

* Paper media supported with metal gauze

Dimensions



For dimension EV see selection chart

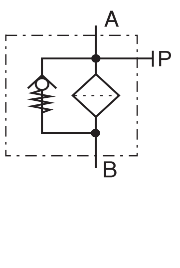
Measurements

Type	A	B	C min./max.	D	E	F*	G	H	I_1	I_2	K	L	M	N	O	P	Q	R_1	R_2	S
FR 043	17,5	75	60/61	51	27,8	11	22	65	175	110	85	88	108	65	11	59	80°	39	42	27
FR 072	20,5	75	60/61	51	27,8	11	22	65	270	110	182	88	108	65	11	59	80°	39	42	27
Type	**U**	**V**	**W**																	
FR 043	20	27	40																	
FR 072	20	27	40																	

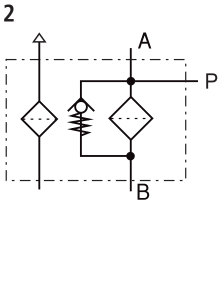
* including the enclosed spring washers Ø10, DIN 137 shape B, corrugated

Symbols

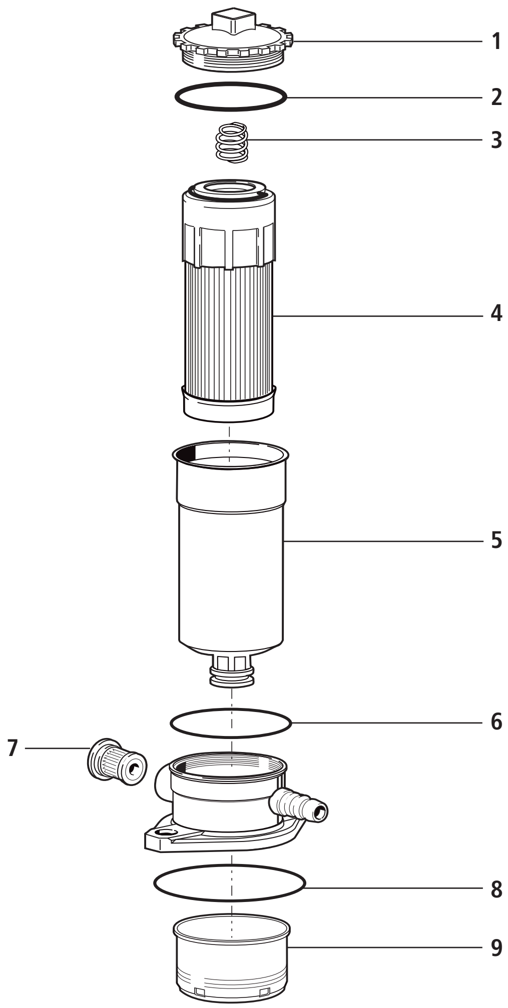
1



2



Spare Parts



Pos.	Designation	Part No.
1	Screw-on cap	FR 043.0201
2	O-ring 57 x 3	N007.0573
3	Compression spring	N015.1606
4	Filter element	s. Chart / col. 9
5	Filter bowl FR 043 *	FR 043.0107
5	Filter bowl FR 072 *	FR 072.0104
6	O-ring 50 x 2	N007.0501
7	Ventilating filter	L1.0403-51
8	O-ring 69 x 4	N007.0704
9	Oil separator	FR 043.0701

* Specify mounting depth (EV) in mm

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

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ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
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We produce fluid power solutions
ARGO-HYTOS GMBH · Industriestraße 9 · 76703 Kraichtal-Menzingen · Germany
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Return Filters

E 094 · E 103 · E 143

- Tank top mounting
- Connection up to G1
- Nominal flow rate up to 135 l/min

20.30-7e

Description

Application
In the return line circuits of hydraulic systems.

Performance features
Protection against wear: By means of filter elements that, in full-flow filtration meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Special features
By-pass valve: The location close to the inlet port prevents dirt particles retained by the filter element from entering into the clean oil side.

Removable bowl: In case of maintenance the filter bowl is removed together with the filter element - therefore dirt particles are not flushed back into the tank.

Oil separator: Prevents oil splashing through the breather on mobile application.

Extension pipe: A correct extension pipe length ensures oil outlet below minimum oil level and prevents foaming.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Ventilating Filter
Ventilation of the reservoir by an integral star-shape pleated filter element:
- removable (replace annually!)
- splash-proof
- fineness 2 μm

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Screw-on cap:	Polyamide, GF reinforced
Filter head:	Aluminium alloy
Filter bowl:	Polyamide, CF reinforced, electrically conducting
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

Accessories
Electrical and optical clogging indicators are available on request. Dimensions and technical data see cataologue sheet 60.20.

An optional oil separator (Part No. E 103.1702) is available on request.

Extension pipes on the bowl outlet are available in several lengths on request.
A self-assembly system for installation of extension pipes can be ordered. For detailed information please see catalogue sheet 20.390.

Characteristics

Nominal flow rate
Up to 135 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines ≤ 4,5 m/s

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
5 μm(c) ... 30 μm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).
With high filling conditions we recommend an electrical conductivity ≥ 500 pS/m at 20 °C.

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

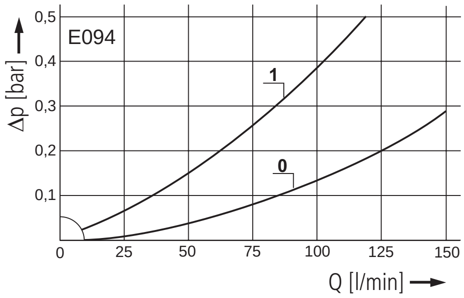
Mounting position
Preferably vertical, outlet downwards

Diagrams

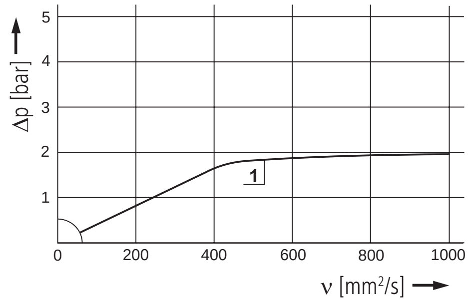
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

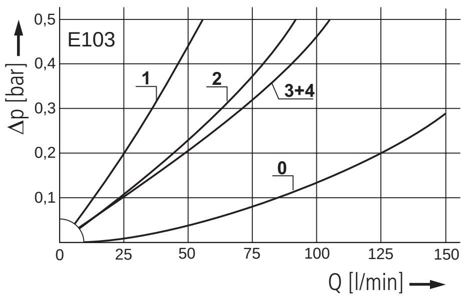


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

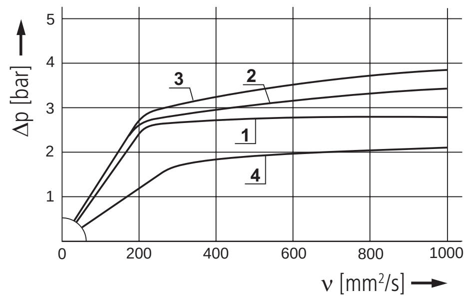


D2

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

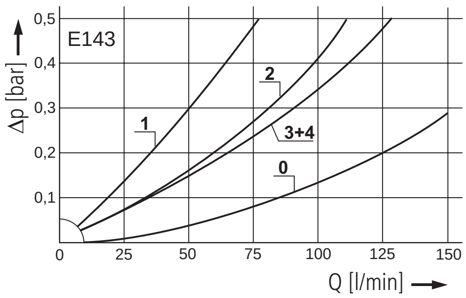


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

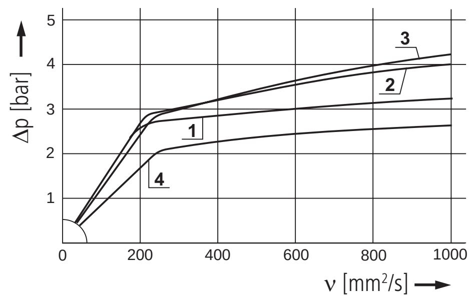


D3

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)



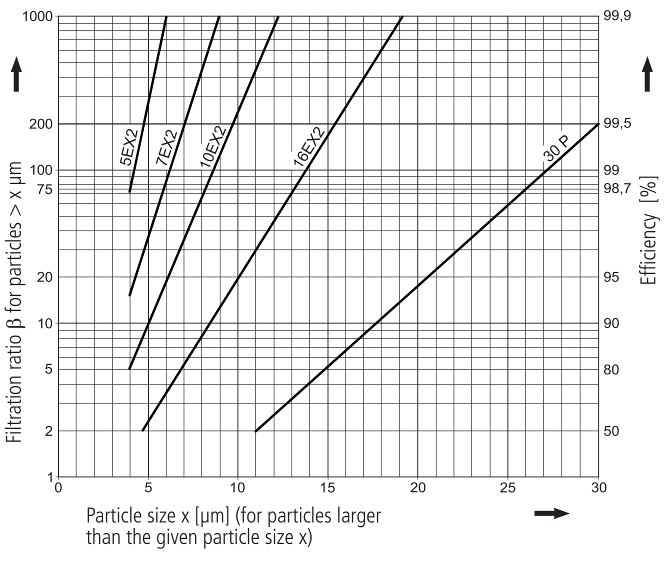
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\overline{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\overline{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\overline{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\overline{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\overline{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size accordung to DIN 4189

For ventilating filter elements:

2CL = 99,5 % efficiency for particles of size 2 µm

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A	Cracking pressure of by-pass	Symbol	Replacement element Part No.	Weight	Replacement ventilating filter Part No. (Filter fineness, see diagrams)	Remarks
	l/min			g		bar			kg		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
E 094-661	50	**D1**/1	30P	11	G$^3/_4$	1,5	2	P3.0613-51	0,8	L1.0503-03 (2CL)	-
E 094-671	50	**D1**/1	30P	11	G$^3/_4$	1,5	1	P3.0613-51	0,8	-	-
E 103-657	45	**D2**/1	5EX2	18	G$^1/_2$	2,5	2	V3.0620-53	1,0	L1.0503-03 (2CL)	-
E 103-677	45	**D2**/1	5EX2	18	G$^1/_2$	2,5	1	V3.0620-53	1,0	-	-
E 103-676	80	**D2**/2	10EX2	25	G$^3/_4$	2,5	2	V3.0620-56	1,0	L1.0503-03 (2CL)	-
E 103-686	80	**D2**/2	10EX2	25	G$^3/_4$	2,5	1	V3.0620-56	1,0	-	-
E 103-898	110	**D2**/3	16EX2	25	G1	2,5	2	V3.0620-58	1,0	L1.0503-03 (2CL)	-
E 103-888	110	**D2**/3	16EX2	25	G1	2,5	1	V3.0620-58	1,0	-	-
E 103-871	70	**D2**/4	30P	11	G$^3/_4$	1,5	2	P3.0620-51*	1,0	L1.0503-03 (2CL)	-
E 103-861	70	**D2**/4	30P	11	G$^3/_4$	1,5	1	P3.0620-51*	1,0	-	-
E 143-657	70	**D3**/1	5EX2	28	G$^3/_4$	2,5	2	V3.0730-53	1,2	L1.0503-03 (2CL)	-
E 143-667	70	**D3**/1	5EX2	28	G$^3/_4$	2,5	1	V3.0730-53	1,2	-	-
E 143-676	115	**D3**/2	10EX2	38	G1	2,5	2	V3.0730-56	1,2	L1.0503-03 (2CL)	-
E 143-686	115	**D3**/2	10EX2	38	G1	2,5	1	V3.0730-56	1,2	-	-
E 143-888	135	**D3**/3	16EX2	38	G1	2,5	2	V3.0730-58	1,2	L1.0503-03 (2CL)	-
E 143-688	135	**D3**/3	16EX2	38	G1	2,5	1	V3.0730-58	1,2	-	-
E 143-851	120	**D3**/4	30P	17	G1	1,5	2	P3.0730-51*	1,2	L1.0503-03 (2CL)	-
E 143-861	120	**D3**/4	30P	17	G1	1,5	1	P3.0730-51*	1,2	-	-

All filters are delivered with a plugged clogging indicator connection M12 x 1,5. As clogging indicators either manometers or electrical pressure switches can be used. Optional extension pipes adapt the filter length to various tank depths. For ordering of accessories please use the below mentioned codes.

Order example: The filter E 103-676 has to be supplied with an extension pipe for a mounting depth of 500 mm.

Order description: **E 103-676** **EV 500**

Part No. (Basic unit)

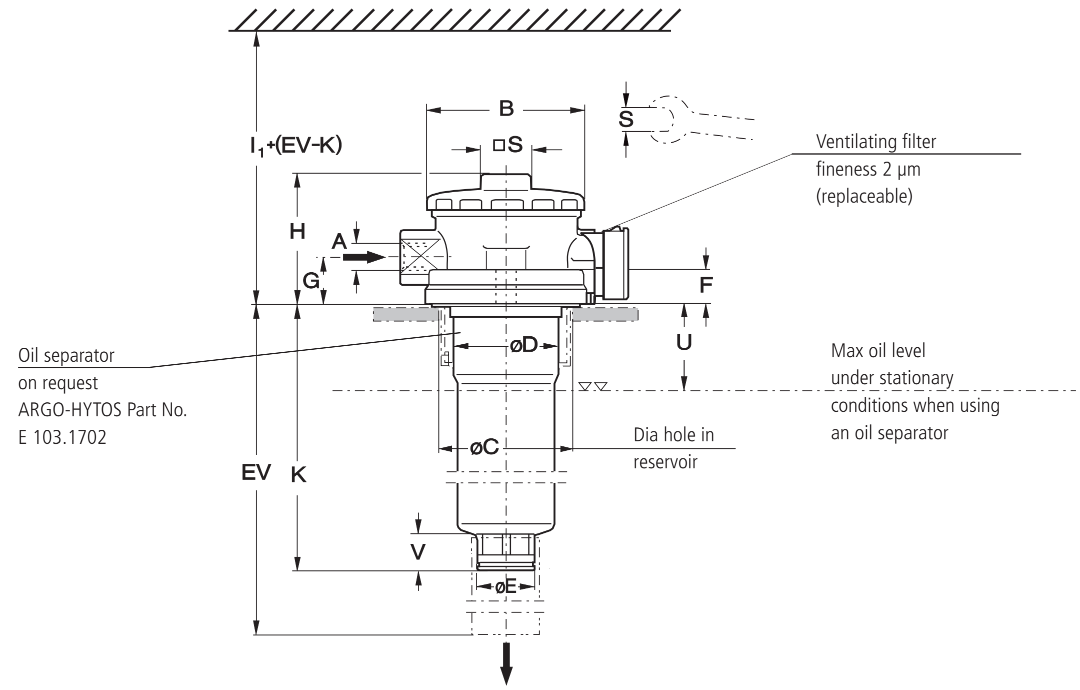
Mounted extension pipe (7 various lengths are available on request)
E 094: EV 130, EV 190, EV 234, EV 284, EV 334, EV 434, EV 534
E 103: EV 196, EV 256, EV 300, EV 350, EV 400, EV 500, EV 600
E 143: EV 297, EV 357, EV 400, EV 450, EV 500, EV 600, EV 700

For the suitable clogging indicators please see catalogue sheet 60.20.

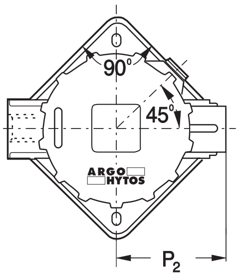
Remarks:
- The switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs available on request.

* Paper media supported with metal gauze

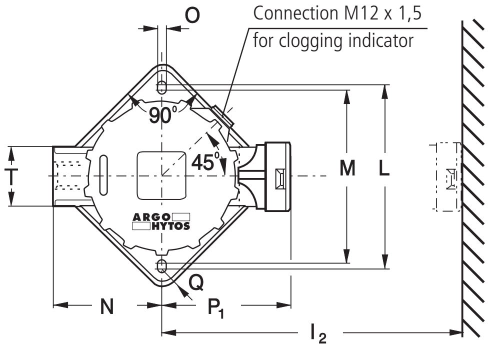
Dimensions



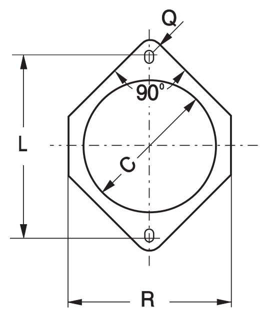
Design without ventilating filter



Design with ventilating filter



Required mounting surface



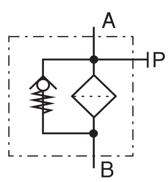
For dimension EV see selection chart

Measurements

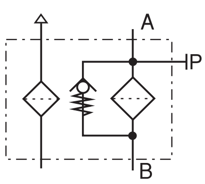
Type	A	B	C min./max.	D	E	F	G	H	l_1	l_2	K	L	M	N	O	P_1	P_2	Q	R
E 094	$G^3/_4$	105	87 / 91	73,5	38	20,5	30	88,5	235	125	111	115	110	70	11	82	69	13,5	107,5
E 103	$G^1/_2$, $G^3/_4$, G1	105	87 / 91	73,5	38	20,5	30	88,5	300	125	177	115	110	70	11	82	69	13,5	107,5
E 143	$G^3/_4$, G1	105	87 / 91	73,5	38	20,5	30	88,5	400	125	278	115	110	70	11	82	69	13,5	107,5
Type	**S**	**T**	**U**	**V**															
E 094	AF 32	AF 41	50	23															
E 103	AF 32	AF 41	50	23															
E 143	AF 32	AF 41	50	23															

Symbols

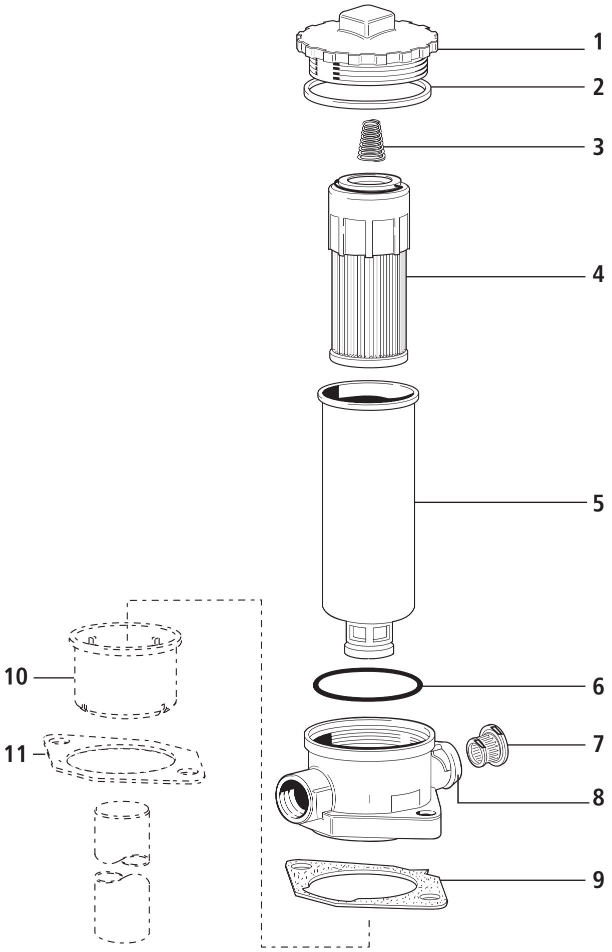
1



2



Spare Parts



Pos.	Designation	Part No.
1	Screw-on cap	E 103.0201
2	Flat gasket	N031.0841
3	Compression spring	N015.3703
4	Filter element	see Chart / col. 9
5	Filter bowl E094 *	E 094.0903
5	Filter bowl E103 *	E 103.0912
5	Filter bowl E143 *	E 143.0903
6	O-ring 69,5 x 3,5	N007.0703
7	Ventilating filter	L1.0503-03K
8	Housing (for pos. 7)	L1.0503.0801
9	Flat gasket (for versions without oil separator)	E 103.0147
10	Oil separator with Pos. 11	E 103.1702
11	Flat gasket (for versions with oil separator)	E 103.0148

* Specify mounting depth (EV) in mm

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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Extension Pipe

for Return Filters E 043/072, FR 043/072, E 094/103/143

ARGO HYTOS

Mounting Instructions

Operating Mode and Installation

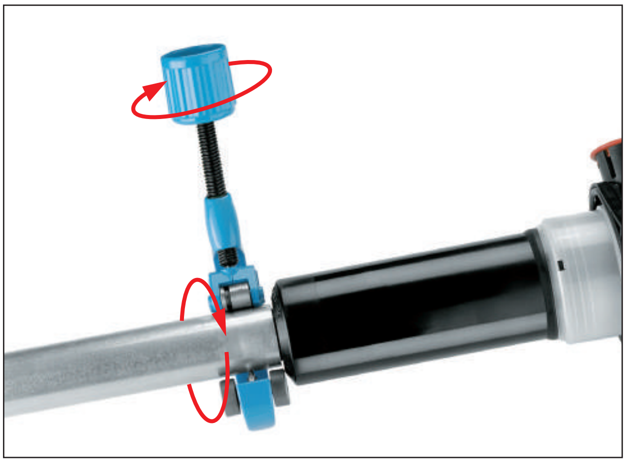
To prevent oil foaming in the tank, it is essential to ensure that the oil outlet is below the oil level under all operating conditions. This can be achieved by assembling of an extension pipe. The distance between tank bottom and extension pipe should be 2 to 3 times the diameter of the outlet (extension pipe diameter), in order to avoid swirling of particles which have sedimented on the bottom of the reservoir.

Return filter and 3 part assembly set

Mounting of the extension pipe

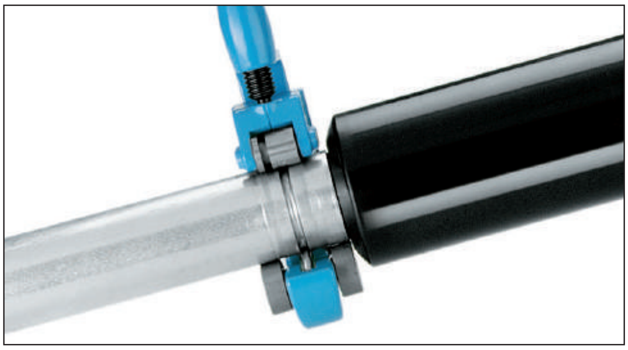
1. Insert the O-ring into the groove at the outlet port.

2. Attach the aluminum pipe to the outlet port and push it down to the stop.



3. Attach the crimping tool to the aluminum pipe. Please note that the fix jaw of the tool shall abut the filter housing.

4. Operate the crimping tool gradually at the handle and move the complete tool several times over the perimeter of the pipe. After approx. 1 handle rotation the necessary depth of the corrugation has been reached.



5. The smallest diameter of the corrugation has to be 1 … 1,5 mm (0.04 … 0.06 inches) less than the diameter of the aluminium pipe.

The following parts are needed:

Aluminium pipe (approx. 500 mm)
for E 043/072 and FR 043/072: Part-No. FR 043.L500
for E 094/103/143: Part-No. E 103.0923
O-ring
for E 043/072 and FR 043/072: Part-No. N007.0223
for E 094/103/143: Part-No. N007.0323
Crimping tool
for E 043/072 and FR 043/072 Part-No. 12326700
for E 094/103/143: Part-No. 19532100 (us)

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Subject to change
20.390-2e · 0714

Return Filters

E 212 · E 222

- Tank top mounting
- Connection up to G1¼
- Nominal flow rate up to 220 l/min

20.40-7e

Description

Application
In the return line circuits of hydraulic systems.

Performance features
Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are proteced from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Special features
By-pass valve: The location close to the inlet port prevents dirt particles retained by the filter element from entering into the clean oil side.

Removable bowl: In case of maintenance the filter bowl is removed together with the filter element - therefore dirt particles are not flushed back into the tank.

Filling filter/By-pass protection strainer: The filling filter is integrated in the filter element and prevents coarse particles from entering during filling or re-filling due to maintenance or repair reasons. Filling can be carried out at the filter. Therefore the cover must be removed.
In operation, the filling filter functions as a by-pass protection strainer and prevents dirt from entering into the tank when the by-pass valve is open.

Port for ventilating filter: The ventilating filter thread connection M42 x 2 allows assembly of a ventilating filter, which assumes ventilation of the tank.
The ventilating filter has to be ordered separately.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Screw-on cap:	Polyester, GF reinforced
Filter head:	Aluminium alloy
Filter bowl:	Polyamide, CF reinforced, electrically conducting
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin
Filling filter:	Polyamide, GF reinforced; Polyester web

Accessories
Electrical and optical clogging indicators are available on request. Dimensions and technical data see catalogue sheet 60.20.

Ventilating filters with connection thread M42 x 2 have to be ordered separately. Dimensions and technical data see catalogue sheet 50.20 and 50.30.

Extension pipes or diffusors on the bowl outlet are available on request.
Extension pipe: A correct extension pipe length ensures oil outlet below minimum oil level and prevents foaming.

Characteristics

Nominal flow rate
Return filter: Up to 220 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines ≤ 4,5 m/s

Filling filter: up to 20 l/min (see Selection Chart, column 3)

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 9 (other port threads on request)

Filter fineness
5 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 5 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 6)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).
With high filling conditions we recommend an electrical conductivity ≥ 500 pS/m at 20 °C.

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

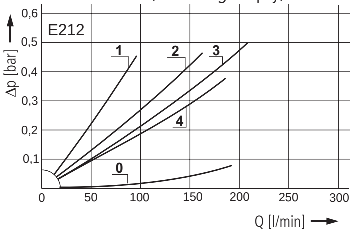
Mounting position
Preferably vertical, outlet downwards

Diagrams

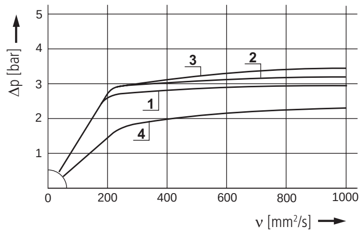
Δp-curves for complete filters in Selection Chart, column 4

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)

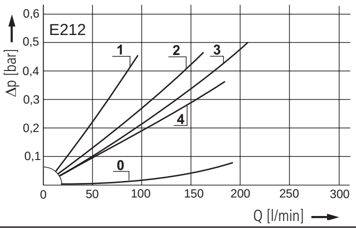


Pressure drop as a function of the **kinematic viscosity** at nominal flow

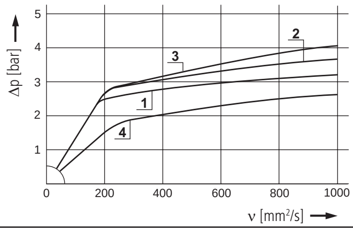


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)

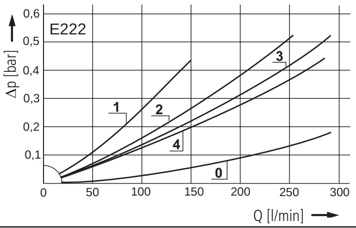


Pressure drop as a function of the **kinematic viscosity** at nominal flow

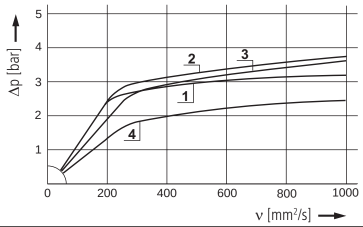


D3

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)

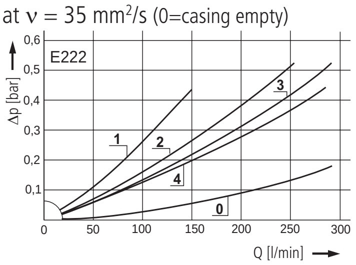


Pressure drop as a function of the **kinematic viscosity** at nominal flow

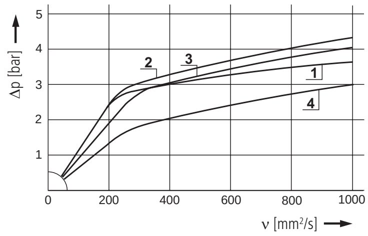


D4

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)



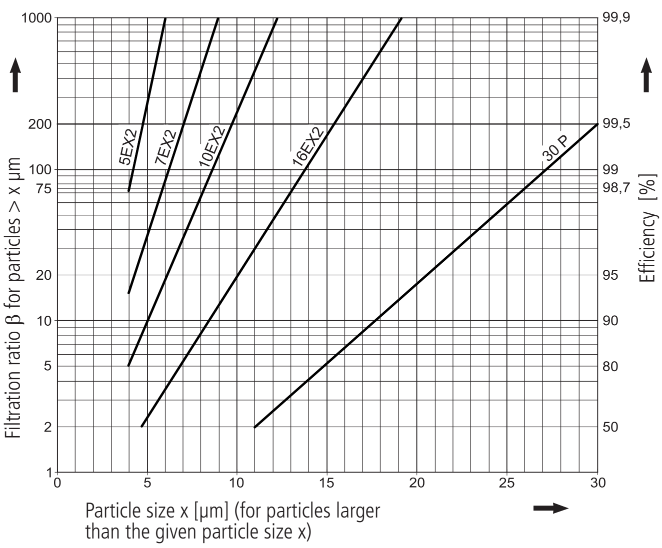
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 5

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2- and Paper elements:

5EX2 = $\overline{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\overline{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\overline{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\overline{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\overline{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189.

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate return filter	Nominal flow rate filling filter[1]	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Filter fineness filling filter/ by-pass protection strainer	Filter surface filling filter/ by-pass protection strainer	Connection A	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Ventilating filter thread connection M42x2	Weight	Remarks
	l/min	l/min			g	µm	cm²		bar				kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
E 212-159	80	-	**D1**/1	5EX2	29	-	-	G1¼	2,5	1	V7.0820-03	-	1,7	
E 212-156	140	-	**D1**/2	10EX2	43	-	-	G1¼	2,5	1	V7.0820-06	-	1,7	
E 212-158	190	-	**D1**/3	16EX2	43	-	-	G1¼	2,5	1	V7.0820-08	-	1,7	
E 212-151	160	-	**D1**/4	30 P	21	-	-	G1¼	1,5	1	P7.0820-11[2]	-	1,7	
E 212-359	80	20	**D2**/1	5EX2	29	450	85	G1¼	2,5	3	K7.0820-03	•	2,0	[3]
E 212-356	140	20	**D2**/2	10EX2	43	450	85	G1¼	2,5	3	K7.0820-06	•	2,0	[3]
E 212-358	190	20	**D2**/3	16EX2	43	450	85	G1¼	2,5	3	K7.0820-08	•	2,0	[3]
E 212-351	160	20	**D2**/4	30 P	21	450	85	G1¼	1,5	3	K7.0820-11[2]	•	2,0	[3]
E 222-159	130	-	**D3**/1	5EX2	50	-	-	G1¼	2,5	1	V7.0833-03	-	2,1	
E 222-156	220	-	**D3**/2	10EX2	74	-	-	G1¼	2,5	1	V7.0833-06	-	2,1	
E 222-158	220	-	**D3**/3	16EX2	76	-	-	G1¼	2,5	1	V7.0833-08	-	2,1	
E 222-151	220	-	**D3**/4	30 P	35	-	-	G1¼	1,5	1	P7.0833-11[2]	-	2,1	
E 222-359	130	20	**D4**/1	5EX2	50	450	85	G1¼	2,5	3	K7.0833-03	•	2,4	[3]
E 222-356	220	20	**D4**/2	10EX2	74	450	85	G1¼	2,5	3	K7.0833-06	•	2,4	[3]
E 222-358	220	20	**D4**/3	16EX2	76	450	85	G1¼	2,5	3	K7.0833-08	•	2,4	[3]
E 222-351	220	20	**D4**/4	30 P	35	450	85	G1¼	1,5	3	K7.0833-11[2]	•	2,4	[3]

All filters are delivered with a plugged clogging indicator connection M12 x 1,5. As clogging indicators either manometers or electrical pressure switches can be used. Optional extension pipes adapt the filter length to various tank depths.
For ordering of accessories please use the below mentioned codes.

Order example: The filter E 222-151 has to be supplied with an extension pipe for a mounting depth of 500 mm.

Order description: **E 222-151** **EV 500**

Part No. (Basic unit)

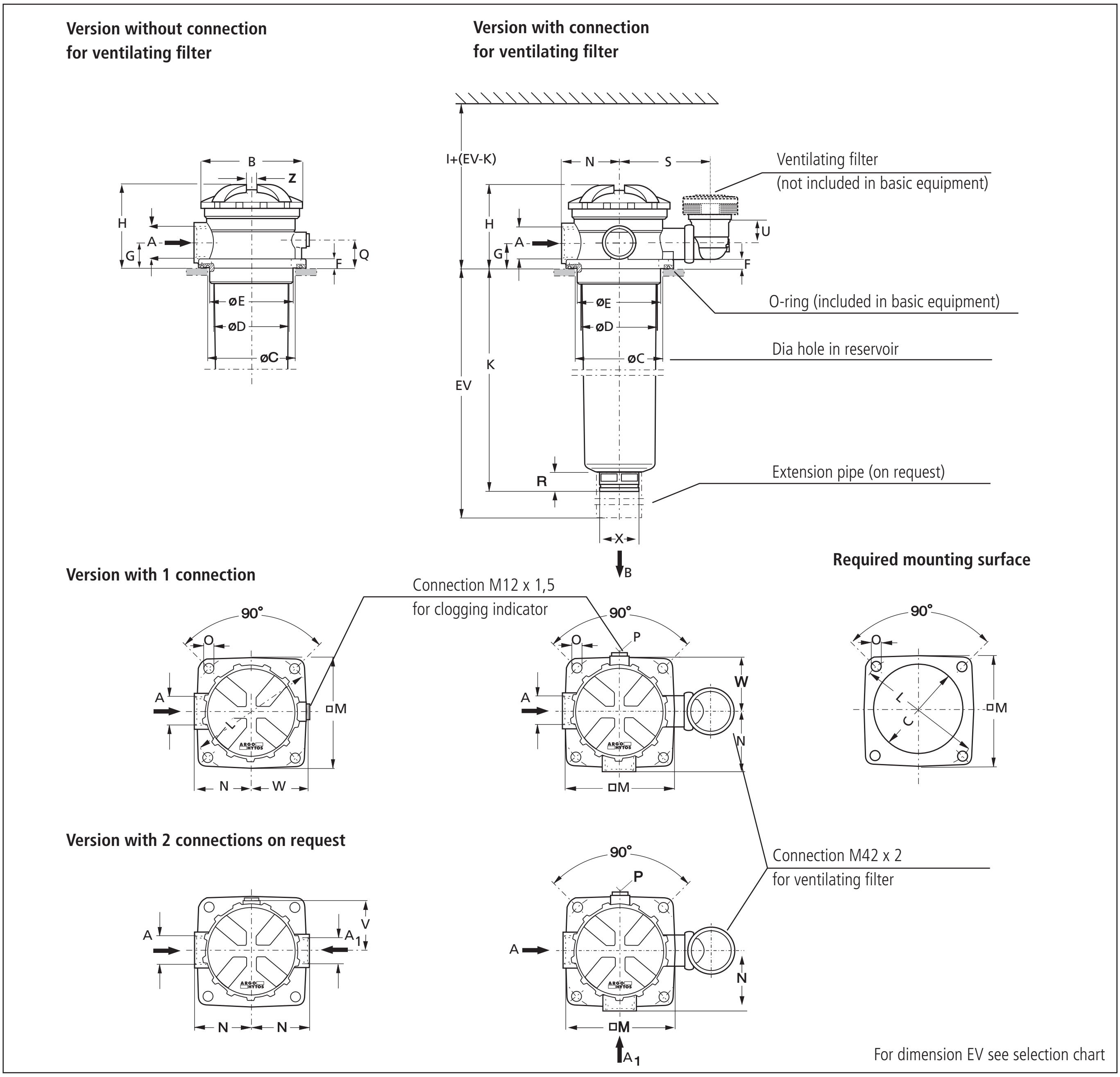
Mounted extension pipe (4 various lengths are available on request)
E 212: EV 300, EV 366, EV 400, EV 466
E 222: EV 434, EV 500, EV 534, EV 600

For the appropriate ventilating filters with M42x2 thread connection see catalogue sheet 50.20 and 50.30, for the appropriate clogging indicators see catalogue sheet 60.20.

Remarks:
- The switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 10).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs available on request.

[1] at 200 mm²/s (ISO VG46 at ca. 15°C)
[2] Paper media supported with metal gauze
[3] Open connection for ventilating filter. Please assemble ventilating filter before operating.

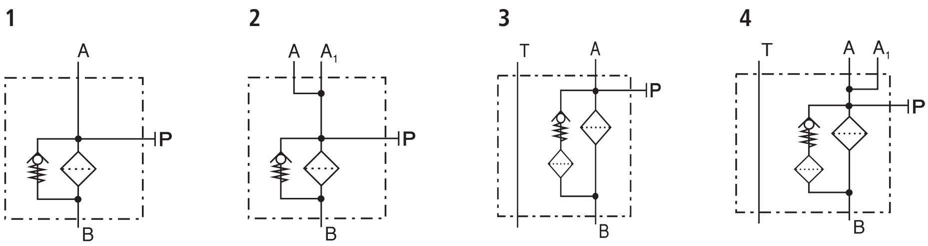
Dimensions



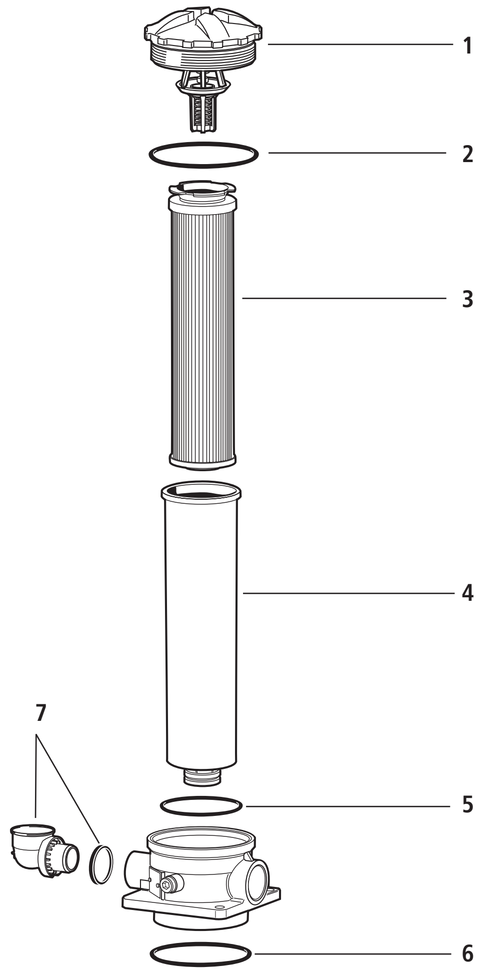
Measurements

Type	A	A_1	B	C min./max.	D	E	F	G	H	I	K	L	M	N	O	Q	R	S	U	V	W	X	Z
E 212	G1¼	G1	126	118/121	95	110	11,5	32	105	325	213	165	141	76	11	35	23	113	28,5	68	74	44	13
E 222	G1¼	G1	126	118/121	95	110	11,5	32	105	455	347	165	141	76	11	35	23	113	28,5	68	74	44	13

Symbols



Spare Parts



Pos.	Designation	Part No.
1	Screw-on cap with valve (2,5 bar) and Pos. 2	E 221.1200
1	Screw-on cap with valve (1,5 bar) and Pos. 2	E 221.1210
2	O-ring 100 x 4	N007.1004
3	Filter element	see Chart/col.12
4	Filter bowl E 212*	E 212.0901
4	Filter bowl E 222*	E 222.0901
5	O-ring 90 x 4	N007.0904
6	O-ring 126 x 4	N007.1264
7	Connection for ventilating filter O-ring 31 x 4	E 222.1900

*Specify mounting depth (EV) in mm

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
ARGO-HYTOS GMBH · Industriestraße 9 · 76703 Kraichtal-Menzingen · Germany
Phone: +49 7250 76-0 · Fax: +49 7250 76-199 · info@argo-hytos.com · www.argo-hytos.com

Return Filters

E 443 · E 453 · E 463
E 643

- Tank top mounting
- Connection up to SAE 2
- Nominal flow rate up to 680 l/min

20.50-6e

Description

Application
In the return line circuits of hydraulic systems.

Performance features
Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Special features
By-pass valve: The location close to the inlet port prevents dirt particles retained by the filter element from entering into the clean oil side.

Removable bowl: In case of maintenance the filter bowl is removed together with the filter element - therefore dirt particles are not flushed back into the tank.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:

- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

In filters with a magnetic system, the ferromagnetic particles in the fluid pass first through a strong magnetic field and are separated.

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Filter head cover:	Aluminium alloy
Filter head:	Aluminium alloy
Filter bowl:	Steel
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin Stainless steel wire mesh (1.4301)

Accessories
Extension pipes and diffusers are available on the bowl outlet.

Extension pipe: A correct extension pipe length ensures oil outlet below minimum oil level and prevents foaming.

Diffuser: Diffusers reduce oil velocity and direct the oil to 90° outlet flow. This function prevents also oil foaming and whirling up of solid particles settled at the tank bottom. The mesh screen element filters the oil in case of an open by-pass valve.

Electrical and optical clogging indicators are available on request.
Dimensions and technical data see catalogue sheet 60.20.

Characteristics

Nominal flow rate
Up to 680 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines ≤ 4,5 m/s

Connection
Threaded ports according to ISO 228 or DIN 13 and SAE-flange (3000 psi). Sizes see Selection Chart, column 6 (other port threads on request).

Filter fineness
5 µm(c) ... 60 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

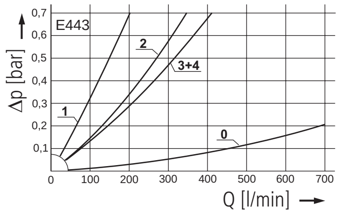
Mounting position
Preferably vertical, outlet downwards

Diagrams

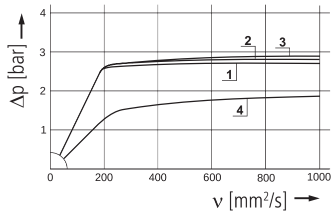
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at $\nu = 35$ mm²/s (0=casing empty)

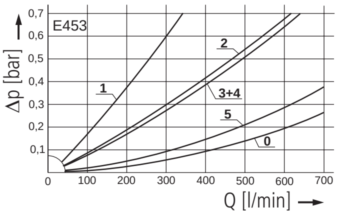


Pressure drop as a function of the **kinematic viscosity** at nominal flow

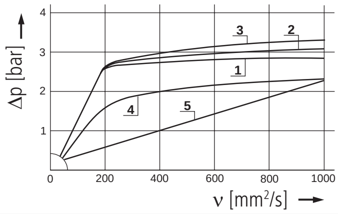


D2

Pressure drop as a function of the **flow volume** at $\nu = 35$ mm²/s (0=casing empty)

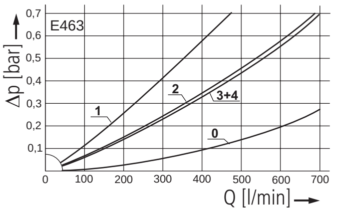


Pressure drop as a function of the **kinematic viscosity** at nominal flow

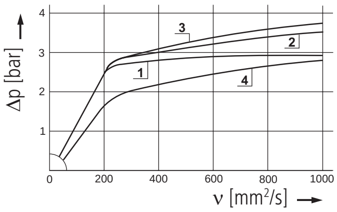


D3

Pressure drop as a function of the **flow volume** at $\nu = 35$ mm²/s (0=casing empty)

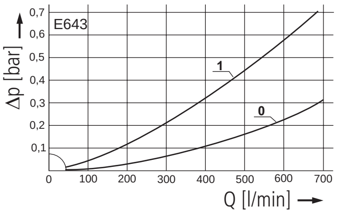


Pressure drop as a function of the **kinematic viscosity** at nominal flow

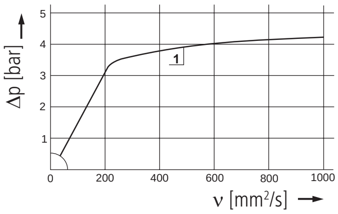


D4

Pressure drop as a function of the **flow volume** at $\nu = 35$ mm²/s (0=casing empty)



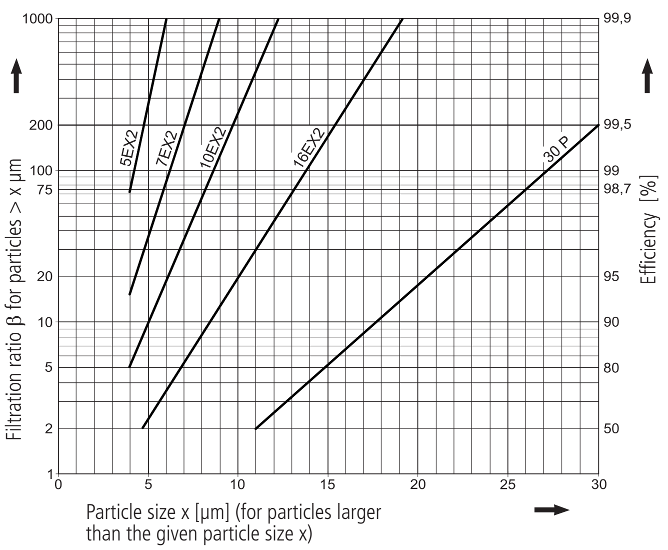
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate[1]	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity Filter surface in ( )	Connection A SAE (3000 psi)	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Remarks
	l/min			g		bar			kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
E 443-459	115	**D1**/1	5EX2	45	2xG1¼/SAE1½,G¾+G1	2,5	3	V2.1217-03	4,4	-
E 443-456	200	**D1**/2	10EX2	61	2xG1¼/SAE1½,G¾+G1	2,5	3	V2.1217-36	4,4	-
E 443-468	270	**D1**/3	16EX2	62	2xG1¼/SAE1½,G¾+G1	2,5	3	V2.1217-08	4,4	-
E 443-481	175	**D1**/4	30P	29	2xG1¼/SAE1½,G¾+G1	1,5	3	P2.1217-21[2]	4,4	-
E 453-459	220	**D2**/1	5EX2	90	2xG1¼/SAE1½,G¾+G1	2,5	3	2 x V2.1217-03	6,1	-
E 453-456	375	**D2**/2	10EX2	122	2xG1¼/SAE1½,G¾+G1	2,5	3	2 x V2.1217-36	6,1	-
E 453-468	480	**D2**/3	16EX2	124	2xG1¼/SAE1½,G¾+G1	2,5	3	2 x V2.1217-08	6,1	-
E 453-453	350	**D2**/4	30P	58	2xG1¼/SAE1½,G¾+G1	1,5	3	2 x P2.1217-21[2]	6,1	-
E 453-400	525	**D2**/5	60S	(3600 cm²)	2xG1¼/SAE1½,G¾+G1	1,5	6	2 x S2.1217-00	6,4	with magnetic system
E 463-459	300	**D3**/1	5EX2	135	2xG1¼/SAE1½,G¾+G1	2,5	3	3 x V2.1217-03	7,8	-
E 463-456	500	**D3**/2	10EX2	183	2xG1¼/SAE1½,G¾+G1	2,5	3	3 x V2.1217-36	7,8	-
E 463-468	600	**D3**/3	16EX2	186	2xG1¼/SAE1½,G¾+G1	2,5	3	3 x V2.1217-08	7,8	-
E 463-453	480	**D3**/4	30P	87	2xG1¼/SAE1½,G¾+G1	1,5	3	3 x P2.1217-21[2]	7,8	-
E 643-476	680	**D4**/1	10EX2	250	2xG1¼/SAE1½,G¾+G1	3,0	3	V2.1260-26	9,5	-

All filters are delivered with a plugged clogging indicator connection M12 x 1,5. (Mounting holes for differential pressure switches on request). As clogging indicators either manometers or electrical pressure switches can be used. Two different head pieces with three various connecting options are available. All filters can also be supplied with an outlet diffuser. Optional extension pipes adapt the filter length to various tank depths. For ordering of accessories please use the below mentioned codes.

Order example: The filter E 453-456 has to be supplied with 2 connections (A and A3), an outlet diffuser and an extension pipe for 564 mm length.

Order description: **E 453-256 / VD / EV 564**

Connections:
3 various options are available
one connection (A) - G1½ / SAE 2 — 1
two connections (A and A3)[1] - G1½ / SAE 2 and G¾ — 2
four connections (A1, A2, A3 and A4)[1] - 2 x G1¼ / SAE 1½, G¾ and G1 — 4

Options (bowl outlet):
2 various options are available
VD: Outlet diffuser, **RV:** Extension pipe

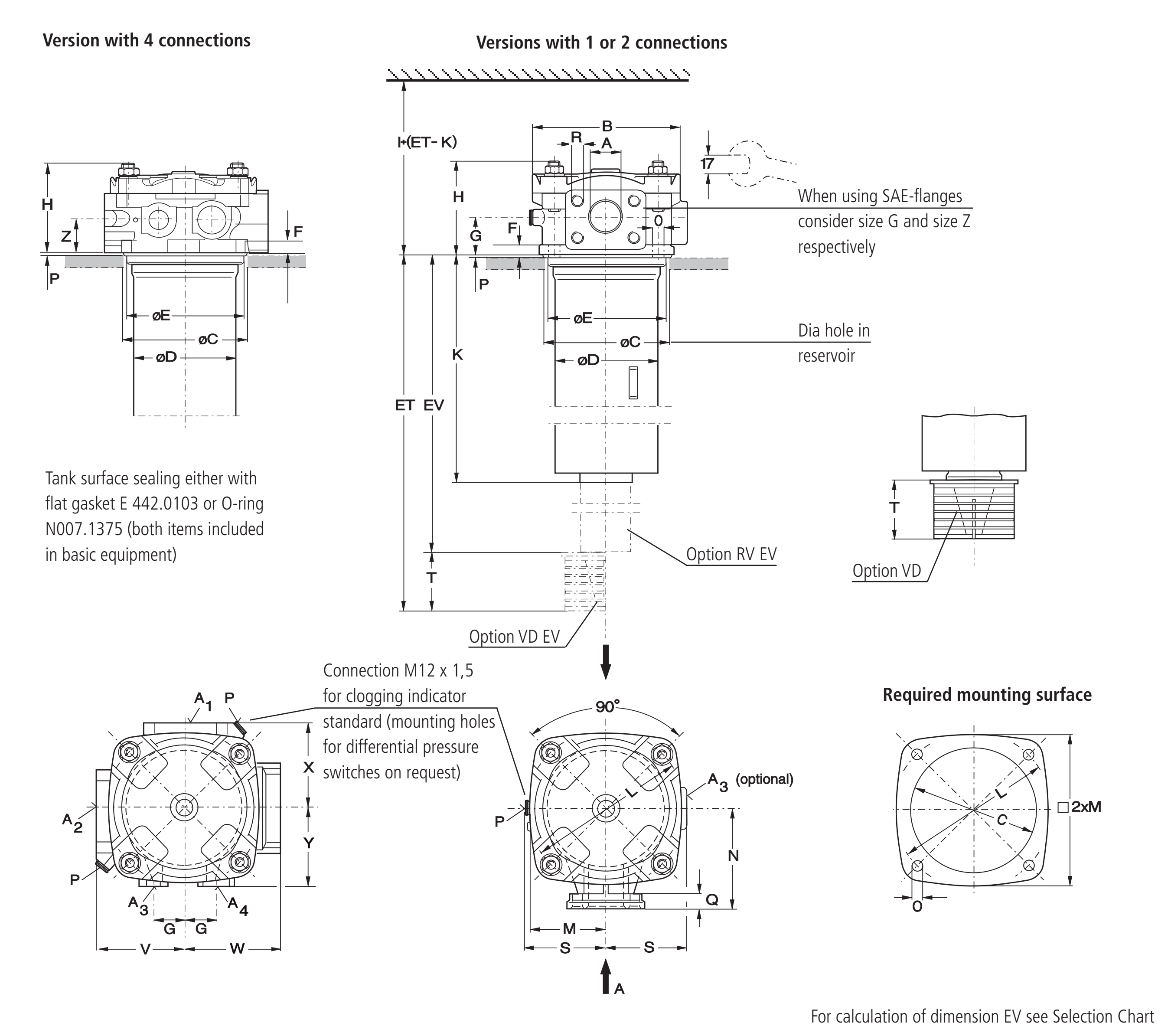
Extension pipe:
7 various lengths are available
EV = K (Bowl length) + 81 / + 136 / + 196 / + 231 / + 356 / + 446 / + 626 mm (see section dimensions and measurements)

For the appropriate clogging indicators see catalogue sheet 60.20.

Remarks:
- The switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs, e.g. with screen elements (mesh size 450 µm) at the bowl outlet, are available on request.

[1] The individual flow rates must match the connections [2] Paper media supported with metal gauze

Dimensions



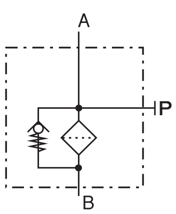
Measurements

Type	A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	V	W	X	Y	Z
E 443	see	174	141	131	139,9	12	36/35*	97	370	201	185	86,5	116	11,5	2	18	M12	92	58	96	106	96	89	32,5
E 453	Selection	174	141	131	139,9	12	36/35*	97	540	368	185	86,5	116	11,5	2	18	M12	92	58	96	106	96	89	32,5
E 463	Chart	174	141	131	139,9	12	36/35*	97	710	536	185	86,5	116	11,5	2	18	M12	92	58	96	106	96	89	32,5
E 643		174	141	131	139,9	12	36/35*	97	840	634	185	86,5	116	11,5	2	18	M12	92	58	96	106	96	89	32,5

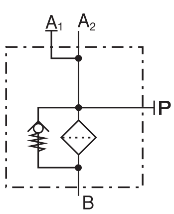
* for design with 4 connections

Symbols

1



2



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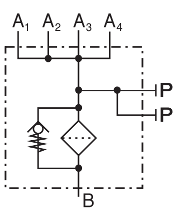
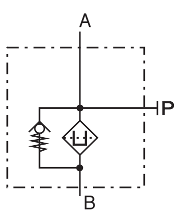
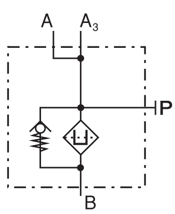


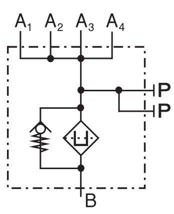
4



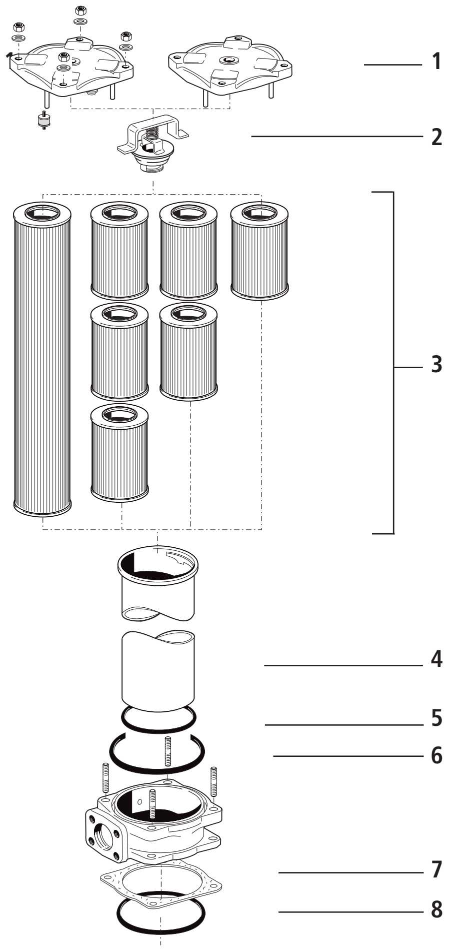
5



6



Spare Parts



Pos.	Designation	Part No.
1	Cover	E 443.1200
1a	cover with magnetic system	E 443.1210
2	By-pass (1,5 bar)	E 440.1500
2	By-pass (2,5 bar)	E 460.1520
2	By-pass (3,0 bar)	E 640.1510
3	Filter elements	see Chart / col. 9
4	Filter bowl E 443 *	E 440.1960
4	Filter bowl E 453 *	E 450.1906
4	Filter bowl E 463 *	E 460.1915
4	Filter bowl E 643 *	E 640.1910
5	O-ring 125 x 6	N007.1256
6	O-ring 151,76 x 5,33	N007.1525
7	Flat gasket	E 442.0103
8	O-ring 136,5 x 5,34	N007.1375

* Please indicate options (VD, VDEV, resp. RVEV)

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

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Return Filters

E 440 · E 450 · E 460
E 640 · E 700

- Tank mounting
- Nominal flow rate up to 800 l/min

20.60-4e

Description

Application
In the return line circuits of hydraulic systems.

Performance features
Protection against wear: By means of filter elements that, in full-flow filtration meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Special features
Installation: Installation directly into a separate tank section for the return oil. This solution allows a number of return line connections and does not show any restriction by a filter head.

By-pass valve: The location close to the inlet port prevents dirt particles retained by the filter element from entering into the clean oil side.

Removable bowl: In case of maintenance the filter bowl is removed together with the filter element - therefore dirt particles are not flushed back into the tank.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- high dirt-holding capacities
- low pressure drop
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Filter bowl: Steel
Seals: NBR (FPM on request)
Filter media: EXAPOR®MAX 2 - inorganic multi-layer microfibre web
Paper - cellulose web, impregnated with resin

Accessories
Extension pipes and diffusers on the bowl outlet are available on request.

Extension pipe: A correct extension pipe length ensures oil outlet below minimum oil level and prevents foaming.

Diffusers: Diffusers reduce oil velocity and direct the oil to 90° outlet flow. This function prevents also oil foaming and whirling up of solid particles settled at the tank bottom.

Electrical and optical clogging indicators are available on request.
Dimensions and technical data see catalogue sheet 60.20.

Characteristics

Nominal flow rate
Up to 800 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines ≤ 4,5 m/s

Installation
Tank immersed installation in a separate return oil chamber of the reservoir.

Filter fineness
10 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

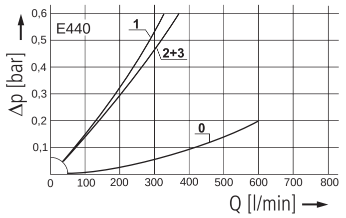
Mounting position
Preferably vertical, outlet downwards

Diagrams

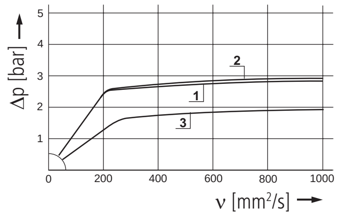
∆p-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)

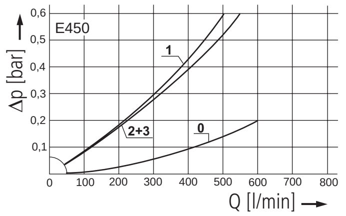


Pressure drop as a function of the **kinematic viscosity** at nominal flow

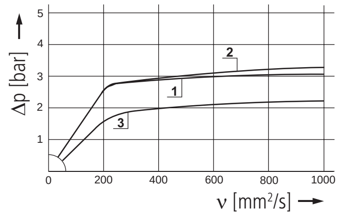


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)

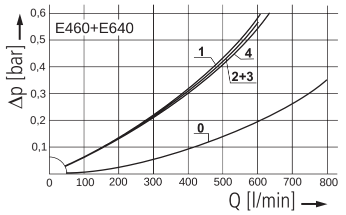


Pressure drop as a function of the **kinematic viscosity** at nominal flow

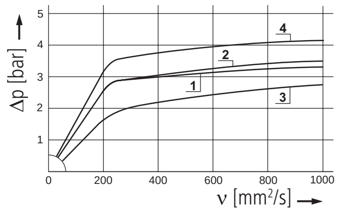


D3

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)

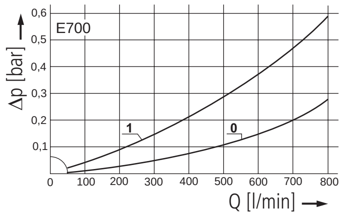


Pressure drop as a function of the **kinematic viscosity** at nominal flow

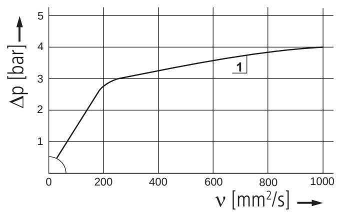


D4

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)



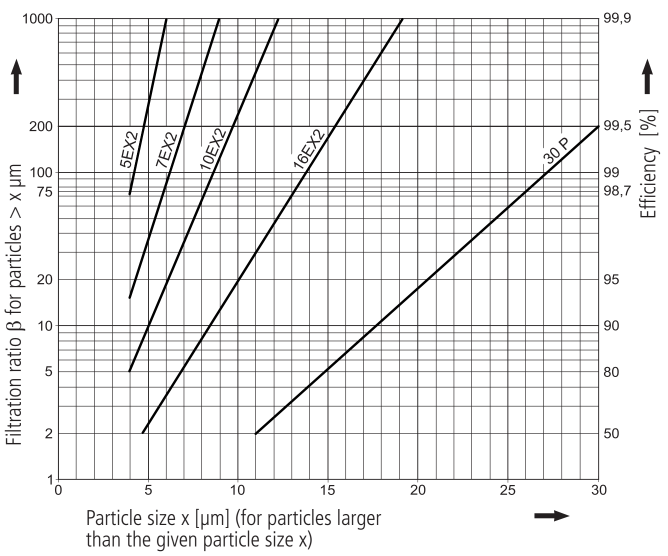
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Charts

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Remarks
	l/min			g		bar			kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
E 440-156	200	**D1**/1	10EX2	61	-	2,5	1	V2.1217-36	2,4	-
E 440-168	270	**D1**/2	16EX2	62	-	2,5	1	V2.1217-08	2,4	-
E 440-153	175	**D1**/3	30P	29	-	1,5	1	P2.1217-21*	2,4	-
E 450-156	375	**D2**/1	10EX2	122	-	2,5	1	2 x V2.1217-36	4,1	-
E 450-168	480	**D2**/2	16EX2	124	-	2,5	1	2 x V2.1217-08	4,1	-
E 450-153	350	**D2**/3	30P	58	-	1,5	1	2 x P2.1217-21*	4,1	-
E 460-156	500	**D3**/1	10EX2	183	-	2,5	1	3 x V2.1217-36	5,8	-
E 460-168	600	**D3**/2	16EX2	186	-	2,5	1	3 x V2.1217-08	5,8	-
E 460-153	480	**D3**/3	30P	87	-	1,5	1	3 x P2.1217-21*	5,8	-
E 640-76	680	**D3**/4	10EX2	250	-	3,0	1	V2.1260-26	7,5	-
E 700-156	800	**D4**/1	10EX2	300	-	2,5	1	V2.1460-26	12,4	-

As clogging indicators either manometers or electrical pressure switches can be used. Filters can also be supplied with an outlet diffuser. Optional extension pipes adapt the filter length to various tank depths. For ordering of accessories please use the below mentioned codes.

Order example: The filter E 450-156 has to be supplied with an outlet diffuser and an extension pipe (EV) for 580 mm length.

Order description: **E 450-156 / VD / EV 580**

Part No. (Basic unit)

Options
Two options are available
VD: Outlet diffuser, **RV**: Extension pipe

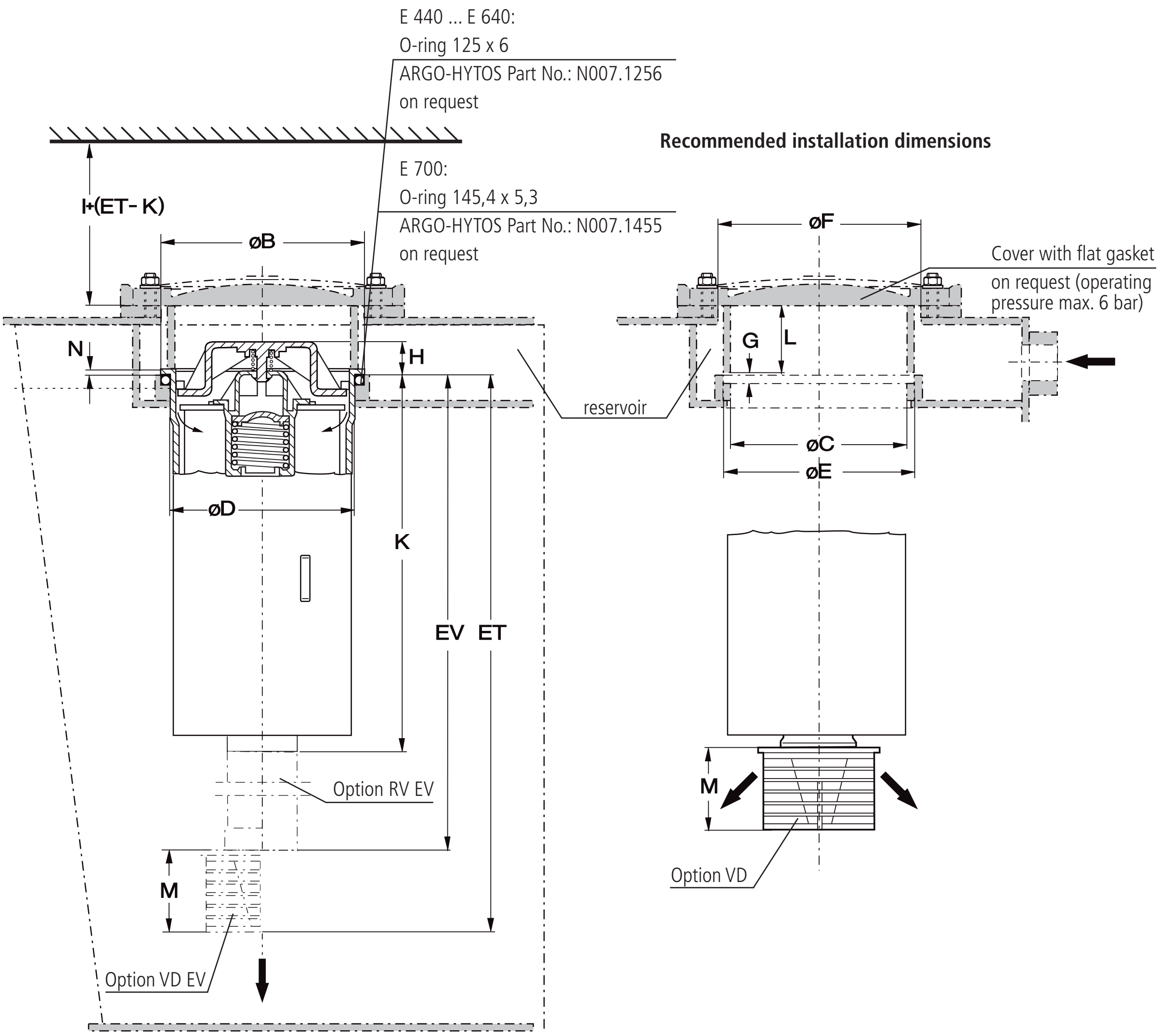
Extension pipes:
7 various lengths are available
E 440 / E 450 / E 460 / E 640
EV = K + 81 / + 136 / + 196 / + 231 / + 356 / + 446 / + 626 mm (see section dimensions and measurements)
E 700
EV on request.

For the appropriate clogging indicators see catalogue sheet 60.20.

Remarks:
- The switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs are available on request.

* Paper media supported with metal gauze

Dimensions



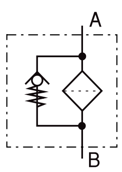
For calculation of dimension EV see data in Selection Chart

Measurements

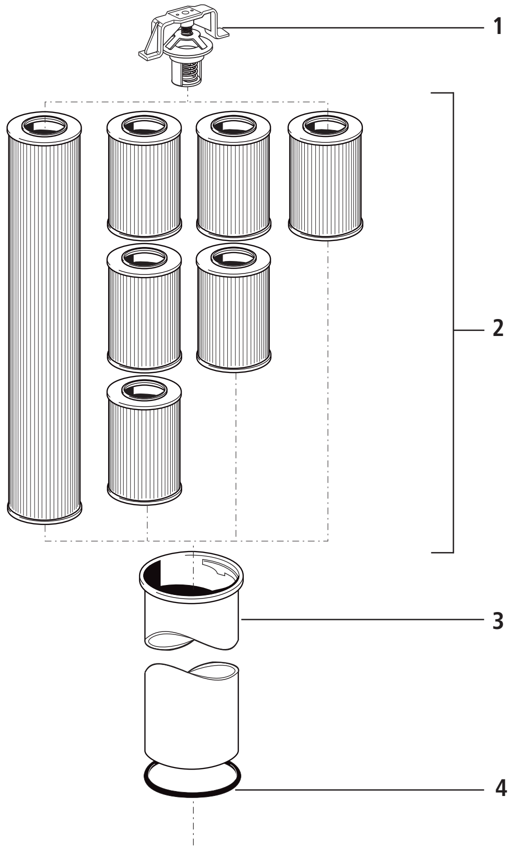
Type	A	B	C	D	E	F	G	H	I	K	L	M	N
E 440	-	142^{+2}	132	130,5	145	>145	6,5	26	250	217	48	58	1,5
E 450	-	142^{+2}	132	130,5	145	>145	6,5	26	410	384	48	58	1,5
E 460	-	142^{+2}	132	130,5	145	>145	6,5	26	580	552	48	58	1,5
E 640	-	142^{+2}	132	130,5	145	>145	6,5	26	680	650	48	58	1,5
E 700	-	167^{+2}	155	155	170	>170	6,5	27	700	651	82	58	1,5

Symbols

1



Spare Parts



Pos.	Designation	Part No.
1	By-pass (1,5 bar)	E 440.1500
1	By-pass (2,5 bar)	E 460.1520
1	By-pass (3,0 bar)	E 640.1510
1	By-pass (2,5 bar) for E 700	E 703.1510
2	Filter elements	see Chart. / col. 9
3	Filter bowl E 440 [1]	E 440.1960
3	Filter bowl E 450 [1]	E 450.1906
3	Filter bowl E 460 [1]	E 460.1915
3	Filter bowl E 640 [1]	E 640.1910
3	Filter bowl E 700	E 700.1900
4.1	O-ring 125 x 6 [2]	N007.1256
4.2	O-ring 145,4 x 5,3 (for E 700) [2]	N007.1455

[1] Please indicate options (VD, VDEV and RVEV respectively)
[2] Not included in basic equipment

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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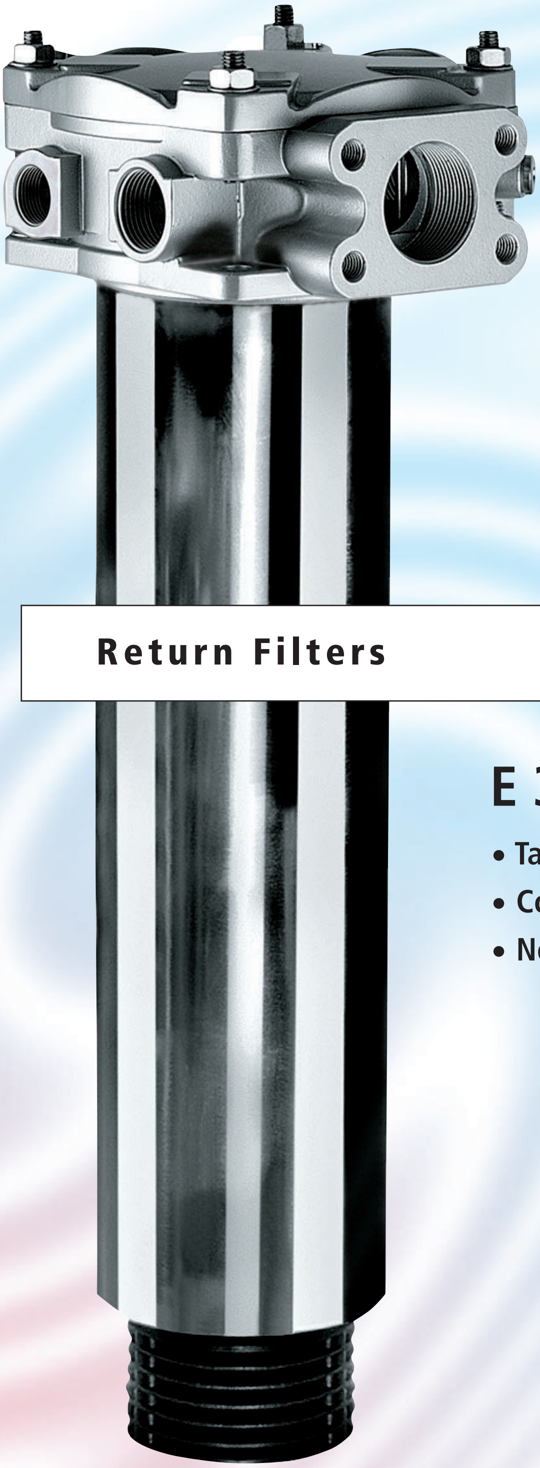
ARGO HYTOS



Return Filters

E 303 · E 503 · E 703

- Tank top mounting
- Connection up to SAE 2½
- Nominal flow rate up to 900 l/min

20.70-5e

Description

Application
In the return line circuits of hydraulic systems.

Performance features

Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Special features

By-pass valve: The location close to the inlet port prevents dirt particles retained by the filter element from entering into the clean oil side.

Removable bowl: In case of maintenance the filter bowl is removed together with the filter element - therefore dirt particles are not flushed back into the tank.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:

- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head cover:	Steel
Filter head:	Aluminium alloy
Filter bowl:	Steel
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web

Accessories
Extension pipes and diffusers on the bowl outlet are available on request.

Extension pipe: A correct extension pipe length ensures oil outlet below minimum oil level and prevents foaming.

Diffuser: Diffusers reduce oil velocity and direct the oil to 90° outlet flow. This function prevents also oil foaming and whirling up of solid particles settled at the tank bottom.

Electrical and optical clogging indicators are available on request. Dimensions and technical data see catalogue sheet 60.20.

Characteristics

Nominal flow
Up to 900 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines $\leq$ 4,5 m/s

Connection
SAE-flange (3.000 psi). Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
5 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

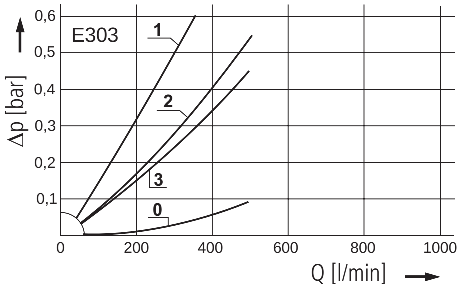
Mounting position
Preferably vertical, outlet downwards

Diagrams

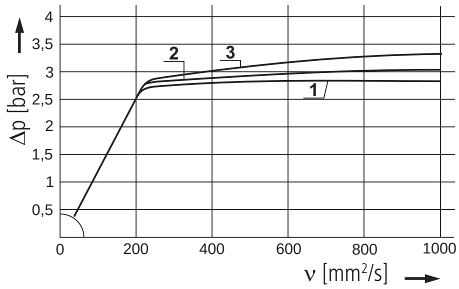
∆p-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)

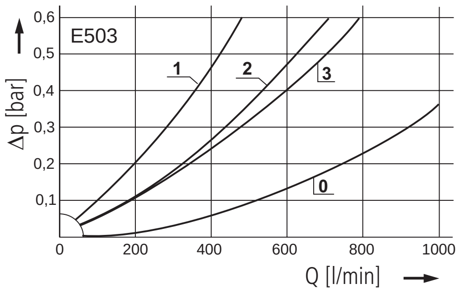


Pressure drop as a function of the **kinematic viscosity** at nominal flow

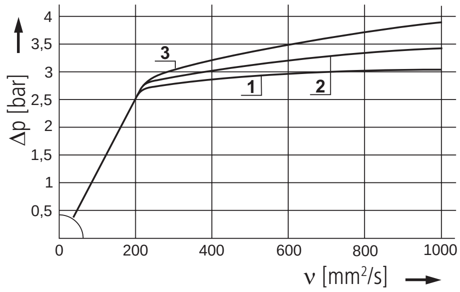


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)

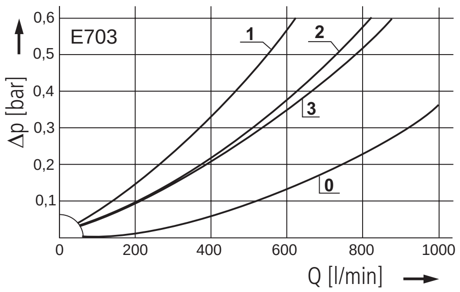


Pressure drop as a function of the **kinematic viscosity** at nominal flow

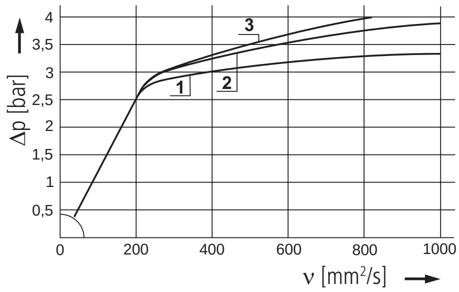


D3

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)



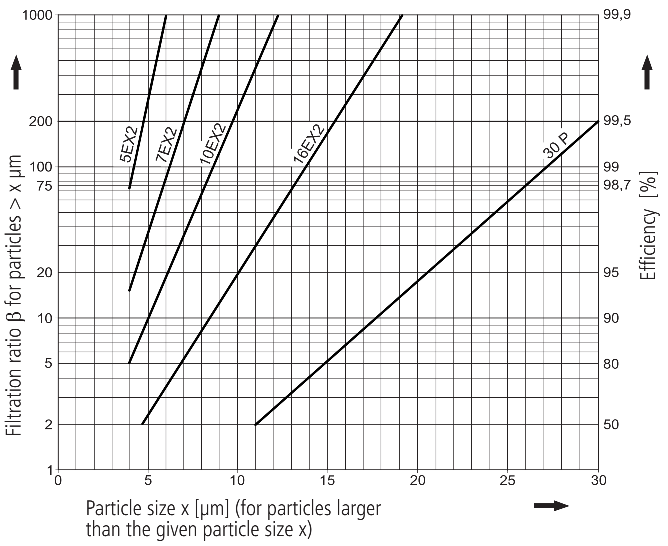
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\overline{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\overline{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\overline{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\overline{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\overline{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189.

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate[1]	Pressure drop diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A SAE (3000 psi)	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Remarks
	l/min			g		bar			kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
E 303-453	220	**D1**/1	5EX2	91	2xG1¼/SAE1½,G¾+G1	2,5	2	V2.1425-23	8,9	-
E 303-456	350	**D1**/2	10EX2	120	2xG1¼/SAE1½,G¾+G1	2,5	2	V2.1425-26	8,9	-
E 303-458	500	**D1**/3	16EX2	130	2xG1¼/SAE1½,G¾+G1	2,5	2	V2.1425-28	8,9	-
E 503-453	350	**D2**/1	5EX2	150	2xG1¼/SAE1½,G¾+G1	2,5	2	V2.1440-23	11,7	-
E 503-456	540	**D2**/2	10EX2	200	2xG1¼/SAE1½,G¾+G1	2,5	2	V2.1440-26	11,7	-
E 503-458	750	**D2**/3	16EX2	200	2xG1¼/SAE1½,G¾+G1	2,5	2	V2.1440-28	11,7	-
E 703-453	500	**D3**/1	5EX2	230	2xG1¼/SAE1½,G¾+G1	2,5	2	V2.1460-23	15,4	-
E 703-456	740	**D3**/2	10EX2	300	2xG1¼/SAE1½,G¾+G1	2,5	2	V2.1460-26	15,4	-
E 703-458	900	**D3**/3	16EX2	310	2xG1¼/SAE1½,G¾+G1	2,5	2	V2.1460-28	15,4	-

All filters are delivered with a plugged clogging indicator connection M12 x 1,5. (Mounting holes for differential pressure switches on request). As clogging indicators either manometers or electrical pressure switches can be used. Two different head pieces with three various connecting options are available. All filters can also be supplied with an outlet diffuser. Optional extension pipes adapt the filter length to various tank depths. For ordering of accessories please use the below mentioned codes.

Order example: **The filter E 703-256 has to be supplied with 2 connections (A and A4) and an extension pipe for 800 mm length.**

Order description: **E 703- 256 / RV / EV 800**

Connections:
two various options are available
two connections[1] (A und A4)[2] - SAE2½ and G1 — 2
four connections[1] (A1, A2, A3 and A4) - 2 x G1¼ / SAE1½, G¾ and G1 — 4

Bowl outlet[2]:
two various options are available
VD - Outlet diffuser, **RV** - extension pipe

Extension pipe[3]:
four various lengths are available
EV = K (Bowl length) + 64 / + 164 / + 264 / + 454 mm (see section dimensions and measurements)

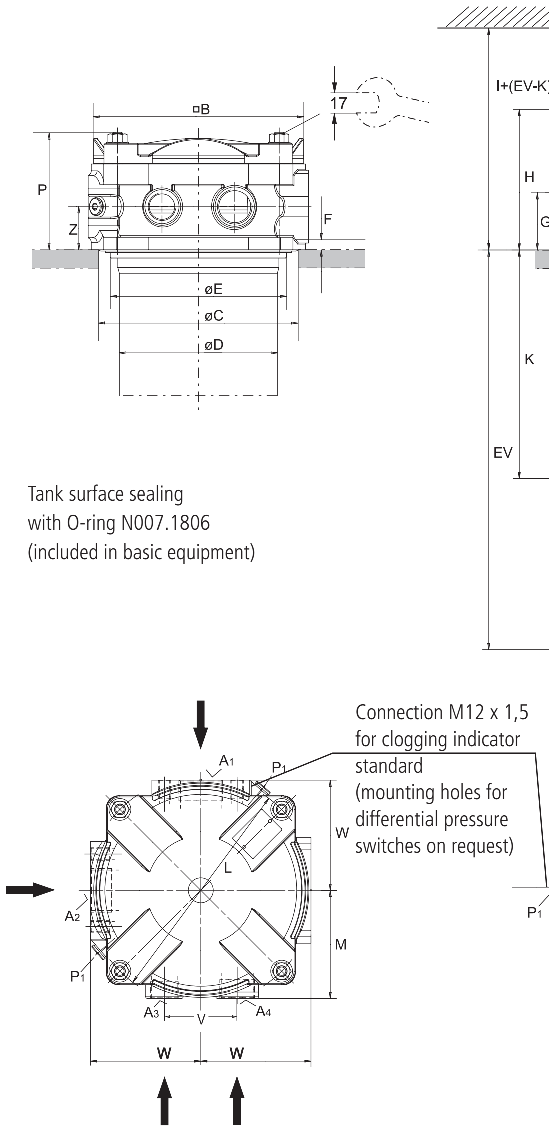
For the appropriate clogging indicators see catalogue sheet 60.20.

Remarks:
- The switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. Other designs available on request.

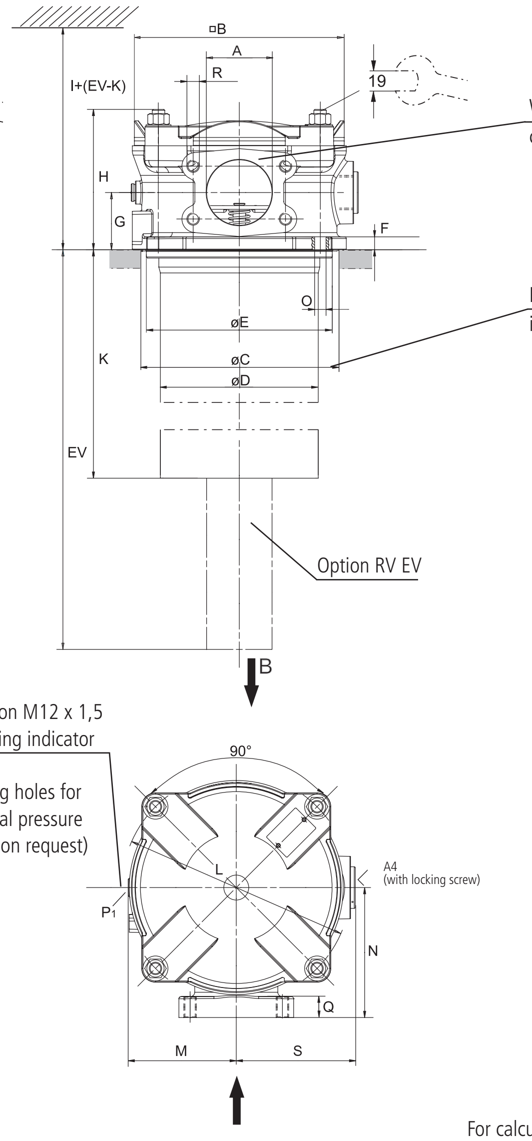
[1] The individual flow rates must be matched to the connections [2] Connection G1 (A4) with locking screw [3] On request an outlet diffuser can be combined with an extension pipe

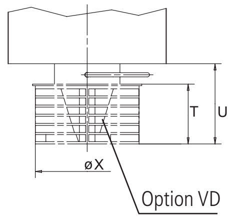
Dimensions

Version with 4 connections

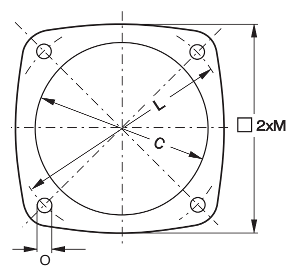


Version with 2 connections





Required mounting surface



For calculation of dimension EV see Selection Chart

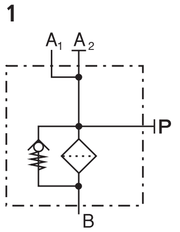
Measurements

Type	A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Z
E 303	see	182	180	152	179	12	55	133	400	276	220	104	125	11,5*	113	20	M12	115	58	79	70	106	100	41,5
E 503	Selection	182	180	152	179	12	55	133	550	430	220	104	125	11,5*	113	20	M12	115	58	79	70	106	100	41,5
E 703	Chart	182	180	152	179	12	55	133	810	636	220	104	125	11,5*	113	20	M12	115	58	79	70	106	100	41,5

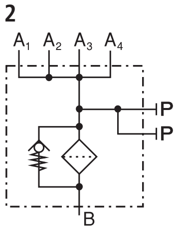
* for M10

Symbols

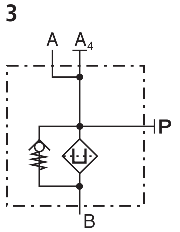
1



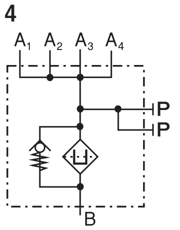
2



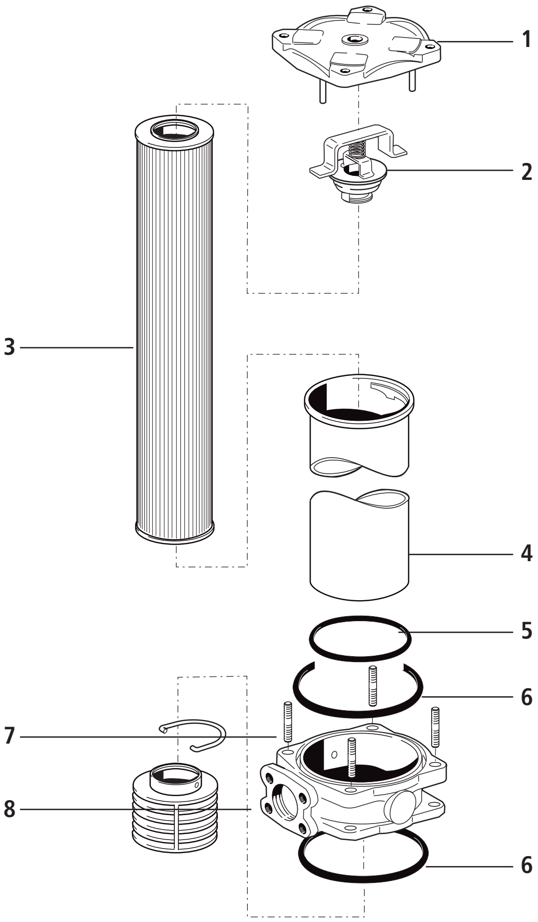
3



4



Spare Parts



Pos.	Designation	Part No.
1	Cover assy (2 connections)	E 303.1200
1	Cover (4 connections)	E 703.2202
2	By-pass (2,5 bar)	E 703.1510
3	Filter elements	see Chart / col. 9
4	Filter bowl E 303*	E 303.1900
4	Filter bowl E 503*	E 503.1910
4	Filter bowl E 703*	E 703.1900
5	O-ring 145,42 x 5,33	N007.1455
6	O-ring 180 x 6	N007.1806
7	Clip (only option VD)	N026.0311
8	Diffuser (only option VD)	E 703.0701

* Please indicate options (VD, VDEV and RVEV respectively)

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advice you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

ARGO HYTOS

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Return-Suction Filters

E 068 · E 088

- In-line mounting
- Connection up to G¾
- Nominal flow rate up to 100 l/min

20.80-2e

Description

Application
For operation in units with hydrostatic drives, when the return flow is under all operating conditions higher than the oil flow of the feed pump.

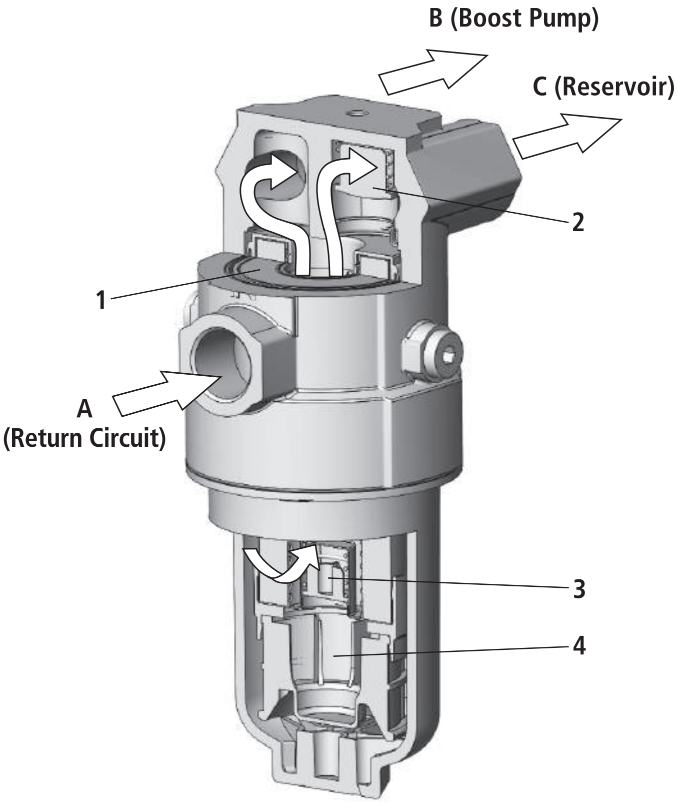
Performance features
Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Suction filter function: Because of the 100 %-filtration of the suction flow, no dirt can get into the feed pump.

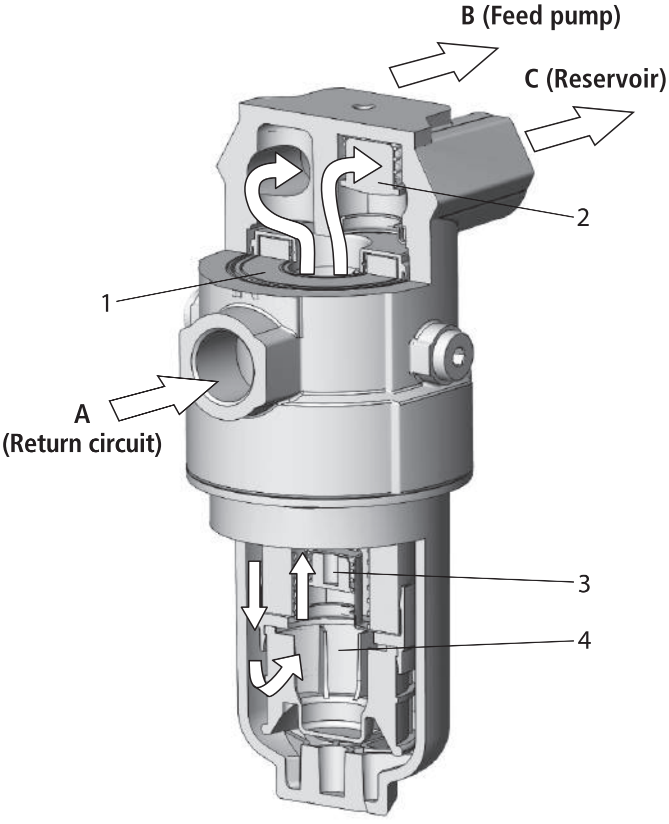
Return filter function: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remainning in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Functional characteristics
The hydraulic oil returning from the circuit (A) passes the filter element (1), is pressurized by a 0,5 bar check valve (2) and supplied to the feed pump (B). The surplus oil flows filtered over the integral check valve into the reservoir (C). As the feed pump is always fed with pressurized oil, the risk of cavitation is minimized and full performance is available even during the critical cold start phase.
An integral bypass valve (3) in the filter element (1) prevents too high back pressure (cold start, element contaminates).
A bypass valve with a 125 µm protection strainer (4) guarantees that only filtered oil can get into the feed pump.

Function (normal operation):



Function with response of the bypass valve (3):



Start up / Deaeration
Deaerating instructions published by the manufacturers of hydraulic drives must be observed.

Filter elements
Flow direction from outside to the center. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is indicated and guarantees therefore the optimum utilization of the filter elements. In case of maintenance the filter bowl is removed together with the filter element – therefore dirt particles are not flushed back into the tank.

Accessories
Electrical and optical clogging indicators are available. Dimensions and technical data see catalogue sheet 60.20.

Layout

General
In machines with a hydrostatic drive and combined working hydraulic system, return-suction filters replace the suction or pressure filters previously required for the feed pump of the closed-loop hydrostatic drive circuit as well as the return filter for the open-loop working hydraulic circuit.
While each circuit operates independently with separate filters, the combination of the two circuits via the return-suction filter causes interaction between the circuits.
If the design criteria described below are taken into account, you can take full advantage of the benefits provided by the return-suction filter concept, thus making sure that your system performs reliably even under extreme operating conditions.

Required return flow in the system
In order to maintain a precharging pressure of approx. 0,5 bar at the intake of the feed pump, the return flow must exceed the suction flow under any operating condition.

Permitted feed pump flow rate
- at operating temperature ($\nu < 60$ mm²/s, rpm=max): feed pump flow rate $\leq$ 0,5 x rated return flow according to column 2 of selection table
- at cold start-up ($\nu < 1.000$ mm²/s, rpm = 1.000 min^{-1}): feed pump flow rate $\leq$ 0,2 x rated return flow according to column of selection table

Please contact us if your system operates with higher flow rates than stated above.

Flow velocity in the connecting lines
- Flow velocity in the return lines ≤ 4,5 m/s
- Flow velocity in the suction lines ≤ 1,5 m/s

Permitted pressure in the suction lines
At cold start up ($\nu < 1.000$ mm²/s, rpm = 1.000 min^{-1}):
feed pump flow rate $\leq$ 0,2 x rated return flow. The pressure loss in the suction lines must not exceed 0,4 bar.

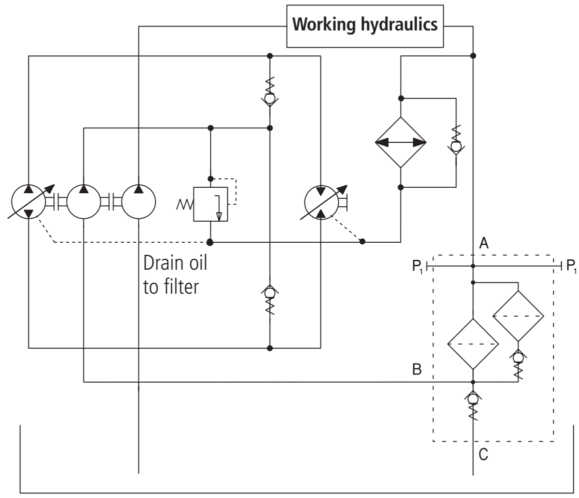
Backpressures in system return lines
If drain oil from the hydrostatic drive is routed across the filter in addition to the flow of the open-loop circuit, the following has to be observed in order to protect the shaft seals:
- permitted leakage oil pressure for a given viscosity and speed (manufacturer's specifications!)
- pressure loss caused by the leakage oil pipes
- pressure loss caused by the oil cooler used
- backpressure of the filter for a given flow rate or kinematic viscosity (refer to pressure loss diagrams)

Depending on the application, the use of a cooler bypass valve is recommended.
Generously sized drain oil pipes are also of advantage.

Filter fineness grades
With the filter fineness grades available, the following oil cleanliness according to ISO 4406 can be achieved:
- 10EX2: 18/15/12 ... 14/11/7
- 16EX2: 20/17/12 ... 17/14/10

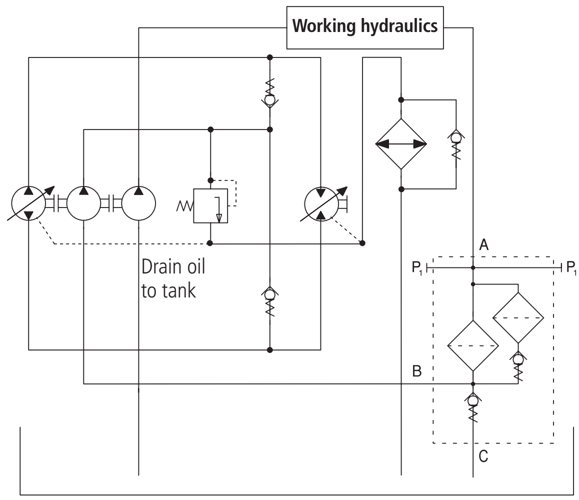
Even with the 16EX2 filter fineness grade, the requirements specified by manufacturers of hydrostatic drives are sometimes exceeded significantly. If components requiring a still better oil purity are used, we recommend the 10EX2 filter fineness grade.

Suggested circuit layouts
A) The leakage oil of the hydrostatic drive is routed across the filter.



The entire dirt produced in the hydrostatic drive by abrasion is filtered out immediately and is thus not taken in by the pump of the open-loop circuit.
This circuit layout is always recommended if the return flow only slightly exceeds the suction flow, i.e. if there is a risk that the 0,5 bar precharging pressure cannot be maintained.

B) The drain oil of the hydrostatic drive is not routed across the filter but is discharged directly into the tank.



This circuit layout has the advantage that drain oil pressures are comparatively low.

Characteristics

Nominal flow rate
Up to 100 l/min in return line (see Selection Chart, column 2)
Up to 45 l/min feed pump flow rate (see Layout)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the return lines ≤ 4,5 m/s
- flow velocity in the suction lines ≤ 1,5 m/s

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 and 7
(other port threads on request)

Filter fineness
10 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-service 00.20).

Temperature range
-30 ° C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.000$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

Materials

Filter head:	Aluminium alloy
Filter bowl:	Polyamid, GF reinforced
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX - inorganic multi-layer microfibre web

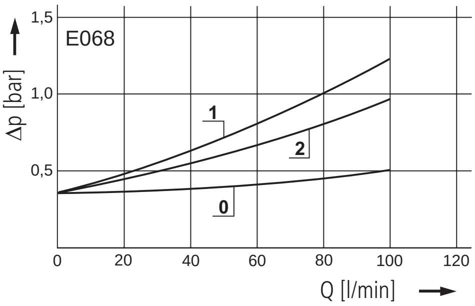
Fitting position
Preferably vertical, filter head on top.

Diagrams

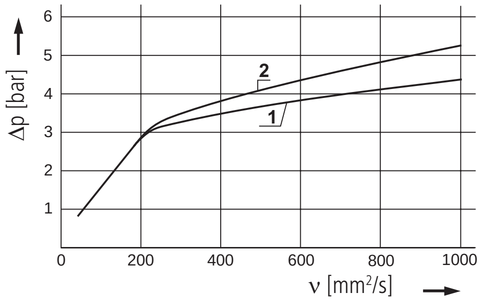
Δp-curves for complete filters in Selection Chart, column 3
(50 % of the nominal flow volume via connection B)

D1

Pressure drop as a function of the **flow volume** at $\nu = 35$ mm²/s (0 = casing empty)

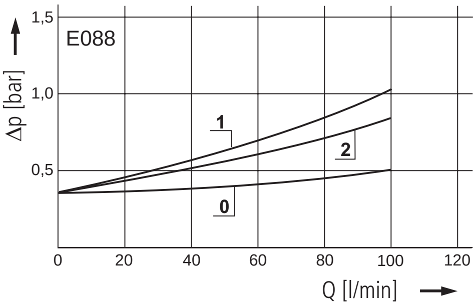


Pressure drop as a function of the **kinematic viscosity** at nominal flow

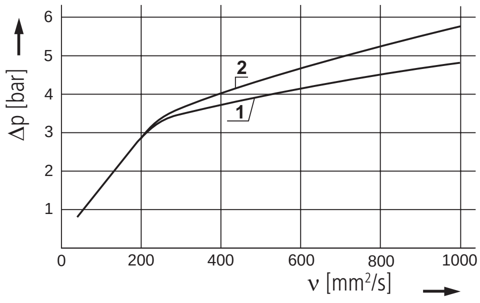


D2

Pressure drop as a function of the **flow volume** at $\nu = 35$ mm²/s (0 = casing empty)



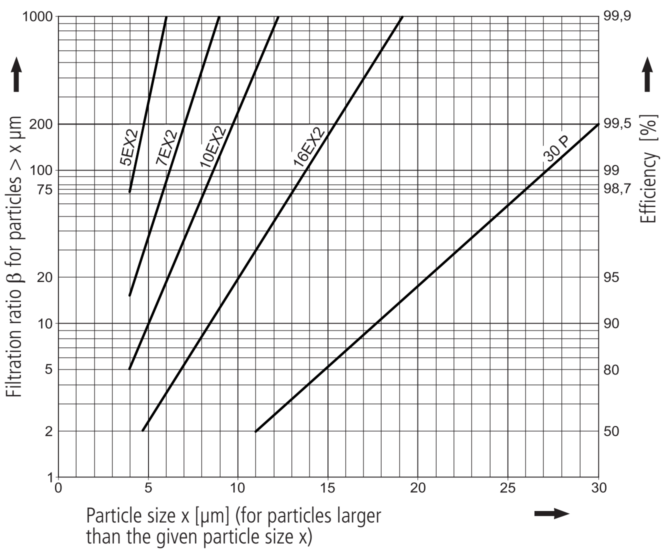
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal return flow	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A	Connections B/C	Cracking pressure of CV[1]	Cracking pressure of PRV[2]	Symbol	Replacement filter element Part No.	Weight	Remarks
	l/min			g			bar	bar			kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
E 068-156	50	**D1**/1	10EX2	15	G¾	G¾	0,5	2,5	1	K3.0718-56	1,3	-
E 068-158	80	**D1**/2	16EX2	15	G¾	G¾	0,5	2,5	1	K3.0718-58	1,3	-
E 088-156	65	**D2**/1	10EX2	20	G¾	G¾	0,5	2,5	1	K3.0721-56	1,4	-
E 088-158	100	**D2**/2	16EX2	20	G¾	G¾	0,5	2,5	1	K3.0721-58	1,4	-

All filters are delivered with two plugged clogging indicator connections M12 x 1,5. As clogging indicators on the return side (P_1) either manometers or electrical pressure switches can be used.

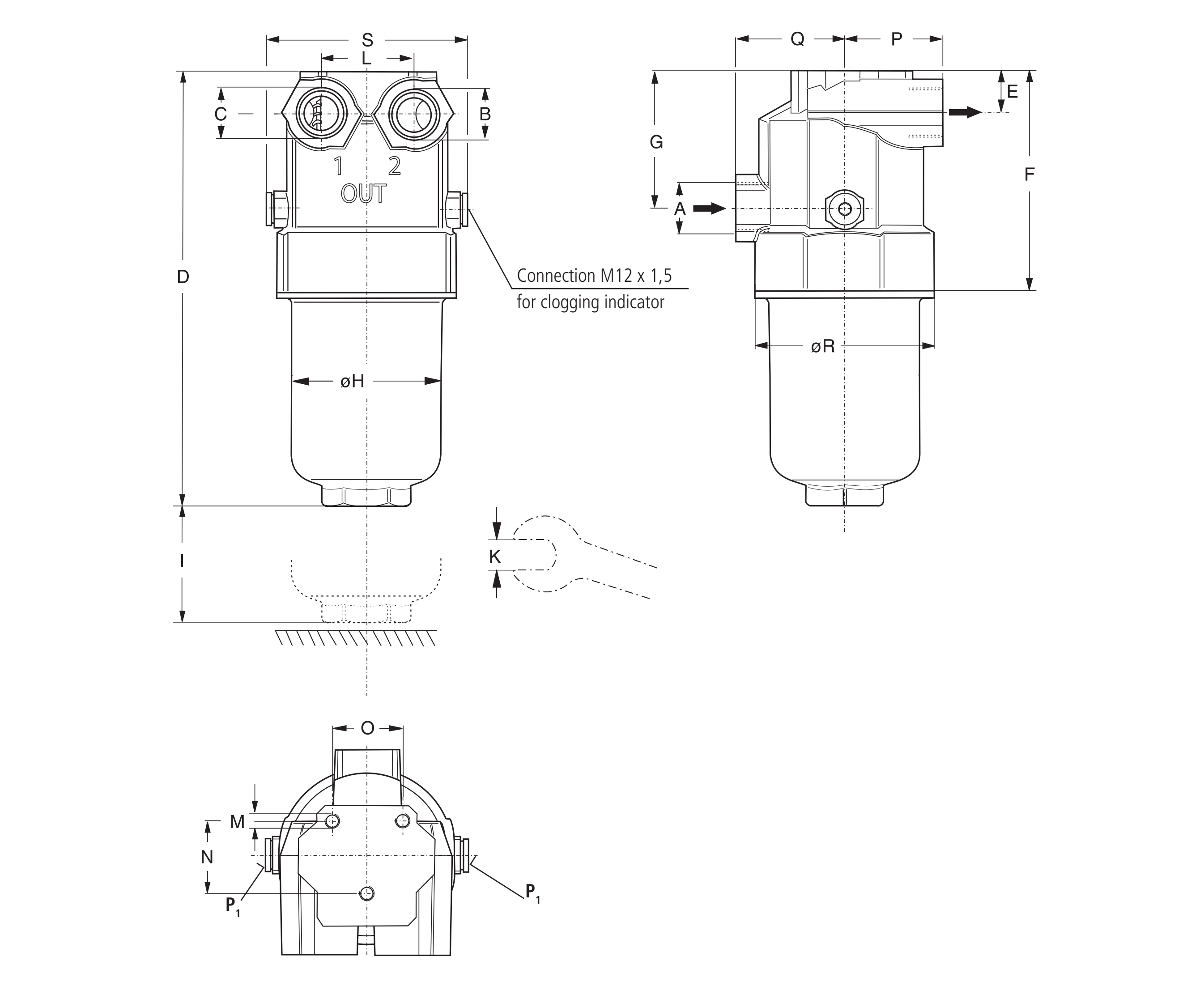
For the appropriate clogging indicators see catalogue sheet 60.20.

Remarks:

- The start of the red area respectively the switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the pressure relief valve (see Selection Chart, column 9).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. If modifications are required, we kindly ask for your request.
- For deaeration a bleed screw (for connection P_1) with Part No. SV 0112.15 is available.

[1] Cracking pressure of check valve
[2] Cracking pressure of pressure relief valve

Dimensions

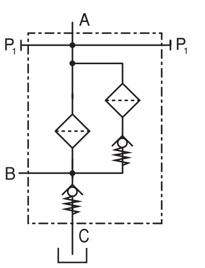


Measurements

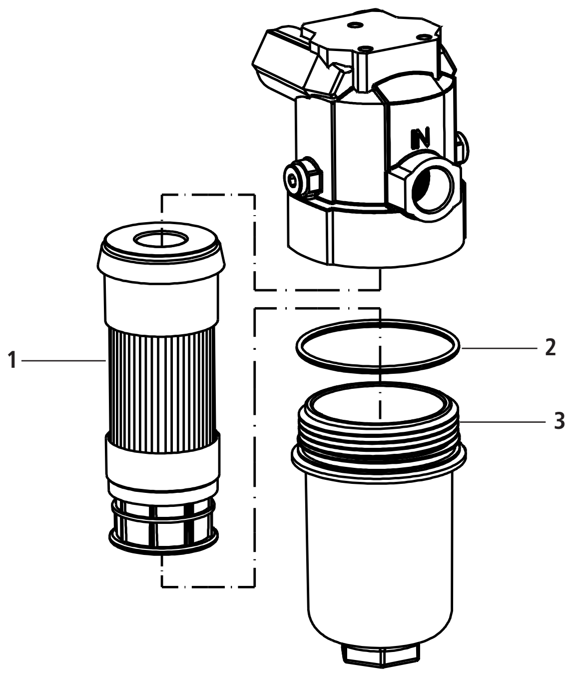
Type	A	B	C	D	E	F	G	H	I	K	L	M Ø / depth	N	O	P	Q	R	S
E 068	G¾	G¾	G¾	234	23,3	119	74,2	80	75	41	50	M8/15	40	38,1	53,5	57,5	95	108
E 088	G¾	G¾	G¾	268	23,3	119	74,2	80	75	41	50	M8/15	40	38,1	53,5	57,5	95	108

Symbols

1



Spare Parts



Pos.	Designation	Part No.
1	Filter element	see chart / col.11
2	O-ring 82,14 x 3,53	N007.0824
3	Filter bowl E 068	E 068.0101
3	Filter bowl E 088	E 068.0102

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

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ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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Phone: +49 7250 76-0 · Fax: +49 7250 76-199 · info@argo-hytos.com · www.argo-hytos.com

Return-Suction Filters

E 084

- Tank top mounting
- Connection up to G1
- Nominal flow rate up to 80 l/min

20.85-7e

Description

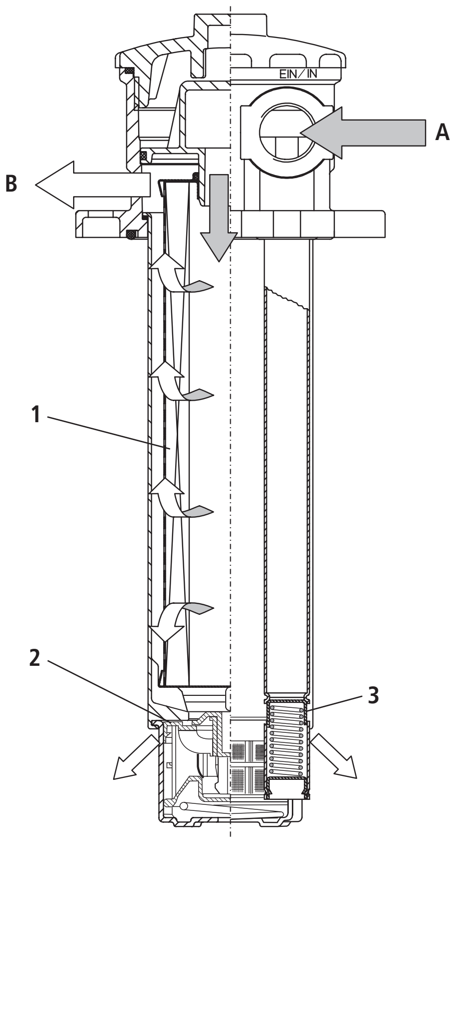
Application
For operation in units with hydrostatic drives, when the return flow is under all operating conditions higher than the oil flow of the feed pump.

Performance features

Protection against wear:	By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.
Suction filter function:	Because of the 100 %-filtration of the suction flow, no dirt can get into the feed pump.
Return filter function:	By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

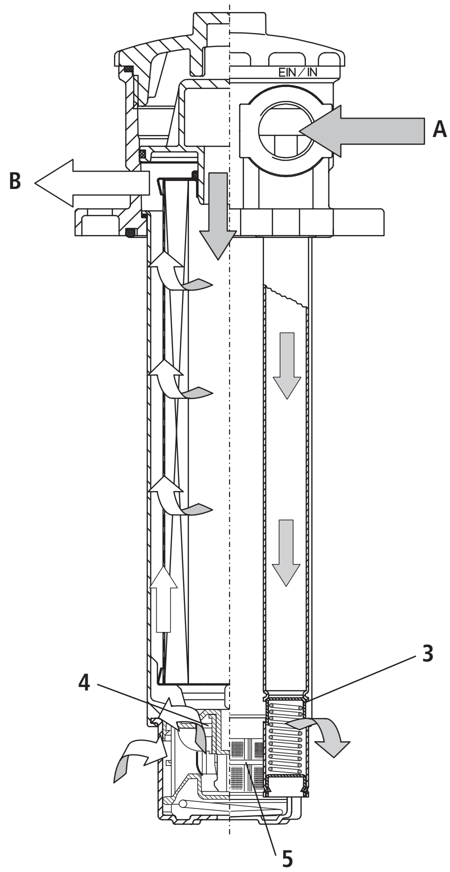
Functional characteristics
The hydraulic oil returning from the circuit (A) passes the filter element (1), is pressurized by a 0,5 bar check valve (2) and supplied to the feed pump (B). The surplus oil flows filtered over the integral check valve into the reservoir. As the feed pump is always fed with pressurized oil, the risk of cavitation is minimized and full performance is available even during the critical cold start phase.
An integral pressure relief valve (3) prevents too high back pressure and protects the shaft seals against damages. As this valve leads the oil directly into the tank there is no direct connection between the return line (A) and the connection of the feed pump (B) (no bypass valve function).

Function (schematic):



The emergency-suction valve (4) with 125 µm protection strainer (5) supplies the feed pump in case of a short term of lack of oil.
During normal operation, a lack of oil may definitely not occur (refer to „Design" section).

Emergency-suction (schematic):



Start up / Deaeration
For units with emergency-suction valve and protection strainer the start up set E 084.1710 can be used to de-aerate the hydraulic system at first start up or at start up after repair; hereby the immediate supply of the feed pump with hydraulic oil is guaranteed.
For all other types, deaerating instructions published by the manufacturers of hydraulic drives must be observed.

Filter maintenance
By using a clogging indicator the correct moment for maintenance is indicated and guarantees therefore the optimum utilization of the filter elements.

Filter elements
Flow direction from centre to the outside. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Dirt deposits are entirely removed when the element is changed and cannot re-enter the tank.

Accessories
Electrical and optical clogging indicators are available.
Dimensions and technical data see catalogue sheet 60.20.

Layout

General
In machines with a hydrostatic drive and combined working hydraulic system, return-suction filters replace the suction or pressure filters previously required for the feed pump of the closed-loop hydrostatic drive circuit as well as the return filter for the open-loop working hydraulic circuit.
While each circuit operates independently with separate filters, the combination of the two circuits via the return-suction filter causes interaction between the circuits.
If the design criteria described below are taken into account, you can take full advantage of the benefits provided by the return-suction filter concept, thus making sure that your system performs reliably even under extreme operating conditions.

Required return flow in the system
In order to maintain a precharging pressure of approx. 0,5 bar at the intake of the feed pump, the return flow must exceed the suction flow under any operating condition:
Special feature:
- Versions with hole (Ø 4 mm) in the pressurizing valve: at least 10 l/min of excess flow

Permitted feed pump flow rate
- at operating temperature (ν < 60 mm^2/s, rpm=max): feed pump flow rate ≤ 0,5 x rated return flow according to column 2 of selection table
- at cold start-up (ν < 1.000 mm^2/s, rpm = 1.000 min^{-1}): feed pump flow rate ≤ 0,2 x rated return flow according to column of selection table

Please contact us if your system operates with higher flow rates than stated above.

Flow velocity in the connecting lines
- Flow velocity in the return lines ≤ 4,5 m/s
- Flow velocity in the suction lines ≤ 1,5 m/s

Permitted pressure in the suction lines
At cold start up (ν < 1.000 mm^2/s, rpm = 1.000 min^{-1}):
feed pump flow rate ≤ 0,2 x rated return flow. The pressure loss in the suction lines must not exceed 0,4 bar.

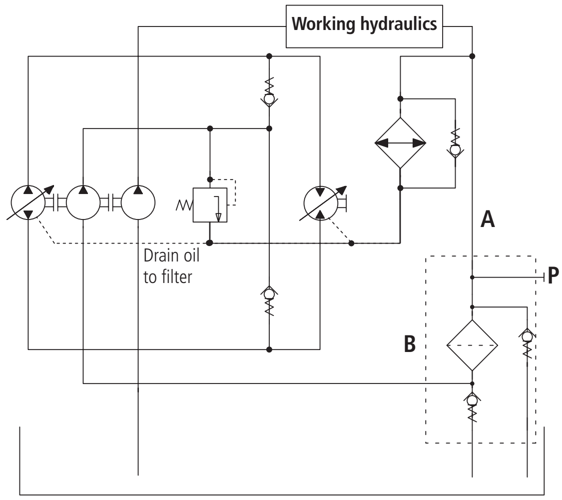
Backpressures in system return lines
If drain oil from the hydrostatic drive is routed across the filter in addition to the flow of the open-loop circuit, the following has to be observed in order to protect the shaft seals:
- permitted leakage oil pressure for a given viscosity and speed (manufacturer's specifications!)
- pressure loss caused by the leakage oil pipes
- pressure loss caused by the oil cooler used
- backpressure of the filter for a given flow rate or kinematic viscosity (refer to pressure loss diagrams)

Depending on the application, the use of a cooler bypass valve is recommended.
Generously sized drain oil pipes are also of advantage.

Filter fineness grades
With the filter fineness grades available, the following oil cleanliness according to ISO 4406 can be achieved:
- 10EX2: 18/15/11 ... 14/11/7
- 16EX2: 20/17/12 ... 17/14/10

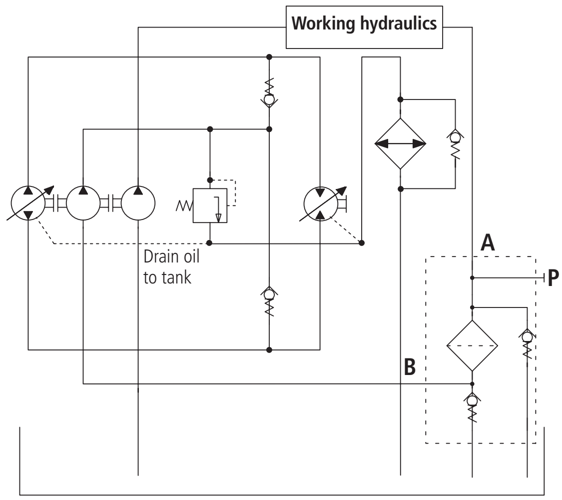
Even with the 16EX2 fineness grade, the requirements specified by manufacturers of hydrostatic drives are sometimes exceeded significantly.
If components requiring a still better oil purity are used, we recommend the 10EX2 filter fineness grade.

Suggested circuit layouts
A) The leakage oil of the hydrostatic drive is routed across the filter.



The entire dirt produced in the hydrostatic drive by abrasion is filtered out immediately and is thus not taken in by the pump of the open-loop circuit.
This circuit layout is always recommended if the return flow only slightly exceeds the suction flow, i.e. if there is a risk that the 0,5 bar precharging pressure cannot be maintained.

B) The drain oil of the hydrostatic drive is not routed across the filter but is discharged directly into the tank.



This circuit layout has the advantage that drain oil pressures are comparatively low.

Characteristics

Nominal flow rate
Up to 80 l/min in return line (see Selection Chart, column 2)
Up to 40 l/min feed pump flow rate (see Layout)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the return lines ≤ 4,5 m/s
- flow velocity in the suction lines ≤ 1,5 m/s

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 and 7
(other port threads on request)

Filter fineness
10 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-service 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.000$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

Materials

Screw-on cap:	Polyamide, GF reinforced
Filter head:	Aluminium alloy
Filter bowl:	Aluminium alloy
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web

Fitting position

- Standard type no restriction, preferably vertical
- Models with emergency-suction valve can vary up to 15° from the vertical
- Models with hole ∅ 4 mm in the check valve can vary up to 45° from the vertical

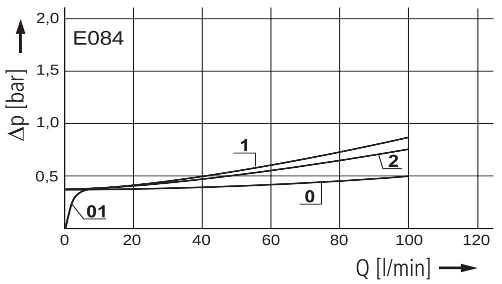
Even under unfavourable operating conditions (min. oil level, max. sloping) the oil outlet resp. emergency suction has to be below the oil level.
Special designs are available for horizontal assembly.

Diagrams

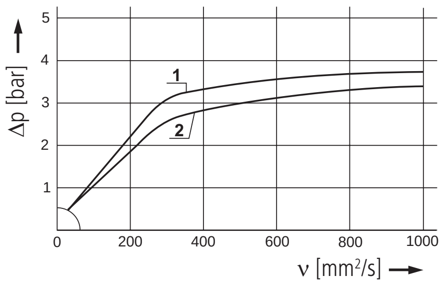
Δp-curves for complete filters in Selection Chart, column 3
(50 % of the nominal flow volume via connection B)

D1

Pressure drop as a function of the **flow volume**
at ν = 35 mm^2/s (00/01 = casing empty without/with hole Ø 4 mm)



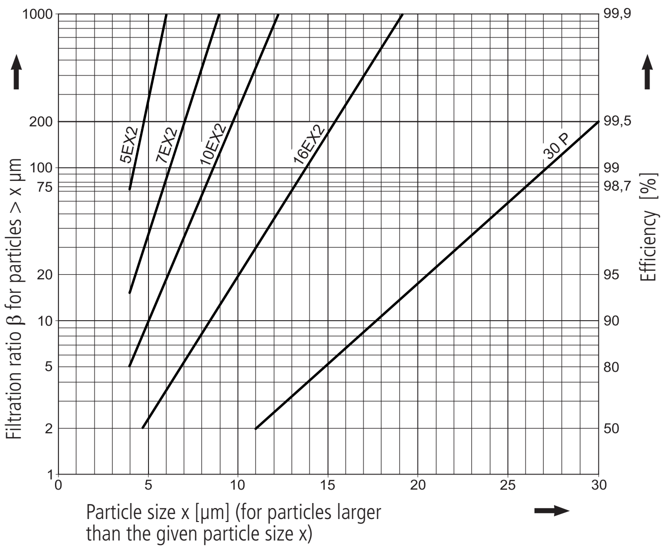
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal return flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A	Connection B	Cracking pressure of CV[1]	Cracking pressure of PRV[2]	Symbol	Suction valve	Replacement filter element Part No.	Weight	Remarks
	l/min			g			bar	bar				kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
E 084-56	75	**D1**/1	10EX2	32	G1	G¾	0,5	3,0	2		V3.0724-06	1,7	[3]
E 084-77	80	**D1**/2	16EX2	31	G1	G¾	0,5	2,5	2		V3.0724-08	1,7	[3]
E 084-88	80	**D1**/2	16EX2	31	G¾	G¾	0,5	2,5	2		V3.0724-08	1,7	[3]
E 084-78	80	**D1**/2	16EX2	31	G1	G¾	0,5	2,5	1		V3.0724-08	1,7	-
E 084-87	80	**D1**/2	16EX2	31	G¾	G¾	0,5	2,5	1		V3.0724-08	1,7	-
E 084-277	80	**D1**/2	16EX2	31	G1	G¾	0,5	2,5	4	•	V3.0724-08	1,8	[4]
E 084-288	80	**D1**/2	16EX2	31	G¾	G¾	0,5	2,5	4	•	V3.0724-08	1,8	[4]
E 084-287	80	**D1**/2	16EX2	31	G1	G¾	0,5	2,5	3	•	V3.0724-08	1,8	[4+5]

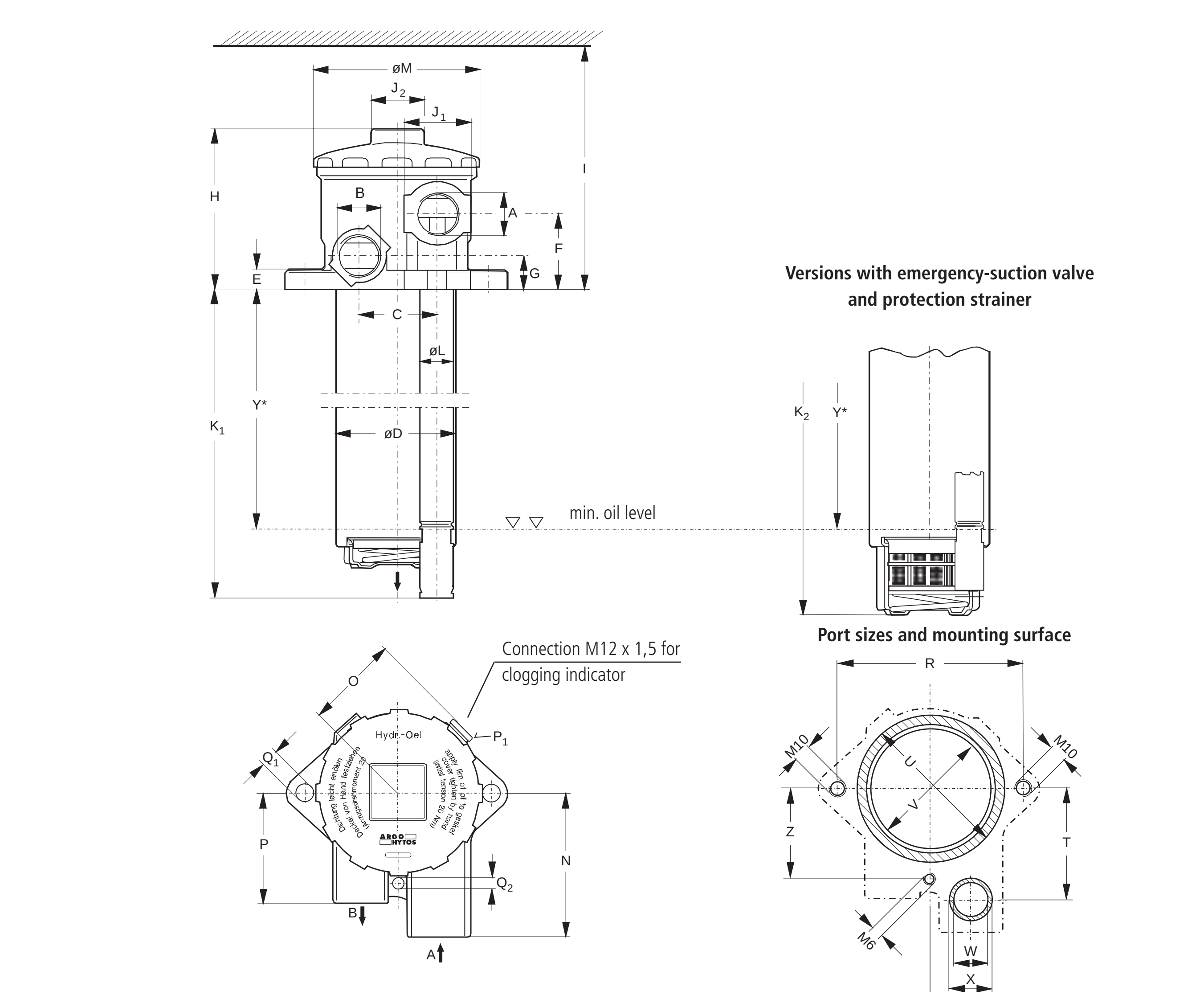
All filters are delivered with a plugged clogging indicator connection M12 x 1,5 (connection P_1).
As clogging indicators either manometers or electrical pressure switches can be used.

For the appropriate clogging indicators see catalogue sheet 60.20.

Remarks:
- The start of the red area respectively the switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the pressure relief valve (see Selection Chart, column 9).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. If modifications are required, e.g. for horizontal assembly or with integrated suction valve integrated into the pressure relief valve (see section symbols, symbol no. 5) to guarantee the emergency steering feature for vehicles with official road use, we kindly ask for your request.
- For deaeration a bleed screw (for connection P_1) with Part No. SV 0112.15 is available.

[1] Cracking pressure of check valve
[2] Cracking pressure of pressure relief valve
[3] With hole Ø 4 mm in the check valve for oil drain when opening the filter cover
[4] With emergency-suction valve and protection strainer (mesh size 125 µm)
[5] Suitable for horizontal assembly

Dimensions



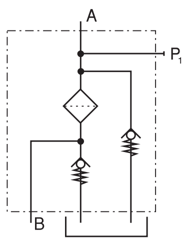
Measurements

Type	A	B	C	D	E	F	G	H	I	J_1	J_2	K_1	K_2	L	M	N	O	P	Q_1	Q_2
E 084	G¾, G1	G¾	48	73,5	12	47	21	102	315	AF 41	AF 32	254	268	20,5	104,5	90	60	69	11	6,6
Type	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y***	**Z**											
E 084	115	25	65	100	79	21	38	224	55											

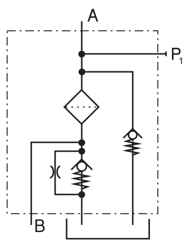
* Oil outlet resp. emergency suction has to be under all operating cond. below min. oil level (given by Y)

Symbols

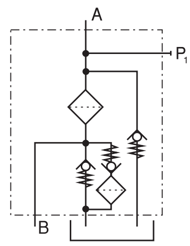
1



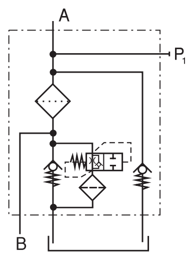
2



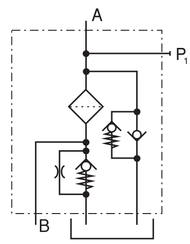
3



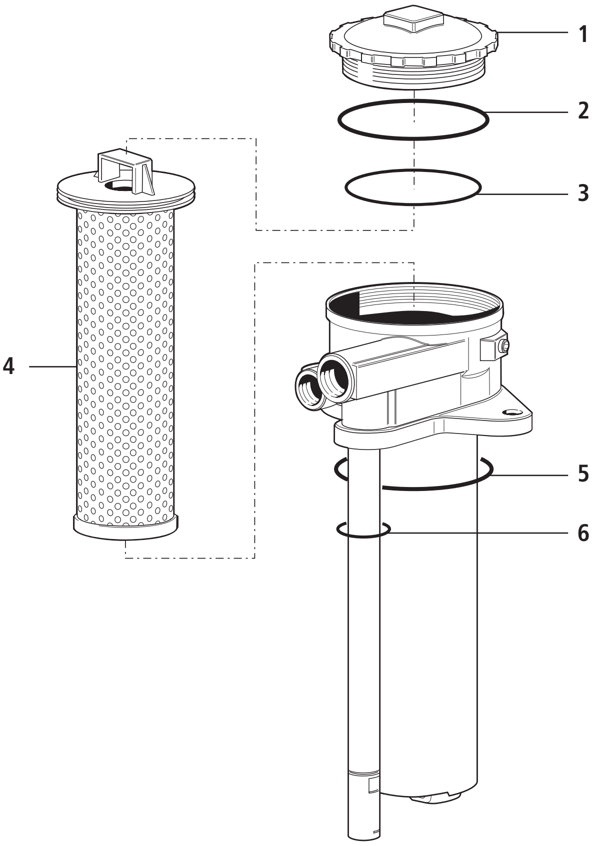
4



5



Spare Parts



Pos.	Designation	Part No.
1	Screw-on cap	E 103.0201
2	Flat gasket	N031.0841
3	O-ring 72 x 3	N007.0723
4	Filter element	see Chart / col. 11
5	O-ring 84 x 4	N007.0844
6	O-ring 23 x 4	N007.0231

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

We produce fluid power solutions
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ARGO HYTOS

Return-Suction Filters

E 158 · E 198 · E 248

- Tank top mounting
- Connection up to G1¼
- Nominal flow rate up to 250 l/min

20.90-7e

Description

Application

For operation in units with hydrostatic drives, when the return flow is under all operating conditions higher than the oil flow of the feed pump.

Performance features

Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

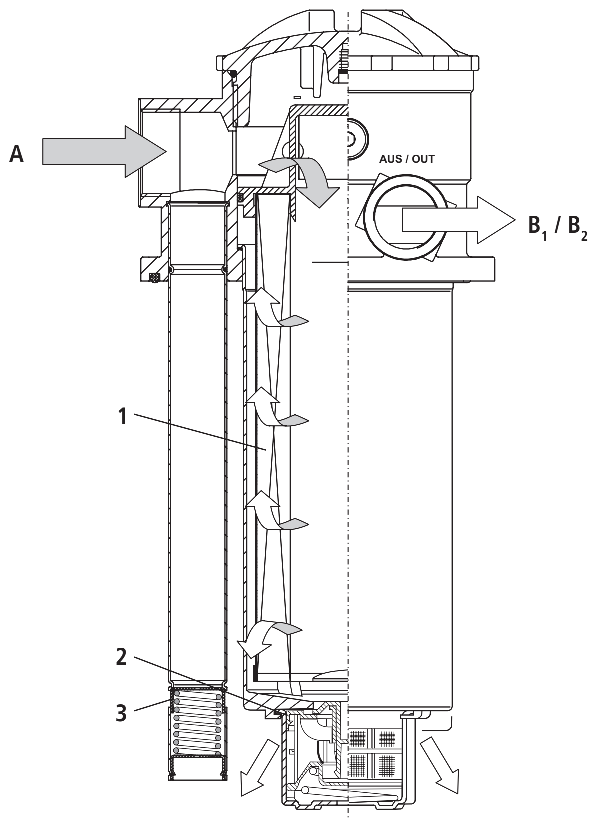
Suction filter function: Because of the 100 %-filtration of the suction flow, no dirt can get into the feed pump.

Return filter function: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remainning in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

Functional characteristics

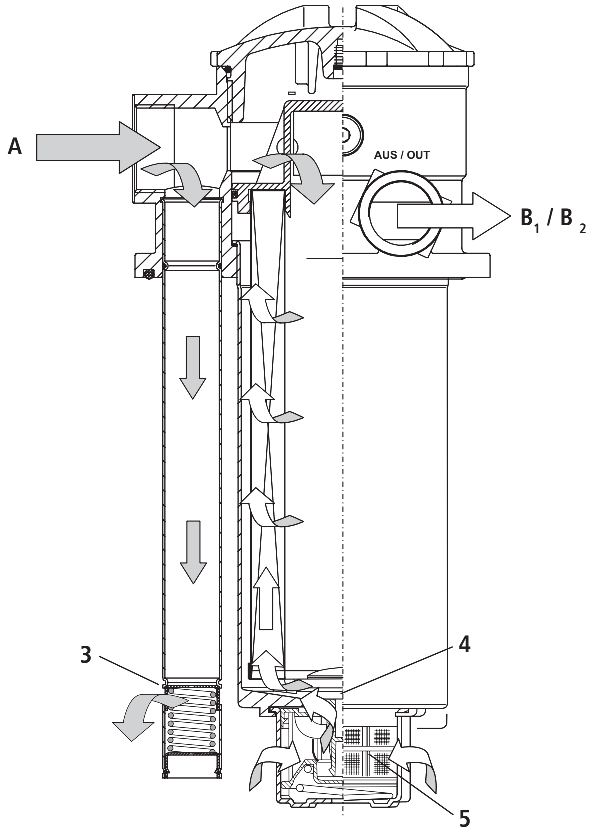
The hydraulic oil returning from the circuit (A) passes the filter element (1), is pressurized by a 0,5 bar check valve (2) and supplied to the feed pump (B). The surplus oil flows filtered over the integral check valve into the reservoir. As the feed pump is always fed with pressurized oil, the risk of cavitation is minimized and full performance is available even during the critical cold start phase.
An integral pressure relief valve (3) prevents too high back pressure and protects the shaft seals against damages. As this valve leads the oil directly into the tank there is no direct connection between the return line (A) and the connection of the feed pump (B) (no bypass valve function).

Function (schematic):



The emergency-suction valve (4) with 125 µm protection strainer (5) supplies the feed pump in case of a short term of lack of oil.
During normal operation, a lack of oil may definitely not occur (refer to „Design" section).

Emergency-suction (schematic):



Start up / Deaeration

For units with emergency-suction valve and protection strainer the start up set E 198.1710 can be used to de-aerate the hydraulic system at first start up or at start up after repair; hereby the immediate supply of the feed pump with hydraulic oil is guaranteed.
For all other types, deaerating instructions published by the manufacturers of hydraulic drives must be observed.

Filter maintenance

By using a clogging indicator the correct moment for maintenance is indicated and guarantees therefore the optimum utilization of the filter elements.

Filter elements

Flow direction from centre to the outside. The star-shaped pleating of the filter material results in:

- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Dirt deposits are entirely removed when the element is changed and cannot re-enter the tank.

Accessories

Electrical and optical clogging indicators are available. Dimensions and technical data see catalogue sheet 60.20.

Layout

General

In machines with a hydrostatic drive and combined working hydraulic system, return-suction filters replace the suction or pressure filters previously required for the feed pump of the closed-loop hydrostatic drive circuit as well as the return filter for the open-loop working hydraulic circuit.
While each circuit operates independently with separate filters, the combination of the two circuits via the return-suction filter causes interaction between the circuits.
If the design criteria described below are taken into account, you can take full advantage of the benefits provided by the return-suction filter concept, thus making sure that your system performs reliably even under extreme operating conditions.

Required return flow in the system

In order to maintain a precharging pressure of approx. 0,5 bar at the intake of the feed pump, the return flow must exceed the suction flow under any operating condition:
Special feature:
- Versions with hole (Ø 4 mm) in the pressurizing valve: at least 20 l/min of excess flow

Permitted feed pump flow rate

- at operating temperature (ν < 60 mm^2/s, rpm=max): feed pump flow rate $\leq$ 0,5 x rated return flow according to column 2 of selection table
- at cold start-up (ν < 1.000 mm^2/s, rpm = 1.000 min^{-1}): feed pump flow rate $\leq$ 0,2 x rated return flow according to column of selection table

Please contact us if your system operates with higher flow rates than stated above.

Flow velocity in the connecting lines

- Flow velocity in the return lines ≤ 4,5 m/s
- Flow velocity in the suction lines ≤ 1,5 m/s

Permitted pressure in the suction lines

At cold start up (ν < 1.000 mm^2/s, rpm = 1.000 min^{-1}):
feed pump flow rate $\leq$ 0,2 x rated return flow. The pressure loss in the suction lines must not exceed 0,4 bar.

Backpressures in system return lines

If drain oil from the hydrostatic drive is routed across the filter in addition to the flow of the open-loop circuit, the following has to be observed in order to protect the shaft seals:
- permitted leakage oil pressure for a given viscosity and speed (manufacturer's specifications!)
- pressure loss caused by the leakage oil pipes
- pressure loss caused by the oil cooler used
- backpressure of the filter for a given flow rate or kinematic viscosity (refer to pressure loss diagrams)

Depending on the application, the use of a cooler bypass valve is recommended.
Generously sized drain oil pipes are also of advantage.

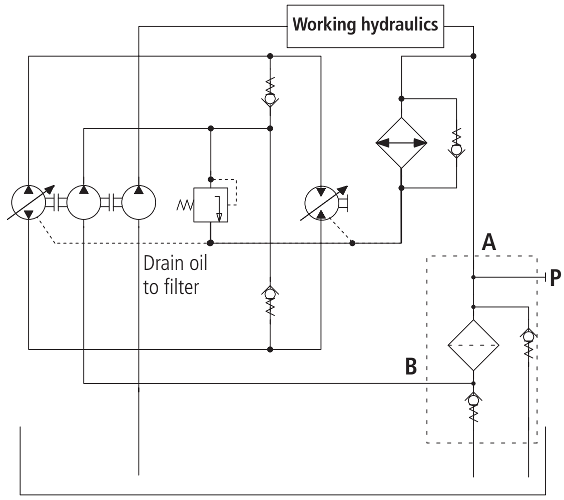
Filter fineness grades

With the filter fineness grades available, the following oil cleanliness according to ISO 4406 can be achieved:
- 10EX2: 18/15/11 ... 14/11/7
- 16EX2: 20/17/12 ... 17/14/10

Even with the 16EX2 filter fineness grade, the requirements specified by manufacturers of hydrostatic drives are sometimes exceeded significantly. If components requiring a still better oil purity are used, we recommend the 10EX2 filter fineness grade.

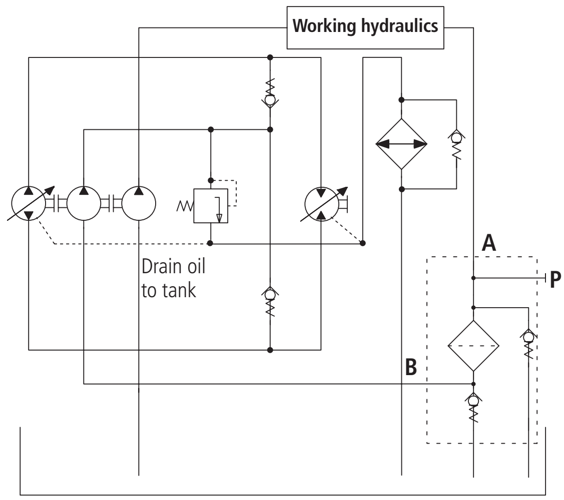
Suggested circuit layouts

A) The leakage oil of the hydrostatic drive is routed across the filter.



The entire dirt produced in the hydrostatic drive by abrasion is filtered out immediately and is thus not taken in by the pump of the open-loop circuit.
This circuit layout is always recommended if the return flow only slightly exceeds the suction flow, i.e. if there is a risk that the 0,5 bar precharging pressure cannot be maintained.

B) The drain oil of the hydrostatic drive is not routed across the filter but is discharged directly into the tank.



This circuit layout has the advantage that drain oil pressures are comparatively low.

Characteristics

Nominal flow rate
Up to 250 l/min in return line (see Selection Chart, column 2)
Up to 125 l/min feed pump flow rate (see Layout)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the return lines ≤ 4,5 m/s
- flow velocity in the suction lines ≤ 1,5 m/s

Connection
Threaded ports according to ISO 228 or DIN 13. Sizes see Selection Chart, column 6 and 7
(other port threads on request)

Filter fineness
10 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-service 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.000$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

Materials

Screw-on cap:	Polyester, GF reinforced
Filter head:	Aluminium alloy
Filter bowl:	Aluminium alloy
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web

Fitting position
- Standard type no restriction, preferably vertical
- Models with emergency-suction valve can vary up to 15° from the vertical
- Models with hole Ø 4 mm in the check valve can vary up to 45° from the vertical

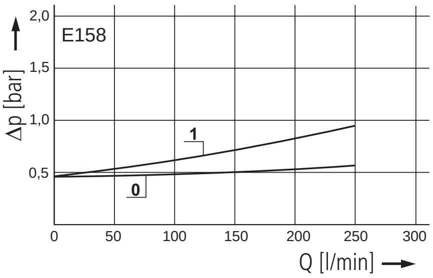
Even under unfavourable operating conditions (min. oil level, max. sloping) the oil outlet resp. emergency suction has to be below the oil level.
Special designs are available for horizontal assembly.

Diagrams

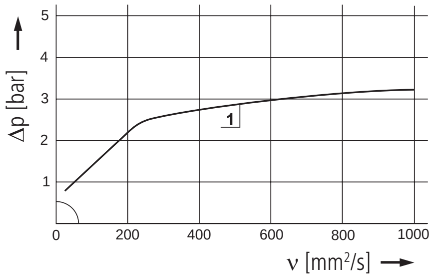
Δp-curves for complete filters in Selection Chart, column 3
(50 % of the nominal flow volume via connection B)

D1

Pressure drop as a function of the **flow volume**
at $\nu = 35$ mm²/s (0 = casing empty with hole Ø 4 mm)

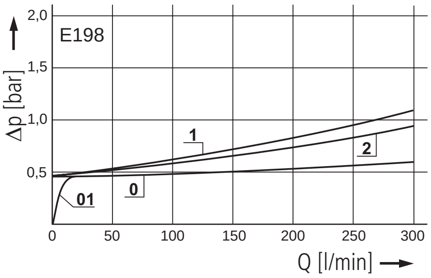


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

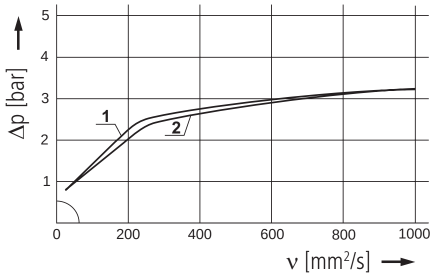


D2

Pressure drop as a function of the **flow volume**
at $\nu = 35$ mm²/s (00/01 = casing empty without/with hole Ø 4 mm)

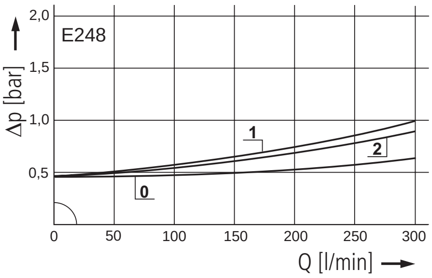


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

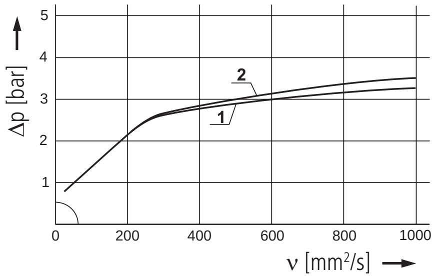


D3

Pressure drop as a function of the **flow volume**
at $\nu = 35$ mm²/s (0 = casing empty with hole Ø 4 mm)



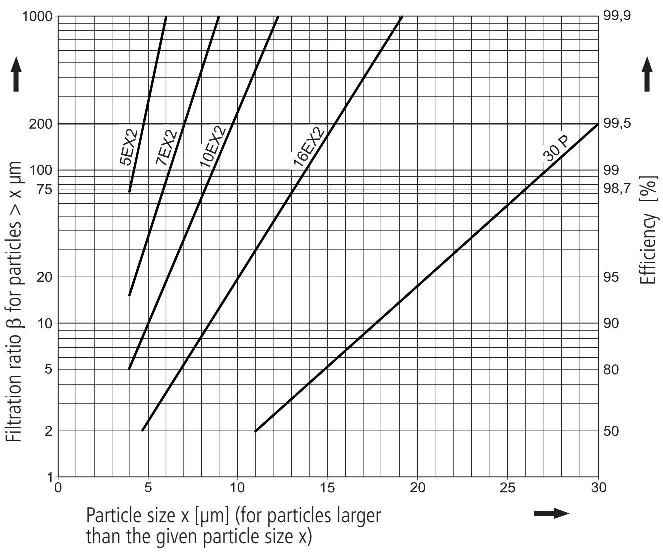
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal return flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A	Connections B_1/B_2	Cracking pressure of CV[1]	Cracking pressure of PRV[2]	Symbol	Suction valve	Replacement filter element Part No.	Weight	Remarks
	l/min			g			bar	bar				kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
E 158-168	180	**D1**/1	16EX2	53	G1¼	G1	0,5	2,5	4		V3.0924-08	3,0	3 + 4
E 198-156	180	**D2**/1	10EX2	73	G1¼	G1	0,5	2,5	1		V3.0934-06	3,7	-
E 198-186	180	**D2**/1	10EX2	73	G1¼	G1	0,5	2,5	4	•	V3.0934-06	3,8	4
E 198-158	200	**D2**/2	16EX2	73	G1¼	G1	0,5	2,5	1		V3.0934-08	3,7	-
E 198-168	200	**D2**/2	16EX2	73	G1¼	G1	0,5	2,5	2		V3.0934-08	3,7	3
E 198-188	200	**D2**/2	16EX2	73	G1¼	G1	0,5	2,5	4	•	V3.0934-08	3,8	4
E 198-468	200	**D2**/2	16EX2	73	G1¼	G1	0,5	2,5	3	•	V3.0934-08	3,8	4 + 5
E 248-156	190	**D3**/1	10EX2	89	G1¼	G1	0,5	2,5	4	•	V3.0941-06	4,3	4
E 248-158	250	**D3**/2	16EX2	90	G1¼	G1	0,5	2,5	4	•	V3.0941-08	4,3	4
E 248-258	250	**D3**/2	16EX2	90	G1¼	G1	0,5	2,5	1		V3.0941-08	4,2	-

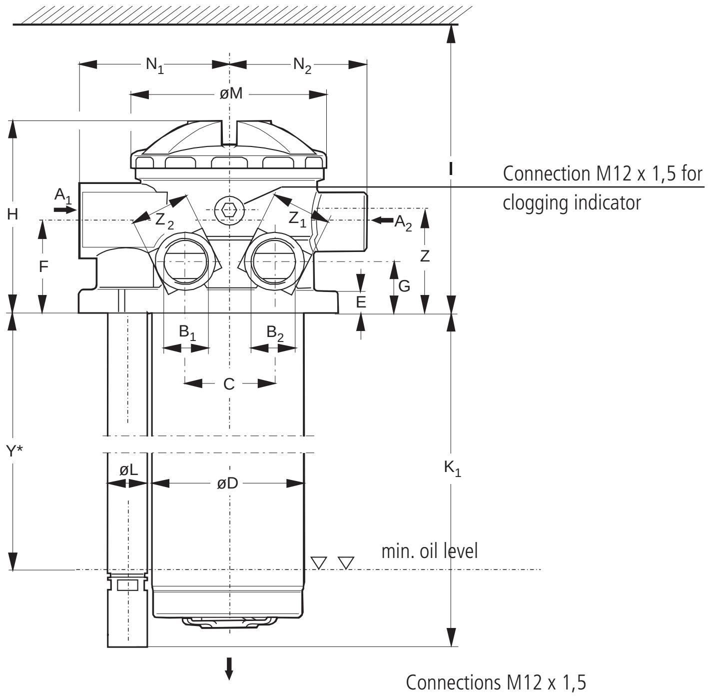
All filters are delivered with three plugged clogging indicator connections M12 x 1,5. As clogging indicators on the return side (P_1) either manometers or electrical pressure switches can be used. The monitoring of the vacuum on the suction side (P_2) is additionally possible.
A second return port A_2 can be opened on request.

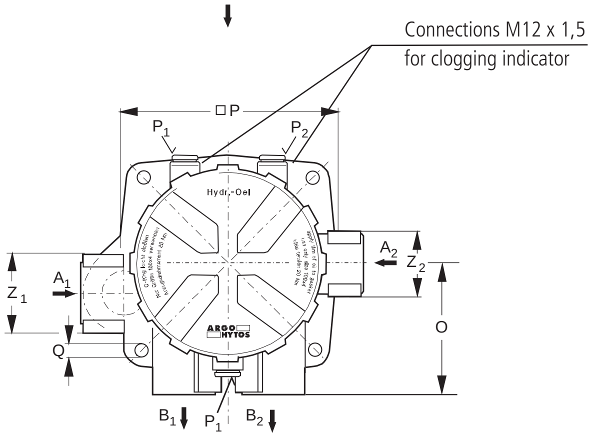
For the appropriate clogging indicators see catalogue sheet 60.20.

Remarks:
- The start of the red area respectively the switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the pressure relief valve (see Selection Chart, column 9).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. If modifications are required, e.g. with integrated suction valve (integrated into the pressure relief valve) to guarantee the emergency steering feature for vehicles with official road use, we kindly ask for your request.
- For deaeration a bleed screw (for connection P_1) with Part No. SV 0112.15 is available.

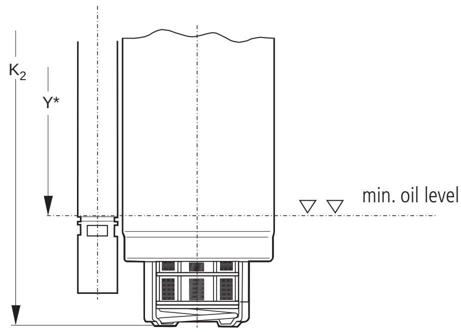
[1] Cracking pressure of check valve
[2] Cracking pressure of pressure relief valve
[3] With hole Ø 4 mm in the check valve for oil drain when opening the filter cover
[4] With emergency-suction valve and protection strainer (mesh size 125 µm)
[5] Suitable for horizontal assembly

Dimensions

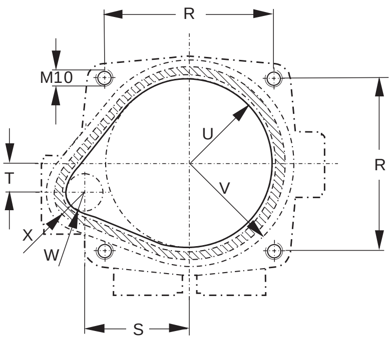




Versions with emergency-suction valve and protection strainer



Port sizes and mounting surface



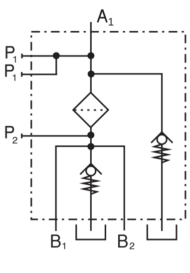
Measurements

Type	A_1	A_2	$B_{1/2}$	C	D	E	F	G	H	I	K_1	K_2	L	M	N_1	N_2	O	P	Q	R
E 158	G1¼	–	G1	56	100	11,5	61,5	30,5	130	430	238	250	28,5	126,5	97	81,5	85,5	141	11	116,5
E 198	G1¼	–	G1	56	100	11,5	61,5	30,5	130	530	338	354	28,5	126,5	97	81,5	85,5	141	11	116,5
E 248	G1¼	–	G1	56	100	11,5	61,5	30,5	130	600	404	417	28,5	126,5	97	81,5	85,5	141	11	116,5
Type	**S**	**T**	**U**	**V**	**W**	**X**	**Y***	**Z**	**Z_1**	**Z_2**										
E 158	68	19,5	51	64	14,5	27	185	68	AF 55	AF 41										
E 198	68	19,5	51	64	14,5	27	285	68	AF 55	AF 41										
E 248	68	19,5	51	64	14,5	27	350	68	AF 55	AF 41										

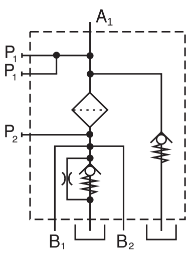
* Oil outlet resp. emergency suction has to be under all operating cond. below min. oil level (given by Y)

Symbols

1



2



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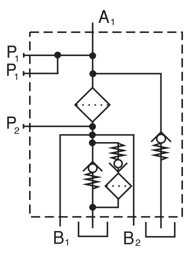
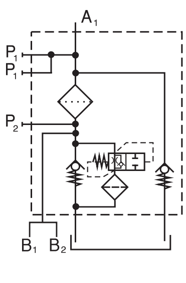
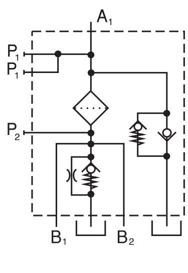


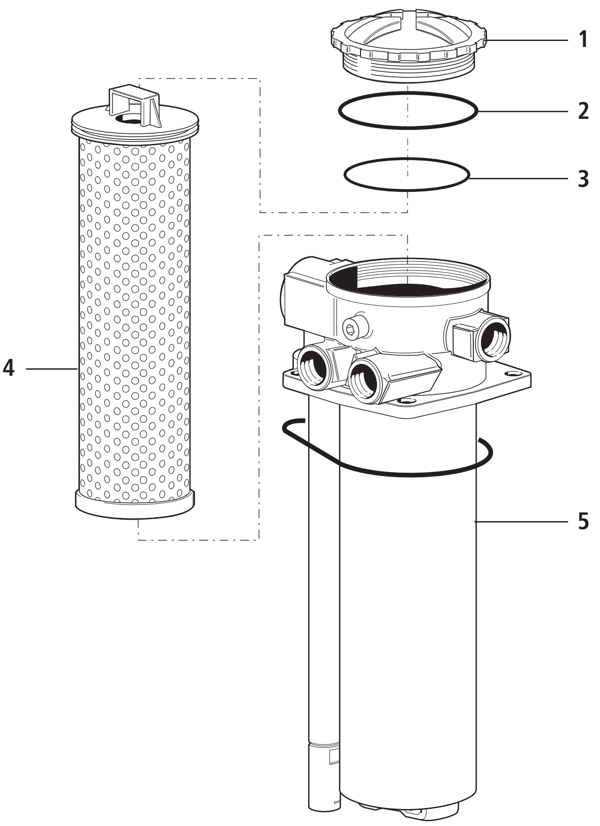
4



5



Spare Parts



Pos.	Designation	Part No.
1	Screw-on cap	ES 074.0206
2	O-ring 100 x 4	N007.1004
3	O-ring 98 x 3	N007.0983
4	Filter element	see Chart / col. 11
5	O-ring 124 x 4,5	N007.1245

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

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ISO 2941 Verification of collapse/burst pressure rating
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ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

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ARGO HYTOS

Return-Suction Filters

E 328 · E 498

- Tank top mounting
- Connection up to G1½ and SAE 2
- Nominal flow rate up to 600 l/min

20.95-4e

Description

Application
For operation in units with hydrostatic drives, when the return flow is under all operating conditions higher than the oil flow of the feed pump.

Performance features

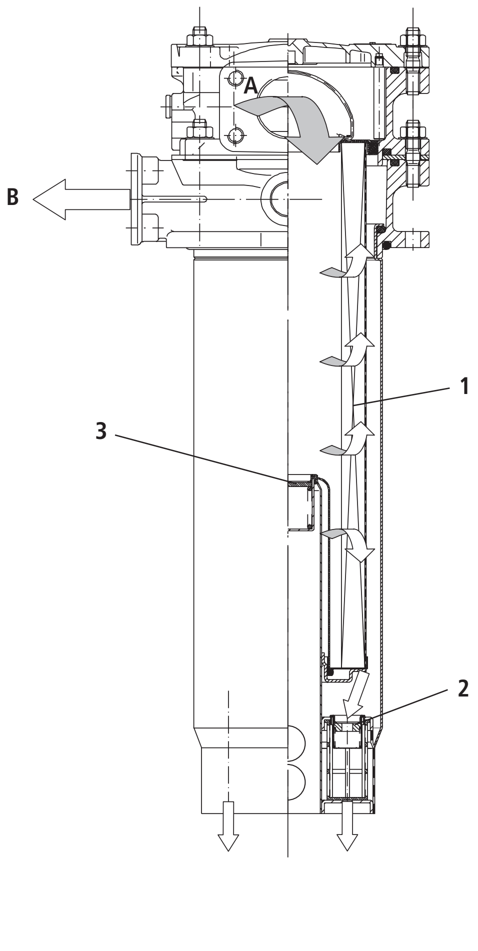
Protection against wear: By means of filter elements that, in fullflow filtration, meet even the highest demands regarding cleanliness classes.

Suction filter function: Because of the 100 %-filtration of the suction flow, no dirt can get into the feed pump.

Return filter function: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

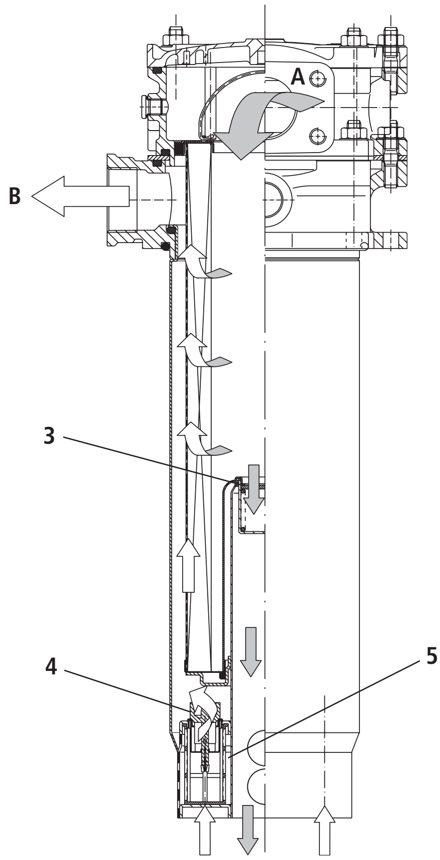
Functional characteristics
The hydraulic oil returning from the circuit (A) passes the filter element (1), is pressurized by three 0,5 bar check valves (2) and supplied to the feed pump (B). The surplus oil flows filtered over the integral check valve into the reservoir.
As the feed pump is always fed with pressurized oil, the risk of cavitation is minimized and full performance is available even during the critical cold start phase.
An integral pressure relief valve (3) prevents too high back pressure and protects the shaft seals against damages. As this valve leads the oil directly into the tank there is no direct connection between the return line (A) and the connection of the feed pump (B) (no bypass valve function).

Function (schematic):



Two emergency-suction valves (4) with 300 µm protection strainer (5) supply the feed pump in case of a short term of lack of oil.
During normal operation, a lack of oil may definitely not occur (refer to „Design" section).

Emergency-suction (schematic):



Start up / Deaeration
For units with emergency-suction valve and protection strainer the start up set E 328.1700 can be used to de-aerate the hydraulic system at first start up or at start up after repair; hereby the immediate supply of the feed pump with hydraulic oil is guaranteed.
For all other types, deaerating instructions published by the manufacturers of hydraulic drives must be observed.

Filter maintenance
By using a clogging indicator the correct moment for maintenance is indicated and guarantees therefore the optimum utilization of the filter elements.

Filter elements
Flow direction from centre to the outside. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Accessories
Electrical and optical clogging indicators are available.
Dimensions and technical data see catalogue sheet 60.20.

Layout

General

In machines with a hydrostatic drive and combined working hydraulic system, return-suction filters replace the suction or pressure filters previously required for the feed pump of the closed-loop hydrostatic drive circuit as well as the return filter for the open-loop working hydraulic circuit.
While each circuit operates independently with separate filters, the combination of the two circuits via the return-suction filter causes interaction between the circuits. If the design criteria described below are taken into account, you can take full advantage of the benefits provided by the return-suction filter concept, thus making sure that your system performs reliably even under extreme operating conditions.

Required return flow in the system

In order to maintain a precharging pressure of approx. 0,5 bar at the intake of the feed pump, the return flow
must exceed the suction flow under any operating conditions:

- Versions with hole (Ø 8 mm) in the pressurizing valve:
  at least 30 l/min of excess flow

Permitted feed pump flow rate

- at operating temperature (ν < 60 mm²/s, rpm = max):
  feed pump flow rate < 0,5 x rated return flow according to column 2 of selection table
- at cold start-up (ν < 1.000 mm²/s, rpm=1.000 min^{-1}):
  feed pump flow rate < 0,2 x rated return flow according to column 2 of selection table

Please contact us if your system operates with higher flow rates than stated above.

Flow velocity in the connecting lines

- Flow velocity in the return lines ≤ 4,5 m/s
- Flow velocity in the suction lines ≤ 1,5 m/s

Permitted pressure in the suction lines

At cold start up (ν < 1.000 mm²/s, rpm = 1.000 min^{-1}):
feed pump flow rate ≤ 0,2 x rated return flow. The pressure loss in the suction lines must not exceed 0,4 bar.

Backpressures in system return lines

If drain oil from the hydrostatic drive is routed across the filter in addition to the flow of the open-loop circuit, the following has to be observed in order to protect the shaft seals:

- permitted leakage oil pressure for a given viscosity and speed (manufacturer's specifications!)
- pressure loss caused by the leakage oil pipes
- pressure loss caused by the oil cooler used
- backpressure of the filter for a given flow rate or kinematic viscosity (refer to pressure loss diagrams)

Depending on the application, the use of a cooler bypass valve is recommended.
Generously sized drain oil pipes are also of advantage.

Filter fineness grades

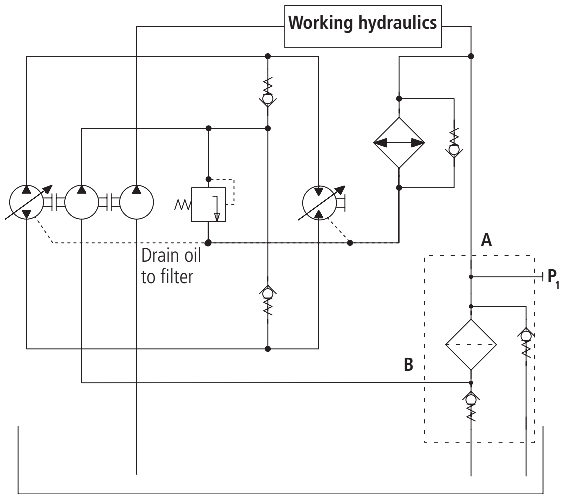
With the filter fineness grades available, the following oil cleanliness according to ISO 4406 can be achieved:

- 10EX2: 18/15/11 ... 14/11/7
- 16EX2: 20/17/12 ... 17/14/10

Even with the 16EX2 filter fineness grade, the requirements
specified by manufacturers of hydrostatic drives are sometimes exceeded significantly.
If components requiring a still better oil purity are used, we recommend the 10EX2 filter fineness grade.

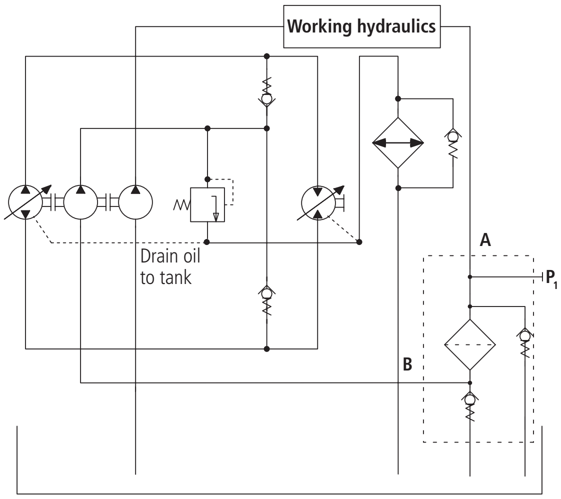
Suggested circuit layouts

A) The leakage oil of the hydrostatic drive is routed across the filter.



The entire dirt produced in the hydrostatic drive by abrasion is filtered out immediately and is thus not taken in by the pump of the open-loop circuit. This circuit layout is always recommended if the return flow only slightly exceeds the suction flow, i.e. if there is a risk that the 0,5 bar precharging pressure cannot be maintained.

B) The drain oil of the hydrostatic drive is not routed across the filter but is discharged directly into the tank.



This circuit layout has the advantage that drain oil pressures are comparatively low.

Characteristics

Nominal flow rate
Up to 600 l/min in return line (see Selection Chart, column 2)
Up to 300 l/min feed pump flow rate (see Layout)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the return lines ≤ 4,5 m/s
- flow velocity in the suction lines ≤ 1,5 m/s

Connection
Threaded ports according to ISO 228 or DIN 13 and SAE flange (3000 psi). Sizes see Selection Chart, column 6 (other port threads on request). Please consider the connection size regarding max. flow volumes.

Filter fineness
10 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

Materials

Screw-on cap:	Aluminium alloy
Filter head:	Aluminium alloy
Filter bowl:	Steel
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web

Fitting position
Up to 15° from the vertical, preferably vertical

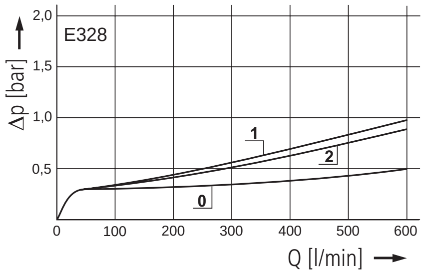
Even under unfavourable operating conditions (min. oil level, max. sloping) the oil outlet resp. emergency suction has to be below the oil level.

Diagrams

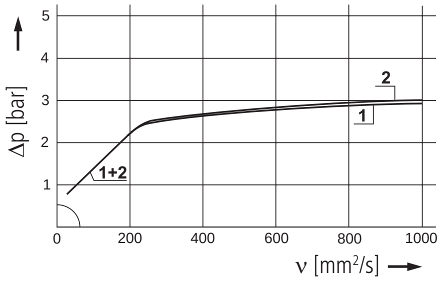
Δp-curves for complete filters in Selection Chart, column 3
(50 % of the nominal flow volume via connection B)

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)

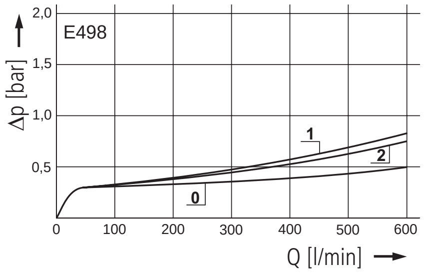


Pressure drop as a function of the **kinematic viscosity** at nominal flow

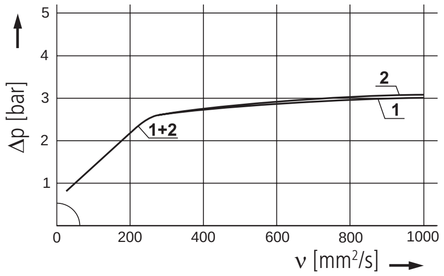


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0=casing empty)



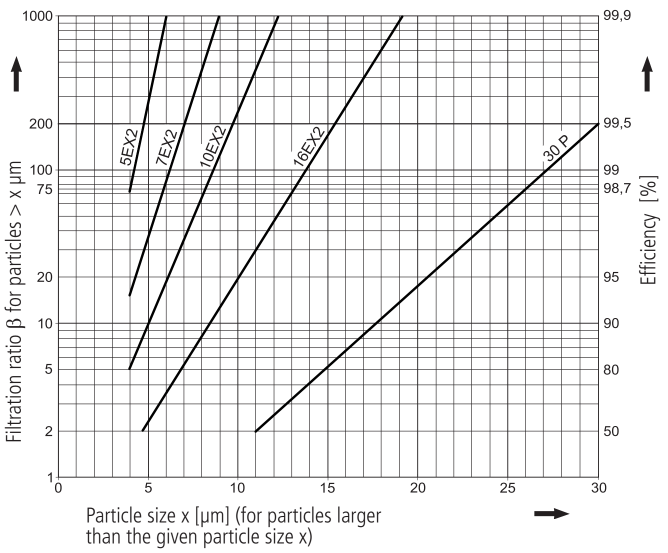
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite propable.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal return flow rate[1]	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connections A/B SAE (3.000 psi)	Cracking pressure of CV[2]	Cracking pressure of PRV[3]	Symbol	Suction valve	Replacement filter element Part No.	Weight	Remarks
	l/min			g		bar	bar				kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
E 328-156	360	**D1**/1	10EX2	140	G1½ / SAE2 + G1	0,5	2,5	1	•	V5.1240-06	8,6	4 + 5
E 328-158	470	**D1**/2	16EX2	140	G1½ / SAE2 + G1	0,5	2,5	1	•	V5.1240-07	8,6	4 + 5
E 498-156	480	**D2**/1	10EX2	200	G1½ / SAE2 + G1	0,5	2,5	1	•	V5.1260-06	10,4	4 + 5
E 498-158	600	**D2**/2	16EX2	200	G1½ / SAE2 + G1	0,5	2,5	1	•	V5.1260-07	10,4	4 + 5

All filters are delivered with plugged clogging indicator connections M12 x 1,5.
As clogging indicators on the return side (P_1) either manometers or electrical pressure switches can be used.
The monitoring of the vacuum on the suction side (P_2) is additionally possible.

Order example: The filter E 328-156 has to be supplied with 2 x 4 connections (A_1 ... A_4, B_1 ... B_4).

Order description: **E 328- 256**

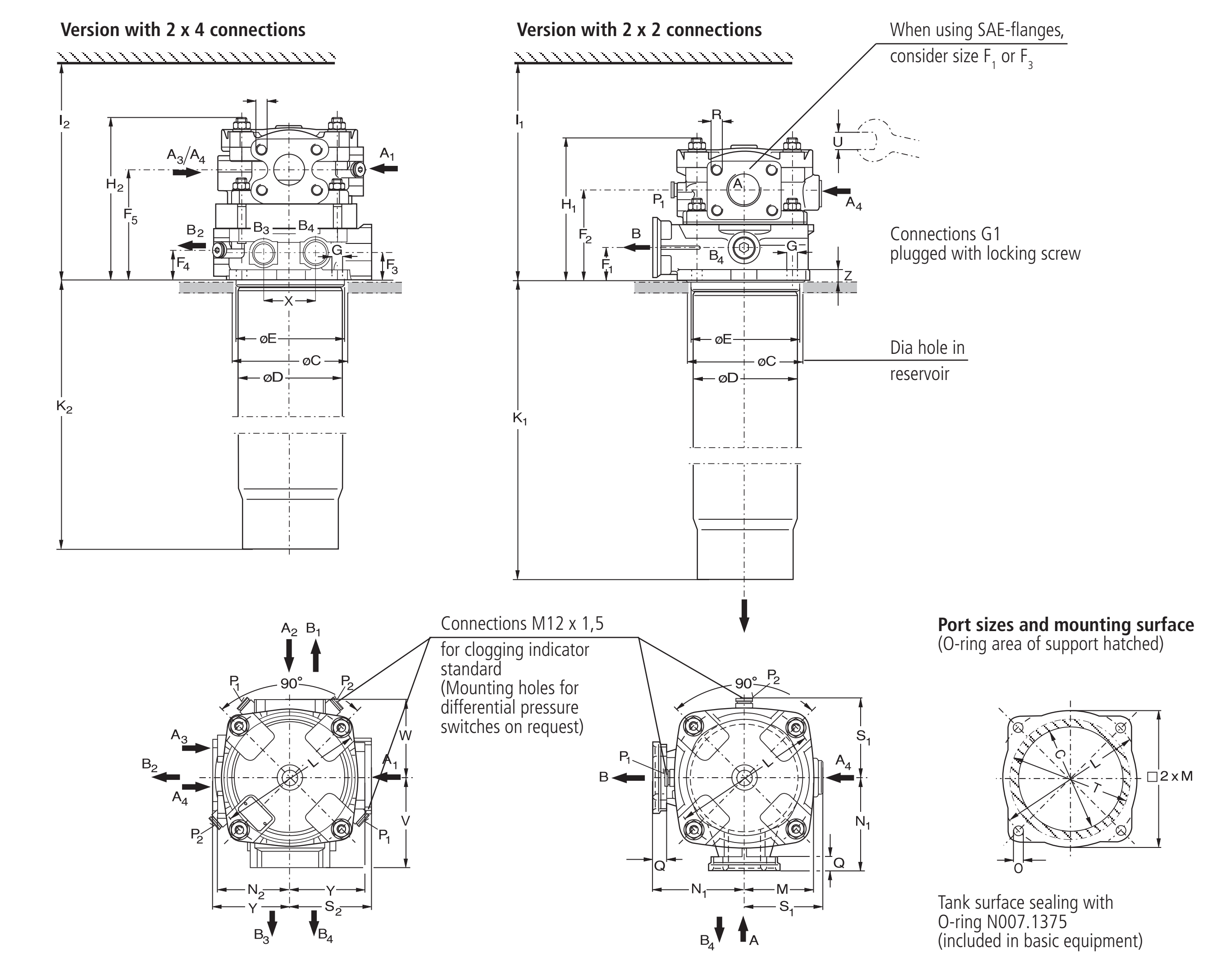
Connections:
2 various options are available:
2 x 2 connections (A and A_4, B and B_4) - G1½ / SAE 2 + G1 (with locking screw) — 1
2 x 4 connections (A_1 ... A_4, B_1 ... B_4) - 2 x G1¼ / SAE 1½, G¾ + G1 — 2
(SAE 2 on request)

For the appropriate clogging indicator see catalogue sheet 60.20.

Remarks:
- The start of the red area respectively the switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the pressure relief valve (see Selection Chart, column 9).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. If modifications are required, we kindly ask for your request.
- For deaeration a bleed screw (for connecting P_1) with Part No. SV 0112.15 is available.

[1] The individual flow rates must be matched to the connections
[2] Cracking pressure of check valve
[3] Cracking pressure of pressure relief valve
[4] with hole Ø 8 mm in the check valve for oil drain when opening the filter cover
[5] with emergency-suction valves and protection strainers (300 µm)

Dimensions



Measurements

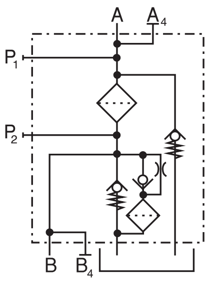
Type	A	B	C	D	E	F_1*	F_2*	F_3*	F_4	F_5	G	H_1	H_2	I_1	I_2
E 328	s. Selection Chart	s. Selection Chart	140,5	138	139,9	36	104,5	32	35	126	11,5	165	185	540	565
E 498	s. Selection Chart	s. Selection Chart	140,5	138	139,9	36	104,5	32	35	126	11,5	165	185	750	780

Type	K_1	K_2	L	M	N_1	N_2	O	Q	R	S_1	S_2	T	U	V	W	X	Y	Z
E 328	425	403	185	86,5	116	89	M10	18	M12	99	109	160	17	106	102	70	98	12
E 498	630	605	185	86,5	116	89	M10	18	M12	99	109	160	17	106	102	70	98	12

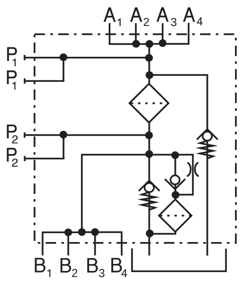
*For use of SAE-flanges see this measurement

Symbols

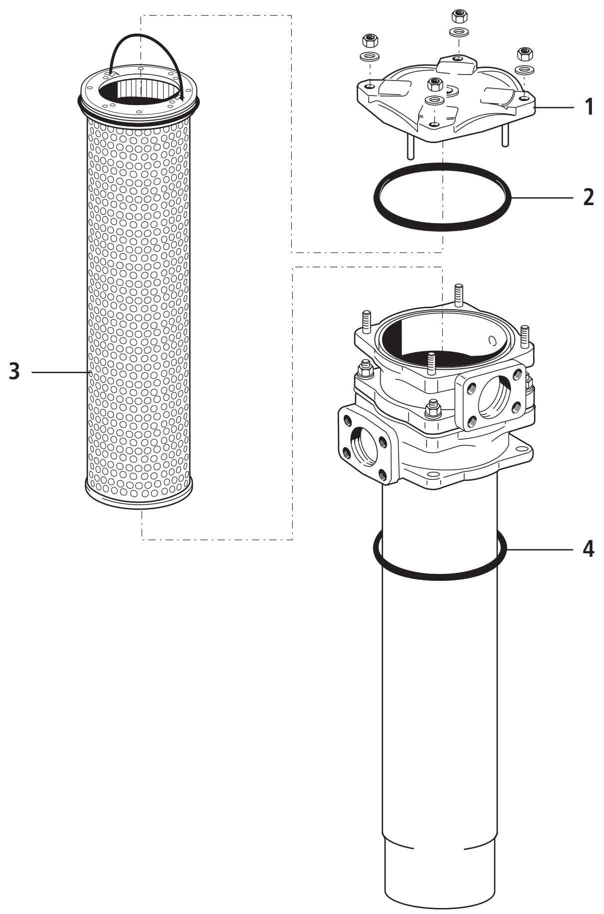
1



2



Spare Parts



Pos.	Designation	Part No.
1	Cover	E 443.1225
2	O-ring 151,76 x 5,33	N007.1525
3	Filter element	see Chart / col. 10
4	O-ring 136,5 x 5,34	N007.1375

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ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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ARGO HYTOS

Return-Suction Filters

E 598 · E 998

- Tank top mounting
- Connection up to G1½ and SAE 2½
- Nominal flow rate up to 850 l/min

20.98-2e

Description

Application
For operation in units with hydrostatic drives, when the return flow is <u>under all operating conditions</u> higher than the oil flow of the boost pump.

Performance features

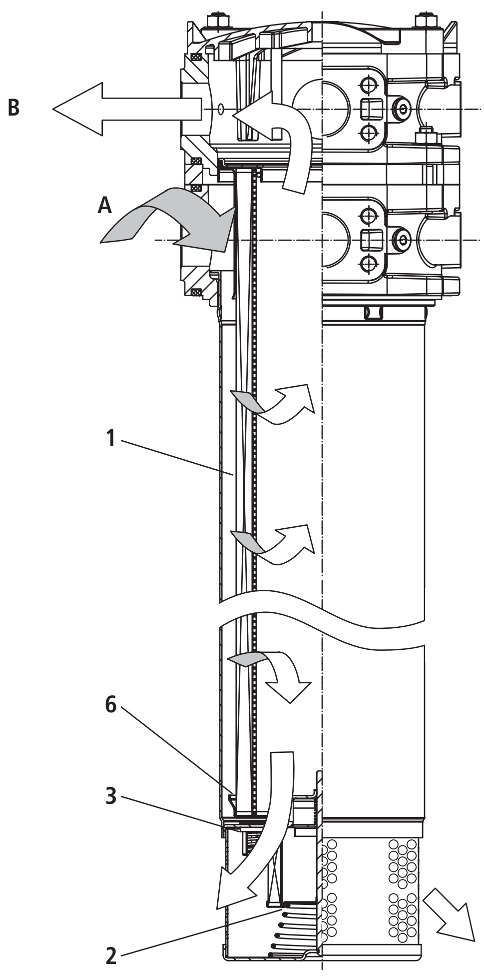
Protection against wear: By means of filter elements that, in fullflow filtration, meet even the highest demands regarding cleanliness classes.

Suction filter function: Because of the 100 %-filtration of the suction flow, no dirt can get into the boost pump.

Return filter function: By means of full-flow filtration in the system return, the pumps above all are protected from dirt particles remaining in the system after assembly, repairs, or which are generated by wear or enter the system from outside.

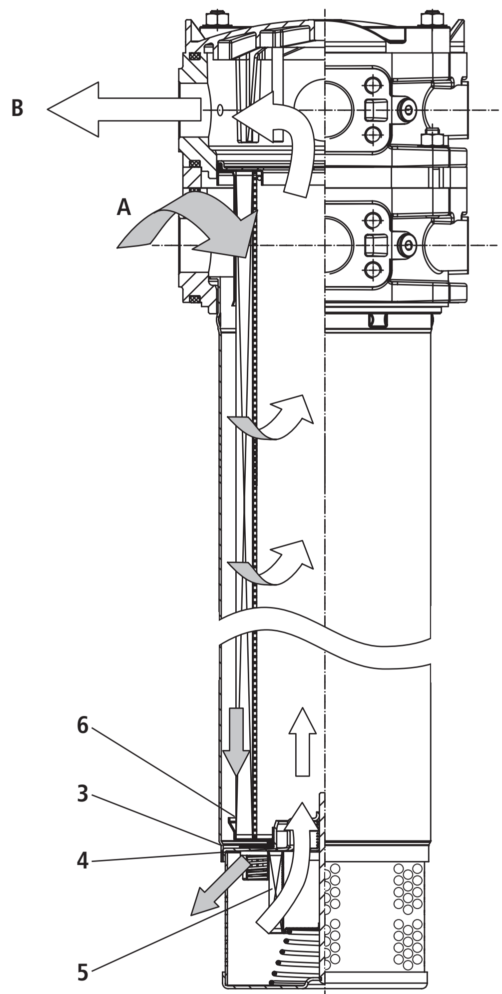
Functional characteristics
The hydraulic oil returning from the circuit (A) passes the filter element (1), is pressurized by a 0,5 bar check valve (2) and supplied to the boost pump (B). The surplus oil flows filtered over the integral check valve into the reservoir.
As the boost pump is always fed with pressurized oil, the risk of cavitation is minimized and full performance is available even during the critical cold start phase.
Six integral pressure relief valves (3) prevent too high back pressure and protects the shaft seals against damages. As this valves lead the oil directly into the tank there is no direct connection between the return line (A) and the connection of the boost pump (B) (no bypass valve function).

Function (schematic):



The emergency-suction valve (4) with 200 µm protection strainer (5) supplies the boost pump in case of a short term of lack of oil.
<u>During normal operation, a lack of oil may definitely not occur</u> (refer to „Design“ section).

Emergency-suction (schematic):



Start up / Deaeration
At first start up or at start up after repair, deaerating instructions published by the manufacturers of hydraulic drives must be observed.

Filter maintenance
By using a clogging indicator the correct moment for maintenance is indicated and guarantees therefore the optimum utilization of the filter elements.

Filter elements
Flow direction from outside to the centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

The dirt collection bowl (6) prevents dirt particles accumulated at the filter element from entering into the tank during maintenance.

Accessories
Electrical and optical clogging indicators are available.
Dimensions and technical data see catalogue sheet 60.20.

Layout

General
In machines with a hydrostatic drive and combined working hydraulic system, return-suction filters replace the suction or pressure filters previously required for the feed pump of the closed-loop hydrostatic drive circuit as well as the return filter for the open-loop working hydraulic circuit.
While each circuit operates independently with separate filters, the combination of the two circuits via the return-suction filter causes interaction between the circuits. If the design criteria described below are taken into account, you can take full advantage of the benefits provided by the return-suction filter concept, thus making sure that your system performs reliably even under extreme operating conditions.

Required return flow in the system
In order to maintain a precharging pressure of approx. 0,5 bar at the intake of the feed pump, the return flow must exceed the suction flow under any operating conditions:
- Versions with hole (Ø 8 mm) in the pressurizing valve: at least 30 l/min of excess flow

Permitted feed pump flow rate
- at operating temperature ($\nu < 60$ mm^2/s, rpm = max): feed pump flow rate < 0,5 x rated return flow according to column 2 of selection table
- at cold start-up ($\nu < 1.000$ mm^2/s, rpm = 1.000 min^{-1}): feed pump flow rate < 0,2 x rated return flow according to column 2 of selection table

Please contact us if your system operates with higher flow rates than stated above.

Flow velocity in the connecting lines
- Flow velocity in the return lines ≤ 4,5 m/s
- Flow velocity in the suction lines ≤ 1,5 m/s

Permitted pressure in the suction lines
At cold start up ($\nu < 1.000$ mm^2/s, rpm = 1.000 min^{-1}):
feed pump flow rate ≤ 0,2 x rated return flow. The pressure loss in the suction lines must not exceed 0,4 bar.

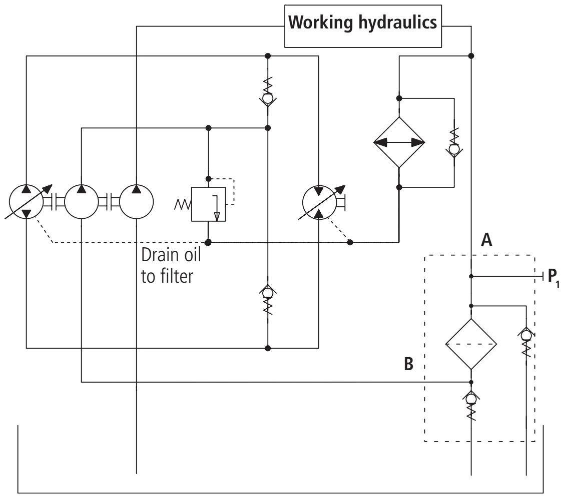
Backpressures in system return lines
If drain oil from the hydrostatic drive is routed across the filter in addition to the flow of the open-loop circuit, the following has to be observed in order to protect the shaft seals:
- permitted leakage oil pressure for a given viscosity and speed (manufacturer's specifications!)
- pressure loss caused by the leakage oil pipes
- pressure loss caused by the oil cooler used
- backpressure of the filter for a given flow rate or kinematic viscosity (refer to pressure loss diagrams)

Depending on the application, the use of a cooler bypass valve is recommended.
Generously sized drain oil pipes are also of advantage.

Filter fineness grades
With the filter fineness grades available, the following oil cleanliness according to ISO 4406 can be achieved:
- 10EX2: 18/15/11 ... 14/11/7
- 16EX2: 20/17/12 ... 17/14/10

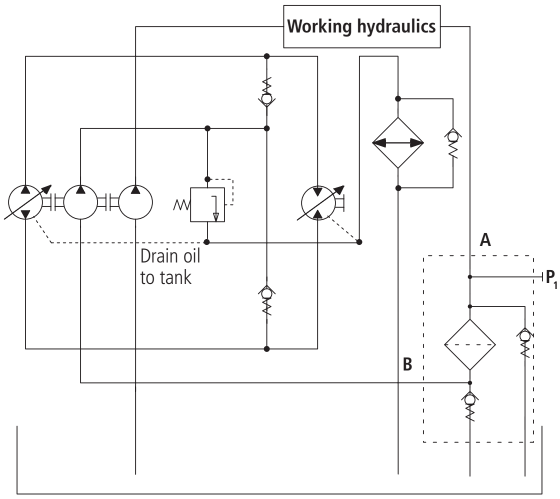
Even with the 16EX2 filter fineness grade, the requirements specified by manufacturers of hydrostatic drives are sometimes exceeded significantly. If components requiring a still better oil purity are used, we recommend the 10EX2 filter fineness grade.

Suggested circuit layouts
A) The leakage oil of the hydrostatic drive is routed across the filter.



The entire dirt produced in the hydrostatic drive by abrasion is filtered out immediately and is thus not taken in by the pump of the open-loop circuit. This circuit layout is always recommended if the return flow only slightly exceeds the suction flow, i.e. if there is a risk that the 0,5 bar precharging pressure cannot be maintained.

B) The drain oil of the hydrostatic drive is not routed across the filter but is discharged directly into the tank.



This circuit layout has the advantage that drain oil pressures are comparatively low.

Characteristics

Nominal flow rate
Up to 850 l/min in return line (see Selection Chart, column 2)
Up to 425 l/min feed pump flow rate (see Layout)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the return lines ≤ 4,5 m/s
- flow velocity in the suction lines ≤ 1,5 m/s

Connection
Threaded ports according to ISO 228 or DIN 13 and SAE flange (3.000 psi). Sizes see Selection Chart, column 6 (other port threads on request). Please consider the connection size regarding max. flow volumes.

Filter fineness
10 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Operating pressure
Max. 10 bar

Materials

Screw-on cap:	Aluminium alloy
Filter head:	Aluminium alloy
Filter bowl:	Steel
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 – inorganic multi-layer microfibre web

Fitting position
Up to 15° from the vertical, preferably vertical

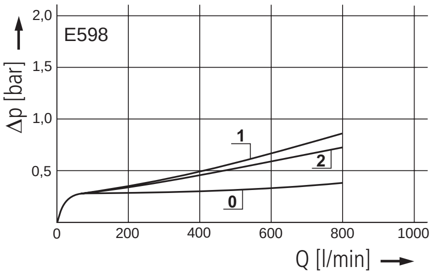
Even under unfavourable operating conditions (min. oil level, max. sloping) the oil outlet resp. emergency suction has to be below the oil level.

Diagrams

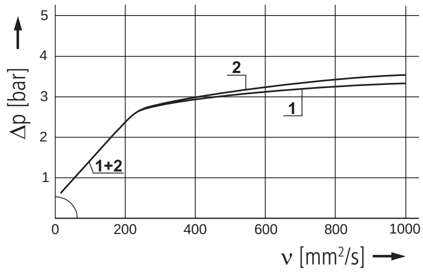
Δp-curves for complete filters in Selection Chart, column 3
(50 % of the nominal flow volume via connection B)

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm^2/s (0 = casing empty)

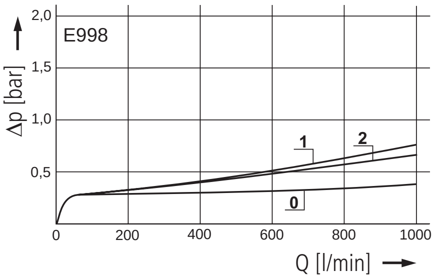


Pressure drop as a function of the **kinematic viscosity** at nominal flow

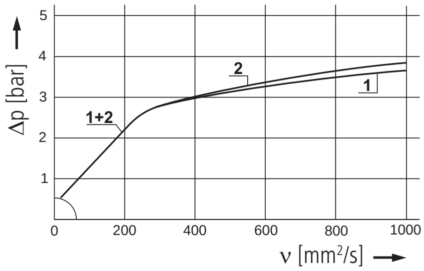


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm^2/s (0 = casing empty)



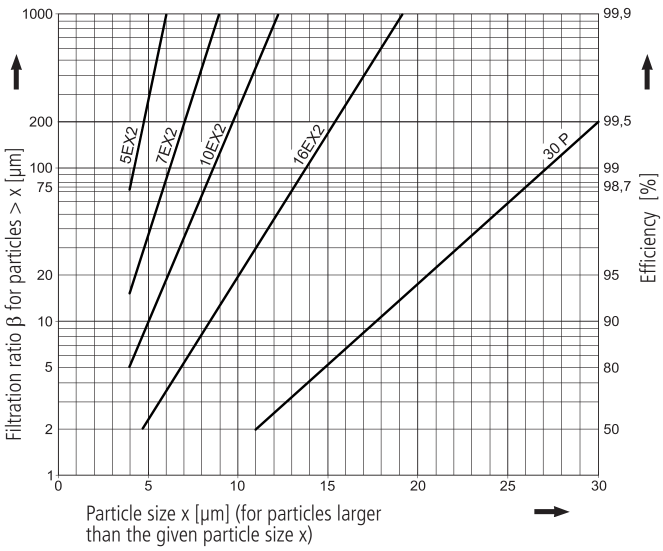
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite propable.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal return flow rate[1]	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connections A/B SAE (3000 psi)	Cracking pressure of CV[2]	Cracking pressure of PRV[3]	Symbol	Suction valve	Replacement filter element Part No.	Weight	Remarks
	l/min			g		bar	bar				kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
E 598-256	470	**D1**/1	10EX2	170	2 + 5 connections	0,5	2,5	1	•	V7.1440-06	11,5	4 + 5
E 598-257	630	**D1**/2	16EX2	180	2 + 5 connections	0,5	2,5	1	•	V7.1440-07	11,5	4 + 5
E 998-256	680	**D2**/1	10EX2	270	2 + 5 connections	0,5	2,5	1	•	V7.1460-06	13,8	4 + 5
E 998-257	850	**D2**/2	16EX2	280	2 + 5 connections	0,5	2,5	1	•	V7.1460-07	13,8	4 + 5

All filters are delivered with plugged clogging indicator connections M12 x 1,5.
As clogging indicators on the return side (P_1) either manometers or electrical pressure switches can be used.
The monitoring of the vacuum on the suction side (P_2) is additionally possible.

Order example: The filter E 598-256 has to be supplied with 5 + 5 connections (A_1 ... A_5, B_1 ... B_5).

Order description: **E 598-556**

Connections:
2 various options are available:

Option	A_1	A_2	A_3	A_4	A_5	B_1	B_2	B_3	B_4	B_5	
2+5 connections	SAE 2½	G1[6]	-	-	-	G1¼ / SAE 1½		G1	G¾	G1½ / SAE 2	2
5+5 connections	G1¼ / SAE 1½		G1	G¾	G1½ / SAE 2	G1¼ / SAE 1½		G1	G¾	G1½ / SAE 2	5

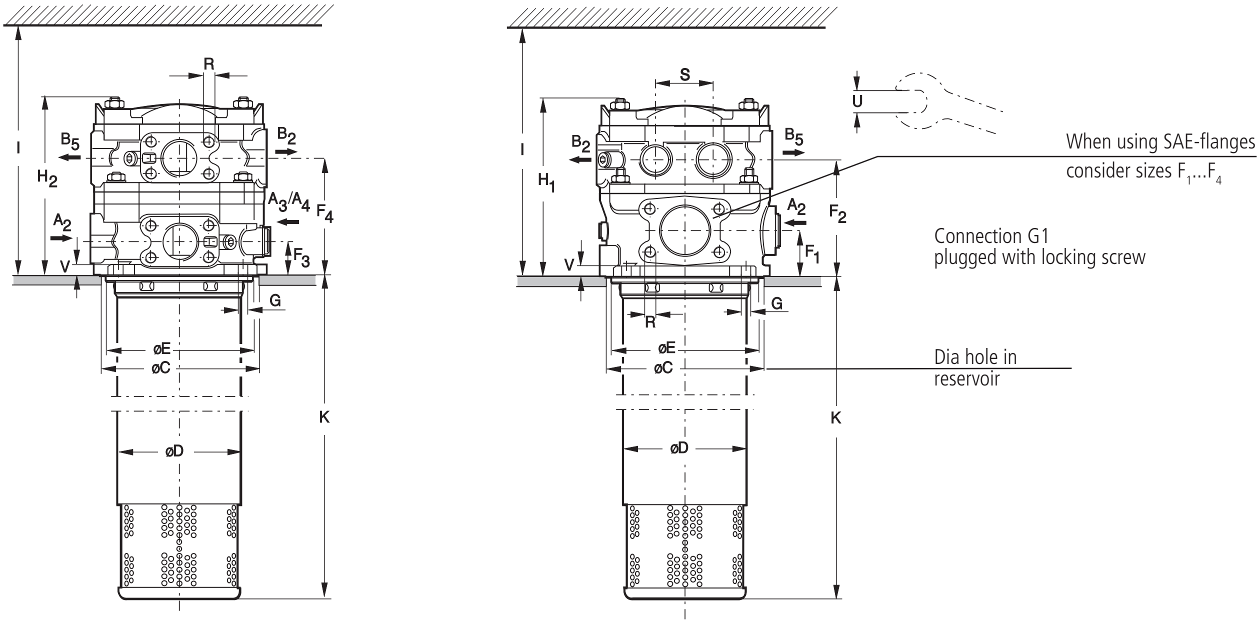
For the appropriate clogging indicator see catalogue sheet 60.20.

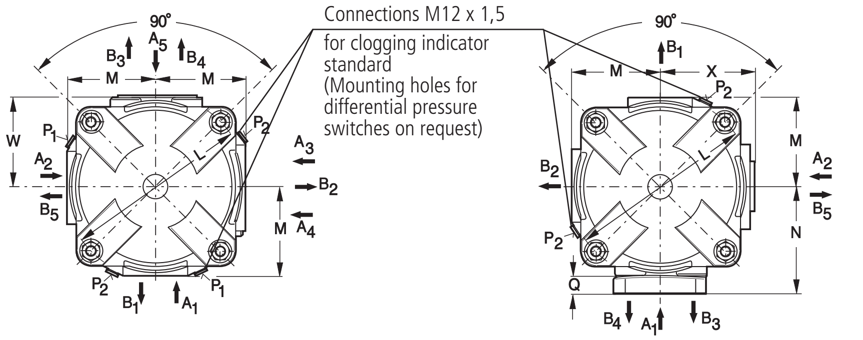
Remarks:
- The start of the red area of the manometer respectively the switching pressure of the electrical pressure switch has always to be lower than the cracking pressure of the pressure relief valve (see Selection Chart, column 8).
- Clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. If modifications are required, we kindly ask for your request.
- For deaeration a bleed valve (for connection P_1) with Part No. SV 0112.15 is available.

[1] The individual flow rates must be matched to the connections
[2] Cracking pressure of check valve
[3] Cracking pressure of pressure relief valves
[4] with hole Ø 8 mm in the check valve for oil drain when opening the filter cover
[5] with emergency-suction valve and protection strainer (200 µm)
[6] Connection G1 (A_2) with locking screw

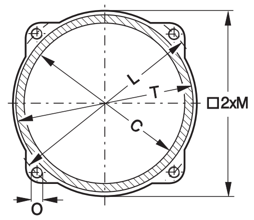
Dimensions

Version with 5 + 5 connections **Version with 2 + 5 connections**





Port sizes and mounting surface
(O-ring area of support hatched)



Tank surface sealing with
O-Ring N007.1806
(included in basic equipment)

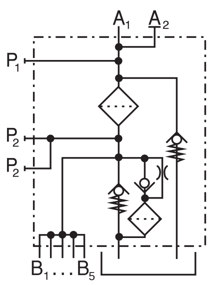
Measurements

Type	A	B	C	D	E	F_1*	F_2*	F_3*	F_4*	G	H_1	H_2	I
E 598	s. Selection	s. Selection	180	152	179	55	141,5	41,5	139,5	11,5	216	214	660
E 998	Chart	Chart	180	152	179	55	141,5	41,5	139,5	11,5	216	214	860
Type	**K**	**L**	**M**	**N**	**O**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**
E 598	406	220	106	125	M10	20	M12	70	200	17	12	104	115
E 998	612	220	106	125	M10	20	M12	70	200	17	12	104	115

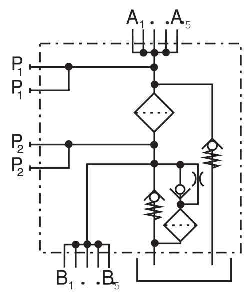
* For use of SAE-flanges see this measurement

Symbols

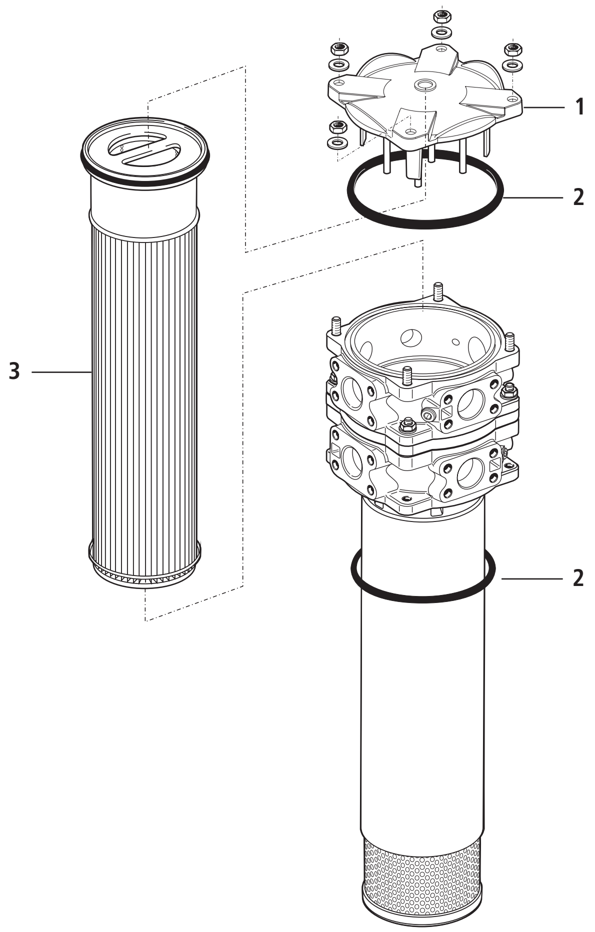
1



2



Spare Parts



Pos.	Designation	Part No.
1	Cover assy	E 998.1200
2	O-ring 180 x 6	N007.1806
3	Filter element	see Chart / col. 10

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

We produce fluid power solutions
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Multifunctional Unit MFE

for Return-Suction Filters and Return Filters

Description

Application
In particular for mobile machines with hydrostatic drives (closed circuit) and working hydraulic (open circuit), equipped with an oil cooler.

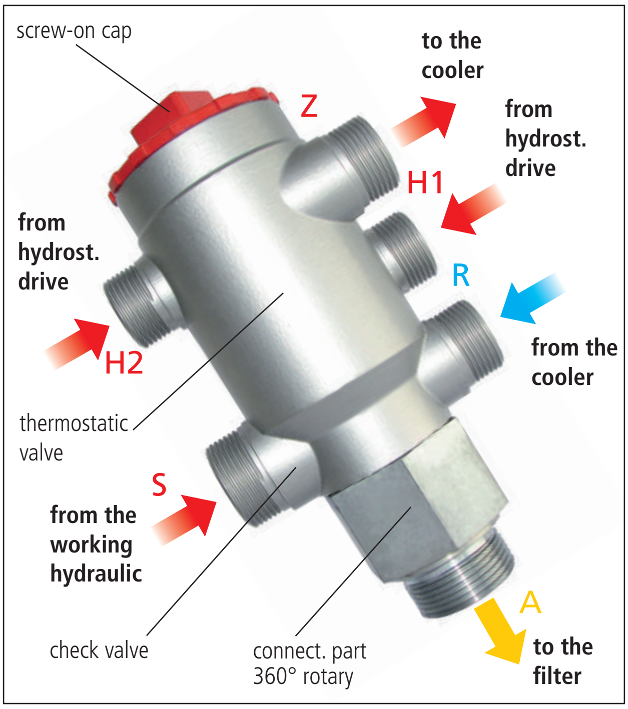
The multifunction unit can be used as collector with integrated check valve and thermostatic valve in combination with ARGO-HYTOS return-suction filters of the series E 084 / E 198 / E 498 / E 998.

Also separate drain oil- / cooler-circuits can be realised by the help of suitable return filters.

Function
Drain oil (H1, H2) from the hydrostatic drive (pump and drive motor) is routed either through a thermostatic cooler-by-pass directly to the filter (A), or at higher operating temperatures, through the cooler (Z ➔ R), then the filter, and then into the tank.

Bypassing the cooler at cold start-up maintains the back pressure of the drain lines within the permitted range, and allowing the operating temperature of the hydraulic system to be reached more quickly.

The return oil from the working hydraulic (S) flows, optionally pressurised by a check valve, through the filter (A) and into the tank.



Characteristics

Nominal flow rate
Up to 200 l/min (total supply)
Splitting: H1 + H2 = 80 l/min, S = 120 l/min

Connection
All connections for drain oil, return oil, cooler and filter are equipped with external threaded ports (direct installation of hose- / pipelines with union nut).

H1, H2, R, Z	M30 x 2 (DKOL* Ø 22)
S	M36 x 2 (DKOL* Ø 28)
A	G1¼ or G1 (see dimensions)

* acc. to ISO 8433-1 (24° cutting ring)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES or HETG, see info-sheet 00.20)

Temperature range
-20 °C … +100 °C (short intervals -30 °C … +120 °C)

Operating pressure
Max. 10 bar

Thermostatic valve
Operating range +50 °C … +70 °C

Check valve
Opening pressure 1 bar

Materials

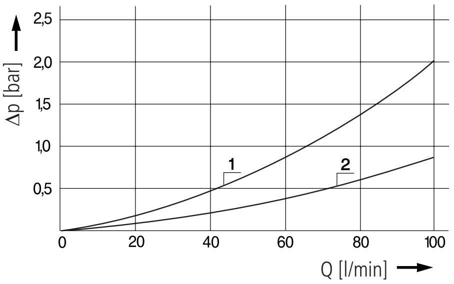
Screw-on cap:	Polyester, GF reinforced
Housing:	Aluminium alloy
Connection:	Steel
Seals:	NBR (FPM on request)
Thermostatic valve:	Polyamide, GF reinforced

Mounting position
As desired, directly screwed into the filter

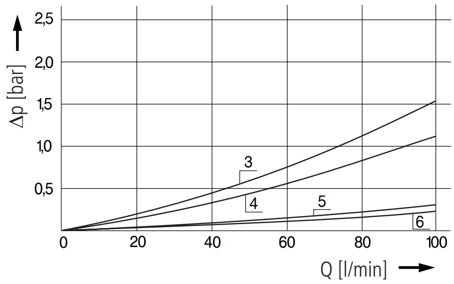
Diagrams

∆p-curves for complete multifunctional units MFE 200-01 (1, 2, 4 and 6) and MFE 200-02 (1, 2, 3 and 5)
Pressure measurement at connection H2 (supply through H1 und H2, S closed, Z hot wired after R)

Pressure drop as a function of the **volume flow**
at ν = 40 mm²/s (1) and ν = 20 mm²/s (2)
Thermostatic valve open

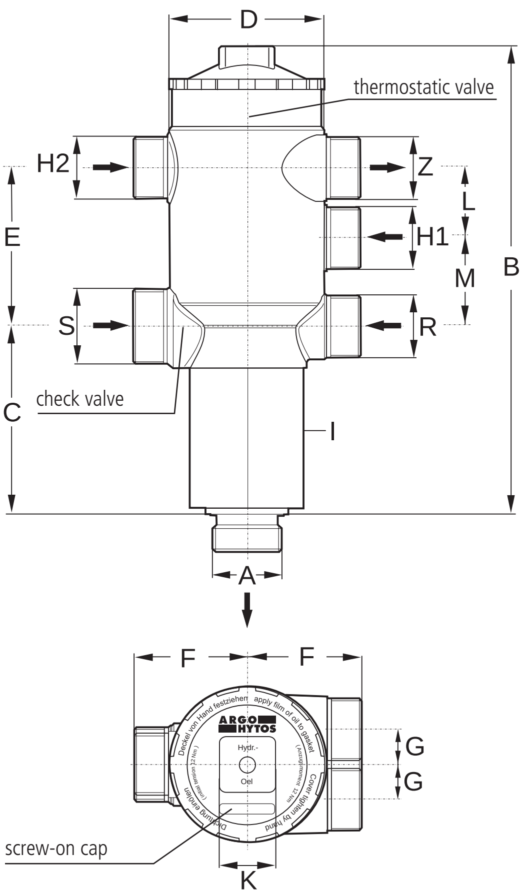


Pressure drop as a function of the **volume flow**
at ν = 1.000 mm²/s (3 and 4) and ν = 200 mm²/s (5 and 6)
Thermostatic valve closed



Note
The pressure drop produced by the pipelines, cooler and filter must be added to those of the multifunctional unit.

Dimensions



Measurements

MFE 200	-01	-02
A	G1¹/₄	G1
B	200	230
C	62	92
D	75	
E	77	
F	56	
G	17	
H1	M30 x 2	
H2	M30 x 2	
I	AF55	
K	AF27	
L	34	
M	43	
R	M30 x 2	
S	M36 x 2	
Z	M30 x 2	

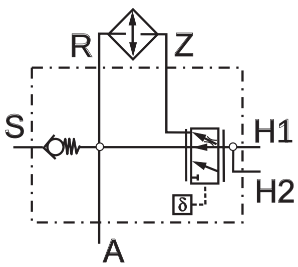
Order no.:

MFE 200-01
with G1¼ (connection A)

MFE 200-02
with G1 (connection A)

Note
Other types e.g. with alternative temperature range or without check valve, on request.

Symbol



We produce fluid power solutions
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Content

ARGO HYTOS

Pressure Filters

D 042 · D 062

- In-line mounting
- Operating pressure up to 100 bar
- Nominal flow rate up to 90 l/min

30.10-3e

Description

Application
In the pressure circuits of hydraulic and lubrication systems.

Performance features

Protection against wear:	By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.
Protection against malfunction:	Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Aluminium alloy
Filter bowl:	Aluminium alloy
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

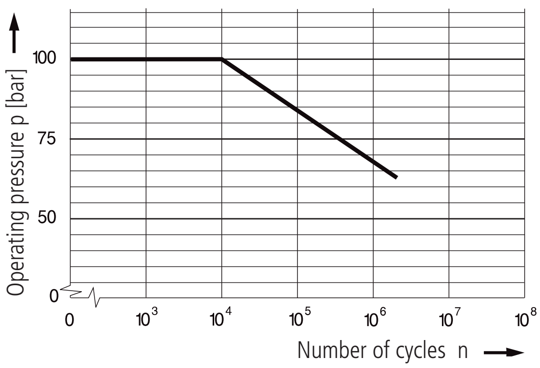
Accessories
Electrical and/or optical clogging indicators are available - optionally with one or two switching points resp. temperature suppression.
Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Operating pressure
0 ... 63 bar, min. 3 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 100 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 90 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 100 bar ≤ 6 m/s

Filter fineness
5 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20)

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

• at operating temperature:	$\nu < 60$ mm²/s
• as starting viscosity:	$\nu_{max} = 1.200$ mm²/s
• at initial operation:	The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

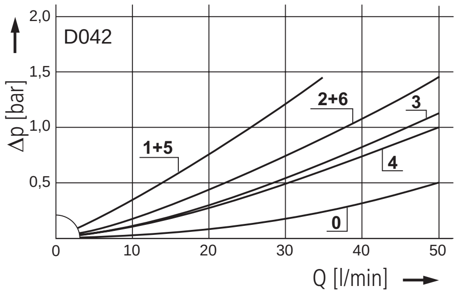
Mounting position
Preferably vertical, filter head on top

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request).

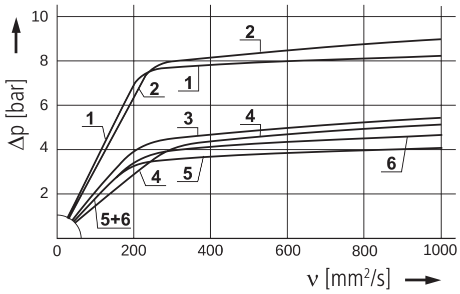
Diagrams

∆p-curves for complete filters in Selection Chart, column 3

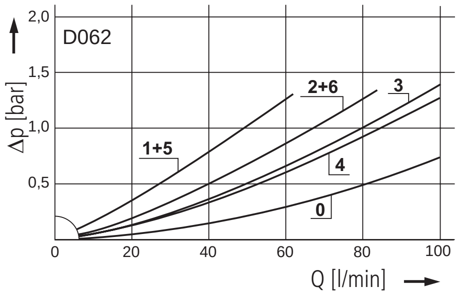
D1 Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)



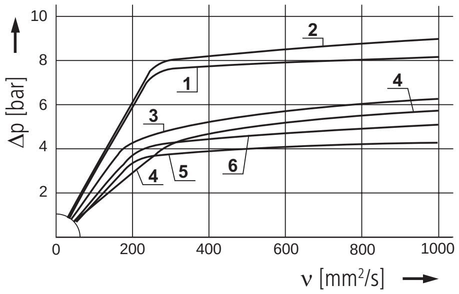
Pressure drop as a function of the **kinematic viscosity** at nominal flow



D2 Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)

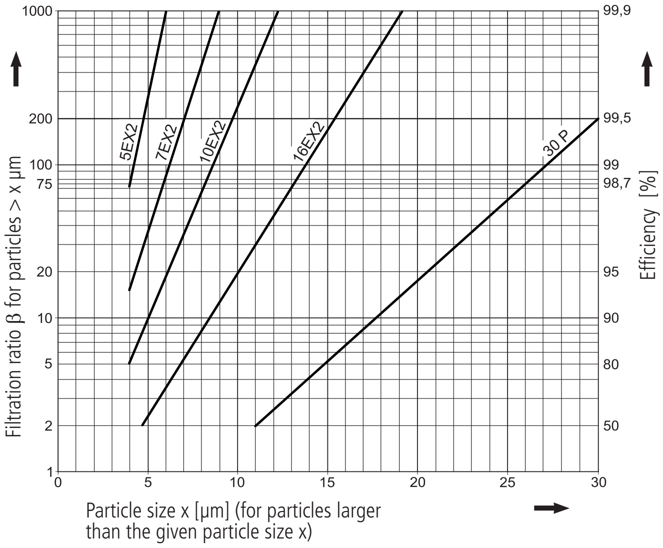


Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator	Remarks
	l/min			g		bar			kg		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
D 042-153	16	**D1**/1	5EX2	4,9	G½	3,5	4	V3.0510-03	0,8	optional	-
D 042-156	27	**D1**/2	10EX2	6,8	G½	3,5	4	V3.0510-06	0,8	optional	-
D 042-158	44	**D1**/3	16EX2	6,9	G½	3,5	4	V3.0510-08	0,8	optional	-
D 042-151	40	**D1**/4	30P	3,6	G½	3,5	4	P3.0510-11*	0,8	optional	-
D 042-183	30	**D1**/5	5EX2	4,9	G½	7	4	V3.0510-03	0,8	optional	-
D 042-186	44	**D1**/6	10EX2	6,8	G½	7	4	V3.0510-06	0,8	optional	-
D 062-153	32	**D2**/1	5EX2	10	G½	3,5	4	V3.0520-03	1,1	optional	-
D 062-156	57	**D2**/2	10EX2	14	G¾	3,5	4	V3.0520-06	1,1	optional	-
D 062-158	90	**D2**/3	16EX2	15	G¾	3,5	4	V3.0520-08	1,1	optional	-
D 062-151	80	**D2**/4	30P	7,1	G¾	3,5	4	P3.0520-01*	1,1	optional	-
D 062-183	48	**D2**/5	5EX2	10	G½	7	4	V3.0520-03	1,1	optional	-
D 062-196	80	**D2**/6	10EX2	14	G¾	7	4	V3.0520-06	1,1	optional	-

Optical or electrical indicators are available to monitor the clogging condition of the element. If the indicator should be already mounted onto the filter head use the abbreviation "M" behind the part number of the indicator. The printed order acknowledgements show both items separately.

Order example: The filter D 042-156 has to be supplied with optical clogging indicator - response pressure 2,0 bar

Order description: **D 042-156 / DG 042-01 M**

Part No. (Basic unit) — D 042-156

Clogging indicator — DG 042-01

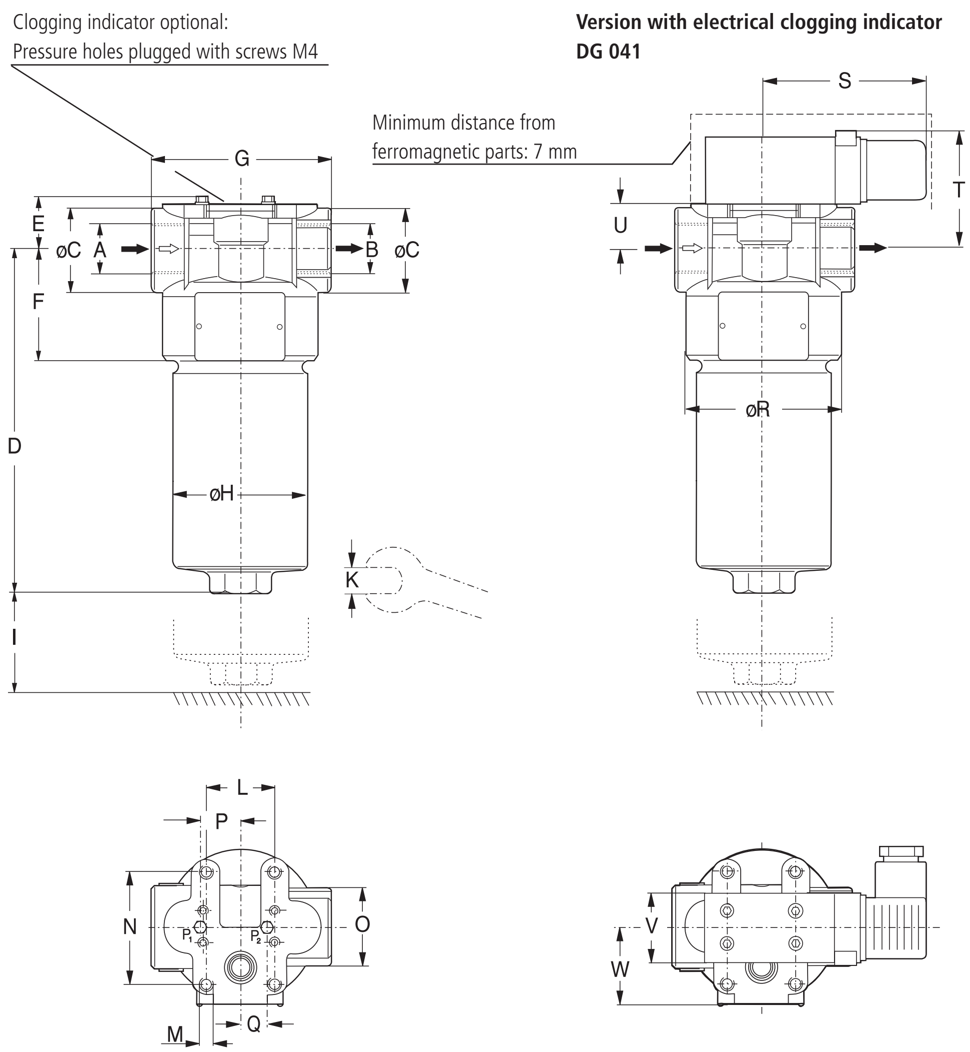
Mounted — M

For the appropriate clogging indicators see catalogue sheet 60.30

Remarks:
- The switching pressure of the clogging indicator has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- The filters listed in this chart are standard filters. Other designs available on request.

* Paper media supported with metal gauze

Dimensions

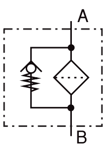


Measurements

Type	A/B	C	D	E	F	G	H	I	K	L	M Ø/depth	N	O	P	Q	R	S	T	U	V	W
D 042	G½	39	148	27	45,5	80	58,5	55	27	35	M6/8	44	AF36	19	15	70	81	55	23	30	35,5
D 062	G½, G¾	39	244	27	45,5	80	58,5	55	27	35	M6/8	44	AF36	19	15	70	81	55	23	30	35,5

Symbols

1



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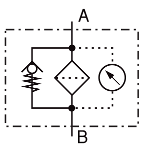

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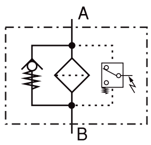

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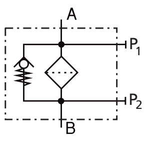

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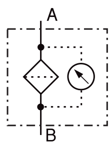

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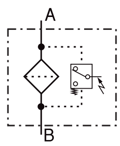
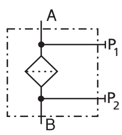
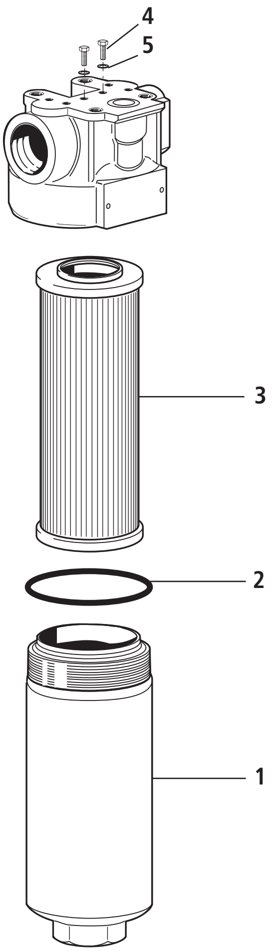


7



Spare Parts



Pos.	Designation	Part No.
1	Filter bowl D 042	D 044.0101
1	Filter bowl D 062	D 064.0101
2	O-ring 50 x 2	N007.0501
3	Filter element (with seal)	see Chart / col. 9
4	Hexagonal head screw M4 x 8 DIN 933-8.8	11385800
5	Bonded seal 4,1 x 7,2 x 1	12504600

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

We produce fluid power solutions
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Phone: +49 7250 76-0 · Fax: +49 7250 76-199 · info@argo-hytos.com · www.argo-hytos.com

Pressure Filters

D 072 · D 112 · D 152

- In-line mounting
- Operating pressure up to 100 bar
- Nominal flow rate up to 170 l/min

30.20-2e

Description

Application
In the pressure circuits of hydraulic and lubrication systems.

Performance features

Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:

- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Aluminium alloy
Filter bowl:	Aluminium alloy
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web

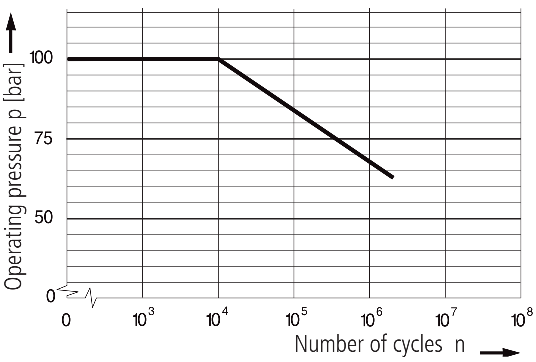
Accessories
If an electrical indicator is used a transparent socket with LED for optical indication is also available with Part No. DG 041.1200.

Characteristics

Operating pressure
0 ... 63 bar, min. 3 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 100 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 170 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines: up to 100 bar ≤ 6 m/s

Filter fineness
5 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20)

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
Preferably vertical, filter head on top

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request).

Electrical clogging indicator

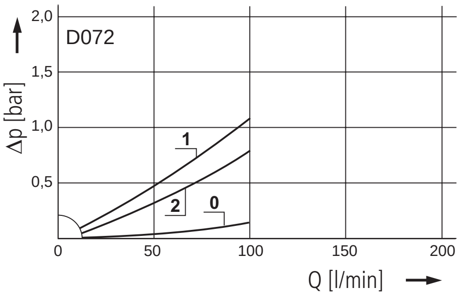
- Switching voltage: max. 120 V AC / 175 V DC
- Switching current: max. 0,17 A AC / 0,25 A DC
- Switching power: max. 3,5 VA AC / 5 W DC
- Type of contact: change-over
- Electrical protection: IP 65 (with mounted and secured socket)

Diagrams

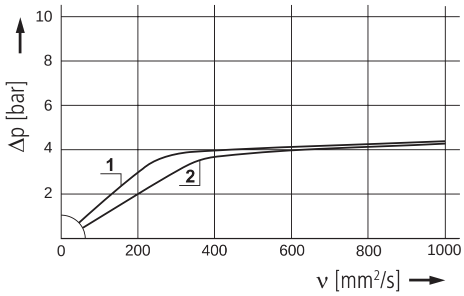
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at $\nu = 35\ mm^2/s$ (0 = casing empty)

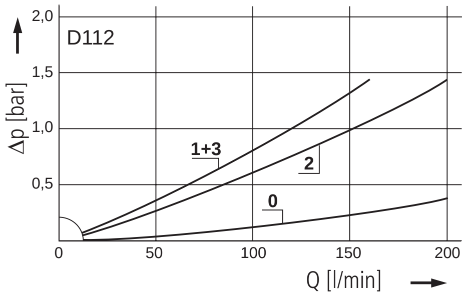


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

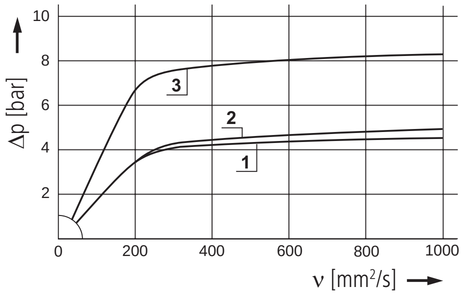


D2

Pressure drop as a function of the **flow volume**
at $\nu = 35\ mm^2/s$ (0 = casing empty)

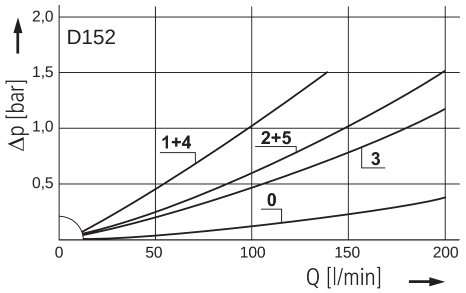


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

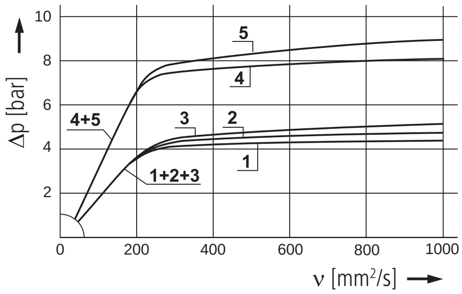


D3

Pressure drop as a function of the **flow volume**
at $\nu = 35\ mm^2/s$ (0 = casing empty)



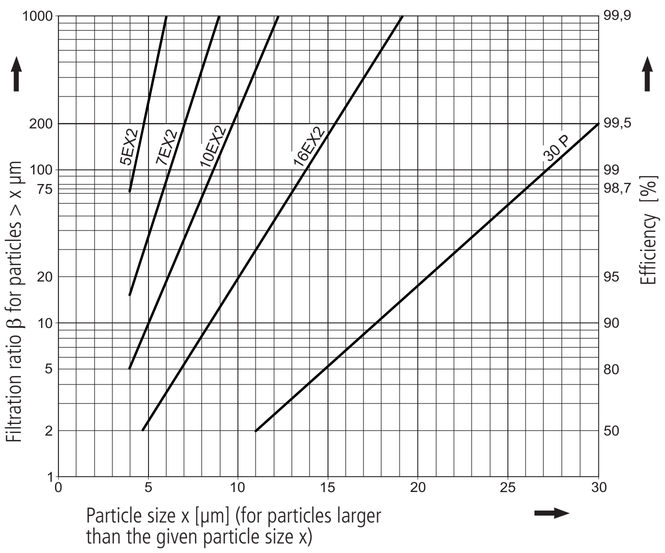
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the
Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30 P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

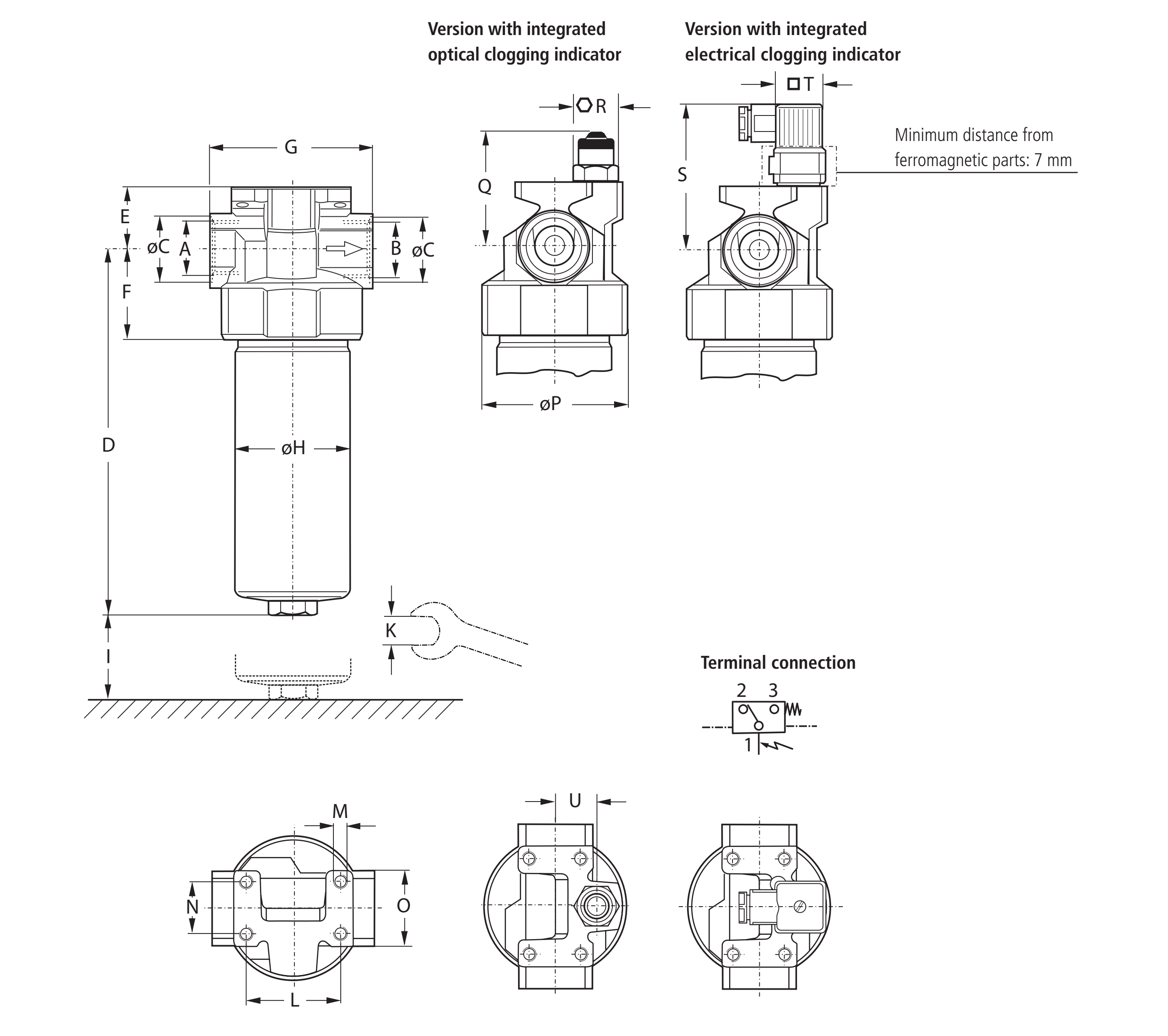
For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator cracking pressure ( )	Remarks
	l/min			g		bar			kg	bar	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
D 072-156	48	**D1**/1	10EX2	12	G½	3,5	1	V3.0613-06	1,1	-	-
D 072-176	48	**D1**/1	10EX2	12	G½	3,5	2	V3.0613-06	1,2	optical (2)	-
D 072-166	48	**D1**/1	10EX2	12	G½	3,5	3	V3.0613-06	1,2	electrical (2)	change-over
D 072-158	48	**D1**/2	16EX2	12	G½	3,5	1	V3.0613-08	1,1	-	-
D 072-178	48	**D1**/2	16EX2	12	G½	3,5	2	V3.0613-08	1,2	optical (2)	-
D 072-168	48	**D1**/2	16EX2	12	G½	3,5	3	V3.0613-08	1,2	electrical (2)	change-over
D 112-156	70	**D2**/1	10EX2	17	G¾	3,5	1	V3.0617-06	1,4	-	-
D 112-176	70	**D2**/1	10EX2	17	G¾	3,5	2	V3.0617-06	1,5	optical (2)	-
D 112-166	70	**D2**/1	10EX2	17	G¾	3,5	3	V3.0617-06	1,5	electrical (2)	change-over
D 112-158	105	**D2**/2	16EX2	17	G1	3,5	1	V3.0617-08	1,4	-	-
D 112-178	105	**D2**/2	16EX2	17	G1	3,5	2	V3.0617-08	1,5	optical (2)	-
D 112-168	105	**D2/**2	16EX2	17	G1	3,5	3	V3.0617-08	1,5	electrical (2)	change-over
D 112-186	130	**D2**/3	10EX2	17	G1	7,0	1	V3.0617-06	1,4	-	-
D 112-189	130	**D2**/3	10EX2	17	G1	7,0	2	V3.0617-06	1,5	optical (5)	-
D 112-196	130	**D2**/3	10EX2	17	G1	7,0	3	V3.0617-06	1,5	electrical (5)	change-over
D 152-153	60	**D3**/1	5EX2	17	G¾	3,5	1	V3.0623-03	1,7	-	-
D 152-173	60	**D3**/1	5EX2	17	G¾	3,5	2	V3.0623-03	1,8	optical (2)	-
D 152-163	60	**D3**/1	5EX2	17	G¾	3,5	3	V3.0623-03	1,8	electrical (2)	change-over
D 152-156	100	**D3**/2	10EX2	23	G¾	3,5	1	V3.0623-06	1,7	-	-
D 152-176	100	**D3**/2	10EX2	23	G¾	3,5	2	V3.0623-06	1,8	optical (2)	-
D 152-166	100	**D3**/2	10EX2	23	G¾	3,5	3	V3.0623-06	1,8	electrical (2)	change-over
D 152-158	135	**D3**/3	16EX2	25	G1	3,5	1	V3.0623-08	1,7	-	-
D 152-178	135	**D3**/3	16EX2	25	G1	3,5	2	V3.0623-08	1,8	optical (2)	-
D 152-168	135	**D3**/3	16EX2	25	G1	3,5	3	V3.0623-08	1,8	electrical (2)	change-over
D 152-183	110	**D3**/4	5EX2	17	G1	7,0	1	V3.0623-03	1,7	-	-
D 152-185	110	**D3**/4	5EX2	17	G1	7,0	2	V3.0623-03	1,8	optical (5)	-
D 152-193	110	**D3**/4	5EX2	17	G1	7,0	3	V3.0623-03	1,8	electrical (5)	change-over
D 152-186	170	**D3**/5	10EX2	23	G1	7,0	1	V3.0623-06	1,7	-	-
D 152-189	170	**D3**/5	10EX2	23	G1	7,0	2	V3.0623-06	1,8	optical (5)	-
D 152-196	170	**D3**/5	10EX2	23	G1	7,0	3	V3.0623-06	1,8	electrical (5)	change-over

Remarks:
- The filters listed in this chart are standard filters. Other designs available on request.
- If an electrical indicator is used a transparent socket with LED for optical indication is also available with Part No. DG 041.1200.

Dimensions

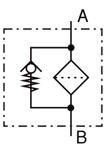


Measurements

Typ	A/B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U
D 072	G ½	27	178	31	46,5	84	70,5	60	AF27	56	M8 x 12	30	AF36	85	61	AF24	80	AF30	21,5
D 112	G¾, G1	34	219	37	51	95	70,5	60	AF27	56	M8 x 12	30	AF44	85	67	AF24	86	AF30	24,5
D 152	G¾, G1	40	283	37	51	95	70,5	60	AF27	56	M8 x 12	30	AF44	85	67	AF24	86	AF30	24,5

Symbols

1



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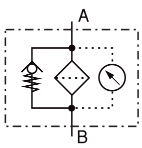

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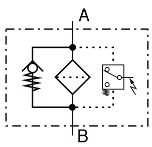

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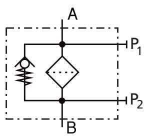

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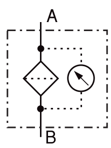

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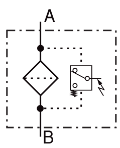
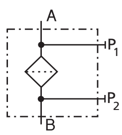
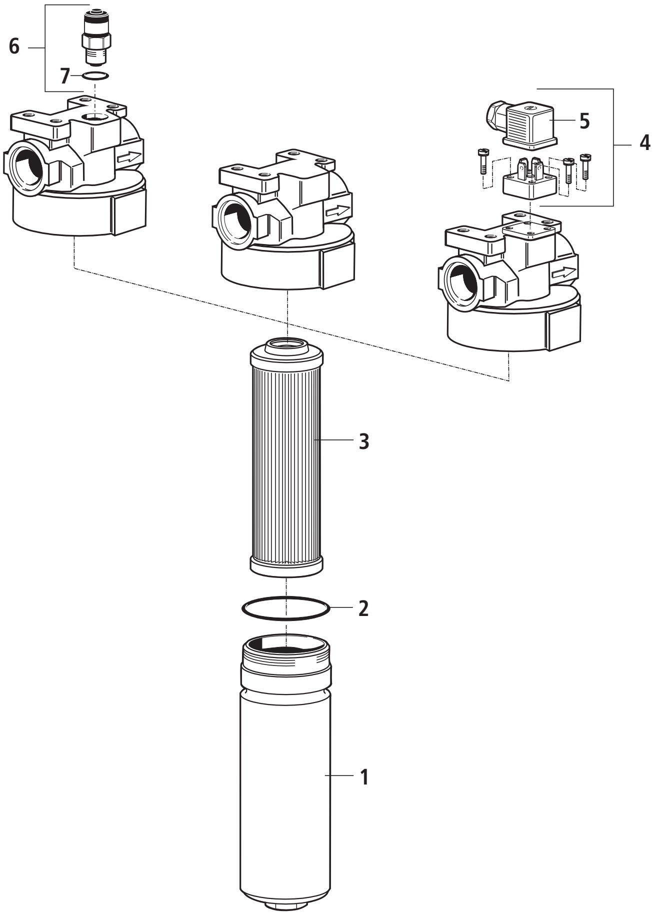


7



Spare Parts



Pos.	Designation	Part No.
1	Filter bowl D 072	D 072.0101
1	Filter bowl D 112	D 112.0101
1	Filter bowl D 152	D 152.0101
2	O-ring 62 x 2	N007.0622
3	Filter element (with seal)	see Chart / col. 9
4	Reed switch with screws and socket (Pos. 5)	HD 049.1410
5	Socket DIN 43650-AF3	DG 041.1220
6	Optical clogging indicator (with Pos. 7)	D 232.1400
7	O-ring 12,3 x 2,4	N007.0124

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

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ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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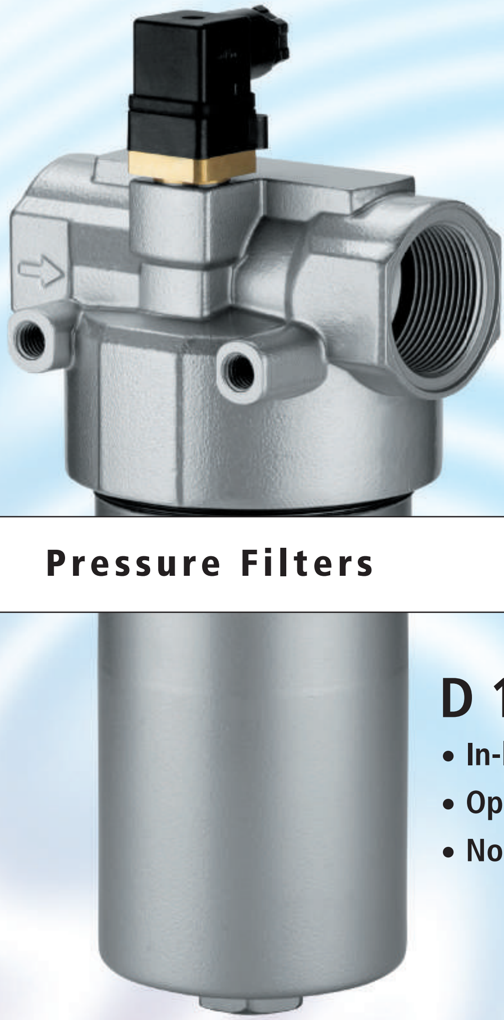


Pressure Filters

D 162 · D 232 · D 332

- In-line mounting
- Operating pressure up to 63 bar
- Nominal flow rate up to 350 l/min

30.30-4e

Description

Application
In the pressure circuits of hydraulic and lubrication systems.

Performance features

Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:

- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Aluminium alloy
Filter bowl:	Aluminium alloy
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

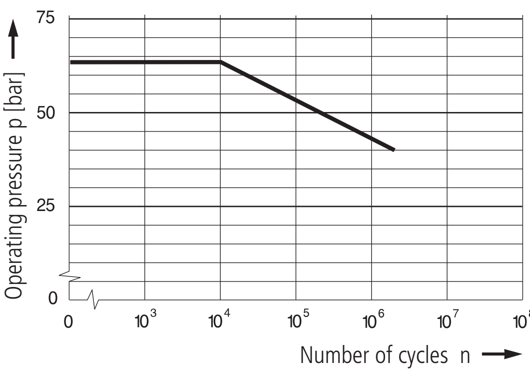
Accessories
Electrical and/or optical clogging indicators are available - optionally with one or two switching points resp. temperature suppression.
Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Operating pressure
0 ... 40 bar, min. 3 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 63 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 350 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines: up to 100 bar ≤ 6 m/s

Filter fineness
5 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEEs and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
Preferably vertical, filter head on top

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request).

Electrical clogging indicator

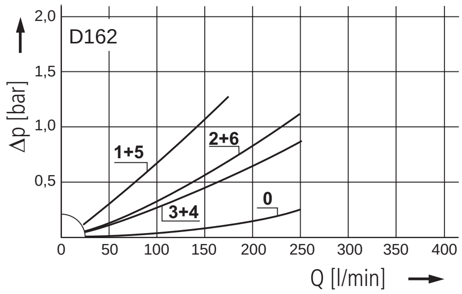
- Switching voltage: max. 120 V AC / 175 V DC
- Switching current: max. 0,17 A AC / 0,25 A DC
- Switching power: max. 3,5 VA AC / 5 W DC
- Type of contact: change-over
- Electrical protection: IP 65 (with mounted and secured socket)

Diagrams

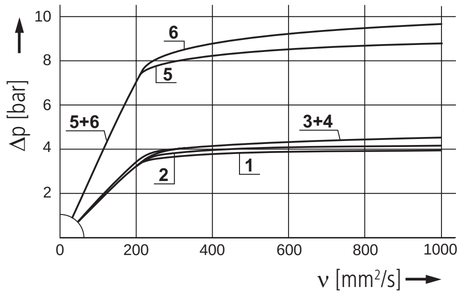
∆p-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

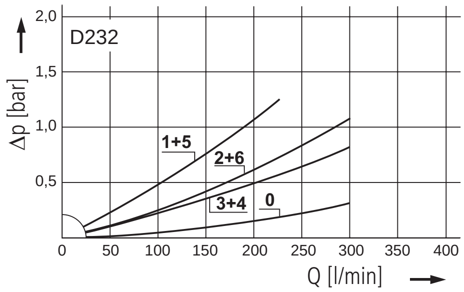


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

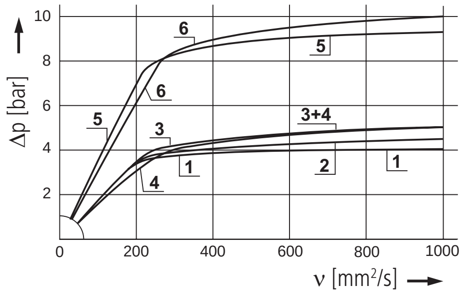


D2

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

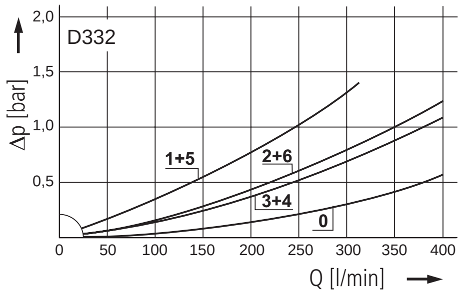


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

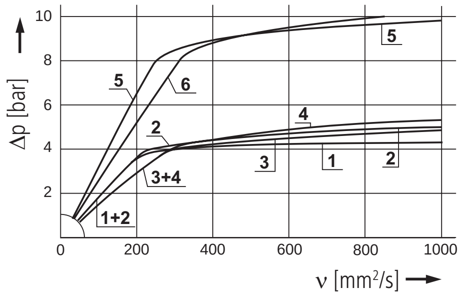


D3

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)



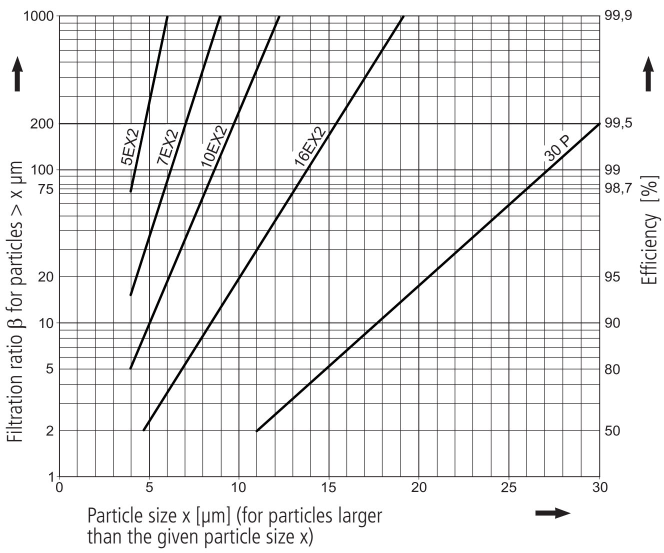
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator	Remarks
	l/min			g		bar			kg		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
D 162-253	85	**D1**/1	5EX2	24	G1¼	3,5	4	V3.0817-03	2,4	optional	-
D 162-256	140	**D1**/2	10EX2	33	G1¼	3,5	4	V3.0817-06	2,4	optional	-
D 162-258	200	**D1**/3	16EX2	33	G1¼	3,5	4	V3.0817-08	2,4	optional	-
D 162-251	220	**D1**/4	30P	18	G1¼	3,5	4	P3.0817-01*	2,4	optional	-
D 162-283	160	**D1**/5	5EX2	24	G1¼	7	4	V3.0817-03	2,4	optional	-
D 162-286	250	**D1**/6	10EX2	33	G1¼	7	4	V3.0817-06	2,4	optional	-
D 232-253	120	**D2**/1	5EX2	33	G1¼	3,5	4	V3.0823-03	3,4	optional	-
D 232-256	195	**D2**/2	10EX2	47	G1¼	3,5	4	V3.0823-06	3,4	optional	-
D 232-258	275	**D2**/3	16EX2	48	G1¼	3,5	4	V3.0823-08	3,4	optional	-
D 232-251	280	**D2**/4	30P	26	G1¼	3,5	4	P3.0823-01*	3,4	optional	-
D 232-283	220	**D2**/5	5EX2	33	G1¼	7	4	V3.0823-03	3,4	optional	-
D 232-286	300	**D2**/6	10EX2	47	G1½	7	4	V3.0823-06	3,4	optional	-
D 332-253	170	**D3**/1	5EX2	49	G1¼	3,5	4	V3.0833-03	4,0	optional	-
D 332-256	275	**D3**/2	10EX2	67	G1¼	3,5	4	V3.0833-06	4,0	optional	-
D 332-258	280	**D3**/3	16EX2	68	G1¼	3,5	4	V3.0833-08	4,0	optional	-
D 332-251	350	**D3**/4	30P	34	G1½	3,5	4	P3.0833-01*	4,0	optional	-
D 332-283	280	**D3**/5	5EX2	49	G1¼	7	4	V3.0833-03	4,0	optional	-
D 332-286	350	**D3**/6	10EX2	67	G1½	7	4	V3.0833-06	4,0	optional	-

Optical or electrical indicators are available to monitor the clogging condition of the element. If the indicator should be already mounted onto the filter head use the abbreviation “M” behind the part number of the indicator. The printed order acknowledgements show both items separately.

Order example: The Filter D 232-256 has to be supplied with optical clogging indicator - response pressure 2,0 bar.

Order description: **D 232-256 / DG 042-01 M**

Part No. (basic unit) — D 232-256

Clogging indicator — DG 042-01

Mounted — M

For the appropriate clogging indicator see catalogue sheet 60.30.

Besides these mounted clogging indicators we also offer - with a certain order quantity - clogging indicators integrated in the filter head (as listed under "dimensions").

Order examples:

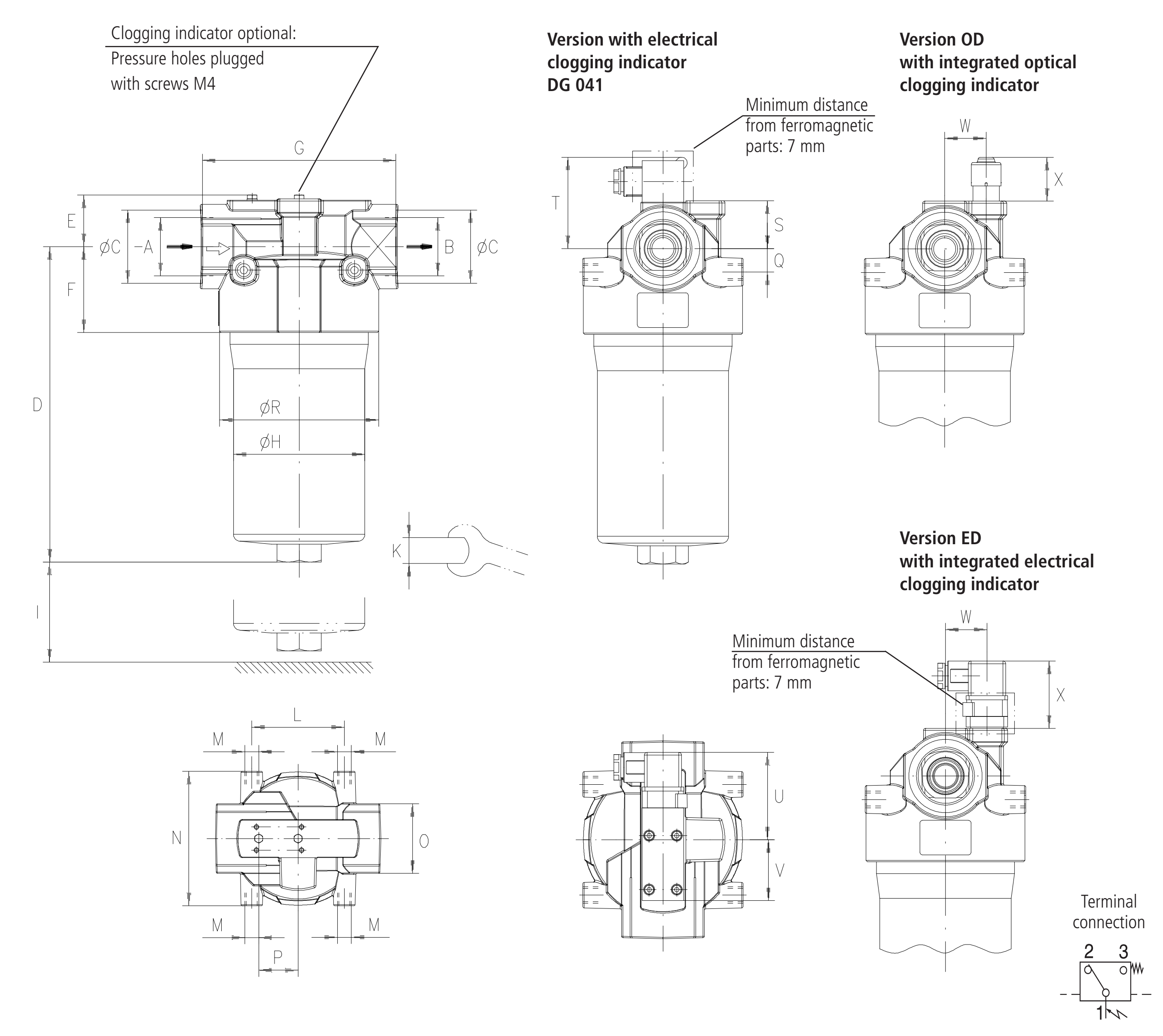
D 232-256 ED (electrical differential pressure switch)
D 232-256 OD (optical differential pressure indicator)
} the switching pressure matches the cracking pressure of the by-pass valve

Remarks:

- The switching pressure of the clogging indicator has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- The filters listed in this chart are standard filters. Other designs available on request.

***** Paper media supported with metal gauze

Dimensions

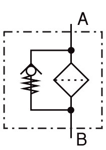


Measurements

Type	A/B	C	D	E	F	G	H	I	K	L	M Ø/depth	N	O	P	Q	R	S	T	U	V	W	X ED	X OD
D 162	G1¼	61	232	38	62	140	95	80	32	80	M12/18	116	AF60	34	17	115	34	66	66	44	30	49	30
D 232	G1¼, G1½	61	296	38	62	140	95	80	32	80	M12/18	116	AF60	34	17	115	34	66	66	44	30	49	30
D 332	G1¼, G1½	61	396	38	62	140	101	80	32	80	M12/18	116	AF60	34	17	115	34	66	66	44	30	49	30

Symbols

1



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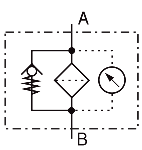

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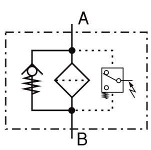

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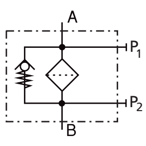

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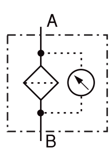

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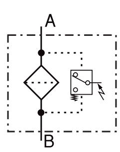

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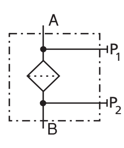
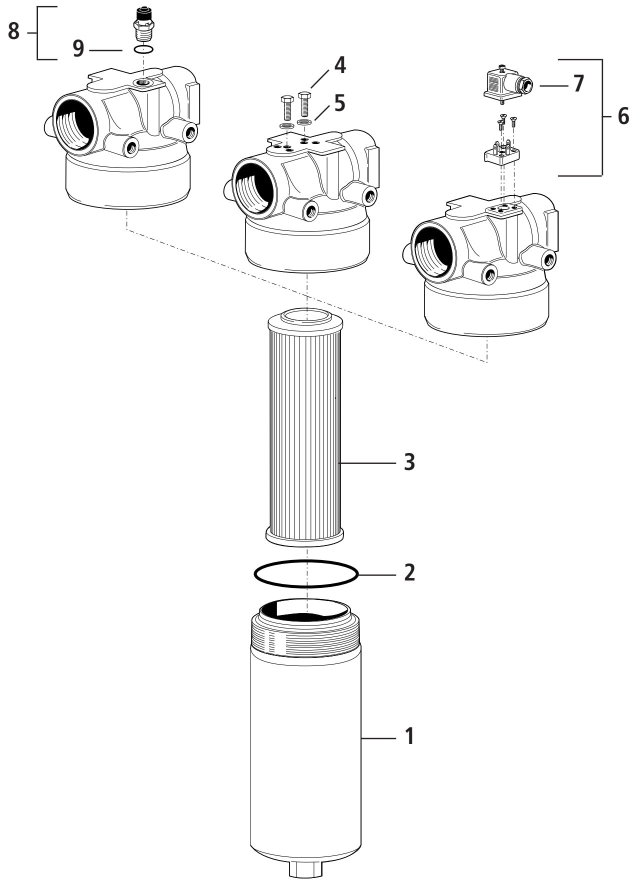


Spare Parts



Pos.	Designation	Part No.
1	Filter bowl D 162	D 162.0102
1	Filter bowl D 232	D 232.0102
1	Filter bowl D 332	D 332.0102
2	O-ring 88,57 x 2,62	N007.0886
3	Filter element (with seal)	see Chart / col. 9
4	Hexagonal head screw M4 x 8 DIN 933-8.8	11385800
5	Bonded seal 4,1 x 7,2 x 1	12504600
6	Reed switch with screws and socket (Pos. 7)	HD 049.1410
7	Socket DIN 43650 - AF3	DG 041.1220
8	Optical clogging indicator (with Pos. 9)	D 232.1400
9	O-ring 12,3 x 2,4	N007.0124

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ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

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Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

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Subject to change
30.30-4e · 0714

ARGO HYTOS

Low-Pressure In-Line Filters

FNL 1000 · FNL 2000

- In-line mounting
- Operating pressure up to 40 bar
- Nominal flow rate up to 1450 l/min

30.50-1e

Description

Application
In the pressure circuits of hydraulic and lubrication systems.

Performance features
Protection against wear: By means of filter elements that meet even the highest demands regarding cleanliness classes.

Protection against malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Cover:	Aluminium alloy
Filter housing:	Aluminium alloy
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

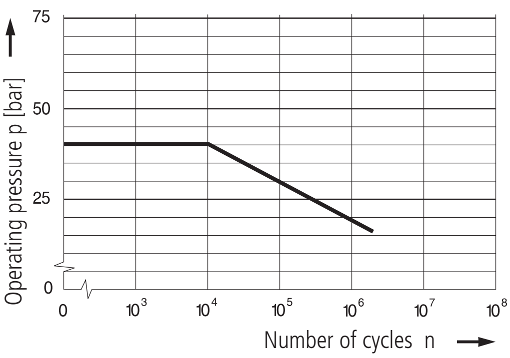
Accessories
Electrical and/or optical clogging indicators are available - optionally with one or two switching points resp. temperature suppression.
Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Operating pressure
0 ... 16 bar, min. 3 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 40 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 1.450 l/min (see Selection Chart, column 2).
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 25 bar ≤ 4,5 m/s

Filter fineness
5 µm(c) ... 10 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEEs and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
Preferably vertical, filter head at the bottom

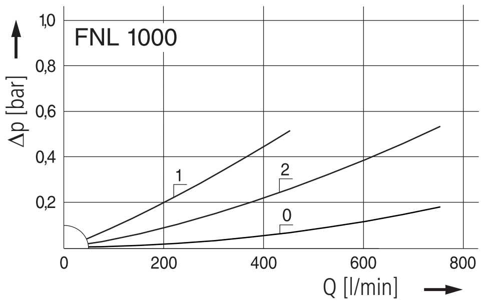
Connection
SAE-flange (3.000 psi). Sizes see Selection Chart, line 6
(other connections on request).
Standard: connection ports A/B opposed
Optional: connection port A sidewise, connection port B at the bottom

Diagrams

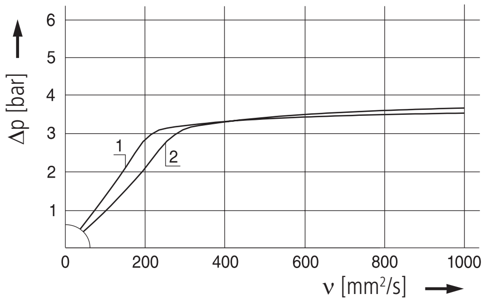
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)

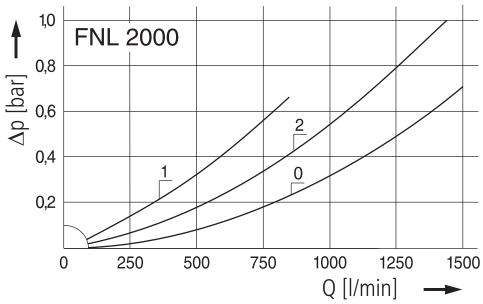


Pressure drop as a function of the **kinematic viscosity** at nominal flow

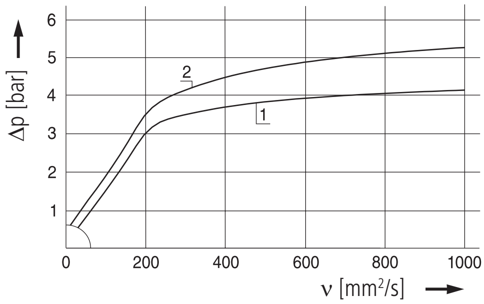


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)



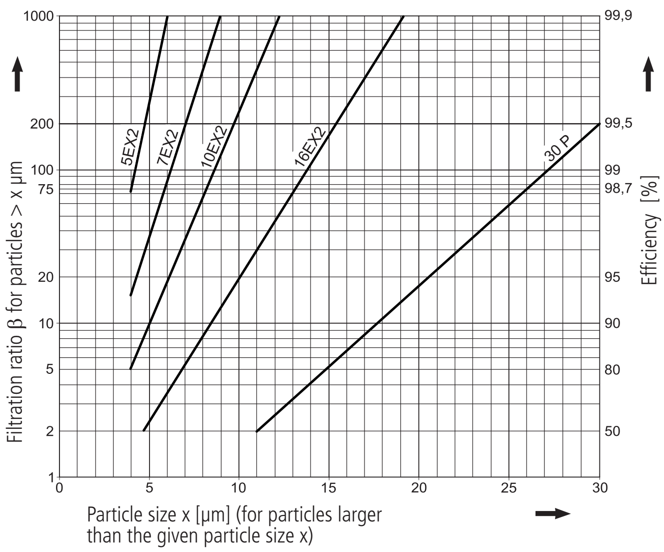
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal flow	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator	Remarks
	l/min			g		bar			kg		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
FNL 1000-153	420	**D1**/1	5EX2	130	SAE 2	3	4	V3.1449-53	21	optional	-
FNL 1000-156	555	**D1**/2	10EX2	190	SAE 2	3	4	V3.1449-56	21	optional	-
FNL 2000-153	820	**D2**/1	5EX2	260	SAE 4	3	4	V3.1493-53	28	optional	-
FNL 2000-156	1450	**D2**/2	10EX2	370	SAE 4	3	4	V3.1493-56	28	optional	-

Optical or electrical indicators are available to monitor the clogging condition of the element. If the indicator should be already mounted onto the filter head use the abbreviation „M“ behind the part number of the indicator. The printed order acknowledgements show both items separately.

Order example: The Filter FNL 1000-153 has to be supplied with electrical clogging indicator - response pressure 2,5 bar.

Order description: **FNL 1000-153 / DG 041-32 M**

Part No. (basic unit) — FNL 1000-153

Clogging indicator — DG 041-32

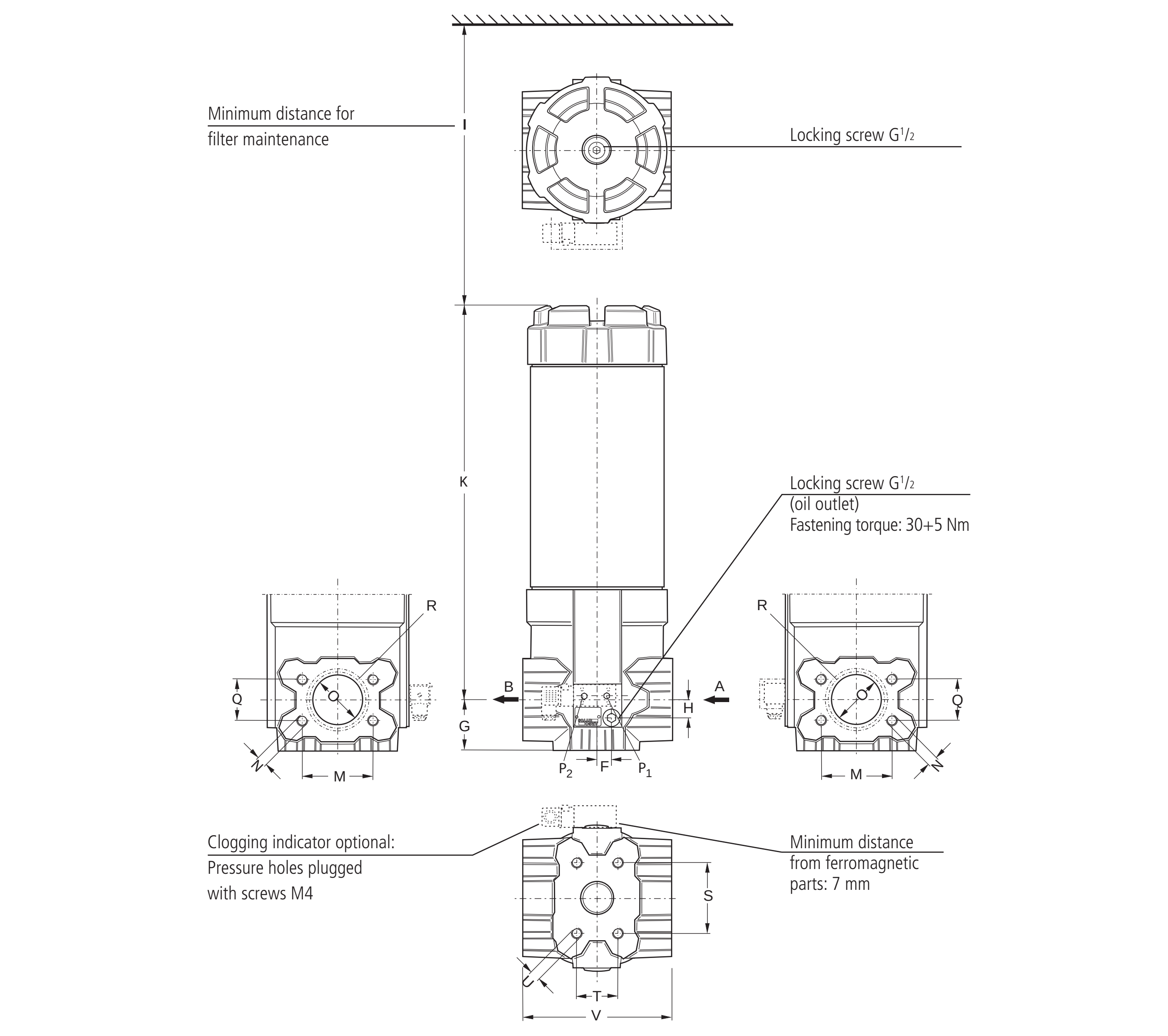
Mounted — M

For the appropriate clogging indicator see catalogue sheet 60.30.

Remarks:
- The switching pressure of the clogging indicator has always to be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- The filters listed in this chart are standard filters. Other designs available on request.

Optionen:
- Other filter finenesses on request.
- Check valve in filter head on request.
- Connection port A sidewise, connection port B at the bottom (standard: connection ports A/B opposed).

Dimensions

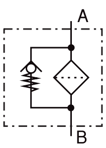


Measurements

Type	A/B	F	G	H	I	K	M	N	O	Q	R	S	T	U	V
FNL 1000	SAE 2	19	76,5	26,5	450	593	77,8	M12	Ø50	42,6	Ø56-Ø64	130,2	77,8	M16	224
FNL 2000	SAE 4	19	76,5	26,5	890	1033	130,2	M16	Ø100	77,8	Ø110-Ø118	130,2	77,8	M16	224

Symbols

1



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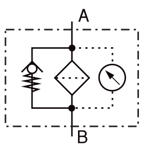
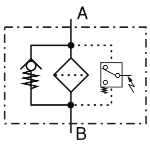


3



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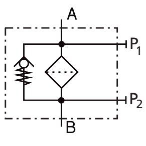

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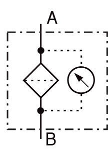
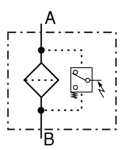
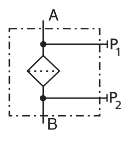


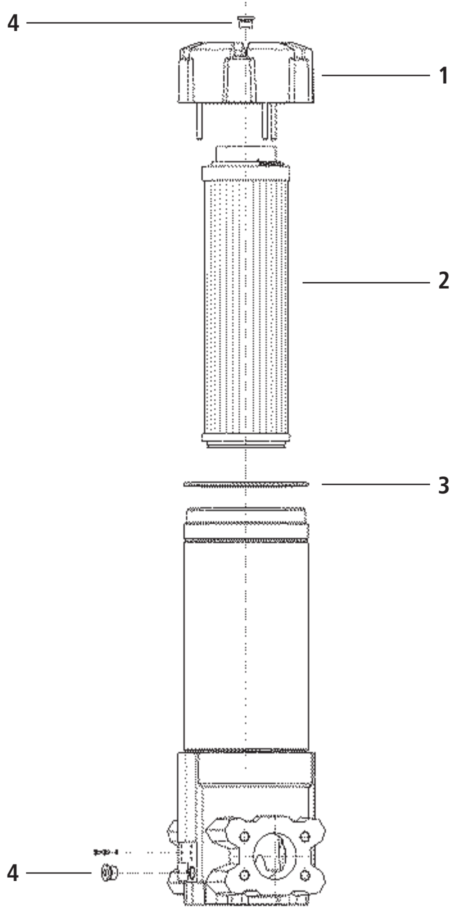
6



7



Spare Parts



Pos.	Designation	Part No.
1	Cover (complete)	FNL 1000.1200
2	Filter element	see Chart / col. 9
3	O-ring	N007.1905
4	Locking screw	SV 0620.08

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

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Content

High-Pressure Safety Filters

HD 040 · HD 081
HD 150

- In-line mounting
- Operating pressure up to 500 bar
- Nominal flow rate up to 100 l/min

40.05-5e

Description

Application
In the high-pressure circuits of hydraulic systems.

Performance features

Functional protection: The high-pressure safety filter retains residues remaining in the system due to installation or after repairs, and intake chips from pumps (especially gear pumps). This prevents functional failures or faults on downstream components, particularly control/regulation or throttle valves.

Protection against wear: For wear protection, a fine filter should be installed elsewhere in the system.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material provides:

- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Materials

Housing:	steel, zinc plated
Seals:	NBR (FPM on request)
Filter media:	stainless steel wire mesh (1.4301)

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness	Filter surface	Cracking pressure of by-pass	Connection A/B	Dimension C	Dimension D	Dimension E	Dimension F	Dimension H	Dimension L	Width across flats $SW_{1/2}$	Symbol	Weight	Remarks
	l/min		µm	cm²	bar		mm	mm	mm	mm	mm	mm			kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
HD 040-110	40	**D1**/1	100[1]	60	-	M22 x 1,5	12	-	7	15	63	97	36/36	1	0,45	1 + 2
HD 081-111	80	**D1**/2	100[1]	125	-	M26 x 1,5	12	52	7,5	18	11	130	46/46	1	1,10	1 + 2
HD 150-01	100	**D1**/3	100[1]	300	-	G¾	12	65	10,5	-	-	142,5	55/36	1	2,00	1
HD 150-50	100	**D1**/4	60	320	3,5	G¾	12	65	10,5	-	-	142,5	55/36	2	1,90	-

Remark:
The filters listed in this chart are standard filters. If modifications are required, e.g. different filter finenesses, we kindly ask for your request.

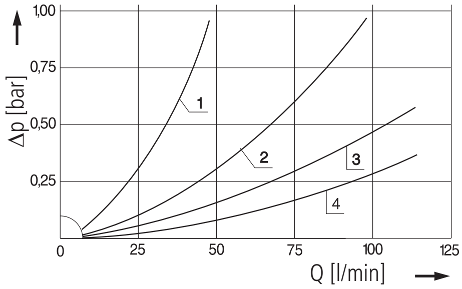
[1] Filter element differential pressure stable up to 160 bar [2] Connection according to DIN 3861

Diagrams

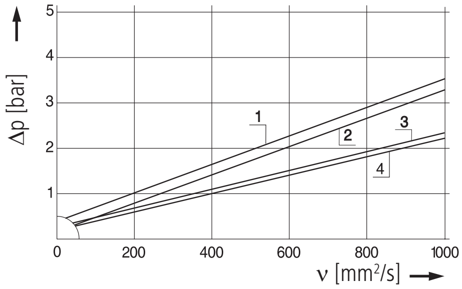
Δp-curves for the filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm^2/s

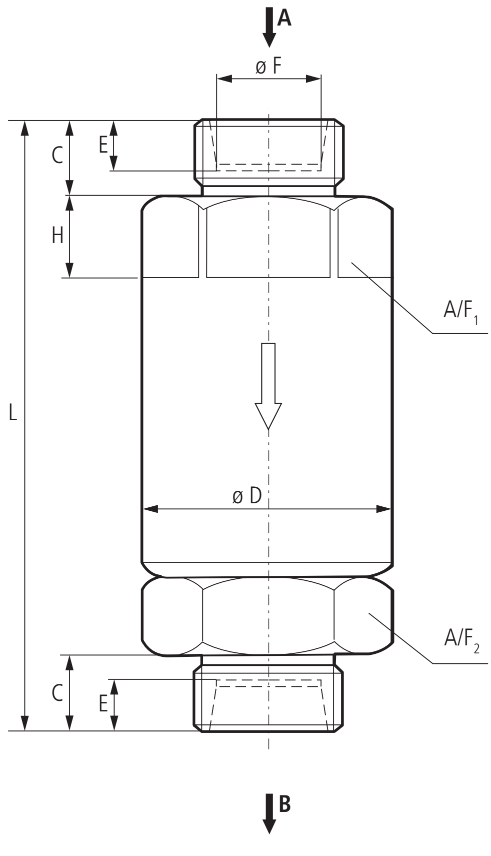


Pressure drop as a function of the **kinematic viscosity** at nominal flow

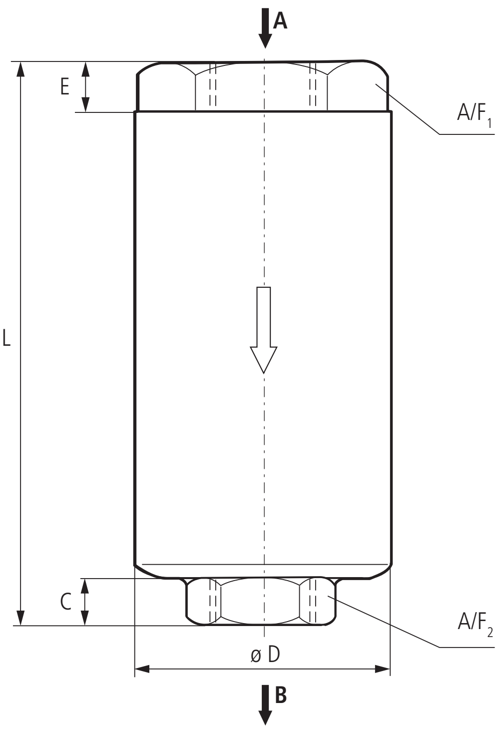


Dimensions

HD 040 / HD 081



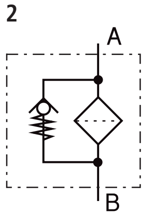
HD 150



Symbols

1

2

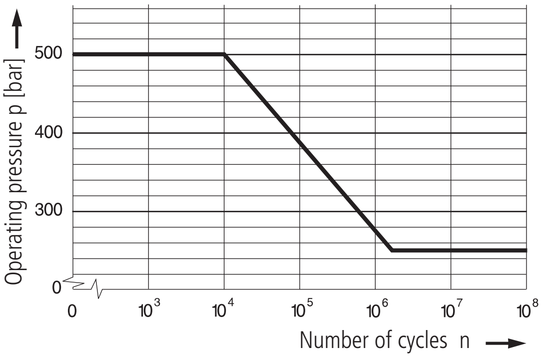


Characteristics

Operating pressure
0 ... 250 bar, min. 2 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 500 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressure for other numbers of cycles



Nominal flow rate
Up to 100 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- flow velocity in the connection lines:
  up to 250 bar ≤ 8 m/s
  > 250 bar ≤ 12 m/s

Filter fineness
60 µm, 100 µm
(see Selection Chart, column 4)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
As desired

Connection
Threaded ports according to ISO 228, DIN 13 and/or DIN 3861. Sizes see Selection Chart, column 7 (other port threads on request).

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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High Pressure Filters – Worldline 100

HD 049 • HD 069

- In-line mounting
- Operating pressure up to 630 bar
- Nominal flow rate up to 105 l/min

40.45-3e

Description

Application
In the high pressure circuits of hydraulic systems.

Performance features

Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at ≤ 200 mm²/s (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:

- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Spheroidal graphite cast iron (SGI)
Filter bowl:	Cold extruded steel
Coating:	Powder paint resp. phosphate coating / primed
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

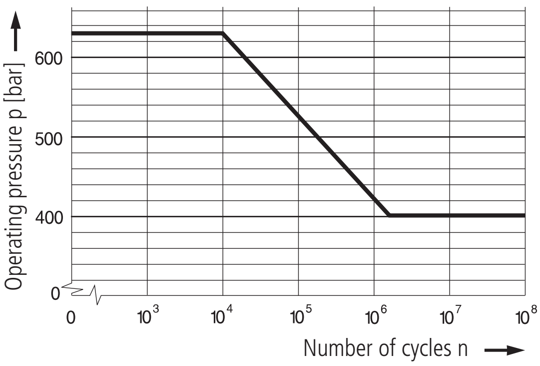
Accessories
If an electrical indicator is used a transparent socket with LED for optical indication is also available with Part No. DG 041.1200.

Characteristics

Operating pressure
0 ... 400 bar, min. 2 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 630 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 105 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 250 bar ≤ 8 m/s
  > 250 bar ≤ 12 m/s

Filter fineness
5 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
Preferably vertical, filter head on top

Connection
Threaded ports according to ISO 228 or DIN 13. Sizes see Selection Chart, column 6 (other port threads on request).

Electrical clogging indicator

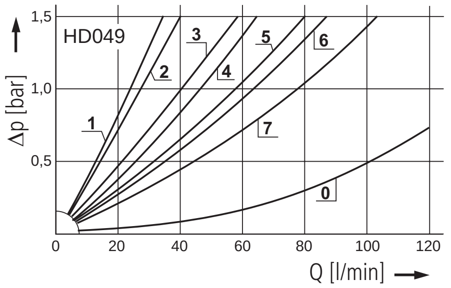
- Switching voltage: max. 120 V AC / 175 V DC
- Switching current: max. 0,17 A AC / 0,25 A DC
- Switching power: max. 3,5 VA AC / 5 W DC
- Type of contact: Change-over
- Electrical protection: IP 65 (with mounted and secured socket)

Diagrams

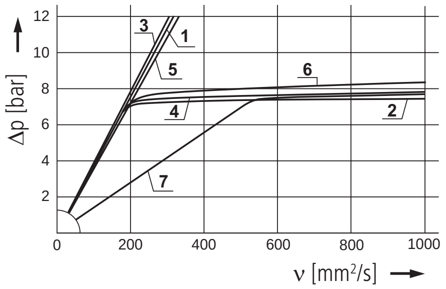
∆p-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)

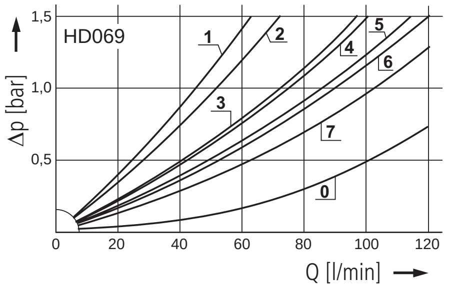


Pressure drop as a function of the **kinematic viscosity** at nominal flow

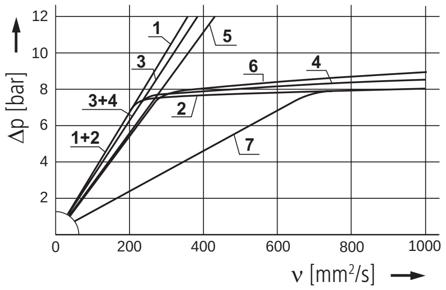


D2

Pressure drop as a function of the **flow volume** at ν = 35 mm²/s (0 = casing empty)



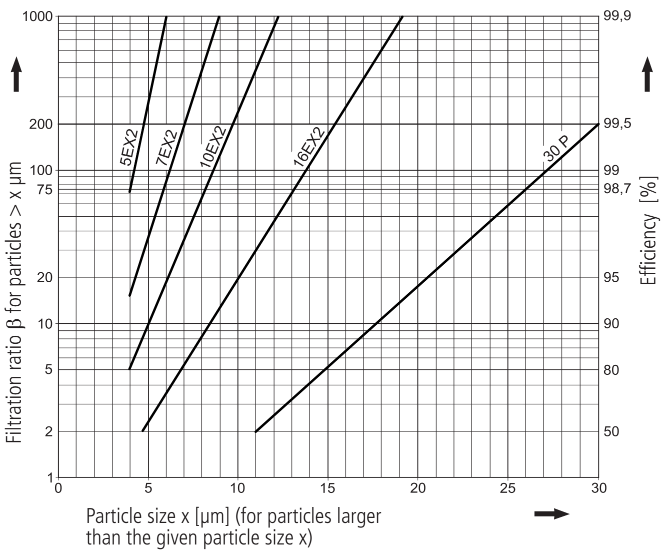
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

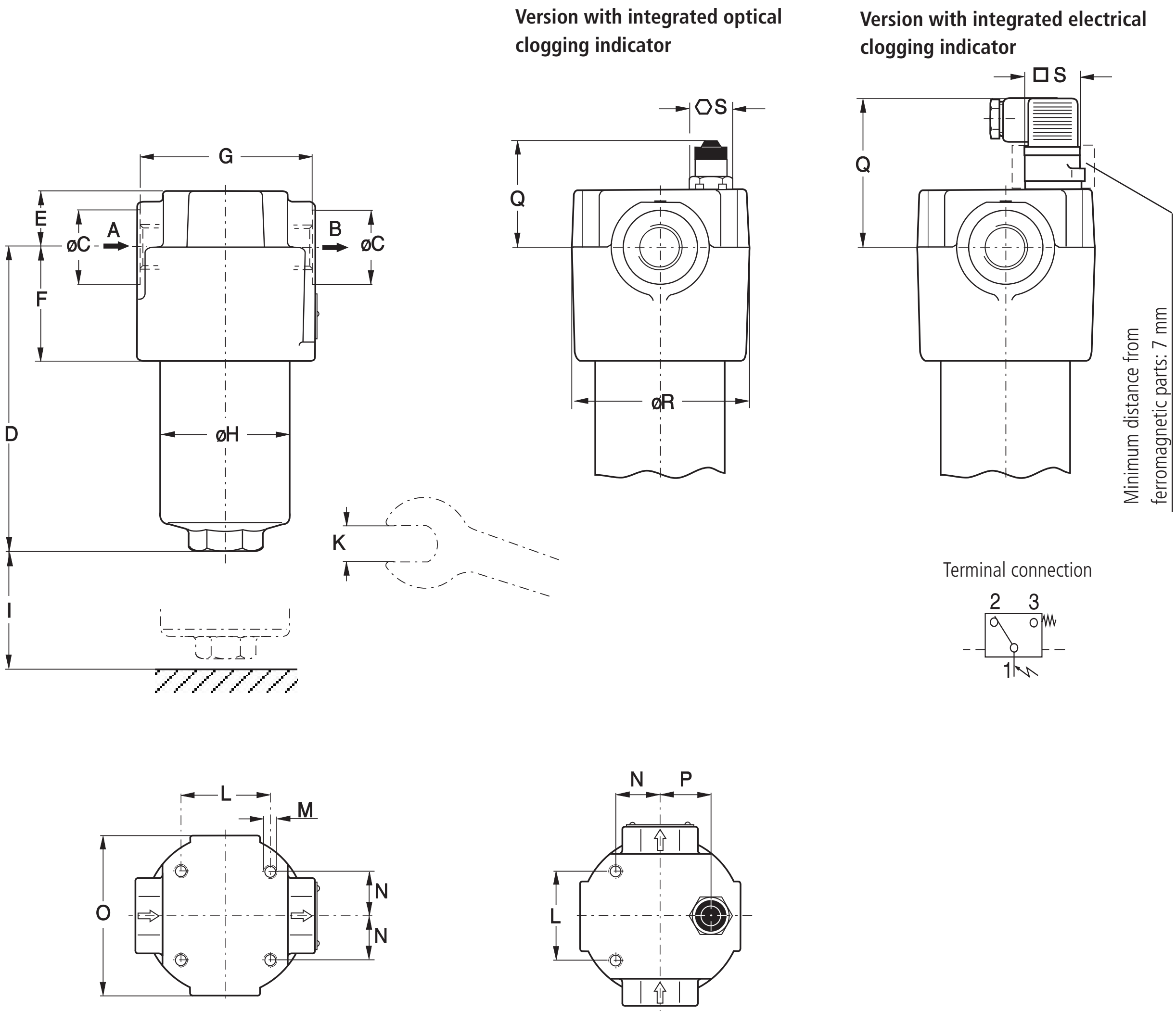
Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement element Part No.	Weight	Clogging indicator	Cracking pressure in ( )	Remarks
	l/min			g		bar			kg		bar	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		**12**
HD 049-189	27	**D1**/1	5EX2	5,2	G½	-	6	V3.0510-13[1]	3,9	electrical	(5)	change-over
HD 049-169	30	**D1**/2	5EX2	4,9	G½	7	1	V3.0510-03	3,8	-		-
HD 049-179	30	**D1**/2	5EX2	4,9	G½	7	2	V3.0510-03	3,9	optical	(5)	-
HD 049-159	30	**D1**/2	5EX2	4,9	G½	7	3	V3.0510-03	3,9	electrical	(5)	change-over
HD 049-186	47	**D1**/3	10EX2	5,1	G½	-	6	V3.0510-16[1]	3,9	electrical	(5)	change-over
HD 049-166	50	**D1**/4	10EX2	6,8	G½	7	1	V3.0510-06	3,8	-		-
HD 049-176	50	**D1**/4	10EX2	6,8	G½	7	2	V3.0510-06	3,9	optical	(5)	-
HD 049-156	50	**D1**/4	10EX2	6,8	G½	7	3	V3.0510-06	3,9	electrical	(5)	change-over
HD 049-188	65	**D1**/5	16EX2	5,6	G½	-	6	V3.0510-18[1]	3,9	electrical	(5)	change-over
HD 049-268	75	**D1**/6	16EX2	6,9	M18 x 1,5	7	1	V3.0510-08	3,8	-		[3]
HD 049-168	75	**D1**/6	16EX2	6,9	G½	7	1	V3.0510-08	3,8	-		-
HD 049-178	75	**D1**/6	16EX2	6,9	G½	7	2	V3.0510-08	3,9	optical	(5)	-
HD 049-158	75	**D1**/6	16EX2	6,9	G½	7	3	V3.0510-08	3,9	electrical	(5)	change-over
HD 049-151	55	**D1**/7	30P	3,6	G½	7	1	P3.0510-11[2]	3,8	-		-
HD 049-161	55	**D1**/7	30P	3,6	G½	7	2	P3.0510-11[2]	3,9	optical	(5)	-
HD 049-171	55	**D1**/7	30P	3,6	G½	7	3	P3.0510-11[2]	3,9	electrical	(5)	change-over
HD 069-189	50	**D2**/1	5EX2	8,7	G½	-	6	V3.0520-13[1]	5,1	electrical	(5)	change-over
HD 069-169	60	**D2**/2	5EX2	10	G½	7	1	V3.0520-03	4,9	-		-
HD 069-179	60	**D2**/2	5EX2	10	G½	7	2	V3.0520-03	5,0	optical	(5)	-
HD 069-159	60	**D2**/2	5EX2	10	G½	7	3	V3.0520-03	5,0	electrical	(5)	change-over
HD 069-186	80	**D2**/3	10EX2	11	G¾	-	6	V3.0520-16[1]	5,1	electrical	(5)	change-over
HD 069-166	85	**D2**/4	10EX2	14	G¾	7	1	V3.0520-06	4,9	-		-
HD 069-176	85	**D2**/4	10EX2	14	G¾	7	2	V3.0520-06	5,0	optical	(5)	-
HD 069-156	85	**D2**/4	10EX2	14	G¾	7	3	V3.0520-06	5,0	electrical	(5)	change-over
HD 069-188	100	**D2**/5	16EX2	12	G¾	-	6	V3.0520-18[1]	5,1	electrical	(5)	change-over
HD 069-268	105	**D2**/6	16EX2	15	G¾	7	1	V3.0520-08	4,9	-		[3]
HD 069-168	105	**D2**/6	16EX2	15	G¾	7	1	V3.0520-08	4,9	-		-
HD 069-178	105	**D2**/6	16EX2	15	G¾	7	2	V3.0520-08	5,0	optical	(5)	-
HD 069-158	105	**D2**/6	16EX2	15	G¾	7	3	V3.0520-08	5,0	electrical	(5)	change-over
HD 069-151	80	**D2**/7	30P	7,1	G¾	7	1	P3.0520-01[2]	4,9	-		-
HD 069-161	80	**D2**/7	30P	7,1	G¾	7	2	P3.0520-01[2]	5,0	optical	(5)	-
HD 069-171	80	**D2**/7	30P	7,1	G¾	7	3	P3.0520-01[2]	5,0	electrical	(5)	change-over

Remarks:

- The filters listed in this chart are standard filters. If modifications are required, e.g. bolt mounted indicators according to catalogue sheet 60.30, we kindly ask for your request.
- If an electrical indicator is used a transparent socket with LED for optical indication is also available with Part No. DG 041.1200.

[1] Element differential pressure up to 160 bar [2] Paper media supported with metal gauze [3] Housing primed/phosphated

Dimensions

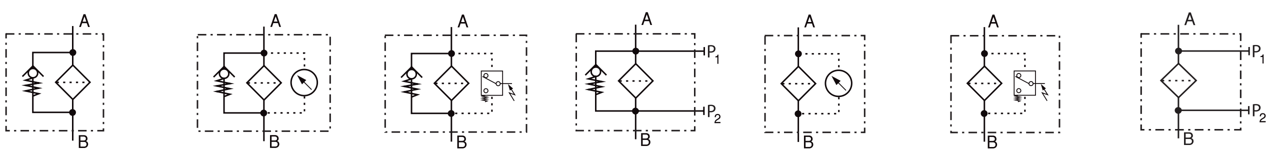


Measurements

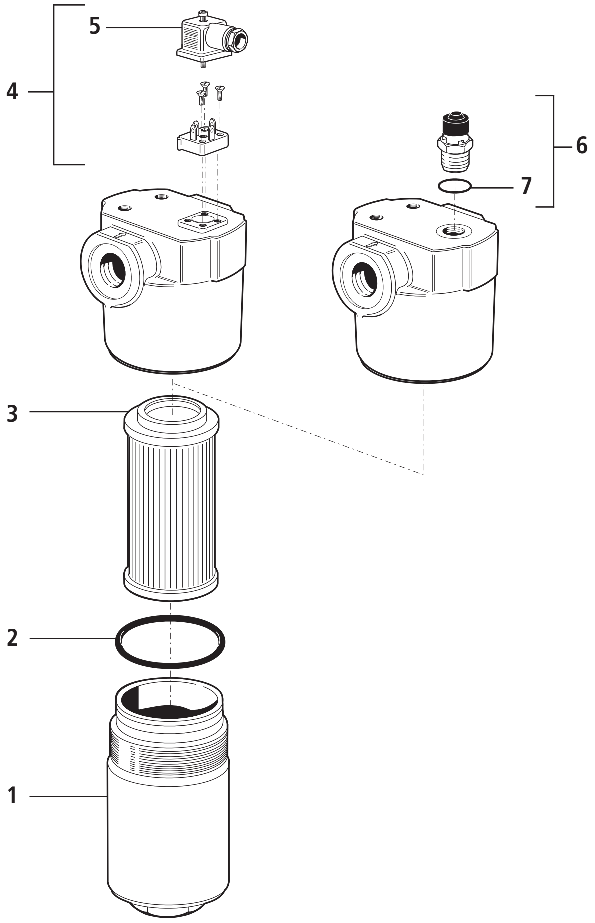
Type	A/B	C	D	E	F	G	H	I	K	L	M Ø/depth	N	O	P	Q opt./electr.	R	S opt./electr.
HD 049	G½, M18 x 1,5	28 resp. 33	158	24,5	61	84	65	55	36	40	M8/12	25	89	27,5	55/72	85	24/30
HD 069	G½, G¾	33 resp. 36	254	24,5	61	84	65	55	36	40	M8/12	25	89	27,5	55/72	85	24/30

Symbols

1 **2** **3** **4** **5** **6** **7**



Spare Parts



Pos.	Designation	Part No.
1	Filter bowl HD 049	HD 052.0102
1	Filter bowl HD 069	HD 072.0102
2	O-ring 53,57 x 3,53	N007.0543/1
3	Filter element	s. Chart / col. 9
4	Reed switch with screws and socket (Pos. 5)	HD 049.1410
5	Socket DIN 43650 - AF3	DG 041.1220
6	Optical indicator (with Pos. 7)	HD 049.1400
7	O-ring 17 x 2	N007.0172

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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ARGO HYTOS

High Pressure Filters – Worldline 200

HD 152 · HD 172

- In-line mounting
- Operating pressure up to 630 bar
- Nominal flow rate up to 190 l/min

40.55-6e

Description

Application
In the high pressure circuits of hydraulic systems.

Performance features

Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Spheroidal graphite cast iron (SGI)
Filter bowl:	Cold extruded steel
Coating:	Powder paint
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 -inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

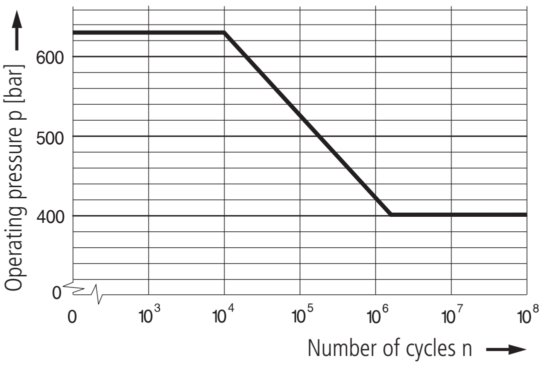
Accessories
If an electrical indicator is used a transparent socket with LED for optical indication is also available with Part No. DG 041.1200.

Characteristics

Operating pressure
0 ... 400 bar, min. 2 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 630 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 190 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 250 bar ≤ 8 m/s
  > 250 bar ≤ 12 m/s

Filter fineness
5 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
Preferably vertical, filter head on top

Connection
Threaded ports according to ISO 228 or DIN 13. Sizes see Selection Chart, column 6 (other port threads on request).

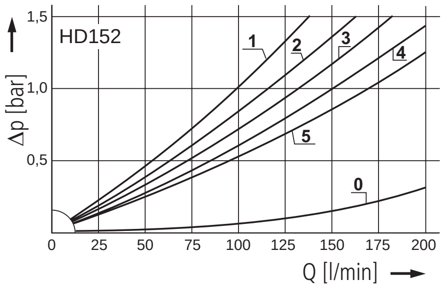
Electrical clogging indicator
- Switching voltage: max. 120 V AC / 175 V DC
- Switching current: max. 0,17 A AC / 0,25 A DC
- Switching power: max. 3,5 VA AC / 5 W DC
- Type of contact: Change-over
- Electrical protection: IP 65 (with mounted and secured socket)

Diagrams

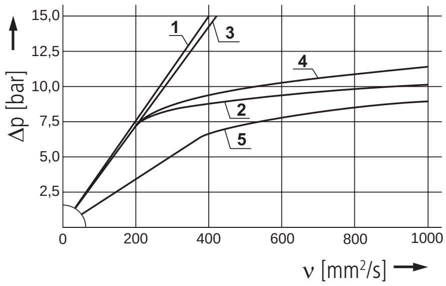
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

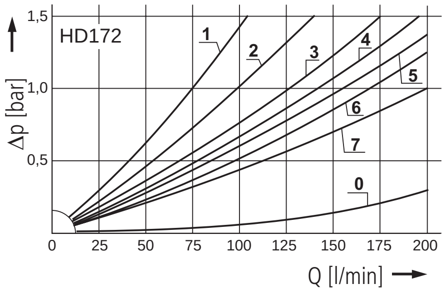


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

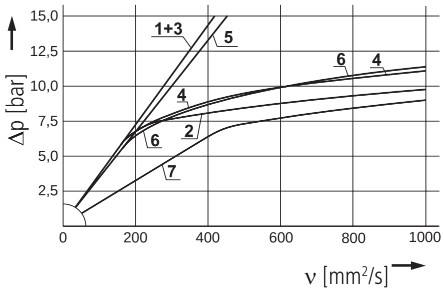


D2

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)



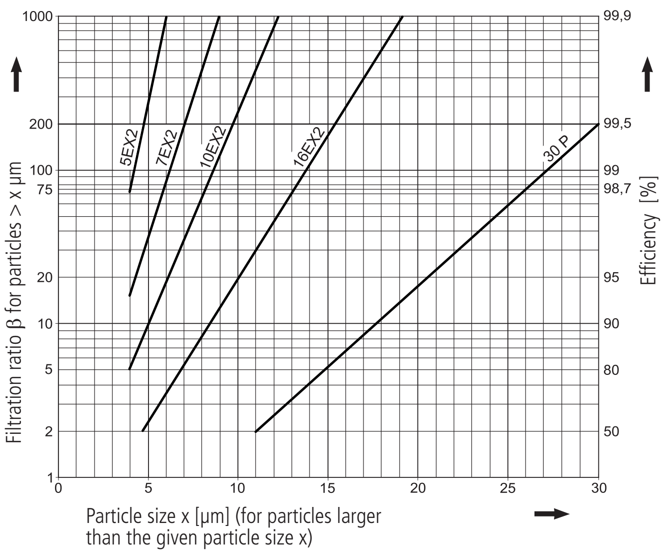
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 μm
60S = screen material with mesh size 60 μm
100S = screen material with mesh size 100 μm

Tolerances for mesh size according to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter media.

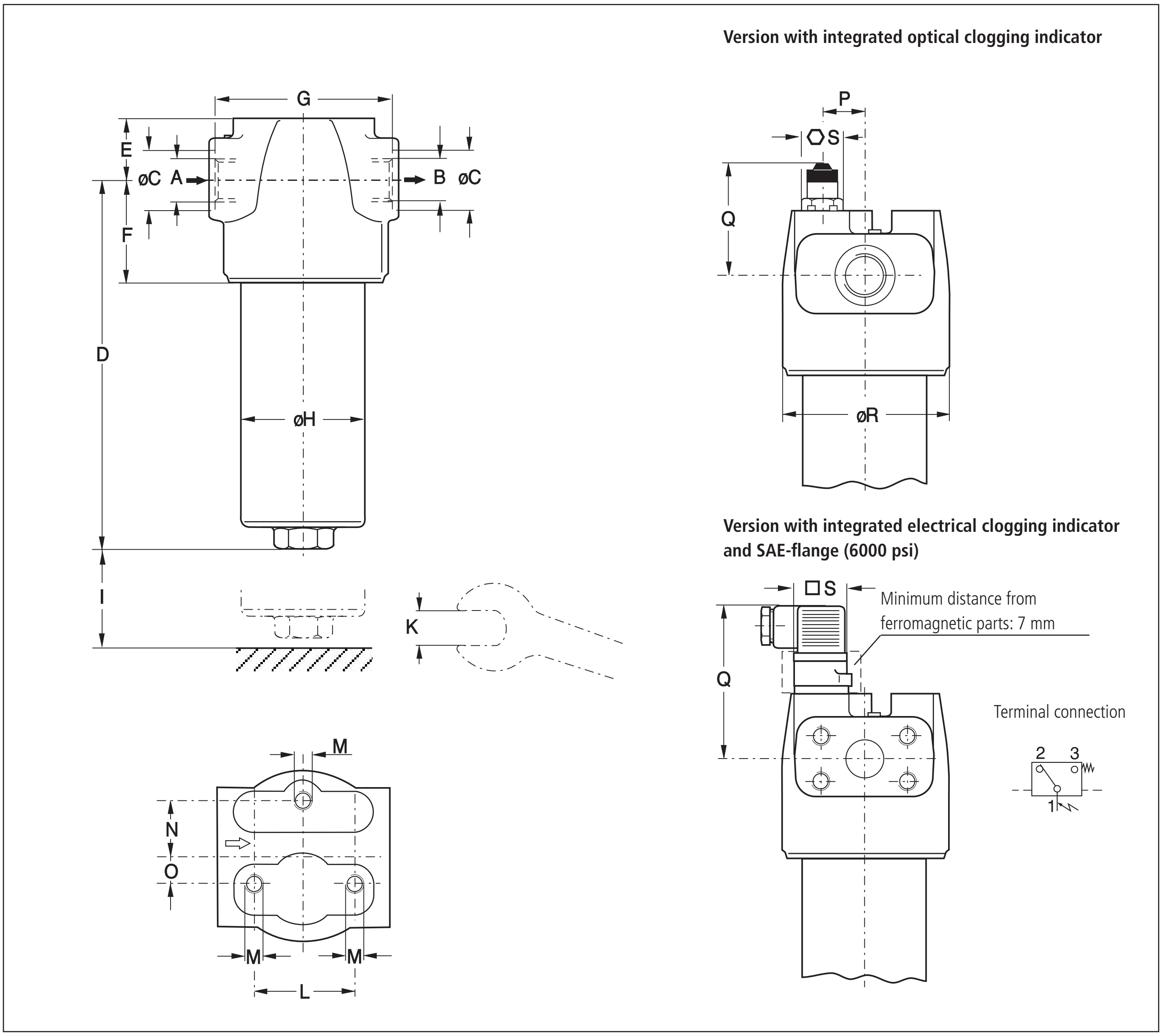
Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator Cracking pressure in ( )	Remarks
	l/min			g		bar			kg	bar	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
HD 152-186	110	**D1**/1	10EX2	13	G¾	-	6	V3.0617-26[1]	7,1	electrical (5)	change-over
HD 152-166	125	**D1**/2	10EX2	17	G¾	7	1	V3.0617-06	6,9	-	-
HD 152-276	125	**D1**/2	10EX2	17	G¾	7	2	V3.0617-06	7,0	optical (5)	-
HD 152-156	125	**D1**/2	10EX2	17	G¾	7	3	V3.0617-06	7,0	electrical (5)	change-over
HD 152-188	150	**D1**/3	16EX2	14	G1	-	6	V3.0617-18[1]	7,1	electrical (5)	change-over
HD 152-168	175	**D1**/4	16EX2	17	G1	7	1	V3.0617-08	6,9	-	-
HD 152-278	175	**D1**/4	16EX2	17	G1	7	2	V3.0617-08	7,0	optical (5)	-
HD 152-158	175	**D1**/4	16EX2	17	G1	7	3	V3.0617-08	7,0	electrical (5)	change-over
HD 152-151	130	**D1**/5	30P	8,7	G1	7	1	P3.0617-01[2]	6,9	-	-
HD 152-261	130	**D1**/5	30P	8,7	G1	7	2	P3.0617-01[2]	7,0	optical (5)	-
HD 172-189	80	**D2**/1	5EX2	16	G1	-	6	V3.0623-13[1]	8,4	electrical (5)	change-over
HD 172-163	110	**D2**/2	5EX2	17	G1	7	1	V3.0623-03	8,0	-	-
HD 172-273	110	**D2**/2	5EX2	17	G1	7	2	V3.0623-03	8,1	optical (5)	-
HD 172-153	110	**D2**/2	5EX2	17	G1	7	3	V3.0623-03	8,1	electrical (5)	change-over
HD 172-186	140	**D2**/3	10EX2	18	G1	-	6	V3.0623-26[1]	8,4	electrical (5)	change-over
HD 172-166	160	**D2**/4	10EX2	23	G1	7	1	V3.0623-06	8,0	-	-
HD 172-276	160	**D2**/4	10EX2	23	G1	7	2	V3.0623-06	8,1	optical (5)	-
HD 172-156	160	**D2**/4	10EX2	23	G1	7	3	V3.0623-06	8,1	electrical (5)	change-over
HD 172-188	180	**D2**/5	16EX2	19	G1	-	6	V3.0623-18[1]	8,4	electrical (5)	change-over
HD 172-168	190	**D2**/6	16EX2	25	G1	7	1	V3.0623-08	8,0	-	-
HD 172-278	190	**D2**/6	16EX2	25	G1	7	2	V3.0623-08	8,1	optical (5)	-
HD 172-158	190	**D2**/6	16EX2	25	G1	7	3	V3.0623-08	8,1	electrical (5)	change-over
HD 172-151	150	**D2**/7	30P	14	G1	7	1	P3.0623-11[2]	8,0	-	-
HD 172-261	150	**D2**/7	30P	14	G1	7	2	P3.0623-11[2]	8,1	optical (5)	-

Remarks:
- The filters listed in this chart are standard filters. If modifications are required, e.g. connections SAE ¾ resp. SAE 1 (6.000 psi), we kindly ask for your request.
- If an electrical indicator is used a transparent socket with LED for optical indication is also available with Part No. DG 041.1200.

[1] Filter element differential pressure stable up to 160 bar   [2] Paper media supported with metal gauze

Dimensions

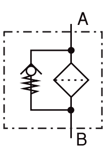


Measurements

Type	A/B	C	D	E	F	G	H	I	K A/F	L	M Ø/depth	N	O	P	Q opt./electr.	R	S opt./electr.
HD 152	G¾, G1	36, 45	224	39	66	104	75	70	27	60	M10/12	35	17,5	30	69/86	102	24/30
HD 172	G1	45	285	39	66	104	75	70	27	60	M10/12	35	17,5	30	69/86	102	24/30

Symbols

1



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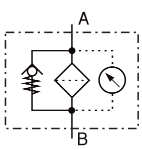

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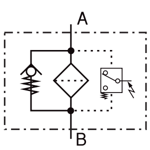

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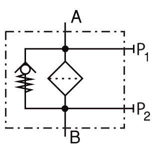

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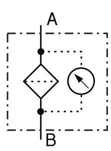

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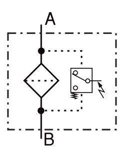

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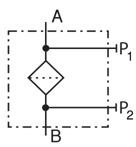
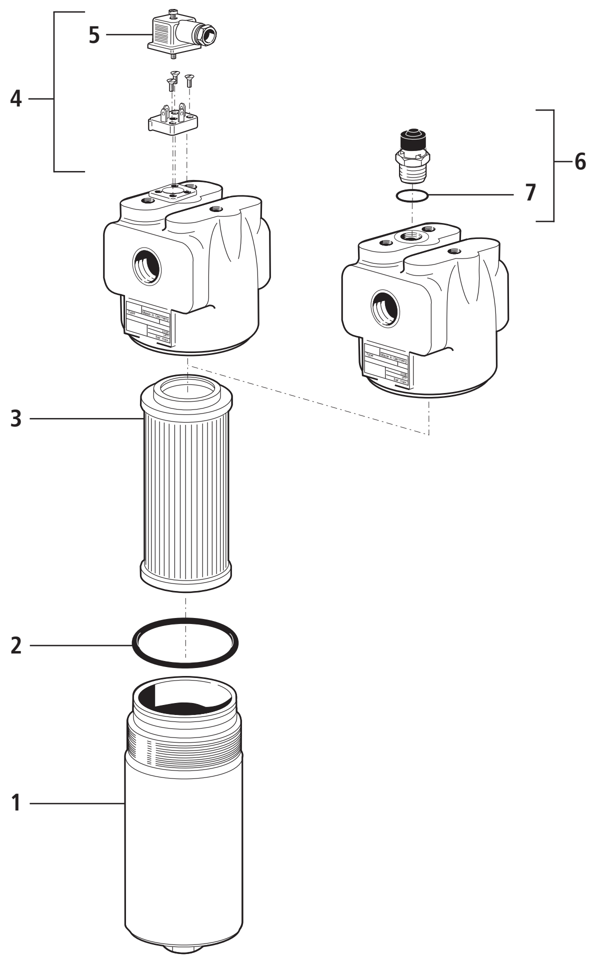


Spare Parts



Pos.	Designation	Part No.
1	Filter bowl HD 152	HD 152.0102
1	Filter bowl HD 172	HD 171.0102
2	O-ring 63 x 3,5	N007.0634
3	Filter element	see Chart/col. 9
4	Reed switch with screws and socket (Pos. 5)	HD 049.1410
5	Socket DIN 43650 - AF3	DG 041.1220
6	Optical indicator (with Pos. 7)	HD 049.1400
7	O-ring 17 x 2	N007.0172

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Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

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ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

We produce fluid power solutions

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High Pressure Filters - Worldline 300

HD 319 • HD 419
HD 619

- In-line mounting
- Operating pressure up to 630 bar
- Nominal flow rate up to 450 l/min

40.70-4e

Description

Application
In the high pressure circuits of hydraulic systems.

Performance features
Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200\ mm^2/s$ (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

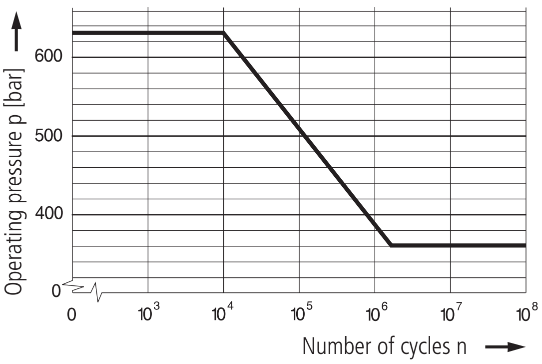
Materials
Filter head:	Spheroidal graphite cast iron (SGI)
Filter bowl:	Cold extruded steel
Coating:	Powder paint
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX - inorganic multi-layer microfibre web

Accessories
If an electrical indicator is used, a transparent socket with LED for optical indication is also available with Part No. DG 041.1200.

Characteristics

Operating pressure
0 ... 360 bar, min. 2 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 630 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles


Nominal flow rate
Up to 450 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200\ mm^2/s$
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 250 bar ≤ 8 m/s
  > 250 bar ≤ 12 m/s

Filter fineness
5 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60\ mm^2/s$
- as starting viscosity: $\nu_{max} = 1.200\ mm^2/s$
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
Preferably vertical, filter head on top

Connection
- Threaded ports according to ISO 228 or DIN 13.
- SAE-flange (6000 psi)

Sizes see Selection Chart, column 6 and ordering example (other connections on request).

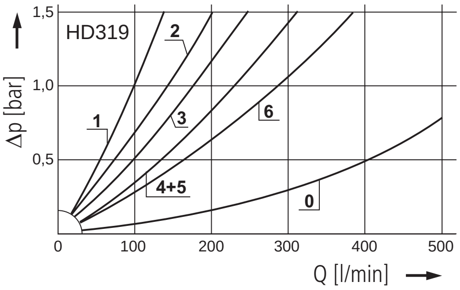
Electrical clogging indicator
- Switching voltage: max. 120 V AC / 175 V DC
- Switching current: max. 0,17 A AC / 0,25 A DC
- Switching power: max. 3,5 VA AC / 5 W DC
- Type of contact: Change-over
- Electrical protection: IP 65 (with mounted and secured socket)

Diagrams

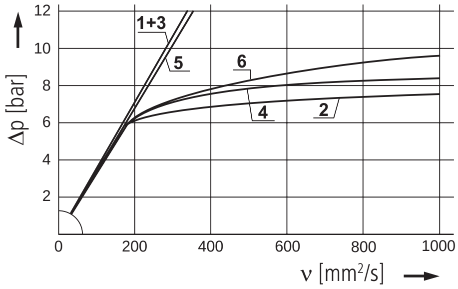
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

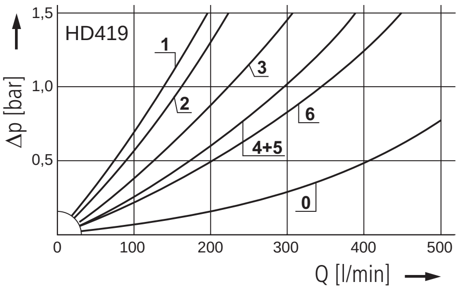


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

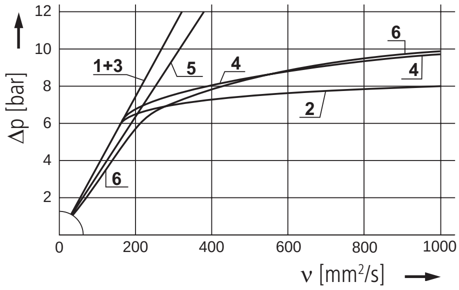


D2

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

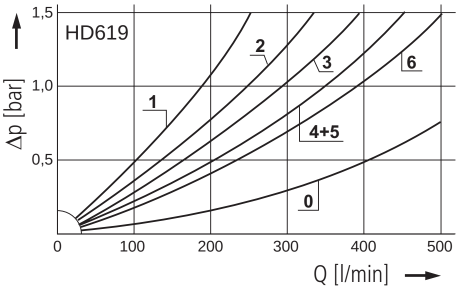


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

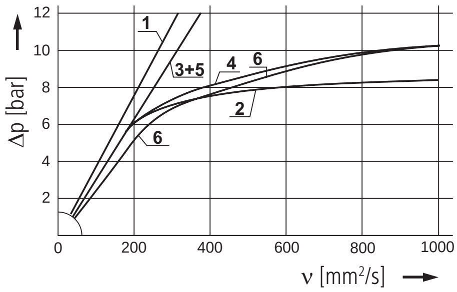


D3

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)



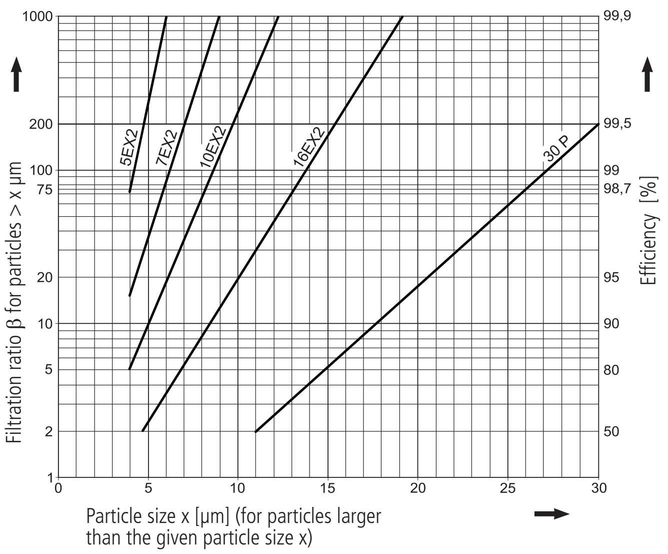
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator Cracking pressure in ( )		Remarks
	l/min			g		bar			kg		bar	
1	2	3	4	5	6	7	8	9	10	11		12
HD 319-289	110	**D1**/1	5EX2	20	G1¼	-	6	V3.0817-13[1]	16,3	electrical	(5)	change-over
HD 319-279	155	**D1**/2	5EX2	24	G1¼	7	2	V3.0817-03	15,9	optical	(5)	-
HD 319-259	155	**D1**/2	5EX2	24	G1¼	7	3	V3.0817-03	15,9	electrical	(5)	change-over
HD 319-286	195	**D1**/3	10EX2	24	G1¼	-	6	V3.0817-16[1]	16,3	electrical	(5)	change-over
HD 319-276	250	**D1**/4	10EX2	33	G1¼	7	2	V3.0817-06	15,9	optical	(5)	-
HD 319-256	250	**D1**/4	10EX2	33	G1¼	7	3	V3.0817-06	15,9	electrical	(5)	change-over
HD 319-288	270	**D1**/5	16EX2	25	G1¼	-	6	V3.0817-18[1]	16,3	electrical	(5)	change-over
HD 319-278	330	**D1**/6	16EX2	33	G1¼	7	2	V3.0817-08	15,9	optical	(5)	-
HD 319-258	330	**D1**/6	16EX2	33	G1¼	7	3	V3.0817-08	15,9	electrical	(5)	change-over
HD 419-289	155	**D2**/1	5EX2	29	G1¼	-	6	V3.0823-13[1]	17,8	electrical	(5)	change-over
HD 419-279	190	**D2**/2	5EX2	33	G1¼	7	2	V3.0823-03	17,2	optical	(5)	-
HD 419-259	190	**D2**/2	5EX2	33	G1¼	7	3	V3.0823-03	17,2	electrical	(5)	change-over
HD 419-286	265	**D2**/3	10EX2	33	G1¼	-	6	V3.0823-16[1]	17,8	electrical	(5)	change-over
HD 419-276	330	**D2**/4	10EX2	47	G1¼	7	2	V3.0823-06	17,2	optical	(5)	-
HD 419-256	330	**D2**/4	10EX2	47	G1¼	7	3	V3.0823-06	17,2	electrical	(5)	change-over
HD 419-288	330	**D2**/5	16EX2	35	G1¼	-	6	V3.0823-18[1]	17,8	electrical	(5)	change-over
HD 419-278	380	**D2**/6	16EX2	48	G1¼	7	2	V3.0823-08	17,2	optical	(5)	-
HD 419-258	380	**D2**/6	16EX2	48	G1¼	7	3	V3.0823-08	17,2	electrical	(5)	change-over
HD 619-289	220	**D3**/1	5EX2	41	G1½	-	6	V3.0833-13[1]	20,6	electrical	(5)	change-over
HD 619-279	280	**D3**/2	5EX2	49	G1½	7	2	V3.0833-03	19,9	optical	(5)	-
HD 619-259	280	**D3**/2	5EX2	49	G1½	7	3	V3.0833-03	19,9	electrical	(5)	change-over
HD 619-286	330	**D3**/3	10EX2	49	G1½	-	6	V3.0833-16[1]	20,6	electrical	(5)	change-over
HD 619-276	400	**D3**/4	10EX2	67	G1½	7	2	V3.0833-06	19,9	optical	(5)	-
HD 619-256	400	**D3**/4	10EX2	67	G1½	7	3	V3.0833-06	19,9	electrical	(5)	change-over
HD 619-288	450	**D3**/5	16EX2	51	G1½	-	6	V3.0833-18[1]	20,6	electrical	(5)	change-over
HD 619-278	450	**D3**/6	16EX2	68	G1½	7	2	V3.0833-08	19,9	optical	(5)	-
HD 619-258	450	**D3**/6	16EX2	68	G1½	7	3	V3.0833-08	19,9	electrical	(5)	change-over

Two different head pieces with two various connecting options are available.

Order example: The Filter HD 319-289 has to be supplied with SAE 1¼ flanged connection.

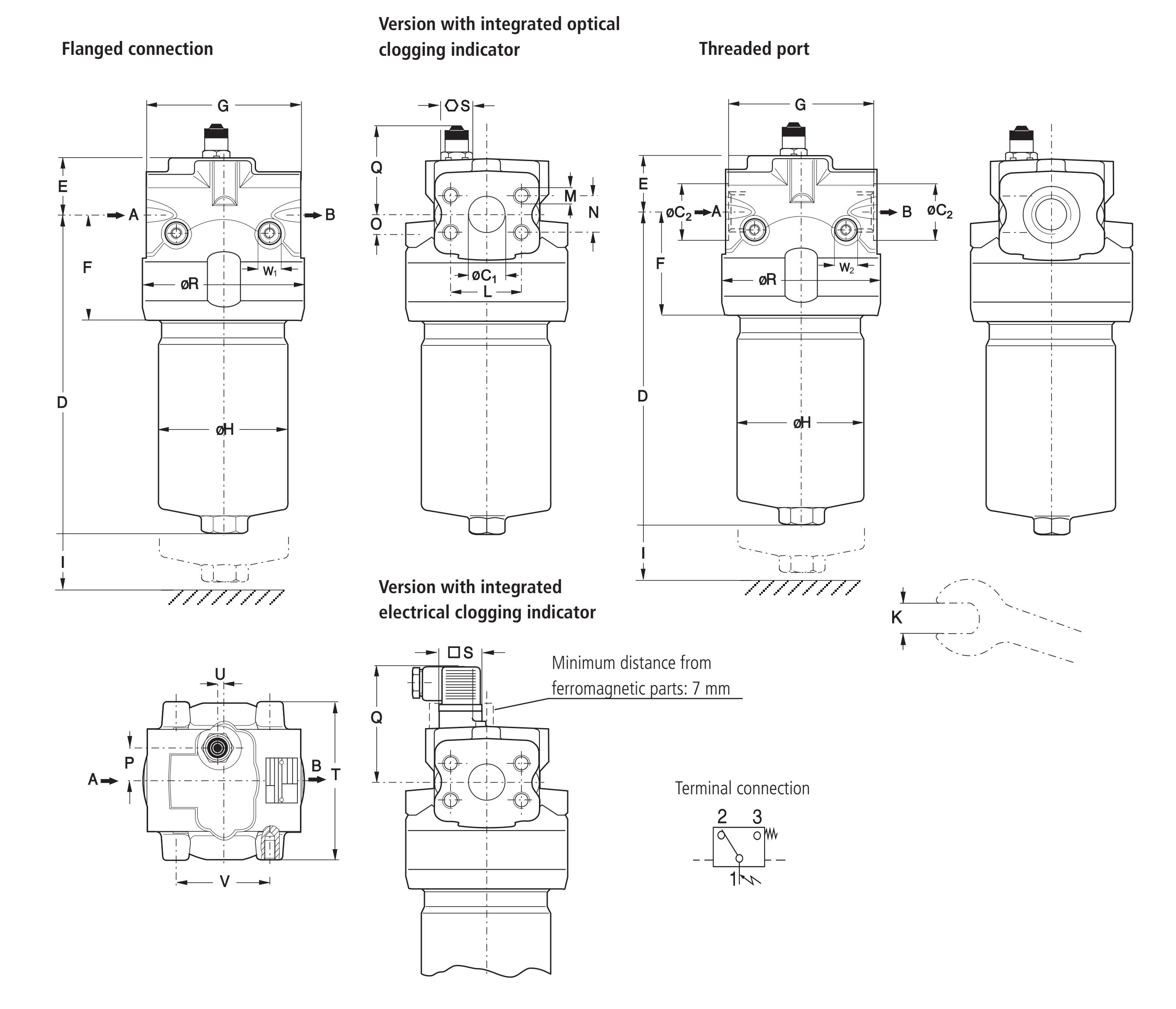
Order description: **HD 319-189**

Connections:
2 options are available
Flanged connection (A/B) SAE 1¼ (6000 psi) —— 1
Threaded port (A/B) G1¼ or G1½[2] —— 2

Remarks:
- The filters listed in this chart are standard filters. If modifications are required, e.g. bolt mounted indicators according to catalogue sheet 60.30, we kindly ask for your request.
- If an electrical indicator is used, a transparent socket with LED for optical indication is also available with Part No. DG 041.1200.

[1] Element differential pressure stable up to 160 bar [2] G1½ for series HD 619

Dimensions

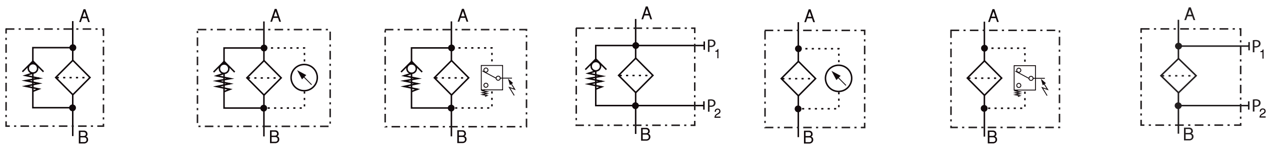


Measurements

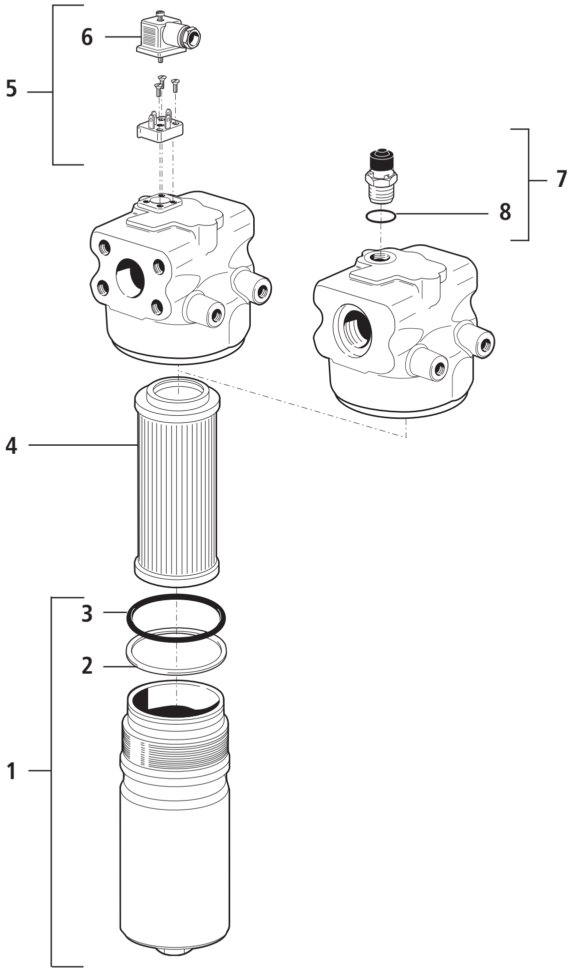
Type	A/B	C_1	C_2	D	E	F	G	H	I	K	L	M Ø/depth	N	O	P	Q opt./electr.	R	S opt./electr.	T	U	V	W Ø/depth
HD 319	see	31	65	255	45	86	145	109	80	32	66,7	M14/22	31,8	18,5	33	75/92	152	24/30	148	8	80	M12/18
HD 419	Selection	31	65	319	45	86	145	109	80	32	66,7	M14/22	31,8	18,5	33	75/92	152	24/30	148	8	80	M12/18
HD 619	Chart	31	65	420	45	86	145	109	80	32	66,7	M14/22	31,8	18,5	33	75/92	152	24/30	148	8	80	M12/18

Symbols

1 2 3 4 5 6 7



Spare Parts



Pos.	Designation	Part No.
1	Filter bowl HD 319 (with Pos. 2 and 3)	HD 250.0701
1	Filter bowl HD 419 (with Pos. 2 and 3)	HD 451.0702
1	Filter bowl HD 619 (with Pos. 2 and 3)	HD 619.0701
2	Back-ring	HD 255.0102
3	O-ring 94,84 x 3,53	N007.0953
4	Filter element	see Chart / col. 9
5	Reed switch with screws and socket (Pos. 6)	HD 049.1410
6	Reed switch with screws DIN 43650 - AF3	DG 041.1220
7	Optical indicator (with Pos. 8)	HD 049.1400
8	O-ring 17 x 2	N007.0172

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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ARGO HYTOS

High Pressure Filters – Worldline 400

HD 790 · HD 990

- In-line mounting
- Operating pressure up to 630 bar
- Nominal flow rate up to 1.000 l/min

40.90-3e

Description

Application
In the high pressure circuits of hydraulic systems.

Performance features
Protection
against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.
Protection against
malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Filter elements
Flow direction from outside to center. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Spheroidal graphite cast iron (SGI)
Filter bowl:	Steel
Housing cover:	Spheroidal graphite cast iron (SGI)
Coating:	Powder paint
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 – inorganic multi-layer microfibre web

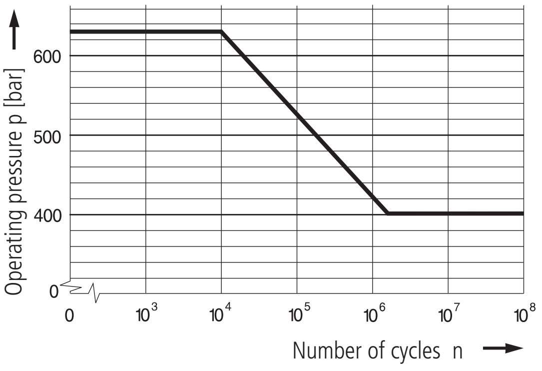
Accessories
Electrical and/or optical clogging indicators are available – optionally with one or two switching points resp. temperature suppression.
Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Operating pressure
0 ... 400 bar, min. 2 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 630 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 1000 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0.07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 250 bar ≤ 8 m/s
  > 250 bar ≤ 12 m/s

Filter fineness
5 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
Preferably vertical. The filter head can be mounted in either the uppermost position or the inverse as required.

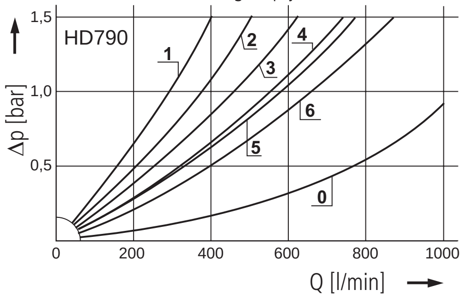
Connection
SAE-flange (6000 psi).
Sizes see Selection Chart, column 6 (other connections on request).

Diagrams

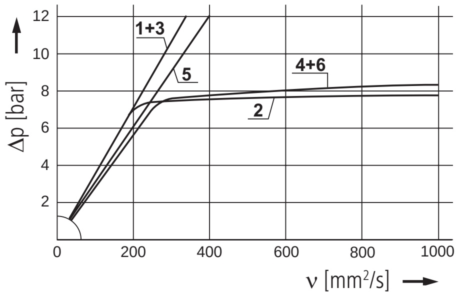
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at ν = 35 mm^2/s (0 = casing empty)

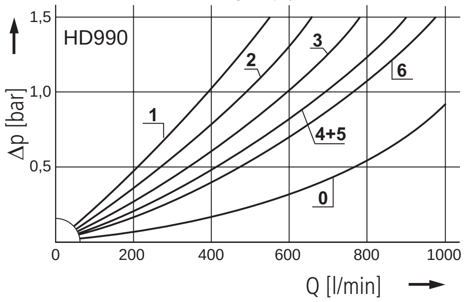


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

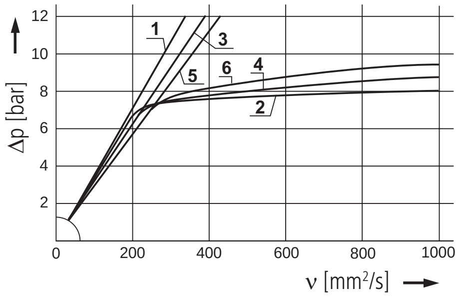


D2

Pressure drop as a function of the **flow volume**
at ν = 35 mm^2/s (0 = casing empty)



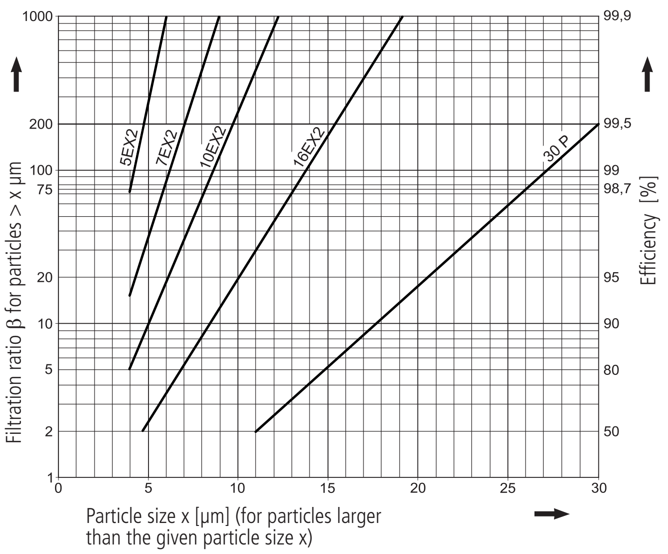
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Charts

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator	Remarks
	l/min			g		bar			kg		
1	2	3	4	5	6	7	8	9	10	11	12
HD 790-189	320	**D1**/1	5EX2	58	SAE 2	-	7	V3.1040-13*	47	optional	-
HD 790-159	440	**D1**/2	5EX2	63	SAE 2	7	4	V3.1040-03	46	optional	-
HD 790-186	540	**D1**/3	10EX2	71	SAE 2	-	7	V3.1040-16*	47	optional	-
HD 790-156	640	**D1**/4	10EX2	88	SAE 2	7	4	V3.1040-06	46	optional	-
HD 790-188	660	**D1**/5	16EX2	72	SAE 2	-	7	V3.1040-18*	47	optional	-
HD 790-158	750	**D1**/6	16EX2	89	SAE 2	7	4	V3.1040-08	46	optional	-
HD 990-189	460	**D2**/1	5EX2	85	SAE 2	-	7	V3.1060-13*	56	optional	-
HD 990-159	570	**D2**/2	5EX2	95	SAE 2	7	4	V3.1060-03	55	optional	-
HD 990-186	680	**D2**/3	10EX2	110	SAE 2	-	7	V3.1060-16*	56	optional	-
HD 990-156	780	**D2**/4	10EX2	130	SAE 2	7	4	V3.1060-06	55	optional	-
HD 990-188	870	**D2**/5	16EX2	110	SAE 2	-	7	V3.1060-18*	56	optional	-
HD 990-158	1000	**D2**/6	16EX2	140	SAE 2	7	4	V3.1060-08	55	optional	-

Optical or electrical indicators are available to monitor the clogging condition of the element. If the indicator should be already mounted onto the filter head use the abbreviation "M" behind the part number of the indicator. The printed order acknowledgements show both items separately.

Order example: The filter HD 790-156 has to be supplied with optical clogging indicator – response pressure 5,0 bar

Order description: **HD 790-156 / DG 042-02 M**

Part No. (Basic unit) — HD 790-156

Clogging indicator — DG 042-02

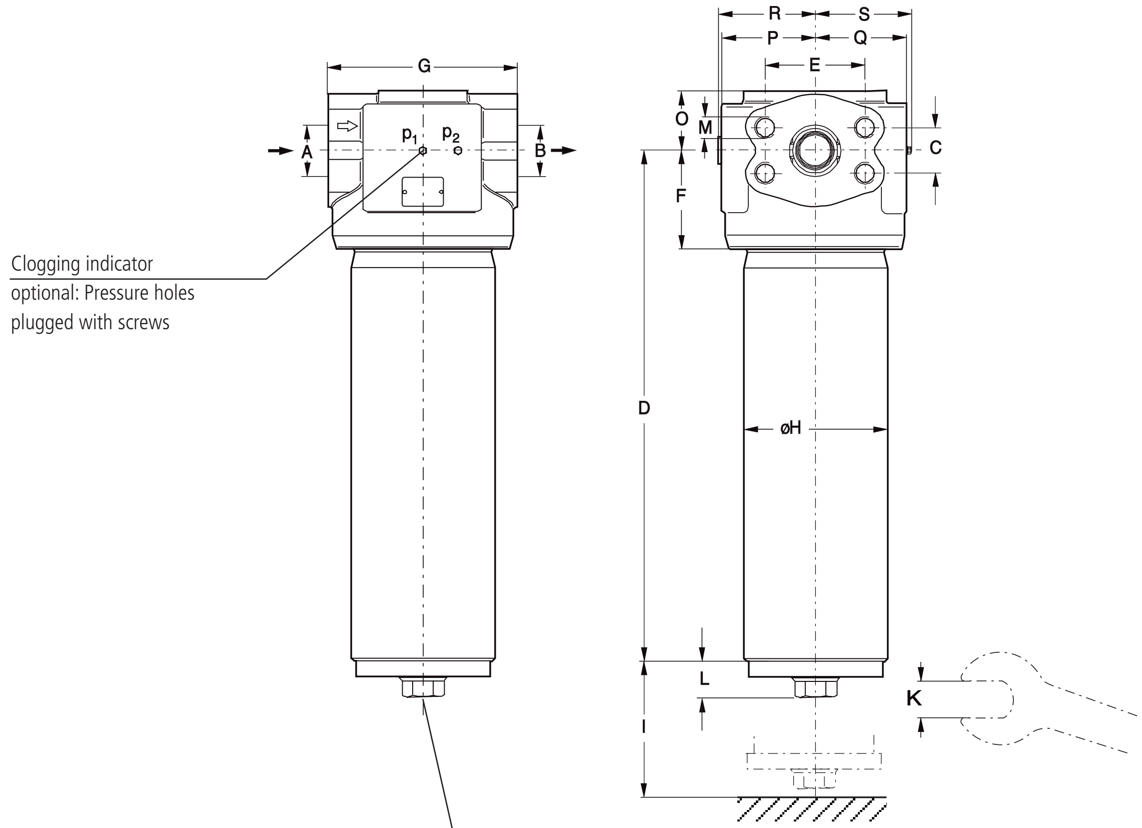
mounted — M

For the appropriate clogging indicators see catalogue sheet 60.30.

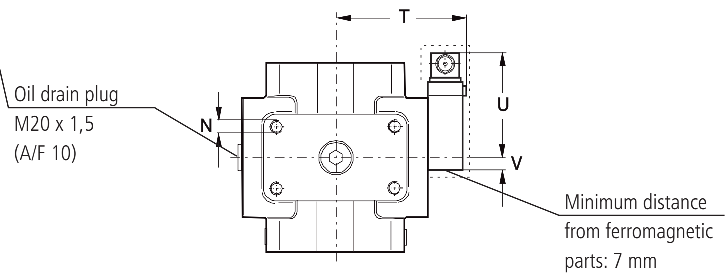
Remarks:
- Filter versions without by-pass valves must always be equipped with a clogging indicator.
- The filters listed in this chart are standard filters. Other designs available on request.

* Element differential pressure stable up to 160 bar, clogging indicator is obligatory

Dimensions



Version with electrical clogging indicator DG 041

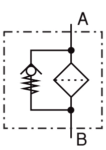


Measurements

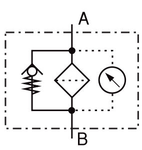
Type	A/B	C	D	E	F	G	H	I	K A/F	L	M Ø/depth	N Ø/depth	O	P	Q	R	S	T	U	V
HD 790	SAE 2	44,4	495	96,6	96	184	140	430	36	36	M20/32	M12/20	58	91	89	95	93	122	102	13
HD 990	SAE 2	44,4	700	96,6	96	184	140	640	36	36	M20/32	M12/20	58	91	89	95	93	122	102	13

Symbols

1



2



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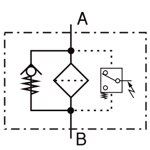

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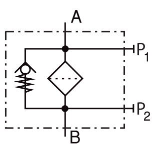

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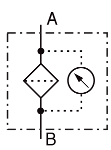
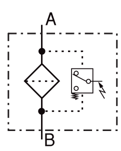
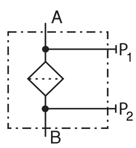


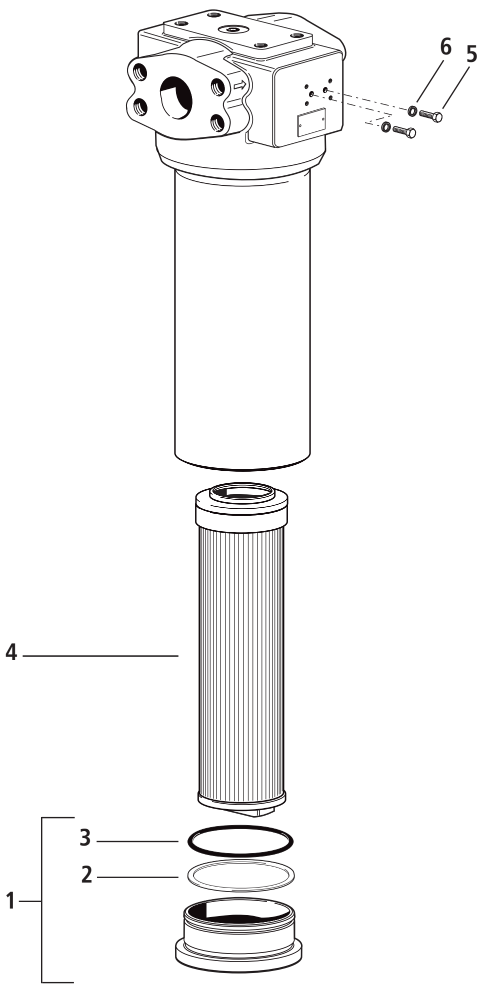
6



7



Spare Parts



Pos.	Designation	Part No.
1	Housing cover (with Pos. 2 and 3)	HD 990.1900
2	Back-ring	HD 256.0104
3	O-ring 104.37 x 3.53	N007.1044S
4	Filter element	see Chart / col. 9
5	Hexagonal head screw M4 x 8 ISO 4017-8.8	11385800
6	Bonded seal 4.1 x 7.2 x 1	12504600

The functions of the complete filters, as well as the outstanding features of the filter elements assured by ARGO-HYTOS, can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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Phone: +49 7250 76-0 · Fax: +49 7250 76-199 · info@argo-hytos.com · www.argo-hytos.com

High Pressure Filters

HD 044 · HD 064

- Flangeable
- Operating pressure up to 500 bar
- Nominal flow rate up to 105 l/min

40.30-4e

Description

Application
In the high pressure circuits of hydraulic systems.

Performance features
Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Filter head:	Spheroidal graphite cast iron (SGI)
Filter bowl:	Cold extruded steel
Coating:	Powder paint
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web

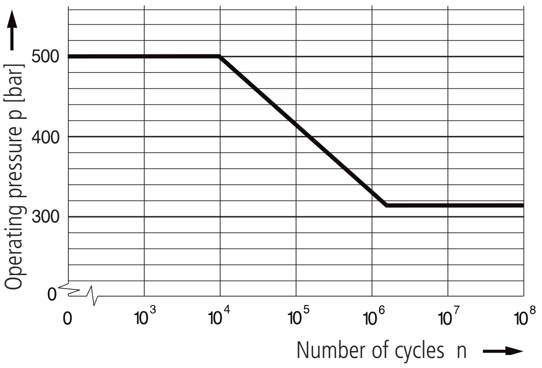
Accessories
Electrical and/or optical clogging indicators are available - optionally with one or two switching points resp. temperature suppression.
Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Operating pressure
0 ... 315 bar, min. 2 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 500 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 105 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 250 bar ≤ 8 m/s
  > 250 bar ≤ 12 m/s

Filter fineness
5 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: < 60 mm²/s
- as starting viscosity: ν_{max} = 1.200 mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
Preferably vertical, filter head on top

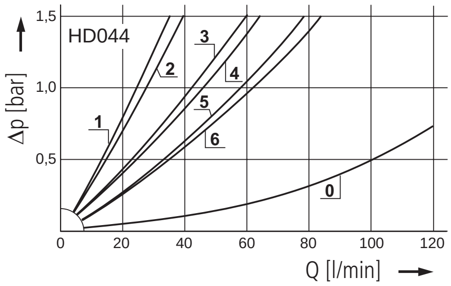
Connection
2 x Ø 15 mm on plain flange

Diagrams

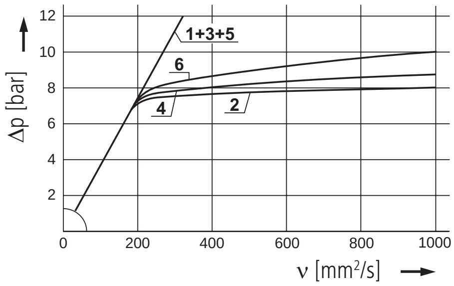
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume** at $\nu = 35\ mm^2/s$ (0 = casing empty)

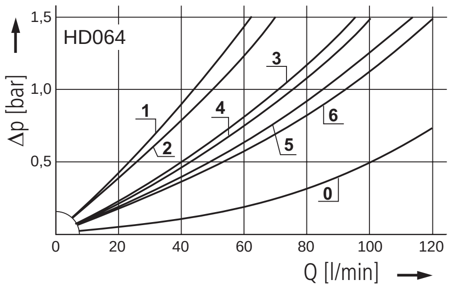


Pressure drop as a function of the **kinematic viscosity** at nominal flow

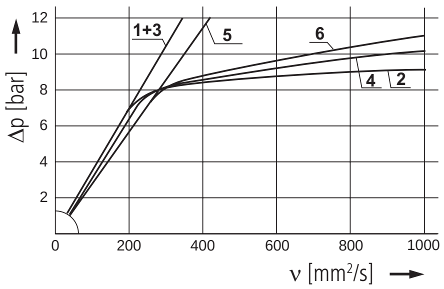


D2

Pressure drop as a function of the **flow volume** at $\nu = 35\ mm^2/s$ (0 = casing empty)



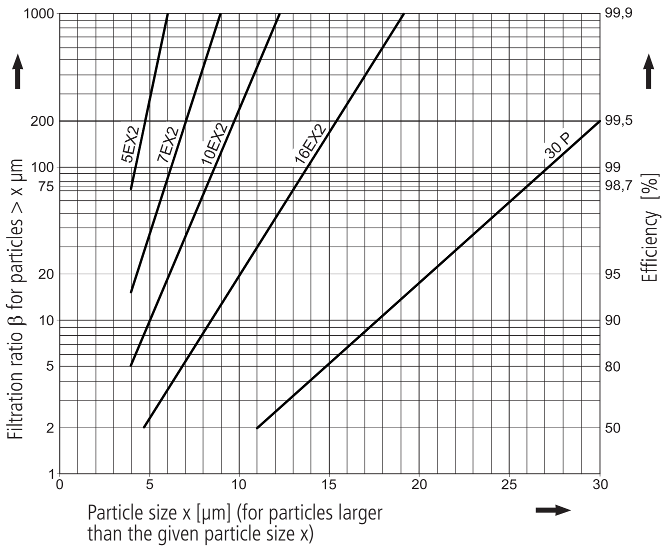
Pressure drop as a function of the **kinematic viscosity** at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator	Remarks
	l/min			g		bar			kg		
1	2	3	4	5	6	7	8	9	10	11	12
HD 044-183	27	**D1**/1	5EX2	5,2	Ø 15	-	7	V3.0510-13[1]	3,4	optional	[2]
HD 044-153	30	**D1**/2	5EX2	4,9	Ø 15	7	4	V3.0510-03	3,4	optional	-
HD 044-186	47	**D1**/3	10EX2	5,1	Ø 15	-	7	V3.0510-16[1]	3,4	optional	[2]
HD 044-156	50	**D1**/4	10EX2	6,8	Ø 15	7	4	V3.0510-06	3,4	optional	-
HD 044-178	65	**D1**/5	16EX2	5,6	Ø 15	-	7	V3.0510-18[1]	3,4	optional	[2]
HD 044-158	75	**D1**/6	16EX2	6,9	Ø 15	7	4	V3.0510-08	3,4	optional	-
HD 064-183	50	**D2**/1	5EX2	8,7	Ø 15	-	7	V3.0520-13[1]	4,6	optional	[2]
HD 064-153	60	**D2**/2	5EX2	10	Ø 15	7	4	V3.0520-03	4,5	optional	-
HD 064-196	85	**D2**/3	10EX2	11	Ø 15	-	7	V3.0520-16[1]	4,6	optional	[2]
HD 064-156	85	**D2**/4	10EX2	14	Ø 15	7	4	V3.0520-06	4,5	optional	-
HD 064-178	100	**D2**/5	16EX2	12	Ø 15	-	7	V3.0520-18[1]	4,6	optional	[2]
HD 064-158	105	**D2**/6	16EX2	15	Ø 15	7	4	V3.0520-08	4,5	optional	-

Optical or electrical indicators are available to monitor the clogging condition of the element. If the indicator should be already mounted onto the filter head use the abbreviation "M" behind the part number of the indicator. The printed order acknowledgements show both items separately.

Order example: The filter HD 064-156 has to be supplied with optical clogging indicator - response pressure 5,0 bar

Order description: **HD 064-156 / DG 042-02 M**

Part No. (Basic unit) — HD 064-156

Clogging indicator — DG 042-02

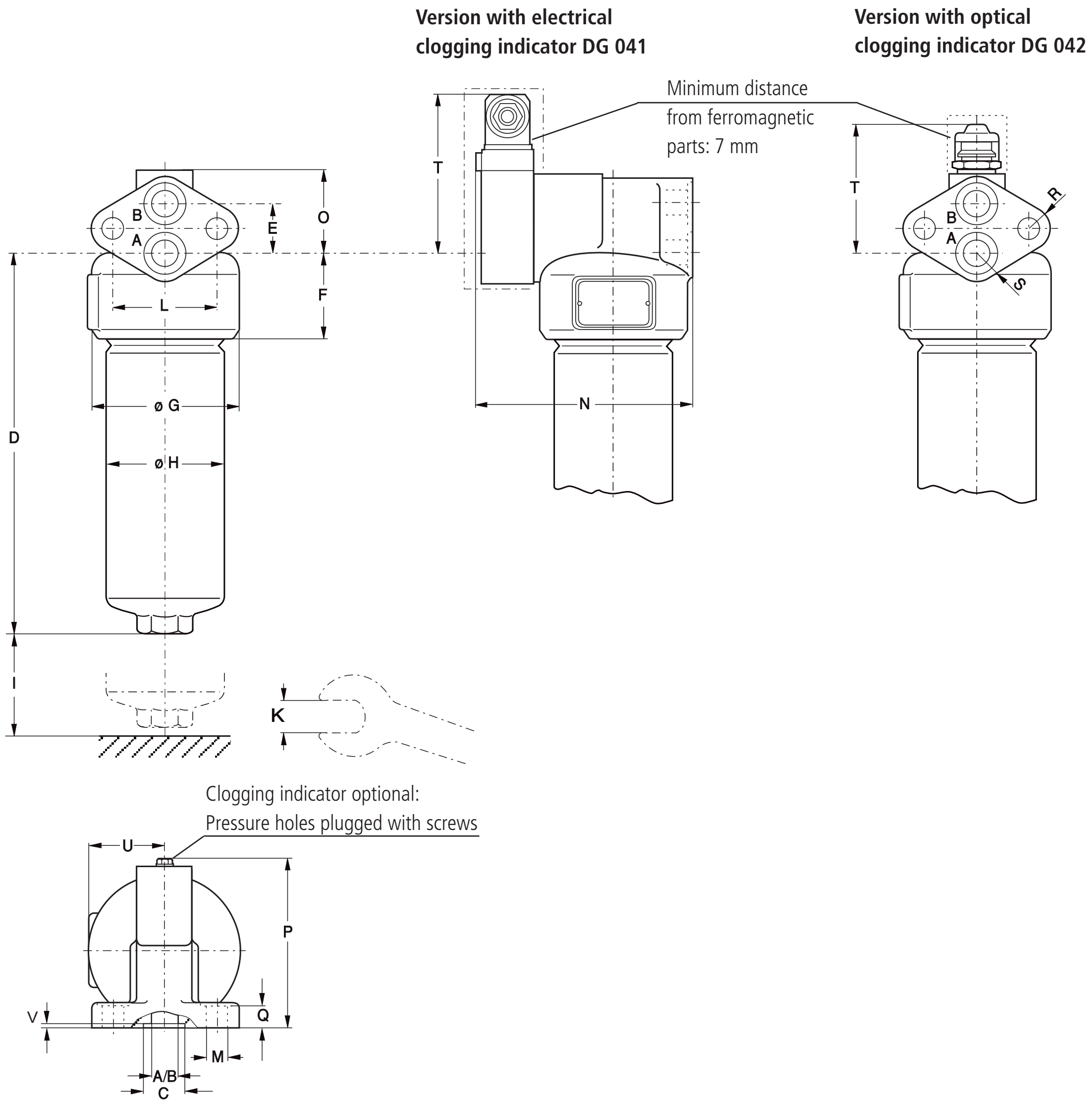
Mounted — M

For the appropriate clogging indicators see catalogue sheet 60.30.

Remarks:
- Filter versions without by-pass valves must always be equipped with a clogging indicator.
- The filters listed in this chart are standard filters. If modifications are required, e.g. filter fineness 30P, we kindly ask for your request.

[1] Element differential pressure stable up to 160 bar
[2] Clogging indicator is obligatory

Dimensions

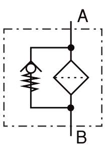


Measurements

Type	A/B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T electr. / opt.	U	V
HD 044	Ø 15	23,5	145	26	49	83	66	70	36	58	12,5	118,5	48	90	17	13	16	106 / 79	45	2
HD 064	Ø 15	23,5	241	26	49	83	66	70	36	58	12,5	118,5	48	90	17	13	16	106 / 79	45	2

Symbols

1



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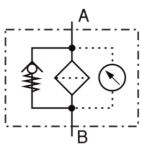

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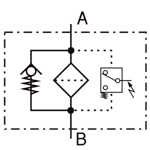

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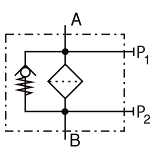

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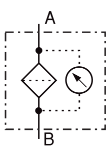

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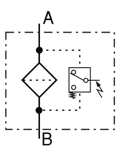

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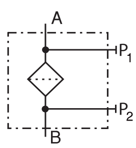
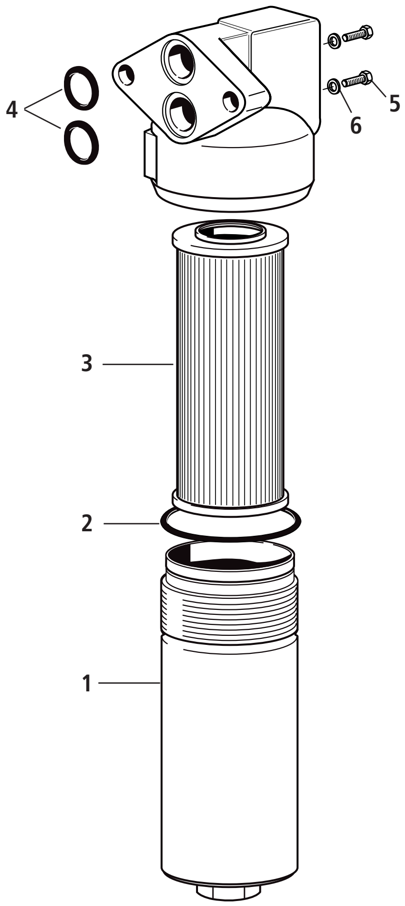


Spare Parts



Pos.	Designation	Part No.
1	Filter bowl HD 044	HD 052.0102
1	Filter bowl HD 064	HD 072.0102
2	O-ring 53,57 x 3,53	N007.0543/1
3	Filter element	s. Chart / col. 9
4	O-ring 18,72 x 2,62 *	N007.0193
5	Hexagonal head screw M4x8 DIN 933-8.8	11385800
6	Bonded Seal 4,1 x 7,2 x 1	12504600

*Not supplied with filter - has to be ordered separately

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

We produce fluid power solutions
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ARGO HYTOS

High Pressure Filters

HD 314 • HD 414
HD 614

- Flangeable
- Operating pressure up to 500 bar
- Nominal flow rate up to 400 l/min

40.35-4e

Description

Application
In the high pressure circuits of hydraulic systems.

Performance features

Protection against wear:	By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.
Protection against malfunction:	Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at ≤ 200 mm^2/s (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Spheroidal graphite cast iron (SGI)
Filter bowl:	Cold extruded steel
Coating:	Powder paint
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

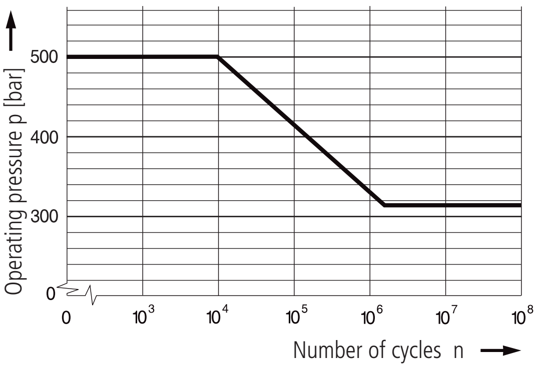
Accessories
Electrical and/or optical clogging indicators are available - optionally with one or two switching points resp. temperature suppression.
Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Operating pressure
0 ... 315 bar, min. 2 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 500 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 400 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm^2/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 250 bar ≤ 8 m/s
  > 250 bar ≤ 12 m/s

Filter fineness
5 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm^2/s
- as starting viscosity: $\nu_{max} = 1.200$ mm^2/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position
Preferably vertical, filter head on top

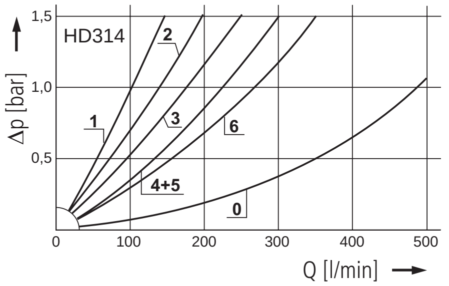
Connection
2 x Ø 31 mm on plain flange

Diagrams

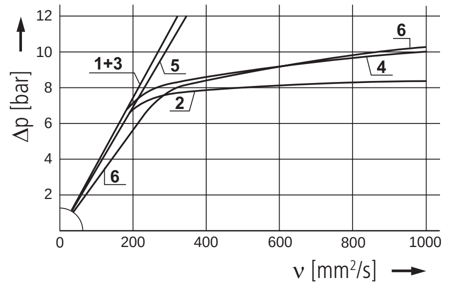
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

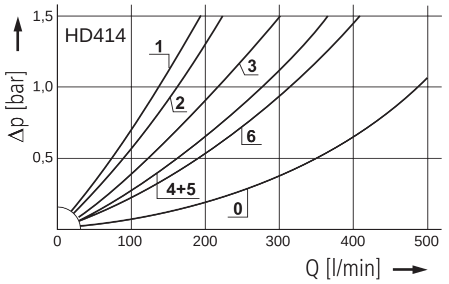


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

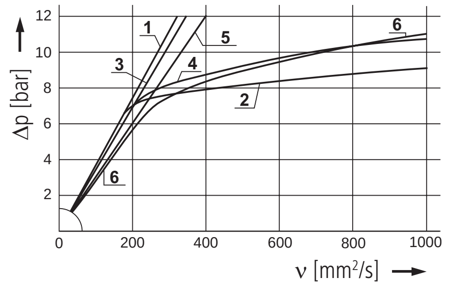


D2

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

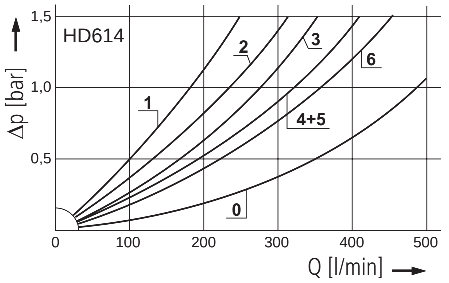


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

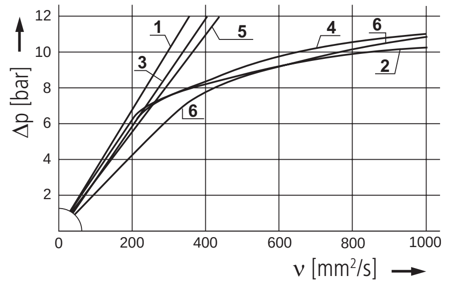


D3

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)



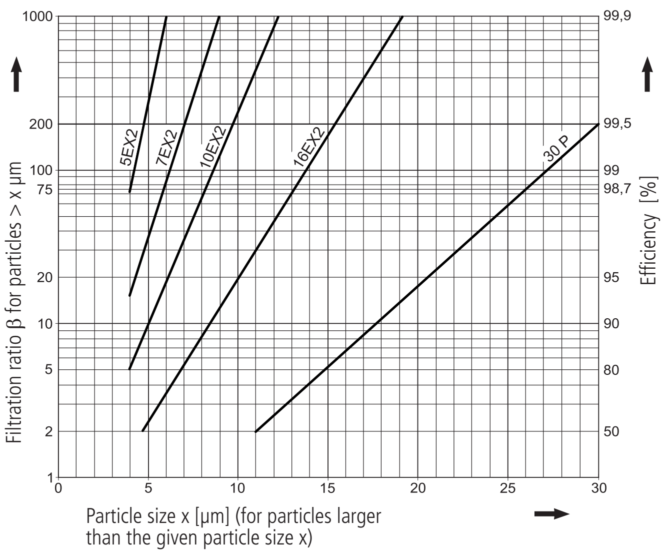
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator	Remarks
	l/min			g		bar			kg		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
HD 314-279	110	**D1**/1	5EX2	20	Ø 31	-	7	V3.0817-13*	14,2	optional	-
HD 314-259	155	**D1**/2	5EX2	24	Ø 31	7	4	V3.0817-03	13,8	optional	-
HD 314-246	195	**D1**/3	10EX2	24	Ø 31	-	7	V3.0817-16*	14,2	optional	-
HD 314-256	250	**D1**/4	10EX2	33	Ø 31	7	4	V3.0817-06	13,8	optional	-
HD 314-248	260	**D1**/5	16EX2	25	Ø 31	-	7	V3.0817-18*	14,2	optional	-
HD 314-258	300	**D1**/6	16EX2	33	Ø 31	7	4	V3.0817-08	13,8	optional	-
HD 414-279	155	**D2**/1	5EX2	29	Ø 31	-	7	V3.0823-13*	15,7	optional	-
HD 414-259	190	**D2**/2	5EX2	33	Ø 31	7	4	V3.0823-03	15,1	optional	-
HD 414-296	250	**D2**/3	10EX2	33	Ø 31	-	7	V3.0823-16*	15,7	optional	-
HD 414-256	310	**D2**/4	10EX2	47	Ø 31	7	4	V3.0823-06	15,1	optional	-
HD 414-298	310	**D2**/5	16EX2	35	Ø 31	-	7	V3.0823-18*	15,7	optional	-
HD 414-258	360	**D2**/6	16EX2	48	Ø 31	7	4	V3.0823-08	15,1	optional	-
HD 614-279	210	**D3**/1	5EX2	41	Ø 31	-	7	V3.0833-13*	18,5	optional	-
HD 614-259	270	**D3**/2	5EX2	49	Ø 31	7	4	V3.0833-03	17,8	optional	-
HD 614-246	310	**D3**/3	10EX2	49	Ø 31	-	7	V3.0833-16*	18,5	optional	-
HD 614-256	360	**D3**/4	10EX2	67	Ø 31	7	4	V3.0833-06	17,8	optional	-
HD 614-288	400	**D3**/5	16EX2	51	Ø 31	-	7	V3.0833-18*	18,5	optional	-
HD 614-258	400	**D3**/6	16EX2	68	Ø 31	7	4	V3.0833-08	17,8	optional	-

Optical or electrical indicators are available to monitor the clogging condition of the element. If the indicator should be already mounted onto the filter head use the abbreviation "M" behind the part number of the indicator. The printed order acknowledgements show both items separately.

Order example: The filter HD HD 314-279 has to be supplied with optical clogging indicator - response pressure 5,0 bar

Order description: **HD 314-279 / DG 042-02 M**

Part No. (Basic unit) — HD 314-279

Clogging indicator — DG 042-02

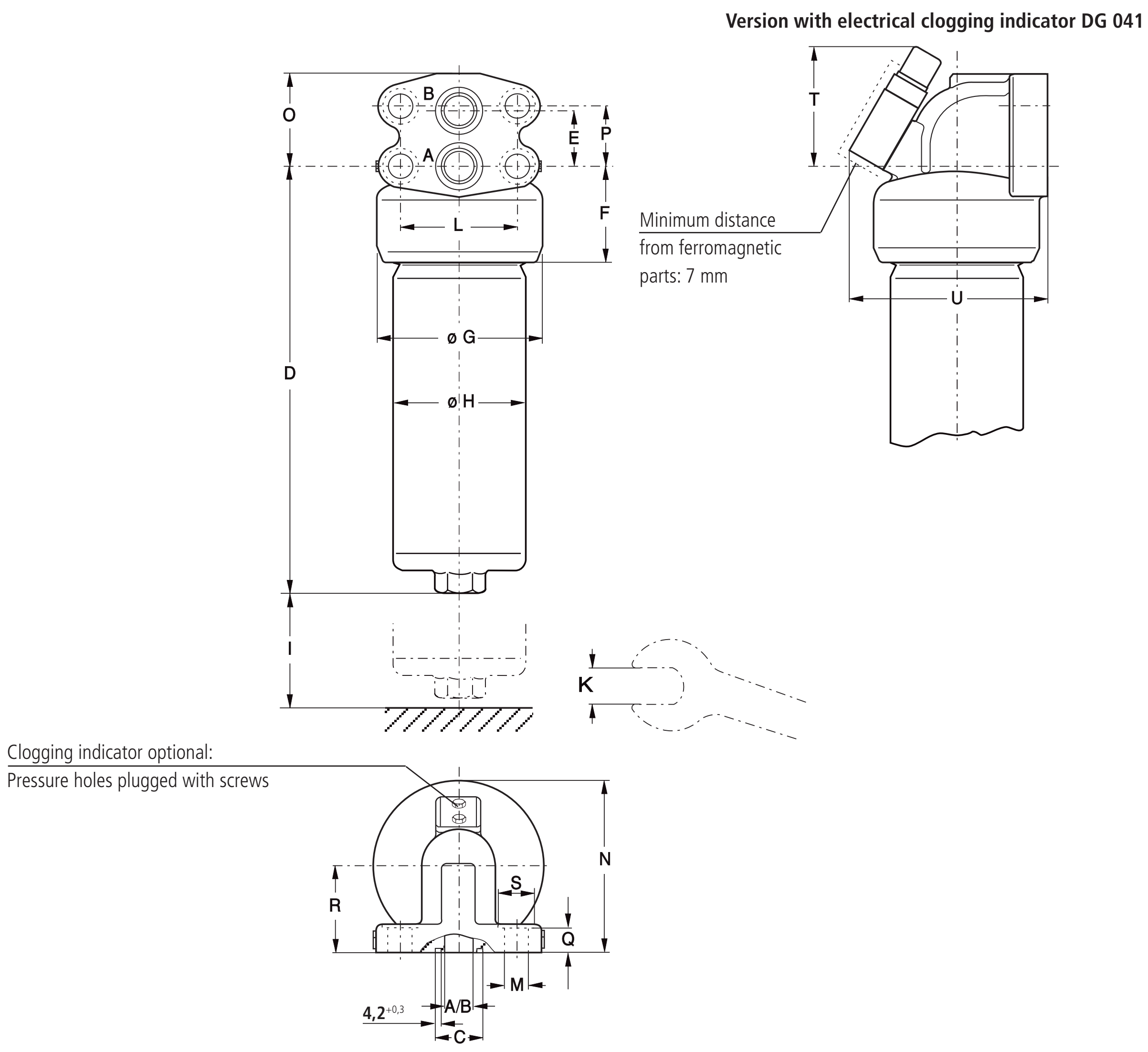
Mounted — M

For the appropriate clogging indicators see catalogue sheet 60.30.

Remarks:
- Filter versions without by-pass valves must always be equipped with a clogging indicator.
- The filters listed in this chart are standard filters. If modifications are required, e.g. filter fineness 30P, we kindly ask for your request.

* Element differential pressure stable up to 160 bar, clogging indicator is obligatory

Dimensions

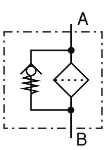


Measurements

Type	A/B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U
HD 314	Ø 31	44,4	263	52	82	138	109	80	32	95	21,5	150	83	58	25	80	34	93	165
HD 414	Ø 31	44,4	325	52	82	138	109	80	32	95	21,5	150	83	58	25	80	34	93	165
HD 614	Ø 31	44,4	426	52	82	138	109	80	32	95	21,5	150	83	58	25	80	34	93	165

Symbols

1



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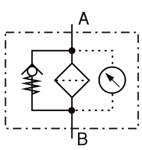

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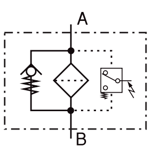

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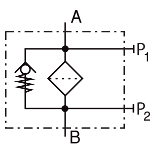
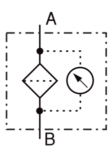
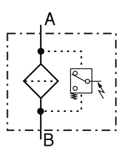


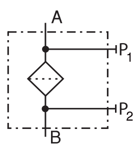
5



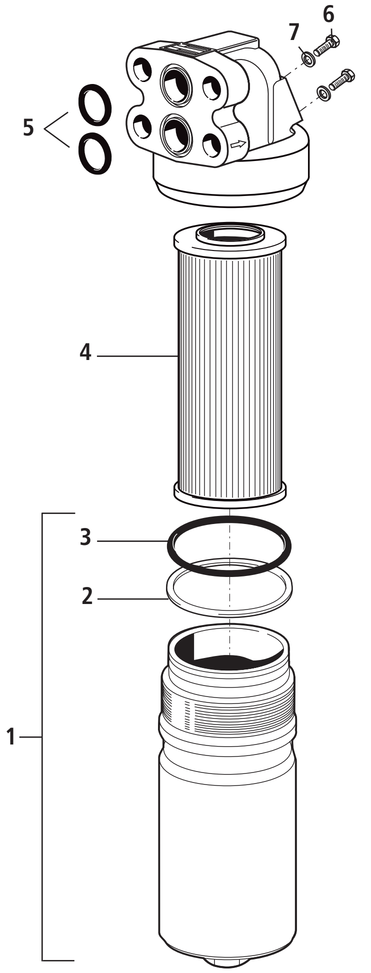
6



7



Spare Parts



Pos.	Designation	Part No.
1	Filter bowl HD 314 (with Pos. 2 and 3)	HD 250.0701
1	Filter bowl HD 414 (with Pos. 2 and 3)	HD 451.0702
1	Filter bowl HD 614 (with Pos. 2 and 3)	HD 619.0701
2	Back-ring	HD 255.0102
3	O-ring 94,84 x 3,53	N007.0953
4	Filter element	s. Chart / col. 9
5	O-ring 37,69 x 3,53 *	N007.0384
6	Hexagonal head screw M4 x 8 DIN 933-8.8	11385800
7	Bonded Seal 4,1 x 7,2 x 1	12504600

* Not supplied with filter - has to be ordered separately

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Illustrations may sometimes differ from the original. ARGO-HYTOS is not responsible for any unintentional mistake in this specification sheet.

We produce fluid power solutions
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ARGO HYTOS

High Pressure Filters

HD 417 · HD 617

- Bi-directional flow
- In-line mounting
- Operating pressure up to 500 bar
- Nominal flow rate up to 420 l/min

40.80-4e

Description

Application
In the high pressure circuits of hydraulic systems with changing flow direction.

Performance features

Protection against wear:	By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.
Protection against malfunction:	Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Special features

Reverse flow valves:	The "Graetz" system (see Symbols) integrated into the head piece ensures the filtration of the hydraulic fluid in both flow directions.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Spheroidal graphite cast iron (SGI)
Filter bowl:	Cold extruded steel
Coating:	Powder paint
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web Paper - cellulose web, impregnated with resin

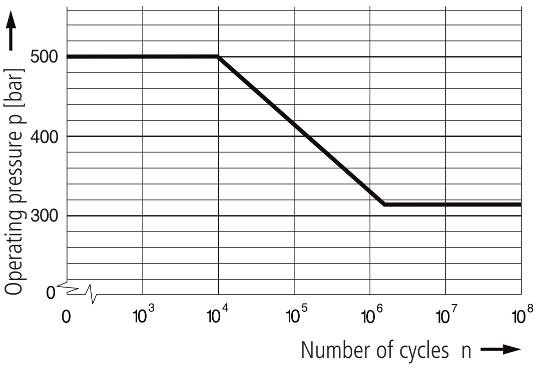
Accessories
Electrical and/or optical clogging indicators are available - optionally with one or two switching points resp. temperature suppression.
Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Operating pressure
0 ... 315 bar, min. 2 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 500 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 420 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 250 bar ≤ 8 m/s
  > 250 bar ≤ 12 m/s

Filter fineness
5 µm(c) ... 30 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

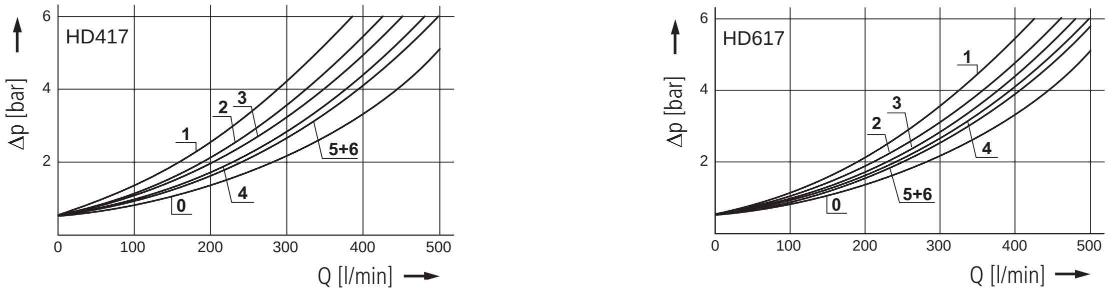
Mounting position
Preferably vertical, filter head on top

Connection
SAE-flange (6000 psi). Sizes see Selection Chart, column 6
(other connections on request)

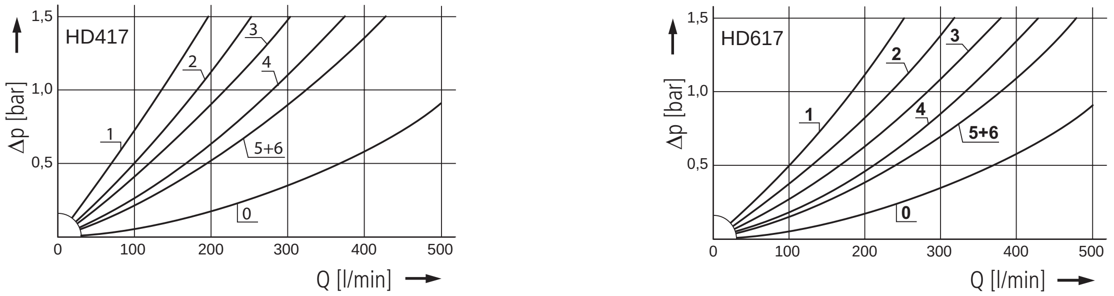
Diagrams

Δp-curves for complete filters in Selection Chart, column 3

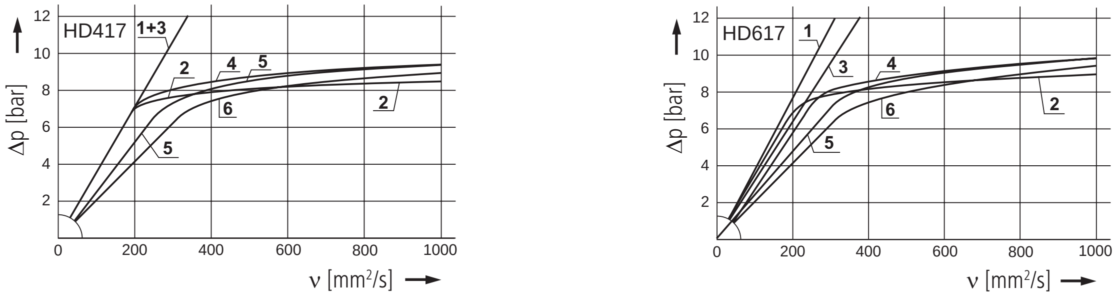
D1 Pressure drop as a function of the **flow volume** at ν = 35 mm²/s, measurement **with** reverse flow valves, (0 = casing empty)



D2 Pressure drop as a function of the **flow volume** at ν = 35 mm²/s, measurement **without** reverse flow valves, (0 = casing empty)

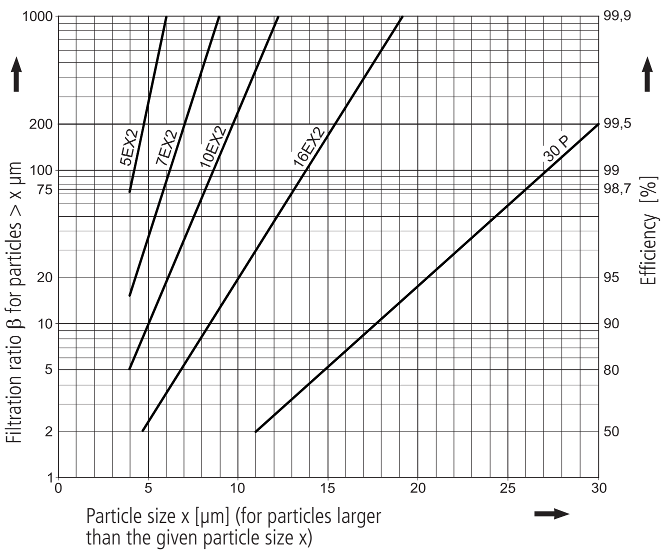


D3 Pressure drop as a function of the **kinematic viscosity** at nominal flow, measurement **without** reverse flow valves



Filter fineness curves in Selection Chart, column 4

Dx Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and Paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm

Tolerances for mesh size according to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator	Remarks
	l/min			g		bar			kg		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
HD 417-149	150	**D1,2,3**/1	5EX2	29	SAE 1¼	-	3	V3.0823-13[1]	20,3	optional	[2]
HD 417-179	220	**D1,2,3**/2	5EX2	33	SAE 1¼	7	1	V3.0823-03	19,7	optional	-
HD 417-146	260	**D1,2,3**/3	10EX2	33	SAE 1¼	-	3	V3.0823-16[1]	20,3	optional	[2]
HD 417-176	320	**D1,2,3**/4	10EX2	47	SAE 1¼	7	1	V3.0823-06	19,7	optional	-
HD 417-168	350	**D1,2,3**/5	16EX2	48	SAE 1¼	7	1	V3.0823-08	19,7	optional	-
HD 417-161	350	**D1,2,3**/6	30P	26	SAE 1¼	7	1	P3.0823-01[3]	19,7	optional	-
HD 617-149	220	**D1,2,3**/1	5EX2	41	SAE 1½	-	3	V3.0833-13[1]	23,1	optional	[2]
HD 617-179	280	**D1,2,3**/2	5EX2	49	SAE 1½	7	1	V3.0833-03	22,4	optional	-
HD 617-146	320	**D1,2,3**/3	10EX2	49	SAE 1½	-	3	V3.0833-16[1]	23,1	optional	[2]
HD 617-176	380	**D1,2,3**/4	10EX2	67	SAE 1½	7	1	V3.0833-06	22,4	optional	-
HD 617-178	420	**D1,2,3**/5	16EX2	68	SAE 1½	7	1	V3.0833-08	22,4	optional	-
HD 617-161	420	**D1,2,3**/6	30P	34	SAE 1½	7	1	P3.0833-01[3]	22,4	optional	-

Optical or electrical indicators are available to monitor the clogging condition of the element. If the indicator should be already mounted onto the filter head use the abbreviation "M" behind the part number of the indicator. The printed order acknowledgements show both items separately.

Order example: The filter HD 417-149 has to be supplied with electrical clogging indicator - cracking pressure 5,0 bar

Order description: **HD 417-149 / DG 041-33 M**

Part No. (Basic unit)

Mounted

Clogging indicator

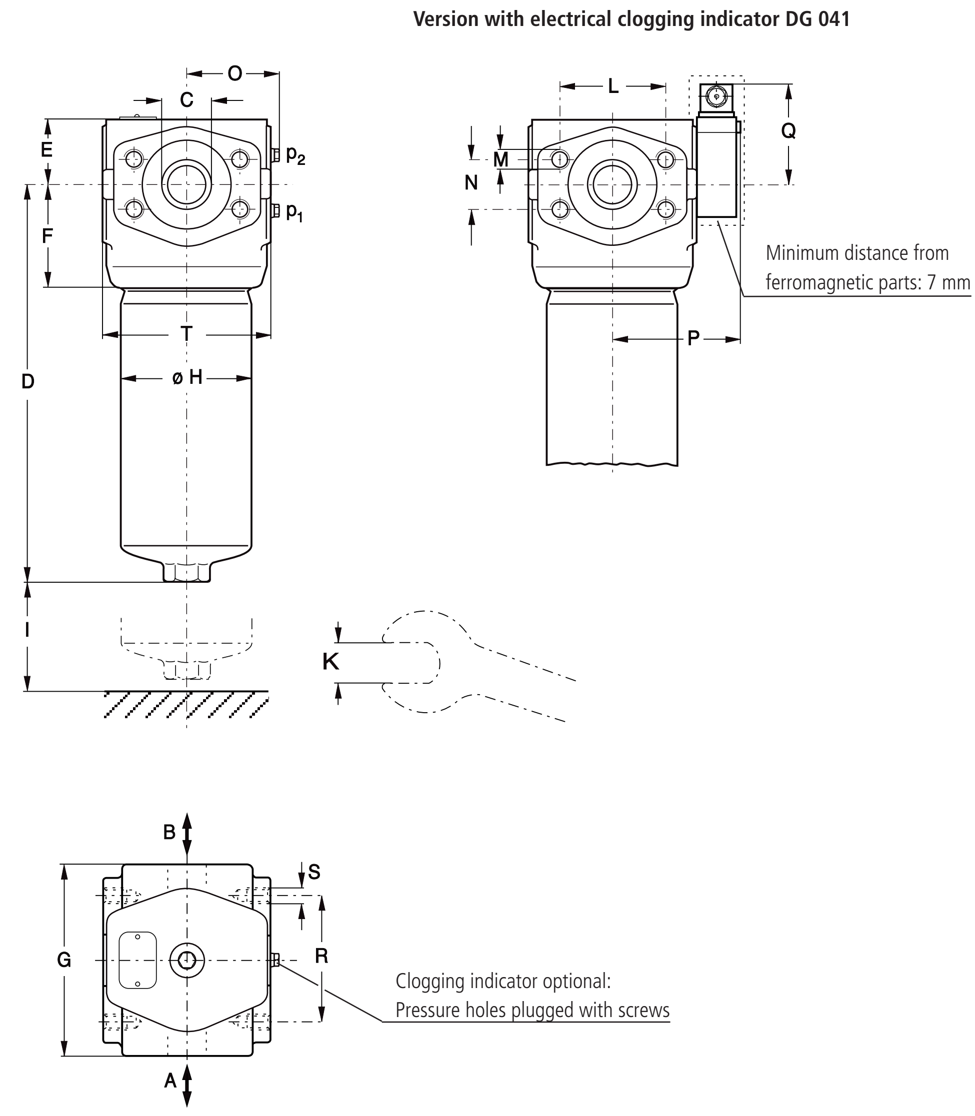
For the appropriate clogging indicators see catalogue sheet 60.30.

Remarks:

- Filter versions without by-pass valves must always be equipped with a clogging indicator.
- The filters listed in this chart are standard filters. Other designs available on request.

[1] Element differential pressure up to 160 bar
[2] Clogging indicator is obligatory
[3] Paper media supported with metal gauze

Dimensions

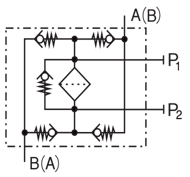


Measurements

Type	A/B	C	D	E	F	G	H	I	K	L	M Ø/depth	N	O	P	Q	R	S Ø/depth	T
HD 417	SAE 1¼	31,5	328	58	87,5	156	108	80	32	66,7	M14/22	31,8	73	102	87	100	M12/18	138
HD 617	SAE 1½	31,5	428	58	87,5	156	108	80	32	79,4	M16/24	36,5	73	102	87	100	M12/18	138

Symbols

1



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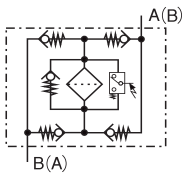

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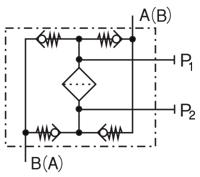

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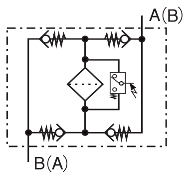
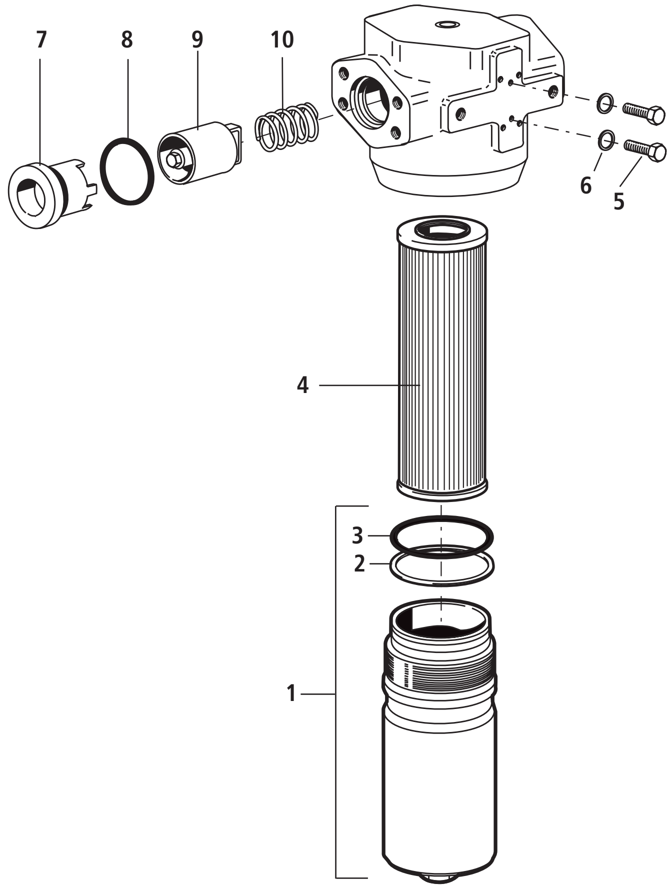


Spare Parts



Pos.	Designation	Part No.
1	Filter bowl HD 417 (with Pos. 2 and 3)	HD 451.0702
1	Filter bowl HD 617 (with Pos. 2 and 3)	HD 619.0701
2	Back-ring	HD 255.0102
3	O-ring 94,84 x 3,53	N007.0953
4	Filter element	see Chart / col. 9
5	Hexagonal head screw M4 x 8 DIN 933-8.8	11385800
6	Bonded seal 4,1 x 7,2 x 1	12504600
7	Sleeve	HD 417.0505
8	O-ring 42,52 x 2,62	N007.0433
9	Reverse flow valve	HD 417.1520
10	Spring DM 38	N015.3801

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Quality Assurance

Quality management according to DIN EN ISO 9001

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ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

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High Pressure Filter Kits

HD 049 · HD 069
HD 172 · HD 319
HD 419 · HD 619

- Operating pressure up to 630 bar
- Nominal flow rate up to 450 l/min

40.95-5e

Description

Application
In the high pressure circuits of hydraulic systems.

Performance features

Protection against wear: By means of filter elements that, in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter bowl:	Cold extruded steel
Coating:	Powder paint
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic multi-layer microfibre web

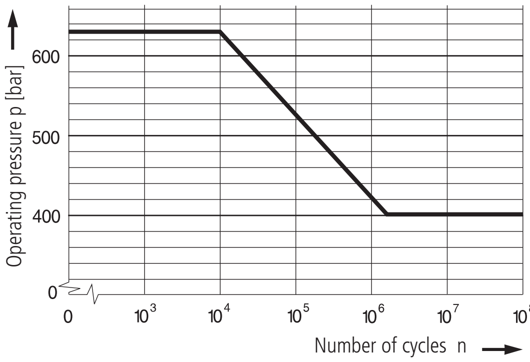
Accessories
To monitor the clogging, screw-in (see section Dimensions) or flange-mounted differential pressure switches are available.
Flange-mounted clogging indicators optionally with one or two switching points resp. temperature suppression – Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Operating pressure
0 ... 400 bar, min. 2 x 10^6 pressure cycles
Nominal pressure according to DIN 24550

0 ... 630 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Permissible pressures for other numbers of cycles



Nominal flow rate
Up to 450 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:
- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines:
  up to 250 bar ≤ 8 m/s
  > 250 bar ≤ 12 m/s

Filter fineness
5 µm(c) ... 16 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 60$ mm²/s
- as starting viscosity $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

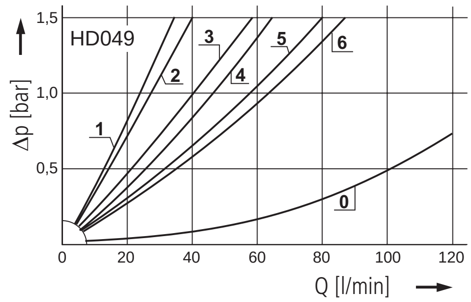
Mounting position
Preferably vertical

Diagrams

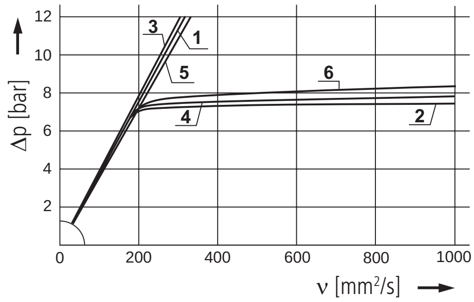
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s

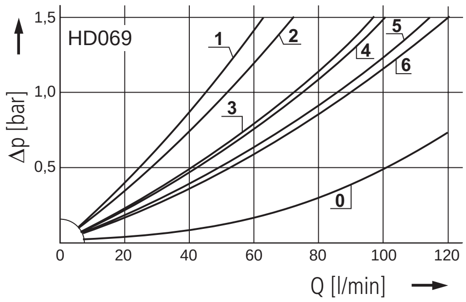


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

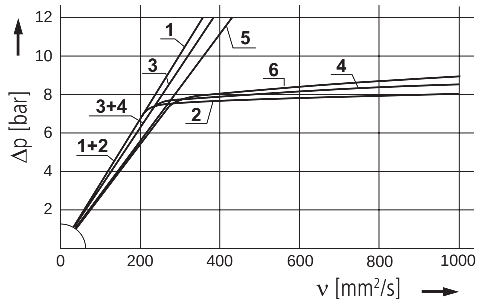


D2

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s

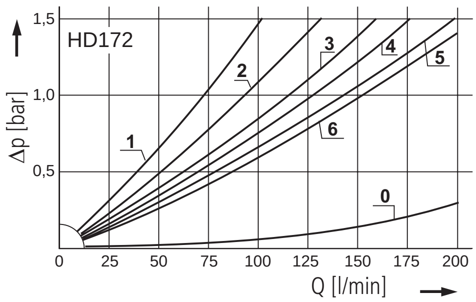


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

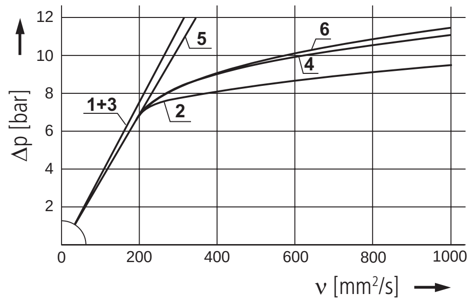


D3

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s

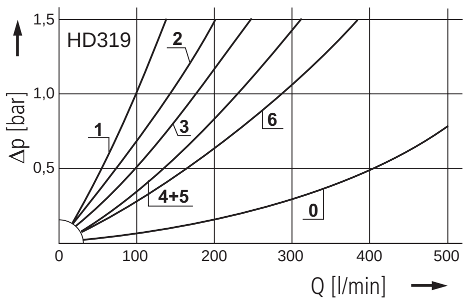


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

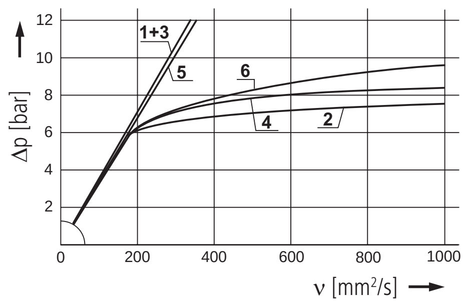


D4

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s



Pressure drop as a function of the **kinematic viscosity**
at nominal flow

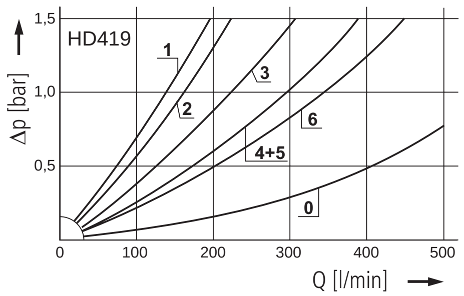


Diagrams

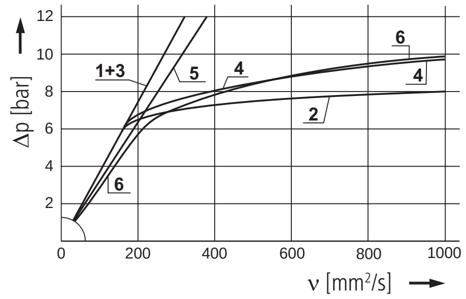
Δp-curves for complete filters in Selection Chart, column 3

D5

Pressure drop as a function of the **flow volume**
at $\nu = 35\ mm^2/s$

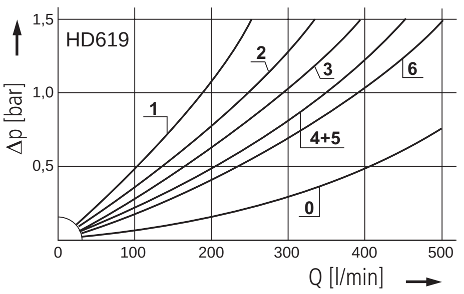


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

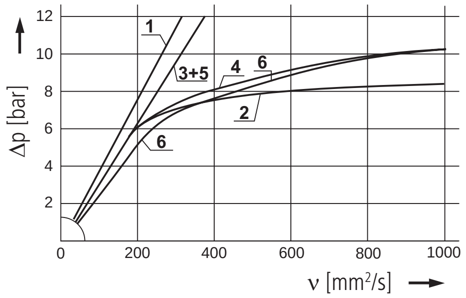


D6

Pressure drop as a function of the **flow volume**
at $\nu = 35\ mm^2/s$



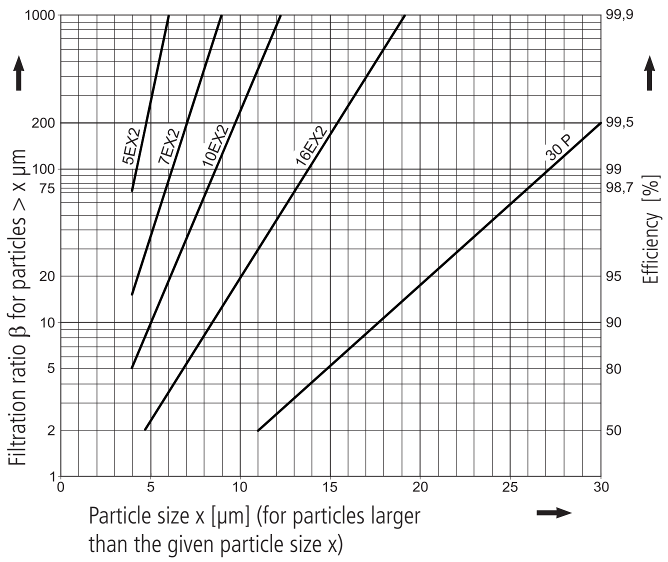
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 and paper elements:

5EX2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
7EX2 = $\bar{\beta}_{7\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2
16EX2 = $\bar{\beta}_{16\,(c)}$ = 200 EXAPOR®MAX 2
30P = $\bar{\beta}_{30\,(c)}$ = 200 Paper

Based on the structure of the filter media of the 30P paper elements, deviations from the printed curves are quite probable.

For screen elements:

40S = screen material with mesh size 40 µm
60S = screen material with mesh size 60 µm
100S = screen material with mesh size 100 µm
Tolerances for mesh size according to DIN 4189

For special applications, finenesses differing from these curves are also available by using special composed filter media.

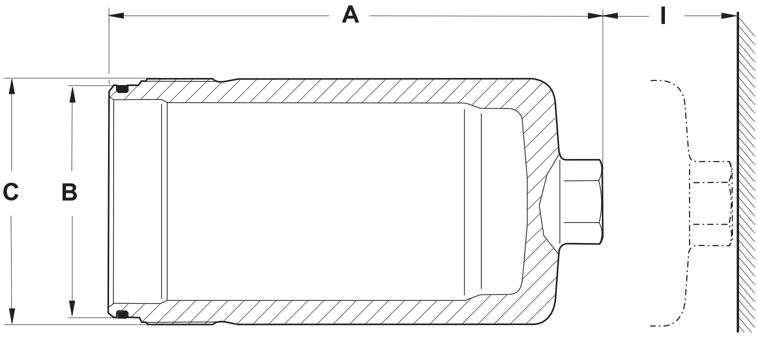
Selection Chart

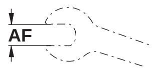
Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Remarks
	l/min			g	bar			kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
HD 049-0213	27	**D1**/1	5EX2	5,2	-	5	V3.0510-13*	1,6	with screw-in bushing
HD 049-1503	30	**D1**/2	5EX2	4,9	7	1	V3.0510-03	1,5	-
HD 049-0216	47	**D1**/3	10EX2	5,1	-	5	V3.0510-16*	1,6	with screw-in bushing
HD 049-1506	50	**D1**/4	10EX2	6,8	7	1	V3.0510-06	1,5	-
HD 049-0218	65	**D1**/5	16EX2	5,6	-	5	V3.0510-18*	1,6	with screw-in bushing
HD 049-1508	75	**D1**/6	16EX2	6,9	7	1	V3.0510-08	1,5	-
HD 069-0213	50	**D2**/1	5EX2	8,7	-	5	V3.0520-13*	2,7	with screw-in bushing
HD 069-1503	60	**D2**/2	5EX2	10	7	1	V3.0520-03	2,6	-
HD 069-0216	80	**D2**/3	10EX2	11	-	5	V3.0520-16*	2,7	with screw-in bushing
HD 069-1506	85	**D2**/4	10EX2	14	7	1	V3.0520-06	2,6	-
HD 069-0218	100	**D2**/5	16EX2	12	-	5	V3.0520-18*	2,7	with screw-in bushing
HD 069-1508	105	**D2**/6	16EX2	15	7	1	V3.0520-08	2,6	-
HD 172-0213	80	**D3**/1	5EX2	16	-	5	V3.0623-13*	4,2	with screw-in bushing
HD 172-1503	105	**D3**/2	5EX2	17	7	1	V3.0623-03	3,9	-
HD 172-0226	130	**D3**/3	10EX2	18	-	5	V3.0623-26*	4,2	with screw-in bushing
HD 172-1506	150	**D3**/4	10EX2	23	7	1	V3.0623-06	3,9	-
HD 172-0218	165	**D3**/5	16EX2	19	-	5	V3.0623-18*	4,2	with screw-in bushing
HD 172-1508	180	**D3**/6	16EX2	25	7	1	V3.0623-08	3,9	-
HD 319-0213	110	**D4**/1	5EX2	20	-	5	V3.0817-13*	6,5	with screw-in bushing
HD 319-1503	115	**D4**/2	5EX2	24	7	1	V3.0817-03	6	-
HD 319-0216	195	**D4**/3	10EX2	24	-	5	V3.0817-16*	6,5	with screw-in bushing
HD 319-1506	250	**D4**/4	10EX2	33	7	1	V3.0817-06	6	-
HD 319-0218	270	**D4**/5	16EX2	25	-	5	V3.0817-18*	6,5	with screw-in bushing
HD 319-1508	330	**D4**/6	16EX2	33	7	1	V3.0817-08	6	-
HD 419-0213	155	**D5**/1	5EX2	29	-	5	V3.0823-13*	8,8	with screw-in bushing
HD 419-1503	190	**D5**/2	5EX2	33	7	1	V3.0823-03	8,2	-
HD 419-0216	265	**D5**/3	10EX2	33	-	5	V3.0823-16*	8,8	with screw-in bushing
HD 419-1506	330	**D5**/4	10EX2	47	7	1	V3.0823-06	8,2	-
HD 419-0218	330	**D5**/5	16EX2	35	-	5	V3.0823-18*	8,8	with screw-in bushing
HD 419-1508	380	**D5**/6	16EX2	48	7	1	V3.0823-08	8,2	-
HD 619-0213	220	**D6**/1	5EX2	41	-	5	V3.0833-13*	11,9	with screw-in bushing
HD 619-1503	280	**D6**/2	5EX2	49	7	1	V3.0833-03	11,1	-
HD 619-0216	330	**D6**/3	10EX2	49	-	5	V3.0833-16*	11,9	with screw-in bushing
HD 619-1506	400	**D6**/4	10EX2	67	7	1	V3.0833-06	11,1	-
HD 619-0218	450	**D6**/5	16EX2	51	-	5	V3.0833-18*	11,9	with screw-in bushing
HD 619-1508	450	**D6**/6	16EX2	68	7	1	V3.0833-08	11,1	-

Remarks:
- Filter versions without by-pass valves must be equipped with a clogging indicator.
- The filter sets listed in this chart are standard filters. If modifications are required, we kindly ask for your request.
- Clogging indicators to screw into the hydraulic block see section Dimensions.
- For the appropriate, flange-mounted clogging indicators see catalogue sheet 60.30.

* Element differential pressure stable up to 160 bar, clogging indicator obligatory

Dimensions

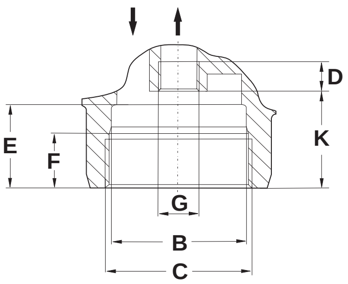


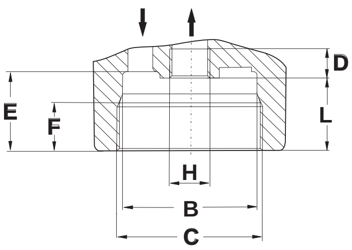


Version with by-pass valve

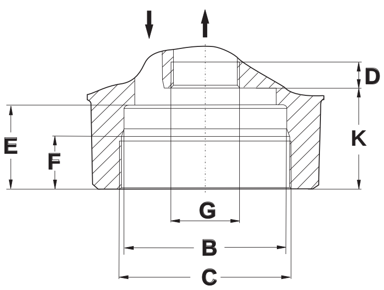
Version with screw-in bushing

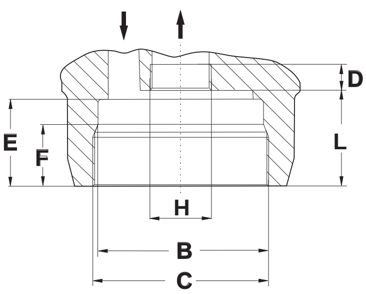
HD 049 / 069



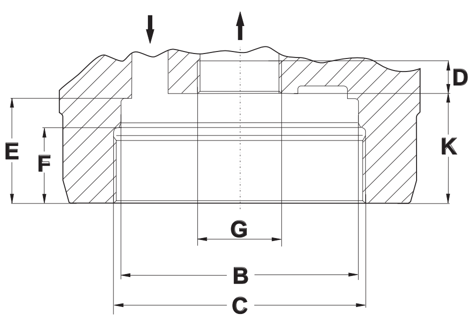


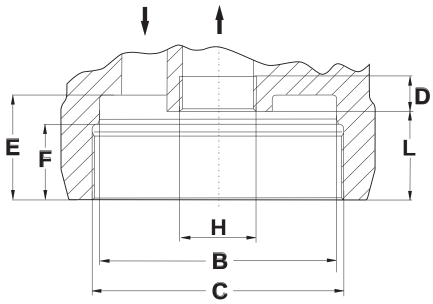
HD 172





HD 319 / 419 / 619



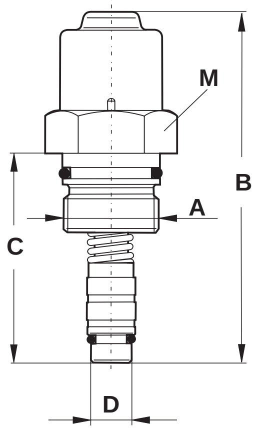


All measurements and tolerances required for machining are available on request.

Dimensions

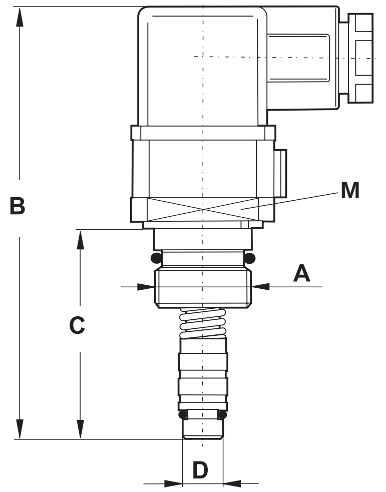
Optical differential pressure indicator

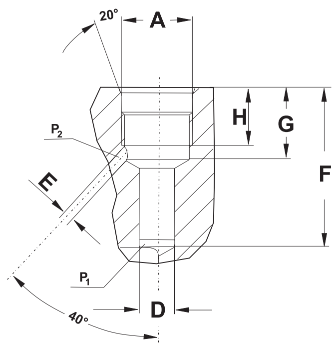
DG 032.1700



Electrical differential pressure switch (change-over)

DG 031.1700

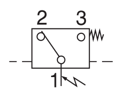




Response/Switching pressure of the clogging indicators
5 bar

Electrical clogging indicator
- Switching voltage: max. 120 V AC / 175 V DC
- Switching current: max. 0,17 A AC / 0,25 A DC
- Switching power: max. 3,5 VA AC / 5 W DC
- Type of contact: change-over
- Electrical protection: IP 65 (with mounted and secured socket)

Terminal connection



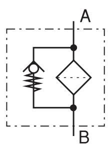
All measurements and tolerances required for machining are available on request.

Measurements

Type	A	B	C	D	E	F	G	H	I	K	L	M
HD 049/069	133/227,5	60	M65 x 1,5	min. 13	35,5	22,5	M18 x 1,5	M18 x 1,5	55	42	32,5	AF 36
HD 172	256,5	71	M75 x 1,5	min. 13	37	22,5	M30 x 1	M26 x 1,5	70	47,5	41	AF 27
HD 319/419/619	218/282/383	102	M108 x 1,5	min. 14	45	32,5	M36 x 1	M36 x 1,5	80	47	38	AF 32
DG 031.1700	M20 x 1,5	93	44	Ø 10	Ø 2,5	45,8	20,5	16,5	-	-	-	AF 30
DG 032.1700	M20 x 1,5	74	44	Ø 10	Ø 2,5	45,8	20,5	16,5	-	-	-	AF 24

Symbols

1



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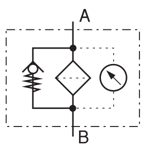

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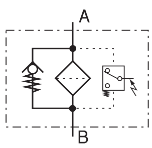

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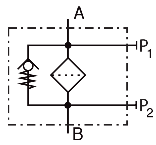
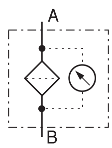


5

6



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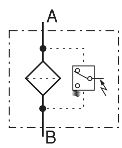

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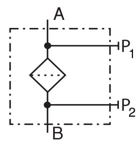
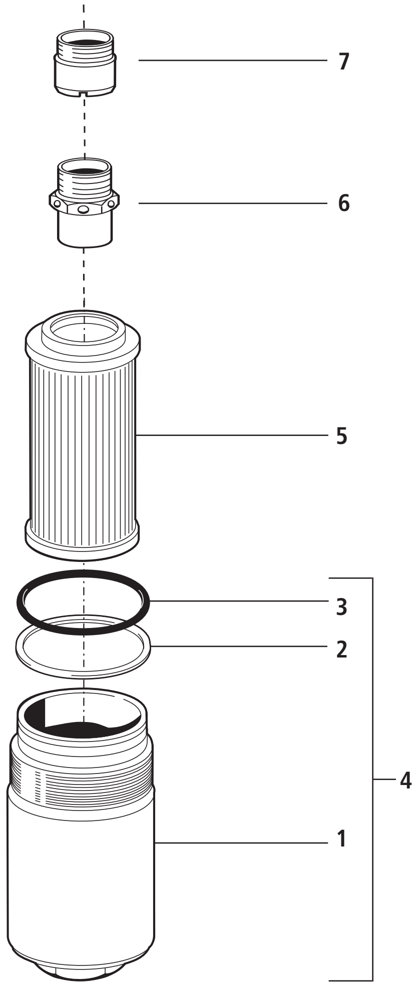


Spare Parts



HD 049 / HD 069

Pos.	Designation	Part No.
1	Filter bowl HD 049	HD 052.0102
1	Filter bowl HD 069	HD 072.0102
3	O-ring 53,57 x 3,53	N007.0543/1
5	Filter element	see Chart / col. 8
6	By-pass valve	HD 045.1510
7	Screw-in bushing	HD 049.0503

HD 172

Pos.	Designation	Part No.
1	Filter bowl HD 172	HD 171.0102
3	O-ring 63 x 3,5	N007.0634
5	Filter element	see Chart / col. 8
6	By-pass valve	HD 172.1500
7	Screw-in bushing	HD 171.0205

HD 319 / HD 419 / HD 619

Pos.	Designation	Part No.
2	Back-ring	HD 255.0102
3	O-ring 94,84 x 3,53	N007.0953
4	Filter bowl HD 319 (with pos. 2 and 3)	HD 250.0701
4	Filter bowl HD 419 (with pos. 2 and 3)	HD 451.0702
4	Filter bowl HD 619 (with pos. 2 and 3)	HD 619.0701
5	Filter element	see Chart / col. 8
6	By-pass valve	HD 319.1510
7	Screw-in bushing	HD 319.0212

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Before release into the series production the filter casing is tested for fatigue strength in our pressure pulse test rig. Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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Phone: +49 7250 76-0 · Fax: +49 7250 76-199 · info@argo-hytos.com · www.argo-hytos.com

Content

Ventilating Filters

L1.0406 · L1.0506
L1.0706 · L1.0807

- Connection up to M60 x 2
- Nominal flow rate up to 850 l/min

50.10-4e

Description

Application
Ventilation of tanks for hydraulic and lubrication systems, and gearboxes.

General
The oil levels in the tanks of hydraulic systems are subject to continuous variation due to temperature changes and the operation of cylinders and pressure vessels.
In order to prevent over pressure in the tanks, an exchange of air with the external atmosphere is necessary. By the use of a ventilating filter, the outside air that is drawn in is filtered and the ingress of dust is therefore prevented.

Special features
The ventilation openings are designed that dust on the surface of the tank is not drawn in, and that the ingress of spray and rainwater is largely prevented.
The use in marine applications presents no problem due to the use of synthetic materials and stainless steel.

Design
Flow direction bi-directional (air IN/OUT). The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Ordering options / versions
Integrated oil-level dipstick (for all types):
A dipstick can be integrated in the ventilating filter for checking the oil level. Therefore, a separate dipstick or an additional opening in the tank is not required.

Oil separator (L1.0406, L1.0706, L1.0807):
An effective protection against splashing oil in mobile operation.

Double check valves (L1.0506, L1.0807):
By the use of double check valves, the exchange of air between the tank and the environment can be considerably reduced, whereby the ingress of dust is minimized and the lifetime of the air filter element can be increased.
With the double check valve, an over-pressure can be created in the tank in order to improve the suction conditions for the pumps.
A further advantage is the reduction of spray water entry and the loss of oil through the ventilating filter.

Roll-over protection (L1.0506):
Breather with safety valve to prevent the hydraulic oil spilling out should the machinery roll or tip over.

Vandalism proof types:
Ventilating filters in patented vandalism proof version, please see catalogue sheet 50.20.
Filling and ventilating filters in standard or patented vandalism proof version, see catalogue sheet 50.30.

Maintenance
Ventilating filters should be changed at least every 1.000 operating hours, or at minimum once a year.

Characteristics

Nominal flow rate
Up to 850 l/min (see Selction Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following criteria:
- Ventilating filters without double check valve:
  $\Delta p < 0{,}03$ bar
- Ventilating filters with double check valve:
  $\Delta p < 0{,}1$ bar for air IN

Connection
Threaded ports according to ISO 228, DIN 13 or DIN 20400.
Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
2 µm
Tested in a single pass test with ISO MTD

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info sheet 00.20).

Temperature range hydraulic fluid
-30 °C ... +100 °C

Temperature range environment
-30 °C ... +100 °C

Materials

Cap:	Polyamide, GF reinforced (L1.0506 Polyester, GK reinforced)
Base:	Polyamide, GF reinforced
Dipstick:	Stainless steel (1.4301)
Gaskets:	NBR (FPM on request)
Filter media:	Composite, multi-layer

Mounting position
No limitation, position on the tank see section Layout.

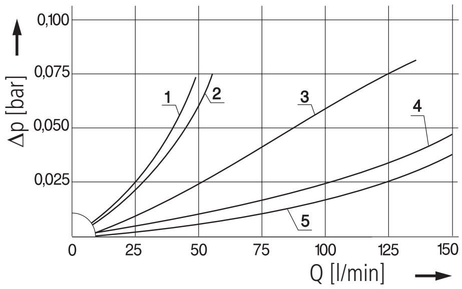
Ventilating filters with roll-over protection must be installed vertically.

Diagrams

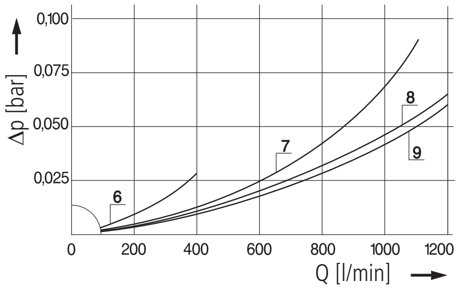
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
Air IN/OUT

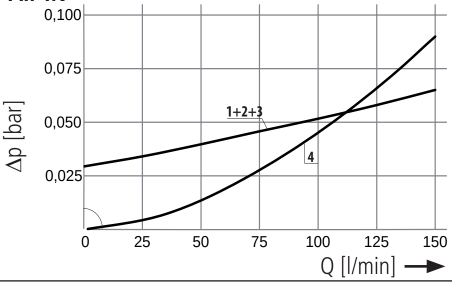


Pressure drop as a function of the **flow volume**
Air IN/OUT

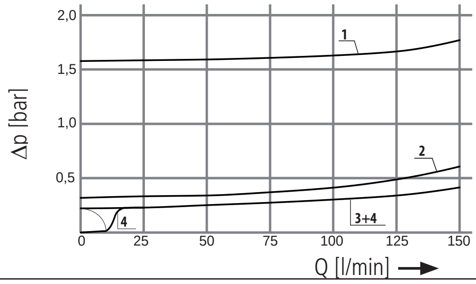


D2

Pressure drop as a function of the **flow volume**
Air IN

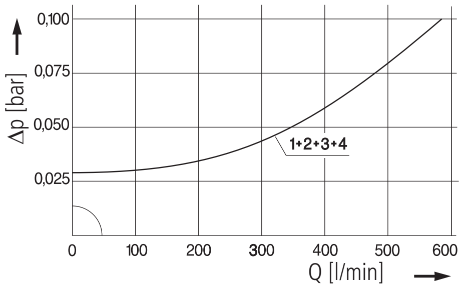


Pressure drop as a function of the **flow volume**
Air OUT

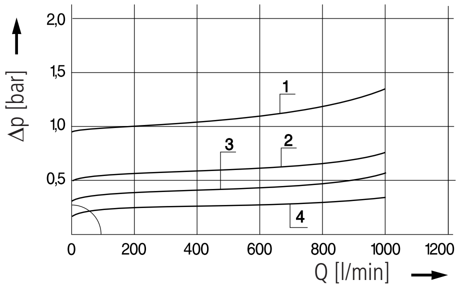


D3

Pressure drop as a function of the **flow volume**
Air IN



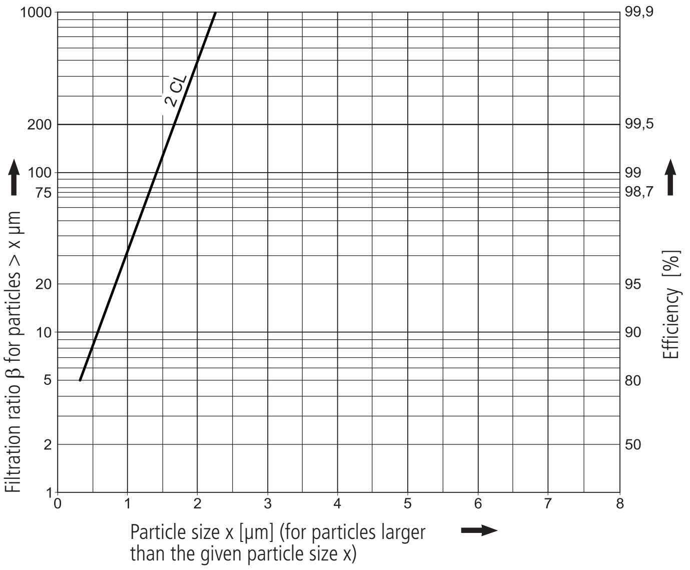
Pressure drop as a function of the **flow volume**
Air OUT



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x tested in a single pass test with ISO MTD



The abbreviations represent the following β-values resp. finenesses:

2 CL = 2 µm Composite
99,5 % efficiency for particles of size 2 µm
tested in a single pass test with ISO MTD

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Filter surface	Connection A	Cracking pressure air IN	Cracking pressure air OUT	Dipstick measurement L1	Dipstick measurement L2	Dipstick measurement L3	Symbol	Weight	Remarks
	l/min			cm²		bar	bar	mm	mm	mm		g	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
L1.0406-12	120	**D1**/4	2CL	35	M18 x 1,5	-	-	-	-	-	1	25	-
L1.0406-21	25	**D1**/1	2CL	35	M18 x 1,5	-	-	-	-	-	1	25	with labyrinth oil separator
L1.0406-73	25	**D1**/1	2CL	35	M18 x 1,5	-	-	75	70	55	1	30	with labyrinth oil separator
L1.0406-76	25	**D1**/1	2CL	35	M18 x 1,5	-	-	80	75	60	1	30	with labyrinth oil separator
L1.0406-45	25	**D1**/1	2CL	35	M18 x 1,5	-	-	95	90	45	1	35	with labyrinth oil separator
L1.0406-69	25	**D1**/1	2CL	35	M18 x 1,5	-	-	100	95	80	1	35	with labyrinth oil separator
L1.0406-56	25	**D1**/1	2CL	35	M18 x 1,5	-	-	130	125	100	1	35	with labyrinth oil separator
L1.0406-03	135	**D1**/5	2CL	35	M22 x 1,5	-	-	-	-	-	1	25	-
L1.0406-87	30	**D1**/2	2CL	35	M22 x 1,5	-	-	-	-	-	1	25	with labyrinth oil separator
L1.0406-60	30	**D1**/2	2CL	35	M22 x 1,5	-	-	85	80	55	1	30	with labyrinth oil separator
L1.0406-79	135	**D1**/2	2CL	35	M22 x 1,5	-	-	120	115	90	1	35	-
L1.0406-51	30	**D1**/2	2CL	35	M22 x 1,5	-	-	130	125	-	1	35	with labyrinth oil separator
L1.0406-59	30	**D1**/2	2CL	35	M22 x 1,5	-	-	130	125	100	1	35	with labyrinth oil separator
L1.0406-98	30	**D1**/2	2CL	35	M22 x 1,5	-	-	180	175	150	1	40	with labyrinth oil separator
L1.0406-33	30	**D1**/2	2CL	35	M22 x 1,5	-	-	250	235	215	1	40	with labyrinth oil separator
L1.0406-101	16	**D1**/3	2CL	6	M22 x 1,5	-	-	-	-	-	1	25	-
L1.0506-73	150 *	**D2**/3	2CL	35	M22 x 1,5	-0,03	0,20	-	-	-	2	55	-
L1.0506-91	150 *	**D2**/2	2CL	35	M22 x 1,5	-0,03	0,35	-	-	-	2	55	-
L1.0506-43	150 *	**D2**/1	2CL	35	M22 x 1,5	-0,03	1,60	-	-	-	2	55	-
L1.0506-185	10	**D2**/4	2CL	35	M22 x 1,5	-	-	-	-	-	3	60	with Roll-Over-Protection
L1.0506-195	10	**D2**/4	2CL	35	Rd42 x 5,0	-	-	-	-	-	3	75	with Roll-Over-Protection
L1.0706-03	250	**D1**/6	2CL	50	M30 x 1,5	-	-	-	-	-	1	50	-
L1.0706-02	250	**D1**/6	2CL	50	M42 x 2,0	-	-	-	-	-	1	50	-
L1.0706-07	250	**D1**/6	2CL	50	Rd42 x 5,0	-	-	-	-	-	1	60	with labyrinth oil separator
L1.0807-04	800	**D1**/8	2CL	203	M30 x 1,5	-	-	-	-	-	1	145	with labyrinth oil separator
L1.0807-11	800	**D1**/8	2CL	203	M30 x 1,5	-	-	-	-	-	1	140	with flat gasket
L1.0807-61	550 *	**D3**/3	2CL	203	M30 x 1,5	-0,03	0,35	-	-	-	2	160	-
L1.0807-07	650	**D1**/7	2CL	203	G¾	-	-	-	-	-	1	145	with labyrinth oil separator
L1.0807-21	650	**D1**/7	2CL	203	G¾	-	-	-	-	-	1	140	-
L1.0807-81	550 *	**D3**/4	2CL	203	G¾	-0,03	0,20	-	-	-	2	160	with flat gasket
L1.0807-71	550 *	**D3**/3	2CL	203	G¾	-0,03	0,35	-	-	-	2	160	-
L1.0807-93	550 *	**D3**/2	2CL	203	G¾	-0,03	0,50	-	-	-	2	160	-
L1.0807-63	550 *	**D3**/1	2CL	203	G¾	-0,03	1,00	-	-	-	2	160	-
L1.0807-05	850	**D1**/9	2CL	203	M42 x 2,0	-	-	-	-	-	1	145	with labyrinth oil separator
L1.0807-31	850	**D1**/9	2CL	203	M42 x 2,0	-	-	-	-	-	1	140	-
L1.0807-91	550 *	**D3**/4	2CL	203	M42 x 2,0	-0,03	0,20	-	-	-	2	160	-
L1.0807-51	550 *	**D3**/3	2CL	203	M42 x 2,0	-0,03	0,35	-	-	-	2	160	-
L1.0807-06	850	**D1**/9	2CL	203	M60 x 2,0	-	-	-	-	-	1	150	with labyrinth oil separator
L1.0807-14	850	**D1**/9	2CL	203	M60 x 2,0	-	-	-	-	-	1	140	-

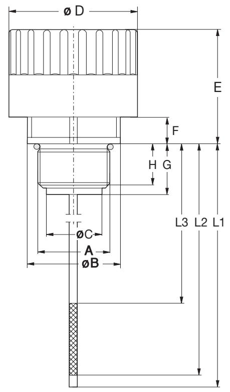
Remarks:

- The ventilating filters listed in this chart are standard filters. If modifications are required, e.g., with integrated dipstick, we kindly ask for your request.

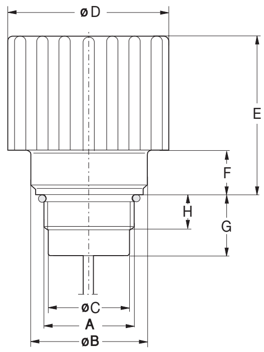
* $\Delta p < 0,1$ bar for air IN

Dimensions

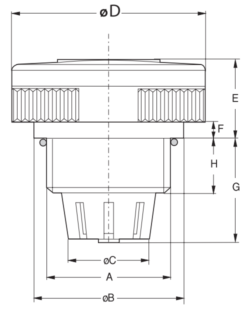
L1.0406



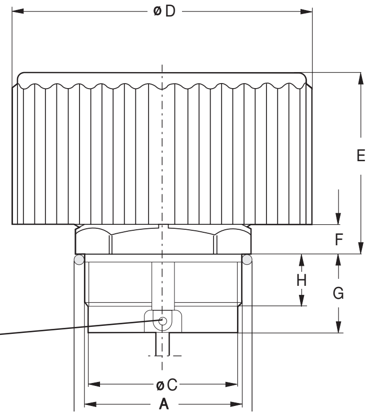
L1.0506



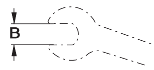
L1.0706



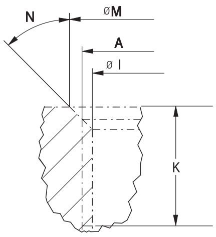
L1.0807



Spanner size
L1.0807



Recommended port sizes



Version with thread M42 x 2
(eye R 2,5 / hole Ø 2)
Fixing chain (length 17 cm)
on request
ARGO-HYTOS Part No. S0.0512.1302

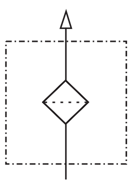
Measurements

Type	A*	B	C	D	E	F	G	H	I	K	M	N
L1.0406	M18 x 1,5, M22 x 1,5	31,5	16	37	33,5	7,5	16,5	13,5	-	-	as A	45°
L1.0506	M22 x 1,5	29	19,5	46	47	13,0	17,5	10,5	-	-	as A	45°
	Rd42 x 5,0**	50	35,0	46	44	10,5	28,0	28,0	35,5	min. 28	45	45°
L1.0706	M30 x 1,5	51	20,5	66	26,5	6	35	18	-	-	as A	45°
	M42 x 2,0	51	28	66	26,5	6	35	18	-	-	as A	45°
	Rd42 x 5,0**	51	28	66	26,5	6	35	28	35,5	min. 28	45	45°
L1.0807	M30 x 1,5	AF47	27	80	50	7,5	17,5	13,5	-	-	as A	45°
	G¾	AF33	24	80	50	7,5	17,5	13,5	-	-	as A	45°
	M42 x 2,0	AF47	40	80	50	8	21	14	-	-	48	45°
	M60 x 2,0	AF47	56,4	80	52	11	18	15	-	-	as A	45°

* The thread dimensions do not exactly conform to the DIN ISO standard thread (functioning with the DIN ISO standard thread is guaranteed)
** Round thread according to DIN 20400, not conforming to thread depth standards (functioning with the DIN standard thread is guaranteed)

Symbols

1



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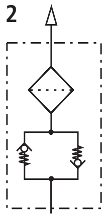

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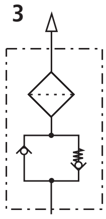

Layout

Sizes
The determining factor for selecting the size is the maximum over / under pressure allowed in the container.
For versions without double check valves, the initial pressure drop with a clean air filter should not exceed 0,03 bar.
For versions with double check valves, the initial pressure drop for air IN with a clean air filter should not exceed 0,1 bar.

Filter fineness
In the ideal case, the fineness of the ventilating filter matches the fineness of the system filter (see also CETOP RP 98 H).
By the use of filter fineness 2 CL the ingress of dust into the tank is effectively reduced.

Mounting
The ventilating filter should be mounted in a low-dust area of the machine and not in depressions in which water can collect.
For mobile use, the ventilating filter is to be mounted on the tank such that neither splashing oil from the inside nor spray water from the outside can reach the area of the ventilation opening.

Double check valves
By the use of double check valves, the exchange of air between the tank and the environment can be considerably reduced, whereby the ingress of dust is minimized and the lifetime of the air filter element is increased.
With the double check valve, a predefined level of pressure can be created in the tank in order to improve the suction conditions for the pumps.
The valve opening pressure required for the ventilating filter can be approximately determined with the ideal gas equation depending on the following system characteristics:

- differential volume
- volume of oil in the system
- volume of air in the tank
- operating temperatures

Calculation tool available.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
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Ventilating Filters – Vandalism Proof

L1.0808 · L1.0809

- Connection up to M42 x 2
- Nominal flow rate up to 850 l/min

50.20-3e

Description

Application
Ventilation of tanks for hydraulic and lubrication systems, and gearboxes.

General
The oil levels in the tanks of hydraulic systems are subject to continuous variation due to temperature changes and the operation of cylinders and pressure vessels.
In order to prevent over pressure in the tanks, an exchange of air with the external atmosphere is necessary. By the use of a ventilating filter, the outside air that is drawn in is filtered and the ingress of dust is therefore prevented.

Special features
The ventilation openings are designed that dust on the surface of the tank is not drawn in, and that the ingress of spray and rainwater is largely prevented.
The use in marine applications presents no problem due to the use of synthetic materials and stainless steel.
The patented vandalism proof ventilating filters can only be removed with the special tool supplied. This makes the removal of the ventilating filter or the ingress of dirt via the filling / ventilation opening considerably more difficult.

Design
Flow direction bi-directional (air IN/OUT). The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Ordering options / versions
Integrated oil-level dipstick:
A dipstick can be integrated in the ventilating filter for checking the oil level. Therefore, a separate dipstick or an additional opening in the tank is not required.

Double check valves:
By the use of double check valves, the exchange of air between the tank and the environment can be considerably reduced, whereby the ingress of dust is minimized and the lifetime of the air filter element can be increased. With the double check valve, an over-pressure can be created in the tank in order to improve the suction conditions for the pumps.
A further advantage is the reduction of spray water ingress and the loss of oil through the ventilating filter.

Vandalism proof version "Standard" (L1.0808):
Ventilating filters in the patented vandalism proof version Can only be removed with the special spanner supplied (A/F 47). This makes the removal of the ventilating filter or the ingress of dirt via the filling / ventilation opening considerably more difficult.

Vandalism proof version "Easy Lock" (L1.0809):
Ventilators in the patented "Easy Lock" version can only be removed with the special pin supplied.
Standard ventilating filters without vandalism proof see catalogue sheet 50.10. Filling and ventilating filters with and without vandalism proof see catalogue sheet 50.30

Maintenance
Ventilating filters should be changed at least every 1.000 operating hours, or at minimum once a year.

Characteristics

Nominal flow rate
Up to 850 l/min (see Selction Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following criteria:
- Ventilating filters without double check valve:
  $\Delta p < 0{,}03$ bar
- Ventilating filters with double check valve:
  $\Delta p < 0{,}1$ bar for air IN

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
2 µm
Tested in a single pass test with ISO MTD

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info sheet 00.20).

Temperature range hydraulic fluid
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Temperature range environment
-30 °C ... +100 °C

Materials

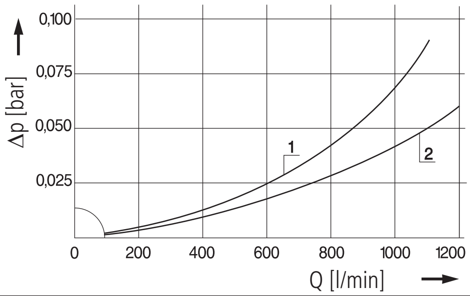
Cap:	Polyamide, GF reinforced
Base:	Polyamide, GF reinforced
Dipstick:	Stainless steel (1.4301)
Spanner:	Steel, galvanized
Gaskets:	NBR (FPM on request)
Filter media:	Composite, multi-layer

Mounting position
No limitation, position on the tank see section Layout

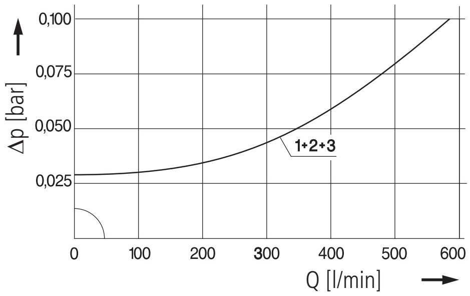
Diagrams

Δp-curves for complete filters in Selection Chart, column 3

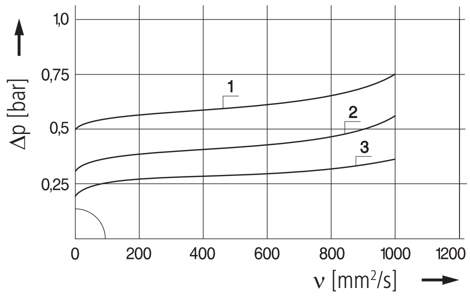
D1 Pressure drop as a function of the **flow volume**
Air IN / OUT



D2 Pressure drop as a function of the **flow volume**
Air IN

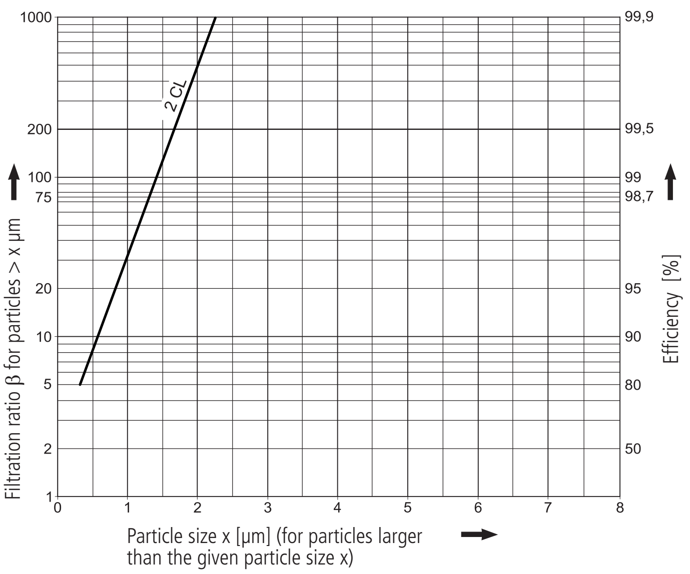


Pressure drop as a function of the **flow volume**
Air OUT



Filter fineness curves in Selection Chart, column 4

Dx Filtration ratio β as a function of particle size x tested in a single pass test with ISO MTD



The abbreviations represent the following β-values resp. finenesses:

2CL = 2 μm Composite
99,5 % efficiency for particles of size 2 μm
tested in a single pass test with ISO MTD

For special applications, finenesses differing from these curves are also available by using special composed filter media.

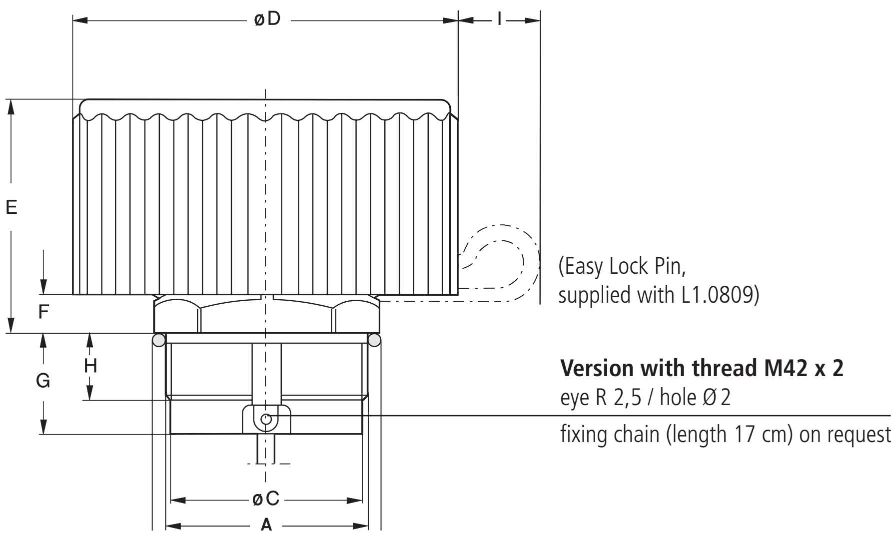
Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Filter surface	Connection A	Cracking pressure air IN	Cracking pressure air OUT	Dipstick measurement L1	Dipstick measurement L2	Dipstick measurement L3	Symbol	Weight	Remarks
	l/min			cm²		bar	bar	mm	mm	mm		g	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
L1.0808-00	850	**D1**/2	2CL	203	M42 x 2,0	-	-	-	-	-	1	140	with spanner AF 47
L1.0808-53	550 *	**D2**/3	2CL	203	M42 x 2,0	-0,03	0,20	-	-	-	2	160	with spanner AF 47
L1.0808-52	550 *	**D2**/2	2CL	203	M42 x 2,0	-0,03	0,35	-	-	-	2	160	with spanner AF 47
L1.0808-61	550 *	**D2**/1	2CL	203	M42 x 2,0	-0,03	0,50	-	-	-	2	160	with spanner AF 47
L1.0809-00	650	**D1**/1	2CL	203	G¾	-	-	-	-	-	1	140	with Easy Lock Pin
L1.0809-52	550 *	**D2**/3	2CL	203	G¾	-0,03	0,20	-	-	-	2	160	with Easy Lock Pin
L1.0809-51	550 *	**D2**/2	2CL	203	G¾	-0,03	0,35	-	-	-	2	160	with Easy Lock Pin
L1.0809-53	550 *	**D2**/1	2CL	203	G¾	-0,03	0,50	-	-	-	2	160	with Easy Lock Pin
L1.0809-01	850	**D1**/2	2CL	203	M42 x 2,0	-	-	-	-	-	1	140	with Easy Lock Pin
L1.0809-54	550 *	**D2**/3	2CL	203	M42 x 2,0	-0,03	0,20	-	-	-	2	160	with Easy Lock Pin
L1.0809-55	550 *	**D2**/2	2CL	203	M42 x 2,0	-0,03	0,35	-	-	-	2	160	with Easy Lock Pin
L1.0809-56	550 *	**D2**/1	2CL	203	M42 x 2,0	-0,03	0,50	-	-	-	2	160	with Easy Lock Pin

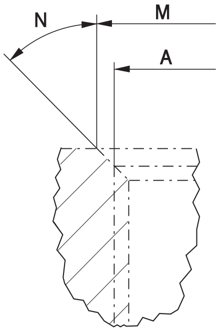
Remarks:
The ventilating filters listed in this chart are standard filters. If modifications are required, e.g., with integrated dipstick or oil separator, we kindly ask for your request.

*$\Delta p < 0{,}1$ bar for air IN

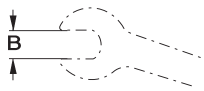
Dimensions



Recommended port sizes



Spanner size
(special wrench, supplied with L1.0808)



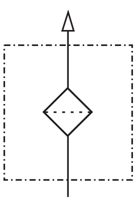
Measurements

Type	A*	B	C	D	E	F	G	H	I	M	N
L1.0808	M42 x 2	AF47	40	80	50	8	21	14	-	48	45°
L1.0809	G¾	AF33	24	80	50	7,5	17,5	13,5	16	as A	45°
	M42 x 2	AF47	40	80	50	8	21	14	16	48	45°

* The thread dimensions do not exactly conform to the DIN ISO standard thread (functioning with the DIN ISO standard thread is guaranteed)

Symbols

1



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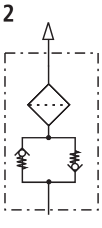

Layout

Sizes
The determining factor for selecting the size is the maximum over / under pressure allowed in the container.
For versions without double check valves, the initial pressure drop with a clean air filter should not exceed 0,03 bar.
For versions with double check valves, the initial pressure drop for air IN with a clean air filter should not exceed 0,1 bar.

Filter fineness
In the ideal case, the fineness of the ventilating filter matches the fineness of the system filter (see also CETOP RP 98 H).
By the use of filter fineness 2 CL the ingress of dust into the tank is effectively reduced.

Mounting
The ventilating filter should be mounted in a low-dust area of the machine and not in depressions in which water can collect.
For mobile use, the ventilating filter is to be mounted on the tank such that neither splashing oil from the inside nor spray water from the outside can reach the area of the ventilation opening.

Double check valves
By the use of double check valves, the exchange of air between the tank and the environment can be considerably reduced, whereby the ingress of dust is minimized and the lifetime of the air filter element is increased.
With the double check valve, a predefined level of pressure can be created in the tank in order to improve the suction conditions for the pumps.
The valve opening pressure required for the ventilating filter can be approximately determined with the ideal gas equation depending on the following system characteristics:

- differential volume
- volume of oil in the system
- volume of air in the tank
- operating temperatures

Calculation tool available.

Quality Assurance

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ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

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ARGO HYTOS

Ventilating Filters – Vandalism Proof

LE.0716 • LE.0817
LE.0827 • LE.0818
LE.0819

- With filling filter
- 6 hole flange
- Nominal flow rate up to 850 l/min

50.30-3e

Description

Application
Filling / ventilation of tanks for hydraulic and lubrication systems as well as gearboxes.

General
The oil levels in the tanks of hydraulic systems are subject to continuous variation due to temperature changes and the operation of cylinders and pressure vessels.
In order to prevent over pressure in the tanks, an exchange of air with the external atmosphere is necessary. By the use of a ventilating filter, the outside air that is drawn in is filtered and the ingress of dust is therefore prevented.
A combined filling filter prevents coarse impurities from entering during filling or re-filling due to maintenance or repair reasons.

Special features
The profiled metal flange with elastomer sealing and the mounting with 6 screws ensure that the filling / ventilating filters seal reliable even on non-planar tank surfaces. Filler screens made of sturdy expanded metal offer 100% safety during filling of the tank – which excludes any damage being caused for example by the filler neck. The ventilating filter is fixed by a chain at the filling filter to prevent it from being lost (exception: LE.0716).
The ventilation openings of the ventilating filters are designed that dust on the surface of the tank is not drawn in, and that the ingress of spray and rainwater is largely prevented.
The patented vandalism proof ventilating filters can only be removed with the special tool supplied. This makes the misuse of the ventilating filter or the ingress of dirt via the filling / ventilation opening considerably more difficult.

Design
Filling filter: cylinder screen - flow direction from centre to outside.
Ventilating filter: Flow direction bi-directional (air IN / OUT). The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Ordering options / versions
Integrated oil-level dipstick
A dipstick can be integrated in the ventilating filter for checking the oil level. Therefore, a separate dipstick or an additional opening in the tank is not required.

Double check valve in the ventilating filter:
By the use of double check valves, the exchange of air between the tank and the environment is considerably reduced, whereby the ingress of dust is minimized and the lifetime of the air filter element is increased.
With the double check valve, an over-pressure is created in the tank in order to improve the suction conditions for the pumps. A further advantage is the reduction of spray water ingress and the loss of oil through the ventilating filter.

Vandalism proof version "Standard" (LE.0818):
Ventilating filters in the patented vandalism proof version can only be removed with the special spanner supplied (A/F 47).
Vandalism proof version "Easy Lock" (L1.0819):
Ventilating filters in the patented "Easy Lock" version can only be removed with the special pin supplied.
This makes the misuse of the ventilating filter or the ingress of dirt via the filling / ventilation opening considerably more difficult.

Maintenance
Ventilating filters should be changed at least every 1.000 operating hours, or at minimum once a year.

Characteristics

Nominal flow rate
Filling filter: up to 200 l/min
Ventilating filter: up to 850 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following criteria:
- Ventilating filters without double check valve: $\Delta p < 0{,}03$ bar for air IN
- Ventilating filters with double check valve: $\Delta p < 0{,}1$ bar for air IN

Connection
Filling filter: 6 hole flange, hole pattern according to DIN 24557/T2
Ventilating filter: outer thread M 42 x 2 (the thread dimensions do not exactly conform to the ISO standard thread / functioning with the ISO standard thread is guaranteed)

Mounting / sealing
Version without double check valve:
6 self-tapping screws ISO 1479-ST4,8x16-C with washers
Version with double check valve:
6 philips head screws ISO 7045 M5x16-4.8-Z with O-rings
Sealing of flange with elastomer gasket
(mounting accessories and gaskets included in basic equipment)

Filter fineness
Filling filter: 800 µm
Ventilating filter: 2 µm, tested in a single pass test with ISO MTD

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info sheet 00.20).

Temperature range hydraulic fluid
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Temperature range environment
-30 °C ... +100 °C

Materials
Cap:	Polyamide, GF reinforced
Base:	Polyamide, GF reinforced
Filler screen:	Steel, galvanized
Spanner:	Steel, galvanized
Gaskets:	NBR (FPM on request)
Filter media:	Composite, multi-layer

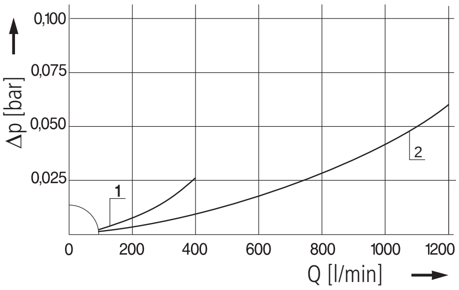
Mounting position
No limitation, position on the tank see section Layout

Diagrams

Δp-curves for complete filters in Selection Chart, column 2

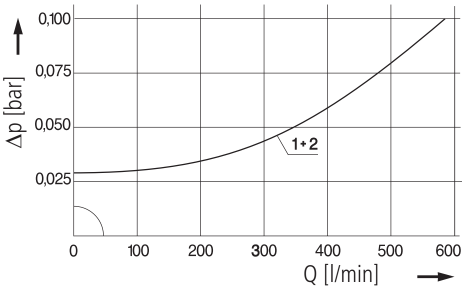
D1

Pressure drop as a function of the **flow volume**
Air IN/OUT

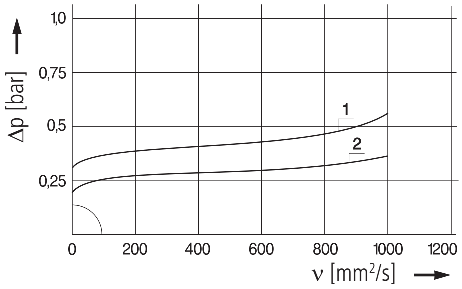


D2

Pressure drop as a function of the **flow volume**
Air IN



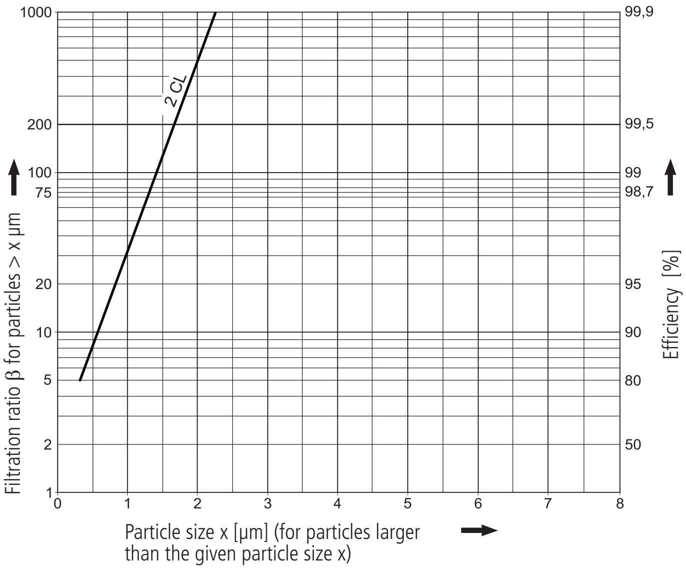
Pressure drop as a function of the **flow volume**
Air OUT



Filter fineness curves in Selection Chart, column 5

Dx

Filtration ratio β as a function of particle size x tested in a single pass test with ISO MTD



The abbreviations represent the following β-values resp. finenesses:

2CL = 2 µm Composite
99,5 % efficiency for particles of size 2 µm
tested in a single pass test with ISO MTD

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

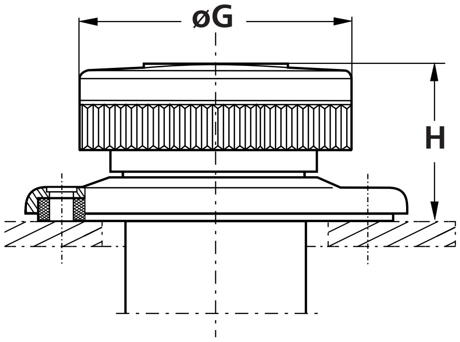
Part No.	Pressure drop see diagram **D**/curve no.	Nominal flow rate filling filter	Nominal flow rate ventilating filter	Filter fineness ventilating filter	Filter surface ventilating filter	Filter fineness filling filter	Filter surface filling filter	Cracking pressure air IN	Cracking pressure air OUT	Replacement ventilating filter Part No.	Symbol	Weight	Remarks
		l/min	l/min		cm²	µm	cm²	bar	bar			g	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
LE.0716-02	**D1**/1	110[1]	250	2CL	50	800	160	-	-	L1.0706-02	1	255	without chain[3]
LE.0817-01	**D1**/2	110[1]	850	2CL	203	800	160	-	-	L1.0807-31	1	350	-
LE.0817-91	**D2**/2	110[1]	550[2]	2CL	203	800	160	-0,03	0,20	L1.0807-91	2	370	-
LE.0817-51	**D2**/1	110[1]	550[2]	2CL	203	800	160	-0,03	0,35	L1.0807-51	2	370	-
LE.0827-01	**D1**/2	200[1]	850	2CL	203	800	285	-	-	L1.0807-31	1	400	-
LE.0827-91	**D2**/2	200[1]	550[2]	2CL	203	800	285	-0,03	0,20	L1.0807-91	2	420	-
LE.0827-51	**D2**/1	200[1]	550[2]	2CL	203	800	285	-0,03	0,35	L1.0807-51	2	420	-
LE.0818-01[4]	**D1**/2	110[1]	850	2CL	203	800	160	-	-	L1.0808-00	1	350	with spanner AF 47
LE.0818-53[4]	**D2**/2	110[1]	550[2]	2CL	203	800	160	-0,03	0,20	L1.0808-53	2	370	with spanner AF 47
LE.0818-51[4]	**D2**/1	110[1]	550[2]	2CL	203	800	160	-0,03	0,35	L1.0808-52	2	370	with spanner AF 47
LE.0819-01[4]	**D1**/2	110[1]	850	2CL	203	800	160	-	-	L1.0809-01	1	350	with Easy Lock Pin
LE.0819-54[4]	**D2**/2	110[1]	550[2]	2CL	203	800	160	-0,03	0,20	L1.0809-54	2	370	with Easy Lock Pin
LE.0819-55[4]	**D2**/1	110[1]	550[2]	2CL	203	800	160	-0,03	0,35	L1.0809-55	2	370	with Easy Lock Pin

Remark:
The ventilating filters listed in this chart are standard filters. If modifications are required, e.g. with integrated dipstick, we kindly ask for your inquiry.

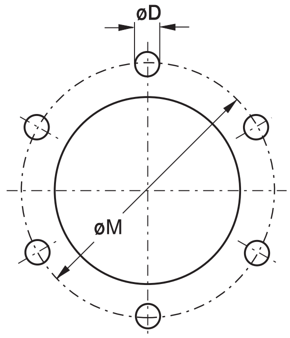
[1] at 200 mm²/s (ISO VG 46 at approx. 15 °C)
[2] $\Delta p < 0{,}1$ bar for air IN
[3] Venilating filter not fixed by a chain at the filling filter
[4] Vandalism Proof

Dimensions

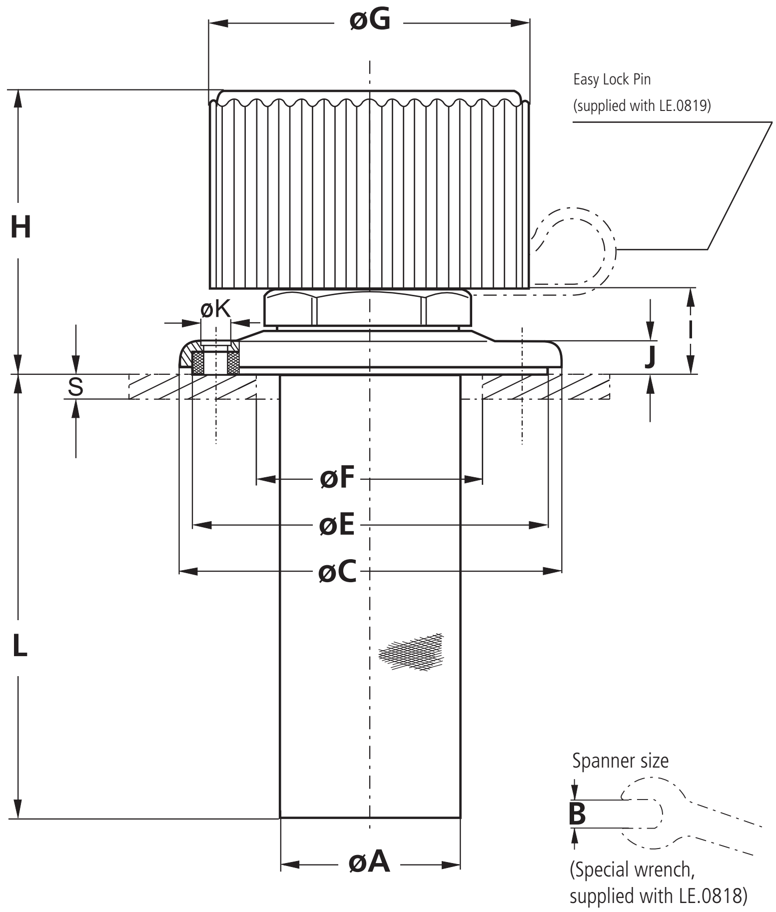
LE.0716



Hole pattern for tank
(core hole Ø D for steel material as per table)



LE.0817 · LE.0827 · LE.0818 · LE.0819



Measurements

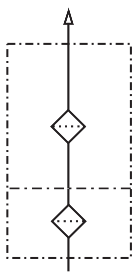
Type	A	B	C	E	F	G	H	I	J	K	L	M
LE.0716	46	-	89,5	84,5	58	66	36	15	6	5,6 ± 0,3	111	73
LE.0817	46	47	89,5	84,5	58	80	61	20	6	5,6 ± 0,3	111	73
LE.0827	46	47	89,5	84,5	58	80	61	20	6	5,6 ± 0,3	200	73
LE.0818	46	47	89,5	84,5	58	80	61	20	6	5,6 ± 0,3	111	73
LE.0819	46	47	89,5	84,5	58	80	61	20	6	5,6 ± 0,3	111	73

Plate thickness **S** over/up to	hole **D***
1,00 / 1,75	3,9
1,75 / 3,00	4,1
3,00 / 4,75	4,4
4,75	M5

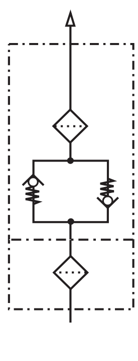
* Core hole Ø D for self-tapping screws according to DIN 7975 for versions without double check valve. For versions with double check valve always use M5.
Fastening screws included in basic equipment.

Symbols

1



2



Layout

Sizes
The determining factor for selecting the size is the maximum over / under pressure allowed in the tank.

For versions without double check valves, the initial pressure drop with a clean air filter should not exceed 0,03 bar.

For versions with double check valves, the initial pressure drop for air IN with a clean air filter should not exceed 0,1 bar.

Filter fineness
In the ideal case, the fineness of the ventilating filter matches the fineness of the system filter (see also CETOP RP 98 H).
By the use of filter fineness 2 CL the ingress of dust into the tank is effectively reduced.

Mounting
The ventilating filter should be mounted in a low-dust area of the machine and not in depressions in which water can collect.
For mobile use, the ventilating filter is to be mounted on the tank such that neither splashing oil from the inside nor spray water from the outside can reach the area of the ventilation opening.

Double check valves
By the use of double check valves, the exchange of air between the tank and the environment can be considerably reduced, whereby the ingress of dust is minimized and the lifetime of the air filter element is increased.
With the double check valve, a predefined level of pressure can be created in the tank in order to improve the suction conditions for the pumps.
The valve opening pressure required for the ventilating filter can be approximately determined with the ideal gas equation depending on the following system characteristics:

- differential volume
- volume of oil in the system
- volume of air in the tank
- operating temperatures

Calculation tool available.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

Content

Clogging Indicators

DG 100 · DG 101 · DG 200 DG 813 · DG 815 · DG 819 DG 902

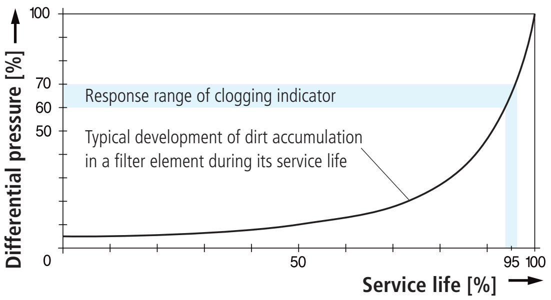
- For Suction or Return Filters
- Connection G¼ resp. M12 x 1,5
- Response/Switching pressure up to 2,5 bar

60.20-5e

Description

Application
Monitoring the contamination of suction resp. return filters.

General
Filter elements installed in hydraulic filters remove dirt from a hydraulic system and therefore become contaminated themselves. Free pores or spaces in the filter material are obstructed by dirt particles, which causes a continuous increase in the pressure loss.



The dirt load collected in a filter element gradually increases during service, which also leads to a higher pressure drop. The resulting vacuum or back pressure is monitored by a clogging indicator. Once a preset value is reached, an electrical and/or optical signal is generated.
The following must be observed in this context:
The pressure drop caused by the filter element increases depending on the flow rate, the dirt load, and the viscosity of the pressure fluid. Therefore, a filter element is not regarded contaminated before the clogging indicator responds at operating temperature of the hydraulic system, causing a continuous signal.

Consequences of an overdue filter element change

Filters with by-pass valve: The more dirt has collected in the filter element, the more frequently the bypass valve opens and part of the hydraulic fluid remains unfiltered. The high pressure drop causes unnecessary power consumption.

Suction filters without by-pass valve: There is a high risk of pump cavitation with increasing vacuum caused by contaminated elements.

Characteristics

Operating pressure
- DG 100: -1,0 ... +0,25 bar
- DG 101: -1,0 ... +0,25 bar
- DG 902: -0,5 ... +1,0 bar
- DG 200: 0 ... +10,0 bar
- DG 813: 0 ... +10,0 bar
- DG 815: 0 ... +10,0 bar
- DG 819: 0 ... +10,0 bar

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request).

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range of fluids
- DG 100: -30 °C ... +100 °C (short term 120 °C)
- DG 101: -30 °C ... +100 °C (short term 120 °C)
- DG 902: -15 °C ... +100 °C (short term 130 °C)
- DG 200: -20 °C ... + 90 °C
- DG 813: -30 °C ... +100 °C (short term 120 °C)
- DG 815: -30 °C ... +100 °C (short term 120 °C)
- DG 819: -30 °C ... +100 °C (short term 120 °C)

Ambient temperature range
- DG 100: -30 °C ... +80 °C
- DG 101: -30 °C ... +80 °C
- DG 902: -30 °C ... +80 °C*
- DG 200: -20 °C ... +90 °C
- DG 813: -30 °C ... +80 °C
- DG 815: -30 °C ... +80 °C
- DG 819: -30 °C ... +80 °C

* Design-related the switching tolerance increases at temperatures -15°C.

Materials
- DG 100: Housing steel, fitting brass, seal copper
- DG 101: Housing steel, fitting brass, seal copper
- DG 902: Housing brass, protection cap polyamide, diaphragm FPM, seal NBR
- DG 200: Housing polyamide, fitting brass, seal PTFE
- DG 813/ DG 819: Housing steel galvanized, protection cap NBR, diaphragm NBR, seal copper
- DG 815: Housing polyamide, fitting steel galvanized, diaphragm NBR, seal copper

Operating voltage
10 ... 30 V DC
(only required for clogging indicators with built-in LEDs)

Electrical service life
DG 902 / DG 813 / DG 815 / DG 819: min. 10^6 switching cycles

Electrical protection
- DG 902: IP 44 (with protection cap)
- DG 813: IP 65 (switch housing), IP 54 (with protection cap)
- DG 815: IP 65 (with mounted and secured socket)
- DG 819: IP 67 (in connected condition)

Electrical connection
- DG 902: Flat plugs DIN 46247 - 6,3 x 1
  Cable diameter approx. 6,5 mm
- DG 813: Flat plugs DIN 46244 - A 6,3 - 0,8
  Cable diameter approx. 4 mm
- DG 815: Socket DIN 43650 - AF3
  Cable diameter 6 ... 8 mm
- DG 819: Mating plug AMP superseal and Deutsch DT04-2P
  resp. cable diameter approx. 4 mm

Mounting position
No limitation

Overview of types

DG 100 / DG 101 - Manometer for Suction Filters

Function: Manometer for optical monitoring of the dirt load in suction filters.
Green reading area = filter element O.K.,
Red reading area = filter element clogged.

Option: Bottom-mounted fitting, making it possible to turn the manometer into the direction from which it is viewed, as compared to a fitting mounted on the back (standard).

DG 902 - Vacuum Switch for Suction Filters (change-over)

Function: When the preset vacuum is reached, the built-in diaphragm switch changes over.
The change-over (CO) switch makes it possible to indicate a broken wire by means of a suitable electronic circuit, as compared to a make contact (normally open / NO) switch.

DG 200 - Manometer for Return Filters

Function: Manometer for optical monitoring of the dirt load in return filters.
Green reading area = filter element O.K.,
Red reading area = filter element clogged.
In order to protect the measuring element from pressure peaks, the unit is provided with a built-in orifice system.

Option: Bottom-mounted fitting, making it possible to turn the manometer into the direction from which it is viewed, as compared to a fitting mounted on the back (standard).

DG 813 / DG 819 - Pressure Switch for Return Filters (make/break)

Function: The diaphragm switch closes resp. opens as soon as the pressure exceeds the preset value.

Accessories: Suitable protection caps for DG 813 are available under part no.
DG 813.0701 (central hole for cable Ø 1,5 up to 5 mm) and
DG 813.0702 (2 holes for cable Ø 1,7 up to 2,2 mm).

DG 815 - Pressure Switch for Return Filters (change-over)

Function: When the preset back pressure is reached, the built-in diaphragm switch changes over.
The change-over (CO) switch makes it possible to indicate a broken wire by means of a suitable electronic circuit, as compared to a make contact (normally open / NO) switch.

Option: The transparent socket with 2 built-in LEDs makes it possible to have an additional optical indication of the element contamination.
When the operating voltage is switched on, a green LED lights up.
When the switching pressure is reached, a yellow LED lights up in addition.

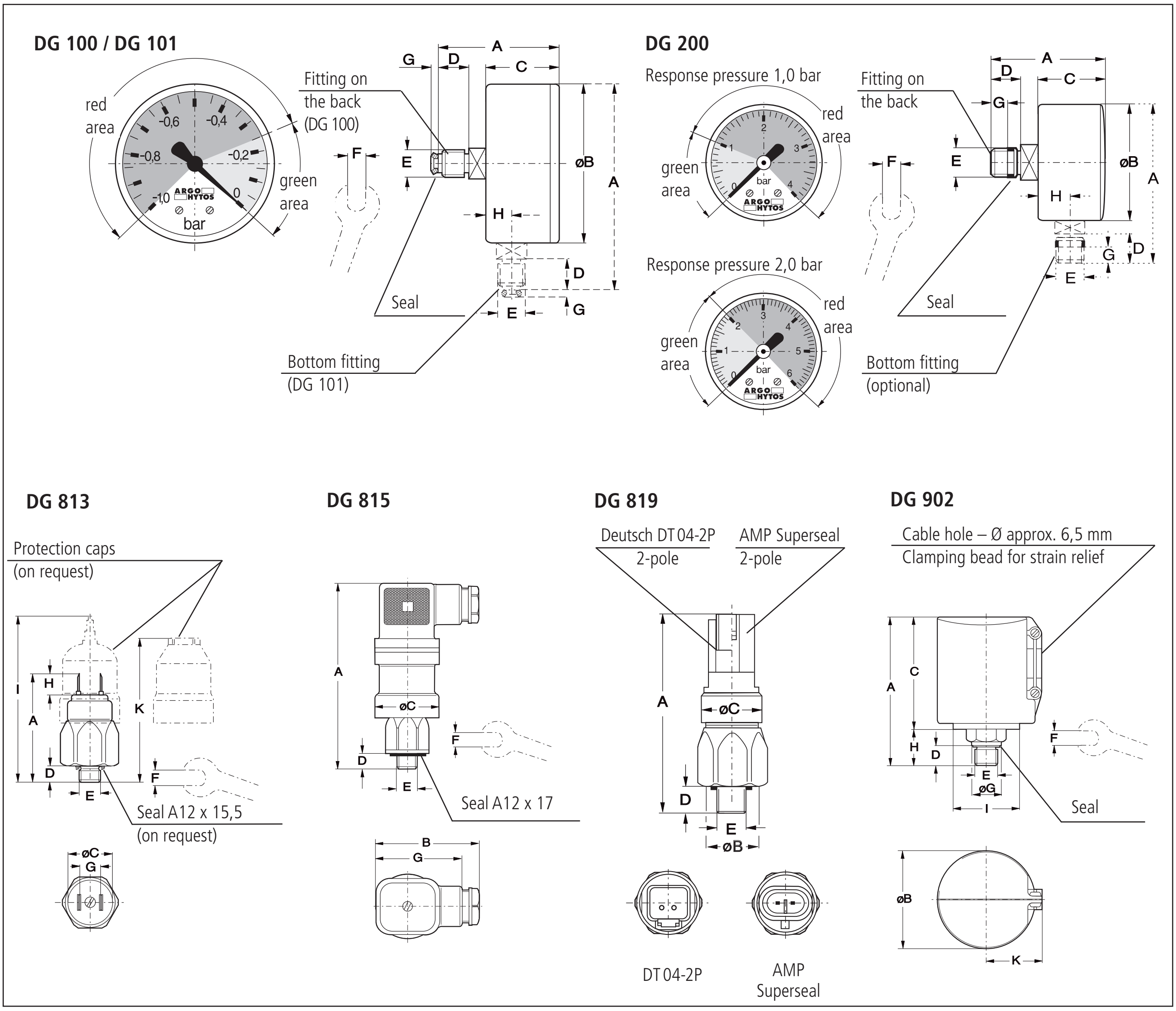
Selection Chart

Part No.	Optical indicator	Electrical switch	Temp. suppression < +32 °C	Response/Switching pressure	Type of contact	Switching voltage U	Switching current I	Switching power P	Symbol	Weight	Remarks
				bar		V AC/DC	A AC/DC	VA/W AC/DC		kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
DG 100-00	•	-	-	-0,25	-	-	-	-	1	0,11	Fitting on the back
DG 101-04	•	-	-	-0,25	-	-	-	-	1	0,11	Bottom fitting
DG 902-11	-	•	-	-0,15	change-over	250/24	6,0/2,0	1.500/48	2	0,13	with protection cap
DG 902-12	-	•	-	-0,25	change-over	250/24	6,0/2,0	1.500/48	2	0,13	with protection cap
DG 200-05	•	-	-	+1,0	-	-	-	-	1	0,07	Fitting on the back
DG 200-11[1]	•	-	-	+1,0	-	-	-	-	1	0,07	Fitting on the back
DG 200-06	•	-	-	+2,0	-	-	-	-	1	0,07	Fitting on the back
DG 200-15[1]	•	-	-	+2,0	-	-	-	-	1	0,07	Fitting on the back
DG 200-16[2]	•	-	-	+2,0	-	-	-	-	1	0,07	Fitting on the back
DG 200-10	•	-	-	+2,0	-	-	-	-	1	0,07	Bottom fitting
DG 813-00	-	•	-	+1,2	make	42/42	4,0/4,0	100/100	3	0,09	without protection cap
DG 813-03	-	•	-	+1,5	make	42/42	4,0/4,0	100/100	3	0,09	without protection cap
DG 813-01	-	•	-	+2,0	make	42/42	4,0/4,0	100/100	3	0,09	without protection cap
DG 813-05	-	•	-	+2,5	make	42/42	4,0/4,0	100/100	3	0,09	without protection cap
DG 813-20	-	•	-	+1,2	break	42/42	4,0/4,0	100/100	4	0,09	without protection cap
DG 813-21	-	•	-	+2,0	break	42/42	4,0/4,0	100/100	4	0,09	without protection cap
DG 819-21	-	•	-	+2,0	break	42/42	≤4,0	100/100	4	0,09	AMP Superseal
DG 819-22	-	•	-	+2,0	break	42/42	≤4,0	100/100	4	0,09	Deutsch DT04-2P
DG 815-01	-	•	-	+1,2	change-over	250/30	4,0/4,0	250/60	5	0,13	incl. socket
DG 815-11	•	•	-	+1,2	change-over	-/30	-/0,25	-/3,0	6	0,13	incl. socket
DG 815-02	-	•	-	+2,0	change-over	250/30	4,0/4,0	250/60	5	0,13	incl. socket
DG 815-12	•	•	-	+2,0	change-over	-/30	-/0,25	-/3,0	6	0,13	incl. socket

Remarks:
- With return filters, the response/switching pressure of the clogging indicator used must be lower than the cracking pressure of the bypass valve, with suction filters it must be higher.
- The clogging indicators listed in this chart are standard units. Other designs available on request.

[1] for FR 043 / FR 072 (with preformed seals) [2] for FNA 008 / FNA 016 (as DG 200-06 but without throttle screw)

Dimensions



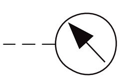
Measurements

Type	A	B	C	D	E	F	G	H	I	K
DG 100 / 101*	50 / 84*	64	30	13	G¼	14	3,2	10*	-	-
DG 902	76	50	56	10	G¼	21	18,5	20	34	30
DG 200	47 / 59*	41	26 / 24*	12	M12 x 1,5	14 / 12*	5	9*	-	-
DG 813	55	23,3	24	9	M12 x 1,5	AF24	13	9	88	74
DG 815	92	50	34	9	M12 x 1,5	AF27	40	-	-	-
DG 819-21	70	23,3	24	9	M12 x 1,5	AF24	-	-	-	-
DG 819-22	71	23,3	24	9	M12 x 1,5	AF24	-	-	-	-

* Bottom fitting

Symbols

1



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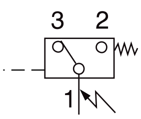

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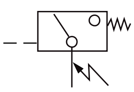

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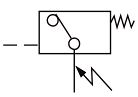

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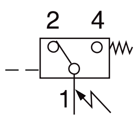

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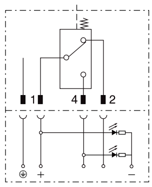
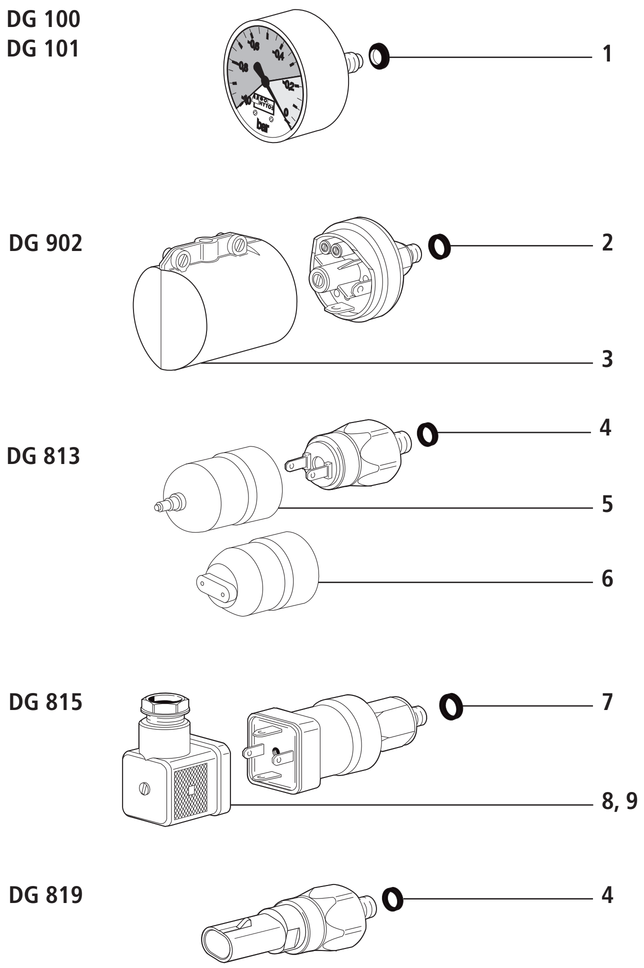


Spare Parts



Pos.	Designation	Part No.
1	Seal	DG 100.0101
2	Seal	DG 902.0103
3	Protection cap	DG 902.1701
4	Seal * A12 x 15,5 DIN 7603-Cu	11049900
5	Protection cap *	DG 813.0701
6	Protection cap *	DG 813.0702
7	Seal A12 x 17 DIN 7603-Cu	11164200
8	Socket DIN 43650 - AF3	DG 041.1220
9	Socket with 2 LED DIN 43650 - AF3	DG 041.1200

*Not included in basic unit

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

Various quality controls during the production process guarantee the leakfree function and solidity of our products.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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ARGO HYTOS

Clogging Indicators

DG 023 • DG 024 • DG 025
DG 041 • DG 042

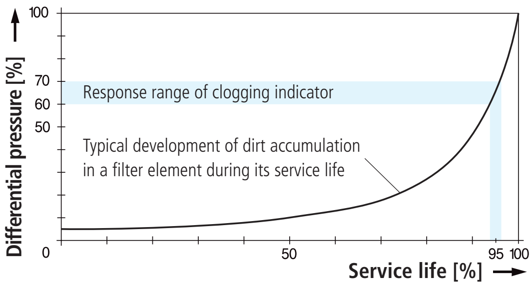
- For Pressure and High Pressure Filters
- Operating pressure up to 450 bar
- Response/Switching pressure up to 5,0 bar

60.30-4e

Description

Application
Monitoring the contamination of pressure and high pressure filters.

General
Filter elements installed in hydraulic filters remove dirt from a hydraulic system and therefore become contaminated themselves.
Free pores or spaces in the filter material are obstructed by dirt particles, which causes a continuous increase in the pressure loss.



The dirt load collected in a filter element gradually increases during service, which also leads to a higher pressure drop. The resulting differential pressure Δp is monitored by a clogging indicator. Once a preset value is reached, an electrical and/or optical signal is generated.
The following must be observed in this context:
The pressure drop caused by the filter element increases depending on the flow rate, the dirt load, and the viscosity of the pressure fluid. Therefore, a filter element is not regarded contaminated before the clogging indicator responds at operating temperature of the hydraulic system, causing a continuous signal.

Consequences of an overdue filter element change

For filters equipped with a bypass valve: The more dirt has collected in the filter element, the more frequently the bypass valve opens and part of the hydraulic fluid remains unfiltered.
The high pressure loss causes unnecessary power consumption.

For filters without a bypass valve: The increasing pressure loss across the filter element, which reduces the efficiency of the hydraulic system, eventually causes malfunctions to occur or a pressure relief valve to respond.

Design and principle of operation
Within the clogging indicator, the differential pressure $\Delta p = p_1 - p_2$ (pressure upstream of the element minus pressure downstream of the element) caused by the filter element acts on a magnetic piston against the force of a spring.
In optical (mechanical) clogging indicators, the increasing differential pressure causes the piston to approach a second magnet with reversed polarity which in turn causes the indicator to change from green to red.
In electrical clogging indicators, the magnetic piston triggers a reed switch.

Special design features

Piston seal: The piston actuated by the differential pressure is equipped with a leak-free O-ring seal.
As a result, the total flow passes the filter element.

Proximity position sensing: Piston movement is detected by sensing a magnetic field, i.e. without mechanical contact. For this reason, ARGO-HYTOS clogging indicators are absolutely leak-free.

Characteristics

Operating pressure
0 ... 315 bar, min. 10^7 pressure cycles
Nominal pressure according to DIN 24550

0 ... 450 bar, min. 10^4 pressure cycles
Quasi-static operating pressure

Connection
For the flange hole layout please refer to the section Dimensions (other fittings on request).

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20).

Temperature range of fluids
-30 °C ... +100 °C (short term +125 °C)

Ambient temperature range
-30 °C ... +80 °C

Materials
- Housing: Aluminium alloy
- Piston: Brass
- Socket: Polyamide
- Display piece DG 042: Polyamide
- Seals: NBR (FPM on request)

Operating voltage
10 ... 30 V DC
(only required for clogging indicators with built-in LEDs)

Electrical service life
Min. 10^7 switching cycles

Electrical protection
IP 65 (with mounted and secured socket)

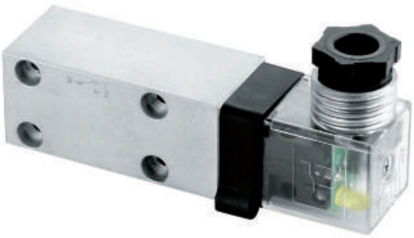
Mounting position
No limitation

Overview of types

DG 042 - Optical differential pressure indicator

Function: When the preset differential pressure is reached, the optical indicator changes from green to red. If the pressure differential returns to a value below the preset limit, the indicator changes back to green, i.e. no manual reset of the indicator is required.

DG 041 - Electrical differential pressure switch (change-over)



Function: When the preset differential pressure is reached, the built-in Reed switch changes over.
The change-over (CO) switch makes it possible to indicate a broken wire by means of a suitable electronic circuit, as compared to a make contact (normally open NO) switch.

Option: The transparent socket with 2 built-in LEDs makes it possible to have an additional optical indication of the filter contamination.
When the operating voltage is switched on, a green LED lights up.
When the switching pressure is reached, a yellow LED lights up in addition.

DG 023 - Electrical differential pressure switch with temperature suppression (change-over)

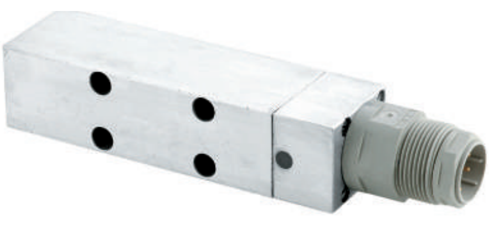
Function: The built-in Reed switch changes over when the preset differential pressure is exceeded.
If the temperature drops below 32 °C, a temperature switch opens and suppresses the signal of the differential pressure switch.
The transparent socket with 2 built-in LEDs makes it possible to have an additional optical indication of the filter contamination (function described at DG 041).

DG 024 - Electrical differential pressure switch with 2 switching points (break)

Function: When 70 % of the preset differential pressure is reached, the first Reed switch opens, at 100 % the second built-in Reed switch opens.

Note: Since the differential pressure of a filter element rises at an exponential rate towards the end of the element's service life (refer to the Description section), approximately 95 % of the service life has expired when the first Reed contact opens (at 70 % of Δp setting).

DG 025 - Electrical differential pressure switch with 2 switching points with/without temperature suppression (change-over)



Function: Upon reaching 60 % and 100 % of the preset differential pressure, the two built-in Reed switches change over.

Option: In order to suppress the signal at temperatures < 32 °C, a temperature-suppressed version of the differential pressure switch is also available.

Accessory: For an additional optical indication of the filter contamination, a socket with 3 built-in LEDs is available with part no. DG 025.2601. When the operating voltage is switched on, a green LED lights up. Upon reaching the first switching pressure, a yellow LED lights up in addition.
Exceeding the 2nd switching pressure causes an extra red LED to light up.

Note: Refer to DG 024.

Selection Chart

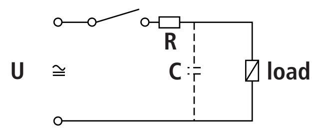
Part No.	Optical indicator	Electrical switch	Temp.-suppression < 32° C S_1	Response/Switching pressure S_2/S_3	Type of contact	Switching voltage U	Switching current I	Switching power P	Symbol	Weight	Remarks
				bar		V AC/DC	A AC/DC	VA/W AC/DC		kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
DG 042-01	•	-	-	2,0	-	-	-	-	1	0,17	-
DG 042-02	•	-	-	5,0	-	-	-	-	1	0,17	-
DG 041-61	-	•	-	1,2	change-over	120/175	0,17/0,25	3,5/5,0	2	0,19	with socket
DG 041-31	-	•	-	2,0	change-over	120/175	0,17/0,25	3,5/5,0	2	0,19	with socket
DG 041-44	•	•	-	2,0	change-over	- /30	- /0,25	- /3,0	3	0,19	with socket
DG 041-32	-	•	-	2,5	change-over	120/175	0,17/0,25	3,5/5,0	2	0,19	with socket
DG 041-33	-	•	-	5,0	change-over	120/175	0,17/0,25	3,5/5,0	2	0,19	with socket
DG 041-43	•	•	-	5,0	change-over	- /30	- /0,25	- /3,0	3	0,19	with socket
DG 023-03	•	•	•	2,0	change-over	- /30	- /0,25	- /3,0	4	0,34	with socket
DG 023-02	•	•	•	5,0	change-over	- /30	- /0,25	- /3,0	4	0,34	with socket
DG 024-02	-	•	-	3,5/5,0	break	120/175	0,17/0,25	3,5/5,0	5	0,27	with socket
DG 025-05	-	•	-	3,0/5,0	change-over	120/175	0,17/0,25	3,5/5,0	6	0,31	without socket
DG 025-06	-	•	•	3,0/5,0	change-over	120/175	0,17/0,25	3,5/5,0	7	0,38	without socket

Remarks:

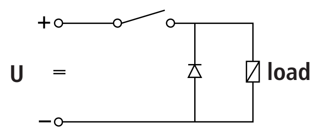
- The response/switching pressure of the clogging indicator must be lower than the cracking pressure of the bypass valve of the filter.
- The clogging indicators listed in this chart are standard units. Other designs available on request.
- Mounting accessories are not included in the scope of delivery and must be ordered separately (Part-no. see spare parts).
- Reed switches are sensitive of excessively strong currents. Even a short-term overload causes an increased contact resistance or failure of the switch. By taking the following precautions, premature failure of Reed switches due to overload is avoided.

Wiring suggestions:

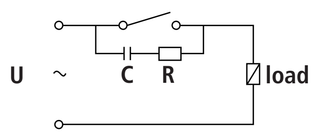
- Current limiter for DC and AC voltage:
  If light bulbs or other loads are connected over long distances (conductor capacity!), a protective resistor should be connected in series in order to limit the current. The same applies when capacitance loads are connected.



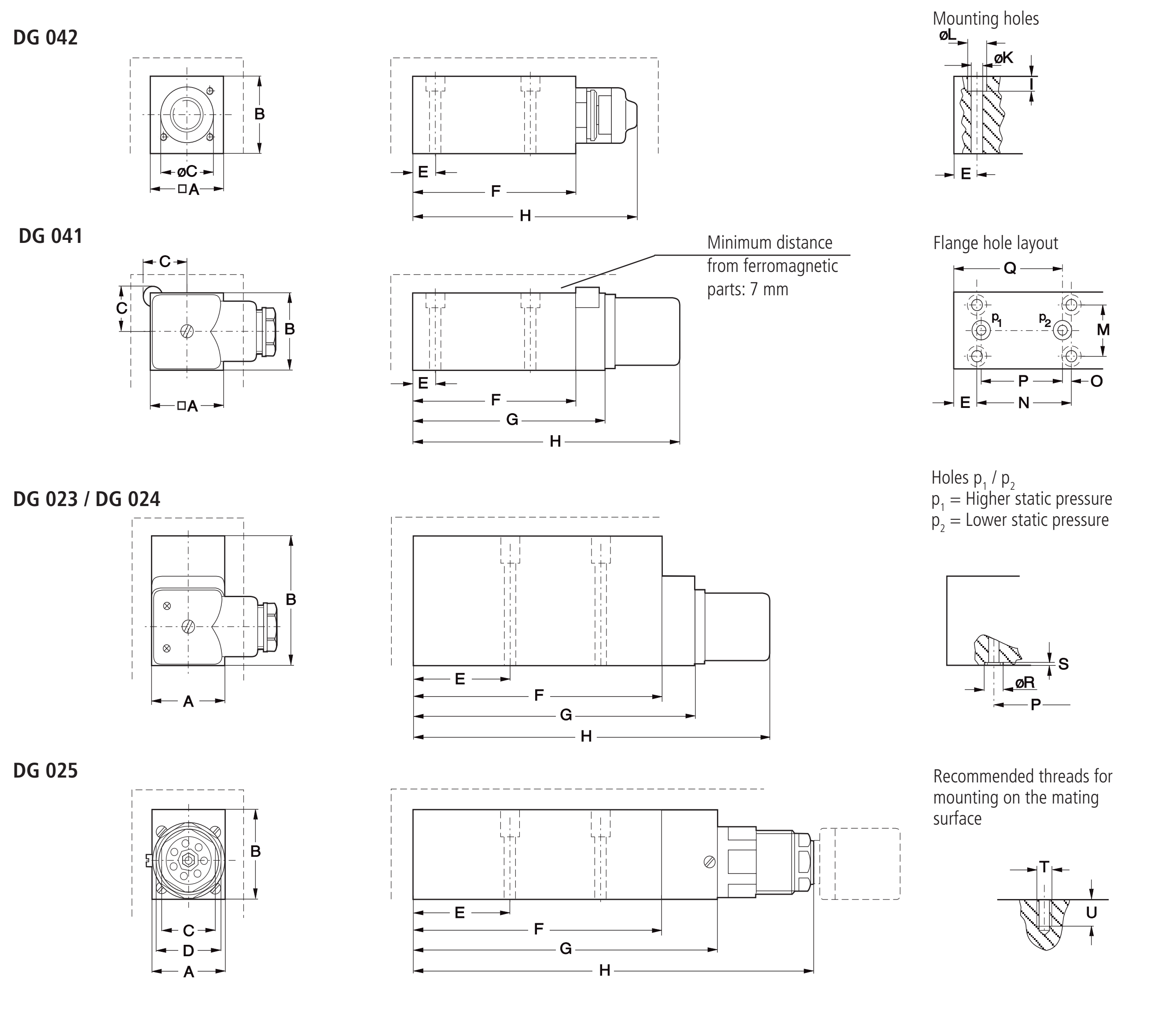
- Spark suppression in DC applications:
  The contacts of Reed switches open extremely fast, causing voltage peaks to be induced when switching off inductive loads, such as relays, lifting magnets, or solenoid valves. The resulting self-induction currents are short-circuited by connecting a diode in parellel to the inductive load.



- Spark suppression in AC applications:
  In AC applications, a diode connected in parallel to the load is not sufficient. RC elements should be used here, connected in parallel to the Reed switch. Please contact our design engineers for advice in order to select a suitable RC element.



Dimensions

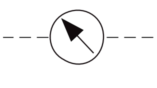


Measurements

Type	A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q	R	S	T	U
DG 042	30	30	21,5	-	8	67	-	93	6	4,5	8	20	39	3	34	44	7,2	1,1	M4	6
DG 041	30	30	17,5	-	11	70	83	115	6	4,5	8	20	39	3	34	47	7,2	1,1	M4	6
DG 023	30	50	-	-	12	76	88	121	6	4,5	8	20	39	3	34	48	7,2	1,1	M4	6
DG 024	30	35	-	-	9	77	89	122	11	4,5	8	20	39	3	34	45	7,2	1,1	M4	6
DG 025-05	30	35	AF22	AF27	9	77	100	139	11	4,5	8	20	39	3	34	45	7,2	1,1	M4	6
DG 025-06	30	50	AF22	AF27	12	77	100	139	6	4,5	8	20	39	3	34	48	7,2	1,1	M4	6

Symbols

1



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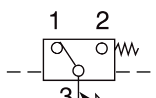

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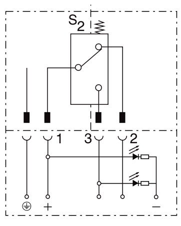

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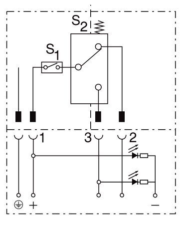

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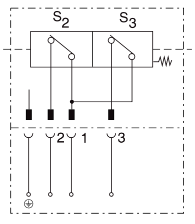

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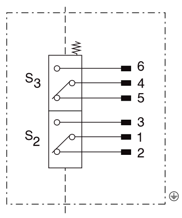

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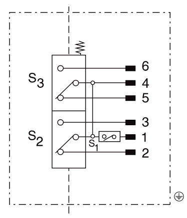
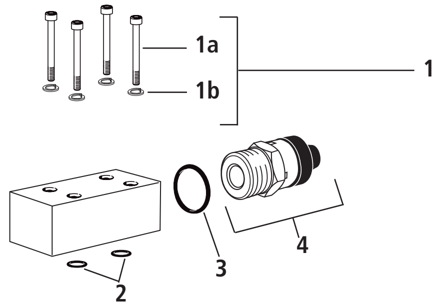
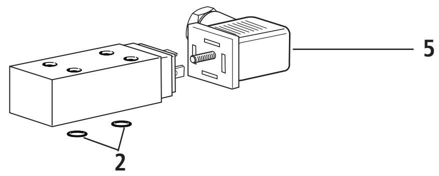


Spare Parts

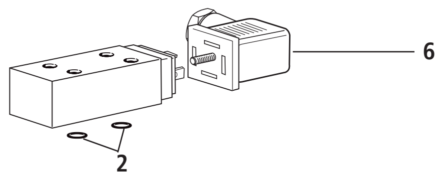
DG 042



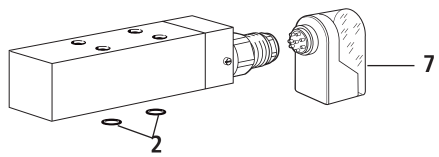
DG 041 / DG 024



DG 041 / DG 023



DG 025



Pos.	Designation	Part No.
1	Mounting accessories * for versions without temperature compensation	DG 020.1710
1	Mounting accessories * for versions with temperature compensation	DG 020.1730
1a	Bolt * M4 x 30 DIN 912-8.8	11272600
1a	Bolt * M4 x 50 DIN 912-8.8	18077800
1b	Spring washer * B4 DIN 127	11272700
2	O-ring 4,5 x 1,5	N007.0041
3	O-ring 12,3 x 2,4	N007.0124
4	Display piece assy (with pos. 3)	DG 042.1410
5	Socket DIN 43650 - AF3	DG 041.1220
6	Socket with 2 LED DIN 43650 - AF3	DG 041.1200
7	Socket with 3 LED * DIN 43651	DG 025.2601

*Not included in basic unit

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

Various quality controls during the production process guarantee the leakfree function and solidity of our products.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions

ARGO-HYTOS GMBH · Industriestraße 9 · 76703 Kraichtal-Menzingen · Germany
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ARGO HYTOS

Content

ARGO HYTOS

Oil Level Dipsticks

C4.0410 · C4.0412
C4.0421 · C4.0431
C4.0450 · C4.0464

- With mounting bolts
- Bolt thread M10
- Dipstick length up to 640 mm

70.10-3e

Description

Application
Controlling the oil level in hydraulic oil or lubricant reservoirs

Construction and function
ARGO-HYTOS oil level dipsticks are robust semicircular metal rods with an O-ring seal.
A mounting bolt with a suitable hole is supplied with each dipstick.
Dipsticks are available in various lengths, with various markings, and with various mounting bolts (see selection chart).

Special features
- The robust material withstands even the most severe operating conditions
- Absolutely leak-free due to integrated O-ring.
- A suitable dipstick mounting bolt can also replace one of the mounting bolts of an in-tank return or suction filter

Mounting
The bolt supplied with the oil level dipstick is installed either in a separate threaded hole or in an already existing mounting hole for an in-tank filter. If used as a filter mounting bolt, a separate threaded hole is eliminated. Care should be taken to provide a proper seal between the tank, the filter and the mounting bolt.

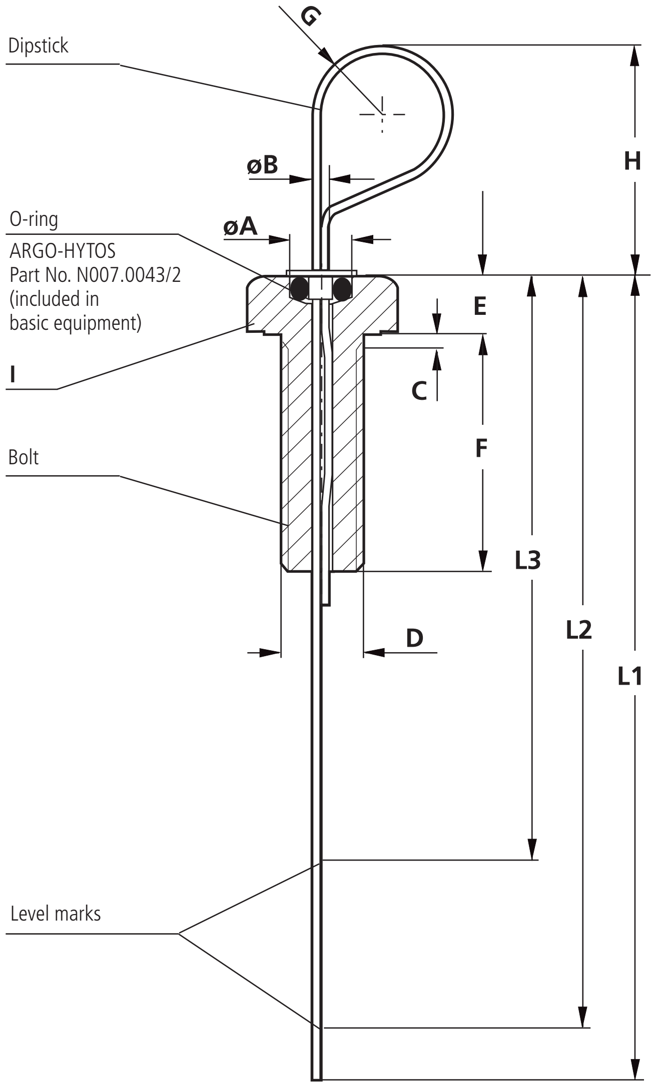
Selection Chart

Part No.	Dipstick dimension L1	Dipstick dimension L2	Dipstick dimension L3	Mounting bolt	Grade	Remarks
	mm	mm	mm			
1	2	3	4	5	7	8
C4.0410-00330	100	-	-	SV.2810.05	8.8	-
C4.0410-01330	100	95	64	SV.2810.05	8.8	-
C4.0412-00330	120	-	-	SV.2810.05	8.8	-
C4.0412-03330	120	97	47	SV.2810.05	8.8	-
C4.0412-04330	120	100	75	SV.2810.05	8.8	-
C4.0421-00330	210	-	-	SV.2810.05	8.8	-
C4.0421-04330	210	118	88	SV.2810.05	8.8	-
C4.0421-06330	210	71	46	SV.2810.05	8.8	-
C4.0431-00330	310	-	-	SV.2810.05	8.8	-
C4.0431-01330	310	190	160	SV.2810.05	8.8	-
C4.0450-00330	500	-	-	SV.2810.05	8.8	-
C4.0464-00330	640	-	-	SV.2810.05	8.8	-
C4.0464-01330	640	630	90	SV.2810.05	8.8	-

Remarks:
The dipsticks listed in the chart are standard dipsticks. If modifications are required, e.g. for the use in pressurized tanks, we kindly ask for your request.

Dimensions

Dipstick with bolt



Dimensions

Mounting bolt	A	B	C	D	E	F	G	H	I
SV.2810.05	10	3,7	4,5	M10	7	30	10	39	AF 17

Characteristics

Operating pressure
Max. 1 bar (abs.)
(not suitable for use in pressurized hydraulic oil tanks)

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see section Dimensions (other port threads on request).

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20)

Temperature range
-30 °C ... +100 °C (temporary +125 °C)

Ambient temperature range
-30 °C ... +80 °C (temporary +100 °C)

Materials

Dipsticks:	Steel, zinc plated
Bolts:	Steel, zinc plated
Seals:	NBR (FPM on request)

Mounting position
Preferably in vertical position, above the oil level

Quality Assurance

Quality management according to DIN EN ISO 9001

Various quality controls during the production process guarantee the leakfree function and solidity of our products.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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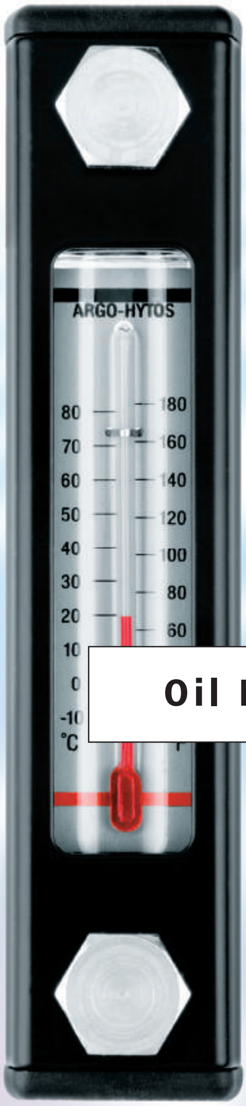


Oil Level Gauges

C5.3511 · C5.3516
C5.3529

- With thermometer
- Indication range up to 194 mm
- Temperature indication up to 80 °C

70.50-4e

Description

Application
Indicates the oil level and the oil temperature in hydraulic oil or lubricant reservoirs.

Design and function
ARGO-HYTOS oil level gauges consist of a robust metal housing equipped with a sight level tube and built-in thermometer. The fluid enters the thermometer chamber through the mounting bolts, which are hollow. O-rings provide a seal against the housing and the reservoir wall.

Special features
- The robust metal housing is designed to withstand even the most severe operating conditions.
- The integrated scale shows the oil temperature in °C and °F.

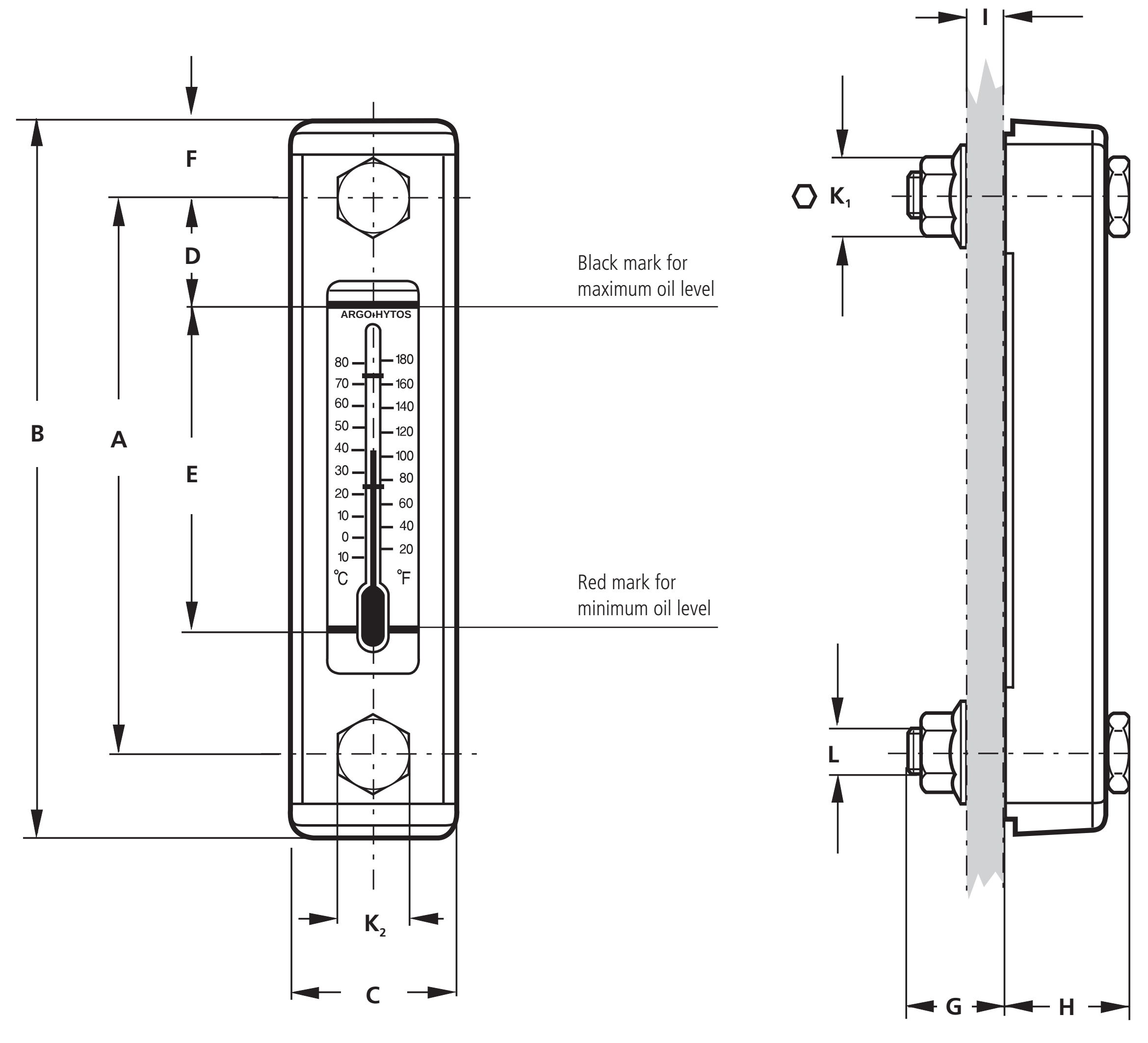
Mounting
The hollow screws and the locking nuts supplied with the gauge, enable installation on the reservoir wall.
The locking nuts serve the purpose of retightening the bolts from the outside (assembly torque: 8 Nm).
Threaded holes are required instead of smooth bore holes if the wall of the reservoir is more than 8 mm thick.

Selection Chart

Part No.	Oil level indicating range E	Total height B	Temperature indicating range	Temperature indicating range	Mounting bolts	Weight	Remarks
	mm	mm	°C	°F		kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
C5.3511-50	33	108	+20 ... +80	80 ... 180	M10	0,18	-
C5.3516-50	74	159	-10 ... +80	20 ... 180	M12	0,24	-
C5.3529-50	194	285	-10 ... +80	20 ... 180	M12	0,32	-

Remarks:
The gauges listed in the chart are standard gauges. If modifications are required, we kindly ask for your request.

Dimensions



At the housing C5.3529-50 the vision panel is splitted in two sections.

Measurements

Type	A	B	C	D	E	F	G	H	I max.	K_1	K_2	L
C5.3511-50	76	108	34,5	22,5	33	16	17	28	8	15	17	M10
C5.3516-50	127	159	34,5	27,5	74	16	17	28	8	18	17	M12
C5.3529-50	254	286	34,5	31	194	16	17	28	8	18	17	M12

Characteristics

Operating pressure
Max. 2 bar (abs.)

Connection
Threaded ports according to DIN 13. Sizes see Selection Chart, column 6 and section Dimensions.

Hydraulic fluids
Mineral oil and biodegradable fluids (HEES and HETG, see info-sheet 00.20).

Temperature range
-20 °C ... +80 °C

Ambient temperature range
-25 °C ... +80 °C

Materials

Housing:	Steel, powder coated, black
Sight level tube:	Polyamide
Scale:	Aluminium
Thermometer:	Glass
Bolts:	Steel, zinc plated
Seals:	NBR (FPM on request)

Mounting position
In the min./max. oil level range on the side wall of the hydraulic oil reservoir.

Quality Assurance

Quality management according to DIN EN ISO 9001

Various quality controls during the production process guarantee the leakfree function and solidity of our products.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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Oil Drain Valves

AV and TV

Application
Alternatively to oil drain plugs at oil tanks you can also insert ARGO-HYTOS oil drain valves of type series AV20 or TV. The oil can precisely be discharged over the drain hole into a container or be sucked off by connected oil pumps or ARGO-HYTOS oil service units. Oil change or oil service is being simplified and can be effected almost without loosing any oil.
Examples for applications: Oil storage tanks in all industries, gear boxes, test benches, axles of rail vehicles.

Design and function
ARGO-HYTOS oil drain valves consist of a housing with spindle and poppet sealing. The poppet is opened by the spindle and the oil then will be drained. Threads at the oil drain hole allow connection of oil pumps or ARGO-HYTOS oil service units.

Special design features
- Sealing by precise steel ball
- With Type AV additional sealing of the spindle

Fixing
At the bottom of the tank by screw connection

Operating pressure
Max. 1 bar absolute (not applicable with pressurized containers)

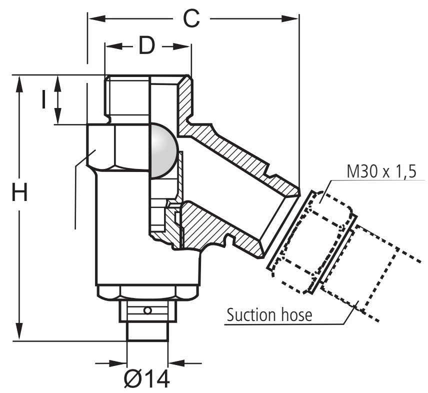
Connection
Threaded port – see Measurements

Hydraulic fluids
Mineral oil and biodegradable hydraulic fluids (HEES and HETG, see info-sheet 00.20)

Temperature range of fluids
-30 °C … +100 °C

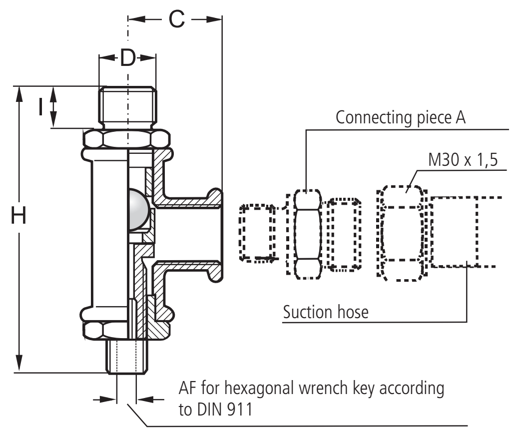
Ambient temperature range
-30 °C … +80 °C

Materials
Housing: GTW-40 powder-coated
Spindle and ball: steel
Operating position: vertical or horizontal



TYPE AV

Type	D	C	H	I	A/F	Part-No.
AV20	M32 x 1,5	75	93	16	14	EC330400
AV20/1	M30 x 1,5	75	93	16	14	EC330410



TYPE TV

Type	D	C	H	I	Connection A	A/F	Part-No.
TV R ½“	R 1/2“	28	92	15	M30 x 1,5 to R 1/2“	6	EC330110
TV R ¾“	R 3/4“	33	102	16	M30 x 1,5 to R 3/4“	8	EC330120
TV R 1“ *	R 1“	38	125	18	M30 x 1,5 to R 1“	8	EC330130

* For Type TV R1“ the spindle is additionally sealed with cap nut and flat gasket (not shown in drawing).

Content

Off-line Filter

FN 060 · FN 300

- In-line mounting
- Operating pressure up to 12 bar
- Nominal flow rate up to 650 l/min

80.10-5e

Description

Application

Main flow filter or off-line filter in hydraulic and lubricating systems.

Performance features

Protection against wear: By means of filter elements that in full-flow filtration, meet even the highest demands regarding cleanliness classes.

Protection against malfunction: Through installation near to the control valves or other expensive components. The specific determined flow rate guarantees a closed by-pass valve even at $\nu \leq 200$ mm²/s (cold start condition).

Special design features

Cover: The cover of the FN 060 can be opened without special auxiliary tools. Fold-out handle parts at the cover of the FN 300 for easy opening.

Automatic ventilation valve (only FN 300): The quick automatic deareation after putting into operation prevents components from consequential damage by a too high air amount in the oil as e.g. prevention of cavitation damages and micro diesel effect.

Dirt retention valve: On the bottom of the from inside to outside flown through filter elements, there is a dirt retention valve. If the filter element is pulled out of the filter housing with the cover the dirt retention valve will close. Sedimented dirt is removed from the housing with the filter element. Because of the design of the cover the filter element can be changed almost without losing any oil.

Filter elements

Flow direction from centre to outside. The star-shaped pleating of the filter material results in:

- large filter surfaces
- low pressure drop
- high dirt holding capacities
- long service life

Filter maintenance

By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter.

Materials:

Filter head:	Aluminium alloy
Filter housing:	Steel (FN 060) Aluminium alloy (FN 300)
Cover:	Aluminium alloy
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic, multi-layer microfibre web

Accessories

Water-absorbing filter elements EXAPOR® AQUA are available on request.
For FN 060 a bleeder screw is available on request and with Part no. FNS 060.1720 a fastening kit.
Electrical and/or optical clogging indicators are available on request – optionally with one or two switching points resp. temperature suppression.
Dimensions and technical data of the clogging indicators see catalogue sheet 60.30.

Characteristics

Operating pressure

Max. 12 bar (FN 060)
Max. 10 bar (FN 300)

Nominal flow rate

Up to 650 l/min (see Selection Chart, column 2)
The nominal flow rates indicated by ARGO-HYTOS are based on the following features:

- closed by-pass valve at $\nu \leq 200$ mm²/s
- element service life > 1.000 operating hours at an average fluid contamination of 0,07 g per l/min flow volume
- flow velocity in the connection lines: up to 10 bar ≤ 4,5 m/s

Filter fineness

3 µm(c) ... 10 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity

Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids

Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20)

Temperature range

-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate

- at operating temperature: $\nu < 35$ mm²/s
- as starting viscosity: $\nu_{max} = 1.200$ mm²/s
- at initial operation: The recommended starting viscosity can be read from the diagram D (pressure drop as a function of the kinematic viscosity) as follows: Find the 70 % Δp of the cracking pressure of the by-pass valve on the vertical axis. Draw a horizontal line so that it intersects the Δp curve at a point. Read this point on the horizontal axis for the viscosity.

Mounting position

Vertical, connection port at the bottom

Connection

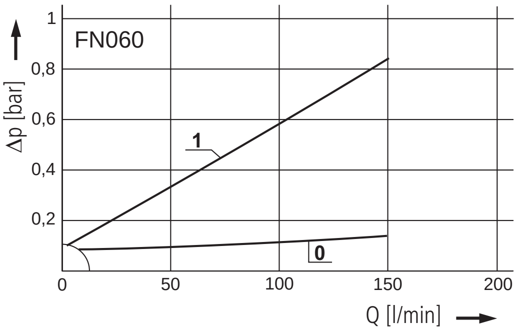
Threaded ports according to ISO 228 or DIN 13 (FN 060) or flange mounting according to SAE-J518 (FN 300).
Sizes see Selection Chart, column 6 (other port threads on request).

Diagrams

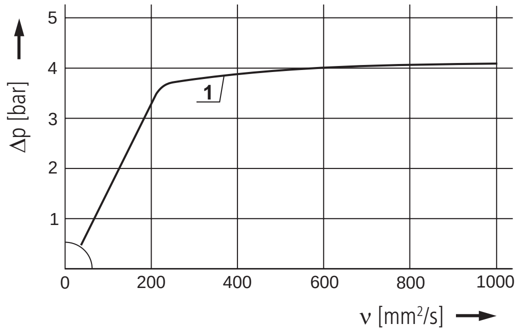
Δp-curves for complete filters in Selection Chart, column 3

D1

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)

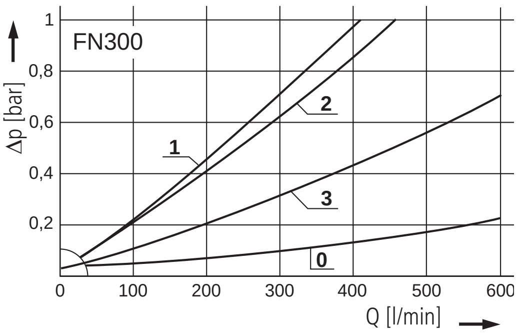


Pressure drop as a function of the **kinematic viscosity**
at nominal flow

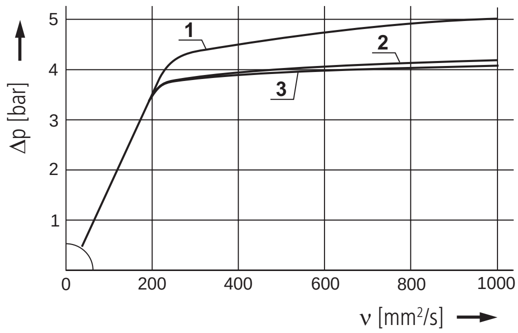


D2

Pressure drop as a function of the **flow volume**
at ν = 35 mm²/s (0 = casing empty)



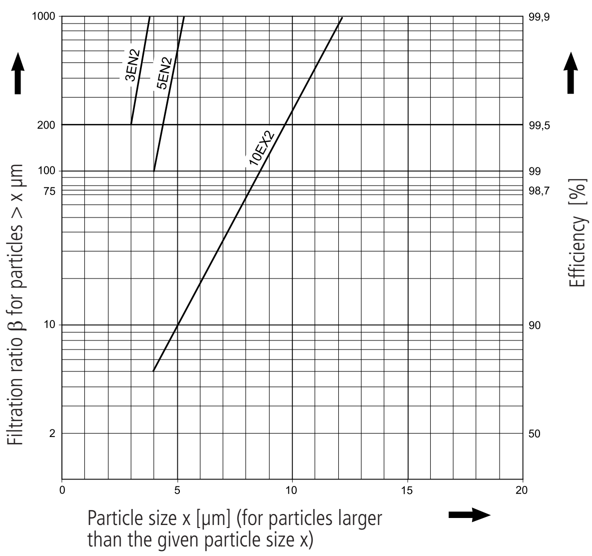
Pressure drop as a function of the **kinematic viscosity**
at nominal flow



Filter fineness curves in Selection Chart, column 4

Dx

Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2-Elements:

3EN2 = $\overline{\beta}_{3\,(c)}$ = 200 EXAPOR®MAX 2
5EN2 = $\overline{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\overline{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator	Remarks
	l/min			g		bar			kg		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
FN 060-273	115	**D1**/1	5EN2	220	G1	3,5	1	V7.1230-53	5	optional	–
FN 300-163	250	**D2**/1	3EN2	740	SAE2½	3,5	2	V7.1560-103	20	optional	*
FN 300-153	300	**D2**/2	5EN2	600	SAE2½	3,5	2	V7.1560-03	20	optional	*
FN 300-156	650	**D2**/3	10EX2	400	SAE2½	3,5	2	V7.1560-06	20	optional	*

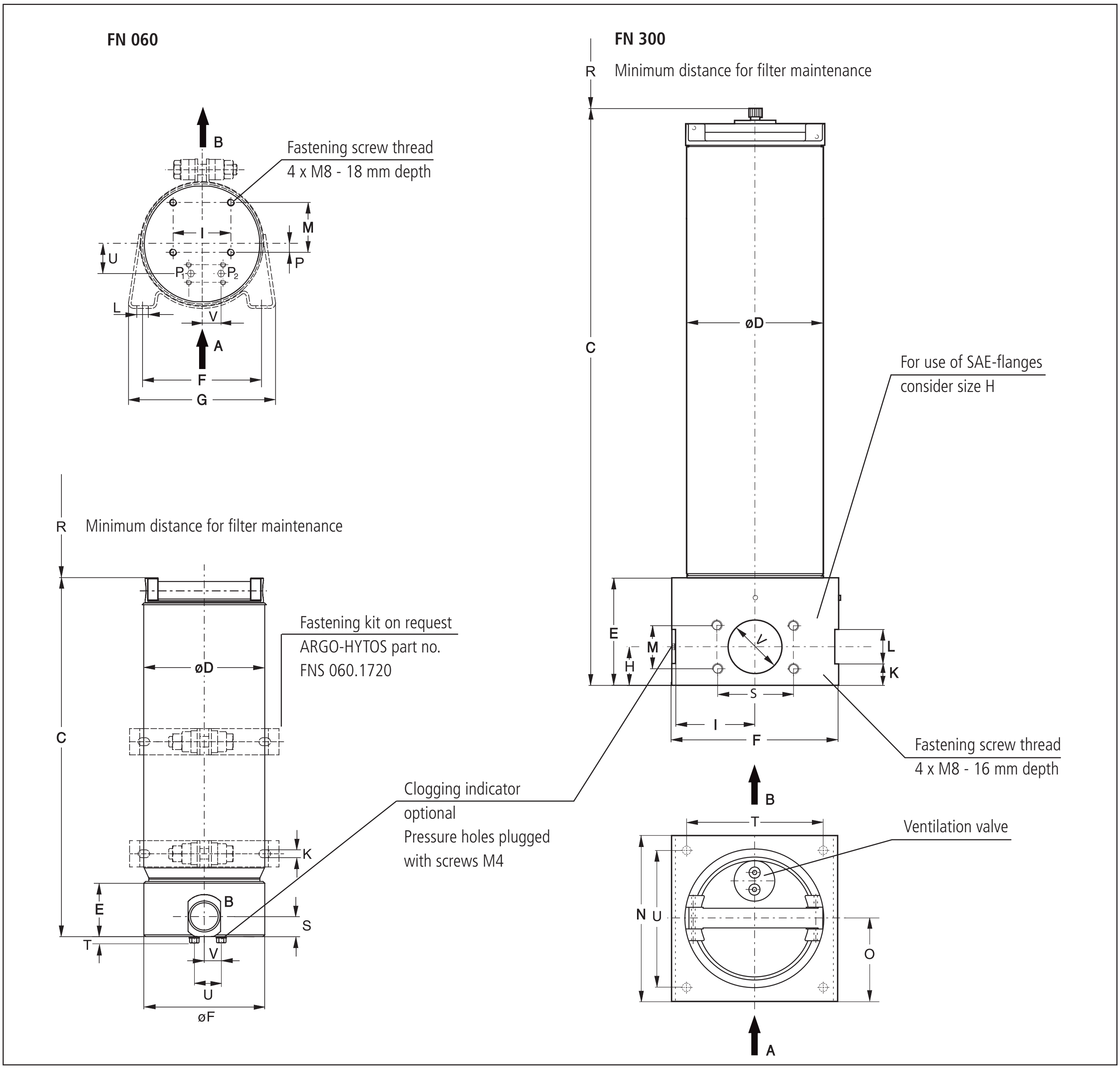
Optical or electrical indicators are available to monitor the clogging condition of the element.

For the appropriate clogging indicators see catalogue sheet 60.30.

Remarks:
- The response/switching pressure of the clogging indicator used must be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- The clogging indicators are optional and always delivered detached from the filter.
- The filters listed in this chart are standard filters. If modifications are required, e. g. with water-absorbing filter elements or fastening kit, we kindly ask for your request.

* with automatic ventilation valve

Dimensions

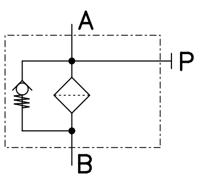


Measurements

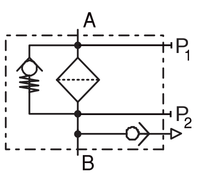
Type	A / B	C	D	E	F	G	H	I	K	L	M	N	O	P	R	S	T	U	V
FN 060	G1	410	140	63	136	170	–	66	9	12	56,5	–	–	9,5	300	23	4	34	21
FN 300	SAE2½	775	160	126	200	–	45	96	25	40	50,8	195	97,5	–	700	88,9	170	165	63

Symbols

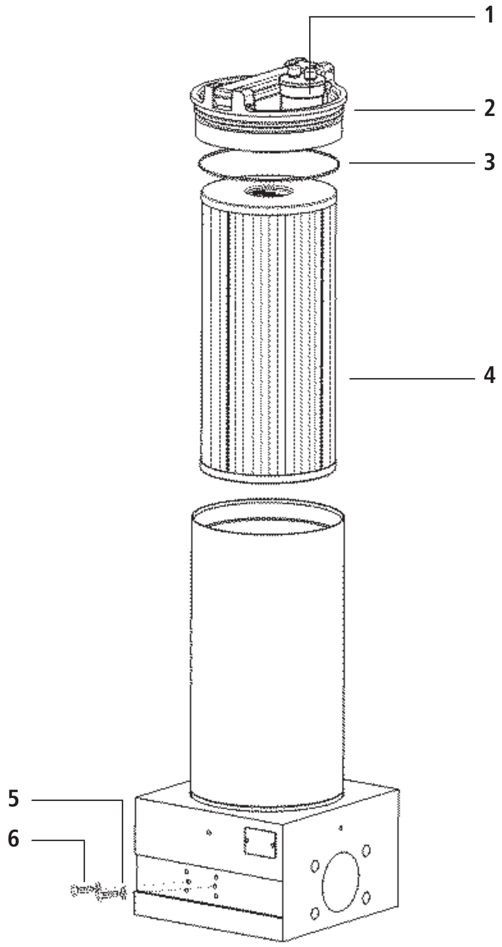
1



2



Spare Parts



Pos.	Designation	Part No.
1	Automatic ventilation valve (FN 300)	FA 016.1801
2a	Cover (FN 060)	FNA 008.1290
2b	Cover (FN 300) (with automatic ventilation valve and Pos. 3b)	FNA 045.1210
3a	O-ring 117,48 x 5,3 (FN 060)	N007.1175
3b	O-ring 145,42 x 5,33 (FN 300)	N007.1455
4	Filter element	see Chart/col. 9
5	Bonded seal 4,1 x 7,2 x 1	12504600
6	Hexagonal head screw M 4 x 8 DIN EN ISO 4017	11385800

The function of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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Off-line Filters

FNS 060

- With flow control valve
- Operating pressure up to 320 bar
- Nominal flow rate up to 4 l/min

80.20-2e

Description

Application
In the high pressure circuits of hydraulic and lubricating oil systems.

Performance features

Protection against wear: By means of ultra-fine filter elements that meet even the highest demands regarding cleanliness classes and dirt-holding capacity.

Protection against malfunction: By means of permanent filtration in the off-line circuits excellent cleanliness classes can be achieved.

Special design features

Cover: The cover can be opened without special auxiliary tools. Because of the cover design the filter element can be changed almost without losing any oil.

Flow control valve: Over the flow control valve the FNS off-line filters are connected directly to the high pressure pipe. The surplus volume (e.g. in circuits with fixed displacement pumps) from the high-pressure circuit is cleaned by the ultra fine filter element.

Dirt retention valve: Ensures that dirt accumulated in the filter is removed together with the element. Settled dirt cannot return into the system.

Filter elements
Flow direction from centre to outside. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Filter head:	Aluminium alloy
Filter housing:	Steel
Cover:	Aluminium alloy
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic, multi-layer microfibre web

Accessories
Water-absorbing filter elements EXAPOR® AQUA are available on request.
Electrical and optical clogging indicators are available on request.
Dimensions and technical data see catalogue sheet 60.20.

Characteristics

Nominal flow rate
Up to 4 l/min (see Selection Chart, column 2)
Refers to the medium flow rate of the flow control valve. With selection of the flow control valve a sufficient surplus volume from the high-pressure circuit has to be guaranteed. If necessary the machine manufacturer should be consulted.

Connection
Threaded port according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 6 (other port threads on request)

Filter fineness
3 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 4 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 5)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20)

Temperature range
-30 °C ... +100 °C (temporary -40 °C ... +120 °C)

Viscosity at nominal flow rate
- at operating temperature: $\nu < 35\ mm^2/s$
- as starting viscosity: $\nu_{max} = 400\ mm^2/s$

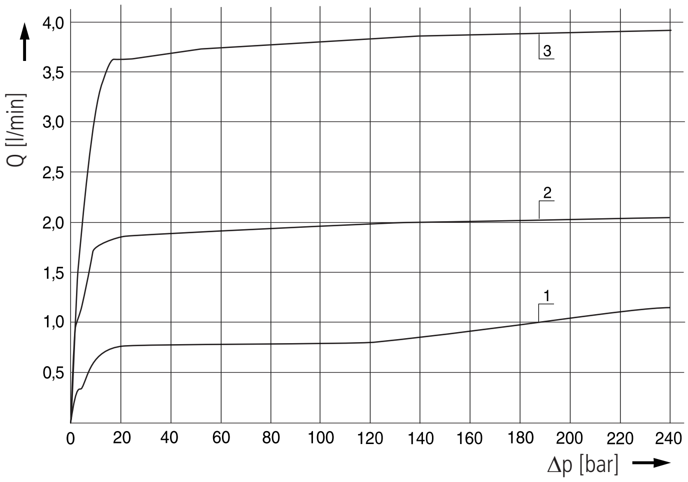
Operating pressure
Max. 320 bar
(max. 5 bar without flow control valve)
Minimum inlet pressure at the flow control valve: 10 bar

Mounting position
Vertical, connection port at the bottom

Diagrams

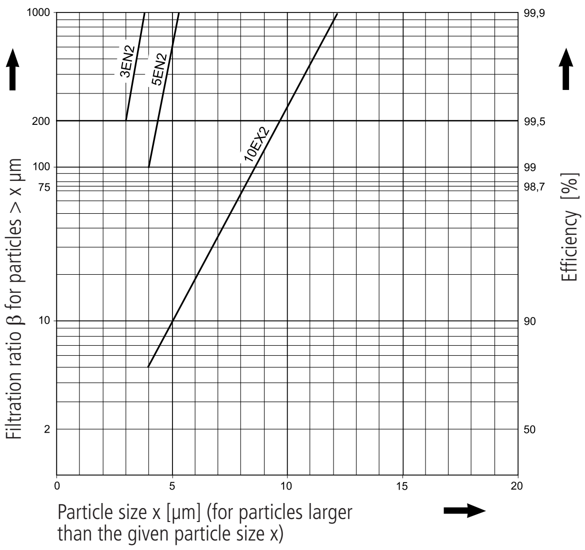
Δp-curves for complete filters in Selection Chart, column 3

D1 Flow volume as a function of the differential pressure at the flow control valve at ν = 35 mm²/s



Filter fineness curves in Selection Chart, column 4

Dx Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2-elements:

3EN2 = $\overline{\beta}_{3\,(c)}$ = 200 EXAPOR®MAX 2
5EN2 = $\overline{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\overline{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal flow rate	Pressure drop see diagram **D**/curve no.	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A/B	Cracking pressure of by-pass	Symbol	Replacement filter element Part No.	Weight	Clogging indicator	Flow control valve	Remarks
	l/min			g		bar			kg			
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
FNS 060-163	*	**D1**/*	3EN2	1.450	G1 / G1	3,5	1	V7.1230-153	5,2	optional	optional	basic unit
Flow control valve – inlet pressure min. 10 bar, max. 320 bar:												
FNS 060.1520	1	**D1**/1			G1 / G¼							–
FNS 060.1530	2	**D1**/2			G1 / G¼							–
FNS 060.1540	4	**D1**/3			G1 / G¼							–

The housing of the off-line filter is designed for a max. operating pressure of 5 bar. To avoid back pressures no components as e.g. ball valves can be inserted at the housing outlet and in the continuative circuit.

Optical or electrical indicators are available to monitor the clogging condition of the element.

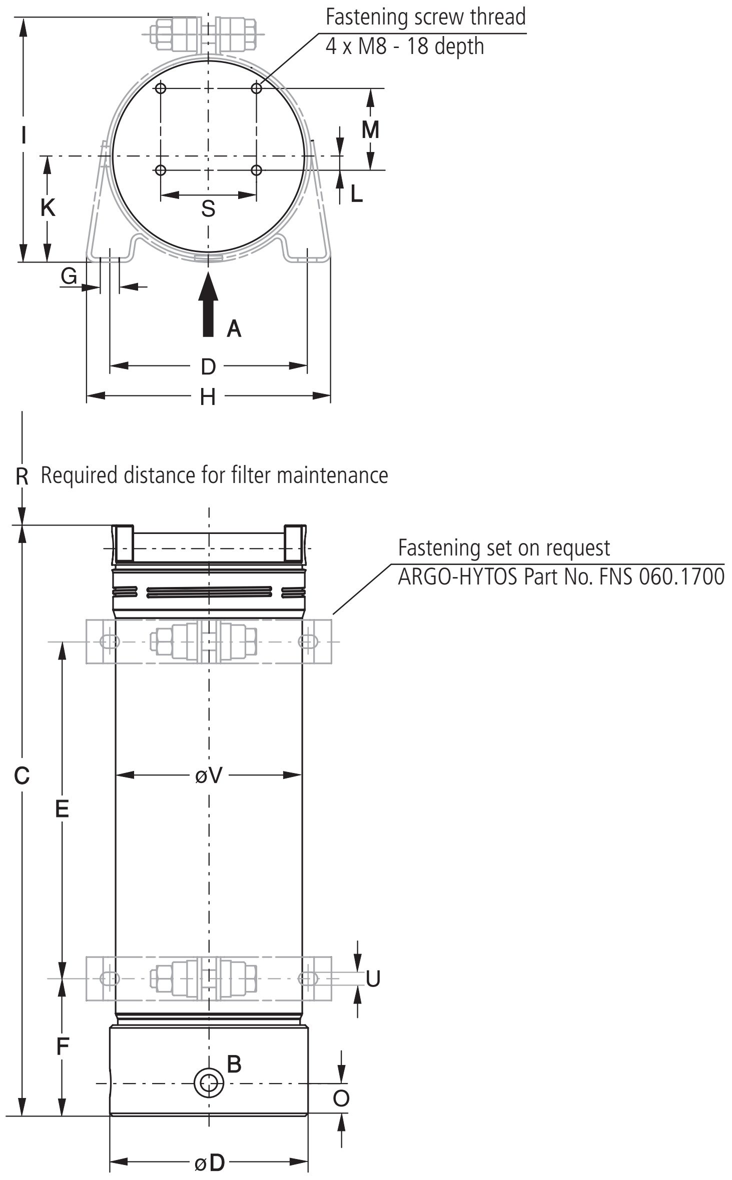
For the appropriate clogging indicators see catalogue sheet 60.20.

Remarks:

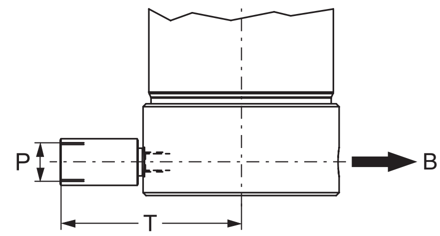
- The response/switching pressure of the clogging indicator used must be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 7).
- The clogging indicators and flow control valves are optional and always delivered detached from the filter.
- The filter units listed in this chart are standard units. If modifications are required, e. g. with water-absorbing filter elements, we kindly ask for your request.

* see nominal flow rate of the flow control valves

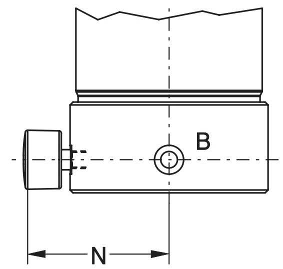
Dimensions



Version with flow control valve



Version with manometer

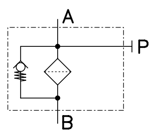


Measurements

Type	A / B	C	D	E	F	G	H	I	K	L	M	N	O	P	R	S	T	U	V
FNS 060	G1	410	136	233	95	12	170	169	73	9,5	56,5	103	23	G¾	300	66	119	9	128

Symbols

1



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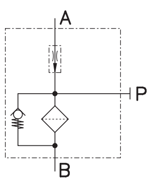
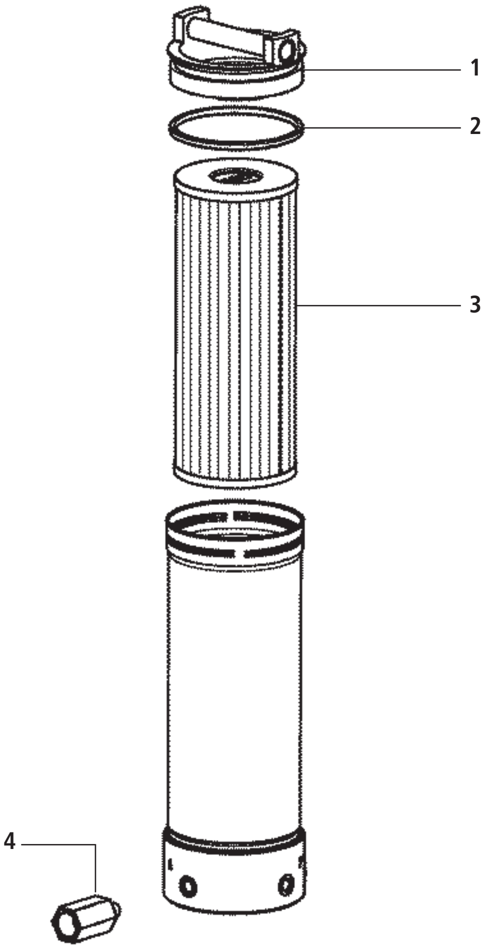


Spare Parts



Pos.	Designation	Part No.
1	Cover	FNA 008.1250
2	O-ring	N007.1175
3	Filter element	see Selection Chart
4	Flow control valve	see Selection Chart

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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Off-line Filter with water absorbing element

FNS 040-105

- Nominal flow rate approx. 6 l/min
- Operating pressure up to 320 bar
- Water capacity approx. 350 ml

80.25-1e

Off-line Filter - FNS 040-105

FNS 040-105
The FNS 040-105 is used to filter permanently solid particles as well as water from hydraulic oil. The clogging of the filter element is displayed by means of a manometer.

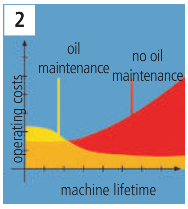
Through a flow control valve the FNS off-line filter can be connected to a high pressure pipe with an inlet pressure of up to 320 bar (minimum inlet pressure approx. 20 bar). The flow rate is kept constant at approx. 6 l/min depending on the inlet pressure.

- minimizing downtime due to contamination
- high component protection
- higher availability and longer machine lifetime
- simple retrofitting

1

1. Compact and ready to connect
The FNS 040-105 is supplied ready to connect, with flow control valve, water absorbing filter element and clogging indicator.

2

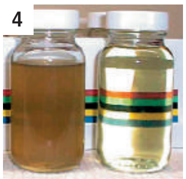


2. Economical
Efficiency through ARGO-HYTOS Fluid Management systems. Fast return on investment by extended service intervals and increased machine availability.

3

3. User-friendly filter element change
Optimal operator handling has been a key feature in the development of FNS 040. No extra tools are needed to open the housing and the filter element can be pulled out through the hang-in technique.

4



4. Easy dewatering
Via a super absorber free water is permanently separated from the oil preventing corrosion of surfaces, cavitation damages and premature oil aging.

5

5. Quality in detail
The EXAPOR Aqua filter element is the heart of the FNS 040-105. The comibination of approx. 8 µm micro-filter material with a super absorber for water allows reaching the highest cleanliness grades and prevents the presence of free water in hydraulic oil.

The installation kit included in the scope of delivery allows easy mounting at the machine!

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889

Hydraulic fluids
Mineral oil and biodegradable fluids (HEES and HETG, see info sheet 00.20).
Other fluids on request.

Temperature range of fluids
- 30 °C ... + 100 °C
(temporary - 40 °C ... + 120 °C)

Ambient temperature range
0 °C ... + 50 °C

Operating Pressure
Max. 320 bar inlet pressure at the flow control valve
(max. 5 bar at the filter housing)

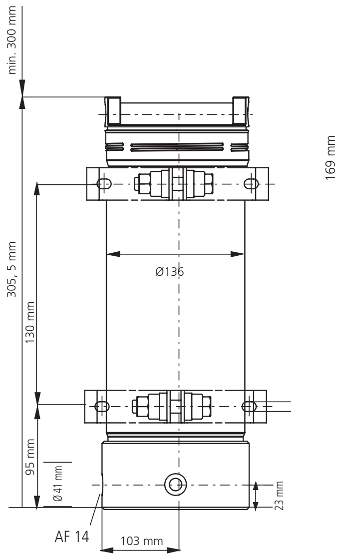
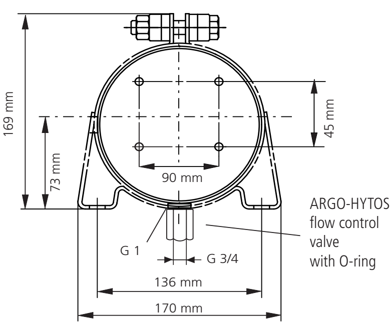
Clogging indicator
Optical pressure indicator (manometer)

Order no.	FNS 040-105
Nominal flow rate	approx. 6 l/min (through flow control valve)
Filter fineness	$\beta_{8(c)} = 200$
Dirt-holding capacity	65 g (according to ISO 16889)
Water capacity	ca. 350 ml
Replacement element order no.	Y7.1220-05
Weight	approx. 7 kg

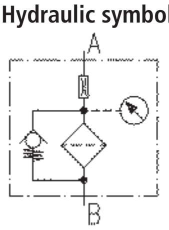
*test dust ISO MTD according to ISO 16889

Caution: The housing of the off-line filter is designed for a maximum operating pressure of 5 bar. To prevent backpressures it is not allowed to install components as e.g. ball valves at the housing outlet and in the connected line.

Dimensions

Hydraulic symbol



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ARGO HYTOS

Filter Cooling Units

FNK 050 · FNK 100

- Operating pressure up to 10 bar
- Nominal flow rate up to 125 l/min
- Cooling capacity up to 45 kW

80.30-2e

Description

Application
Return-flow or off-line filter in hydraulic systems with water cooling.

General
High power densities in modern hydraulic systems require on one hand excellent cleanliness classes of the oil and on the other hand powerful cooling systems. The ARGO-HYTOS filter cooling unit FNK meets both demands on smallest installation space.

Performance features

Protection against wear:	By means of filter elements that meet even the the highest demands regarding cleanliness classes.
Cooling:	Efficient discharge of large heat flow volumes by means of a powerful cooler.

Assembly and operating mode
Oil that has to be cooled is first cleaned over a fine filter element and then flows – through a check-valve and the high-performance tubular cooler – in cooled-down condition into the tank.
Monitoring of filter clogging is effected by an optionally available differential pressure indicator. The integrated by-pass valve protects the filter element in cold start against increasing differential pressures.

Special design features
By combination of fine filter and cooler in one unit the necessary space is considerably reduced compared to conventional solutions. This also results in less assembling and piping.
The filter element is hooked to the cover and is pulled upwards when it has to be changed. Because of the cover design the filter element can be changed almost without losing any oil.
An integrated check valve prevents draining of oil from the tank when assembling the filter cooling unit below the oil level.
With maintenance work at the cooler it simply can be removed from the housing after removing the water connections.

Filter elements
Flow direction from outside to centre. The star-shaped pleating of the filter results in:
- large filter surfaces
- low pressure drop
- high dirt holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter.
The cooler is maintenance-free up to a large extent.
Unfavourable water qualities (e.g. high water hardness and PH-value) and high temperatures may lead to sediments in the water pipes and/or the cooler surface. The water quality therefore has to be controlled regularly and if necessary improved.
For cleaning of the water pipes the cover of the cooler can be removed.
The maintenance instructions give detailed information on the maintenance of the cooler.

Materials:

Filter housing FNK 050:	GG, Filter head: Steel
Filter housing FNK 100:	Aluminium alloy
Filter cover:	GG
Cooler cover:	GG
Cooler catalyst tube:	Steel
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 – inorganic multi-layer microfibre web

Accessories
Electrical and optical clogging indicators are available. Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Operating pressure
Max. 10 bar

Cooling capacity
Up to 45 kW

Nominal flow rate
Up to 125 l/min
(see Selection Chart, column 3)

Filter fineness
5 μm(c)
β-values according to ISO 16889
(see Selection Chart, column 5 and Diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 6)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20)

Temperature range of fluids
-30 °C … +100 °C (temporary -40 °C ... +120 °C)

Mounting position
Filter preferably vertical and/or cooler horizontal

Connection
Threaded ports according to ISO 228 or DIN 13.
Sizes see Selection Chart, column 7.

Selection Recommendations

1. Selection of the filter cooling unit according to the cooling performance chart

The displayed performance curves are based on:

- Ratio flow rate water/oil 2:1
- Water inlet temperature 25 °C
- Oil discharge temperature 50 °C
- Oil viscosity 35 mm²/s

For differing viscosity the correction factor A can be read off from the viscosity correction chart on the right hand.

With deviating oil discharge and/or oil entry temperatures and viscosities please calculate as shown in the following example:

Given

Heat to be discharged (AW)	=	17 kW
Oil flow (Q)	=	80 l/min
Oil discharge temperature($T_{oil\ out}$)	=	45 °C
Water entry temperature ($T_{water\ in}$)	=	25 °C
Oil species	=	ISO VG 32

Procedure

1.1. Calculation of the temperature difference ΔT
Temperature difference ΔT (°C) = (AW x 34,1) / Q = 7,2

1.2. Calculation of the middle oil temperature
$(2 \times T_{oil\ out} + \Delta T) / 2 \cong$ 49 °C

1.3. Calculation of the viscosity with middle oil temperature ν_{actual}
ν_{actual} from the oil manufacturer chart
for ISO VG 32 at 49 °C: 21 mm²/s

1.4. Viscosity factor “A”
From the viscosity correction chart “A” at 21 mm²/s: 0,88

1.5. Determination of the necessary cooling performance
Heat to be discharged
$AW_{eff.} = (AW \times 27{,}5 \times A) / (T_{oil\ out} - T_{water\ in})$
$= (17 \times 27{,}5 \times 0{,}88) / 20 =$ 20,6 kW

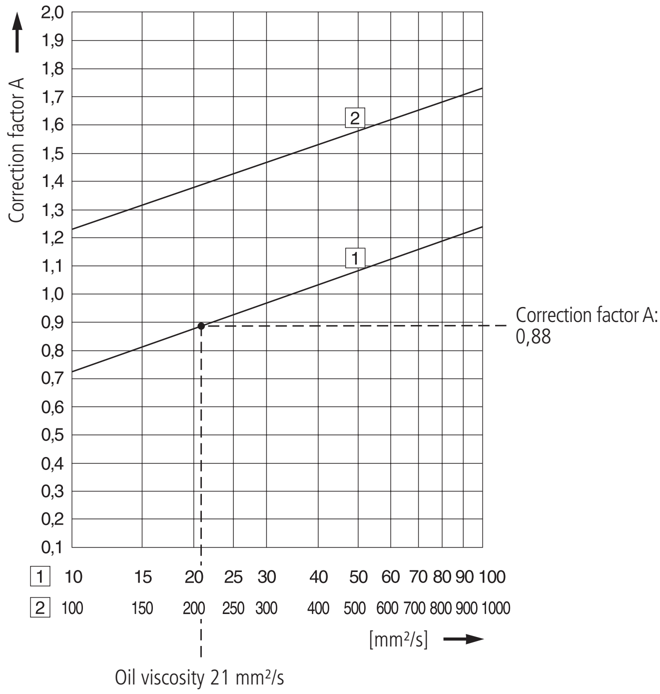
1.6. Selection of the filter cooling unit
The cooler performance chart shows
Q = 80 l/min and
$AW_{eff.}$ 20,6 kW the filter cooling unit: FNK 100-3153

2. Controlling pressure drop

To determine the pressure drop it is possible to interpolate within the given set of curves in the diagrams D1.1-D2.3 between 35 mm²/s and 300 mm²/s. Finally it has to be checked, if there is enough operating pressure for the determined pressure drop of the filter cooling units.
In case the pressure drop of the selected filter cooling unit should be too high, on the basis of the pressure drop curves an adequate version has to be chosen. If necessary the cooling performance has to be verified again.
With volume flows over 100 l/min and operating viscosities from 200 mm²/s on (e.g. at cold start) the by-pass valve can be open with a partially contaminated filter element (temporary poor filtration performance).

Viscosity correction chart

For determination of the correction factor “A” with oil viscosities differing from 35 mm²/s (in the displayed calculation example 21 mm²/s).



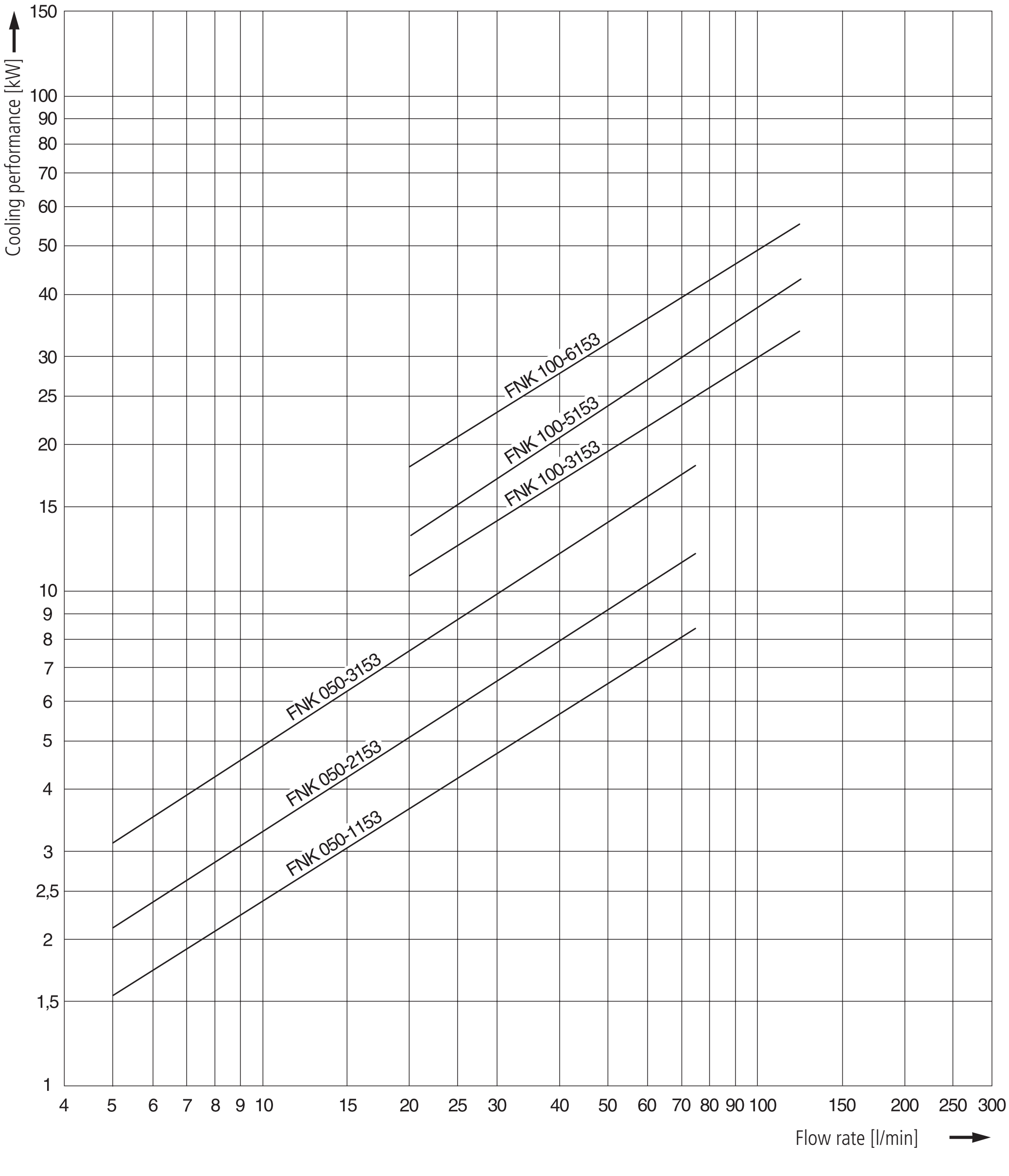
Diagrams

Characteristic curves cooler performance

Dk

The displayed performance curves are based on:
- Water inlet temperature 25 °C
- Oil discharge temperature 50 °C
- Oil viscosity 35 mm²/s

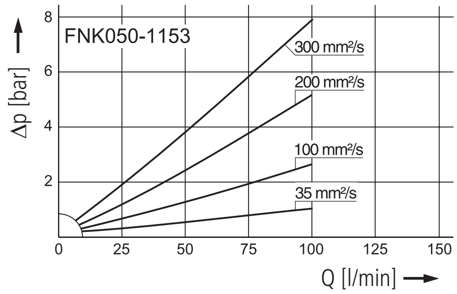
For differing viscosities the correction factor A can be read off from the viscosity correction chart.



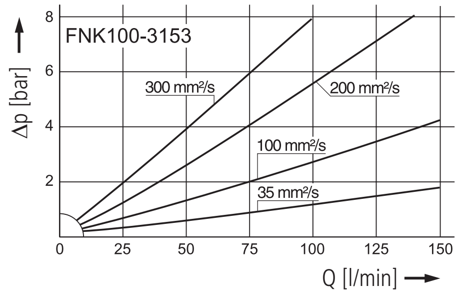
Diagrams

Δp-curves for complete filters in Selection Chart, column 4

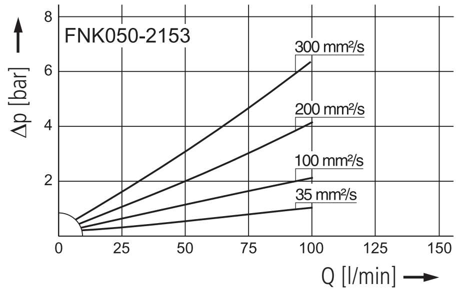
D1.1 Pressure drop as a function of the **flow volume**



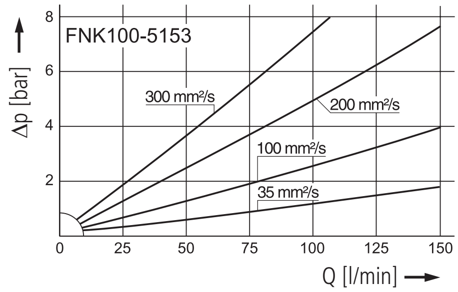
D2.1 Pressure drop as a function of the **flow volume**



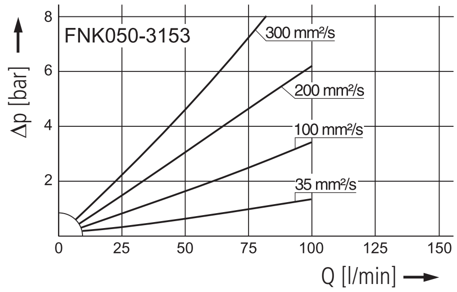
D1.2 Pressure drop as a function of the **flow volume**



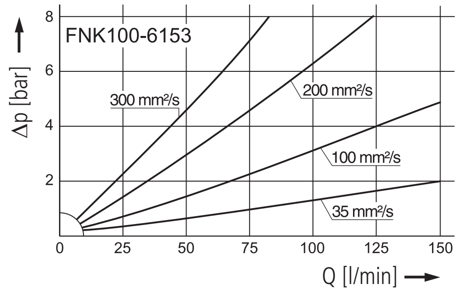
D2.2 Pressure drop as a function of the **flow volume**



D1.3 Pressure drop as a function of the **flow volume**



D2.3 Pressure drop as a function of the **flow volume**

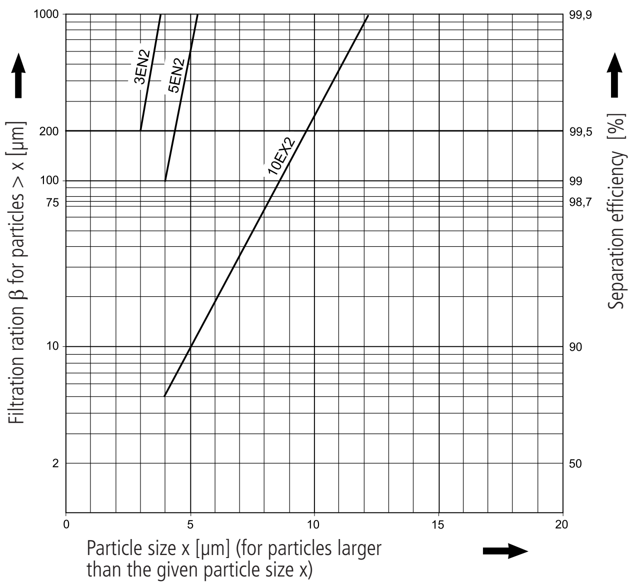


In general the pressure drop increases in line with a larger cooler length.
Exception:
Due to lower distances of the disk sheets in the cooler the pressure drop of the FNK 050-1153 is higher than the one of the larger FNK 050-2153.

Due to lower distances of the disk sheets in the cooler the pressure drop of the FNK 100-3153 is higher than the one of the larger FNK 100-5153.

Filter fineness curves in Selection Chart, column 5

Dx Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β–values resp. finenesses:

For EXAPOR®MAX 2-Elements:

3EN2 = $\bar{\beta}_{3\,(c)}$ = 200 EXAPOR®MAX 2
5EN2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart

Part No.	Nominal cooling capacity	Nominal flow rate	Pressure drop see diagram **D**	Filter fineness see Diagr. **Dx**	Dirt-holding capacity	Connection A_1 / A_2 inlet	Cracking pressure of by-pass	Replacement filter element Part No.	Clogging indicator	Weight	Cooler element
	kW	l/min			g		bar			kg	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
FNK 050-1153	5	75	**D1.1**	5EN2	190	G1¼	3,5	V7.1235-53	optional	23	FNK 050.1700
FNK 050-2153	8	75	**D1.2**	5EN2	190	G1¼	3,5	V7.1235-53	optional	24	FNK 050.1710
FNK 050-3153	13	75	**D1.3**	5EN2	190	G1¼	3,5	V7.1235-53	optional	26	FNK 050.1720
FNK 100-3153	33	125	**D2.1**	5EN2	150	G1¼	3,5	V7.1235-53	optional	15	FNK 100.0703
FNK 100-5153	40	125	**D2.2**	5EN2	150	G1¼	3,5	V7.1235-53	optional	16	FNK 100.0705
FNK 100-6153	45	125	**D2.3**	5EN2	150	G1¼	3,5	V7.1235-53	optional	17	FNK 100.0706

Optical or electrical clogging indicators are available to monitor the clogging condition of the element. If the indicator should be already mounted use the abbreviation "M" behind the part number of the indicator. The printed order acknowledgements show both items separately. For optimal element utilization we recommend clogging indicators with a start-up pressure of 2,5 bar.

Order example: The filter FNK 100-3153 has to be supplied with electrical clogging indicator – response pressure 2,5 bar.

Order description: **FNK 100-3153 / DG 041-32 M**

Part No. (Basic unit) — FNK 100-3153

Clogging indicator — DG 041-32

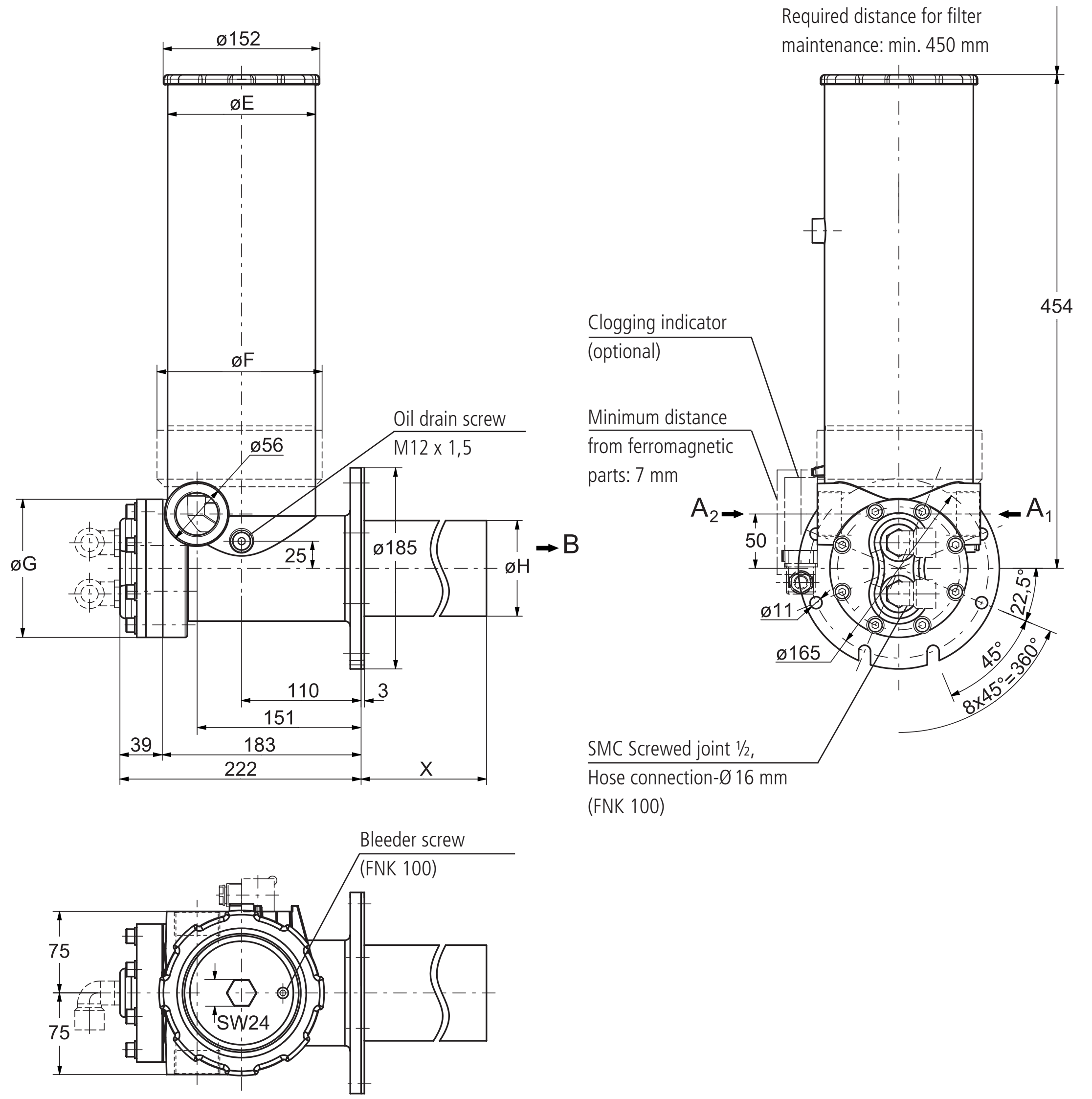
Mounted — M

For the appropriate clogging indicator see catalogue sheet 60.30.

Remarks:

- The response/switching pressure of the clogging indicator used must be lower than the cracking pressure of the by-pass valve (see Selection Chart, column 8).
- The filter units listed in this chart are standard units. If modifications are required, we kindly ask for your request.

Dimensions

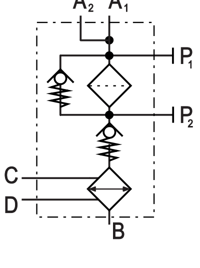


Measurements

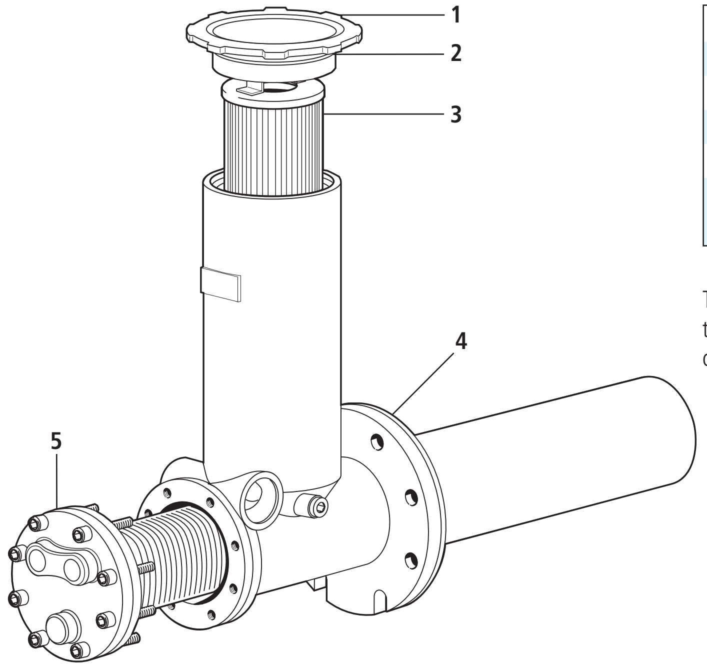
Type	A_1 / A_2	E	F	G	H	X				
FNK 050-1153	G1¼	133	152	105	65	203				
FNK 050-2153	G1¼	133	152	105	65	203				
FNK 050-3153	G1¼	133	152	105	65	457				
FNK 100-3153	G1¼	145	-	127	88	330				
FNK 100-5153	G1¼	145	-	127	88	480				
FNK 100-6153	G1¼	145	-	127	88	785				

Symbols

1



Spare Parts



Pos.	Designation	Part No.
1	Cover complete (with pos. 2)	FNK 100.1210
2	O-ring	N007.1245
3	Filter element (with pos. 2)	V7.1235-53
4	Flat seal	FNK 100.0110
5	Cooler (with water supply cover and seal)	s. chart / column12

The functions of the complete filters as well as the outstanding features of the filter elements assured by ARGO-HYTOS can only be guaranteed if original ARGO-HYTOS spare parts are used.

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941 Verification of collapse/burst pressure rating
ISO 2942 Verification of fabrication integrity (Bubble Point Test)
ISO 2943 Verification of material compatibility with fluids
ISO 3968 Evaluation of pressure drop versus flow characteristics
ISO 16889 Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181 Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

We produce fluid power solutions
ARGO-HYTOS GMBH · Industriestraße 9 · 76703 Kraichtal-Menzingen · Germany
Phone: +49 7250 76-0 · Fax: +49 7250 76-199 · info@argo-hytos.com · www.argo-hytos.com

Off-line Filter Units

FNA 008 • FNA 016

- Operating pressure up to 4 bar
- Nominal flow rate up to 16 l/min
- For tank capacities up to 1.500 l

Description

Application
Off-line filtration in hydraulic and lubricating oil systems.

Performance features

Protection against wear: By means of filter elements that meet even the highest demands regarding cleanliness classes and dirt-holding capacity.

Protection against malfunction: By means of permanent filtration in the off-line circuits excellent cleanliness classes can be achieved. This can lead to significantly longer intervals between maintenance work and oil changes, as well as reduction of machine failures due to contamination.

Special design features

Cover: The cover can be opened without special auxiliary tools.
Because of the cover design the filter element can be changed almost without losing any oil. No pipes are needed except for the connection lines. The power units feature minimal noise output and low power consumption.

Pressure relief valve: An integrated PRV (pressure relief valve) protects against overload.

Dirt retention valve: Ensures that dirt accumulated in the filter is removed together with the element. Settled dirt cannot return into the system.

Filter elements
Flow direction from centre to outside. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials

Pump housing:	Aluminium alloy
Filter housing:	Steel
Cover:	Aluminium alloy
Seals:	NBR (FPM on request)
Filter media:	EXAPOR®MAX 2 - inorganic, multi-layer microfibre web

Accessories
Water-absorbing filter elements EXAPOR®AQUA are available on request.
With Part No. FNA 008.1700 a mounting set that facilitates the fitting of incoming and outgoing pipes onto an existing filling/venting connection is available.
For installation in filter cooling circuits a version with by-pass valve is available on request.
Electrical and optical clogging indicators are available.
Dimensions and technical data see catalogue sheet 60.20.

Characteristics

Nominal flow rate
Up to 16 l/min at ν = 35 mm²/s
(see Selection Chart, column 2)

Connection
Threaded port according to ISO 228 or DIN 13.
Sizes see Selection Chart, columns 9 and 10

Filter fineness
3 µm(c) ... 10 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 3 and Diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 4)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20)

Temperature range of fluids
0 °C ...+65 °C (also see viscosity range)

Ambient temperature range
0 °C ...+50 °C

Viscosity range

Electro motor air cooled type of protection: IP 55	Continous operation min.	Continous operation max.	Short-term operation max.
3 ~ 400 V / 460 V	15 mm²/s	200 mm²/s	400 mm²/s
1 ~ 230 V	15 mm²/s	200 mm²/s	400 mm²/s
1 ~ 110 V	15 mm²/s	200 mm²/s	400 mm²/s

Chamber volume
approx. 2,4 l

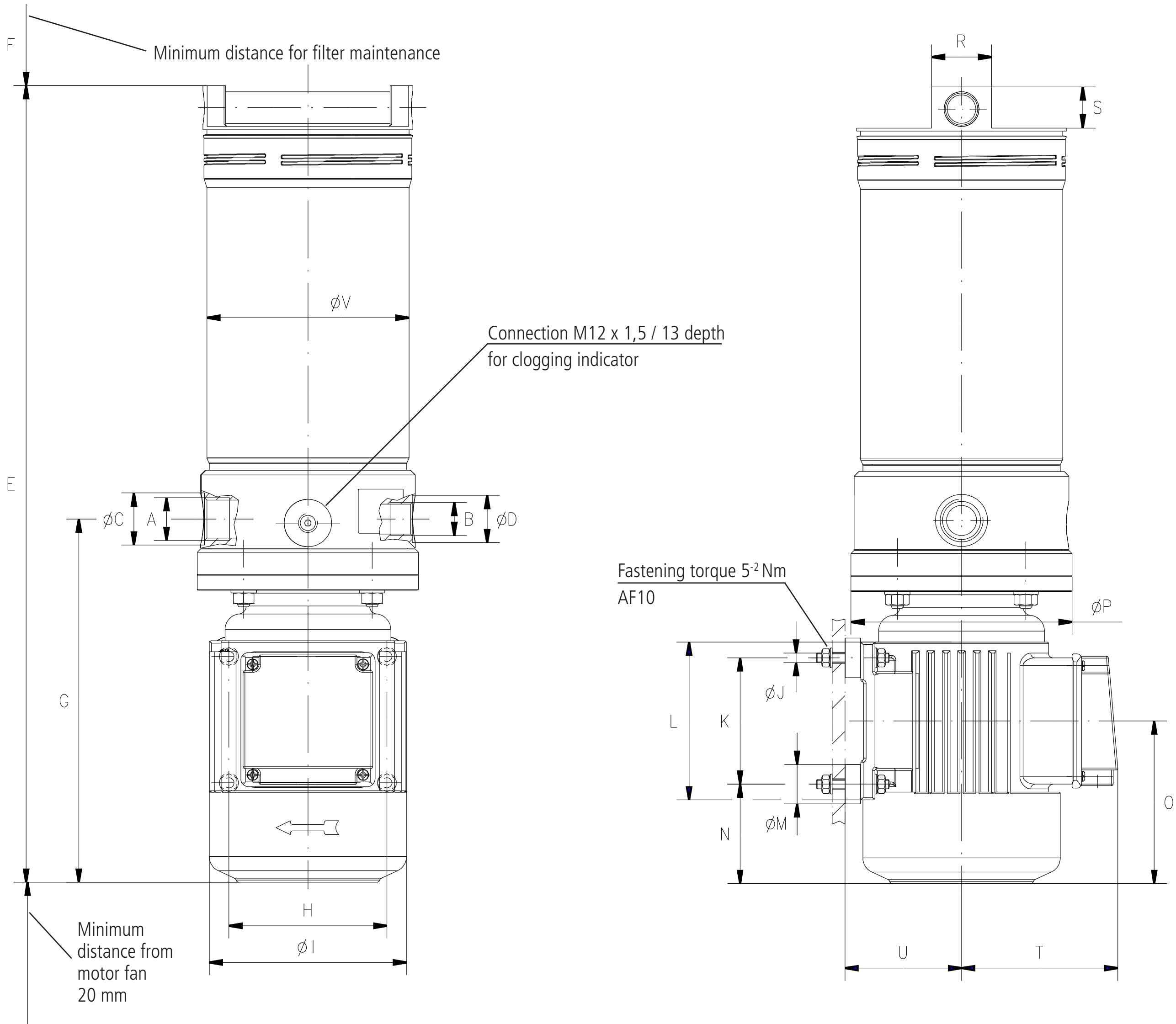
Maximum suction height
1,5 m

Operating pressure
Max. 4 bar, pressure protection with pressure relief valve;
cracking pressure see Selection Chart, column 11

Operating position
Vertical, motor at the bottom

Recommended tank capacities
FNA 008: 100 l ... 800 l
FNA 016: 400 l ... 1500 l
Off-line filter units for tank capacities exceeding 1500 l
see catalogue sheet 80.50

Dimensions



Weight: approx. 11 kg

Measurements

Typ*	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	R	S	T	U	V
1	$G^{3}/_{4}$	$G^{1}/_{2}$	33	30	510	340	230	100	125	M6	80	100	25	63	105	140	38,5	27	100	74	128
2	$1^{1}/_{16}$-12 UN-2B	$^{3}/_{4}$-16 UNF-2B	33	30	510	340	230	100	125	M6	80	100	25	63	105	140	38,5	27	100	74	128
3	$1^{1}/_{16}$-12 UN-2B	$^{3}/_{4}$-16 UNF-2B	33	30	535	340	255	100	125	M6	80	100	25	88	130	140	38,5	27	125	74	128
4	$G^{3}/_{4}$	$G^{1}/_{2}$	33	30	525	340	245	100	125	M6	80	100	25	90	121	140	38,5	27	125	73	128

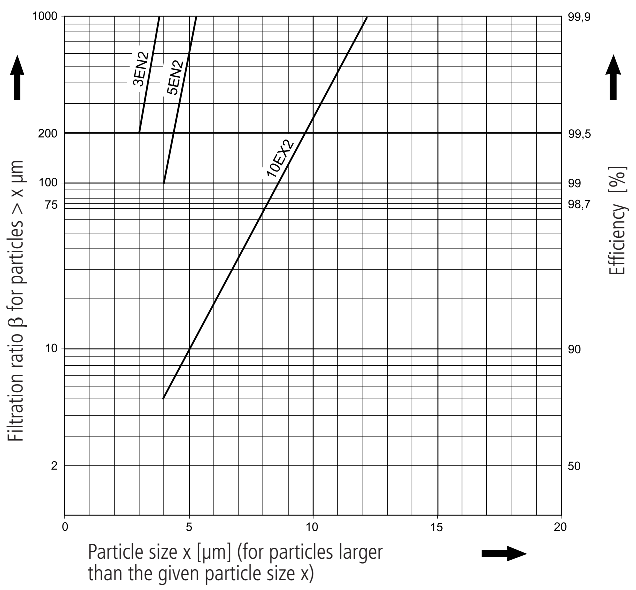
Selection Chart, columns 1-10

Part No.	Nominal flow rate	Filter fineness, see Diagr. **Dx**	Dirt-holding capacity	E-motor operating voltage	E-motor operating frequency (max.)	E-motor power (max.)	E-motor speed at 50 Hz (max.)	Connection A Inlet	Connection B Outlet
	l/min		g	V	Hz	kW	min^{-1}		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
FNA 008-763	8	3EN2	490	1 ~ 110 V	(60)	0,25 (0,3)	1400 (1700)	1 1/16-12 UN-2B	3/4-16 UN-2B
FNA 008-163	8	5EN2	460	1 ~ 110 V	(60)	0,25 (0,3)	1400 (1700)	1 1/16-12 UN-2B	3/4-16 UN-2B
FNA 008-573	8	3EN2	490	1 ~ 230 V	50	0,25	1400 (1700)	G3/4	G1/2
FNA 008-553	8	3EN2	490	3 ~ 400 V/460 V	50 (60)	0,25 (0,3)	1400 (1700)	G3/4	G1/2
FNA 008-753	8	3EN2	490	3 ~ 400 V/460 V	50 (60)	0,25 (0,3)	1400 (1700)	1 1/16-12 UN-2B	3/4-16 UN-2B
FNA 008-153	8	5EN2	460	3 ~ 400 V/460 V	50 (60)	0,25 (0,3)	1400 (1700)	G3/4	G1/2
FNA 008-556	8	10EX2	340	3 ~ 400 V/460 V	50 (60)	0,25 (0,3)	1400 (1700)	G3/4	G1/2
FNA 016-763	16	3EN2	280	1 ~ 110 V	(60)	(0,3)	2800 (3300)	1 1/16-12 UN-2B	3/4-16 UN-2B
FNA 016-163	16	5EN2	270	1 ~ 110 V	(60)	(0,3)	2800 (3300)	1 1/16-12 UN-2B	3/4-16 UN-2B
FNA 016-573	16	3EN2	280	1 ~ 230 V	50	0,45	2700 (3200)	G3/4	G1/2
FNA 016-173	16	5EN2	270	1 ~ 230 V	50	0,45	2700 (3200)	G3/4	G1/2
FNA 016-553	16	3EN2	280	3 ~ 400 V/460 V	50 (60)	0,45 (0,55)	2700 (3200)	G3/4	G1/2
FNA 016-753	16	3EN2	280	3 ~ 400 V/460 V	50 (60)	0,45 (0,55)	2700 (3200)	1 1/16-12 UN-2B	3/4-16 UN-2B
FNA 016-153	16	5EN2	270	3 ~ 400 V/460 V	50 (60)	0,45 (0,55)	2700 (3200)	G3/4	G1/2
FNA 016-773	16	5EN2	270	3 ~ 400 V/460 V	50 (60)	0,45 (0,55)	2700 (3200)	1 1/16-12 UN-2B	3/4-16 UN-2B

Diagrams

Filter fineness curves in Selection Chart, column 3

Dx Filtration ratio β as a function of particle size x obtained by the Multi-Pass Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2-elements:

3EN2 = $\overline{\beta}_{3\,(c)}$ = 200 EXAPOR®MAX 2
5EN2 = $\overline{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\overline{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2

For special applications, finenesses differing from these curves are also available by using special composed filter media.

Selection Chart, columns 11-17

Part No.	Cracking pressure of by-pass	Symbols hydraulic	Symbols electric	Measurements, Type No.	Replacement filter element Part No.	Clogging indicator	Remarks
	bar						
	11	**12**	**13**	**14**	**15**	**16**	**17**
FNA 008-763	4	1	3	3	V7.1220-113	optional	-
FNA 008-163	4	1	3	3	V7.1220-13	optional	-
FNA 008-573	4	1	3	4	V7.1220-113	optional	-
FNA 008-553	4	1	1, 2	1	V7.1220-113	optional	-
FNA 008-753	4	1	1, 2	2	V7.1220-113	optional	-
FNA 008-153	4	1	1, 2	1	V7.1220-13	optional	-
FNA 008-556	4	1	1, 2	1	V7.1220-06	optional	-
FNA 016-763	4	1	3	2	V7.1220-113	optional	-
FNA 016-163	4	1	3	2	V7.1220-13	optional	-
FNA 016-573	4	1	3	1	V7.1220-113	optional	-
FNA 016-173	4	1	3	1	V7.1220-13	optional	-
FNA 016-553	4	1	1, 2	1	V7.1220-113	optional	-
FNA 016-753	4	1	1, 2	2	V7.1220-113	optional	-
FNA 016-153	4	1	1, 2	1	V7.1220-13	optional	-
FNA 016-773	4	1	1, 2	2	V7.1220-13	optional	-

All filter units are delivered with an unplugged clogging indicator connection M12 x 1,5. As clogging indicators either manometers or electrical pressure switches can be used.

For the appropriate clogging indicators see catalogue sheet 60.20.
By the use of a manometer version DG 200-16* has to be chosen.

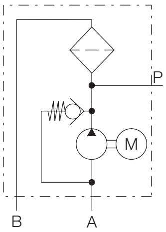
Remarks:

- If operating frequency increases, pump delivery will increase as well.
- The filter units listed in this chart are standard units. If modifications are required, e.g. with water-absorbing filter elements, pipe extensions or mounting sets, we kindly ask for your request.
- The clogging indicators are optionally available and then will be loosely provided.

* Manometer without throttle screw

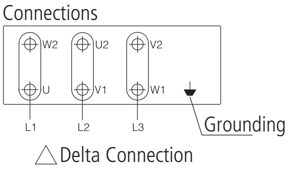
Symbols

Hydraulic:
1



Electric:

1



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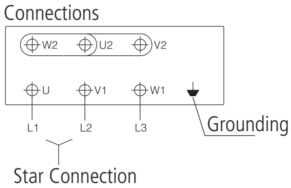

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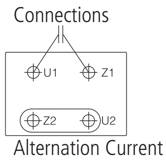

Quality Assurance

Quality management according to DIN EN ISO 9001

To ensure constant quality in production and operation, ARGO-HYTOS filter elements undergo strict controls and tests according to the following ISO standards:

ISO 2941	Verification of collapse/burst pressure rating
ISO 2942	Verification of fabrication integrity (Bubble Point Test)
ISO 2943	Verification of material compatibility with fluids
ISO 3968	Evaluation of pressure drop versus flow characteristics
ISO 16889	Multi-Pass-Test (evaluation of filter fineness and dirt-holding capacity)
ISO 23181	Determination of resistance to flow fatigue using high viscosity fluid

Various quality controls during the production process guarantee the leakfree function and solidity of our filters.

Our engineers will be glad to advise you in questions concerning filter application, selection as well as the cleanliness class of the filtered medium attainable under practical operating conditions.

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Off-line Filter Units

FNA 040-553

- Operating pressure up to 10 bar
- Nominal flow rate up to 40 l/min
- For tank volumes up to 5.000 l

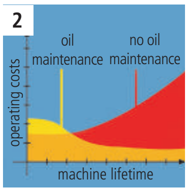
80.45-2e

Off-line Filter Units - FNA 040-553

FNA 040-553
The FNA 040-553 can be used as an additional off-line filter unit or as a sole system filter for continuous improvement of the oil cleanliness. Operation of the unit is independent of the working cycles of the machine. Thereby the filter element can be changed without interrupting the working process.

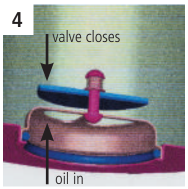
Compact and efficient
The compact design allows installation in small areas. The oil is continuously pumped over a 3 µm fine filter. Thereby highest cleanliness classes are reached even with tank volumes of up to 5.000 liters.

1. Compact and ready to connect
The FNA 040-553 is supplied ready to connect, with hose packages and filter elements.

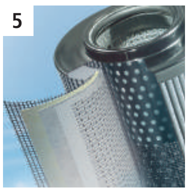


2. Economical
Efficiency through ARGO-HYTOS Fluid Management systems. Fast return on investment by extended service intervals and increased machine availability.

3. User-friendly filter element change
Optimal operator handling has been a key feature in the development of FNA 040. No extra tools are needed to open the housing and the filter element can be pulled out through the hang-in technique.



4. Maintenance-free filter housing thanks to a clever filter element technique
Fluid flows through the element from the centre outwards. The built-in dirt retention valve closes automatically when the element is removed, ensuring that all dirt is removed from the housing with the element.



5. Quality in detail
The EXAPOR®MAX 2 fine element is the heart of the FNA 040. High cleanliness levels protect hydraulic systems against dirt during the oil filling process.

The tubing of the pressure control valve to the tank has to be effected by the user!

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889

Hydraulic fluids
Mineral oil and biodegradable fluids (HEES and HETG, see info sheet 00.20).
Other fluids on request.

Temperature range of fluids/ Viscosity range
0 °C ... +60 °C
Continuous operation min.: 15 mm²/s
Continuous operation max.: 400 mm²/s

Ambient temperature range
0 °C ... +50 °C

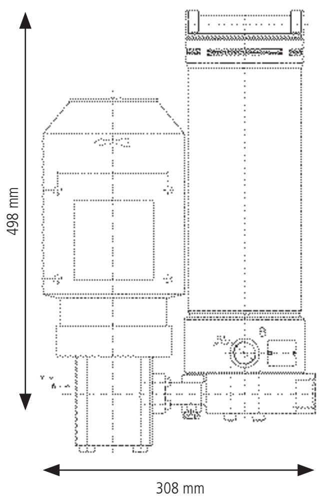
Operating Pressure
Max. 8 bar

Clogging indicator
Electrical differential pressure indicator

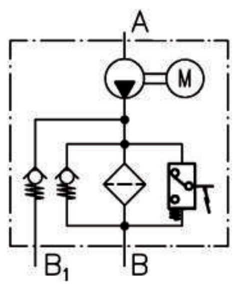
Order no.	FNA 040-553
Nominal flow rate	40 l/min
Filter fineness	$\overline{\beta}_{3(c)} = 200$*
Dirt-holding capacity	380 g*
Electric drive	3~400 V, 1,5 KW, n = 1.500 min^{-1} bei 50 Hz, n = 1.800 min^{-1} bei 60 Hz
Replacement element order no.	V7.1230-153
Weight	approx. 30 kg

*test dust ISO MTD according to ISO 16889

Dimensions



Hydraulic symbol



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ARGO HYTOS

Off-line Filter Units

FNA 045

- Operating pressure up to 4 bar
- Nominal flow rate up to 45 l/min
- For tank capacities up to 5.000 l

80.50-4e

Description

Application
In the off-line circuits of hydraulic and lubricating oil systems.

Performance features
Protection against wear: By means of filter elements that meet even the highest demands regarding cleanliness classes and dirt-holding capacity.

Protection against malfunction: By means of permanent filtration in the off-line circuits excellent cleanliness classes can be achieved. This can lead to significantly longer intervals between maintenance work and oil changes, as well as reducing machine failure due to contamination.

Special design features
Cover: The fold-out handles at the cover facilitate opening. Because of the cover design the filter element can be changed almost without losing any oil. No pipes are needed except for the connection lines. The power units feature minimal noise output and low power consumption.

Pressure relief valve: An integrated PRV (pressure relief valve) protects against overload.

Dirt retention valve: Ensures that dirt accumulated in the filter is removed together with the element. Settled dirt cannot return into the system.

Filter elements
Flow direction from centre to outside. The star-shaped pleating of the filter material results in:
- large filter surfaces
- low pressure drop
- high dirt-holding capacities
- long service life

Filter maintenance
By using a clogging indicator the correct moment for maintenance is stated and guarantees the optimum utilization of the filter life.

Materials
Pump and filter housing: Aluminium alloy
Cover: Aluminium alloy
Seals: NBR (FPM on request)
Filter media: EXAPOR®MAX 2 - inorganic, multi-layer microfibre web

Accessories
Water-absorbing filter elements EXAPOR®AQUA are available on request.
Electrical and optical clogging indicators are available on request – optionally with one or two switching points resp. temperature suppression. Dimensions and technical data see catalogue sheet 60.30.

Characteristics

Nominal flow rate
Up to 45 l/min at ν = 35 mm²/s
(see Selection Chart, column 2)

Connection
Threaded port according to ISO 228.
Sizes see Selection Chart, columns 9 and 10

Filter fineness
3 µm(c) ... 5 µm(c)
β-values according to ISO 16889
(see Selection Chart, column 3 and diagram Dx)

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889
(see Selection Chart, column 4)

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info-sheet 00.20)

Temperature range of fluids
0 °C ... +65 °C (also see viscosity range)

Ambient temperature range
0 °C ... +50 °C

Viscosity range

Electro motor air cooled type of protection: IP 55	**Continuous operation min.**	**Continuous operation max.**	**Short-term operation max.**
3 ~ 400 V / 460 V	15 mm²/s	600 mm²/s*	800 mm²/s*
1 ~ 230 V	15 mm²/s	600 mm²/s*	800 mm²/s*

* If the filter unit is operated together with the ARGO-HYTOS oil particle counter PODS, maximum viscosity in the "PODS" position is 400 mm²/s.

Vessel volume
approx. 10 l

Maximum suction height
1,5 m

Operating pressure
Max. 4 bar, pressure protection with pressure relief valve;
cracking pressure see Selection Chart, column 11

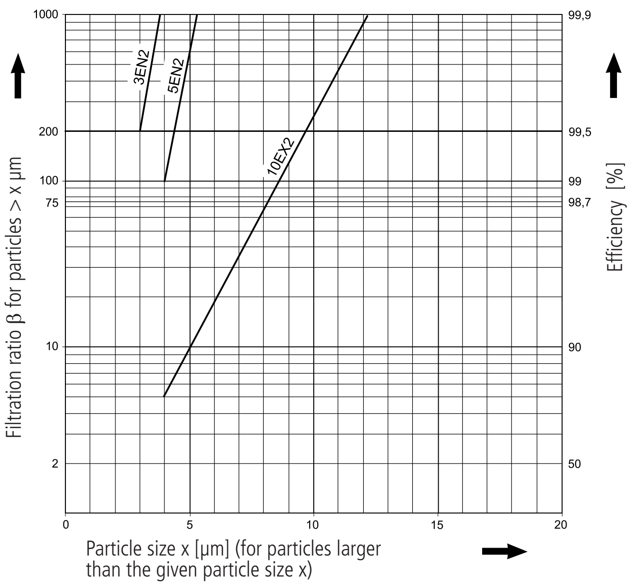
Operating position
Vertical, pump block at the bottom

Recommended tank capacities
From 500 l ... 5.000 l
Off-line filter units for smaller tank capacities see catalogue sheet 80.40.

Diagrams

Filter fineness curves in Selection Chart, column 3

Dx Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2-elements:

3EN2 = $\bar{\beta}_{3\,(c)}$ = 200 EXAPOR®MAX 2
5EN2 = $\bar{\beta}_{5\,(c)}$ = 200 EXAPOR®MAX 2
10EX2 = $\bar{\beta}_{10\,(c)}$ = 200 EXAPOR®MAX 2

For special applications, finenesses differing from these curves are also available by using special composed filter material.

Selection Chart

Part No.	Nominal flow rate	Filter fineness, see Diagr. **Dx**	Dirt-holding capacity	E-motor operating voltage	E-motor operating frequency (max.)	E-motor power	Engine speed at 50 Hz	Connection A Inlet	Connection B Outlet	Cracking pressure of by-pass	Symbols hydraulic	Symbols electric	Replacement filter element Part No.	Clogging indicator
	l/min		g	V	Hz	kW	min^{-1}			bar				
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
FNA 045-1553	45	3EN2	1.950	1 ~ 230 V	50	1,1	1.500	G1¼	G1	4	1	3	V7.1560-103	optional
FNA 045-1153	45	5EN2	1.980	1 ~ 230 V	50	1,1	1.500	G1¼	G1	4	1	3	V7.1560-03	optional
FNA 045-4553	45	3EN2	1.950	3 ~ 400 V/460 V	50 (60)	1,1	1.500	G1¼	G1	4	1	1, 2	V7.1560-103	optional
FNA 045-4153	45	5EN2	1.980	3 ~ 400 V/460 V	50 (60)	1,1	1.500	G1¼	G1	4	1	1, 2	V7.1560-03	optional

Optical or electrical indicators are available to monitor the clogging condition of the element. If the indicator should be already mounted onto the filter head use the abbreviation “M” behind the part number of the indicator. The printed order acknowledgements show both items separately.

Order example: The filter FNA 045-1553 has to be supplied with optical clogging indicator - response pressure 2,0 bar.

Order example: **FN 045-1553 / DG 042-01 M**

Part No. (Basic unit) — FN 045-1553

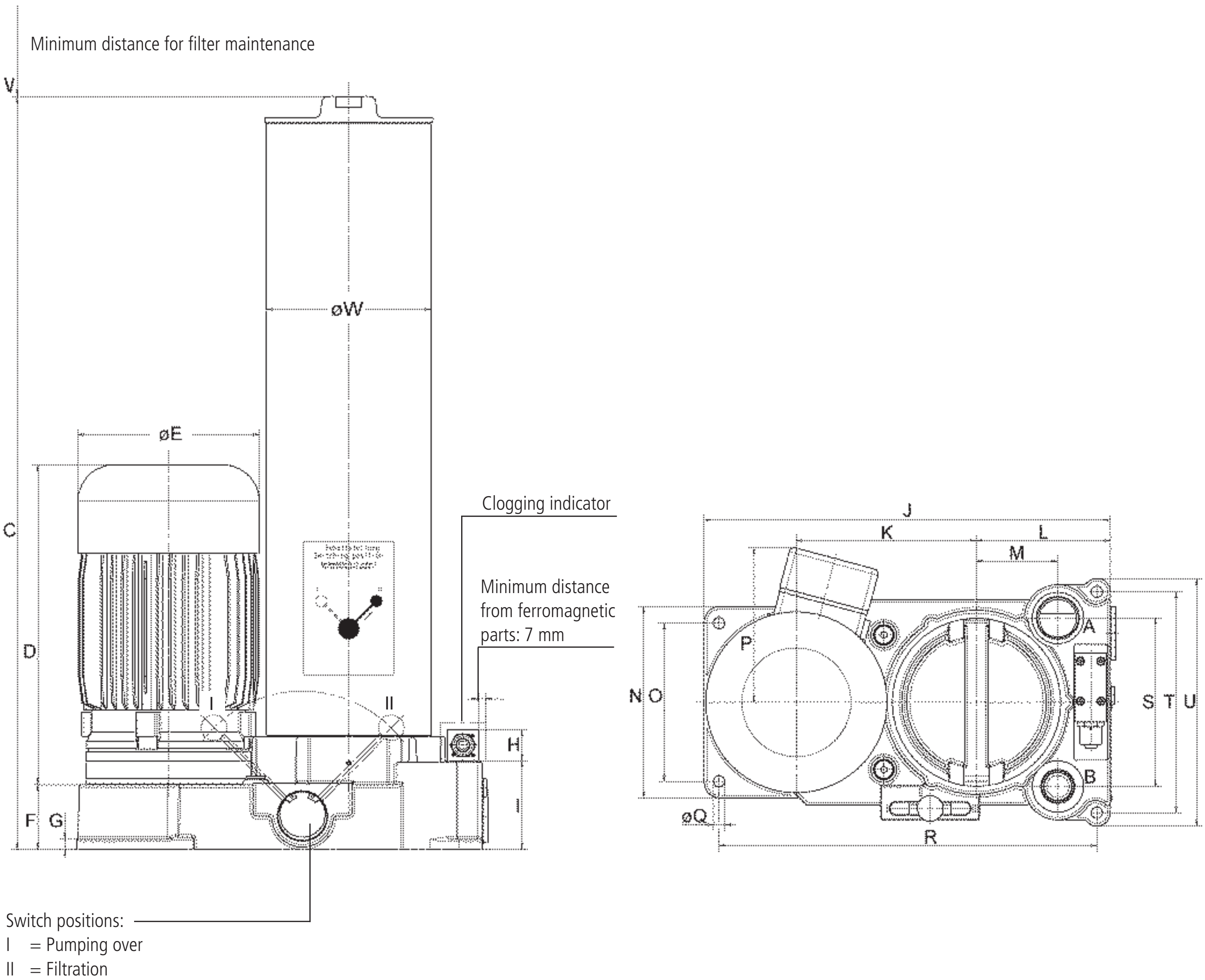
Clogging indicator — DG 042-01

Mounted — M

For the appropriate clogging indicators see catalogue sheet 60.30.

Remarks:
- If operating frequency increases, pump delivery will increase as well.
- The filter units listed in this chart are standard units. If modifications are required, e.g. with water-absorbing filter elements, we kindly ask for your request.

Dimensions



Weight: approx. 37 kg

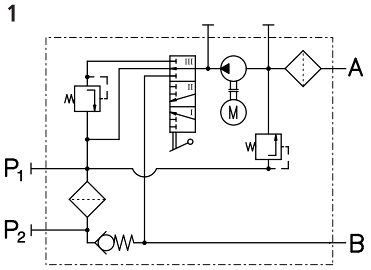
Measurements

Type	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
FNA 045	G1¼	G1	735	312	176	63	10	30	87	395	175	130	79	186	154	150	11	367	164	215	241	700	160

Symbols

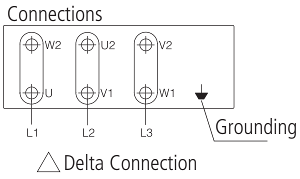
Hydraulic:

1



Electric:

1



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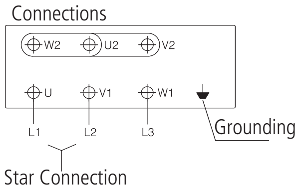
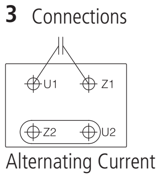


3



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Oil Service Units

Cleanline portable light FA 014

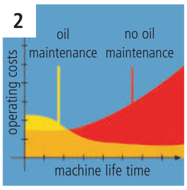
- Easy filling and cleaning
- Compact design
- Comfortable handling

80.60-3e

Cleanline portable light – quick, simple and compact

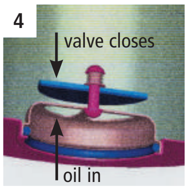
With the oil service unit FA 014 hydraulic or lubricating systems can be easily filled or cleaned.

1. Compact design
The compact design allows easy access to the oil tank.
FA 014 comes ready to connect, with hose packages.

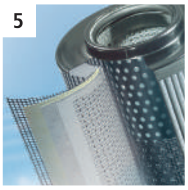


2. Economical
Efficiency through ARGO-HYTOS Fluid Management systems. Fast return on investment by extended service intervals and increased machine availability.

3. User-friendly filter element change
Optimal operator handling has been a key feature in the development of FA 014. No extra tools are needed to open the housing and the filter element can be pulled out through the hang-in technique.



4. Maintenance-free filter housing due to a clever filter element technique
On the bottom of the from inside to outside flown through filter elements there is a dirt retention valve. If the filter element is pulled out of the filter housing with the cover, the dirt retention valve will close. Sedimented dirt is removed from the housing with the filter element.



5. Quality in detail
The EXAPOR®MAX 2 fine element is the heart of the FA 014. High cleanliness levels protect hydraulic systems against dirt during the oil filling process.

For filling and cleaning of hydraulic or lubricating systems with high demands to the oil cleanliness we recommend the ARGO-HYTOS oil service unit Cleanline portable FA 016.

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info sheet 00.20).
Other fluids on request.

Temperature range of fluids / Viscosity range
0 °C ... +60 °C

Continuous operation min.:	15 mm²/s
Continuous operation max.:	250 mm²/s
Short-term operation max.:	400 mm²/s

Ambient temperature range
0 °C ... +50 °C

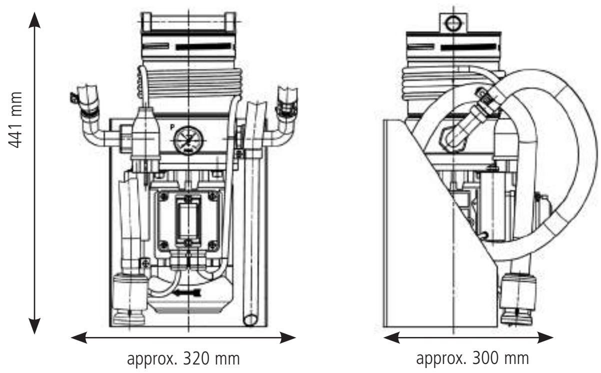
Suction height
max. 1,5 m

Operating pressure
max. 4 bar

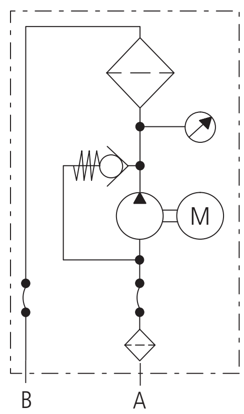
Clogging indicator
Manometer

Order no.	FA 014-1600
Nominal flow rate	16 l/min
Filter fineness	10EX2 ($\overline{\beta}_{10(c)} = 200$)
Dirt-holding capacity	65 g
Operating voltage / frequency	1 ~ 230 V / 50 Hz
Power / Protection type	0,45 kW / IP 55
Replacement element order no.	V7.1210-06
Weight	16 kg

Dimensions



Hydraulic symbol



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ARGO HYTOS

Oil Service Units

Cleanline portable

FA 016/FAPC 016

- Easy filling and cleaning
- Compact design, comfortable handling
- High filtration efficiency
- Option: with oil cleanliness monitor
- FAPC 016 with data storage

80.65-4e

Oil service – simple, quick and compact

Cleanline portable – FA 016

With the Cleanline portable, hydraulic or lubricating systems can be easily filled or cleaned with off-line filtration.

Compact design and comfortable handling
The compact design allows easy access to the oil tank. Cleanline portable comes ready to connect with hose packages. The suction hose and the pressure hose can be wound around the hose fixtures. Residual oil from the hoses is collected in the oil pan. The ultra-fine elements can be quickly changed without special auxiliary tools.

Protection of components through ultra-fine filtration
The EXAPOR®MAX 2 ultra-fine elements are the heart of the ARGO-HYTOS filter units Cleanline portable. High separation efficiency guarantees excellent cleanliness levels and thereby highest protection of components. The high dirt holding capacity of the EXAPOR®MAX 2 ultra-fine elements allow economic operation of the Cleanline portable.

Cleanline portable with OPCom II – FAPC 016

2 in 1: Cleanline portable with Oil Cleanliness Monitor OPCom II
The Cleanline portable can be equipped with a Oil Cleanliness Monitor. The ARGO-HYTOS OPCom II permanently monitors the current cleanliness class during the cleaning or filling process.

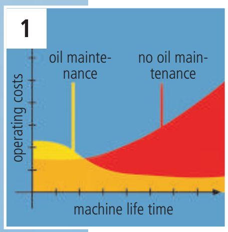
When monitoring the cleanliness classes a ball valve is used to select "behind filter" (e.g. when filling systems) or "before filter" (e.g. when cleaning filled oil). At the display of the OPCom II the ordinal numbers of the particle sizes 4, 6, 14 and 21 µm are shown according to ISO 4406:1999.

FAPC 016 can store up to 3000 data sets. A PC-software for data recording and representation of the measured values can be downloaded for free at www.argo-hytos.com. The data can be transmitted to a computer via an RS232 interface so that the progression can be visualized and followed graphically or in table form.

Easy Transport

For easy transportation for FA 016 and FAPC 016 a trolley can be hooked onto the standing unit. Also, trouble-free transportation is possible for long distances.

Advantages at a glance



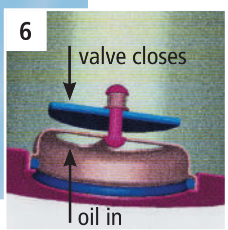
1. Economical
Efficiency through ARGO-HYTOS Fluid Management systems. Fast return on investment by extended service intervals and increased machine availability.

2. Portable in any position
Thanks to the compact design the Cleanline portable can be easily carried and also be used in difficult areas of hydraulic systems. Hoses and electric cables can be fixed at the service unit. The Cleanline portable can be operated and transported in both up-right and horizontal positions.

3. User-friendly filter element change
Optimal operator handling has been a key feature in the development of Cleanline portable. No extra tools are needed to open the housing and the filter element can be pulled out with the cover.

4. Quality in detail
The EXAPOR®MAX 2 ultra-fine element is the heart of the Cleanline portable. High separation efficiency and dirt holding capacities guarantee maximum cleanliness levels and service intervals in line with practical needs.

5. Controlled cleaning by
Oil Cleanliness Monitor OPCom II
The Cleanline portable can also be equipped with the ARGO-HYTOS Oil Cleanliness Monitor OPCom II which allows to monitor the oil cleanliness during the cleaning or filling process. The current cleanliness classes are indicated on the display or can be transferred by the provided RS232-interface.



6. Maintenance-free filter housing thanks to a unique filter element technique
On the bottom of the from inside to outside flown through filter elements there is a dirt retention valve. If the filter element is pulled out of the filter housing with the cover, the dirt retention valve will close. Sedimented dirt is removed from the housing with the filter element.

Characteristics

Hydraulic connection
Hoses:
Suction hose NG 20, length 1,8 m, with suction strainer 300 µm, Ø ca. 49 mm pressure hose NG 20, length 2 m, pressure or supply lance Ø ca. 20 mm (extensions on request)

Electrical connection / Electric motor
Electric motor, air cooled fan type

Cable:	length 2,5 m
Electro motor types:	1~ 110 V / 60 Hz
	1~ 230 V / 50...60 Hz
Protection type:	IP 55

Vessel volume
approx. 2,4 l

Pump design
Internal gear pump

Operating and transportation position
Upright or horizontal

Hydraulic fluids
Mineral oil and biodegradable fluids
(see info service sheet 00.20).
Other fluids on request.

Temperature range of fluids
0 °C ... +60 °C

Ambient temperature range
0 °C ... +50 °C

Accessories
Water-absorbing filter elements EXAPOR® AQUA
These can be used for short-term water absorption in all standard units (on request).

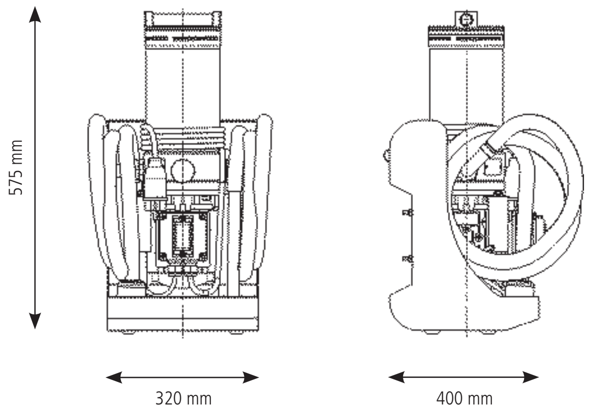
Trolley
Easy transportation for long transport ways.

Viscosity range

Type	Continuous operation min.	Continuous operation max.	Short-term operation max.
FA 016-1100	15 mm²/s	250 mm²/s	400 mm²/s
FA 016-1110	15 mm²/s	200 mm²/s	400 mm²/s
FA 016-1300	15 mm²/s	250 mm²/s	400 mm²/s
FA 016-1600	15 mm²/s	250 mm²/s	400 mm²/s
FAPC 016-2175	15 mm²/s	150 mm²/s	150 mm²/s*

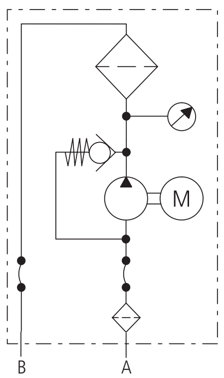
* An exact measurement of the oil cleanliness class is only possible within a viscosity range from 15 mm²/s to 150 mm²/s

Dimensions

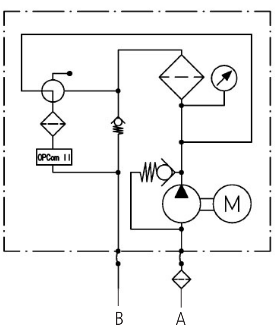


Symbols

Symbol 1



Symbol 2



Cleaning speed

The cleaning speed depends on the efficiency of the filter elements ($\beta_{x\,(c)}$), the nominal volume flow ($Q_{nominal}$) and the oil volume (V_{actual}).

In graph D1-D2 the cleaning time is shown in relation to the filter fineness (cleanliness information according to ISO 4406:1999). The values are recorded by laboratory methods and they may be influenced by environmental conditions (such as continuous additional introduction of dirt on running systems, high water content, etc.).

All characteristic curves (see graphs D1-D2) relate to a **reference oil volume of 180 l** and a **nominal volume flow of 15 l/min**.

The following formula should be used to convert to the actual oil volume:

$$t_{actual} = \frac{V_{actual} \cdot \Delta t}{12 \cdot Q_{nominal}}$$

t_{actual} = actual cleaning speed

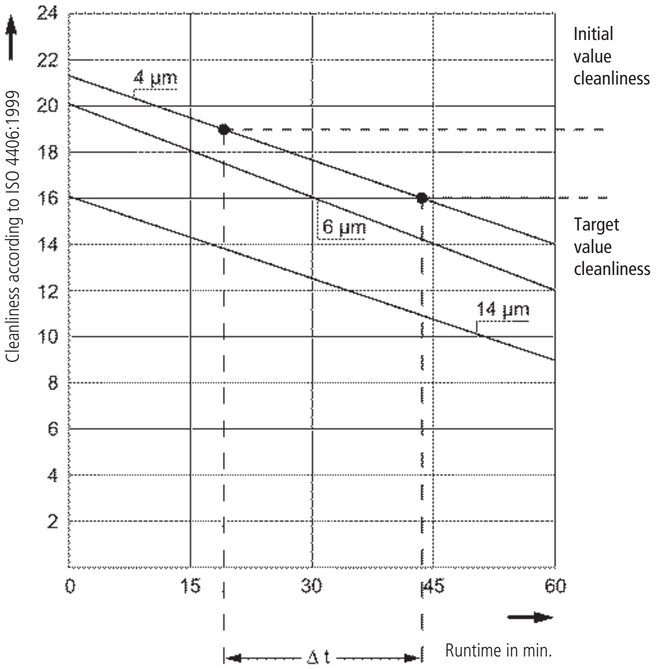
Δt = cleaning speed for oil volume of 180 l

V_{actual} = volume of oil to be cleaned

$Q_{nominal}$ = nominal volume flow, see selection chart

For monitoring purposes we recommend the OPCom from ARGO-HYTOS, integrated in the version FAPC 016 or the PODS ***Pro*** (Portable Oil Diagnostic System) particle counter.

Determining the cleaning time



1. Determine the initial cleanliness class and enter it on the graph, e. g. 19/17/14 according to ISO 4406:1999
2. Enter the target cleanliness class on the graph, e.g. 16/14/11 according to ISO 4406:1999
3. Determine Δt, in this case $\Delta t = 25$ min
4. Insert the value in the formula, where $V_{actual} = 350$ l and $Q_{nominal} = 16$ l/min

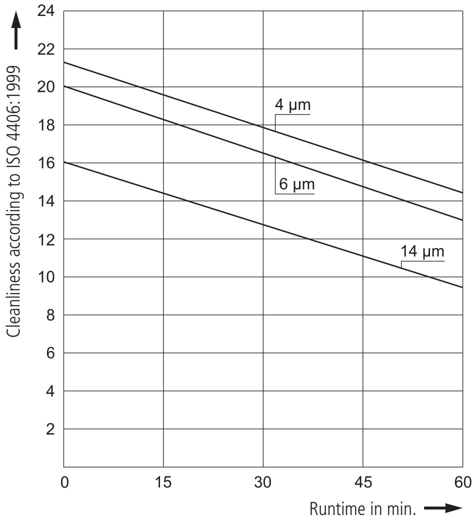
$$t_{actual} = \frac{V_{actual} \cdot \Delta t}{12 \cdot Q_{nominal}}$$

$$= \frac{350 \cdot 25}{12 \cdot 16} \approx 46 \text{ min}$$

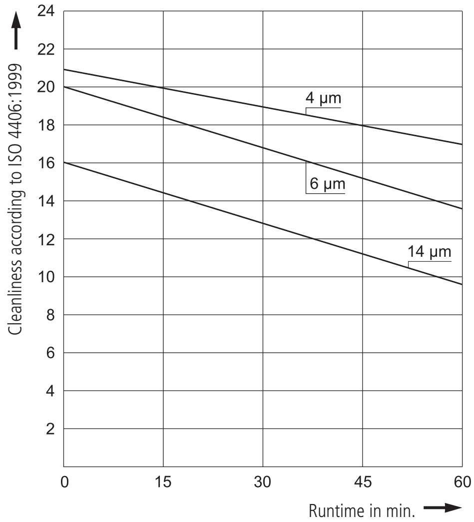
Diagrams

Curves for cleaning time as a function of the filter fineness

D1 FA 016 with 3EN2 and 5EN2 EXAPOR®MAX 2 filter elements

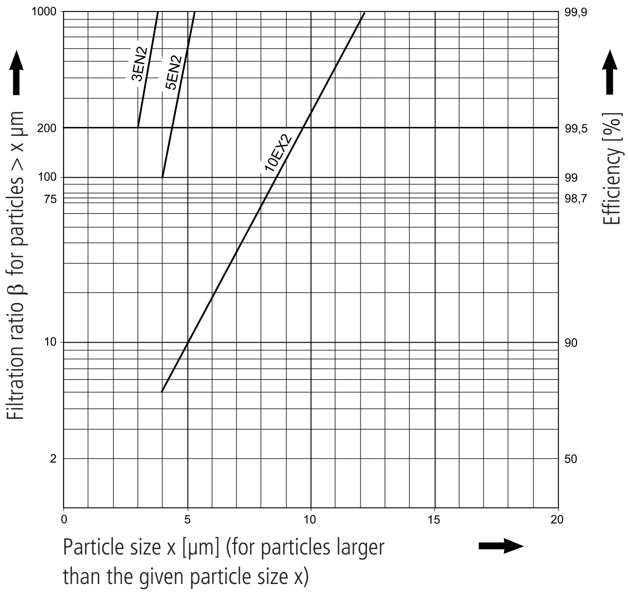


D2 FA 016 with 10EX2 EXAPOR®MAX 2 filter elements



Filter fineness curves in selection chart

Dx Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2 elements:

3EN2 = $\overline{\beta}_{3(c)} \geq 200$ EXAPOR®MAX 2
5EN2 = $\overline{\beta}_{5(c)} \geq 200$ EXAPOR®MAX 2
10EX2 = $\overline{\beta}_{10(c)} \geq 200$ EXAPOR®MAX 2

Selection Chart

	Order no. FA 016-1100	Order no. FA 016-1300	Order no. FA 016-1600	Order no. FA 016-1110	Order no. FAPC 016-2175
Nominal flow rate	16 l/min*	16 l/min*	16 l/min*	19 l/min	16 l/min*
Filter fineness see diagram Dx	3EN2	5EN2	10EX2	3EN2	3EN2
Dirt capacity Mi at Q	280 g	270 g	210 g	280 g	280 g
E-Motor operating voltage	1 ~ 230 V	1 ~ 230 V	1 ~ 230 V	1 ~ 110 V	1 ~ 230 V
E-Motor operating frequency	50/60 Hz	50/60 Hz	50/60 Hz	60 Hz	50/60 Hz
E-Motor power	0,45 kW*	0,45 kW*	0,45 kW*	0,3 kW	0,45 kW*
Length suction hose	1,8 m	1,8 m	1,8 m	1,8 m	1,8 m
Length pressure hose	2 m	2 m	2 m	2 m	2 m
Viscosity max.	400 mm^2/s	400 mm^2/s	400 mm^2/s	400 mm^2/s	150 mm^2/s
Suction height max.	1,5 m	1,5 m	1,5 m	1,5 m	1,5 m
Operating pressure PRV max.	4 bar	4 bar	4 bar	4 bar	4 bar
Symbol	1	1	1	1	2
Replacement element order no.	V7.1220-113	V7.1220-13	V7.1220-06	V7.1220-113	V7.1220-113
Weight	18,9 kg	18,9 kg	18,9 kg	18,9 kg	24 kg
Clogging indicator	Manometer	Manometer	Manometer	Manometer	Manometer
Particle monitor	-	-	-	-	OPCom II

* Indications at 50 Hz. At 60 Hz the value increases by approx. 20 %.

Other versions on request.

Filter elements: see selection chart.
Water-absorbing filter elements order no. Y7.1220-05 on request.

Accessories:
- Hose extensions on request.
- For the appropriate clogging indicators see datasheet 60.20.
- Trolley for FA 016 and FAPC 016 order no. FA 016-1760.
- Suction strainer set FA 016.1775 for tank openings on request in case the existing suction strainer can't be used.

We produce fluid power solutions
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ARGO HYTOS

Oil Service Units

ECOLINE

UM 045 / UMP 045 / UMPC 045

- Easy filling, cleaning and pumping over
- Unbeatable ergonomics, optimal handling
- High filtration performance
- May be combined with portable oil diagnostic system optionally
- Optionally with integrated particle monitor
- Optionally with integrated humidity sensor

80.70-3e

ECOLINE

Easy, compact and ergonomic
With ECOLINE hydraulic or lubrication systems can simply be filled, cleaned or fluid can be pumped over without using the filter function. The ergonomic design allows simple handling also on closest work space.

Protection of components through ultra-fine filtration
The EXAPOR®MAX 2 ultra-fine element is the heart of the ARGO-HYTOS oil service unit ECOLINE. High separation efficiency guarantees excellent cleanliness levels and thereby highest protection of components.
The high dirt holding capacity of the EXAPOR®MAX 2 ultra-fine elements allows economic operation of the ECOLINE.

ECOLINE base model – UM 045

The UM 045 is delivered equipped with hoses, and is ready to connect. For easy transport, electrical cables, as well as suction and return hose, are mounted with support fixtures on the carrier device. The tool can be stowed in the basket of the carrier device.

ECOLINE with integrated particle monitor – UMPC 045

The integrated particle monitor in the UMPC 045 permanently monitors the oil cleanliness during the filtering process. A humidity sensor (LubCos H2O) is optionally available, which permanently monitors the humidity of the oil during the filtering process.

Cleanliness class monitoring can be selected for "cleaning" or "filling" with a change-over cock. The ordinal numbers of the particle sizes are shown on the display in accordance with ISO 4406:1999. Also the humidity in %rh is shown on the display.

Via a W-Lan SD card data can be transmitted to a computer or Smartphone during measurement. If data transmission is not possible, the data are stored on the SD card and can be retrieved at a later point in time.

… with programmable oil diagnostic system

ECOLINE with oil diagnostic system PODS *Pro* – UMP 045

ECOLINE in the UMP 045 version, is prepared for connnection of the portable ARGO-HYTOS oil diagnostic system PODS *Pro*. With few turns of your hand PODS *Pro* can be attached to the ECOLINE and is immediately ready for operation. Oil purity is monitored in the bypass with PODS *Pro* when cleaning hydraulic systems.

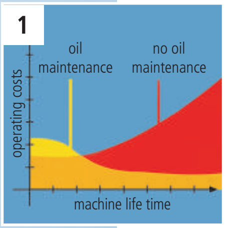
In conjunction with PODS *Pro* (Portable Oil Diagnositc System), ECOLINE makes it possible to verify the cleaning efficiency. Selective cleaning is possible by input of the desired cleanliness class. After reaching the programmed target cleanliness class the complete unit UMP 045 and PODS *Pro* turns off. In addition with PODS *Pro* the cleanliness class can be determined online on high-pressure lines or per bottle sampling in accordance with all standard cleanliness classifications.

The intelligent software also enables the implementation of cleaning processes that are controlled by the level of fluid contamination.

The determined cleanliness classes can be documented on a print-out on-site, indicated on the PODS *Pro* itself at any time or can be downloaded on an external memory later on by using the special PODSWare.

The PODSWare enables the user to issue a purity certificate with individual labels.

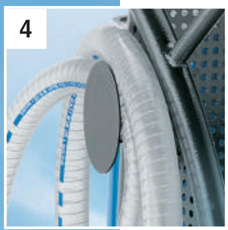
Advantages at a glance



1. Economical
Efficiency through ARGO-HYTOS Fluid Management systems. Fast return on investment by extended service intervals and increased machine availability.

2. User-friendly filter element change
The filter element can be removed from the housing together with the cover. The dirt retention valve ensures that solid particle sediment is completely removed with the filter element. During operation, the fluid passes through the filter element from the inside to the outside, which eliminates the need for flushing the filter housing.

3. Switching functions
The rotary valve is used to switch between the basic modes of operation: "filtering" and "pumping over without filtering".



4. Keeping hoses in place
The retainers attached to the sides of the frame secure the hoses in any transport position.

5. Compact design
Among the numerous advanced features, listed in the specification of the ECOLINE, compact design was a basic requirement to be met by our team of design engineers. Transporting the ECOLINE in horizontal position, e.g. in the cargo area of a service vehicle, is facilitated by the wheels and the curved design of the frame.

6. Unbeatable ergonomics
Superior technology and excellent design are of no use if the service equipment requires great physical effort form the operator. Therefore, ergonomics were of primary importance when the ECOLINE design was conceived.
Owing to its optimized weight distribution, the ECOLINE can be tilted from the standing position with minimum effort. In the tilted position, the ECOLINE can be moved walking upright, removing strain from the back.

Description

Cleaning speed

The cleaning speed depends on the efficiency of the filter elements ($\beta_{x\,(c)}$), the nominal volume flow ($Q_{nominal}$) and the oil volume (V_{actual}).

In graph D1-D2 the cleaning speeds are shown in relation to the filter fineness (cleanliness information according to ISO 4406:1999). The values are recorded by laboratory methods and they may be influenced by environmental conditions (such as continuous additional introduction of dirt on running systems, high water content, etc.).

All characteristic curves (see graphs D1-D2) relate to a **reference oil volume of 180 l** and a **nominal volume flow of 15 l/min.**

The following formula should be used to convert to the actual oil volume:

$$t_{actual} = \frac{V_{actual} \cdot \Delta t}{12 \cdot Q_{nominal}}$$

t_{actual} = actual cleaning speed

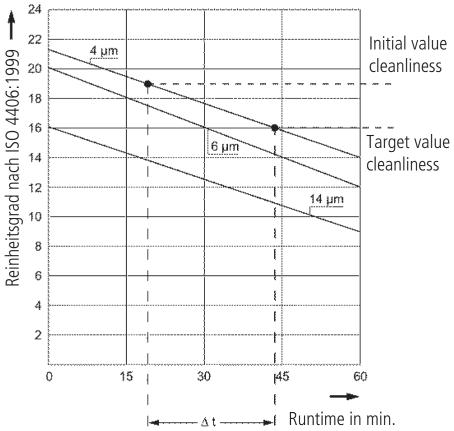
Δt = cleaning speed for oil volume of 180 l

V_{actual} = volume of oil to be cleaned

$Q_{nominal}$ = nominal volume flow, see selection chart

For monitoring purposes we recommend the ARGO-HYTOS OPCom which is built in the version FAPC 016 or the oil particle counter PODS *Pro* (Portable Oil Diagnostic System).

Determining the cleaning speed

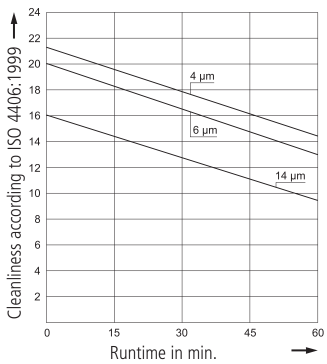


1. Determine the initial cleanliness class and enter it on the graph, e. g. 19/17/14 according to ISO 4406:1999
2. Enter the target cleanliness class on the graph, e.g. 16/14/11 according to ISO 4406:1999
3. Determine Δt, in this case Δt = 25 min
4. Insert the value in the formula, where V_{actual} = 350 l and $Q_{nominal}$ = 16 l/min

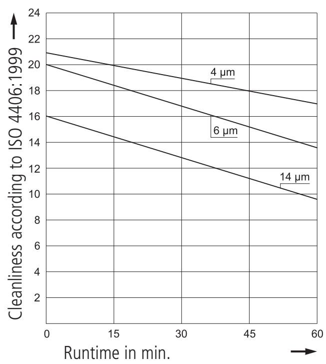
$$t_{actual} = \frac{V_{actual} \cdot \Delta t}{12 \cdot Q_{nominal}} = \frac{350 \cdot 25}{12 \cdot 16} \approx 46 \text{ min}$$

Curves for cleaning speed as a function of the filter fineness

D1 3EN2 and 5EN2 EXAPOR®MAX 2 filter element
Reference oil volume with $Q_{\text{off-line filter}}$=15 l/min.

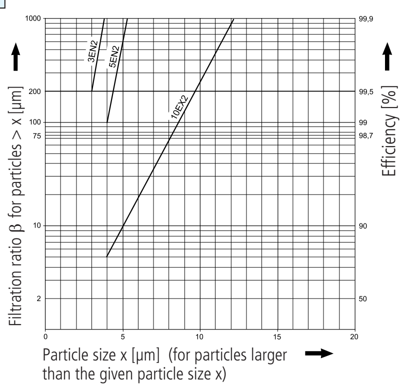


D2 10EX2 EXAPOR®MAX 2 filter element
Reference oil volume with $Q_{\text{off-line filter}}$=15 l/min.



Filter fineness curves in selection chart

Dx Filtration ratio β as a function of particle size x obtained by the Multi-Pass-Test according to ISO 16889



The abbreviations represent the following β-values resp. finenesses:

For EXAPOR®MAX 2-elements:

3EN2 = $\bar{\beta}_{3\,(c)} \geq 200$ EXAPOR®MAX 2

5EN2 = $\bar{\beta}_{5\,(c)} \geq 200$ EXAPOR®MAX 2

10EX2 = $\bar{\beta}_{10\,(c)} \geq 200$ EXAPOR®MAX 2

Characteristics

Hydraulic connection
Hoses:
Suction hose NG 32, length 2,7 m, with suction strainer 280 µm, pressure hose NG 25, length 2,7 m

Electrical connection / Electric motor
Electric motor, air cooled fan type

Cable:	length 6 m
Electro motor types:	1 ~ 230 V / 50 Hz
	3 ~ 400 V / 50 Hz
	(3 ~ 460 V / 60 Hz)
Type of protection:	IP 54
(See selection chart)	

Tank capacity
approx. 13 l

Pump design
Internal gear pump

Operating and transportation position
Operating position: upright
Transportation position: upright or horizontal

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info service sheet 00.20).
Other fluids on request.

Temperature range of fluids
0 °C ... +65 °C (also see fluid viscosity range)

Ambient temperature range
0 °C ... +50 °C

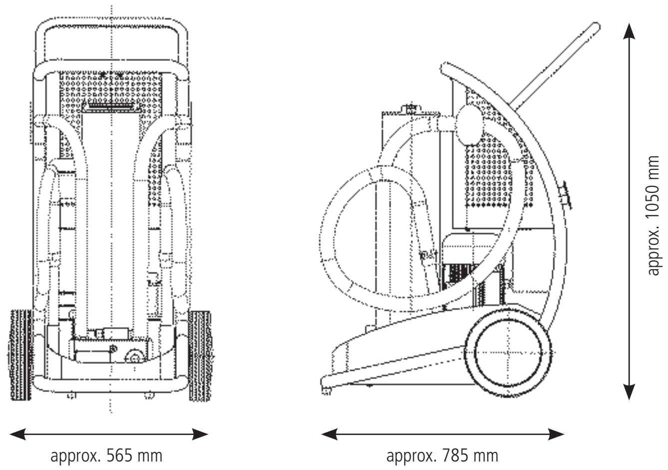
Options
Water-absorbing filter elements EXAPOR® AQUA
These can be used for short-term water absorption in all standard units. (please inquire)

Viscosity range

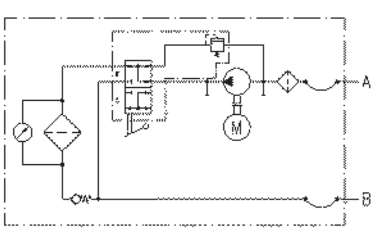
Type	Continuous operation min.	Continuous operation max.	Short-term operation max.
UM 045/UMP 045	15 mm²/s	600 mm²/s	800 mm²/s
UMPC 045	15 mm²/s	250 mm²/s* 600 mm²/s*	800 mm²/s

*Precise determination of the cleanliness class is possible within a viscosity range of 15 mm²/s to 250 mm²/s

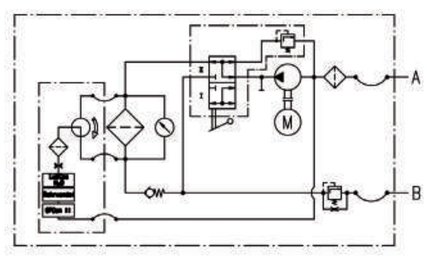
Dimensions



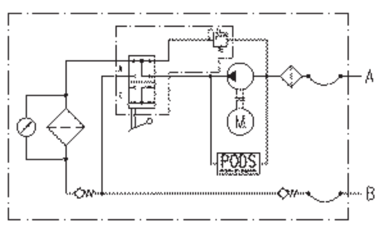
Hydraulic symbol 1 – UM 045



Hydraulic symbol 2 – UMPC 045



Hydraulic symbol 3 – UMP 045



Selection Chart

Order No.	Nominal flow rate	Filter fineness see diagram **Dx**	Dirt capacity Mi at $Q_{nominal}$	E-Motor operating voltage	E-Motor max. operating frequency	E-Motor power	Length suction hose (lance incl.)	Length pressure hose (lance incl.)	Viscosity	Suction height max.	Hydraulic symbol	Replacement element order no.	Clogging indicator	Weight
ECOLINE basic model – UM 045														
UM 045-1553	45 l/min***	3EN2	1.950 g	1~230 V	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s	2,0 m	1	V7.1560-103	optical	76,5 kg
UM 045-4553	45 l/min***	3EN2	1.950 g	3~400 V 50 Hz 3~460 V 60 Hz	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s	2,0 m	1	V7.1560-103	optical	76,5 kg
UM 045-1153	45 l/min***	5EN2	1.980 g	1~230 V	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s	2,0 m	1	V7.1560-03	optical	76,5 kg
UM 045-4153	45 l/min***	5EN2	1.980 g	3~400 V 50 Hz 3~460 V 60 Hz	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s	2,0 m	1	V7.1560-03	optical	76,5 kg
ECOLINE with integrated particle monitor OPCom – UMPC 045														
UMPC 045-15735	45 l/min***	3EN2	1.950 g	1~230 V	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s*	2,0 m	2	V7.1560-103	electrical	97 kg
UMPC 045-45735	45 l/min***	3EN2	1.950 g	3~400 V 50 Hz 3~460 V 60 Hz	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s*	2,0 m	2	V7.1560-103	electrical	97 kg

Please request our data sheet no. 100.10 for more detailed information on the OPCom particle monitor.

ECOLINE prepared for connection of oil diagnostic system PODS – UMP 045**														
UMP 045-1553	45 l/min***	3EN2	1.950 g	1~230 V	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s	2,0 m	3	V7.1560-103	optical	84 kg**
UMP 045-4553	45 l/min***	3EN2	1.950 g	3~400 V 50 Hz 3~460 V 60 Hz	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s	2,0 m	3	V7.1560-103	optical	84 kg**
UMP 045-1153	45 l/min***	5EN2	1.980 g	1~230 V	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s	2,0 m	3	V7.1560-03	optical	84 kg**
UMP 045-4153	45 l/min***	5EN2	1.980 g	3~400 V 50 Hz 3~460 V 60 Hz	50/60 Hz	1,1 kW***	2,7 m	2,7 m	15 ... 600 mm^2/s	2,0 m	3	V7.1560-03	optical	84 kg**

Please request our brochure for more detailed information on the PODS *Pro* oil diagnostic system.

* The exact determination of the cleanliness class is possible in a viscosity range of 15 mm^2/s to 250 mm^2/s.
** without PODS *Pro*
*** Indications at 50 Hz. At 60 Hz the value increases by 20 %.

Other versions on request

Filter elements: see selection chart.
Water-absorbing filter elements EXAPOR®AQUA on request.

Accessories: Hose extensions on request.
For the appropriate clogging indicators see datasheet 60.20.

We produce fluid power solutions
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ARGO HYTOS

Oil Service Units for Gear Applications

FA 003-2341

- Easy filling and cleaning
- Nominal flow rate up to 3 l/min
- Viscosity up to 5.000 mm²/s

80.55-3e

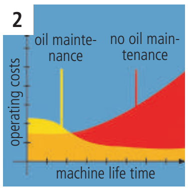
Oil Service Units for Gear Applications - FA 003-2341

FA 003-2341
The FA 003-2341 Oil Service Unit allows easy filling and cleaning of hydraulic and lubricating systems.

Suitable for up to 5.000 mm²/s
The unit is designed to operate with viscosities between 15 and 5.000 mm²/s. This allows transmission fluid, for example, to be filtered at low temperatures when filling or cleaning.

1

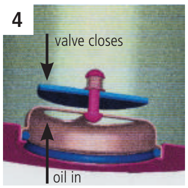

1. Compact and ready to connect
The FA 003-2341 is supplied ready to connect, with hose packages and filter elements.

2


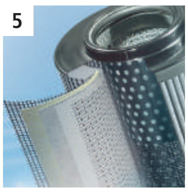
2. Economical
Efficiency through ARGO-HYTOS Fluid Management systems. Fast return on investment by extended service intervals and increased machine availability.

3


3. User-friendly filter element change
Optimal operator handling has been a key feature in the development of FA 003. No extra tools are needed to open the housing and the filter element can be pulled out through the hang-in technique.

4


4. Maintenance-free filter housing thanks to a clever filter element technique
Fluid flows through the element from the centre outwards. The built-in dirt retention valve closes automatically when the element is removed, ensuring that all dirt is removed from the housing with the element.

5


5. Quality in detail
The EXAPOR®MAX 2 fine element is the heart of the FA 003. High cleanliness levels protect hydraulic systems against dirt during the oil filling process.

6


6. For high oil viscosity
Specifically designed for high viscosity fluids, the FA 003 is highly suited to cleaning and filling at low temperatures - for example: transmission fluid for azimuth gears for wind turbines.

Hydraulic connection
Suction hose DN 32 mm x 1,5 m length CEL28
(connection M36 x 2, external thread with sealing cone 24°)
Pressure hose DN 25 mm x 1,5 m length CEL28
(connection M36 x 2, external thread with sealing cone 24°)
Suction and pressure hoses can be removed quickly or mounted on quickly with special ARGO-HYTOS fast locking couplings.

Hydraulic fluids
Mineral oil and biodegradable fluids
(HEES and HETG, see info sheet 00.20).
Other fluids on request.

Temperature range of fluids/ Viscosity range
0 °C ... +60 °C
Continuous operation min.: 15 mm²/s
Continuous operation max.: 5.000 mm²/s

Ambient temperature range
0 °C ... +50 °C

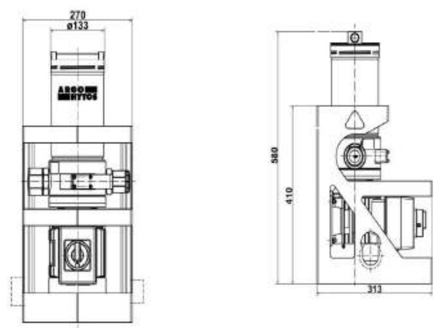
Operating pressure
max. 6 bar

Clogging indicator
optical

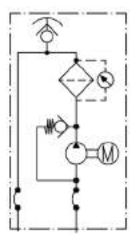
Order no.	FA 003-2341
Nominal flow rate	3 l/min
Filter fineness	$\overline{\beta}_{5(c)} = 200$*
Dirt-holding capacity	460 g*
Electric drive	3 ~ 400 V / 50 Hz; 0,25 kW
Replacement filter element order no.	V7.1220-13
Weight	ca. 22 kg

*according to ISO 16889 at 8 l/min and Δp 3 bar

Dimensions



Hydraulic symbol



We produce fluid power solutions
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Oil Service Units

FA 016-1160

- Easy filling and cleaning
- Nominal flow rate up to 16 l/min
- Operating pressure up to 30 bar

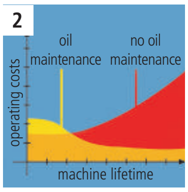
80.68-3e

Oil service unit - FA 016-1160

FA 016-1160
With the oil service unit FA 016-1160 hydraulic or lubricating systems can be easily filled or cleaned.

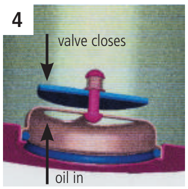
Suitable for up to 30 bar
The unit is designed to operate up to 30 bar filling or system pressure. This allows e.g. filling and filtering of transmission fluids over valve blocks.

1. Compact and ready to connect
The FA 016-1160 is supplied ready to connect, with hose packages and filter elements.

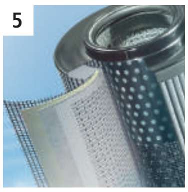


2. Economical
Efficiency through ARGO-HYTOS Fluid Management systems. Fast return on investment by extended service intervals and increased machine availability.

3. User-friendly filter element change
Optimal operator handling has been a key feature in the development of FA 016-1160. No extra tools are needed to open the housing and the filter element can be pulled out through the hang-in technique.



4. Maintenance-free filter housing thanks to a unique filter element technique
Fluid flows through the element from the centre outwards. The built-in dirt retention valve closes automatically when the element is removed, ensuring that all dirt is removed from the housing with the element.



5. Quality in detail
The EXAPOR®MAX 2 fine element is the heart of the FA 016-1160. High cleanliness levels protect hydraulic systems against dirt during the oil filling process.

Dirt-holding capacity
Values in g test dust ISO MTD according to ISO 16889

Hydraulic fluids
Mineral oil and biodegradable fluids (HEES and HETG, see info sheet 00.20).
Other fluids on request.

Temperature range of fluids/ Viscosity range
0 °C ... +60 °C
Continuous operation min.: 15 mm²/s
Continuous operation max.: 400 mm²/s

Ambient temperature range
0 °C ... +50 °C

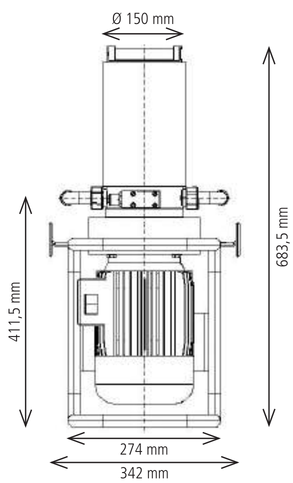
Operating pressure
Max. 30 bar

Clogging indicator
Optical differential pressure indicator

Order no.	FA 016-1160
Nominal flow rate	16 l/min
Filter fineness	$\overline{\beta}_{3(c)} = 200$*
Dirt-holding capacity	280 g*
Electric drive	1 ~ 230 V / 50 Hz; 1,5 kW, n = 3,000 min^{-1}
Replacement element order no.	V7.1220-113
Weight	approx. 30 kg

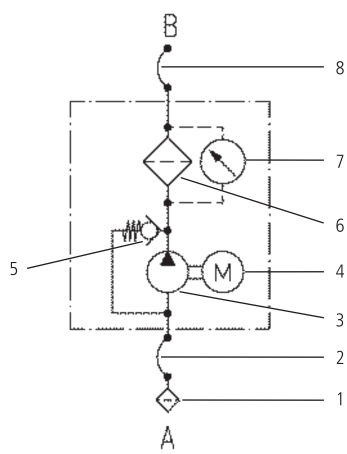
*test dust ISO MTD according to ISO 16889

Dimensions



Hydraulic symbol

1 Suction strainer
2 Suction hose
3 Pump
4 Electric motor
5 Pressure control valve
6 Fine filter element
7 Clogging indicator
8 Pressure hose



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Suction Strainer Set FA 016.1775

Accessories for units FA 014, FA 016, FAPC 016, FNA 008, FNA 016

Description

The suction strainer set FA 016.1775 guarantees pump protection, when the existing suction strainer at the suction pipe of the oil service units FA 014, FA 016 and FAPC 016 cannot be used. This is the case, when the oil service units have to be mounted to the hydraulic unit by quick fitting coupling or ball valve, or the opening of the tank is not sufficiently dimensioned. The suction strainer set FA 016.1775 is also applicable for the off-line filter units FNA 008 or FNA 016, if they are mounted to hydraulic units afterwards and installation of a suction strainer within the tank is impossible.

The suction strainer set FA 016.1775 consists of a suction strainer element 280 µm (1), a clip (2), a connection part with O-ring (3) and a connection piece (4).

Installation of the suction strainer set

- The suction pipe and suction strainer mounted to the ARGO-HYTOS oil service unit has to be dismounted.

- The suction strainer set FA 016.1775 is directly screwed into the filter housing.

- A suction pipe with DN 25 is connected (can be locked by hose clip).

The suction strainer set FA 016.1775 is designed in a way, so that the DN 25 hose connection can be rotated by 360° and thus be adapted to the position of the pipe inlet.

> **Caution:**
> With application of the FA 016.1775 strainer set in the version of FA 016-1160 an additional male end fitting has to be used!

Maintenance

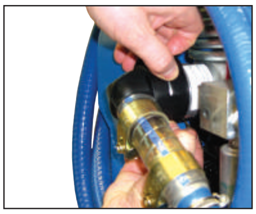
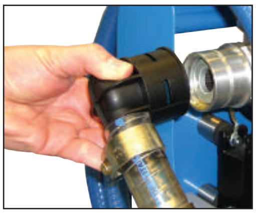
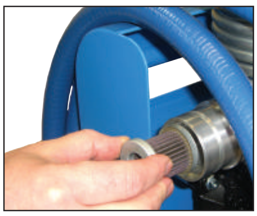
The suction strainer (1) should be checked once a month with oil service units and every 12 months with off-line filter units.

- Therefore demount the clip (2) and pull the connection piece (4) from the housing (3).

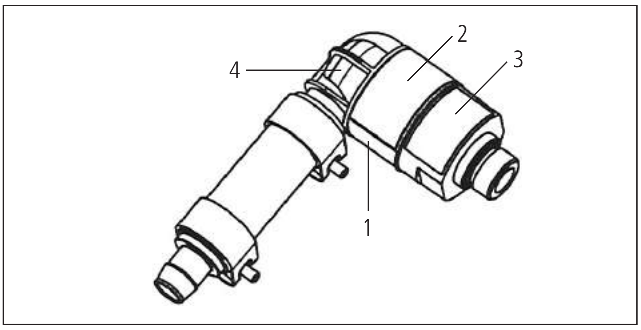
- Remove the suction strainer from the connection piece and clean it with cleaning solvent.

- Replace suction strainer (1) if damaged by a new one S3.0405-02.

- Mount cleaned or new suction strainer (1) S3.0405-02 onto the housing and secure it with the plastic clip (2).

FA 016 with screwed-in suction strainer set FA 016.1775



Suction strainer set FA 016.1775

Order-No.:

Suction strainer set complete:	**FA 016.1775**
Suction strainer filter fineness 200 µm (1)	**S3.0405-02**

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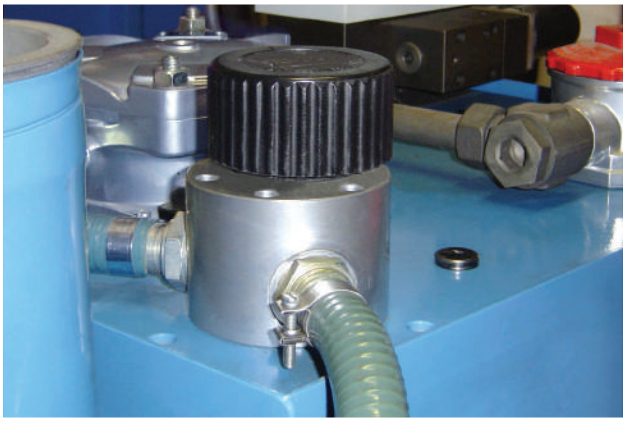
Mounting Set FNA 008.1700

Accessories for FNA 008, FNA 016 (FA 014, FA 016, FAPC 016)

Operating mode and mounting

The mounting set FNA 008.1700 enables easy connection of the supply and discharge pipe to the tank of the ARGO-HYTOS off-line filter units, provided that there is a connection for a ventilating filter at the tank according to the displayed connection scheme (e. g. for ARGO-HYTOS filling and ventilating filter LE.0716 and LE.0817…0827).

The mounting set can also be used as service connection for ARGO-HYTOS oil service units, e. g. if hydraulic systems require regular oil cleaning. For this purpose the mounting set is additionally equipped with adequate hose nipples so that the ARGO-HYTOS oil service units can be easily and quickly connected (in this case we recommend to insert the suction strainer set FA 016.1770 for pump protection).



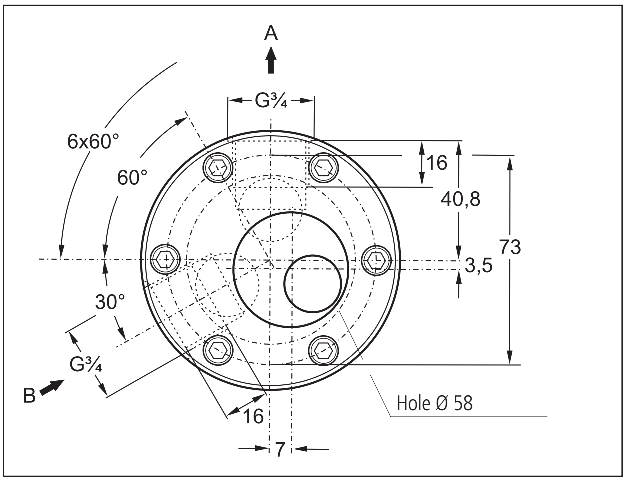
Mounting set attached onto the tank

Installation of the mounting set

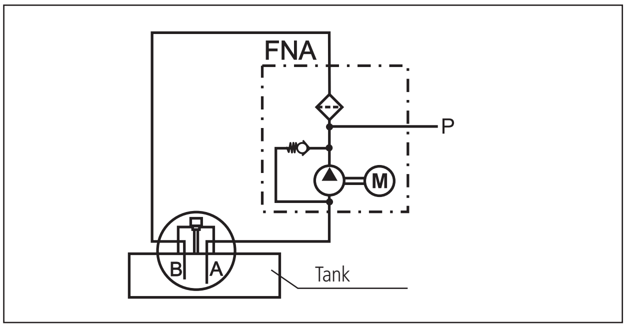
- Instead of the filling filter the mounting set FNA 008.1700 is attached to the tank.
- The off-line filter unit is tubed or piped to the mounting set.
- The ventilating filter is directly screwed onto the mounting set.

Order no.

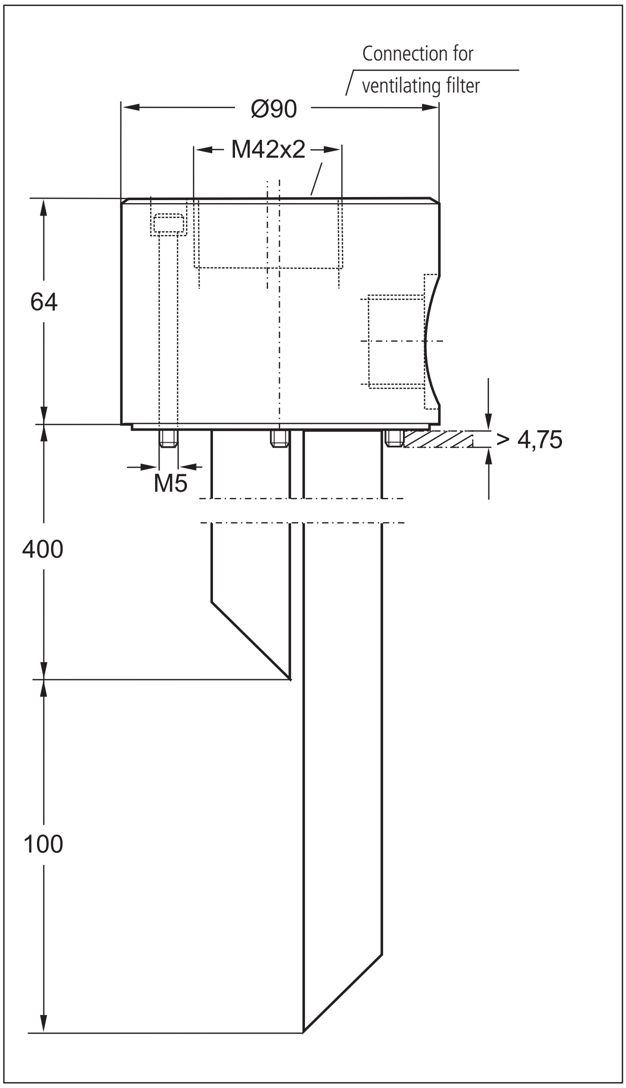
Mounting set	**FNA 008.1700**



Connection schema



Connection schema



Dimensions

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ARGO HYTOS

Dewatering Unit

COPS 010

- Fast dewatering and filtration of oils
- Compact design
- Easy handling
- Monitoring with water sensor

80.80-2e

Dewatering – compact and easy

COPS 010

The smallest amount of free water can cause acidification in oils and corrode components surfaces. An increase in water content can dramatically alter the characteristics of the oil. The consequences include reduced load capacity, lower temperature resistance and, ultimately, rapid oil oxidation (aging), which all results in economic damage. Some of the causes of water in hydraulic and lubricating oil are: Ambient moisture, splash water, cooler breakage.

Compact and easy

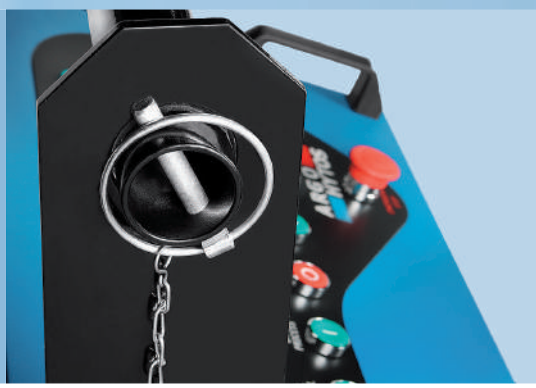
With the new COPS mobile dewatering unit large quantities of free water can be removed economically. The oil is heated and channelled into a vacuum chamber. The water is reduced quickly, long before the saturation limit is reached, thanks to the reduced steam pressure. A fine filter is installed downstream from the drying process to ensure that the oil is dry and filtered when it flows back into the machine or tank.
Water content is constantly monitored with the ARGO-HYTOS LubCos H_2O water sensor. A digital display reading water content (relative humidity) and indicator lights show the user the current state of the dewatering process.

Design and accessories

1 Operating panel
2 Inspection glass water collection tray
3 Connections
4 Electrical power supply
5 Reactor
6 Oil outlet pump
7 Vacuum pump
8 Filter

Accessories

9 Hose support
10 Automatic coupling for load hooks or loop



Design

The unit consists of an upper housing with operating panel and cover for the electrical components as well as a lower housing.

Reactor, collection tray, heating element, pumps and filter are assembled separately from the electrical components in the lower housing.

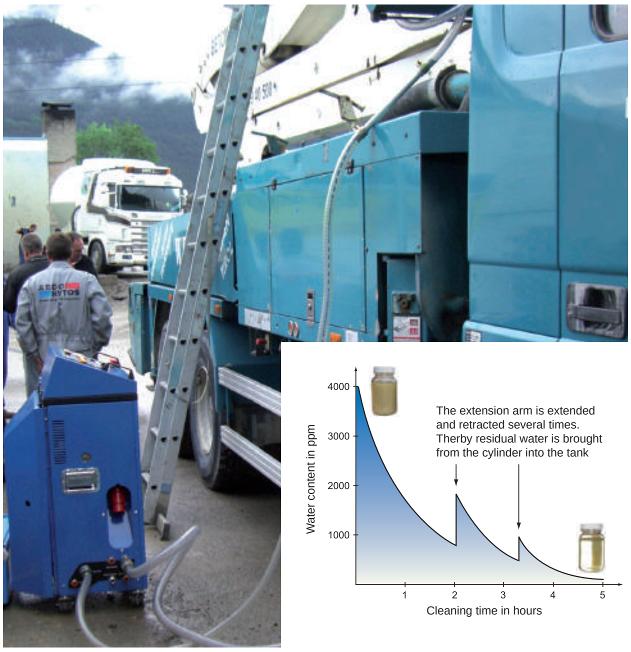
All connections are situated easily accessible at one side of the housing.

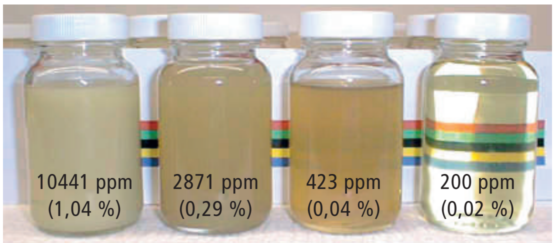
Functionality

The unit separates free and dissolved water from hydraulic and lubricating oils. By means of a vacuum pump low pressure is produced within the reactor and oil is sucked in via the oil inlet. A heater warms up the oil to the adjusted temperature.

Inside the reactor the water evaporates far below the saturation limit. The steam is cooled down and condensed. The condensed water conglomerates in a collection tray. With full collection tray the process is stopped by a floating switch and the collection tray must be emptied. The dried oil conglomerates within the reactor. Herein level switches are found for switching on and off the outlet pump. As soon as the maximum filling level is reached the outlet pump operates and delivers the dewatered oil via a fine filter to the oil outlet.

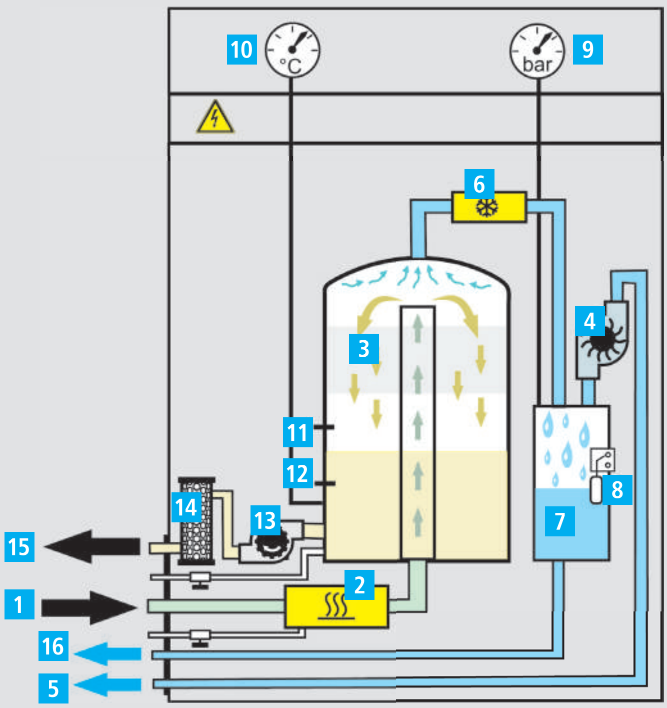
On site the cooled oil sample can be evaluated optically. As long as the cooled oil is clouded, the water content is impermissible high. In case the cooled oil sample seems to be clear, the water content lies within the permitted range. An exact examination of the water content is carried out by an oil sample analysis in the laboratory (e. g. determination of the water after the Karl-Fischer-Method according to DIN 51777).



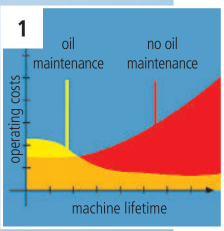


Oil samples with different water content

1 Oil inlet
2 Heater
3 Reactor
4 Vacuum pump
5 Air outlet
6 Cooler
7 Collecting tray – water
8 Floating switch
9 Manometer – low pressure
10 Oil temperature – Reactor
11 Level switch (min.) – outlet pump on
12 Level switch (max.) – outlet pump off
13 Outlet pump
14 Fine filter
15 Oil outlet
16 Outlet water collecting tray



Advantages at a glance

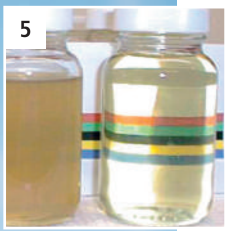


1. Economical
Efficiency through ARGO-HYTOS Fluid Management systems. Fast return on investment by extended service intervals and increased machine availability.

2. Easy handling
The operating panel is clearly and easily arranged. All operating elements and indications can be realized at a glance.

3. User-friendly filter element change
The filter element can be pulled out of the housing together with the cover. By means of the dirt retention valve sedimented solid particles are removed together with the filter element which is flown through from the centre outwards. Extensive flushing of the filter housing is not necessary.

4. Compact design
Due to its compact design, COPS may be transported also in service vehicles as mobile unit and can operate in places where space is limited.



5. Efficient dewatering
By means of the vacuum chamber and tempering of the oil the COPS dewaters far below the saturation limit.

6. Monitored dewatering
With the water sensor LubCos H_2O the relative humidity is monitored during the dewatering process.

Technical data

COPS 010

Order no.	COPS 010-41110
Nominal flow rate	10 l/min
Dewatering rate	0,9 l/h*
Viscosity range	10…700 mm²/s
Replacement filter element no.	V7.1230-53
Filter fineness	5 µm (c) ($\bar{\beta}_{5(c)}$ = 200**)
Dirt-holding capacity	220 g
Electrical supply	3 ~ 400 V / 50/60 Hz
Max. power input	7.4 kW
Weight	approx. 160 kg (without accessories)

* typical dewatering rate with 200 litres of oil at > 10.000 ppm water content

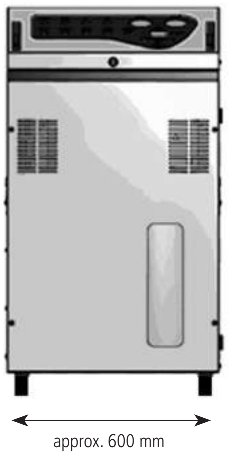
**with test dust ISO MTD determined by ISO 16889

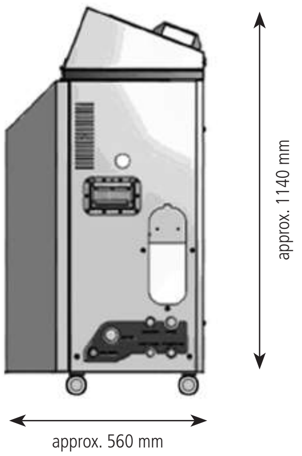
Accessories

Description	**Order no.**
Suction hose 3 m (DN 32)	COPS010.1702
Return hose 3 m (DN 25)	COPS010.1704
Electric cable 4 m, 3 ~ 400 V / 50/60 Hz / 16 A	COPS010.1703

Automatic coupling for load hooks or loop as well as hose support on request.

Dimensions





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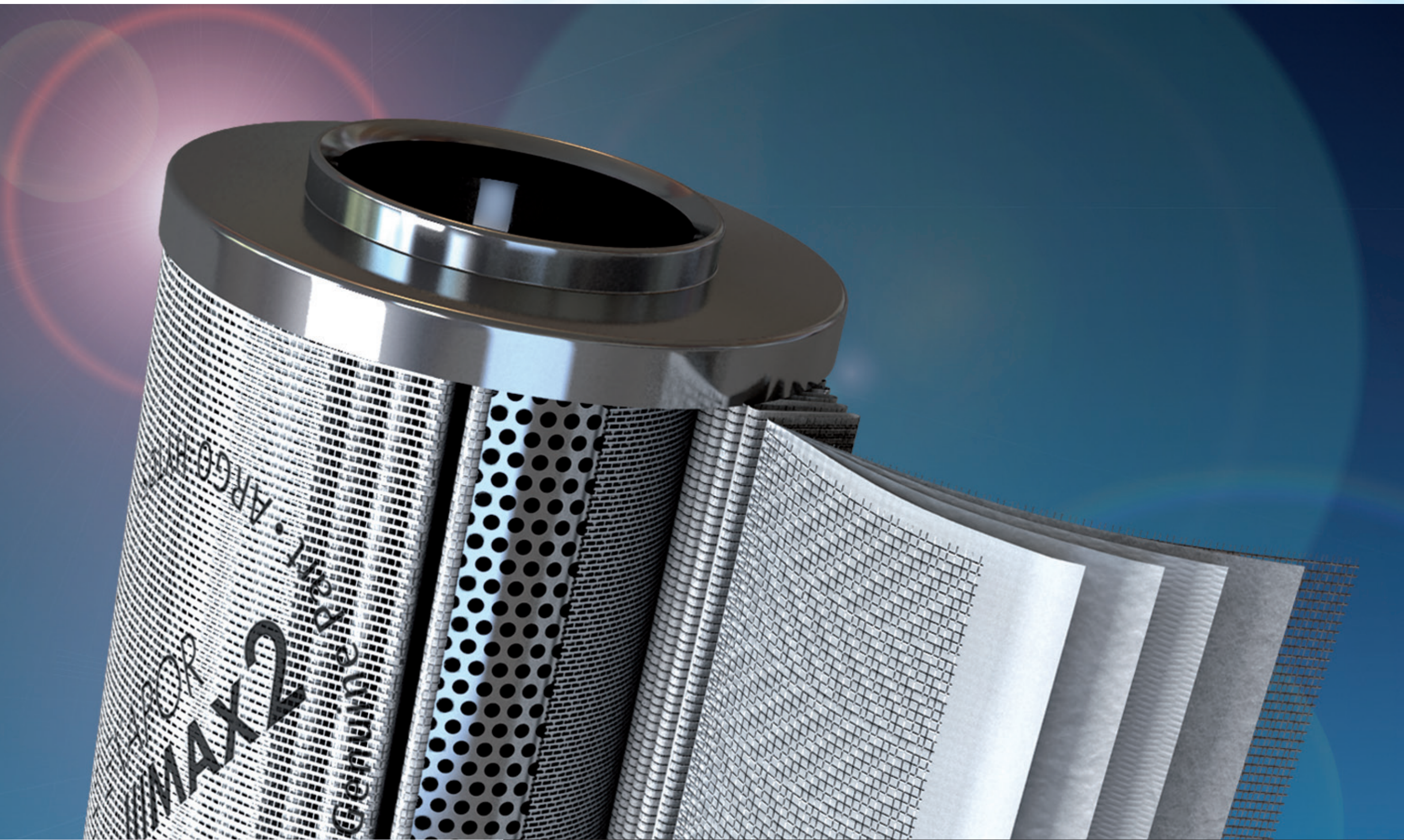
Content

ARGO HYTOS



Innovation in Filtration

EXAPOR® MAX 2

The new generation of filter elements

90.10-1e

ARGO-HYTOS sets the standard with the introduction of EXAPOR®MAX 2

Higher machine availability, longer service intervals and lower operating costs. These were the development goals for the new generation of filter elements.

With the introduction of **EXAPOR®MAX 2,** ARGO-HYTOS is opening a new chapter in filtration for hydraulic and lubrication systems.

The structure of the specially developed 3-layer filter material was designed for optimum performance, using glass and polyester fibers of different finenesses combined with an improved hybrid support fabric (patent pending) made of stainless steel and polyester. This sets the standard for:

- **Pressure loss**
- **Dirt holding capacity**
- **Flow fatigue stability**

The plastic sleeve used on the **EXAPOR®MAX 2** for the first time offers the following benefits:

- **Custom label**
- **Protection from damage**
- **Improvement of flow fatigue stability**

For the user, these improvements bring:

- **Extended service intervals**
- **Higher operational reliability**
- **Improved oil cleanliness**
- **Increased performance**
- **Positive element identification**
- **Reduced operating and maintenance costs**





Focus on user benefits

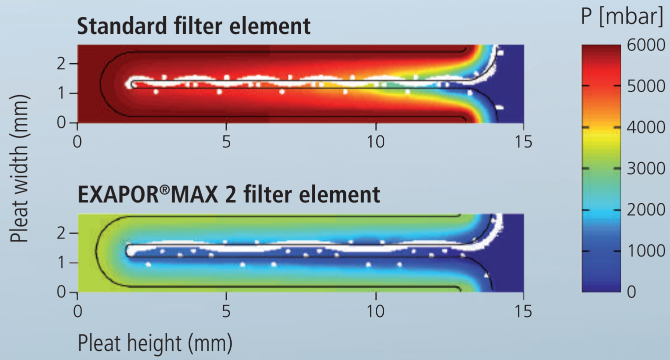
Extended service intervals
Higher dirt holding capacity and improved flow fatigue stability are of particular importance in achieving extended service intervals.

The new performance-oriented structure of the filter material makes a substantial contribution to improving dirt holding capacity, reducing pressure losses and improving the differential pressure stability. The improved hybrid support fabric (patent pending) dissipates electrostatic charge completely, gives the best possible flexural strength while reducing pressure losses. The plastic sleeve shrunk onto the filter bellows ensures that it tightly fits the edges of the hole, which has a positive effect on flow fatigue stability. These improvements make a substantial contribution to increasing the life of the filter elements.

Higher operational reliability
When used on existing machinery with fixed service intervals, **EXAPOR®MAX 2** filter elements bring greater operational reliability, minimizing the risk of sudden machine downtimes as well as reducing downtime caused by time-consuming and expensive maintenance work.

Improved oil cleanliness
A high degree of oil cleanliness has a positive effect on both the life of components and that of the hydraulic medium itself. To meet rising standards, in the new generation of filter elements the filter fineness has been improved to 10 µm(c) compared with 12 µm(c) previously. The **EXAPOR®MAX 2** filter elements are available in filter finenesses of 5 µm(c), 10 µm(c) and 16 µm(c).

Increased performance
The factors that influence pressure loss could be worked out with the aid of calculations and flow simulations, and the structure of the filter material optimized accordingly. The result is a reduction in pressure losses in the pleat of up to 50 % and up to 40 % in the filter element. Conversely, this means that at a constant pressure loss the **EXAPOR®MAX 2** filter elements can achieve a flow rate that is up to 65 % higher. The substantial reduction in pressure losses allied to an improved dirt holding capacity leads to an increase in power density, so that, depending on the application, smaller filters could be used.

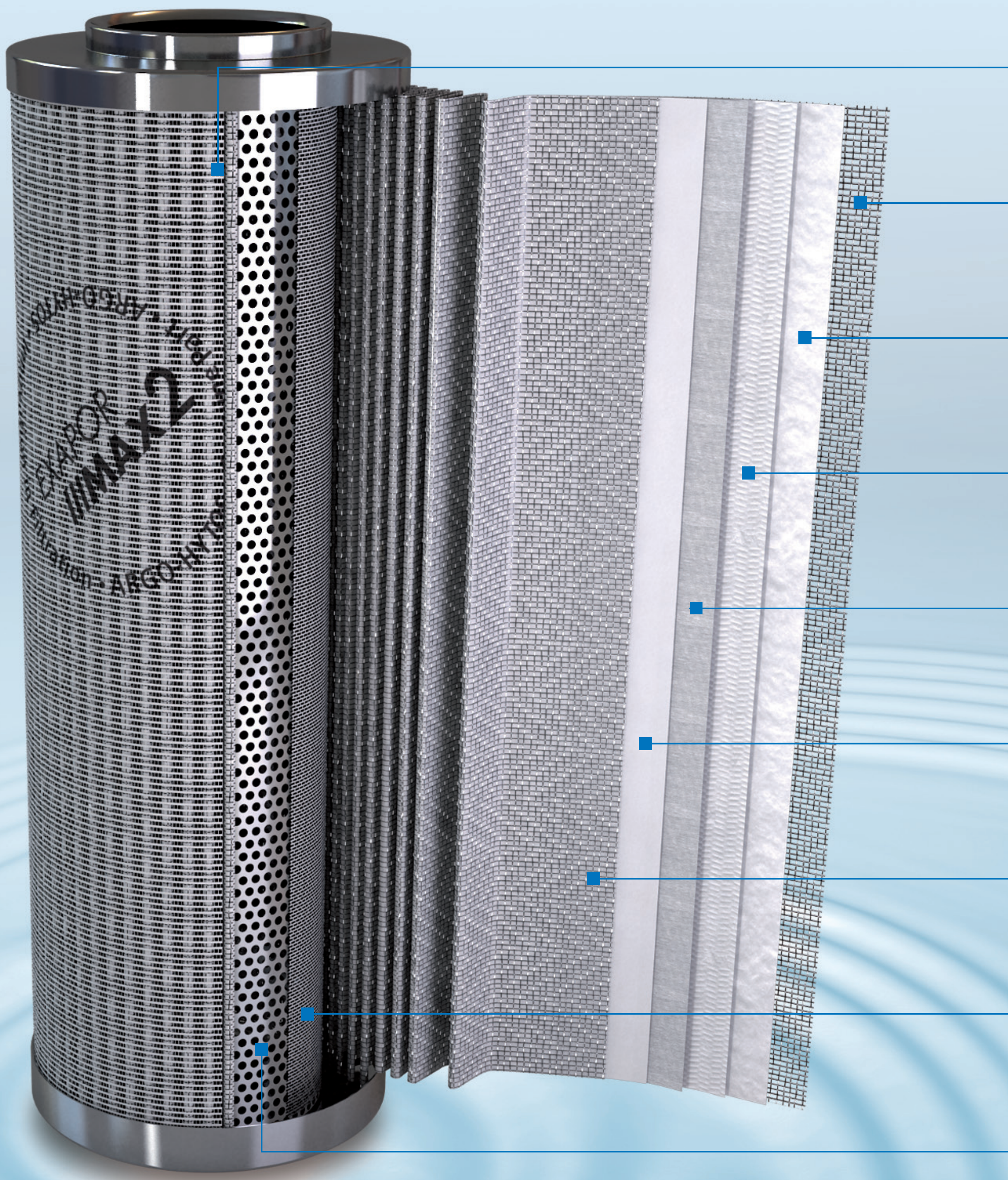


Positive identification of elements
The plastic sleeve used on the **EXAPOR®MAX 2** filter elements can be printed as required. This substantially improves positive identification and is an important feature for building up and securing a strategic spare part business.

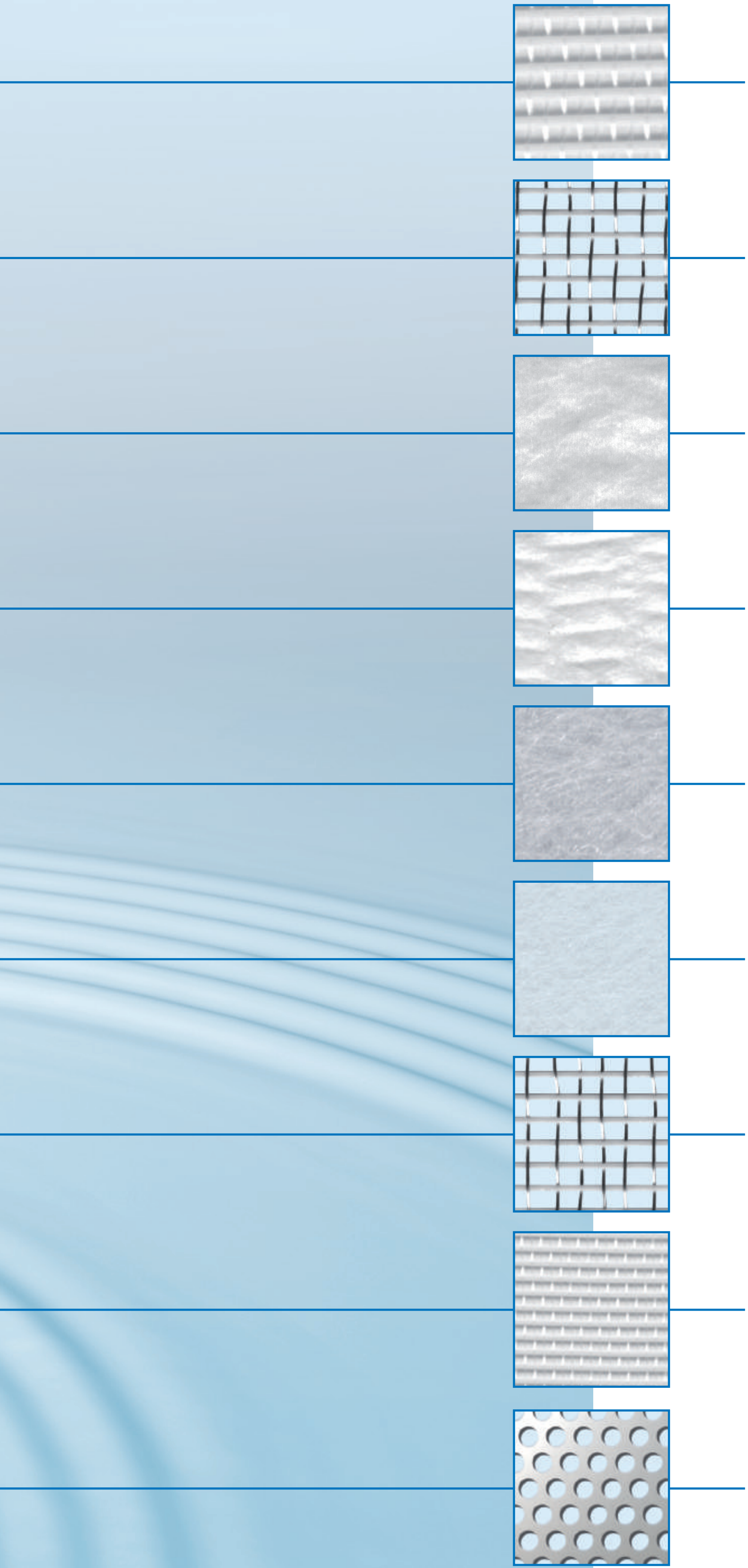
Choose the Original
Choose Success!
A campaign by VDMA
www.vdma.org/original

Reduced operating and maintenance costs
These innovations work together to reduce operating and maintenance costs and bring about an improvement in the productivity and economy of machinery and plant.

Schematic construction



Schematic construction



Plastic sleeve NEW
Custom label, damage protection,
improved flow fatigue stability

Hybrid support fabric (patent pending) NEW
Protection of filter materials from external mechanical damage, prevents electrostatic charge, keeps the pleats open for the free flow of hydraulic medium.

Pre-filter layer NEW
Separation of coarse particles, increase in the dirt holding capacity

Fine filter layer NEW
Separation of fine particles, improvement of oil cleanliness

Protective fleece NEW
Protection of the fine filter layer, improved differential pressure and flow fatigue stability

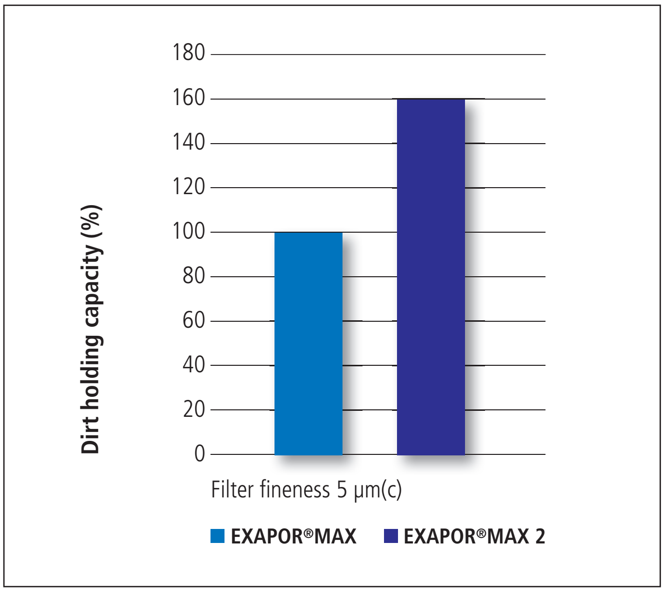
Safety fabric
Additional protection of the filter elements with a differential pressure stability of 160 bar

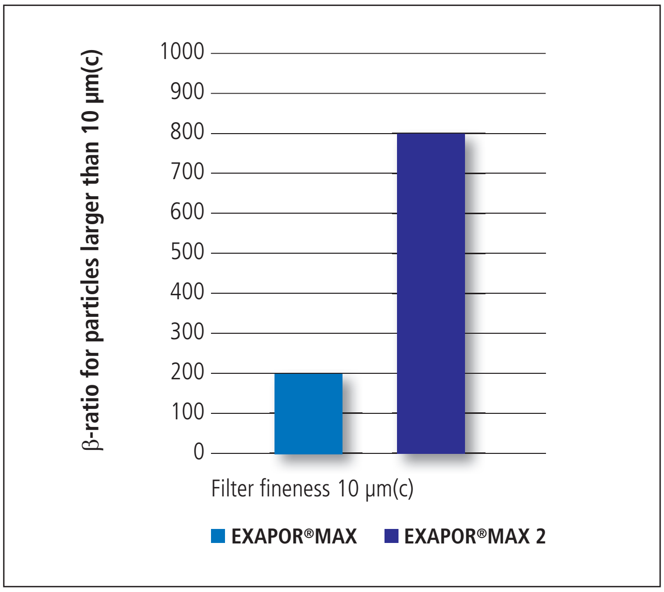
Hybrid support fabric (patent pending) NEW
Support of the filter materials, keeping the pleats open for free flow of medium. Prevents build-up of electrostatic charges, improved flow fatigue stability

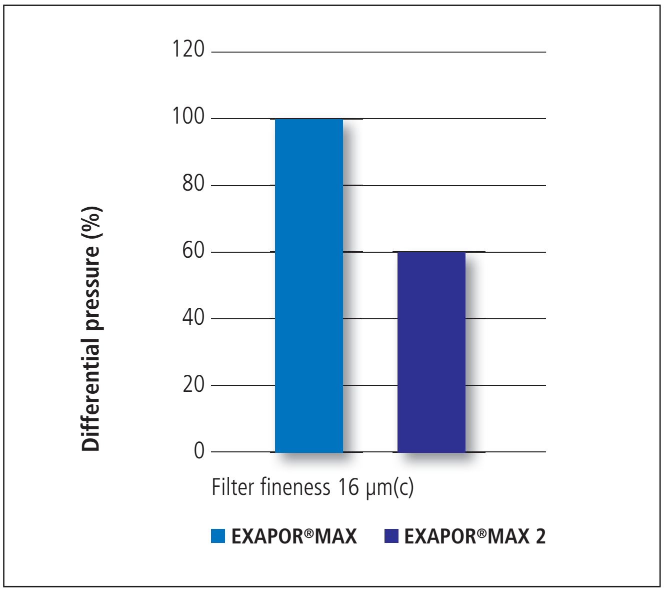
Woven sleeve
Fine wire mesh provides additional support for the pleated filter material with filter elements that have a differential pressure stability of 160 bar

Perforated core
Full surface support of the pleated filter material,
ensuring collapse pressure stability

Overview of the improvements in EXAPOR®MAX 2 filter elements







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Filter Elements

for protection against electrostatic discharges

ARGO HYTOS

EXAPOR®SPARK PROTECT

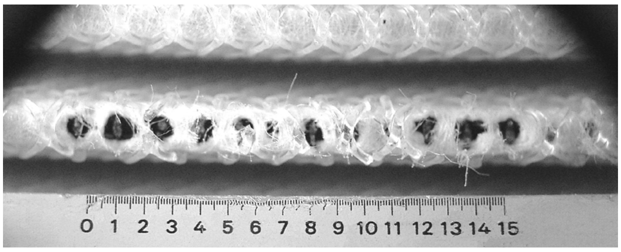
The new EXAPOR®SPARK PROTECT filter elements combine the well-known high performance characteristics with 100 % protection against electrostatic discharges.

When using modern hydraulic oils as e.g. biologically degradable oils, it should be taken into account that these oils are zinc and ash-free in most cases, so that they possess hardly any or just a low electrostatic conductivity, often a lot lower than 500 pS/m.

This can lead to a charge separation within the hydraulic system caused by friction, which allows an electrostatic charge in the filter element to increase to such dimensions that flashes of several thousand volts might appear.

Consequences of electrostatic discharges

- Sudden discharges which may destruct the filter material layers and also the electric components
- High temperatures, caused by flashes, lead to increased oil aging, thus to a deterioration of the oil characteristics and to reduced oil lifetime.
- Earlier contamination of filter elements due to oil aging products
- Higher wear and hydraulic components failures



Damages at the filter material caused by electrostatic discharges

Oil aging products at tube bundels of an oil cooler

The new element technology

The filter elements with the designation **EXAPOR®SPARK PROTECT** have especially been developped for non-conductive or low-conductive hydraulic fluids and provide a controlled charge balance in the filter material, so that the oil within the filter element is not exposed to an additional electrostatic charge.

Regarding the construction no further measures are needed, merely the exchange of the standard filter element by the **EXAPOR®SPARK PROTECT** element.

ARGO HYTOS SPARK PROTECT

Availability and performance

The new technology is available for all filter elements of ARGO-HYTOS and does not have an influence on the performance data of the filter elements that are characterized by:

- **High dirt holding capacity**
- **Excellent filter fineness**
- **Low pressure loss**
- **High flow fatigue restistance**
- **Very good media resistance**

Additional aspects:

- **100 % protection against electrostatic discharges in the filter and prevention of all related disadvantages.**

Customer benefits:

- No destruction of the filter material layers by electrostatic discharges
- No premature oil aging due to electrostatic discharges
- Protection of electronic components against destruction or failures
- Optimal lifetime of filter elements and hydraulic fluids
- No rebuilding or additional measures at already installed filters
- Higher operational safety

ARGO-HYTOS recommends:

In case the electrostatic conductivity of the used hydraulic fluid should be

- higher than 500 pS/m, e.g. the proven **EXAPOR®MAX 2** filter elements
- lower than 500 pS/m, the new **EXAPOR®SPARK PROTECT** filter elements

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Water Absorbing Filter Elements

EXAPOR®AQUA

Quick and efficient dewatering of hydraulic and lubrication oils

Water in hydraulic and lubrication oils may have the following causes:

- Radiator leakage
- Environment humidity
- Spray-water
- Fresh oil

Already small quantities of free water in oil can lead to acidification. Corrosion of surfaces at components can be the result. Due to free water the oil characteristics changes, e.g. decreased load-carrying capacity, reduced temperature resistance. In order to avoid economic damage, the oil must be protected against free water or existing water must be withdrawn as fast as possible.

Large water quantities can be withdrawn by oil change, flushing of the system or with dewatering units.
On systems with hygroscopic (materials that absorb water are described as hygroscopic) oils or with permanent water entry through seals (e.g. hydraulic excavator used in water constructions) ARGO-HYTOS off-line filters and filter units with EXAPOR®AQUA filter elements can be installed permanent in the system, in order to withdraw water. To withdraw remaining water quantities, e.g. after new filling, the ARGO-HYTOS EXAPOR®AQUA elements in portable off-line filter units also can be used during operation of the system.

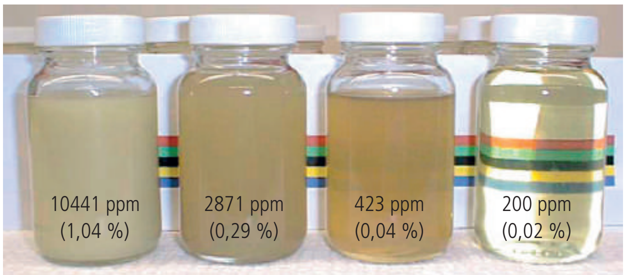
Filling unit
FA 016

Oil service unit
FNA 008/016

EXAPOR®AQUA filter elements are applicable in different ARGO-HYTOS filter units. Depending on the operating situation the water absorption amounts to approx. 350 ml/element. The combination of water-absorbing filter layers with micro-filter material in the EXAPOR®AQUA also permits the use in hydraulic and lubrication systems with high requirements to the oil cleanliness.

Simply the cooled down oil sample can be judged optically. As long as a turbidity is visible in the cooled down oil, the water content will be unacceptably high. If the cooled down oil sample appears clear, the water content usually lies in the permissible range. An exact measurement of the water content is made by an oil sample analysis in the laboratory (e.g. water content regulation after the Karl Fischer method in accordance with DIN 51777).

EXAPOR® AQUA filter elements



Oil samples with varying water content

EXAPOR®AQUA Filter element	Water capacity per element at $\nu = 30\ mm^2/s$	Filter fineness	Dirt-holding capacity (values in g test dust ISO MTD according to ISO 16889)	Applicable in ARGO-HYTOS filter units
Y7.1220-05	350 ml	8E-A $\tilde{\beta}_{8(c)} \geq 200$	64 g	FA 016, FNA 008, FNA 016, FAPC 016 (with filter element size V7.1220)

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ARGO HYTOS

Content

Continuous
Oil Condition Monitoring

LubCos H_2O Humidity Sensor

Application area

Water is not desired in hydraulic fluids and lubricants. High concentration of water can cause severe disturbance in operation and damage.

Performance features

The LubCos H_2O measures the relative humidity of the oil and therefore displays the saturation degree in the water directly:

- 0 %: Absolutely dry oil.
- 100 %: The oil is completely saturated with water. Additional water will not be dissolved anymore and will present itself as free water.

In contrast to the humidity analysis from laboratories, where the absolute water content is defined in ppm (parts per million), the saturation limit of the oil can be determined by relative humidity measurement. The advantage of the relative humidity over the absolute water content is, that it is not necessary to know the oil or its saturation limit in order to determine if there is free or dissolved water.

Example:

- Mineral oils (e.g. HLP) have a comparatively low water absorption capacity. 500 ppm may signify that the oil is over-saturated and that free water exists.
- Ester oils (e.g. HEES) have a relatively high water capacity. 500 ppm may show that the oil is just saturated by 15 %.

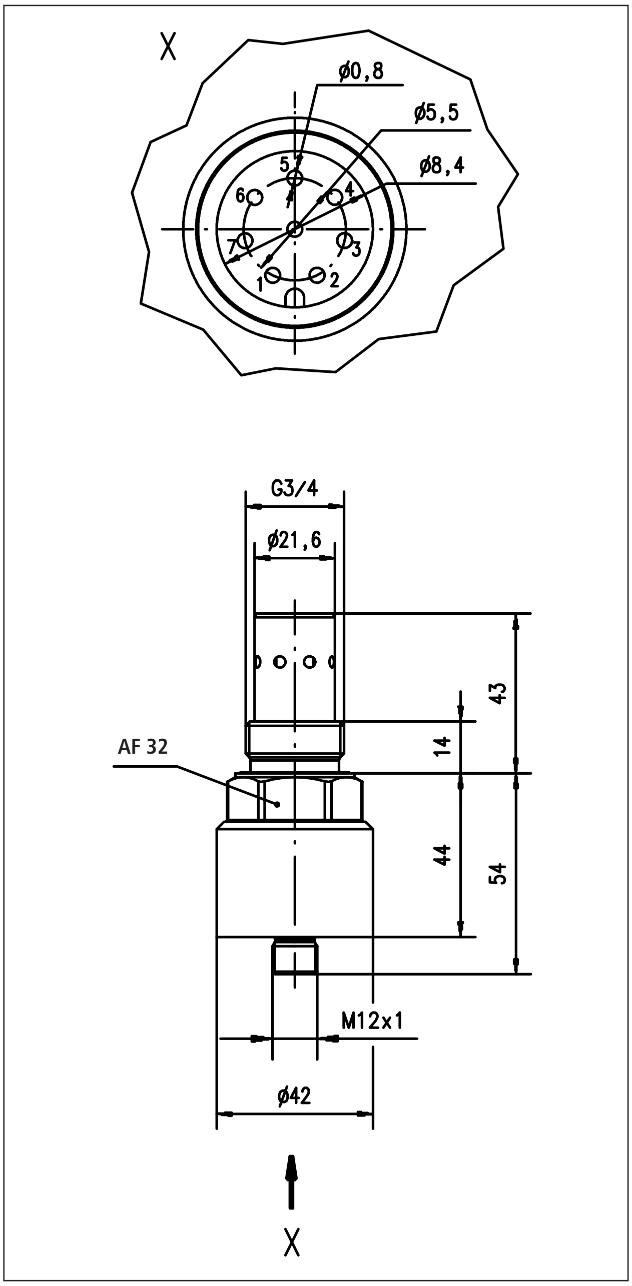
Please also note the characteristics of the relative humidity with different temperatures: Warm oil can dissolve more water than cold oil. Therefore the relative humidity of the oil increases in case of no further water supply. Hot, relatively dry oil, may suddenly keep free water if the ambient temperature cools down.

The LubCos H_2O points out the current saturation of the oil with water, independent from oil type and temperature and additionally assures operation of systems by directly warning.

Design characteristics

The sensor is provided with a G¾ thread and can be integrated in the tank or via adapter in lines.
The communication with the sensor either takes place over a serial interface or over two analog outputs (4 ... 20 mA).

LubCos H_2O



Technical data

Measuring principle

The sensor records the relative oil humidity and oil temperature. Through an oil specific calibration it is possible to calculate the absolute humidity up to the saturation limit.

The measuring values are given by RS232 and the analog outputs.

Software

A free software for data recording and evaluation of the measured values can be downloaded from our website at www.argo-hytos.com within the download area.

Order code

LubCos H_2O	SCSO 300-1000

Accessories

Screw-in block for mounting in a return line, connection G¾	SCSO 100-5070
Complete data cable set, 5 m length	SCSO 100-5030
Data cable with open ends, 5 m length	SCSO 100-5020
Contact box for connection of a data cable	SCSO 100-5010
USB adapter - RS232 serial	PPCO 100-5420
Power supply	SCSO 100-5080
Ethernet - RS232 gateway	SCSO 100-5100
Display and storage device LubMon Visu	SCSO 900-1000

Sensor data	Size	Unit
Max. operating pressure	10	bar
Operating temperature fluid[1]	-20 ... +100[2]	°C
Ambient conditions, operating: Temperature Humidity	 -20 ... +80 0 ... 95	 °C % r.H.
Ambient conditions, storing: Temperature Humidity	 -20 ... +80 0 ... 95	 °C % r.H.
Pressure fluids	HLP, HLPD, HVLP (acc. to DIN 51524), HETG, HEES, HEPR (acc. to DIN ISO 15380)	
Wetted materials	Aluminium, HNBR, epoxy resin	
Power supply[3]	9 ... 33	V
Power input	max. 60	mA
Output Power output (2x)[4] Interface	 4 ... 20 RS232	 mA
Connection Threaded connection Electr. connection 8-pole connector	 G¾ M12 x 1	
Measuring range rel. humidity Temperature	 0 ... 100 -20 ... +120	 % °C
Measuring resolution rel. humidity Temperature	 1 0,1	 % r.H. K
Measuring accuracy[6] rel. humidity[7] Temperature	 ± 3 ± 2	 % FS[5] % FS[5]

[1] Permanently
[2] Short-term +120 °C
[3] Automatic switch-off at U < 8 V and U > 36 V, with load-dump impulses over 50V an external protection must be provided
[4] Outputs IOut1 und IOut2 are freely configurable (see handbook)
[5] Fullscale
[6] Works calibration
[7] Calibrated to air at +25°C

Continuous
Oil Condition Monitoring

LubCos H_2O*plus* II Lubrication Condition Sensor

Application area

Stationary screw-in sensor for the continuous determination of the **oil condition**, **humidity** and **temperature** in hydraulic and lubricating oils.

Performance features

Measurement and documentation of changes in hydraulic fluids and lubricants. Data is continuously documented evaluated and stored. In that way deterioration and changes in the oil (e.g. water inleakage, oil change, ...) can be indicated. Through this, damage can be recognized or completely avoided at an early stage. This offers the opportunity to prevent machine failures as well as to prolong maintenance and oil change intervals by means of appropriate measures. Furthermore, by monitoring the lubricant, correctly performed maintenance work and the use of the required lubricant quality may be documented.

Design characteristics

The sensor is provided with a G¾ thread and can be e.g. integrated in a return line or the tank.
The communication with the sensor either takes place over a serial RS232 interface, over two analog outputs (4 ... 20 mA) or CANopen.
In order to also enable a long-term record of data up to half a year, the sensor has a data storage unit which can be read out over the serial interface and over CAN.

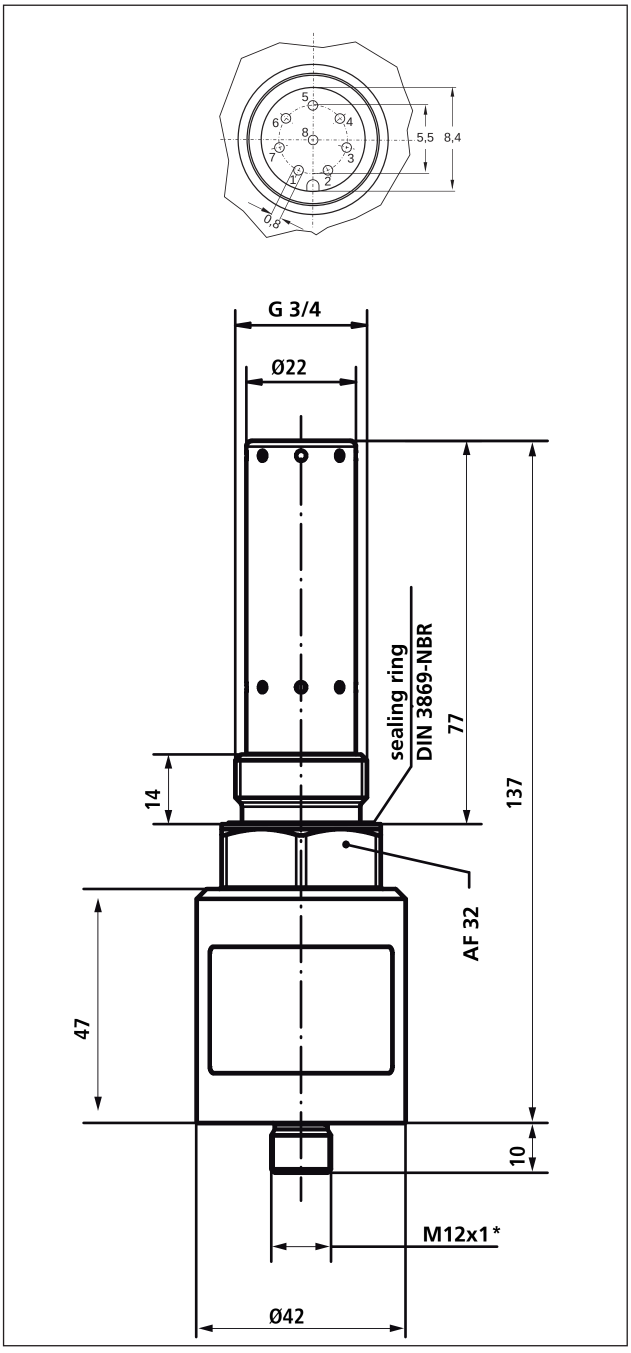
Measuring principle

The sensor records the following physical oil characteristics as well as its periodic change: Temperature, relative oil humidity and water activity, relative dielectric number and conductivity of the fluid respectively.
As especially the conductivity and the relative dielectric number show a strong connection to the temperature, next to the characteristic values at current temperature the sensor also sends the data at reference temperature (40 °C).
The sensor is able to evaluate condition changes automatically. Alerts, Warnings and errors are sent to the CAN interface or per RS232 as error codes.

Software

A free software for data recording and evaluation of the measured values can be downloaded from our website at www.argo-hytos.com within the download area.

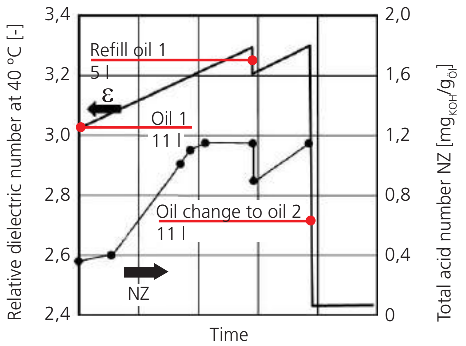
LubCos H_2O*plus* II

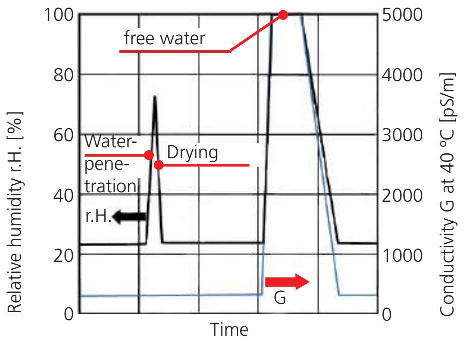


Technical data / Application example

Application example

By using the sensor different changes of the oil condition can be detected. The following example shows a typical course of relative dielectric number, conductivity and relative humidity during various changes of the condition in the system. By means of the characteristics, different oil types may be differed, oil refreshing and oil change can be detected and the relative humidity, free water as well as the deterioration and deterioration rate can be defined respectively.





Order code

LubCos H_2O*plus* II	SCSO 100-1010

Accessories

Screw-in block for mounting in a return line, connection G¾	SCSO 100-5070
Complete data cable set, 5 m length	SCSO 100-5030
Data cable with open ends, 5 m length	SCSO 100-5020
Contact box for connection of a data cable	SCSO 100-5010
USB adapter - RS232 serial	PPCO 100-5420
Power supply	SCSO 100-5080
Ethernet - RS232 gateway	SCSO 100-5100
Display and storage device LubMon Visu	SCSO 900-1000

Sensor data	Size	Unit
Max. operating pressure	10	bar
Operating temperature fluid[1]	-20 ... +100[2]	°C
Ambient conditions, operation: Temperature Humidity	 -20 ... +80 0 ... 95	 °C % r.H.
Ambient conditions, storing: Temperature Humidity	 -20 ... +80 0 ... 95	 °C % r.H.
Pressure fluids	HLP, HLPD, HVLP (acc. to DIN 51524) HETG, HEES, HEPR (acc. to DIN ISO 15380)	
Wetted materials	Aluminium, HNBR, epoxy resin	
Power supply[3]	9 ... 33	V
Power input	max. 0,2	A
Output Power output (2x)[4] Interface	 4 ... 20 RS232/ CANopen	 mA
Connection Threaded connection Electr. connection 8-pole connector	 G ¾ M12 x 1	
Measuring range rel. dielectric number rel. humidity Conductivity Temperature	 1 ... 7 0 ... 100 100 ... 800000 -20 ... +120	 - % pS/m °C
Measuring resolution rel. dielectirc number rel. humidity Conductivity Temperature	 $1*10^{-4}$ 0,1 1 0,1	 - % r.H. pS/m K
Measuring accuracy[7] rel. dielectric number[5] rel. humidity[8] Conductivity Temperature	 ± 0,015 ± 3 Typ. <10 / ±200 ± 2	 - % FS[6] % FS[6] / pSm % FS[6]

[1] Permanently
[2] Short-term +120° C
[3] Automatic switch-off at U < 8 V and U > 36 V, with load-dump impulses over 50V an external protection must be provided
[4] Outputs IOut1 und IOut2 are freely configurable (see handbook)
[5] Calibrated to n-Pentan at +25 °C
[6] Fullscale
[7] Works calibration
[8] Calibrated to air at +25 °C

Continuous
Oil Condition Monitoring

ARGO HYTOS

LubCos Vis*plus* Lubrication Condition Sensor

Application area

A service sensor for determination of the **viscosity,** relative **dielectric number** and **temperature** in hydraulic and lubricating oils. The sensor is a screw-in sensor and immersion sensor respectively and is designed for continuous monitoring of the oil condition in service applications.

Performance features

Measurement and documentation of changes in hydraulic fluids and lubricants. The measured values are continuously documented, evaluated and stored. In that way deterioration and changes in the oil (e.g. viscosity and polarity) can be indicated. Through this, damage can be recognized or completely avoided at an early stage. This provides the opportunity to avoid machine malfunction by appropriate actions and to extend maintenance and oil change intervals. By monitoring of the lubricant, it is also possible to record service measures and the use of the prescribed lubricant quality.

Design characteristics

The sensor is provided with a G¾ thread and can be integrated in the tank. Optionally the sensor can be used as immersion sensor for analyzing of oil samples.
The communication with the sensor takes place optionally over a serial RS232 interface, CANopen or over two analogue outputs (4 ... 20 mA).
In order to enable a long-term recording of data, the sensor is provided with an internal storage unit which can be read out over the serial interface or over CAN.

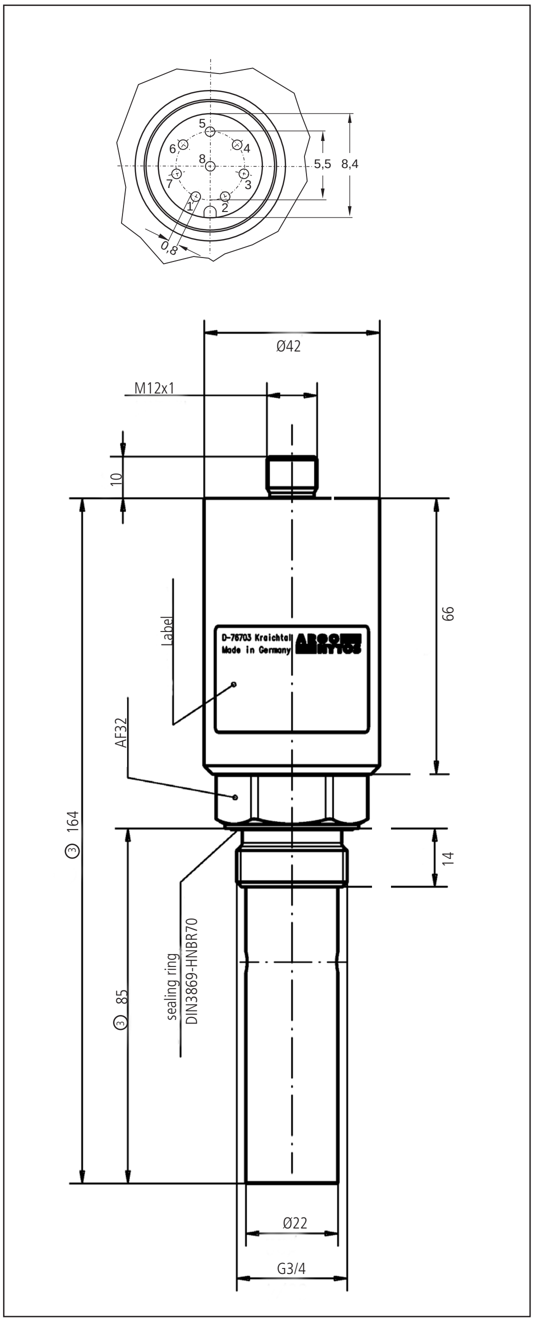
Measuring principle

The sensor records the following physical oil characteristics as well as periodic changes: Temperature, SAW-dynamic viscosity, and the relative dielectric number of the fluid. As the viscosity and the relative dielectric number show a strong connection to the temperature, the sensor, after a learning phase, also sends the data at reference temperature (40 °C), next to the characteristics values at current temperature.
The sensor is able to evaluate constitutional changes as well as its own functional condition automatically. Alarm messages, warnings and errors are displayed as error codes.

Software

A free software for data recording and evaluation of the measured values can be downloaded from our website at www.argo-hytos.com within the download area.

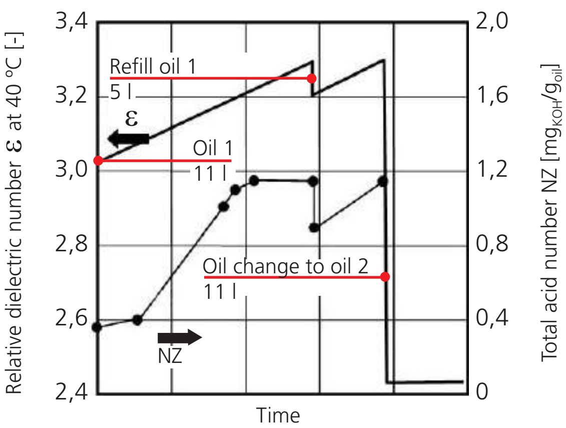
LubCos Vis*plus*



Technical data / Application example

Application example

For operation, the sensor can be integrated in the system for the time of measuring and there e.g. be operated as a data logger. Alternatively the sensor may be used as an immersion sensor. For this an oil sample will be taken into a sample glass and the sensor will be immersed into the glass for the time of measuring. For correct measurement, the sensor element must be completely immersed into the oil. With both methods the sensor element has to be cleaned from dirt and sediments from time to time with the help of cleaning-alcohol to guarantee reliable measurement.



Order code

LubCos Vis*plus*	SCSO 200-1000

Accessories

Screw-in block for mounting in a return line, connection G¾	SCSO 100-5070
Display and storage device LubMon Visu	SCSO 900-1000
Complete data cable set, 5 m length	SCSO 100-5030
Data cable with open ends	SCSO 100-5020
Contact box for connection of a data cable	SCSO 100-5010
USB adapter - RS232 serial	PPCO 100-5420
Power supply	SCSO 100-5080
Ethernet - RS232 gateway	SCSO 100-5100

Sensor data	Size	Unit
Max. operation pressure	10	bar
Operating temperature fluid[1]	-20 ... +100[2]	°C
Ambient conditions, operation: Temperature Humidty	 -20 ... +80 0 ... 95	 °C % r.H.
Ambient conditions, storing: Temperature Humidity	 -20 ... +80 0 ... 95	 °C % r.H.
Pressure fluids	HLP, HLPD, HVLP (acc. to DIN 51524) HETG, HEES, HEPR (acc. to DIN ISO 15380)	
Wetted materials	Aluminium, HNBR, polyurethane resin, epoxy resin, aluminium oxide, silicon carbid	
Power supply[3]	9 ... 33	V
Power input	max. 0,2	A
Output Power output (2x)[4] Interface	 4 ... 20 RS232/ CANopen	 mA
Connection Threaded connection Electr. connection 8-pole connector	 G¾ M12 x 1	
Measuring range SAW-shear viscosity [5] rel. dielectric number Temperature	 8 ... 400 1 ... 7 -20 ... +120	 mm^2/s - °C
Measuring resolution SAW-shear viscosity rel. dielectric number Temperature	 0,1 $1*10^{-4}$ 0,1	 mm^2/s - K
Measuring accuracy[6] SAW-shear viscosity[7] rel. dielectric number Temperature	 ± 5 ± 0,02 ± 0,5	 **%** **-** K

[1] Permanently
[2] Short-term +120 °C
[3] Automatic switch-off at U < 8 V and U > 36 V, with load-dump impulses over 50V an external protection must be provided
[4] Outputs IOut1 und IOut2 are freely configurable (see handbook)
[5] Calibrated to Panolin HLP Synth 100 in a temperature range between +15°C and +95°C, Reference device: Ubbelohde viscometer
[6] Works calibration
[7] Depending on the oil type

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Continuous
Oil Condition Monitoring

LubCos Level Lubrication Condition Sensor

Application area

Stationary screw-in sensor for the continuous determination of the **oil condition, humidity** and **temperature** in hydraulic and lubricating oils as well as measuring the **fluid level.**

Performance features

Measurement and documentation of changes in hydraulic fluids and lubricants. Data is continuously documented, evaluated and stored. In that way deterioration and changes in the oil (e.g. water inleakage, oil change, ...) can be indicated. Through this, damage can be recognized or completely avoided at an early stage. This offers the opportunity to prevent machine failures as well as to prolong maintenance and oil change intervals by means of appropriate measures. Furthermore, by monitoring the lubricant, correctly performed maintenance work and the use of the required lubricant quality may be documented.

Design characteristics

The sensor is provided with a G¾ thread and can be integrated in the tank. The sensor that measures the oil parameters is on the end of the lance. This ensures that the sensor element is always fully immersed and the oil parameters and their changes may be correctly defined. Above the sensor element there is a special level transducer by which the filling level can be determined. Thus this sensor may not only be used to monitor the oil condition, it additionally updates the user on the actual filling level and oil temperature. Separate sensors for measuring these parameters are dispensable. Measurement of the parameters in order to determine the oil condition allows precise determination of the filling level without separate calibration independent of the oil type.
The communication with the sensor either takes place over a serial RS232 interface, over two analog outputs (4 ... 20 mA) as well as CANopen.
In order to also enable a long-term record of data up to half a year, the sensor has a data storage unit which can be read out over the serial interface or over CAN.

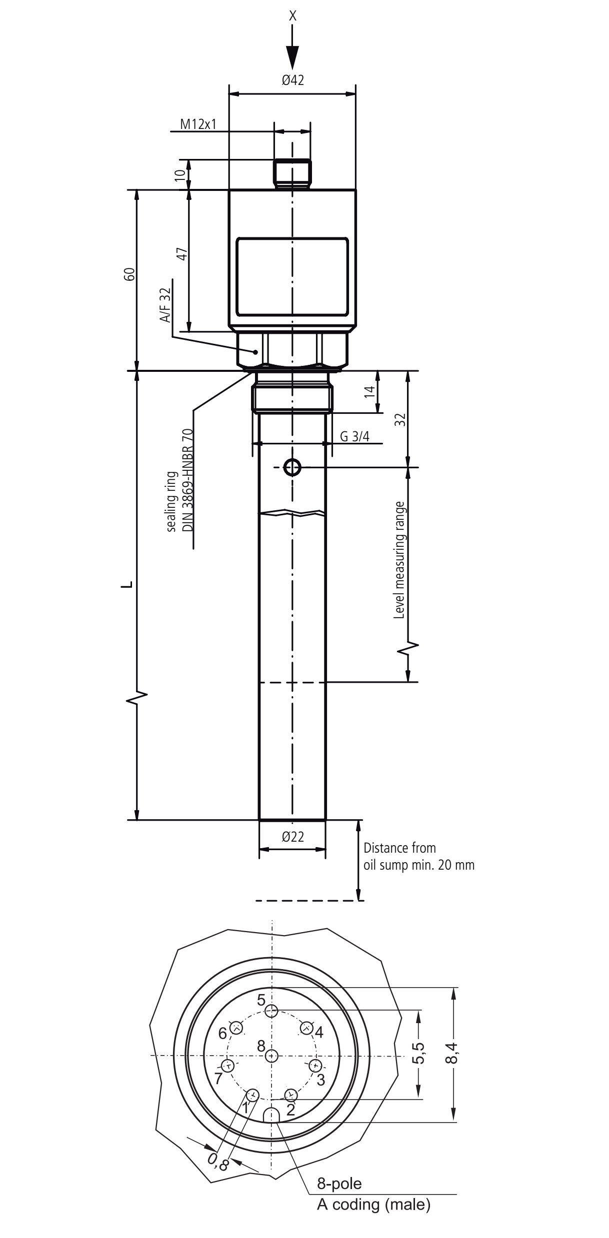
Measuring principle

The sensor records the following different physical oil characteristics as well as its periodic change: Temperature, relative oil humidity and water activity, relative dielectric number, conductivity of the fluid and fluid level respectively.
As especially the conductivity and the relative dielectric number show a strong connection to the temperature, next to the characteristic values at current temperature the sensor also sends the data at reference temperature (40 °C).
The sensor is able to evaluate condition changes automatically. Alerts, Warnings and errors are sent to the CAN interface or per RS232 as error codes.

Software

A free software for data recording and evaluation of the measured values can be downloaded from our website at www. argo-hytos.com within the download area.

LubCos Level

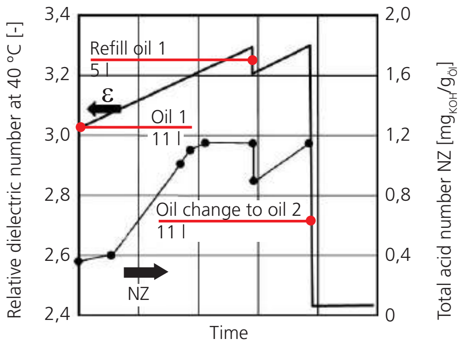


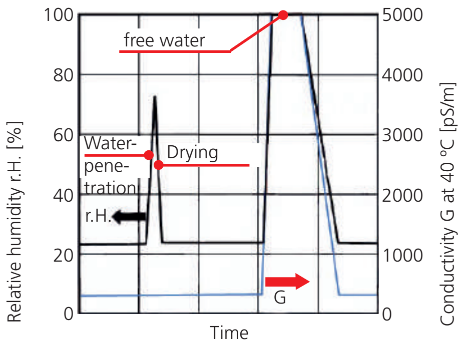
LubCos Level 200: L = 200 mm, level measuring range = 115 mm
LubCos Level 375: L = 375 mm, level measuring range = 288 mm
LubCos Level 615: L = 615 mm, level measuring range = 515 mm

Technical data / Application example

Application example

By using the sensor different changes of the oil condition can be detected. The following example shows a typical course of relative dielectric number, conductivity and relative humidity during various changes of the condition in the system. By means of the characteristics, different oil types may be differed, oil refreshing and oil change can be detected and the relative humidity, free water as well as the deterioration and deterioration rate can be defined respectively.





Order code

LubCos Level 200, lenght 200 mm	SCSO 150-1200
LubCos Level 375, lenght 375 mm	SCSO 150-1375
LubCos Level 615, lenght 615 mm	SCSO 150-1615

Accessories

Complete data cable set, 5 m length	SCSO 100-5030
Data cable with open ends, 5 m length	SCSO 100-5020
Contact box for connection of a data cable	SCSO 100-5010
USB adapter - RS232 serial	PPCO 100-5420
Power supply	SCSO 100-5080
Ethernet - RS232 gateway	SCSO 100-5100
Display and storage device LubMon Visu	SCSO 900-1000

Sensor data	Size	Unit
Max. operating pressure	10	bar
Operating temperature fluid[1)]	-20 ... +100[2)]	°C
Ambient conditions operation: Temperature Humidity	 -20 ... +80 0 ... 95	 °C % r.H.
Ambient conditions storing: Temperature Humidity	 -20 ... +80 0 ... 95	 °C % r.H.
Pressure fluids	HLP, HLPD, HVLP (acc. to DIN 51524) HETG, HEES, HEPR (acc. to DIN ISO 15380)	
Wetted materials	Aluminium, HNBR, epoxy resin	
Power supply[3)]	9 ... 33	V
Power input	max. 0,2	A
Output Power output (2x) [4)] Interface	 4 ... 20 RS232, CANopen	 mA
Connection Threaded connection Electr. connection 8-pole connector	 G¾ M12 x 1	
Measuring range rel. dielectric number rel. humidity Conductivity Temperature Fluid level	 1 ... 7 0 ... 100 100 ... 800000 -20 ... +120 115/288/515	 - % pS/m °C mm
Measuring resolution rel. dielectric number rel. humidity Conductivity Temperature Fluid level	 $1*10^{-4}$ 0,1 1 0,1 0,1	 - % r.H. pS/m K %
Measuring accuracy[7)] rel. dielectric number[5)] rel. humidity[8)] Conductivity Temperature Fluid level	 ± 0,015 ± 3 Typ < 10 / ±200 ± 2 ± 5	 - % FS[6)] % FS[6)] / pS/m % FS[6)] % FS[6)]

[1)] Permanently
[2)] Short-term +120 °C
[3)] Automatic switch-off at U < 8 V and U > 36 V, with load-dump impulses over 50V an external protection must be provided
[4)] Outputs IOut1 und IOut2 are freely configurable (see handbook)
[5)] Calibrated to n-Pentan at +25 °C
[6)] Fullscale
[7)] Works calibration
[8)] Calibrated to air at +25°C

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ValvE – Electronic for Valves

SiCon Signal Generator for Valve Control

Application area

SiCon is a standalone signal generator, designed for controlling valves with programmable parameters. By the use of standard connectors, the device is suitable for all valves, regardless of the manufacturer.

Performance features

SiCon can operate a valve of up to two magnetic coils. The control of the coil can be operated via a PWM signal by either setting the duty cycle ratio or the coil current value. The present coil current is thereby given out on a measuring channel as an analog voltage value.

Furthermore, two analog outputs (±10V and ±20mA) are available for controlling valves with integrated electronics.

SiCon offers several configurable functions such as sine, ramp, triangle or sweep. Moreover, even set-points can be preset, from either an external device via two analog inputs (±10V and ±20mA), or with the integrated potentiometer.

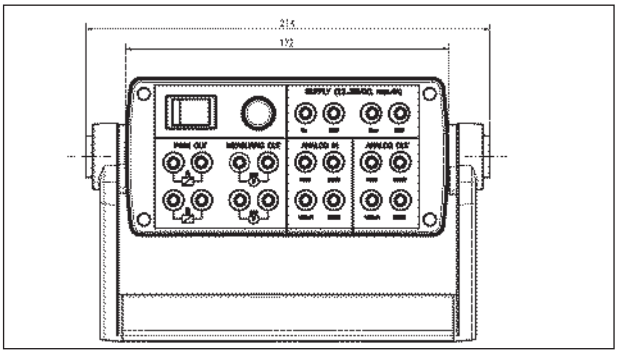
The graphical display in combination with the keypad on the front panel enables an easy operation of the unit. In addition to the graphical display, the current conditions are shown via four status LEDs.

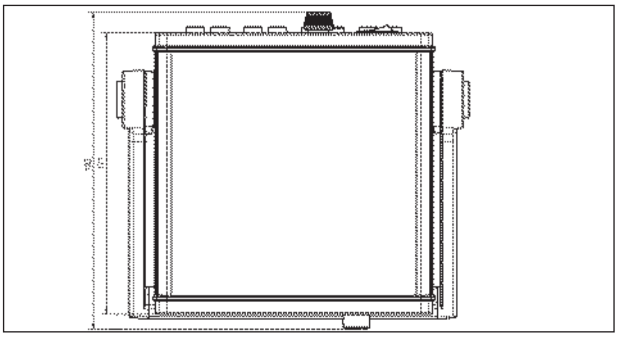
Design characteristics

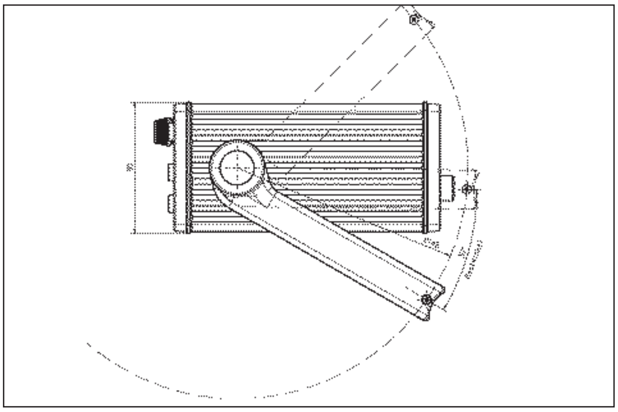
SiCon is designed for desktop use. The angle of the device can be modified by a fixable handle in steps of 30°. For all inputs and outputs banana jack plugs at the back of the device are used.

Order Code

SiCon	VE 100-1000







Technical Data

Device data	Value	Unit
Power supply		
Voltage	9 ... 28	VDC
Current consumption	Max. 4	A
Ambient conditions		
Temperature, storing	0 ... +60	°C
Temperature, operation	+5 ... +50	°C
Humidity, storing	0 ... 95	%
Humidity, operation (non-condensing)	0 ... 95	%
Connections		
Banana jacks	20	
Operation		
Membrane keyboard	6	keys
Display		
Graphical display	128 x 32	pixel
Brightness	adjustable	
Analog inputs		
Voltage (1x)	±10	V
Current (1x)	±20	mA
Resolution	12	Bit
Analog outputs		
Voltage (1x)	±10	V
Current (1x)	±20	mA
Resolution	12	Bit
PWM outputs (2x)		
Resolution	12	Bit
Measuring output	1	V / A
Frequency range		
PWM	20 ... 9.999	Hz
Dither	0 ... 500	Hz
Signal (sine, triangle,...)	0 ... 500	Hz

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Continuous
Oil Condition Monitoring

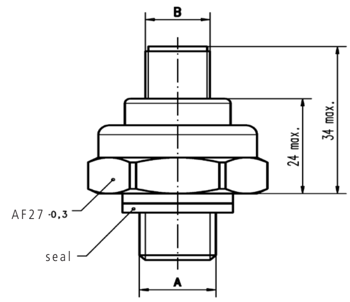
PSC Pressure Sensor

Application area

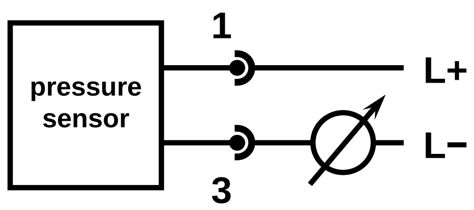
The new pressure sensors of series PSC of ARGO-HYTOS have been developed for mobile and industrial applications. The used thin film technology provides a hermetically sealed design which does not need an inner seal. Together with the stainless steel housing, the sensor is extremely sturdy and suitable for measurements in all fluids or gases. The sensor is resistant to pressure peaks, high temperatures as well as excessive vibrations and can therefore also be used under extreme conditons.

A wide range of pressure and plug variants allows use in various applications. Thanks to the low weight and the compact design the sensor is especially suited for OEMs, requiring direct integration into the machine e.g. in pressure measurement at control blocks.

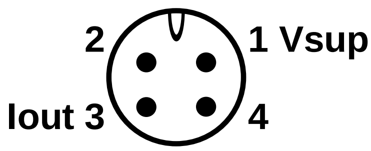
PSC



Connection example for M12 plug with current output 4-20mA



Plan view of M12 plug



Order code	Pressure range	Output	Seal	Connection „A“ Material 1.4301	Electrical connection „B“
PSC 400-1843	0 - 400 bar	4-20 mA	Aluminium washer	G$^1/_4$ A DIN 3852-A	M12 - 4pole
PSC 250-1843	0 - 250 bar	4-20 mA	Aluminium washer	G$^1/_4$ A DIN 3852-A	M12 - 4pole
PSC 100-1843	0 - 100 bar	4-20 mA	Aluminium washer	G$^1/_4$ A DIN 3852-A	M12 - 4pole
PSC 010-1713	0 - 10 bar	4-20 mA	FKM (Viton) O-ring	G$^1/_4$ A DIN 3852-E	M12 - 4pole

Technical data

Pressure range (relative pressure)		PSC 010-1713	PSC 100-1843	PSC 250-1843	PSC 400-1843	
Measuring range	**bar**	**10**	**100**	**250**	**400**	
Overload pressure	bar	20	200	375	600	
Burst pressure	bar	30	300	500	800	
Service life		**10 mio. pressure cycles**				
Output signal - options		4 … 20 mA				
Auxiliary power UB	VDC	8-30				
Current consumption	mA	signal current (max. 20) for current output				
Insulation voltage	VDC	500				
Total error in the nominal temperature range	%	≤ 1,0 % of margin				
Response time	ms	≤ 2 ms, max. to 63 % of full scale pressure with step change on input				
Accuracy	%	≤ 0,5 % of margin				
Nonlinearity	%	≤ 0,1 % of margin				
1-year stability	%	≤ 0,2 % of margin				
Pressure connection		G1/4"A DIN 3852-E				
Electrical connection (plug) / IP protection classes		M12 - 4 POLE			IP 67	
Weight	g	approx. 80				
Materials in contact with measured medium						
Pressure connnection / housing		1.4301				
Sensor measuring cell		1.4542 or comparable				
Permitted temperature ranges						
Media temperature	°C	-30 °C to +110 °C				
Ambient temperature range	°C	-30 °C to +100 °C*				
Storage temperature range	°C	-30 °C to +100 °C*				
*Limited temperature range with M12 connection plug	°C	-15 °C to +85 °C				
Nominal temperature range	°C	0 to +80 °C				
Vibration resistance	g PSD	20 according to IEC 60068-2-6 (Vibration under resonance) 20 according to IEC 60068-2-64 (noises)				
EMV tests		EN 61000-4-1 to -6 EN 61000-6-4				
CE conformity						
EMV Directive		2004/108/EG noise emission und interference resistance				
Pressure Equipment Directive		Classification according to Pressure Equipment Directive 97/23/EG as pressure maintaining components with safety function (article 3. sect. 3).				
RoHs conformity		Yes				

We produce fluid power solutions
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Continuous Oil Condition Monitoring

LubMon Visu Display Unit and Data Logger

Application area

LubMon Visu is a display unit, suitable for panel-mounting, with integrated data memory for connection of various sensors. ARGO-HYTOS offers a wide range of compatible sensors for monitoring of hydraulic and lubricating fluids. These are amongst others particle monitors, temperature, humidity and oil aging sensors as well as sensors for monitoring of the filter lifetime. Furthermore any sensor with analog current output may be connected e. g. for filter monitoring.

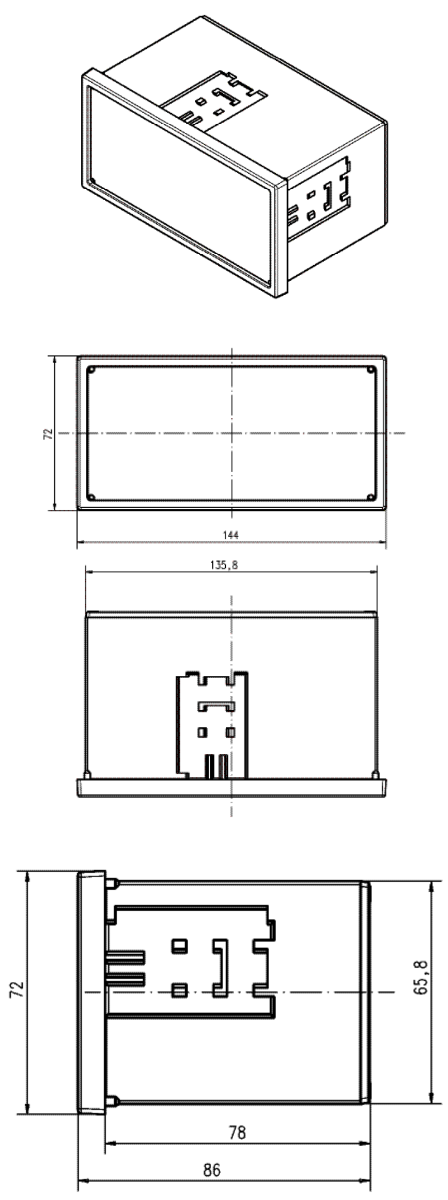
Performance features

2 sensors with serial interface as well as 2 sensors with analog interface, as e.g. pressure and differential pressure sensors in addition may be attached to the LubMon Visu. The recorded measured values are collected in the data memory and may be copied onto a SD-memory card if desired. By means of the integrated display the current measured values as well as the stored data may be indicated with timestamp. Navigation through the data and the operating menu is carried out over 6 keys at the front side of the module. Besides of the graphical display, alarms and status information are shown by 4 LEDs.
Communication with a processor or a SPS is effected by USB 2.0 or optionally by Ethernet. In order to activate the switch signals, there are also 3 potential-free switch contacts available. Optionally the printer, listed under accessories, may be connected to the module.

Design characteristics

LubMon Visu is designed for panel-mounting. Cabling is effected by the plug at the back side of the device. The sensors are supplied with power by the connecting plugs also.

LubMon Visu



Technical Data

Order Code

LubMon Visu, Standard	SCSO 900-1000
LubMon Visu, Ethernet	SCSO 900-1010

Compatible Sensors

LubCos H_2O	SCSO 300-1000
LubCos H_2O*plus* II	SCSO 100-1010
LubCos Level 200 / 375 / 615	SCSO 150-1200
LubCos Level 375	SCSO 150-1375
LubCos Level 615	SCSO 150-1615
LubCos Vis*plus*	SCSO 200-1000
OPCom II	SCSO 300-1000

Accessories

Connecting plug	SCSO 900-5010
Data cable with open ends, 5 m length	SCSO 100-5020
USB-SD-card reader SD-card Compatible thermal printer USB-cable Retaining clips	SCSO 900-5060 SCSO 900-5050 SCSO 900-5070 SCSO 900-5040 SCSO 900-5030

Module data	Size	Unit
Power supply		
Voltage	9 ... 33	VDC
Power input	typ. 100 max. 300	mA
Ambient conditions		
Temperature, operation	0 ... +60	°C
Temperature, storing	+5 ... +50	°C
Humidity, operation	0 ... 95	%
Humidity, storing	0 ... 95	%
Connections		
RJ45[1)]	1x	
8-pole switch contact, provided with thread	3x	
USB-B	1x	
SD-card slot	1x	
Operation		
Membrane keyboard	6	Menue keys
Display		
Graphical display	128 x 32	Pixel
Brightness	adjustable	

[1)] Only availabe with Ethernet version

We produce fluid power solutions
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Continuous
Oil Condition Monitoring

ARGO HYTOS

LubMon PC*light* PC-visualisation and recording software for condition sensors

Application area

The software LubMon PClight allows **recording, storing** and **visualizing** the incoming data from the condition sensors LubCos H_2O, LubCos H_2O*plus* II, LubCos Level, LubCos Vis*plus* and OPCom II.

Performance features

The scope of operation of the LubMon PC*light* is specified below:

Communication

- Communication optionally over RS232-journal or TCP/IP
- Free selection of IP-address, port number and COM-Port
- Free adjustability of the sampling rat

Graphical visualisation of the measured data

- Two diagrams with respectively two y-axis and one x-axis
- Flexible axis assignment
- Logarithmic and linear axis display
- Diverse zoom and formatting options
- List display of the currently measured data and units

Storing

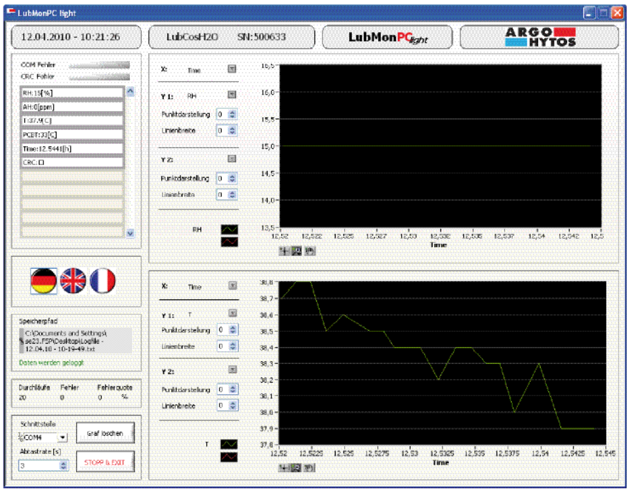
- Start/stop-function for automatic storing
- Storing in .txt-format with header for series of measurement and labelling of the units
- Recording of the current timestamp

Others

- Intuitive operation

System requirements

The software is written in NI-LabVIEW. For operation the current runtime environment LabVIEWRun-Time Engine and the NI.Visa Runtime Engine are necessary. This can optionally be downloaded together with the programme in packet.
The system requirements apply to the requirements of the runtime environment. The following operating systems are supported: Windows 2000/ XP/Vista x86/Vista x64/Windows 7.



Order code

LubMon PC*light*	SCSO 800-1000

Software

The software can be downloaded from our website at www.argo-hytos.com

Supported sensors

LubCos H_2O	SCSO 300-1000
LubCos H_2O*plus* II	SCSO 100-1010
LubCos Level	SCSO 150-1375
LubCos Vis*plus*	SCSO 200-1000
OPCom II	SPCO 300-1000

Accessories

Contact box for connection of a data cable, M12 x 1, 8-pin	SCSO 100-5010
Data cable with open ends (5m)	SCSO 100-5020
Complete data cable set, M12 x 1, 8-pin, (5m)	SCSO 100-5030
USB adapter - RS232 serial	PPCO 100-5420
Power supply	SCSO 100-5080
Ethernet - RS232 Gateway for sensor connection	SCSO 100-5100

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Continous
Oil Condition Monitoring

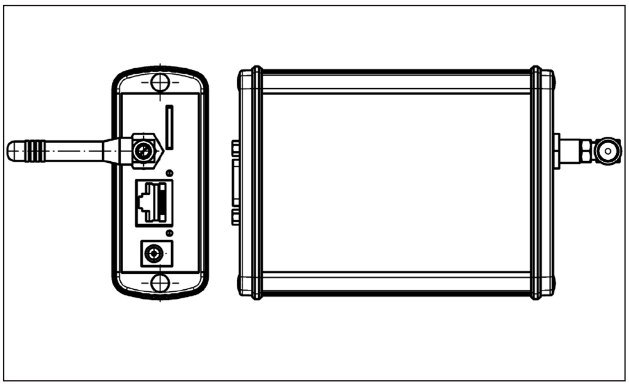
ARGO HYTOS

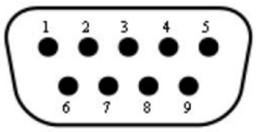
Remote Interface **LubMon Connect**

Application area

The LubMon Connect is a remote gateway for connection of ARGO-HYTOS sensors via a CANopen interface. The data of the connected sensors are automatically transfered to a web database and can be displayed or exported via an internet page.
By the use of the CAN Bus and the CANopen protocol a simple and robust possibility is provided to integrate the sensors into existing systems in order to guarantee secure communication.
At the gateway an ethernet interface and a GSM module are provided for data transfer to the internet. The communication can be carried out either via the at the location existing network or - with mobile or remote systems - also via the worldwide available GSM network.
The LubMon Connect communicates with an internet server which can store all incoming data in variable time intervals. The data can directly online be visualized in form of diagrams or exported for processing. For this purpose a ring memory of 100.000 data sets is availblable.

Supported Sensors	Order No.
LubCos H20plus II	SCSO 100-1010
LubCos Level 200	SCSO 150-1200
LubCos Level 375	SCSO 150-1375
LubCos Level 615	SCSO 150-1615
LubCos Vis+	SCSO 200-1000
OPCom II	SPCO 300-1000



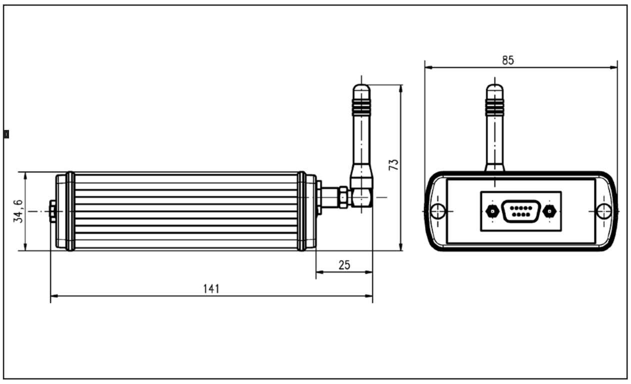


(view on plug from outside)

- Pin 1 ---
- Pin 2 CAN-L
- Pin 3 GND
- Pin 4 ---
- Pin 5 SHIELD
- Pin 6 ---
- Pin 7 CAN-H

------------ Galvanically isolated ----------

- Pin 8 supply + (24VDC)
- Pin 9 supply

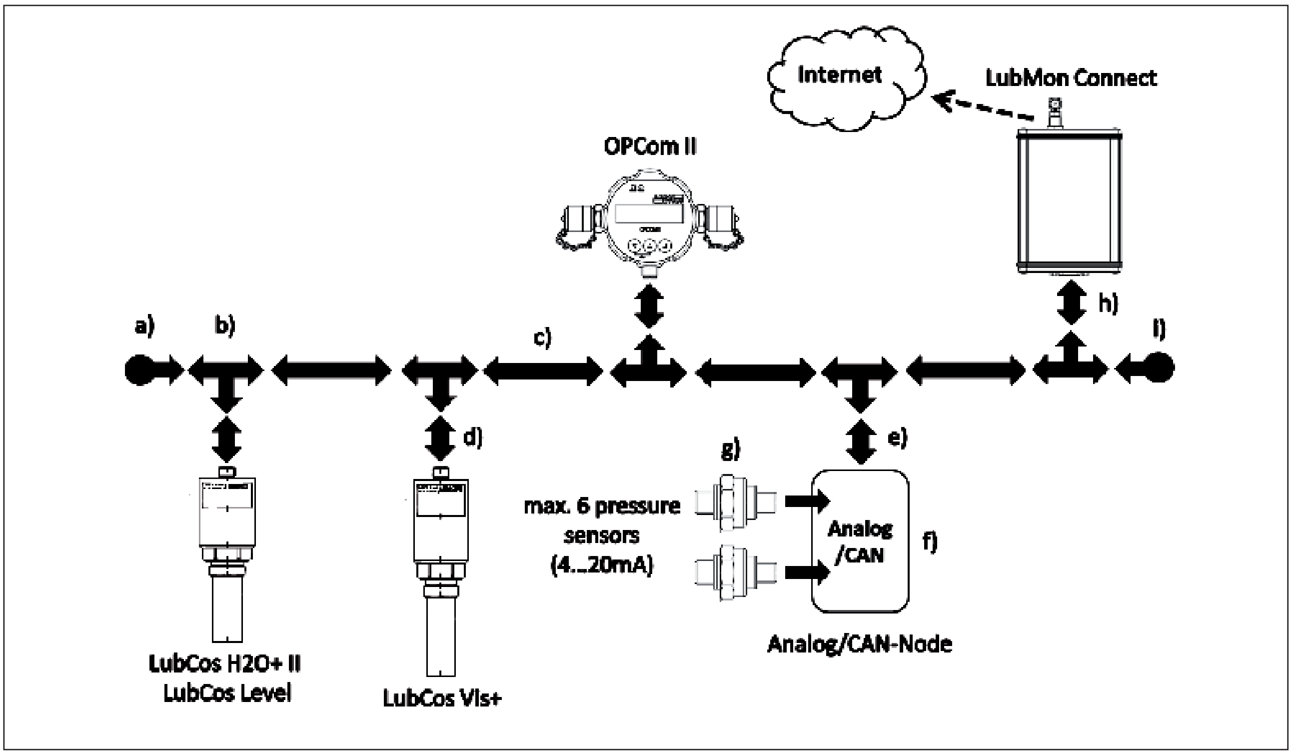


Technical data

Data	Size	Unit
Ambient conditions operation		
Temperature	+5 ... +50	°C
Humidity	0 ... 95	% r.H.
Ambient conditions storing		
Temperature	0 ... +60	°C
Humidity	0 ... 95	% r.H.
Power supply	12 ... 28	VDC
Power input	max. 0,3	A
CAN interface		
Plug	SUB-D9	-
Bus speeds	100 / 125 / 250 / 500	kBaud
Protocol	CANopen	-
Ethernet interface		
Connection type	RJ45	-
Speed	10 / 100	MBit
Protocol	UDP	

Date	Size	Unit
GSM		
Aerial	Stub Antenna FME	-
Transmission power @ 850/900 MHz	2	W
Transm. power @ 1800/1900 MHz	1	W
SIM card type	Standard SIM card 1,8V / 3V	-
Frequencies	850 / 900 / 1800 / 1900 (Quad-Band EGSM)	MHz

Optical indications	
Power LED	Green
Ethernet LED	Yellow



Fixing clamp LM Connect short side	SCSO 700-5010
Fixing clamp LM Connect long side	SCSO 700-5020
Subscription for one-year-use LM Connect	SCSO 700-5030
SMS-Card 50 pcs. LM Connect	SCSO 700-5040
a) CAN terminator female	SCSO-700-5160
b) CAN T-connector	SCSO 700-5140
c) CAN cable standard 2 m	SCSO 700-5120
d) CAN sensor cable	SCSO 700-5110

e) CAN cable open leads 0,3 m	SCSO 700-5130
f) Analog CAN adapter LM Connect	SCSO 700-5060
g) PSC pressure sensor	PSC 400-1843 PSC 250-1843 PSC 100-1843 PSC 010-1713
h) Sub-D CAN adapter LM Connect	SCSO 700-5050
i) CAN terminator male	SCSO 700-5150

Continuous
Oil Condition Monitoring

OPCom II Particle Monitor

Application area

The OPCom II is a compact particle monitor for continuous monitoring of the contamination in hydraulic fluids and lubricants.

Performance features

• Recognizing changes in your hydraulic fluid

Particle monitors precisely display any change of contamination in your system. In that way you can react quickly when an increase in particle concentration occurs and the appropriate countermeasures can be taken. Subsequent damages are minimized and costs are reduced.

• High pressure range

The OPCom II is designed for operating with pressures of up to 420 bar. In that way it can be mounted directly to a pressure line.

• Intuitive operating

The OPCom II is equipped with an intensely illuminated graphic display and a keypad by which you may set up all required adjustments. The menu navigation is made up intuitively and logically.

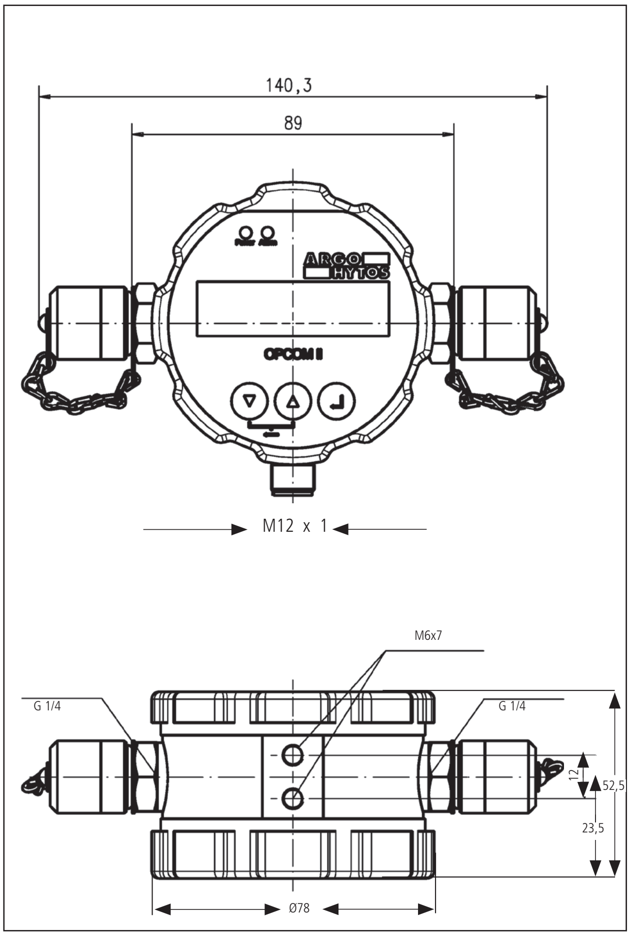
• Wide communication possibilities

The OPCom II exports data to a serial interface or optionally to a CAN-Bus (CANopen). Parallel, the configurable 4 - 20 mA interface can be connected. Over a digital alarm output you will be warned when limits are exceeded or fallen below. Readings can run time-controlled, manually or started and stopped over a digital input. The data can also be stored on the integrated memory unit.

Design characteristics

On the fluid side the OPCom II is equipped with two Minimess connections to connect the sensor generally in the off-line circuit to the system. The electrical connection is installed via an 8-pole M12 x 1 circular plug. The integrated data memory allows data recording over a longer period. Besides all its technical functions the OPCom II scores by its compact and optical design.

OPCom II



8-pole A coding (male)

Technical data

Measuring principle

The OPCom II is an optical particle monitor which works to a so-called light extinction principle. This means that the particles are classified within a measuring cell with the help of a laser regarding their size and quantity. The measured values are displayed according to ISO 4406:99 and SAE AS 4059 respectively.

Software

A free PC-software for data recording and evaluation of the measured values can be downloaded from our website at www.argo-hytos.com within our download area.

Order code

OPCom II	SPCO 300-1000

Accessories

Complete data cable set, 5 m length	SCSO 100-5030
Data cable with open ends, 5 m length	SCSO 100-5020
Contact box for connection of a data cable	SCSO 100-5010
USB adapter - RS232 serial	PPCO 100-5420
Power supply	SCSO 100-5080
Ethernet - RS232 gateway	SCSO 100-5100
Display and storage device LubMon Visu	SCSO 900-1000
Minimess connection with volume flow limiting Pressure range 1: 2 … 50 bar Pressure range 2: 50 … 400 bar	 SPCO 300-5105 SPCO 300-5140
Minimess connection with control loop	SPCO 300-5100

Technical data

Size channels	4, 6, 14, 21 µm
Display	Cleanliness classes according to ISO 4406:99 and SAE AS 4059
Measuring range Calibrated range Measuring accuracy (calibrated range)	0 ... 24 OZ 10 ... 22 OZ ±1 OZ OZ = ordinal number
Voltage	9 … 33 VDC
Fluid pressure	up to 420 bar (dynamic) up to 600 bar (static)
Flow rate	50 … 400 ml/min
Temperature range	Oil: -10 … +80 °C Ambience: -10 … +60 °C Storage: -20 ... +80 °C Display readable up to +60 °C
Protection class	IP 67
Electrical connection	M12 x 1; 8-pole
Interface	RS-232, CANopen Analog output 4 … 20 mA configurable, digital alarm output digital input to start and stop readings
Data memory	3000 data records
Operation	via keys, PC or digital I/O
Fluid compatibility	Mineral oils (e.g. HLP), ester oils (e.g. HEES), polyalphaolefines and biodegradable oils (e.g. HETG), phosphate ester optionally, diesel fuels

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Portable Particle Monitor

OPCom Portable Oil Lab - Particle Counting - The Easy Way

- Easy
- Compact
- Cost-Efficient

100.60-5e

OPCom Portable Oil Lab - Particle Counting - The Easy Way

Mobile oil laboratory for oil cleanliness and condition monitoring – easy, compact and cost-efficient

The OPCom Portable Oil Lab is a mobile oil laboratory for service, with which the oil cleanliness and the oil condition in hydraulic and lubrication systems can be measured quickly and easily.

Sampling can be carried out directly via a pressure line or optionally via the integrated pump. In this connection, measurement can be effected either manually or automatically in an adjustable time interval.

The OPCom Portable Oil Lab enables particle measuring according to the latest standard and displays the cleanliness classes according to ISO 4406:1999 and SAE AS4059. In addition, the relative humidity and oil temperature are displayed. Optionally, further information on the oil condition, taken from the conductivity and polarity of the oil, can be shown via the integrated display.

All functions of the OPCom portable Oil Lab can intuitively be operated via the integrated keypad. The internal data memory allows saving of more than 1.250 data records, which may comfortably be transferred to a processor via USB adapter or SD card. Furthermore the OPCom portable Oil Lab includes an integrated printer to print any data record on the spot.

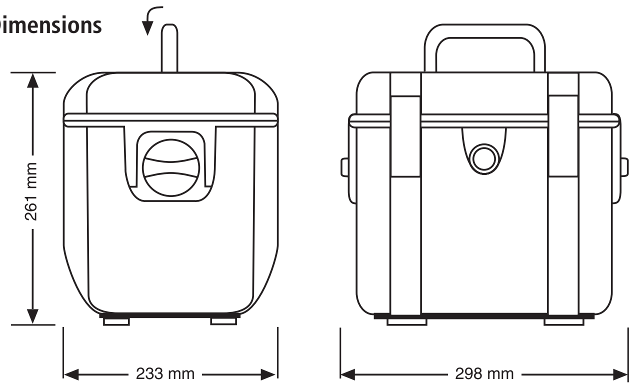
The real-time clock, integrated in the OPCom portable Oil Lab, adds a time-stamp to all measured data in order to facilitate a later allocation. The measured data can additionally be marked with a freely definable indication of the measuring point.

The integrated powerful battery pack is available in two capacity classes and allows operation of several hours. The used batteries are characterized by a low self-discharge and thus long operating state as well as a recharging of less than 1 hour.

The compact particle counter is supplied with a power supply, hoses and couplings. Amongst others, the OPCom portable Oil Lab can additionally be delivered together with a convenient carrying bag with separated pockets for hoses and samples on one side as well as for the recharger and other accessories on the other side.

The portable oil service device OPCom portable Oil Lab offers an intelligent and cost-efficient possibility for monitoring of your system and oil parameters.

Dimensions



Order Code

OPCom Portable Oil Lab	PPCO 300-1000

Spare parts

Set, cover for SD and USB	PPCO 300-5090
Hose set with couplings	PPCO 300-5050
Minimess cable 2 m M16 x 2	PPCO 100-5280
Paper rolls for thermal printer	SCSO 900-5075
Power supply	PPCO 300-5120
Power cable	PPCO 300-5130
Protection caps (2x)	PPCO 300-5080
Suction connection	PPCO 300-5060
Protective strainer	PPCO 300-5070

Optional accessories (not included in the scope of delivery)

Carrier bag for accessories	PPCO 200-5020
Carrying strap	PPCO 200-5010
SD-card	SCSO 900-5050
SD-card reader	SCSO 900-5040
Power cable with non-European plug on demand	

Technical data

Paramater	Size	Unit
Operating pressure Via high-pressure connection [1] With pump operation	 5 ... 320 0	 bar bar
Viscosity range fluid	5 ... 1000	mm²/s
Operating temperature range fluid [2]	0 ... +60	°C
Ambient conditions operation Temperature Humidity (non-condensing)	 -10 ... +60 0 ... 95	 °C % rel.
Ambient conditions storing Temperature Humidity (non-condensing)	 -20 ... +60 0 ... 95	 °C % rel.
Pressure fluids	Mineral and ester fluids, polyalphaolefins, diesel fuels	
Wetted materials	Aluminium, NBR, HNBR, viton, epoxy resin, stainless steel, steel, saphire, chromium, brass, PVC (hoses)	
Power supply device Power supply Current consumption	 24 max. 8	 VDC A
Power supply of the according power adaptor Power supply Current consumption Power at 24VDC output	 100 ... 240 max. 4 max. 221	 VAC (50/60 Hz) A W
Characteristics battery Nominal capacity Loading time Running time when measuring without pump (When measuring with pump the running time decreases depending on the oil viscosity)	 6900 < 1 > 24	 mAh h h
Measuring range particle measurement according to ISO 4406:1999 Cleanliness degree Cleanliness degree (calibrated range) Size channels	 0 ... 24 10 ... 22 4, 6, 14, 21	 ordinal number (OZ) ordinal number (OZ) µm (c)
Measuring range oil parameter rel. permittivity rel. humidity Conductivity Temperature	 1 ... 7 0 ... 100 100 ... 800000 -20 ... +120	 - % pS/m °C
Measuring accuracy Particle measurment (within the calibrated range) rel. permittivity [3] rel. humidity [4] Conductivity Temperature	 ± 1 ± 0,015 ± 3 Typ. < 10 / ± 200 ± 2	 ordinal number (OZ) - % Fullscale % Fullscale / pS/m % Fullscale
Hydraulic connecting dimensions Oil inlet (high pressure, without pump operation) Oil inlet (pump operation) oil outlet	 Minimess M16x2 CPC-LC plug CPC-LC couplings	
Interfaces	USB-B, SD-card (SD or SD-HC in FAT/FAT16/FAT32-data format)	
Size internal data memory	1250 readings (with time stamp)	
Weight	< 10	kg
Scope of delivery	Manual, power supply 100-240V, power cable, low-pressure hose set incl. connection couplings, high-pressure hose	

1) Depending on the oil viscosity
2) Viscosity of the fluid must be within the permissible range
3) Calibrated in n-Pentan at +25 °C
4) Calibrated in air at +25 °C

Oil Diagnostic Systems

PODS *Pro*

PORTABLE OIL DIAGNOSTIC SYSTEM

- **Online and bottle measurement**
- **Mobile and stationary operation**
- **Lab quality accuracy**

100.90-1e

The new generation of oil diagnostics

Mobile and stationary operation:
Compressed air connection for laboratory measurement and gas bottle for field measurement

Online and bottle measurement:
Bottle adapter for batch sampling and minimess connector for online measurement

PODS *Pro*

PORTABLE OIL DIAGNOSTIC SYSTEM

PODS *Pro* is the new generation of portable oil-diagnostic instruments for simple, quick and reliable monitoring of oil cleanliness.

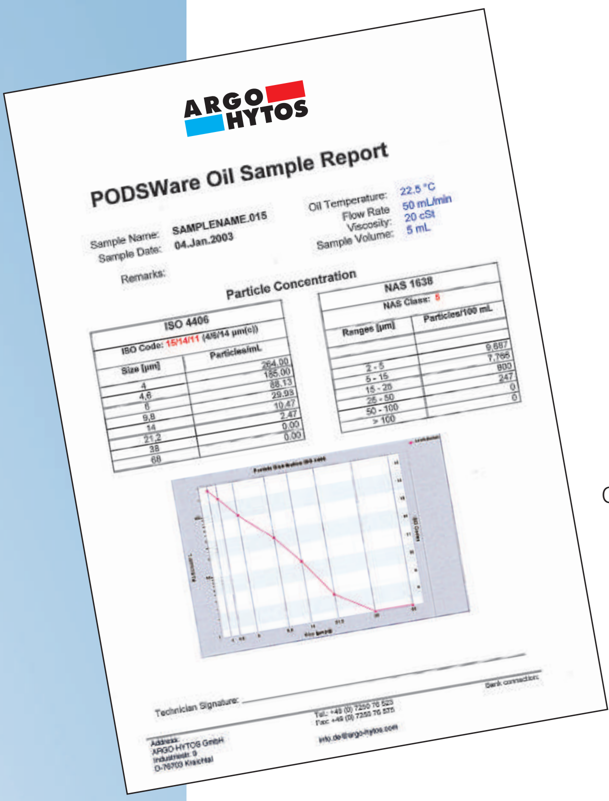
PODS *Pro* is based on many years of Know-how and represents the advanced version of PODS with newest technology. Many features were improved, thus PODS *Pro* is not only lighter than its predecessor, but also offers the classification according to SAE AS 4059.

Productive – Online & Bottle sample analysis by one instrument.
As before you can rely on PODS *Pro* even under severest operating conditions. The measurement results are reported simply, quickly and reliably. With PODS *Pro* you have the option to run online or bottle sample analysis with the same instrument.

Profitable – the PODS *Pro* Special:
The all-inclusive delivery program includes a robust rollerbox with all necessary accessories.
The ARGO-HYTOS software PODSWare sets new standards for service statistics and allows, for example, a detailed mapping of the machine life.

Proving – PODS *Pro* „live"
We would be happy to show you PODS *Pro* „live". Simply ask for a noncommittal demonstration.

Rely on hightech oil diagnostic systems from ARGO-HYTOS.



Certificate for measurements according to the different standards. These certificates can be issued with individual labels.

PODS *Pro*

PORTABLE OIL DIAGNOSTIC SYSTEM

1

1. Online and bottle sample analysis

With two turns of your hand, using the two fluid adapters in the all-inclusive delivery, PODS *Pro* is converted from a "Monitor" to a "Lab analyzer". In the online mode PODS *Pro* is connected directly to the hydraulic circuit via Minimess™ tubing and allows specific and continuous monitoring of the oil cleanliness.

2

2. Flexibility

Due to its lower weight PODS *Pro* can be easily carried to each location. For longer distance transport the rollerbox is used.

3

3. All-included delivery

PODS *Pro* is supplied with a very robust rollerbox, which is air- and water tight and contains all necessary accessories such as gas cartridges, power adapter, fluid adapters for online and bottle mode, handpump for oil sampling as well as clean sample bottles. The box is lockable and can be used for safe shipping to the ARGO-HYTOS Service Center, for instance for calibration.

4

4. Pressure range up to 420 bar

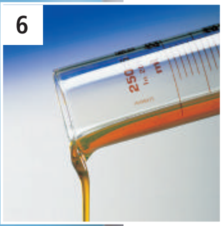
By direct measurement at system pressures up to 420 bar without bypassing, the risk of outgasing and bubble counting is drastically reduced.

5

5. High viscosity and high contamination

PODS *Pro* can measure particle contamination up to code 24 according to ISO 4406:1999. This is achieved by a sensor with a limit concentration of 90.000 particles/ml at 10 % optical coincidence and avoids time consuming and complicated dilution procedures. Another important advantage is its ability to measure oils with a viscosity up to 850 mm^2/s.

6



6. Variable flow rate

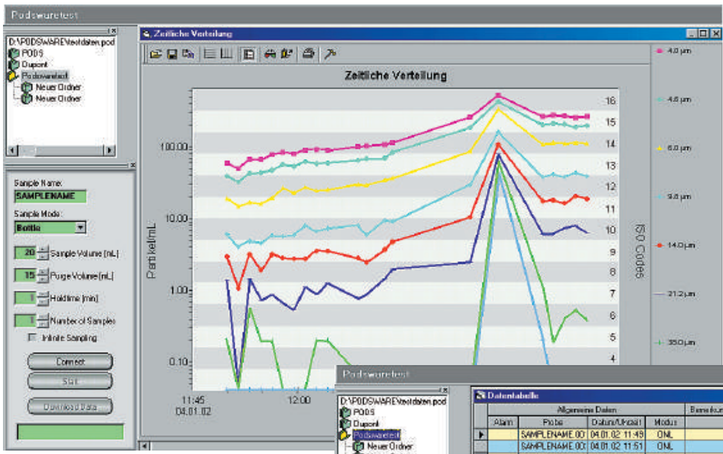
PODS *Pro* automatically regulates the flow rate to an appropriate value between 15 and 50 ml/min, depending on the oil pressure and the viscosity. This feature makes it insensitive to variations in the hydraulic system during the measurement.

7

7. Controlled cleaning with ECOLINE

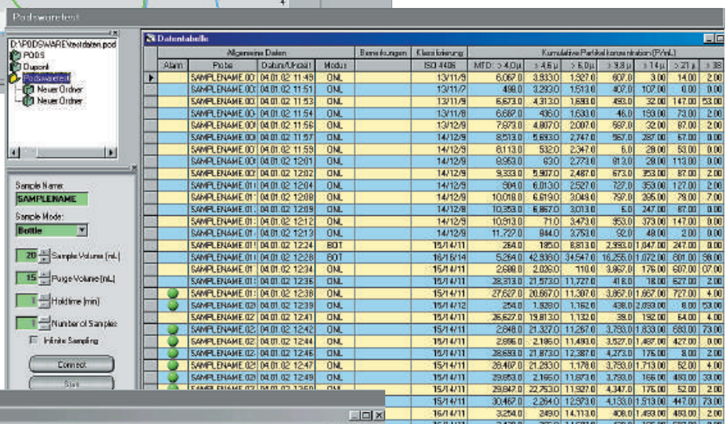
The oil service filter unit ECOLINE cleans oils up to a selected cleanliness class with PODS *Pro*. For this purpose ECOLINE pumps the oil over a filter. At the same time PODS *Pro* measures the cleanliness of the oil in front of the filter online and turns off ECOLINE when the target cleanliness class is reached. The cleanliness class is documented on a printout.

PODSWare – A powerful software!
PODSWare as supplement to PODS *Pro* is a tool to record and evaluate the measured data in a comfortable manner.
Apart from this PODS *Pro* may be completely controlled from the control window of the software.
The PODSWare includes the following languages: German, English, French, Italian.



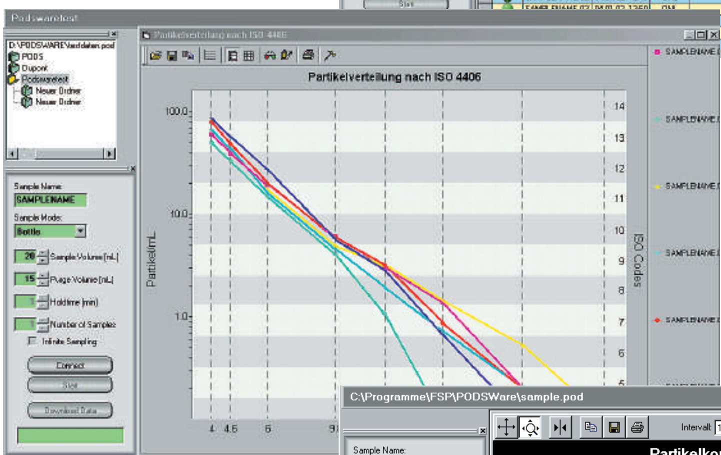
Starting and stopping measurements. Setting parameters and downloading stored data.

Graphical tracking of online measurements by time graphics.

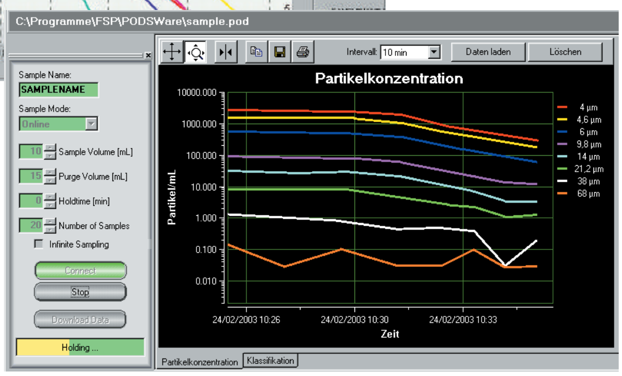


Build-up of a data bank and linking of measurements to machines.

Historic review of the oil cleanliness.



Particle concentration-size distribution.



Chronological review of the particle concentration.

Technical information

Detection	Light extinction
Sensitivity	complies with Japanese Industry Standard (JIS-B-9925:1997)
Size ranges	4 - 100 µm(c) (ISO-MTD)
Size channels	4 - 100 µm(c) (ISO-MTD)
Flow rate	15 - 50 ml/min automatic regulation
Calibration	ISO-MTD in oil (ISO 11171:1999)
Cleanliness classification	ISO 4406; NAS 1638; MIL-STD-1246C; NAVAIR 01-1A17, SAE AS 4059
Cleanliness classes	ISO 4406 code 1 to 24
Concentration limit	90.000 particles/ml at 10 % optical coincidence
Measurement results	Oil cleanliness classes (according to standard), concentration (particles/ml), viscosity (mm²/s, cSt or SUS), temperature
Light source	Laser diode
Counting efficiency	By JIS-B-9925:1997
Wetted materials	Stainless steel, sapphire, aluminium, Aflaz™, PTFE
Fluid pressure	0,5 - 420 bar
Temperature	0 - +90 °C oil at +25 °C ambient; 0 - +50 °C ambient; +5 - +40 °C housing
Relative humidity	20 - 85 % non-condensing, up to 98 % when stored
Viscosity	2 - 424 mm²/s particle counting with viscosity measurement
Material compatibility	Mineral oils, Skydrol™, environmentally compatible pressure fluids and phosphate esters
Pressure medium	CO_2 liquid (1 cartridge for about 60 oil samples), or pressurized shop air
Sample bottles	100 ml
System properties	Metal housing / Carry handle and shoulder strap / Universal power adapter/charger (90 - 240 VAC) Built-in thermal printer / LCD-display and keyboard / Memory for 500 samples / RS232C-interface Tube connector for filtered and dry pressurized shop air / Exchangeable CO_2-gas cartridges, refillable, 100 g filling NiMH-battery, computer controlled recharging for extended battery life Digitaloutput 0-5VDC / < 20 mA, potential-free output 0-5VDC / Online-adapter with Minimess™ tubing M16x2
Operating modes	Bottle sample analysis (4 - 7 bar); online-analysis (0,5 - 420 bar); Monitoring of ECOLINE UMP-045 by ARGO-HYTOS
Software (optional)	PODSWare for download, storage and management of PODS *Pro* data under Windows 9X/Me/2000 and XP
Weight	8,5 kg
Dimensions	(B x H x T) 330 x 350 x 200 mm

Size channels:

8 channels	1	2	3	4	5	6	7	8
ISO-MTD sizes [µm(c)]	4	4,6	6	9,8	14	21,2	38	68
ACFTD sizes [µm]	~1	2	~5	10	~15	25	~50	100

We produce fluid power solutions
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