The right Air Oil Separator ...

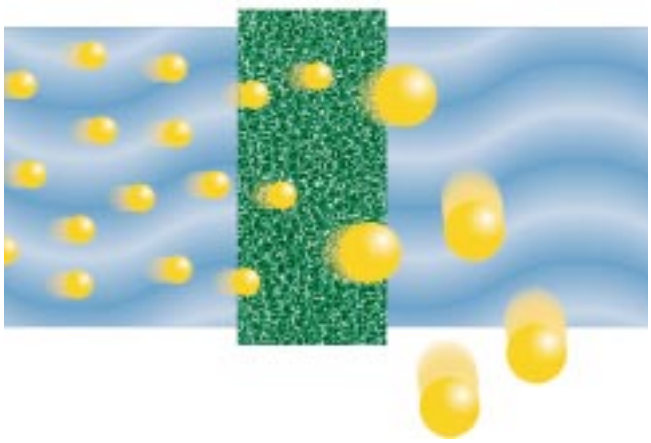
... for any installation situation

Types	Figure	Installation site	Residual oil content mg/m³ 1 to 3 mg/m³	Operating temperature 120 °C	Pressure drop for a given nominal flow rate bar	Available nominal flow rates (at 7 bar (0.7 MPa)	Advantages
Standard Wrap Element Page 5		in pressure reservoir	●	●	0.17	2 to 42 m³/min	• High process reliability by using top quality filtration media • Low oil consumption due to low residual oil content • Thoroughly tried and tested and reliable
Depth Separator Element Page 7		in pressure reservoir	●	●	0.2	3.5 to 39 m³/min	• High process reliability by using top quality filtration media • Low oil consumption due to low residual oil content • Space saving achieved through compact design
Air Oil Separator Box Page 9		upright on pressure reservoir	●	●	0.25	1 to 5.5 m³/min	• High process reliability by using top quality filtration media • Simple and time-saving assembly and disassembly • Cost advantages with services as compared with traditional air oil separators • Low oil consumption due to low residual oil content
Air Oil Separator Filter Page 11		suspended in the compressed air pipe	●	●	0.3	1 to 11 m³/min	• High process reliability by using top quality filtration media • Simple and time-saving assembly and disassembly • Cost advantages with services as compared with traditional air oil separators • Low oil consumption due to low residual oil content
Air Oil Separator Element for vacuum pumps Page 13		in pressure reservoir	●	●	0.25	0.1 to 2.9 m³/min	• High process reliability by using top quality filtration media • Low oil consumption due to low residual oil content

MANN Air Oil Separators...

The use of compressed air is now an integral feature of every industrial firm. Compressors and vacuum pumps are used in the construction industry, mechanical engineering and in highly sensitive sectors such as the foodstuffs, pharmaceuticals and electrical engineering industries. MANN Air Oil Separators are important quality components in the compressed air processing chain.

Functional description
MANN Air Oil Separators work according to the „principle of coalescence“. Micro-glass-fibre layers separate drops of oil from the compressed air and return them in large drops to the oil circuit of the compressor. The separation process is effective right down to the submicron range. This ensures that oil consumption in the compressors and oil entrainment into the compressed air networks are kept to a minimum. Vapour oil particles are not separated.
MANN Air Oil Separators can be used with all types of standard compressor lubricating oils, irrespective of whether they are mineral-based, synthetic or partially synthetic products.



Oil separation according to the «principle of coalescence»

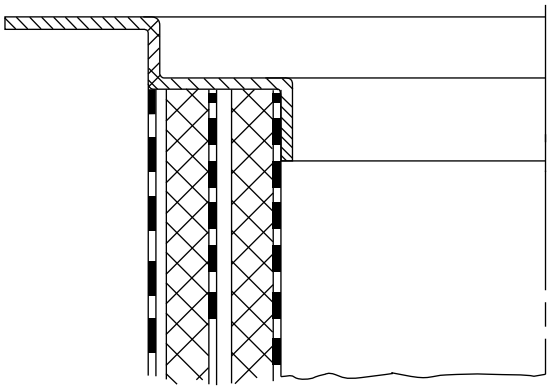
Separation of oil drops
Depending on the size of the drops, various physical separation effects result in the fine drops being adsorbed by the micro-glass fibres. The number of fibres, fibre diameter and flow velocity have a major impact on separation efficiency. If the design is modified, interaction between inertia, sealing and diffusion effects is optimised.
The larger drops produced in the first separation phase by the coalescence of fine drops are pressed through the glass-fibre layer and sink to the bottom on the dry side under the influence of gravity. The remaining air-borne proportion of smaller drops is separated in the second phase. Selection of the correct materials in conjunction with low flow resistances ensures that nearly all oil drops left in the air flow can be separated or drained off. This also applies to load fluctuations around the nominal utilisation point.

Return of separated oil
Depending on the make of compressor, oil is returned in a number of different ways. In the standard design of MANN Air Oil Separators, oil flows from the outside to the inside and the drainage oil is drawn off on the dry side through a centrally positioned pipe running from the base cup of the separator.

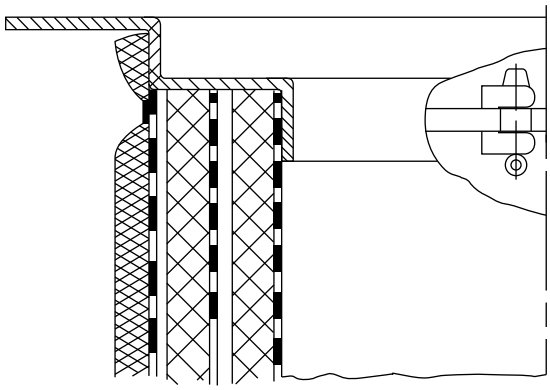
... for constant compressed air quality

Design

MANN Air Oil Separators contain either two or three layers. The first separation layer is normally the fine particle layer made of borosilicate glass fibres in defined layer thicknesses and pore sizes. These almost binder-free microfibre papers ensure resistance to different types of lubricating oil even at relatively high operating temperatures. The second separation layer is made of a polyester fleece.
In difficult pre-separation conditions, a third pre-separation layer can protect the other two layers against overloading, thus increasing the service life of the air oil separator. Please ask about pre-separation layers.
In accordance with the requirements of the trade association of the chemical industry, the metal parts of MANN Air Oil Separators for compressors have an electrically conductive interconnection in order to transfer any static charges reliably. Suitably prepared mounting seals produce conductive connections to the compressor housing.



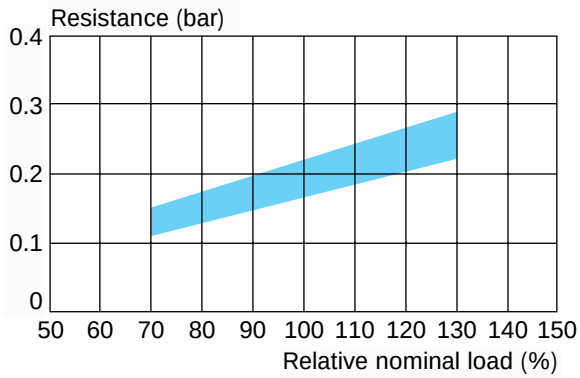
MANN Air Oil Separator Element with two-layer separation



MANN Air Oil Separator Element with three-layer separation

Flow resistance

Depending on their type, MANN Air Oil Separators have flow resistances of between 0.17 bar (17 KPa) and 0.22 bar (17 KPa), referred to the oil-moistened operating state at nominal volumetric flow and at operating temperature.

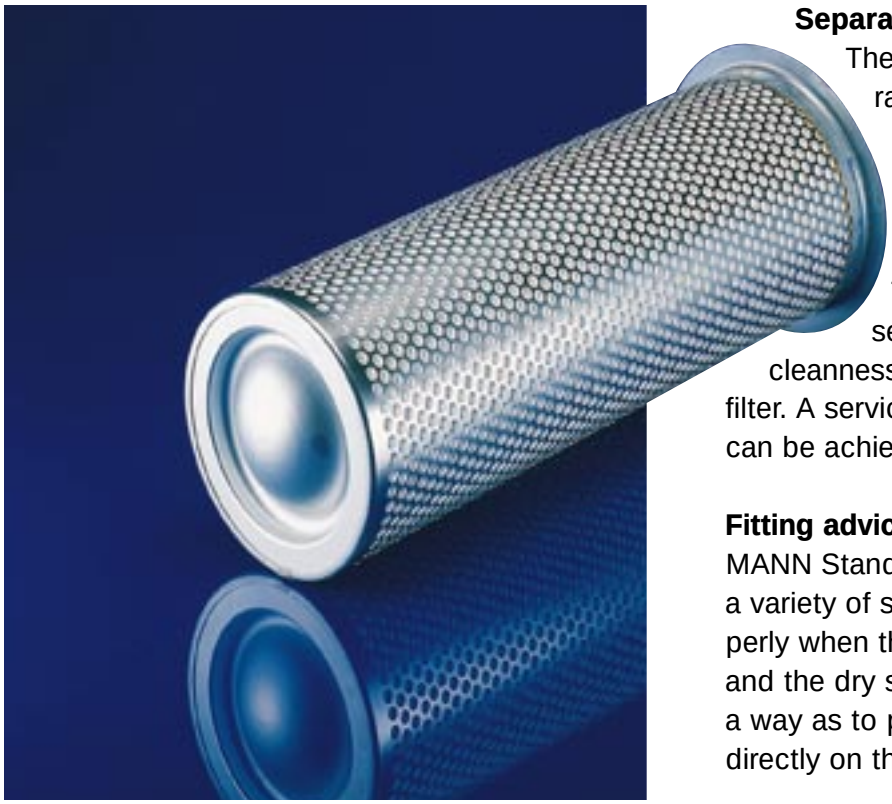


Flow resistances of MANN Air Oil Separator Elements

Quality Features

- High resistance to differential pressure
- Operating temperature: up to 120 °C
- Residual oil content: 1 to 3 mg/ m^3 or ppm (for nominal flow load)
- Nominal flow rates: (at 7 bar/0.7 MPa)
  - Standard wrap element: 2 to 42 m^3/min
  - Depth separator element: 3.5 to 39 m^3/min
  - Air oil separator box: 1 to 5.5 m^3/min
  - Air oil separator filter: 1 to 11 m^3/min
  - Air oil separators for vacuum pumps: 0.1 to 2.9 m^3/min

MANN Standard Wrap Element ...



Separation efficiency

The residual oil content at nominal flow rate and at 7 bar (0.7 MPa) operating pressure is approximately 1 to 3 mg/m³ (1 to 3 ppm).

Service life

The rise in flow resistance and thus service life primarily depend on the cleanness of the oil and the quality of the air filter. A service life of several thousand hours can be achieved with a well-functioning system.

Fitting advice

MANN Standard Wrap Elements are available in a variety of sizes. They will only function properly when there is no leakage between the wet and the dry sides. Air should be guided in such a way as to prevent the air oil stream impacting directly on the surface of the filter element.

Design and function

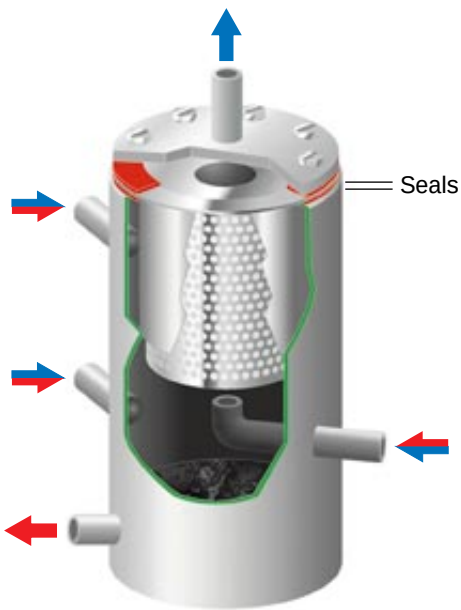
This product is suitable for flow from the outside to the inside. It can be used for the entire range of current versions of screw-type and sliding vane compressors.
The standard wrap elements are particularly insensitive to design variations and achieve optimal results with regard to separation efficiency and service life.

Pressure drop

The pressure drop at nominal flow rate and at 7 bar (0.7 MPa) operating pressure with a new element is 0.17 bar (17 KPa). If a higher resistance is permitted, the volumetric flow rate can be doubled without downgrading performance.

Pressure resistance

MANN Air Oil Separators are designed for differential pressures of up to 5 bar (0.5 MPa).



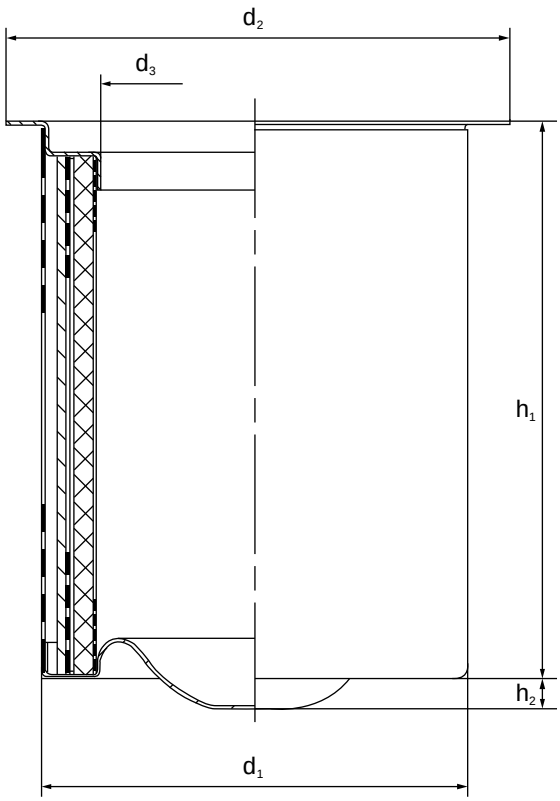
Compressed air inlets for oil saturated air (3 inlet alternatives)

to oil injection

oil-free compressed air

Installation of MANN Standard Wrap Element in pressure reservoir

... tried and tested thousand times



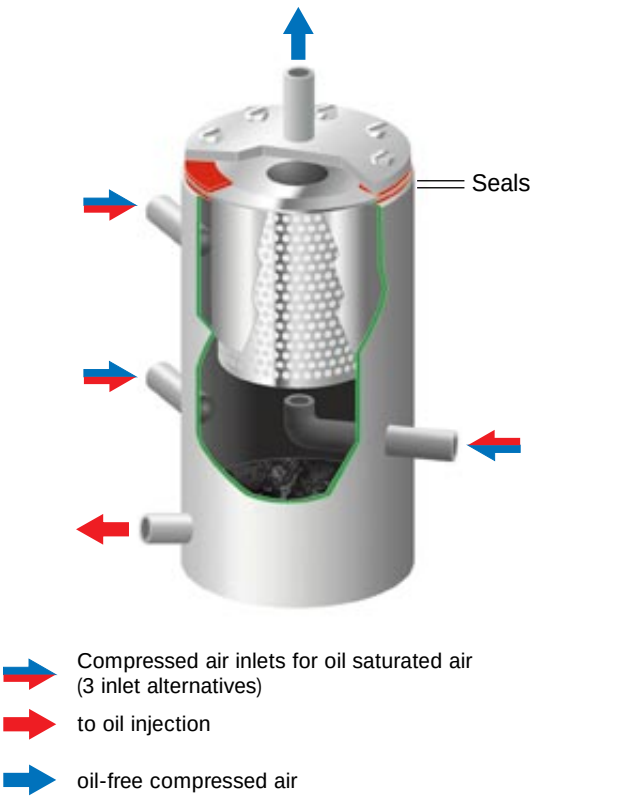
Part No. Packaged model	Flow rate[1] [m³/min]	Dimensions in mm				
		d_1	d_2	d_3	h_1	h_2
49 000 51 531	2	135	170	88	200	12
49 000 51 411	3.5	135	170	88	305	12
49 000 51 201	3.5	170	200	123	230	12
49 000 51 121	4.5	170	200	123	305	12
49 000 51 111	6.5	170	200	123	435	12
49 000 51 101	8	275	328	220	305	12
49 000 51 171	9	220	274	165	435	12
49 000 51 321	12	275	328	220	450	12
49 000 51 131	12	220	274	165	600	12
49 000 51 191	14	300	355	245	500	12
49 000 51 181	17	300	355	245	600	12
49 000 51 221	19	300	355	245	660	12
49 000 51 521	20	275	324	220	750	12
49 000 51 481	24	300	355	245	820	12
49 000 51 541	29	300	355	245	1 000	12
49 000 51 581	42	475	570	400	900	20

[1] Flow rate according to DIN 1945 at 7 bar (0.7 MPa) operating pressure.
Specially adapted sizes are available on request.

MANN Depth Separator Element ...

Design and function
This product takes up very little space and is suitable for the entire range of current versions of screw-type and sliding vane compressors. In the depth separator element, oil flows from the outside to the inside.

Pressure drop
The pressure drop at nominal flow rate and at 7 bar (0.7 MPa) operating pressure with a new element is approx. 0.2 bar (20 KPa). If a higher resistance is permitted, the volumetric flow rate can be increased to 1.5 times the nominal flow rate without downgrading performance.



Installation of MANN Depth Separator Element in pressure reservoir

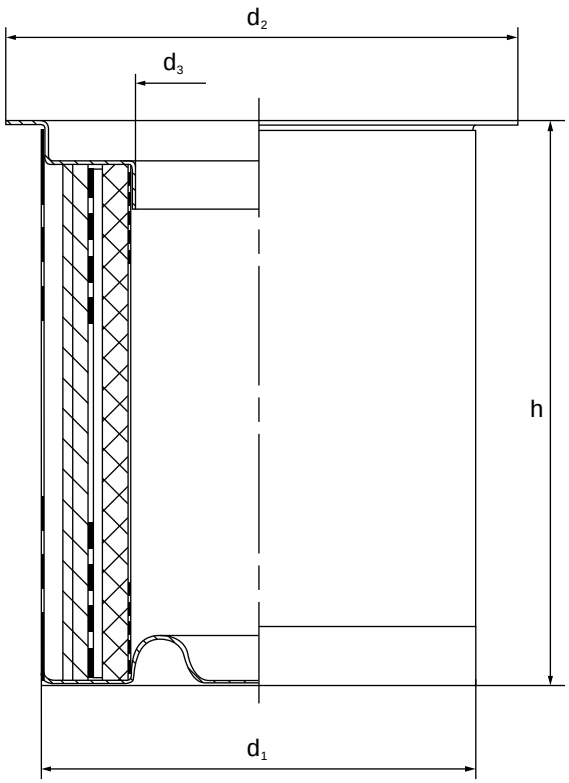
Pressure resistance
MANN Depth Separator Elements are designed for differential pressures of up to 5 bar (0.5 MPa).

Separation efficiency
The residual oil content at nominal flow rate and at 7 bar (0.7 MPa) operating pressure is approx. 1 to 3 mg/m^3 (1 to 3 ppm).

Service life
The rise in flow resistance and thus service life primarily depend on the cleanness of the oil and the quality of the air filter. A service life of several thousand hours can be achieved with a well-functioning system.

Fitting advice
MANN Depth Separator Elements are available in a variety of sizes. They will only function properly when there is no leakage between the wet and the dry sides. Air should be guided in such a way as to prevent the air oil stream impacting directly on the surface of the filter element.

... high performance in a confined space



Part No. Packaged model	Flow rate[1] [m³/min]	Dimensions in mm			
		d_1	d_2	d_3	h
49 301 53 131	4.5	135	170	75	200
49 301 53 101	6.5	170	200	109	230
49 302 53 131	9	170	200	109	305
49 303 53 121	16	300	355	220	305
49 303 53 111	20	275	328	209	400
49 304 53 101	22	300	355	220	400
49 305 53 111	28	300	355	220	500
49 305 53 101	33.5	300	355	220	600
49 306 53 102	39	300	355	220	700

[1] Flow rate according to DIN 1945 at 7 bar (0.7 MPa) operating pressure.
Specially adapted sizes are available on request.

MANN Air Oil Separator Box ...

Flow rates
MANN Air Oil Separator Boxes are available for nominal flow rates of 1 m³/min up to 5.5 m³/min (35 to 194 cfm) at an operating pressure of 7 bar (0.7 MPa).

Pressure drop
The pressure drop at nominal flow rate and at 7 bar (0.7 MPa) operating pressure is approx. 0.25 bar (25 KPa) with a new element.

Pressure resistance
The housings of the MANN Air Oil Separator Boxes are designed for operating pressures up to a maximum of 20 bar (2 MPa) or a maximum of 14 bar (1.4 MPa) (please see table on page 10). The built-in filter elements can withstand pressure differences up to 5 bar (0.5 MPa).

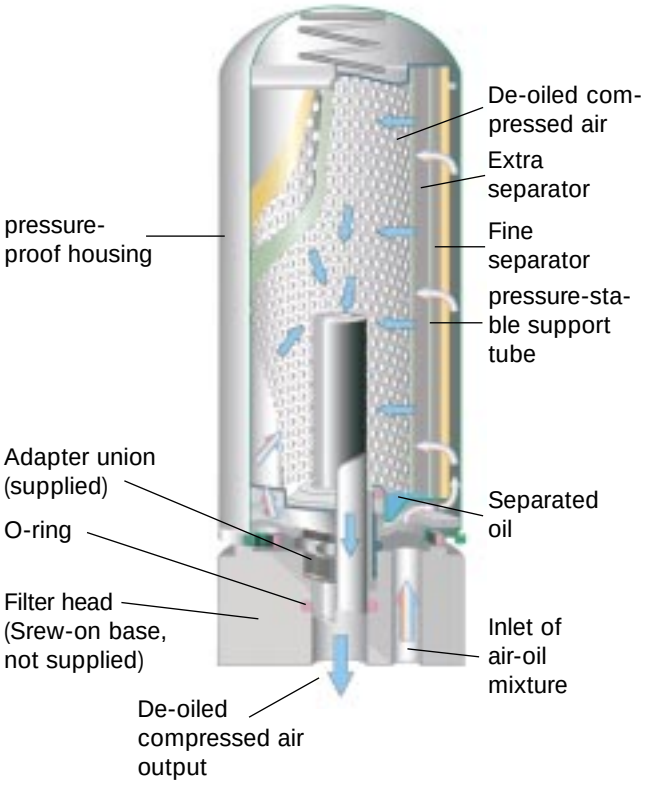
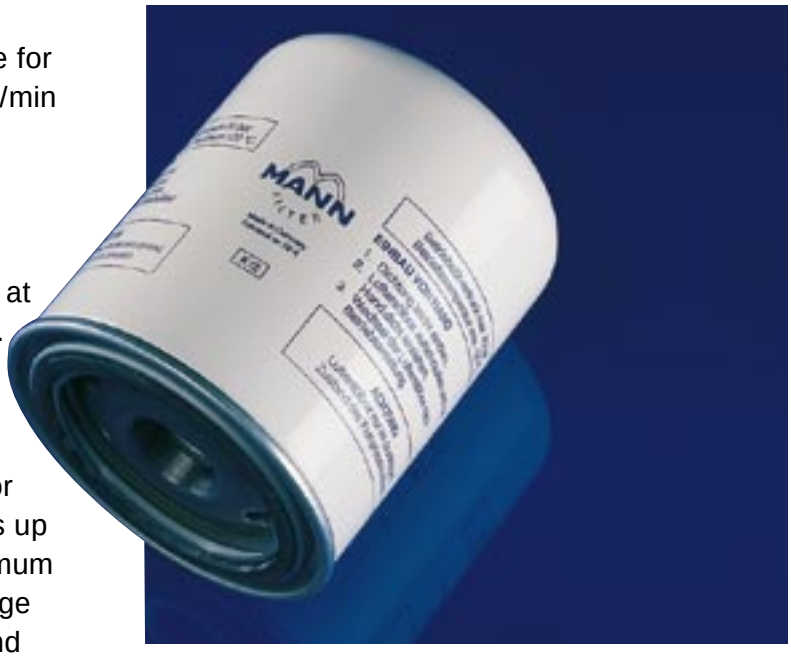


Fig. 1



Separation efficiency
The residual oil content of the compressed air at nominal flow rate and 7 bar (0.7 MPa) operating pressure is approximately 1 to 3 mg/m³ (1 to 3 ppm).

Service life
The rise in flow resistance and thus service life primarily depend on the cleanness of the oil and the quality of the air filter. A service life of several thousand hours can be achieved with a well-functioning system.

Fitting advice
MANN Air Oil Separator Boxes are fitted vertically (Fig. 1) by hand on the firmly installed filter head using a suitable adapter union. MANN+HUMMEL recommends installation in a maintenance-friendly position.

Maintenance
The air oil separator boxes must be replaced if the flow resistance reaches 1 bar (0.1 MPa). The box may only be replaced when the system is depressurised. A commercially available belt wrench is sufficient to remove the box. The box is fitted and tightened manually.

... for simple maintenance

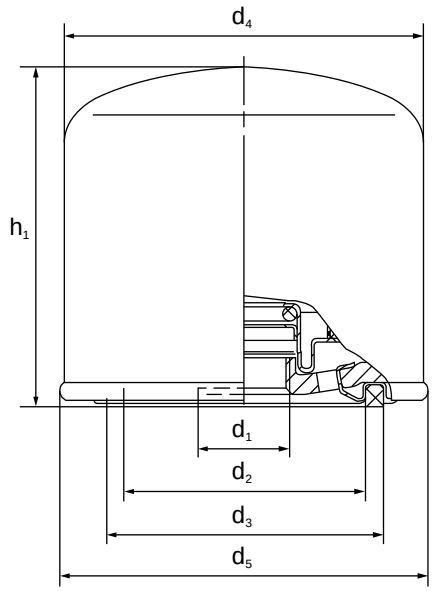


Fig. 1

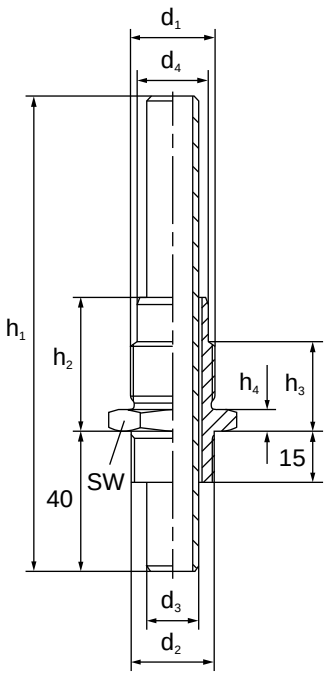


Fig. 2

MANN Air Oil Separator Box (Fig. 1)

Part No.	Flow rate[1] [m³/min]	Dimensions in mm and inches						max. working pressure	
		d_1	d_2	d_3	d_4	d_5	h_1	[bar]	[MPa]
LB 719/2	1	M 22 x 1.5	62	71	76	80	127	20	2
LB 962/2	2	M 24 x 1.5	62	71	93	96	212	20	2
LB 1374/2	3	M 39 x 1.5	100	111	136	140	177	20	2
LB 11 102/2	4	M 32 x 1.5	93	104	108	110	260	14	1.4
LB 13 145/3	5.5	M 39 x 1.5	100	111	136	140	302	20	2

Adapter Union (Fig. 2)

Part No.	Dimensions in mm and inches									suitable for separator box
	d_1	d_2	d_3	d_4	h_1	h_2	h_3	h_4	sw	
21 024 15 981	M 22 x 1.5	M 24 x 1.5	14	19.2	135	38	25.4	6	27	LB 719/2
21 027 15 991	M 24 x 1.5	M 27 x 1.5	15	19.8	135	38	25.4	6	32	LB 962/2
21 036 15 991	M 32 x 1.5	M 36 x 1.5	22	28.1	155	41.5	27.4	6	41	LB 11 102/2
21 042 15 991	M 39 x 1.5	M 42 x 1.5	30	35.8	175	47.5	34.4	7	46	LB 1374/2 LB 13 145/3

[1] Flow rate according to DIN 1945 at 7 bar (0.7 MPa) operating pressure.

MANN Air Oil Separator Filter ...

Flow rates
MANN Air Oil Separator Filters are available for nominal flow rates of 1 m^3/min up to 11 m^3/min at a compressor pressure of 7 bar (0.7 MPa).

Pressure drop
The pressure drop at nominal flow rate and at 7 bar (0.7 MPa) operating pressure is approx. 0.3 bar (30 KPa) with a new element.

Pressure resistance
The housings of the MANN Air Oil Separator Filters are designed for operating pressures up to a maximum of 20 bar (2 MPa) or a maximum of 14 bar (1.4 MPa) (please refer to values in the table on page 12). The built-in filter elements can withstand pressure differences up to 5 bar (0.5 MPa).

Separation efficiency
The residual oil content of the compressed air at nominal flow rate and at 7 bar (0.7 MPa) operating pressure is approx. 1 to 3 mg/m^3 (1 to 3 ppm).

Service life
The rise in flow resistance and thus service life primarily depend on the cleanness of the oil and the quality of the air filter. A service life of several thousand hours can be achieved with a well-functioning system.

Fitting advice
The air oil separator filters are fitted in an easily accessible position either vertical or suspended in the pipe downstream of the compressed air tank. Please observe the marked flow direction. The oil return pipe supplied by the customer (steel pipe 8x1C-PHR) is oiled by the screw connection in the head. The steel pipe is not part of the scope of supply.

Maintenance
The air oil separator boxes of the filters must be replaced if flow resistance reaches 1 bar (0.1 MPa). The box may only be replaced when the system is depressurised. A commercially available belt wrench is sufficient to remove the box. The box is fitted and tightened manually.

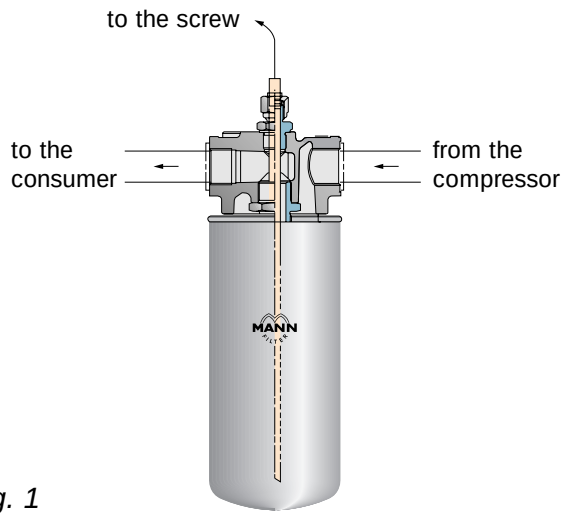


Fig. 1

Installation of the MANN Air Oil Separator in the compressed air pipe

... low maintenance and flexible installation

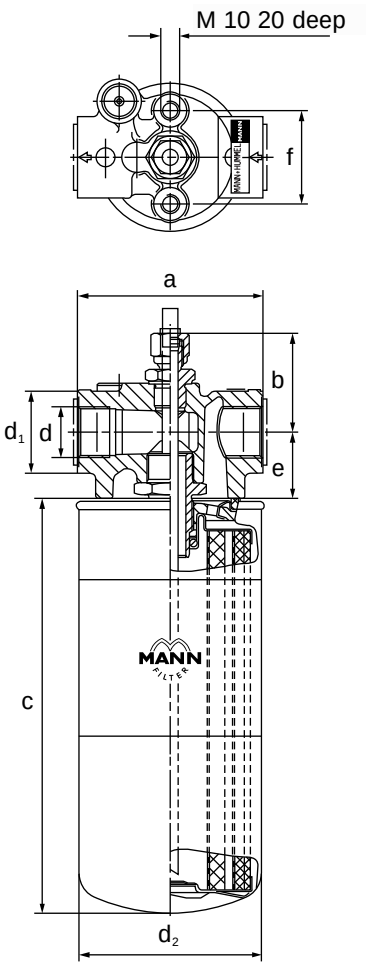


Fig. 2

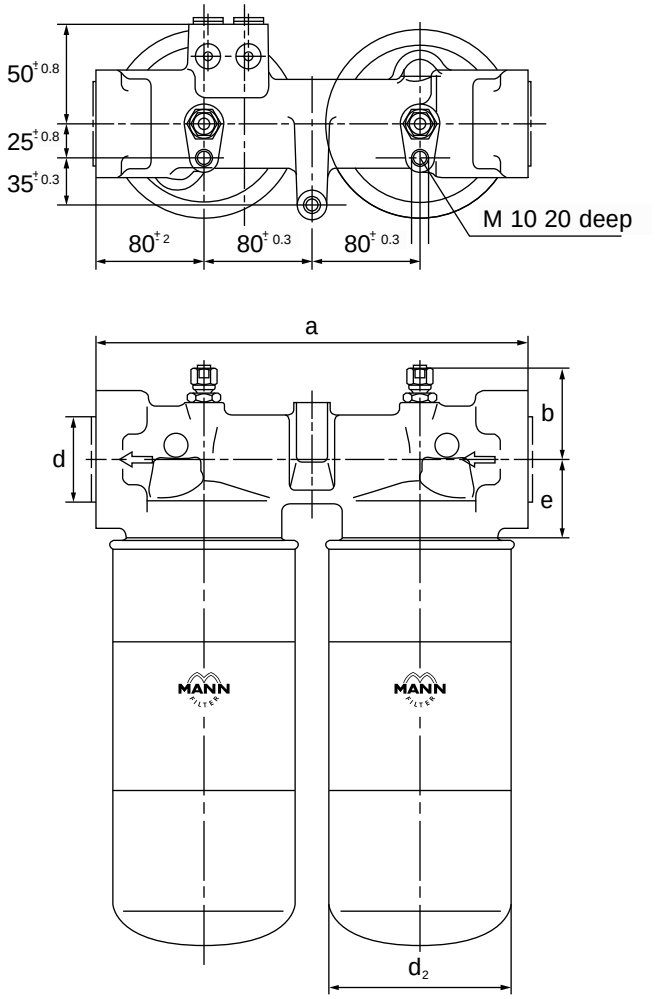


Fig. 3

Part No.	Matching separator box	Fig.	Flow rate[1] [m³/min]	Dimensions in mm and inches a	b	c	d	d_1	d_2	e	f	max. working pressure [bar]	[MPa]
49 303 62 101	LB 719/2	2	1	95	50	127	G 3/4	36	76	34	47.5	20	2
49 306 62 101	LB 962/2	2	2	95	50	212	G 3/4	36	93	34	47.5	20	2
49 308 62 101	LB 1374/2	2	3	135	54	177	G 1 1/4	50	136	41	56	20	2
49 312 62 101	LB 11 102/2	2	4	130	81	260	G 1 1/4	50	108	46	47.5	14	1.4
49 316 62 101	LB 13 145/3	2	5.5	135	54	302	G 1 1/4	50	136	41	56	20	2
49 330 62 101	2x LB 13 145/3	3	11	320	68	302	G 2	–	136	58	–	20	2

[1] Flow rate according to DIN 1945 at 7 bar (0.7 MPa) operating pressure.

MANN Air Oil Separators for vacuum pumps ...

Design and function
This product is designed for flow from the outside to the inside. The air oil separators listed in the table on page 14 are particularly suitable for integration in oil-flooded vacuum pumps. Any installation position is acceptable.

Pressure resistance
The MANN Air Oil Separators for vacuum pumps are designed for differential pressures of up to at least 1.5 bar (150 KPa).

Separation efficiency
The residual oil content at nominal air flow is approx. 1 to 3 mg/m^3.

Service life
The rise in flow resistance and thus service life primarily depend on the cleanness of the oil and the quality of the air filter. A service life of several thousand hours can be achieved with a well-functioning system.

Fitting advice
The full separation efficiency of the air oil separators is only available fully when there is no leakage between the wet and dry sides.

... flexible installation

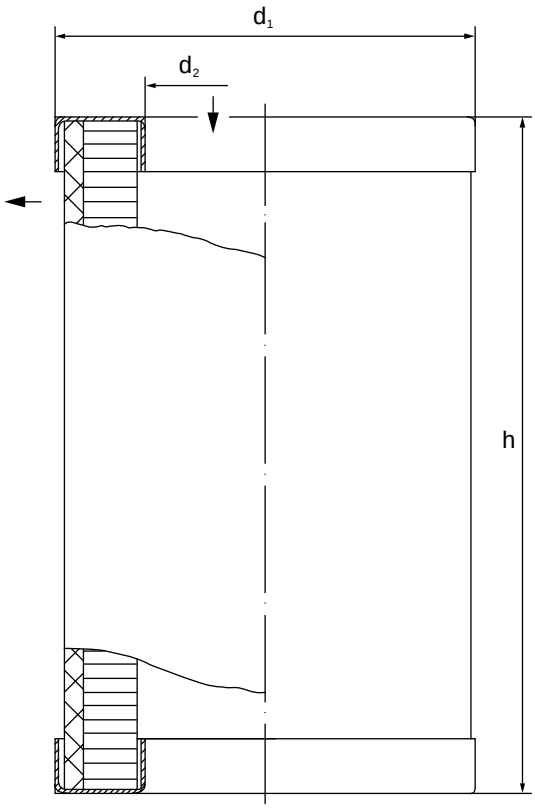


Fig. 1

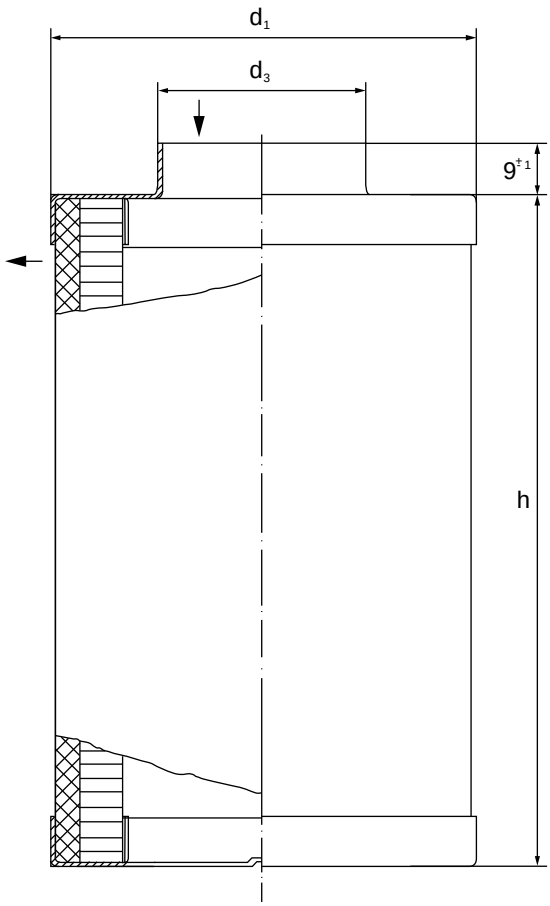


Fig. 2

Part No.	Fig.	Flow rate [m³/min]	Dimensions in mm and inches			
			d_1	d_2	d_3	h
49 000 52 108	1	0.1	30	10	–	60
49 000 52 351	1	0.25	55	25.5	–	75
49 000 52 352	1	0.4	72	32.2	–	80
49 000 52 353	1	0.7	80	45.2	–	125
49 000 50 611	1	0.9	80	45	–	145
49 000 52 391	2	1.2	72	–	35	202
49 000 52 107	1	1.4	70	40	–	250
49 000 52 103	2	1.45	72	–	35	252
49 001 52 112	1	1.8	70	40	–	330
49 001 52 152	2	2.2	72	–	35	377
49 001 52 151	2	2.9	72	–	35	502

Customized versions are available on request. Please contact us.

Practical Tips and Tricks

Service life of air oil separators

Dirt deposits, e.g. old oil products, air contamination or abrasion reduce the service life of air oil separators. Various final differential pressures are determined by the user. In practice, final values of between 0.8 bar (80 KPa) and 1 bar (100 KPa) are normal for compressors and approx. 0.5 bar (50 KPa) for vacuum pumps. Fouling which accumulates in the air oil separator may also increase on account of higher oil flow. This is measurable as drainage flow. The drainage flow volume depends directly on the structural design of the pre-separation mechanisms in the compressor. Optimum values for drainage flows are around 1 g of oil per m^3 of oil.

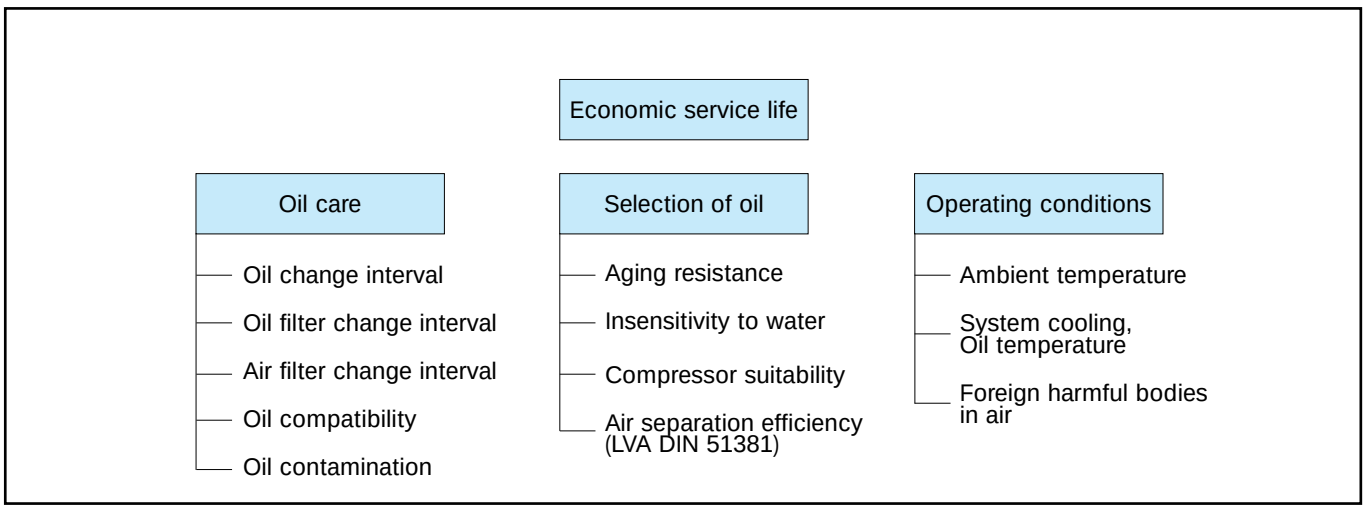
Measures to secure an economic service life of air oil separators

Correct oil care is a basic precondition for a satisfactory service life of air-oil separators. Generally speaking, the service life of air oil separators is only restricted by deposits of solid particles (old oil products, abrasion) in the fine separation layer and the resulting increase in differential pressure. The entry of fouling into the lubricating oil can be restricted by changing the air and oil filters in good time and by observing the oil change intervals. The amount of fouling entering the air oil separator is thus kept to a minimum and this has a positive effect on maintenance intervals. The selection of oil also plays an important role as regards service life. Only approved, aging-resistant and water-insensitive oils should be used. Unsuitable oils with insufficient oxidation resistance may block the air oil separator even after a relatively short operating period due to the build-up of deposits which have a similar consistency to jelly. Accelerated oil aging is the result of high operating temperatures. Accordingly, attention must be paid to the supply of cooling air and to cooler contamination. During oil changes, all used oil should be removed to avoid initial damage caused by residual oil or incompatibility between oils if the make of oil is changed. In order to take full advantage of the long service life of synthetic oils, any existing mineral oil residues must be removed completely.

In rare cases, oil may age prematurely due to gaseous foreign substances which are entrained in with the ambient air.

Reduced service life due to operational faults in compressors

MANN Air Oil Separators are insensitive to normal back flows or pulsation. However, abnormally large backflows may lead to defects in the fine separation layer of the air oil separators. This damage is generally not visible and therefore cannot be detected with the naked eye. However, even small defects in the separation layers may produce higher residual oil contents. In order to identify this damage, extensive tests such as residual oil measurements and destructive tests must be carried out.



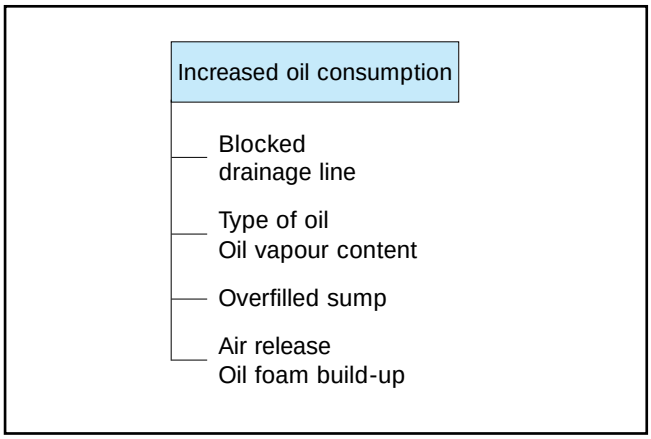
Practical Tips and Tricks

Residual oil measurements
Residual oil contents are measured most effectively using suitable absolute filters. In this case, it is important to measure both the oil drops and the wall flow since larger drops tend to be deposited on the wall. In order to avoid problems caused by condensation water, MANN+HUMMEL recommends that residual oil measurements be carried out in pressure-relieved condition. Measuring devices containing electronic particle counters only detect the airborne proportion of oil drops and do not take any account of the wall flow.

Improvements in pre-separation in existing compressors
In spite of the above reasons, the air oil separators in compressors with imperfect pre-separation may still have an adequate service life if three-layer elements are used. The so-called third layer consists of an open-pore fleece in front of the fine separation layers and separates a considerable proportion of the large oil drops. In individual cases, this pre-separation layer can be retrofitted.

Oil consumption in the compressor
Operating and marginal conditions which have an effect on the oil level in the pressure reservoir of the compressor, oil degasification processes, the effectiveness of pre-separation and the drainage system may result in increased oil flow rates in the short or long terms. For example, blockages in the drainage system lead to an accumulation of oil on the dry side of the air oil separator. Depending on the accumulated quantity, different quantities of oil may be accumulated.

An excessive oil level in the pressure reservoir may have similar effects. If a marked phase separation zone cannot be formed between the oil and air either temporarily or permanently, this will impair the pre-separation of the oil drops and also have a negative effect on the residual oil content downstream of the air oil separator after a certain size.
Overfilling the receiver tank with oil may lead to the penetration of abnormally large amounts of foaming oil into the air oil separator under certain operating conditions at low oil temperatures



and when slowly degassing oils are used.
The oil flow rate may rise substantially due to overwetting of the air oil separator.
In addition to the above-mentioned influences and operating faults which have a negative effect on oil consumption, the vaporous oil portion may reach a considerable level and thus also simulate faults in an air oil separator.
Depending on the type and make of oil, oil vapour contents of up to 10 mg/m³ are possible at normal operating temperatures of 80 °C.

Protection against corrosion
MANN Air Oil Separators are galvanised and thus protected against corrosion.

Installation and maintenance tips

An air oil separator or an air oil separator box must be changed when it reaches the final differential pressure which is determined for each product and is dependent on economic considerations. MANN Air Oil Separators and Air Oil Separator Boxes are easy to handle and install, and pose no special problems. However, the time taken to install or replace MANN Air Oil Separators and Air Oil Separator Boxes depends on the particular installation conditions and may increase in the case of larger systems with greater dimensions and component weights.
Whenever an air oil separator is installed or replaced, care should be taken to ensure that the associated seals are in a perfect state and that they are seated properly. In normal cases, the seals are selected and supplied by the compressor manufacturer.
In the case of standard elements with flow from the outside to the inside and upright installation, special attention must be paid to the discharge of drainage oil. The scavenge pipe must have the correct length and extend as far as the base cup of the element.
It is very easy to replace the so-called air oil separator boxes which are merely screwed on or off from the outside.

Quality is no coincidence
The quality features and product advantages of filters and elements are often not noticed at first glance. It is therefore important, however, to compare service life, separation efficiency and design features.

Products by MANN+HUMMEL are subjected to quality planning and assurance from development through to series maturity.

Our quality assurance system satisfies the requirements of DIN/ISO 9001 and incorporates quality in technical and organisational processes.

Zero defect production through FMEA
Design FMEA (failure mode and effects analysis) plays a vital role in defect avoidance and thus to achieve zero defect production. FMEA is used with new product developments in order to detect any weak points in the design and to define future quality characteristics. In order to detect weak points in production and define test specifications and processes, design FMEA is supplemented by process FMEA.

MANN+HUMMEL employees are capable of assuming responsibility for their own work and test the quality of manufactured products themselves. Important process parameters and test features are documented in order to monitor the manufacturing process. Quality awards from our customers document the high quality standards of our products.

A good basis for co-operation.