



MANN+HUMMEL ProVent®

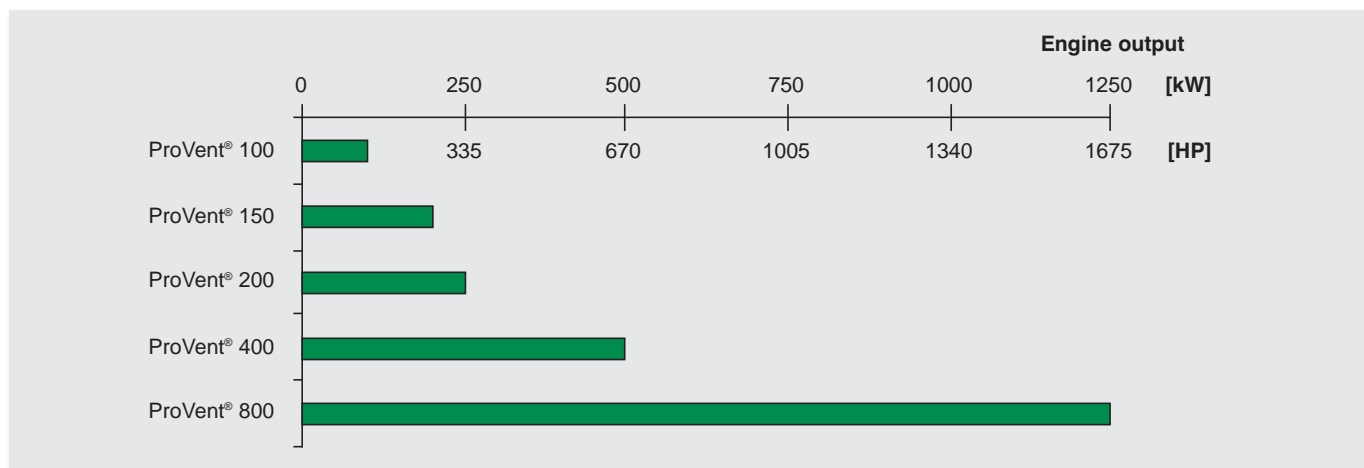
**Oil separator for closed and open
crankcase ventilation**



ProVent® – high performance with distinct advantages

The development of the whole MANN+HUMMEL ProVent® product family was directed towards the newest generation of industrial diesel engines. ProVent® sets the standard for crankcase ventilation and offers important advantages:

- Highly efficient oil separation through high performance media
- Excellent protection for the turbocharger and components fitted downstream
- Integrated safety feature against irregularly high crankcase pressure
- Low installation height to oil level possible through low pressure drop
- Lower engine oil consumption in comparison to less efficient separators or to conventional open systems without an oil separator
- Easy to service through quick access and protection against incorrect insertion of replacement element
- Suitable for universal use with different flow rates
- Excellent flexibility for choice of installation position and ports
- Compact and light design, but robust
- No auxiliary power required
- Extremely reliable, also at low temperatures
- Very low running costs
- All ProVent® products are suitable for use with open or closed crankcase ventilation



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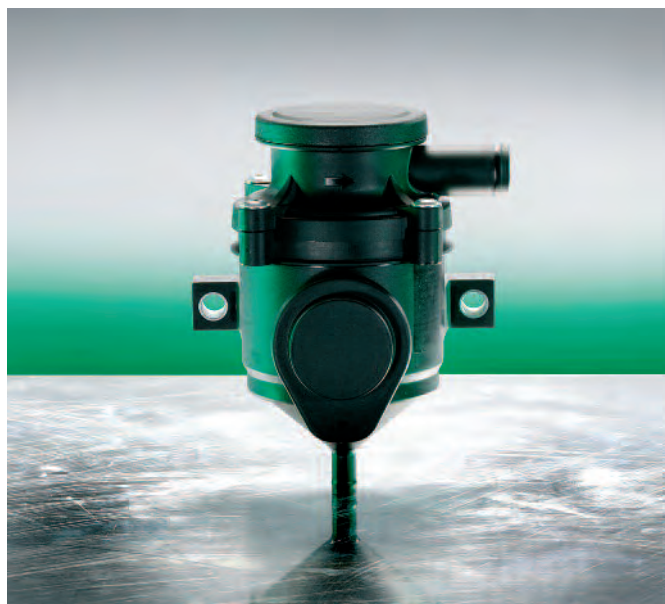
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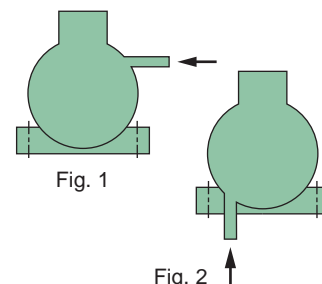
ProVent® 100

The ProVent® 100 is designed to offer compact crankcase ventilation for engines up to 100 kW and is characterised by the following advantages:

- Up to 100 l/min blow-by gas
- Compact design suitable for fitting in tight installation spaces
- Integrated pressure regulation for crankcase
- High-efficiency medium
- Available with by-pass valve or pressure-relief valve



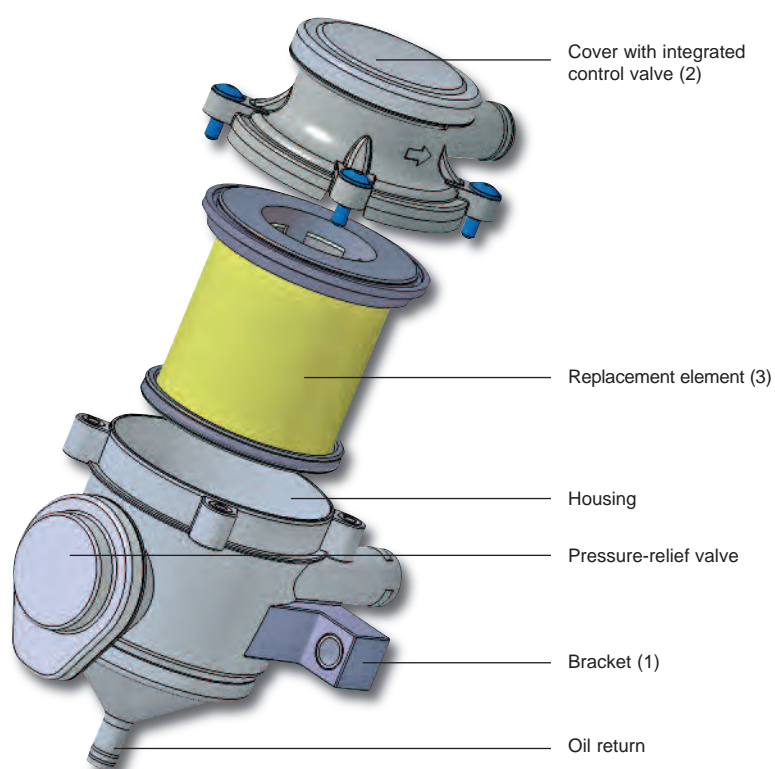
- Suitable for open or closed CCV
- Use of two ProVent® 100 in parallel possible
- Check valve for oil return available as option (recommended)
- Symmetrical element design protects against incorrect insertion



Part No.		Fig.	Blow-by inlet to housing	MANN-FILTER replacement element	
ProVent® with pressure-relief valve	ProVent® with by-pass valve			HE*	UE**
39 310 70 792	39 310 70 793	1	right	LC 7001	on request
39 310 70 790	39 310 70 791	2	rear		

* HE = High-efficiency medium

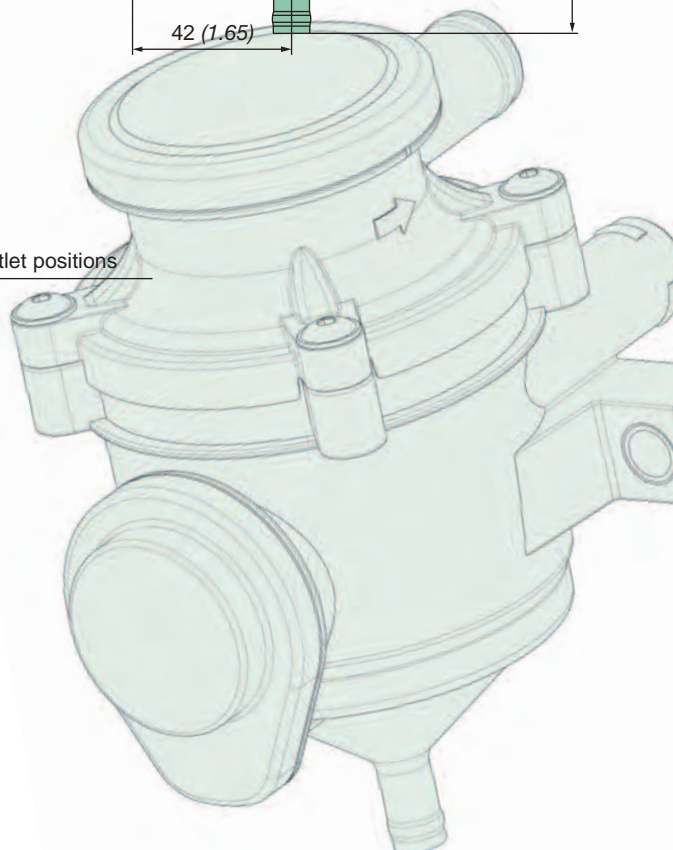
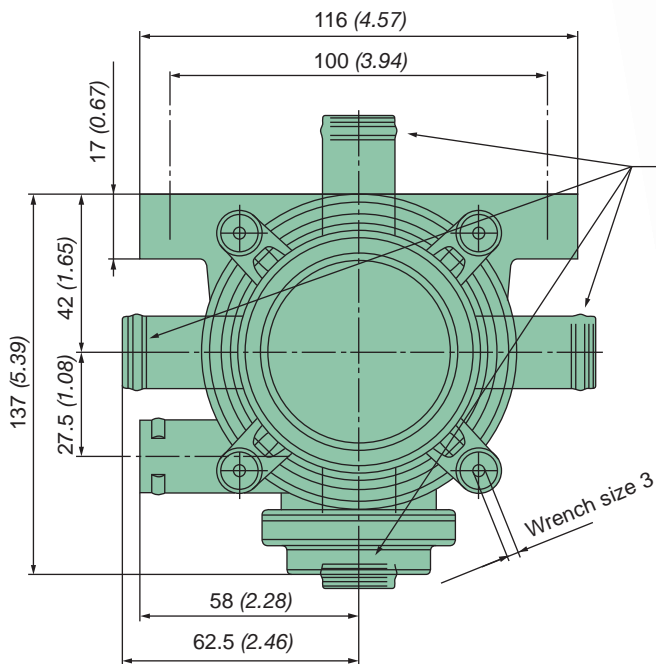
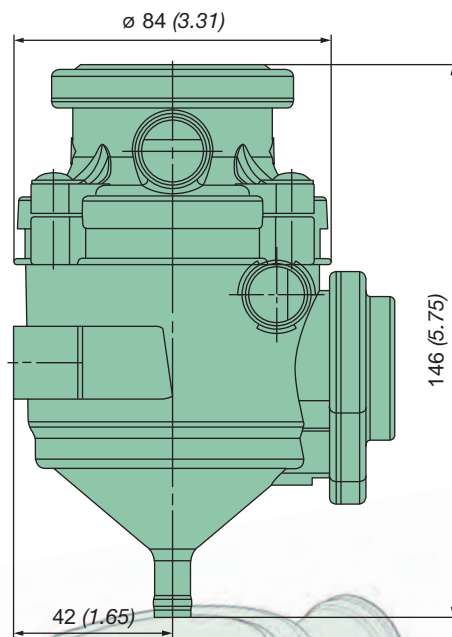
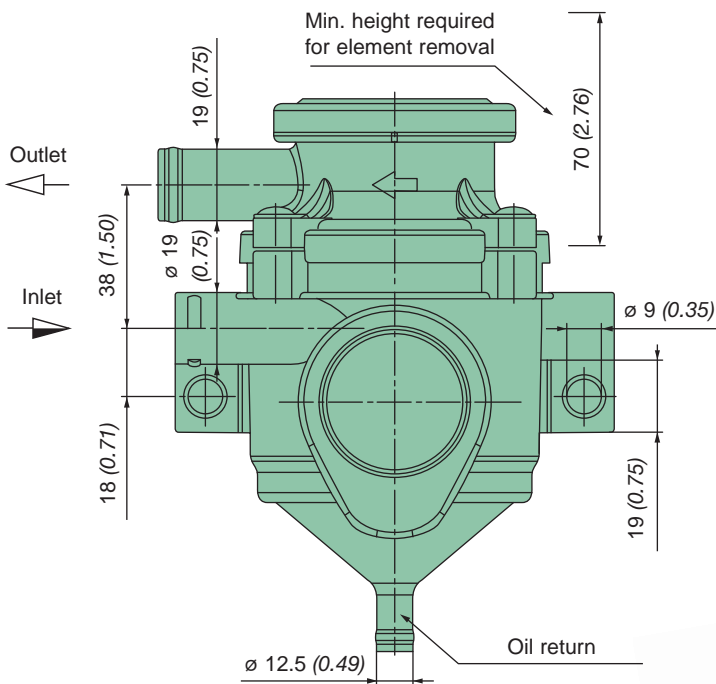
** UE = Ultra-efficiency medium



ProVent® 100 spare parts list

	Part No.	Art.	Quantity
Bracket	integrated	1	1
Cover	39 310 30 320 (integrated pressure regulation)	2	1
Replacement element HE	LC 7001	3	1

ProVent® 100 – Specifications



Standard value for use of ProVent®	single unit *	up to 100 kW
Blow-by flow rate		max. 100 l/min
Installation position		vertical
Allowed tilt position of vertical axis		45° in all directions
Positioning	Inlet	2 positions
	Outlet	4 positions
Ambient temperature		-35 °C to 120 °C, for a short time to 140 °C
Screw mounting to engine block		2 x M8
Material	Housing	PA GF
	Cover	
	Bracket	
Resistant against		diesel fuel, engine oil, lube oil, cleaning agents

* Use of two ProVent® of the same type in parallel possible

ProVent® 150



The ProVent® 150 is a compact crankcase ventilation unit for engines up to 200 kW and is characterised by the following advantages:

- Ultra-compact design
- Up to 150 l/min blow-by gas
- Equipped as standard with high-efficiency medium
- Pressure regulation
- Available with by-pass or pressure-relief valve
- Suitable for use as an open or closed CCV

- Use of two ProVent® 150 in parallel possible
- Protection against incorrect insertion of replacement element through symmetrical design
- Check valve for oil return available as option (recommended)
- Cover position adjustable in steps of 3 degrees

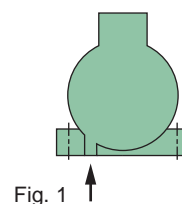


Fig. 1

Part No.		Fig.	Blow-by inlet housing	MANN-FILTER replacement element	
ProVent® with pressure-relief valve	ProVent® with by-pass valve			HE*	other
39 310 70 870	on request	1	rear (integrated in bracket)	LC 7201 X	on request
on request	on request	2	left		
on request	on request	3	right		

* HE = High-efficiency medium

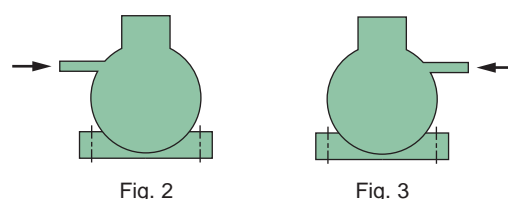
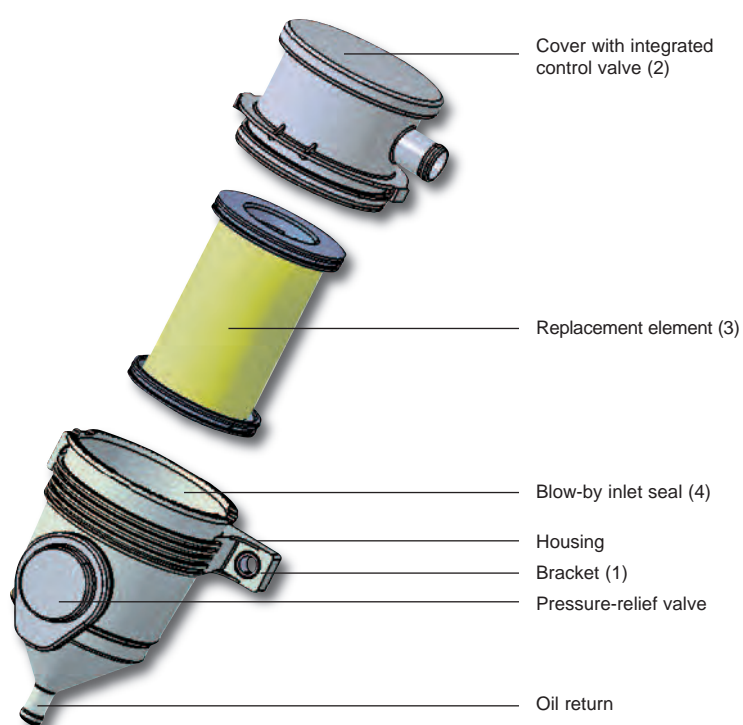


Fig. 2

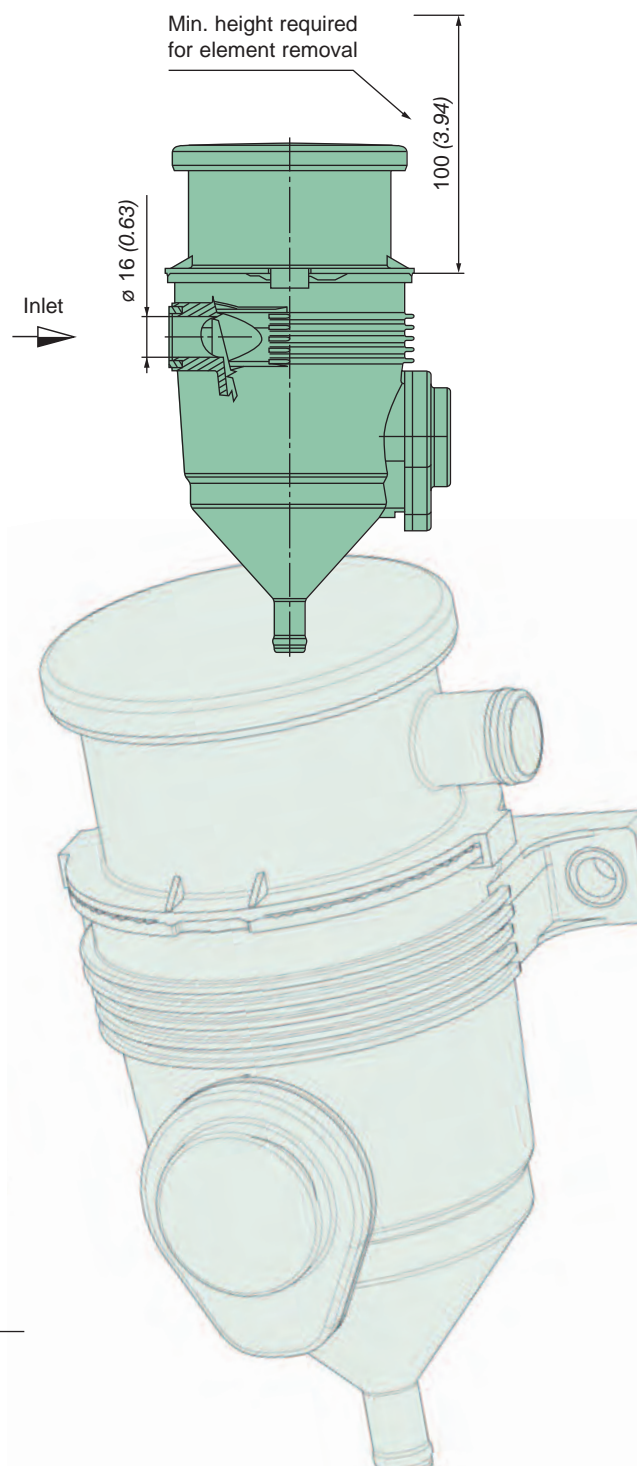
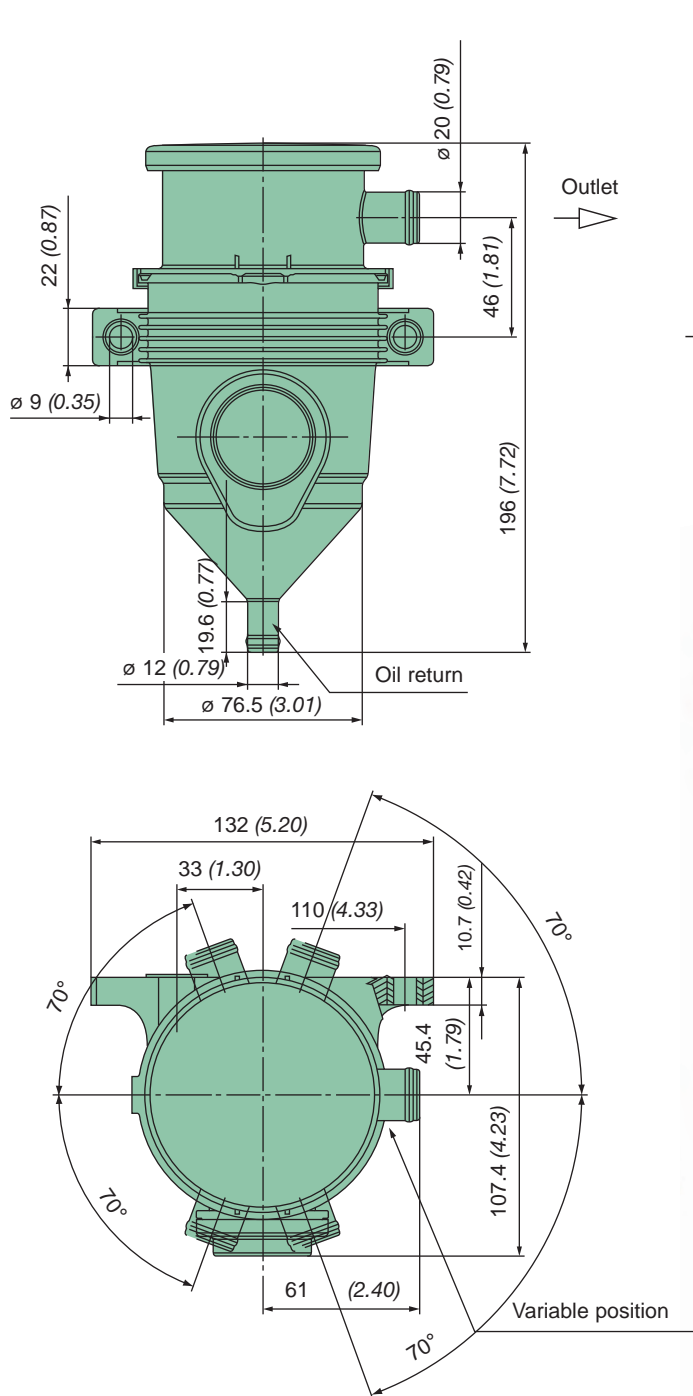
Fig. 3

ProVent® 150 spare parts list

	Part No.	Art.	Quantity
Bracket	integrated	1	1
Cover	39 310 50 990 (integrated pressure regulation)	2	1
Replacement element HE	LC 7201 X **	3	1
Blow-by inlet seal	23 019 33 171	4	1

** Sealing element for cover supplied

ProVent® 150 – Specifications



Standard value for use of ProVent®	single unit *	up to 200 kW
Blow-by flow rate		max. 150 l/min
Installation position		vertical
Allowed tilt position of vertical axis		45° in all directions
Positioning	Inlet Outlet	1 position adjustable in steps of 3 degrees!
Ambient temperature		-35 °C to 120 °C, for a short time to 140 °C
Screw mounting to engine block		2 x M8
Material	Housing Cover Bracket	PA GF
Resistant against		diesel fuel, engine oil, lube oil, cleaning agents

* Use of two ProVent® of the same type in parallel possible

ProVent® 200

The ProVent® 200 is a compact crankcase ventilation system for engines up to 250 kW and is characterised by the following advantages:

- Up to 200 l/min blow-by gas
- Very compact design
- Available with high-efficiency or ultra-efficiency medium
- Integrated pressure regulation for crankcase
- Also available with by-pass valve (integrated in separation element)



- Tool-free element replacement with protection against incorrect insertion through turn-lock mechanism and element with integrated handle
- Suitable for use with open or closed CCV system
- Use of two ProVent® 200 in parallel possible
- Check valve for oil return available (recommended)

Part No. ProVent® with pressure-relief valve	Fig.	Blow-by inlet housing	MANN-FILTER replacement element		
			HE*	UE**	HE/UE each with by-pass valve
39 310 70 550	1	Fixed position for inlet and outlet adjustable bracket	LC 5001 X	LC 5002 X	on request

* HE = High-efficiency medium

** UE = Ultra-efficiency medium

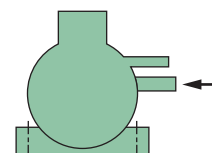
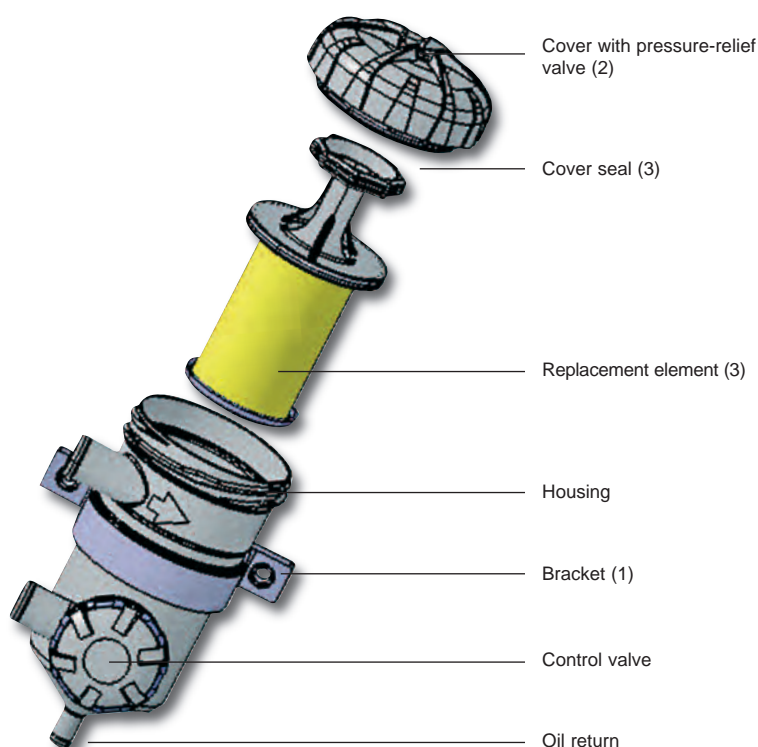


Fig. 1

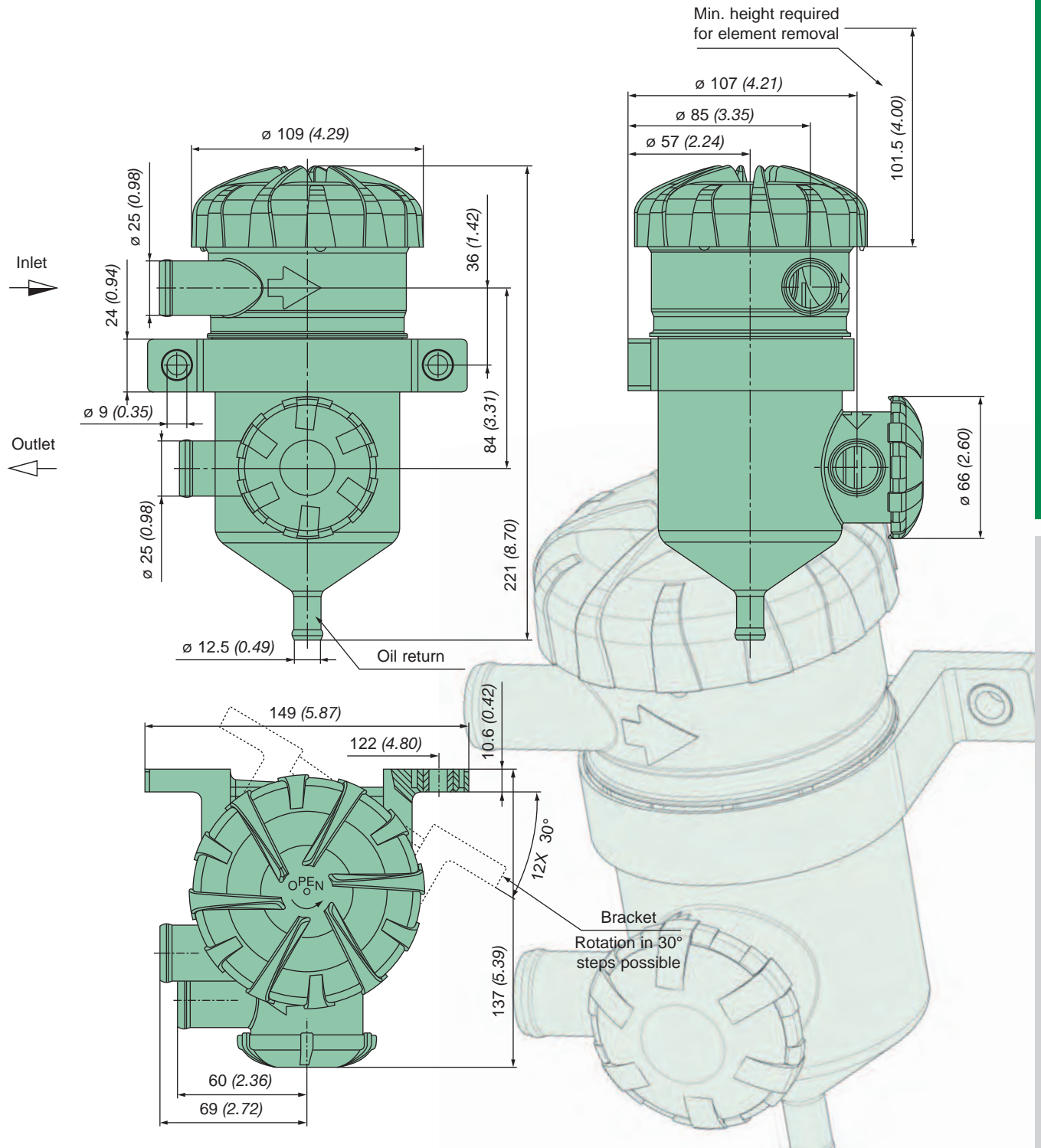


ProVent® 200 spare parts list

	Part No.	Art.	Quantity
Bracket	39 310 30 955	1	1
Cover	39 310 17 950	2	1
Replacement element HE	LC 5001 X ***	3	1
Replacement element UE	LC 5002 X ***	3	1

*** Sealing element for cover supplied

ProVent® 200 – Specifications



Standard value for use of ProVent®	single unit *	up to 250 kW
Blow-by flow rate		max. 200 l/min
Installation position		vertical
Allowed tilt position of vertical axis		45° in all directions
Positioning	Inlet Outlet	12 positions, further positions on request
Ambient temperature		-35 °C to 120 °C, for a short time to 140 °C
Screw mounting to engine block		2 x M8
Material	Housing Cover Bracket	PA GF
Resistant against		diesel fuel, engine oil, lube oil, cleaning agents

* Use of two ProVent® of the same type in parallel possible

ProVent® 400

The ProVent® 400 is a compact crankcase ventilation system for engines up to 500 kW and is characterised by the following advantages:

- Up to 400 l/min blow-by gas
- Very compact design
- High-efficiency medium
- Integrated pressure regulation for crankcase

- Very easy to service with tool-free element replacement and fitting of element and cover in only one position
- Suitable for use with open or closed CCV system
- Use of two ProVent® 400 in parallel possible
- Check valve for oil return available (recommended)



Part No. ProVent®	Fig.	Blow-by inlet housing	MANN-FILTER replacement element		
			HE*	UE**	HE/UE each with by-pass valve
39 310 70 700	1	Fixed position for inlet and outlet adjustable bracket	LC 10 001 X	on request	on request

* HE = High-efficiency medium

** UE = Ultra-efficiency medium

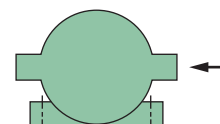
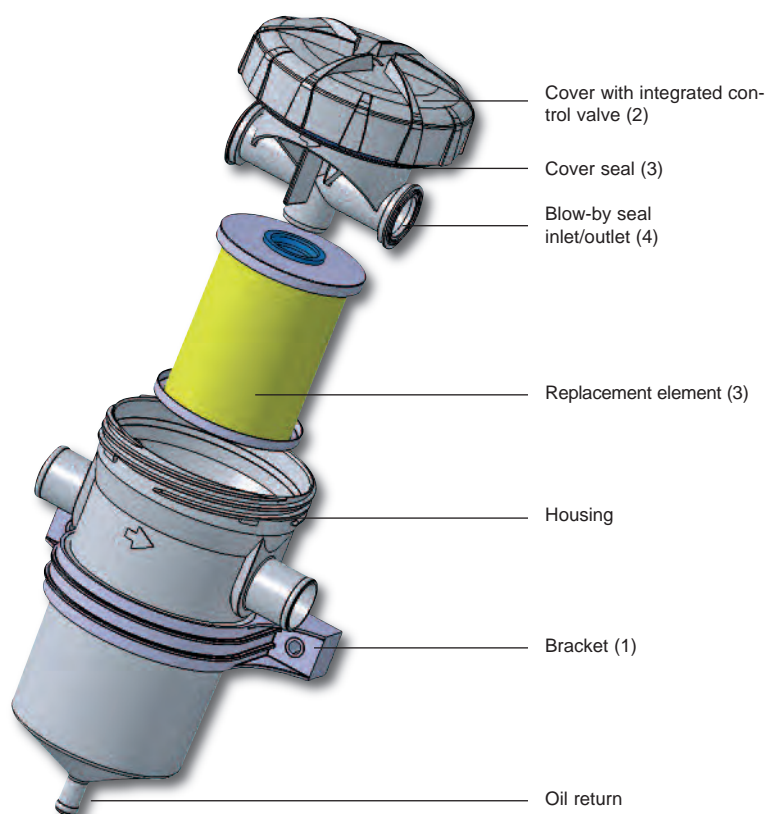


Fig. 1

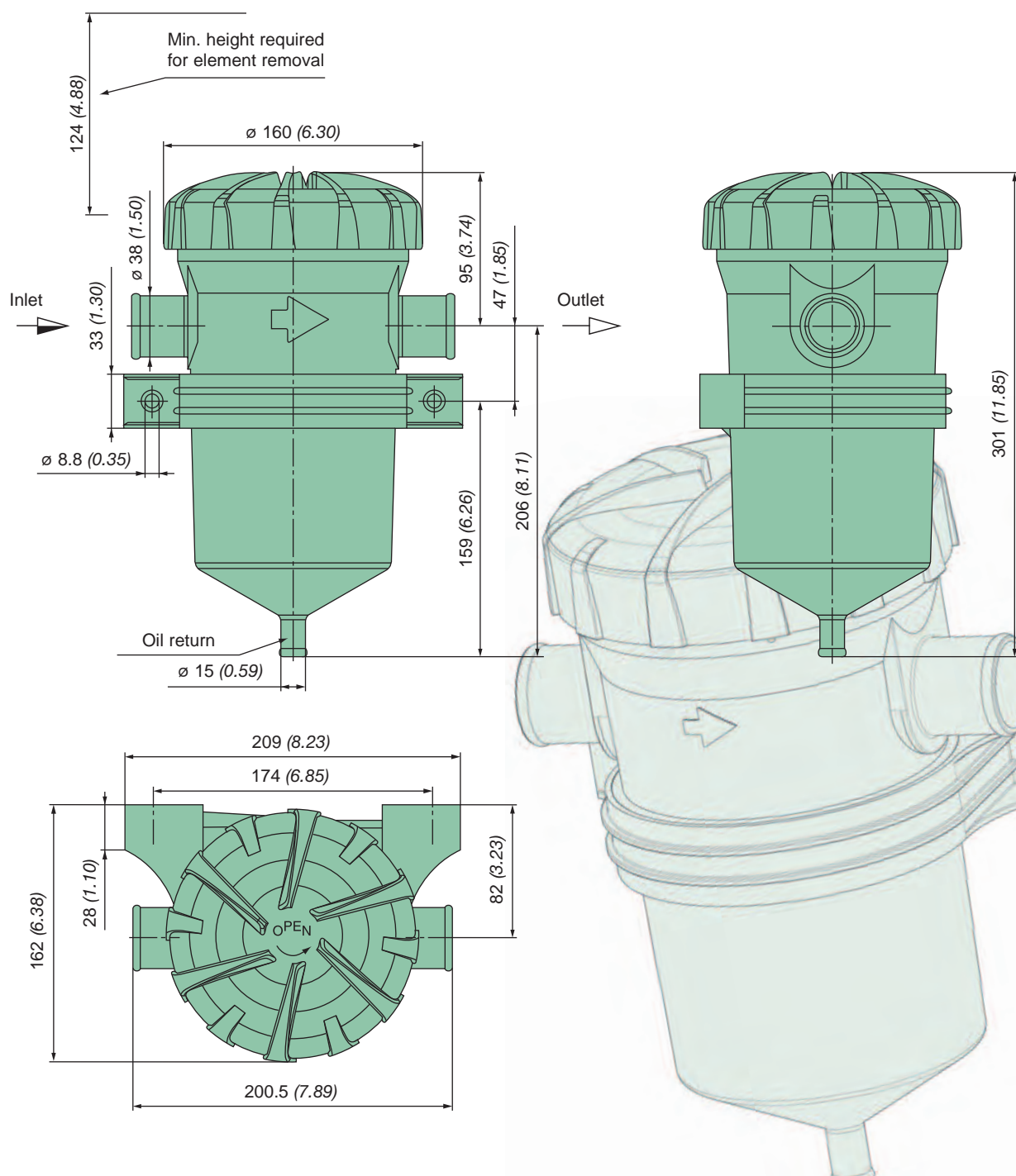


ProVent® 400 spare parts list

	Part No.	Art.	Quantity
Bracket	39 310 30 956	1	1
Cover	39 310 30 970 (integrated pressure regulation)	2	1
Replacement element HE	LC 10 001 X ***	3	1
Blow-by seal inlet/outlet	23 033 33 102	4	2

*** Sealing element for cover supplied

ProVent® 400 – Specifications



Standard value for use of ProVent®	single unit *	up to 500 kW
Blow-by flow rate		max. 400 l/min
Installation position		vertical
Allowed tilt position of vertical axis		45° in all directions
Positioning	Inlet Outlet	12 positions
Ambient temperature		-35 °C to 120 °C, for a short time to 140 °C
Screw mounting to engine block		2 x M8
Material	Housing Cover Bracket	PA GF
Resistant against		diesel fuel, engine oil, lube oil, cleaning agents

* Use of two ProVent® of the same type in parallel possible

ProVent® 800



The ProVent® 800 is the largest available crankcase ventilation system. It is suitable for engines up to 1250 kW and is characterised by the following advantages:

- Extremely stable design in steel (housing and bracket)
- Up to 1000 l/min blow-by gas
- Equipped as standard with high-efficiency medium
- Pressure regulation
- Suitable for use as open or closed crankcase ventilation system
- Pressure-relief and by-pass valve available on request
- Use of two ProVent® 800 in parallel possible
- Easy to service through tool-free element replacement and fitting of element and cover in only one position
- Check valve for oil return available (recommended)

Part No. ProVent®	Fig.	Blow-by inlet housing	MANN-FILTER replacement element		
			HE*	UE**	HE/UE each with by-pass valve
39 310 70 800	1	Fixed position for inlet and outlet adjustable bracket	LC 16 001 X	on request	on request

* HE = High-efficiency medium

** UE = Ultra-efficiency medium

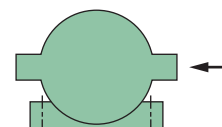
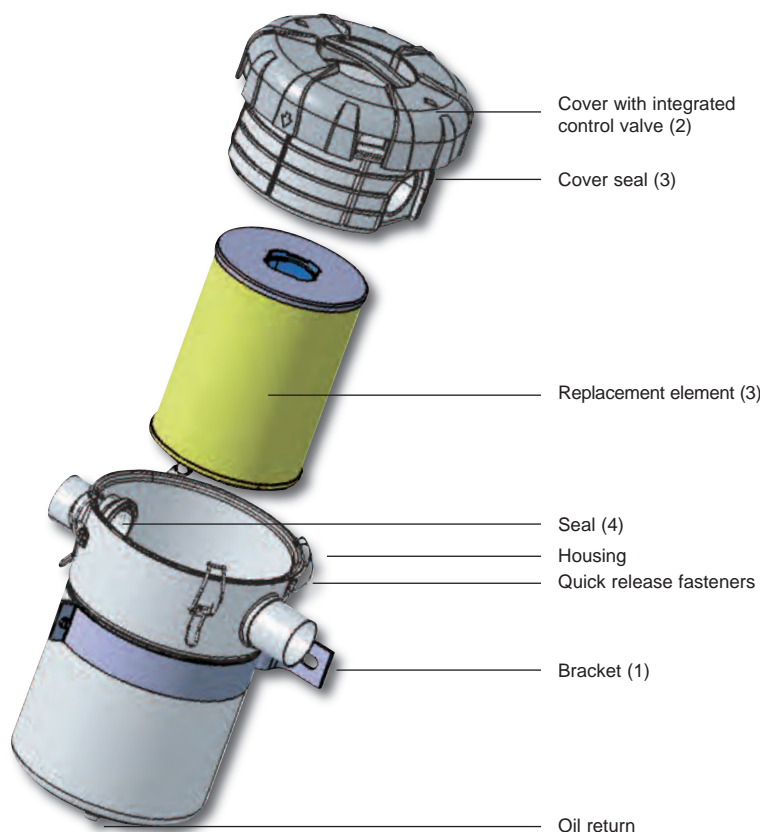


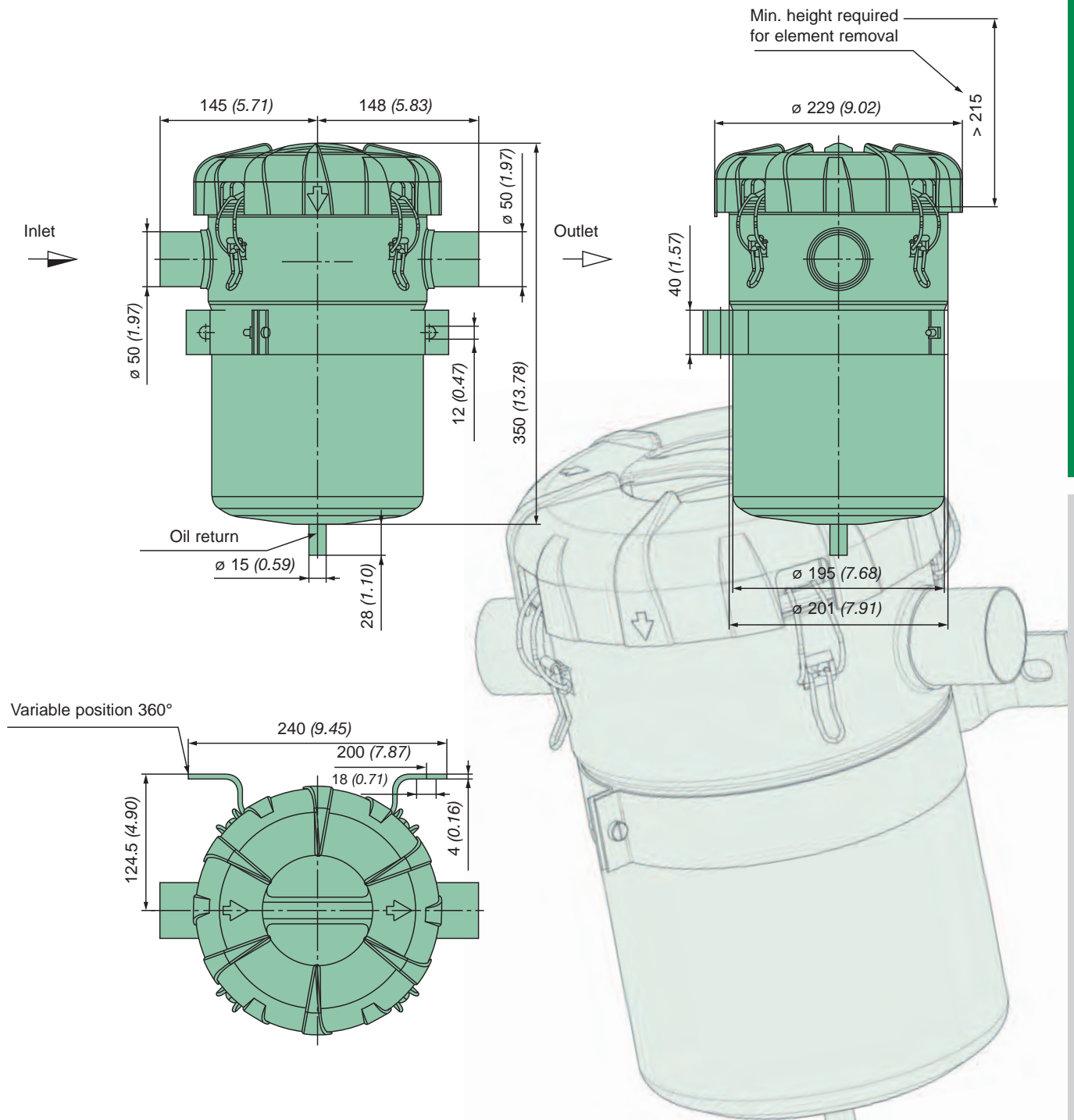
Fig. 1

ProVent® 800 spare parts list

	Part No.	Art.	Quantity
Bracket	39 165 38 970	1	1
Cover	39 111 71 948 (integrated pressure regulation)	2	1
Replacement element HE	LC 16 001 X ***	3	1
Blow-by seal inlet/outlet	23 051 33 131	4	2

*** Sealing element for cover supplied

ProVent® 800 – Specifications



Standard value for use of ProVent®	single unit *	up to 1250 kW
Blow-by flow rate		max. 1000 l/min
Installation position		vertical
Allowed tilt position of vertical axis		45° in all directions
Positioning	Inlet Outlet	stepless
Ambient temperature		-35 °C to 120 °C, for a short time to 140 °C
Screw mounting to engine block		2 x M10
Material	Housing Cover Bracket	Steel PA GF Steel
Resistant against		diesel fuel, engine oil, lube oil, cleaning agents

* Use of two ProVent® of the same type in parallel possible

ProVent® – Protects the crankcase and the environment

The service life of diesel engines used in commercial and industrial applications is longer than the service life of diesel engines used in motor cars. Therefore components of diesel engines used in industrial applications are subject to higher requirements with regard to efficiency and lifetime. One of these components is the closed crankcase ventilation system, which is becoming increasingly important.

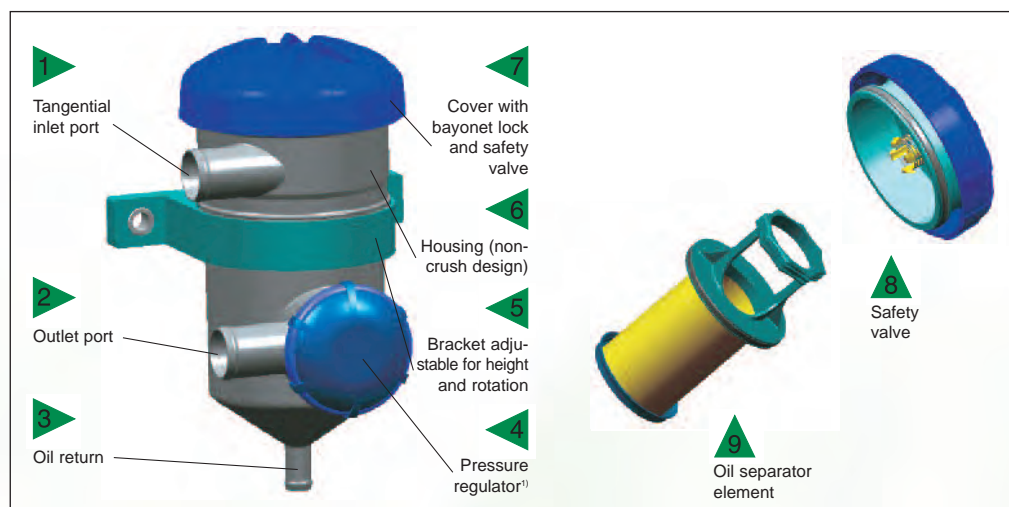


Fig. 1: Components with example of ProVent® 200 ¹⁾ only effective with closed systems

Generation of blow-by gases

For every piston stroke in a combustion engine there are exhaust gases which flow between the piston rings and sleeves. These gases enter the crankcase. In turbocharged engine applications, air can also make its way into the crankcase through the oil return pipe of the turbo-

charger. These gases are generally called **blow-by gases**. The pressure they generate leads to an unacceptable pressure build-up and crankcase ventilation becomes necessary.

In many countries, regulations governing car emissions

stipulate that gases removed from the crankcase during the ventilation process must not enter the atmosphere. That is the reason why blow-by gases from car engines are redirected by so-called closed crankcase ventilation to the intake pipe assembly and burned. Commercial and

industrial diesel engines are also subject to international emission regulations which in future can only be met through the application of reliable closed crankcase ventilation systems.

Closed crankcase ventilation

All MANN+HUMMEL crankcase ventilation solutions are suitable for use in closed systems. They therefore offer ideal protection for the crankcase and enable compliance with future environmental regulations. Contaminants can cause damaging, oily deposits in

the engine intake, turbocharger and charge cooler. In addition, they compromise engine performance, increase fuel consumption and shorten engine life. To avoid this, an oil separator (9) is used to remove oil from the blow-by gas. The separated engine oil is then returned to the

oil sump without loss where it can re-enter the oil circuit. After the blow-by gases are cleaned in the oil separator, they pass the pressure valve (4). This valve regulates the pressure inside the crankcase to within permissible limits.

Open crankcase ventilation

All ProVent® systems can also be used for open crankcase ventilation. In this case the pressure regulator of the ProVent® is not in operation. The outlet port (2) leads to the atmosphere. In this configuration there is a slight excess pressure in the crankcase.

Design and function of ProVent®

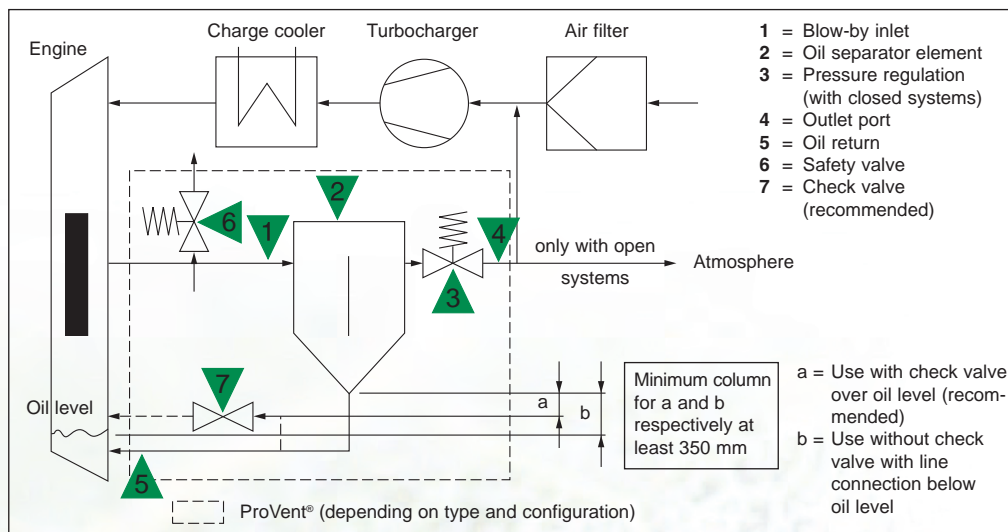


Fig. 2: Diagram of closed and open crankcase ventilation

Design and function of ProVent®

During development of the ProVent®, priority was given to functionality and design. High quality, robust components (see Fig. 2) are representative of the high performance of the whole system.

Oil separator

The filter elements used by MANN+HUMMEL (see item 2 in diagram) are the result of intensive development work and experience. The respective medium is perfectly matched to each ProVent® while satisfying the requirements for quality and economy. The high performance coalescence separators are able to reduce the residual oil content of the blow by gas to an extremely low level. Depending on the particle spectrum of the oil content, the separator uses the most appropriate separation principle. As a result, ProVent® is ideally suitable to comprehensively meet the require-

ments of the next generation of engines. Servicing of the oil separator is made according to the installation and maintenance instructions under consideration of the specifications of the engine producer.

Pressure regulation

In closed systems the pressure regulator (item 3 in diagram) can be set as required to maintain a constant level independent of the negative pressure of the air intake manifold. The set pressure level simply depends on the quantity of blow-by gases (see Fig. 3). The crankcase pressure remains within a narrow

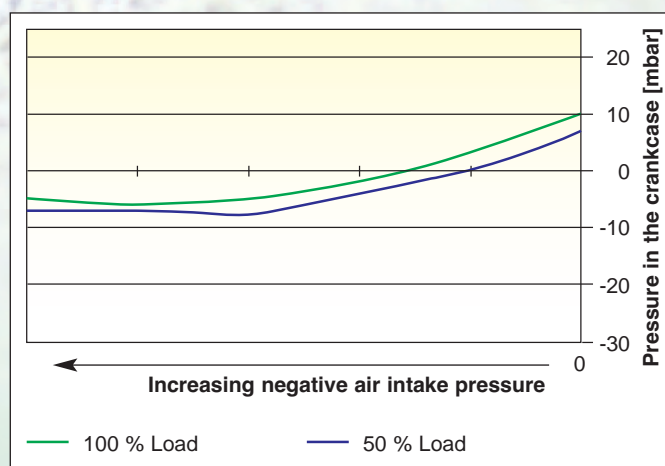


Fig. 3: Pressure adjustment curve (ProVent® 200)

range even with a variable negative air intake pressure and fluctuating blow-by gas volumes. The pressure regulator does not operate in an open ProVent® system.

Housing

All ProVent® systems have a low flow resistance in order to protect the engine from excessive crankcase pressure. Generous cross-section

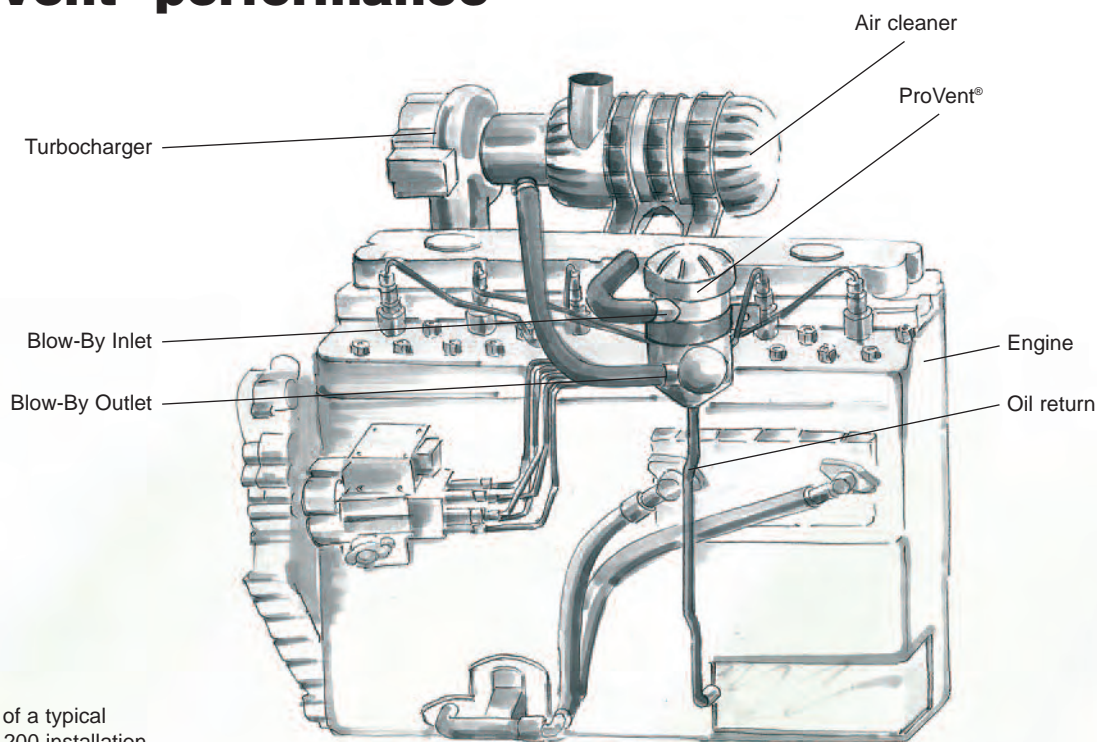
connections and other technical details facilitate the flow and ensure that its compact design is not subject to high flow resistance.

Safety valve

A safety valve (item 6 in diagram) is integrated in the housing cover to protect the engine from an impermissible rise in pressure in case other components fail. If the engine is fitted with a crankcase pressure monitoring

system, it is possible to configure the bypass valve such that the opening pressure of the safety valve is greater than the pick-up pressure of the monitoring pressure on the engine side.

ProVent® performance



Example of a typical ProVent® 200 installation.

Fractional separation efficiency

As there is no standard governing the determination of separation efficiency, it is not possible to publish standardised values. However, numerous tests have shown that operating conditions such as speed, output, torque and age of the unit are relevant factors with regard to the generation of oil droplets. Thus the size and distribution of the oil droplets partly depend on these factors.

The separation efficiencies listed in the table for MANN+HUMMEL HE and UE media relate to an oil presence of $\leq 1 \text{ g/m}^3$ in the blow-by gas with an oil droplet distribution of $d_s = 0.8$ (Sauter diameter).

Separation efficiencies of media types		
Medium	Efficiency	Δp
HE	80 - 85 %	10 - 15 mbar
UE	85 - 90 %	20 - 35 mbar

In respect of the Δp value, a lower value signifies a greater flexibility with regard to the mounting location. If the Δp is lower, the ProVent® can be fitted closer to the oil level or check valve in the oil return pipe of the engine.

The exact fractional separation efficiencies, i.e. the separation efficiencies of certain particle size ranges, have to be determined for the respective application in tests.

The non-existence of a standard and numerous operating parameters requiring definition mean that in many cases dimensioning of the filter is necessary.

In this case MANN+HUMMEL offers support and technical assistance.



Instructions regarding the use of ProVent®

Mounting location on the engine

ProVent® systems are designed for OE producers and are also suitable for retrofitting.

Instructions

- ProVent® can be fitted to the engine or application frame.
- Observe the installation and maintenance instructions of the respective ProVent® system.

Connection to the engine

Observe the following when connecting to diesel engines:

- Position the blow-by outlet in an area free of splashing oil (e.g. upper area of the crankcase).
- Observe the mounting and maintenance instructions of the respective ProVent® system.

Connection with a closed system

The respective outlet port is connected to the engine intake. As opposed to conventional systems, the ProVent® installation location is practically independent of the negative air intake pressure on the outlet port. The result is a large degree of flexibility for the fitting position on the engine. The negative air intake pressure present during

operation sucks the blow-by gas via ProVent® and returns the cleaned blow-by gas to the engine air intake.

Connection with an open system

The blow-by gas now free of oil is released into the atmosphere.

Oil return

The respective port of the oil return (see diagram on page 15) is connected to the oil sump via a drainage pipe. There are two principal connection possibilities:

1. Below the oil level

The oil return is connected via a drainage pipe below the minimum permissible oil level of the engine oil sump. According to the principle of connected pipes, the same oil level is present in the oil sump and the drainage pipe. This oil receiver acts like a siphon so that when the oil is sucked from the outlet port the blow-by is directed via the oil separator. The negative pressure in the oil return pipe during operation is the same as the negative pressure at the oil separator. As opposed to conventional solutions, this intake negative pressure is reduced due to design considerations so

that the height of the oil column in the drainage pipe during operation is accordingly low. As a result the drainage pipe need only take into account a respectively low oil column and this enables numerous installation possibilities.

2. Above the oil level

This connection variation requires fitting of a check valve which is available as an option. The valve is fitted in the drainage pipe as close to the engine as possible. Separated oil collects above the check valve during operation. The check valve is

closed during operation by the negative suction pressure present in the housing of the ProVent®. When the weight of the oil column is above the closing pressure of the valve, for example when the engine has been switched off, the separated oil flows back to the oil sump.

Instruction

In all cases observe Fig. 2 on page 15, the general overview, and the respective installation and maintenance instructions.



ProVent® – Overview

			ProVent® 100	ProVent® 150	ProVent® 200	ProVent® 400	ProVent® 800
Specifications	Standard value for use of ProVent®	single * up to [KW]	100	200	250	500	1250
		single * up to [HP]	135	270	340	675	1690
	Blow-by flow rate (single unit)		max. 100 l/min	max. 150 l/min	max. 200 l/min	max. 400 l/min	max. 1000 l/min
	Installation position		vertical				
	Allowed tilt position of vertical axis		45° in all directions				
	Positioning	Inlet	2 positions	1 position further on request	12 positions	12 positions	stepless
		Outlet	4 positions	adjustable in steps of 3°	further positions on request		
	Ambient temperature		-35 °C bis 120 °C, kurzzeitig bis 140 °C				
	Screw mounting to engine block		2 x M8				2 x M10
	Material	Housing	PA GF				Bracket
		Cover					PA GF
		Bracket					Bracket
Resistant against		diesel fuel, engine oil, lube oil, cleaning agents					
Weight		0.25 kg	0.33 kg	0.39 kg	1.20 kg	5.41 kg	

Part Nos.	ProVent® standard version	Complete	39 310 70 792	39 310 70 870	39 310 70 550	39 310 70 700	39 310 70 800
		with element	HE element **				
	Oil separator element	HE **	LC 7001	LC 7201 X	LC 5001 X	LC 10 001 X	LC 16 001 X
		UE **	on request	on request	LC 5002 X	on request	on request
	Check valve for oil return (recommended)		24 008 43 621			24 013 45 992	

Configuration & instructions	Highly efficient oil separation		S	S	S	S	S
	Crankcase pressure regulation		S	S	S	S	S
	Oil return		S	S	S	S	S
	Mounting bracket		S	S	S	S	S
	Pressure-relief valve		S	S	S	O	O
	Check valve for oil return (recommended)		O	O	O	O	O
	By-pass valve		option instead of pressure-relief valve		option	on request	on request
	Used as open CCV system		yes	yes	yes	yes	yes
	Used as closed CCV system		yes	yes	yes	yes	yes
	Service interval		depends on the application				
	Installation height of ProVent® above check valve or oil level	Stationary applications	For continuous operation at the rated load dimensioning is necessary by MANN+HUMMEL.				
		Mobile applications	min. 350 mm with use of the check valve				

O = Option

S = Series/within scope of delivery

* Use of two ProVent® of the same type in parallel possible

** HE = High-efficiency medium UE = Ultra-efficiency medium