



ADDITIONAL MANUAL FOR KEEL COOLING APPLICATIONS

WHISPER GENERATOR SETS



Art.nr. 50200251

MASTERVOLT
Snijdersbergweg 93,
1105 AN Amsterdam
The Netherlands
Tel.: +31-20-3422100
Fax.: +31-20-6971006
www.mastervolt.com

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THIS MANUAL HAS TO BE READ IN COMBINATION WITH THE STANDARD USER'S AND INSTALLATION MANUAL

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1 INTRODUCTION

1.1 GENERAL

This installation manual applies to the installation and use of Mastervolt Whisper generator sets in marine applications using keel-cooling. This manual is valid for the following models:

Part number	Description
51102020	Whisper 6 - 230V 3000rpm – Mobile / keel cooling
51103026	Whisper 6 - 230V 3000rpm – Mobile / keel cooling -ungrounded
51104020	Whisper 10 - 230V 3000rpm – Mobile / keel cooling
51104026	Whisper 10 - 230V 3000rpm – Mobile / keel cooling -ungrounded
51105020	Whisper 6 Ultra 230V 1500rpm – Mobile / keel cooling
51105026	Whisper 6 Ultra 230V 1500rpm – Mobile / keel cooling -ungrounded
51106020	Whisper 8 Ultra 230V 1500rpm – Mobile / keel cooling
51106026	Whisper 8 Ultra 230V 1500rpm – Mobile / keel cooling -ungrounded
51107020	Whisper 12 Ultra 230V 1500rpm – Mobile / keel cooling
51107325	Whisper 12 Ultra Three Phase 230V-400V 1500rpm – Mobile / keel cooling
51107326	Whisper 12 Ultra Three Phase 230V-400V 1500rpm – Mobile / keel cooling -ungrounded
51108325	Whisper 16 Ultra Three Phase 230V-400V 1500rpm – Mobile / keel cooling
51108326	Whisper 16 Ultra Three Phase 230V-400V 1500rpm – Mobile / keel cooling -ungrounded
51107026	Whisper 12 Ultra 230V 1500rpm – Mobile / keel cooling -ungrounded
51108020	Whisper 16 Ultra 230V 1500rpm – Mobile / keel cooling
51108026	Whisper 16 Ultra 230V 1500rpm – Mobile / keel cooling -ungrounded
51101020	Whisper 25 Ultra 230/400V 1500rpm – Mobile / keel cooling
51101026	Whisper 25 Ultra 230/400V 1500rpm – Mobile / keel cooling -ungrounded

For other models see our website: www.mastervolt.com

This manual has to be read in combination with the standard users manual and installation manual for Whisper generator sets that apply to marine installations based on seawater cooling (inter-cooling) This manual contains instructions for installation as well as for operation.



WARNING

A warning symbol draws attention to special warnings, instructions or procedures which, if not strictly observed, may result in damage or destruction of equipment, severe personal injury or loss of life.



DANGER

This danger symbol refers to electric danger and draws attention to special warnings, instructions or procedures which, if not strictly observed, may result in electrical shock which will result in severe personal injury or loss of life.



WARNING!

Before working (installation) on the system read the section safety instructions in the user's manual

1.2 KEEL COOLING

When using a marine sea water cooling system, seawater is pumped by an impeller pump through a heat exchanger and dumped overboard via the exhaust. The heat exchanger unit is normally mounted on the engine. When the cooler is part of the construction of the ship, we talk about "keel cooling". This cooler can be a section of the keel or a ballast water tank. Sometimes one uses pipes welded along the bottom, or a special designed cooler to be mounted in the bottom. A specially designed cooler that is often used in the hull of steel ships is called a "box-cooler" and is available as a Mastervolt installation kit. Coolers to be mounted in the hull of wooden boats and boats made of fibreglass are available on the market but rarely used. Mastervolt does not supply these coolers. This manual refers to the box-cooler units, which are supplied by Mastervolt. Similar instructions are valid for other types of keel cooling.

1.3 DIFFERENT COOLING AND EXHAUST

A keel-cooling system and as a consequence the dry exhaust system is completely different from standard “wet” or “intercooling” marine systems. Standard marine generators are cooled by seawater that nowhere exceeds 30° Celsius and is seldom warmer than 20° Celsius in the northern territories. Cold seawater is pumped through the alternator, through a heat exchanger and is injected in the exhaust. The exhaust gasses are therefore cooled and rubber exhaust hose can be used.

With most Mastervolt generator sets both the alternator and the engine are water cooled. Therefore, when applying keel-cooling, two cooling systems are necessary: one for the engine and one for the alternator. Exception: the alternators of the Whisper 25 Ultra, Whisper 12 Ultra Three Phase and Whisper 16 Ultra Three Phase are air cooled. Therefore these generator-sets need one cooling system, for the engine only.

The exhaust is of the dry type and includes a stainless flexible bellow and high quality metal mufflers.



Never use rubber exhaust hose, neither fibreglass nor plastic exhaust parts in a dry exhaust system.

1.3.1 Why two coolers:

The optimum engine operating temperature is 87° up to 95° Celsius. The cooler cools the temperature of the cooling liquid in the engine only 5° to 12° down. The returning “cold” coolant therefore has a minimum temperature of 75° Celsius. The alternator should be kept as cool as possible. In practice an alternator starts getting less efficient above 40° Celsius. Because of the divergence in the working temperature of engine and alternator it will be clear that it is not possible to combine the cooling of the engine and alternator in one cooler system.

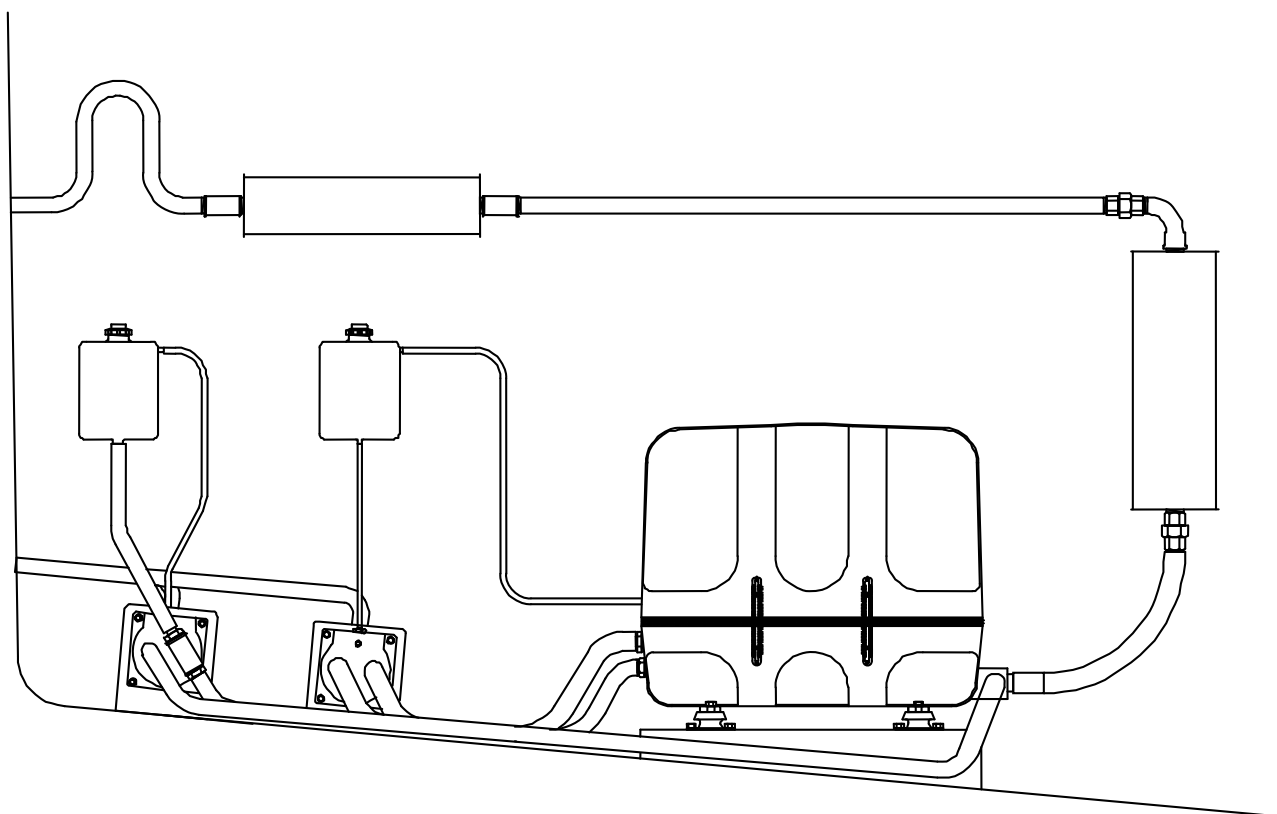


Figure 1: Typical keel-cooling application

2 INSTALLATION

2.1 INSTALLATION OF THE COOLERS

2.1.1 General

Different from marine inter-cooling systems, marine keel-cooling systems use an open -non pressurised-system. Therefore the 12 mm overflow pillar on the expansion tank should stay open. A piece of hose can be used to drain redundant liquid that is thrown out because of the expansion of the liquid in the system. When open the expansion tanks can easily release air that is ventilated by the different connections.

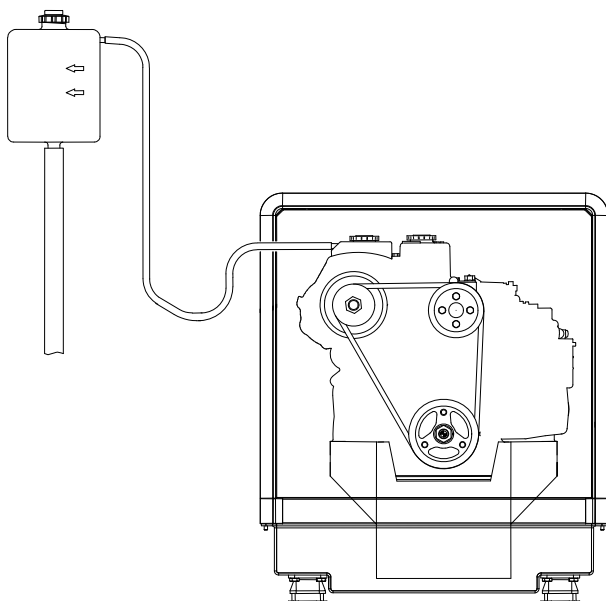


Figure 2: The exhaust manifold to be ventilated into the expansion tank

It is necessary to ventilate the exhaust manifold. The exhaust manifold has a cap that let the 8 mm connection open to ventilate the manifold. There is a 8 mm inner diameter high temperature resistant synthetic hose in the delivery to connect the hose connection on the side of the filling cap of the manifold with the expansion tank. This hose can go down first through a hole one has to drill in the lower green part of the soundshield canopy and than up again to the expansion tank. (refer to figure 2).

2.1.2 Location of the box-coolers

Box-coolers can be installed in the bottom or in the side of a steel vessel. A hole is made in the hull and the box cooler is welded in this hole. When the box is on the bottom a connection has to be made from the top of the cooler to the side of the ship to release the air and optimise the flow of water through the cooler. A 90° elbow is in the box cooler kit. (refer to figure 3)

2.1.3 Ventilation and expansion tank

Special attention should be spent to the ventilation of the systems. Each installation system is standard supplied with an expansion tank for the coolant, that is also used to release air bubbles and makes it possible to add coolant to the system in an easy way. This expansion tank should be at the highest point of the system.

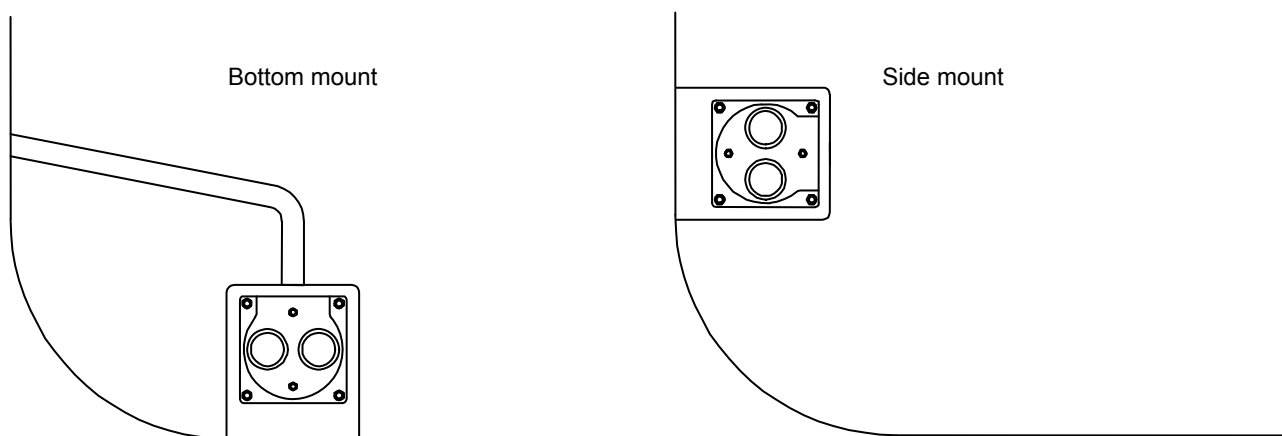


Figure 3: Bottom mount and side mount box cooler



Most cooling problems originate from air traps blocking the circulation of the engine coolant.



It is prescribed to have the expansion tank of the engine cooling system connected to the outlet connection of the cooler unit.

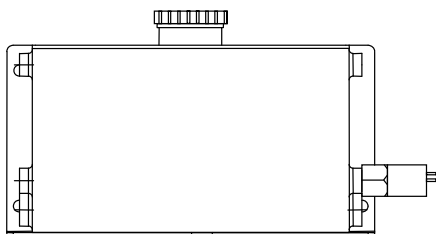


Figure 4:
7 litres optional expansion tank with low level alarm.

As a keel-cooling system mostly contains much coolant a large seven litres expansion tank with low level alarm is recommended for the engine cooling system (refer to fig. 4 and fig. 5, detail A)

The alternator system can be ventilated on the box cooler and a small expansion tank will be sufficient (refer to figure 5 detail B).

2.1.4 Further recommendations

As the (indirect) cooling by outboard water is very efficient, keel cooling is without problems. Most important is to avoid air traps in the piping and additional ventilation of the pipes can be necessary when bents are not to be avoided (refer to figure 7).

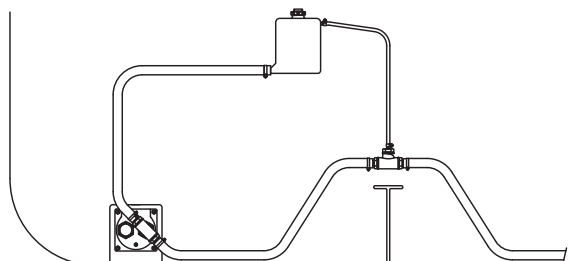


Figure 7: Ventilating an air trap

2.1.5 Cooling capacity

Using a box cooler the outboard water will bring the temperature of the engine coolant only 10 up to 15° Celsius down. The difference between 90° "in" and 80° "out" (ΔT) is hardly noticeable. So do not conclude too fast that the system is not working well. When using another system than the recommended box-coolers one has to be certain that the cooling capacity is enough. Paint and fouling on the hull or on pipes along the bottom can reduce the cooling capacity of the system.

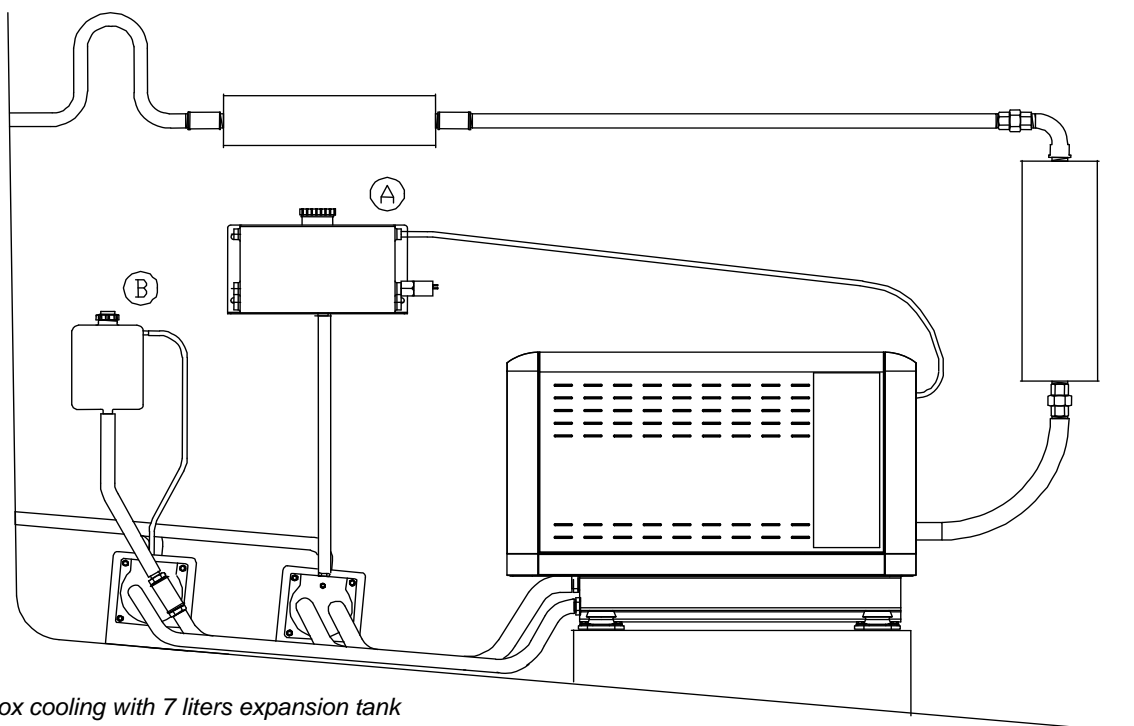


Figure 5: Box cooling with 7 liters expansion tank

2.2 DRY EXHAUST SYSTEM

2.2.1 General remarks

A dry exhaust muffler system should be as effective in silencing the exhaust as a wet marine exhaust system when applying the right mufflers. However noise could be generated by vibrations in the mufflers and be transferred to the structure of the ship. Tacit factors like the length of specific pipe sections could be important. It is very difficult to take these factors into account.



A dry exhaust system on a boat can generate noise problems caused by resonance of the pipes and mufflers.

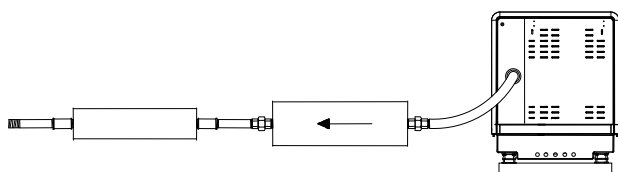


Figure 8: Dry exhaust system

The standard Mastervolt exhaust kit contains the materials to perform a professional installation. In the kit is a stainless steel flexible bellow (hose) to prevent vibrations to be transferred. Also rubbers are supplied to mount the mufflers flexible. The insulation blanket for the flexible bellow and the mufflers are also very effective in damping vibrations. Still it could be that additional measures has to be taken like an extra clamp in a vibrating section of pipe, insulation blankets on other parts of the system and possibly even additional mufflers.



Special care has to be given to avoid water from outside to get into the system. When the exhaust is led through the deck or through the roof of the wheelhouse, measures has to be taken to prevent rainwater to enter the system. Special rain caps are available as an option.

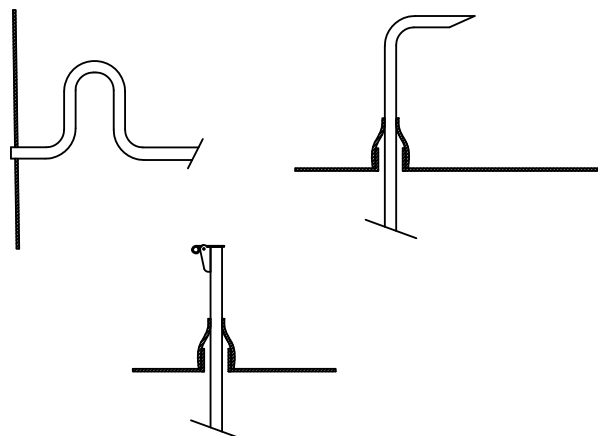


Figure 9. Ways to prevent water to get in

A negative feature of a dry exhaust system is the heat radiated by its components.

Measures are to be taken to overcome the heat problem: The exhaust bent to bring the exhaust out of the canopy is cooled by water. Insulation blankets are included in the exhaust kit to insulate the flexible bellow and the mufflers. When a dry exhaust has its outlet on the deck or the roof, all the pipes inside the ship that can be touched by people, has to be insulated.



The exhaust pipes will be very hot and all accessible pipes are dangerous to people when not insulated.

There are companies that are specialised in insulating hot pipes and fancy systems are available to make it good looking. However it is also possible to do it yourself by winding fibreglass around the pipes and seal it with aluminium tape.

2.2.2 The standard dry exhaust system

The standard exhaust system contains:

On the generator set:

- An insulated exhaust bent

In the exhaust installation kit:

- A stainless steel shielded flexible bellow.
- One resonance muffler
- One absorption muffler
- Clamps and rubbers to mount the system flexible
- Fittings, bents and pipes to make the different connections
- Blankets for thermal and sound insulation.

The mufflers are high quality industrial mufflers that are much more effective, robust and durable than mufflers made for automotive use.

2.2.3 Installation of the exhaust

Before determining the location of the generator set one has to consider how to get away with the exhaust. The outlet should blow the fumes away from the doors to avoid a nasty smell. In wind still conditions a light smell of exhaust fumes around then vessel will not be avoidable.

To bring the exhaust to the top of the roof of the wheelhouse gives the best results on noise and smell. However, when the pipes go through the interior of the vessel, they should be insulated and around the hole in the roof should be a collar to prevent rainwater to leak in. Both mufflers could be on the roof or one of them or both could be below the deck.

In general it is better to have the mufflers wide apart: the resonance muffler close to the generator and the absorption muffler on the end of the line. A short pipe (30cm / 1 ft.) should be on the far end after the absorption muffler. The absorption muffler has no flow direction and could be mounted both ways. The resonance muffler should be mounted in the gas flow according to the indication on the muffler itself.



The resonance muffler should be fitted according to direction of the gas flow indicated.

In the kit are clamps to mount the exhaust pipes to steel bars. These bars should be mounted to the structure of the ship. It is recommend to use rubber mountings only when there is risk to transfer vibrations to the structure. However take care that the heat conducted through the brackets will not affect the rubber.

Refer to figure 10 how to mount the rubber in a safe way. When any doubt an extra safe guard could be constructed from steel wire or chain.

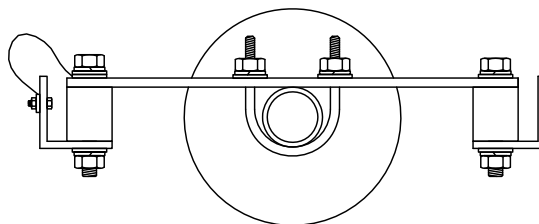


Figure 10. Mounting bracket in rubber with safe guard

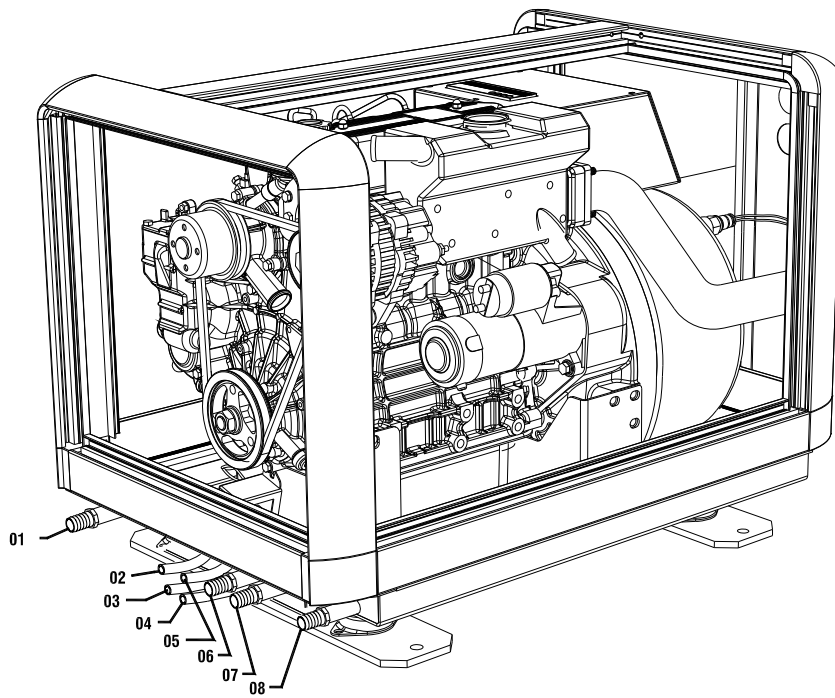


Due to the effects of inertia when a boat is heavily moving in rough water not all bars should be in rubber but bolted or welded to the superstructure of the vessel.

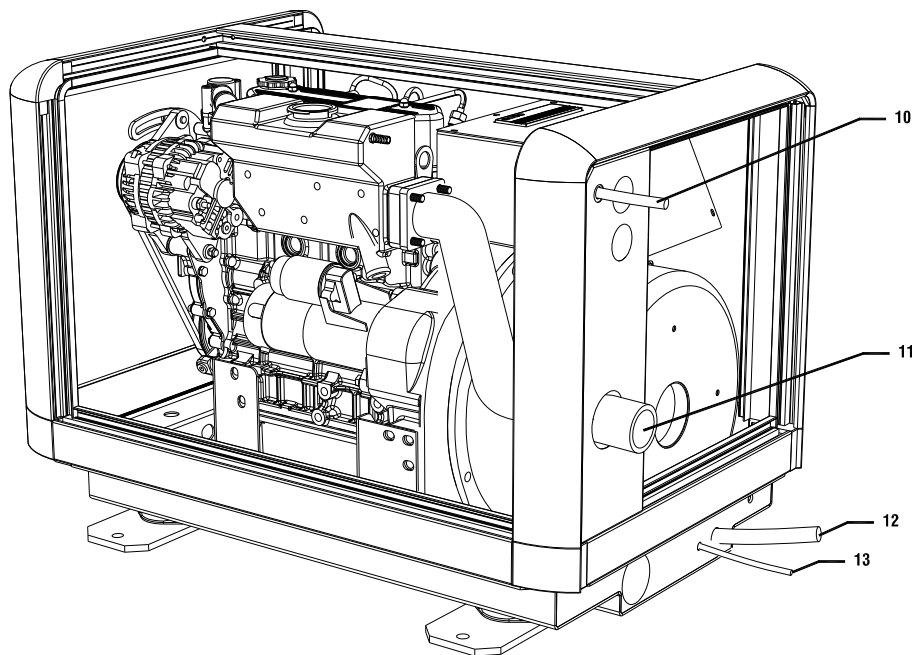
2.3 CONNECTIONS

The generating set comes with all supply lines and output cable (i.e. electric cables, coolant connections, exhaust, fuel lines etc.) already connected to the engine and alternator. The supply lines are fed through the capsule's base. The connections are marked as shown in figures 10 till 17.

All electrical connections, cable types and sizes must comply with the appropriate national regulations. Supplied cables are rated for ambient temperatures up to 70°C. If the cables are required to meet higher temperature requirements, they must be run through conduits.

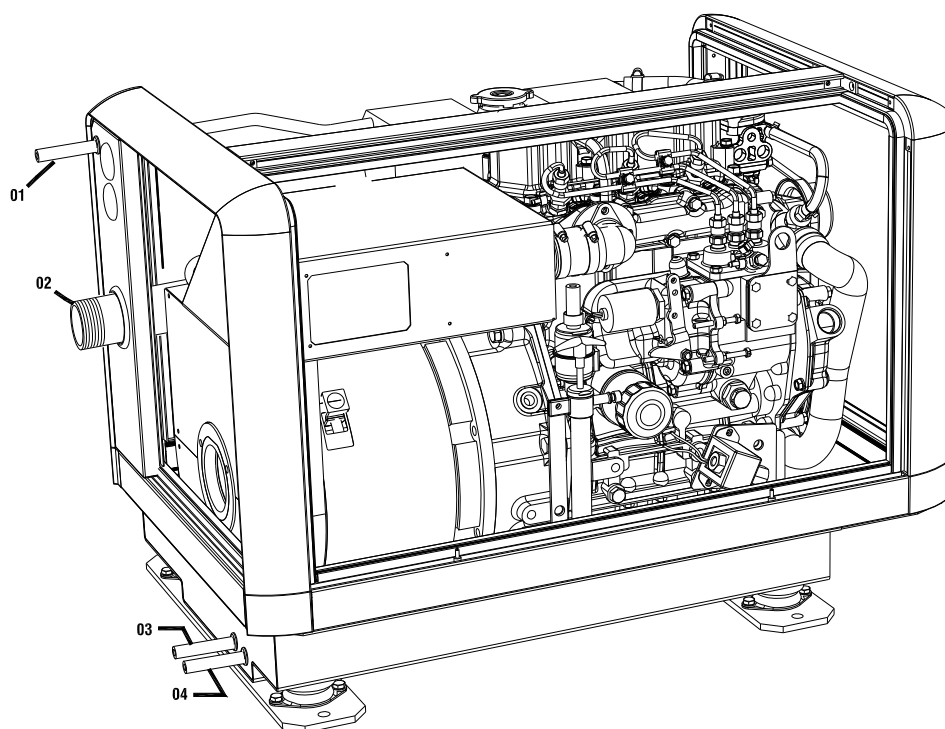


- 01 Coolant generator in
- 02 Battery positive (+)
- 03 Fuel out Ø8mm
- 04 Fuel in Ø8mm
- 05 Battery negative (-)
- 06 Coolant engine out
- 07 Coolant engine in
- 08 Coolant generator out



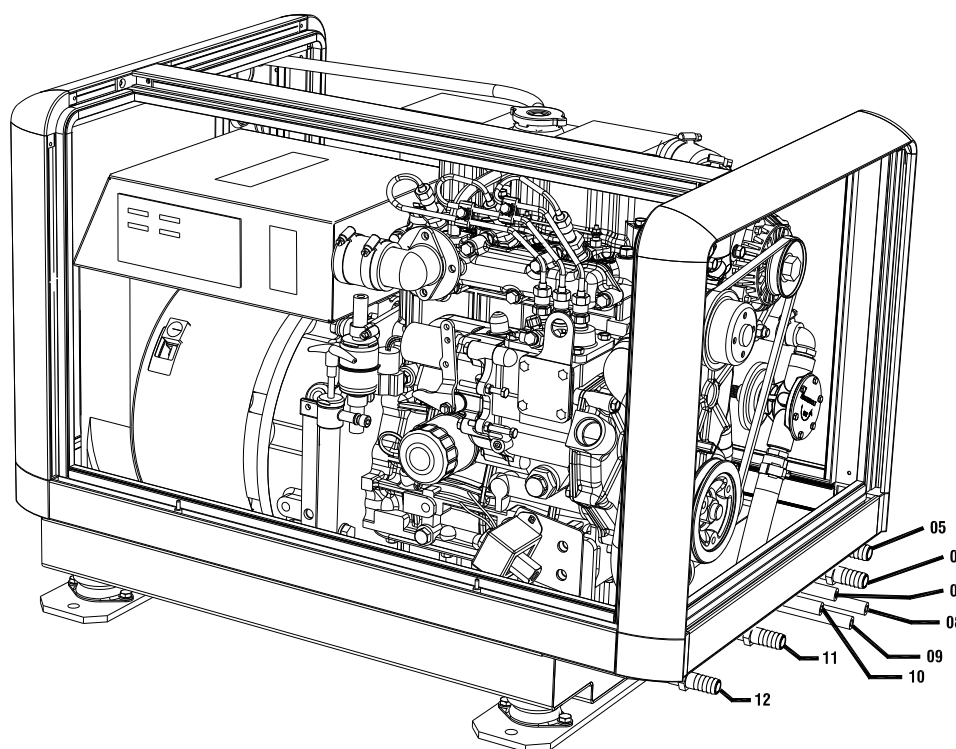
- 10 Expansion tank
- 11 Exhaust 1" (Whisper 6 – 3000rpm)
Exhaust 1½" (Whisper 10 – 3000rpm
and Whisper 6 Ultra)
- 12 AC power output
- 13 Remote control

Fig. 13 Connections Whisper 6 -3000rpm, Whisper 10-3000rpm and Whisper 6 Ultra



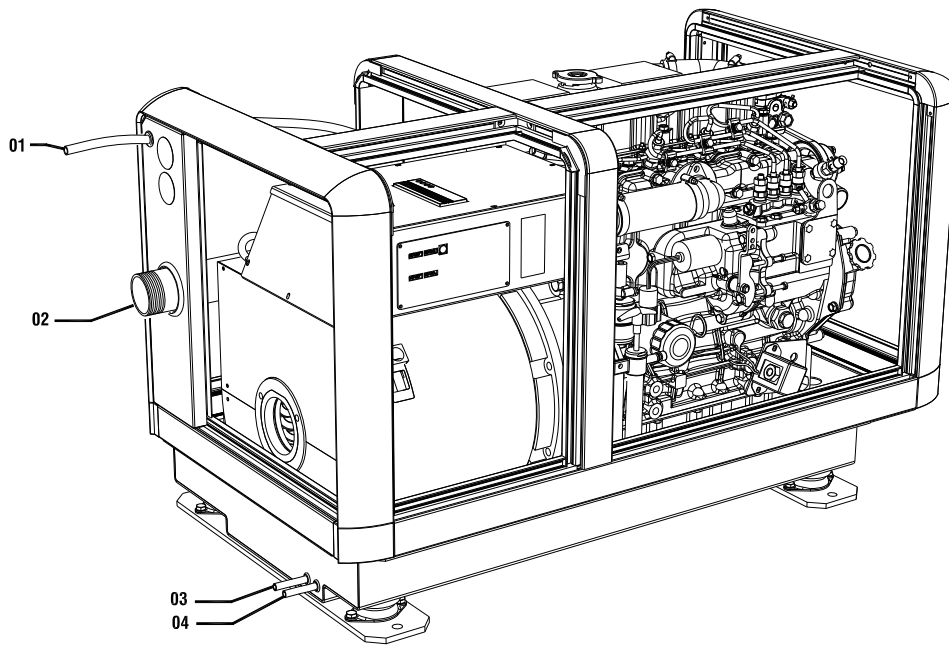
- 01 Expansion tank Ø8mm
- 02 Exhaust 1½"
- 03 Remote control
- 04 AC power output

Fig. 14a Connections Whisper 8 Ultra



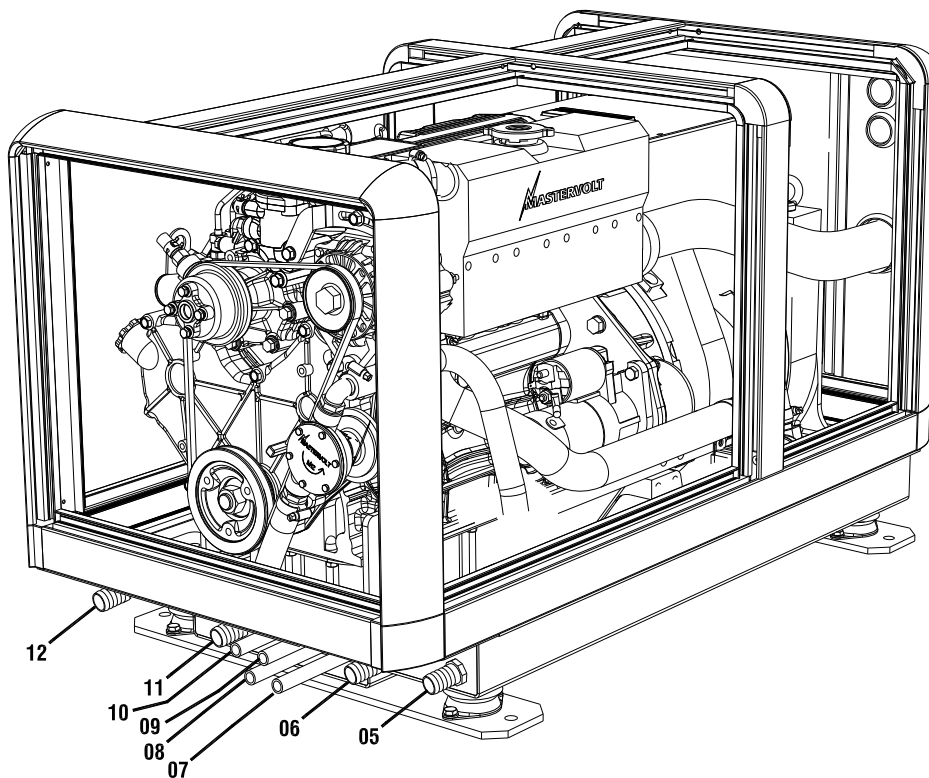
- 05 Coolant engine out
- 06 Coolant generator out
- 07 Battery negative (-)
25mm²
- 08 Fuel out Ø8mm
- 09 Fuel in Ø8mm
- 10 Battery positive (+)
25mm²
- 11 Coolant generator in
- 12 Coolant engine in

Fig. 14b Connections Whisper 8 Ultra



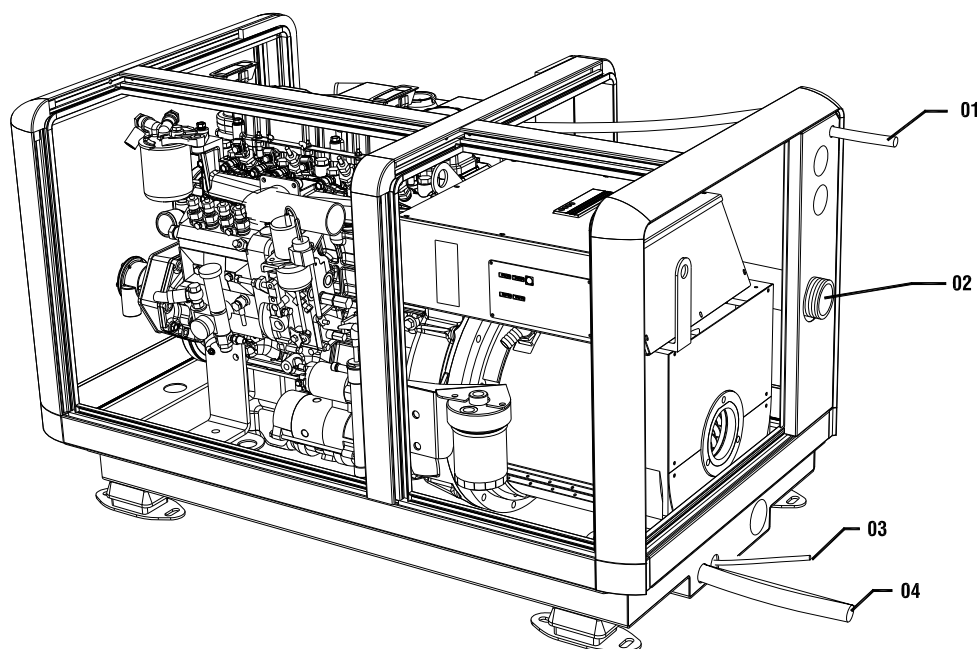
- 01 Expansion tank Ø8mm
- 02 Exhaust 1½"
- 03 Remote control
- 04 AC power output

Fig. 15a Connections Whisper 12 Ultra



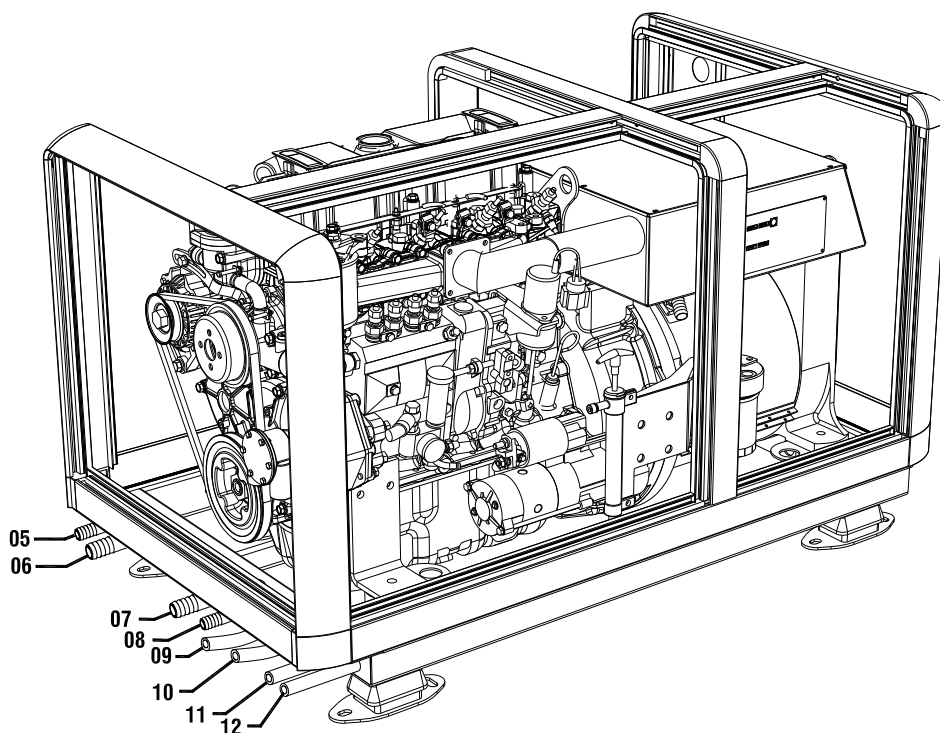
- 05 Coolant engine out
- 06 Coolant generator out
- 07 Fuel out Ø8mm
- 08 Fuel in Ø8mm
- 09 Battery negative (-)
25mm²
- 10 Battery positive (+)
25mm²
- 11 Coolant generator in
- 12 Coolant engine in

Fig. 15b Connections Whisper 12 Ultra



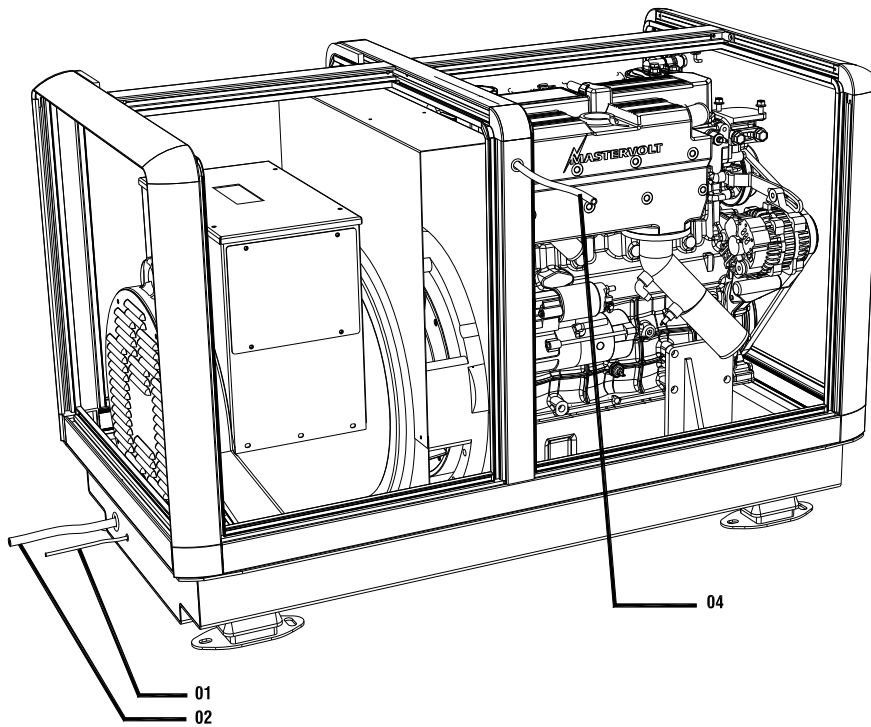
- 01 Expansion tank Ø8mm
- 02 Exhaust 1½"
- 03 Remote control
- 04 AC power output

Fig. 16a Connections Whisper 16 Ultra



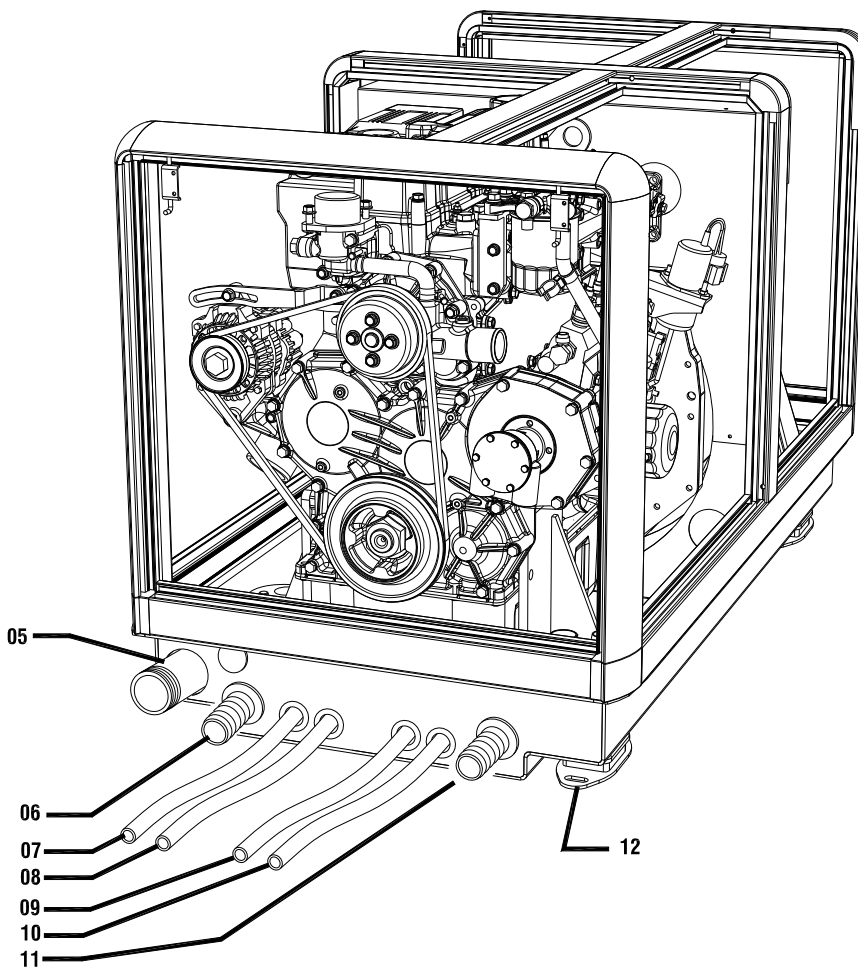
- 05 Coolant generator out
- 06 Coolant engine out
- 07 Coolant engine in
- 08 Coolant generator in
- 09 Battery positive (+)
35mm²
- 10 Battery negative (-)
35mm²
- 11 Fuel in Ø8mm
- 12 Fuel out Ø8mm

Fig. 16b Connections Whisper 16 Ultra



- 01 Remote control
- 02 AC power output
- 04 Expansion tank

Fig. 17a Connections Whisper 25 Ultra



- 05 Exhaust connection 2"
- 06 Engine coolant uit
- 07 Battery positive + 35mm2
- 08 Battery negative - 35mm2
- 09 Fuel out Ø8mm
- 10 Fuel in Ø8mm
- 11 Engine coolant in
- 12 Rubber engine mounting

Fig. 17b Connections Whisper 25 Ultra

3 INSTALLATION MATERIALS

50201303 Box-cooler kit Whisper 6 – 3000 rpm and Whisper 6 Ultra 1500rpm

No	Qty		Article no	Description
1	1	ST	50230510	Box cooler 140-60 for engine"
2	2	ST	50221109	Straight reducer m/f 1 1/2 x 3/4
3	2	ST	50221010	Male hose connection 1x25
4	6	M	50220012	Hose vacuum (1") 25,4x38mm"
5	4	ST	50221503	Hose clamp stainless 26-38
6	8	ST	50221599	Hose support stainless 35x12 mm
7	1	ST	50230529	Bracket expansion tank for 50230531
7	1	ST	50230531	Expansion tank 20 mm
7	1	ST	50230532	Cap tank 0502 30531
8	1	ST	50221064	Male nipple 1"
9	1	ST	50221044	TEE fitting 1"
10	1	ST	50221103	Straight reducer m/f 1"-3/4"
11	1	ST	50221004	Male hose connection 3/4x20
12	2	ST	50221502	Hose clamp stainless19-29
13	1.500	M	50220011	Hose vacuum (3/4") 19x31,5mm"
14	1	ST	50221532	Hose clamp stainless mini 9-11
21	1	ST	50230510	Box cooler 140-60 for alternator
22	2	ST	50221110	Straight reducer m/f 1 1/2 x 3/4
24	1	ST	50221063	Male nipple 3/4"
25	1	ST	50221043	TEE fittings 3/4"
26	3	ST	50221004	Male hose connection 3/4x20
27	8	M	50220011	Hose vacuum (3/4") 19x31,5mm"
28	8	ST	50221599	Hose support stainless 35x12 mm
29	1	ST	50230529	Bracket expansion tank for 50230531
29	1	ST	50230531	Expansion tank 20 mm
29	1	ST	50230532	Cap tank 0502 30531
30	6	ST	50221502	Hose clamp stainless19-29
31	2	M	50220081	Hose polyurethane 8x11mm
32	2	ST	50221532	Hose clamp stainless mini 9-11

50201320 Dry exhaust kit 1" for Whisper 6 – 3000rpm

No	Qty		Article no	Description
61	1	ST	50220041	Exhaust hose 500mm SS male/female 1"
62	1	ST	50220042	Insulation blanket 35x60 exhaust hose 1 1/2
63	1	ST	50230520	Absorption muffler steel 1"
64	1	ST	50230521	Resonance muffler steel 1"
65	1	ST	50230522	Insulation blanket R-muffler 1"
66	2	ST	50221401	Pipe nipple 1"x300mm galvanized
67	2	ST	50221421	Parallel male coupling 1" galvanized
68	2	ST	50221411	Straight coupling f/f 1"galvanized
69	3	ST	50221661	U-clamp 42mm M10
70	3	ST	50221664	Bracket U-clamp 25cm M10/48mm passivated
71	6	ST	50211406	Washer SP M10
72	6	ST	50211447	Washer spring SP M10
73	6	ST	50211466	Nut hexagonal SP M10
75	1	ST	50221471	Elbow 90 degr m/f galvanized 1"

50201873 Box-cooler kit Whisper 10-3000 rpm, Whisper 8Ultra and Whisper 12Ultra

No	Qty		Article no	Description
7	1	ST	50230529	Bracket expansion tank for 50230531
7	1	ST	50230531	Expansion tank 20 mm
7	1	ST	50230532	Cap tank 0502 30531
1	1	ST	50230510	Box cooler 140-60 for engine
6	8	ST	50221597	Hose support stainless 45x20 mm
14	1	ST	50221532	Hose clamp stainless mini 9-11
5	4	ST	50221504	Hose clamp stainless 38-50
3	2	ST	50221014	Male hose connection 1x35
4	6	M	50220013	Hose vacuum (1 1/4") 31,8x45mm
2	2	ST	50221109	Straight reducer m/f 1 1/2 x 1
10	1	ST	50221103	Straight reducer m/f 1"-3/4"
11	1	ST	50221004	Male hose connection 3/4x20
12	2	ST	50221502	Hose clamp stainless 19-29
9	1	ST	50221044	TEE fitting 1"
8	1	ST	50221064	Male nipple 1"
13	1.500	M	50220011	Hose vacuum (3/4") 19x31,5mm"
21	1	ST	50230510	Box cooler 140-60 for alternator
22	2	ST	50221110	Straight reducer m/f 1 1/2 x 3/4
24	1	ST	50221063	Male nipple 3/4"
25	1	ST	50221043	TEE fittings 3/4"
26	3	ST	50221004	Male hose connection 3/4x20
27	8	M	50220011	Hose vacuum (3/4") 19x31,5mm"
28	8	ST	50221599	Hose support stainless 35x12 mm
29	1	ST	50230529	Bracket expansion tank for 50230531
29	1	ST	50230531	Expansion tank 20 mm
29	1	ST	50230532	Cap tank 0502 30531
30	6	ST	50221502	Hose clamp stainless 19-29
31	2	M	50220081	Hose polyurethane 8x11mm
32	2	ST	50221532	Hose clamp stainless mini 9-11

Optional

No	Qty		Article no	Description
16	1	ST	50230535	Expansion tank 7L + low level alarm switch

50201874 Box-cooler kit Whisper 16Ultra

No	Qty		Article no	Description
7	1	ST	50230529	Bracket expansion tank for 50230531
7	1	ST	50230531	Expansion tank 20 mm
7	1	ST	50230532	Cap tank 0502 30531
1	1	ST	50230580	Box cooler 140-90 for engine
6	8	ST	50221597	Hose support stainless 45x20 mm
14	1	ST	50221532	Hose clamp stainless mini 9-11
5	4	ST	50221504	Hose clamp stainless 38-50
3	2	ST	50221014	Male hose connection 1x35
4	6	M	50220013	Hose vacum (1 1/4") 31,8x45mm
2	2	ST	50221109	Straight reducer m/f 1 1/2 x 1
10	1	ST	50221103	Straight reducer m/f 1"-3/4"
11	1	ST	50221004	Male hose connection 3/4x20
12	2	ST	50221502	Hose clamp stainless19-29
9	1	ST	50221044	TEE fitting 1"
8	1	ST	50221064	Male nipple 1"
13	1.500	M	50220011	Hose vacuum (3/4") 19x31,5mm"
21	1	ST	50230510	Box cooler 140-60 for alternator
22	2	ST	50221110	Straight reducer m/f 1 1/2 x 3/4
24	1	ST	50221063	Male nipple 3/4"
25	1	ST	50221043	TEE fittings 3/4"
26	3	ST	50221004	Male hose connection 3/4x20
27	8	M	50220011	Hose vacuum (3/4") 19x31,5mm"
28	8	ST	50221599	Hose support stainless 35x12 mm
29	1	ST	50230529	Bracket expansion tank for 50230531
29	1	ST	50230531	Expansion tank 20 mm
29	1	ST	50230532	Cap tank 0502 30531
30	6	ST	50221502	Hose clamp stainless19-29
31	2	M	50220081	Hose polyurethane 8x11mm
32	2	ST	50221532	Hose clamp stainless mini 9-11

Optional

No	Qty		Article no	Description
16	1	ST	50230535	Expansion tank 7L + low level alarm switch

50201894 Box-cooler kit Whisper 25Ultra

No	Qty		Article no	Description
16	1	ST	50230535	Expansion tank 7L + low level alarm switch
1	1	ST	50230589	Box cooler 140-120 for engine
6	8	ST	50221597	Hose support stainless 45x20 mm
14	1	ST	50221532	Hose clamp stainless mini 9-11
5	4	ST	50221504	Hose clamp stainless 38-50
3	2	ST	50221014	Male hose connection 1x35
4	6	M	50220013	Hose vacuum (11/4") 31,8x45mm
2	2	ST	50221109	Straight reducer m/f 1 1/2 x 1
10	1	ST	50221103	Straight reducer m/f 1"-3/4"
11	1	ST	50221004	Male hose connection 3/4x20
12	2	ST	50221502	Hose clamp stainless 19-29
9	1	ST	50221044	TEE fitting 1"
8	1	ST	50221064	Male nipple 1"
13	1.500	M	50220011	Hose vacuum (3/4") 19x31,5mm"

50201875 Dry exhaust kit 1½" for Whisper 10 – 3000rpm and Whisper 6 Ultra, 8Ultra, 12Ultra and 16Ultra

No	Qty		Article no	Description
61	1	ST	50220043	Exhaust hose SS 500mm fem./male 11/2"
62	1	ST	50220042	Insulation blanket 35x60 exhaust hose 1 1/2
63	1	ST	50230523	Absorption muffler steel 11/2"
64	1	ST	50230524	Resonance muffler steel 11/2"
65	1	ST	50230525	Insulation blanket 80x75 muffler SDHC 11/2"
66	2	ST	50221403	Pipe nipple 11/2"x300mm galvanised
67	2	ST	50221423	Parallel male coupling 11/2" galvanised
68	2	ST	50221413	Straight coupling f/f 11/2" galvanised
69	3	ST	50221663	U-clamp 48 mm M10
70	3	ST	50221664	Bracket U-clamp 25cm M10/48mm passivated
71	6	ST	50211406	Washer SP M10
72	6	ST	50211447	Washer spring SP M10
73	6	ST	50211466	Nut hexagonal SP M10
75	1	ST	50221473	Elbow 90 degr m/f galvanised 11/2"

50201889 Dry exhaust kit 2" for Whisper 25Ultra

No	Qty		Article no	Description
61	1	ST	50220067	Exhaust hose SS 500mm male/female 2"
62	1	ST	50220042	Insulation blanket 52x26 exhaust hose
63	1	ST	50230574	Absorption muffler steel HD G2"
64	1	ST	50230575	Resonance muffler steel SDHC G2"
65	1	ST	50230576	Insulation blanket muffler HD 2"
66	2	ST	50221404	Pipe nipple 2"x300mm galvanised
67	2	ST	50221424	Parallel male coupling 2" galvanised
68	2	ST	50221414	Straight coupling f/f 2" galvanised
	2	ST	50230577	End cover HD 2"
	1	ST	50230578	Insulation blanket SDHC 2"
	2	ST	50230579	End cover SDHC 2"
75	1	ST	50221473	Elbow 90 degr m/f galvanised 2"

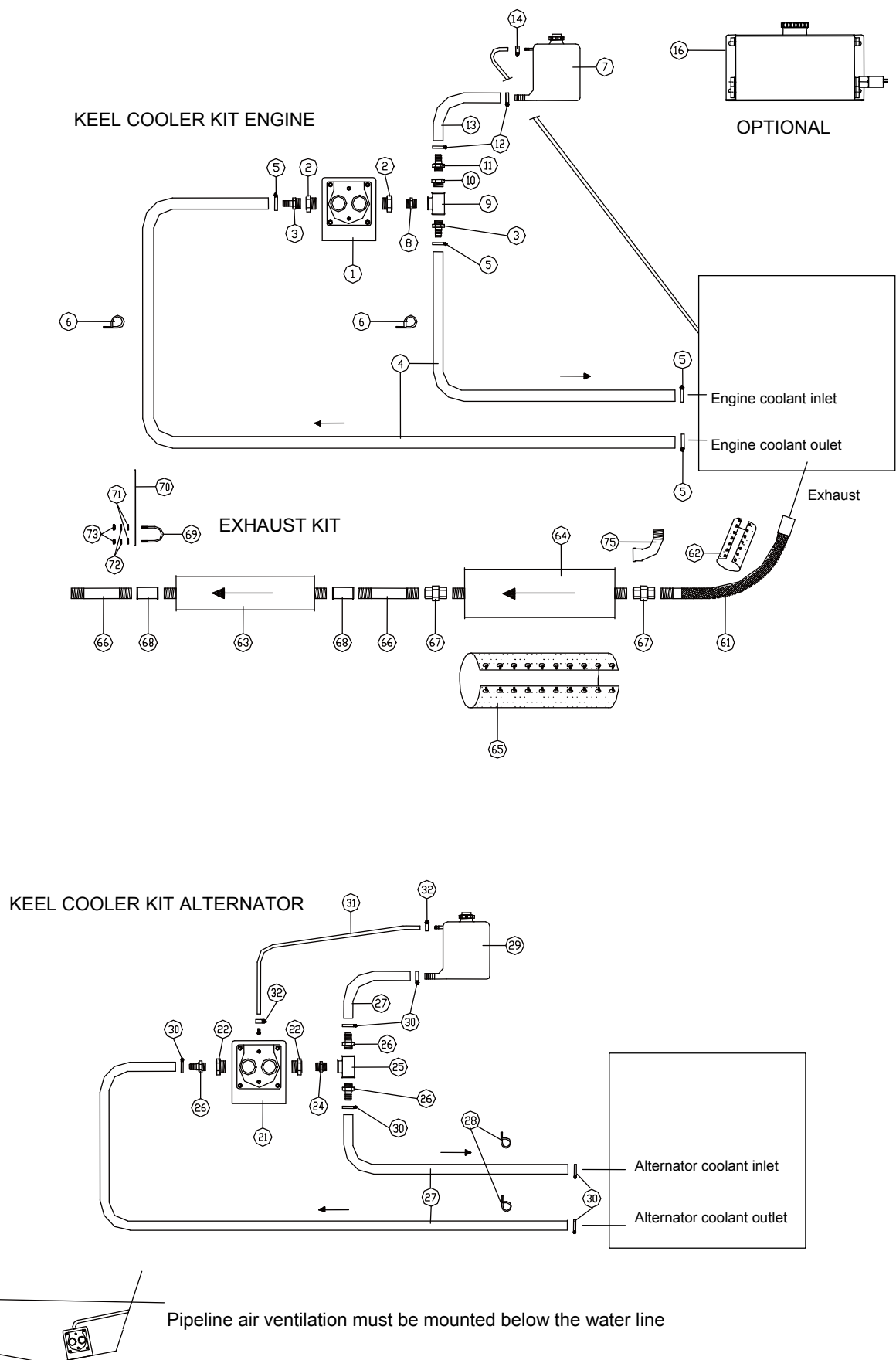
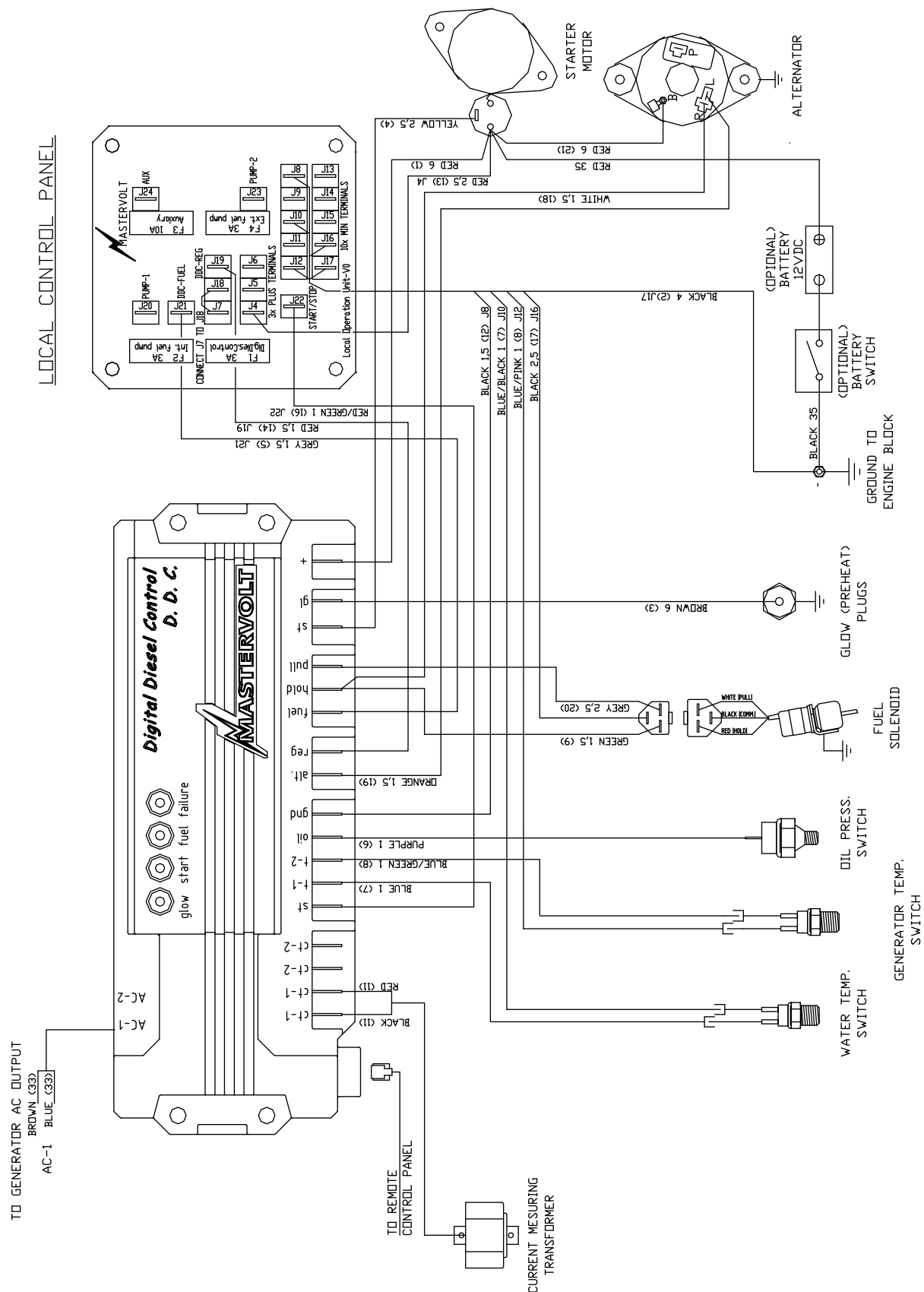
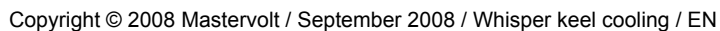


Figure 20: Installation kits

4.2 DC WIRING DIAGRAM WHISPER 16 ULTRA



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Snijdersbergweg 93, 1105 AN Amsterdam, The Netherlands

Tel : + 31-20-3422100 / Fax : + 31-20-6971006

www.mastervolt.com / info@mastervolt.com