Installation manual

Electrical systems

Industrial engines
DC09, DC13, DC16, OC16

Marine engines
DI09, DI13, DI16

03:01 Issue 11 en-GB

Introduction

Changes from the previous issue

The changes made in this document compared with the previous issue are marked with a line in the left-hand margin. The changes are also described below.

- Information about harness-to-harness connectors C4125 and C4126: Throttle control for Stage V engines has been added to section Engine interface.
- The requirements for the electrical cables for OC16 ignition coils have been clarified in section C4094: Harness-to-harness connectors for ignition coils and throttle actuator at gas mixer.

Different requirements

For PDE engines, except marine engines with PDE and SCR systems, engine control unit S6 is used. For XPI engines and marine engines with PDE and SCR systems, engine control unit S8 is used. 16 litre gas engines use engine control unit OCE1.

There are two different requirements for the electrical installation of S6 and S8: with or without Scania's base system. This installation manual does not describe Scania's electrical systems. Information about these can be found in

- *03:04 Instrumentation 2.1*.
- *03:03 Instrumentation 2.0*.
- *03:02 Coordinator and base system*.

Grounding

In this document the term ground is used. Ground means that there is a connection to the battery negative terminal.

Abbreviations

Abbreviations used in this document are listed in the table below.

Abbreviation	Explanation
EGR	Emission control system (Exhaust Gas Recirculation).
OCE1	Engine control unit for gas engines.
PDE	Fuel injection system (unit injector).
S6	Engine control unit for PDE engines, apart from marine engines with PDE and SCR systems.
S8	Engine control unit for XPI engines and marine engines with PDE and SCR systems.
SCR	Emission control system (Selective Catalytic Reduction).
SDP3	Scania Diagnos & Programmer 3.
XPI	Fuel injection system (extra high pressure injection).

Voltage terms

The terms in the table below are used to describe different types of voltage. Unless otherwise specified, always +24 V.

Abbreviation	Explanation
15 voltage	Starter key voltage
30 voltage	Battery voltage

Safety during electric welding

IMPORTANT!

When carrying out welding work on and near the engine, disconnect the battery and alternator leads. Pull out the multi-pin connector for the engine control unit as well.

Connect the welding clamp as close to the welding site on the component as possible. The welding clamp must not be connected to the engine, or so that the current can cross a bearing.

When welding is finished:

1. Connect the alternator and engine control unit cables first.
2. Then connect the batteries.

Batteries and alternators

Batteries

Use lead batteries of the starter battery type. This type of battery is able to deliver high current even at low temperatures for long enough for the engine to start.

Connect two 12 V batteries in series for 24 V system voltage.

If standard lead acid batteries are used, Scania recommends batteries with a starting capacity of min. 160 Ah and a cold cranking amperage of 800 A for all engine types.

In warm climates in which the temperature only briefly falls below 0°C, batteries with a starting capacity of min. 118 Ah and a cold cranking amperage of 490 A at 0°C may be used for all engine types.

The battery capacity indicates how high a current a battery can be discharged at for 20 hours at ambient temperature. A 100 Ah battery can, for example, be discharged at max. 5 A for 20 hours.

At low temperatures, the battery capacity is reduced considerably as shown in the following table:

Battery capacity at +20 °C	Battery capacity at -18°C
100%	50%
70%	35%
40%	25%

The cold cranking amperage above indicates the highest current with which a 12 V battery can be loaded at -18°C so that the terminal voltage after 30 seconds is a minimum of 8.4 V and the discharge time to 6 V is no less than 120 seconds.

Note:

If the engine is fitted with an alternator, the battery master switch must not be switched off or the batteries disconnected when the engine is running. Voltage peaks can damage components in the alternator and the charge regulator.

The batteries in stand-by generator sets must be checked for their state of charge and fluid level and charged if required. Batteries may be charged either during the normal test drive (once a month) for approx. 1 hour or using a battery charger and timer.

Boost charge and continuous trickle charge shorten the service life of the batteries.

Connection of batteries

Connect the battery cables correctly, i.e. negative (-) to the engine ground point and positive (+) to the starter motor terminal screw 30.

Note:

The alternator rectifier diodes will be damaged if these cables are connected incorrectly.

Do not disconnect the connections while the engine is running, as this may damage the charge regulator.

- Removing: Always disconnect the negative cable before the positive cable.
- Fitting: Always connect the positive cable before the negative cable to reduce the risk of short-circuiting the battery with the tool.
- Make sure that the battery box, batteries and battery cable terminals are clean.
- Do not bang the battery cable terminals. Terminal posts and cell plates come off easily.
- Lubricate battery cable terminals and terminal posts using a thin layer of Vaseline or grease.

Battery cables

When manufacturing battery cables, dimension the cables between the battery and starter motor as depicted in the diagram. This indicates the minimum permissible cable cross-section at different lengths for the various engine types.

The cable length in the diagram relates to the total length of both positive and negative cables.

Minimum permissible cable cross-section is 70 mm^2. If the ambient temperature constantly exceeds +10°C, the minimum permissible cable cross-section is 50 mm^2.

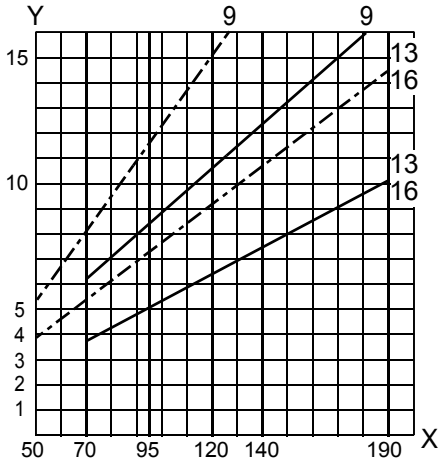


Diagram for dimensioning of battery cables.

The dotted lines apply at a constant ambient temperature of more than 10°C.
The unbroken lines apply at an ambient temperature of -20°C.

Y = Total cable length in metres.
X = Cable cross-section in mm²

Battery master switch

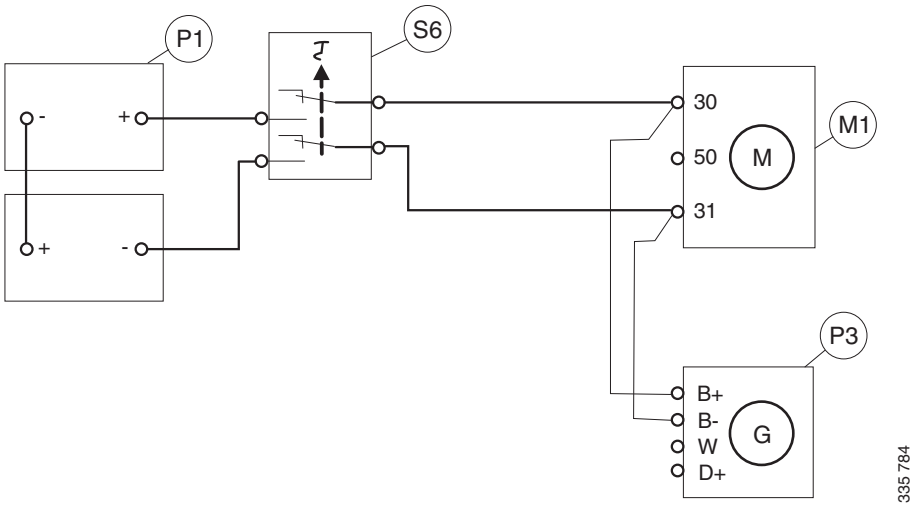
If a battery master switch is installed between the starter motor and the batteries, it must be positioned as close to the batteries as possible.

The power must not be switched off directly after switching off the engine. In order for the control units to store operational data and switch off any systems, it is important to allow a 10 second delay before switching off the power.

IMPORTANT!

The SCR system may need up to 30 minutes to cool the reductant doser in extreme conditions. The battery master switch must not be switched off before then.

Status for post-running is sent out in CAN message DLN7. More information is available in section *DLN7* in *03:05 CAN interface*.

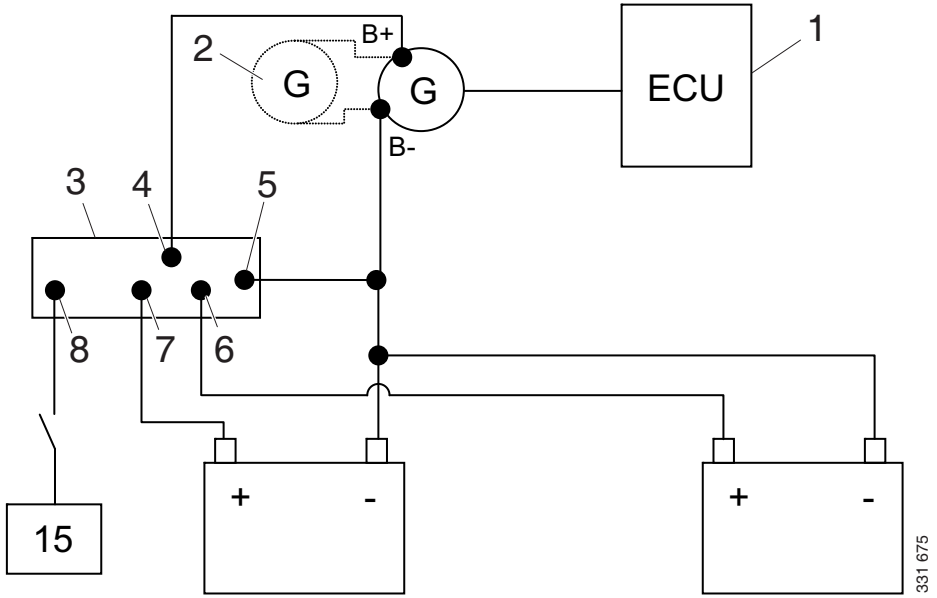


Mechanical battery master switch.
M1 = Starter motor.
P1 = Battery.
P3 = Alternator 1.
S6 = Mechanical battery master switch.

Alternator charging for marine engines

In order for the alternator to start charging, the B+ terminal of the alternator must have +24 V. For certain engine installations, it may be necessary to use an electronic battery insulator in order for B+ to receive +24 V. Refer to the illustration for connection of the battery insulator.

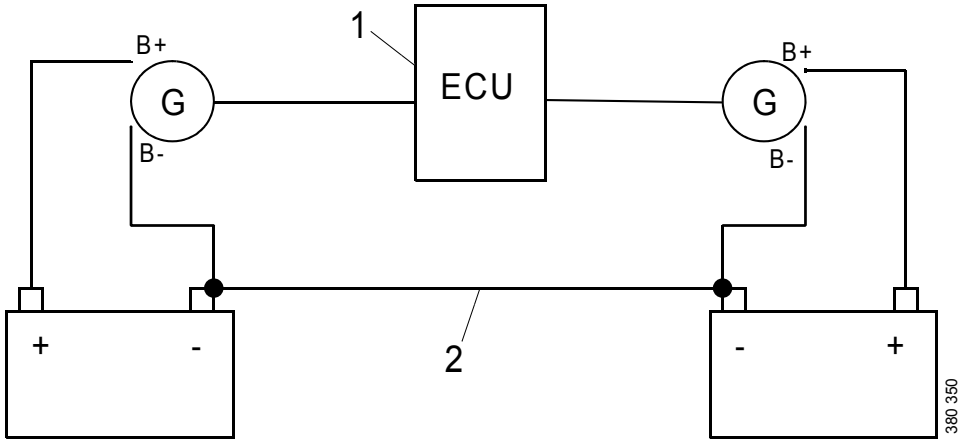
1. Engine control unit
2. Alternator 2 (only with double alternators)
3. Battery insulator
4. Input to battery insulator
5. Ground
6. Output from battery insulator
7. Output from battery insulator
8. 15 voltage to battery insulator



Marine engines with split ground system

When double alternators controlled from the engine control unit charge different battery groups, the battery negative terminals must be connected together. Otherwise, a fault code is generated.

1. Engine control unit
2. Ground connection between batteries

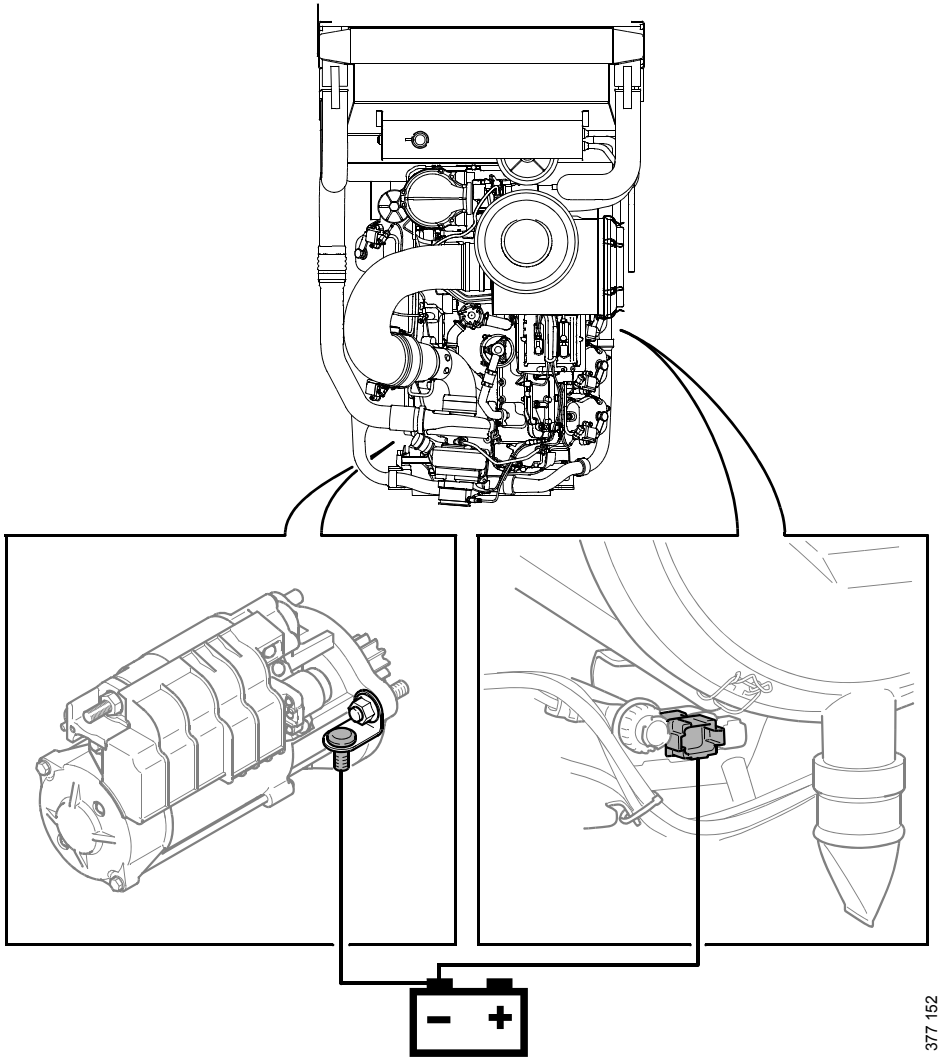


Ground connection on gas engines

On gas engines, the control unit ground and engine ground should be connected to the same electrical ground point. Otherwise, the various components of the system may detect different potential, which leads to interference.

The term control unit ground refers to pins 2 and 5 in the C4001 harness-to-harness connector. See also C4001: Harness-to-harness connector for engine control unit.

Engine ground refers to the ground screw on the starter motor.



Ground connection, OC16.

Electrical cables

Routing cables

When engines are supplied without instrumentation, all cables from the engine, except for the starter and alternator cables, should be collected together on a junction block or in a junction box and then continued with an extension cable to the instrument panel or central electric unit.

Do not place the junction box or junction block directly on the engine as this will expose it to harmful vibrations. Protect it from water, oil, heat and mechanical damage.

Ideally, route the cables along the bottom part of the engine where there is least movement.

When routing electrical cables, there must be no risk of chafing. Use chafing covers if there is such a risk. The cables must not touch any sharp edges, radius < 0.5 mm, e.g. sharp edges or ends of threaded screws.

When the cables are clamped to rubber hoses, the cable must not interfere with the movement of the hose.

The cables must be long enough so that they are not stretched.

The distance between the cable clamps, e.g. cable ties, should be 350-400 mm.

The cables must be routed as far away from hot areas, > 70°C, as possible. The following minimum distance applies if there is no heat shield:

- Exhaust pipe upstream of silencer, front part of silencer – 100 mm.
- Exhaust pipe downstream of silencer, rear part of silencer – 60 mm.
- Exhaust pipe, engine and cab heater – 40 mm.
- Coolant pipe, engine – 60 mm.

A conventional cable harness and CAN cable harness can be routed side by side without interference.

Calculating cable cross-section

Use the following formula to calculate the cable cross-section:

$$u_f = I \times \frac{0.0175 \times L}{A}$$

U_f = Permissible voltage drop, V

I = Current consumption, A

L = Length of cable, m

A = Cable cross-section, mm^2

0.0175 = copper resistance when L = 1 m and A = 1 mm^2 at +15°C.

The highest permissible voltage drop for cables between alternator, starter motor and battery is 2.5% or 0.6 V. For other cables, the highest permissible voltage drop is 5.0% or 1.2 V.

Each connection point gives a voltage drop of 0.1 V at connection points and 0.3 V at joints.

When installing an electrical component with a known load (I, ampere) and location, which gives the cable length (L), the necessary cable cross-section is calculated as follows:

$$A = I \times \frac{0.0175 \times L}{U_f}$$

The voltage drop for connection points and any joints must be subtracted from the maximum permissible voltage drop before calculating the cable cross-section.

Note:

In 2 pin systems, both the positive and the negative cables must be included in the cable length.

REQUIREMENT!

For durability reasons, the minimum permissible cable cross-section for electrical cables routed to the engine is 1.5 mm^2 for single-core cables, and 1.0 mm^2 for multi-core cables.

The minimum permissible cable cross-section for a specific load also depends on which type of electrical cable is used. Scania recommends the use of PVC 105°C electrical cable type RK.

Maximum permissible current and cable length for RK 105°C electrical cable at different cable cross-sections.

Cable cross-section, mm² [2]	**Current, A** [1]	**Uf = 2.5% = 0.6 V Length, m (max)** [2]	**Uf = 5.0% = 1.2 V Length, m (max)** [b]
0.75 [3]	8	3.2	6.4
1.0 [c]	8	3.2	8.6
1.5	16	3.2	6.4
2.5	20	4.3	8.6
4.0	27	5.1	10.1
6.0	36	5.7	11.4
10	51	6.7	13.4
16	70	7.8	15.6

1. Maximum permissible current under continuous load.
2. For cable lengths above these values the highest permissible voltage drop determines the cross-section.
3. The minimum permissible cable cross-section for electrical cables routed to the engine is 1.5 mm² for single-core cables, and 1.0 mm for multicore cables.

Splicing and repair

It is advisable to renew the entire electrical cable if the cable is damaged or when carrying out a conversion.

If the electrical cable must be spliced, this should preferably be done with the aid of watertight DIN harness-to-harness connectors such as Cannon Sure Seal, Deutsch series DT or the equivalent.

Alternatively the electrical cable can be repaired by using a jointing sleeve with glue and shrinking tubing. The sleeve must be appropriate for the cable cross-section.

DIN harness-to-harness connectors and jointing sleeves with glue can be ordered from Scania dealers.

Position the joint in a well protected location so that it is not subjected to mechanical loading.

Fitting the jointing sleeve with glue

1. Remove the damaged part of the electrical cable. Position the joints so that they are not subjected to bending. Strip off 7-8 mm of insulation at each end.
2. Strip off 7-8 mm of insulation at each end of the new cable.
3. Use shrinking tubing. The length of the shrinking tubing should be at least three times the length of the jointing sleeve. Cut a length of shrinking tubing and slide it onto the cable.
4. Fit the jointing sleeve so that the cable ends reach the bottom of the sleeve. Use a sleeve that is appropriate for the cable cross-section.
5. Crimp the sleeve at the peeled off parts of the cable ends using a crimping tool.
6. Apply heat from the centre of the sleeve and outwards using a hot air gun which is fitted with a reflector, until the ends of the sleeve shrink and glue seeps out.

IMPORTANT!

Do not heat too much.

7. Press the ends of the jointing sleeve gently using flat-nose pliers. Take care not to damage the plastic. Check that the glue has seeped out all around the cable.
8. Thread the shrinking tubing over the jointing sleeve, and heat the tube until the joint is tight and strong.
9. Test the joint.

Connection to engine

This section describes the engine interface for the different engine types. The engine interface is configured differently, depending on the engine type.

If the customer has not ordered the Scania base system, the customer must connect his system to the engine interface himself.

Connection to engine without Scania base system

The CAN cables must comply with SAE J1939-15, i.e. they must be unshielded, twisted cables (40 turns/m). Maximum recommended length is 40 metres.

The engine control unit has an integrated resistor of 120 ohms. In a CAN network, two resistors must be located between the CAN cables (CAN high and CAN low) at the ends of the CAN bus. The Scania coordinator has no integrated resistor.

Therefore, position a resistor of 120 ohms as close to the other end of the CAN network as possible. The Scania base system has an integrated resistor of 120 ohms. As a result, a resistor is not necessary.

Current consumption of the electrical system

The table below indicates guide values for how much current different consumers in the electrical system use.

Consumer	Current (A)	Note
Engine control units S6, S8	Average: approx. 3.5-4 A Short term top value of each injection: approx. 15 A	
SCR control unit EEC3	Approximately 4 A, excluding heating of hoses and components An additional 10 A is needed for heating	Only engines with SCR systems.
Coordinator	Max. 1.5 A	
Electric throttle	Nominal value: 1 A Top value: 3 A	Only industrial engines with electric throttle.
EGR valve	Nominal value: 2 A Top value: 4.5 A	Only industrial engines with EGR systems.
Exhaust brake actuator	Nominal value: 2 A Top value: 5 A	Only industrial engines with SCR and EGR systems.
Variable geometry turbocharger	Nominal value: 2.5 A Top value: 6 A	Only industrial engines with SCR and EGR systems.
Exhaust routing valve actuator	Nominal value: 2 A Top value: 5 A	Only marine engines with SCR systems. The values are for 1 actuator.
Actuator for throttle at gas mixer	Nominal value: 0.3 A Top value: 1.3 A	Gas engines only.
Actuator for throttle at flame arrestor	Nominal value: 1.5 A Top value: 2.5 A	Gas engines only.
Ignition coils	Nominal value: 2 A Top value: 8 A	Gas engines only. The values are for 1 ignition coil.

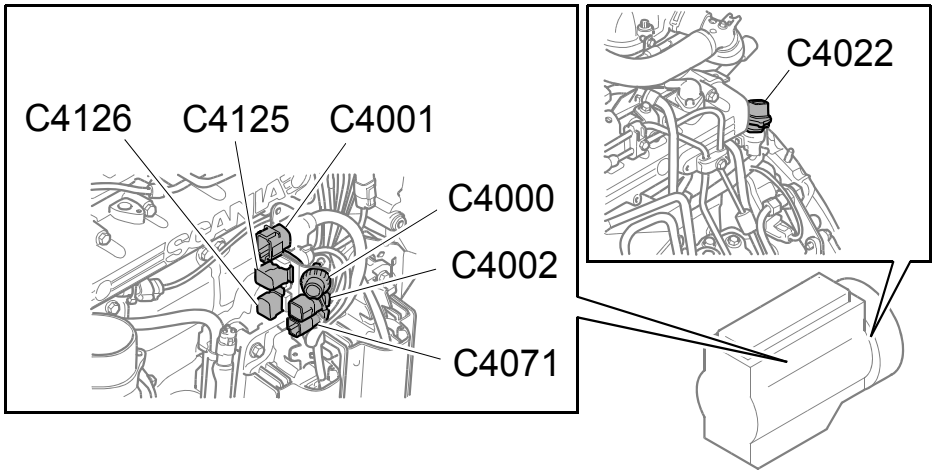
Engine interface

Industrial engines, diesel

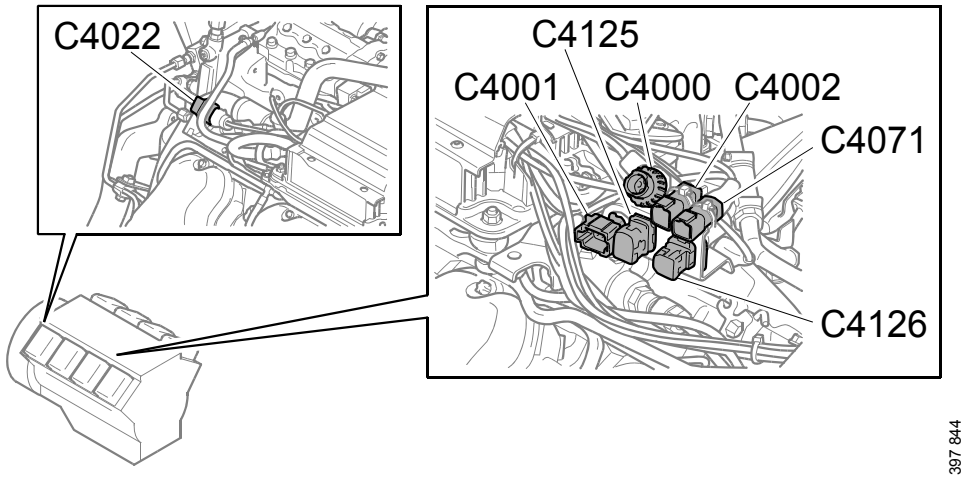
The following abbreviations are used in the table for the emission level of the engines:

Abbreviation	Emission level
S3B/T4i	Stage IIIB/Tier 4 interim
S4/T4f	Stage IV/Tier 4 final
S5	Stage V

Harness-to-harness connector	Interface	Emission level			
		All	S3B/ T4i	S4/T4f	S5
C4000	Diagnostics.	x	x	x	x
C4001	Customer interface to engine control unit.	x	x	x	x
C4002	Voltage to SCR-systems or EGR systems as well as exhaust brake actuator, if present.	-	x	x	x
C4022	SCR system, cable harness supplied with the engine.	-	x	x	x
C4071	Voltage to variable geometry turbocharger and warning lamps for the SCR system.	-	-	x	x
C4125	Scania Communicator.	-	-	-	x
C4126	Throttle control.	-	-	-	x



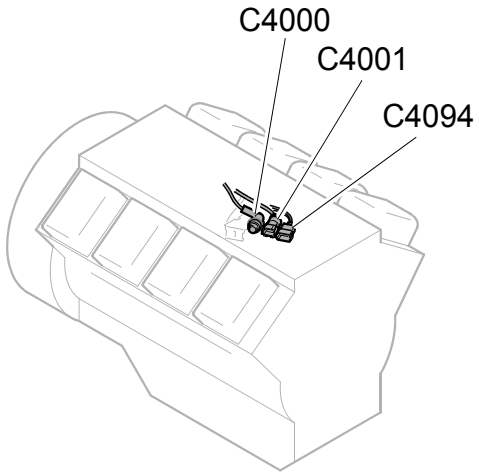
DC09, DC13.



DC16.

Industrial engines, gas

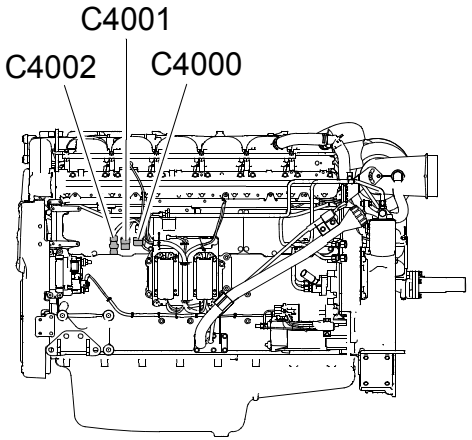
Harness-to-harness connector	Interface
C4000	Diagnostics.
C4001	Customer interface to engine control unit.
C4094	Voltage to ignition coils and throttle actuator at gas mixer.



OC16.

Marine engines without SCR system

Harness-to-harness connector	Interface
C4000	Diagnostics.
C4001	Customer interface to engine control unit.
C4002	Connection of limp home mode.



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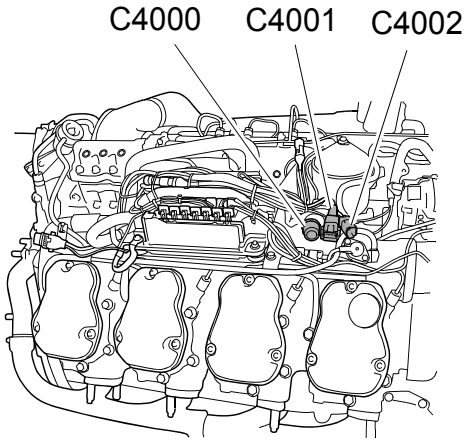
DI19, DI13.



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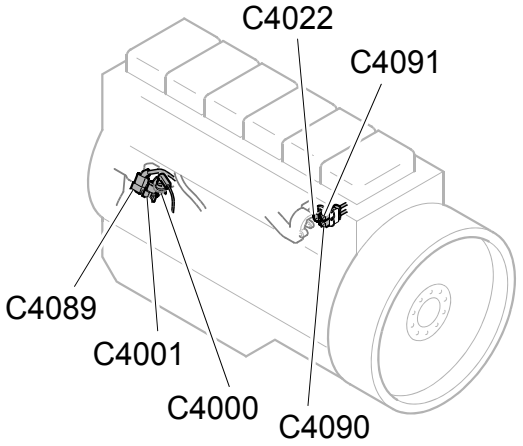
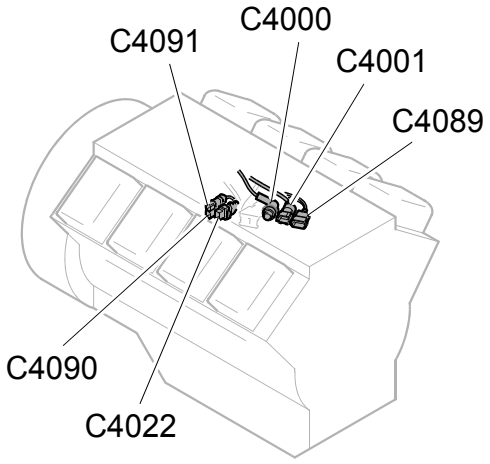
DI16.

Marine engines with SCR system

Harness-to-harness connector	Interface
C4000	Diagnostics.
C4001	Customer interface to engine control unit.
C4022	SCR system. Cable harness supplied with the engine.
C4089	Connection of limp home mode and voltage to SCR system and exhaust routing valve.
C4090	Connection to exhaust routing valve harness-to-harness connector M4001. Cable harness supplied with the engine.
C4091	Connection to exhaust routing valve harness-to-harness connector M4002. Cable harness supplied with the engine.



DI13.



DI16.

Pin numbering for harness-to-harness connectors

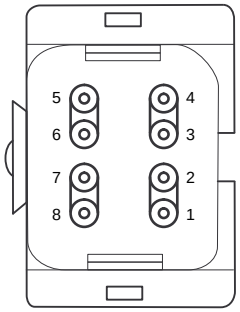
C4001: Harness-to-harness connector for engine control unit

Pin	Task	Note
1	30 voltage to the engine control unit	Cable cross-section 2.5 mm^2, fuse 20 A
2	Ground	Cable cross-section 2.5 mm^2
3	15 voltage to the engine control unit	Cable cross-section 1.5 mm^2, fuse 10 A.
4	30 voltage to the engine control unit	Cable cross-section 2.5 mm^2, fuse 20 A
5	Ground	Cable cross-section 2.5 mm^2
6	CAN high	Use electrical cables with gold-plated pins which are twisted 40 turns per metre
7	CAN low	
8	Engine running[1] +24 V	Cable cross-section 1.5 mm^2

1. See the instructions in the Engine running signal section.

C4001 is either connected with a 6.2 m pre-assembled electrical cable, or with contact housing kit 2 110 918. Use hand crimping tool 588 206 and dismantling tool 99 591 for the contact housing kit. Contact housing kit 2 110 918 contains the following components:

Qty	Part No.	Designation	Note
1	1 547 479	Harness-to-harness connector	8-pin
5	1 504 108	Cable terminal	2.5 mm^2
3	1 427 166	Cable terminal, round socket	1.1-2.0 mm^2
1	1 547 480	Locking part	8-pin green



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harness-to-harness connector C4001 on the engine viewed from the electrical cable input side.

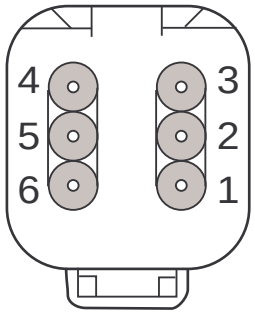
C4002 on industrial engines: Harness-to-harness connector for exhaust gas aftertreatment management system, electric throttle and EGR system

Stage V

Pin	Task	Note
1	30 voltage to exhaust gas aftertreatment management system and electric throttle	Cable cross-section 2.5 mm^2, fuse 20 A
2	Ground connection for exhaust gas aftertreatment management system	Cable cross-section 2.5 mm^2
3	15 voltage to exhaust gas aftertreatment management system	Cable cross-section 1.5 mm^2, fuse 10 A
4	Not used	To be plugged
5	Ground connection for electric throttle and exhaust brake	Cable cross-section 2.5 mm^2
6	15 voltage for electric throttle and exhaust brake	Cable cross-section 2.5 mm^2, fuse 20 A

Stage IV/Tier 4f

Pin	Task	Note
1	30 voltage to exhaust gas aftertreatment management system	Cable cross-section 2.5 mm^2, fuse 20 A
2	Ground connection for exhaust gas aftertreatment management system	Cable cross-section 2.5 mm^2
3	15 voltage to exhaust gas aftertreatment management system	Cable cross-section 1.5 mm^2, fuse 10 A
4	Not used	To be plugged



harness-to-harness connector C4002 on the engine viewed from the electrical cable input side.

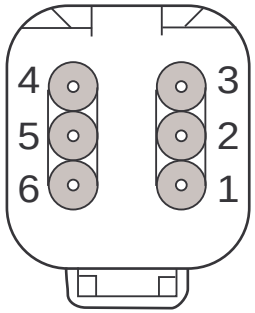
Pin	Task	Note
5	Ground connection for EGR system/ exhaust brake actuator	Cable cross-section 2.5 mm^2
6	15 voltage to EGR system/exhaust brake actuator	Cable cross-section 2.5 mm^2, fuse 20 A

Stage IIIB/Tier 4i

Pin	Task	Note
1	15 voltage to SCR system	Cable cross-section 1.5 mm^2, fuse 10 A
2	Not used	To be plugged
3	+24 V to warning lamp for low reductant level	Cable cross-section 1.5 mm^2
4	Ground connection for low reductant level warning lamp	Cable cross-section 1.5 mm^2
5	+24 V to warning lamp for SCR malfunction	Cable cross-section 1.5 mm^2
6	Ground connection for SCR error warning lamp	Cable cross-section 1.5 mm^2

PDE engines with EGR system - single-speed engine

Pin	Task	Note
1	15 voltage to EGR system	Cable cross-section 1.5 mm^2, fuse 10 A
2	Ground	Cable cross-section 1.5 mm^2
3	Not used	To be plugged
4	Not used	To be plugged
5	Not used	To be plugged



harness-to-harness connector C4002 on the engine viewed from the electrical cable input side.

Pin	Task	Note
6	Not used	To be plugged

C4002 on marine engines: Harness-to-harness connector for connecting limp home mode

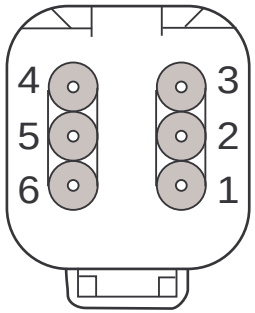
This harness-to-harness connector is not in marine engines with SCR systems.

Pin	Task	Note
1	Not used	To be plugged
2	Ground connection to potentiometer	Cable cross-section 1 mm^2
3	Signal from potentiometer to engine control unit[1]	Cable cross-section 1 mm^2
4	+5 V to potentiometer	Cable cross-section 1 mm^2
5	+24 V if there is a fault on the accelerator pedal	Cable cross-section 1 mm^2
6	+24 V to indicator lamp when the remote control lock is activated	Cable cross-section 1 mm^2

1. For further information on connection, see the section Connection of limp home mode.

Note:

Electrical cables to C4002-2, C4002-3 and C4002-4 must be twisted 35-40 turns per metre.



harness-to-harness connector C4002 on the engine viewed from the electrical cable input side.

Connection of harness-to-harness connector C4002

C4002 is either connected with a 6.2 m pre-assembled electrical cable, or with contact housing kit 2 110 930. Use hand crimping tool 588 206 and dismantling tool 99 591 for the contact housing kit. Contact housing kit 2 110 930 contains the following components:

Qty	Part No.	Designation	Note
1	1 505 950	Contact housing	6-pin black

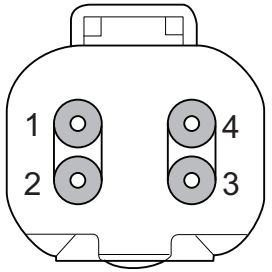
Qty	Part No.	Designation	Note
6	1 427 164	Cable terminal, round socket	0.5-1.0 mm^2
1	1 505 951	Locking part	6-pin green
6	1 427 166	Cable terminal, round socket	1.1-2.0 mm^2
5	1 504 108	Cable terminal	2.5 mm^2

C4071: Harness-to-harness connector for voltage to variable geometry turbocharger and warning lamps for the SCR system

Pin	Task	Note
1	30 voltage to variable geometry turbocharger	Cable cross-section 2.5 mm^2, fuse 20 A
2	Ground connection for variable geometry turbocharger	Cable cross-section 2.5 mm^2
3	+24 V to warning lamp for low reductant level	Cable cross-section 1.5 mm^2
4	+24 V to warning lamp for SCR malfunction	Cable cross-section 1.5 mm^2

C4071 is either connected with a 6.2 m pre-assembled electrical cable, or with contact housing kit 2 151 234. Use hand crimping tool 588 206 and dismantling tool 99 591 for the contact housing kit. Contact housing kit 2 151 234 contains the following components:

Qty	Part No.	Designation	Note
1	1 528 286	Contact housing	4-pin
1	1 529 440	Locking part	4-pin green
3	1 427 166	Cable terminal, round socket	1.1-2.0 mm^2



338 666

harness-to-harness connector C4071 on the engine viewed from the electrical cable input side.

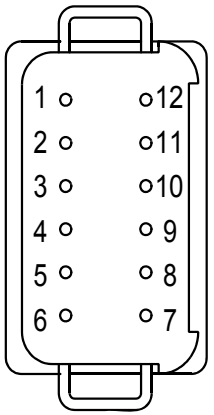
Qty	Part No.	Designation	Note
3	1 504 108	Cable terminal	2.5 mm^2
1	1 779 819	Boot	4-pin black

C4089: Harness-to-harness connector for the connection of limp home mode and voltage to SCR system and exhaust routing valve

This harness-to-harness connector is only in marine engines with SCR systems.

Pin	Task	Note
1	Ground connection for potentiometer	Cable cross-section 1 mm^2
2	Signal from potentiometer to engine control unit[1]	Cable cross-section 1 mm^2
3	+5 V to potentiometer	Cable cross-section 1 mm^2
4	+24 V to warning lamp for low reductant level	Cable cross-section 1.5 mm^2
5	+24 V to warning lamp for SCR malfunction	Cable cross-section 1.5 mm^2
6	15 voltage to exhaust routing valve	Cable cross-section 2.5 mm^2, fuse 20 A
7	Ground connection for exhaust routing valve	Cable cross-section 2.5 mm^2
8	Not used	To be plugged
9	15 voltage to SCR system	Cable cross-section 1.5 mm^2, fuse 10 A
10	30 voltage to SCR system	Cable cross-section 2.5 mm^2, fuse 20 A
11	Not used	To be plugged
12	Ground connection for SCR system	Cable cross-section 2.5 mm^2

1. For further information on connection, see the section Connection of limp home mode.



harness-to-harness connector C4089 on the engine viewed from the electrical cable input side.

C4089 is either connected with a 6.2 m pre-assembled electrical cable, or with contact housing kit 2 134 366. Use hand crimping tool 588 206 and dismantling tool 99 591 for the contact housing kit. Contact housing kit 2 134 366 contains the following components:

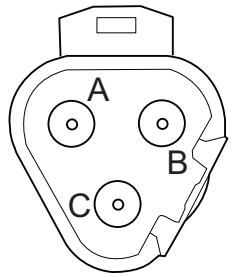
Qty	Part No.	Designation	Note
1	1 781 032	Contact housing	12-pin
1	1 783 122	Locking part	12-pin green
5	1 504 108	Cable terminal	2.5 mm^2
4	1 427 166	Cable terminal, round socket	1.1-2.0 mm^2
4	1 427 164	Cable terminal, round socket	0.5-1.0 mm^2
2	1 342 966	Plug	

C4109: Harness-to-harness connector for connecting reductant pump

This harness-to-harness connector is only in marine engines with SCR systems.

Pin	Task	Note
A	+24 V	Cable cross-section 1.5 mm^2
B	Signal	Cable cross-section 1.5 mm^2
C	Ground	Cable cross-section 1.5 mm^2

C4109 is connected using contact housing kit 2 599 614, alternatively cable harness 2 587 366 can be used. The positioning of the harness-to-harness connector is shown in *02:07 SCR-system*.



Harness-to-harness connector C4109 for connecting reductant pump.

C4094: Harness-to-harness connectors for ignition coils and throttle actuator at gas mixer

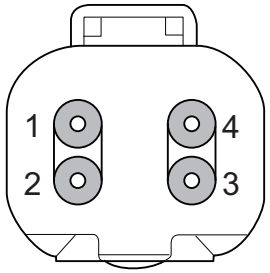
The harness-to-harness connector is only on gas engines.

Pin	Task	Note
1	15 voltage to ignition coil, cylinders 1-4	Cable cross-section 2.5 mm^2, fuse 20 A. See also the notes below.
2	15 voltage to ignition coil, cylinders 5-8	
3	Not used	To be plugged
4	Not used	To be plugged

The following applies for the ignition coil electrical cables:

- The electrical cables should be as short as possible. Maximum length is 6.2 m.
- The electrical cables must be positioned in such a way that they are not exposed to electromagnetic interference.
- The electrical cables must not be spliced. Junction boxes must not be used.

Power supply to the ignition coils should come from a stable power source, such as a battery, and not an alternator.



338 666

harness-to-harness connector C4094 on the engine viewed from the electrical cable input side.

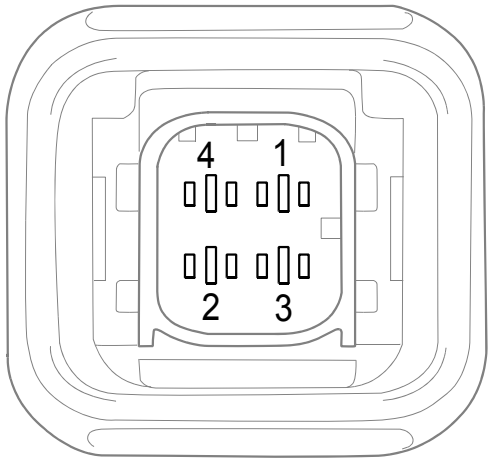
C4094 is either connected with a 6.2 m pre-assembled electrical cable, or with contact housing kit 2 151 234. Use hand crimping tool 588 206 and dismantling tool 99 591 for the contact housing kit. Contact housing kit 2 151 234 contains the following components:

Qty	Part No.	Designation	Note
1	1 528 286	Contact housing	4-pin
1	1 529 440	Locking part	4-pin green
3	1 427 166	Cable terminal, round socket	1.1-2.0 mm^2
3	1 504 108	Cable terminal	2.5 mm^2
1	1 779 819	Boot	4-pin black

C4126: Throttle control

Pin	Task	Note
1	Ground connection to potentiometer	Cable cross-section 1 mm^2
2	Signal from potentiometer to engine control unit	Cable cross-section 1 mm^2
3	+5 V to potentiometer	Cable cross-section 1 mm^2
4	Not used	To be plugged

C4126 is connected with a 6.2 m pre-assembled electrical cable.



harness-to-harness connector C4126 on the engine viewed from the electrical cable input side.

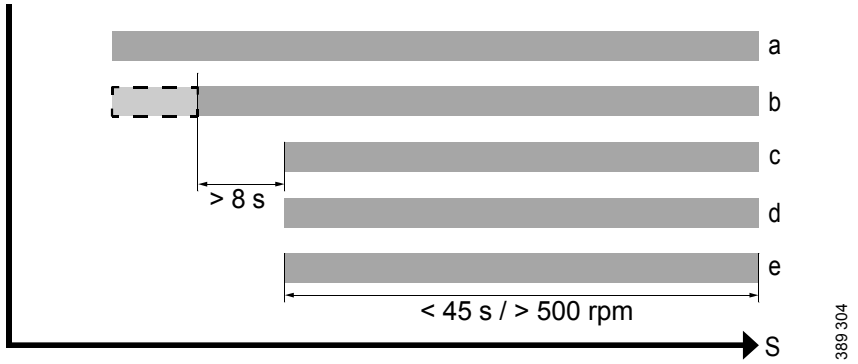
Starting and shutdown procedure for gas engines

Starting procedure

1. Disconnect the engine from any load.
2. Starting sequence:
   a) 30 voltage to the engine control unit is activated via C4001-1 and C4001-4.
   b) 15 voltage to the engine control unit and to the throttle actuator by the gas mixer is activated by C4001-3 or C4094-4, with or without delay.
   c) The 15 voltage to the ignition coils is activated via C4094-1 and C4094-2. The delay should be at least 8 seconds.
   d) The shut-off valve opens via external control, without delay.
   e) A start request is sent from the coordinator to the engine control unit via CAN, without delay. See *DLN1-Proprietary* in *03:05 CAN interface*. CAN is connected via C4001-6 and C4001-7. The start request will be active for 45 seconds or until the engine speed exceeds 500 rpm.

      The starter motor is run normally for approx. 15-20 seconds. Then, the engine runs at idling speed for about 10 seconds. Then, the engine increases speed by approx 50 rpm per second to its operating speed of 1,500 rpm (50 Hz) or 1,800 rpm (60 Hz).
3. Warm the engine up by letting it run at the nominal engine speed without load for at least 2 minutes.
4. Run the engine under load.

The connection of C4001 and C4094 is described in more detail in the section Pin numbering for harness-to-harness connectors.



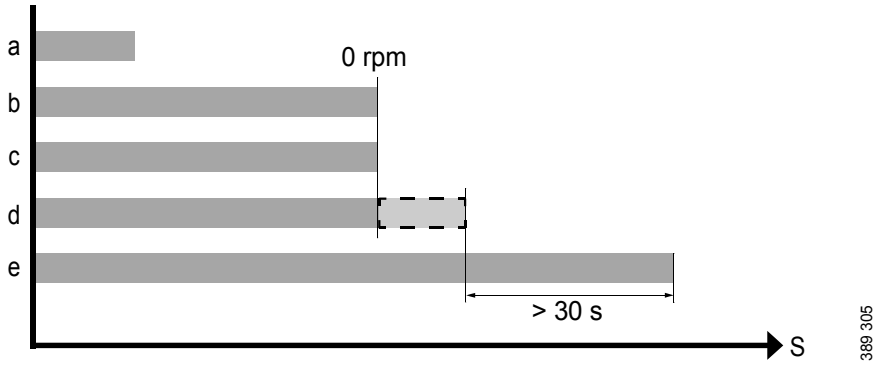
Starting sequence for OC16.

a) 30 voltage to the engine control unit is activated via C4001-1 and C4001-4.
b) 15 voltage to the engine control unit and to the throttle actuator by the gas mixer is activated by C4001-3 or C4094-4, with or without delay.
c) The 15 voltage to the ignition coils is activated via C4094-1 and C4094-2. Delay at least 8 s.
d) The shut-off valve opens via external control, without delay.
e) The start request is sent from the coordinator to the engine control unit via CAN (C4001-6 and C4001-7), without delay. The start request is active for 45 seconds or until the engine speed exceeds 500 rpm.

Shutdown procedure

1. Disconnect the engine from any load.
2. Run the engine at the nominal engine speed for at least 3 minutes.
3. Shutdown sequence:
   a) The shut-off valve is closed via external control.
   b) The engine runs until the gas runs out and the engine stops. A shutdown request is sent from the coordinator to the engine control unit via CAN when 0 rpm has been attained. See *DLN1-Proprietary* in 03:*05 CAN interface*. CAN is connected via C4001-6 and C4001-7.
   c) The 15 voltage to the ignition coils is deactivated via C4094-1 and C4094-2.
   d) 15 voltage to the engine control unit and to the throttle actuator by the gas mixer is deactivated by C4001-3 or C4094-4, with or without delay.
   e) 30 voltage to the engine control unit is deactivated via C4001-1 and C4001-4. The delay should be at least 30 seconds.

The connection of C4001 and C4094 is described in more detail in the section Pin numbering for harness-to-harness connectors.



Shutdown sequence for OC16.

a) The shut-off valve is closed via external control.
b) The engine runs until the gas runs out and the engine stops. When it has reached 0 rpm, a shutdown request is sent from the coordinator to the engine control unit via CAN (C4001-6 and C4001-7).
c) The 15 voltage to the ignition coils is deactivated via C4094-1 and C4094-2.
d) 15 voltage to the engine control unit and to the throttle actuator by the gas mixer is deactivated by C4001-3 or C4094-4, with or without delay.
e) 30 voltage to the engine control unit is deactivated via C4001-1 and C4001-4. Delay at least 30 s.

Connection of starter motor or alternator

When connecting electrical cables between the battery and starter motor or alternator, cable terminals in the sizes specified below must be used.

Industrial engines

Alternator 100A	
Battery positive	M8

Alternator 150A	
Battery positive	M10

Starter motor	
Battery positive	M10
Ground connection near starter motor	M10

Marine engines

Alternator	
Battery positive	M8
Battery negative	M10

Starter motor	
Battery positive	M10
Battery negative	M12

Note:

If several battery groups are to be connected to the alternator and separated, battery voltage is required on the positive terminal in order for the alternator to start charging.

Connection of coolant level monitor

Scania recommends that the cooling system be fitted with a coolant level monitor to warn when the coolant drops below a specific level.

REQUIREMENT!

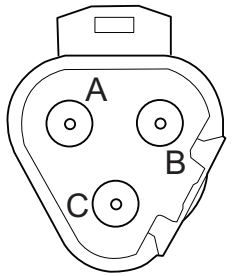
If the cooling system temperature monitor has an alarm temperature above 100°C, a coolant level monitor must be installed. A coolant level monitor is always a requirement when there is no operator continuously monitoring the engine monitoring system.

Connect coolant level monitor to harness-to-harness connector T8 as follows:

Pin	Task
A	+5 V to coolant level monitor
B	Ground connection for coolant level monitor
C	Signal from coolant level monitor to engine control unit

In SDP3, the coolant level monitor can be deactivated or configured as breaking or closing.

The engine can either be configured from the factory prepared for coolant level monitor or with the function deactivated. If the function is deactivated at the factory, it is configured as a breaking monitor according to the table on the next page.



Harness-to-harness connector T8 for connecting coolant level monitor

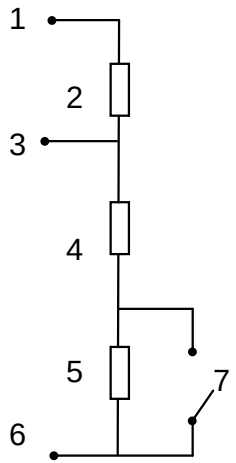
The following voltage levels are required from the coolant level monitor depending on if the level monitor is closing or breaking:

Type of level monitor	Voltage level	
Breaking	0-0.5 V	fault code
	0.5-2.26 V	adequate coolant level
	2.26-4.5 V	low coolant level
	4.5-5.0 V	fault code
Closing	0-0.5 V	fault code
	0.5-2.26 V	low coolant level
	2.26-4.5 V	adequate coolant level
	4.5-5.0 V	fault code

If the coolant level monitor is a closing or breaking level monitor it is possible to achieve the correct voltage levels by installing a resistor net between harness-to-harness connector T8 and the coolant level monitor. An example of what this type of resistor net looks like is shown in the illustration to the right.

Use contact housing kit 1 456 342 with hand crimping tool 588 206 and dismantling tool 99 591 to connect the coolant level monitor. Contact housing kit 1 456 342 contains the following components:

Quantity	Part No.	Designation
1	1 383 572	Sleeve
1	1 349 112	Locking part
5	1 361 119	Cable terminal, round pin

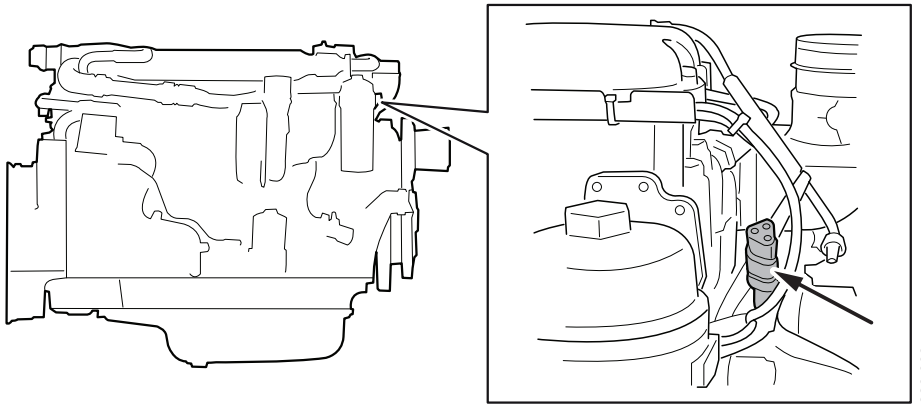


Example of resistor net between harness-to-harness connector T8 and coolant level monitor.

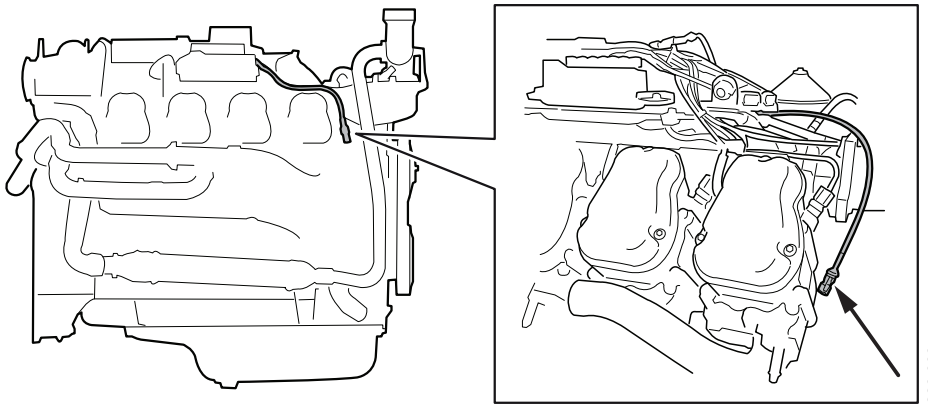
1. *5 V.*
2. *Resistor 330 ohms.*
3. *Signal.*
4. *Resistor 120 ohms.*
5. *Resistor 470 ohms.*
6. *0 V.*
7. *Coolant level monitor.*

Connecting a coolant level monitor on an industrial engine

On industrial engines the coolant level monitor is connected to harness-to-harness connector T8, which is positioned as shown in the figures.



Connecting a coolant level monitor on a DC09 and DC13.



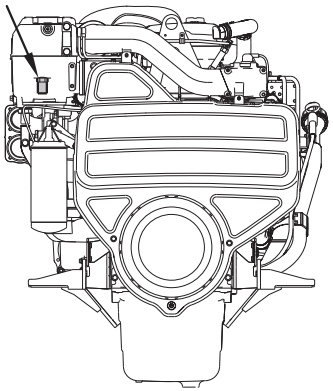
Connecting a coolant level monitor on a DC16 and OC16.

Coolant level monitor on marine engines with heat exchanger

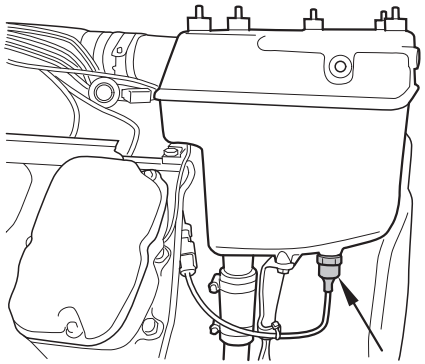
On engines with heat exchanger, the cooling system is supplied with a coolant level monitor that warns when the coolant level is below a set level.

On the DI09 and DI13, the coolant level monitor is positioned at the very bottom on the front of the expansion tank. On DI16, it is positioned on the underside of the expansion tank.

DI09, DI13



DI16



337 380

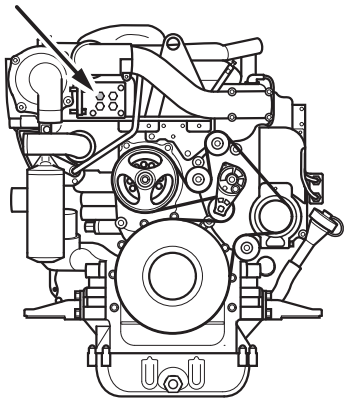
Coolant level monitor on marine engines with heat exchanger.

Connection of coolant level monitor on marine engines with keel cooling

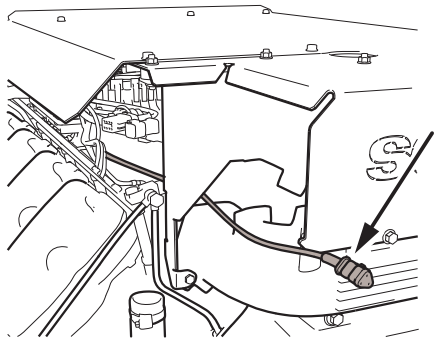
Engines with keel cooling can be supplied with or without coolant level monitor. If the Scania coolant level monitor is not used, Scania recommends that the cooling system be fitted with a coolant level monitor from another manufacturer.

On the DI09 and DI13, it is connected in the front, upper part of the exhaust manifold with thread M18x1.5. On the DI16, it is connected in connector T8 at the top left of the front of the engine.

DI09, DI13



DI16



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Connection of coolant level monitor on marine engines with keel cooling.

Connection of oil level sensor

On XPI engines the oil level sensor may be connected to the engine control unit. The oil level values are then read via CAN.

On PDE engines, the customer connects the T110 oil level sensor. The customer can also choose to connect the sensor on XPI engines. The oil level is then read using the voltage levels. Refer to next page.

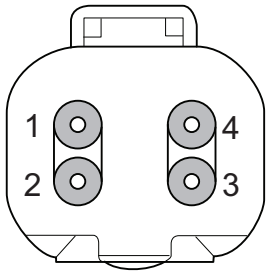
Connect the oil level sensor as follows:

Pin	Task
1	+5 V to oil level sensor
2	Ground connection for oil level sensor
3	Signal from oil level sensor
4	Not used

The following parts are required to connect the oil level sensor:

Quan-tity	Part No.	Designation
1	1 757 720	Contact housing
3	1 427 160	Cable terminal, round pin
1	1 347 493	Locking part
1	1 342 966	Plug

Use hand crimping tool 588 206 and dismantling tool 99 591.



338 666

Harness-to-harness connector T110 on the engine viewed from the electrical cable input side.

The tables below show the oil level limit values grouped according to displacement:

DC09, DI09		
Limit value	**Voltage (V)**	**Level (mm)**
Min. alarm level	2.2	42.4
Min. level	2.7	54.5
Max. level	3.5	74.2
Max. alarm level	4.1	89.2

DC13, DI13		
Limit value	**Voltage (V)**	**Level (mm)**
Min. alarm level	1.8	33.5
Min. level	2.4	48.0
Max. level	3.3	69.8
Max. alarm level	3.9	86.0

DC16, DI16, OC16		
Limit value	**Voltage (V)**	**Level (mm)**
Min. alarm level	1.7	29.1
Min. level	2.4	48.3
Max. level	3.6	78.4
Max. alarm level	4.3	95.5

The measuring range of the oil level sensor is 0.2-4.8 V.

Engine control unit

Operating voltage

For the engine control unit to function according to specification, the voltage must be 22-30 V. The normal voltage is 28 V.

Protective ratings

The S8 and OCE1 engine control units have an IP a rating 6K9K when all harness-to-harness connectors are connected to the engine control unit. S8 and OCE1 have an IP rating of 5K4 when the harness-to-harness connectors are not connected to the engine control unit.

The S6 engine control unit has an IP rating of 6K9K when all harness-to-harness connectors are connected to the engine control unit. S6 has an IP rating of 40 when the harness-to-harness connectors are not connected to the engine control unit.

Connection of limp home mode

Limp home mode can be used if the accelerator pedal fails.

For industrial engines with PDE, connect limp home mode to harness-to-harness connector A2 on the engine control unit. For industrial engines with XPI, connect limp home mode to harness-to-harness connector A6 on the engine control unit.

For marine engines without an SCR system, limp home mode is connected using harness-to-harness connector C4002 to the engine interface. See the C4002 on marine engines: Harness-to-harness connector for connecting limp home mode section. For marine engines with an SCR system, limp home mode is connected using harness-to-harness connector C4089 to the engine interface. See the C4089: Harness-to-harness connector for the connection of limp home mode and voltage to SCR system and exhaust routing valve section.

Note:

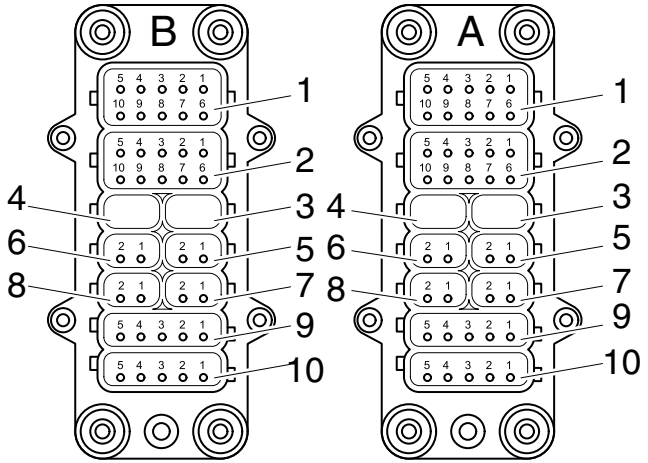
Existing connections must be put back to the same position.

Pin, industrial PDE	Pin, industrial XPI	Pin, marine PDE	Task
A2-5	A6-4	C4002-2	Ground connection to potentiometer
A2-7	A6-5	C4002-4	+5 V to potentiometer
A2-8	A6-10	C4002-3	Signal from potentiometer to engine control unit 0-100% throttle = 0.485-2.693 V[1]

1. A fault code is generated if the value from the potentiometer is below 0.1 V or above 4.9 V.

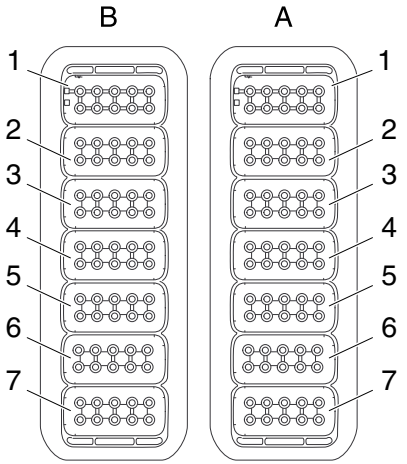
Use electrical cables which are twisted 40 turns per metre.

The following parts are needed in order to connect a backup accelerator pedal to the engine control unit harness-to-harness connector A2 (PDE) or A6 (XPI):



339 186

Engine control unit for PDE engines.



339 187

Engine control unit for XPI engines.

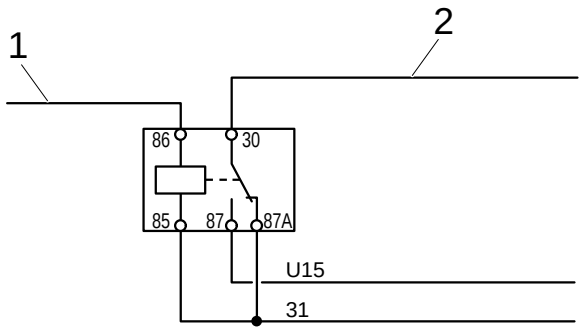
Quantity	Part No.	Designation
3	1 380 386	Sleeve
3	1 380 388	Seal

Use hand crimping tool 588 206 and dismantling tool 99 591.

Engine running signal

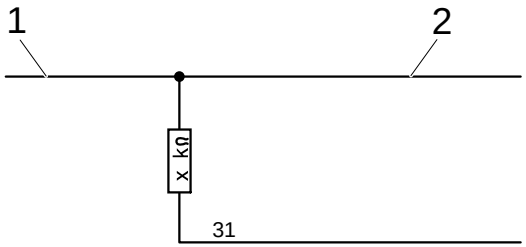
When the engine is stationary, the voltage on the engine control unit output for engine running signal is not 0 V, but 14 V because of a pull-up resistor. Depending on how the signal should be read, there are two different ways.

- If 0 V is to be detected, a relay which switches between 24 V and 0 V can be connected.
- If the signal should be read from a threshold voltage of approx. 2-3 V, a resistor can be connected.



339 495

1. *Engine running signal output from the control unit, 14 V.*
2. *Engine running: 24 V. Engine stationary: 0 V.*



339 189

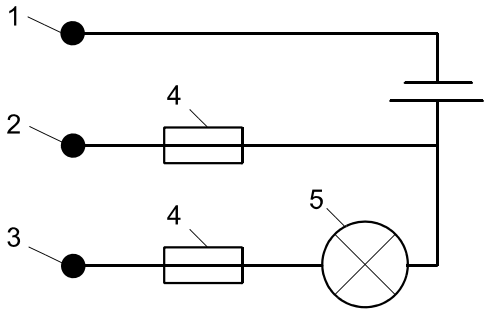
1. *Engine running signal output from the control unit, 14 V.*
2. *Resistance:*
   - *5.6 kohms provides a voltage of approximately 3.0 V.*
   - *4.7 kohms provides a voltage of approximately 2.5 V.*
   - *3.3 kohms provides a voltage of approximately 1.85 V.*

Connecting auxiliary equipment

Connection of the water separating prefilter on marine engines

Connect the warning lamp as follows:

Pos.	Connection
1.	Black (A), ground.
2.	Red (B), +12/24 V to prefilter.
3.	Yellow (C), signal when the sensor detects the maximum water level in the filter.
4.	Fuse, 1 A.
5.	Lamp, max. 12 W.



Prefilter harness-to-harness connectors.

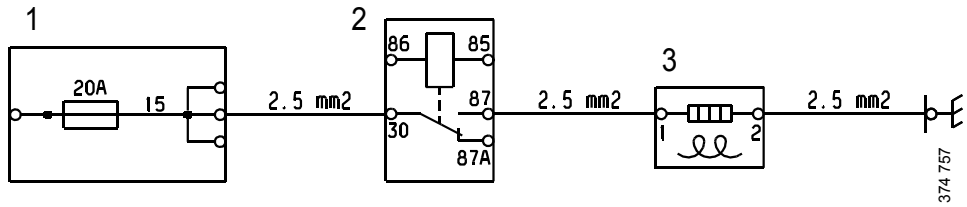
Connecting fuel heaters for industrial engines with XPI

Material: Harness-to-component connector 2-pin DTP: 1 907 302 (DTP06-2S-CE09) with shrinking tubing adapter (Boot adapter).

Locking part: 1 507 728 (WP2S).

Cable terminal x 2: 1 507 723 (1062-12-1066) 2-4 mm^2.

Shrinking tubing between harness-to-component connector and cable: Raychem type HTAT, size 24/6.



Example of fuel heater connection.

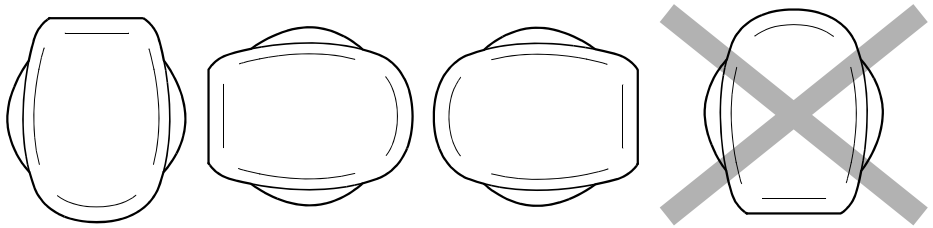
1. *Fuse, 20 A.*
2. *Relay.*
3. *Fuel heater.*

Installation of the supply connector for engine heater

The supply connector can be installed in 2 different ways:

- Recessed fitting with expansion screw.
- Separate fitting with bracket.

Fit the supply connector so it is accessible from the outside and protected from water penetration and mechanical damage. Normally, the connector is fitted with the hinge of the cover facing upwards, but it can also be fitted with the hinge at the side. The connector must not be fitted with the hinge facing down, as water cannot then be drained from the connector. See illustration.



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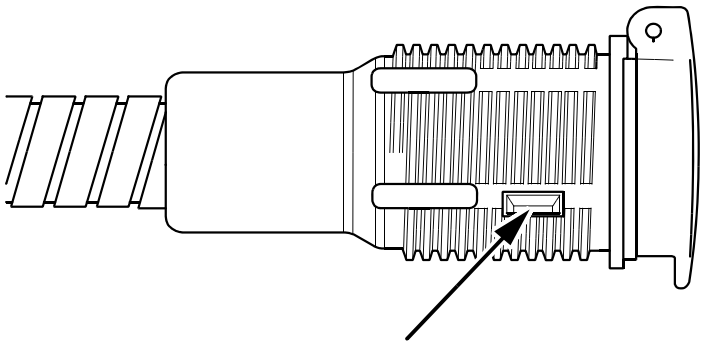
Also open the lower of the two weakenings so that condensation water can drain out of the connector. This applies both at to recessed and separate fitting. See illustration.



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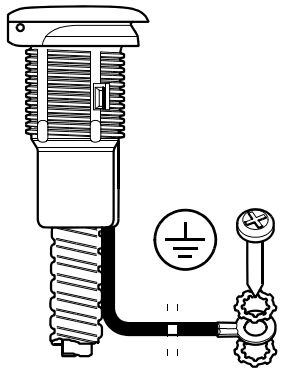
The ground connect (the black electrical cable with ring cable terminal) should be attached to the metal of the bodywork. The mounting area must be clean and free of paint and other substances.



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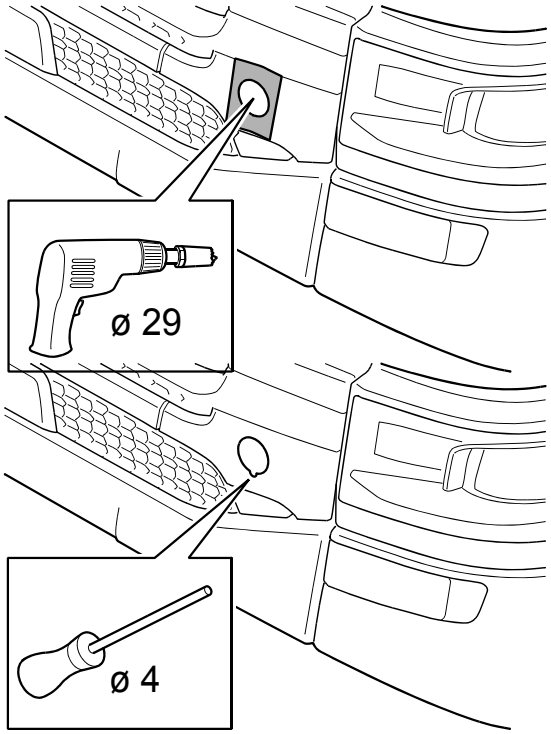
Recessed fitting with expansion screw

1. Make sure that there is enough space for the electrical cable on the rear side of the input.
2. Affix the template in the desired position for the hole.
3. Drill a Ø 29 mm hole through the template. Drill carefully so that the existing components, electrical cables, etc. are not damaged.



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4. File a Ø 4 mm guide groove at the lower edge of the hole.

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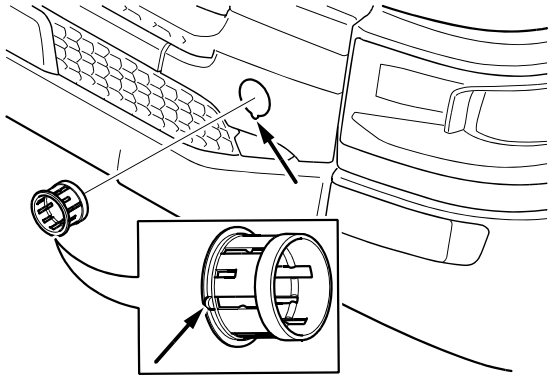
5. Fit the expander screw into the hole.



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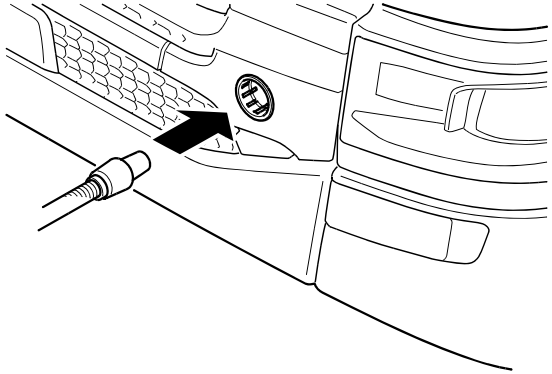
6. Thread the electrical cable through.



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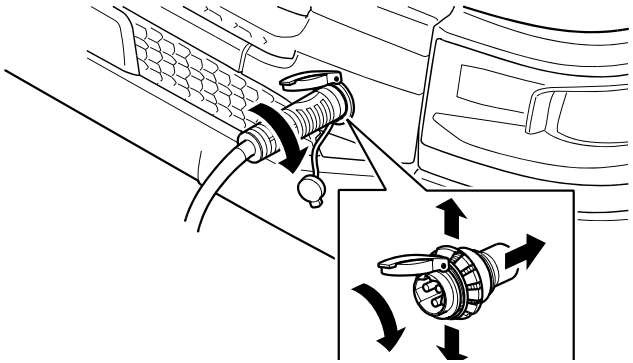
7. Insert the female part into the male part and tighten the expander screw using the female.



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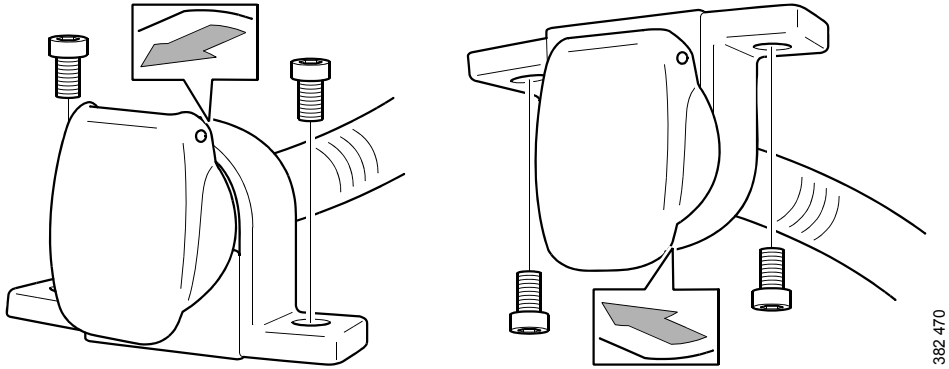
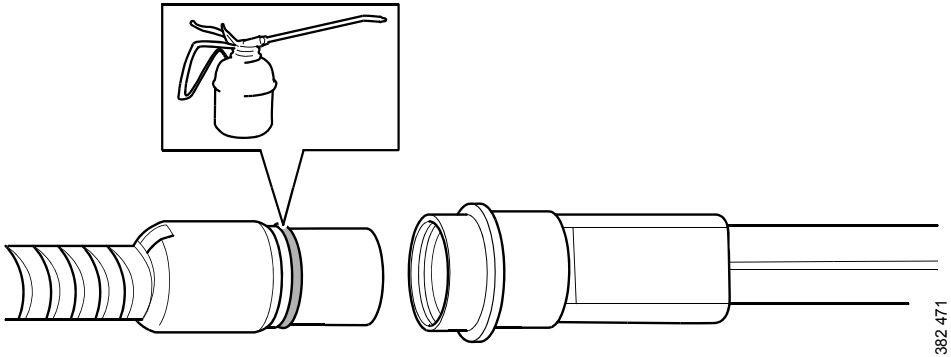
Separate fitting with bracket

The bracket can be fastened with screws facing upwards or downwards independent of the contact.



Lubrication before connection

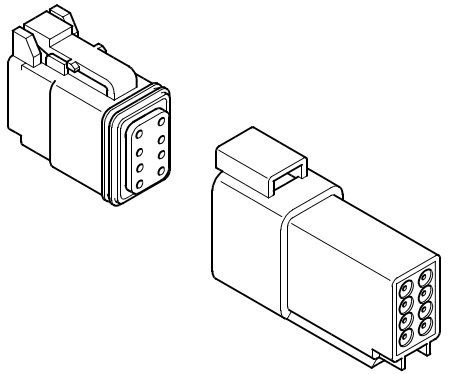
Before the heat source is connected, lubricate the O-ring with oil. The connection is pressed in when the gap between the connectors (male and female) is 0 to 0.5 mm.



Work description for harness-to-harness connectors

Harness-to-harness connector for engine interface

The work description depicts a 2-pin harness-to-harness connector, but the procedure is the same for 6, 8 and 12-pin harness-to-harness connectors.



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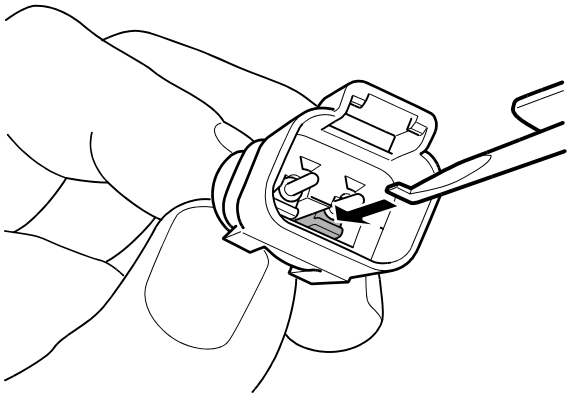
Deutsch harness-to-harness connector.

Female

1. Release the secondary locking device by placing tool 99 591 in the slot in the contact housing.

Note:

The locking device may be stuck. Be careful not to lose the locking device.



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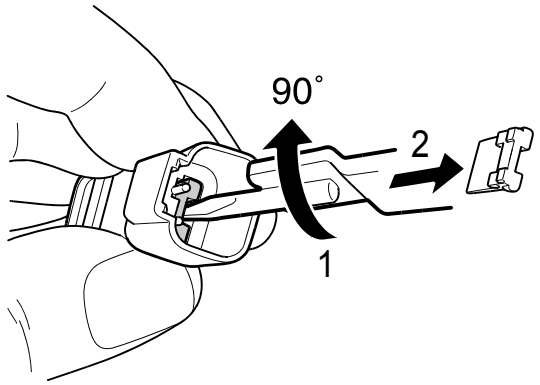
2. Tool 99 591 should be turned 90° to keep it in place under the secondary lock.
3. Pull out the locking device from the contact housing.



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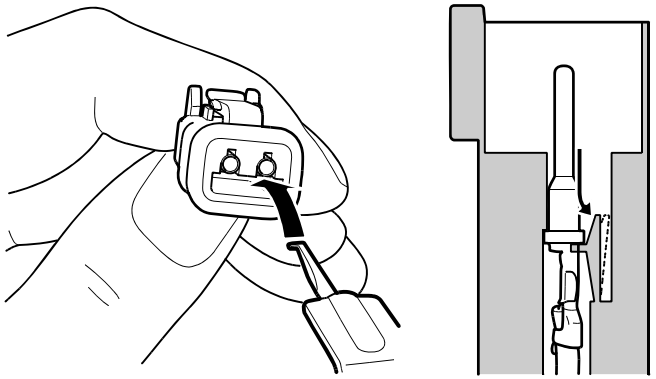
Note:

Note: Push in the cable terminal using the cable to make it easier to release the primary lock.

4. Release the primary lock by bending away the plastic tongue securing the cable terminal using tool 99 591 or a small screwdriver.
5. Pull out the cable terminal using the cable.



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Male

1. Release the secondary lock by removing the cover from the contact housing.

Note:

Push in the cable terminal using the cable to make it easier to release the primary lock.

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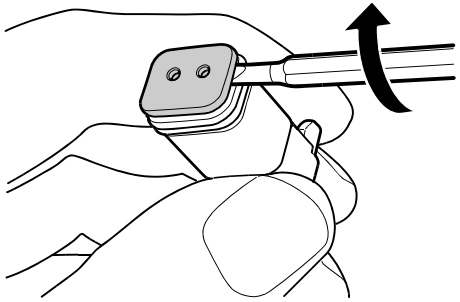
2. Release the primary lock by bending away the plastic tongue securing the cable terminal using tool 99 591 or a small screwdriver.
3. Pull out the cable terminal using the cable.



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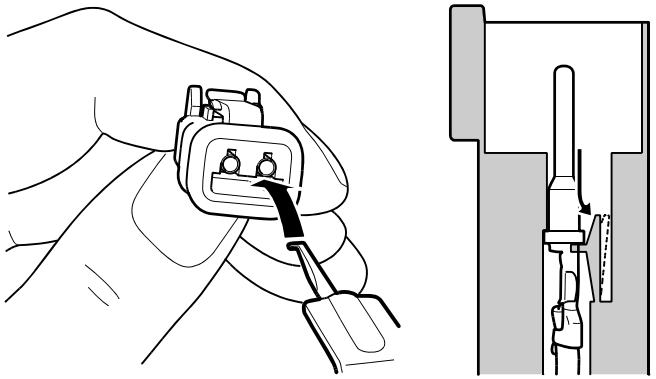

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Harness-to-harness connector for engine control unit

1. Harness-to-component connector
2. Secondary lock
3. Cable connection 0.5-1.0 mm^2 or 1.5-2.5 mm^2 tin
4. Seal 1.2-2.1 mm diameter (red) or 1.9-3.0 mm diameter (grey) depending on the diameter of the cable casing.
5. Cable
6. Plug

Assembly instructions

A. Press together at the stripped end and the lower section of the seal.

B. The rear section of the seal should be aligned with the housing after assembly.

C. The rear section of the seal must be aligned with the edge of the insulation.