# Service and Repair Manual

Service Level 2

(Original Service and Repair Manual)

Diesel engine

From serial number 2020730163



EN\_US 33525088601\_8\_1 09-2022

# For United States only

▲ WARNING: This product can expose you to chemicals, including carbon monoxide and benzene, which are known to the State of California to cause cancer and birth defects or other reproductive harm.

For more information, go to www.p65warnings.ca.gov/

▲ WARNING: Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. - Always start and operate the engine in a well-ventilated area.

- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information, go to www.p65warnings.ca.gov/diesel

# **Revision history**

Version	Author	Modification	Date
05	TB12 - Technical documentation	According to development and improvement	2018-07
06	TB12 - Technical documentation	First 3.02 engine version According to development and improvement	2019-02
07	TB12 - Technical documentation	According to development and improvement	2021-07
08	TB12 - Technical documentation	HVO introduction According to development and improvement	2022-09

## Preface

## About this document

This repair and service manual is dedicated for the mechanics and the workshop personnel of the Kohler Co. dealers and subsidiaries.

This repair manual provides information regarding the assembly, disassembly, and adjustment tasks for KOHLER Diesel engines.



#### Information

#### Information for the United States

Failing to follow these instructions when installing a certified engine in a piece of nonroad equipment violates federal law (40 CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act.

If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the equipment, as described in 40 CFR 1068.105.

Some sections of this manual do not apply to all engines.

Some illustrations in this repair and service manual show details and implements that may be different from your engine and machinery.

Protective devices and covers have been removed to provide a clearer representation in some illustrations.

KOHLER engines are subject to continuous development and improvement. This may result in modifications to your engine which may not be referred to in this repair and service manual.

If you require further explanations or information, please contact your nearest authorized Kohler service representative. See "Service Assistance" section.

#### **Spare parts**

Only original KOHLER spare parts, or spare parts purchased by Kohler Co. should be used for repairing KOHLER Diesel engines.

Kohler Co. will declare all possible undertakings carried out by Kohler Co. and/or their dealers, such as guarantees, service orders, etc. null and void without advance notice, if spare parts other than original KOHLER spare parts or spare parts purchased by Kohler Co. are used for maintenance or repair.

#### Fuels, lubricants and coolants

Only fuels, lubricants and coolants approved by Kohler Co. may be used for the operation of KOHLER Diesel engines.

Kohler Co. will declare all possible undertakings carried out by Kohler Co. and/or their dealers, such as guarantees, service orders, etc. null and void without advance notice, if fuel, lubricants and coolants other than fuel, lubricants and coolants approved by Kohler Co. are used for maintenance or repair.

#### Liability and warranty

Due to the wide variety of products offered by other manufacturers (e.g. service products, lubricants, tool attachments and spare parts), Kohler Co. cannot examine the general suitability and absence of defects in third-party products which are used in or on KOHLER products. The same applies to possible interactions between third-party products and products approved by Kohler Co.

Third-party products are used in or on KOHLER engines at the user's own discretion. Kohler Co. does not offer any warranty or accept any liability for losses of any kind caused by failures of or damage to KOHLER engines attributable to the use of third-party products.

Furthermore, Kohler Co. will not recognize any warranty claims attributable to incorrect operation, inadequate or insufficient maintenance or use of unapproved operating fluids or noncompliance with safety regulations.

Kohler Co. will cancel any obligations entered into by Kohler Co. and/or its dealers, such as guarantees, service contracts etc., without advance notice if any parts other than original KOHLER parts or spare parts purchased from Kohler Co. are used for maintenance and repairs.

The aforementioned provisions do not extend the warranty and liability conditions in the general terms and conditions of business of Kohler Co.

#### Modifications, conditions, copyright

Kohler Co. reserves the right to make modifications in the course of technical development, without issuing prior notification.

The aforementioned provisions do not extend the warranty and liability conditions in the general terms and conditions of business of Kohler Co..

#### Copyright - Proprietary notice ISO 16016

The reproduction, distribution, and utilization of this document as well as the communication of its contents to others without express authorization is prohibited.

Offenders will be held liable for the payment of damage.

All rights reserved in the event of the grant of a patent, utility model, or design.

## Other applicable documents

Document	Application
Operation and Maintenance Manual	Operator's manual for the engine operation
KoDIA Operation Manual	Description of KoDIA, diagnosis software

## **General information**

#### Manual structure



#### Information

Read and understand this manual before performing any service or maintenance procedures on any component.

The procedures described in this manual are based on the following structure:

- 1. Product description (For more information see: 1 Product description, page 17.)
- 2. Safety (For more information see: 2 Safety, page 34.)
- 3. Repair (For more information see: 3 Repair, page 54.)
- 4. Tools and devices (For more information see: 4 Tools and devices, page 258.)
- 5. Appendix (For more information see: 5 Appendix, page 266.)

#### Task layout



#### Information

Before any intervention, read the complete task procedure.

Each task in this manual has the following structure:

#### Preface

General information



#### Task layout description

- 1. Chapter heading
- 2. Previous tasks with details of the chapter
- 3. Specific safety instructions which complete the general safety instructions
- 4. Special tools, consumables, and equipment which are needed to fulfill the task
- 5. One or more overviews of the assembly with list of components
- 6. Instructions to remove and install the components, with additional directives
- 7. Specific values spreadsheet to check the nominal and tolerances values of critical components and data recording sheet, if required, to inform the engine manufacturer
- 8. Tightening sequence table if required
- 9. Tightening specifications table for specific fastener

#### Additional identifications

i Note	Indicates helpful advice and tips.
Precondition	Identifies a condition that must be fulfilled in order to be able to carry out the actions subsequently described.

General information

	Action	Identifies an action which has to be carried out.
$\triangleright$	Result	Identifies the result of an action.
	Listing	Identifies a listing.
Nm	Torque value	Identifies special tightening torque or specification.

Additional symbols

# Contents

Pro	duct de	escription	17			
1.1	Technical description					
	1.1.1	Conventions	19			
	1.1.2 Engine or component identification					
1.2	Functi	on description	28			
	1.2.1	Fuel system	28			
	1.2.2	Cooling system	30			
	1.2.3	Charge air system	31			
	1.2.4	Charge air diagram (engine with EATS)	32			
Saf	ety		34			
2.1	Identif	fication of the warnings	34			
	2.1.1	Warnings	34			
	2.1.2	Additional rules and directives	34			
2.2	Target	get audience				
	2.2.1	Responsibility of machinery owner	35			
	2.2.2	Recommended occupations according to International standards	35			
	2.2.3	Unauthorized personnel - servicing	36			
2.3	Intend	led use	36			
2.4	Limita	tion of liability	37			
2.5	Safety	Safety instructions				
	2.5.1	General safety instructions	38			
	2.5.2	Safety while commissioning	38			
	2.5.3	Safety when starting	39			
2.6	Prever	nting injuries	41			
	2.6.1	Preventing bruising	41			
	2.6.2	Preventing burns	41			
	2.6.3	2.6.3 Preventing fires and explosion hazards				
	2.6.4	Preventing intoxication and poisoning hazards	43			

© 2022 by Kohler Co. All rights reserved.

#### Contents

	2.6.5	Preventing electrical hazards	43						
	2.6.6	Preventing noise hazards	43						
	2.6.7	Preventing vibrations hazards	44						
	2.6.8	Preventing electro-magnetic hazards	44						
	2.6.9	Preventing falling risks	44						
2.7	Persor	al Protective Equipment (PPE)	44						
2.8	Accessible areas								
	2.8.1	Engine ready for use or in operation	46						
	2.8.2	Engine in commissioning – test run	47						
	2.8.3	Emergency stop	47						
	2.8.4	Signage recommendations	48						
2.9	Preven	t property damage	49						
	2.9.1	Safety instructions for engine control unit (ECU)	49						
	2.9.2	Alarm conditions	49						
	2.9.3	Safety instructions for the fuel system	50						
	2.9.4	Cleanliness standards and safety	51						
2.10	Disposal and environment protection								
Rep	air		54						
3.1	Preven	Prevent property damage							
3.2	Prepar	atory maintenance activities	55						
3.3	Post m	aintenance activities	56						
	3.3.1	Spray painting	56						
3.4	Covers	3	58						
	3.4.1	Vibration damper cover removal and installation	58						
	3.4.2	Battery charging alternator & PTO cover removal and installation	60						
	3.4.3	Cylinder head cover removal and installation	64						
3.5	Rocker	arms	68						
	3.5.1	Rocker arms - Valve clearance set (SL 204)	68						
	3.5.2	Inlet and outlet rocker arms removal and installation							
	3.5.3	Rocker arms housing removal and installation							
3.6	Cylind	er head	89						
	3.6.1	Removing and installing cylinder head	89						

3.7 Driving gear 3.7.1 Power unit 

	3.7.2	Torsional vibration damper removal and installation - SL2-1340	99					
3.8	Fuel sy	stem	109					
	3.8.1	Fuel return and venting pipes removal and installation	109					
	3.8.2	High pressure pipes removal and installation	112					
	3.8.3	Fuel supply pipes removal and installation	120					
	3.8.4	Injector removal and installation (SL 205)	121					
	3.8.5	Fuel filters removal and installation	130					
	3.8.6	Leakage fuel block removal and installation	132					
	3.8.7	Fuel pump HP and LP removal and installation (SL 209)	133					
3.9	Charge	air system	139					
	3.9.1	Air intake line removal and installation	139					
	3.9.2	Charge air line removal and installation	140					
	3.9.3	Charge air cooler removal and installation (SL 220)	149					
3.10	Exhaus	st gas system	154					
	3.10.1	Admission pipes to turbocharger removal and installation	154					
	3.10.2	Exhaust pipes to turbocharger removal and installation	156					
	3.10.3	Turbocharger removal and installation (SL 213)	166					
	3.10.4	Oil supply – turbocharger removal and installation	171					
	3.10.5	Turbocharger brackets removal and installation	176					
	3.10.6	Exhaust pipes and compensators (SL 214)	181					
3.11	Lubrica	ating system	188					
	3.11.1	Crankcase breather system rubber hoses (SL 219)	188					
	3.11.2	Oil centrifuge removal and installation (depending on application)	190					
	3.11.3	Spin-on oil filters removal and installation	193					
	3.11.4	Oil cooler by-pass valve (SL 212)	194					
	3.11.5	Prelubricating pump removal and installation (option)	196					
3.12	Cooling	g system	200					
	3.12.1	Venting line removal and installation	200					
	3.12.2	Turbocharger cooling lines removal and installation	206					
	3.12.3	Thermostat HT and housing removal and installation (SL 217)	218					
	3.12.4	Thermostat LT and housing removal and installation (SL 217)	220					
	3.12.5	Coolant pump HT removal and installation (SL 216)	222					
	3.12.6	Coolant pump LT removal and installation (SL 215)	225					
	3.12.7	Fan drive (option)	227					
3.13	3 Electrical system							

© 2022 by Kohler Co. All rights reserved.

#### Contents

	3.13.1	Power take-off (PTO) and battery charging alternator removal and installation (SL 218, SL 223)	23					
	3.13.2	Starter removal and installation (SL 260)	240					
3.14	Exhaust gas aftertreatment system (depending on configuration)							
	3.14.1	Removing and installing diesel exhaust fluid injector (SL2-5330)	246					
	3.14.2	Diesel exhaust fluid pump removal and installation (SL2-5340)	252					
Tool	s and o	devices	258					
4.1	Tools		258					
	4.1.1	Special tools	258					
	4.1.2	Turning device	26					
Арр	endix		266					
5.1	Techni	cal design documents	266					
5.2	Cleanir	ng agents, thread-locking adhesives and greases	267					
	5.2.1	Cleaning agents, thread-locking adhesives and greases	267					
5.3	Standard tightening torques							
	5.3.1	Lubricant and threadlocker application rules	268					
	5.3.2	Screws pre-tightening, reuse, and marking	268					
	5.3.3	Standard torques for hexagonal / socket / flange screws and hexagonal / flange nuts	27					
	5.3.4	Standard torques for internal drive pipe plug with conical thread	272					
	5.3.5	Standard torques for screws according to DIN 7643, DIN 910, DIN 908	272					
	5.3.6	Standard torques for flange joints	274					
	5.3.7	Assembling pipes with cutting rings	280					
	5.3.8	Standard torques for triple lock flange joints	28					
	5.3.9	Standard torques for VSTI screw plugs for steel and iron cast part	282					
	5.3.10	Standard torques for VSTI screw plugs for aluminium	283					
	5.3.11	Assembling pipes with DKO connectors (EL, ET, EW, GZ, GZR, RED)	285					
	5.3.12	Standard torques for collar clamps	286					
	5.3.13	Standard torques for pipe clamps according to DIN 3015	287					
5.4	Abbrev	viations - Acronyms	288					
5.5	Unit co	onversion tables	290					
	5.5.1	Length conversion factors	290					
	5.5.2	Mass conversion factors	290					
	5.5.3	Pressure conversion factors	290					

5.5.4	Volume conversion factors	290					
5.5.5	Power conversion factors						
5.5.6	Moment of inertia and torque conversion factors	291					
5.5.7	Factors of fuel consumption conversion						
5.5.8	Flow conversion factors	291					
5.5.9	Temperature conversion factors	291					
5.5.10	Density conversion factors	291					
5.5.11	Length conversion factors	292					
5.5.12	Mass conversion factors	292					
5.5.13	Pressure conversion factors	292					
5.5.14	Volume conversion factors	292					
5.5.15	Power conversion factors	293					
5.5.16	Moment of inertia and torque conversion factors	293					
5.5.17	Fuel consumption conversion factors	293					
5.5.18	Flow conversion factors	293					
5.5.19	Temperature conversion factors	293					
5.5.20	Density conversion factors	293					
Prefix		295					

5.6

Contents

# **1** Product description

## 1.1 Technical description



Fig. 1: Diesel engine / view from the driving end

- **DE** Driving end
- 1 Engine brackets
- 2 Flywheel
- **3** Fuel filter
- 4 Crankcase breather system filter housing
- **5** Exhaust gas turbocharger assembly
- 6 Charge air cooler
- 7 Battery charging alternator
- 8 Oil dipstick
- 9 High-pressure fuel pump

Technical description



Fig. 2: Diesel engine / view from the free end

- FE Free end
- **10** High-temperature coolant pump
- **11** High-temperature thermostat housing
- **12** Low-temperature coolant pump
- 13 Low-temperature thermostat housing
- 14 Exhaust gas connection
- 15 Lifting lug
- 16 Oil cooler
- 17 Oil filter



Fig. 3: Diesel engine / view from the free end

- FE Free end
- 18 Torsional vibration damper cover
- 19 Engine control unit
- 20 Straight air intake

- **21** Cylinder head cover
- 22 Charge air pipe
- 23 Starter
- 24 Oil pan

## **1.1.1** Conventions

#### Cylinder designation, direction of rotation, firing sequence

In this manual, all locations and directions shown on the diesel engine are compliant with ISO 1204 in its English version.

Cylinder A1 and cylinder B1 are located on the driving end of the diesel engine. Direction of rotation is counterclockwise, as seen from the driving end of the diesel engine.



Fig. 4: Cylinder designation - direction of rotation according to ISO 1204

A1-An	Series of cylinders – Bank A	Х	Exhaust valves
B1-Bn	Series of cylinders – Bank B	I	Intake valves
DE	Driving end	L	Left engine side
FE	Free end	R	Right engine side
DoR	Direction of rotation		

Firing sequence: A1-B2-A2-B4-A4-B6-A6-B5-A5-B3-A3- B1

## 1.1.2 Engine or component identification

# Type designation

Designation				esignation					Description	
К	D	62	V	12	-	5	Α	F	С	Engine type description
К										Engine manufacturer
	D									Fuel type (D=Diesel)
62							Total displacement in liter			
V								Cylinder configuration		
12								Number of cylinders		
						5				Frequency. 5=50Hz; 6=60Hz
A							A			Power level. A=power level designation, where A= the lowest power level, B=next higher power level, C=next higher power level
F								F		Emissions or fuel optimization. F=Fuel Opti- mized, E=Emissions Optimized
									С	Application. C=COP; P=Prime; S=Stand by; D=Data center

Tab. 1: Engine type description

## Diesel engine nameplate



Fig. 5: Engine nameplate

- 1 Engine main values
- 2 USA regulations references
- 3 QR code area

4 Notes regarding emissions exemptions, fuel, and application types

Technical description



Fig. 6: Engine nameplate location

#### Engine serial number

The engine serial number is stamped onto the engine nameplate.

Designation			Description
20##	73	0001	Engine serial number
20##			Year of manufacture
	73		Engine type code (73= KD62V12) (74= KD83V16) (75= KD103V20)
		0001	Incremental production number

Tab. 2: Engine serial number



Fig. 7: Serial number on nameplate

1 Serial number

### **Engine control nameplates**





- **Product designation**
- 2 Product type
- Engine designation 3
- 4 QR Code
- 5 Delivery date

- 6 Engine serial number
- Engine control unit ID number 7
- Certification ID number 8
- Data set ID number 9



- 2 Engine control unit ID number
- 3 Hardware version
- 4 Delivery date

- Supplier number 6
- 7 **QR** Code

#### Information

- The information on the engine control unit nameplate corresponds to the delivery status (ex: works Kohler Co.). Depending on software updates in the field, it may be the case that this information is no longer up to date.
- The real information can be viewed in the device display or read out with the KOHLER diagnosis and service tool KODIA.

#### **Crankcase identification**

The crankcase identification is stamped onto the left side of the crankcase.



Fig. 11: Crankcase identification location

### **Connecting rod identification**

The connecting rod identification is stamped on the connecting rod and on the connected rod bearing cap.

Technical description



Fig. 12: Connecting rod number location

Matching of the connecting rod and connecting rod bearing cap is identified by connecting rod number.

### **Turbocharger identification**



*Fig. 13: Turbocharger nameplate* 

The turbocharger company nameplate is mounted on the turbocharger.

## Oil cooler identification

MAHLE	
Industry	Made in Germany
Draw. No.	Prod. yr.
Permiss working temp.	°C Serial No.
Testing over-	bar
pressure	bar
Ref. Draw. No	
Customer No.	

Fig. 14: Oil cooler nameplate

The oil cooler company nameplate is mounted on the oil cooler.

## Injector identification



Fig. 15: Injection number location

The injector identification number is stamped on the side of the injector.

## High-pressure pumps identification



Fig. 16: High pressure pump nameplate



Fig. 17: High pressure pump number

The high pressure pump number is stamped on the pump.

## Charge air cooler identification

	Date	1323 00	1	5755	
Aluminium-Cooler Year-round Coolant Requirement:	1101	199800-/	_xxxx	_xx	
50% mixture of anti-freeze approved from engine manufacturer corresponds to		LLK	КМК		
-37°C freeze protection		CAC	RAD		
	PS bar	3,6	3		
	TS °C	241	83,9		
	V L	54,5	17,2		
	PT bar	6,0	4,5		

Fig. 18: Charge air cooler nameplates

The charge air cooler company nameplate is mounted on the charge air cooler.

#### Thermostat opening point value



Fig. 19: Thermostat markings

The opening point value of the thermostat is engraved on the thermostat.

## **1.2 Function description**

## 1.2.1 Fuel system



#### DANGER

Fire or explosion by flammable and explosive lubricants and fuels. Burns or explosion release will result in death or serious injury.

- ▶ Keep all caps and valves closed near the operating temperature.
- Avoid any contact of flammable and explosive operating fluids, gases or combustible materials with any hot surface or ignition source.
- ▶ Keep the engine clean and free from accumulation of dust and flammable liquids.
- ▶ Keep the insulation free of operating fluids contamination.
- ▶ Never release operating fluids while operating the engine.
- Check the electrical system. Immediately rectify all errors, such as loose connections and frayed cables.
- ▶ During refueling, switch off any additionally installed heater (optional).
- ▶ Lock out and tag out the engine prior to accessing to engine.
- Ensure a good ventilation while refueling or prior to accessing to the engine.
- Regularly check all lines, hoses and screw connections for leaks and damage. Immediately rectify the leaks and replace the damaged parts.
- Smoking and open flames are forbidden in the vicinity of the engine.
- Always start the engine according to the instructions in the instructions manual of the machinery.

#### **Fuel diagram**



Fig. 20: Fuel diagram

- Low pressure single walled а
- b Return line - single walled
- 1 Fuel tank
- 2 Fuel prefilter & water separator
- 2.1 Servicing point
- 2.2 B710 - WIF pre-filter 1
- 2.3 B745 - WIF pre-filter 2
- 3 Low pressure pump

High pressure - double С walled

- d Depending on engine configuration
- 4.1 B709 - Before fuel filter (Temperature)
- 4.2 B702 - After fuel filter (Pressure) 5
  - High pressure pump A and B
- 5.1 Y703 and Y704 - Fuel pump VCV
- 5.2 Y708 and Y707 - Fuel pump PCV 1
- 5.3 Y728 and Y727 - Fuel pump PCV 2

- CR Customer responsibility
- 6 Connecting block
- 7 Injectors A1 - B8
- 8 Break leakage detection block (if available)
- B7921 HP leakage detec-8a tion Bank A (Leakage)
- 8b B7922 - HP leakage detection Bank B (Leakage)
- 9 Fuel cooler (optional)

See next page for continuation of the image legend

Function description

4 Fuel filter

5.4 B704 and B705 – HP pump 10 Distribution Block (Bank A and B)

#### 1.2.2 Cooling system

### Coolant diagram



#### Fig. 21: Coolant diagram

- a High temperature
- **b** Low temperature
- **1** Aggregate support
- 2 Charge Air Cooler A
- **3** Charge Air Cooler B
- 4 Elbow A
- 5 Elbow B
- 6 ECU 2-HD
- 7 HT Water radiator

#### Sensors list

- **15** B708 Coolant temperature after engine
- 16 B718 Coolant temperature before cooler

- c Depending on engine configuration
- **CR** Customer responsibility
- 8 LT Water radiator
- 9 HT Expansion tank (including ventilation line)
- **10** LT Expansion tank (including ventilation line)
- **11** Venting HT
- 12 Venting LT
- 13 Engine oil cooler
- 14 Preheating
- 17 S710 HT Coolant Min level alert
  18 S711 LT Coolant Min level alert

- **19** Venting point
- 20 Drain point
- 21 Coolant pump HT
- 22 Coolant pump LT
- 23 Mechanical thermostat
- 24 Manual venting point

### 1.2.3 Charge air system

#### Charge air diagram



#### Fig. 22: Charge air diagram

- **a** Exhaust gas
- **b** Fresh air
- **1** Aggregate support
- 2 Charge air cooler B side
- **3** Charge air cooler A side
- 4 Elbow B side
- 5 Elbow A side

#### Sensors list

- 14 B785x Exhaust gas temperature on cylinder Ax (optional)
- 15 B786x Exhaust gas temperature on cylinder Bx (optional)

- c Oil vapor
- **d** Depending on engine configuration
- 6 Turbocharger
- 7 Air filter A side
- 8 Air filter B side
- 9 Exhaust catalyst
- **10** Blowby filters
- 18 B780 Air intake pressure switch - A side (clogging)
- 19 B749 Air intake temperature - A side

- e For odd number of turbochargers only
- **CR** Customer responsibility
- 11 Venting point
- 12 Engine A bank
- 13 Engine B bank
- 22 B707 Charged air temperature A after charge air cooler
- 23 Bxx1 Atmospheric pressure (on ECU 2-HD)

See next page for continuation of the image legend

#### Product description

Function description

#### Sensors list

- **16** B7811 Exhaust gas temperature before turbocharger 1&2
- 17 B781 Air intake pressure switch B side (clogging)

20 B7923 - Crankcase pressure

21 B703 - Charged air pressure A after charge air cooler

Engine type	Number of turbochargers	TC1	TC2	TC3	TC4	TC5
V12	3		x	x		
V16	4			х	х	
V20	5				Х	х

Tab. 3: Blowby connections

## 1.2.4 Charge air diagram (engine with EATS)



Fig. 23: Charge air diagram

- a Exhaust gas
- **b** Fresh air

- **c** Oil vapor
- **d** Depending on engine configuration
- e For odd number of turbochargers only
- **CR** Customer responsibility

# Product description Function description

1 2 3 4 5	Aggregate support Charge air cooler - B side Charge air cooler - A side Elbow - B side Elbow - A side	6 7 8 9 10	Turbocharger Air filter - A side Air filter - B side Exhaust catalyst Blowby filters	11 12 13 14	Venting point Engine A bank Engine B bank Engine by-pass flap
Sen	sors list				
15	B78xx - Exhaust gas temper- ature on cylinder Ax (optional)	19	B780 - Air intake pressure switch - A side (clogging)	23	B707 - Charged air tempera- ture A after charge air cooler
16	B78xx - Exhaust gas temper- ature on cylinder Bx (optional)	20	B749 - Air intake tempera- ture - A side	24	Bxx1 - Atmospheric pressure (on ECU 2-HD)
17	B7811 - Exhaust gas temper- ature before turbocharger 1&2	21	B7923 - Crankcase pressure		
18	B781 - Air intake pressure switch - B side (clogging)	22	B703 - Charged air pressure A after charge air cooler		

Engine type	Number of turbochargers	TC1	TC2	TC3	TC4	TC5
V12	3		х	х		
V16	4			х	х	
V20	5				х	х

Tab. 4: Blowby connections

# 2 Safety

## 2.1 Identification of the warnings

### 2.1.1 Warnings

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injuries or death.

Tab. 5: Example of warning

The safety alert symbol always appears in connection with one of the signal words:

- DANGER
- WARNING
- CAUTION

	DANGER	Indicates a hazardous situation that, if not avoided, will result in death or serious injury.
Â	WARNING	Indicates a hazardous situation that, if not avoided, could result in death or serious injury.
	CAUTION	Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

Tab. 6: Warning signs

The **NOTICE** signal word indicates a risk not related to personal injury.

The risks of engine failure are classified according to ISO 2710-2:

- Critical failure: that may cause engine scrap or breaking the laws or regulations
- Major failure: that causes remarkable degradation of engine performance or operating fault of main components, and cannot be repaired by replacing the part with spare with common tools in a short time
- Minor failure: that affects the performance of the engine, but does not cause operating fault of main components, and can be repaired by replacing the part with spare with common tools, usually in a short time

The short time is generally 30 minutes.

### 2.1.2 Additional rules and directives

#### Follow these instructions and observe any additional or local rules and directives.

Note the following points:

- Safety regulations applicable on site
- Guidelines provided by professional associations

© 2022 by Kohler Co. All rights reserved.

## 2.2 Target audience

#### 2.2.1 Responsibility of machinery owner

## j

Information

The machinery owner is responsible for the following:

- Checking the knowledge and skills of the personnel
- Establishing the required additional, refresher, and further training
- Establishing the responsibilities and authorizations
- Applying the ILO "C138 Minimum Age Convention, 1973" with a minimum age for admission to employment of 14 years
- Supplying the required tools and spare parts

#### 2.2.2 Recommended occupations according to International standards

The international standard classification of occupations (ISCO-08) of the International Labor Office (ILO) determines occupational unit groups. The following groups are listed as references to define the target groups, occupations, and joint tasks.

The listed skill levels and occupation unit groups perform the following work in accordance with the "General safety instructions" chapter (For more information see: 2.5.1 General safety instructions, page 38.) :

- Main tasks described in this manual or these instructions
- Tasks identified as requirements to prepare the main tasks

#### ILO - Skill level

#### Skill level 3 definition

Occupations at skill level 3 involve the performance of the following tasks:

- Ensuring compliance with health, safety and related regulations

Preparing detailed estimates of quantities and costs of materials and labour required for specific projects

Coordinating, supervising, controlling, and scheduling the activities of other workers Performing technical functions in support of professionals

The following abilities are essential:

 Many occupations at this skill level require high level of literacy and numeracy skills and well-developed interpersonal communication skills.

The following education levels are essential:

The knowledge and skills are obtained as the result of study at a higher educational institution for a period of 1 to 3 years following completion of secondary education (ISCED-97 Level 5b). In some cases, extensive relevant work experience and prolonged on-the-job training may substitute for the formal education.

### ILO - Occupations unit groups

# For SL2 to SL3 maintenance: Agricultural and Industrial Machinery Mechanics and Repairers – Unit group 7233 / ISCED-97 level 3 to 4

Skill level 3 required.

Agricultural and industrial machinery mechanics and repairers fit, install, examine, service and repair engines, agricultural and industrial machinery and mechanical equipment, except motor vehicle, aircraft, and electric motors.

Tasks include:

- Fitting, installing, examining, servicing, and repairing engines, machinery, and mechanical equipment
- Oiling and greasing stationary engines and machinery
- Inspecting and testing new machinery and mechanical equipment for conformity with standards and specifications
- Disassembling machinery and equipment to remove parts and make repairs
- Examining parts for defects such as breakage and excessive wear
- Operating newly repaired machinery and equipment to verify the adequacy of repairs
- Recording repairs and maintenance performed

#### 2.2.3 Unauthorized personnel - servicing

All other persons, including operators, supervisors and trainees, are classified as "unauthorized personnel" for maintenance work.

They are not allowed to service the engine or access the engine compartment or engine cover.

## 2.3 Intended use

The Diesel engines produced by Kohler Co. are partly completed machinery according to Machinery Directive 2006/42/EC Article 2 g (only for European Union).

The Kohler Co. products described in these instructions are intended for use according to the followings:

- The engines are intended to supply power to equipment (electric generator) and to equipment auxiliaries as specified by customer.
- The engines are intended for installation in machineries.
- Engines that are used in conjunction with alternators as emergency power generator must be firmly connected to the ground of the operation site. Appropriate mounting must be used to reduce the generated vibrations. This mounting must be released by Kohler Co.
- The engines may only be operated in faultless condition.
- The engines may be operated in closed rooms only with adequate ventilation. If additional fresh air is needed, open the doors and windows.
- The conditions prescribed by the manufacturer of the machinery in which the engine has been installed are also part of intended use.
- The engines must only be installed by personnel who have been trained and familiarized herewith and are aware of the dangers.
- Unauthorized changes on the engines or their components void the liability of Kohler Co. for any resulting property damage or personal injury.
- Interference with the injection and control system may influence the power and exhaust gas parameters of the engines, meaning that compliance with statutory environmental requirements is no longer assured.
Any other use above and beyond this is considered to be improper use. In this case, Kohler Co. is not liable for any damage. The risk is borne solely by the user.

## 2.4 Limitation of liability

The use of an engine under conditions or for purposes not intended by Kohler Co., but which can happen, induced by the engine in combination with, or as a result of, common human behavior, is considered as reasonably foreseeable misuse. It includes, but is not limited to the following:

- Drive of machinery not specified by the documentation.
- Overload of the engine
- Use of different applications and conditions rather than those specified
- Improper use of fuels, lubricants, starting aids and coolants
- Use of the engine manipulated overspeeds controls
- Modifications of the engine mounting and suspensions
- Lifting of the engine using unforeseen lifting points
- Continued use of the engine in emergency mode
- Operation of the engine with open engine cover
- Attachment of external cables and wires on Diesel engine cables and pipes
- Drawing of power from the damper side
- Unauthorized modifications to the engine

In the event that the above mentioned uses are undertaken in combination with the engine, the risk is borne entirely by the user and Kohler Co. is not liable.

#### NOTICE

Risk of engine failure.

Non-compliant installation according to installation plan and torque tightening values will lead to engine main failure (leakage in the charge air circuit, parts ejection, and others). Mount any component according to:

- ► For the KOHLER application, the "Operation and Maintenance Manual" and its "Service and Repair Manual".
- ► For non KOHLER components, refer to the "Instructions" or "Assembly Instructions" from the supplier.

## 2.5 Safety instructions

## 2.5.1 General safety instructions



#### DANGER

Failure to follow safety and hazard instructions will result in death or serious injury. Death or serious injury by failure to follow safety and hazard prevention instructions.

► Follow and enforce the safety instructions according to this Operation and Maintenance Manual, the application set manual and local regulations.



#### The machinery owner must apply following requirements:

- Before receiving the engine, the responsibilities and the definition of the safe conditions have to be established by the machinery owner.
- Only trained and instructed operators expressly authorized to do so must install, operate, maintain or repair the engine and the machinery.
- Only allow operators who have been trained, instructed or are present for training purposes, to work on the engine or the machinery under constant supervision of an experienced supervisor.

#### Organization commitments for the machinery owner:

- The Operation and Maintenance Manual of the engine has to be at the operator's disposal until the commissioning of the machinery. Afterwards the Operation and Maintenance Manual has to be a part of operator's manual of the manufacturer of the machinery.
- Familiarize yourself with the Operation and Maintenance Manual of the machinery before commissioning the machine.
- Develop, document, implement, and enforce a safety and health program, adapted to the machinery and its environment, and comply with the local regulations or at least with the International Labour Organization Standards.
- Make sure that operators are conscious of safety and hazards involved in their work and that they regularly check the Operation and Maintenance Manual of the machinery. This is especially to be repeated for the operators which occasionally operate the machinery.

#### NOTICE

Risk of engine failure by use of non-compliant operating fluids! Use of non-compliant operating fluids will lead to engine main failure.

▶ Use only operating fluids tested and approved by Kohler Co.

#### NOTICE

Risk of engine failure by use of non-original spare parts! The use of original spare parts guarantees the compliance with the technical requirements established by Kohler Co.

▶ Use only original spare parts approved by Kohler Co.

## 2.5.2 Safety while commissioning

Before initial operation, the owner must check that the installation complies with local regulations and instructions of the manufacturer of the application set.

Always ensure that:

- All installation, maintenance, and repair works are fulfilled.
- All loose parts and tools have been secured or removed, especially safety devices.
- Each operator has been properly trained and applies the local safety measures.

After start-up of the application set, make sure that all control, display, and warning devices are working.

## 2.5.3 Safety when starting



#### DANGER

Hazards by entanglement, trapping, ejection of parts or impact. On starting and while operation, hazards by entanglement, trapping, impact by ejection of parts will result in death or serious injury.

- ▶ The engine shall not be started until the drive train has been connected to the flywheel.
- Ensure the integrity of the machine and the engine before starting.
- All openings must be closed and the safe conditions established by the manufacturer of the machinery must be fulfilled.
- Standing in the vicinity of the engine while starting or operating the manufacturer's machinery is forbidden.



#### DANGER

Crushing, ejection of parts or high-pressure fluid ejection hazards. Fatal or serious injuries.

- Standing in the vicinity of the engine while starting or operating the machinery of the manufacturer is forbidden.
- ▶ Wear proper personal protective equipment.



#### WARNING

Hazards generated by exposure to environments temperatures. Exposure to radiant heat sources in the engine compartment could result in death or serious injuries.

- The manufacturer of the machinery shall define the appropriate ventilation of the engine compartment.
- ► The manufacturer of the machinery shall define the appropriate insulation of the exhaust pipe and the engine compartment.
- ► Wear proper personal protective equipment.
- ▶ Wait until the environment of the engine and the engine itself have cooled down.



#### WARNING

Hazards due to high sound level.

Exposure to high sound level could result in death or serious injuries by hearing loss or other physiological disorders (e.g. loss of balance, loss of awareness).

- Wear proper personal protective equipment in the vicinity of the engine.
- Noise reduction systems adapted to the machinery should be designed by the manufacturer, to comply with the local regulations.



#### WARNING

Hazards generated by excessive vibrations. Vibrations generated by the engine could result in death or serious injuries.

Standing in the vicinity of the engine while starting or operating the equipment is forbidden.



#### WARNING

Hazards generated by materials and substances processed, used or exhausted by machinery for example.

Materials and substances processed, used or exhausted could result in death or serious injuries by intoxication or poisoning.

- The manufacturer of the machinery shall design and implement an adapted extraction system.
- Wear proper personal protective equipment.



#### DANGER

Ejection of parts due to moving parts. Fatal or serious injuries.

- Standing in the vicinity of the engine while starting or operating the manufacturer's machinery is forbidden.
- Starter activation for service without engine start, e.g. for fuel injection system, must not operate longer than a maximum of 3 cycles lasting 30 seconds each, and with a minimum of 30 seconds between each starter activation.
- ▶ Wear proper personal protective equipment.

#### NOTICE

Engine failure by non-compliant starting procedure.

- Unless otherwise instructed, start the engine according to the instructions in the instructions manual of the machinery.
- Ensure that the engine is started after all display units and control devices have been checked.
- Ensure that the engine is only running in an enclosed space and sufficient ventilation is available.
- Ensure that all devices used to ensure evacuation of stagnant air and ensure air supply are functional.



#### WARNING

Ejection of parts and impact hazards by missing guards on rotating or drive sytem. On starting and while operation, accessing to the engine could cause serious injury or death by ejection of parts and impact on human body.

- ► The manufacturer of the machinery shall observe and enforce the country-specific regulations regarding prevention of injuries and risks.
- The manufacturer of the machinery shall define the appropriate guards according to the country-specific regulations regarding ergonomics-related hazards, for the entire life-cycle of the machinery.
- Standing in the vicinity of the engine while starting or operating the machinery is forbidden.
- ► Wear proper personal protective equipment.

## 2.6 Preventing injuries

## 2.6.1 Preventing bruising



#### WARNING

Hazards by moving parts.

Impacts by ejected objects coming into contact with moving parts could result in death or serious injuries and property damage.

- ▶ When the engine is running, avoid any contact with moving parts.
- ▶ It is forbidden to throw any object into the engine while running.

## 2.6.2 Preventing burns



#### WARNING

Hazards by hot engine near operating temperature. Any contact with hot surfaces could result in death or serious injuries by burns. The engine control unit (ECU) is hot while operating the engine.

- ► Avoid any contact with the engine, parts carrying hot coolant or oil, the exhaust system, the turbocharger, the heat protection, the battery, the covers, and the ECU.
- Proceed with the tasks on the engine only once the temperature has cooled down enough so that surfaces can be touched with bare hands.



#### WARNING

Hazards by ejection of operating fluids under pressure. Ejection of operating fluids under pressure could result in death or serious injuries by burns.

- Check operating fluid levels only once the temperature has cooled down enough so that surfaces can be touched with bare hands.
- Carefully open the cover in order to first reduce the excessive pressure.

## 2.6.3 Preventing fires and explosion hazards



#### DANGER

Fire or explosion by flammable and explosive lubricants and fuels. Burns or explosion release will result in death or serious injury.

- ▶ Keep all caps and valves closed near the operating temperature.
- Avoid any contact of flammable and explosive operating fluids, gases or combustible materials with any hot surface or ignition source.
- ▶ Keep the engine clean and free from accumulation of dust and flammable liquids.
- ▶ Keep the insulation free of operating fluids contamination.
- ▶ Never release operating fluids while operating the engine.
- Check the electrical system. Immediately rectify all errors, such as loose connections and frayed cables.
- During refueling, switch off any additionally installed heater (optional).
- ▶ Lock out and tag out the engine prior to accessing to engine.
- Ensure a good ventilation while refueling or prior to accessing to the engine.
- Regularly check all lines, hoses and screw connections for leaks and damage. Immediately rectify the leaks and replace the damaged parts.
- Smoking and open flames are forbidden in the vicinity of the engine.
- Always start the engine according to the instructions in the instructions manual of the machinery.



#### DANGER

Fire or explosion by ignition of the air/gas mixture in the air intake, initiated by electrostatic charging from insulated mounting.

Burns or explosion release will result in death or serious injury.

 Ground every component potentially electrically insulated from the engine, especially the turbocharger.



#### Information

According to local regulations, the manufacturer of the specific application is responsible to design adapted fire protection system.



#### Information

Engines provided by Kohler Co. are not intended to be used in potentially explosive atmospheres according to Directive 2014/34/EC.

## 2.6.4 Preventing intoxication and poisoning hazards



#### WARNING

Hazards by operating fluids and exhaust gases emissions.

Exhaust gases emissions increase the likelihood of cancers and could result in death or serious injury.

Operating fluids generate toxic gases and emanations and could result in death or serious injury.

- Ensure a good ventilation while running or refueling the engine.
- In case of doubt, apply any means to ensure evacuation of personnel and stale air, ensure air supply and ventilation.
- Respect the local health and safety regulations, the material safety data sheets (MSDS) and the instructions manual of the manufacturer's machinery.
- Avoid any contact with additives, operating fluids, gases, battery acid and fumes and acid condensate in charge air or exhaust system, especially by inhalation.
- Regularly check the exhaust gas circuit and turbochargers.
- Immediately rectify the errors and replace the damaged parts. Safety instructions of the fluids have to be considered.

### 2.6.5 Preventing electrical hazards



#### WARNING

Hazards by electrical shocks.

Contact with live conductor could result in death or serious injury.

- Access to live parts shall only be possible with voluntary action.
- Proceed to lock out and tag out prior to accessing to the engine.
- ▶ Respect the voltage indication of the engine technical data sheet.
- Check the grounding connection to avoid any risk of electrical arc.
- Observe the local safety regulations that apply to the machinery.

## 2.6.6 Preventing noise hazards



#### CAUTION

Increased hazards by drowned out warning sounds and high sound pressure level. Exposure to drowned out warning sounds and high sound pressure level could result in minor or moderate injuries by hearing loss or other physiological disorders.

- ▶ Wear proper personal protective equipment where applicable.
- Noise reduction systems adapted to the machinery must be designed by the manufacturer, to comply with the local regulations.
- ▶ In case of abnormal noises, rectify it immediately.

## 2.6.7 Preventing vibrations hazards



#### CAUTION

Hazards by exposure to vibrations.

Vibrations, by their acceleration, intensity, frequency and duration of exposure, could affect the health of personnel through vascular, neuro-sensory or musculoskeletal disorders, could result in minor or moderate injuries and cause property damage.

- The manufacturer of the machinery must design adapted dampering to comply with the local legislation.
- ▶ In case of abnormal vibration noises, identify and rectify immediately.

## 2.6.8 Preventing electro-magnetic hazards



#### WARNING

Harzards by electromagnetic field and pulse generated by the engine starting and speed variations.

Exposure to electromagnetic fields could result in death or serious injury.

- The manufacturer must ensure the conformity of its machinery to the current Electromagnetic Compatibility (EMC) Directive.
- Observe the safety regulations that apply to the machinery.
- Avoid any electromagnetic sensitive devices in the vicinity of the engine, especially artificial health assist devices.

## 2.6.9 Preventing falling risks



#### CAUTION

Hazards by slipping and falling. Climbing on the engine or leaks could result in minor or moderate injuries by slip and fall.

- Climbing on the engine is prohibited.
- Perform visual inspections for leaks or damage.
- In case of leak, correct deficiencies discovered immediately, clean and dry the operating fluids contaminated area.
- The manufacturer of the machinery must provide adapted stairs and gangways to work in safe conditions.

## 2.7 Personal Protective Equipment (PPE)



#### WARNING

Risk of injuries by not wearing of personal protective equipment. Missing, non-adapted, altered or misuse of personal protected equipment may accentuate the severity of injuries and could result in death or serious injuries.

- ► The manufacturer of the machinery shall define the safe conditions, including the personal protective equipment to wear before starting to work on the engine.
- ▶ The manufacturer of the machinery shall forbid any accessories and loose clothing.

The following personal protective equipment is necessary:

Sign (ISO 7010)	Description
R	<b>Protective work wear</b> Protection against objects and chemical splashes Must be worn in the direct vicinity of the engine
	<b>Safety helmet</b> Protection against falling/flying objects and against head injuries Must be worn in the direct vicinity of the engine
	<b>Safety shoes</b> Protect feet against falling objects and from entanglement. Additional protection against slipping Must be worn in the direct vicinity of the engine
	<b>Safety gloves</b> Protection against hot elements and chemicals Must be worn when handling hot parts, chemicals, operating fluids
	<b>Hearing protection</b> Protection against noise Must be worn in the direct vicinity of the engine
$\Theta$	<b>Safety goggles</b> Protection against flying objects and chemical splashes Must be worn when handling operating materials and during mechanical opera- tions

Tab. 7: Personal protective equipment

## 2.8 Accessible areas

Before first start-up, the manufacturer of the machinery shall observe and enforce following safety and health instructions:



#### DANGER

Hazards by entanglement, trapping, ejection of parts or impact.

On starting and while operation, hazards by entanglement, trapping, impact by ejection of parts will result in death or serious injury.

- > The engine shall not be started until the drive train has been connected to the flywheel.
- Ensure the integrity of the machine and the engine before starting.
- All openings must be closed and the safe conditions established by the manufacturer of the machinery must be fulfilled.
- Standing in the vicinity of the engine while starting or operating the manufacturer's machinery is forbidden.

### 2.8.1 Engine ready for use or in operation



Fig. 35: Areas in operation – view from above and driving end

#### Access to the following areas is forbidden:

- A Engine free end
- B Engine sides
- C Engine driving end

- **D** Above the engine
- E Below the engine

## 2.8.2 Engine in commissioning – test run



Fig. 36: Engine areas during commissioning and test run – view from above and driving end

#### Access to the following areas for commissioning and test run tasks is permitted:

A Engine free end

C Engine driving endD Above the engine

**B** Engine sides

Access to the following areas is forbidden:

**E** Below the engine

## 2.8.3 Emergency stop

#### Information

The machinery owner is responsible for marking the hazardous areas and the fail-safe devices.

The emergency stops must withstand the operational conditions, be kept visible and legible during the entire life cycle.

Additional emergency stops and measures according to project standards and local regulations and standards are possible.

The emergency stop button and signals, as the acknowledge buttons are described in the generator set manual.

#### NOTICE

Property damage by misuse of emergency stops. Misusing the emergency stops to stop the engine could lead to property damage.

▶ Initiate an emergency stop only in emergency situations.

#### Initiating an emergency stop:

Press the emergency stop button.

#### After an emergency stop:

- ▶ Remedy to the emergency situation.
- Acknowledge the emergency stop button and signals.

## 2.8.4 Signage recommendations



#### Information

The machinery owner is responsible for marking the hazardous areas and the fail-safe devices.

The signs must withstand the ambient conditions, and be kept visible and legible during the entire life cycle.

Additional signs and measures according to project standards and local regulations and standards are possible. For example: the signs for the United States market shall comply with ANSI Z535.4.

The following warning signs must be clearly visible and mounted in the accessible areas:

Sign (ISO 7010)	Description
A	ISO 7010/W012 – Warning sign - Electricity Death or serious injury due to electrical shocks!
	ISO 7010/W017 – Warning sign - Hot surface Severe injuries due to hot surfaces!
	ISO 7010/W025 – Warning sign - Counterrotating rollers Severe injuries due to drawing-in movement!
	ISO 7010/M002 – Mandatory action sign - Refer to instruction manual/booklet In order to ensure that all residual risks are known by the personnel, the system documentation must be read and understood. Make sure that all residual risks according to the risk assessment are reflected in the system documentation. Provide documentation to the personnel according to the "Target audience".

Tab. 8: Engine area signs requirement

## 2.9 Prevent property damage

## 2.9.1 Safety instructions for engine control unit (ECU)

#### NOTICE

Improper installation or misuse of the engine leads to ECU damage. Property damage due to non-compliant installation or operation.

- Ensure the connection to power supply before starting the engine.
- ▶ It is prohibited to disconnect the electrical power supply during operation.
- Ensure the connection of the ECU before starting the engine.
- Using a rapid charging device to start the engine is prohibited. Only jump start with separate batteries is allowed.
- Electrical welding in the vicinity of the engine is forbidden, especially near the ECU.
- Switch off the electrical system before connecting or disconnecting the ECU. Apply to the prescribed tightening torque to tighten the fixing screws of the interface plugs. The manufacturer of the machinery has to provide an electrical disconnect.
- ▶ Reversing the polarity of supply voltage results in the ECU destruction.
- Apply to the prescribed torque to tighten the connections to the injection system.
- Extreme engine compartment temperatures will damage the ECU. Please refer to the technical data sheet for temperatures values.
- ▶ Use suitable test cables to ensure the measures at plug connectors.
- Connecting the sensors or actuators individually to or between external voltage sources for testing purposes is prohibited. Risk of destruction or malfunction of the engine. Connect the sensors or actuators to the ECU.
- Mount and fix the mating connectors to protect the ECU against dust and moisture. When the mating connectors are dismounted, ensure protection of the ECU against dust and moisture by protective covers.
- Using mobile phones and wireless devices in the vicinity of the engine is prohibited. Risk of malfunction of the ECU and the engine.

## 2.9.2 Alarm conditions



#### CAUTION

Property damage and/or injuries due to neglect of fault codes.

Neglecting the fault code may lead to engine failure (for example, overspeed) and could result in minor or moderate injuries (for example, ejection of parts) by hazards from related actions. The engine is equipped with an engine control unit, which monitors the engine and itself (selfdiagnosis). After assessment of an identified fault, the following actions are automatically initiated:

- ▶ Issue of a fault message with a fault code.
- ▶ In combination with the machinery diagnosis system, the fault code is shown via a display.
- Switch over to appropriate backup/emergency functions for additional, restricted operation of the engine (for example, constant limp-home speed).
- ▶ Make sure that the faults are immediately repaired.



#### Information

The manufacturer of the machinery is responsible to design and provide a display to get the messages and codes generated by the ECU, and to develop, document, implement, and enforce emergency procedures to be followed in the event of accident or breakdown.

Refer to the "Electrical Installation Guideline". (For more information see: 5 Appendix, page 266.) .

## 2.9.3 Safety instructions for the fuel system



#### DANGER

Hazards due to flammable fluids under high pressure.

When the engine is running, the fuel lines are under a constant pressure of up to 2000 bar (29,007.40 psi).

Fuel escaping under pressure can penetrate the skin or vaporize and explode when an ignition source is present, which will result in death or serious injury.

- Never release the screws on the fuel circuit, especially between the high-pressure pump and the injector when the engine is running.
- ▶ Before starting any task on the fuel system, ensure the build-up pressure in the circuit has been released, and the temperature of the engine has cooled down.
- Keep the engine away from heat, sparks, open flame, or any other ignition source.

## 2.9.4 Cleanliness standards and safety

#### NOTICE

Property damage due to neglect of cleanliness standards!

Modern components, especially the injection system, consist of high precision parts that are subject to extreme loading.

Dirt particles of 20  $\mu$ m (0.79 th) or greater can result in component outages. Due to this high precision engineering, maintain a high standard of cleanliness for all tasks. Before and while performing any task, observe the following precautions:

- Ensure a clean area, free of stirred up dust by air movements.
- Perform visual inspections for leaks or damage.
- Before starting any task on the closed fuel system, clean the engine and its compartment with lint free tissue.
- Ensure waterproof covers are on the electrical components.
- ▶ Do not direct steam jet at electrical components or their covers.
- Clean and dry the area around the still closed fuel system with compressed air.
- Remove loose dirt particles such as paint chips and insulation material with suitable equipment.
- Cover the areas of the engine compartment which could produce dirt particles with a new and clean covering film.
- Before beginning the dismantling work, wash hands and put on fresh personal protective equipment.
- Clean tools and working materials.
- ▶ Perform work on components at a suitably equipped workplace.
- Use only undamaged tools.
- After opening the fuel system, the use of compressed air for cleaning is prohibited.
- ▶ Remove any loose dirt during installation work with suitable equipment.
- ▶ Remove any paint chips before loosening or tightening any connections.
- ► Use only lint-free cleaning tissues.
- ► Use particle and fiber-free materials.
- ▶ Immediately seal the opened connection with sealing caps.
- ▶ Keep the sealing material in dust-free packaging until use and dispose of it after single use.
- Place the components into a clean, sealed container.
- Never use contaminated cleaning or testing fluids.
- Remove new components from the original packaging immediately before use.
- ▶ Use the original packaging of the new parts to ship removed parts.

## 2.10 Disposal and environment protection



#### CAUTION

Environmental and health hazards by incorrect disposal.

Incorrect waste disposal leads to environment and water supply pollution and could result in minor or moderate injuries by hazards from related actions.

- Observe the country-specific regulations regarding environmental protection when disposing of scrap materials.
- Before disposing or recycling waste products, ask for the correct method at the responsible environmental or recycling center.
- When handling waste, lubricants and fuel make sure that none is disposed into the environment.
- Collect and dispose waste, lubricants and fuel in separate, suitable, properly designated containers.
- Use adapted leak-proof containers to drain lubricants and fuel. Use of food or drink containers is prohibited.
- ▶ Dispose all scrap materials only at official locations in an environment-friendly manner.

# 3 Repair

## 3.1 Prevent property damage

#### NOTICE

Risk of engine failure.

Non-compliant installation according to installation plan and torque tightening values will lead to engine main failure (leakage in the charge air circuit, parts ejection, and others). Mount any component according to:

- ► For the KOHLER application, the "Operation and Maintenance Manual" and its "Service and Repair Manual".
- ► For non KOHLER components, refer to the "Instructions" or "Assembly Instructions" from the supplier.

#### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

- ► Replace all sealings.
- Check reusable removed parts for re-usability; see the relevant information in the Service and Repair Manual.
- Replace any removed parts that cannot be re-used.
- If no specific torques and tensioning instructions are specified: Screw connections are to be tightened with the standard torques. Additional information can be found in the "Standard tightening torques" chapter, (For more information see: 5.3 Standard tightening torques, page 268.)
- Replace self-locking screw connections.
- Clean the Diesel engine connections and screw connections thoroughly of oil, fuel or care products before assembly.
- Use lint-free cleaning rags.
- Do not touch electric contacts. The connection may be affected by dirt or components may be destroyed by electrostatic discharges (ESD).
- Before cleaning the Diesel engine, cover or tape shut all openings into which water, steam or detergents must not penetrate due to safety or functional reasons.
- Remove the covers/seals after cleaning.
- Check the fuel lines, Diesel engine oil lines and hydraulic lines for the following defects:
  Leaks
  - Loose connections
  - Chafe marks
  - Damage
- Make sure the electrical power supply is firmly connected when starting.
- Make sure the engine is switched off before disconnecting the electrical power supply.
- Use suitable test leads for measurements at plug connections.
- Protect the engine control unit against dust and water if no mating plug has been connected.

## 3.2 Preparatory maintenance activities



#### DANGER

Hazards by entanglement, rotating or moving and ejected parts. Impacts by ejected parts will result in death or serious injury. Before monitoring or accessing to the engine covers, housing or compartment:

- Switch off the engine.
- Make sure that all parts are stopped.
- ▶ Secure all parts against unexpected movements.



#### Information

The application set owner shall develop, document, implement, and enforce lockout/tagout procedures.

Ensure the engine maintenance conditions as follows:

- ▶ Position the engine horizontally.
- Secure the area according to local lockout/tagout procedures.
- ► Turn off battery main switch.
- ▶ If present, remove main switch key.
- ▶ Let the engine cool down to ambient temperature.

## 3.3 Post maintenance activities

## 3.3.1 Spray painting

## Specific safety instructions



#### DANGER

Fire or explosion by flammable and explosive chemical products. Burns or explosion release will result in death or serious injury.

- Avoid any contact of flammable and explosive chemical products with any hot surface or ignition source.
- ▶ Lock out and tag out the engine prior to carrying out paint works on it.
- Ensure a good ventilation while carrying out paint works on the engine.
- Smoking and open flames are forbidden in the vicinity of the engine.



#### WARNING

Risk of injuries by contact with or inhalation of chemical products. Contact with or inhalation of chemical products could result in death or serious injuries by intoxication or poisoning.

- ▶ Wear proper personal protective equipment.
- Refer to the local regulations and the product associated data to safely handle, store, and use these products.



#### WARNING

Risk of injuries by explosion of pressurized container. Explosion of pressurized container could result in death or serious injuries.

- ▶ Do not pierce or burn the pressurized container, even after use.
- Protect the pressurized container from sunlight.
- Make sure the pressurized contained is not exposed to temperatures over 50 °C (122 °F).

## Scope

Spray painting may be necessary in the following cases:

- Touch-ups following damage to the original paint
- Painting of spare parts delivered unpainted

### **Previous tasks**

- □ Make sure that the surface to be painted is clean and free of grease, dust, and debris.
- Make sure that the spray paint can is at ambient temperature.
- □ Make sure that all areas not to be painted are masked.

## **Consumables and equipment**

- Spray paint can black color (12692707)
- Rags
- Cleaner

## Painting

- Shake the spray paint can for 3 minutes.
- Spray the paint at a distance of 25 cm (9.84 in) to 30 cm (11.81 in), making a criss-cross pattern.
- Spray enough layers to cover the whole unpainted area.
- ▶ Turn the spray can upside down and bleed the valve after finishing the paint work.



#### Information

In optimal conditions (20 °C (68 °F), 65% of humidity), the paint is completely dry after 24 hours.

## 3.4 Covers

## 3.4.1 Vibration damper cover removal and installation

## **Previous tasks**

Not applicable.

## **Specific safety instructions**

Not applicable.

## **Special tools**

Not applicable.

## **Consumables and equipment**

Not applicable.

## Overview



Fig. 41: Task overview

- 1 Screw (M8)
- 2 Protection plate

3 Cover4 Screw (M12)

## Removal

Remove screws 1.

- Remove cover 3.
- Unscrew screws 4.
- Remove protection plate **2**.

### Installation

- Screw cover **3** with screws **1**.
- Screw protection plate 2 with screws 4.

### **Specific values**

Not applicable.

## **Tightening specifications**



Fig. 42: Vibration damper cover screws

ICe			וt *	*		Torque	Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	055AA	DIN 6929 M12x1.75x155-10.9-FLZN	-	Yes	1	70 Nm 52 ft-lb	-	-

Tab. 9: Tightening specifications table

\*Lubricants: MG = Molykote G-n-plus MW = Castrol Optimol paste white T

- MH = Molykote HSC
- 0 = Engine oil
- XX = Loctite 243
- YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

## 3.4.2 Battery charging alternator & PTO cover removal and installation

### **Previous tasks**

Not applicable.

## **Specific safety instructions**



#### DANGER

Hazards by entanglement, trapping, ejection of parts or impact. On starting and while operation, hazards by entanglement, trapping, impact by ejection of parts will result in death or serious injury.

- ▶ The engine shall not be started until the drive train has been connected to the flywheel.
- Ensure the integrity of the machine and the engine before starting.
- All openings must be closed and the safe conditions established by the manufacturer of the machinery must be fulfilled.
- Standing in the vicinity of the engine while starting or operating the manufacturer's machinery is forbidden.



#### WARNING

Hazards by electrical shocks.

Contact with live conductor could result in death or serious injury.

- Access to live parts shall only be possible with voluntary action.
- Proceed to lock out and tag out prior to accessing to the engine.
- Respect the voltage indication of the engine technical data sheet.
- Check the grounding connection to avoid any risk of electrical arc.
- Observe the local safety regulations that apply to the machinery.

## **Special tools**

Not applicable.

### **Consumables and equipment**

- Rags
- Cleaner

## Overview





- 1 Pin
- 2 Distance sleeve
- **3** Vibration damper
- 4 Pin
- 5 Cover back side

- 6 Nut (M8)
- 7 Lock washer
- 8 Captive screw (M8)
- 9 Cover front side

## Removal



Fig. 44: Removing cover - front part

- ▶ Remove screws 8 and lock washers 7.
- Remove cover front side 9.



Fig. 45: Removing cover - back part

- ▶ Remove nuts 6, vibration dampers 3, distance sleeves 2 and pins 1, 4.
- Remove cover back side 5

## Installation



Fig. 46: Installing pins

Screw pins **1**, **4** on aggregate support and PTO bracket.



#### Fig. 47: Installing first part of cover

- Mount distance sleeves 2 and vibration dampers 3 on pins 1, 4.
- Mount cover back side **5** on pins **1**, **4**.
- Mount distance sleeves 2 and vibration dampers 3 on pins 1, 4.
- Screw cover with nuts **6**.



Fig. 48: Installing cover

- Mount cover 9 on pins 1, 4.
- Fix cover 9 with lock washers 7 and screws 8.

## **Specific values**

Not applicable.

## **Tightening specifications**



#### Fig. 49: Cover screws

lce			וt *	*		Torque	Angle (°)	
Referen	Кеу	Screw specifications	Lubrica	Reuse	Step	± 5%	Step	± 5°
1	440AA	M10x1,5x12	-	Yes	1	66 Nm 49 ft-lb	-	-
2	440AB	M10x1,25x12	-	Yes	1	34 Nm 25 ft-lb	-	-
3	440AC	EN 1664 M8-10-FLZN	-	Yes	1	34 Nm 25 ft-lb	-	-

Tab. 10: Tightening specifications table

\*Lubricants: MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

## 3.4.3 Cylinder head cover removal and installation

## **Previous tasks**

Not applicable.

## Specific safety instructions



#### DANGER

Contacts with hot parts! Risk of death or injury by burn.

- ▶ When the engine is in operation, stay away from the engine.
- Before servicing the engine, let it cool down until surface temperature allows you to touch it with bare hand.
- ▶ Wear proper personal protective equipment.

## **Special tools**

Not applicable.

## **Consumables and equipment**

Not applicable.

## Overview



#### Fig. 50: Task overview

1 Cylinder head cover

3 Seal

2 Screw (M8)

#### Removal

- Remove screw 2.
- Remove cylinder head cover 1 and seal 3.

## Installation

- Mount a new seal **3** on cylinder head cover **1**.
- Position screws 2 into the bores of the cylinder head cover 1.
- > Position cylinder head cover 1 on rocker arm housing.
- ▶ Tighten screws 2.

## Specific values

Not applicable.

## **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

## 3.5 Rocker arms

## 3.5.1 Rocker arms - Valve clearance set (SL 204)

### **Previous tasks**

- Remove cylinder head covers. (For more information see: 3.4.3 Cylinder head cover removal and installation, page 64.)
- □ Install turning device. (For more information see: 4.1.2 Turning device, page 261.)



Fig. 51: Turning device installed

## Specific safety instructions



#### WARNING

Injuries by contact with hot surfaces! Engine is hot near operating temperature. The contact with hot surfaces could lead serious injuries or death.

- Avoid any contact with the engine, parts carrying hot coolant or oil, the exhaust system, the turbocharger, the heat protection, the battery, the covers.
- After the temperature has cooled down to a level it can be touched, proceed with the tasks on the engine.

## **Special tools**

Special tool	Designation
11133437	Turning device

Tab. 11: Special tools

## **Consumables and equipment**

Not applicable.

## Overview



Fig. 53: Cylinder designation - direction of rotation according to ISO 1204

A1-A6	Series of cylinders – Bank A
B1-B6	Series of cylinders – Bank B
DE	Driving End (engine rear)
FE	Free End (engine front)
DoR	Direction of rotation

- Exhaust valves
- + Inlet valves

-

- **L** Left engine side
- **R** Right engine side

## Valve set order



#### Information

There is a marking on the flywheel to set the valve clearance.

The flywheel grooves 1 to 6 are identified in the picture below.

The valves must be set in the correct position for the matching cylinder.



Fig. 54: Flywheel marking

Stop	Start point	Groova Nº	Soguonco	V12			
Step	Start point	GIOOVEIN	Sequence	Bank A	Bank B		
1	TDC overlap - Al	1		No action	No action		
2	-	2		A5, A6	B5		
3	-	6	let turp	No action	No action		
4	-	3	150 0011	No action	No action		
5	-	4		A3	B1, B3		
6	-	5		No action	No action		
7	TDC injection - A1	1		No action	No action		
8	-	2		A1, A2	B2		
9	-	6	2nd turn	No action	No action		
10	-	3		No action	No action		
11	-	4		A4	B4, B6		

Tab. 12: Reference table for the flywheel positioning

#### Set the valve clearance

#### Step 1

Rotate crankshaft in direction of rotation with turning device to index 1.



Fig. 55: Position of flywheel and turning device



Fig. 56: TDC positions of cylinder A1

- 1 Rocker arm position in ignition TDC 2 Rocker arm position in overlap TDC
- Check if cylinder Al is in TDC overlap position. If not, turn the crankshaft another 360°.
- ► Verify TDC overlap position again.

#### Step 2

- Rotate crankshaft in direction of rotation with turning device to index 2.
- Set valve clearance for cylinders A5, A6 and B5. (For more information see: Checking valve clearance, page 73.), (For more information see: Setting valve clearance, page 73.)

#### Step 3

▶ Pass flywheel groove index 6.

#### Step 4

▶ Pass flywheel groove index 3.

#### Step 5

- Stop at flywheel groove index 4.
- Set valve clearance for cylinders A3, B1 and B3. (For more information see: Checking valve clearance, page 73.), (For more information see: Setting valve clearance, page 73.)

#### Step 6

Pass flywheel groove index 5.

#### Step 7

Pass flywheel groove index 1.

- Stop at flywheel groove index 2.
- Set valve clearance for cylinders A1, A2 and B2. (For more information see: Checking valve clearance, page 73.), (For more information see: Setting valve clearance, page 73.)

#### Step 9

▶ Pass flywheel groove index 6.

#### Step 10

▶ Pass flywheel groove index **3**.

#### Step 11

- Stop at flywheel groove index 4.
- Set valve clearance for cylinders A4, B4 and B6. (For more information see: Checking valve clearance, page 73.), (For more information see: Setting valve clearance, page 73.)

## Valve set order (alternative method)



#### Information

There is a marking on the flywheel to set the valve clearance.

The marking may become illegible.

The only possibility is to set by overlap position.

Ignition TDC*	A1	B2	A2	B4	A4	B6	A6	B5	A5	B3	A3	B1
Overlap TDC**	A6	B5	A5	B3	A3	B1	A1	B2	A2	B4	A4	B6

\* Ignition order

\*\* Opposite cylinder (overlap)

Tab. 13: Valve set order

- ▶ Set cylinder to overlap TDC position.
- Adjust valve clearance of ignition TDC cylinder.
# Checking valve clearance



Fig. 57: Checking and adjusting valve clearance

- 1 Inlet rocker arm
- 2 Locknut
- **3** Allen key
- 4 Key

- 5 Exhaust rocker arm
- 6 Rocker ball cap
- 7 Valve bridge
- 8 Feeler gauge
- Check valve clearance of cylinder by entering feeler gauge between rocker ball cap 4 and valve bridge 5. (For more information see: Specific values, page 73.)
- Move feeler gauge back and forth to sense the friction.
   The gauge shows a slight resistance when pulling.



#### Information

If the valve clearance is not correct, follow the valve set clearance procedure. (For more information see: Setting valve clearance, page 73.)

### Setting valve clearance

- Loosen locknut **2** of inlet rocker arm **1**.
- Position feeler gauge with correct value between rocker ball cap 4 and valve bridge 5. (For more information see: Specific values, page 73.)
- ► Turn the adjusting screw with allen key until the gauge shows a slight resistance when pulling.
- ▶ Tighten locknut while holding set screw with allen key in setting position.
- ▶ Re-check gauge tight fit.
- Repeat procedure for next valve.
- Mark cylinder when the operation is completed.
- ▶ Repeat entire procedure for exhaust rocker arm 5.

### **Specific values**

Use feeler gauge to set valve clearance.



Fig. 58: Valve clearance

Refer-	Denomina-	Nominal	Tolerance values			
ence	tion	value	Upper value - Lower value	Maximum wear	Calcu- lated gap min/max	Actual value
а	Inlet valve/	500 µm	+100 µm (3.94 th)	-	-	-
	clearance	19.69 th	0			
b	Exhaust	1 mm	+100 µm (3.94 th)	-		-
	valve/ clear- ance	0.04 in	0			

Tab. 14: Tolerance values

# **Tightening specifications**



Fig. 59: Rocker arms locknuts

Repair

Rocker arms

Ice			t *	*		Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse*	Step	± 5%	Step	± 5°	
1	081AA	DRW 11132681	0	Yes	1	40 Nm 30 ft-lb	-	-	

Tab. 15: Tightening specifications table

\*Lubricants:

```
MG = Molykote G-n-plus
MW = Castrol Optimol paste white T
MH = Molykote HSC
O = Engine oil
XX = Loctite 243
YY = Loctite 577
```

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

### 3.5.2 Inlet and outlet rocker arms removal and installation

### **Previous tasks**

- Remove retaining plate and high pressure pipe. (For more information see: 3.8.4 Injector removal and installation (SL 205), page 121.)
- Remove cylinder head covers. (For more information see: 3.4.3 Cylinder head cover removal and installation, page 64.)

### **Specific safety instructions**

Not applicable.

### **Special tools**

Special tool	Designation
11133437	Turning device. (For more information see: Use the turning device, page 263.) .

Tab. 16: Special tools

### **Consumables and equipment**

- Engine oil
- Rags
- Cleaner

### Overview



#### Fig. 61: Task overview

- **1** Swing follower
- 2 Pushrod
- **3** Valve bridge
- 4 Fitting sleeve
- 5 Inlet rocker arm

- 6 Inlet shaft
- 7 Screw (M12)
- 8 Exhaust rocker arm
- 9 Exhaust shaft
- **10** Rocker arm housing

#### Removal



#### WARNING

The valve springs must not be under stress. Risk of injuries.

► Turn crankshaft to firing TDC position using turning device.



Fig. 62: Removing screws

Remove screws 7.



Fig. 63: Removing rocker arms

Remove inlet rocker arm assembly 5 and exhaust rocker arm assembly 8.



Fig. 64: Removing shafts from rocker arms

- ▶ Remove inlet shaft 6 from inlet rocker arm 5.
- ▶ Remove exhaust shaft **9** from exhaust rocker arm **8**.



Fig. 65: Removing pushrods and valve bridges

Remove valve bridges 3 and pushrods 2 from swing followers 1.

### Installation



#### Information

Put matching cylinder in firing TDC position.



Fig. 66: Preparing inlet and exhaust shafts

▶ Inspect presence of plug in inlet shaft and exhaust shaft.



Fig. 67: Pre-mounting rockers arms

- ▶ Insert inlet shaft 6 into inlet rocker arm 5, making sure the plug on the shaft faces outwards.
- ► Insert exhaust shaft 9 into exhaust rocker arm 8, making sure the plug on the shaft faces outwards.



Fig. 68: Installing pushrods and valve bridges

- ▶ Insert pushrods 2 into cylinder head and fit it with swing followers 1.
- ▶ Insert valve bridges **3** into inlet and exhaust valves.



Fig. 69: Installing screws

Screw and fit rocker arms with screws **7** in inlet shaft, exhaust shaft and fitting sleeves **4**.

### **Specific values**

(For more information see: 3.5.1 Rocker arms - Valve clearance set (SL 204), page 68.)

# **Tightening specifications**



Fig. 70: Rocker arms screws

Repair

Rocker arms

lce			וt *	*		Torque		Angle (°)
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	081AC	ISO 4762 M12x1.75x150-10.9	0	Yes	1	100 Nm 74 ft-lb	-	-

Tab. 17: Tightening specifications table

\*Lubricants:

```
MG = Molykote G-n-plus
MW = Castrol Optimol paste white T
MH = Molykote HSC
O = Engine oil
XX = Loctite 243
YY = Loctite 577
```

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

### 3.5.3 Rocker arms housing removal and installation

### **Previous tasks**

- Drain HT coolant.
- □ Remove turbochargers. (For more information see: 3.10.3 Turbocharger removal and installation (SL 213), page 166.).
- Remove turbocharger brackets. (For more information see: 3.10.5 Turbocharger brackets removal and installation, page 176.).
- Remove retaining plate. (For more information see: 3.8.4 Injector removal and installation (SL 205), page 121.).
- □ Remove inlet and outlet rocker arms. (For more information see: 3.5.2 Inlet and outlet rocker arms removal and installation, page 75.)
- Remove high pressure pipes. (For more information see: 3.8.2 High pressure pipes removal and installation, page 112.)

### Specific safety instructions

- Set cylinders to ignition TDC position.

### **Special tools**

Special tool	Designation
11343242	Coolant connector pipe tool

Tab. 18: Special tools

Rocker arms

# **Consumables and equipment**

- Engine oil
- Rags
- Cleaner

### Overview



#### Fig. 72: Task overview

- **1** Positioning pin
- 2 Screw (M8)
- 3 Closing cover
- 4 Seal
- **5** Fitting sleeve (x5)

- 6 Seal (x4)
- 7 Coolant pipe HT
- 8 Locking ring
- 9 Rocker arm housing
- 10 Seal

# Removal



Fig. 73: Sliding locking ring

Slide locking ring 8.



Fig. 74: Placing tool

- Place tool on pipe.
- Slide pipes out of rocker arm housing.



Fig. 75: Removing rocker arm housing

- Lift rocker arm housing **9**.
- Move rocker arm housing and coolant pipe HT to remove the assembly.



Fig. 76: Removing coolant pipe HT and closing cover

- ▶ Remove screws **2** and locking ring **8**.
- Separate rocker arm housing from coolant pipe HT 7 and closing cover 3.
- ▶ Remove seals 4, 6 from closing cover and coolant pipe HT.
- ► Remove fitting sleeves **5**.

### Installation



Fig. 77: Preparing rocker arm housing

- ► Grease coolant pipe.
- ► Insert fitting sleeves 5.





▶ Mount closing cover **3** on rocker arm housing with screws **2** and seal **4**.



Fig. 79: Mounting coolant pipe HT

- ▶ Put seals 6 and locking ring 8 on coolant pipe HT 7.
- ▶ Insert coolant pipe HT **7** in rocker arm housing.



© 2022 by Kohler Co. All rights reserved.

KOHLER.

Fig. 80: Inserting pins and seal

- ▶ Position seal **10** on cylinder head.
- ▶ Insert positioning pins 1 in rocker arm housing.



Fig. 81: Placing tool



#### Information

Tighten screws from inlet and outlet rocker arms.

- Place tool on pipe.
- ► Insert pipe into rocker arm housing.



Fig. 82: Installing locking ring

- Secure pipe with locking ring 8.
- ▶ Mount rocker arm housing on cylinder head.



#### Information

Vent cooling system at the end of installation.

# **Specific values**

Not applicable.

### **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

# 3.6 Cylinder head

# 3.6.1 Removing and installing cylinder head

### **Previous tasks**

Make sure that the following preconditions are met:

- Cylinder head covers are removed. (For more information see: Previous tasks, page 64.)
- □ Exhaust gas turbochargers are removed .
- Brackets of exhaust gas turbocharger are removed (For more information see: 3.10.5 Turbocharger brackets removal and installation, page 176.).
- Rocker arm housings are removed (For more information see: 3.5.3 Rocker arms housing removal and installation, page 81.).
- □ Inlet and outlet rocker arms are removed (For more information see: 3.5.2 Inlet and outlet rocker arms removal and installation, page 75.).
- Retaining plate is removed (For more information see: 3.8.4 Injector removal and installation (SL 205), page 121.).
- Oil supply of exhaust gas turbocharger is removed (For more information see: 3.10.4 Oil supply turbocharger removal and installation, page 171.).
- □ Air intake line is removed (For more information see: 3.9.1 Air intake line removal and installation, page 139.).
- □ Fuel return pipes are removed (For more information see: 3.8.1 Fuel return and venting pipes removal and installation, page 109.).

# Specific safety instructions

Not applicable.

### **Special tools**

Make sure that the following tools are available:

- Lifting device for cylinder head
- Socket
- Torque wrench
- Electric torque multiplier or manual torque multiplier
- Torque reaction arm for electric torque multiplier or manual torque multiplier
- Spare battery pack for electric torque
- Battery charger 110 V or 230 V for electric torque multiplier only
- Adapter

(For more information see: 4.1.1 Special tools, page 258.)

### **Consumables and equipment**

Make sure that the following consumables and equipment are available:

- Vaseline
- Castrol Optimol paste white T
- Rags
- Cleaner

### Overview



Fig. 83: Task overview

- 1 Cylinder head
- 2 O-ring set
- 3 Multichannel gasket
- 4 Cylinder head gasket (soft metal)
- **5** Flame ring
- 6 Bolt (M30)
- 7 Washer
- 8 Locating pin

### Removal



Fig. 84: Lifting the cylinder head

▶ Unscrew bolts 6 with washers 7.

- ► Mount lifting device on cylinder head.
- ▶ Lift and push cylinder head **1** up and down to dismantle it.
- Remove cylinder head **1**.
- Remove multichannel gasket **3** and o-ring set **2**.
- Remove cylinder head gasket **4**.
- Remove flame ring **5**.

# Installation



Fig. 85: Installing cylinder head gasket and flame ring

- ▶ Mount flame ring **5** in liner.
- Mount cylinder head gasket **4** on liner.



Fig. 86: Installing multichannel gasket and o-rings

- Mount locating pins 8.
- Grease o-rings **2**.
- Mount multichannel gasket **3** with o-rings **2**.



Fig. 87: Installing cylinder head

- ▶ Mount lifting device on cylinder head.
- ► Mount cylinder head on engine block.



Fig. 88: Inserting cylinder head bolts

- Lubricate bolts 6 and washers 7 with Castrol Optimol paste white T.
- ▶ Insert and tighten the bolts **6** by hand.
- ► Tighten all bolts **6** with the torque wrench according to the specifications. (For more information see: Tightening specifications, page 95.)



Fig. 89: Mounting lifting lug

- ▶ Lubricate bolts 9 with Castrol Optimol paste white T.
- Mount lifting lug 10 with extended length bolts 9.
- ▶ Insert and tighten the bolts **6** by hand.
- ► Tighten all bolts **6** with the torque wrench according to the specifications. (For more information see: Tightening specifications, page 95.)



#### Information

If cylinder heads **1** are connected with a lifting lug bracket, both cylinder heads **1** need to be removed.



#### Information

Bleed coolant circuit at the end of installation.

### **Specific values**

Not applicable.

# **Tightening specifications**



Fig. 92: Cylinder head tightening sequence



Fig. 93: Cylinder head bolts

eo			וt *	*		Torque	Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	080AA	DRW 11344154 M30x2x322	MW	No	1	250 Nm 184 ft-lb	2	210°
2	080AB	DRW 11344155 M30x2x377	MW	No	1	280 Nm 207 ft-lb	2	210°

Tab. 19: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243

© 2022 by Kohler Co. All rights reserved.

#### YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.7 Driving gear

### 3.7.1 Power unit

### Endoscopy - Combustion chambers (SL 206)

#### **Previous tasks**

Make sure that the following preconditions are met:

- □ Cylinder head covers are removed. (For more information see: 3.4.3 Cylinder head cover removal and installation, page 64.)
- □ Injectors are removed. (For more information see: 3.8.4 Injector removal and installation (SL 205), page 121.)

#### Specific safety instructions

Not applicable.

#### **Special tools**

Make sure that the following tools are available:

Turning device

(For more information see: 4.1.1 Special tools, page 258.)

#### **Consumables and equipment**

Not applicable

#### Overview



#### Endoscopy

- ▶ Place endoscope in injector bore on top of cylinder head.
- ▶ Turn engine until piston is in BDC (Bottom Dead Center) position.
- Check inside of liner by endoscope.
- ▶ Note findings on data sheet.
- ▶ Repeat procedure for each cylinder.

If defect is detected:

• Make sure that authorized service personnel correct the defect.

#### **Specific values**



Fig. 95: Example of note on datasheet

- 1 Carbon ring area
- 2 Visible liner space

**3** Space covered by piston in BDC position

Endoscopy results								
Posi	tion	Findings	Remarks					
From	То							
350°	10°	Scratch traces	Complete length					
290°	-	Dirt traces	Center 2 cm					
170°	200°	Traces	80% of height					
-	-	-	Honing pattern visible					

Tab. 20: Example of note on endoscopy results

# 3.7.2 Torsional vibration damper removal and installation - SL2-1340

### **Previous tasks**

Remove the protection plate of the torsional vibration damper. (For more information see: 3.4.1 Vibration damper cover removal and installation, page 58.)

### Specific safety instructions

#### NOTICE

```
Risk of engine failure.
```

Shock or damage to the torsional vibration damper will lead to engine failure.

- Observe the lifting instructions.
- ► Use only adapted lifting devices.
- ▶ In case of shock or damage, always replace the torsional vibration damper.

### **Special tools**

Special tool	Designation
11133372	Guiding rod M28 – Damper (x2)
11343230	Locking device

Tab. 21: Special tools

### **Consumables and equipment**

- Rags
- Cleaner

Driving gear

### **Overview**



### Removal



Fig. 99: Lifting thread location

► Using the turning device, rotate the torsional vibration damper so that the lifting thread is located at the top. (For more information see: 4.1.2 Turning device, page 261.)



#### Fig. 100: Locking device

- ▶ Install locking device with screws (M16) to lock crankshaft.
- ▶ Remove two diametrically opposed bolts 4.
- ► Install guiding rods.
- Remove bolts **4** and disk **3**.





Fig. 101: Lifting thread location

- ► Install lifting device on the lifting thread.
- Remove screws 2.
- Remove torsional vibration damper **1**.

- ▶ Remove guiding rods.
- ▶ Remove locking device.

### Installation



Fig. 102: Locking device

▶ Install locking device with screws (M16) to lock crankshaft.





Fig. 103: Lifting thread location

- ▶ Install lifting device on the lifting thread.
- ▶ Lift torsional vibration damper 1.



#### Information

Use lifting thread at the top to lift and align torsional vibration damper to flange.

- ▶ Position torsional vibration damper **1** using guiding rod.
- ▶ Install torsional vibration damper **1** with screws **2**.
- ► Tighten screws **2** to torque.
- ▶ Position disk **3** and bolts **4**.
- ► Tighten bolts 4 to torque.
- ► Remove locking device.

### **Specific values**

Not applicable.

### **Tightening specifications**



Fig. 104: Bolts sequence



Fig. 105: Torsional vibration damper bolts

ce			lt *	*		Torque	Angle (°) $\frac{1}{2}$ $\pm 5^{\circ}$	
Referen	Кеу	Screw specifications	Lubricar	Lubrican Reuse*	Step	± 5%	Step	± 5°
1	056AC	M28x2x122	-	No	1	430 Nm 317 ft-lb	2	75°

Tab. 22: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

### Sampling silicon oil from torsional vibration damper - SL2-1345

#### **Previous tasks**

Make sure that the following tasks are performed:

- □ Torsional vibration damper is cool enough to be touched with bare hands.
- □ The area around the sample openings is clean and free from engine oil and dirt.
- □ Torsional vibration damper cover is removed.

#### Specific safety instructions

Not applicable.

### **Special tools**

Not applicable.

#### **Consumables and equipment**

Make sure that the following consumables and equipment are available:

- Sampling kit for silicon oil collection (sampling instructions, form, sample container, sample plugs, padded return envelope)

#### Overview



Fig. 106: Task overview

**1** Upper sample opening

2 Lower sample opening

Driving gear

#### Sample collection



Fig. 107: Collecting silicon oil sample

Rotate the crankshaft until sample openings 1, 2 are located vertically.



#### Information

Use the turning device to rotate the crankshaft. (For more information see: 4.1.2 Turning device, page 261.)

▶ Remove the cap from one end of the sample container.



#### Information

Place the sample container cap in a safe place.

- Make sure that the lower sample opening 2 is clean and free from dirt, grease, and engine oil.
- Remove the plug from the lower sample opening 2.
- Immediately install the sample container into the lower sample opening 2.
- ▶ Tighten the sample container by hand, then loosen it by one turn.

Remove the cap from the other end of the sample container.



#### Information

Do not use any tool to tighten the sample container.



#### Information

Place the sample container cap in a safe place.

Make sure that silicon oil flows from the torsional vibration damper into the sample container.



#### Information

If the flow of silicon oil is very slow, open the upper sample opening  ${\bf l}.$ 

- ▶ When the sample container is 75% full, install a cap on the end of the sample container.
- ▶ Tighten the sample container cap by hand.



#### Information

Do not use any tool to tighten the sample container cap.

▶ Install a new screw plug into the upper sample opening **1** if it has been opened.



#### Information

Always replace the screw plug.

- Tighten the screw plug to torque. (For more information see: Tightening specifications, page 108.)
- Remove the sample container from the lower sample opening 3.



#### Information

Make sure that silicon oil does not leak from the sample container.

- ▶ Install a cap on the sample container.
- ▶ Tighten the sample container cap by hand.
- ▶ Install a new screw plug into the lower sample opening 2.



#### Information

Always replace the screw plug.

- Tighten the screw plug to torque. (For more information see: Tightening specifications, page 108.)
- ▶ Fill in the sample form delivered with the sampling kit.
- Place the sample container and form into the padded envelope and send them for analysis.

#### **Specific values**

Not applicable.

Driving gear

### **Tightening specifications**



Fig. 108: Screw plugs for silicon oil collection

e			וt *	*		Torque		Angle (°)
Referen	Кеу	Screw specifications	Lubricar	Lubrican Reuse*	Step	± 5%	Step	± 5°
1	-	Screw plug	-	No	1	15 Nm 11 ft-lb	-	-

Tab. 23: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

Otherwise, refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)
# 3.8 Fuel system



#### DANGER

Fire or explosion by flammable and explosive lubricants and fuels. Burns or explosion release will result in death or serious injury.

- ▶ Keep all caps and valves closed near the operating temperature.
- Avoid any contact of flammable and explosive operating fluids, gases or combustible materials with any hot surface or ignition source.
- ▶ Keep the engine clean and free from accumulation of dust and flammable liquids.
- ▶ Keep the insulation free of operating fluids contamination.
- Never release operating fluids while operating the engine.
- Check the electrical system. Immediately rectify all errors, such as loose connections and frayed cables.
- During refueling, switch off any additionally installed heater (optional).
- ▶ Lock out and tag out the engine prior to accessing to engine.
- Ensure a good ventilation while refueling or prior to accessing to the engine.
- Regularly check all lines, hoses and screw connections for leaks and damage. Immediately rectify the leaks and replace the damaged parts.
- Smoking and open flames are forbidden in the vicinity of the engine.
- Always start the engine according to the instructions in the instructions manual of the machinery.

#### 3.8.1 Fuel return and venting pipes removal and installation

#### **Previous tasks**

□ Close fuel supply.

#### Specific safety instructions

Not applicable.

#### **Special tools**

Not applicable.

#### **Consumables and equipment**

- Rags
- Cleaner
- Bucket for fuel

## Overview



Fig. 109: Fuel return and venting pipes



Fig. 110: Fuel pump pipes



Fig. 111: Connections of distributor block

- 1 Fuel connection from injectors (B bank)
- 2 Fuel connection from injectors (A bank)
- **3** Fuel connection from HP pump
- 4 Screw plug
- 5 Distributor block
- **6** Fuel connection from high pressure system

### Removal

▶ Remove fuel return and venting pipes.

- 7 Fuel connection from high pressure system
- 8 Fuel return block
- 9 Connection to tank
- **10** Fuel connection from HP pump
- **11** Connection from fuel return block to distributor block
- **12** Connection from permanent venting on fuel filters

## Installation



Fig. 112: Fuel return and venting pipes inclination

• Mount fuel return and venting pipes.



#### Information

Install fuel return and venting pipes with an angle of 30° minimum in relation to the crankcase.

▶ Tighten fuel return and venting pipes to torque.

## **Specific values**

Not applicable.

## **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

### 3.8.2 High pressure pipes removal and installation

### **Previous tasks**

□ Release the pressure of the HP fuel system using KoDIA tool.

 $\hfill\square$  Close the fuel supply.

## Specific safety instructions



#### DANGER

Hazards due to flammable fluids under high pressure. When the engine is running, the fuel lines are under a constant pressure of up to 2000 bar (29,007.40 psi).

Fuel escaping under pressure can penetrate the skin or vaporize and explode when an ignition source is present, which will result in death or serious injury.

- ► Never release the screws on the fuel circuit, especially between the high-pressure pump and the injector when the engine is running.
- Before starting any task on the fuel system, ensure the build-up pressure in the circuit has been released, and the temperature of the engine has cooled down.
- ▶ Keep the engine away from heat, sparks, open flame, or any other ignition source.

#### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

Replace all sealings.

### **Special tools**

- Plugs for piping

## **Consumables and equipment**

- Rags
- Cleaner
- Bucket for fuel

Fuel system

## **Overview**



- Holder 11
- 12 Screw (M8)
- 13 Clamp



#### Fig. 115: Task overview

19	Fuel pipe
20	Fuel pipe

21 Fuel pipe

Fuel pipe
Fuel pipe
Flange joint

## Removal



Fig. 116: Removing high pressure piping

- Remove screw 1 with retaining plate 6 and clamp 7.
- Remove screw 3.
- Remove distributor block **4**.
- ▶ Remove fuel pipes **2, 5**.





- Remove screws 8, 15.
- ▶ Remove clamps **9**, **10**, **17**, **18** and plate **16**.
- Remove holder **11**.
- Remove screws 12.
- Remove clamps 13, 14.



Fig. 118: Removing high pressure piping

▶ Remove fuel pipes 19, 20, 21, 22, 23 with flange joints 24.

## Installation



Fig. 119: Installing high pressure piping

- ▶ Lubricate o-rings of fuel pipes **19, 20** with Castrol Optimol Paste White T.
- Lubricate threads and cones of fuel pipes **19, 20** with clean engine oil.
- ▶ Install fuel pipes 19, 20, 21, 22, 23 with flange joints 24.



Fig. 120: Installing clamps

- ▶ Install clamps **13**, **14** with screws **12**.
- ▶ Install clamps 9, 10, 17, 18, plate 16 and holder 11 with screws 8, 15.

Fuel system



Fig. 121: Installing high pressure piping

- ▶ Lubricate o-rings of fuel pipes **2**, **5** with Castrol Optimol Paste White T.
- Lubricate threads and cones of fuel pipes **2**, **5** with clean engine oil.
- ▶ Install fuel pipes 2, 5.
- ▶ Install distributor block 4 with screws 3.
- ▶ Install clamp 7 with retaining plate 6 and screw 1.
- Pre-tighten all fuel pipes to torque. (For more information see: Tightening specifications, page 118.)
- Tighten all fuel pipes and screws to torque. (For more information see: Tightening specifications, page 118.)

### **Specific values**

Not applicable.

## **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)



Fig. 122: High pressure pipes

lce	Кеу	Screw specifications	וt *	Reuse**	Torque		Angle (°)	
Referen			Lubrica		Step	± 5%	Step	± 5°
1	-	-	0	Yes	1	26 Nm 19 ft-lb	-	-
					2	189 Nm 139 ft-lb		
2	-	-	0	Yes	1	26 Nm 19 ft-lb	-	-
					2	150 Nm 111 ft-lb		

Tab. 24: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

## 3.8.3 Fuel supply pipes removal and installation

## **Previous tasks**

□ Close fuel supply line.

## **Specific safety instructions**

Not applicable.

## **Special tools**

Not applicable.

## **Consumables and equipment**

- Rags
- Cleaner

## Overview



Fig. 123: Low pressure circuit piping

## Removal

▶ Remove fuel supply pipes.



#### Information

Close all open connections with original plugs.

### Installation

- Mount fuel supply pipes.
- ▶ Tighten according to tightening specifications.

### **Specific values**

Not applicable.

## **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

## 3.8.4 Injector removal and installation (SL 205)

## **Previous tasks**

Make sure that the following preconditions are met:
Cylinder head covers are removed. (For more information see: 3.4.3 Cylinder head cover removal and installation, page 64.)

## **Specific safety instructions**



#### DANGER

Hazards due to flammable fluids under high pressure.

When the engine is running, the fuel lines are under a constant pressure of up to 2000 bar (29,007.40 psi).

Fuel escaping under pressure can penetrate the skin or vaporize and explode when an ignition source is present, which will result in death or serious injury.

- Never release the screws on the fuel circuit, especially between the high-pressure pump and the injector when the engine is running.
- Before starting any task on the fuel system, ensure the build-up pressure in the circuit has been released, and the temperature of the engine has cooled down.
- ▶ Keep the engine away from heat, sparks, open flame, or any other ignition source.

#### NOTICE

Risk of property damage by reuse of sealing. Leaks by faulty seal.

Replace all sealings.

Fuel system

## **Special tools**

Special tool	Designation
12226280	Injector extractor

Tab. 25: Special tools

## **Consumables and equipment**

Make sure that the following consumables and equipment are available:

- Rags
- Cleaner
- Loctite 243
- Engine oil
- Castrol Optimol Paste White T

## Overview



#### Fig. 125: Task overview

- 1 Injector sleeve
- 2 Retaining plate
- **3** Screw (M12)
- 4 Injector
- 5 High-pressure pipe

- 6 Screw (M12)
- 7 Injector clamp
- 8 Collet
- 9 Adaptor

## Removal



#### Fig. 126: Removing electrical contacts

- ▶ Remove electrical contacts from injector.
- ▶ Disconnect injector cable on both ends.
- ▶ Disconnect HT sensor on both ends if installed.
- Remove both adaptors from rocker arm housing.



Fig. 127: Removing high-pressure pipe

► Take off high-pressure pipe **5** from adaptor **9**.



Fig. 128: Removing retaining plate

- Remove retaining plate **2** with screws **3**.
- Close all open connections with the matching plugs (available as replacement parts).



Fig. 129: Removing clamp

▶ Remove clamp **7** by opening screw **6**.



Fig. 130: Extracting injector

▶ Remove injector **4** with extracting tool.

## Installation



Fig. 131: Lubricating injector O-rings

- Clean carbon from injector seat surface on injector sleeve.
- Lubricate injector 4 O-rings with Castrol Optimol Paste White T.



Fig. 132: Installing injector and clamp

Lubricate thread and head contact surface of screw **6** with clean engine oil.



#### Information

Make sure the copper washer is present before installing the injector.

- Position injector 4 with its connection upwards into sleeve 1.
- ▶ Install clamp **7** with screw **6**.



Fig. 133: Positioning injector and clamp



#### Information

Injectors can be mounted in two positions. Note that only one position is correct. Make sure the clamp is centered between valve springs.



Fig. 134: Installing retaining plate

- Lubricate screws **3** with engine oil.
- ▶ Position retaining plate 2 with screws 3.



Fig. 135: Installing high-pressure pipe

- Lubricate threads and cones of high-pressure pipe **5** with clean engine oil.
- ▶ Lubricate o-rings of adaptor 9 with Castrol Optimol Paste White T.
- ▶ Push back the union nut of fuel pipe.
- ▶ Install high-pressure pipe **5** above the adaptor **9**.
- ▶ Tighten screw 6 to torque. (For more information see: Tightening specifications, page 128.)
- Pre-tighten high-pressure pipe 5 to torque. (For more information see: Tightening specifications, page 128.)
- Tighten high-pressure pipe 5 to torque. (For more information see: Tightening specifications, page 128.)



#### Fig. 136: Connecting electrical contacts

- Connect electrical cables on the corresponding solenoid connector.
- ▶ Tighten to torque.

## **Specific values**

Not applicable.

## **Tightening specifications**

□ Put all parts in place and tighten by hand before following the sequence.



#### Information

Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)





Step	Bolt / Tie rod.	Sequence from to	Action	Torque	Angle (°)
1	Clamp <b>1</b> (Allen screw)	-	Tighten	76 Nm 56 ft-lb	-
2	Distributor block nut <b>4</b> and injector nut <b>2</b>	-	Pre- tighten	26 Nm 19 ft-lb	-
3	Distributor block nut <b>4</b>	-	Tighten	189 Nm 139 ft-lb	-
4	Injector nut <b>2</b>	-	Tighten	150 Nm 111 ft-lb	-
5	Electrical wires <b>3</b>	-	Tighten	0.5 Nm 0.36 ft-lb	-

Tab. 26: Tightening sequence Injector



Fig. 138: Retaining plate screws

lce			t *	*	Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	081AB	ISO 4762 M12x1.75x80-10.9	0	Yes	1	70 Nm 52 ft-lb	-	-

Tab. 27: Tightening specifications table

\*Lubricants: MG = Molykote G-n-plus

- MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243
- YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

## 3.8.5 Fuel filters removal and installation

### **Previous tasks**

Disconnect fuel pipes and sensors.
 Class fuel supply

Close fuel supply.

## **Specific safety instructions**

Not applicable.

## **Special tools**

Not applicable.

## **Consumables and equipment**

- Rags
- Cleaner
- Bucket for fuel

## Overview



Fig. 139: Task overview

- 1 Fuel filter
- 2 Flange joint
- **3** Flange joint

- 4 Flange joint
- 5 Flange joint
- 6 Screw (M10)

### Removal

- Remove flange joints **2**, **3**, **4**, **5**.
- ▶ Remove screws 6.
- Remove fuel filters 1.

## Installation

- ▶ Install fuel filters **1** with screws **6**.
- ► Tighten screws **6** to torque.
- ▶ Install flange joints **2**, **3**, **4**, **5**.

## **Specific values**

Not applicable.

## **Tightening specifications**



Fig. 140: Fuel filter screws

e			Lubricant *	*	Torque		Angle (°)	
Referen	Кеу	Screw specifications		Reuse	Step	± 5%	Step	± 5°
1	201AA	EN 1665 M10x1.5x30-8.8-FLZN	-	Yes	1	25 Nm 18 ft-lb	-	-

Tab. 28: Tightening specifications table

#### \*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

## 3.8.6 Leakage fuel block removal and installation

### **Previous tasks**

Disconnect fuel pipings.

## **Specific safety instructions**

Not applicable.

## **Special tools**

Not applicable.

## **Consumables and equipment**

- Rags
- Cleaner
- Bucket for fuel

### Overview



#### Fig. 141: Task overview

- 1 Fuel return block
- 2 Screw (M10)
- **3** Retaining plate
- 4 Screw (M8)

- 5 Distributor block
- 6 Screw plug
- 7 Screw (M8)

#### Removal

- Remove screws 7.
- Remove distributor block **5**.
- Remove screws 4.
- Remove retaining plate **3**.
- Remove screws 2.
- Remove fuel return block **1**.

### Installation

- ▶ Install fuel return block **1** with screws **2**.
- ▶ Install retaining plate **3** with screws **4**.
- ▶ Install new screw plugs **6**.
- ▶ Install distributor block **5** with screws **7**.
- ▶ Tighten screws 2, 4, 7 to torque.

### **Specific values**

Not applicable.

## **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

### 3.8.7 Fuel pump HP and LP removal and installation (SL 209)

#### **Previous tasks**

- □ Close fuel supply.
- $\hfill\square$  Release the pressure of the HP fuel system using KoDIA tools.
- $\hfill\square$  Remove fuel pipings connected to HP fuel pump.

### Specific safety instructions

#### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

Replace all sealings.

Fuel system

## **Special tools**

Special tool	Designation
12226441	HP Fuel Pump Lifting Device
12427300	Guiding rod M12 (x2)

Tab. 29: Special tools

## **Consumables and equipment**

- Vaseline
- Oil
- Castrol Optimol paste white T
- Rags
- Cleaner

## Overview



Fig. 144: Task overview

- **1** HP Fuel pump without LP pump
- 3 Screw (M12)

## 2 HP Fuel pump with LP pump

#### Removal

- ▶ Remove a first screw **3** and a second one diametrically opposed.
- ▶ Place guiding rods in place of the two screws.
- Remove remaining screws **3**.



Fig. 145: Installing fuel pump lifting device

- ► Install fuel pump lifting device.
- ▶ Remove fuel pumps.
- Remove guiding rods.

### Installation

► Install new O-ring.

# $\mathbf{i}$

#### Information

Lubricate HP connection o-ring with Castrol Optimol paste white T. Lubricate shaft teeth and o-rings with engine oil.



Fig. 146: Fuel pump O-rings

Place guiding rods.



Fig. 147: Installing fuel pump lifting device

- ▶ Use lifting device to position fuel pumps into gearbox.
- ▶ Place screw 3.
- Remove guiding rods.
- ▶ Place remaining screws and remove lifting tools.
- Tighten screws to torque following the given order. (For more information see: Tightening specifications, page 137.)
- ▶ Install HP pump piping.
- ▶ Perform the venting on the fuel circuit.

## **Specific values**

Not applicable.

## **Tightening specifications**



*Fig. 148: Fuel pump tightening sequence* 



Fig. 149: Fuel pump screws

Ice	e		it *	*	Torque			Angle (°)	
Referen	Кеу	Screw specifications	Lubrica	Reuse	Step	± 5%	Step	± 5°	
1	171AA	171AA DIN 34800 M12x1.75x55-10.9-FLZN -	-	Yes	1	60 Nm 44 ft-lb	-	-	
					2	120 Nm 89 ft-lb	-	-	
2	171AB	22L M26x1.5	0	Yes	1	140 Nm 103 ft-lb	-	-	
3	212AA	22L M26x1.5	0	Yes	1	140 Nm 103 ft-lb	-	-	

Tab. 30: Tightening specifications table

\*Lubricants: MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.9 Charge air system

## 3.9.1 Air intake line removal and installation

## **Previous tasks**

Not applicable.

### **Specific safety instructions**

Not applicable.

## **Special tools**

Not applicable.

## **Consumables and equipment**

- Vaseline
- Rags

### Overview



Fig. 150: Task overview

- 1 Charge air pipe end segment (B bank)
- **2** O-ring
- **3** Pipe
- 4 Charge air pipe middle segment (B bank)
- 5 Gasket
- 6 Screw (M10)

- 7 Screw (M10)
- 8 Screw plug
- **9** Connection piece
- **10** O-ring
- 11 Screw plug

© 2022 by Kohler Co. All rights reserved.



#### Information

There are four charge air pipes - middle segments in V12 engine.

There are six charge air pipes – middle segments in V16 engine.

There are eight charge air pipes – middle segments in V20 engine.

## Removal

- Remove screws 6.
- ▶ Remove charge air pipes **1**, **4** and pipes **3** individually.

## Installation

- ▶ Install screw plugs 11 on charge air pipe 1.
- ▶ Put o-rings **2** on charge air pipes **1**, **4** and grease them.
- > Put o-ring **10** and screw plugs **8**, **11** on connection piece **9**.
- Screw connection piece 9 with screws 7.
- Mount charge air pipe 4 next to connection piece 9 using gasket 5 and screws 6 to fix charge air pipe to cylinder heads.
- Repeat procedure for next charge air pipes 4 using pipe 3.
- Repeat procedure for last charge air pipe 1 using pipe 3.

## **Specific values**

Not applicable.

## **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

## 3.9.2 Charge air line removal and installation

#### **Previous tasks**

Not applicable.

## Specific safety instructions

#### NOTICE

Risk of property damage by reuse of sealing. Leaks by faulty seal.

Replace all sealings.

## Special tools

Not applicable.

## **Consumables and equipment**

- Rags
- Cleaner
- Grease (Optimol)

## Overview



Fig. 151: Task overview

- 1 Nut (M10)
- 2 Seal
- **3** Compensator
- 4 Screw (M10)
- 5 Nut (M10)
- 6 Pipe
- 7 Clamp
- 8 Locking plate
- **9** Screw (M12)
- 10 Screw (M10)

See next page for continuation of the image legend

- 12 Compensator
- 13 End cover
- 14 Screw (M10)
- **15** Pipe
- 16 Screw (M10)
- 17 Screw plug
- 16 Screw (M10)
- 19 Screw (M10)
- 20 Screw (M10)
- 21 Distance sleeve

#### Repair Charge air system



Fig. 152: Task overview - Without engine by-pass flap

23 Compensator



Fig. 153: Task overview - With engine by-pass flap

- **24** O-ring
- Engine by-pass flap Flange joint 25
- 26

- 27 Screw (M10)
- 28 Screw (M10)
- 29 Compensator

#### Removal



Fig. 154: Removing charge air lines

- ▶ Remove screws 4, 10 with nuts 1, 5.
- ▶ Remove compensator **3** with seals **2**.
- ▶ Remove screws 9, 20 with locking plates 8 and distance sleeves 21.
- ▶ Remove clamps **7**, **22**.
- Remove screws 10 with nuts 1.
- Remove pipe **6**.
- Remove screws 11.
- ▶ Remove compensator **3** with seals **2**.
- ▶ Remove screws 4, 11 with nuts 1.
- Remove compensator **12** with seals **2**.



Fig. 155: Removing charge air lines

Charge air system

- Remove screws 14.
- Remove end cover **13** with seal **2**.
- Remove screws 16, distance sleeves 18, and nuts 1.
- Remove screws 4, 19.
- Remove pipe 15
- Remove screws 11.
- Remove compensator **3** with seal **2**.



Fig. 156: Removing compensator - Without engine by-pass flap

- Remove screws 11.
- Remove compensator **23** with seals **2**.
Charge air system



Fig. 157: Removing engine by-pass flap and compensator - With engine by-pass flap

- ▶ Remove screws 27, 28.
- Remove compensator 29 with o-rings 24.
- ▶ Remove engine by-pass flap **25**.

### Installation



#### Information

Preassemble all seals on compensators.



#### Information

At first, install the whole line without tightening the screws.

Tighten all screws to torque at the end of installation, making sure that compensators are aligned evenly.



Fig. 158: Installing charge air lines

- Screw compensator 12 to charge air coolers with screws 11 and seal 2.
- Screw compensator 12 to charge air coolers with screws 4, seal 2, and nuts 1.
- Assemble pipe 6 with compensators 3 using screws 10, seals 2, and nuts 5.
- Screw assembly to charge air cooler with screws **11** and seal **2**.
- Screw assembly to exhaust gas turbocharger with screws 4, seal 2, and nuts 1.
- Screw clamps 7, 22 with screws 9, 20, locking plates 8, and distance sleeves 21.





• Pretighten both screws **9** simultaneously to ensure  $\Delta_1 = \Delta_2$  after tightening.



#### Information

Bend locking plates  ${\boldsymbol 8}$  after assembly.

► Tighten screws 9 to torque.



Fig. 160: Installing compensators and charge air lines

- Screw end cover 13 to charge air cooler with screws 14 and seal 2.
- Assemble pipe **15** with compensator **3** using screws **4**, **19** and seal **2**.
- Screw assembly to charge air cooler with screws **11** and seal **2**.
- Screw assembly to exhaust gas turbocharger with screws 16, distance sleeves 18, seal 2, and nuts 1.
- ▶ Install screw plug 17.
- ► Tighten screws **16** to torque.



Fig. 161: Installing compensator - Without engine by-pass flap

Screw compensator 23 with screws 11 and seals 2.



Fig. 162: Installing engine by-pass flap and compensator - With engine by-pass flap

▶ Install engine by-pass flap **25** and compensator **29** with screws **27**, **28** and o-rings **24**.

# **Specific values**

Not applicable.

# **Tightening specifications**



Fig. 163: Screws

ce		* *	*		Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	230AB	ISO 4014 M12x1.75x80-10.9-FLZN	-	Yes	1	30 Nm 22 ft-lb	-	-
2	230AH	EN 1665 M10x1.5x80-10.9-FLZN	-	Yes	1	43 Nm 32 ft-lb	-	-

Tab. 31: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.9.3 Charge air cooler removal and installation (SL 220)

### **Previous tasks**

- Remove venting line. (For more information see: 3.12.1 Venting line removal and installation, page 200.)
- Drain LT coolant circuit until level is lower than the base of the charge air coolers.

# Specific safety instructions



#### DANGER

Hoisting and Rigging Hazards. Falling of the load or rigging hardware will cause death or serious injuries.

- ► The manufacturer of the machinery shall observe and enforce the country-specific regulations regarding prevention of injuries and risks.
- Only trained riggers are authorized to rig, lift and land loads. Crane operators, working with a rigger, must be aware of the all the aspects of the lifting operation. Means of communication must be agreed upon, including the used signals.

A safe rigging operation requires:

- To know the weight and center of gravity of the load and rigging hardware, the capacity of the hoisting device, the working load limit of the hoisting ropes, slings, and hardware.
- ▶ To use only safe and suitable equipment.
- ▶ To ensure the load stability during handling, under all wind and weather conditions.
- ▶ To avoid any contact or to come into close proximity with energized power lines.

### **Special tools**

- Adapted lifting equipment (including lifting bolts, slings, lifting device)



#### Information

Several adapted lifting devices are available.

Follow the instructions manual of the hoisting beam, handling devices and the local safety regulations.

For further information, please contact your nearest authorized Kohler service representative.

### **Consumables and equipment**

- Vaseline
- Rags

# Overview



Fig. 164: Task overview

- 1 Screw (M12)
- 2 Screw (M12)
- **3** Distance sleeve

- 4 Charge air cooler
- 5 O-ring
- 6 Pipe

### Removal



#### Fig. 165: Lifting bolt locations

- ▶ Install lifting bolts on the charge air coolers 4.
- Secure the charge air coolers **4** with an adapted lifting device.
- Remove screws 1, 2.
- ▶ Remove charge air coolers **4**.

# Installation

- ▶ Insert o-ring **5** in charge air coolers **4**.
- ▶ Insert pipes 6 in aggregate support.

Charge air system

- ▶ Install lifting bolts on the charge air coolers 4.
- Secure the charge air coolers **4** with an adapted lifting device.
- ▶ Position charge air coolers 4.
- Screw charge air coolers 4 with screws 1, 2 and distance sleeve 3.
- ▶ Refill the coolant circuit with coolant.
- ▶ Inspect the coolant circuit for leaks.



#### Information

Vent coolant circuit at the end of installation.

### **Specific values**

Not applicable.

# **Tightening specifications**



Fig. 166: Charge air coolers screws

Се		* *	*		Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	233AE	ISO 1665 M12x1.75x50-8.8-FLZN	-	Yes	1	60 Nm 44 ft-lb	-	-

Tab. 32: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.10 Exhaust gas system

# 3.10.1 Admission pipes to turbocharger removal and installation

### **Previous tasks**

Disconnect admission connection of application set.

# **Specific safety instructions**

#### NOTICE

Risk of property damage by reuse of sealing. Leaks by faulty seal.

Replace all sealings.

# **Special tools**

Not applicable.

# **Consumables and equipment**

- Rags
- Cleaner

### Overview



- 1 Nut
- 2 Straight air intake connection
- 3 Plug
- 4 Screw (M8)

- 5 Flange
- **6** O-ring
- 7 Straight air intake connection
- 8 Flange



#### Information

Depending on application, flange 8 may be replaced with flange 5.

### Removal

- Remove nuts 1.
- Remove straight air intake connections 2, 7.

### Installation

- ▶ Install straight air intake connections **2**, **7** with nuts **1**.
- ▶ Install flanges **5**, **8** with o-rings **6** and screws **4**.
- ▶ Install plugs **3** in straight air intake connections **2**, **7**.

# **Specific values**

Not applicable.

# **Tightening specifications**



Fig. 168: Admission pipes

lce			nt *	*		Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubrica	Reuse	Step	± 5%	Step	± 5°	
1	221AA	EN 1664 M10x1,5-10.9-FLZN	-	Yes	1	35 Nm 26 ft-lb	-	-	
2	221AB	EN 1665 M8x1.25x25-8.8-FLZN	-	Yes	1	25 Nm 18 ft-lb	-	-	

Tab. 33: Tightening specifications table

\*Lubricants: MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.10.2 Exhaust pipes to turbocharger removal and installation

### **Previous tasks**

Disconnect application set exhaust system.

# **Specific safety instructions**



#### **WARNING** Risk of injuries by contact with hot surfaces! Engine is hot near operating temperature.

- Avoid any contact with the engine, parts carrying hot coolant or oil, the exhaust system, the turbocharger, the heat protection, the battery and the covers.
- After the temperature has cooled down to a level it can be touched, proceed with the tasks on the engine.

#### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

▶ Replace all sealings.

# **Special tools**

Not applicable.

### **Overview**



#### Fig. 169: Task overview

- **1** Screw (M12)
- 2 Distance sleeve
- 3 Support
- 4 Exhaust elbow
- 5 Seal
- 6 Clamp segment

- 7 Nut (M10)
- 8 Turbocharger
- 9 Turbocharger
- **10** Screw plug
- 11 Washer

### Removal

- Remove screws 1 with distance sleeves 2.
- Remove supports 3.
- Remove nuts **7** with clamp segments **6**.
- Remove exhaust elbow 4.

# Installation

- ▶ Install screw plugs **10** with washers **11** into exhaust elbows **4**.
- ▶ Tighten screw plugs **10** to torque.
- ▶ Position exhaust elbow 4 with seal 5 in turbocharger 8, 9 outlet.
- Position clamp segments 6 and hand tight nuts 7.
- Position supports **3** with distance sleeves **2**.
- ► Tighten nuts **7** to torque.
- ▶ Tighten screws 1 to torque.

### **Specific values**

Not applicable.

# **Tightening specifications**



Fig. 170: Exhaust pipes

Exhaust gas system

eo		* *	*	Torque		Angle (°)		
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	412AA	M12x1.75x50-C3J	-	Yes	1	67 Nm 49 ft-lb	-	-
2	412AB	DIN 908 G1/4 A	MH	No	1	30 Nm 22 ft-lb	-	-
3	430AA	DIN 939 M10x1.5x22	MH	Yes	1	24 Nm 18 ft-lb	-	-

Tab. 34: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# Exhaust pipes to turbocharger removal and installation (EATS configuration)

#### **Previous tasks**

□ Disconnect application set exhaust system.

#### **Specific safety instructions**



#### WARNING

Risk of injuries by contact with hot surfaces! Engine is hot near operating temperature.

- Avoid any contact with the engine, parts carrying hot coolant or oil, the exhaust system, the turbocharger, the heat protection, the battery, and the covers.
- After the temperature has cooled down to a level it can be touched, proceed with the tasks on the engine.

#### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

▶ Replace all sealings.

#### **Special tools**

Not applicable.

### **Consumables and equipment**

- Hot temperature grease
- Rags
- Cleaner

#### Overview



Fig. 171: Task overview

- 1 Exhaust elbow
- 2 Exhaust gas turbocharger
- **3** Nut (M10)
- 4 Seal

See next page for continuation of the image legend

- **6** Washer
- 7 Screw plug
- 8 Distance sleeve
- 9 Retaining plate



Fig. 172: Task overview

- 11 Screw (M8)
- 12 Cover
- **13** O-ring
- 14 Compensator

- 15 Compensator
- **16** O-ring
- 17 Compensator

#### Removal



#### Fig. 173: Removing compensators

Remove screws 11.

### Repair

Exhaust gas system

- Remove compensators **14, 15, 17**.
- Remove cover 12.



#### Fig. 174: Removing elbows

- Remove screws **10**, and distance sleeves **8**.
- ▶ Remove retaining plates **9**.
- ▶ Remove exhaust elbow 1.

### Installation



#### Fig. 175: Installing elbows

- ▶ Install orifice plate **5** on exhaust elbow **1**.
- ▶ Install screw plugs 7 with washers 6 into exhaust elbow 1.
- ► Tighten screw plugs **7** to torque.
- ▶ Install exhaust elbow 1, and seal 15 on turbocharger outlet.
- ▶ Install retaining plates 9 with screws 10, and distance sleeves 8.
- ► Tighten screws **10** to torque.
- ▶ Repeat procedure for each exhaust elbow.



Fig. 176: Installing compensators

- ▶ Install cover **12** with screws **11**, and o-ring **13**.
- ▶ Install compensators 14, 17 with screws 11, and o-rings 13.
- ▶ Install compensator **15** with screws **11**, and o-rings **13, 16**.
- ► Tighten screws **11** to torque.

### **Specific values**

Not applicable.

### **Tightening specifications**



Fig. 177: Exhaust pipes

lce			זר *	*		Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubrica	Reuse	Step	± 5%	Step	± 5°	
1	230AI	M8x1.25x20-C3J	MH	Yes	1	20 Nm 15 ft-lb	-	-	
2	412AB	DIN 908 G1/4 A	MH	No	1	30 Nm 22 ft-lb	-	-	
3	412AD	M12x1.75x50-C3J	-	Yes	1	56 Nm 41 ft-lb	-	-	
4	430AA	DIN 939 M10x1.5x22	MH	Yes	1	24 Nm 18 ft-lb	-	-	

Tab. 35: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.10.3 Turbocharger removal and installation (SL 213)

### **Previous tasks**

- Drain LT coolant water.
- □ Remove turbocharger cooling lines. (For more information see: Previous tasks, page 206.)

### Specific safety instructions



#### WARNING

Hazards by hot engine near operating temperature. Any contact with hot surfaces could result in death or serious injuries by burns. The engine control unit (ECU) is hot while operating the engine.

- ► Avoid any contact with the engine, parts carrying hot coolant or oil, the exhaust system, the turbocharger, the heat protection, the battery, the covers, and the ECU.
- Proceed with the tasks on the engine only once the temperature has cooled down enough so that surfaces can be touched with bare hands.

#### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

▶ Replace all sealings.

# Special tools

Not applicable.

### **Consumables and equipment**

- Hot temperature grease
- Rags
- Cleaner

# Overview



Fig. 178: Task overview

- 1 Screw (M16)
- 2 Washer
- 3 Stud
- 4 Turbocharger
- 5 Seal
- **6** Compensator
- 7 Distance sleeve

- 8 Screw (M16)
- 9 V-clamp
- **10** O-ring
- **11** O-ring
- 12 Turbocharger
- 13 Screw plug
- 14 Screw (M10)

### Removal



Fig. 179: Removing turbocharger

- Remove screws 1 and washers 2.
- ▶ Open and loosen V-clamp 9.
- ► Lift the turbocharger.

Exhaust gas system



#### Information

During lifting, make sure the turbocharger does not tilt.

- ▶ Place the turbocharger on a workbench.
- Remove the straight air intake connection. (For more information see: 3.9.1 Air intake line removal and installation, page 139.)
- Remove the exhaust elbow. (For more information see: 3.10.2 Exhaust pipes to turbocharger removal and installation, page 156.)
- Remove screws 8 and distance sleeves 7.
- Remove compensator 6 and seal 5.
- ▶ Repeat procedure for all turbochargers.

### Installation



Fig. 180: Installing turbocharger

- ▶ Place the turbocharger on a workbench.
- Install the straight air intake connection. (For more information see: 3.10.1 Admission pipes to turbocharger removal and installation, page 154.)
- Install the exhaust elbow. (For more information see: 3.10.2 Exhaust pipes to turbocharger removal and installation, page 156.)
- ▶ Grease screws **1** and screws **8** with Molykote HSC before installation.
- Install studs 3.
- Mount compensator 6 with seal 5 on turbocharger 4 and turbocharger 12.
- ▶ Tighten screws 8 with applied distance sleeves 7 to torque.
- ▶ Insert o-rings **10, 11** in turbocharger bracket.
- Position V-clamp 9 on exhaust pipe outlets.
- ► Lift the turbocharger.



#### Information

During lifting, make sure the turbocharger does not tilt.

Before installation, the turbocharger should be perfectly aligned with the exhaust pipe connection.



Fig. 181: Aligning turbocharger with exhaust pipe connection

- Position the turbocharger on the bracket so that the compensator is aligned with the exhaust pipe connection.
- ▶ Tighten screws 1 with washers 2 to torque.
- ▶ Install V-clamp 9 on exhaust pipe connection to compensator 6 and tighten to torque.
- Install turbocharger cooling lines. (For more information see: 3.12.2 Turbocharger cooling lines removal and installation, page 206.)



#### Information

Vent coolant circuit at the end of installation.

# Specific values

Not applicable.





Fig. 182: Turbocharger screws

ce	Кеу	Screw specifications	וt *	*		Torque	Angle (°)	
Referer			Lubricar	Reuse*	Step	± 5%	Step	± 5°
1	430AB	ISO 4014 M16x2x220-10.9-FLZN	MH	Yes	1	230 Nm 170 ft-lb	-	-
2	430AD	M16x2x90-C3J	MH	No	1	120 Nm 89 ft-lb	-	-
3	430AE	M8x1.25	MH	Yes	1	20 Nm 15 ft-lb	-	-
4	430AF	M22x1.5	0	Yes	1	90 Nm 66 ft-lb	-	-
4	430AG	M10x1.5	-	Yes	1	20 Nm 15 ft-lb	-	-

Tab. 36: Tightening specifications table

\*Lubricants: MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577 \*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.10.4 Oil supply – turbocharger removal and installation

### **Previous tasks**

Not applicable.

# Specific safety instructions

Not applicable.

# **Special tools**

Not applicable.

# **Consumables and equipment**

Make sure that the following consumables and equipment are available:

- Rags
- Cleaner

# Overview





- 3 Clamp
- 4 Plate
- Screw (M8) 5
- 6 Screw (M8)
- Distribution block 7

- 10 Pipe
- 11 Screw (M8)
- 12 Orifice
- 13 0-ring



Fig. 184: Task overview

- 14
- 0-ring Flange 15
- 16 Screw (M8)

17 0-ring Pipe 18

# Removal



Fig. 185: Removing pipes

- Remove screws **5** with plate **4** and clamps **3**.
- Remove pipe 2.
- Remove screws 11.
- Remove pipe 10, orifice 12, and o-ring 13.
- Remove screws 6.
- Remove distribution block 7 and o-ring 9.
- Remove flange joints **1**, **8**.



Fig. 186: Removing flanges and pipe

- Remove screws 16.
- Remove flanges 15 with o-rings 14 and pipe 18.

# Installation



Fig. 187: Installing flanges and pipe

- Assemble o-rings **17** on pipe **18** and place both flanges **15**.
- ▶ Insert o-rings **14** in both flanges **15**.
- Position assembly with screws 16 between both turbocharger brackets on oil supply connection.

© 2022 by Kohler Co. All rights reserved.





Fig. 188: Installing pipes

- ▶ Insert o-ring **9** in distribution block **7**.
- ▶ Position distribution block 7 with screws 6 on oil entry of turbocharger bracket.
- ▶ Tighten screws 6.
- ▶ Install flange joints **1, 8**.
- ► Tighten flange joints 1, 8.
- Grease orifice 12.
- ▶ Install pipe **10** with orifice **12**, screws **11**, and seal **12** between flange joint **8** and crankcase.
- ▶ Install pipe 2 with flange joint 1 on oil entry of turbocharger bracket.
- Tighten screws 11.
- ▶ Install plate 4 and clamps 3 with screws 5.
- ► Tighten screws 5.

### **Specific values**

Not applicable.

# **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

# 3.10.5 Turbocharger brackets removal and installation

### **Previous tasks**

Remove oil supply pipes. (For more information see: 3.10.4 Oil supply – turbocharger removal and installation, page 171.)

### Specific safety instructions

Not applicable.

### **Special tools**

Not applicable.

### **Consumables and equipment**

- Rags
- Cleaner

# Overview



Fig. 189: Task overview

- 1 Turbocharger bracket
- 2 Washer
- 3 Screw (M16)
- 4 Holder
- 5 Screw plug
- 6 Flange joint
- 7 Screw (M16)
- 8 Screw (M10)

- 9 Bracket
- 10 Seal
- 11 Oil return pipe
- **12** O-ring
- 13 Screw (M8)
- 14 Screw plug
- 15 Cover



Fig. 191: Removing holders

- ▶ Remove screws 16, 17.
- Remove holders **18**.
- Remove screws 19.



Fig. 192: Removing turbocharger brackets

- Remove screws 7.
- Lift off turbocharger bracket **1**.
- Remove screws 8.
- Remove brackets 9.

2022-09



Fig. 193: Removing oil return pipes

- Remove screws 13.
- ▶ Remove oil return pipes **11**.
- Remove cover 15.

# Installation

▶ Install brackets 9 with screws 8 on turbocharger bracket 1.



Fig. 194: Installing oil return pipes

- ▶ Install oil return pipes 11 with screws 13, seals 10, and o-rings 12.
- ▶ Install cover **15** with screws **13**.
- ► Tighten screws **13** to torque.



Fig. 195: Installing turbocharger brackets

- ▶ Install screw plugs **5**, **14** and flange joint **6**.
- Screw turbocharger brackets 1 with screws 7
► Tighten screws **7** to torque.



#### Fig. 196: Installing holders

- Screw holders 18 with screws 16, 17.
- Screw holder **20** with screws **19**.
- ▶ Tighten screws 16, 17, 19 to torque.

#### **Specific values**

Not applicable.

#### **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

## 3.10.6 Exhaust pipes and compensators (SL 214)

#### **Previous tasks**

- □ Remove turbocharger. (For more information see: 3.10.3 Turbocharger removal and installation (SL 213), page 166.)
- Remove turbocharger bracket. (For more information see: 3.10.5 Turbocharger brackets removal and installation, page 176.)

## Specific safety instructions



#### WARNING

Risk of injuries by contact with hot surfaces! Engine is hot near operating temperature.

- Avoid any contact with the engine, parts carrying hot coolant or oil, the exhaust system, the turbocharger, the heat protection, the battery and the covers.
- After the temperature has cooled down to a level it can be touched, proceed with the tasks on the engine.

#### **Consumables and equipment**

Not applicable.

#### Consumables

- Hot temperature grease
- Rags

#### Overview



3

V-clamp

Fig. 197: Task overview

- 1 Compensator
- 2 Seal

#### Removal

- ► Loosen V-clamps 3.
- Remove compensators 1 with seals 2.

#### Installation

- ▶ Install compensators 1 with seals 2 and V-clamps 3.
- ► Tighten V-clamps **3** to torque.

### **Specific values**

Not applicable.

## **Tightening specifications**



Fig. 198: V-clamps

e			lt *	*	Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	410AF	M8x1.25	MH	Yes	1	20 Nm 15 ft-lb	-	-

Tab. 37: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

## Exhaust pipes removal and installation

#### **Previous tasks**

Remove exhaust gas turbocharger. (For more information see: 3.10.3 Turbocharger removal and installation (SL 213), page 166.) Remove exhaust gas turbocharger bracket. (For more information see: 3.10.5 Turbocharger brackets removal and installation, page 176.)

#### **Specific safety instructions**



#### WARNING

Risk of injuries by contact with hot surfaces! Diesel engine is hot near operating temperature.

- Avoid any contact with the Diesel engine, parts carrying hot coolant or oil, the exhaust system, the exhaust gas turbocharger, the heat protection, the battery, and the covers.
- ► After the temperature has cooled down to a level it can be touched, proceed with the tasks on the Diesel engine.

#### **Special tools**

Not applicable.

#### **Consumables and equipment**

- Hot temperature grease
- Rags

#### Overview



Fig. 199: Task overview

- 1 Seal
- 2 Outlet manifold
- 3 Screw (M10)
- 4 Seal
- 5 Sealing ring
- 6 Plug
- 7 Sealing ring

- 8 Plug
- 9 Outlet manifold
- 10 Outlet manifold
- 11 V-clamp
- 12 Compensator
- 13 Outlet manifold

#### Removal

- Loosen V-clamp 11.
- ▶ Remove screws **3** from outlet manifolds **2**.
- ► Remove outlet manifolds **2**.
- Remove screws **3** from outlet manifolds **9**.
- ► Remove outlet manifolds 9.
- ▶ Remove screws **3** from outlet manifolds **10**.
- ► Remove outlet manifolds **10**.
- Remove screws **3** from outlet manifolds **13**.
- Remove outlet manifolds **13**.

#### Installation

- ▶ Install plug 6 with sealing ring 5 in outlet manifolds 2, 10.
- ▶ Install plug 8 with sealing ring 7 in outlet manifolds 2.

1	•	
(	٦	)
1	-	$\checkmark$

#### Information

At first, install the whole line without tightening the screws.

Tighten all screws to torque at the end of installation, making sure that compensators are aligned evenly.

- Apply hot temperature grease to lips of V-clamps 11.
- Mount outlet manifolds 2, 10 together with seals 4, V-clamps 11 and compensator 12.
- ▶ Place outlet manifolds **2**, **10** with seals **1** and screws **3**.
- Mount outlet manifolds 9 on outlet manifolds 2, 10 with seals 4, V-clamps 11 and compensator 12.
- Place outlet manifolds 9 with seals 1 and screws 3.
- Mount outlet manifolds 2, 13 on outlet manifolds 9 with seals 4, V-clamps 11, and compensator 12.
- Mount outlet manifolds **2, 13** together with seals **4**, V-clamps **11**, and compensator **12**.
- ▶ Place outlet manifolds 2, 13 with seals 1 and screws 3.
- ▶ Tighten plugs 6, 8, V-clamps 11, and screws 3 to torque.

#### **Specific values**

Not applicable.

#### **Tightening specifications**



Fig. 200: Exhaust pipe screws tightening sequence



Fig. 201: Exhaust pipe screws and plugs

e			וt *	*	Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	410AA	DRW 10123168 M10x1.5x80-C3J	MH	No	1	20 Nm 15 ft-lb	-	-

Exhaust gas system

lce	Кеу	Screw specifications	Lubricant *	Reuse**		Torque	Angle (°)	
Referer					Step	± 5%	Step	± 5°
					2	52 Nm 38 ft-lb	-	-
2	410AD	DIN 908 G3/8 A	MH	Yes	1	60 Nm 44 ft-lb	-	-
3	410AE	DIN 908 M16x1.5	MH	Yes	1	50 Nm 37 ft-lb	-	-
4	410AF	M8x1.25	MH	Yes	1	20 Nm 15 ft-lb	-	-

Tab. 38: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.11 Lubricating system

## 3.11.1 Crankcase breather system rubber hoses (SL 219)

#### **Previous tasks**

□ Not applicable.

## **Specific safety instructions**



## WARNING

**Risks of burns** 

▶ Wait until the engine has cooled down.

## **Special tools**

Not applicable.

## **Consumables and equipment**

Not applicable.

### **Overview**



Fig. 202: Task overview

- 1 Clamp
- 2 Hose
- 3 Clamp

4 Screw (M8)

- Screw (M12) 5 6
  - Hose

## Removal



Fig. 203: Removing hoses

- ▶ Remove screws 4, 5.
- Remove clamp **3**.
- Loosen clamps 1.
- Remove hoses 2, 6.

## Installation



Fig. 204: Installing hoses

- ▶ Install hoses **2**, **6** with clamps **1**.
- ▶ Install clamp **3** with screws **4**, **5** on hose **6**.
- ▶ Tighten clamps 1.

## Specific values

Not applicable.

## **Tightening specifications**

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

## 3.11.2 Oil centrifuge removal and installation (depending on application)

#### **Previous tasks**

Drain engine oil.

#### **Specific safety instructions**

Not applicable.

## **Special tools**

Not applicable.

#### **Consumables and equipment**

- Rags
- Cleaner

#### Overview



Fig. 205: Task overview

- 1 Oil centrifuge
- 2 O-ring
- **3** O-ring
- 4 Screw (M8)
- 5 Cover plate
- **6** 0-ring
- 7 Oil centrifuge base
- 8 Screw (M12)
- 9 Screw (M12)
- 10 Holder

- **11** Screw (M8)
- **12** O-ring
- **13** Pipe
- 14 Flange joint
- 15 Flange joint
- 16 Screw (M10)
- 17 Flange18 O-ring
- **19** Pipe
- **20** O-ring

#### Removal

- Remove screws 4 from pipe 13.
- ▶ Disconnect pipe **13** with flange joints **14**, **15**.
- Remove screws 4, 9.
- Remove screws 11.
- Remove holders 10.
- Remove screws 8.
- ▶ Remove oil centrifuge base 7 from oil centrifuge 1.
- Remove screws 16.
- ▶ Remove flange **17** with pipe **19**.

#### Installation

▶ Install o-rings **20** on pipe **19**.

Lubricating system

- ▶ Install o-ring **18** on flange **17**.
- Assemble pipe **19** with flange **17**.
- Screw assembly with screws 16.
- ▶ Assemble oil centrifuge base 7 and oil centrifuge 1 with screws 8 and o-rings 2, 3.
- ▶ Install holders **10** with screws **11**.
- ▶ Install oil centrifuge assembly to oil pan with o-ring 12 and screws 4, 9.
- ▶ Install pipe **13** to oil centrifuge base **7** with o-ring **6** and screws **4**.
- Connect flange joints **14, 15** to pipe **13**.
- ▶ Install cover plate **5** with o-ring **6** and screws **4**.

#### **Specific values**

Not applicable.

#### **Tightening specifications**



Fig. 206: Oil centrifuge screws

ICe			וt *	*	Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	025AA	ISO 4017 M8x1.25x40-10.9-FLZN	-	Yes	1	27 Nm 20 ft-lb	-	-

Tab. 39: Tightening specifications table

\*Lubricants: MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577 \*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

## 3.11.3 Spin-on oil filters removal and installation

#### **Previous tasks**

Not applicable.

## Specific safety instructions

Not applicable.

## **Special tools**

Not applicable.

#### **Consumables and equipment**

- Cleaner
- Rags
- Optimol

#### Overview



#### Fig. 207: Task overview

- 1 Spin-on oil filter
- 2 Filter head

3 Seal

- Removal
- Clean sealing area.
- Open spin-on oil filter **1** with filter wrench.
- ► Remove filter.
- ▶ Repeat procedure for all filters.

## Installation

- Clean sealing area.
- Lubricate filter seal **3** with engine oil.
- Screw spin-on oil filter **1** in filter head **2** until it contacts base.
- ▶ Tighten filter by hand by 1/2 turn.

#### **Specific values**

Not applicable.

## **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

## 3.11.4 Oil cooler by-pass valve (SL 212)

#### **Previous tasks**

Not applicable.

#### Specific safety instructions



#### Information

Risks of damage to the engine Pressure loss if the valve is not in place.

• Engine stopped and secure against starting.

#### NOTICE

Risk of property damage by reuse of sealing. Leaks by faulty seal.

Replace all sealings.

## Special tools

Not applicable.

#### **Consumables and equipment**

Make sure that the following consumables and equipment are available:

- Rags
- Cleaner

#### Overview



Fig. 208: Task overview

1 By-pass valve

#### Removal

► Remove by-pass valve **1**.

#### Installation

- ► Insert by-pass valve 1.
- ▶ Tighten by-pass valve to torque.

## **Specific values**

Not applicable.

## **Tightening specifications**



Fig. 209: Oil cooler by pass valve

# Lubricating system a b a b

Tab. 40: Tightening specifications table

M33x1.5

\*Lubricants:

130AC

1

Repair

```
MG = Molykote G-n-plus
MW = Castrol Optimol paste white T
MH = Molykote HSC
O = Engine oil
XX = Loctite 243
YY = Loctite 577
```

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

## 3.11.5 Prelubricating pump removal and installation (option)

## **Previous tasks**

Drain engine oil.

## Specific safety instructions

Not applicable.

## Special tools

Not applicable.

## **Consumables and equipment**

– Rags

Angle (°)

± 5°

\_

Step

\_

1

Yes

\_

60 Nm

44 ft-lb

#### Overview



Fig. 210: Task overview

- 1 Screw (M8)
- 2 Clamp
- **3** Prelubricating pump
- 4 Screw (M10)
- 5 Distance sleeve
- 6 Nut
- 7 Holder

#### Removal

- Remove oil line **9**.
- Remove return valve **8**.
- ▶ Remove oil line **13** and screws **12**.
- Remove o-ring **10**.
- Remove screws 1.
- Remove clamps 2.
- Remove prelubricating pump **3**.
- Remove screws 4, distance sleeves 5 and nuts 6.
- Remove holders 7.

### Installation



#### Information

Do not install relay **11** on the engine.

▶ Install holders 7 with screws 4, distance sleeves 5 and nuts 6.

- 8 Return valve
- 9 Oil line
- **10** O-ring
- 11 Relay
- 12 Screw (M12)
- 13 Oil line

Lubricating system

- ▶ Tighten screws 4.
- ▶ Hand-tighten prelubricating pump **3** with clamps **2** and screws **1**.
- ▶ Hand-tighten oil line **13** with screws **12** and o-ring **10**.
- ▶ Install return valve 8.
- ▶ Tighten return valve 8.
- ▶ Hand-tighten oil line **9**.
- ▶ Tighten screws 1.
- ► Tighten oil lines **9, 12** nuts.

#### **Specific values**

Not applicable.

## **Tightening specifications**



Fig. 211: Prelubricating pump screws and connections

ce			lt *	*	Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	-	M8 10.9 480H	-	Yes	1	34 Nm 25 ft-lb	-	-
2	-	M10 10.9 FLZN	-	Yes	1	66 Nm 49 ft-lb	-	-
3	-	M12 10.9 FLZN	-	Yes	1	113 Nm 83 ft-lb	-	-

Repair

Lubricating system

lce	Key Screw specificati		Lubricant *	Reuse**	Torque		Angle (°)	
Referen		Screw specifications			Step	± 5%	Step	± 5°
4	-	M33x2	0	Yes	1	340 Nm 251 ft-lb	-	-

Tab. 41: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.12 Cooling system

## 3.12.1 Venting line removal and installation

## **Previous tasks**

Not applicable.

## Specific safety instructions

#### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

Replace all sealings.

## Special tools

Not applicable.

## **Consumables and equipment**

- Rags
- Cleaner
- Loctite 243

#### Overview



#### Fig. 212: Task overview

- **1** Venting LT turbocharger
- 2 Flange joint
- **3** Venting LT charge air cooler
- 4 T connector
- 5 Screw (M10)
- 6 Distribution block

- 7 Venting LT charge air cooler
- 8 Flange joint
- **9** Venting HT thermostat
- **10** Venting LT turbocharger
- **11** Venting HT collecting pipe



Cooling system



- Fig. 214: Task overview
- 23 Venting line

### Removal



Fig. 215: Removing venting lines

• Remove venting line **23** with flange joints **2**.



Fig. 216: Removing venting lines

- Remove clamps **14** with screws **13**, and nuts **15**.
- ▶ Remove holders 16, 18, 19, 20, 21, 22 with screws 5, 12, and distance sleeve 17.

Repair Cooling system



Fig. 217: Removing venting lines

- ▶ Remove venting pipes 1, 3, 7, 9, 10, 11.
- Remove screws 5. ►
- Remove distributor block **6**.

## Installation



Fig. 218: Installing venting lines

- Screw distributor block **6** with screws **5**.
- ▶ Install venting pipes 1, 3, 7, 9, 10, 11 with T connector 4 and flange joints 2, 8.



Fig. 219: Installing venting lines

Install clamps 14 and holders 16, 18, 19, 20, 21, 22 with screws 5, 12, 13, distance sleeve 17 and nuts 15.



#### Information

Use Loctite 243 only for screw **13** in holder **19**.



Fig. 220: Installing venting lines

▶ Install venting lines 23 with flange joints 2.

#### **Specific values**

Not applicable.

## **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

#### 3.12.2 Turbocharger cooling lines removal and installation

#### **Previous tasks**

Remove venting lines. (For more information see: 3.12.1 Venting line removal and installation, page 200.)

#### Specific safety instructions

#### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

▶ Replace all sealings.

#### **Special tools**

Not applicable.

#### **Consumables and equipment**

- Vaseline \_
- Rags
- Cleaner

#### **Overview**



- 1 Screw (M10)
- 2 Plate
- 3 Clamp
- 4 T connector
- 5 Pipe
- 6 Distance sleeve
- 7 Screw (M8)
- 8 Screw (M8)
- 9 Retaining plate
- **10** Screw (M8)
- Flange joint 11
- 12 T connector
- 13 Pipe
- 14 Screw (M10)

- 0-ring 15
- 16 0-ring
- 17 Aggregate support connector
- Screw (M10) 18
- Screw (M8) 19
- 20 Pipe
- 21 Retaining plate
- 22 Fitting
- 23 Fitting
- 24 Retaining plate
- 25 Screw (M8)
- 26 Pipe
- 27 Pipe

Cooling system



43 Pipe

- 34 NUL
- 35 Plug

# Removal

#### Turbocharger coolant supply



© 2022 by Kohler Co. All rights reserved.

KOHLER.

▶ Remove screws 1, 7, 19.

Fig. 223: Removing pipes

- Remove plates **2** and clamps **3**.
- ▶ Remove screws 8, 10, 25 and distance sleeve 6.
- Remove retaining plates 9, 21, 24.
- Remove screws 14, 18.
- Remove aggregate support connector 17.
- Unscrew connection nuts of pipes 5, 13, 20, 27.
- ▶ Remove pipes 5, 13, 20, 27.
- ▶ Remove fittings **22, 23**.

#### Information

Fittings **22, 23** have different internal diameters, depending on the side of the engine. Make a note of which kind of fitting is installed on which side of the engine.

#### Turbocharger coolant return



Fig. 224: Removing pipes

- Remove screws 1.
- Remove plate 2 and clamps 3.
- Remove screws 42.
- Remove retaining plate **41**.
- Remove screws 14, 40.
- Remove aggregate support connector 39.
- Unscrew connection nuts of pipes 33, 36, 37, 43.
- ▶ Remove pipes **33**, **36**, **37**, **43**.
- ▶ Disconnect fittings, flange joints and connectors.

## Installation



#### Turbocharger coolant return

Fig. 225: Installing pipes

- Screw aggregate support connector **39** with screws **40** and o-ring **38**.
- ▶ Install pipe **37** on aggregate support connector **39** with screws **14** and o-ring **16**.
- Mount pipes **33**, **36**, **37**, **43** with connectors **12**, **29**, **31**, **32** and flange joints **11**, **30**.
- ▶ Install plugs **35** with nuts **34** on T connectors **12, 29** and flange joint **11**.
- ▶ Install retaining plate **41** with screws **42**.
- ▶ Install plates 2 with clamps 3 and screws 1.
- ► Tighten screws **1** to torque.



#### Turbocharger coolant supply

Fig. 226: Installing pipes

- Screw aggregate support connector 17 with screws 18 and o-ring 15.
- ▶ Install pipe **13** with screws **14** and o-ring **16**.
- Mount pipes 5, 13, 20, 27 with T connectors 4, 12 and flange joint 11.
- ▶ Install fittings 22, 23.



#### Information

Fittings **22, 23** have different internal diameters, depending on the side of the engine. Make sure to install the correct kind of fitting on the correct side of the engine.

- Screw retaining plate 9 with screws 8, 10 and distance sleeve 6.
- ▶ Install plates 2 and clamps 3 with screws 1, 7.
- ▶ Tighten screws 1 to torque.
- Screw retaining plates **21**, **24** with screws **8**, **25**.

#### **Specific values**

Not applicable.

## Tightening specifications



Fig. 227: Turbocharger coolant lines

e			Lubricant *	*	Torque			Angle (°)	
Referen	Кеу	Screw specifications		Reuse	Step	± 5%	Step	± 5°	
1	383AA	ISO 4014 M10x1.5x60-8.8-FLZN	-	Yes	1	30 Nm 22 ft-lb	-	-	

Tab. 42: Tightening specifications table

\*Lubricants: MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

#### Turbocharger cooling lines removal and installation (EATS configuration)

#### **Previous tasks**

Remove venting lines. (For more information see: 3.12.1 Venting line removal and installation, page 200.)

#### **Specific safety instructions**

#### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

Replace all sealings.

#### **Special tools**

Not applicable.

#### **Consumables and equipment**

- Vaseline
- Rags
- Cleaner

#### Overview



Fig. 228: Task overview

- **1** Screw (M10)
- 2 Plate
- 3 Clamp
- 4 T connector
- 5 Screw (M8)
- 6 Pipe
- 7 Pipe
- 8 Distance sleeve
- **9** Screw (M8)
- 10 Screw (M8)
- 11 Clamp
- 12 Screw (M8)
- **13** Retaining plate
- 14 Adaptor

- **15** Pipe
- 16 Screw (M10)
- **17** O-ring
- 18 O-ring
- **19** Aggregate support connector
- 20 Screw (M10)
- 21 Screw (M8)
- 22 Retaining plate
- **23** Pipe
- 24 Fitting
- 25 Retaining plate
- 26 Fitting27 Pipe



Fig. 229: Task overview

- 28 Fitting
- 29 Fitting
- **30** 90° connector
- 31 T connector
- **32** Pipe
- 33 Pipe
- 34 Coupling
- **35** Flange joint
- **36** T connector
- 37 Pipe
- 38 Pipe

- **39** O-ring
- 40 Aggregate support connector
- 41 Screw (M10)
- 42 Pipe
- 43 Plug
- 44 Nut
- 45 Retaining plate
- 46 Pipe
- 47 Screw (M10)
- 48 T connector

#### Removal



© 2022 by Kohler Co. All rights reserved.

KOHLER.

Fig. 230: Removing pipes

▶ Remove screws 1, 9, 21.

- Remove plates 2 and clamps 3.
- ▶ Remove clamp 11.
- Remove screws 16, 20.
- Remove aggregate support connector **19**.
- ▶ Loosen connection nuts of pipes 6, 7, 15, 23, 27.
- ▶ Remove fittings **24, 26**.



#### Information

Fittings **24, 26** have different internal diameters, depending on the side of the engine. Make a note of which kind of fitting is installed on which side of the engine.

- Remove screws 10, 12 and distance sleeve 8.
- Remove retaining plate **13**.
- Remove screws 5.
- Remove retaining plate **25**.
- Remove screws 10.
- Remove retaining plate 22.



Fig. 231: Removing pipes

- Remove screws 1.
- Remove plates 2 and clamps 3.
- Remove screws 47.
- Remove retaining plates 45.
- Remove screws 16, 41
- Remove aggregate support connector **40**.
- Loosen connection nuts of pipes 32, 33, 37, 38, 42, 46.

© 2022 by Kohler Co. All rights reserved.

- ▶ Remove pipes 32, 33, 37, 38, 42, 46.
- ▶ Disconnect fittings, flange joints, and connectors.

#### Installation



Fig. 232: Installing pipes

- ▶ Install aggregate support connector **40** with screws **41** and new o-ring **39**.
- ▶ Install pipe **38** on aggregate support connector **40** with screws **16** and new o-ring **18**.
- ▶ Install T connector **36** and flange joint **35** with coupling **34** between pipes **33**, **37**, **38**.
- ▶ Install pipes **32, 42** with T connectors **31**.
- ▶ Install 90° connectors **30**, fittings **29**, and T connectors **48** on T connectors **31**.
- ▶ Install pipe **46** on T connector **48**.
- ▶ Install fittings **28**.
- ▶ Install plug **43** and nut **44**.
- ▶ Install retaining plates **45** with screws **47**.
- ▶ Install plates 2 and clamps 3 with screws 1.
Cooling system



### Fig. 233: Installing pipes

- ▶ Install aggregate support connector **19** with screws **20** and o-ring **17**.
- ▶ Install pipe **15** with screws **16** and o-ring **18**.
- ▶ Install pipes 6, 7, 15, 23, 27 with T connectors 4 and adaptor 14.
- ▶ Install fittings 24, 26.



### Information

Fittings **24, 26** have different internal diameters, depending on the side of the engine. Make sure to install the correct kind of fitting on the correct side of the engine.

- ▶ Install retaining plate 13 with screws 10, 12 and distance sleeve 8.
- ▶ Install plates 2, clamps 3, clamp 11 with screws 9.>
- ▶ Install retaining plate 22 with screws 10.
- Install plate 2 and clamps 3 with screws 21.
- ▶ Install retaining plate **25** with screws **5**.
- Install plates 2 and clamps 3 with screws 1.

### Specific values

Not applicable.

Cooling system

### **Tightening specifications**



### Fig. 234: Clamp screws

e			וt *	Reuse**	Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar		Step	± 5%	Step	± 5°
1	383AA	ISO 4014 M10x1.5x60-8.8-FLZN	-	Yes	1	30 Nm 22 ft-lb	-	-

Tab. 43: Tightening specifications table

### \*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

### 3.12.3 Thermostat HT and housing removal and installation (SL 217)

### **Previous tasks**

□ HT coolant circuit drained.

### **Specific safety instructions**

```
NOTICE
```

Risk of property damage by reuse of sealing. Leakage by faulty seal.

Replace all sealings.

# **Special tools**

Special tool	Designation
12465862	Guiding rod M12x230 – Thermostat (x2)

Tab. 44: Special tools

# **Consumables and equipment**

- Vaseline
- Rags
- Cleaner

### **Overview**



### Fig. 236: Task overview

- 1 Thermostat
- **2** Test point fitting
- **3** Thermostat housing
- 4 Screw (M12)
- 5 O-ring

- **6** Flange
- 7 Screw (M10)
- 8 O-ring
- 9 Pipe

### Removal

- ▶ Remove two screws 4 diametrically opposed.
- Place guiding rods in place of the two screws 4.

- Remove remaining screws 4 and screws 7.
- Remove thermostat housing **3**.
- Remove guiding rods.
- Remove thermostats 1.
- Remove pipe **9** with flange **6**.

### Installation

- Assemble pipe **9** and flange **6** with o-rings **5**, **8**.
- ▶ Insert o-rings 8 on coolant pump inlet.
- Position pipe assembly on coolant pump inlet.
- Position thermostats 1 in thermostat housing 3.
- Place guiding rods in place of two screws 4.
- Place thermostat housing.
- Place screws 4.
- Remove guiding rods.
- ▶ Place remaining screws.
- Screw thermostat housing **3** with screws **4**, **7**.
- ► Insert test point fitting **2**.
- ▶ Tighten screws to torque according to tightening specifications.

# **i**

Vent coolant circuit at the end of installation.

# **Specific values**

Information

Thermostats HT start to open at 71 °C (160 °F) and are fully opened at 81 °C (178 °F).

### **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

### 3.12.4 Thermostat LT and housing removal and installation (SL 217)

### **Previous tasks**

Make sure that the following preconditions are met: LT coolant circuit is drained.

□ Venting line LT charge air cooler is removed. (For more information see: 3.12.1 Venting line removal and installation, page 200.)

# Specific safety instructions

### NOTICE

Risk of property damage by reuse of sealing. Leaks by faulty seal.

▶ Replace all sealings.

# **Special tools**

Make sure that the following special tools are available:

- Guiding rod M12x230 - Thermostat (x2)

(For more information see: 4.1.1 Special tools, page 258.)

# **Consumables and equipment**

Make sure that the following consumables and equipment are available:

- Vaseline
- Rags
- Cleaner

### **Overview**



Fig. 237: Task overview

LT thermostat Flange 1 5 Screw (M10) 2 Thermostat housing 6 3 Screw (M12) 7 0-ring 4 0-ring 8 Pipe

### Removal

- ▶ Remove two screws **3** diametrically opposed.
- Place guiding rods in place of the two screws 3.
- Remove remaining screws 3 and screws 6.
- Remove thermostat housing **2**.
- Remove guiding rods.
- Remove LT thermostats 1.
- Remove pipe 8 with flange 5.

### Installation

- Assemble pipe 8 and flange 5 with o-rings 4, 7.
- ▶ Insert o-rings 7 on coolant pump inlet.
- Position pipe assembly on coolant pump inlet.
- Position LT thermostats 1 in thermostat housing 2.
- Place guiding rods in place of two screws 3.
- Place thermostat housing 2.
- Place screws 3.
- Remove guiding rods.
- Place remaining screws.
- Screw thermostat housing 2 with screws 3, 6.
- ▶ Tighten screws to torque according to tightening specifications.



### Information

Vent coolant circuit at the end of installation.

### **Specific values**

LT thermostats start to open at 45 °C113 °F and are fully opened at 57 °C135 °F.

### **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

### 3.12.5 Coolant pump HT removal and installation (SL 216)

### **Previous tasks**

- Drain HT coolant circuit.
- □ Remove machinery HT cooling system piping.

# Specific safety instructions

### NOTICE

Risk of property damage by reuse of sealing. Leakage by faulty seal.

▶ Replace all sealings.

# **Special tools**

Special tool	Designation
12427300	Guiding rod M12x100 - Coolant pump (x2)

Tab. 45: Special tools

# **Consumables and equipment**

- Rags
- Cleaner
- Vaseline

### Overview



See next page for continuation of the image legend

- 2 T-pipe
- **3** O-ring
- 4 Pipe
- 5 Screw (M10)
- **6** Flange
- 7 O-ring
- 8 Test point fitting9 Coolant pump HT

### Removal

- Remove screws 1, 5.
- Remove piping assemblies **2**, **4**, **6**.
- Remove two screws 16.
- Install guiding rods.
- Remove remaining screws 16.
- ▶ Remove coolant pump HT 9.
- ▶ Remove screws 5, 15.
- Remove coolant pipe **13** with flange **6**.
- ▶ Remove pipe **14** with flange **6**.

# Installation

- ▶ Insert o-ring **7** and flange **6** on pipe from oil cooler casing.
- Mount pipe 14 with o-rings 3 on flange 6.
- Mount coolant pipeline 13 with o-ring 7 on flange 6.
- ▶ Insert guiding rods in coolant pump 9.
- Insert o-rings 10, 11, 12.
- ▶ Insert coolant pump HT **9**.
- ▶ Tighten screws **1, 16** according to tightening specifications.
- Remove guiding rods.
- Tighten remaining screws **16** to torque.
- Assemble t-pipe 2, pipe 4 and flange 6 with o-rings 3, 7, 17.
- > Position assembly with screws **1**, **5** and tighten according to tightening specifications.
- ▶ Install test point fitting 8 on coolant pump.



### Information

Vent coolant circuit at the end of installation.

### **Specific values**

Not applicable.

- **11** 0-ring
- 12 O-ring13 coolant pipeline
- **14** Pipe
- 15 Screw (M12)
- 16 Screw (M12)
- **17** O-ring

# Tightening specifications

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

# 3.12.6 Coolant pump LT removal and installation (SL 215)

### **Previous tasks**

Make sure that the following preconditions are met:

- □ LT cooling system is drained.
- □ Machinery LT cooling system piping is removed.
- □ Cover of torsional vibration damper is removed. (For more information see: 3.4.1 Vibration damper cover removal and installation, page 58.)
- Cover of battery charging alternator is removed.

# **Specific safety instructions**

### NOTICE

Risk of property damage by reuse of sealing. Leaks by faulty seal.

▶ Replace all sealings.

# **Special tools**

Make sure that the following special tools are available:

- Guiding rod M12x100 - coolant pump (x2)

### **Consumables and equipment**

Make sure that the following consumables and equipment are available:

- Rags
- Cleaner
- Vaseline

### **Overview**



Fig. 240: Task overview

- Screw (M12) 1
- 2 Branch pipe
- 3 0-ring
- 4 0-ring
- 5 Pipe
- Screw (M10) 6

- 7 Flange
- 8 0-ring
- 9 0-ring
- 10 0-ring
- Coolant pump LT 11
- 12 Screw



- 0-ring 13
- 14 Flange
- 15 0-ring
- 16 Screw (M10)

- 18 Elbow pipe 19
  - Screw (M12)

### Removal

- ▶ Remove screws **6**, **1**, **16**, **19**.
- ▶ Remove piping assemblies **2**, **5**, **7**, **14**, **18**.
- Remove screws 12.
- Remove coolant pump LT **11**.

### Installation

- ► Install guiding rods.
- ▶ Insert o-rings 9, 10.
- ▶ Insert coolant pump LT **11**.
- Place four screws 12.
- Remove guiding rods.
- ▶ Place the remaining screws **12**.
- Assemble elbow pipe **18** with flange **14** and o-rings **13**, **15**, **17**.
- ► Tighten screws **16, 19** to torque.
- Assemble branch pipe 2 with pipe 5 and flange 7 with o-rings 3, 4, 8.
- ▶ Position assembly with screws 1, 6.
- ► Tighten screws **1**, **6** to torque.



### Information

Vent coolant circuit at the end of installation.

# **Specific values**

Not applicable.

# **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

# 3.12.7 Fan drive (option)

### **Previous tasks**

Remove vibration damper cover. (For more information see: 3.4.1 Vibration damper cover removal and installation, page 58.)

# **Specific safety instructions**

Not applicable.

Cooling system

# **Special tools**

Special tool	Designation
11343230	Locking device

Tab. 46: Special tools

# **Consumables and equipment**

- Rags
- Cleaner

### Overview



Fig. 243: Task overview

- 1 Screw (M16)
- 2 Washer
- **3** Pulley

- 4 Screw (M28)
- 5 Axle

# Removal



Fig. 244: Locking device

▶ Install locking device with screws (M16) to lock crankshaft.



Fig. 245: Removal of fan drive pulley

- ▶ Remove screws 1, and washers 2.
- ▶ Remove pulley **3**.
- Remove screws 4.
- Remove axle 5.
- ► Remove locking device.

# Installation



Fig. 246: Locking device

▶ Install locking device with screws (M16) to lock crankshaft.



Fig. 247: Installation of fan drive pulley

▶ Install axle **5** with screws **4**.



### Information

Observe screws 4 tightening sequence and tightening torque.

- ► Tighten screws 4 to torque.
- ▶ Install pulley **3** with screws **1**, and washers **2**.
- ► Tighten screws **1** to torque.

# **Specific values**

Not applicable.

# **Tightening specifications**



Fig. 248: Tightening sequence of pulley axle screws



Fig. 249: Screws of fan drive pulley

ce		±		*	Torque		Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	-	M16x55 10.9 FLZN	-	No	1	275 Nm 203 ft-lb	-	-
2	056AC	M28x2x122	-	No	1	430 Nm 317 ft-lb	2	75°

Tab. 47: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# **3.13** Electrical system

# 3.13.1 Power take-off (PTO) and battery charging alternator removal and installation (SL 218, SL 223)

# **Previous tasks**

□ Remove battery charging alternator cover. (For more information see: 3.4.2 Battery charging alternator & PTO cover removal and installation, page 60.)

# **Specific safety instructions**



### WARNING

Hazards by electrical shocks.

Contact with live conductor could result in death or serious injury.

- Access to live parts shall only be possible with voluntary action.
- Proceed to lock out and tag out prior to accessing to the engine.
- Respect the voltage indication of the engine technical data sheet.
- Check the grounding connection to avoid any risk of electrical arc.
- Observe the local safety regulations that apply to the machinery.

### NOTICE

Risk of property damage by reuse of sealing. Leaks by faulty seal.

Replace all sealings.

### **Special tools**

Special tool	Designation
12217125	Pin for belt tensioner (x1)
	Frequency meter

Tab. 48: Special tools

# **Consumables and equipment**

- Vaseline
- Rags
- Belt tension frequency meter

# Overview



Fig. 251: Task overview

- 1 Battery charging alternator
- 2 Bracket
- 3 Pin
- 4 Screw (M10)
- 5 Retaining plate
- **6** Washer
- 7 Screw (M12)
- 8 Screw (M8)
- 9 Roller
- **10** O-ring
- **11** O-ring

- **12** Auxiliary PTO
- 13 Belt
- 14 Screw (M10)
- 15 Tensioning device
- 16 Screw (M10)
- 17 Washer
- 18 Screw (M10)
- 19 Screw (M12)
- 20 Distance sleeve (EATS only)
- 21 Sleeve

### Removal



Fig. 252: Removing belt and pin location

- ▶ Install ratchet wrench in tensioning device 15.
- ▶ Pivot back the tensioning device against the spring force to the limit stop.
- Use a guiding rod in the specified location to lock the tensioning device.
- Remove belt 13.
- ► Remove guiding rod.



Fig. 253: Removing battery charging alternator

- Remove screws 4, 18.
- Remove battery charging alternator **1**.
- ► Remove distance sleeve **20**.

Remove sleeve **21**.



Fig. 254: Removing auxiliary PTO

- Remove screws 7.
- Remove auxiliary PTO **12**.
- ▶ Remove o-rings **10, 11**.



Fig. 255: Removing tensioning device

- Remove screw 14.
- Remove tensioning device **15**.



Fig. 256: Removing roller

- ► Loosen roller **9** fastening.
- Remove roller 9.
- Remove screws 7, 8, 16 and washers 6, 17.
- Remove plate 5.

### Installation



Fig. 257: Installing auxiliary PTO

- ▶ Grease o-rings **10, 11**.
- ▶ Insert o-rings **10, 11** in auxiliary PTO **12**.
- ▶ Install auxiliary PTO **12** with screws **7**.



Fig. 258: Installing battery charging alternator

- ▶ Insert sleeve **21** into bracket.
- > Position battery charging alternator **1** in bracket.
- ▶ Install battery charging alternator 1 with screw 4 and screw 18 with distance sleeve 20.



Fig. 259: Installing roller

- ▶ Install roller 9 on plate 5.
- ▶ Install plate 5 with screws 7, 8, 16 and washers 6, 17.
- ► Tighten roller **9** to torque.



Fig. 260: Installing tensioning device

▶ Install tensioning device **15** on bracket with screw **14**.





- ▶ Install ratchet wrench in tensioning device **15**.
- > Pivot back the tensioning device **15** against the spring force to the limit stop.
- Use a guiding rod in the specified location to lock the tensioning device **15**.
- ▶ Install belt **13** on the PTO pulley.
- Remove the guiding rod.
- Use the ratchet wrench in tensioning device **15** to tension belt **13**.
- Check belt **13** tension.

# **Specific values**

Belt tension: 165 Hz (Min 149 Hz - Max 182 Hz).

# **Tightening specifications**



Fig. 262: Belt tensioner

ce			nt *	*		Torque	Angle (°)	
Referen	Кеу	Screw specifications	Lubricar	Reuse	Step	± 5%	Step	± 5°
1	441AD	M10x55-10.9-Zinc Coating	-	Yes	1	50 Nm 37 ft-lb	-	-

Tab. 49: Tightening specifications table

\*Lubricants: MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# 3.13.2 Starter removal and installation (SL 260)

# **Previous tasks**

Not applicable.

# **Specific safety instructions**

Not applicable.

### **Special tools**

Not applicable.

### **Consumables and equipment**

- Rags
- Cleaner

### Overview



Screw (M16)

Ground cable

Power supply T30, battery +

4

5

6

Fig. 263: Task overview

- 1 Ground connection -
- 2 Starter
- **3** Wiring harness connection

### Removal

- ► Unplug wiring harness connection **3**.
- Remove nut from ground connection **1**.
- Disconnect ground cable **6**.
- ▶ Remove nut from power supply **5**.
- ► Disconnect power supply cable.
- KD62V12 33525088601\_8\_1 EN\_US 2022-09

241

- Remove screws 4.
- Remove starter **2**.

### Installation

- Position starter 2.
- Tighten screws 4.
- Connect plug 3.
- Connect power supply **5** with nut.
- ► Tighten nut to torque.
- Connect ground cable **6** with nut and tighten according to tightening specifications.

### **Specific values**

Not applicable.

# **Tightening specifications**



Fig. 264: Starter nuts

lce			וt *	*		Torque	Angle (°)	
Referen	Кеу	Screw specifications	Lubrica	Reuse	Step	± 5%	Step	± 5°
1	-	M12	-	Yes	1	22 Nm (16 ft-lb)- 30 Nm (22 ft-lb)	-	-
2	-	M12	-	Yes	1	22 Nm (16 ft-lb)- 30 Nm (22 ft-lb)	-	-

Tab. 50: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

# Prestolite starter removal and installation (option)

### **Previous tasks**

Disconnect the battery.

### **Specific safety instructions**

- Not applicable.

### **Special tools**

- Not applicable.

### Consumables and equipment

- Not applicable.

### Overview



- Fig. 265: Task overview
- 1 Starter

2 Screw (M16)

### Removal

▶ Disconnect starter electrical connections.

- Remove screws 2.
- Remove starter **1**.

### Installation

- ▶ Install starter **1** with screws **2**.
- ▶ Tighten screws **2** to 180 <sup>±45</sup> Nm (133 <sup>±33</sup> ft-lb).
- Apply general-purpose lubricating grease to flywheel ring gear.



### Information

The application of general-purpose lubricating grease to flywheel ring gear eases gear engagement.

► Connect starter electrical connections.

### **Specific values**

Not applicable.

### **Tightening specifications**



Fig. 266: Starter screws and connections

e		*   *		*		Torque		Angle (°)	
Referer	Кеу	Key Screw specifications	Reuse	Step	± 5%	Step	± 5°		
1	450AA	ISO 4762 M16x2x35-10.9-FLZN	-	Yes	1	180 Nm (133 ft-lb) ***	-	-	
2	-	Nut	-	-	1	9.5 Nm 7 ft-lb	-	-	
3	-	Nut	-	-	1	1.6 Nm 1 ft-lb	-	-	

Tab. 51: Tightening specifications table

\*Lubricants:

MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil XX = Loctite 243 YY = Loctite 577

\*\*Refer to screws reuse rules. (For more information see: 5.3.2 Screws pre-tightening, reuse, and marking, page 268.)

\*\*\* ± 25% Accuracy is accepted.

For more information about sensors location, refer to the "Electrical Wiring Diagram" manual.

# **3.14 Exhaust gas aftertreatment system (depending on configuration)**

# 3.14.1 Removing and installing diesel exhaust fluid injector (SL2-5330)

### **Previous tasks**

Make sure that the following preconditions are met:

- □ The engine is switched off.
- $\hfill\square$  The exhaust system has cooled down.
- The exhaust gas aftertreatment system is drained.

# **Specific safety instructions**



### DANGER

Contacts with hot parts! Risk of death or injury by burn.

- ▶ When the engine is in operation, stay away from the engine.
- Before servicing the engine, let it cool down until surface temperature allows you to touch it with bare hand.
- ▶ Wear proper personal protective equipment.

### NOTICE

Risk of property damage by reuse of sealing. Leaks by faulty seal.

▶ Replace all sealings.

# Special tools

Not applicable.

### **Consumables and equipment**

Make sure that the following consumables and equipment are available:

- High temperature grease
- Rags
- Cleaner

### Overview



- 1 Dosing cover
- 2 Screw (M8)
- **3** Gasket
- 4 Back mounting plate
- 5 V-clamp

- 6 Gasket
- 7 Diesel exhaust fluid injector
- 8 Front mounting plate
- 9 Washer
- 10 Nut (M8)



### Information

The design of the diesel exhaust fluid injector and its installation method may vary depending on application.

Contact your nearest authorized Kohler service representative for up-to-date information about the installation method.

### Removal



### Information

Always make sure that dust is prevented from going into the system.



Fig. 268: Disconnecting electrical connector and diesel exhaust fluid lines

- Disconnect electrical connector **a** from the injector.
- Disconnect diesel exhaust fluid return line **b** from the injector.
- Disconnect diesel exhaust fluid inlet line **c** from the injector.





- Remove injector fixing nuts 10, and washers 9.
- Remove injector 7, and mounting plates 4, 8 together as an assembly.



### Information

Prevent top screw **2** from falling down.

- Remove screws 2.
- Remove front mounting plate **8** from injector assembly.

© 2022 by Kohler Co. All rights reserved. **KOHLER.** 

- Loosen v-clamp 5.
- Remove back mounting plate **4** from injector assembly.
- ▶ Discard injector 7, and gaskets 3, 6.

### Installation



### Information

Always make sure that dust is prevented from going into the system.



Fig. 270: Installing the injector

- Remove protective caps from new injector 7.
- ▶ Install new gasket 6 on injector 7.
- Assemble injector 7, and back mounting plate 4 with v-clamp 5.



### Information

Make sure that gasket 6 is located between back mounting plate 4 and injector 7.



Fig. 271: Aligning injector with v-clamp

- ▶ Align diesel exhaust fluid inlet line **c** with the center of v-clamp **5** opening.
- ▶ Tighten v-clamp nut to 3.7 Nm (3 ft-lb)-4 Nm (3 ft-lb).
- ▶ Install front mounting plate 8 on injector assembly.



Fig. 272: Installing top screw

- Apply high temperature grease to the threads of screws 2.
- ▶ Install top screw 2 on front mounting plate with nut 10, and washer 9.
- ▶ Install new gasket **3** at the back of injector assembly.



Fig. 273: Installing bottom screws

- ▶ Install screws 2 into the bottom slots of dosing cover 1.
- Install injector assembly by simultaneously sliding top screw 2 into the corresponding slot of dosing cover 1, and inserting bottom screws 2 through the corresponding bores of front mounting plate 8.



### Information

During installation, make sure that gasket **3** remains in place at the back of injector assembly.

- ▶ Tighten top nut **10** by hand.
- Push the injector assembly until back mounting plate 4 is completely inserted into dosing cover 1.
- ▶ Install nuts **10**, with washers **9** on bottom screws **2**.
- ► Tighten bottom nuts **10** by hand.
- ► Use a 0.13 mm (0.01 in) feeler gauge to confirm that the injector assembly is correctly installed.



### Information

The injector assembly is correctly installed when it is impossible to insert the feeler gauge between dosing cover **1** and back mounting plate **4**.

If the feeler gauge can be inserted between dosing cover **1** and back mounting plate **4**, loosen nuts **10**, then push the injector assembly further while retightening nuts **10**.

▶ Tighten nuts **10** to 17 Nm (13 ft-lb)-20 Nm (15 ft-lb).



Fig. 274: Connecting electrical connector and diesel exhaust fluid lines

- Connect diesel exhaust fluid inlet line **c** to the injector.
- Connect diesel exhaust fluid return line **b** to the injector.
- Connect electrical connector **a** to the injector.
- ▶ Run the system for 30 minutes to confirm leak-free operation.

### **Specific values**

Not applicable.

# **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

# 3.14.2 Diesel exhaust fluid pump removal and installation (SL2-5340)

### **Previous tasks**

Make sure that the following preconditions are met:

- □ Engine is switched off.
- Exhaust gas aftertreatment system is drained.
## Specific safety instructions



#### DANGER

Crushing, shearing or impact hazards by instable transportation conditions or losing control of the means of transport, load or loose part.

Loss of control of the load, of any loose part or means of transport will result in death or serious injury.

- Secure the means of transport.
- ► Use only adapted means of transport.
- ▶ Fix or remove any loose part on the load.
- ▶ Pay attention to the center of gravity and the total weight.
- Ensure the load against slipping and toppling.

## **Special tools**

Not applicable.

## **Consumables and equipment**

Not applicable.

#### **Overview**



- 1 Diesel exhaust fluid pump
- 2 Screw (M10)
- **3** Lifting hook
- 4 Connection (M22)

- **5** Connection (M26)
- 6 10-pin connector
- 7 48-pin connector

## Removal



#### Fig. 276: Securing pump

▶ Using lifting hooks **3**, secure pump **1** to a crane.



Fig. 277: Disconnecting connectors

Exhaust gas aftertreatment system (depending on configuration)



Fig. 278: Connector locking device - handling forbidden

▶ Disconnect 10-pin connector 6.



#### Information

It is forbidden to handle connector locking device **8** on the pump side. Only use the lock on the harness side to disconnect 10-pin connector **6**.

- ▶ Remove the fastening screws of 48-pin connector **7**.
- Disconnect 48-pin connector 7.
- ▶ Disconnect connectors 4, 5 of the diesel exhaust fluid lines.



#### Fig. 279: Removing screws

- Remove screws 2.
- Remove pump 1.

Exhaust gas aftertreatment system (depending on configuration)

## Installation

▶ Make sure that the door of pump **1** is securely locked.



#### Fig. 280: Installing pump

- ▶ Install pump **1** with screws **2**.
- ▶ Tighten screws **2** to 33 <sup>±3</sup> Nm (24 <sup>±2</sup> ft-lb).



Fig. 281: Connecting connectors

- Remove the shipping caps from pump **1** connections.
- Connect the diesel exhaust fluid lines to pump 1 with connectors 4, 5.
- ▶ Tighten connectors 4, 5 to 35<sup>±5</sup> Nm (26<sup>±4</sup> ft-lb).
- Connect 48-pin connector **7** to pump **1**.
- Tighten the fastening screws of 48-pin connector **7** to  $4^{\pm 0.5}$  Nm ( $3^{\pm 0}$  ft-lb).

Exhaust gas aftertreatment system (depending on configuration)



Fig. 282: Connector locking device - handling forbidden

Connect 10-pin connector **6** to pump **1**.



#### Information

It is forbidden to handle the connector locking device on the pump side.

Only use the lock on the harness side to connect 10-pin connector **6**.

▶ Run the system for 30 minutes to confirm successful priming and leak-free operation.

## **Specific values**

Not applicable.

## **Tightening specifications**

Refer to standard tightening torques. (For more information see: 5.3 Standard tightening torques, page 268.)

## 4 Tools and devices

## 4.1 Tools

## 4.1.1 Special tools

Special tool	Designation	Qty	Ident	KOHLER Ident number
11133437	Turning device	1	11133437	230611637
11343230	Locking device	1	11343230	230612868
11133371	Guiding rod M30x2 - Cylinder head	2	11133371	230610035
11133372	Guiding rod M28x2 - Damper	2	11133372	230610036
11133373	Guiding rod M24x2 - Intermediate gear	2	11133373	230610037

Special tool	Designation	Qty	Ident	KOHLER Ident number
11133374	Guiding rod M22x2 - Flywheel	2	11133374	230612869
11133375	Guiding rod M20 - Oil filter	2	11133375	230610038
11133376	Guiding rod M16 - Oil cooler support	2	11133376	230610039
11133377	Guiding rod M12 - Oil cooler	2	11133377	230610040
11133379	Guiding rod M10 - Exhaust line	2	11133379	230610041
12427300	Guiding rod M12 coolant pump	2	12427300	230610042
12465862	Guiding rod M12 Thermostat	2	12465862	230611638

Special tool	Designation	Qty	Ident	KOHLER Ident number
12217125	Pin for belt tensioner	1	12217125	230611639
	Frequency meter	1	12693396	230612870
12226280	Injector Extraction Tool	1	12226280	230611925
12226441	HP Fuel Pump Lifting Device	1	12226441	230612457
12588884	Power unit extracting and lifting device	1	12588884	230612871
	Injector Connector Torque Screwdriver	1	12691409	230612675
	Sampling Tube for each liquid sampling	1	7002475	230612676
	Handling bar	1	11344345	230612677
	Electric Torque Multiplier	1	12226986	230612678
	Torque Reaction Arm for Electric Torque Multiplier	1	12226968	230612679
	Manual Torque Multiplier	1	12227994	230612680
	Torque Reaction Arm for Manual Torque Multiplier		12227989	230612681
	Spare Battery pack	1	12226992	230612682
	Battery Charger 110V	1	12226970	230612683
	Battery Charger 230V	1	12226972	230612684
	Adapter	1	11343096	230612685

Special tool	Designation	Qty	Ident	KOHLER Ident number
11343242	Coolant Connector Pipe Tool	1	11343242	230612686
12588878	Cylinder head lifting device		12588878	230612865
12569852	Piston ring compressor		12569852	230613049

Tab. 52: Special tools

## 4.1.2 Turning device

## Safe handling of the turning device

The turning device is used to turn a gearwheel which drives the flywheel gear rim.

#### NOTICE

#### Risk of engine main failure by forgotten turning device

Keeping the turning device screwed on the flywheel housing while operating the engine will lead to a break of the turning device and to an engine main failure!

▶ Dismount immediately the turning device and mount the cover on the flywheel housing.



#### WARNING

**Risk of crushing, shearing, cutting or severing by use of the turning device** Using the turning device can lead to injuries to personnel working on the engine!

Before using the turning device, prevent the personnel in the vicinity of the engine and get confirmed they stand in a secure area.



#### WARNING

#### Risk of injuries by ejected tools or turning devices parts

Keeping the turning device screwed on the flywheel housing or the wrench tool on the turning device while operating the engine can lead to injuries by tool ejection or break of turning device!

- Check for spring function of the turning device. If faulty, replace by new turning device.
- Always take away the wrench tool from the turning device, after the flywheel has been turned.
- ▶ Dismount immediately the turning device and mount the cover on the flywheel housing.



#### Information

The wrench tool and the turning device are available for maintenance task only. Please contact your nearest authorized Kohler service representative.

### Mount the turning device



3

4

Cover

Screws (M16x25 - 8.8)

Fig. 302: Mounting the turning device

- **1** Screws (M16x35 8.8)
- 2 Turning device

To mount the turning device:

- Unscrew screws 4.
- Remove cover 3.
- Position turning device 2.
- Mount and tighten screws 1 according to standard torques values.



#### Information

For queries, please contact your nearest authorized Kohler service representative.

© 2022 by Kohler Co. All rights reserved.

## Use the turning device

□ The turning device is mounted on the engine.

Depending on the required setting:

- Engage a manual wrench tool to turn the wheel from the turning device which drives the flywheel gear rim.
- ▶ Turn the engine flywheel to the required position or as long needed by turning the wrench.
- ▶ Disengage the manual wrench each time you stop to turn.

At the end of the setting:

- ▶ Dismount the turning device and mount the cover on the flywheel housing.
- ▶ Tighten the turning device cover bolts according to standard torques values.

### Unmount the turning device



#### WARNING

Risk of injuries by ejected tools or turning devices parts. Keeping the turning device screwed on the flywheel housing could result in death or serious injuries by tool ejection or break of turning device.

▶ Dismount immediately the turning device and mount the cover on the flywheel housing.



Cover

Screws (M16x25 - 8.8)

3

Fig. 303: Unmount the turning device

- **1** Screws (M16x35 8.8)
- 2 Turning device

To dismount the turning device:

- Unscrew screws 1.
- Remove turning device **2**.
- Position cover 3.
- Mount and tighten screws **4** according to standard torques values.



#### Information

For queries, please contact your nearest authorized Kohler service representative.

## **5** Appendix

## 5.1 Technical design documents



#### Information

The technical design documents are specific to the delivered engine. Using those documents for other engines is forbidden. For inquiry, please contact your nearest authorized Kohler service representative.

# 5.2 Cleaning agents, thread-locking adhesives and greases

## 5.2.1 Cleaning agents, thread-locking adhesives and greases

This list includes all thread-locking adhesives and greases required for repair and maintenance tasks on the engine.

The application is described in the respective job specifications.



#### Information

Should a thread-locking adhesive be required, first clean, degrease, and dry the respective screw thread and threaded bore.

## Cleaning agents and thread-locking adhesives

Designation		Designation	Amount (g / fl-oz)	Supplier
Omniclean	or	Loctite 7063	500 / 16.9	Loctite
Loctite 243			250 / 8.4	Loctite
Loctite 270	or	Omnifit 200 M	250 / 8.4	Loctite
Loctite 577			250 / 8.4	Loctite
Loctite 648	or	Omnifit 230 M	250 / 8.4	Loctite
Loctite 5900			50 / 1.7	Loctite
Loctite 5910			300 / 10.1	Loctite

Tab. 53: Cleaning agents and thread-locking adhesives

Designation		Designation	Amount (g / fl-oz)	Supplier
Omnivisc 1050	or	Loctite 601, Reinzo- plast, Hylomar SQ32 / M	90 / 3.0	Loctite
Loctite 480			500 / 16.9	Loctite

Tab. 54: Cleaning agents and thread-locking adhesives

#### Greases

Designation	Amount (g / fl-oz)	Supplier
Molykote Longterm 2 Plus	1000 / 33.8	Molykote
Staburags NBU 30	1200 / 40.6	Kübler
Copper Paste; Motorex 14	850 / 28.7	Motorex
Optimol White T	100 / 3.4	Castrol

Tab. 55: Greases

## 5.3.1 Lubricant and threadlocker application rules

	Application method		Product
Lubricant		Apply lubricant under the screw head and on the first third of the thread.	MG = Molykote G-n-plus MW = Castrol Optimol paste white T MH = Molykote HSC O = Engine oil
Threadlocker		Apply threadlocker on the first third of the thread.	XX = Loctite 243 YY = Loctite 577

Tab. 56: Lubricant and threadlocker application rules

## 5.3.2 Screws pre-tightening, reuse, and marking

#### NOTICE

Property damage by improper pre-tightening, turning angle or reuse of screws or nuts. Improper pre-tightening, turning angle or reuse of screws or nuts could lead to the rupture of the screw or nut and lead to property damage by malfunction, ejection, fall or tilting of components.

- ▶ Respect the following pre-tightening, turning angle, reuse and marking specifications.
- In case of failure or damage, replace any threaded fastener immediately by the authorized personnel.



#### Information

The values of the pre-tightening torque and the turning angle are specified in the maintenance tasks.

Unless otherwise noted, use the standard torque values into the column of screws quality class "8.8" to tighten screws and bolts.

The screws quality classes "10.9" and "12.9" are always indicated with the "Nm" symbol.

## Pre-tightening torque and turning angle



Fig. 306: Pre-tightening marking and angles

- ▶ Tighten mounting bolt with the specified pre-tightening torque.
- ▶ Mark the specified turning angle on the screw head and on the component 1.



#### Information

One edge of hexagonal screw corresponds to 60°.

- On the socket key of the torque wrench 2, mark the initial position, aligned with the marking on the component.
- Use the torque wrench to tighten until the marking of the initial position is aligned with the marking on the component.
- Repeat process for the other screws, according to standard or described sequence.



#### Information

For every maintenance task, when a sequence is specified, achieve step 1 for all the sequence before starting step 2.



Fig. 307: Standard sequence for four, five, and six screws.

3

5

### Screws reuse



#### Information

Except components listed below, and otherwise noted,

Reuse screws as many times as no visible damage appears (thread, coating).

Replace screws with the same quality class as soon as damage appears (thread, coating).

For screws on:

- Main bearing
- Connecting rod
- Cylinder head
- Damper
- Flywheel
- Camshaft
- Trunnion mount
- Exhaust screws with copper coating
- ▶ Replace screws after each dismounting.

#### **Counterweight:**

▶ Untightening screws is forbidden.

#### Screw plugs:

▶ Replace screw plugs after each dismounting.

#### On fuel and HP injections pipes:

- ▶ Replace connections after first dismouting.
- ► Change connections after 3 tightenings.

#### For cutting rings:

- ▶ Replace connections after first dismouting.
- Change connections after 3 tightenings.





#### Information

Except components listed below, and otherwise noted,

• Marking on screws or nuts to track their reuse is not required.





Fig. 308: Examples of markings on screws and HP pipe nut

Some nuts and screws are marked to track their reuse:

- Fuel and HP injection pipes

- Cutting rings

If 2 punches appear:

▶ Replace pipe or system after each untightening.

If none or 1 punch appears:

► Add one punch after each untightening.

## 5.3.3 Standard torques for hexagonal / socket / flange screws and hexagonal / flange nuts



#### Information

Tolerances of the indicated tightening torques: 10%.

Values apply only to screws with coating and without lubricant.

For hexagonal screws in accordance with:

```
- ISO 4014
```

- ISO 4017

For socket screws in accordance with:

- ISO 4762

For flange screws in accordance with:

- EN 1665

For hexagonal nuts in accordance with:

- ISO 4032 / ISO 4034 / ISO 4035

For flange nuts in accordance with:

- EN 1664

Thread diam- eter	Quality class 8.8					Qual	ity class	10.9		
	Hexag- onal screw	Socket screw	Hexag- onal nut	Flange screw	Flange nut	Hexag- onal screw	Socket screw	Hexag- onal nut	Flange screw	Flange nut
		$-\frac{1}{2} \sum_{i=1}^{N} \frac{1}{i}$					$-\frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{i=1}^{n} \sum_{j=1}$			
M6	9 Nm 7 ft-lb				14 Nm 10 ft-lb					
M8	22 Nm 16 ft-lb					33 Nm 24 ft-lb				
M10	43 Nm 32 ft-lb				63 Nm 46 ft-lb					
M12	70 Nm 52 ft-lb			75 Nm 55 ft-lb		100 Nm 74 ft-lb		110 81 f	Nm t-lb	
M16	165 Nm 122 ft-lb			183 135	Nm ft-lb	240 Nm 177 ft-lb			270 Nm 199 ft-lb	

Thread diam- eter	Quality class	Quality class 8.8 Quality clas		
M20	320 Nm 236 ft-lb	358 Nm 264 ft-lb	470 Nm 347 ft-lb	525 Nm 387 ft-lb
M24	550 Nm 406 ft-lb	-	800 Nm 590 ft-lb	-
M30	1100 Nm 811 ft-lb	-	1600 Nm 1,180 ft-lb	-

Tab. 57: Standard torques for hexagonal / socket / flange screws and hexagonal / flange nuts, with coating without lubricant

## 5.3.4 Standard torques for internal drive pipe plug with conical thread



Fig. 319: Internal drive pipe plug with conical thread DIN 906



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).

Thread	Tightening torque	Thread	Tightening torque	Thread	Tightening torque
M 6 x 1	5 Nm 4 ft-lb <sup>ນ</sup>	M 14 x 1.5	57 Nm 42 ft-lb	M 20 x 1.5	98 Nm 72 ft-lb
M 8 x 1	12 Nm 9 ft-lb	M 16 x 1.5	68 Nm 50 ft-lb	M 36 x 1.5	280 Nm 207 ft-lb
M 10 x 1	18 Nm 13 ft-lb	M 18 x 1.5	87 Nm 64 ft-lb	M 48 x 1.5	280 Nm 207 ft-lb
M 12 x 1.5	30 Nm 22 ft-lb	-	-	-	-

Tab. 58: Standard torques for internal drive pipe plug with conical thread

<sup>1)</sup> Special tolerance: +0.5 mm (0.02 in)

## 5.3.5 Standard torques for screws according to DIN 7643, DIN 910, DIN 908

With copper sealing ring according to DIN 7603, for:

- Hollow screw for ring-type banjos according to DIN 7643
- Hexagon head screw plugs with collar Cylindrical thread according to DIN 910
- Internal drive screw plugs with collar Cylindrical thread according to DIN 908



Tab. 59: Hollow screw DIN 7643, Hexagon head screw DIN 910, Internal drive screw DIN 908



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).

Thread	Tightening torque	Thread	Tightening torque	Thread	Tightening torque
M 6 x 1	7 Nm 5 ft-lb	M 24 x 1.5	68 Nm 50 ft-lb	M 42 x 2	240 Nm 177 ft-lb
M 8 x 1	7.5 Nm 6 ft-lb	M 26 x 1.5	75 Nm 55 ft-lb	M 45 x 1.5	270 Nm 199 ft-lb
M 8 x 1.5	7.5 Nm 6 ft-lb	M 27 x 2	87 Nm 64 ft-lb	M 45 x 2	270 Nm 199 ft-lb
M 10 x 1	15 Nm 11 ft-lb	M 30 x 1.5	115 Nm 85 ft-lb	M 48 x 1.5	300 Nm 221 ft-lb
M 10 x 1.25	15 Nm 11 ft-lb	M 30 x 2	115 Nm 85 ft-lb	M 48 x 2	300 Nm 221 ft-lb
M 12 x 1.5	20 Nm 15 ft-lb	M 33 x 2	120 Nm 89 ft-lb	M 52 x 1.5	380 Nm 280 ft-lb
M 14 x 1.5	30 Nm 22 ft-lb	M 36 x 1.5	155 Nm 114 ft-lb	M 52 x 2	380 Nm 280 ft-lb
M 16 x 1.5	40 Nm 30 ft-lb	M 36 x 2	155 Nm 114 ft-lb	M 56 x 2	430 Nm 317 ft-lb
M 18 x 1.5	40 Nm 30 ft-lb	M 38 x 1.5	171 Nm 126 ft-lb	M 60 x 2	510 Nm 376 ft-lb
M 20 x 1.5	47 Nm 35 ft-lb	M 39 x 2	215 Nm 159 ft-lb	M 64 x 2	570 Nm 420 ft-lb
M 22 x 1.5	70 Nm 52 ft-lb	M 42 x 1.5	240 Nm 177 ft-lb	M 65 x 2	620 Nm 457 ft-lb

Tab. 60: Tightening torques for screws according to DIN 7643, DIN 910, DIN 908

## 5.3.6 Standard torques for flange joints



Fig. 323: Flange joints overview

## Standard torques for metric thread unions L series (up to 500 bar/ 7252 Psi) for steel and iron cast part

According to ISO 9974-2/3 / ISO 6149-2/3 / DIN 3852-1/2, metric threading.



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing	Form F with O-ring
M 10 x 1.0	9 Nm	18 Nm	18 Nm	15 Nm
	7 ft-lb	13 ft-lb	13 ft-lb	11 ft-lb
M 12 x 1.5	20 Nm	30 Nm	25 Nm	25 Nm
	15 ft-lb	22 ft-lb	18 ft-lb	18 ft-lb
M 14 x 1.5	35 Nm	45 Nm	45 Nm	35 Nm
	26 ft-lb	33 ft-lb	33 ft-lb	26 ft-lb
M 16 x 1.5	45 Nm	65 Nm	55 Nm	40 Nm
	33 ft-lb	48 ft-lb	41 ft-lb	30 ft-lb
M 18 x 1.5	55 Nm	80 Nm	70 Nm	45 Nm
	41 ft-lb	59 ft-lb	52 ft-lb	33 ft-lb
M 22 x 1.5	65 Nm	140 Nm	125 Nm	60 Nm
	48 ft-lb	103 ft-lb	92 ft-lb	44 ft-lb
M 26 x 1.5	90 Nm	190 Nm	180 Nm	100 Nm
	66 ft-lb	140 ft-lb	133 ft-lb	74 ft-lb
M 33 x 2.0	150 Nm	340 Nm	310 Nm	160 Nm
	111 ft-lb	251 ft-lb	229 ft-lb	118 ft-lb
M 42 x 2.0	240 Nm	500 Nm	450 Nm	210 Nm
	177 ft-lb	369 ft-lb	332 ft-lb	155 ft-lb
M 48 x 2.0	290 Nm	630 Nm	540 Nm	260 Nm
	214 ft-lb	465 ft-lb	398 ft-lb	192 ft-lb

Tab. 61: Standard torques for metric thread unions L series, for steel and iron cast part

## Standard torques for metric thread unions S series (up to 800 bar/ 11603 Psi) for steel and iron cast part

According to ISO 9974-2/3 / ISO 6149-2/3 / DIN 3852-1/2, metric threading.



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing	Form F with O-ring
M 10 x 1.0	/	/	23 Nm 17 ft-lb	/
M 12 x 1.5	20 Nm	35 Nm	35 Nm	35 Nm
	15 ft-lb	26 ft-lb	26 ft-lb	26 ft-lb
M 14 x 1.5	35 Nm	55 Nm	55 Nm	45 Nm
	26 ft-lb	41 ft-lb	41 ft-lb	33 ft-lb
M 16 x 1.5	45 Nm	70 Nm	70 Nm	55 Nm
	33 ft-lb	52 ft-lb	52 ft-lb	41 ft-lb
M 18 x 1.5	55 Nm	110 Nm	90 Nm	70 Nm
	41 ft-lb	81 ft-lb	66 ft-lb	52 ft-lb
M 20 x 1.5	55 Nm	150 Nm	125 Nm	80 Nm
	41 ft-lb	111 ft-lb	92 ft-lb	59 ft-lb
M 22 x 1.5	65 Nm	170 Nm	135 Nm	100 Nm
	48 ft-lb	125 ft-lb	100 ft-lb	74 ft-lb
M 27 x 2.0	90 Nm	270 Nm	180 Nm	170 Nm
	66 ft-lb	199 ft-lb	133 ft-lb	125 ft-lb
M 33 x 2.0	150 Nm	410 Nm	310 Nm	310 Nm
	111 ft-lb	302 ft-lb	229 ft-lb	229 ft-lb
M 42 x 2.0	240 Nm	540 Nm	450 Nm	330 Nm
	177 ft-lb	398 ft-lb	332 ft-lb	243 ft-lb
M 48 x 2.0	290 Nm	700 Nm	540 Nm	420 Nm
	214 ft-lb	516 ft-lb	398 ft-lb	310 ft-lb

Tab. 62: Standard torques for metric thread union S series, for steel and iron cast part

## Standard torques for imperial thread unions L series (up to 500 bar/7252 Psi) for steel and iron cast part

According to ISO1179-1 / DIN 3852-T2-Form X / DIN 3852-T3-Form X BSP threading.



#### Information

Tolerances of the indicated tightening torques: 10%. Always lubricate the thread before tightening these parts (engine oil).

## Appendix

Standard tightening torques

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing
G 1/8A	9 Nm	18 Nm	18 Nm
	7 ft-lb	13 ft-lb	13 ft-lb
G 1/4A	35 Nm	35 Nm	35 Nm
	26 ft-lb	26 ft-lb	26 ft-lb
G 1/4A	35 Nm	35 Nm	35 Nm
	26 ft-lb	26 ft-lb	26 ft-lb
G 3/8A	45 Nm	70 Nm	70 Nm
	33 ft-lb	52 ft-lb	52 ft-lb
G 1/2A	65 Nm	140 Nm	90 Nm
	48 ft-lb	103 ft-lb	66 ft-lb
G 1/2A	65 Nm	100 Nm	90 Nm
	48 ft-lb	74 ft-lb	66 ft-lb
G 3/4A	90 Nm	180 Nm	180 Nm
	66 ft-lb	133 ft-lb	133 ft-lb
G 1A	150 Nm	330 Nm	310 Nm
	111 ft-lb	243 ft-lb	229 ft-lb
G11/4A	240 Nm	540 Nm	450 Nm
	177 ft-lb	398 ft-lb	332 ft-lb
G11/2A	290 Nm	630 Nm	540 Nm
	214 ft-lb	465 ft-lb	398 ft-lb

Tab. 63: Standard torques for imperial thread unions L series, for steel and iron cast part

## Standard torques for imperial thread unions S series (up to 800 bar/11603 Psi) for steel and iron cast part

According to ISO1179-1 / DIN 3852-T2-Form X / DIN 3852-T3-Form X BSP threading.



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing
G 1/4A	35 Nm	55 Nm	40 Nm
	26 ft-lb	41 ft-lb	30 ft-lb
G 1/4A	35 Nm	55 Nm	40 Nm
	26 ft-lb	41 ft-lb	30 ft-lb
G 3/8A	45 Nm	90 Nm	80 Nm
	33 ft-lb	66 ft-lb	59 ft-lb
G 3/8A	45 Nm	90 Nm	80 Nm
	33 ft-lb	66 ft-lb	59 ft-lb
G 1/2A	65 Nm	150 Nm	115 Nm
	48 ft-lb	111 ft-lb	85 ft-lb
G 1/2A	65 Nm	130 Nm	115 Nm
	48 ft-lb	96 ft-lb	85 ft-lb

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing
G 3/4A	90 Nm	270 Nm	180 Nm
	66 ft-lb	199 ft-lb	133 ft-lb
G 1A	150 Nm	340 Nm	310 Nm
	111 ft-lb	251 ft-lb	229 ft-lb
<b>G 1 1/4</b> A	240 Nm	540 Nm	450 Nm
	177 ft-lb	398 ft-lb	332 ft-lb
G 1 1/2A	290 Nm	700 Nm	540 Nm
	214 ft-lb	516 ft-lb	398 ft-lb

Tab. 64: Standard torques for imperial thread union S series, for steel and iron cast part

## Standard torques for metric thread unions L series (up to 500 bar/ 7252 Psi) for aluminum

According to ISO 9974-2/3 / ISO 6149-2/3 / DIN 3852-1/2, metric threading.



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing	Form F with O-ring
M 10 x 1.0	7 Nm	14 Nm	14 Nm	12 Nm
	5 ft-lb	10 ft-lb	10 ft-lb	9 ft-lb
M 12 x 1.5	16 Nm	24 Nm	20 Nm	20 Nm
	12 ft-lb	18 ft-lb	15 ft-lb	15 ft-lb
M 14 x 1.5	28 Nm	36 Nm	36 Nm	28 Nm
	21 ft-lb	27 ft-lb	27 ft-lb	21 ft-lb
M 16 x 1.5	36 Nm	52 Nm	44 Nm	32 Nm
	27 ft-lb	38 ft-lb	32 ft-lb	24 ft-lb
M 18 x 1.5	44 Nm	64 Nm	56 Nm	36 Nm
	32 ft-lb	47 ft-lb	41 ft-lb	27 ft-lb
M 22 x 1.5	52 Nm	112 Nm	100 Nm	48 Nm
	38 ft-lb	83 ft-lb	74 ft-lb	35 ft-lb
M 26 x 1.5	72 Nm	152 Nm	144 Nm	80 Nm
	53 ft-lb	112 ft-lb	106 ft-lb	59 ft-lb
M 33 x 2.0	120 Nm	272 Nm	248 Nm	128 Nm
	89 ft-lb	201 ft-lb	183 ft-lb	94 ft-lb
M 42 x 2.0	192 Nm	400 Nm	360 Nm	168 Nm
	142 ft-lb	295 ft-lb	266 ft-lb	124 ft-lb
M 48 x 2.0	232 Nm	504 Nm	432 Nm	208 Nm
	171 ft-lb	372 ft-lb	319 ft-lb	153 ft-lb

Tab. 65: Standard torques for metric thread unions L series, for aluminium – see figure above

© 2022 by Kohler Co. All rights reserved.

## Standard torques for metric thread unions S series (up to 800 bar/ 11603 Psi) for aluminum

According to ISO 9974-2/3 / ISO 6149-2/3 / DIN 3852-1/2, metric threading.



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing	Form F with O-ring
M 10 x 1.0	-	-	19 Nm 14 ft-lb	-
M 12 x 1.5	16 Nm	28 Nm	32 Nm	28 Nm
	12 ft-lb	21 ft-lb	24 ft-lb	21 ft-lb
M 14 x 1.5	28 Nm	44 Nm	32 Nm	36 Nm
	21 ft-lb	32 ft-lb	24 ft-lb	27 ft-lb
M 16 x 1.5	36 Nm	56 Nm	56 Nm	44 Nm
	27 ft-lb	41 ft-lb	41 ft-lb	32 ft-lb
M 18 x 1.5	44 Nm	88 Nm	72 Nm	56 Nm
	32 ft-lb	65 ft-lb	53 ft-lb	41 ft-lb
M 20 x 1.5	44 Nm	120 Nm	100 Nm	64 Nm
	32 ft-lb	89 ft-lb	74 ft-lb	47 ft-lb
M 22 x 1.5	52 Nm	136 Nm	108 Nm	100 Nm
	38 ft-lb	100 ft-lb	80 ft-lb	74 ft-lb
M 27 x 2.0	72 Nm	216 Nm	144 Nm	136 Nm
	53 ft-lb	159 ft-lb	106 ft-lb	100 ft-lb
M 33 x 2.0	120 Nm	328 Nm	248 Nm	248 Nm
	89 ft-lb	242 ft-lb	183 ft-lb	183 ft-lb
M 42 x 2.0	192 Nm	432 Nm	360 Nm	264 Nm
	142 ft-lb	319 ft-lb	266 ft-lb	195 ft-lb
M 48 x 2.0	232 Nm	560 Nm	432 Nm	336 Nm
	171 ft-lb	413 ft-lb	319 ft-lb	248 ft-lb

Tab. 66: Standard torques for metric thread unions S series, for aluminium - see figure above

## Standard torques for imperial thread unions L series (up to 500 bar/7252 Psi) for aluminium

According to ISO1179-1 / DIN 3852-T2-Form X / DIN 3852-T3-Form X BSP threading.

#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing
G 1/8A	7 Nm	14 Nm	14 Nm
	5 ft-lb	10 ft-lb	10 ft-lb
G 1/4A	28 Nm	28 Nm	28 Nm
	21 ft-lb	21 ft-lb	21 ft-lb
G 1/4A	28 Nm	28 Nm	28 Nm
	21 ft-lb	21 ft-lb	21 ft-lb
G 3/8A	36 Nm	56 Nm	56 Nm
	27 ft-lb	41 ft-lb	41 ft-lb
G 1/2A	52 Nm	112 Nm	72 Nm
	38 ft-lb	83 ft-lb	53 ft-lb
G 1/2A	52 Nm	80 Nm	72 Nm
	38 ft-lb	59 ft-lb	53 ft-lb
G 3/4A	72 Nm	144 Nm	144 Nm
	53 ft-lb	106 ft-lb	106 ft-lb
G 1A	120 Nm	264 Nm	248 Nm
	89 ft-lb	195 ft-lb	183 ft-lb
G11/4A	192 Nm	432 Nm	360 Nm
	142 ft-lb	319 ft-lb	266 ft-lb
G 1 1/2A	232 Nm	504 Nm	432 Nm
	171 ft-lb	372 ft-lb	319 ft-lb

Tab. 67: Standard torques for imperial thread unions L series, for aluminium – see figure above

## Standard torques for imperial thread unions S series (up to 800 bar/11603 Psi) for aluminium

According to ISO1179-1 / DIN 3852-T2-Form X / DIN 3852-T3-Form X BSP threading.



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing
G 1/8A	29 Nm	45 Nm	45 Nm
	21 ft-lb	33 ft-lb	33 ft-lb
G 1/4A	28 Nm	44 Nm	32 Nm
	21 ft-lb	32 ft-lb	24 ft-lb
G 1/4A	28 Nm	44 Nm	32 Nm
	21 ft-lb	32 ft-lb	24 ft-lb
G 3/8A	36 Nm	72 Nm	64 Nm
	27 ft-lb	53 ft-lb	47 ft-lb
G 1/2A	52 Nm	120 Nm	92 Nm
	38 ft-lb	89 ft-lb	68 ft-lb
G 1/2A	52 Nm	104 Nm	92 Nm
	38 ft-lb	77 ft-lb	68 ft-lb

© 2022 by Kohler Co. All rights reserved.

Thread Y	Form A with sealing edge	Form B with sealing ring	Form E with flat sealing
G 3/4A	72 Nm	216 Nm	144 Nm
	53 ft-lb	159 ft-lb	106 ft-lb
G 1A	120 Nm	272 Nm	248 Nm
	89 ft-lb	201 ft-lb	183 ft-lb
<b>G 1 1/4</b> A	192 Nm	432 Nm	360 Nm
	142 ft-lb	319 ft-lb	266 ft-lb
G11/2A	232 Nm	560 Nm	432 Nm
	171 ft-lb	413 ft-lb	319 ft-lb

Tab. 68: Standard torques for imperial thread union S series, for aluminium – see figure above

## 5.3.7 Assembling pipes with cutting rings



Fig. 324: Cutting ring lubrication



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).



Fig. 325: Cutting ring tightening



#### Information

- To assemble pipes with cutting rings, observe the following steps:
- Assemble pipe tension free. Mount support clamp after pipe assembling.
- ▶ When tightening nut **A**, make sure connector **B** does not rotate.
- ▶ Tighten nut A by hand until the resisting point.
- ▶ Tighten nut **A** a further 90°.
- ▶ Tighten all pipe support clamps if necessary.

Alternatively, refer to the following table for tightening sequence of nut A:

Size	Equivalent specification	Size	Equivalent specification
06L	14 Nm (10 ft-lb) + 90°	06S	20 Nm (15 ft-lb) + 90°
08L	20 Nm (15 ft-lb) + 90°	08S	24 Nm (18 ft-lb) + 90°
10L	26 Nm (19 ft-lb) + 90°	10S	34 Nm (25 ft-lb) + 90°
12L	30 Nm (22 ft-lb) + 90°	12S	36 Nm (27 ft-lb) + 90°
15L	50 Nm (37 ft-lb) + 90°	14S	58 Nm (43 ft-lb) + 90°
18L	82 Nm (60 ft-lb) + 90°	16S	70 Nm (52 ft-lb) + 90°
22L	120 Nm (89 ft-lb) + 90°	20S	130 Nm (96 ft-lb) + 90°
28L	95 Nm (70 ft-lb) + 90°	25S	120 Nm (89 ft-lb) + 90°
35L	190 Nm (140 ft-lb) + 90°	30S	165 Nm (122 ft-lb) + 90°
42L	310 Nm (229 ft-lb) + 90°	38S	325 Nm (240 ft-lb) + 90°

Tab. 69: Alternative tightening torques for cutting ring flange joints

## 5.3.8 Standard torques for triple lock flange joints



Fig. 326: Triple lock flange joints

Serie	Pipe diam. X		Thread Z	Tightening torque	
	mm	inch	UN/UNF	Steel	Stainless steel
4	6	1/4	7/17-20	15 Nm 11 ft-lb	30 Nm 22 ft-lb
5	8	5/16	1/2-20	20 Nm 15 ft-lb	40 Nm 30 ft-lb
6	10	3/8	9/16-18	30 Nm 22 ft-lb	60 Nm 44 ft-lb
8	12	1/2	3/4-16	60 Nm 44 ft-lb	115 Nm 85 ft-lb

### Appendix

Standard tightening torques

Serie	Pipe diam. X		Thread Z	Tighten	ing torque
	mm	inch	UN/UNF	Steel	Stainless steel
10	14, 15, 16	5/8	7/8-14	75 Nm 55 ft-lb	145 Nm 107 ft-lb
12	18, 20	3/4	1 1/16-12	110 Nm 81 ft-lb	180 Nm 133 ft-lb
16	22	7/8	1 5/16-12	135 Nm 100 ft-lb	225 Nm 166 ft-lb
16	25	1	1 5/16-12	175 Nm 129 ft-lb	255 Nm 188 ft-lb
	28		1 5/8-12	260 Nm 192 ft-lb	295 Nm 218 ft-lb
20	30, 32	11/4	1 5/8-12	260 Nm 192 ft-lb	295 Nm 218 ft-lb
	35		1 7/8-12	340 Nm 251 ft-lb	345 Nm 254 ft-lb
24	38	11/2	1 7/8-12	340 Nm 251 ft-lb	345 Nm 254 ft-lb
28	42		2 1/4-12	380 Nm 280 ft-lb	400 Nm 295 ft-lb
32		2	2 1/2-12	450 Nm 332 ft-lb	470 Nm 347 ft-lb

Tab. 70: Standard torques for triple lock flange joints



#### Information

To tighten the screwed socket:

- ► Hold screwed socket instead.
- ▶ Unscrew union nut until noticeable resistance (without wrench extension).
- ▶ Tighten union nut according to torque above.

#### 5.3.9 Standard torques for VSTI screw plugs for steel and iron cast part

According to DIN EN ISO 6149-2 / ISO 11926-2, metric threading.



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).



Fig. 327: VSTI screw plugs with ED seal (left), with o-ring (right)

Size	Tightening torque		Size	Tighteni	ng torque
	<sup>1)</sup> VSTI ED	VSTI o-ring		<sup>1)</sup> VSTI ED	VSTI o-ring
M8x1	10 Nm 7 ft-lb	10 Nm 7 ft-lb	G 1/8	13 Nm 10 ft-lb	-
M10x1	12 Nm 9 ft-lb	20 Nm 15 ft-lb	G 1/4	30 Nm 22 ft-lb	-
M12x1.5	25 Nm 18 ft-lb	35 Nm 26 ft-lb	G 3/8	60 Nm 44 ft-lb	-
M14x1.5	35 Nm 26 ft-lb	45 Nm 33 ft-lb	G 1/2	80 Nm 59 ft-lb	-
M16x1.5	50 Nm 37 ft-lb	55 Nm 41 ft-lb	G 3/4	140 Nm 103 ft-lb	-
M18x1.5	65 Nm 48 ft-lb	70 Nm 52 ft-lb	G 1	200 Nm 148 ft-lb	-
M20x1.5	75 Nm 55 ft-lb	80 Nm 59 ft-lb	G 1 1/4	400 Nm 295 ft-lb	-
M22x1.5	90 Nm 66 ft-lb	100 Nm 74 ft-lb	G 1 1/2	450 Nm 332 ft-lb	-
M24x1.5	90 Nm 66 ft-lb	-	-	-	-
M26x1.5	125 Nm 92 ft-lb	-	3/4-16 UNF	70 Nm 52 ft-lb	-
M30x1.5	240 Nm 177 ft-lb	-	7/8-1/4 UNF	100 Nm 74 ft-lb	-
M27x2	130 Nm 96 ft-lb	170 Nm 125 ft-lb	R 3/4"	140 Nm 103 ft-lb	120 Nm 89 ft-lb
M30x2	-	215 Nm 159 ft-lb	-	-	-
M33x2	225 Nm 166 ft-lb	310 Nm 229 ft-lb	-	-	-
M42x2	360 Nm 266 ft-lb	330 Nm 243 ft-lb	-	-	-
M48x2	360 Nm 266 ft-lb	420 Nm 310 ft-lb	-	-	-
M60x2	-	500 Nm 369 ft-lb	-	-	-

Tab. 71: VSTI screw plug tightening torques for steel and iron cast parts

<sup>1)</sup> Do not use hydropneumatic screwdriver.

## 5.3.10 Standard torques for VSTI screw plugs for aluminium

According to DIN EN ISO 6149-2 / ISO 11926-2, metric threading.



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).



Fig. 328: VSTI screw plugs with ED seal (left), with o-ring (right)

Size	Tighteniı	ng torque	Size	Tightenii	ng torque
	<sup>1)</sup> VSTI ED	VSTI o-ring		<sup>1)</sup> VSTI ED	VSTI o-ring
M8x1	8 Nm 6 ft-lb	8 Nm 6 ft-lb	G 1/8	10 Nm 7 ft-lb	-
M10x1	10 Nm 7 ft-lb	16 Nm 12 ft-lb	G 1/4	25 Nm 18 ft-lb	-
M12x1.5	20 Nm 15 ft-lb	28 Nm 21 ft-lb	G 3/8	50 Nm 37 ft-lb	-
M14x1.5	28 Nm 21 ft-lb	36 Nm 27 ft-lb	G 1/2	65 Nm 48 ft-lb	-
M16x1.5	40 Nm 30 ft-lb	44 Nm 32 ft-lb	G 3/4	112 Nm 83 ft-lb	-
M18x1.5	52 Nm 38 ft-lb	56 Nm 41 ft-lb	G 1	160 Nm 118 ft-lb	-
M20x1.5	60 Nm 44 ft-lb	64 Nm 47 ft-lb	G 1 1/4	320 Nm 236 ft-lb	-
M22x1.5	72 Nm 53 ft-lb	80 Nm 59 ft-lb	G 1 1/2	360 Nm 266 ft-lb	-
M24x1.5	72 Nm 53 ft-lb	-	-	-	-
M26x1.5	100 Nm 74 ft-lb	-	3/4-16 UNF	56 Nm 41 ft-lb	-
M30x1.5	192 Nm 142 ft-lb	-	7/8-1/4 UNF	80 Nm 59 ft-lb	-
M27x2	105 Nm 77 ft-lb	135 Nm 100 ft-lb	R 3/4"	112 Nm 83 ft-lb	96 Nm 71 ft-lb
M30x2	-	172 Nm 127 ft-lb	-	-	-
M33x2	180 Nm 133 ft-lb	250 Nm 184 ft-lb	-	-	-
M42x2	290 Nm 214 ft-lb	265 Nm 195 ft-lb	-	-	-
M48x2	290 Nm 214 ft-lb	335 Nm 247 ft-lb	-	-	-

Size	Tightening torque		Size	Tighteniı	ng torque
	<sup>1)</sup> VSTI ED	VSTI o-ring		<sup>1)</sup> VSTI ED	VSTI o-ring
M60x2	-	400 Nm 295 ft-lb	-	-	-

Tab. 72: VSTI screw plug tightening torques for aluminium parts

<sup>1)</sup> Do not use hydropneumatic screwdriver.

## 5.3.11 Assembling pipes with DKO connectors (EL, ET, EW, GZ, GZR, RED)



Fig. 329: DKO connector



Fig. 330: DKO connector lubrication



#### Information

Tolerances of the indicated tightening torques: 10%.

Always lubricate the thread before tightening these parts (engine oil).



#### Information

To assemble pipes with DKO connectors:

- When tightening the nut, make sure that the connector does not rotate.
- ▶ Tighten the nut by hand.
- ▶ Hold a wrench as close as possible to the nut.
- ▶ Tighten the nut with the wrench until the resisting point.
- ▶ Tighten the nut a further 90°.

Alternatively, refer to the following table for tightening sequence of the nut:

Size	Equivalent specification	Size	Equivalent specification
06L	20 Nm 15 ft-lb	06S	25 Nm 18 ft-lb
08L	30 Nm 22 ft-lb	08S	40 Nm 30 ft-lb

Size	Equivalent specification	Size	Equivalent specification
10L	40 Nm 30 ft-lb	10S	50 Nm 37 ft-lb
12L	50 Nm 37 ft-lb	12S	60 Nm 44 ft-lb
15L	70 Nm 52 ft-lb	14S	75 Nm 55 ft-lb
18L	90 Nm 66 ft-lb	16S	85 Nm 63 ft-lb
22L	120 Nm 89 ft-lb	20S	140 Nm 103 ft-lb
28L	160 Nm 118 ft-lb	25S	190 Nm 140 ft-lb
35L	250 Nm 184 ft-lb	30S	270 Nm 199 ft-lb
42L	380 Nm 280 ft-lb	385	400 Nm 295 ft-lb

Tab. 73: Alternative tightening torques for DKO connectors

## 5.3.12 Standard torques for collar clamps



Fig. 331: Collar clamp

Band width	Tightening torque
18 mm	4 Nm
0.71 in	3 ft-lb
20 mm	7 Nm
0.79 in	5 ft-lb
25 mm	12 Nm
0.98 in	9 ft-lb
30 mm	30 Nm
1.18 in	22 ft-lb

Tab. 74: Tightening torques for collar clamps according to DIN 3017-3

## 5.3.13 Standard torques for pipe clamps according to DIN 3015



Fig. 332: Pipe clamps

Sorioo	Dimen-	External diameter of nine 7	Tightening torque according to material marking of clamp 2		
561165	sion	screw 1	External diameter of pipe 5	PP (polypropy- lene)	PA (polyamid)
Light (DIN 3015-1)	All	M6	All	8 Nm 6 ft-lb	10 Nm 7 ft-lb
1 2 3	1	M10	6 mm (0.24 in)-18 mm (0.71 in)	12 Nm 9 ft-lb	20 Nm 15 ft-lb
	2		19 mm (0.75 in)-30 mm (1.18 in)	12 Nm 9 ft-lb	20 Nm 15 ft-lb
	3	-	30 mm (1.18 in)-42 mm (1.65 in)	15 Nm 11 ft-lb	25 Nm 18 ft-lb
Heavy	4	M12	38 mm (1.5 in)-66 mm (2.6 in)	30 Nm 22 ft-lb	40 Nm 30 ft-lb
3015-2)	5	M16	70 mm (2.76 in)-90 mm (3.54 in)	45 Nm 33 ft-lb	55 Nm 41 ft-lb
	6	M20	90 mm (3.54 in)-127 mm (5 in)	80 Nm 59 ft-lb	150 Nm 111 ft-lb
	7	M24	127 mm (5 in)-168 mm (6.61 in)	110 Nm 81 ft-lb	200 Nm 148 ft-lb
	8	M30	168 mm (6.61 in)-220 mm (8.66 in)	180 Nm 133 ft-lb	350 Nm 258 ft-lb

Tab. 75: Tightening torques for pipe clamps according to DIN 3015

© 2022 by Kohler Co. All rights reserved.

## 5.4 Abbreviations - Acronyms

To ensure consistency, we kept the abbreviations and acronyms in English in all translated versions of this document. The following tables include their translations in the targeted language of the manual.

Abbr.	Designation	Translation
AC	Alternating Current	Alternating Current
BDC	Bottom Dead Center	Bottom Dead Center
CAN	Controller Area Network	Controller Area Network
CCS	Counter Coupling Side = Damper side	Counter Coupling Side = Damper side
CR	Common Rail	Common Rail
CS	Coupling Side = Flywheel side	Coupling Side = Flywheel side
DC	Direct Current	Direct Current
DE	Driving End	Driving End
EATS	Exhaust Gas Aftertreatment System	Exhaust Gas Aftertreatment System
ECU	Engine Control Unit	Engine Control Unit
EMC	Electromagnetic Compatibility	Electromagnetic Compatibility
EPDM	Ethylene-Propylene-Diene Monomer	Ethylene-Propylene-Diene Monomer
FE	Free End	Free End
HFRR	High Frequency Reciprocating Rig – Meas- ured value for the lubricity of diesel fuels	High Frequency Reciprocating Rig – Meas- ured value for the lubricity of diesel fuels
HP	High Pressure	High Pressure
HT	High Temperature	High Temperature
LOTO	Lockout/tagout	Lockout/tagout
LP	Low Pressure	Low Pressure
LT	Low Temperature	Low Temperature
OMM	Operation and Maintenance Manual	Operation and Maintenance Manual
PCV	Pressure Control Valve	Pressure Control Valve
PPE	Personal Protective Equipment	Personal Protective Equipment
PTO	Power Take-Off	Power Take-Off
SAPS	Sulphated Ash, Phosphorus, and Sulfur	Sulphated Ash, Phosphorus, and Sulfur
SRM	Service and Repair Manual	Service and Repair Manual
TDC	Top Dead Center	Top Dead Center
VCV	Volume Control Valve	Volume Control Valve

Tab. 76: Abbreviations table

Acronym	Designation	Translation	
ANSI	American National Standards Institute	American National Standards Institute	
Acronym	Designation	Translation	
---------	--	--	
DIN	German standard	German standard	
EN	European standard	European Standard	
EU	European Union	European Union	
ILO	International Labor Organization	International Labor Organization	
ISCED	International Standard Classification of Education	International Standard Classification of Education	
SAE	Society of Automotive Engineers	Society of Automative Engineers	
WHO	World Health Organization	World Health Organization	

Tab. 77: Acronyms table

# 5.5 Unit conversion tables

Use the following tables to convert units used in this guideline. Suitable number of decimals are used for inaccurate conversion factor.

# 5.5.1 Length conversion factors

Convert from	То	Multiply by
mm	in	0.0394
mm	ft	0.00328
μm	th	0.0394

Tab. 78: Length conversion factors

#### 5.5.2 Mass conversion factors

Convert from	То	Multiply by
kg	lb	2.205
kg	OZ	35.274

Tab. 79: Mass conversion factors

#### 5.5.3 Pressure conversion factors

Convert from	То	Multiply by
kPa	psi (lbf/in²)	0.145
kPa	lbf/ft²	20.885
kPa	inch H2O	4.015
kPa	foot H2O	0.335
kPa	mm H2O	101.972

Tab. 80: Pressure conversion factors

## 5.5.4 Volume conversion factors

Convert from	То	Multiply by
m <sup>3</sup>	in³	61023.744
m³	ft³	35.315
m³	Imperial gallon	219.969
m <sup>3</sup>	US gallon	264.172
m <sup>3</sup>	l (liter)	1000

Tab. 81: Volume conversion factors

## 5.5.5 Power conversion factors

Convert from	То	Multiply by
kW	hp (metric)	1.360
kW	US hp	1.341

Tab. 82: Power conversion factors

#### **5.5.6** Moment of inertia and torque conversion factors

Convert from	То	Multiply by
kgm²	lbft²	23.730
kNm	lbf ft	737.562

Tab. 83: Moment of inertia and torque conversion factors

#### 5.5.7 Factors of fuel consumption conversion

Convert from	То	Multiply by
g/kWh	g/hph	0.736
g/kWh	lb/hph	0.00162

Tab. 84: Factors of fuel consumption conversion

#### 5.5.8 Flow conversion factors

Convert from	То	Multiply by
m³∕h (liquid)	US gallon/min	4.403
m³∕h (gas)	ft³/min	0.586

Tab. 85: Flow conversion factors

## **5.5.9** Temperature conversion factors

Convert from	То	Multiply by
٦°	°F	F = 9/5*C + 32
۵°	К	K = C + 273.15

Tab. 86: Temperature conversion factors

#### 5.5.10 Density conversion factors

Convert from	То	Multiply by
Kg/m³	lb/US gallon	0.00834
Kg/m³	lb/imperial gallon	0.01002

Unit conversion tables

Convert from	То	Multiply by
Kg/m³	lb∕ft³	0.0624

Tab. 87: Density conversion factors

## 5.5.11 Length conversion factors

Convert from	То	Multiply by
mm	in	0.0394
mm	ft	0.00328
μm	th	0.0394

Tab. 88: Length conversion factors table

#### 5.5.12 Mass conversion factors

Convert from	То	Multiply by
kg	lb	2.205
kg	OZ	35.274

Tab. 89: Mass conversion factors table

#### 5.5.13 Pressure conversion factors

Convert from	То	Multiply by
kPa	psi (lbf/in²)	0.145
kPa	lbf/ft²	20.885
kPa	inch H2O	4.015
kPa	foot H2O	0.335
kPa	mm H2O	101.972

Tab. 90: Pressure conversion factors table

# 5.5.14 Volume conversion factors

Convert from	То	Multiply by
m <sup>3</sup>	in³	61023.744
m <sup>3</sup>	ft³	35.315
m <sup>3</sup>	Imperial gallon	219.969
m <sup>3</sup>	US gallon	264.172
m <sup>3</sup>	l (liter)	1000

Tab. 91: Volume conversion factors table

## 5.5.15 Power conversion factors

Convert from	То	Multiply by
kW	hp (metric)	1.360
kW	US hp	1.341

Tab. 92: Power conversion factors table

#### **5.5.16** Moment of inertia and torque conversion factors

Convert from	То	Multiply by
kgm²	lbft <sup>2</sup>	23.730
kNm	lbf ft	737.562

Tab. 93: Moment of inertia and torque conversion factors table

#### 5.5.17 Fuel consumption conversion factors

Convert from	То	Multiply by
g/kWh	g/hph	0.736
g/kWh	lb/hph	0.00162

Tab. 94: Fuel consumption conversion factors table

#### 5.5.18 Flow conversion factors

Convert from	То	Multiply by
m³∕h (liquid)	US gallon/min	4.403
m³∕h (gas)	ft³/min	0.586

Tab. 95: Flow conversion factors table

## **5.5.19** Temperature conversion factors

Convert from	То	Multiply by
°C	°F	F = 9/5*C + 32
٥C	К	K = C + 273.15

Tab. 96: Temperature conversion factors table

#### 5.5.20 Density conversion factors

Convert from	То	Multiply by
Kg/m³	lb/US gallon	0.00834
Kg/m³	lb/imperial gallon	0.01002

Appendix Unit conversion tables

Convert from	То	Multiply by
Kg/m³	lb∕ft³	0.0624

Tab. 97: Density conversion factors table

# 5.6 Prefix

Name	Symbol	Factor
tera	Т	1012
giga	G	10°
mega	М	106
kilo	k	103
milli	m	10-3
micro	μ	10-6
nano	n	10.9

Tab. 98: Common prefix multipliers table

# 33525088601\_8\_1 EN\_US 2022-09

LHID12566187 © 2022 by Kohler Co. All rights reserved.