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Distribution list Jenbach, Subsidiaries, Service Providers		Andreas FRÖHLICH Service Engineering GE Jenbacher GmbH & Co OG Achenseestr. 1-3 A-6200 Jenbach, Austria T +43 5244 600 3385 andreas.froehlich@ge.com
Service Technician Instruction	ST-142	22 April 2015

Engine type **J420 – 1800rpm**

Subject **Gear train**
Upgrading to the new version

The purpose of Service Technician Instruction ST-142 is to explain how to upgrade to the enhanced version of the gear train.

AFFECTED ENGINES / SCOPE OF THIS BULLETIN

The content of this instruction applies to Type J420 engines, versions (A/B/C) 81, 82, 85 and 86, which are operated at a speed of 1800 rpm.

On these engines a proactive upgrade to the enhanced version of the gear train needs to be carried out, if one of the 3 criteria below applies:

1. The upgrade is recommended proactively at next minor maintenance if the engine has less than 30.000 operating hours. → See Table 01:
 - a. Landfill Gas/Biogas Engines Minor Maintenance at 20 & 40k OPH
 - b. Natural Gas Engines Minor Maintenance at 30k OPH
2. The upgrade is required according to the gear train inspection specified in ST-136
3. GEJ approval for engine upgrade

The following Maintenance Table 01 describes how the implementation of the upgrade is related to the engine operating hours:

Engine Version	Type of Gas	Maintenance Interval	Engine Operating Hours ⇒ Upgrade at Overhaul		
			<20k ⇒ 20k overhaul*	20-30k ⇒ 40k overhaul **	>30k ⇒ no Upgrade
A/B/C-81	Landfill Gas/Biogas	20/40/60k	<20k ⇒ 20k overhaul*	20-30k ⇒ 40k overhaul **	>30k ⇒ no Upgrade
A/B/C-82	Landfill Gas/Biogas	20/40/60k	<20k ⇒ 20k overhaul *	20-30k ⇒ 40k overhaul **	>30k ⇒ no Upgrade
A/B/C-85	Natural Gas	30/60k	<30k ⇒ 30k overhaul		>30k ⇒ no Upgrade
A/B/C-86	Natural Gas	30/60k	<30k ⇒ 30k overhaul		>30k ⇒ no Upgrade

Table 01: upgrade interval for specific engine versions

*if the engine has less than 20.000 operating hours ⇒ the upgrade needs to be carried out at the 20k overhaul

**if the engine operating hours are between 20.000 – 30.000 ⇒ the upgrade needs to be carried out at the 40k overhaul

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SITUATION

The upgrade is used as an additional lubrication in the contact zone at the small idler gear. The oil passes from the clean oil gallery the welded cooling oil nozzle and hits the contact zone between camshaft gear and small idler gear.

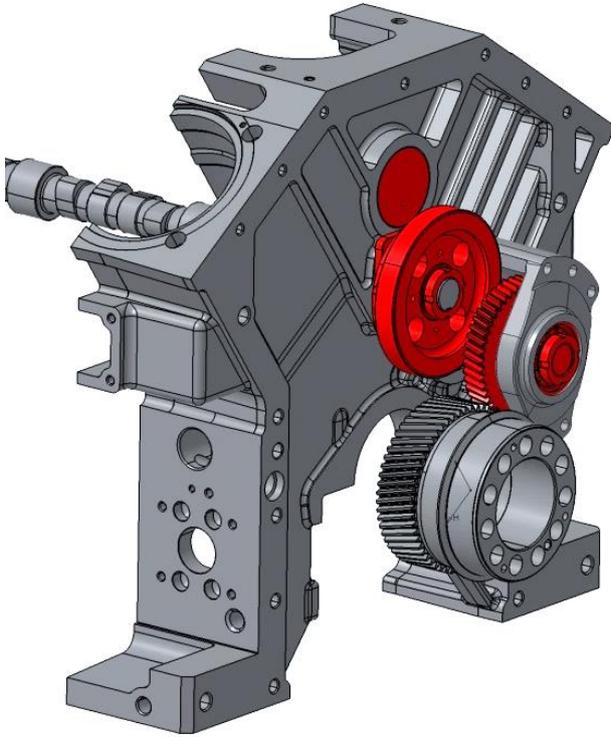


fig. 1: overview previous design

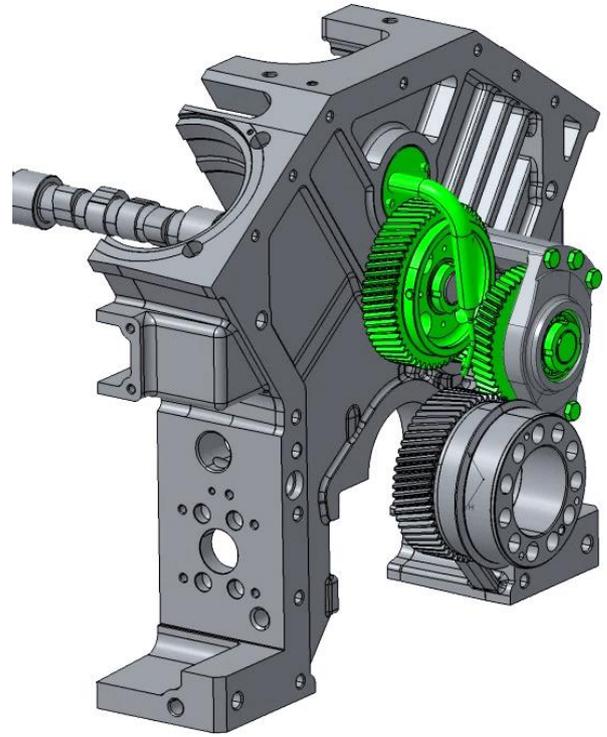


fig. 2: overview enhanced design (upgraded parts in green)

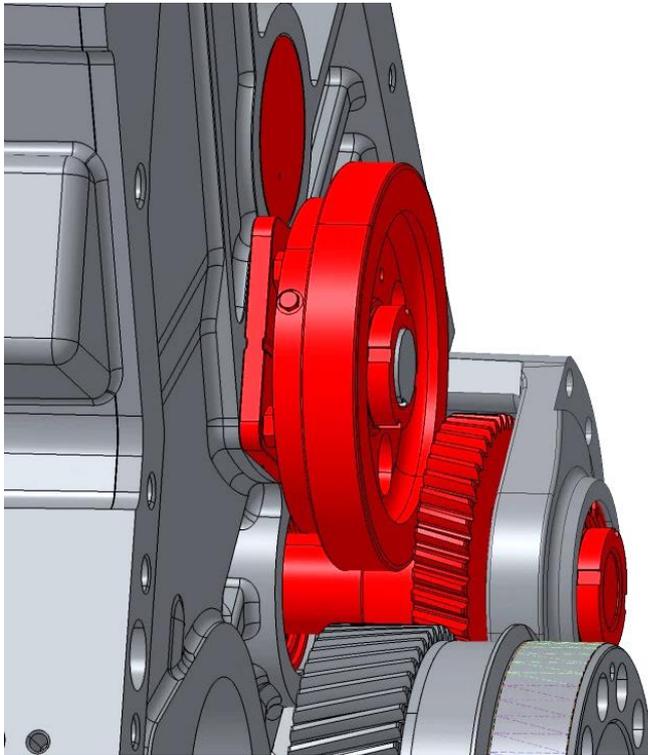


fig. 3: previous design in detail

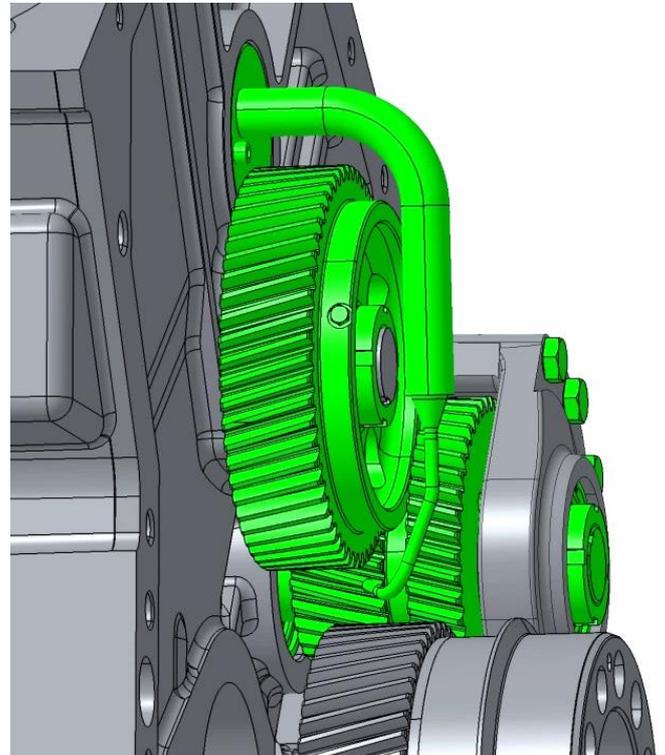


fig. 4: enhanced design in detail



MODIFICATION CRANKCASE AND GEAR TRAIN

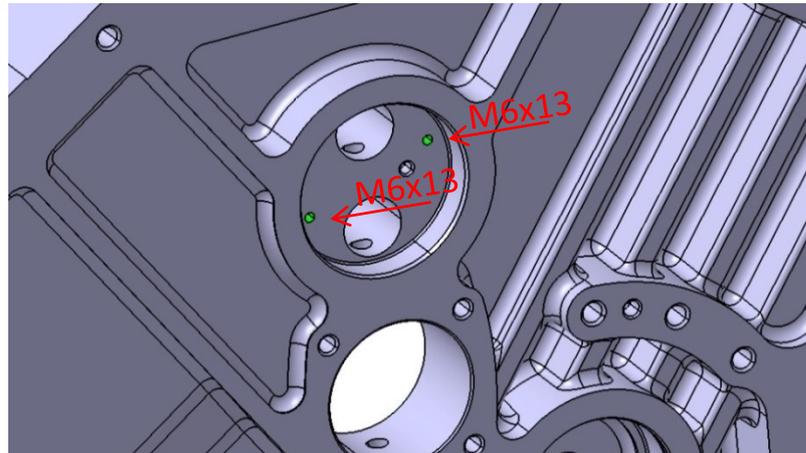


fig. 5: overview modification crankcase

WORK STEPS

The procedure below can be regarded as a guide to upgrading the crankcase and gear train:

- Shut down the engine in accordance with Technical Instruction 1100-0105 and ensure that unauthorised persons cannot start the engine as per TA 2300-0010
- Observe the safety instructions in TA 2300-0005
- For not mentioned tightening torques observe instructions in TA 1902-0213
- Remove gear train cover (lift engine, lower oil pan, remove oil pump, etc.)
- Remove the old idler gear with bearing cap, remove the outer ring of the rear roller bearing installed in the crankcase
- Remove the old camshaft gear → do not heat the gear to avoid seizures on the fitting surface
- Remove the old camshaft axial bearing
- Cover camshaft, crankshaft and oil pan
- Drill centred into the old main oil gallery blanking plate, producing a thread so that it can be lifted or knocked out.
CAUTION: Use screws M6x10. Do not drill through the blanking plate! The blanking plate thickness is 16mm or 5/8 inch – drilling depth max. 13mm!!
- Vacuum away the metal chips and pull out this cover
CAUTION: From this point on, you have to maintain absolute cleanliness as the main oil gallery is open!
- Insert the black plastic plugs into the two main clean oil galleries.
TIP: Due to tolerances of the main oil gallery bores it may happen, that the plugs do not sit properly in the bores. In this case use electric insulation tape to close the gap between the plug and the bore. In any case, contamination of the main oil gallery must be avoided.



fig. 6: oil bore plugs



fig. 7 & 8: plugs inserted into main oil gallery



- Position the drilling template for drilling the holes/thread as follows. There are 2 screw fixed pairs of drill guides in the template. Drill guides (pos. 1) for pre-drilling and drill guides (pos. 2) for thread cutting. In position **A** the M6x13 drilling will be done and position **B** is used as a placeholder for the currently not needed pair of drill guides. For pre-drilling place depth stop (pos. 3) on twist drill M6 and adjust it to the required drilling depth of 13mm (see fig. 10). For thread cutting switch the pair of guide pins (see fig. 12) and fix those with the overlapping screw heads- thread length 10mm!

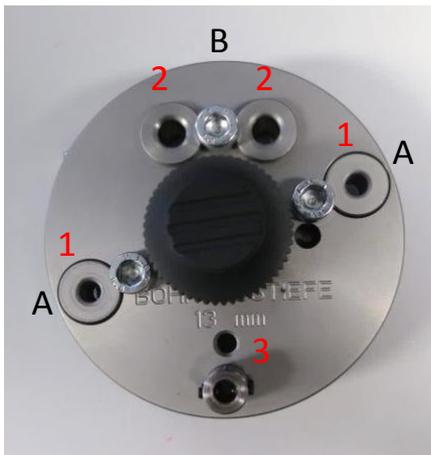


fig. 9: overview template

- Pos. 1 guide pins (pre-drilling)
- Pos. 2 guide pins (thread cutting)
- Pos. 3 depth stop



fig. 10: adjusting the drilling depth 13mm



fig. 11: depth stop

- Pos. A drilling/thread cutting - position
- Pos. B placeholder position



fig. 12: pre-drilling M6



fig. 13: thread cutting M6

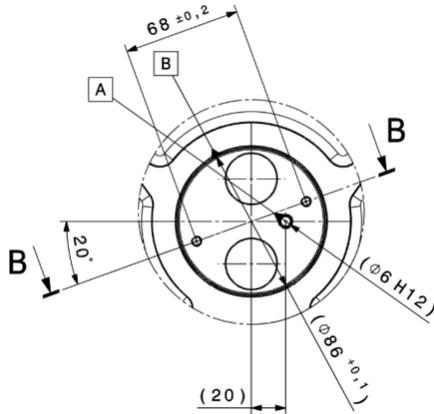


fig. 14: front section of bores in crankcase

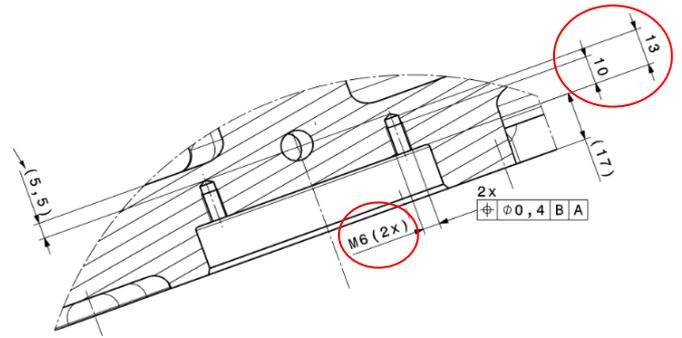


fig. 15: bores in crankcase section B - B

- Clean the housing, the new drill holes, etc.

CAUTION: Be very careful with brake cleaner, etc. because the main oil gallery is open and brake cleaner and metal chips could easily get into main bearing 1!

- Clean the contact surface of the axial bearing on the crankcase
- Install the new axial bearing. To do so, you have to centre the axial bearing on the camshaft stub. Leave approx. 0.6 mm of clearance all around (use a feeler gauge to make adjustments). Secure the bolts using Loctite 243 and tighten them with a tightening torque of 45 Nm.
- Insert the new outer ring of the rear idler gear roller bearing into the crankcase and secure with a circlip.
- Push the inner rings of the roller bearings on to the new idler gear.
TIP: In order to no available machine for pressing on bearings on site, it is recommended to heat the bearing rings to 100°C (210°F, not more).
- Install the new outer ring of the roller bearing in the bearing cap and secure it with a circlip.
- Fit the O-ring on to the new oil injection nozzle (always lubricate). Also oil the hole generously before fitting, but not the just cuttet threads.
- Insert the nozzle into the hole in the crankcase. Turn the nozzle slightly upwards to allow enough room to fit the gear. Don't insert the bolts yet.

NOTE: The nozzle must be inserted now because it will no longer be possible to install it once the camshaft timing gear has been installed.

- Test the feather key on the camshaft stub in the new camshaft timing gear to ensure that it is operating smoothly and then insert it back unto the camshaft stub.
- Check the bore on the new camshaft timing gear for damage or burrs so that it can be fitted smoothly later. The same applies to the shaft end, which must also be checked for burrs, etc. If the camshaft stub fit is damaged, replace the camshaft.
- While the gear is being fitted, the camshaft must be held securely (by a second person) to prevent it from sliding into the engine
- Heat the new camshaft timing gear to approx. 180°C and fit on to the camshaft until the gear is level with the shoulder of the fit. Allow the camshaft and the gear to cool to room temperature.
- Secure the trigger bolt (M5x10) on the camshaft pickup with Loctite 243 and screw it into the camshaft timing gear (don't do this any sooner as otherwise the Loctite could lose its adhesion as a result of heating the gear).
- Fit the tab washer and slotted nut on the gear, tighten with 350Nm and secure it.
- Fit new idler gear with bearing cap. Ensure that the camshaft timing is set correctly. Secure the bolts on the bearing cap using Loctite 243 and tighten them with a tightening torque of 80Nm.
- Turn the oil injection nozzle and fit them with the two bolts (9 Nm). The bolts should be secured using Loctite 243. Please use only a small amount of Loctite so that nothing ends up in the clean oil gallery or the oil injection nozzle.

MODIFICATION GEAR TRAIN HOUSING

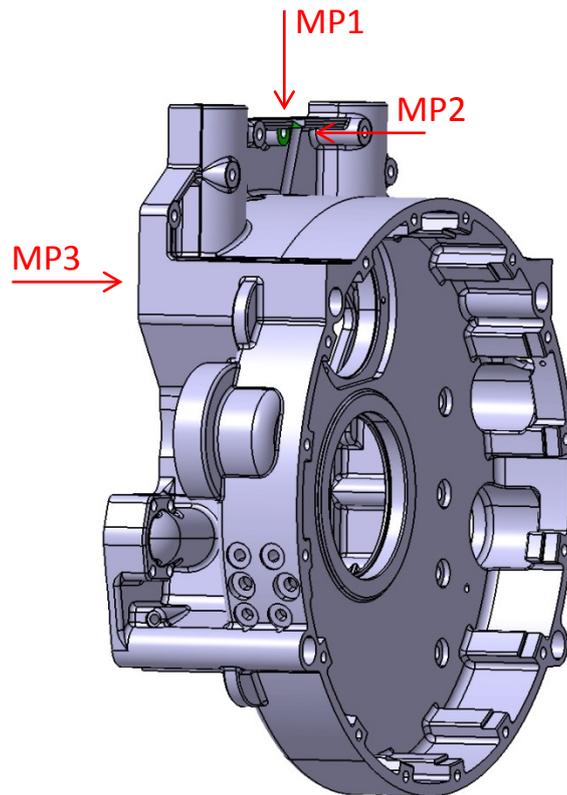


fig. 16: overview modification gear train housing

WORK STEPS

The procedure below can be regarded as a guide to upgrading the gear train housing.



fig. 17: overview position numbers



fig. 18: overview milling device pos. 15

pos. 1	base plate	pos. 7	spacers	pos. 20	core drill diameter 32mm
pos. 2	attachment pin	pos. 8	security brackets	pos. 21	ejector pin 6 x 99
pos. 3	washer	pos. 10	screw DIN 912 M8 x 20	pos. 22	flat countersink 2/32
pos. 4	adapter 1	pos. 11	nut M16 x 1.5	pos. 23	guide pin 14mm
pos. 5	centering spike	pos. 12	thread pin part of pos. 4/6	pos. 24	guide pin 14.5mm
pos. 6	adapter 2	pos. 13	screw Din 912 M5 x 40	pos. 25	twist drill 14.5mm
		pos. 15	magnetic drill incl. case	pos. 26	tap 5/8-18

Machining position 1 (MP1)

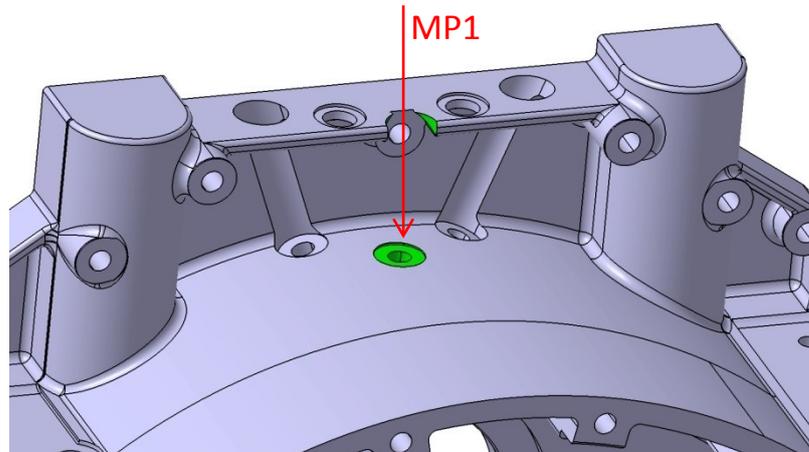


fig. 19: overview nachinings in MP1

- Screw in two screws M12x160mm at the bottom of the case as standing support.

CAUTION: The screws are not part of the Kit Item 9015073 → see table 02 and table 05!

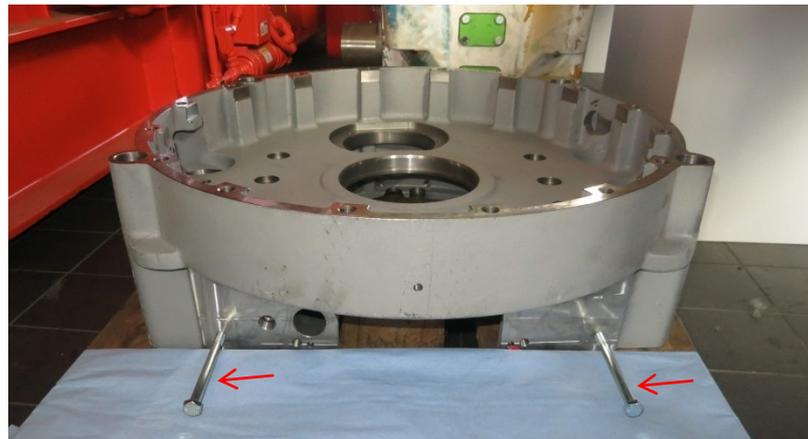


fig. 20: gear train case bottom with screws M12x160 as standing support

- Position the gear train housing vertically and fix it against falling according to the existing safety standards.
- Insert attachment pins (pos. 2) in the upper pickup holes and screw nut M16 (pos. 11) and washer (pos. 3) on but do not tighten. Leave a space between washer and case.



fig. 21: parts for MP1

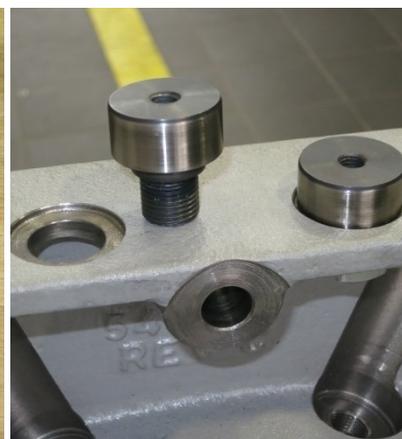


fig. 22: attachment pins

- Place the base (pos. 1) onto the attachment pins (pos. 2) and tighten with screw M8x20 (pos. 10).

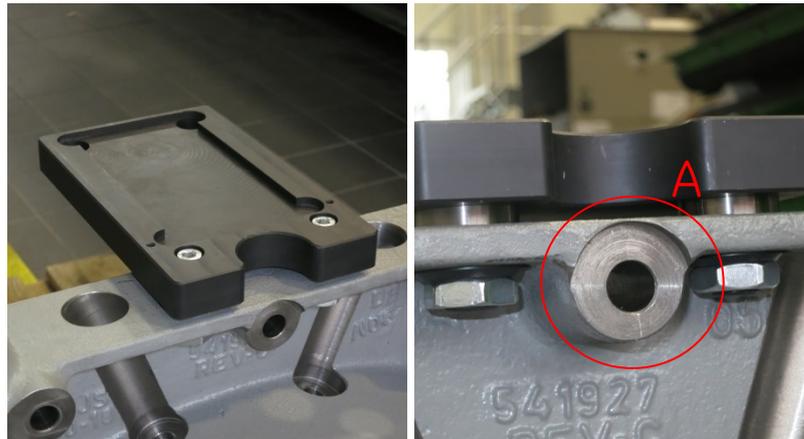


fig. 23 & 24: milling device in MP1

- Tighten Nut M16 (pos. 11).
- Place core drill 32mm (pos. 20) together with the ejector pin (pos. 21) into the drill chuck and tighten.
- Place magnetic drill (pos. 15) into base (pos. 1).

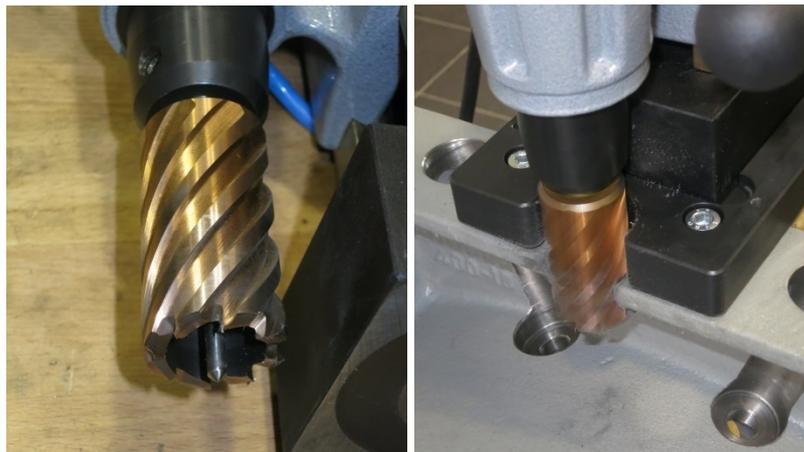


fig. 25 & 26: overview core drill 32mm and MP1

- Drill vertical hole through horizontal clearance hole (see fig. 24, section A) afterwards clean and remove the chips.
- Remove core drill 32mm (pos. 20) and ejector pin (pos. 21) from drill chuck.
- Place adapter 1 (pos. 4) together with twist drill 14.5mm (pos. 25) into drill chuck and tighten.
- Place magnetic drill (pos. 15) into the base plate (pos. 1).
- Drill vertical hole through the upper side of the case and remove chips afterwards.

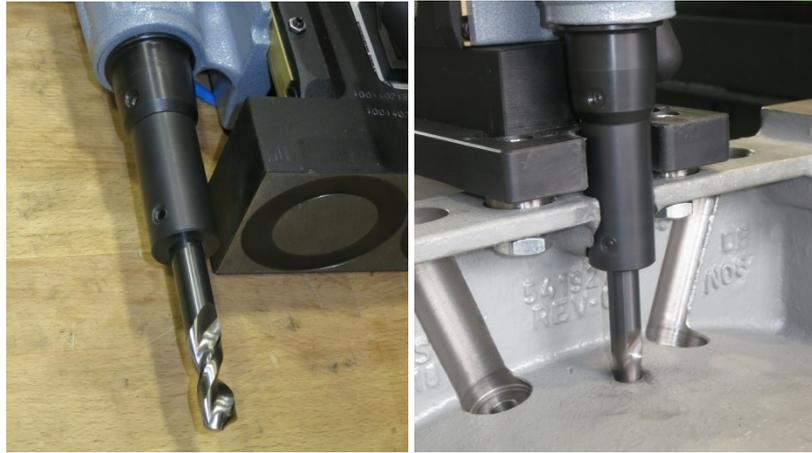


fig. 27 & 28: overview twist drill 14.5mm and MP1

- Remove adapter 1 (pos. 4) and twist drill 14.5mm (pos. 25) from drill chuck.
- Place adapter 2 (pos. 6) with flat countersink 2/32 (pos. 22) and guide pin 14.5mm (pos. 24) into drill chuck and tighten.
- Countersink the through-hole 14.5mm with flat countersink 2/32 (pos. 22) until a round, plane contact surface exists. Clean and remove the chips afterwards.
TIP: If the countersink is rattling, use briefly higher pressure while countersinking.

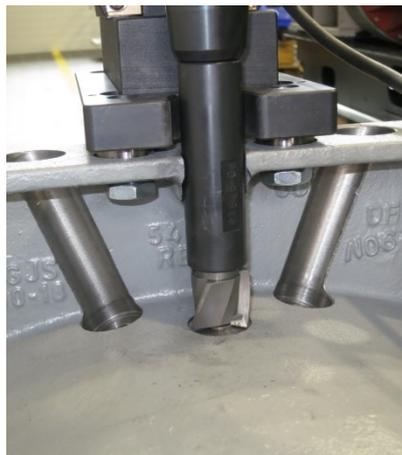


fig. 29: flat countersink 2/32

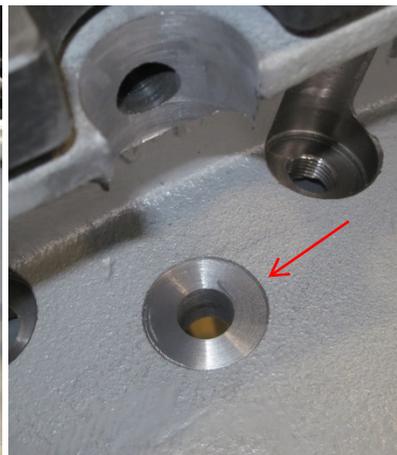


fig. 30: spotfaced through-hole at MP1

- Remove adapter 2 (pos. 6) with flat countersink 2/32 (pos. 22) and guide pin 14.5mm (pos. 24) from drill chuck.
- Place adapter 1 (pos. 4) with centering spike (pos. 5) into drill chuck and tighten



fig. 31: centering spike



fig. 32: tap 5/8-18



- Position tap 5/8-18 (pos. 26) in the previous done through-hole 14.5mm. Place magnetic drill in base plate (pos. 1) and center tap 5/8-18 (pos. 26) with the tightened centering spike (pos. 5).
- **CAUTION:** Fix the magnetic drill by pressing the luminous key "Magnet On/Off". Do not switch on the "Power key"!
- For thread cutting place 9mm open wrench on the square end of the tap 5/8-18 (pos. 26). Guide the tap 5/8-18 (pos. 26) with centering spike (pos. 5) while cutting the thread.

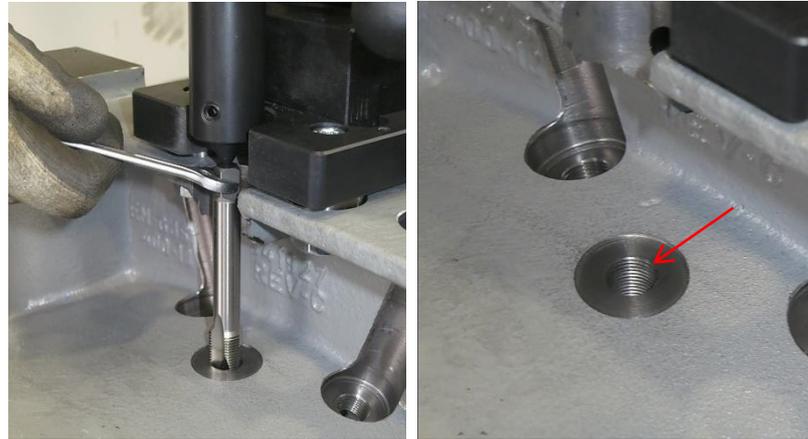


fig. 33 & 34: overview thread cutting at MP1

- Remove adapter 1 (pos. 4) with centering spike (pos. 5) from drill chuck.

Machining position 2 (MP2)

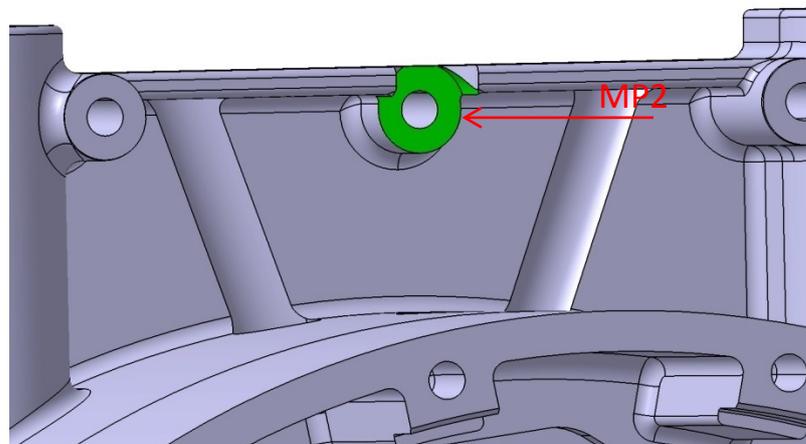


fig. 35: overview machinings in MP2

- Remove base (pos. 1) from attachment pins (pos. 2).
- Place spacers (pos. 7) on attachment pins (pos. 2) in generator side position. Insert screws M8x20 (pos. 10) and gently tighten them until you notice slight resistance.
- Place base plate (pos. 1) on the spacers (pos. 7) fronts and fix it with screws M8x20 (pos. 10) to align the spacers (pos. 7).
- Now tighten the screws M8x20 (pos. 10) at the attachment pins (pos. 2).
- Loosen screws M8x20 (pos. 10) at spacers (pos. 7) fronts to make the base (pos. 1) movable in the slots.

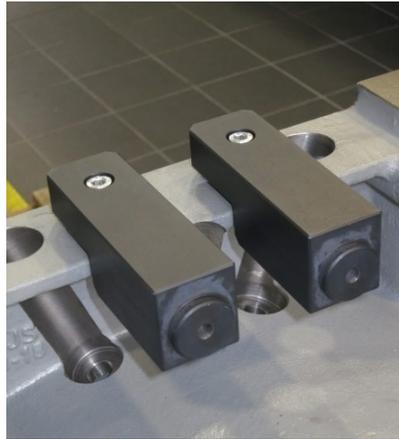


fig. 36: spacers

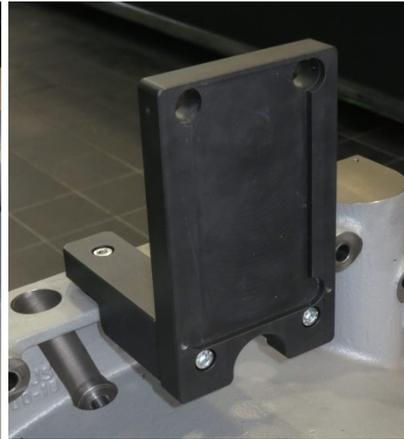


fig. 37: overview MP2

- Place adapter 2 (pos. 6) with flat countersink 2/32 (pos. 22) and guide pin 14mm (pos. 23) in drill chuck and tighten.
- Place magnetic drill (pos. 15) in base plate (pos. 1), fix the magnetic drill (pos. 15) by pressing the luminous key "Magnet On/Off" and secure it with the security jaws (Pos. 8).
- Align the base (pos. 1) so that the guide pin 14mm (pos. 23) fits in the through-hole. Now tighten the screws M8x20 (pos. 10).
- **CAUTION:** Always make sure that the flat countersink 2/32 (pos. 22) is at least 5mm away from the drilling at MP1!

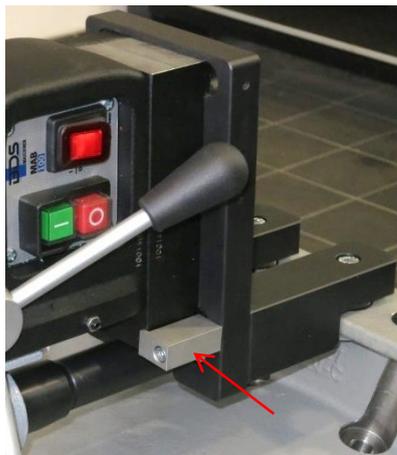


fig. 38: security brackets



fig. 39: starting position flat countersink

- Countersink the horizontal through-hole with flat countersink 2/32 (pos. 22) until a case thickness of 40mm. In any case a sufficient contact surface must be provided.
TIP: If the countersink is rattling, use briefly higher pressure while countersinking.

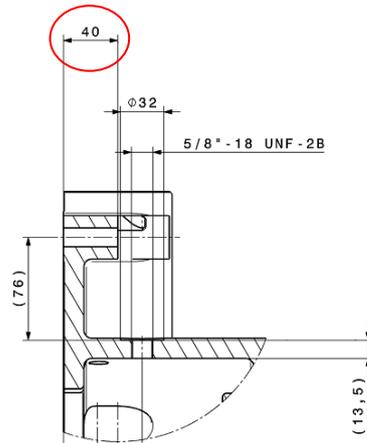


fig. 40: section through core drilling BP1



fig. 41: countersink at MP2

- Remove adapter 2 (pos. 6) with flat countersink 2/32 (pos. 22) and guide pin 14mm (pos. 23) from drill chuck.
- Disassemble base plate (pos. 1), spacers (pos. 7) and attachment pins (pos. 2).
- **Deburr** all holes.

Machining position 3 (MP3)

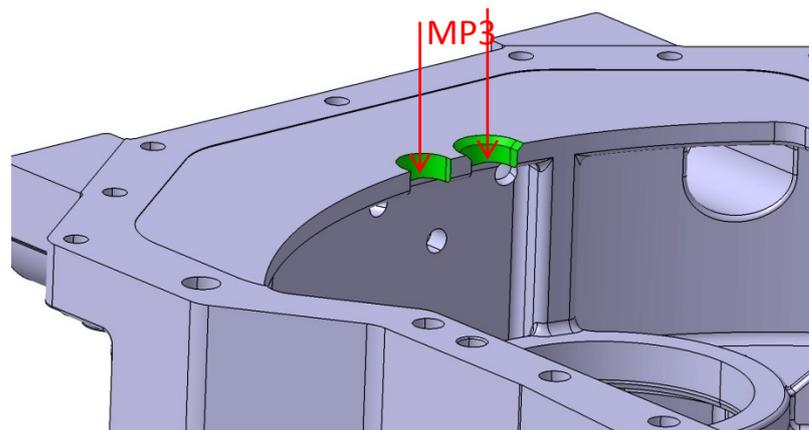


fig. 42: overview machinings in MP3

- Place template with screws M12x60 and M12x100 as shown in fig. 52 and table 02 at the inside of the housing. Let it rest on the screws under its own weight.
- **CAUTION:** Fix the template only by tightening the externally mounted nut, to ensure that the template stays connected with the screw. A rotating bolt might lift the template.
- Mark the recesses with the template and remove it afterwards.



fig. 43: template

- Check the position of the recesses according to the drawing section in fig. 44.
CAUTION: Recesses are off-center!

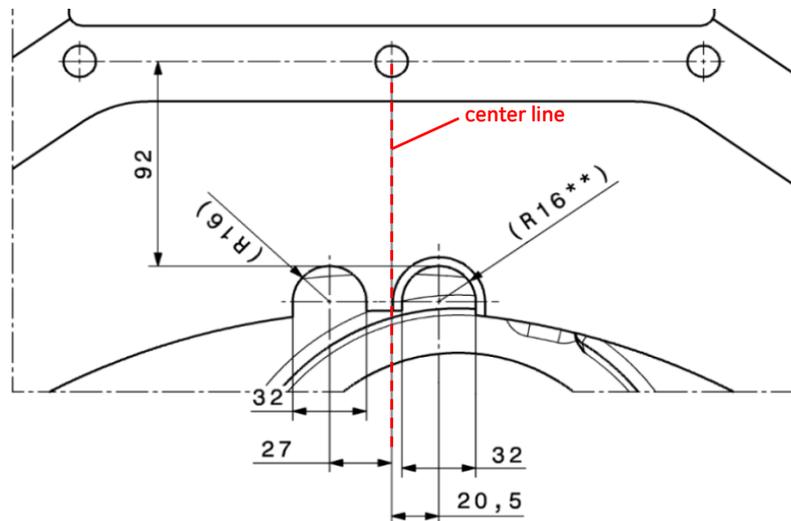


fig. 44: drawing section - recesses

- Place the gear train housing onto a flat, solid surface with the flywheel side downwards.
- Place core drill 32mm (pos. 20) together with ejection pin (pos. 21) into drill chuck and tighten.
- Place magnetic drill (pos. 15) within the sealing surface area and line up with the marking.
- **CAUTION:** Always make sure that the magnetic drill rests flat on a clean contact surface.



fig. 45 & 46: overview MP3

- Deburr all holes.
- Chamfer the right drilling (bank A side) at least $4 \times 45^\circ$ using an angle grinder with flap disc. Additionally abrade the overlying corners on both recesses (see fig. 47, 48).



fig. 47: recesses at MP3



fig. 48: chamfer at least $4 \times 45^\circ$

- Clean housing under TA 1100-0113 (Technical Instruction on Cleanliness) and prepare for reassembly.
- Refit the gear train cover and reassemble the engine, including the oil pump. The proper clearance of the new oil cooling oil nozzle can be checked by the cover behind the flywheel.
Note: Cover may not be available on older engines.



fig. 49: clearance of cooling oil nozzle



- Edit the upgrade in Oracle
 - Update the parts list (BOM)
 - Close the tasks and service requests.

REQUIRED TIME

The amount of time that has to be spent on upgrading the gear train will be determined by the conditions in the plant (crane, sufficient space) and the experience of the technician carrying out the work (in general and with the upgrade). An engine standstill of at least 5 days will have to be scheduled.

REQUIRED PARTS

Quantity	Part No.	Item Description	Comments	see fig.
1	9015073	gear train (Kit Item)	Gear train assembly consists of individual gear train parts (wheels, bearings, sealings etc.)	fig. 55 table 05
1	1225744	device for gear train housing (Kit Item)	device for drilling the various recesses in the gear train housing	fig. 51 table 06
1	1225752	device for crankcase (Kit Item)	device for drilling the bores in the crankcase	fig. 50+51 table 07
1	1225886	consumable tools (Kit Item)	individual tools required for the upgrade (consumables)	table 08
1	9016956	template	To mark the recesses at the inside of the housing	fig. 52
1	100481	hexagon screw M12x60	To fix the template on the gear train housing (LEFT SIDE)	fig. 52+53
1	100310	hexagon screw M12x100	To fix the template on the gear train housing (RIGHT SIDE)	fig. 52+53
2	101823	nut M12	To tighten and secure both hexagon screws, M12x60 and M12x100	fig. 52+53
2	100317	hexagon screw M12x160	gear train housing bottom with screws M12x160 as standing support	fig. 20

Table 02: required parts

ADDITIONAL REQUIRED PART NUMBERS

Quantity	Part No.	Item Description	Comments	see fig.
1	9013883	wheel casing	Drawing of the wheel casing showing all recesses	fig. 56
1	9013919	crankcase	Drawing of the crankcase showing the new bores	fig. 57

Table 03: additional required part numbers



fig. 50: device for crankcase



fig. 51: device for gear train housing

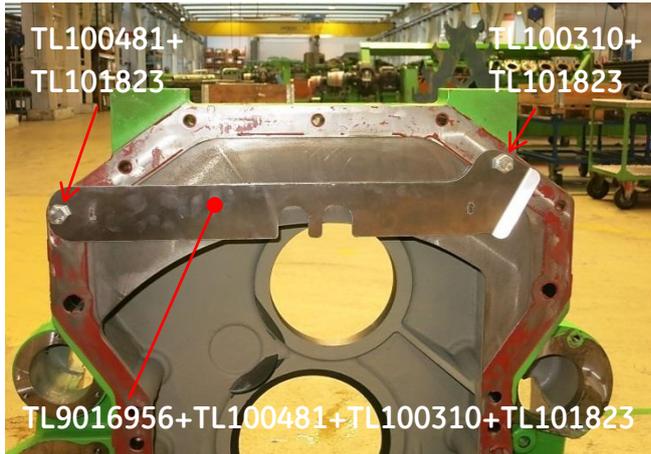


fig. 52: fitting of the template to the inside of the housing



fig. 53: screws with nuts for fastening the template

NOTE: For fastening the template two hexagon screws M12 with proper nuts M12 are needed. The different screw lengths of 60 and 100mm come from the varying thickness of the housing in the screwing area.

CAUTION: Screws and nuts are not part of the Kit Item 9015073 → see table 02 and table 05!

GENERAL CONDITIONS

- Work on the plant may only be carried out by specialist staff who have received relevant electrical and mechanical training.
- Machining operations should not be carried out in the engine room (if possible).

RELEVANT DOCUMENTS

The relevant instructions are all part of the plant documentation handed over to every customer on delivery of an engine. Furthermore, the latest versions of the documents referred to here can be downloaded from the Jenbacher Web portal (<http://information.jenbacher.com>) under the heading "Technical Knowledge Base".

- Service Technician Instruction ST-136, Gear Train Inspection
- Technical Drawing E17098-10-00, Gear Train 9015073
- Technical Drawing E15544-10-00-01-1Y, Wheel Casing 9013883
- Technical Drawing JY0859-905-01-01-3, Crankcase 9013919
- Technical Instruction TA 1100-0105, Engine shut-down
- Technical Instruction TA 1100-0113 Cleanliness during service work involving clean oil parts
- Technical Instruction TA 1902-0213 Screwing and tightening torques for type 4 engines
- Technical Instruction TA 2300-0005, Safety regulations
- Technical Instruction TA 2300-0010, Guidelines for using the LOTO kit

REVISION CODE

INDEX	DATE	DESCRIPTION / REVISION SUMMARY
01	Apr. 22, 2015	First version of this document

Table 04: revision history



The following tables no. 05, 06, 07 and 08 show the individual parts included in which Kit Item

BOM Parent: 9015073 gear train components					
Item Sequence Number	Item	Quantity	Item Description	Comments	
1	9014168	1	Spacer disk	Components of Kit Item 9015073 required for the gear train upgrade	
3	9014144	1	Oil pipe		
5	9013877	1	Idler gear		
6	280789	1	Reduction		
7	9013876	1	Wheel		
9	456748	1	O-ring 78,79 x 3,53		
13	110964	2	Groove nut M35x1,5		
15	110959	2	Locking washer 35		
17	104715	1	Sealing ring 16x22		
19	103042	1	Curved washer 6x11		
21	102989	2	Cylinder pin 8x20		
22	127734	1	Screw plug		
23	102316	3	Snap ring 80x2,5		→these parts are shown in fig. 55
25	102235	1	Snap ring 35x1,5		
27	101363	2	Cylinder screw M6x25		
29	100481	1	Hexagonal head screw M12x60		
31	100441	4	Hexagonal head screw M10x25		
33	100423	1	Cylindrical roller bearing		
35	100421	1	Cylindrical roller bearing		
37	100391	1	Hexagonal head screw M5x10		
39	100314	5	Hexagonal head screw M12x130		
41	456731	2	O-ring 56,74x3,53		
42	468727	1	O-ring 88,49x3,53		
44	103143	9	Sealing 65x2	Additional relevant parts of Kit Item 9015073	
45	395570	1	Shaft seal		
47	348964	1	O-ring 151,99x3,53		
50	352953	1	Sealing Frontpart I 504 x 257.5		
51	352954	1	Sealing Frontpart II 504x225,5		
52	352495	4	Sealing Sidepart I 466x24		
53	352496	4	Sealing Sidepart II 581x24		
55	101790	8	Sealing 80x2		
56	102995	3	Cylinder pin M6x20		→these parts are not shown in fig. 55
57	236907	3	O-ring 50,39x3,53		
58	240789	5	Sealing 135x124		
59	241824	1	O-ring 31,34x3,53		
60	302612	1	O-ring 94,84x3,53		
61	376511	2	O-ring 21,82x3,53		
62	394274	1	Feather key 6x6x14		
63	557647	2	Sealing		

Table 05: individual components of the Kit Item 9015073



BOM Parent: 1225744		device for gear train housing			
Item Sequence No.	Item	Quantity	Item Description	Comments	
1	1225696	1	Base plate	see fig. 17 & 54	
2	1225699	2	Attachment pin		
3	1225701	2	Washer		
4	1225702	1	Adapter 1		
5	1225706	1	Centering spike		
6	1225705	1	Adapter 2		
7	1225709	2	Spacers		
8	1225710	2	Security brackets		
10	101369	4	Cylinder bolt DIN 912 M8 x 20		
11	113799	2	Hex nut M16 x 1,5		
12	-(*)	3	Thread pin part of pos. 4/6		see fig. 54
13	101359	2	Cylinder bolt DIN 912 M5 x 40		
15	1225658	1	Magnetic drill incl. case		

Table 06: individual components of Kit Item 1225744
(*) together with pos. 4/6

BOM Parent: 1225752		device for crankcase		
Item Sequence No.	Item	Quantity	Item Description	Comments
-(**)	1225733	1	Drill template	see fig. 9
-(**)	1225739	1	Oil bore plug	see fig. 7 & 8

Table 07: individual components of Kit Item 1225752

BOM Parent: 1225886		consumable tools			
Item Sequence No.	Item	Quantity	Item Description	Comments	
20	1225720	1	Core drill diameter 32mm	see fig. 17 & 54	
21	1225727	1	Ejector pin 6 x 99		
22	1225721	1	Flat countersink 2/32		
23	1225722	1	Guide pin 14mm		
-(**)	1225849	1	Spiral drill (Dia 5, HSS)		see fig. 12
-(**)	1225850	1	Thread drill (M6 HSS)		see fig. 13
24	1225730	1	Guide pin 14,5mm		
25	1225728	1	Twist drill 14,5mm		
26	1225729	1	Tap 5/8-18		

Table 08: individual components of Kit Item 1225886

(**) Items are listed in oracle parts list in this order. Items are listed without sequence no. because items are not shown in fig. 17/54

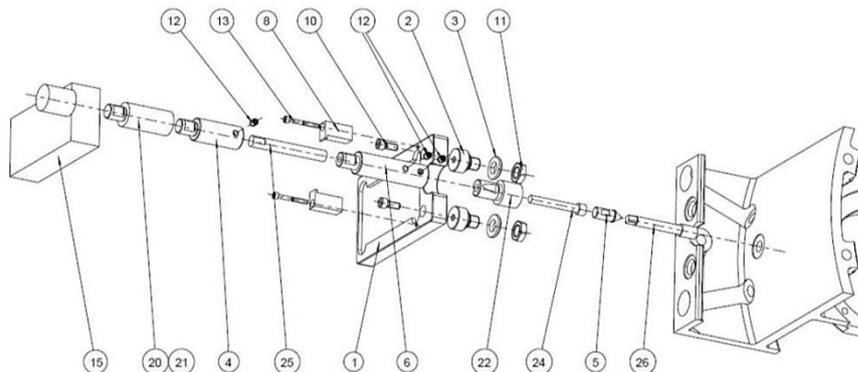


Abb. 54: exploded view of relevant components

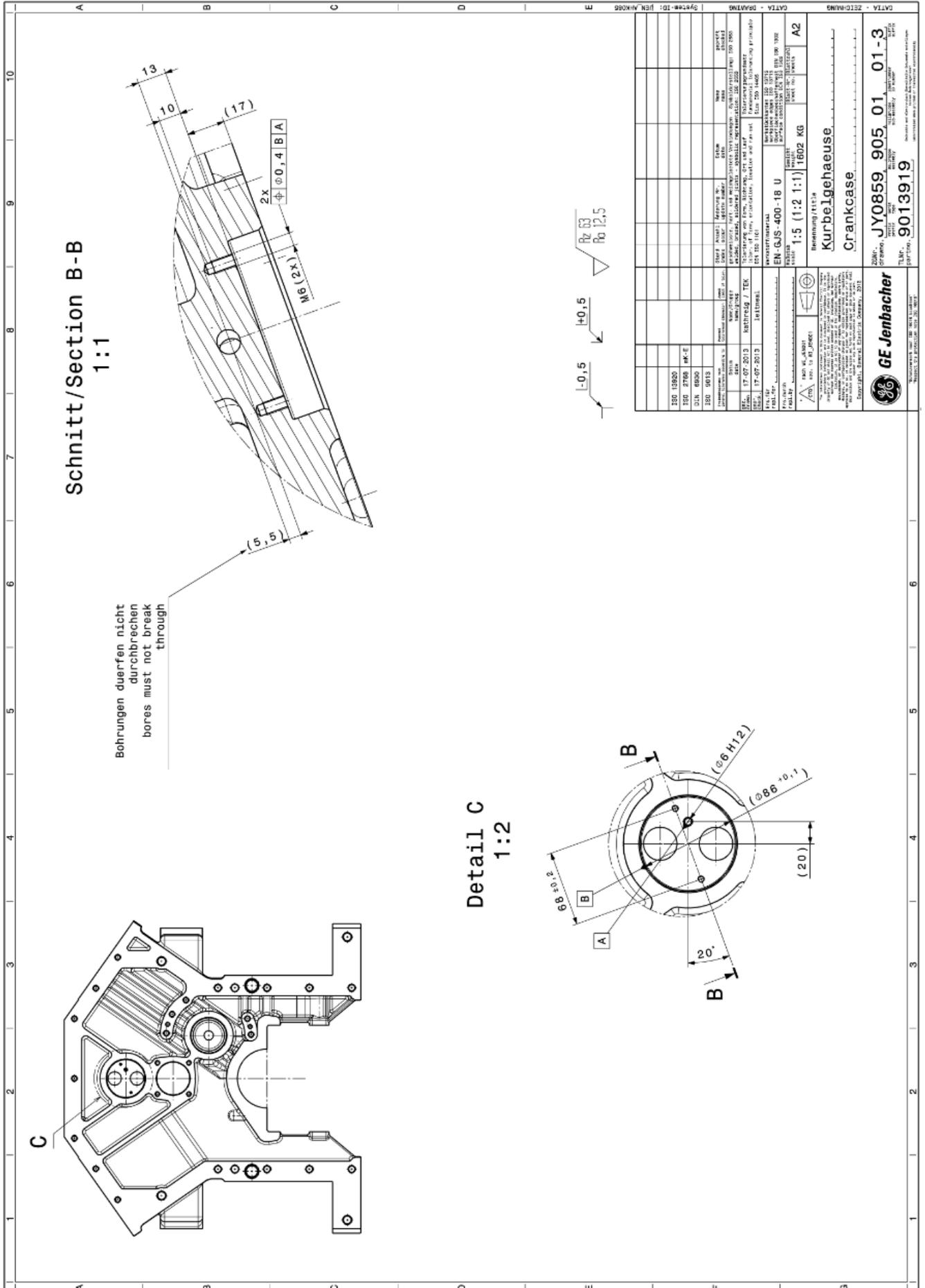


fig. 57: crankcase