# SD50 Cone repair procedure DRAFT (version Rev1)

Applied models: SD40 and SD50 and Service Manual (0BSDM-G00100) - Rev 3 - Nov 08

This repair procedure is done without changing parts and without lifting boat out of the water.

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| **Disassembly-procedure** | |
| 1. Remove all the oil and measure the quantity (see operation manual for procedure). Procedure can be performed without lifting boat out of the water.   🡺 Do NOT use the oil anymore; oil could have overheated, and there might be debris in the oil !! | |
| 1. Remove topcover (4 bolts)   Take care for shims T5 and O-ring in the cover 🡺 | SD40 cone-01 |
| 1. Remove remote control shifting cable 2. Remove shifting device assembly and bracket (2 bolts) 🡺 | SD40 cone-09-3 SD40 cone-10 |
| 1. Loosen the four nuts on the outside of mounting flange 2. Push the thread + nuts inwards with screwdrivers. If resistance is too high, position a plastic hammer diagonally to one of the lower nuts   (Result is that the inputshaft & pinion gear assembly are pushed in the mounting­flange towards the engine) | SD40 cone-09-5  Inputshaft assy push-2 |
| 1. Mount the lifting eye with a M8 bolt in the shaft 2. Lift the complete assembly upwards | Lift-eyeSD40 cone-17-3 |
| 1. Fix the assembly in a vice, use wood or use a special tool | New photo |
| 1. Check the Top nut clearance with a feeler gauge.   This gap should be 0,05~0,5 mm  If >0,5mm, then use thicker “thrust collar” (= copper washer) |  |
| 1. The top nut is secured to the shaft, by a “tab”-deformation of the nut. 2. Use a sharp tool to “Unsecure” this fix.  * First use a small screwdriver, tap under the tab. | New photo |
| Take care when tapping out the top nut fix tab:   * Far enough so the tab will not damage the threads when removing topnut * But not too far outward and will break off | |
| 1. Use a sharp small chisel and **Carefully** tap out top nut tab.  * You must use **a NEW top nut** when reassembling. But if you are forced to finish with old topnut, take extra care to make as little damage as possible. | New photo |

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| **Disassembly of Cone assembly:** | |
| 1. Remove topnut (Note: LEFT Thread, torque   147±5.0 N·m  (15±0.5 kgf·m)   1. Disassemble the complete cone assembly   🡺 Pay close attention to mounting order | Mounting order SD40 clutch lower  Mounting order SD40 clutch upper | |

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| **Inspection of shifter, cups and drive cone** | | | | | | | | |
| 1. Inspect the shifter for wear marks.   Examples: | | | | Too much wear; new and correct shifter | | | | | |
|  | | | New photo  New photo | | | | | |
| 1. Inspect cups:   Contact surface with drive cone:  Visually inspect the tapered surface of the cup & gear set where they make contact with the drive cone to check if any abnormal condition or sign of overheating exists. If any defect is found, replace the cup & gear set or the complete cone assembly   * Shiny surface = Bad, Surface with lines = OK * Shiny surface can be repaired by lapping Cup and Cone. | | | | | | SD40 cup and gear | | |
| 1. Measure the amount of wear on the tapered surface of the drive cone, and replace the cone when the wear exceeds the following limits for dimension L:  |  |  |  | | --- | --- | --- | |  | Standard dimension | Limit dimension | | L | 29,4 ~ 30,0 mm | 29,1 mm | | | | | | | sdcone3 | | |
| 1. Make sure all the oil grooves in the cone are open, without burrs. Oil should be able to flow from circular grooves into the FOUR deep grooves. 2. Check if the circular grooves are open, if not use a very thin file or saw to open them     New photo | | | | | |  | | |
| 1. Check if the Four big grooves are open at the sides: | | OK ; Not OK  New photo  New photo | | | | | | |
| 1. If the Four grooves are not open enough, use a saw to open them. | | New photo | | | | | | |
| **Perform lapping procedure for cone** | | | | | | | |
| 1. Mix lapping powder (67 micron Silicon Carbide #280) with SAE#30 oil, and coat onto the inner taper surface of the cups | 2) Set the large gear + cup on the clutch shaft with a needle bearing and then set the drive cone on the clutch shaft | | | | | | 3) Lap the cup and drive cone, pushing them together by hand |
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| 1. Push and turn the clutch gear about 50 times clockwise and counter-clockwise | 5) Remove the parts from the clutch shaft and repeat the procedure for the other gear+cup and matching side of the cone | | | | | | 6) After lapping, all lapped parts should be cleaned completely with washing oil. |
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| **NOTICE!**  Do not mix the combination of the lapped parts. The washing oil should be changed frequently in order to prevent residual powder being left on the parts | | | | | | | |
| 1. Again, measure the amount of wear on the tapered surface of the drive cone, and replace the cone when the wear exceeds the following limits for dimension L:  |  |  |  | | --- | --- | --- | |  | Standard dimension | Limit dimension | | L | 29,4 ~ 30,0 mm | 29,1 mm | | | | | | sdcone3 | | |

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| **Re-assembly procedure** | | | | |
| 1. Make sure the torque limiter is inserted correctly: | | New photo | |
| 1. First, measure dimension L1 from the LOWER GEAR   (L1 standard dimension: 68,2mm) | |  | |
| 1. Determine Dimension “A”.   Standard dimension A is 78.5. the deviation is stamped on Saildrive:  In this case, deviation is “4” = 0.04:   * Deviation from standard value is 0.04 mm   Then A = 78.50 + 0.04 = 78.54mm | | |  |
| 1. Calculate shim thickness T1: T1 = (A - L1 - 10) ± 0.025 mm | | | | |
| 1. Assemble cone assy.   **Take Notice!**   1. When assembling all parts, take care of mounting direction of cone: the engraved letter and wide ring should **face down**. 2. Mount T2 on top of spacer | ..\Shims measuring\SD40 cone-12.JPG ..\Shims measuring\SD40 cone-14.JPG | | | |
| 1. Mount upper gear + cup, washers in correct order. | | | | | |
| 1. Tighten the top nut by torque. This can be done: 2. After inserting assy in saildrive 3. In a vice, by using special tool   (when cone assy in clamped in wood or Alu., the shaft will turn due to big torque). Take care not to damage shaft spline! | New photo | | | |
| **Note**: The top nut (left thread) torque is quite big 147±5.0 N·m (15±0.5 kgf·m) | | | | | |

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| **Determining bottom shim and Inserting Cone assembly** | | |
| Positions of shims: | | |
| T5 = top shim  Part no. 196322-02320  T1= bottom shim  Part no. 196322-02320  T2 = middle shim  Part no. 196320-02230  C:\Documents and Settings\dk0113\My Documents\My Pictures\SD40 cone assy.jpg | | | | | |
| 1. Measure bottom shim T1, and compare with the calculated value in previous page. 2. Re-use the shim or select correct one. 3. Insert the shim(s) T1 at the bottom of the upper unit case. | | SD40 cone-19-2 | |
| 1. Insert new complete assembly   **🡺 ! Take care of following notices!**   * 1. Slide in carefully because of tight sliding fit   2. Align the holes in the assembly correctly   3. Shim(s) T2 is already assembled in complete assy. Make sure this shim(s) T2 won’t be damaged when the assy is inserted! 🡺 | SD40 cone-18.JPG SD40 cone-20-3.jpg  T2 | | |
| 1. Turn and wiggle the top nut until the spline at bottom of shaft is seated into the sleeve; the assembly sinks into the housing | ..\Shims measuring\SD40 cone-06-2.jpg | | |

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| Measurement and adjustment of shift lever | | | | | |
| 1. First, align hole of the spacer centric to the hole of the housing!!   **Spacer**  **Housing** | | | ..\Shims measuring\Positioning spacer inside housing-2.jpg Example Position **NOT OK**:  ..\Shims measuring\Spacer wrong position.JPG | |
| 1. Mount shifter device + bracket;   🡺Pay attention to mounting direction of shifter; the wider part should point to the back | | | ..\Shims measuring\Position shifter.JPG C:\Documents and Settings\dk0113\My Documents\My Pictures\SD-shift.jpg | | |
| 1. Remove the Allan bolt. 2. Measure the bolt-length H (Standard length 17.0 mm). | | | C:\Documents and Settings\dk0113\My Documents\My Pictures\Sd-bolt.jpg | | |
| 1. Set the shift lever 10º~15º from neutral position; in this position the shifter is most moved inward | | | C:\Documents and Settings\dk0113\My Documents\My Pictures\shift.JPG | | |
| 1. Insert depth gauge. Be aware that there is a small hole in the shifter: **be sure not to insert measuring tip of depth gauge in this hole** | | | C:\Documents and Settings\dk0113\My Documents\My Pictures\sd shift 2.jpg..\Shims measuring\Shift lever meas depth A page 31-2.jpg | | |
| 1. Because the cone-groove is off-center (± 0.5 mm from center), the assembly must be turned by **top-nut** (left thread) to find the smallest depth dimension L | | | ..\Shims measuring\SD40 cone-06-2.jpg | | |
| 1. Measure the dimension L (Standard depth 16.35 mm). | | | | | |
| C:\Documents and Settings\dk0113\My Documents\My Pictures\SD50.bmp | | | | | |
| 1. Calculate shim thickness: (see page 55~56 in service manual)   L  T  H  C  L = Depth [mm] 🡪 Standard ≈16.35 mm.  H = Bolt length [mm] 🡪 Standard ≈ 17.0 mm. T = Shim thickness [mm] 🡪 Standard ≈ 0.95 mm. C = Clearance [mm] 🡪 Standard 0.3 (± 0.1) mm  🡺 **Tshift formula: T = (H – L + C) ± 0.1 mm**  **Example**: H= 17.15, L = 16.4, C= 0.3 (std.)  🡺 T = (17.15 - 16.4 + 0.3) ± 0.1 = 1.05 ± 0.1 mm.  🡪 Select shim thickness T = 1.0 or 1.1 mm. | | | | | |
| Examples | **Before shimming** | | **After shimming** | |
| Bolt shorter than depth(L – H) = 0.7 mm Clearance before shimming = 0.7 mm  Formula T = ( H - L) + 0.3  = ((L-0.7) - L) + 0.3  T = - 0.4 mm 🡪 not possible  🡪 Clearance C will stay 0.7 mm 🡪 too big and can’t be adjusted by shims  🡺 mount new shift lever/ longer bolt. | H  L  T  C | | H  L  T  C | |
| Bolt shorter than depth(L – H) = 0.3 Clearance before shimming = 0.3 mm  Formula T = ( H - L) + 0.3  = ((L-0.3) - L) + 0.3  T = 0 mm  After shimming C stays 0.3 mm  🡪 Actually no shims needed | L  T  H  C | | L  T  H  C | |
| Bolt same length as depthH = L Clearance before shimming = 0 mm  Formula T = (H-L) + 0.3  = 0 + 0.3  T = 0.3 mm  After shimming T = C = 0.3 mm | L  C  H | | L  T  H  C | |
| Bolt longer than depth( H – L) > 0 Clearance before shimming = 0 mm  H ~ 17.0 mm  L ~ 16.35 mm  Formula T = (17.0 - 16,35) + 0.3  T = 0.95 mm  After shimming C = 0.3 mm | L  H  C | | L  T  H  C | |
| 1. Select correct shim 2. Apply Threebond 1104 on the Allan Bolt as follows (leave last 5 mm. clean): 3. Mount the Allan bolt while holding the shift lever | | | | |

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| Final assembly | | | | | | |
| 1. Insert inputshaft into housing:   Pull threads outwards by pushing with screwdrivers between housing and washers, while at the same time **turn upper and lower gears** through the shifter hole, until pinion gear is seated into upper and lower gear   1. Tighten the four nuts lightly. 2. Align spacer hole with housing | | SD40 cone-09-5.jpg | | | |
| **IMPORTANT: TOP NUT torque** | | | | | |
| 🡺 Apply or check top nut tightening torque (**Check Only if already done**) | | | | |
| 4-a) Turn shifter Counterclockwise (CCW) | 4-b) Block pinion shaft: When SD40 is coupled to the engine | | | 4-c) Block pinion shaft: When SD40 is separated |
| SD40 cone-09-3 | SD40 cone-07-2 | | | Top nut fix with torque-2 |
| 4-d) Fix top nut by tightening torque (left screw) of 147±5.0 N·m (15±0.5 kgf·m)   1. Finalize assembly by caulking the top nut with a flat driver | | | Top nut caulking-2 | |

Checking top shims:

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| 1. Measure depth H6 in top cover. 2. Measure bearing protrusion L6. 3. Calculate T5 shim thickness:   T5 = (H6 – L6) +0~0.05 mm.  (see first page and page 57 of service manual)   1. Select and position correct shim | **H6** **L6**  Scan-measure T5-2Meas H6 page 23 Meas L6 page 23-3 |
| 1. Mount top cover with four bolts. 2. Tighten any other bolts and nuts |  |

**END of procedure**