Procedure for SD40-SD50 clutch assy replacement (version 17)

- Applied models: SD40 and SD50 and Service Manual M2215-04E140
- Procedure can be performed without lifting boat out of the water. However the engine need to be moved ±20 cm forward to be able to measure the backlash on the inputshaft.

Necessary tools (for replacement and shimming):

2x Flat Screwdrivers No.5 (big)	Plastic hammer	Digital caliper + Bridge for Caliper to convert Caliper into depth-gauge
1x Flat Screwdriver No.2	Flat driver	
1x Screwdriver Cross No.2	Allan Hexagon (wrench) No. 6	For gear backlash measurement: Iron plate, lever type dial gauge and magnetic base
Fork / Ring spanners 12, 13, 19, 27	Lifting eye with M8 bolt thread	

Necessary parts; Cone Replacement Kit P/N 796450-04890, includes:

Qty	Part name	Part Number	Remarks
2	Shim set 75/85	196322-02320	Shim T1 (bottom shim) and T5 (top shim)
1	Shim set 85/92	196320-02230	Shim T2 **(only necessary if backlash out of limit)**
1	Shifter	177088-06390	Shifter only
10	Shim	196322-06630	Shims 0.2 mm for shifter device (Tshift)
1	O-ring	24321-000950	O-ring under top cover (only necessary if damaged)
1	O-ring	24321-000400	O-ring at shifter device (only necessary if damaged)
1 1	Cotter pin Washer	22417-250200 22137-060000	To lock cable to pivot stud (parts might be lost)
1	SD40-SD50 assembly & operation check sheet of new cone assy		

Other required parts (damper disk only if old type is present):

Qty	Part name	Part number	Remarks
1	Damper Disk	196440-04310 or: 196440-04300	Torflex (SP10) in case of SD40-3, SD40-4 and SD50 Torflex (SP26) in case of SD40-4T and SD50-4T
1	Warning sticker: "When sailing keep gear in neutral. When propeller has to be locked use only ASTERN"		
1	SD40-SD50 assembly & operation check sheet of original SD40 (supplied by YMI on request)		

Calculation table SD40 shim thicknesses

		upper case A		L1	H6		L6	Bolt-length H		Depth L				Result T	Result Margin	Calculated Limits Min	Calculated Limits Max
Standard values		78,5		68,2	16,5		16,2	17,0		16,35							
Example with std. values	T1 =	78,50	-	68,20							-	10	=	0,3	± 0,025	0,275	0,325
	T5 =				16,50	-	16,20						=	0,3	+0~0.05	0,30	0,35
	Tshift =							17,00	-	16,35	+	0,3	=	0,95	± 0,1	0,85	1,05
	T1 =		-								-	10	=		± 0,025		
	T5 =					-							=		+0~0.05		
	Tshift =								-		+	0,3	=		± 0,1		
Formulas	T1 =	(A-L1-10) ± 0,025	See page 46~48 in service manual														
	T5 =	(H6-L6) +0~0.05	See page 52 of service manual														
	Tshift =	(H-L)+0,3 ± 0,1	See page 60~61 in service manual														

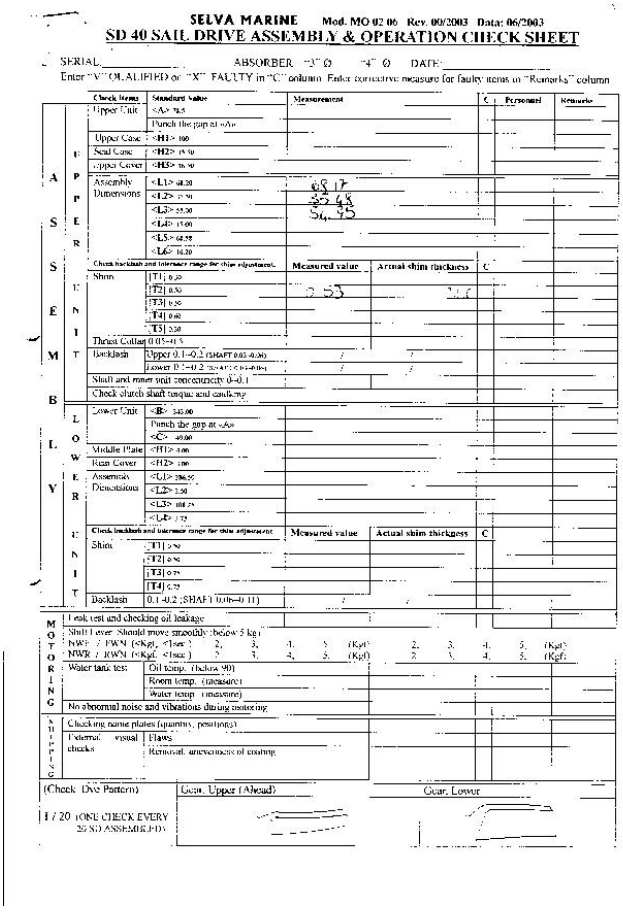
Backlash

Gear	Shift position	Limit [mm]	Measured values (3 positions !!!)		
			0°	120°	240°
Upper gear	Reverse	0.03 ~ 0.06			
Lower gear	Forward	0.03 ~ 0.06			

How to interpret the "SD40 sail drive assembly & operation check sheets"

Delivered with the cone assembly:

➔ Check sheet with only inner dimensions of cone assembly



SELVA MARINE Mod. MO 02 06 Rev. 00/2003 Data: 06/2003

SD 40 SAIL DRIVE ASSEMBLY & OPERATION CHECK SHEET

SERIAL:_____ ABSORBER "3" Ø "4" Ø DATE:_____

Enter "V" QUALIFIED or "X" FAULTY in "C" column. Enter corrective measure for faulty items in "Remarks" column.

	Check Items	Standard Value	Measurement	C	Personnel	Remarks
UPPER UNIT	Upper Unit	<A> 78.5				
		Punch the gap at <A>				
	Upper Case	<H1> 100				
	Seal Case	<H2> 15.50				
	Upper Cover	<H3> 16.50				
	Assembly Dimensions	<L1> 68.20	68.17			
		<L2> 35.50	35.48			
		<L3> 55.00	54.95			
		<L4> 15.00				
		<L5> 68.58				
		<L6> 16.20				
	Check backlash and tolerance range for shim adjustment.		Measured value	Actual shim thickness	C	
	Shim	[T1] 0.30				
		[T2] 0.50	2.53			
		[T3] 0.35				
		[T4] 0.60				
		[T5] 2.50				
	Thrust Collar	0.05–0.5				
	Backlash	Upper 0.1–0.2 (SHAFT 0.03–0.06)	/	/		
		Lower 0.1–0.2 (SHAFT 0.03–0.06)	/	/		
	Shaft and inner unit concentricity 0–0.1					
	Check clutch shaft torque and caulking					
LOWER UNIT	Lower Unit	<B> 343.00				
		Punch the gap at <A>				
		<C> 49.00				
	Middle Plate	<H1> 4.00				
	Rear Cover	<H2> 3.00				
	Assembly Dimensions	<L1> 286.35				
		<L2> 3.50				
		<L3> 108.75				
		<L4> 2.75				
	Check backlash and tolerance range for shim adjustment.		Measured value	Actual shim thickness	C	
	Shim	[T1] 0.50				
		[T2] 0.50				
		[T3] 0.75				
		[T4] 0.75				
	Backlash	0.1–0.2 (SHAFT 0.06–0.11)				
MOTORING	Leak test and checking oil leakage					
	Shift Lever Should move smoothly (below 5 kg)					
	NWF / FWN (<Kgf, <1sec.)	2, 3, 4, 5, (Kgf)				
	NWR / RWN (<Kgf, <1sec.)	2, 3, 4, 5, (Kgf)				
	Water tank test	Oil temp. (below 90)				
		Room temp. (measure)				
		Water temp. (measure)				
	No abnormal noise and vibrations during motoring					
SHIPPING	Checking name plates (quantity, positions)					
	External visual checks	Flaws				
		Removal, unevenness of coating				
(Check Dye Pattern)		Gear, Upper (Ahead)		Gear, Lower		
1 / 20 (ONE CHECK EVERY 20 SD ASSEMBLED)						

The L1 value is necessary to determine shim thickness T1, in the formula:

➔ T1 = (A - L1 - 10) ± 0.025 mm

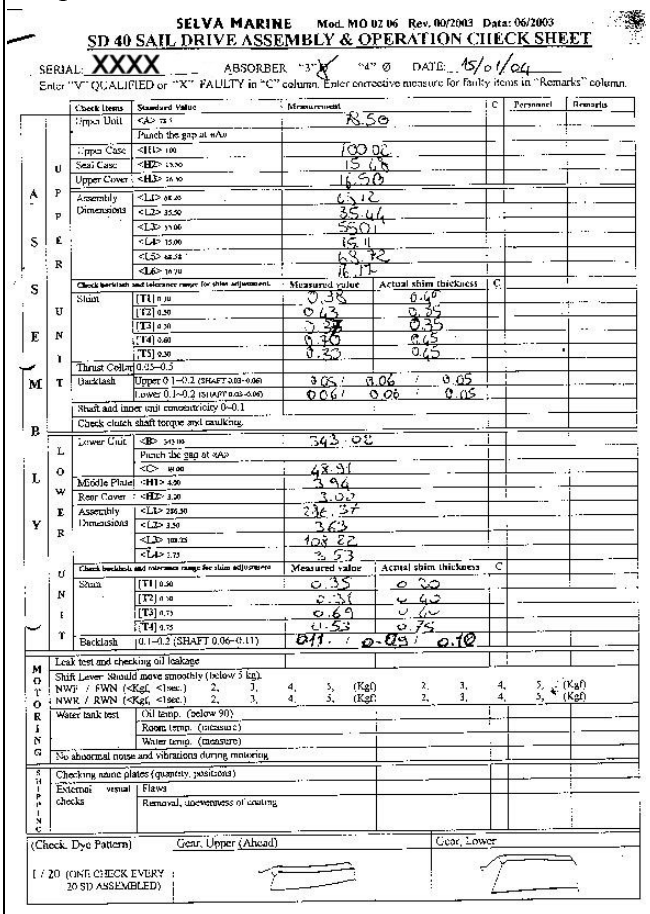
The Shim T2 value "Measured value" is the calculated shim thickness by the following formula:

T2 = (L2 – L3 + 20) ± 0.025 mm

The Shim T2 value "Actual shim thickness" is the shim as installed in the cone assembly

Delivered after notifying Saildrive serial number:

➔ Check sheet with all dimensions for that particular saildrive



SELVA MARINE Mod. MO 02 06 Rev. 00/2003 Data: 06/2003

SD 40 SAIL DRIVE ASSEMBLY & OPERATION CHECK SHEET

SERIAL: XXXX ABSORBER "3" X "4" Ø DATE: 15/01/04

Enter "V" QUALIFIED or "X" FAULTY in "C" column. Enter corrective measure for faulty items in "Remarks" column.

	Check Items	Standard Value	Measurement	C	Personnel	Remarks
UPPER UNIT	Upper Unit	<A> 78.5	78.50			
		Punch the gap at <A>				
	Upper Case	<H1> 100	100.00			
	Seal Case	<H2> 15.50	15.60			
	Upper Cover	<H3> 16.50	16.50			
	Assembly Dimensions	<L1> 68.20	68.12			
		<L2> 35.50	35.44			
		<L3> 55.00	55.01			
		<L4> 15.00	15.11			
		<L5> 68.58	68.72			
		<L6> 16.20	16.17			
	Check backlash and tolerance range for shim adjustment.		Measured value	Actual shim thickness	C	
	Shim	[T1] 0.30	0.38	0.40		
		[T2] 0.50	0.43	0.35		
		[T3] 0.35	0.38	0.35		
		[T4] 0.60	0.70	0.65		
		[T5] 2.50	2.20	0.65		
	Thrust Collar	0.05–0.5				
	Backlash	Upper 0.1–0.2 (SHAFT 0.03–0.06)	0.05 / 0.06 / 0.05			
		Lower 0.1–0.2 (SHAFT 0.03–0.06)	0.06 / 0.06 / 0.05			
	Shaft and inner unit concentricity 0–0.1					
	Check clutch shaft torque and caulking					
LOWER UNIT	Lower Unit	<B> 343.00	343.02			
		Punch the gap at <A>				
		<C> 49.00	48.91			
	Middle Plate	<H1> 4.00	3.94			
	Rear Cover	<H2> 3.00	3.02			
	Assembly Dimensions	<L1> 286.35	286.37			
		<L2> 3.50	3.63			
		<L3> 108.75	108.82			
		<L4> 2.75	2.53			
	Check backlash and tolerance range for shim adjustment.		Measured value	Actual shim thickness	C	
	Shim	[T1] 0.50	0.35	0.20		
		[T2] 0.50	0.31	0.40		
		[T3] 0.75	0.69	0.60		
		[T4] 0.75	0.53	0.75		
	Backlash	0.1–0.2 (SHAFT 0.06–0.11)	0.11 / 0.05 / 0.10			
MOTORING	Leak test and checking oil leakage					
	Shift Lever Should move smoothly (below 5 kg)					
	NWF / FWN (<Kgf, <1sec.)	2, 3, 4, 5, (Kgf)	2, 3, 4, 5, (Kgf)			
	NWR / RWN (<Kgf, <1sec.)	2, 3, 4, 5, (Kgf)	2, 3, 4, 5, (Kgf)			
	Water tank test	Oil temp. (below 90)				
		Room temp. (measure)				
		Water temp. (measure)				
	No abnormal noise and vibrations during motoring					
SHIPPING	Checking name plates (quantity, positions)					
	External visual checks	Flaws				
		Removal, unevenness of coating				
(Check Dye Pattern)		Gear, Upper (Ahead)		Gear, Lower		
1 / 20 (ONE CHECK EVERY 20 SD ASSEMBLED)						

The A value is necessary to determine shim thickness T1, in the formula:

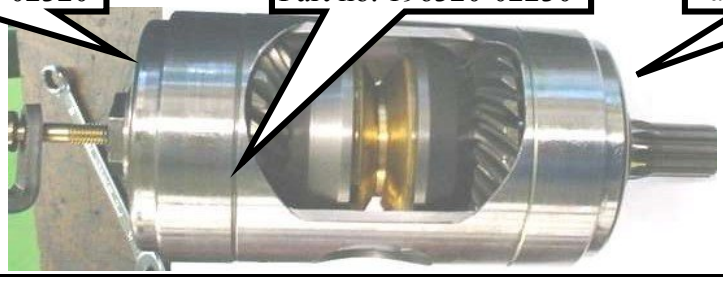
➔ T1 = (A - L1 - 10) ± 0.025 mm

Positions of shims:

T5 = top shim
Part no. 196322-02320

T2 = middle shim
Part no. 196320-02230

T1= bottom shim
Part no. 196322-02320

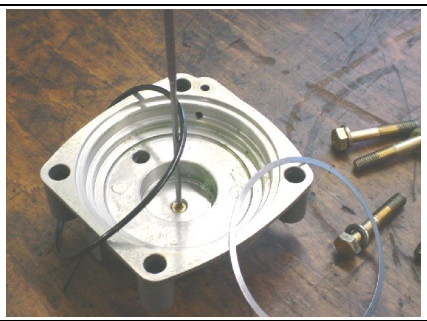


Disassembly-procedure

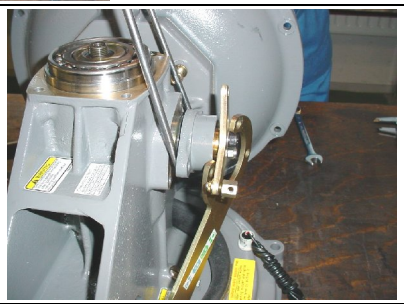
1) Remove all the oil and measure the quantity (see operation manual for procedure).

➔ Do NOT use the oil anymore; oil could have overheated, and there might be debris in the oil !!

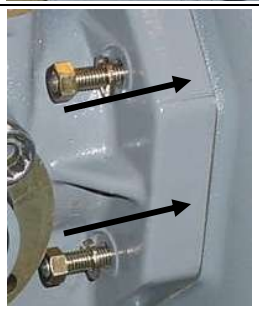
2) Remove topcover (4 bolts)
   Take care for shims T5 and O-ring in the cover ➔



3) Remove remote control shifting cable
4) Remove shifting device assembly and bracket (2 bolts) ➔



5) Loosen the four nuts on the outside of mounting flange
6) 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)



7) Mount the lifting eye with a M8 bolt in the shaft
8) Lift the complete assembly upwards

In case of slipping cone

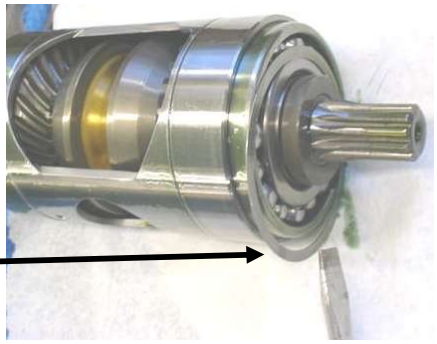
In some cases lapping the cone can solve a slipping cone problem. In that case see Appendix A for procedures.

Re-assembly-procedure

1) Calculate shim thickness T1:
   T1 = (A - L1 - 10) ± 0.025 mm (see first page and page 46~48 in service manual)

➔ Values A and L1 are unique for each cone and saildrive. Value A can be supplied by YMI on request by mentioning **saildrive serial number**. Value L1 is attached with each new cone assembly

2) Calculate and select correct shims T1
3) Insert the shim(s) T1 at the bottom of the upper unit case.



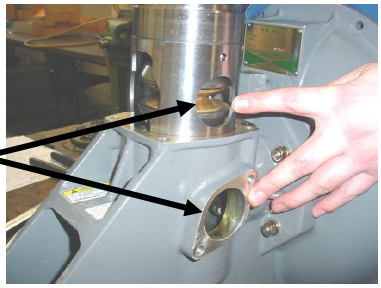
4) Insert new complete assembly

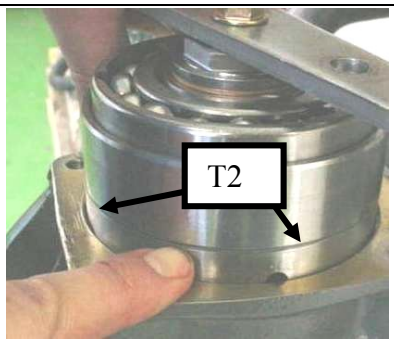
➔ **! Take care of following notices!**

I) Slide in carefully because of tight sliding fit

II) Align the holes in the assembly correctly

III) Shim(s) T2 is already assembled in complete assy. Make sure this shim(s) T2 won't be damaged when the assy is inserted! ➔





5) Turn and wiggle the top nut until the spline at bottom of shaft is seated into the sleeve; the assembly sinks into the housing

6) Measure depth H6 in top cover.
7) Measure bearing protrusion L6.
8) Calculate T5 shim thickness:
   T5 = (H6 – L6) +0~0.05 mm.
   (see first page and page 52 of service manual)
9) Select and position correct shim
10) Mount top cover

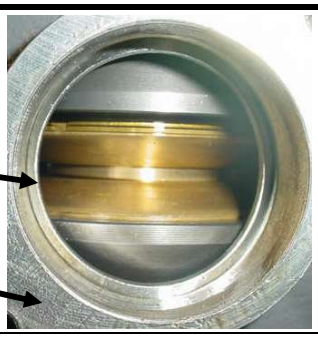
H6 **L6**

Measurement and adjustment of shift lever

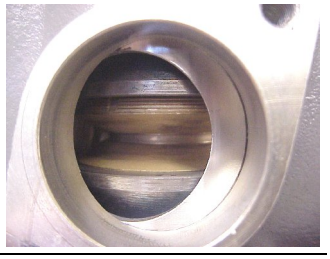
1) First, align hole of the spacer centric to the hole of the housing!!

Spacer

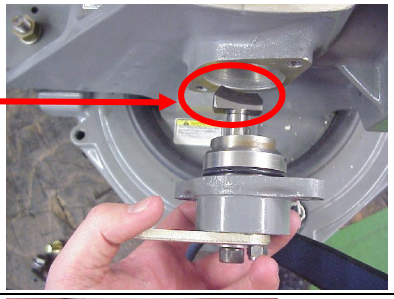
Housing

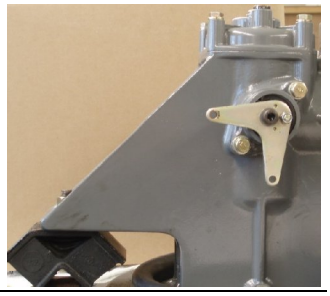


Example Position **NOT OK**:



4) Mount shifter device + bracket;
➔Pay attention to mounting direction of shifter; the wider part should point to the back

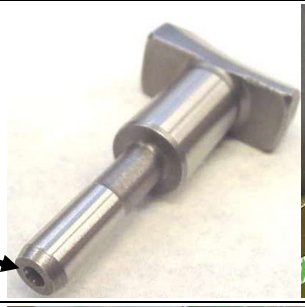


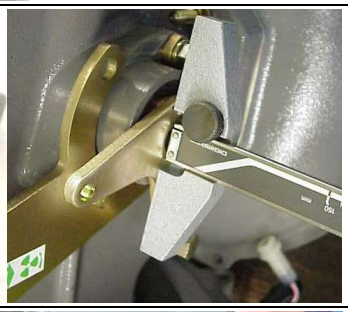


1) Remove the Allan bolt.
2) Measure the bolt-length H (Standard length 17.0 mm).

3) Set the shift lever 10º~15º from neutral position; in this position the shifter is most moved inward

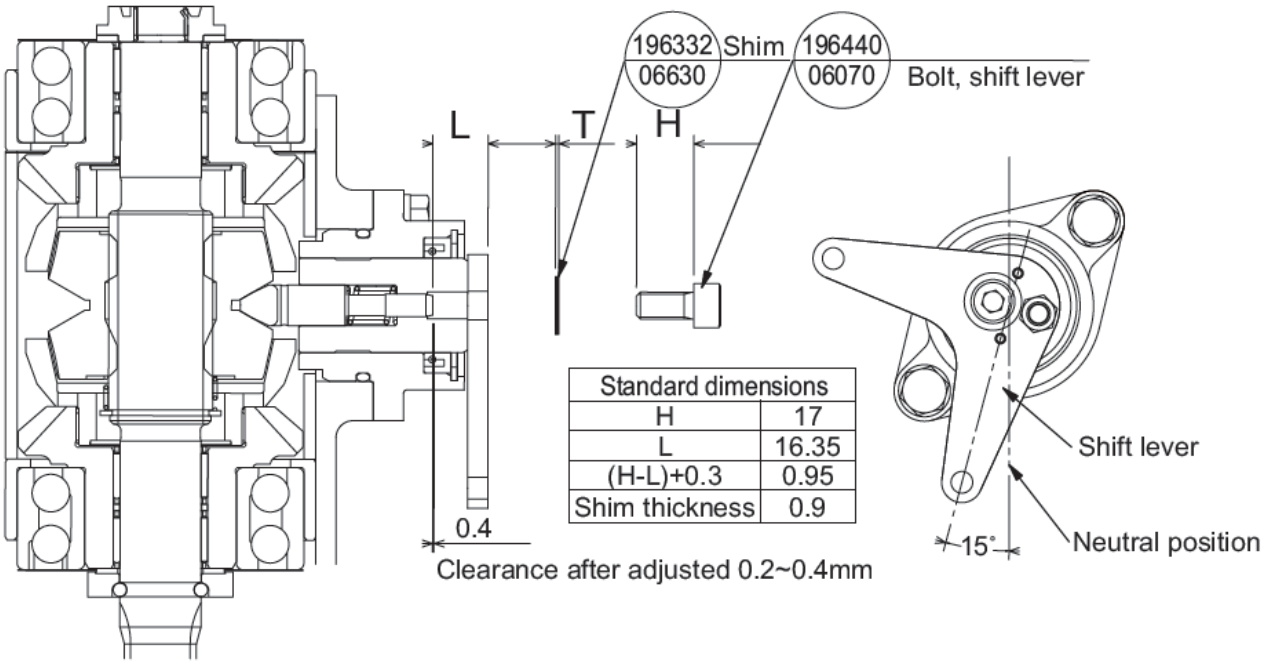
4) Insert depth gauge. Be aware that there is a small hole in the shifter: **be sure not to insert measuring tip of depth gauge in this hole**





5) 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

6) Measure the dimension L (Standard depth 16.35 mm).



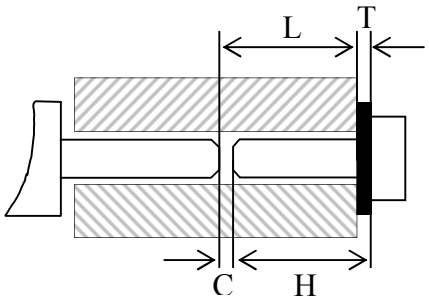
7) Calculate shim thickness: (see page 55~56 in service manual)

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

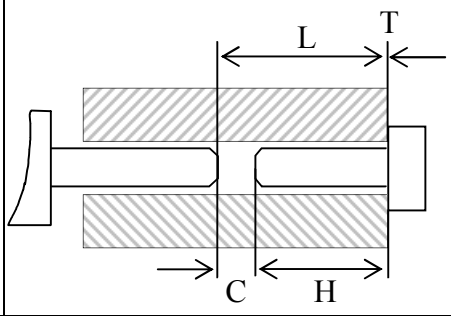
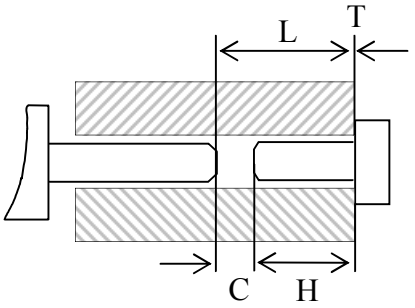
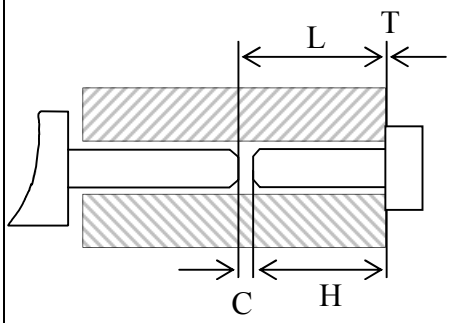
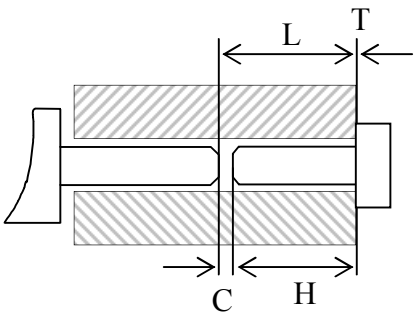
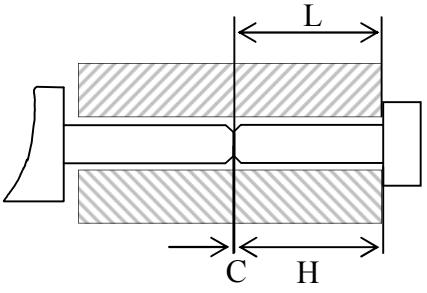
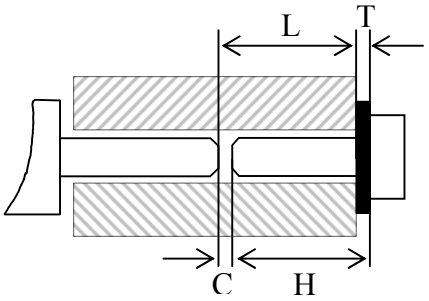
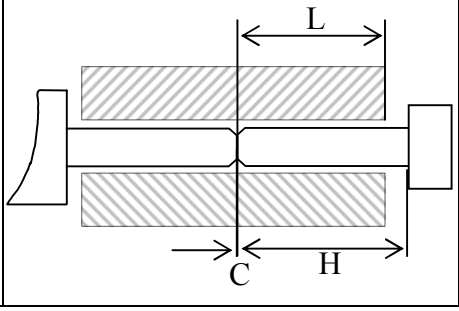
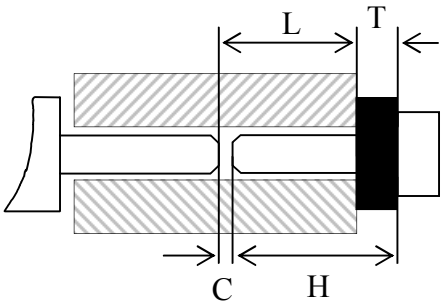


➔ **Tshift formula: T = (H – L + C) ± 0.1 mm**

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.		
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		
Bolt same length as depth H = 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		
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		

8) Select correct shim

9) Apply Threebond 1104 on the Allan Bolt as follows (leave last 5 mm. clean):

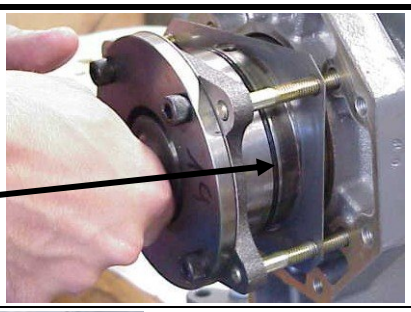
10) Mount the Allan bolt while holding the shift lever

IMPORTANT: CHECK GEAR BACKLASH (UPPER/LOWER GEAR)

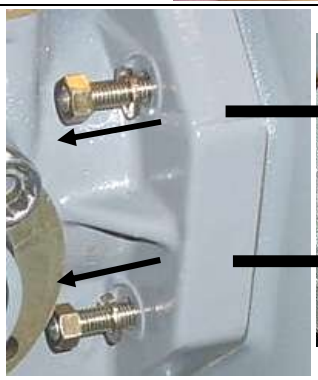
1) Provide wooden supports under the engine and move engine forward (±20 cm, enough to install tool);

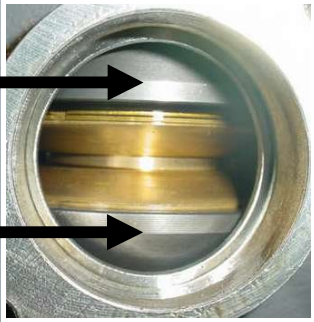
➔ To make backlash adjustment more easy:

2) Remove Pinion shaft assembly
3) Remove O-ring from assembly
4) Assemble pinion shaft assembly again

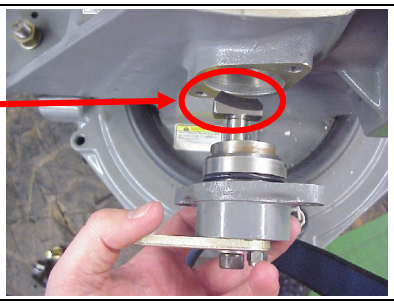


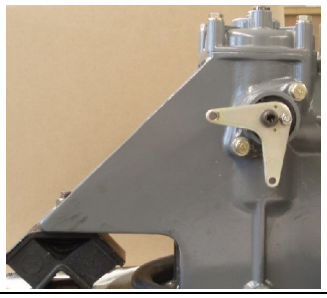
5) Insert inputshaft into housing: Pull threads outwards by pushing with screwdrivers between housing and washers, while at the same time **turn upper and lower gears** through the shifter hole, until pinion gear is seated into upper and lower gear
6) Tighten the four nuts lightly.
7) Align spacer hole with housing





8) Mount shifter device + bracket;
➔Pay attention to mounting direction of shifter; the wider part should point to the back

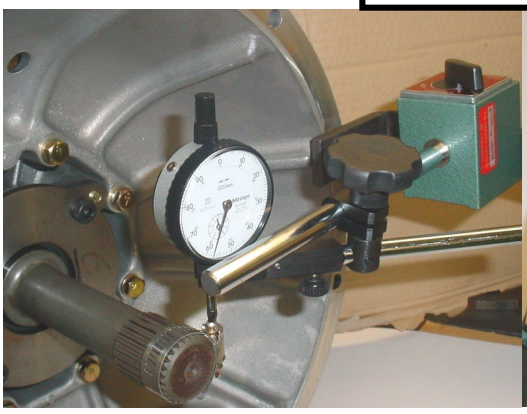


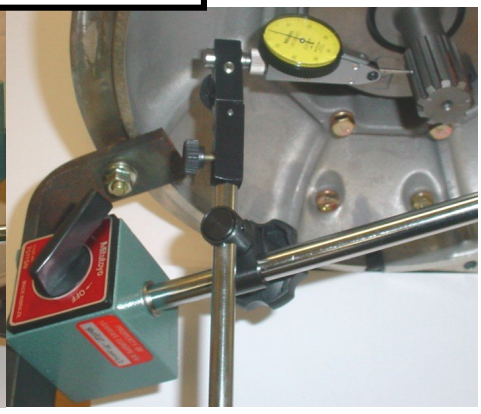


9) Attach an iron metal plate or piece to the Aluminium housing.

Two examples:

10) Mount and position magnetic base and dial gauge

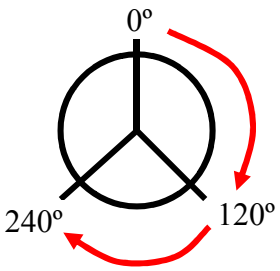




11) Position the measuring tip of dial gauge on the spline of the inputshaft.

12) In case of SD40-4T with small teeth, you can use a clamp around the spline like shown and measure on the clamp

13) Engage shifter to FWD or REV.
14) Measure backlash of the input shaft in FWD and REV at THREE positions!



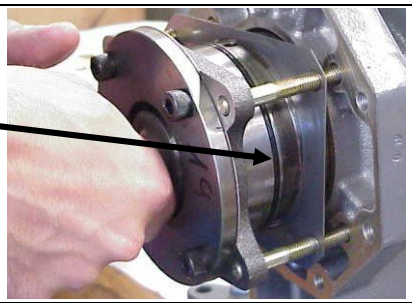
PLEASE NOTICE:
Backlash limit at the gears itself is 0.1~0.2 mm. As the spline diameter is smaller, the backlash measured at the spline is smaller. And if you measure on a clamp instead of on the spline, the backlash measured at the clamp is bigger than measured on the spline-tooth!

	Diameter	**Limit**
Backlash at spline SD40-3 & SD40-4	**28 mm**	**0.031~0.06 mm**
Backlash at SD40-4T when measuring on clamp	**52 mm**	**0.07~0.14 mm**

15) If the backlash of LOWER gear is OUT of the limit, select other shims **T1** until the backlash is in the limit.
➔ **NOTICE**: If you change the Shim T1 you need **also** to change Shim **T5**, see procedure above.

16) If the backlash of UPPER gear is OUT of the limit, select other shims **T2** until the backlash is in the limit.
➔ **NOTICE**: If you change the Shim T2 you need **also** to change Shim **T5**, see procedure above.

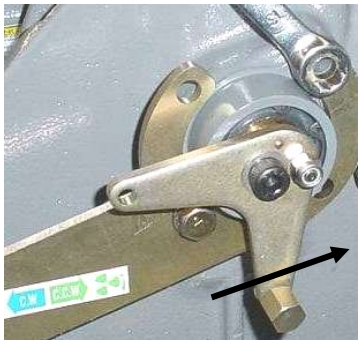
After all shims and backlash are adjusted:
17) Remove Pinion shaft assembly
18) Inspect and install O-ring to assembly
19) Assemble pinion shaft assembly again



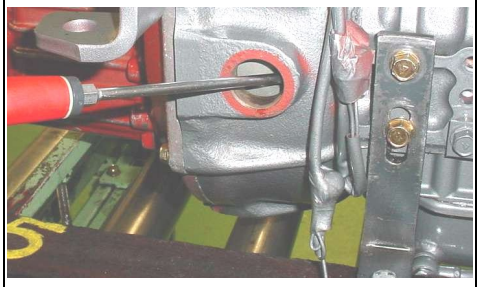
IMPORTANT: TOP NUT torque

20) ➔ Apply or check top nut tightening torque (In case of pre-assembled cone – Only check)

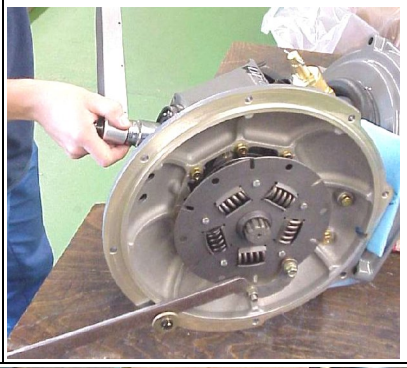
21-a) Turn shifter Counterclockwise (CCW)



21-b) Block pinion shaft: When SD40 is coupled to the engine



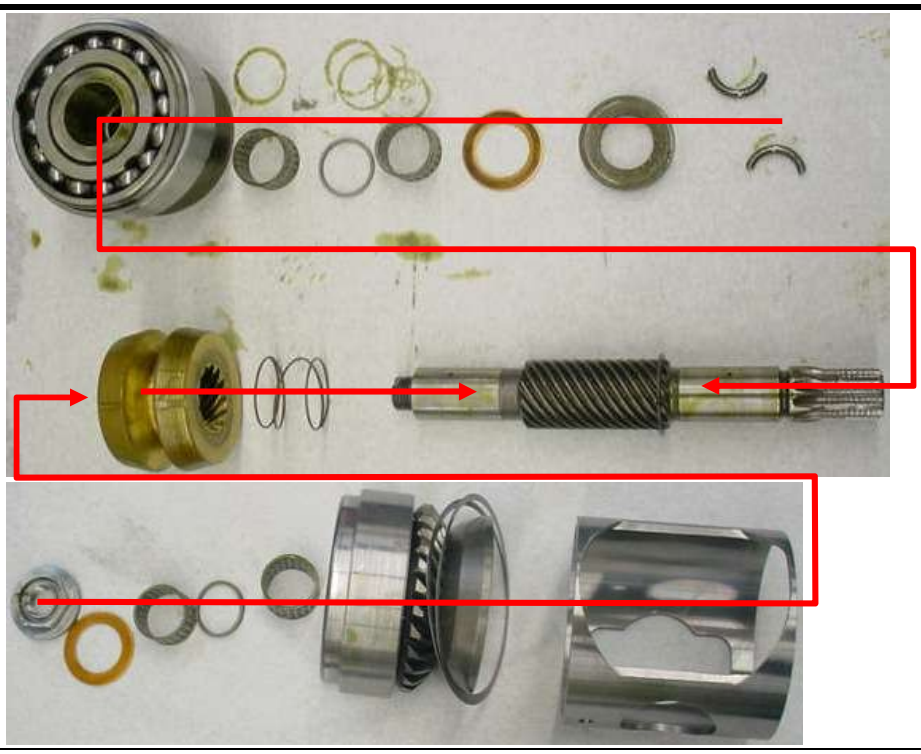
21-c) Block pinion shaft: When SD40 is separated



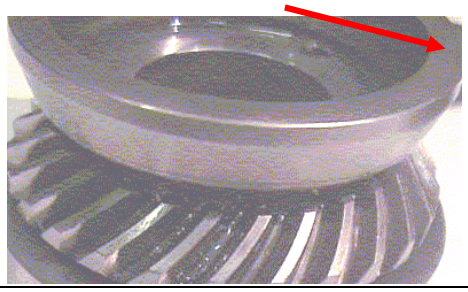
21-d) Fix top nut by tightening torque (left screw) of $147^{\pm 5.0}$ N·m ($15^{\pm 0.5}$ kgf·m)
22) Finalize assembly by caulking the top nut with a flat driver
23) Mount top cover with four bolts

Appendix A: Measuring, checking and lapping procedure for cone (in case of slipping)

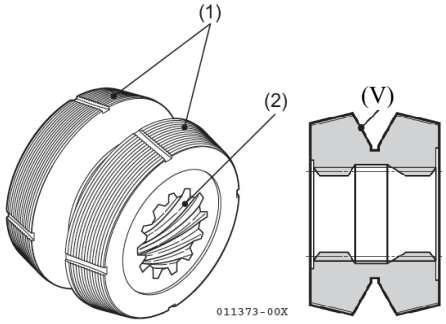
1) Disassemble the complete cone assembly
➔ Pay close attention to mounting order



2) 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.

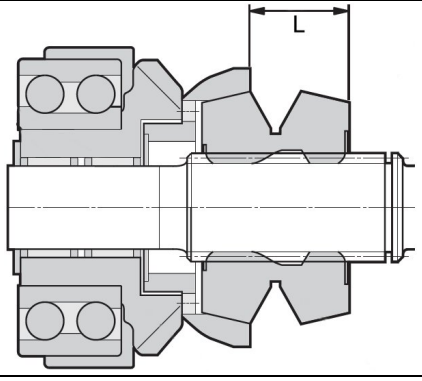


3) Visually inspect the contact surface with thin grooves (1) that contacts with the tapered surface of the gear to check for signs of scoring, overheating or wear. If deep scoring or signs of overheating are found, replace the cone.
4) Check the helical involute spline (2) for any abnormal condition on the tooth surface, and repair or replace
5) If the wear of the V-groove (V) of the drive cone is excessive, replace the part.



6) 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:

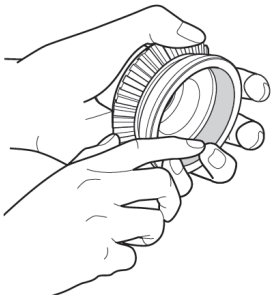
	Standard dimension	Limit dimension
L	29,3 ~ 29,95 mm	29,1 mm



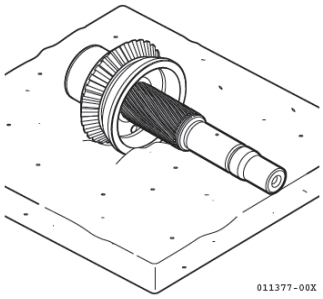
7) When replacing only drive cone, the drive cone and cups need to be lapped slightly prior to assembly (For procedure see next page).

Lapping procedure for cone

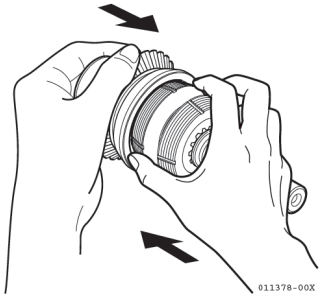
1) Mix lapping powder (67 micron Silicon Carbide #280) with SAE#30 oil, and coat onto the inner taper surface of the cups



2) Set the large gear + cup on the clutch shaft with a needle bearing and then set the drive cone on the clutch shaft



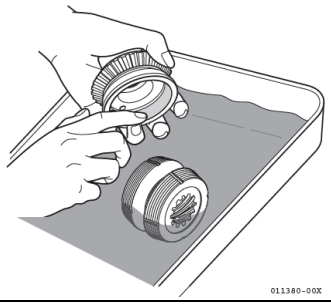
3) Lap the cup and drive cone, pushing them together by hand



4) Push and turn the clutch gear about 5 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.

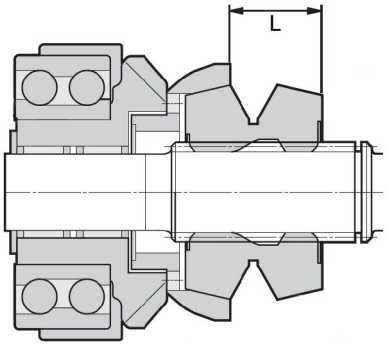


NOTICE!

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

7) 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:

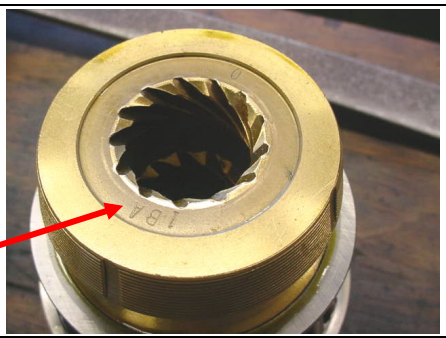
	Standard dimension	Limit dimension
L	29,3 ~ 29,95 mm	28,3 mm

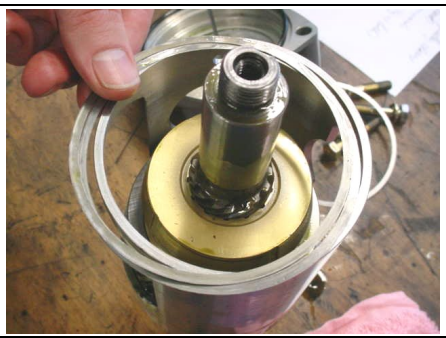


8) **Take Notice!**

a) When assembling all parts, take care of mounting direction of cone: the engraved letter and wide ring should **face down**.

b) Mount T2 on top of spacer





9) Mount upper gear + cup, washers in correct order.

10) Tighten the top nut by small torque.

11) Continue with Re-Assembly procedure (Page 4 of 10).