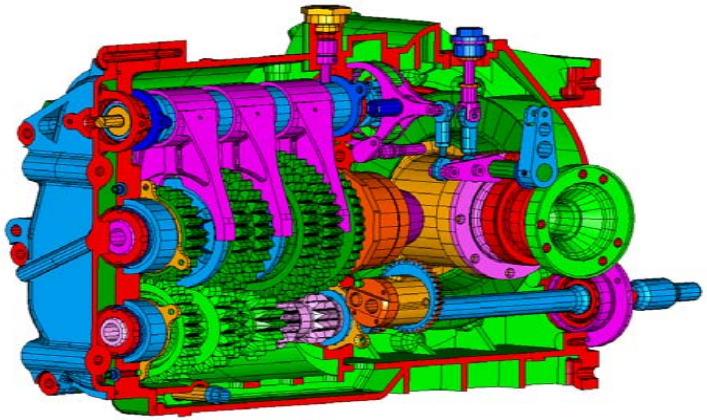
Swift Engineering Inc.

Swift SG3 Gearbox Service Manual



Swift Engineering Inc.
1141A Via Callejon
San Clemente, CA 92673
TEL 949-492-6608
FAX 949-492-7516
info@swiftengineering.com
www.swiftengineering.com

Part Number SG3-Manual

CONTENTS

ILLUSTRATIONS

WARNING

THE SWIFT PRODUCTS WHICH ARE THE SUBJECT OF THE SERVICING INSTRUCTIONS AND ILLUSTRATED PARTS LIST FOR THE SWIFT SG3 GEARBOX ARE INTENDED TO BE USED IN ULTRA-HAZARDOUS ACTIVITIES AND ARE SUBJECT TO THE FOLLOWING WARNING:

(a) SWIFT PRODUCTS ARE INTENDED FOR USE IN OR AS HIGH SPEED AND HIGH PERFORMANCE RACING VEHICLES. THE RACING OF HIGH SPEED AND HIGH PERFORMANCE VEHICLES IS AN ULTRA-HAZARDOUS ACTIVITY AND INVOLVES A SUBSTANTIAL POSSIBILITY OF SERIOUS PHYSICAL INJURY OR DEATH. SWIFT PRODUCTS WILL NOT WITHSTAND ALL FORESEEABLE IMPACTS DURING THEIR NORMAL INTENDED USE IN OR AS A RACING VEHICLE WITHOUT THE SUBSTANTIAL POSSIBILITY OF SERIOUS PHYSICAL INJURY OR DEATH TO THE DRIVER OR DAMAGE TO SWIFT PRODUCTS WHICH MAY AFFECT SUCH SWIFT PRODUCT'S PERFORMANCE AND SAFE USE.

(b) SWIFT PRODUCTS SHOULD ONLY BE DRIVEN OR USED (1) BY A DRIVER WITH THE REQUISITE TRAINING, SKILL AND EXPERIENCE NECESSARY FOR THE RACING OF HIGH SPEED AND HIGH PERFORMANCE VEHICLES; (2) ON SPECIALLY DESIGNED RACING TRACKS AND UNDER THE SUPERVISION OF SANCTIONED RACING ORGANIZATIONS OR OTHERWISE UNDER PROPER AND REASONABLE OPERATING CONDITIONS; AND (3) WITH PROPER MAINTENANCE AND REPAIRS TO PARTS SUBJECT TO WEAR AND TEAR, FATIGUE, OR DISINTEGRATION, AND/OR DAMAGE DUE TO COLLISION OR IMPROPER USE.

INFORMATION DISCLAIMER

The information and/or graphics presented in the Swift SG3 Gearbox Service Manual may include inaccuracies or typographical errors. Changes and/or improvements may also be made to the information presented herein without notice at any time. Swift Engineering Inc. makes no representations about the suitability, reliability, availability, timeliness or accuracy of the information and/or graphics presented herein. All such information and/or graphics are provided "AS IS" without warranty, representation or guaranty of any kind, express or implied. Swift Engineering Inc. hereby disclaims all warranties and conditions with regard to this information and/or graphics, including all implied warranties and conditions of merchantability, fitness for a particular purpose, and workmanlike effort.

The user of the information and/or graphics contained in the Swift SG3 Gearbox Service Manual is solely responsible for its use. If the user is dissatisfied with any of such information and/or graphics, or with the terms of use, the user's sole and exclusive remedy is to discontinue using the information and/or graphics. In no event shall Swift Engineering Inc. be liable for any direct, indirect, incidental, special, consequential damages whatsoever, including, without limitation, damages for accident, injury, property damage, loss of use, loss of data or loss of profits, arising out of or in any way connected (i) with the use or performance of the information and/or graphics presented in the Swift SG3 Gearbox Service Manual , (ii) with any inability to use such information and/or graphics, or (iii) with any other use of such information and/or graphics, whether such damages are based on contract, tort, negligence, strict liability or otherwise, even if Swift Engineering Inc. has been advised of the possibility of damages.

DESCRIPTION

The SG3 gearbox is a transaxle unit, designed for mid-engined, rear wheel drive cars. The unit is produced with five forward gears, reverse, and a powerflow differential.

The gear selection mechanism is sequential, with a separate mechanically actuated reverse / neutral lockout mechanism. The gear selection order is Rev - Neutral - 1st 2nd 3rd 4th 5th.

The SG3 gearbox has built in selectable shaft locking to facilitate tightening of the shaft nuts. Therefore **it is imperative that the reverse lockout plunger is always fitted before using the gearbox.**

The drive is taken from the engine via the clutch shaft, which turns input and pinion gears to drive the final drive and differential.

Gear changing is effected through non-synchronising face dogs. An extensive range of gear ratios provides a wide range of gearing permutations. The gear ratios and differential assembly can easily be changed without removing the gearbox from the vehicle.

Heat treated nickel chrome steel is used to manufacture all gears and shafts. The selector forks are also steel. The gearbox has an extensive lubrication system via an internal gear type pump.

In general configuration, the SG3 gearbox is a high tech racing transaxle unit which achieves the maximum effective use of power in conjunction with extremely stiff integral rear suspension and wing mountings.

TECHNICAL SPECIFICATIONS				
Weight	88 lbs (40 Kg)		Final drive ratio	9/34
Oil type	SAE 80 or 90		Clutch shaft	Made to customer's requirements
Oil quantity	2.65 US pints (1.25 litres)		Pinion shaft nut tightening torque	120 lbs.ft. (160 Nm)
Oil qty (with oil cooler)	3.12 US pints (1.48 litres)		Pinion bearing nut tightening torque	150 lbs.-ft. (205 Nm)
Max. torque	195 lbs.-ft (265 Nm)		Layshaft nut tightening torque	80 lbs.-ft. (110 Nm)
Max. power	300 Hp		Crownwheel bolt tightening torque	75 lbs.-ft. (100 Nm)

GENERAL NOTES

1. Read these instructions carefully and with reference to the illustrations.

2. Before dismantling the gearbox, see that a clean tray is available, in which to place the parts.

3. Thoroughly clean and inspect all parts before reassembly. Discard any worn or damaged components and replace with new ones.

4. Use only genuine Swift parts as replacements. These are manufactured to the fine tolerances necessary and are rigorously inspected.

5. Always ensure that locknuts, locking washers, and oil seals are in good condition when reassembling.

6. All studs and screws must be secured using a threadlocking adhesive or wirelocked in position, unless stated otherwise.

7. Bearing Replacement : Bearings can only be removed or installed if the casings have been warmed in an oven or with a torch. In the latter case, keep the torch moving while heating the casing. Use caution not to overheat the case. Test with a spot of water which will bounce off at the correct temperature or use a temperature crayon (approx 120ºC/250ºF). Once the case is heated, all bearings should be pressed into their respective seatings without delay, thus eliminating the need to reheat. At the correct temperature, fitting the bearings should present no difficulty. Ensure that the layshaft front bearing has the anti-rotation hole aligned with the screw hole. When the case has cooled lightly press the bearings to ensure that they are correctly seated.

8. Oil: Fill the gearbox through the plug hole on top of the maincase. The oil will find it's own level within the gearbox. Too much oil will not directly cause any harm, but is undesirable as it may induce power loss and overheating of internals.

DIFFERENTIAL BEARING PRELOAD

Requires special tool SG3-SK-119 (2 Required)

Assemble the differential case (86) and end cap (86.2), and bolt the crownwheel (88.2) to it. Fit the differential unit into the maincase (72) using dummy bearings SG3-SK-119 and fit the sideplate (74). Adjust the shims (24) if necessary, to achieve .007”/.009” preload across the bearings.

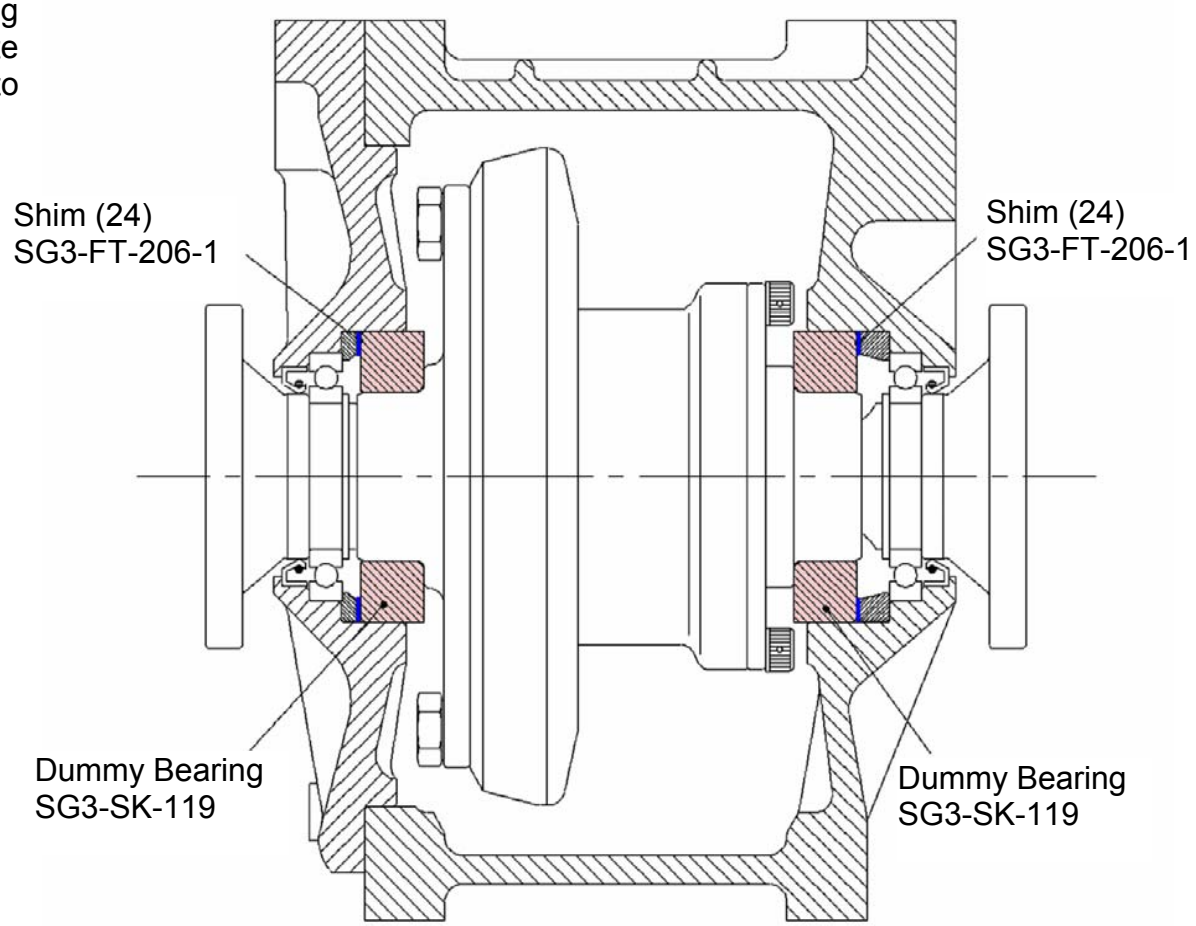


fig. 1

PART No.	RATIO	MOUNTING DISTANCE	ITEM # (23)	ITEM # (23)
SG3-221-9/34	9/34	1.800”	SG3-FT-205-2A	SG3-FT-205-2A

PINION SHAFT SETTING

Requires special tool SG3-SK-1722

Press the pinion head bearing assembly (35) onto the pinion shaft (88.1). Heat the maincase in the area of the pinion bearing (use a metal heat shield to prevent overheating of the selector components) and insert the pinion shaft with its bearing assembly and a .010" shim (37) into the maincase. Install the pinion bearing washer (38) and nut (36) and tighten to the specified torque. Slide hubs (29, 89), bearing inner tracks (27, 28), washers (90, 91) and the pinion tail bearing (4) inner race onto the pinion shaft and install and torque the pinion shaft nut (146) to the specified torque using socket SG3-SK-962.

Fit tool SG3-SK-1722 into the maincase differential bearing bore, and use feeler gauges to measure the gap between the tool and the pinion front face. This clearance should comply with the dimension indicated on the pinion shaft label (also stamped on the front face of the pinion shaft), and can be adjusted by adding or removing shims (37) from behind the pinion head bearing housing (35).

Important Note: It is imperative to check the selector barrel setting after changing / resetting a pinion shaft or pinion head bearing.

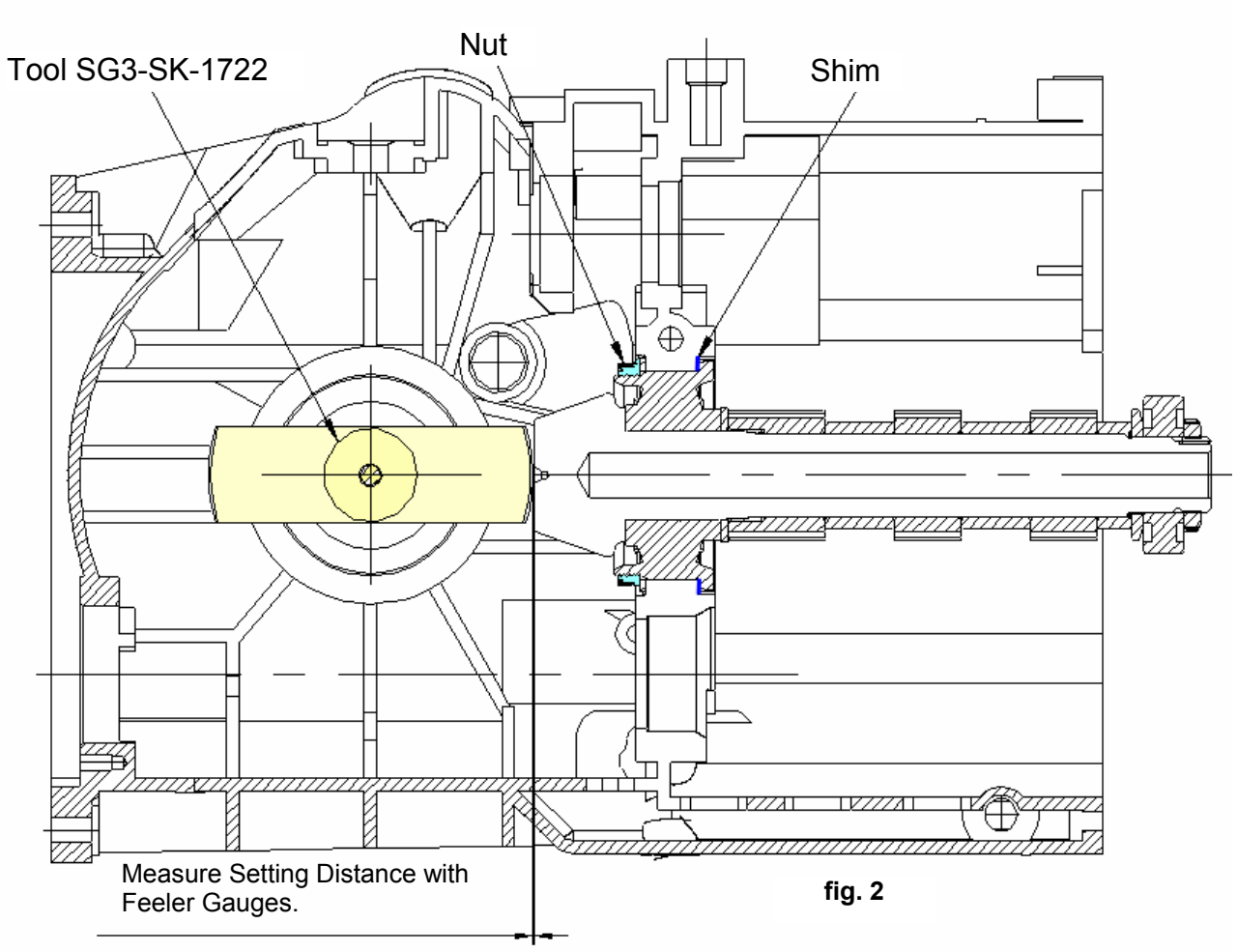


fig. 2

SETTING CROWNWHEEL BACKLASH

With the pinion shaft correctly fitted and the correct crownwheel bearing shims ascertained, the actual backlash can be measured by means of a dial indicator against the crownwheel tooth flank (fig 3a & 3b). Be sure to take at least 6 backlash readings, turning the crownwheel 30-45 degrees between each reading to account for any variation due to manufacturing tolerances.

Using this method the minimum backlash should be .005" (.127mm). If the measured backlash is incorrect, remove the appropriate thickness of shims (24) from behind one differential bearing and insert them behind the other differential bearing, thus moving the differential laterally in the maincase.

Do not add or discard any shims at this stage as to do so would affect the differential bearing preload. Once the correct backlash has been achieved, replace the dummy differential bearings with bearings (22) and confirm that the backlash is still correct.

Note: Dummy bearings are used so that it is easy to change the shims during the setting procedure. Before fitting the actual differential bearings it is important to compare their width with that of the dummy bearings and compensate the shims accordingly for any difference.

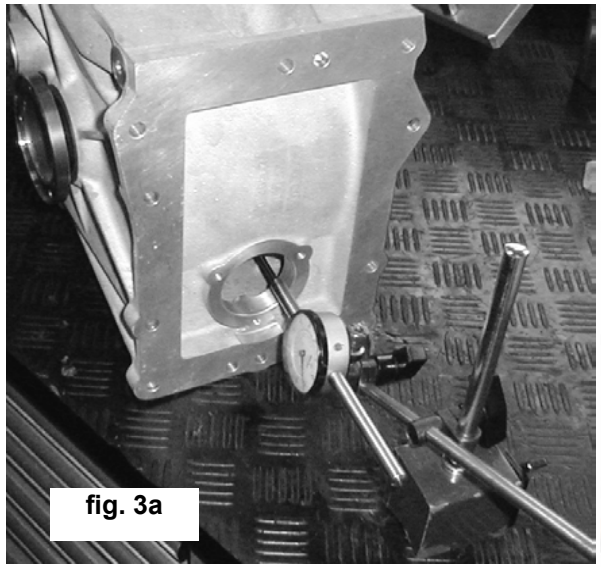


fig. 3a

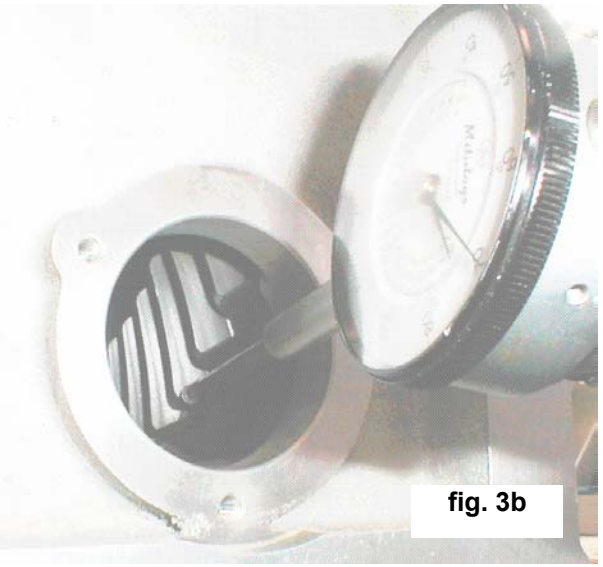


fig. 3b

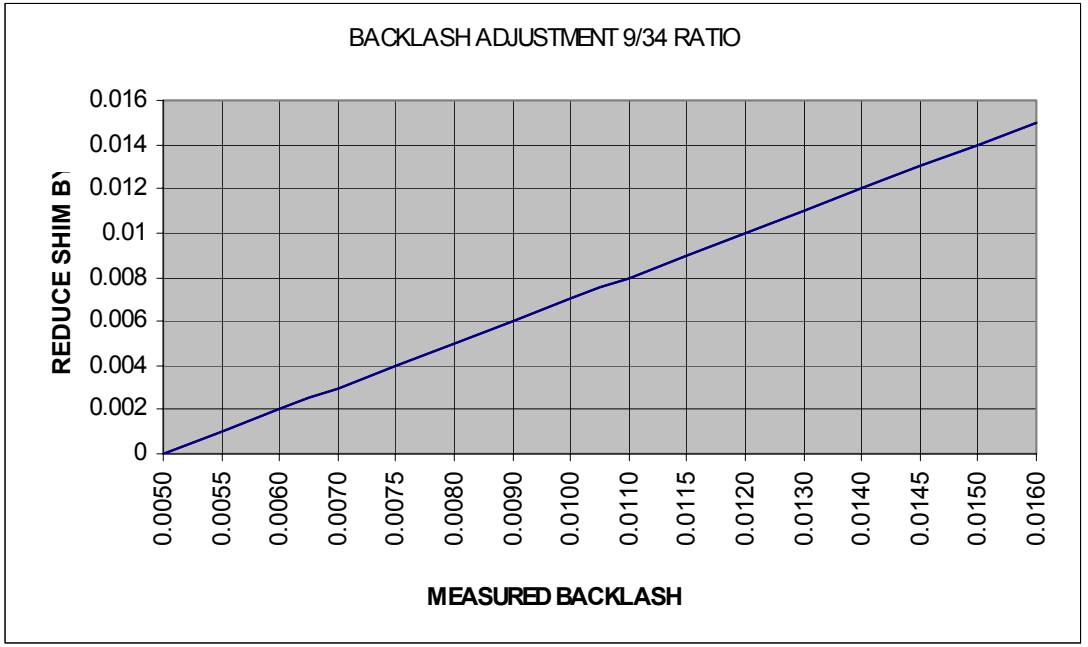


fig. 4

SETTING BARREL ALIGNMENT - Requires special tool No.SG3-SK-1721

1. Place the roller (5) onto the detent plunger (2), and insert them into the bearing carrier (71). Slide the bearing retaining plate (77) into position and insert the screws (63).

2. Assemble the spacers (106,107), springs (119), bearing (3), barrel (99) and circlip (12) into the bearing carrier, and secure using bearing retaining plate (82) and nuts (51). Ensure that each spring is oriented so that it's overlapping ends are not aligned with those of any other springs in the same set. It is necessary to apply about 100 lbs. force to compress the springs to enable the circlip to be fitted. This can be done by hand or in a press using an appropriately shaped mandrel.

3. Add the detent spring (1), bonded seal (129), and detent plug (81).

4. Slide the selector forks (98) over the barrel (99) and secure using selector pins (46). Use a threadlocking adhesive on the pins for final assembly.

5. Measure the depth from the rear face of the maincase to the rear face of the pinion bearing inner race. Use shims to reproduce the same measurement on the fork setting fixture from the shoulder of the dummy shaft to the ends of the spacer bars.

6. Stack the pinion gears (115.1,116,117), hubs (29,89), bearing tracks (27,28), clutch rings (93), reverse sliding gear (92) and spacers (90,91) in place in the bearing carrier and slide the assembly onto the dummy pinion shaft of the fork setting fixture.

7. Torque the pinion shaft nut (146) onto the end of the dummy pinion shaft.

8. Rotate the barrel to the neutral position. Measure and record the gap between the dogfaces of first and fifth gears. First, third and fifth gear dog gap measurements will be similar as will second and fourth. Any difference between the odd and even gear measurements must be adjusted by changing the thickness of the pinion shaft spacer (91).

Note:
It is not possible (or necessary) to adjust each fork individually.
After setting the forks, engage each gear in turn and ensure that there is no binding of the pinion gears against the hubs. Such binding is indicative of incorrect barrel setting or damaged parts.

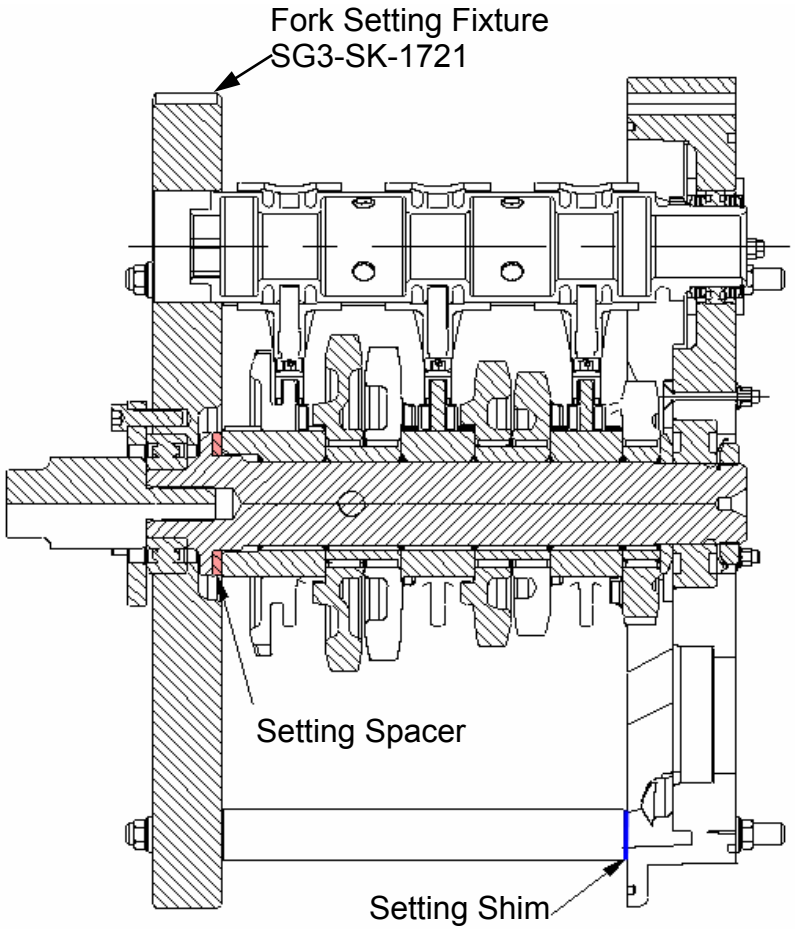


fig. 5

POWERFLOW DIFFERENTIAL

This powerflow differential unit is designed with versatility as its major asset. Many factors will contribute to the settings required. A car with good traction and low power may require a completely different arrangement to that of a car with poor traction and high power.

There are 10 friction plates within the unit, 4 splined (86.3) to the differential casing (86.9) and 6 splined (86.7) to the side bevel gears (86.8). Slip limiting is dependent on the friction resistance between these plates, and is affected by clamping the plates together. Four factors contribute to the total friction torque between the plates (see equation for torque locking on page 27):

1. The side bevel gears (86.8) thrust apart to clamp the plates as they transmit the driving torque. This is a feature of the gear geometry and is not adjustable.

2. The ramp angles cut on the side ring gears (86.6) have an effect on how much of the transmitted torque is converted into sideways (clamping) force onto the plates. For example, on the drive side ramp, 45 degrees transmits less sideways force than 30 degrees. Likewise on the coast side ramp, an 80 degree angle will transmit little or no clamping force onto the plates, whereas a 45 degree angle will transmit a much greater force. Side ring gears (86.6) are available with many different drive/coast ramp angle combinations.
Note: Ramp angle notation convention is [Drive/Coast].

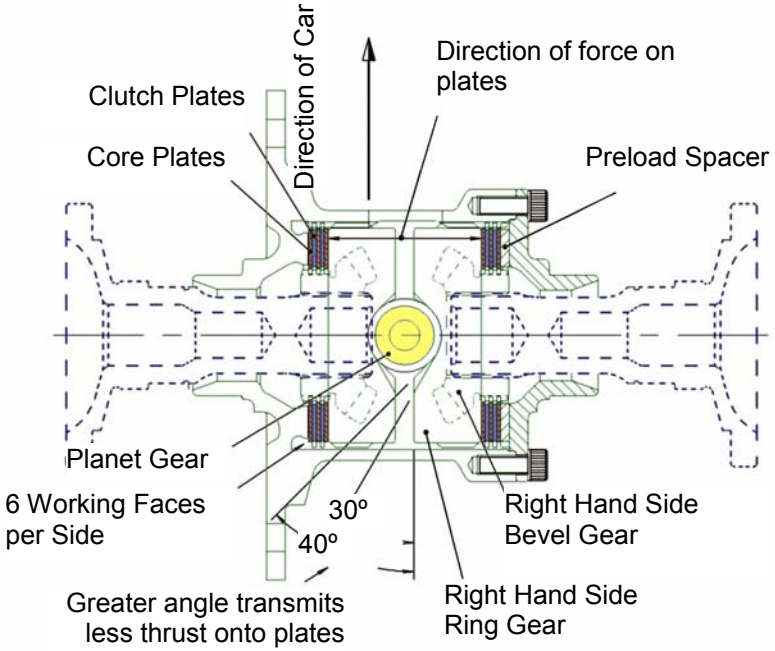


fig. 6

3. The second adjustable factor is how tightly the plate stack is compressed on assembly (known as static preload). Included in the plate stack is a preload spacer (86.4). The preload torque is measured between the side bevel gears by holding one side bevel gear (86.6) stationary and measuring the torque required to turn the other using tools SG3-SK-846. When the differential is assembled, the preload torque must be at least 10 lbs.ft, but can be much greater if required. Note that new plates 'run in' so a higher preload is advised than with used plates.

4. The final adjustment is simply to re-order the plate stack so as to change the number of relatively rotating faces. The diagram shows the stack setup with the maximum 12 working faces. Standard stack may be shuffled to give as few as 2 working faces.

GEARBOX ASSEMBLY

1. It is assumed that all bearings, oil seals, studs, oil jets, and dowels are already fitted into casing. (see page 5).

2. Slide the rearmost tophat bush (31) into place in the maincase, then slide it rearwards as far as it will go. Push the other tophat bush into place in the maincase. Press the bearing into the reverse idler gear (95), slide the sleeve into the bearing and position the gear between the tophat bushes with the chamfer facing aft. Apply threadlocking adhesive to the retaining bolt and tighten into place.

3. Assemble and lubricate the oil pump (113). Slide on the pump drive gear (142) and secure with circlip (127). Fit the pump in place in the maincase and secure with screw (122).

4. Slide the crank spindle (108) into it's bearings (9), slide on the washer (135) and fit the selector lever (112) to the crank spindle using roll pin (33). Assemble spherical rod end pair #1 (101 & 111) and adjust to centre distance 1.75" and lock with nut (54). Attach one rod end to the clevis (102) using screw (66) and nut (51). Push the clevis into the bore in the maincase, then add the washers (130), spring (120), spacer (19), screw (65), and plug (78) from the outside of the maincase. Attach the lower rod end to the crank (108) using screw (61) and washer (131).

5. Press the bearing (10) into the ratchet arm (110) bore. Sub-assemble the pawls (109) and spring (137). Fit the pawls into the ratchet arm (110), and secure with screws (70) and nuts (51). Assemble spherical rod end pair #2 (101 & 111) and adjust to centre distance 2.00" (with rod end axes at 90°) & lock with nut (54). Secure one of the rod ends to the ratchet arm using screw (61). Fit the tophat spacer (104) into the maincase. At this point it is useful to wedge the pawls in their fully disengaged position by inserting a piece of sheet metal (approx 1.25" wide) between them, adjacent to the spring. Hold the ratchet arm in position in the maincase, then fit the spindle (103) and secure with screw (67). Attach the lower rod end to the crank spindle (108) using screw (61) and washer (131). Insert the barrel driver into the maincase, through the ratchet arm (take care not to trap the pawls) and secure into the bearing with nut (40). Add the bearing retaining plate (49) and screws (45). Remove the sheet metal tool from between the pawls to allow them to engage the barrel driver.

fig. 7

6. It is important that the backlash between the barrel driver and the pawls be equal in both upshift and downshift directions. Ensure that the barrel (99) and barrel driver (100) 'D' drives are indexed similarly, then temporarily fit the barrel and bearing carrier (71) onto the maincase. Restrain the barrel from rotating by fitting a temporary dowel in place of the detent spring and lightly screwing the detent cap down onto it. Measure the movement of the selector lever (fig. 7) in both

upshift and downshift directions. If the movement is not equal in both directions it can be adjusted by lengthening or shortening rod end pair #1.

7. Add the reverse lock plunger (84), 'o'ring (56), spring (121), and cap (85). Note: When inserting the gear cluster, ensure that the barrel is in the neutral position or that the reverse lock plunger is lifted to avoid damaging either.

8. Oil the pinion head bearing, and fit the pinion shaft and pinion head bearing assembly as described on page 8.

9. Fit the clutch shaft bearing (8), seal (26) and circlip (15) into the clutch shaft bearing housing (97). Slide the bearing assembly over the clutch shaft (96) and secure with circlip (14). Fit a wire clip (11) onto the clutch shaft, slide on the oil pump driver gear (143) and add the second wire clip (11). The second wire clip is only fitted to hold the pump gear in position when changing ratios. It serves no purpose when the gearbox is fully assembled. Slide the clutch shaft assembly into the maincase and secure with screws (45) and washers (132).

10. Adjust the differential bearing preload (see page 7) and the crownwheel backlash (page 9). Oil the differential case taper roller bearings and load the differential assembly through the sideplate bore. Install the sideplate and secure with nuts (50).

11. Carry out sequential barrel setting as described on page 10.

12. Build the gear cluster up onto the bearing carrier. Note that the 'D' drive on the barrel and driver have the flat horizontal and at the bottom of the barrel driver when neutral is selected. Offer the whole assembly up to the maincase and slide the complete cluster into position. It may be necessary to rotate the shafts or clutch rings to help engage the pinion shaft splines.
Tighten the layshaft nut (53) to the specified torque settings (see page 5). Bend the tab washer (134) to lock the nut. Tighten the pinion shaft nut (146), fit the vernier locking ring (148) and secure with the circlip (147). Check that all gears are selectable and that the selector lever returns freely to it's rest position after each shift.

Note: A barrel position has been provided which selects two gear simultaniously and so enables tightening of the shaft nuts by preventing rotation of the pinion shaft. This position can be selected by upshifting from 5th gear while pulling the reverse lock plunger. FOR THIS REASON IT IS IMPERATIVE NOT TO USE THE GEARBOX WITHOUT THE REVERSE LOCK PLUNGER FITTED. It is not possible to select this barrel position without first withdrawing the reverse lock plunger.

13. Position the rear cover (73) and secure with nuts (50) Assure that the oil spray tube aft o-ring is in position before fitting the rear cover.

CHANGING GEAR RATIOS

1. With a drip tray beneath the gearbox, remove the nuts (50) and remove the rear cover (73). If the cover is found to be tight or stuck, tap it gently with a soft faced mallet to break the joint. (Never attempt to force the cover off by levering between the joint faces, as this may damage the castings and result in an oil leak).
2. Pull the reverse lock and select locking position over 5th gear. This engages 1st and 5th gears together to lock the shafts. Remove the pinion and layshaft nuts (52,53) and washer (133) and loosen the layshaft.
3. Ease the bearing carrier and gear cluster assembly out of the maincase. The pinion shaft gears and hubs will need supporting as the cluster is withdrawn. This can be done by hand or by inserting tool SG3-SK-1727 through the pinion shaft tail bearing (4) .
4. Take the pinion shaft gears (116), bearings (47), hubs (29,27,28) and reverse pinion gear (92) out of the assembly.
5. Remove the layshaft nut and washer (53,134) and withdraw the layshaft (115). The input gears (116,117) may now be removed.
6. Replace the gears with the correct ratios. Gears must be exchanged in matched pairs. For identification purposes, each gear is marked with two sets of numbers. The first of these indicates the number of teeth on the layshaft gear while the second number indicates the number of teeth on the mating pinion shaft gear. It is essential that these gears are correctly paired to as mismatching of types will result in damage or failure. For first gears, the teeth are machined integral with the layshaft. If change is required to either of these ratios both the pinion shaft gear and the layshaft itself will have to be changed.
7. While changing ratios it is advisable to wash and inspect all components which are to be refitted. Check for wear and cracks, particularly to the engagement dogs. If the corners of the engagement dogs are badly damaged, gear selection will be poor and the selector components may be damaged. If the driver has experienced any difficulty in selecting gears, check for bent selector forks, a worn or damaged barrel or a damaged fork pin. A good tip is to check the fork setting in the fixture each time the gearbox is re-assembled. A bent fork will show up as a badly set fork (unequal dog gap on each side of the relevant clutch ring).
8. Re-assembly is the reverse of the above. See page 5 for nut torque settings. Ensure that the barrel is in the neutral position before assembly into the maincase.

Note:
The layshaft rear bearing inner track consists of a flanged race and a thrust ring. The thrust ring should be fitted on the forward side of the rollers to avoid the possibility of it dropping into the groove at the end of the layshaft thread.

GEAR POSITION INDICATOR

The 2002 Swift Formula Atlantic car has facility to display gear position. Please read the following instructions carefully, as failure to do so may lead to the driver's display giving incorrect gear position indication.

1. The potentiometer has a small marker (dimple) on one end of it's tang drive. With first gear selected, the potentiometer should be mounted on the gearbox rear cover, with the tang marker to the right side of the car and the wires exiting from the top of it's body. If it is more convenient to have the wires exiting from the bottom of the unit, assemble the unit with the tang marker to the left side of the car.
2. Switch on the vehicle power supply to the potentiometer. This should consist of +5 volts at the brown wire and ground at the orange wire. Connect a voltmeter across the red wire and ground, and turn the potentiometer body until a reading of 0.50 ±.01 Volts is obtained (again, with neutral selected). Tighten the fixing screws in this position.
3. The Toyota ECU must be programmed to the values shown in the table opposite.

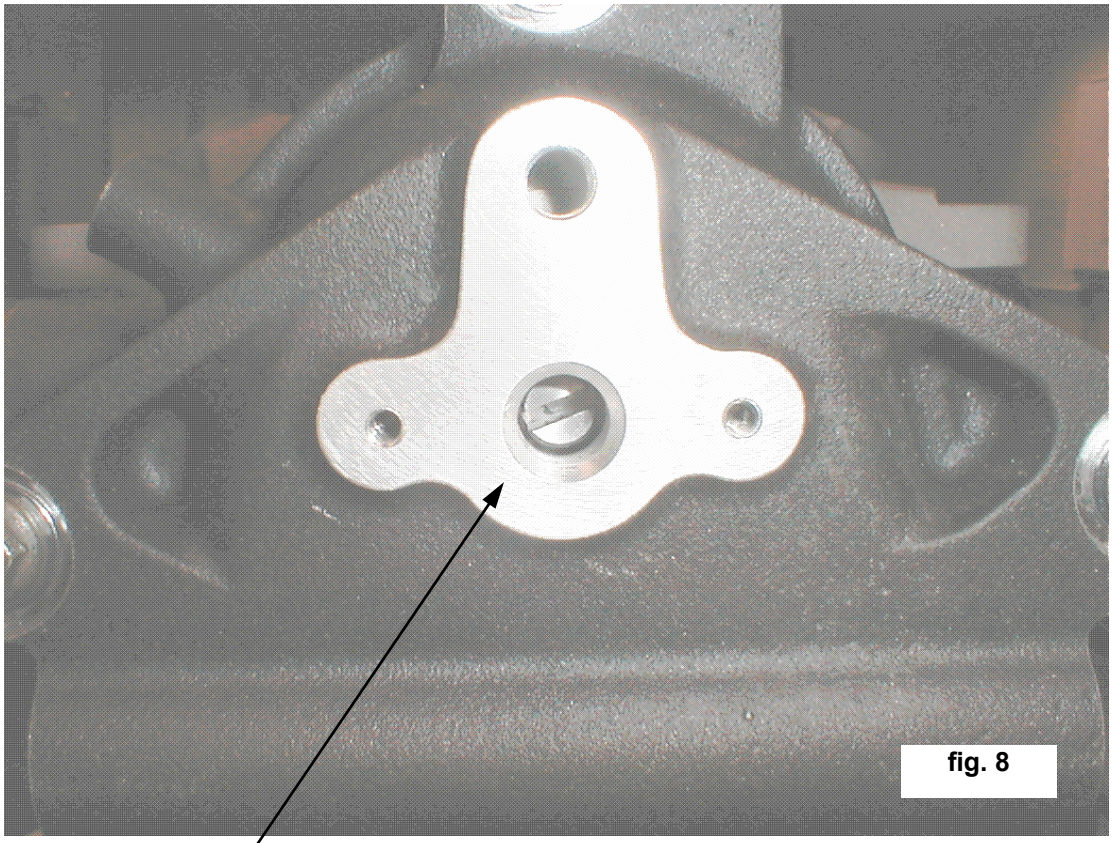


fig. 8

Toyota ECU Gear Position Indicator Settings	
Gear Position	mVolt Threshold
Reverse	2
Neutral	705
1st	1396
2nd	2105
3rd	2871
4th	3710
5th	4714

REVERSE GEAR LOCKOUT FEATURE

WARNING: DO NOT UNDER ANY CIRCUMSTANCES OPERATE THE GEARBOX WITHOUT THE REVERSE GEAR LOCKOUT ASSEMBLY INSTALLED.

The Swift SG3 reverse gear lockout assembly performs three functions:

1. Neutral lockout
2. Reverse gear lockout
3. Shaft Lock lockout

Comments on each function follow the shift barrel description.

Shift Barrel Description

A full shift lever stroke is required to rotate the shift barrel to all 8 positions. There are no half-stroke positions. The complete shift barrel sequence is: Reverse, Neutral, 1st, 2nd, 3rd, 4th, 5th, Shaft Lock. The Shaft Lock position simultaneously engages 1st gear and 5th gear to allow removal and tightening of the shaft nuts during servicing. The Reverse gear and Shaft Lock positions share the same detent position, but are engaged at opposite ends of the shift barrel rotation range. The reverse gear lockout plunger rides in a dedicated track on the shift barrel with three rotation stop features: Neutral stop, Reverse gear stop, and Shaft Lock stop.

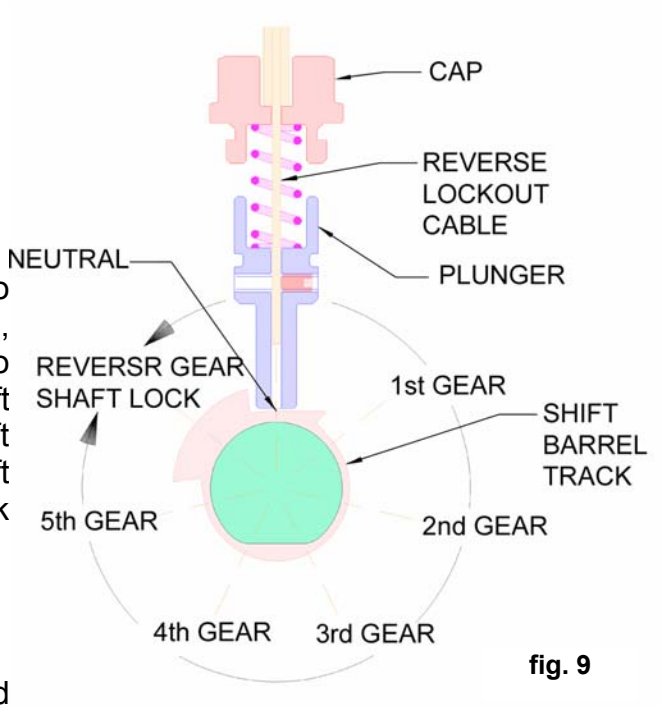


fig. 9

1. Neutral lockout

To select Neutral from 1st gear, pull the reverse gear lockout cable to at least half stroke and hold it while pushing the shift lever forward to full stroke.

The Neutral stop feature is a one way stop, allowing a Neutral-to-1st gear shift but blocking a 1st gear-to-Neutral shift. There is no danger of inadvertent selection of Reverse gear if the lockout cable is pulled to full stroke because all shifts require full travel of the gear shift lever.

The Neutral lockout feature can be bypassed by removing 0.100”±0.005” [2.5mm±0.1mm] from the end of the reverse lockout plunger as

illustrated in fig. 10.

If this modification is performed, a 1st gear-to-Neutral shift can be performed without using the reverse gear lockout cable, but shifting to Reverse gear and Shaft Lock requires pulling the reverse gear lockout cable.

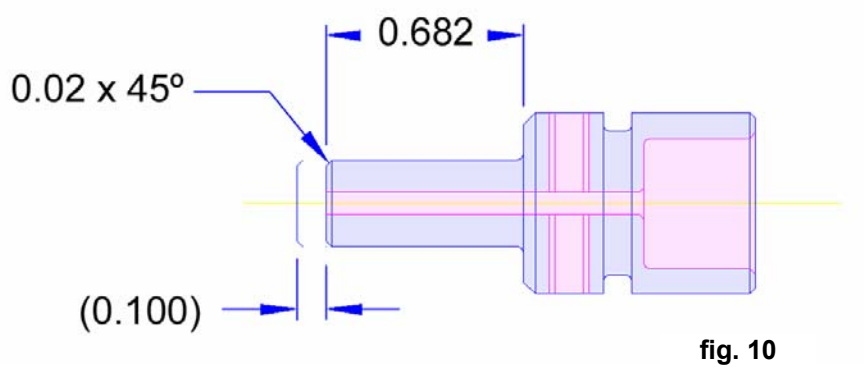


fig. 10

2 Reverse gear lockout

To select Reverse gear from Neutral, hold the clutch pedal down, pull the reverse gear lockout cable to full stroke and hold it, then push the shift lever forward to full stroke. Do not select Reverse gear if the car is moving.

To select Neutral from Reverse gear, pull the shift lever aft to full stroke. It is not necessary to pull the reverse lockout cable for this shift.

3. Shaft Lock lockout

The Shaft Lock position is **ONLY** to be used for gearbox servicing with the car at rest and the engine off. To select Shaft Lock, upshift to 5th gear, then pull the reverse gear lockout cable to full stroke and hold it while pulling the shift lever aft. While performing these shifts, it may be necessary to rotate the differential assembly back and forth slightly to clear any dog to dog face contact.

With the gearbox in the Shaft Lock position, 1st gear and 5th gear are engaged simultaneously, so the shafts cannot rotate. This allows removal and tightening of the shaft nuts.

Ensure that Neutral is selected before returning the car to service.

Ensure that the Reverse gear lockout cable has some slack to allow the plunger to fully seat.

ILLUSTRATED PARTS LIST

CASING AND ASSOCIATED PARTS

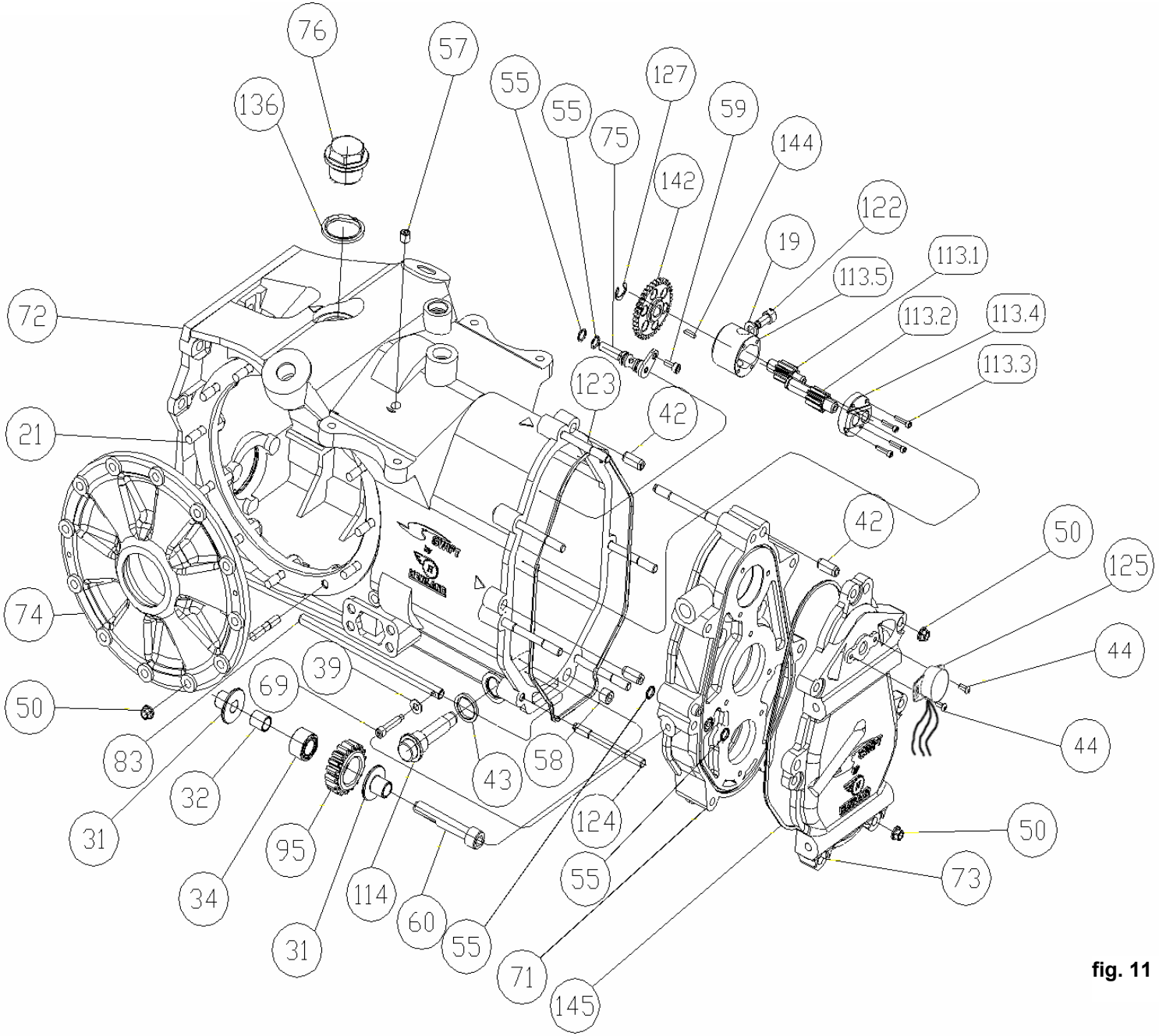
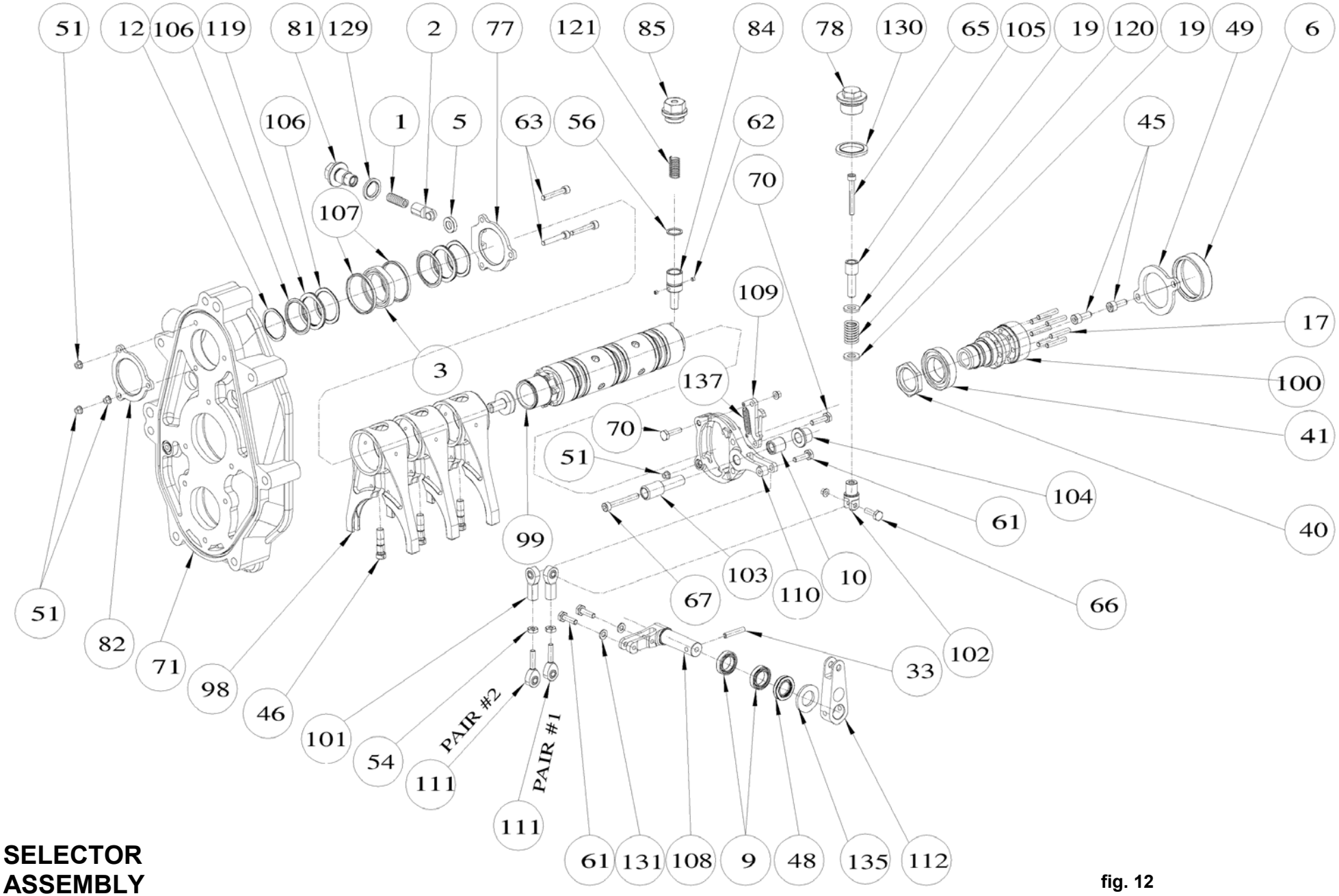


fig. 11



SELECTOR ASSEMBLY

fig. 12

PINION SHAFT ASSEMBLY

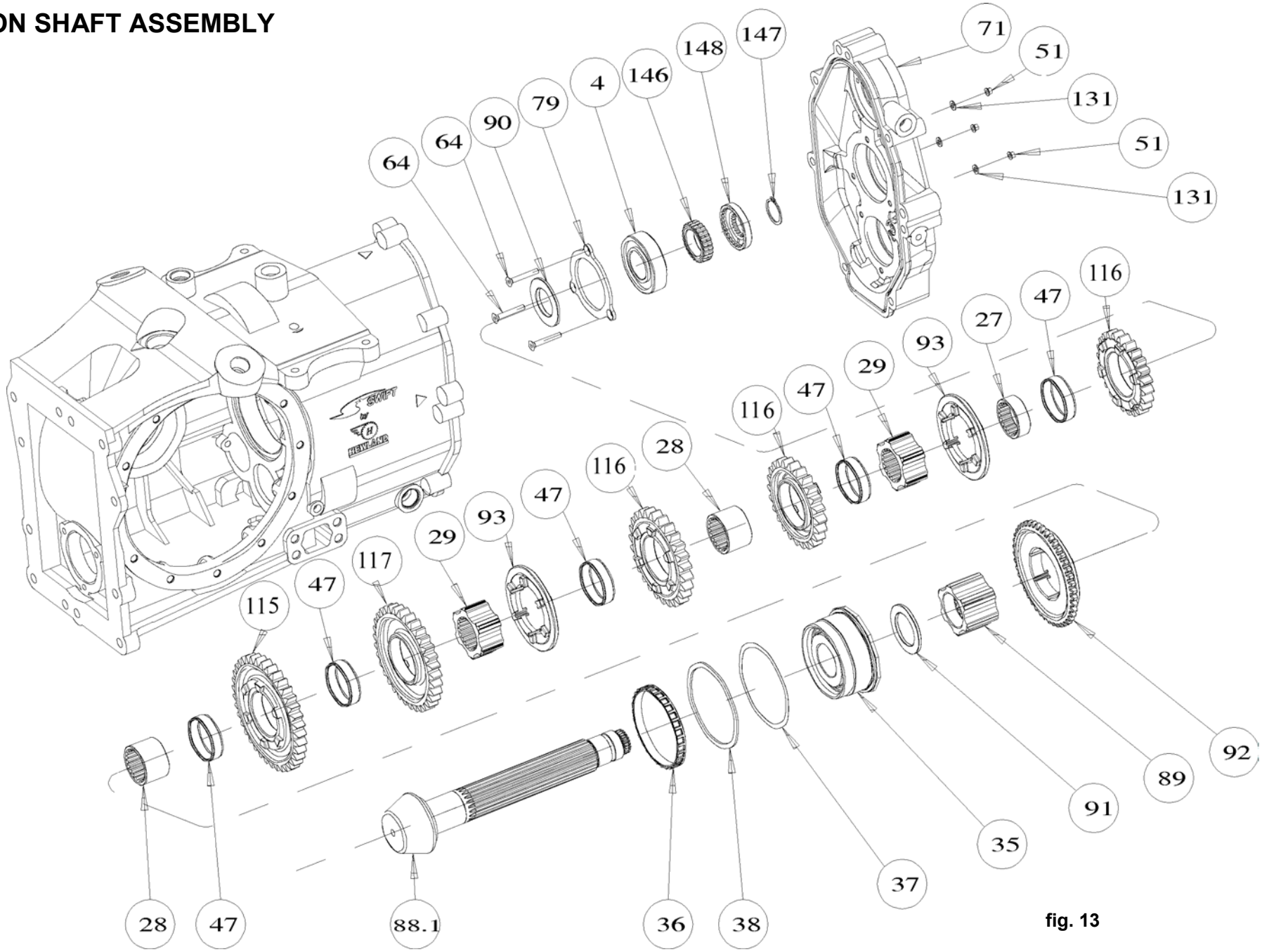


fig. 13

LAYSHAFT ASSEMBLY

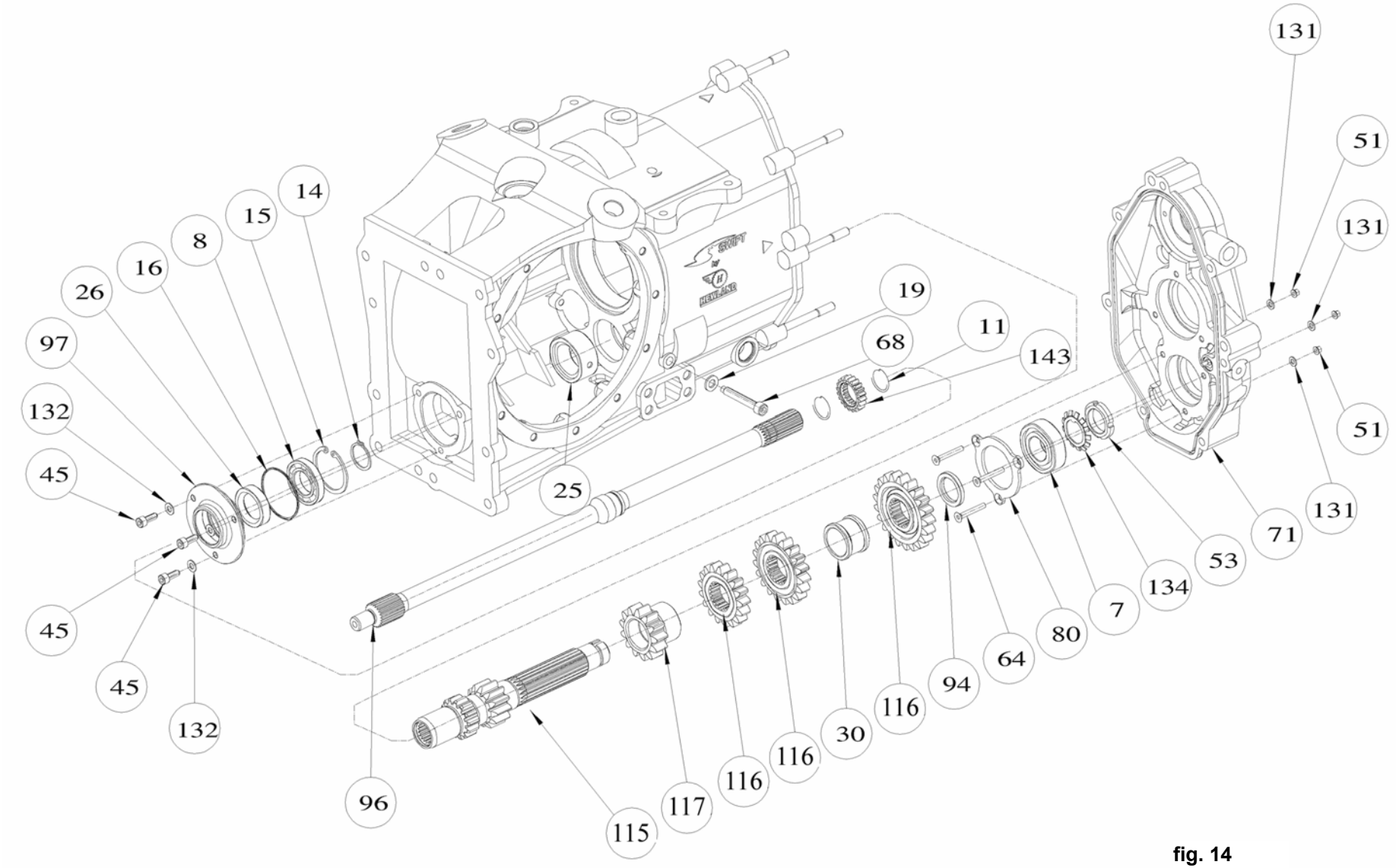


fig. 14

POWERFLOW DIFFERENTIAL ASSEMBLY

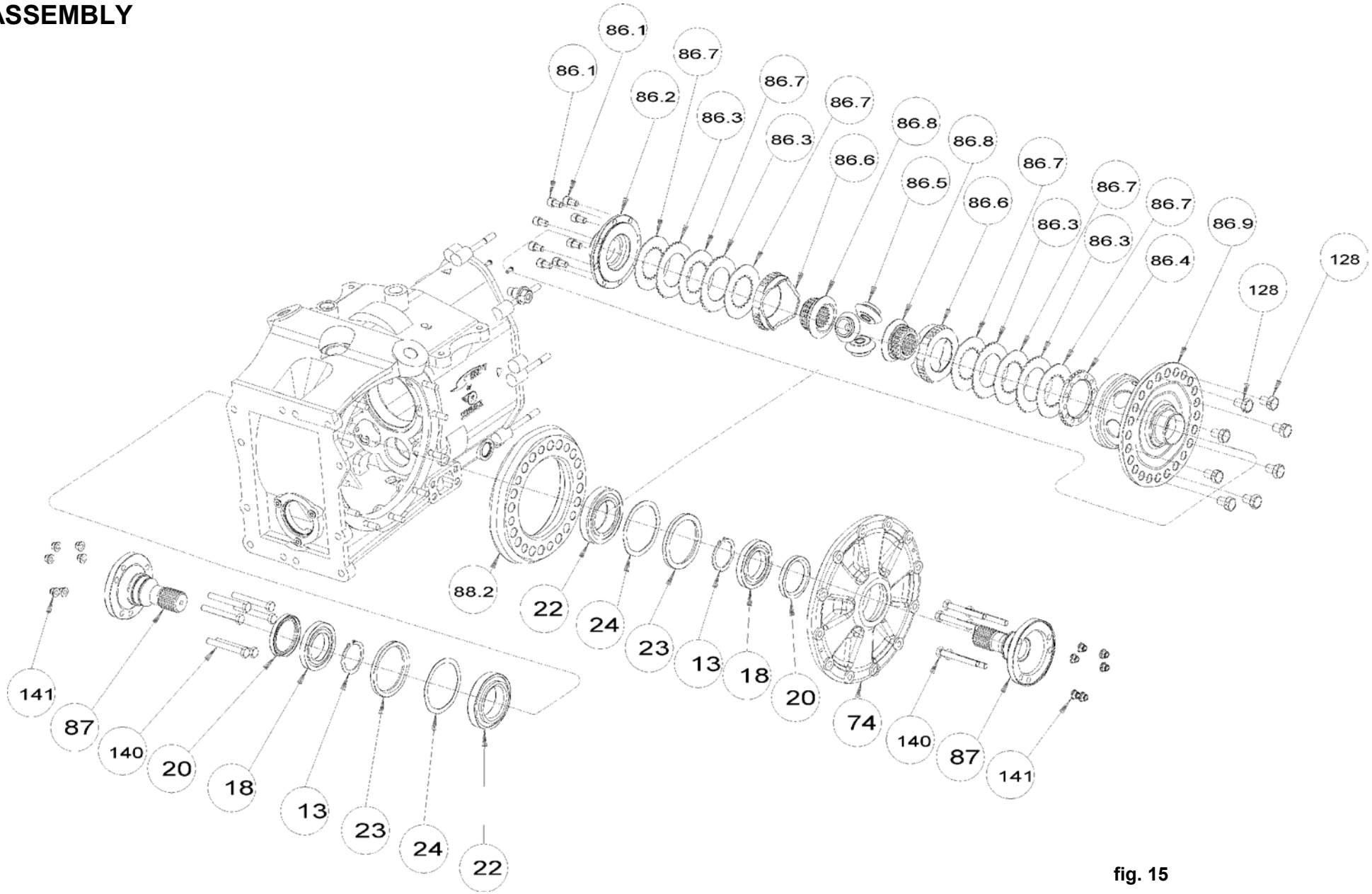


fig. 15

Item	Qty	Part #	Description
1	1	SG3-102-205-11	SPRING
2	1	SG3-102-260-4	DETENT PLUNGER
3	1	SG3-BEA-037	BEARING
4	1	SG3-BEA-058	BEARING
5	1	SG3-BEA-059	BEARING
6	1	SG3-BEA-142	NEEDLE ROLLER
7	1	SG3-BEA-159	BEARING
8	1	SG3-BEA-163	BEARING
9	2	SG3-BEA-164	BEARING
10	1	SG3-BEA-165	BEARING
11	2	SG3-CIR-085	CIRCLIP
12	1	SG3-CIR-139	CIRCLIP
13	2	SG3-DG-219-1A	CIRCLIP
14	1	SG3-DGB-239-0	CIRCLIP
15	1	SG3-DGB-244-10	CIRCLIP
16	1	SG3-ORI-101	O-RING
17	7	SG3-DOW-037	DOWEL
18	2	SG3-F3A-205-3	BEARING
19	4	SG3-F3D-236-1	WASHER
20	2	SG3-FGC-205-4	SEAL
21	12	SG3-FT-201-2	STUD
22	2	SG3-FT-205-1	BEARING
23	2	SG3-FT-205-2A	LEFT HAND SPACER
24	3	SG3-FT-206-1	SIDEPLATE SHIM
25	1	SG3-FT-229-1	BEARING
26	1	SG3-FT-244-11	OIL SEAL
27	1	SG3-FTR-225	BEARING INNER TRACK
28	2	SG3-FTR-226	BEARING INNER TRACK
29	2	SG3-FTR-227	HUB
30	1	SG3-FTR-234-1	SPACER - INPUT SHAFT
31	2	SG3-FTR-237-1	REVERSE IDLER SPIGOT
32	1	SG3-FTR-237-2	SLEEVE
33	1	SG3-FV-252-4	ROLL PIN
34	1	SG3-HC-237-2	BEARING

Item	Qty	Part #	Description
35	1	SG3-HC8-222-1	PINION HEAD BEARING
36	1	SG3-BEA-031	NUT
37	1	SG3-HC8-222-2	SHIM
38	1	SG3-HC8-222-2A	SPACER
39	1	SG3-WSH-015	WASHER
40	1	SG3-HGL-260-10A	SELECTOR BEVEL NUT
41	1	SG3-HP-M-8008	BEARING
42	4	SG3-HP-M-9015	DOWEL
43	2	SG3-HP-M-9042	DOWTY WASHER
44	2	SG3-SCR-145	SCREW
45	5	SG3-HP-N-9006	SCREW
46	3	SG3-IGT-250-1	SELECTOR FORK PIN
47	5	SG3-LD-226-1	BEARING
48	1	SG3-LIP-044	LIPSEAL
49	1	SG3-NMT-260-2	KEEP PLATE
50	19	SG3-NUT-002	NUT
51	12	SG3-NUT-019	NUT
52	1	SG3-NUT-021	NUT
53	1	SG3-NUT-022	NUT
54	2	SG3-NUT-023	NUT
55	4	SG3-ORI-001	O-RING
56	1	SG3-ORI-014	O-RING
57	1	SG3-SCR-133	SCREW
58	2	SG3-SCR-134	SCREW
59	1	SG3-SCR-012	SCREW
60	1	SG3-SCR-117	SCREW
61	3	SG3-SCR-120	SCREW
62	2	SG3-SCR-121	SCREW
63	3	SG3-SCR-122	SCREW
64	6	SG3-SCR-123	SCREW
65	1	SG3-SCR-125	SCREW
66	1	SG3-SCR-126	SCREW
67	1	SG3-SCR-127	SCREW
68	1	SG3-SCR-128	SCREW

Item	Qty	Part #	Description
69	1	SG3-SCR-131	SCREW
70	2	SG3-SCR-132	SCREW
71	1	SG3-0020	BEARING PLATE
72	2	SG3-0010	MAINCASE
73	1	SG3-0030	REAR COVER
74	1	SG3-0040	SIDEPLATE
75	1	SG3-201-1	OIL SPRAY PIN HD BEARING
76	1	SG3-201-2	PLUG
77	1	SG3-202-1	BEARING RETAINING PLATE
78	1	SG3-202-2	PLUG - RATCHET RETURN
79	1	SG3-202-3	BEARING RETAINING PLATE
80	1	SG3-202-4	BEARING RETAINING PLATE
81	1	SG3-202-5	DETENT PLUNGER PLUG
82	1	SG3-202-6	BEARING RETAINING PLATE
83	1	SG3-202-7	OIL SPRAY TUBE
84	1	SG3-210-35	REVERSE LOCK PLUNGER (CABLE)
85	1	SG3-210-36	REVERSE LOCK PLUG
86	1	SG3-212	DIFF ASSY
86.1	8	SG3-F3A-213-12	SCREW
86.2	1	SG3-F3A-214	END PLATE
86.3	4	SG3-FTC-213-10	CLUTCH PLATE (OUTER SPLINE)
86.4	1	SG3-FTC-213-3	SPACER
86.5	3	SG3-FTC-213-5AH	PLANET BEVEL GEAR
86.6	2	SG3-FTC-213-7	SIDE GEAR RINGS
86.7	6	SG3-FTC-213-8	CORE PLATE
86.8	2	SG3-HCC-213-6AH	SIDE BEVEL GEAR
86.9	1	SG3-213	DIFF CASE
87	2	SG3-218	DRIVESHAFT
88	1	SG3-221	CROWNWHEEL AND PINION
88.1	1	SG3-221-P	PINION SHAFT
88.1	1	SG3-221-W	CROWNWHEEL
89	1	SG3-228	REFERSE HUB
90	1	SG3-229	THRUST WASHER
91	1	SG3-229-1	PINION SHAFT SPACER

Item	Qty	Part #	Description
92	1	SG3-231	REVERSE SLIDING GEAR
93	2	SG3-232	CLUTCH RING
94	1	SG3-234-1	LAYSHAFT SPACER
95	1	SG3-237	REVERSE IDLER GEAR
96	1	SG3-239-1	CLUTCH SHAFT
97	1	SG3-244	CLUTCH SHAFT BEARING HOUSING
98	3	SG3-250	SELECTOR FORK
99	1	SG3-260	SELECTOR BARREL
100	1	SG3-260-1	BARREL DRIVER
101	2	SG3-260-10	FEMALE ROD END- BOUGHT OUT
102	1	SG3-260-11	CLEVIS
103	1	SG3-260-12	PIVOT SHAFT
104	1	SG3-260-13	SPACER - PIVOT SHAFT
105	1	SG3-260-14	SLEEVE RETAINING PLUNGER
106	4	SG3-260-15	BARREL SPACER
107	2	SG3-260-16	BEARING SPACER
108	1	SG3-260-2	CRANK
109	2	SG3-260-3	PAWL - RATCHET
110	1	SG3-260-6	DRUM SHIFTER
111	2	SG3-260-9	MALE ROD END- BOUGHT OUT
112	1	SG3-263	SEQUENTIAL LEVER ARM
113	1	SG3-265	OIL PUMP ASSY
113.1	1	SG3-DG-256-4	OIL PUMP ROTOR
113.2	1	SG3-DG-256-5	OIL PUMP ROTOR
113.3	1	SG3-DGB-265-10	SCREW
113.4	1	SG3-FGA6-265-2A	OIL PUMP END COVER
113.5	1	SG3-265-2	OIL PUMP BODY
114	1	SG3-266	OIL FILTER
115	1	SG3-LAYSHFT-INT	LAYSHAFT
115.1	3	SG3-FTR-233	PINION SHAFT GEAR
116	3	SG3-RATIO-STD	SG3 STANDARD GEAR PAIR
117	1	SG3-RATIO-HUB	HUBBED GEAR PAIR
118	1	SG3-SGT-202-8	SCREW
119	6	SG3-SPR-059	WAVE SPRING

Item	Qty	Part #	Description
120	1	SG3-SPR-060	SPRING
121	1	SG3-SPR-061	SPRING
122	1	SG3-ST-204-4A	SCREW
123	3	SG3-STU-067	STUD
124	4	SG3-STU-068	STUD
125	1	1433-1600	GEAR POSITION SENSOR
126	1	SG3-TE-260-1A	GEAR SENSOR BUNG
127	1	SG3-DG-265-8	CIRCLIP
128	8	SG3-VG-221-1C	BOLT
129	1	SG3-WSH-004	DOWTY WASHER
130	1	SG3-WSH-010	WASHER
131	8	SG3-WSH-011	WASHER
132	3	SG3-LD-202-9	SHAKEPROOF WASHER
133	1	SG3-WSH-040	TAB WASHER
134	1	SG3-WSH-041	WASHER
135	1	SG3-WSH-042	WASHER
136	1	SG3-WSH-043	WASHER
137	1	SG3-SPR-062	SPRING
140	12	SG3-HC9-219-4	SCREW
141	12	SG3-FT-201-3	NUT
142	1	SG3-265-7	OIL PUMP DRIVEN GEAR
143	1	SG3-265-9	OIL PUMP DRIVER GEAR
144	1	SG3-DG-265-6	KEY
145	1	SG3-VG-201-9	0-RING CORD
146	1	SG3-236	PINION SHAFT NUT
147	1	SG3-CIR-041	EXTERNAL CIRCLIP
148	1	SG3-HP-M-4026	LOCKING RING

SPECIAL TOOLS

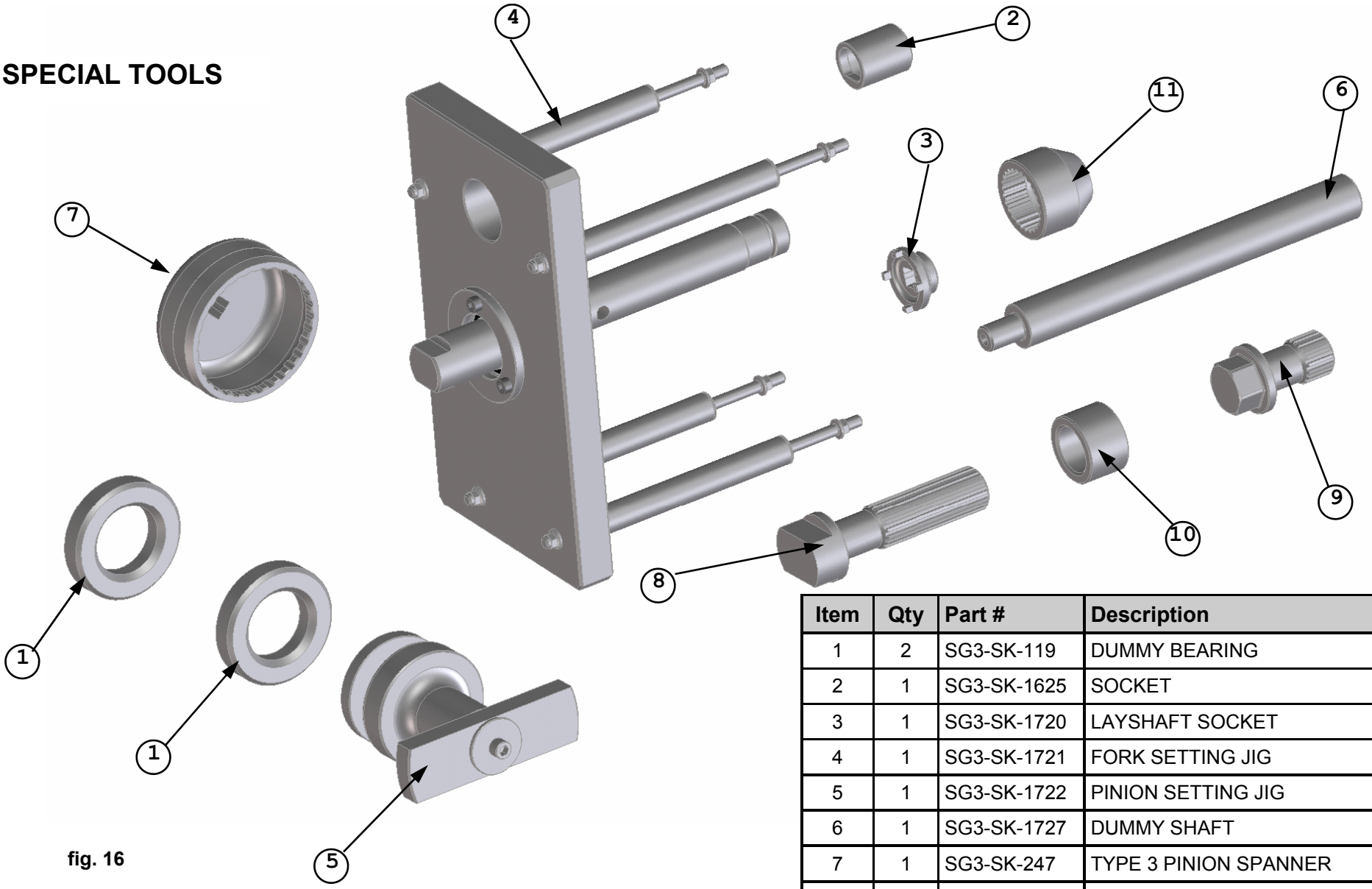
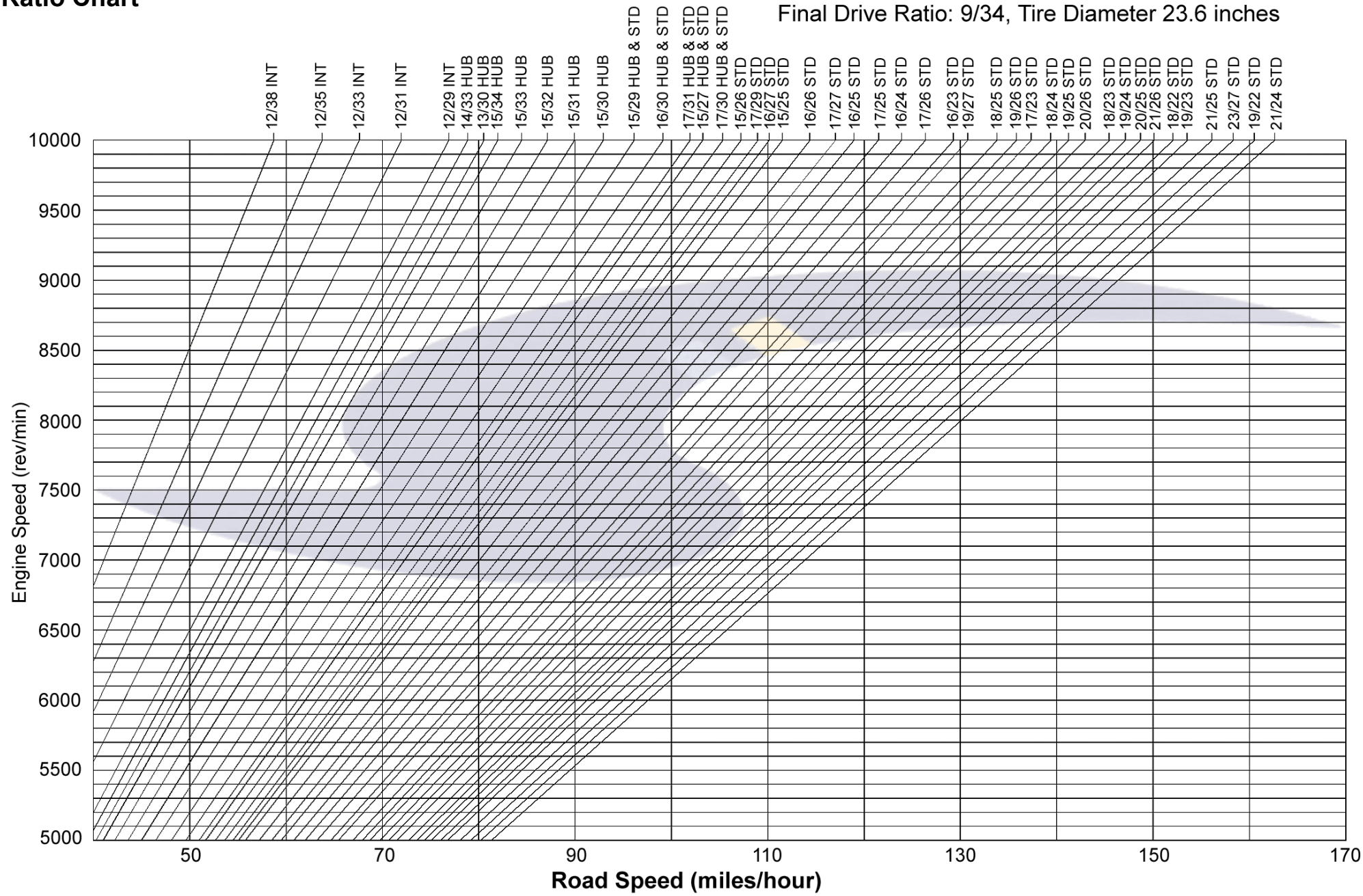


fig. 16

Item	Qty	Part #	Description
1	2	SG3-SK-119	DUMMY BEARING
2	1	SG3-SK-1625	SOCKET
3	1	SG3-SK-1720	LAYSHAFT SOCKET
4	1	SG3-SK-1721	FORK SETTING JIG
5	1	SG3-SK-1722	PINION SETTING JIG
6	1	SG3-SK-1727	DUMMY SHAFT
7	1	SG3-SK-247	TYPE 3 PINION SPANNER
8	1	SG3-SK-846-A	DIFFERENTIAL SETTING TOOL
9	1	SG3-SK-846-B	DIFFERENTIAL SETTING TOOL
10	1	SG3-SK-846-C	SERVICE TOOL
11	1	SG3-SK-962	HP2000 SERRATED SOCKET

Ratio Chart



POWERFLOW DIFFERENTIAL - LOCKING PERCENTAGE RATING

Below is a formula for rating different ramp angles in terms of percentage of the achievable lock.

$$Crownwheel\ Torque * \{.378 + [.415 / Tangent(Ramp\angle)]\} * \mu * NoOfPlateSurfacesUsed = TorqueTransferableBetweenWheels$$

The above formula gives a good approximation of the locking force as a percentage of a diff that has been set up with a full complement of working plate surfaces, and a set of 30 degree ramps.
It can be seen from the above formula that 34 percent of the locking action is not provided by the ramps. This locking component is due to the reaction forces of the side bevel gears.

Put another way, the locking torque can be approximated using this formula :

$$[\frac{38}{Tangent(Ramp\angle)} + 34] * \frac{NoOfPlateSurfacesUsed}{\text{Max } PossibleNoOfWorkingSurfaces} = PercentageLock$$

Where μ is the friction coefficient between the plates. μ=0.1 can be used for steel plates.

SG3 Technical Bulletin Number 001 19th July 2002
Potential Gear Shift Issue

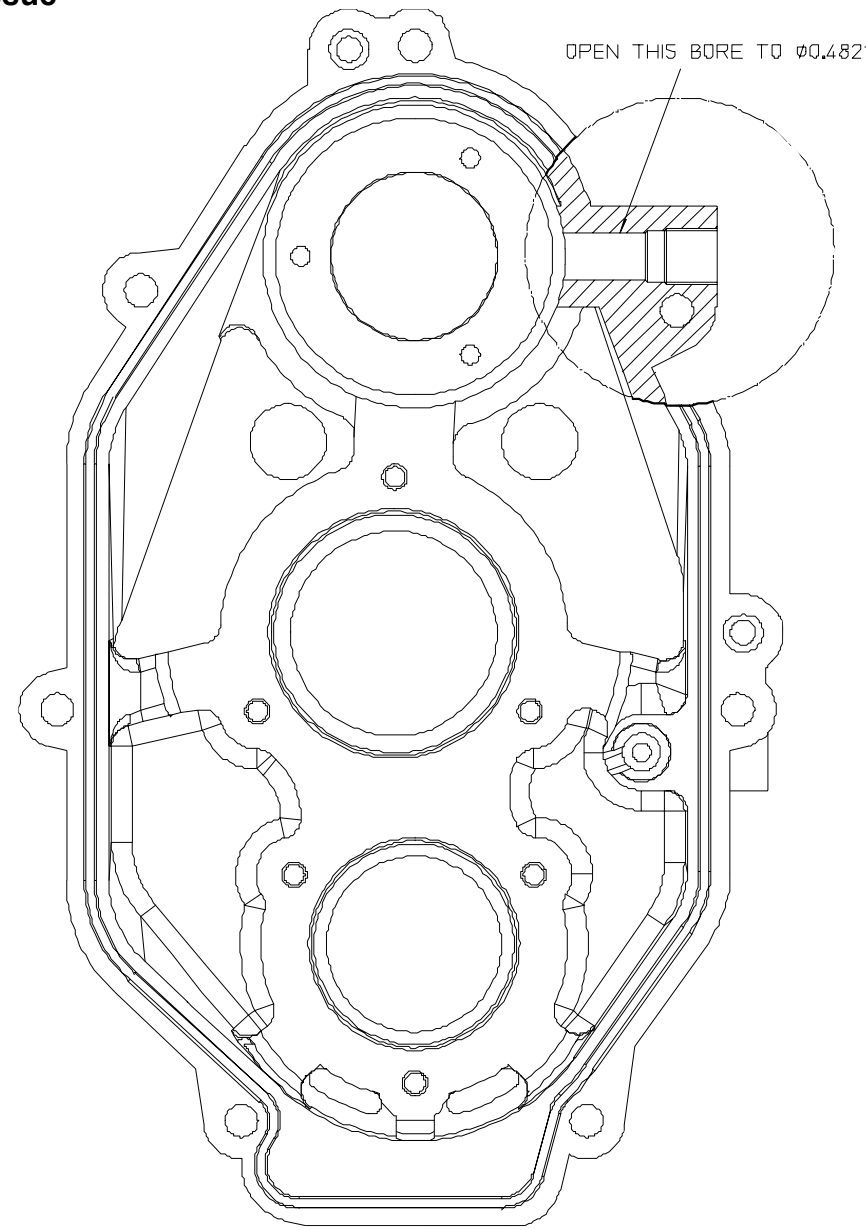
Some Formula Atlantic teams have highlighted a problem during gear shifting. The symptom is that either the upshift or downshift requires greater than normal force from the driver to initiate the shift.

After looking over the various scenarios of component tolerances, it has come to our attention that there is a possibility of conflict between the detent plunger and the bearing carrier bore in which the plunger is housed. In this situation the plunger may interfere with one side of the bearing housing bore, resulting in the above symptom. The detent roller is guided by the bearing retaining plate, the plunger is not utilised for any purpose other than transferring spring load to the detent roller, therefore it doesn't need to be a close fit in the housing.

This problem has only manifested itself on a small number of gearboxes to date. Therefore the modification described below is advisable only if you are experiencing the above symptom.

To overcome the problem Hewland Engineering recommends that the plunger bore in the bearing carrier is opened up to a maximum diameter of 0.482" to relieve any interference problems. See sketch below.

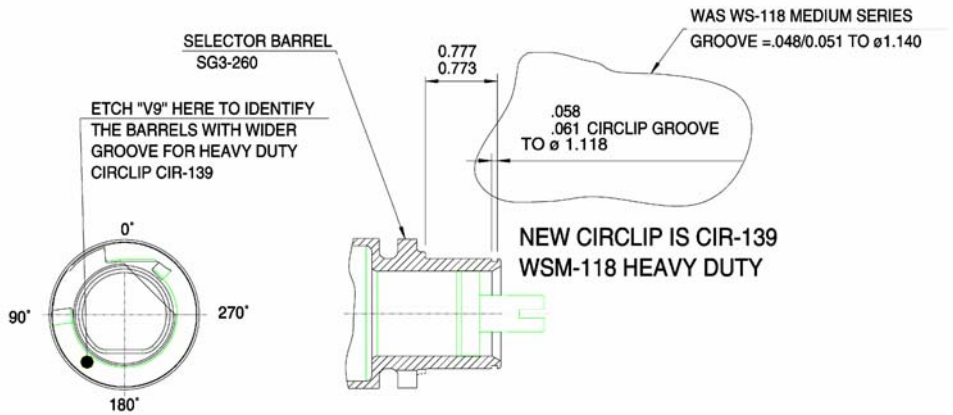
All existing and future stock will feature this increased plunger bore diameter



SG3 Technical Bulletin Number 002
CIRCLIP ON SG3-260 BARREL

Some Formula Atlantic teams have highlighted a problem during gear shifting. The symptom is that circlip CIR-087 on the SG3-260 barrel jumps out of the circlip groove. This can cause damage to internal components.

To overcome this potential problem Hewland Engineering revised the barrel design to accommodate the new heavy-duty circlip. We recommend that all existing gearboxes be modified to use this heavy-duty circlip. The ciclip groove on existing barrels can be open-up to accommodate the new circlip CIR-139. (See attached sketch for exact dimension)



All new SG3-260 barrels delivered by Hewland Engineering from today will have revised barrel and will be etched "V9" for identification. (See picture below)

Barrel with original circlip groove.

Barrel with revised circlip groove.

Etching on modified barrel.

Swift Engineering Inc.

1141-A Via Callejon, San Clemente, CA 92673
TEL 949• 492• 6608 FAX 949• 492• 7516

Swift Tech Memo

Chassis - Section # - Memo #

December 6, 2001 Memo # **014-33-001** Pages: 2

To: All Toyota Atlantic Teams

Reverse Gear Lockout Feature - Additional Details

WARNING: DO NOT UNDER ANY CIRCUMSTANCES OPERATE THE GEARBOX WITHOUT THE REVERSE GEAR LOCKOUT ASSEMBLY INSTALLED.

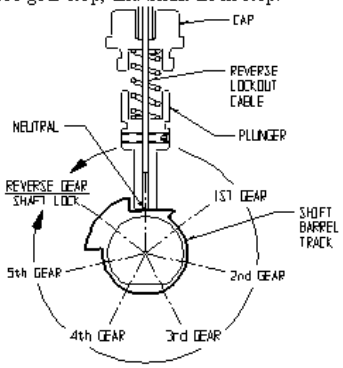
The Swift SG3 reverse gear lockout assembly performs three functions:

1. Neutral lockout
2. Reverse gear lockout
3. Shaft Lock lockout

Comments on each function follow the shift barrel description.

Shift Barrel Description

A full shift lever stroke is required to rotate the shift barrel to all 8 positions. There are no half-stroke positions. The complete shift barrel sequence is: Reverse, Neutral, 1st, 2nd, 3rd, 4th, 5th, Shaft Lock. The Shaft Lock position simultaneously engages 1st gear and 5th gear to allow removal and tightening of the shaft nuts during servicing. The Reverse gear and Shaft Lock positions share the same detent position, but are engaged at opposite ends of the shift barrel rotation range. The reverse gear lockout plunger rides in a dedicated track on the shift barrel with three rotation stop features: Neutral stop, Reverse gear stop, and Shaft Lock stop.

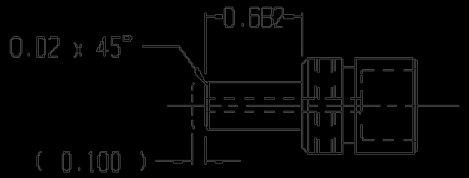


1. Neutral lockout

To select Neutral from 1st gear, pull the reverse gear lockout cable to at least half stroke and hold it while pushing the shift lever forward to full stroke.

The Neutral stop feature is a one way stop, allowing a Neutral-to-1st gear shift but blocking a 1st gear-to-Neutral shift. There is no danger of inadvertent selection of Reverse gear if the lockout cable is pulled to full stroke because all shifts require full travel of the gear shift lever.

The Neutral lockout feature can be bypassed by removing 0.100"±0.005" [2.5mm±0.1mm] from the end of the reverse lockout plunger as illustrated below.



If this modification is performed, a 1st gear-to-Neutral shift can be performed without using the reverse gear lockout cable, but shifting to Reverse gear and Shaft Lock requires pulling the reverse gear lockout cable.

2. Reverse gear lockout

To select Reverse gear from Neutral, hold the clutch pedal down, pull the reverse gear lockout cable to full stroke and hold it, then push the shift lever forward to full stroke. Do not select Reverse gear if the car is moving.

To select Neutral from Reverse gear, pull the shift lever aft to full stroke. It is not necessary to pull the reverse lockout cable for this shift.

3. Shaft Lock lockout

The Shaft Lock position is ONLY to be used for gearbox servicing with the car at rest and the engine off. To select Shaft Lock, upshift to 5th gear, then pull the reverse gear lockout cable to full stroke and hold it while pulling the shift lever aft. While performing these shifts, it may be necessary to rotate the differential assembly back and forth slightly to clear any dog to dog face contact.

With the gearbox in the Shaft Lock position, 1st gear and 5th gear are engaged simultaneously, so the shafts cannot rotate. This allows removal and tightening of the shaft nuts.

Ensure that Neutral is selected before returning the car to service.

Ensure that the Reverse gear lockout cable has some slack to allow the plunger to fully seat.

Swift Engineering Inc.
1141-A Via Callejon, San Clemente, CA 92673
TEL 949• 492• 6608 FAX 949• 492• 7516

Swift Tech Memo

Chassis - Section # - Memo #

April 4, 2002 Memo # **014-33-006** Pages: 2

To: All Toyota Atlantic Teams

Differential Gears

During the production run of gearbox assembly, Hewland has updated their spider gear design. This was to provide a better root radius, a better cutting finish and improved rolling action.

Hewland has decided to implement yet another new version of these gears, with higher impact resistance. The p/n for these are: Spider gear SG3-FTC-213-5AF / Side Bevel gear SG3-HCC-213-6AF.

Hewland advises to only use matching spider/side bevel gears together. There is a tooth profile variation between the revisions of these gears. Likewise they recommend a preload range of .001" preload to .001" of clearance in the clutch/plate stack up dimension. This is to ensure proper gear mesh and minimize bending loads on gear teeth.

This evolution can be identified by markings as seen on the following illustration by Hewland.

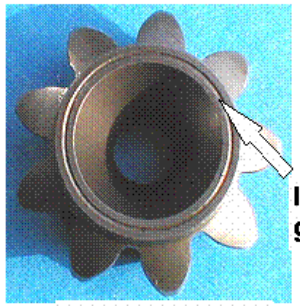
HEWLAND ENGINEERING LIMITED

General Technical Bulletin 17

Identification of FTC side and planet bevel gears.

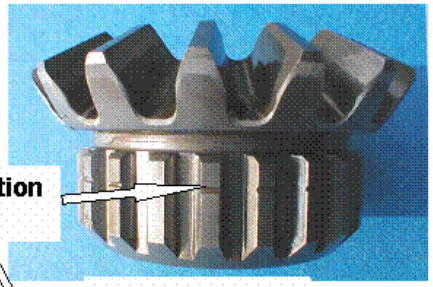
FTC-213-5A

HCC-213-6A



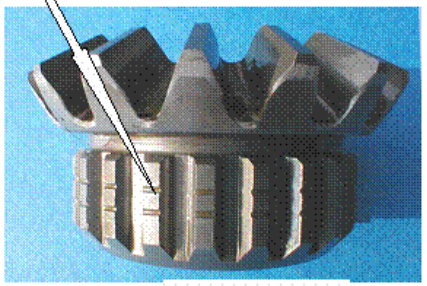
FTC-213-5AD

Identification grooves



HCC-213-6AD

FTC-213-5AF



HCC-213-6AF

SUPERCEDED BY HEWLAND TECHNICAL BULLETIN SG3-003

Swift Engineering Inc.

1141-A Via Callejon, San Clemente, CA 92673
TEL 949• 492• 6608 FAX 949• 492• 7516

Swift Tech Memo

Chassis - Section # - Memo #

Date May 9, 2002 Memo # **014-33-009** Pages: 1

To: All Teams

Shift Fork Pin Identification

We have seen a few cases of accelerated shift fork pin wear. We asked Hewland about this and they informed us that a small batch of these pins were defective. By design, these pins are to be induction hardened at the shank end of the pin. This small batch of pins were mistakenly hardened at the wrong (socket head/thread) end.

The easy way to identify which pin you have is to run a file over each end of the pin. The hardened end will simply resist the file while the opposite will happen at the other end.

In the event you do have a defective pin(s), please call the Swift parts dept. for a no-charge exchange. The part number is: SG3-IGT-250-1

Swift Engineering Inc.
1141-A Via Callejon, San Clemente, CA 92673
TEL 949• 492• 6608 FAX 949• 492• 7516

Swift Tech Memo

Chassis - Section # - Memo #

May 9th, 2003 Memo # **014-33-015** Pages: 2

To: All Toyota Atlantic Teams

Pinion Bearing Nut

****Update 8/10/03**--Hewland has advised Swift of a torque specification increase to 130 ft/lbs****

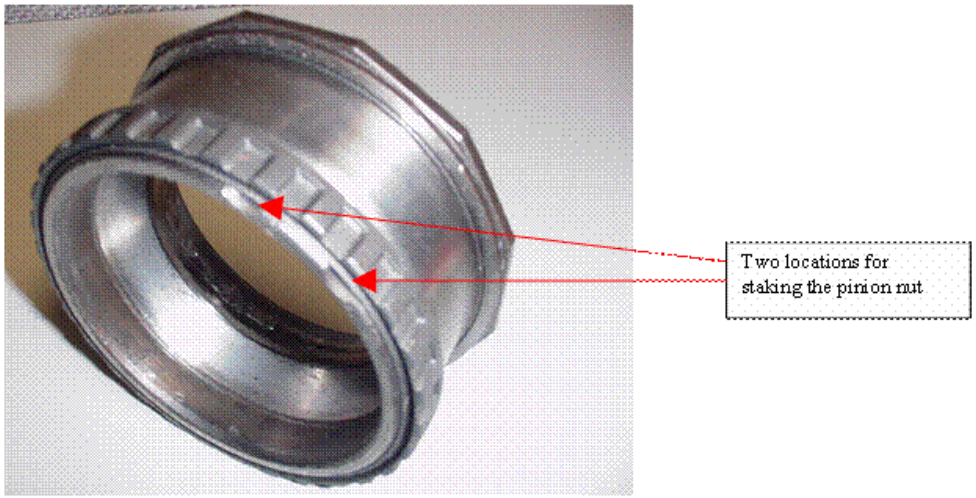
During the 2002 season, we have seen a few isolated incidents of the pinion bearing retaining nut coming loose. In all but one of these cases, although loctited, the nut had not been 'staked' in the two areas that are provided to do so (see figure 1). This year we had this happen again, so I am providing this bulletin as a reminder.

Figure 1

Figure 2 is of the pinion nut and illustrated is the ring in which to be staked.

Figure 2

Figure 3 illustrates the nut threaded onto the pinion bearing outer race and locations of the two staking points. Be sure to orient these to be accessible when installing the pinion bearing. We also recommend using Red Loctite 272 on the threads as well. Also, assure the nut is **not** bottoming at the end of the thread and is clamping the maincase casting.



For technical questions, feel free to call me at 949-492-6608 Ext. 272.

Swift Engineering Inc.
1141-A Via Callejon, San Clemente, CA 92673
TEL 949• 492• 6608 FAX 949• 492• 7516

Swift Tech Memo

Chassis - Section # - Memo #

10/20/03 Memo # **014-33-019** Pages: 03

To: All Toyota Atlantic Teams

Differential Oil Feed

With certain differential set-ups, few teams have experienced unusual wear within the differential. Particularly with the clutch and steel plates, as well as the differential end cap p/n SG3-F3A-214. This wear represents material pick-up or galling creating rough or pitted surfaces.

Since the differential is not currently fed with gearbox oil, introducing an oil feed source to the differential could minimize this wear.

This modification simply involves tapping into an existing oil pressure source (see point "A" of illustration #1) and routing it to the gearbox fill plug (point "B" of illustration #1), This is quite simple since the gearbox fill plug is located directly above the center of the differential.

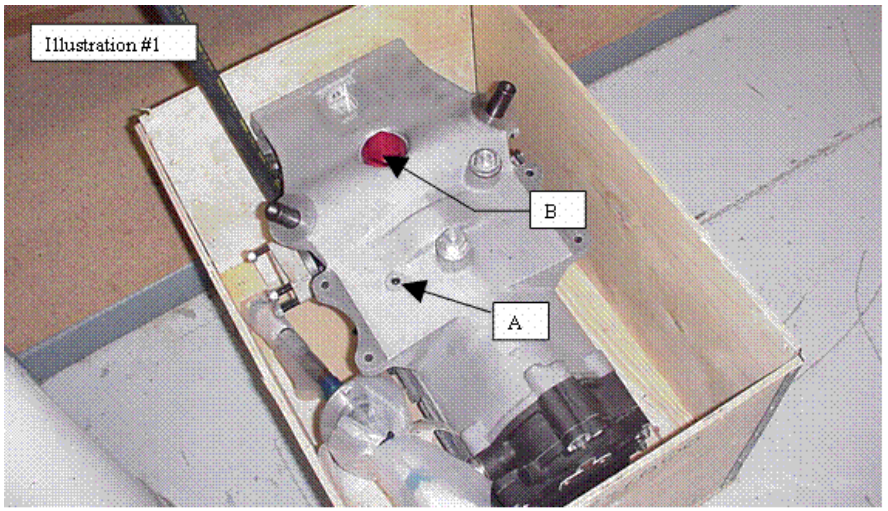
Assemble a steel braided oil line (-3) to connect the fittings of the pressure source and the fill plug. With the amount of excessive gearbox oil pressure we have in the SG3, a slight oil pressure drop should not be an issue.

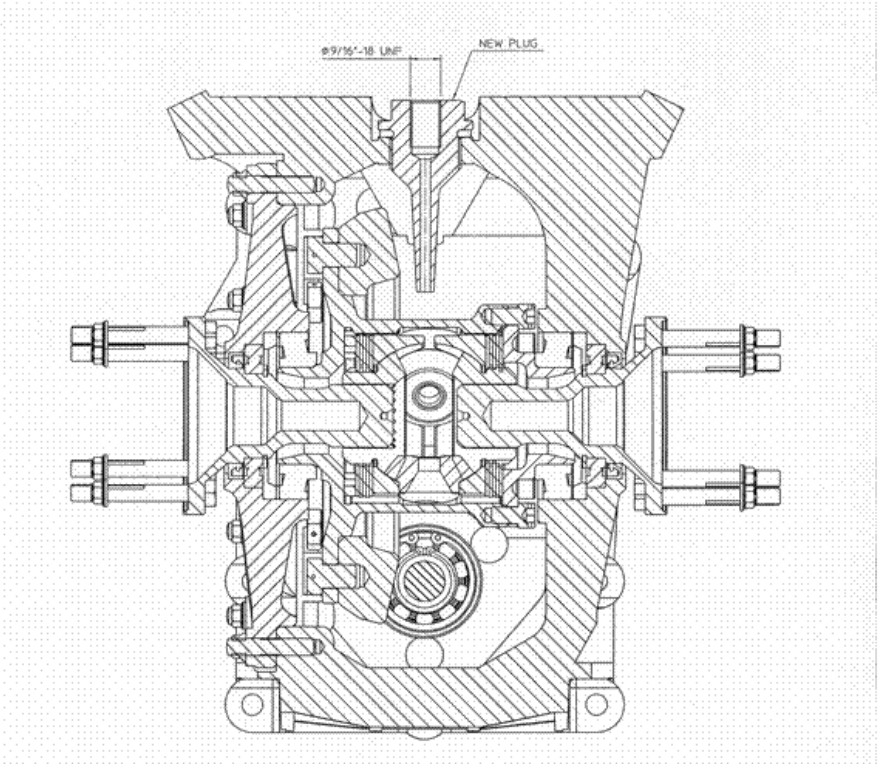
Location 'A' is a 3/8-24 tapped hole with a setscrew that seals a pressurized oil galley. A –3 banjo fitting can be used since the –3 banjo fitting bolt has a 3/8-24 thread. The local casting surface will need to be machined or spot-faced normal to the threaded hole to provide crush washers seating and sealing surfaces.

Note: Alternatively, oil pressure can be achieved by plumbing into the gearbox oil cooler ports on the right side of the gearbox maincase casting.

Location 'B' is the point where pressurized oil is fed to, ultimately sprayed into the center of the differential housing, lubricating the assembly. Please refer to the detailed drawings of the alternative fill plug available from Hewland, located on the following pages.

For technical questions, please don't hesitate to call me at 949-492-6608 Ext. 272.

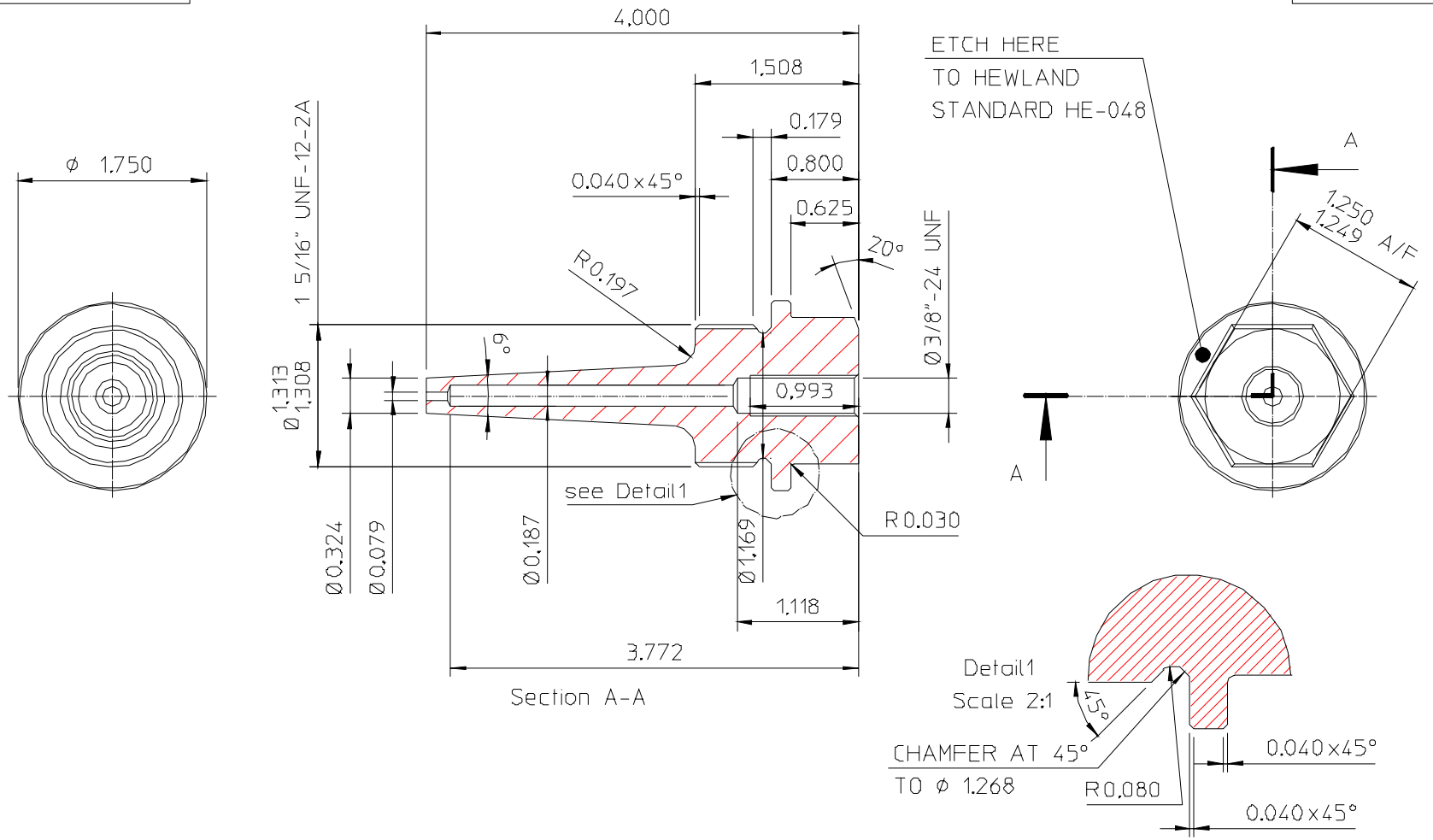




PROJECTION

DO NOT SCALE - IF IN DOUBT ASK
REMOVE SHARP EDGES

DRG. No.
SG3-201-2A



ISSUE	MODIFICATION	DATE

MATERIAL: HE30TF BAR	SCALE: 1:1	DIMENSIONS: INCHES
HEAT TREATMENT: NONE	DRAWN: L.M. 08/09/2003	APPROVED: L.M. 21/10/2003
SHOT PEEN: NONE	RELEASED TO MANUFACTURE: L.M. 21/10/2003	
FINISH: ANODISE RED		

MACHINING TOLERANCES UNLESS STATED
GENERAL DIM TOL TO BE ±0.12mm (±0.005")
ANGULAR DIM TOL TO BE ±0.25°
HOLE POS'N TOL TO BE ±0.25mm (±0.010")
REMOVE ALL BURRS & SHARP EDGES

HEWLAND ENGINEERING LIMITED

TITLE: PLUG OIL DIFF FEED

DRG. No.
SG3-201-2A
Sheet 1 Of

30th March 2004

SG3 Technical Bulletin No. 003

Differential Bevel Gear Revision

Subsequent to the AF type planetary bevel gears specified in Technical Bulletin No.001, the design of the gear teeth has been updated to further improve tooth strength, and therefore crack resistance.

The new side bevel gear part number is HCC-213-6AH
The new planet bevel gear part number is FTC-213-5AH

These two new parts will only mesh correctly with each other and cannot be used with any previous version.

The new parts are easily visually identified as they have part numbers marked on them. Also the teeth are slightly curved (as opposed to all previous version having straight teeth).

30th March 2004

SG3 Technical Bulletin No. 004

Pinion Bearing Nut Revision

Some Formula Atlantic users have reported instances of pinion bearing nuts coming loose. The previous step of increasing the tightening torque has proved only partially successful, so we have manufactured a replacement nut from a tougher material. This revision allows the nut to be tightened to a greater torque value than it's predecessor (see SG3 gearbox manual page 5).

The replacement nut is part number NUT-031