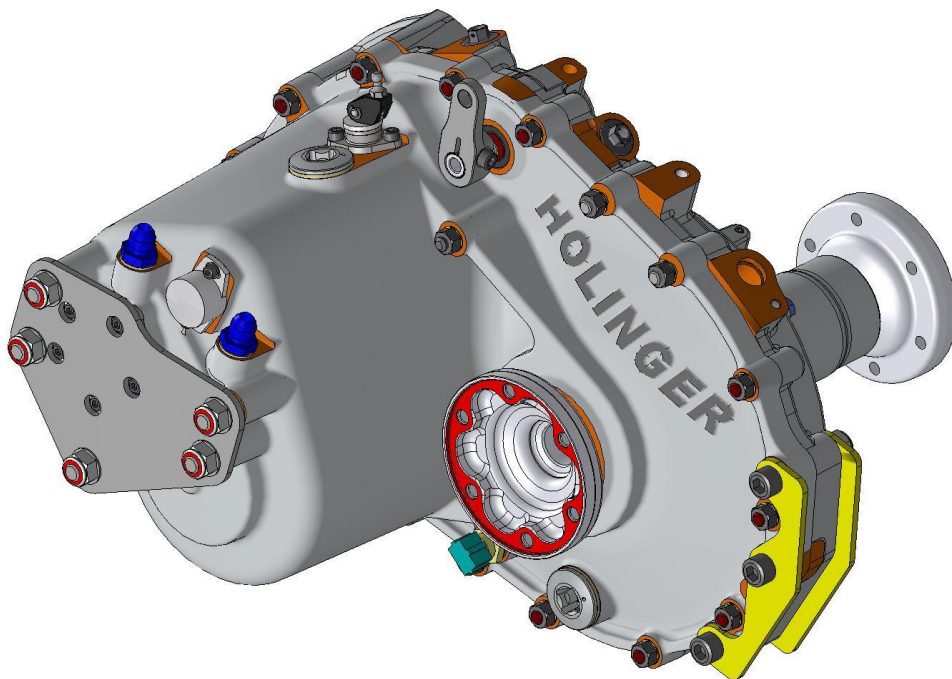


HOLINGER
ENGINEERING
Racecar Gearbox Manufacturers

HOLINGER SF GEARBOX MANUAL



Approved By: Leigh Nash

Date: 26/05/2011

FOREWORD

The Holinger SF is a sequential-shift transaxle designed for use in transverse engine, two-wheel-drive race cars.

The transaxle is fitted with 6 forward gears, a reverse gear, and a final drive. All the forward gears are profile ground for increased efficiency and durability and have an extensive range of ratios available.

Features:

- Torque rating for endurance events of 365Nm (270ft.lb).

- The engine side bolt pattern is either cast and machined integral, or fitted with a removable bellhousing on a standard Holinger bolt pattern.

- Input is via a removable quill-shaft which can be customised to suit individual requirements.

- Output is available with bolt up flanges, integral tripods, or can be customised to suit individual requirements.

- The internal lubrication system consists of a magnetic / paper element filter, an oil pump with provision for an external cooler, a spray bar to feed cooled oil directly onto the gears, through-shaft lubrication to all needle roller bearings and a jet feed through the differential.

- A gear position sensor is supplied for interfacing with an electronic dash display. Alternatively a stand-alone gear indicator display is available for cars not fitted with an electronic dash.

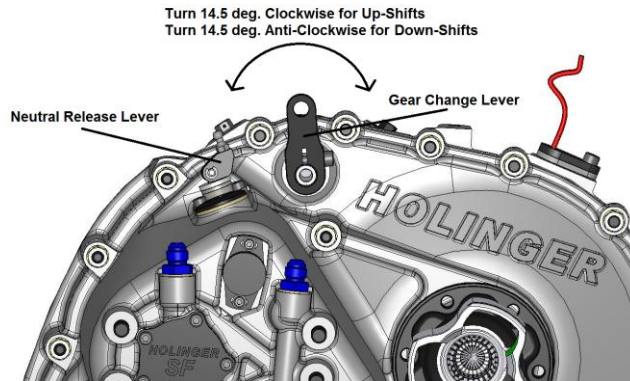
- The Gearbox basic weight is 34kg (75 lbs) and approximately 38kg (84 lbs) with a Bellhousing and Drive-Flanges (this can vary with different configurations).

CONTENTS

CHANGING GEARS	4
Gear Level System.....	5
GEARBOX MOUNTS.....	5
SUB ASSEMBLIES.....	6
Right Case	6
Gearbox Housing	7
Pinion Shaft.....	8
Input Shaft.....	9
Differential	10
Neutral Release.....	18
Reverse Gear Spindle	18
Oil Pump	19
Output Bearing Support.....	20
SETUP.....	21
Bearing Height Setup	21
Cam Setup	23
GEARBOX ASSEMBLY.....	26
Gear Position Potentiometer Installation/Setup.....	32
DISASSEMBLY.....	33
BEARING END-FLOAT SETTINGS.....	37
DIFFERENTIAL CLUTCH PACK END-FLOAT	37
TORQUE SETTINGS.....	37
LUBRICATION.....	37

CHANGING GEARS

The gear-change lever is positioned on the gearbox as shown in the following diagram (This diagram illustrates the gearbox when viewed from the outside “left” of the vehicle):



To change up and down between gears, the driver must shift using a remotely mounted “gear-lever” system. Typically this gear-lever would be floor mounted inside of the car, and attached to the gearbox via a cable or mechanical linkages.

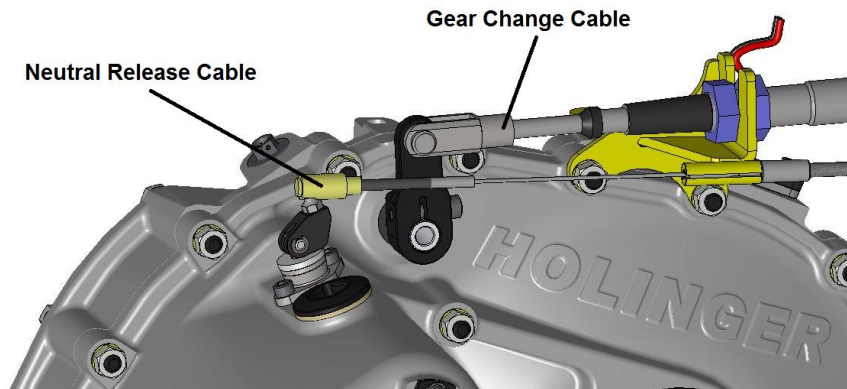
Shifting between gears is achieved by moving the Gear Lever forward and backward in a straight line. One movement in either direction (*generally a backward movement is for up-shifting and a forward movement is for down-shifting*) corresponds to one gear change, in sequence from Reverse-Neutral-1st-2nd-3rd-4th-5th-6th and back.

To avoid selecting Neutral or Reverse at an unwanted time, a Lock-Out system has been incorporated.

To engage Neutral when in 1st gear, the “Neutral Release Lever” must be actuated, while the driver simultaneously shifts “down” once more. From this position the driver can then select Reverse Gear with a single down-change or 1st gear with a single up-change as per normal.

Gear Level System

The following diagram shows an example of a cable mounted system which can be supplied by Holinger Engineering:

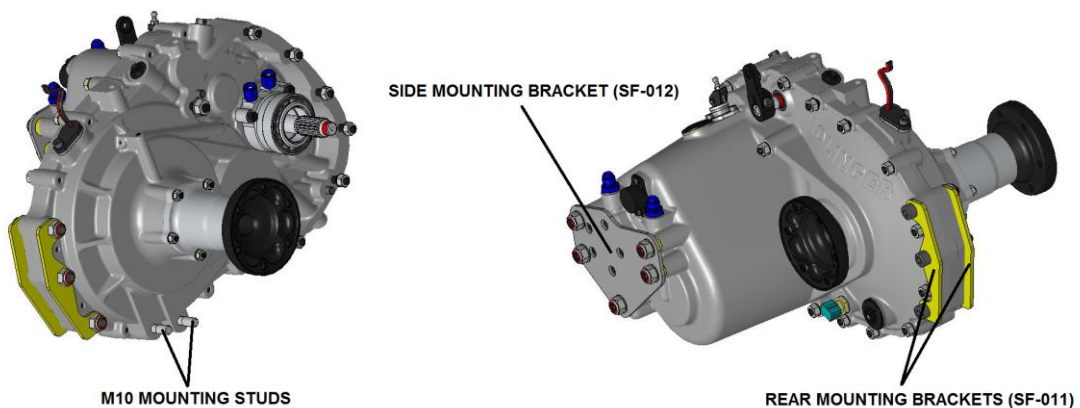


Each gear shift will require the gearbox mounted gear-change lever to turn 14.5 degrees in one direction and then return to its central position.

NOTE: 14.5 degrees is approximately 10.5mm of linear travel.

GEARBOX MOUNTS

Three generic mounts are supplied with the Holinger SF, all of which can be modified to suit the mounting requirements of individual vehicles. There are also 2 x M10 Mounting Studs underneath the Output-Shaft on the engine side of the gearbox, which can be used to secure an additional mount.

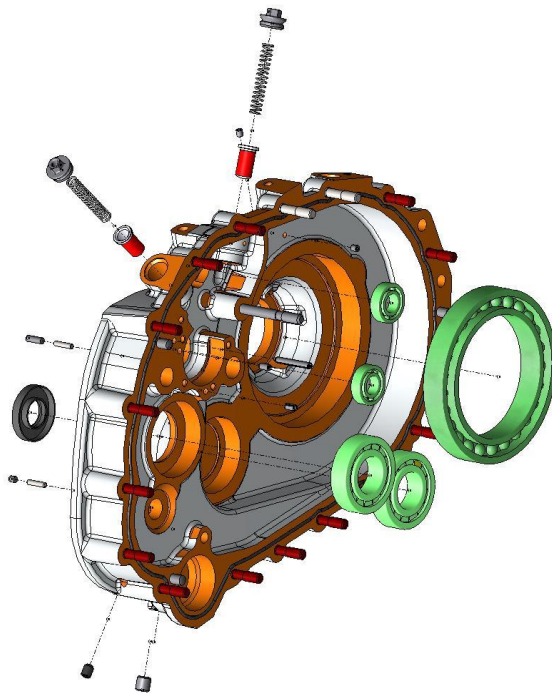


Use the SF exploded diagram in conjunction with this manual to assist in carrying out the following:

SUB ASSEMBLIES

NOTE: Ensure all parts are thoroughly cleaned before commencing any work. All threads that are to be secured with Loctite should first be sprayed with 7471 Loctite Primer.

Right Case



On the engine side of the housing insert two 102-0416 4mm rolls followed by an M5x5mm SHSS and an M5x15mm SHSS. Secure using Loctite 263.

Blank the oil galleries with grub-screws and secure using Loctite 263.

Fit the studs into the case, securing with Loctite 263:

-2 x M8x50mm studs into the case to suit the cable anchor mount, approximately 32mm should be protruding.

-15 x M8x45mm studs with 27mm protruding.

-1 x M8x83mm stud into the case next to the cam with 62mm protruding.

-5 x M6x35mm SHSS for the output bearing support. 17mm should be protruding.

Warm the case to 100°C and fit the bearings by hand then when the case has cooled, ensure the bearings are seated with a light press.

NOTE: Keep the inner-races of the 104-306216NJ (NJ206 E C3) bearings together with their corresponding outer-race during assembly.

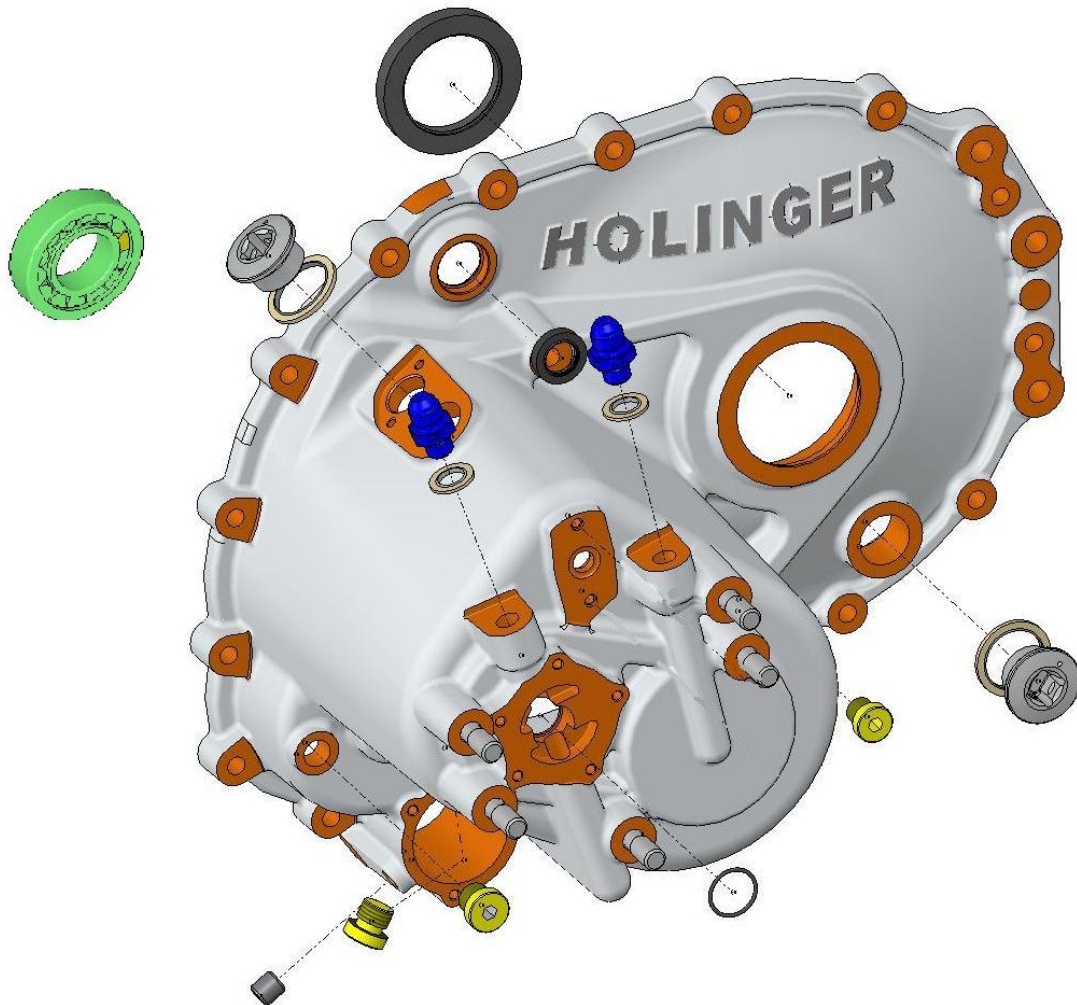
Once the case has cooled insert the 130-224507 lip seal. Then insert the SF-032 gasket o-ring into the mounting face.

Fit the M5x35mm rollpin into the case which acts as a spring reaction post.

Lubricate three M8x25mm dowels with grease and insert them into the case.

Fit two H6S-SEQ-015 plungers lubricated with oil, followed by two J6S-107 detent springs. Secure them with two RD6-122 plugs using Loctite 243. Make sure the thread is oil free and primed with Loctite 7471.

Gearbox Housing



Insert five M10x44mm studs into the rear of the housing and secure using Loctite 263. Approximately 23mm should be protruding.

Insert a 7/16 UNF SHSS into the side oil gallery flush with the cast surface. Secure with Loctite 263.

Seal the oil level check holes with M14 VSTI plugs.

If not using a temperature sensor seal the hole with an M12 VSTI plug.

Support the case on the machined surface between the oil inlet and outlet holes with a clean flat aluminium disk; then insert a 107-354212 HK roller bearing for the camshaft using a press. Ensure the bearing is well oiled.

Insert the axle seal (130-456508) and the gear-change seal (130-152405).

Insert a 132-201.5 o-ring for the oil-pump body, and an 132-092.0 o-ring for the potentiometer. Ensure it is lubricated with Rubber Grease.

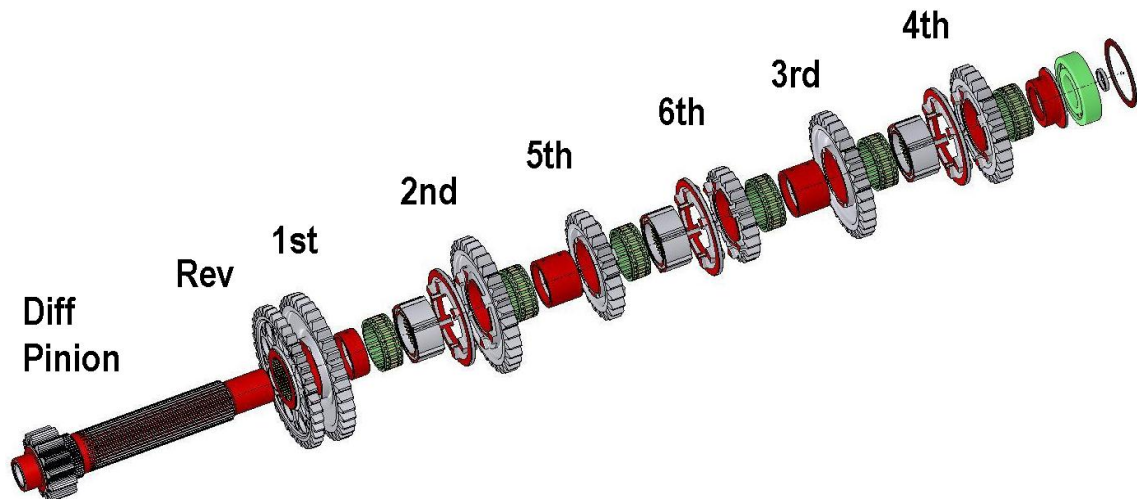
Fit the Drain and Fill plugs.

Fit two M12x1.5mm Dash-6 oil-line fittings, using M12 Dowty washers (034-12) to seal them.

Only fit the 104-306216NJ (NJ206 E C3) outer-race for the Input Shaft.

NOTE: The other two bearings must be fitted with shims. Please refer to the SETUP section.

Pinion Shaft



Before assembling the Pinion Shaft ensure the SF-034 oil baffle is inserted into the end of the shaft.

NOTE: During this procedure, lubricate all Needle Roller bearings with oil.

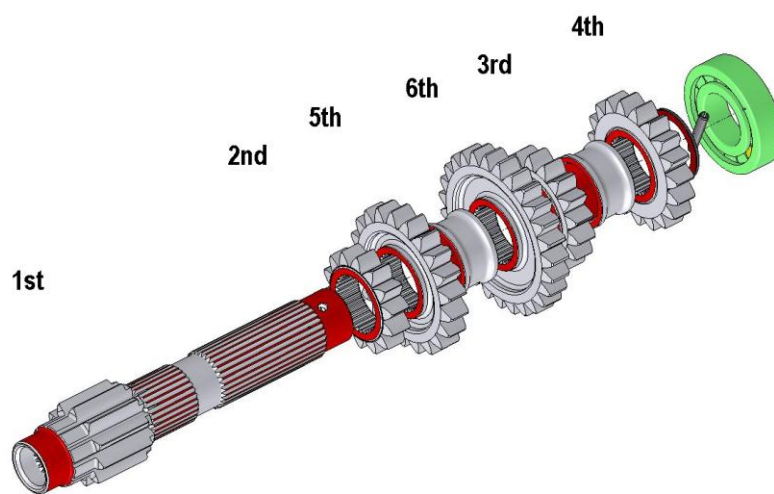
Fit the SF-008 reverse spline-gear, followed by the SF-031 bearing sleeve, 106-424717 needle roller and the 1st dog-gear (Z-005).

Place the Z-016 selector hub and Z-017 1st/2nd selector ring onto the shaft. Follow this with the 5th dog gear, the 5th/6th selector ring and the 6th dog gear along with their bearings and sleeves. Finally slide on the 3rd dog gear, 3rd/4th selector ring and the 4th dog gear.

Place the 104-306216NJ (NJ206 E C3) inner-race on the end of the shaft.

NOTE: Keep the inner-race of the 104-306216NJ with its outer-race. The bearing will require shimming for end float during gearbox assembly.

Input Shaft

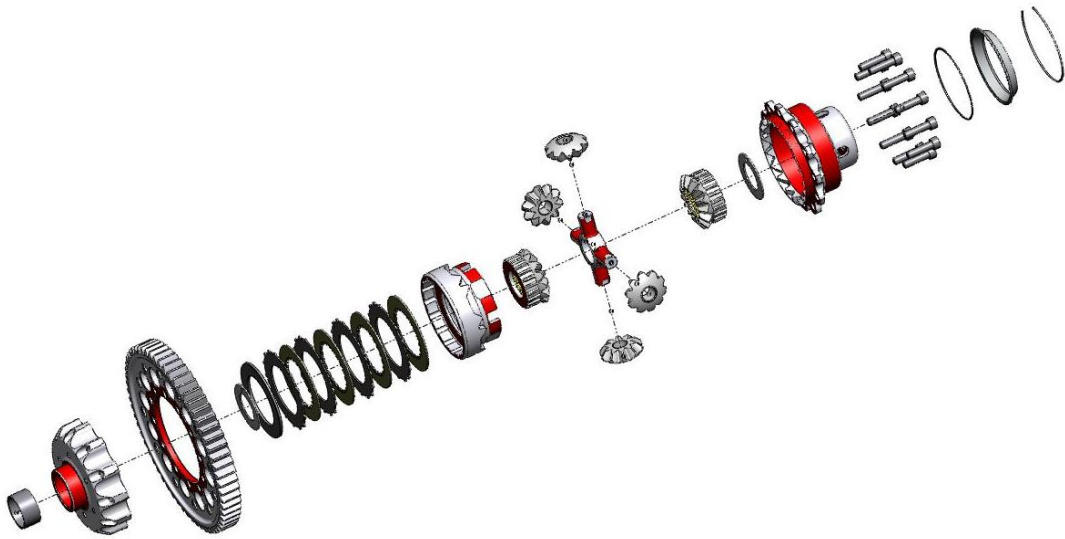


Fit an M5x30mm roll pin into the input shaft for the oil pump drive.

Slide the spline gears onto the shaft starting with the 2nd gear followed by 5th gear, a Z-027 spacer, 6th gear, 3rd gear, another Z-027 spacer and finally the 4th spline gear.

NOTE: Keep the inner-race of the 104-306216NJ (NJ206 E C3) with its outer-race. The bearing will require shimming for end float during gearbox assembly.

Differential



Description:

The Limited Slip Differential has two sets of “Ramps” that actuate a “Clutch Pack” to offer different drive characteristics.

The Pressure Ring (SF-505) can be fitted to the Right Housing (SF-504) with either of the two ramp sets engaged.

Ramp engagement example (The following diagrams do not represent the full range of available ramp angles for the Holinger SF):



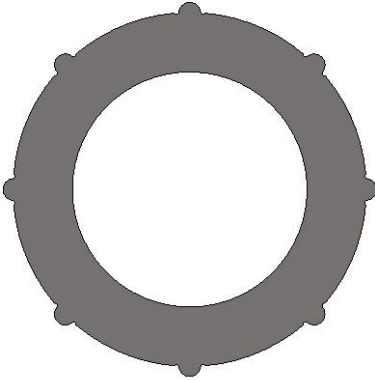
45-45 RAMPS



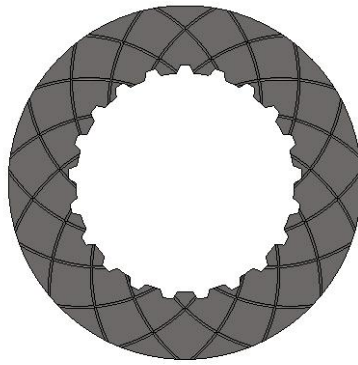
30-80 RAMPS

The Clutch Pack contains-

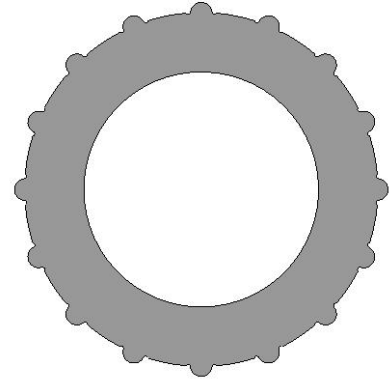
- Four inner-plates (internal splines) *SF-509*
- Three outer-plates (external splines) *SF-510*
- Shim (8 outer splines) *SF-508*
- Spacer *SF-515* or Belleville spring *SF-507-X*



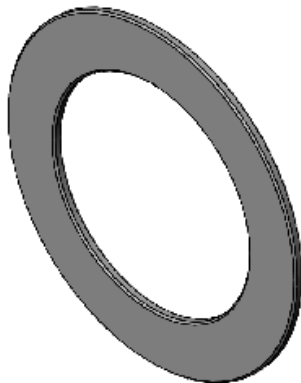
SF-508 CLUTCH SHIM



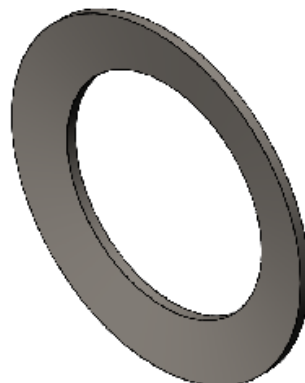
**SF-509-NITRIDED OR
SF-509-FLAME SPRAYED**



SF-510 OUTER CLUTCH PLATE



SF-515 SPACER



SF-507 - A, NO HOLES SPRING



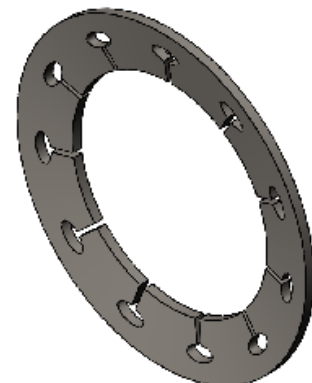
SF-507 - B, 3 HOLES SPRING



SF-507 - C, 6 HOLES SPRING

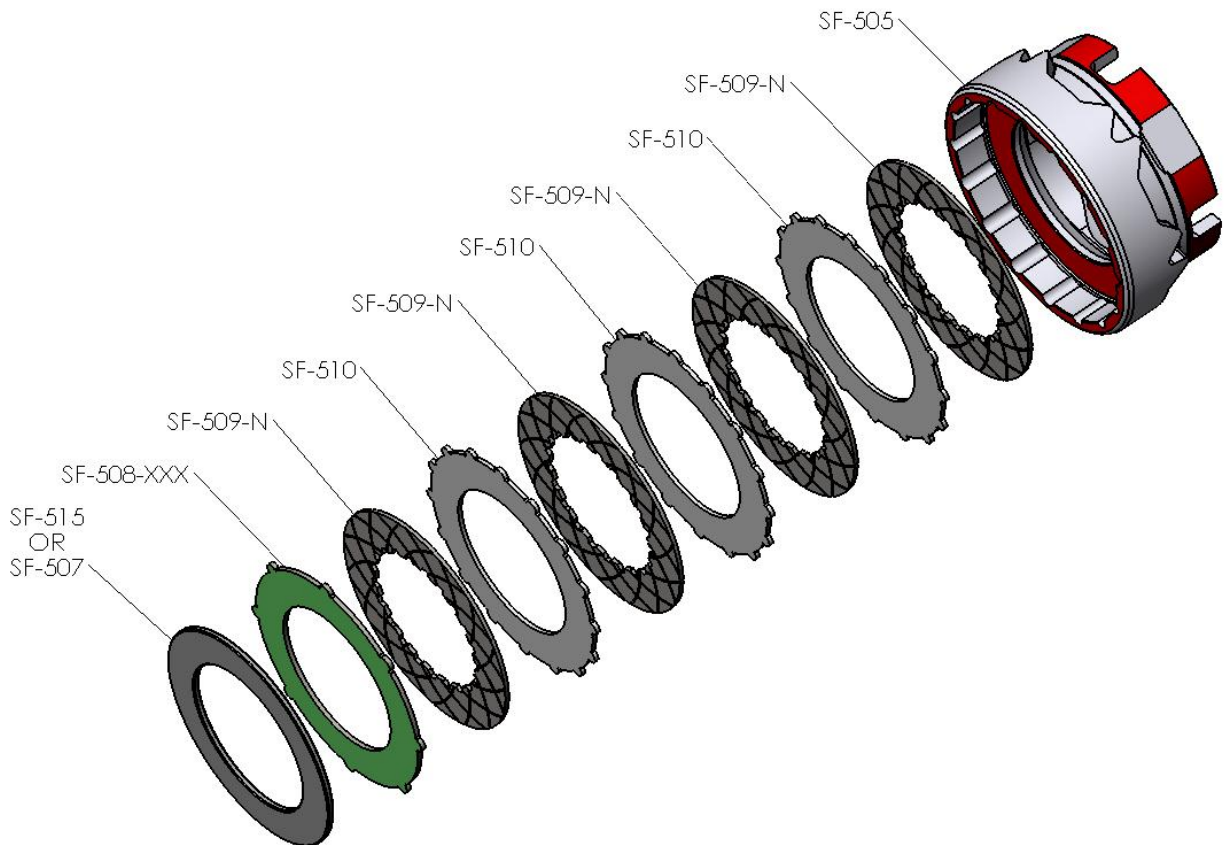


SF-507 - D, 11 HOLES SPRING



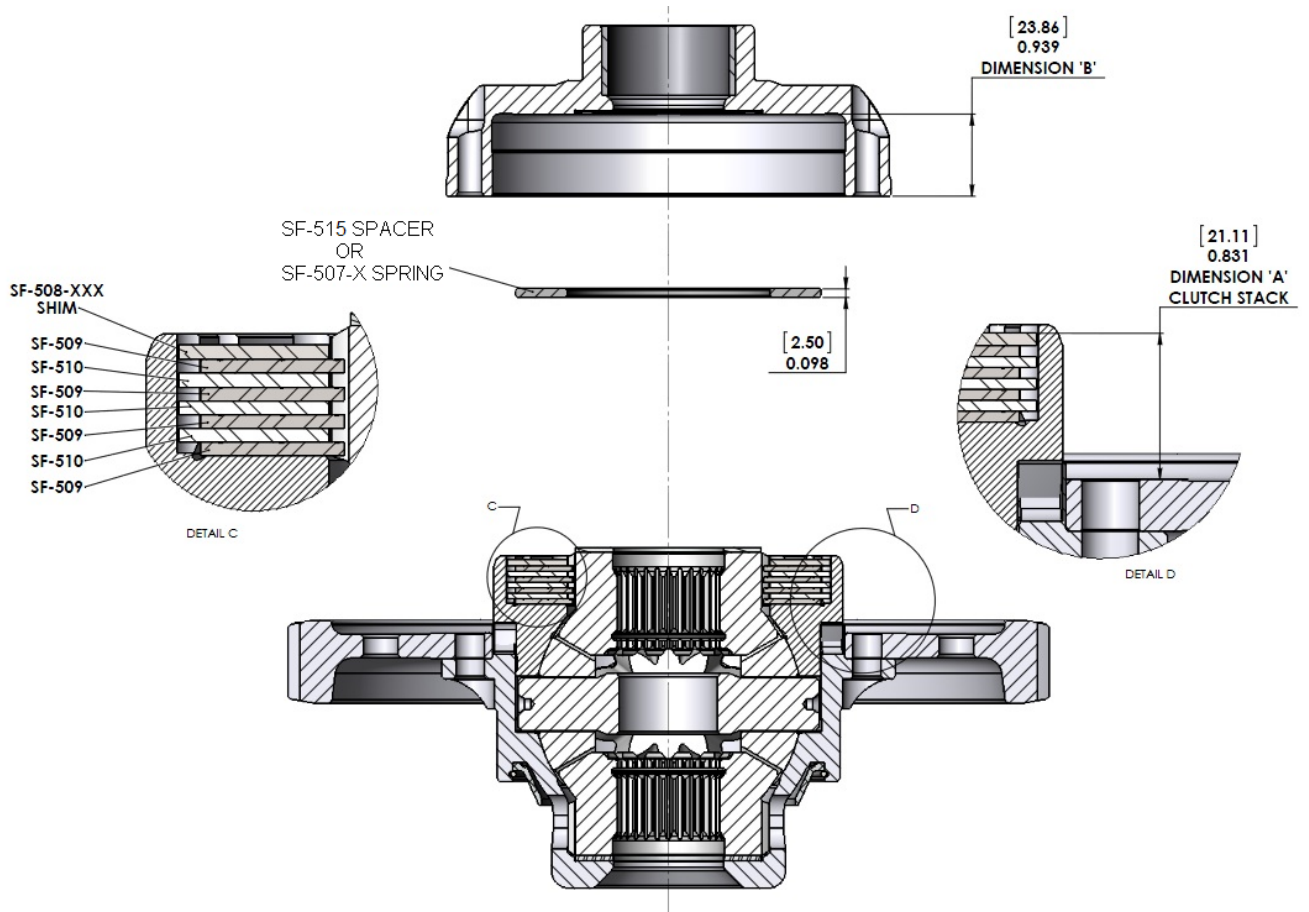
SF-507 - E, 11 HOLES LARGE PCD SPRING

The Clutch Pack can be installed with ZERO PRELOAD or it can be PRELOADED with a Belleville spring.



Setting the Clutch Pack End Float:

The differential is assembled in the same method for PRELOADED or ZERO PRELOAD configurations.



Assemble the differential as illustrated in the diagram above, dry with no oil.

-Set the clutch stack to dimension 'A' **21.11mm +/- 0.05mm** by adjusting the shim (SF-508) thickness.

The end float should be **0.254mm +/- 0.05** and can be verified-

$$\text{End float} = B - (2.5\text{mm} + A)$$

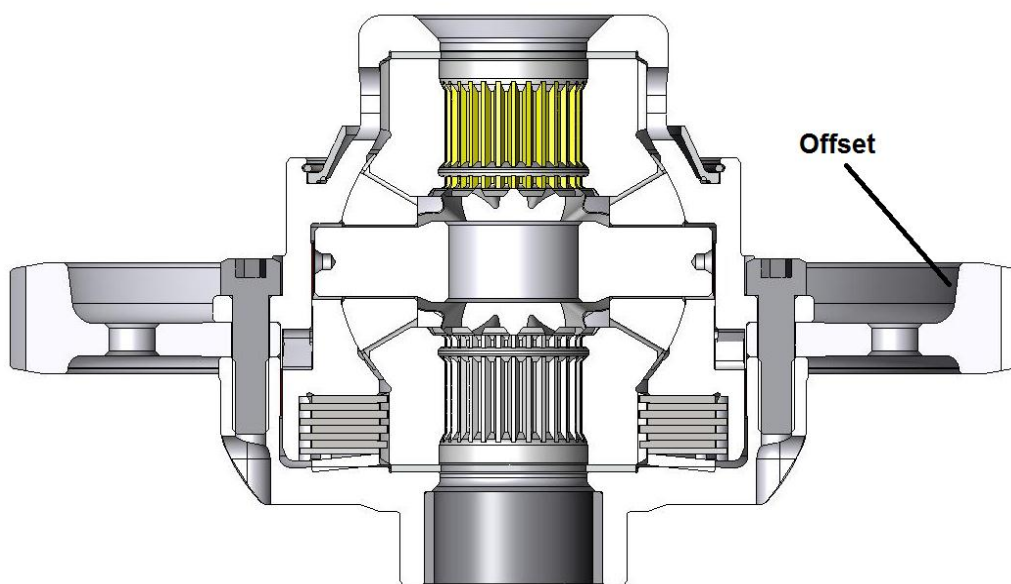
The shim SF-508 is available ground to the required thickness from Holinger Engineering.

After the Shim is set, reassemble the differential thoroughly lubricating all the parts.

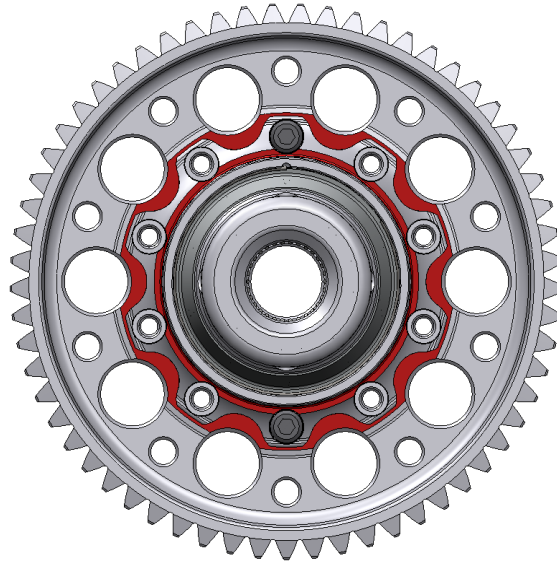
-Check that the Teflon face of the side gear thrust washer (122-32) faces the side gear.

-Check that the ramps are engaged according to the diagram.

-Check the Ring gear is fitted with the offset facing the correct way.



Ensure the M8 threads are free of oil and clean. Prime the M8 screws and holes, with Loctite 7471.

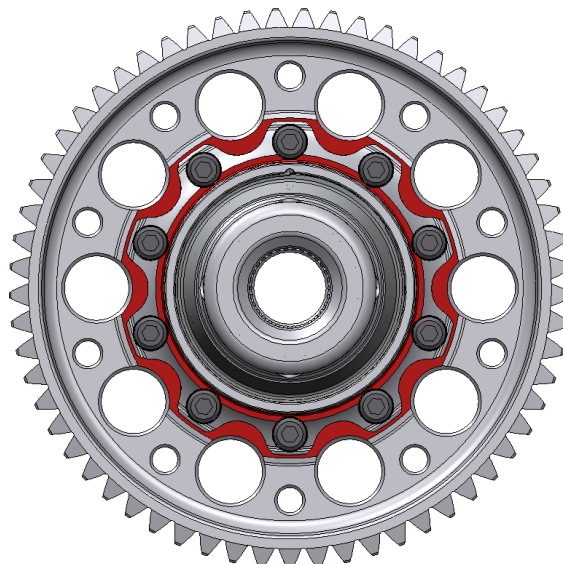


To seat the housings, fit 2 bolts with no Loctite, diagonally opposing, first tighten by hand, then tighten to 39Nm. *Mark these bolts, as they must be removed and re-fastened with Loctite later.*

Use your fingers to check the side gears have end float and back-lash.

Fit the remaining bolts with Loctite 263, tighten to 39Nm.

Remove the two bolts with no Loctite, and refit with Loctite 263, 39Nm.



Normal Clutch Wear

The clutch pack will wear in normal operation and it should be inspected at each service interval.

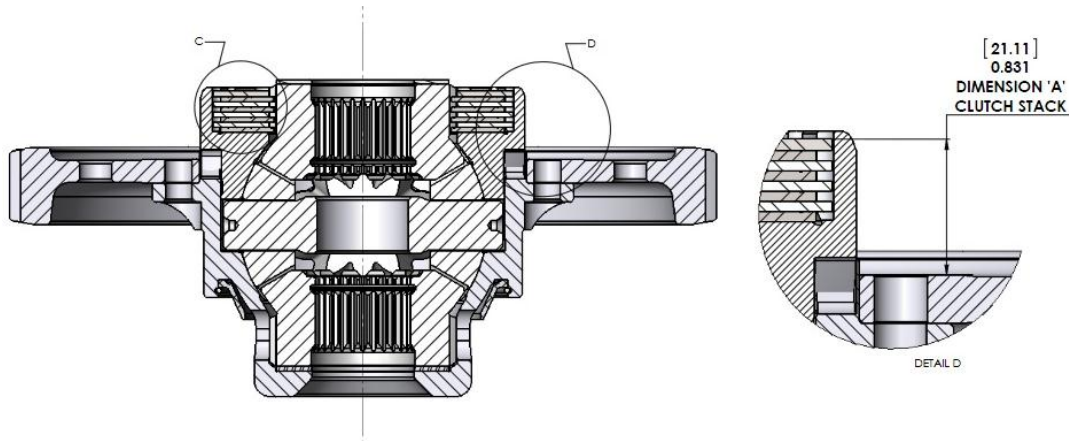
The wear rate will vary depending on the ramp angles, clutch material and the severity of use.

The clutch wear should not exceed 1mm (0.040") between service intervals.

It should be checked at "clutch stack" Dimension A

-Originally 0.831" 21.11mm

-Wear limit 0.792" 20.11mm



If the wear is excessive the pressure ring (SF-505) can rest on the cover (SF-506) and the load on the clutch pack will be lost, allowing the clutch to slip.

The clutch plates also have a wear limit:

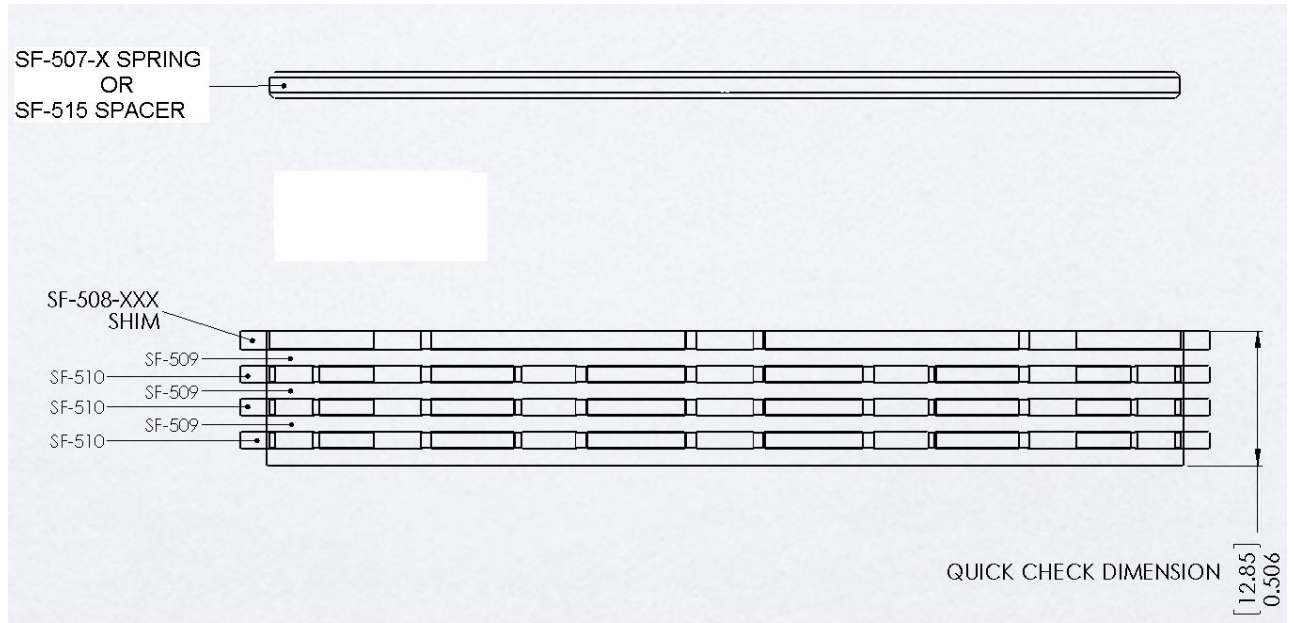
MINIMUM THICKNESS		
INNER PLATE (SF-509)		
METALLIC	1.35mm	0.053"
CARBON	2.2mm	0.087"
OUTER PLATE (SF-510)	1.4mm	0.055"

Replacement plates, shims and new ramp angles are available from Holinger Engineering.

Clutch Quick Check

As a “quick check” the clutch can be measured for thickness on its own.

It should be measured WITHOUT the spring SF-514 or spacer SF-507.

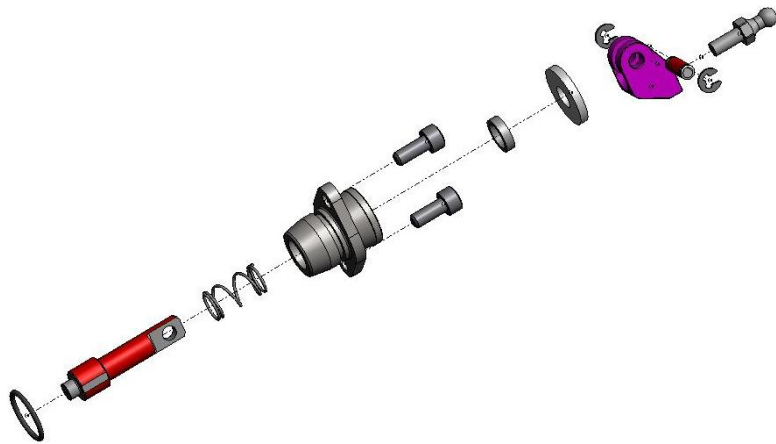


The “quick check” thickness IS 12.85mm (0.506”)

It will give 0.254mm (0.010”) end float as described in the previous section, **Setting The Clutch Pack End Float.**

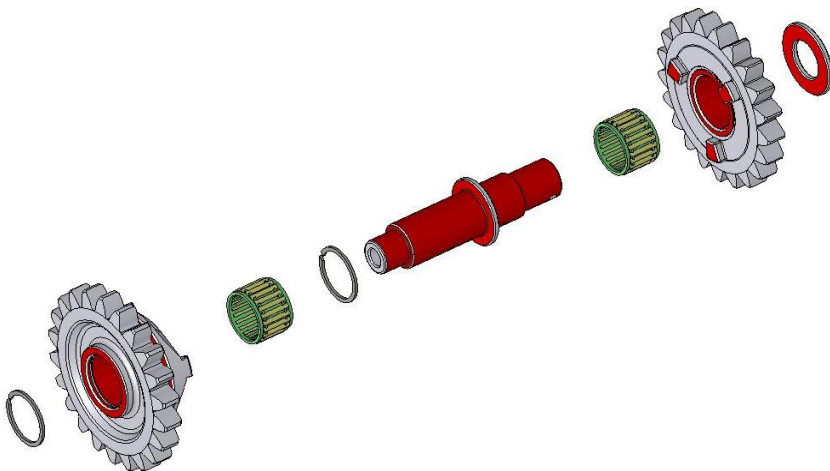
NOTE: all Holinger Springs (SF-507-x) and spacers (SF-515) are the same thickness and are interchangeable.

Neutral Release



Assemble the neutral release mechanism. First install the seal 133-081203, then the o-ring, followed by the remaining parts; lubricate the seal with rubber grease.

Reverse Gear Spindle

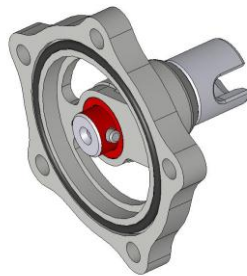


Assemble the two reverse dog gears with the needle rollers. The SF-004 Reverse Dog Gear uses two circlips to secure the bearing, whereas the SF-007 Reverse Idler relies on the spindle shoulder and a thrust washer to retain the bearing; ensure both bearings are lubricated with oil.

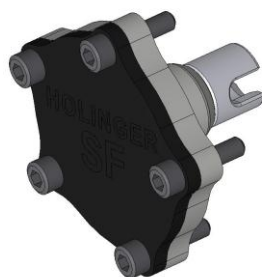
Oil Pump



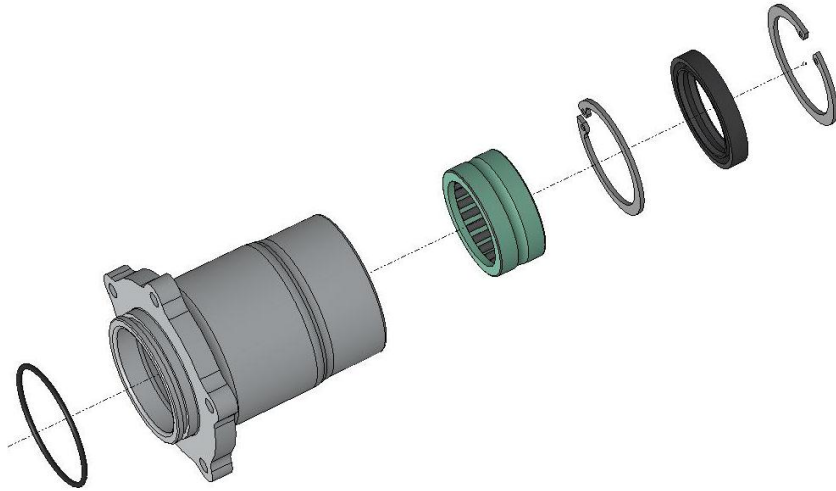
Assemble the oil pump drive spindle (*SF-027*) into the body (*SF-028*), then place the thrust washer hard up against the recess followed by the roll/drive pin and o-rings:



Now place the oil pump rotor assembly (*J6S-077*) over the spindle/pin and cover with the blackened plate (*SF-029*):



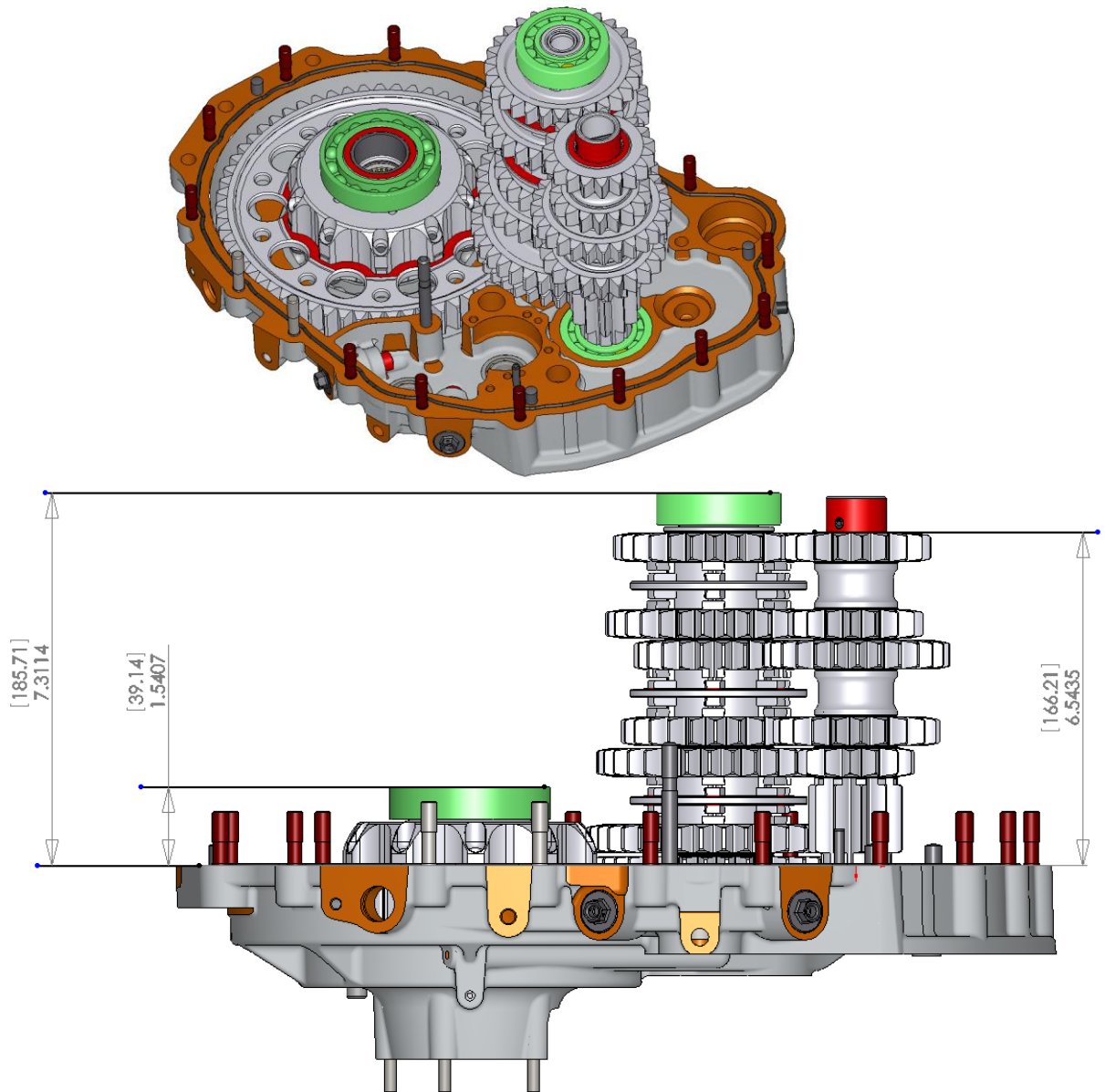
Output Bearing Support



Warm the *SF-010* Output Bearing Support to 100°C, and insert the bearing by hand. When it has cooled retain the bearing with a circlip, then insert the seal and retain this with another circlip. Finish by placing the o-ring in the groove. Lubricate the seal and o-ring with grease.

SETUP

Bearing Height Setup



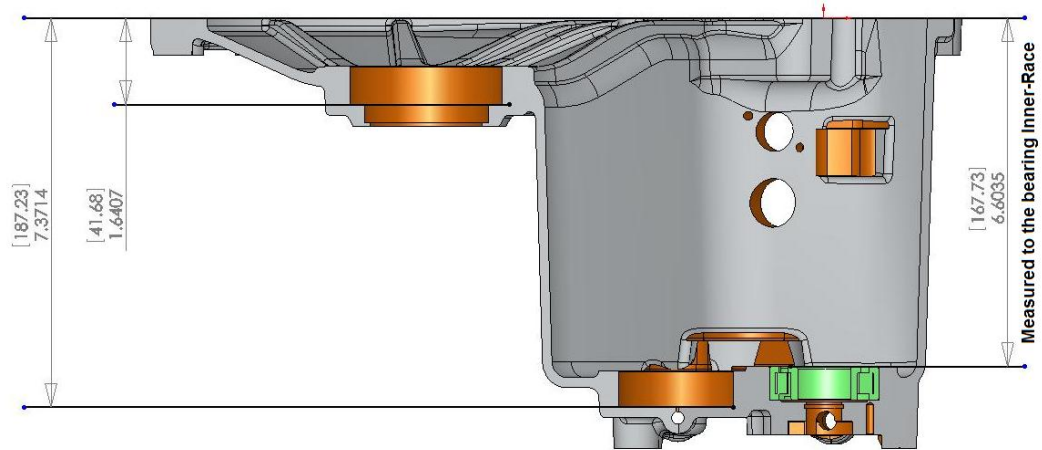
STEP 1

Fit both gearbox Shafts together with the Differential. The bearings should be fitted to the differential and the pinion shaft- 103-508016 (6010) and 104-306216NJ (NJ206 E C3).

The bearing for the Input Shaft should be fitted to the Gearbox Housing.

Take three measurements as shown in the diagram above.

STEP 2



Using a depth micrometer, measure the distance from the gasket surface of the gearbox housing to the bearing bore seats of the differential and pinion shaft; and the bearing inner race of the input shaft.

STEP 3

Compare the measurements in STEP 1 and STEP 2.

Calculate the shim thickness to leave 0.003"-0.005" (0.08-0.12mm) end float, for the differential and both shafts.

All shims are available, ground to the required size, from Holinger Engineering.

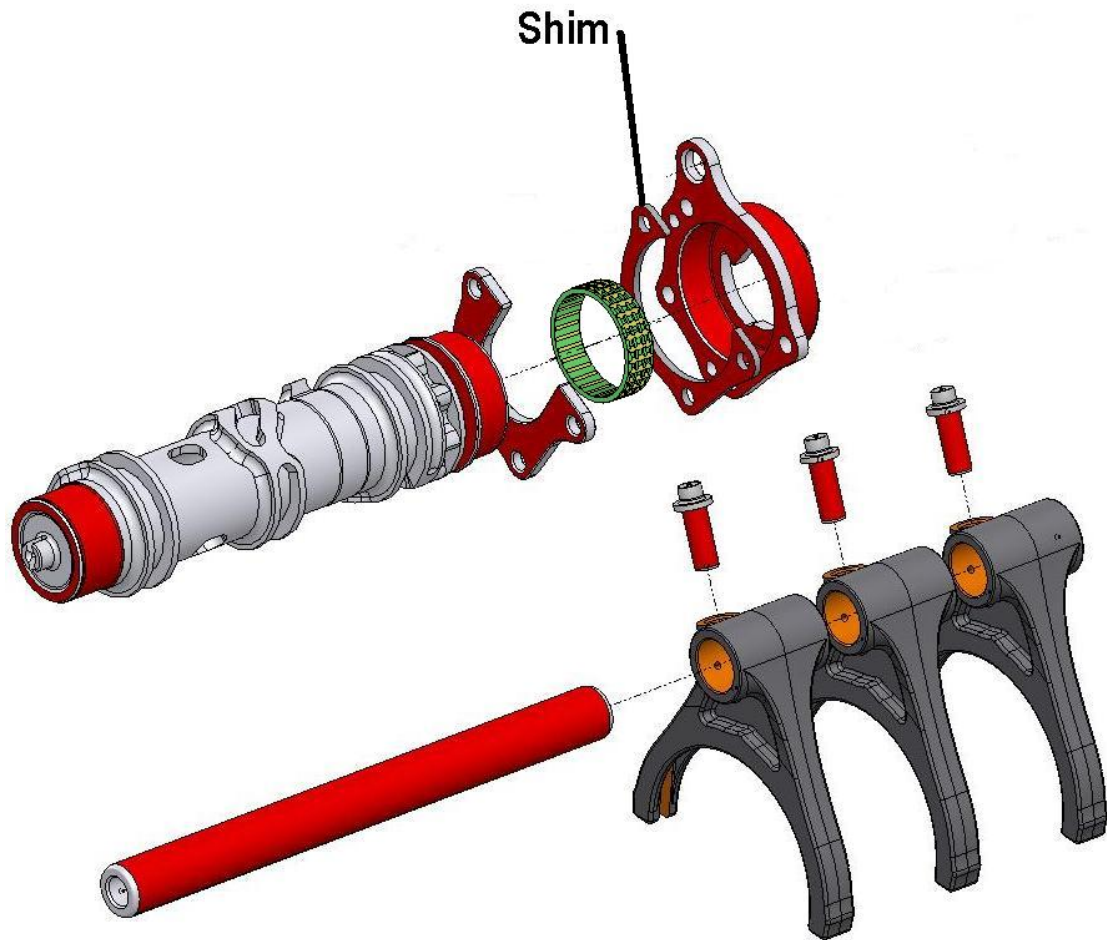
Diff shim: *SF-512*
Pinion shim: *SG-023*
Input shim: *SG-124*

Check the Axle seal is fitted, and warm the gearbox housing Case to 100°C.

Fit the Differential Shim *SF-512*, and the Pinion shim *SG-023*, and then fit their bearings by hand.

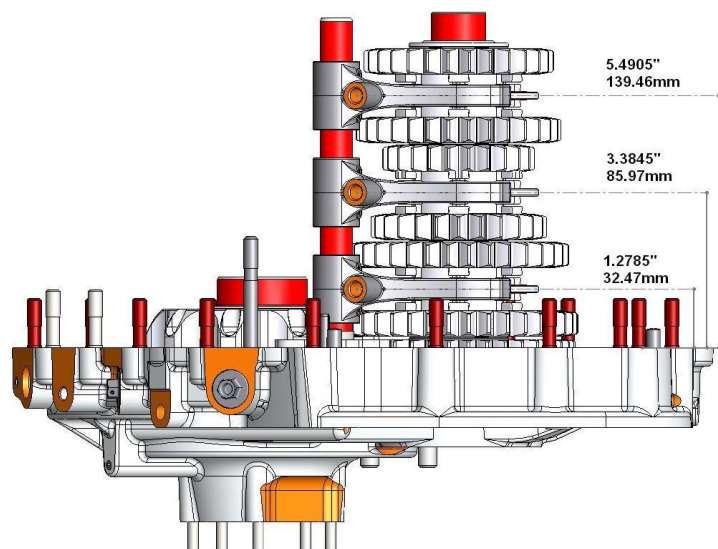
Allow the case to cool and ensure the bearings are seated properly.

Cam Setup



The axial position of the camshaft is matched to the gear set by adjusting the camshaft Shim.

STEP 1



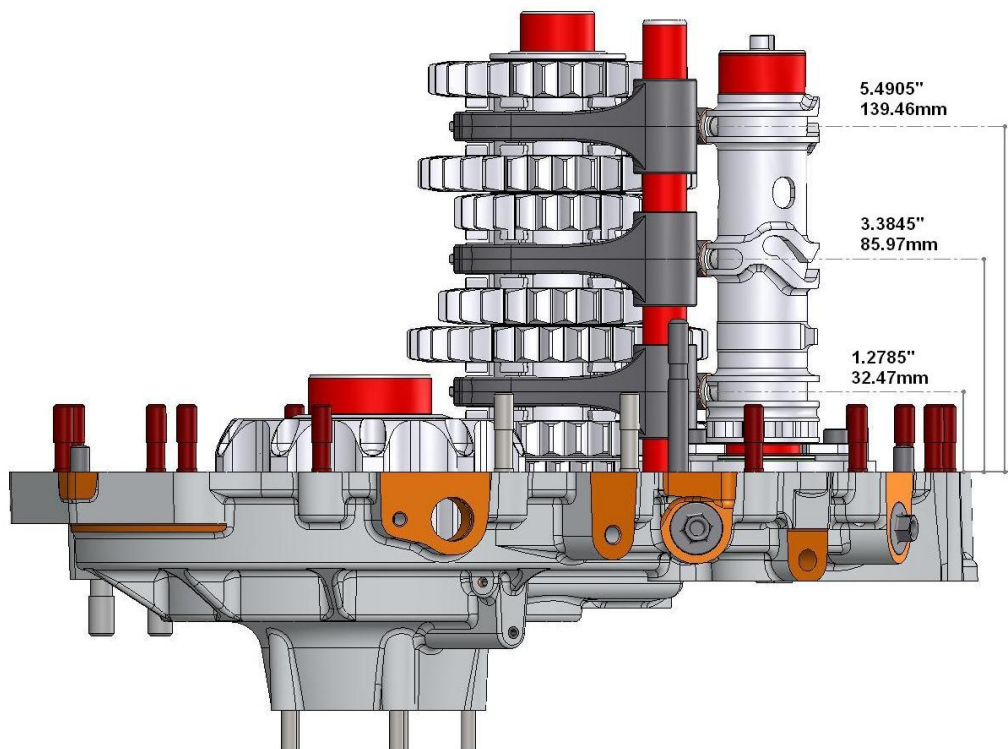
Fit the pinion shaft cluster into the main case, along with the selector forks and the selector rod.

NOTE: The selector rod is timed in the main case to align the oil jets. Ensure the slot in the end of the selector rod lines up with the pin in the main case.

Measure and record the central position of each selector fork between the fully engaged positions (*measure to the hole in the selector fork*).

Calculate the average of these values.

STEP 2



Fit the Cam with the Collar (SF-018), Shim (SF-019), Needle roller bearing (106-424713), and Stop Plate (SF-020). Fit the four M6 screws.

Measure and record the central position of each cam track in the Neutral position.

Calculate the average position.

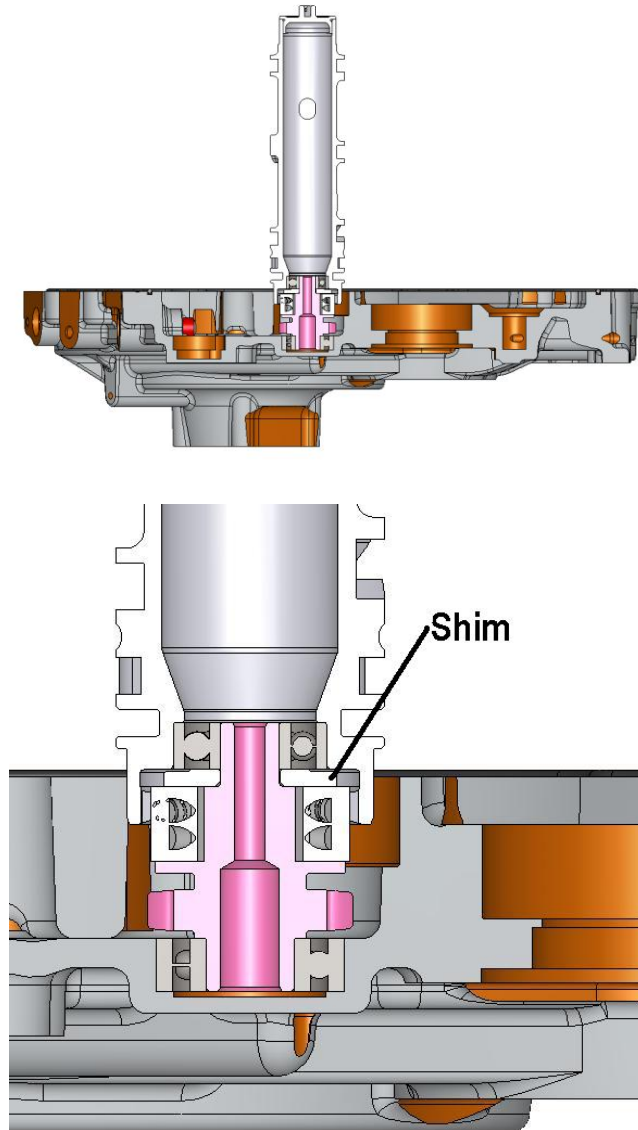
STEP 3

Compare the average from Step 1 and Step 2, and adjust the cam shim so that the cam track matches the gear train.

The shim SF-019 is available ground to the required thickness from Holinger Engineering.

STEP 4

If the Cam shim *SF-019* is adjusted, then the Pawl carrier shim *GTR-SEQ-023* must be adjusted also.



Fit the Pawl Carrier (*SF-022*), the Shim (*GTR-SEQ-023*), the Bearing 103-102608 (6000) and the Cam (*SF-017*).

Repeat Step 2, and calculate an average value for the cam tracks.

Calculate a Shim (*GTR-SEQ-023*) thickness to position the cam 0.004"-0.008" (0.1-0.2mm) **below** the value in Step 1.

When the camshaft is finally assembled with all parts in place, the Collar (*SF-018*) will hold the cam in position, and the Pawl Carrier (*SF-022*) should have end float.

GEARBOX ASSEMBLY.

Check that the sub-assemblies are complete - refer to the SUB ASSEMBLY section.

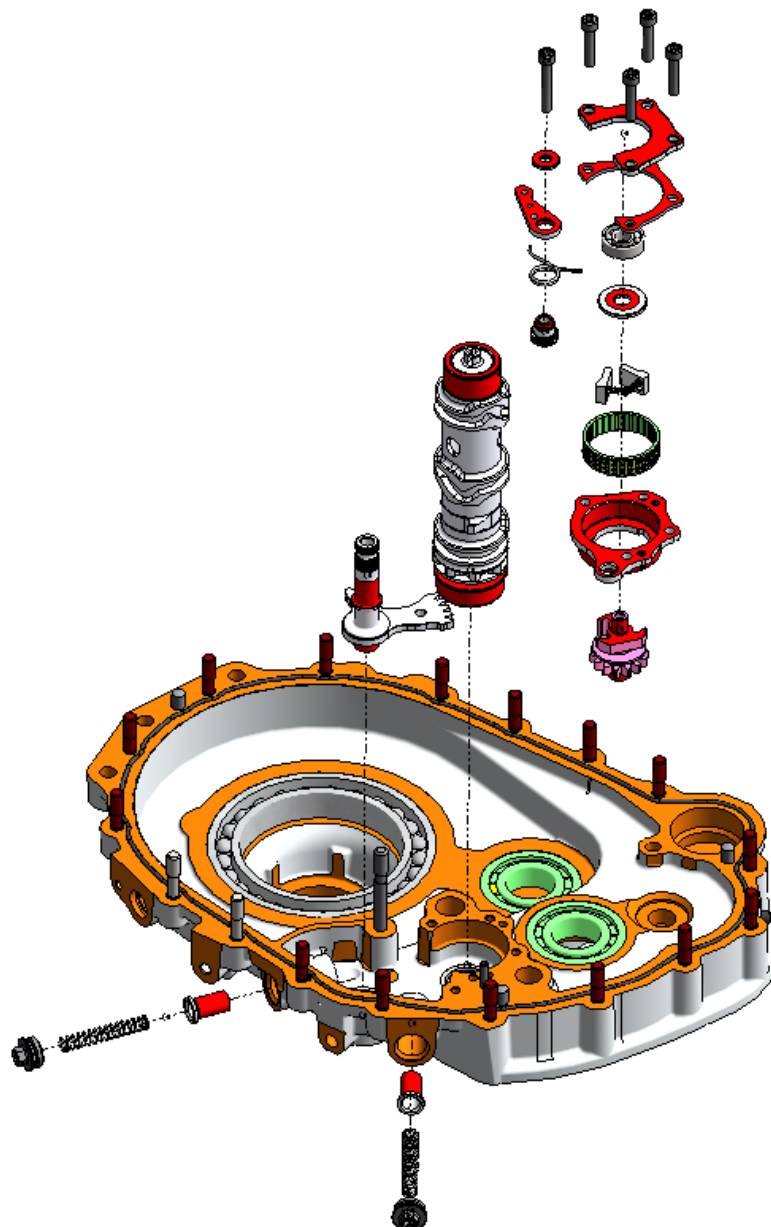
Check that the shims are set - refer to the SETUP section.

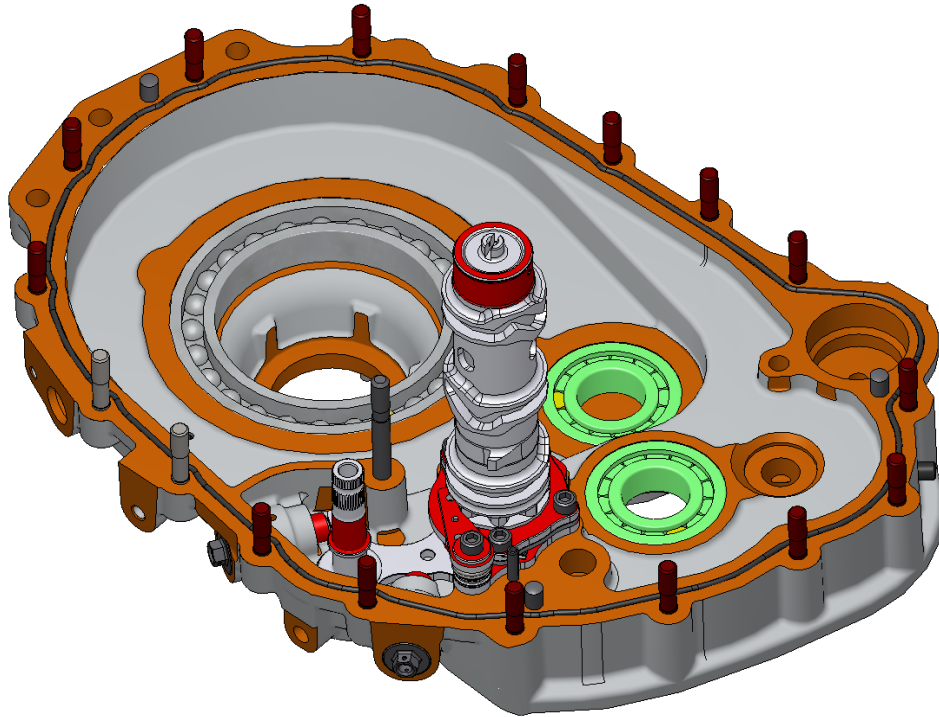
Check that the reverse *Idler* Gear Ratio matches the 1st Gear Ratio.

STEP 1

Assemble the camshaft mechanism according to the diagrams below:

Fasten the five M6 screws using Loctite 243. Tighten to 16Nm.

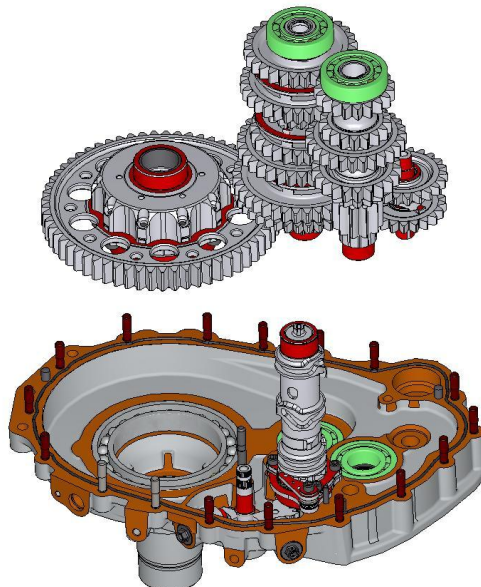




STEP 2

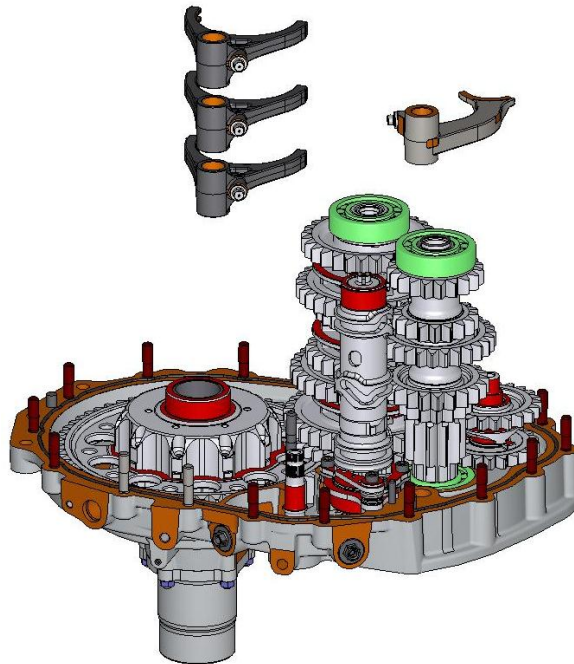
Fit the Gear train as a group.

NOTE: The reverse spindle (*SF-013*) must be aligned with the pin in the bore.



STEP 3

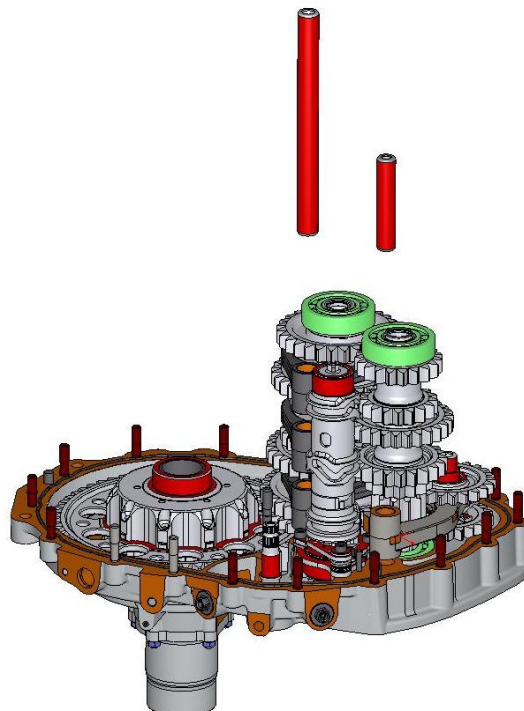
Fit the Forks and Follower Pins.



STEP 4

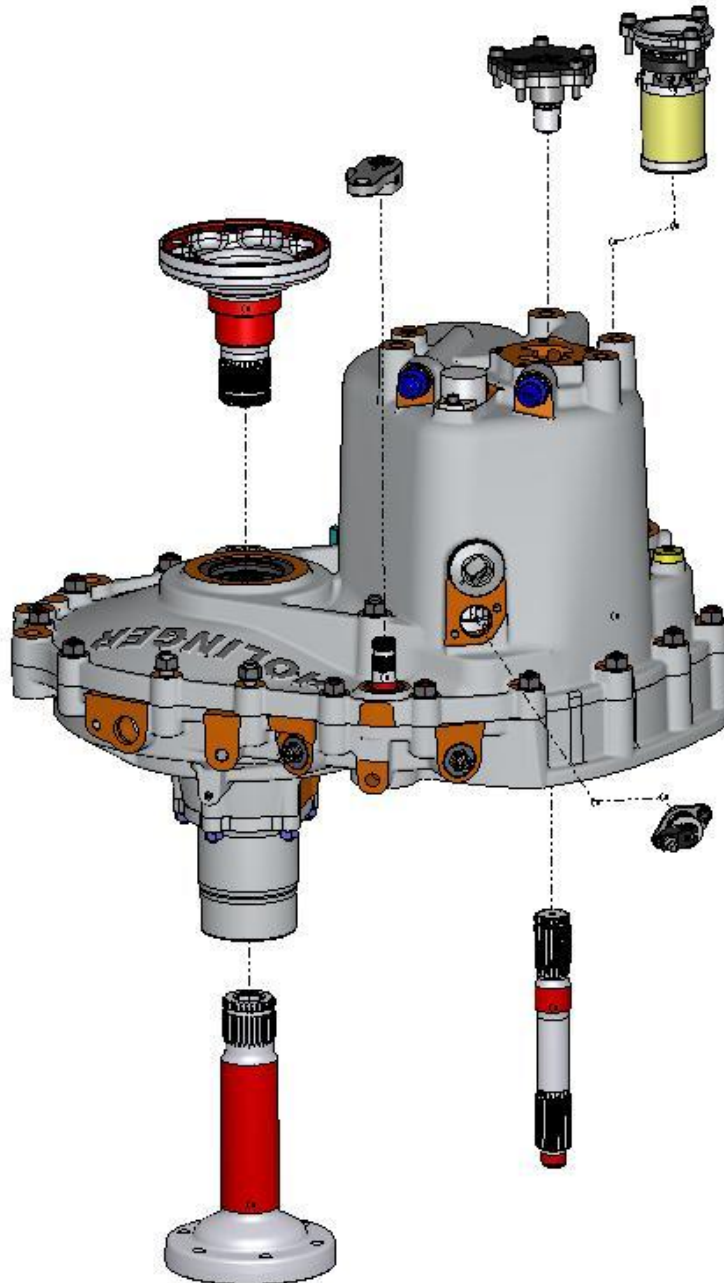
Fit the Selector rods.

NOTE: The forward ratio Selector Rod (*SF-026*) has an alignment slot. Its purpose is to align the Oil Jets. Ensure it is fully inserted and the oil jets line up with the holes in the fork - *when a gear is engaged*.



STEP 5

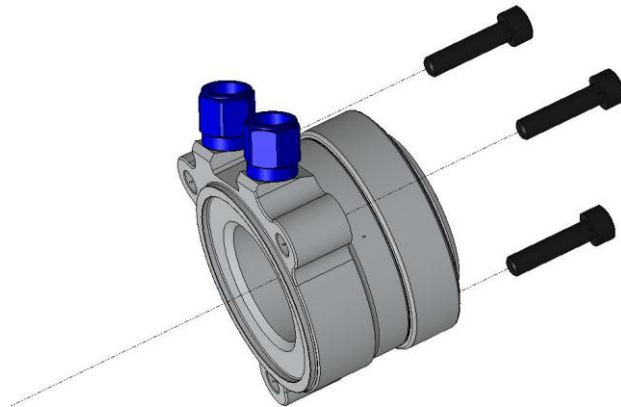
After fitting the Gearbox Housing (SF-002), fit the remaining components; the output bearing support (SF-010), the quill shaft (SF-009), the output shafts (SF-6XX), the gear-change lever (SF-003), oil pump assembly, oil filter/magnet and the neutral release mechanism.



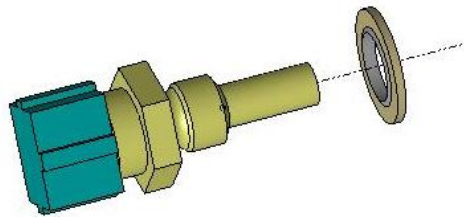
Shift back and forward between all the gears (to go from 1st to neutral, pull on the neutral release lever and shift down a gear), including reverse.

Check that the gear-change lever centralises properly and the gears engage in the correct sequence.

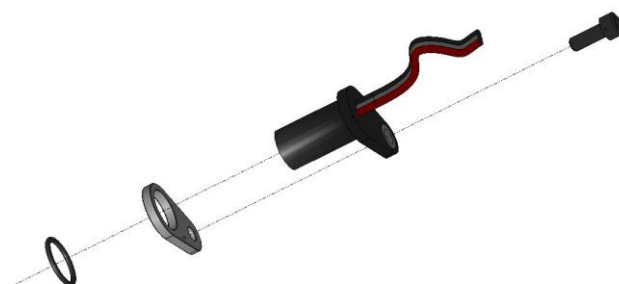
Optional Installation: Also install Clutch Release Cylinder (CR-003) if being used:



Optional Installation: Install the gearbox temperature sensor, sealing with a dowty washer.



Optional Installation: Install either the vehicle speed sensor or a blanking plug.



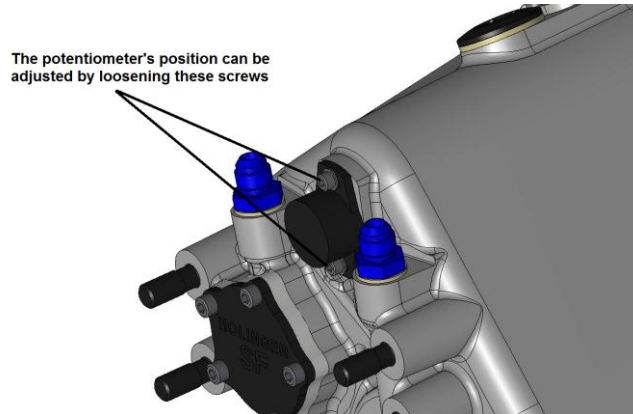
NOTE: Depending on the Ring Gear (*SF-006*) ratio the spacer (*SF-035*) thickness will change.

RATIO	DP	N2	N1	MODIFIED O.D.	SPACER HEIGHT [mm]
4.923	7.5	64 :	13	8.814	11
4.846	7.5	63 :	13	8.789	11
4.857	8	68 :	14	8.784	10
4.786	8	67 :	14	8.761	10
4.692	7.26	61 :	13	8.751	10
4.615	7.26	60 :	13	8.723	10
4.500	7.5	63 :	14	8.686	9
4.467	8	67 :	15	8.663	9
4.429	7.5	62 :	14	8.659	9
4.400	8	66 :	15	8.638	9
4.286	7.26	60 :	14	8.617	8
4.214	7.26	59 :	14	8.587	8
4.133	7.5	62 :	15	8.557	8
4.125	8	66 :	16	8.542	7
4.067	7.5	61 :	15	8.528	7
4.063	8	65 :	16	8.515	7
3.933	7.26	59 :	15	8.483	7
3.867	7.26	58 :	15	8.451	6
3.813	7.5	61 :	16	8.428	6
3.824	8	65 :	17	8.420	6
3.750	7.5	60 :	16	8.397	6
3.765	8	64 :	17	8.391	5
3.625	7.26	58 :	16	8.349	5
3.563	7.26	57 :	16	8.315	4
3.556	8	64 :	18	8.298	4
3.529	7.5	60 :	17	8.298	4
3.500	8	63 :	18	8.268	4
3.471	7.5	59 :	17	8.266	4
3.353	7.26	57 :	17	8.214	3
3.294	7.26	56 :	17	8.178	3
3.316	8	63 :	19	8.177	3
3.278	7.5	59 :	18	8.169	3
3.263	8	62 :	19	8.145	2
3.222	7.5	58 :	18	8.135	2
3.111	7.26	56 :	18	8.080	2
3.100	8	62 :	20	8.055	1
3.056	7.26	55 :	18	8.041	1
3.053	7.5	58 :	19	8.039	1
3.050	8	61 :	20	8.021	1
3.000	7.5	57 :	19	8.003	0

Gear Position Potentiometer Installation/Setup

Place the gearbox in 2nd or 3rd gear and install the PCS-050 gear position potentiometer into the side of gearbox behind the camshaft.

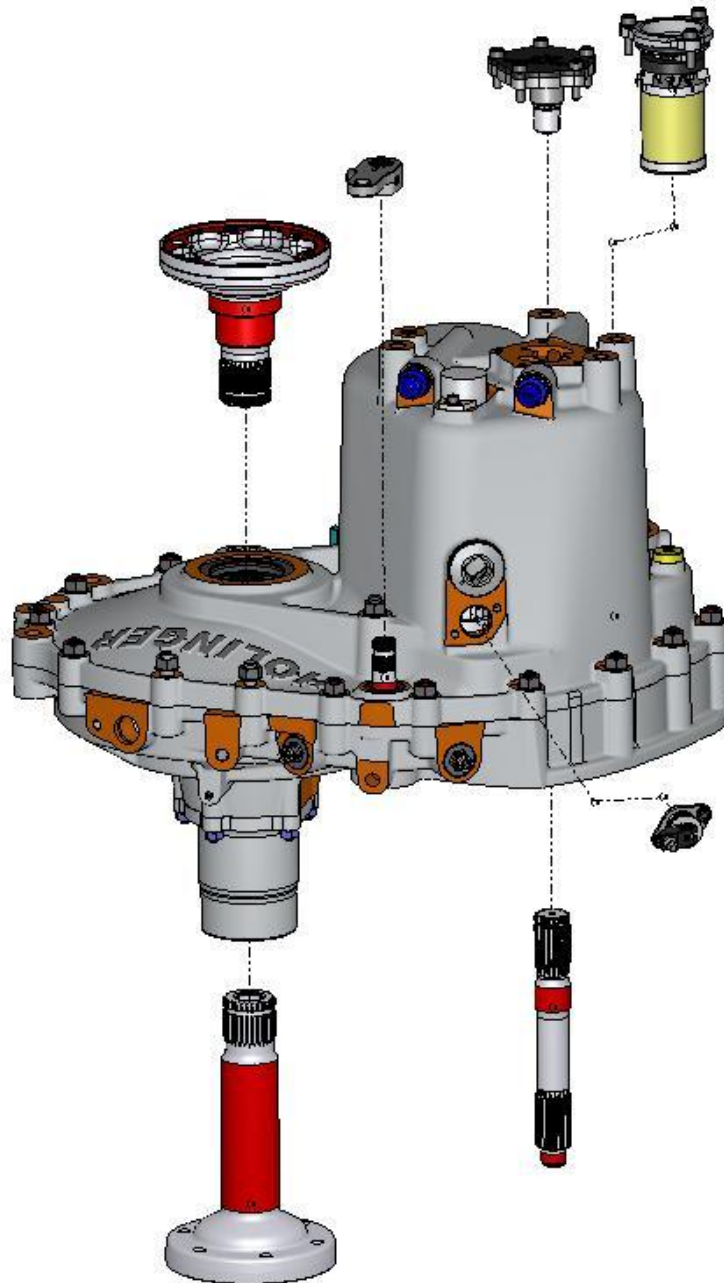
NOTE: Be sure to insert the sealing o-ring (132-092.0) first and roughly align the dot on the potentiometers spindle with the red wire in its body.



Plug in the dash mounted gear indicator, supply 12 Volts and shift through all the gears. If the display reads incorrectly, it will require adjustment by rotating the potentiometer body on the gearbox.

DISASSEMBLY

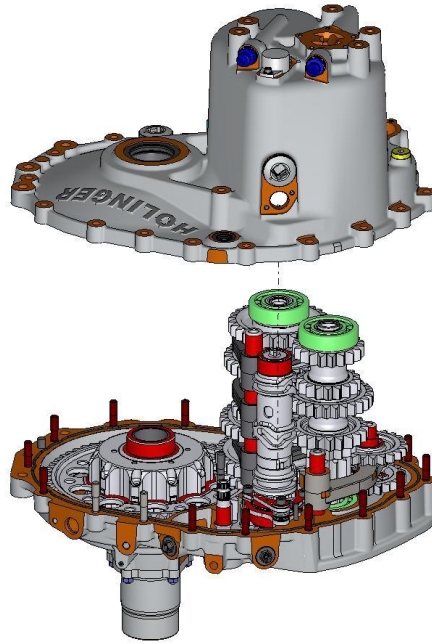
STEP 1



Remove the axles using a slide-hammer.

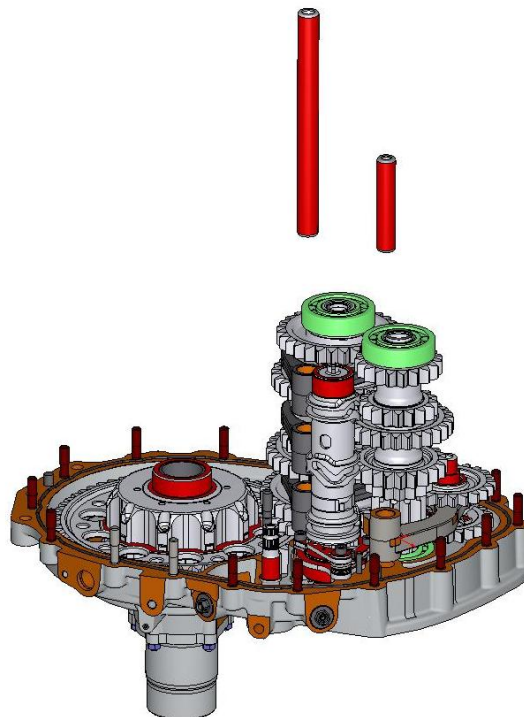
Remove the gear-change lever, oil filter, oil pump, quill shaft and neutral release mechanism.

STEP 2



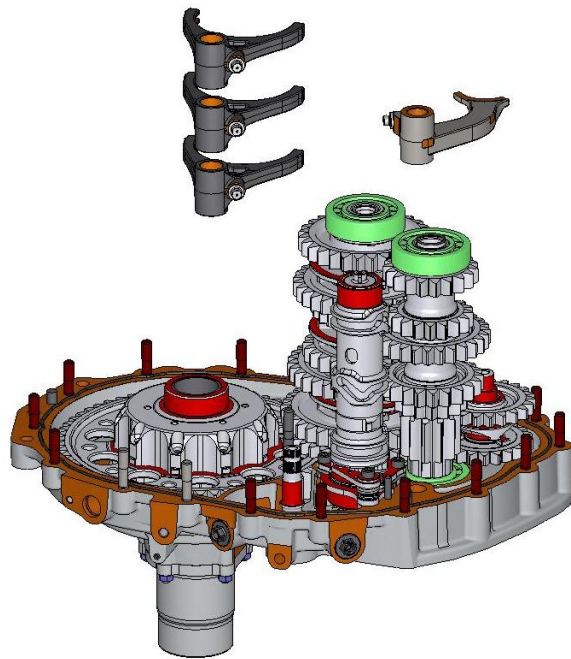
Remove the M8 nuts and the Gearbox Housing.

STEP 3



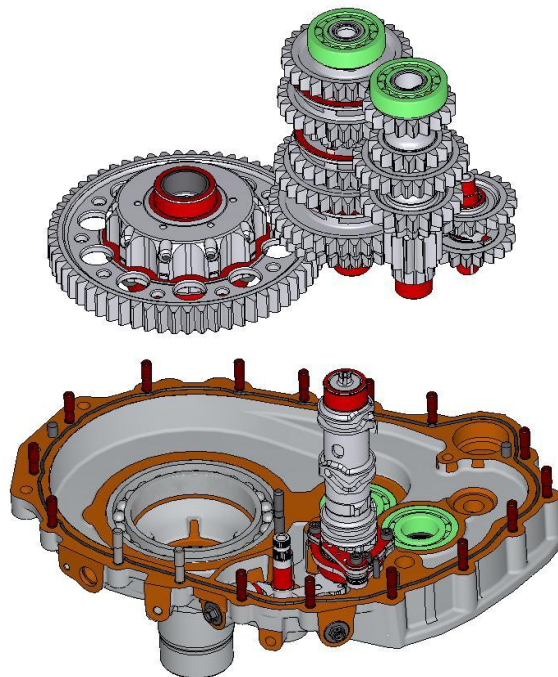
Remove the two selector rods.

STEP 4



Remove the forks with the follower pins.

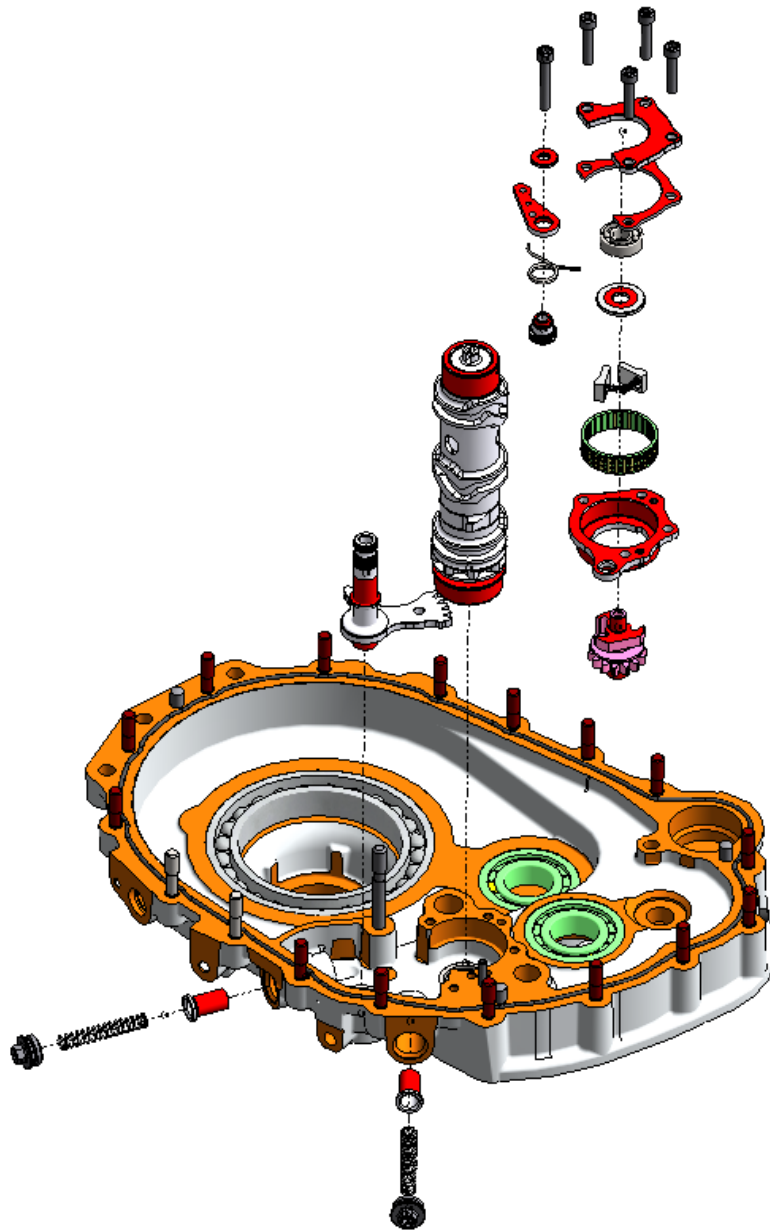
STEP 5



Remove the gear train as a group.

STEP 6

Remove remaining components as required.



Thoroughly clean and inspect all parts for cracks and wear.

BEARING END-FLOAT SETTINGS

Input Shaft / Pinion Shaft / Differential	0.003"-0.005" (0.08mm-0.12mm)
Pawl Carrier	0.004"-0.008" (0.1mm-0.2mm)

DIFFERENTIAL CLUTCH PACK END-FLOAT

Clutch Pack End Float	0.005"-0.010" (0.13mm-0.25mm)
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TORQUE SETTINGS

Drain and filler plugs	60 lbs-ft (80 N-m)
Differential Bolts (M8)	29 lbs-ft (39 N-m)
M8 Nuts	20 lbs-ft (27 N-m)
M6 Nuts	10 lbs-ft (14 N-m)
M6 Capscrews	12 lbs-ft (16 N-m)
M5 Capscrews	7 lbs-ft (9.5 N-m)

LUBRICATION

The extreme pressure additives in Limited Slip Differential oil have proven to aid gear life.

We recommend fully synthetic LSD oil, with an API GL 5 or higher rating and heavier viscosity range, typically 85w-140. 75w-90 is also acceptable.

Note: Some "Shockproof" oils are not suitable for use in this gearbox. It can clog the oil pump, paper element filter, galleries, and spray bar.

The Holinger SF requires approximately 1.8litres of gear oil. The gear oil and filter should be checked regularly to quickly evaluate the gearbox condition. If oil condition looks overly metallic in appearance, further inspection of gearbox and differential should be conducted.