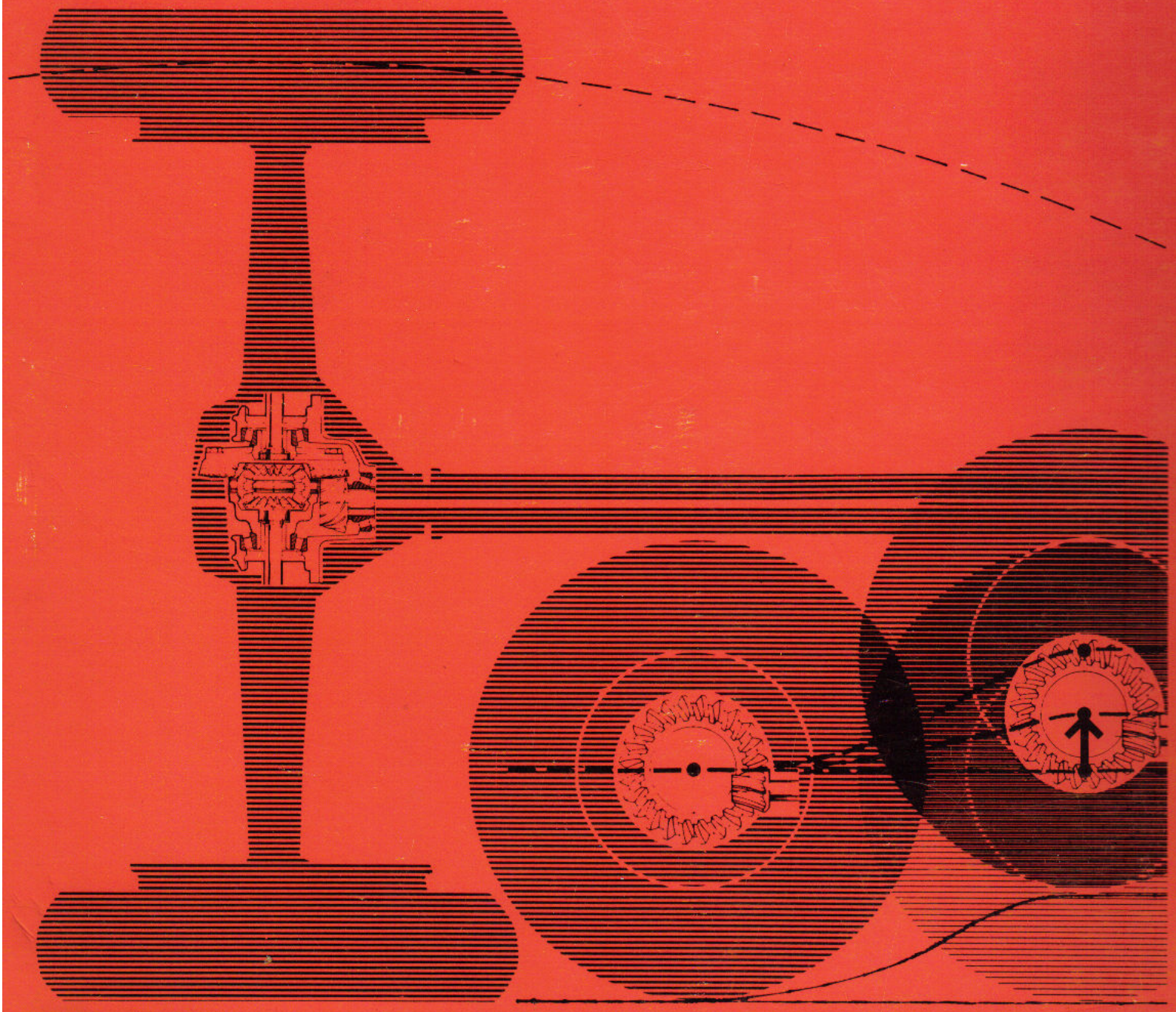
DIFFERENTIAL SERVICE GUIDE

SERVICE TECHNICAL TRAINING / NISSAN MOTOR CORPORATION IN U.S.A.

DATSUN



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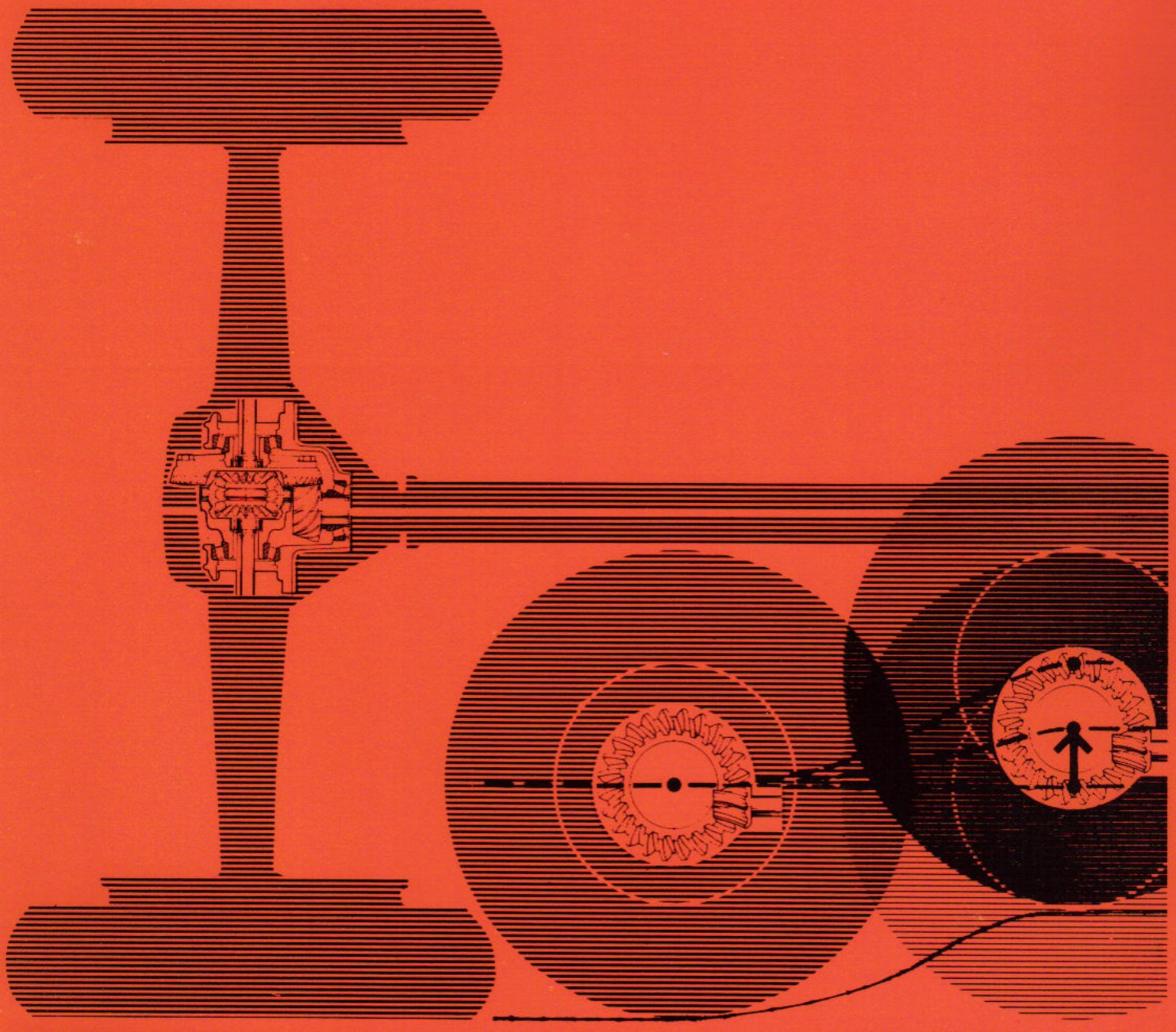
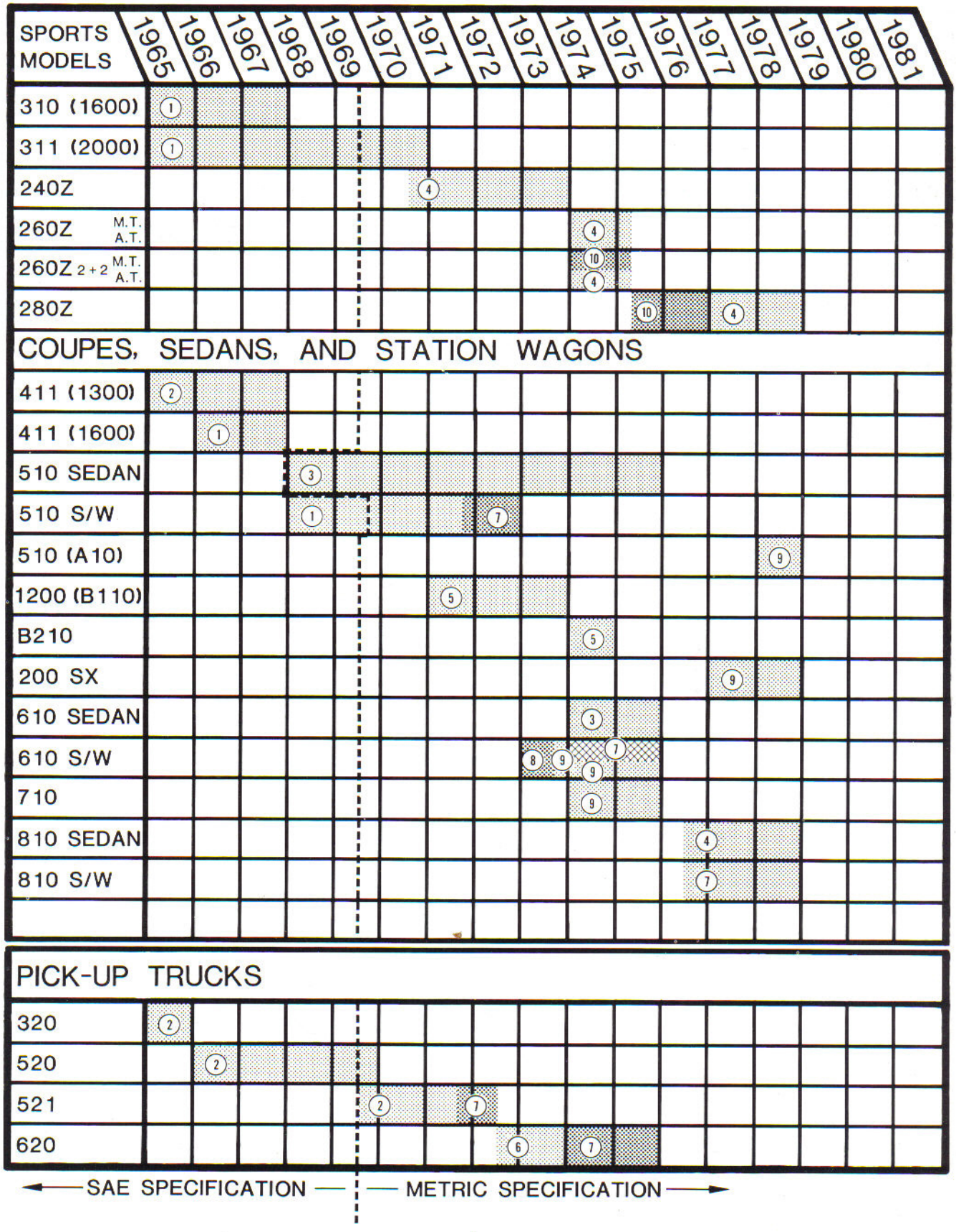
INTRODUCTION



DIFFERENTIAL APPLICATION CHART



KEY TO DIFFERENTIAL APPLICATION CHART

(1) SAE 190 (old) ALUMINUM CASE

Small rear pinion bearing
Collapsible spacer available (with pinion change)
Shim under bearing race: from 1965 to 6/71
Shim under pinion head: from 7/71 to 5/72

(2) SAE 190 (new) CAST IRON (most common) or ALUMINUM (very few)

Large rear pinion bearing
Solid spacer
Shim under pinion head

(3) R160 CAST IRON CASE (long neck)

Solid spacer
1. Thick pinion washer
2. Thick pinion washer and adjustment shim (older models)

(4) R180 CAST IRON CASE (long neck)

Solid spacer
1. Thick pinion washer
2. Thick pinion washer and adjustment shim (older models)

(5) H145A ALUMINUM CASE

Collapsible spacer
Small rear pinion bearing
Shim under pinion head

(6) H190 ALUMINUM CASE (Metric)

Small rear pinion bearing
Collapsible spacer
Shim under pinion head

(7) H190 CAST IRON CASE (Metric)

Large rear pinion bearing
Shim under pinion head
Solid spacer (replaced with collapsible spacer during overhaul)

(8) H165 CAST IRON CASE

Solid spacer (collapsible spacer available with pinion change)
Thin pinion shim under head

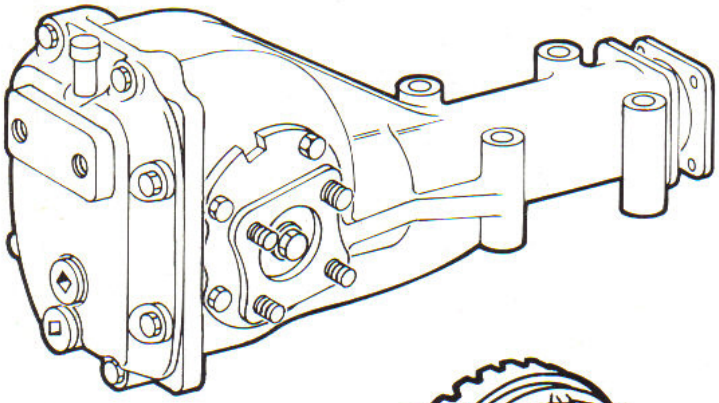
(9) H165B CAST IRON CASE

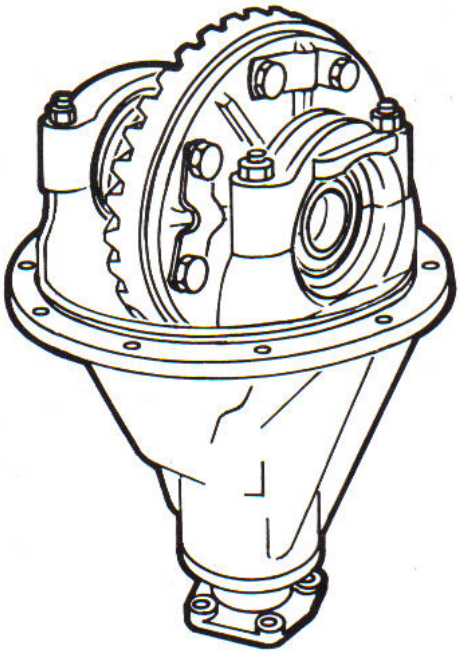
Collapsible spacer
Thick pinion washer

(10) R200 CAST IRON CASE (long neck)

Solid spacer
Thick pinion washer

DATSUN DIFFERENTIAL IDENTIFICATION

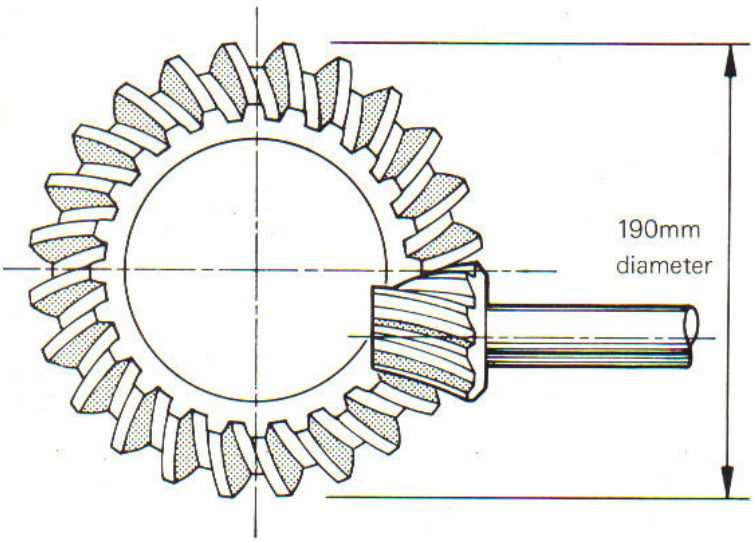




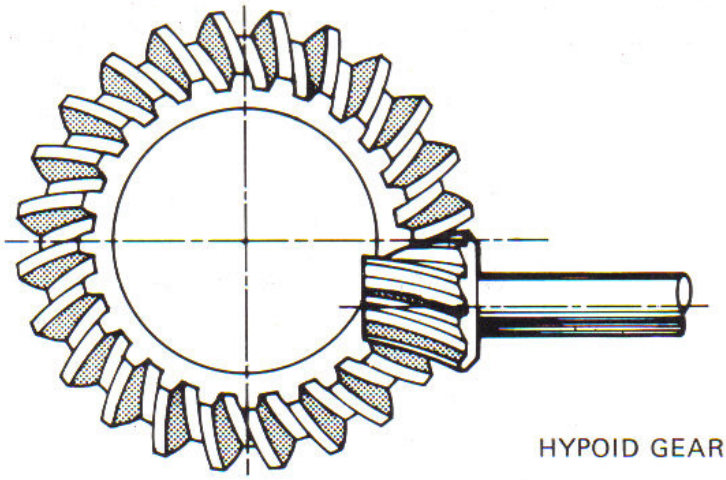
Two types of differentials are used on Datsun vehicles. They are:

"R" Type: Used on Datsun vehicles with independent rear axle (I.R.S.) system. This differential is identified by its "long neck" and side drive flanges.

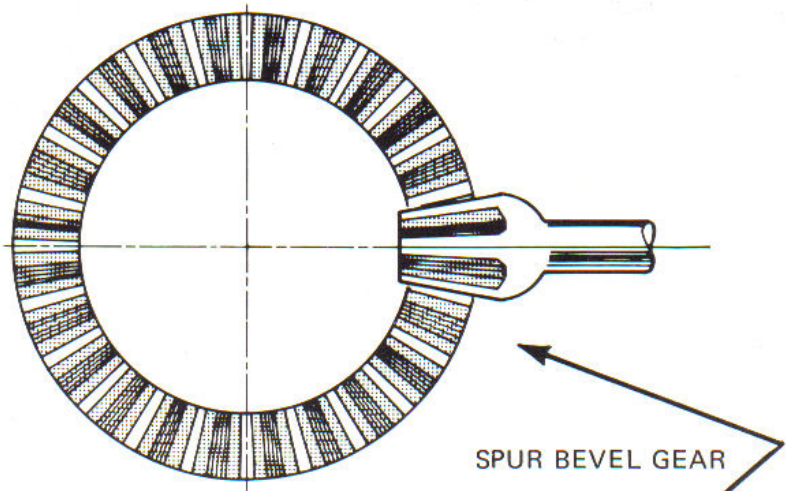
"H" Type: Used on Datsun vehicles with solid rear axle. This differential is recognized by its short neck. The carrier housings are produced in cast iron or aluminum alloys.



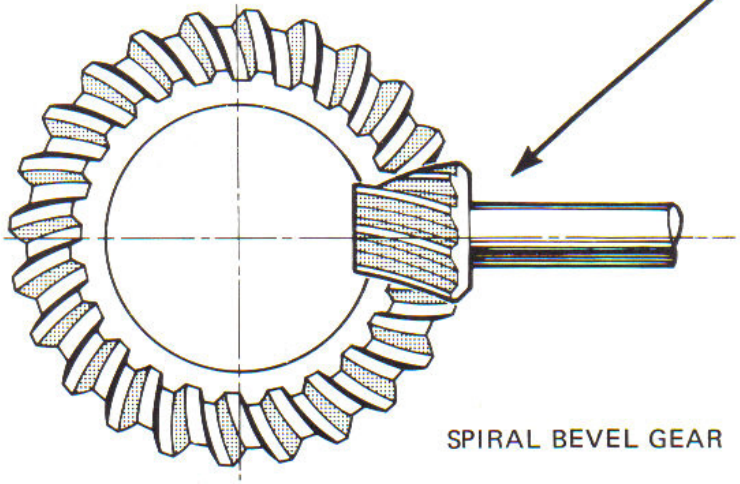
The numbers (like "190") following the letter represent the diameter of the ring gear in millimeters.



HYPOID GEAR



SPUR BEVEL GEAR



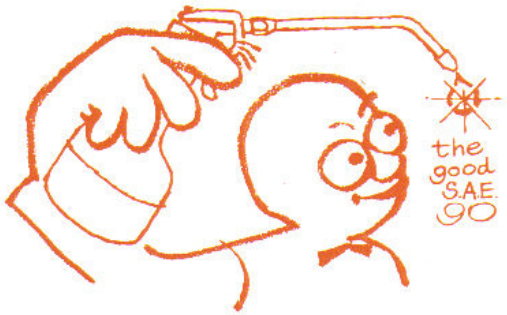
SPIRAL BEVEL GEAR

GEAR TYPES

Both the "R" and the "H" type differentials use "hypoid gear sets". Hypoid gear sets are designed so that the drive pinion center line is below the center line of the ring gear. The gear teeth are curved so that more than one set of mating teeth are always in contact.

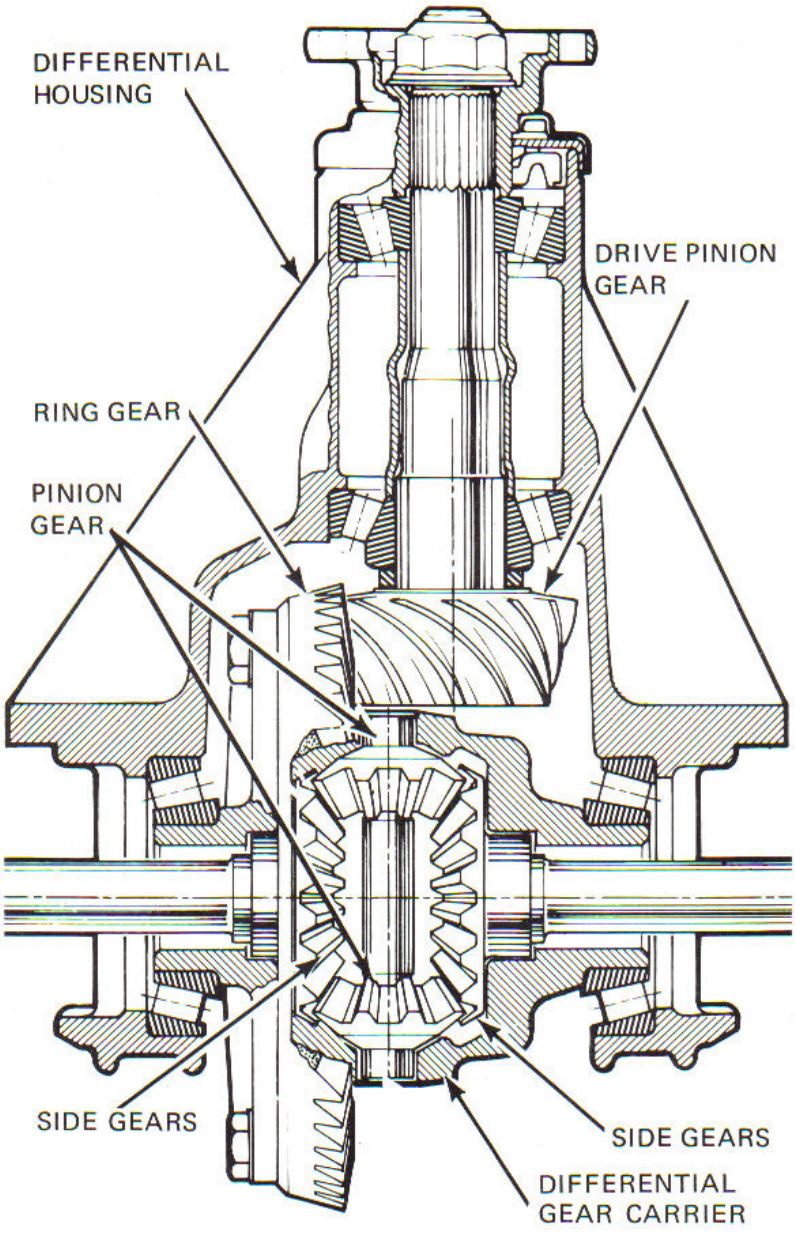
This multiple tooth contact operates smoothly and quietly. The curved surface of the gear teeth permits a greater area of tooth contact which, in turn, produces a greater distribution of load or force.

The predecessors to the hypoid gear were the spur bevel gear and the spiral bevel gear. Both had less tooth contact than the hypoid type, and are no longer in common use today.



LUBRICANTS

The recommended lubricating oil for hypoid gears is an extreme pressure ("EP") S.A.E. 90 weight gear oil which has an American Petroleum Institute (API) rating of GL-5 in order to cope with the wiping action of the curved hypoid gear teeth. This type of lubricant also prevents any foaming that the hypoid unit might create as a result of its multi-toothed contact.



DEFINITIONS OF DIFFERENT COMPONENTS

Differential Housing – houses the internal differential parts; usually cast iron but some were made of aluminum.

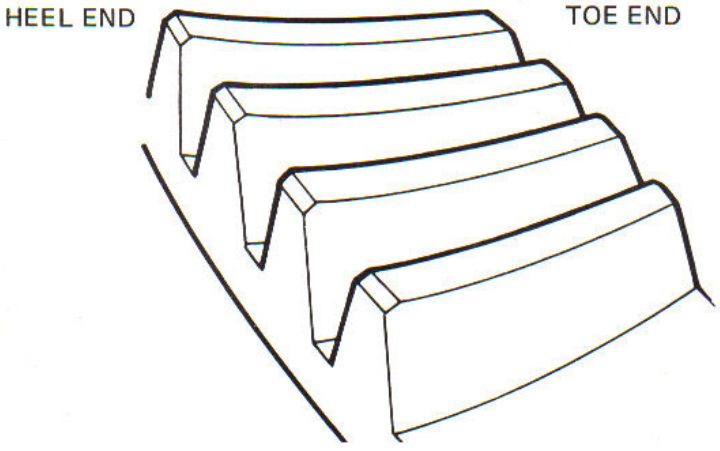
Drive Pinion – gear on shaft which is driven by propeller shaft, usually through a universal joint.

Ring Gear – large gear driven by drive pinion gear; is bolted to differential gear carrier.

Differential Gear Carrier – part of which ring gear is bolted; contains side and pinion gears; sometimes referred to as the gearcase.

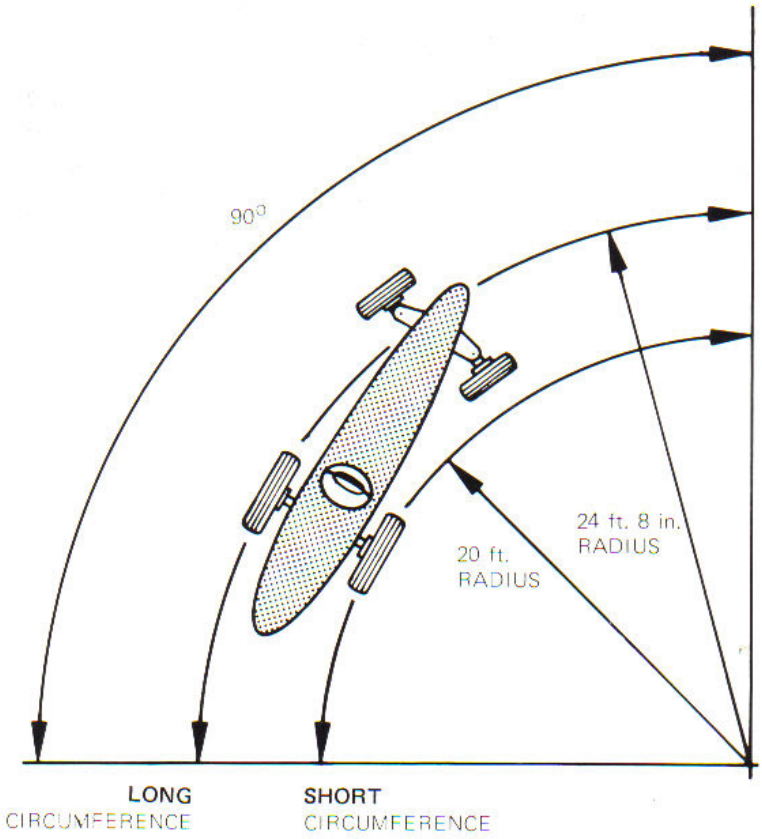
Side Gears – gears inside differential case, attached to axle shafts, and driven by the pinion gears.

Pinion Gears – small gears inside of differential case which drive the side gears. Sometimes called spider gears.



HEEL AND TOE

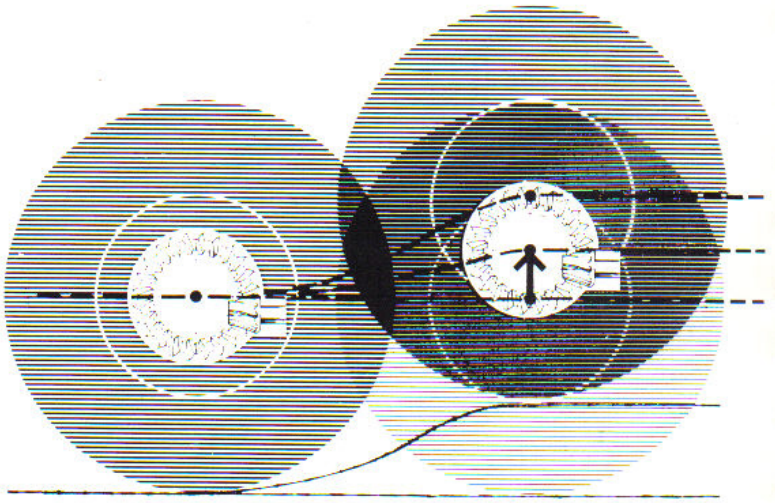
The "heel" of the tooth is the end toward the outer edge of the ring gear circumference and the "toe" is the end nearest the center.

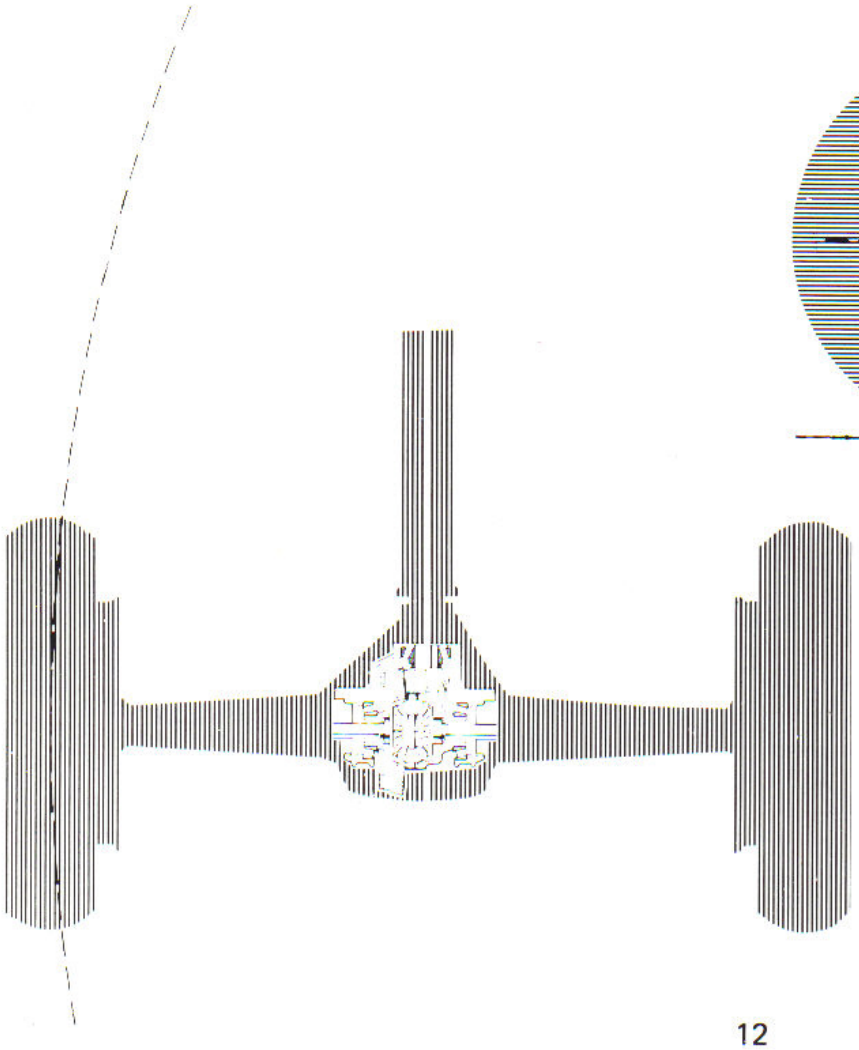


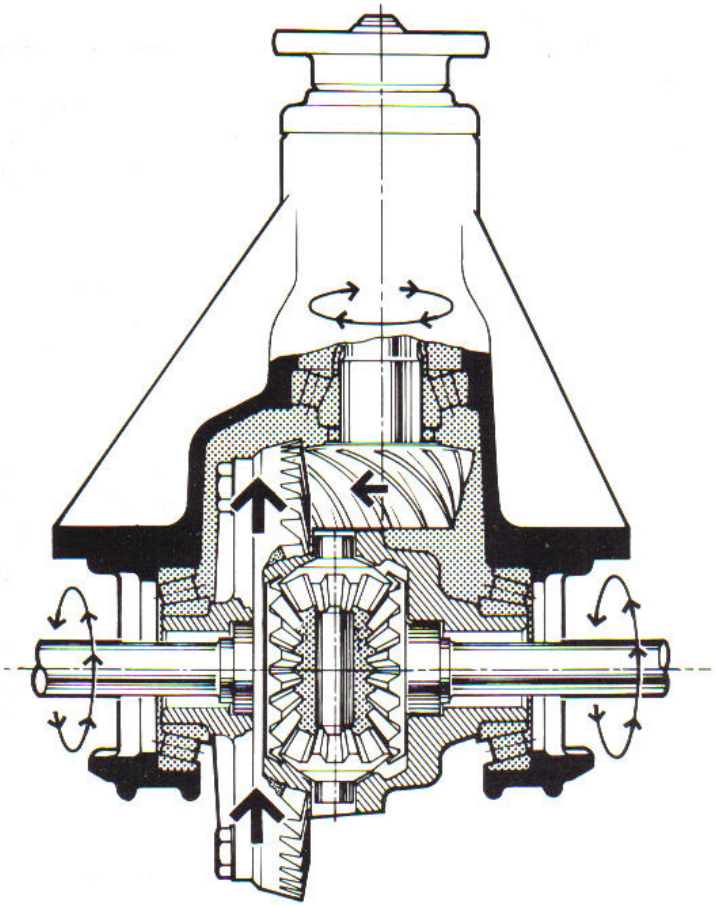
PURPOSE OF DIFFERENTIAL

A differential transmits power from the propeller shaft through its gears to the wheel axles and assures smooth transmission of power to the rear wheels during cornering as well as straight-ahead driving.

If a vehicle were to be driven only in a straight line, a differential would not be needed. However, when the car rounds a curve, there is a difference in wheel travel between the inner and outer wheels — the outer wheel must roll farther than the inner. If the wheels' axles were locked together, then both wheels would be forced to rotate the same amount and the inner wheel would skid and hop. In addition to causing extremely rapid tire wear and severe strain on drive-line components, the vehicle would be nearly impossible to control. As the lower drawing shows, this same problem would occur when one wheel had to roll over a bump. The differential eliminates these problems by allowing each driven wheel to rotate only as needed, thereby eliminating skidding.

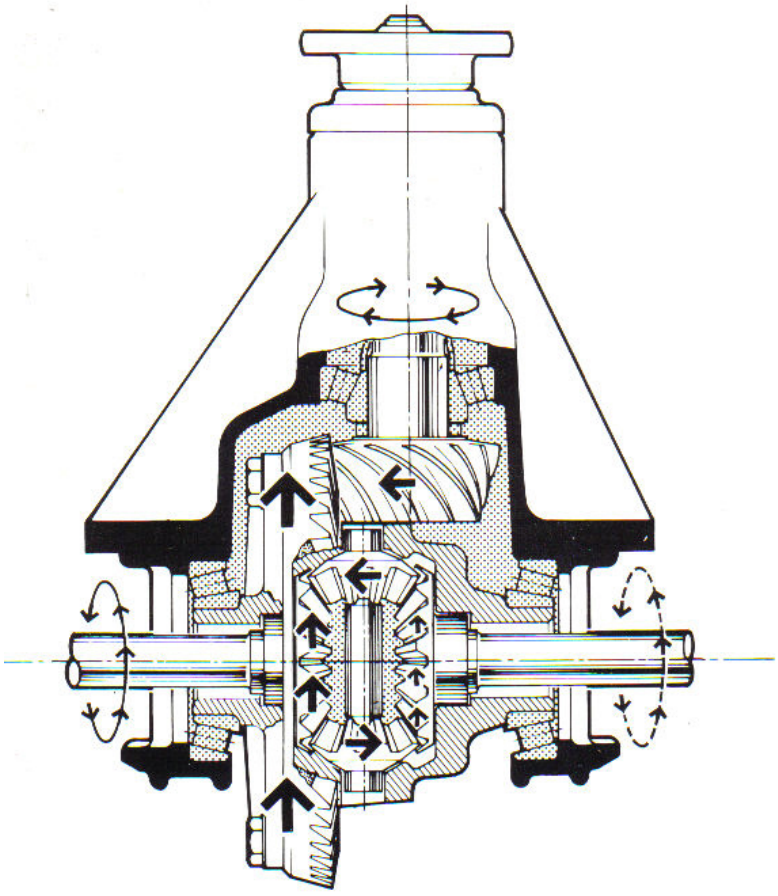




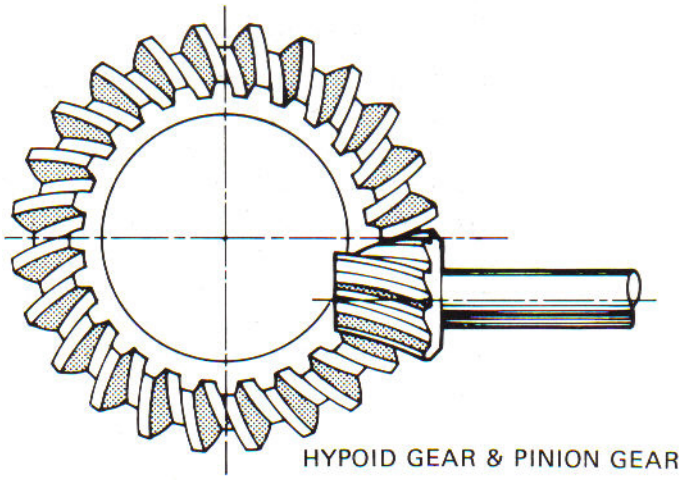


OPERATION OF DIFFERENTIAL

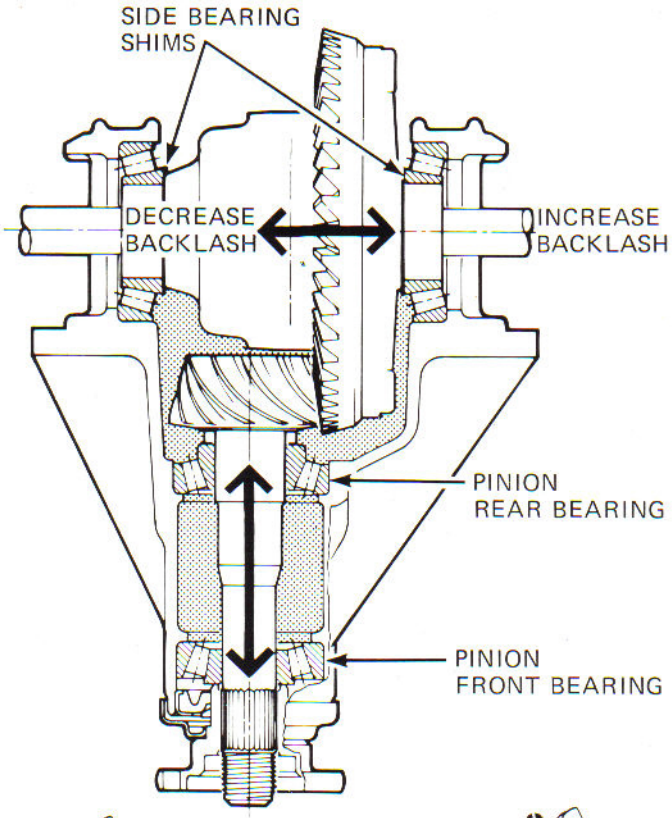
1. Differential operation on a straight course: The turning operation of the drive pinion causes the ring gear to rotate. When the differential gear carrier rotates with the ring gear, the spider shaft with its two spider gears also rotates. When the car is on a straight road, road resistance is applied equally to both rear wheels. Therefore, the pinion gears drive the side gears without actually rotating themselves. Rotation of the side gears is transferred to the rear wheels by the axle shafts.

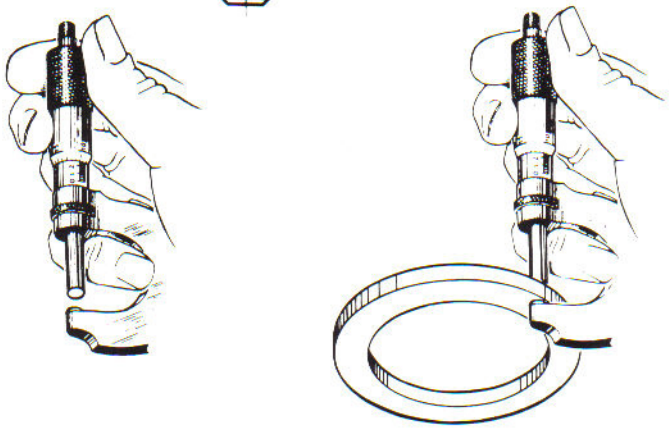


2. Differential operation when cornering: When the car begins to round a curve, the outer wheel must roll a greater distance than the inner wheel, thereby forcing the outer wheel to rotate more than the inner wheel. This means that both side gears must also be rotating at different speeds. To accommodate these varying rotation speeds, the two pinion gears rotate on the pinion shaft and transmit more turning movement to the outer side gear than to the inner side gear. Thus, the side gear on the outer wheel axle rotates more than the side gear on the inner wheel axle, permitting the outer wheel to travel the longer distance.



HYPOID GEAR & PINION GEAR





DIFFERENTIAL OVERHAUL ADJUSTMENTS

A beneficial feature of the hypoid gear set is that the lower centerline of the drive pinion permits a lower center of gravity for the vehicle as well as increased interior space.

Further, because of the greater tooth contact, this unit can do more work (transmit greater torque loads) than can other types.

Despite these advantages, the gears are not easy to manufacture, and the adjustment of the gear set's tooth contact during assembly is a precise operation.

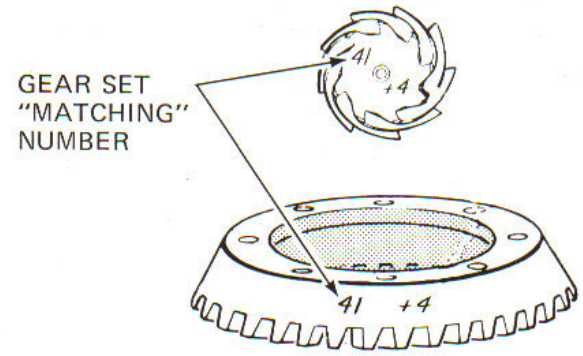
Slight mislocation of the drive pinion in front and rear directions, and/or ring gear in left and right directions, prevents normal contact between the gears, thus causing gear-tooth wear, whine, and/or a "clunking" noise in the differential.

Since the differential transmits considerable torque, large bearings support the various components within the carrier housing. These bearings must be accurately preloaded to assure long life and to minimize noise. Therefore, the modern differential is a sophisticated mechanism which requires precision treatment during its manufacture and overhaul.

As with any mass produced unit, some individual differential components and assemblies will vary from their original engineering specifications. These manufacturing tolerance variations must be carefully measured and compensated for when performing overhaul adjustments.

On Datsun differentials, production tolerances are recorded.

Datsun engineers have simplified overhaul adjustments by measuring the production tolerance variations at the factory. These tolerances are stamped or painted on every major differential part. Let's look at these tolerances, or factors. Remember, these measurements are metric and recorded in .01 mm (hundredths of millimeters) except the SAE 190, where they are in .001" (thousandths of an inch).

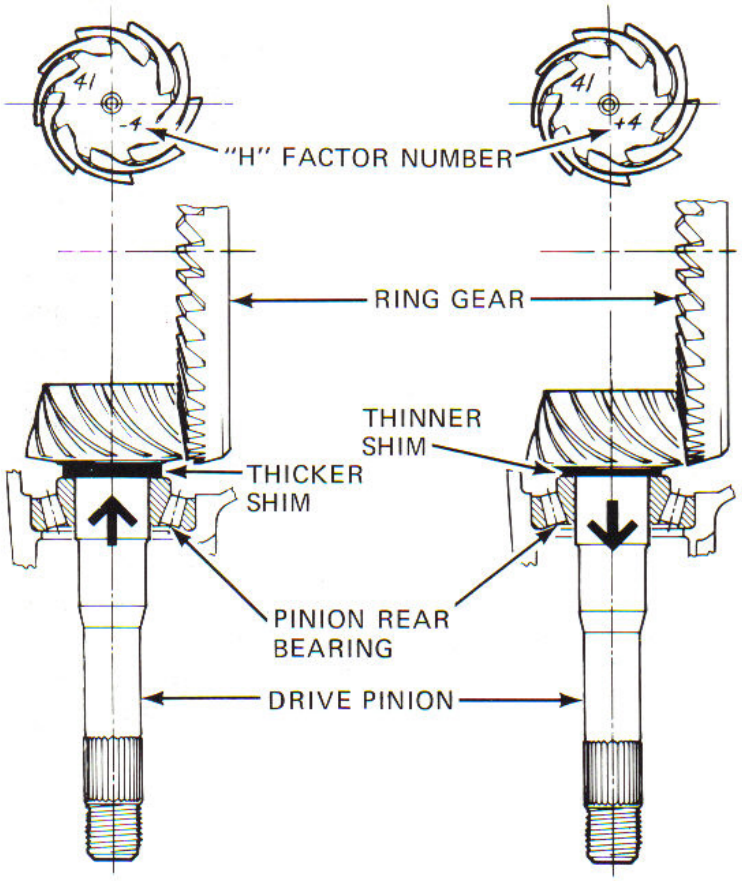


Matching or Set Number

From the first stage of manufacturing and matching through final assembly, the ring gear and drive pinion are handled as a set. Therefore, we can find a "set" or "matching" number painted on every ring gear and drive pinion. This brings us to the first basic rule: *Always replace a ring and pinion as a matched set and never as individual gears.*

Drive Pinion Gear Head "H" Factor

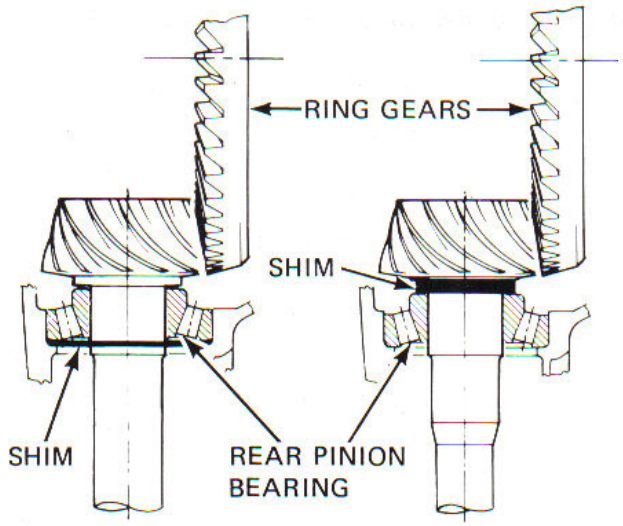
During the manufacturing process the flat area under the pinion head is machined to standard specifications and the drive pinion gear is positioned to the ring gear where it can perform best under all load conditions and with the least amount of noise or vibration. This positioning is accomplished by moving the pinion gear slightly into or out of the ring gear. After the machining of the two gears is finished, the factory-machinest measures the machining variance under the pinion head **and** the in and out movement, then he records this measurement. This total measurement is referred to as the "H" factor and is painted with white paint on the head of the pinion gear. This "H" factor can be plus (+) or minus (-).



"H" FACTOR MINUS (–), PINION GEAR MACHINED SLIGHTLY UNDERSIZE.

"H" FACTOR PLUS (+), PINION GEAR MACHINED SLIGHTLY OVERSIZE.

Therefore, the pinion gear must be positioned to the ring gear in exactly the same position in the carrier housing as it was during manufacture in order to assure proper operation. This positioning is accomplished by the so-called pinion height adjustment.

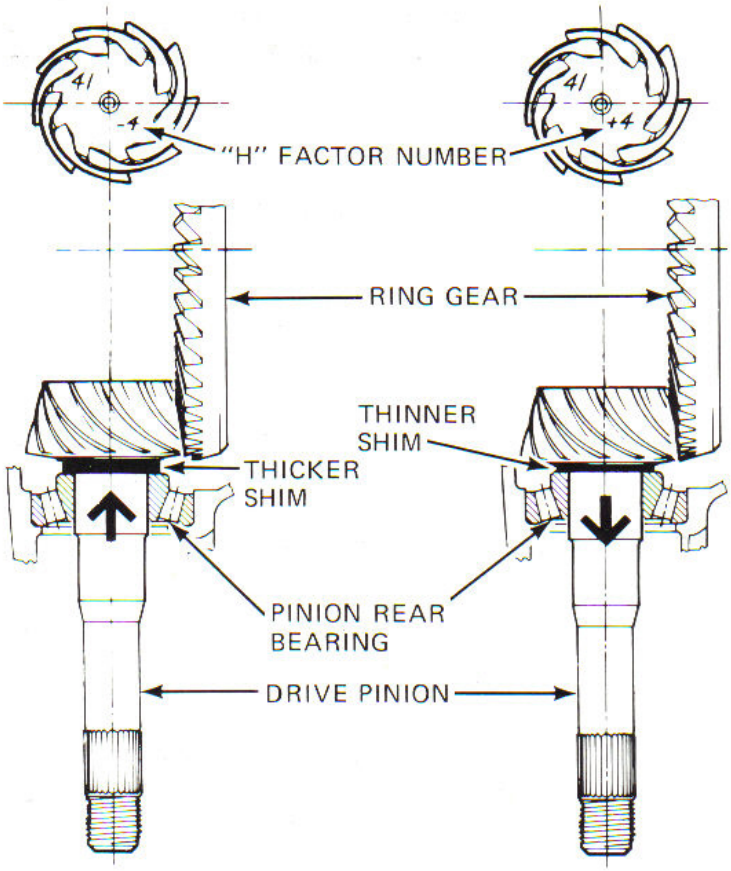


SOME OLDER DIFFERENTIALS

NEWER DIFFERENTIALS

Pinion Height Adjustment

In Datsun differentials, shims are used to adjust the pinion height. The shims are usually inserted between the pinion gear and the rear pinion bearing. However, in some older differentials, the shim is inserted between the rear pinion bearing outer race and the carrier housing.

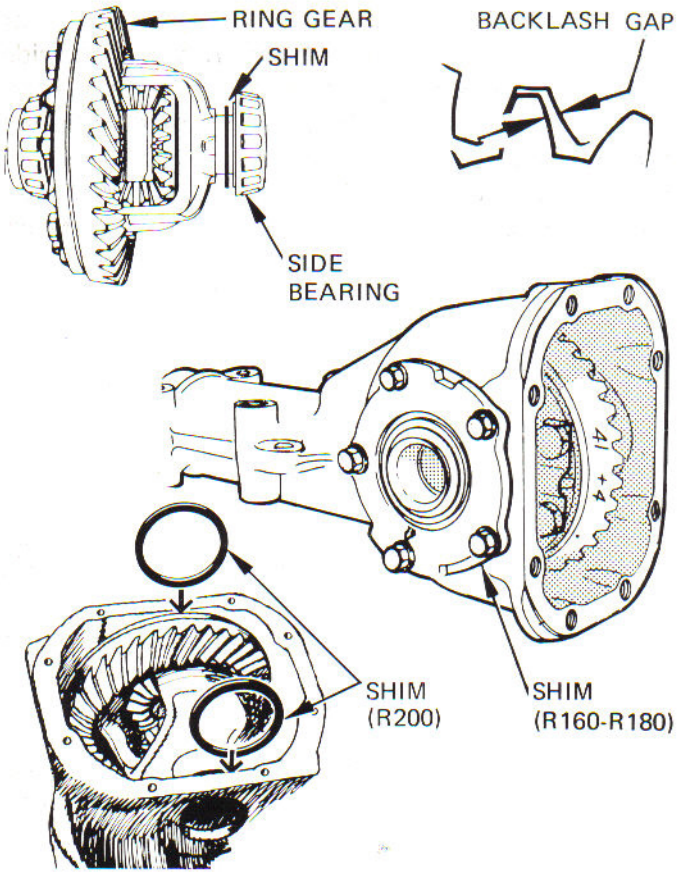


"H" FACTOR MINUS (–), PINION GEAR MACHINED SLIGHTLY UNDERSIZE.

"H" FACTOR PLUS (+), PINION GEAR MACHINED SLIGHTLY OVERSIZE.

If the pinion gear "H", or "height", factor is marked "minus" (–), this indicates that the gear had been machined slightly undersize and/or the pinion gear had been moved toward the center of the ring gear during the matching process "run in". Therefore, a shim slightly *thicker* than the standard one is needed to "raise" the pinion farther into the ring gear (to assure duplication of original tooth contact).

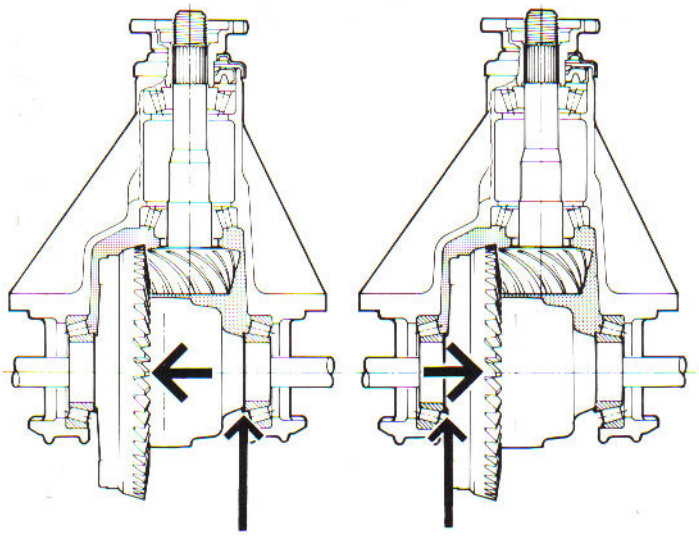
On the other hand, if the pinion gear "H" factor is marked with a plus (+), this tells you that not quite enough metal was machined away during manufacture and/or the pinion gear was moved slightly away from the center of the ring gear. In this case, a thinner-than-standard shim is used to "drop" the pinion farther away from the center of the ring gear.



Gear Backlash and Side Bearing Preload

The term "backlash" refers to the clearance between two mating teeth of the drive pinion and ring gear. If there is *too much* clearance (backlash), the gears will clunk. If there is *not enough* clearance, the gears may overheat and wear out very quickly.

Backlash is adjusted by moving the ring gear closer to or farther from the pinion gear *after* the pinion height has been set. On Datsun differentials, shims are used to correctly position the ring gear. On most "H" type differentials, these shims are placed between the side bearings and the differential gear case. On R-160 and R-180 models, the shims are placed between the carrier housing and the side bearing retainers. On R-200's the shims are placed between the side bearings and the differential carrier housing.



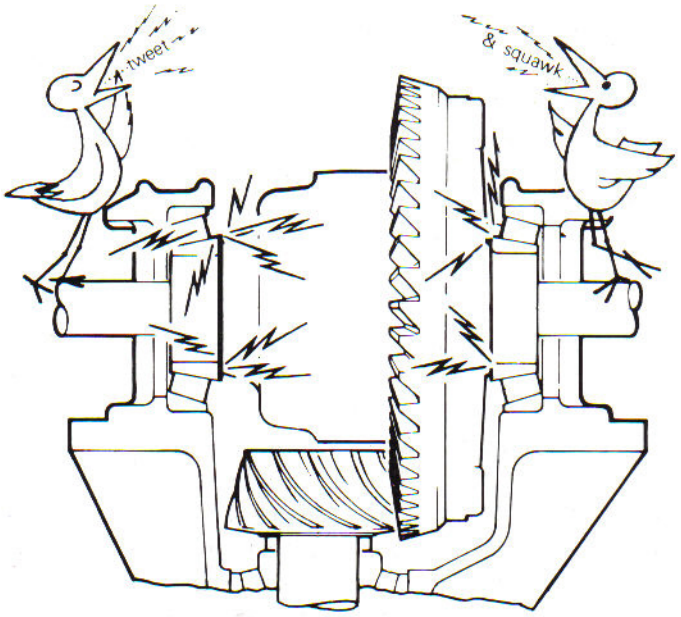
THICKER SHIM HERE MOVES RING GEAR **FURTHER** FROM DRIVE PINION

THICKER SHIM HERE MOVES RING GEAR **CLOSER** TO DRIVE PINION

If thicker shims are placed on the right side, then the ring gear will move further from the drive pinion gear and the backlash will increase.

If thicker shims are placed on the left side (outside ring gear), the ring gear will move closer to the pinion gear and the backlash will decrease.

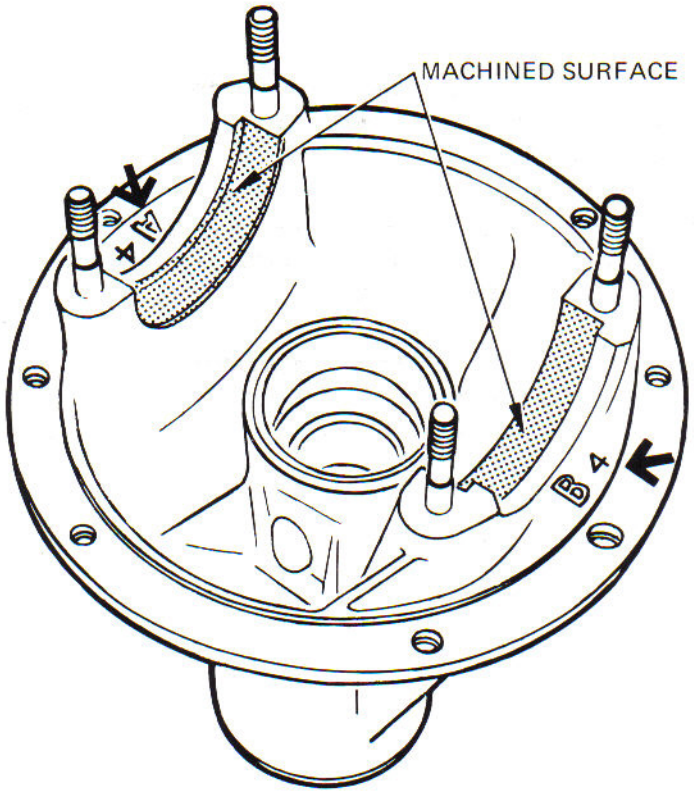
A backlash measurement is taken to determine how close the ring gear is positioned to the drive pinion. This procedure is covered in the overhaul section of this book.



Note that these shims not only affect the position of the ring gear, but also control the preload on the side bearings. For example, if the shims at both side bearings are thicker, the bearings will be squeezed tighter and the preload will be increased. Since the choice of side bearing shims affects both preload and backlash, extreme care must be taken to select the correct size shims.

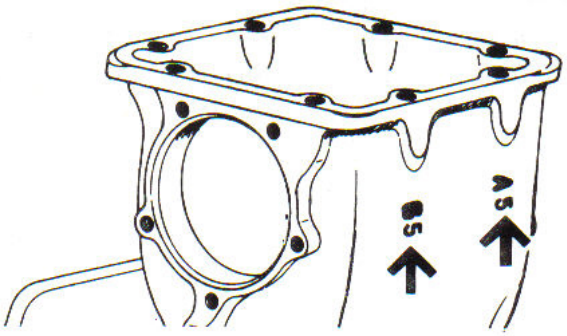
The factory engineers designed the differential so that if all parts are machined exactly to specifications, the preload and backlash would be correct when a standard quantity of shims are placed behind each bearing.

However, not all parts are machined perfectly — some may be under or oversize by a few *hundredths* of a millimeter. Thus, the shims selected must be "custom" fitted to a particular differential. Let's look at the factors involved.

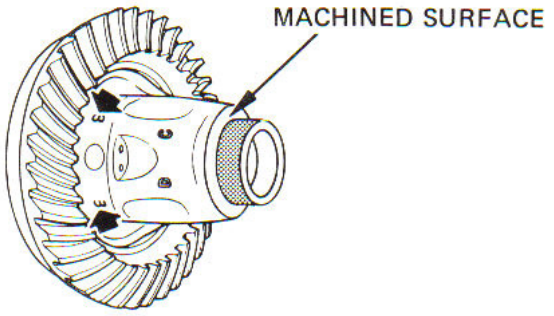


First, there are the bearing bores in the housing. The side bearing races seat in these bores, which are precision machined at the factory.

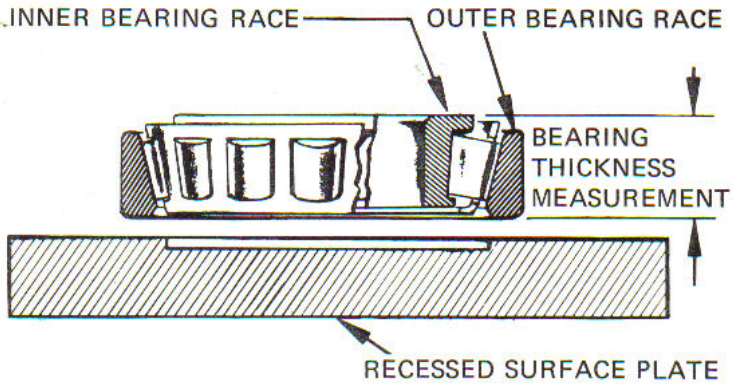
After the machining is finished, a factory worker measures the bore on each side of the housing. If the machining has not been perfect, he marks a record of the variation on the side of the housing. These marks are referred to as "A" and "B" factors. In fact, you can see these two factor letters cast into the housing during manufacture; the measurement variation numbers are stamped next to these cast-in letters.



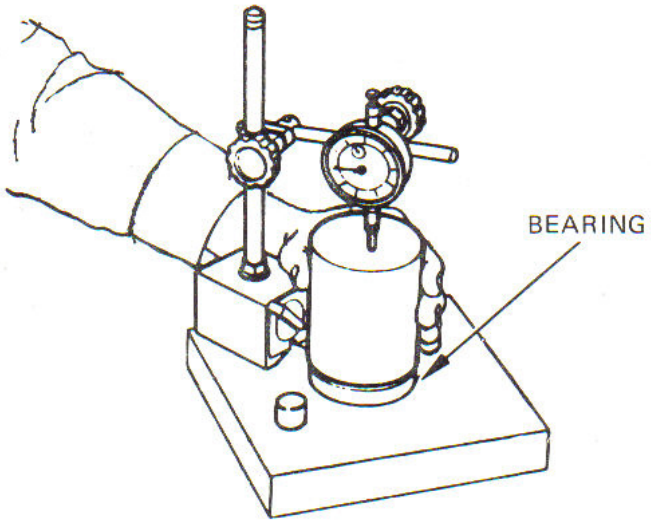
Since the construction of the "R" type differential differs slightly from that of the "H" type, different machining is used. However, the letters "A" and "B" are also cast into the "R" housing for easy identification.



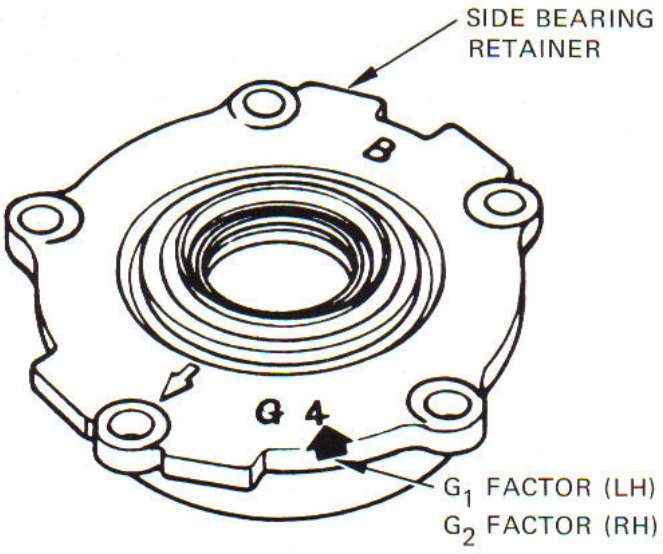
Next, the side bearings are pressed onto the gear case, so the surface against which the bearings are pressed is also machined. Again, there is room for variation during manufacture and this machined surface is measured. A record of this measurement is then stamped onto the gear case next to the letters "C" and "D". Just like the "A" and "B" factors, the letters "C" and "D" are cast into the carrier during manufacture.



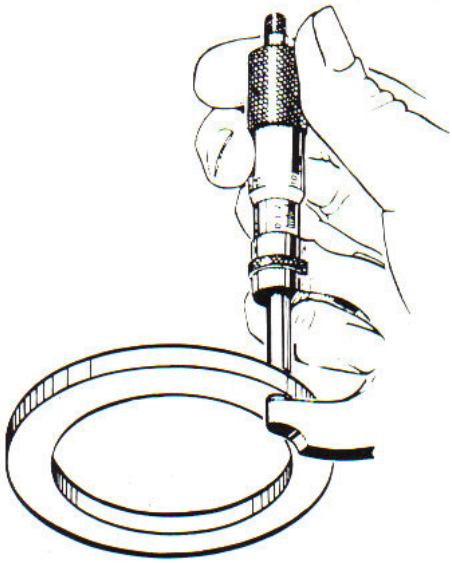
There is another tolerance, the thickness of the side bearings, which the factory cannot control and which the dealer technician must measure. If the bearings are sized exactly to specifications, then they will have a certain standard thickness. For example, on a B210, a perfect size side bearing would measure 17.5 mm. Most bearings measure less than the standard when preload is applied on them. To find out how much the bearing has been compressed, we compare it to a standard or known thickness. The measurements are recorded as the "E" and "F" factors when the shims are computed.



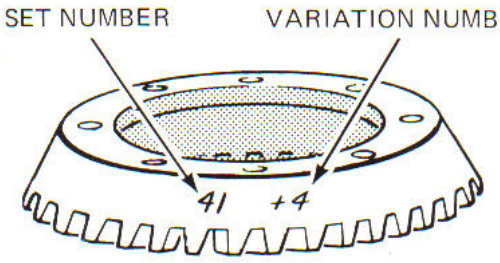
The method used to perform the side bearing measurement is described in the overhaul section of this book.



The next tolerance or factor to be considered is found only on "R 160 – 180 type" differentials. The side bearing races on these differentials are pressed into the side bearing retainers, which also have machined surfaces. Since there is again a margin for variation, this tolerance is measured. This measurement is recorded on the bearing retainer next to the letter "G", which is cast into the retainer. The bearing retainers are physically interchangeable from one side to the other, but should NOT be interchanged. Thus, the *left side is called "G^1"* and the *right side is "G^2"*. Since these retainers are not marked "left" or "right", one should always be marked before disassembly in order to avoid confusion during reassembly.



There is only one "G" factor on the R200 differential. This is the thickness of the large side bearing washer less than the standard of 8.10 mm. It must be measured by the technician.

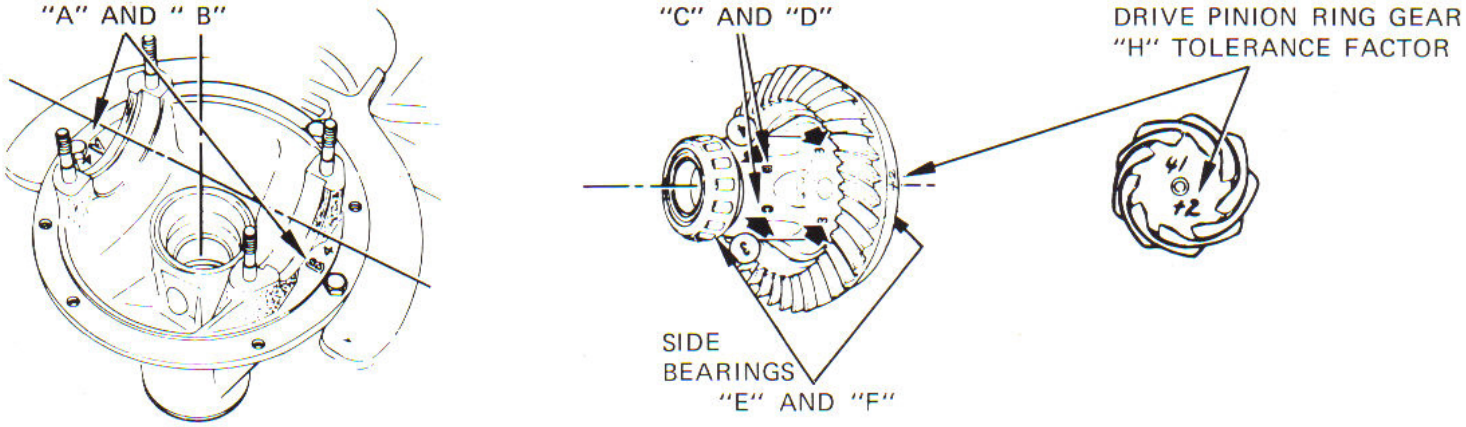


The last measured machined surface is the back face of the ring gear. This face is machined to insure that it seats flat against the gear case to which it is bolted. This tolerance is painted on the ring gear after the machining, and indicates either an over-cut or an under-cut, just like the machining of the pinion gear. This tolerance mark is assigned either a plus or a minus which must be considered when the shims are chosen.

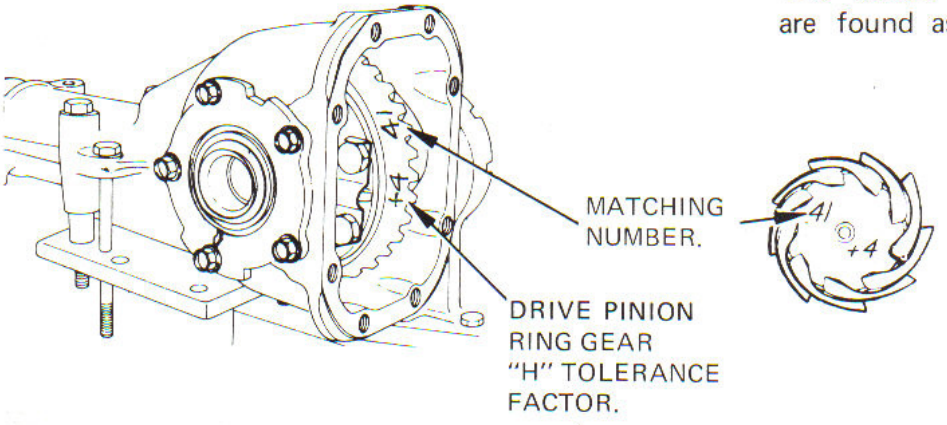
By now you might be having a difficult time remembering the reasons for these measurements and marks. Let's review these factors before going into more detail. The factors on the "H" differentials are illustrated here.

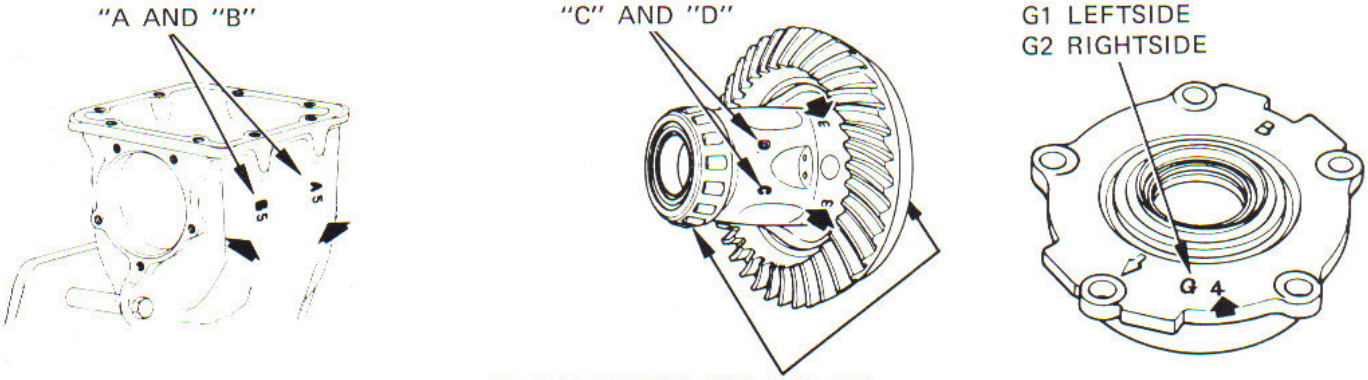
The factors on the "H" differentials are found as illustrated here.

RING GEAR "H" TOLERANCE FACTOR

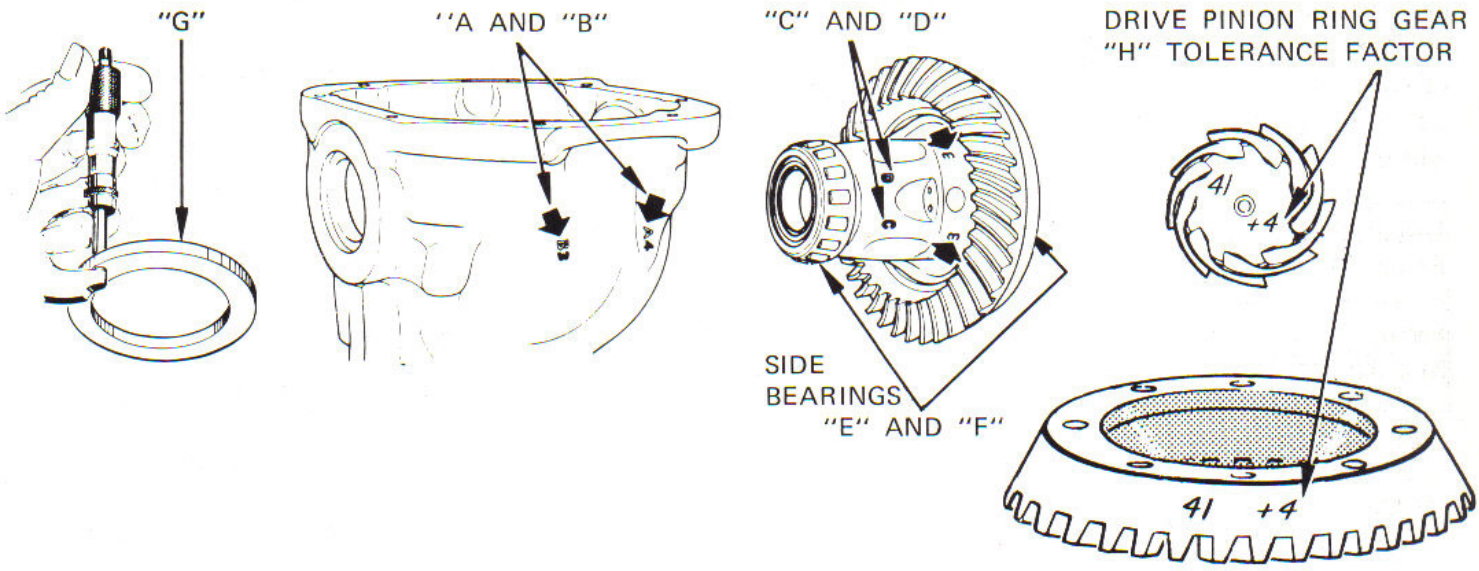


The factors on the R160 and R180 differentials are found as illustrated here.





The R200 differential factors are illustrated here.



LETTERS	HUNDREDTHS OF A MILLIMETER	THOUSANDTHS OF AN INCH
A Left housing	3	
B Right housing	4	
C Gear case	4	
D Gear case	5	
E Left side bearing	16	.006
F Right side bearing	20	.008
G1 Left side bearing retainer	5	
G2 Right side bearing retainer	4	
H Ring gear: (+) or (–)	+2	

SIDE BEARING SHIM THICKNESS CALCULATED ON DATSUN DIFFERENTIALS

Because formulas and calculators are used to select shims, some technicians may be afraid to calculate side bearing shim thicknesses on Datsun differentials. However, by using formulas and calculators, you will perform this job much faster and with more precision than by using the trial and error method of shim fitting used on some other cars. Take a few minutes to read the following pages and learn the step-by-step instructions, and you will find that Datsun differential overhaul is really not very difficult.

We recommend calculating the side bearing shim packs using BOTH the calculator and the formula. This provides you with a cross check, since it's easy to make an arithmetic or calculator error. However, if both calculated answers are identical, you can be sure your choice of shim packs will be correct.

Whether you use the formula or the calculator, the first step is to record all the factor numbers. Remember, all the factor numbers are stamped into the components and represent hundredths of a millimeter on all units (except the SAE 190). To make this job easier, first make a chart like the one shown here and record the factor letters and numbers.

Side Bearing Shim Thickness Calculation Using Formula Method

Referring to formula chart page 29, select the formula for the differential type. Since we are working on an R180 differential, the formula for the left side or (T1): A + C + G1 – D – E + H + .76 = shim thickness. Let's add our left side factor numbers and the answer will be:

Left Side Formula	A	+C	+G1	–D	–E	+H	+.76*
Factor Numbers	3	+4	+5	–5	–16	+2	+76

= .69 mm - required shim pack thickness

*.76 could be the standard shim pack if all components were machined exactly to engineering specifications.

To simplify this operation, draw a vertical line on paper. Write the pluses on one side, the minuses on the other side and add both columns. *Subtract the smaller from the larger sum.* The result is the thickness measurement of the shim pack needed for the left side (T1).

Plus (+)		Minus (–)	
A	3	D	5
C	4	E	16
G1	5		
H	+2		
standard shim	.76		
sub total	90		21 (smaller number)
subtract smaller fig.	–21		
	.69	total thickness of shim pack for left side = .69mm	

For a second example, let's calculate the shim pack for the R180 right side. The R180 formula for the right side, page 29, reads as follows:

Right side (T2): B + G2 + D – F – H + .76 = shim thickness

The Numbers: 4 + 4 + 5 – 20 – +2 + .76 = .67 or .67 mm

Notice the "H" figure in the formula calls for a minus, however, the ring gear number is a plus. Each time we come up with – + (minus plus), we subtract. This is based on the following "H" variables:

+ +	means *add* the number
+ –	means *subtract* the number
– –	means *add* the number
– +	means *subtract* the number

Remember, if you have two of the same signs, you add; otherwise, you subtract.

Let's see how the R180 factor numbers look on paper:

Plus (+)		Minus (–)	
B	4	F	20
G2	4	H	2
D	5		
standard shim	.76		
sub total	89		22
subtract smaller fig.	22		
	.67	total thickness of shim pack for right side = .67mm	

So the total measurement of the shim pack needed for the right hand side (T2) = .67mm.

it's fun isn't it?

Let's do a third example. This time use an "H165" differential with the following factor numbers:

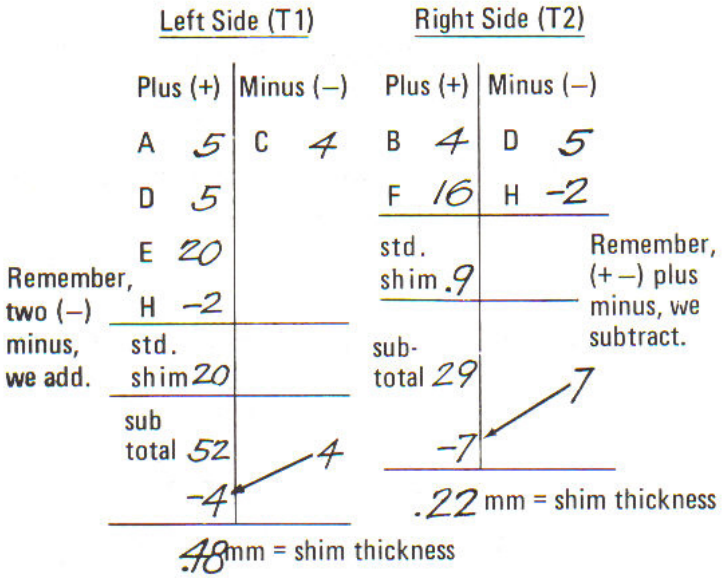
A = 5, B = 4, C = 4, D = 5, E = 20, F = 16, and H = –2.

The selected formulas, page 29, read as follows:

Left side (T1) = A – C + D + E – H + .20 = shim thickness

Right side (T2) = B – D + F + H + .09 = shim thickness

Since we are experts by now, we can do both calculations at the same time.

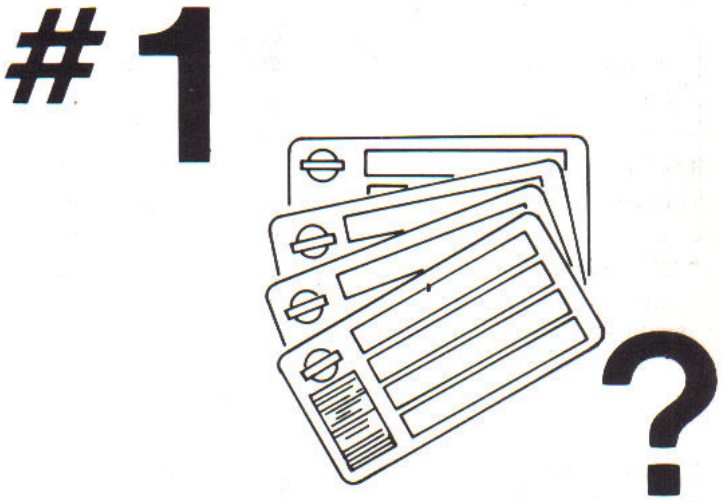


So, as you can see, the shim pack thickness measurements for the left hand side = .48mm

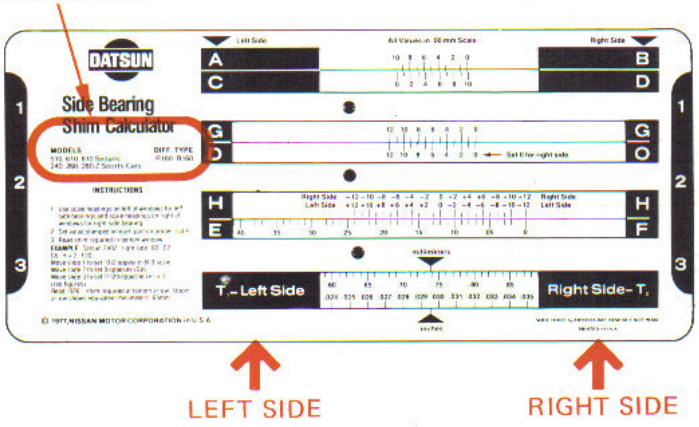
and for the right hand side = .22mm

Side Bearing Shim Thickness Calculation Using Calculator Method

Let's repeat the side bearing shim calculation for the same R180 and R160 type differentials. But this time we will use the slide calculator. The first thing we have to do is find the right calculator for the type differential we are working on.



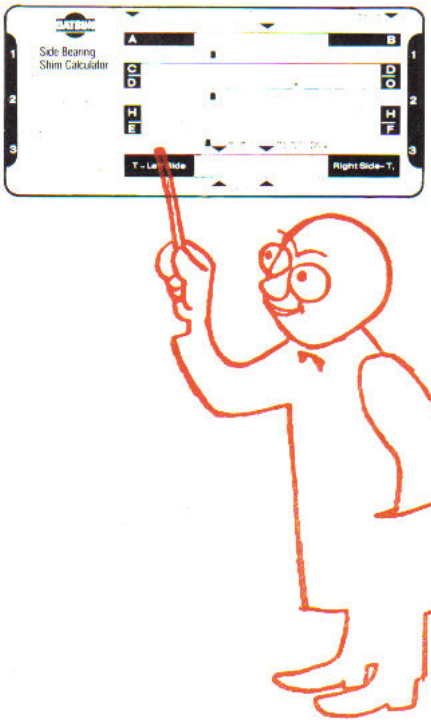
In the first example, select the calculator which pertains to "R180" type differential. Note the differential type numbers on the face of each of the calculators.



We use the left letter headings for the left side bearing shim thickness calculations and the right letter headings for the right hand side bearing shim thickness calculations.

Remember, for the R180–R160 calculator, the factor numbers in the first example are:

A = 3	D = 5	G1 = 5
B = 4	E = 16	G2 = 4
C = 5	F = 20	H = +2



the Left side

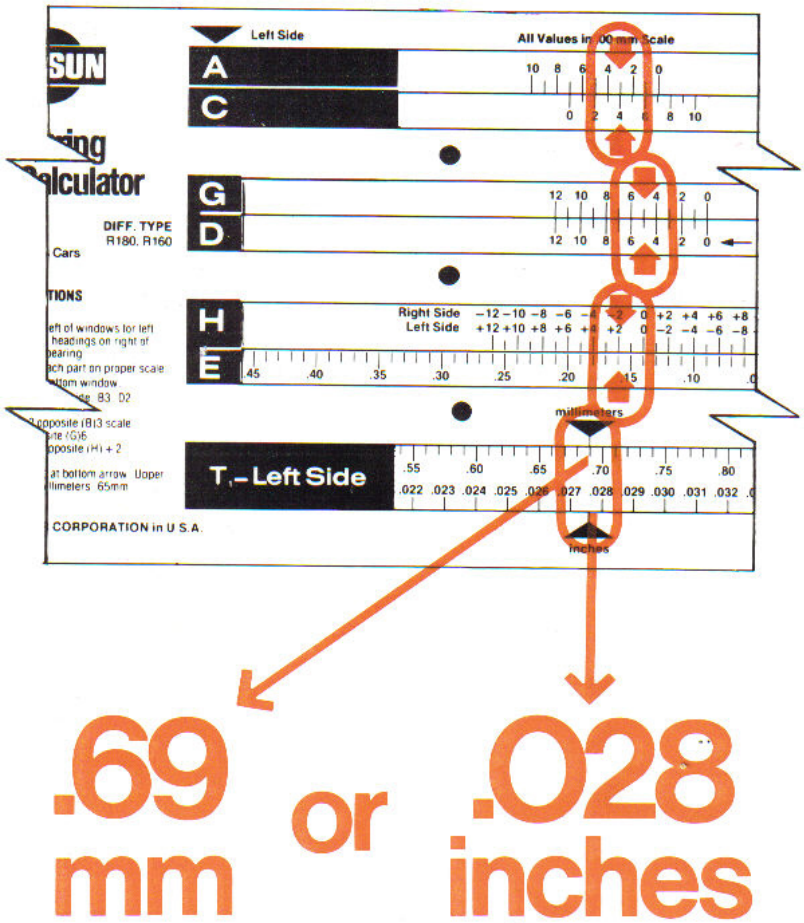
To calculate the required shim thickness for the left side bearing, proceed as follows:

Step 1. A, left housing = .03mm; C, left side gear case = .04mm. Move slide 1 to place the 4 on the C scale in line with the 3 on the A scale.

Step 2. G, left side bearing retainer = .05mm; D, gear case right side = .05mm. Maintaining slide 1's position (Step 1), move slide 2 to place the 5 on the D scale in line with the 5 on the G scale.

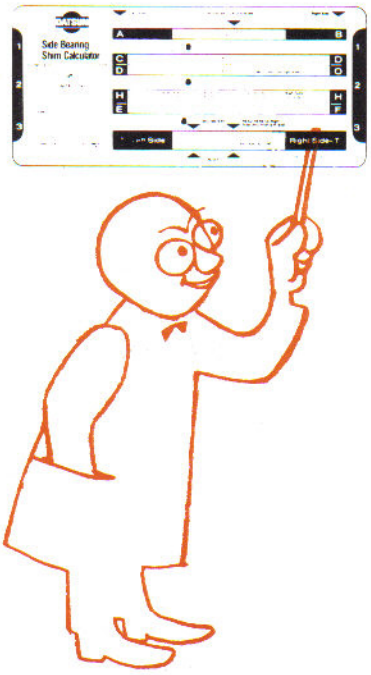
Step 3. H, ring gear variation + or – = + .02; E, left side bearing = .16mm. Maintaining slide 1 and 2 positions (Steps 1 and 2), move slide 3 to place the 16 on the E scale in line with the + 2 on the H scale.

Step 4. Maintaining slides 1, 2 and 3 positions (Step 1, 2 and 3), read the numbers on the bottom scale.



Thus, the shim thickness required for the left side bearing = .69 or .69mm, or approximately .028 in.

.69 mm or **.028 inches**

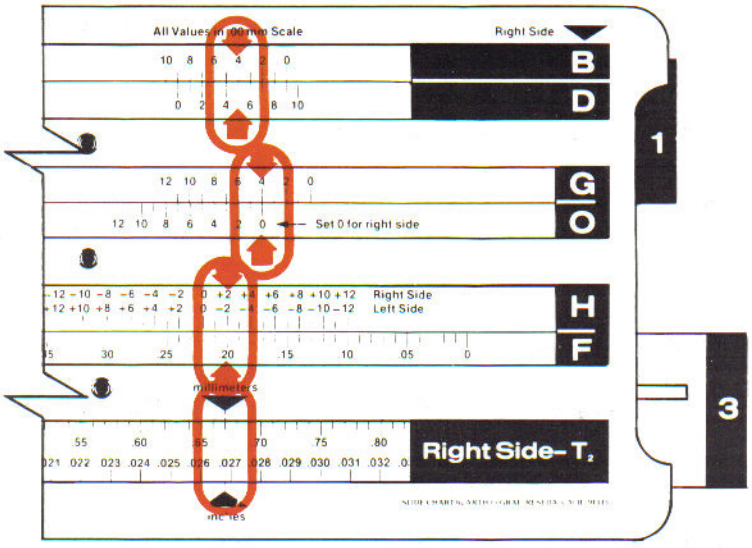


the Right Side

Let's try the right side of the R180—R160 differential.

B. Right housing = ... 4
D. Gear housing = ... 5
F. Right side bearing = ... 20
G2. Right side bearing retainer =. 4
H. Ring rear (3 or —) = ... +2

Use the right side headings on the calculator and move the right side slides as follows:



Step 1. Move slide 1 to place D 5 in line with B 4.

Step 2. Move slide 2 to place O 0 in line with G 4.

Step 3. Move slide 3 to place F 20 in line with H + 2.

Step 4. Read the result on the bottom scale. The required shim thickness is .67mm or approximately .027 inches.

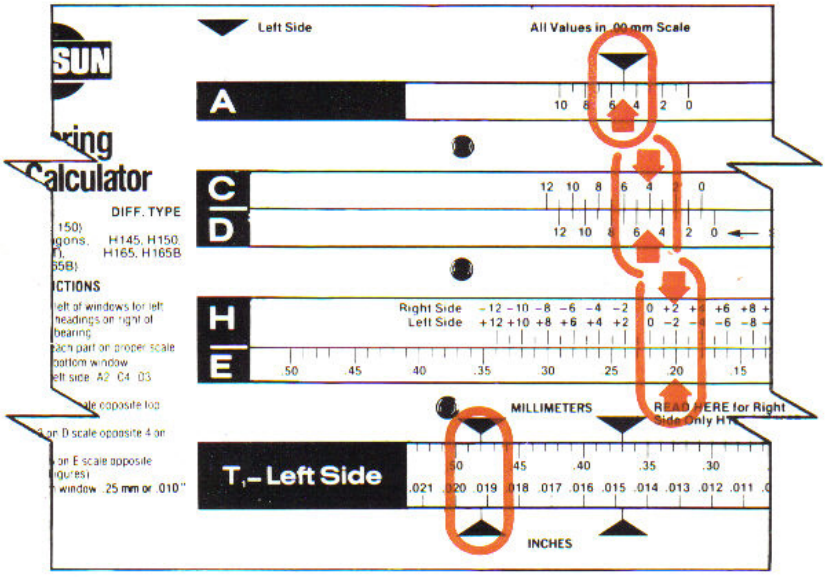
#2

the Left side

As a second example, use a "H165" type differential. Start by using the correct calculator. The factor numbers used to select the correct shim thickness are:

A = 5	D = 5	H = -2
B = 4	E = 20	
C = 4	F = 16	

Use the left side headings on the calculator and move the left side slides as follows:

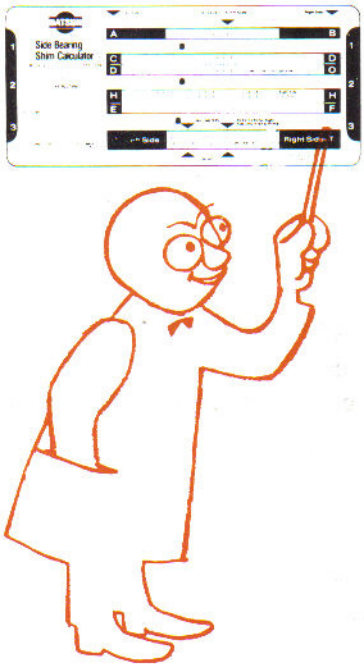


Step 1. Move slide 1 to place A 5 in line with the red arrow.

Step 2. Move slide 2 to place D 5 in line with C 4.

Step 3. Move slide 3 to place E 20 in line with H –2 (blue scale).

Step 4 Read the result on the bottom scale, the number opposite the left set of arrows, .48mm or approximately .019 inches.

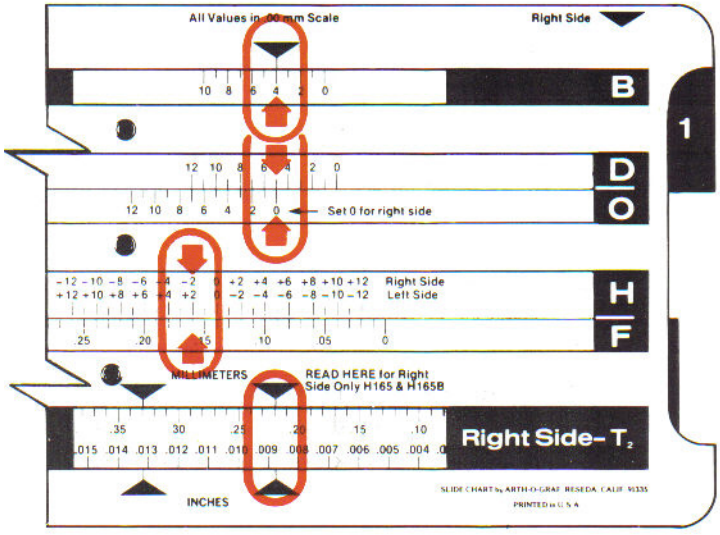


#3 the Right Side

As a third example, using a H165 type differential, the right side factor numbers used to select the correct shim thickness are:

A = 5	D = 5	H = –2
B = 4	E = 20	
C = 4	F = 16	

Use the right side headings on the calculator and move the right side slides as follows:



Step 1. Move slide 1 to place B 4 in line with the red arrow.

Step 2. Slide 2 to place O 0 in line with D 5.

Step 3. Move slide 3 to place F 16 in line with H –2.

Step 4. Read the result on the bottom scale, the number opposite the right set of arrow, .22mm or approximately .009 inches.

As you can see, using the calculator to determine shim thickness for the side bearings is easy. And it's an easier and faster method than using the formulas and mathematics. Nevertheless, using both methods will help insure the accuracy required for correct differential set-up and performance.

FORMULA CHART

	DIFFERENTIAL TYPE	FORMULA
A	R 160 AND R 180	LEFT SIDE (T_1) = A+C+G_1−D−E+H+.76 RIGHT SIDE (T_2)= B+G_2+D−F−H+.76
B	R 200	LEFT SIDE (T_1) = A−C+D+E−H+2.05 RIGHT SIDE (T_2)= B−D+F+G+H+1.95
C	H 165 AND H 165B	LEFT SIDE (T_1) = A−C+D+E−H+.20 RIGHT SIDE (T_2) = B−D+F+H+.09
D	H 145A AND H 150	LEFT SIDE (T_1) = A−C+D+E−H+.20 RIGHT SIDE (T_2) = B−D+F+H+.20
E	H 190 "ALUMINUM" AND "CAST IRON"	LEFT SIDE (T_1) = A−C+D+E−H+.17 RIGHT SIDE (T_2)= B−D+F+H+.15
F	SAE 190	THIS FORMULA IS FOR CALCULATIONS BASED ON THOUSANDTHS OF AN INCH. USE FORMULA "E" FOR METRIC CALCULATIONS. LEFT SIDE (T_1) A−C+D+E−H+.007 RIGHT SIDE (T_2) B−D+F+H+.006

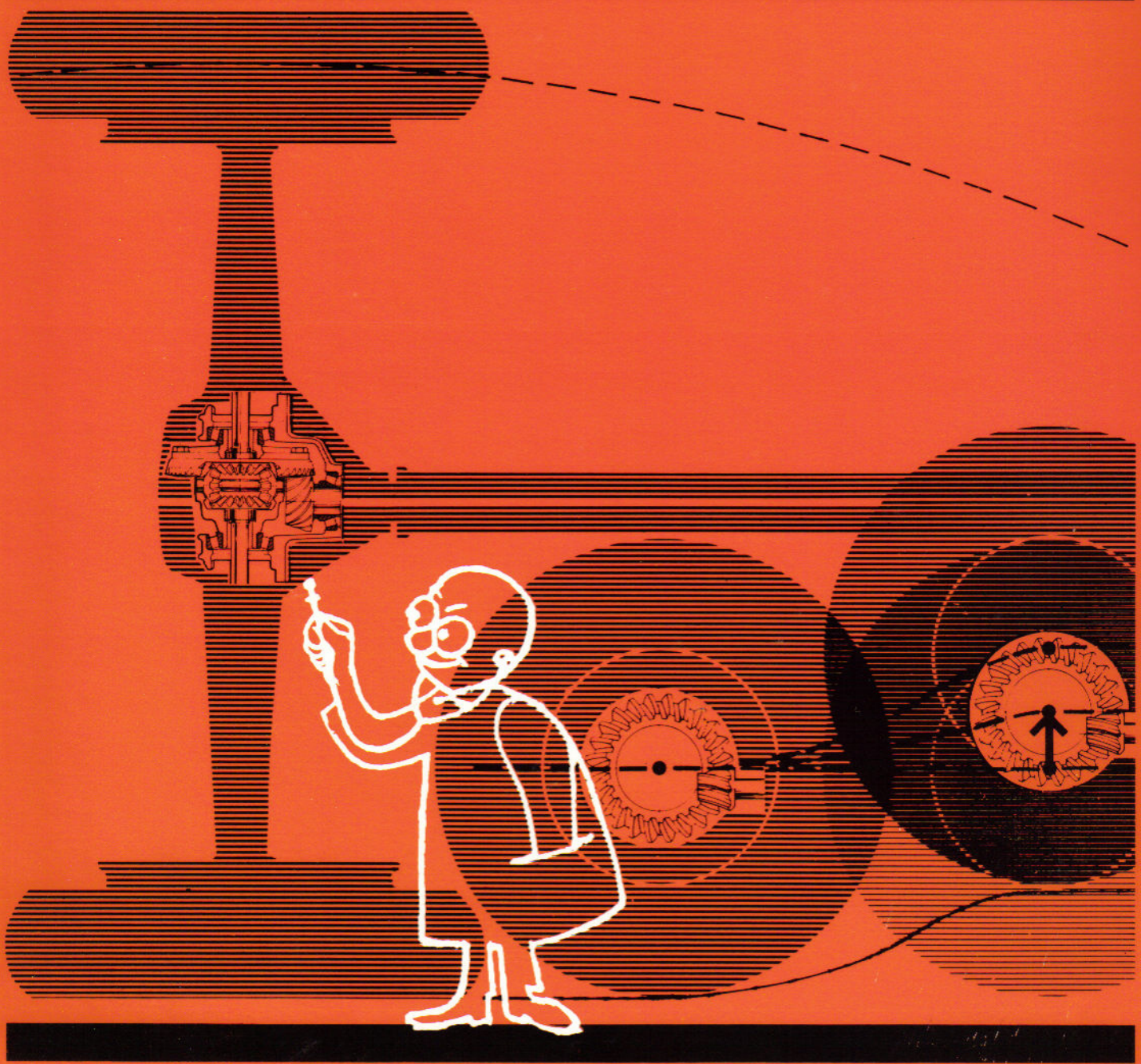
INCH TO METRIC CONVERSION TABLE (Rounded-out for automotive use)

inches	mm	inches	mm	inches	mm	inches	mm	inches	mm
.001	**.02**	.041	**1.04**	.081	**2.06**	.310	**7.87**	.710	**18.03**
.002	**.05**	.042	**1.07**	.082	**2.08**	.320	**8.13**	.720	**18.29**
.003	**.08**	.043	**1.09**	.083	**2.11**	.330	**8.38**	.730	**18.54**
.004	**.10**	.044	**1.12**	.084	**2.13**	.340	**8.64**	.740	**18.80**
.005	**.13**	.045	**1.14**	.085	**2.16**	.350	**8.89**	.750	**19.05**
.006	**.15**	.046	**1.17**	.086	**2.18**	.360	**9.14**	.760	**19.30**
.007	**.18**	.047	**1.19**	.087	**2.21**	.370	**9.40**	.770	**19.56**
.008	**.20**	.048	**1.22**	.088	**2.23**	.380	**9.65**	.780	**19.81**
.009	**.23**	.049	**1.24**	.089	**2.26**	.390	**9.91**	.790	**20.07**
.010	**.25**	.050	**1.27**	.090	**2.29**	.400	**10.16**	.800	**20.32**
.011	**.28**	.051	**1.30**	.091	**2.31**	.410	**10.41**	.810	**20.57**
.012	**.30**	.052	**1.32**	.092	**2.34**	.420	**10.67**	.820	**20.83**
.013	**.33**	.053	**1.35**	.093	**2.36**	.430	**10.92**	.830	**21.08**
.014	**.36**	.054	**1.37**	.094	**2.39**	.440	**11.18**	.840	**21.34**
.015	**.38**	.055	**1.40**	.095	**2.41**	.450	**11.43**	.850	**21.59**
.016	**.41**	.056	**1.42**	.096	**2.44**	.460	**11.69**	.860	**21.84**
.017	**.43**	.057	**1.45**	.097	**2.46**	.470	**11.94**	.870	**22.10**
.018	**.46**	.058	**1.47**	.098	**2.49**	.480	**12.19**	.880	**22.35**
.019	**.48**	.059	**1.50**	.099	**2.51**	.490	**12.45**	.890	**22.61**
.020	**.51**	.060	**1.52**	.100	**2.54**	.500	**12.70**	.900	**22.86**
.021	**.53**	.061	**1.55**	.110	**2.79**	.510	**12.95**	.910	**23.11**
.022	**.55**	.062	**1.57**	.120	**3.05**	.520	**13.21**	.920	**23.36**
.023	**.58**	.063	**1.60**	.130	**3.30**	.530	**13.46**	.930	**23.62**
.024	**.61**	.064	**1.63**	.140	**3.56**	.540	**13.72**	.940	**23.88**
.025	**.64**	.065	**1.65**	.150	**3.81**	.550	**13.97**	.950	**24.11**
.026	**.66**	.066	**1.68**	.160	**4.06**	.560	**14.22**	.960	**24.38**
.027	**.69**	.067	**1.70**	.170	**4.32**	.570	**14.48**	.970	**24.64**
.028	**.71**	.068	**1.73**	.180	**4.57**	.580	**14.73**	.980	**24.89**
.029	**.74**	.069	**1.75**	.190	**4.83**	.590	**14.99**	.990	**25.15**
.030	**.76**	.070	**1.78**	.200	**5.08**	.600	**15.24**	1.000	**25.40**
.031	**.79**	.071	**1.80**	.210	**5.33**	.610	**15.49**	2.000	**50.80**
.032	**.81**	.072	**1.83**	.220	**5.59**	.620	**15.75**	3.000	**76.20**
.033	**.84**	.073	**1.85**	.230	**5.84**	.630	**16.00**	4.000	**101.60**
.034	**.86**	.074	**1.88**	.240	**6.10**	.640	**16.26**	5.000	**127.00**
.035	**.89**	.075	**1.90**	.250	**6.35**	.650	**16.51**	6.000	**152.40**
.036	**.91**	.076	**1.93**	.260	**6.60**	.660	**16.76**	7.000	**177.80**
.037	**.93**	.077	**1.96**	.270	**6.86**	.670	**17.02**	8.000	**203.20**
.038	**.97**	.078	**1.98**	.280	**7.11**	.680	**17.27**	9.000	**228.60**
.039	**.99**	.079	**2.00**	.290	**7.37**	.690	**17.53**	10.000	**254.00**
.040	**1.02**	.080	**2.03**	.300	**7.62**	.700	**17.78**	20.000	**508.00**

METRIC TO INCH CONVERSION TABLE (Rounded-out for automotive use)

mm	inches	mm	inches	mm	inches	mm	inches	mm	inches
0.01	.0004	**0.41**	.016	**0.81**	.032	**21**	.827	**61**	2.402
0.02	.001	**0.42**	.0165	**0.82**	.032	**22**	.866	**62**	2.440
0.03	.001	**0.43**	.017	**0.83**	.0325	**23**	.905	**63**	2.480
0.04	.0015	**0.44**	.017	**0.84**	.033	**24**	.945	**64**	2.520
0.05	.002	**0.45**	.0175	**0.85**	.033	**25**	.984	**65**	2.559
0.06	.002	**0.46**	.018	**0.86**	.034	**26**	1.024	**66**	2.598
0.07	.003	**0.47**	.0185	**0.87**	.034	**27**	1.062	**67**	2.637
0.08	.003	**0.48**	.019	**0.88**	.0345	**28**	1.102	**68**	2.677
0.09	.0035	**0.49**	.019	**0.89**	.035	**29**	1.142	**69**	2.717
0.10	.004	**0.50**	.0195	**0.90**	.035	**30**	1.181	**70**	2.756
0.11	.004	**0.51**	.020	**0.91**	.036	**31**	1.220	**71**	2.795
0.12	.0045	**0.52**	.020	**0.92**	.036	**32**	1.260	**72**	2.835
0.13	.005	**0.53**	.021	**0.93**	.0365	**33**	1.299	**73**	2.874
0.14	.0055	**0.54**	.021	**0.94**	.037	**34**	1.339	**74**	2.913
0.15	.006	**0.55**	.0215	**0.95**	.0375	**35**	1.378	**75**	2.953
0.16	.006	**0.56**	.022	**0.96**	.038	**36**	1.417	**76**	2.992
0.17	.0065	**0.57**	.0225	**0.97**	.038	**37**	1.457	**77**	3.031
0.18	.007	**0.58**	.023	**0.98**	.0385	**38**	1.496	**78**	3.070
0.19	.0075	**0.59**	.023	**0.99**	.039	**39**	1.535	**79**	3.110
0.20	.008	**0.60**	.0235	**1.00**	.039	**40**	1.575	**80**	3.150
0.21	.008	**0.61**	.024	**1**	.039	**41**	1.614	**81**	3.189
0.22	.0085	**0.62**	.0245	**2**	.079	**42**	1.653	**82**	3.228
0.23	.009	**0.63**	.025	**3**	.118	**43**	1.693	**83**	3.268
0.24	.0095	**0.64**	.025	**4**	.157	**44**	1.732	**84**	3.307
0.25	.010	**0.65**	.0255	**5**	.197	**45**	1.772	**85**	3.346
0.26	.010	**0.66**	.026	**6**	.236	**46**	1.811	**86**	3.386
0.27	.0105	**0.67**	.026	**7**	.276	**47**	1.850	**87**	3.425
0.28	.011	**0.68**	.0265	**8**	.314	**48**	1.890	**88**	3.465
0.29	.0115	**0.69**	.027	**9**	.354	**49**	1.929	**89**	3.504
0.30	.012	**0.70**	.0275	**10**	.394	**50**	1.969	**90**	3.543
0.31	.012	**0.71**	.028	**11**	.433	**51**	2.008	**91**	3.583
0.32	.0125	**0.72**	.028	**12**	.472	**52**	2.047	**92**	3.622
0.33	.013	**0.73**	.029	**13**	.512	**53**	2.087	**93**	3.661
0.34	.013	**0.74**	.029	**14**	.551	**54**	2.126	**94**	3.700
0.35	.014	**0.75**	.0295	**15**	.590	**55**	2.165	**95**	3.740
0.36	.014	**0.76**	.030	**16**	.630	**56**	2.205	**96**	3.780
0.37	.0145	**0.77**	.030	**17**	.669	**57**	2.244	**97**	3.819
0.38	.015	**0.78**	.030	**18**	.709	**58**	2.283	**98**	3.858
0.39	.015	**0.79**	.031	**19**	.748	**59**	2.322	**99**	3.898
0.40	.016	**0.80**	.0315	**20**	.787	**60**	2.362	**100**	3.937

DIAGNOSIS



DIFFERENTIAL ROAD TEST AND DIAGNOSIS

BEFORE you remove the differential from a vehicle, perform a complete diagnosis. Road testing a vehicle to detect exact symptoms is essential for proper diagnosis. This will save time, since you may avoid overhauling the differential because of a noisy transmission or wheel bearing. A complete diagnosis will also tell you exactly where to look for defects during disassembly.

CONTENTS: for defects during disassembly.

1. ROAD TEST PROCEDURE

A complete road test includes the following steps. Make a note of any malfunctions or noises.

	Noise Factors			
	Med.	Loud	Clunk	OK
1. Steady acceleration, light throttle.				
2. Steady acceleration, heavy throttle.				
3. Steady deceleration, from high speed.				
4. Light deceleration – on and off accelerator pedal.				
5. Cruising at low speeds up to 30 - 45 MPH.				
6. Cruising at high speeds 45 MPH and over.				
7. Cornering, steady speed at part throttle.				
8. Cornering, deceleration and acceleration.				
9. Harsh shifts, first to second on straight road and around corners.				
10. Vehicle stopped, shift between first and reverse, brake applied.				
11. Shift between first and reverse, brake released.				

2. INTERPRETING THE ROAD TEST

Use the following Diagnostic Chart (2 pages) to isolate the problem.

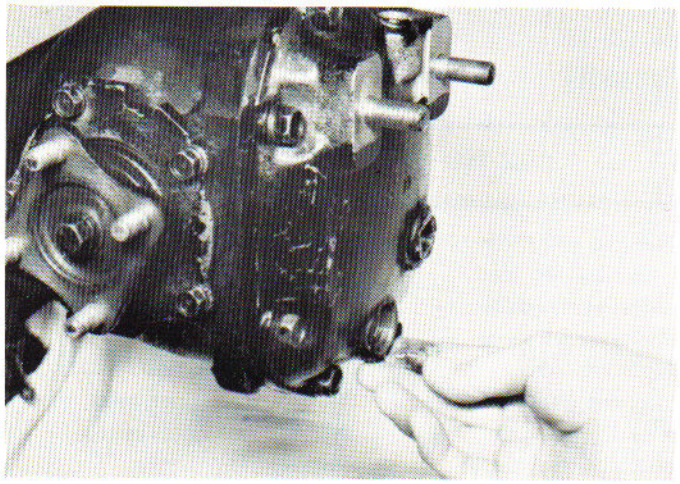
DIAGNOSTIC CHART

Customer Comment	Probable Cause of Defect	Diagnostic Step – Road Test	Final Diagnosis – Shop Test
Whines at high speeds.	(A) Transmission speedometer gear. (B) Defective differential front pilot bearing (independent suspension models). (C) Defective wheel bearings.	(A) Drive vehicle at speeds 45 MPH and over. (B) If whine present on deceleration, this indicates front bearing or pilot bearing.	(A) With vehicle on lift, use hearing device to locate noise at transmission housing and gear cable. (B) Use hearing device to locate noise at front of differential housing and to make sure that the noise is not caused by wheel bearings or transmission problems.
Whines or howls at low speed under a load (heavy throttle or when 2 or more passengers occupy vehicle).	(A) Defective rear pinion bearing. (B) Improper pinion height causing poor tooth contact area.	(A) Drive vehicle at low speeds up a hill if possible, and under a load. If noisy, see (b) shop test. (B) Check noise factor on deceleration. If present, see (b) shop test.	(A) Using a hoist or jack and stand, run the vehicle to verify loudest noise using hearing device. Replace rear pinion bearing. (B) If noise is present on both acceleration and deceleration, it is most likely caused by improper pinion height. Be sure to take a pattern reading.
Whines or howls on deceleration only.	(A) Improper backlash. (B) Improper pinion height.	(A) Drive vehicle at all speeds. (B) If noise only present on deceleration, the problem can usually be corrected by adjustment of backlash or pinion height. If backlash is incorrect, you will also feel a slight clunk if you accelerate and decelerate quickly.	(A-B) Testing on a lift will usually not be beneficial as you would not hear the noise factor without deceleration load. Disassemble and check tooth pattern.

DIAGNOSTIC CHART

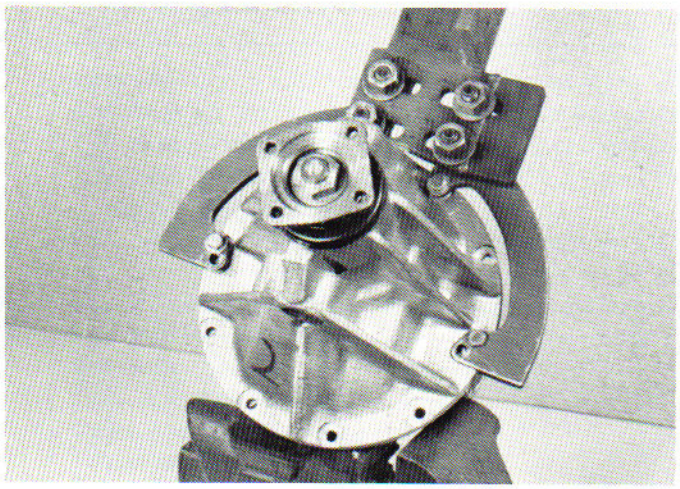
Customer Comment	Probable Area of Defect	Diagnostic Step — Road Test	Final Diagnosis — Shop Test
Clunks when shifting or going around corners.	(A) Differential hangers, bushings loose or worn. (B) Improper clearance of side gears. (C) Spider gear shaft worn. (D) Improper backlash.	(A) Drive vehicle and shift under load and no load conditions. If the differential hangers are loose or the mounts are defective, the clunk will be heavy and felt through the entire body. (B-C-D) If more of a knocking sound, drive the vehicle around corners while shifting. This will increase the clunk effect.	(A) Check on hoist using pry bar. Replace defective parts. (B) If the vehicle clunks while testing on straight road, this indicates improper backlash. (C) If the vehicle clunks on straight roads when shifting and around corners, this indicates side gear clearance. Readjust or replace side gears.
Howls or growls at all speeds	(A) Defective gear set. (B) Defective side bearings. (C) Rear wheel bearings.	(A-B) Drive vehicle at various speeds to determine if noise changes tone under load or coasting. (C) Drive the vehicle around corners to see if the noise level is high around right or left turns.	(A-B) If the noise level changes very little, the problem is most likely bearings. If the noise level changed excessively, it is most likely the gear set. (C) If the noise level changed around corners, jack up one wheel at a time (use jack stand). Run in gear while one wheel is locked. Observe noise factor change. Use hearing device to isolate the loudest area (wheel bearing or side bearing).
Leaks	(A) Front case pinion shaft seal. (B) Cover gasket. (C) Loose plug.	(A) Road test to verify that the leak is not accompanied by a noise indicating a defective pilot or front pinion bearing.	(A-B) Place the vehicle on a hoist and inspect for loose pinion shaft seal or defective gasket. (C) Check the drain plug and plug socket (may be cracked around housing).

3. DIAGNOSIS ON THE BENCH, PRIOR TO DISASSEMBLY

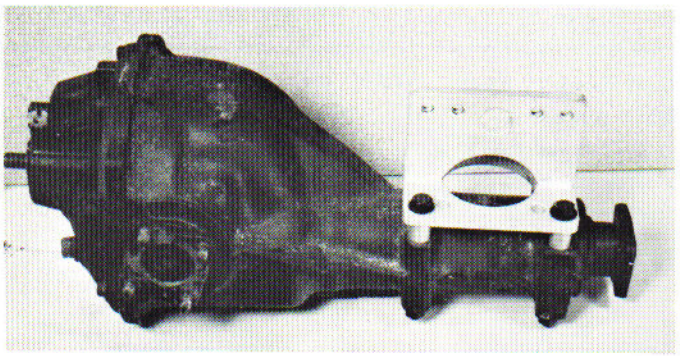


If the problem has been traced to the differential, remove the differential from the vehicle and proceed to the final diagnosis. Whether you drain the lubricant out of the differential while it is still on the car or you drain it after removal, always check the lubricant which was in the differential. Look for metal chips, filings, or burnt lube (evidence of overheating and possible bearing damage).

After the differential is thoroughly cleaned, mount it in a vise with one of the following holding fixtures.



For "H" type differentials use special tool J25602-01 (Differential Holding Fixture). This holding fixture is a vise mount unit that will securely hold all solid axle type differentials. It supersedes the old J25601, J25602, and J25603 holding tools. This adjustable fixture can also be used on many smaller transmissions and other similar components.



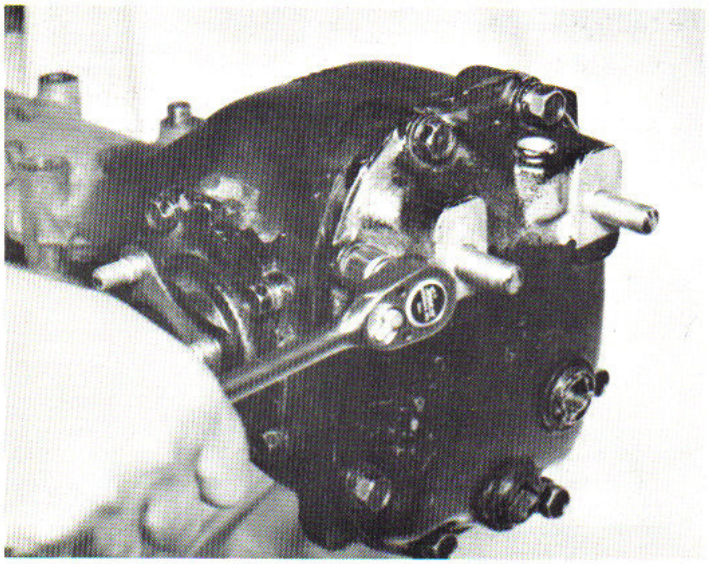
For "R" type differentials, you can use one of the following special tools:

J25604-01 — Axle shaft remover & stand differential holding fixture

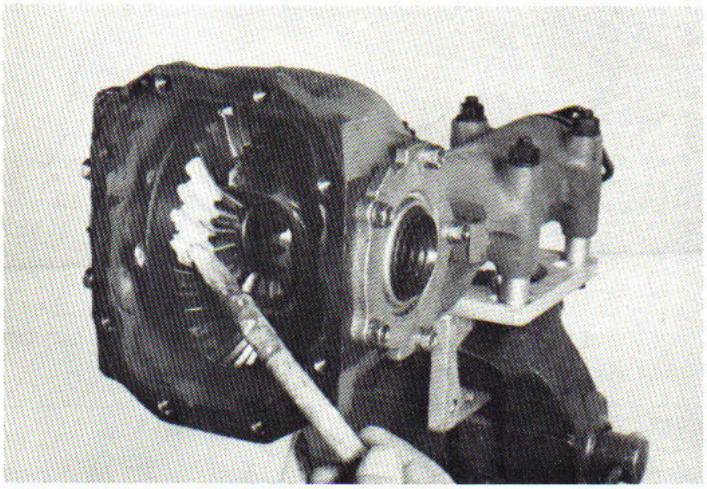
J25967 — Differential carrier mounting attachment (vise mount)

J26033 — Differential carrier mounting attachment (use with J26023 stand)

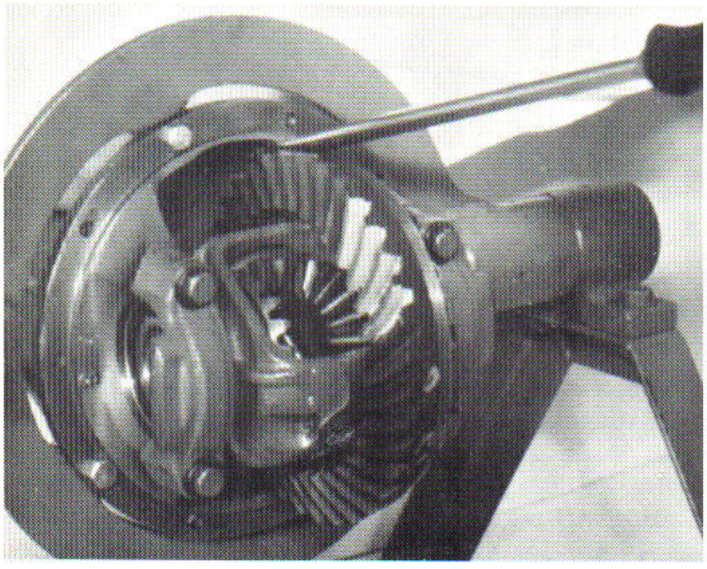
In your first step, you have to take a tooth pattern reading. Use the following procedure:



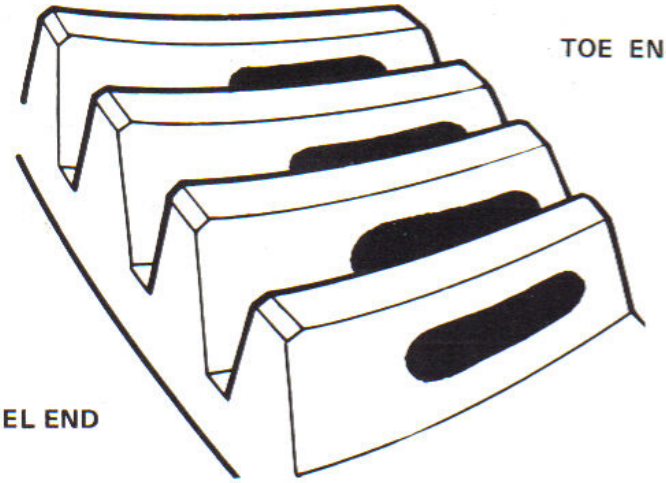
Remove the rear cover on "R" type differentials.



Paint three or four teeth on the ring gear **drive side,** using white grease, machinist's blue, lipstick, or latex house paint.



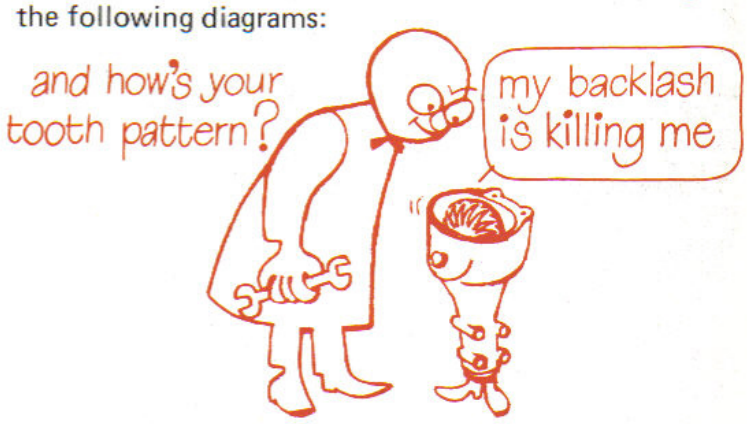
Now put a load on the ring gear with a large screwdriver or pry bar, and turn the pinion in a forward direction against the load as shown.

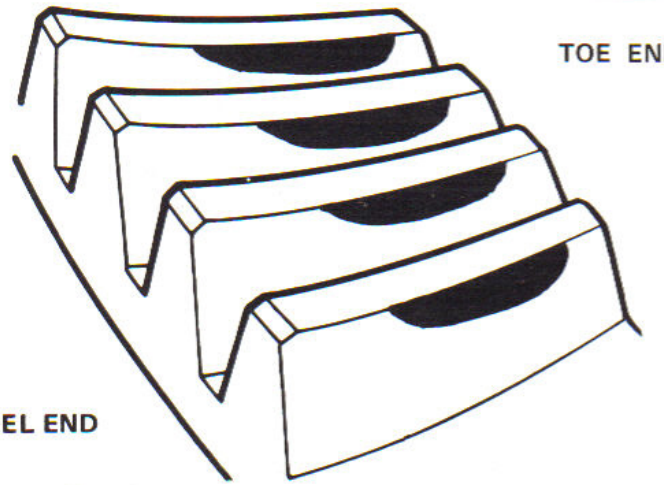


Perfect tooth pattern.

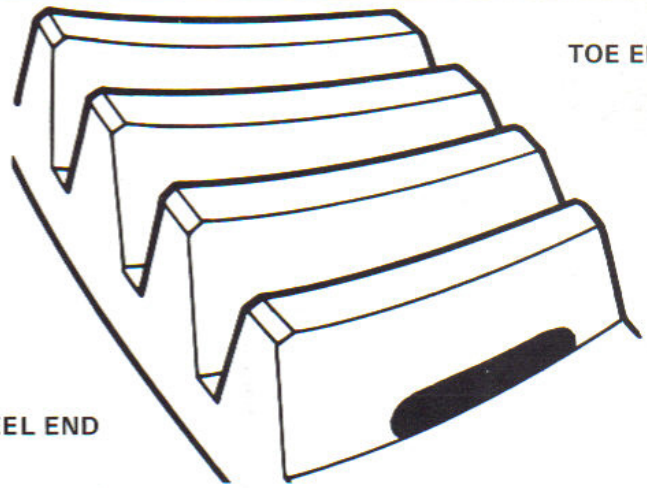
TOOTH PATTERN INTERPRETATION

Now you can interpret the tooth pattern according to the following diagrams:

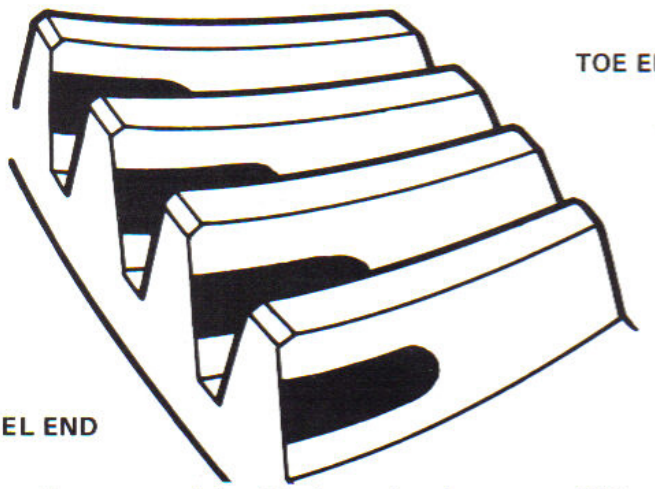




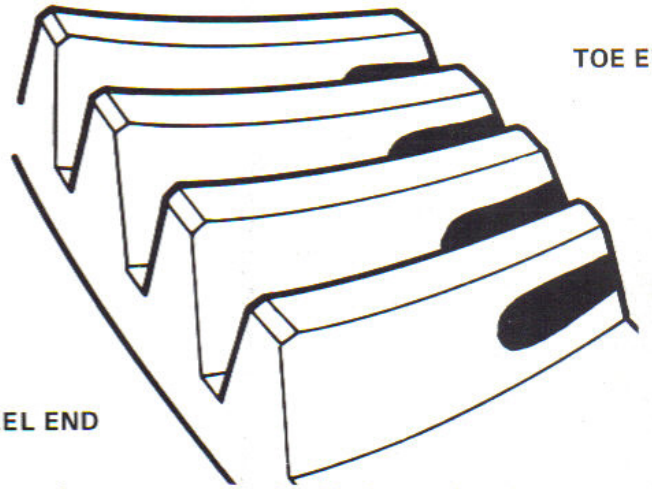
The pinion is too low. You will have to add to the shim(s) under the pinion.



The pinion is too high. The shim(s) under the pinion will have to be decreased.

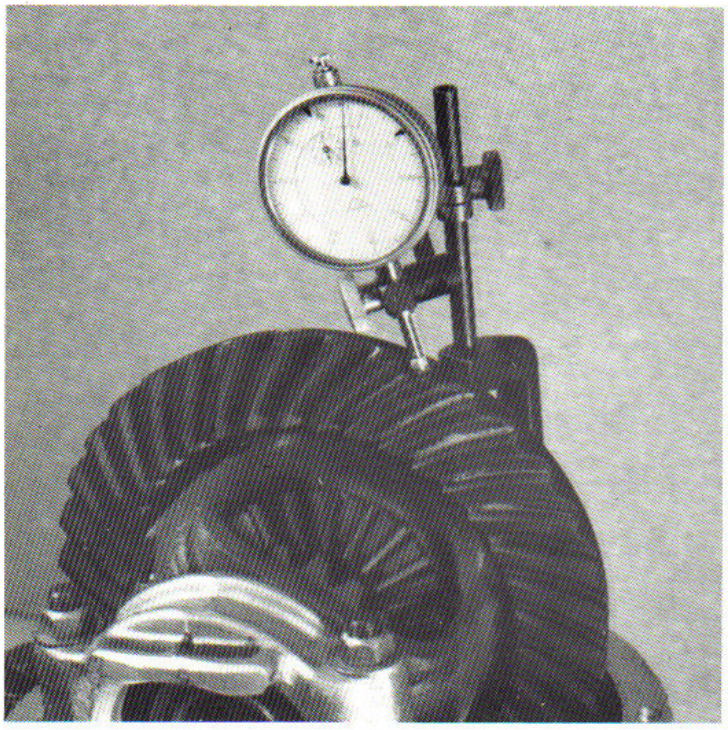


There is too much backlash — the ring gear will have to be moved closer to the pinion.



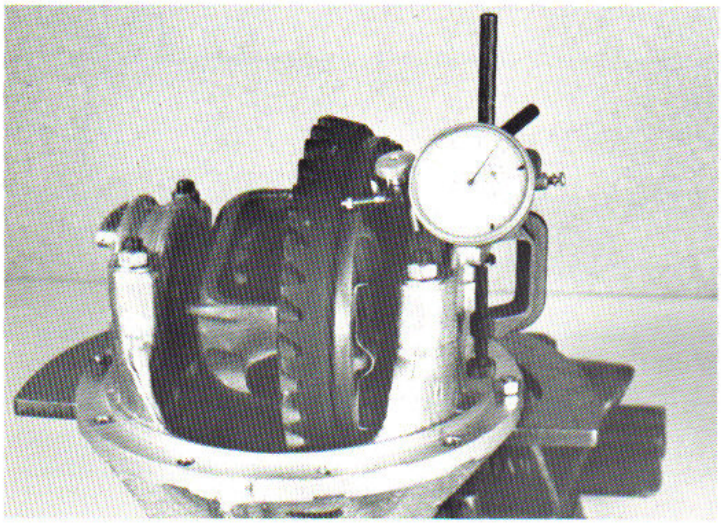
There is not enough backlash — the ring gear will have to be moved away from the pinion.

Note: A change in pinion height will also cause a change in backlash, so both will usually have to be adjusted



Finally, before you begin with your disassembly, take a backlash and a run-out reading of the ring gear.

Check the backlash as shown. It varies slightly from model to model. Look into the proper model section for exact specifications.



Check the runout of the ring gear with a dial indicator. It should be less than .05mm or .002 in.

Now you are ready for the final disassembly. Make sure to check all parts for wear and damage during disassembly.

R160/R180
OVERHAUL PROCEDURE

CHART A

LETTER LOCATION	.00mm	.000"
A Left housing		
B Right housing		
C Gear carrier		
D Gear carrier		
E Left side bearing		
F Right side bearing		
G1 Left side bearing retainer		
G2 Right side bearing retainer		
H Ring gear: + or −		

PINION HEIGHT CALCULATION	
Standard measure	3.00
Add dial indicator reading.	
Sub-total	3
Pinion height tolerance. Add if minus − Subtract if plus +	
Total shims needed	3

NOTE:
This work sheet could be Xeroxed and used during differential overhaul

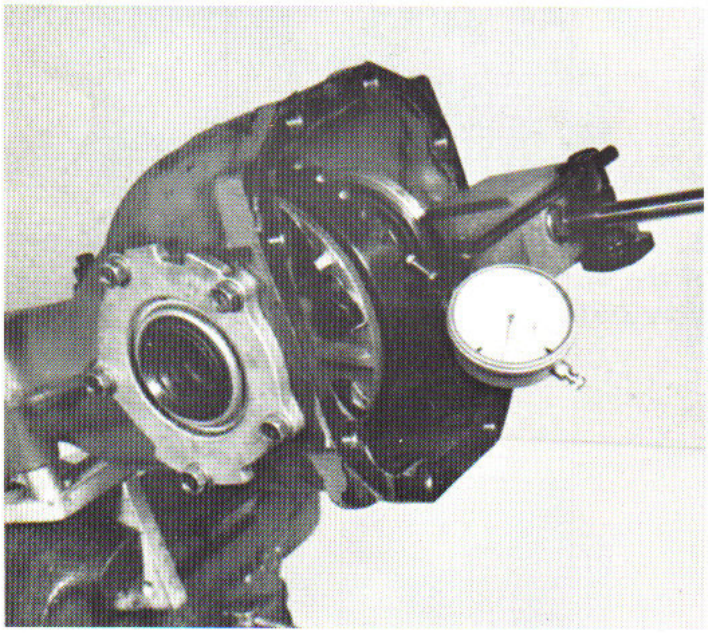
SIDE BEARING SHIM CALCULATION SHEET, R160. R180.

Record numbers from chart A and add.

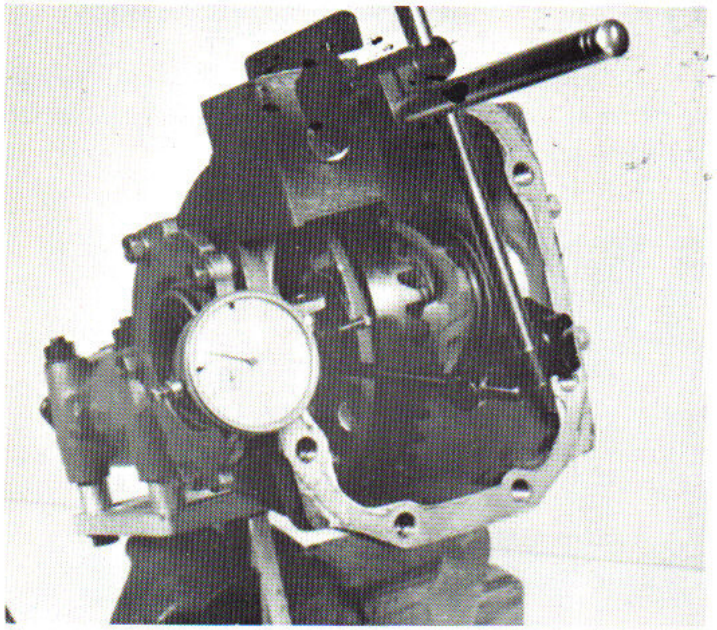
LEFT SIDE T1				RIGHT SIDE T2			
column 1		column 2		column 1		column 2	
A		D		B			
C		E		G2			
G1				D		F	
H if + (plus)		H if −(minus)		H if − (minus)		H if + (plus)	
Standard shim	.76			Standard shim	.76		
Total column 1		Total column 2		Total column 1		Total column 2	
Subtract total from column 2				Subtract total from column 2			
Total shim needed left side				Total shim needed right side			

OVERHAUL PROCEDURE R160–R180 (INDEPENDENT REAR SUSPENSION)

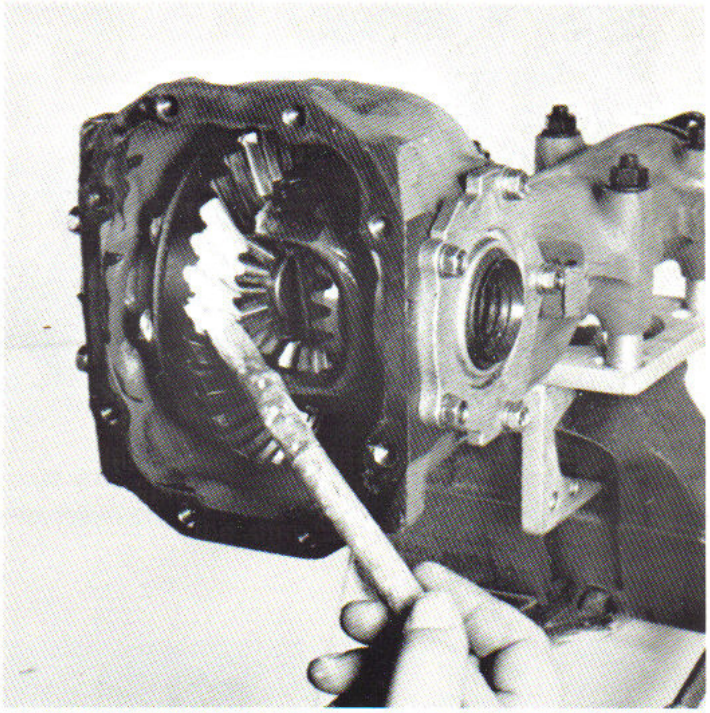
Perform a pre-disassembly diagnosis, as outlined in the diagnosis section of this book.



The backlash must be .10–.20mm (.004–.008 in.).

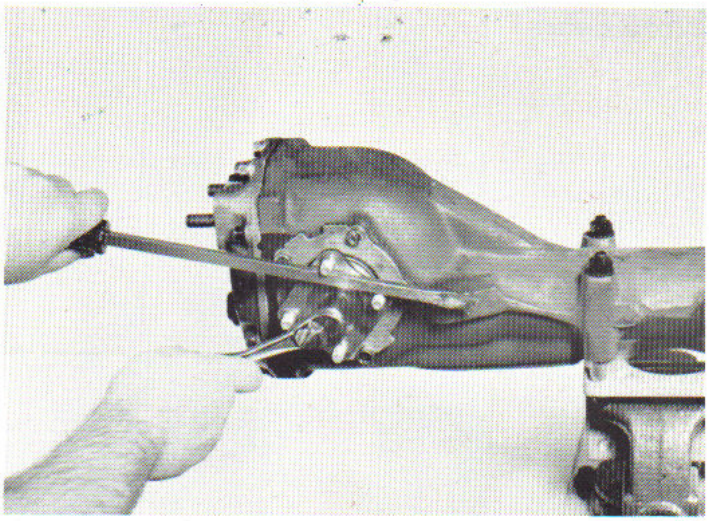


The run-out of the ring gear must be less than .05mm (0.002 inches).

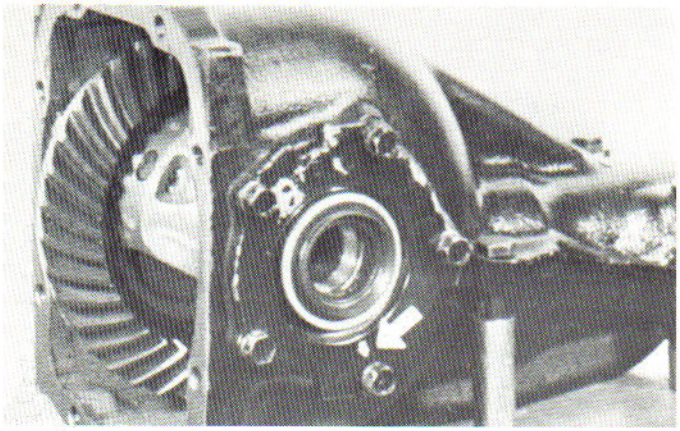


Take a tooth pattern reading. For interpretation of the pattern, look in the diagnosis section of this book. It is very important to take a tooth pattern reading at this point – it can save you time during overhaul by telling you where to look for maladjustments.

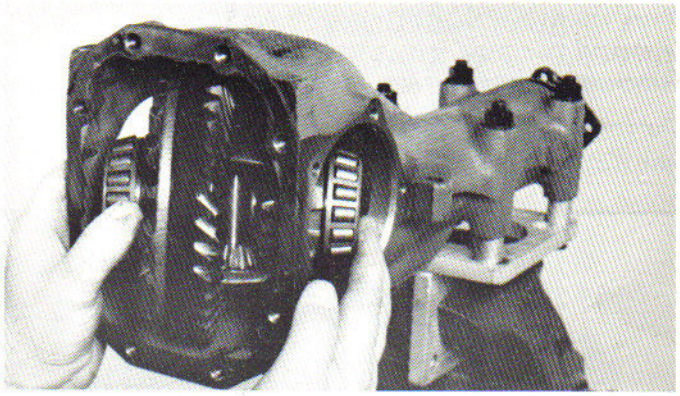
DISASSEMBLY:



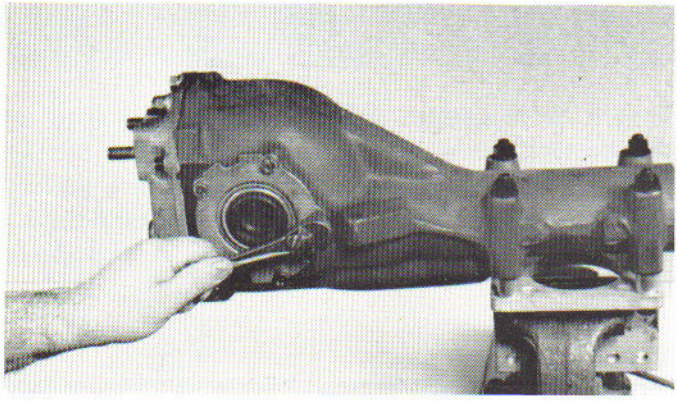
1. Hold the side flanges with a screwdriver as shown, and remove the flange bolt with a 14mm socket. Pull the flanges out by hand.



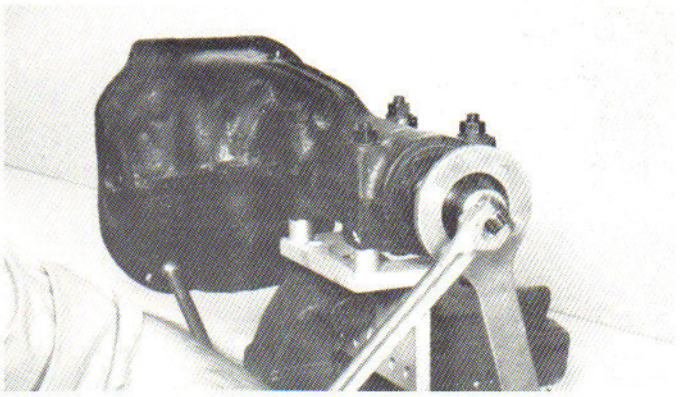
2. Mark one of the side bearing retainers to keep them from becoming mixed up during the overhaul.



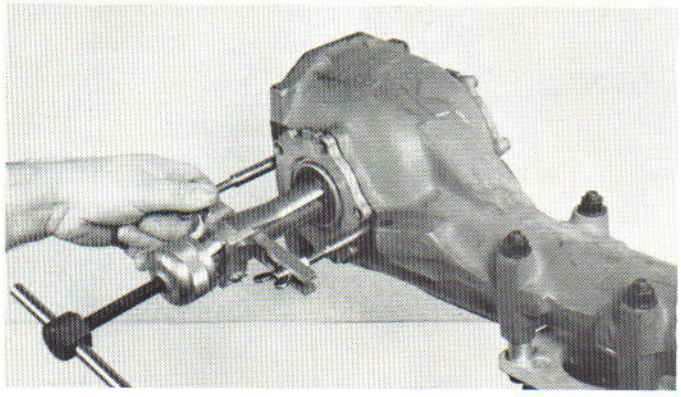
5. Turn the ring gear assembly until the open side of the carrier is facing you, and remove the carrier from the housing.



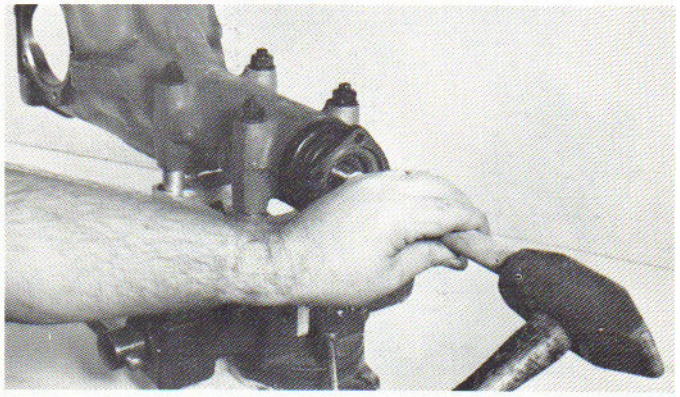
3. Remove the side bearing retainer bolts using a 12mm socket.



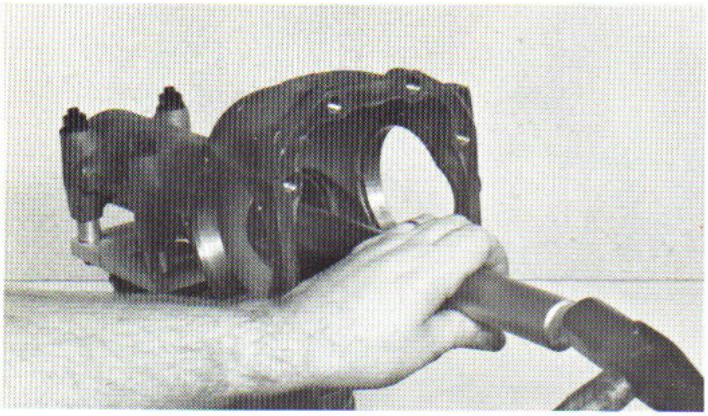
6. Attach the flange wrench J-25774 to the flange to prevent its turning, and remove the pinion shaft nut using a 27mm socket and breaker bar.



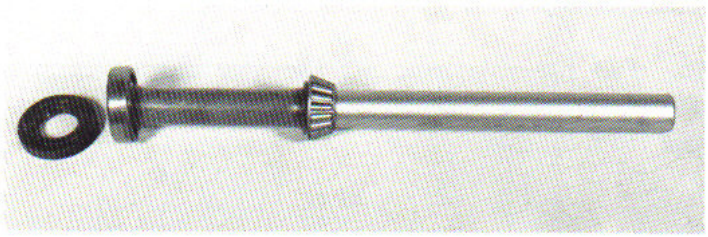
4. Remove the side bearing retainers. Usually they will slide out easily, but sometimes you will have to use special tool J-25810, side bearing race remover.



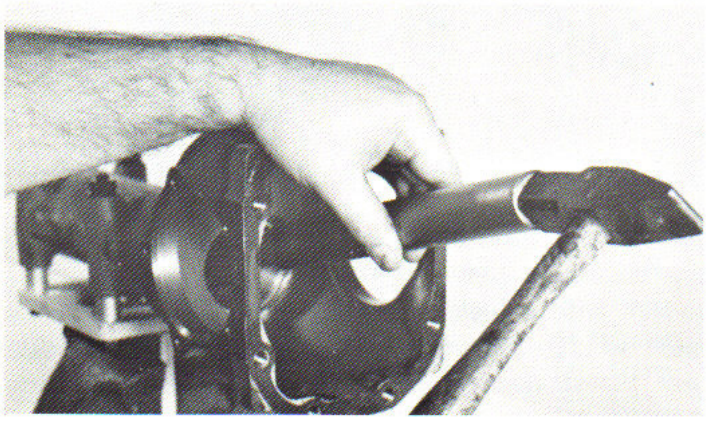
7. Drive the pinion through the housing using a brass drift and a heavy hammer. Keep the pinion head from being damaged.



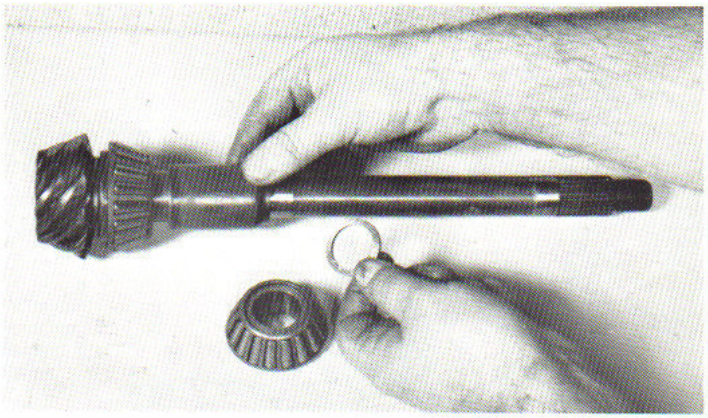
8. Slide the pilot bearing drift (J-25749) into the open end of the housing, through the pinion bearings and sleeve. You will probably have to lift the sleeve with your finger before the drift will slide through.



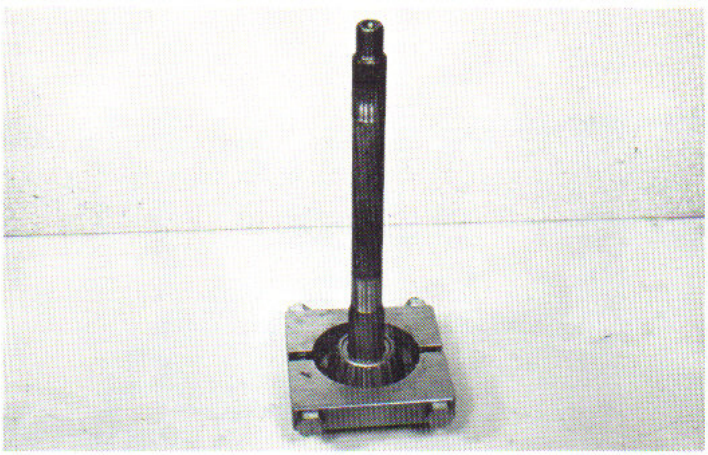
9. Using the drift and a heavy hammer, drive the drift on through the housing. This will remove the front pinion bearing sleeve, pilot bearing and oil, seal.



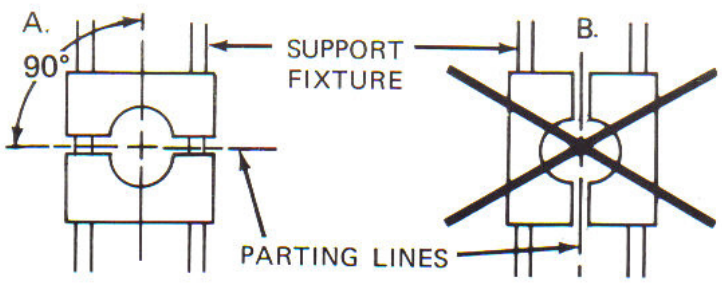
10. Remove both bearing races, using the same pilot bearing drift (special tool J-25749). This completes the disassembly of the housing.

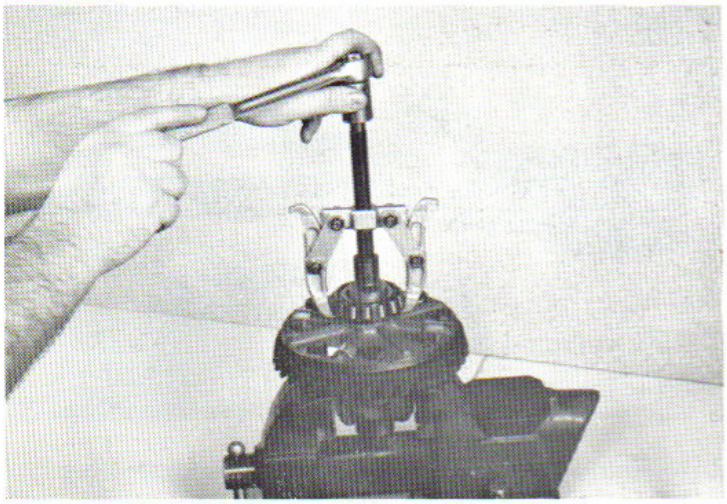


11. Remove the preload shim and spacer from the pinion shaft. Sometimes the shim will be found sticking to the front pinion bearing. Save the shim and spacer.

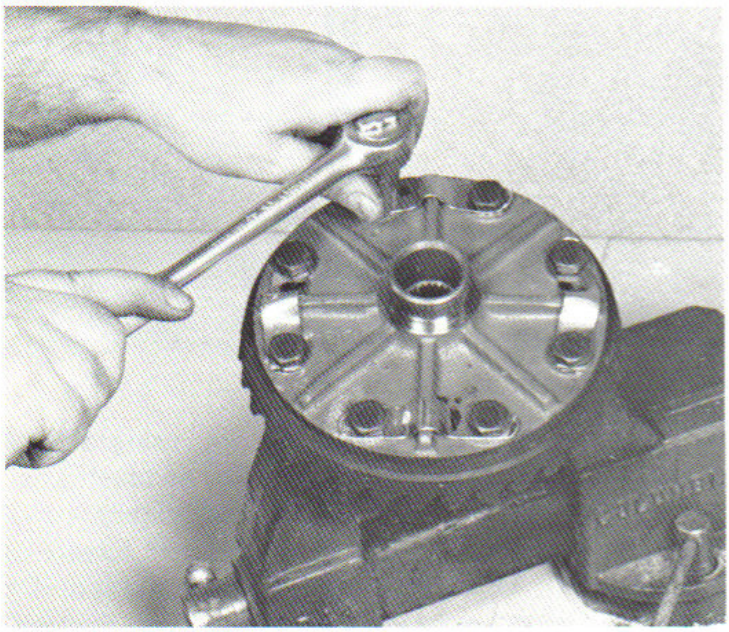


12. Remove the rear pinion bearing using a press and special tool J-25733-1. Care must be taken when setting the tool in the press that the parting line of the tool is at a right angle to the support fixture of the press (A). This is to prevent bending the tool (B). Save the pinion height washer found behind the bearing. This will be reused.

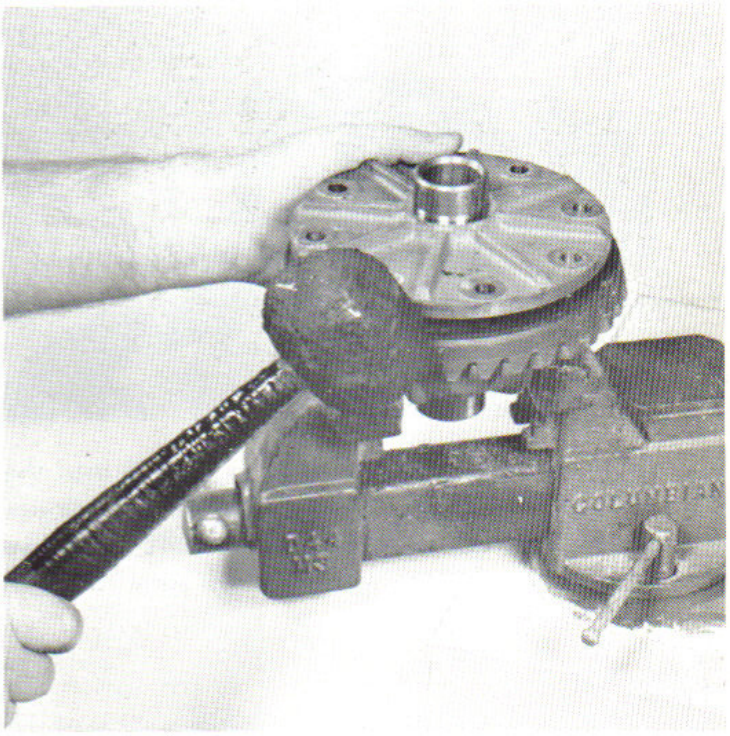




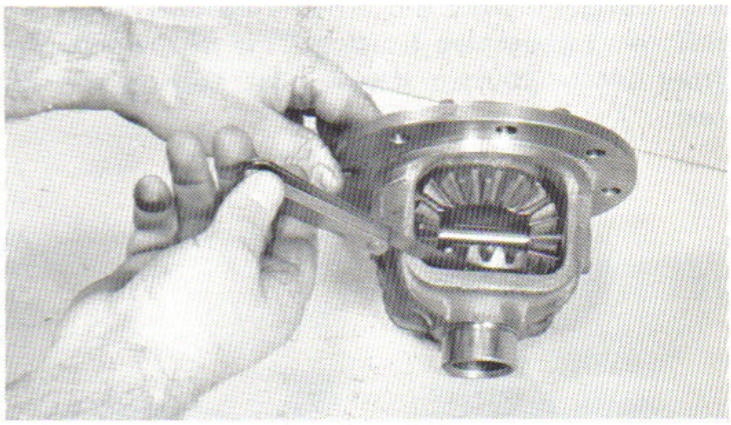
13. Attach the side bearing puller (special tool J-22888 and J-25797-2) to the side bearing and remove both side bearings. Keep bearings and races together.



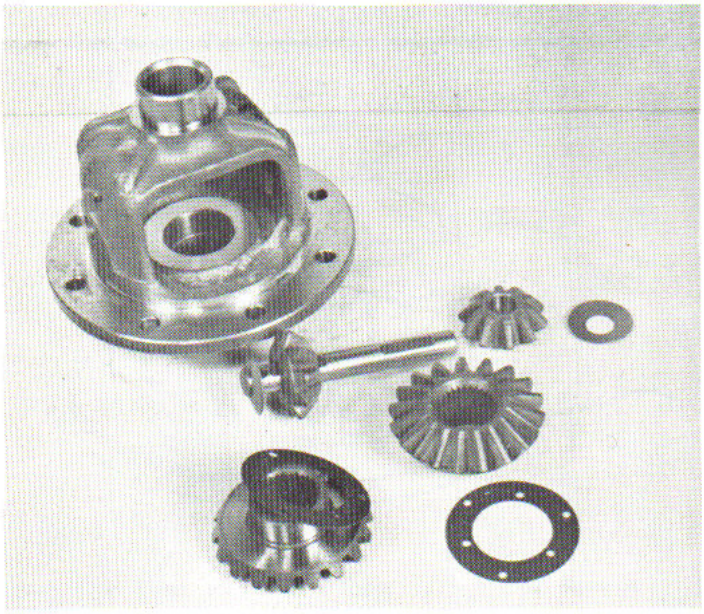
14. Flatten the lock tabs and remove the ring gear bolts in a criss-cross fashion using a 17mm socket.



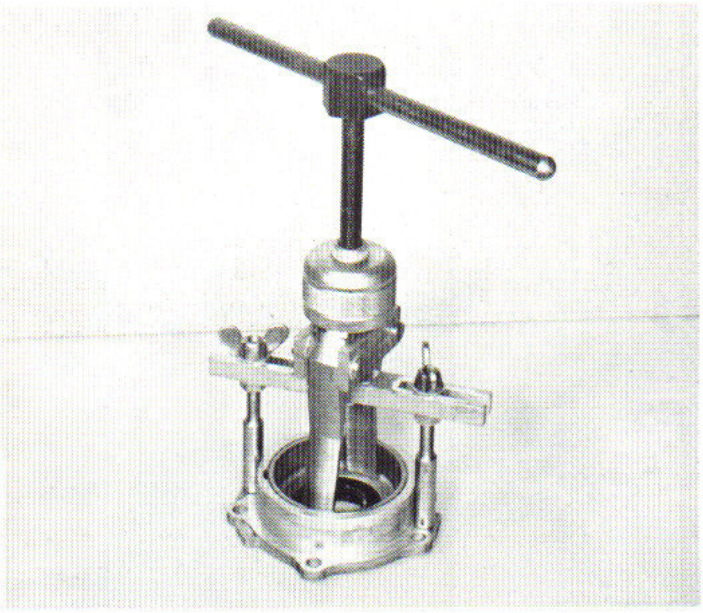
15. Tap the ring gear off the gear carrier using a plastic hammer. Tap evenly all around to keep the gear from binding.



16. Before disassembling the gear carrier, measure the clearance between the side gear and the gear carrier with a feeler gauge as shown. The clearance must be .10—.20mm (.004—.008 in.). If not, the side gear thrust washers will have to be changed during reassembly.

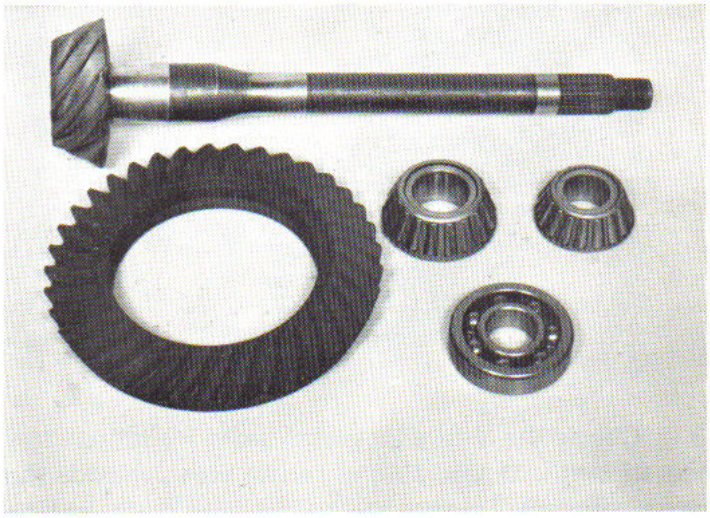


17. Using a long drift, drive the lock pin out of the gear carrier. Remove the spider gear shaft and rotate the spider gears out of the carrier. Keep the spider gears and washers together — after removal, reassemble the gears on the shaft as shown. Remove the side gears and thrust washers, keeping all parts in order.



18. Next, remove the side bearing races from the retainers using special tool J-25810. THE RACES MUST BE REMOVED EACH TIME YOU OVERHAUL THIS TYPE OF DIFFERENTIAL SINCE THEY ARE NEEDED TO MEASURE THE TOTAL SIDE BEARING THICKNESS DURING THE PROCESS OF SHIM DETERMINATION.

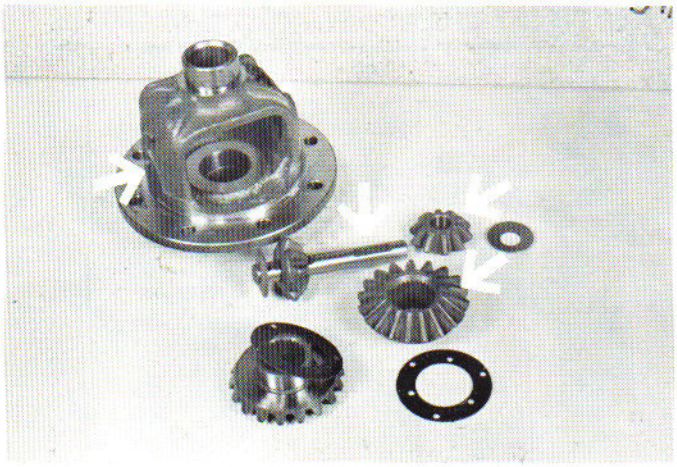
PARTS INSPECTION:



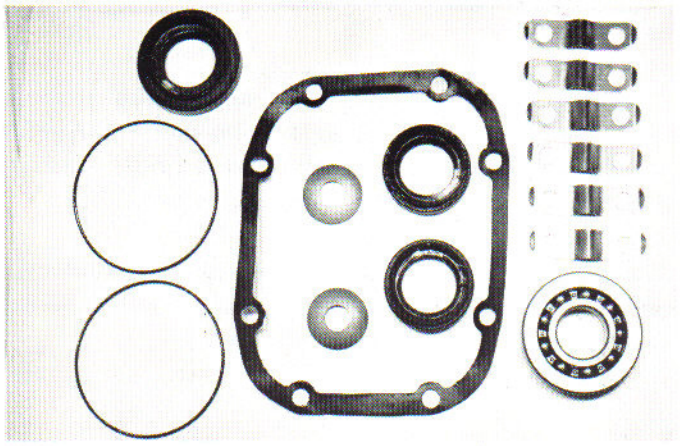
1. If the gears do not have the proper tooth pattern, and the differential has been in service for more than 1,000 miles, the ring and pinion gears should be replaced. Otherwise, gear whine may result when the gears are reinstalled with a different mesh pattern. (The ring and pinion are, of course, replaced as a set.)

2. To ensure silent operation, new pinion bearings are recommended whenever the ring and pinion gears are replaced. These bearings operate under tremendous load and are very susceptible to wear.

The side bearings may or may not be replaced, depending upon wear. They will be inspected during the reassembly procedure.



3. Check the side and spider gears for chipped or scored teeth. If you find excessive wear, replace the gears affected. Inspect the spider gear shaft and its bores in the differential gear carrier for wear. Replacement is necessary if the gear carrier bores are elongated or if ridges are worn in the gear shaft.



4. The following parts must be replaced during each overhaul:

Spider gear cup washers

Ring gear bolt lock tabs

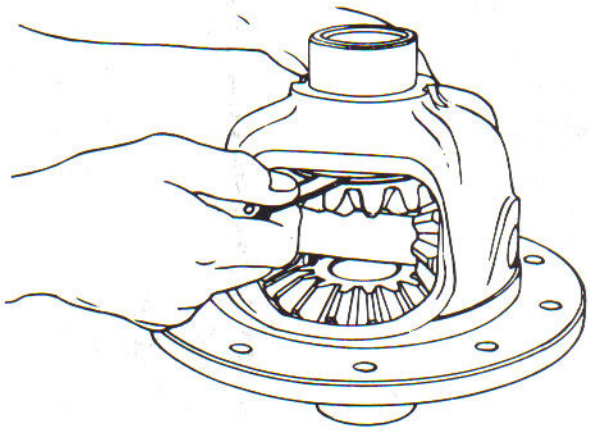
Pinion seal

Side retainer O-rings and seals

Cover gasket

Front pilot bearing

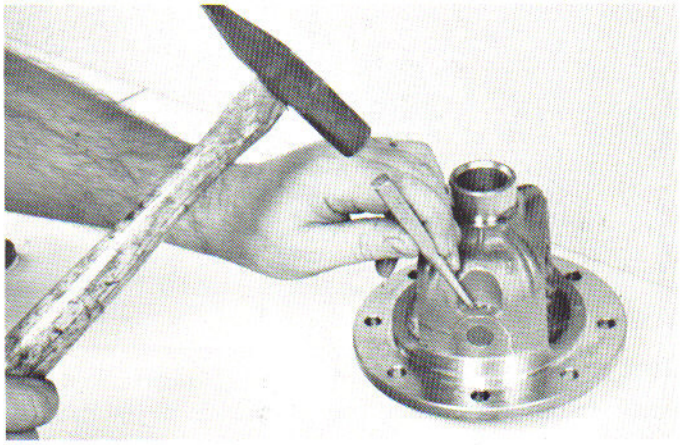
REASSEMBLY:



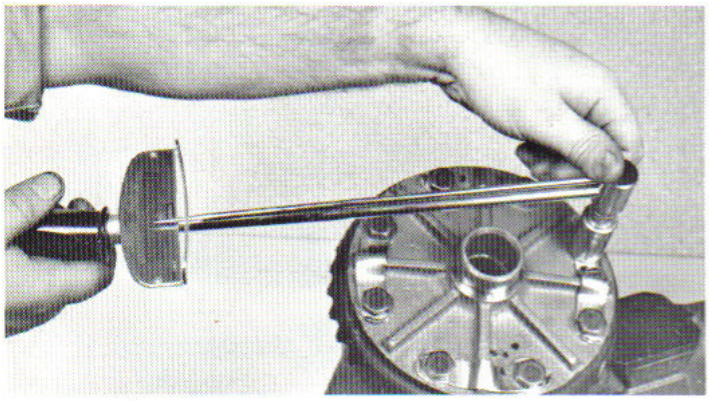
1. Install the spider and side gears, and side gear thrust washers into the gear carrier.

2. Side gear clearance must not exceed .20mm (.008 in.). Side gear clearance can be adjusted by thrust washers of various thicknesses. These washers can be found on the shim board or can be ordered from the Parts Department.

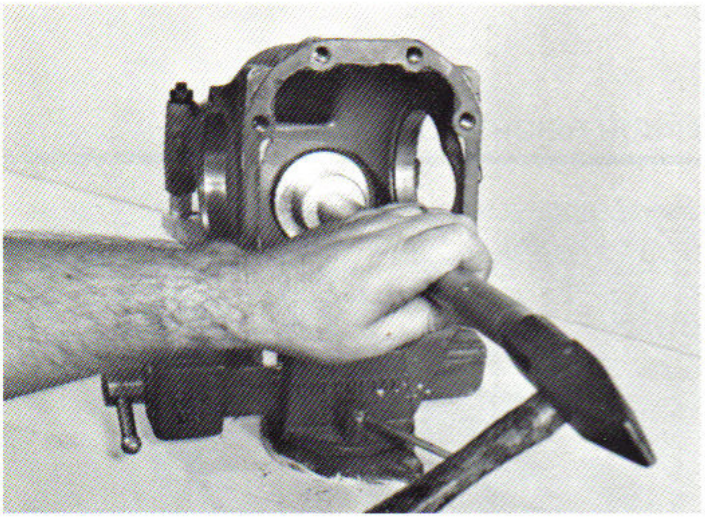
Part Number	mm	Inches
38424-21000	.77	.030
38424-21001	.82	.032
38424-21002	.87	.034



3. Be sure to stake-punch the spider gear shaft lock pin after completing the reassembly of the carrier. If the pin is not staked, it might come out under load and destroy the differential.



4. Install the ring gear, ring gear bolts, and new bolt lock tabs. Torque the bolts to 7–8 kg.m (51 – 58 ft.lbs.), tap the bolt heads with a hammer, and re-torque. Care must be taken to prevent the ring gear from becoming warped during this operation.(Note: DO NOT REASSEMBLE THE SIDE BEARINGS AT THIS POINT.)

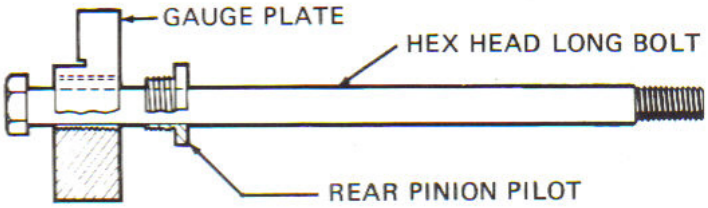


5. Install the pinion bearing outer and inner races into the differential housing. Make sure that the bearing races are seated squarely in their respective bores. Use the following special tools:

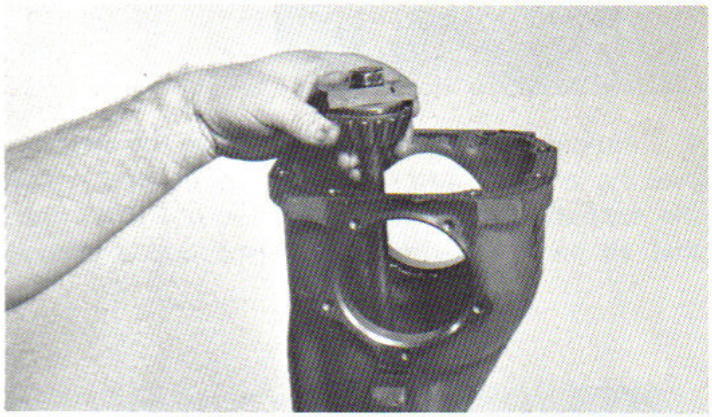
R160 – J-25742-1 drift handle
J-25742-2 adapter
J-25742-3 adapter

R180 - J-25742-1 drift handle
J-25742-2 adapter
J-25742-5 adapter

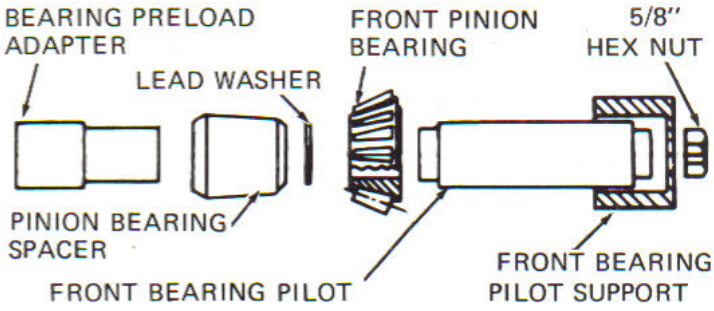
PINION HEIGHT AND/OR PRELOAD ADJUSTMENT



1. Install bearing pilot into the gauge plate and slide over the long bolt.

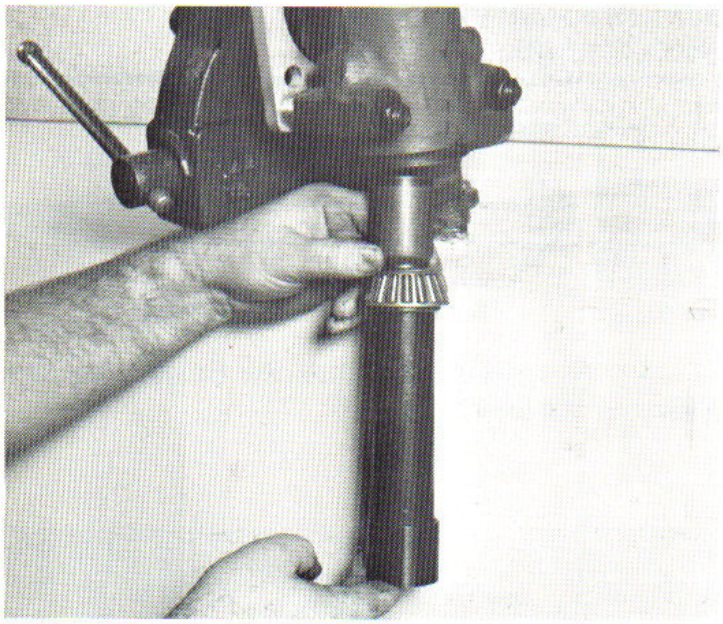


2. Install the rear pinion bearing in the differential case. Slide the long bolt and gauge plate through the bearing.

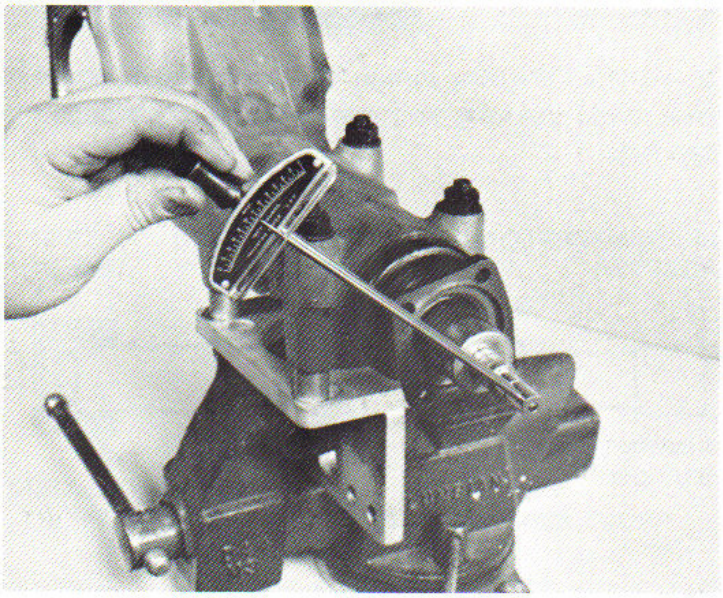


3. Stand the front bearing pilot support on the bench with the appropriate side up and assemble the component parts and special tools in the following order: Front bearing pilot support, front bearing pilot, front pinion bearing, lead washer, and then the pinion bearing spacer and bearing pre-load adapter together. Ensure that all parts are seated.

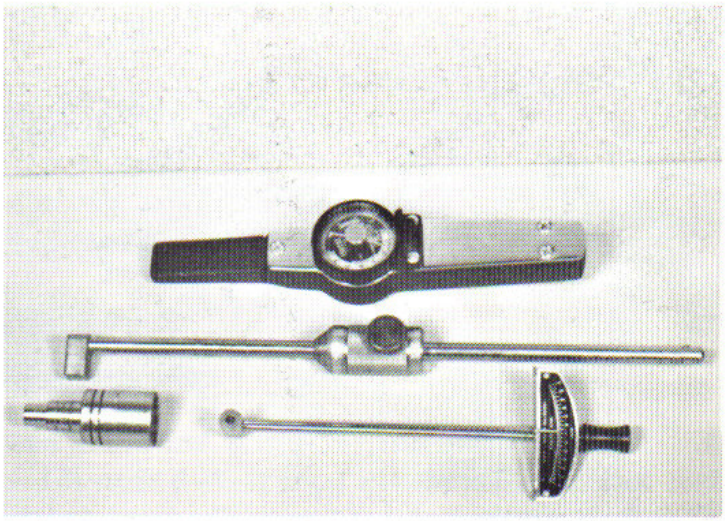
NOTE: If a lead washer is not available, use a piece of thick roll solder (7) to obtain preload washer size.



4. Holding these parts together, slide the assembly over the long bolt into the differential housing. Install the support nut. Finger tighten the nut and ensure that all parts turn freely and are properly aligned.



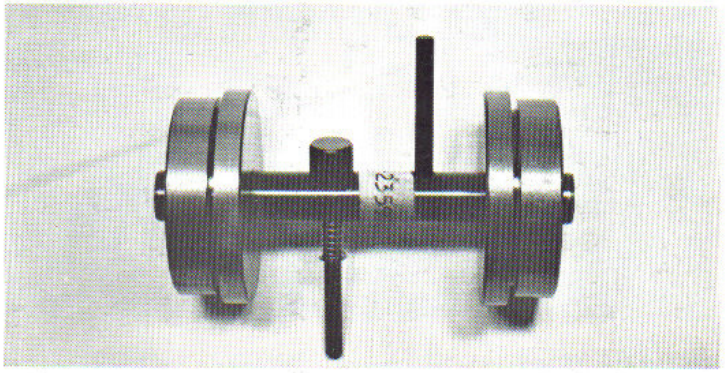
5. Tighten nut carefully to obtain the correct preload of 6 to 10 kg-cm or 5 to 8 in. lbs.



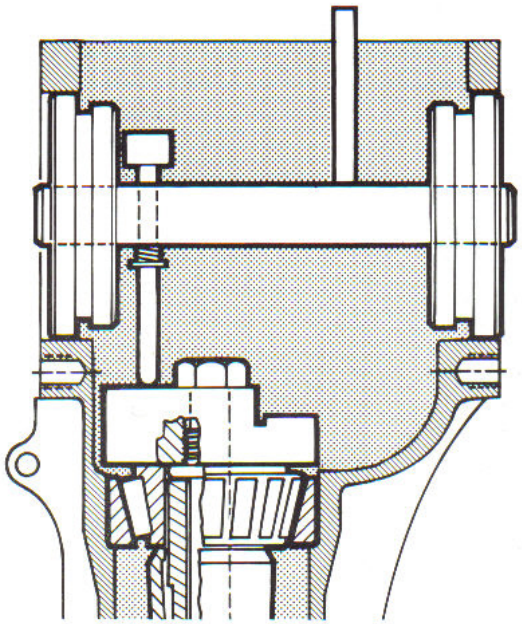
6. To measure preload, use one of the tools shown.

NOTE: This concludes the preload adjustment for now. DO NOT DISASSEMBLE THE SPECIAL TOOLS AT THIS TIME. (The measurement of the lead washer, if used, will be taken after the pinion height adjustment.)

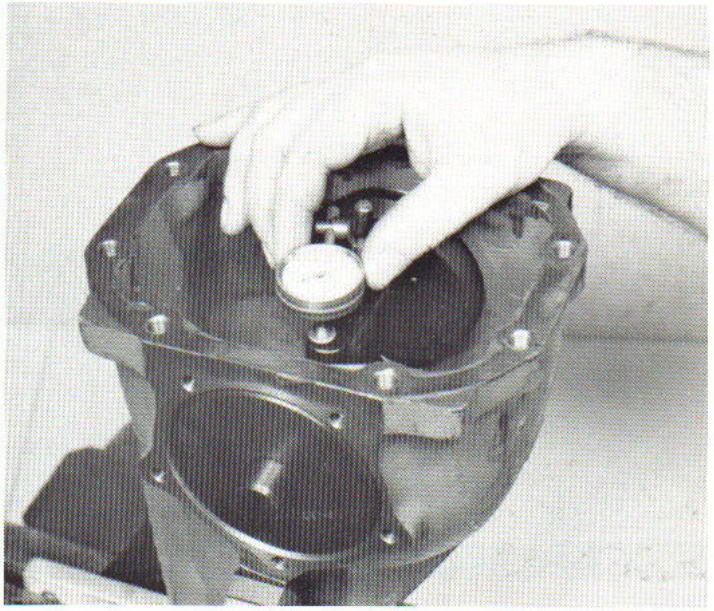
PINION HEIGHT ADJUSTMENT



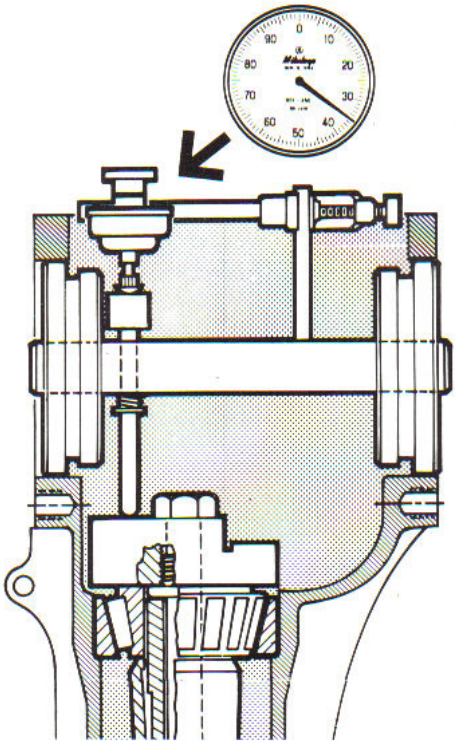
7. Install two discs with arbor assembly. Ensure that the arbor turns freely. Use special tool J-25269.



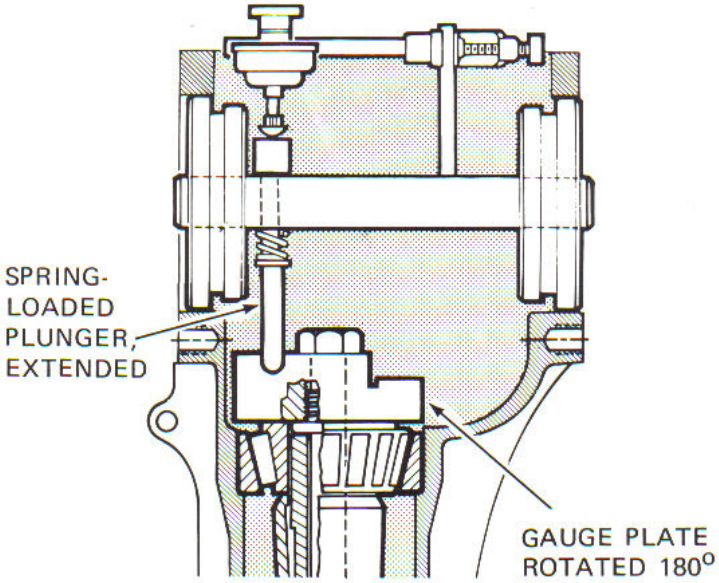
8. Lift the spring loaded plunger and place it on the face of the gauge plate (use the correct gauge plate step).



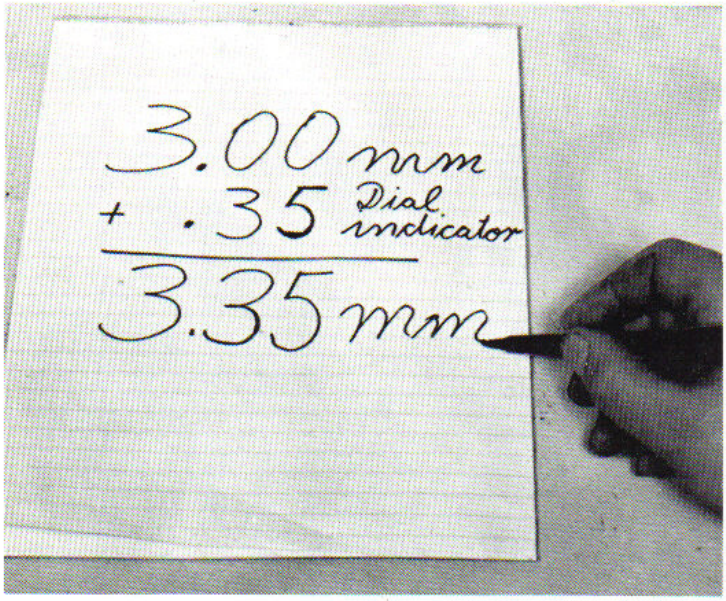
10. To zero the dial indicator, rotate the arbor and plunger back and forth and note highest deflection, (the point where the needle changes direction). Now set the dial indicator at zero.



9. Install the dial indicator and tighten the hold down clamp.



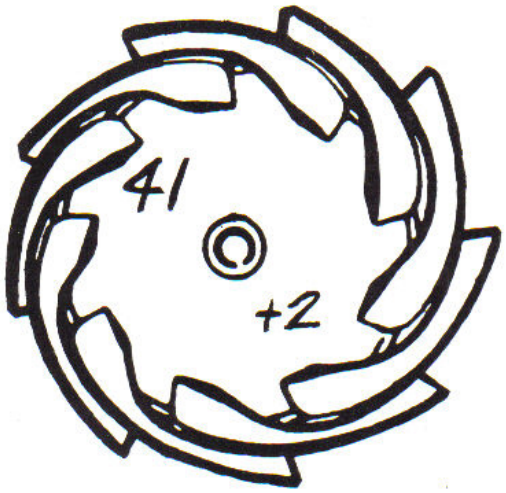
11. Rotate the arbor assembly until the plunger falls off of the gauge plate and read the dial indicator. Repeat to ensure accuracy.



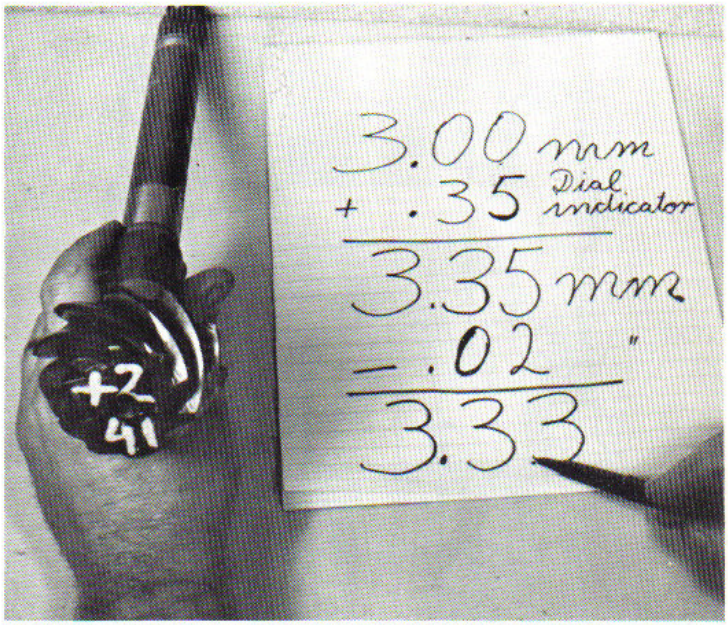
12. Select the standard number for the differential from the table below.

H165—Use dial indicator reading only.	add 0.00mm
H165B,R160,R180,R200	add 3.00mm
H145,H150,H190 (Metric Cast Iron)	add 2.50mm
H190 (Metric Aluminum) and 190 SAE (Aluminum)	add 2.00mm
190 SAE (Cast Iron)	add 0.00mm

If you are servicing an R160 or R180, add 3.00mm to the dial indicator reading from step 11.



13. Look at the pinion head to determine whether it is marked by a plus or minus sign and a number (+2, −1, etc.). If unmarked or marked "zero", then the number you arrived at in step 12 is the pinion height shim you will need. Go to step 16.



14. If the pinion head has a plus or minus number, then this will have to be used in your shim calculation. The number refers to hundredths of millimeters (.01mm)

15a. If the number is preceded by a plus sign (+), then SUBTRACT it from the total amount from step 12. This is the shim you will need.

Example: Dial Indicator Reading: 35mm
Number on Pinion Head: +2
3.00 (standard measure)
+ .35 (indicator reading)
3.35
− .02 (pinion head is plus, so you SUBTRACT it)
3.33 (mm = total pinion shim you will need)

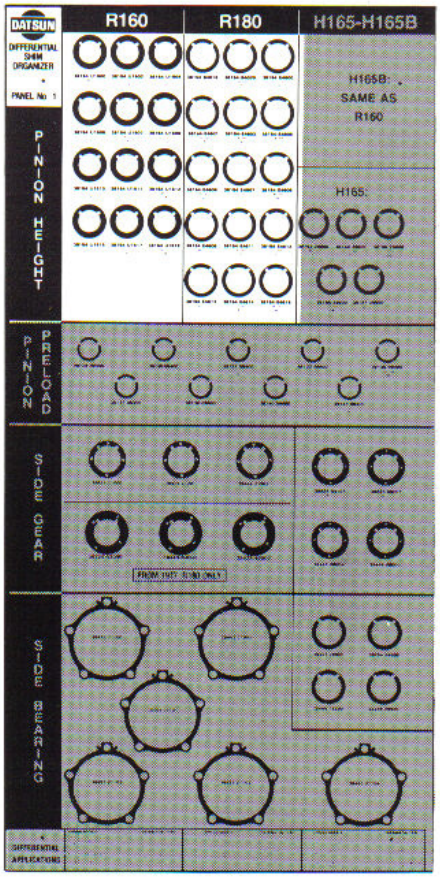
15b. If the number is preceded by a minus sign (−), then ADD it to the total amount from step 12. This is the shim you will need.

Example: Dial Indicator Reading: .35mm
Number on Pinion Head: −2

3.00 (standard measure)
+ .35 (indicator reading)
3.35
+ .02 (pinion head is minus, so you ADD it)
3.37 (mm = total pinion shim you will need)

16. Now obtain the proper shim from your shim board or parts department. The shim board is marked in both millimeters and inches.

Note: MEASURE SHIMS BEFORE USE AS A PRECAUTION AGAINST MISLABELED PARTS.

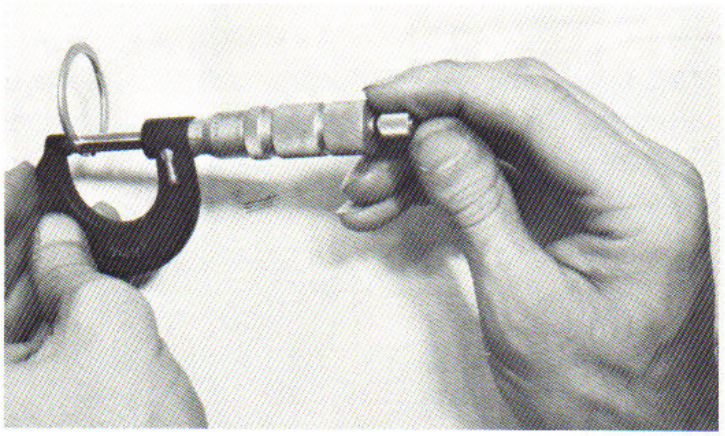


R160

Part No.	mm	Inches
38154-U1500	3.09	.122
38154-U1502	3.15	.124
38154-U1504	3.21	.126
38154-U1505	3.24	.128
38154-U1507	3.30	.130
38154-U1508	3.33	.131
38154-U1510	3.39	.134
38154-U1512	3.45	.136
38154-U1515	3.54	.139
38154-U1517	3.60	.142
38154-U1519	3.66	.144

R180

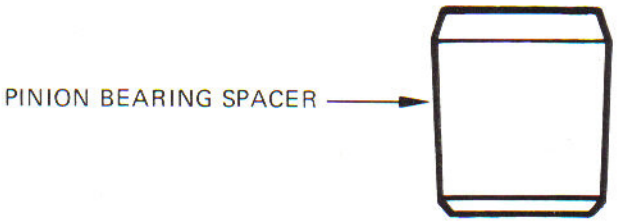
Part Number	mm	inches
38154-B4018	3.12	.123
38154-B4020	3.18	.125
38154-E4600	3.21	.126
38154-E4601	3.24	.128
38154-E4603	3.30	.130
38154-E4605	3.36	.132
38154-E4606	3.39	.134
38154-E4607	3.43	.135
38154-E4608	3.45	.136
38154-E4609	3.48	.137
38154-E4611	3.54	.139
38154-E4612	3.57	.141
38154-E4613	3.60	.142
38154-E4614	3.63	.143
38154-E4615	3.66	.144

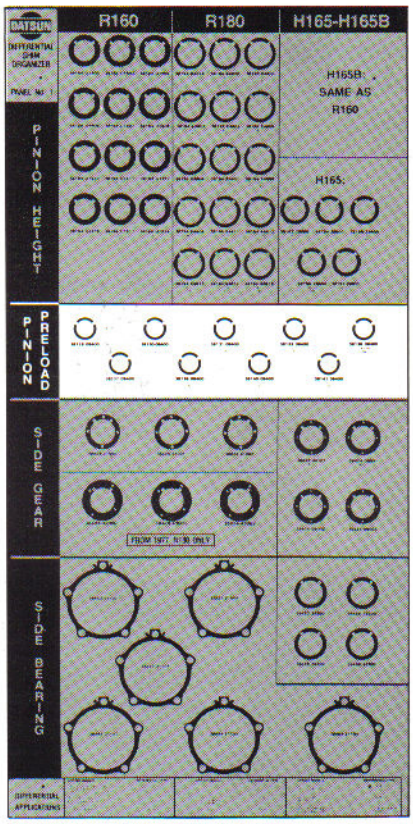


17. To determine pinion bearing preload, disassemble the pinion height/bearing preload tool and measure the thickness of the lead washer. This is the correct size preload washer required. Discard the used lead washer.

18a. Now select the proper shim from your shim board or parts department. As you can see in the illustration, the preload shims for the R160 and R180 are the same.

Part Number	mm	Inches
38141-09400	2.31	.091
38140-09400	2.33	.092
38138-09400	2.37	.093
38137-09400	2.39	.094
38135-09400	2.43	.0956
38133-09400	2.47	.097
38131-09400	2.51	.099
38130-09400	2.53	.100
38128-09400	2.57	.101





18b. In case the right preload cannot be obtained by using the shims only, the spacer has to be changed. Spacers are available from your parts department and come in the following sizes:

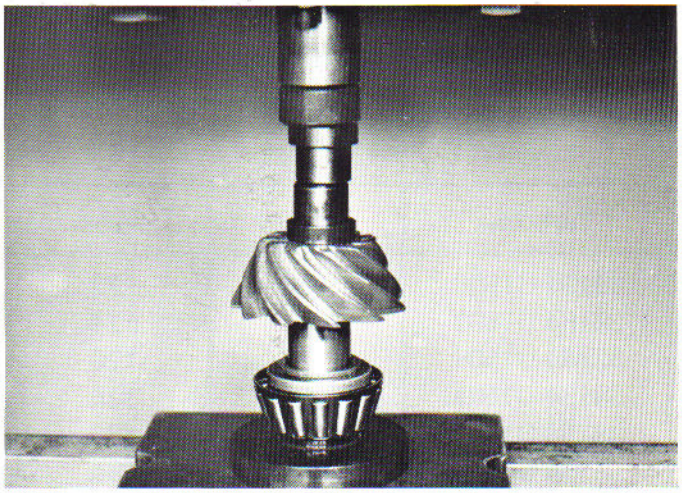
R180

38130-78500	52.2mm
38131-78500	52.4mm
38132-78500	52.6mm
38133-78500	52.8mm
38134-78500	53.0mm
38135-78500	53.2mm

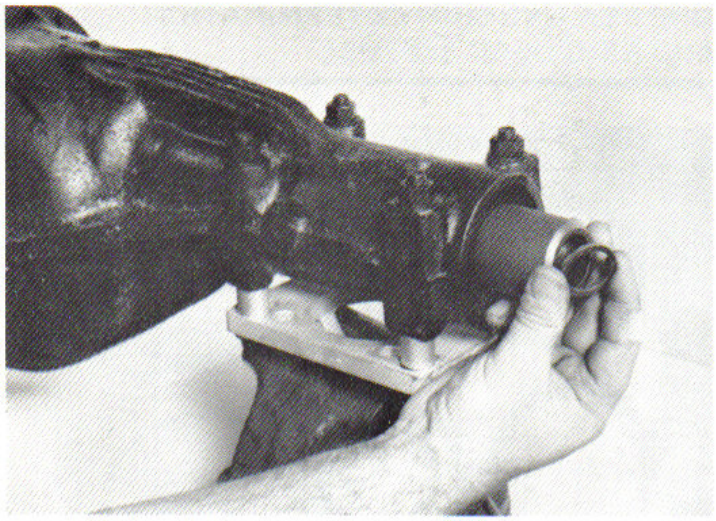
R160

38130-21000	56.2mm
38131-21000	56.4mm
38132-21000	56.6mm
38133-21000	56.8mm
38134-21000	57.0mm
38135-21000	57.2mm

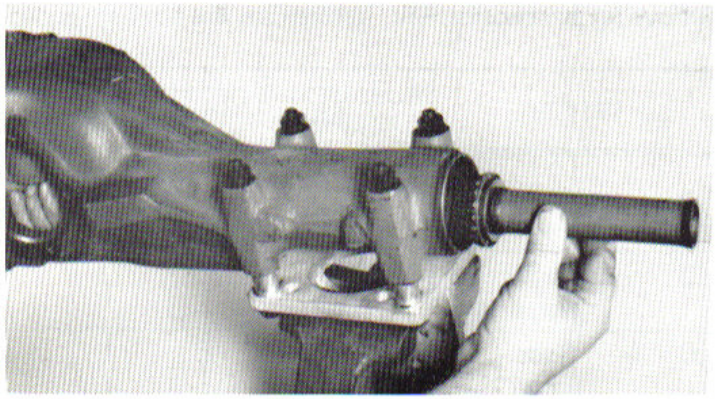
PINION ASSEMBLY



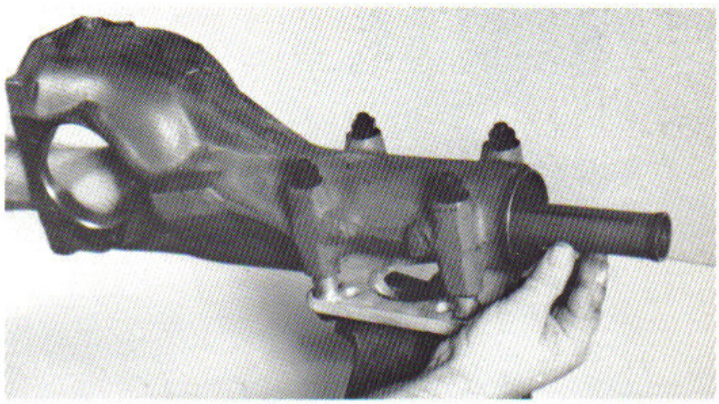
1. Place a pinion shim of the correct size on the pinion shaft, bevel side toward the gear. (Some shims are not beveled). Using the press stand, press the bearing on the shaft.



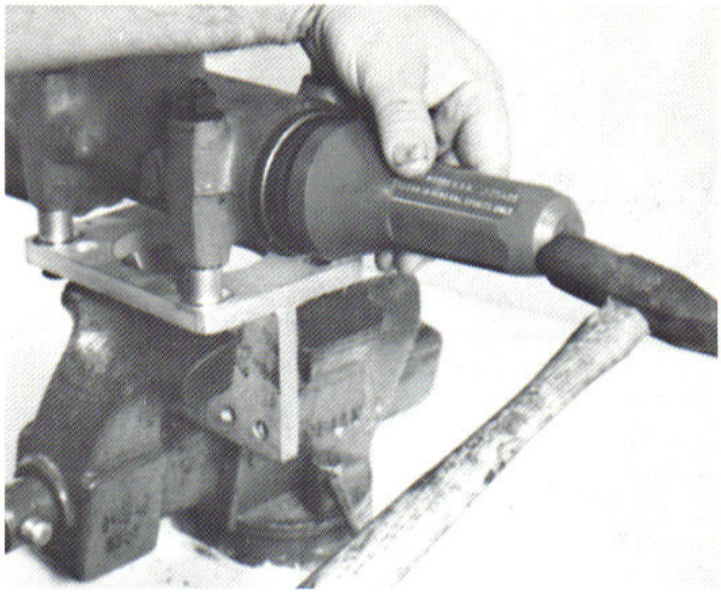
2. Install the spacer and preload shim on the shaft, and place the shaft in the housing. Make sure the bearing turns freely on its race.



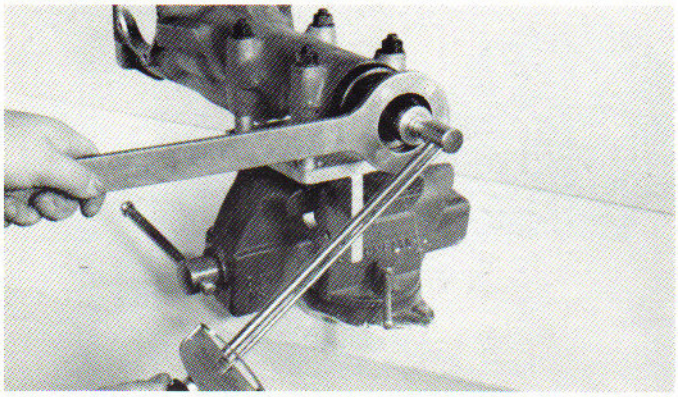
3. Slide the front pinion bearing on the shaft from the other end. You may have to tap it down the shaft using a tool such as J-25863.



4. Install the sleeve on the pinion shaft (either way is OK), and slide the pilot bearing on the shaft, tapping it with the same tool as before.

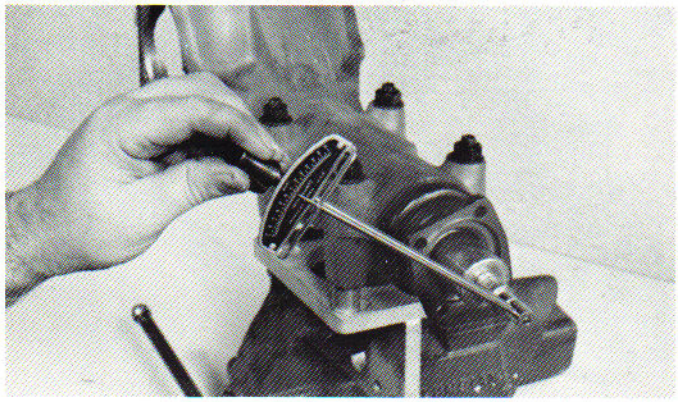


5. Install a new oil seal, using special tool J-25405. Grease the seal with differential lubricant.



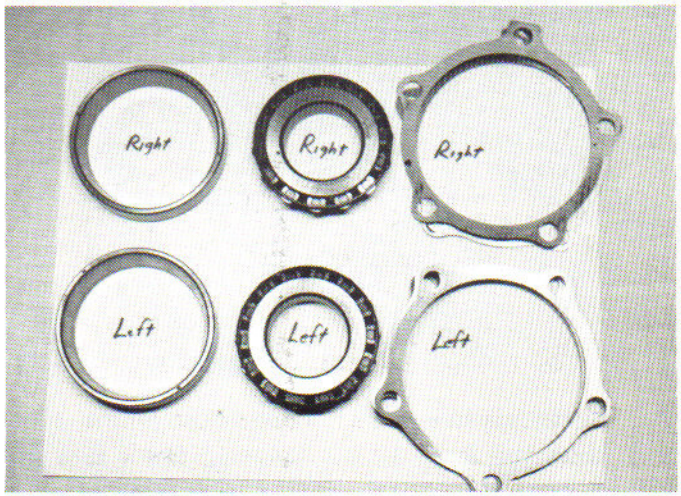
6. Install the flange, washer, and nut. Hold the flange with the flange wrench and tighten the nut in steps to the final torque.

Final Torque Setting: Solid Spacer Type
14 – 17 kg-m
(101 – 123 ft.lbs)



7. Check the bearing pre-load. It must be 8 – 11 kg-cm (7 – 10 in.lbs.). IMPROPER BEARING PRE-LOAD IS THE MAJOR CAUSE OF DIFFERENTIAL NOISE AND FAILURE.

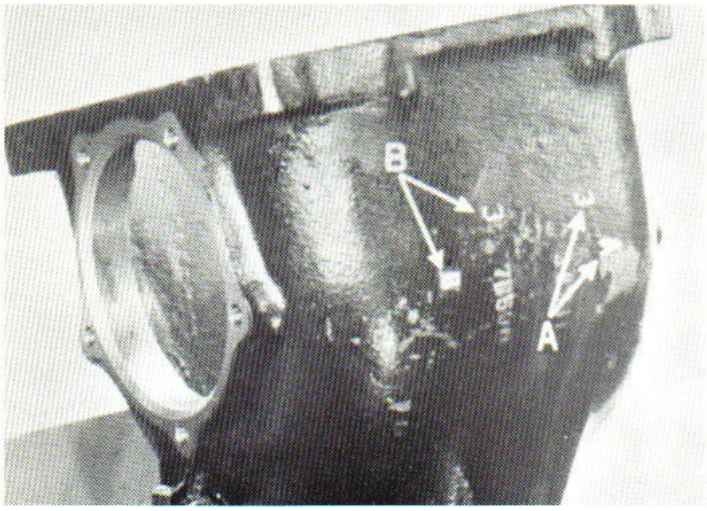
SIDE BEARING SHIM DETERMINATION AND RING GEAR ASSEMBLY:



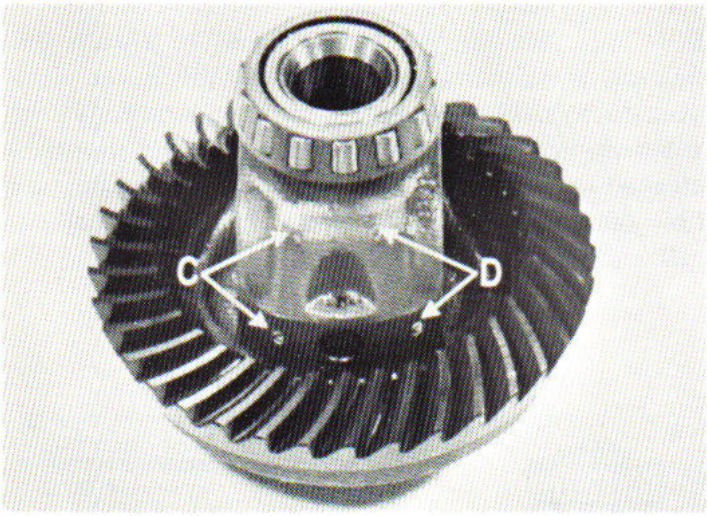
1. Locate the two side bearings, side bearing races and shims. You will also need the Side Bearing Shim Calculator for the R160 and R180 differentials. The following procedure will determine the shims needed.

LETTERS	HUNDREDTHS OF A MILLIMETER	THOUSANDTHS OF AN INCH
A – Left housing		
B – Right housing		
C – Gear case		
D – Gear case		
E – Left side bearing		
F – Right side bearing		
G1 – R160 180 Left side bearing retainer		
G2 – R160 180 Right side bearing retainer		
H – Ring gear: (+) ror (–)		

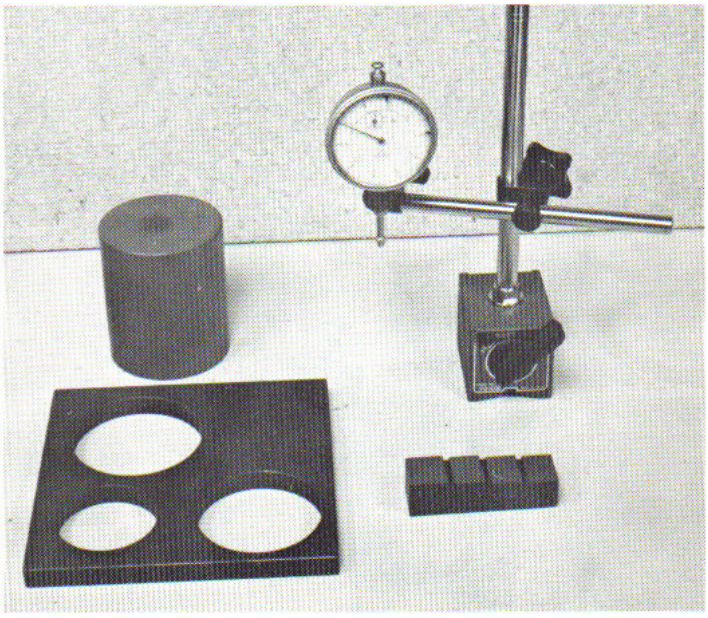
2. To simplify the job, make a chart, like the one above, to organize your calculations.



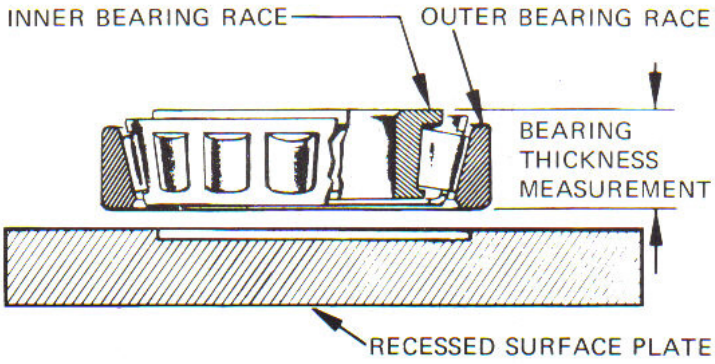
3. Locate the numbers stamped next to the letters "A" and "B", and record them on the chart.



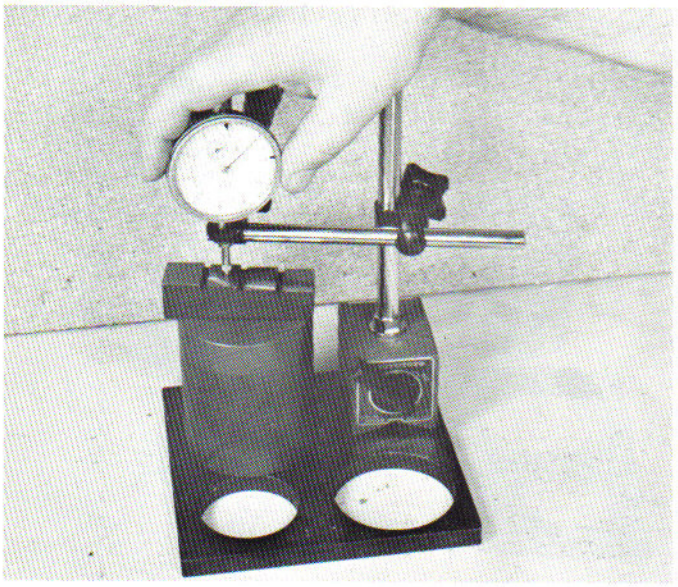
4. Locate the numbers stamped next to the letters "C" and "D" on the differential carrier, and write these down.



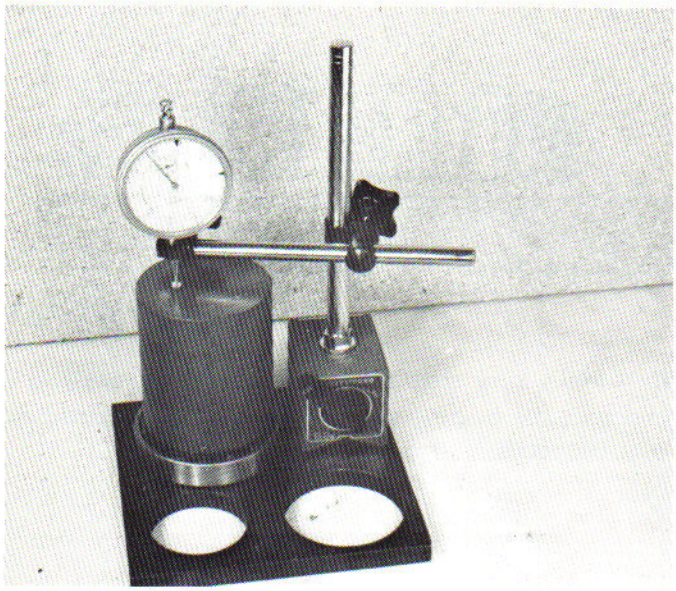
5. Measure how far under the standard thickness (20mm) the side bearings are. You will need the tools shown here.



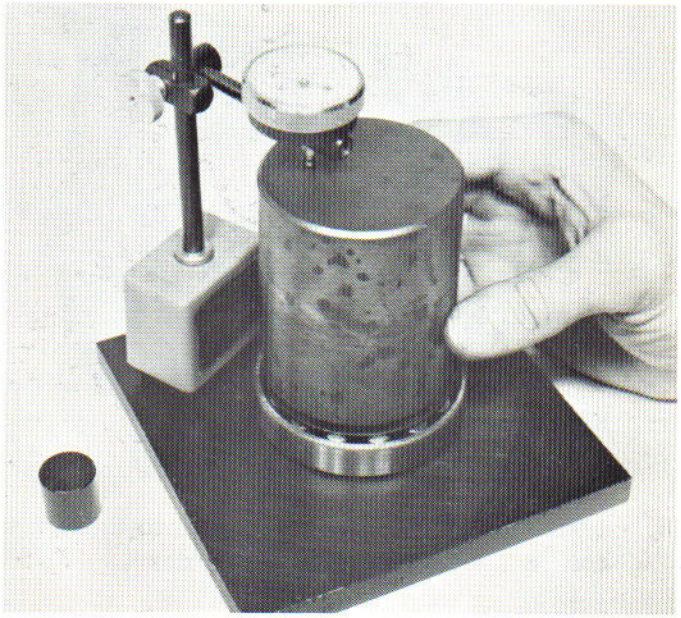
6. Make sure that the base plate has a recess in it and that the bearing will turn freely when positioned over the recess as shown.



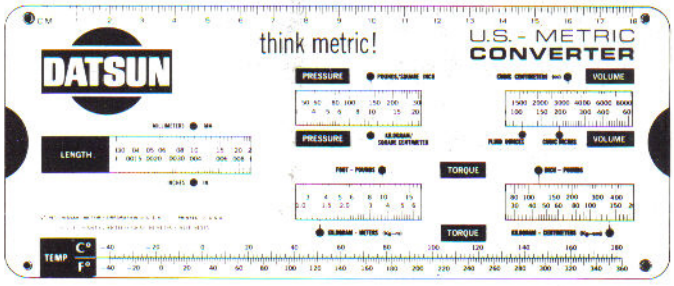
7. Mount the dial indicator on the base plate, place the 5 pound weight on the base plate and put the 20mm gauge block on top. Zero the dial indicator on the gauge block, as shown.



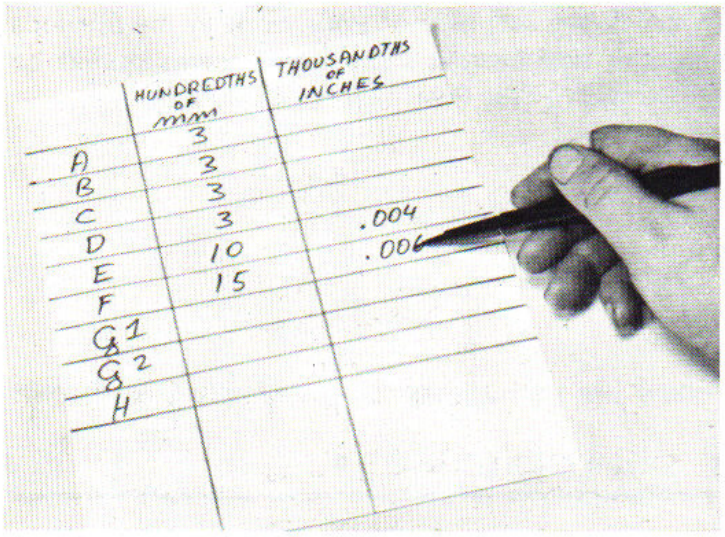
8. Carefully slide the gauge block out from under the dial indicator. Lift the weight block, and slide the bearing and race to be measured under the weight.



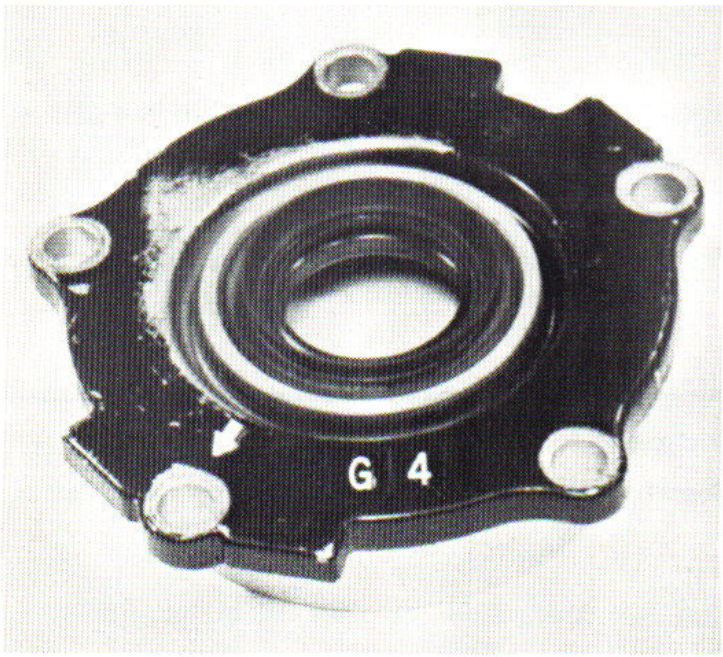
9. Turn the weight a few times to ensure that bearing is properly seated. Watch the gauge while you do this. If the needle fluctuates erratically then the bearing is either dirty or defective and should be cleaned or replaced. If the reading is not erratic, note how far the indicator dropped. This will normally be .10 – .30mm (.004 – .012 in.).



10. To avoid any confusion while calculating side bearing shims, it is absolutely necessary to stay with the metric system. If you measure anything in inches, the results MUST be converted to the metric system. You can use a conversion chart or a calculator as illustrated.



11. Measure both bearings in the same way and write the left side bearing measurement next to "E" and the right side bearing measurement next to "F".



12. Next, look on the side bearing retainers. Write down the left side retainer marking next to "G1" and the right side retainer marking next to "G2".

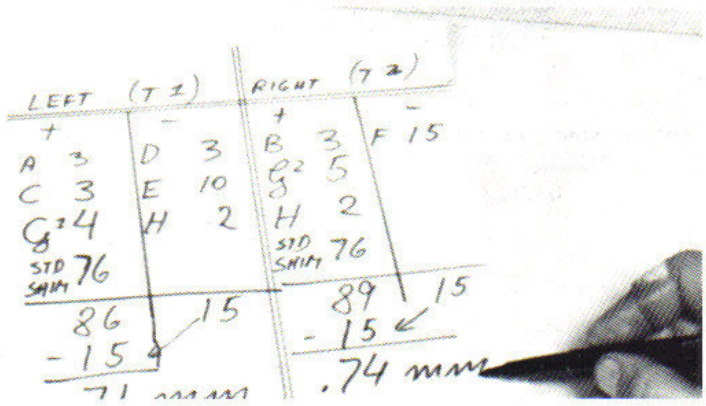
LETTERS	HUNDREDTHS OF A MILLIMETER	THOUSANDTHS OF AN INCH	
A	2		
B	2		
C	4		
D	5		
E	20	.008	
F	15	.006	
G1	4		
G2	5		
H	-2		

13. Finally, look on the ring gear for markings. If you find a plus (+) or minus (–) sign followed by a number, write the sign and the number down next to "H".

The formulas are as follows:
Left side (T1): A + C + G1 – D – E + H + .76

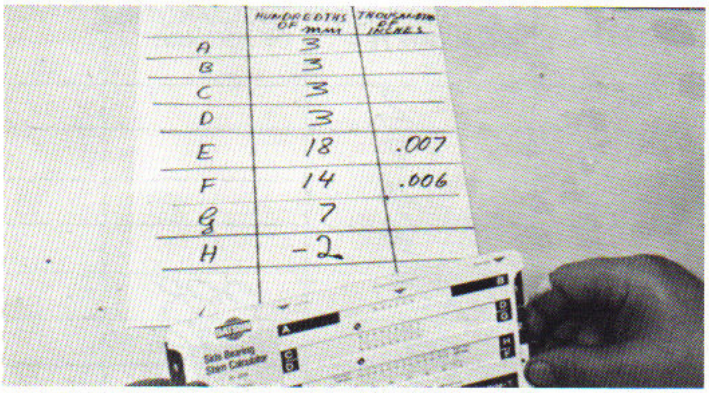
Right side (T2): B + G2 + D – F – H + .76

A. SAMPLE CALCULATION FORMULA



14. The side bearing shim adjustment can now be calculated. For a detailed description of this process, see pages 22–28 of the introductory section of this book.

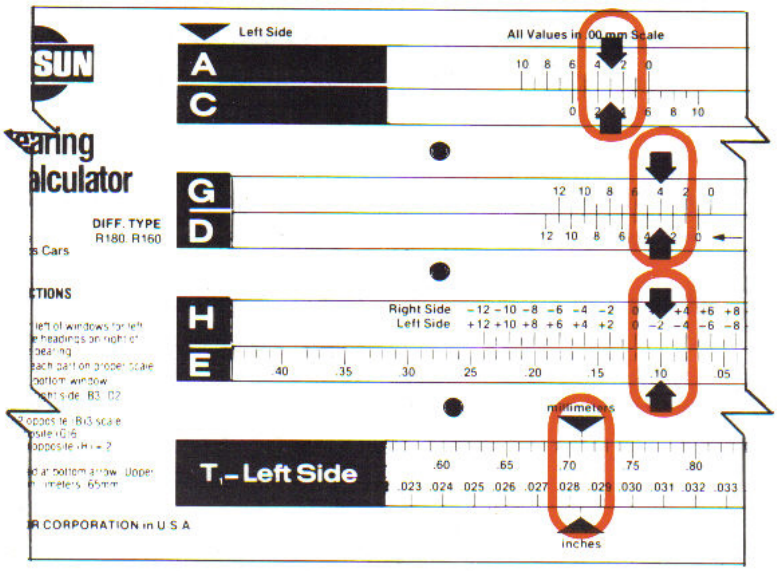
The measurement for the shim pack on the left (T1) should be .71mm and for the right (T2), .74mm.



To check the accuracy of your work in the previous step, the side bearing shim measurement should be figured with a Side Bearing Shim Calculator.

Follow the instructions for the sample given below:

B. SAMPLE CALCULATOR



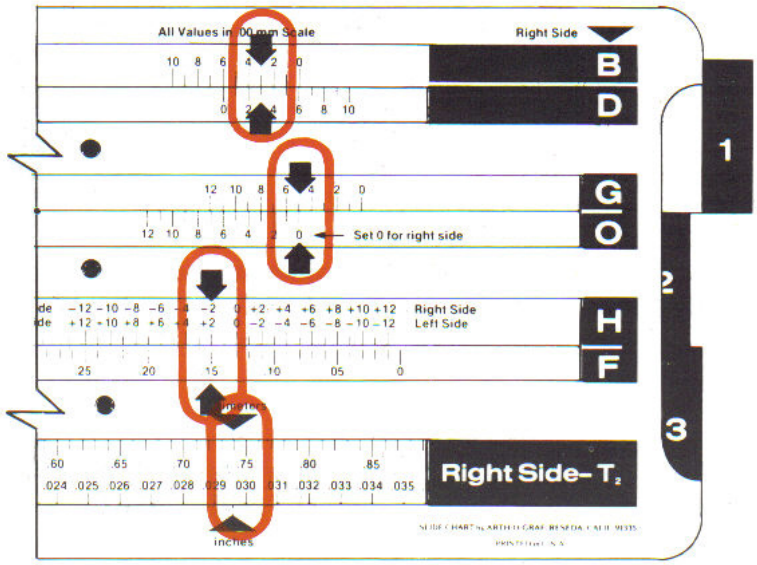
Left side

Step 1. Move slide 1 to place C 3 in line with A 3.

Step 2. Move slide 2 to place D 3 in line with G 4.

Step 3. Move slide 3 to place E 10 in line with H –2.

Step 4. Read answer on bottom scale, .71mm or close to .028 in.



Right side

Step 1. Move slide 1 to place D 3 in line with B 3.

Step 2. Move slide 2 to place O 0 in line with G2 5.

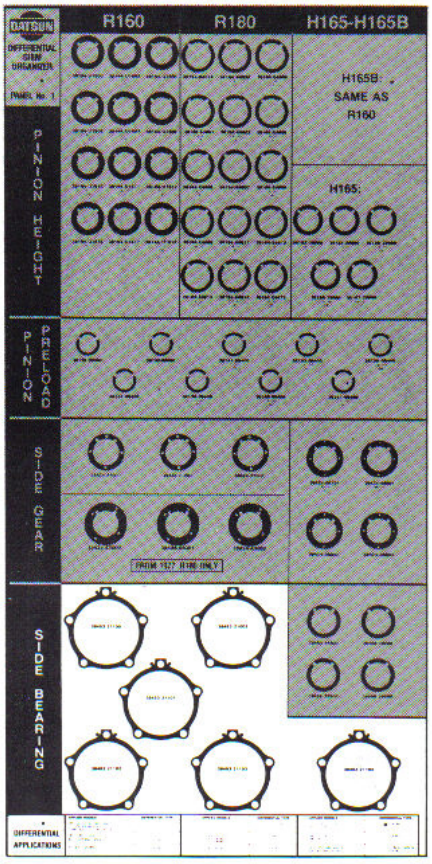
Step 3. Move slide 3 to place F 15 in line with H –2. (Read numbers right side.)

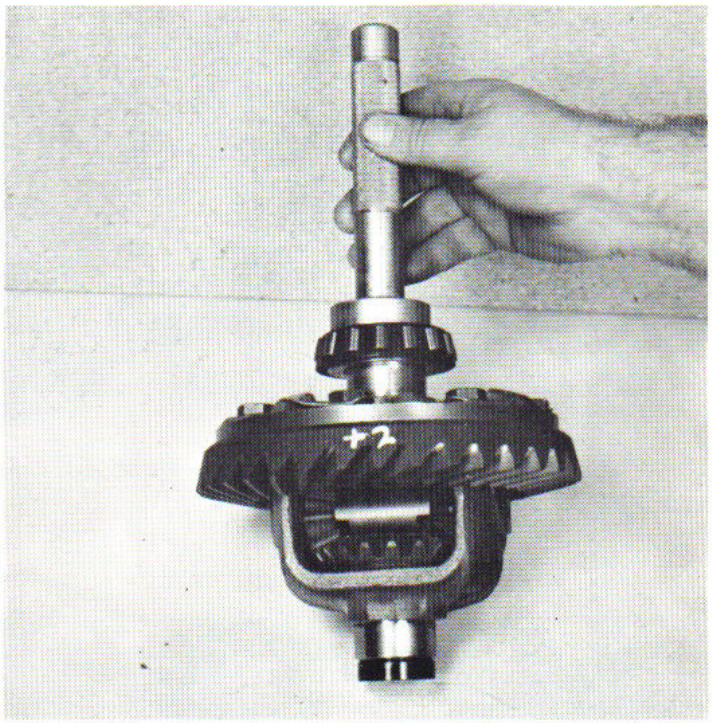
Step 4. Read answer on bottom scale, .74mm or close to .030 in.

Now compare these answers with the answers of 14A. If both answers agree, proceed to the next step.

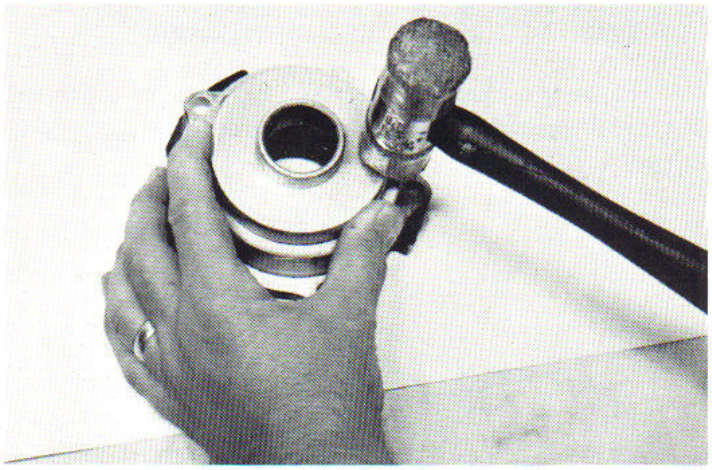
15. Select the proper shims from the shim board as illustrated below or from your Parts Department.

Part Number	mm	inches
38453-21100	.20	.008
38453-21002	.22	.009
38453-21101	.25	.010
38453-21102	.30	.012
38453-21103	.40	.016
38453-21104	.50	.020



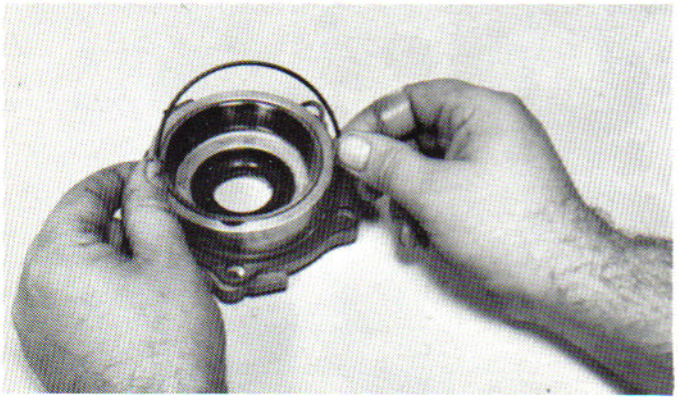


16. Press on the side bearings, using drift J-25805. Be sure to protect the lower bearing as shown by using the puller adapter J-25797-2.

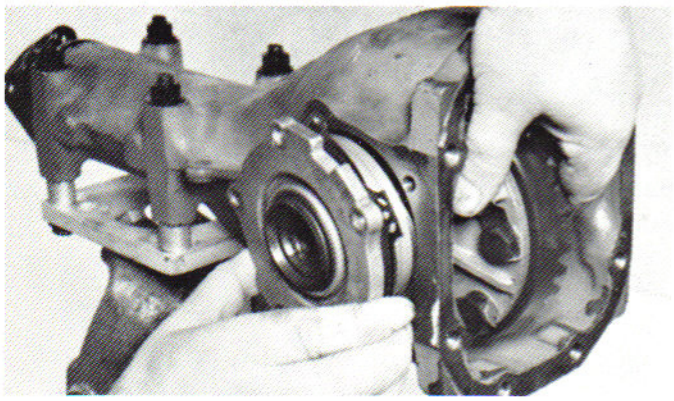


17. Install the bearing races into the retainers using press stand J-25809 and a hammer as shown.

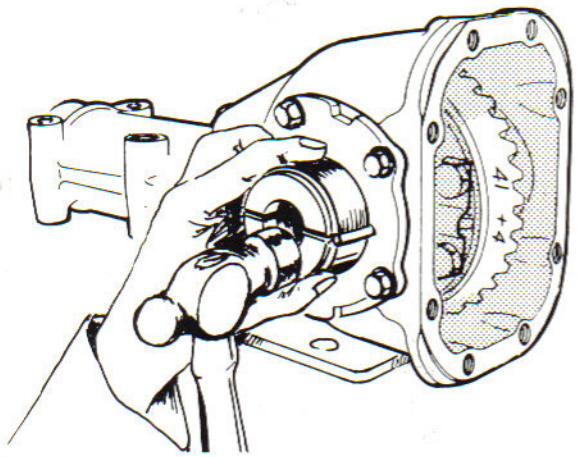
Note: THIS WILL BE MUCH EASIER IF YOU SOAK THE RETAINER IN VERY HOT WATER FOR A FEW MINUTES TO MAKE IT EXPAND. THE RACE WILL DROP RIGHT IN IF YOU LINE IT UP CORRECTLY.



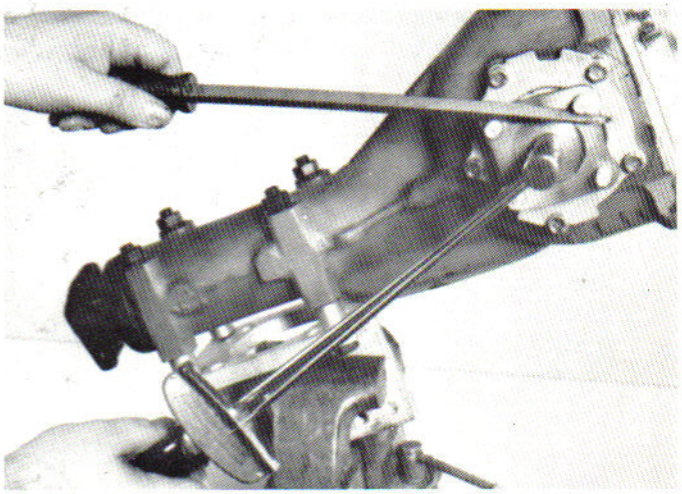
18. Place the shims and then the O-rings on the retainers, in that order.



19. Place the ring gear carrier assembly in the housing and install the side bearing retainers in the proper places.

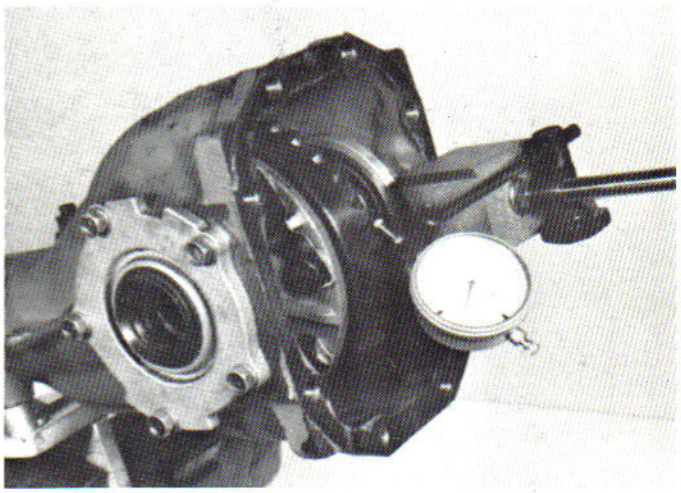


20. Install new oil seals in the retainers using drift J-25809.



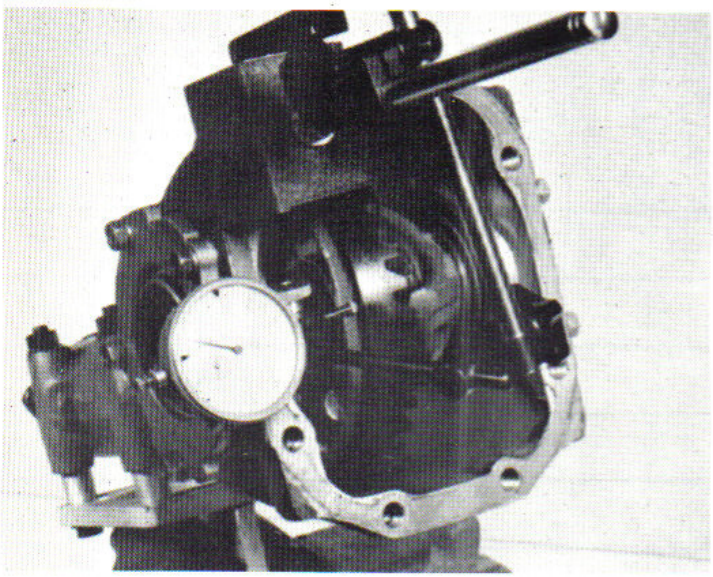
21. Lubricate the side retainer seals, and slide the side flanges into the splines of the gear case. Tighten the flange bolts.

FINAL VERIFICATION:

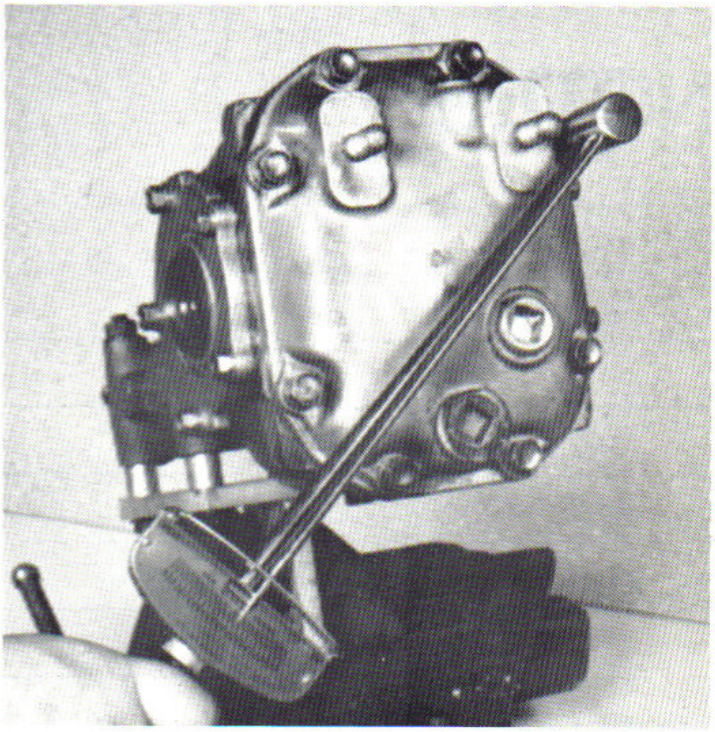


1. Check ring and pinion gear backlash with a dial indicator. It must be .10–.20mm (.004–.008 in.). To increase the amount of backlash, move the gears slightly out of mesh by transferring shims from the ring gear side to the opposite side. To decrease the amount of backlash, move the gears closer in mesh by transferring shims to the ring gear side from the opposite side.

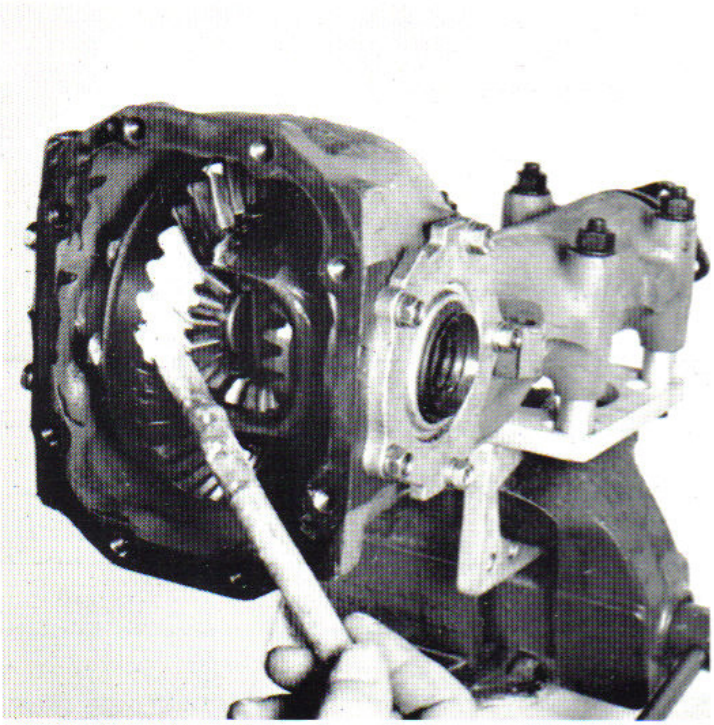
Note: NEVER ADD OR SUBTRACT FROM THE TOTAL AMOUNT OF SHIMS OR BEARING PRELOAD WILL BE CHANGED.



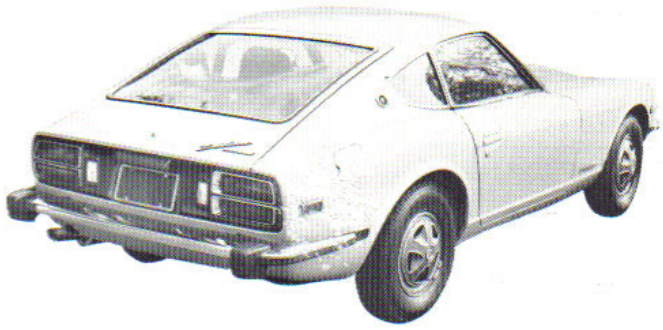
2. Check the runout of the ring gear with a dial indicator. It must not be more than .05mm (.002 in.). Excessive runout indicates a warped ring gear and/or gear carrier, and replacement is required.



4. Install the rear cover using a new gasket.



3. Finally, take a tooth pattern reading and interpret it according to the instructions given in the first section of this Guide.



5. After installing the differential in the vehicle, fill with hypoid type E.P. gear oil, then make a complete road test according to the instructions given in the first section of this Guide.

R200
OVERHAUL PROCEDURE

CHART A

LETTER LOCATION	.00mm	.001"
A Left housing		
B Right housing		
C Gear carrier		
D Gear carrier		
E Left side bearing		
F Right side bearing		
G Spacer measure		
H Ring gear: + or –		

PINION HEIGHT CALCULATION	
Standard measure	3.00
Add dial indicator reading.	
Sub-total	3.
Pinion height tolerance. Add if minus – Subtract if plus +	
Total shims needed	3.

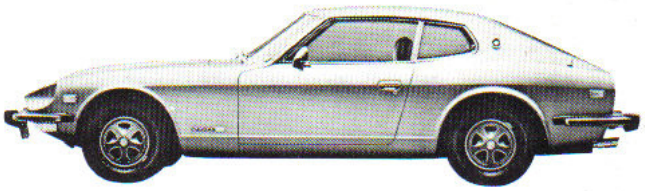
NOTE:
This work sheet could be Xeroxed and used during differential overhaul.

SIDE BEARING SHIM CALCULATION SHEET, R200

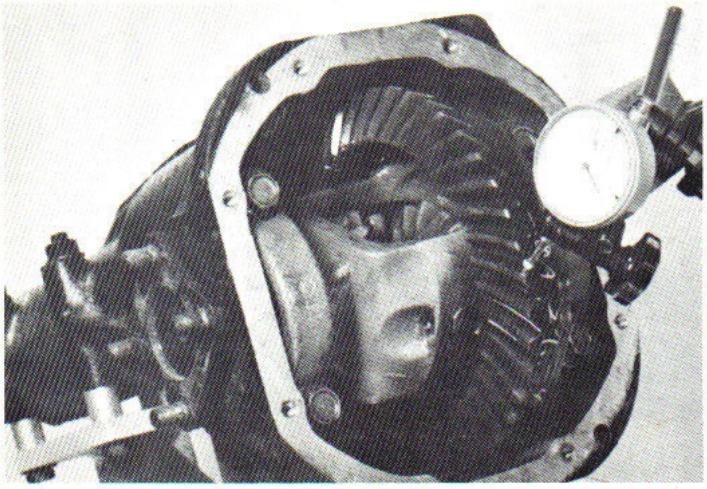
Record numbers from chart A and add.

LEFT SIDE T1				RIGHT SIDE T2			
column 1		column 2		column 1		column 2	
A		C		B			
D				F			
E				G		D	
H if – (minus)		H if + (plus)		H if + (plus)		H if – (minus)	
Standard shim	2.05			Standard shim	1.95		
Total column 1		Total column 2		Total column 1		Total column 2	
Subtract total from column 2				Subtract total from column 2			
Total shim needed left side				Total shim needed right side			

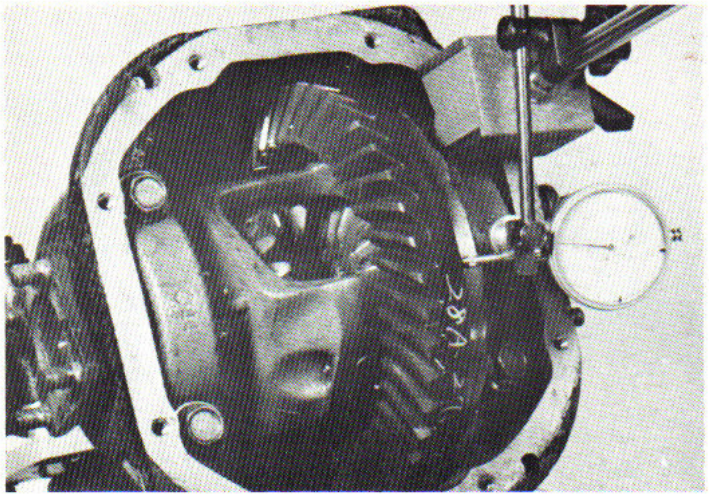
OVERHAUL PROCEDURES:



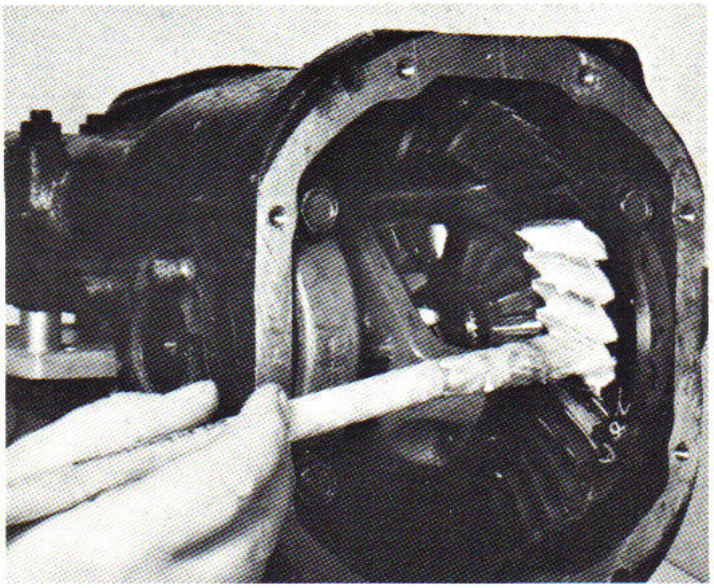
Perform a pre-disassembly diagnosis, as outlined in the diagnosis section of this book.



The backlash must be .13 – .18mm (.005 – .007 in.).

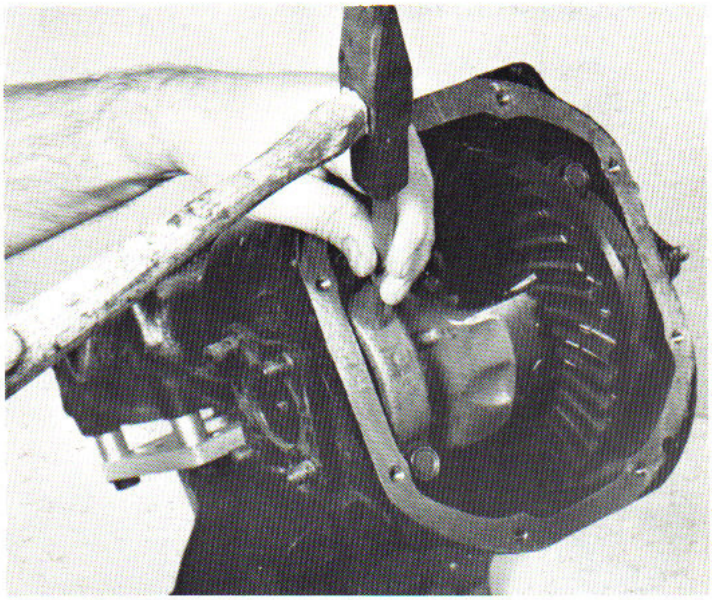


The run-out of the ring gear must be less than .05mm (0.002 in.).

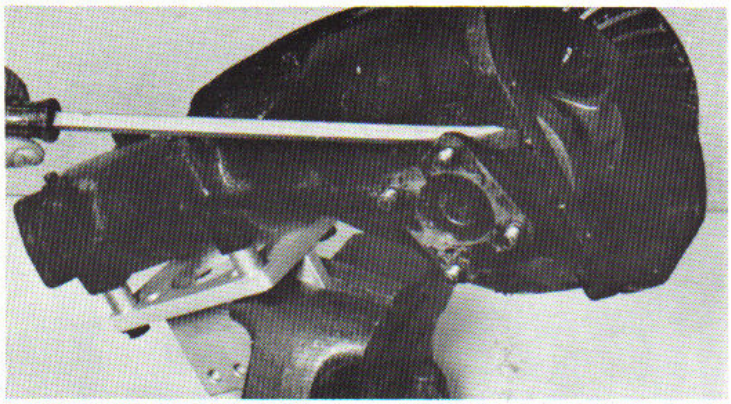


Take a tooth pattern reading. For interpretation of the pattern, look in the diagnosis section of this book. It is very important to take a tooth pattern reading at this point – it can save you time during overhaul by telling you where to look for maladjustments.

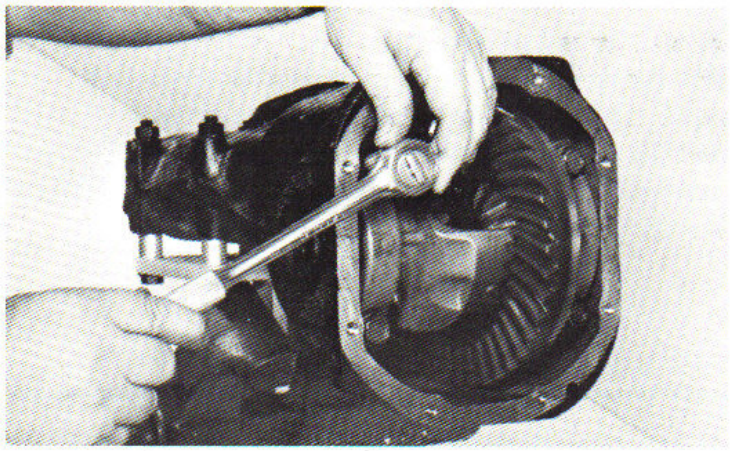
DISASSEMBLY:



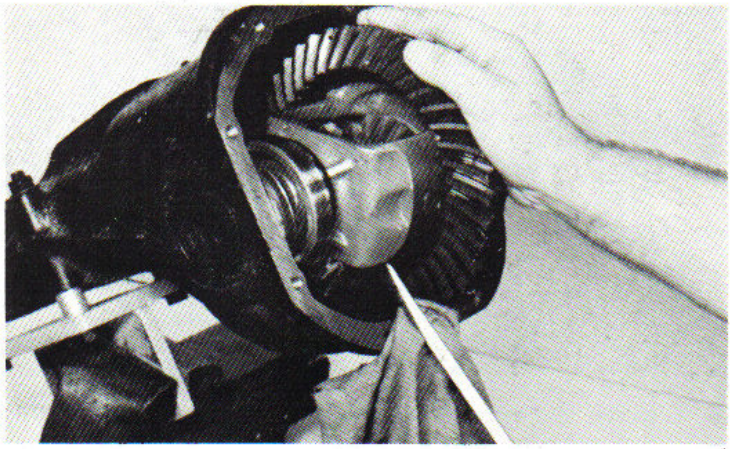
1. Mark the side bearing cap on one side with paint or a punch to ensure that it is replaced in the proper position during reassembly. (The bearing caps are line-bored during manufacture and must be put back in their original places.)



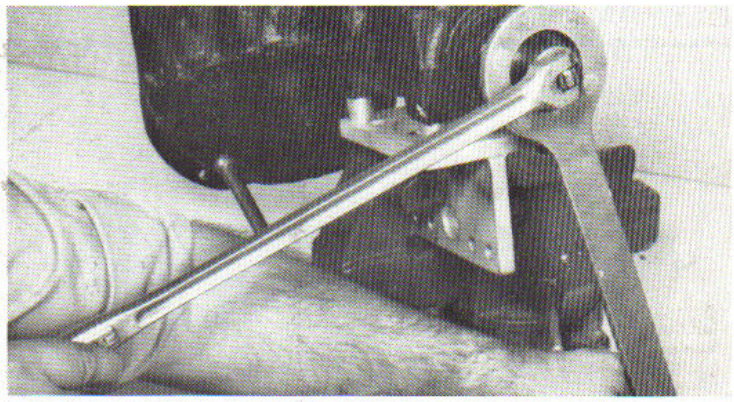
2. Using a pry bar, remove the side flanges as shown.



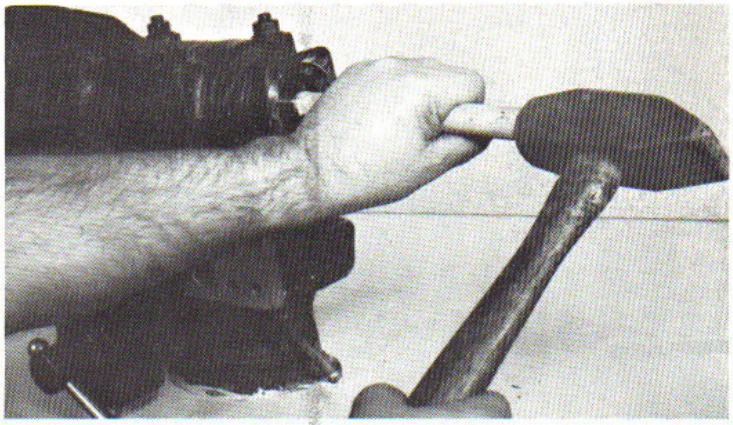
3. Using a 17mm socket, remove the side bearing cap bolts and bearing caps.



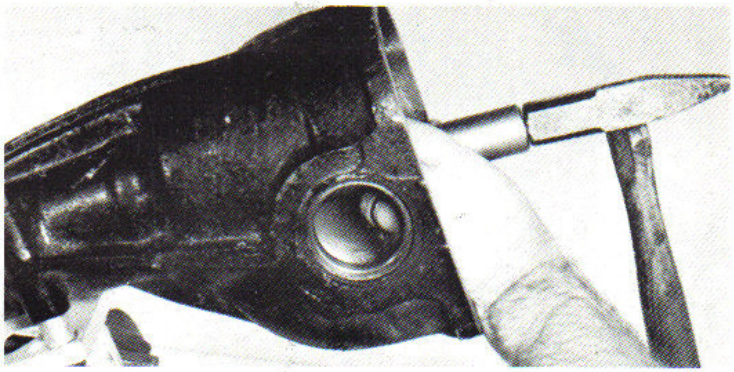
4. Using a pry bar, remove the ring gear assembly from the differential housing. Keep the bearing races with the corresponding bearings.



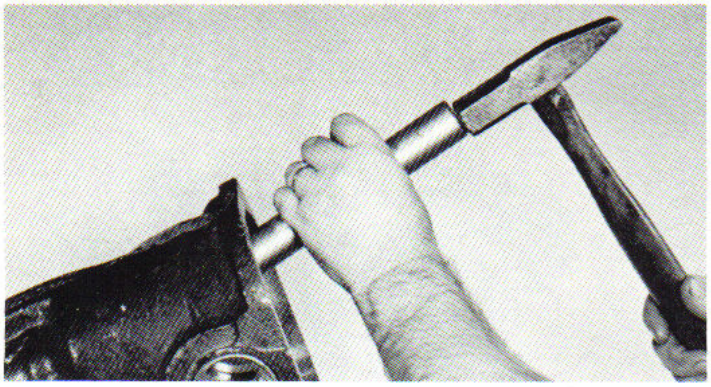
5. Attach the flange wrench J-25774 to the flange to prevent its turning, and remove the pinion shaft nut using a 27mm socket and breaker bar.



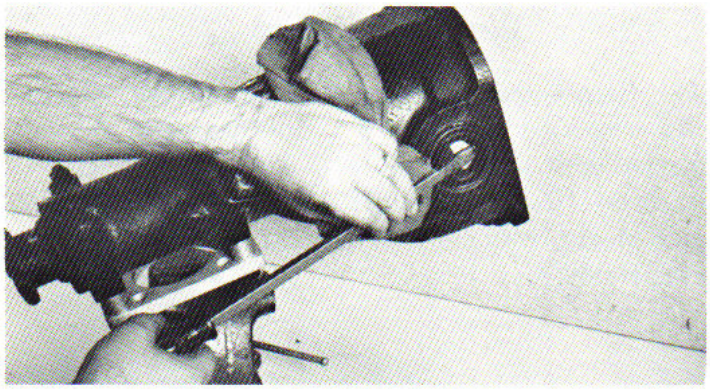
6. Drive the pinion through the housing using a brass drift and a heavy hammer. Be careful not to damage the pinion shaft threads. Pull the companion flange out by hand.



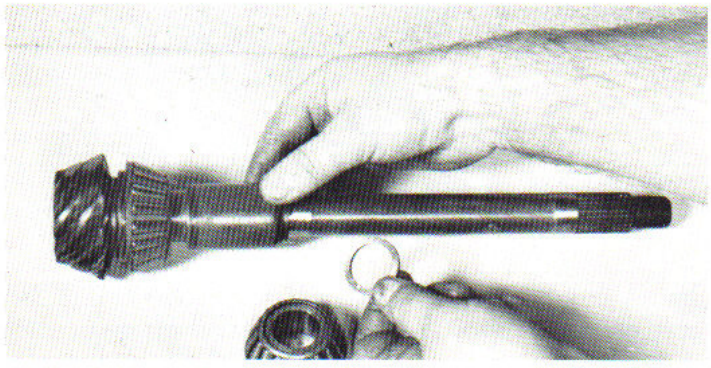
7. Slide the pilot bearing drift, J-25749, through the open end of the housing, to the front pinion bearing. Using a hammer, drive out the front pinion bearing, sleeve, pilot bearing and oil seal.



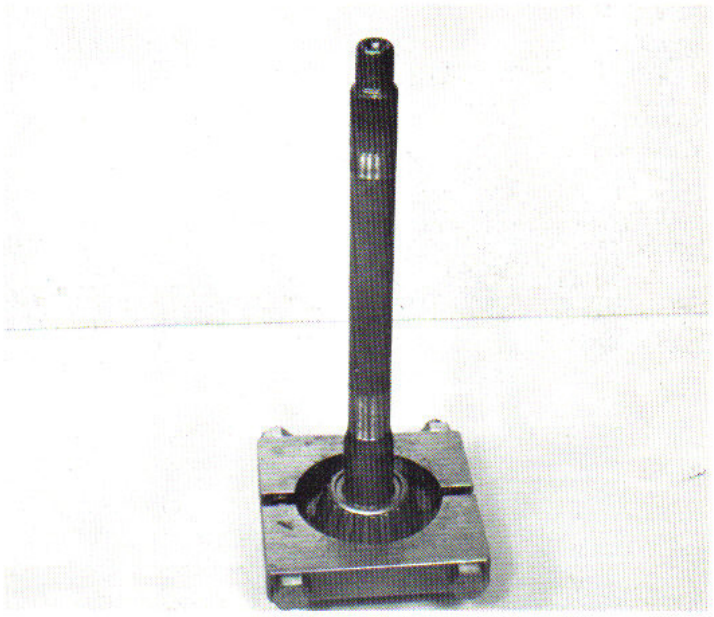
8. Using the same drift, remove the bearing races.



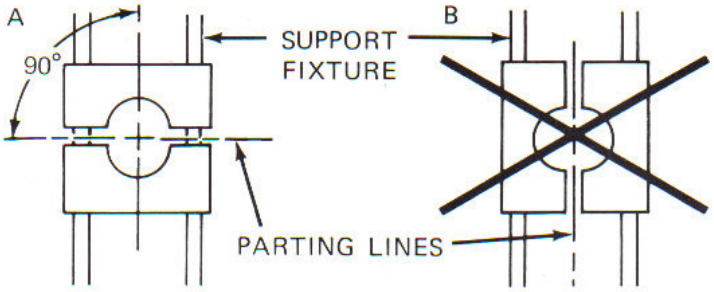
9. Remove the side bearing oil seals by prying up with a large screwdriver as shown. (Note: DO THIS CAREFULLY TO AVOID SCRATCHING THE HOUSING BORE WITH THE SCREWDRIVER. COVER THE END OF THE SCREWDRIVER WITH A RAG AS SHOWN.)

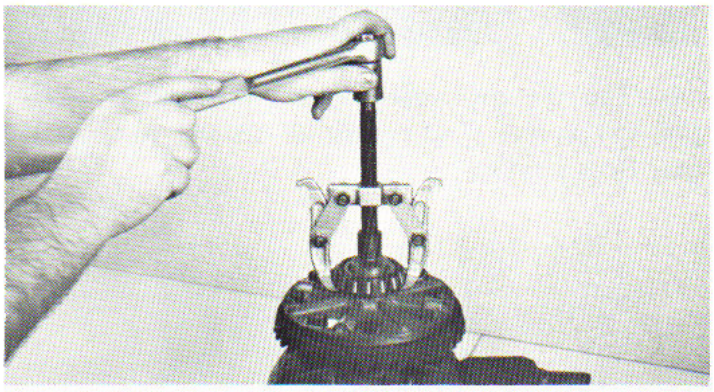


10. Remove the preload shim and spacer from the pinion shaft. Sometimes the shim will be found sticking to the front pinion bearing. Save the spacer and shim.

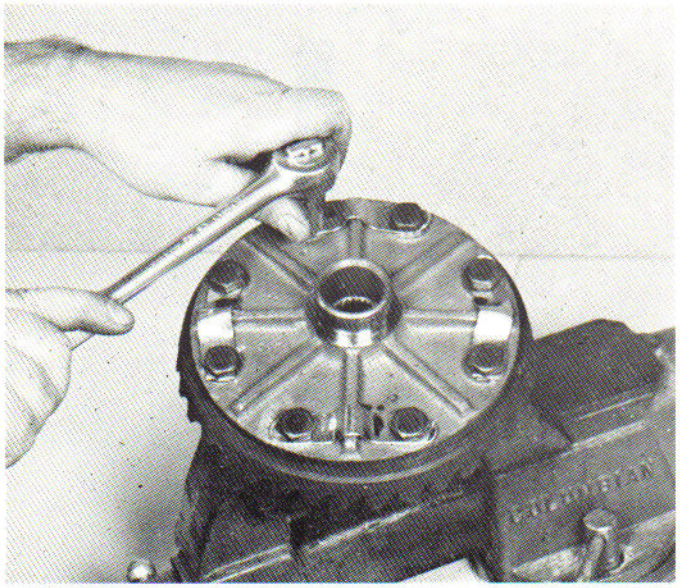


11. Remove the rear pinion bearing using a press and special tool J-25733-1. Care must be taken when setting the tool in the press that the parting line of the tool is at a right angle to the support fixture of the press. This is to prevent bending the tool. Save the pinion height washer found behind the bearing. This will be reused.

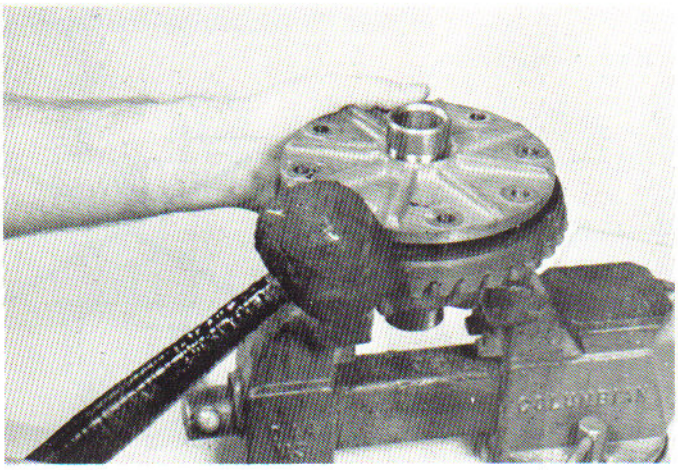




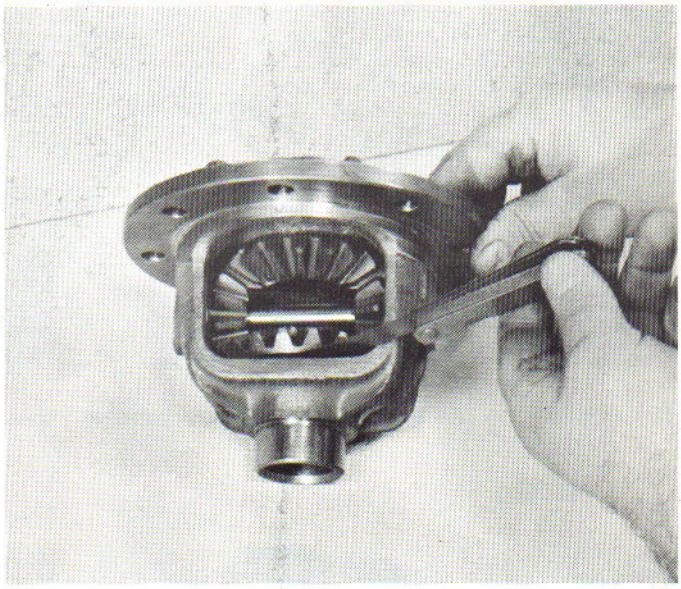
12. Attach the side bearing puller (special tool J-22888 and J-25797-2) to the side bearing and remove both side bearings. Keep bearings and races together.



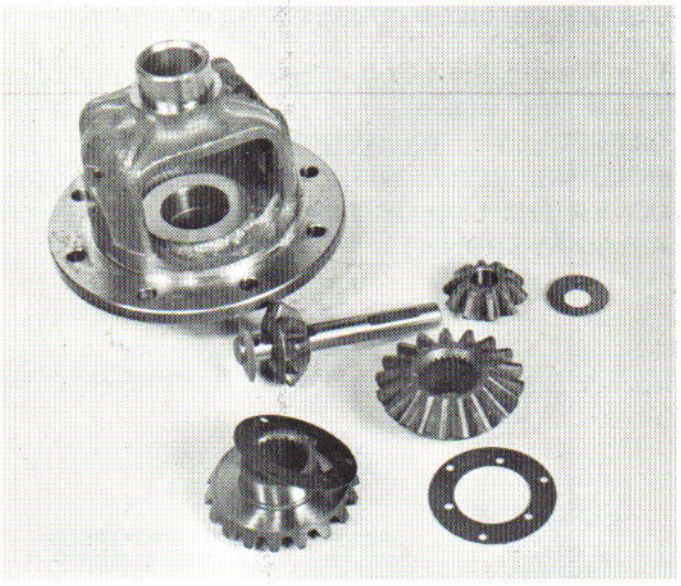
13. Flatten the lock tabs and remove the ring gear bolts in a criss-cross fashion using a 17mm socket.



14. Tap the ring gear off the gear carrier using a plastic hammer. Tap evenly all around to keep the gear from binding.

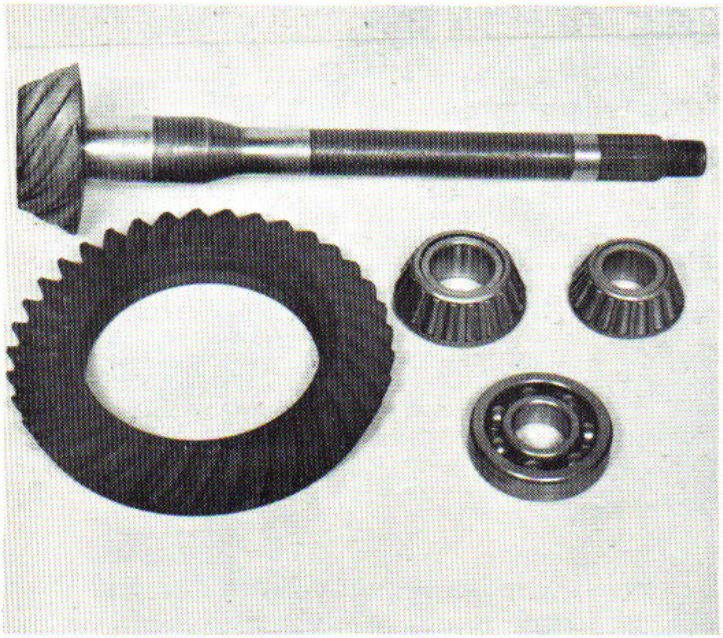


15. Before disassembling the gear carrier, measure the clearance between the side gear and the gear carrier with a feeler gauge as shown. The clearance must be .10—.20mm (.004—.008 in.). If not, the side gear thrust washers will have to be changed during reassembly.



16. Using a long drift, drive the lock pin out of the gear carrier. Remove the spider gear shaft and rotate the spider gears out of the carrier. Keep the spider gears and washers together — after removal, reassemble the gears on the shaft as shown. Remove the side gears and thrust washers, keeping all part in order.

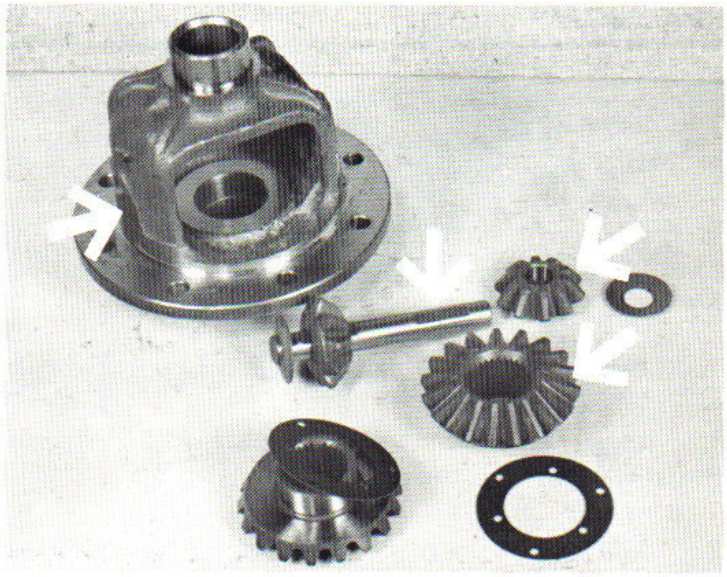
PARTS INSPECTION:



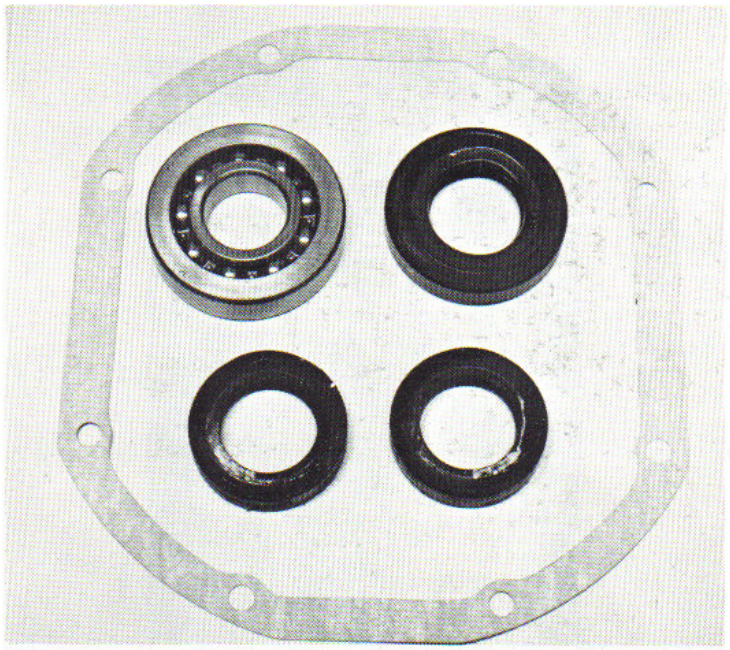
1. If the gears do not have the proper tooth pattern, and the differential has been in service for more than 1,000 miles, the ring and pinion gears should be replaced. Otherwise, gear whine may result when the gears are reinstalled with a different mesh pattern. (The ring and pinion are, of course, replaced as a set.)

2. To ensure silent operation, new pinion bearings are recommended, whenever the ring and pinion gears are replaced. These bearings operate under tremendous load and are very susceptible to wear.

The side bearings may or may not be replaced, depending upon wear. They will be inspected during the reassembly procedure.



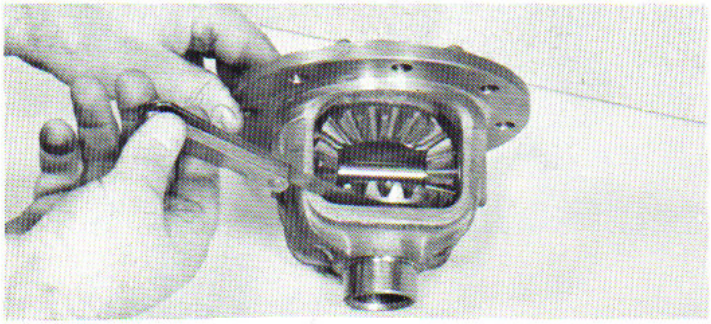
3. Check the side and spider gears for chipped or scored teeth. If you find excessive wear, replace the gears affected. Inspect the spider gear shaft and its bores in the differential gear carrier for wear. Replacement is necessary if the gear carrier bores are elongated or if ridges are worn in the gear shaft.



4. The following parts must be replaced during each overhaul:

- Spider gear cup washers
- Ring gear bolt lock tabs
- Pinion seal
- Cover gasket
- Front pilot bearing

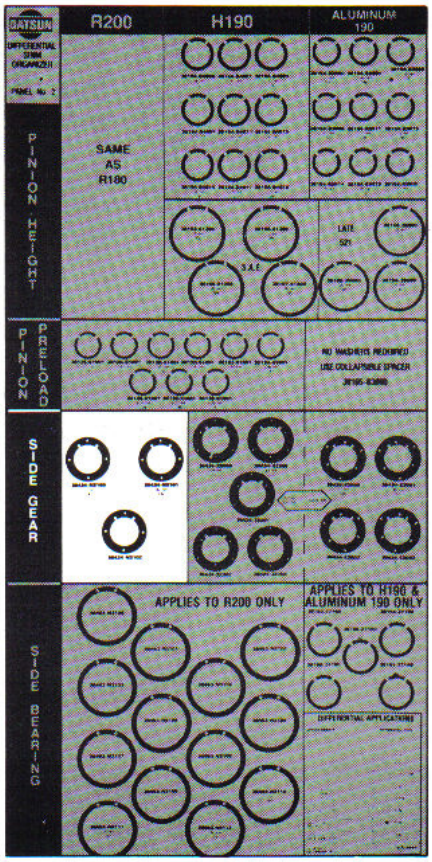
REASSEMBLY:

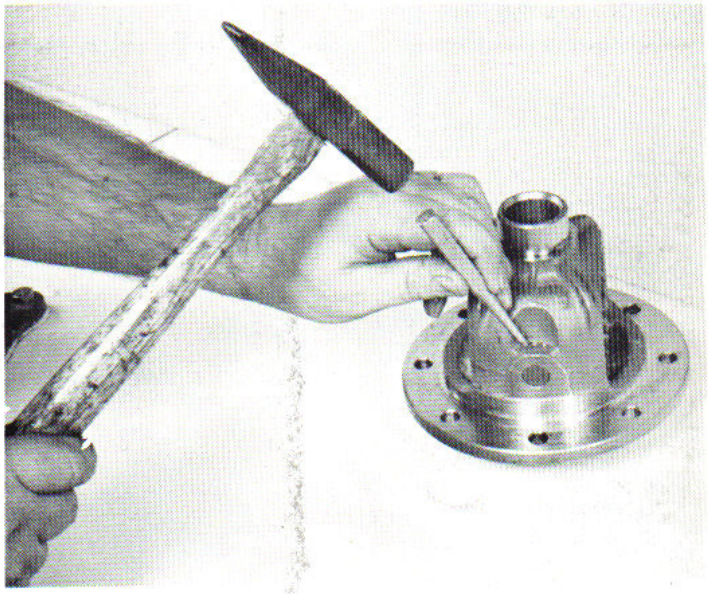


1. Install the spider and side gears, and side gear thrust washers into the gear carrier.

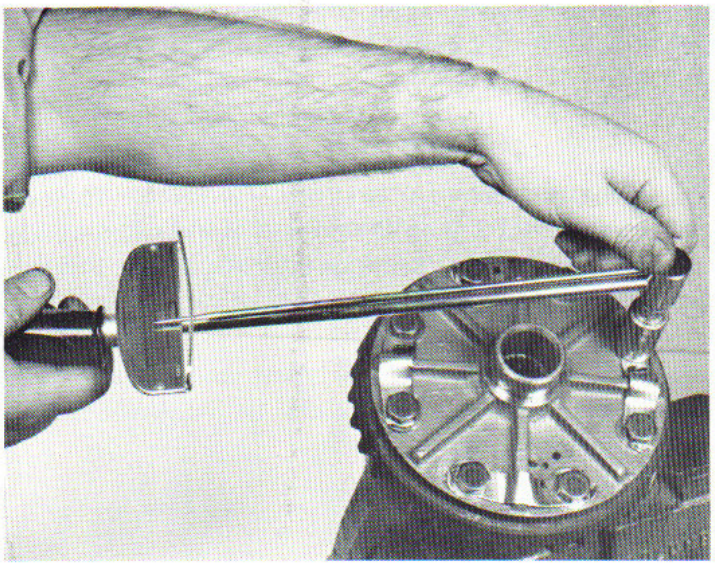
2. Side gear clearance must not exceed .20mm (.008 in.). Side gear clearance can be adjusted by thrust washers of various thicknesses. These washers can be found on the shim board or can be ordered from the Parts Department.

Part Number	mm	Inches
38424-N3100	.77	.030
38424-N3101	.82	.032
38424-N3102	.87	.034

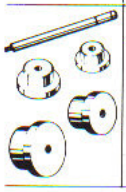




3. Be sure to stake-punch the spider gear shaft lock pin after completing the reassembly of the carrier. If the pin is not staked, it might come out under load and destroy the differential.



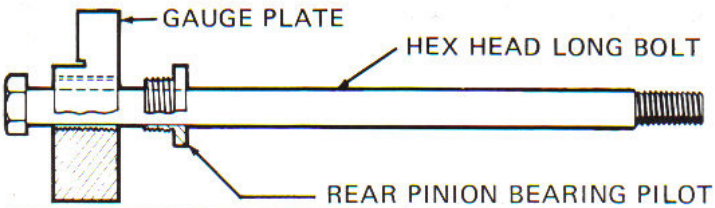
4. Install the ring gear, ring gear bolts, and new bolt lock tabs. Torque the bolts to 7–8 kg.m (51 – 58 ft.lbs.), tap the bolt heads with a hammer, and re-torque. Care must be taken to prevent the ring gear from becoming warped during this operation.(Note: DO NOT REASSEMBLE THE SIDE BEARINGS AT THIS POINT.)

ILLUSTRATION	TOOL NO.	DESCRIPTION	DIFFERENTIAL APPLICATION										
			H-145	H-150	R-160	H-165A	H-165B	R-180	SAE H-190	ALUM H-190	H-190	R-200	FRONT WHEEL DRIVE
	J 25742	Pinion Bearing Race Installer Set Consists of:											
		J 25742-1 Driver Handle	X	X	X	X	X	X	X	X	X	X	
		J 25742-2 Installer	X	X	X	X	X	X		X			
		J 25742-3 Installer			X	X	X		X	X	X	X	
		J 25742-4 Installer	X										
		J 25742-5 Installer						X	X		X	X	

5. Install the pinion bearing outer and inner races in the differential housing. Make sure that the bearing races are seated squarely in their respective bores. Use the following special tools:

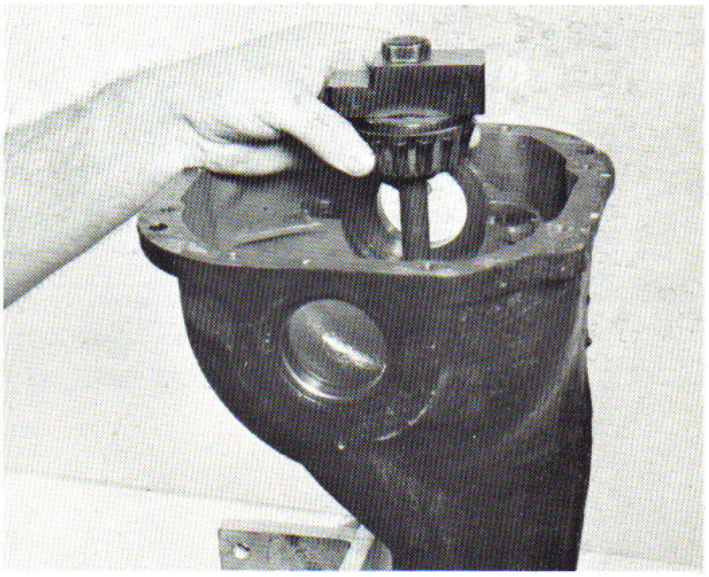
J-25742-1 Driver handle
J-25742-3 Installer (front race)
J-25742-5 Installer (rear race)

PINION HEIGHT AND/OR PRELOAD ADJUSTMENT

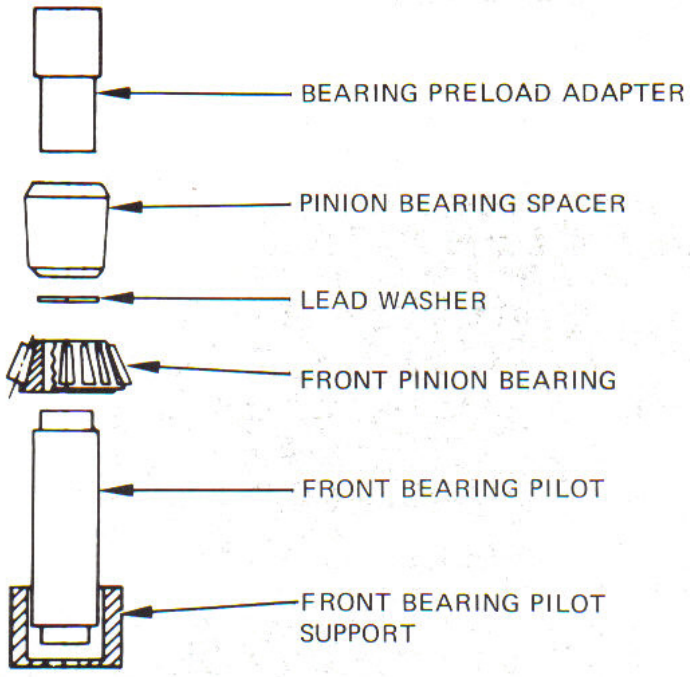


ILLUSTR.	DESCRIPTION	TOOL NO.	H-145	H-150	R-160	H-165A	H-165B	R-180	SAE H-190	ALUM H-190	CAST IRON H-190	R-200
	Bolt & Nut	J 25269-23	•	•	•	•	•	•	•	•	•	•
	Arbor (Long Plunger)	J 23597-1*		•	•	•	•	•	•	•	•	•
	Short Plunger Use with J 23597-1	J 25269-16*	•									
	Gauge Plates	J 25269-1*						•				•
		J 25269-11*	•	•								
		J 25269-19*			•		•					
		J 25269-20*				•				•		
		J 25269-30									•	
	Rear Pinion Bearing Pilots	J 25269-2*						•			•	•
		J 25269-12*	•	•	•	•	•			•		

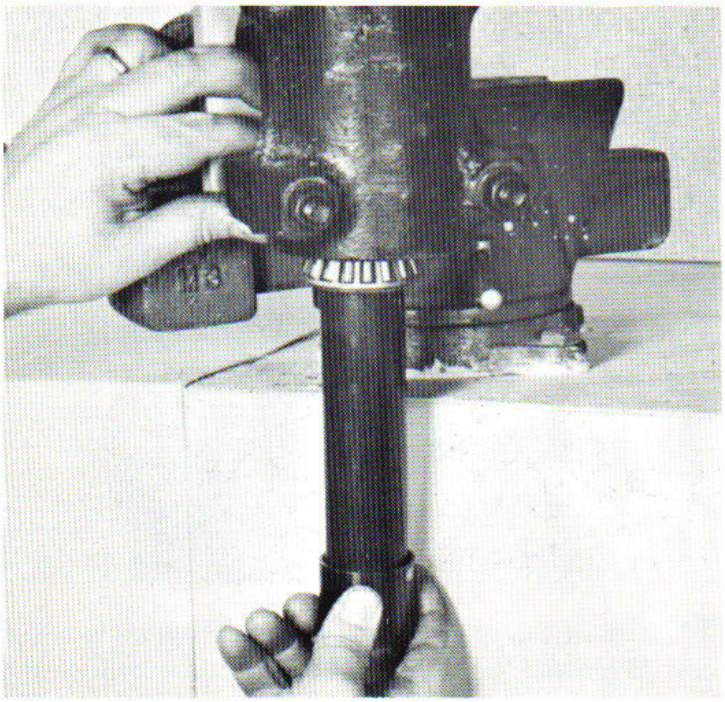
1. Install bearing pilot into the gauge plate and slide over the long bolt. Use special tools as listed above:



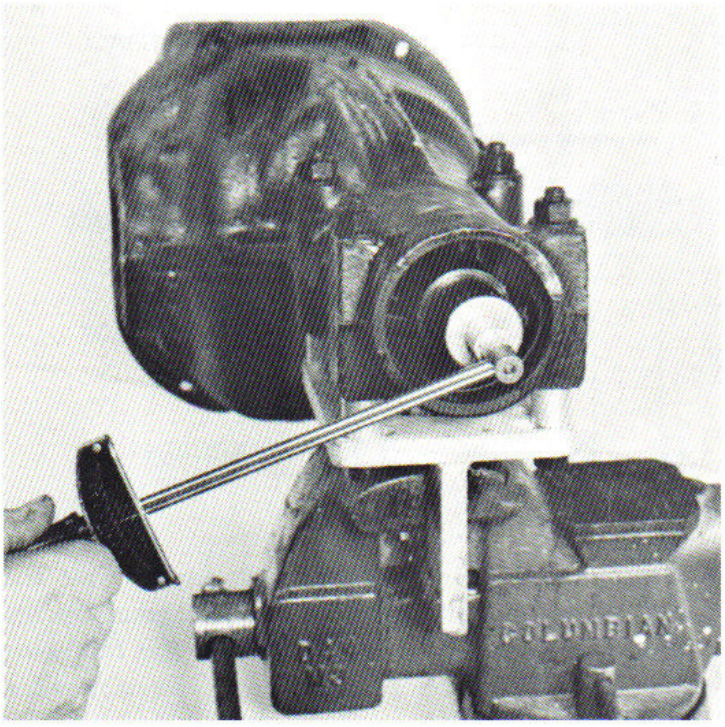
2. Install the rear pinion bearing in the differential case. Slide the long bolt and gauge plate through the bearing.



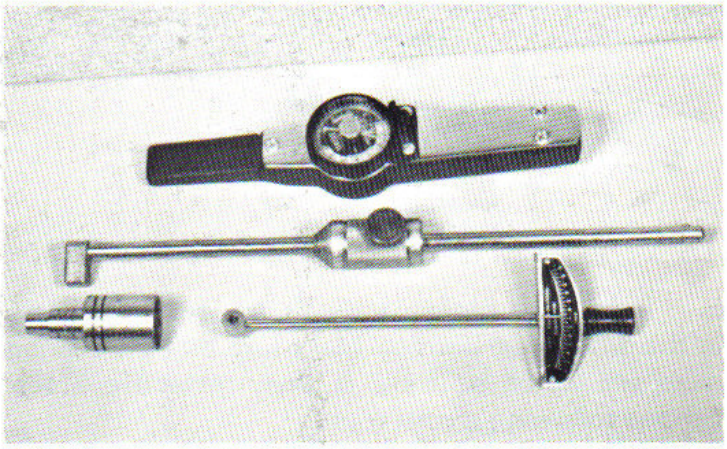
3. Stand the front bearing pilot support on the bench with the appropriate side up and assemble the component parts and special tools in the following order: Front bearing pilot support, front bearing pilot, front pinion bearing, lead washer, and then the pinion bearing spacer and bearing preload adapter together. Ensure that all parts are seated.



4. Holding these parts together, slide the assembly over the long bolt into the differential housing. Install the support nut. Finger tighten the nut and ensure that all parts turn freely and are properly aligned.



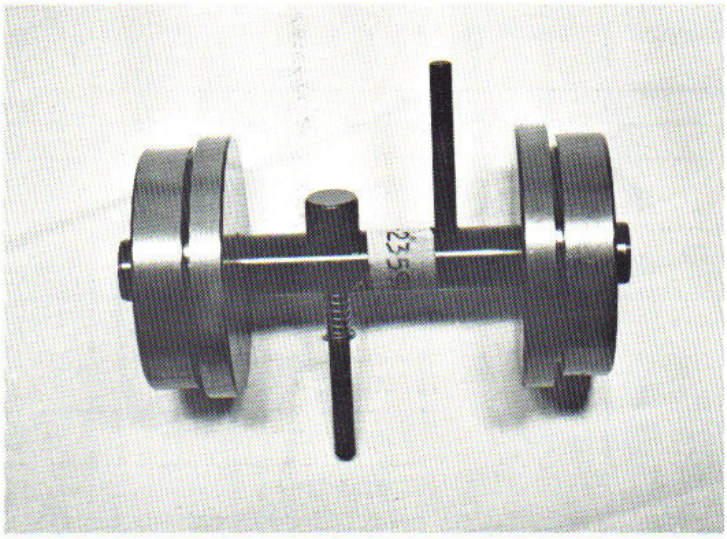
5. Tighten nut carefully to the correct preload of 6 – 10 kg-cm or 6 – 8 in.lbs.



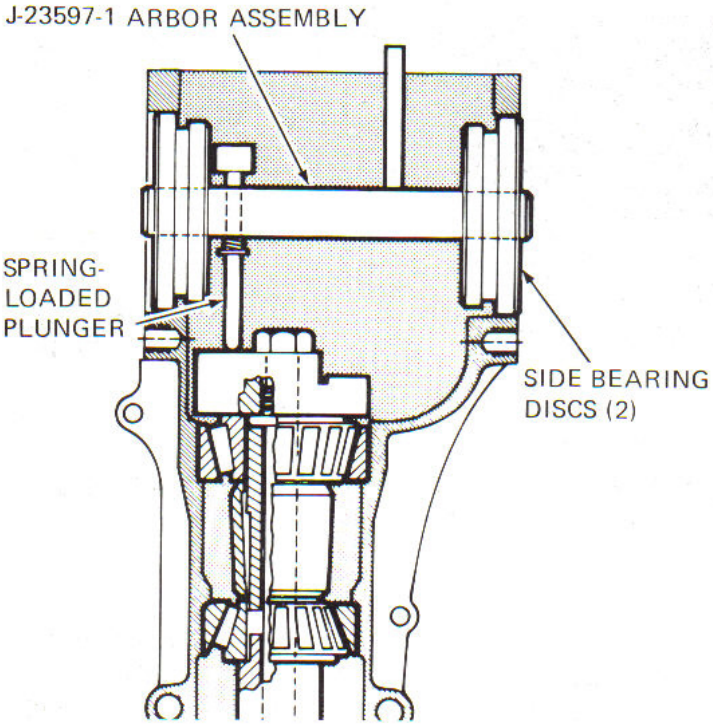
6. To measure preload, use one of the tools shown.

This concludes this part of the preload adjustment. DO NOT DISASSEMBLE THE SPECIAL TOOLS AT THIS TIME. The measurement of the lead washer will be taken after the pinion height adjustment.

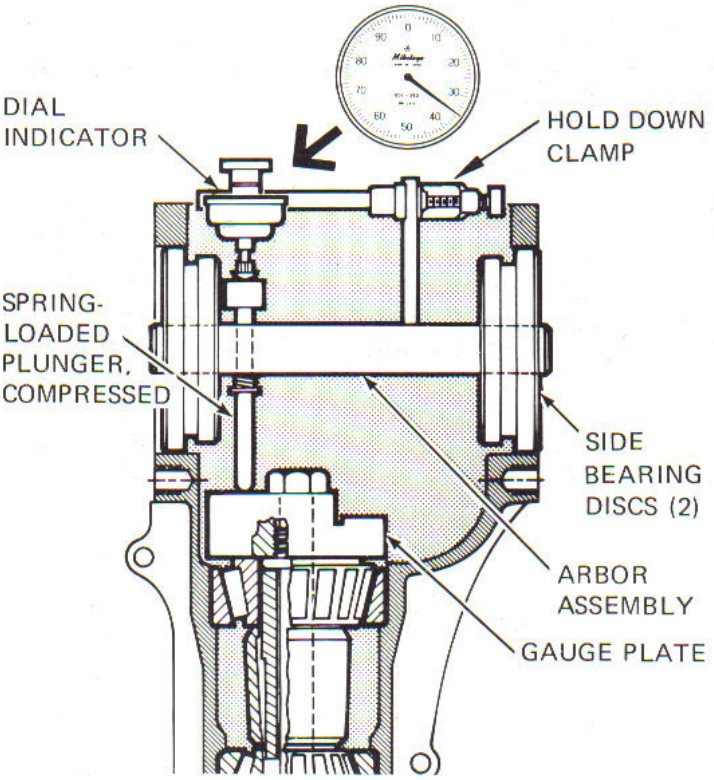
PINION HEIGHT ADJUSTMENT



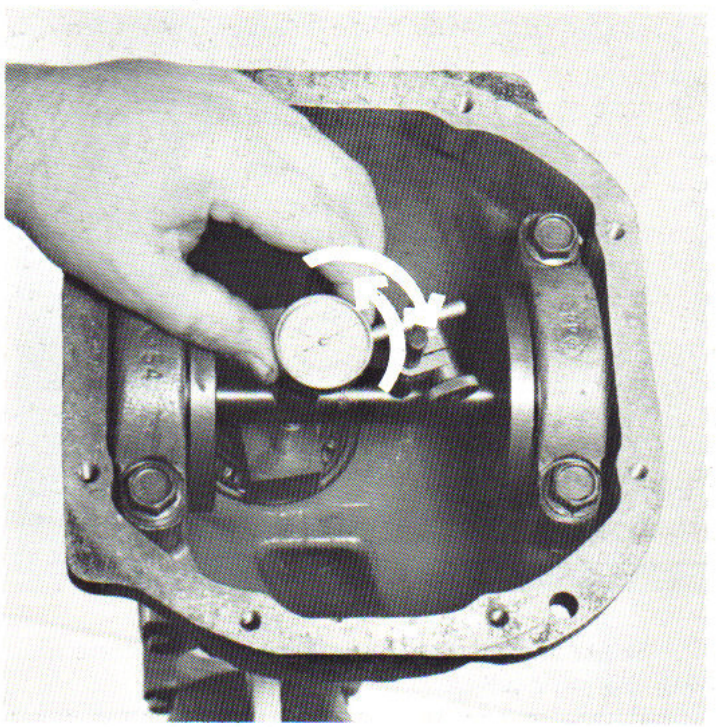
7. Install two discs with arbor assembly. Ensure that the arbor turns freely. Use special tool J-25269.



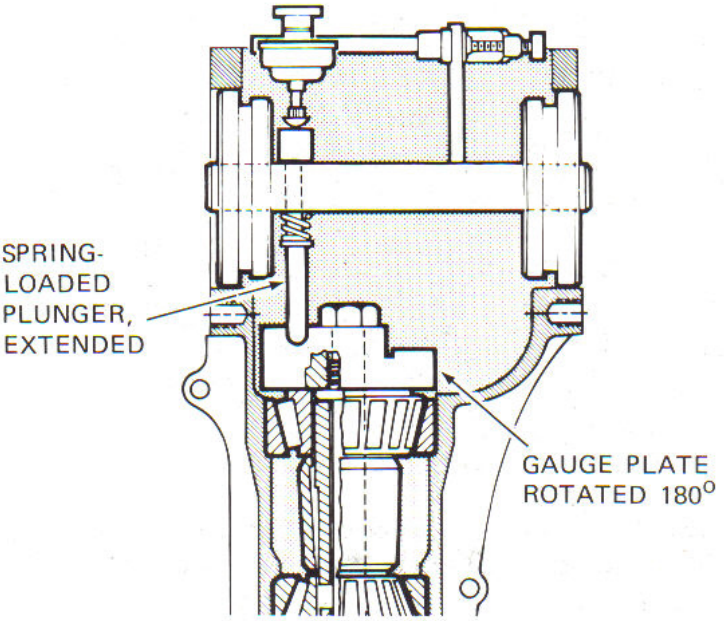
8. Lift the spring loaded plunger and place it on the face of the gauge plate (use the correct gauge plate step).



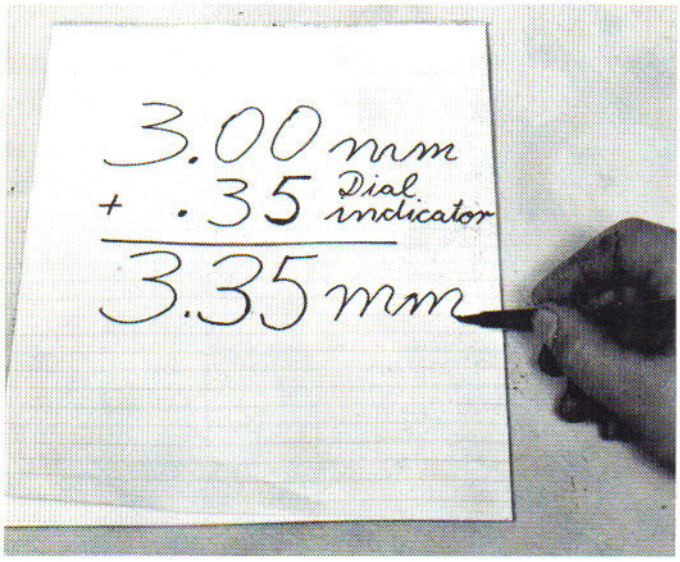
9. Install the dial indicator and tighten the hold down clamp.



10. To zero the dial indicator, rotate the arbor and plunger back and forth and note highest deflection, (the point where the needle changes direction). Now set the dial indicator at zero.



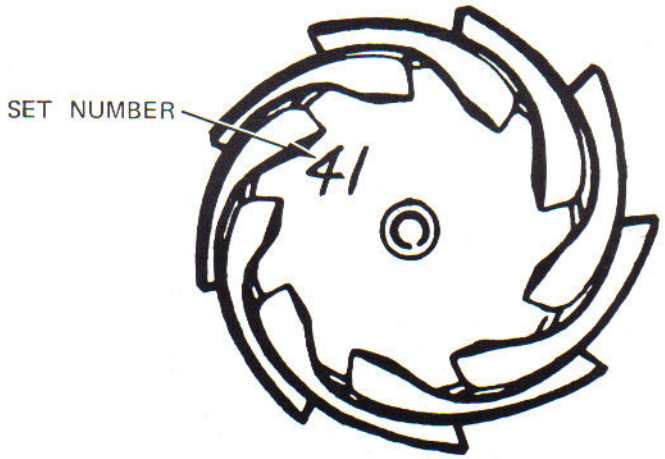
11. Rotate the arbor assembly until the plunger falls off of the gauge plate and read the dial indicator. Repeat to ensure accuracy.



12. Select the standard number for the differential from the table below.

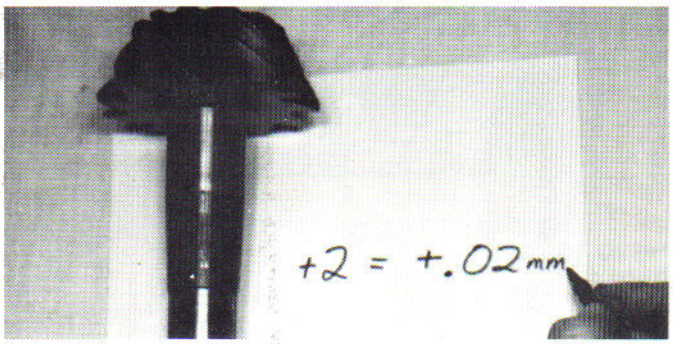
H165—Use dial indicator reading only.	add 0.00mm
H165B,R160,R180,R200	add 3.00mm
H145,H150,H190 (Metric Cast Iron)	add 2.50mm
H190 (Metric Aluminum) and 190 SAE (Aluminum)	add 2.00mm
190 SAE (Cast Iron)	add 0.00mm

Now add dial indicator reading to 3.0 millimeters, (R200).

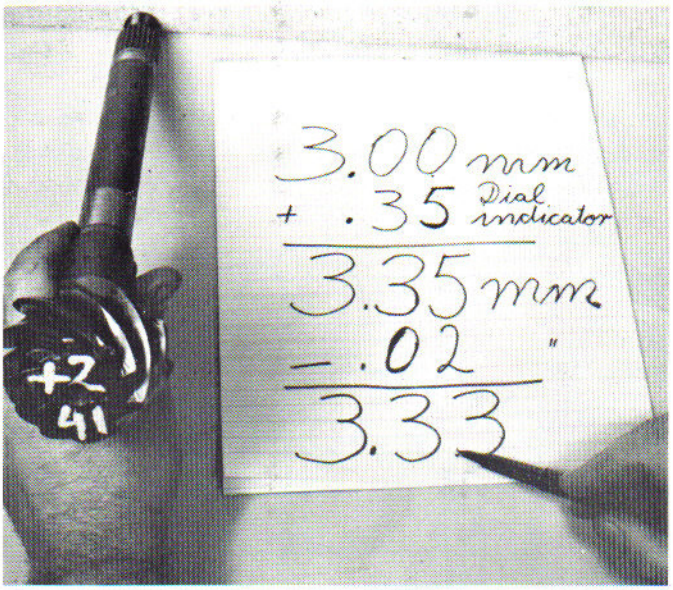


VARIATION NUMBER ON DRIVE PINION

13. Look at the pinion head to determine whether it is marked by a plus or minus sign and a number (+2, −1, etc.). If unmarked or marked "zero", then the number you arrived at in step 12 is the pinion height shim you will need. Go to step 16.



14. If the pinion head has a plus or minus number, then this will have to be used in your shim calculation. The number refers to hundredths of millimeters (.01mm) and is a tolerance factor.



15a. If the number is preceded by a plus sign (+), then SUBTRACT it from the total amount from step 12. This is the shim you will need.

Example: Dial Indicator Reading: .35mm

Number on Pinion Head: +2

3.00 (standard measure)
+ .35 (indicator reading)
3.35 (Pinion head is plus, so you
− .02 SUBTRACT it)
3.33 (mm = total pinion shim you will need)

15b. If the number is preceded by a minus sign (–), then ADD it to the total amount from step 12. This is the shim you will need.

Example: Dial Indicator Reading: .35

Number on Pinion Head: –2

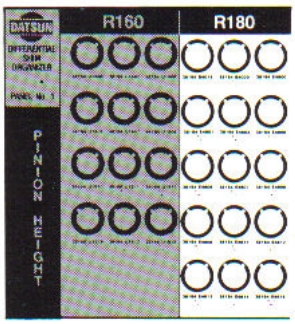
3.00 (standard measure)
+ .35 (Indicator reading)

3.35 (pinion head is minus, so you ADD it)
+ .02

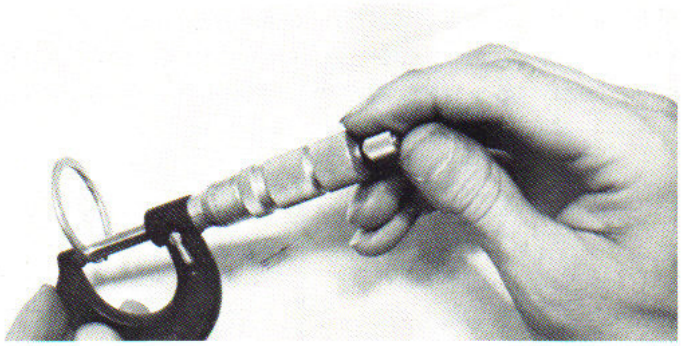
3.37 (mm = total pinion shim you will need)

16. Now obtain the proper shim from your shim board or Parts Department. The shim board is marked in both millimeters and inches.

Note: MEASURE SHIMS BEFORE USE AS A PRECAUTION AGAINST MISLABELED PARTS.



Part Number	mm	inches
38154-B4018	3.12	.123
38154-B4020	3.18	.125
38154-E4600	3.21	.126
38154-E4601	3.24	.128
38154-E4603	3.30	.130
38154-E4605	3.36	.132
38154-E4606	3.39	.134
38154-E4607	3.43	.135
38154-E4608	3.45	.136
38154-E4609	3.48	.137
38154-E4611	3.54	.139
38154-E4612	3.57	.141
38154-E4613	3.60	.142
38154-E4614	3.63	.143
38154-E4615	3.66	.144

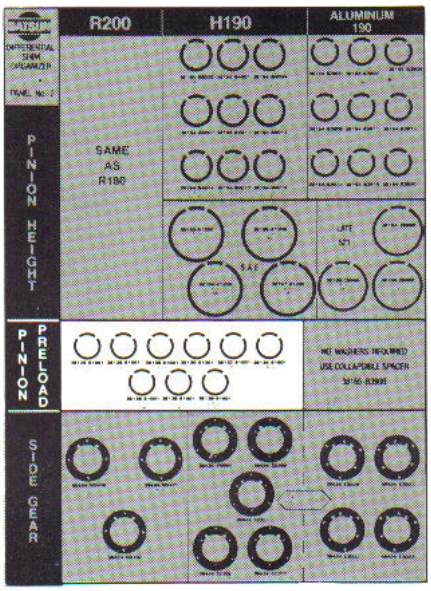


17. To determine pinion bearing preload, disassemble the pinion height/bearing preload tool and measure the thickness of the lead washer. This is the correct size preload washer required. Discard the used lead washer.

NOTE: *If a lead washer is not available, use a piece of thick roll solder (7) to obtain preload washer size.

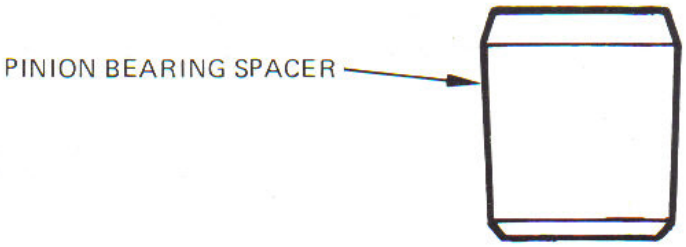
18a. Now select the proper shim from your shim board or parts department.

Part Number	mm	Inches
38125-61001	3.81	.150
38126-61001	3.83	.151
38128-61001	3.87	.152
38130-61001	3.91	.153
38132-61001	3.95	.155
38134-61001	3,99	,157
38136-61001	4.03	.158
38138-61001	4.07	.160
38139-61001	4.09	.161

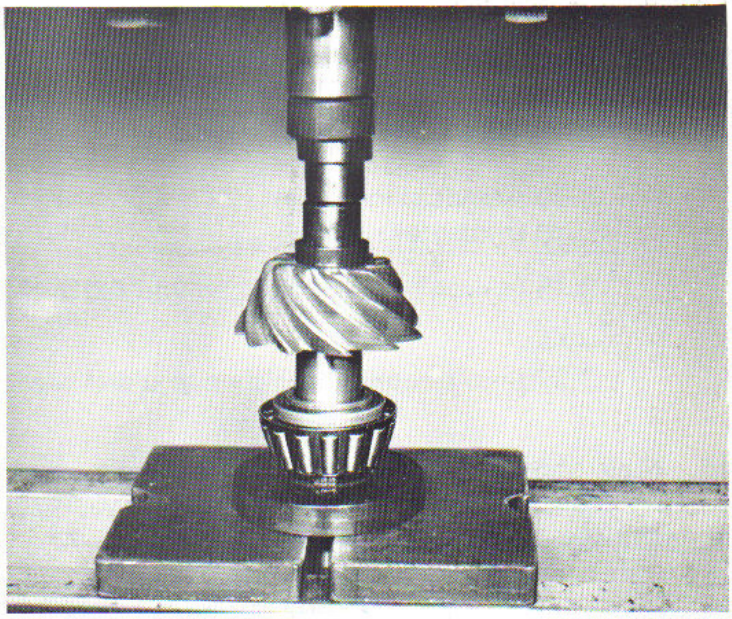


18b. Sometimes the correct dimension cannot be set with shims alone. In these cases, shims may be used in combination with spacers of the following sizes:

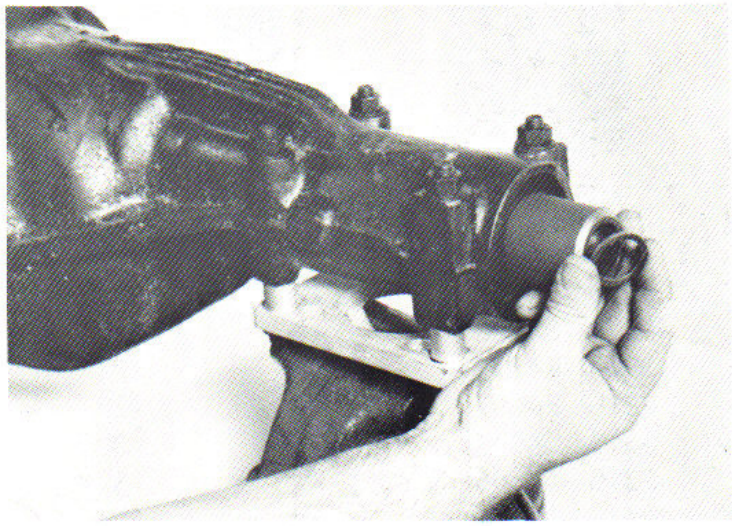
38165-B4002	55.10mm
38165-B4003	55.40mm
38165-B4004	55.70mm
38165-61001	56.00mm
38166-61001	56.25mm



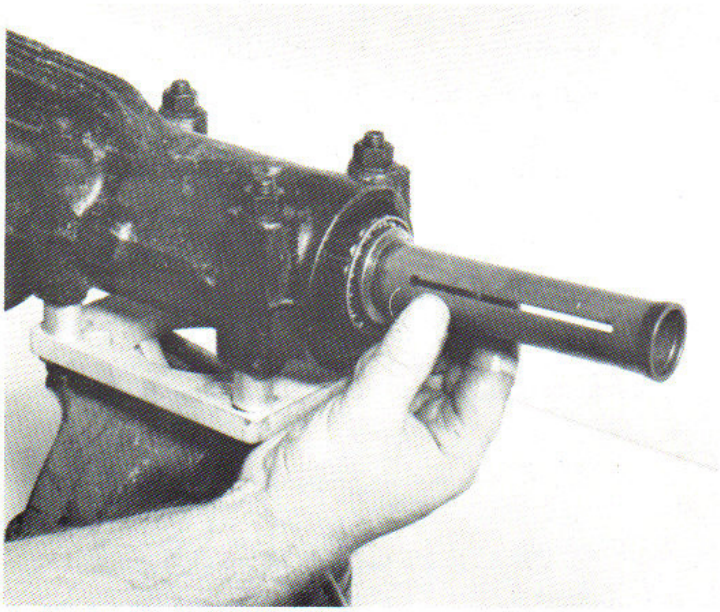
PINION ASSEMBLY:



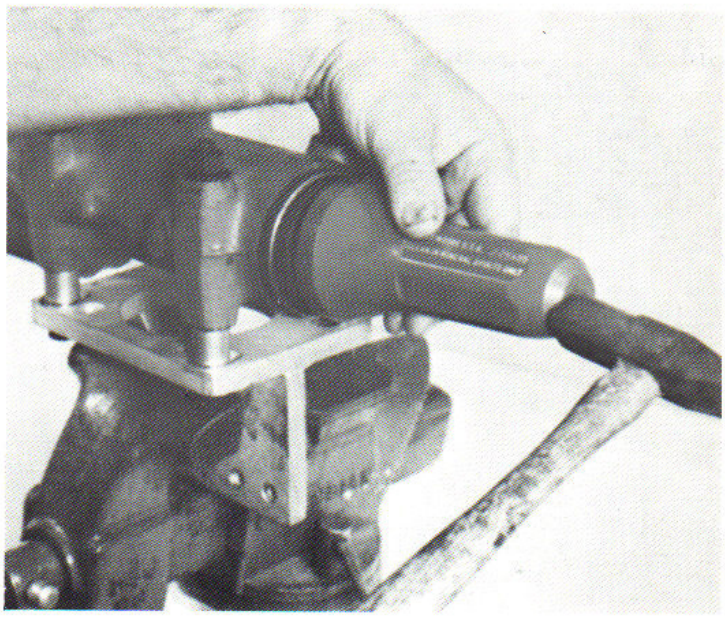
1. Place a pinion shim of the correct size on the pinion shaft, bevel side toward the gear. Using the press stand, press the bearing on the shaft.



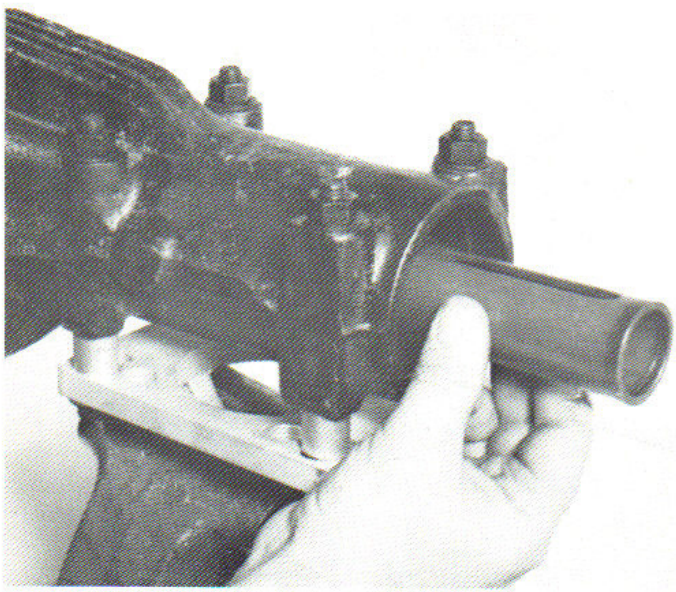
2. Install the spacer and preload shim on the shaft, and place the shaft in the housing. Make sure the bearing turns freely on its race.



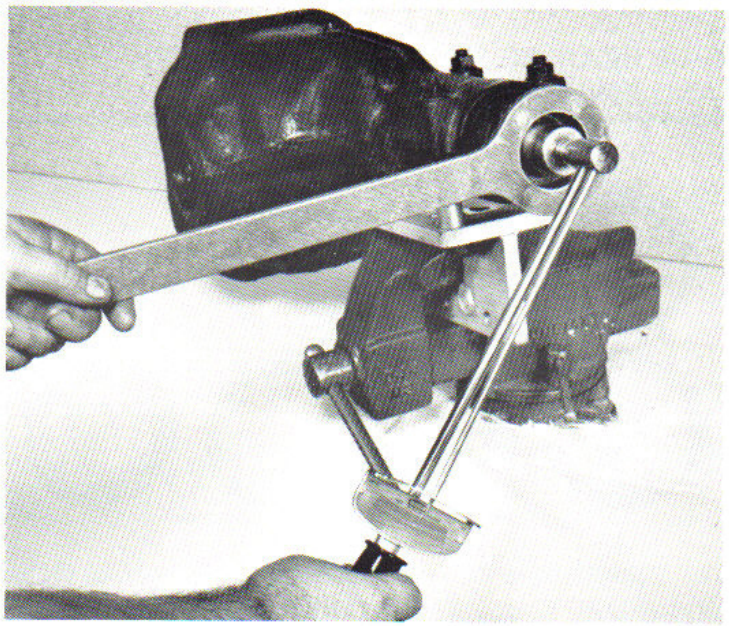
3. Slide the front pinion bearing on the shaft from the other end. Tap it down the shaft using special tool J-25863.



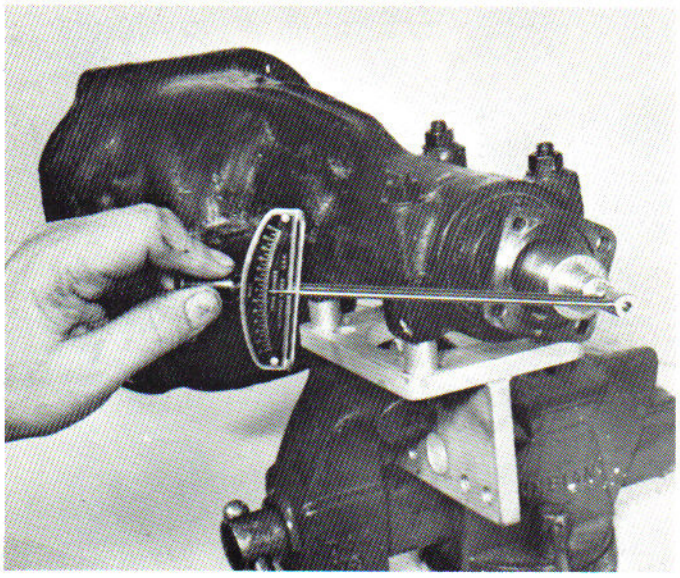
5. Using special tool J-25273, install a new oil seal. Lubricate seal with differential lubricant.



4. Install the sleeve and pilot bearing on the pinion shaft. Tap them down the shaft using special tool J-25863.

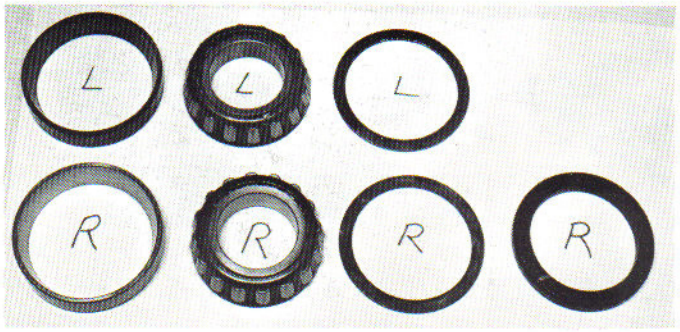


6. Install the flange, washer, and nut. Torque in steps of 50 ft.lbs. Spin the shaft after each tightening to prevent the bearings from binding. Tighten to final torque of 137 – 159 ft.lbs.



7. Check the preload. It must be 8 – 11 kg-cm (7 – 10 in.lbs.) IMPROPER BEARING PRELOAD IS THE MAJOR CAUSE OF NOISE AND FAILURE IN THESE DIFFERENTIALS.

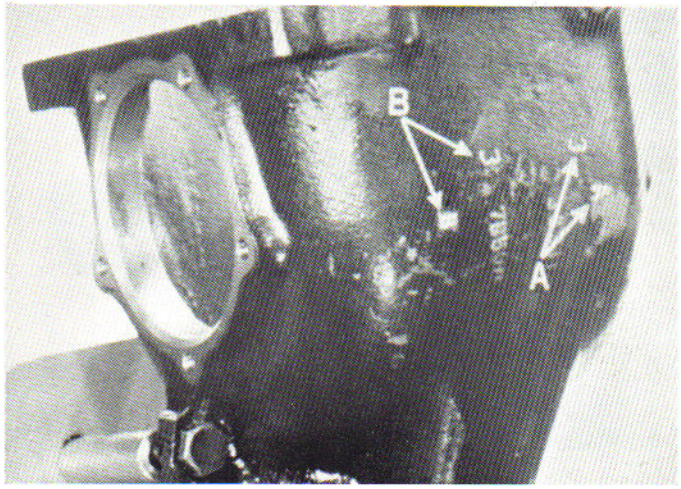
SIDE BEARING SHIM DETERMINATION AND RING GEAR ASSEMBLY:



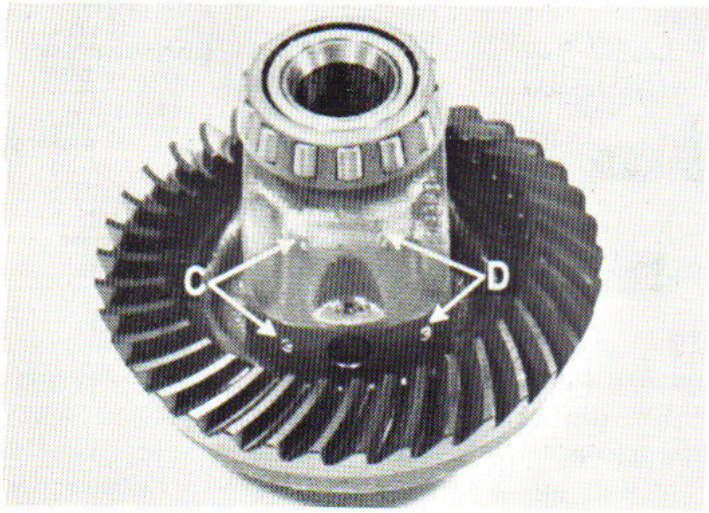
1. Locate the two side bearings, side bearing races, and shims. You will also need the Side Bearing Shim Calculator for R200. The next step will be to decide what shims to put back into the differential.

LETTERS	HUNDREDTHS OF A MILLIMETER
A - Left housing	
B - Right housing	
C - Gear case	
D - Gear case	
E - Left side bearing	
F - Right side bearing	
G - Spacer measurement	
H - (+) or (-): ring gear	

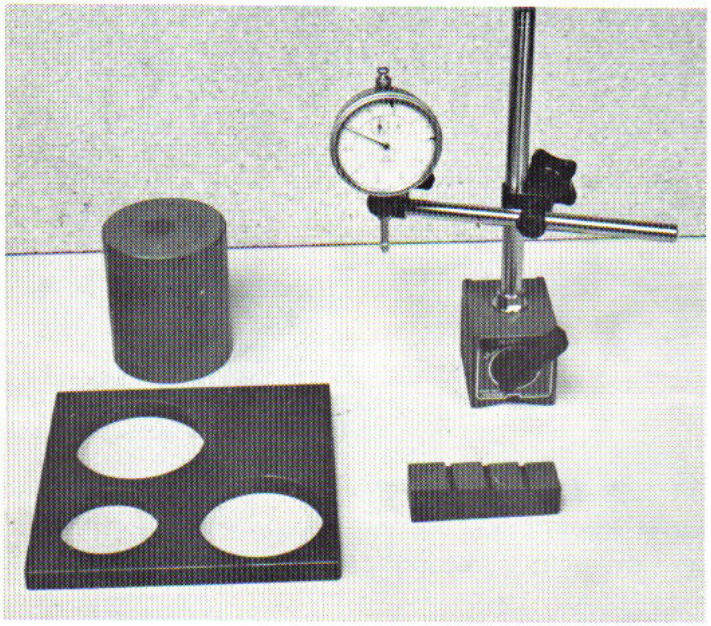
2. To simplify the job, make a chart, like the one above, to organize your calculations.



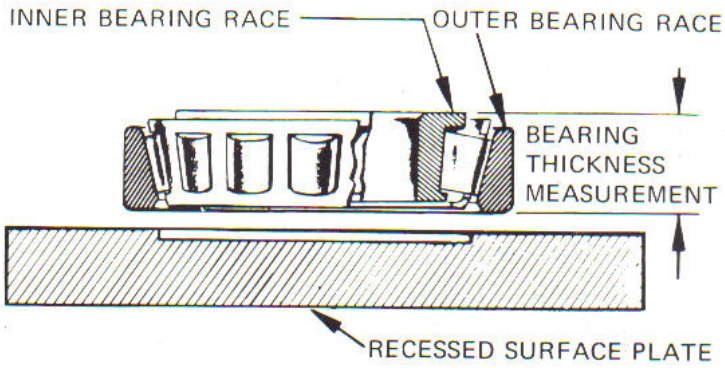
3. Locate the numbers stamped next to the letters "A" and "B", and record them on the chart.



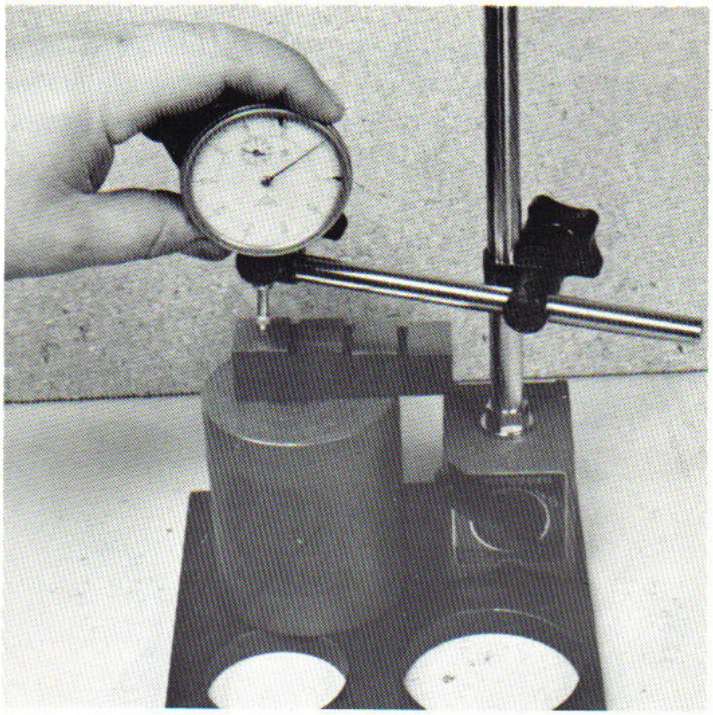
4. Locate the numbers stamped next to the letters "C" and "D" on the differential carrier, and write these down.



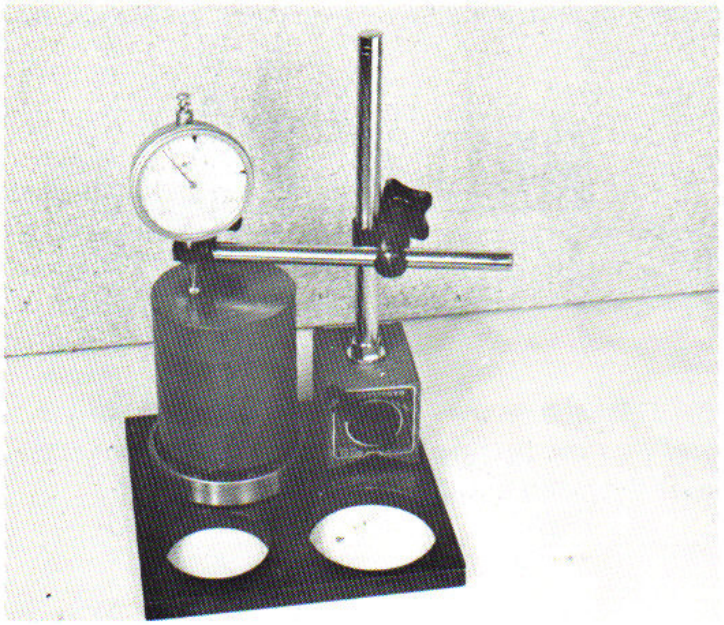
5. Measure how far under the standard thickness (21 mm) the side bearings are. You will need the tools shown here.



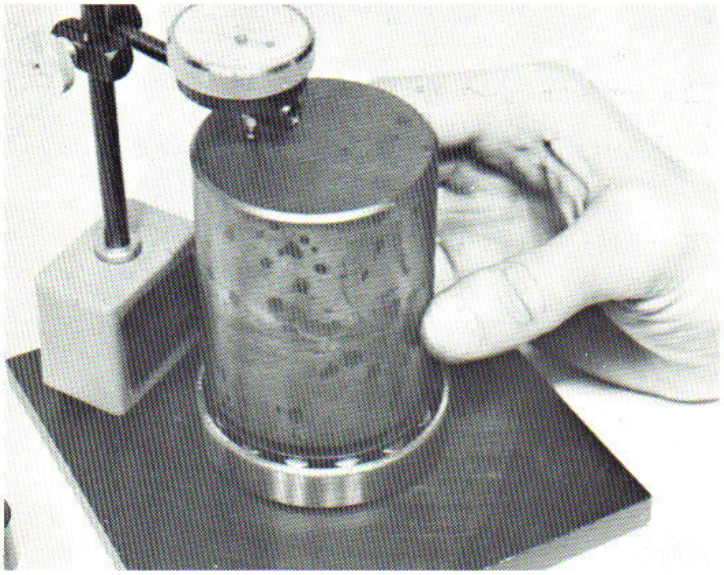
6. Make sure that the base plate has a recess in it and that the bearing will turn freely when positioned over the recess as shown.



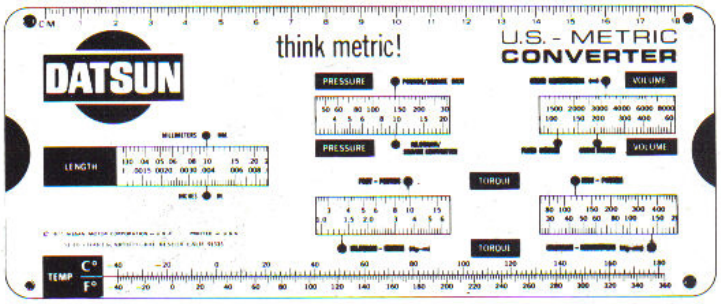
7. Mount the dial indicator on the base plate, place the 5 pound weight on the base plate and put the 21mm gauge block on top. Zero the dial indicator on the gauge block, as shown.



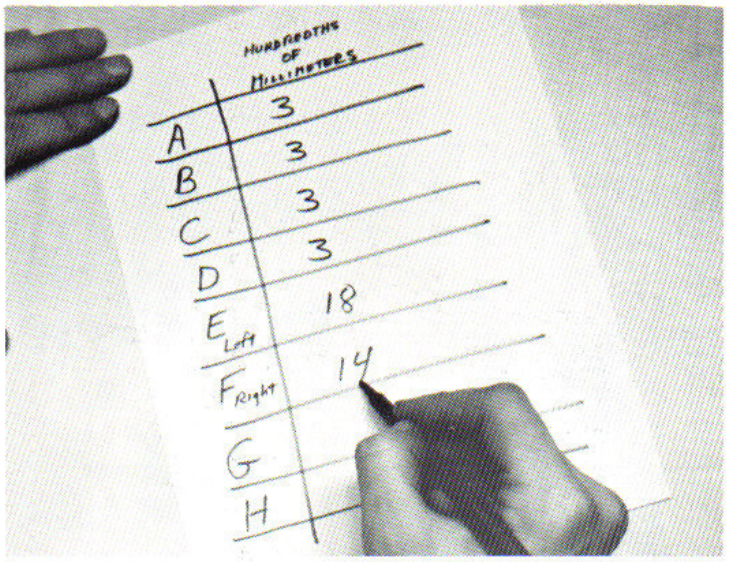
8. Carefully slide the gauge block out from under the dial indicator. Lift the weight block, and slide the bearing and race to be measured under the weight.



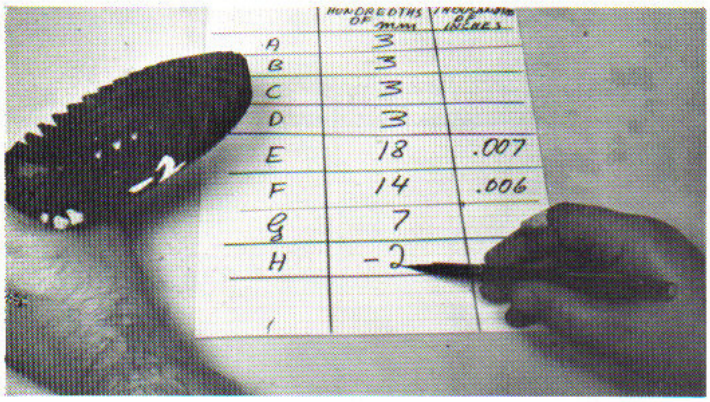
9. Turn the weight a few times to ensure that bearing is properly seated. Watch the gauge while you do this. If the needle fluctuates erratically then the bearing is either dirty or defective and should be cleaned or replaced. If the reading is not erratic, note how far the indicator dropped. This will normally be .10 – .30mm (.004 – .012 in.).



10. To avoid any confusion while calculating side bearing shims, it is absolutely necessary to stay with the metric system. If you measure anything in inches, the results MUST be converted to the metric system. You can use a conversion chart or a calculator as illustrated.



11. Measure both bearings in the same way and write the left side bearing measurement next to "E" and the right side bearing measurement next to "F".



12. Finally, look on the ring gear for markings. If you find a plus (+) or minus (—) sign followed by a number, write the sign and the number down next to "H".

13. The side bearing shim adjustment can now be calculated. For a detailed description of this process, see pages 22—28 of the introductory section of this book.

The formulas are as follows:

(T1) Left: A — C + D + E — H + 2.05

(T2) Right: B — D + F + G + H + 1.95

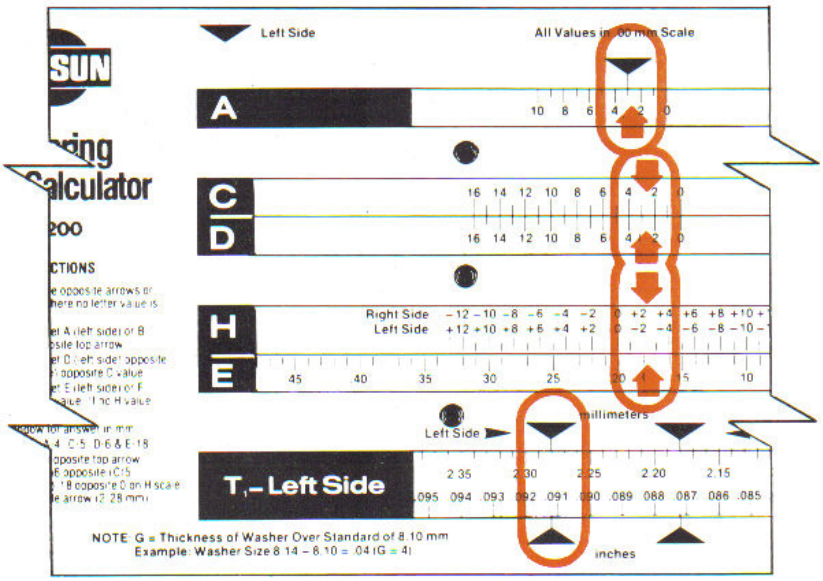
A. SAMPLE CALCULATION FORMULA

Left Side T1		Right Side T2	
+	—	+	—
A 3	C 3	B 3	D 3
D 3		F 14	H 2
E 18		G 7	
H 2		std. shim 1.95	
std. shim 2.05		2.19	5
2.31	3	-5	
-3			
2.28		2.14	

The measurement for the shim pack on the left (T1) should be 2.28mm and for the right (T2) 2.14mm. To check the accuracy of your work in the previous step, the side bearing shim measurement should be figured with a Side Bearing Shim Calculator.

Follow the instructions for the sample given below:

B. SAMPLE CALCULATOR



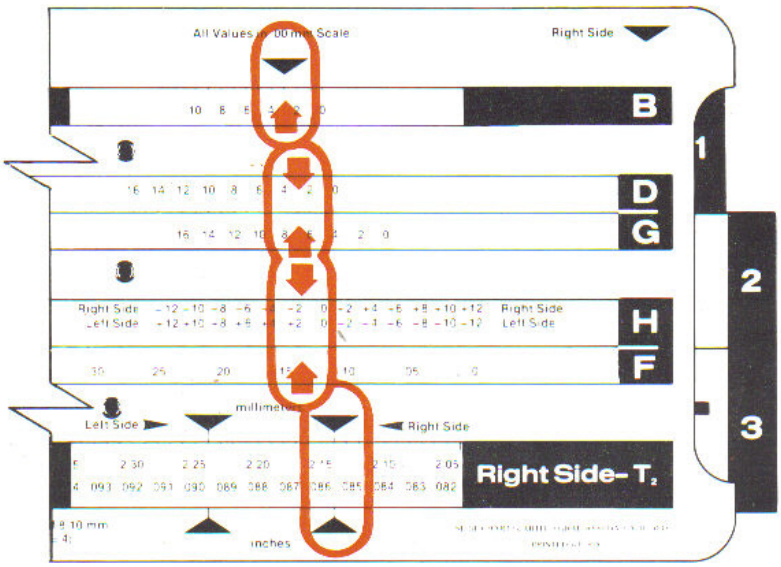
Left Side

Step 1. Move slide 1 to place C 3 in line with the red arrow.

Step 2. Move slide 2 to place D 3 in line with C 3.

Step 3. Move slide 3 to place E 18 in line with H –2.

Step 4. Read answer at left side arrow, 2.28mm or close to .087 in.



Right Side

Step 1. Move slide 1 to place B 3 in line with red arrow.

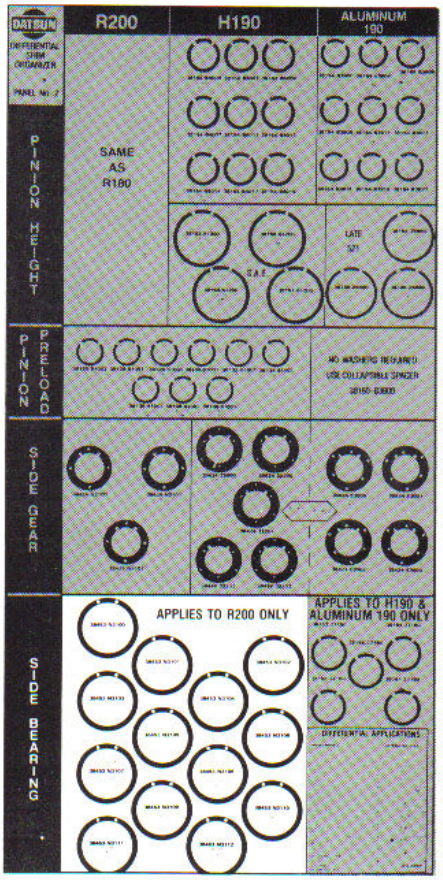
Step 2. Move slide 2 to place G 7 in line with D 3.

Step 3. Move slide 3 to place F 14 in line with H 2 (red scale for right side).

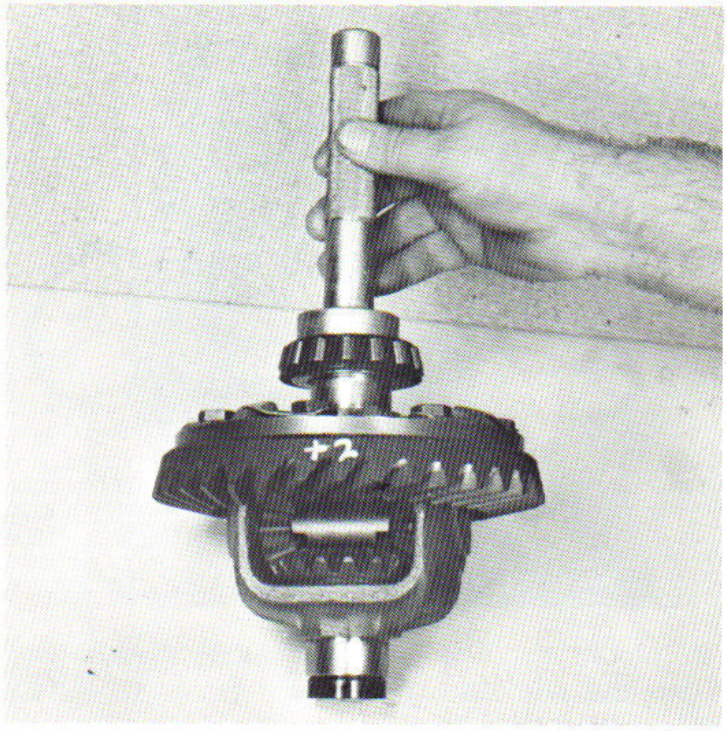
Step 4. Read answer at right side arrow 2.14mm or close to .086 in.

14. Now compare these answers with the answers of 13, A. If both answers agree, proceed to the next step.

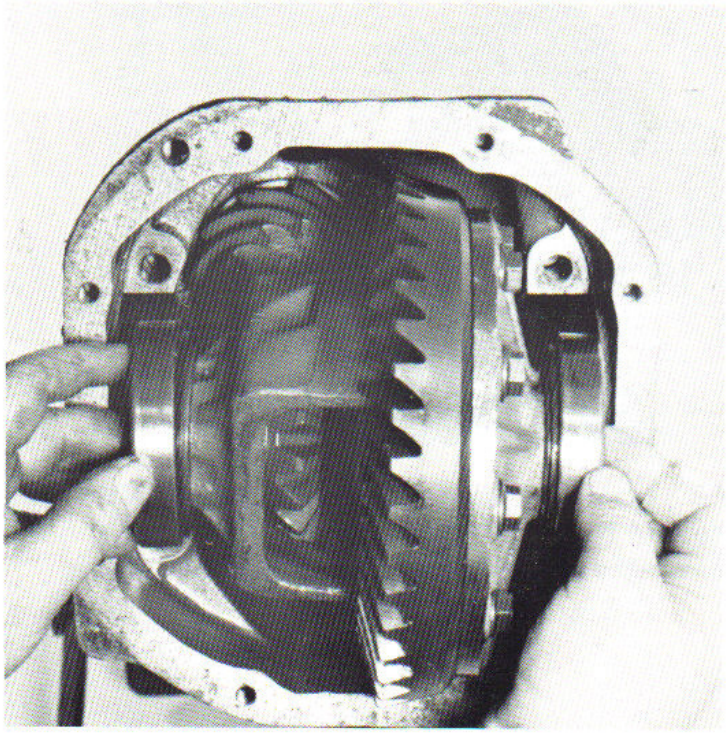
15. Select the proper shims from the shim board as illustrated below or from your Parts Department.



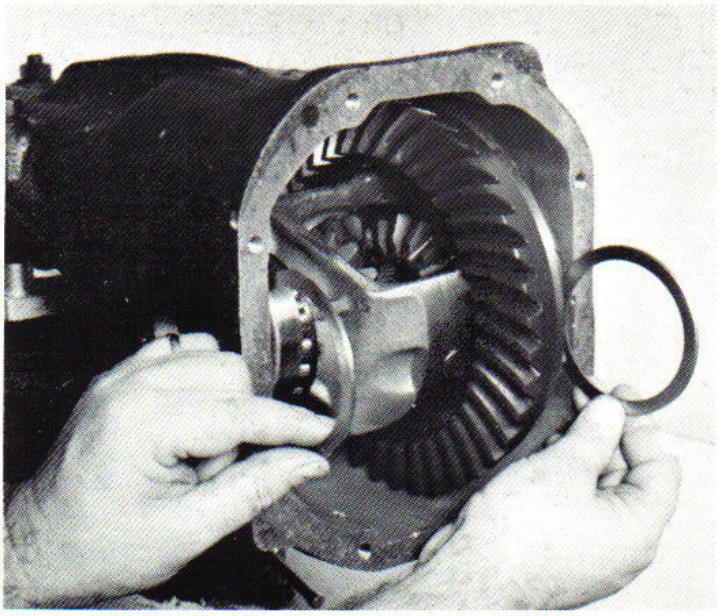
Part Number	mm	inches
38453-N3100	2.00	.079
38453-N3101	2.05	.081
38453-N3102	2.10	.083
38453-N3103	2.15	.085
38453-N3104	2.20	.087
38453-N3105	2.25	.089
38453-N3106	2.30	.091
38453-N3107	2.35	.093
38453-N3108	2.40	.095
38453-N3109	2.45	.097
38453-N3110	2.50	.099
38453-N3111	2.55	.100
38453-N3112	2.60	.102



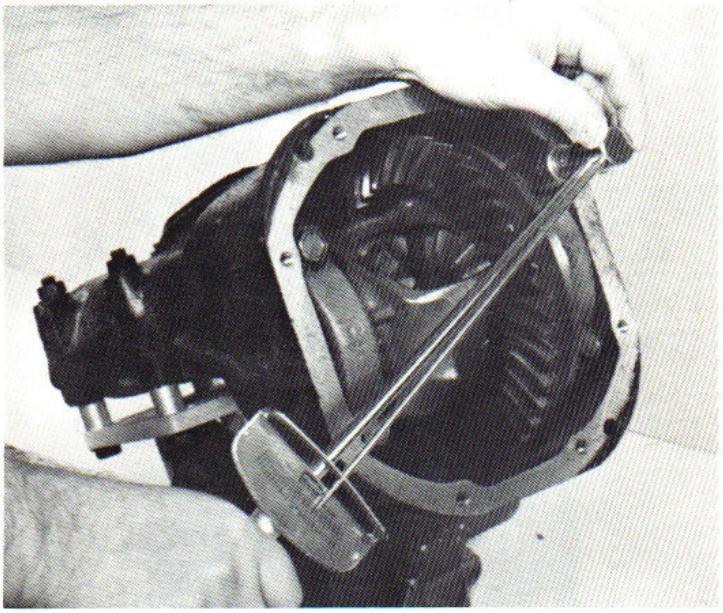
16. An adaptor is needed to install the side bearings. A good source for this is the inner race of an old bearing. Protect the lower bearing cage by using the puller adapter J-25797-2.



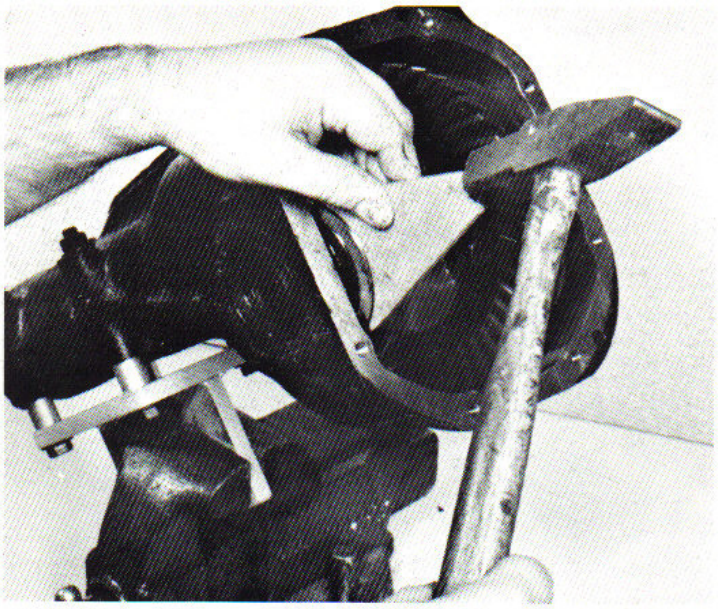
17. Place the carrier gear assembly with the side bearing races into the housing and tap it into place.



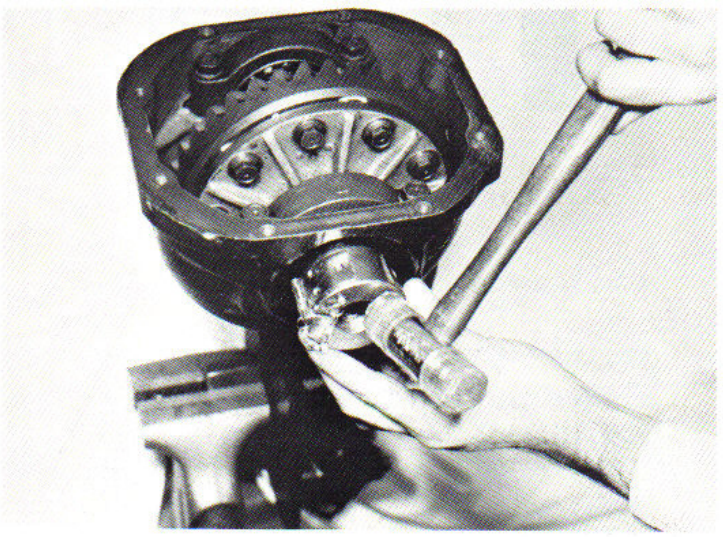
18. Mount the ring gear assembly in the housing, install the side bearing caps, and tap them lightly with a plastic hammer to seat them.



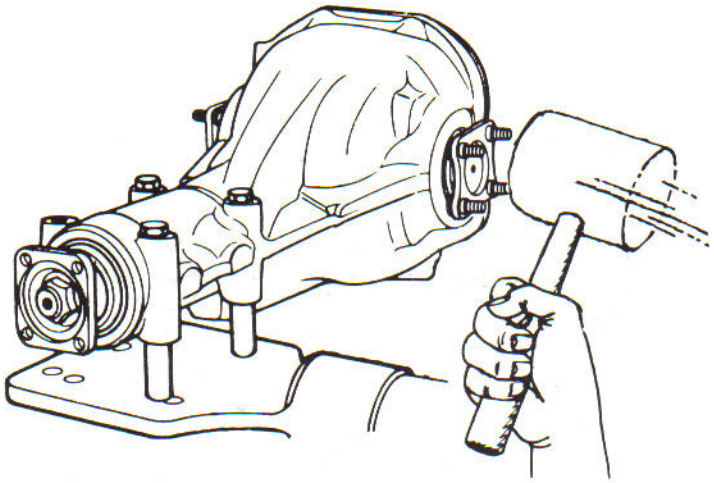
20. Install the bearing caps and tap them into place with a plastic hammer. Tighten the cap bolts to 9 — 10 kg-m (65 — 72 ft.lbs).



19. Now using special tool J-25267, drive the side bearing spacer (measured for the "G" figure) in between the right side bearing shim and the housing.



21. Install the side bearing oil seal using the drift shown.

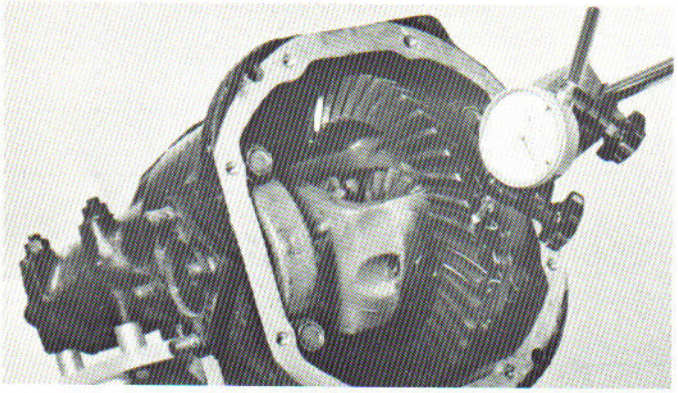


22. Place the side flanges into the splines in the gear case, and tap the flanges with a hammer until they snap into place.

NOTE: Make sure to install the flanges the right way:

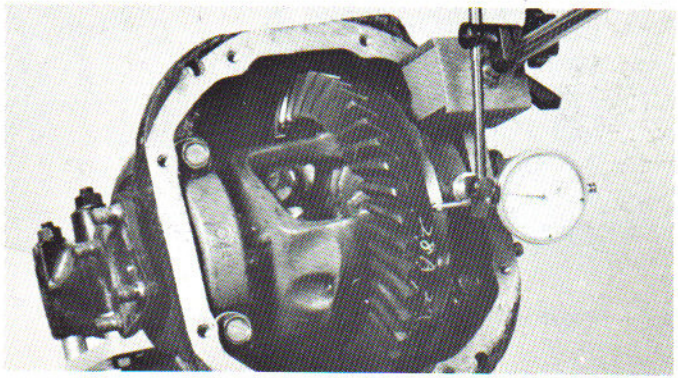
SHORT FLANGE LEFT (RING GEAR SIDE.)
LONG GEAR RIGHT SIDE.

FINAL VERIFICATION:

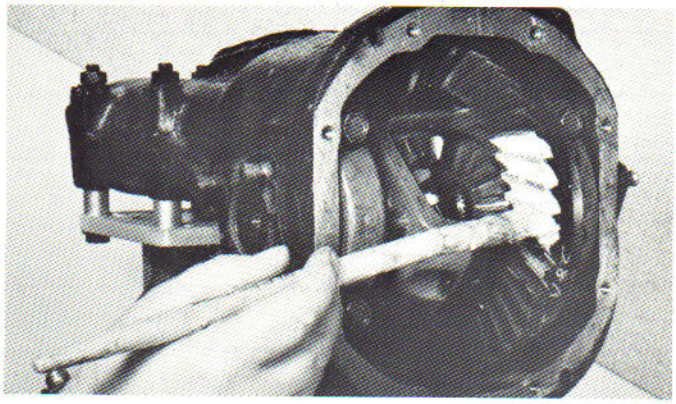


1. Check ring and pinion gear backlash with a dial indicator. It must be .13 – .19mm (.005–.007"). To increase the amount of backlash, move the gears slightly out of mesh by transferring shims from the ring gear side to the opposite side. To decrease the amount of backlash, move the gears closer in mesh by transferring shims to the ring gear side from the opposite side.

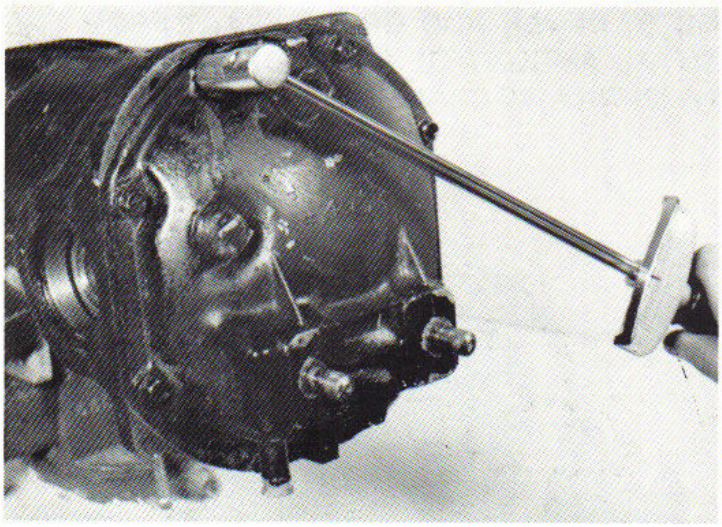
NOTE: NEVER ADD OR SUBTRACT FROM THE TOTAL AMOUNT OF SHIMS OR BEARING PRE-LOAD WILL BE CHANGED.



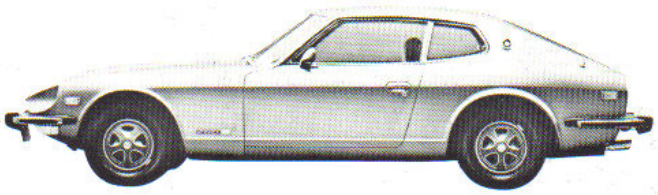
2. Check the runout of the ring gear with a dial indicator. It must not be more than .05mm (.002"). Excessive runout indicates a warped ring gear and/or gear carrier and replacement is required.



3. Finally, make a tooth pattern reading and interpret it according to the instructions given in the first section of this Guide.



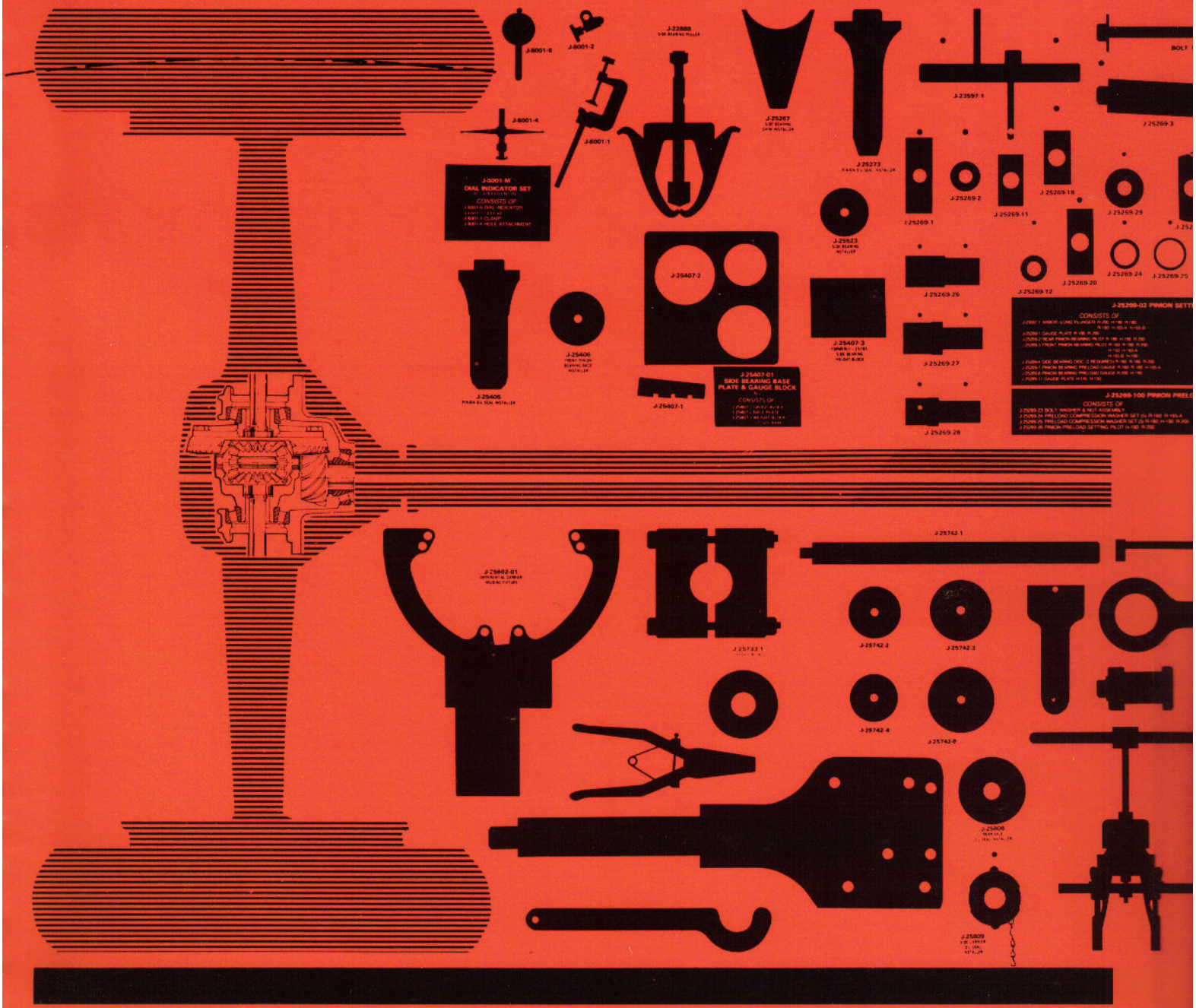
4. Install the rear cover using a new gasket.



5. After installing the differential in the vehicle, make a complete road test according to the instructions given in the first section of this Guide.

NOTES

SPECIAL TOOLS



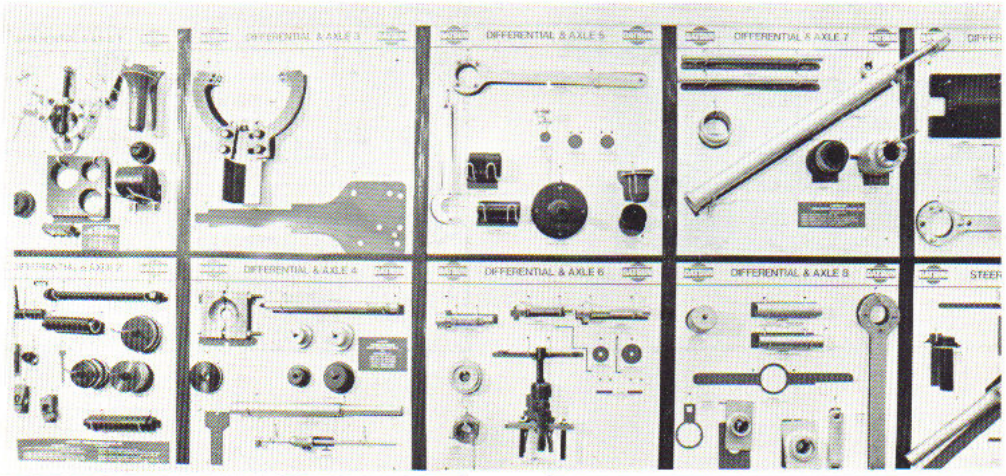
DIFFERENTIAL SPECIAL TOOLS

Special servicing is a must in the service of differentials. There are special tools which we sometimes assume that we can do without. However, each tool has a specific purpose. What does this mean?

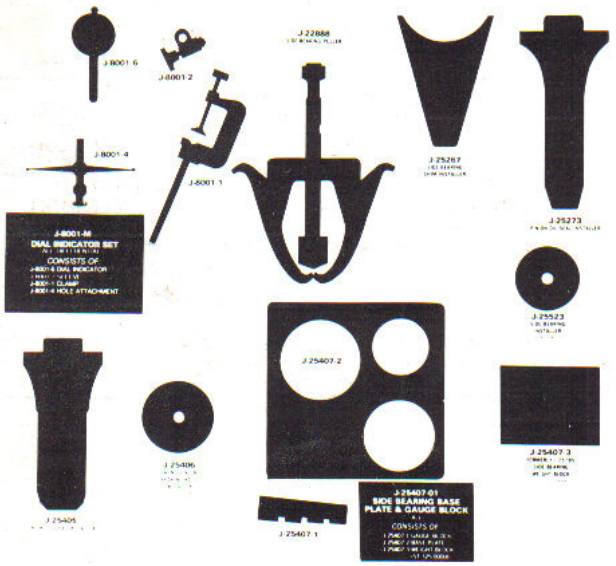
Alternate methods can sometimes be used to supplement the special tool. You will, however, find that each tool has a specific value. In some cases it will make your job a little easier, in some cases it will be safer, in some cases it will prevent damage to the parts. Most of all, when using the proper tool to do the right job, you look and act much more professional.

Listed, you will find the tools which we recommend for use by the technicians.

Datsun special tool boards, for wall-hanging, display your special tools. The boards keep your tools where you want them – when you want them. They also reflect the professional look – for you, the technician.



DATSUN DIFFERENTIAL & AXLE 1 DATSUN



DIFFERENTIAL & AXLE *(continued)*

ILLUSTRATION	TOOL NO.	DESCRIPTION	DIFFERENTIAL APPLICATION										
			H145	H150	R180	H185A	H185B	R180	SAE H-190	ALUM H-190	H-190	R200	FRONT REAR DRIVE
	J 8001-M	Metric Dial Indicator Set	X	X	X	X	X	X	X	X	X	X	
	J 22888	Side Bearing Puller (Use with J 25797-1, -2 or -3 as Required)	X	X	X	X	X	X	X	X	X	X	X
	J 25267	Side Bearing Shim Installer										X	
	J 25269-01	Pinion Setting Gauge Set	X	X	X	X	X	X	X	X	X	X	
		Consists of:											
		J 23597-1 Arbor (Long Plunger)		X	X	X	X	X	X	X	X	X	
		J 25269-1 Gauge Plate						X				X	
		J 25269-2 Rear Pinion Bearing Pilot						X			X	X	
		J 25269-3 Front Pinion Bearing Pilot			X	X	X	X			X	X	
		J 25269-4 Side Bearing Disc (2 Req'd)			X			X				X	
		J 25269-11 Gauge Plate	X	X									
		J 25269-12 Rear Pinion Bearing Pilot	X	X	X	X	X						
		J 25269-16 Short Plunger (Use with J 23597-1)	X										
		J 25269-17 Side Bearing Disc (2 Req'd)	X	X		X	X						
		J 25269-18 Side Bearing Disc (2 Req'd)									X		
		J 25269-19 Gauge Plate			X		X						
		J 25269-20 Gauge Plate				X					X		
		J 25269-21 Front Pinion Bearing Pilot	X	X									
		J 25269-22 Instructions	X	X	X	X	X	X	X	X	X	X	
		J 25269-23 Hardware Set	X	X	X	X	X	X	X	X	X	X	
	J 25273	Pinion Oil Seal Installer										X	
	J 25405	Pinion Oil Seal Installer		X			X			X			
	J 25406	Front Pinion Bearing Cup Installer (Use with J 26090)		X									
	J 25407-01	Side Bearing Measuring Set	X	X	X	X	X	X	X	X	X	X	
		Consists of:											
		J 25407-1 4-Step Gauge Block											
		J 25407-2 Base Plate											
		J 25407-3 Weight Block											
	J 25523	Side Bearing Installer (Use with J 26090)										X	

DIFFERENTIAL & AXLE 2

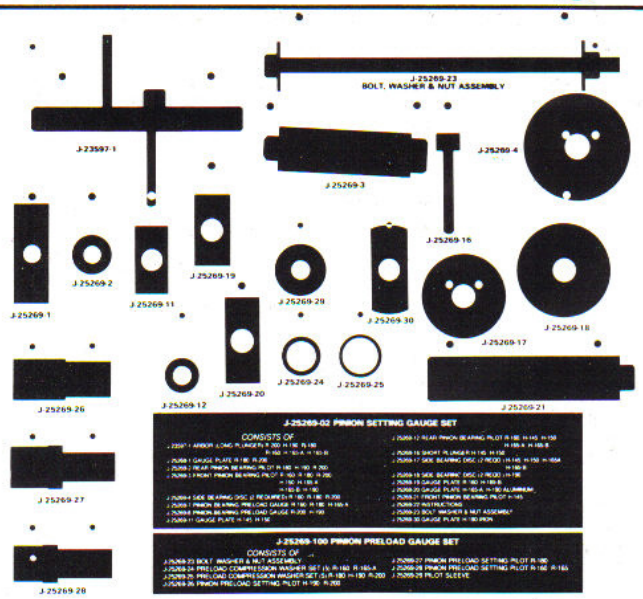
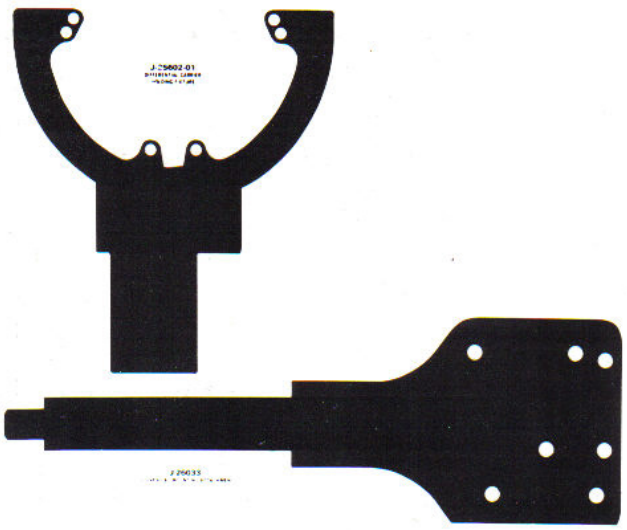


ILLUSTRATION	DESCRIPTION	TOOL NO.	DIFFERENTIAL									
			H-145	H-150	R-160	H-165A	H-165B	R-180	SAE H-190	ALUM H-190	CAST IRON R-190	R-200
	Bolt & Nut	J 25269-23	•	•	•	•	•	•	•	•	•	•
	Arbor (Long Plunger)	J 23597-1*		•	•	•	•	•	•	•	•	•
	Short Plunger Use with J 23597-1	J 25269-16*	•									
	Gauge Plates	J 25269-1*						•				•
		J 25269-11*	•	•								
		J 25269-19*			•		•					
		J 25269-20*				•				•		
		J 25269-30									•	
	Rear Pinion Bearing Pilots	J 25269-2*						•			•	•
		J 25269-12*	•	•	•	•	•			•		
	Front Pinion Bearing Pilots	J 25269-3*				•	•	•		•	•	•
		J 25269-21*	•	•	•							
	Side Bearing Discs (2 Req'd)	J 25269-4*			•			•				•
		J 25269-17*	•	•		•	•					
		J 25269-18*								•	•	
	Lead Preload Washers (Pkg. of 5)	J 25269-24			•			•				
		J 25269-25									•	•
	Bearing Preload Adapters	J 25269-26									•	•
		J 25269-27						•				
		J 25269-28			•							
	Front Pinion Bearing Pilot Support	J 25269-29			•			•			•	•
	Instructions	J 25269-32*	•	•	•	•	•	•	•	•	•	•

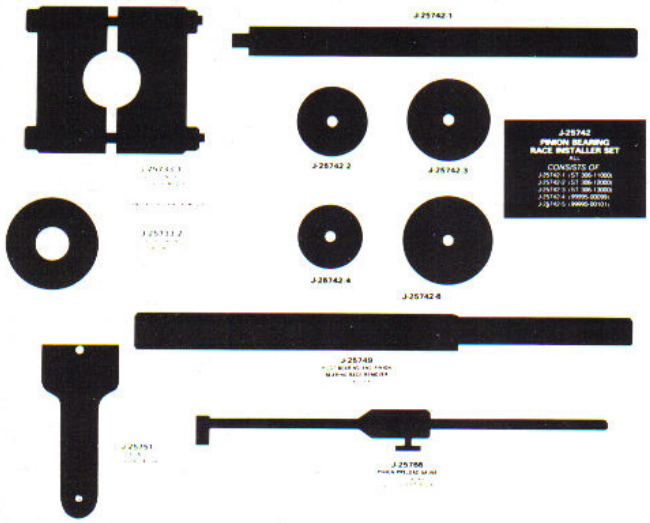
DIFFERENTIAL & AXLE 3



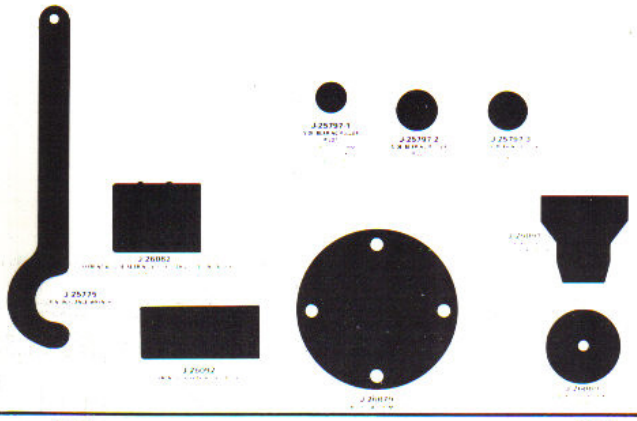
DIFFERENTIAL & AXLE (continued)

ILLUSTRATION	TOOL NO.	DESCRIPTION	DIFFERENTIAL APPLICATION										
			H-145	H-150	R-160	H-165A	H-165B	R-180	SAE H-190	ALUM H-190	H-190	R-200	4-WHEEL DRIVE
	J 25602	Differential Carrier Mounting Attachment (Use with Vise)	X	X									
	J 26033	Differential Carrier Mounting Attachment (Use with J 26023 Stand)		X			X					X	

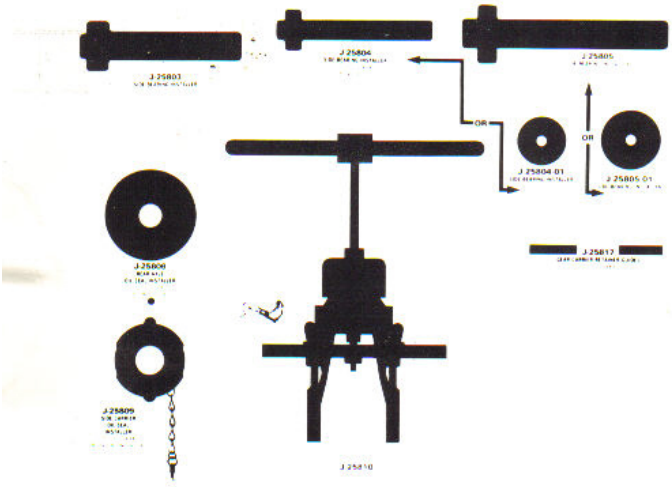
DIFFERENTIAL & AXLE 4



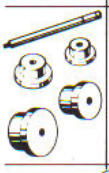
DIFFERENTIAL & AXLE 5



DIFFERENTIAL & AXLE 6



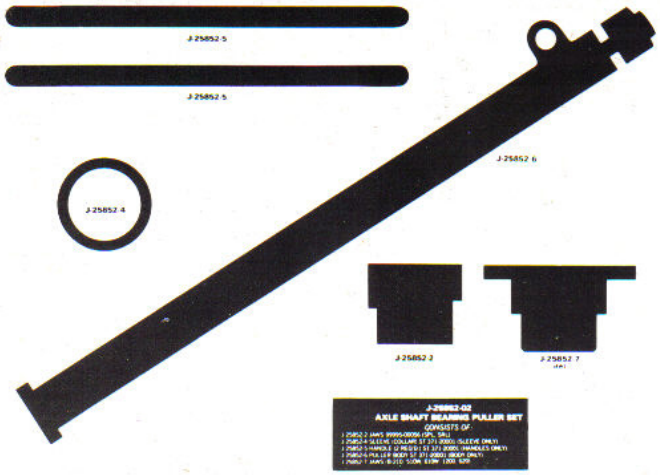
DIFFERENTIAL & AXLE *(continued)*

ILLUSTRATION	TOOL NO.	DESCRIPTION	DIFFERENTIAL APPLICATION										
			H-145	H-150	R-180	H-165A	H-165B	R-180	SAE H-190	ALUM H-190	H-190	R-200	FRONT WHEEL DRIVE
	J 25733	Rear Pinion Bearing Remover & Installer Consists of: J 25733-1 Bearing Remover J 25733-2 Bearing Installer	X X X	X X X	X X	X X X	X X X	X X	X X	X X	X X	X X	X X
	J 25742	Pinion Bearing Race Installer Set Consists of: J 25742-1 Driver Handle J 25742-2 Installer J 25742-3 Installer J 25742-4 Installer J 25742-5 Installer	 X X X	 X X	 X X X	 X X X	 X X X	 X X X	 X X X	 X X X	 X X X	 X X X	
	J 25749	Pilot Bearing & Pinion Bearing Race Remover	X	X	X	X	X	X	X	X	X		
	J 25751	Pinion Oil Seal Installer	X		X	X	X	X	X	X	X		
	J 25765	Pinion Preload Gauge	X	X	X	X	X	X	X	X	X		
	J 25774	Pinion Flange Wrench			X	X	X	X	X	X	X	X	
	J 26092	Front Hub Bearing Installer											X
	J 26093	Front Hub Knuckle Bearing Preload Gauge Set											X
	J 25775-01	Pinion Flange Wrench	X										

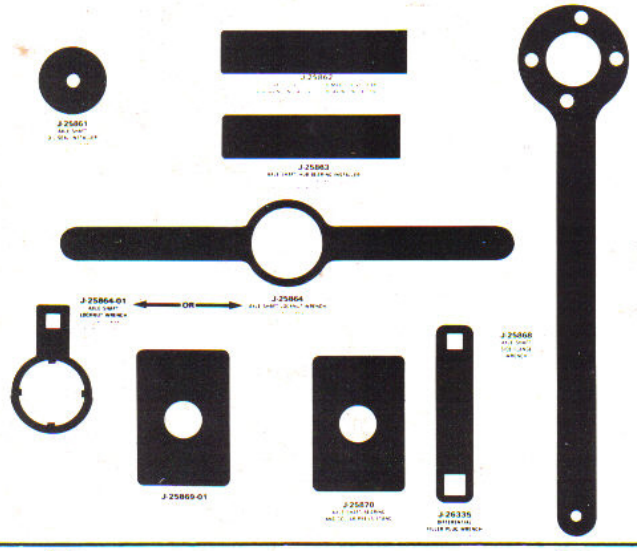
DIFFERENTIAL & AXLE *(continued)*

ILLUSTRATION	TOOL NO.	DESCRIPTION	DIFFERENTIAL APPLICATION										
			H-145	H-150	R-180	H-165A	H-165B	R-180	SAE H-190	ALUM H-190	H-190	R-200	FRONT WHEEL DRIVE
	J 25797-1	Side Bearing Puller Pilot (Use with J 22888)	X	X									
	J 25797-2	Side Bearing Puller Pilot (Use with J 22888)			X			X	X	X	X	X	
	J 25797-3	Side Bearing Puller Pilot (Use with J 22888)				X	X						
	J 25803	Side Bearing Installer				X	X						
	J 25804-01	Side Bearing Installer (Use with J 26090)	X	X									
	J 25805-01	Side Bearing Installer (Use with J 26090)			X			X	X	X	X		
	J 25806	Rear Axle Oil Seal Installer						X				X	
	J 25809	Side Carrier Oil Seal Installer			X			X				X	X
	J 25810	Side Bearing Race Remover			X			X				X	X
	J 25817	Gear Carrier Retainer Guides			X			X					

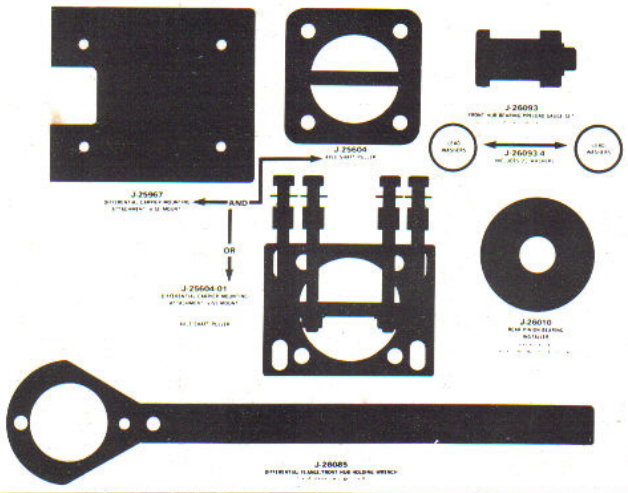
DATSUN DIFFERENTIAL & AXLE 7



DATSUN DIFFERENTIAL & AXLE 8



DATSUN DIFFERENTIAL & AXLE 9



DIFFERENTIAL & AXLE (continued)

ILLUSTRATION	TOOL NO	DESCRIPTION	DIFFERENTIAL APPLICATION										
			H-145	H-150	R-160	H-1854	H-1658	R-180	SAE H-190	ALUM H-190	H-190	R-200	FRONT WHEEL DRIVE
	J 25852-01	Axle Shaft Bearing Puller Set Consists of:	X	X		X	X		X	X	X		
		J 25852-2 Jaws	SPL — SRL										
		J 25852-4 Sleeve J 25852-5 Handle (2 Req'd) J 25852-6 Puller Body	X X X	X X X		X X X	X X X		X X X	X X X	X X X		
	J 25861-01	Axle Shaft Oil Seal Installer			X								
	J 25862	Axle Shaft Hub Bearing Installer			X								X

	J 25863	Axle Shaft Hub Bearing Installer						X				X	
	J 25864-01	Axle Shaft Locknut Wrench (521, 620)									X		
	J 25868	Axle Shaft Side Flange Wrench			X			X					
	J 25869-01	Axle Shaft Bearing & Collar Press Stand			X		X						
	J 25870-01	Axle Shaft Bearing & Collar Press Stand	X	X									
	J 25967	Differential Carrier Mounting Attachment (Vise Mount)			X			X				X	
	J 26010	Rear Pinion Bearing Installer			X			X	X		X	X	
	J 26068	Axle Shaft Remover & Stand (Truck Only)							X	X	X		
	J 26079	Drive Shaft Remover											X
	J 26082	Side Bearing & Side Flange Seal Installer											X
	J 26085	Differential Flange & Front Hub Holding Tool											X
	J 26089	Front Hub Bearing Outer Race Installer											X
	J 26091	Front Hub & Inner Knuckle Oil Seal Installer											X
	J 26099	Differential Shim Organizer	X	X	X	X	X	X	X	X	X	X	X
	J 26335	Differential Filler Plug Wrench			X			X				X	

	J 25604-01	Axle Shaft Remover & Stand	X	X			X	X		X	X	X		X
		Differential Holding Fixture			X				X				X	