



MAINTENANCE INSTRUCTION

TRACTION MOTOR OVERHAUL

Traction motor overhaul instructions are presented in seven sections, each under separate cover, and contain detailed instructions to completely disassemble, inspect, overhaul, assemble, and test the traction motor. Refer to Maintenance Instruction M.I. 3904 for general or "running" maintenance of the traction motor and also for procedures to remove the traction motor from the locomotive truck. These instructions apply to Models D19, D29, D29CC, D29CC-7, D29CCBT, D31, and D36 traction motors unless specifically identified. References to Model D29 motors will include Models D29CC, D29CC-7, D29CCBT, and D31.

<u>Section No.</u>	<u>Title</u>
1	Motor Disassembly
▶2	Bearing Component Inspection
3	Stator Inspection And Reconditioning - Mechanical
4	Stator Inspection And Reconditioning - Electrical
5	Armature Inspection And Reconditioning
6	Armature Overhaul
7	Motor Assembly

SECTION 2 BEARING COMPONENT INSPECTION

INTRODUCTION

This section contains inspection procedures and condemning limits of bearing components. The condemning limit is given on the illustration as a minimum or maximum dimension along with the manufacturing tolerance for the dimension. The condemning limits are given only where wear or distortion is permitted. Any bearing component which does not meet the limits of this Maintenance Instruction should be replaced with a new bearing component.

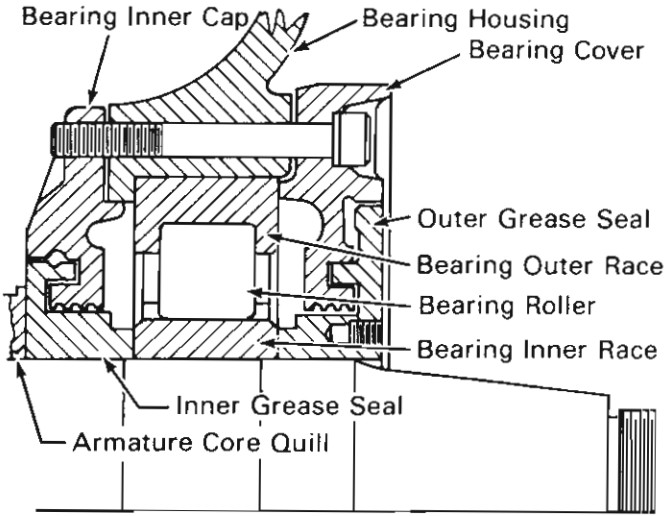
Bearing parts should also be thoroughly inspected for possible evidence of impending failure. Any part which shows signs of distress should be replaced with a new part.

The armature bearings are critical components of the traction motor and should be given most careful handling and a thorough inspection. Refer to Figs. 1 and 2 for illustration of pinion end and commutator end bearing assemblies.

CLEANING

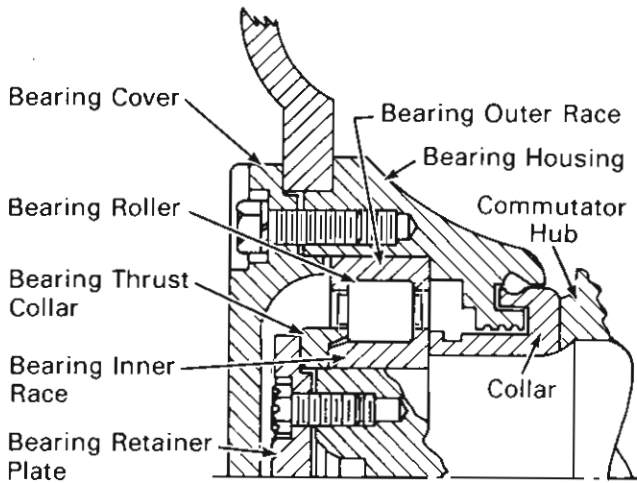
Components associated with the bearing assembly, such as housing, cap, cover, and seals should be thoroughly cleaned prior to inspection to remove all dirt, grease, and other foreign materials. Stoddards Solvent or similar non-corrosive solvent having a flash point of 46° C (115° F) can be used.

*This bulletin is revised and supersedes previous issues of this number.



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Fig. 1 - Pinion End Bearing Assembly



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Fig. 2 - Commutator End Bearing Assembly

CAUTION: Do not wash bearing housing assembly in caustic or submit to cob blast.

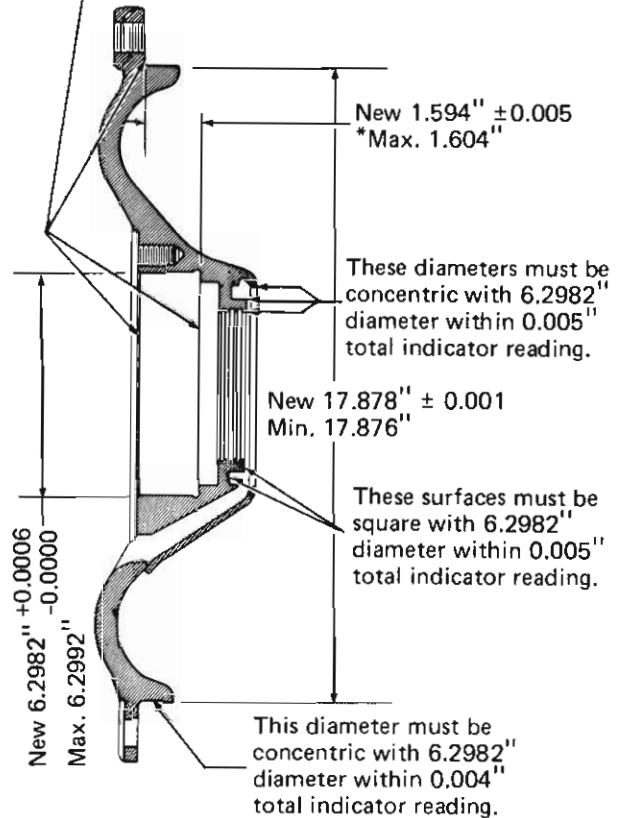
A clean brush or lintless cloth can be used to facilitate cleaning. Gasket surfaces should be given special attention to remove all traces of remaining gasket material.

BEARING ASSOCIATED COMPONENTS

COMMUTATOR END BEARING HOUSING

1. Check bearing housing bore diameter, Fig. 3 or Fig. 4. The bore diameter should be a minimum of 159.974 mm (6.2982") and a maximum of 160.000 mm (6.2992"). When bore diameter is beyond acceptable limits and all other dimensions are within tolerance, the

These surfaces must be square with 17.876" diameter within 0.002" total indicator reading at the bolt circle diameter.



*1/64" distortion allowable 2" either side of jack screw holes.

METRIC CONVERSION CHART			
(inches)	mm	(inches)	mm.
0.0006	0.015	1.604	40.74
0.001	0.03	2	51
0.002	0.05	6.2982	159.974
0.004	0.10	6.2992	160.000
0.005	0.13	17.876	454.05
1/64	0.4	17.878	454.10
1.594	40.49	19-1/2	495

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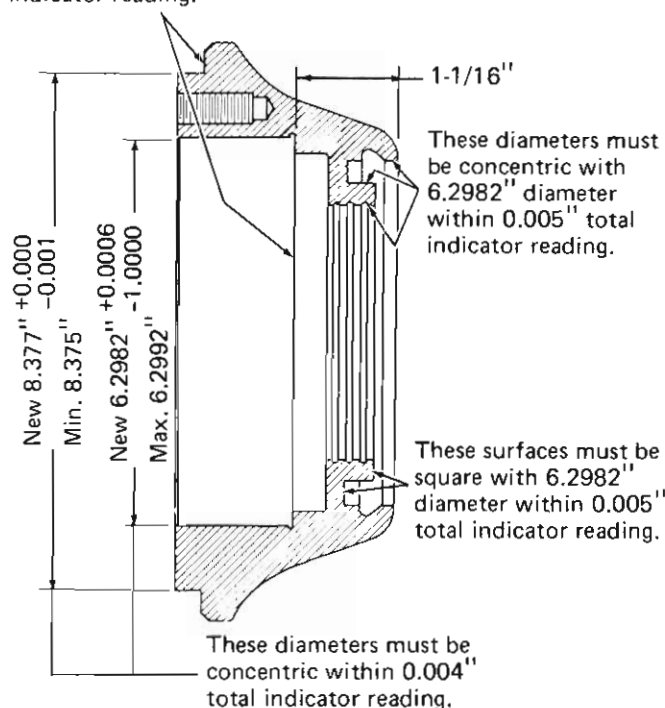
Fig. 3 - Model D19 Commutator End Bearing Housing

bore may be restored by iron, nickel, or chrome plating and remachined to new bore tolerance.

2. Check the inner labyrinth lands for rubbing and broken lands. Broken lands or rubbing in the labyrinth bore shall be cause for rejection.

NOTE: Small nicks or imperfections on ridges are permissible providing they are smoothed down. Remove protrusions only.

These surfaces must be square with 8.377" and 6.2982" diameters within 0.002" total indicator reading.



METRIC CONVERSION CHART			
(inches)	mm	(inches)	mm
0.0006	0.015	1-11/16	42.9
0.001	0.03	6.2982	159.974
0.002	0.05	6.2992	160.000
0.004	0.10	8.375	212.73
0.005	0.13	8.377	212.78

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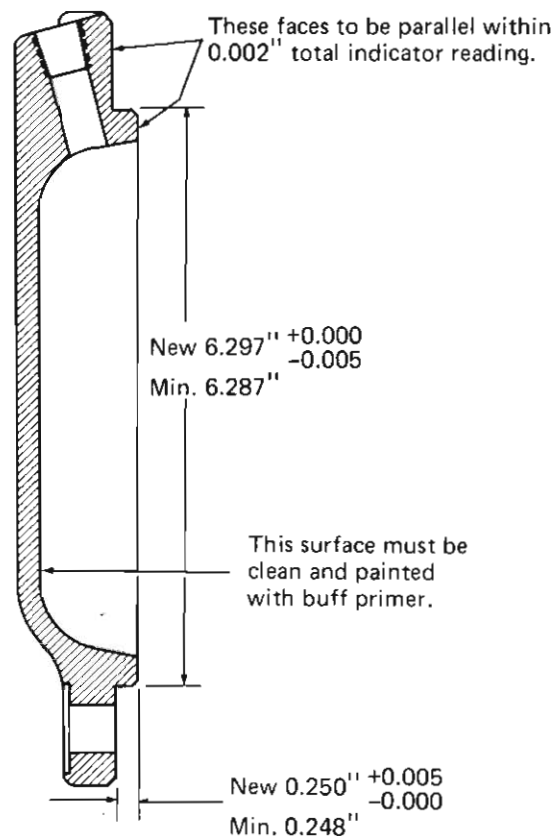
Fig. 4 - Model D29, D31, And D36 Commutator End Bearing Housing

3. Inspect the inside and outside diameter of the counterbore. These diameters should not show any sign of rubbing.
4. Inspect the mounting flange on Model D19 bearing housing for distortion. The mounting surface to inside bearing bore face should not exceed 40.74 mm (1.604"), except an area of 51 mm (2") on either side of the jack-out holes which may be pulled out as much as 0.4 mm (1/64"). If distorted more than this, the housing should not be used.
5. Inspect all tapped holes to make certain they are in usable condition.

6. Check the housing to frame pilot diameter. The condemning limit for a Model D19 bearing housing is 454.05 mm (17.876") and 212.73 mm (8.375") for the Model D29, D31, and D36 bearing housings.

COMMUTATOR END BEARING COVER

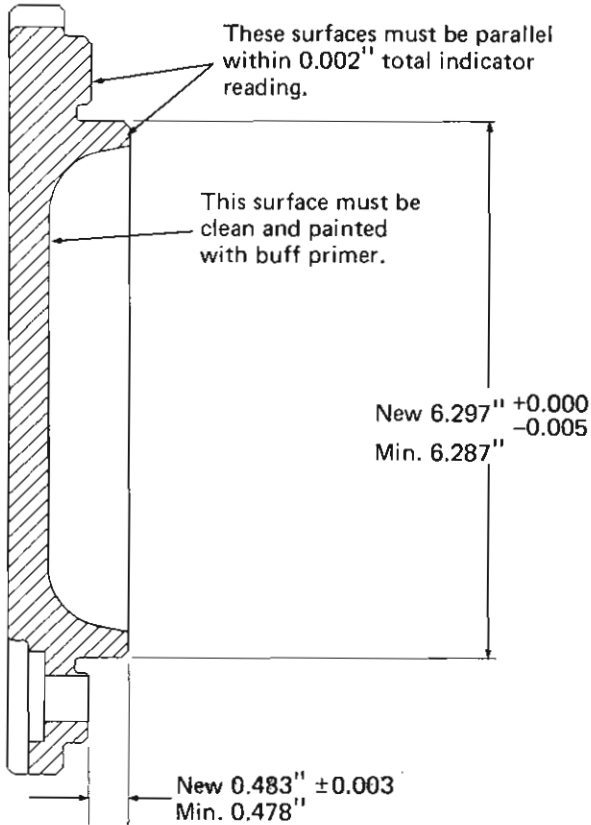
1. Inspect the bearing cover pilot diameter, Fig. 5 or Fig. 6. The pilot diameter should be a minimum of 159.69 mm (6.287") and a maximum of 159.94 mm (6.297").



METRIC CONVERSION CHART	
(inches)	mm
0.002	0.05
0.005	0.13
0.248	6.30
0.250	6.35
6.287	159.69
6.297	159.94

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Fig. 5 - Model D19 Commutator End Bearing Cover



METRIC CONVERSION CHART	
(inches)	mm
0.002	0.05
0.003	0.08
0.005	0.13
0.478	12.14
0.483	12.27
6.287	159.69
6.297	159.94

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Fig. 6 - Model D29, D31, And D36 Commutator End Bearing Cover

2. Check the step next to the mounting face. On Model D19, the step should be a minimum of 6.30 mm (0.248") and a maximum of 6.48 mm (0.255"). On Model D29, D31, or D36, the step should be a minimum of 12.14 mm (0.478") and a maximum of 12.34 mm (0.486").

3. On Model D19 bearing cover, check the threads of the grease tube. The threads must be capable of pressure tightness.

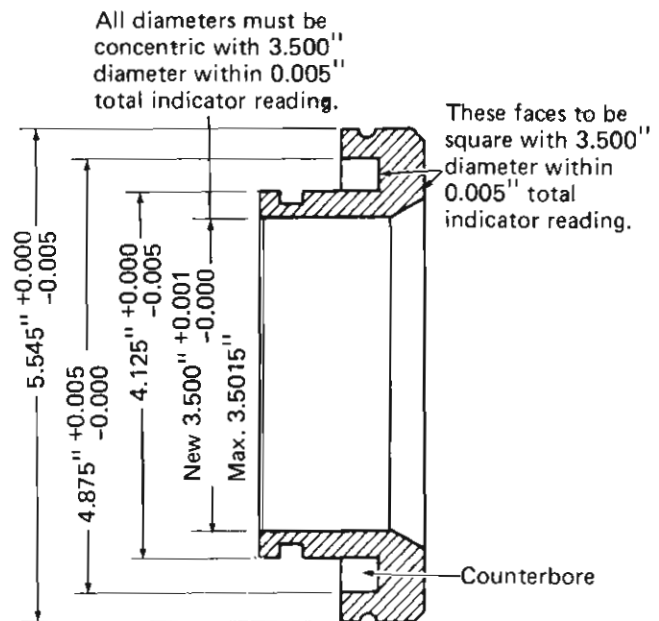
4. Check the mounting surfaces for warped condition. To prevent bearing distortion, the mounting surface must be flat when cover is bolted to the motor.

COMMUTATOR END BEARING RETAINER

The bearing retainer must be flat when assembled to the armature shaft. The contact surface between the bearing retainer and the bearing thrust collar shall not allow a 0.25 mm (.010") feeler gauge to pass at the outside diameter of the bearing retainer.

COMMUTATOR END COLLAR

1. Check the collar bore diameter, Fig. 7. The bore diameter should be a maximum of 88.938 mm (3.5015") and a minimum of 88.90 mm (3.500").



METRIC CONVERSION CHART	
(inches)	mm
0.001	0.03
0.005	0.13
3.5015	88.938
3.500	88.90
4.125	104.78
4.875	123.83
5.545	140.84

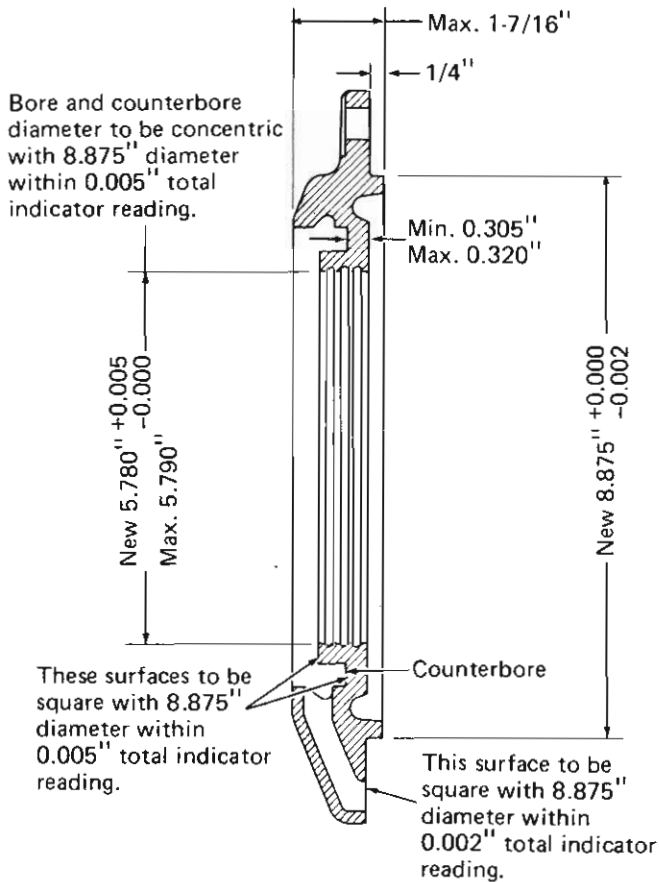
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Fig. 7 - Commutator End Collar

2. Visually inspect the collar outside diameter and the outside and inside diameter of the collar counterbore for rubbing marks. When rubbing is found on any of these diameters and the dimensions deviate 0.13 mm (0.005") from dimensions shown in Fig. 7, the part must not be used.

PINION END BEARING INNER CAP

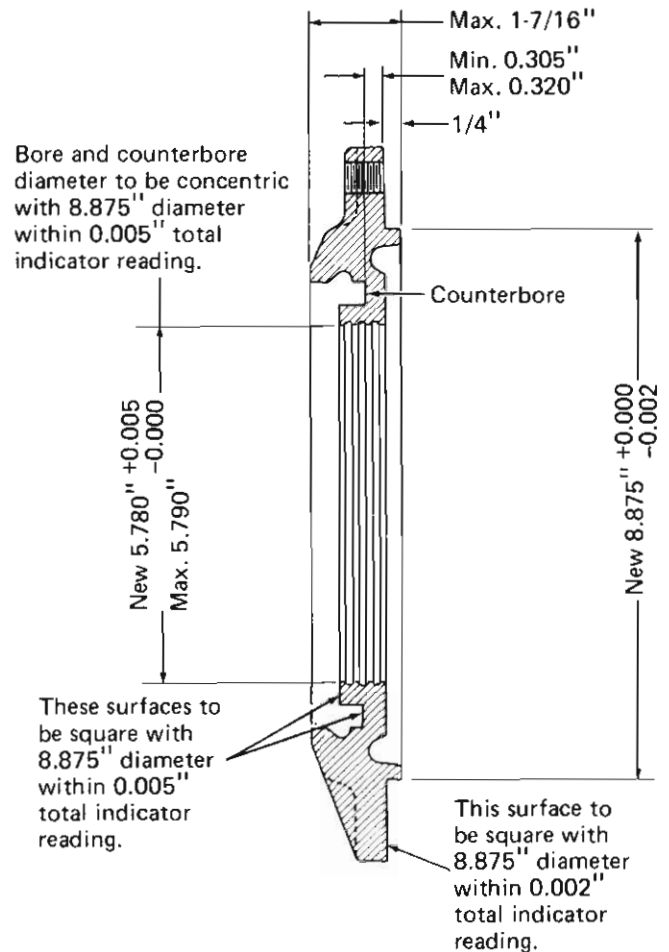
1. Inspect the bearing inner cap labyrinth lands for wear and broken lands. No rubbing or broken lands are permissible. Small nicks should be smoothed out.



METRIC CONVERSION CHART	
(inches)	mm
0.002	0.05
0.005	0.13
1/4	6.4
0.305	7.75
0.320	8.13
1-7/16	36.5
5.780	146.81
5.790	147.07
8.875	225.43

Fig. 8 - Model D19 Pinion End Bearing Inner Cap

2. Check the bearing bore diameter, Fig. 8 or Fig. 9. The bore diameter should be a minimum of 146.81 mm (5.780") and a maximum of 147.07 mm (5.790"). The bore must be concentric with the 225.43 mm (8.875") pilot diameter and have no taper.
3. Check the counterbore inside and outside diameters for wear or rubbing. No wear or rubbing is permitted on these diameters.



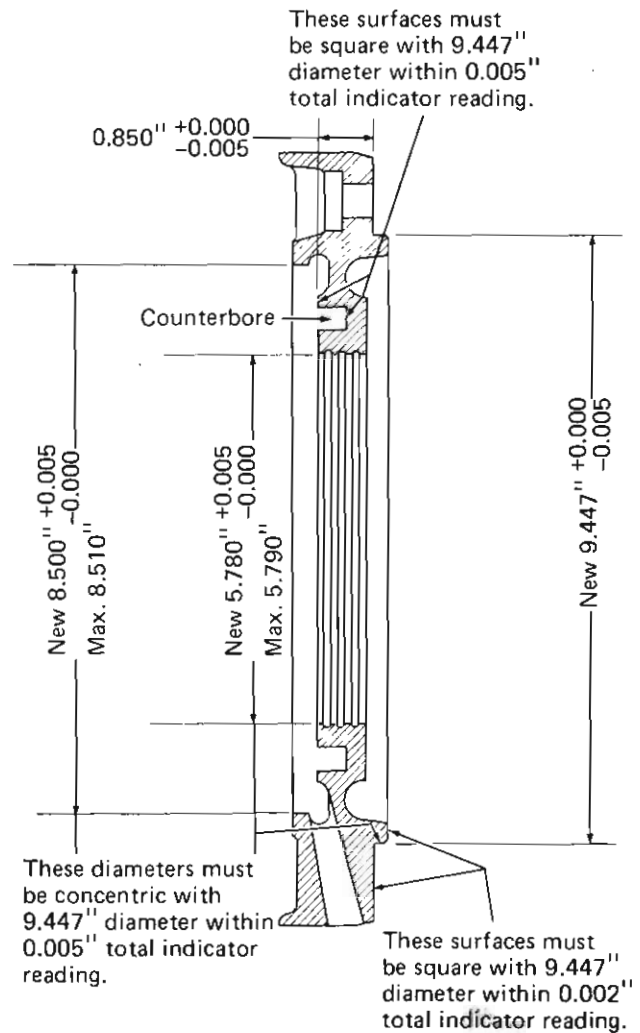
METRIC CONVERSION CHART	
(inches)	mm
0.002	0.05
0.005	0.13
1/4	6.4
0.305	7.75
0.320	8.13
1-7/16	36.5
5.780	146.81
5.790	147.07
8.875	225.43

Fig. 9 - Model D29, D31, And D36 Pinion End Inner Bearing Cap

4. Check the dimension from the gasket face surface to the bottom of the counterbore. The dimension should be a minimum of 7.75 mm (.305") and a maximum of 8.13 mm (.320"). When the dimension is beyond these limits, it is assumed that the cap is distorted and must be replaced with a new cap.

PINION END BEARING COVER

1. Inspect the bearing cover labyrinth lands for wear and broken lands. No rubbing or broken lands are permissible. Small nicks should be smoothed out.
2. Check the bearing bore diameter, Fig. 10. The bore diameter should be a minimum of 146.81 mm (5.780") and a maximum of 147.07 mm (5.790"). The bore must be concentric with the 239.95 mm (9.447") pilot diameter and have no taper.
3. Check the counterbore inside and outside diameters for wear or rubbing. No wear or rubbing is permitted on these diameters.
4. Check the dimension from the gasket face surface to the top of the counterbore. The dimension should be a minimum of 21.46 mm (.845") and a maximum of 21.59 mm (.850"). When the dimension is beyond these limits, it can be assumed that the cover is distorted and must be replaced with a new cover.
5. Check the outer seal diameter surface for wear or rubbing. Wear or rubbing on this surface is not permitted. The diameter should be a minimum of 215.90 mm (8.500") and a maximum of 216.15 mm (8.510"). When the dimension is beyond these limits, the cover must be replaced with a new cover.



METRIC CONVERSION CHART	
(inch)	mm
0.002	0.05
0.005	0.13
0.850	21.59
5.780	146.81
5.790	147.07
8.500	215.90
8.510	216.15
9.447	239.95

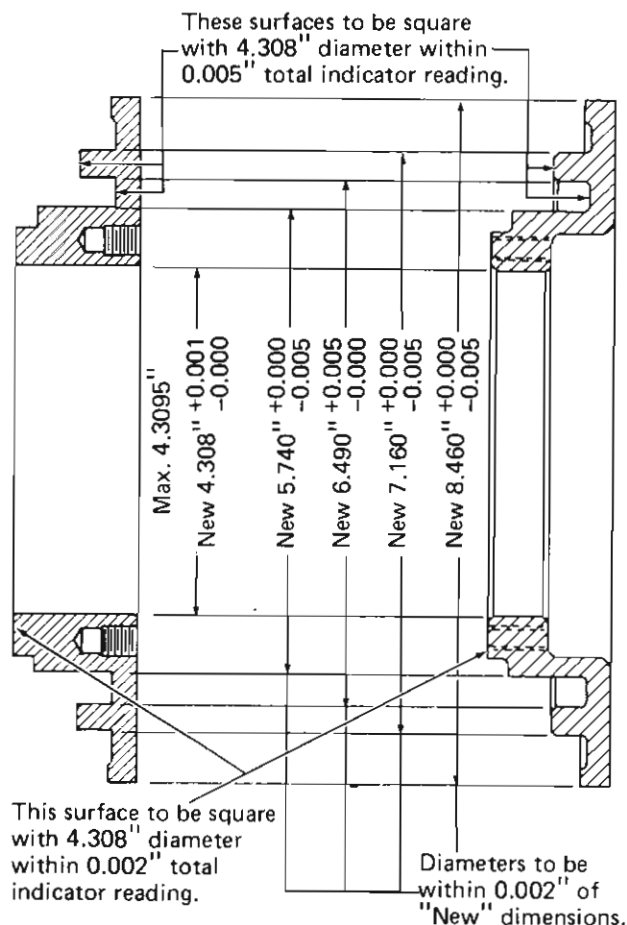
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Fig. 10 - Pinion End Bearing Cover

PINION END OUTER GREASE SEAL

1. Check the outer grease seal bore diameter, Fig. 11. The bore diameter should be a minimum of 109.42 mm (4.308") and a maximum of 109.461 mm (4.3095").
2. Inspect all the diameters for wear or rubbing. When any diameter, other than bore diameter, deviates more than 0.05 mm (.002") from dimensions of Fig. 11, replace outer grease seal with a new outer grease seal.

All diameters to be concentric with 4.308" diameter within 0.005" total indicator reading.



D19 And D29

D36

METRIC CONVERSION CHART	
(inch)	mm
0.001	0.03
0.002	0.05
0.005	0.13
4.308	109.42
4.3095	109.461
5.740	145.80
6.490	164.85
7.160	181.86

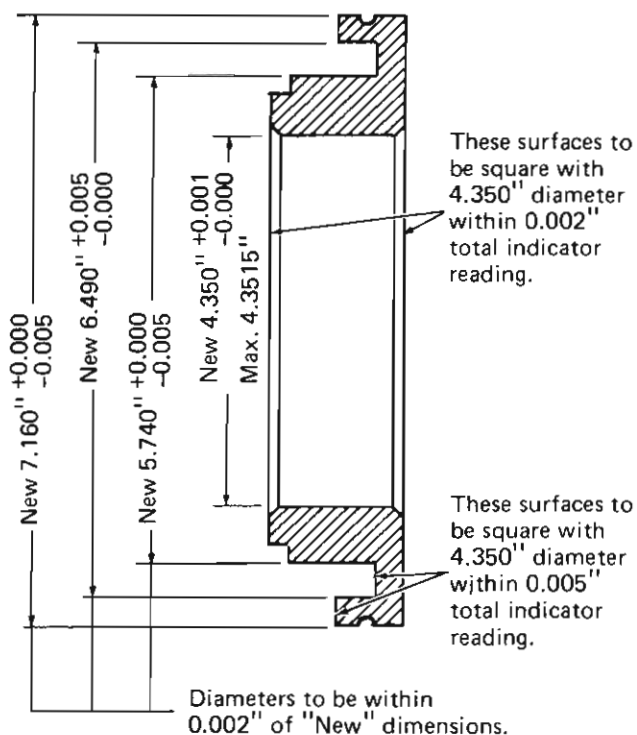
Fig. 11 - Pinion End Outer Grease Seal

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3. Check the outer grease seal for flatness and squareness. Flatness and squareness must conform to the limits of Fig. 11. When the dimensions are beyond these limits, it can be assumed the outer grease seal is distorted and must be replaced with a new outer grease seal.

PINION END INNER GREASE SEAL

1. Check the inner grease seal bore diameter, Fig. 12. The bore diameter should be a minimum of 110.49 mm (4.350") and a maximum of 110.528 mm (4.3515").



METRIC CONVERSION CHART	
(inches)	mm
0.001	0.03
0.002	0.05
0.005	0.13
4.350	110.49
4.351	110.52
5.740	145.80
6.490	164.85
7.160	181.86

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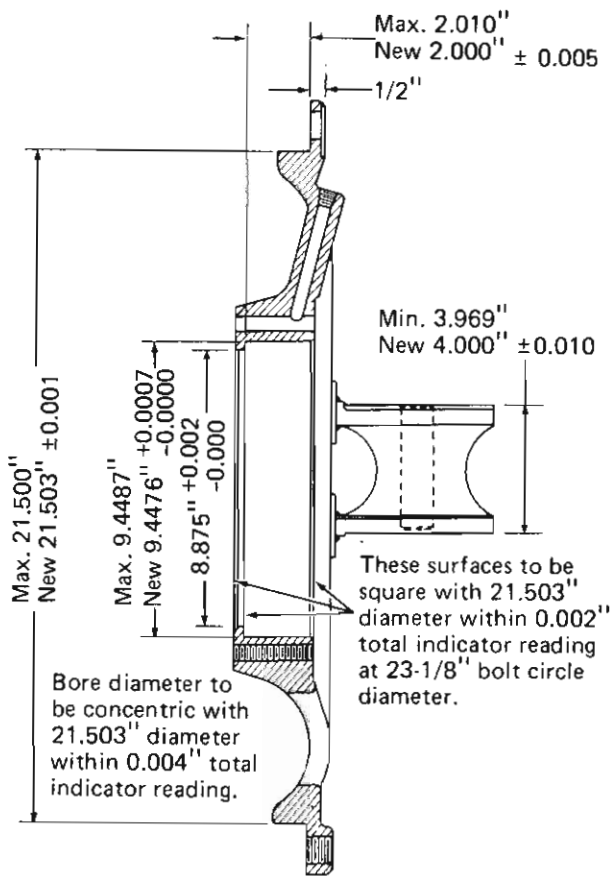
Fig. 12 - Pinion End Inner Grease Seal

2. Inspect all the diameters for wear or rubbing. When any diameter, other than bore diameter, deviates more than 0.05 mm (.002") from dimensions of Fig. 12, replace inner grease seal with a new seal.

3. Check the inner grease seal for flatness and squareness. Flatness and squareness must conform to the limits of Fig. 12. When the dimensions are beyond these limits, it can be assumed the inner grease seal is distorted and must be replaced with a new seal.

PINION END BEARING HOUSING

1. Check the bearing housing bore diameter, Fig. 13 or Fig. 14. The bore diameter should be a minimum of 239.969 mm (9.4476") and a maximum of 239.997 mm (9.4487").
2. Check the housing to frame pilot diameter. The pilot diameter should be a minimum of



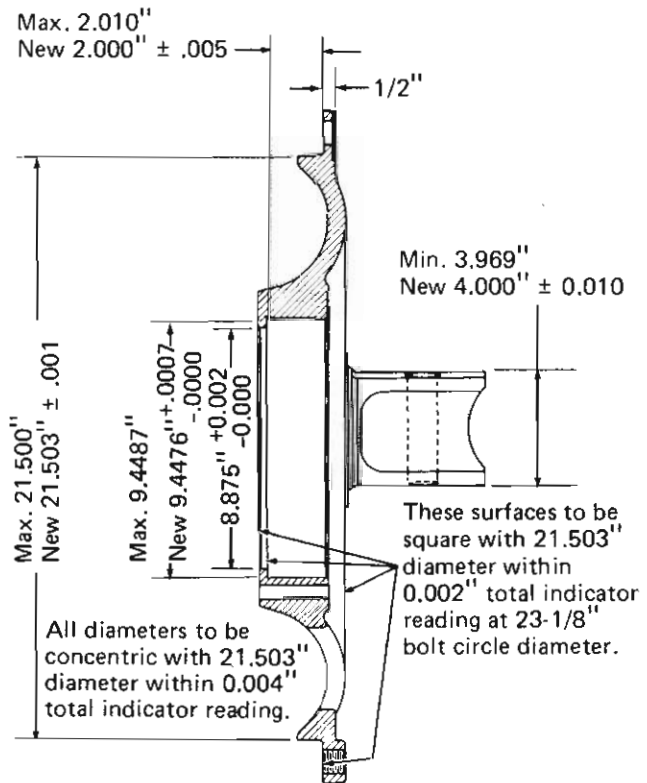
METRIC CONVERSION CHART			
(inch)	mm	(inch)	mm
0.0007	0.018	2.010	51.05
0.001	0.03	3.969	100.81
0.002	0.05	4.000	101.60
0.004	0.10	8.875	225.43
0.005	0.13	9.4476	239.969
0.010	0.25	9.4487	239.997
1/2	13	21.500	546.10
2.000	50.80	21.503	546.18
		23-1/8	587.4

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Fig. 13 - Model D19 Pinion End Bearing Housing

546.15 mm (21.502") and a maximum of 546.10 mm (21.500").

3. Inspect the housing for warped or distorted condition. The mounting surface to the inside bearing seat should not exceed 51.05 mm (2.010"), except an area of 51 mm (2") on either side of the jack screw holes may be distorted up to 0.40 mm (1/64"). If distorted more than this, the housing should be replaced with a new housing.
4. Check the dimension between the upper and lower faces of the gear case support lug. The dimension should be a minimum of 100.81 mm (3.969"). When the dimension is worn



METRIC CONVERSION CHART			
(inches)	mm	(inches)	mm
0.0007	0.018	3.969	100.81
0.001	0.03	4.000	101.60
0.002	0.05	8.875	225.43
0.004	0.10	9.4476	239.969
0.005	0.13	9.4487	239.997
0.010	0.25	21.500	546.10
1/2	13	21.503	546.18
2.000	50.80	23-1/8	587.4
2.010	51.05		

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Fig. 14 - Model D29, D31, And D36 Pinion End Bearing Housing

below limit, the surface can be built up with weld and machined to the "new" dimension of Fig. 13 or 14.

5. Inspect all tapped holes. Ensure tapped holes are in usable condition.
6. In older models where screens are used over ventilation holes, check condition of screens. Repair or replace damaged screens by welding end of each wire to the housing.

BEARING COMPONENTS

CLEANING

Upon disassembly of the traction motor, the armature bearings should have been kept together as an assembly and protected from dirt or damage by wrapping in clean noncorrosive paper. After unwrapping for cleaning and inspection, every care should be taken to keep the bearings clean and to handle them carefully.

Bearings should be washed with clean Stoddards Solvent or some similar noncorrosive solvent with flash point of 46°C (115° F) or higher. Apply solvent with a brush or rag, being careful that bristles and threads do not become loose in bearings. Cotton waste should never be used. A tank with a small motor driven pump with hose and nozzle connection will be found advantageous in reaching inaccessible spots in the bearing.

INSPECTION PROCEDURE

Roller bearing assemblies should be carefully inspected with the aid of adequate light and a magnifying glass of two power (2X). Bearings should be handled with clean hands adequately protected by lanolin to prevent staining and corrosion.

In order to keep the details of each inspection as clear and concise as possible, a glossary of terms follows.

GLOSSARY OF TERMS

Cracks -- Separations of the bearing material resulting in jagged dark lines or chasms, caused by material defects, severe mishandling, overheating, overstressing, or fatiguing.

Craters -- Small deformities in the normal surface with ragged edges, molten, discolored, bright bottoms, and a contrasting edge. They are formed

by the passage of electrical currents through the bearing and are dangerous when the area is large enough to increase the unit load, or when the depth indicates a large electrical discharge and subsequent tempering of the bearing metal.

Dents -- Shallow deformations in the normal surface. They are caused by smoothedged particles being forced or rolled into the surface. If severe, they may rupture the surface, cause a protrusion, or if large, act as a flat.

Flaking -- Small areas of the normal surface where the steel has been freed, revealing a "fish-scale" appearance. Flaking is usually the next stage after pitting (but sometimes is the first apparent indication of fatigue) which has developed from a pit formed since the last inspection.

Flats -- Sections of the normal surface with bright bottoms which have been reduced from the original diameter. They can be caused by grinding, severe denting due to handling, skidding of a roller when held in the loaded area, by faulty reduction of a protrusion, and by severe denting from static load (brinnelling). Flats cause the bearing parts to be stressed abnormally.

Galling -- Transfer of metal from one part onto another. This is caused by relative motion under extremely high pressures without lubrication, generally accompanied by heating.

Nicks -- Sharp-bottomed deformations in normal surface of some depth, but relatively little width. They are caused by a sharp edge being forced into the surface. If severe, they may rupture the surface or cause a protrusion.

Operating Surfaces -- The areas of the rollers and races which contact each other under load.

Pits -- Small holes in the normal surface with ragged edges and dark bottoms. They are caused by extended corrosion, fatigue cracking, and minute flaking. Those due to fatiguing will generally be accomplished by indentation or imprinting of the material freed from the surface and then rolled between the rollers and races. Those due to corrosion will be localized to those sections originally stained or etched. It can be seen that fatigue pits are the initial signal of failure and the end of useful life, and therefore demand scrapping of the parts involved. Corrosion pits, if isolated and arrested in growth, are dangerous only in that they reduce the contact area and increase the unit load, thereby increasing the rate at which the part is fatiguing.

Protrusions – Metal displaced above normal surface. On operating surfaces, this results in stress concentrations at protrusions and hastens fatigue. They are found around some dents, nicks, scratches, scores, and craters.

Roller Path -- That section of the race which the rollers contacted in service. This can be detected from the normal surface by the wearing of the original grinding nap.

Ruptures – Separations of the normal surface generally leaving sharp corners, jagged edges, or cracked sections at their bottoms. They are found in some dents, scratches, nicks, and scores. Ruptures are the focal points for fatigue stresses and so can be the origin of the cracks, pits, flaking, spalling, and the ultimate failure.

Scores – Axial deformations of heavy character with a rough or torn bottom. They are caused by gouging a bearing surface while forcing a roller over a race under load and while slightly cocked.

Scratches – Deformations of the normal surface with bright bottoms caused by forcing hard sharp objects over the surface in long, narrow, sharp-bottomed gouges. Scratches are generally of little danger so long as they have no protruding edges, do not rupture the normal surface, and do not constitute a flat.

Seams – Inclusions of foreign material in the bearing metal which are exposed on the normal surface. They are harmful only when too large or numerous.

Shelling – Areas on the normal surface where the material has broken loose, leaving jagged edges with a rough "washboard" bottom which is sometimes bright. This is caused by advanced fatiguing beyond the pitting stage, in which large sections of the surface are freed by extensive subsurface cracking.

GENERAL

On all bearings which have seen appreciable service, some dents, nicks, pits, and craters will be found. If these are small and scattered, they should not cause rejection; however, they must be evaluated with good judgment and with reference to the overall condition of the bearing. All doubtful parts should be discarded to be on the safe side.

Failed parts should be replaced with either new or acceptable reconditioned parts. It must be remembered that if one part of an assembly has been under any extended or excessive stresses which result in a visible defect severe enough to scrap the part, then the rest of the assembly requires a detailed inspection and evaluation before use.

The inspection procedure which follows is divided into four parts as follows: (1) Operating surfaces, (2) Nonoperating surfaces, (3) Cages, and (4) Dimensional.

OPERATING SURFACES

All exposed operating surfaces must be inspected visually to ensure that they contain none of the following defects which will be cause for rejection:

1. Protrusions above the normal surface.

NOTE: Protrusions should be reduced to the normal surface by light circumferential honing with Arkansas stone (novaculite) or grade 240 abrasive cloth. Likewise, the sharp edges should be smoothed. Care must be taken to work down to the normal surface only, to prevent reduction of contact area, and to work circumferentially so as to prevent the formation of flats.

2. Cracks and flats.
3. Ruptures, tears or seams 2.4 mm (3/32") or more in length, or more than hairline width.
4. Scores, or deep scratches which extend more than 75% of the length of the operating surface and are inclined at less than 10° to the axis.
5. Corrosion pits 0.8 mm (1/32") or more in diameter.
6. Craters or pits from electrical arcing 0.8 mm (1/32") or more in diameter.
7. Profuse denting or cratering.
8. Overheating.
9. Circumferential pattern of pits or dents at the ends of the roller path.
10. Fatigue pits, flaking, shelling or galling.

NONOPERATING SURFACES

All nonoperating surfaces are to be visually inspected for:

Rust – Remove by rubbing with a grade 240 abrasive cloth. If rust pits of great depth are encountered they must be cleaned.

Galling -- Smooth down by rubbing with a grade 240 abrasive cloth. Care must be taken not to reduce the normal surface. (See Dimensional).

Cracks – Reject bearing.

Severe Physical Abuse – Evaluate to determine if it is heavy enough to affect the operating surfaces. In addition, each such location must be reduced by light honing with an Arkansas stone.

Overheating – Reject bearing.

CAGES

Cages must be inspected to ensure that they are free from cracks and burrs and have no loose or missing rivets.

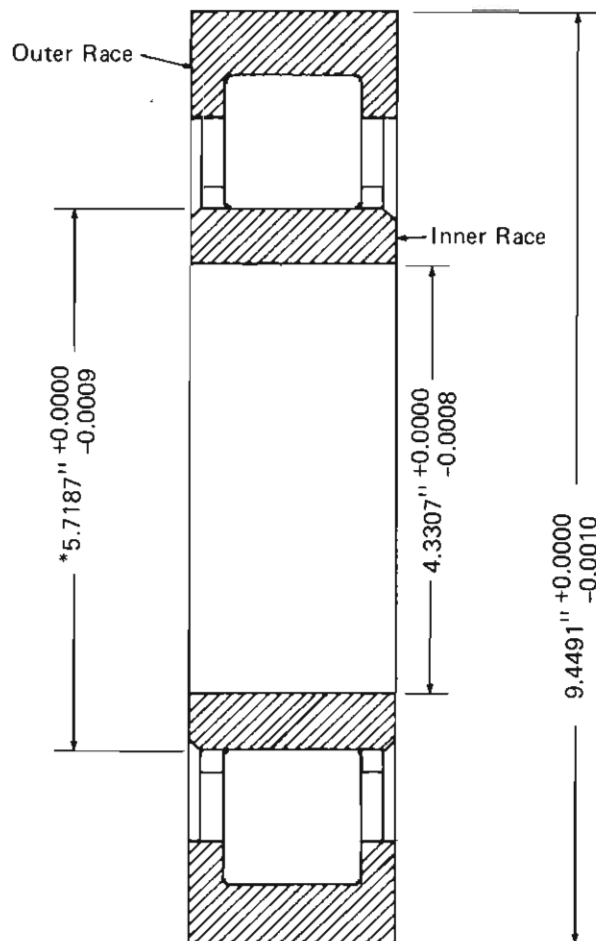
DIMENSIONAL

Bearing parts must be checked dimensionally so as to maintain the proper fits and to determine the change in internal clearance due to wear.

The following tolerances must be held on the diameters of the races:

Pinion End Bearing

1. Inner race inside diameter 110.000 mm to 109.979 mm (4.3307" to 4.3299"). See Fig. 15.
2. Outer race outside diameter 240.007 mm to 239.982 mm (9.4491" to 9.4481"). See Fig. 15.



*Bearing Roller Assembly Inside Diameter 5.7251" to 5.7243"

METRIC CONVERSION CHART			
(inches)	mm	(inches)	mm
0.0008	0.020	5.7187	145.255
0.0009	0.023	5.7243	145.397
0.0010	0.025	5.7251	145.418
4.3307	110.000	9.4491	240.007

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Fig. 15 – Pinion End Bearing

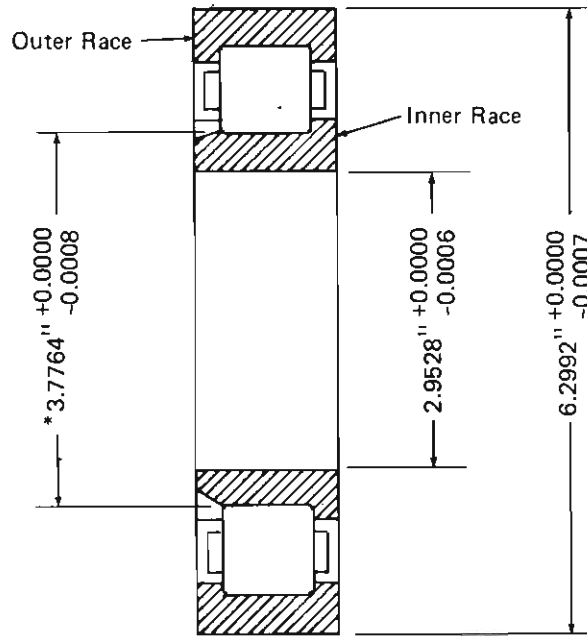
Commutator End Bearing

1. Inner race inside diameter 75.001 mm to 74.986 mm (2.9528" to 2.9522"). See Fig. 16.
2. Outer race outside diameter 160.000 mm to 159.982 mm (6.2992" to 6.2985"). See Fig. 16.

Pinion end inner races must be measured to assure that no race, with a roller path diameter deviating 0.03 mm (.001") or more from the normal unworn surface, will be used. Races with such a deviation are to be scrapped because of the possibility of being assembled so that the rollers will run on the ridge rather than on the worn circumference.

The free internal radial clearance is checked by hanging the assembled bearing by its inner race and passing a feeler gauge between each roller and race on the unloaded side for limits to be maintained. Clearance between race and rollers of bearings not installed in motors is as follows:

- Pinion end bearing - 0.142 mm to 0.185 mm (0.0056" to 0.0073").
- Commutator end - 0.102 mm to 0.142 mm (0.0040" to 0.0056").



*Bearing Roller Assembly Inside Diameter 3.7812" to 3.7804"

METRIC CONVERSION CHART			
(inches)	mm	(inches)	mm
0.0006	0.015	3.7764	95.921
0.0007	0.018	3.7804	96.022
0.0008	0.020	3.7812	96.042
2.9528	75.001	6.2992	160.000

Fig. 16 - Commutator End Bearing

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SERVICE DATA

MATERIAL LIST

Primer, Buff - 4 litre (1 gal) 8228726