

# Synchronizer Warranty Repair Strategy TRSM0915 EN-US

October 2007



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## Warnings and Precautions



Before starting a vehicle always be seated in the driver's seat, place the transmission in neutral, set the parking brakes and disengage the clutch.

Before working on a vehicle place the transmission in neutral, set the parking brakes and block the wheels.

Before towing the vehicle place the transmission in neutral, and lift the rear wheels off the ground, remove the axle shafts, or disconnect the driveline to avoid damage to the transmission during towing.

The description and specifications contained in this service publication are current at the time of printing.

Eaton reserves the right to discontinue or modify its models and/or procedures and to change specifications at any time without notice.

Any reference to brand name in this publication is made as an example of the types of tools and materials recommended for use and should not be considered an endorsement. Equivalents may be used.



This symbol is used throughout this manual to call attention to procedures where carelessness or failure to follow specific instructions may result in personal injury and/or component damage.

Departure from the instructions, choice of tools, materials and recommended parts mentioned in this publication may jeopardize the personal safety of the service technician or vehicle operator.

**Warning:** Failure to follow indicated procedures creates a high risk of personal injury to the servicing technician.

**Caution:** Failure to follow indicated procedures may cause component damage or malfunction.

**Note:** Additional service information not covered in the service procedures.

**Tip:** Helpful removal and installation procedures to aid in the service of this unit.

**Always use genuine Eaton replacement parts.**

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## What Is In This Guide?

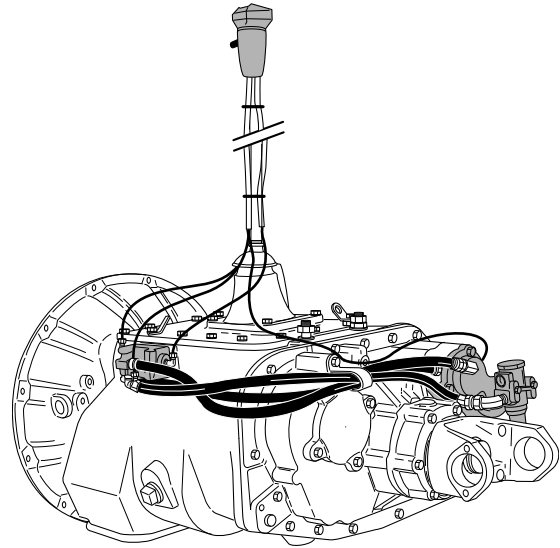
The repair strategy contained in this document is intended to guide the mechanic in the proper replacement of parts associated with a synchronizer repair for standard heavy duty Eaton Fuller transmissions. For questions regarding warrantability, call the Roadranger Call Center at 1-800-826-HELP (4357).

## Tips for Synchronizer Repairs

- Always confirm the complaint.
- Always perform diagnostics before any repair.
- Always verify proper transmission performance after any repair.

## Reference Literature

- Eaton Warranty Manual - TCWY-0900
- Air System Troubleshooting/Operation Guide - TRTS-0902
- General Troubleshooting Guide - TRTS-0910
- Understanding Spur Gear Life - TRSM-0913



## Most Common Reasons for Delayed, Adjusted or Rejected Warranty Claims

These apply to Transmission, Axle, and Brake Warranty Claims

1. Labor hours exceed Standard Repair Times (SRT).
  - The original equipment manufacturer determines R & R labor times.
  - Eaton Truck Components determines bench repair labor times.
2. Labor hours charged to a claim contain operations not required to perform necessary repairs.
  - Example, complete overhaul of transmission for a synchronizer repair or an auxiliary repair for a mainshaft repair.
3. Parts mark-up exceed normal margins.
  - Parts improperly priced
4. Unauthorized product updates.
  - Any product update not related to the warrantable repair must first be authorized by Roadranger Truck Components.
5. Over repair.
  - Replacing reusable parts
  - Replacing component that should be repaired
6. All parts replaced during the repair were not returned when requested.
7. Non-covered parts added to an extended warranty claim\*.
  - Miscellaneous parts or shop supplies
  - Towing added to a claim
  - Secondary damage to non-Roadranger parts
  - See warranty manual for complete list of non-covered items (ref. TCWY-0600, Section 5)
8. Roadranger product is not the primary cause for repair.
  - Driveline failure, master clutch breakage, or suspension worn or misadjusted, any of which damages the Roadranger component.
9. Subsequent repair/rebuild from an improper prior repair.
  - Gasket leaks
  - Debris from previous failure
  - Repeat failures

10. Non-warrantable failure.
  - Engine/Transmission mismatch (possible result of engine re-rate)
  - Application/Vehicle mismatch which results in an unapproved application
  - Operational abuse
  - Faulty maintenance practices
  - Normal wear
11. No failure.
12. Vehicle out of warranty.
13. Claim too old.
  - Claims must be submitted within 90 days of the repair.
14. No Roadranger product serial number on claim.
15. Claim has already been paid.
16. Vehicle not meeting the requirements for extended warranty.
17. Re-submitted original rejected claim with no new information to support claim.
18. Warranty claim without an itemized list of parts replaced.

\* During the OEM warranty period, the truck manufacturer may cover items listed on the Exclusions List in the Roadranger Warranty Manual. Contact your OEM for details.

## Synchronizer Warranty Coverage

Please read the following information carefully when performing a synchronizer-related repair during the warranty period.

Synchronizer repairs not covered during the warranty period include those repairs caused by vehicle air system contamination, drivetrain torsional activity (vibration), driver induced damage, vocationally induced damage, and damage due to inadequate or improper previous repairs.

During the warranty period, use this guide to make repairs to the synchronizer assembly and related parts. Replace parts under the "Replace when" category and reuse parts under the "Reuse when" category. Warranty claims with usable parts replaced and non-warrantable parts charged to the claim are not reimbursable during the warranty period. Duplicate parts used in different kits are not reimbursable on a warranty claim. Synchronizer repairs will not require the replacement of the transmission.

**Note:** Any elective repair made during the warranty period is not reimbursable on a warranty claim. Normal wear on parts not associated with the repair are not covered under warranty.

### Labor Necessary to Repair Synchronizer

R & R auxiliary section only. Use standard OEM repair times or refer to section 4 of the Eaton Warranty Manual, TCYT-0900 for labor hour guidelines. Labor hour guidelines include replacement of all damaged synchronizer pieces. Repair does not require complete transmission removal or complete auxiliary overhaul, except the "FR" series, which in some cases, requires complete transmission removal.

### Air System Repair

Repairing air system components are not part of a normal repair unless proper diagnosis reveals air leaks, piston/shaft binding, contamination, or low air pressure. Air system components include the air regulator, master control valve, slave valve, air cylinders overhaul (o-rings), and cylinder/cover valve assemblies used in splitter style transmissions. Refer to the Air System Troubleshooting/Operation Guide, TRTS-0920, for proper diagnostics of air system components.

### Bearing Replacement

Bearing replacement is not considered a normal part of a warrantable synchronizer repair.

### Auxiliary Countershaft

Countershaft replacement is not considered a normal part of a warrantable synchronizer repair. Wear to the countershafts due to the synchronizer contacting the gear face is not cause to replace countershafts.

### Miscellaneous Parts Normally Replaced During a Repair

The following parts are considered normal replacement parts for a warrantable synchronizer repair:

1. Gasket between main case and auxiliary case
2. Gaskets for countershaft rear bearing covers
3. Gasket for shift bar housing on "FR" series only
4. Gasket for range cylinder cover (not all models)

### Lubrication Replacement is NOT a Normal Part of a Repair

See the Roadranger Lubrication Manual, TCMT-0021 for specific lubrication usage.

Replacing seals, gaskets, and output shaft nuts are not considered a normal part of a synchronizer repair.

### Troubleshooting Synchronizer Complaints

Refer to the General Troubleshooting Guide, TRTS-0910.

## Repair Standards

The following descriptions cover the normal repair strategy for the mainshaft assembly. All mainshaft parts should be inspected for abnormal wear while transmission is disassembled.

### Labor Necessary to Repair Front Box Mainshaft Assembly

Transmission mainshaft repair requires complete removal of the transmission from the vehicle. Use standard OEM repair times or refer to Section 4 of the Roadranger Warranty Manual for labor hour guidelines. Labor hour guidelines include replacement of all damaged mainshaft pieces. Repair does not normally require overhaul of the auxiliary section, except when contamination is significant as indicated below.



*Replace lube and bearings when damage to gearing appears similar to or worse than damage on this gear. Replacement is required due to fine particle contamination.*

### Air System Repair

Repairing air system component is not part of a mainshaft assembly repair.

### Bearing and Lubrication Replacement

Bearing replacement is only required when bearings are damaged during normal removal and with high levels of oil contamination. Reuse most bearings during mainshaft assembly repair. Refer to figures for "rule of thumb" on how to determine when contamination levels require bearing replacement.



*Re-use lube and bearings when damage to gearing appears similar to damage on this gear.*

Lubrication replacement is recommended when significant damage is done to external gear teeth. Use the same criteria of contamination used for proper bearing replacement. See the Eaton Warranty Manual for specific lubrication usage.

### Miscellaneous Parts Normally Replaced During a Repair


The following parts are considered normal replacement parts for a warrantable mainshaft washer repair:

- All gaskets where sealing surface was broken.
- The rear bearing on the upper countershaft in the front section. This bearing is typically damaged during removal.

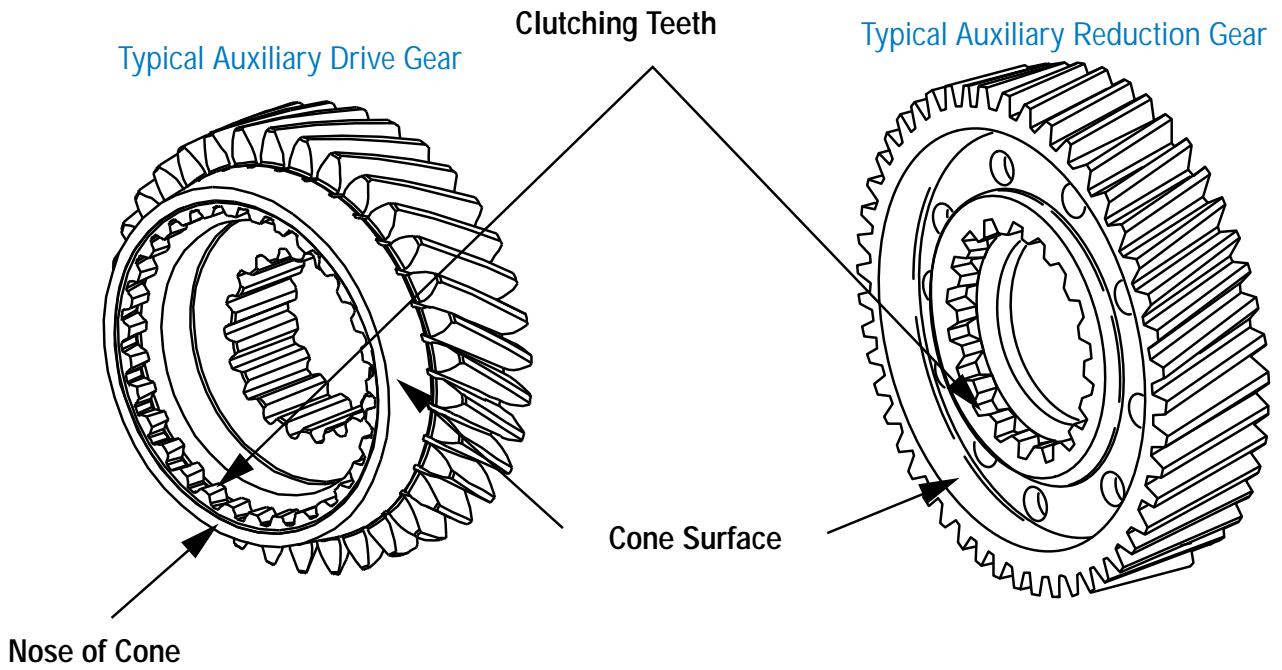
Replacing other gaskets, the input shaft, clutch brake, output seal, output shaft nut, PTO repair, etc. is not considered a normal part of a mainshaft assembly repair.



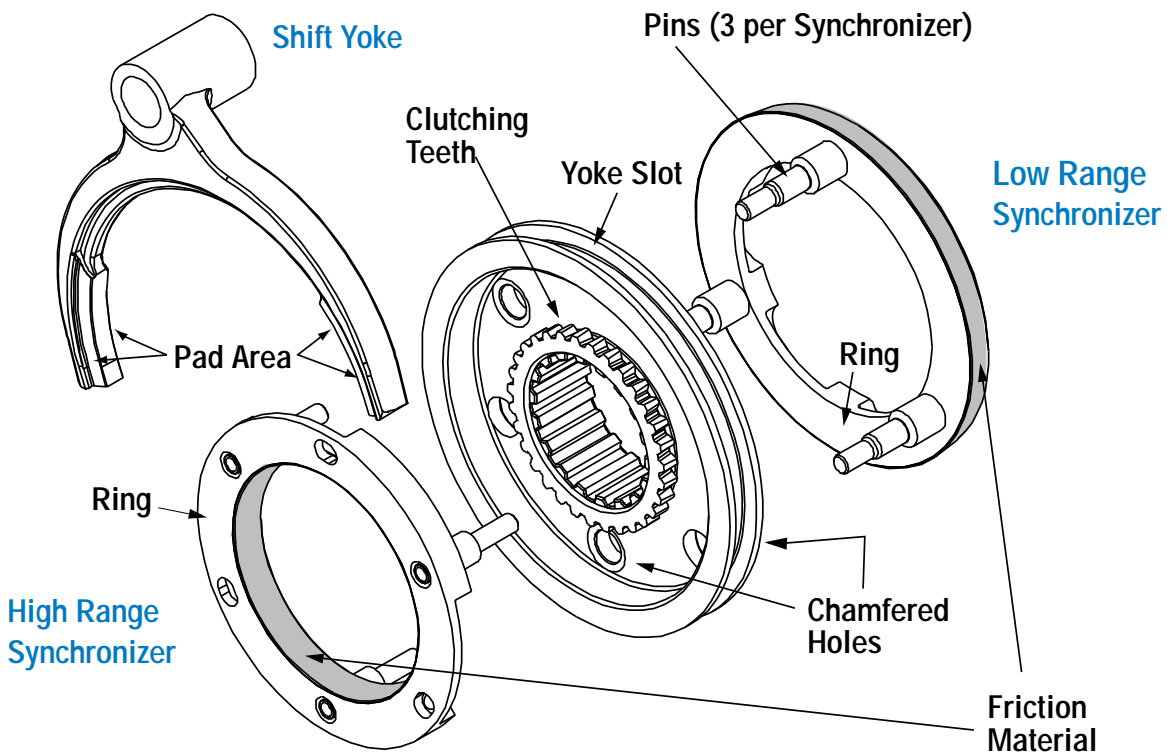
## Causes For Synchronizer Damage

<i>Observed Condition</i>	<i>Cause</i>
<ul style="list-style-type: none"> <li>• Broken Pins</li> <li>• Broken Synchronizer Ring</li> <li>• Sides of Clutch Teeth Indented</li> </ul> 	<p><i>This damage is the result of excessive driveline vibration. Check the following items for the cause of excessive vibration:</i></p> <ul style="list-style-type: none"> <li>• Worn u-joints</li> <li>• Improper driveline angles</li> <li>• Prop shaft balance or improper phasing</li> <li>• Ride height improperly adjusted</li> <li>• Worn suspension parts</li> </ul>
<ul style="list-style-type: none"> <li>• Burned Synchronizer Friction Material</li> <li>• Friction Material Transfer to Cone Surface</li> <li>• Burned Cone Surface</li> <li>• Heat on Nose of Cone</li> </ul>	<ul style="list-style-type: none"> <li>• Range shifting with the lever in neutral. Always pre-select the range shift by moving the range button prior to leaving the gear.</li> <li>• Operating the driveline PTO without completing synchronizer shift to high range.</li> <li>• Releasing clutch after having selected high range with vehicle stationary and begin driving. Always use Low range to start the vehicle moving.</li> <li>• Vehicle air system contamination. A dirty air system slows the performance of the synchronizer. Drain air tanks and check air system as a regular part of maintenance.</li> <li>• Improperly repaired from a previous failure. Alignment dowel pins to rear case must be properly installed to avoid case-to-case misalignment. Refer to the Service Manual for proper installation procedures.</li> <li>• Low air pressure and air leaks. Perform system checks at repair.</li> </ul>
<ul style="list-style-type: none"> <li>• Chipped Clutching Teeth</li> <li>• Severely Rounded Clutching Teeth</li> <li>• Excessive Scoring on Shift Fork</li> </ul>	<ul style="list-style-type: none"> <li>• Failed Synchronizer (see causes for burned friction material above).</li> <li>• Worn friction material</li> <li>• Low or high air pressure. Regulator is preset, replace if air pressure is low or high. Air pressure is normally between 57.5–62.5 PSI. Some transmissions use different filter/regulators, refer to the proper service manual for exact setting.</li> </ul>

Synchronizer Parts Terminology



Typical Synchronizer and Yoke Assembly


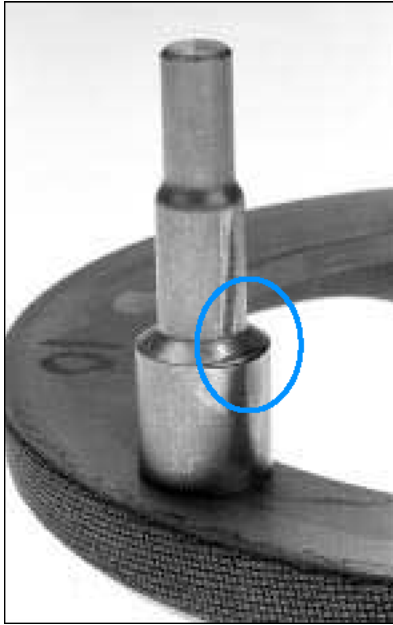


## Replacing/Reusing of Parts During Synchronizer Repair



Note: This document guides the repairing technician in the proper replacement of synchronizer parts.

### High Range Synchronizer

#### Pin Appearance

<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Loose pins</li> <li>• Excessive wear on blocker pin corners</li> <li>• Broken pins</li> </ul> 	<ul style="list-style-type: none"> <li>• Wear appearance on pin shanks, slight rounding of blocker pin corners</li> </ul> 

**Ring Appearance**


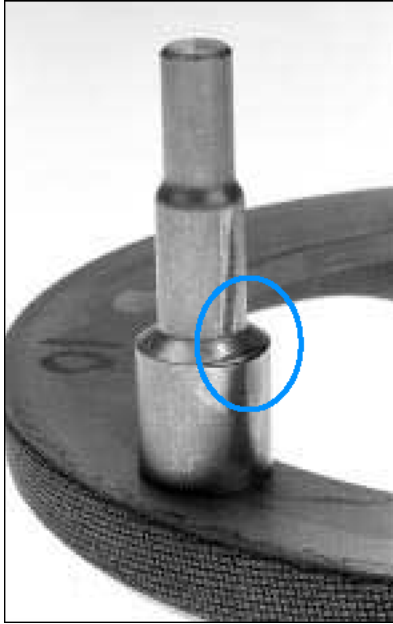
<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Cracked</li> <li>• Ring has contacted gear face leaving marks</li> </ul>  <ul style="list-style-type: none"> <li>• Ring adjacent to friction material discolored due to heat (color is purple to black)</li> </ul> 	<ul style="list-style-type: none"> <li>• Uniform or splotchy baked "carmel" color appearance on ring from manufacturing</li> </ul>

**Friction Material Appearance**


<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Sections of friction material greater than 1/8 inch square missing from the ring exposing bare metal or black adhesive</li> </ul>	<ul style="list-style-type: none"> <li>• Small pieces of material are missing (up to 1/8 inch square)</li> <li>• Circular damage tracks in material</li> <li>• Friction material has frayed woven edge</li> <li>• Tiny metal pieces embedded into friction material (unless pieces are scoring cone surface)</li> </ul>

## Low Range Synchronizer

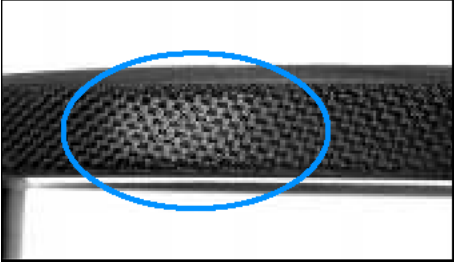
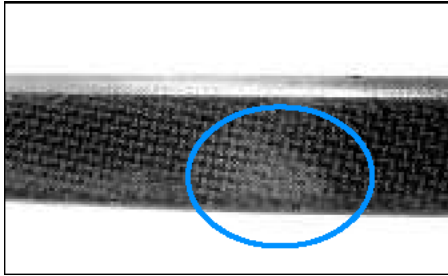
### Pin Appearance

<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Excessive wear on blocker pin corners</li> <li>• Loose pins</li> <li>• Broken pins</li> </ul> 	<ul style="list-style-type: none"> <li>• Pins have indents where springs contact pins</li> <li>• Wear appearance on pin shanks, slight rounding of blocker pin corners</li> </ul> 

### Ring Appearance

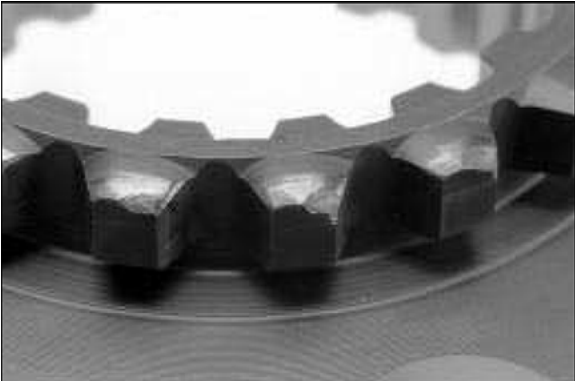
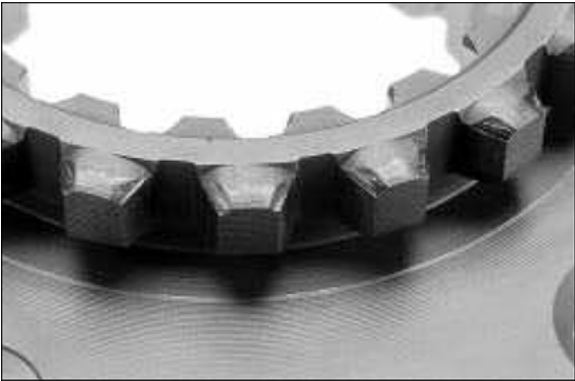


<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Ring adjacent to friction material discolored due to heat (color is purple to black)</li> <li>• Cracked</li> <li>• Ring contacts gear leaving marks on rear face</li> </ul> 	<ul style="list-style-type: none"> <li>• Uniform or splotchy baked "carmel" color appearance on ring from manufacturing</li> </ul>

Friction Material Appearance

<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Sections of friction material greater than 1/8 inch square debonded from the ring exposing bare metal or black adhesive</li> <li>• Glazed appearance</li> </ul> 	<ul style="list-style-type: none"> <li>• Small pieces of material are missing (up to 1/8 inch square)</li> <li>• Friction material has frayed woven edge</li> <li>• Tiny metal pieces embedded into friction material (unless pieces are scoring cone surface)</li> <li>• Friction material has "fuzzy" appearance</li> </ul> 

## Auxiliary Drive Gear/Reduction Gear

### Clutching Teeth Appearance

<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Blue or blackened range clutching teeth</li> <li>• Clutching teeth snubbed, severely chipped, or sides of teeth worn from vibrations</li> </ul>   	<ul style="list-style-type: none"> <li>• Clutching teeth are rounded, sides of teeth polished, or small chips at corners</li> </ul> 

## Cone Appearance

<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Friction material or metal chips embedded into cone surface</li> <li>• Grooves on cone surface — Do not attempt to refinish damaged cone surfaces</li> <li>• Synchronizer slides over cone surface or into cone surface and contacts gear face</li> <li>• Blue or blackened on nose of cone</li> </ul>	<ul style="list-style-type: none"> <li>• High polish on cone</li> <li>• Light heat discoloration - "straw" color on cone surface</li> </ul>



## Gear Teeth Appearance

<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Gear teeth heavily pitted or missing (reference <i>Spur Gear Life, TRSM-0913</i>, for gear and spline wear)</li> </ul>	<ul style="list-style-type: none"> <li>• Polished surface or very light signs of frosting. Reference <i>Spur Gear Life TRSM-0913</i></li> </ul>



## Auxiliary Range Shift Yoke

### Shift Yoke Wear

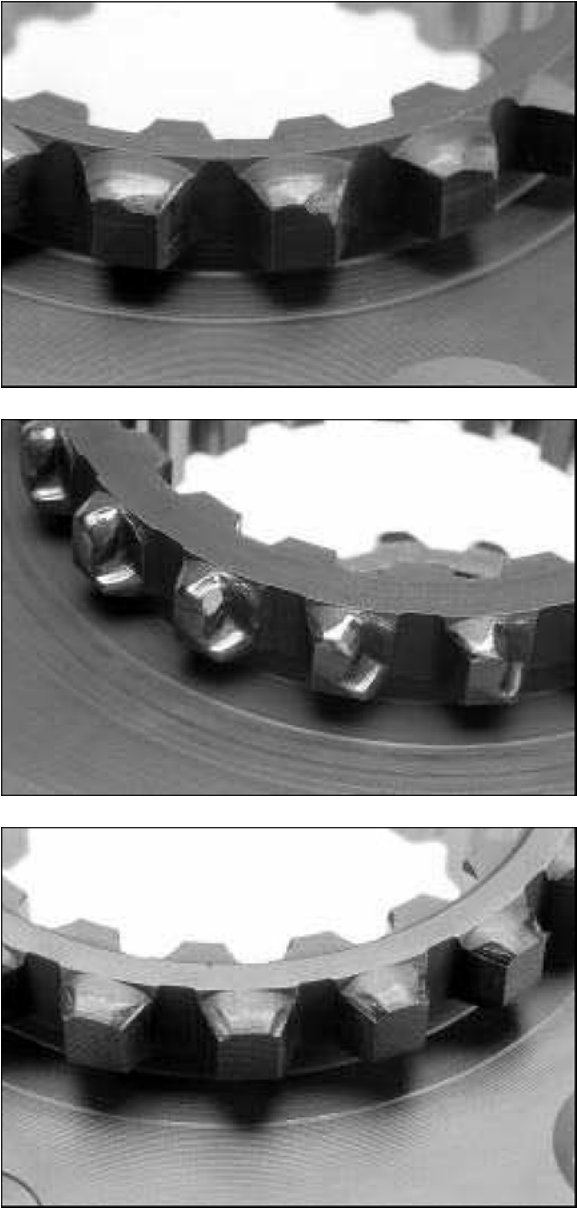

<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Yoke pad thickness is less than 0.4 inch at any point on the pad area (refer to page 6)</li> </ul>	<ul style="list-style-type: none"> <li>• Polish or light wear on pads</li> <li>• Uneven pad wear</li> </ul> <p><b>Note:</b> Uneven pad wear is normal</p>

### Shift Yoke Appearance

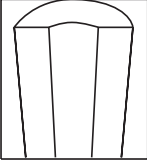
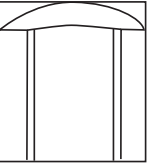
<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"> <li>• Broken shift yoke or bar</li> <li>• Weld on bar end is cracked</li> <li>• Threads are damaged and cannot be re-threaded</li> </ul>	<ul style="list-style-type: none"> <li>• Thread damage is repairable.</li> </ul>

## Auxiliary Range Sliding Clutch

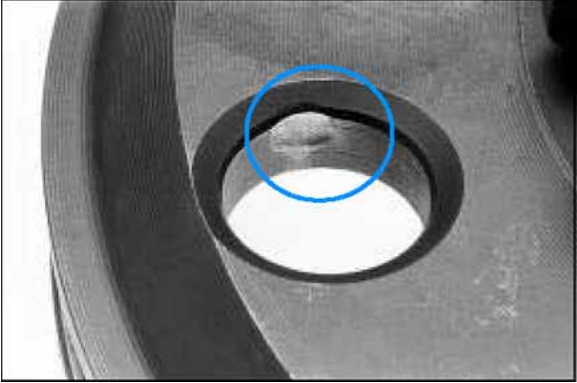
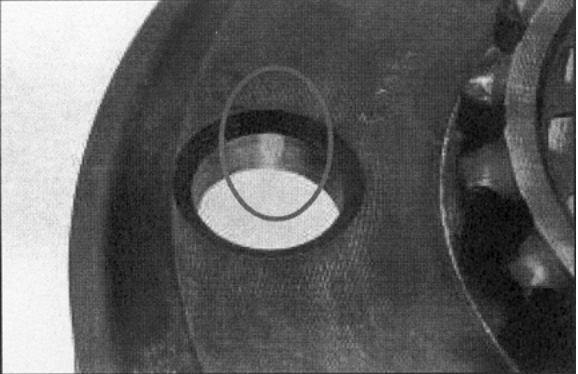
### Clutching Teeth Appearance

<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"><li>• Clutching teeth snubbed, severely chipped, or worn from vibration</li></ul>  <p>The three images in the 'Replace when' column illustrate different types of damage to the clutching teeth. The top image shows teeth that are 'snubbed', appearing flattened and irregular. The middle image shows teeth that are 'severely chipped', with significant material missing from the tips. The bottom image shows teeth that are 'worn from vibration', appearing rounded and polished.</p>	<ul style="list-style-type: none"><li>• Clutching teeth are rounded, sides of teeth polished, or small chips at corners</li></ul>  <p>The image in the 'Reuse when' column shows teeth that are 'rounded, sides of teeth polished, or small chips at corners'. The teeth are still clearly defined but have a smoother, more rounded appearance compared to the 'Replace when' examples.</p>

## Yoke Slot Wear

<b>Replace when</b>			<b>Reuse when</b>
<ul style="list-style-type: none"> <li>• How to determine when yoke slot wear exceeds usable limits for the range synchronizer sliding clutch.</li> </ul> <ol style="list-style-type: none"> <li>1. Identify sliding clutch by tooth design or transmission model</li> <li>2. Measure yoke slot width</li> <li>3. Determine if slot wear is on one side on both sides</li> <li>4. Compare with numbers given in the table</li> </ol>			<ul style="list-style-type: none"> <li>• Polish or light wear in yoke slot</li> </ul>
<b>Models</b>	<b>Sliding Clutch Tooth Identification (top view)</b>	<b>Maximum Slot Width When</b>	
RTLO-1X713A RTLO-1X718B RTL-1X710B FR(0)-1X210	 <p style="text-align: center;">Tapered Clutch Tooth</p>	Wear on one side 0.560 inch  Wear on both sides 0.590 inch	
Most other transmission models	 <p style="text-align: center;">Straight Clutch Tooth</p>	Wear on one side 0.470 inch  Wear on both sides 0.500 inch	

Clutch Chamfered Holes

<i>Replace when</i>	<i>Reuse when</i>
<ul style="list-style-type: none"><li>• <i>Badly worn chamfered pin holes</i></li><li>• <i>Stepped or indentations in chamfered holes</i></li></ul> 	<ul style="list-style-type: none"><li>• <i>Slight rounding of chamfered holes</i></li></ul> 

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