
# Chelsea® Power Take-Off

## 280 Series Service Manual

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Parker Chelsea

ENGINEERING YOUR SUCCESS.

CHELSEA®

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## Contents





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Chelsea Products Division
Olive Branch, MS 38654 USA

# SECTION 1



**Parker Hannifin Corporation**
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Olive Branch, MS 38654 USA

## NOTES

| | |
|---|---|
| **1** | Visually inspect parts before assembly for flaws. |
| **2** | The item numbers identifying parts are the same item numbers used on the engineering drawings. |
| **3** | Ensure tools and fixtures are current and have the required inspection and calibration labels and/or tags. |
| **4** | The terms **OUTPUT** and **DRIVE** are used interchangeably. |
| **5** | Lubricate most bearings before assembly. Use MELCOMOL “Y”, EP-2 or equal. |
| **6** | When assembling bearings, always place the bearings rounded end into the part. |
| **7** | Use Parker O-Lube or equal to lubricate O-Rings and seals before assembly. |
| **8** | When assembling O-Rings, do not roll it into their grooves. Use a O-Ring tool for assembly. O-Rings are not to be twisted or damaged. |
| **9** | Always reference the current Chelsea Parts List for part numbers and assemblies. 280 Series is HY25-2280-M1/US |

## Suggested Tools

| | | | |
|---|---|---|---|
| Safety Glasses | Oil Seal Slide | Shop Press | 3/16" Hex Wrench |
| Oil Seal Driver | Pliers | 5/32" Hex Bit Driver | Hammer/Mallet |
| 1/2" Socket | 1/2" Hex Wrench | | |

## Suggested Service Kits

| Part Number | Description |
|---|---|
| **329071-62X** | Gasket & Seal Kit (All Outputs Except BA) |
| **329071-63X** | Bearing Kit “AC”, “XD”, “XV”, “RF”, “RK”, “RS”, “RY”, “RZ” (All Outputs Except “BA”, “UN”) |
| **329071-64X** | Bearing Kit (“BA”, “UN” Outputs) |
| **329678X** | Gear & Clutch Plates Kit (All) |
| **7170-86X** | Mounting Kit (“FJ” Gear Pitch) |
| **7170-117X** | Mounting Kit (“KV” Gear Pitch) |

See Page 35-36 for Kits Bill of Materials

**280 G B FJ P - B 5 XD**

**Basic Model**
**280**

**Mounting Option**
**G** = Standard Mount

**Gear Ratio**

**[3 & 5 Arr.]**
**B** = 22/50
**C** = 25/47
**D** = 28/44
**G** = 31/41
**K** = 33/39
**M** = 35/37
**P** = 37/35
**S** = 39/33
**T** = 41/31

**[8 Arr.]**
**B** = 22/53
**C** = 25/50
**D** = 28/47
**G** = 31/44
**M** = 35/40
**P** = 37/38
**S** = 39/36
**T** = 42/33

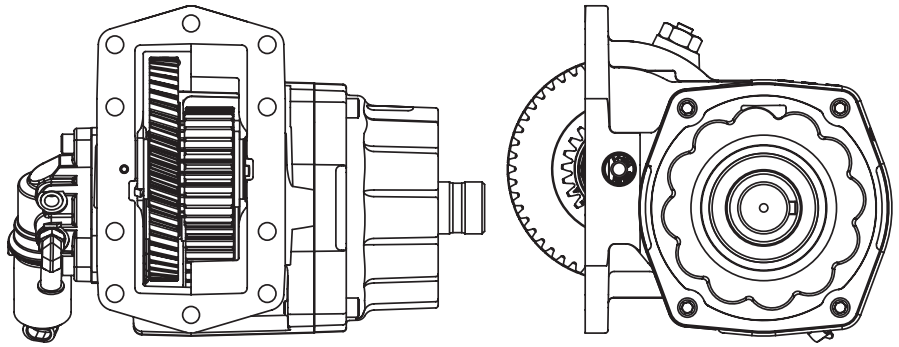
**Input Option**
**FJ** = Allison
**KV** = Caterpillar

**Lube Option**
**P** = Pressure Lube Only
**R** = Valve Cap Rotated 120°
**S** = Valve Cap Rotated 240°
**W** = Wet Spline
**V** = Valve Cap Rotated 120° with Wet Spline
**Y** = Valve Cap Rotated 240° with Wet Spline

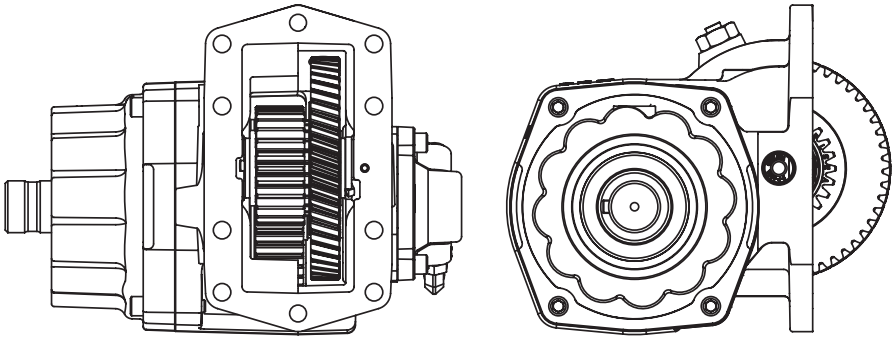
**Output Option**
**AB** = DIN 120 Flange
**AC** = DIN 100 Flange
**BA** = 1410 Flange with Shaft Brake
**BD** = 1.250" Keyed with Shaft Brake
**RF** = Class “B” 2 & 4-Bolt Rotatable Pump Mount, 15T
**RK** = Class “B” 2 & 4-Bolt Rotatable Pump Mount, 13T
**RS** = Class “C” 2 & 4-Bolt Rotatable Pump Mount, 14T
**RY** = DIN 5462 Pump Mount, 8T
**RZ** = Class “B” 2 & 4-Bolt Pump Flange,Class “C” Shaft
**UN** = UNI 8953 3-Bolt Pump Flange, 6T
**XD** = 1.250" Round Shaft Keyed
**XV** = 1-1/2" - 10T Spline Shaft with 1410 Flange

**Assembly Arrangement**
3 - Gear Forward, Shaft Rear, Bulge Up Left Side, Bulge Down Right Side
5 - Gear Forward, Shaft Rear, Bulge Up Right Side, Bulge Down Left Side
8 - Gear Forward, Shaft Rear

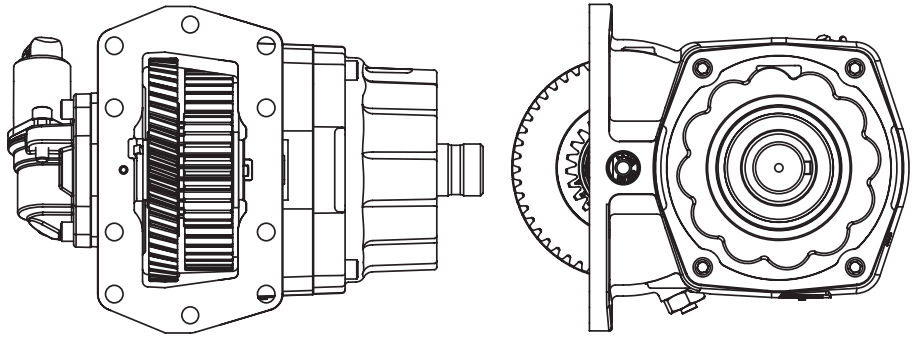
**Shift Option**
**B** = 12V Hydraulic Valve
**D** = 24V Hydraulic Valve
**G** = 12V Remote Valve w/o E.O.C.
**H** = 24V Remote Valve w/o E.O.C.
**K** = 12V Hydraulic Valve w/E.O.C.
**L** = 24V Hydraulic Valve w/E.O.C.
**M** = 12V w/o Installation Kit
**N** = 24V w/o Installation Kit
**S** = P.T.O. (Air/Elec/Hyd) & Dump Pump (Air) Combo Valve - with P.T.O. Kick Out & Neutral Spring Return
**T** = P.T.O. (Air/Elec/Hyd) & Dump Pump (Air) Combo Valve - Less P.T.O. Kick Out & Neutral Spring Return



Assembly 3



Assembly 5



Assembly 8



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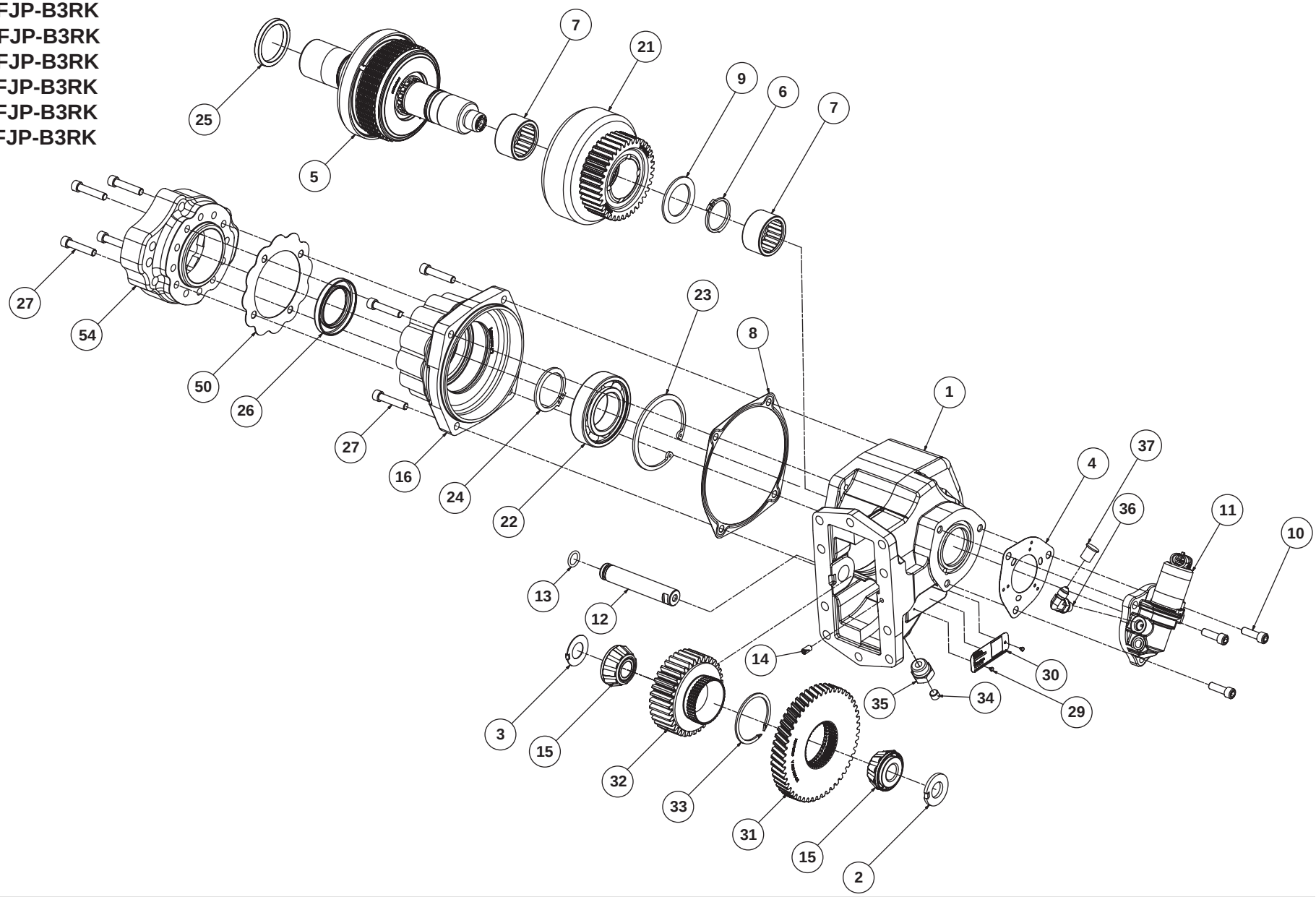
**280GBFJP-B3RK**
**280GCFJP-B3RK**
**280GDFJP-B3RK**
**280GGFJP-B3RK**
**280GKFJP-B3RK**
**280GPFJP-B3RK**
**280GSFJP-B3RK**
**280GTFJP-B3RK**



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## 280GMFJP-B3RK

| Item | Part Number | Description | Qty. |
|---|---|---|---|
| 1 | **1-P-703** | Housing | 1 |
| 2 | **14-P-73-1** | Spacer .762" x 1.500" x .150" Thickness As Required | 1 or |
| | **14-P-73-2** | Spacer .762" x 1.500" x .153" | 1 or |
| | **14-P-73-3** | Spacer .762" x 1.500" x .156" | 1 |
| 3 | **31-P-102** | Washer Thrust .754" x .440" x .030" | 1 |
| 4 | **22-P-112** | Gasket | 1 |
| 5 | **329724-4X** | Drive Shaft & Clutch Assembly “RK” | 1 |
| 6 | **379746** | Lockring | 1 |
| 7 | **560972** | Bearing Needle Roller Assembly 1.500" x 1.875" x 1.000" | 2 |
| 8 | **22-P-101** | Gasket | 1 |
| 9 | **31-P-70** | Washer Thrust 1.507" x 2.167" x .094" | 1 |
| 10 | **378447-6** | Capscrew SH .312" - 18 x 1.000" | 3 |
| 11 | **329463-12X** | 12V Valve Cap Assembly | 1 |
| 12 | **9-P-106** | Idler Shaft .75" | 1 |
| 13 | **28-P-191** | O-Ring .549" x .103" | 1 |
| 14 | **378452-7** | Set Screw SH .250" - 20 x .500" | 1 |
| 15 | **550439** | Tapered Bearing Cone .750" x .8598" | 2 |
| 16 | **21-P-767** | Bearing Cap | 1 |
| 21 | **2-P-933** [1] | Output Gear 37T | 1 |
| 22 | **550311** | Ball Bearing 1.77" x 3.346" x .748" | 1 |
| 23 | **378263** | Lockring | 1 |
| 24 | **379555** | Lockring | 1 |

[1] **See Page 23 for other Gear Options**

| Item | Part Number | Description | Qty. |
|---|---|---|---|
| 25 | **4-P-187** | Spacer 1.776" x 2.200" x .239" | 1 |
| 26 | **28-P-267** | Oil Seal 2.627" x 1.750" x .312" | 1 |
| 27 | **378447-8** | Capscrew SH .312" - 18 x 1.500" | 4 |
| 29 | **378422** | Drive Screw | 2 |
| 30 | **68-P-51** | Name Plate | 1 |
| 31 | **5-P-1491** [1] | Input Gear 50T (“FJ” Gear Pitch) | 1 |
| 32 | **5-P-1482** [1] | Gear Ratio 35T | 1 |
| 33 | **379522** | Lockring | 1 |
| 34 | **379231** | Pipe Plug .125" - 27 | 1 |
| 35 | **379242** | Adapter Straight .125" - 27 x .750" - 16 | 1 |
| 36 | **379486** | Fitting 90° | 1 |
| 37 | **379564-2** | Cap Thread .438" | 1 |
| 50 | **35-P-101** | Gasket Bearing Cap Wet Spline | 1 |
| 54 | **21-P-731** | Pump Flange | 1 |

### Service Kits

| Part Number | Description |
|---|---|
| **329071-62X** | Gasket & Seal Kit (All Outputs Except “BA”) |
| **329071-63X** | Bearing Kit “AC”, “XD”, “XV”, “RF”, “RK”, “RS”, “RY” and “RZ” (All Outputs Except “BA” and “UN”) |
| **329678X** | Gear & Clutch Plates Kit (All) |

See Page 35-36 for Kits Bill of Materials



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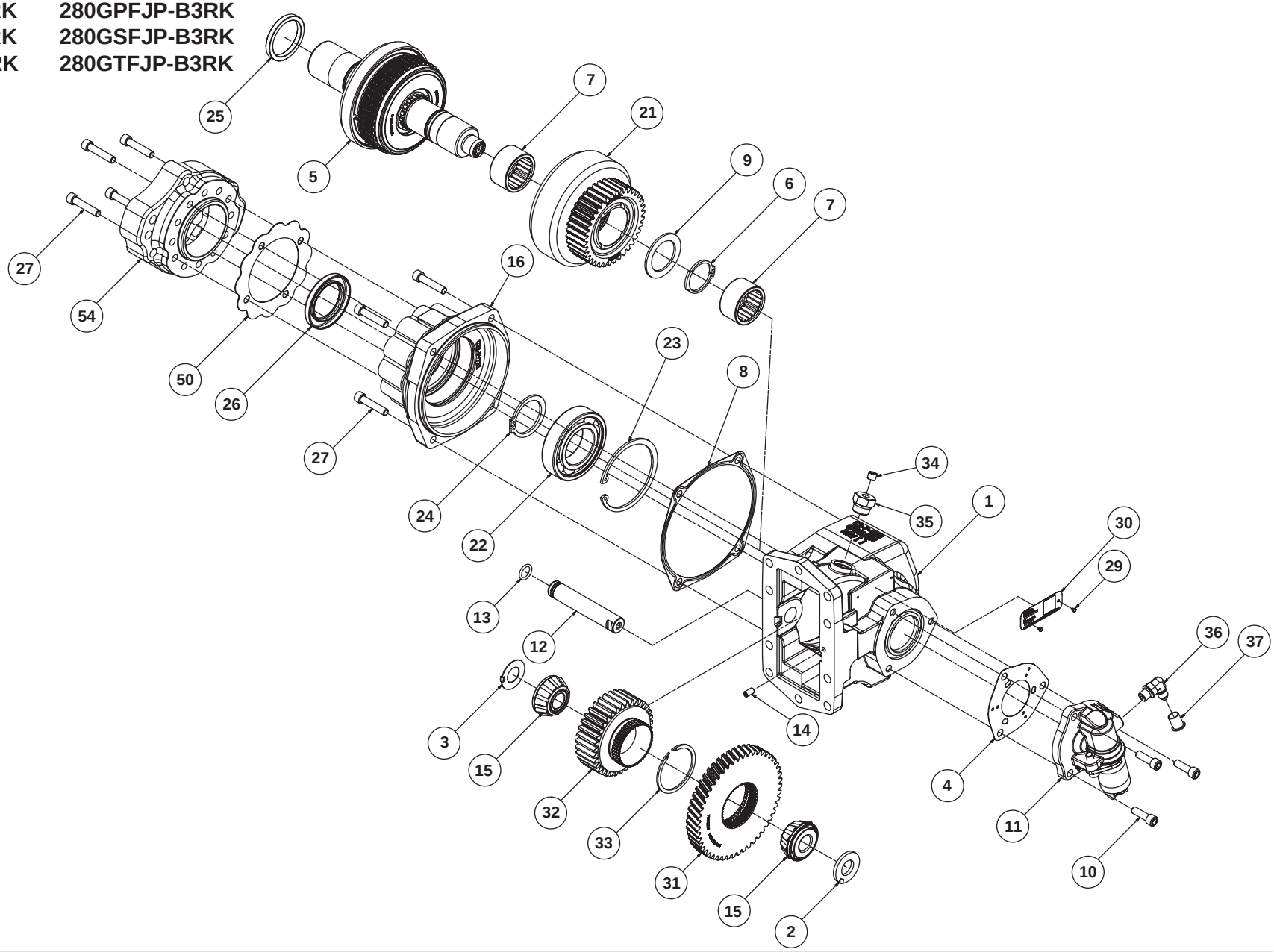
**280GBFJP-B3RK** **280GKFJP-B3RK**
**280GCFJP-B3RK** **280GPFJP-B3RK**
**280GDFJP-B3RK** **280GSFJP-B3RK**
**280GGFJP-B3RK** **280GTFJP-B3RK**



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## 280GMFJP-B5RK

| Item | Part Number | Description | Qty. |
|---|---|---|---|
| 1 | **1-P-705** | Housing | 1 |
| 2 | **14-P-73-1** | Spacer .762" x 1.500" x .150" Thickness As Required | 1or |
| | **14-P-73-2** | Spacer .762" x 1.500" x .153" | 1or |
| | **14-P-73-3** | Spacer .762" x 1.500" x .156" | 1 |
| 3 | **31-P-102** | Washer Thrust .754" x .440" x .030" | 1 |
| 4 | **22-P-112** | Gasket | 1 |
| 5 | **329724-4X** | Drive Shaft & Clutch Assembly “RK” | 1 |
| 6 | **379746** | Lockring | 1 |
| 7 | **560972** | Bearing Needle Roller Assembly 1.500" x 1.875" x 1.000" | 2 |
| 8 | **22-P-101** | Gasket | 1 |
| 9 | **31-P-70** | Washer Thrust 1.507" x 2.167" x .094" | 1 |
| 10 | **378447-6** | Capscrew SH .312" - 18 x 1.000" | 3 |
| 11 | **329463-12X** | 12V Valve Cap Assembly | 1 |
| 12 | **9-P-106** | Shaft Idler .75" | 1 |
| 13 | **28-P-191** | O-Ring .549" x .103" | 1 |
| 14 | **378452-7** | Set Screw SH .250" - 20 x .500" | 1 |
| 15 | **550439** | Tapered Bearing Cone .750" x .8598" | 2 |
| 16 | **21-P-767** | Bearing Cap | 1 |
| 21 | **2-P-933** [1] | Output Gear 37T | 1 |
| 22 | **550311** | Bearing Ball 1.77" x 3.346" x .748" | 1 |
| 23 | **378263** | Lockring | 1 |
| 24 | **379555** | Lockring | 1 |

[1] **See Page 23 for other Gear Options**

| Item | Part Number | Description | Qty. |
|---|---|---|---|
| 25 | **4-P-187** | Spacer 1.776" x 2.200" x .239" | 1 |
| 26 | **28-P-267** | Oil Seal 2.627" x 1.750" x .312" | 1 |
| 27 | **378447-8** | Capscrew SH .312" - 18 x 1.500" | 4 |
| 29 | **378422** | Drive Screw | 2 |
| 30 | **68-P-51** | Name Plate | 1 |
| 31 | **5-P-1491** [1] | Gear Input 50T (“FJ” Gear Pitch) | 1 |
| 32 | **5-P-1482** [1] | Gear Ratio 35T | 1 |
| 33 | **379522** | Lockring | 1 |
| 34 | **379231** | Plug Pipe .125" - 27 | 1 |
| 35 | **379242** | Adapter Straight .125" - 27 x .750" - 16 | 1 |
| 36 | **379486** | Fitting 90° | 1 |
| 37 | **379564-2** | Cap Thread .438" | 1 |
| 50 | **35-P-101** | Gasket Bearing Cap Wet Spline | 1 |
| 54 | **21-P-731** | Pump Flange | 1 |

### Service Kits

| Part Number | Description |
|---|---|
| **329071-62X** | Gasket & Seal Kit (All Outputs Except “BA”) |
| **329071-63X** | Bearing Kit “AC”, “XD”, “XV”, “RF”, “RK”, “RS”, “RY” and “RZ” (All Outputs Except “BA” and “UN”) |
| **329678X** | Gear & Clutch Plates Kit (All) |

See Page 35-36 for Kits Bill of Materials



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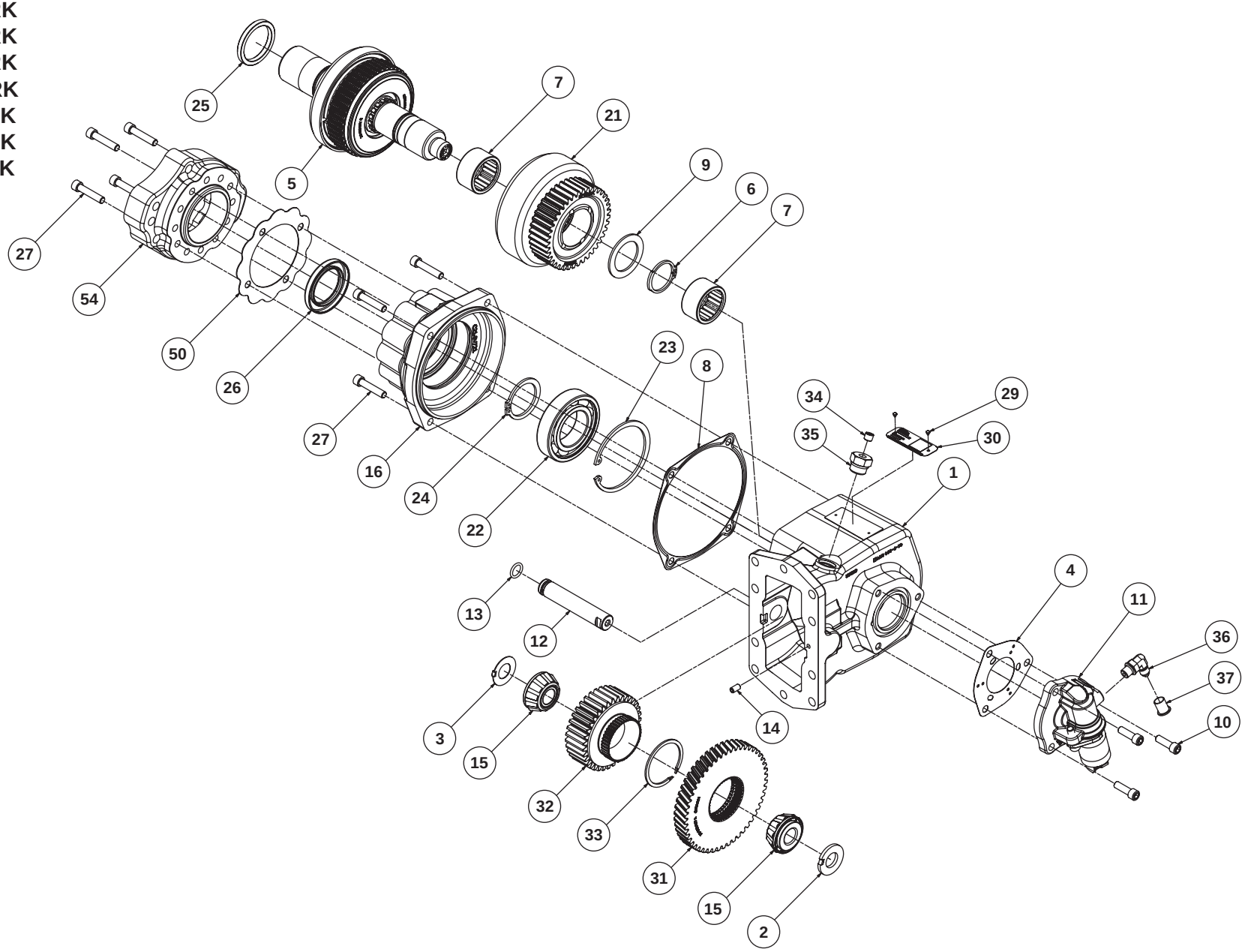
**280GBFJP-B3RK**
**280GCFJP-B3RK**
**280GDFJP-B3RK**
**280GGFJP-B3RK**
**280GPFJP-B3RK**
**280GSFJP-B3RK**
**280GTFJP-B3RK**



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## 280GMFJP-B8RK

| Item | Part Number | Description | Qty. |
|---|---|---|---|
| 1 | **1-P-708** | Housing | 1 |
| 2 | **14-P-73-1** | Spacer .762" x 1.500" x .150" Thickness As Required | 1 or |
| | **14-P-73-2** | Spacer .762" x 1.500" x .153" | 1 or |
| | **14-P-73-3** | Spacer .762" x 1.500" x .156" | 1 |
| 3 | **31-P-102** | Washer Thrust .754" x .440 x .030" | 1 |
| 4 | **22-P-112** | Gasket | 1 |
| 5 | **329724-4X** | Drive Shaft & Clutch Assembly “RK” | 1 |
| 6 | **379746** | Lockring | 1 |
| 7 | **560972** | Bearing Needle Roller Assembly 1.500" x 1.875" x 1.000" | 2 |
| 8 | **22-P-101** | Gasket | 1 |
| 9 | **31-P-70** | Washer Thrust 1.507" x 2.167" x .094" | 1 |
| 10 | **378447-6** | Capscrew SH .312" - 18 x 1.000" | 3 |
| 11 | **329463-12X** | 12V Valve Cap Assembly | 1 |
| 12 | **9-P-106** | Idler Shaft .75" | 1 |
| 13 | **28-P-191** | O-Ring .549" x .103" | 1 |
| 14 | **378452-7** | Set Screw SH .250" - 20 x .500" | 1 |
| 15 | **550439** | Tapered Bearing Cone .750" x .8598" | 2 |
| 16 | **21-P-767** | Bearing Cap | 1 |
| 21 | **2-P-930** [1] | Output Gear 40T | 1 |
| 22 | **550311** | Ball Bearing 1.77" x 3.346" x .748" | 1 |
| 23 | **378263** | Lockring | 1 |
| 24 | **379555** | Lockring | 1 |

[1] **See Page 23 for other Gear Options**

| Item | Part Number | Description | Qty. |
|---|---|---|---|
| 25 | **4-P-187** | Spacer 1.776" x 2.200" x .239" | 1 |
| 26 | **28-P-267** | Oil Seal 2.627" x 1.750" x .312" | 1 |
| 27 | **378447-8** | Capscrew SH .312" - 18 x 1.500" | 4 |
| 29 | **378422** | Drive Screw | 2 |
| 30 | **68-P-51** | Name Plate | 1 |
| 31 | **5-P-1491** [1] | Input Gear 50T (“FJ” Gear Pitch) | 1 |
| 32 | **5-P-1482** [1] | Gear Ratio 35T | 1 |
| 33 | **379522** | Lockring | 1 |
| 34 | **379231** | Pipe Plug .125" - 27 | 1 |
| 35 | **379242** | Adapter Straight .125" - 27 x .750" - 16 | 1 |
| 36 | **379486** | Fitting 90° | 1 |
| 37 | **379564-2** | Cap Thread .438" | 1 |
| 50 | **35-P-101** | Gasket Bearing Cap Wet Spline | 1 |
| 54 | **21-P-731** | Pump Flange | 1 |

### Service Kits

| Part Number | Description |
|---|---|
| **329071-62X** | Gasket & Seal Kit (All Outputs Except “BA”) |
| **329071-63X** | Bearing Kit “AC”, “XD”, “XV”, “RF”, “RK”, “RS”, “RY” and “RZ” (All Outputs Except “BA” and “UN”) |
| **329678X** | Gear & Clutch Plates Kit (All) |

See Page 35-36 for Kits Bill of Materials



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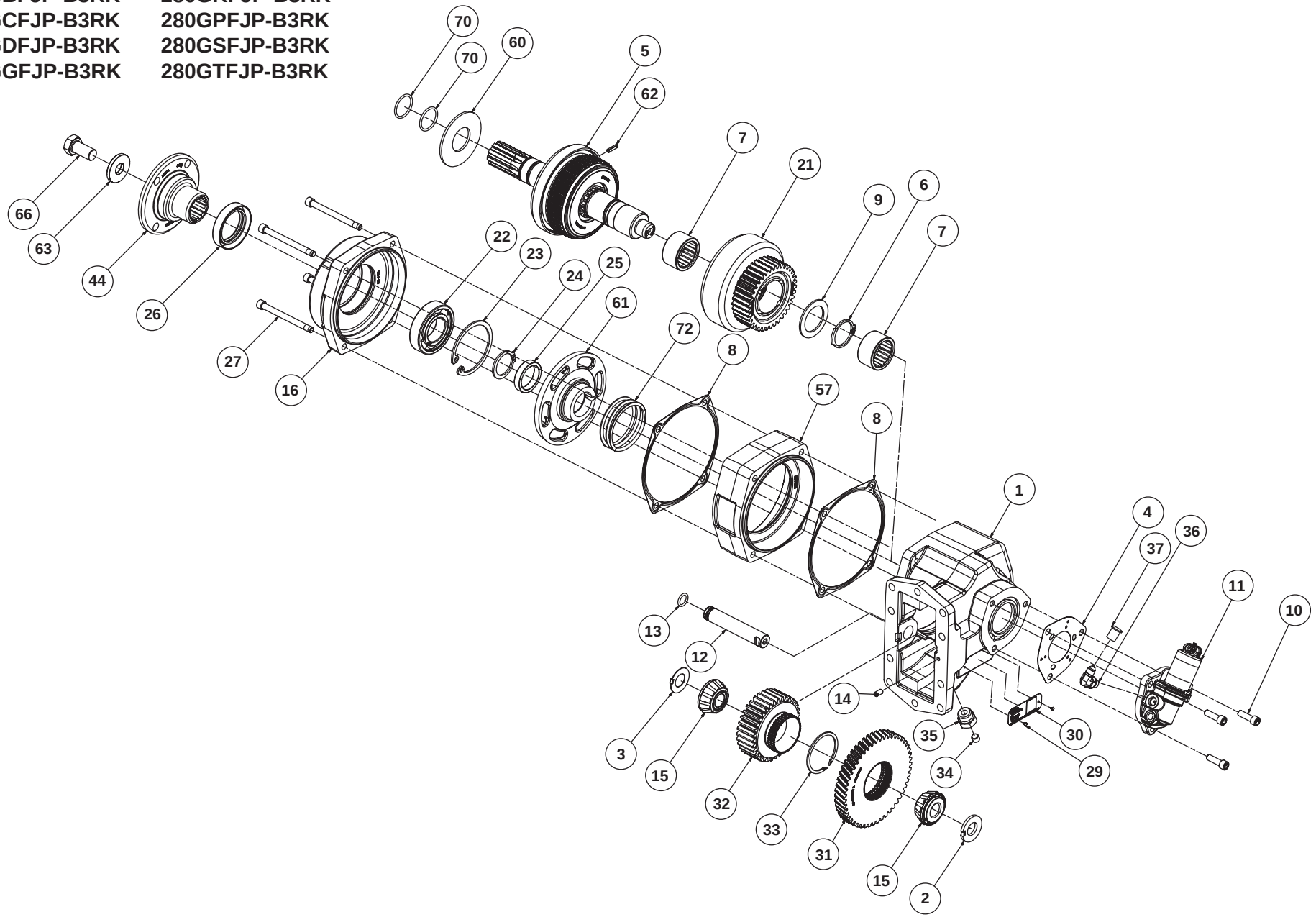
**280GBFJP-B3RK** **280GKFJP-B3RK**
**280GCFJP-B3RK** **280GPFJP-B3RK**
**280GDFJP-B3RK** **280GSFJP-B3RK**
**280GGFJP-B3RK** **280GTFJP-B3RK**



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## 280GMFJP-B3BA

| Item | Part Number | Description | Qty. |
|---|---|---|---|
| 1 | **1-P-703** | Housing | 1 |
| 2 | **14-P-73** | Spacer .762" x 1.500" x .156" | 1 |
| 3 | **31-P-102** | Washer Thrust .754" x .440" x .030" | 1 |
| 4 | **22-P-112** | Gasket | 1 |
| 5 | **329723X** | Drive Shaft & Clutch Assembly | 1 |
| 6 | **379746** | Lockring | 1 |
| 7 | **560972** | Bearing Needle Roller Assembly 1.500" x 1.875" x 1.000" | 2 |
| 8 | **22-P-101** | Gasket | 2 |
| 9 | **31-P-70** | Washer Thrust 1.507" x 2.167" x .094" | 1 |
| 10 | **378447-6** | Capscrew SH .312" - 18 x 1.000" | 3 |
| 11 | **329463-12X** | 12V Valve Cap Assembly | 1 |
| 12 | **9-P-106** | Idler Shaft .75" | 1 |
| 13 | **28-P-191** | O-Ring .549" x .103" | 1 |
| 14 | **378452-7** | Set Screw SH .250" - 20 x .500" | 1 |
| 15 | **550439** | Bearing Tapered Cone .750" x .8598" | 2 |
| 16 | **21-P-773** | Bearing Cap | 1 |
| 21 | **2-P-933** [1] | Output Gear 37T | 1 |
| 22 | **550010** | Ball Bearing 1.378" x 2.8346" x .6693" | 1 |
| 23 | **378895** | Lockring | 1 |
| 24 | **378576** | Lockring | 1 |
| 25 | **4-P-186** | Spacer 1.385" x 1.750" x .365" | 1 |
| 26 | **28-P-212** | Oil Seal 2.506" x 1.750" x .315" | 1 |
| 27 | **378447-16** | Capscrew SH .312" - 18 x 3.500" | 4 |
| 29 | **378422** | Drive Screw | 2 |
| 30 | **68-P-51** | Name Plate | 1 |
| 31 | **5-P-1491** [1] | Input Gear 50T (“FJ” Gear Pitch) | 1 |
| 32 | **5-P-1482** [1] | Gear Ratio 35T | 1 |
| 33 | **379522** | Lockring | 1 |
| 34 | **379231** | Pipe Plug .125" - 27 | 1 |
| 35 | **379242** | Adapter Straight .125" - 27 x .750" - 16 | 1 |
| 36 | **379486** | Fitting 90° | 1 |
| 37 | **379564-2** | Cap Thread .438" | 1 |
| 44 | **380081** | Companion Flange 1410 | 1 |
| 57 | **23-P-68** | Spacer Drag Brake Bearing Cap | 1 |
| 60 | **31-P-113** | Washer Thrust 1.385" x 3.125" x .125" | 1 |
| 61 | **329410X** | Brake Assembly | 1 |
| 62 | **379977** | Spring Pin | 1 |
| 63 | **4-P-130** | Washer | 1 |
| 66 | **378435-7** | Hex. Head Capscrew .625" - 11 x 1.250" | 1 |
| 70 | **28-P-244** | O-Ring 1.174" x .103" | 2 |
| 72 | **37-P-60** | Spring 2.531" x 2.13" x .172" | 1 |

[1] **See Page 23 for other Gear Options**

### Service Kits

| Part Number | Description |
|---|---|
| **329071-64X** | Bearing Kit (“BA” and “UN” Outputs) |
| **329678X** | Gear & Clutch Plates Kit (All) |

See Page 35-36 for Kits Bill of Materials



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# SECTION 2



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Before disassembling any Chelsea P.T.O. inspect it for clues to the failure. Do this now so you don't lose valuable evidence during disassembly.

Check the case for wear or damage. Gears should spin freely, with no side-to-side movement. The output shaft should turn with no radial movement.

## Disassembly

1. Output Bearing and Clutch Pack
   - 1.1. Remove the four Pump Flange Cap Capscrews (**27**). Lift the Pump Flange (**54**) from the Open End Bearing Cap (**16**).
   - 1.2. Remove the four Capscrews (**27**) from the Open End Bearing Cap (**16**), lift the Bearing Cap (**16**), Gasket (**8**) and Shaft/Clutch Assembly (**5**) from the Housing (**1**).
   - 1.3. **NOTE:** At this point Items (**25**), (**5**), (**7**), (**21**), (**9**) and (**6**) will come out of the unit.
   - 1.4. Place the Assembly in a Soft-Jawed Vise. Support the Shaft above the Bearing surface.
   - 1.5. Use a Screwdriver or a Seal Remover to pry the Oil Seal (**26**) from the Bearing Cap (**16**). **Important:** This Seal will be damaged during removal. Replace it with a new one.
   - 1.6. Remove the Retaining Ring (**24**) from the Output Shaft.
   - 1.7. Support the Assembly directly underneath the Bearing Cap (**16**). Using an Arbor Press, press the Output Shaft through the Bearing Cap (**16**).
   - 1.8. Remove the Retaining Ring (**23**) and Bearing (**22**) from the Bearing Cap (**16**). If the Bearing sticks, tap it with a Soft Mallet and a Driver.


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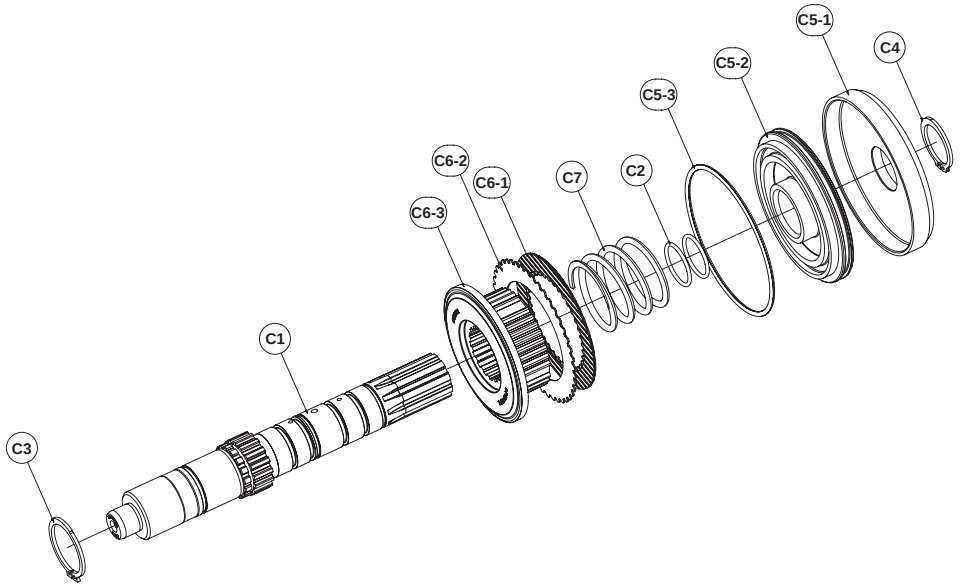
## Disassembly

2. Clutch Pack and Output Shaft
   - 2.1. Remove the Spacer (**25**) from the Shaft (**C1**).
   - 2.2. Remove the Retaining Ring (**6**), Thrust Washer (**9**) and Output Gear (**21**). Inspect the Washer (**9**) for heat damage. Replace if necessary.
   - 2.3. Next, compress the Clutch Assembly (**5**).
   - 2.4. Remove the Retaining Ring (**C4**)
   - 2.5. Slide the Clutch Back-Up Cylinder (**C5-1**) and Piston (**C5-2**) off the Shaft (**C1**). Remove the O-Ring (**C5-3**) from the Piston (**C5-2**). Inspect the Piston for galling or scratches.
   - 2.6. Remove the Return Spring (**C7**). Check it for cracks or breaks. Also remove the two Shaft O-Rings (**C2**) that seal off the Piston (**C5-2**) and Clutch Back-Up Cylinder (**C5-1**).
   - 2.7. Remove and inspect the Clutch Plates (**C6-2**) and Friction Discs (**C6-1**). If debris is present but the Chelsea P.T.O. Gears (**C6-3**) aren't damaged, it indicates possible transmission problems. If the components are burnt, the problem may be low lubricant levels, misapplication, or P.T.O. engagement at too high an R.P.M.
   - 2.8. Remove the Clutch Gear (**C6-3**) off the Shaft (**C1**). Check it for wear or damage. Replace if necessary. Retaining Ring (**C3**) can stay on the Shaft (**C1**) if they aren't damaged.
   - 2.9. Remove and inspect Shaft (**C1**) especially the Bearing surfaces for nicks, scratches, or other damage. The best way to discover these problems is to run your fingernail across the Shaft (**C1**) surface. If you feel a scratch, replace the Shaft (**C1**). Also make sure the Pressure Port is clear. Do this by blowing air through the hole.
   - 2.10. Reference main drawing. Using an appropriate driver, press the Internal Needle Bearing (**7**) from the Output Gear (**21**). Press against the flat surface of the Bearing (**7**).
   - 2.11. Inspect the Output Gear (**21**) for cracks, pitting, missing teeth or other damage. Replace if necessary.




| Item | Part Number | Description | Qty. |
|---|---|---|---|
| C1 | **3-P-1072** | Output Shaft 10T Straight (329723X) | 1 or |
| C1-1 | **3-P-1141** | Output Shaft 1.25" Keyed (329723-1X) | 1 |
| C2 | **28-P-244** | O-Ring 1.174" x .103" | 2 |
| C3 | **380069** | Lockring | 1 |
| C4 | **378576** | Lockring | 1 |
| C5 | **329179-1X** | Ass'y Piston & Back-Up Cylinder | 1 |
| C5-1 | **379323-1** | Cylinder Clutch Back-Up | 1 |
| C5-2 | **380057-1** | Piston Clutch Hydraulic | 1 |
| C5-3 | **28-P-178** | O-Ring 4.484" x .138" | 1 |
| C6 | **329678X** | Gear & Plates Kit | 1 |
| C6-1 | **379485** | Disc Friction | 11 |
| C6-2 | **380065** | Clutch Plate | 10 |
| C6-3 | **2-P-858** | Output Gear 36T | 1 |
| C7 | **37-P-39** | Spring 2.552" x 1.985" | 1 |



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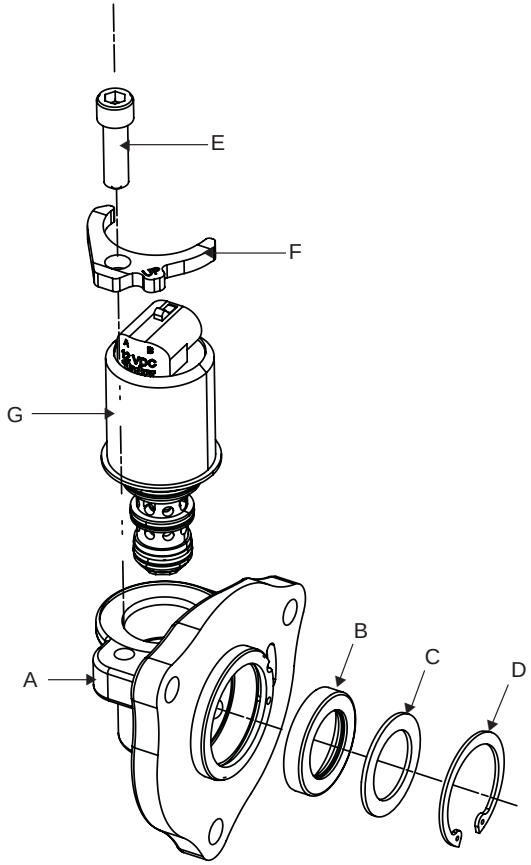
## Disassembly

3. Valve & Cap Asembly
   - 3.1. Remove the three Socket Head Capscrews (**10**), Valve Assembly (**11**), and Valve Cap Gasket (**4**) from the Chelsea P.T.O.
   - 3.2. Carefully remove the Retaining Ring (**D**) and Washer (**C**). Visually inspect the Oil Seal (**B**) now. If you see signs of wear or leakage, remove the Seal (**B**).
     **Important:** Do not nick the Seal Bore. This could result in leakage or further damage to the P.T.O.
   - 3.3. Remove the Solenoid Valve (**G**) Socket Capscrew (**E**). Use a Screwdriver in the Shaft Seal Opening to carefully pry the Solenoid Valve (**G**) loose from the Housing (**A**). Be careful not to damage the Seal.
   - 3.4. Remove the Solenoid Valve (**G**) from the cap. Check the O-Rings for damage. If they are damaged, replace the O-Rings.




| Item | Part Number | Description | Qty. |
|---|---|---|---|
| 11 | **329442-12X** | Valve & Cap Assembly (12V) (“KV” Pitch Only) | 1 or |
| | **329442-24X** | Valve & Cap Assembly (24V) (“KV” Pitch Only) | 1 |
| | **329463-12X** | Valve & Cap Assembly (12V) (“FJ” Pitch Only) | 1 or |
| | **329463-24X** | Valve & Cap Assembly (24V) (“FJ” Pitch Only) | 1 |
| A | **34-P-143** | Valve Cap | 1 |
| B | **28-P-119** | Oil Seal (Hi Pressure) | 1 |
| C | **378811** | Washer | 1 |
| D | **378849** | Retaining Ring | 1 |
| E | **378447-6** | Sockethead Capscrew .312" - 18 x 1.00" | 1 |
| F | **379995** | Clamp (“KV”) Included with 379993 Valve | 1or |
| | **380012** | Clamp (“FJ”) used with 380011 Valve | 1 |
| | **380124** | Clamp (“FJ”) used with 380123 Valve | 1 |
| G | **379993-12** | Hydraulic Valve (12V) (“KV”) (White Connector) | 1 or |
| | **379993-24** | Hydraulic Valve (24V) (“KV”) (Black Connector) | 1 |
| | **380011-12** | Hydraulic Valve (12V) (“FJ”) (White Side Connector) | 1 |
| | **380011-24** | Hydraulic Valve (24V) (“FJ”) (Black Side Connector) | 1 or |
| | **380123-12** | Hydraulic Valve (12V) (“FJ”) (White Connector Top) (New Style) | 1 or |
| | **380123-24** | Hydraulic Valve (24V) (“FJ”) (Black Connector Top) (New Style) | 1 |



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## Disassembly

4. Input Gear Sub-Assembly
   - 4.1. Next, remove Set Screw (**14**) from Main Housing (**1**).
   - 4.2. Pull the Idler Shaft (**12**) from the Housing (**1**) by using a long threaded 3/8" - 16 Bolt. Replace Shaft (**12**) if it is nicked or scratched. Inspect the Shaft O-Ring (**13**) for nicks or cuts, replace if necessary.
   - 4.3. Remove the Input Gear section (**31**), (**32**) & (**33**), one Spacer (**2**) and one Thrust Washer (**3**). Remove the two Tapped Bearing Cones (**15**) from the Gear. Inspect Gear Races and Teeth for cracks, nicks, heat signs or other damage. Replace if necessary.
   - 4.4. Press the remaining Needle Bearing (**7**) from the Housing (**1**). **Important:** This Bearing (**7**) will be damaged during removal. Replace it with a new one.
   - 4.5. Inspect the Housing (**1**) for deep grooves, gouges, and cracks. Make sure sealing surfaces are smooth
   - 4.6. Chelsea strongly recommends that you replace all used Retaining Rings, O-Rings, Seals, Bearings and Gaskets with new ones during P.T.O. service. Also replace any worn or damaged components you found during disassembly.
   - 4.7. Clean all reusable components.



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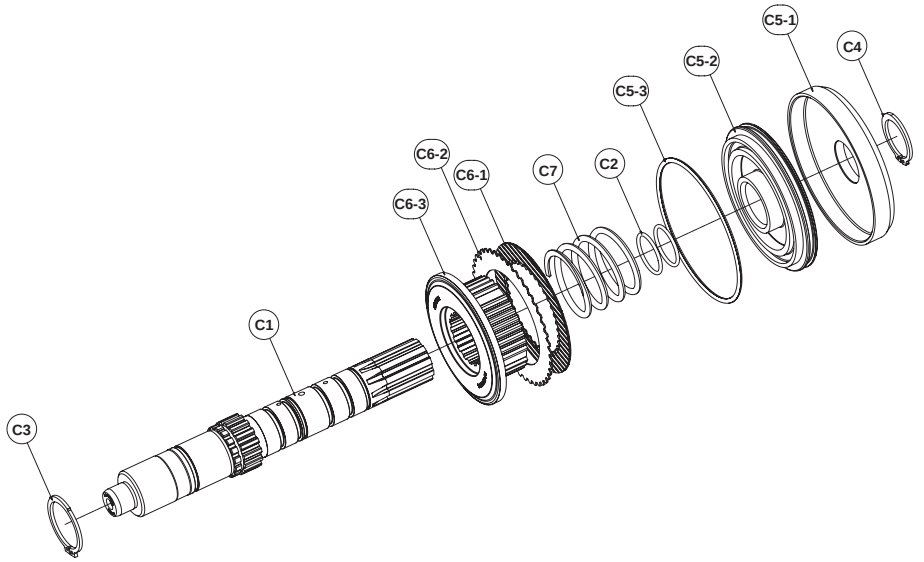
## Assembly

1. Assembly
   1.1. Output Shaft and Clutch Pack Assembly - Standard
      1.1.1. If the Spacer (**25**) and Retaining Ring (**C4**) were removed from the Shaft earlier, replace them with new ones now.
      1.1.2. Lubricate the Output Shaft (**C1**). Secure it in a Vise, making certain not to scratch it.
      1.1.3. Install the Clutch Gear (**C6-3**).
      1.1.4. Lubricate the metal Clutch Plates (**C6-1**). Then starting with a Friction Disc (**C6-1**) (which has teeth on the inner diameter), alternately stack all the Friction Discs (**C6-1**) and Clutch Plates (**C6-2**) (which have teeth on the outer diameter) on the Shaft.
      1.1.5. Install the two O-Rings (**C2**) on the Shaft.
      1.1.6. Install the Return Spring (**C7**).
      1.1.7. Lubricate a new Block Vee Ring (**C5-3**) and position it on the Piston (**C5-2**). The open face of the Ring should face toward the Clutch Back-Up Cylinder (**C5-1**).
      1.1.8. Install the Piston (**C5-2**), centering it over the Spring. Install the Clutch Back-Up Cylinder (**C5-1**).
      1.1.9. Compress the Piston and Clutch Assembly down past the Retaining Ring groove. Install a new Retaining Ring (**C4**).
      1.1.10. **NOTE:** If servicing a unit with a Shaft Brake (“BD” output) refer to “Shaft Brake Assembly” if standard Shaft Output go to 1.1.11
         1.1.10.1. Shaft Brake Assembly
         1.1.10.2. Slide Washer (**60**) onto output side of Shaft.
         1.1.10.3. Slide the two O-Rings (**70**) onto Shaft and into the grooves in shaft. Take care not to nick O-Rings.
         1.1.10.4. Slide Spring (**72**) onto output side of Shaft.
         1.1.10.5. Install Brake Assembly (**61** onto Shaft making sure the slot slides over the Pin (**62**) on the Shaft.
         1.1.10.6. Install Spacer (**25**)
         1.1.10.7. Install Snap Ring (**24**) on shaft to hold Brake Assembly on Shaft.
         1.1.10.8. Go to 1.1.12
      1.1.11. Install the Spacer (**25**)
      1.1.12. Lubricate a new Ball Bearing (**22**) and install it into the Bearing Cap (**16**). Use a soft Mallet and a proper Driver to do this.
      1.1.13. Secure the Bearing with a new Retaining Ring (**23**).
      1.1.14 Position the Bearing Cap over the Output Shaft. Support the Shaft Assembly in a press, being careful not to damage it. Using an appropriate Driver, press on the inner Bearing Race until resistance is felt.
      1.1.15. Secure the Assembly with a new Retaining Ring (**24**)
      1.1.16. Lubricate a new Bearing Cap Oil Seal (**26**). Then using an appropriate Shaft Seal Slide, Driver and a soft Mallet or Press, install it into the Bearing Cap (**16**).




| Item | Part Number | Description | Qty. |
|---|---|---|---|
| C1 | **3-P-1072** | Output Shaft 10T Straight (329723X) | 1 or |
| C1-1 | **3-P-1141** | Output Shaft 1.25" Keyed (329723-1X) | 1 |
| C2 | **28-P-244** | O-Ring 1.174" x .103" | 2 |
| C3 | **380069** | Lockring | 1 |
| C4 | **378576** | Lockring | 1 |
| C5 | **329179-1X** | Ass’y Piston & Back-Up Cylinder | 1 |
| C5-1 | **379323-1** | Cylinder Clutch Back-Up | 1 |
| C5-2 | **380057-1** | Piston Clutch Hydraulic | 1 |
| C5-3 | **28-P-178** | O-Ring 4.484" x .138" | 1 |
| C6 | **329678X** | Gear & Plates Kit | 1 |
| C6-1 | **379485** | Disc Friction | 11 |
| C6-2 | **380065** | Clutch Plate | 10 |
| C6-3 | **2-P-858** | Output Gear 36T | 1 |
| C7 | **37-P-39** | Spring 2.552" x 1.985" | 1 |



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## Assembly

1.3. P.T.O. Housing
- 1.3.1. Lubricate a new Needle Bearing (**7**) and install it into the Chelsea P.T.O. Housing (**1**). Using a proper Driver will help ensure that the Bearing is seated properly. Press on the flat side of the Bearing. The rounded side of the Bearing should face away from the Housing (**1**).

1.4. Output and Flange Assembly Installation
- 1.4.1. Place a new Gasket (**8**) on the P.T.O. Housing (**1**) mating face.
- 1.4.2. **Caution:** Do not use sealing compounds. It could affect the correct operation of the transmission. Install the Clutch Pack/ Bearing Cap Assembly into the Chelsea P.T.O. Housing (**1**)
- 1.4.3. **NOTE:** See "BA" Flange Output for Shaft Brake Installation
- 1.4.4. Secure the Bearing Cap (**16**) with Socket Head Capscrews (**27**). Tighten them, and torque to 16-20 Lbs. ft. (22 – 27 N.m.).
- 1.4.5 **"XD" Output Option**
  - 1.4.5.1. Use a soft Mallet to install a new Woodruff Key (**63**) into the Output Shaft.
- 1.4.6. **"VX" Output Option**
  - 1.4.6.1. Place a new Gasket (**8**) on the P.T.O. Housing (**1**) mating face.
  - 1.4.6.2. **Caution:** Do not use sealing compounds. It could affect the correct operation of the transmission. Install the Clutch Pack/ Bearing Cap Assembly into the Chelsea P.T.O. Housing (**1**)
  - 1.4.6.3. Secure the Bearing Cap (**16**) with Socket Head Capscrews (**27**). Tighten them, and torque to 16-20 Lbs. ft. (22 – 27 N.m.).
  - 1.4.6.4. Install Output Shaft Companion Flange (**44**) onto Output Shaft
  - 1.4.6.5. Install Washer (**63**) and Hex Head Capscrew (**66**) into Threaded Bore on Output Shaft and torque to 75-85 Lbs. ft. [102 – 115 N.m.].
- 1.4.7. **"BA" Output Option**
  - 1.4.7.1. Place a new Gasket (**8**) on the P.T.O. Housing (**1**) mating face.
  - 1.4.7.2. **Caution:** Do not use sealing compounds. It could affect the correct operation of the transmission. Install the Clutch Pack/ Bearing Cap Assembly into the Chelsea P.T.O. Housing (**1**)
  - 1.4.7.3. Install Shaft Brake Housing (**1**) Spacer (**57**) with another Gasket (**8**)
  - 1.4.7.4. Secure the Bearing Cap (**16**) with Socket Head Capscrews (**27**). Tighten and torque to 16-20 Lbs. ft. (22 – 27 N.m.).
  - 1.4.7.5. Install Output Shaft Companion Flange (**44**) onto Output Shaft
  - 1.4.7.6. Install Washer (**63**) and Hex Head Capscrew (**66**) into Threaded Bore on Output Shaft and torque to 75-85 Lbs.ft. [102 – 115 N.m.].
- 1.4.8. **Pump Flange Options**
  - 1.4.8.1. Install Rotatable Flange (**54**) and Gasket (**50**) after installing P.T.O. on transmission or on bench. Torque the four Socket Head Capscrews (**27**) to 16-20 Lbs. ft. [22 – 27 N.m.].

1.5. Input Gear Assembly
- 1.5.1. Install new, lubricated Bearing Cones (**15**) into the Input Gear (**31**), (**32**) and (**33**). The tapers should go toward the center of the Gear.
- 1.5.2. Next, place Tabbed Washer (**12**) next to the tall side of the Gear. This Washer shims the unit.
- 1.5.3. Place the Thrust Washer (**3**) on the ratio side of the Gear. Place the components into the Housing (**1**).
- 1.5.4. Align the Gear Assembly with the Idler Shaft (**12**) hole.
- 1.5.5. Place a new, lubricated O-Ring (**13**) on the Idler Shaft (**12**). Push it into the Housing (**1**) from the side opposite of the Roll Pin until it is just below the Housing (**1**) surface. Use the special alignment tool to make the job easier. The Shaft can only be installed from one direction because of the Roll Pin in the Housing (**1**).
- 1.5.6. **NOTE:** Once the Input Gear Assembly is installed, spin the Gear to seat the Tapered Bearing Cones. There should be no side-to-side Gear movement. If side-to-side movement exists, re-shim the Gear with the appropriate thickness of shims.


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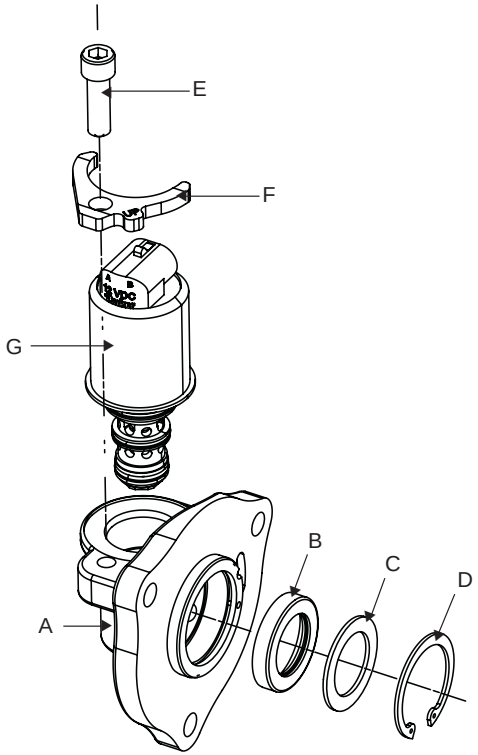
## Assembly

1.6. Valve Cap Assembly
- 1.6.1. If the Valve Assembly Oil Seal (**B**) was worn or damaged, replace it now. Lubricate a new Seal. Install it carefully with the proper Driver. **Important:** Avoid nicking the Housing (**1**). This could cause leakage or other P.T.O. damage.
- 1.6.2. Next install the Washer (**C**) and Retaining Ring (**D**).
- 1.6.3. Lubricate and attach the Solenoid Valve (**G**) to the Cap (**A**).
- 1.6.4. Next install the Clamp (**F**) and Socket Head Capscrew (**E**). Secure the Solenoid to the Valve Cap (**A**) with Socket Head Capscrew (**E**). Torque them to 48-72 Lbs. in. (5.4 – 8.1 N.m.).
- 1.6.5. Place a new Valve Cap Gasket (**4**) on the Valve Assembly. Make sure the holes are aligned. **Caution:** Do not use sealing compounds. It could affect the correct operation of the transmission.
- 1.6.6. Attach the Valve Assembly to the P.T.O. Housing (**1**). Tighten the three Capscrews (**10**) and torque them to 16-20 Lbs. ft. (22 – 27 N.m.).

2. Final Check
- 2.1. While holding the Input Gear, turn the Output Shaft. If everything is assembled correctly, the Shaft will turn freely. Next, roll the Gears. They should roll freely. No side-to-side wobble should occur if the unit is assembled correctly.
- 2.2. The unit is ready to be installed back on the transmission




| Item | Part Number | Description | Qty. |
|---|---|---|---|
| 11 | **329442-12X** | Valve & Cap Assembly (12V) (“KV” Pitch Only) | 1 or |
| | **329442-24X** | Valve & Cap Assembly (24V) (“KV” Pitch Only) | 1 |
| | **329463-12X** | Valve & Cap Assembly (12V) (“FJ” Pitch Only) | 1 or |
| | **329463-24X** | Valve & Cap Assembly (24V) (“FJ” Pitch Only) | 1 |
| A | **34-P-143** | Valve Cap | 1 |
| B | **28-P-119** | Oil Seal (Hi Pressure) | 1 |
| C | **378811** | Washer | 1 |
| D | **378849** | Retaining Ring | 1 |
| E | **378447-6** | Sockethead Capscrew .312" - 18 x 1.00" | 1 |
| F | **379995** | Clamp (“KV”) Included with 379993 Valve | 1or |
| | **380012** | Clamp (“FJ”) used with 380011 Valve | 1 |
| | **380124** | Clamp (“FJ”) used with 380123 Valve | 1 |
| G | **379993-12** | Hydraulic Valve (12V) (“KV”) (White Connector) | 1 or |
| | **379993-24** | Hydraulic Valve (24V) (“KV”) (Black Connector) | 1 |
| | **380011-12** | Hydraulic Valve (12V) (“FJ”) (White Side Connector) | 1 |
| | **380011-24** | Hydraulic Valve (24V) (“FJ”) (Black Side Connector) | 1 or |
| | **380123-12** | Hydraulic Valve (12V) (“FJ”) (White Connector Top) (New Style) | 1 or |
| | **380123-24** | Hydraulic Valve (24V) (“FJ”) (Black Connector Top) (New Style) | 1 |



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# SECTION 3



**Parker Hannifin Corporation**
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| Location | Torque (English) | Torque (Metric) |
|---|---|---|
| Idler Pin Screw Set | 20 - 30 In. Lbs. | 2 - 3 N.m. |
| Bearing Cap Open | 24 - 28 Lbs. ft. | 33 - 38 N.m. |
| Rotatable Flanges | | |
| “RK”, “RF”, “RY” and “RS” (378447-8) (Qty. 4) | 16 - 20 Lbs. ft. | 22 - 27 N.m. |
| Valve Cap Assembly | 24 - 28 Lbs. ft. | 33 - 38 N.m. |
| Hydraulic Valve Clamp | 96 - 120 In. Lbs. | 11 - 13 N.m. |
| Shaft Nut “BA” and “XV” (378435-7) | 75 - 85 Lbs. ft. | 102 - 115 N.m. |
| Straight Thread Connector 90° (379486) | 120 - 156 In. Lbs. | 14 - 18 N.m. |
| Speed Sensor Port | | |
| With E.O.C. (379243) | 25 - 30 Lbs. ft. | 34 - 41 N.m. |
| Without E.O.C. | | |
| O-Ring Boss Plug (379242) | 25 - 30 Lbs. ft. | 34 - 41 N.m. |
| Pipe Plug (379231) | 8 - 12 Lbs. ft. | 11 - 16 N.m. |



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## "3" and "5" Assembly Gear Chart

| Gear Designator | Input Gear (31) | No. Teeth Input | Ratio Gear (32) | No. Teeth Ratio | Output Gear (21) | No. Teeth Output |
|---|---|---|---|---|---|---|
| 280*BFJ | 5-P-1491 | 50 | 5-P-1478 | 22 | 2-P-926 | 50 |
| 280*CFJ | 5-P-1491 | 50 | 5-P-1495 | 25 | 2-P-927 | 47 |
| 280*DFJ | 5-P-1491 | 50 | 5-P-1479 | 28 | 2-P-928 | 44 |
| 280*GFJ | 5-P-1491 | 50 | 5-P-1480 | 31 | 2-P-929 | 41 |
| 280*KFJ | 5-P-1491 | 50 | 5-P-1481 | 33 | 2-P-931 | 39 |
| 280*MFJ | 5-P-1491 | 50 | 5-P-1482 | 35 | 2-P-933 | 37 |
| 280*PFJ | 5-P-1491 | 50 | 5-P-1483 | 37 | 2-P-935 | 35 |
| 280*SFJ | 5-P-1491 | 50 | 5-P-1484 | 39 | 2-P-936 | 33 |
| 280*TFJ | 5-P-1491 | 50 | 5-P-1497 | 41 | 2-P-937 | 31 |
| 280*BKV | 5-P-1493 | 45 | 5-P-1478 | 24 | 2-P-926 | 50 |
| 280*CKV | 5-P-1493 | 45 | 5-P-1495 | 22 | 2-P-927 | 47 |
| 280*DKV | 5-P-1493 | 45 | 5-P-1479 | 28 | 2-P-928 | 44 |
| 280*GKV | 5-P-1493 | 45 | 5-P-1480 | 31 | 2-P-929 | 41 |
| 280*KKV | 5-P-1493 | 45 | 5-P-1481 | 33 | 2-P-931 | 39 |
| 280*MKV | 5-P-1493 | 45 | 5-P-1482 | 35 | 2-P-933 | 37 |
| 280*PKV | 5-P-1493 | 45 | 5-P-1483 | 37 | 2-P-935 | 35 |
| 280*SKV | 5-P-1493 | 45 | 5-P-1484 | 39 | 2-P-936 | 33 |
| 280*TKV | 5-P-1493 | 45 | 5-P-1497 | 41 | 2-P-937 | 31 |

## "8" Assembly Gear Chart

| Gear Designator | Input Gear (31) | No. Teeth Input | Ratio Gear (32) | No. Teeth Ratio | Output Gear (21) | No. Teeth Output |
|---|---|---|---|---|---|---|
| 280*BFJ | 5-P-1491 | 50 | 5-P-1478 | 22 | 2-P-925 | 53 |
| 280*CFJ | 5-P-1491 | 50 | 5-P-1495 | 25 | 2-P-926 | 50 |
| 280*DFJ | 5-P-1491 | 50 | 5-P-1479 | 28 | 2-P-927 | 47 |
| 280*GFJ | 5-P-1491 | 50 | 5-P-1480 | 31 | 2-P-928 | 44 |
| 280*MFJ | 5-P-1491 | 50 | 5-P-1482 | 35 | 2-P-930 | 40 |
| 280*PFJ | 5-P-1491 | 50 | 5-P-1483 | 37 | 2-P-932 | 38 |
| 280*SFJ | 5-P-1491 | 50 | 5-P-1484 | 39 | 2-P-934 | 36 |
| 280*TFJ | 5-P-1491 | 50 | 5-P-1485 | 42 | 2-P-936 | 33 |
| 280*BKV | 5-P-1493 | 45 | 5-P-1478 | 22 | 2-P-925 | 53 |
| 280*CKV | 5-P-1493 | 45 | 5-P-1495 | 25 | 2-P-926 | 50 |
| 280*DKV | 5-P-1493 | 45 | 5-P-1479 | 28 | 2-P-927 | 47 |
| 280*GKV | 5-P-1493 | 45 | 5-P-1480 | 31 | 2-P-928 | 44 |
| 280*MKV | 5-P-1493 | 45 | 5-P-1482 | 35 | 2-P-930 | 40 |
| 280*PKV | 5-P-1493 | 45 | 5-P-1483 | 37 | 2-P-932 | 38 |
| 280*SKV | 5-P-1493 | 45 | 5-P-1484 | 39 | 2-P-934 | 36 |
| 280*TKV | 5-P-1493 | 45 | 5-P-1485 | 42 | 2-P-936 | 33 |



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SECTION 4



**Parker Hannifin Corporation**
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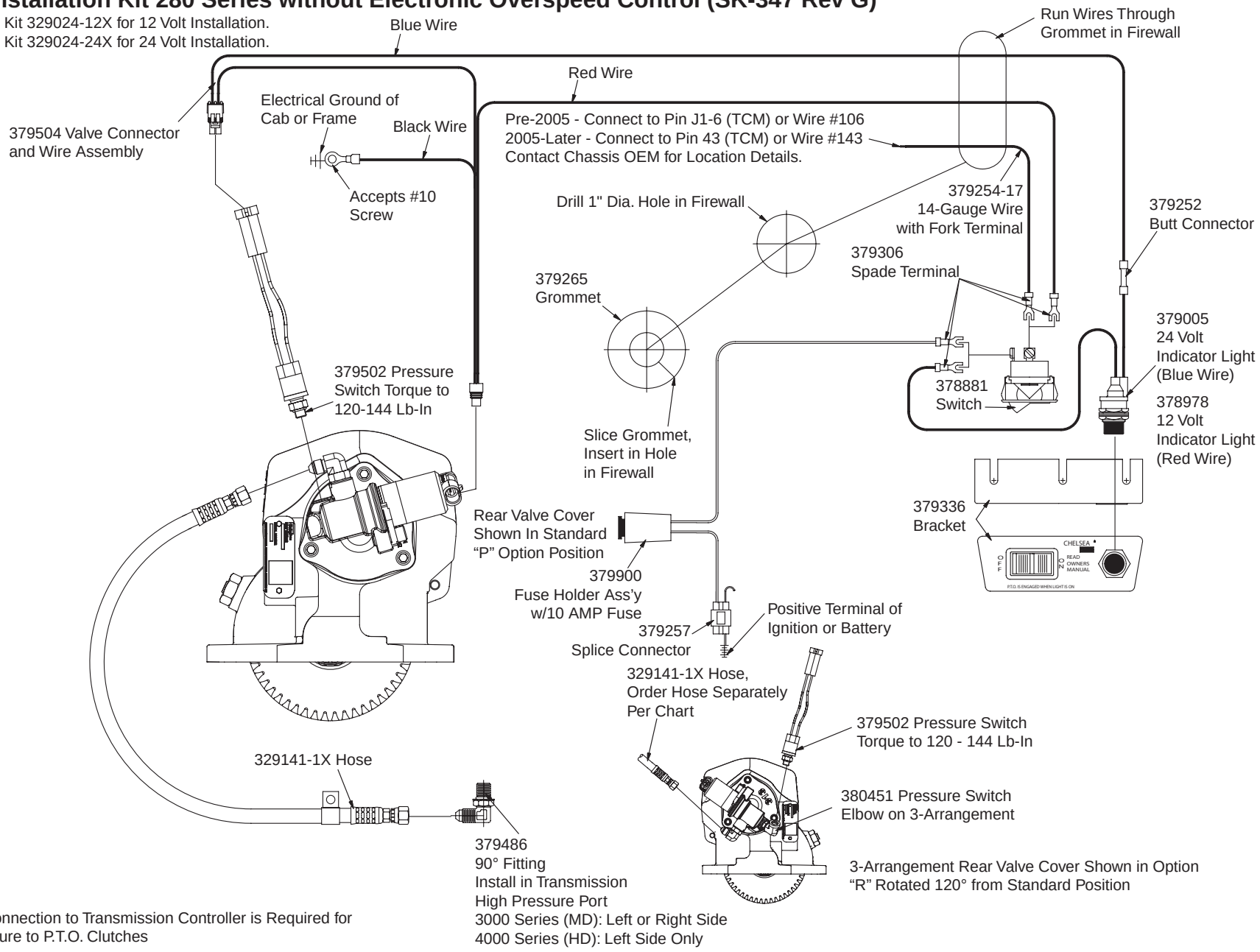
## Shift Installation Kit 280 Series without Electronic Overspeed Control (SK-347 Rev G)

Reference Kit 329024-12X for 12 Volt Installation.
Reference Kit 329024-24X for 24 Volt Installation.




**NOTE:** Connection to Transmission Controller is Required for Full Pressure to P.T.O. Clutches



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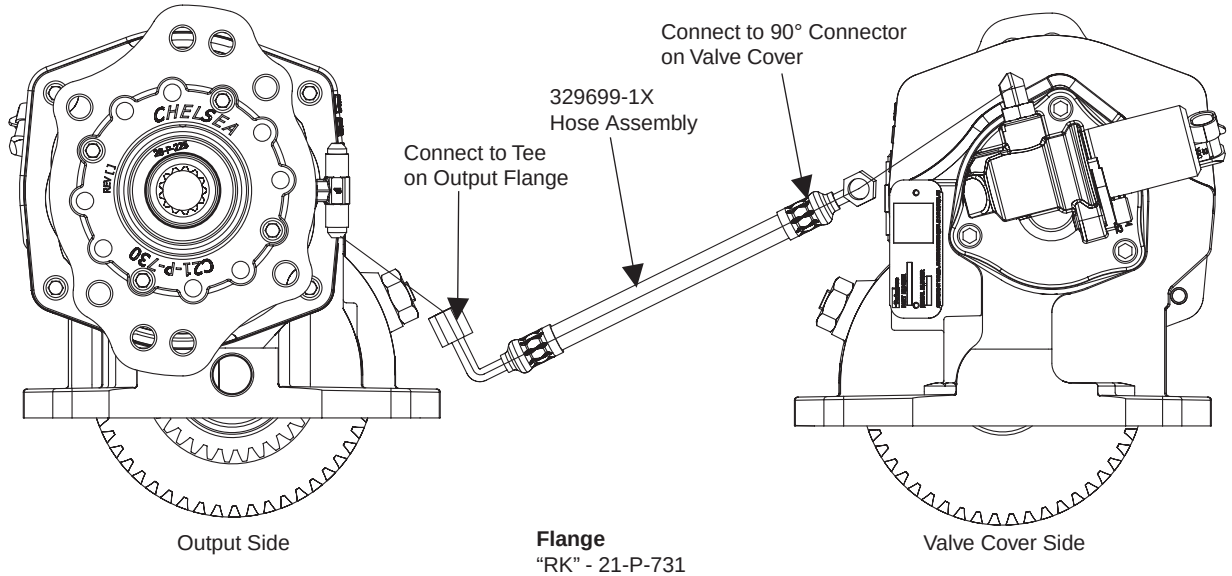
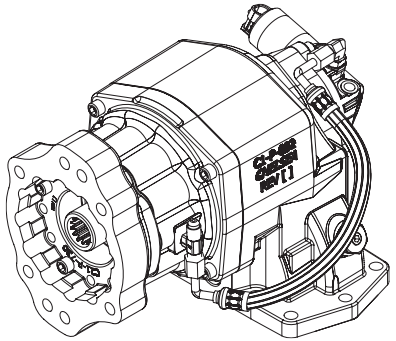
## Installation “RF”, “RK”, “RS”, “RY”, “RZ” & “UN” Wet Spline 280 Series (SK-508)

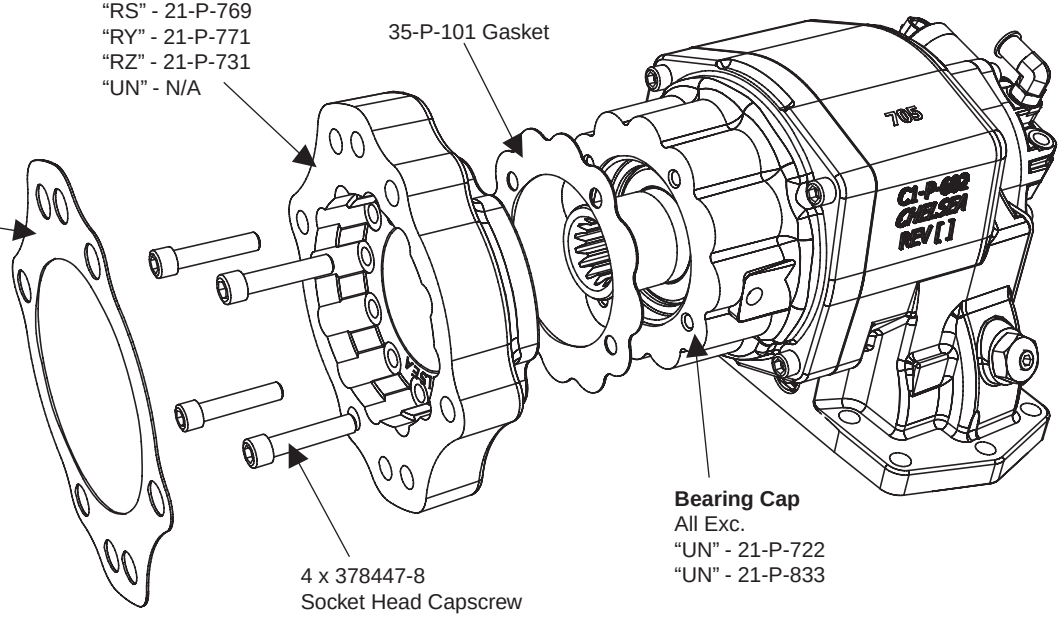


| Cover Plates | | | |
|---|---|---|---|
| RF | **329658X** | RY | **329659X** |
| RK | **329658X** | RZ | **329658X** |
| RS | **329654X** | | |

**Flange**
“RK” - 21-P-731
“RF” - 21-P-731
“RS” - 21-P-769
“RY” - 21-P-771
“RZ” - 21-P-731
“UN” - N/A

35-P-101 Gasket




**Gasket or O-Ring**
“RK” - 35-P-102
“RF” - 35-P-102
“RS” - 28-P-245
“RY” - 35-P-111
“RZ” - 35-P-102
“UN” - 22-P-100

**Bearing Cap**
All Exc.
“UN” - 21-P-722
“UN” - 21-P-833

4 x 378447-8
Socket Head Capscrew
Torque 16 - 20 Lbs. ft. [22 - 27 N.m.]



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# SECTION 5



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## Mounting the P.T.O. on the Transmission for Allison

When installing a P.T.O., always wear protective clothing and safety glasses.

1. Begin by draining the oil from the transmission. Use caution, since the oil may be hot (**Fig. 1**).

**NOTE:** Installation shown is for Left Side (Street Side) of transmission.

2. Remove the P.T.O. aperture plate with a 15mm socket (**Fig. 2**).

3. Remove the gasket and clean the aperture surface (**Fig. 3**).

**NOTE:** Do not reuse the gasket that comes with the transmission.

4. Using a screwdriver, install the guide pins until they bottom out (**Fig. 4**).

**NOTE**: Do not use sealing compounds because they are generally incompatible with automatic transmission fluid.

5. Install the special gasket over the guide pins. The ribbed surface should face outward, toward the installer (**Fig. 5**).

**NOTE:** To ensure proper backlash and sealing of P.T.O. to transmission only use gasket furnished with the P.T.O.

6. Position the P.T.O. and secure it with the top capscrew (**Fig. 6**).

7. Install the remaining capscrews. Torque all to 40 - 50 Lbs. ft. (54 - 68 N.m. or 5.5 - 6.9 Kg.m) (**Fig. 7**).

**NOTE:** Always use a crossing pattern with tightening capscrews.

8. If installing a wet spline output, attach hose to tee fitting on output flange. If non wet spline option attach hose to fitting at P.T.O. valve (**Fig. 8**).

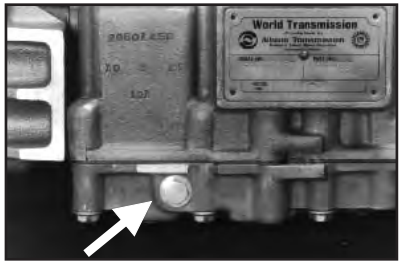

Fig. 1


Fig. 2


Fig. 3

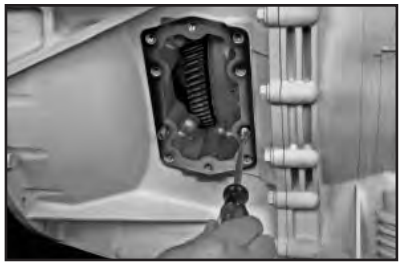
Fig. 4


Fig. 5

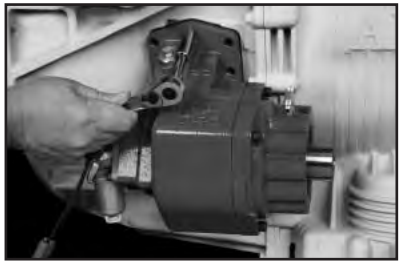
Fig. 6


Fig. 7


Fig. 8



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9. Remove the Transmission High Pressure port plug and securely install the 90° elbow fitting supplied with the P.T.O. (**Fig. 9**).

10. Wet spline Option - Connect the pressure hose between the tee fitting on the output bearing cap and high pressure port on the transmission. Non-Wet spline Option - Attach hose between P.T.O. valve fitting and High Pressure Port on the transmission (**Fig. 10**).

11. After determining the position of the rotatable flange /pump, install the flange with the gasket and cap screws supplied with the P.T.O. (**Fig. 11**).

**Installing Rotatable Flanges**
The rotatable flange is shipped loose with the P.T.O. units for ease of installation. After determining the flange position, attach the flange to the P.T.O. bearing cap using the capscrews provided in the bag kit. After installing the capscrews make sure to torque the screws to 16 - 20 Lbs. ft. [22-27 N.m.]. Consideration should be taken on the size and weight of the pump being installed.

**CAUTION:** If not installing direct mount pump at this time install gasket, cover plate and bolts to wet spline output option to prevent transmission fluid from leaking out of P.T.O. flange if truck engine is turned “ON” (**Fig. 12**).

**NOTE:** Also see page 23 for rotatable flange/wet spline information.

12. Complete the assembly by installing the electrical connection to the valve assembly (**Fig. 13**) and the pressure switch (**Fig. 14**).

13. Reference SK-Drawings in this book for complete installation information.

**NOTE:** After installation is complete refill transmission with oil as per manufacture recommendation. Run PTO for approximately 5-10 minutes. Check for any unusual noise or vibration also check for leaks and/or loose fittings or fasteners. Disengage P.T.O. and shut vehicle engine off.


Fig. 9

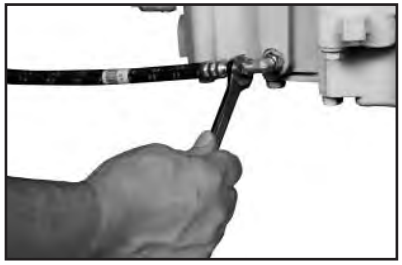
Fig. 10

Fig. 11

Fig. 12

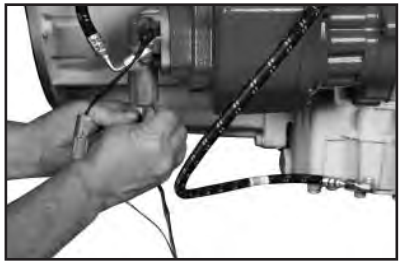
Fig. 13


Fig. 14



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# SECTION 6



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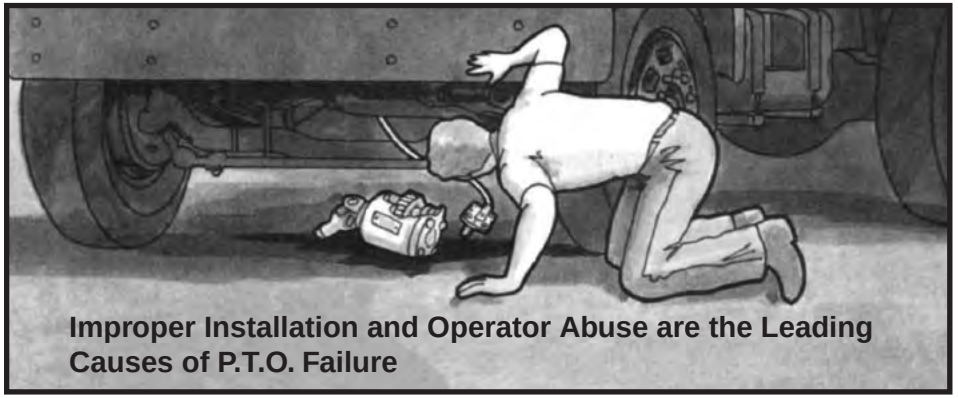


**Improper Installation and Operator Abuse are the Leading Causes of P.T.O. Failure**

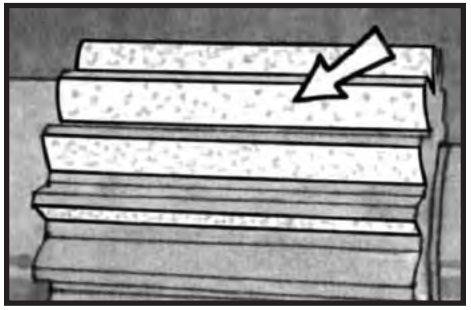
The Chelsea P.T.O. is designed and built to meet the rugged demands of the Mobile Equipment Industry. With proper use and maintenance, the Chelsea P.T.O. will provide a long service life, both on-highway and off. Yet, if a problem does arise, it is important to diagnose its causes and correct it at once.

The first place to look when troubleshooting a P.T.O. failure is in the application itself. Repeated or premature failure may be a sign of an incorrect application. This can be discovered by using the Chelsea HY25-3001/US General Information Catalog or HY25-3000/US Applications Catalog. Check to see if the proper P.T.O. was specified for the transmission, then find out if the torque handling capabilities of the P.T.O. are satisfactory for the job being done. A P.T.O. works best when it is properly specified for the transmission and job requirement.

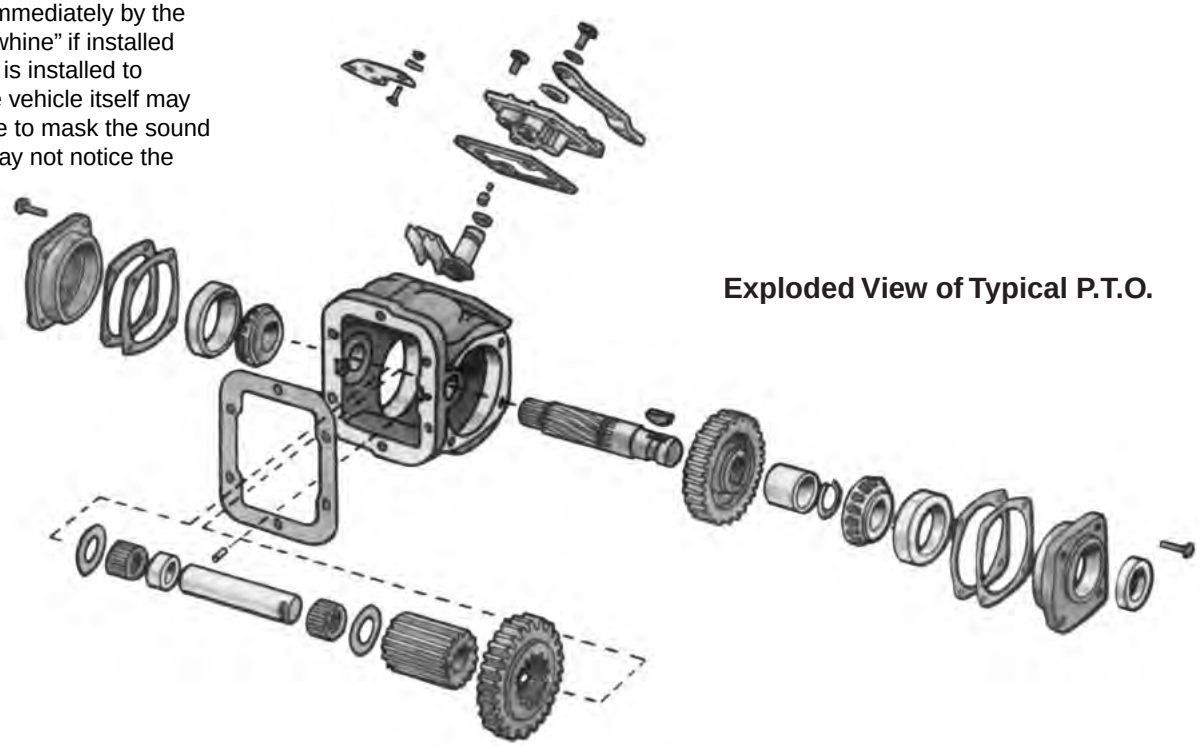
If the P.T.O. was correctly specified and then failed prematurely, there are two likely causes: improper installation and/or operator misuse. These are tough problems because they involve people as well as product. An improperly installed P.T.O. can normally be identified immediately by the sound it makes. It will “whine” if installed to tightly, or “clatter” if it is installed to loosely. Sometimes, the vehicle itself may contribute enough noise to mask the sound of the P.T.O. and one may not notice the problem.

If a problem is allowed to continue, then damage to the P.T.O. will result. A unit that has been mounted to loosely could result in broken gear teeth. A unit that is mounted too tightly could result in premature wear to the gear teeth. Also, when a P.T.O. is installed without enough filler blocks, spacers, or gaskets between it and the transmission, a deep wear pattern will occur on the gear teeth. These patterns will lead to fatigue and early tooth failure. To help prevent this from occurring, always test the P.T.O. for noise just after it is installed.

Whatever the reason for a P.T.O. failure, there will be confusion over who, or what, is at fault. More than likely the product will be blamed. Although the P.T.O. cannot defend itself, its failed parts will tell a story.



The first parts to inspect should be the gears. Check the surface of the gear teeth for signs of pitting . . . pitting is a normal wear pattern in most cases. However, contaminants in the oil or an installation that is too tight will cause severe pitting.



**Exploded View of Typical P.T.O.**



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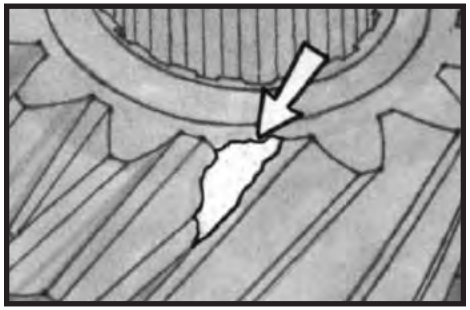
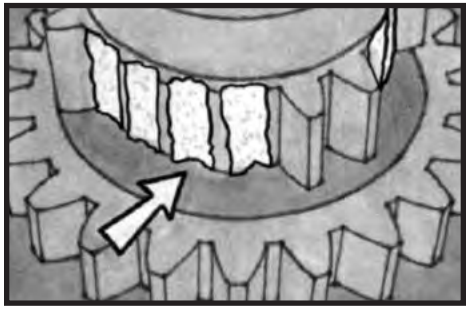
Once pitting of the gear surfaces has begun, there is nothing that can stop it. Severe pitting will eventually lead to gear tooth failure, therefore the damaged gear should be replaced when a P.T.O. is repaired or rebuilt.

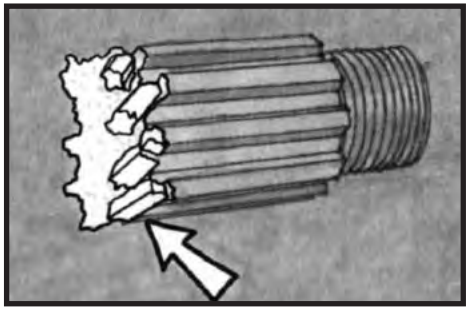


Sometimes a gear will chip a tooth because of mishandling or improper shifting. Even though a P.T.O. may continue to run with a chipped tooth, the damaged gear should be replaced immediately. It will damage the other teeth it comes in contact with during operation, not to mention the possible damage which could result from the loose chip. If the problem is allowed to continue, then failure to other parts in the P.T.O. or transmission could result.

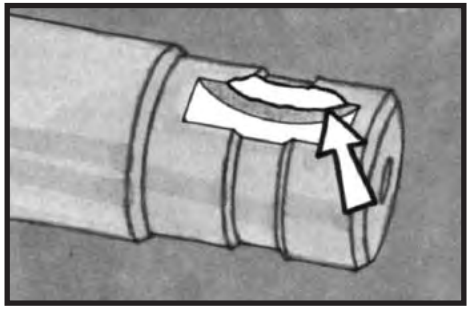
Another possible problem during vehicle operation is “shock load.” This occurs when the torque demands on a P.T.O. are suddenly greater than it was designed to take. “Shock load” could be caused by torque overloads, improper shifting, equipment failure, or excessive loads over a short period of time. If this happens, the P.T.O. is likely to fail immediately. The vehicle operator may not even be aware of the reason for the P.T.O. failure.



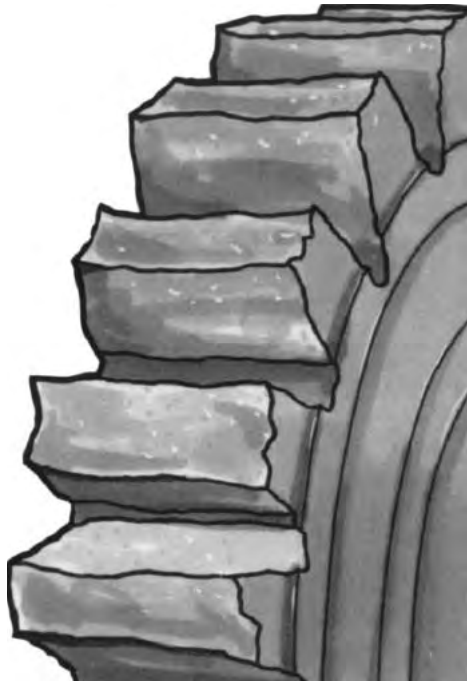
Worn gears can easily be affected by “shock load.” If the worn gears are not replaced, they can eventually lead to broken gear teeth. This is the most severe form of P.T.O. failure. Worn or damaged gears are likely to break because of their reduced load carrying capacity. To prevent the possibility of broken gear teeth, always inspect auxiliary equipment for possible freeze-up. Also, recheck P.T.O. application, operating conditions and P.T.O. installation.



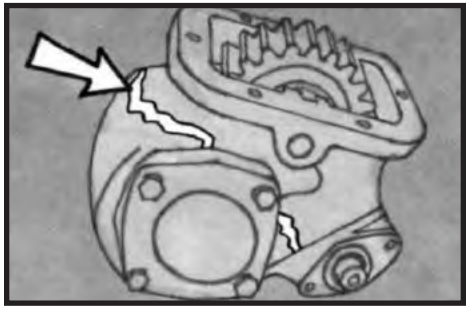
P.T.O. shafts are also vulnerable to operating abuse. If the shaft break is irregular, this usually indicates a torsional overload. Bending fatigue failure usually shows up as a smooth, flat break. To correct a P.T.O. shaft problem replace the failed shaft and check the speed and operating angle of the universal joint. Also, make sure the P.T.O. driveshaft is properly phased, (yokes in-line with each other). If a driveline is improperly installed it will cause vibration, which may lead to P.T.O. driveshaft or driven equipment problems.



When inspecting a P.T.O. output shaft, always inspect the keyway. Sometimes a P.T.O. will fail because of a displaced keyway on the shaft caused by a loose fitting yoke or equipment freeze-up. Proper maintenance on auxiliary equipment and replacing a worn yoke and/or P.T.O. driven shaft will prevent this problem.



**Deep Mesh Pattern Caused by Improper Backlash Adjustment**



One of the most serious problems a P.T.O. can suffer is a cracked case. This condition can lead to oil loss and eventual transmission failure. Improper installation, poorly torqued bolts, or an unsupported direct mount pump can cause such a problem. A P.T.O. case can also be damaged by foreign objects meshing between the gear teeth, severe shock load, or even hitting an obstacle in the road.

Prevention is the best cure for P.T.O. case damage. Therefore, always torque the P.T.O. flange bolts in sequence and the proper specifications. Also, be sure to check the weight of the direct mount pump and, if it is over forty pounds, make a support bracket for it.



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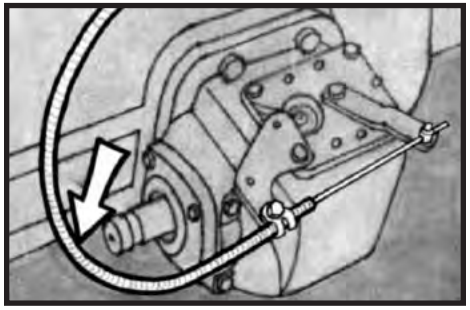
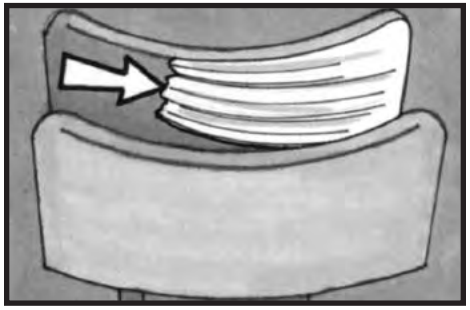
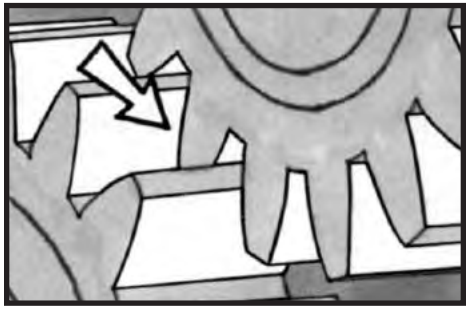


Shifting problems are sometimes a complaint an operator will have about his P.T.O. A P.T.O. that is hard to shift may be caused by a tight bend in the shifter cable, poor leverage, a gear that is installed backwards, or too tight of an installation. Many of these problems can be solved by inspecting the P.T.O. installation and making the proper adjustments regarding cable length, gear position, or shift lever.

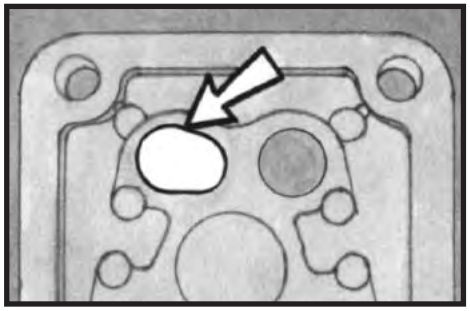
Remember, a lever-operated shift linkage should not be connected to a wire shift cover. The mechanical advantage of the lever is often too great for the wire shift cover and could severely damage it. Also inversely, don't use a cable with a lever shift cover. The cable isn't capable of transmitting the force necessary to shift a lever mechanism.



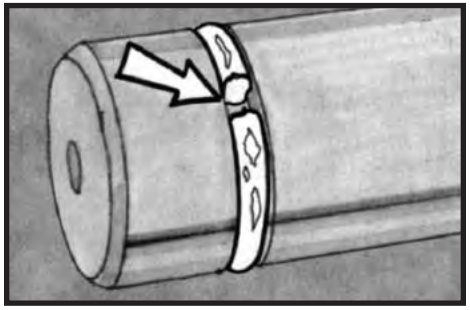
Most shifting complaints are caused by improper shifting procedure or incorrect linkage installation. Both of these situations will cause premature wear on the shift pad or fork and the shift rod or rail. To prevent this premature wear, avoid overshifting or undershifting the P.T.O. Overshifting causes the shifter fork to press against a P.T.O. gear during operation. This results in unnecessary friction and wear.



Undershifting allows incomplete gear tooth contact with the driver gear. This means only part of the tooth width is transmitting the torque and R.P.M. during P.T.O. operation. This situation can lead to gear failure or it could cause the P.T.O. to jump out of gear. These two problems can be overcome by checking linkage adjustments and proper operator training.



Shifting problems can also be caused by a worn or elongated shifter poppet hole. This causes the P.T.O. to jump out of gear and the parts in the shifter assembly to break or become loose. If this happens, replace those parts that are worn.



Seals and O-Rings may cause special problems in P.T.O. operations. Improper installation or heat build-up can cause O-Rings and seals to fail prematurely. Once seals or O-Rings fail, they should be replaced. The proper procedure for installing these parts is to lubricate them first so they will easily slide on the shaft.



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SECTION 7



**Parker Hannifin Corporation**
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| | | |
|---|---|---|
| **329071-62X** | Gasket & Seal Kit (All Outputs Except “BA”,) | |
| 2-P-112 | Gasket | 1 |
| 22-P-101 | Gasket | 1 |
| 28-P-191 | O-Ring .549" x .103" | 1 |
| 28-P-119 | Oil Seal 1.379" x .875" x .250" | 1 |
| 28-P-211 | Oil Seal 3.001" x 2.00" x .375" | 1 |
| 28-P-267 | Oil Seal 2.627" x 1.750" x .312" | 1 |
| 28-P-285 | O-Ring 1.597" x .103" | 2 |
| 28-P-178 | O-Ring 4.484" x .138" | 1 |
| 35-P-101 | Bearing Cap Gasket Wet Spline | 1 |
| **329071-63X** | Bearing Kit “AC”, “XD”, “XV”, “RF”, “RK”, “RS”, “RY”, “RZ” (All Outputs Except “BA” and “UN”) | |
| 379746 | Lockring | 1 |
| 378263 | Lockring | 1 |
| 379555 | Lockring | 1 |
| 560972 | Needle Roller Bearing Ass’y 1.500" x 1.875" x 1.000" | 1 |
| 550311 | Ball Bearing 1.77" x 3.346" x .748" | 1 |
| 550439 | Tapered Cone Bearing .750" x .8598" | 2 |
| 561056 | Plain Bearing 1.500" x 1.656" x 1.00" | 1 |
| 31-P-102 | Thrust Washer .754" x .440" x .030" | 1 |
| 14-P-73-1 | Spacer .762" x 1.500" x .150" | 1 |
| 14-P-73-2 | Spacer .762" x 1.500" x .153" | 1 |
| 14-P-73-3 | Spacer .762" x 1.500" x .156" | 1 |
| **329071-64X** | Bearing Kit (“BA”, “UN” Outputs) | |
| 379746 | Lockring | 1 |
| 378263 | Lockring | 1 |
| 379555 | Lockring | 1 |
| 378895 | Lockring | 1 |
| 378576 | Lockring | 1 |
| 550010 | Ball Bearing 1.378" x 2.8346" x .6693" | 1 |
| 560972 | Needle Roller Bearing Ass’y 1.500" x 1.875" x 1.000" | 1 |
| 550439 | Tapered Cone Bearing .750" x .8598" | 2 |
| 561056 | Plain Bearing 1.500" x 1.656" x 1.00" | 1 |
| 31-P-102 | Thrust Washer .754" x .440" x .030" | 1 |
| 14-P-73-1 | Spacer .762" x 1.500" x .150" | 1 |
| 14-P-73-2 | Spacer .762" x 1.500" x .153" | 1 |
| 14-P-73-3 | Spacer .762" x 1.500" x .156" | 1 |

| | | |
|---|---|---|
| **329175-12X** | Conversion Kit E.O.C. 12V (“FJ” Pitch) | |
| 28-P-171 | O-Ring | 1 |
| 329650X | Electronic Overspeed Controller | 1 |
| 329076X | Hydraulic Shift | 1 |
| 379243 | Speed Sensor | 1 |
| **329175-24X** | Conversion Kit E.O.C. 24V (“FJ” Pitch) | |
| 28-P-171 | O-Ring | 1 |
| 329650X | Electronic Overspeed Controller | 1 |
| 329076X | Hydraulic Shift | 1 |
| 379243 | Speed Sensor | 1 |
| **329354-12X** | Conversion Kit 12 Volt Remote Valve (All) | |
| 22-P-112 | Gasket | 1 |
| 500457-6 | Mounting Screw | 2 |
| 500357-7 | Lockwasher | 2 |
| 379686-1 | Solenoid Valve | 1 |
| 379449 | Screen Adapter | 1 |
| 379258 | Bracket | 1 |
| 379564-2 | Cap Thread | 2 |
| 329231X | Valve Connector | 1 |
| 329230X | Connector | 1 |
| 328075X | Hose Assembly | 1 |
| 379700 | Tee Female | 1 |
| 380010 | Union Female | 1 |
| 379486 | 90˚ Elbow | 1 |
| 329403X | Assembly Seal | 1 |
| 379711 | Female Bracket | 1 |
| 379131-1 | Adapter | 1 |
| SK-432 | Installation | 1 |
| 329057-4X | Hose Assembly | 2 |

Continued on Next Page

| | | |
|---|---|---|
| **329354-24X** | Conversion Kit 24 Volt Remote Valve (All) | |
| 500457-6 | Mounting Screw | 2 |
| 500357-7 | Lockwasher | 2 |
| 379686-2 | Solenoid Valve | 1 |
| 379449 | Screen Adapter | 1 |
| 379258 | Bracket | 1 |
| 379564-2 | Cap Thread | 2 |
| 329231X | Valve Connector | 1 |
| 329230X | Connector | 1 |
| 328075X | Hose Assembly | 1 |
| 22-P-112 | Gasket | 1 |
| 379700 | Tee Female | 1 |
| 380010 | Union Female | 1 |
| 379486 | 90˚ Elbow | 1 |
| 329403X | Assembly Seal | 1 |
| 379711 | Female Bracket | 1 |
| 379131-1 | Adapter | 1 |
| SK-432 | Installation | 1 |
| 329057-4X | Hose Assembly | 2 |

| | | |
|---|---|---|
| **329448-12X** | Conversion Kit E.O.C. 12V (“KV” Pitch) | |
| 28-P-171 | O-Ring | 1 |
| 329650X | Electronic Overspeed Controller | 1 |
| 329444X | E.O.C. Wire Installation Kit | 1 |
| 379243 | Speed Sensor | 1 |

| | | |
|---|---|---|
| **329448-24X** | Conversion Kit E.O.C. 24V (“KV” Pitch) | |
| 28-P-171 | O-Ring | 1 |
| 329650X | Electronic Overspeed Controller | 1 |
| 329444X | E.O.C. Wire Installation Kit | 1 |
| 379243 | Speed Sensor | 1 |

| | | |
|---|---|---|
| **329678X** | Gear & Clutch Plates Kit (All) | |
| 2-P-858 | Output Gear 36T | 1 |
| 379485 | Friction Disc | 11 |
| 380065 | Clutch Plate | 10 |

| | | |
|---|---|---|
| **7170-86X** | Mounting Kit (“FJ” Gear Pitch) | |
| 379451 | Screw Pilot | 2 |
| 379453-10 | Capscrew M10 - 1.5" x 1.378" | 8 |
| 379486 | 90˚ Elbow | 1 |
| SK-355 | Installation | 1 |

| | | |
|---|---|---|
| **7170-117X** | Mounting Kit (“KV” Gear Pitch) | |
| 379451 | Screw Pilot | 2 |
| 379453-10 | Capscrew M10 - 1.5" x 1.378" | 8 |
| 379812 | Male Connector | 1 |



**Parker Hannifin Corporation**
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## Notes




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# Offer of Sale

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods, services or work described will be referred to as "Products".

**1. Terms and Conditions.** Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional terms or conditions of Buyer's order or any other document issued by Buyer.

**2. Price Adjustments; Payments.** Prices stated on Seller's quote or other documentation offered by Seller are valid for 30 days, and do not include any sales, use, or other taxes unless specifically stated. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). Payment is subject to credit approval and is due 30 days from the date of invoice or such other term as required by Seller's Credit Department, after which Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

**3. Delivery Dates; Title and Risk; Shipment.** All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon placement of the products with the shipment carrier at Seller's facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.

**4. Warranty.** Seller warrants that all products sold, other than the 590 Series, conform to the applicable Parker Chelsea standard specification for the lesser period of 2 years (24 Months) from date of service or 2-1/2 years (30 Months) from date of build (as marked on the product name plate). Seller warrants that the 590 Series will conform to the applicable Seller standard specification for the lesser period of 2 years (24 Months) from date of service or 2000 hours of usage. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

**5. Claims; Commencement of Actions.** Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery. Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for an amount due on any invoice) must be commenced within 12 months from the date of the breach without regard to the date breach is discovered.

**6. LIMITATION OF LIABILITY. UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**

**7. User Responsibility.** The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

**8. Loss to Buyer's Property.** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, will be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

**9. Special Tooling.** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

**10. Buyer's Obligation; Rights of Seller.** To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.

**11. Improper use and Indemnity.** Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

**12. Cancellations and Changes.** Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

**13. Limitation on Assignment.** Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

**14. Force Majeure.** Seller does not assume the risk and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.

**15. Waiver and Severability.** Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

**16. Termination.** Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days written notice of termination. Seller may immediately terminate this agreement, in writing, if Buyer: (a) commits a breach of any provision of this agreement (b) appointments a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or by a third party (d) makes an assignment for the benefit of creditors, or (e) dissolves or liquidates all or a majority of its assets.

**17. Governing Law.** This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement.

**18. Indemnity for Infringement of Intellectual Property Rights.** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

**19. Entire Agreement.** This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

**20. Compliance with Law, U. K. Bribery Act and U.S. Foreign Corrupt Practices Act.** Buyer agrees to comply with all applicable laws and regulations, including both those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA") and the U.S. Anti-Kickback Act (the "Anti-Kickback Act"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that they are familiar with the provisions of the U. K. Bribery Act, the FCPA and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer shall not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.

07/14

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