I. REAR PTO

Beginning in late 2016, the DT12 will be available with a rear-facing Power Take-Off (PTO). This PTO is a mechanical drive that attaches to the rear of the transmission and is used to transfer power produced by the engine to an auxiliary component.

NOTE: This rear facing PTO is approved for stationary & launch gear use only.

The interface is normally closed by a cover plate when not offered. However, when the DT12 PTO is ordered by the OEM/Dealer, the DT12 Transmission will arrive with the PTO hardware preinstalled from DETROIT™.

Figure 1: Rear of DT12 without PTO (cover plate only).

CONFIGURATIONS AVAILABLE

The 6 different SpecPro DT12 PTO configurations available from DETROIT™ are shown below:

1. 362-2HB DT12 Hydrocar P89 Rear Mounted PTO for Hydraulic Pump (1:1.32 PTO Ratio)

In this configuration, the cover plate shown in Figure 1 above is replaced by a PTO drive assembly as shown in Figures 2 & 3 below.
Figure 2: Rear DT12 PTO drive assembly (option 362-2HB) with cover plate.

With the access cover removed, the PTO drive assembly mounting flange offers SAE-B mounting for 2 or 4 bolt configurations and an SAE B-B 15 tooth spline as shown below:

Figure 3: PTO drive assembly shown with SAE-B 2 or 4 bolt configuration.

The thread type for the 2 or 4 bolt pattern is M14 x 2.0 with a depth of 20mm. It is recommended to use a bolt length that allows for thread engagement of 1-1.5 times the diameter of the bolt used to connect the hydraulic pump. Unless otherwise specified by the pump manufacturer, use a bolt torque of 26-30 lb-ft (35-40 Nm) for the fasteners mounting the pump to the PTO drive assembly.
With option 362-2HB:
- A transmission cooler will be added to DT12 configuration in SpecPro
- Some exhaust configurations are not compatible with DT12 PTO. Please consult with your local vehicle representative to obtain specifics.
- Harnesses and controls are included for PTO operation
- The pneumatic line is installed
- The PTO is ready for operation via dashboard mounted switch
- Consult Section 8.28 of the DDEC13 A&I Manual (DDC-SVC-MAN-0127) for CPC parameterization

2. 362-318 DT12 Hydrocar P89 Rear Mounted PTO for Driveshaft (1:1.32 PTO Ratio).

This configuration is for applications utilizing a driveshaft in place of a direct mounted hydraulic pump. From a transmission and PTO hardware perspective, it is identical to configuration #1 above. However, the difference in the options is that the prep for driveshaft allows for more clearance on the chassis around the PTO. When this option is ordered, the customer must order the following parts from the DTNA PDC:
- Spicer 1350/1410 or 1310 flange kit. The two available Spicer flange kit part numbers are:
  a. Spicer 1350/1410 Flange: A9472600317  (See Figure 6 for the dimensions)
  b. Spicer 1310 Flange: A9472600417  (See Figure 7 for the dimensions)

![Figure 4: Rear DT12 PTO driveshaft assembly with driveshaft mount.](image)

An example of a successfully installed Spicer flange per option #2 can be seen in the following figure.
With option 362-318:
- A transmission cooler will be added to DT12 configuration in SpecPro
- Some exhaust configurations are not compatible with DT12 PTO. Please consult with your local vehicle representative to obtain specifics.
- Harnesses and controls are included for PTO operation
- The pneumatic line is installed
- The PTO is ready for operation via dashboard mounted switch
- Consult Section 8.28 of the DDEC13 A&I Manual (DDC-SVC-MAN-0127) for CPC parameterization

To correctly install a Spicer flange kit onto the DT12 PTO:
1. Remove cover plate on DT12 PTO housing
2. Insert the stud “1” into the center of the splined PTO drive on the DT12
3. Tighten stud to a torque of 11 ± 1.5 lb-ft (15 ± 2 Nm)
4. Install the spacer “3” on the back of the flange “4”
5. Apply grease “OKS 200” on the profile spline of the flange “4”
6. Install flange “4” into the PTO gear, then install nut “5” and torque to 26 ± 3.5 lb-ft (35 ± 5 Nm)
With this configuration the PTO drive shaft angle must be in the range of 1° to 6°. Bolts and nuts for attaching the driveshaft to this adaptor flange are not included in either of the Spicer kits. Use standard torque values to attach bolts to adaptor flange based on hardware material and grade.


This option is the same as option #1 (362-2HB), except that the PTO Drive ratio here is 1:1. With Option #3 (362-424):
- The PTO drive assembly mounting flange offers SAE-B mounting for 2 or 4 bolt configurations and an SAE B-B 15 tooth spline as shown in Figure 3 above.
- The thread type for the 2 or 4 bolt pattern is M14 x 2.0 with a depth of 20mm. It is recommended to use a bolt length that allows for thread engagement of 1-1.5 times the diameter of the bolt used to connect the hydraulic pump. Unless otherwise specified by the pump manufacturer, use a bolt torque of 26-30 lb-ft (35-40 Nm) for the fasteners mounting the pump to the PTO drive assembly.
- A transmission cooler will be added to DT12 configuration in SpecPro.
- Some exhaust configurations are not compatible with DT12 PTO. Please consult with your local vehicle representative to obtain specifics.
- Harnesses and controls are included for PTO operation.
- The pneumatic line is installed.
- The PTO is ready for operation via dashboard mounted switch.
- Consult Section 8.28 of the DDEC13 A/I Manual (DDC-SVC-MAN-0127) for CPC parameterization.

4. 362-425 DT12 Hydrocar P89 Rear Mounted PTO for Driveshaft (1:1 PTO Ratio).

This configuration is for applications utilizing a driveshaft in place of a direct mounted hydraulic pump. From a hardware perspective, it is identical to configuration #2 above (362-318), except that the PTO Drive ratio here is 1:1 instead of the 1:1.32 of option #2 (362-318) above.

With configuration #4 (362-425), the customer must order the following parts from the DTNA PDC:
- Spicer 1350/1410 or 1310 flange kit. See Figure 4-5 above for installation pics of the driveshaft adaptor. The two available Spicer flange kit part numbers are:
  - Spicer 1350/1410 Flange: A9472600317 (See Figure 6 for the dimensions)
  - Spicer 1310 Flange: A9472600417 (See Figure 7 for the dimensions)
- A transmission cooler will be added to DT12 configuration in SpecPro
- Some exhaust configurations are not compatible with DT12 PTO. Please consult with your local vehicle representative to obtain specifics.
- Harnesses and controls are included for PTO operation.
- The pneumatic line is installed.
- The PTO is ready for operation via dashboard mounted switch.
- Consult Section 8.28 of the DDEC13 A/I Manual (DDC-SVC-MAN-0127) for CPC parameterization.

To correctly install a Spicer flange kit onto the DT12 PTO:
1. Remove cover plate on DT12 PTO housing
2. Insert the stud “1” into the center of the splined PTO drive on the DT12
3. Tighten stud to a torque of 11 ± 1.5 lb-ft (15 ± 2 Nm)
4. Install the spacer “3” on the back of the flange “4”
5. Apply grease “OKS 200” on the profile spline of the flange “4”
6. Install flange “4” into the PTO gear, then install nut “5” and torque to 26 ± 3.5 lb-ft (35 ± 5 Nm)
With this configuration the PTO drive shaft angle must be in the range of 1° to 6°. Bolts and nuts for attaching the driveshaft to this adaptor flange are not included in either of the Spicer kits. Use standard torque values to attach bolts to adaptor flange based on hardware material and grade.

See Figure 6 above for the installation of the 1350/1410 and 1310 series flange adaptor kits to the DT12 PTO.

5. **362-822 PTO Prep Kit for DT12 Hydrocar P89 Rear Mounted PTO Prep for Driveshaft.**

This is the same as option #2 (262-318) and option #4 (362-425) above, except the PTO drive assembly is NOT installed on the DT12 transmission as delivered. When this option is ordered, the customer must order the following parts from the DTNA PDC:

- **DT12 PTO drive assembly**
  - Assembly p/n A9472600705 for the 1:1 PTO ratio
  - Assembly p/n A9472600605 for the 1:1.32 PTO ratio
- **Transmission Top 5 shim kit**, p/n A3892625056
- **Shaft kit for attaching the rear-mount DT12 PTO drive assembly**
  - P/N A9472602492 for A-box transmissions
  - P/N A9472602192 for B-box transmissions
- **Spicer 1350/1410 or 1310 flange kit.**

See DTNA PTO installation guideline document for installation instructions and torque specifications for installing the DT12 PTO drive housing.

With option 362-822:
- A transmission cooler will be added to DT12 configuration in SpecPro
- Some exhaust configurations are not compatible with DT12 PTO. Please consult with your local vehicle representative to obtain specifics.
- Harnesses and controls are included for PTO which is installed at a later time
- The pneumatic airline is NOT installed and would need to be added at the time of PTO install
- Consult Section 8.28 of the DDEC13 A&I Manual (DDC-SVC-MAN-0127) for CPC parameterization

6. **362-825 PTO Prep Kit for DT12 Hydrocar P89 Rear Mounted PTO Prep for Hydraulic Pump.**

This is the same as option #1 (362-2HB) and option #3 (362-424) above, except the PTO drive assembly is NOT installed on the DT12 transmission as delivered. When this option is ordered, the customer must order the following parts from the DTNA PDC:

- **DT12 PTO drive assembly**
  - Assembly p/n A9472600705 for the 1:1 PTO ratio
  - Assembly p/n A9472600605 for the 1:1.32 PTO ratio
- **Transmission Top 5 shim kit**, p/n A3892625056
- **Shaft kit for attaching the rear-mount DT12 PTO drive**
  - P/N A9472602492 for A-box transmissions
  - P/N A9472602192 for B-box transmissions
With option 362-825:
- A transmission cooler will be added to DT12 configuration in SpecPro
- Some exhaust configurations are not compatible with DT12 PTO. Please consult with your local vehicle representative to obtain specifics.
- Harnesses and controls are included for PTO which is installed at a later time
- The pneumatic airline is NOT installed and would need to be added at the time of PTO install.
- Consult Section 8.28 of the DDEC13 A&I Manual (DDC-SVC-MAN-0127) for CPC parameterization

See DTNA PTO installation guideline document for installation instructions and torque specifications for installing the DT12 PTO drive assembly as well as the pneumatic line referenced above.

The dimensions for the Spicer 1350/1410 and 1310 series PTO flanges are listed in the figures below.

Figure 7: PTO mounting adaptor flange for Spicer 1350/1410 series, p/n A9472600317.
REAR PTO TECHNICAL INFORMATION / INSTALLATION REQUIREMENTS

- Engine speed: 850 - 2080 rpm
- Vehicle speed during PTO Operation:
  1) 0 mph (vehicle is stationary)
  2) Launch gear only operation
- PTO output speed:
  - 1:1.32 PTO Ratio:
    - Direct Drive Split Low 900 - 2250 rpm
    - Direct Drive Split High 1150 - 2850 rpm
    - Over Drive Split Low 1150 - 2850 rpm
    - Over Drive Split High 1500 - 3700 rpm
  - 1:1 PTO Ratio:
    - Direct Drive Split Low 650 - 1600 rpm
    - Direct Drive Split High 850 - 2100 rpm
    - Over Drive Split Low 850 - 2100 rpm
    - Over Drive Split High 1100 - 2700 rpm
- Max PTO output torque:
  - 295 lb·ft (400 N·m)
  - 384 lb·ft (520 N·m) max. shock load
- **PTO drive shaft angle**: 1° to 6°
- **Interface (mount)**: 2 or 4 bolt SAE B pad mount
  **Interface (shaft)**: SAE BB 15 tooth spline drive
  **Interface (flange drive)**: Spicer 1350/1410 and Spicer 1310 flange drives
- **PTO rotation**: Counterclockwise (CCW) looking from rear of DT12 (Requires CW input pump)

**Figure 9: PTO rotation direction**

- **Transmission Oil temperature range**: average 80°C (176°F) max. 100°C (212°F)
- **Ambient operating conditions**: -40°C (-40°F) to 45°C (113°F)
- **Transmission PTO variant availability**: All DT12 variants (oil cooler is required)
- **The maximum bending moment**: 29.5 lb-ft (40 Nm)

**LAUNCH GEAR ONLY REAR PTO OPERATION**

This configuration is only allowed when launching from a complete stop, utilizing the vehicle’s launch gear. To operate in this manner:

- Make sure the transmission is in neutral,
- Engage the Rear PTO,
- Shift transmission into gear with foot on the service brake,
- Release brake to get the vehicle moving,
- To disengage the PTO, unload the PTO/system first,
- Then disengage the Rear PTO while moving or stopped.

**NOTE**: The transmission may not shift gears while the vehicle is being driven with the Rear PTO engaged. Manually shifting gears with the Rear PTO engaged is also not allowed.
NOTE: Maximum bending moment of the transmission PTO on the mounting surface must be calculated including the length of unsupported hydraulic hoses, and the weight of the fittings and hydraulic fluid.

Unless specific information is available on the pump mounting hardware, please use the following formulas and weights provided below.

- Hydraulic hose fittings: 1.18 lbs each
- Weight of hydraulic fluid:
  \[ M_{\text{fluid}} = (\# \text{ of hydraulic hoses}) \times (0.0361) \times \left(\frac{(3.142) \times ((\text{Hose ID}/2)^2) \times (\text{Length of hoses to first clipping point})}{2}\right) \]
- Weight of hydraulic hose
  \[ M_{\text{hoses}} = (\# \text{ of hydraulic hoses}) \times (\text{Hose weight/ft}) \times (\text{length in feet of hoses to 1st clipping point}) \]
- Hydraulic hose weight estimation chart:

<table>
<thead>
<tr>
<th>Hydraulic Hose</th>
<th>Chart Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hose I.D.</td>
<td>lbs/ft</td>
</tr>
<tr>
<td>1/4</td>
<td>0.16</td>
</tr>
<tr>
<td>3/8</td>
<td>0.23</td>
</tr>
<tr>
<td>1/2</td>
<td>0.35</td>
</tr>
<tr>
<td>5/8</td>
<td>0.44</td>
</tr>
<tr>
<td>3/4</td>
<td>0.58</td>
</tr>
<tr>
<td>1</td>
<td>0.79</td>
</tr>
<tr>
<td>1-1/4</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Table 1: Typical hydraulic hose weight estimation chart.

Max Bending Moment = \( M_{\text{pump}} + M_{\text{fittings}} + M_{\text{fluid}} + M_{\text{hoses}} \)

where

- \( M_{\text{pump}} \) = Bending Moment of the hydraulic pump (lb-ft)
  \[ M_{\text{pump}} = (\text{weight of pump in lbs}) \times \left(\frac{(\text{distance from pump center of gravity to PTO mounting surface in inches})}{12}\right) \]
  If center of gravity is not known, assume this is at ½ the total length of the pump

- \( M_{\text{fittings}} \) = Bending moment of the hydraulic line fittings (lb-ft)
  \[ M_{\text{fittings}} = (\# \text{ of fittings}) \times (\text{weight of fittings in lbs}) \times \left(\frac{(\text{distance of fittings from pump mounting surface in inches})}{12}\right) \]

- \( M_{\text{fluid}} \) = Bending moment due to the hydraulic fluid (lb-ft)
  \[ M_{\text{fluid}} = (\# \text{ of hydraulic hoses}) \times (\text{weight of fluid}) \times \left[\frac{(1/2 \times \text{length of hoses until first clipping point}) + (\text{distance of pump center of gravity to PTO mounting surface})}{2}\right] \]

- \( M_{\text{hoses}} \) = Bending moment due to the hydraulic hoses (lb-ft)
  \[ M_{\text{hoses}} = (\# \text{ of hydraulic hoses}) \times (\text{weight of hoses in lbs}) \times \left[\frac{(1/2 \times \text{length of hoses until first clipping point}) + (\text{distance of pump center of gravity to PTO mounting surface})}{12}\right] \]

If the calculated Bending Moment exceeds the 29.5 lb-ft limit, try shortening the length of the hydraulic hoses to the first clipping/support point.
PTO OUTPUT SPEED CALCULATION

Since the DT12 PTO is driven by the countershaft inside the transmission, there are two effective gear ratios possible, low neutral or high neutral. The low neutral and high neutral are referred to as “split low” and “split high” respectively.

There is a data code module in SpecPro that allows for operation to be set to either “split low” or “split high”. This functionality allows the operator to engage the PTO at the desired gear ratio for proper operation. The PTO ratio, once chosen, will be active at the time of the PTO engagement. Split Low/High cannot be changed by the driver in the cab.

The default data code for the DT12 PTO is “split low” upon PTO activation.

The available options in SpecPro are:

85P-001: PTO LOW NEUTRAL
85P-002: PTO HIGH NEUTRAL
85P-998: NO PTO NEUTRAL GEAR SELECTION

The default operation for the DT12 PTO is “split low” upon PTO activation. However, parameterization in the CPC allows for operation to be set to either “split low” or “split high”. See the GHG17 DDEC13 Electronic Controls Application and Installation Manual (DDC-SVC-MAN-0127) Section 8.28 Throttle Control/Governors via DDCSN.com for specific parameter programming information.

PTO speed can be calculated by using the PTO output speed summary table below (the released of the 1:1.83 ratio is TBD at this time):

<table>
<thead>
<tr>
<th>DT12 Variant</th>
<th>&quot;Split&quot;</th>
<th>Engine : PTO</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT12-DB (DHL)</td>
<td>Split Low</td>
<td>1: 1.06</td>
<td>106%</td>
</tr>
<tr>
<td></td>
<td>Split High</td>
<td>1: 1.16</td>
<td>136%</td>
</tr>
<tr>
<td>DT12-OB (OHL)</td>
<td>Split Low</td>
<td>1: 1.06</td>
<td>106%</td>
</tr>
<tr>
<td></td>
<td>Split High</td>
<td>1: 1.36</td>
<td>136%</td>
</tr>
<tr>
<td>DT12-DA (DH)</td>
<td>Split Low</td>
<td>1: 1.06</td>
<td>106%</td>
</tr>
<tr>
<td></td>
<td>Split High</td>
<td>1: 1.36</td>
<td>136%</td>
</tr>
<tr>
<td>DT12-OA (OH)</td>
<td>Split Low</td>
<td>1: 1.36</td>
<td>136%</td>
</tr>
<tr>
<td></td>
<td>Split High</td>
<td>1: 1.76</td>
<td>176%</td>
</tr>
<tr>
<td>DT12-DC (DHE/DV)</td>
<td>Split Low</td>
<td>1: 1.36</td>
<td>136%</td>
</tr>
<tr>
<td></td>
<td>Split High</td>
<td>1: 1.61</td>
<td>161%</td>
</tr>
<tr>
<td>DT12-OC (OHE/OV)</td>
<td>Split Low</td>
<td>1: 1.25</td>
<td>125%</td>
</tr>
<tr>
<td></td>
<td>Split High</td>
<td>1: 1.61</td>
<td>161%</td>
</tr>
<tr>
<td>DT12-OD (OVX)</td>
<td>Split Low</td>
<td>1: 1.28</td>
<td>128%</td>
</tr>
<tr>
<td></td>
<td>Split High</td>
<td>1: 1.65</td>
<td>165%</td>
</tr>
</tbody>
</table>

NOTE: Ratios Greater than 1:1, or over 100% → PTO spins faster than engine

Table 2: PTO output speed summary table.
For example, the PTO speed with a DT12-DA (DH) Split Low with the 1:1 PTO Ratio would be:

\[(\text{Engine RPM}) \times (\text{Engine:PTO Ratio}) = 850 \text{ rpm} \times 0.78 = 663 \text{ rpm}\]

Similarly, the PTO speed with a DT12-OC (OHE & OV) Split High with the 1:1.32 PTO Ratio would be

\[(\text{Engine RPM}) \times (\text{Engine:PTO Ratio}) = 850 \text{ rpm} \times 1.61 = 1369 \text{ rpm}\]

Figure 10: Example of PTO Power Flow through a Direct Drive DT12-DA (DH) or DT12-DB (DHL)

For a complete list of programming options for the DT12 PTO, please see the DETROIT™ Transmissions Electronic Application and Installation Manual (DDC-SVC-MAN-0128) via DTNAconnect.com.
II. SIDE PTO

Auxiliary equipment require power take-offs, either when the truck is stationary or when it is in motion. Various power take-off alternatives can be chosen, depending on the bodywork. The work is generally carried out by equipment which is powered by a hydraulic motor. The hydraulic motor, together with a pump and associated equipment, form the basis of the hydraulic system. The pump, which provides the hydraulic pressure and flow to the motor, is the heart of the hydraulic system. Below are some guidelines for Side PTO operation with the new DT12 variants:

- PTOs are not designed to handle axial or radial forces. No direct installation of belt pulley or sprocket on PTO output shaft is allowed.
- Due to the risk of PTO overloading, overload protection must be installed.
- Engine speed with the PTO engaged and under load must follow the instructions "Torque – Restriction (engine speed)".
- Whole number ratios are not acceptable because of risk to built-up resonance vibrations (contact PTO supplier).
- Beside the torque capacity of the PTO, its retrievable output torque (lowest torque result of the following three situations) depends on the torque reduction values for:
  - shock loads (dynamic torque)
  - high bending angle of driveshaft
  - power split

The new DT12 Side PTO is being released to the following DT12 variants:
- DT12-DC (DHE & DV)
- DT12-OC (OHE & OV)
- DT12-OD (OVX)

The following DT12 variants will only have the Rear PTO available:
- DT12-DB (DHL)
- DT12-OB (OHL)
- DT12-DA (DH)
- DT12-OA (OH)

The DT12 Side PTO hardware is available through your Chelsea PTO parts provider. The Side PTO adaptor, which adapts the standard Chelsea PTO’s approved for use to the Chelsea PTO, can be provided by your DTNA service parts representative. Adaptor part numbers are shown later in this document in Figure 23.
MAXIMUM ALLOWABLE TORQUE

1) Stationary Operation:
   See Table 3 below for the maximum allowed torque for permanent and intermittent operation.

<table>
<thead>
<tr>
<th>Series</th>
<th>Chelsea</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>823</td>
</tr>
<tr>
<td>Max Torque Continuous</td>
<td>525 lb-ft</td>
</tr>
<tr>
<td>Max Torque Intermittent</td>
<td>750 lb-ft</td>
</tr>
<tr>
<td>Weight</td>
<td>76 lbs</td>
</tr>
<tr>
<td>Shift Type</td>
<td>Dog clutch</td>
</tr>
</tbody>
</table>

Table 3: Info table on released Side PTO variants

2) Moving of the vehicle with Side PTO engaged.
   This configuration is only allowed when launching from a complete stop, utilizing the vehicle's launch gear (example: roll-off application).
   To operate in this manner:
   o Make sure the transmission is in neutral,
   o Engage the Side PTO,
   o Shift transmission into gear with foot on the service brake,
   o Release brake to get the vehicle moving.
   o To disengage the PTO, unload the PTO/system first.
   o Then disengage the Rear PTO while moving or stopped.

   See Table 3 above for maximum allowed torques for permanent and intermittent Side PTO operation.

   **NOTE:** The transmission may not shift gears while the vehicle is being driven with the side PTO engaged. Manually shifting gears with the Side PTO engaged is also not allowed.

   **NOTE:** Maximum Side PTO output speed for all operation is 2000rpm. Higher Side PTO output speeds can lead to PTO and/or vehicle equipment damage.

3) Running Side PTO during normal vehicle operation.
   Operation of the Side PTO during normal vehicle operation (while driving the vehicle with the transmission shifting gears normally) is NOT ALLOWED at this time.
CHELSEA MODEL NUMBER CHARTS

The Chelsea PTO model number provides a lot of information about the application where the PTO will be used. This information includes:

- PTO model number,
- Mounting type / transmission for which the PTO is designed,
- Gear ratio of the PTO as a percentage of engine speed (percentages > 100% indicate a PTO speed faster than the engine speed, while percentages < 100% indicate a PTO speed slower than the engine speed),
- Input gear designator for which the PTO is designed,
- Pressure lubrication status,
- Shifter type,
- Output designation (bolt pump mount, flange type, din spec).

Following are the model charts for the Chelsea 823 PTO for the various DT12 variants.

Figure 11: Model Chart for the Chelsea 823 PTO and the DT12-DC (DHE & DV).

Figure 12: Model Chart for the Chelsea 823 PTO and the DT12-OC (OHE & OV).
Figure 13: Model Chart for the Chelsea 823 PTO and the DT12-OD (OVX).

Below are the model charts for the Chelsea 880 PTO for the various DT12 variants.

Figure 14: Model Chart for the Chelsea 880 PTO and the DT12-DC (DHE & DV).

Figure 15: Model Chart for the Chelsea 880 PTO and the DT12-OC (OHE & OV).
Figure 16: Model Chart for the Chelsea 880 PTO and the DT12-OD (OVX).

Below are the model charts for the Chelsea 680 PTO for the various DT12 variants.

Figure 17: Model Chart for the Chelsea 680 PTO and the DT12-DC (DHE & DV)

Figure 18: Model Chart for the Chelsea 680 PTO and the DT12-OC (OHE & OV).
Figure 19: Model Chart for the Chelsea 680 PTO and the DT12-OD (OVX).

Below are the model charts for the Chelsea 489 PTO for the various DT12 variants.

Figure 20: Model Chart for the Chelsea 489 PTO and the DT12-DC (DHE & DV).

Figure 21: Model Chart for the Chelsea 489 PTO and the DT12-OC (OHE & OV).
DT12 Side PTO Assembly & Installation

1. PTO Adaptor Installation

The DT12 needs a separate adaptor to mate the side pto to the transmission input shaft. This adapter is different for each of the transmission variants; there is also one for low power and another for high power side PTO’s. Below is a summary of the side PTO adapters.

PTO Adaptor Chart

<table>
<thead>
<tr>
<th>PTO Output</th>
<th>Transmission</th>
<th>PTO Type</th>
<th>Adaptor Assy p/n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Power</td>
<td>DC (DHE &amp; DV)</td>
<td>489</td>
<td>329954X</td>
</tr>
<tr>
<td>Low Power</td>
<td>OC (OHE &amp; OV)</td>
<td>489</td>
<td>329932X</td>
</tr>
<tr>
<td>Low Power</td>
<td>OD (OVX)</td>
<td>489</td>
<td>329955X</td>
</tr>
<tr>
<td>High Power</td>
<td>DC (DHE &amp; DV)</td>
<td>823 / 880 / 880</td>
<td>330033X</td>
</tr>
<tr>
<td>High Power</td>
<td>OC (OHE &amp; OV)</td>
<td>823 / 880 / 680</td>
<td>330032X</td>
</tr>
<tr>
<td>High Power</td>
<td>OD (OVX)</td>
<td>823 / 880 / 680</td>
<td>330034X</td>
</tr>
</tbody>
</table>

Follow up with your DTNA parts representative to acquire the correct adaptor.

NOTE: It is critical to use the correct Side PTO Adaptor Assembly – part failure could result due to the use of the wrong adaptor! The Low Power adaptor must only be combined with the Low Power PTO, but the High Power Adaptor can be used with both the High Power & Low Power PTO.

There are features designed/machined into the Low Power Adaptor and Low Power PTO housing to ensure that the rating of the adaptor is correctly matched with that of the Side PTO Housing as shown below.
2. Adaptor to PTO Installation & Backlash Adjustment

Use the below procedure to properly mate the PTO Adaptor to the PTO and adjust the backlash.

- On a workbench, insert qty=1 thick gasket onto either the PTO Adaptor or PTO Housing.
- Mate the PTO Adaptor to the PTO Housing with qty=8 M12 (.438") hex head bolts and nuts. Torque the bolts to 54-61 Nm (40-45 lb-ft).
- With a dial indicator measure the backlash between the PTO gear and the adapter gear.
- Acceptable backlash measurement is 0.15-0.30 mm (.006"-.012"). See page 9 of Owner’s Manual.
  - If backlash is less than 0.15 mm then repeat assembly and add a thin gasket.
  - If the backlash is more than 0.30 mm then replace the thick gasket with a thin gasket.

NOTE: The maximum number of gaskets allowed between the PTO housing and Adaptor is 2.
3. Studs

Below is the detail on the studs as well as the information on how to install them for use with the DT12 Side PTO:

Figure 25: Stud detail information

Figure 26: Stud installation information
4. Dowel Pins

Below is the detail on the dowel pins as well as the information on how to install them for use with the DT12 Side PTO:

Install the studs and dowel pins into the side PTO interface of the DT12 transmission per the diagram below:

**Figure 27: Stud installation information**

**Figure 28: Stud and dowel pin installation locations**
5. Adapter Gasket

Use the below procedure to properly install the DT12 Side PTO Adaptor Gasket between the transmission and the adaptor.

Install adapter gasket over studs and dowel pins. Begin with (1) thin gasket.

Gasket Thickness:
- Thin Gasket = 0.25mm (0.010")
- Thick Gasket = 0.51mm (0.020")

Offset to be towards the rear of the transmission.

Figure 29: Side PTO HD adaptor gasket installation
PTO POWER SPLIT

The term PTO Power Split refers to the simultaneous operation of the Side and Rear PTO’s. While operating at the same time, the maximum torque load distribution among the PTO’s has to meet the following boundary conditions:

Max Continuous Torque = 525 lb-ft
Max Intermittent Torque = 750 lb-ft

The definition of “Intermittent Torque” is as follows:

Maximum torque for 1.5 minutes in a 15 minute cycle.

Figure 30: Torque signal showing intermittent vs Continuous Torque
SIDE MOUNTED PTO SUPPORT REQUIREMENTS

A side PTO support bracket must be used if either of the two conditions below are met:

1. The combined weight of the pump, fittings and hoses exceeds 40 lbs (18.1 kg)
2. The combined length of the PTO and pump is 18 inches or more from the PTO centerline to the end of the pump.

![Figure 31: Combined Length Requirement for Side PTO Support Bracket](image)

NOTE: The bracket must be installed without the weight of the installed pump to avoid additional stresses on the PTO mounting and the transmission-side PTO interface.

Hydraulic Hoses

To reduce the impact of hose weight on the PTO assembly, bracket(s) MUST be installed to support the hoses. The minimum distance between pump fitting and the first bracket is approximately 2 ft (~600mm). Brackets installed too close to the hydraulic pump might cause additional stresses.

Also, you MUST use supporting brackets for the connections to the hydraulic oil, etc. once it is routed away from the pump or PTO connection as described above.

The support brackets mentioned above are NOT available through DETROIT™ or DTNA; they are the responsibility of the Body Builder to provide. Below is an example support bracket for mounting the side PTO on the DT12 transmission mid-housing.
The required size and thread pitch for the side PTO support bracket bolts is M10 x 25. The thread depth in the hole in the block is 25mm, the drilled depth is 30mm.

Below are the dimensions on the DT12 mid-housing if a support bracket is needed. The available mounting hole locations are highlighted in red for clarity.
Figure 34: Mid-housing dimensions for Side PTO Support Bracket

Below are the dimensions on the DT12 rear-housing if a support bracket is needed. The available mounting hole locations are highlighted in red for clarity.

Figure 35: Rear-housing dimensions for Side PTO Support Bracket
Here are some examples of actual side PTO support brackets:

![Actual Side PTO support bracket, pic 1](image1)

*Figure 36: Actual Side PTO support bracket, pic 1*

![Actual Side PTO support bracket, pic 2](image2)

*Figure 37: Actual Side PTO support bracket, pic 2*

The mating piece to the 90 degree connection off of the side PTO pump shown in the above pictures must also be supported.
RESONANCE FREQUENCIES & PTO OPERATION SPEEDS

Beside the torsional excitation of the system by engine combustion or driveshafts the resonance frequency of the system is also a major concern. To avoid critical operation conditions and/or damages of powertrain components the pto operation rpm has to stay away from natural frequency. The allowable PTO Torque by engine speed is shown in the graph below.

<table>
<thead>
<tr>
<th>Engine Speed (rpm)</th>
<th>823 PTO (lb-ft)</th>
<th>880 PTO (lb-ft)</th>
<th>680 PTO (lb-ft)</th>
<th>489 PTO (lb-ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>650</td>
<td>147</td>
<td>147</td>
<td>147</td>
<td>147</td>
</tr>
<tr>
<td>1000</td>
<td>147</td>
<td>147</td>
<td>147</td>
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<tr>
<td>1000</td>
<td>525</td>
<td>350</td>
<td>263</td>
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<tr>
<td>1625</td>
<td>525</td>
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<tr>
<td>1800</td>
<td>525</td>
<td>350</td>
<td>263</td>
<td>175</td>
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</table>

In addition to the maximum PTO output torque limits shown above, proper PTO setup must also keep PTO output speeds below maximum limit by the PTO Manufacturer.

For the Chelsea 823, 880, 680, and 489 PTO’s:
  * Maximum allowable PTO output speed for all operation = 2000rpm.
PTO DRIVESHAFT INSTALLATION

Maximum torque can only be applied if the operation is completely oscillation and shock free. To keep the excitation as low as possible, the following requirements must be met.

- Bending angles $\alpha_1 = \alpha_2 / \Delta\alpha \leq \pm 1^\circ$
- Both driveshaft joint in one plane
- Drive shaft installation; either Z – or W - pattern

![Correct Installation; both joints in one plane](image1.png)

![Wrong Joint Installation](image2.png)

Figure 39: Driveshaft installation angle requirements

In the case of three dimensional driveshaft installation, when the lines of the input and output shafts are crossing each other with an offset (combined cases of Z = and W – pattern), the following conditions must be met to avoid additional excitation.

- Bending angles $\beta_1 = \beta_2 / \Delta\beta \leq \pm 1^\circ$
- The inner driveshaft joint forks have to be twisted until they in the planes A and B.

![Correct Installation; both joints in one plane](image3.png)

Figure 40: Driveshaft installation angle requirements when in 2 planes
In either of the above driveshaft angle configurations, if a driveshaft bend angle > 6° is not avoidable, follow the instructions below for large Joint Bend Angles.

**JOINT BEND ANGLES**

In addition to the driveshaft installation pattern, the joint bend angle significantly effects the driveshaft acceleration and additional dynamic torque load. The minimum bend angle requirement is shown below.

![Minimum Bend Angle Requirement](image)

**Figure 41: Minimum bend angle requirement**

When bending angles > 6° the maximum PTO torque load must be reduced per the table below.

<table>
<thead>
<tr>
<th>Shaft Angle (degrees)</th>
<th>Torque Factor (1.00 = 100% torque)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>1.00</td>
</tr>
<tr>
<td>3</td>
<td>1.00</td>
</tr>
<tr>
<td>4</td>
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<td>19</td>
<td>0.35</td>
</tr>
<tr>
<td>20</td>
<td>0.32</td>
</tr>
</tbody>
</table>

**Figure 42: Torque Reduction when bend angles > 6 degrees.**
SHOCK LOAD (DYNAMIC TORQUE)

Maximum torque can only be applied if the operation is completely oscillation and shock free. The dynamic torque or shock load varies by application, but the system has to be dimensioned and set-up to handle the highest combination of static plus dynamic torque.

The following overview is only an example, please verify the specifics of your application meet the appropriate dynamic factor.

The Operation Torque plus the shock overload MUST be less than the PTO torque limit.

Figure 43: PTO Shock Load Factor
## Engineering Change Log

<table>
<thead>
<tr>
<th>Technical Content / Publisher Owner</th>
<th>Rev. #</th>
<th>Rev. Date</th>
<th>Description of Revisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. Grissom</td>
<td>R01</td>
<td>12OCT16</td>
<td>Initial release.</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R02</td>
<td>27OCT16</td>
<td>Added notes to PTO configurations 1 &amp; 2. Added Figure 5 showing option #2 installed in truck. Updated torque values on Spicer flange kit installation. Modified torque values to show English units first. Clarified verbiage for Table 1.</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R03</td>
<td>07DEC16</td>
<td>Updated footer, and added note regarding CPC parameterization for each configuration offered.</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R04</td>
<td>19DEC16</td>
<td>Corrected PTO rotation direction on page 7.</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R05</td>
<td>23JAN17</td>
<td>Corrected PTO drive shaft angular requirement on page 6; clarified split low/high verbiage on page 9.</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R06</td>
<td>08APR17</td>
<td>Modified document name, revised Technical Information on page 7 including rotation direction, added Table 2 on page 9.</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R07</td>
<td>03MAY17</td>
<td>Updated/inserted/labeled Figure 9 on page 7.</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R08</td>
<td>19MAY17</td>
<td>Added note to page 7 regarding pump input direction</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R09</td>
<td>25OCT17</td>
<td>Updated Figures 9 &amp; 10.</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R10</td>
<td>16APR18</td>
<td>Inserted 2 new PTO configurations (#3 &amp; #4) and corresponding configuration information, then renumbered existing configurations to #5 &amp; #6; Removed previous Table 1, inserted new Table 1, inserted and modified verbiage in PTO output speed calculation section.</td>
</tr>
<tr>
<td>C. Grissom</td>
<td>R11</td>
<td>10JUL20</td>
<td>Added part numbers for the Rear PTO prep kits, clarified examples on how to calculate PTO speed after Table 2, added entire Side PTO section for new option on Transmission 2020 releases.</td>
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