How To Specify a P.T.O. Information Necessary to Understand Proper P.T.O. Specification
If all vehicles were created and designed equally, there would be no problem in selecting the correct P.T.O.
But have you ever gone into a hardware store or Lowes and just asked for a hammer?

- You know how the salesman probably responded?
- What are you going to use it for?
- What weight do you want?
- Do you want a tempered, forged or cast head?
- Fiberglass or wooden handle?

Selection of a P.T.O. requires the same kind of job analysis but is somewhat more detailed and technical.
A P.T.O. must be able to transmit a sufficient amount of power to some other driven equipment.

To accomplish this, P.T.O.s are available in many sizes and with various capabilities to meet output requirements.

They range from:
- Light-duty, one-speed, single-gear units – 100 Series
- Extra-heavy-duty units – 870, 890, 859 Series
- Forward and reverse operation units – 340, 352 & 863 Series
- Rear mounts 522, 541 & CAT-D & H Series
1. To begin analyzing any P.T.O. application, you need to determine the necessary technical information about its work and the installation requirements.

A P.T.O. application sheet will help you organize your information and make this task much easier.

The form first calls for determining the make and model of transmission being used.
2. What type of equipment is to be driven by the P.T.O.?

   Is it a hydraulic pump?

   Is it a winch, or any other number of mechanical devices requiring power?
3. Input horsepower (HP) required of driven equipment.

**Mechanical Horsepower**

\[ HP = \frac{T \times \text{R.P.M.}}{5,252} \]

**Torque**

\[ T = HP \times \frac{5,252}{\text{R.P.M.}} \]

**Pump Input Horsepower**

\[ HP = \frac{\text{GPM} \times \text{PSI}}{1,714 \times \text{Eff}} \]

4. Desired operating speed of driven equipment.
5. Approximate Engine Speed desired during operation.

This speed relationship is stated as a percentage of P.T.O. speed to engine speed.

For example, if the required pump speed is 1000 R.P.M., and the engine operating speed is 1500 R.P.M., the percentage of P.T.O. to engine speed is approximately two-thirds, or approximately 67 percent (67%).

Eq: Equipment Speed ÷ Desired Engine Speed = P.T.O. Speed (% of Engine)

1000 ÷ 1500 = 0.666 (67%)
6. Determine which direction of Driven Equipment Shaft Rotation in relation to direction of engine rotation.

There are two choices:

1. engine or
2. opposite-engine

The P.T.O. requirements of the device being driven will determine what direction you choose.

**NOTE:** The P.T.O. output shaft rotation listed on the application page as it relates to the vehicle crankshaft rotation when viewed from the rear of the vehicle.
6. Determine which direction the P.T.O. is to turn.

- The rotation of the vehicle crankshaft is always clockwise when viewed from the front of the vehicle.
Engine Rotation

- P.T.O. Rotation is established from the Rear of the vehicle looking forward
- Engine (looks “counterclockwise”) P.T.O. output shaft rotates the same direction as the engine crankshaft
- Common with Automatic transmissions
Opposite Rotation

- P.T.O. Rotation is established from the Rear of the vehicle looking forward
- Opposite (looks “clockwise”) P.T.O. output shaft rotates the opposite direction as the engine crankshaft
Changing Rotation - Geared Adapter

- P.T.O. Rotation is established from the Rear of the vehicle looking forward

How to Specify a P.T.O. Determining Rotation
### How to Specify a P.T.O. Determining Rotation

**Driven Equipment**

<table>
<thead>
<tr>
<th>P.T.O.</th>
<th>Driven Equipment</th>
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<tbody>
<tr>
<td>OPP (looks “clockwise”)</td>
<td>Driven equipment must rotate counterwise (also called left-hand, “A” for anti-clockwise or C.C.W. for counterwise)</td>
</tr>
<tr>
<td>ENG (looks “counterclockwise”)</td>
<td>Driven equipment must rotate clockwise (also called right-hand rotation or “CW” for clockwise)</td>
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</tbody>
</table>
How to Specify a P.T.O. Determining Rotation

Driven Equipment

- From front of truck, pump shaft rotates counterclockwise.
- From rear of truck, P.T.O. shaft rotates opposite engine/clockwise.
- From front of truck, pump shaft rotates clockwise.
- From rear of truck, P.T.O. shaft rotates with engine/counterclockwise.
7. Type of connection between P.T.O. and driven equipment

- Remote

- Direct
How to Specify a P.T.O.

Supporting the Pump

• Direct Mount
• Support Bracket for Pump and Hoses
• 40 lbs. or 18 Inch Rule
8. Mounting Location  
   (Check all suitable locations)  
   Top  
   Right  
   Bottom  
   Left  
   Countershaft  

9. Duty Cycle  
   A. Intermittent  
   B. Continuous  

10. Other P.T.O. Speeds or reverse gear requirements
11. After you have the transmission make and model, refer to the Chelsea® Applications Catalog (HY25-3000/US) for a listing of the P.T.O.s that will fit your particular transmission.

Next a number of questions need to be answered concerning the particulars of your P.T.O. application.
12. From Item 3 and 4 determine the intermittent torque requirements of the driven equipment using the following formula:

\[(\text{HP} \times 5252) \div \text{R.P.M.*} = \text{Lbs. ft.}\]

\[T = \underline{\text{_______}} \text{ Lbs. ft. (intermittent)}\]

* P.T.O. Output R.P.M.
13. The torque requirement for the P.T.O. is calculated by using the torque formula mentioned earlier:

$$\text{HP} \times \frac{5252}{\text{R.P.M.}} = \text{Lbs. ft. of Torque}$$

plus data gathered from the customer.

If the application is “continuous” (the P.T.O. is in operation more than five minutes out of every 15), the torque handling requirements of the P.T.O. must be increased.

This increased torque requirement can be found by dividing the torque required by 0.7.

For example, 140 Lbs. ft. of torque divided by 0.7 equals 200 Lbs. ft. of Torque

$$(140 \div 0.7 = 200 \text{ Lbs. ft.})$$
14. Find the P.T.O. on the application page from item 11 that meets the torque, rotation, and speed percentage requirements of the application.

Note the P.T.O. model number and all numbers for mounting parts.
P.T.O. Pressure or Self Lubrication

• When?
  - P.T.O. opening above oil reservoir

• Why?
  - The input gears on the P.T.O. and transmission will burn without proper lubrication

• How?
  - From the high-pressure port on the transmission, connect a hose to the P.T.O.’s lube port
15. Determine what options are needed and change model number prefix and suffix to obtain correct options

NOTE: See model construction in section 3 of HY25-3000/US
Once the proper P.T.O. part number has been selected, review the application and make sure that you have included all of the necessary information.

When selecting any P.T.O. from the catalog, it is important to remember to read the footnotes.

Some transmissions may not be able to withstand the torque capacity of the P.T.O. and its application or some other unique feature of the unit may be pointed out by the footnotes.
Questions?
The engine transmission and driveline make the truck run. **CHELSEA P.T.O.s** make the truck work.

**How to Specify a P.T.O. Power Take-Off Applications**
How to Specify a P.T.O. Power Take-Off Applications
How to Specify a P.T.O. Mechanical Winch

Mech. Winch

Torque                RPM

+    +

RPM

+    +

Torque

-    -

+    +

TORQUE

-    -

TORQUE
How to Specify a P.T.O. Product Pumps

Mech. Winch

Torque

RPM

Product Pump

Torque

RPM
How to Specify a P.T.O. Generators

Mech. Winch

+ Torque

Torque

- RPM

RPM

Product Pump

+ Torque

Hydraulic Generator
How to Specify a P.T.O. Blowers

- Mech. Winch
- Product Pump

Torque: +
RPM: +

Hydraulic Generator

- Blowers
- Torque: +
How to Specify a P.T.O. Hydraulic Pump

Mech. Winch +

Torque -

RPM +

Product Pump

Blowers +

Hydr. Pump

Hydraulic Generator

TORQUE

Pump
How to Specify a P.T.O.

- Mech. Winch
- Blowers
- TORQUE
- RPM
- Hydr. Pump
- Generators
- Product Pump

+ + +

TORQUE
Determining the Proper Torque Requirements

- HP Requirement of Hydraulic System

- Pump Input HP

\[
HP = \frac{\text{GPM} \times \text{PSI}}{1714 \times \% \text{ Efficiency}}
\]
Determining the Proper Torque Requirements

\[
\text{GPM} \times \text{PSI} = \text{HP} \\
1714 \times .85
\]

Example:

\[
\text{GPM} 30 \times \text{PSI} 2000 = 41 \text{ HP} \\
1714 \times .85
\]

\[
\text{HP} 41 \times 5252 = \text{Torque 180 Lbs. ft.} \\
\text{R.P.M. 1200}
\]

It takes One Horse Power For Each One Gallon of Flow At a Pressure of 1500 PSI
Using The Rule Of Thumb

• 30 Gallons per minute  2000 PSI
• Subtract 1500 from 2000
• Remainder of 500 which is 1/3 of 1500
• Multiply 1-1/3 times 30 = 40 Horse Power
How to Specify a P.T.O. Useful Formulas

1. Pump Output Horsepower: \[ HP = GPM \times PSI \div 1714 \]
2. Pump Input Horsepower: \[ HP = GPM \times PSI \div 1714 \div E \]
3. Pump Input Torque (Lbs.ft): \[ T = CID \times PSI \div 75.36 \]
4. Gallons Per Minute: \[ GPM = CID \times R.P.M. \div 231 \]
5. Cubic Inches Displacement: \[ CID = GPM \times 231 \div R.P.M. \]
6. Horse Power: \[ HP = T \times R.P.M. \div 5252 \]
7. Flow in G.P.M. using P.T.O.: \[ GPM = \text{Engine R.P.M.} \times \text{P.T.O.} \% \times CID \div 231 \times E \]
8. CCM Conversion: \[ CCM = CID \times 16.39 \]
9. CID Conversion: \[ CID = CCM \times .06102 \]
How to Specify a P.T.O.
Looking at Applications
How to Specify a P.T.O.
Common Dump Truck
How to Specify a P.T.O. Common Class 8 Dump Truck

What We Know from Customer

- RTLO-16913-T2
- Dump Pump 6.38 CID
- Air Shift Pump & P.T.O.
- S.A.E. “B” 4-Bolt w/ 13 - Tooth
- Pump pressure 2000 PSI
- Pump R.P.M. 1200
- Engine R.P.M. 1000
How to Specify a P.T.O.
Common Class 8 Dump Truck

What We Know from Customer

• RTLO-16913-T2
• Dump Pump 6.38 CID
• Air Shift Pump & P.T.O.
• S.A.E. “B” 4-Bolt w/ 13 - Tooth
• Pump Pressure 2000 PSI
• Pump R.P.M. 1200
• Engine R.P.M. 1000

1. RTLO-16913-T2
2. Dump Pump = 3149325227 - Rotation CCW
3. HP = 36
4. 1200 R.P.M. (Driven)
5. 1000 R.P.M. (Engine)
   • 120%
6. CCW
7. Direct Mount “B” Flange
8. Bottom
9. Intermittent
10. N/A
11. FLR-58
12. T = 158 Lbs. ft.
13. Intermittent
14. 489XLAHX-*3
15. 489XLAHX-S3XK
How to Specify a P.T.O. Utility Truck

What We Know from Customer

- Allison 3000 RDS
- Pump R.P.M. 1400
- Engine R.P.M. 1100
- 8 GPM / 2500 PSI
- Pump 1” 15 - Tooth 2-Bolt “B”
- P.T.O. to Mount on Driver’s side
How to Specify a P.T.O. Utility Truck

What We Know from Customer

- Allison 3000 RDS
- Pump R.P.M. 1400
- Engine R.P.M. 1100
- 8 GPM / 2500 PSI
- Pump 1” 15 - Tooth 2-Bolt “B”
- P.T.O. to Mount on Driver’s side

1. Allison 3000 RDS
2. Direct Mount Hydraulic Pump
3. HP = 13.5
4. 1400 R.P.M. (Driven)
5. 1100 R.P.M. (Engine)
   - 127%
6. CW
7. Direct Mount “B” Flange
8. Left
9. Intermittent
10. N/A
11. ALL-13
12. T = 50.6 Lbs. ft.
13. Intermittent
14. 277XMFJP-*5
15. 277XMFJP-B5RF
How to Specify a P.T.O. Water Truck

What We Know from Customer

- Mack CH612
- T2070 7 Speed
- Berkeley B3ZRMS Water Pump
- Engine R.P.M. 1000-1700
- Pump R.P.M. 1300-2100
- Pump input 25 HP Max
- Pump Rotation CW
- Do Not Want Pump to Turn when P.T.O. is Off
- Drive Shaft
### How to Specify a P.T.O. Water Truck

**What We Know from Customer**

- T2070 7 Speed  
  - Drive Shaft  
- Product Pump 400 GPM  
  - P.T.O. w/ Shaft Brake  
- Engine R.P.M. 1000-1700  
  - Pump R.P.M. 1300-2100  
- Pump 25 HP  
  - Pump Rotation CW

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<table>
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<tbody>
<tr>
<td>1.</td>
<td>T2070</td>
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<tr>
<td>2.</td>
<td>Water Pump</td>
</tr>
<tr>
<td>3.</td>
<td>HP = 25</td>
</tr>
<tr>
<td>4.</td>
<td>2100 R.P.M. (Driven)</td>
</tr>
</tbody>
</table>
| 5. | 1700 R.P.M. (Engine)  
  |  - 124% |
| 6. | CW |
| 7. | 1-1/4” w/key Shaft |
| 8. | Left |
| 9. | Continuous |
| 10. | N/A |
| 11. | MAK-25 |
| 12. | T = 62.5 Lbs. ft. |
| 13. | 89.2 Lbs. ft. |
| 14. | 238XKAHX-*3 (129%) |
| 15. | 238XKAHX-A3BD |
How to Specify a P.T.O. Propane Truck for Home Delivery

What We Know from Customer

- RT-9710B
- Product Pump
- 0.5 HP Pump
- Engine R.P.M. 1000
- Pump R.P.M. 750 Max
- Drive shaft
- P.T.O. Air Shifted Powershift
### How to Specify a P.T.O. Propane Delivery Truck

#### What We Know from Customer
- RT-9710B (Eaton)
- Pump Input 0.5 HP
- Product Pump
- Drive Shaft Connection
- Engine R.P.M. 1000
- P.T.O. Air Shifted Powershift
- Pump R.P.M. 750 Max
- Do not want shaft to rotate when off

<table>
<thead>
<tr>
<th>#</th>
<th>Specification</th>
<th>Details</th>
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<tr>
<td>1</td>
<td>Eaton RT-9710B</td>
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<tr>
<td>2</td>
<td>Roper Product Pump</td>
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<tr>
<td>3</td>
<td>0.5 HP</td>
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<tr>
<td>4</td>
<td>750 R.P.M.</td>
<td></td>
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<tr>
<td>5</td>
<td>850 R.P.M.</td>
<td>• 88%</td>
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<tr>
<td>6</td>
<td>CCW</td>
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<tr>
<td>7</td>
<td>Drive Shaft</td>
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<tr>
<td>8</td>
<td>Bottom</td>
<td></td>
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<tr>
<td>9</td>
<td>Continuous</td>
<td></td>
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<tr>
<td>10</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>FLR-34</td>
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<tr>
<td>12</td>
<td>3.5 Lbs. ft.</td>
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<tr>
<td>13</td>
<td>5.95 Lbs. ft.</td>
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<tr>
<td>14</td>
<td>230XDAHX-*3 (89%)</td>
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<tr>
<td>15</td>
<td>230XDAHX-A3BD</td>
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How to Specify a P.T.O.
Ford Super Duty

- MY2012 Ford F550 4 x 2
- TorqShift 6
- Pump 13 GPM
- Working Pressure 2200 PSI
- Pump Speed 1300 R.P.M.
How to Specify a P.T.O. Ford Super Duty

- MY2012 Ford F550 4 x 2
- TorqShift 6
- Pump Speed 1300 R.P.M.
- 13 GPM / 2200 PSI
- Will operate up to 6 hours at one setting

<table>
<thead>
<tr>
<th>1. Ford Automatic 6 Speed</th>
<th>8. Left Side</th>
</tr>
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<tbody>
<tr>
<td>2. Gen Set</td>
<td>9. Continuous</td>
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<tr>
<td>3. 20.0 HP</td>
<td>10. N/A</td>
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<tr>
<td>4. 1300 R.P.M.</td>
<td>11. FRD-10</td>
</tr>
<tr>
<td>5. 1048 R.P.M.</td>
<td>12. 80 Lbs. ft.</td>
</tr>
<tr>
<td>• 124%</td>
<td>13. 115 Lbs. ft.</td>
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<tr>
<td>6. CCW</td>
<td>14. 248FMLLX-B211(124%)</td>
</tr>
<tr>
<td>7. Direct Pump Mount</td>
<td>15. 248FMLLX-B211</td>
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Thank You!

Questions?

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