

PRINCIPLES AND CONCEPTS OF HYDRAULICS

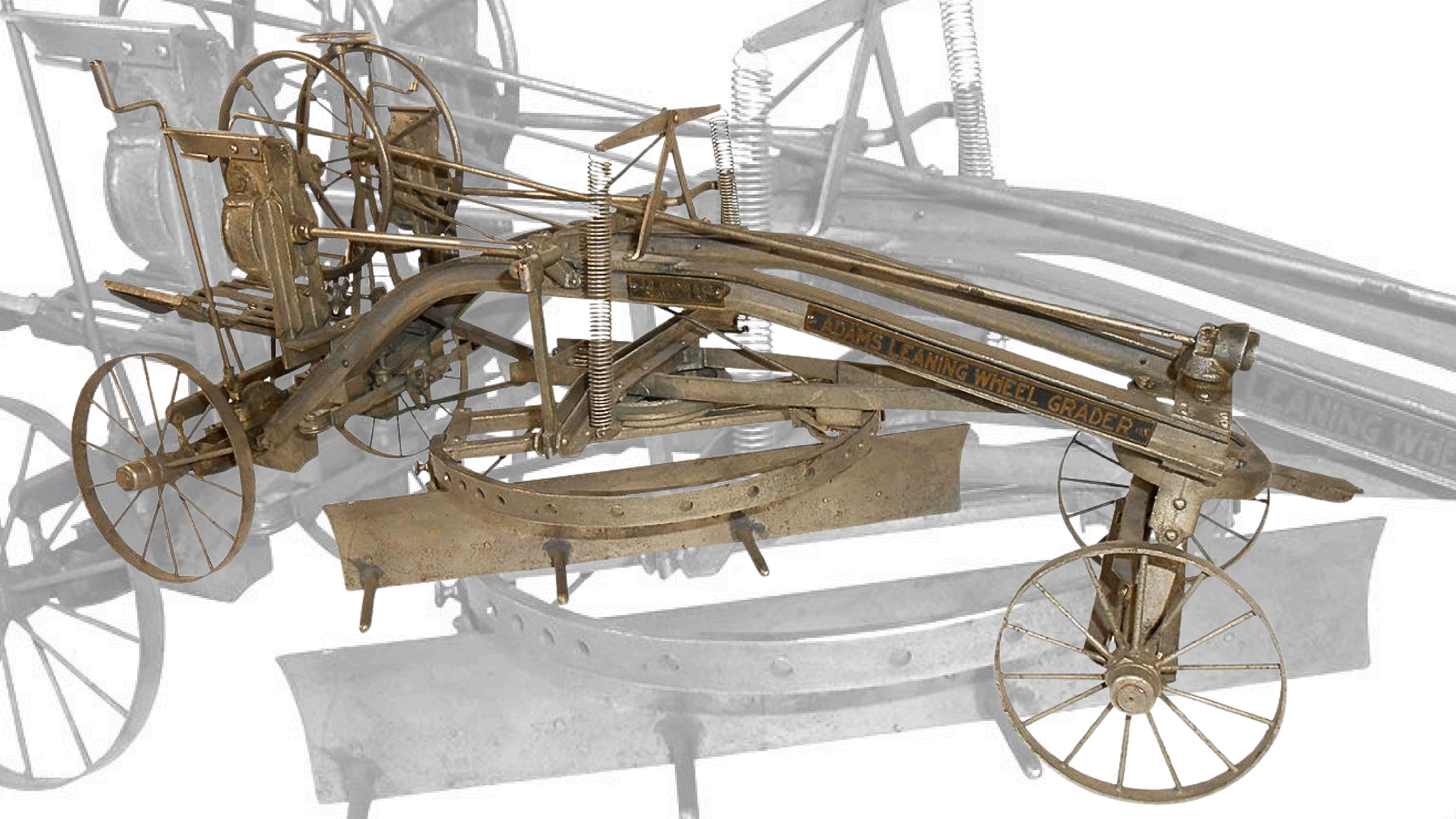
WHAT IS A HYDRAULIC SYSTEM?

A hydraulic system is a technology that converts mechanical energy into hydraulic energy (fluid pressure) and then back into mechanical energy to perform work such as lifting, pushing, or rotating.

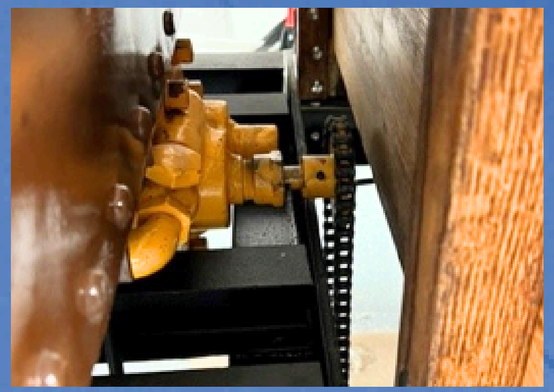







ADAMS LEANING WHEEL GRADER

1916 GMC
DUMP TRUCK











FORCE TRANSFER

- Pascal's Law:
  - **A pressure applied to a confined fluid at rest is transmitted with equal intensity throughout the fluid and to all surfaces of the container.**
- Compressible 0.5% per 1,000 PSI
- Bulk Modulus of Elasticity
- Resistance to compression
- Air is 10,000 times more compressible

Blaise Pascal

17th Century French
Mathematician and Philosopher

HARRY VICKERS

- 20th century engineer and inventor
- Revolutionized industrial hydraulics
- Invented the vane pump
- Founded Vickers Inc.
- Laid the groundwork for modern hydraulic systems, known as the “Father of Modern Hydraulics”





3 MOVEMENTS:

1. Claw is opening and closing
2. Claw is raising up and down
3. Claw is twisting

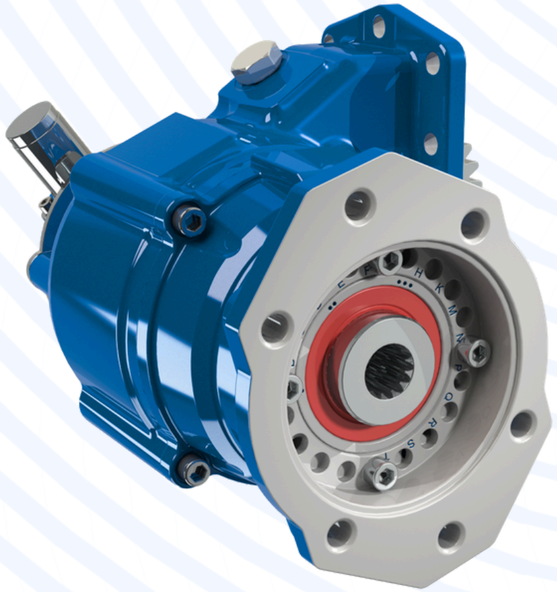


COMPONENTS, CHASSIS, & TRANSMISSIONS

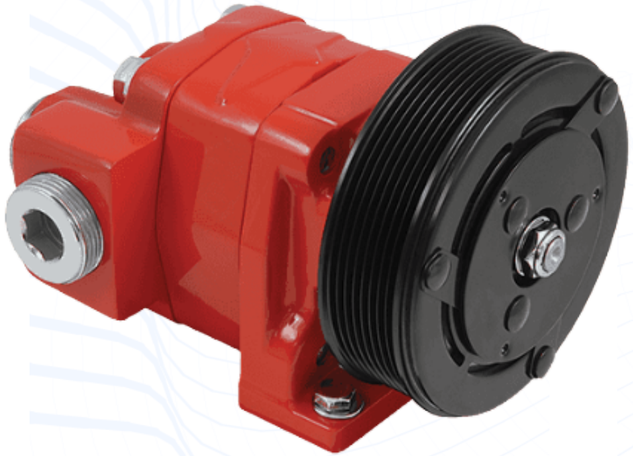


WAYS TO RUN HYDRAULICS

Power Take-offs



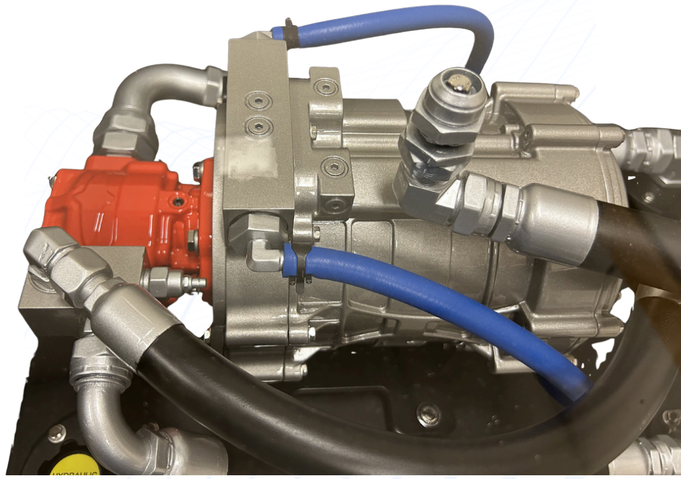
Belt & Pulley



Driveshaft

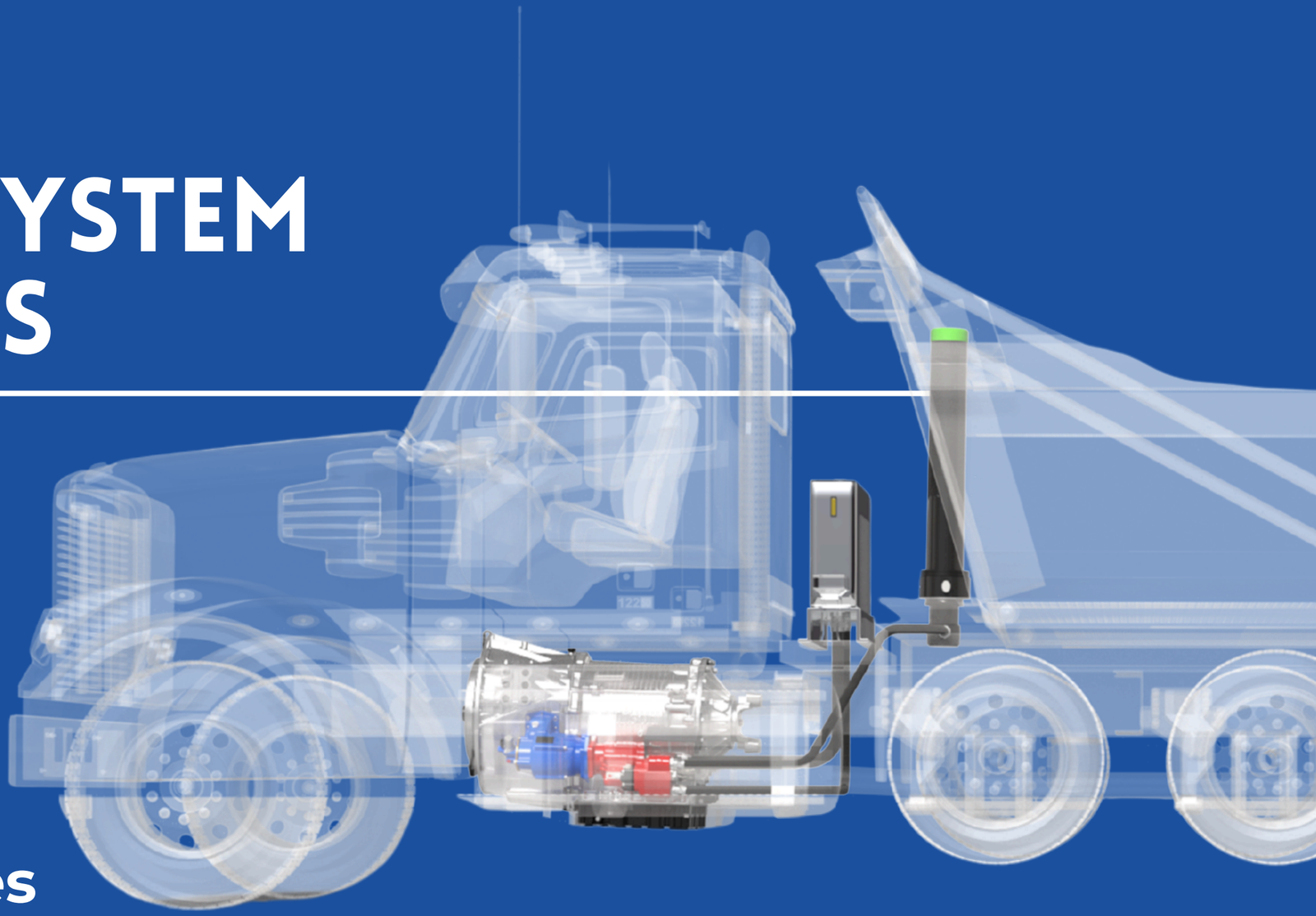


Electric Motor

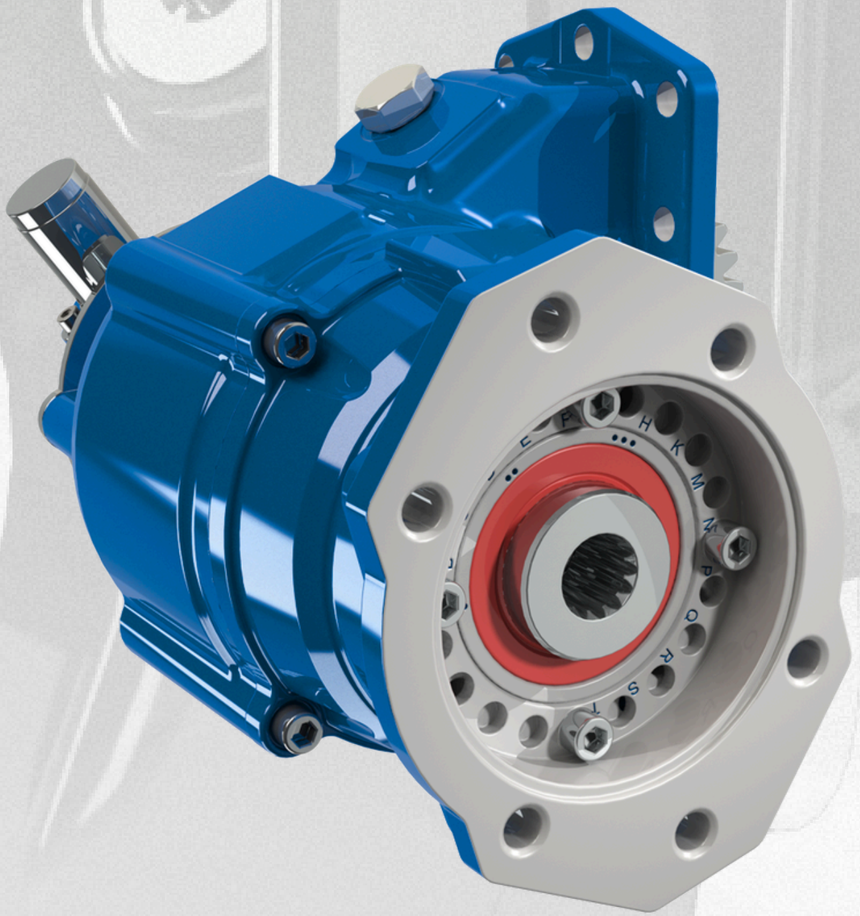


HYDRAULIC SYSTEM COMPONENTS

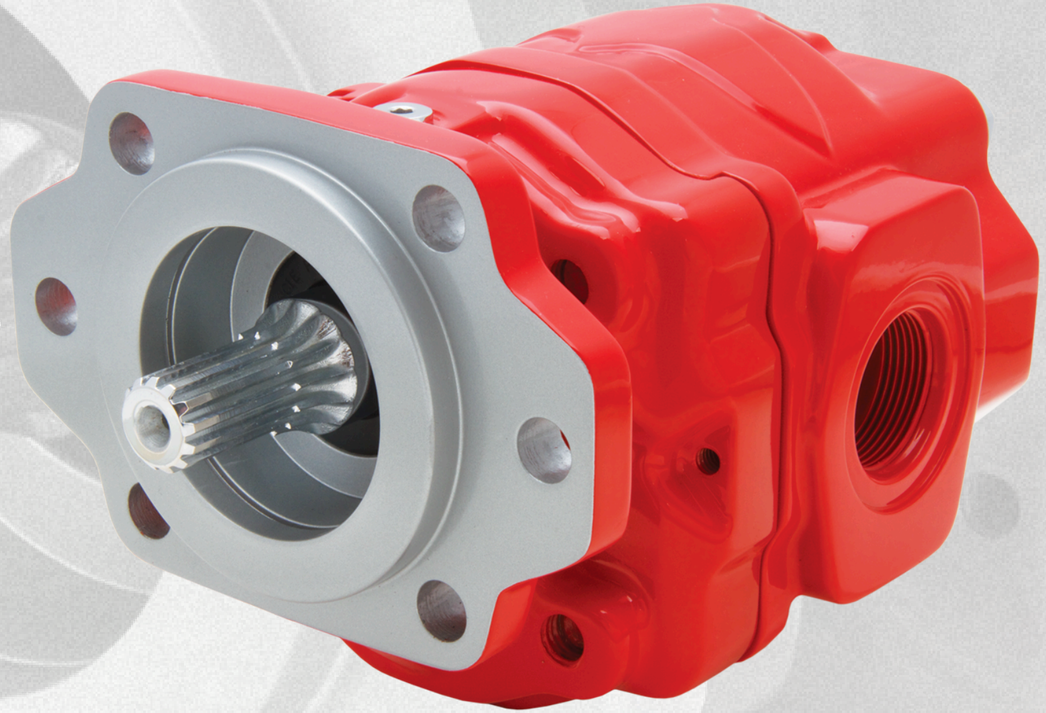
Power Take-off
Hydraulic Pump
Hydraulic Tank
Valves
Cylinder
Fluid Conveyance
Coolers & Accessories



POWER TAKE-OFF



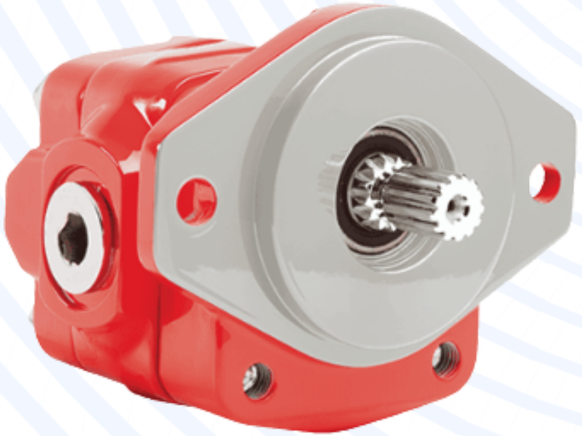
HYDRAULIC PUMP



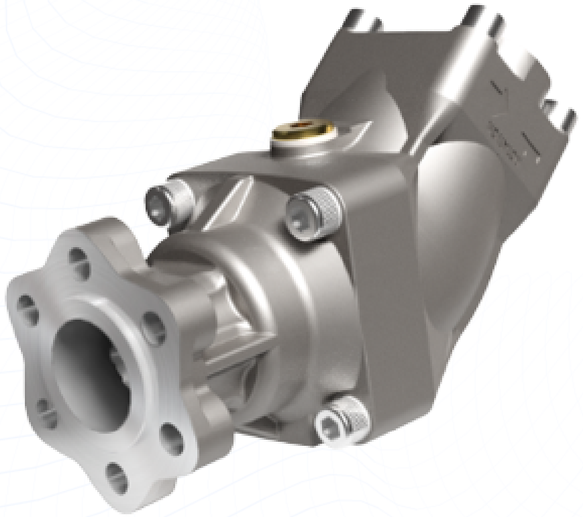


TYPES OF PUMPS ON VOCATIONAL TRUCKS

Gear Pumps



Piston Pumps



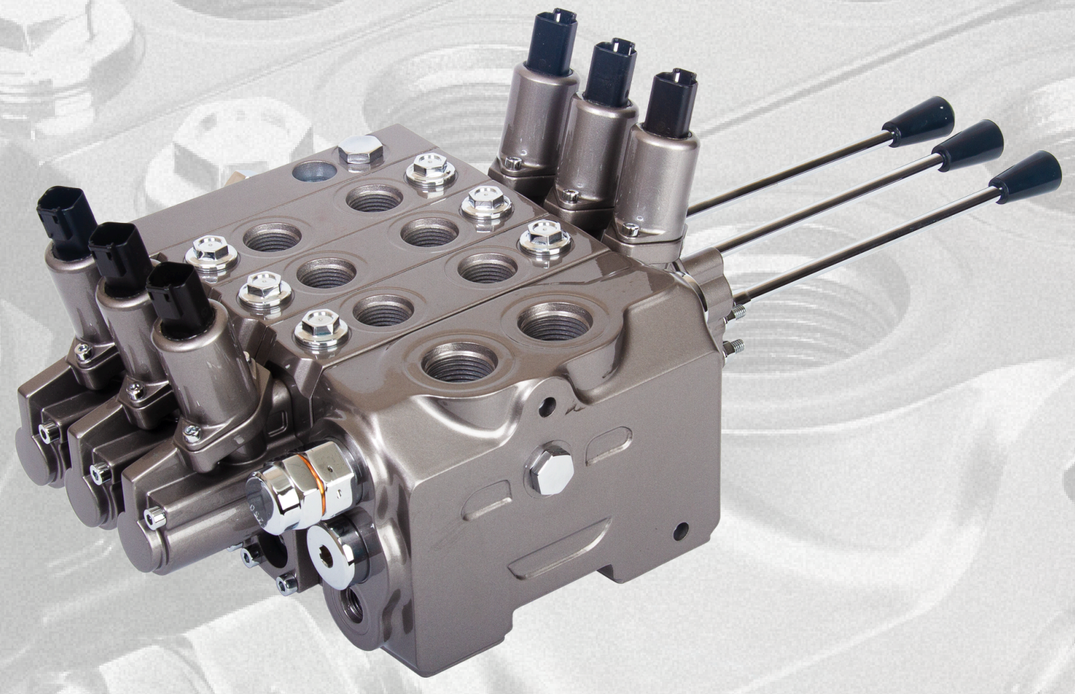
Vane Pumps



HYDRAULIC TANK



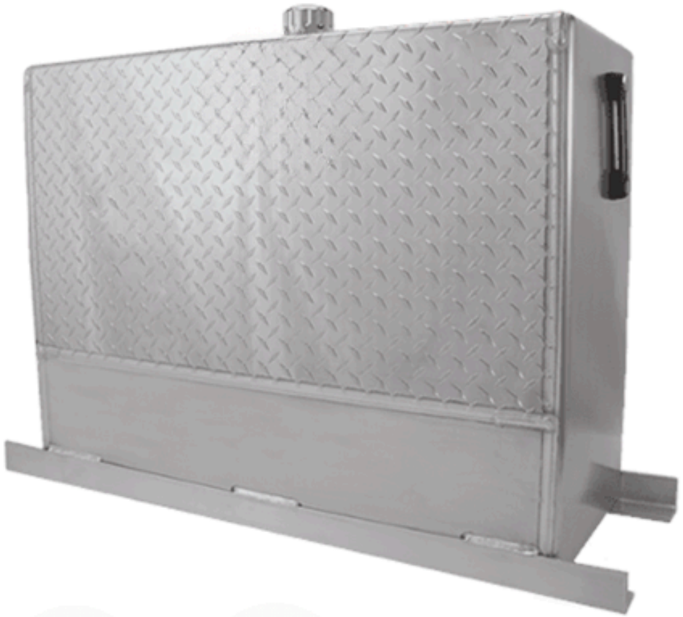
DIRECTIONAL CONTROL VALVES



Types of Tanks

Materials

Aluminum



Steel



Polyethylene

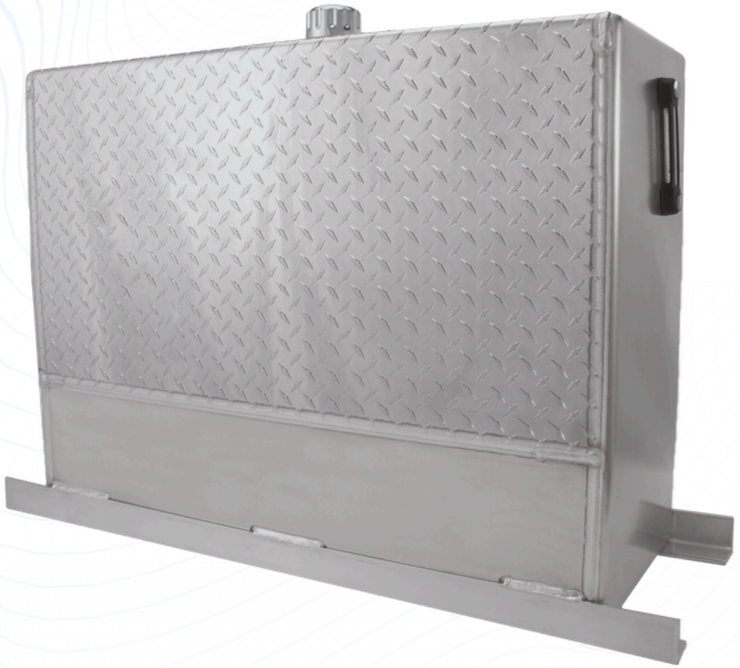


TYPES OF TANKS: MATERIALS

Steel



Aluminum



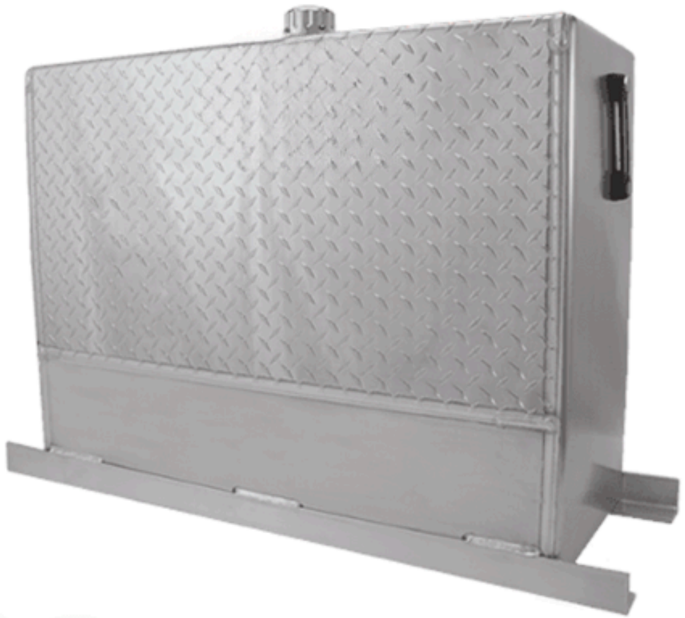
Polyethylene



Types of Tanks

Styles

Upright



Box

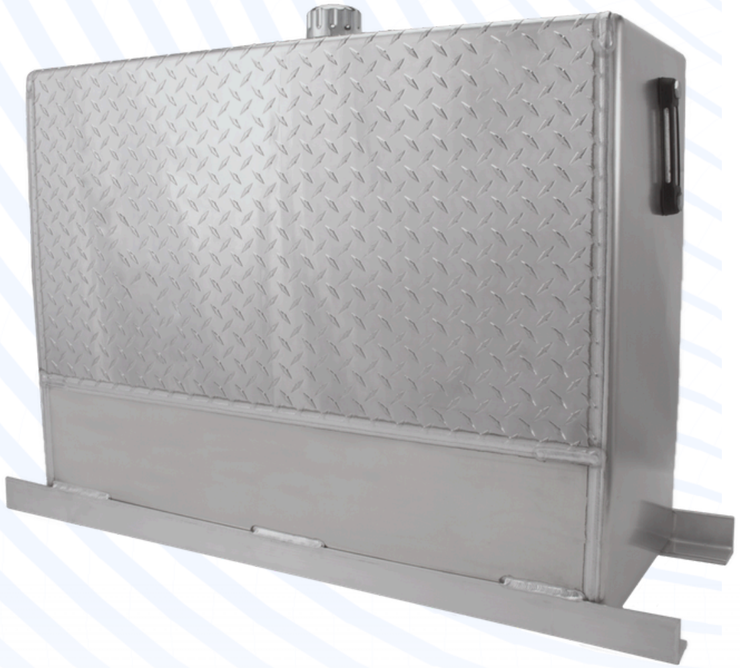


round



TYPES OF TANKS: MOUNTING STYLES

Upright



Side Mount



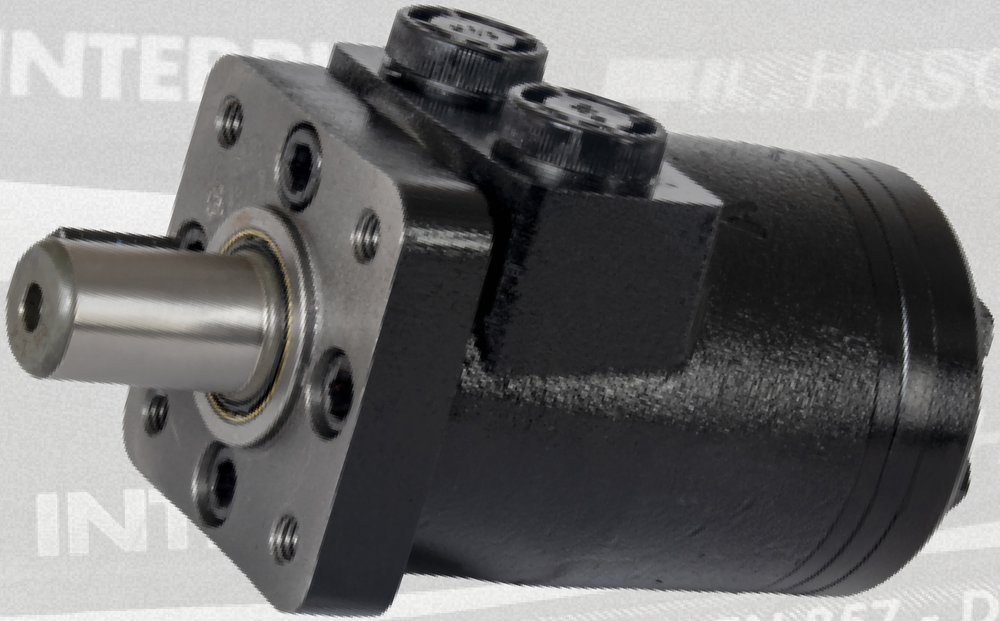
Saddle Mount



CYLINDER



MOTORS



FILTERS



HOSE & FITTINGS



TRUCK CHASSIS



TRUCK CHASSIS

Ford F-750



Freightliner M2



Kenworth T880





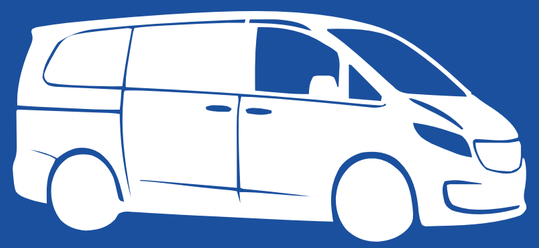
GROSS VEHICLE WEIGHT RATING

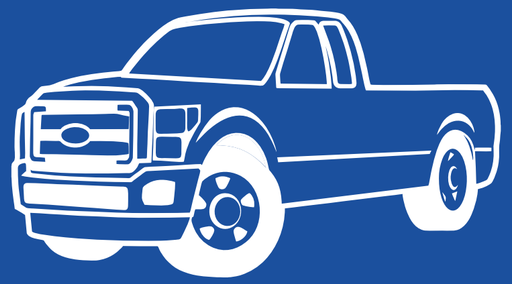
- Gross Vehicle Weight Rating (GVWR)
  - Determined by the manufacturer
  - Includes vehicle, load, fuel, and passengers
- Gross Vehicle Weight (GVW)
  - Actual loaded weight
- GVW should **not** exceed GVWR

TRUCK CLASSIFICATIONS

CLASS 1

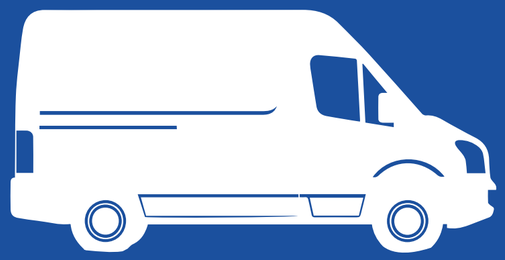
Less than
6,000 lbs. GVWR

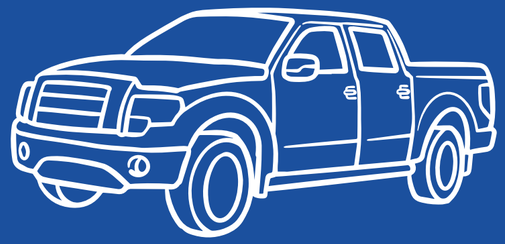




CLASS 2

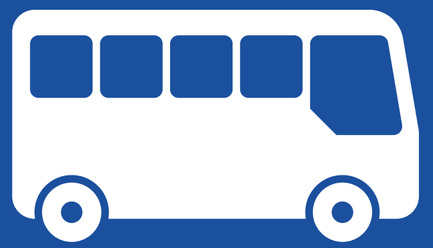
6,001–10,000 lbs.
GVWR





CLASS 3

10,001–14,000 lbs.
GVWR





LIGHT-DUTY APPLICATIONS

CLASS 1–3







TRUCK CLASSIFICATIONS

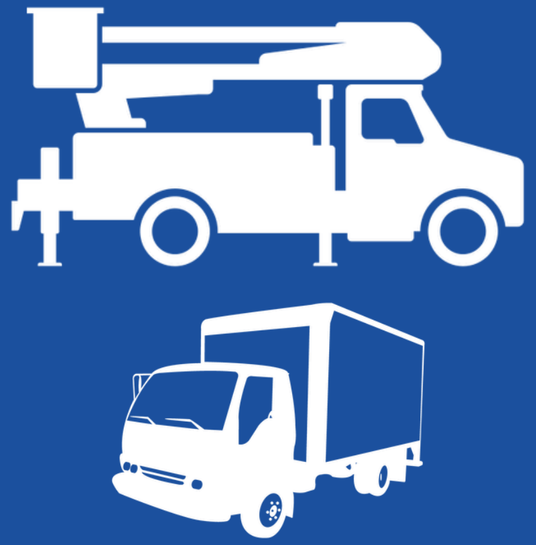
CLASS 4

14,001–16,000 lbs.
GVWR



CLASS 5

16,001–19,500 lbs.
GVWR



CLASS 6

19,501–26,000 lbs.
GVWR



MEDIUM-DUTY APPLICATIONS

CLASS 4–6







TRUCK CLASSIFICATIONS

CLASS 7

26,001–33,000 lbs.
GVWR





CLASS 8

Over 33,000 lbs.
GVWR





HEAVY-DUTY APPLICATIONS

CLASS 7–8







TRUCK TRANSMISSIONS

AISIN

EATON

PACCAR

Allison Transmission

Ford

RAM

DETROIT

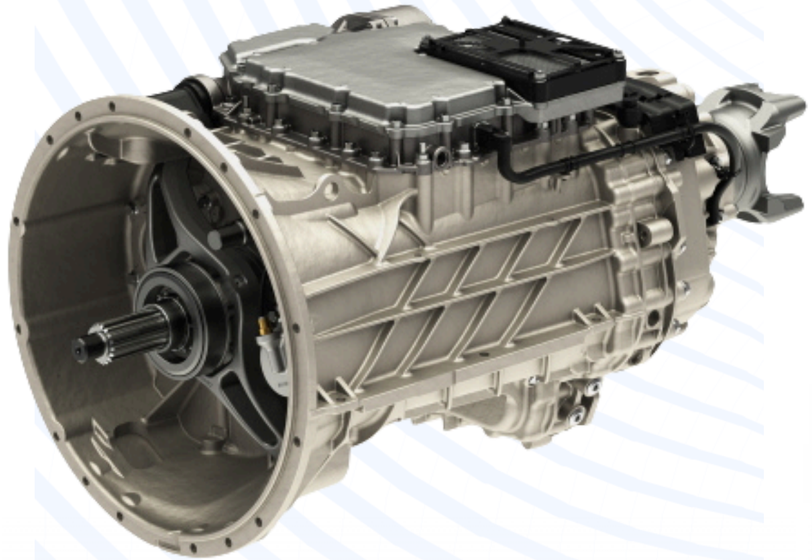
MACK

VOLVO

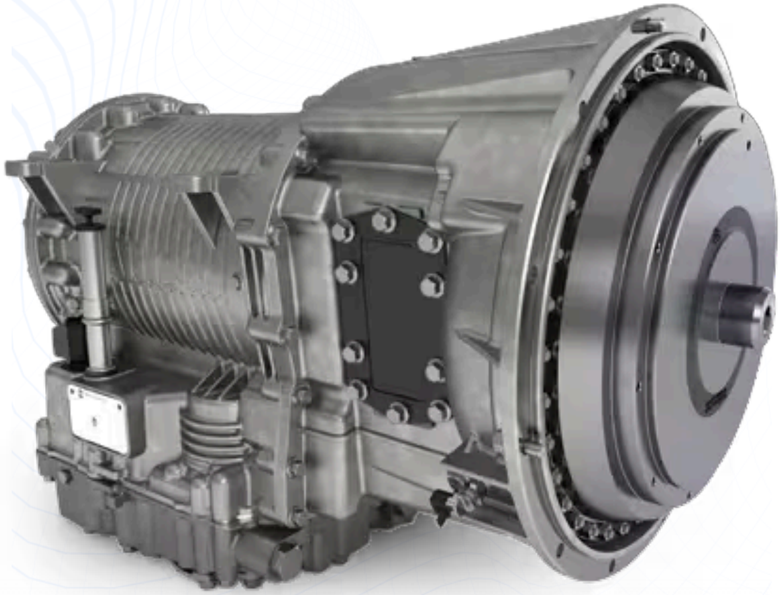
ZF

TRUCK TRANSMISSIONS

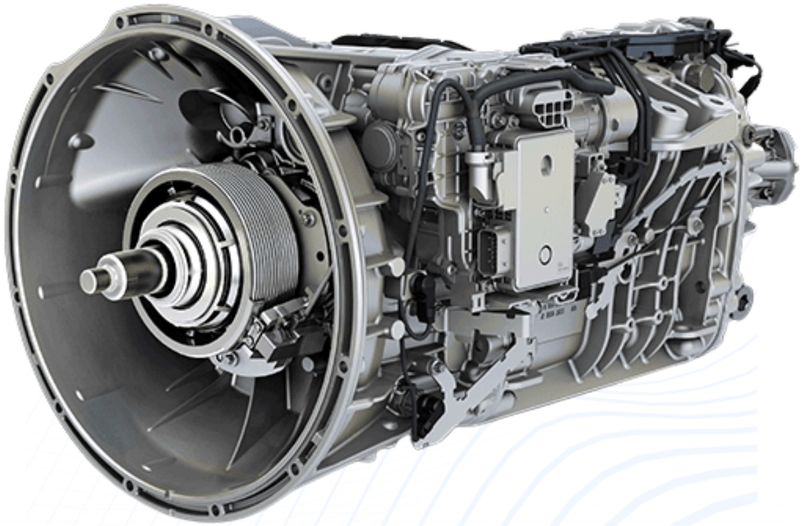
Eaton Fuller 18 Speed



Allison 3000 Series



Detroit Diesel

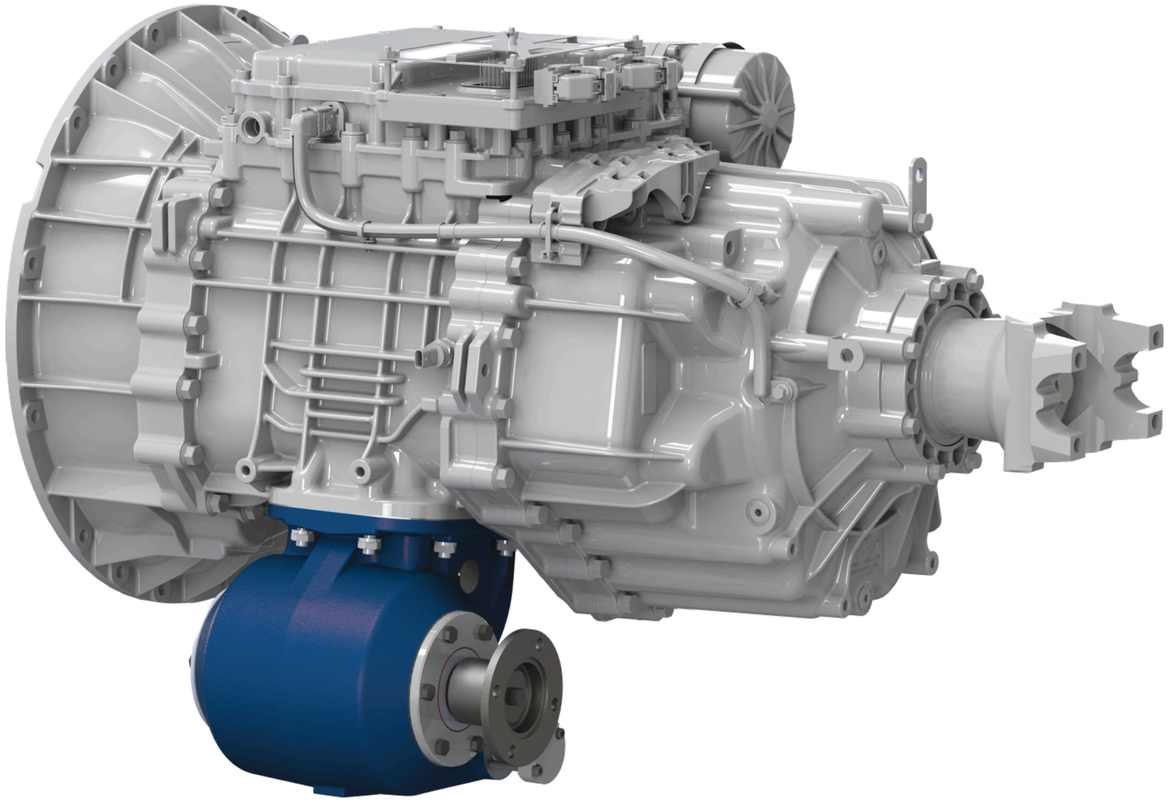


PTO OPENINGS

Rear Mount and Side Mount



Bottom Mount



UNDERSTANDING LIVE-BOTTOM TRAILERS



WHAT IS A LIVE-BOTTOM TRAILER?

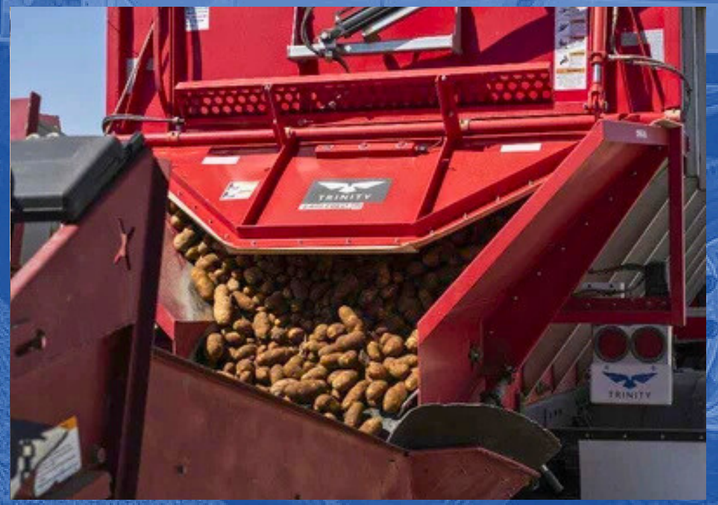
- An alternative to a standard dump trailer
- Allows for material to be unloaded via a belt at the bottom of the trailer instead of raising the bed in the air, which could be unstable.



HOW ARE THEY USED?

Live-bottom trailers are used as semi-trailers to haul loose material such as asphalt, grain, potatoes, sand, and gravel.








Williams

DECIDING COMPONENTS

Components should be selected according to the specs determined by the manufacturer.

Let’s work through an example of finding the right components based on the manufacturer’s specs!

Manufacturer Provided Specs:

- Motor: 15.26 CID
- Pump: 20 GPM
- Engine: 1,400 RPM
- Tank: 20-gallon minimum
- System PSI: 2500



PRACTICE WORK: MOTOR

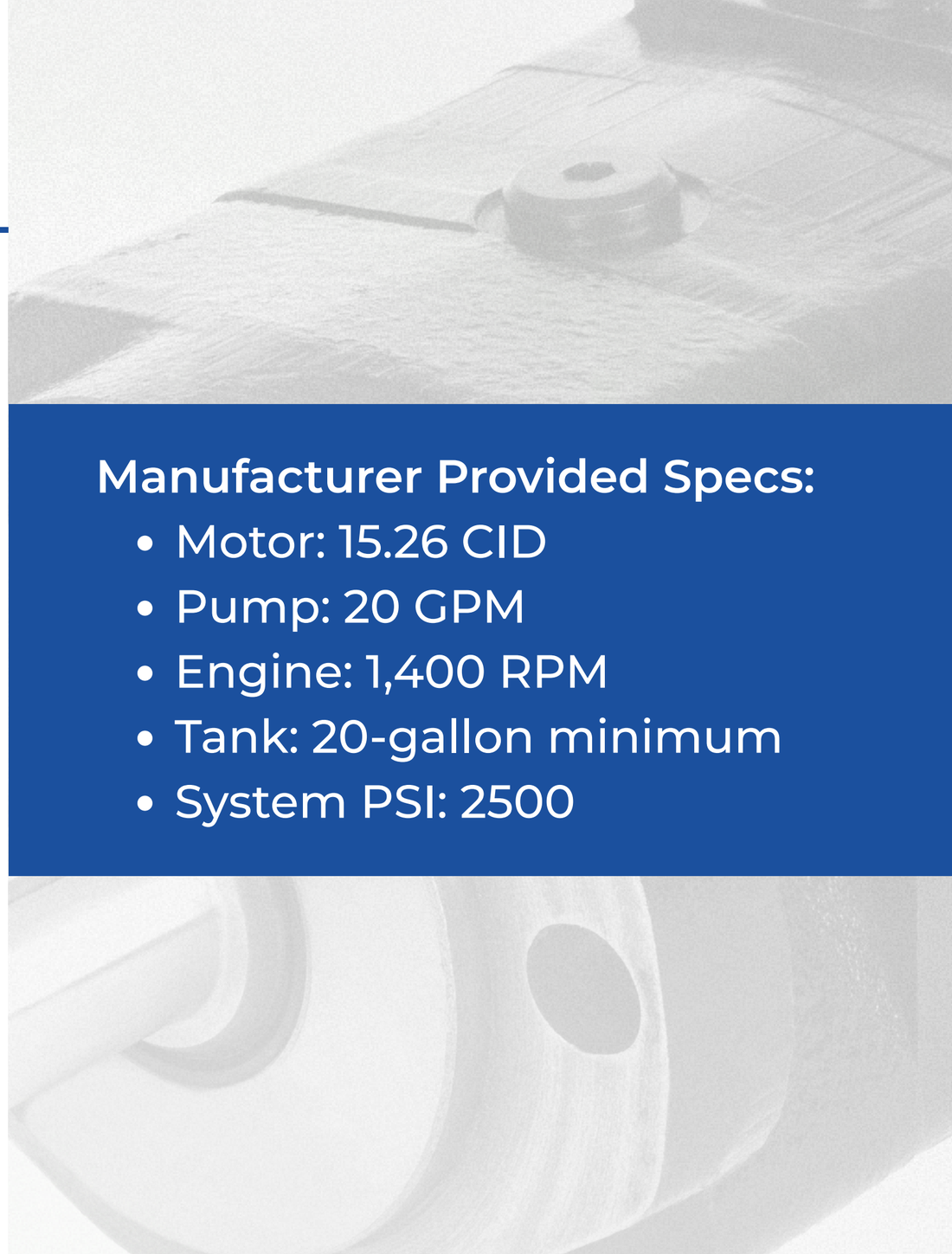
The formula to determine how fast the motor's belt will turn is

$$RPM = GPM \times 231 \div CID \times E$$

E = Efficiency, which is 90% in this example.

Using our provided specs, we know the GPM needs to be 20. Below is how fast we need the motor's belt to turn:

$$272 = 20 \times 231 \div 15.26 \times 90\%$$



Manufacturer Provided Specs:

- Motor: 15.26 CID
- Pump: 20 GPM
- Engine: 1,400 RPM
- Tank: 20-gallon minimum
- System PSI: 2500

PRACTICE WORK: PTO & PUMP

The factors that go into how many gallons of oil a pump will produce are

- Engine RPM
- PTO %
- Pump size

The pump in our example must handle 2,500 PSI system pressure.

The formula for GPM is

$$GPM = EngineRPM \times PTO\% \times CID \div 231 \times E$$

If we use a PTO of 120% and a pump with a 2.96 CID, below is our needed GPM:

$$19.4 = 1,400 \times 120\% \times 2.96 \div 231 \times 90\%$$



Manufacturer Provided Specs:

- Motor: 15.26 CID
- Pump: 20 GPM
- Engine: 1,400 RPM
- Tank: 20-gallon minimum
- System PSI: 2500



PRACTICE WORK: TANK & FILTER

For a motor circuit, use a tank twice the flow rate unless an oil cooler is present.

Short duty cycles may not need a cooler.

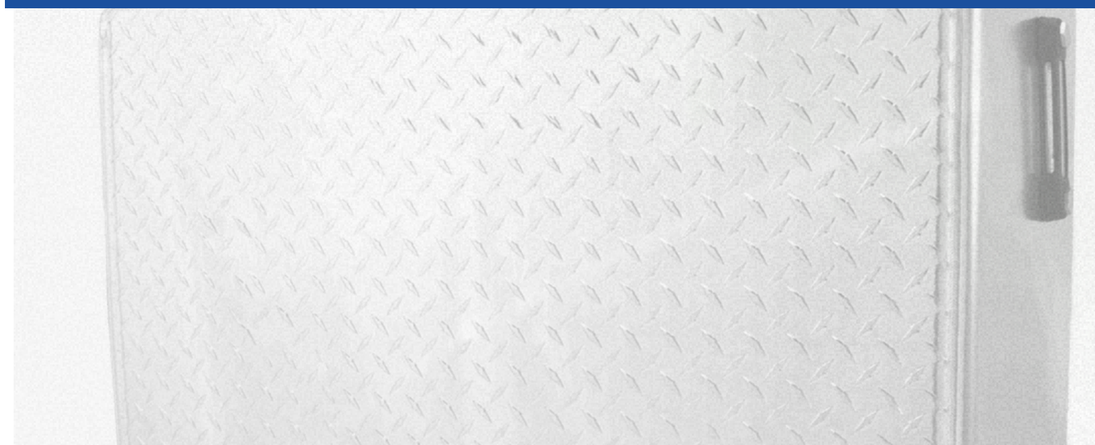
Upright, side, or saddle mount tanks in steel or aluminum are suitable

A 25 GPM filter covers the required 20 GPM flow. Common filter sizes are 25, 50, and 100 GPM.



Manufacturer Provided Specs:

- Motor: 15.26 CID
- Pump: 20 GPM
- Engine: 1,400 RPM
- Tank: 20-gallon minimum
- System PSI: 2500

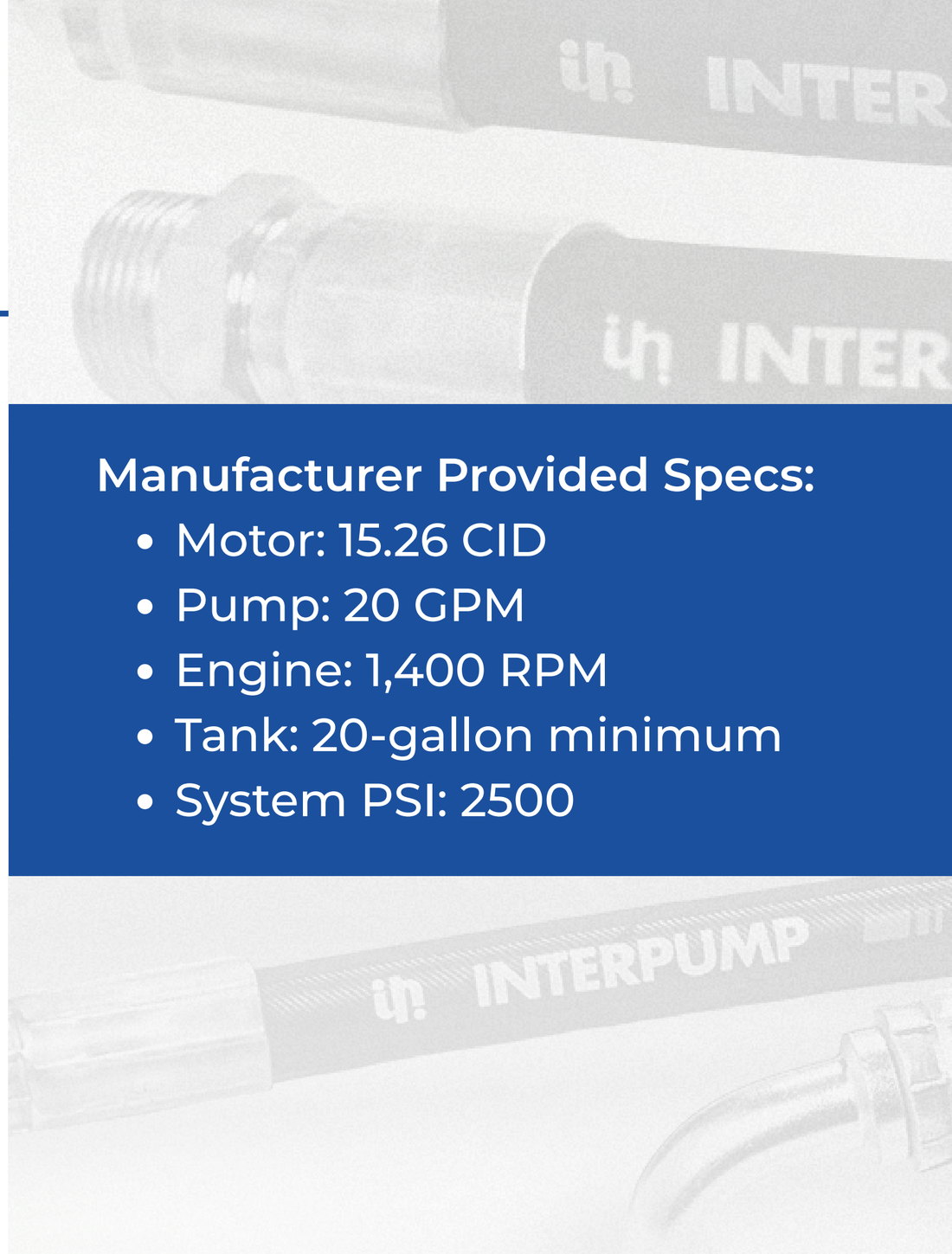


PRACTICE WORK: HOSE & FITTINGS

Three hose types are required: inlet, pressure, and return. Each hose must be appropriately rated for the specific system.

Hose size should be determined by oil flow—not pump or motor port size. Here are three recommended hoses for our example:

- Inlet hose: 1 ½"
- Pressure hose: ¾"
- Return hose: 1"



Manufacturer Provided Specs:

- Motor: 15.26 CID
- Pump: 20 GPM
- Engine: 1,400 RPM
- Tank: 20-gallon minimum
- System PSI: 2500



THANK YOU!

GARY STEPHENS

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