

# Vibro Definition



A vibro is a tool that, when attached to a pile, shakes it up and down in a vertical motion for the purpose of installing or removing it from the soil.

# **Vibratory Pile Driver/Extractors In Action!**



Example:

Vibrating  
H-Beams



# Example: Vibrating Casings



Example: Vibrating Plastic Sheets



# Example: Pulling Concrete Piles



# Example: Pulling Piles



# Example: Power Pole Foundations

# Example: Excavator Mounted





# Example: Vibrating Large Caissons



# Example: Vibrating Wick Drains



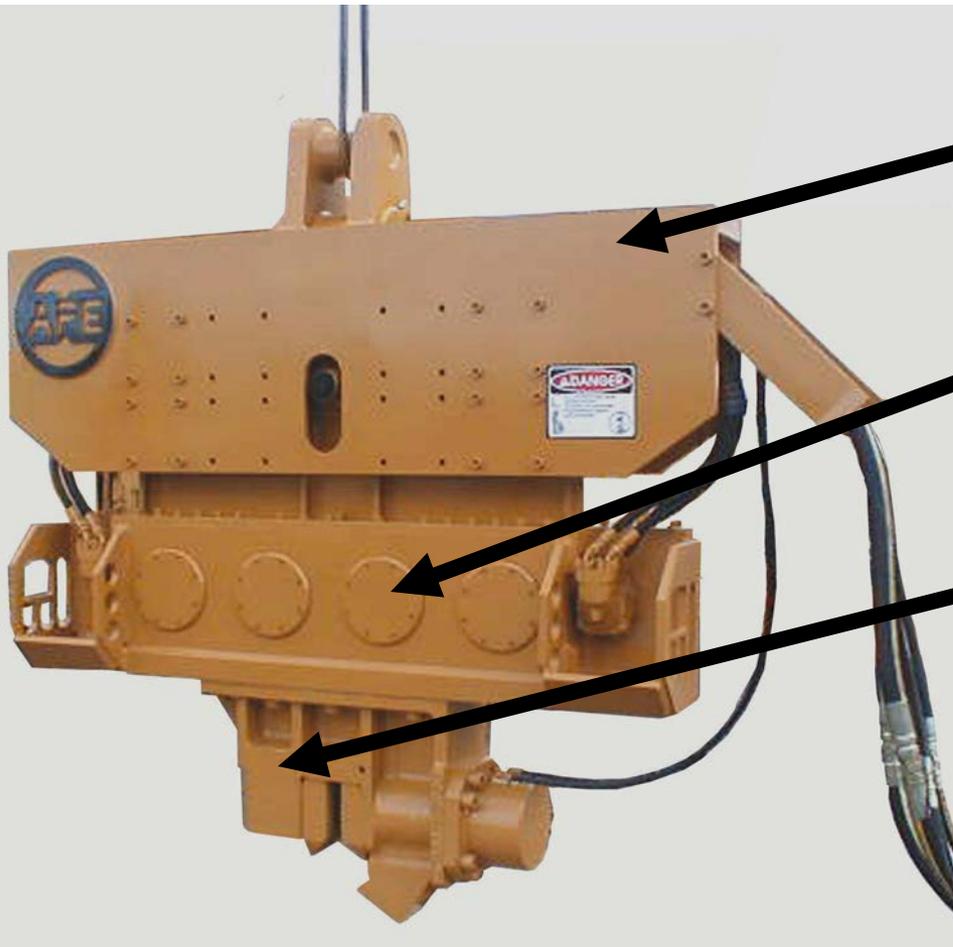
# Example: Vibrating Sheet Piles



# Example: Big Concrete Caissons

# Understanding The Components Of a Vibratory Pile Driver/Extractor

# Vibratory Pile Drivers/Extractors



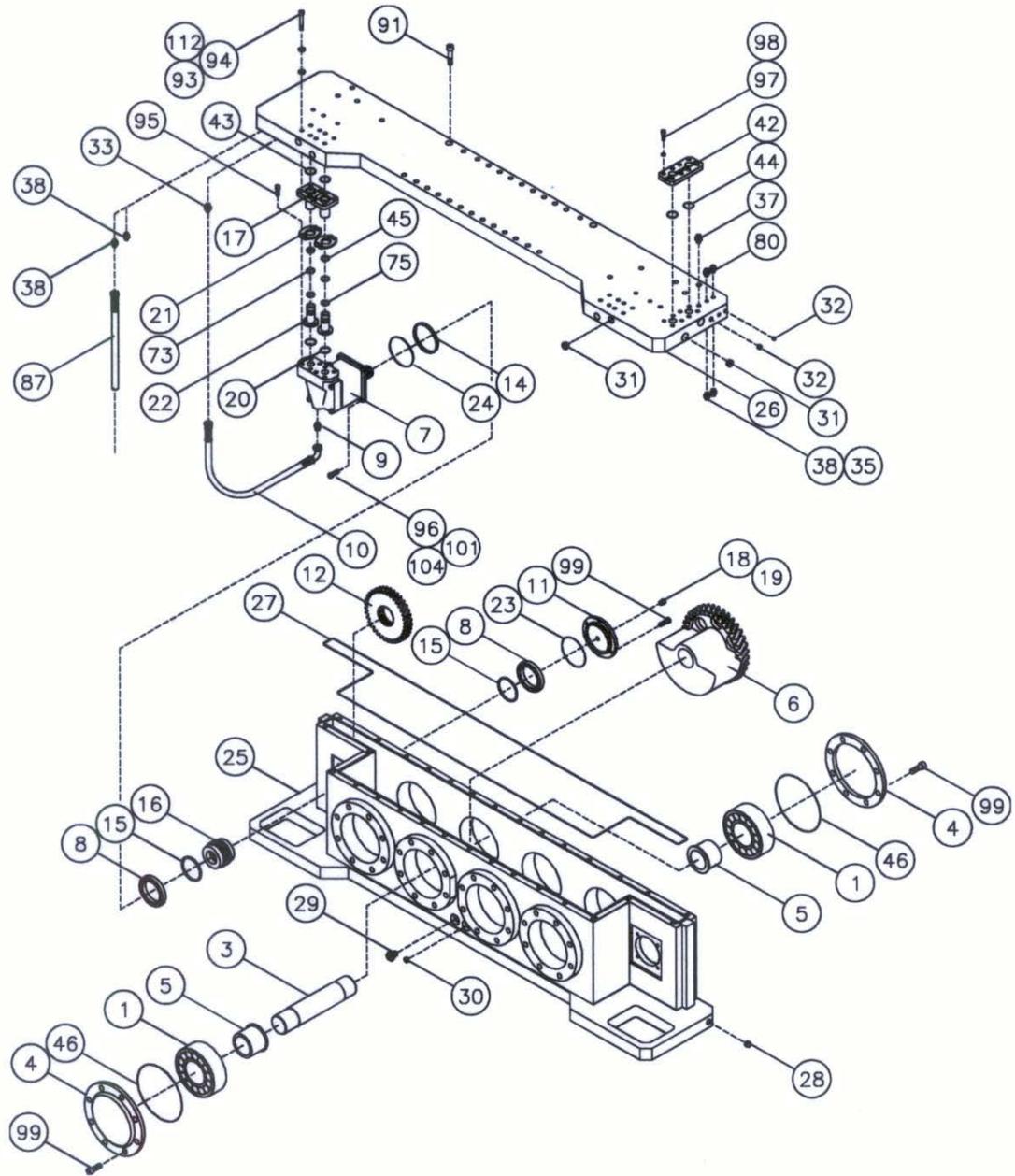
Suppressor Housing

Gearbox

Clamp Attachment

# How Does A Vibratory Pile Driver/Extractor Work?

# What's Inside The Gearbox



# Eccentrics: The Heart of the Vibro



All Vibratory Pile Driver/Extractors Have Rotating Eccentrics.

This Photo Shows One Example Of An Eccentric And Gear.



A look inside a vibro



# Eccentric

# Two Eccentrics

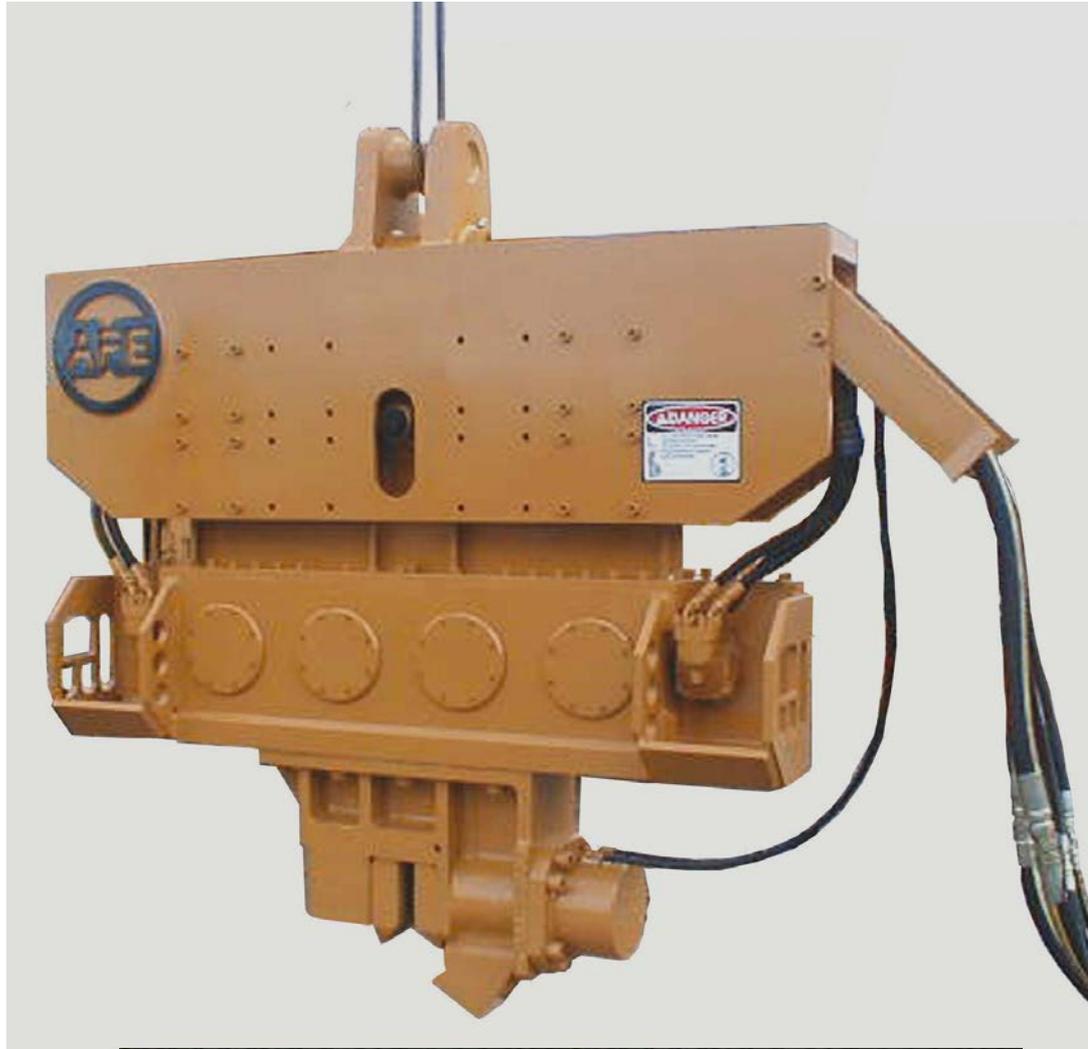
All Vibratory Pile Driver Extractors Have At Least Two Paired Eccentrics





# Two Eccentrics

# Four Eccentrics

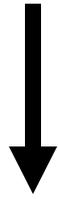




# Six Eccentrics

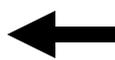
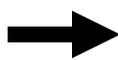
# Four strokes of the paired eccentrics

1 work



Forces the vibro and the casing downward

2 Cancel



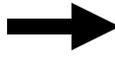
Nothing happens.  
Each eccentric  
cancels other out.

3 work



Both eccentrics for  
vibro and casing  
upward

4 Cancel



Nothing happens.  
Each eccentric  
cancels other out.

## *History*

Russia's Barken

French/Japan

MKT: Hyd

H&M

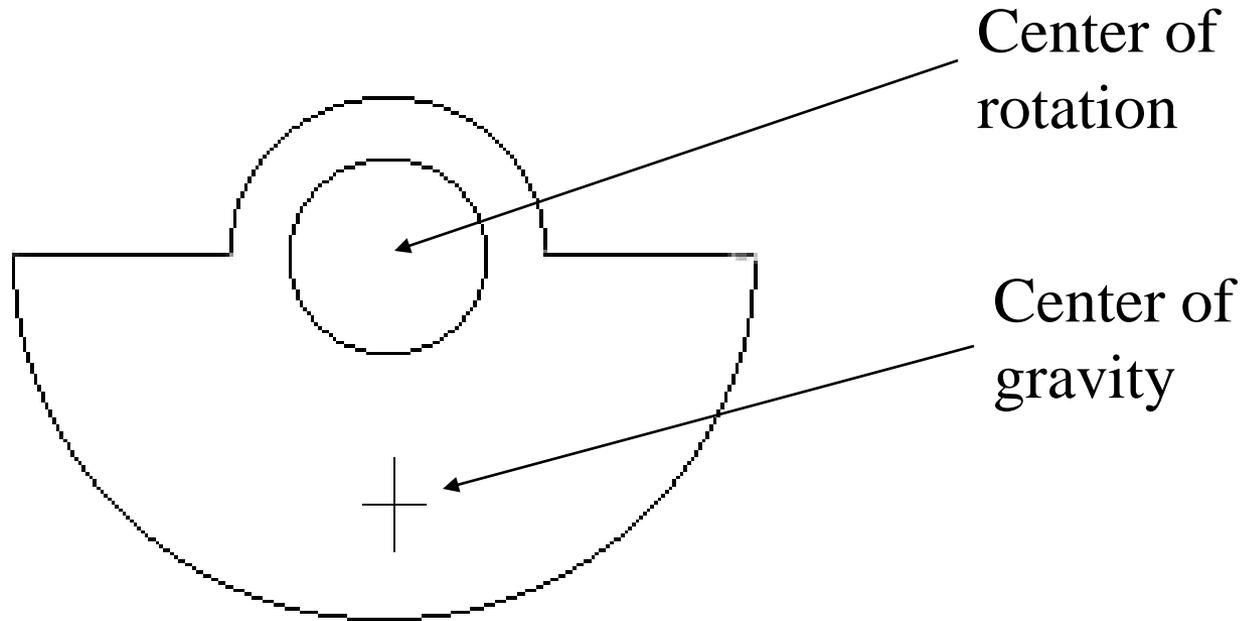
ICE: Rubber springs

APE- Two stage, rifle bore, etc.

Variable Moment

# Vibro-Driver/Extractors

Eccentric moment



Eccentric moment = distance between the center of rotation and the center of gravity  $\times$  the total mass of the eccentric.

# Example of calculating eccentric moment of one eccentric:

Equation:

Distance between

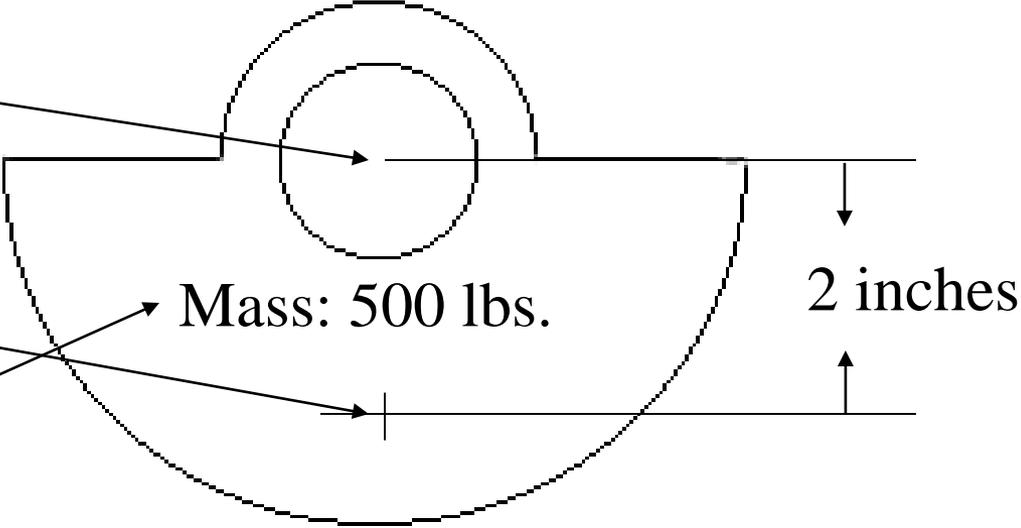
*Center of Rotation*

and

*Center of Gravity*

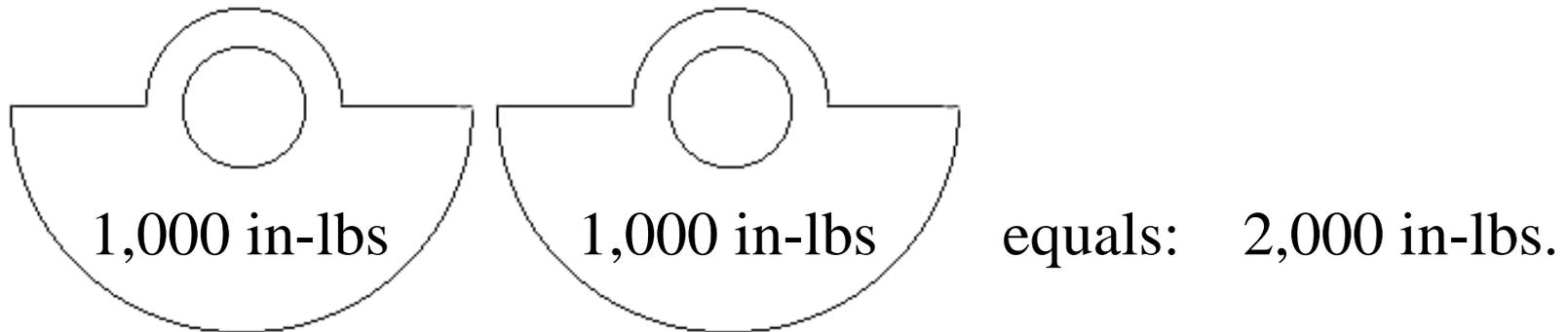
Multiplied by

The Mass



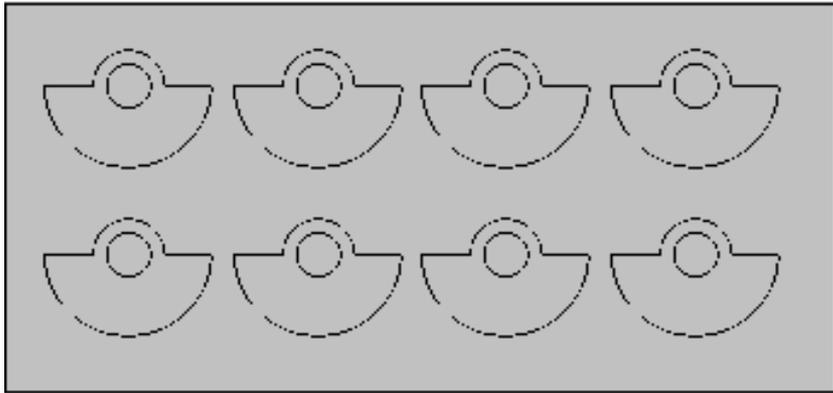
2 times 500 equals: 1,000 inch pounds

Eccentric moment of a vibro is measurement of all eccentrics combined.

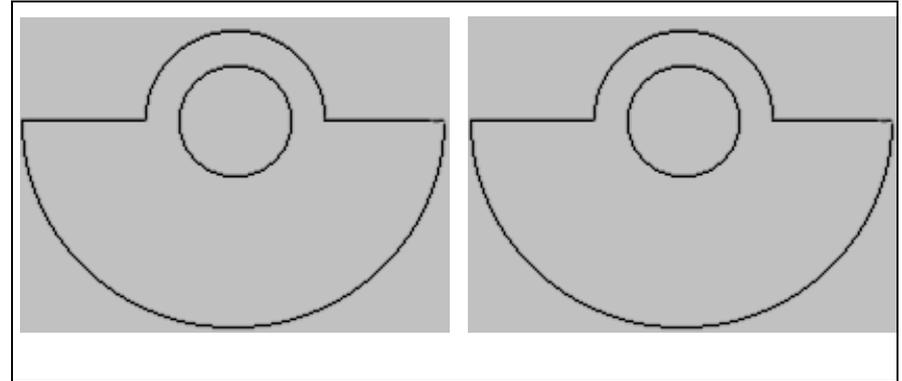


If each eccentric has 1,000 in-lbs then the vibro has a total of 2,000 in-lbs.

Some Vibros have many small eccentrics to get a large total inch pounds while others have less eccentrics that are bigger.

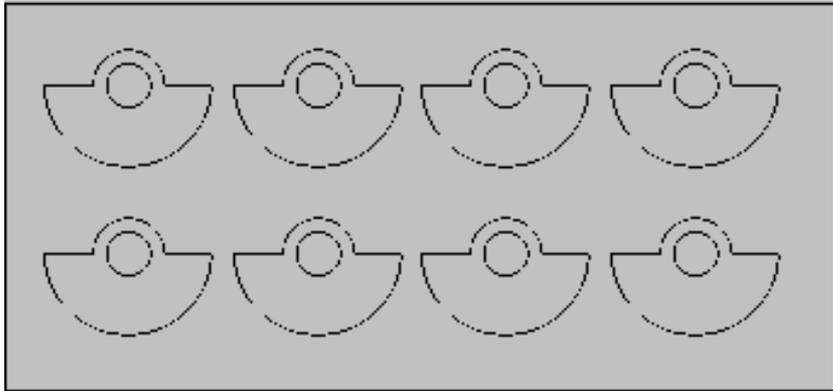


More vibrating weight  
Less amplitude

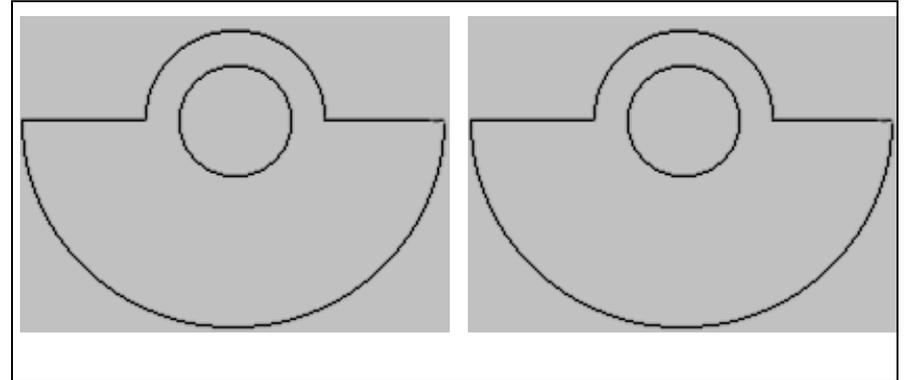


Less vibrating weight  
More amplitude

Smaller weights means more bearings,  
shafts, gears



More parts



Less parts

# Amplitude

$$A = 2 \times \frac{Mt}{Mv}$$

$Mv$

Mt = Eccentric Moment in inch pounds

Mv = Total Vibrating Weight

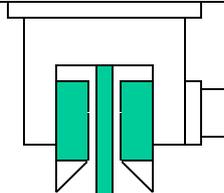
A = Amplitude in inches

Vibrating weight: Mv

The vibrating weight is the sum of all the weights of the vibrating mass.

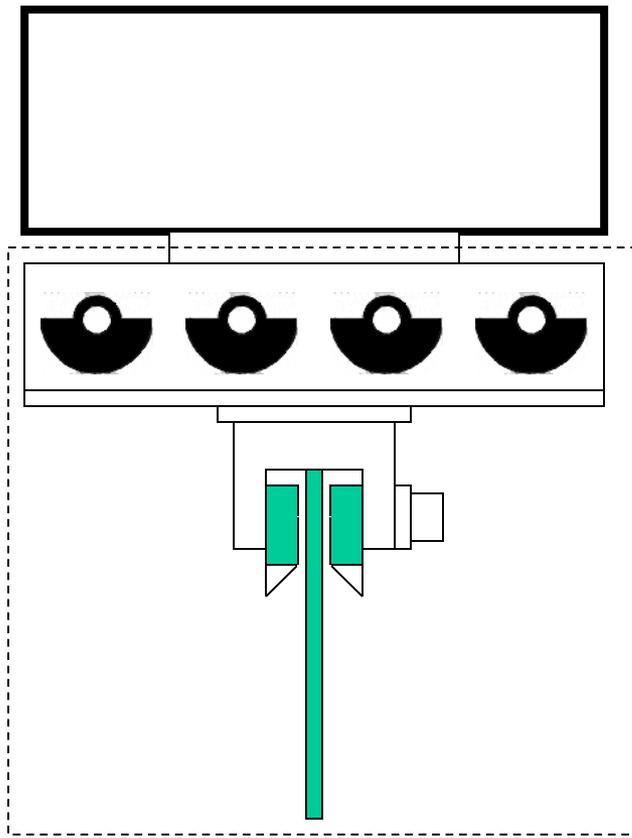
- B: Gear Box (vibrating mass)
- C: Clamping device including all plates or clamps
- D: Pile weight

Suppressor does not  
vibrate.  
Non-vibrating mass.



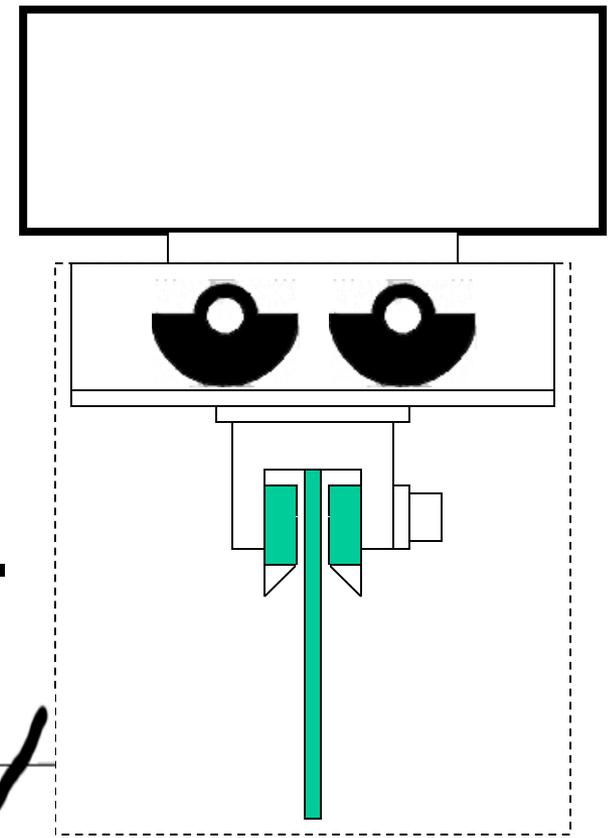
vibrating

mass



Amplitude

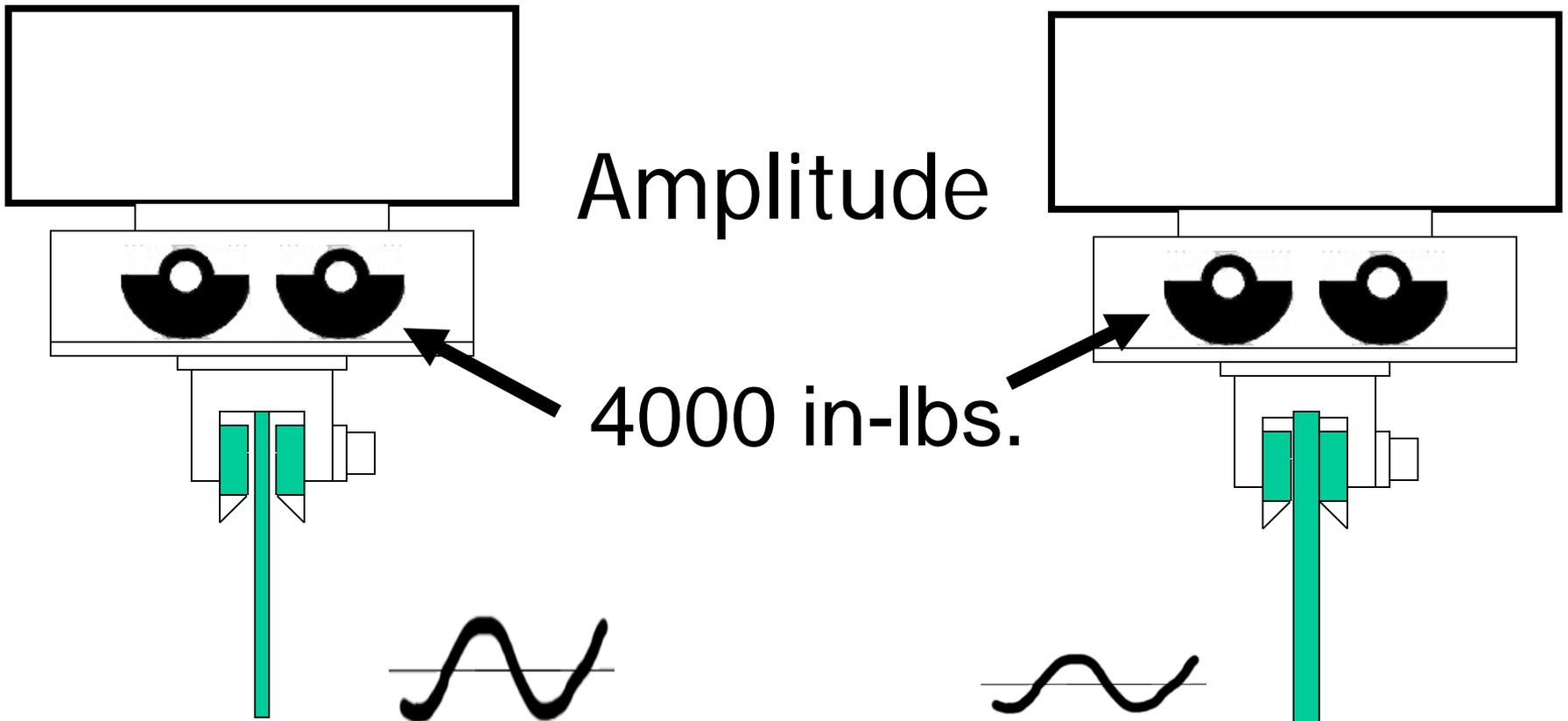
4000 in-lb.



Vibrating mass: 6500 lb

Vibrating mass: 5000 lb

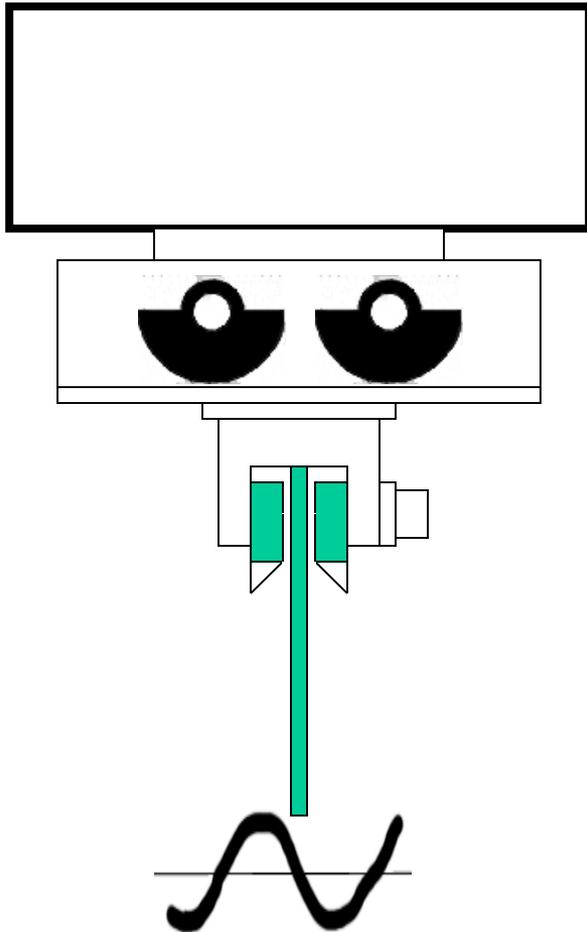
The hammer on the left has the same eccentric moment but less amplitude because the vibrating mass is heavier.



Amplitude will decrease  
with increase of pile  
weight. Big piles need bigger vibros  
to offset loss of amplitude.

# Amplitude

Amplitude will decrease with increase of:



- Pile weight
- Soil resistance
- Weights, gears, shafts, hoses, motors
- Extra clamp attachments
- Anything that increases vibrating mass.

$$\text{Amplitude} = \frac{2 \times \text{EM}}{\text{VM}}$$

EM: Eccentric Moment

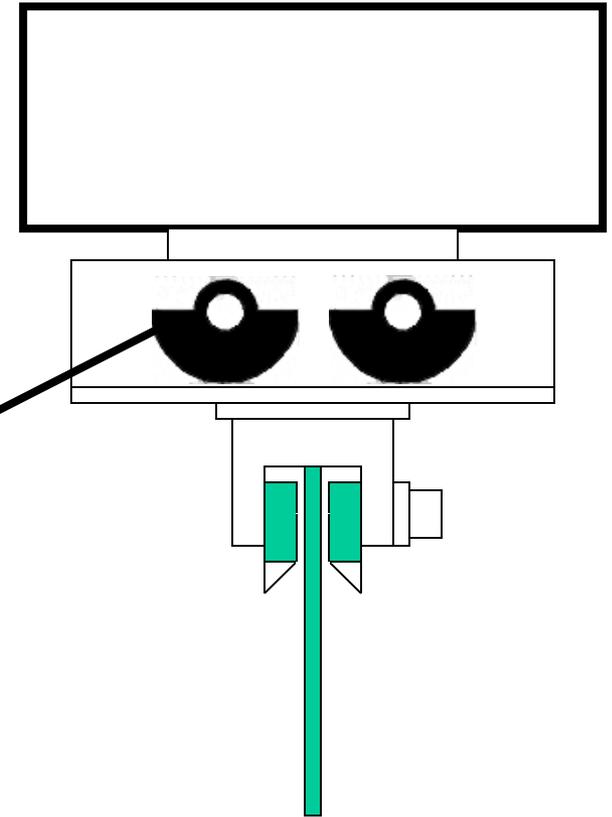
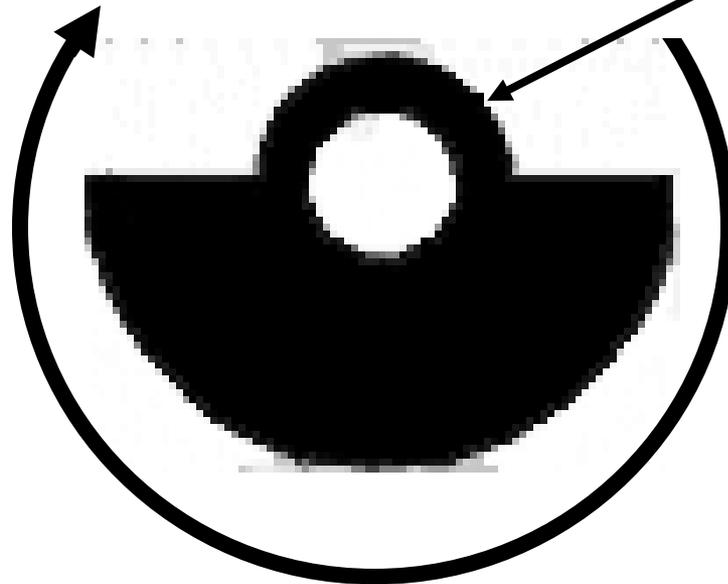
VM: Vibrating Mass

# VPM

# CPM

Frequency (Vibrations Per Minute) or (Cycles Per Minute)

Frequency is the rotational speed of the vibro eccentrics.



# Drive Force (Dynamic Force)

(Cycles per minute)

$$\text{Drive Force} = \frac{\text{Eccentric Moment} \times 0.0142 \times \text{Frequency squared}}{1,000,000}$$

## Example:

Moment: 4400 in-lb.

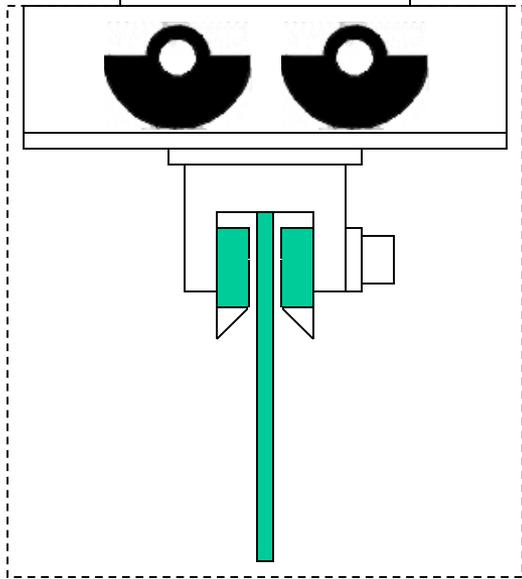
Frequency: 1600 Cycles per minute

$$\frac{4400 \times 0.0142 \times 1600 \times 1600}{1,000,000} = 159.94 \text{ Tons}$$

## Drive Force

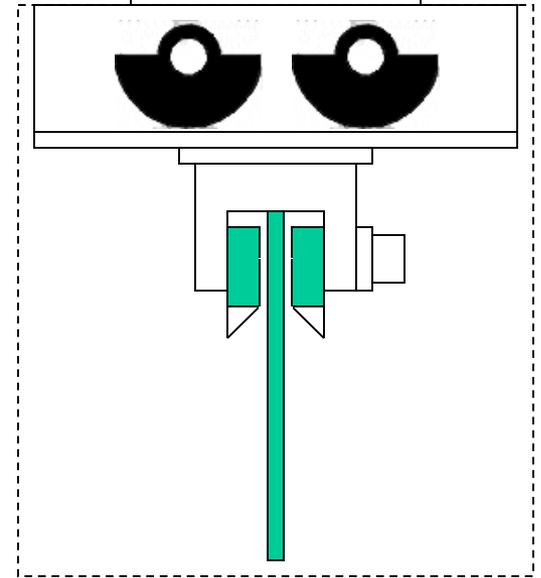
# How Frequency Matters

1100 cpm



4000 in-lb.

1600 cpm



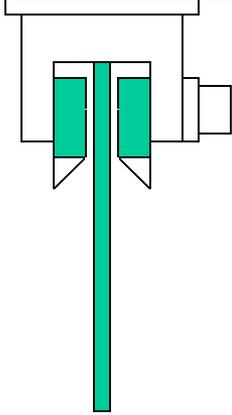
$$\frac{4400 \times 0.0142 \times 1100 \times 1100}{1,000,000} = 75 \text{ tons}$$

$$159.94 = \frac{4400 \times 0.0142 \times 1600 \times 1600}{1,000,000}$$

Higher frequency dramatically increases drive force because frequency is squared.

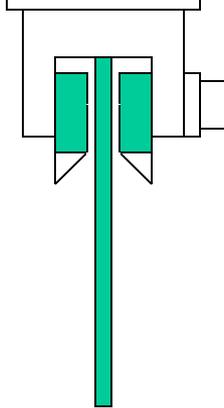
1100 cpm

5208 in-lbs



1600 cpm

4400 in-lbs



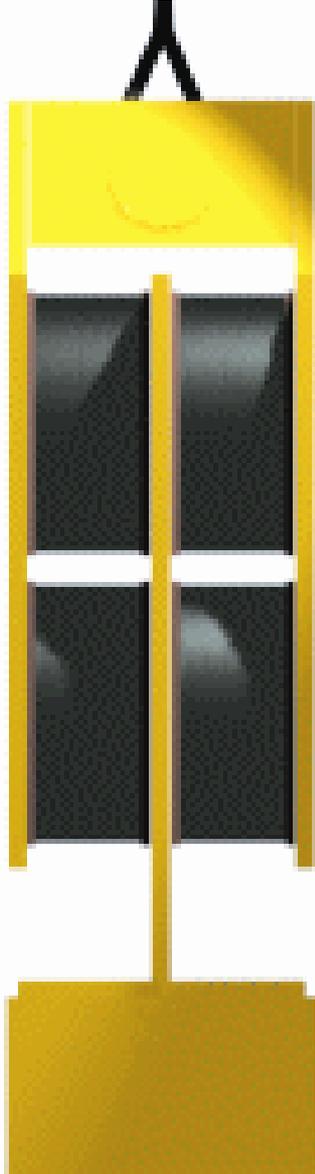
$$\frac{5208 \times 0.0142 \times 1100 \times 1100}{1,000,000} = 89 \text{ tons}$$

159.94 =

$$\frac{4400 \times 0.0142 \times 1600 \times 1600}{1,000,000}$$

# Understanding Vibro Suppressors

Old Technology



New Technology



**Much  
more  
capacity  
with no  
vibration  
to the  
crane  
line.**

# Centerline Clamp

A Centerline Clamp has two jaws that are controlled by giant gears to keep the pile always in the center. Used to drive or extract pipe, wood, or concrete piles. It is also used to extract concrete filled shell piles.



# Centerline Clamp Pulling Concrete



# Extracting Concrete Piles





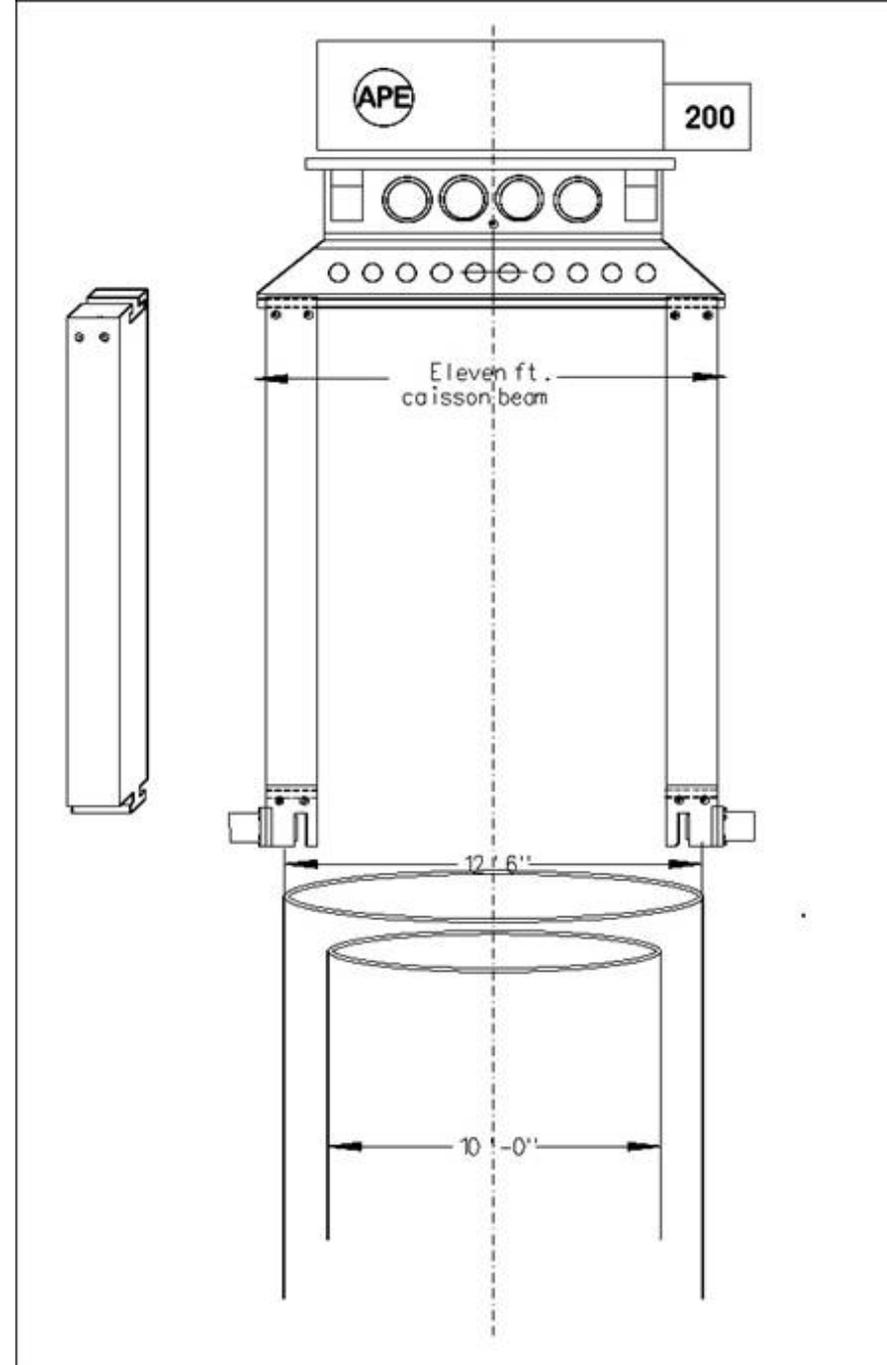
# 90 degree plate



# Clamp Extension



Extending caisson  
clamps down to  
clear rebar cage.

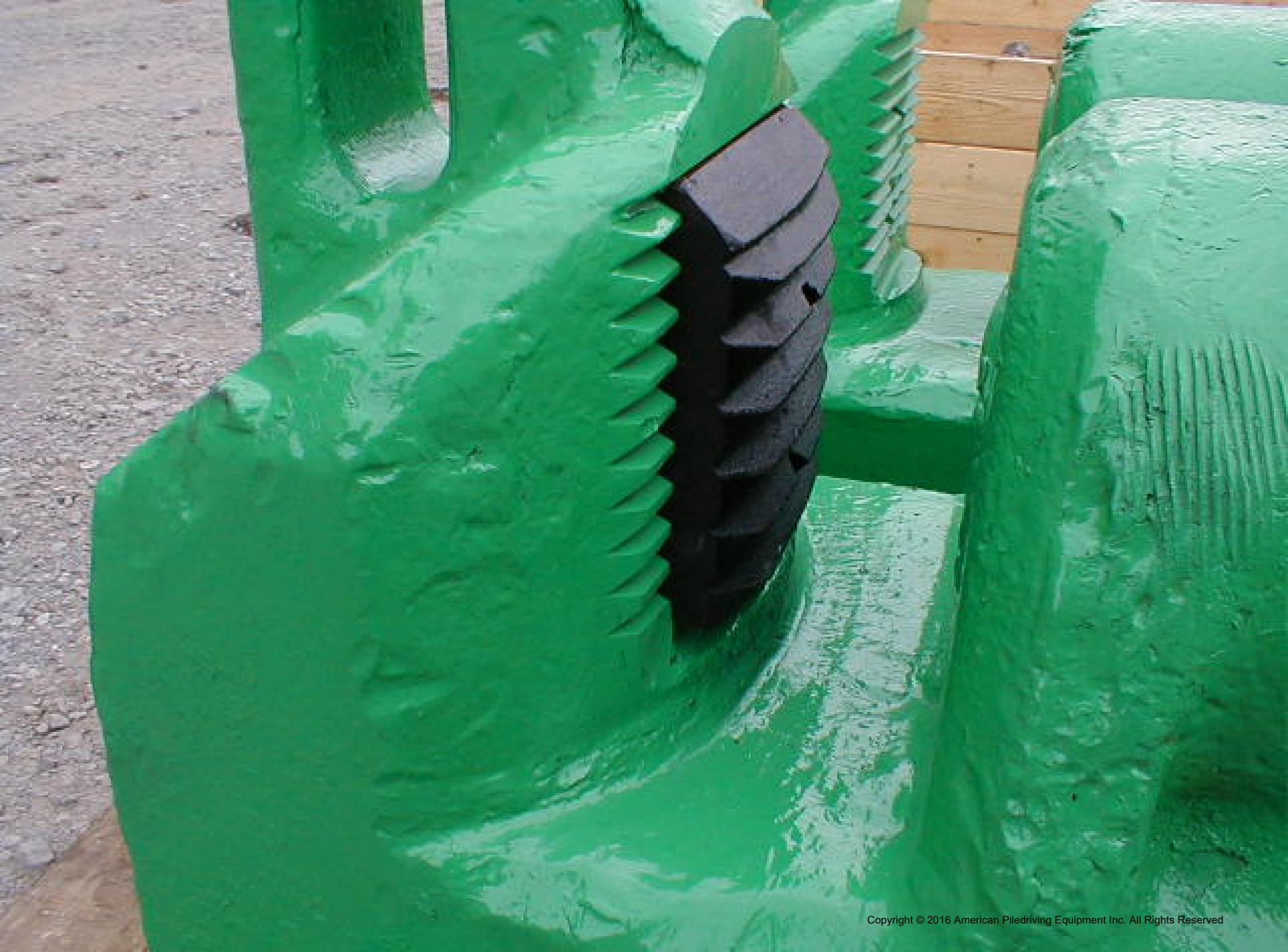














**Dual guiding, full six inch slide, check valve clamp, easy to read**



# Understanding the Power Unit.



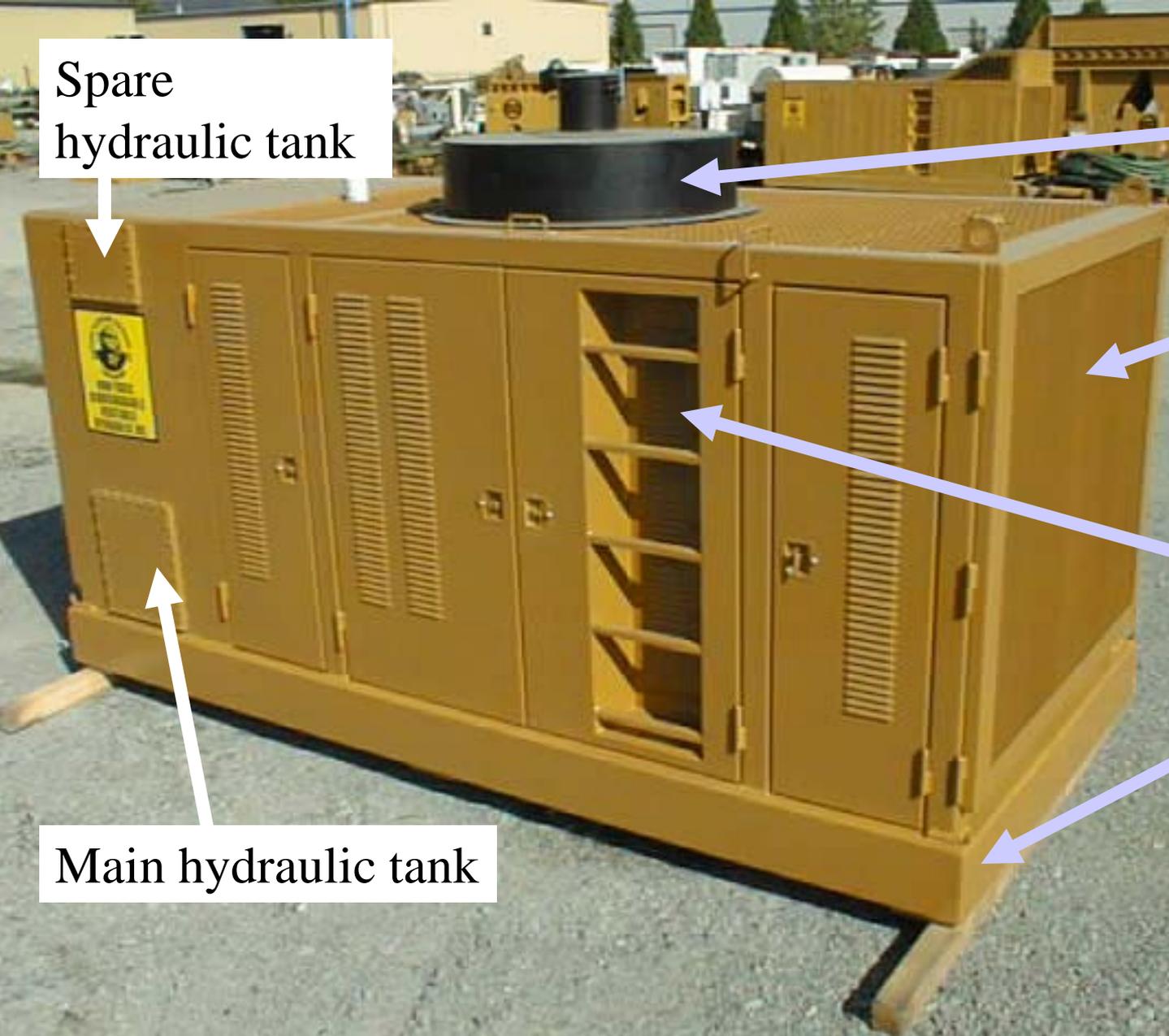
Skid

Quick disconnects

Hydraulic tank

Inspection cover

Power Unit view on quick disconnect side.



Spare hydraulic tank

Muffler

Oil cooler guard

Ladder

Diesel fuel tank

Main hydraulic tank

View of power unit from ladder side.

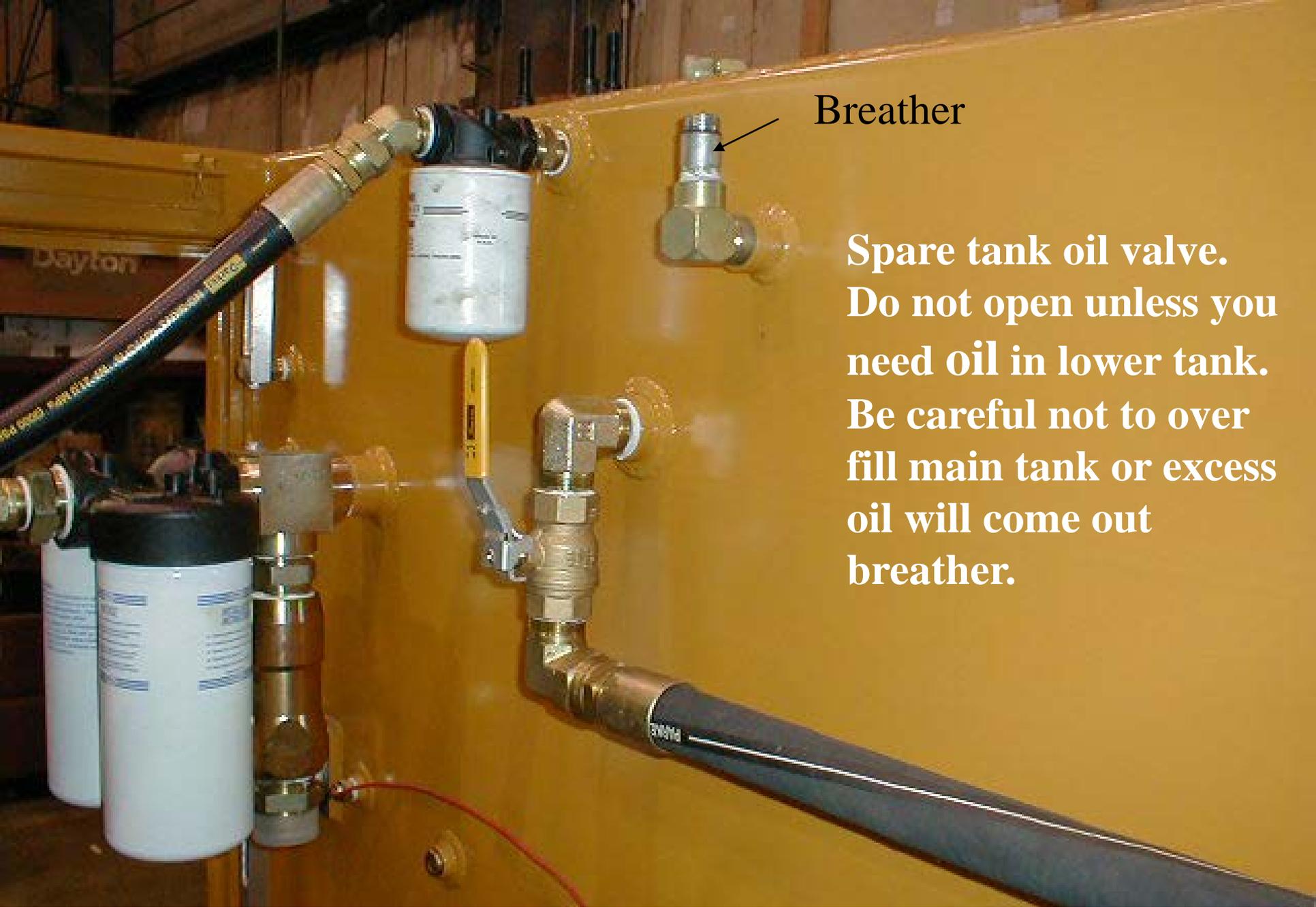
Spare tank site glass

Filter

Main tank site glass



View of hydraulic tank level gauges and return filter.

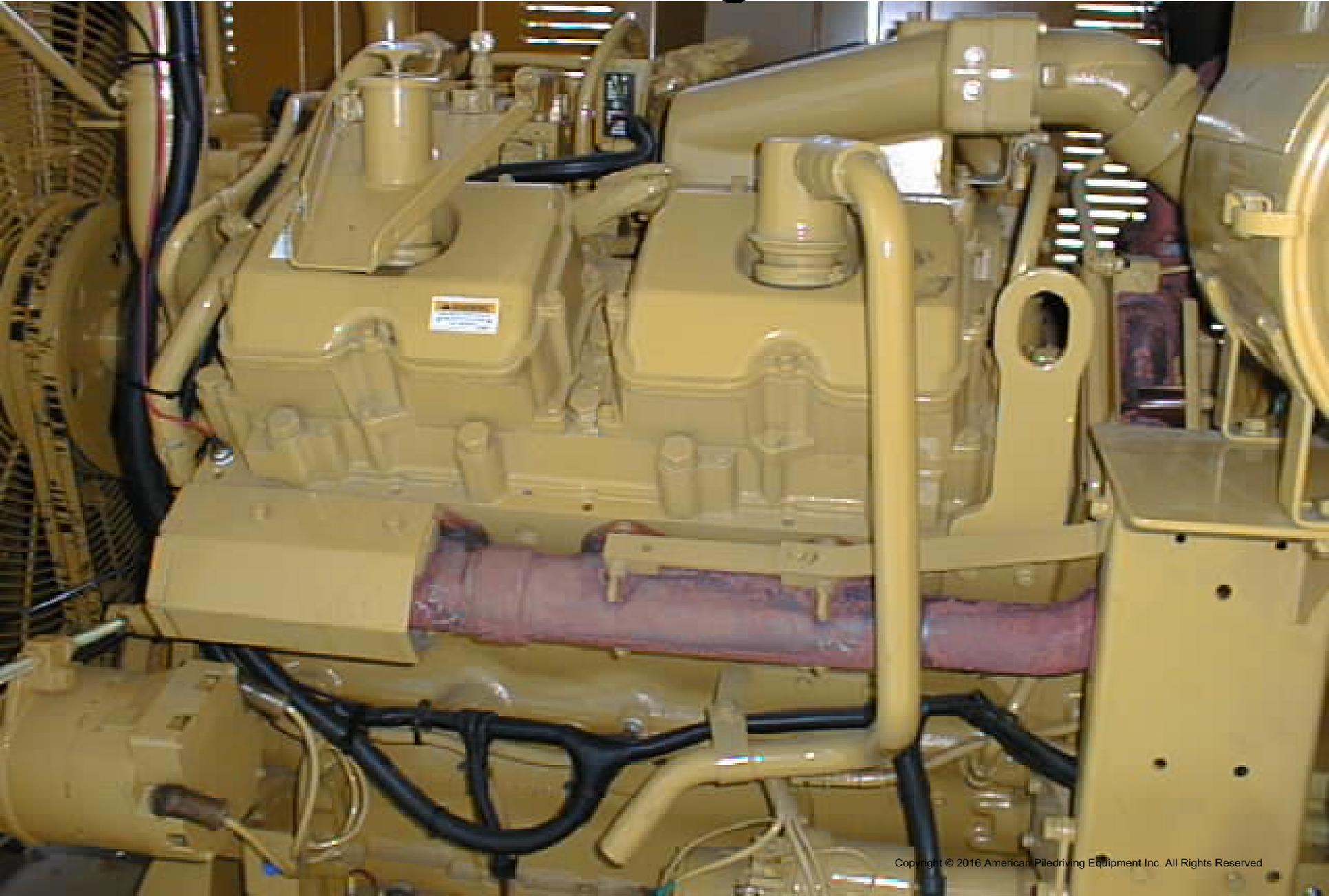


Breather

**Spare tank oil valve.  
Do not open unless you  
need oil in lower tank.  
Be careful not to over  
fill main tank or excess  
oil will come out  
breather.**

**Spare tank 1/4 turn valve.**

# CAT Engine



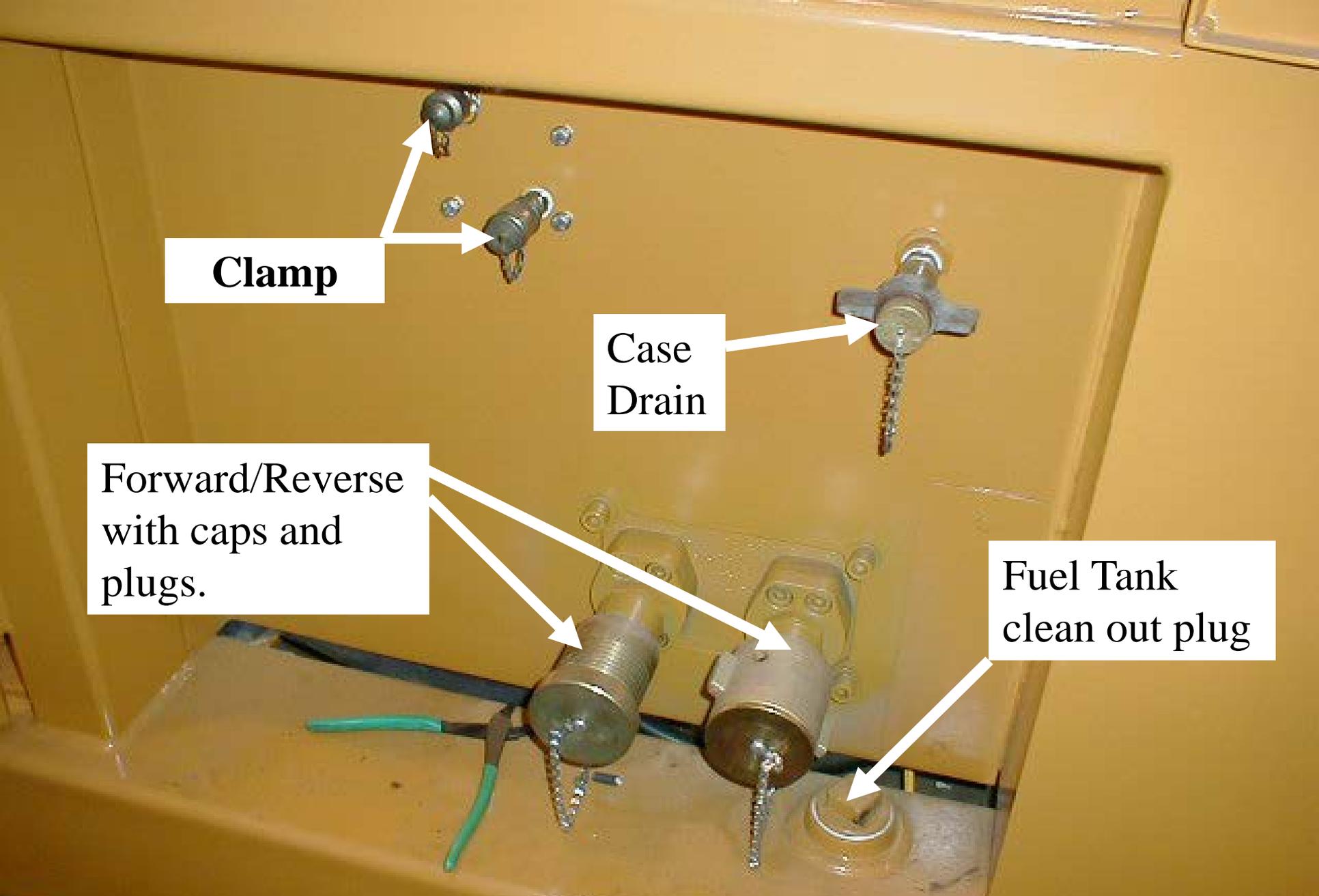


# Float switch





# Quick disconnects



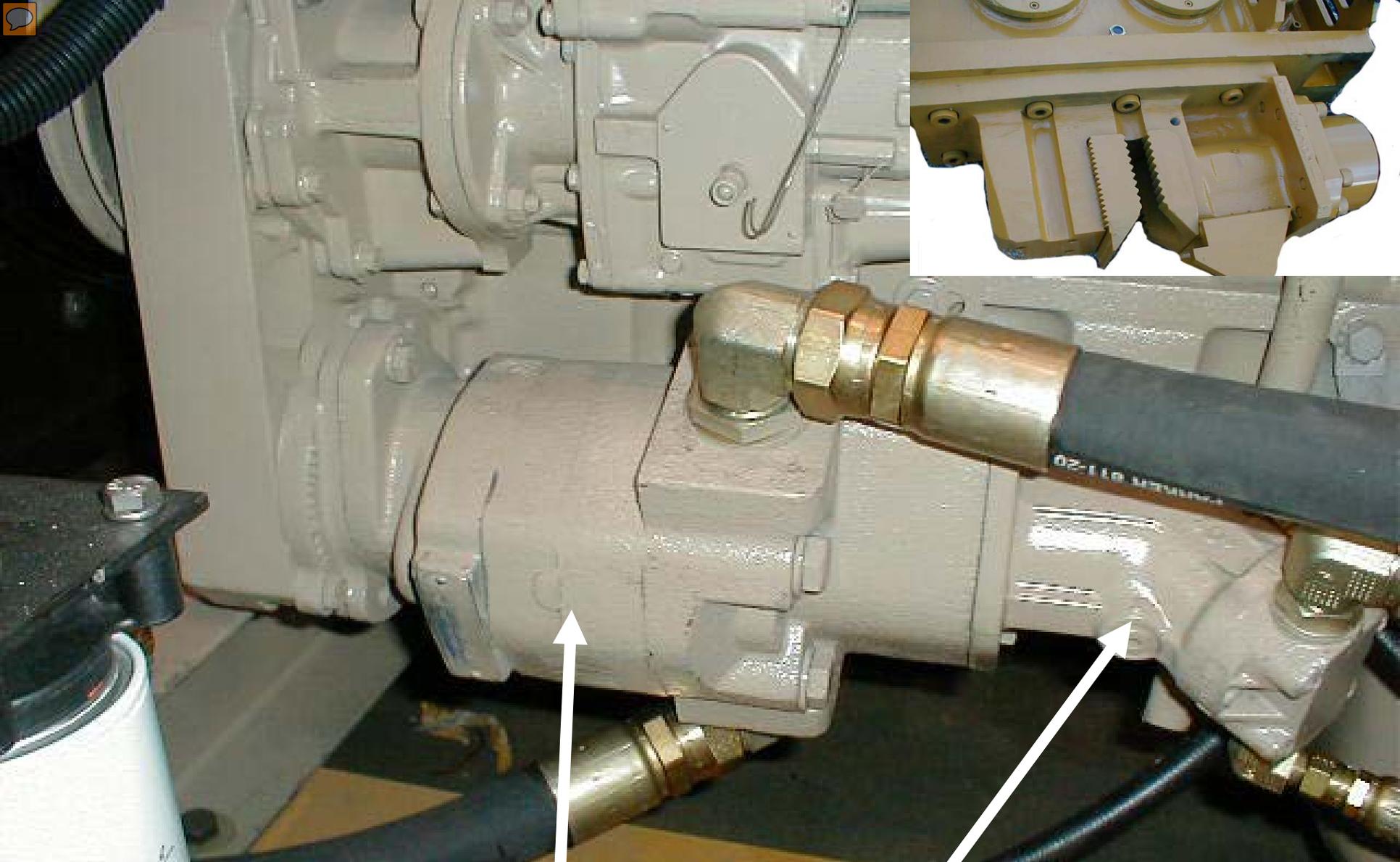
**Clamp**

**Case  
Drain**

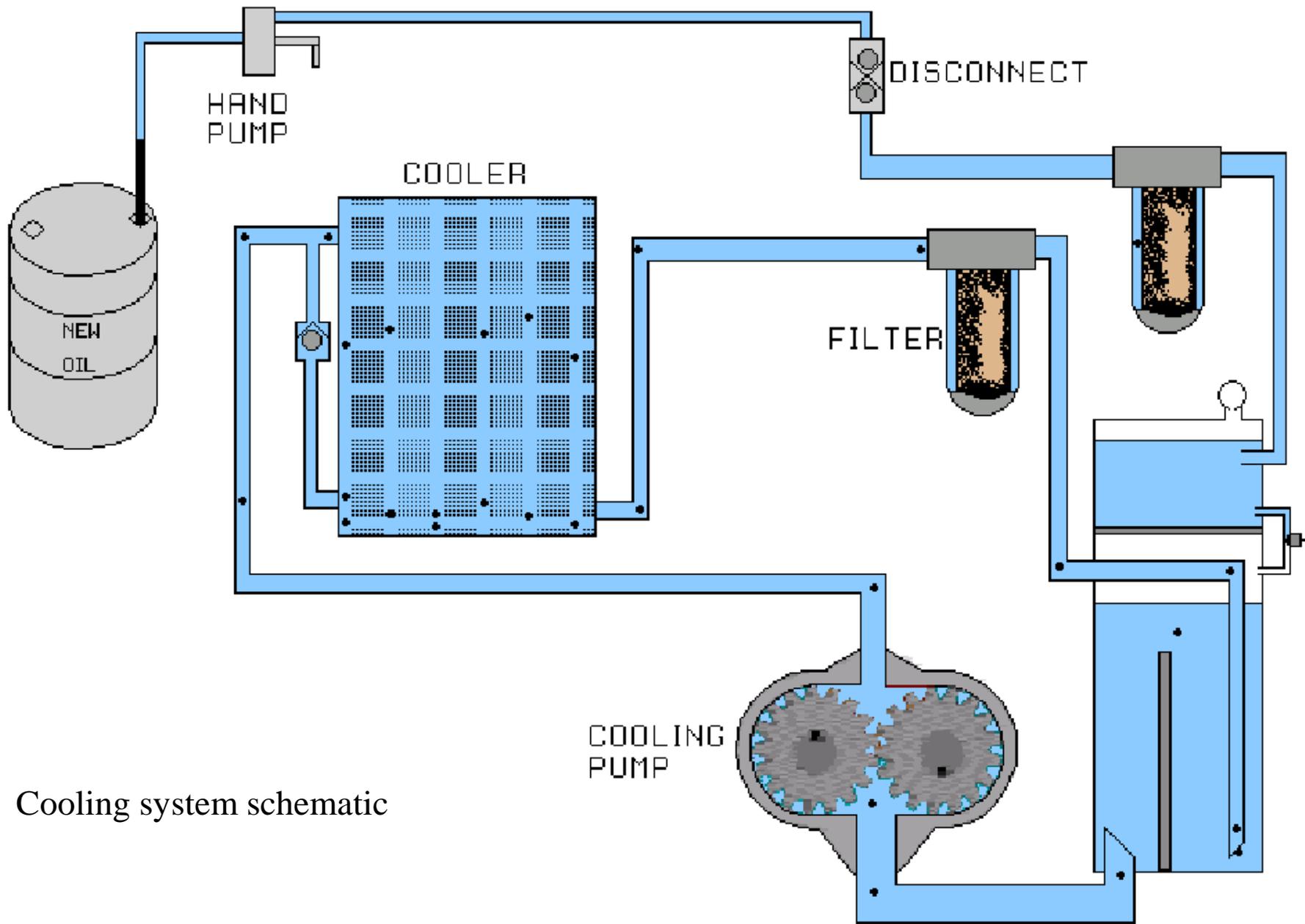
**Forward/Reverse  
with caps and  
plugs.**

**Fuel Tank  
clean out plug**

# Quick disconnects



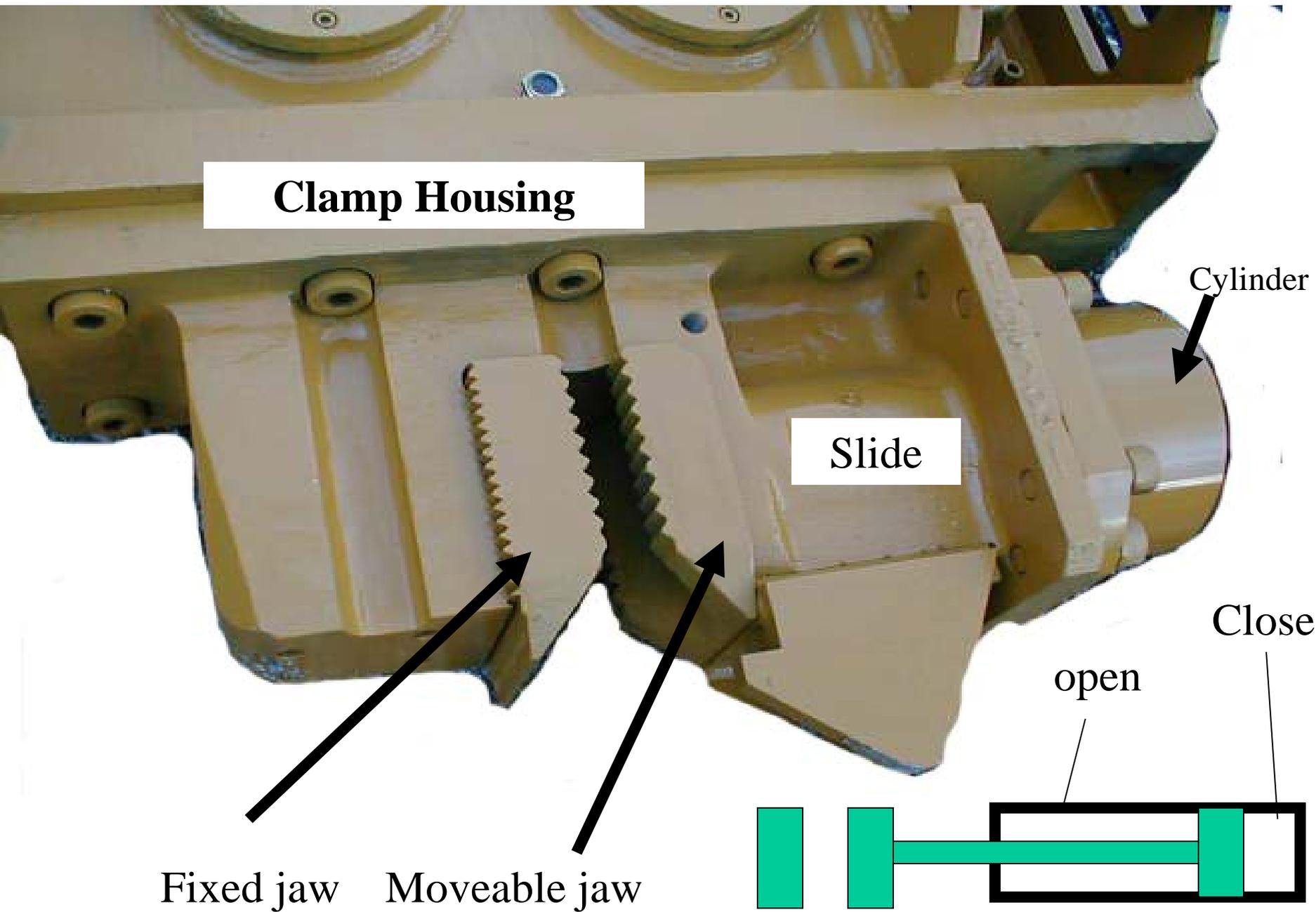
Cooling pump with piggy back clamp pump.



Cooling system schematic



# View of clamp and its components



**Clamp Housing**

**Slide**

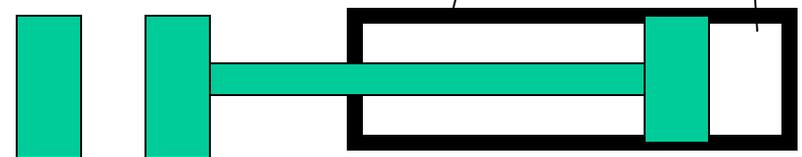
**Cylinder**

**Close**

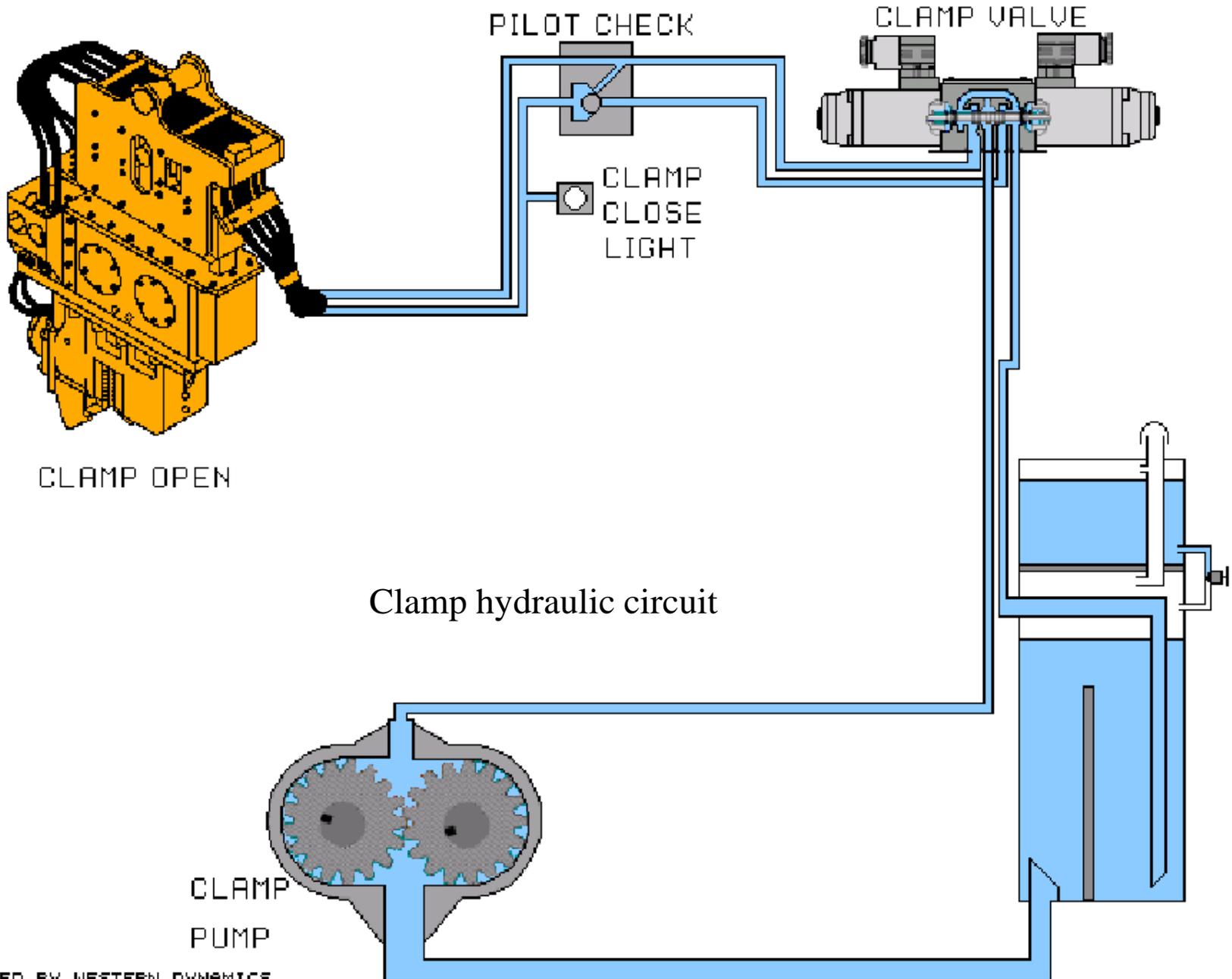
**open**

**Fixed jaw**

**Moveable jaw**



**Cylinder**



CLAMP OPEN

Clamp hydraulic circuit

CLAMP  
PUMP

PILOT CHECK

CLAMP VALVE

CLAMP  
CLOSE  
LIGHT



Clamp disconnects with caps and plugs attached.

# Clamp manifold

Solenoid Valve

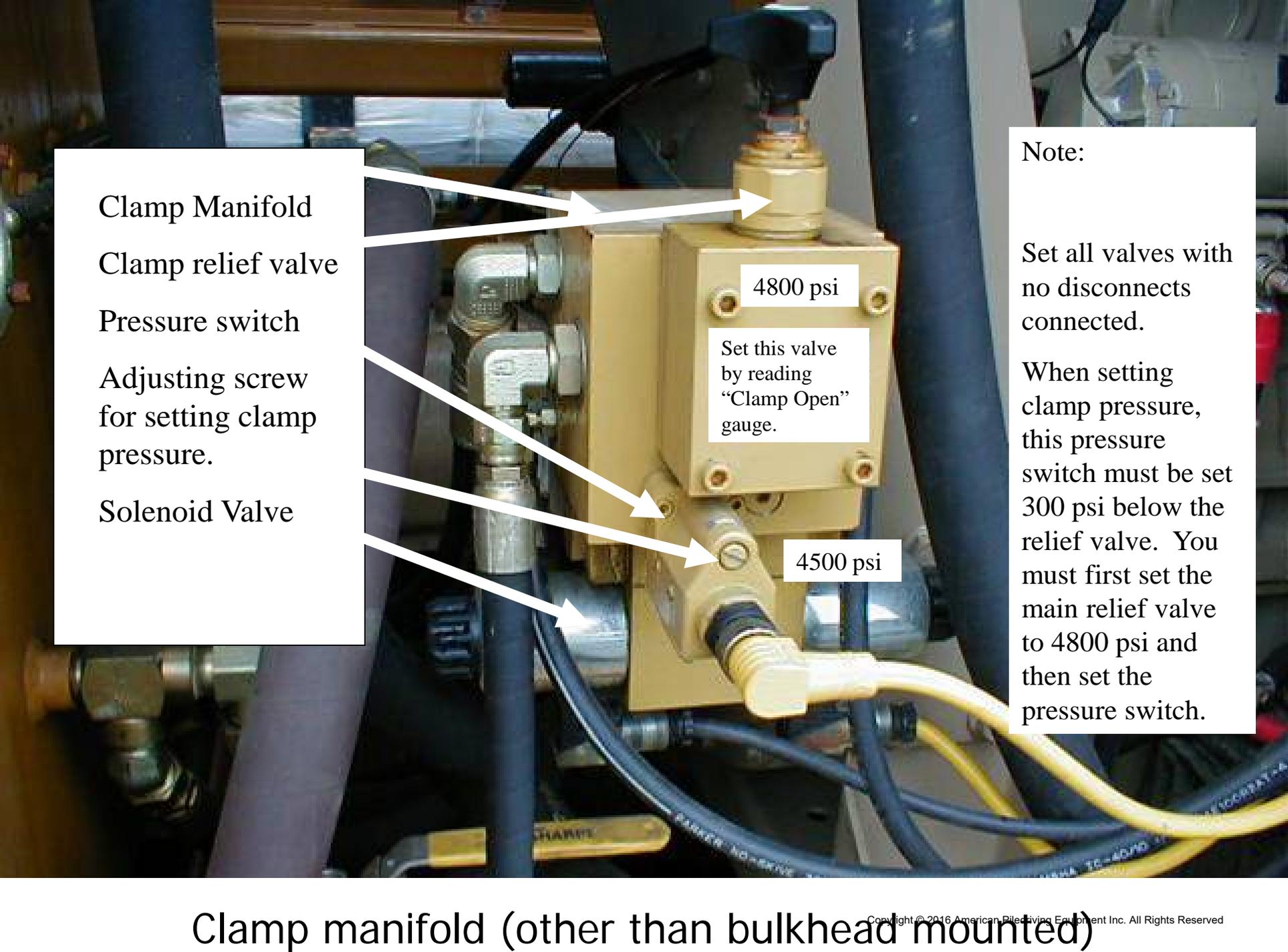
Safety Check

Pressure Switch

Note: Turn slot with screw driver to adjust.

For driving wood piles or other soft piles like concrete, you may need to lower the pressure.

Clamp Manifold  
Clamp open gauge hose  
Clamp close gauge hose  
Main Clamp Relief Valve  
To adjust, loosen lock nut and turn "in" to increase relief pressure or turn "out" to decrease pressure.  
Note: Normal setting is 4800.



Clamp Manifold

Clamp relief valve

Pressure switch

Adjusting screw  
for setting clamp  
pressure.

Solenoid Valve

Note:

Set all valves with  
no disconnects  
connected.

When setting  
clamp pressure,  
this pressure  
switch must be set  
300 psi below the  
relief valve. You  
must first set the  
main relief valve  
to 4800 psi and  
then set the  
pressure switch.

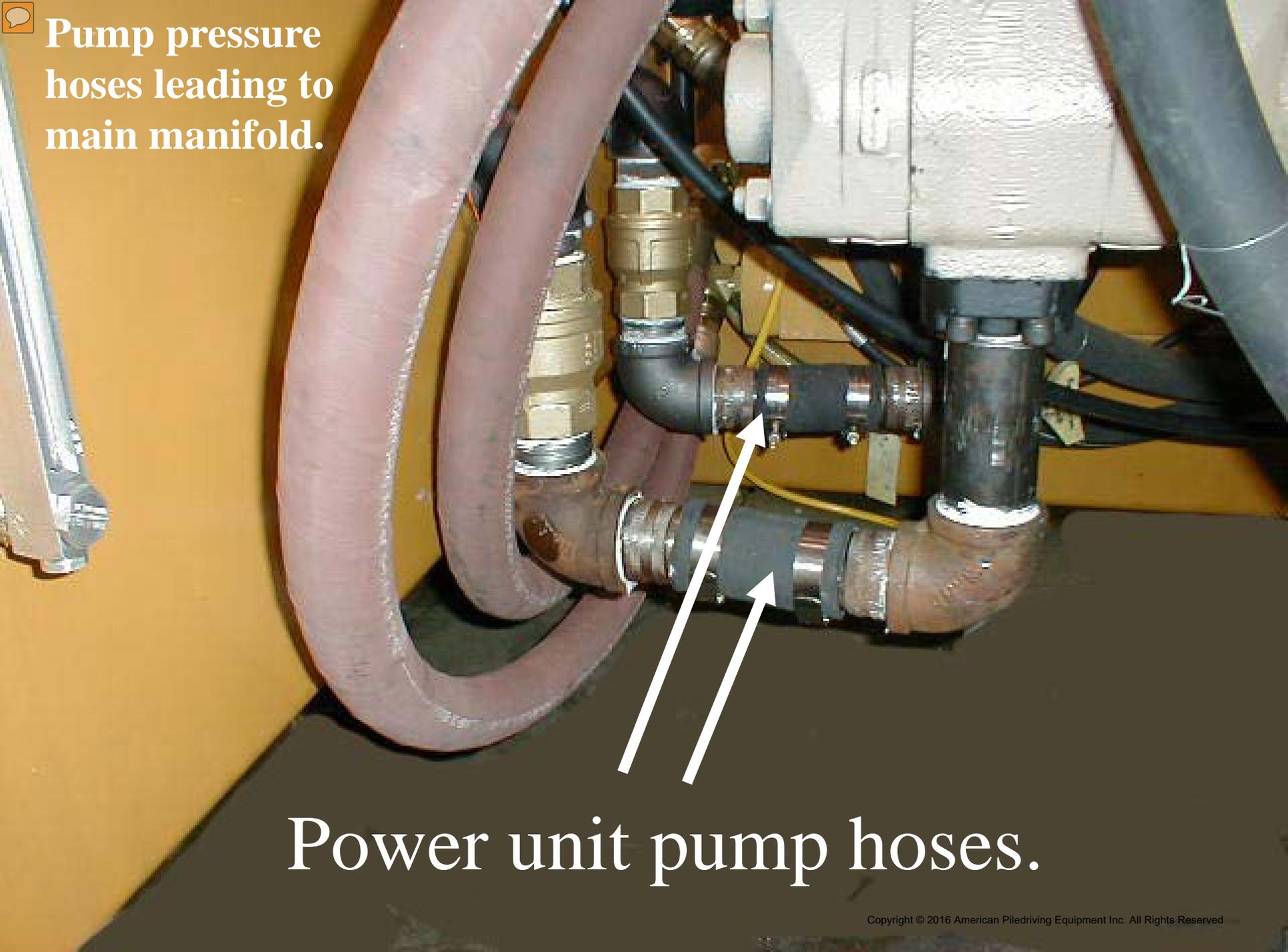
4800 psi

Set this valve  
by reading  
"Clamp Open"  
gauge.

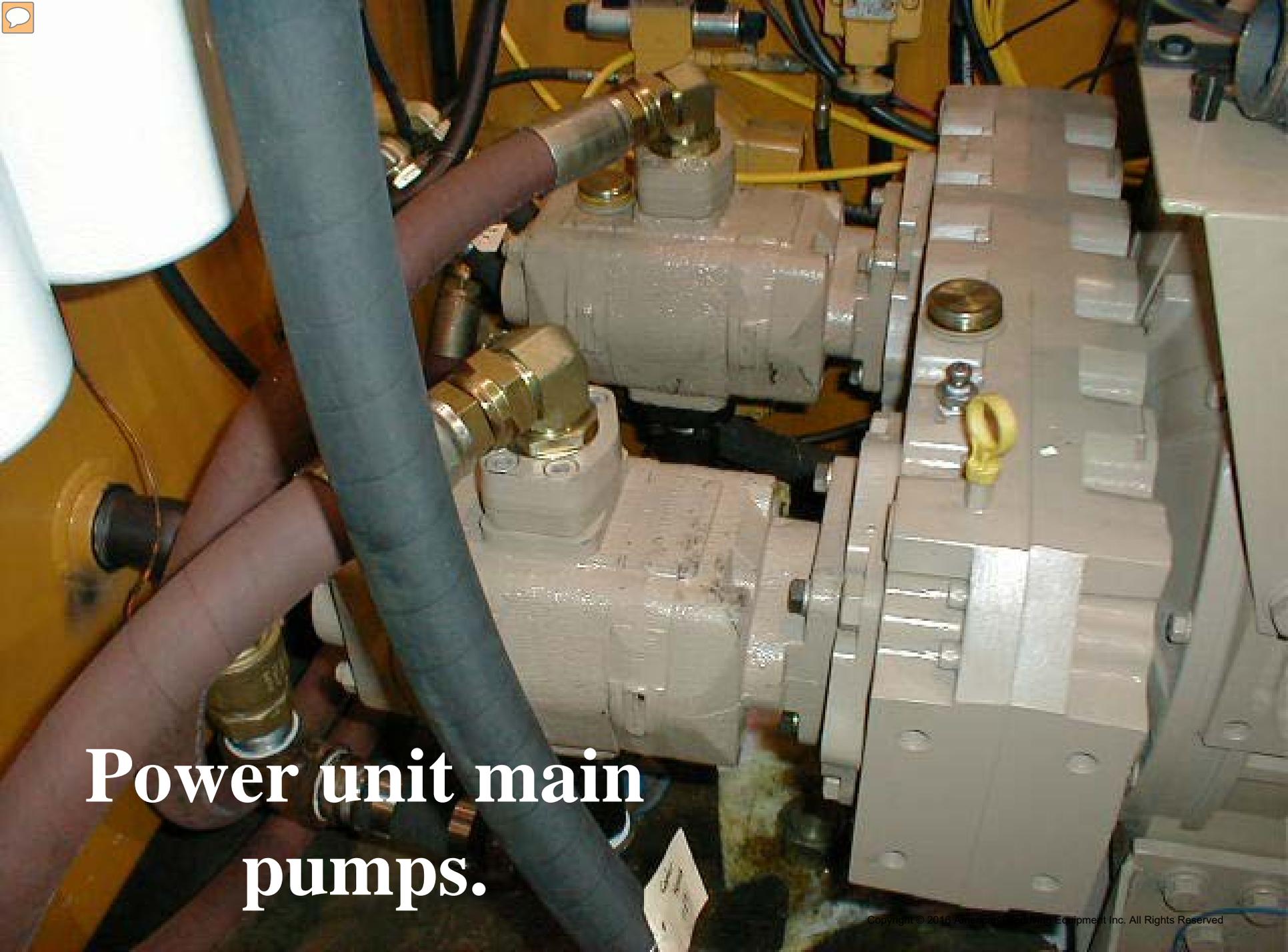
4500 psi

Clamp manifold (other than bulkhead mounted)

 Pump pressure hoses leading to main manifold.

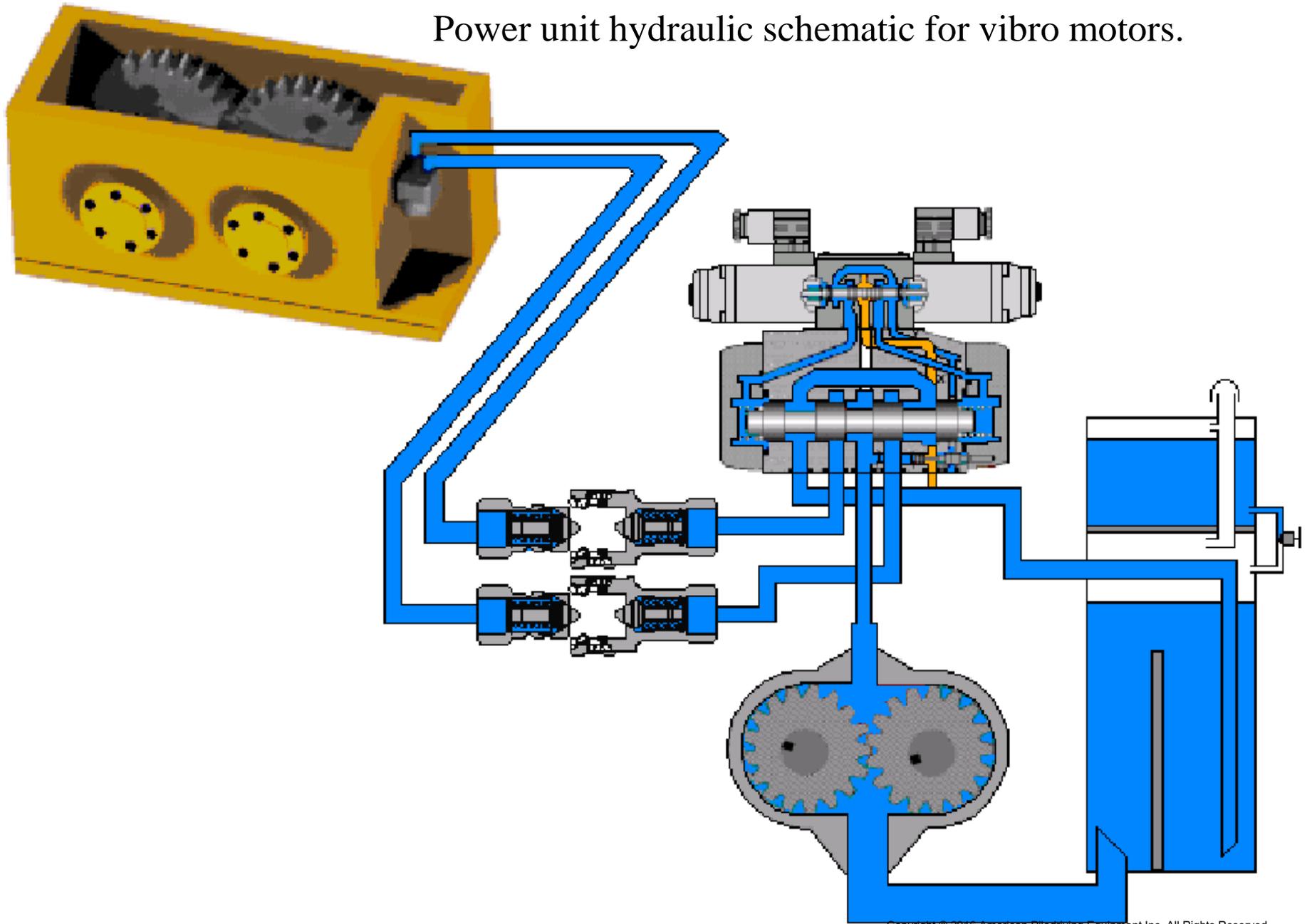


Power unit pump hoses.



**Power unit main  
pumps.**

Power unit hydraulic schematic for vibro motors.



PILOT CHECK

CLAMP VALVE

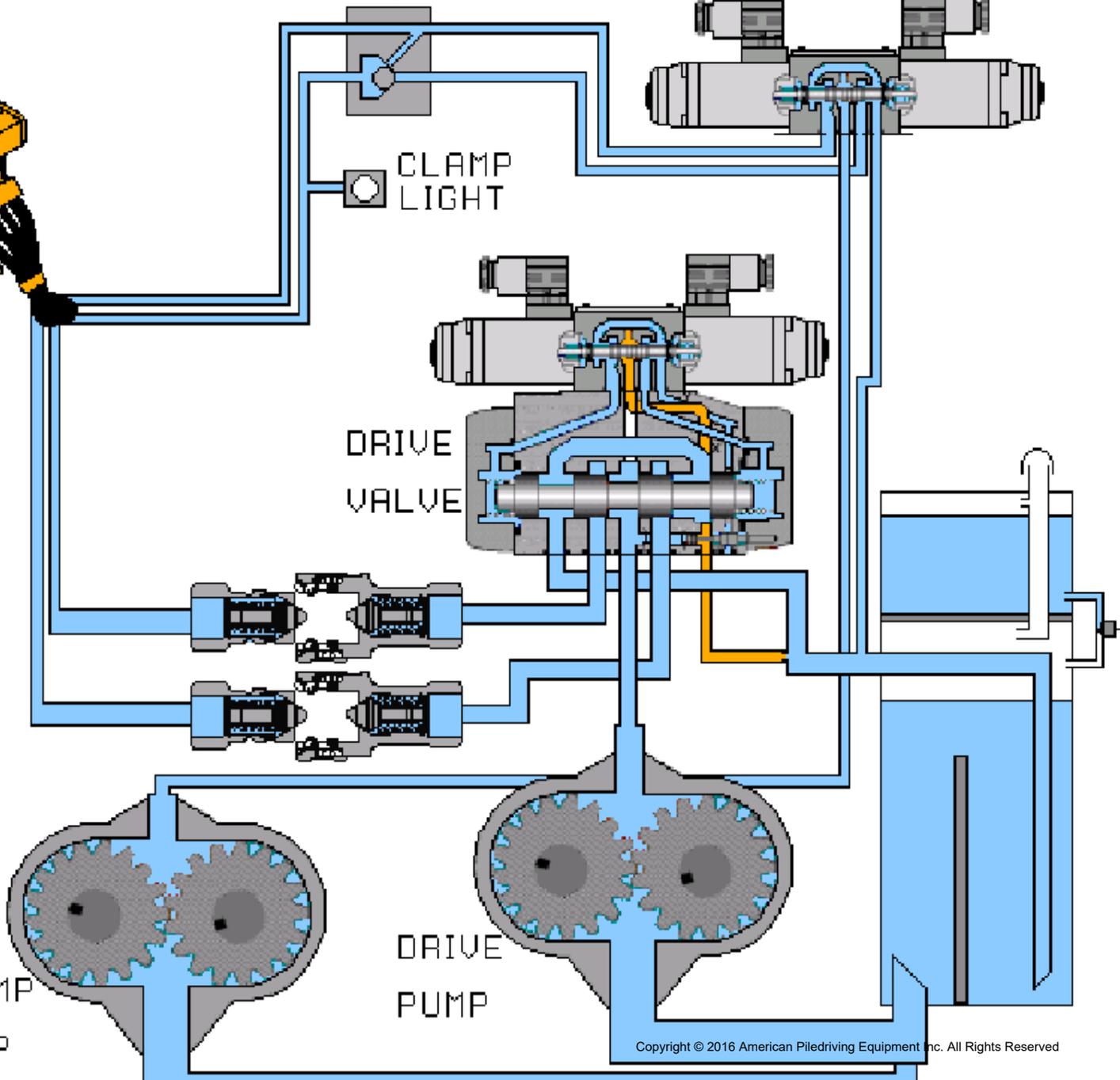
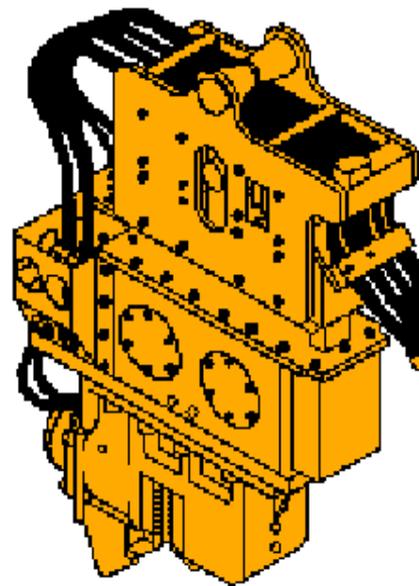
CLAMP LIGHT

DRIVE VALVE

DRIVE PUMP

CLAMP PUMP

Clamp and Drive animation.



# Main drive forward and reverse QD's



# Case Drain QD





Control panel showing how power cables for solenoids can be removed quickly.



# Controls for power unit



Emergency stop

Vibro start/stop/reverse

Clamp open/close/off

Engine throttle



Stop

Engine throttle

Clamp open/off/close

Drive forward/reverse

# Remote pendant control box



HOURMETER

OIL PRESS   COOLANT TEMP   HYD LEVEL   HYD TEMP

DIAGNOSTIC

STARTING INSTRUCTIONS



VOLT METER

**OPERATOR'S MANUAL**  
**OPERATIONAL INSTRUCTIONS**

- GENERAL**
  - Preventive measures will help eliminate costly downtime. Please read manual.
- DAILY MAINTENANCE**
  - Check all bolts and nuts.
  - Release clamps in driving head.
  - Always work up and down before and after working.
  - Check all hoses and fittings.
- START UP PROCEDURE**
  - Set throttle as low as possible.
  - Adjust head position and oil pressure is set.
  - Start switch starts engine.
  - Clamp and adjust in forward position.
- LUBRICATION**
  - Oil - Diesel - Multi GRADE Synthetic.
  - Diesel Engine - 15W/40
  - Hydraulic Oil - Mobil EAL 324 Big Breakdown.

Before operation - It is critical to tighten all nuts.  
 Disconnect P.E.L.T.  
 200-998-000



OIL PRESSURE



WATER TEMPERATURE

CLAMP  
 OPEN   CLOSE

SYSTEM OK

GOVERNOR  
 RAISE   LOWER

CIRCUIT BREAKER

DRIVE  
 REV   OFF   FWD

LOCAL   PENDANT

ENGINE FAULT  
 PUSH TO RESET

ENGINE RUN START  
 OFF   RUN   START

# Control panel

# Shut down warning indicators





**HOURMETER**

# Engine Hour Meter



# Hour Meter

# Volt Meter



VOLT METER

Reads water temp and is also shut down switch.

Adjust here.



**WATER TEMPERATURE**

Pops out when  
something is  
wrong.

CIRCUIT  
BREAKER

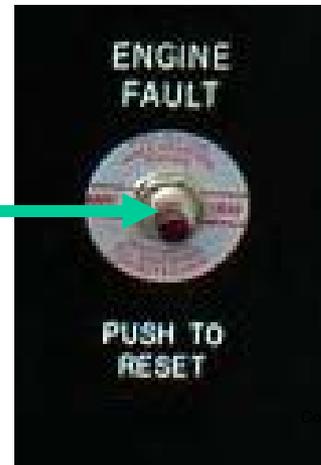


Starts diesel engine.

You must hold in the fault switch to override the engine oil pressure switch until oil pressure is reached.



Push and hold until oil pressure is normal, then let go.





**You must push this button in and then watch oil pressure gauge until it goes up past switch setting**

Engine Oil Pressure Gauge is also a switch that is adjustable with a small Allen wrench.



**GOVERNOR**

**RAISE**

**LOWER**



Controls  
engine  
RPM

LOCAL PENDANT



## Local/Pendant Switch

Turn to *“pendant”* when you are using the 50 foot hand held pendant.  
Switch to *“local”* if you are going to run the power unit off the control panel.

**Turn to forward to  
vibrate.**

**Turn to reverse if you  
are using a drill.**

Note: Do not use reverse at  
any time to run the vibro.  
Vibro drives and extracts in  
forward position only!





Turn to “open” to open jaws.

Turn to “close” to close jaws. Keep on “close” and make sure light comes on.



Switch is also a light. Light comes on when jaw pressure raises high enough to engage the pressure switch.

# Understanding power unit gauges





Hydraulic oil temp gauge and switch. Switch shuts engine down when oil temp passes setting. Set the maximum temp using a small allen wrench. Usually set at about 190 degrees.



CLAMP CLOSE

Clamp Close gauge reads hydraulic pressure on the clamp jaws.



Clamp open reads the actual relief valve setting on the clamp manifold. You are reading the safety relief valve setting.

**Note:** This is not the valve you change if you are wishing to lower pressure on the clamp. Use the pressure switch for that. This gauge reads your pressure setting and it should be at 4800 pounds per square inch.

**Note:** Always check this first. With clamp lines disconnected, turn the clamp switch and hold it to open and read the gauge. It should be at 4800 psi.



# Drive Forward/ Reverse

Drive forward is used to turn the vibro eccentrics. Turn to forward for driving and extracting. Note: Only use the reverse when the power unit is operating a drill and you need to reverse the rotation of that drill. Vibro will not work in reverse.



Hydraulic oil filter gauge tells you if the oil filter needs changing.

Change filter if you pass 50 pounds per square inch. Note: May read high if oil is cold. Wait until oil is 100 degrees.

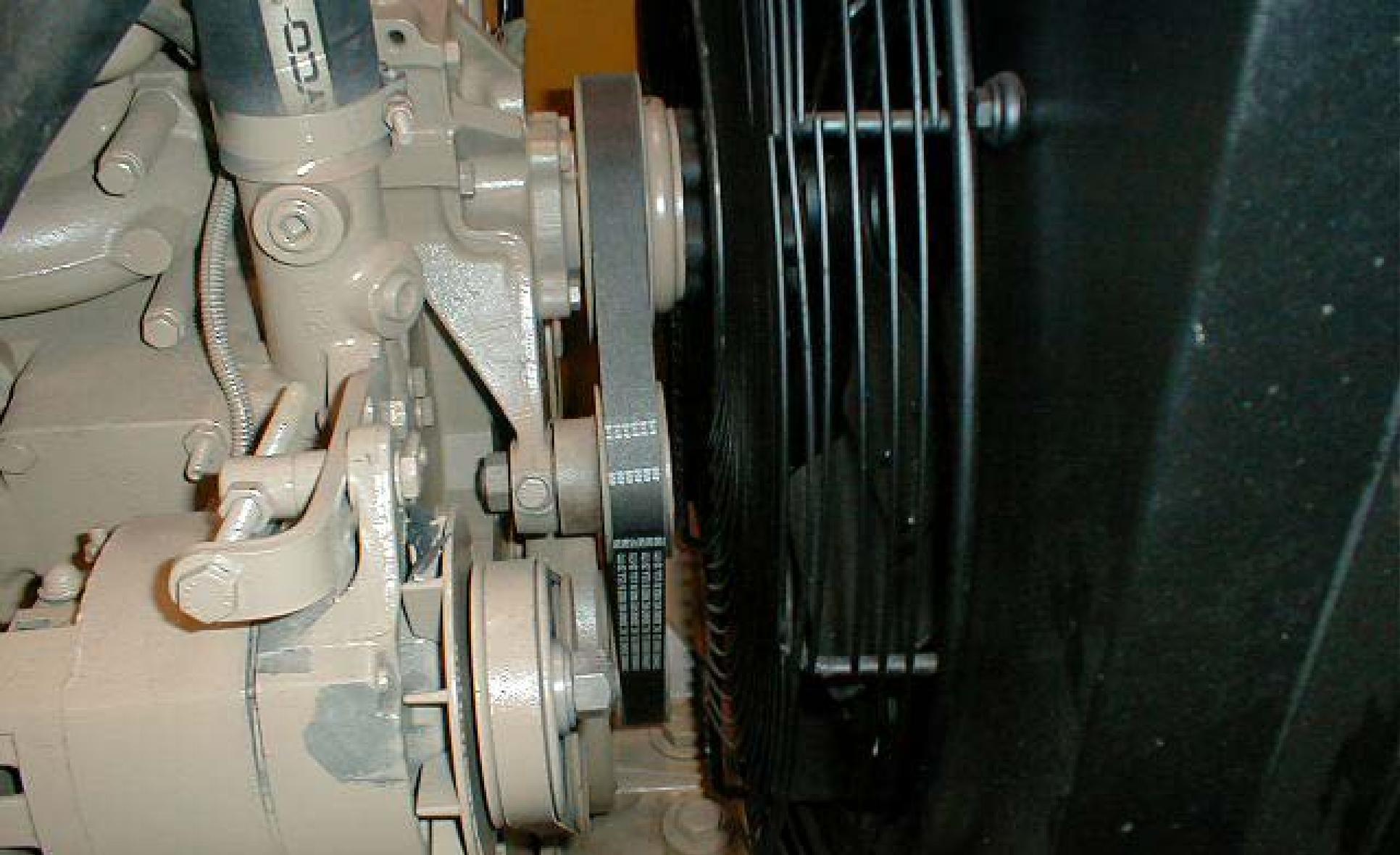
# Things to do before starting the engine

# Radiator Cap - Check level.





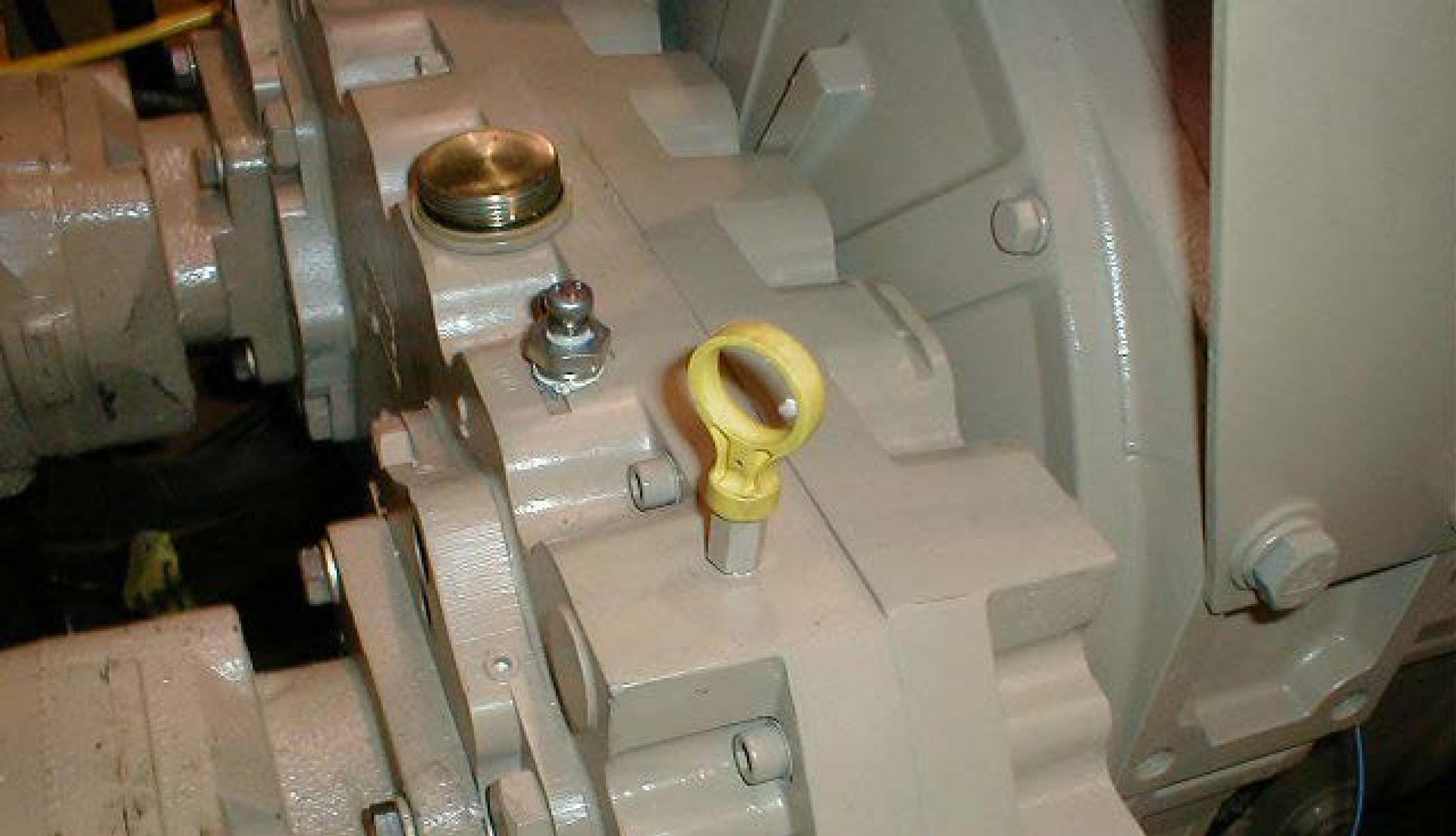
Check engine oil level



Check V-belts



Check hydraulic oil level



Check pump drive gear box oil level



Check diesel fuel level



To Start:

Push and hold while turning the start switch. Holding the fault button overrides the engine oil pressure shut down switch. Once oil pressure is reached, you can let go of the button.

LOCAL PENDANT



## Local/Pendant Switch

Turn to “pendant” when you are using the 50 foot hand held pendant.  
Switch to “local” if you are going to run the power unit off the control panel.

Unit will not start  
if drive forward  
switch is turned  
on.



# Controls for power unit



Emergency stop

Vibro start/stop/reverse

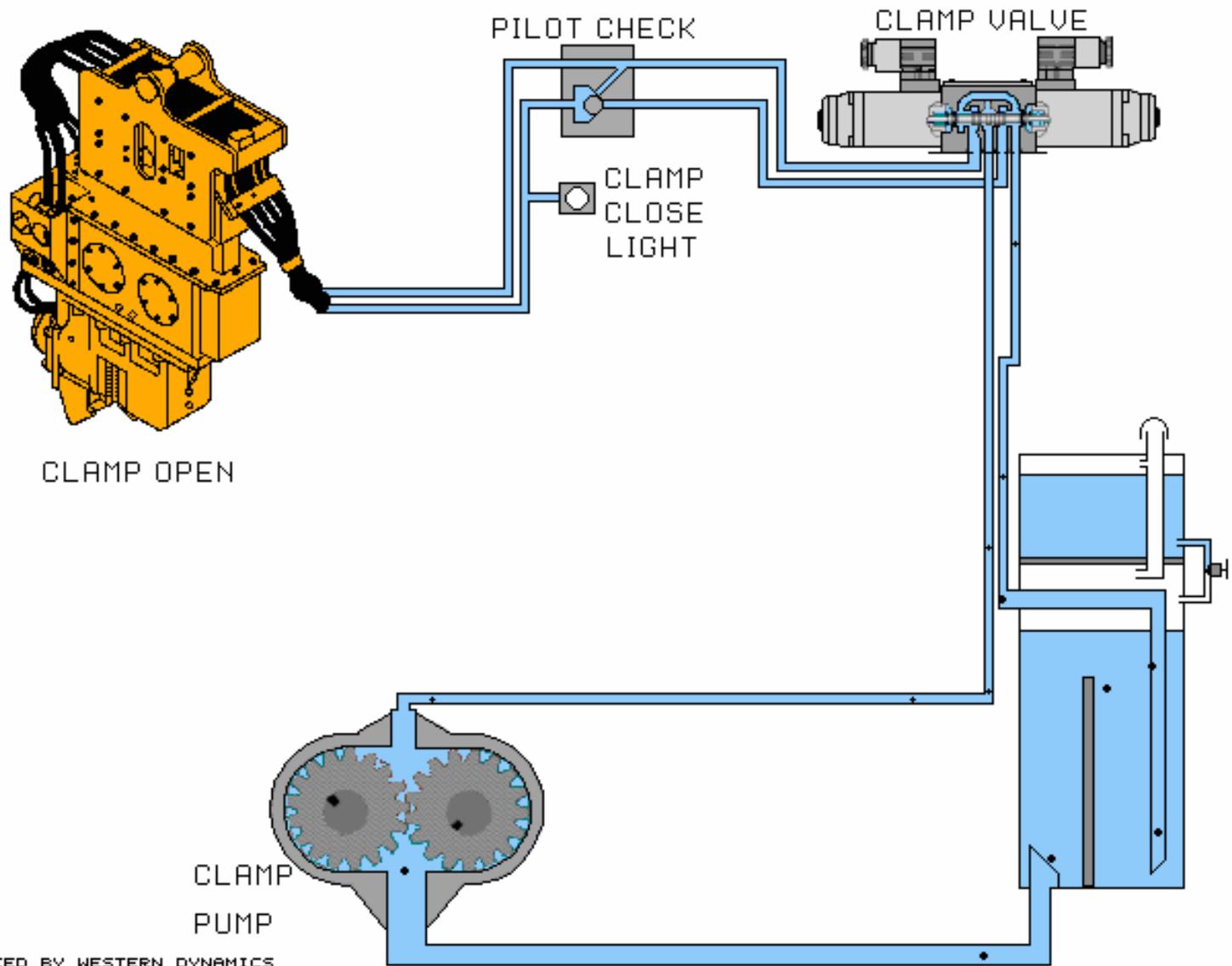
Clamp open/close/off

Engine throttle

# Control panel on power unit



Same controls as on hand held pendant serve as back up controls if hand held pendant is damaged. Gauges show all pressures.



CLAMP OPEN

PILOT CHECK

CLAMP VALVE

CLAMP  
CLOSE  
LIGHT

CLAMP  
PUMP

PRODUCED BY WESTERN DYNAMICS

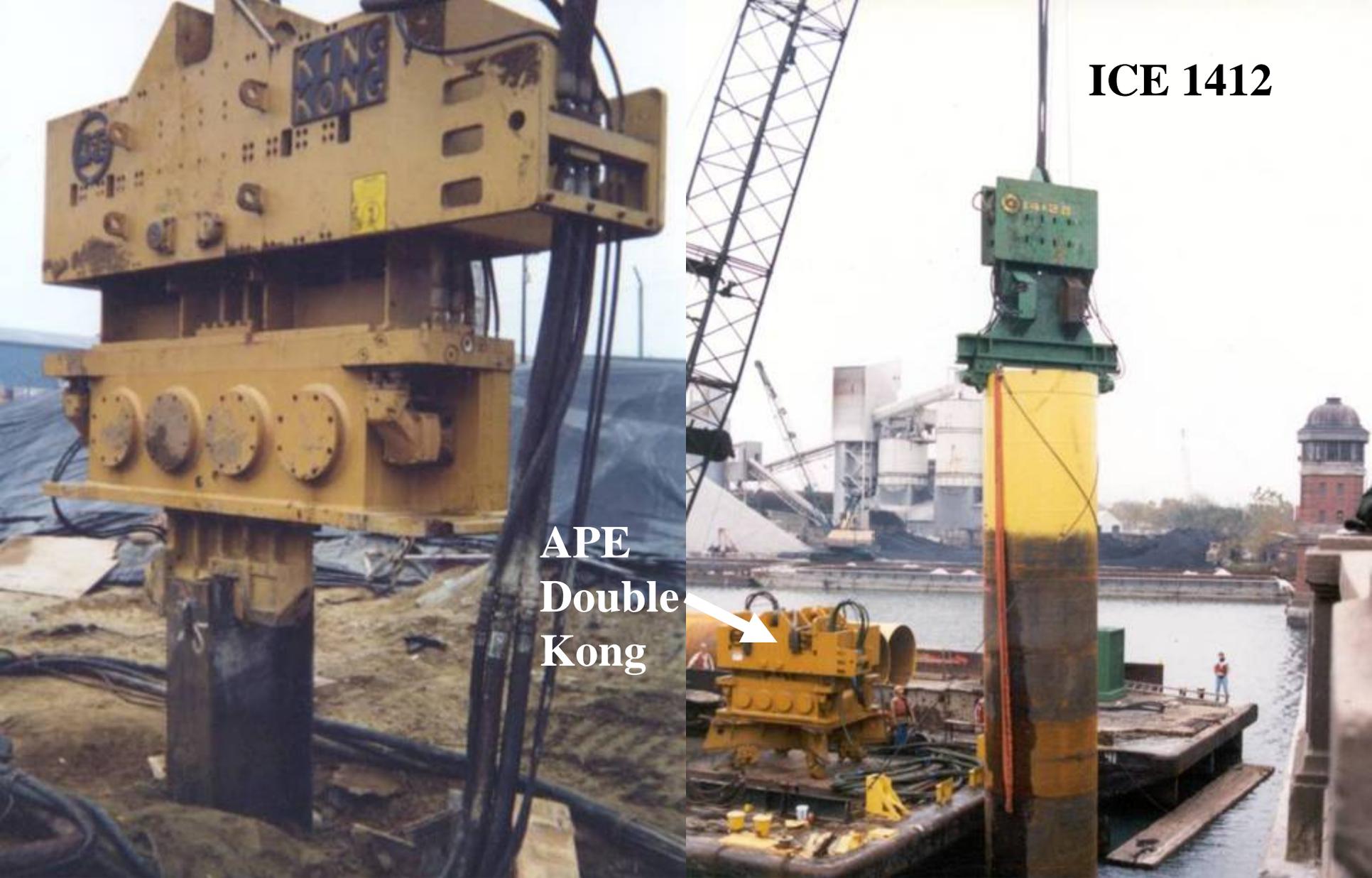


*Vibro in action*

# Vibros in action



**ICE 1412**



**APE  
Double  
Kong**

**Vibros in action**



# Vibros in action



**Vibros in action** Copyright © 2016 American Piledriving Equipment Inc. All Rights Reserved



# Vibros in action



**Tandem vibro with tandem power units**



Clamp attachments- two clamps



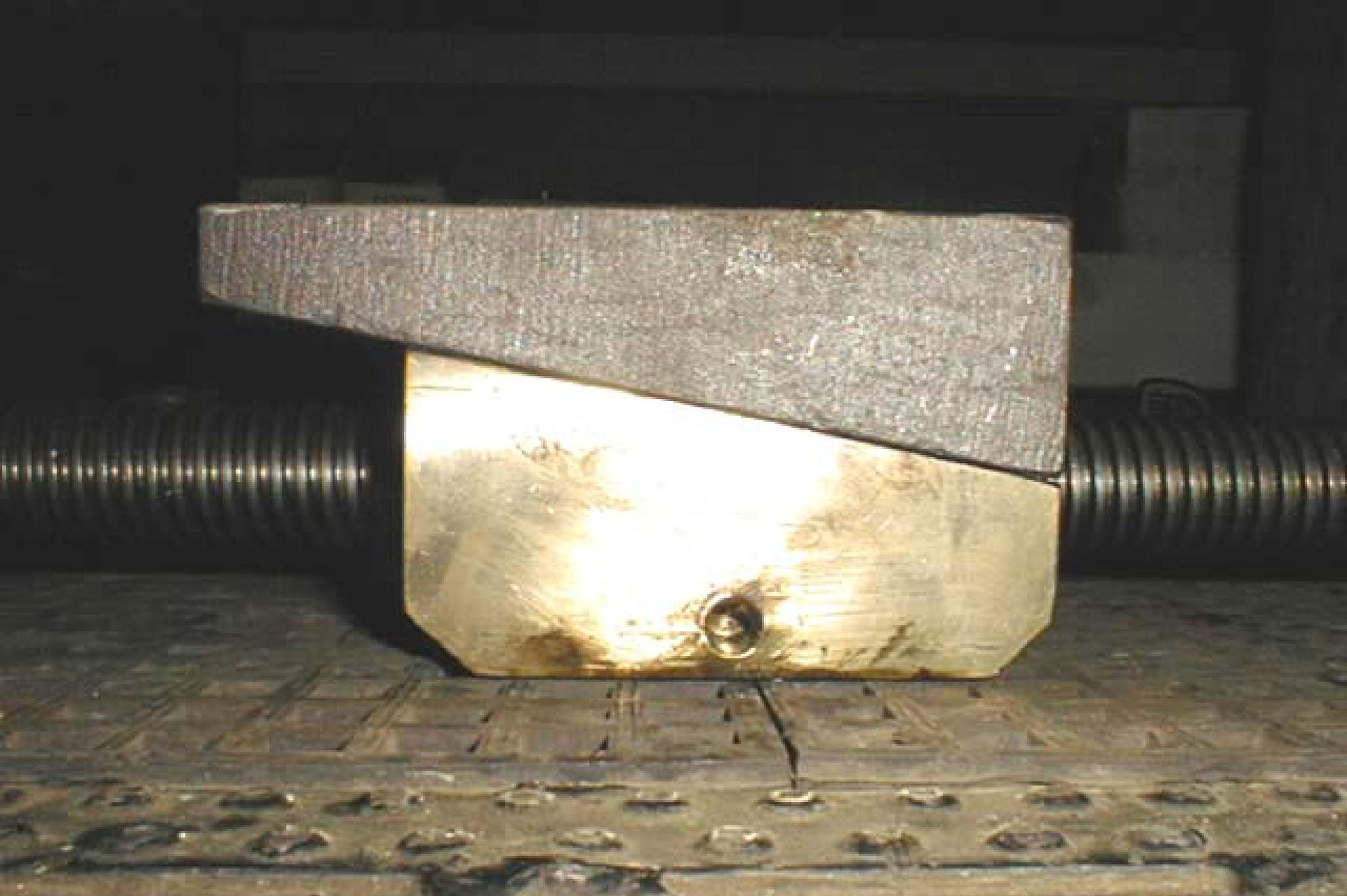
Casing clamps- two clamps Japanese style



**Two clamp system-French style**

# Adjusting clamps





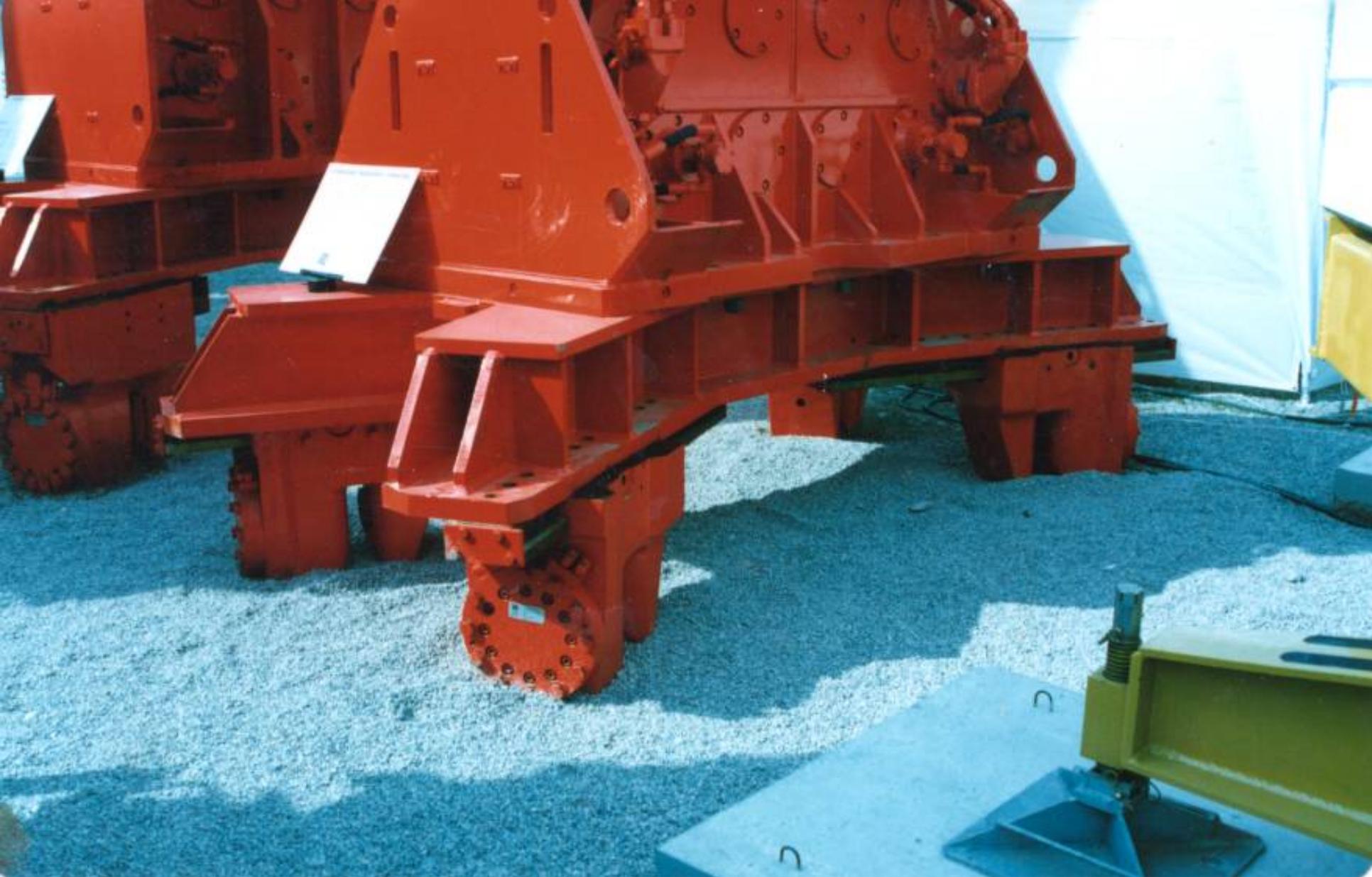
**Rotating all thread raises or lowers wedge distance**

**Nut is welded. Always look at wedges while turning to make sure you are turning the right direction.**



Wedges must be greased. If wedges are not tight the vibro will not put energy into the casing.





# Attachments: Four Clamp



# Attachments: Concrete



# Attachments concrete piles



Center pull clamp has two jaws that are gear timed to make sure pile is centered. Designed for pipe up to 24", concrete piles, & wood piles.

# H-Beams



# Sheet Piles



# Pile failures



*Casing was too light in this situation*

Pile or casing failures



**Belly bands are added to the top and sometimes to the bottom of the casing to solve the following problems:**

**Keep jaws from tearing off top of casing**

**Prevent flexing of the casing which causes unwanted vibrations to adjacent soil and buildings.**

**Flexing also takes away energy from the vibro that needs to be at the tip.**

# Adding belly bands

# ***Vibros underwater***





# ***Underwater operations***



# ***Underwater operations***