

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



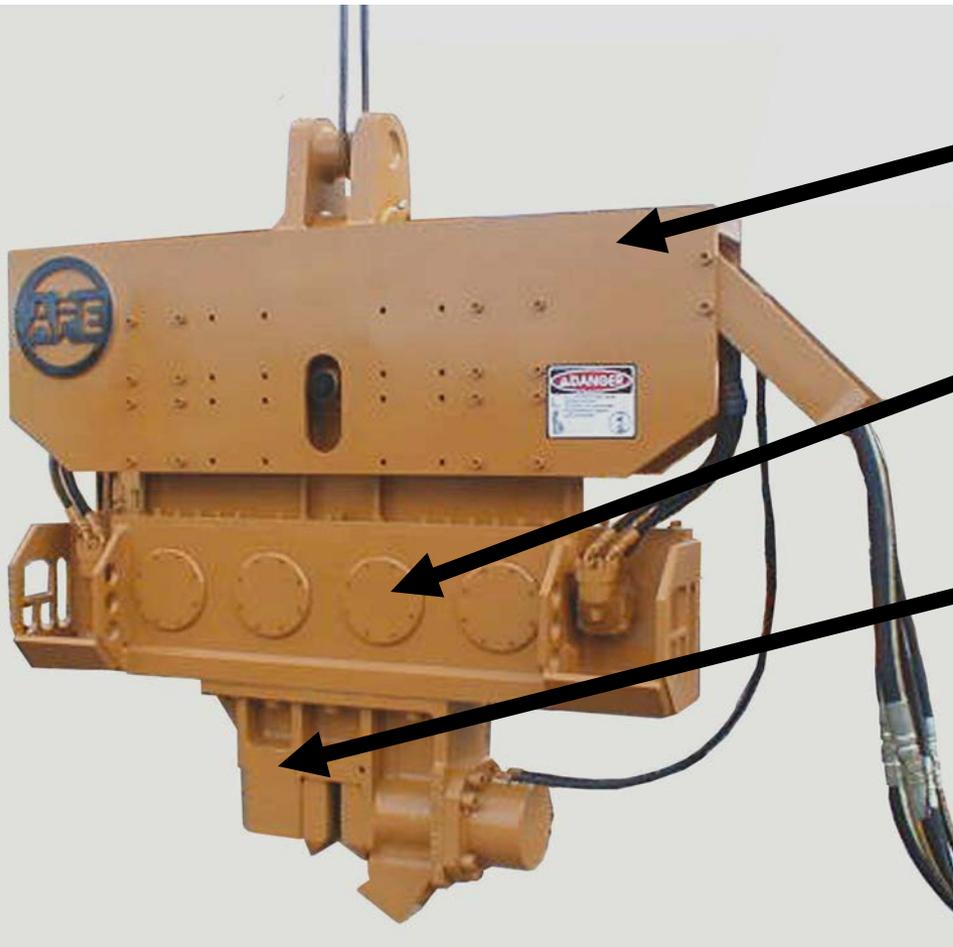
Example: Vibrating Sheet Piles



Example: Big Concrete Caissons

Understanding The Components Of a Vibratory Pile Driver/Extractor

Vibratory Pile Drivers/Extractors



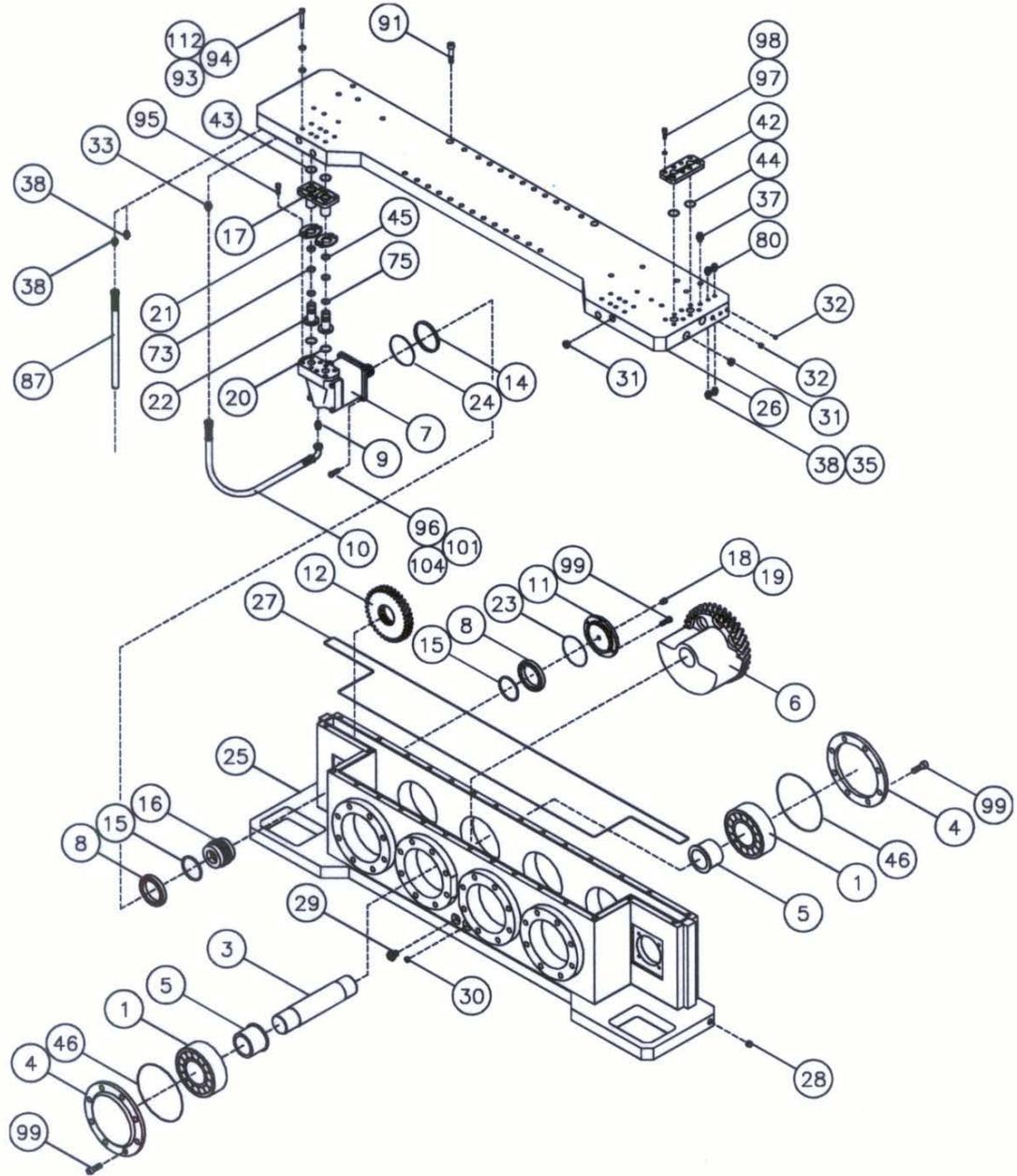
Suppressor Housing

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

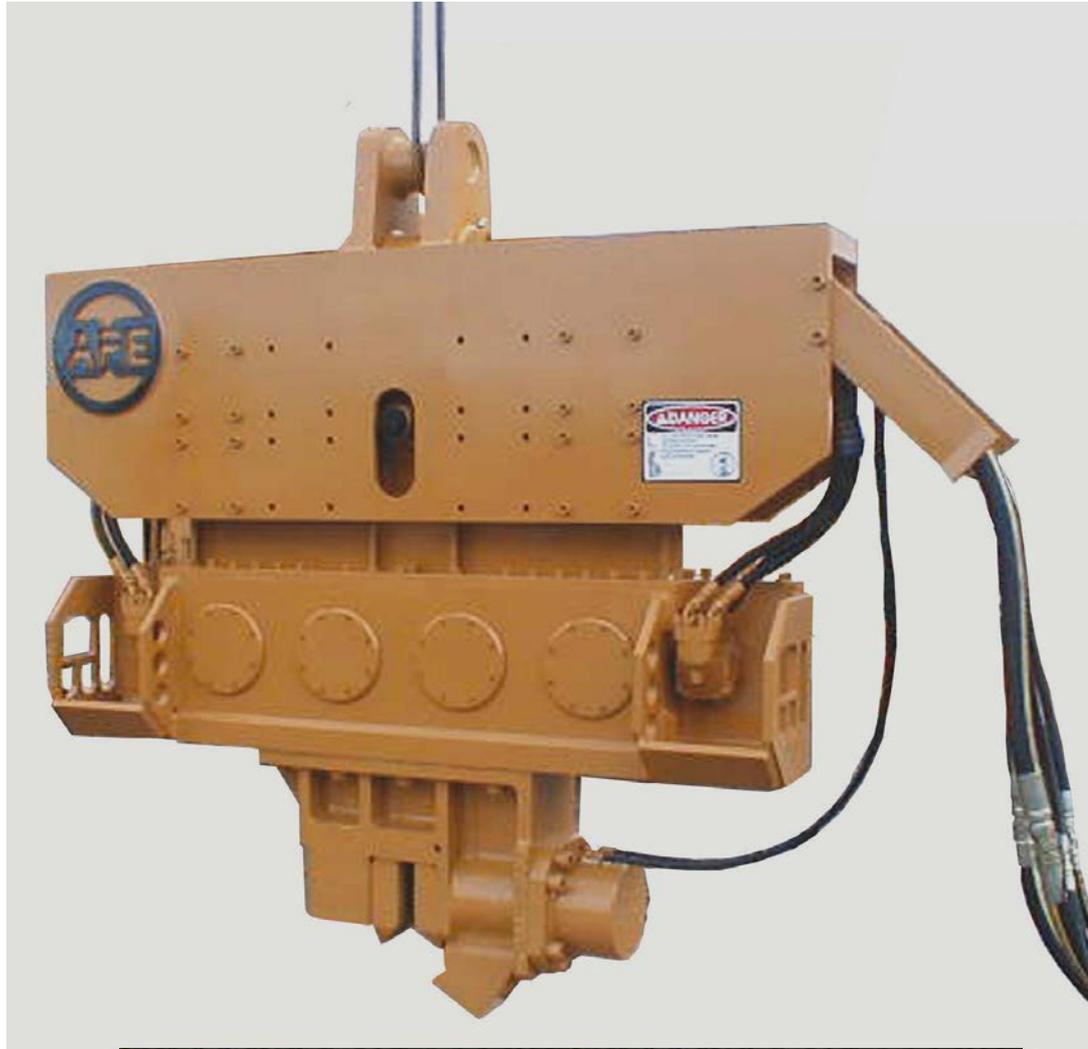
All Vibratory Pile Driver Extractors Have At Least Two Paired Eccentrics





Two Eccentrics

Four Eccentrics

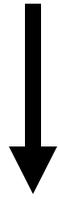




Six Eccentrics

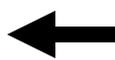
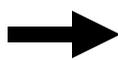
Four strokes of the paired eccentrics

1 work



Forces the vibro and the casing downward

2 Cancel



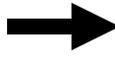
Nothing happens.
Each eccentric
cancels other out.

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

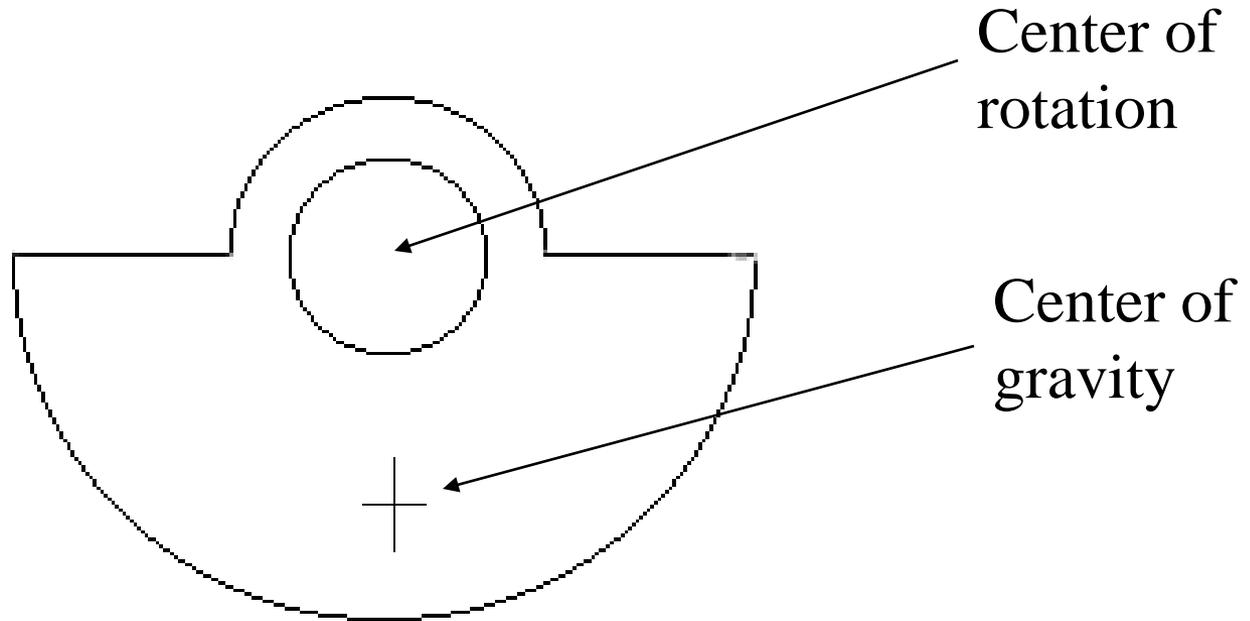
ICE: Rubber springs

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

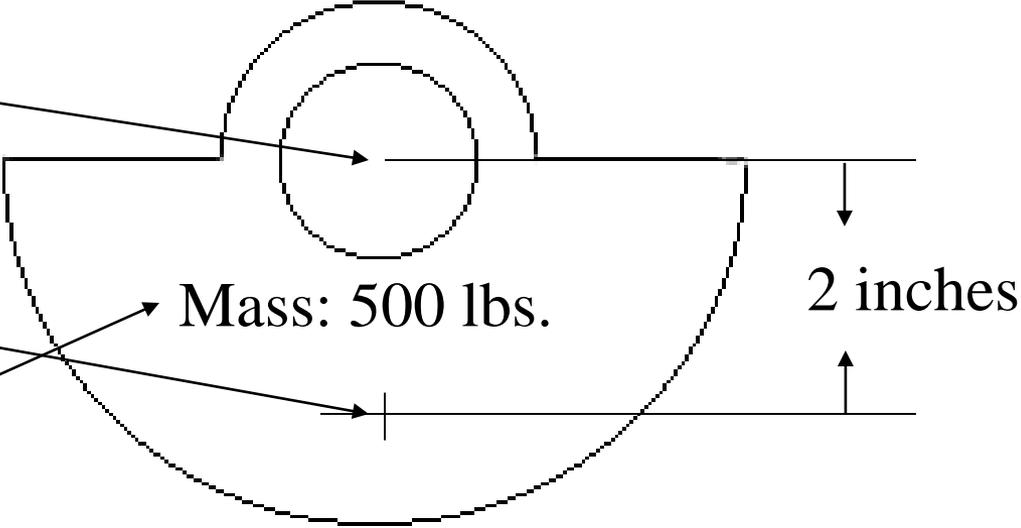
Center of Rotation

and

Center of Gravity

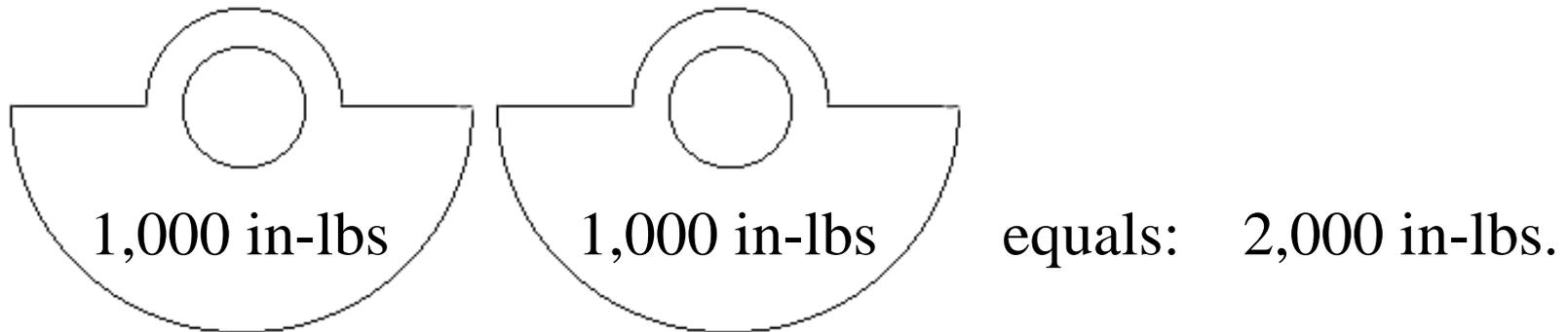
Multiplied by

The Mass



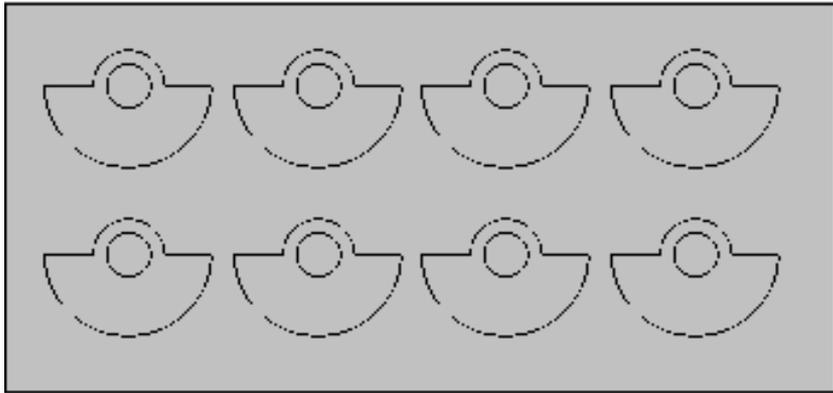
2 times 500 equals: 1,000 inch pounds

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

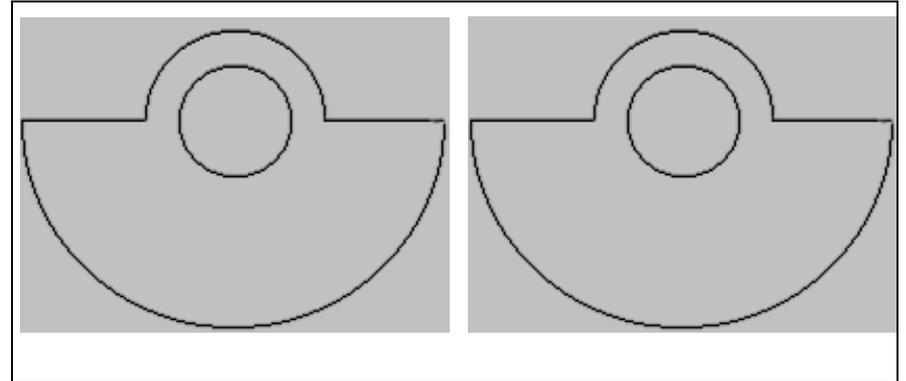


If each eccentric has 1,000 in-lbs then the vibro has a total of 2,000 in-lbs.

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

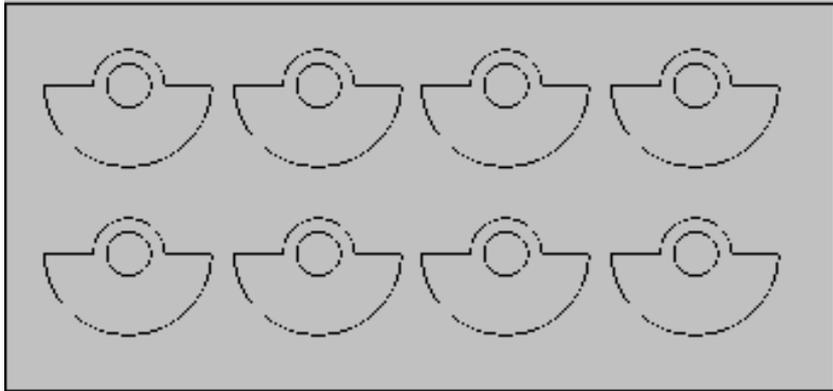


More vibrating weight
Less amplitude

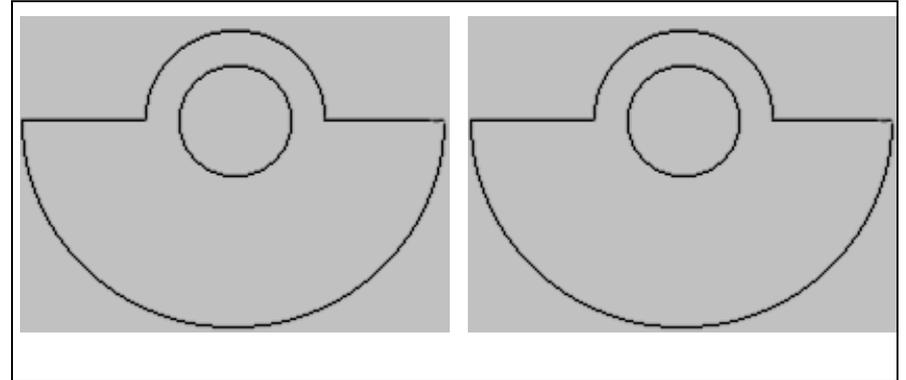


Less vibrating weight
More amplitude

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

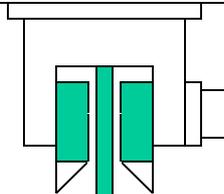
A = Amplitude in inches

Vibrating weight: Mv

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

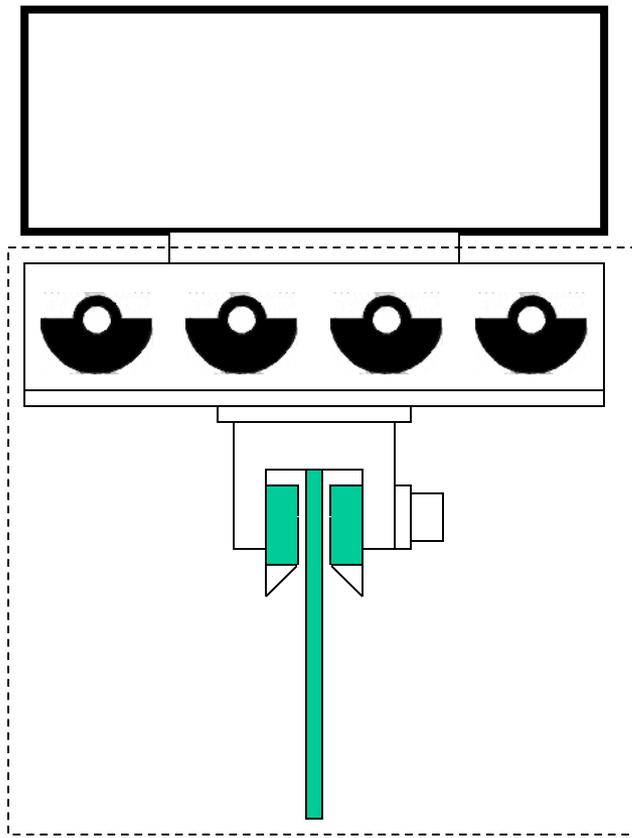
- B: Gear Box (vibrating mass)
- C: Clamping device including all plates or clamps
- D: Pile weight

Suppressor does not
vibrate.
Non-vibrating mass.



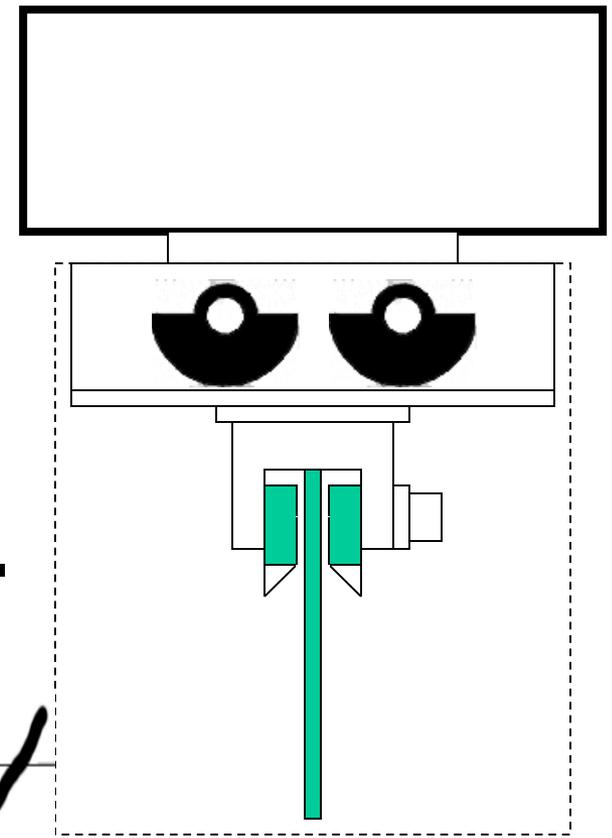
vibrating

mass



Amplitude

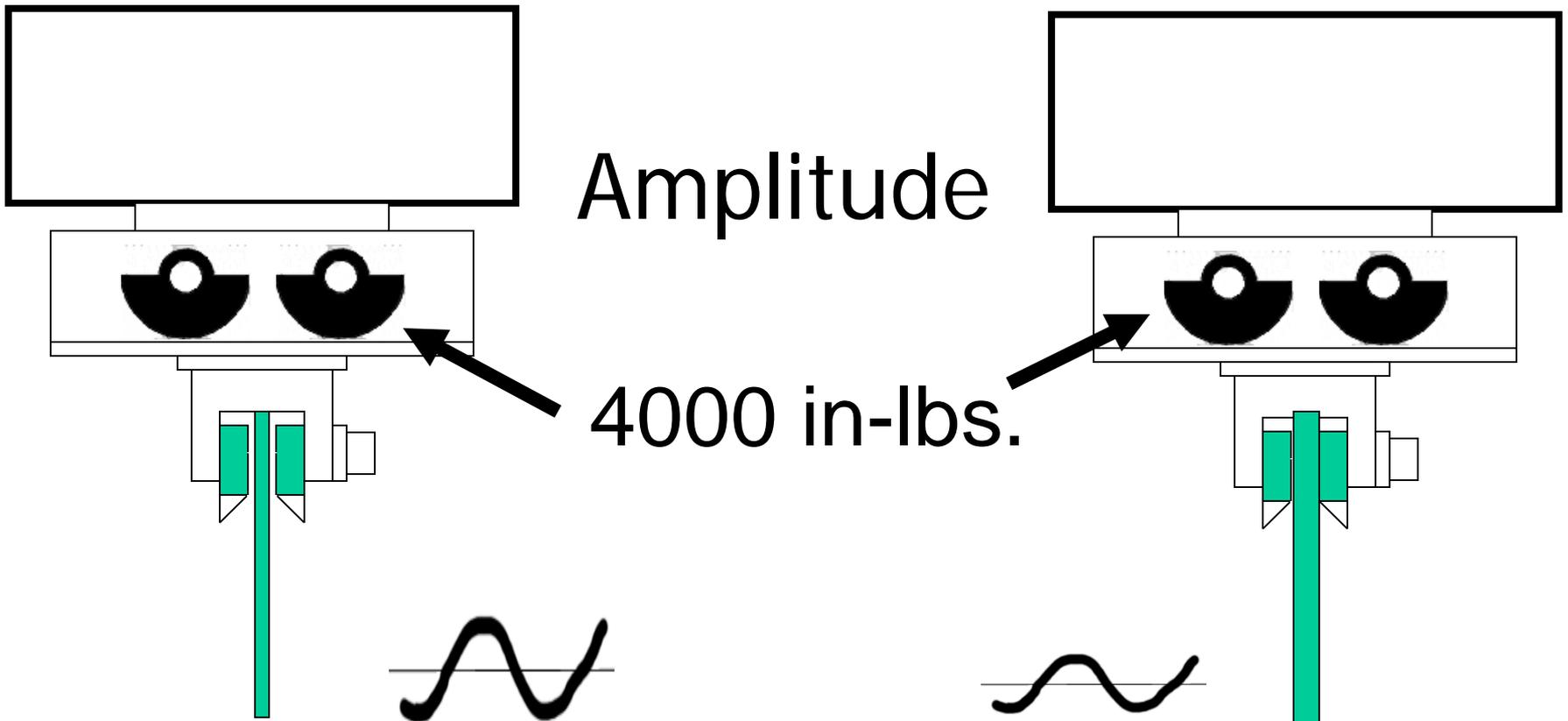
4000 in-lb.



Vibrating mass: 6500 lb

Vibrating mass: 5000 lb

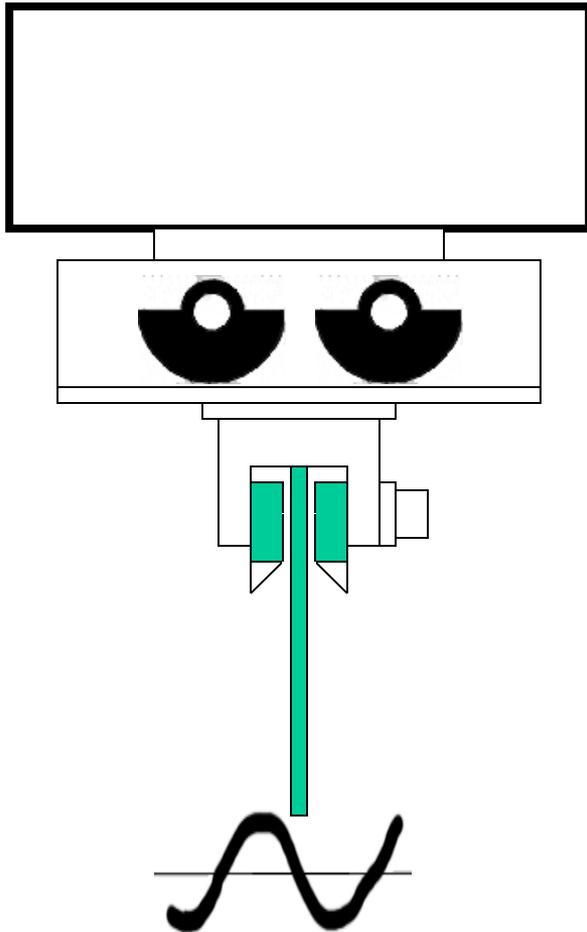
The hammer on the left has the same eccentric moment but less amplitude because the vibrating mass is heavier.



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

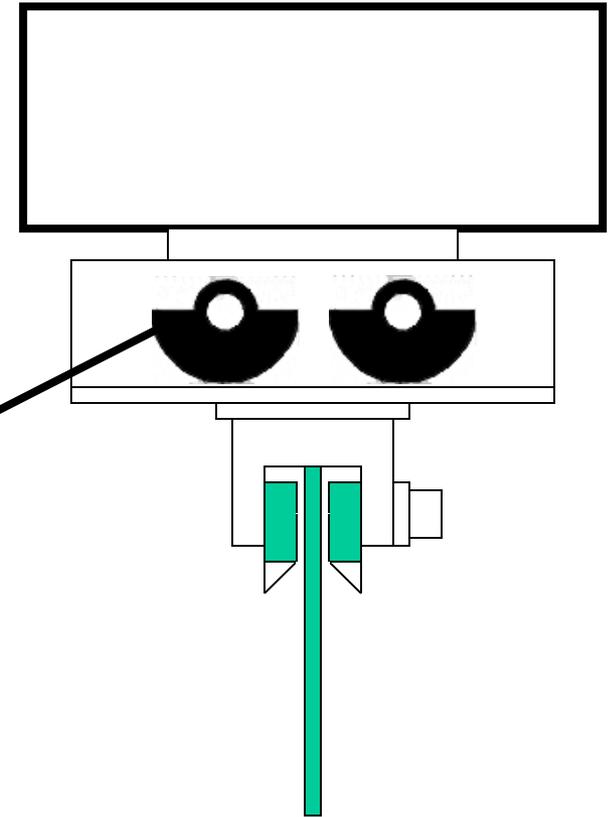
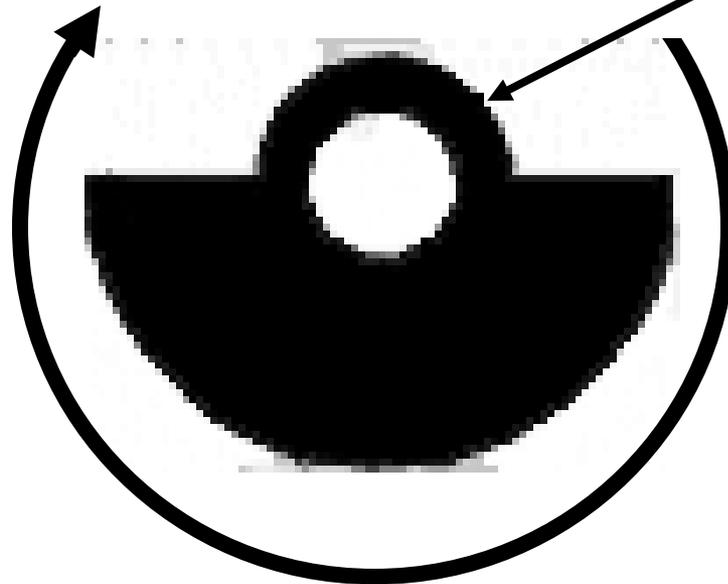
VM: Vibrating Mass

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.

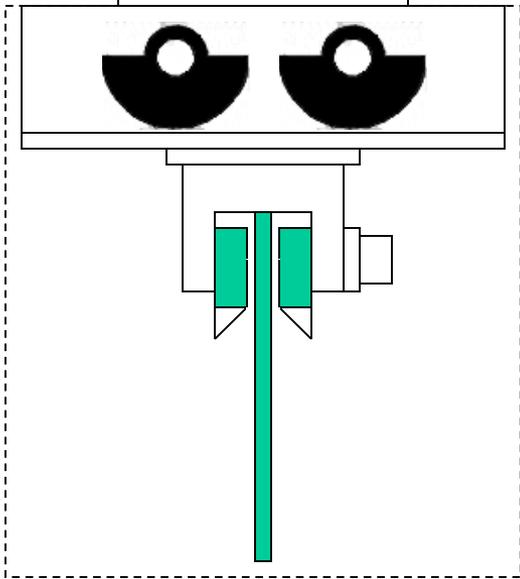
Frequency: 1600 Cycles per minute

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

Drive Force

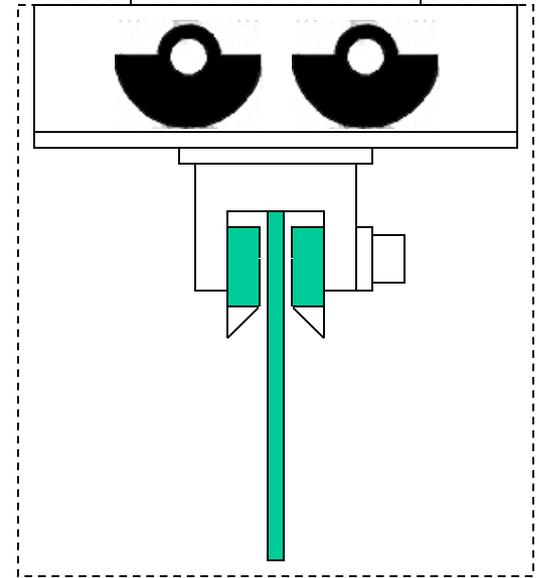
How Frequency Matters

1100 cpm



4000 in-lb.

1600 cpm



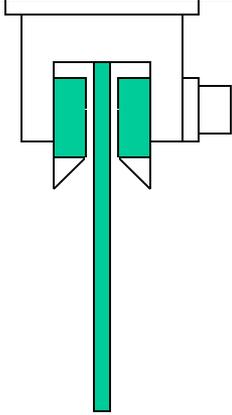
$$\frac{4400 \times 0.0142 \times 1100 \times 1100}{1,000,000} = 75 \text{ tons}$$

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

Higher frequency dramatically increases drive force because frequency is squared.

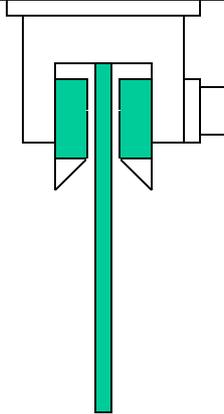
1100 cpm

5208 in-lbs



1600 cpm

4400 in-lbs



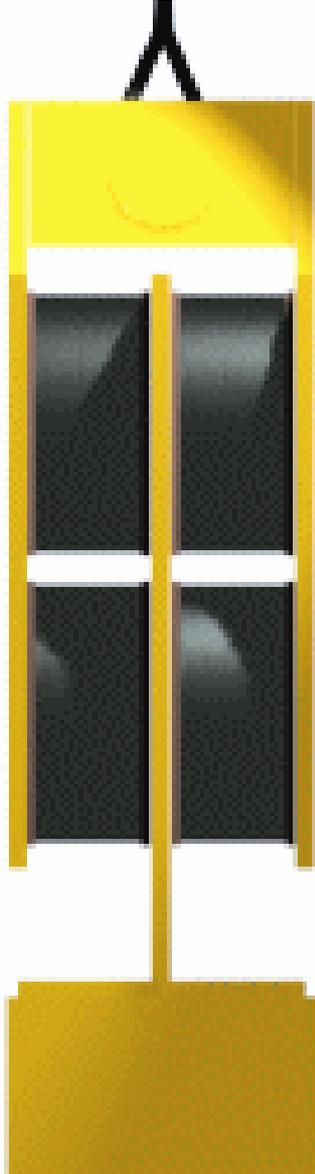
$$\frac{5208 \times 0.0142 \times 1100 \times 1100}{1,000,000} = 89 \text{ tons}$$

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





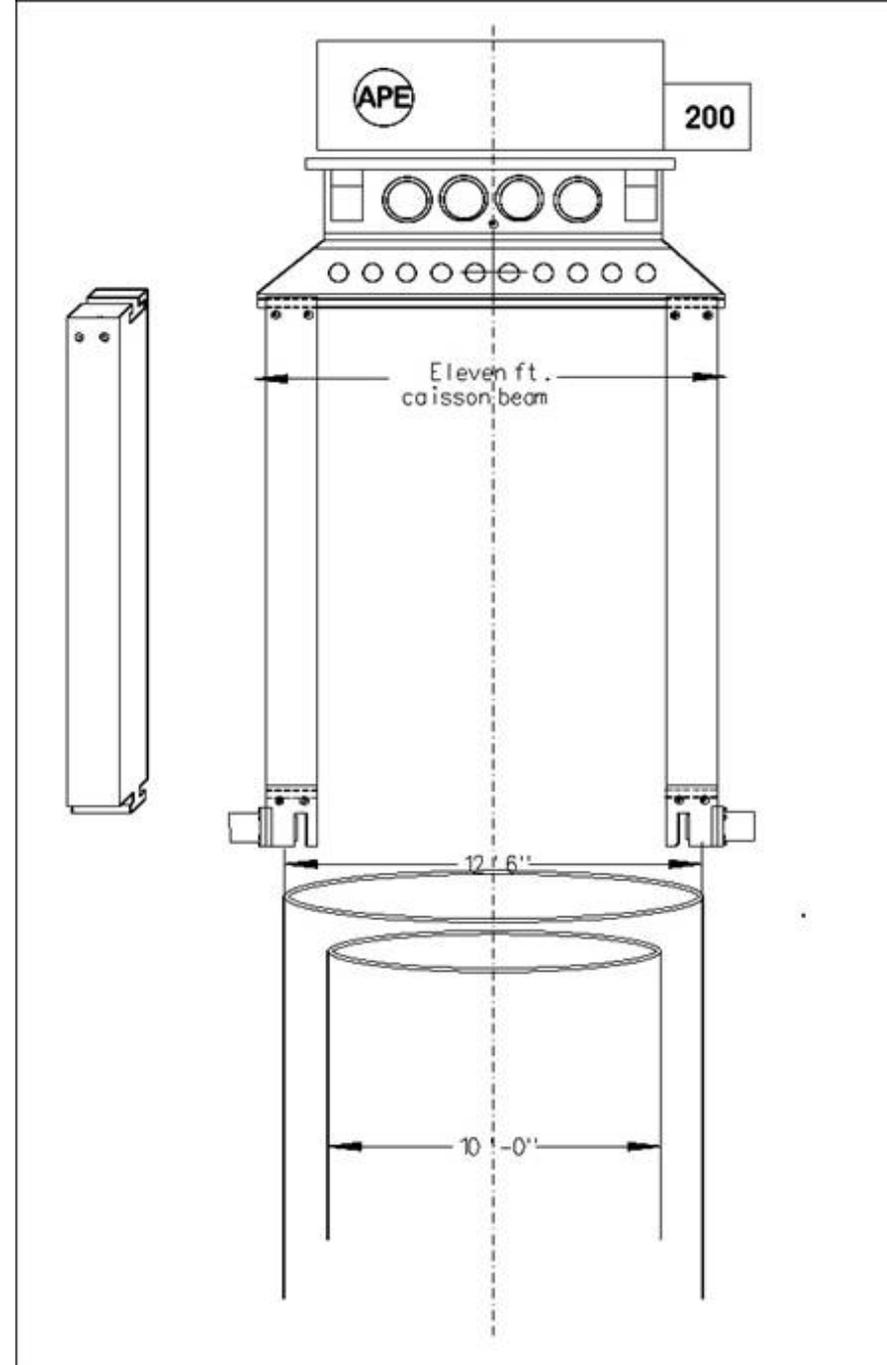
90 degree plate



Clamp Extension



Extending caisson
clamps down to
clear rebar cage.

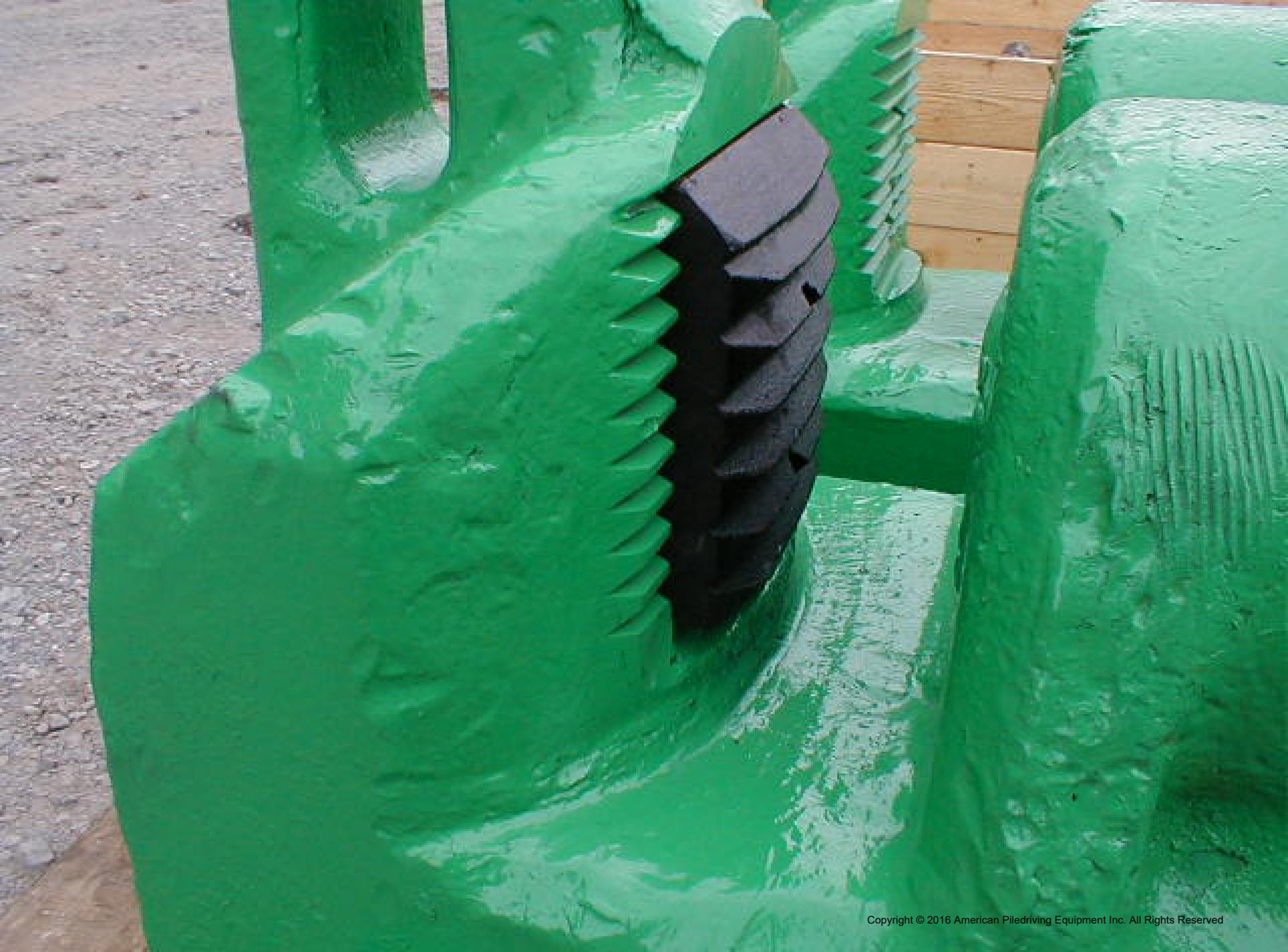














Duel guiding, full six inch slide, check valve clamp, easy to read



Understanding the Power Unit.



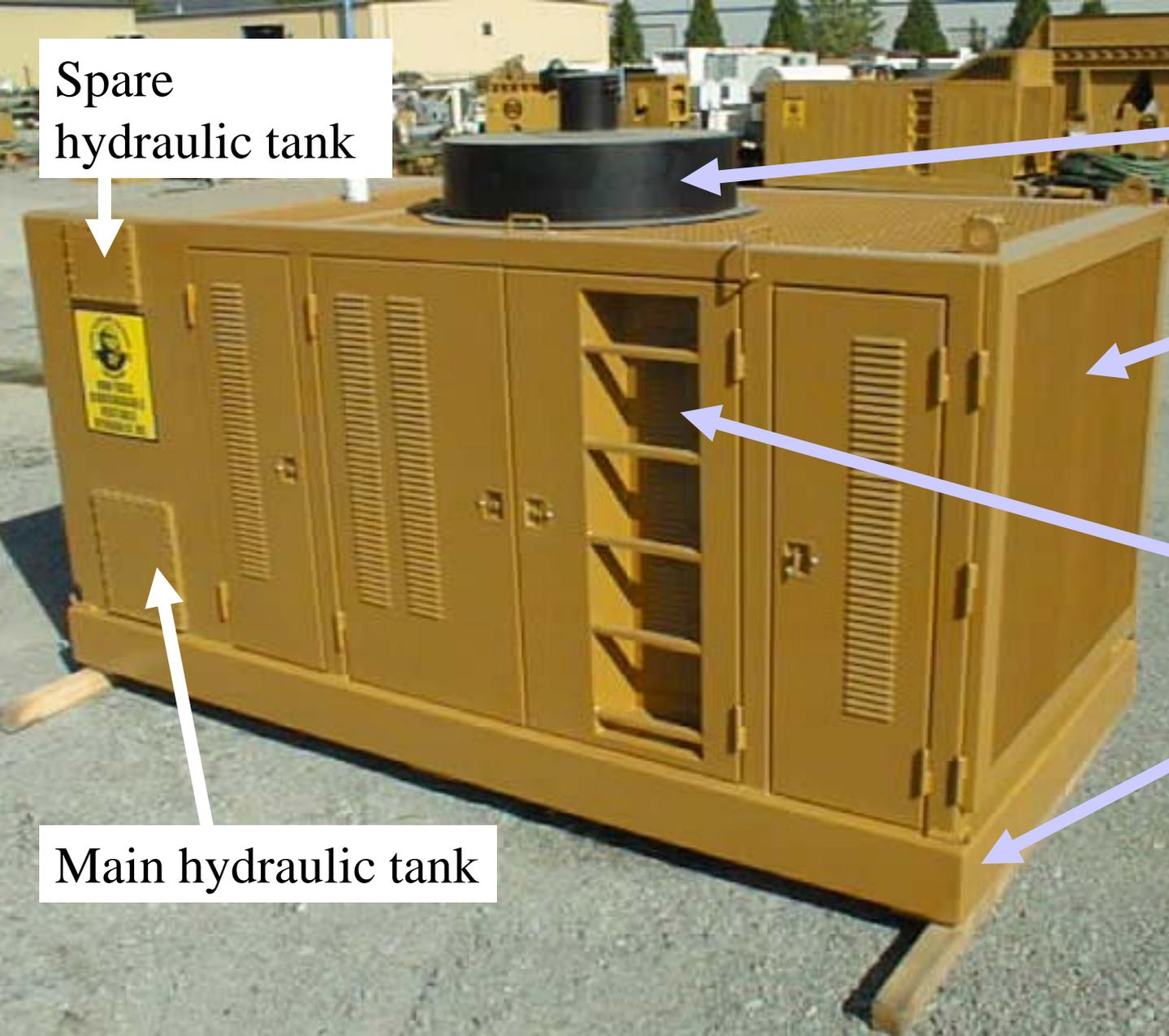
Skid

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.

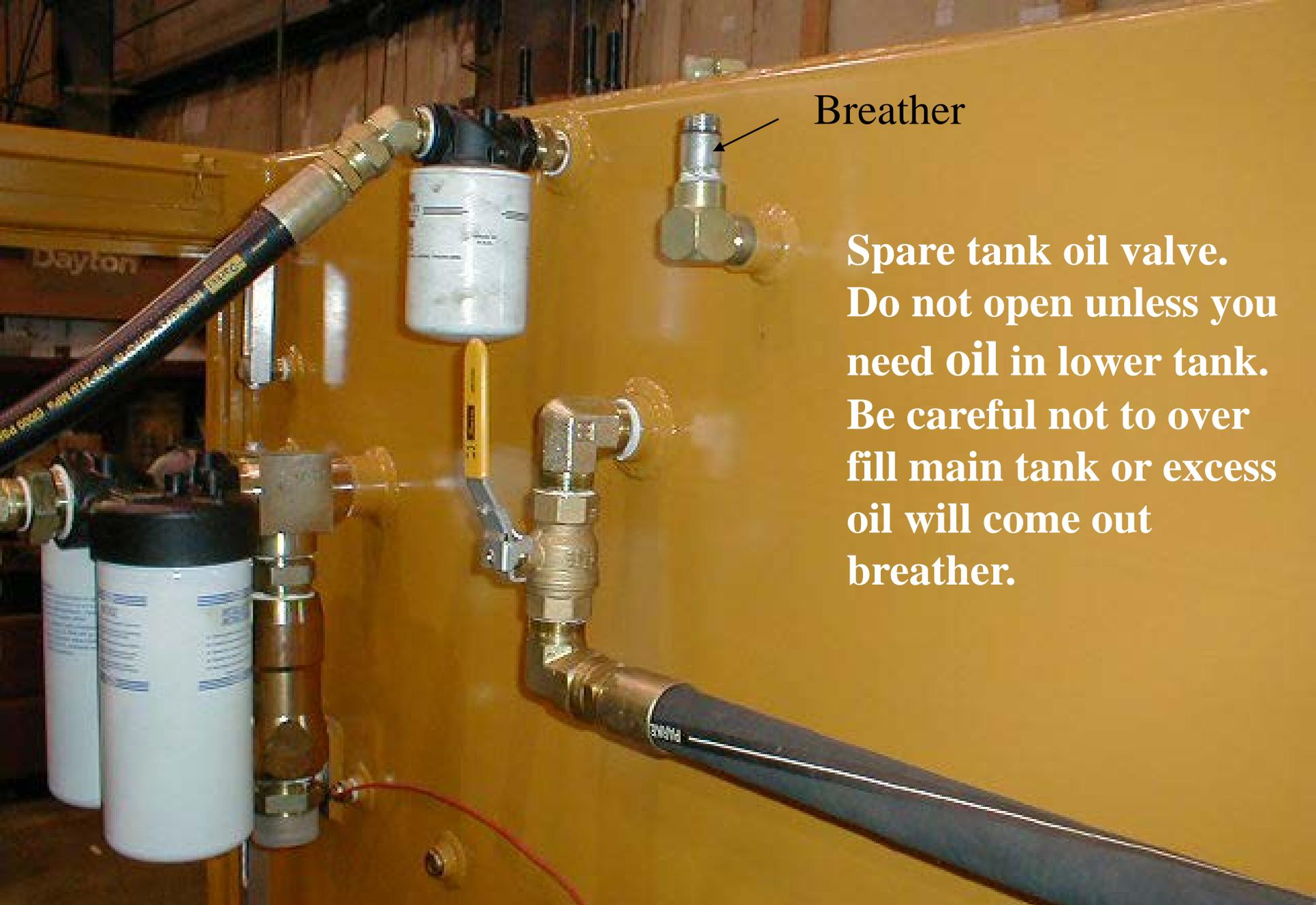
Spare tank site glass

Filter

Main tank site glass



View of hydraulic tank level gauges and return filter.

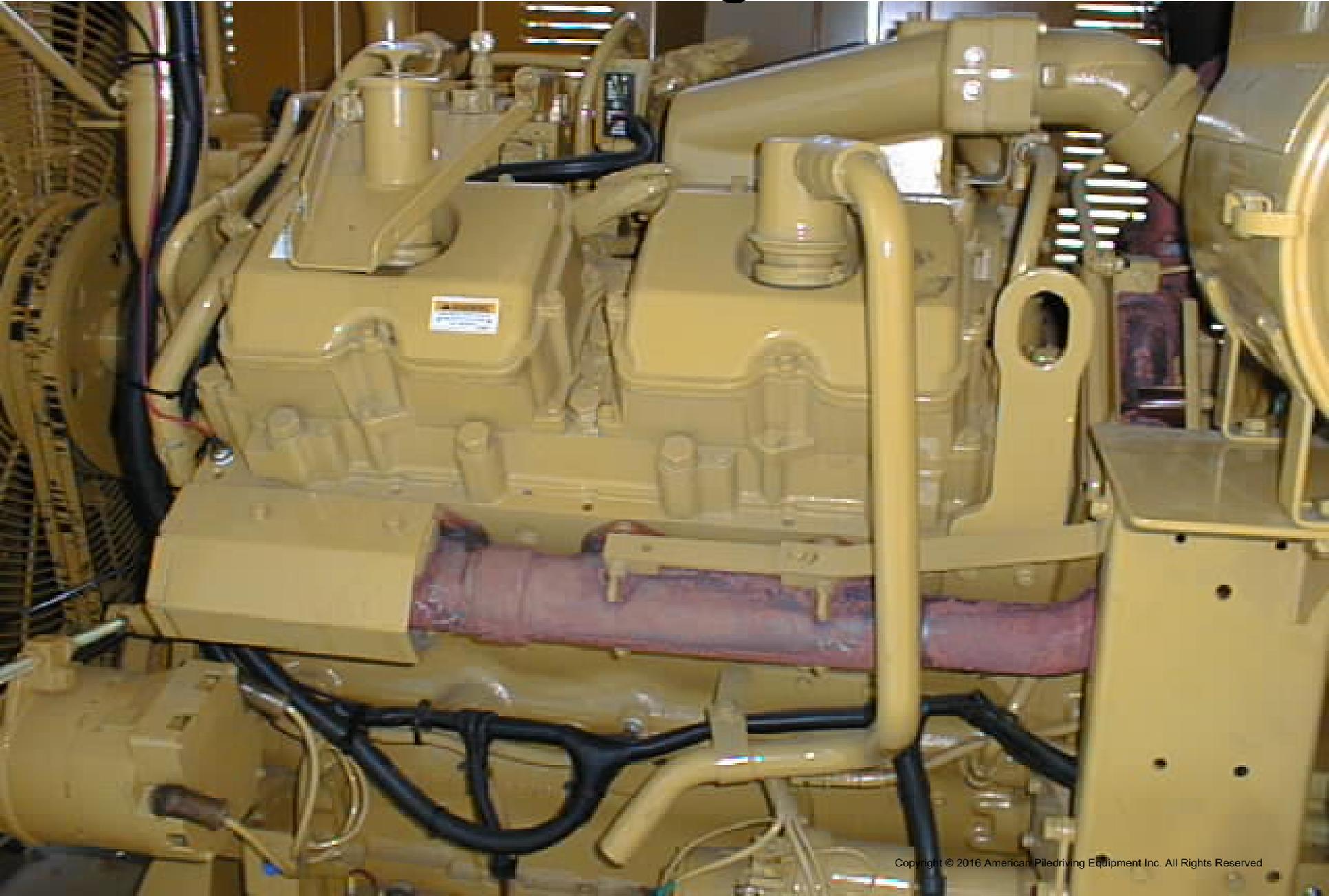


Breather

**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 ¼ turn valve.

CAT Engine



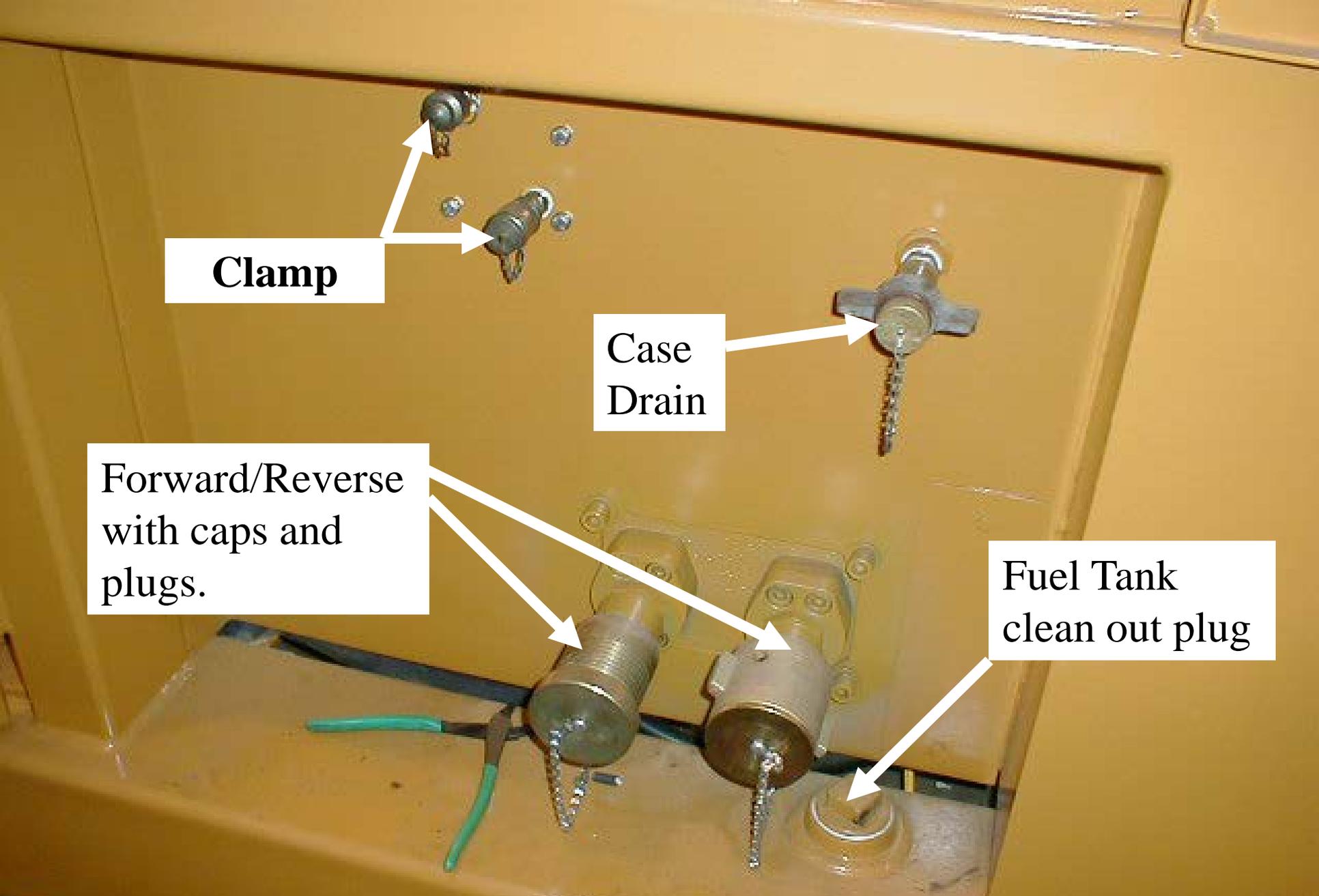


Float switch





Quick disconnects



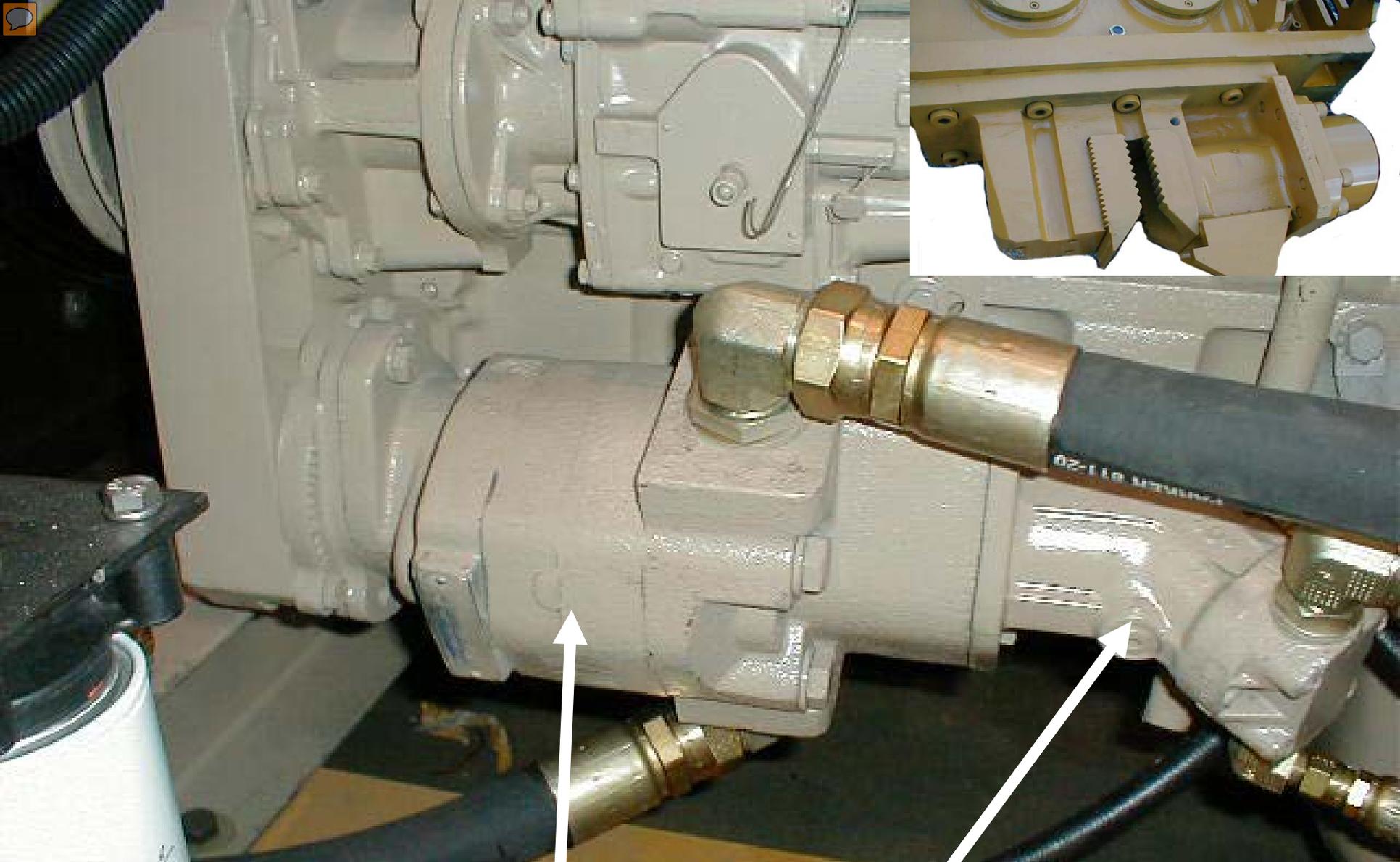
Clamp

**Case
Drain**

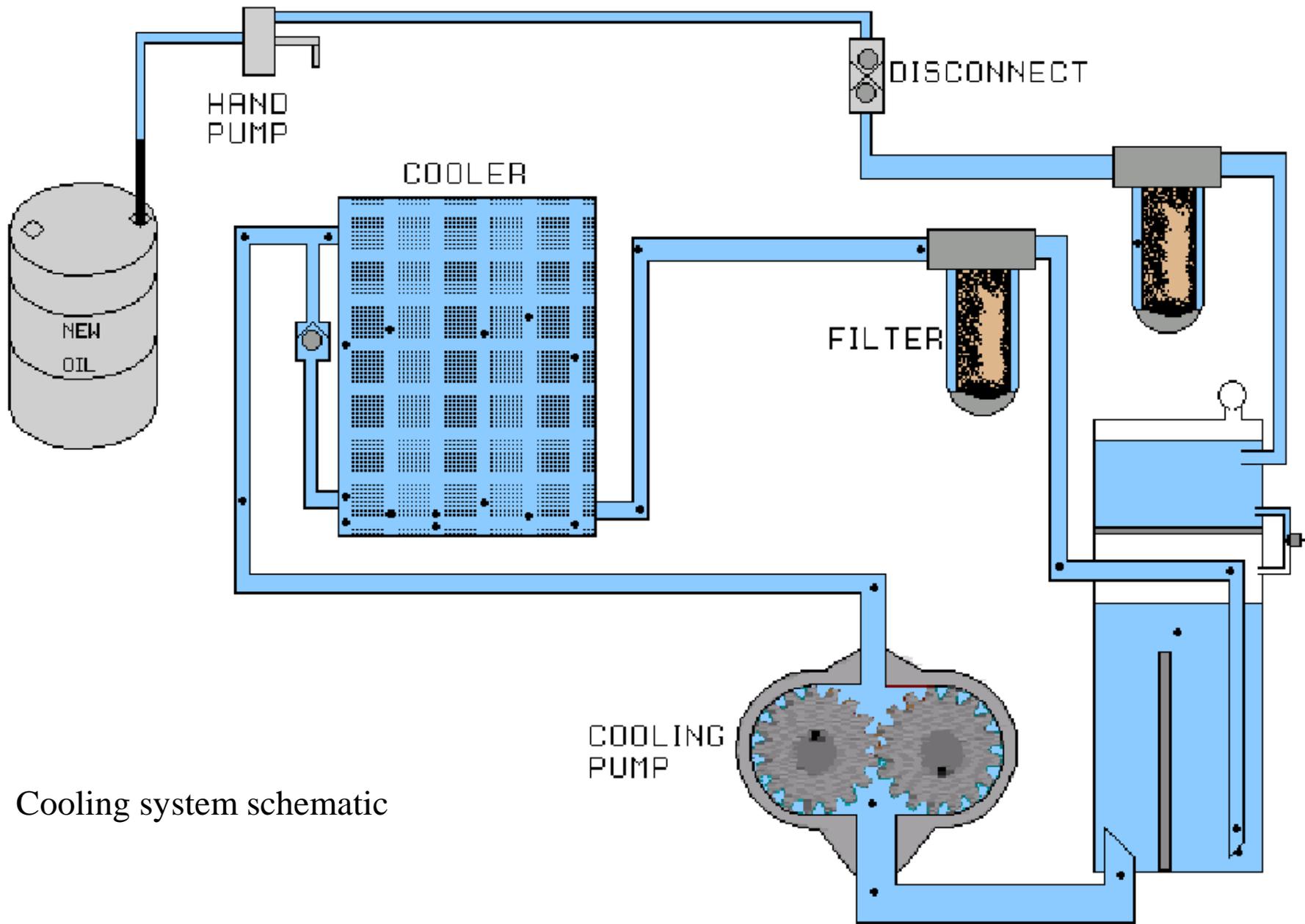
**Forward/Reverse
with caps and
plugs.**

**Fuel Tank
clean out plug**

Quick disconnects



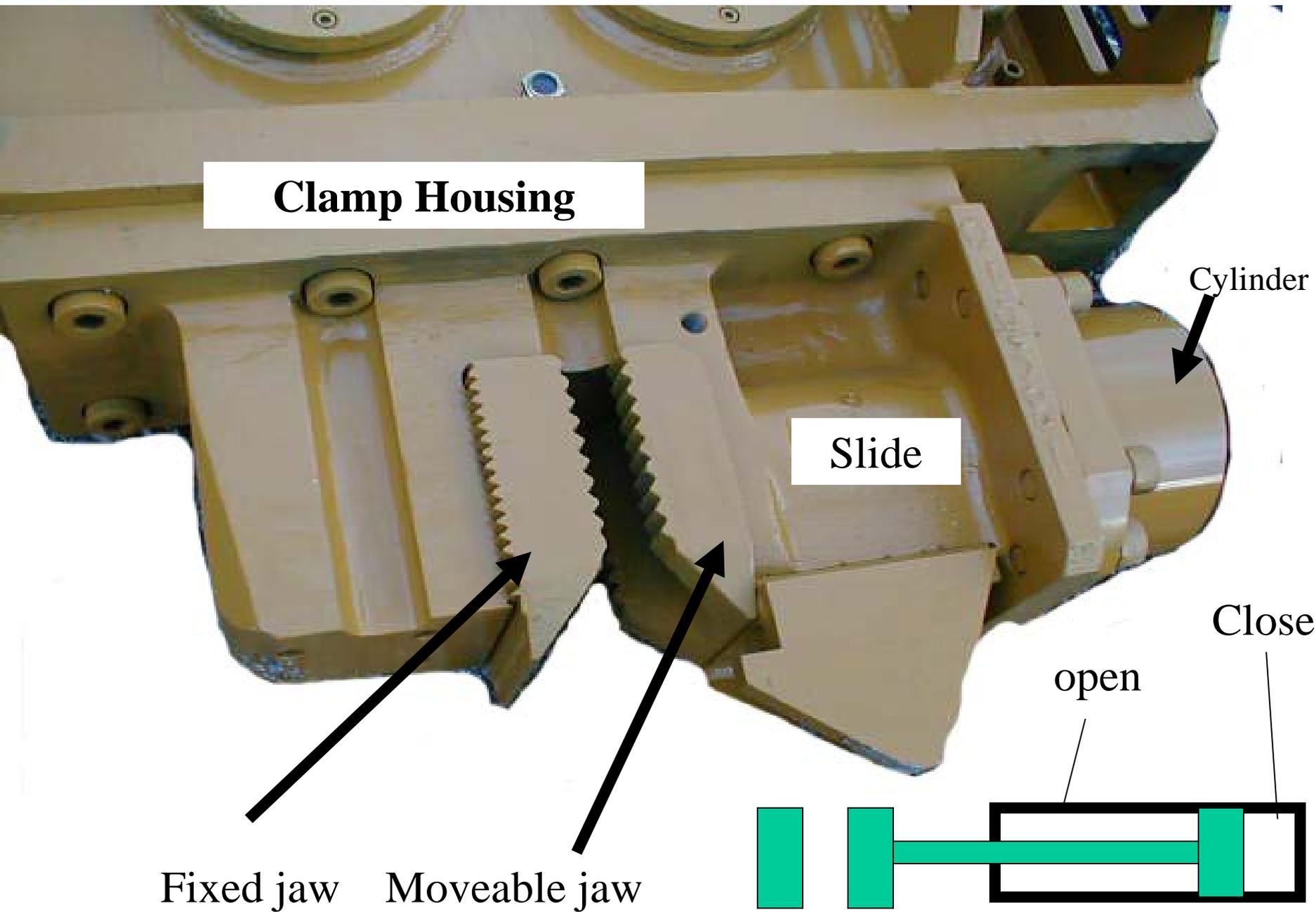
Cooling pump with piggy back clamp pump.



Cooling system schematic



View of clamp and its components



Clamp Housing

Slide

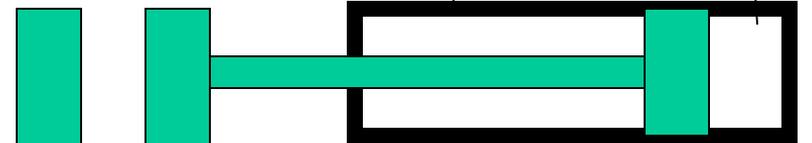
Cylinder

Close

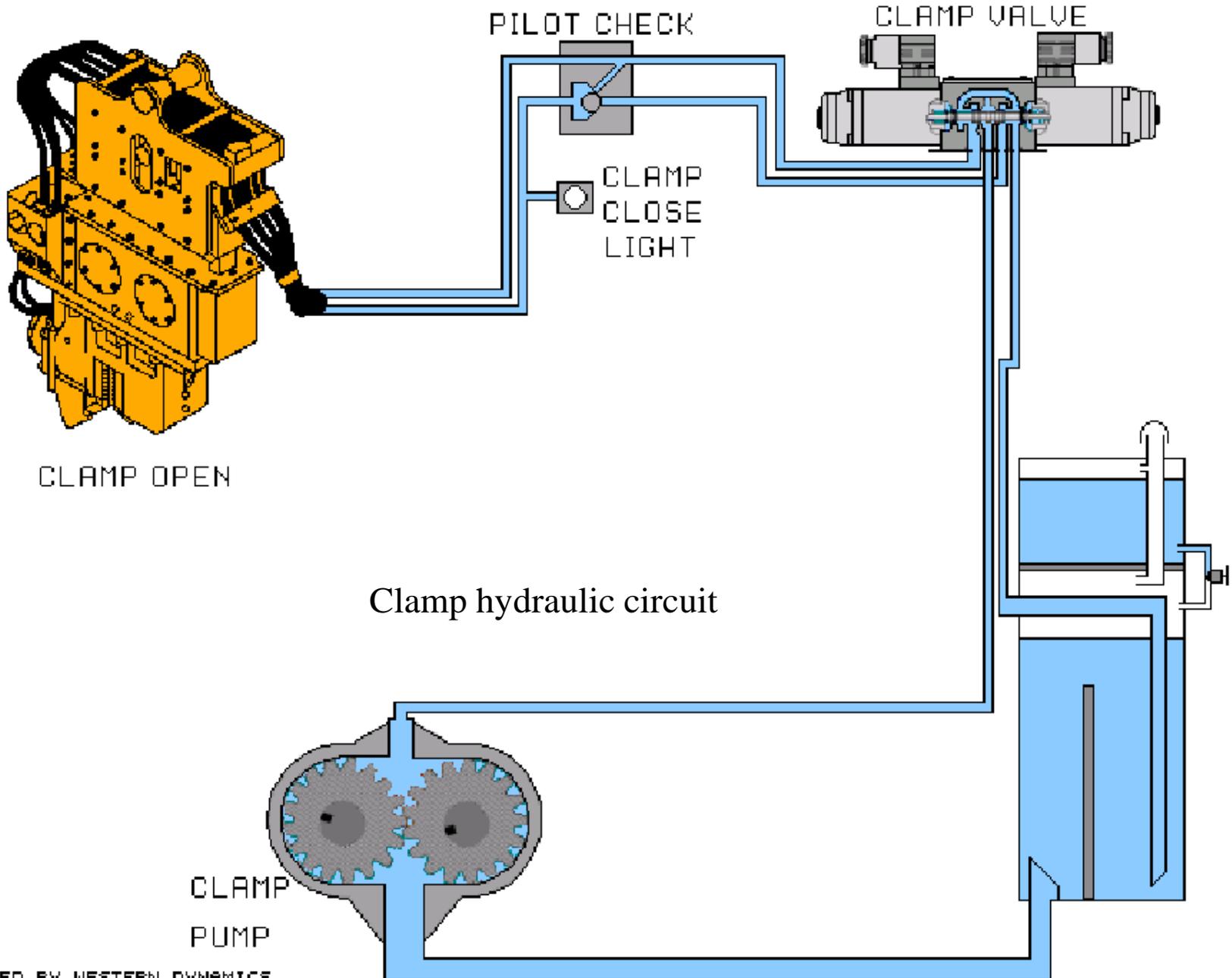
open

Fixed jaw

Moveable jaw



Cylinder



Clamp hydraulic circuit



Clamp disconnects with caps and plugs attached.

Clamp manifold

Solenoid Valve

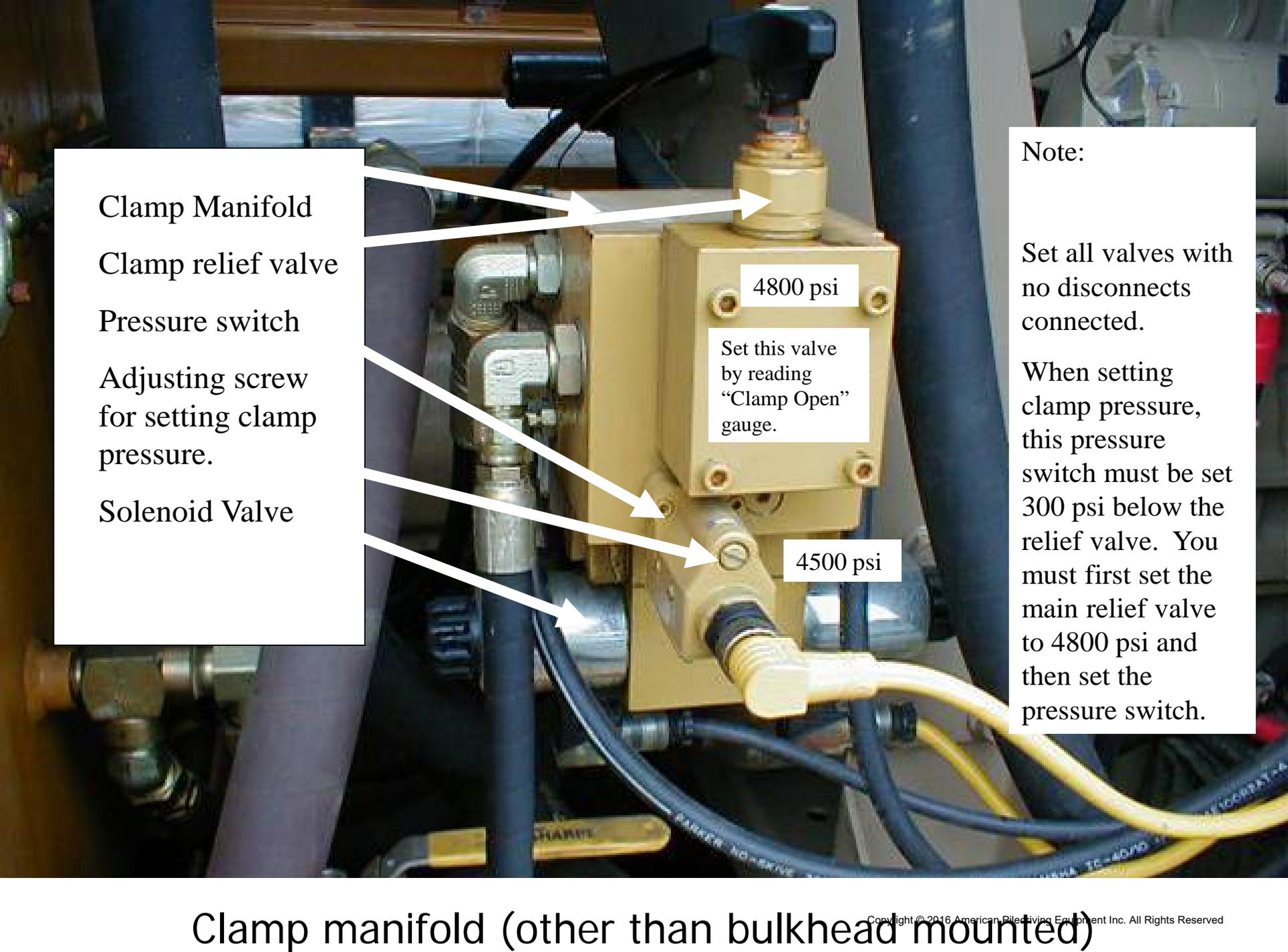
Safety Check

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

4800 psi

Set this valve
by reading
"Clamp Open"
gauge.

4500 psi

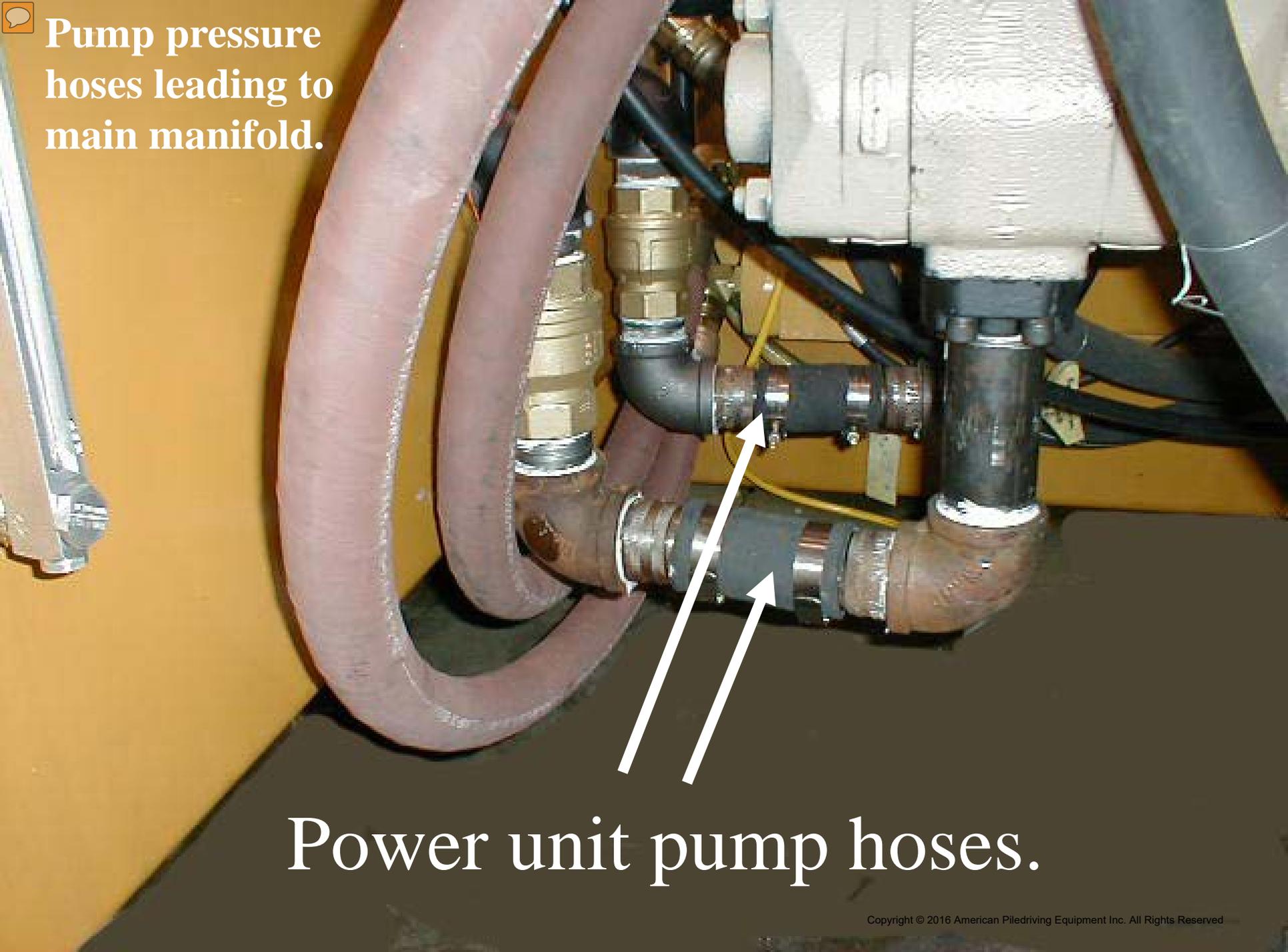
Note:

Set all valves with
no disconnects
connected.

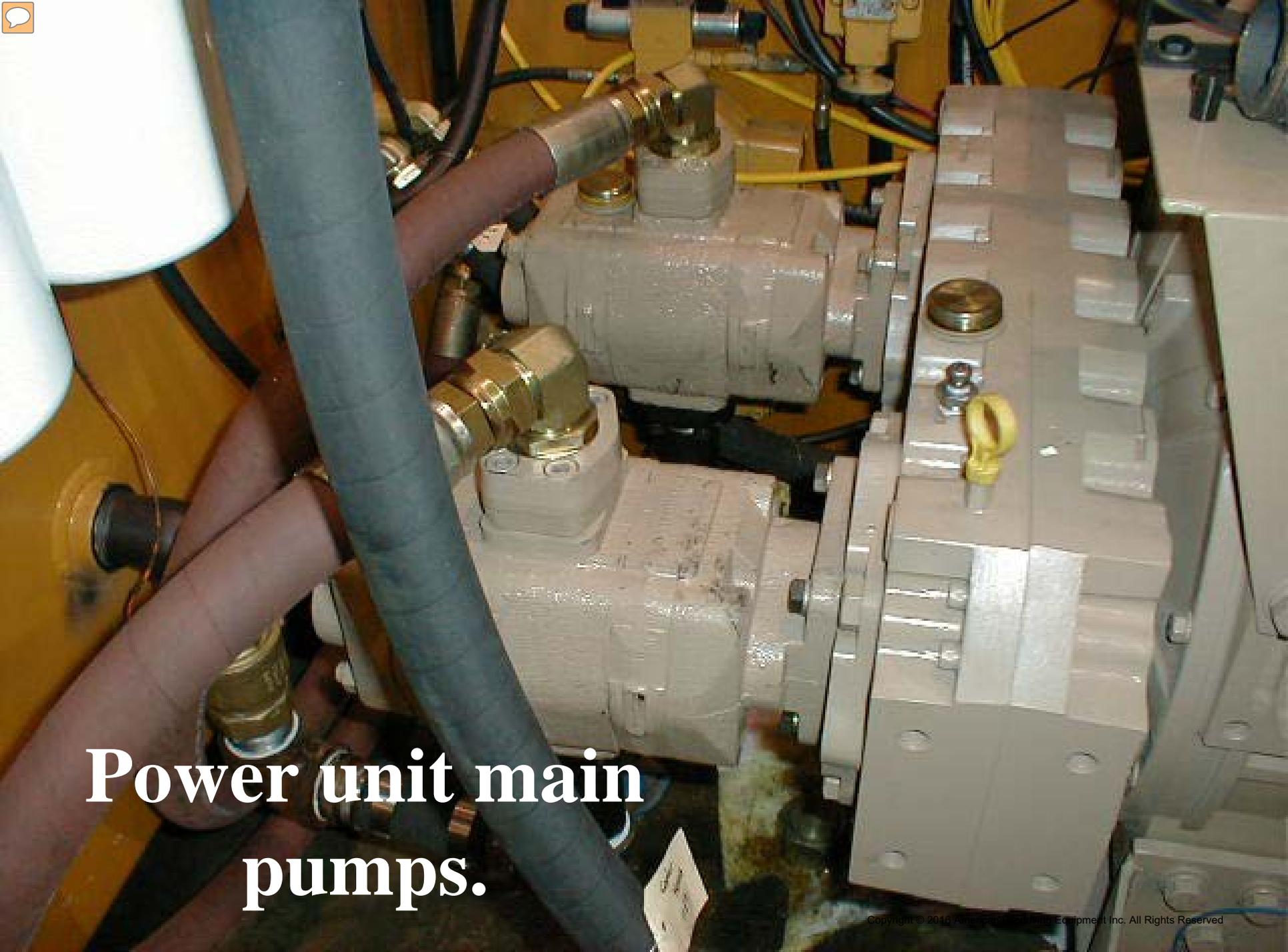
When setting
clamp pressure,
this pressure
switch must be set
300 psi below the
relief valve. You
must first set the
main relief valve
to 4800 psi and
then set the
pressure switch.

Clamp manifold (other than bulkhead mounted)

 Pump pressure hoses leading to main manifold.

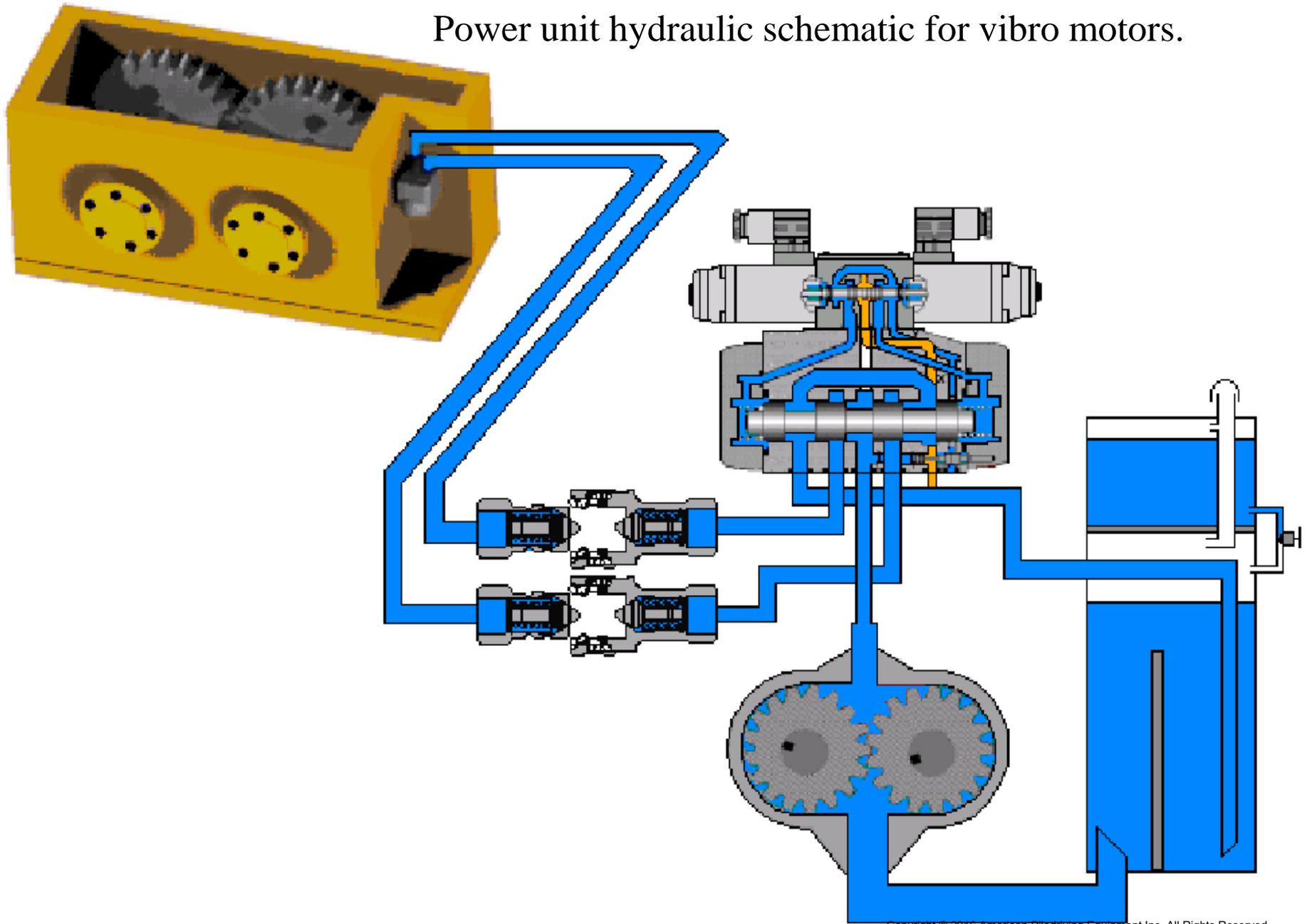


Power unit pump hoses.



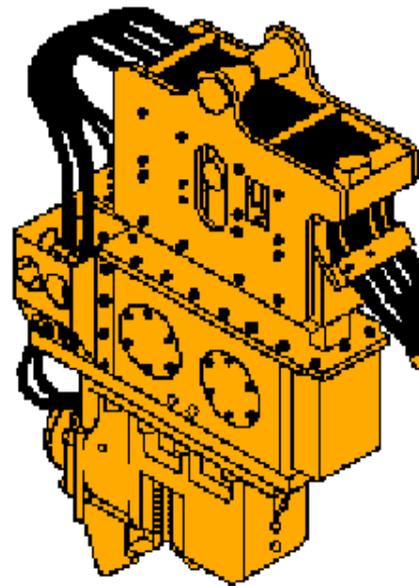
**Power unit main
pumps.**

Power unit hydraulic schematic for vibro motors.



PILOT CHECK

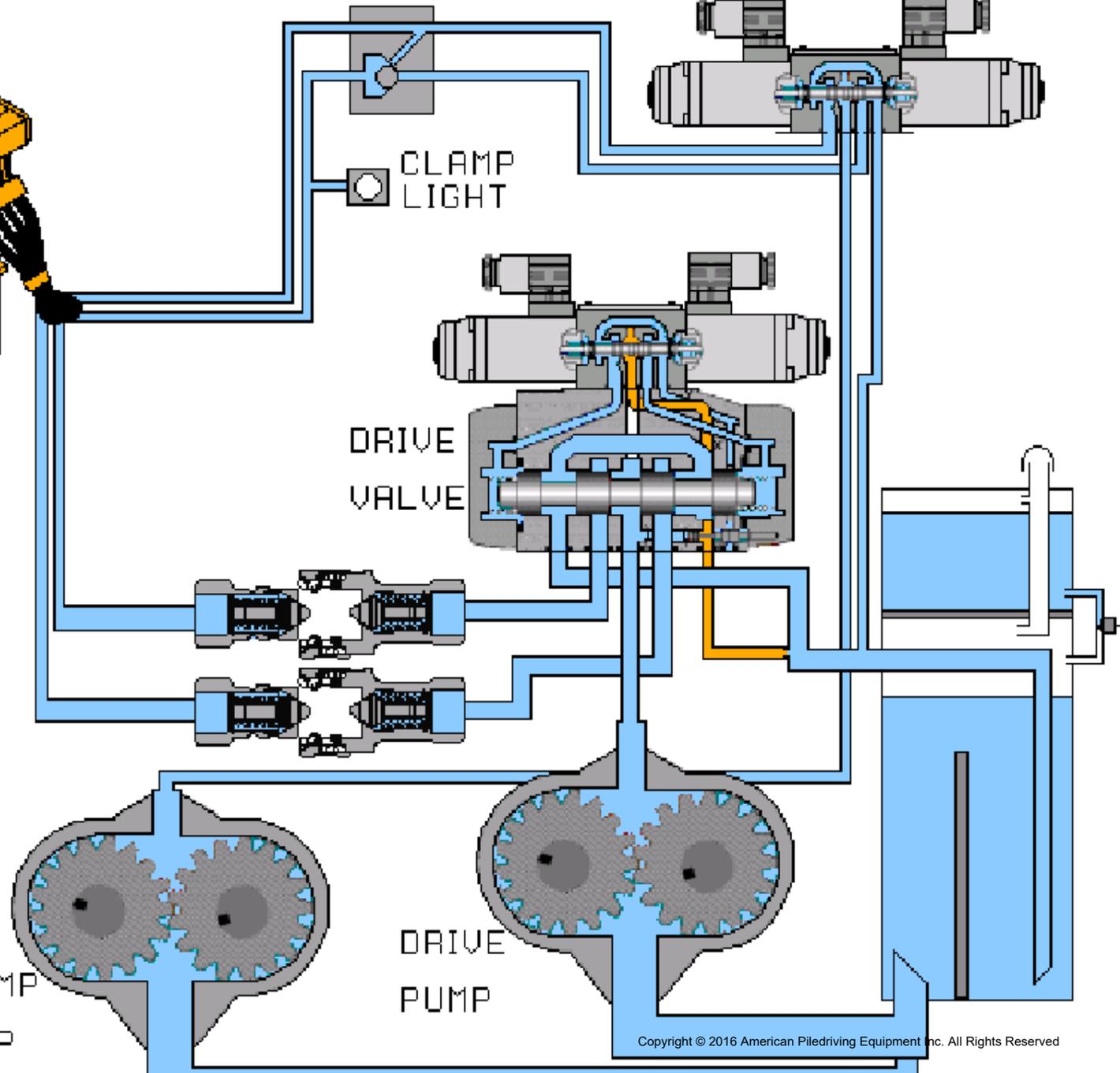
CLAMP VALVE



CLAMP LIGHT

DRIVE VALVE

Clamp and Drive animation.



CLAMP PUMP

DRIVE PUMP

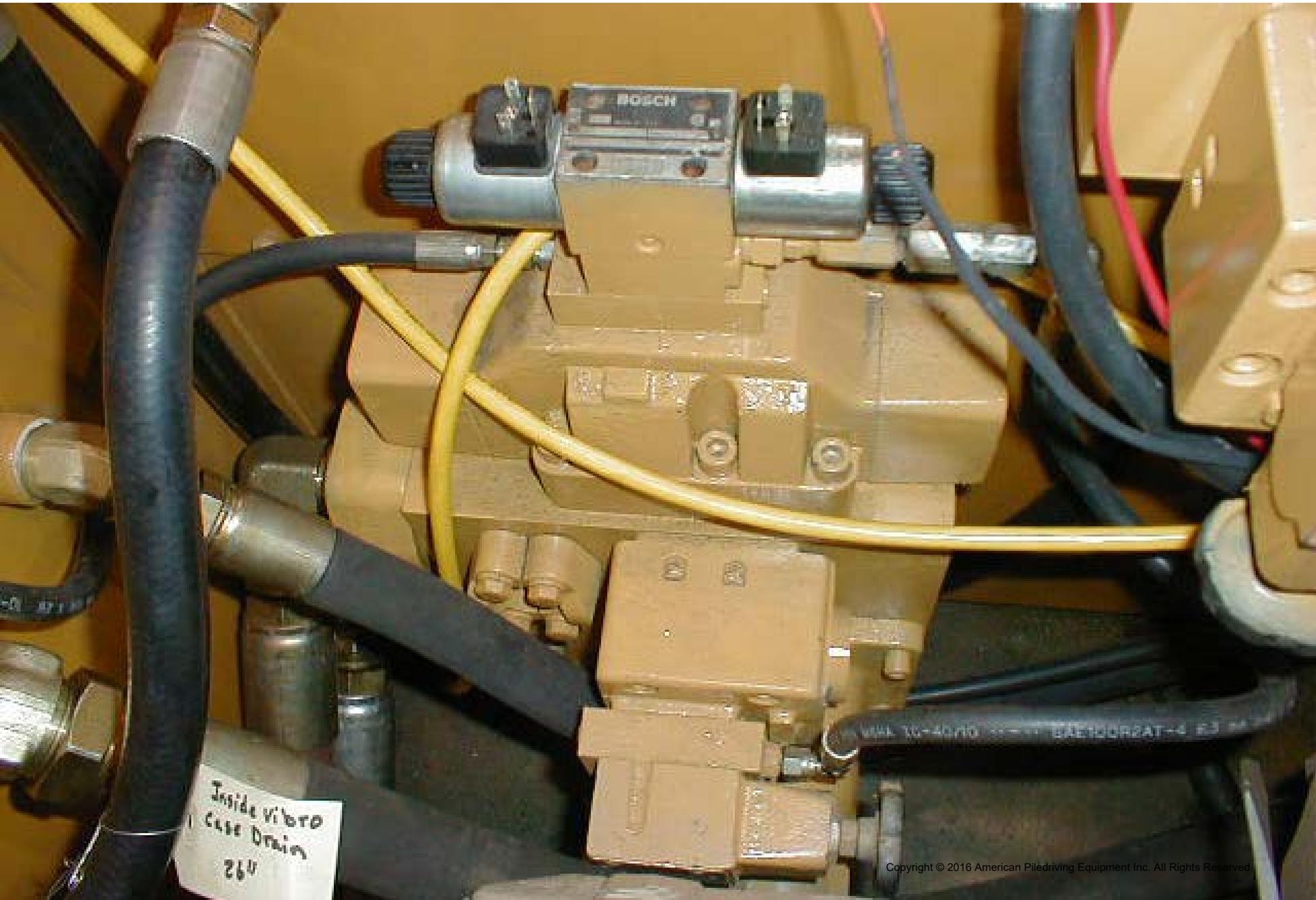
Main drive forward and reverse QD's



Case Drain QD



Drive manifold



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



HOURLMETER

OIL PRESS COOLANT TEMP HYD LEVEL HYD TEMP

DIAGNOSTIC



VOLT METER

STARTING INSTRUCTIONS

APC
American Piledriving Equipment
OPERATOR'S MANUAL

- GENERAL**
 - Preventative measures will help eliminate costly downtime. Please read manual.
- DAILY MAINTENANCE**
 - Check all bolts and nuts.
 - Grease pumps 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 surface and oil pressure in set.
 - Start switch starts engine.
 - Drive and retract in forward position.
- LUBRICATION**
 - Washer - Mobil 10000 Synthetic
 - Overal Engine - TORCO
 - Hydraulic Oil - Mobil EAL 224 Big Redgradeable

Before operation - B is critical to tighten all nuts.
Disconnect P.E.L.C.

200-000-000



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

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

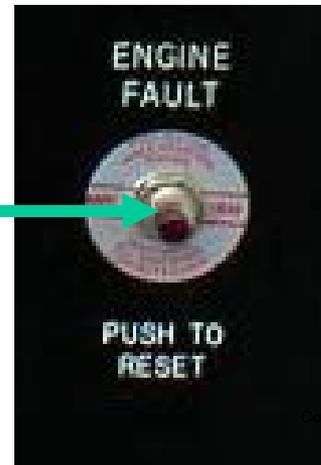


Starts diesel engine.

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.



ENGINE
FAULT



PUSH TO
RESET



OIL PRESSURE

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.

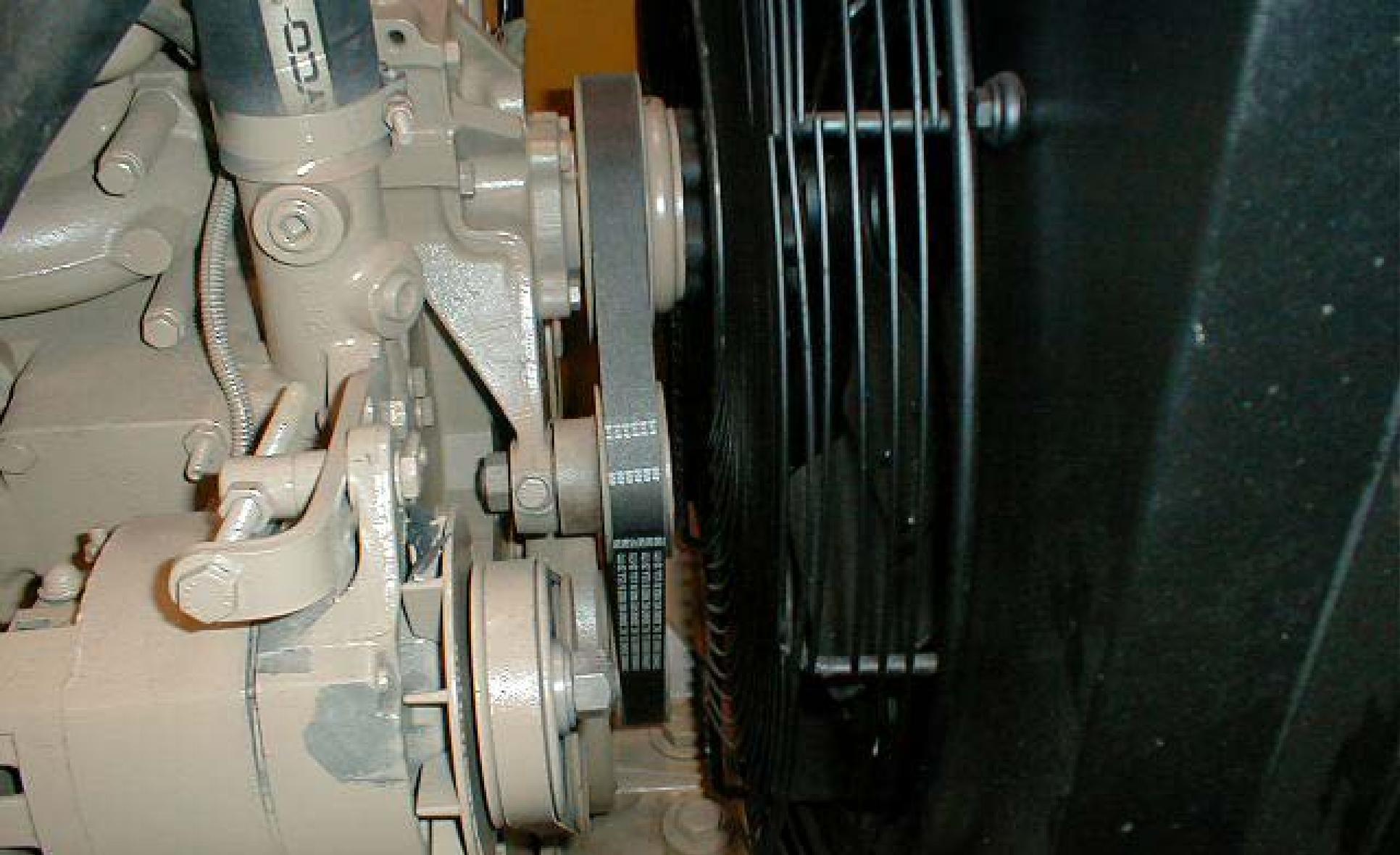
Things to do before starting the engine

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

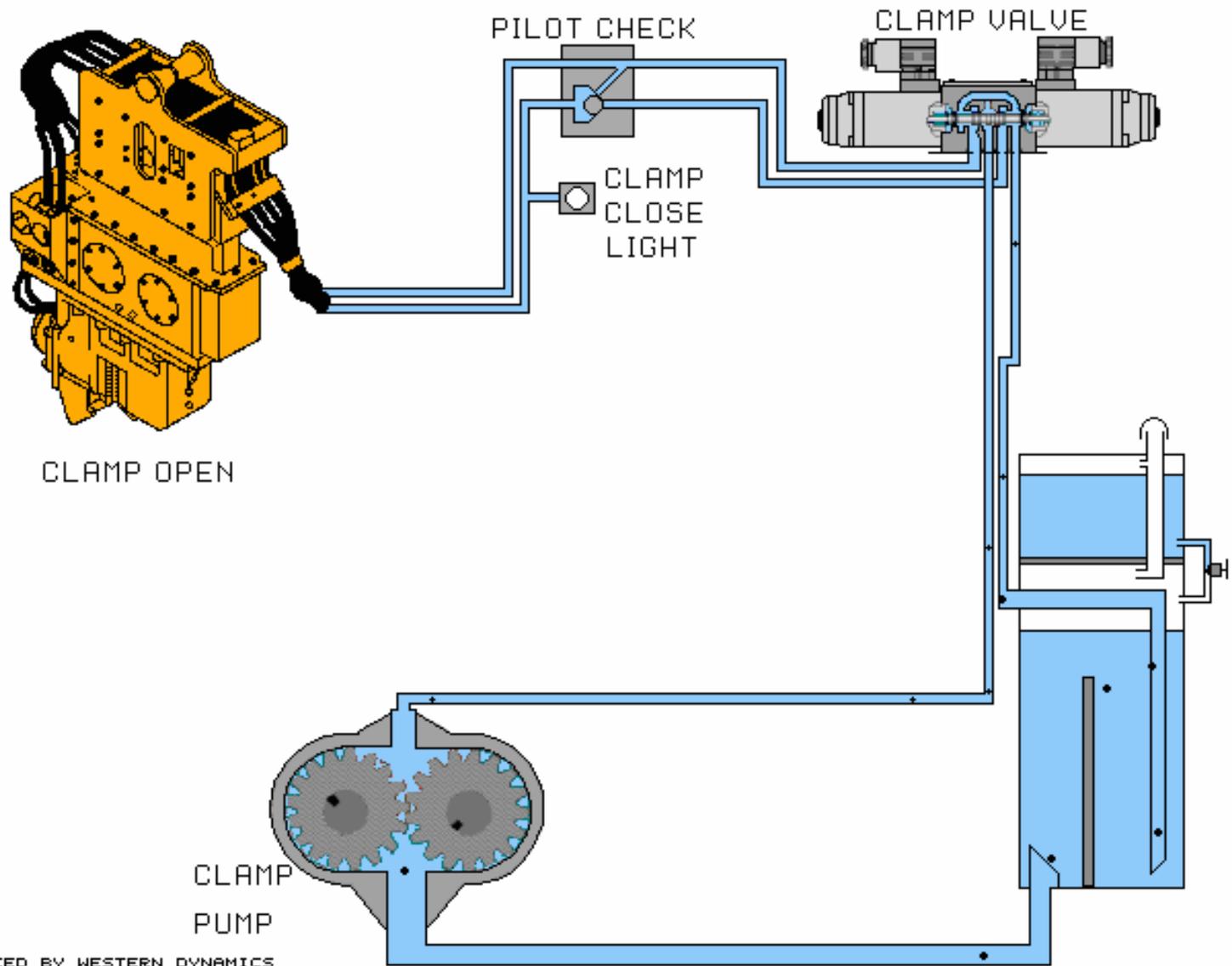
Clamp open/close/off

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

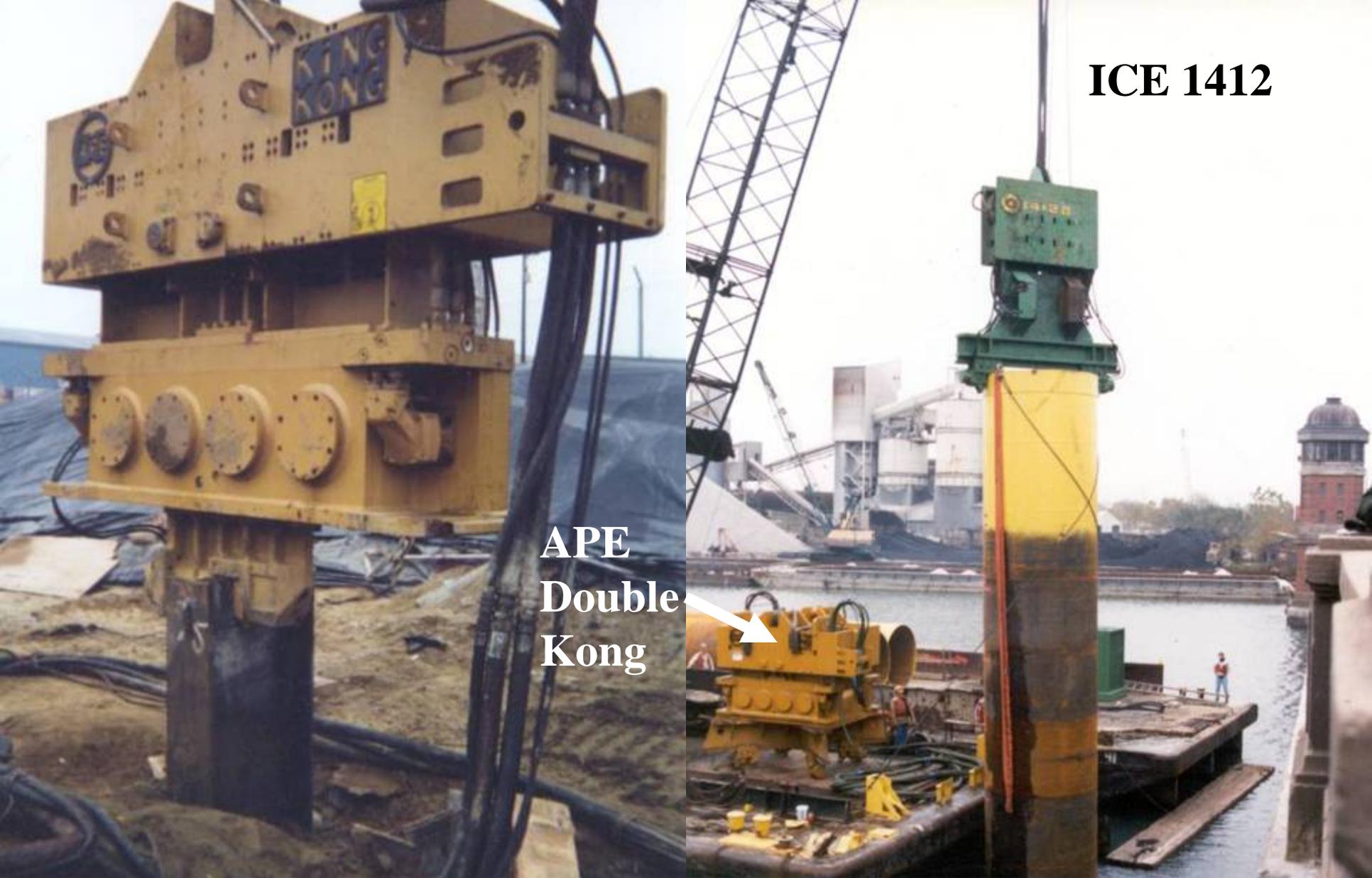


Vibro in action

Vibros in action



ICE 1412



**APE
Double
Kong**



Vibros in action



Vibros in action



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Vibros in action



Tandem vibro with tandem power units



Clamp attachments- two clamps



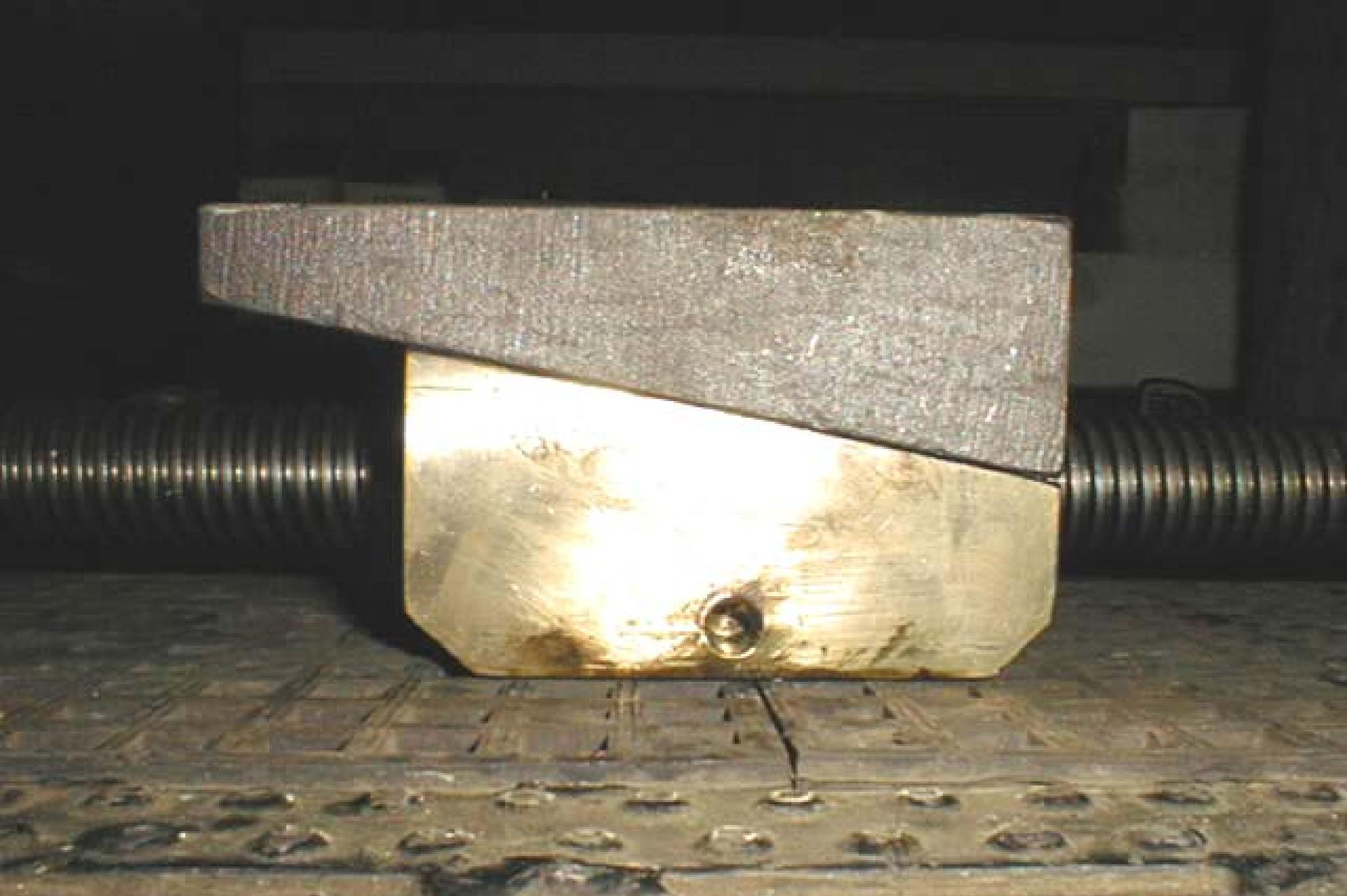
Casing clamps- two clamps Japanese style



Two clamp system-French style

Adjusting clamps





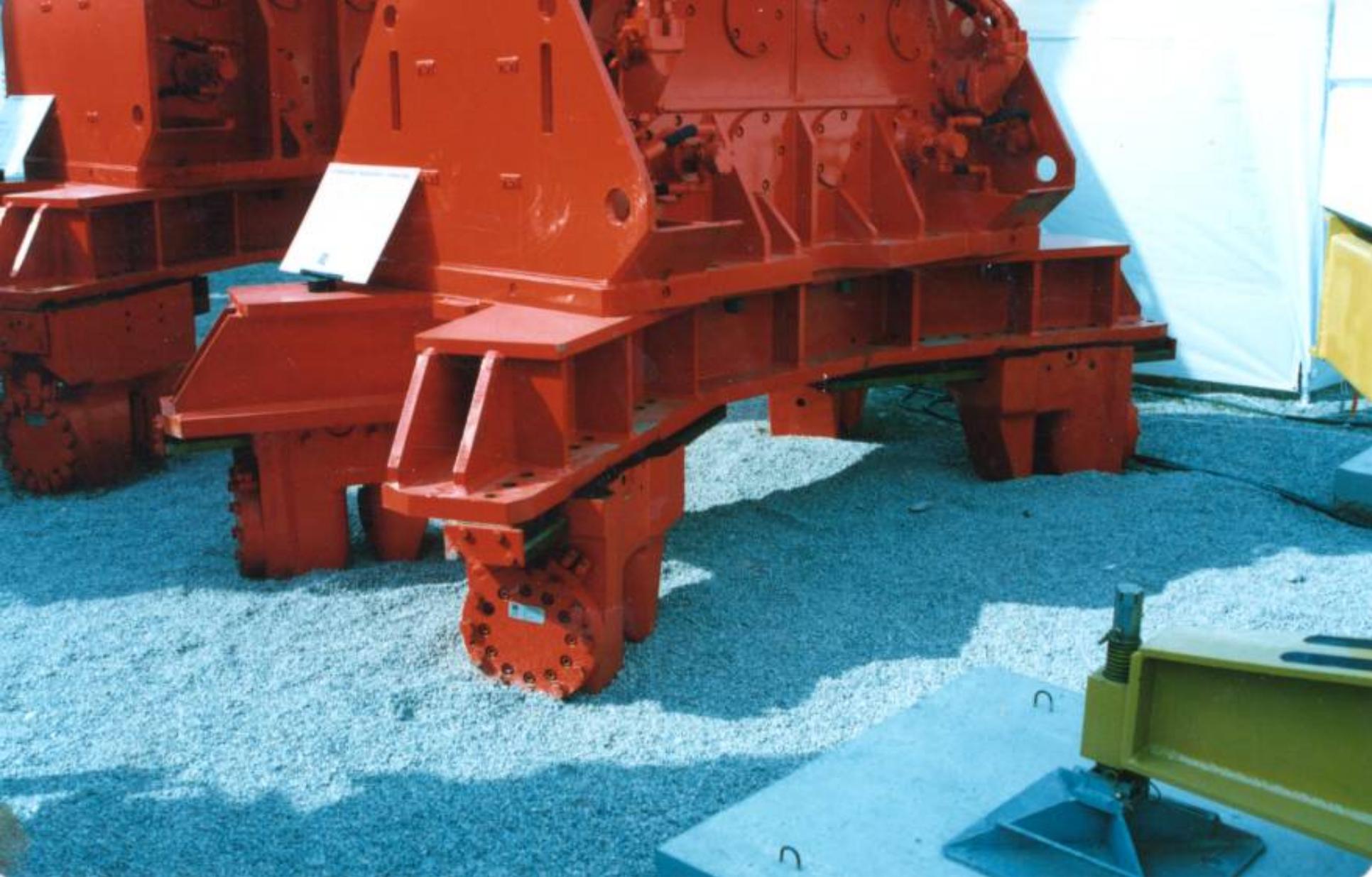
Rotating all thread raises or lowers wedge distance

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:

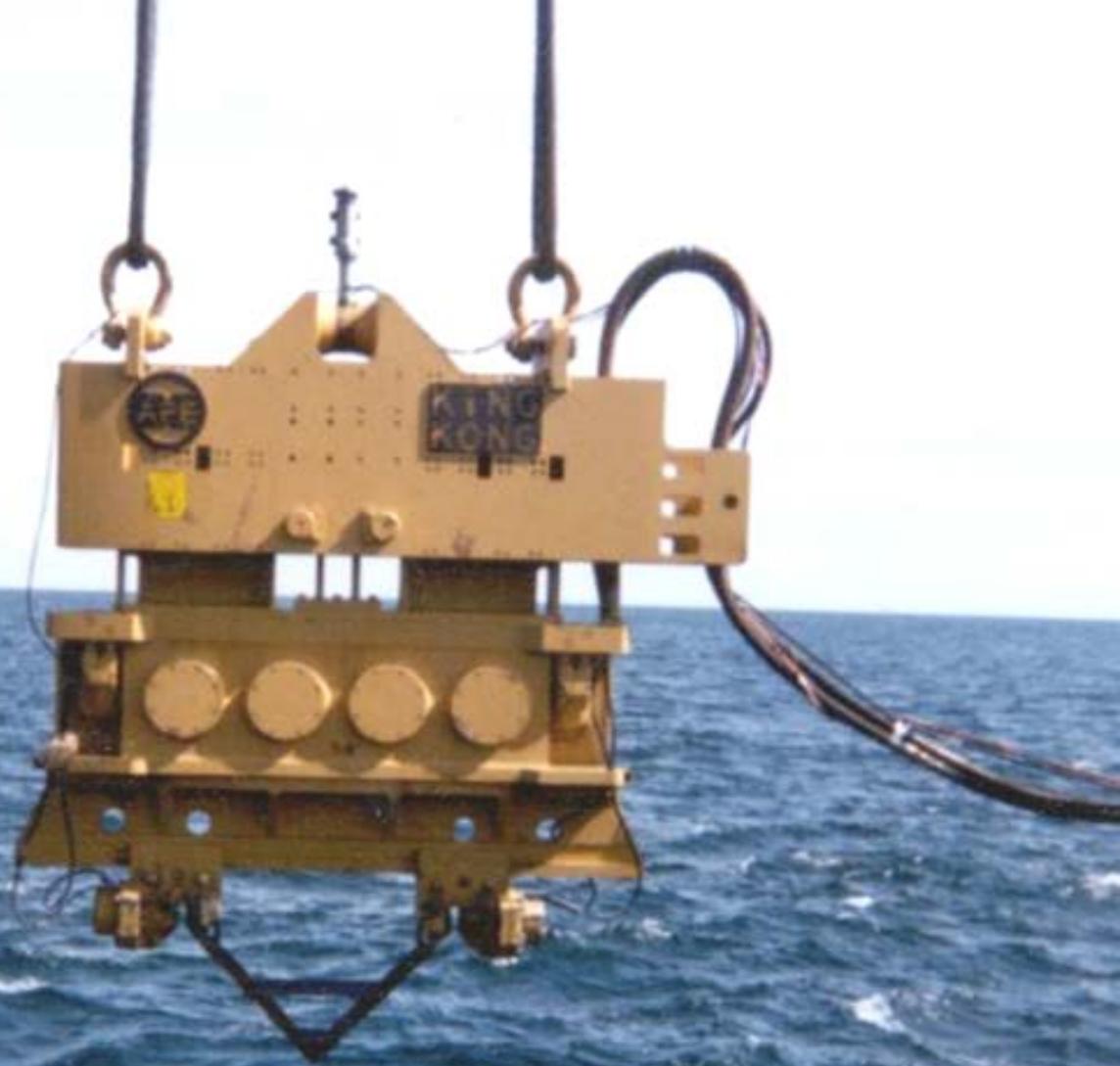
Keep jaws from tearing off top of casing

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