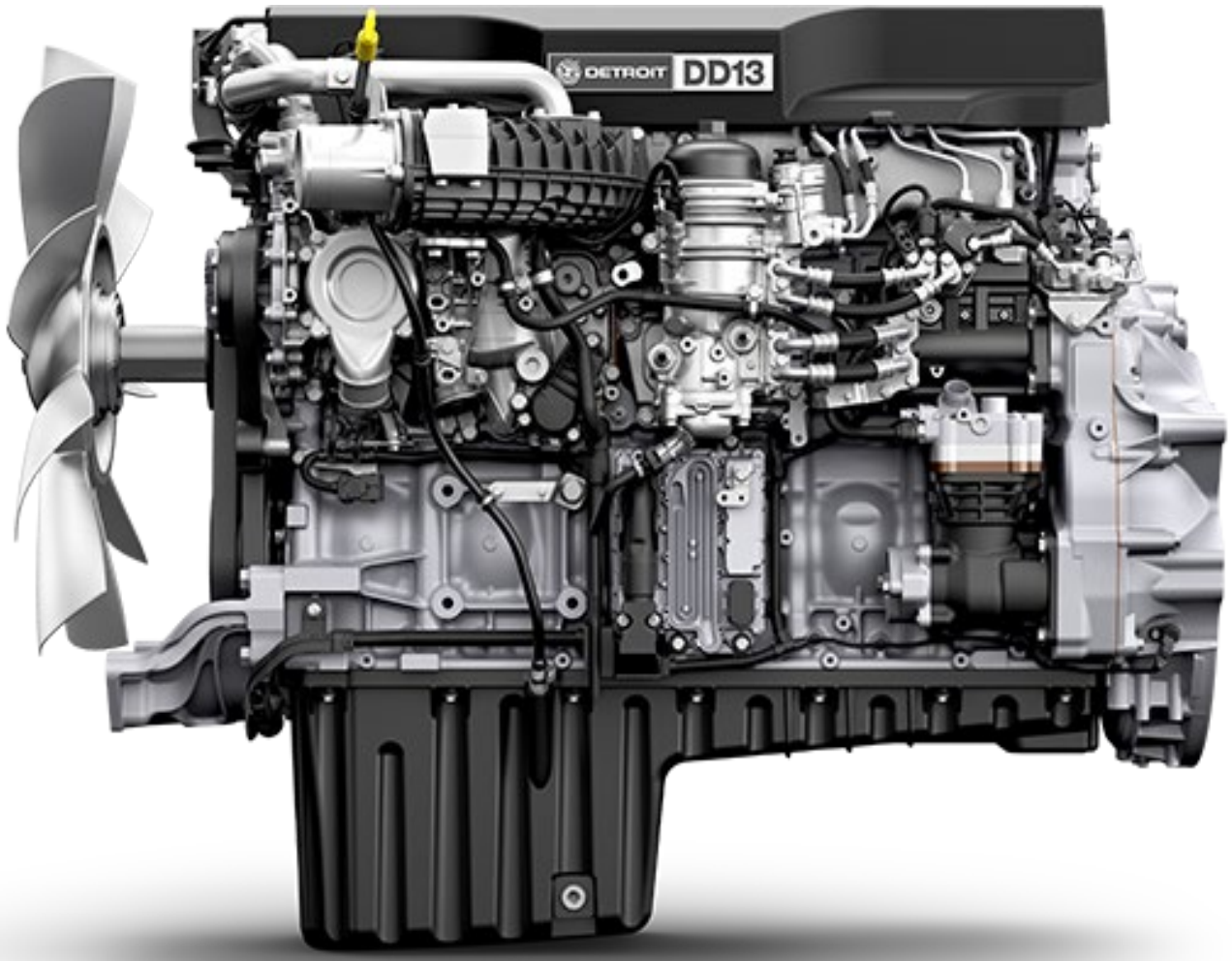
Session III

Components

Revised 8/22

Diesel Engine Theory



Why do I need to know this?

- Enhance your ability to interact with the repair facility and the mechanics when discussing diesel engines.

- To build confidence and teamwork between you and the repair facility.

Gasoline Vs. Diesel Engines

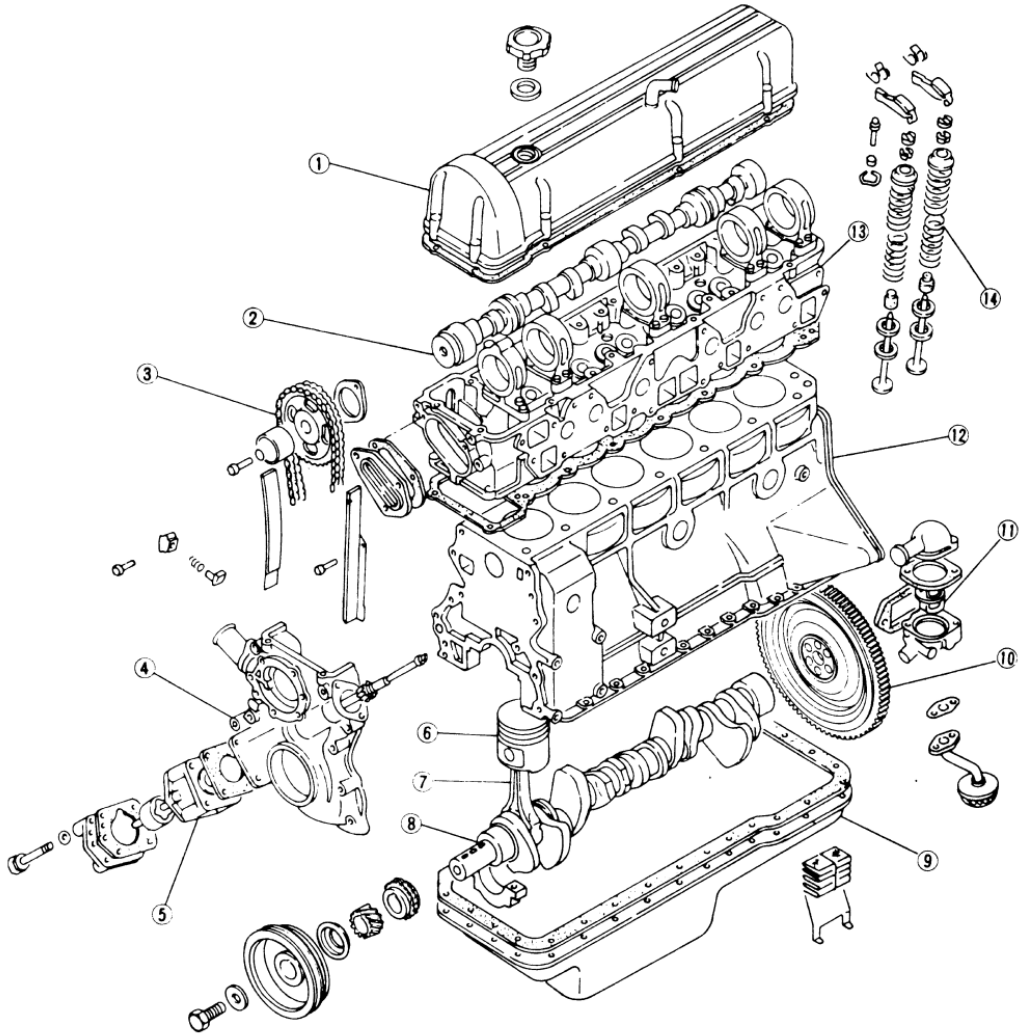
Gasoline Engines

- Internal combustion
- Intakes a mixture of fuel and air into combustion chamber
- Depends on spark plugs for ignition
- Higher horsepower
- Lower torque
- Lower compression
  (Aver gas engine 9:1 compress = 139 psi)
- Turn at higher RPM's

Diesel Engines

- Internal combustion
- Injects fuel into compressed air in the combustion chamber
- Uses the "heat of compression" for ignition, No Spark plugs.
- Higher torque
- Higher compression
  (DD13, 18.4:1 compression = 270 psi)
- Turn slower, Last longer

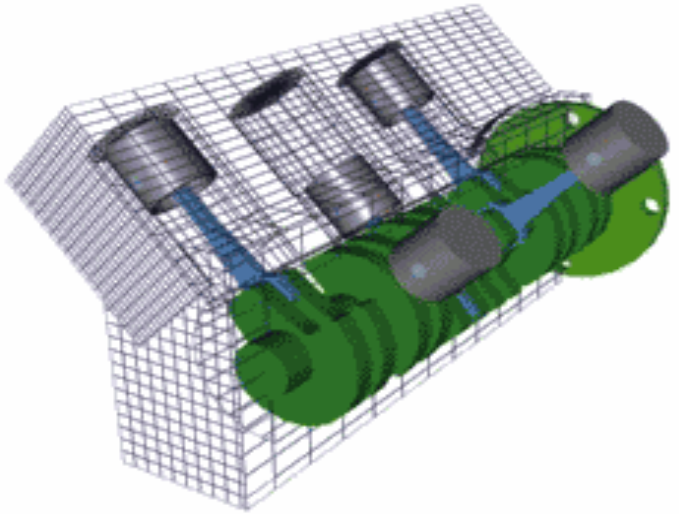
Basic Engine Components

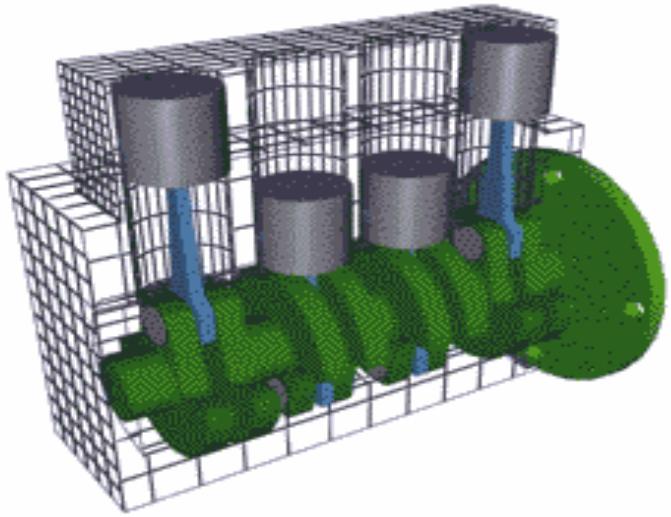


1. Rocker cover
2. Camshaft
3. Timing gear
4. Front cover
5. Oil pump
6. Piston
7. Connecting rod
8. Crankshaft
9. Oil pan
10. Flywheel
11. Thermostat
12. Cylinder block
13. Cylinder head
14. Valve mechanism

Basic Engine Components

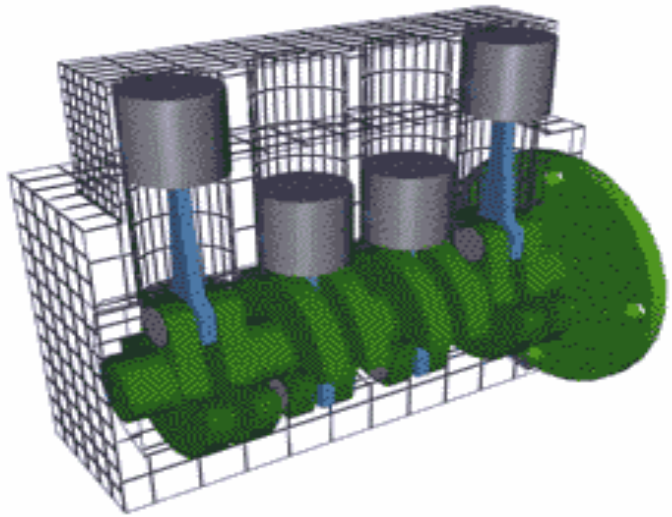
Crankshaft and Pistons





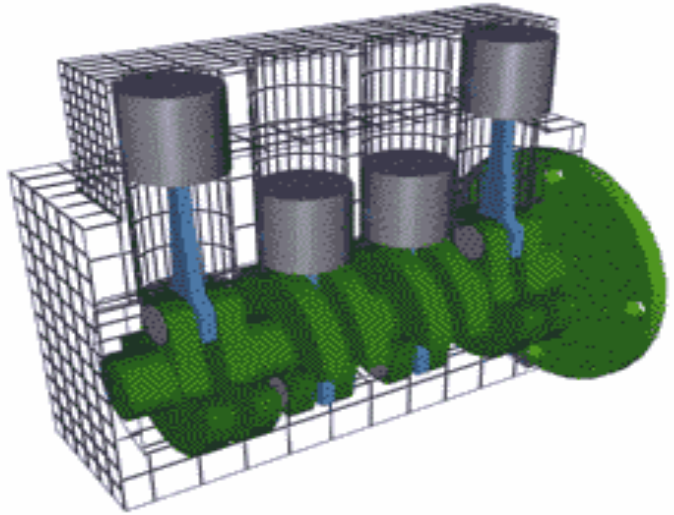
Principles of Operation

1. The starter cranks the engine, turning the crankshaft.
2. The crankshaft pushes and pulls the connecting rods up and down.
3. This moves the pistons up and down in the cylinders.
4. When the piston moves downward air is pulled into the cylinder.



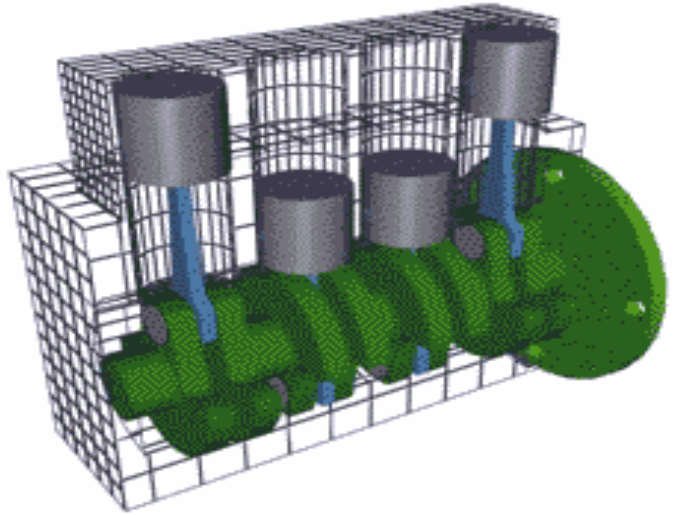
Principles of Operation

- The piston moves upward compressing the air.
- As the air is being compressed, it also begins to heat up. When the piston gets close to top dead center of the cylinder, fuel is injected into the cylinder. The hot compressed air ignites the fuel.

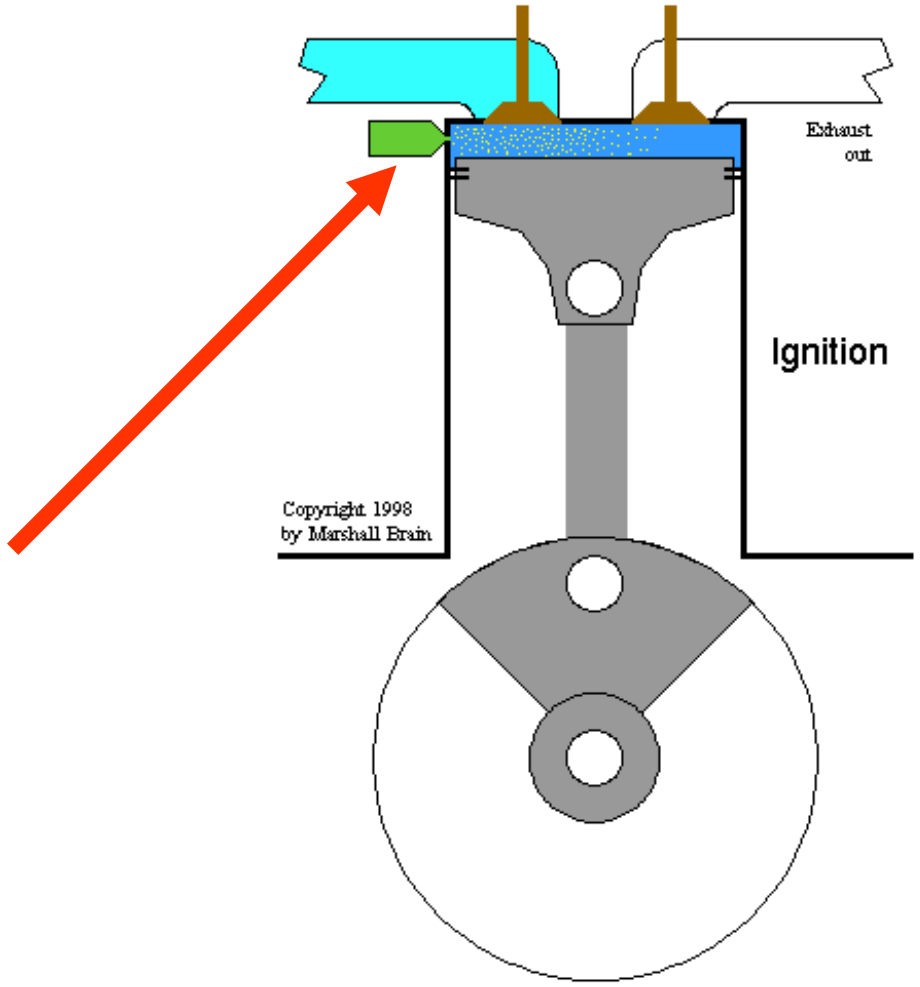


Principles of Operation

- The temperature and compression increase as the fuel burns.
- The pressure forces the piston down.
- The connecting rod transfers this downward thrust to the crankshaft

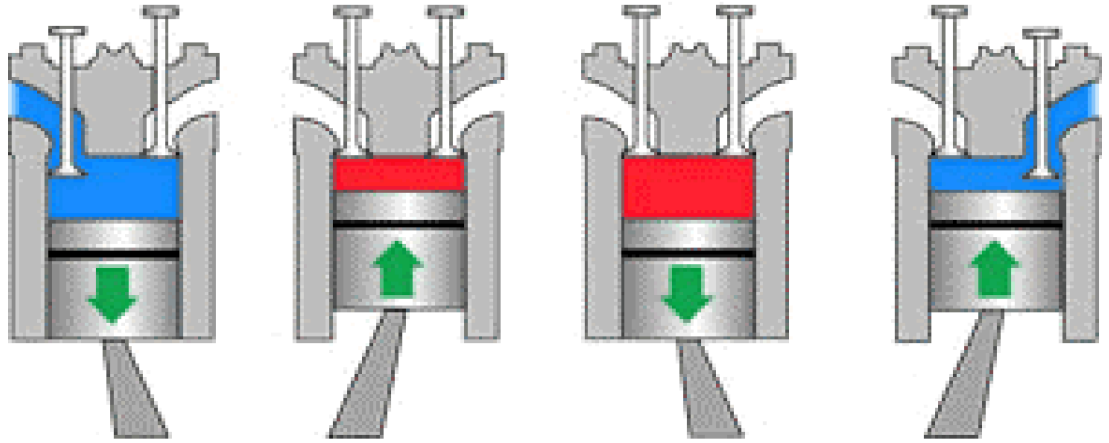


Fuel Injectors



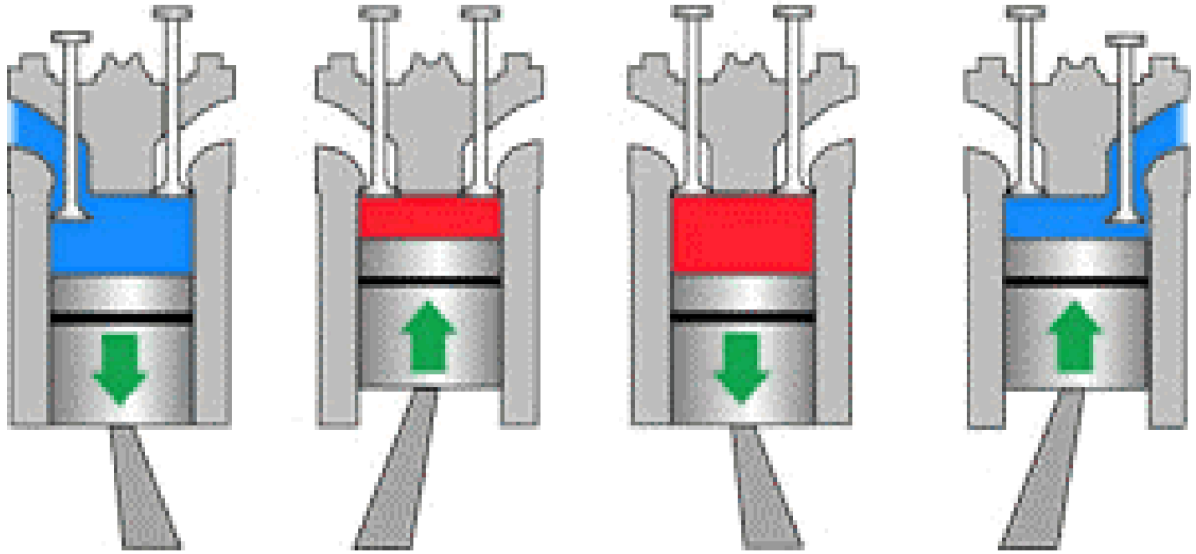
Four Stroke (Cycle) Engines

- The piston makes four strokes in its combustion process: Intake, Compression, Power, and Exhaust.
- Intake stroke, downward motion with intake valves open.
- Compression stroke, upward motion with both valves closed.



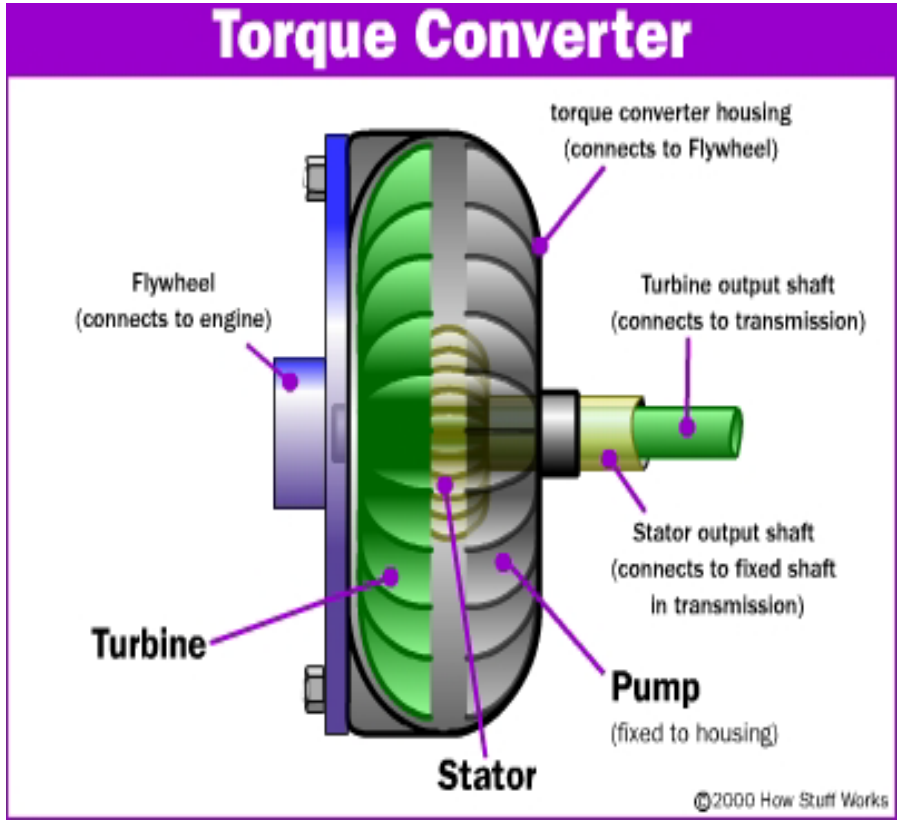
Four Stroke (Cycle) Engines

- Power stroke, downward motion after fuel ignited, both valves closed
- Exhaust stroke, upward motion with exhaust valves open.
    - Intake, Compression, Power, and Exhaust



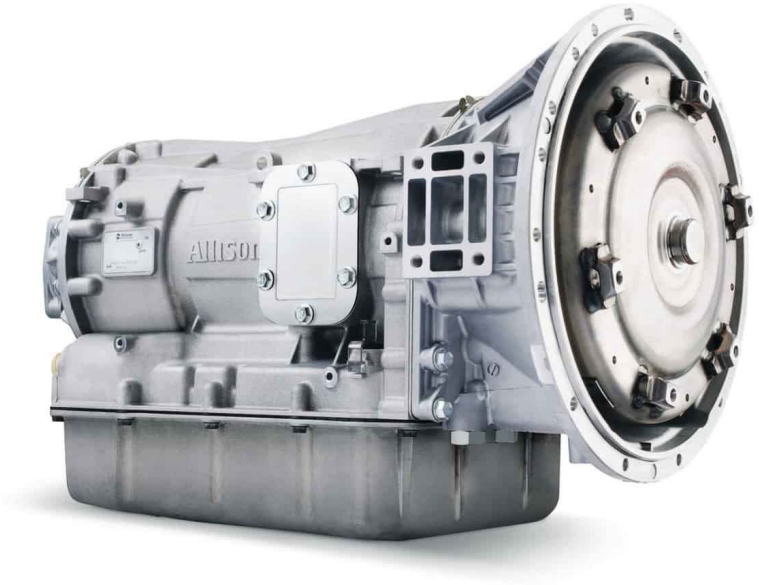
Automatic Transmission

- The torque converter is a fluid coupling that acts like a clutch.
- The engine transmits power from the crankshaft to the transmission through a torque converter.
- On large apparatus these are referred to as “Torque Multiplier”.



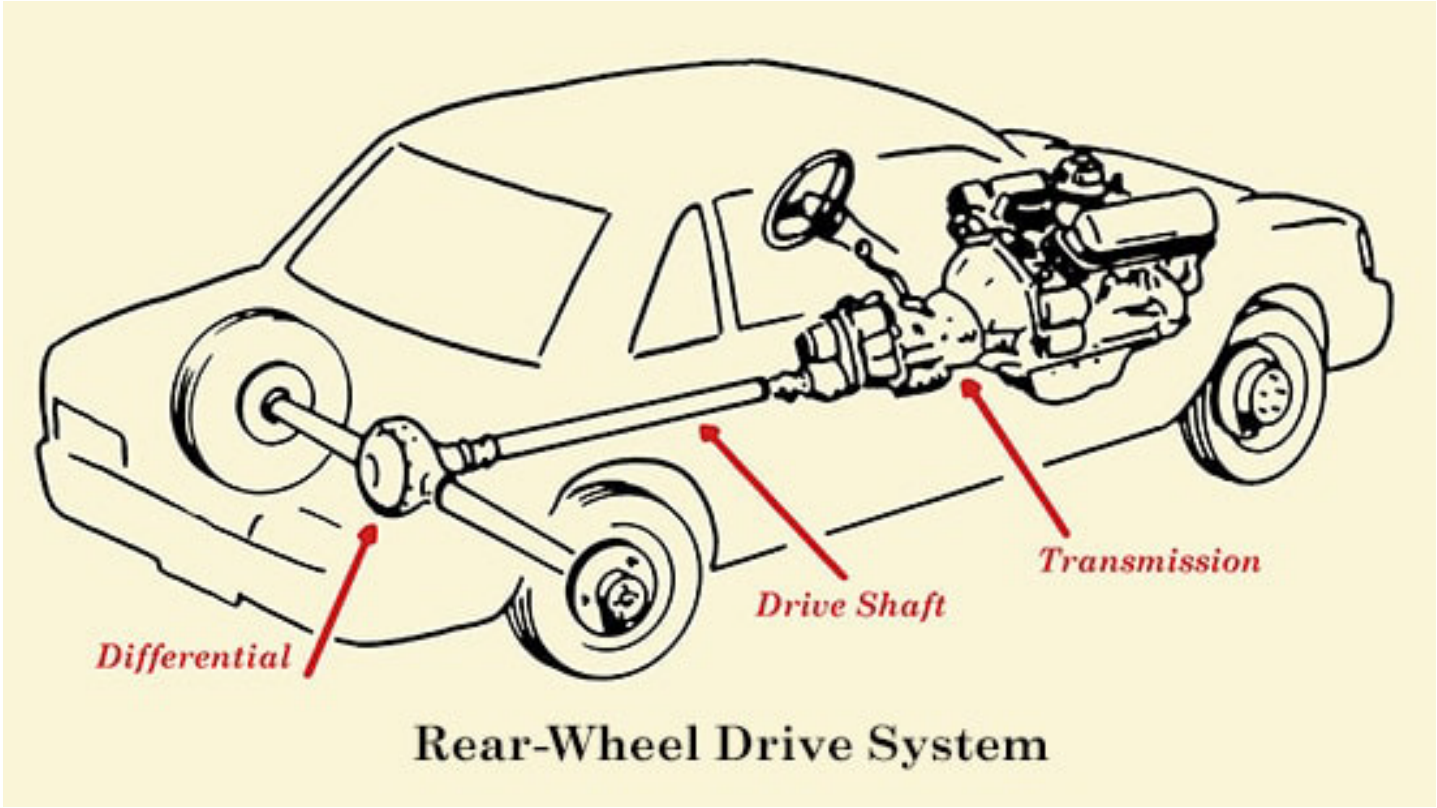
Automatic Transmission

- The transmission transmits power to the wheels through the drivetrain.
- The drivetrain is the transmission, drive shaft(s), differential, axles and wheels.



Principles of Operation

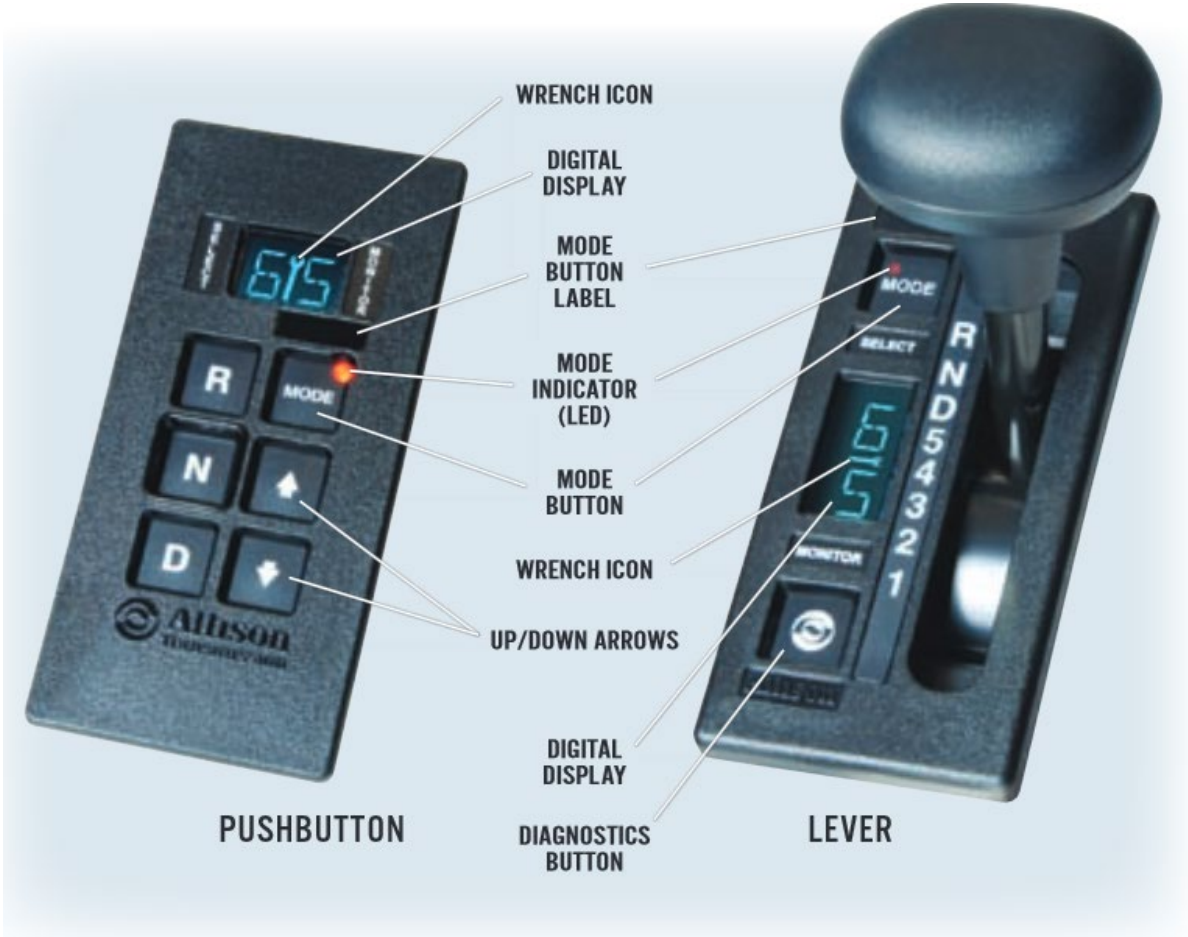
The Drivetrain



Rear-Wheel Drive System

Automatic Transmission

T-handle or push button to select gears.



Automatic Transmission

- T-handle shifter; LED display shows the gear range on top and the current gear that it is in on the bottom.
- Push button selectors; LED display shows the gear range on the left and the current gear on the right.
- For road operations place in "D", the transmission will operate from 1 - 6th gear.

Automatic Transmission

- The most accurate and effective process for checking the transmission fluid in an Allison Transmission is to use the push button shift selector and request that the transmission do so itself.

- While warmed up (104° to 220° F), idling and on level ground, push the up and down arrows simultaneously.

- If the fluid is warm enough, a countdown will start. When complete the transmission will report back O -L -O -K. If low, it will state O –L –L –O and the number of quarts it needs. If too high it will state O –L –H –I and the amount in quarts needing removed.

- Exit by hitting the “N” neutral button

Automatic Transmission

Transmission oil check procedures

Cold Check Method 1, Engine not running

- Place apparatus on level surface; set parking brake, and position wheel blocks.
- Engine off. Using the transmission dip-stick, check to see that there is transmission fluid present on the stick. If not, do not start the vehicle. There is not enough fluid to prevent damage.

Automatic Transmission

Transmission oil check procedures

Cold Check, Method 2, Engine Running at Idle.

- Using the dipstick, Check that the fluid level is within the cold range. If it is below the cold range, add fluid until it is within but not above the cold range.
- If the fluid level is above the cold range, it is either “not cold” and has expanded, or it is overfilled.
- If overfilled, please call the shop and ask for help correcting this.

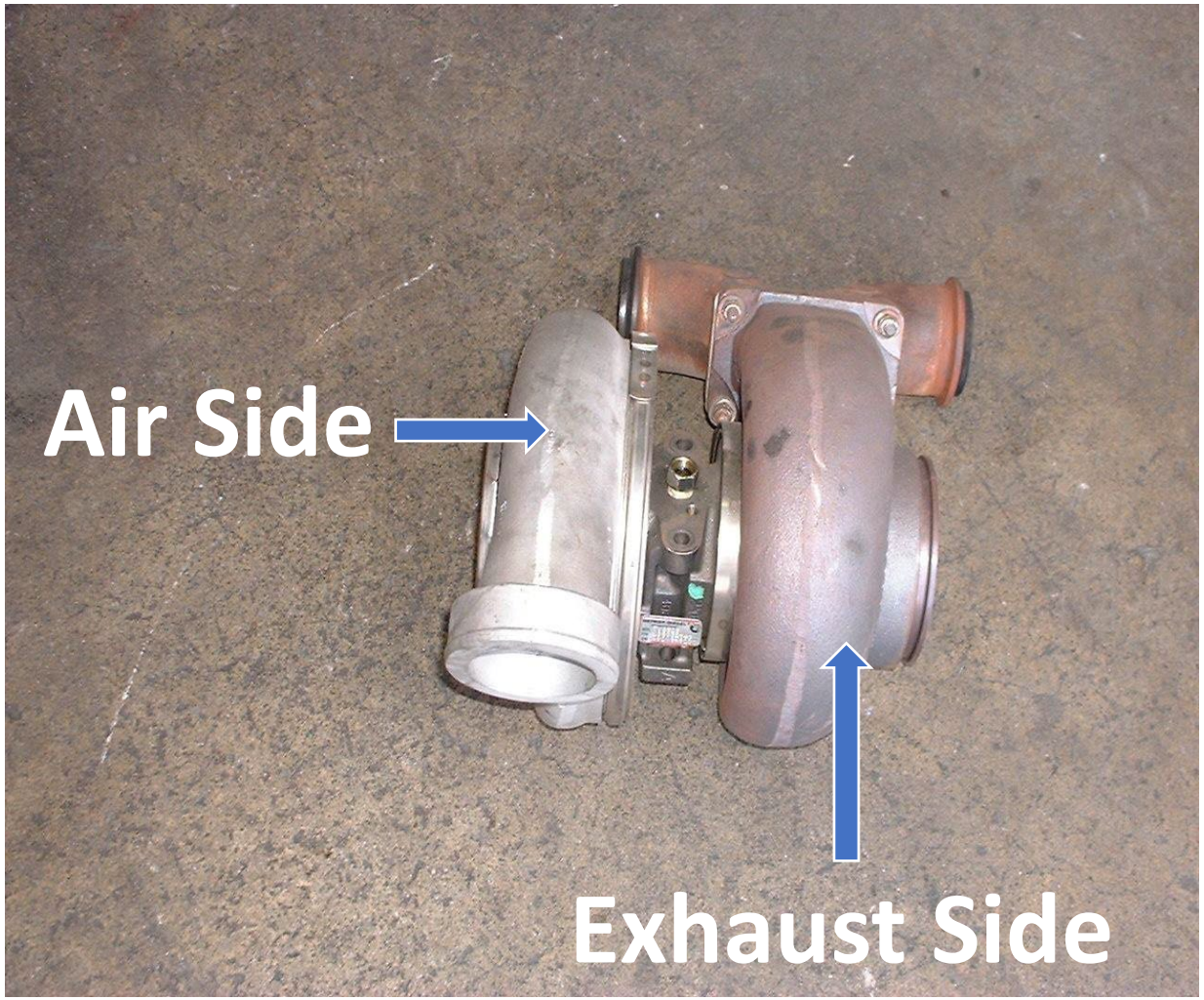
Automatic Transmission

Transmission oil check procedures

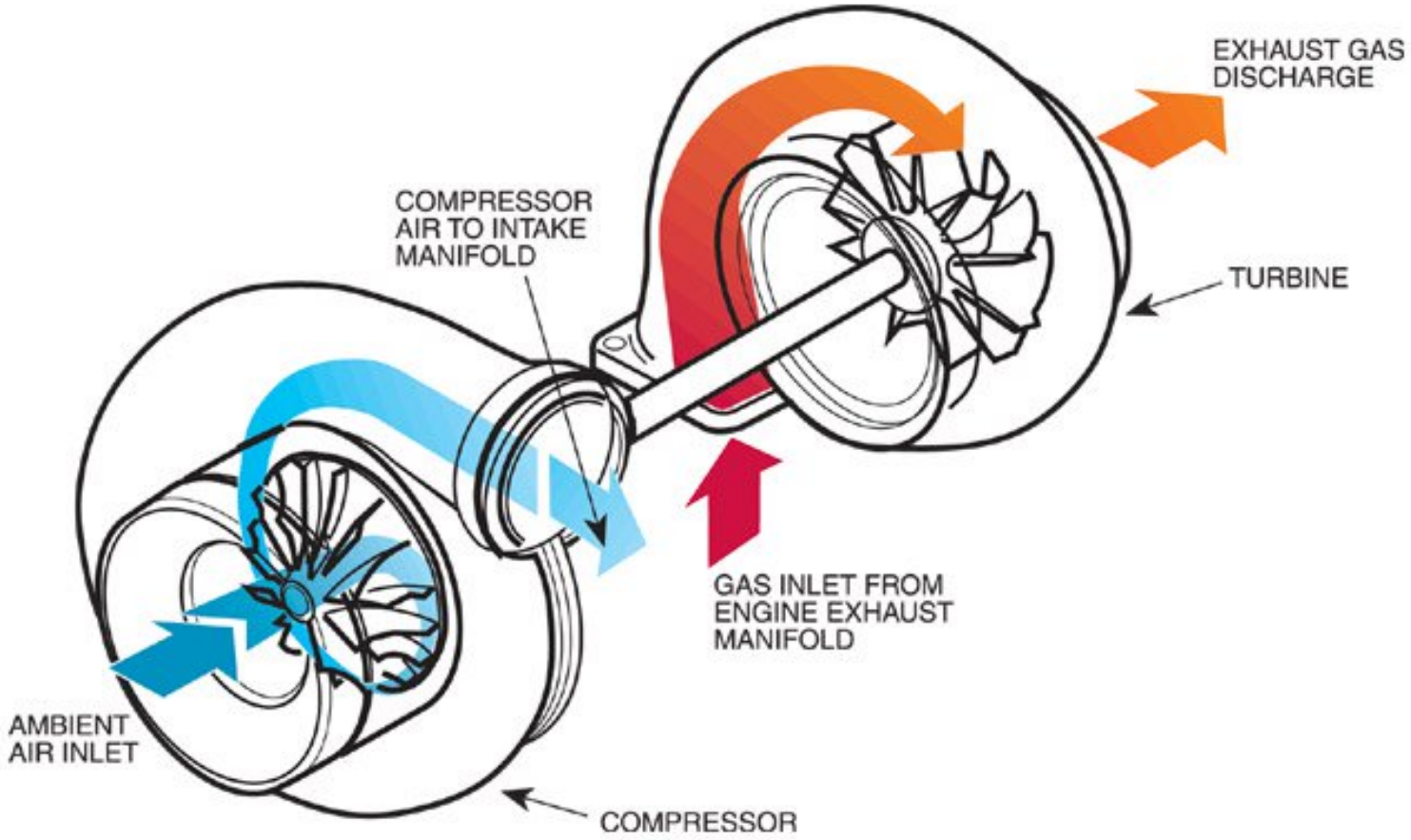
- **Hot check** Engine running
- As before, engine running at idle speed, level ground, brakes set and wheel blocks in position.
- Use the dipstick and check that the fluid is in the “Hot” range. If low add as necessary to bring it up to the “Hot – full” level. Please do not over-fill. Should this happen, please call the shop for assistance.

Turbo Charger

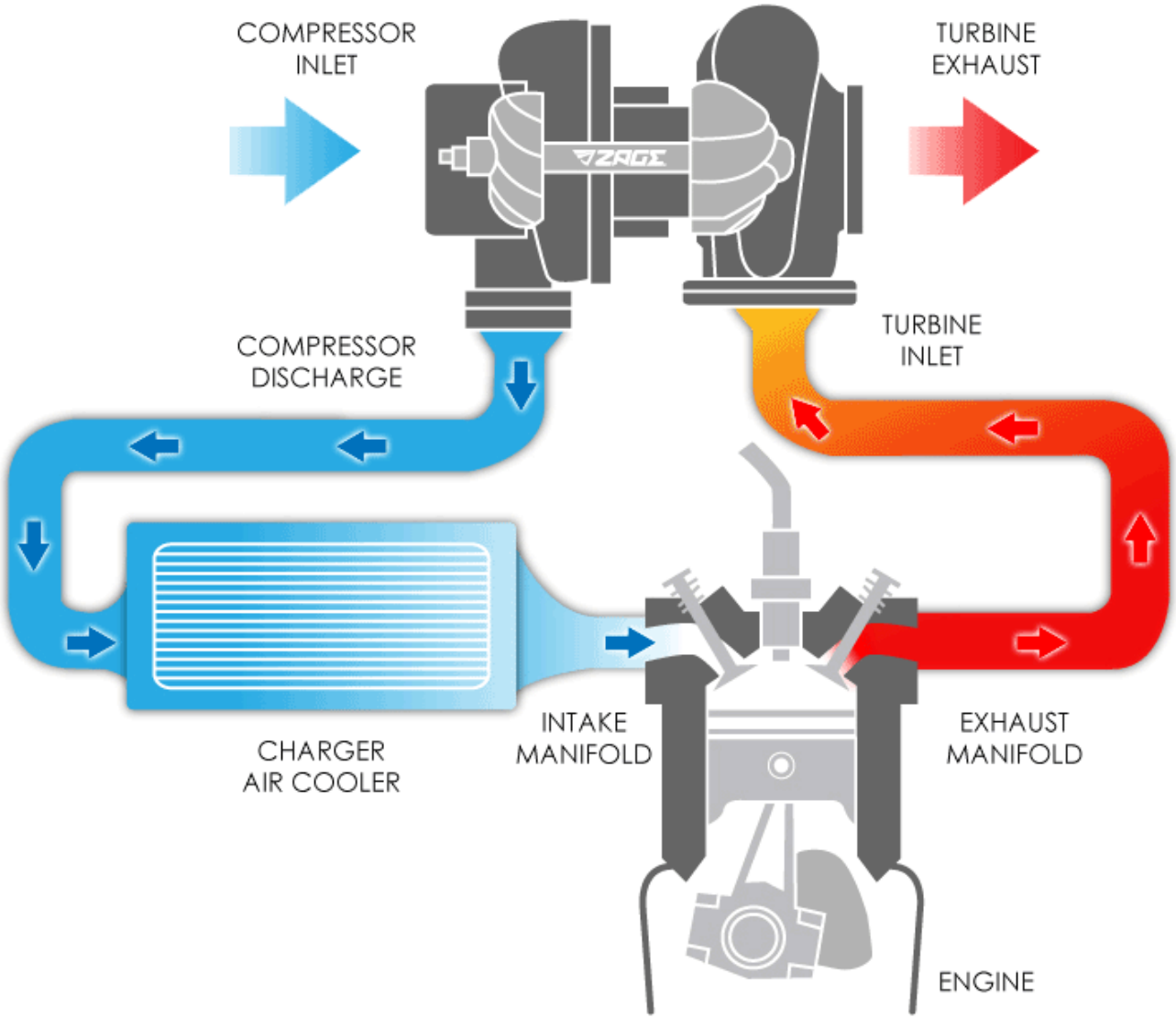
Turbo Charger



Turbo Charger Theory

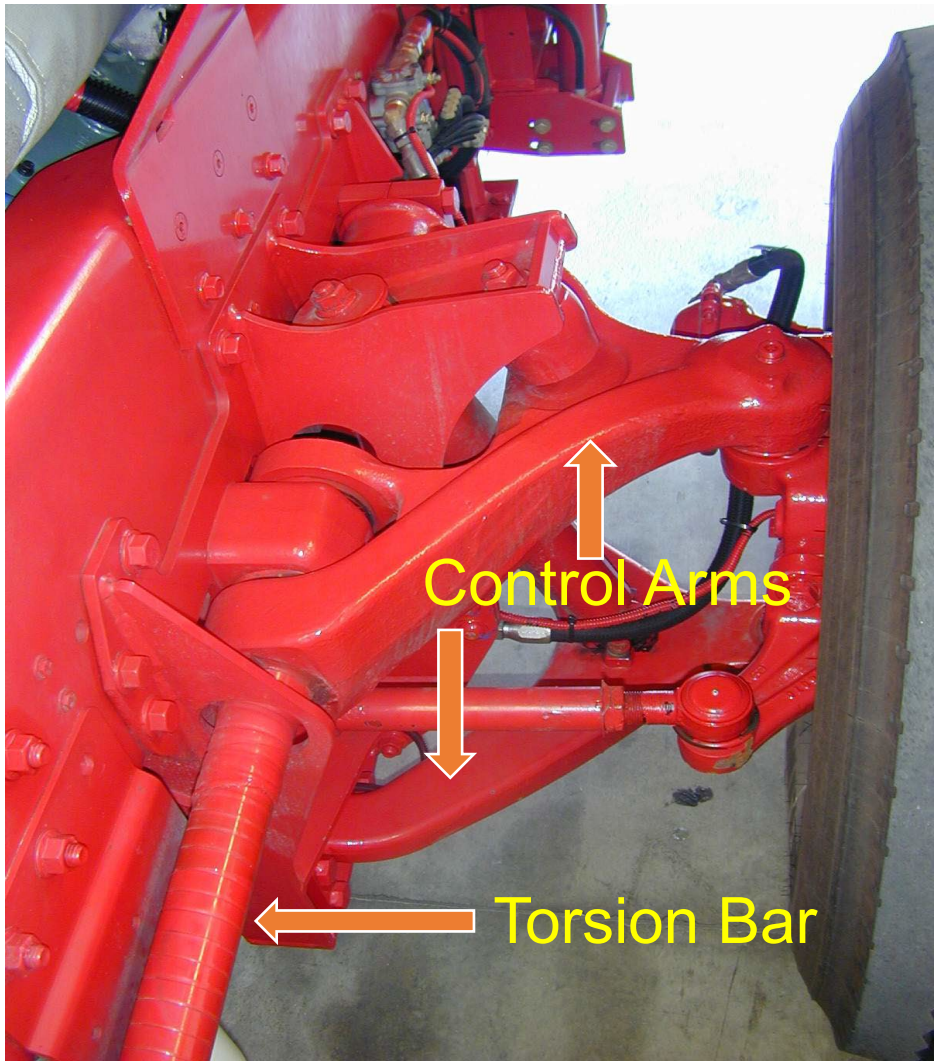


Turbo Charger Theory

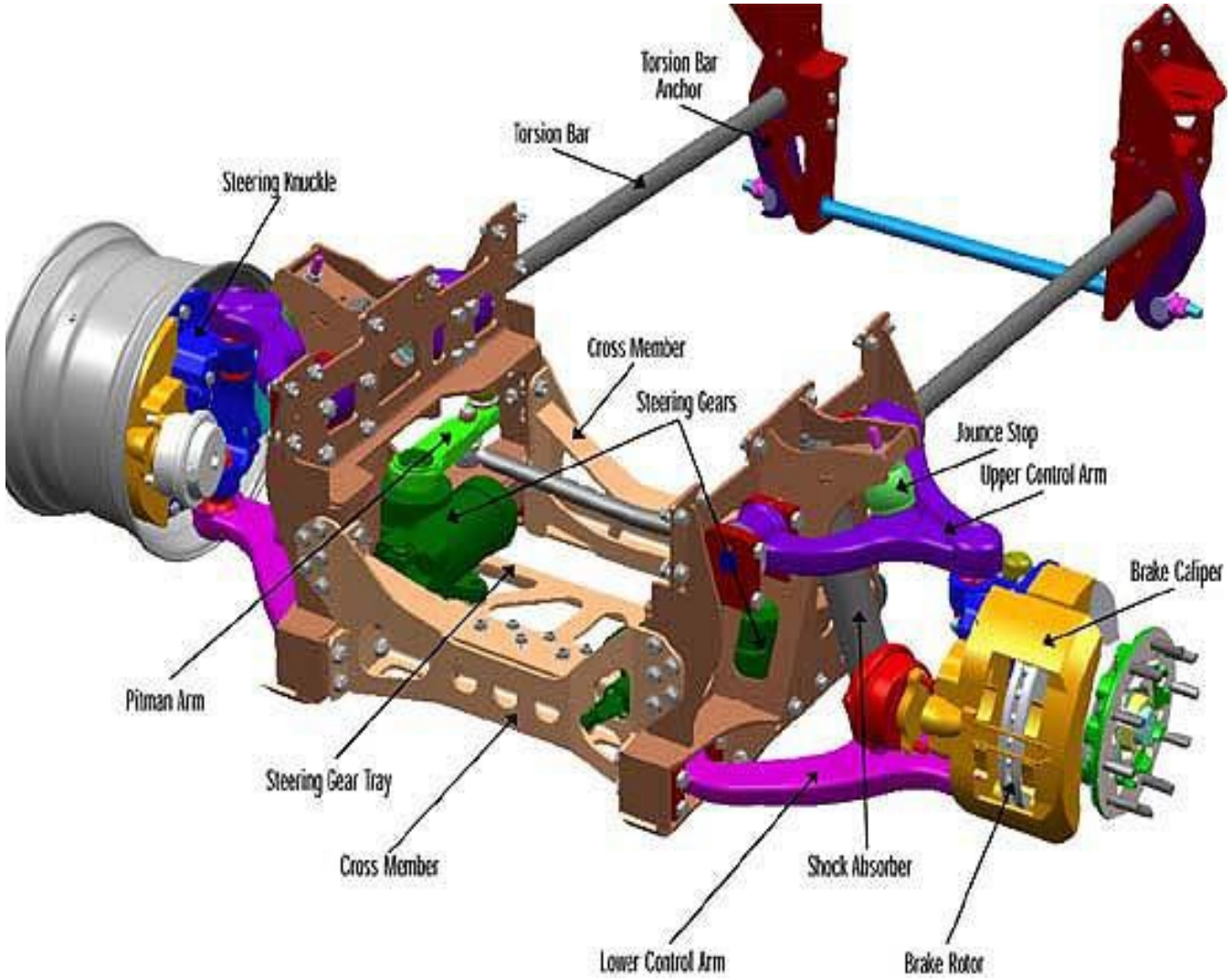


Independent Front Suspension

- Upper and Lower control arms (“A” arms)
- Torsion Bars = Springs
- 45° Turning Angle
- Smooth Ride



Independent Front Suspension



Engine Governor

- Controls fuel input to limit maximum engine speed and to maintain idling speed.
- The Fire Pump sets the maximum horsepower and engine speed limits for our Triple Combo Pumpers.
- Refer to apparatus specification manual or pump panel placard for the specific governor speed for each apparatus.

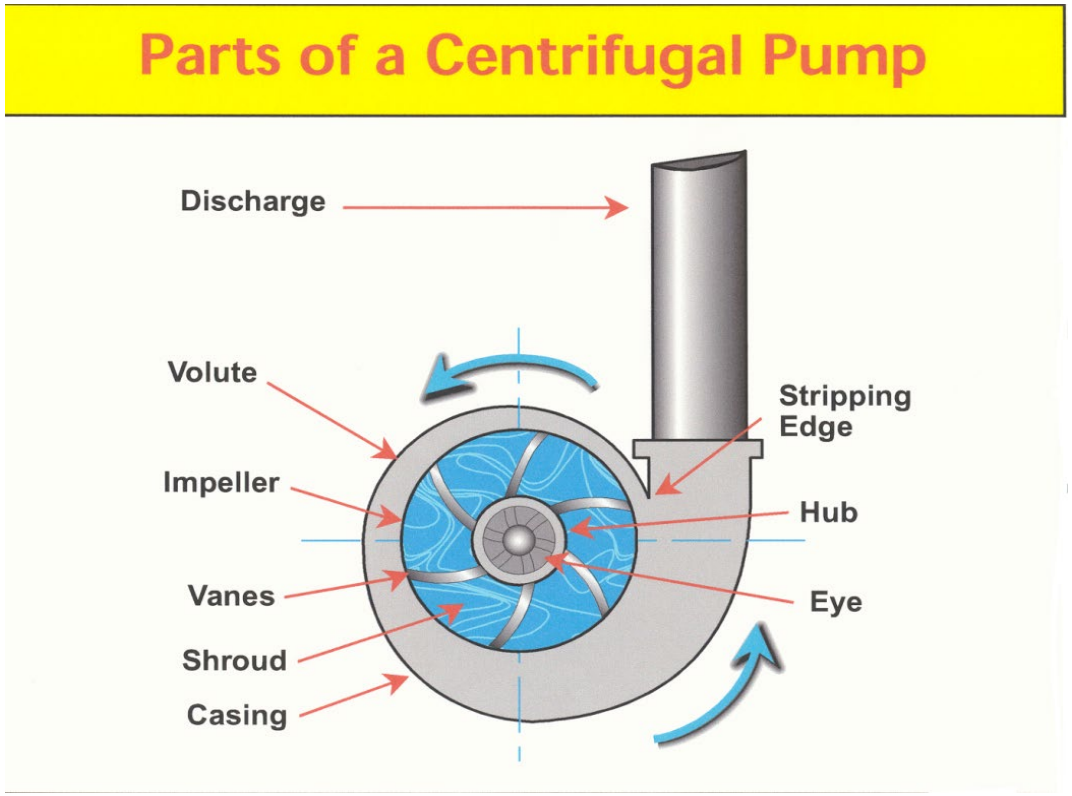
Types of Water Tanks and Design

- Poly Tanks (most common)
- Aluminum Tanks
- Steel Tanks

- Tank design helps keep a lower center of gravity and prevent liquid surge in the apparatus.
- The “T Tank” design is the most common

Centrifugal pump

The operation of centrifugal pumps is based on the principle that a rapidly revolving disc will tend to throw water introduced at the center toward the outer edge of the disc through the volute.

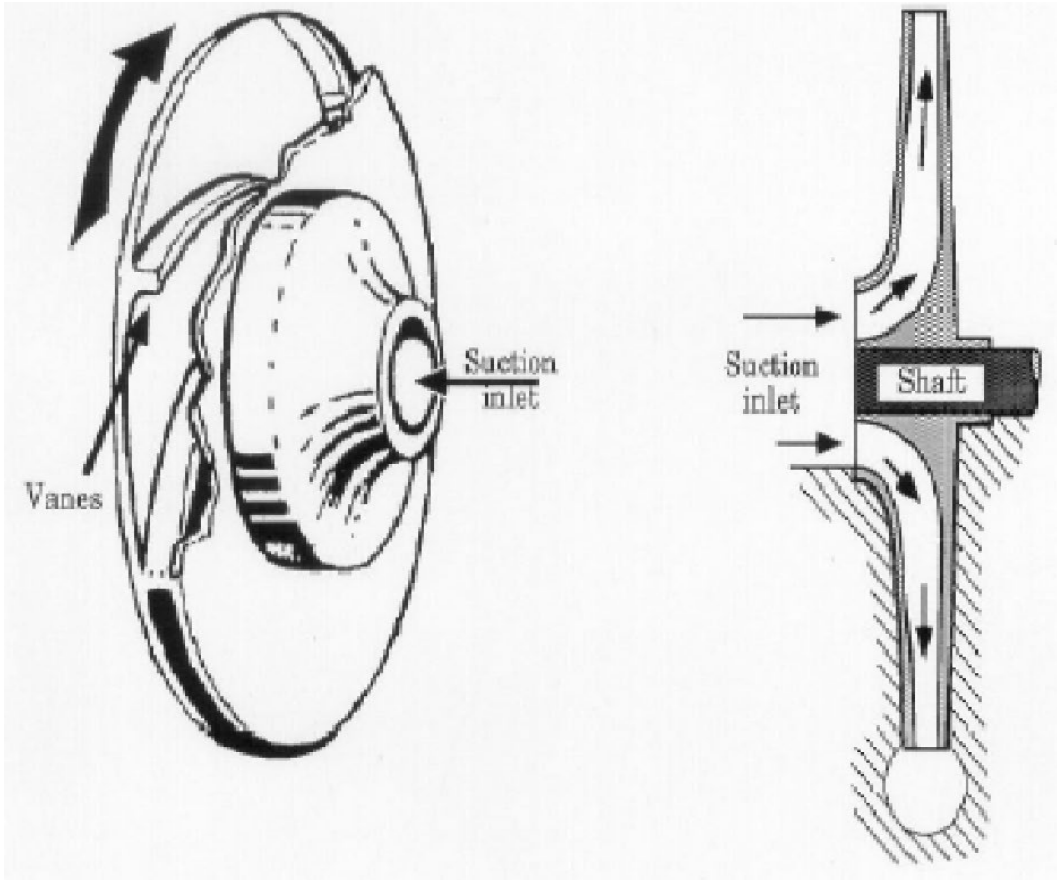


Centrifugal Pump

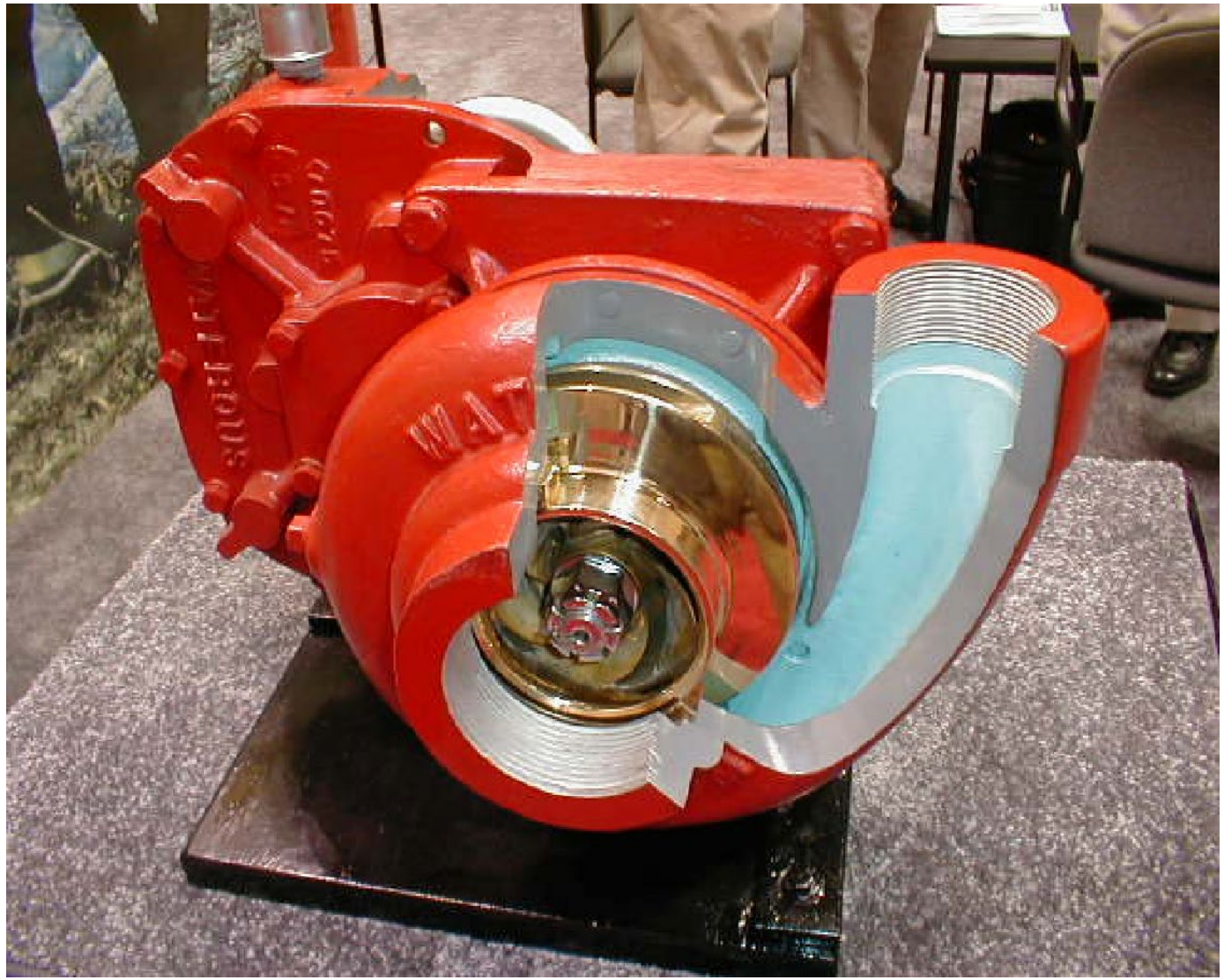
- Most common
- Positive pressure
- Cannot pump air
- Uses a primer pump
- Single or multiple stage

Centrifugal Pump

- Centrifugal
- Water is introduced at eye, thrown out by impeller



Pump Cutaway



Single & Two Stage Pumps

YouTube Videos explaining the basic concepts

https://www.bing.com/videos/search?q=waterous+two+stage+centrifugal+pump&view=detail&mid=782826D65905281DDAA4782826D65905281DDAA4&FORM

2 Stage Fire Pumps

- Two stage pumps are ideal for lower horsepower apparatus (brush Rigs).

- The two smaller impellers are easier to turn yet the pump can be reconfigured to behave like a much larger pump.

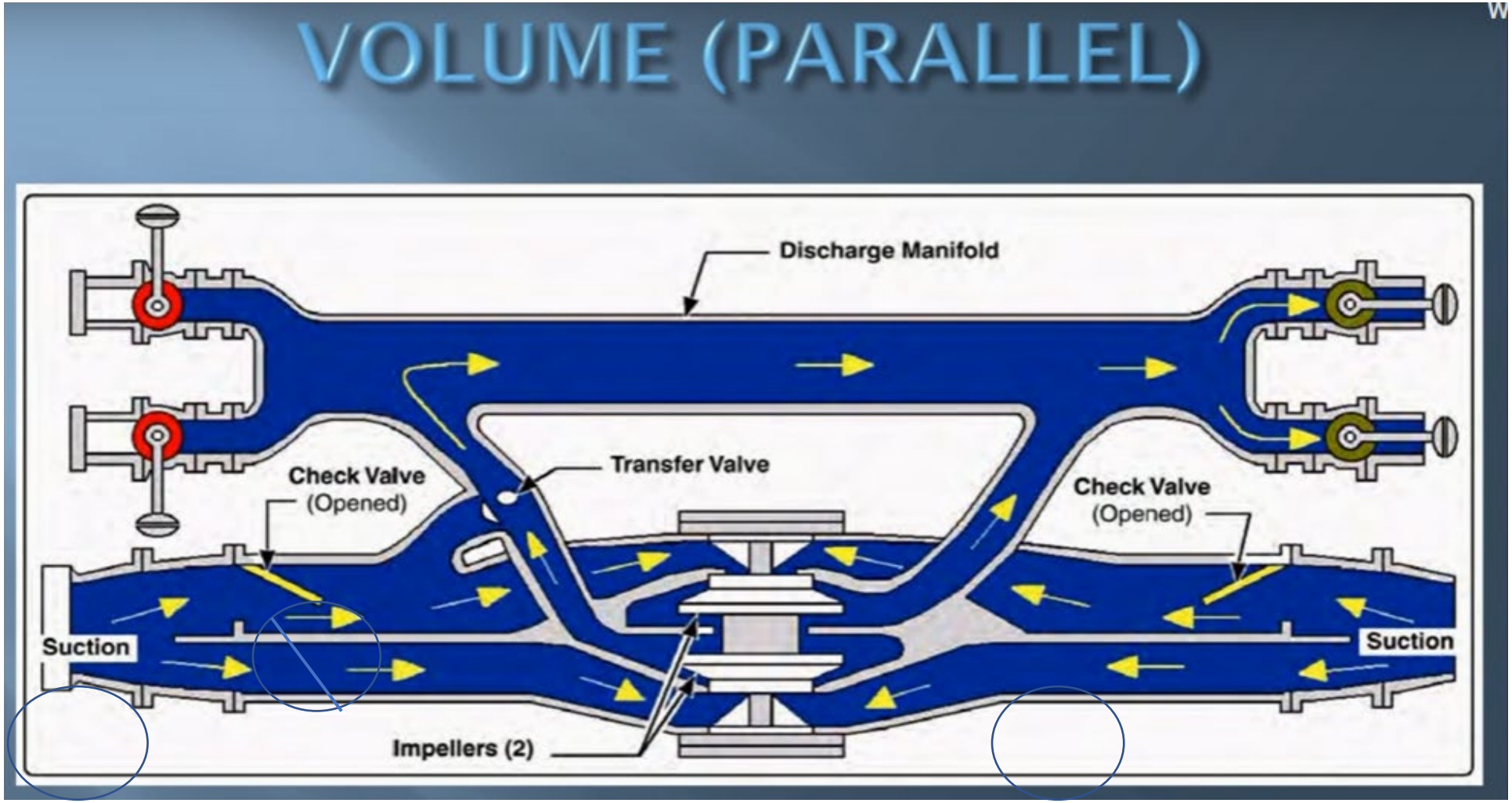
2 Stage Fire Pumps

Volume/Capacity Stage (Parallel)

- Water enters the eye of the primary and secondary impellers at the same time. The same pressure is created by both impellers and is not added together. Equal volumes of water are being pumped into the same discharge manifold doubling the volume.

- Two pumps working together side by side creating twice the volume but half of the pressure.

2 Stage Fire Pumps



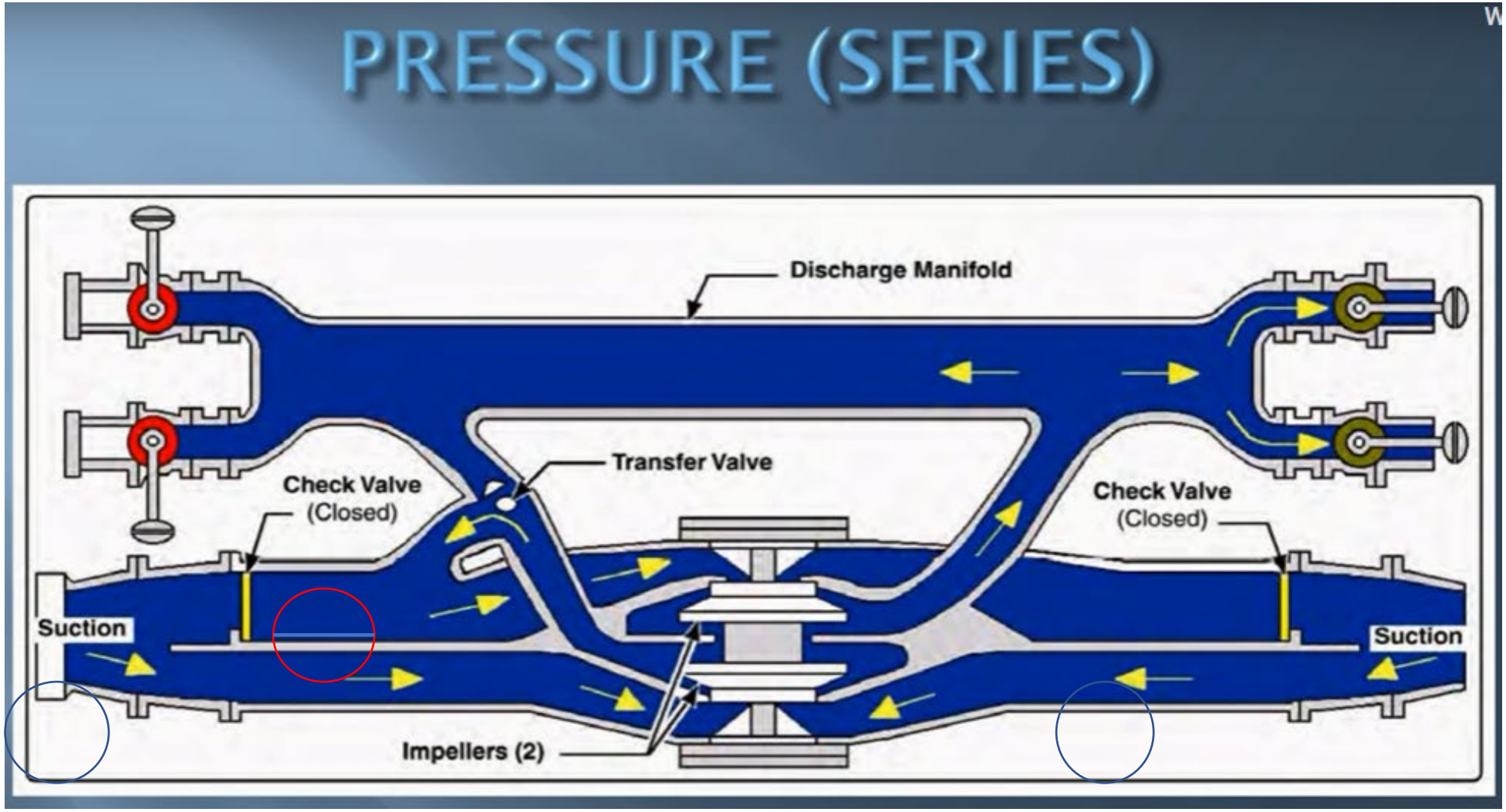
2 Stage Fire Pumps

Pressure Stage (Series)

- Water enters the eye of the primary impeller where the initial pressure is created. The same water now under pressure is directed to the eye of the second impeller where the pressure is doubled.

- Two pumps working together; One feeding the other creating twice the pressure but half of the volume.

2 Stage Fire Pumps



2 Stage Pump Changeover

- The changeover must occur when the pump is at idle speed.
- You should change from “pressure” mode to “volume” mode when the needed flow exceeds 50% of the pump’s rated capacity.
- If you are not sure of which mode to use, start off in “volume”. It will not hurt the apparatus and it may avoid a changeover during a firefight.
- ***ADVICE FROM AN ‘OL GUY***; If using a 500 gpm pump on a brush rig: If you pull more than one 2 ½” or two 1¾” hoses, you will need to be in “Volume”!

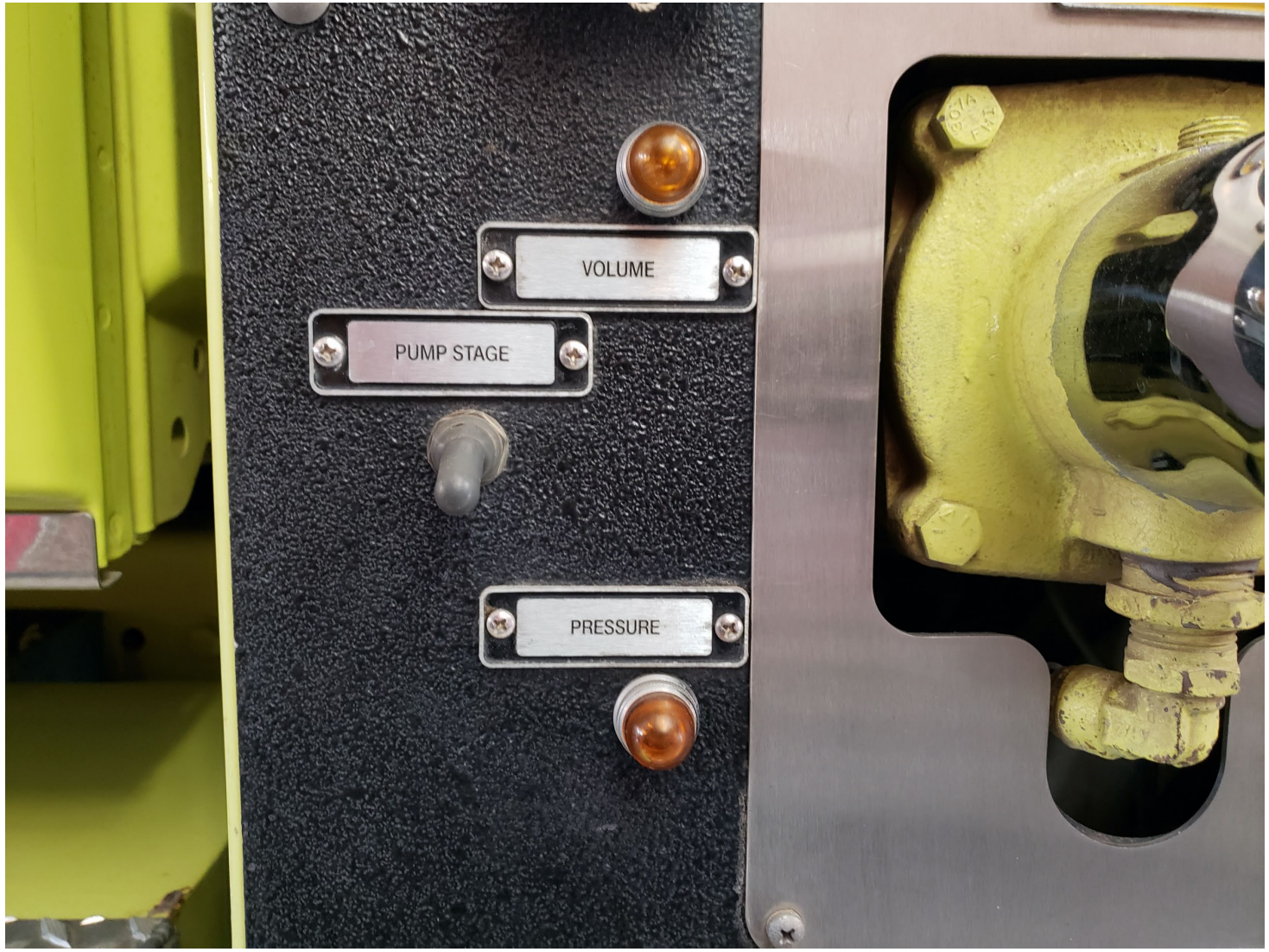
Transfer / 2 stage valve

Transfer / 2 stage valve

Darley Pumps

Transfer / 2 stage valve

OES Brush Rigs



Priming Pump

- A priming pump is a positive displacement pump used to replace air in the centrifugal pump with water.

- The priming pump is used when an air lock has occurred in the pump or while drafting.

Priming Pump

Cavitation

The implosion of vapor pockets/bubbles inside the pump formed by boiling water.

Causes:

1) Trying to pump more water than can be received from the water supply or hose.

This causes a vapor flash, (steam bubbles) to form. As the bubbles collapse and return to liquid state a shock wave is generated causing the popping sound and hammering effect on pump and plumbing

Cavitation

Causes continued

2) Churning / Overheating the same water in a pump causing it to boil.

Water boils at a lower temperature in a vacuum. The higher the vacuum the lower temperature.

Boiling occurs under normal air pressure at approx. 212^{o}. At 16 inches vacuum, it boils at 176°, and at 29 inches of vacuum, it boils at 80^{o}. Our pumps can achieve between 10 and 20 inches of vacuum. Boiling at 193^{o} and 160^{o} respectively

Prime Loss / Cavitation

Signs of Prime Loss are:

Increase of engine rpm that does not increase the pump pressure. Because there is air in the pump, it will be noisier. This is not cavitation!

Signs of cavitation are:

Sounds similar to gravel circulating in the pump caused by the implosions.

Heat related Cavitation does not occur immediately after prime loss. The water must heat and boil first.

Prime Loss / Cavitation

Prevent prime loss and cavitation by:

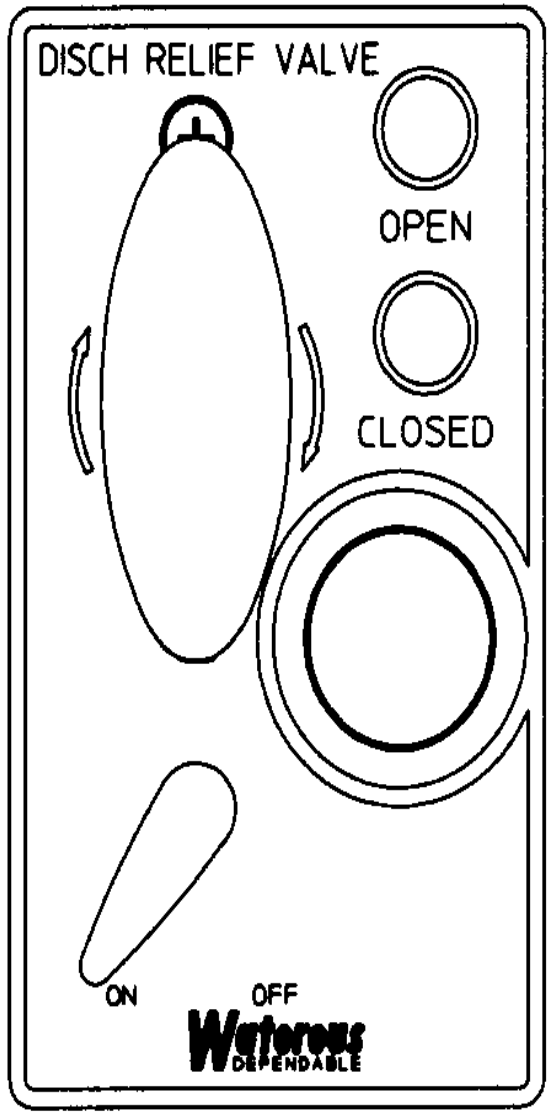
- Gating down on discharges
- Reducing Engine RPM's (reducing flow)
- Cooling the pump; open recirculation valve, slightly open a discharge drain, or both
- Least effective; Priming the pump (evacuate air) and introducing cooler water into the pump

Thermal Protection Valve

- The pump is thermally protected.
- This light will illuminate, and an alarm will sound if the pump water reaches 120^{o}. A small stream of water will discharge to the ground from behind the pump panel.

Discharge Pressure Relief Valve

- Handles sudden changes in pressure on the pressure side of the pump, by rerouting the water to the intake side.
- This valve ***<u>can be overcome</u>*** by sudden surges in intake pressure with large volumes of water, i.e.; 4-inch intake hose.



Discharge Pressure Relief Valve

Discharge Pressure Relief Valve

- Most relief valves have an operating pressure range of **75 - 300** psi. Some are **75-500** psi.

- There must be at least 25-30 psi difference between the intake pressure (supply) and the discharge pressure for the valve to recognize the difference.

- The pressure relief valve should be exercised weekly and reset after each use to **150** psi by opening the "tank fill" valve. A.K.A “Ramp Test”

Pressure Governor System

The Pressure Governor System

- Controls the engine RPM to maintain pump pressure

- Throttle Mode
- Pressure Mode
- System Shut-Down
- Mode Transfer

Throttle Control Mode

After the parking brake is set and transmission is shifted to “Neutral”:

- The Governor Control System automatically
- initializes in Throttle Control Mode
- The green THROTTLE CONTROL indicator light illuminates on the operator’s control panel

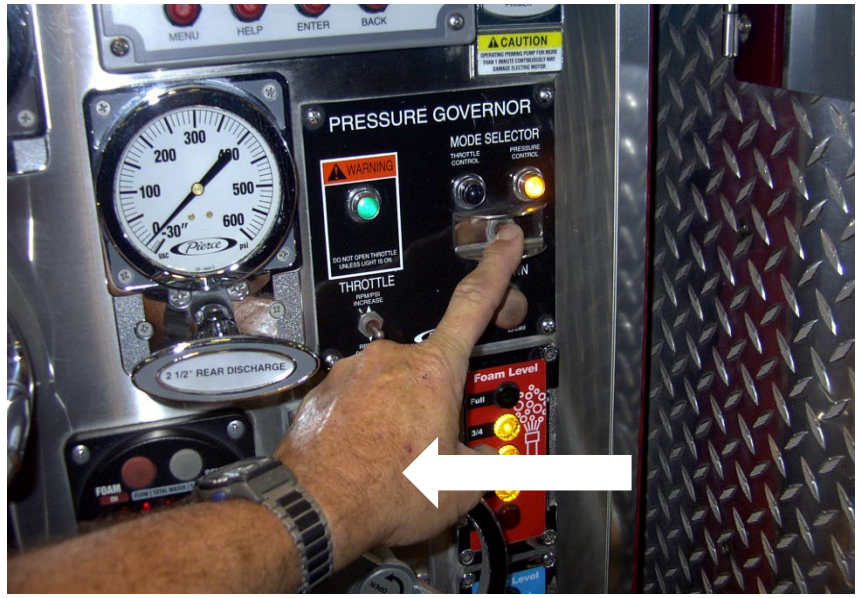
Throttle Control Mode

- Pressing THROTTLE (RPM/PSI) control switch in the Up position increases pump discharge pressure in 4 PSI increments.
- DOWN on THROTTLE switch decreases pressure in 4 PSI increments
- Holding UP/DOWN >.5/seconds changes pressure 8 PSI/second
- NO PRESSURE PROTECTION IN THIS MODE!

Pressure Control Mode

- Pressure Control Mode is achievable only if pump is engaged and the parking brake is set.

- To activate, push Mode Selector Switch to the PRESSURE position
  - The amber PRESSURE CONTROL light will illuminate on the operator's control panel



System Shut-Down

- For RAPID or EMERGENCY return to idle speed, press the red SYSTEM SHUT-DOWN button for >1 second

- The Pressure Control System instantly re-initializes at idle speed in selected mode of operation (THROTTLE or PRESSURE)

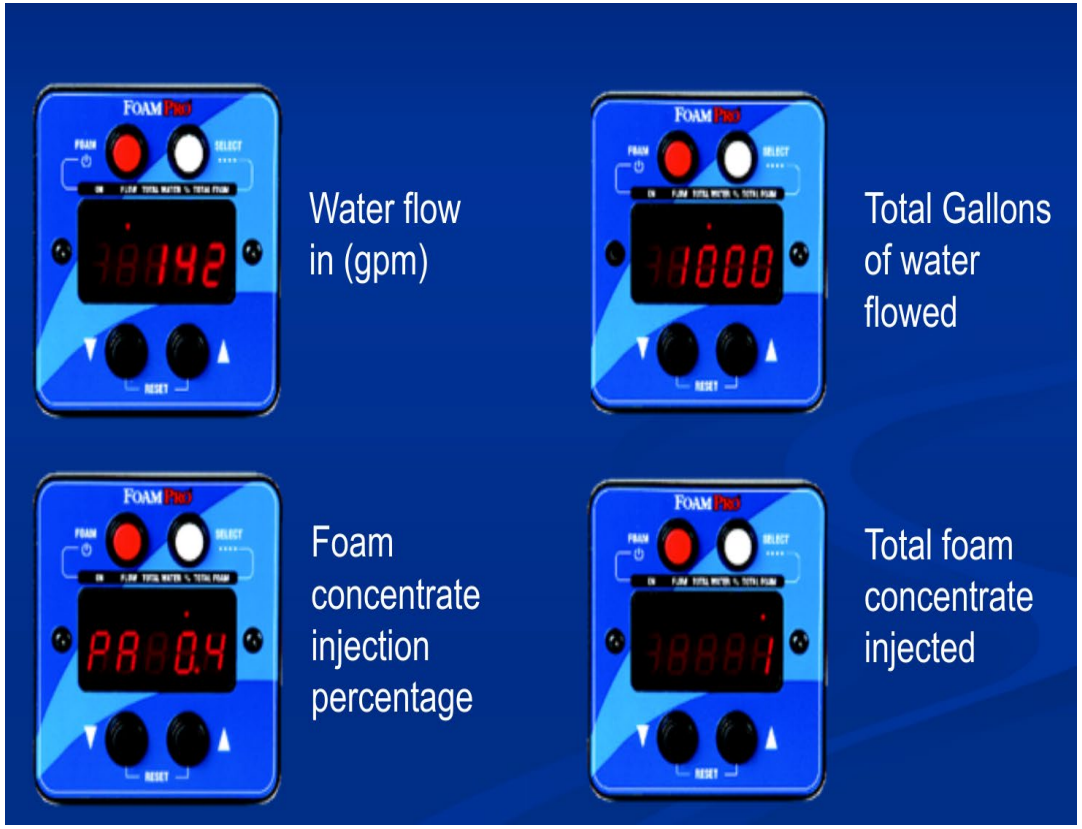
System Shut-Down

For NORMAL shut-down, engine speed may be gradually reduced to idle by holding the THROTTLE control switch in the DOWN position

Pierce Foam Pro

Components:

- Digital Display
- Foam Tank
- Foam pump
- Inject Valve
- Flow Meter



Foam Pro

Operating Instructions

1. Turn apparatus Battery on, FoamPro with turn on "**HYPRO**" will appear in display.

2. Establish water flow to foam capable discharge. Press the **FOAM** button (red upper left button).

3. Press Select button (white upper right button) until the LED lamp below the TOTAL WATER label is illuminated. Reset value to zero by pressing both up and down buttons at same time.

Or

- **The totals will be erased when the power is turned off.**

Pierce Foam Pro

4. Press the **SELECT** button again until the LED lamp below the **%** is displayed. Press the **up** or **down** arrows to change the **%** setting.

5. Press the **SELECT** button until LED lamp below the TOTAL FOAM is displayed. The total amount of foam concentrate used will be displayed. Reset by pressing both arrows at same time.

DPF Regeneration

- **REGEN (Specific for different engine types)**
- **OUR DIFFERENT ENGINE TYPES**
- **ARD LIGHT (aftertreatment regeneration device) (On CAT powered engines)**
- **DEF FLUID (Diesel Exhaust Fluid)**

What is Regeneration (REGEN)

- Diesel Regeneration is a process initiated by the ECM to burn off pollution, the soot and ash that comes from the pollutants build up in your DPF (Diesel Particulate Filter). On average a Diesel engine only burns 55% of the fuel injected into it. The ECO Fuel Enhancer reorganizes fuel to help it burn cleaner. The cleaner burning fuel results in less required RE-Gens cycles and improved fuel efficiency.

- Diesel Regeneration is a manufacturer update initiated in 2007 to help reduce pollution. A Diesel engine that does excessive idling or in town driving is more prone to having the DPF filter get clogged. A Regen warning light goes off when the DPF filter tells the computer it is full. When it is full it can create a back pressure causing the engine to run poorly and use much more fuel.

REGEN Cat and Detroit Diesel Series 60

REGEN PROCEDURE
for
CAT and DETROIT DIESEL Series 60

HOW TO PERFORM A "PARKED REGEN"

- **Must** have the DPF light on or flashing  to REGEN. Engine should be at 140 or above.
- Insure tailpipe and surrounding area is clear. **Must be done outside.**
- Set wheel blocks, start apparatus with parking brake set and in neutral.
- Release parking brake.
- Place transmission in "D", watch transmission "Monitor" to show "1".
- Return to neutral.
- Set Parking and Front Brakes.
- Request a "PARKED REGEN"
- **CAT and Pierce Arrow XT with Detroit Diesel Series 60**
  - Under dash, far left side, behind grab handle, far left bottom switch marked "REGEN"
  - Push and hold for 5 seconds, release.
- **International Chassis (water tenders, etc…)**
  - To right of steering column, switch on left marked "PARKED REGEN"
  - Push and hold for 5 seconds, release.
- Idle should increase on its own, REGEN will start.
- DPF light will go out shortly after starting, REGEN is continuing until a return to idle. (20-60) minutes.
- When Apparatus returns to idle with a successfully completed REGEN, complete **ENGINE REGENERATION RECORD in** Engineer Manual.

To interrupt "PARKED REGEN", release parking brake and wait to return to idle.
To interrupt "AUTOMATIC REGEN", use "REGEN INHIBIT" switch.

REGEN TYPES

- PASSIVE- Will occur when driving. No DPF burn, just higher exhaust temps. No action required by operator.
- AUTOMATIC- Active burn off of soot occurs while driving. Must be sustained "Freeway" driving or pumping of 45-60 minutes. No action required by operator.
- PARKED- Operator uses on board "REGEN" switch to initiate a REGEN. Works for all levels. 45-60 minutes.
- LAPTOP- Used by the shop to perform a REGEN when all other attempts have failed. Only true way to check and analyze system performance.

OTHER TIPS

- **CAT ARD HEAD CLEAN-** On Cat-equipped engines, if the "ARD Clean" Green LED is on (next to park brake control), attempt to continue driving or park &idle whenever possible. This will extend regen intervals & reduce out of service events.
- **INHIBIT REGEN-** If using vehicle vocationally (PTO engaged-pumping, aerial ops, etc.) and regen starts but must be interrupted, depress "Regen inhibit" switch for 5 sec. & release. It's adjacent to the "Request Regen" switches on Pierce and internationals.
- **Strike Team Response-** If freeway driving and the DPF light comes on, you can keep driving to allow an "automatic" regen. Stop and perform a "manual" regen if DPF light starts to flash, "Check Engine "light comes on or you're at the incident.

REGEN Procedure for CAT and Detroit Diesel Series 60 Engines

	The amber **Check Engine Lamp (CEL)** warning light indicates a fault with the engine controls or after treatment controls and/or components has occurred. The operator can drive the vehicle to the end of their shift and call service to remedy the problem.
	The red **Stop Engine** warning light indicates a major engine fault that may result in engine damage. The operator should move the vehicle to a safe location and shutdown the engine.
	The **Malfunction Indicator (MIL)** light provides an indication to the vehicle operator that a fault has occurred on an emission related component. This light may illuminate at the same time as the Check Engine light. The operator can drive the vehicle to the end of their shift and call service to remedy the problem.
	**High Exhaust System Temperature (HEST) Automatic** (passive) regen occurring. Continue to drive or park with the high idle on when possible. This will extend regen intervals. No other action required. No need to log this event. Note difference between this & the DPF light.

	The **Diesel Particulate Filter (DPF)** light will illuminate when a regeneration is necessary. There are progressive stages of need for regeneration indicated by this light:
LEVEL 1  *(SOLID)*	1. DPF on solid (low to medium levels of particulate build-up). The vehicle requires regeneration but should be able to complete the current mission. Perform a regeneration in a reasonable amount of time. • **In Service.** • **Ensure the Regen Inhibit Switch is not activated.** • **Initiate a DPF regeneration by switching to a more challenging duty cycle (such as highway driving for at least 20 minutes or pumping) OR perform a parked regeneration.**
LEVEL 2  *(Flashing)*	2. DPF flashing (medium to high levels of particulate build-up). DPF reaching system limits and regeneration required as soon as possible. • **Out of Service.** • **Perform a Mandatory Parked Regeneration as soon as possible.** • **Complete Regeneration Record**
LEVEL 3  *(Flashing)*	3. DPF flashing, CEL lit. System has REACHED limitations. • **Out of Service.** • **Return to quarters** • **Contact Repair Facility- Requires mechanic to do Laptop regen. Engine Damage will occur with continued operation.**
LEVEL 4  *(Flashing)*	4. DPF flashing, CEL lit, and Stop Engine light lit. System has EXCEEDED limitations. ENGINE SHUTDOWN. • **Out of Service. Stop when safe.** • **Shut down engine** • **Contact Repair Facility- Requires mechanic to do Laptop regen. Engine Damage will occur with continued operation.**

REGEN Detroit Diesel (DD13 Engines)

REGEN PROCEDURE

DETROIT DIESEL (DD13 ENGINES)

HOW TO PERFORM A "PARKED REGEN"

- **Must** have the DPF light on or flashing  to REGEN. Engine should be at 140 or above.
- Insure tailpipe and surrounding area is clear. **Must be done outside.**
- Set wheel blocks, start apparatus with parking brake set and in neutral.
- Release parking brake.
- Place transmission in "D", watch transmission "Monitor" to show "1".
- Return to neutral.
- Set Parking and Front Brakes.
- Request a "PARKED REGEN"
- Push and hold REGEN button (far left bottom switch) for 5 seconds and release.

- Idle should increase on its own, REGEN will start.
- DPF light will go out shortly after starting, REGEN is continuing until a return to idle. (45-60) minutes.
- **If REGEN is unsuccessful the first time, initiate a second REGEN. After two failed attempts, contact the shop.**
- When Apparatus returns to idle with a successfully completed REGEN, complete ENGINE REGENERATION RECORD.

To interrupt "PARKED REGEN", release parking brake and wait to return to idle.
To interrupt "AUTOMATIC REGEN", use "REGEN INHIBIT" switch.

REGEN TYPES

- PASSIVE- Will occur when driving. No DPF burn, just higher exhaust temps. No action required by operator.
- AUTOMATIC- Active burn off of soot occurs while driving. Must be sustained "Freeway" driving or pumping of 45-60 minutes. No action required by operator.
- PARKED- Operator uses on board "REGEN" switch to initiate a REGEN. Works for all levels. 45-60 minutes.
- LAPTOP- Used by the shop to perform a REGEN when all other attempts have failed. Only true way to check and analyze system performance.

REGEN Procedure for Detroit Diesel 13 Engines

	The amber **Check Engine Lamp (CEL)** warning light indicates a fault with the engine controls or after treatment controls and/or components has occurred. The operator can drive the vehicle to the end of their shift and call service to remedy the problem.
	The red **Stop Engine** warning light indicates a major engine fault that may result in engine damage. The operator should move the vehicle to a safe location and shutdown the engine.
	The **Malfunction Indicator (MIL)** light provides an indication to the vehicle operator that a fault has occurred on an emission related component. This light may illuminate at the same time as the Check Engine light. The operator can drive the vehicle to the end of their shift and call service to remedy the problem.
	**High Exhaust System Temperature (HEST) Automatic** (passive) regen occurring. Continue to drive or park with the high idle on when possible. This will extend regen intervals. No other action required. No need to log this event. Note difference between this & the DPF light.

	The **Diesel Particulate Filter (DPF)** light will illuminate when a regeneration is necessary. There are progressive stages of need for regeneration indicated by this light:
LEVEL 1  *(SOLID)*	1. DPF on solid (low to medium levels of particulate build-up). The vehicle requires regeneration but should be able to complete the current mission. Perform a regeneration in a reasonable amount of time. **In Service.** **Ensure the Regen Inhibit Switch is not activated.** **Initiate a DPF regeneration by switching to a more challenging duty cycle (such as highway driving for at least 20 minutes or pumping)** **OR perform a parked regeneration.**
LEVEL 2  *(Flashing)*	2. DPF flashing (medium to high levels of particulate build-up). DPF reaching system limits and regeneration required as soon as possible. **Out of Service.** **Perform a parked regeneration as soon as possible. If lamps remain on after parked regeneration, repeat the parked regeneration. If second attempt fails, notify the shop.**
LEVEL 3  *(Flashing)*	3. DPF flashing, CEL lit. System has REACHED limitations. **Out of Service.** **Parked regeneration must be performed in a safe location. If lamps remain on after parked regeneration, repeat the parked regeneration. If second attempt fails, notify the shop.**
LEVEL 4  *(Flashing)*	4. DPF flashing, CEL lit, and Stop Engine light lit. System has EXCEEDED limitations. ENGINE SHUTDOWN. **Out of Service.** **Parked regeneration must be performed in a safe location IMMEDIATELY. If lamps remain on after parked regeneration, repeat the parked regeneration. If second attempt fails, notify the shop.** **Engine can be restarted, but a parked regeneration must be initiated within 30 seconds or engine will shut down.**

Types of Regen

Passive Will occur when driving. No DPF burn, just higher exhaust temps. No action required by driver.

Automatic Soot loading in filter reaches a preset position (about 45%). The vehicles ECU will start post combustion fuel injection, which will increase exhaust temps to Automatic Regen levels. Must be sustained driving or pumping, 45-60 minutes to complete.

Parked Park and use on board Regen switch to activate Regen process. 45-60 minutes.

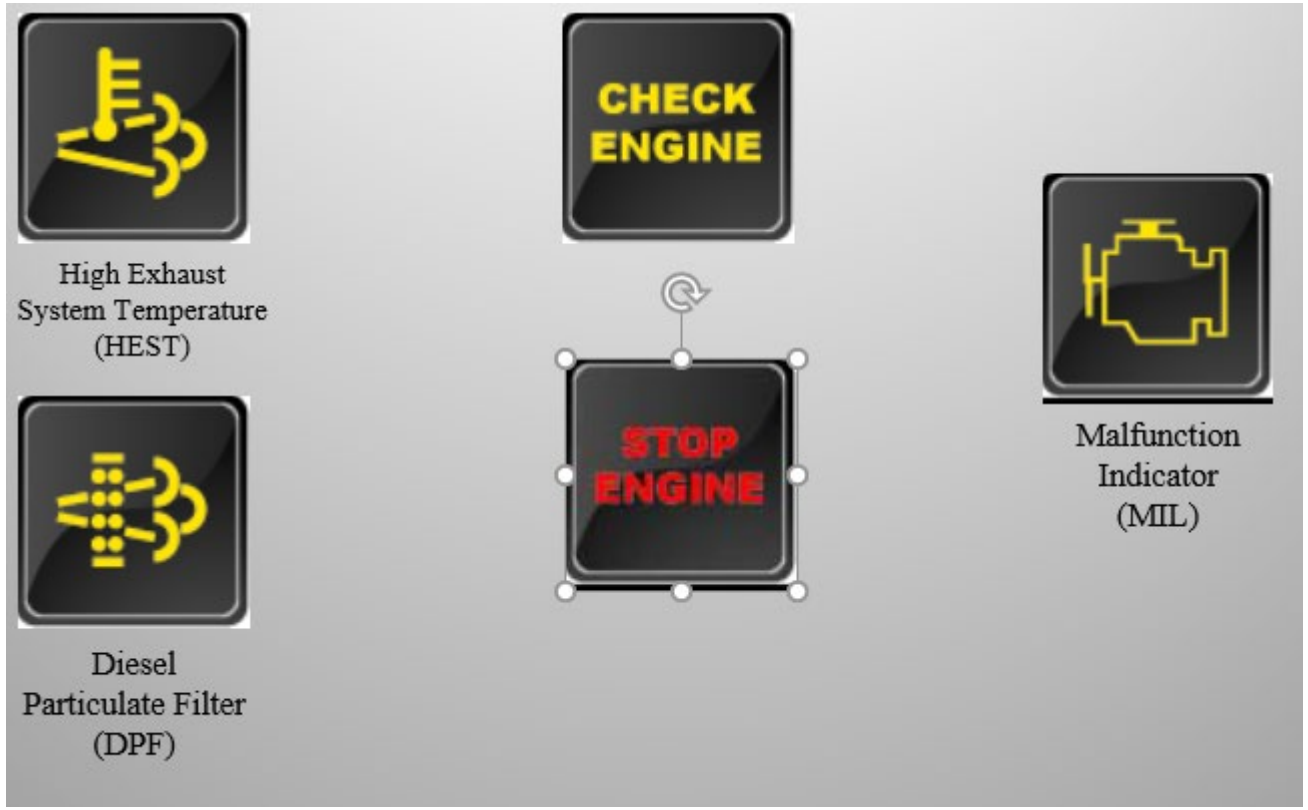
Laptop/Forced Performed by the Shop, 45-60 minutes. Only true way to check and analyze system performance.

Levels of Regen

There are four levels of REGEN

- **Level 1** DPF light on solid (low to medium levels of particulate build-up).
- **Level 2** DPF light flashing (medium to high levels of particulate build-up). DPF is reaching system limits.
- **Level 3** DPF light flashing, along with solid Check Engine light. System has REACHED its limitations.
- **Level 4** DPF flashing, Both Check Engine, and Stop Engine lights will be lit. Engine or emissions equipment could be damaged.

Regen Related Dash Lights



Indicator Lights

- **High Exhaust System Temperature (HEST)**
  (Passive) Regen is occurring. Continue to drive or park in high idle to help extend Regen intervals. Or Engine under heavy load (pulling a hill)
- **DPF (Diesel Particulate Filter)** Regen is needed. Can be solid or blinking light.
- **Check Engine** Amber warning light that indicates there is a problem with the engine and or aftertreatment components. Flashing is more urgent than steady burning.
- **Stop Engine** Red warning light indicates a major engine fault that could result in engine damage.
- **Malfunction Indicator (MIL)** Yellow picture of engine that indicates a fault with emission related components.
- **ARD LIGHT** Green light added to the dash to indicate that the ARD head is actively cleaning.

Caterpillar Engine

- Yellow in color.
- On early models of our Pierce Arrows.
- 400 – 530 Horsepower
- 1450 Torque
- Occasional problems with getting a successful Regen.
- This Engine is not made anymore.

Detroit Series 60 Engine

- Turquoise in color.
- Oldest Engine in the fleet.
- On Pierce Dash's and some Arrows.
- 450 Horsepower
- 1450 Torque
- Very easy to Regen with little to no problems.

Detroit DD13 Engine

- Grey and Black in color.
- Newest Engine in the fleet.
- On all Pierce Arrow XT's.
- 470 Horsepower.
- 1650 torque.
- Dependable, little to no Regen issues.

REGEN Procedures

- **Level 1** Solid DPF light. Remain in service, preform a Regen when convenient. 0700 – 1900 hrs
- **Level 2**. Flashing DPF light. ***Out of service***, Regen as soon as possible. If regen fails, attempt a second time. If failed again, contact the shop.
- **Level 3** Flashing DPF with Check Engine light. ***Out of service***, return to station, and contact the shop.
- **Level 4** Flashing DPF with Stop Engine light. ***Out of service***, stop when safe, and shut down the engine. Contact the shop.

- Levels 3 and 4 Require a “Laptop Regen”
- After any level Regen, fill out Regen record.

REGEN Procedures

- Must have the DPF light on or flashing. Engine should be warmed up.
- Ensure tailpipe and surrounding area is clear.
- Set wheel blocks.
- Start apparatus with parking brakes set, and in neutral.
- Release parking brake.
- Place transmission into Drive and ensure transmission monitor shows “1”.
- Return to neutral.
- Set both parking brake and front brakes.
- Request Regen by holding Regen button down for 5 seconds and releasing.
- Idle should increase on its own, Regen will begin.
- DPF light will go out, Regen will continue until apparatus returns to idle.

Cancelling a REGEN

Two ways to stop a Regen

1. By pressing “REGEN INHIBIT” button for 5 seconds, the Regen will stop until you can successfully complete it. It will show a “Regen Inhibit” light until you hold down the “DPF Regen” button for 5 seconds and restart the Regen.
2. Release the Parking Brake, and let Engine return to Idle.

ARD Light On Caterpillar Engines

CAT ARD Head Clean

- On CAT powered engines the “ARD Clean” is a green light just below the parking brake. If this light is on and blinking, attempt to continue driving or park and idle when possible. This will extend Regen4 intervals and reduce OOS events.
- Usually lasts 5-60 minutes.

Diesel Exhaust Fluid

- **AKA “DEF”**
- **For use in all “on road” diesel vehicles after 2010.**

What is Regeneration (REGEN)

Q. Why do some of our rigs need DEF and others don't ?

A. There was an EPA requirement change in 2010. All Diesels produced in 2010 or later will need DEF.

Q. What is DEF?

A. 32.5% urea and 67.5% de-ionized water.

Q. What does DEF do?

A. It changes a normal byproduct of combustion; NOx (nitric oxide and nitrogen dioxide) and converts it to simple nitrogen and water.

DEF Fluid

- DEF Tank is 4.5 gallons.
- Approximately 50:1 Fuel to DEF ratio.
- 1-year shelf life.
- Always have a full spare on your Apparatus.
- Low DEF levels will reduce engine torque
- If DEF tank ignored, engine will be reduced to 5 mph
- You can wait until tank reads just above ¼ full to fill, should take the whole jug, and not spill
- Store in cool, dry area, out of sunlight

If you accidently put DEF in Diesel Tank, don't start engine. Contact Shop and follow their direction

DPF Components

DEF Pump

Diesel Particulate Filter

Apparatus Inspection Program

All discrepancies found during the inspection shall have an "Alert" created and entered into PS Trax at:

https://app.pstrax.com/

Apparatus Inspection Program

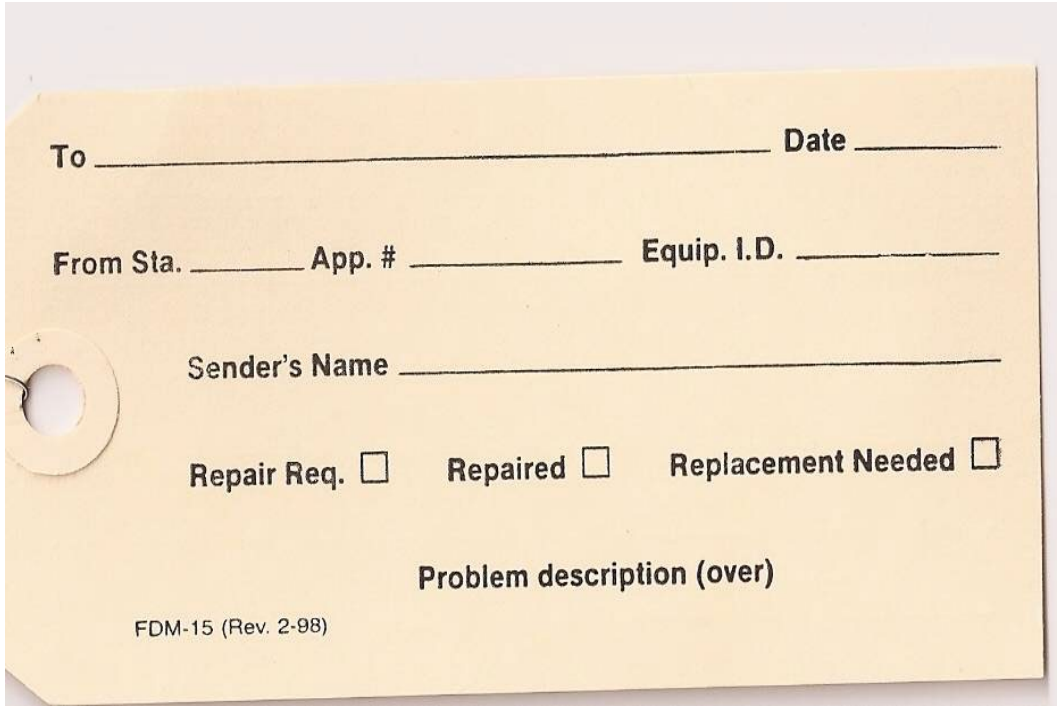
Discrepancies, which could be detrimental to the apparatus, equipment operation or to the safety of the personnel and any items meeting the North American Out-of-Service Criteria, shall be reported by phone immediately to the Repair Facility and followed by an “Urgent Alert” being entered into PSTrax

Apparatus Inspection Program

The **Engineer / Operator**, by completing the items in PSTrax , is certifying that he / she has made the Pre-Trip inspection of the apparatus:

- to ensure that it is in safe operating condition
- equipped as required by law
- and that all equipment is in good working order

FDM-15 Shipping Tag



FDM-16 Monthly Breathing Apparatus Log

COMPANY #_____ REGULATOR SERIAL#_____ FIREFIGHTER POSITION 1 2 3 4

MONTHLY BREATHING APPARATUS LOG	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
CYLINDER												
CONDITION												
PRESSURE GAUGE												
HYDRO DATE												
BACKFRAME AND HARNESS ASSEMBLY												
BACKFRAME AND HARNESS ASSEMBLY												
LED DISPLAY/BATTERIES												
ALARM FUNCTIONS												
BUDDY BREATHING WHIP												
HOT FILL/FILL CAP CONNECTIONS CONDITION OF CORDS AND CONNECTIONS												
REGULATOR												
*MANUAL SHUTOFF *PURGE VALVE												
BREATHABLE AIR FLOW												
REGULATOR COVER												
INDICATOR LIGHTS												
SEMS PDA ASSEMBLY												
FUNCTION TEST *Transmits and Receives*												
TIME TEST "PASS" ALARMS WITH PRE ALARM (20 SEC) FULL ALARM (32 SEC)												

DATE	REMARKS AND REPAIRS	SIGNATURE

Two Year Functional Test Date:_____

Place check (√) in box for Test/Inspection "OK". Place (F) in box for failure and describe in remarks. Contact Station 36 for loaner and/or Repairs

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FDM-17 Apparatus Hose List

Apparatus # _____ Sta. _____ Date: _____

APPARATUS HOSE LIST

List all hose top to bottom of load in each hose bed

4 "	2 1/2" LEFT	2 1/2" RIGHT	MATTYDALE #1	MATTYDALE #2
100#	#	#	Whip#	#
200#	100#	100#	#	#
300#	#	#	#	#
400#	200#	200#	#	#
500#	#	#	#	#
600#	300#	300#	Mattydale #3	Mattydale #4
700#	#	#	#	#
800#	400#	400#	#	#
900#	#	#	#	#
1000#	500#	500#	#	#
	#	#	#	#
	600#	600#	High Rise Pack	Wildland 1"
	#	#	2 1/2" Whip #	#
	700#	700#	#	#
25'X4"#	#	#	#	#
50'x4"#	800#	800#	#	#
6'x4"#	#	#	#	#
	900#	900#	Other Hose	#
	#	#	Filler #	#
	1000#	1000#	Filler #	#
	#	#		
	#	#		

FDM-17 (11-95)

NOTE: Log High Pressure Hose (Blue) in 2 1/2" Right Column.

FDM-20 Apparatus Inventory Report*

APPARATUS INVENTORY REPORT

STATION #	APPARATUS #	COMPANY #	DATE:

TO: REPAIR FACILITY **FROM:**_____

INVENTORY STATUS: (CHECK APPROPRIATE BOX)

☐ ALL EQUIPMENT ACCOUNTED FOR.

☐ EXTRA OR MISSING EQUIPMENT IDENTIFIED:

1. Complete form below. Indicate missing or extra equipment in last column.
2. Clean, tag, and return damaged or extra equipment or hose to Storeroom 42 or station 20.
3. Order missing or damaged standard, supplemental, or environmental equipment through Director of Material on an FD-7.
4. Complete and attach stores requisition to Storeroom 42 for standard supply category items.
5. Order missing manuals through Training and Safety Division on an FD-7.
6. Order missing map books through Communications on an FD-7.
7. Order missing or damaged hose through Station 20 on an FD-7.
8. Captain and Battalion Chief must sign rear page of the form.
9. Attach all FD - 7's and stores requisitions to this inventory.

* NOTE: Include reason for missing or damaged item and what was done to locate missing item on an FD - 7, or utilize line(s) below item to enter this information. Use additional FDM - 20's to complete inventory if needed.

Item	Qty	Bar Code #	Serial #	Missing / Extra

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The End