

# Diesel Fuel Systems

## Injection Nozzles

# Unit Terms

- Injection nozzle
  - Nozzle, nozzle holder, valve, spring assembly
- Nozzle assembly
  - Valve, body, and spray valve
- Orifice
  - Small hole
- Pintle
  - Valve which the end extends into the shank or pin

# Functions of Injection Nozzles

- Atomizes the fuel for better combustion
- Spreads the fuel spray to fully mix with air

# Moving Parts of the Nozzle

- Valve
- Spring
- Spindle
- Retainer

# Common Types of Nozzles

- Single hole, capsule
  - Used in engines with pre-combustion chambers
- Multiple orifice
  - Has several small holes
  - Has a tendency to plug
- Single hole, pintle
  - Produces a hollow spray pattern
  - Can be either inward or outward opening

# Injection Nozzle Adjustment

- Shim adjustment
- Screw adjustment
- Needle lift
- Pressure ranges

# Injection Nozzle Action

- Hydraulic action
  - Diesel fuel hydraulically lifts the needle valve
- Opening
  - Pressure varies by injection nozzle design and application
- Nozzle chatter
  - An indicator of a properly working nozzle

# Factors to Consider for Proper Nozzle Operation

- Maintain cleanliness
- Follow manufacturers specification exactly
  - Adjusting opening pressure 150 psi over spec will
    - Delay the start of injection
    - Increase fuel spray velocity
    - Lengthen spray cone
    - Decrease spray cone angle
    - Fuel droplet size to decrease
    - Cause fuel to settle out of the air stream



# Locating Faulty Injectors

- Safety
  - Fuel leaking under pressure can penetrate skin
  - Watch for moving parts
  - Watch for hot parts

# Locating Faulty Injectors

- When to perform test
  - Rough running engine
  - Engine misses
  - Major overhaul

# Locating Faulty Injectors

- How to perform test
  - Operate engine at optimum rpm to detect miss
  - Crack each injection nozzle connector open one at a time using two wrenches, one hand method
  - Listen for a change in engine to indicate location of problem

# Removing an Injection Nozzle

- Thoroughly clean area around injection nozzle.
- Identify type of retainer used to secure injection nozzle into the cylinder head.



# Removing an Injection Nozzle

- Remove and cap high pressure fuel line.
- Remove and cap return line.
- Remove injection nozzle clamp.
- Pry injection nozzle out using two pry bars or by using a slide hammer puller.

# Testing Injection Nozzles

- Superficial checks
  - Spray tip condition
  - Nozzle body condition
  - Threaded connection condition

# Testing Injection Nozzles

- Cracking pressure
  - Bleed air from tester
  - Operate tester to purge air and seat valve
  - Open gauge valve, pump slowly to raise pressure
  - Read gauge when nozzle valve opens and closes

# Testing Injection Nozzles

- Valve seat pressure
  - Relieve all pressure from tester
  - Dry spray tip
  - Bring pressure up to 200 psi below cracking pressure and hold for 10 to 15 seconds
  - Relieve pressure, recheck for fuel accumulation on spray tip



# Testing Injection Nozzles

- Back leakage test
  - Checks fit of needle valve and nozzle bore
  - Bring pressure to within 100 psi of cracking pressure
  - Time the rate of pressure drop
  - Average pressure drop of not more than 880 psi in 6 seconds shows good nozzle valve lubrication

# Testing Injection Nozzles

- Spray pattern test
  - Close gauge valve to prevent damage to gauge
  - Operate pump at a rate of two strokes per second to simulate injection pump operation
  - Observe spray pattern
    - No spray distortion
    - No unatomized fuel
    - Uniform spray cone length and width
    - Audible nozzle chatter

# Injection Nozzle Disassembly

- Work in a clean environment.
  - Care in working clean and using clean tools can not be encouraged enough. Quality work starts here.
- Required tools.
  - Trays to hold each injection nozzle.
  - Wash containers.
  - Holding fixture to disassemble nozzles.
  - Cleaning tools.
  - Injection nozzle tester.

# Disassembly Procedures

- Disassembly procedures.
  - Clean external surfaces of dirt and oil.
  - Using the holding fixture, remove spring retaining nut, spring, spring retainer and spindle.
  - Using holding fixture, remove the nozzle nut.
  - Place all parts in a tray containing diesel fuel or calibrating fluid to help prevent contamination.

# Disassembly Procedures

- Parts cleaning.
  - Clean parts using a brass brush to prevent damage to polished surfaces.
  - Nozzle holder can be cleaned in solvent tank, however, nozzle valve assembly should be cleaned by hand to prevent damage.
  - Inspect needle valve for signs of burning, if burned or discoloration is evident, valve assembly should be replaced.

# Checking Nozzle Parts

- Fuel sac
  - Clean fuel sac with a brass scraper

# Checking Nozzle Parts

- Spray orifices
  - Select proper cleaning wire size
  - Use wire shaping stone to remove any burrs from wire
  - May need to shape a flat spot on wire to help remove carbon
- Sealing surfaces
  - Inspect sealing surfaces for indications of internal leakage
  - Lap on a lapping plate lubricated with mutton tallow
  - Clean with clean diesel fuel and air

# Needle Lift

- Proper needle lift insures
  - Length of lift off time
  - Flow of fuel into combustion chamber
  - Spray cone width will be varied
  - Length of spray cone will be affected
  - Checked with a dial indicator
    - Typically ranges from 0.012-0.027
  - Lap nozzle valve body to change if lift is to great



