### SECTION Unit 4: Injectors/Nozzles

**1. Title Page**

Be able to describe unit learning objectives:

**Notes:**

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**2. Fuel System**

Be able to briefly note the components of a typical fuel injection system

**Notes:**

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**3. Nozzle Location**

Know the difference between:
- Delivery tubes (injection lines)
- Leak off fittings and lines

**Notes:**
Focus On Training
Diesel Fuel Injection Training Program

Model Type: All Pump Types
Page 2

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4. Fuel Injector Functions
   Be able to list the nozzle functions
   
   Fuel Injection Functions
   - Determine Opening Pressure
   - Fuel Atomization
   - Fuel Targeting
   - Sealing

   Notes:

5. Injectors and Nozzles
   Be able to identify the following:
   - 17 and 21 mm injectors
   - Pencil nozzles
   - Calibration Injectors

   Notes:

6. 17 and 21 mm Injectors
   Points to be discussed
   - Information sources
   - Nomenclature
   - High spring, low spring and pintle injectors

   Notes:
SECTION Unit 4: Injectors/Nozzles

7. Conventional Injector Service Manual 99118
   - 17 and 21 mm injector service procedures
   - Nomenclature
   - Service kits

   Notes:

8. Injector Nomenclature
   - Injector specification per nozzle holder assembly
   - Specification contains multiple fuel injector part numbers, using that holder assembly
   - Holder assembly plus nozzle assembly creates a fuel injector assembly

   Notes:

9. 17 mm Injector, Exploded View
   - Be able to point out main components
   - Be able to describe function of pressure adjusting shims

   Notes:
### SECTION Unit 4: Injectors/Nozzles

#### 10. Nozzle Assemblies

- Stanadyne conventional nozzles are a closed, inward opening, differential pressure, hydraulically operated type
- Nozzle assemblies consist of a matched needle valve and nozzle body
- Maximum valve lift is determined by the distance from the top of the valve stem shoulder and the nozzle body pressure face
- Understand the difference between standard and VCO nozzle assemblies

#### 11. Injector Nomenclature

Understand the construction of the high spring holder type injector. Referred to as a high spring injector due to the nozzle spring location. High spring injectors are used in direct injection applications where higher pressures are required

**Notes:**

#### 12. 17 mm Injector, Exploded View

- Point out main components
- Note pressure adjusting screw

**Notes:**
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13. Low Spring Injector

Understand the construction of the low spring hole type injector. Referred to as a low spring injector due to the location of the nozzle spring in the nozzle body. Low spring hole type injectors are typically used in direct injection engines where higher injection pressures are required. Low spring injectors are used more often in today's engine designs due to its lower reciprocating mass (no spring spindle, less friction) which results in faster opening and closing of the needles valve (emission benefit).

14. Injector Nomenclature

- Be able to point out the different components
- Review servicing procedures as outlined in the Conventional Injector Service Manual 99118

Notes:

15. 17 mm Injector, Exploded View

- Understand construction and fuel flow of the pintle nozzle
- Pintle nozzles are normally used on indirect injection engines. They operate at relatively low injection pressures (5000 psi)
- The spray pattern is cone shaped and is injected into the engine’s pre-combustion chamber

Notes:
16. Throttling Pintle

Designed to restrict flow at initial opening of the valve providing a gradual pressure rise for quiet and smooth engine operation.

Notes:

17. Injector Specification

- Understand the importance of referring to the injector specification for parts and servicing information.
- Service specifications for 17 and 21 mm injectors are listed by the nozzle holder assembly number.

Notes:

18. Injector Specification Masthead

Know what information is listed on the specification masthead. Edition Number, Customer Part Number, Customer, Nozzle Holder Assembly Number, etc.

Notes:
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19. Injector Specification
Nozzle body assembly’s parts breakdown

20. Injector Specification
Review the injector application and service information

21. 17/21 mm Injector Customers
Listing of current 17/21 mm customers

17 and 21 mm injector customers

<p>| Acme Motors | MWM |
| Ado | Navistar |
| Cummins | Perkins |
| Farnese | Ruggerini |
| Isotta Fraschini | Scania |
| Iveco | Wiis-Con (Teledyne) |
| John Deere | Valmet |
| Leyland | VM Motori |
| Lister-Petter | Volkswagen |</p>
<table>
<thead>
<tr>
<th>22. 29618 Conventional Injector Clamping Fixture</th>
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<tbody>
<tr>
<td>• Understand the proper way to disassemble and re-assemble both the high and low spring injectors using the Stanadyne 29618 fixture</td>
</tr>
<tr>
<td>• The 29618 fixture is part of the 29617 conventional injector tool kit which also includes the injector plates and wrenches</td>
</tr>
<tr>
<td>• Also know how to adjust the nozzle opening pressure and check for correct spray patterns, nozzle chatter and seat leakage</td>
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<td>Notes:</td>
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<tr>
<th>23. Pencil Nozzles</th>
</tr>
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<tbody>
<tr>
<td>What will be covered</td>
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<tr>
<td>• Components, operation and flow</td>
</tr>
<tr>
<td>• Understand the suitability for direct injection engines, due to size</td>
</tr>
<tr>
<td>Notes:</td>
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</tbody>
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<tr>
<th>24. STPN vs. PN</th>
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<tr>
<td>• Slim tip pencil nozzle designed with a 5.4 mm slim tip while the standard PN has a 9.5 mm tip</td>
</tr>
<tr>
<td>• Smaller tip allows engine manufacturer to place the spray apex closer to the centerline of the engine cylinder thereby enhancing combustion efficiency</td>
</tr>
<tr>
<td>• Also provides manufacturer option of increasing cylinder head strength and/or improving engine volumetric efficiency</td>
</tr>
<tr>
<td>Notes:</td>
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</table>
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25. Pencil Nozzle Exploded View
- Be able to point out the main components of the pencil nozzle
- Review servicing procedures as outlined in SB 467

Notes:

26. STPN Cutaway
- Slim tip pencil nozzle
- Note I.D. of the spring chamber

Notes:

27. STPN vs. PN2
- Compare the STPN & PN2 (Pencil Nozzle 2nd generation)
  - Both use the same tip design
  - PN2 has a larger spring chamber which permits the use of a larger pressure adjusting spring for higher opening pressures, faster closing rates and reduced spring stress

Notes:
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28. PN2 Cutaway
   Note I.D. of the spring chamber

29. PN2
   - Note the seals (2)
   - Note O.D. of the spring chamber area

30. Slim Tip Seal Installation
    Service tool 28017 is required to install the compression seal. Review the servicing instructions outlined in SB 425

Notes:
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31. RSN®

Rate Shaping Nozzle

- Benefits
  - Features used in pencil and conventional injectors
  - Current applications

Notes:

32. 17/21 mm RSN®

- Application
  - Understand BOI function
  - Refer to SB 523 and the Conventional Injector Service Manual

Notes:

33. PN2 RSN®

Applications

Notes:
34. **RSN® Principles of Operation-Pencil Nozzles**

- Nozzle flow vs. needle lift graph compares a typical nozzle design to a typical RSN design.
- For both designs zero lift sealing is identical.
- Beginning of injection RSN flow rate increases at a lower rate due to the RSN throttling feature.
- As valve lift continues into the final stage of rate shaping, the RSN design's flow increases to the same rate as the conventional design.
- This ability to restrict and tailor the fuel flow during the early period of the injection sequence is used to produce the desired noise reductions and lowering of NOX levels needed to meet the needs of our OEM customers.

Notes:

35. **RSN® Principles of Operation-17/21 mm Injectors**

Same principle except RSN feature is located in the nozzle assembly closer to the tip.

Notes:
36. **RSN® Pencil Nozzle Cutaway**
   - Be able to point out the RSN feature
   - Note the similarities with the conventional design

   Notes:

37. **RSN® 17/21 mm Cutaway**
   - Be able to point out the RSN feature
   - As with the pencil injector grinding or lapping of an RSN nozzle valve or body must not be performed since the flow characteristics are dependent on close valve to body and seat to transition dimensional tolerances, which will be affected by those operations

   Notes: