

## **7FDL Diesel Engine Overview**

### **Screen 1:**

#### **Welcome Screen:**

Welcome to the 7FDL Diesel Engine Overview module of the 7FDL Diesel Engine Basic course.

### **Screen 2:**

#### **Introduction to 7FDL Diesel Engine:**

Engineering developed the 7FDL engine for use in diesel engine railroad locomotives. Its design and rating is based on extensive laboratory tests backed by millions of hours of field experience with thousands of engines in service today.

At the end of this module, you will be able to:

- State the information represented by the 7FDL engine classification.
- Define the terms associated with the 7FDL diesel engine orientation and cylinder locations.
- Recognize the differences in engine specifications for the 7FDL 12-cylinder and 16-cylinder engines.
- Explain how 7FDL engines have evolved to meet regulatory requirements.

### **Screen 3:**

#### **Overview of 7FDL Diesel Engine:**

The letter-and-numeral code combination used to classify the 7FDL engine is based on the following:

- '7' indicates our category of mechanical devices.
- 'F' represents the 9" engine cylinder bore and 10.5" piston stroke.
- 'D' stands for diesel.
- 'L' indicates that the engine is designed for a locomotive application.

If you are working on one of our diesel engines using the documentation provided with your locomotive, certain terms will be used to describe component locations. This module will familiarize you with the terms and locations described in official documentation.

### **Screen 4:**

#### **7FDL Engine Orientation:**

The two ends of the diesel engine are referred to as the free end and the alternator end. The free end of the engine is the end where the turbocharger and intercoolers are mounted. This end faces the radiator cab when the engine is mounted on the locomotive. The generator or alternator end is the end of the engine where the generator or alternator is mounted. This end of the engine is oriented towards the operator's cab.

### **Screen 5:**

#### **7FDL Engine Orientation (Cont'd):**

The cylinders are numbered from the free end to the alternator or generator end of the engine. The No. 1 right and No. 1 left cylinders are nearest the turbocharger on all our diesel engines. The right side or left side of the engine is determined when viewing the engine while facing the generator or

alternator end of the engine. The right side of the engine is on the left side of the locomotive. During engine operation, the crankshaft rotates counterclockwise when viewed from the alternator end and clockwise when viewed from the free end.

#### **Screen 6:**

##### **Engine Specifications:**

The specifications, dimensions and weights of the 7FDL 12-cylinder and 16-cylinder diesel engines are shown in the table. The 12- and 16- cylinder engines are similar on many counts but differ with regard to number of cylinders and their firing order, and also their length and weight. The 7FDL diesel engine has undergone numerous improvements in its 50-plus years of locomotive history. Recently, the changes made to the 7FDL diesel engine have been driven by evolving exhaust emission regulatory standards that govern the locomotive freight hauling industry.

#### **Screen 7:**

##### **7FDL Tier 0 Compliant Engines:**

To reduce the emissions from locomotives, the United States Environmental Protection Agency (EPA) first issued a set of standards in 1973, referred to as the Tier 0 Standards.

- The primary focus of the EPA regulations is the reduction of nitrogen oxides or NO<sub>x</sub>. Also measured and regulated are hydrocarbons, carbon monoxide, particulate matter, and smoke.
- These pollutants are measured in weight (grams) of pollutants emitted to produce 1 horsepower for 1 hour. The table displays the EPA Tier 0 limits for these pollutants.

Although the Tier 0 standards were issued in 1973, they did not become effective until 2000, which allowed manufacturers time for the design and development of new engines to meet the standards.

#### **Screen 8:**

##### **7FDL Tier 0 Compliant Engines (Cont'd):**

To meet the Tier 0 standards, modified 7FDL diesel engines were first put into production on January 1<sup>st</sup>, 2001. All 7FDL engines manufactured between January 1<sup>st</sup>, 2001 and December 31<sup>st</sup>, 2001, were compliant with Tier 0 emission standards. Once the Tier 0 standards became effective in 2000, the standards also applied to all locomotive engines originally manufactured from 1973 through 2001, and included both newly manufactured and remanufactured engines.

#### **Screen 9:**

##### **7FDL Tier 1 Compliant Engines:**

Beginning in January of 2002, all 7FDL diesel engines placed into production through 2004 complied with the EPA Tier 1 regulations. Going from Tier 0 to Tier 1 represented a 22% reduction in NO<sub>x</sub> and a 25% reduction in particulate matter. The table displays the EPA Tier 1 limits for these pollutants. In order to meet the Tier 2 standards that became effective in 2005, Engineering introduced the Evolution Series of locomotives in North America, replacing the Dash 9 and AC4400 locomotives, both of which used the 7FDL engine.

**Screen 10:****7FDL Tier 0+ and 1+ Compliant Engines:**

In 2008, the emission standards were modified and the revised Tier 0 and Tier 1 were designated as Tier 0+ and Tier 1+. These revised guidelines are applicable to 7FDL engines that were originally produced between 1993 and 2004, but are remanufactured as of January 1<sup>st</sup>, 2010. The revised guidelines are documented in the United States Code of Federal Regulations (CFR), Title 40, Part 1033. For ease of reference, this regulation is referred to as 40 CFR Part 1033. Part 1033 deals specifically with the control of emissions from locomotives. There are currently two different versions of Part 1033-compliant 7FDL diesel engines; the Tier 0+ and the Tier 1+ compliant engines. Differences between the two versions of diesel engines are that Tier 0+ versions maintain the Tier 0 camshaft assemblies and turbochargers. NOx credits allow for a limited number of engines to keep the Tier 0 camshaft assemblies and turbochargers. These units would be Part 1033 Tier 0+ compliant units. The Part 1033 regulation reduces the emissions of particulate matter by approximately 50% from the Tier 1 limits.

**Screen 11:****Emission Critical Components:**

Certain parts and assemblies on our locomotives manufactured or remanufactured after January 1<sup>st</sup>, 2001 are equipped with "Emission Critical Components". These components have been identified as being critical in enabling the locomotives to be operated in compliance with EPA emissions requirements. Accordingly, for our various warranties and representations regarding emissions compliance for these locomotives to remain in force and effect, replacement and repair of Emission Critical Components should be done only in accordance with the most recent compliant engine parts list published by our engineering group.

**Screen 12:****Engine Maintenance to Ensure EPA Compliance:**

Failure to install compliant parts and/or parts meeting required engineering specifications may even result in serious mechanical failures and may void our mechanical and emissions defect warranties for the locomotives. By law, beginning January 1, 2001, the owners of these locomotives are required to ensure that all scheduled or required emissions-related maintenance is performed on a timely basis and that all emissions-related repairs and maintenance performed on these locomotives is performed in accordance with the maintenance instructions provided by the manufacturer.

**Screen 18:****Summary:**

You have reached the end of this module!

In this module, you learned to:

- State the information represented by the 7FDL engine classification.
  - The letter-and-numeral code combination used to classify the 7FDL engine is based on the following:
    - '7' indicates our category of mechanical devices.
    - 'F' represents the 9" engine cylinder bore and 10.5" piston stroke.
    - 'D' stands for diesel.
    - 'L' indicates that the engine is designed for a locomotive application.

- Describe the terms associated with the 7FDL diesel engine orientation and cylinder locations.
  - The free end of the engine faces the radiator cab. It is the end where the turbocharger and intercoolers are mounted.
  - The alternator end of the engine is the end where the generator or alternator is mounted. This end of the engine is oriented towards the operator's cab.
  - The cylinders are numbered from the free end to the alternator end of the engine.
  - The right side or left side of the engine is determined when viewing the engine while facing the generator or alternator end of the engine. The right side of the engine is on the left side of the locomotive.
  - During engine operation, the crankshaft rotates clockwise when viewed from the free end and counterclockwise when viewed from the alternator end.
  
- Recognize the differences in engine specifications for the 7FDL 12-cylinder and 16-cylinder engines.
  - The 7FDL 12-cylinder and 16-cylinder engines differ with respect to engine specifications, such as number of cylinders, firing order, and weight.
  
- Explain how 7FDL engines have evolved to meet regulatory requirements.
  - The primary focus of the EPA regulation is the reduction of nitrogen oxides or NOx. Also measured and regulated are hydrocarbons, carbon monoxide, particulate matter, and smoke.
  - To meet the Tier 0 emission standards set by the Environmental Protection Agency (EPA), modified 7FDL diesel engines were put into production on January 1<sup>st</sup>, 2001. Engines manufactured between January 1<sup>st</sup>, 2001 and December 31<sup>st</sup>, 2001 were Tier 0 compliant.
  - 7FDL diesel engines were put into production on January 1<sup>st</sup>, 2002 through 2004 to comply with the EPA Tier 1 regulations. Going from Tier 0 to Tier 1 represents a 22% reduction in NOx and a 25% reduction in particulate matter.
  - In 2008, the emission standards were modified and the revised Tier 0 and Tier 1 were designated as Tier 0+ and Tier 1+. These revised guidelines are applicable to 7FDL engines that were originally produced between 1993 and 2004, but are remanufactured as of January 1<sup>st</sup>, 2010.
  - There are currently two different versions of Part 1033-compliant 7FDL diesel engines - the Tier 0+ and the Tier 1+ compliant engines. Differences between the two versions of diesel engines are that Tier 0+ versions maintain the Tier 0 camshaft assemblies and turbochargers.
  - There are some Emission Critical Components in the engine that are critical to ensuring compliance with EPA standards. Customers must follow our guidelines for maintenance, repair, and replacement of these components to ensure EPA compliance. Validity of our warranties is also dependent on following these guidelines.