§ 7.98 Technical requirements.

(a) The diesel power package shall use a category A diesel engine approved under subpart E of this part with the following additional requirements:

1. A hydraulic, pneumatic, or other mechanically actuated starting mechanism. Other means of starting shall be evaluated in accordance with the provisions of §7.107.

2. If an air compressor is provided, the intake air line shall be connected to the engine intake system between the air cleaner and the flame arrester. If the air compressor’s inlet air line is not connected to the engine’s intake system, it shall have an integral air filter.

(b) The temperature of any external surface of the diesel power package shall not exceed 302 °F (150 °C).

1. Diesel power package designs using water jacketing to meet this requirement shall be tested in accordance with §7.101.

2. Diesel power packages using other techniques will be evaluated under the provisions of §7.107.

3. When using water-jacketed components, provisions shall be made for positive circulation of coolant, venting of the system to prevent the accumulation of air pockets, and effective activation of the safety shutdown system before the temperature of the coolant in the jackets exceeds the manufacturer’s specifications or 212 °F (100 °C), whichever is lower.

(c) External rotating parts shall not be constructed of aluminum alloys containing more than 0.6 percent magnesium.

(d) If nonmetallic rotating parts are used, they shall be provided with a means to prevent an accumulation of static electricity. Static conducting materials shall have a total resistance of 1 megohm or less, measured with an applied potential of 500 volts or more. Static conducting materials having a total resistance greater than 1 megohm will be evaluated under the provisions of §7.107.

(e) All V-belts shall be static conducting and have a resistance not exceeding 6 megohms, when measured with a direct current potential of 500 volts or more.

(f) The engine crankcase breather shall not be connected to the air intake system of the engine. The discharge from the breather shall be directed away from hot surfaces of the engine and exhaust system.

(g) Electrical components on diesel power packages shall be certified or approved by MSHA under parts 7, 18, 20, and 27 of this chapter.

(h) Electrical systems on diesel power packages consisting of electrical components, interconnecting wiring, and mechanical and electrical protection shall meet the requirements of parts 7, 18, and 27 of this chapter, as applicable.

(i) The diesel power package shall be equipped with a safety shutdown system which will automatically shut off the fuel supply and stop the engine in response to signals from sensors indicating—

1. The coolant temperature limit specified in paragraph (b) of this section;

2. The exhaust gas temperature limit specified in paragraph (s)(4) of this section;

3. The minimum allowable low water level, for a wet exhaust conditioner, as established by tests in §7.100. Restarting of the engine shall be prevented until the water level in the wet exhaust conditioner has been replenished above the minimum allowable low water level; and

4. The presence of other safety hazards such as high methane concentration, actuation of the fire suppression system, etc., if such sensors are included in the safety shutdown system.

(j) The safety shutdown system shall have the following features:

1. A means to automatically disable the starting circuit and prevent engagement of the starting mechanism while the engine is running, or a starting mechanism constructed of non-sparking materials.

2. If the design of the safety shutdown system requires that the lack of
§ 7.98

engine oil pressure must be overridden to start the engine, the override shall not be capable of overriding any of the safety shutdown sensors specified in paragraph (i) of this section.

(k) The diesel power package shall be explosion-proof as determined by the tests set out in § 7.100.

(l) Engine joints that directly or indirectly connect the combustion chamber to the surrounding atmosphere shall be explosion-proof in accordance with paragraphs (m) through (q) of this section and § 7.100. This paragraph does not apply to the following:

(1) Pistons to piston rings;
(2) Pistons to cylinder walls;
(3) Piston rings to cylinder walls;
(4) Cylinder head to cylinder block;
(5) Valve stem to valve guide; or
(6) Injector body to cylinder head.

(m) Each segment of the intake system and exhaust system required to provide explosion-proof features shall be constructed of metal and designed to withstand a minimum internal pressure equal to four times the maximum pressure observed in that segment in tests under § 7.100 or a pressure of 150 psig, whichever is less. Castings shall be free from blowholes.

(n) Welded joints forming the explosion-proof intake and exhaust systems shall be continuous and gas-tight. At a minimum, they shall be made in accordance with American Welding Society Standard D14.4-77 or meet the test requirements of § 7.104 with the internal pressure equal to four times the maximum pressure observed in tests under § 7.100 or a pressure of 150 psig, whichever is less.

(o) Flexible connections shall be permitted in segments of the intake and exhaust systems required to provide explosion-proof features, provided that failure of the connection activates the safety shutdown system before the explosion-proof characteristics are lost.

(p) Flame-arresting paths in the intake and exhaust systems shall be formed either by—

(1) Flanged metal to metal joints meeting the requirements of paragraph (q) of this section; or
(2) Metal flanges fitted with metal gaskets and meeting the following requirements:

(i) Flat surfaces between bolt holes that form any part of a flame-arresting path shall be planed to within a maximum deviation of one-half the maximum clearance specified in paragraph (q)(7) of this section. All metal surfaces forming a flame-arresting path shall be finished during the manufacturing process to not more than 250 micro-inches.

(ii) A means shall be provided to ensure that fastenings maintain the tightness of joints. The means provided shall not lose its effectiveness through repeated assembly and disassembly.

(iii) Fastenings shall be as uniform in size as practicable to preclude improper assembly.

(iv) Holes for fastenings shall not penetrate to the interior of an intake or exhaust system and shall be threaded to ensure that all specified bolts or screws will not bottom even if the washers are omitted.

(v) Fastenings used for joints of flame-arresting paths on intake or exhaust systems shall be used only for attaching parts that are essential in maintaining the explosion-proof integrity. They shall not be used for attaching brackets or other parts.

(vi) The minimum thickness of material for flanges shall be 1/4-inch, except that a final thickness of 7/16-inch is allowed after machining rolled plate.

(vii) The maximum fastening spacing shall be 6 inches.

(viii) The minimum diameter of fastenings shall be 3/8-inch, except smaller diameter fastenings may be used if the joint first meets the requirements of the static pressure test in § 7.104, and the explosion test in § 7.100.

(ix) The minimum thread engagement of fastenings shall be equal to or greater than the nominal diameter of the fastenings specified, or the intake or exhaust system must meet the test requirements of the explosion tests in § 7.100 and the static pressure test in § 7.104.

(x) The minimum contact surface of gaskets forming flame-arresting paths shall be 3/8-inch, and the thickness of the gaskets shall be no greater than 7/16-inch. The minimum distance from the interior edge of a gasket to the edge of a fastening hole shall be 3/8-inch. The gaskets shall be positively
(q) The following construction requirements shall apply to flame-arresting paths formed without gaskets:

(1) Flat surfaces between fastening holes that form any part of a flame-arresting path shall be planed to within a maximum deviation of one-half the maximum clearance specified in paragraph (q)(7) of this section. All metal surfaces forming a flame-arresting path shall be finished during the manufacturing process to not more than 250 microinches. A thin film of nonhardening preparation to inhibit rusting may be applied to these finished metal surfaces, as long as the final surface can be readily wiped free of any foreign materials.

(2) A means shall be provided to ensure that fastenings maintain the tightness of joints. The means provided shall not lose its effectiveness through repeated assembly and disassembly.

(3) Fastenings shall be as uniform in size as practicable to preclude improper assembly.

(4) Holes for fastenings shall not penetrate to the interior of an intake or exhaust system and shall be threaded to ensure that all specified bolts or screws will not bottom even if the washers are omitted.

(5) Fastenings used for joints of flame-arresting paths on intake or exhaust systems shall be used only for attaching parts that are essential in maintaining the explosion-proof integrity. They shall not be used for attaching brackets or other parts.

(6) The flame-arresting path of threaded joints shall conform to the requirements of paragraph (q)(7) of this section.

(7) Intake and exhaust systems joints shall meet the specifications set out in Table F-1.

### Table F-1—Dimensional Requirements for Explosion-Proof Intake and Exhaust System Joints

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Minimum Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum thickness of material for flanges</td>
<td>1/2&quot;²</td>
</tr>
<tr>
<td>Minimum width of joint; all in one plane</td>
<td>1&quot;</td>
</tr>
<tr>
<td>Maximum clearance; joint all in one plane</td>
<td>0.004&quot;</td>
</tr>
<tr>
<td>Minimum width of joint; portions of which are different planes; cylinders or equivalent</td>
<td>1/4&quot;²</td>
</tr>
<tr>
<td>Maximum clearance; joint in two or more planes, cylinders or equivalent:</td>
<td></td>
</tr>
<tr>
<td>Portion perpendicular to plane</td>
<td>0.008&quot;³</td>
</tr>
<tr>
<td>Plane portion</td>
<td>0.006&quot;</td>
</tr>
<tr>
<td>Maximum fastening spacing; joints in one plane</td>
<td>6&quot;</td>
</tr>
<tr>
<td>Minimum diameter of fastening (without regard to type of joint)</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td>Minimum thread engagement of fastening</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>Maximum diametrical clearance between fastening body and unthreaded holes through which it passes</td>
<td>5/8&quot;⁴, 1/2&quot;⁵, 5/16&quot;³, 7/32&quot;⁶</td>
</tr>
<tr>
<td>Minimum distance from interior of the intake or exhaust system to the edge of a fastening hole:</td>
<td>7/16&quot;⁷, 1/4&quot;², 1/8&quot;³</td>
</tr>
<tr>
<td>Joint-minimum width 1&quot;</td>
<td></td>
</tr>
<tr>
<td>Shafts centered by ball or roller bearings:</td>
<td></td>
</tr>
<tr>
<td>Minimum length of flame-arresting path</td>
<td>1&quot;</td>
</tr>
<tr>
<td>Maximum diametrical clearance</td>
<td>0.030&quot;</td>
</tr>
<tr>
<td>Other cylindrical joints:</td>
<td></td>
</tr>
<tr>
<td>Minimum length of flame-arresting path</td>
<td>1&quot;</td>
</tr>
<tr>
<td>Maximum diametrical clearance</td>
<td>0.010&quot;</td>
</tr>
</tbody>
</table>

² 1/4" less is allowable for machining rolled plate.
³ Only two planes are involved; neither portion of a joint shall be less than 1/4" wide, unless the wider portion conforms to the same requirements as those for a joint that is all in one plane. If more than two planes are involved (as in labyrinths or tongue-in-groove joints), the combined lengths of those portions having prescribed clearances are considered.
⁴ The allowable diametrical clearance is 0.008-inch when the portion perpendicular to the plane portion is 1/4" or greater in length. If the perpendicular portion is more than 1/4" wide but less than 1/4" wide, the diametrical clearance shall not exceed 0.006-inch.
⁵ Shafts, when provided, shall bottom in blind holes, be completely welded in place, or have the bottom of the hole closed with a plug secured by weld or braze. Fastenings shall be provided at all comers.
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5 The requirements as to diametrical clearance around the fastening and minimum distance from the fastening hole to the inside of the intake or exhaust system apply to steel dowel pins. In addition, when such pins are used, the spacing between centers of the fastenings on either side of the pin shall not exceed 5 inches.

6 Fastening diameters smaller than specified may be used if the joint or assembly meets the test requirements of §7.104.

7 Minimum thread engagement shall be equal to or greater than the nominal diameter of the fastening specified, or the intake or exhaust system must meet the test requirements of §7.104.

8 The requirements as to diametrical clearance around the fastening and minimum distance from the fastening hole to the inside of the intake or exhaust system apply to steel dowel pins. In addition, when such pins are used, the spacing between centers of the fastenings on either side of the pin shall not exceed 5 inches.

9 The maximum clearance only applies when the fastening is located within the flame-arresting path.

10 Edge of the fastening hole shall include any edge of any machining done to the fastening hole, such as chamfering.

12 If the diametrical clearance for fastenings does not exceed 1/32-inch, then the minimum distance shall be 1/4-inch.

(r) Intake system. (1) The intake system shall include a device between the air cleaner and intake flame arrester, operable from the equipment operator’s compartment, to shut off the air supply to the engine for emergency purposes. Upon activation, the device must operate immediately and the engine shall stop within 15 seconds.

(2) The intake system will include a flame arrester that will prevent an explosion within the system from propagating to a surrounding flammable mixture when tested in accordance with the explosion tests in §7.100. The flame arresters shall be located between the air cleaner and the intake manifold and shall be attached so that it can be removed for inspection or cleaning. The flame arresters shall be constructed of corrosion-resistant metal and meet the following requirements:

(i) Two intake flame arrester designs, the spaced-plate type and the crimped ribbon type, will be tested in accordance with the requirements of §7.100. Variations to these designs or other intake flame arrester designs will be evaluated under the provisions of §7.107.

(ii) In flame arresters of the spaced-plate type, the thickness of the plates shall be at least 0.125-inch; spacing between the plates shall not exceed 0.014-inch; and the flame-arresting path formed by the plates shall be at least 1 inch wide. The unsupported length of the plates shall be short enough that permanent deformation resulting from explosion tests shall not exceed 0.002-inch. The plates and flame arrester housing shall be an integral unit which cannot be disassembled.

(iii) In flame arresters of the crimped ribbon type, the dimensions of the core openings shall be such that a plug gauge 0.018-inch in diameter shall not pass through, and the flame-arresting path core thickness shall be at least 1 inch. The core and flame arrester housing shall be an integral unit which cannot be disassembled.

(s) Exhaust system. (1) The exhaust system shall include a flame arrester that will prevent propagation of flame or discharge of glowing particles to a surrounding flammable mixture. The flame arrester shall be constructed of corrosion-resistant metal.

(i) If a mechanical flame arrester is used, it shall be positioned so that only cooled exhaust gas at a maximum temperature of 302 °F (150 °C) will be discharged through it.

(ii) If a mechanical flame arrester of the spaced-plate type is used, it must meet the requirements of paragraph (r)(2)(ii) of this section and the test requirements of §7.100. Variations to the spaced-plate flame arrester design and
§ 7.99 Critical characteristics.

The following critical characteristics shall be inspected or tested on each diesel power package to which an approval marking is affixed:

(a) Finish, width, planarity, and clearances of surfaces that form any part of a flame-arresting path.

(b) Thickness of walls and flanges that are essential in maintaining the explosion-proof integrity of the diesel power package.

(c) Size, spacing, and tightness of fastenings.

(d) The means provided to maintain tightness of fastenings.