ascertain compliance with the requirements of § 7.304 of this part.

(b) All drawings shall be titled, dated, numbered, and include the latest revision.

§ 7.304 Technical requirements.

(a) Voltage rating of the motor shall not exceed 4160 volts.

(b) The temperature of the external surfaces of the motor assembly shall not exceed 150 °C (302 °F) when operated at the manufacturers' specified ratings.

(c) Minimum clearances between uninsulated electrical conductor surfaces, or between uninsulated conductor surfaces and grounded metal surfaces, within the enclosure shall meet the requirements of table J–1 of this section.

TABLE J–1—MINIMUM CLEARANCES BETWEEN UNINSULATED SURFACES

Phase-to-phase voltage (rms)	Clearances (inches)	
	Phase-to-phase	Phase-to-ground or control circuit
0 to 250	0.25	0.25
251 to 600	0.28	0.25
601 to 1000	0.61	0.25
1001 to 2400	1.4	0.6
2401 to 4160	3.0	1.4

(d) Parts whose dimensions can change with the motor operation, such as ball and roller bearings and oil seals, shall not be used as flame-arresting paths.

(e) The widths of any grooves, such as grooves for holding oil seals or o-rings, shall be deducted in measuring the widths of flame-arresting paths.

(f) An outer bearing cap shall not be considered as forming any part of a flame-arresting path unless the cap is used as a bearing cartridge.

(g) Requirements for explosion-proof enclosures of motor assemblies.

(1) Enclosures shall be—

(i) Constructed of metal;

(ii) Designed to withstand a minimum internal pressure of 150 pounds per square inch (gauge);

(iii) Free from blowholes when cast; and

(iv) Explosion proof as determined by the tests set out in § 7.306 of this part.

(2) Welded joints forming an enclosure shall be—

(i) Continuous and gas-tight; and

(ii) Made in accordance with or exceed the American Welding Society Standard AWS D14.4–77, ''Classification and Application of Welded Joints for Machinery and Equipment,'' or meet the test requirements set out in § 7.307 of this part. AWS D14.4–77 is incorporated by reference and has been approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from the American Welding Society, Inc., 2501 NW 7th Street, Miami, FL 33125. Copies may be inspected at the U.S. Department of Labor, Mine Safety and Health Administration, Approval and Certification Center, 765 Technology Drive, Triadelphia, WV 26059, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202–741–6030, or go to: *http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html*.

(3) External rotating parts shall not be constructed of aluminum alloys containing more than 0.6 percent magnesium. Non-metallic rotating parts shall be provided with a means to prevent an accumulation of static electricity.

(4) Threaded covers and mating parts shall be designed with Class 1A and 1B (coarse, loose fitting) threads. The covers shall be secured against loosening.

(5) Flat surfaces between fastening holes that form any part of a flame-arresting path shall be plane to within a maximum deviation of one-half the maximum clearance specified in paragraph (g)(19) of this section. All 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.

(6) For a laminated stator frame, it shall be impossible to insert a 0.0015 inch thickness gauge to a depth exceeding ⅛ inch between adjacent laminations or between end rings and laminations.

(7) Lockwashers, or equivalent, shall be provided for all fastenings. Devices other than lockwashers shall meet the requirements of §7.308 of this part. Equivalent devices shall only be used in the configuration in which they were tested.

(8) Fastenings shall be as uniform in size as practicable to preclude improper installation.

(9) Holes for fastenings in an explosion-proof enclosure shall be threaded to ensure that all specified bolts or screws will not bottom even if the washers are omitted.

(10) Holes for fastenings shall not penetrate to the interior of an explosion-proof enclosure, except holes made through motor casings for bolts, studs, or screws to hold essential parts, such as pole pieces, brush rigging, and bearing cartridges. The attachments of such parts shall be secured against loosening. The threaded holes in these parts shall be blind unless the fastenings are inserted from the inside, in which case the fastenings shall not be accessible with the rotor in place.

(11) For direct current motor assemblies with narrow interpoles, the distance from the edge of the pole piece to any bolt hole in the frame shall be at least ⅛ inch. If the distance is ⅛ to ¼ inch, the diametrical clearance for the pole bolt shall not exceed 1/64 inch for not less than ½ inch through the frame. Furthermore, the pole piece shall have the same radius as the inner surface of the frame. Pole pieces may be shimmed as necessary. If used, the total resulting thickness of the shims shall be specified. The shim assembly shall meet the same requirements as the pole piece.

(12) Coil-thread inserts, if used in holes for fastenings, shall meet the following:

(i) The inserts shall have internal screw threads.

(ii) The holes for the inserts shall be drilled and tapped consistent with the insert manufacturer's specifications.

(iii) The inserts shall be installed consistent with the insert manufacturer's specifications.

(iv) The insert shall be of sufficient length to ensure the minimum thread engagement of fastening specified in paragraph (g)(19) of this section.

(13) A minimum of ⅛ inch of stock shall be left at the center of the bottom of each blind hole that could penetrate into the interior of an explosion-proof enclosure.

(14) Fastenings shall be used only for attaching parts that are essential in maintaining the explosion-proof integrity of the enclosure, or necessary for the operation of the motor. They shall not be used for making electrical connections.

(15) Through holes not in use shall be closed with a metal plug. Plugs, including eyebolts, in through holes where future access is desired shall meet the flame-arresting paths, lengths, and clearances of paragraph (g)(19) of this section and be secured by spot welding or brazing. The spot weld or braze may be on a plug, clamp, or fastening (for example see figure J–1). Plugs for holes where future access is not desired shall be secured all around by a continuous gas-tight weld.

(16) O-rings, if used in a flame-arresting path, shall meet the following:

(i) When the flame-arresting path is in one plane, the o-ring shall be located at least one-half the acceptable flame-arresting path length specified in paragraph (g)(19) of this section from within the outside edge of the path (see figure J–2).

(ii) When the flame-arresting path is one of the plane-cylindrical type (step joint), the o-ring shall be located at least ½ inch from within the outer edge of the plane portion (see figure J–3), or at the junction of the plane and cylindrical portion of the joint (see figure J–4), or in the cylindrical portion (see figure J–5).

(17) Mating parts comprising a pressed fit shall result in a minimum interference of 0.001 inch between the parts. The minimum length of the pressed fit shall be equal to the minimum thickness requirement of paragraph (g)(19) of this section for the material in which the fit is made.

(18) The flame-arresting path of threaded joints shall conform to the requirements of paragraph (g)(19) of this section.

(19) Explosion-proof enclosures shall meet the requirements set out in table

J–2 of this section, based on the internal free volume of the empty enclosure.

TABLE J–2—EXPLOSION-PROOF REQUIREMENTS BASED ON VOLUME

	Volume of empty enclosure		
	Less than 45 cu. ins.	45 to 124 cu. ins. inclusive	More than 124 cu. ins.
Minimum thickness of material for walls [1]	1/8″	3/16″	1/4″
Minimum thickness of material for flanges and covers	[2] 1/4″	[3] 3/8″	[3] 1/2″
Minimum width of joint; all in one plane	1/2″	3/4″	1″
Maximum clearance; joint all in one plane	0.002″	0.003″	0.004″
Minimum width of joint, portions of which are in different planes; cylinders or equivalent	[4] 3/8″	[4] 5/8″	[4] 3/4″
Maximum clearances; joint in two or more planes, cylinders or equivalent: [5]			
(a) Portion perpendicular to plane [6]	0.008″	0.008″	0.008″
(b) Plane portion	0.006″	0.006″	0.006″
Maximum fastening [7] [8] spacing; joints all in one plane	(16)	(16)	(16)
Maximum fastening spacing; joints, portions of which are in different planes	(17)	(17)	(17)
Minimum diameter of fastening [9] (without regard to type of joint)	1/4″	1/4″	3/8″
Minimum thread engagement of fastening [10]	1/4″	1/4″	3/8″
Maximum diametrical clearance between fastening body and unthreaded holes through which it passes [8] [11] [12]	1/64″	1/32″	1/16″
Minimum distance from interior of enclosure to the edge of a fastening hole: [8] [13]			
Joint—minimum width 1″	.....	.....	[14] 7/16″
Joint—less than 1″ wide	1/8″	3/16″	
Cylindrical Joints			
Shaft centered by ball or roller bearings:			
Minimum length of flame-arresting path	1/2″	3/4″	1″
Maximum diametrical clearance	0.020″	0.025″	0.030″
Other cylindrical joints: [15]			
Minimum length of flame-arresting path	1/2″	3/4″	1″
Maximum diametrical clearance	0.006″	0.008″	0.010″

[1] This is the minimal nominal dimension when applied to standard steel plate.
[2] 1/32 inch less is allowable for machining rolled plate.
[3] 1/16 inch less is allowable for machining rolled plate.
[4] If only two planes are involved, neither portion of a joint shall be less than 1/8 inch 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-and-groove joints) the combined lengths of those portions having prescribed clearances are considered.
[5] For winding compartments having internal free volume not exceeding 350 cubic inches and joints not exceeding 32 inches in outer circumference and provided with step joints between the stator frame and the end bracket the following dimensions shall apply:

DIMENSIONS OF RABBET (STEP) JOINTS-INCHES

[See figure J–6 in appendix]

Minimum total width	Minimum width of clamped radial portion	Maximum clearance of radial portion	Maximum diametrical clearance at axial portion
3/8	3/64	0.0015	0.003
1/2	3/64	0.002	0.003
1/2	3/32	0.002	0.004

[6] The allowable diametrical clearance is 0.008 inch when the portion perpendicular to the plane portion is 1/4 inch or greater in length. If the perpendicular portion is more than 1/8 inch but less than 1/4 inch wide, the diametrical clearance shall not exceed 0.006 inch.
[7] Studs, 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 corners.
[8] The requirements as to diametrical clearance around the fastening and minimum distance from the fastening hole to the inside of the explosion-proof enclosure 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] Fastening diameters smaller than specified may be used if the enclosure meets the test requirements of 30 CFR 7.307 and then 7.306 in that order.
[10] Minimum thread engagement shall be equal to or greater than the diameter of the fastening specified, or the enclosure must meet the test requirements of 30 CFR 7.307 and then 7.306 in that order.
[11] This maximum clearance applies only when the fastening is located within the flame-arresting path.
[12] Threaded holes for fastening bolts shall be machined to remove burrs or projections that affect planarity of a surface forming a flame-arresting path.
[13] Edge of the fastening hole shall include the edge of any machining done to the fastening hole, such as chamfering.
[14] If the diametrical clearance for fastenings does not exceed 1/32 inch, then the minimum distance shall be 1/4 inch.

[15] Shafts or operating rods through journal bearings shall be at least ¼″ in diameter. The length of the flame-arresting path shall not be reduced when a pushbutton is depressed. Operating rods shall have a shoulder or head on the portion inside the enclosure. Essential parts riveted or bolted to the inside portion are acceptable in lieu of a head or shoulder, but cotter pins and similar devices shall not be used.
[16] 6″ with a minimum of 4 fastenings.
[17] 8″ with a minimum of 4 fastenings.

(h) *Lead entrances.* (1) Each cable, which extends through an outside wall of the motor assembly, shall pass through a stuffing-box lead entrance (see figure J–7). All sharp edges shall be removed from stuffing boxes, packing nuts, and other lead entrance (gland) parts, so that the cable jacket is not damaged.

(2) When the packing is properly compressed, the gland nut shall have—

(i) A clearance distance of ⅛ inch or more, with no maximum, to travel without interference by parts other than packing; and

(ii) A minimum of three effective threads engaged (see figures J–8, J–9, and J–10).

(3) Packing nuts (see figure J–7) and stuffing boxes shall be secured against loosening (see figure J–11).

(4) Compressed packing material shall be in contact with the cable jacket for a length of not less than ½ inch.

(5) Requirements for lead entrances in which MSHA accepted rope packing material is specified, are:

(i) Rope packing material shall be acceptable under § 18.37(e) of this chapter.

(ii) The width of the space for packing material shall not exceed by more than 50 percent the diameter or width of the uncompressed packing material (see figure J–12).

(iii) The maximum diametrical clearance, using the specified tolerances, between the cable and the through holes in the gland parts adjacent to the packing (stuffing box, packing nut, hose tube, or bushings) shall not exceed 75 percent of the nominal diameter or width of the packing material (see figure J–13).

(6) Requirements for lead entrances in which grommet packing made of compressible material is specified, are:

(i) The grommet packing material shall be accepted by MSHA as flame-resistant material under § 18.37(f)(1) of this chapter.

(ii) The diametrical clearance between the cable jacket and the nominal inside diameter of the grommet shall not exceed 1/16 inch, based on the nominal specified diameter of the cable (see figure J–14).

(iii) The diametrical clearance between the nominal outside diameter of the grommet and the inside wall of the stuffing box shall not exceed 1/16 inch (see figure J–14).

(i) *Combustible gases from insulating material.* (1) Insulating materials that give off flammable or explosive gases when decomposed electrically shall not be used within explosion-proof enclosures where the materials are subjected to destructive electrical action.

(2) Parts coated or impregnated with insulating materials shall be treated to remove any combustible solvent before assembly in an explosion-proof enclosure.

[57 FR 61193, Dec. 23, 1992, as amended at 73 FR 52210, Sept. 9, 2008]

§ 7.305 Critical characteristics.

The following critical characteristics shall be inspected on each motor assembly to which an approval marking is affixed:

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

(b) Clearances between mating parts that form flame-arresting paths.

(c) Thickness of walls, flanges, and covers that are essential in maintaining the explosion-proof integrity of the enclosure.

(d) Spacing of fastenings.

(e) Length of thread engagement on fastenings and threaded parts that assure the explosion-proof integrity of the enclosure.

(f) Use of lockwasher or equivalent with all fastenings.

(g) Dimensions which affect compliance with the requirements for packing gland parts in § 7.304 of this part.

§ 7.306 Explosion tests.

(a) The following shall be used for conducting an explosion test:

(1) An explosion test chamber designed and constructed to contain an