

Federal Wage System Job Grading Standard for Welding, 3703

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WORK COVERED

This standard covers the nonsupervisory work of welding metals and alloys. The work requires knowledge of electric, gas, and other welding processes such as electron beam welding, and the skill to apply these processes in manufacturing, repairing, modifying, rebuilding, and assembling various types of metal and alloy parts, equipment, systems, and structures such as buildings, aircraft, and ships.

WORK NOT COVERED

This standard does not cover the following work:

- cutting metal by hand or machine, using flame-cutting, arc-cutting, or other methods (see [Flame/Arc Cutting Series, 3702](#), or other appropriate occupations in the [Metal Processing Family, 3700](#)); or
- fabricating, repairing, and installing lead fixtures and equipment using leadburning methods (see [Leadburning Series, 3716](#)).

TITLES

Jobs graded by this standard below the grade 10 level are to be titled *Welding Worker*.

Jobs graded by this standard at the grade 10 level and above are to be titled *Welder*.

GRADE LEVELS

This standard does not describe all possible grades for this occupation. Some jobs may differ substantially from the levels of skill, knowledge, and other work requirements of the grades described in the standard. Such jobs may be graded above or below these grades based on sound job grading methods.

HELPER AND INTERMEDIATE JOBS

Helper jobs are graded by the U.S. Office of Personnel Management [Job Grading Standard for Trades Helper Jobs](#). The Grade 8 level in this standard covers the operation of a variety of electric resistance welding machines, or the use of manual gas torch and electric arc welding processes to carry out standard, previously done kinds of work. The grade 8 level described in this standard does *not* apply to welder jobs that are a part of a planned program of training and development of skills for advancement to a higher grade. Such trainee jobs are covered by the

standard for [Intermediate Jobs](#). (Grade 10 in this standard is to be used as the "journey level" in applying the intermediate job grading table.)

NOTES TO USERS

1. *Incidental duties*

This standard is directly applicable only to welding work. However, many welders perform a variety of other work operations incidental to their welding duties, such as brazing, soldering, flame and arc-cutting, and surface hardening. Therefore such incidental work operations, other than welding, are mentioned at different grade levels in this standard.

It should be noted that the standard is not directly applicable to such other nonwelding work itself. For example, the standard does not provide directly applicable criteria for grading the position of an employee performing brazing work on a full-time basis, or for determining the level of the flame and arc-cutting work performed by an employee when these duties are the highest level and grade controlling work of the position involved.

2. *Welding position*

The welding position used, to a limited degree, affects the difficulty of welding work. Generally, the vertical and overhead positions are considered more difficult than the flat and horizontal positions. However, the use of particular welding positions is, in itself, not grade significant. Rather in grading welder jobs, an overall judgement must be made considering all the criteria, including the trade knowledges, skills, and quality requirements described at the various grade levels in the standard.

3. *Work situations*

Because of the great variety of work situations in which welding is done in the Federal Service, no attempt has been made to mention more than a few of them in the standard. However, it should be noted that work situations or settings, in themselves, do not necessarily determine the level of welding work involved. For example, the level of the welding work performed in experiments or research and development activities may range from grade 8 to higher grades depending on the nature of the welding duties performed.

Similarly, although welding on high-pressure piping systems is used in an example at the grade 11 level in the standard, welding on such higher pressure piping systems does not automatically exceed the grade 10 level. Rather, the grade 11 level is warranted for such work only when it requires the degree of skill necessary to meet the level of radiographic standards indicated at the grade 11 level. Thus, welding work subject to less stringent radiographic standards than those described at the grade 11 level does not meet this skill requirement and typically is at the grade 10 level. Use of a particular "Navy" work situation in the example described at the grade 11 level in the standard does not mean that other welding work of comparable difficulty may not be found and recognized in other work situations.

WELDING WORKER, GRADE 8

General: Grade 8 welding workers apply a variety of electric resistance welding methods and equipment, or one or more manual welding processes, to carry out standard, previously done welding operations. For example, they operate various electric resistance welding machines such as spot, seam, and flash, or use a manual gas torch welding process such as oxyacetylene, to join a variety of different kinds of parts or components. They determine the welding techniques and machine settings to be used, assemble and set up the parts to be welded, and make the required welds following guides such as resistance welding control charts, specifications, accepted shop practices, and oral or written instructions from the supervisor. Depending on the process used and the requirements of the work, welds are usually made in flat or horizontal positions.

Skill and Knowledge: Grade 8 welding workers apply skill and knowledge to set up and operate various electric resistance welding machines, or to use one or more manual welding processes, for example, a gas welding process such as oxyacetylene or oxyhydrogen, and an arc welding process such as gas carbon-arc or gas metal arc, to weld parts made of commonly used metals. Welding Workers at the grade 8 level assure proper spacing, pressures, and heat cycles when operating electric resistance welding machines. They control the torch or arc, and the positioning and feeding of the welding rod or electrode when welding manually, to prevent burning of base metals and to obtain the desired penetration and weld bead dimensions.

As needed, grade 8 welding workers apply skill in using jigs and fixtures and in clamping pieces together to assemble and set-up the parts to be welded. When welding contoured shapes, they adjust the arms of the electric resistance welding machine to obtain set-ups that will provide access to all surfaces to be joined. Incidental to the welding work, grade 8 Welding Workers also may apply knowledge of one or two related trade processes, for example, flame-cutting when close tolerances do not have to be met.

Responsibility: Grade 8 welding workers perform welding operations on the basis of written or oral instructions from the supervisor, and blueprints, sketches, and work orders that clearly show what is to be done. At this grade level, Welding Workers select the techniques, machines, materials, and, when needed, the jigs and fixtures commonly used to do the assigned work.

Welding workers are responsible for making welds to meet specifications, and to assure proper penetration and freedom from pockets, scales, or other defects. Work is only spot-checked during its progress. The supervisor advises on unusual problems and checks the overall work for adequacy.

Physical Effort: The work involves standing, walking, stooping, bending, kneeling, climbing, and crawling. Work may be done in awkward and cramped positions such as when welding in hard to reach places, welders frequently handle objects weighing from 9 to 23 kilograms (20 to 50) pounds and, occasionally, objects weighing in excess of 23 kilograms (50 pounds), in setting up work and equipment and in completing assignments.

Working Conditions: The work is done indoors and outdoors, sometimes in bad weather, in areas that may vary from "clean rooms" to areas that are noisy, dirty, and smoky. Welding involves exposure to fumes, infrared and ultraviolet radiation, heat, flying sparks, the glare of torches and heated materials, the possibility of eye injury, electrical shock, burns, broken bones, and the chance of cuts when working with sharp objects. There is discomfort when wearing protective clothing, gloves, and flash shield or eye goggles.

WELDER, GRADE 10

General: In comparison with the application of a variety of electric resistance welding processes and equipment, or the use of one or more manual welding processes to carry out standard previously done welding operations as described at the grade 8 level, grade 10 welders use accepted trade methods and a variety of manual welding processes, for example, several different gas torch processes, various electric arc processes including inert gas shielded ones, or a number of both kinds of processes, to weld all types of commonly used metals and alloys of various sizes, shapes, and thicknesses, including dissimilar metals such as copper to steel.

In comparison with the grade 8 level, grade 10 welders also assure complete penetration when required as well as complete fusion of base and filler metals. They control the metals and the welding techniques to prevent distortion or burning of the metals, and to meet weld dimension, tolerance, strength, and other requirements. The welds are made in all positions including flat, horizontal, vertical, and overhead.

Skill and Knowledge: In comparison with the grade 8 level, grade 10 welders apply knowledge of a wider range of manual welding processes and make more difficult welds.

For example, the gas welding torch processes used by grade 10 welders involve processes such as oxyacetylene, oxyhydrogen, and other industrial gases. The arc processes used (including inert gas-shielded ones) involve methods such as gas metal-arc, gas tungsten-arc, gas carbon-arc, plasma-arc, and atomic hydrogen welding. Grade 10 welders apply a knowledge of welding standards and how various metals and alloys such as different kinds of steel, aluminum, cast iron, nickel, Monel metal, brass, copper, bronze, magnesium, beryllium, and titanium react to different welding processes and techniques. They weld metal parts and structures that may vary in size, shape, and thickness from very thin (for example, .025 inches or less) to very thick (for example, armor plating), requiring multiple welding passes, and weld dissimilar metals such as copper to steel. In comparison with the grade 8 level, grade 10 welders also use greater skill to make welds that require complete penetration as well as complete fusion of base and filler metals even when welding in hard to reach places.

As needed, grade 10 welders devise special jigs and fixtures to hold the parts to be welded. They use techniques such as preheating, heat sinks, and stress relieving to maintain specified dimensions and to prevent distortion or burning of the parts being welded. Incidental to the welding work, they also apply a knowledge of several related trade procedures, for example, brazing, soldering, flame and arc-cutting, surface hardening, annealing, and metal spraying.

Responsibility: Grade 10 welders determine the work to be done and the steps needed to accomplish it. They plan and lay out the work from blueprints, sketches, drawings, specifications, and work orders. They determine the welding techniques to use and select the proper materials such as the right size and type of welding electrodes or rods.

In comparison with the grade 8 level, grade 10 welders apply a variety of manual welding processes to make more difficult welds, including welds in hard to reach places that must meet close tolerance, strength, and other requirements, for example, evenness of fit and smoothness of contour.

The work is done with little or no in-progress check. Final products are reviewed to see that completed welds are free from cracks, slag, or other defects, and meet specifications and accepted trade standards. Welds are subject to radiographic, magnetic particle, dye penetrant, pressure inspection, and other tests. The supervisor is called on for advice on unusual problems.

Physical Effort: Physical effort required at this grade is the same as that described at the [grade 8 level](#).

Working Conditions: Working conditions at this grade are the same as those described at the [grade 8 level](#).

WELDER, GRADE 11

General: In comparison with the application of accepted trade methods to weld commonly used metals and alloys as described at the grade 10 level, grade 11 welders weld recently developed or experimental metals and alloys with welding properties that are not fully known, modify welding procedures, and recommend the most suitable metals and alloys for new or experimental applications.

Other grade 11 welders apply an unusually high degree of skill to make welds that must pass very high standards of radiographic examination to assure that piping systems and pressure vessels such as boilers can meet extreme operational requirements. (See class 1 radiographic standards in publications such as the Department of Defense publication MIL-STD-278 and Department of the NAVSHIPS 0900-003-9000, or equivalent standards.) For example, such welding may be required on piping systems that carry gases or liquids that are extremely volatile or lethal, at pressures above 150 pounds per square inch, or at temperatures over 650 degrees Fahrenheit.

Skill and Knowledge: In comparison with the grade 10 level, grade 11 welders apply greater practical knowledge of welding principles and skill to meet more difficult requirements. When welding with experimental base metals, electrodes, filler metals, fluxes, and shieldings. Grade 11 welders consider elements such as arc stability, degree of penetration, surface tension, and viscosity of the flux and shielding slag to determine adequacy of the welding performance. If the method used does not give good results, they modify the welding procedure by altering factors

such as the voltage, amperage, preheat, postheat, temperature of the metals and length of time between successive passes of the welding rod or electrode, rate at which filler metal is added to the joint during the welding process, and the width, appearance, and other characteristics of the molten puddle.

In comparison with the grade 10 level, grade 11 welders also apply a greater degree of manual skill and a higher level of concentrated attention for prolonged periods of time to weld piping systems and pressure vessels, such as boilers, that must meet critical requirements, for example, in repairing high-pressure pipelines aboard nuclear submarines.

The following examples are typical of the level of the radiographic standards which grade 11 welders must regularly meet in performing such work:

- When welding piping of less than two inch diameter, radiographic indications of root concavity and centerline shrinkage may not exceed 0.031 inches, and root undercutting may not exceed 0.016 inches.
- When welding pipe of less than 3/4 inch diameter, no radiographic indications of incomplete fusions or penetration are acceptable.
- The total combined lengths of slag indications for a 5 inch length of a weld:
 - May not exceed 7/16 of an inch if the weld is 2 of an inch thick;
 - May not exceed 2 of an inch if the weld is 1 inch thick.

Grade 11 welders also use special techniques such as flowing insert rings to achieve internal finishes within prescribed tolerances, mirrors to observe the weld site when access is difficult because of obstructions or other space limitations, and blocking methods to prevent distortion when there are problems of uneven heat dissipation. They also apply more skill in constantly changing the "angle of attack" (welding position and electrode angle) while welding, in completing welds from one side only (with no possibility of backgouging the weld root to remove defects), and in using special instrumentation such as dew point analyzers, oxygen analyzers, and manometers to assure that piping systems are properly purged before welding.

Responsibility: Grade 11 welders work independently on the basis of oral or written instructions from the supervisor, engineers, or scientists, and from blueprints, sketches, drawings, work orders, or other specifications which indicate the requirements to be met. In comparison with the use of accepted welding techniques as described at the grade 10 level, grade 11 welders modify details of shielding procedures, make trial welds to select the best welding process for new applications (for example, welding the parts of a prototype model involving newly developed metals), and recommend changes in joint design or in the base metals to be used.

In comparison with the grade 10 level, grade 11 welders also apply and maintain a higher degree of alertness, concentration, and visual and physical coordination when welding high pressure

pipng systems and pressure vessels. They assure that welds made meet very high standards of radiographic or other examination concerning slag, incomplete fusion or penetration, root surface concavity or convexity, porosity, or other defects.

Physical Effort: Physical effort required at this grade is the same as that described at the [grade 8 level](#).

Working Conditions: Working conditions at this grade are the same as those described at the [grade 8 level](#).