

Federal Wage System Job Grading Standard For Machining, 3414

Table of Contents

WORK COVERED	2
WORK NOT COVERED.....	2
TITLES	3
GRADE LEVELS	3
HELPER AND INTERMEDIATE JOBS	3
NOTES TO USERS.....	4
MACHINE TOOL OPERATOR, GRADE 8	5
MACHINE TOOL OPERATOR, GRADE 9	7
MACHINIST, GRADE 10	8
MACHINIST, GRADE 11	10

WORK COVERED

This standard covers nonsupervisory work involved in the manufacture of parts and items of equipment from castings, forgings, and other raw stocks made of various metals, metal alloys, and other materials, and/or machining operations required in the repair of such items. The work requires the use of various types of conventional and/or computer numerical control (CNC) machine tools and their attachments to perform machining operations in the repair and/or manufacture of parts from raw stock.

The work performed by machine tool operators requires basic knowledge of machining processes and skill in performing machining operations such as boring, drilling, planing, milling, and turning on milling machines, radial, or multiple spindle drill presses, shapers, planers, lathes, or equivalent types of conventional and/or CNC machine tools.

The work performed by machinists requires skill in the initial planning of necessary work sequences, laying out reference points and lines to be followed in the machining processes, planning for and setting up the work in the machine, sometimes programming the cutter path, selecting and shaping metal cutting tools and inserts, operating all types of machine tools, and performing precision handwork to fit, finish, and assemble machined parts and equipment. The work also requires knowledge of the makeup of blueprints and drawings and the skill necessary to interpret them; and skill in working from other types of specifications such as sketches, models of parts to be manufactured, or work orders.

This standard cancels and supersedes the Job Grading Standards for Machine Tool Operator, 3431, issued in May 1973, and Machinist, 3414, issued in September 1973.

WORK NOT COVERED

- Planning and fabricating research and prototype models using machinist trade processes *in combination* with those of one or more other trades (See [Job Grading Standard for Model Making Series, 4714.](#))
- Planning and fabricating research and prototype instruments using machinist trade processes *in combination* with one or more other trades (See [Job Grading Standard for Instrument Making Series, 3314.](#))
- Fabricating, manufacturing, calibrating, reconditioning, and repairing tools, jigs, fixtures, dies, punches, and gages used in the manufacture, overhaul, and repair of equipment (See [Job Grading Standard for Toolmaking Series, 3416.](#))
- Dismantling, repairing, relocating, modifying, maintaining, aligning, overhauling, and installing a wide variety of machinery, equipment, and systems such as propulsion machinery, lifeboat davits, anchor handling gear, and missile tube equipment that are located

aboard submarines, ships, and other floating craft. (See [Job Grading Standard for Marine Machinery Mechanic Series, 5334.](#))

- Dismantling, repairing, relocating, modifying, maintaining, aligning, overhauling, and installing fixed and semi-fixed production machinery, equipment, and systems such as various standard and numerically controlled machine tools, woodworking, and metalworking machines used in the production of goods. (See [Job Grading Standard for Production Machinery Mechanic Series, 5350.](#))
- Dismantling, repairing, aligning, overhauling, and installing general nonproduction industrial plant machinery, equipment, and systems such as bridge cranes, conveyor and pneumatic tube systems, sandblasting machines, and other industrial waste and flood control equipment such as compressors, pumps, and valves; and engraving machines, aircraft test block equipment, and fire extinguishing systems. (See [Job Grading Standard for Industrial Equipment Mechanic Series, 5352.](#))

TITLES

Jobs at grade 10 and above that involve the manufacture and repair of parts and items of equipment using a variety of conventional, nonconventional, and/or computer numerical control machine tools are titled Machinist.

Jobs below grade 10 are titled Machine Tool Operator.

GRADE LEVELS

This standard does not describe all possible grades at which jobs might be classified. If jobs differ substantially from the skill, knowledge, and responsibility levels or other work requirements described in the standard, they may be graded either above or below the grade levels described based on sound job grading methods.

HELPER AND INTERMEDIATE JOBS

Helper and Intermediate Machinist jobs are graded by the Office of Personnel Management [Job Grading Standards for Trades Helper](#) and [Intermediate](#) Jobs. The grade 10 machinist in this standard is to be used as the Afull performance@ level or grade in applying the Intermediate Job Grading Table.

NOTES TO USERS

PARTS PROGRAMMING

The evolution of parts programming from manually prepared programs using punch tape equipment or a mainframe computer to the use of a mini, micro, and now personal computers (PCS) has brought with it a revolution in how parts programs are generated.

With the power of the modern computer, the integration of CAD/CAM (computer aided design/computer aided manufacturing) has become a reality. The various functions under CAD/CAM fit roughly into three general areas: design/drafting, planning/scheduling, and fabrication. They are sometimes referred to as computer-aided engineering, management information systems, and manufacturing automation, respectively. CAD is often used separately as a term to cover all those functions involved in readying a product idea for fabrication. CAM is applied to those functions involved in producing that product, including the computer numerical control (CNC) parts programming.

The heart of CAD is computer graphics-the computer systems that create, transform, and display pictorial and symbolic data. In other words, computer graphics systems are high-speed replacements for the traditional drafting boards, drawings, and documents used in manufacturing. Any computer system that involves the display of a pictorial or graphic image is considered a computer graphics system. The image can range from a simple, two-dimensional, straightline plot of a cutter path to a multicolor representation of a three-dimensional assembly. Such representations may feature sculptured surfaces and moving parts, with shading and perspective to create the illusion of depth, which may be rotated and viewed like an object in space.

PAY PLAN DETERMINATION

Parts programming complexity and difficulty rests on the geometry of the part being machined. There are two levels of difficulty and complexity. The first level involves shop floor programming. The second level involves developing computer programs for three-dimensional contouring requiring simultaneous motion of 3 or more axis of machine tool motion. Level 1 involves up to three axis levels of programming complexity that is limited to drilling, boring, and similar operations at a fixed XY coordinate axes location plus some straight-line milling in a fixed plane and includes: repetitive and simple point-to-point; contour profiling limited to straight lines tangent to circles and arcs; circles intersecting circles; straight lines intersecting circles; pocket milling in a single plane with straight cuts; repetitive point-to-point operations irregularly spaced about a circle; formula curves such as an ellipse; and pocket milling of irregular pockets when points are described. Level 2 includes: pocket cleanouts at various depths; drilling on an inclined plane and rapid traversing to a point above the plane; machining an inclined plane; constant angular rotation of a cutter with tool axis normal to workpiece surface; three axis simultaneous motion with cutter axis tilted-axis of cutter to remain parallel to a canted surface; and one piece impeller screws that are difficult to machine without simultaneous five-axis control.

The majority of all CNC machined parts programmed fall in the first level of programming difficulty and require 2-axis contouring and 1-axis positioning programming that can be done by the machinist on the shop floor utilizing manual data input (MDI) or shop floor programming. MDI technically means manually entering options into the menu driven control unit (software program) for every block of the part programming data. Shop floor programming, on the other hand, means the entry of source data such as G coding into the machine CNC. Once programming reaches the levels of difficulty of three-dimensional contouring requiring simultaneous motion of three or more axis of machine tool motion, shop floor programming usually is not practical. At the second level of difficulty (i.e., the highest level), the programmer will not only have to be well versed in mathematics but generally have a strong background in computer programming and usage. In fact, knowledge and understanding of computers, operating systems, networks, applications software packages, peripheral equipment and programming languages are equally as important as knowledge of machining procedures. It is also at this level of difficulty where parts programming requires the application of engineering concepts, principles, and practices in developing methods and designs for the production of the full range of continuous path and multi-axis programs utilizing CAD systems. Consequently, positions meeting all of the aspects described at level 2, are considered to be under the General Schedule.

MACHINE TOOL OPERATOR, GRADE 8

General: Grade 8 machine tool operators operate one or more conventional or computer numerical control (CNC) machines to perform a specific machining operation in the machining of castings, forgings, or other raw stocks made of various metals, metal alloys, and other materials. Assignments are usually to the same type of closely related types of machine tools that have similar spindle and table movements; use comparable speed and feed controls; require the same type of cutting tools; or that perform essentially the same machining operation.

Grade 8 machine tool operators usually operate machines of the same type to carry out production runs involving standard operations. New jobs are normally set up in the machine with detailed operating instructions provided by a higher grade worker. On a conventional machine, they control the machine feeds and speeds, change and use different cutting tools for successive operations, and make minor changes in machine settings to maintain sizes or shape of the workpiece. On a CNC machine, they operate it in the automatic mode utilizing the feeds and speeds programmed. No changes in set up or manual input are required, except for minor adjustments and compensations for tool and workpiece size differences, as well as tool changes. Grade 8 operators insure that dimensions meet those prescribed by blueprints, sketches, or other instructions using standard measuring instruments.

Skill and Knowledge: Grade 8 machine tool operators have skill in performing machine operations on conventional and CNC machine tools such as lathes, boring mills, milling machines, grinding machines, shapers, planers, or radial drills after the machine has been set up and checked for proper operation by a higher grade worker.

They have the ability to follow detailed instructions concerning the location of necessary dimensions on blueprints, sequence of machine operations, machine feeds and speeds, tools to be used, alignment processes, and predetermined machined dimensions.

They have skill in aligning parts in the machine according to set methods and given reference points, exercising care to keep material, holding fixtures, and machine stops clear of chips and particles.

They use knowledge of machine operations to enable them to recognize defective tooling, improper coolant flow, the need for changing speeds or feeds, machine malfunctions, or obvious dimensional deviations and either correct the problem by adjusting the machine, cutting tool, or fixture or obtaining assistance from a higher grade worker.

Grade 8 operators have skill in the use of measuring instruments such as internal and external micrometers, vernier height and depth gages, indicators, scales, and various standard or preset snap, plug, or ring gages to check the accuracy of dimensions or they maintain dimensions through the use of fixtures or preset machine stops, depending upon the dimensional tolerances allowed.

Responsibility: Grade 8 machine tool operators follow detailed instructions from the supervisor or higher grade workers that indicate the dimensions, machine to be used, machining sequence, proper feeds and speeds, and appropriate cutting tools for each operation. Grade 8 operators are responsible for the proper and safe operation of equipment. They are continually aware of whether tools are sharp, the coolant flow is adequate, and dimensions are being held. They determine when the fixture, holding device, cutting tool, or the entire setup is in need adjustment and obtain assistance from a higher grade worker.

The work is typically checked in progress. A supervisor or higher grade workers are available to help and advise on any problems encountered. Grade 8 operators insure that machined parts meet dimensional requirements in accordance with instructions provided.

Physical Effort: The work requires standing, stooping, bending, and reaching. Grade 8 operators frequently handle, lift, and carry objects weighing up to 18 kilograms (40 pounds). They are sometimes required to lift and move items weighing in excess of 23 kilograms (50 pounds) with the help of weight handling equipment or with assistance from other workers.

Working Conditions: Work is performed inside in areas that are usually noisy and dirty, and where there is a constant danger to the skin and eyes from flying metal chips and abrasive particles; skin irritation from contact with coolants, lubricants, and abrasive compounds; danger to fingers, hands, and other parts of the body from cutting tools, grinding wheels, rotating pieces, and moving parts of machines.

MACHINE TOOL OPERATOR, GRADE 9

General: Grade 9 machine tool operators operate one or more conventional or computer numerical control (CNC) machines of the type operated by grade 8 operators to perform assigned machining operations that may require the use of various machine tool attachments. While grade 8 operators receive assistance on machining problems and have the machines set up and checked before operation, grade 9 operators make their own set ups and independently resolve machining problems during the actual machining process. On conventional machines, grade 9 operators use various standard machine attachments such as rotary tables, magnetic chucks, taper attachments, and universal milling attachments. They select proper cutting tools according to the type of metal being machined and correct machine feeds and speeds necessary to perform the required operation. On CNC machines, they do repetitive set ups on 2 and 3 axis machines. Adjustments are performed according to pre-programmed requirements, and are limited to coolant flow, and settings necessary to establish dimensional tolerances. They make manual cutter compensation adjustments to obtain tolerances, i.e., override one point in machine path to make an adjustment for size control for that particular cut, then machine returns to normal path on next cut.

Grade 9 machine tool operators receive work from the supervisor or higher grade worker in the form of work orders accompanied by blueprints and instructions for the machine and attachments to be used and the processes to be performed. They obtain tools and materials, note tolerances, set up machines, and perform machining operations according to instructions received.

Skill and Knowledge: Grade 9 machine tool operators have skill in operating the same machine tools as operators at the grade 8 level; however, they extend the scope of operations on these machines by applying additional skill in using various standard machine attachments such as rotary tables, magnetic chucks, gear changing boxes, angular drive heads, taper attachments, and universal milling attachments; and have skill in performing precision work on parts that present complex configurations and close tolerances between interrelated surfaces.

They have skill in the operation of CNC machine tools when the manual input required is limited to changes in coolant flow, increases or decreases in speeds and feeds, or stops are programmed for dimensional checks or minor adjustments.

While grade 8 machine tool operators have most jobs set up for them, grade 9 operators have skill in normal machine set ups. They have the ability to read and interpret blueprints, program readouts, and technical directives to determine and obtain materials and cutting tools for the job and to visualize the finished part and critical surfaces, dimensions, and tolerances.

Grade 9 operators have knowledge of various metals, alloys, and other materials and their machining characteristics that enable them to select the proper cutting tools and determine correct machine feeds and speeds necessary to perform the job.

They have skill in the use of measuring instruments such as internal and external micrometers, vernier height and depth gages, indicators, scales, and various types of snap, plug, and ring gages to achieve and maintain critical dimensions and tolerances during the machining process.

Responsibility: Grade 9 machine tool operators receive work assignments from their supervisor or higher grade worker. Work assignments are typically supplemented with blueprints and instructions for the machine or machines and attachments to be used, sequence of operations on each machine, and critical dimensions or unusual aspects of the job. They are responsible for obtaining the prescribed fixtures, tools, and materials; setting up the job in the machine; determining the proper machine speeds and feeds based on the type of material to be machined and the tolerances desired; and maintaining dimensions and tolerances to meet job specifications. They may assist or instruct lower grade workers in setting up machines and obtaining materials, and follow through to assure satisfactory completion of the job.

The work may be checked during progress or upon completion. A supervisor or higher grade worker are available for consultation or advice on any problems. Grade 9 operators ensure that machined parts meet dimensional and finish requirements.

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

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

MACHINIST, GRADE 10

General: Grade 10 machinists manufacture, repair, and rebuild parts and items of equipment from raw stock of different metals and metal alloys such as stainless steel alloys, aluminum, titanium, magnesium and other materials such as rubber, plastics, and nylon through the use of conventional or computer numerical control (CNC) machine tools and precision handwork. As compared to grade 9 machine tool operators who independently set up and operate the same types of machines as grade 8 operators, grade 10 machinists set up and operate most types of conventional and CNC machine tools such as lathes, vertical and horizontal boring mills; bench, plain, and universal milling machines; shapers; planers; internal and external grinders; thread cutters; and radial drills. They use a variety of auxiliary machine tool attachments such as rotary vises, dividing heads, taper attachments, magnetic chucks, vertical milling heads, tapping attachments, rotary tables, and others.

On conventional machines, they work from blueprints, sketches, work orders, models of parts to be made, or other specifications; determine which machine tool would best be used for each operation to be performed, which attachments are to be used on each machine; and make new job setups on a variety of different types of equipment involving accurate alignment in order to maintain specified tolerances.

On CNC machines, they operate machines using program tapes, manual data inputs, or a direct numerical control (DNC) system. They may prove out program tapes that have been developed

by higher grade workers for machining operations involving Level 1 complexity as described in Notes to Users. They set up CNC machines using proper tooling components, optical tool setter, gage blocks, micrometers, etc. They manually adjust coolant flow, speeds and feeds, and other settings to obtain dimensional tolerances.

Grade 10 machinists determine speeds, feeds, and coolants, lubricants, or abrasives to be used to cut, turn, drill, mill, bore, tap, ream, lap, hone, shape, grind, or finish an item. They perform precision handwork to finish, fit, and assemble machined parts using various bench mounted and hand held power tools and hand tools such as files, drills, reamers, buffers, die grinders, and scrapers. They maintain dimensional accuracy during these processes through the use of precision measuring instruments such as vernier calipers, inside and outside micrometers, surface gages, height gages, squares, dial indicators and comparators. They use shop mathematics and handbook formulas in computing and verifying dimensions in the planning, laying out, and final dimensional checking processes.

Skill and Knowledge: Grade 10 machinists have skill in performing the full range of machining operations on most types of conventional or CNC machine tools and their various attachments. They have knowledge of various metals and other materials such as aluminum, brass, bronze, high carbon and alloy steels, chrome, nickel, titanium, molybdenum, super alloys, nylon, rubber, plastics, teflon, etc. to produce the desired cuts and finishes on each material. They have skill to plan and lay out work from blueprints, work sheets, and drawings that may have missing or incorrect information.

They have skill in determining work procedures, machine, tools, equipment, and attachments to be used; proper type and size of raw stock; sequence of machining operations, and the speeds and feeds necessary to attain the required finishes and tolerances.

On CNC machines, they have skill to setup and operate a variety of machine tools and to debug programs developed by higher grade workers to perform machining operations involving Level 1 complexity. They have knowledge of a variety of machine controls and have skill in making necessary manual inputs to insure accurate dimensional tolerances.

Grade 10 machinists have a knowledge of trade mathematics including plane geometry and the use of trigonometric functions and machinist handbook formulas in establishing needed dimensions, such as those required for chasing threads or machining angular surfaces; locating and marking surfaces and angles to be machined, locating reference points, or performing other layout work necessary to facilitate accurate job setups on a variety of conventional or CNC machine tools. They have skill in manufacturing an entire item, carrying out all the machining operations necessary for completion, and performing precision handwork such as filing, scraping and lapping to fit, assemble, and finish machined parts.

Grade 10 machinists have skill in using many types of precision instruments and equipment such as vernier calipers, height gages, squares, protractors, inside, outside and depth micrometers, surface gages, vee blocks, parallel bars, gage blocks, dial indicators, optical and mechanical comparators, and Ago@ and Ano-go@ thread, ring, bore and plug gages to attain accurate dimensions and maintain tolerances.

Responsibility: Grade 10 machinists receive work assignments from the supervisor that are accompanied by blueprints, sketches, drawings, models of parts, or other work specifications. In some work situations, the blueprints or drawings may have missing or incorrect information. They independently determine the work procedures, machine tools and attachments to be used, and the sequence of machining operations. They are responsible for laying out their own work, accurately computing and checking dimensions and tolerances, setting up the job in the machine, and selecting the proper tools to achieve the desired dimensions, tolerances, and surface finishes. The supervisor provides technical assistance on unusual or difficult problems. Completed work is checked for conformance to specifications and accepted trade practices. Grade 10 machinists may provide technical assistance to lower grade workers.

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

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

MACHINIST, GRADE 11

General: Grade 11 machinists manufacture complex and non-routine parts and items of equipment from raw stock of different metals, metal alloys, and other materials. Work products are typically one-of-a-kind, involving unusual trade problems and requiring a high degree of ingenuity and responsibility.

Assignments at grade 11 typically involve the machining of surfaces at unusual or compound angles, items that require differential or compound indexing, multiple lead and various other nonstandard screw threads, helical or other types of gears, worm threads, or surfaces closely interrelated dimensions or complex configurations that usually require special adaption or extension of the use of conventional machine tools; and/or performing machining operations on computer numerical control (CNC) machine tools including shop floor programming and using such procedures as multiple setups, in place machining of fixtures, debugging first run programs, and making or suggesting changes to machine tool programs.

Work assignments at grade 11 require more skill and ingenuity in their completion than those at grade 10 in that they often require accomplishing untried tasks, procedures, and prototypes; making independent interpretation and translation of work orders, drawings, and specifications that are often lacking in such items as dimensions, tolerances, and types of fits and finishes; planning and coordinating related work processes with support organizations such as engineering and planning; and planning sequences of operations that involve original innovations in setups, attachments, techniques, and tools.

Some work may require grade 11 machinists to independently troubleshoot on a wide range of air, sea, and ground vehicles and determine repair processes in conjunction with appropriate engineering and/or other technical authority at diverse locations, some of which may be overseas.

Skill and Knowledge: Grade 11 machinists apply a comprehensive knowledge of and skill in using any of the accepted trade methods and techniques, and any of the conventional types and/or CNC machine tools. They exercise skill and ingenuity in using conventional machine tools and their attachments to perform machining processes requiring special adaption of the equipment or processes for which they were not specifically designed, for example, through the use of special or improvised tools, fixtures, and setups to machine unusual surface configurations such as curved surfaces requiring machine feeds in different planes simultaneously; surfaces having closely interrelated dimensions, or surfaces having unusual or compound angular relationships.

They have skill in programming machining operations, setting up, and operating CNC machine tools. They have skill to operate machines through one complete cycle to manufacture the first part; to proof part dimensions; to check sufficiency of programming, tooling, fixturing, and machine operations, to edit the program on CNC machines and make the normal changes required; to recommend changes to CNC machine tool tape programs on deficiencies noted; and to coordinate directly with the parts programmer or toolmaker.

They have skill to operate CNC machines in automatic and semiautomatic mode and to make logical decisions at each program stop or decision point to manually input, change, adjust, or otherwise complete the machine instructions to produce a quality finished product and prevent machine collision and damage to machine tooling or part.

Grade 11 machinists apply a knowledge of software, flow sequence, flow time inspection requirements and operations of computer numerical control machines to help engineering personnel develop software specifications to complement equipment specifications for CNC equipment procurement i.e., machine tools, flexible machining systems, robots, and automated inspection equipment.

Grade 11 machinists have a thorough knowledge of advanced shop mathematics. They have skill in using geometric and trigonometric formulas to compute compound angles, angular indexing, hole patterns, pitch lead, and pitch diameters for various standard and non-standard screw threads. They have skill in determining proper values for contour standard and non-standard screw threads and determining proper values for contour and circular interpolation milling for manual programming. They have skill in setting up machines to machine unusual or compound angles.

Grade 11 machinists have skill in performing work assignments that require accomplishing untried tasks or procedures such as those required in machining a rare metal, new metal alloy, or other new material for which they determine the best tooling material, tool types, coolants, and machine feeds and speeds to use in performing a particular machining operation; or independent interpretation and translation of work orders, drawings, and specifications frequently requiring computing and establishing missing tolerances, dimensions, and types of fits and finishes. Because work assignments are usually more general at this level and may involve related work processes, grade 11 machinists apply a knowledge of the effect and relationship of heat treating, annealing, plating, welding, and other related work processes on various machining operations in

completing an assignment. Based on their overall knowledge of the trade, they plan sequence of operations that involve innovations in setups, attachments, techniques, and tooling.

Grade 11 machinists use a thorough knowledge of all aspects of the machining operation as well as extensive knowledge of related trades in order to resolve problems concerning complex machining operations or procedures and to suggest more efficient or economic machining processes where necessary.

Responsibility: Grade 11 machinists may receive assignments in the form of work orders or oral instructions accompanied by blueprints, sketches, drawings, sample parts, parts programs or other work specifications. They are responsible for independently interpreting and applying sets and series of interrelated prints and drawings, to prepare supplementary sketches, and to compute missing dimensions.

As compared to the work performed at the grade 10 level, grade 11 machinists make more independent judgments and decisions and have greater leeway in methods and procedures for accomplishing their assignments. They are responsible for a wider scope of machining operations, including extending the use of conventional machine tools and/or programming (CNC) machine tools. They use a greater degree of independent judgment in determining the need for and improvising special setups and procedures on conventional and/or (CNC) machine tools to perform machining operations that have not been tried before, occur on a one-time or infrequent basis, require machining to tolerances that are difficult to attain or hold, or require machining of unusual surface configurations.

Grade 11 machinists are responsible for recommending and using methods and procedures that contribute toward more efficient and economic machining operations, greater dimensional accuracy, or savings in machining time. They are relied upon for their judgment and decisions relative to the use of new machine tools for particular types of jobs and, generally, keeping abreast of technological changes in the machining occupation. They may provide technical assistance to lower grade workers. The supervisor is available to provide advice on unusually difficult problems. Completed work is subject to spot checks by the supervisor for compliance with accepted trade practices.

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

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