

Federal Wage System Job Grading Standard For Model Making, 4714

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WORK COVERED

This standard is used to grade all nonsupervisory jobs involved in planning and fabricating complex research and prototype models which are made from a variety of materials and are used in scientific, engineering, developmental, experimental, and test work.

TITLES

Jobs graded by this standard are to be titled *Model Maker*.

GRADE LEVELS

This standard describes two levels at which jobs might be established. If jobs differ substantially from the skill, knowledge, and other work requirements described in the grade levels of the standard, they may warrant grading below these grades.

NOTES TO USERS

During the factfinding study for this occupation, certain characteristics were found to be consistent even though agency and installation grading practices differed considerably. These characteristics form the framework of the job grading standard. They are emphasized in this section to assist in identifying the occupation in contrast to other, similar work, and are intended to reinforce the information in the factors as described in the body of the standard.

Most model makers were found to be working in organizational units that provided service to research and development activities. Some jobs were found in other shops (for example, machine shops and woodworking shops) that primarily service other functional areas such as manufacturing or maintenance. The jobs in the model shops were usually identified as model makers at a variety of levels of the Federal Wage System (FWS) grade structure. Jobs in other shops were usually identified as premium jobs in a single trade (for example, machinist, grades 12 or 13). While both of these arrangements may be satisfactory for grade level purposes, comparisons are provided to assist in distinguishing the characteristics between the model maker and jobs in other occupations of the FWS.

Jobs that substantially match the characteristics in column A, below are model makers regardless of the organizational location of the position.

Jobs that substantially match the characteristics in column B, below are more appropriately considered as premium jobs in a specific trade regardless of their organizational location. These jobs are to be classified by closely comparing them with the grade levels described in the appropriate job grading standard to determine whether the match or exceed the skill and

knowledge outlined in the standard and by interpolation between these standards and the one for the model maker.

These jobs are to be titled to the occupation that includes the single trade work processes.

A.
MODEL MAKER

1. The work processes used to make items require the skill and knowledge of more than one specific trade; for example, the workers use work processes of (a) machining, welding, and metal surface treating; or (b) metal working and electronics. While the workers do not need the skill to perform all the work processes in the broad trade areas, they must have sufficient knowledge of them to establish the requirements for other tradesmen to follow and to accept or reject their work.
2. The project requires considerable initiative and imagination in extending and modifying trade work processes and improvising with them in various combinations to manufacture unique and one-of-a-kind items.
3. Assignments are usually on a project-to-project basis although the workers may be occasionally called on to assist on another project because they possess expertise in a specialty.
4. After original assignment by the supervisor, the employees work with engineering, professional, or technical personnel for the duration of the project. They consult with his supervisor on principally the most complex trade problems and for administrative purposes.
5. The worker is assigned to and responsible for the end item --the complete model or a complex component of the model.

B.
PREMIUM JOURNEYMAN

1. The work processes used to make the item require skill and knowledge of a single trade; for example, machinist, toolmaker or sheet metal worker. The workers have the skill to perform all the work processes. On large, multipart projects, they may assign work to other workers in their trade, check their plans, and provide technical advice and assistance on the work processes.
2. The project requires a very high degree of ability to work to critical exactness and precise tolerances. Trade processes are used to the fullest extent or extended beyond that normally expected of a journey worker.
3. Assignments are varied. Because they require the use of the fullest extent of the trade work processes, assignments on some projects may be shared with other trade specialists.
4. Although work orders are usually initiated by engineering, professional, or technical personnel, work processes are usually approved by the supervisor, especially when trade techniques deviate from normal trade practices.
5. Although the worker may work closely with the work order initiator, completed items are usually approved by a supervisor or an inspector before release.

A.
MODEL MAKER

6. When the assignment is to make a model component, the component is either a complete component item that can operate as a separate unit and is as complex as complete models normally assigned to the shop, or the planning and making of it requires a knowledge of the purpose and use of the model in which the component is a critical item.

B.
PREMIUM JOURNEYMAN

6. When the assignment is to make a model component, the component is usually recognized as an integral part that must fit precisely but does not usually require the knowledge of the purpose and use of the complete model.

MODEL MAKER, GRADE 14

General: Grade 14 work in the model making occupation involves planning, laying out, fabricating, and modifying research and prototype models which are made from a variety of materials including wood, wood substitutes, and other pliable materials such as plastic, plaster, and light weight metals; or from a variety of ferrous and nonferrous metals; or from a variety of complex electronic and electrical circuitry and components. The models are identified with a single broad category such as mechanical models, or electronic models, and are used for testing in actual conditions or in wind and ballistic tunnels, surface, underwater, and atmospheric conditions, gymnasticators, shock tubes, and other similar research and test facilities.

Grade 14 model makers independently plan, construct, and assemble complete models without detailed instructions or close past precedents. Completed work is reviewed by the supervisor as unusual problems arise; through periodic progress reports from the employee; and through discussions with project engineers, medical doctors, or scientists.

Skill and Knowledge: Grade 14 model makers apply a knowledge of a variety of manufacturing processes and methods during the planning stages of a project. They discuss the general idea of a desired item with the work-order initiator (engineer, doctor, or scientist) in terms of the intended use, operational characteristics, approximate configuration, size, weight, dimensions, tolerances, and the number and kind of assemblies and subassemblies. They make calculations such as loads, sizes, dimensional fits and weights, using shop algebraic and trigonometric formulas and tables.

They recommend alternative methods when design characteristics cannot be met by proposed fabrication processes and suggests changes because of unsuitable or unavailable material, unrealistic component alignment or other fabrication requirements in the original design. From the nature of the test, experiment, or intended use of the model, they determine what materials and work methods are best to use and the operational and fabrication processes to follow by considering such factors as strength, desired life, location of component members, surface finish, atmospheric, oceanographic or biological environment, pressure, heat, pitch, yaw, stress, and strain.

Grade 14 model makers know how to plan and lay out complete models, assemblies, and subassemblies; to reproduce scale designs, and to plan work requirements so that other employees assigned to the project can easily follow instructions. For example, specialists in making metal models must be familiar with the latest production processes to select, cut, fit, and achieve trueness and to fasten and hold several metals together with allowances for desired moving, bending, and oscillating according to design and operational requirements. They must be skilled in using tools such as soldering irons, welding equipment, bonding and brazing equipment, and the full variety of metal working machines including the latest machines such as numerically controlled and electrical discharge machines.

As another example, specialists in making nonmetal models are skilled in a variety of trade functions such as woodworking, plastic working, sheet metal, and tube working and are able to fabricate, assemble, and align parts and components with critical centerline dimensions. They are skilled in setting up and operating a variety of wood and plastic working machines and apparatus. They know how to define reference points with compound, three-dimensional configurations to hold, machine, fabricate, and assemble items with compound curves and intersecting compound angles. They must know the characteristics of a variety of plastics, epoxies, resins, and catalysts to obtain the proper weight and strength of synthetic materials. They shape and mold them to correct configurations, using the latest forming methods such as vacuum and pressure techniques. Some nonmetal model makers at this level also may plan and fabricate patterns from wood, plastic, and plaster materials to be used in casting metal objects in addition to other wood and plastic fabricating processes.

Another example of work at the grade 14 is an assignment to plan and construct a complete model from electronic and electrical components, units, and assemblies. For example, grade 14 model makers, specializing in this kind of work, devise and construct complex circuitry based on the determination of cable and wave guide size, insulation, fuse requirements and other similar needs. They plan and lay out the chassis and determine the number, type, and placement of elements such as relays, solenoids, transformers, condensers, tubes, transistors, switches, inductors and motors. They determine the number and type of components needed to produce the required current-carrying capacity, torque, power and other characteristics of the model. They assemble units such as indicators, meters, counters, transmitters, receivers, amplifiers, pattern recording equipment and servomechanisms. They make all connections and complete the model by soldering, riveting, screwing, bolting, or by other similar fastenings. When the components, units, and assemblies are not available from sources of supply, grade 14 model makers fabricate or adapt them from available materials. They check the operation of the assembled model using various measuring instruments such as oscilloscopes, bridges, capacitance checkers, analyzers, signal generators, wave inductors, and various types of meters. They also check the operation of the associated mechanical elements or structural features of the completed model to insure that it meets all the requirements as established by the work order initiator.

Grade 14 model makers know how to develop and fabricate special tools, fixtures, and jigs to hold, machine, fabricate, and assemble items with compound curves and intersecting compound angles. In addition, they are skilled in using a variety of specialized and precise measuring devices such as supermicrometers, shadowgraphs, and a variety of specialized tools and

equipment such as electrical discharge machines, jewelers lathes, microsoldering and welding equipment, and a variety of electronic tools and meters.

Responsibility: The supervisor or designer makes general assignments without detailed instructions on projects typically associated with the development of specialized complex research apparatuses which are new, novel, or without close precedent. The guidelines provided consist mainly of incomplete drawings, photographs, sketches, and oral information related to basic design data without specific details of component relationships, sizes, fits, shapes, or materials (such specific details are developed during the fabrication processes).

Researchers depend on the originality and ingenuity of the employees for the solution of fabrication, assembly, installation, and related problems. In addition to personally performing the more complex machine and assembly operations, grade 14 model makers assume the responsibility of a project by planning and coordinating the efforts of other workers on large, multipart, or extended projects. They consult with their supervisor principally on problems such as obtaining required equipment, materials, and manpower. The supervisor reviews the work on only the most complex technical problems and through discussions with technical and professional personnel with whom the model makers are working.

Physical Effort: Grade 14 model makers frequently handle objects weighing up to 5 kilograms (10 pounds), and occasionally handle objects weighing up to 23 kilograms (50 pounds) without the assistance of lifting devices. The work involves standing, walking, stooping, bending, kneeling, climbing up and down ladders and scaffolding, and pulling and pushing at various stages of assignments to assemble items and install assemblies.

Working Conditions: Grade 14 model makers work inside in areas that are noisy, dirty, and occasionally outside. They are exposed to the possibility of cuts, bruises, scrapes, burns, and broken bones. The tasks may involve discomfort while wearing helmets, aprons, gloves, safety glasses, hard hats, and other protective equipment as required by changing assignments.

MODEL MAKER, GRADE 15

General: Grade 15 model makers plan, lay out, modify, and fabricate models that are more complex than those described at the grade 14 level. In contrast to the grade 14 model makers whose work involves skill and knowledge of a single, broad occupational area, grade 15 model makers' work involves skill and knowledge of a combination of occupational areas. For example, grade 15 model makers make models with powered and moving assemblies and the associated instrumentation devices such as electromechanical detection and recording equipment, strain gage members, survey rakes, optical assemblies, calibrating nozzles, shock tube valves, probes, and gages.

Grade 15 model makers are responsible for all the planning and the manufacturing processes whether they personally perform them or are assisted by other workers. This is also typical at

grade 14, but because of the requirement to use skill and knowledge of a wider variety and a greater number of work processes, grade 15 model makers meet and solve more problems that require them to make additional judgments and decisions.

Skill and Knowledge: Grade 15 model makers know how to plan and lay out the most complicated models and to perform or direct the fabrication processes for the complete model. The model represents a broad knowledge of several occupational categories and a variety of design characteristics. For example, based on a thorough knowledge of their characteristics, grade 15 model makers develop the circuitry and determine the need for a variety of electrical or electronic components. After personally fabricating the metal components, they assemble, arrange, mount, wire the components, make precision fitting and align and test the complete assembly.

Given the same assignment, other grade 15 model makers would assemble and fabricate the electrical and electronic components and plan and direct the fabrication of the metal components of the complete electromechanical model. In either example, grade 15 model makers are responsible for all components of the model, its accuracy, and operating quality.

Other typical models which are assigned to grade 15 model makers require skill in working materials such as steel, aluminum, copper, fiberglass, plastics, ceramics, rubber, fiber, phenolics, and in addition, soldering and welding, cable splicing, harnessing, isolation and miniaturization techniques. As another example, the kinds of models assigned to grade 15 model makers require the understanding of optical system design and its related mechanical design principles for holding and moving optical components without deformation or misalignment and the ability to manufacture, fit, and align all components by machining and assembling parts of the complete model to extremely close fits and tolerances.

Grade 15 model makers are skilled in the operation of more of a variety of specialized tools and equipment than grade 14 model makers. For example, they plan and make special jigs, fixtures, and tools to assist in the machining processes and on the same project they use a variety of electronic equipment such as volt-ohm meters, frequency meters, audio-oscillators, autocollimators, alignment telescopes, and other similar equipment for testing components and assemblies of the more complicated models. The knowledge of shop mathematics used by grade 15 model makers is more extensive than that used by grade 14 model makers because the design characteristics of the models to be manufactured present problems in broader trade areas. For example, a model with electromechanical features requires the calculation of various angles and planes and unusual contours and shapes to plan and layout the mechanical components and, in addition, the calculation of load, resistance, capacitance, voltage, and other electrical and electronic mathematical problems.

Responsibility: The supervisor makes general assignments without detailed instruction on projects typically associated with the development of unique and complex research models which are without precedent or closely related work. Guidelines provided consist mainly of oral information related to basic model requirements and environmental conditions.

Grade 15 model makers make unreviewed trade judgments and decisions on how models will be fabricated, including determinations of precise specifications required to achieve the final operating characteristics requested by scientists and engineers. Both researchers and their supervisors depend on the broad experience, originality, and ingenuity of the model maker for the solution of fabrication, practical design, assembly, and installation problems. Grade 15 model makers consult with professional instrumentation engineers, and other specialists, on unusually complex and difficult problems which cannot be solved through practical designer fabrication techniques. The supervisor typically reviews work through periodic progress reports from the model makers and through discussions with technical and professional personnel with whom the model makers are working.

The work at grade 15 is more responsible than at grade 14 because the more complicated models require more judgments and decisions concerning a greater variety of alternative methods, materials, work sequences, and planning, assembling, and testing techniques.

Physical Effort: Physical effort at this grade level is the same as that described at the [grade 14](#) level.

Working Conditions: Working conditions at this grade level are the same as those described at the [grade 14](#) level.