

# Federal Wage System Job Grading Standard for Electronic Integrated Systems Mechanic, 2610

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## WORK COVERED

This standard covers nonsupervisory jobs involved in rebuilding, overhauling, installing, troubleshooting, repairing, modifying, calibrating, aligning, and maintaining integrated electronic systems, i.e., where the output of a number of sensor subsystems is integrated in a logic subsystem and the resultant used to modify the operation of the total system. Examples are: fire control, flight/landing control, automatic test equipment, flight simulators, bombing navigation, and electronic warfare or multiple integrated electronic systems composed of several of these systems which are closely interrelated and interdependent. This work requires knowledge of electronics principles involved in a number of applications such as radar, data processing, and data display and usually mechanical and hydraulic knowledges involved in operation of equipment such as control valves, gyros, turrets and mounts, and mechanical computing devices.

## WORK NOT COVERED

This standard does not cover work that primarily involves:

- Overhauling, modifying, assembling, installing, aligning, and repairing optical fire control instruments. (See [Optical Instrument Repairing Series, 3306.](#))
- Maintaining, repairing, calibrating or certifying precision electronic measurement and reference equipment used for precise measurement of electrical and electronic values and relationships and to assure precision operation of airborne, marine, industrial, or ground electronic systems and equipment. (See [Electronic Measurement Equipment Mechanic, 2602.](#))
- Fabricating, overhauling, installing, maintaining, and repairing ground, airborne, and marine electronic equipment such as radar, radio, sonar, navigational aids and similar devices which are not part of an integrated system, i.e., which work independently to perform an operation (detecting and ranging, communicating) without receiving feedback from other diverse sensing or logic devices which automatically modifies their operations. Or--Performing work on portions of an integrated system where the work does not require that the employee consider the interaction of the item worked upon with the total integrated system. (See [Electronics Mechanic Series, 2604.](#)) (**Note:** The [introduction to the 2600 family](#) contains a detailed discussion of the difference between electronics mechanics and electronics integrated system mechanics.) (See [Digest Vol. 5](#) for additional guidance on this subject.)
- Maintaining and repairing electronic controls and indicating devices used on industrial machinery. (See [Electronic Industrial Control Mechanic Series, 2606.](#))
- Repairing electronic digital computers. (See [Electronic Digital Computer Mechanic Series, 2608.](#))

- Installing and maintaining electronics equipment when this is an integral part of the engineering testing, analysis, alignment and performance evaluation of complex electronic systems, or the employee is responsible for solving engineering problems of site selection, systems integration, and modification of the equipment to adapt to novel site characteristics. (See [Electronics Technician, GS-0856](#).) (Note: The [Introduction to the 2600 family](#) contains a detailed discussion of the differences between electronics mechanic and electronics technician work which is also applicable to this determination.) (Also, see [Digest Vol. 5](#).)

## TITLES

Jobs graded by this standard are to be titled *Electronic Integrated Systems Mechanic*.

## GRADE LEVELS

This standard describes work at grades 12 and 13. It may not describe all possible grade levels for this occupation. If jobs differ substantially from the skill, knowledge, and other work requirements described for the jobs in the standard, they may be graded at levels other than those described, based on the application of sound job grading methods.

## HELPER AND INTERMEDIATE JOBS

Neither helper nor intermediate electronic integrated systems mechanic jobs are included in the coverage of this standard. The type and scope of knowledge and skill required of this occupation makes it inappropriate for trainee work. Lower level jobs should be assigned to one of the other electronics occupations as appropriate to the duty assignment.

## NOTES TO USERS

In addition to work on integrated systems, a further criterion for determining that jobs are covered by this standard is that the employee utilizes knowledge of the complete system in day-to-day work. Many jobs may be limited to specialization in one area such as radar, computers, etc., or even to consecutive assignments in a number of these areas, where the work does not require that the employee consider the interaction of the item worked upon with the total integrated system. In such cases, consideration should be given to classifying the jobs to a more specific series.

*Definitions:* Certain general terms may have different meanings to different users. For the purpose of this standard, the terms subsystem, integrated system, and multiple integrated system are defined as:

**Subsystem** -- A subsystem is an item which is independent in operation, that is, it is capable of performing its basic task without modifying or controlling signals from other items of equipment. A clarifying example is the introduction of commercial digital computers for use in integrated fire control systems. The computer, as a subsystem, receives and processes input from the other subsystems. With no modification to internal circuitry and little external change to connectors and cables, the same computer could be hooked to standard input and output devices to operate independently as a data processing system.

**Integrated system (or system)** -- An integrated system is an item composed of a number of subsystems in which, in order to accomplish the designed objective, the output of the sensor subsystems is integrated in a logic subsystem and the resultant used to modify the operation of the sensor subsystems and actuator subsystems in response to the internal as well as external changing conditions.

**Multiple integrated system (or multi-system complex)** -- A multiple integrated system is an item composed of a number of integrated systems. Since the design objective is so broad, complex, and varying and the necessary data inputs are so varied, multipurpose and affected by possible internal and external change of conditions, the outputs of the integrated systems must be further combined in an electronic logic device which can automatically select the necessary data, evaluate the influence of the data on the objective or objectives, issue control impulses, and monitor performance of the affected integrated systems.

Examples of subsystems, systems, and multisystems are provided in the grade level descriptions.

**Integrated System vs. Integrated Circuit** -- Confusion exists between the terms integrated system and integrated circuit. An integrated circuit is an electronic circuit fabricated as an inseparable assembly of parts, in a single, small structure. These circuits, also called IC's or chips, combine a number of functions. A single chip, only a small fraction of an inch square, may have as much circuitry as an eight transistor radio. Even the largest chip, however, has only a limited number of circuits and functions, compared to an integrated system.

Electronic integrated systems have a very large number of circuits and functions. They are composed of a number of complete simple subsystems such as radar, computers, missile launchers, or other, which are very closely interconnected to each other to accomplish the design objectives. (**Note:** The group of equipments called a subsystem when we discuss integrated systems may well be a complete system in its own right when discussed in some other context.)

In summary, there is no connection between the presence or absence of integrated circuit chips in equipment and the determination whether or not the total system is an electronic integrated system. An integrated system may have hundreds of IC chips or it may have none.

Refer to the [Introduction to the Electronic Equipment Installation and Maintenance Family, 2600](#) for further information on the intent and coverage of this occupation.

## **ELECTRONIC INTEGRATED SYSTEMS MECHANIC, GRADE 12**

*General:* Grade 12 mechanics repair, overhaul, rebuild, modify, test and troubleshoot ground, shipboard, or airborne electronic systems composed of a number of individual subsystems (i.e., radar, computers, gyro or inertia sensing units, launching control units, etc.) which are linked together and interrelated so that their combined functions accomplish a specific objective and comprise a complete system such as fire control, ballistic missile control, missile guidance, air traffic control, dead reckoning navigation or bombing-navigation. The mechanics apply a broad range of electronic principles as well as knowledge of mechanics, hydraulics, optics, or pneumatics to correct malfunctions because the system's equipment is so interrelated that output or functions of one component affect the total system operation and a malfunction may cause error indications in subsystems remote from the defect.

Grade 12 mechanics mate, align, calibrate and otherwise integrate all operable subsystems into a functional system. They analyze indications obtained during operation, relate them to the technical data available on the individual subsystems and the various data and function exchanges between the subsystems. They determine type and location of malfunction and perform the repairs or turn the defective sub-systems over to lower grade employees for repair. The grade 12 mechanics monitor the operation of the complex of interrelated subsystems, analyze operating trends, propose preventive maintenance down time to assure continued operating capability, and recommend units for overhaul or engineering evaluation for disposal. They study technical data and equipment specifications to determine the impact that equipment modifications or substitutions will have upon total system operation and on the various maintenance and alignment procedures.

*Skill and Knowledge:* Grade 12 Electronic Integrated Systems Mechanics must have:

- Ability to repair, align, and adjust major integrated electronic systems such as inertial navigation system, automatic flight control, or fire control system. Extensive knowledge of electronic, pneumatic, hydraulic, and mechanical systems in order to understand and predict the progressive effects of malfunctions throughout the interrelated units, (e.g., trace an apparent operating error in the hydraulic controls of a gun mount back to the failure of a tactical computer to integrate yaw, pitch, azimuth, and velocity inputs) and to predict areas of technical difficulty in order to assist lower grade employees.
- Thorough knowledge of the application of electronic theories and practices to one or more complex integrated systems such as fire control, inertial navigation, or automatic landing control systems. Broad knowledge of such applications as radar, digital or analog computers, digital or cathode ray tube display devices, etc., and specific knowledge of the technology and practices which integrate these components into a total functional system.

- Knowledge of mathematics including algebra and basic trigonometric functions in order to adapt standard formulas to the specific requirements of the integrated system.
- Ability to follow drawings for integrated electronic systems such as radar navigation systems which integrate terrain information from the radar, pitch, roll, and turn rate, etc. from sensing devices and actuate control relays. Ability to trace the effect of a change in one subsystem to other integrated subsystems and determine which controls and devices must be changed or adjusted to compensate.
- Ability to diagnose and determine needed repairs for malfunctions in electronics systems such as weapons control where knowledge of the entire system is necessary to interpret error data and trace back through a number of units of the system to locate the deficiency.

*Responsibility:* Grade 12 Electronic Integrated Systems Mechanics receive oral and written assignments in the form of work orders and a general discussion of the work to be performed, including such things as planned completion dates and modification schedules. They exercise judgment and independence in determining solutions to maintenance and repair problems which are complicated by the interactions of the various complex subsystems so that the cause of an observable malfunction may be in some other area of the equipment and changes made in one area may affect other remote portions of the system. The mechanics frequently coordinate the work assignments and provide technical assistance to one or more lower grade employees. They often coordinate with technical and professional personnel on matters affecting operating specifications and changes of equipment, for instance, validating technical data and test programs, reporting discrepancies, and recommending solutions.

The supervisor reviews work for compliance with acceptable trade practices and relies on the grade 12 mechanics to take independent action in solving problems.

*Physical Effort:* Light to moderate physical exertion is required in lifting and carrying items weighing from 5 to 18 kilograms (10 to 40 pounds) and occasional objects weighing in excess of 18 kilograms (40 pounds). Mechanics are required to stoop, bend, and stand for extended periods of time on concrete or composition floors. On some assignments they must climb 6 to 15 meters (20 to 50 foot) towers.

*Working Conditions:* Work is often performed inside in well lighted, heated, and ventilated areas. Work is often performed on shipboard, at missile sites, or in aircraft, sometimes outside in inclement weather. Mechanics are subject to injuries such as cuts and bruises, as well as burns caused by electrical shock, RF energy and soldering irons.

## **ELECTRONIC INTEGRATED SYSTEMS MECHANIC, GRADE 13**

*General:* Grade 13 Electronic Integrated Systems Mechanics perform trouble analysis and final alignment of multisystem complexes consisting of several complete integrated systems where the complex accomplishes a number of major functions. The individual systems depend on data generated by other systems and, in turn, produce feedback which is used by the originating system, creating a complex information loop, encompassing electronics, and optical, mechanical, hydraulic, and pneumatic applications.

The Electronic Integrated Systems Mechanics make functional tests, interpreting and applying a broad range of technical data. They evaluate operational characteristics of the integrated systems by observing and analyzing waveforms, voltage/current/power indications, computer registers or printouts, optical presentations, and instrument readings. They analyze the malfunctions encountered, devise repair procedures and perform the repairs or, if extensive repairs are needed, provide instructions to lower grade employees. They review and analyze data; determine if the criteria are sufficient to provide adequate test, troubleshooting, and repair procedures; and devise and recommend tests, procedural changes, or data corrections.

Grade 13 Electronic Integrated Systems Mechanics may construct, operate, and repair prototype or experimental systems such as described at the grade 12 level. They layout and fabricate systems in breadboard or prototype configuration. They analyze equipment failure and malfunctions and, based on extensive practical knowledge of electronics, suggest changes to improve operation.

*Skill and Knowledge:* Grade 13 Electronic Integrated Systems Mechanics require:

- Ability to repair, overhaul, rebuild, align, and adjust complete multisystems such as the electronics package in a highly automated aircraft where target acquisition and tracking, weapons control, aircraft attitude control, navigation, and other complex functions are performed by numerous systems which are extensively interconnected with data feedback loops. Applies comprehensive knowledge of all major units of the complete multisystem, i.e., how they function independently, how they are interfaced in the integrated subsystems, and how the subsystems interact to achieve operating specifications. Able to determine proper sequence of operations and start point in sequential operations in order to pinpoint areas of malfunction.
- Extensive practical knowledge of the theories and practices of electromagnetic propagation, electronic circuits, computer theory, hydraulic or pneumatic control and power systems, and many other areas covering a wide range of system applications.
- Broad knowledge of the interactions among a number of closely integrated complex systems.

- Knowledge of mathematics, including trigonometry, to calculate power relationships, signal phasing, etc.
- Ability to interpret drawings for multisystem complexes such as the complete electronics package for an aircraft including numerous interconnections of signal paths both between and within individual subsystems of the multisystem complex.
- Ability to isolate malfunctions of complete multiple integrated systems consisting of closely interrelated fire control, bombing-navigation, flight control, countermeasures or similar systems and to determine the methods of repair where extremely complex relationships exist among numerous interconnected units and control circuits not only within the individual control systems but between them as well, requiring complete knowledge of all electronic, mechanical, and or optical systems and units.

*Responsibilities:* Grade 13 Electronic Integrated Systems Mechanics receive broad general instructions covering the scope of the task assigned. Available technical data may refer only to specific portions of the complete integrated system. The mechanic must adapt and extend this data to take into account the multiple interrelationships of the total system. They receive little technical guidance from their supervisors. They are considered to be highly qualified experts in the trade and are responsible for advising engineering personnel on the operation and maintenance effects of proposed modifications or new equipment. They are responsible for providing technical assistance to lower grade employees and for coordinating the work of employees assigned on a task basis to assist them. The mechanic's work is reviewed in terms of overall results achieved, i.e., compliance of the finished product with durability and accuracy requirements.

*Physical Effort:* Physical efforts are the same as described at the [grade 12 level](#).

*Working Conditions:* Working conditions are the same as described at the [grade 12 level](#).