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POSITION CLASSIFICATION STANDARD FOR ELECTRICAL ENGINEERING SERIES, GS-0850

ELECTRONICS ENGINEERING SERIES, GS-0855

Workforce Compensation and Performance Service

Theodore Roosevelt Building 1900 E Street, NW Washington, DC 20415-8330 Classification Programs Division

Electrical Engineering Series
Electronics Engineering Series

GS-0850/0855

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ELECTRICAL ENGINEERING SERIES- GS-0850

This series includes professional engineering positions which require primarily application of knowledge of (a) the physical and engineering sciences and mathematics, (b) electrical phenomena, and (c) the principles, techniques, and practices of electrical engineering. The work pertains primarily to electrical circuits, circuit elements, equipment, systems, and associated phenomena concerned with electrical energy for purposes such as motive power, heating, illumination, chemical processes, or the production of localized electric or magnetic fields.

ELECTRONICS ENGINEERING SERIES - GS-0855

This series includes professional engineering positions which require primarily application of knowledge of (a) the physical and engineering sciences and mathematics, (b) electronic phenomena, and (c) the principles, techniques, and practices of electronics engineering. The work pertains primarily to electronic circuits, circuit elements, equipment, systems, and associated phenomena concerned with electromagnetic or acoustical wave energy or electrical information for purposes such as communication, computation, sensing, control, measurement, and navigation.

This standard applies to positions in two series: the Electrical Engineering Series, GS-0850, and the Electronics Engineering Series, GS-0855. It supersedes the standard for the Electrical Engineering Series, GS-0850, published in June 1958 and the standard for the Electronics Engineering Series, GS-0855, published in August 1959.

Electrical engineering and electronics engineering are generally considered to be closely related fields of engineering. They overlap greatly. In general, electrical engineering is concerned with energy transport (power) in an efficient manner (low energy loss); whereas electronics engineering is concerned with information transport (communication) in an efficient manner (low distortion).

Wherever the term "engineer" is used in the grade-level portion of this standard, it applies equally to electrical engineers and electronics engineers.

EXCLUSIONS

The following kinds of positions illustrate those which are excluded from the Electrical Engineering Series and the Electronics Engineering Series because of the nature of the paramount qualifications required and the primary emphasis of the work. Thus, excluded are positions which involve:

1. Electrical or electronics engineering work as an incidental or secondary part of broader assignments which primarily require specialized knowledge of the principles and practices of another field of engineering. Such positions are classified in the Mechanical Engineering Series, GS-0830, Aerospace Engineering Series, GS-0861, or other series, as appropriate.

2. Electrical or electronics engineering work in combination with work in several other fields of engineering where no one is predominant. Such positions are classified in the General Engineering Series, GS-0801.

   Note: Positions whose duties are predominantly in both electrical and electronics engineering are not classified in the General Engineering Series, GS-0801, inasmuch as these engineering fields are so closely related. Such positions should be classified in either the Electronics Engineering Series or the Electrical Engineering Series depending on which better reflects the qualifications required for the work considering work objectives, relative difficulty of problems, lines of promotion, recruitment aspects, and other factors.

3. Application primarily of fundamental scientific principles and theoretical concepts pertaining to the properties of matter and energy in the investigation of electrical or electronic phenomena. These positions are usually similar to or overlap electrical or electronics engineering positions in many respects, especially in research areas. They may be distinguished from electrical and electronics engineering positions because knowledge of engineering principles and practices is not a primary requirement. Such positions are classified in the Physics Series, GS-1310.

4. Technical work that requires application of a practical knowledge of engineering methods and techniques as distinguished from full professional knowledge of engineering. Such positions are classified in the Engineering Technician Series, GS-0802, the Electronics Technician Series, GS-0856, Engineering Drafting Series, GS-0818, or other appropriate series. For further discussion of professional-technician relationships, please refer to the introductory material for the Engineering and Architecture Group, GS-0800.

5. Technical and analytical work pertaining to phases of communications management, i.e., the planning, development, integration, utilization, or modification of communications facilities, procedures, and networks. Such positions that do not require primarily engineering knowledge characteristic of professional engineering or technician positions are classified in the Communications Specialist Series, GS-0393.

6. Work that involves primarily application of knowledge concerning the business practices, rate structures, and operating characteristics of telecommunications or electric power systems, and does not require primarily professional or technician-level knowledge of engineering. Such positions are classified in the Public Utilities Specialist Series, GS-1130.

SPECIALIZATIONS AND TITLES

Electronics engineers and electrical engineers typically specialize in one or more aspects of their broad field of work. A great many specialty areas can be identified on the basis of function, subject matter, or area of application, each having utility for some personnel purpose. Because of the wide variation in the nature and extent of the specialty areas, it is not practicable to reflect these in class titles. In consideration of the differing needs of the agencies and the effect of changes in programs and in technology, the establishment of such specialized titles would needlessly complicate the processes of personnel management. The specialty areas may be considered in selective placement and other personnel actions even though they are not specified in the titles.

Titles for Electrical Engineering Series

-- *Electrical Engineer* is the authorized title for nonsupervisory positions classified in this series.

-- *Supervisory Electrical Engineer* is the authorized title for positions which require supervisory qualifications.

Titles for Electronics Engineering Series

-- *Electronics Engineer* is the authorized title for nonsupervisory positions classified in this series.

-- *Supervisory Electronics Engineer* is the authorized title for positions which require supervisory qualifications.

DETERMINING WHICH STANDARD TO USE

Positions of electrical or electronics engineers engaged in the functions listed below are to be evaluated by the indicated grade-evaluation guides:

Research. -- Positions engaged in basic and applied research should be evaluated by reference to the Research Grade-Evaluation Guide. This guide may also be used to evaluate the research portion of mixed positions.

Research Grants. -- Positions engaged in reviewing, evaluating, and recommending approval of research grants and contracts should be evaluated by reference to the Research Grants Grade-Evaluation Guide.

Development. -- Positions concerned with in-house or contract development of equipment, instruments, systems, and techniques should be evaluated by reference to the Equipment Development Grade-Evaluation Guide.

Test and Evaluation. -- Positions, or those portions of positions devoted to test and evaluation should be evaluated by reference to the Test and Evaluation Engineering Grade-Evaluation Guide, GS-0800.

Education. -- Positions requiring professional knowledge of engineering, but which are engaged primarily in education programs should be evaluated by reference to the Multiseries Standard for the Classification of Positions in the Field of Education and Training, GS-1710/1712.

Supervision. -- Supervisory positions should be evaluated by reference to the General Schedule Supervisory Guide.

Valuation. -- Engineering positions engaged in determining rates of depreciation or in estimating costs or the fair exchange worth of specific electrical and electronic equipment or services should be evaluated by reference to the Valuation Engineering Grade-Evaluation Guide, GS-0800.

Note: The guides without codes are filed immediately following the Introductory Material to Classification Standards. The others with codes are filed by code number.

This standard should be used for positions in the Electrical Engineering Series and the Electronics Engineering Series in functions such as design, installation, maintenance, standardization, and regulation.

In addition to the grade-evaluation guides for certain functions, the General Grade-Evaluation Guide for Nonsupervisory Professional Engineering Positions, GS-0800, may be used as a supplement to this standard. It will be especially useful for positions with functions or responsibilities not adequately covered by the criteria in this standard.

EVALUATION FACTORS

Two factors are used to determine the degree of difficulty and complexity and level of responsibility for engineering positions covered by the grade-level criteria in this standard. They are: *Nature of Assignment* and *Level of Responsibility*.

Qualification requirements are not described separately; rather, they are reflected as appropriate in both the *Nature of Assignment* and *Level of Responsibility* factors.

Nature of Assignment

This factor deals with:

-- Nature, variety, and purpose of duties performed;
-- Scope and difficulty of the assignments;
-- Knowledge required and the degree to which experienced judgment is required in evaluating alternative courses of action or diagnosing problems or failures;

-- The extent to which the engineer must define the problem;
-- Originality required.

Particular functions should not be associated with certain grade levels. For instance, engineers at various levels may develop performance specifications for computers. Engineers at all levels must be proficient in preparation of written technical reports.

Level of Responsibility

This factor deals with:

-- Extent and depth of review given to completed work and guidance received while the work is in progress;
-- Nature and purpose of personal contacts;
-- Impact of findings, recommendations and advice;
-- Authority to commit the activity or agency to a course of action;
-- Availability and pertinency of guidelines and precedents.

Typically, engineers at grade levels above the GS-5 and GS-7 levels have numerous contacts. At the lower levels the contacts are generally for exchange of information, to coordinate assignments, and to advise on simple in-house matters. However, at the higher grade levels the purposes of the contacts may be to negotiate important design changes or to represent their agencies on technical planning committees.

EVALUATION NOTES

This standard provides grade-level criteria for nonsupervisory positions in grades GS-5 through GS-13. Because nonsupervisory positions at grades above GS-13 are highly individualized, it is not practicable to provide grade-level criteria for such positions. Positions above GS-13 should be evaluated by extension of the criteria in this standard and the application of sound position-classification judgment.

Also, the General Grade-Evaluation Guide for Nonsupervisory Professional Engineering Positions, GS-0800, may be used for evaluation of positions above grade GS-13.

Since the same criteria are valid for evaluation of either electronics engineer or electrical engineer positions, to the extent practicable the illustrations are written in such a manner as to be applicable to either.

GRADE-LEVEL CRITERIA

ELECTRICAL ENGINEER, GS-0850-05
ELECTRONICS ENGINEER, GS-0855-05

Nature of Assignment

GS-5 engineers are trainees. They apply such knowledge of engineering and science as may be acquired through completion of a bachelor's degree in engineering. Their assignments are planned
to familiarize them with the employing activity's programs, and the projects and functions assigned to their particular offices. They also become familiar with pertinent engineering manuals and procedures.

GS-5 engineers assist more experienced engineers. As such they may participate in various types of work that is done in their offices for orientation and exposure.

Level of Responsibility

GS-5 engineers receive detailed instructions and close supervision while carrying out their assignments. Review of their completed work is thorough.

Their contacts are primarily with engineers within their immediate organizations to obtain data. Outside contacts are in the company of more experienced engineers whom they assist or observe. GS-5 engineers have no commitment authority.

ELECTRICAL ENGINEER, GS-0850-07
ELECTRONICS ENGINEER, GS-0855-07

Nature of Assignment

This is an advanced trainee and limited assignment level. GS-7 engineers receive assignments of limited scope and difficulty. They make direct application of varied rules, procedures, and precedents to their assignments. Relationships are clear and there is little question of the appropriate process to follow. Sufficient relevant material is available and it is clearly applicable.

GS-7 assignments presuppose some knowledge of work processes and capability to apply standard engineering practices. The knowledge may have been acquired through education or experience. By comparison, GS-5 assignments assume little prior knowledge of operating practices.

Limited judgment is required in:

-- selecting standard practices and data to be applied to specific problems where precedents are applicable;
-- recognizing situations which may require referral to others;
-- planning work procedures;
-- searching for information which may bear on a problem.

Level of Responsibility

GS-7 engineers receive specific instructions on the manuals to use, procedures to follow, and the end product to be obtained. Assignments are usually screened beforehand. The supervisor reviews the work while it is in progress as well as upon completion for inconsistencies and miscalculations in drawings and specifications. The supervisor is readily available to provide guidance as needed.

Personal contacts are primarily within the activity's engineering organization to obtain or give data. Their contacts outside the local activity are normally in the company of more experienced engineers, as observers, except in those instances where they may perform the more routine inspections or gather data. They have no commitment authority.

ELECTRICAL ENGINEER, GS-0850-09
ELECTRONICS ENGINEER, GS-0855-09

Nature of Assignment

GS-9 engineers independently perform a wide range of tasks within a subject-matter or functional area. They make engineering determinations and apply judgment in the selection, interpretation, and application of relevant rules, standard procedures, or precedents. GS-9 engineers know where to find and how to apply the appropriate precedents to their assignments. The engineers often must make minor adaptations of the guides in order to tailor them to particular assignments.

They perform blocks of work which may be either complete in themselves or segments of much broader projects. Assignments are composed of several aspects, each requiring independent analysis and solution, and which must be integrated for the final solution. If complete projects are assigned, they frequently pertain to conventional or well-established types of equipment or systems on which development has been completed and which are not undergoing constant modification.

GS-9 engineers improve or update existing circuit element, equipment, or systems in order to incorporate new advances where the technical data is generally adequate. The problems or operational requirements are usually defined at the time of assignment.

The following assignments are illustrative:

1. Design or perform the production engineering for equipment or devices for which design criteria are standardized or well established by applying standard engineering practices, components and circuit design approaches.

   -- Prepare engineering drawings or direct others in their preparation.
   -- Review contractors' drawings for accuracy and adequacy.
   -- Prepare or evaluate specifications for fabrication and assembly and prescribe or advise on production test methods.
   -- Investigate suitability of specific materials and parts for their intended purposes.
   -- Determine requirements for special test equipment, if necessary.
   -- Evaluate contractor's requests for design deviations, overall compatibility, and cost implications, and recommend disposition of them.
   -- Advise on use of standard and commercial parts or substitution of parts, in the production stage.
   -- Review service reports for failure trends and advise supervisor of any developing trend for possible corrective action.
   -- Witness factory tests of initial production models and other critical tests and report findings to supervisor, recommending modifications if judged necessary.
   -- Evaluate design changes whose effects are readily defined and circumscribed.

2. Perform the engineering tasks necessary for the installation of established or modified equipment aboard a ship, aboard an aircraft, in a building, or other environment. Precedents exist for the installation and the manufacturer's specifications and drawings are generally adequate.

   -- Conduct site survey to determine what must be done to prepare the specified environment for the new equipment, such as removal of older types of equipment. Specify types of new equipment, amount and types of cable, power and cooling requirements, and minor structural modifications.
   -- Prepare detailed installation plans and instructions, including checkout procedures, tolerances, and criteria for inspection.
   -- Prepare instructions and sketches for the draftsmen and construction personnel.

3. Carry out maintenance engineering assignments for an in-service equipment or a complex of equipment comprising a system.

   -- Investigate reports of post-installation equipment failures or unsatisfactory performance; the problems have been generally localized and there are usually precedents for solving them.
   -- Analyze and test circuitry or components to arrive at a solution and determine the appropriate changes in design, overhaul, repair or testing. Evaluate the effect of changes on operation and maintenance. This includes the checkout and inspection procedures and manual changes.

-- Collect data and conduct reliability investigations of equipment or system being maintained to determine how long they will last without needing repair; quantify and report the results; determine length of time required to get the equipment back into operation.

4. Perform engineering evaluation of manufacturers' data packages containing specifications, schematics, test data, construction details, etc. These data packages pertain to devices such as semiconductor diodes, switches, electron tubes, relays or insulating materials, which conform to well-known technology.

   -- Determine if the products meet the agency's requirements for addition to an approved or standard parts list; this includes analysis and evaluation not only of the design and performance characteristics of the items, but of their test methods as well.
   -- Recommend addition to or removal from the approved parts list.

5. Design or review designs of electric power distribution and utilization systems or electrical generating equipment of limited scope and complexity such as for small ordinary office buildings, or designated portions of larger, more complex electrical projects. Established design criteria and ample precedents are adequate to solve any problems which are typically not difficult or unusual.

   -- Make field studies and power surveys of existing equipment and facilities to determine their nature and condition.
   -- Search for and study available information and precedent designs to determine design approach.
   -- Perform calculation to determine load capacities and size and type of equipment to be used.
   -- Coordinate with in-house engineers those details of electrical features which relate to other fields of engineering.
   -- Prepare or direct the preparation of working drawings and specifications, and develop cost estimates.

6. Use established criteria to perform engineering analysis and evaluation of applications for a variety of applications for broadcast stations, point-to-point, or land mobile communications facilities to insure interference-free communication. The applications involve complex, but commonly used, antennae setups, transmitting, and receiving equipment which have been previously approved by the agency for use. If new equipment is used it is not markedly different from commonly-used ones. Physiographic features in the service area typically do not create critical reception or transmission problems and the spectrum in the vicinity is relatively uncrowded.

   -- Plot service areas for daytime and nighttime coverages.
   -- Determine operating tolerances.
   -- Determine effect on existing services.
   -- Recommend approval or rejection of the applications to the supervisor.

7. Independently plan and conduct diverse field investigations of complaints of interference in the radio broadcast media; or conduct investigations of electromagnetic interference with communications, guidance, or other equipment aboard ships. In either case there are precedent approaches which the engineers may follow to locate and eliminate the source of trouble.

   -- Make detailed measurements with mobile and other detection and measurement instruments to locate the interference source. Terrain, industrial concentration, or presence of large amounts of electrical and electronic equipment may make locating the source difficult.
   -- Analyze a number of factors and potential sources of trouble.
   -- Prescribe adjustments and alterations which will correct the problem.

Level of Responsibility

The supervisor provides guidance primarily on aspects of individual assignments which involve deviations from the norm. Precedents, methods, and practices are pointed out by the supervisor for assignments involving unfamiliar aspects.

GS-9 engineers independently plan and carry out assignments. They select those precedents and practices most applicable to the particular engineering conditions involved and the purposes of the assignment. By comparison, GS-7 engineers receive specific instructions concerning methods and techniques to be used on new assignments. Engineers GS-9 bring to their supervisor's attention, conditions which are questionable from a safety, reliability, cost, and time schedule standpoint.

The supervisor spot checks critical features of work in progress to insure that schedules, priorities, and similar requirements are being met. The supervisor carefully reviews the completed work for technical accuracy, conformance with established precedents and policy, and attainment of objectives.

GS-9 engineers demonstrate sound judgment in their dealings on noncontroversial matters with engineers who represent contractors and others, in their factgathering and review roles. By comparison, GS-7 engineers have few contacts outside their installations, except as observers, in the company of more experienced engineers.

Whereas GS-7 engineers obtain or provide specific factual data in their contracts, within the limits of their experience and guidelines, GS-9 engineers give engineering opinions to in-house groups (e.g., maintenance, procurement, testing, and other units) about apparent causes of malfunctions, acceptability of routine changes in maintenance and operating procedures, and alternate plans and specifications.

ELECTRICAL ENGINEER, GS-0850-11
ELECTRONICS ENGINEER, GS-0855-11

Nature of Assignment

GS-11 engineers apply broad knowledge of diverse engineering concepts and procedures of a functional or subject-matter area. They carry out a wide range of professional engineering studies and assignments.

Agency manuals, standards, and precedents normally apply to their assignments. However, the GS-11 engineers usually make significant adaptations of them for particular applications. By comparison, GS-9 engineers typically make only minor adaptations.

GS-11 engineers apply knowledge of related disciplines and normally deal with specialists in them, e.g., in determining air conditioning, heating, and space requirements. They must be aware of the ramifications of their findings and actions for related equipment or systems. In order to expedite completion of some assignments, supervisors may assign lower grade engineers, technicians, and draftsmen to assist GS-11 engineers.

Characteristically, GS-11 engineers first adequately define the problem or assess several alternatives prior to determining the course of action. The action may involve a corrective measure or recommending a system or design approach. By comparison, the supervisor usually defines the problems or operational requirements for the GS-9 engineers at the time of assignment.

The following assignments are illustrative:

1. Perform design and production engineering functions for older or well-established equipment when new requirements or changed requirements are imposed, such as greater efficiency or closer tolerances involving substantial modification of existing equipment. Use sound engineering judgment and experience to adapt guidelines and precedents and select commonly used approaches to overcome weight, volume, vibration, micro-miniaturization, heat transfer, heat dissipation, or other problems. Witness and evaluate various tests, including factory acceptance tests of production models and authorize changes in the test procedures on the spot within the legal constraints of the contract, if production is not in-house.

2. Conduct a variety of investigations and analyses relating to site selection and systems integration, in connection with installation of systems to be installed at several facilities or in numerous craft. For some assignments they may travel away from the local employing activity; consequently, the supervisor is not immediately available for consultation. The system's component equipment is mostly off-the-shelf items which may have been modified to incorporate the latest developments. The modifications dictate alteration of previously used installation and check-out procedures. The subsystems or equipment have independent functions and technologies (e.g., a navigation system, which among other things, contains a

digital computer, sensors, gyroscope, amplifiers, display console). The engineer must understand the technology of each and their interrelationships. He must also resolve structural, weight, systems incompatibility, or instability problems, applying some technical knowledge of related fields in order to solve these problems.

3. In the maintenance and operation of major equipment or systems, perform such duties as:

   -- Develop or evaluate adequacy of maintenance programs, training equipment and materials, operating manuals, and repair procedures.
   -- Inspect newly installed or modified equipment and systems for conformance to performance requirements. When inconsistencies or inadequacies are detected, prescribe corrective measures on the spot if precedents or guidelines apply, but reserve action on those which have unanticipated impact or are not adequately covered by guidelines and precedents until after consultation with the supervisor.
   -- Resolve equipment failure or unsatisfactory performance problems where the user has not been able to pinpoint the problem in circuitry or components. This may include revision of the checkout and inspection procedure as well. Certify acceptable completion of installations.

4. Evaluate manufacturers' data packages for devices or components for addition to or removal from an approved parts list. The devices or components do not conform to the established design and testing specifications for such items. Perform complete engineering analyses which require adaptation or extension of the agency standards for such devices to determine whether they are acceptable.

   -- Determine what changes the manufacturer should make if his data do not comply.
   -- Develop amendments to existing general specifications for a category of devices or rewrite them, if failures are too frequent or requirements are so rigid that no submissions qualify.

5. Design, analyze, and review designs of high and low voltage electric power distribution and utilization systems for large, diverse installations or buildings, e.g., dam complexes, hydroelectric power plants, hospitals, industrial shops, airfields, or technical laboratories. The systems are typically rather commonplace but of considerable complexity, size, and extent.

   -- Supervise construction if required and inspect completed work for acceptability.
   -- Determine or review plans and specifications for maintenance of the systems, including cleaning, inspecting, and testing.
   -- Make field surveys and investigations to determine condition of electrical systems and study operational problems such as voltage regulation.

6. Evaluate applications for a variety of types of broadcast stations or communications facilities which utilize approved and rather well-established equipment. The affected locale is characterized by a crowded spectrum which requires that the equipment be highly reliable and precise to insure proper channel separation and minimum interference. Prescribe changes that must be made in order to be acceptable, such as a different antenna height or the use of a different antenna to avoid interference with a distant station.

7. Conduct a wide variety of comprehensive investigations of broadcast interference and unauthorized use of the air-waves. The interference problems are ones which cannot be readily solved by application of precedents, so the engineers use sound knowledge of the specialty area to isolate the possibilities and determine the source. Determine the precise cause and prescribe appropriate changes. Assemble necessary information for legal proceedings when legal action is taken against the person causing the interference. In other instances, confer with him to explain the interference consequences and to recommend corrective procedures or equipment.

8. Make studies, analyses, and calculations for the solution of problems connected with the overall planning, design, or operation of a high-voltage power generation and transmission system. The scope or nature of the assignment requires application of a thorough knowledge of standard high-voltage power systems. Assignments may require adaptation, modification or compromise with guidelines and precedents in consideration of ecological or esthetic factors which affect the approach to engineering problems. Studies are concerned with matters such as:

   -- Determine the need and feasibility of new generation or transmission facilities.
   -- Determine the best characteristics of lines and equipment for the guidance of designers.
   -- Determine the most economical transmission voltage for a segment of a transmission system.
   -- Solve problems involved in securing optimum operation of a generation or transmission system.

Level of Responsibility

Supervisors of GS-11 engineers provide background information and guidance on unusual problems or important and novel issues. Engineers GS-11 receive most assignments within their subject-matter or functional area without instructions, whereas assignments given GS-9 engineers are screened for unfamiliar aspects. GS-11 engineers determine the nature of the questions and issues involved, and independently plan and carry out the investigation, analysis, and details of the work. In controversial or novel issues, they discuss the approach and general plans with the supervisor who also approves them.

Their supervisors review the completed work for general adequacy, effect of findings and recommendations on other assignments, and conformance with agency policies and procedures. The supervisor normally assumes that the drawings, specifications, manuals, and similar data which the GS-11 engineers prepare are technically accurate and complete. The supervisors

accept them as such without intensively reviewing them when sufficiently related precedents or guidelines exist. By comparison, all aspects of the work of GS-9 engineers are reviewed for technical accuracy. Supervisors review the critical features of actions of GS-11 engineers thoroughly when precedents are inadequate and standard practices are not applicable.
In dealing with contractors and other Government activities, Engineers GS-11 make commitments on matters in their assigned area which are covered by precedents, agency regulations, policies, and accepted engineering practices. By comparison, GS-9 engineers are limited largely to giving opinions to in-house groups.

ELECTRICAL ENGINEER, GS-0850-12
ELECTRONICS ENGINEER, GS-0855-12

Nature of Assignment

GS-12 engineers apply deep and diversified knowledge to atypical or highly difficult assignments, in a subject-matter or functional area, e.g., unusual problems that arise during the rework of major systems for which they have technical responsibility. Precedents for their assignments are sometimes absent, but more commonly, their relationship to the particular assignment is obscure. Conflicting issues often characterize GS-12 assignments. By comparison, GS-11 engineers apply broad knowledge of the subject-matter or functional area to those assignments which can be carried out through significant and skillful adaptation of precedents and established approaches.

GS-12 engineers are required to comprehend fully the relationships between their assigned and related areas and branches of engineering. For example, installation or overhaul engineers may recommend structural changes to naval architects, civil engineers or aerospace engineers. Also, a great many items involve mechanical as well as electrical or electronics technology.

They usually perform preliminary engineering analyses on large and complicated projects. Consequently, they must be knowledgeable of research and developmental activities and technological advances in order to incorporate them into their assignments. The approaches and procedures which they adapt or develop are followed by less experienced engineers on subsequent assignments of similar nature. By comparison, GS-11 engineers follow the approaches and procedures which higher graded engineers develop or consult them on especially difficult problems. Some GS-12 engineers coordinate and direct the work of other engineers and technicians who are assigned to them for accomplishment of portions of broad tasks.

GS-12 engineers are relied upon heavily for studies in which they thoroughly evaluate the various alternatives for meeting an objective, with adequate consideration of peripheral as well as technical factors, recommend the best one. When planning large systems or complexes, they conceive several configurations, i.e., they develop and compare alternative layouts or designs which utilize equipment of various kinds and capabilities in diverse physical arrangements. This may involve consideration of structural, mechanical, and hydraulic features.

Their assignments are frequently further complicated by the many operations which the equipment or systems must perform and the many variables which the engineers must consider. Coordination with related groups and integration of many design changes or major equipment alterations characterize GS-12 assignments.

The following assignments are illustrative:

1. Design or perform the production engineering for the latest, state-of-the-art equipment which will be integrated into systems with very precise tolerances. New and even previously untried methods and designs were utilized in order to meet the system requirements. For example, these could be new approaches to circuitry and power distribution, or incorporation of automatic self-test methods in the equipment design.

    -- From preliminary designs and specifications, determine funding, personnel, and equipment requirements.
    -- Evaluate the numerous and frequent changes in design and performance which affect the assigned equipment prior to and during production.

2. Review or develop the installation instructions for systems which include a number of physically separate and technologically different components. The particular type of installation has not been made in a similar environment previously. Consequently, many problems must be resolved by a tailored combination of principles and practices of the functional or subject-matter area. It may be installation of a prototype or experimental equipment for testing under operational conditions or an initial installation which is to set the standard for similar installations agencywide. In some instances the customer knows only his operational requirements. The GS-12 engineer must help him write his requirements, perform a feasibility study, and discuss the findings with the customer.

3. In an equipment or systems maintenance program perform such duties as:

    -- Develop the instructions and specifications for the repair, modification, maintenance and testing of new types of systems with many component pieces of equipment. The procedures serve as the type standard for other activities with similar missions to follow with respect to the systems if the activity has servicewide engineering cognizance over the systems.
    -- Determine where major failure problems or instabilities within assigned systems exist through the agency failure report system. The problems which arise are not usually susceptible of solution by application of the maintenance instructions or other guidelines; thus, the engineers must draw upon their experience and originality to locate the problems and to determine how to correct them. Redesign any part of the system as necessary, prescribe changes in materials used, prescribe new calibration procedures, etc.

4. Evaluate manufacturers' data, specifications, and drawings for novel and somewhat controversial devices or components proposed for addition to or removal from an acceptable or standard parts list. The items are first articles or major innovations which will advance the technology.

   -- Conduct studies to determine if general specifications or standards for such devices or components are needed in order to provide guidance to manufacturers in preparing their data packages for submission to the agency for approval.
   -- Write the general specification or standard if needed. Evaluate alternative manufacturers' specifications for the item and select the best as the basis for the general specification; this requires getting agreement where disagreement prevails on what the general specification should contain.

5. Plan and coordinate feasibility studies for extensive modifications of major segments or component equipment of communications networks or high-voltage transmission networks. The objectives of the studies may be to find means of improving performance, increasing capacity, correcting unsatisfactory conditions, or reducing number of stations.

   -- Determine nature and extent of problems and the actions needed to resolve conflicting requirements and constraints.
   -- Define the investigation, equipment, engineering, tests, and production effort required to accomplish the modification.
   -- Take advantage of the latest state-of-the-art equipment.

6. Evaluate applications for broadcast or point-to-point communications services which involve some important advancements such as a new complex antenna array which will be incorporated into the system, or automatic checkout provisions, which will probably have far-reaching impact in the communications field, if successful. Other complicating factors may be the extreme or changing environmental conditions in which the system will operate, such as atmospheric, physiographic, antenna site, insufficient or over-abundance of power, potential interference with or from other services in the operating area. As a consequence of investigations connected with the assignments, may propose new rules if present ones are inadequate or none exist which cover the conditions encountered. Evaluate competing applications for the same service, and recommend the best for approval.

7. Develop or review designs, specifications, and cost estimates for electric power distribution and utilization systems of the level of complexity and novelty such as those for a research laboratory using very large blocks of power for wind tunnels; or a unique installation which must satisfy conflicting requirements of such factors as aesthetic values in architecture, minimal space, higher voltages, and more critical load balance. There are typically conflicting and inadequate guides and precedents. The problems to be solved require intensive investigation and analysis, resolution of conflicting engineering considerations, and advanced competence in the field.

Level of Responsibility

Supervisors inform GS-12 engineers of the objectives or operational requirements that the equipment or systems must meet and relative priority of their assignments, but the engineers are free to analyze problems and develop their own approaches and work plans. They receive little technical advice or guidance. Technical manuals or specifications pertinent to their assignments are frequently inadequate. By comparison, GS-11 engineers can usually adapt precedents and available guidelines to their assignments. Supervisors review the completed work of GS-12 engineers for technical soundness and for compliance with broad local or agency policy. They consult with supervisors when they discover that assignments will have significant unforeseen impact or that they must depart from policy.

Technical decisions and recommendations of GS-12 engineers are usually accepted by higher authority as basis for action except when policy, program, or budgetary considerations are overriding. In their assigned functions they act as spokesmen for their activities, e.g., witnessing tests and accepting initial production models at manufacturers' plants and authorizing important modifications, all of which conform to broad policy. GS-12 engineers coordinate their assignments with those of engineers in other disciplines or engineers who are specialists in other subject-matter areas. They represent their offices in the exchange of data and discussion of technical problems at meetings. They meet with customers' representatives and advise on means of meeting operational requirements.

GS-12 engineers point out areas for investigation or improvement which result in large savings and much improved efficiency. In connection with regulatory functions of their agencies, GS-12 engineers present data at hearings on important issues.

ELECTRICAL ENGINEER, GS-0850-13
ELECTRONICS ENGINEER, GS-0855-13

Nature of Assignment

GS-13 engineers are highly knowledgeable specialists in their subject-matter areas, which may be rather narrow, e.g., telemetry, or quite broad, or they may be authorities in functional areas, e.g., standardization or maintenance. Other engineers and managers within their activities often consult GS-13 engineers for advice and assistance within their areas of expertise. By comparison, GS-14 engineers are widely recognized experts who are used as consultants by engineers and managers outside the immediate organization on unusually difficult and controversial matters where the opinion of an engineer of high repute is considered vital. An example of GS-14 expertise would be the determination of which approach to take for the major revamping of a strategic communications network or power transmission system for an area with several large urban and industrial complexes. In either case, there is a high level of public criticism or official concern.

Characteristically, the assignments of GS-13 engineers require that they represent the activity in reaching engineering compromises and agreements with engineers of other organizations and

contractors. In addition to the diversity of problems and conflicting issues involved in assignments at the GS-12 level, GS-13 engineers solve unusual and controversial problems of a decisive nature.

GS-13 engineers plan and coordinate programs or projects for which they must be innovative and original. They devise methods and procedures which are normally adopted for use and become the activity's established precedent; sometimes they are adopted for use by other activities. By comparison, GS-14 engineers characteristically devise methods, procedures, and approaches which have agencywide influence in the subject-matter or functional area and in related areas. GS-13 engineers review, evaluate, and advise on the effectiveness, technical adequacy and suitability of work and proposals of others (in-house, other activities, industry) in resolving complicated and critical problems in the specialized area.

GS-13 engineers make critical analyses and evaluations of the ramifications, advisability, and impact of large engineering projects. Examples are:

-- Modification of major facilities or systems in order to have them meet new and considerably more demanding performance requirements; such modifications normally involve large sums of money to be spent over several years.
-- New configurations whereby unusual combinations of equipment or systems are called for and major compatibility problems must be resolved.

GS-13 engineers are required to keep abreast of and evaluate new developments that pertain to their subject-matter or functional areas to insure that their program planning, approaches,

findings, and decisions reflect the latest thinking in the area. They do this by maintaining close contact with research and development laboratories, manufacturers, scientists, and other Federal activities. Also, they must anticipate the implications that probable technological change will have for their programs. By comparison, GS-12 engineers primarily investigate technological advances and develop new approaches for application to particular assignments or problems.

GS-13 engineers apply extensive background knowledge of the broad field of engineering as well as expert knowledge in the subject-matter or functional area to the resolution of problems, development of approaches, and settlement of conflicts in their assignments.

The following assignments are illustrative:

1. Serve as the coordinating engineer for the production of a system which consists of many separate functional items of equipment, e.g., a missile guidance system, or a category of equipment or devices, which incorporates the latest, state-of-the-art advances. The problems of getting the system into production may be heightened by (1) the inadequacy of documentation for some of the prototype components and (2) the fact that the production of certain equipment requires major retooling which would overrun cost figures or would result in low yield or marginal performance. Consequently, means must be found for simplifying them without sacrificing performance characteristics or substitute parts must be found.

-- Simplify the original functional designs for the prototype components in order to improve the system from a production engineering standpoint.
-- Resolve novel production problems which may require new techniques and additional design considerations.
-- Determine or evaluate significant alterations in production methods or materials used in the fabrication process, which are due to changed requirements, technological advances, or shortcomings unveiled in further testing.

2. Plan modifications to complex subsystems or major category of equipment, e.g., switching or transmission equipment of an extensive nationwide communications network. The purpose of the modifications may be to improve service, expand capacity, or reduce the number of links.

-- Analyze and evaluate present and future network requirements; recommend optimum technical and economic trade-offs to integrate existing subsystems and to determine new network capabilities in accordance with customer's requirements and goals.
-- Determine modifications to be made to salvageable existing equipment to bring it up to the required standards and determine requirements for new equipment.
-- Translate resulting subsystem plans into engineering tasks which are turned over to an action agency which carries out the work. Prepare the procedures, criteria and specifications for systems modification and for procurement and testing of new equipment.
-- Determine distribution of the subsystems.
-- Resolve difficult and controversial problems relative to interfacing with other subsystems of the network.
-- Maintain liaison with the action agency to insure that new equipment which is developed complies with customer's requirements.

3. Conduct system analyses of a primary power system consisting of several subsystems, e.g., generating plants, high-voltage transmission lines. The assignment requires thorough knowledge of the current state of technology in the power field as well as the functioning of the existing system. The area covered has several large urban and industrial concentrations which have increasing heavy power demands. The objectives of the study are to determine means to increase efficiency of operation; plan for future system expansion due to anticipated demand; improve network reliability; reduce vulnerability of loads to system disturbances; identify and develop the best combined system characteristics for normal and emergency operation.

-- Evaluate a wide variety of factors which affect system performance characteristics, including the system's controls, the system configuration, generation system, and protection of the system.
-- Conduct or direct many different investigations, analyses, and possible design modifications of the subsystems for overall system improvement; also determine requirements for new equipment.

-- Prescribe special performance requirements for the system and for new equipment which would be introduced into it.
-- Review and evaluate the possible overall effect of the more critical changes in equipment, operation, and repair.

Level of Responsibility

Their supervisors and others readily accept the recommendations and decisions of GS-13 engineers from the standpoint of technical accuracy and adequacy. GS-13 engineers have technical responsibility for their assignments and programs. They determine the approaches to be used and are responsible for the results. They keep the supervisor informed as to the status of the work and discuss decisions involving critical changes or major controversial issues in policy and precedent determinations. Supervisors or managers review the completed work of GS-13 engineers for satisfactory compliance with overall policy and attainment of program objectives.

GS-13 engineers make continuing contacts as engineering advisors and as the representatives of their organizations in interpreting and applying policies and requirements. GS-13 engineers negotiate with engineers who have differing or opposing views, in order to resolve the engineering aspects of controversial cases. By comparison, GS-12 engineers typically refer such matters to the supervisor.

GS-13 engineers normally resolve technical problems, independently, even in those areas where guidelines are lacking. They are regarded as knowledgeable advisors within their functions and specialty areas. They interpret the agency's national guidelines that pertain to their subject-matter or functional areas for application at their activities. They make and justify long-range and controversial proposals. They defend their findings and recommendations against attack by top engineering personnel of manufacturers or other organizations. By comparison, the evaluations and recommendations of GS-12 engineers typically, do not carry such weight.