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Industrial Product Guide Specifications Explained

INTRODUCTION

A specification outlines the technical requirements and performance expectations of equipment intended to be used in a particular application. The specifications also ensure that the design application meets code requirements.

In this paper, we will discuss industry standard elements included in contract specifications, focusing particularly on the language used when specifying packaged generator assemblies for emergency power applications.

SPECIFICATION TYPES

Project specifications can be categorized into three kinds: prescriptive, performance, and proprietary; each of which offers unique value to a project.

PRESCRIPTIVE

Prescriptive specifications define what products are to be provided and how they are to be installed. Manufacturer names and part numbers are included so that exact materials and methods are used in the application. Engineers use prescriptive specifications to name specific products (often by exact part numbers or product marketing language) that they believe meets and supports their design's integrity. In a prescriptive specification, engineers design their application around one manufacturer's product, which becomes the basis of design, and then list other manufacturers with comparable products to meet the application's requirements.

It is up to the "or equal by" manufacturer (not listed with the product as basis of design) to "prove" their product meets the engineer's design intent. One benefit to listing multiple manufacturers to provide a particular product is that it allows competitive bidding and provides the best price to the owner for the equipment.

PROPRIETARY

Proprietary specifications are the opposite of prescriptive specifications in that they call out a specific, single approved manufacturer to supply the product for the application. Like prescriptive specs, proprietary specification language includes part numbers and descriptions of equipment unique to a single manufacturer as the "basis of design," while conversely, no other manufacturers are listed as "equals" or are considered.

Some multiple generator applications, like Central Utility or large water treatment plants, may require a propriety specification because the owner/end user prefers a specific manufacturer's equipment, and they may already own equipment from a single manufacturer.

Advantages to specifying a sole sourced manufacturer are 1) end users find it easier and more cost effective for equipment maintenance if all the generators are from the same manufacturer and 2) the end user may have a cost savings contract set up with a single supplier on equipment, parts, maintenance, and service. Conversely, if a project with a proprietary specification goes to a competitive bid, the cost of the equipment could come at a premium because products can only be provided by one supplier.

PERFORMANCE

Performance specifications are markedly different from prescriptive and proprietary specs because no manufacturers or suppliers are listed in the specifications.

This type of specification can be thought of as agnostic and defines product/equipment in terms of measurable outcomes or goals, rather than by part numbers and manufacturer names. Engineers use specification language to describe how the generator is intended to function once it is installed, focusing on application conditions or requirements that must be met when the generator is operating.

One advantage of performance specifications is that once engineers define generator performance requirements, contractors have flexibility in deciding the best way to meet these requirements through means and methods.

SPECIFICATION FORMAT

Specifications are legally binding documents. When combined with construction drawings, they are used to communicate design intent and project requirements effectively, clearly, and concisely to contractors.

In the United States, specifications typically conform to guidelines established by the Construction Specifications Institute (CSI), an organization founded in 1948, focusing on improving the transfer of information between designers and builders in the construction industry.

CSI developed a specifications index called MasterFormat, grouping specification sections into easily identifiable disciplines using a six-digit system, grouped into three sets of two. For example, the MasterFormat specification section for Packaged Generator Assemblies is 26 32 13.

The first two numbers, 26, indicate the Division, a top-level category of work the specification section covers (Electrical). The second two numbers, 32, describe the basic unit of work specific to a product or process (Packaged Generator Assemblies). The third set of numbers, 13, is the identifier which distills the section into categories unique to a specific kind of product or material (Engine Generators). And in rare instances, a fourth set of numbers further sorts the section based on a nuanced factor (for example a fuel source type). *See Figure 1.*

Figure 1

26 32 00 — **Packaged Generator Assemblies**

DIVISION SECTION IDENTIFIER

Construction Specifications Institute (CSI)

Master Format

CSI Code	Description
26 32 13	Engine Generators
26 32 13.13	Diesel-Engine-Driven Generator Sets
26 32 13.16	Gas-Engine-Driven Generator Sets
26 32 13.26	Gas-Turbine-Engine-Driven Generators
26 32 16	Steam-Turbine Generators
26 32 19	Hydro-Turbine Generators
26 32 23	Wind Energy Equipment
26 32 26	Frequency Changers
26 32 29	Rotary Converters
26 32 33	Rotary Uninterruptible Power Units
26 32 36	Resistive Load Banks

Engineers utilize MasterFormat as a starting point when writing specifications. Engineering firms may edit a MasterFormat specification into a starting template for staff engineers to meet quality assurance and business goals.

SECTION FORMAT

A specification section defines the area of concentration or the topic of interest and includes the MasterFormat six-digit index number and title exposing quick identification. Specification sections are formatted like an outline and divided into three parts – general, product, and execution. *See Figure 2*.

Each part is subdivided into Articles, which are further divided into paragraphs. In some instances, a specification section may be written in paragraph format only; however, specifiers will commonly use MasterFormat outline headings, keeping with industry standards.

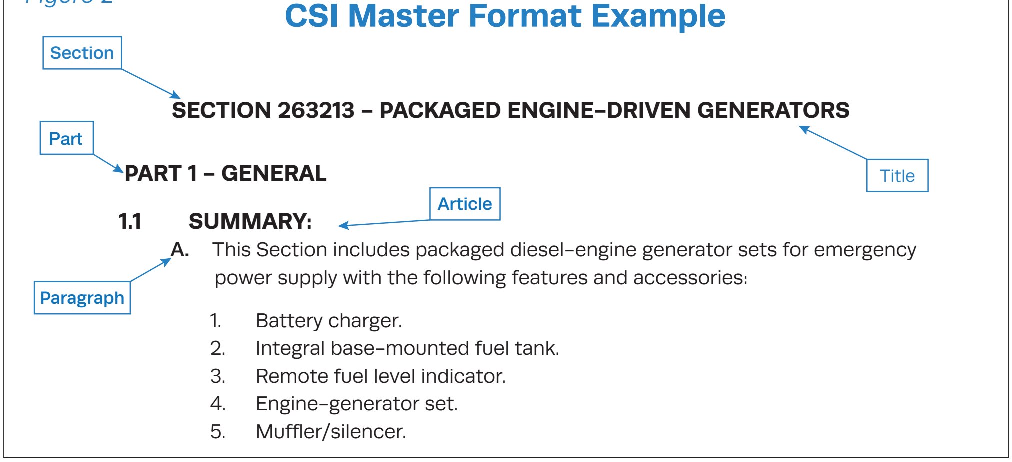

Figure 2

PART 1 – GENERAL

The purpose of Part 1– General is to detail the scope of the section. It covers the administrative and procedural requirements unique to the section and not already covered in Division 01. Articles include Scope Summary, Related Requirements (pulling in other sections relevant to this section), Code References, Submittal Requirements, Definitions, Quality Assurance Requirements, Coordination of other trades with this section, Warranty and Maintenance criteria and spare parts requirements.

PART 2 – PRODUCT

This Part concentrates on requirements and criteria for the product itself and details approved product manufacturers, performance requirements and specific criteria of individual components of the generator set. Articles found in this Part include Approved Manufacturers, Performance Requirements, Engine Generator Assembly Description, Engine Requirements, including cooling exhaust, and starting, Fuel System, Control and Monitoring, Overcurrent Ground Fault Protection, Generator, Exciter and Voltage Regulator (AKA Alternator), Enclosure / Finishes, Vibration Isolators, Accessories, and Source Quality Control.

PART 3 – EXECUTION

The purpose of Part 3 is to Detail the way products, materials, and equipment will be installed. The articles in Part 3 outline requirements above and beyond those instructions included in Division 1, specifically Examination, Installation, Connections, Identification, Field Quality Control, Demonstration, and Startup and Commissioning.

THE CODE DRIVES SPECS

Engineers may not be aware that codes directly drive construction design specifications. Codes and standards are developed and adopted to ensure safety, reliability, and performance of engineered building systems, and provide guidelines for the design, construction, and maintenance of such systems as electrical and mechanical systems. It is recommended that when engineers begin new projects, the first thing they do is a code study for due diligence, uncovering mandatory requirements/criteria managed and monitored by the local authority having jurisdiction (AHJ) governing body. This study provides the foundation for engineers to design engineered systems, meeting or exceeding requirements which protect the public, building occupants, and the environment.

Codes also drive product features and accessories, and the application determines which set of codes apply to the design. Understanding of this triad and how it interplays will assist engineers in providing quality information in their design documents to ensure competitive bids.

The most referenced codes in a generator design specification originate from the National Fire Protection Association (NFPA), Underwriters Laboratory (UL) and the Environmental Protection Agency (EPA). *See Figure 3*.

Figure 3

Specification language example listing code references

1.2 REFERENCE STANDARDS:

A. National Fire Protection Association (NFPA):
1. NFPA 30 – Flammable and Combustible Liquids.
2. NFPA 37 – Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
3. NFPA 70 – National Electric Code.
4. NFPA 99 – Essential Electrical Systems for Health Care Facilities.
5. NFPA 110 – Emergency and Standby Power Systems.

B. Underwriters Laboratories, Inc. (UL):
1. UL 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors.
2. UL 2200 – Stationary Engines Generator Assemblies.

C. Engine Exhaust Emissions: Comply with EPA Tier [2] [3] [4] requirements and applicable state and local government requirements.

Other standards bodies, such as International Building Code (IBC) for seismic considerations, Institute of Electrical and Electronics Engineers (IEEE), National Electrical Manufacturers Association (NEMA), and The Uptime Institute, may also be referenced; however, the purpose of this paper is to focus on the three listed as most common.

THE CODE DRIVES SPECS – CONT:

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

There are several NFPA standards specific to generator design. Most familiar to engineers are NFPA 110: Emergency and Standby Power Systems, and NFPA 70: National Electrical Code. Both standards provide key design requirements pertaining to power generation systems.

NFPA 110 defines Emergency Power Supply System (EPSS) outlining all the necessary components, including conductors, disconnecting means, ATS's and all support devices needed for a safe reliable source of electrical power upon utility failure. It also defines the EPSS classification, including the Class, Type, and Level. See Figure 4.

Figure 4

NFPA 110 Categories

Level
Dictates performance standards your system needs to follow.

Class
Duration your system must be able to run without refueling.

Type
Time your generator has to be operational after a power failure.

These classifications align with specific Articles in the NFPA 70 (NEC (National Electric Code)), which outlines the electrical safety of the installation, operation, and maintenance of the EPSS. For example, the scope of NFPA Level 1 directly relates to Article 700 – Emergency Systems in the NEC, whereas the scope of NFPA Level 2 relates to Article 701 – Legally Standby Systems.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) – CONT:

Deep diving further, Level 1 classification requires multiple items that are not necessarily mentioned in Article 700. Such items, with their design implications, are as follows as shown in the table detailed in Figure 5.

Figure 5	
NFPA 110 Level 1 Requirement	Design Implication
The generator **shall** be heated as necessary to maintain jacket water and battery temperature for cold start and load acceptance.	Accessories: including Cold Weather accessories such as battery blankets, etc. in the design spec.
Ambient air temperature in the equipment room or generator housing **shall not** be less than 40 degrees F when equipment is not operating.	Trade coordination: Heaters or AC may be needed depending on the location of the application.
The fuel supply **shall not** be used for any other purpose unless features are designed into the system to guarantee the required quantity of fuel supply available.	If a central plant application already has onsite fuel tanks, these tanks may not be used and dedicated fuel tanks will be provided, increasing the cost of the equipment.
A Low-fuel switch **shall** indicate when less than minimum fuel as required by class remains in the main fuel tank.	Tank specification and accessories: ensuring standard tank offerings have a low-level switch or providing a separate fuel float system.
The minimum capacity of the main fuel tank **shall** be either at least 133% of either the low fuel sensor quantity or the quantity required to support the minimum required time (duration of run) as designated by the CLASS Classification.	Tank sizing: the application CLASS may be 48hrs, however, depending on the application and the amount of fuel remaining in the tank at low level, a 64hr tank may be required.
Duration and type of cranking cycles relating to starting equipment **shall** be sized appropriately (per a specific included table in the standard).	Accessory: Battery selection and specification.
Battery charger **shall** fully recharge batteries to 100% within a specific time (as indicated in included standard table).	Accessory: Battery Charger selection and specification.
Level 1 applications **shall** have local and facility remote annunciation (or local and network).	Accessory: providing remote annunciator panel, or ensuring tie-ins (RS232, Modbus, ethernet, etc. capabilities) are included.
-This list is not inclusive of all NFPA 110, Level 1 requirements.	

The above table illustrates one example of the interplay between codes. Therefore, as a spec tip, it is a good idea for engineers to know how the codes can play off each other so that important requirements are not missed in the specifications document, which would lead to change orders after the bid.

UNDERWRITERS LAB (UL)

UL is a globally recognized organization specializing in product safety and certifications. In 1998, responding to the need for reliable backup power during power outages, UL developed the UL2200 certification for stationary generators – a rigorous testing and evaluation process to ensure generators meet strict safety and performance standards. This certification became a "nice to have," until the NEC 2020 code update when Article 445.6 – LISTING was added, requiring all generators be UL2200 listed.

UL2200 certification validates various genset components for safety and installation, through an extensive evaluation process. These components would include genset and engine controllers, voltage regulators, battery chargers and cabling, engine block heaters, on-board load banks, terminals and terminal blocks, circuit breakers and transfer switches, fuses and fuse blocks, power disconnects, control switches, lighting and convenience power outlets, control and power cable routings, acoustic insulation, exhaust heat wraps, air filters, fuel hoses, and exhaust silencers.

Because this type of extensive testing would not typically be part of a manufacturer's standard production testing, it can create a "gotcha" for engineers if they specify UL2200 certification for projects that predate the NEC2020 update. The key takeaway is to remember when dealing with NEC codes prior to 2020, UL2200 certification can add additional cost to the price of the generator during bid.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

The EPA is responsible for implementing and enforcing national standards to reduce the impact of hazardous air pollutants. Diesel generators are regulated by EPA 40 Code of Federal Regulations Part 60 Subpart IIII, which sets performance standards, limiting emissions, setting operating guidelines, and steering certification test methodologies. Stationary Diesel Generators operating in the U.S. must be powered by engines meeting the EPA New Source Performance Standards for Stationary Compression Ignition Internal Combustion Engines. EPA performance standards classify engines by application type, expressed in a Tier system – Tier 1 through Tier 4, based on the rated power and the manufacture date of the diesel engine. Each Tier becomes progressively more stringent, the higher the Tier number.

Governing exhaust emissions is becoming increasingly prevalent and is starting to drive generator design specifications. States, like California, Florida, New York, and Texas, are requiring exhaust emissions conditioning regardless of the EPA application type.

Key design and specification considerations when dealing with the more stringent Tier 4 rating are to understand the difference between Tier 4 Certified and Tier Compliant. *Figure 6* explains the EPA definitions and implications of both.

Figure 6

US EPA Engine Terminology

EPA Certified:

- All testing and emissions data for an engine has been certified by the US EPA to meet emissions standards.
- **Diesel engines must be EPA certified to ship inside the U.S.**
- **EPA Certified generators are certified at the factory. No other testing after installation is required.**
- There is a high first cost to EPA certified units.

EPA Compliant:

- Emission testing has been done to confirm the engine will comply with all US EPA emissions standards but has not been submitted and certified by EPA.
- **Generators are packaged on site with emissions conditioning and tested by EPA on site.**
- **EPA Certified compliant generators must be tested every 2-years to ensure emissions requirements are being met. (This becomes a maintenance responsibility of the end user.)**
- First costs for EPA compliant is not as high as EPA certified units.

Specification Tip: When an end user asks the design engineer for an EPA Tier 4 Certified generator, it is good for engineers to know specifically what the end user is trying to accomplish and if a Tier 4 Certified system is truly required by an air district or governing AHJ. In some cases, EPA compliant systems, or just designing minimal emissions conditioning may suffice an end user's goals without creating major additional first costs.

SPECIFICATION LANGUAGE

Engineers who write quality, meaningful specifications use a simplified writing style that provides exact meaning of requirements and criteria without resorting to jargon or ambiguous wording. Unclear, indirect language or vague terms can easily be misinterpreted by contractors, leading to alternate understandings of the design, which can result in costly change orders or misbidding. Direct, authoritative language is essential to prevent project miscommunication and ensure that all project stakeholders have a clear and consistent understanding of the project's requirements.

Another challenge engineers face is the reliance on outdated templates or the reuse of specifications from previous projects as a starting point. While tools like the CSI MasterSpec can be valuable, their effectiveness depends on regular updates to reflect technological advancements and current construction practices. Using old or adapted templates can introduce inaccuracies or outdated standards that may not align with the latest industry developments. Outdated templates may also contain obsolete clauses or assumptions that could result in inadequate system performance or non-compliance with current codes. Although it might seem more efficient to modify an existing template, starting from scratch when writing specifications often proves to be a more reliable approach. This method ensures that specifications are fully tailored to project needs, avoiding contradictory requirements, ultimately minimizing the risk of errors and improving the overall quality of the final specification documents.

In a competitive bidding environment, specifications using proprietary callouts, which describe a particular manufacturer's product, should be avoided. Inclusion of such language can undermine the competitive bidding process, limiting the pool of potential bidders and potentially inflating project costs. Examples of ways proprietary language would appear in specifications include:

1. calling out a specific controller model or enclosure type by branding,
2. referencing alternator or engine model numbers specific to one manufacturer or,
3. naming specific component manufacturers (e.g., "Breakers only by Eaton") to be used in the manufacturing assembly of the final product. Specification language focused on performance criteria, project design requirements and quality standards not only promote a fair bidding process but also encourages innovation and cost-effective solutions from a broader range of suppliers.

References:

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SUMMARY

Engineers use written specifications to communicate product performance and features needed to meet design intent and specific project application conditions. Specifications supplement construction drawings and provide valuable information to contractors and equipment suppliers. It is important that construction specifications use language that is clear and concise so that there are not misinterpretations which can create additional costs to a project.

It is good for engineers to understand the differences between each specification type: Prescriptive, Performance, and Proprietary specifications and know when it is appropriate to use one type or another. In the U.S., specifications follow guidelines set by the Construction Specifications Institute (CSI) and its MasterFormat system, which categorizes sections into a detailed numerical index. This format includes three main parts:

Part 1 provides General information, in addition to Division 1 requirements.

Part 2 focuses on Product specific requirements to meet project and application nuances.

Part 3 details the Execution of proper installation, startup/commissioning, and maintenance to ensure equipment longevity.

Specification language is highly influenced by codes and standards, such as NFPA 110 and 70, UL2200, and EPA regulations, which drive design requirements for emergency power systems. Engineers aware of how codes impact equipment design, safety, performance, and environmental considerations, can avoid costly change orders, ensuring compliance with design in intent and project requirements. Avoiding outdated templates and proprietary language fosters competitive bidding and innovation. Using clear, updated specifications tailored to the project's needs helps prevent misunderstandings and ensures high-quality outcomes.

If you have questions or would like design or specification assistance, reach out to a local Rehlko distributor for support.

REHLKO ADVANTAGE

Rehlko creates custom specifications for each generator and automatic transfer switch model and offers them for free in CSI Masterspec© format on each product web page. Reach out to your local Rehlko distributor to ask for assistance in creating a specification to meet your project needs.

ABOUT THE AUTHOR

Jennifer Nekuda, P.E. is a licensed electrical professional engineer with 12 years of experience in electrical building design and 12 years of experience in manufacturing as an applications engineering and sales manager. An Engineered Solutions Manager with Rehlko, Jennifer excels in delivering innovative generator and switchgear solutions, collaborating closely with specifiers, contractors, and clients, leveraging her expertise to provide strategic guidance and build lasting partnerships. She speaks regularly at engineering seminars and industry events on a wide range of topics. Her academic credentials include a Bachelor of Business Administration in Marketing from Wichita State University, a Bachelor of Science in Architectural Engineering and a Master of Engineering in Project Management from The University of Kansas.

Her extensive experience, combined with her ongoing commitment to professional development, underscores her drive to excellence and innovation in power systems engineering, making significant contributions to the industry and the success of her clients.

ABOUT POWER SYSTEMS

Power Systems, Rehlko's largest division, delivers worldwide energy solutions designed to ensure resilience for mission-critical applications of all sizes. Building on more than a century of expertise and dedication, the company offers complete power systems, including industrial backup generators (HVO, diesel, gaseous), enclosures, hydrogen fuel cells systems, automatic transfer switches, switchgear, monitoring controls, genuine parts and end-to-end services. As a global company with service partners in every country, Power Systems provides reliable, cutting-edge technology to keep industries and businesses running.
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ABOUT REHLKO

A global leader in energy resilience, Rehlko delivers innovative energy solutions critical to sustain and improve life across home energy, industrial energy systems, and powertrain technologies, by delivering control, resilience and innovation. Leveraging the strength of its portfolio of businesses – Power Systems, Home Energy, Uninterruptible Power, Clarke Energy, Heila Technologies, Curtis Instruments, and Engines, and more than a century of industry leadership, Rehlko builds resilience where and when the grid cannot, and goes beyond functional, individual recovery to create better lives and communities, and a more durable and reliable energy future.