



Specifications

February 2019

Continuing Education from the
American Society of Plumbing Engineers

ASPE.ORG/ReadLearnEarn

CEU 2600



Note: In determining your answers to the CE questions, use only the material presented in the corresponding continuing education article. Using information from other materials may result in a wrong answer.

Plumbing drawings, plumbing specifications, general conditions, special conditions, and the addenda comprise the documents that make up the contract between the owner and the contractor. None of these items can stand alone—the drawings cannot serve as a contract without the specifications and vice versa. The plumbing designer must, therefore, be familiar with specification writing. If others prepare the specifications, then the plumbing designer must coordinate the drawings with the project specifications.

When writing specifications, the language used must be clear, precise, and exact to convey the information required. The essence of a well-written specification includes clarity, brevity, accuracy, and completeness.

Specification writers should follow established, uniform practices that will ensure good communication between the designer and all other segments of the construction industry. The result will be a set of documents that will allow an engineer in one part of the country to converse with a supplier or contractor in another location, and the language in the specifications will be clear to all parties.

DEFINITION OF TERMS

It is necessary to understand the terms that are used in these documents so one term, and only that one term, is used for any one part of the documents.

Bid The price submitted to the owner by the contractor to perform the work per the contract documents.

Bidder The person or firm that has met the requirements set forth in the general conditions to submit a price in writing to the owner to do the work per the contract documents.

Bidding documents Construction documents issued to bidders before the owner/contractor agreement has been signed.

Bidding requirements The explanation of the procedures to follow when preparing and submitting a bid; also used to attract potential bidders.

Construction contract documents More often referred to as the contract documents, these describe the proposed construction, or the work that will result from construction. Many times these documents are erroneously referred to as the plans and specifications. It should be noted that many times these documents do not include plans or specifications. Instead of using the term *plans* when referring to the graphic documents, the term *drawings* should be used. Many times the term *specifications* is expanded to generally refer to all written documents. The correct term when describing all of the documents, with the exception of the drawings, is *project manual*.

Contract documents The legally enforceable requirements that become part of the contract when the agreement is signed.

Contractor The successful bidder after award of the contract.

Furnish To supply and deliver to a project site, ready for unloading, unpacking, assembly, installation, and similar operations.

Install To perform operations at a project site such as unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

May This term is used in specifications to indicate non-mandatory recommendations or permissions.

Provide To furnish and install, complete and ready for the intended use.

Shall This term is used in specifications to indicate a mandatory requirement that can be verified.

Should This term is used in specifications to indicate non-mandatory design criteria or preference.

Will This term is used in specifications to indicate a statement of fact.

Work Performing services, furnishing labor, and supplying and incorporating materials and equipment during construction.

The Contractor

The word *contractor* is often used in the contract documents incorrectly, so it is important to understand how the construction contract will be delivered. In many instances, the project will be delivered by a general contractor. In some states, the project will be delivered by multiple prime contractors, and in others projects are delivered by different types of prime contractors such as the general construction contractor, plumbing and fire protection contractor, mechanical contractor, and electrical contractor. Similarly, the owner may decide to have several prime contractors install different portions of the work on site. Indiscriminately using the term *plumbing contractor* when there is only supposed to be a general contractor may create an issue of somebody thinking that another contractor is supposed to deliver that work.

Words that would be better to use are *plumbing trade*, *fire protection trade*, *automatic control subcontractor*, *Division 22*, etc.

Theoretically, the point behind dividing the work among different divisions and sections of the contract with a single prime contractor is so all parties look in the same locations for different parts and pieces of the work. The purpose of dividing the work among different divisions and sections is not for the designer to determine how the work will be divided between subcontractors and suppliers.

If there are multiple prime contractors, then it is important for the work to be divided between the various contractors. For instance, who will furnish the starters and VFDs? The bidding contractors need to know if these devices will be furnished by the electrical contractor or the plumbing contractor. What about access panels in hard ceilings? What happens in a renovation project when the work will primarily happen

in one area, but the plumbing contractor needs to run a new water line for 300 feet through an existing facility? Who is going to pay to have the walls repaired and painted? These are questions that need to be answered, and division of the work between the contractors is important.

One final thought has to do with when the client wants to pre-purchase equipment to expedite the work or potentially have greater control over what equipment is used on the project. Say the plumbing engineer is working on a large compressed air plant. The pre-purchase specification not only should cover the normal three-part aspect of furnishing the equipment, but also should include specifications about what the contractor is supposed to do to install the equipment and how much assistance the vendor is to provide during delivery and startup. What startup reports must be included? How many hours of instruction are necessary?

Approved Equal

The standardized specifications from the major specification suppliers do not include definitions of the words *approved equal*. Later in this chapter is a discussion of open and closed specifications. Clients often require designers or engineers to include more than one supplier that can provide each type of product used on the project. Most products are competitive among suppliers but are not identical. For instance, flushometers are not identical between manufacturers, but the engineer might wish to include three brand-name manufacturers for the products.

Following is an example of how to establish products that the contractor can purchase for the project. It would be defined in the Common Work Results for Plumbing section of the specifications. These definitions could also be included in Section 016000—Product Requirements.

“Materials and equipment are specified to provide a level of quality and performance as a part of these Specifications.

“Where the Specification requires the installation of a product by a reference standard (for example, ASTM B88 Type L pipe), the contractor may install any product meeting the reference standard’s requirements and which is produced by any domestic manufacturer.

“Where the Specification requires the installation of a particular manufacturer’s model or an approved equal by several other listed manufacturers, the contractor shall provide the particular product specified or a comparable item with all the specified characteristics and accessories that is manufactured by one of the other listed manufacturers.

“Bidders wishing to obtain approval on manufacturers other than those specified by name must submit their request to the Architect not less than ten (10) days before the bid opening. Approval by the Architect will be in the form of an Addendum to the Specification; the Addendum will indicate that the additional manufacturer or manufacturers are approved as equal to those specified so far as the requirements of the project are concerned.

“Where the Specification requires the installation of a particular manufacturer’s model or an approved equal with no other manufacturers listed, the contractor shall provide the particular product specified or a comparable item with all the specified characteristics and accessories that is manufactured by a reputable manufacturer and meets the approval of the Architect and the Owner and Engineer. These items are often generic in nature.

“Where the Specification requires the installation of a particular manufacturer’s model without an approved equal, the contractor shall provide the product specified. There is no option, and no substitutions will be permitted.”

PROJECT MANUAL

The project manual consists of the following documents, but not the drawings.

- Pre-bid information advises prospective bidders about the proposed project. The pre-bid information for private work can be sent directly to certain bidders by the architect, engineer, or owner, and the bid is restricted to those bidders. This method is usually referred to as bid by invitation. Pre-bid information for public work is required by law to be advertised for a predetermined period in the immediate area where the work will be done. The exact length of time is set forth by local ordinances governing public notices.
- Instructions to bidders are written to inform prospective bidders how to prepare their bid so all bids are in the same format and can be easily and fairly compared.
- Bid forms are prepared by the architect or engineer to provide uniform bid submittals by the bidders and to facilitate the comparison and evaluation of the bids received.
- Bonds and certificates are the legal documents that bind a third party into the contract as a surety that the bidder and the owner will perform as agreed or that the contractor and subcontractors will perform as agreed. The types of bonds and certificates commonly used are:
 - Bid bond: Ensures that the bidder will enter into a contract with the owner or the contractor if the bidder is selected during the bidding phase.
 - Performance bond: Ensures that, once a contract has been signed, the work will be completed in compliance with the contract documents.
 - Labor and materials payment bond: Ensures that workers on the project will be paid in full and that all suppliers that have provided materials for the project will be paid in full prior to the project closeout.
 - Guaranty bond: Guarantees that the contractor will be paid in full for all work performed to construct the project.
 - Certificates: Certificates of insurance, or proof of insurance from the contractors and/or subcontractors, as well as certificates of compliance with applicable codes, laws, and regulations.
- The agreement is the written document signed by the owner and the contractor, or by the contractor and a subcontractor or a material supplier, that is the legal instrument binding these parties to the contract. The agreement defines the relationships as well as the obligations between the signing parties.
- General conditions are the general clauses that establish how the project is to be administered. These clauses contain provisions that are common practice in the United States. The American Institute of Architects (AIA) has developed Document A201: *General Conditions of the Contract for Construction*. A printed copy of this document is usually included in the project manual and referenced by the other documents that are included in the manual. Other general conditions documents are available from organizations such as the National

Society of Professional Engineers (NSPE), American Council of Engineering Companies (ACEC), American Society of Civil Engineers (ASCE), and Construction Specifications Institute (CSI).

- Supplementary conditions are the clauses that modify or supplement the general conditions as needed to provide for requirements that are specific to the project. They consist of modifications and/or substitutions such as insurance requirements and prevailing wage rates. It is important to remember that these are not standardized documents and must be prepared based on the requirements of the specific project.
- Specifications describe the required materials and equipment, the level of quality required for installation and equipment, and the methods by which the materials and equipment are assembled, installed, and interface within the project as a whole. The specifications also set the administrative requirements for the contract. All items pertaining to the work under the contract should be included in the specifications.
- Addenda are the written or graphic documents that are issued prior to the bid to clarify, revise, add to, or delete information in the original bid documents or in previous addenda. It should be noted that while an addendum is typically issued prior to the bid opening, AIA A201 permits the issuance of an addendum any time up to the execution of the contract, which allows for the negotiated adjustment of a selected bid after the bid opening. In contrast, a similar document by the Engineers Joint Contract Documents Committee (EJCDC) restricts the issuance of addenda to before the bid opening.
- Modifications are the written or graphic documents that are issued after the construction agreement has been signed to allow for additions to, deletions from, or modifications of the work that is to be performed. These changes are accomplished by the use of change orders, construction change directives, work change directives, field orders, architect's supplemental instructions (ASI), and written amendments to the construction agreement. These changes or modifications can be issued any time during the contract period.

Each of the documents listed above is a separate piece, but when grouped together, they are collectively referred to as the front-end documents. Although the specifications document usually comprises the bulk of the project manual, it is only one of the required documents. If the project is primarily plumbing, then the plumbing engineer/designer may be responsible for preparing the entire project manual.

SPECIFICATIONS

Originally all documentation for a given project was placed in the drawings, but as the amount of information increased to where it would not fit on the drawings, another way was needed to present this information. Thus, designers started compiling all of the notes that would not fit on the drawings and over time added more information, product requirements, contractual provisions, and construction methods and systems. Known as the project specifications, this information is used to define the qualitative requirements for the products, materials, and workmanship that will be used to construct a given project.

As the popularity of the specification grew among design professionals, so did the problems this new idea created—especially the lack of universal guidelines to ensure uniform documents. Designers wrote specifications using their own style according to what they thought was important. Even the specifications that came from large firms lacked consistency between documents. Materials, methods, or items that were related were not grouped together in a logical manner but were scattered throughout the document. This practice made it very easy to overlook important and costly items when the contractor tried to prepare a specific bid. Also, coordination among the various trades and the contractor was difficult at best.

Specifications can be generated in many ways. They can be produced by the designer as part of the design process or by a specific individual within the firm who is employed full time for writing project specifications. Large firms may even have a full-time specifications department.

To develop a specification, the designer must have as much information as possible that pertains to the section that is to be written. This includes any reference materials that describe products and methods of construction to be included within the specification section. The project information would include the drawings prepared by the designer, the project's scope of work, and any applicable laws and/or building codes. Information for the products can be obtained from a variety of sources, including previous project specifications, owner requirements, manufacturer's literature, handbooks, reference standards, governmental agencies, trade associations, technical and professional societies, commercially prepared guide specifications, and personal experience.

It is a bad idea to edit previous specifications to use for a new project, as they may or may not contain the required language, the standards cited may have changed, the products specified may not be available, or the codes and/or laws may have changed since those specifications were written.

Once the needed information has been gathered, the designer must decide what type of format will be used as the basis of the specifications to be written. Depending on the size of the project or the project phase, the designer may choose a short, abbreviated format such as CSI's UniFormat. For larger, more complex projects, the designer may choose the full format as found in CSI's MasterFormat. Specification formats are also developed by EJCDC, AIA, and NSPE, as well as various governmental agencies such as the U.S. Army Corps of Engineers and NASA. The designer needs to become knowledgeable of the different specifications that are available to decide which format is best suited for the phase of the project being designed. The architect may be responsible for choosing the specification format, so determine this before proceeding.

UniFormat

UniFormat is a specification system that was developed during the early 1970s, and its format is systems based. This format is used mostly during the schematic phase as well as for preliminary or budgetary cost estimates. CSI and Construction Specifications Canada (CSC) recommend the use of UniFormat to organize project data during the preliminary project phases.

UniFormat is divided into eight broad sections:

1. Substructure
2. Shell
3. Interiors

4. Services
5. Equipment and Furnishings
6. Other Building Construction
7. Sitework
8. General

For more information and the subcategories that are found within each of the eight categories of this format, refer to Appendix 3-A.

One of the best features of UniFormat is that each category or subcategory can be easily expanded as more information is accumulated during the design process. As more information is added, the specification will provide the estimator with valuable information to prepare an informed preliminary cost estimate.

Once the project progresses from the preliminary or schematic phase to the design development, or DD, phase, more detailed information is required that UniFormat is not designed to handle. At this stage of the project, outline specifications are usually introduced to organize the required information. In some projects, use of the outline specification may be required as part of the agreement between the owner and the architect/engineer (A/E). Refer to AIA Document B101: *Standard Form of Agreement Between Owner and Architect* for additional information.

Drawings that are prepared during the design development phase contain more detail, both general and specific, than the schematic phase drawings.

MasterFormat

At this point, some designers organize their outline specifications using CSI's MasterFormat because this format can be used from the design development phase to the construction documents (CD) phase.

MasterFormat was created in the 1960s and later became the industry standard in both the United States and Canada. At the core of the system were five-digit numbers with titles that organized construction and/or project data into an easily understood sequence.

The numbers and titles were organized into six groups: Introductory Information, Bidding Requirements, Contracting Requirements, Facilities and Spaces, Systems and Assemblies, and Construction Products and Activities. While they were not specifications, the first five groups were usually included in the project manual as Division 0. The last group—Construction Products and Activities—contained 16 divisions comprising the construction specifications.

On December 31, 2009, CSI officially ended its support of the 16-division format, also known as MasterFormat 95, though some in the construction industry continue to use it. For a more detailed listing of the discontinued format beyond what is shown in Appendix 3-B, refer to CSI's website (csiresources.org) or contact the CSI chapter in your area.

Significant changes were made to MasterFormat when it was transformed from 16 divisions to 49 divisions. The original six groups were condensed into two groups: the Procurement and Contracting Requirements Group and the Specifications Group. The Procurement and Contracting Requirements Group contains the first five groups of MasterFormat 95 and is still known as the front-end documents. The Specifications Group is divided into five subgroups that are further divided into 49 divisions. The subgroups and the divisions contained within each are as follows:

- General Requirements, Division 01
- Facility Construction, Divisions 02–19
- Facility Services, Divisions 20–29
- Site and Infrastructure, Divisions 30–39
- Process Equipment, Divisions 40–49

Refer to Appendix 3-C for a complete list of the divisions that are contained within each subgroup along with a short description of the changes.

In addition to increasing the number of divisions from 16 to 49, the original five-digit numbering system was increased to a six-digit numbering system. For example, Concrete Reinforcement, which was 03200 in the old system, became 03 20 00. The addition of the extra digit increased the number of possible subjects tenfold.

Another change was the relocation of items from one division to another. For example, Plumbing was moved from Division 15 to Division 22, while HVAC was moved from Division 15 to Division 23. Division 15 is now reserved for future expansion. Fire Suppression, previously located in Division 13, was relocated to Division 21. See Appendix 3-D for a complete listing of the numbers and titles for Division 21–Fire Suppression and Appendix 3-E for a complete listing of the numbers and titles for Division 22–Plumbing.

Also included in the new document are sections for facility operations and maintenance, repairs, and commissioning. These sections are located within each division instead of being located in a separate division. These changes can be seen in Appendix 3-E as Section 22 01 00–Operation and Maintenance of Plumbing and Section 22 08 00–Commissioning of Plumbing.

MasterFormat provides a standardized numbering system and the section titles to be used in the project manual, but it does not address how information should be organized. CSI and CSC publish another format—SectionFormat/PageFormat—that provides a uniform standard for arranging specification text using a three-part format as well as a framework for formatting and designating sections. The three parts are Part I–General, Part II–Products, and Part III–Execution, and this organization system helps develop specification sections that provide answers to the following questions:

- How does the work that is defined in the section relate to the work that is defined for the rest of the project?
- What materials and/or products are to be used to complete the work under this section?
- How are these materials and/or products to be incorporated into the work under this section and the project as a whole?

Appendix 3-F contains the shell outline developed by AIA that conforms to this system. The order in which the parts are used within each section is fixed, providing a consistent format throughout all sections and thereby simplifying the designer's job by making it easier to locate information.

MasterFormat and SectionFormat/PageFormat, when used together, will help produce specifications that are clear, complete, accurate, and coordinated, allowing the information to flow from the divisions to the sections to the parts and vice versa.

SPECIFICATION METHODS

Specifications are written using one of the following methods of specifying products, materials, or workmanship:

- Descriptive specification
- Performance specification
- Reference standard specification
- Proprietary specification

Descriptive Specifications

A descriptive specification consists of a detailed written description of the required properties of a product, material, or piece of equipment and the workmanship required for its proper installation. It is important to remember that proprietary or brand names of manufactured products shall not be used in descriptive specifications and that the burden of performance is assumed by the specifier. This method of specifying, while once widely used, has declined in popularity because writing a descriptive specification is very tedious and time-consuming. Descriptive specifications are used when the use of proprietary names is prohibited by law (such as with federally funded projects) or it is not possible to write a reference standard specification due to a lack of reference standards.

To write a descriptive specification, the specifier needs to adhere to certain basic steps:

- Research available products that will be included in the section.
- Research the critical features that will be required in the section, and analyze and compare these requirements with the products that are available.
- Review the features that are required and determine those features that are best described by the specification and those features that would be best shown on the drawings.
- Describe those features that are considered to be critical and the minimum acceptable requirements that must be met by the products to be supplied.

The designer should take care not to select and specify unique features from different products and manufacturers (i.e., pick features from one product and combine them with features from other products). This could create a descriptive specification of a particular product that does not exist. Unnecessary features and minutely detailed requirements should also be avoided.

Performance Specifications

A performance specification includes a statement of the required results with the criteria that the specifier is requiring to verify compliance. Criteria for verifying compliance include measurement, test evaluation, or other means as required by the designer to ensure that the standards of performance have been met. All desired end results the specifier wants must be spelled out completely, but the performance specification should not contain unnecessary limitations on the methods for achieving the required results. An incomplete performance specification will result in the designer losing control over the quality of materials, equipment, and workmanship that will go into the project.

When the performance specification is the primary method of design and contracting, specialized contract documents will be required that are far more complex and often will involve a variety of participants in the contract proceedings.

Reference Standard Specifications

A reference standard specification involves the use of a nationally or internationally recognized standard to specify a product, materials, or workmanship instead of writing a detailed description. A standard is a set of requirements developed by a recognized authority, such as a trade association, professional society, or governmental organization, using a consensus process. Standards usually are authored by a committee that includes architects, engineers, scientists, technicians, manufacturers, and product users who are very knowledgeable about a particular subject area.

The reference-based standards commonly used when writing a specification are:

- Basic material standards
- Product standards
- Design standards
- Workmanship standards
- Test method standards

An example of a basic material standard is ASTM B88: *Standard Specification for Seamless Copper Water Tube*, of a product standard is ASME B16.22: *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*, of a design standard is ASPE 45: *Siphonic Roof Drainage*, of a workmanship standard is ASTM B828: *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings*, and of a test standard is ASTM E53: *Standard Test Method for Determination of Copper in Unalloyed Copper by Gravimetry*.

When referring to a standard in a specification, it is not necessary to include the entire text of the standard. The specifier can simply use the standard's number and/or title. The most common form is to cite the standard's sponsoring organization and the number, such as ASTM B88-02. The last two digits are the date the standard was written or last revised. A lowercase "a" after the date indicates an amendment to the standard. These cited standards become part of the specification just as if the standard's entire text were included.

When using a reference standard specification, the designer should thoroughly familiarize himself with the standards he plans to use and how to incorporate these standards into the document correctly, as well as how to enforce the requirements of the standard once it has been

included. Some standards may contain requirements of which the designer is unaware, and many standards meet only the minimum requirements; thus, their inclusion in the specification may cause myriad problems during enforcement of the contract conditions. Also, indiscriminate use of standards within the specification can result in duplication, contradiction, and general chaos for the designer, contractor, and owner.

Due to the possible conflicts between the language of the written standard and the general conditions of the contract, the designer should include a clause in the supplementary conditions stating that the contract conditions shall govern over the requirements of the cited reference standards. Another clause should be included stating that the more stringent requirement shall apply should a conflict or discrepancy arise between a reference standard and another cited reference and the specifications. Once the standard has been specified, it becomes necessary for the designer to be able to enforce its requirements once the project begins. The most common means to ensure compliance with a material, product, design, or testing standard is to check the shop drawings and other submittals, including manufacturer literature, samples, and test reports. Making regular site visits can help ensure compliance with workmanship standards.

Proprietary Specifications

The last method of specifying is the proprietary specification, which identifies each product to be used by the manufacturer's name, brand name of the product, model number, type designation, and/or unique characteristics. A specification is considered proprietary if the product to be specified is available from a single source.

The proprietary specification has advantages and disadvantages. Advantages include closer control in the selection of products, more detailed and complete drawings due to the more precise information from the product suppliers, shorter specifications that result in less production time, the removal of product pricing as a major variable, and a simplified bidding process. Disadvantages to the use of this method include the elimination or narrowing of the competition. Also, the contractor might be forced to work with a product with which they have little or no prior experience, which could result in poor performance by the contractor. A last disadvantage is the potential to specify a product that is no longer available.

The two types of proprietary specifications are open and closed. The difference between them is how substitutions of the specified products are addressed. An open specification typically allows substitution with products that can be shown to be equal to the specified item, while the closed specification does not allow any substitutions.

The closed proprietary specification allows the design to be completed with a higher level of detail while reducing the variables, thus promoting more accurate bids. It will not protect against a supplier of a specified product taking an unfair advantage of their proprietary position and increasing the price. In many cases where only one manufacturer is acceptable, the client will require a single source bid request to be submitted by the architect or engineer during design. These requests typically must be accompanied by a business case justification.

The closed proprietary specification can list one product or multiple products as the designer sees fit without allowing substitutions, and the designer can control product selection using the instructions found in Section 012500—Substitution Procedures and Section 016000—Product Requirements (or Section 01630 under the old 16-division format) if Division 01 is included in the front-end documents.

Under a closed proprietary specification, when only a single product is specified, the substitution of another product is not allowed, and the bids submitted must be based on the specified product only. When products by several different manufacturers are specified, the substitution of other products by unlisted manufacturers will not be permitted; the bids submitted should be based only on the products specified. The successful bidder is usually required to submit a list of the product or products that they intend to use within a specified time following the bid for approval prior to purchase and installation.

In many cases, the client will allow closed proprietary specifications if three or more acceptable manufacturers are named. If three products are named and competition is achieved in the bid process, the designer must make sure the products specified are equal and acceptable for the purpose for which they are being specified.

The open proprietary specification specifies or names products or materials in the same manner as the closed specification. The difference is that alternatives for the specified products or materials also are listed. The bidder must bid on the specified items and may also provide prices for the alternative items specified. These prices are usually included on the bid form in the spaces provided. To clarify the bidding process, the designer could include instructions to the bidder such as the following: "When the product is specified to only one manufacturer, substitution of products will not be permitted. If alternates to the base bid are requested, then the bidder may submit bids for the alternative items. These bid prices shall include the amount required to incorporate the alternate products into the project. Requests for additional monies for alternate products or materials shall not be considered after the agreement has been executed." Open proprietary specifications remove the problem of overpricing, which is common in sole-source product or material bids, by allowing for the selection of alternate items and price quotations for those items.

The major problem with the use of proprietary specifications is the attempts made by some bidders to introduce products or materials that are of inferior quality to those originally specified. This problem is the greatest when the bidder is allowed to specify substitutions after the award of the contract, which leads to the practice known as bid shopping. This practice is unfair to those who submitted bids originally, and pressure can be put on the designer to accept these substitutions of inferior products. The designer must maintain control over the bidding process by including requirements similar to the following into the specifications:

- All substitution requests are to be in writing from the bidders only, and any requests from manufacturers and suppliers will not be considered.
- The submission of substitution requests by the bidder shall be made at a minimum of 10 days prior to the bid opening.
- All requests for substitutions shall be submitted with the request for approval.
- Submissions without supporting documentation shall not be considered.

The designer shall review all submissions and issue notification of any accepted substitutions to all bidders by addendum. The period between the deadline for requests and the addendum is at the discretion of the designer, but should not be less than three days to allow proper examination of the submitted materials.

The federal government and other public authorities forbid the use of the proprietary or other exclusionary specifications except under special conditions.

CREATING THE SPECIFICATION SECTION

Under Section Format, a specification section is divided into three parts: Part 1—General, Part 2—Products, and Part 3—Execution.

Part 1—General includes the scope, necessary references to the related work, codes and standards that will be in force during the project, performance requirements, qualifications for both manufacturers and workmanship, required submittals (including the format required for submission), any samples required for examination by the designer, required information on product manufacturing and shipping schedules, receiving and storage requirements, special warranties, spare parts to be included with the package, and any other information considered to be necessary.

Part 2—Products includes those products that are to be used on the project that are part of the work described by this specification section. These products should be described as accurately, completely, and briefly as possible to give the user the facts needed in least amount of text. Any descriptions of these products should be to describe the product that is to be used and to present any pertinent data that is required for the use of that product.

Part 3—Execution contains the detailed instructions of how the products listed in Part 2 are to be used or installed into the work being performed. Information on any testing that is to be performed must include instructions on who pays for the testing as well as what tests and how many are required. Instructions for coordination among the various trades, the acceptance of the substrate, and any required tolerances for installations shall also be included in this section. Contractor or supplier operation and maintenance training instructions are also included.

Refer to Appendix 3-F, Section Shell Outline, for additional information.

Beginning at the top, the first item to be completed is the section number. The section number is a six-digit number corresponding to the MasterFormat system. Following the section number is the section title. The designer should keep this to a maximum of one line, approximately six to eight words. Then comes Part 1—General, Part 2—Products, and Part 3—Execution. The section number is usually either level two or level three. Level four section numbers are becoming more common, while level one section numbers are being phased out.

Part 1—General

Section 1.1 Summary

This section includes the description of the work that is to be performed, a list of any products that are to be furnished but not installed, and products that are not furnished but are to be installed under this section, sometimes referred to as owner furnished, contractor installed (OFCI). The next item found in Part 1 is the list of related sections, where other sections in the specifications containing requirements that relate to this particular section are listed. Some designers choose to omit this part because during last-minute changes, it often is not updated, resulting in a confusing, flawed document.

Also found in the summary are allowances, unit prices, and alternates. An allowance is a predetermined monetary amount agreed to by both the designer and the owner to be inserted into the bid for certain items such as artwork, furniture, or even plumbing fixtures. A unit price is a fixed bid price amount for an item such as a water closet, lavatory, or 4-inch cast iron pipe. An alternate is a defined portion of the work that is priced separately and provides an option for the owner to select the final scope of work. Alternates usually allow choices among the products to be used or for portions of the work to be added or deleted from the project.

It may be useful to outline all of the systems incorporated in this subsection of the specification. For instance, in Section 221116—Domestic Water Piping, the designer may have several piping systems that might use the piping systems described in this section, including nonpotable water, rainwater collection, etc.

Section 1.2 References

Here, the reference standards that have been cited in this section are listed alphabetically. Standards are usually written in the following manner: standard number, standard title, standard society or agency, and date of the last revision—for example, ASME B16.22: *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*, American Society of Mechanical Engineers (ASME), 2013. When multiple references by the same organization are listed, those references are arranged in ascending numerical order.

Section 1.3 Definition

Any special definitions required to explain the work or products used are listed alphabetically.

Section 1.4 System Description

The system description is used by some designers and omitted by others. This is usually a brief but accurate description of how this specification section fits into the work.

Section 1.5 System Performance Criteria

This subsection should include the standardized pressures and temperatures the designer expects the systems described to experience. It forces him to think about the products he is specifying. For example, what is the gas pressure? What if the street water pressure is 130 pounds per square inch gauge (psig)? What if the domestic hot water design temperature is 160°F? What are the seismic bracing requirements?

Section 1.6 Submittals

This portion of Part 1 is probably one of the most important because it governs the submittals. It tells what is required for all products that will be used in the project. The designer must decide what information will be submitted for review and approval. On some government projects, the submittal process will be under governmental control, not the designer’s control. MasterSpec now includes three categories of submittals: action submittals, informational submittals, and closeout submittals.

The information required for the submittal can include the following:

Action Submittals

- Product data as prepared by the manufacturer or third-party organization
- Shop drawings from either the manufacturer or the contractor
- Coordination drawings
- Piping connection diagrams from the manufacturer or the contractor
- Power and control wiring diagrams from the manufacturer or the contractor
- Product certifications from manufacturers that these products have been tested and comply with the appropriate standards

Informational Submittals

- Test reports from an independent (or third-party) test laboratory certifying those products
- Qualification data for manufacturers, firms, or individuals as requested
- Qualification data for persons or firms responsible for delegated design

Closeout Submittals

- Maintenance data for the materials and products used for inclusion in the operation and maintenance (O&M) manuals for the owner (if required)

What is the difference between action submittals, informational submittals, and closeout submittals?

- Action submittals require an architect’s action, including returning the reviewed submittal to the contractor. Ultimately the submittal must be approved for the contractor to rely on it to build the project. This approval puts the construction players on notice that the architect has reviewed the document and found that it complies with the design intent.
- Informational submittals, however, imply inaction by architects. The submittal is often simply a file of information for record. Some observers believe that the architect still has a responsibility to review informational submittals to ensure that the submittal actually reflects what is required for the project. Simply filing an erroneous or incorrect submittal without any review could subject the architect to unexpected liability if something goes wrong. For example, consider explaining to a jury that you never looked at the design calculations to confirm that the correct design loads were used for the structural computations because it was just an informational submittal.
- Closeout submittals are submittals that must be provided to the owner before final payment is made to the contractor.

Section 1.7 Quality Assurance

This is the quality control for the project. In this section the designer can include what he or she feels is needed to ensure that the project is correctly completed. Included in this section are manufacturer and installer qualifications, typically a set number of years of experience. The typical experience for manufacturers is five years minimum, and for installers it is three years minimum. Also, requirements for supervision and licensure can be included—for example, “All work required by this specification section shall be performed by licensed, experienced tradesmen working under the direct supervision of a licensed, experienced supervisor with a minimum of 10 years of experience. No unsupervised work by unlicensed workers shall be permitted.” Requirements for testing laboratories, welding and welder certifications, compliance with UL standards, compliance with NFPA 70 (National Electrical Code), ASME compliance, and others are also included within this section.

Section 1.8 Delivery, Storage, and Handling

This section deals with the delivery, storage, and handling of materials and equipment until installation, including instructions on the shipping and handling of materials and equipment from the manufacturer to the jobsite as well as lifting and rigging instructions, storage requirements, and coordination between shipping schedules, delivery dates, and installation dates.

Section 1.9 Project Conditions

Site condition disclaimers and disclaimers for field measurements direct the contractor to verify all measurements prior to starting work. This section is optional at the discretion of the designer. Provide information here if there are special instructions concerning utility system shut-downs and what approvals are necessary.

Section 1.10 Sequence and Scheduling

This section is used to coordinate the various portions of the project and can cross trades. Since it is the responsibility of the general contractor, not the plumbing designer, to schedule and coordinate work that is under contract, this section is usually omitted.

Section 1.11 Warranty

The designer lists any special warranties required or any warranty conditions that are different from the contractor’s standard warranty. If the products specified normally include standard warranties extending beyond the first year, this is where this information would be included.

Section 1.12 Maintenance

This section contains any special maintenance requirements for the equipment installed.

Section 1.13 Extra Materials

This section lists any necessary extra materials such as valve repair kits, faucet repair parts, extra belts, handles, lubricants, or seals. Items and quantities required to be supplied to the owner by the contractor are also listed.

Part 2—Products

This section deals with the products, materials, equipment, and manufacturers that will be included in the work.

Section 2.1 Manufacturers (Refer to Appendix 3-F Paragraph 2.1 for “Paragraphs A, B, C, and D”)

Under paragraph A, the contractor may supply products by any manufacturer that he feels are compliant with the specification section covering that portion of the work. Most of the time the products to be supplied comply with the specifications, but sometimes they do not.

Paragraph B states that the designer decides which manufacturers of a particular product to be used will be permitted and which will not. Under this paragraph, the contractor is given a list of approved manufacturers from which to choose. The designer must research both the products and manufacturers to make sure the products meet or exceed the standards set forth by that section of the specification. For example, a listing for a water closet would be:

- Water closet, floor outlet, flushometer
 - Manufacturer A
 - Manufacturer B
 - Manufacturer C
 - Manufacturer D
 - Substitutions

Under this arrangement, the contractor must supply a water closet made by one of the four manufacturers listed. With the use of a substitution option, the designer may elect to allow the substitution of a water closet by a non-listed manufacturer as long as it is proven to be equal to the others. Many designers feel that allowing no substitutions levels the bidding field and takes away the problems of a bidder getting a lower bid by using a substandard product. Under this method, the decision can be made about the product as well as the manufacturer. Only one of these methods should be used—either an open specification in paragraph A or a closed specification in paragraph B. The same is true for paragraphs C and D. As stated earlier, the closed method gives the designer more control over the quality of the products being included in the project.

Sections 2.2, 2.3, and 2.4

These are similar to Section 2.1. In Section 2.3 the materials that will be used are specified using either a descriptive specification or a performance specification.

Sections 2.5, 2.6, 2.7, 2.8, and 2.9

These are not usually included in plumbing specifications. However, that does not mean they cannot be used if the designer feels they are needed.

Part 3—Execution

Section 3.1 Examination

This section is concerned with the installation of the products and materials for the project. The first part involves the instructions to the contractor to examine the sites, plans, existing or constructed walls, and floors and ceilings that must be installed. The contractor should also be instructed in this section to not proceed with the work until all unsatisfactory items have been corrected.

Sections 3.2 through 3.5

These sections deal with the general and specific installation requirements of the products and/or materials being used. Often included, but not mandatory by CSI standards, is a section on connections (shown as Section 3.5). In this section, connection requirements for OFCI (or GFCI on government projects) are found. A good example of this is a commercial kitchen where the kitchen equipment supplier sets the equipment, but the plumber connects it to the utilities.

Also, if a piece of equipment that is assembled on site appears to be complicated, this is where the designer could include a requirement to provide the services of a factory-authorized service technician to supervise the assembly.

Section 3.6 Field Quality Control

In this section, the designer deals with system flushing and pressure and leak testing, as well as what standard(s) must be met. Also included is what remedy must be made if the tests prove that the products and/or materials are not compliant with the standards set forth in the specification section.

Section 3.7 Adjusting and Cleaning

A section that covers the adjustment, cleaning, and calibration of the products included in the project is well advised. One of the most common requirements is the cleaning and disinfection of the potable water system. Another is balancing the water flow through the hot water recirculation loops, adjusting the sensitivity of sensor faucets and flushometers, and adjusting thermostatic mixing valves.

Section 3.8 Commissioning

Commissioning, or placing the building into service for the owner to use, should address items such as:

- Equipment startup by factory-authorized service technicians
- Testing and adjusting of controls and safeties with the replacement of all malfunctioning parts
- Providing adequate training to the owner's maintenance staff with regard to the startup and shutdown of the equipment, troubleshooting, servicing, and maintenance
- Reviewing the data in the O&M manuals with the maintenance staff

USING MASTER SPECIFICATIONS

Very few plumbing specifications today are written as an original document, or from scratch. In most cases, project specifications are created using an office-prepared master specification or commercially prepared specifications that have been published by various industry organizations, such as AIA's MasterSpec or the Construction Sciences Research Foundation's SpecText. The use of a master specification to prepare a project specification is certainly more cost-efficient than starting from scratch with each new project.

One of the best features of the master specification programs is the periodic updates, with new sections being added and obsolete sections being deleted. Also in these updates, the reference standards that are included in each section are updated to the latest version. For any specifier who has spent several hours researching these standards, this feature is worth the price of the program.

These programs have evolved into interactive systems that contain checklists or interactive input dialogue for the specifier to utilize. Also, many programs interface with BIM and CAD systems to extract the data to produce the specifications, estimates, and life-cycle analysis reports.

CONCLUSION

Writing effective specifications requires broad experience as a plumbing designer. In most engineering offices, specifications are prepared by the project engineer or team leader or under their supervision. The designer must remember that the essence of plumbing specifications is communication among the people involved with both the design and the construction of the project. Plumbing specifiers must develop skills to communicate the project requirements in a clear, concise, and easy-to-understand manner.

The one thing that has not changed in specification writing and never will is the amount of time that is allotted by project managers to complete the specifications. The amount of time given is never enough.

Like most plumbing engineering, specification writing is learned on the job. This is because university-level courses in specification writing are rare. Classes may be available as continuing education programs offered by CSI at both the national and local level. Interested parties should contact their local CSI chapter for more information about what is available.

Plumbing designers who have at least five years of specification writing experience can demonstrate their proficiency and understanding by taking the Certified Construction Specifier (CCS) examination that is given by CSI.

In this world of continually changing workplaces and corporate restructuring, the plumbing designer who demonstrates the ability to produce a clear, concise set of specification documents is a valuable asset to project design teams.

APPENDIX 3-A: CSI UNIFORMAT UNIFORM CLASSIFICATIONS

A. Substructure

- A10 Foundations
- A20 Basement Construction

B. Shell

- B10 Superstructure
- B20 Exterior Closure
- B30 Roofing

C. Interiors

- C10 Interior Construction
- C20 Stairways
- C30 Interior Finishes

D. Services

- D10 Conveying Systems
- D20 Plumbing Systems
- D30 Heating, Ventilation, and Air-Conditioning (HVAC) Systems

- D40 Fire Protection Systems
- D50 Electrical Systems

E. Equipment and Furnishings

- E10 Equipment
- E20 Furnishings

F. Other Building Construction

- F10 Special Construction
- F20 Selective Demolition

G. Building Sitework

- G10 Site Preparation
- G20 Site Improvements
- G30 Site Mechanical Utilities
- G40 Site Electrical Utilities
- G50 Other Site Construction

Z. General

- Z10 General Requirements
- Z20 Bidding Requirements, Contract Forms, and Conditions
- Z90 Project Cost Estimate

APPENDIX 3-B: CSI MASTERFORMAT LEVEL TWO SECTION TITLES

(Note: This Appendix is retained for those designers who still use this format. The 16-division format is no longer supported by CSI.)

Division 1 General Requirements

- 01100 Summary of Work
- 01200 Price and Payment Procedures
- 01300 Administrative Requirements
- 01400 Quality Procedures
- 01500 Temporary Facilities and Controls
- 01600 Product Requirements
- 01700 Execution Requirements
- 01800 Facility Operation
- 01900 Facility Decommissioning

Division 2 Site Construction

- 02050 Basic Site Materials and Methods
- 02100 Site Remediation
- 02200 Site Preparation
- 02300 Earthwork
- 02400 Tunneling, Boring, and Jacking
- 02450 Foundation and Load Bearing Elements
- 02500 Utility Services
- 02600 Drainage and Containment
- 02700 Bases, Ballasts, Pavements, and Appurtenances
- 02800 Site Improvements and Amenities
- 02900 Planting
- 02950 Site Restoration and Rehabilitation

Division 3 Concrete

- 03050 Basic Concrete Materials and Methods
- 03100 Concrete Forms and Accessories
- 03200 Concrete Reinforcement
- 03300 Cast-in-Place Concrete
- 03400 Precast Concrete
- 03500 Cementitious Decks and Underlayment
- 03600 Grouts
- 03700 Mass Concrete

03900 Concrete Restoration and Cleaning

Division 4 Masonry

04050 Basic Masonry Materials and Methods
 04200 Masonry Units
 04400 Stone
 04500 Refractories
 04600 Corrosion-Resistant Masonry
 04700 Simulated Masonry
 04800 Masonry Assemblies
 04900 Masonry Restoration and Cleaning

Division 5 Metals

05050 Basic Metal Materials and Methods
 05100 Structural Metal Framing
 05200 Metal Joists
 05300 Metal Deck
 05400 Cold-Formed Metal Framing
 05500 Metal Fabrications
 05600 Hydraulic Fabrications
 05650 Railroad Track and Accessories
 05700 Ornamental Metal
 05800 Expansion Control
 05900 Metal Restoration and Cleaning

Division 6 Wood and Plastics

06050 Basic Wood and Plastic Materials and Methods
 06100 Rough Carpentry
 06200 Finish Carpentry
 06400 Architectural Woodwork
 06500 Structural Plastics
 06600 Plastic Fabrications
 06900 Wood and Plastic Restoration and Cleaning

Division 7 Thermal and Moisture Protection

07050 Basic Thermal and Moisture Protection Materials and Methods
 07100 Damp proofing and Waterproofing
 07200 Thermal Protection
 07300 Shingles, Roof Tiles, and Roof Coverings
 07400 Roofing and Siding Tiles
 07500 Membrane Roofing
 07600 Flashing and Sheet Metal
 07700 Roof Specialties and Accessories
 07800 Fire and Smoke Protection
 07900 Joint Sealers

Division 8 Doors and Windows

08050 Basic Doors and Windows Materials and Methods
 08100 Metal Doors and Frames
 08200 Wood and Plastic Doors
 08300 Specialty Doors
 08400 Entrances and Storefronts
 08500 Windows
 08600 Skylights
 08700 Hardware
 08800 Glazing
 08900 Glazed Curtain Wall

Division 9 Finishes

09050 Basic Finishes Materials and Methods

09100	Metal Support Assemblies
09200	Plaster and Gypsum Board
09300	Tile
09400	Terrazzo
09500	Ceilings
09600	Flooring
09700	Wall Finishes
09800	Acoustical Treatment
09900	Paints and Coatings

Division 10 Specialties

10100	Visual Display Boards
10150	Compartments and Cubicles
10200	Louvers and Vents
10240	Grilles and Screens
10250	Service Walls
10260	Wall and Corner Guards
10270	Access Flooring
10290	Pest Control
10300	Fireplaces and Stoves
10340	Manufactured Exterior Specialties
10350	Flag Poles
10400	Identification Devices
10450	Pedestrian Control Devices
10500	Lockers
10520	Fire Protection Specialties
10530	Protective Covers
10550	Postal Specialties
10600	Partitions
10670	Storage Shelving
10700	Exterior Protection
10750	Telephone Specialties
10800	Toilet, Bath, and Laundry Accessories
10880	Scales
10900	Wardrobe and Closet Specialties

Division 11 Equipment

11010	Maintenance Equipment
11020	Security and Vault Equipment
11030	Teller and Service Equipment
11040	Ecclesiastical Equipment
11050	Library Equipment
11060	Theater and Stage Equipment
11070	Instrumental Equipment
11080	Registration Equipment
11090	Check Room Equipment
11100	Mercantile Equipment
11110	Commercial Laundry and Dry-Cleaning Equipment
11120	Vending Equipment
11130	Audio/Visual Equipment
11140	Vehicle Service Equipment
11150	Parking Control Equipment
11160	Loading Dock Equipment
11170	Solid Waste Handling Equipment
11190	Detention Equipment
11200	Water Supply and Treatment Equipment
11280	Hydraulic Gates and Valves
11300	Fluid Waste Treatment and Disposal Equipment
11400	Food service Equipment
11450	Residential Equipment

11460	Unit Kitchens
11470	Darkroom Equipment
11480	Athletic, Recreational, and Therapeutic Equipment
11500	Industrial and Process Equipment
11600	Laboratory Equipment
11650	Planetarium Equipment
11660	Observatory Equipment
11680	Office Equipment
11700	Medical Equipment
11780	Mortuary Equipment
11850	Navigation Equipment
11870	Agricultural Equipment
11900	Exhibit Equipment

Division 12 Furnishings

12050	Fabrics
12100	Art
12300	Manufactured Casework
12400	Furnishings and Accessories
12500	Furniture
12600	Multiple Seating
12700	Systems Furniture
12800	Interior Plants and Planters
12900	Furnishings Restoration and Repair

Division 13 Special Construction

13010	Air-Supported Structures
13020	Building Modules
13030	Special-Purpose Rooms
13080	Sound, Vibration, and Seismic Control
13090	Radiation Protection
13100	Lightning Protection
13110	Cathodic Protection
13120	Pre-Engineered Structures
13150	Swimming Pools
13160	Aquariums
13165	Aquatic Park Facilities
13170	Tubs and Pools
13175	Ice Rinks
13185	Kennels and Animal Shelters
13190	Site Constructed Incinerators
13200	Storage Tanks
13220	Filter Underdrains and Media
13230	Digester Covers and Appurtenances
13240	Oxygenation Systems
13260	Sludge Conditioning Systems
13280	Hazardous Material Remediation
13400	Measurement and Control Instrumentation
13500	Recording Instrumentation
13550	Transportation Control Instrumentation
13600	Solar and Wind Energy Equipment
13700	Security Access and Surveillance
13800	Building Automation and Control
13850	Detection and Alarm
13900	Fire Suppression

Division 14 Conveying Systems

14100	Dumbwaiters
14200	Elevators
14300	Escalators and Moving Walks

14400	Lifts
14500	Material Handling
14600	Hoists and Cranes
14700	Turntables
14800	Scaffolding
14900	Transportation

Division 15 Mechanical

15050	Basic Mechanical Materials and Methods
15100	Building Services Piping
15200	Process Piping
15300	Fire Protection Piping (See 13900)
15400	Plumbing Fixtures and Equipment
15500	Heat Generation Equipment
15600	Refrigeration Equipment
15700	Heating, Ventilation, and Air-Conditioning Equipment
15800	Air Distribution
15900	HVAC Instrumentation and Control
15950	Testing, Adjusting, and Balancing

Division 16 Electrical

16050	Basic Electrical Materials and Methods
16100	Wiring Methods
16200	Electrical Power
16300	Transmission and Distribution
16400	Low Voltage Distribution
16500	Lighting
16700	Communications
16800	Sound and Video

APPENDIX 3-C: CSI MASTERFORMAT DIVISIONS

Procurement and Contracting Documents Group

Division 00—Procurement and Contracting Requirements: This division is essentially the same in scope as it was in the previous formats.

Specifications Group

General Requirements Subgroup

Division 01—General Requirements: The area for performance requirements was added to allow for the writing of performance requirements for the elements that are found in more than one work section such as building envelope, structure, etc. This feature allows the specifier to include a mixture of broad performance specifications and descriptive specifications in the project manual.

Facility Construction Subgroup

Division 02—Existing Conditions: Division 2 is restricted to construction tasks that relate to the items at the site when the project commences, such as selective demolition, subsurface and other investigations, surveying, and site decontamination and/or remediation. (All site construction as well as heavy civil and infrastructure items including pavement and utilities are in the Site and Infrastructure Subgroup.)

Division 03—Concrete: This division is essentially as it was under MasterFormat95.

Division 04—Masonry: This division is essentially as it was under MasterFormat95.

Division 05—Metals: This division is essentially as it was under MasterFormat95.

Division 06—Wood, Plastics, and Composites: This division is essentially as it was under MasterFormat95, but also includes expanded areas for plastics and other composite materials.

Division 07—Thermal and Moisture Protection: This division is essentially as it was under MasterFormat95.

Division 08—Openings: This section was called Doors and Windows under MasterFormat95 but was renamed to include other openings such as louvers and grilles.

Division 09—Finishes: This division is essentially as it was under MasterFormat95.

Division 10—Specialties: This division is essentially as it was under MasterFormat95.

Division 11—Equipment: This division is essentially as it was under MasterFormat95, with the exception that equipment related to process engineering was relocated to the Process Equipment Subgroup and equipment related to infrastructure was relocated to the Site and Infrastructure Subgroup.

Division 12—Furnishings: This division is essentially as it was under MasterFormat95.

Division 13—Special Construction: This division is essentially as it was under MasterFormat95 except that special construction related to process engineering was relocated to the Process Equipment Subgroup. Security, building automation, detection, and alarms as well as fire suppression were relocated to the Facility Services Subgroup.

Division 14—Conveying Equipment: This division was renamed, and process-related material handling equipment was relocated to the Process Equipment Subgroup.

Division 15—Reserved for Future Expansion: This division was divided and relocated to Division 22—Plumbing and Division 23—Heating, Ventilation, and Air-Conditioning in the Facility Services Subgroup.

Division 16—Reserved for Future Expansion: This division was divided and relocated to Division 26—Electrical and Division 27—Communications in the Facility Services Subgroup.

Facility Services Subgroup

Division 21—Fire Suppression: This division contains the fire suppression sections relocated from Division 13 in previous formats.

Division 22—Plumbing: This division contains the plumbing sections relocated from Division 15 in previous formats.

Division 23—Heating, Ventilation, and Air Conditioning: This division contains the HVAC sections from Division 15 in previous formats.

Division 25—Integrated Automation: This division contains the expanded integrated automation sections that were relocated from Division 13 in previous formats.

Division 26—Electrical: This division contains the electrical and lighting sections relocated from Division 16 in previous formats.

Division 27—Communications: This division contains the expanded communications sections relocated from Division 16 in previous formats.

Division 28—Electronic Safety and Security: This division contains the expanded electronic safety and security sections relocated from Division 13 in previous formats.

Site and Infrastructure Subgroup

Division 31—Earthwork: This division contains site construction sections, predominately below grade, that were relocated from Division 02 in previous formats.

Division 32—Exterior Improvements: This division contains site construction sections, predominately above grade, that were relocated from Division 02 in previous formats.

Division 33—Utilities: This division includes utility sections with expansions that were relocated from Division 02 in previous formats.

Division 34—Transportation: This division contains transportation sections with expansions relocated from the various divisions in previous formats.

Division 35—Waterway and Marine: This division includes expanded waterway and other marine sections from Division 02 and other divisions in previous formats.

Process Equipment Subgroup

Division 41—Material Processing and Handling Equipment: This division includes equipment for the processing and conditioning of raw materials, material handling equipment for bulk materials as well as discrete units, manufacturing equipment and machinery, and test equipment and packaging/shipping systems.

Division 42—Process Heating, Cooling, and Drying Equipment: This division contains equipment for process heating, cooling, and drying of materials, liquids, gases, and manufactured items and/or materials.

Division 43—Process Gas and Liquid Handling, Purification, and Storage Equipment: This division includes equipment for handling the purification and storage of process liquids, gases, and slurries including atmospheric tanks as well as pressure vessels.

Division 44—Pollution Control Equipment: This division includes equipment for controlling the emission of contaminants from manufacturing processes and the treatment of air, soil, and water contaminants.

Division 45—Industry-Specific Manufacturing Equipment: In this division, the owner can specify equipment that is used only within a single industry. (All industries currently identified in the North American Industry Classification System [NAICS] are allocated space within this division.)

Division 46—Solid Waste Equipment: Not defined at this time.

Division 48—Electrical Power Generation: This division includes plants and equipment for the generation and control of electrical power from fossil fuel, nuclear energy, hydroelectric, wind, solar energy, geothermal energy, electrochemical energy, and fuel cells.

APPENDIX 3-D: MASTERFORMAT FACILITY CONSTRUCTION SUBGROUP, DIVISION 21

This appendix is based on MasterFormat 2016 as published by CSI.

Division 21—Fire Suppression

21 00 00—Fire Suppression

21 01 00—Operation and Maintenance of Fire Suppression

21 01 10—Operation and Maintenance of Water-Based Fire-Suppression Systems

21 01 20—Operation and Maintenance of Fire-Extinguishing Systems

21 01 30—Operation and Maintenance of Fire-Suppression Equipment

21 05 00—Common Work Results for Fire Suppression

21 05 05—Selective Demolition for Fire Suppression

21 05 13—Common Motor Requirements for Fire-Suppression Equipment

- 21 05 16—Expansion Fittings and Loops for Fire-Suppression Piping
- 21 05 17—Sleeves and Sleeve Seals for Fire-Suppression Piping
- 21 05 19—Meters and Gages for Fire-Suppression Systems
- 21 05 23—General-Duty Valves for Water-Based Fire-Suppression Piping
- 21 05 29—Hangers and Supports for Fire-Suppression Piping and Equipment
- 21 05 33—Heat Tracing for Fire-Suppression Piping
- 21 05 48—Vibration and Seismic Controls for Fire-Suppression Piping and Equipment
 - 21 05 48.13—Vibration Controls for Fire-Suppression Piping and Equipment
- 21 05 53—Identification for Fire-Suppression Piping and Equipment
- 21 06 00—Schedules for Fire Suppression
 - 21 06 10—Schedules for Water-Based Fire-Suppression Systems
 - 21 06 20—Schedules for Fire-Extinguishing Systems
 - 21 06 30—Schedules for Fire-Suppression Equipment
- 21 07 00—Fire Suppression Systems Insulation
 - 21 07 16—Fire-Suppression Equipment Insulation
 - 21 07 19—Fire-Suppression Piping Insulation
- 21 08 00—Commissioning of Fire Suppression
- 21 09 00—Instrumentation and Control for Fire-Suppression Systems
- 21 10 00—Water-Based Fire-Suppression Systems
- 21 11 00—Facility Fire-Suppression Water-Service Piping
 - 21 11 16—Facility Fire Hydrants
 - 21 11 19—Fire-Department Connections
- 21 12 00—Fire-Suppression Standpipes
 - 21 12 13—Fire-Suppression Hoses and Nozzles
 - 21 12 16—Fire-Suppression Hose Reels
 - 21 12 19—Fire-Suppression Hose Racks
 - 21 12 23—Fire-Suppression Hose Valves
- 21 13 00—Fire-Suppression Sprinkler Systems
 - 21 13 13—Wet-Pipe Sprinkler Systems
 - 21 13 16—Dry-Pipe Sprinkler Systems
 - 21 13 19—Preaction Sprinkler Systems
 - 21 13 23—Combined Dry-Pipe and Preaction Sprinkler Systems
 - 21 13 26—Deluge Fire-Suppression Sprinkler Systems
 - 21 13 29—Water Spray Fixed Systems
 - 21 13 36—Antifreeze Sprinkler Systems
 - 21 13 39—Foam-Water Systems
- 21 16 00—Fire-Suppression Pressure Maintenance Pumps
- 21 20 00—Fire-Extinguishing Systems
- 21 21 00—Carbon-Dioxide Fire-Extinguishing Systems
 - 21 21 13—Carbon-Dioxide Fire-Extinguishing Piping
 - 21 21 13.13—High-Pressure, Carbon-Dioxide Fire-Extinguishing Systems
 - 21 21 13.16—Low-Pressure, Carbon-Dioxide Fire-Extinguishing Systems
 - 21 21 16—Carbon-Dioxide Fire-Extinguishing Equipment
- 21 22 00—Clean-Agent Fire-Extinguishing Systems
 - 21 22 13—Clean-Agent Fire-Extinguishing Piping
 - 21 22 16—Clean-Agent Fire-Extinguishing Equipment
- 21 23 00—Wet-Chemical Fire-Extinguishing Systems
 - 21 23 13—Wet-Chemical Fire-Extinguishing Piping
 - 21 23 16—Wet-Chemical Fire-Extinguishing Equipment
- 21 24 00—Dry-Chemical Fire-Extinguishing Systems
 - 21 24 13—Dry-Chemical Fire-Extinguishing Piping
 - 21 24 16—Dry-Chemical Fire-Extinguishing Equipment
- 21 30 00—Fire Pumps
- 21 31 00—Centrifugal Fire Pumps
 - 21 31 13—Electric-Drive, Centrifugal Fire Pumps
 - 21 31 16—Diesel-Drive, Centrifugal Fire Pumps
- 21 32 00—Vertical-Turbine Fire Pumps
 - 21 32 13—Electric-Drive, Vertical-Turbine Fire Pumps
 - 21 32 16—Diesel-Drive, Vertical-Turbine Fire Pumps

- 21 33 00—Positive-Displacement Fire Pumps
 - 21 33 13—Electric-Drive, Positive-Displacement Fire Pumps
 - 21 33 16—Diesel-Drive, Positive-Displacement Fire Pumps
- 21 34 00—Fire Pump Accessories
 - 21 34 13—Pressure Maintenance Pumps
- 21 40 00—Fire-Suppression Water Storage
- 21 41 00—Storage Tanks for Fire-Suppression Water
 - 21 41 13—Pressurized Storage Tanks for Fire-Suppression Water
 - 21 41 16—Elevated Storage Tanks for Fire-Suppression Water
 - 21 41 19—Roof-Mounted Storage Tanks for Fire-Suppression Water
 - 21 41 23—Ground Suction Storage Tanks for Fire-Suppression Water
 - 21 41 26—Underground Storage Tanks for Fire-Suppression Water
 - 21 41 29—Storage Tanks for Fire-Suppression Water Additives

APPENDIX 3-E: MASTERFORMAT FACILITY CONSTRUCTION SUBGROUP, DIVISION 22

This appendix is based on MasterFormat 2016 as published by CSI.

Division 22—Plumbing

- 22 00 00—Plumbing
 - 22 01 00—Operation and Maintenance of Plumbing
 - 22 01 10—Operation and Maintenance of Plumbing Piping and Pumps
 - 22 01 10.16—Video Piping Inspections
 - 22 01 10.51—Plumbing Piping Cleaning
 - 22 01 10.61—Plumbing Piping Repairs
 - 22 01 10.62—Plumbing Piping Relining
 - 22 01 30—Operation and Maintenance of Plumbing Equipment
 - 22 01 40—Operation and Maintenance of Plumbing Fixtures
 - 22 01 50—Operation and Maintenance of Pool and Fountain Plumbing Systems
 - 22 01 60—Operation and Maintenance of Laboratory and Healthcare Systems
 - 22 05 00—Common Work Results for Plumbing
 - 22 05 05—Selective Demolition for Plumbing
 - 22 05 13—Common Motor Requirements for Plumbing Equipment
 - 22 05 16—Expansion Fittings and Loops for Plumbing Piping
 - 22 05 17—Sleeves and Sleeve Seals for Plumbing Piping
 - 22 05 19—Meters and Gages for Plumbing Piping
 - 22 05 23—General-Duty Valves for Plumbing Piping
 - 22 05 29—Hangers and Supports for Plumbing Piping and Equipment
 - 22 05 33—Heat Tracing for Plumbing Piping
 - 22 05 48—Vibration and Seismic Controls for Plumbing Piping and Equipment
 - 22 05 48.13—Vibration Controls for Plumbing Piping and Equipment
 - 22 05 53—Identification for Plumbing Piping and Equipment
 - 22 05 73—Facility Drainage Manholes
 - 22 05 76—Facility Drainage Piping Cleanouts
 - 22 06 00—Schedules for Plumbing
 - 22 06 10—Schedules for Plumbing Piping and Pumps
 - 22 06 10.13—Plumbing Pump Schedule
 - 22 06 12—Schedules for Facility Potable Water Storage
 - 22 06 15—Schedules for General Service Compressed-Air Equipment
 - 22 06 30—Schedules for Plumbing Equipment
 - 22 06 30.13—Domestic Water Heater Schedule
 - 22 06 40—Schedules for Plumbing Fixtures
 - 22 06 40.13—Plumbing Fixture Schedule
 - 22 06 50—Schedules for Pool and Fountain Plumbing Systems
 - 22 06 60—Schedules for Laboratory and Healthcare Systems
 - 22 07 00—Plumbing Insulation
 - 22 07 16—Plumbing Equipment Insulation
 - 22 07 19—Plumbing Piping Insulation
 - 22 08 00—Commissioning of Plumbing
 - 22 09 00—Instrumentation and Control for Plumbing

- 22 09 63—Medical Gas Alarms
- 22 10 00—Plumbing Piping
- 22 11 00—Facility Water Distribution
 - 22 11 13—Facility Water Distribution Piping
 - 22 11 16—Domestic Water Piping
 - 22 11 17—Gray-Water Piping
 - 22 11 19—Domestic Water Piping Specialties
 - 22 11 23—Domestic Water Pumps
 - 22 11 23.13—Domestic-Water Packaged Booster Pumps
 - 22 11 23.23—Domestic-Water In-Line Pumps
 - 22 11 23.26—Close-Coupled, Horizontally Mounted, In-Line Centrifugal Domestic-Water Pumps
 - 22 11 23.29—Close-Coupled, Vertically Mounted, In-Line Centrifugal Domestic-Water Pumps
 - 22 11 23.33—Separately Coupled, In-Line Centrifugal Domestic-Water Pumps
 - 22 11 23.36—Separately Coupled, Horizontally Mounted, In-Line Centrifugal Domestic-Water Pumps
 - 22 11 23.43—Domestic-Water, Base-Mounted Pumps
 - 22 11 63—Gray-Water Pumps
- 22 12 00—Facility Potable-Water Storage Tanks
 - 22 12 13—Facility Roof-Mounted, Potable-Water Storage Tanks
 - 22 12 16—Facility Elevated, Potable-Water Storage Tanks
 - 22 12 19—Facility Ground-Mounted, Potable-Water Storage Tanks
 - 22 12 21—Facility Underground Potable-Water Storage Tanks
 - 22 12 23—Facility Indoor Potable-Water Storage Tanks
 - 22 12 23.13—Facility Steel, Indoor Potable-Water Storage Pressure Tanks
 - 22 12 23.16—Facility Steel, Indoor Potable-Water Storage Non-Pressure Tanks
 - 22 12 23.23—Facility Plastic, Indoor Potable-Water Storage Pressure Tanks
 - 22 12 23.26—Facility Plastic, Indoor Potable-Water Storage Non-Pressure Tanks
- 22 13 00—Facility Sanitary Sewerage
 - 22 13 13—Facility Sanitary Sewers
 - 22 13 16—Sanitary Waste and Vent Piping
 - 22 13 19—Sanitary Waste Piping Specialties
 - 22 13 19.13—Sanitary Drains
 - 22 13 19.23—Fats, Oils, and Grease Disposal Systems
 - 22 13 19.26—Grease Removal Devices
 - 22 13 19.33—Backwater Valves
 - 22 13 19.36—Air-Admittance Valves
 - 22 13 23—Sanitary Waste Interceptors
 - 22 13 26—Sanitary Waste Separators
 - 22 13 29—Sanitary Sewerage Pumps
 - 22 13 29.13—Wet-Pit-Mounted, Vertical Sewerage Pumps
 - 22 13 29.16—Submersible Sewerage Pumps
 - 22 13 29.23—Sewerage Pump Reverse-Flow Assemblies
 - 22 13 29.33—Sewerage Pump Basins and Pits
 - 22 13 33—Packaged, Submersible Sewerage Pump Units
 - 22 13 36—Packaged, Wastewater Pump Units
 - 22 13 43—Facility Packaged Sewage Pumping Stations
 - 22 13 43.13—Facility Dry-Well Packaged Sewage Pumping Stations
 - 22 13 43.16—Facility Wet-Well Packaged Sewage Pumping Stations
 - 22 13 63—Facility Gray Water Tanks
- 22 14 00—Facility Storm Drainage
 - 22 14 13—Facility Storm Drainage Piping
 - 22 14 16—Rainwater Leaders
 - 22 14 19—Sump Pump Discharge Piping
 - 22 14 23—Storm Drainage Piping Specialties
 - 22 14 26—Facility Storm Drains
 - 22 14 26.13—Roof Drains
 - 22 14 26.16—Facility Area Drains
 - 22 14 26.19—Facility Trench Drains
 - 22 14 29—Sump Pumps
 - 22 14 29.13—Wet-Pit-Mounted, Vertical Sump Pumps

- 22 14 29.16—Submersible Sump Pumps
- 22 14 29.19—Sump-Pump Basins and Pits
- 22 14 33—Packaged, Pedestal Drainage Pump Units
- 22 14 36—Packaged, Submersible, Drainage Pump Units
- 22 14 53—Rainwater Storage Tanks
- 22 14 63—Facility Storm-Water Retention Tanks
- 22 15 00—General Service Compressed-Air Systems
 - 22 15 13—General Service Compressed-Air Piping
 - 22 15 16—General Service Compressed-Air Valves
 - 22 15 19—General Service Packaged Air Compressors and Receivers
 - 22 15 19.13—General Service Packaged Reciprocating Air Compressors
 - 22 15 19.16—General Service Packaged Liquid-Ring Air Compressors
 - 22 15 19.19—General Service Packaged Rotary-Screw Air Compressors
 - 22 15 19.23—General Service Packaged Sliding-Vane Air Compressors
- 22 30 00—Plumbing Equipment
- 22 31 00—Domestic Water Softeners
 - 22 31 13—Residential Domestic Water Softeners
 - 22 31 16—Commercial Domestic Water Softeners
- 22 32 00—Domestic Water Filtration Equipment
 - 22 32 13—Domestic-Water Bag-Type Filters
 - 22 32 16—Domestic-Water Freestanding Cartridge Filters
 - 22 32 19—Domestic-Water Off-Floor Cartridge Filters
 - 22 32 23—Domestic-Water Carbon Filters
 - 22 32 26—Domestic-Water Sand Filters
 - 22 32 26.13—Domestic-Water Circulating Sand Filters
 - 22 32 26.16—Domestic-Water Multimedia Sand Filters
 - 22 32 26.19—Domestic-Water Greensand Filters
- 22 33 00—Electric Domestic Water Heaters
 - 22 33 13—Instantaneous Electric Domestic Water Heaters
 - 22 33 13.13—Flow-Control, Instantaneous Electric Domestic Water Heaters
 - 22 33 13.16—Thermostat-Control, Instantaneous Electric Domestic Water Heaters
 - 22 33 30—Residential, Electric Domestic Water Heaters
 - 22 33 30.13—Residential, Small-Capacity Electric Domestic Water Heaters
 - 22 33 30.16—Residential, Storage Electric Domestic Water Heaters
 - 22 33 30.23—Residential, Collector-to-Tank, Solar-Electric Domestic Water Heaters
 - 22 33 30.26—Residential, Collector-to-Tank, Heat-Exchanger-Coil, Solar-Electric Domestic Water Heaters
 - 22 33 33—Light-Commercial Electric Domestic Water Heaters
 - 22 33 36—Commercial Domestic Water Electric Booster Heaters
 - 22 33 36.13—Commercial Domestic Water Electric Booster Heaters
 - 22 33 36.16—Commercial Storage Electric Domestic Water Heaters
- 22 34 00—Fuel-Fired Domestic Water Heaters
 - 22 34 13—Instantaneous, Tankless, Gas Domestic Water Heaters
 - 22 34 30—Residential Gas Domestic Water Heaters
 - 22 34 30.13—Residential, Atmospheric, Gas Domestic Water Heaters
 - 22 34 30.16—Residential, Direct-Vent, Gas Domestic Water Heaters
 - 22 34 30.19—Residential, Power-Vent, Gas Domestic Water Heaters
 - 22 34 36—Commercial Gas Domestic Water Heaters
 - 22 34 36.13—Commercial, Atmospheric, Gas Domestic Water Heaters
 - 22 34 36.16—Commercial, Power-Burner, Gas Domestic Water Heaters
 - 22 34 36.19—Commercial, Power-Vent, Gas Domestic Water Heaters
 - 22 34 36.23—Commercial, High-Efficiency, Gas Domestic Water Heaters
 - 22 34 36.26—Commercial, Coil-Type, Finned-Tube, Gas Domestic Water Heaters
 - 22 34 36.29—Commercial, Grid-Type, Finned-Tube, Gas Domestic Water Heaters
 - 22 34 46—Oil-Fired Domestic Water Heaters
 - 22 34 46.13—Large-Capacity, Oil-Fired Domestic Water Heaters
 - 22 34 56—Dual-Fuel-Fired Domestic Water Heaters
- 22 35 00—Domestic Water Heat Exchangers
 - 22 35 13—Instantaneous Domestic Water Heat Exchangers
 - 22 35 13.13—Heating-Fluid-in-Coil, Instantaneous Domestic Water Heat Exchangers

- 22 35 13.16—Domestic-Water-in-Coil, Instantaneous Domestic Water Heat Exchangers
- 22 35 13.19—Heating-Fluid-in-U-Tube-Coil, Instantaneous Domestic Water Heat Exchangers
- 22 35 23—Circulating, Domestic Water Heat Exchangers
 - 22 35 23.13—Circulating, Compact Domestic Water Heat Exchangers
 - 22 35 23.16—Circulating, Storage Domestic Water Heat Exchangers
- 22 35 29—Noncirculating, Domestic Water Heat Exchangers
 - 22 35 29.13—Noncirculating, Compact Domestic Water Heat Exchangers
 - 22 35 29.16—Noncirculating, Storage Domestic Water Heat Exchangers
- 22 35 36—Domestic Water Brazed-Plate Heat Exchangers
- 22 35 39—Domestic Water Frame-and-Plate Heat Exchangers
- 22 35 43—Domestic Water Heat Reclaimers
- 22 36 00—Domestic Water Preheaters
 - 22 36 13—Solar Domestic Water Preheaters
 - 22 36 23—Geothermal Domestic Water Preheaters
- 22 40 00—Plumbing Fixtures
- 22 41 00—Residential Plumbing Fixtures
 - 22 41 13—Residential Water Closets, Urinals, and Bidets
 - 22 41 13.13—Residential Water Closets
 - 22 41 13.16—Residential Urinals
 - 22 41 13.19—Residential Bidets
 - 22 41 16—Residential Lavatories and Sinks
 - 22 41 16.13—Residential Lavatories
 - 22 41 16.16—Residential Sinks
 - 22 41 19—Residential Bathtubs
 - 22 41 23—Residential Showers
 - 22 41 26—Residential Disposers
 - 22 41 36—Residential Laundry Trays
 - 22 41 39—Residential Faucets, Supplies, and Trim
- 22 42 00—Commercial Plumbing Fixtures
 - 22 42 13—Commercial Water Closets, Urinals, and Bidets
 - 22 42 13.13—Commercial Water Closets
 - 22 42 13.16—Commercial Urinals
 - 22 42 16—Commercial Lavatories and Sinks
 - 22 42 16.13—Commercial Lavatories
 - 22 42 16.16—Commercial Sinks
 - 22 42 19—Commercial Bathtubs
 - 22 42 23—Commercial Showers
 - 22 42 26—Commercial Disposers
 - 22 42 29—Shampoo Bowls
 - 22 42 33—Wash Fountains
 - 22 42 36—Commercial Laundry Trays
 - 22 42 39—Commercial Faucets, Supplies, and Trim
 - 22 42 43—Flushometers
- 22 43 00—Healthcare Plumbing Fixtures
 - 22 43 13—Healthcare Water Closets
 - 22 43 16—Healthcare Sinks
 - 22 43 19—Healthcare Bathtubs
 - 22 43 23—Healthcare Showers
 - 22 43 39—Healthcare Faucets
 - 22 43 43—Healthcare Plumbing Fixture Flushometers
- 22 45 00—Emergency Plumbing Fixtures
 - 22 45 13—Emergency Showers
 - 22 45 16—Eyewash Equipment
 - 22 45 19—Self-Contained Eyewash Equipment
 - 22 45 23—Personal Eyewash Equipment
 - 22 45 26—Eye/Face Wash Equipment
 - 22 45 29—Hand-Held Emergency Drench Hoses
 - 22 45 33—Combination Emergency Fixture Units
 - 22 45 36—Emergency Fixture Water-Tempering Equipment

- 22 46 00—Security Plumbing Fixtures
 - 22 46 13—Security Water Closets and Urinals
 - 22 46 13.13—Security Water Closets
 - 22 46 13.16—Security Urinals
 - 22 46 16—Security Lavatories and Sinks
 - 22 46 16.13—Security Lavatories
 - 22 46 16.16—Security Sinks
 - 22 46 19—Security Showers
 - 22 46 39—Security Faucets, Supplies, and Trim
 - 22 46 43—Security Plumbing Fixture Flushometers
 - 22 46 53—Security Plumbing Fixture Supports
- 22 47 00—Drinking Fountains and Water Coolers
 - 22 47 13—Drinking Fountains
 - 22 47 16—Pressure Water Coolers
 - 22 47 19—Water-Station Water Coolers
 - 22 47 23—Remote Water Coolers
- 22 50 00—Pool and Fountain Plumbing Systems
- 22 51 00—Swimming Pool Plumbing Systems
 - 22 51 13—Swimming Pool Piping
 - 22 51 16—Swimming Pool Pumps
 - 22 51 19—Swimming Pool Water Treatment Equipment
 - 22 51 23—Swimming Pool Equipment Controls
- 22 52 00—Fountain Plumbing Systems
 - 22 52 13—Fountain Piping
 - 22 52 16—Fountain Pumps
 - 22 52 19—Fountain Water Treatment Equipment
 - 22 52 23—Fountain Equipment Controls
- 22 60 00—Gas and Vacuum Systems for Laboratory and Healthcare Facilities
- 22 61 00—Compressed-Air Systems for Laboratory and Healthcare Facilities
 - 22 61 13—Compressed-Air Piping for Laboratory and Healthcare Facilities
 - 22 61 13.53—Laboratory Compressed-Air Piping
 - 22 61 13.70—Healthcare Compressed-Air Piping
 - 22 61 13.74—Dental Compressed-Air Piping
 - 22 61 19—Compressed-Air Equipment for Laboratory and Healthcare Facilities
 - 22 61 19.53—Laboratory Compressed-Air Equipment
 - 22 61 19.70—Healthcare Compressed-Air Equipment
 - 22 61 19.74—Dental Compressed-Air Equipment
- 22 62 00—Vacuum Systems for Laboratory and Healthcare Facilities
 - 22 62 13—Vacuum Piping for Laboratory and Healthcare Facilities
 - 22 62 13.53—Laboratory Vacuum Piping
 - 22 62 13.70—Healthcare, Surgical Vacuum Piping
 - 22 62 13.74—Dental Vacuum Piping
 - 22 62 19—Vacuum Equipment for Laboratory and Healthcare Facilities
 - 22 62 19.53—Laboratory Vacuum Equipment
 - 22 62 19.70—Healthcare Vacuum Equipment
 - 22 62 19.74—Dental Vacuum and Evacuation Equipment
 - 22 62 23—Waste Anesthesia-Gas Piping
- 22 63 00—Gas Systems for Laboratory and Healthcare Facilities
 - 22 63 13—Gas Piping for Laboratory and Healthcare Facilities
 - 22 63 13.53—Laboratory Gas Piping
 - 22 63 13.70—Healthcare Gas Piping
 - 22 63 19—Gas Storage Tanks for Laboratory and Healthcare Facilities
 - 22 63 19.53—Laboratory Gas Storage Tanks
 - 22 63 19.70—Healthcare Gas Storage Tanks
- 22 66 00—Chemical-Waste Systems for Laboratory and Healthcare Facilities
 - 22 66 53—Laboratory Chemical-Waste and Vent Piping
 - 22 66 70—Healthcare Chemical-Waste and Vent Piping
 - 22 66 83—Chemical-Waste Tanks
 - 22 66 83.13—Chemical-Waste Dilution Tanks

- 22 66 83.16—Chemical-Waste Neutralization Tanks
- 22 67 00—Processed Water Systems for Laboratory and Healthcare Facilities
 - 22 67 13—Processed Water Piping for Laboratory and Healthcare Facilities
 - 22 67 13.13—Distilled-Water Piping
 - 22 67 13.16—Reverse-Osmosis Water Piping
 - 22 67 13.19—Deionized-Water Piping
- 22 67 19—Processed Water Equipment for Laboratory and Healthcare Facilities
 - 22 67 19.13—Distilled-Water Equipment
 - 22 67 19.16—Reverse-Osmosis Water Equipment
 - 22 67 19.19—Deionized-Water Equipment

APPENDIX 3-F: SECTION SHELL OUTLINE

This shell outline has been developed by the American Institute of Architects (AIA) .

SECTION XXXXXX

Part 1—General

1.1 Summary

- A. This section includes [description of the essential unit of work included in this section].
- B. Products furnished but not installed under this section include [description].
- C. Products installed but not furnished under this section include [description].
- D. Systems covered under this section of the specification
- E. Related Sections: The following sections contain requirements that relate to this section.
 - 1. Division [#] Section [Title] for [Description of Work].
 - 2. Division [#] Section [Title] for [Description of Work].
 - 3. Division [#] Section [Title] for [Description of Work].
 - 4. Division [#] Section [Title] for [Description of Work].
- F. Allowances
- G. Unit Prices
- H. Unit Prices

1.2 References

1.3 Definitions

1.4 System Description

1.5 System Performance Requirements

- A. Performance Requirements: Provide [system] complying with requirements specified.
- B. Normal Operating Pressure for [System] System: Up to [#] psig maximum. Temperature limits: [#] to [#] deg F.
- C. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
- D. This project is Risk Category [#] which results in seismic design category [#], which ...

1.6 Submittals

- A. General: Submit the following:
- B. Product data for each type of [products] specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- C. Product data for the following products:
 - 1. [Product]
 - 2. [Product]
 - 3. [Product]
 - 4. [Product]
- D. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, methods of field assembly, components, utility requirements, and location and size of each field connection.
- E. Include setting drawings, templates, and directions for installation of the anchor bolts and other anchorages to be installed as unit of work of other sections.
- F. Coordination drawings for [unit of work].

- G. Coordination plans for reflected ceiling plans drawn accurately to scale and coordinating penetrations and ceiling-mounted items including sprinklers, diffusers, grilles, light fixtures, speakers, and access panels.
- H. Power and control wiring diagrams from manufacturer for electrically operated equipment.
- I. Wiring diagrams detailing wiring for power, signal, and control systems, differentiating between manufacturer and field-installed wiring.
- J. Material certificates signed by the manufacturer certifying that each material item complies with requirements, in lieu of laboratory test reports, when permitted by the Architect.
- K. Material certificates signed by manufacturers of [products] certifying that their products comply with the requirements.
- L. Welder certificates signed by the contractor certifying that welders comply with requirements of the “quality assurance” article.
- M. Qualifications data for firms and persons specified in the “quality assurance” article to demonstrate their capabilities and experience. Include list of all similar projects with project name, addresses, name(s) of architect(s) and owner(s), plus any other information specified.
- N. Test reports from and based on tests performed by qualified, independent testing laboratory evidencing compliance of [product] with requirements based on comprehensive testing.
- O. Maintenance data for [materials and products] for inclusion into operating and maintenance (O&M) manuals.

1.7 Quality Assurance

- A. Installer Qualifications: Engage an experienced installer who has successfully completed [unit of work] similar in material, design, and extent to that indicated for the project.
- B. Installer’s Field Supervision: Require the installer to maintain an experienced full-time supervisor who will be on the jobsite during times that [unit of work] is in progress.
- C. Testing Laboratory Qualifications: Demonstrate the required experience and capability to conduct the indicated testing without delaying progress of the work based on evaluation of the laboratory submitted criteria conforming to ASTM E 699.
- D. Qualify welding process and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, “Welding and Brazing Qualifications.”
- E. Regulatory Requirements: Fabricate and stamp [product] to comply with [code].
- F. Regulatory Requirements: Comply with the following codes.
 - 1. [Itemize codes in the form of separate subparagraphs under the above.
- G. UL Standard: Provide [products] complying with the UL [designation, title].
- H. Electrical Component Standard: Provide components complying with NFPA 70: National Electrical Code and listed and labeled by UL where available.
- I. UL and NEMA Compliance: Provide [components] required as part of [product or system] which are listed and labeled by UL and comply with applicable NEMA standards.
- J. ASME Compliance: Fabricate and stamp [product] to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- K. Single Source Responsibility: Obtain [system] components from single source having the responsibility and accountability to answer and resolve any problems regarding proper installation, compatibility, performance, and acceptance.
- L. Manufacturer and Product Selection: The drawings indicate sizes, profiles, and dimensional requirements of [product or system]. A [product or system] having equal performance characteristics with deviations from indicated dimensions and profiles may be considered, provided the deviations do not change the design concept or intended performance. The burden of proof of equality rests on the proposer of the change.

1.8 Delivery, Storage, and Handling

- A. Deliver materials and equipment to the site in such quantities and at such times to ensure continuity of installation. Store them at the site to prevent any cracking, distortion, staining, and other physical damage and so that markings are visible.
- B. Lift and support equipment only at designated lifting or supporting points as shown on the final shop drawings.
- C. Deliver [product] as a factory-assembled unit with the protective crating (packaging) and covering undamaged and in place.
- D. Store [products] on elevated platforms, etc. in a dry location.
- E. Coordinate delivery of [product] in sufficient time to allow movement into the building.

1.9 Project Conditions

- A. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity of these conditions [between soil borings]. It is expressly understood that the owner and engineer will not be responsible for any interpretations or conclusions drawn there from by the contractor. The data is made available for the convenience of the contractor and is not guaranteed to represent conditions that may be encountered.
- B. Field Measurements: Verify dimensions by field measurements. Verify that the [system, product, or equipment] may be installed in compliance with the original design and referenced standards.

1.10 Sequencing and Scheduling

- A. Coordinate the size and location of the concrete equipment pads. Cast anchor bolt inserts into the pad. Concrete reinforcement and formwork requirements are specified in Division 3.
- B. Coordinate the installation of roof penetrations. Roof specialties are specified in Division 7.

1.11 Warranty

- A. Special Project Warranty: Submit written warranty, executed by the manufacturer agreeing to repair or replace [product], which fails in materials or workmanship within the specified warranty period. This warranty shall be in addition to and not limit other rights the owner may have against the contractor under the contract documents.
 - 1. The minimum warranty period shall be one (1) year following the date of substantial completion.

1.12 Maintenance

1.13 Extra Materials

- A. Deliver extra materials to owner. Furnish extra materials described below matching the products installed and packaged with a protective covering for storage and identified with labels clearly describing the contents.

Part 2—Products

2.1 Manufacturers

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. [Name of Product]
 - a. [Manufacturer’s Name]
 - b. [Manufacturer’s Name]
 - c. [Manufacturer’s Name]
 - 2. [Name of Product]
 - a. [Manufacturer’s Name]
 - b. [Manufacturer’s Name]
 - c. [Manufacturer’s Name]
 - 3. [Name of Product]
 - a. [Manufacturer’s Name]
 - b. [Manufacturer’s Name]
 - c. [Manufacturer’s Name]
 - 4. [Name of Product]
 - a. [Manufacturer’s Name]
 - b. [Manufacturer’s Name]
 - c. [Manufacturer’s Name]
- C. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to the following:
- D. Products: Subject to compliance with the requirements, provide one of the following:

2.2 Materials [Product Name]

- A. [Material or Product Name]: [Nonproprietary description of the material] complying with [standard designation] (for type, grade, etc.).
- B. [Material or Product Name]: [Nonproprietary description of the material] complying with [standard designation] (for type, grade, etc.).
- C. [Material or Product Name]: [Standard designation], [type, grade, etc. as applicable to the referenced standard].
- D. [Material or Product Name]: [Standard designation], [type, grade, etc. as applicable to the referenced standard].

2.3 Materials, General [Product, General]

- A. [Description] Standard: Provide [product or material] that complies with [standard designation].
- B. [Description] Standard: Provide [product or material] that complies with [standard designation].
- C. [Kind of Performance] Characteristics: [Insert requirements for kind of performance involved and type of test method as applicable unless the requirements are included under Part 1 Article (“System Description”).]
- D. [Kind of Performance] Characteristics: [Insert requirements for kind of performance involved and type of test method as applicable unless the requirements are included under Part 1 Article (“System Description”).]

2.4 Equipment [Name of Manufactured Unit]

- A. [Equipment or Unit Name]: [Nonproprietary description of] complying with [standard designation] (for type, grade, etc.).
- B. [Equipment or Unit Name]: [Nonproprietary description of] complying with [standard designation] (for type, grade, etc.).
- C. [Equipment, Unit, or Product Name]: [standard description] (type, grade, etc. as applicable to the referenced standard).
- D. [Equipment, Unit, or Product Name]: [standard description] (type, grade, etc. as applicable to the referenced standard).

2.5 Components

- A. [Component Name]: [Nonproprietary description of] complying with [standard designation] (for type, grade, etc.).
- B. [Component Name]: [Nonproprietary description of] complying with [standard designation] (for type, grade, etc.).

2.6 Accessories

- A. Manufacturer's standard factory finish

2.7 Mixes

2.8 Fabrication

2.9 Source of Quality Control

Part 3—Execution

3.1 Examination

- A. Examine [substrates] [areas] [land] [conditions] [with installer present] for compliance with the requirements for [maximum moisture content], installation tolerances, [other specific conditions], and other conditions affecting the performance of [unit of work of this section]. Do not proceed with installation until the unsatisfactory conditions have been corrected.

3.2 Preparation

- A. Protection:

3.3 Installation, General [Application, General]

- A. [Description] Standard: Install [name of product, material or system] to comply with [standard designation].

3.4 Installation {of [Name]} {Application of [Name]}

- A. Install [name of unit of work] level and plumb in accordance with the manufacturer's written instructions, rough-in drawings, the original design, and the referenced standards.

3.5 Connections (not a CSI article but useful for Division 15 or 22)

- A. Piping installation requirements are found in other specification sections. The drawings indicate the general arrangement of the piping, fittings, and specialties. The following are specific connection requirements:
- B. Install piping adjacent to equipment to allow servicing and maintenance.

3.6 Field Quality Control

- A. Testing Laboratory: Owner will employ and pay an independent testing laboratory to perform field quality control testing.
- B. Testing Laboratory: Provide the services of an independent testing laboratory experienced in the testing of [unit of work] and acceptable to the engineer to perform field quality control testing.
- C. Extent and Testing Methodology: Arrange for testing of completed [unit of work] in successive stages in areas of extent described below; do not proceed with [unit of work] of the next area until the test results for the previously completed work verify compliance with the requirements.
- D. Testing laboratory shall report test results promptly and in writing to the contractor and engineer.
- E. Repair or replace [unit of work] within the areas where the test results indicate [unit of work] does not comply with the requirements.
- F. Manufacturer's Field Service: Provide the services of a factory-authorized service representative to supervise the field assembly of components, the installation of [products] including piping and electrical connections, and to report the results in writing.

3.7 Adjusting [Cleaning] [Adjusting and Cleaning]

3.8 Commissioning (not a CSI article but useful)

- A. Startup Services, General: Provide services of a factory-authorized service representative to provide startup service and to demonstrate and train owner's maintenance personnel as specified below.
- B. Test and adjust controls. Replace damaged or malfunctioning controls and equipment.
- C. Train owner's maintenance personnel on procedures and schedules that are related to startup and shutdown, troubleshooting, servicing, and preventative maintenance.
- D. Review the data in the operation and maintenance (O & M) manuals. Refer to Division 1, Section ["Project Closeouts"] ["Operating and Maintenance Manuals"].
- E. Schedule training with the owner through the Architect [Engineer] with at least seven (7) days' notice.

3.9 Protection

3.10 Schedules

- A. Schedule the types of piping materials that are acceptable for the different systems described based on size and application.
- B. Schedule the types of insulation that are to be used for each system based on size. Include specifications for acceptable materials, wall thickness, standard service jacket, and special final PVC or metal jacket.

ASPE Read, Learn, Earn Continuing Education

You may submit your answers to the following questions online at aspe.org/ReadLearnEarn. If you score 90 percent or higher on the test, you will be notified that you have earned 0.1 CEU, which can be applied toward CPD or CPDT recertification or numerous regulatory-agency CE programs. (Please note that it is your responsibility to determine the acceptance policy of a particular agency.) CEU information will be kept on file at the ASPE office for three years.

Expiration date: Continuing education credit will be given for this examination through **February 29, 2020**.

Thank you to Ethan Grossman, PE, CPD, LEED AP of the Boston Chapter for authoring the questions of this Read, Learn, Earn article.

CE Questions — "Specifications" (CEU 268)

- "Project manual" is a term used to describe _____.
 - bidding documents
 - all documents in the contract, except for drawings.
 - construction contract documents
 - specifications that are part of the contract
- The purpose of using different specification divisions is _____.
 - so all parties look in the same location for different types of work.
 - for the designer and engineer to determine how the work will be divided between subcontractors
 - to determine who is going to pay for different types of work.
 - both A and C.
- The contract between the owner and the contractor includes _____.
 - plumbing drawings
 - plumbing specifications
 - general conditions
 - all of the above, including addenda
- The purpose of a bid form, prepared by architects or engineers, is to _____.
 - assure the contractor agrees to the contract
 - provide a uniform submittal so that all bids can be compared equally.
 - make sure that the contractor can complete the project.
 - provide a notarized record of the contractor's intent at the bid opening.
- Which of the following is a method of specifying products, materials, or workmanship based mainly on required results?
 - Descriptive
 - Performance
 - Proprietary
 - Referenced standards
- _____ are changes to the bid documents, issued prior to the contract being signed.
 - RFIs (requests for information)
 - Bulletins
 - Sketches
 - Addenda
- Uniformat is a type of specification used to _____.
 - help the estimator develop a cost estimate
 - organize project data during the preliminary design phase
 - divide the work into broad sections, mostly during the schematic phase
 - all of the above
- The three main parts of a MasterFormat specification are:
 - General, Products, and Execution
 - Submittals, Products, and Execution
 - General, Products, and Close out
 - General, Manufacturers, and Execution
- Under MasterFormat, the 6-digit numbering system assigned for plumbing is:
 - 210000
 - 150000
 - 220000
 - 230000
- The term "approved equal," used to define a level of quality, should be defined in the following specification section:
 - Common Work Results for Plumbing – 220000
 - Division 016000 – Product Requirements
 - approved equal should never be used. Always specify 3 manufacturers.
 - Both A and C.
- When developing the products section in a specification, the designer should obtain information from:
 - personal experience.
 - owner requirements.
 - code requirements and referenced standards.
 - All of the above.
- Some advantages of proprietary specifications include:
 - Better competition
 - Lower pricing for the owner
 - Closer control in the selection of products
 - All of the above