Specification Writing - Fundamentals of Structure, Language, Writing and Risk Management

By Leo Marsh, PE, RCDD
CH2M Hill
Safety Moment

Safety in the Sun
Schedule

1:30 to 2:45    Part 1
2:45 – 15 minute break
3:00 to 4:15    Part 2
4:15 Q&A and wrap up
Purpose of this Course

Understanding Specifications

- What is a Specification Document
- Contract Basics
- Specification Writing
- Specification Language
- CSI Master Format
- Data Center Examples
- Master Specs
- Risk Management
References
Specifications are one of the basic components that make up the contract agreement between the Owner and the Contractor.
Construction Documents
Specifications

Administrative
• Schedule
• Terms and Conditions
• Definitions
• Address of the project site
• Identification of the Parties to the Contract
Specifications

Specifications define the requirements for products, materials and workmanship upon which the contract is based and the requirements for administration and performance of the project. They are written to achieve a **Work Result**.
Specifications

Specifications are generally written for each subject as sections and organized under [CSI] MasterFormat. MasterFormat is a list of titles that represent construction practices or work results that result from the application of skills and procedures to the materials, products or assemblies.

It’s a Standard!
Specifications - Drawings

The drawings are graphic representations of the work upon which the contract is based.
As the graphic documents usually contain more than plan views, the preferred term is Drawings rather than Plans.
The Relationship Between Specifications and Drawings - Differences

- **Drawings**
  - Graphically show the components in relation to the rest of the building and surrounding components.
  - Graphically show a symbol representing a component not drawn to scale.
  - Provides dimensions for the component placement.
  - Annotations specific to the component placement. Such as “Coordinate the fire pull station with the fire extinguisher mounted adjacent to the door.”
  - Specification items are not repeated on the drawings.

- **Specifications**
  - Provides the component specifications of performance, size, weight.
  - Provides component labeling and testing requirements.
  - Identifies the Contractor qualifications to install the components.
  - Provides direction to the contractor in the execution of construction to get a common work result. It does not repeat manufacturers or Code requirements.
  - Drawing information is not repeated in the specs.
Specifications and Drawings - Similarities

• Drawings & Specifications
  – Part of the “Contract” between the Owner and the Contractor
  – Use the same contract language, and terms.
  – They work together and cannot be used or developed separately.
  – Engineers and Architects that write the specifications need access to the drawings.
  – Designers and Drafters that create the drawings need access to the specifications.
  – Specs do not supersede drawings. Drawings do not supersede specs. If they contradict each other, it is a design error.
Specification Owners & Authors

Architects
Engineers & Designers
Others
Vendors
Suppliers
Equipment Manufacturers
Owner
Intended Recipients of Specifications

Knowing the Recipients of the document helps the author to make decisions on the language in writing the specification.

The specifications are intended to be read by the Contractor.

Contractor may then hand off to the subcontractors, vendors and manufacturers.
Elements of a Contract

1. Offer
2. Consideration – something of value
3. Acceptance – must mirror the terms
4. Mutuality
   1. ‘A meeting of the minds’ this means the parties understood and agreed to the basic substance and terms of the contract.
How is a Contract Interpreted?

• In general the court reads the contract as a whole (drawings, specifications, etc) and according to the ordinary meaning of the words. To interpret or clarify the contract, additional information such as submittals, emails or other correspondence can be used.
The Contract

Design-Bid-Build Contract Relationship

Owner

Architectural/Engineering

Consultant

Contractor or CM

Subcontractor or Vendor

The Contract
Contracting Strategies

Design – Bid – Build

Design/Build
Parties to the Contract

Parties

- Owner
- Contractor
- Architect
- Engineer

- Design-Builder
- Construction Manager
- Vendor
- Subcontractor

- All the parties above may be mentioned in the specifications but it typically is only the Owner and the Contractor that are considered the “Parties to the Contract”.
Specification Writing

Know your audience – It’s the Contractor(s)
Know the Parties of the Contract –
Understand the contracting strategy

Writing Style

Be Accurate, Brief, Clear

Avoid complex sentences and stilted language (artificially formal).

Use simple sentences with terms and words that are easily understood.
Writing to the Parties of the Contract

Design-Bid-Build

Bad Example: The Communications Contractor shall coordinate with the Electrical Subcontractor for cable supports and pathways.

Good Example: Cable supports and pathways are shown on the Electrical Drawings.

The bad example refers to a subcontractor. For Design-Bid-Build we always write as if the Owner if talking directly to the General Contractor. We never identify the subcontractors because we don’t assume who the General Contractor will subcontract to.
Writing Style Example 1

Be Accurate, Brief and Clear

• Bad Example:
  • The Contractor shall mount the TO above lab bench matching the height of light switch, fire alarm pull station and avoiding the fire extinguisher on the wall unless noted otherwise.

• Good Example
  • Mount the telecommunications outlet above the lab bench. Coordinate the mounting height with other wall mounted devices.
Avoid complex sentences and stilted (artificially formal) language

• Bad Example:
  • Stilted: Perform permanent link test on temporarily removed outlets.
  • Complex: For outlets that were temporarily removed during remodeling, perform a permanent link test on each circuit according to paragraph 3.4 of this section.

• Good Example:
  • Perform a permanent link test on the outlets that were temporarily removed during remodeling.
Use simple sentences and common words

• Bad Example: Rte cable orthogonal to building lines UNO. Obscure cable rte in column façade. Cable should not be visible across the column plinth, architrave or tablature.

• Good Example: Route the cables parallel to other utilities and building lines. Do not route the cable exposed on the surface of the building columns.
Use simple sentences and common words

- Bad Example: **Rte** cable **orthogonal** to building lines **UNO**. Obscure cable **rte** in column façade. Cable should not be visible across the column **plinth**, **architrave** or **tablature**.
Sentence Form

Form simple declarative sentences or imperative statements

• The Imperative Form
  • Example: “Place a label on the front of the data outlet face plate.”

• Do Not Write in the Indicative Form
  • Example: “Contractor Shall place a label on the front of the data outlet face plates.”
The Imperative Form (Good) Example

Coffee-making Instructions

• Place a coffee filter in the filter holder.
• Fill the decanter with cold water and pour into the water reservoir of the coffee maker.
• Add 1 tablespoon of coffee grounds to the filter for each cup of water poured into the reservoir.
• Turn the coffee pot selector knob to “brew”.
Coffee-making Instructions

- The Consumer Shall place a coffee filter in the filter holder.
- The Consumer Shall fill the decanter with cold water and pour the water into the water reservoir of the coffee maker.
- The Consumer shall add 1 tablespoon of coffee grounds to the filter for each cup of water poured into the reservoir.
- The Consumer shall turn the coffee pot selector knob to “brew”.

The Indicative Form (Bad) Example
The Imperative Form (Good) Example

Start with a verb. A word of action.

Coffee Pot Instructions

- **Place** a coffee filter in the filter holder
- **Fill** the decanter with cold water and pour into the water reservoir of the coffee maker
- **Add** 1 tablespoon of coffee grounds to the filter for each cup of water poured into the reservoir
- **Turn** coffee the pot selector knob to “brew”.
The imperative form is the preferred sentence form. This does not mean the indicative form, using the word “shall”, can never be used.

Tip: Use this same sentence form for writing notes on drawings.
Specification Language

Words to Avoid

• All
• Any
• Every
• Should
• Could
• Please
• Must
• Is to
Specification Language

Know the meaning of your words and use them consistently.

• Terms should be defined in the contract.
  
  **Furnish** – to supply and deliver to the project site, ready to install.

  **Install** – to place in position for service or use.

  **Provide** – to furnish and install, complete, ready for use.
Specification Language

Abbreviations

• Only use on drawings and in schedules when space is limited.
• Every abbreviation must be defined on the Drawing Legend Sheet.
• Avoid using them in the body of a specification.
Every word in a specification is important.

• Do not:
  – Underline
  – Bold
  – Italicize
  – Highlight

• Do not use color in final specifications.
CSI Master Format

• Old Format used 5 digits
  – Example: 16704 Communication Cabling

• New Format uses 6 digits
  – Example: 27_10_00 Structured Cabling

• New Format with 8 digits
  – Example: 27_15_00.19 Data Communications Horizontal Cabling
## CSI Master Format

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 00 00</td>
<td><strong>COMMUNICATIONS</strong></td>
</tr>
<tr>
<td>27 01 00</td>
<td><strong>Operation and Maintenance of Communications Systems</strong></td>
</tr>
<tr>
<td>27 01 10</td>
<td>Operation and Maintenance of Structured Cabling and Enclosures</td>
</tr>
<tr>
<td>27 01 20</td>
<td>Operation and Maintenance of Data Communications</td>
</tr>
<tr>
<td>27 01 30</td>
<td>Operation and Maintenance of Voice Communications</td>
</tr>
<tr>
<td>27 01 40</td>
<td>Operation and Maintenance of Audio-Video Communications</td>
</tr>
<tr>
<td>27 01 50</td>
<td>Operation and Maintenance of Distributed Communications and Monitoring</td>
</tr>
<tr>
<td>27 05 00</td>
<td><strong>Common Work Results for Communications</strong></td>
</tr>
<tr>
<td>27 05 13</td>
<td>Communications Services</td>
</tr>
<tr>
<td>27 05 13.13</td>
<td>Dialtone Services</td>
</tr>
<tr>
<td>27 05 13.23</td>
<td>T1 Services</td>
</tr>
<tr>
<td>27 05 13.33</td>
<td>DSL Services</td>
</tr>
<tr>
<td>27 05 13.43</td>
<td>Cable Services</td>
</tr>
<tr>
<td>27 05 13.53</td>
<td>Satellite Services</td>
</tr>
<tr>
<td>27 05 26</td>
<td>Grounding and Bonding for Communications Systems</td>
</tr>
<tr>
<td>27 05 28</td>
<td>Pathways for Communications Systems</td>
</tr>
</tbody>
</table>
CSI Master Format

Recommendations for selecting CSI numbers:

– Remember to keep it simple
– Use the 6 digit number when possible.
– Avoid using every CSI number in the Master Format
– Ideally use only one CSI number
  • Example: “27_00_00 Communications”
  • Example for Performance Spec. “27_00_05 Common Work Results for Communications”
CSI Section Format

Section Format has 3 parts

• Part 1 – General
  – Administrative information unique to this section that is not covered in the Division 1 administrative section.

• Part 2 – Products
  – Products specific to this section. Description, manufacturer, part numbers, color, ....
Part 3 – Execution
   – Executable information on the products listed in Part 2.
   – Assembly information
   – Testing
   – Action Items

• Avoid repeating information in each Part.
CSI Section Format - Sample

SECTION 27 00 00

GENERAL COMMUNICATIONS REQUIREMENTS

PART 1 -- GENERAL

1.1 WORK INCLUDED

A. This Section specifies the requirements necessary to furnish and install:
   1. 
   2. 
   3. 

1.2 RELATED WORK

A. Use this Section in conjunction with the following other specifications and related Contract Documents to establish the total requirements for 27 00 00 General Communications Requirements:
   1. The Contract.
   2. Division 1 sections included in the project specifications.
   3. Section 02 30 00 - Earthworks.
   4. Section 07 48 00 - Firestopping.
   5. Appendix included at the end of this Section.
CSI Section Format - Sample

PART 3 -- EXECUTION

3.1 INSPECTION
   A. 

3.2 FIELD PREPARATION
   A. 

3.3 INSTALLATION
   A. 

3.4 FIELD QUALITY CONTROL
   A. 

3.5 TOLERANCES
   A. 

CSI Section/Page Format

The CSI Section Format/Page Format document includes:

– Examples
– Article Headers
– Sample Templates in the Appendix
CSI Page Format

Figure PF-2a - PageFormat Example with Descriptive Notes

NOTES:
'HAND-LETTER' TYPEFACE INDICATES DESCRIPTIVE NOTES WHICH ARE NOT PART OF THE PAGE FORMAT.
"F" INDICATES CHARACTERS (NUMBERS OR LETTERS) SUBJECT TO CHANGE WITH CONTEXT.
REFER TO GLOSSARY FOR DEFINITION OF TERMS.

MORE IMPORTANT INFO
0.5" - 0.6"

TOP MARGIN
0.5" - 0.6"

HEADER AREA

TITLE ZONE (FIRST PAGE ONLY) TEXT OPTIONAL.

LEFT JUSTIFY TEXT BELOW TITLE ZONE

SECTION IN #.

PROVIDE SPACE TO SEPARATE TEXT FROM HEADER.

EXTRA SPACE BEHIND "END METHOD"

MORE IMPORTANT INFO

TOP MARGIN
0.5" - 0.6"

HEADER AREA

TITLE ZONE (FIRST PAGE ONLY) TEXT OPTIONAL.

LEFT JUSTIFY TEXT BELOW TITLE ZONE

SECTION IN #.

PROVIDE SPACE TO SEPARATE TEXT FROM HEADER.

EXTRA SPACE BEHIND "END METHOD"

MORE IMPORTANT INFO
Example Specification

SECTION 27 00 00

COMMUNICATIONS GENERAL REQUIREMENTS

PART 1 -- GENERAL

1.1 WORK INCLUDED

A. General requirements specifically applicable to Division 27 communications requirements.

B. The Contractor is responsible for:
   1. Furnishing materials, labor, and equipment in accordance with these Specifications and the accompanying Drawings.
   2. Complete systems in accordance with the intent of these Contract Documents.
   3. Coordinating the details of facility equipment and construction for other specification divisions that affect the communications system work covered under this division.
   4. Furnishing and installing incidental items not actually shown or specified, but which are required by good practice to provide complete functional systems.
D. This Section specifies the requirements necessary to furnish, install, identify, and test products and materials listed below.
1. Communications raceway, tray, innerduct, and fittings.
2. Communications room subsystems, including:
   a. Backboards, cabinets, and equipment racks.
   b. Equipment rack shelves.
   c. Protector panels and protectors.
   d. Wiring block systems.
   e. Modular patch panels.
   f. Fiber optic distribution units (FDUs).
   g. Cable management accessories.
   h. Ground busbar hardware.
   i. Equipment rack and cabinet ground bars.
3. Horizontal unshielded twisted-pair (UTP) distribution subsystem, including:
   a. UTP cable placement and termination.
   b. Telecommunications outlet components.
4. Communications cable and accessories, including:
   a. Unshielded twisted-pair UTP cable.
Example Specification Part 2

2.16 FIBER OPTIC DISTRIBUTION UNITS (FDU)

A. Acceptable Manufacturers:
   1. Systimax Communications.
   2. Corning Cable Systems.

B. FDUs: Enclosure arranged for 19-inch equipment rack mounting equipped to hold adapter connector panels and cable mounting accessories.
   1. Four-Rack Unit Connector Panel Housing:
      a. Systimax Communications: LST1U-72/7.
      b. Corning Cable Systems: CCH-04U.
   2. Three-Rack Unit Connector Panel Housing:
      a. Systimax Communications: LSC2U-024/5.
      b. Corning Cable Systems: CCH-03U.
   3. Two-Rack Unit Connector Panel Housing - Corning Cable Systems: CCH-02U.
   4. Fiber Adapter Connector Panels: modular panels for use with adapters to make direct fiber optic interconnections.
      a. SC Duplex Connector Panels:
         1) Systimax Communications: 1000SC1-DPLX, connector panel with 3 adapters.
            a) C6060A-4, single-mode ceramic-insert adapter.
            b) C6061A-4, multimode metallic-insert adapter.
         2) Corning Cable Systems:
Example Specification – Part 3

3.19 FIBER OPTIC CABLE INSTALLATION

A. Use care when handling fiber optic cable. Carefully monitor pulling tension and cable bend radius so as not to exceed the limits specified by the manufacturer.

B. Provide the following service loop of cable for connectorizing, polishing, and serviceability:
   1. Backbone Cable Segment:
      b. Sheathed in Communication Vault: as indicated on the Drawing or cable schedule.
      c. Unsheathed in FDU: 10 feet.
   2. Horizontal Cable Segment:
      a. Unsheathed in FDU: 10 feet.
      b. Unsheathed at Outlet: 4 feet.

• All 3 Parts work together
Part 1
Questions ?
Data Center Examples
2.1 EQUIPMENT RACKS

A. Floor-Supported Equipment Racks:
   1. Material: Aluminum.
   2. Finish: Aluminum with clear iridite finish.
   3. Uprights: 4-inches wide with EIA drilling for 1-3/4-inch panels on the front.

B. Cabling Management Sections:
   1. 84-inches-high by 6-inch-wide vertical aluminum rack cabling section, including formed assembly, and assembly hardware.
2.1 EQUIPMENT CABINETS

A. Equipment Cabinets:
2. Finish: Black.
3. Overall Dimensions: 24-inches wide by 36-inches deep by 76-1/4-inches high.
5. Mounting Spaces: 40 1-3/4-inch-high panels.
7. Side Panels: With side panels.
8. Doors: With front and rear doors.
10. Latching (Door Handles): Key lockable.
What's a PDU?

• And in what spec section would you find it?
Power Distribution Unit

• 26 26 00 Power Distribution Units  

Or

• 27 11 16 Communications Rack Mounted Power Protection and Power Strips  

Bicsi
Power Distribution Unit’s

PDU
Includes transformer

pdu
Power strip
Master Specifications

• Referred to as Boiler Plate Specifications
• Owner Master Specifications
• A/E or Consultant Master Specifications.
• Saves a lot of time in not writing specs from scratch
• Provides consistency in construction requirements.
• Can result in a non-specific project scope if not properly revised by the author.
Create Your Own Masters

• Editing Software
  • ARCOM, BSD and UFGS have software to manage the spec content.
    • ARCOM – SpecWare and SpecAgent
    • BSD – SpecLink-E
    • UFGS - SpecIntact

• Integrated Spec and Design Software
  • Interspec – e-Specs for Revit, for AutoCAD
  • Bently - SpecWave
### Master Spec. Tips

- Using Notes to Specifier (NTS) within body of text.

#### 2.2 CONDUIT AND FITTINGS

A. Metallic:

1. [Rigid Steel Conduit: rigid galvanized steel.]
2. [Electrical Metallic Tubing (EMT): galvanized tubing.]
3. [Flexible Metal Conduit: steel.]
4. [Liquidtight Flexible Conduit: flexible metal conduit with PVC jacket.]

---

Setscrew fittings are not acceptable on food projects.

---

5. Fittings and Conduit Bodies: threaded type or [setscrew] [compression] type for EMT; material to match conduit.

---
Master Spec. Tips

• Using Specifier choices in Brackets

2.2 CONDUIT AND FITTINGS

A. Metallic:

1. [Rigid Steel Conduit: rigid galvanized steel.]
2. [Electrical Metallic Tubing (EMT): galvanized tubing.]
3. [Flexible Metal Conduit: steel.]
4. [Liquidtight Flexible Conduit: flexible metal conduit with PVC jacket.]

Setscrew fittings are not acceptable on food projects.

5. Fittings and Conduit Bodies: threaded type or [setscrew] [compression] type for EMT; material to match conduit.
Master Spec. Tips

Highlight action items required by the specifier.

2.2 CONDUIT AND FITTINGS
A. Metallic:
1. [Rigid Steel Conduit: rigid galvanized steel.]
2. [Electrical Metallic Tubing (EMT): galvanized tubing.]
3. [Flexible Metal Conduit: steel.]
4. [Liquidtight Flexible Conduit: flexible metal conduit with PVC jacket.]

***************************************************************************** Setscrew fittings are not acceptable on food projects.*****************************************************************************

5. Fittings and Conduit Bodies: threaded type or [setscrew] [compression] type for EMT; material to match conduit.

Do not publish until highlights, brackets and NTS have been deleted.
### PART 2 -- PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. 
   B. 
   C. 

2.2 GENERAL
   A. 

2.3 MATERIALS
   A. 

2.4 FABRICATION
   A. 

2.5 ACCESSORIES
   A. 

2.6 FINISHES
   A.
Master Spec. Tips

• Other Considerations
  – Use Revision Control with Word to track edits.
  – Organize submittals within the body of the specification in one location. Create a table or list of contractor submittals.
  – Avoid repeating information on your drawings that is already in your specification.
Other Considerations

- The Contractor is responsible for reading the specifications but you do not have to make it a treasure hunt.
- Keep it simple. More text is not better.
Disclaimer:

- Any views or opinions presented herein are solely those of the author and do not represent those of BICSI, CH2M Hill or AAA. The information provided is used for general discussion purposes. Use of this information should be used with a full understanding of law by a qualified representative.
Who would sue whom?

Design-Bid-Build Contract Relationship

Owner

Architectural/Engineering

Consultant

Contractor or CM

Subcontractor or Vendor

The Contract
Again, Who would sue whom?
Risk Management

• How do we reduce risk?

• Where do we start?

• What would a judge, jury or an arbitrator look at?
Risk Management

Definitions

• Litigation - An action brought in court to enforce a particular right. The act or process of initiating a lawsuit.

• ADR (Alternative dispute resolution) - refers to a range of procedures for resolving disputes. Mediation and arbitration are the two most common ADR procedures.
Risk Management

Definitions

• Mediation - is a non-binding process which helps parties try to resolve their dispute voluntarily on a mutually agreeable terms. **Non-binding** means the mediator has no power to make any decisions.

• Arbitration – is a **binding** process by which disputes are resolved after a hearing known as arbitration. **Binding** means the arbitrator issues an award that can be enforced in the courts.
Risk Management

Definitions

- **Discovery** - Part of the pre-trial or pre-arbitration process during which each party requests relevant information and documents from the other side in an attempt to "discover" pertinent facts.
  - Generally includes:
    - Depositions, interrogatories, requests for admissions, document production requests and requests for inspection.
Risk Management

Definitions
• Winning?
  – prevailing in a lawsuit?
  – preserving relationship?
  – avoiding distraction of key personnel?
  – setting precedents?
  – minimizing expenses?
Alternative Dispute Resolution

Advantages

• Flexibility of procedure - the process is determined and controlled by the parties the dispute
• Lower costs
• Less complexity
• Parties choice of neutral third party (and therefore expertise in area of dispute) to direct negotiations/adjudicate
• Practical solutions tailored to parties’ interests and needs
• Durability of agreements
• Confidentiality
• The preservation of relationships and reputations.
Risk Management

Reducing risk. Where do we start?

• Internal processes and procedures.
  – Standard agreements (clauses) with Owner or Design/Builder.
  – Qualified risk management department.
  – Specification development and quality control processes
  – Training in specification development.
  – PM’s trained in risk management
  – Construction phase activities
  – E&O Insurance
Risk Management

- Clarifications by construction phase duties can reduce risk.
  - Submittal review
  - Shop drawing review
  - RFI
  - Field observation notes
Risk Management

Communications

• Words to avoid
  – Extreme words, such as final, all, complete or best
  – Words of multiple meaning such as inspect or estimate
  – Words of promise, such as guarantee or certify
Risk Management

COORDINATE, COORDINATE, COORDINATE

Common coordination issues include:

• Referencing wrong sections
• Assigning work to ‘others’
• Specifying Division 01 requirements in technical sections
Errors or Omissions

Do the specs have to be perfect?
Or to what degree do they need to be accurate.
Errors or Omissions

Do the specs have to be perfect?
Or to what degree do they need to be accurate.

• Depends on the industry.
  
  Example 1: Home deck
  Example 2: Fire Alarm System
  Example 3: Space shuttle
Part 2
Questions ?