PDHonline Course G467 (2 PDH)

Preparing the Written Equipment Specification

Instructor: John C. Huang, Ph.D, PE

2020

PDH Online | PDH Center

5272 Meadow Estates Drive
Fairfax, VA 22030-6658
Phone: 703-988-0088
www.PDHonline.com

An Approved Continuing Education Provider

Preparing the Written Equipment Specification

W.N. Weaver PE and John C. Huang, PhD, PE

1.0 INTRODUCTION

Preparing any written document including a specification is best accomplished when the reason for the document is understood, we'll explore that first. Afterwards we'll look at the various times when a written specification is beneficial and finally what we expect the specification to accomplish and how the verbiage accomplishes this goal. Throughout this material the reader should refer to the attached vessel specification, Attachment A.

A specification has several purposes one of which is to provide insurance that individuals understand what equipment or labor is to be provided. Considerable information can be incorporated into the written document and accompanying sketches. The intent of the verbiage and sketches is to convey **all** of the information necessary to obtain the desired piece of equipment.

1.1 POINTS TO CONSIDER

When preparing a written specification keep the following points in mind:

- What type of specification are you preparing, Specific or Performance? See Section 2.
- Who are you preparing the specification for, Purchasing or for direct submittal to a specific vendor?
- Does your specification contain all the necessary information to completely identify what you want to purchase?
- Does the specification provide adequate protection for classified information?
- Have you incorporated all applicable plant and national standards?
- Is there a conflict between any of the attachments and the written document?
- Is plant contact information incorporated into the document?

2.0 TYPE OF SPECIFICATIONS

There are two basic types of specifications; in very simple terms they are:

A. Specific

A Specific specification describes the desired item completely and may be as simple as a model number in the description section of a purchase order form. No "engineering" effort is required of the vendor.

B. Performance

A performance specification describes what the item is to accomplish.

The difference is critical: If written properly a Performance specification places the responsibility for the ordered item accomplishing the desired goal on the supplier whereas the Specific specification places that responsibility on the person placing the order.

EXAMPLE:

REQUIRED: Pump water at 100 gallons per minute to a storage tank located 75 feet above the pump using 100 feet of 2" sch 40 carbon steel pipe with four elbows, two tees and two ball valves. Calculated required developed head is about 83.7 feet including change in elevation. Water is at 70 ^{o}F with a viscosity of 1.0 centipoise and density of 62.3 #/ft^3. Available suction head above the pump (NPSHA) is 16 feet.

A. Specific Specification

Provide one Goulds Model 3196 2x3x10 with 9.5" impeller direct drive pump mounted on a painted carbon steel base with 5 Hp 1750 rpm TEFC motor; voltage to be 220/440/3/60. Include OSHA coupling guard and FlowServ single mechanical seal.

B. Performance Specification

Provide one Goulds model 3196 pump as follows

Size	By vendor
Impeller diameter	By vendor
Flow rate	100 gpm
Minimum developed head	100 feet
Fluid	Water
Temperature	70 ^{o}F
Viscosity	1.0 cps
pH	neutral
Particulate	None
Abrasive characteristics	None
Density	62.3 #/ft^3
NPSHA	16 feet
Mounting	Standard direct drive on frame
Finish	Vendor standard
Options	OSHA rated coupling guard
Packing / Seal	FlowServ single mechanical seal model by vendor
Electrical classification	Non hazardous, TEFC required
Motor Hp	By vendor
Motor manufacturer	GE or equal
Voltage	220/440/3/60
Installation location	Indoors, Ambient temperature, Dry

Now let us assume that you have done your pressure / flow calculations and issued the purchase specification. Once the pump is correctly installed with proper piping as listed above there are two possible outcomes: the pump works as required or does not work as required. Let's assume the pump fails to deliver the 100 gpm. What are our probable outcomes from these two specifications?

SITUATION	Specific Specification	Performance Specification
Data for pump conditions is **correct** and pump fails to deliver 100 gpm	You have no recourse to the vendor who merely supplied exactly what you requested	Vendor has performed all the calculations and selected the pump / impeller / motor and is responsible for the pump failure
Data for pump conditions is **incorrect** and pump fails to deliver 100 gpm	You have no recourse to the vendor who merely supplied exactly what you requested	You have no recourse to the vendor who supplied a pump based on your erroneous data

The preparation of a Performance Specification generally requires more thought and less engineering calculations effort than is required for a Specific Specification. A performance specification requires that the engineer determine what has to be accomplished by the equipment whereas for a Specific specification the engineer needs to do all the calculations and spend time with vendor data selecting the equipment.

In the example above suppose the ordering engineer's request for a "Goulds 3196" creates a problem meeting the specification; perhaps the requested flow rate is off all curves for the 3196. There is no way the vendor can meet the performance requirements as written so he either elects not to offer the equipment or he requests permission to offer a substitute. The Specific specification is still fulfilled by the vendor by supplying the specified Goulds 3196 pump which will not meet the requirement.

With a Performance specification the vendor may want to spend more time looking at your data and if applicable make a field visit. A secondary benefit is that the vendor knows his / her equipment offerings better than you do and frequently can suggest a less expensive option than you might select with a Specific Specification. Likewise his factory calculations may be more accurate and will probably call for a smaller safety factor than you would and you may end up with a smaller pump and motor combination. For these reasons your data in the specification needs to be accurate.

Remember the pump vendor probably runs hundreds of pump sizing calculations during the year compared to the few you may calculate. However, it is a good plan to make at least a quick sizing calculation in order to have a feel for the probable pump size to expect.

Consider the Performance Specification as an insurance policy with the potential of saving you money. This is important enough that it needs repeating. A Performance Specification places the responsibility for proper equipment selection on the vendor whereas a Specific Specification places that responsibility on the specification writer.

3.0 HOW MUCH INFORMATION IS ENOUGH

Suppose you wanted to have someone supply a round metal bar. What information does the supplier need in order to meet your request?

1. Bar dimensions: diameter and length
2. Metal alloy
3. Surface finish
4. Surface treatment (paint, etc.)
5. Surface hardness
6. Core hardness
7. Machinability index
8. Tolerance on length
9. Tolerance on diameter
10. Allowable bend in bar (straightness tolerance)
11. Allowable out-of-roundness (roundness tolerance)
12. Shipping packaging
13. Delivery time

In different circumstances all of the above criteria are critical, most likely not all at the same time. There are thirteen areas where you must provide adequate information to the vendor for this simple metal bar. This sample is not necessarily all of the criteria a company may apply to something as simple as a round metal bar however it does give us an idea of the breadth of information which can be used to describe that bar and thus might need to be presented in order to receive exactly what is needed.

In some cases you need to provide details on all aspects of the item as above with the metal bar. Other times you can save time by using existing standards, which describe exactly what you want.

As an example of how this works let's order a section of structural steel

4.0 VARIOUS ORDERING APPROACHES

Part of working is to avoid useless work where possible. There are several approaches to ordering equipment, in this case equipment could be as simple as the round bar above or as complex as complete equipment packages such as a compressor.

The goal here is to create written specifications only when necessary; shown below are various methods of ordering equipment.

Purchase order with minimal description

ABC CHEMICALS 1410 Adams St. Winston, NC 28730	Purchase Order #	ISSUED BY	APPR'V'D BY
	AS-1417	Joe Smith	Fred Smith
Jones Metal Supply 12 State St. Winston, NC 28731	DELIVERY REQ'D		
	June 26, 2009		

ITEM	DESCRIPTION	COST EA	TOTAL
1	400 feet 1 inch hot rolled rebar	$0.115/ feet	$46.00

Purchase order with drawing

ABC CHEMICALS 1410 Adams St. Winston, NC 28730	Purchase Order #	ISSUED BY	APPR'V'D BY
	AS-1417	Joe Smith	Fred Smith
Jones Metal Supply 12 State St. Winston, NC 28731	DELIVERY REQ'D		
	June 26, 2009		

ITEM	DESCRIPTION	COST EA	TOTAL
1	400 feet rebar per attached drawing number RB-145 (not included in course materials)	$0.115/ feet	$46.00

PURCHASE ORDER WITH ITEM MODEL NUMBER

ABC CHEMICALS 1410 Adams St. Winston, NC 28730	Purchase Order #	ISSUED BY	APPR'V'D BY
	AS-1417	Joe Smith	Fred Smith
Jones Metal Supply 12 State St. Winston, NC 28731	DELIVERY REQ'D		
	June 26, 2009		

ITEM	DESCRIPTION	COST EA	TOTAL
1	400 feet rebar per your material code 1516	$0.115/ feet	$46.00

Purchase order with minimal description and standard reference

ABC CHEMICALS 1410 Adams St. Winston, NC 28730	Purchase Order # AS-1417	ISSUED BY Joe Smith	APPR'V'D BY Fred Smith
Jones Metal Supply 12 State St. Winston, NC 28731	DELIVERY REQ'D June 26, 2009		

ITEM	DESCRIPTION	COST EA	TOTAL
1	400 feet #8 rebar meeting ASTM A706/A706M	$0.115/ feet	$46.00

WRITTEN SPECIFICATION

ABC CHEMICALS 1410 Adams St. Winston, NC 28730	Purchase Order # AS-1417	ISSUED BY Joe Smith	APPR'V'D BY Fred Smith
Jones Metal Supply 12 State St. Winston, NC 28731	DELIVERY REQ'D June 26, 2009		

ITEM	DESCRIPTION	COST EA	TOTAL
1	400 lineal feet of hot rolled steel rebar for use in 4000 psi concrete as reinforcing, core diameter to be 1 inch with 1/8" spiral ribs on an alternating 45^{o} pitch, two 1/8" longitudinal ribs 180 degrees apart. Rib height to be 0.125 inches, rib radius to be 0.125 inches. Mill rolled finish. Bar minimum length to be 20 feet. Minimum yield strength to be 40,000 psi.	$0.115/ feet	$46.00

Let's look at these methods from the perspective of the best use of the ordering engineer's time for the necessary rebar above.

ORDERING APPROACH	RANK BASED ON ESTIMATED AMOUNT OF TIME REQUIRED TO PREPARE THE PURCHASE ORDER	**COMMENTS**
Purchase order with minimal description	3	REQUIRES SOME WRITTEN DESCRIPTION
PURCHASE ORDER WITH DRAWING	4	DRAWING CREATION REQUIRED
PURCHASE ORDER WITH ITEM MODEL NUMBER	1 (LEAST)	SIMPLEST APPROACH
PURCHASE ORDER WITH MINIMAL DESCRIPTION AND STANDARD REFERENCE	2	NEED TO FIND THE NECESSARY REFERENCE
WRITTEN SPECIFICATION	5 (MOST)	MULTIUPLE LINES OF VERBIAGE PLUS FINDING THE NECESSARY DETAILS

Rebar, unless the order also requires forming the bar into specific shapes, is not an item where a written specification makes sense; the least expensive approach to preparing the order is to utilize a model number or a standard reference.

EXAMPLE
Suppose you need to order a length of 6 inch by 8.2 #/ft steel channel. You can write the purchase order in two ways:

> Develop a detailed listing of chemical and physical properties of the steel you want the channel made from

or

> Utilize an existing standard and specify an existing ASTM steel such as A36

When processed by the vendor these two orders produce exactly the same result. Making use of existing standards generally saves time in purchase specification creation but may require some time finding a standard that matches your requirements.

The use of nationally recognized standards such as ASTM A36 in place of a detailed written description offers two additional benefits:

- Reduction of the chances of an error in the specification

- In the event of (in this example) a structural failure resulting in injuries or damages the use of a recognized standard eliminates some potential liability issues and places more responsibility on the supplier.

Remember the goal of a specification is to tell the vendor everything he needs to know in order to provide the material you want; utilizing an accepted standard accomplishes that goal more accurately than most engineers can with a paragraph of verbiage.

5.0 WHEN TO USE PERFORMANCE AND SPECIFIC SPECIFICATIONS

There are times when a Performance Specification just doesn't work or make sense; let's look at a variety of equipment items and select the most appropriate type of specification.

ITEM	PERFORMANCE	SPECIFIC
Pumps, fans, compressors	Best	
Structural steel		Best
Standard electric motors		Best
Pipe		Best
Valves		Best
Control valves	Best	
Safety Relief Valves	Best	
Tanks, reactors, process vessels – non-pressure	Best	
Tanks, reactors, process vessels – pressure	Best	
Agitators	Best	
Heat Exchangers, condensers	Best	
Nuts, bolts, fasteners		Best
Electrical power components (motor starters, etc)		Best
Standard instrumentation (pressure gages, temperature gages, etc)		Best
Control instrumentation	Best	
Insulation		Best
Paint		Best

Items such as pipe, nuts and bolts, wire and structural steel meet accepted national standards and are usually incorporated into the design as manufactured. Instead of having someone manufacture a quantity of 1 & 13/16" bolts most engineers will use a Specific specification for a 1 & 7/8" or 2" standard bolt. When the design will incorporate standard items as supplied from the factory; pipe, valves, fittings, motors, structural steel, nuts and bolts, etc., there is little benefit to using a Performance Specification

Some items are arrived at by combining two or more standard items. Insulation calculations may indicate the economic thickness is 5 inches which in most cases is not a standard thickness but is achieved by installing a layer of 2" and a layer of 3" insulation. A Specific Specification in this example would call for 5" of insulation whereas a

Performance specification will call for a specified heat loss under specified conditions (pipe temperature, installation locations, exterior temperature, etc.).

Some items meet the required specification by being slightly larger than required by the design, as an example a pump motor is rarely selected to exactly match the calculated horsepower. Instead a calculated 4.5 Hp pump motor will most likely end up as either a 5 Hp or 7.5 Hp selection.

Those items requiring the equipment to meet potentially variable conditions are usually better specified using a Performance Specification. For example an agitator may have to mix a wide range of products so the specification can provide the vendor with the expected minimum and maximum density and viscosity.

Frequently the choice between a Performance Specification and a Specific Specification is determined by what the equipment does with energy. When the desired equipment must be sized based on surface area (heat transfer), watts (heaters), horsepower (pumps and agitators), developed head (pumps and fans), or similarly calculated values then considering a Performance Specification is generally advisable.

6.0 ATTACHEMENTS TO A SPECIFICATION

Frequently attachments are included with a specification. This accomplishes two things: they confirm the specification verbiage and reduce the required verbiage. The goal is to minimize any chance that the vendor will supply something other than what you have specified.

Commonly attached items include:

Equipment Data Sheets
- Pump data sheet (See Attachment C)
- Agitator data sheet
- Filter data sheet
- Etc.

Plant Standards
- Pipe codes
- Wiring standards
- Painting standards
- Etc.

National Standards
- The following sample indicates some of the recognized standards the incorporation of which simplifies the specification writing effort and provides additional insurance.

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
SSPC	Steel Structures Painting Council

AWS	American Welding Society
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturers Association
NEC	National Electrical Code
UL	Underwriters' Laboratory
API	American Petroleum Institute

Equipment Drawings, See Attachment B, Tank Specification Drawing
- Showing size and shape of equipment (tanks, etc.)
- Showing orientation of nozzles
- Showing desired mounting arrangements
- Showing desired utility termination points
- Showing desired nameplate location
- Etc.

Plant drawings
- Showing planned installation location
- Showing details which may affect equipment selection such as pipe routings

List of required vendor submittals
- Drawings for comment
- Construction drawings
- Documents:
  - Test reports
  - Mill specification sheets for materials
  - Calculations

Attachment B is a sample of a vessel specification drawing designed to attach to the specification, review this with the goal of transmitting necessary information to the vendor in mind. Certain types of information are easier to transmit with the drawing than with verbiage in the written specification.

Shown are approximate desired locations of nozzles on the vessel top head, bottom head and sidewall. Not shown is the actual position of any of the nozzles, instead a rough desired location is given along with the note "Final nozzle orientation to be provided on approval drawing." In part this is to simply the purchasing engineer's work and in part because of the need to position nozzles in such a way that they can be reinforced to meet code and so that nozzle flange interference is eliminated. This activity requires information on the size of the nozzle reinforcing pad which the purchasing engineer probably does not have. Final nozzle positioning is best accomplished with a CAD drafting program that allows for scaled drawings; this is something best produced by the fabricator and becomes part of the "approval drawings" set.

In the example above you may want to skip the "approval drawing" steps which can consume several days or weeks of waiting time. The location of nozzles on the vessel

head is relatively easy to specify in writing involving only a radius and angle from some specified zero degree line lying on a head diameter. Even then a drawing such as Attachment D is a worthwhile insurance policy. The fabricator will have to alert the purchasing engineer to any interference problems.

Equipment Data sheets, Attachment C, with changes can almost stand alone as a specification sheet for some items such as pumps, motors, etc. Remember these attachments are in support of the written specification and care must be taken to eliminate conflicting details between the two papers. A review of the data sheet indicates it contains significant data which would tend to lengthen the written specification if incorporated into the specification document veribage.

7.0 SPECIFICATION CONTENTS

There are several basic sections to most written specifications:

- Equipment Detail
- Boiler Plate
- Shipping Information
- Legal
- Documents
- Attachments

Refer to Attachment A for the following discussion of individual specification sections. Recognize that specifications are company specific and frequently personalized by the specification writer. Attachment A and the following comments are a sample only.

In larger companies, engineering companies and governments specifications are standardized to save time and money. Additional standardization is employed to reduce maintenance costs by always specifying specific manufacturers and equipment model numbers for items such as pumps where large quantities of spare parts are stocked.

1.0 Scope (Introduction, General)

1.1 Contains some basic information about what is being specified, some conflict resolution verbiage and the warning that the information included is confidential. Additional common content includes some project description, company information and the required delivery date.

2.0 Equipment

2.1 The equipment or what the equipment is to accomplish is described in this section. For example if we are specifying a pump then we need to place all the pertinent data for the desired pump here. This is the point where it becomes a Performance Specification or a Specific Specification. This section with the attached drawings should be adequate to tell the vendor all he needs to know. All other verbiage within the specification is supporting this section.

2.2 At this point the desired quantity and equipment number or name is frequently included.

3.0 Codes and Standards

3.1 The purpose of this section is to ensure the supplied items meet specific recognized codes and plant standards. This is in part to ensure the equipment is safe for installation and meets the plant insurance requirements. If for some reason the equipment fails or causes injury the requirement that specific national standards be met improves the specifying engineer's legal position.

3.1.1 For example by including the National Electrical Code as a standard the equipment must meet the specification the writer has incorporated. This insures the electrical equipment design and construction will be in compliance with most insurance carriers, OSHA and local jurisdiction requirements with a simple sentence.

3.1.2 Incorporation of ASME requirements eliminates exhaustive descriptions relative to the construction of the pressure shell for a reactor or boiler.

3.1.3 Specific plant standards which are more restrictive than applicable codes should be included here; examples might be the plant painting code or pipe codes for unusual materials

3.1.4 By incorporating this section significant verbiage can be eliminated.

4.0 Design and Fabrication

4.1 Regardless of the number of drawings and referenced standards there are always items which the engineer wants to emphasize or which are specific problems he wants to ensure are addressed. This section covers those items.

4.2 This section also provides room for "boiler plate" items such as "abrasive tools used on carbon steel shall not be used on stainless materials."

4.3 Requirements for bolting materials, gaskets, pipe flanges, nozzle extensions, etc. are commonly included in this section to stress the requirements.

4.4 Finally content of this section is not fixed and it becomes the "catch all" section of the specification.

5.0 Testing and Inspection

5.1 The vendor needs to understand the required type and extent of testing and probable inspection points as these items impact his bid.

5.2 The specification needs to establish inspection points based on seeing critical alignments, gear box running tests, pump testing, hydrostatic tests, surface finish prior to painting, electrical power and controls testing, etc. Some items need inspection prior to assembly since once assembled the parts cannot be seen; examples might be an extruder screw, gear box internals, large castings, etc.

5.2.1 The vendor needs to be supplied with a list of these inspection points and instructions on whom to contact and how much notice is to be given prior to the inspection.

5.3 All required testing needs to be detailed sufficiently for the vendor to estimate his material, labor and equipment costs for this activity. For example test pass-fail data is included here:
- 5.3.1 Hydrostatic testing to 1.5 times design pressure, hold 1 hour, no leaks
- 5.3.2 Gear box run tests at full speed and load for 20 hours, temperature rise within specifications
- 5.3.3 Electronic equipment powered and under 50% full load for 24 hours with minimum of 10 shutdowns and restarts once at operating temperature, no dropouts of circuit

5.4 Equally important he needs to understand what paper work he is expected to generate and issue with the equipment.
- 5.4.1 Copies of all tests and results

6.0 Cleaning and Painting

6.1 In this section the specification tells the vendor how you want the equipment finished and what precautions should be taken to prevent corrosion as a result of fabrication and testing.

6.2 When a sufficiently detailed plant painting standard exists it may be sufficient to reference that along with cautions about cleaning.

6.3 The specifying engineer should not assume that the fabrication shop understands the corrosion potential of city water on stainless steel. Additional corrosion problems arise by using chloride containing markers in the fabrication process.

7.0 Shipping and Tagging Requirements

7.1 This portion of the specification is frequently left out on the assumption that the vendor knows how to ship his equipment; that is not always true.
- 7.1.1 For example a fabricator of large pressure vessels most likely has a shop equipped with overhead traveling cranes with a capacity several times the equipment weight. His effort to load the equipment is minimal. On the other hand when the equipment arrives at its delivery point the available lifting equipment will most likely be much different.
- 7.1.2 The vendor needs to load the equipment on the truck in such a manner that it can be handled with the available equipment.
- 7.1.3 The vendor may need to break the equipment down into smaller parts for field handling due to lifting capacity or clearance problems.

7.2 Tagging or identifying components when shipping to a small facility with one receiving agent is simple enough; with large facilities boxes and even relatively large equipment items can become lost in multiple receiving departments. Tagging should be directed at eliminating the “lost” equipment in large facilities.

8.0 Information Required From Vendor

8.1 The purpose of this section is to ensure the equipment comes with enough information which at a minimum includes the following:
- 8.1.1 Operating manuals

8.1.2 Assembly instructions
8.1.3 Rigging and or lifting instructions
8.1.4 Anchoring instructions
8.1.5 Lubrication instructions
8.1.6 Maintenance manuals
8.1.7 Manuals for vendor purchased components (control valves, instrumentation, gear boxes, etc.) not manufactured by the primary equipment vendor
8.1.8 Electrical drawings
8.1.9 Mechanical drawings
8.1.10 Weight distribution drawings
8.1.11 Mill test reports
8.1.12 Welding data

8.2 This information is frequently detailed in an attachment titled "VENDOR DOCUMENTATION REQUIREMENTS". Refer to Attachment E.

8.2.1 Documents are required at two different times:
8.2.1.1 With the original vendor's bid (Send with bid)
8.2.1.2 With submittal drawings (Send with approval & final drawings)

8.2.2 Specific quantities of each submittal are required. For example Maintenance and engineering need electrical drawings.

8.2.3 Some submittals are required as reproducibles, for example foundation drawings will need to be sent to multiple construction groups.

8.2.4 In the past "Reproducibles" meant drawings which could be copied (Mylars as an example); today this generally means electronic file formats such as AutoCad, Windows Word, etc.

8.2.5 Many vendors hesitate to submit electronic drawing files since some of the information is confidential. Remember that later modifications to equipment and the facility need to be incorporated into some vendor drawings so electronic files are the best and least expensive method. Likewise an AutoCad drawing of a piece of equipment simplifies the designer's work when he / she can copy and paste equipment into design drawings. This is a critical point which needs to be resolved with the vendor up front. Frequently the engineer can find CAD drawings for standard equipment at the vendor's web site (pumps, motors, agitators, etc.).

8.3 Note that both "APPROVAL" and "FINAL" submittals are required for some items. Generally vessel nozzle arrangements should be requested as both APPROVAL and FINAL drawings. The difference between the two submittals is that APPROVAL drawings indicate where the vendor thinks the nozzles should be and offers the engineer the opportunity to adjust those positions. If the purchasing engineer adjusts the position of nozzles on the "APPROVAL" drawing then the vendor should create a revised drawing and resubmit that drawing for approval. When approved the drawing should be signed and returned to the vendor.

The "FINAL" drawing shows where the nozzles actually ended up after construction, there may be some minor differences but they should be small.

9.0 Attachments

9.1 All specification support documents should be attached to the specification and noted as becoming legally a part of the specification.

8.0 SPECIFICATION APPROVALS

Specifications need to be reviewed by other engineering functions impacted by the equipment; for example when ordering a pump with motor then the electrical group needs to review the motor portion of the specification to insure it meets their standards. This review should include all attachments to the specification, in the pump example note on the pump data sheet (Attachment C) a motor detail section.

Purchasing and under some conditions Legal also need to review the documents. The list of specification reviewers changes depending on the equipment but generally should include:

All impacted engineering groups
Maintenance
Operations
Purchasing
Legal

In many facilities the specification will become part of a bid document for equipment. Naming a specific manufacturer for the equipment limits the specification's use in bid documents. A Performance specification for a pump with no manufacturer listed opens the bidding process to most pump manufacturers and potentially offers cost savings to the facility.

9.0 REFERENCES

AIA American Institute of Architects
Various engineering organizations
AIChE
AIEEE
ASHRAE
ASME

10. CONCLUSION

Ensuring that the equipment ordered actually matches the need is a critical part of the engineer's job. The preparation of a complete written specification requires a thorough review of the ordered equipment and its capabilities.

A properly written specification should be an insurance policy offering confidence that the ordered equipment will be what is required and received. It also serves to ensure all affected facility individuals have the opportunity to input to the purchasing activity. When properly prepared this document provides the engineer with legal protection and leverage with the supplier to ensure what he / she has specified is what is actually delivered.

The written specification provides future value when maintenance or replacement of equipment is required. On one piece of paper is the entire specification along with the operating requirements for the equipment.