PDHonline Course G466 (2 PDH)

Fabricated Equipment Inspections for the Engineer

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Fabricated Equipment Inspections for the Engineer

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

1. INTRODUCTION

"The new 10,000 gallon storage tank arrived and was set in place on the waiting concrete slab. A beautiful sight except that the tank noticeably leaned a few degrees to the north."

"The replacement heat exchanger fit into the old piping and support structures perfectly, the installation was complete and the piping system hydrostat was underway. Except for the spray of water from the heat exchanger body flange it looked pretty good."

"The new reactor slid into the hole in the production room floor and settled its mounting lugs onto the steel beams. A nice fit except for the fact that the reactor was sitting two feet too high."

Typical horror stories of fabricated equipment purchases gone wrong.

It is not enough to prepare a written equipment specification for a piece of equipment, today's engineer needs to inspect the fabrication himself or call in someone to do that job. Most fabricators do an excellent job but all fabricators make an occasional mistake. Chances for a mistake are numerous and can occur in the engineer's efforts, the material supply area, and the fabrication area.

Catching those errors before the equipment leaves the fabricator's shop is crucial to the correction effort. That last chance to catch the error occurs when the engineer inspects the fabricated item at the point of fabrication.

2. TYPICAL FABRICATED EQUIPMENT

All industrial equipment comes from some sort of fabrication process. Generally equipment an engineer purchases falls into one of four categories:

1.	One of a kind shop fabricated items	ex. Storage Tank
2.	Standard production items	ex. Pump
3.	Assembly shop items	ex. Pump and filter assembled as a skid
4.	Field assembly items	ex. 100,000 gallon tank

There is no limit to the type or size of equipment which the engineer will have fabricated for a project.

Examples of frequently shop fabricated items are (NOTE 1)

Small to medium sized storage tanks

Reaction vessels
Heat exchangers and condensers
Pump skids
Filters
One of a kind control panels

Examples of typical production line items are:

Pumps
Filters
Pipe
Electrical components (starters, switches, etc)
Valves

Examples of assembly items (NOTE 1)

Pump, heater, filter and piping skid
Small reaction vessel, agitator, pumps and condenser skid pilot plant

Field Assembly

Large storage tanks
Large furnaces, incinerators, boilers
Water towers
Electrical towers

(NOTE 1). Clarification is in order here. A "shop fabricated" item generally implies the work is performed by a shop providing machining, welding, cutting and metal forming and where equipment items are generally fabricated on site. Whereas an "assembly shop" is one where purchased items are assembled to produce the desired product. As an example suppose you needed a new feedwater tank and pump skid for your boiler. As a simplified example here's what happens in these two shops.

TABLE 1: FABRICATION SHOP VERSES ASSEMBLY SHOP

ITEM	Fabrication Shop	Assembly Shop
Feedwater Tank	Rolls the metal and fabricates the tank	Purchases a ready made tank from a supplier
Pumps	Purchases from a manufacturer and mounts to a base plate	Purchases from a manufacturer and mounts to a base plate
Pump Controls	Purchases from a manufacturer and mounts to a base plate	Purchases from a manufacturer and mounts to a base plate
System Base	Fabricates from flat	May fabricate by

Plate	plate by forming and welding	welding up plate and angle iron
Piping	Cuts and welds piping	May cut and weld piping but also may call in a pipe fitting company to complete the task

Although the differences shown in the tabulation are small the effect on required inspections may be significant and the effort required to correct defects will be considerably different. We'll look at this in more detail in Section 7.

The reason the distinction between the four locations of production is important is that it influences the type and need for equipment inspections. Table 2 below lists the most common quality control efforts by where the fabrication occurs and the probable degree of testing. Facilities manufacturing multiple units in a production line have a relatively easy task in developing adequate testing procedures; locations building one-of-a-kind items do much less testing and field erection generally gets the least inspection of all. Those guidelines obviously do not apply to all fabricators nor to all fabricated items; however, using them to determine how much inspection the engineer needs to make offers additional insurance.

TABLE 2: FABRICATION LOCATION VS INSPECTION

Production by	Output	Type of Equipment	Established QC
Shop fabrication	Single unit	One of a kind	Simple, walk around with a few measurements, hydrostatic pressure test
Production line	Multiple units, high speed production	Mostly all the same	Complex testing as well as multiple measurements, QC lab
Assembly shop	Single units	One of a kind	Simple, walk around with a few measurements, hydrostatic pressure test, start motors
Field Assembly	Single unit	One of a kind in multiple sizes	Visual inspection of welds, hydrostatic pressure test

Obviously the separation between these four types of suppliers can and will be blurred. Your local fabrication shop may well have some line of equipment they fabricate routinely in the manner of a production facility and the assembly shop may be large enough to build anything you want from standard metal shapes and plate.

3. TOLERANCES

Before we look at how to inspect, what to inspect and when to inspect let's get familiar with sizes of errors. This subject is a field in itself and there is no intent here to do more than make the engineer aware of the tolerance issue.

RULE 1. Every specification involving a dimension must have some dimensional tolerance assigned to it.

Tolerance is defined as:

a. Leeway for variation from a standard.
b. The permissible deviation from a specified value of a structural dimension, often expressed as a percent.

The reason this permissible deviation was developed is that every mechanical operation involving dimensions is subject to a variety of errors: human and machine.

Tolerances come in a variety of forms:

Length	Surface finish
Thickness	Color
Angularity	Hardness
Concentricity	Diameter
Out of Roundness	Etc.

As an example if your specification calls for the diameter of a vessel to be 96 inches and your ”tolerance” for rolled metal is 0.5% then the diameter has a range of acceptable dimensions from 95.52 inches to 96.48 inches.

The engineer needs to decide “When It Matters.” If the part to be fabricated is made by rolling metal and welding the tolerance is much wider than if the same part is to be made by machining the part to shape. The other part in “When it Matters” is where the item is to be installed. For example a 96 inch diameter tank fabricated by rolling will probably fit into the planned location whether the OD is 95.52 inches or 96.48 inches, however a machined cylinder 4 inches in diameter will usually fit if the diameter is less than 4 inches but might not if the OD is more than 4 inches. The engineer needs to decide what tolerance is suitable for his equipment.

RULE 2. The tighter your tolerances the more expensive the fabrication process becomes.

The other variation which comes into play in inspections is the accuracy of your measurements. In the example above 0.48 inches equals about 31/64 of an inch. The average engineer's measuring devices for something 96 inches in diameter are a folding rule, a metal tape and perhaps a digital laser distance measuring unit. With a folding rule or metal tape you might get to 1/16 inch, some laser measuring devices are capable of a 64th or less.

RULE 3. Don't specify dimensions and tolerances beyond your ability to measure. The tighter your tolerances and specifications the longer the inspection process requires.

There are acceptable standards for tolerances for almost everything from bricks and 2 x 4's to machined surfaces. The engineer's specification should list either the actual tolerance such as 96"+/- 0.5%, 96" +/- 0.48", 96" +/- 31/64" or a recognized standard. See the Reference listing at the end for several sources.

4. WHAT NEEDS INSPECTION

This becomes a critical question, inspections take time and money and the benefit must at least match the cost, be less than the cost of correction or eliminate the time lost in corrections. Occasionally the correction can only be accomplished by returning the item to the point of manufacturing so the time impact of correction could become critical.

Let's answer this based on how the item in question, item to be inspected, is produced. There were four basic fabrication points: Production Unit, Field Fabrication, Fabrication Shop, and Assembly Shop.

If we assume that in the Production Unit they are manufacturing something like a standard pump or filter then the company most likely has a QC (Quality Control) program, which has established tests for all critical points on the equipment. Those tests and the manufacturer's QC report should cover most critical points. Someone needs to review the item and determine what needs to be tested and review the manufacturer's QC program to ensure adequate testing. In this case the engineer may elect to have someone observe a run test and any hydrostatic testing.

Field Fabrication generally involves construction of some large item such as a storage tank, boiler, cooling tower, etc. The advantage being that assembly occurs on site where the engineer can actually observe the entire fabrication process if desired. In this case an occasional walk through by the engineer may be adequate when coupled with final testing.

That leaves us with the Fabrication Shop and Assembly Shop. For this section we can consider these two to be so similar, depending on size, that we can assume that an inspection program for one will do for the other. The big difference between the two comes when the inspection reveals problems. We'll go into that in Section 7.

The Fabrication Shop and Assembly Shop produce one-of-a-kind items. They may be made up of purchased items and assembled to meet the specification or they may be totaled fabricated from basic shapes of metal or other materials. Either way unless the engineer's experience with the vendor indicates otherwise the equipment needs several inspections and in depth testing as appropriate.

The first inspection is of the shop itself for simple things.

- Is it clean and orderly?
- Do they have tools adequate for the effort required?
- Are their tools in good repair?
- If you need to see their welder certifications are they available?
- Do they segregate stainless steels from carbon steels?
- Do they have a stock of materials on hand?
- Do they have a QC program?
- Can they do the necessary run testing?

Depending on the item being fabricated the engineer needs to break down the equipment being fabricated into logical inspection points.

For example for a vessel those might be:

- When rolling of the shell is complete and the shell seam has been welded and the top and bottom at least tack welded in place.
- When the various nozzles have been tack welded in place
- When all welding is completed and the vessel is ready for testing.
- For the hydrostatic testing.
- After final preparation for shipping.

For a pump, heat exchanger and tank skid they might be:

- When the heat exchanger, pump and tank arrive.
- When the heat exchanger, pump, tank and controls are mounted.
- At the run testing.

For an electrical control panel they might be:

- When all the components have been received.
- When the cabinet is assembled and ready for testing.
- At the power up and run test

Each one of a kind item needs to be analyzed to cover critical components, dimensions or run testing and then an inspection program covering these points as early in the fabrication process as possible is developed.

Likewise who is best for the various inspections needs to be determined. This part of the inspection process is frequently mishandled by many companies. Sometimes the inspection of equipment involves a trip out of town and is something of a perk. However, sending an engineer to make measurements on tank nozzle positions is probably not as effective as sending the pipe fitter who will connect the tank into the system and makes pipe measurements as a routine in his work. Sending the engineer to inspect an electrical panel and sending the electrician who will connect the wires gives two entirely different views. Generally sending purchasing agents is a waste of money and gains little on getting a good inspection.

Finally the inspection schedule, who will be coming and what the inspectors expect to see must be communicated to the vendor. This actually should be done with the original specification since some items of inspection will add costs to the manufacturing process.

5. TYPES OF INSPECTION

Each engineer needs to develop his own inspection guidelines but to do a good job of that he needs to understand what can go wrong and assign levels of concern to those errors. Let's take an example to help get the concept down.

Example 1: Small 24 inch inside diameter with 0.25 inch wall tank with 2 inch schedule 40 side entry pipe nozzle with 150# ANSI flange and 3 inch schedule 40 bottom outlet pipe nozzle with 150# ANSI flange, top 2 inch schedule 40 pipe vent nozzle with 150# ANSI flange. Each nozzle is designed to be 4 inches from the face of the flange to the vessel wall and the straight side of the vessel is to be 48 inches. The tank materials of construction should be 316 stainless steel free of any carbon steel contact. Grind shell welds smooth. Vessel rating is 250 degrees F and 25 pounds per square inch gage pressure. Volume and pressure rating require an ASME U stamp. Tank will have four angle iron legs, carbon steel, attached with stainless isolation pads to lower edge of tank wall, each leg to have 4 x 4 x ½ inch base plates, anchor hole locations shown on drawing; finished unit to receive 1 inch of cellular glass insulation top, side and bottom installed after hydro testing.

TABLE 3. A FEW OF THE POSSIBLE FABRICATION ERRORS ON A SMALL TANK

ITEM	Specification	Specified dimensions	Tolerance	Indication of error
Tank shell	Inside Diameter	24 inch	.5%	25 inch
	Wall Thickness	0.25 inch	.05%	3/16 inch
	Straight side height	48 inch	.05%	46 inch
	Top head seam to side wall	Ground smooth, full penetration weld	Subjective	Weld not ground
	Bottom head seam to side wall	Ground smooth, full penetration weld	Subjective	Crack in bottom weld
	Vertical shell	Ground	Subjective	Internal

	seam	smooth, full penetration weld		inspection with mirror indicates less than full penetration welding
	Metal specification	316 stainless steel	0%	No mill test reports
	No carbon steel contact	Specification	0%	Signs of rust indicating carbon steel contact
Legs	Size of angles used	3 x 3 x 3/8	0%	4 x 4 x ¼
	Number of legs	4	0%	Other than 4
	Angle between legs	90 degrees	0.5º	85, 100, 95, 80 degrees between legs
	Presence of weld pad between leg and shell	Weld pad	0%	Weld pad missing on one leg
	Size of leg foot pads	4 x 4	0.5%	4 x 4.5
	Location of holes in foot pad	Specified dimensions	0.1%	One hole 1 inch out of position
	Thickness of foot pad	½ inch	0.5%	5/8 inch

Obviously some of the errors noted above are not likely to occur even in the worst shop. The point is that we only listed some characteristics for two items making up the finished tank and we have a substantial list of things to test. To establish a proper inspection record every critical characteristic must be listed and tolerance or acceptable tests detailed. For some items there is no dimensional test and thus no allowable tolerance, as an example:

Metal specification is 316 stainless steel. This becomes a Pass Fail test with a 0% tolerance, it is either 316 or it is not. (Listing 316 is not a sufficient specification as there are several grades and shapes of this material.)

The specification calls for no carbon steel contact with the metal in the vessel body. This is also a Pass Fail test less easily performed than the 316 test above; the results of this requirement may not show up for some period of time.

The specification calls for the welds to be ground smooth. This could be a little subjective and depend on your definition of "ground smooth"; some people confuse ground smooth with ground flush. The specification must use language which is as precise as possible or necessary. If the weld sticking up above the metal surface but ground so there are no ridges and ripples present is acceptable then "ground smooth" is adequate. However, if the weld must be flush with the parent metal then "ground flush and smooth" is necessary.

So far we have inspections which look like this:

Inspection Type	Example	
Numerical	Vessel diameter	48" +/- .48"
Pass / Fail	316 stainless steel	Fails because it is 304 ss
Subjective	Welds ground smooth	Actually might be smooth but wanted "flush" as well

The next class of inspection falls under the classification of a "run" test. This encompasses actually introducing external energy to test some specific critical characteristic. Examples might be:

1. Hydrostatic pressure test
2. Pneumatic pressure test
3. Motor rotation testing
4. Equipment processing speed or accuracy
5. Structural loading of a beam

The first three are easy to visualize and numbers 1 and 2 are essentially identical. However, a pneumatic test is considerably more dangerous than a hydrostatic test.

Rule #4 Try to select the least dangerous and still adequate testing.

Choose a hydrostatic test over a pneumatic test; where water is objectionable consider a non flammable liquid "hydro" test rather than air, consider a vacuum test or a helium leak test using low pressure helium over pneumatic.

Number 4 above is generally the most involved, most expensive and requires the most effort on everyone's part. There are several levels to this test; the following examples will help.

Equipment	Test	Requirements
Pump	Output in gallons per minute at specified pressure	Liquid supply and supply and discharge piping with some instrumentation
Oven	Maximum temperature and heat up time	Power supply (electric or gas) and instrumentation

Reactor vessel	Hydrostatic pressure test	Structure capable of holding the vessel full of water, pure water (no chlorides for stainless steel) and a pressurizing system
Bottle Filling Machine	Throughput of accurately filled bottles	Source of liquid for fill, empty bottles, power, empty and full bottle conveying systems, manpower to operate, testing equipment for filled bottles

Rule #5 Evaluate the benefits of a specific test against the cost in time, materials and money.

Rule #6 Don't waste time or money doing run testing which becomes invalid on disassembly of the equipment for shipping. Equipment assembled on the fab shop floor will not have the same alignment as when installed at the final use point.

The more complex the required testing the more expensive it becomes; complex testing may even eliminate some potential suppliers. Testing a 10 gallon per minute water pump and a 1000 gallon per minute water pump on a skid are two entirely different problems for the assembly shop.

Number 5 above involves some method of providing a simulated or actual load on a structure. The testing may require specialized foundations or other supports to carry the test effort. This may introduce large costs with minimal benefit.

The last test is appearance. Generally appearance does not impact operations however, it might impact the company's image. A sloppily built vessel that holds the liquid and allows the piping system, agitator and pump to function normally is acceptable except for example the impact of this sloppiness on the employees using the vessel.

Most people are less likely to keep their operational area clean and neat if the equipment itself looks "sloppy". One proven end result of a sloppy installation is that it results in sloppy work and injuries.

Recapping we have inspections of the following types:

Dimensional
Pass / Fail
Subjective
Operational or running
Appearance

Obviously "appearance" is subjective but needs to be separated from other specific subjective testing.

6. THE IMPACT OF WHERE THE INSPECTION OCCURS

Generally inspections can occur at two locations:

At the manufacturer	When the inspection is a final inspection and acceptance test it is referred to as an FAT or Factory Acceptance Test
At the receiving facility	When the inspection is a final inspection and acceptance test it is referred to as an SAT or Site Acceptance Test

During a routine inspection of several pressure vessels you observe that one weld was not ground flush and smooth as required by the specification. The shop foreman calls over the welder and gives him instructions and in a few minutes the weld is now in compliance with the original specification.

Suppose this same defect was noted when the vessel had already been delivered to your facility? If you have your installer do the grinding and polishing several possible problems come to light:

- Do you need a pressure vessel certified welder to do this work?
- By having someone other than the manufacturer do this work have you voided his warranty?
- Do you need to obtain a pressure vessel repair certification to attach to the original pressure vessel papers?
- Because you have made modifications to the vessel do you now need a new hydrostatic test?
- Etc.

The other possibility is to call in the original manufacturer to correct the problem:

- You need to know how much time it will require him to get a welder to your facility.
- What will be the impact on your installation schedule?
- Can you just let this weld stay as it is?

7. CORRECTING DEFECTS

We briefly touched on corrections in Section 6, now we need to dig a little deeper.

Testing indicates that a nozzle on a vessel is not perpendicular to the vessel wall. What does the engineer do?

Step #1 Evaluate the difficulty this creates for installation, other construction activities, operation and the future.

- Installation impact.

Normally the angles used in piping systems are multiples of 45 degrees so if the nozzle angle is not a multiple of 45 degrees and the error is much more than several degrees out then the piping system will require someone to expend some effort to bring the pipeline back into alignment. In severely restricted piping systems the only solution might be to rework the fitting to proper alignment.

Correction of the error may delay the installation of piping or the vessel itself.

- Impact on other construction activities

Most likely the only other construction activity other than piping involved with a tank nozzle will be insulation. A slight misalignment should not impact this activity or change the insulation cost.

- Operational impact.

If the nozzle purpose is strictly fluid flow then the misalignment's affect on that is probably negligible. If however the nozzle misalignment is severe it might set up unacceptable swirling motion in the tank contents. Finally if the nozzle is intended to be used as an instrument mount then an analysis of the effect on the instrument's accuracy is called for.

- Future impact

Generally all that is left are maintenance and life span. Once the system has been piped up to the nozzle maintenance should not have problems. Does the misalignment affect the life span of the nozzle or tank? The answer is most likely no unless the misalignment generates abnormal stresses in the tank wall or piping.

- Appearance impact

This is subjective and must be evaluated for each instance. The guidelines for this are usually individualized by engineer and company philosophy.

Step #2 Evaluate the best location for repairs

Before we look at these let's pick up on the earlier idea that the location of fabrication and type of shop impacts the costs of correction. We also need to look at the location of the inspection. This information becomes critical to the answers developed for Step #2.

Let's look first at where to do the inspection
Back to the original four fabrication choices:

1. One of a kind shop fabricated items
2. Assembly Shop items
3. Standard production items
4. Field assembly items

In an Assembly Shop where purchased components are mounted rather than fabricated on site correction activity can become involved and may require returning these items to their point of manufacture for correction.

Based on what we studied in Section 6 it is fair to assume that for fabrication locations 1, 2 and 3 inspections at the fabrication or manufacturing facility almost always offer the optimum location for repairs of errors. Obviously for location 4 repairs must be field corrected or at least the offending part must be returned to the fabrication shop for correction.

Step #3 Decide who makes the repairs.

Except in unusual circumstances the preference is to have the manufacturer make all corrections. An exception might be if the error is discovered in the field and the field team has the necessary talents and tools to do an adequate job of repair AND the manufacturer is willing to have the repairs made in this manner. At this point the Purchasing Department needs to be involved to protect the warranty and recover the costs of repair.

8. CONCLUSION

The engineer has the responsibility for specifying equipment to build and expand facilities. This activity contains several steps the result of which is the installation of new equipment. At each of those steps the potential for errors exists and the responsibility of inspections to catch and correct those errors generally falls to the engineer.

Avoidance of errors begins with the engineer's specification and continues through the fabrication of the equipment. Catching and correcting errors early in the process generally reduces the costs of corrections, which include delays in project completion. Recognizing that quality cannot economically be "inspected in" to fabrication is a key portion of the inspection philosophy.

It is not necessary to inspect every item ordered for a project, selecting those needing inspection and reducing inspections to the essentials is a challenge for the engineer. Money wasted in useless inspections could better be spent for other capital efforts.

- Keep testing logical and ensure each test can actually be accomplished at the fabrication point
- Make sure tests at the fabrication shop actually translate to the final location
- Be sure you have the necessary tools to accomplish the inspection and determine if these should be calibrated
- Make sure you can actually measure items to the tolerances you specified
- Arrive to the inspection point with the proper protective clothing to allow for climbing on and into vessels, etc.
- Have your inspection documents ready and if possible send a copy to the manufacturer prior to your arrival to allow time for preparation

The engineer needs to develop an inspection philosophy, which covers all items of equipment appropriately. That philosophy includes determining which critical parts of equipment require inspection and which items do not. The task may seem simple but it contains significant room for wasting money and time as well as significant room for saving the facility money and eliminating problems before they develop.

9. SAMPLE INSPECTION SHEETS

The following samples are not intended as actual inspection sheets or reports; they should stimulate thinking about what needs inspection and what records of the inspection are needed immediately and in the future.

Records should be kept of each inspection and in particular where corrective action is required. Items requiring correction should be addressed during the inspection and notes made relative to who was informed of the need for corrective action and their response. These corrective requirements should be confirmed in writing to the vendor and copied to the Purchasing Department. A vendor signature and a copy of the inspection report for the vendor is generally helpful in ensuring corrective action requirements were acknowledged in the event that legal action is required.

SAMPLE VESSEL INSPECTION DATA SHEET

Inspection Date ___________ Purchase Order Number ______________________________
Project Number ________________ Specification Number _________________________
Inspection By ___________________________ Position ____________________________
Vendor Representative ___________________Position ____________________________
Vendor Name ____
Inspection Address ____
Vessel Description ____
Equipment Name ________________________ Equipment Number _________________
Applicable Codes ____
Initial Inspection ___Follow Up Inspection _____ Corrective Action Inspection _____
Run Test _____ Hydrostat Observation ______ Final Acceptance Inspection _______
Fabrication Drawing Review ____Purchased Component Receiving Review _______
Electrical Controls ____ Structural _____ Piping ____ Hydraulics ____ Shipping ___
Other ____
Measuring Equipment Used and last calibration if applicable_____________________
Re-inspection required _____ Scheduled for ________________

ITEM	SPECIFIED	ACTUAL	COMMENTS
Diameter			
Straight Side Height			
Materials of Construction			
Thickness			
Surface Finish			
WELDS	LOCATION	QUALITY	
Vertical Seam #1			
Vertical Seam #2			
Vertical Seam #3			
HORIZONTAL SEAM #1			
HORIZONTAL SEAM #2			
HORIZONTAL SEAM #3			
HORIZONTAL SEAM #4			
BOTTOM HEAD			
TOP HEAD			
ITEM	SPEC. SIZE	ACTUAL	
LEG ISOLAT. PADS			
ANCHOR PLATES			
STIFFENING RINGS			
INSULATION RINGS			
LADDER / RAILS			
DAVITS			

NOZZLE SCHEDULE			ACTUAL		ACTUAL			
			SIZE		CONNECTION		QUALITY	
NOZ.	SPEC DIA	SPEC EXTEN	Dia.	Exten	Flange	Thread	WELDS	ALIGN. (BOLT HOLES STRADLE CENTERLINE)
A								
B								
C								
D								
E								
MAN WAY								
TESTING		PRESSURE		HOLD TIME		COMMENTS		
ALL WATER USED IN STAINLESS STEEL VESSEL TO HAVE LESS THAN 25 PPM CHLORIDES								
HYDROSTAT		LIQUID USED						
DRAINDOWN		RESULTS, LIQUID REMAINING IN BOTTOM						
CORRECTION ACTION NEEDED								
DATE		VENDOR REPRESENTATIVE				OWNER REPRESENTATIVE		

SAMPLE PUMP SKID INSPECTION DATA SHEET

Inspection Date ___________ Purchase Order Number ____________________________
Project Number ________________ Specification Number ___________________________
Inspection By ___________________________ Position ____________________________
Vendor Representative ___________________Position ____________________________
Vendor Name ____
Inspection Address ____
Equipment Description ____
Equipment Name ________________________ Equipment Number _________________
Applicable Codes ____
Initial Inspection ___Follow Up Inspection _____ Corrective Action Inspection _____
Run Test _____ Hydrostat Observation ______ Final Acceptance Inspection _______
Fabrication Drawing Review ____Purchased Component Receiving Review _______
Electrical Controls ____ Structural _____ Piping ____ Hydraulics ____ Shipping ___
Other ____
Measuring Equipment Used and last calibration if applicable_____________________
Re-inspection required _____ Scheduled for ________________

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<tr><td>ITEM</td><td colspan="2">SPECIFIED</td><td colspan="2">ACTUAL</td><td colspan="2">COMMENTS</td></tr>
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<tr><td colspan="7">RUN TESTING</td></tr>
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DESCRIBE LIQUID FEED SYSTEM			
LIQUID	Temperature	Density	Viscosity
RUN TIME	Starting Pressure	Ending Pressure	Ending Temperature
CORRECTION ACTION NEEDED			

DATE	VENDOR REPRESENTATIVE	OWNER REPRESENTATIVE

10. REFERENCES

Each of the following organizations offers or requires specific tolerances for items under their area of responsibility. Occasionally the problem is to determine which code is applicable to the equipment being inspected. For example storage tank fabrication can come under ASME, UL, API, ASHRAE, or NFPA.

AGMA	American Gear Manufacturers Association.
ANSI	American National Standards Institute
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASQ	American Society for Quality
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CEN	European Committee for Standardization
CSA	Canadian Standards Association
IEEE	Institute of Electrical and Electronic Engineers, Inc.
ISA	International Society for Measurement and Control
ISO	International Organization for Standardization
ISP	International Organization for Measurement and Control
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
SAE	Society of Automotive Engineers
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SME	Society of Manufacturing Engineers
SSPC	Steel Structures Painting Council
TEMA	Tubular Exchanger Manufacturers Association, Inc
UL	Underwriters' Laboratory

