Instrumentation Specifications -- The Key to a Good System

Abstract

One of the keys to efficient incinerator operation is a well designed and properly functioning instrumentation system. The key to a good instrumentation system is a good set of specifications, which assures high quality equipment, proper installation, and thorough testing. This paper examines the problem of specification writing and suggests specifications which will assure a good system in terms of results.

When a municipality builds a new incinerator facility, an important part of this facility is the instrumentation system. The instrumentation system enables the operator to operate the incinerator at maximum efficiency while producing a minimum of air pollution. It follows then that the effective operation of an incinerator depends very much on the proper installation of the initial instrumentation system.

The selection of the right equipment, the proper installation of this equipment and the careful testing of the entire system are factors which influence the proper operation of an instrumentation system. How carefully these three functions are performed depends very much on the manner in which the specifications of a job are written. The purpose of this paper is to assist the consulting engineer to develop specifications which will assure the engineer and the municipality of a properly operating instrumentation system.

Instrument Specifications

Before instrument specifications can be written, the basic instrumentation system design must be developed. During the development of the system design, certain questions must be answered. Is the plant operation to be performed from local panels located at each furnace or from one central control panel? Is the mode of transmission of signals to be electric or pneumatic? If pneumatic, has space been allowed for a dependable supply of clean, dry air? Which variables must be graphically recorded, and which variables may be indicated only? Which variables must have alarms? What type and size of recording charts are required?

Assuming that the basic instrumentation system design has been developed, there is a variety of methods by which instrument specifications can be written. One method is known to the trade as the "tight hardware spec." The major feature of this type of specification is the extreme detail used in describing the features and functions of a particular manufacturer's instrument. Engineers have been known to specify the number of threads on the screw holding the door hinge. The detailing of this type of information in the specifications is a long and laborious job, but it will assure the engineer of getting the quality of instrumentation which he desires. However, because the features of one manufacturer's instrument may not be available from other
manufacturers, the engineer runs the risk of writing a specification so tightly that he eliminates competition in bidding. This is and has been the complaint of many instrument manufacturers and the complaint of many contractors who find that they cannot obtain competitive bids on instrumentation systems.

At the other end of the spectrum is a method of writing specifications known as a "functional spec." In this type of specification there is little or no detail, leaving the door open to obtaining a great amount of competition. However, there is a high probability of obtaining inferior instrumentation with this type of specification.

Somewhere between these two extremes is a specification which will obtain for the engineer and the municipality the quality of instrumentation desired, while enabling instrument companies to bid competitively. Such a specification should carefully describe the function of the instrument; the accuracy with which the instrument must perform that function; pertinent data, such as chart size and configuration; and a manufacturer's model number to be used as a standard of quality. Critical materials and features which may affect the life and maintenance costs of the instrumentation system should, of course, be detailed.

The following is an example of an instrument specification of a functional nature but with enough detail to assure the desired features and quality:

"The stack temperature recorder shall record the temperature as measured by the stack temperature thermocouple. The recorder shall be of the 12-in. circular-chart, potentiometric type. It shall be equipped with a solid-state voltage reference to eliminate the need for periodic standardizing. The accuracy of the recorder shall be ± 0.5 percent of span, and shall correct for changes in reference junction temperature. For purposes of quality determination, the recorder shall be equal to Model ABC as manufactured by XYZ Company."

**Installation Specifications**

The proper installation of an instrumentation system is of equal importance to the proper selection of instrumentation equipment and is one of the most neglected areas of the specifications. A thermocouple installed in such a manner that it cannot be removed for maintenance and replacement because of insufficient clearances is as bad as no thermocouple at all. Instruments which are improperly wired will not perform the functions for which they were designed. Transmitters which are improperly mounted may give false readings and may be impossible to maintain.

There are basically two remedies to this problem. The first remedy is for the consulting engineer to include in the plans and specifications, complete mounting, wiring and piping details. The location and mounting of all instrumentation must be detailed with respect to architectural features of the building and the location of other equipment. Unfortunately, because of the fact that sizes of major pieces of equipment may not be known prior to the publishing of the plans and specifications, this may not be a practical solution.

The second remedy is to establish in the specifications the responsibility for the proper location, mounting, wiring and piping of the instrumentation. The logical party on whom the responsibility should fall is the party who should know most about the proper installation of instrumentation, i.e., the instrumentation supplier. A statement in the instrumentation section of the specifications, such as the following will establish this responsibility:

"It shall be the responsibility of the instrument supplier to supervise the installation of all instrumentation. The instrument supplier shall determine, with the approval of the engineer, the proper location and method of mounting for all instrument components. The instrumentation supplier shall furnish to the engineer, for approval, all necessary wiring and piping diagrams for the instrumentation system. The instrumentation supplier shall supervise the wiring and piping and shall certify to the engineer that all wiring and piping have been properly installed."

Another area which should be given careful consideration in the development of specifications is the area of qualifications of the person or persons doing the installation work. Specifications should be developed which will insure that the instrumentation installation personnel are qualified and experienced in instrumentation system installation. The following is suggested as a specification which will insure that installation personnel are qualified, and which will establish the responsibility for a properly installed system.

"The instrumentation system specified in this section shall be installed by competent, experienced, installation personnel, who have had a minimum of five years experience in the installation of this type of instrumentation system. The contractor may elect to subcontract the instrumentation installation to a company regularly engaged in the business of instrumentation contracting, or the contractor may elect to qualify his own installation personnel. If the contractor elects to qualify his own installation personnel, he shall furnish the engineer with the names and experience records of the personnel who will perform the instrumentation installation, along with a list of previous installations and enough documentation, photographs, etc., to enable the engineer to determine the qualifications of said personnel.

"In the event the contractor elects to qualify his own installation personnel, the contractor shall be responsible for all provisions of this section of the specifications.

"The work covered by this section of the specification
consists of the furnishing of all labor, equipment and material and performing all operations necessary for the installation and commissioning of the complete instrumentation and control system as specified herein, or as indicated on the drawings. This is applicable to all instruments and control devices including the mounting and/or piping or wiring of all analyzers, transmitters, panel and locally mounted indicators, recorders, and controllers, level, pressure, and temperature switches, relays, annunciator systems, thermocouple wiring, and control piping to control valves.

"The instrumentation subcontractor shall install a complete and operable instrumentation system installed in accordance with drawings and specifications. He will be responsible for avoiding all interference of tubing and conduit with building facilities. All dimensions will be verified in the field prior to fabrication and installation. He shall coordinate his work with that of all other trades and suppliers and vendors so that the complete system may be installed and placed into operation in a neat, efficient and first-class mannfmanlike manner.

"Within____ weeks or prior to beginning installation of the instrumentation system, the instrument subcontractor will submit____ sets of system schematic specifications and mounting, wiring, and piping diagrams for approval.

"Supervision of the installation of all instruments and controls and installation of the pneumatic tubing associated with the instrumentation and controls and the electrical connections of all instruments shall be provided by qualified factory-trained service representatives or instrument engineers regularly employed by the instrumentation subcontractor.

"The services of the service representative or instrument engineer shall also be required for assistance during startup of the systems and to instruct the operating personnel in the operation of instruments and controls.

"Installation of all pneumatic tubing, connections, and mounting of all instruments shall be by qualified mechanics who specialize and regularly engage in the installation of pneumatic instruments and controls. The instrument subcontractor must have installed at least two similar systems within the past five years. Instrument mounting brackets, pipe stands, etc., bundled copper tubing, tubing trays, junction boxes, and single control lines from instruments are to be furnished and installed by the instrument subcontractor. This subcontractor shall test all instrument tubing and piping after installation. Pneumatic tubing circuits must be tested for continuity, restrictions, plugging, tightness and elimination of leaks.

"Impulse lines to level, pressure, and flow instruments, including necessary shutoff valves, three-valve manifolds, blow down lines, etc., from the first block valves at the tap in the process line, will be furnished and installed by the instrument subcontractor.

"The instrumentation subcontractor shall submit as a supplement to his bid the cost per year on a contract basis for complete maintenance of the total system covered by this specification for a period of 15 years, commencing one year after acceptance of this system."
and a Bureau of Standards thermocouple. The tests results may be vastly different.

It is, therefore, recommended that the Instrumentation Subcommittee of the ASME Incinerator Committee establish a project to develop and recommend instrumentation testing procedures and recommended primary standards.

Conclusions

The instrumentation system is an important part of incinerator construction and operation. One of the major problems with instrumentation systems today is faulty installation. An incinerator instrumentation system is made up of the products of several manufacturers which must be coordinated into a working system. The solution lies in making these problems the responsibility of an instrumentation subcontractor.

Clear, concise but complete specifications, the clear establishment of the prime responsibility for instrumentation installation and operation, and the development of proper testing procedures will lead to better instrumentation systems and better incinerator operation.