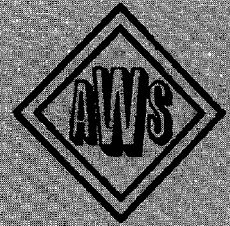


**CHAPTER 1:****THE WELDING INSPECTOR****Introduction**

Welding Inspectors function as quality representatives of organizations that may be the manufacturer, the purchaser, an insurance company, or a government agency. The inspector is responsible for judging the acceptability of a product according to a written specification. The inspector must understand the specification both as to its limitations and intent. Keep in mind that the goal is to strive for the required quality without delaying completion and delivery without proper cause.

Welding inspectors find themselves working in dozens of different industries, with each situation having slightly different job responsibilities. Among those industries employing welding inspectors are: energy production, chemical processing, petroleum product refining and distribution, transportation, and bridge and building construction.

The welding inspector is a composite person, a specialist, highly qualified in the field of welding. Welding inspectors can be classified as:

- Code or governing agency inspector
- Purchaser's, customer's, or owner's inspector

- Fabricator's, manufacturer's, or contractor's inspector
- Architect's or engineer's inspector

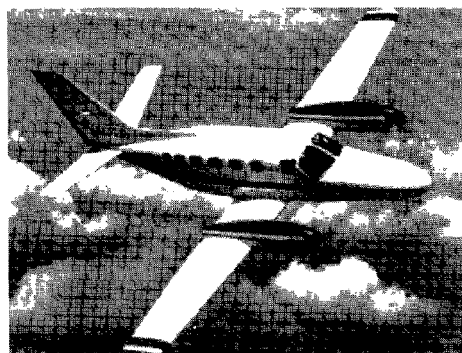
Even though the in-house inspector may have different duties from the outside inspector, within this manual, only a single inclusive category of inspector is considered. Hence, the contents of this manual sometimes may apply to all the categories above or limited to one or more of them. In all cases, the inspector has the necessary qualifications and is competent to make the examinations appropriate for the type of weldment being inspected.



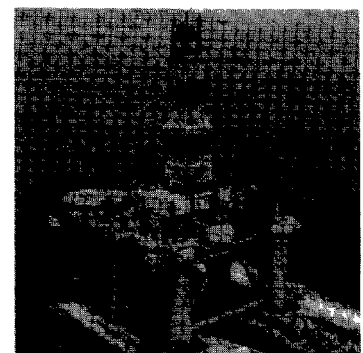
Nippon Steel



Lukens Steel Company



Cessna Aircraft Corporation



Western Oceanic Inc.

## Important Qualifications for the Welding Inspector

For a person to become a welding inspector, there are a number of important qualifications. Any person who wishes to do his or her inspection job conscientiously and professionally must take these qualifications seriously.

### Physical Condition

A welding inspector's physical condition must allow him to be an active inspector. Inspection requires examination before, during and after fabrication. Climbing around large fixtures and assemblies can be a job requirement. Inspection conditions are frequently difficult. Work is sometimes positioned for the convenience of welders and welding operators, but not necessarily for the inspector.

Short of unnecessary endangerment, the inspector must be able to see the weld to perform the visual inspection. Inspecting completed welds in the shortest possible time requires the same means of access to the weld that the welder had.

### Vision

Good vision is vital. The ability to examine weld surface conditions and judge their acceptability according to written quality requirements are the primary function of a welding inspector. An AWS Certified Welding Inspector (CWI) is required to have 20-40 vision, as determined by corrective eye charts, and Jaeger J-1 near vision acuity, with or without corrective lenses. The required eye examination may also include a color perception test for red/green and blue/yellow differentiation. Color perception for most visual welding inspection jobs is not a requirement. According to AWS QC 1, *"It is the employer's responsibility to determine and enforce any color perception requirement."*

### Professional Attitude

It is extremely important that the welding inspector maintain a professional attitude. Attitude determines the degree of success or failure. Success will be dependent upon the cooperation of associates in all departments, and the welding inspector must have their respect to obtain their help. It is important that the welding inspector strive to be impartial and consistent in all decisions. The inspector should develop a definite method for inspection procedures. Remember, the welding inspector must be neither stubborn nor readily swayed by persuasive arguments. Under no circumstances may the welding inspector seek favor or incur obligation through his decisions or pending decisions.

### Knowledge of Welding and Inspection Terminology

The improper use of welding terminology by a welding inspector could create an embarrassing situation if it becomes apparent to others in job related conversations. Consequently, the welding inspector must know and communicate correctly the language of welding. The job of welding inspector requires communication of findings to the shop people, who created the welds & make repairs, and the engineers who planned the work and accept the final structure. The vocabulary used in speaking and writing must be in terms understandable to all involved.

Inspectors should make ready use of AWS A3.0, *Welding Terms and Definitions*. The latest edition provides AWS approved terminology used to describe the various aspects of welding. It is advisable that welding inspectors study and consult the standard until the terms become part of their natural vocabulary.

Included in this manual will be explanations of: types of joints and welds, parts of welds and weld application terminology (Chapter 4); terminology related to destructive testing (Chapter 7) and nondestructive examination (Chapter 11); names and descriptions of weld and base metal

discontinuities (Chapter 10); terms related to welding metallurgy (Chapter 6); and terminology related to various welding processes (Chapter 9).

### Knowledge of Drawings and Specifications

An inspector must be familiar with engineering drawings and able to understand specifications. Welding inspectors must be able to read and understand blueprints and drawings and must know welding and nondestructive examination symbols. It is not necessary to memorize the various standards and specifications that may be in effect. Rather, they should be available for reference whenever the welding inspector needs information contained in these documents. The welding inspector should be familiar with the contents so that it doesn't take long to find information.

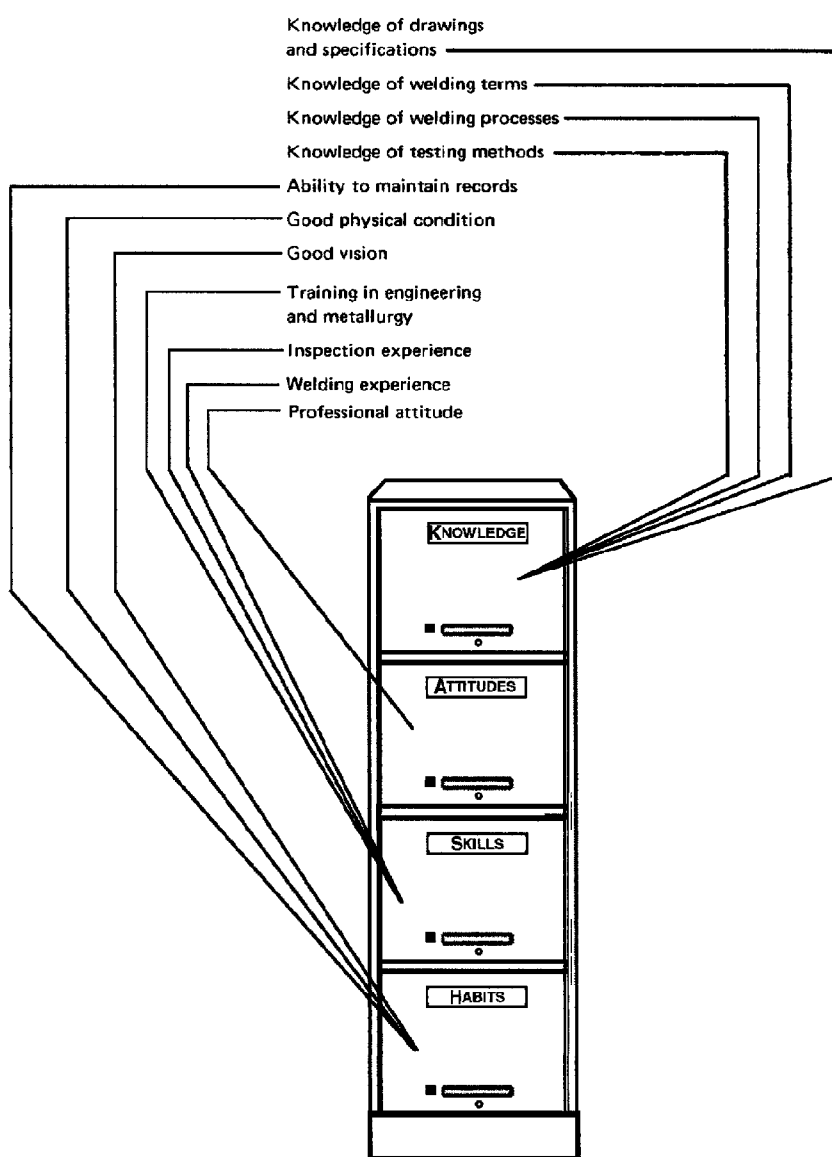
### Knowledge of Testing Methods

Numerous destructive and nondestructive testing methods are available for use in determining whether a base metal, weld metal, and/or a weldment meets certain specification requirements. While perhaps not performing the testing, the welding inspector must be aware of the test basics, including: application technique, obtainable information, and the advantages and limitations.

If others are performing the tests, the welding inspector must

be certain the NDT technicians have the proper credentials and be familiar enough with the method to determine if the test results obtained meet prescribed requirements.

## A WELDING INSPECTOR BRINGS CERTAIN AMOUNTS OF KASH TO THE JOB



## Ability to Produce and Maintain Records

A welding inspector should be able to develop and maintain inspection records. He must be able to write concise, accurate reports. The report should be simple and understandable to anyone familiar with the project. Reports should, at the same time, be complete enough so that the reason for decisions will be clear months or years later.

It is important to remember that well-known facts at the time of the writing often are not remembered as clearly, completely, or accurately later. Records should include not only all results of inspections and tests but also supporting records relating to: welding procedures, welder qualifications, drawing or specification revisions, etc. Good records also protect the welding inspector's reputation.

## Knowledge of Welding Processes

Since the welding inspector spends the major portion of his time evaluating welds, knowledge of the various welding processes is essential. Further, actual experience as a welder or welding operator is valuable to a welding inspector, but is not mandatory. Welding experience broadens the inspector's welding knowledge, commands respect, and gives his opinions more credibility when weld quality is being evaluated. There are some employers who require actual welding experience as a prerequisite to becoming a welding inspector; however, welding experience is not a prerequisite to certification as an AWS CWI or CAWI. The inspector who is familiar with the advantages and limitations of the various welding processes is able to identify problems when, or even before, they occur.

## Ability to be Trained

Welding inspectors are expected to possess knowledge in a number of different areas to be considered effective, and to be trained in areas of

unfamiliarity. Many employers select persons as potential welding inspectors based on their ability to study and gain the necessary knowledge. Training in fundamental engineering can apply toward partial satisfaction of the experience requirements for becoming a CWI. AWS QC1, *Standard for Qualification and Certification of Welding Inspectors* outlines these limits for the CWI program.

## Inspection Experience

Only through inspection experience is the attitude and point of view of a good inspector acquired. Even experience in inspecting unwelded materials is extremely helpful in the inspection of weldments, since a good inspector has developed a distinct way of thinking and working. Those learning the ropes should observe the behavior and techniques of experienced inspectors.

To comply with the experience requirement for AWS certification, the welding inspector must show evidence of having performed the functions of a welding inspector. Other job functions that have a close relationship to welding inspection also provide this evidence. Periods of qualifying experience are counted by the actual number of calendar months employed at jobs (not the number of employers). The jobs must have a close relationship to fabrication of weldments according to a code, standard, or specification, and directly involve one or more of the following:

- Design: Preparation of plans and drawings for weldment construction/fabrication.
- Production: Planning and control of welding materials, welding procedures and welding operations for weldment fabrication.
- Construction: Fabrication and/or erection of weldments.

- Inspection: Detection and measurement of weld discontinuities; verification of fabrication requirements, as described in Section 4.2 of AWS QC1.
- Repair: Repair of welds that are defective.

## Ethical Requirements for the Welding Inspector

### Introduction

This manual will discuss the technical methods, procedures, processes, and functions of the welding inspector. However, effective weld inspection requires not only the performance of duties consistent with the specification requirements, but also the practice of professional conduct and ethical principles. Below is the "Code of Ethics" for welding inspectors, which is included in AWS QC1, *Standard for Qualification and Certification of Welding Inspectors*. The latest edition of AWS QC1 should be consulted for the most recent requirements.

### Preamble

In order to safeguard the public's health and well-being and to maintain integrity and high standards of skills, practice, and conduct in the occupation of welding inspection, the AWS Certified Welding Inspector (CWI) and Certified Associate Welding Inspector (CAWI) shall be cognizant of the following principles and the scope to which they apply, with the understanding that any unauthorized practice is subject to the AWS Qualification and Certification Committee's review and may result in suspension, reprimand or revocation of certification.

### Integrity

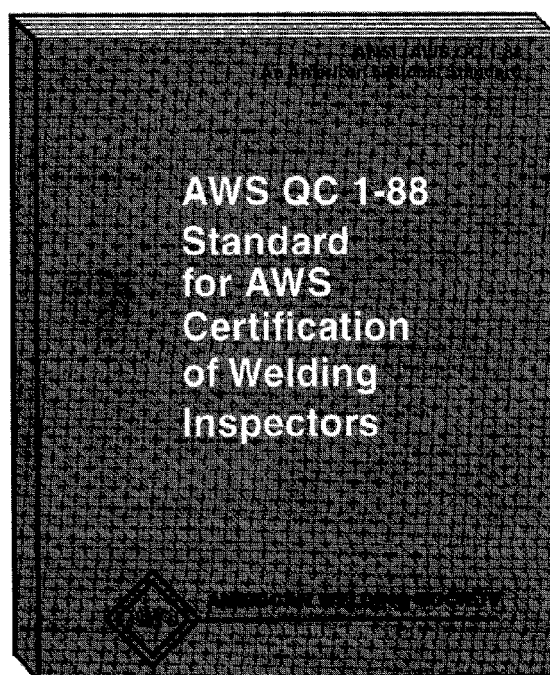
The CWI and CAWI shall act with complete integrity (honesty) in professional matters and to

be forthright and candid to the Committee or its representatives on matters pertaining to AWS QC1.

### Responsibility to the Public

The CWI and CAWI shall act to preserve the health and well-being of the public by performing the duties required of weld inspection in a conscientious and impartial manner to the full extent of the inspector's moral and civic responsibility and qualification. Accordingly, the CWI and CAWI shall:

- Undertake and perform assignments only when qualified by training, experience and capability.
- Present credentials upon request.
- Neither falsely represent current status nor seek to misrepresent certification level (CWI/CAWI) by modification of certification documents false verbal or written testimony of current level or status.



- Be completely objective, thorough and factual in any written report, statement or testimony of the work and include all relevant or pertinent testimony in such communiques or testimonials.
- Sign only for work the inspector has inspected, or for work over which the inspector has personal knowledge through direct supervision.
- Neither associate with nor knowingly participate in a fraudulent or dishonest venture.

### **Public Statements**

The CWI or CAWI shall issue no statements, criticisms or arguments on weld inspection matters connected with public policy which are inspired or paid for by an interested party, or parties, without first identifying the party, the speaker, and disclosing any possible financial interest.

The CWI or CAWI shall publicly express no opinion on welding inspection subjects unless it is founded upon adequate knowledge of the facts in issue, upon a background of technical competence pertinent to the subject, and upon honest conviction of the accuracy and propriety of the statement.

### **Conflict of Interest**

The CWI or CAWI shall avoid conflict of interest with the employer or client and will disclose any business association, or circumstance that might be so considered.

The CWI or CAWI shall not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties or their authorized agents.

The CWI or CAWI shall not solicit or accept gratuities, directly or indirectly, from any party, or

parties dealing with the client or employer in connection with the CWI's and CAWI's work.

The CWI or CAWI shall, while serving in the capacity of an elected, retained or employed public official, neither inspect, review nor approve work in the capacity of CWI or CAWI on projects also subject to his administrative jurisdiction as a public official, unless this practice is expressly dictated by a job description and/or specification and all affected parties to the action are in agreement.

### **Solicitation of Employment**

The CWI and/or CAWI shall neither pay, solicit, or offer, directly or indirectly, any bribe or commission for professional employment with the exception of the usual commission required from licensed employment agencies.

The CWI and/or CAWI shall neither falsify, exaggerate, nor indulge in the misinterpretation of personal academic and professional qualifications, past assignments, accomplishments, and responsibilities, or those of the inspector's associates. Misrepresentation of current CWI/CAWI certification status at the time of, or subsequent to, submission of requested employment information, or in the solicitation of business contracts wherein current certification is either required or inherently beneficial (advertisements for training courses, consulting services, etc.) shall be a violation of this section.

The CWI and/or CAWI shall not function as an independent inspector in public fields out of his or her capability, without first investigating for possible industry or public requirements and additional education/experience requirements (e.g., industrial labs, in the concrete and soil testing field, etc.).

### **CAUTION:**

While the CWI has established excellent credentials, certification alone may not legally qualify the Inspector to provide inspection services to the public. Contract documents,

Building or Jurisdiction Laws may require inspection to be performed under the direction and responsibility of others, such as a Registered Professional Engineer.

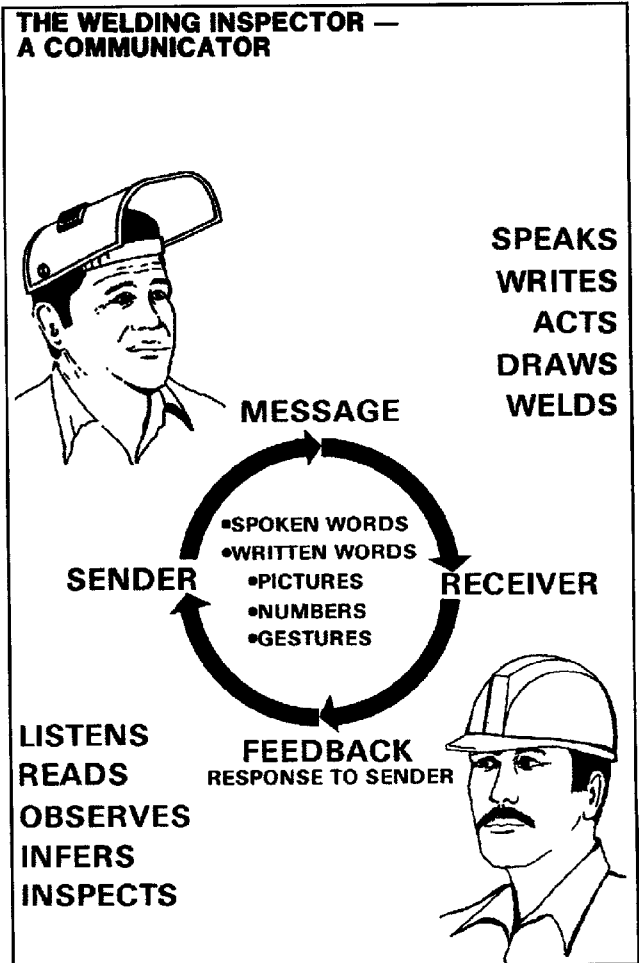
### Unauthorized Practice

Any violation of any part of the standard of conduct prescribed by AWS QC1 if related to a CWI's or CAWI's occupation, including any violation of the Code of Ethics contained in AWS QC1, shall constitute an unauthorized practice subject to the imposition of sanctions.

## Establishing Lines of Communication

The welding inspector must possess the physical, technical, and ethical qualifications mentioned earlier, as well as the skill of a communicator. The welding inspector's success will be affected by his ability to convey information to others as well as understand what others are trying to explain. Communication can occur in numerous forms, including: spoken words, written words, pictures, numbers, or gestures. Each provides an effective means of conveying information. The inspector should always be cautious regarding verbal communication. It is often important to have verbal communication supported by written information, especially when it relates to changes in the inspection requirements or results. Any form of communication should be a continuous loop. That is, the receiver should have the opportunity to respond to the sender. Effective communication must be considered as a two-way proposition.

The welding inspector often finds himself as the central figure in many fabrication situations; consequently, he must be capable of communicating effectively with many individuals involved in the project. The welding inspector must be able to establish lines of communication with a varied number of associates to accomplish



the necessary tasks and responsibilities efficiently and professionally. For example, the associates of a fabricator's inspector will often include the following:

### Reporting Supervisor

Virtually all welding inspectors will report to someone; in some cases, it will be the chief inspector. In other situations, it could be the project engineer, a plant manager, an architect, or government official. Regardless of who this individual is, the welding inspector should be able to refer questions or job difficulties to him for answers or guidance. Through effective communication, that supervisor should be able to help the inspector become more knowledgeable of the job, and therefore more effective.

## Welders

The relationship between the inspector and the welder is of utmost importance. The welder often knows which welds are of borderline quality. The welder may know where the joint fitup was improper or not as specified. A welder who looks on the inspector as an enemy is not concentrating on making each weld a good one. At any rate, he will not be trying to make the inspector's job any easier. In most cases, good rapport between the welder and inspector will result in improved quality and higher efficiency because problems are identified and corrected when they occur instead of later when repairing it is costly.

## Welding Foremen or Supervisors

The welding foreman or supervisor is highly important to the inspector. Given a group of welders equally qualified to meet specifications, the foreman still decides which welder is best suited for more difficult welding jobs. Both the welding inspector and the foreman should be in agreement as to which welders are considered qualified to produce satisfactory welds. At times, the fabricator's representative may suggest that the welding inspector tell the welder what he wants. This would make the welding inspector a party to the operation, and perhaps eliminate the fabricator's

responsibility to meet the specification requirements. Remember, the inspector's authority extends only to the determination as to whether the weld is acceptable or rejectable. Volunteering unsolicited information may overstep an inspector's responsibility and should therefore be limited.

These supervisory people are also concerned with production, so some communication must occur to indicate when parts or assemblies will be ready for inspection. After that inspection, they

will need to know if the welding has been found to be acceptable. If rejects are noted, then more communication will be necessary to describe and locate the defect so that repairs can be accomplished.

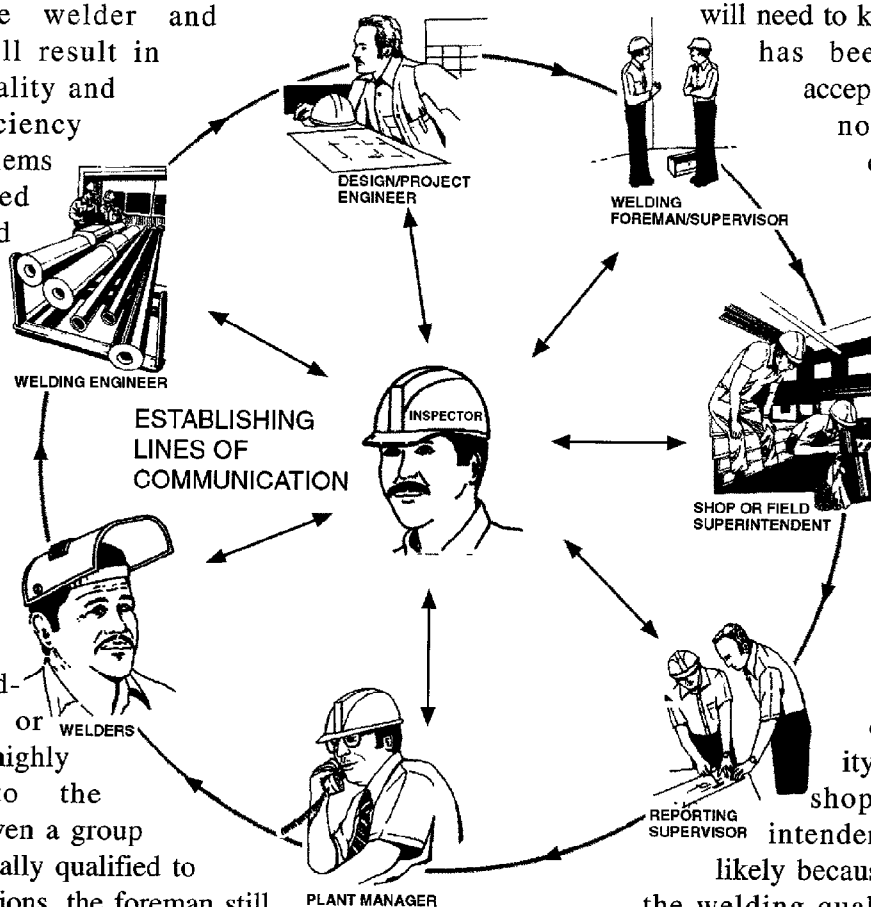
## Shop or Field Superintendent

There may also be the need to discuss weld quality matters with the shop or field superintendent. This is most likely because some aspect of the welding quality is having an

effect on the overall production schedule of a project. In other cases, the welding inspector may simply have encountered some problem which is beyond the responsibility of the welding foreman or supervisor.

## Plant Manager

Communication with the plant manager is much the same as that with the shop or field



superintendent. They are responsible for production, as well as the product quality. Consequently, they are very concerned about learning what the status of some part may be when it is subjected to inspection. A single rejected weld could result in delays for the entire project. The welding inspector needs to keep him informed so he is aware of the acceptability or rejectability of some item so appropriate scheduling can be accomplished.

### **Design/Project Engineers**

The design engineer is responsible for the details of any welded fabrication. His intentions are communicated through drawings and specifications. The project engineer is then responsible for the interpretation of these requirements when the work is being performed. The welding inspector may need to communicate with both of these individuals regarding these welding requirements. An overview of the job in consultation with the project engineer will bring out any fabrication or inspection tasks that may require additional planning. For example, in a massive, complex weldment, weld sequencing may be necessary to assure weld soundness and minimize distortion, or some design detail may need modification to facilitate successful fabrication and inspection.

### **Welding Engineer**

The welding inspector should have access to the welding engineer, welding technician or welding specialist so that possible welding-related construction problems can be brought to his attention before they become inspection problems. The welding inspector can be thought of as the welding engineer's "eyes" as the welding is being

performed. When such an arrangement exists, the welding inspector can communicate with the welding engineer to describe fabrication problems so that corrective action can be instituted. Proper communication is important to the inspection process. The welding inspector's primary function is to inspect the fabricator's work to see that it meets the requirements of the contract. The quality of work being accomplished is the substance of the welding inspector's reports. Whether the fabricator takes advantage of this information may depend upon how clearly it has been presented in the report. The fabricator still has full responsibility for the quality of the final product.

Proper communications will allow the welding inspector to keep in touch with the activities of the production organization. Early correction of a fault results in producing a satisfactory product instead of one that would otherwise have to be rejected and subsequently repaired.

## **Summary**

The job of welding inspector requires a wide variety of talents and physical capabilities. The individual must be both mentally and physically prepared for the many tasks at hand. The inspector's day-to-day existence dictates that he has the proper knowledge and training, can accurately report his findings and maintain that information for future reference, and can conduct himself in an ethical manner.

Good welding inspectors are invaluable to a company. When permitted to act as specified by an effective quality control system, the welding inspector can often save a company money by identifying problems when or before they occur to minimize correction costs.

**REVIEW****CHAPTER 1  
THE WELDING INSPECTOR**

- Q1-1** Of the following, which is considered an important duty of the welding inspector?
- a. It is a welding inspector's responsibility to judge the quality of the product in relation to some form of written specification.
  - b. A welding inspector functions as a judicial representative of an organization.
  - c. A welding inspector must be able to interpret the specification limitations and intent.
  - d. all of the above
  - e. none of the above
- Q1-2** Of the following, which is not considered an important attribute of a welding inspector?
- a. welding experience
  - b. inspection experience
  - c. professional attitude
  - d. engineering experience
  - e. ability to be trained
- Q1-3** What document describes the important requirements of the AWS Certified Welding Inspector program?
- a. AWS D1.1
  - b. AWS A5.1
  - c. AWS QC 1
  - d. AWS D14.1
  - e. none of the above
- Q1-4** As a welding inspector, must you know how to weld?
- a. yes, according to AWS D1.1
  - b. yes, according to AWS QC 1
  - c. yes, if inspecting highway bridges
  - d. no, according to AWS D1.1
  - e. not mandatory, according to AWS QC 1

- Q1-5** When may you, as a welding inspector, speak out on matters of public policy?
- a. when paid by an interested party or parties
  - b. anytime, if no money interest is involved
  - c. after disclosing all possible financial connections of the statement, criticism, or argument presented
  - d. when the statement is based upon adequate facts, upon a background of technical competence pertinent to the subject, and upon honest conviction of the accuracy and propriety of the statement
  - e. Welding inspectors should never make public statements
- Q1-6** Which of the following are important ethical requirements for the welding inspector?
- a. integrity
  - b. professional ability
  - c. good physical condition
  - d. volunteering public statements regarding an inspection for personal exposure.
  - e. all of the above
- Q1-7** Of those attributes considered to be important to the welding inspector, which is probably most influential in his gaining the cooperation and respect of others with which he works?
- a. ability to be trained
  - b. professional attitude
  - c. ability to complete and maintain inspection records
  - d. good physical condition
  - e. ability to interpret drawings and specifications
- Q1-8** The welding inspector is likely to work in which of the following industries?
- a. shipbuilding
  - b. automotive
  - c. bridge construction
  - d. pressure vessel construction
  - e. all of the above

1-12

- Q1-9** According to the requirements of the AWS CWI program, what is the necessary visual acuity of a welding inspector?
- a. 20/20 natural vision
  - b. 20/20 corrected vision
  - c. 20/40 natural vision
  - d. 20/40 corrected vision
  - e. 20/40 natural or corrected vision
- Q1-10** Which of the following are considered to be essential knowledge for a welding inspector?
- a. nondestructive testing
  - b. welding symbols
  - c. welding processes
  - d. destructive testing
  - e. all of the above
- Q1-11** When a weld requires repair due to some deficiency, to whom should your inspection report be directed?
- a. to the welder whose mark is on the weld
  - b. to another welder, better trained
  - c. to the project engineer
  - d. to the welding engineer
  - e. to the welding foreman or supervisor
- Q1-12** What professional attributes are most helpful in performing inspection duties?
- a. being informed, impartial and consistent in your decisions
  - b. being close friends with welders and superiors
  - c. being a former welder
  - d. being a non-union employee
  - e. being a nondestructive examination technician as well as CWI

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- Q1-13** With whom may the welding inspector communicate during the performance of his or her inspection responsibilities?
- a. welding engineer
  - b. welding foreman
  - c. welders
  - d. inspection supervisor
  - e. all of the above
- Q1-14** What document defines the proper terminology for use by the CWI?
- a. AWS QC 1
  - b. AWS A3.0
  - c. AWS D1.1
  - d. AWS A5.1
  - e. none of the above
- Q1-15** With regard to drawings and specifications, the CWI must:
- a. be familiar with engineering drawings and able to understand specifications.
  - b. memorize the content.
  - c. memorize those portions of these documents applicable to a particular job.
  - d. all of the above
  - e. none of the above