



# Welding & Joining Management Group

FORENSIC EXPERTS • METALS TESTING

## **“Trends in Nondestructive Testing of Infrastructure”**

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### INTRODUCTION

We live in a real-time communications age. It is no longer necessary for us to imagine the suffering caused by any disaster; it is immediately before us on a computer monitor or screen.

“Ready access to information on the internet” is not the same as truth obtained by education, experience examination and personal observations.

Infrastructure is the basic physical systems of a country's or community's population, including roads, utilities, water, sewage, etc. These systems are considered essential for enabling productivity in the economy. Developing infrastructure often requires large initial investment, but the economies of scale tend to be significant.

Engineering is the application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes, and systems. The engineer needs to know how to apply the intent of the building codes, specify correct materials, and select the best suited connection techniques for the design life of the component. The engineer also needs practical information found in handbooks, and gained by hands-on experience.

Trends in nondestructive testing (NDT) of man-made infrastructure items placed in-service during the 19<sup>th</sup> and 20<sup>th</sup> centuries are proven NDT tests. These test techniques often are used to examine components that have exceeded their intended design life and yet need to safely remain in-service. Removal of paint, coverings and debris that prohibit examination are required for NDT to be effective.

To consider such topics it is necessary to consult sources from a wide range of engineering disciplines. Visual examination by qualified personnel is always the primary NDT method.

### CHOICES

Practical education continues to be the best choice for success in NDT testing of infrastructure. Education is the only way to maintain and improve safety and security.

Engineers and technicians must perform suitable NDT tests and report the findings about in-service the general visual quality of an item, materials, welds and bolts. Owners and managers must learn to understand these reports, interpret the results, and act in a responsible manner. Every individual in the NDT information process must be professional, ethical and accountable for their actions.

Techniques for maintenance and repair of existing infrastructure are fitness-for-service, engineering considerations. All personnel involved in NDT must know and demonstrate with proficiency the ability to perform assigned duties as required for the specific NDT assignment.



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## CODES

Codes are systematic statements of a body of law. A code is intended to be mandatory and a requirement by an authority having jurisdiction. A code is a systematically arranged, comprehensive set of rules, standards and specifications for welding applications, published to secure uniformity and to protect the public. A code is established and enforced usually by a public agency. A code consists of a set of conditions and requirements relating to a particular subject and indicating appropriate procedures by which it can be determined that the requirements were met.

A standard is a guide established by authority, custom or general consent as a model or example to be followed. A specification is a detailed precise, explicit presentation of something or a plan or proposal of something that clearly and accurately describes the essential technical requirement for a material, product, system or service.

## LOADS

Whatever the type of load, when it is applied to any member, the member becomes stressed. The stresses cause strains, or movements which are related to the material properties. Service conditions cause stress, distortion and fatigue. Loads produce incremental movement in materials and structural members.

Welded joint design is determined on the basis of load requirements. Variables in design and layout substantially affect costs. Excess weld reinforcement is a common source of weldment failures. Keep the amount of welding to a minimum to reduce distortion, internal stress and the need for straightening.

Accountability and responsibility by all members of the weld team improves weld quality. Every person, designer, purchasing, operations, quality needs to leave their contact number for accessibility. In-process examination is a real-time operation that cannot be delayed.

## NONDESTRUCTIVE TESTING

The purpose of nondestructive examination is to know the truth and make the truth known. Code compliance is never discretionary. An approved Quality Management System (QMS) is a proven way to develop and document NDT procedures that embody the process of continuous improvement and consistency.

The NDT inspector knows how to confirm the designer's intent and strictly adhere to the codes and quality standards incorporated in an approved QMS.

An NDT QMS provides:

- systematic reduction of variation.
- meets customer expectations.
- achieves the designer's intent.
- results of high intentions, sincere efforts, intelligent direction and skillful execution.
- cumulative experience of craftsmen.



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It is a requirement to utilize a documented and accepted QMS - before, during and after NDT operations. NDT can improve infrastructure examinations. Managers must take steps to emphasize the ethical importance of accurate NDT tests and reports of findings.

A few items that the NDT technician should do are:

- Understand the latest revision of the print, welding and nondestructive testing symbols.
- Know the code, specification, essential variables and acceptance criteria.
- Know the appropriate time to be allotted for NDT inspections.
- Always keep the workplace safe, ventilated, well-lighted and suitably clean.
- Monitor the NDT equipment condition and operation. Keep extra parts and consumables etc.
- Wear prescription, safety glasses, and personal protective equipment when inspecting.
- Keep adequate consumables readily accessible and safely stored.
- Know the code requirements and follow the scheduled nondestructive testing regime.

NDT inspectors often use visual samples as aids to compare the appearance of acceptable welds and rejected welds. It is important that NDT personnel know what is expected and can perform good tests.

Individual NDT technicians must be qualified, certified, ethical and always report the truth. If new tools are needed, get them. If vision is a problem, get glasses or portable lights. If the weld is inaccessible, stop and change the inspection technique. No one can inspect quality into a welded part. "Quality" is relative term and means compliance with the code and the designer's intent.

The choice of an NDT method depends on the inspection location, shop or field. There are two regions in every weld for NDT examinations. These are:

Surface discontinuities. Visual Testing (VT) is the most common and least costly inspection method for locating discontinuities on the welds and adjacent surfaces. To enhance surface VT, use Magnetic Particle Testing (MT) or Penetrant Testing (PT). While welding, VT, MT or PT, may be used to reveal discontinuities.

Subsurface discontinuities. Final welds may be examined by Radiographic Testing (RT) commonly called x-ray or gamma ray, and Ultrasonic Testing (UT). These techniques locate volumetric discontinuities. The cost for RT or UT is relatively high.

As the NDT expert, the technician determines the quality stipulated for a component. Careless mistakes during NDT tests can cause problems. NDT quality is a choice made by management and technicians.

NDT personnel know that weld quality varies between fabrication industries. Each industry has its own personality. Managers must provide the resources necessary for NDT personnel to perform proper examinations of base materials, welds, bolts and joined components. Common NDT Methods are:

Common NDT Methods		
Visual Testing	VT	Primary method of welding inspection. Portable
Magnetic Particle Testing	MT	Magnetic field applied from two directions on weld. Portable
Penetrant Testing	PT	Reveals discontinuities open to the surface. Portable
Ultrasonic Testing	UT	Instrument for straight beam and shear wave tests. Portable
Radiographic Testing, field	RT	Gamma rays and provides a film for interpretation. Portable
Radiographic Testing, shop	RT	X-rays and gamma rays and provides a film for interpretation.



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## CONCLUSIONS

The NDT inspector represents the last line of defense against infrastructure catastrophes. The NDT inspector must be accountable and take responsibility for fitness-for-service of the component tested. The NDT technician is under tremendous pressure to produce more tests in less time.

Education continues to be the answer to the success in NDT testing of infrastructure. Practical education and practical experience for NDT personnel are the only way to maintain and improve our nation's safety and security. The cost of books and training may be expensive, but the cost of ignorance is more.

NDT professionals perform tests to determine with reasonable accuracy the fitness for continued service for infrastructure items. NDT personnel must be accountable and responsible for quality NDT tests. Truth, ethics and NDT quality are choices.

An in-service quality weld is a weld that continues to meet the designer's intent. It is important that every in-service weld meets the code requirements and does not fall short of the required quality.

### References (latest edition):

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