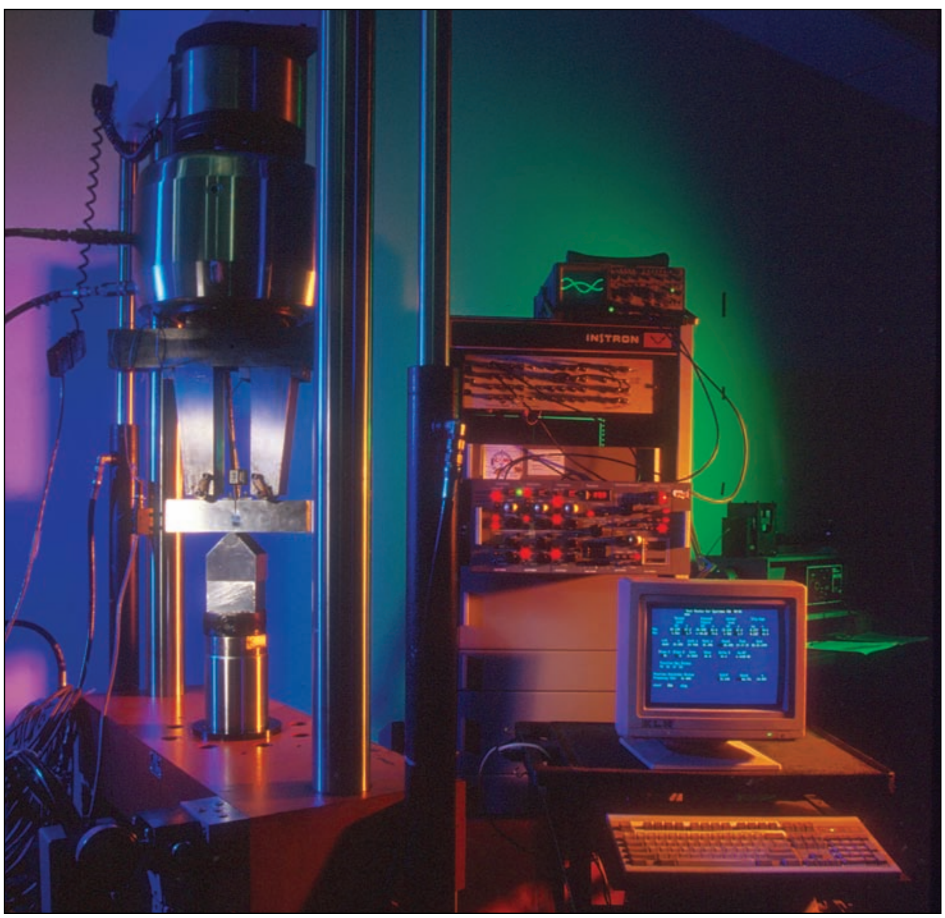
TEST METHODS FOR EVALUATING WELDED JOINTS



Prepared by the Welding Handbook Chapter Committee on Test Methods for Evaluating Welded Joints:

D. E. Williams, Chair
Consulting Engineer

D. M. Beneteau
Centerline (Windsor) Limited

J. A. Clark
Westinghouse Electric Corporation

B. H. Lyons
Consultant

E. R. Sampson
Consultant

R. F. Waite
Consultant

Welding Handbook Volume 1 Committee Member:

D. W. Dickinson
The Ohio State University

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CHAPTER 6

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INTRODUCTION

All types of welded structures—from steel bridges to jet components—serve a function. Likewise, the welded joints in these structures and components are designed for service-related capabilities and properties. Predicting service performance on the basis of laboratory testing presents a complex problem because weld size, configuration, and the environment as well as the types of loading to which weldments are subjected differ from structure to structure. This complexity is further increased because welded joints—consisting of unaffected base metal, weld metal, and a heat-affected zone (HAZ)—are metallurgically and chemically heterogeneous. In turn, each of these regions is composed of many different metallurgical structures as well as chemical heterogeneities.

Testing is usually performed to ensure that welded joints can fulfill their intended function. The ideal test, of course, involves observing the structure in actual or simulated service. An example of such "mock-up" testing is that done to validate new designs of moment frame and similar connections for large buildings in strong seismic areas.[1] Unfortunately, mock-up and actual service tests are expensive, time consuming, and potentially hazardous. Therefore, standardized tests and testing procedures are performed in the laboratory to compare a specimen's results with those of metals and structures that have performed satisfactorily in service. Standardized testing provides a bridge between the properties assumed by designers and analysts and those exhibited by the actual structure.

Mechanical testing provides information on the mechanical or physical properties of a small sample of welds or metals to infer the properties of the remaining material within a lot, heat range, or welding procedure. Standardized procedures are used to sample, orient, prepare, test, and evaluate the specimens in order to provide results that can be compared to design criteria. For example, virtually all design codes are based on a minimum tensile strength that must be achieved not only in the base metal but also in the weldment.

When selecting a test method, the test's purpose must be considered and balanced against the amount of time and the resources available. For example, tension and hardness tests both provide a measure of strength, but the latter are simpler and more economical to perform. Hardness tests can be used to confirm that adequate strength has been achieved in some heat-treated components. Although they can verify that a maximum heat-affected-zone hardness has not been exceeded, hardness tests cannot adequately establish the strength of a welded joint because of the heterogeneous nature of welds. Regardless of the differences between test methods, all testing procedures measure either a composite average or a "weak-link" component of the property of interest within the area sampled. Thus, an understanding of the test details is necessary to interpret the results.

When testing a welded or brazed joint, the investigator must not only relate the test to the intended service of the actual structure but also determine whether true properties are measured by the limited region tested.

1. American Institute for Steel Construction (AISC), *Seismic Provisions for Structural Steel Buildings,* Chicago: American Institute for Steel Construction.