CHAPTER 13

WELD QUALITY

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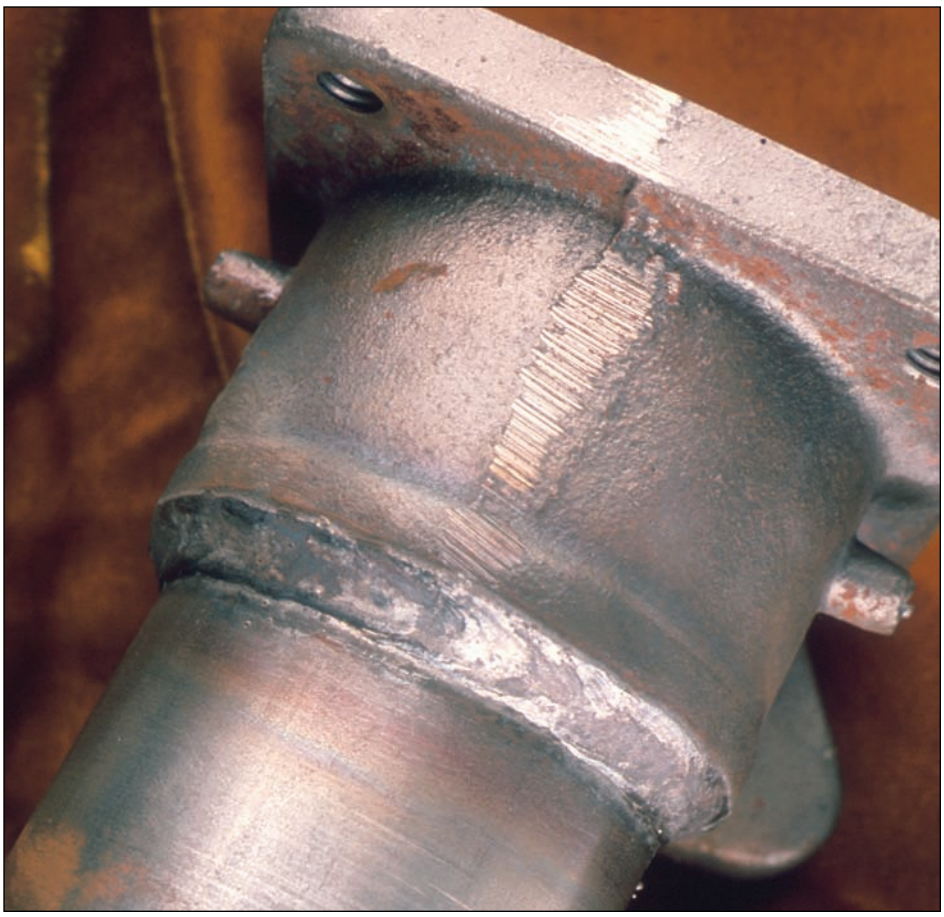

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INTRODUCTION

Weld quality is an area that requires attention in every phase of the manufacturing and service life of welded, brazed, and soldered assemblies. The process begins with a design that properly addresses the service life requirements for the product as well as manufacturing requirements. Next, manufacturing and construction factors must be considered, which include the selection of joining processes, materials, and filler metals; the establishment of welder and operator performance qualifications; and the selection of the methods and frequency of inspection and nondestructive examination.

Due to our increased expectations of components in service, efforts to fabricate weldments that are stronger and lighter and have higher performance threshold limits are at the forefront of industry. The risks associated with loss of service, maintenance and repair, replacement, and other liabilities are so great that an adequate quality control program is ultimately very affordable. Thus, at the heart of weld quality is the understanding of the occurrence of discontinuities, their significance, methods of examination, detectability, and correction.[1]

This chapter presents an overview of the discontinuities associated with welding, brazing and soldering. Descriptions of the discontinuities are included, along with a discussion of their common causes and remedies. A process-specific discussion is beyond the scope of this chapter; the reader is encouraged to consult *Welding Processes*,[2] Volume 2 of the *Welding Handbook*, 8th edition, for further information on the weld discontinuities applicable to a particular process.

DEFINING WELD QUALITY

Weld quality relates directly to the integrity of weldments. If a weldment, brazement, or soldered joint is to have the required reliability throughout its life, it must exhibit a sufficient level of quality and fitness for purpose. Quality includes design considerations, which means that each weldment should be:

1. Adequately designed to meet the intended service for the required life;
2. Fabricated with specified materials and in accordance with the design standards; and
3. Installed, operated and maintained within the stress, fatigue, and corrosion design limits.

Both economic and safety considerations influence weld quality. Economic considerations require that a product be competitive in the market, while safety requires that the product function without presenting a hazard to people or property. In order to perform at the intended levels for the required service life, weldments and brazements must be adequately designed. They must be fabricated with the materials specified in accordance with accepted design standards, and they must be operated and maintained properly.

Although weld quality considerations are often narrowly confined to the physical features normally examined by inspectors, quality also includes such factors as hardness, chemical composition, and mechanical properties. All of these characteristics contribute to the fitness for purpose of a weld. The quality level required to provide the desired reliability depends on the expected modes of failure under the anticipated service conditions.

"Quality" is both a qualitative and a quantitative term and is often used in a relative manner to address the perceived need to improve a product. To require higher quality standards than are needed for an application is not only unnecessary but also economically imprudent. Therefore, quality levels are permitted to vary among different weldments and individual welds, depending on the quantitative aspects of their design requirements.

The majority of welded fabrication standards define quality requirements to ensure safe operation in the intended service. The stipulations in these standards are to be considered minimum requirements, and the accep-

1. Inspection methods and procedures for detecting discrepancies in welded and brazed joints are discussed in Chapter 14.
2. O'Brien, R. L., ed., 1991, *Welding Processes*, Vol. 2 of *Welding Handbook,* 8th ed., Miami: American Welding Society.