CHAPTER 2

BRAZEMENT DESIGN

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INTRODUCTION

Many variables are considered in the design and manufacture of reliable mechanical assemblies. Mechanically, the design of a brazement is no different from the design of any other component. The guidelines that apply to machined or other fabricated parts with respect to concentrated loads, stress raisers, stress concentration, static loading, and dynamic loading, for example, also apply to the brazement.

Brazed joints must be properly engineered, processed, and inspected. Therefore, they must be designed in such a manner so as to permit ease of fabrication and examination. The ultimate goal is to produce quality brazements that are able to withstand the service conditions to which the finished fabrication is exposed.

Brazed joints have specific design requirements that must be met if adequate operating characteristics are to be achieved. These factors—including the composition of the base and filler metals, the type and design of joint, the stress applied to the brazed joint, and service requirements, among others—are discussed in this chapter. The chapter concludes with a discussion of the testing, inspection, and drafting conventions as these relate to brazed joint design.

DESIGN VARIABLES

Brazement designers must define as many of the design variables of the brazed joint as practical in order to ensure the desired service properties and life of the joint and the completed brazement. These design variables include the following:

1. Base metal(s), including specifications, chemistry, and physical properties;
2. Joint design, including joint clearance at room temperature and at the brazing temperature and the physical shape of the members (i.e., stress concentration points and base metal fillets);
3. Brazing atmosphere or flux (see Chapter 4, Tables 4.1 and 4.2);
4. Stress distribution at the brazed joint;
5. Service requirements, such as mechanical performance, electrical conductivity, pressure tightness, corrosion resistance, and service temperature;
6. Brazing filler metal, joint strength, melting characteristics, vapor pressure characteristics, and method of placement;
7. Brazing process variables, including temperature, atmosphere, time at temperature, heating and cooling rates, and distortion;
8. Prebraze cleaning, including grease and oil removal, oxide removal, and the prebraze clean-up cycle (outgassing) in the furnace with the appropriate atmosphere of gas or vacuum, when required;
9. Postbraze cleaning, including flux or oxide removal and stop-off removal;
10. Postbraze heat treatment, including tempering, annealing, hardening heat treatment, solution treatment, and aging;
11. Testing of the brazed joint to attain design data; and
12. Inspection method, including examination method(s), test requirements, frequency, test limits, and qualification requirements.

2. At the time of the preparation of this chapter, the referenced standards were valid. If a standard is cited without a date of publication, it is understood that the latest edition of the document referred to applies. If a standard is cited with the date of publication, the citation refers to that edition only, and it is understood that any future revisions or amendments to the code or standard are not included; however, as standards undergo frequent revision, the reader is encouraged to consult the most recent edition.