BCTB-502 **MATERIALS FOR FATIGUE RESISTANCE**

INTRODUCTION

Reciprocating, positive displacement compressors must have a structural design that contains the pressure and mechanical loads, and resists failures due to metal fatigue. Fatigue is an important design consideration because the stresses in many components go from minimum to maximum cycle, up to 1000 times per minute.

This bulletin lists the basic characteristics to be met for metals and design in order to resist failure by fatigue. For a detailed discussion concerning diaphragm compressors and diaphragm material, refer to Technical Bulletin BCTB-504.

DEFINITION

Fatigue resistance is the ability of a material to resist progressive localized permanent structural changes that occur as the material is subjected to repeated or fluctuating strains at stresses having a maximum value less than the tensile strength of the material. These structural changes may culminate in cracks or fracture after a sufficient number of fluctuations.

DESIRABLE METAL AND DESIGN CHARACTERISTICS

1. Resistance to crack nucleation by the presence of alloying enhanced cross-slip, twinning or work hardening properties; high toughness alloys.

2. Increased tensile strength achieved by alloying or heat treatment to attain adequately high stress/life cycle relationship.

3. Increased fatigue strength by work hardening of certain alloys.

4. Minimized component section and surface discontinuities for increased fatigue strength; avoidance of notches, grooves, holes, fillets, threads, key-ways and splines, especially in high-tensile-stress regions; use of smooth rather than sharp section changes, and polished rather than coarsely machined surfaces.

5. Use of low stress levels, relative to the material's fatigue strength for fluctuating loads.

6. In some cases, reduced grain size increases fatigue life (high cycle fatigue); in others, fatigue life is relatively independent of grain size (low cycle fatigue).

7. Absence of metallurgical discontinuities such as porosity, inclusions, internal bursts in forgings or roll-formed members, shrinkage in castings, or localized alloy segregation to provide more difficult fatigue-crack-nucleation conditions.

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8. Presence of surface compressive residual stresses achieved by coining, surface rolling or shot peening to enhance surface resistance to fatigue-crack initiation and progressive.

9. Component design accommodation and environmental conditioning to avoid the initiation of internal cracks from thermal fatigue (result of temperature cycling) or from corrosion fatigue (fluctuating stress in a corrosive environment).

10. Avoidance of metallic coatings, such as chromium, nickel or cadmium plating that can reduce fatigue life.

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