

# Fastener Design Manual

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**NASA**  
National Aeronautics and  
Space Administration  
Office of Management,  
Scientific and Technical  
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# Fastener Design Manual

**United States. National Aeronautics  
and Space Administration**



## **Fastener Design Manual:**

Fastener Design Manual Richard T. Barrett, 1990      *Fastener Design Manual* Richard T. Barrett, National Aeronautics and Space Administration (NASA, 2011-07-27) This manual was written for design engineers to enable them to choose appropriate fasteners for their designs. Subject matter includes fastener material selection, platings, lubricants, corrosion, locking methods, washers, inserts, thread types, and classes, fatigue loading, and fastener torque. A section on design criteria covers the derivation of torque formulas, loads on a fastener group, combining simultaneous shear and tension loads, pullout load for tapped holes, grip length, head styles, and fastener strengths. The second half of this manual presents general guidelines and selection criteria for rivets and lockbolts. To the casual observer, the selection of bolts, nuts, and rivets for a design should be a simple task. In reality, it is a difficult task requiring careful consideration of temperature, corrosion, vibration, fatigue, initial preload, and many other factors. The intent of this manual is to present enough data on bolt and rivet materials, finishes, torques, and thread lubricants to enable a designer to make a sensible selection for a particular design. Lockouts, washers, locking methods, inserts, rivets, and tapped holes are also covered. Bolts can be made from many materials, but most bolts are made of carbon steel, alloy steel, or stainless steel. Stainless steels include both iron and nickel-based chromium alloys. Titanium and aluminum bolts have limited usage, primarily in the aerospace industry. Carbon steel is the cheapest and most common bolt material. Most hardware stores sell carbon steel bolts, which are usually zinc plated to resist corrosion. The typical ultimate strength of this bolt material is 55 ksi. An alloy steel is a high strength carbon steel that can be heat treated up to 300 ksi. However, it is not corrosion resistant and must therefore have some type of coating to protect it from corrosion. Aerospace alloy steel fasteners are usually cadmium plated for corrosion protection. Bolts of stainless steel are available in a variety of alloys with ultimate strengths from 70 to 220 ksi. The major advantage of using stainless steel is that it normally requires no protective coating and has a wider service temperature range than plain carbon or alloy steels. A partial listing of bolt materials is given in table 1. The following precautions are to be noted: 1. The bolt plating material is usually the limiting factor on maximum service temperature. 2. Carbon steel and alloy steel are unsatisfactory because they become brittle at temperatures below 65 F. 3. Hydrogen embrittlement is a problem with most common methods of plating unless special procedures are used. This subject is covered more fully in the corrosion section. 4. Series 400 stainless steel contains only 12 percent chromium and thus will corrode in some environments. 5. The contact of dissimilar materials can create galvanic corrosion, which can become a major problem. Galvanic corrosion is covered in a subsequent section of this manual. Platings and Coatings. Most plating processes are electrolytic and generate hydrogen. Thus, most plating processes require baking after plating at a temperature well below the decomposition temperature of the plating material to prevent hydrogen embrittlement. However, heating the plating to its decomposition temperature can generate free hydrogen again. Thus, exceeding the safe operating temperature of the plating can cause premature fastener failure due to hydrogen embrittlement.

as well as loss of corrosion protection A summary of platings and coatings is given in table II Cadmium Plating The most common aerospace fastener plating material is cadmium Plating is done by electrodeposition and is easy to accomplish However cadmium plated parts must be baked at 375 F for 23 hours within 2 hours after plating to prevent hydrogen embrittlement Since cadmium melts at 600 F its useful service temperature limit is 450 F *Fastener Design Manual* National Aeronautics and Space Administration (NASA),2018-07-08 This manual was written for design engineers to enable them to choose appropriate fasteners for their designs Subject matter includes fastener material selection platings lubricants corrosion locking methods washers inserts thread types and classes fatigue loading and fastener torque A section on design criteria covers the derivation of torque formulas loads on a fastener group combining simultaneous shear and tension loads pullout load for tapped holes grip length head styles and fastener strengths The second half of this manual presents general guidelines and selection criteria for rivets and lockbolts Barrett Richard T Glenn Research Center **Handbook of Bolts and Bolted Joints** John Bickford,1998-04-28 Presenting time tested standard as well as reliable emerging knowledge on threaded fasteners and joints this book covers how to select parts and materials predict behavior control assembly processes and solve on the job problems It examines key issues affecting bolting in the automotive pressure vessel petrochemical aerospace and structural steel industries The editors have successfully created a useful rather than scholarly handbook with chapters written in a straightforward how to do it manner Theory is discussed only when necessary and the handbook s logical organization and thorough index enhances its usefulness NASA Reference Publication ,1977 Track Design Handbook for Light Rail Transit ,2012 TCRP report 155 provides guidelines and descriptions for the design of various common types of light rail transit LRT track The track structure types include ballasted track direct fixation ballastless track and embedded track The report considers the characteristics and interfaces of vehicle wheels and rail tracks and wheel gauges rail sections alignments speeds and track moduli The report includes chapters on vehicles alignment track structures track components special track work aerial structures bridges corrosion control noise and vibration signals traction power and the integration of LRT track into urban streets NASA Tech Briefs ,1991-10 Voi-Shan Aerospace Fastener Design Manual Voi-Shan (Firm),1975 *Navy Research Task Summary, 1961* United States. Office of Naval Research,1962 Computer Integrated Machine Design Charles E. Wilson,1997 This book is designed to take advantage of the almost universal availability of personal computers Utilizing computer aided design methods this book allows readers to optimize a design with a few key strokes to ask what if to examine alternatives and to plot and interpret the effect of design changes Emphasis is placed on evaluation and interpretation of results and development of design skills Tech Notes ,1992 **NASA SP.** ,1962 *Pamphlets on Forestry in Virginia* ,1929 NASA Scientific and Technical Publications United States. National Aeronautics and Space Administration,1987 **EDN, Electrical Design News** ,1967 **Assembly Engineering** ,1979 *Industrial Design* ,1972 Government Reports Annual Index ,1990 **Science Trends** ,1989-12

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