

Figure 3.—Deformed-thread locknut.

Deformed thread.—The deformed-thread locknut (fig. 3) is a common locknut, particularly in the aerospace industry. Its advantages are as follows:

- (1) The nut can be formed in one operation.
- (2) The temperature range is limited only by the parent metal, its plating, or both.
- (3) The nut can be reused approximately 10 times before it has to be discarded for loss of locking capability.

Nylok pellet.—The Nylok[®] pellet (of nylon) is usually installed in the nut threads as shown in figure 4. A pellet or patch projects from the threads. When mating threads engage, compression creates a counterforce that results in locking contact. The main drawback of this pellet is that its maximum operating temperature is approximately 250 °F. The nylon pellet will also be damaged quickly by reassembly.

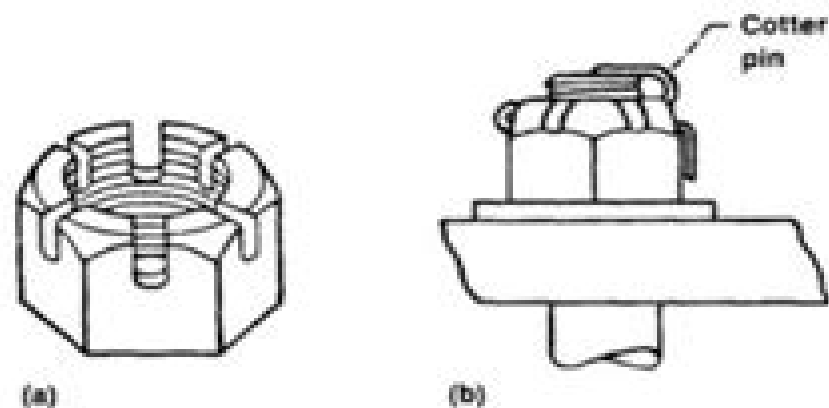
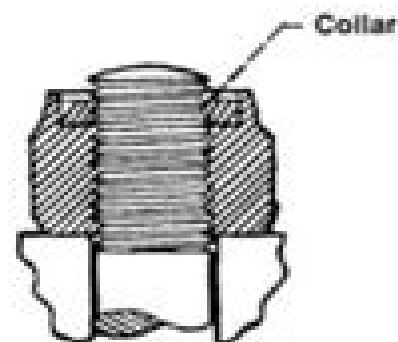
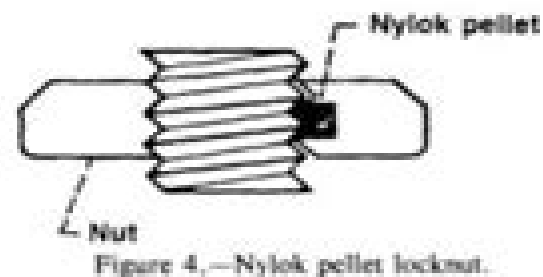


Figure 6.—Castellated nut.

Fastener Design Manual

Marcel A. Müller



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 CRES are available in a variety of alloys with ultimate strengths from 70 to 220 ksi. The major advantage of using CRES 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 CRES 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

Handbook of Bolts and Bolted Joints Sayed A. Nassar,John H. Bickford,2025-03-20 Presenting time tested standards as well as validated emerging knowledge on threaded fasteners and bolted joints this updated edition covers how to design select parts and materials control assembly processes predict behavior and solve on the job problems This handbook examines key issues affecting bolting in the automotive pressure vessel petrochemical aerospace energy and structural steel industries The editors have successfully created a useful rather than scholarly handbook with chapters written in a straightforward how to manner Theory is discussed only when necessary and the handbook s logical organization and thorough index enhance its usefulness

Handbook of Bolts and Bolted Joints Second Edition includes updated chapters solved numerical examples and case studies This new edition is an essential handbook for professionals researchers and students in all fields in which threaded joints are used including automotive aerospace structural chemical and naval and ocean engineering as well as agricultural equipment wind turbines and medical devices

NASA Reference Publication ,1977 *NASA Tech Briefs* ,1991-10 **NASA Scientific and Technical Publications** ,1991

The Design of Aircraft Landing Gear Robert Kyle Schmidt,2021-02-18 The aircraft landing gear and its associated systems represent a compelling design challenge simultaneously a system a structure and a machine it supports the aircraft on the ground absorbs landing and braking energy permits maneuvering and retracts to minimize aircraft drag Yet as it is not required during flight it also represents dead weight and significant effort must be made to

minimize its total mass The Design of Aircraft Landing Gear written by R Kyle Schmidt PE B A Sc Mechanical Engineering M Sc Safety and Aircraft Accident Investigation Chairman of the SAE A 5 Committee on Aircraft Landing Gear is designed to guide the reader through the key principles of landing system design and to provide additional references when available Many problems which must be confronted have already been addressed by others in the past but the information is not known or shared leading to the observation that there are few new problems but many new people The Design of Aircraft Landing Gear is intended to share much of the existing information and provide avenues for further exploration The design of an aircraft and its associated systems including the landing system involves iterative loops as the impact of each modification to a system or component is evaluated against the whole It is rare to find that the lightest possible landing gear represents the best solution for the aircraft the lightest landing gear may require attachment structures which don t exist and which would require significant weight and compromise on the part of the airframe structure design With those requirements and compromises in mind The Design of Aircraft Landing Gear starts with the study of airfield compatibility aircraft stability on the ground the correct choice of tires followed by discussion of brakes wheels and brake control systems Various landing gear architectures are investigated together with the details of shock absorber designs Retraction kinematics and mechanisms are studied as well as possible actuation approaches Detailed information on the various hydraulic and electric services commonly found on aircraft and system elements such as dressings lighting and steering are also reviewed Detail design points the process of analysis and a review of the relevant requirements and regulations round out the book content The Design of Aircraft Landing Gear is a landmark work in the industry and a must read for any engineer interested in updating specific skills and students preparing for an exciting career

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

Ceramics Science and Technology, Volume 3 Ralf Riedel,I-Wei Chen,2011-12-12 Although ceramics have been known to mankind literally for millennia research has never ceased Apart from the classic uses as a bulk material in pottery construction and decoration the latter half of the twentieth century saw an explosive growth of application fields such as electrical and thermal insulators wear resistant bearings surface coatings lightweight armour or aerospace materials In addition to plain hard solids modern ceramics come in many new guises such as fabrics ultrathin films microstructures and hybrid composites Built on the solid foundations laid down by the 20 volume series Materials Science and Technology Ceramics Science and Technology picks out this exciting material class and illuminates it from all sides Materials scientists

engineers chemists biochemists physicists and medical researchers alike will find this work a treasure trove for a wide range of ceramics knowledge from theory and fundamentals to practical approaches and problem solutions **AIAA Aerospace Design Engineers Guide** AIAA (American Institute of Aeronautics and Astronautics),2005-07-18 An indispensable reference for aerospace designers analysts and students This fifth revised and enlarged edition of this classic indispensable and practical guide provides a condensed collection of commonly used engineering reference data specifically related to aerospace design New material on air breathing propulsion systems engineering and radar cross section has been added to reflect recent data in aircraft design Features New material on air breathing propulsion systems engineering and radar cross section Most commonly used formulas and data for aerospace design Convenient size and binding Large easy to read tables charts and figures Handy reference for everyday use Developed by aerospace professionals AIAA Aerospace Design Engineers Guide is an essential tool for every design engineer and every aspiring aerospace engineering student

Scientific and Technical Aerospace Reports ,1990 Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database **Mechanics of Structures and Materials XXIV** Hong Hao,Chunwei Zhang,2019-08-08 **Mechanics of Structures and Materials Advancements and Challenges** is a collection of peer reviewed papers presented at the 24th Australasian Conference on the Mechanics of Structures and Materials ACM24 Curtin University Perth Western Australia 6-9 December 2016 The contributions from academics researchers and practising engineers from Australasian Asia pacific region and around the world cover a wide range of topics including Structural mechanics Computational mechanics Reinforced and prestressed concrete structures Steel structures Composite structures Civil engineering materials Fire engineering Coastal and offshore structures Dynamic analysis of structures Structural health monitoring and damage identification Structural reliability analysis and design Structural optimization Fracture and damage mechanics Soil mechanics and foundation engineering Pavement materials and technology Shock and impact loading Earthquake loading Traffic and other man made loadings Wave and wind loading Thermal effects Design codes **Mechanics of Structures and Materials Advancements and Challenges** will be of interest to academics and professionals involved in Structural Engineering and Materials Science

Government Laboratory Technology Transfer Sally Rood,2018-02-06 This title was first published in 2000 Due to budget cuts and competitiveness pressures determining the outcome of technology transfer from government R D laboratories to private industry and entrepreneurial start ups is of increasing interest This book presents a series of case studies of successful technology transfer by examining the same list of topics for each case It presents a format for analyzing the cases topic by topic a methodology that could be used by any R D laboratory The book also goes one step further and compares the cases that took place prior to national technology transfer legislation with those cases that took place after passage of such legislation An additional feature is the summary of existing attempts to measure and evaluate

technology transfer This follows a background section on the technology policy context The analysis finds that there is a significant commercial impact from government laboratory transfer using this approach **Advanced Manufacturing Processes III** Volodymyr Tonkonogyi,Vitalii Ivanov,Justyna Trojanowska,Gennadii Oborskyi,Ivan Pavlenko,2021-11-17 This book offers a timely snapshot of innovative research and developments at the interface between manufacturing materials and mechanical engineering and quality assurance It covers a wide range of manufacturing processes such as grinding boring milling turning woodworking coatings including additive manufacturing It focuses on laser ultrasonic and combined laser ultrasonic hardening treatments and dispersion hardening It describes tribology and functional analysis of coatings separation purification and filtration processes as well as ecological recirculation and electrohydraulic activation highlighting the growing role of digital twins optimization and lifecycle management methods and quality inspection processes It also covers cutting edge heat and mass transfer technologies and energy management methods Gathering the best papers presented at the 3rd Grabchenko's International Conference on Advanced Manufacturing Processes InterPartner 2021 held in Odessa Ukraine on September 7-10 2021 this book offers a timely overview and extensive information on trends and technologies in manufacturing mechanical and materials engineering and quality assurance It is also intended to facilitate communication and collaboration between different groups working on similar topics and to offer a bridge between academic and industrial researchers

Proceedings of the 2nd International Conference on Innovative Materials, Manufacturing, and Advanced Technologies Lotfi Sai,Rabî Ben Sghaier,Krichen Abdelkader,Kacem Saï,Wassila Bouzid Saï,Med Amine Laribi,2023-09-12 This book presents select proceedings of the 2nd International Conference on Innovative Materials Manufacturing and Advanced Technologies IMMAT 2022 held in Sousse Tunisia on October 27-29 2022 The covered topics include theoretical experimental and technological works and its application in various challenging domains like materials sciences mechanical design manufacturing environment and heat transfer The volume provides an overview of innovations and technological advances in mechanical engineering Given the selected and peer reviewed papers it will be a useful resource for practitioners working on cutting edge topics in several areas related to the mechanics such as mechanical behavior material process interaction fatigue behavior tribological behavior of surfaces manufacturing organization and optimization of production processes additive manufacturing processes renewable energy design of lightweight components robotics and industry 4.0 This book is intended to serve researchers engineers and professionals working in the fields of material and mechanical engineering

Fatigue of Structures and Materials J. Schijve,2008-12-16 Fatigue of structures and materials covers a wide scope of different topics The purpose of the present book is to explain these topics to indicate how they can be analyzed and how this can contribute to the designing of fatigue resistant structures and to prevent structural fatigue problems in service Chapter 1 gives a general survey of the topic with brief comments on the significance of the aspects involved This serves as a kind of a program for the following chapters The central issues in this book are

predictions of fatigue properties and designing against fatigue These objectives cannot be realized without a physical and mechanical understanding of all relevant conditions In Chapter 2 the book starts with basic concepts of what happens in the material of a structure under cyclic loads It illustrates the large number of variables which can affect fatigue properties and it provides the essential background knowledge for subsequent chapters Different subjects are presented in the following main parts Basic chapters on fatigue properties and predictions Chapters 2 8 Load spectra and fatigue under variable amplitude loading Chapters 9 11 Fatigue tests and scatter Chapters 12 and 13 Special fatigue conditions Chapters 14 17 Fatigue of joints and structures Chapters 18 20 Fiber metal laminates Chapter 21 Each chapter presents a discussion of a specific subject

Aerospace Environmental Technology Conference Ann F. Whitaker, 1995

Engineering

Metrology for Pedestrian Falls Prevention and Protection In-Ju Kim, 2022-03-25 This book explains how to improve the validity reliability and repeatability of slip resistance assessments amongst a range of shoes floors and environments from an engineering metrology viewpoint covering theoretical and experimental aspects of slip resistance mechanics and mechanisms Pedestrian falls resulting from slips or falls are one of the foremost causes of fatal and non fatal injuries that limit people's functionality There have been prolonged efforts globally to identify and understand their main causes and reduce their frequency and severity This book deals with large volumes of information on tribological characteristics such as friction and wear behaviours of the shoes and floors and their interactive impacts on slip resistance performances Readers are introduced to theoretical concepts and models and collected evidence on slip resistance properties amongst a range of shoe and floor types and materials under various ambulatory settings These approaches can be used to develop secure design strategies against fall incidents and provide a great step forward to build safer shoes floors and walking working environments for industries and communities around the world The book includes many case studies

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