



Introduction to Mechanical Engineering, Lecture 6

Connections:

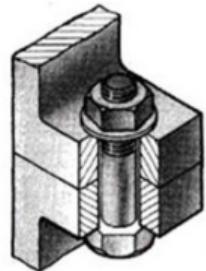
Detachable (Threaded, Keyed, ...)

Permanent (Riveting, Welding, ...)

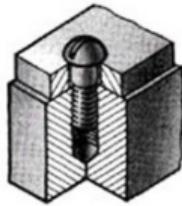


Connections

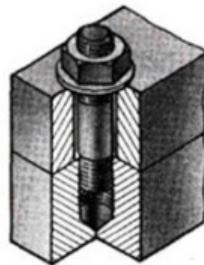
Classification



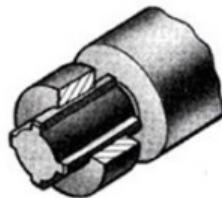
боловое



винтовое



шпилечное



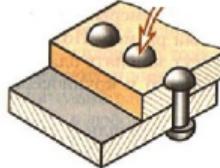
шлифтовое



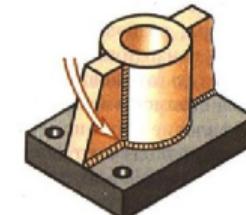
шпоночное



штифтовое



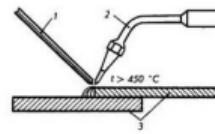
клепаное



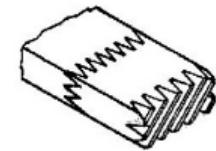
сварное



шивное



паяное



клеевое

Detachable (Разъемные)

Permanent (Неразъемные)



Keyed (Шпоночное) and Spline (Шлицевое)

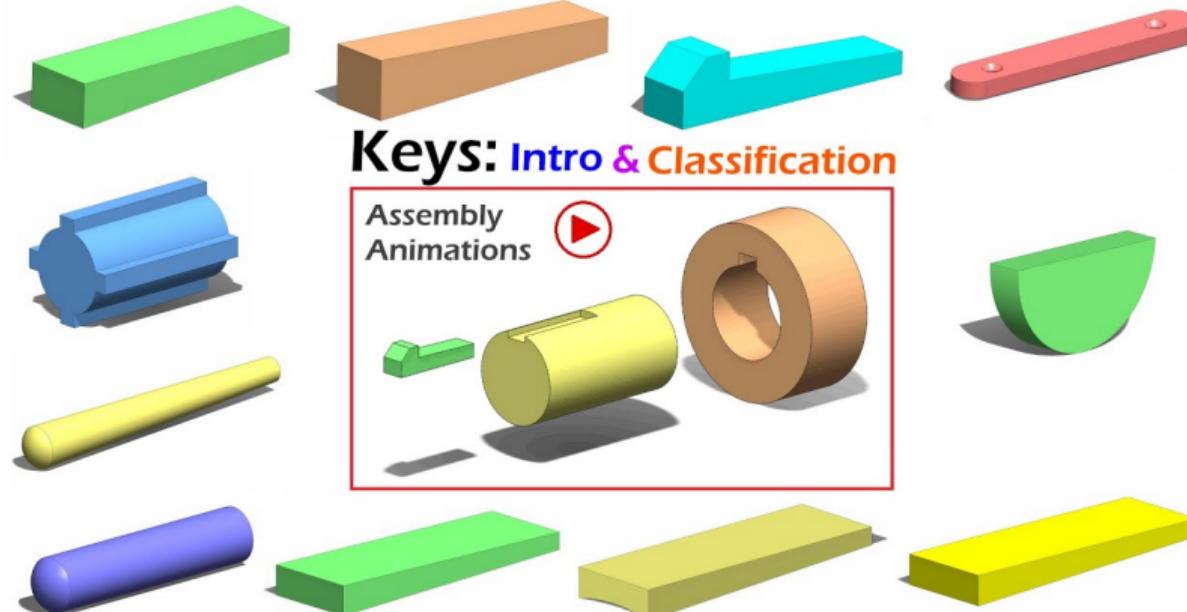
Using keyed connection, you can attach, gears, pulleys, and cams on shafts to obtain machinery.





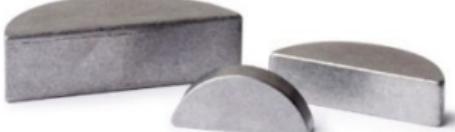
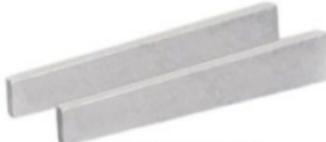
Types of keys

Video





Types of keys





Keys and Splines (rus)

Video

ШПОНОЧНЫЕ И ШЛИЦЕВЫЕ СОЕДИНЕНИЯ



Эти соединения служат для окружной фиксации деталей на валах и осях и передачи вращающего момента.



Keyed connection

Reference material

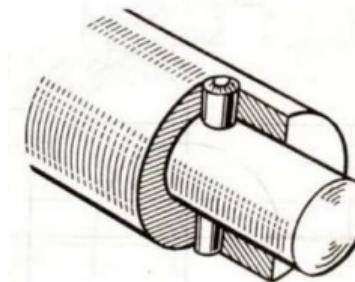
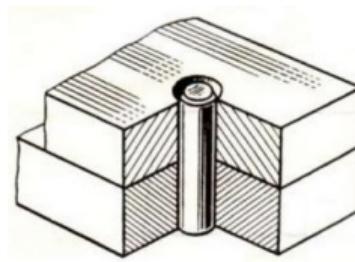
- Shaft Keys and Keyways; Design, Explanation Applications



Pin (Штифтовое)

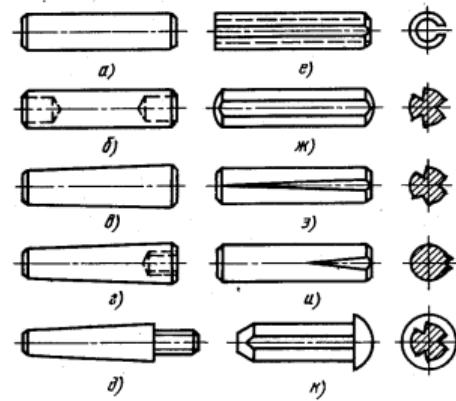
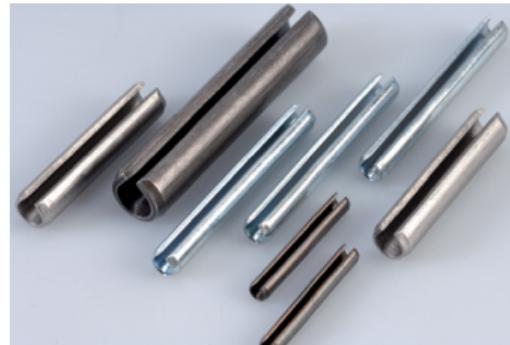
It is a fastening element in the form of a cylindrical or tapered rod designed for a fixed connection.

The pin is inserted tightly into the hole that runs through both parts, preventing their mutual displacement.





Types of pin connections

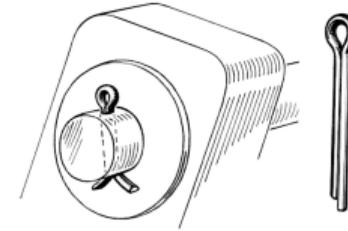




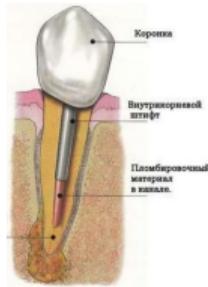
Pin connections: applications



Common usage



Splint pin (Шплинтовое)



Stomatology



Dowel (Шкант)



Pin types

Video





Split Pin (Шплинтовое)

Video

ШПЛИНТОВОЕ КРЕПЛЕНИЕ:



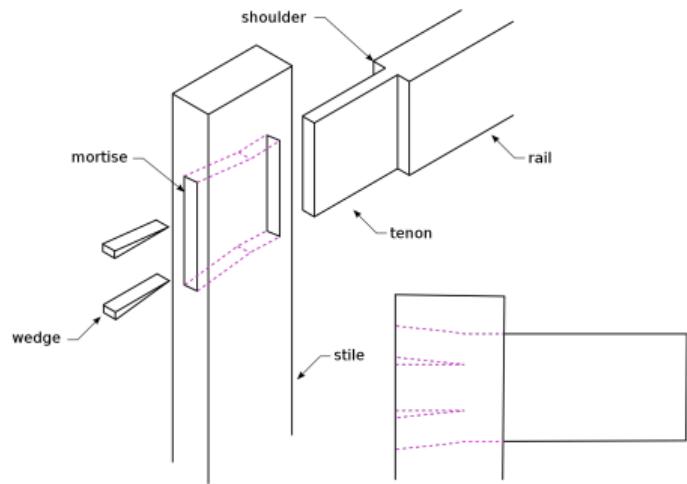
о-шплинты
круглогубцы



Tongue & Groove (Шпунт), Mortise & Tenon (Шиповое)



Tongue and Groove (Шпунт)

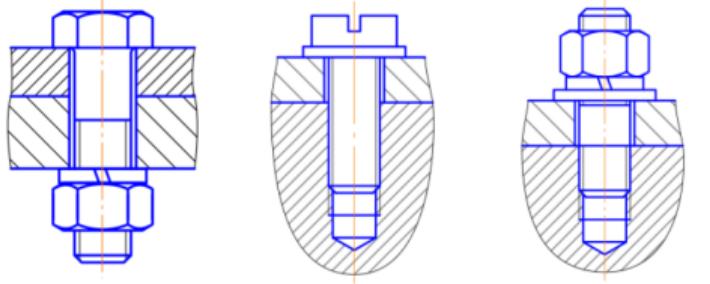


Mortise and Tenon (Шиповое)



Threaded connection

A bolted joint consists of a male threaded fastener (e. g., a bolt) that captures and joins other parts, secured with a matching female screw thread.



Bolted Joint (Болтовое)

Screw Joint (Винтовое)

Stud Joint (Шпилечное)



Studs

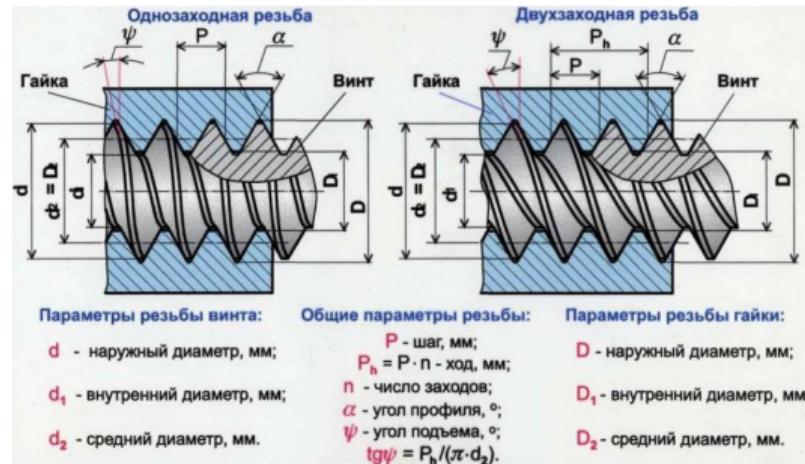
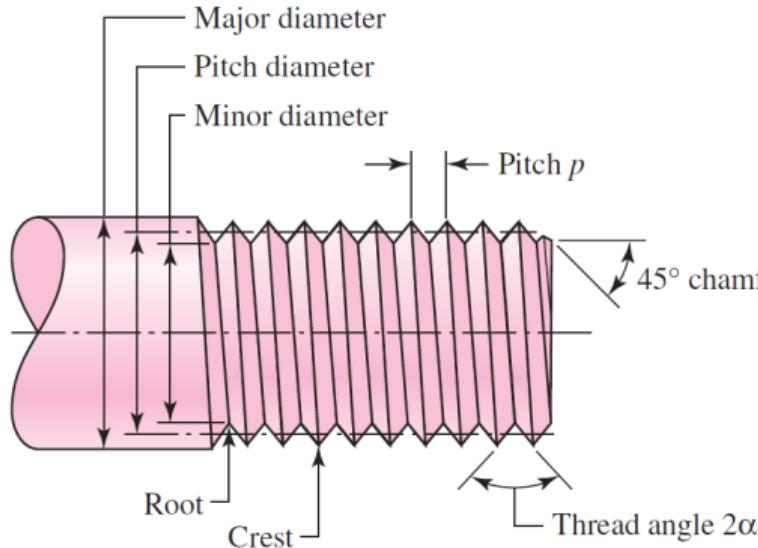


What should we know about threaded connection

1. Terminology of screw threads
2. Their types, features
3. How to prepare a place for them correctly
4. How to mount them

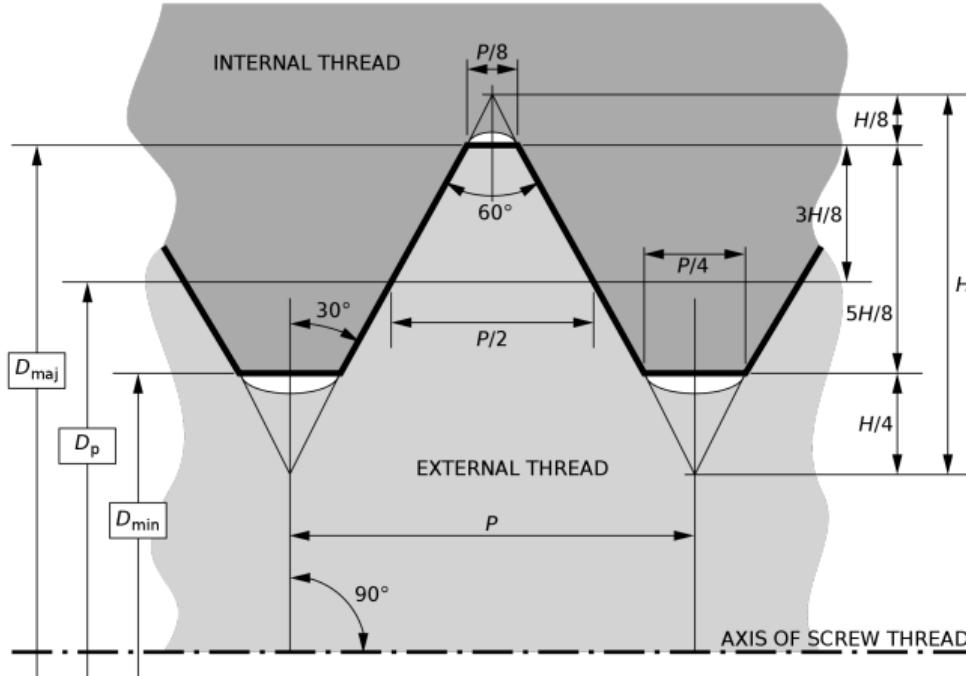


Terminology of screw threads





Thread Dimensions





Multiple-Start thread

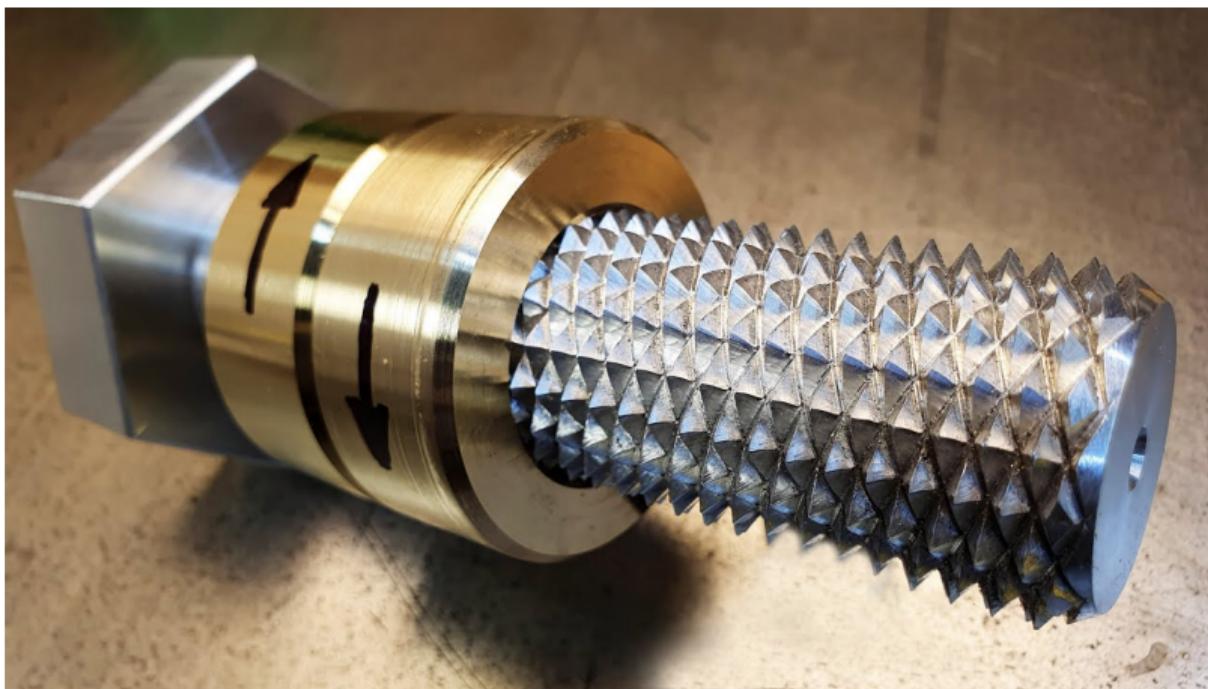
Video





Magic Two-Sided screw

Video





Types of screws

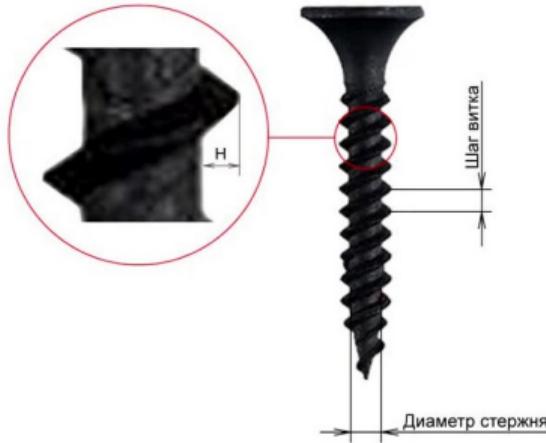
Video



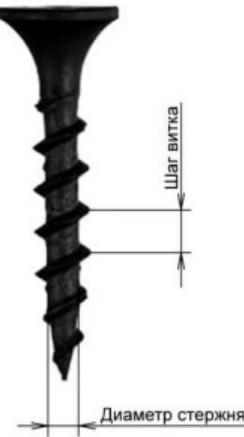


Difference between screws

По металлу



По дереву



Confirmat (Конфирмат, Евровинт)



Screw drive types (Шлицев)

Your
BRO





Site for ordering screws

Link to the site

**МЕТИЗЫ
от А до...
МАГАЗИНЫ КРЕПЕЖА**

КАТАЛОГ ДОСТАВКА ОПЛАТА СПРАВОЧНИКИ О КОМПАНИИ КОНТАКТЫ

Главная > Каталог > Метизы

МЕТИЗЫ (МЕТАЛЛИЧЕСКИЕ ИЗДЕЛИЯ) И КРЕПЕЖ

- Анкера
Анкера распорные, клиновые, раковидные, ударные. Moly, Racher, Mungo, Powers, Wikret-Met
- Гвозди
Гвозди строительные, финишные, винтовые, ершевые, толевые и мебельные.
- Дюбель-гвозди
Дюбель-гвозди для быстрого монтажа SWS, Tech-KREP, Mungo, Wikret-Met
- Саморезы
Саморезы для дерева, металла, гипсокартона, фанеры, по стандартам DIN
- Кольца стопорные
Кольца стопорные на вал и для отверстия
- Болты
Болты с шестигранной головкой, с полукруглой головкой и фланцем
- Винты
Винты по стандартам DIN, ГОСТ и ОСТ
- Гайки
Гайки шестигранные, квадратные, самоконтрящиеся, корончатые, пружинные
- Дюбеля
Дюбеля полипропиленовые и нейлоновые. Mungo, Racher, Sormat

Каталог

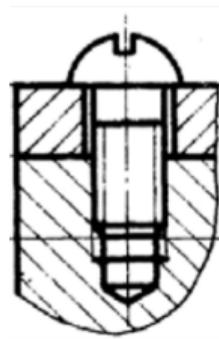
→ Milwaukee

↳ Метизы

- Анкера
- Гвозди
- Дюбель-гвозди
- Саморезы
- Кольца стопорные
- Болты
- Винты
- Гайки
- Дюбеля
- Шурупы
- Дробели раменные
- Шайбы
- Шплинты
- Заклепки
- Шпильки
- Дюбеля фасадные
- Дюбеля для теплоизоляции
- Штифты
- Втулки
- Крюки м5-м16



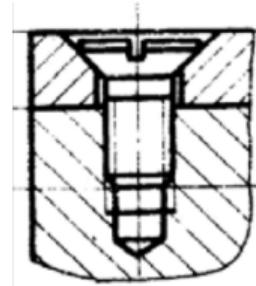
Types of holes



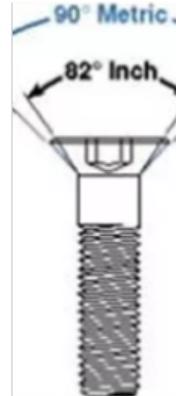
Common hole (Отверстие)



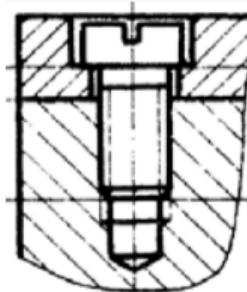
Button head



Countersunk hole



Flat head



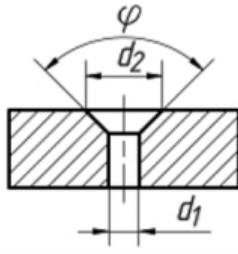
Counterbored hole



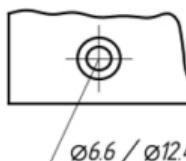
Socket
head cap
screw



Types of holes (drawings)



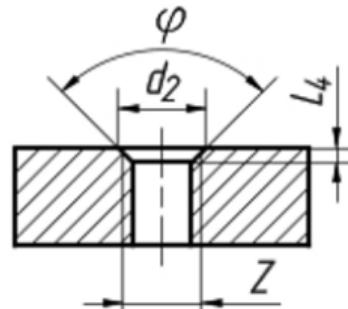
$\varnothing 3.4 H13 / \varnothing 4.8 \times 90^\circ -2^\circ$



$\varnothing 6.6 / \varnothing 12.4 \times (90 \pm 1)^\circ$

Размеры зенкovanного сквозного отверстия

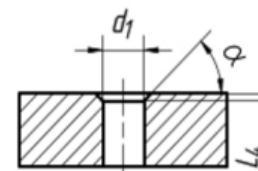
Countersunk hole (Зенкование)



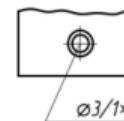
$M5-6H \times 16 / \varnothing 6 \times 90^\circ$ $M6-6H / 1 \times 90^\circ$



Thread with chamfer (с фаской)



$\varnothing 10 H7 / 1 \times 45^\circ$ $\varnothing 8 H11 / 1 \times 45^\circ$



$\varnothing 3 / 1 \times 45^\circ$

Обозначение сквозного отверстия с фаской

Hole with chamfer



Type of drills

Video





Type of drills

Бетон



Металл



Дерево





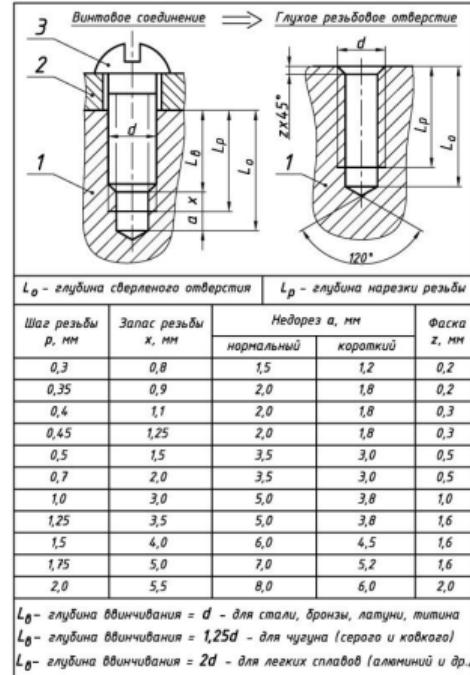
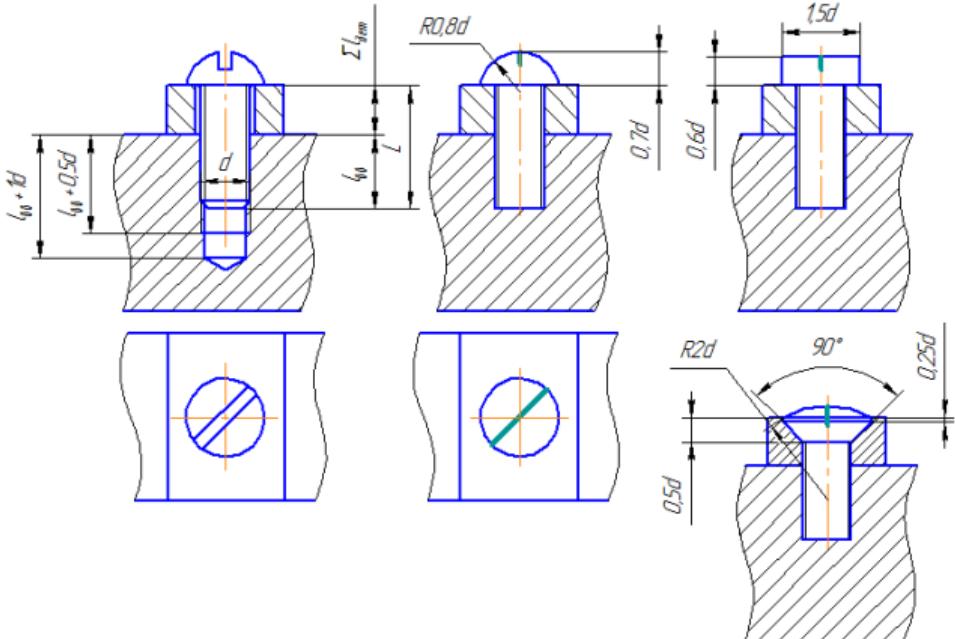
Threaded hole with a tap drill (мечик)

Video





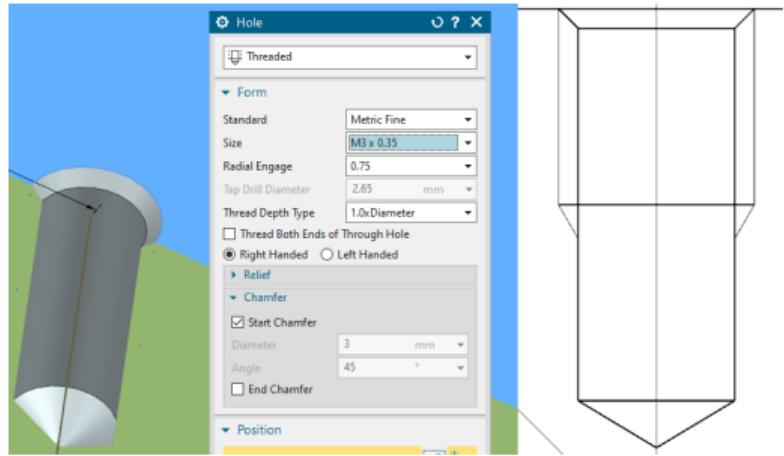
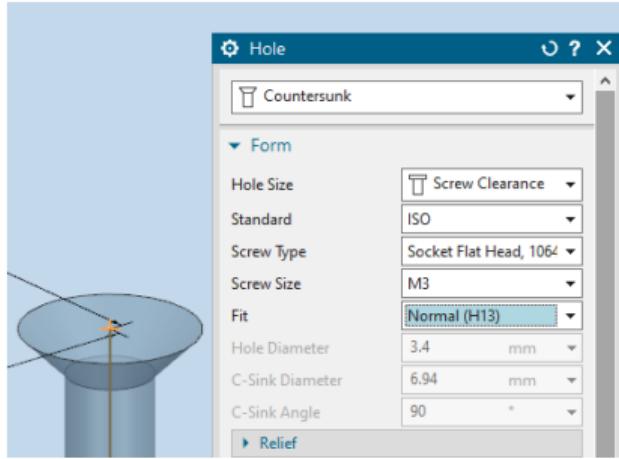
How to make holes correctly





Clearances for hole

Reference material



- Clearance Hole Size for Bolts and Screws (Metric)
- Tap drill size chart



Types of nuts (Гайки)

**Hex**

A six sided nut. Also referred to as a Finished Hex Nut.

**Heavy Hex**

A heavier pattern version of a standard hex nut.

**Nylon Insert Lock**

A nut with a nylon insert to prevent backing off. Also referred to as a Nylock.

**Jam**

A hex nut with a reduced height.

**Nylon Insert Jam Lock**

A nylock nut with a reduced height.

**Wing**

A nut with 'wings' for hand tightening.

**Cap**

A nut with a domed top over the end of the fastener.

**Acorn**

Acorn nuts are a high crown type of cap nut, used for appearance.

**Flange**

A nut with a built in washer like flange.

**Coupling**

Coupling nuts are long nuts used to connect pieces of threaded rod or other male fasteners.

**Square**

A four sided nut.

**Slotted**

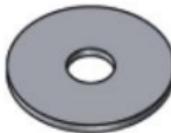
Slotted nuts are used in conjunction with a cotter pin on drilled shank fasteners to prevent loosening.



Types of washers (Шайбы)

**Flat**

A flat washer, used to distribute load. Available in SAE, USS and other patterns.

**Fender**

An oversize flat washer used to further distribute load especially on soft materials.

**Finishing**

A washer used to obtain a 'finished' look. Usually used with oval head screws.

**Split Lock**

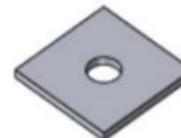
The most common style of washer used to prevent nuts and bolts from backing out.

**External Tooth Lock**

A washer with external 'teeth'. Used to prevent nuts and bolts from backing out.

**Internal Tooth Lock**

A washer with internal 'teeth'. Used to prevent nuts and bolts from backing out.

**Square**

A square shaped washer.

**Dock**

Dock washers have a larger outside diameter and are thicker than standard.



Threaded

Reference material

- Threaded connection (video, rus)
- Multy start thread (rus)
- Doc with all references to GOST (rus)
- Nice material about holes (rus)
- Four common washer types and uses (video)



Glued (Adhesive) (Клеевое)

Adhesive, also known as glue is any non-metallic substance applied to one or both surfaces of two separate items that binds them together and resists their separation.

The use of adhesives offers certain advantages over other binding techniques such as sewing, mechanical fastenings, or welding.





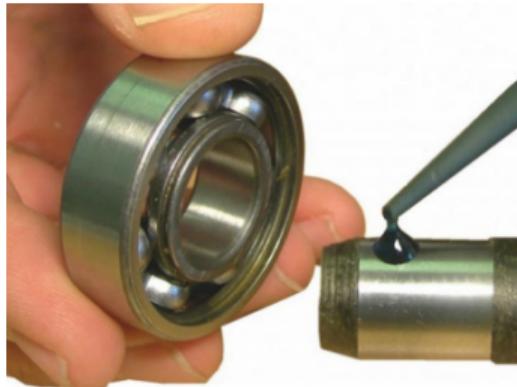
Glues for wood

Video





Threadlocker (Фиксатор Резьбы)

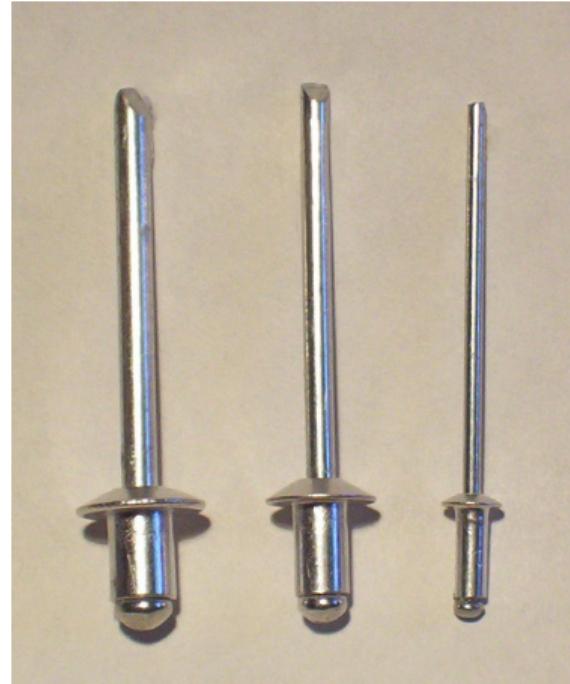




Riveting (Заклепочное)

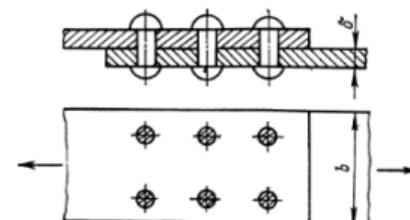
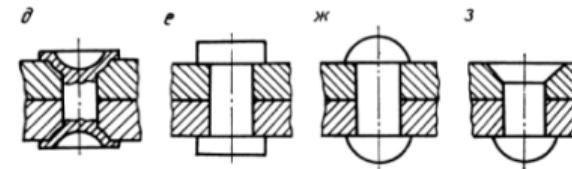
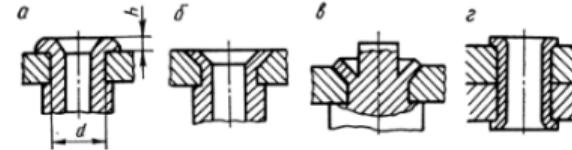
The riveted joint is a permanent joint cause rivet is a permanent mechanical fastener. A rivet is a cylindrical shaft with a head on one end and the opposite end known as a tail.

Used in structures, bridges, sheet metal operations, ships, and many industries. Main benefit — **resistance to vibrations**.





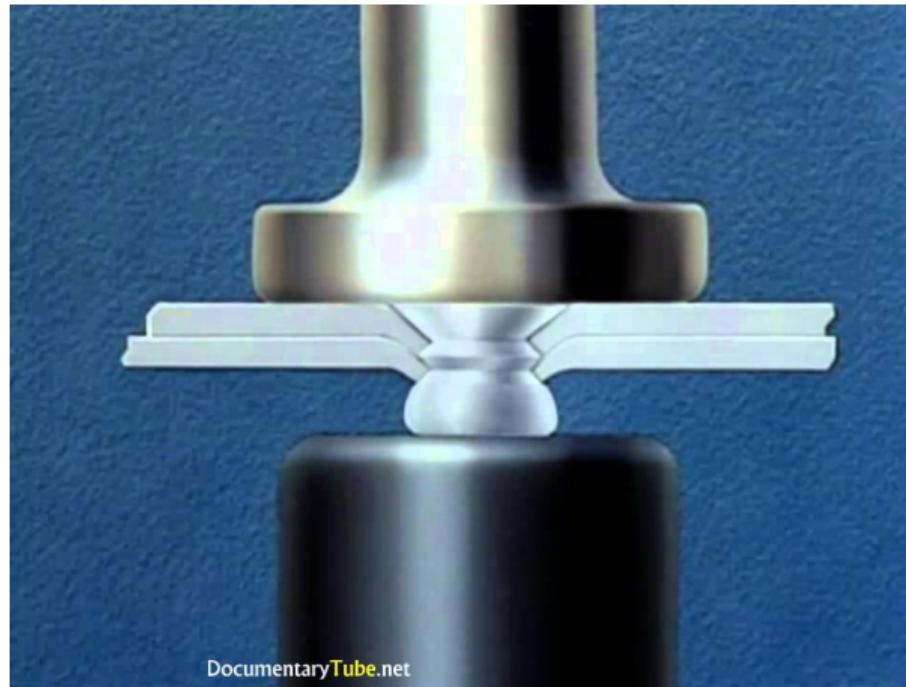
Riveting in general





Rivets in aircrafting

Video



DocumentaryTube.net



Rivets in leather industry





Riveting (RUS)

Video



Неразъемные соединения



постройка Титаника





How to remove rivets

Video





Riveting Rofl

Video





Riveting

Reference material

- Types of rivets



Welding (Сварка)

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by using high heat to **melt the parts together** and allowing them to cool, causing fusion.



Difference between Welding and Soldering (Пайка) (RUS)

Video





Introduction to welding process

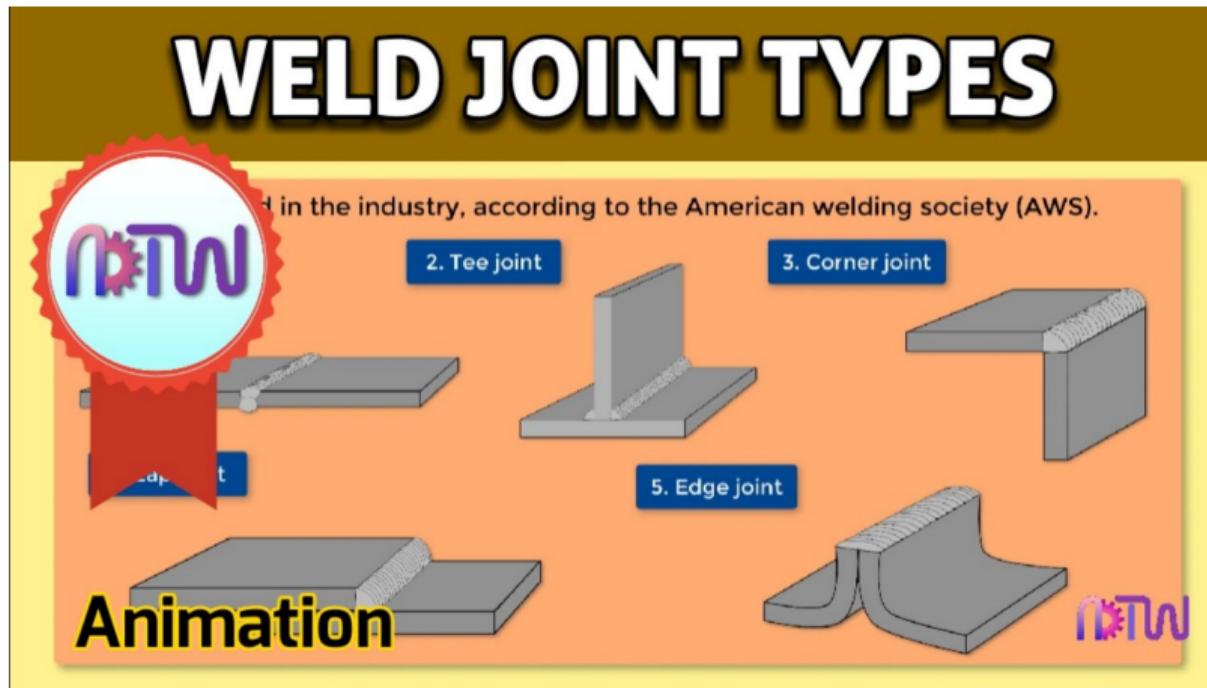
Video





Weld joint types

Video



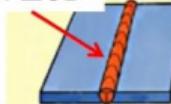


Welding (RUS)

Video

ВИДЫ СОЕДИНЕНИЙ И ШВОВ

стыковой шов



стыковое

угловой шов



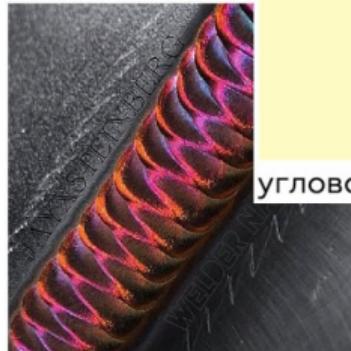
тавровое

нахлесточное



угловое

торцовое





Classical Welding techniques

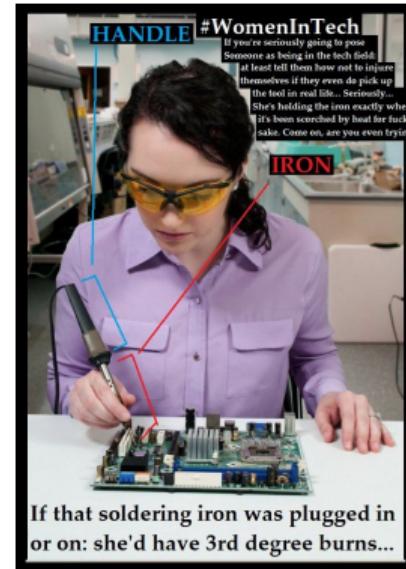
Reference material

- Stick (Ручная дуговая) (SMAW)
- MIG (С помощью Инертного газа) (GMAW)
- TIG (Аргонодуговая)
- Flux Cored Arc (Порошковым флюсом)
- Another explanation of all 4 types



Soldering (Пайка) & Brazing (Высокотемпературная)

It is a process in which two or more items are joined by melting and putting a filler metal (solder) into the joint, the filler metal having a lower melting point than the adjoining metal.

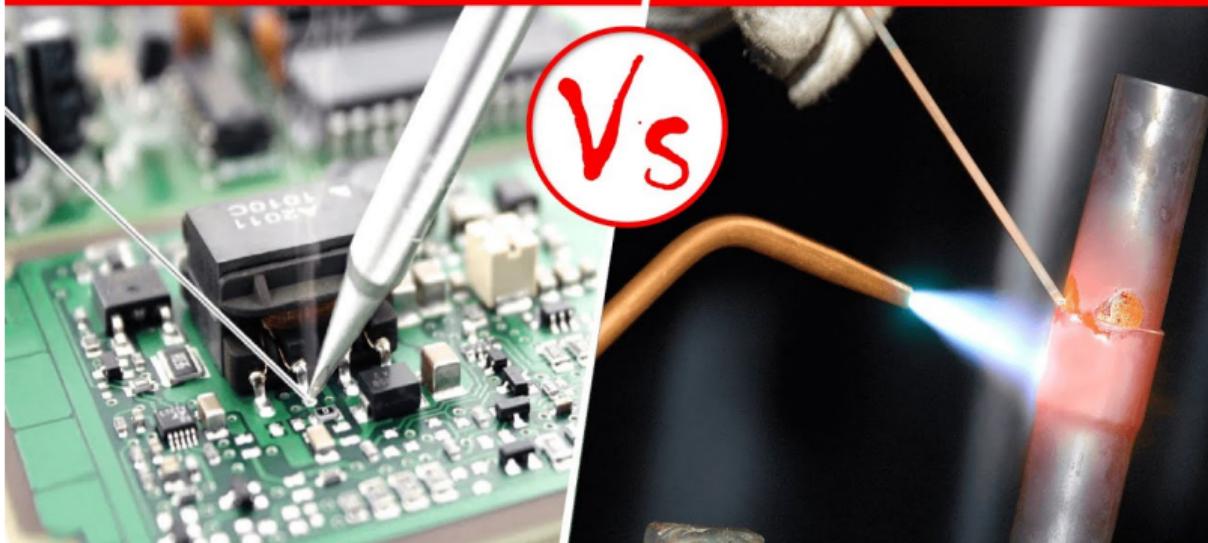




Difference between Soldering and Brazing

Video

Soldering/Brazing



VS



Soldering & Brazing

Reference material

- Brazing soldering welding difference



Reference material

1. Mott R. L., Vavrek E. M., Wang J. Machine Elements in Mechanical Design, Ed. — 2011
2. Avallone E. A., Baumeister III T., Sadegh A. Marks' standard handbook for mechanical engineers. — McGraw-Hill Education, 2007.
3. Budynas R. G. et al. Shigley's mechanical engineering design. — New York : McGraw-Hill, 2011.
4. Types of connection (rus, video)
5. A lot of engineering books in english

Deserve “A” grade!

– Oleg Bulichev

✉ o.bulichev@innopolis.ru

↗ @Lupasic

🚪 Room 105 (Underground robotics lab)