Fundamentals of the thread types and threading
Principle and application with SINUMERIK Operate
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# Fundamentals of the thread types and threading

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# Overview of threads

**Definition and tasks**

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<th>Definition</th>
<th>Main tasks</th>
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| A thread is a spiral groove on a (usually) cylindrical object. | • Connecting (friction locking)  
• Conversion of a rotating motion (rotary) to an axial motion (translatory) |

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<th>Classification</th>
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| In terms of manufacturing/technology, threads are fits (standardized tolerances with narrow dimensions) | For an male thread there is a matching female thread, i.e. same thread pitch, same core and flank dimensions, and same thread type.  
**Connecting:**  
The connection is prevented from coming loose by the forces of friction on the flanks.  
**Conversion of the motion:**  
When turning the threaded rod, the counterpart moves along the threaded rod. |

Source: https://www.augenblicke-eingefangen.de/1/4-20-unc-button-head-screw
The various types of threads differ in regard to:

- Flank profile
- Outer diameter
- Pitch
- Thread direction
- Number of threads
- System of units
- Runout
- Tapering
- Tolerance zone

Threads are given designations via the thread ID letters and the outer/nominal diameter (supplements, if necessary).
Thread types and their advantages

Metric ISO thread

• The most widely used thread is the **metric ISO thread** (regular, standard or sharp thread)

• Profile shape in which the outer edges come together to form wedges. Due to this design, the thread is **self-locking**, i.e. it cannot come loose on its own.

• The flank angle for this type of thread is 60°

• Metric threads are used for threaded rods, nuts and bolts for securing frictional connections.

**Thread designation:**

- **M** = thread identification letter (metric ISO thread)
- **20** = nominal diameter
- **6H** = tolerance

Source: Roloff, Matek, Maschinenelemente, 2007

Source: https://schraube-mutter.de/gewinde-m18/
Thread types and their advantages
Metric ISO fine thread

• Same design as with a standard metric thread. The difference lies in a narrower, more shallow cut thread profile and non-standardized pitch.
  → As a consequence the metric fine thread can withstand more tensile force

• Often used where space is limited. For a regular thread, only a few threads would then be in the engagement.

• The flank angle is also 60°.

• The pitch is also specified in the designations of fine threads.

Thread designation:

M = thread identification letter
(metric ISO thread)

20 = nominal diameter

6H = tolerance

2 = pitch

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Thread types and their advantages

Acme threads

- In cross-section, the shape of the thread corresponds to an equal-sided trapezoid with an angle of 15°. This results in a flank angle of 30°.

- The acme thread is thicker than a standard thread and therefore has a larger pitch. In addition, it has relatively high friction, which has a self-locking effect.

- The acme thread is distinguished according to DIN:
  - DIN 380 – sharp-edged acme thread
  - DIN 30295 – rounded-off acme thread

- Used for screw clamps, printers, assembly belts, forklifts, etc.
Thread types and their advantages
Pipe thread / Whitworth thread

- The first thread (GB) that was subject to a standard.
- Flank angle of 55°, therefore not compatible with metric threads
- The Whitworth thread is available in two different versions:
  - Standard thread – BSW (British Standard Whitworth Coarse Thread)
  - Fine thread – BSF (British Standard Fine Thread) or BSP (British Standard Pipe Thread)
- Used especially in tube fittings (e.g. in shower fixtures)
- Unlike metric threads, the designations are based on inches. The pitch is also measured differently, using the number of windings per inch.

Flank angle

Source: Roloff, Matek; Maschinenelemente, 2007
Thread types and their advantages

Knuckle threads

• The knuckle thread was developed to reduce the maintenance and cleaning costs.
• Due to its shape, the thread is protected against contamination and, at the same time, they are more resistant due to rounded-off edges.
• Flank angle of 30° (DIN 405, 15403, 20400)
• Used in large valves or, for example, coupling spindles of railway carriages

Source: Roloff, Matek; Maschinenelemente, 2007
Thread types and their advantages

Buttress threads

- Asymmetrical thread shape, the profile of which resembles a saw tooth
- Due to the asymmetrical shape, the thread can transmit very high forces, in particular in the axial direction, i.e. along the threaded rod.
- Flank angle varies between 30° and 45°
- Thread form is defined in DIN 513, 2781, 20401, 55525 and 6063.
- This thread is mainly used in industrial applications for presses or hoisting systems.

Source: Roloff, Matek; Maschinenelemente, 2007
Thread types and their advantages

Left-hand thread

- A left-hand thread is any thread that can be screwed into the material by turning counter-clockwise. It is the "mirror image" of a right-hand thread.
- Used whenever a standard thread could come loose under a given load.
- Application example:
  - Left-hand bike pedal – a right-hand thread would automatically become unscrewed due to the rotating motion.
  - Securing the valves of gas bottles – prevents other fixtures, such as those for oxygen bottles, from being connected.
Thread types and their advantages

Multi-start threads

- Any thread that has more than one thread turn is called a multi-start thread.

- Multi-start threads are especially suitable when the thread pitches are large, because the thread turn already has a large distance from the last revolution after one revolution.

- Additional thread turns can be added in this gap.

- Used especially in small or thin-walled workpieces (e.g. shafts) of the optical industry, in which a single thread is not sufficient due to the space and the rotating/direction of motion.

Source: Ketterer
Introduction to threading

Overview

- Thread turning
- Thread whirling
- Thread milling
- Tapping
- Drill thread milling
- Punch tapping

Threading can be done on both a turning or a milling machine.
# Introduction to threading

**Threading with rotating workpiece - thread whirling**

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<th>Thread whirling</th>
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<td><strong>Process features</strong></td>
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<td>Thread whirling is a special method of threading. The tool is a whirling ring with blades that are aimed inward, which is positioned eccentrically with a high speed and circles the slowing rotating workpiece.</td>
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<tr>
<td><strong>Advantages</strong></td>
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<tr>
<td>• Uniform, favorable chip formation, high surface quality achievable</td>
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<td>• Dry machining for the most part</td>
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<tr>
<td>• No buckling or striking of the rotating workpieces</td>
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<td><strong>Disadvantages</strong></td>
</tr>
<tr>
<td>• Complex systems and special tools needed</td>
</tr>
<tr>
<td>• Time-consuming setting of the cutting edges on the whirling ring</td>
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Source: Spur et al., Metal Cutting Manual, 2014
Introduction to threading
Threading with rotating workpiece - thread turning

Thread turning

Process features

• Chipping process
• Suitable for female and male threading
• Flexibility with regard to the thread type (also multi-start threads, tapered threads, or thread chains)

Prerequisites

• Tool selection depends on the thread type
• Use of partial or full profile indexable inserts

Please note

• Profile tool, i.e. limited use of tool

Source: Spur et al., Metal Cutting Manual, 2014
Thread turning with SINUMERIK Operate
Thread turning of parallel threads
Thread turning with SINUMERIK Operate

Thread turning of tapered threads
Thread turning with SINUMERIK Operate

Thread turning of face threads
Thread turning with SINUMERIK Operate
Thread turning of thread chains
Thread turning with SINUMERIK Operate

Thread undercuts – predefined in SINUMERIK Operate!

Standardized undercut according to DIN

Thread undercut (can be freely parameterized)
Practical part: Thread turning
Summary
Fundamentals of thread types and threading

- Fast and reliable threading with SINUMERIK Operate!
- Convenient cycle screens for producing a wide variety of thread types and thread undercuts.
- Realistic production-relevant simulation of threading.
- Longitudinal thread, tapered thread, thread chains, face thread, thread undercuts

With SINUMERIK, both cutting and non-cutting threading is possible on turning and milling machines!
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