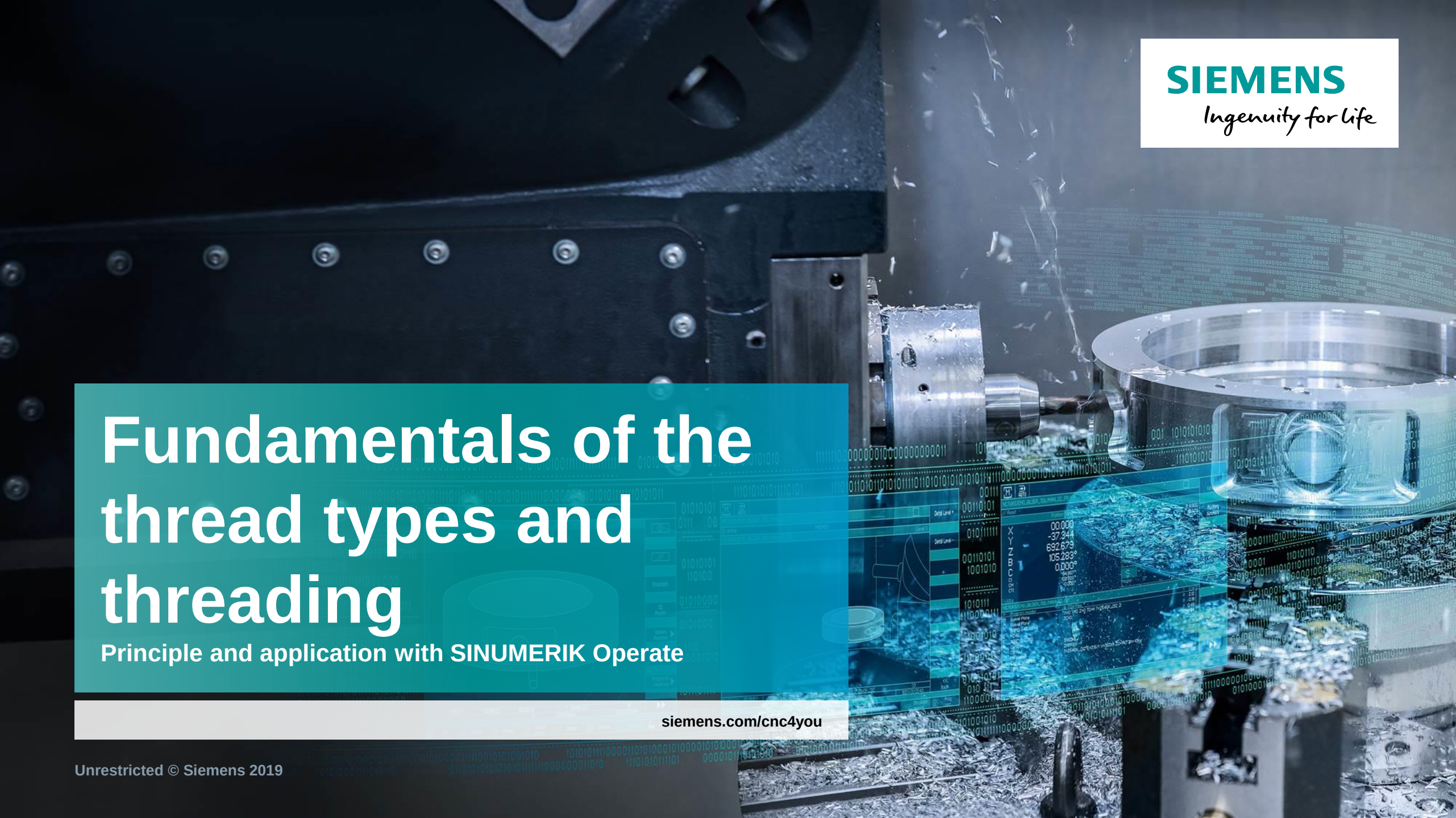

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# Fundamentals of the thread types and threading

## Principle and application with SINUMERIK Operate

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# Fundamentals of the thread types and threading

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# 1 Overview of threads

## Definition and tasks

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### Definition

A thread is a spiral groove on a (usually) cylindrical object.

### Main tasks

- Connecting (friction locking)
- Conversion of a rotating motion (rotary) to an axial motion (translatory)

### Classification

In terms of manufacturing/technology, threads are fits (standardized tolerances with narrow dimensions)

Source: https://www.augenblicke-eingefangen.de/1/4-20-unc-button-head-screw

### Principle

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.

# 1 Overview of threads

## Dimensions and designations

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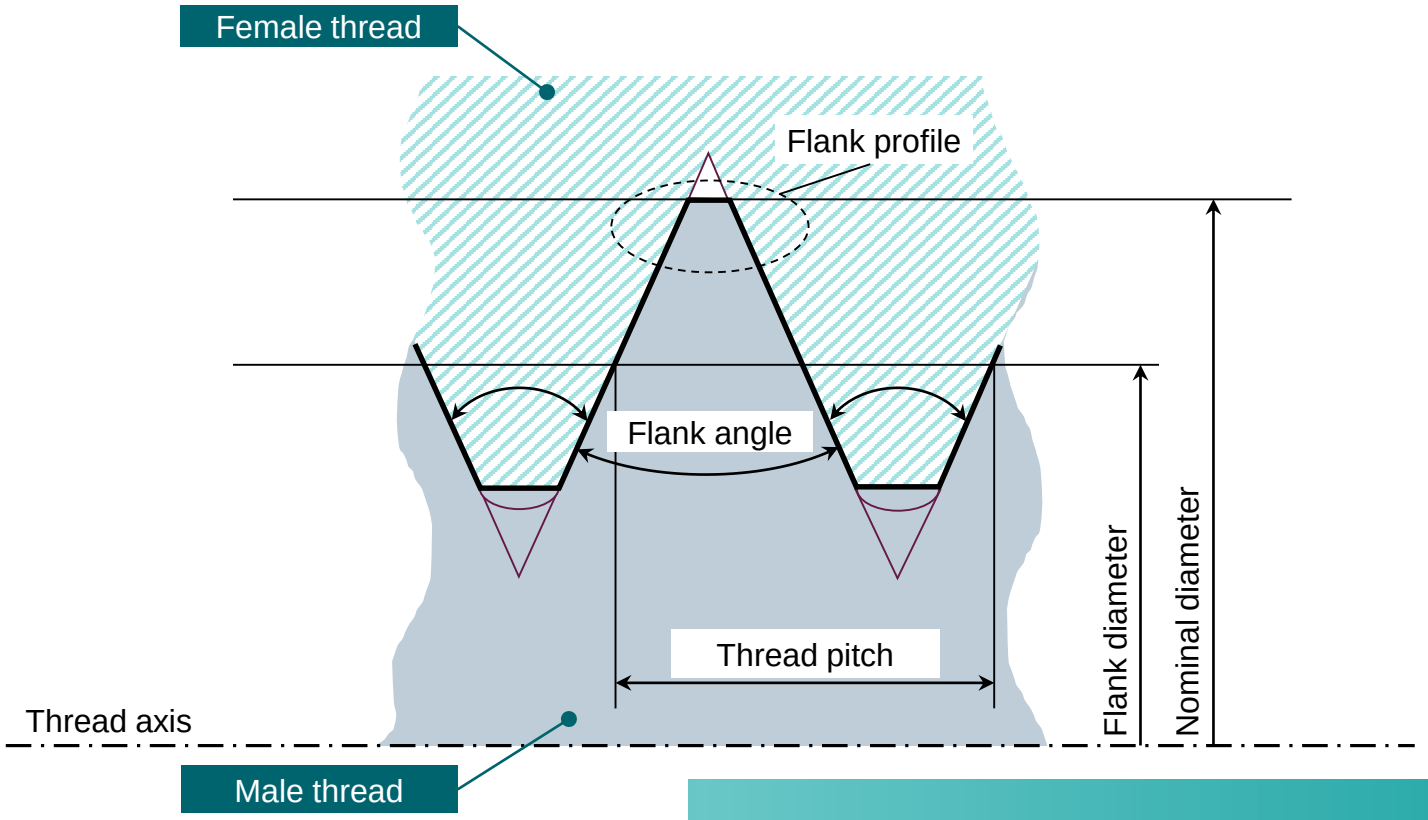



The various types of threads differ in regard to:

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

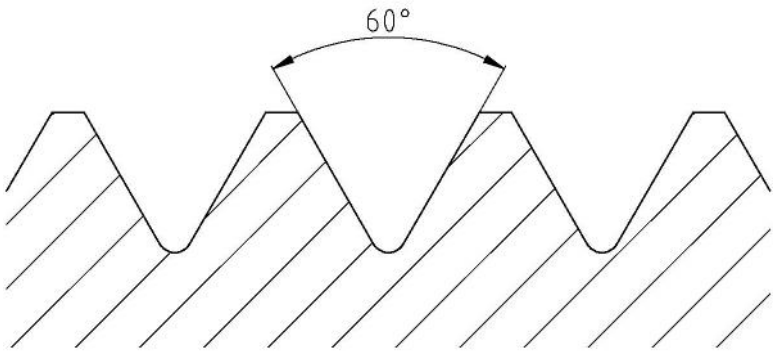
Threads are given designations via the thread ID letters and the outer/nominal diameter (supplements, if necessary).

# 2 Thread types and their advantages

## Metric ISO thread

Source: https://schraube-mutter.de/gewinde-m18/

Flank angle




Source: Roloff, Matek; Maschinenelemente, 2007

- 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:

20 = nominal diameter

M = thread identification letter
(metric ISO thread)

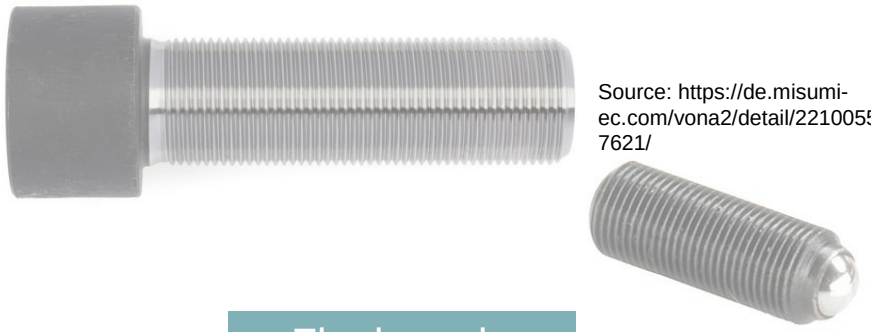
M 20

6H = tolerance

6H

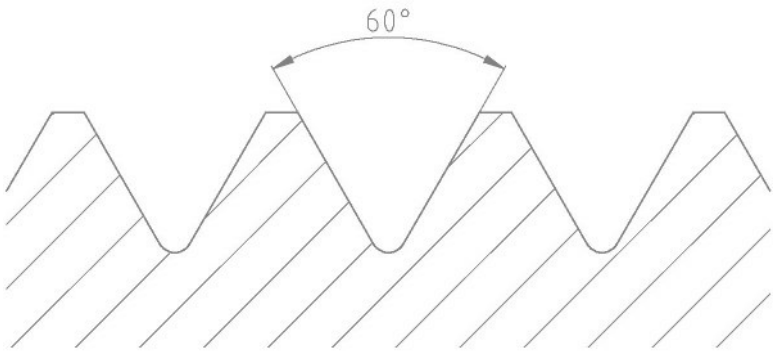
# 2 Thread types and their advantages

## Metric ISO fine thread



Source: https://de.misumi-ec.com/vona2/detail/221005517621/

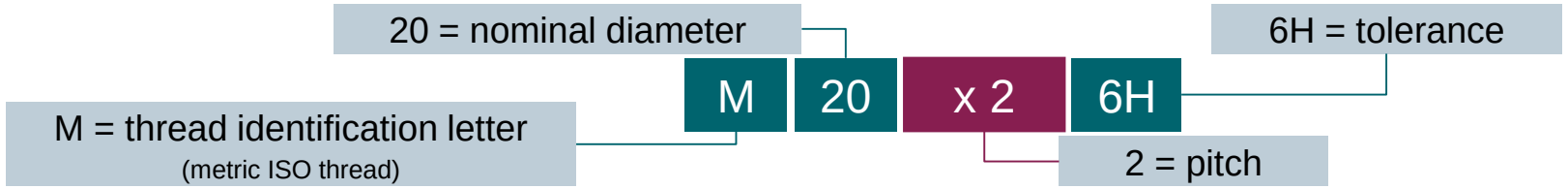
Flank angle




Source: Roloff, Matek; Maschinenelemente, 2007

- 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:

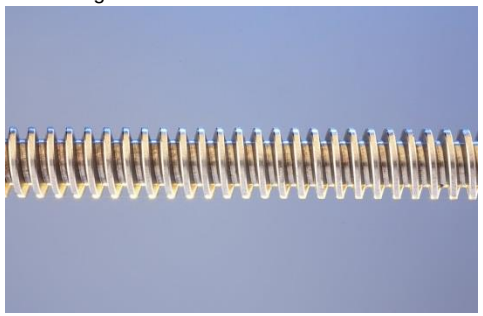


# 2 Thread types and their advantages

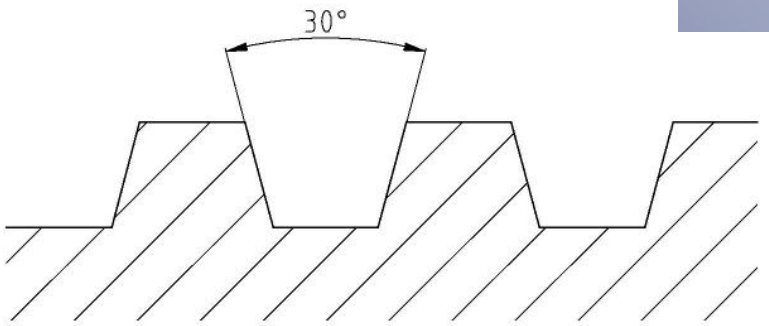
## Acme threads

Source: https://www.befestigungsfuchs.de/blog/die-wichtigsten-gewindearten-im-ueberblick/

Source: https://www.bornemann-gewindetechnik.de/de/schwere-lasten-im-griff-hochbelastete-trapezgewindetriebe-fuer-hebeanlagen/



### Flank angle



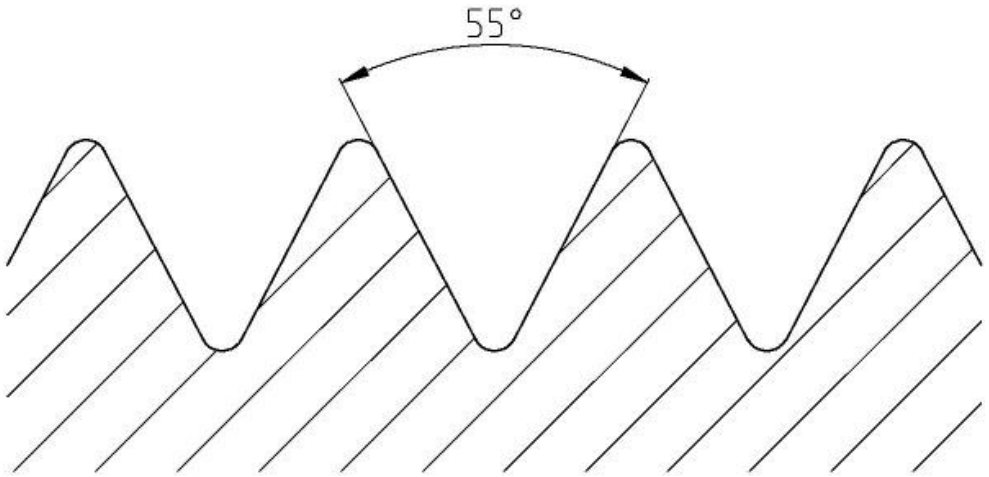

Source: Roloff, Matek; Maschinenelemente, 2007

- 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.

# 2 Thread types and their advantages

## Pipe thread / Whitworth thread

Flank angle




Source: Roloff, Matek; Maschinenelemente, 2007

- 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.

# 2 Thread types and their advantages

## Knuckle threads

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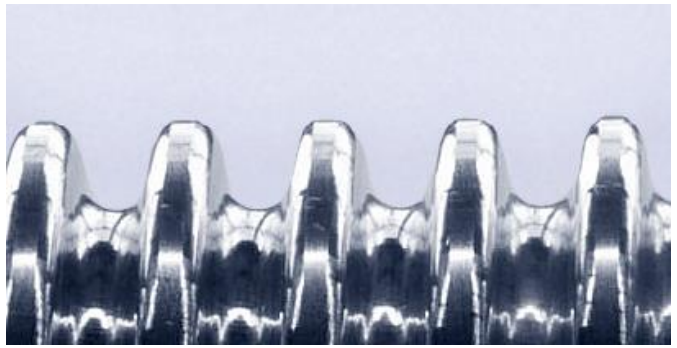
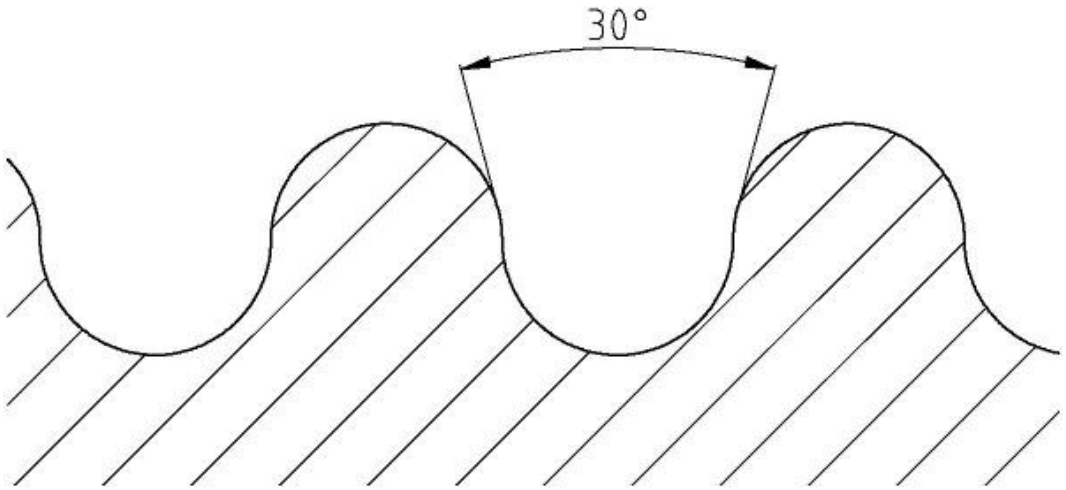


**Flank angle**

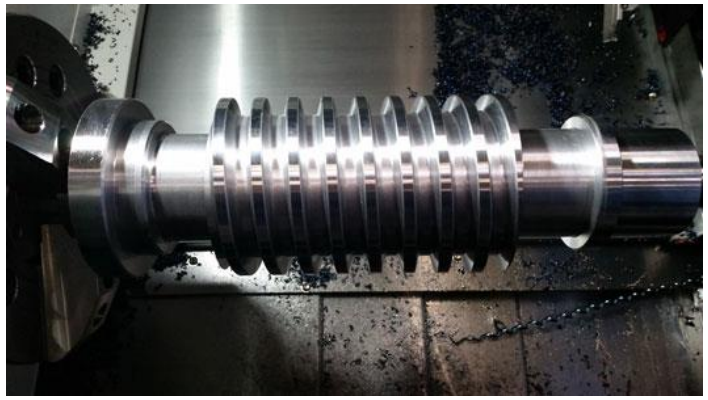



Source: Roloff, Matek; Maschinenelemente, 2007

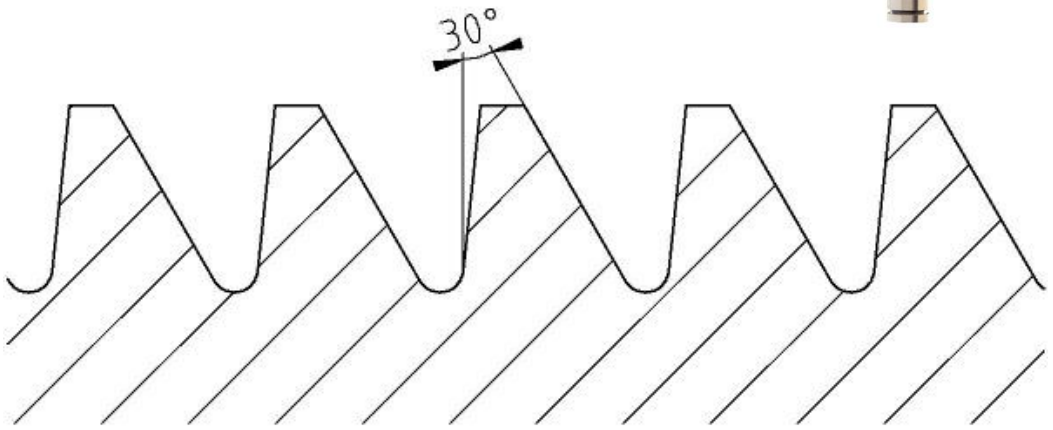
- The knuckle thread was developed to reduce the maintenance and cleaning costs.
- Due to its shape, the thread is protected against contamination and, at the same time, they are more resistant due to rounded-off edges.
- Flank angle of 30° (DIN 405, 15403, 20400)
- Used in large valves or, for example,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

# 2 Thread types and their advantages

## Buttress threads



Flank angle




Source: Roloff, Matek; Maschinenelemente, 2007

- 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.

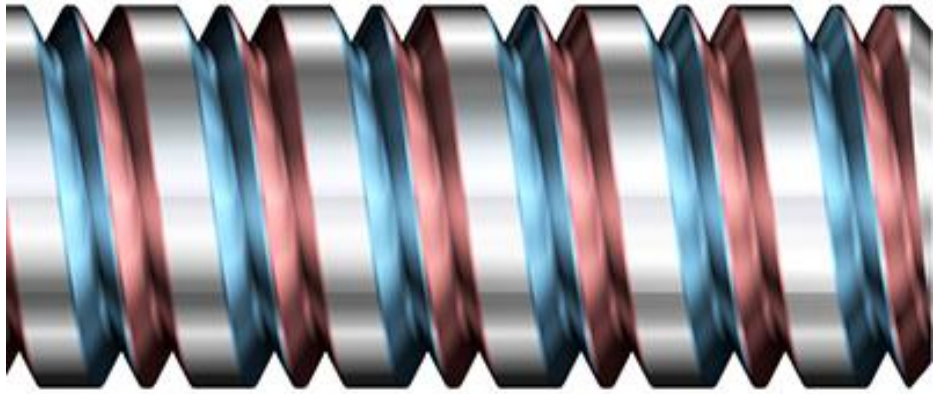
# 2 Thread types and their advantages

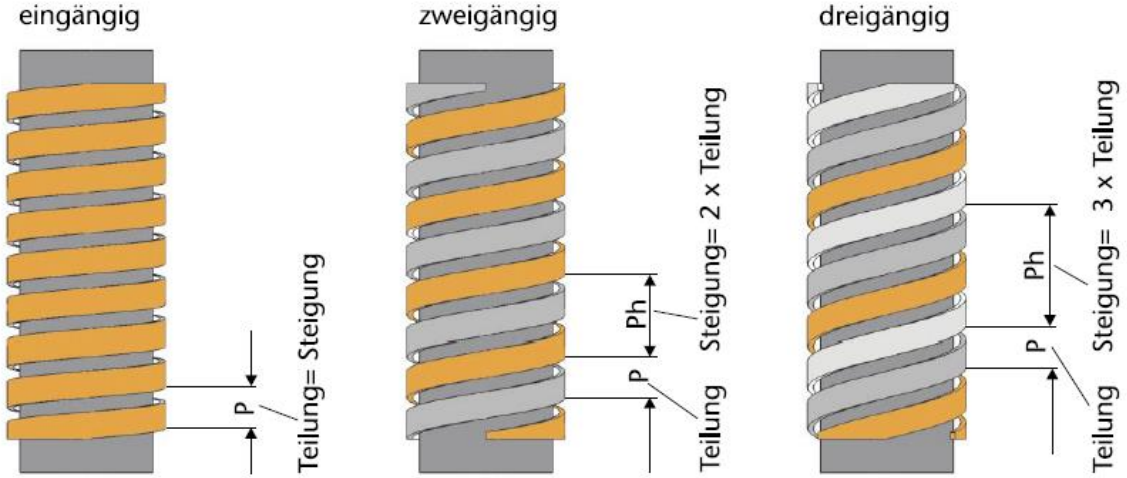
## Left-hand thread

- 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.

# 2 Thread types and their advantages

## Multi-start threads






Source: Ketterer

- 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.

# Introduction to threading

## Overview

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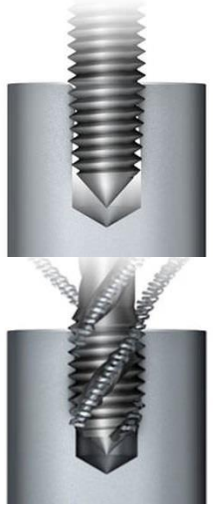
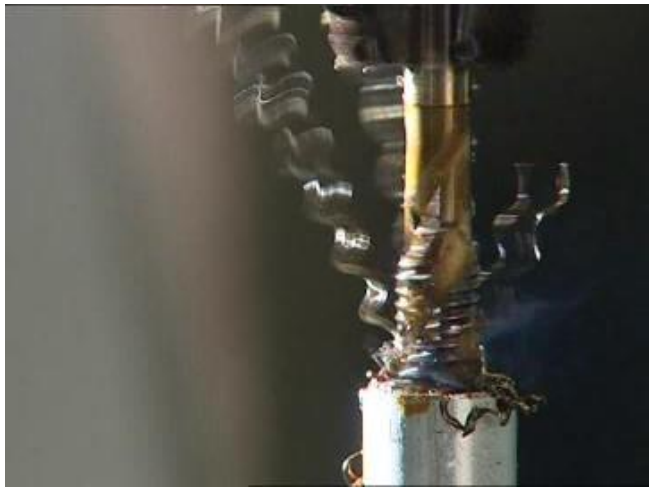
- Thread turning
- Thread whirling
- Thread milling
- Tapping
- Drill thread milling
- Punch tapping

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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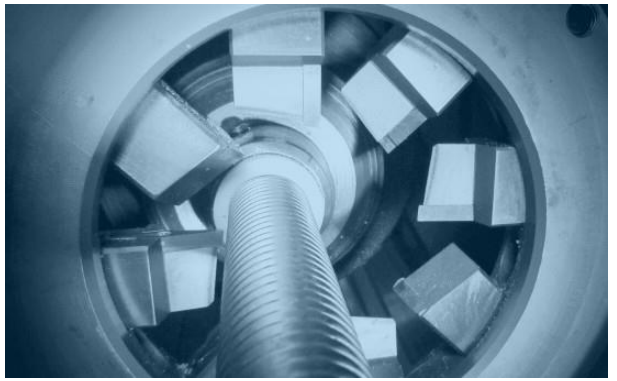
### Thread whirling

#### Process features

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.

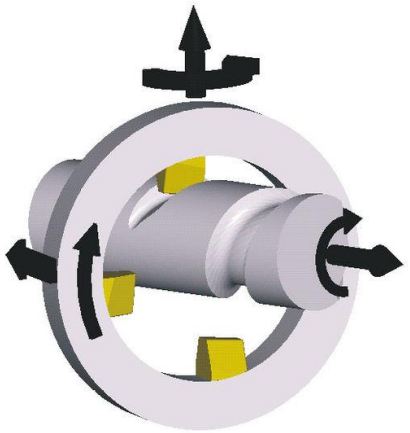


#### Advantages

- Uniform, favorable chip formation, high surface quality achievable
- Dry machining for the most part
- No buckling or striking of the rotating workpieces

#### Disadvantages

- Complex systems and special tools needed
- Time-consuming setting of the cutting edges on the whirling ring



Source: Spur et al., Metal Cutting Manual, 2014

# Introduction to threading

## Threading with rotating workpiece - thread turning

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## Thread turning

### Process features

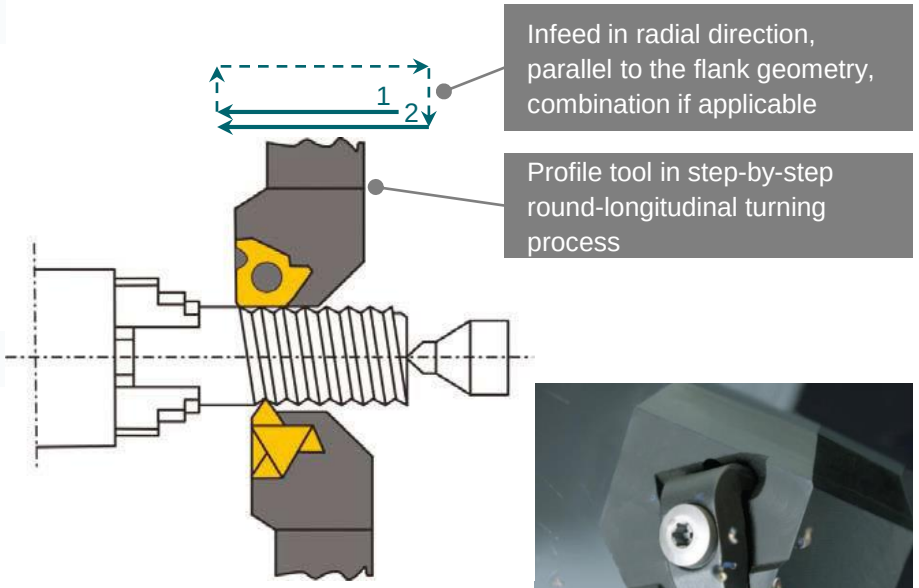
- Chipping process
- Suitable for female and male threading
- Flexibility with regard to the thread type (also multi-start threads, tapered threads, or thread chains)

### Prerequisites

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

### Please note

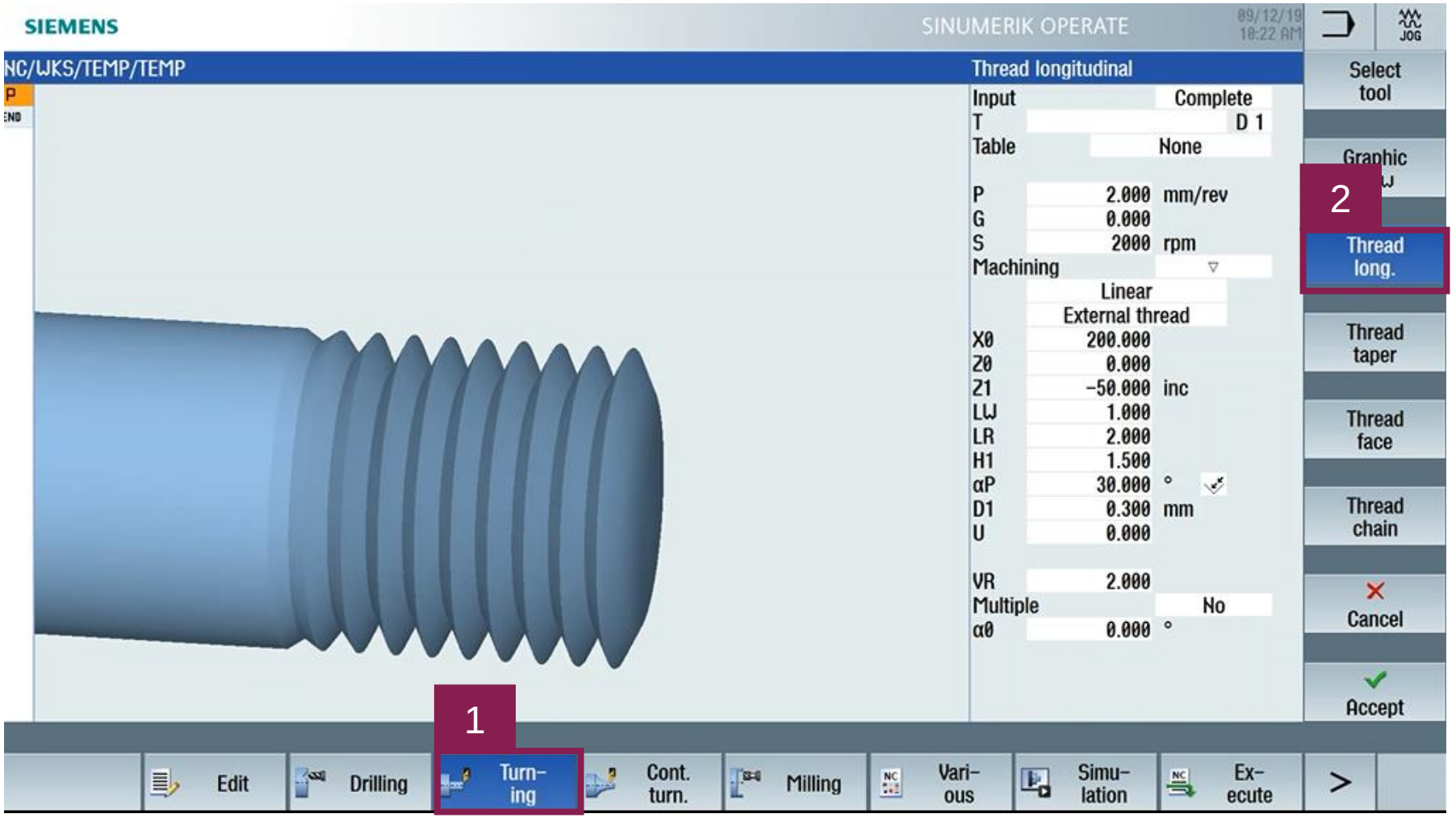
- Profile tool, i.e. limited use of tool




Source: Spur et al., Metal Cutting Manual, 2014

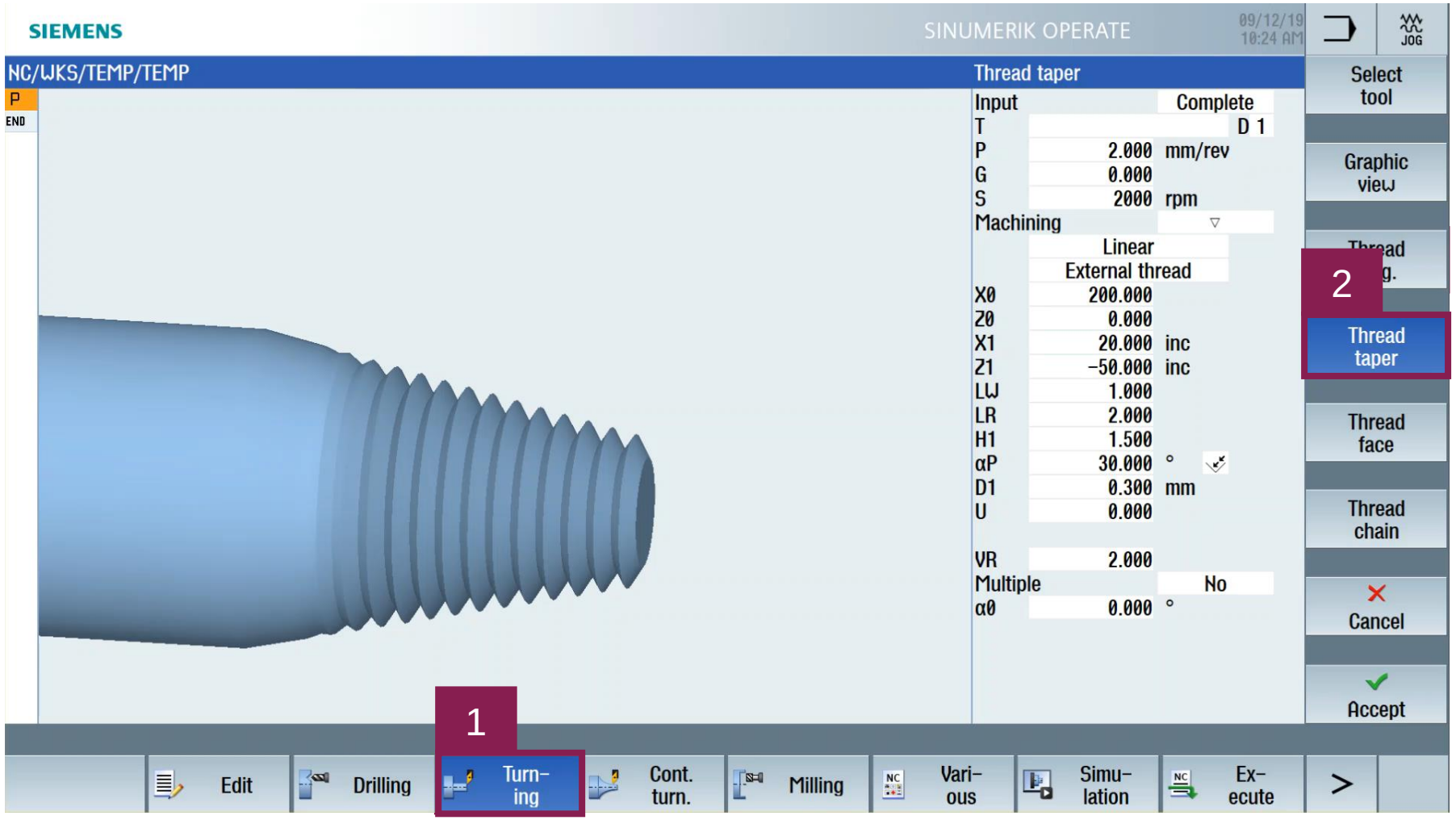
# 3 Thread turning with SINUMERIK Operate

## Thread turning of parallel threads



# 3 Thread turning with SINUMERIK Operate

## Thread turning of tapered threads



# 3 Thread turning with SINUMERIK Operate

## Thread turning of face threads

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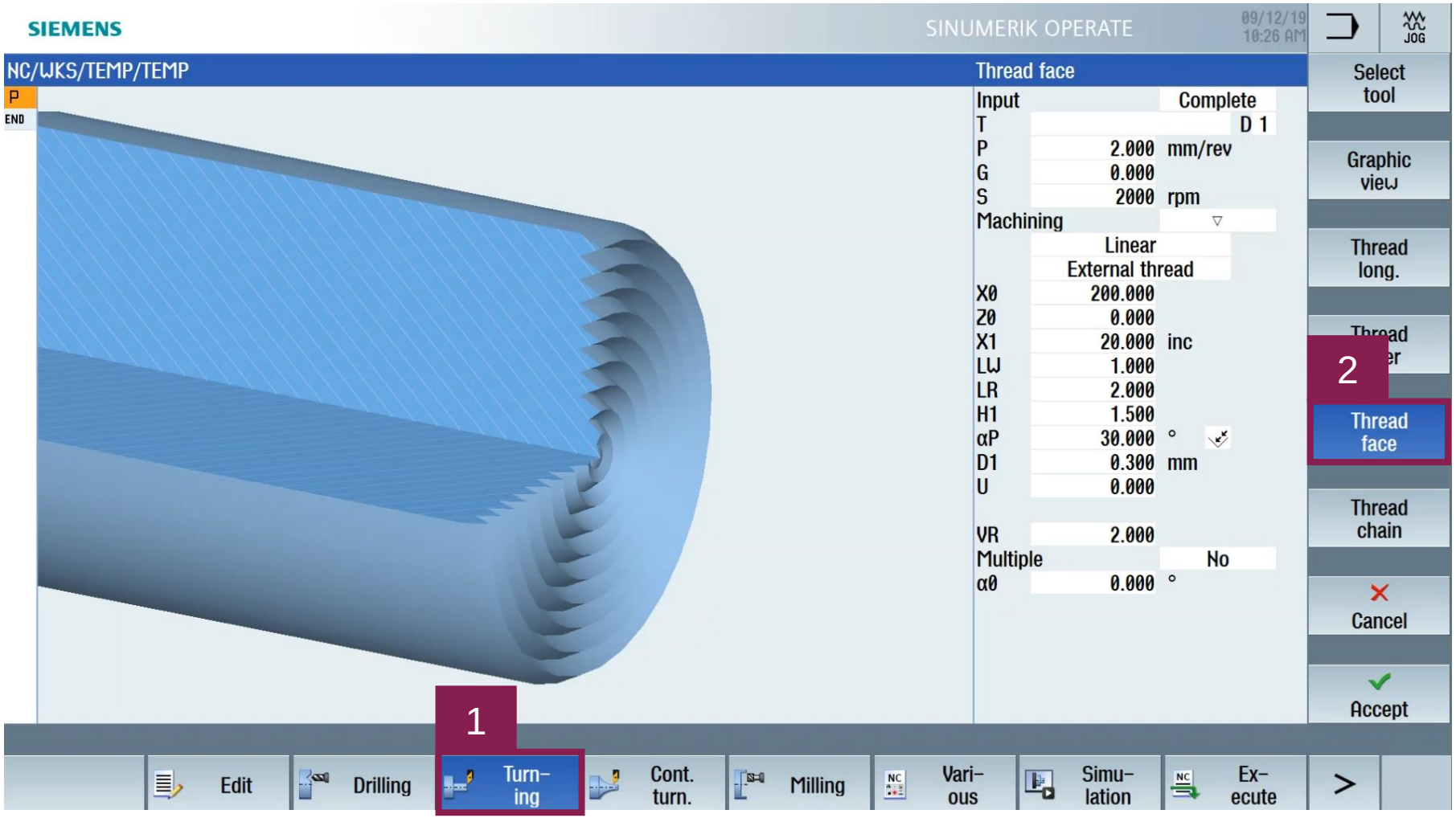

# 3 Thread turning with SINUMERIK Operate

## Thread turning of thread chains

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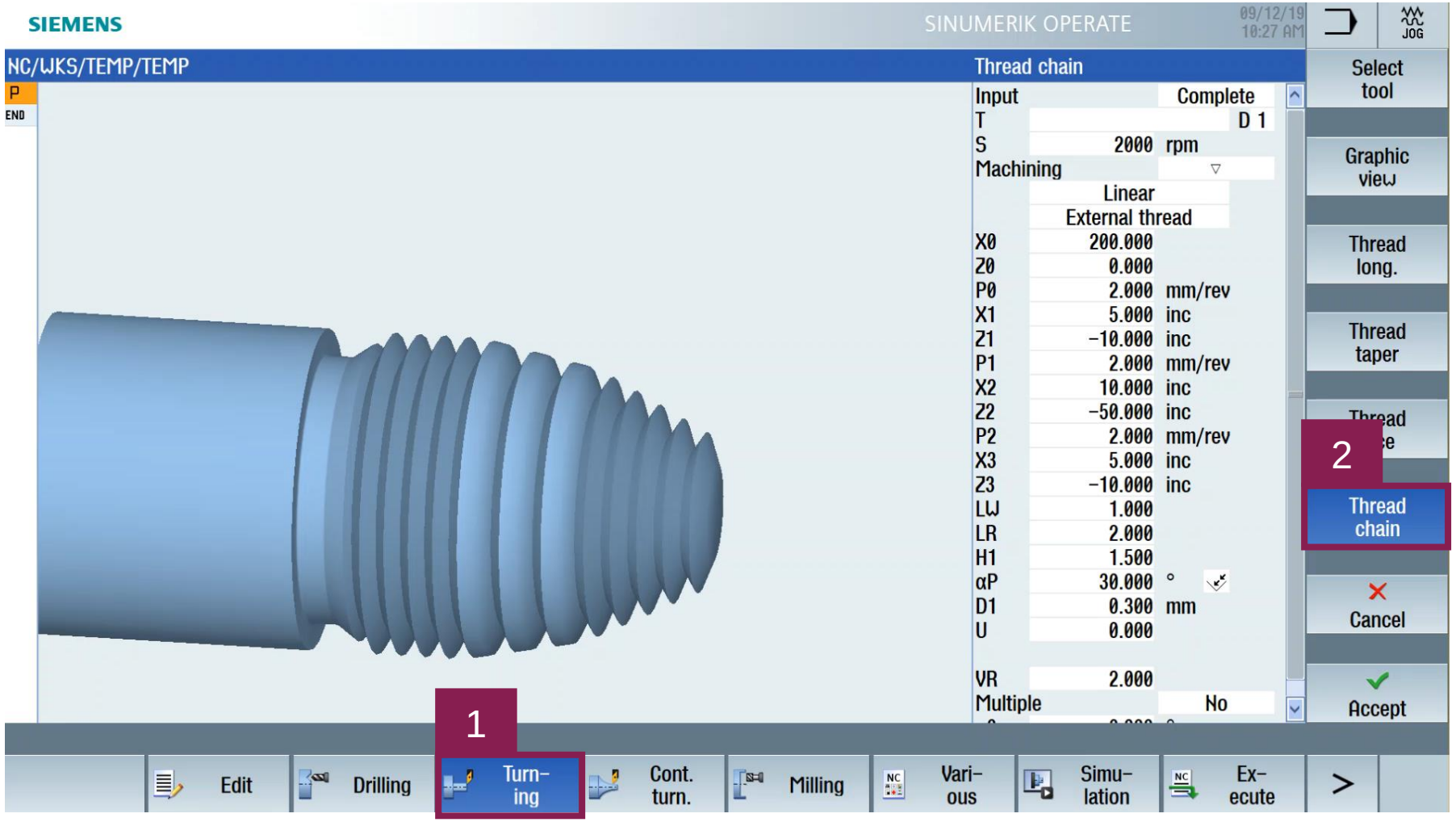

# 3 Thread turning with SINUMERIK Operate

## Thread undercuts – predefined in SINUMERIK Operate!

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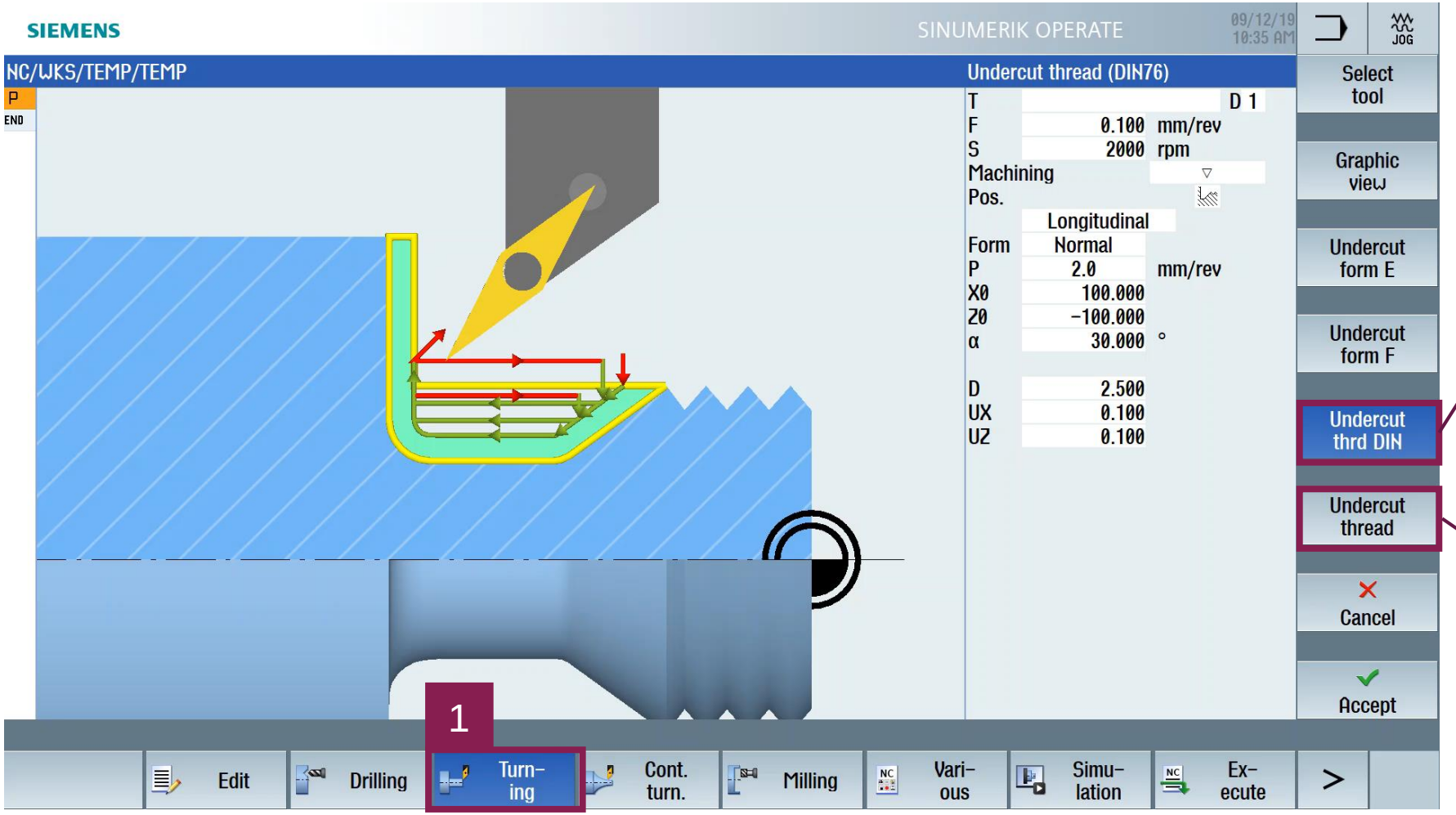


Standardized undercut according to DIN

Thread undercut (can be freely parameterized)

# 4 Practical part: Thread turning

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# 5 Summary

## Fundamentals of thread types and threading

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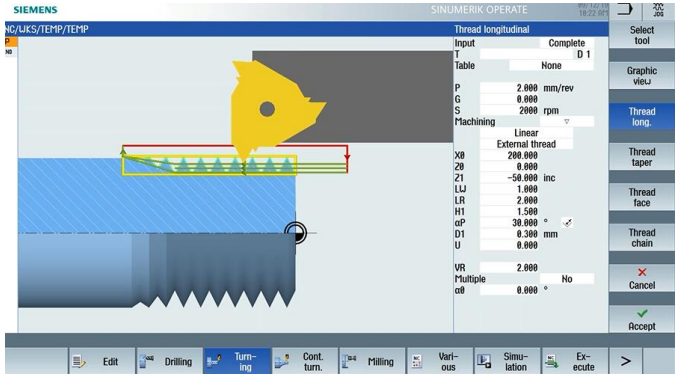
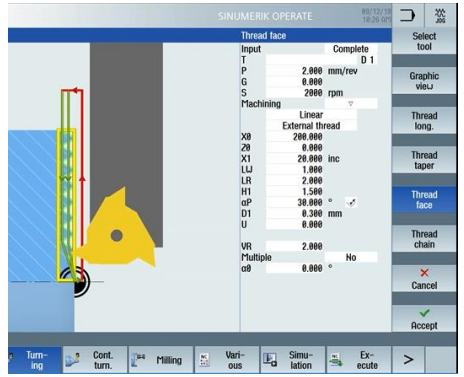
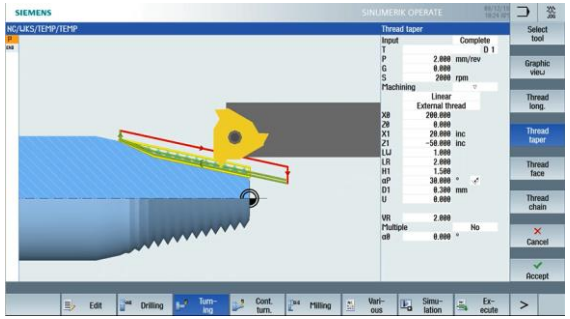
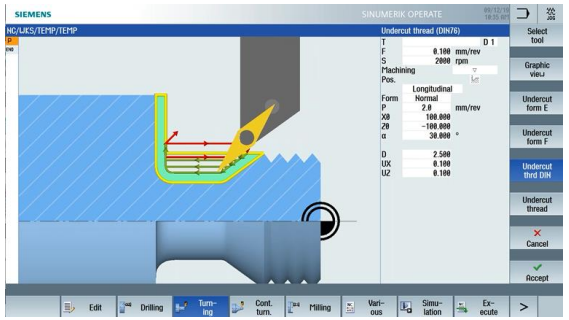
- **Fast and reliable** threading with SINUMERIK Operate!
- **Convenient** cycle screens for producing a wide variety of thread types and thread undercuts.
- **Realistic production-relevant** simulation of threading.
- Longitudinal thread, tapered thread, thread chains, face thread, thread undercuts




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

# Produced by

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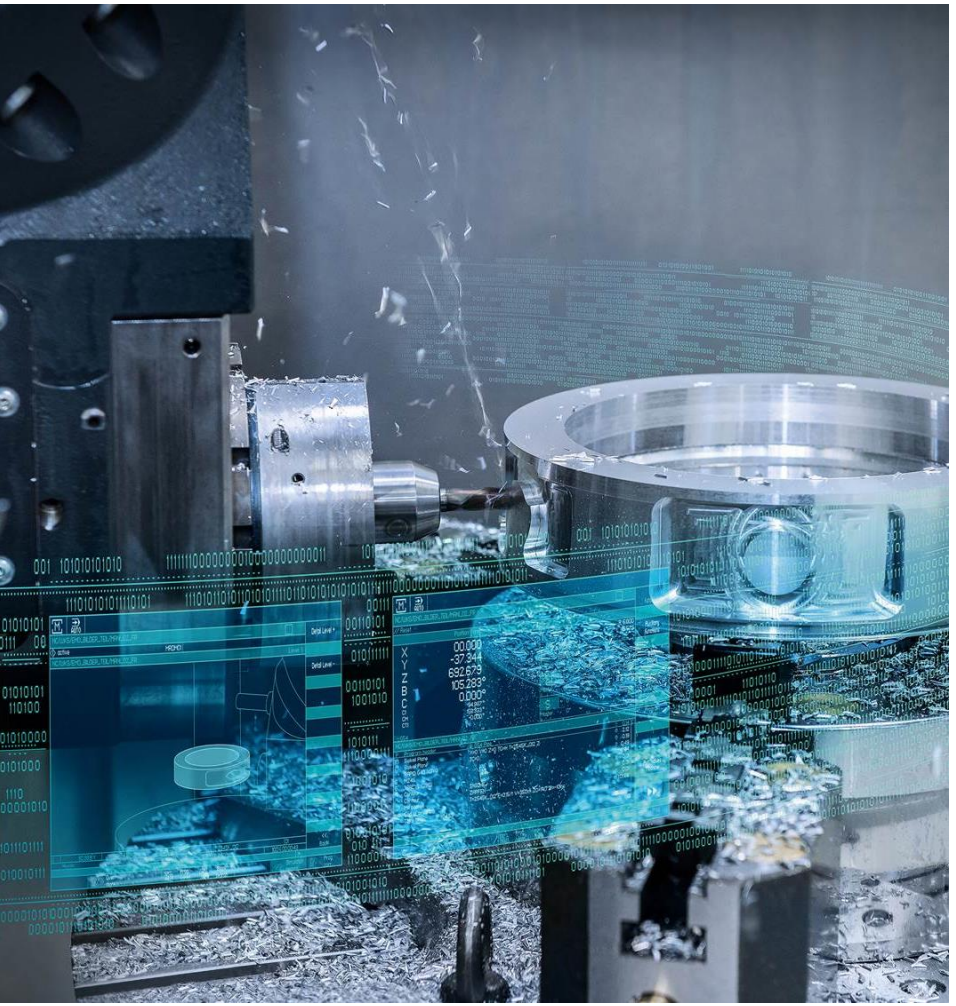

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