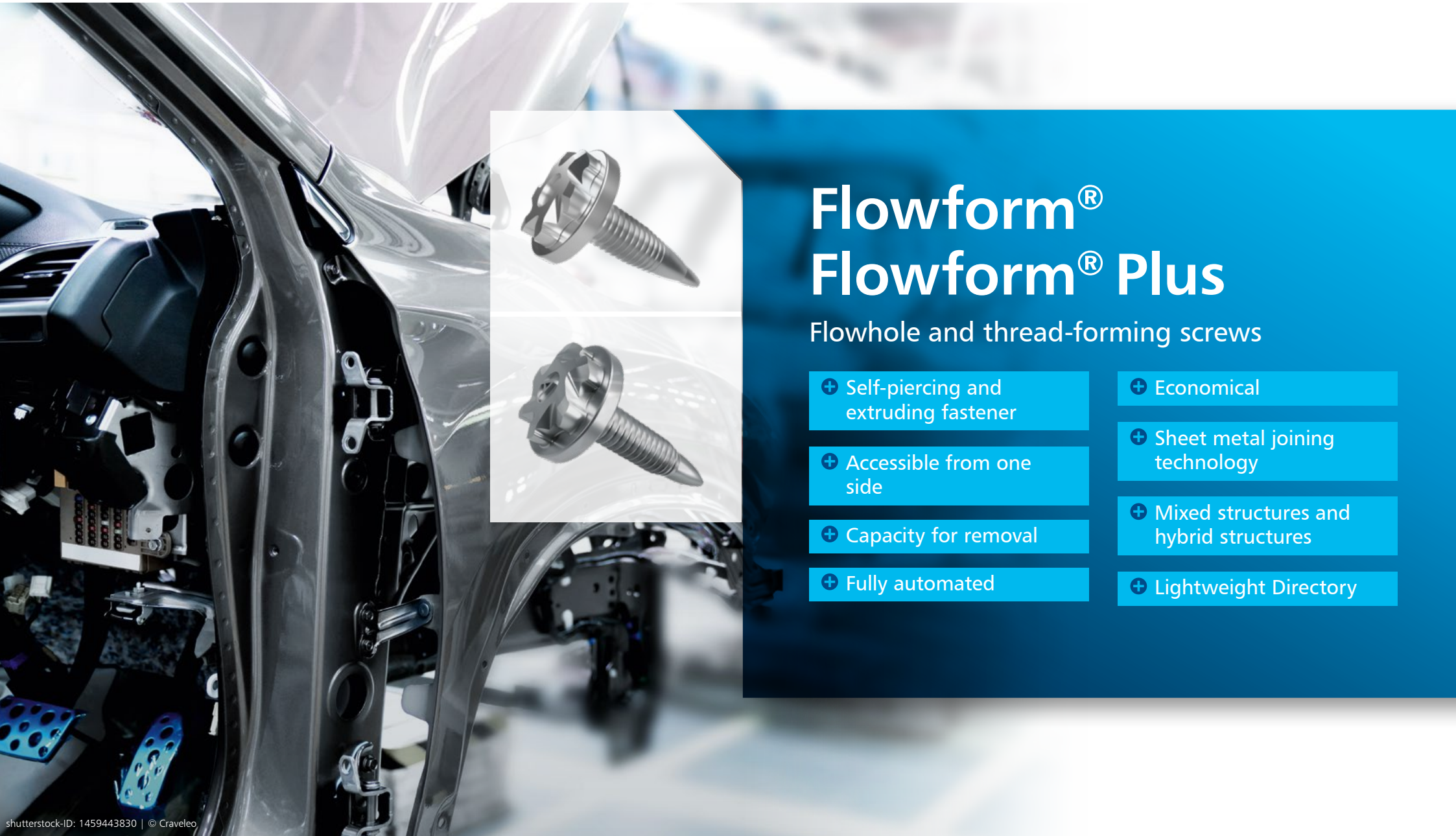
Version dated 03.2026
www.arnold-fastening.com

ARNOLD®
BlueFastening Systems



Flowform®
Flowform® Plus

Flowhole and thread-forming screws

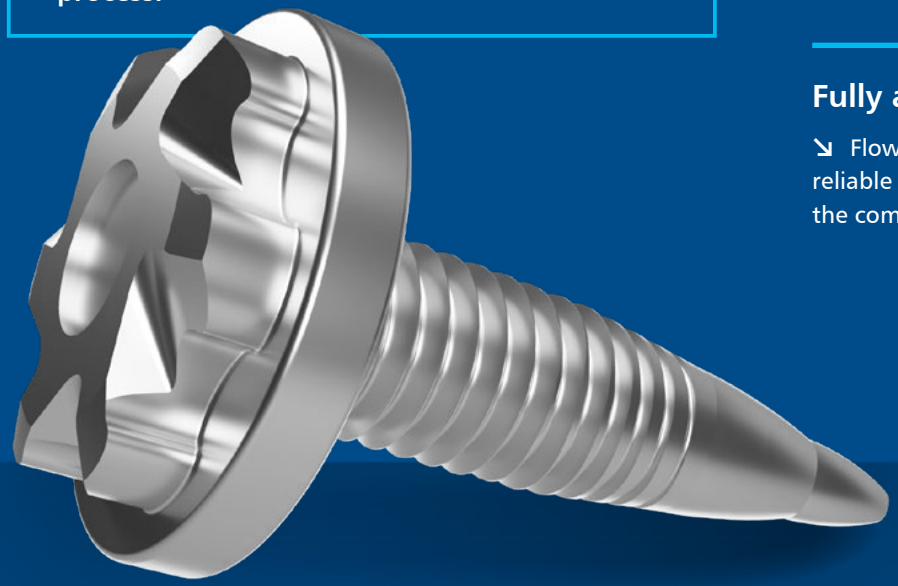
- Self-piercing and extruding fastener
- Accessible from one side
- Capacity for removal
- Fully automated
- Economical
- Sheet metal joining technology
- Mixed structures and hybrid structures
- Lightweight Directory

shutterstock-ID: 1459443830 | © Craveleo

<3 sec.

Innovative joining technology

with single-sided access for closed-section composite constructions. Flowform® is based on an interplay between the screw, the customer's application and the processing technology used. The challenge is to achieve a short cycle time and thus control the axial joining force and rotation speed during all steps of the Flowform® screw-in process.



The Flowform® Effect

Accessible from one side

↘ Our Flowform® screw requires only single-sided access to the joint, and can therefore be tightened or loosened from one side.

Composite and hybrid constructions

↘ Flowform® fasteners can be used elementarily or as a fixing method for hybrid composite joints (such as aluminum-steel) in combination with adhesive.

Fully automated

↘ Flowform® fastenings provide a reliable and permanent join between the components in question.

Capacity for removal

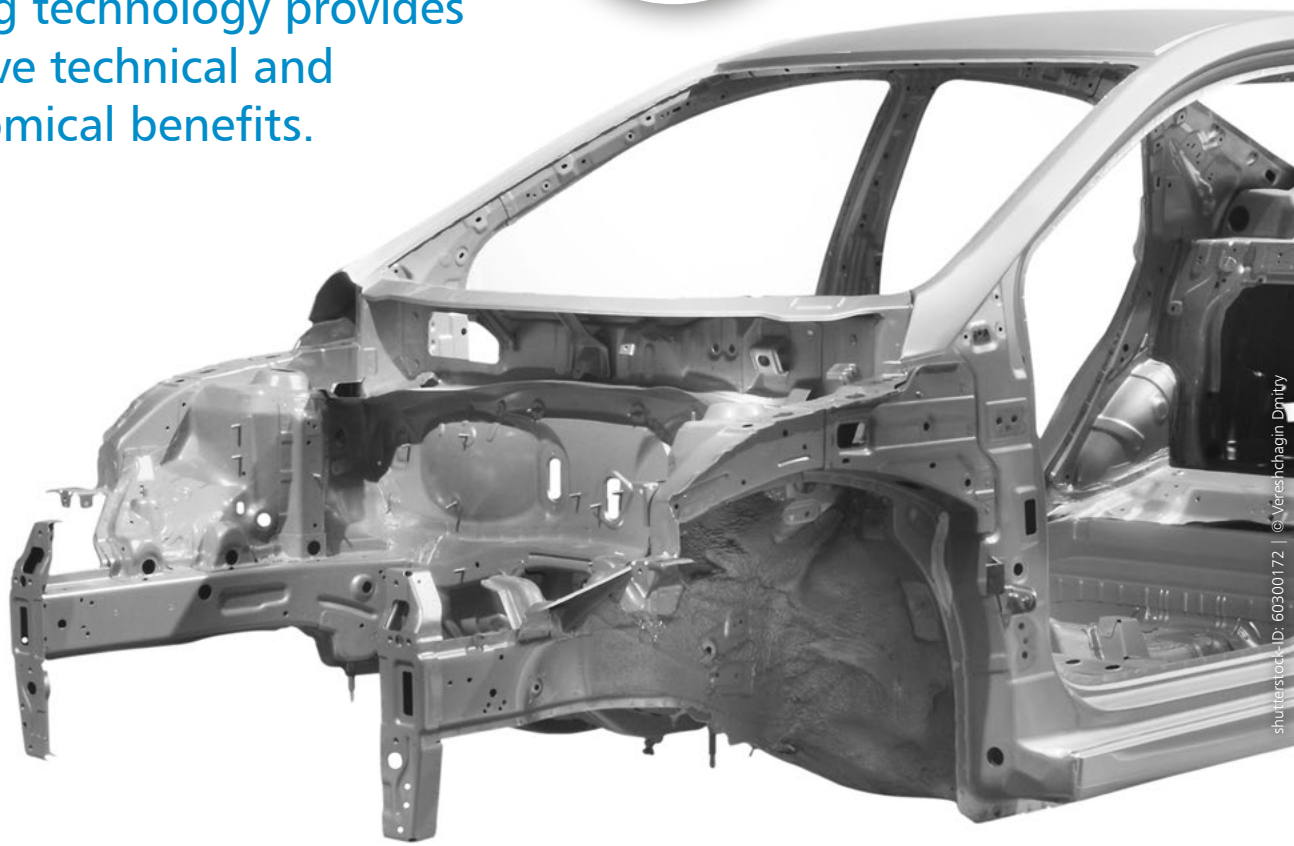
↘ Flowform® fastenings are detachable and re-fastenable, making them ideal for applications with disassembly requirements

Flowform®
The sheet metal joining technology of the future



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The innovative sheet-metal joining technology provides positive technical and economical benefits.



Flowform®
The innovative metal fastening

In sheet metal joining technology, the trend is towards thin, high-strength steels (lightweight construction potential) and increasing overall component thicknesses due to the required crash properties. The need at times to join highly disparate materials makes the task even more challenging. In such situations, conventional joining processes often reach their limits. Our answer to the increasing challenges arising in the metal-joining sector is called Flowform®. This self-Piercing and Extruding Fastener provides a fully automated join, with no pre-drilling and accessible from one side. Flowform® fastenings are also very economical and reliable.

shutterstock-ID: 60300172 | © Vereschagin Dmitry

Save time and money with **Flowform®**



Cut threaded joining

Extruding the hole

↓

Cut thread

↓

Remove hips

↓

Screw in the screw



Pierce-clinch nut joining

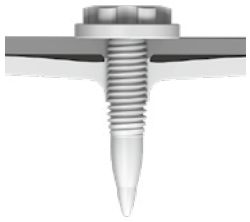
Introduce pierce-clinch nut

↓

SAVINGS POTENTIAL

↓

Screw in the screw



Flowform®

↓

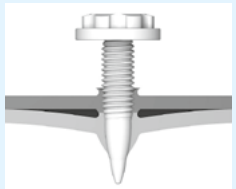
SAVINGS POTENTIAL

↓

Screw in the screw



1 | Hole forming



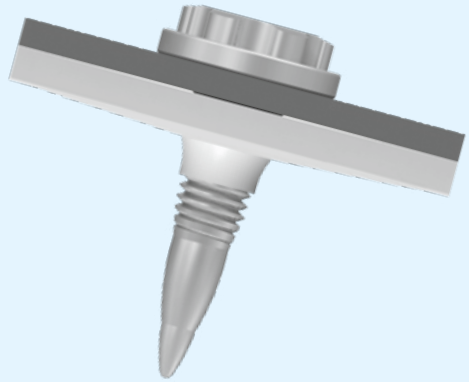
2 | Thread tapping



3 | Screwing-in



4 | Tightening

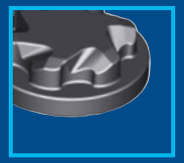


- No pre-drilling operations
- No thread cutting
- No chip formation
- Greatly reduced cycle times

This is how Flowform® works

The Flowform® screw heats and penetrates the parts to be joined. With its polygonal tip geometry, it forms a flow-hole and creates a thread. This thread can accommodate a metric screw in the event of a repair. During this process, a through-hole is created which increases the effective screw-in length and thus the load capacity of the joint, especially in the case of thin threaded parts.

Flowform®
Structure



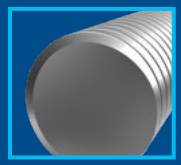
Application of load

Short location times and high torque transfer



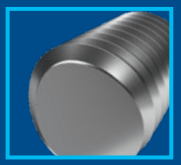
Underhead channelling

Recess to accept rising material as the join is made



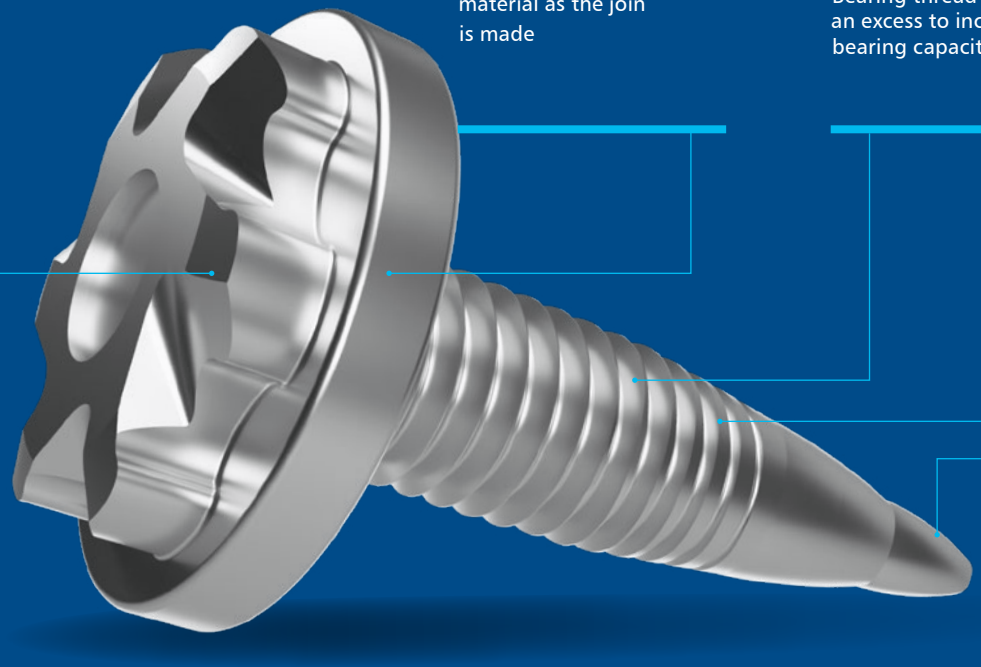
Round shaft cross-section

Bearing thread area with an excess to increase load-bearing capacity



Polygonal shaft cross-section

Thread-forming area to form the counter-thread





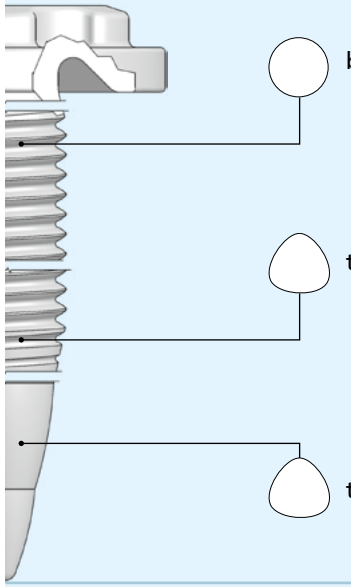
Polygonal tip cross-section

Solid tip geometry makes it possible to drill into sheet metals

Find out more
about Flowform®, innovative sheet-metal fastenings, and possible applications

www.arnold-fastening.com

Flowform® shaft of screw
benefits and specifics



Over-sized thread diameter

- the over-sized thread
- 100% thread engagement
- high pull-out forces
- High tightening torque
- formed thread able to accept a metric screw

Thread-forming area

- low thread-forming torques
- no chip formation during thread-forming

Slim tip shape

- low axial joining forces
- fast cycle times
- short penetration times
- little component deformation
- no chip formation

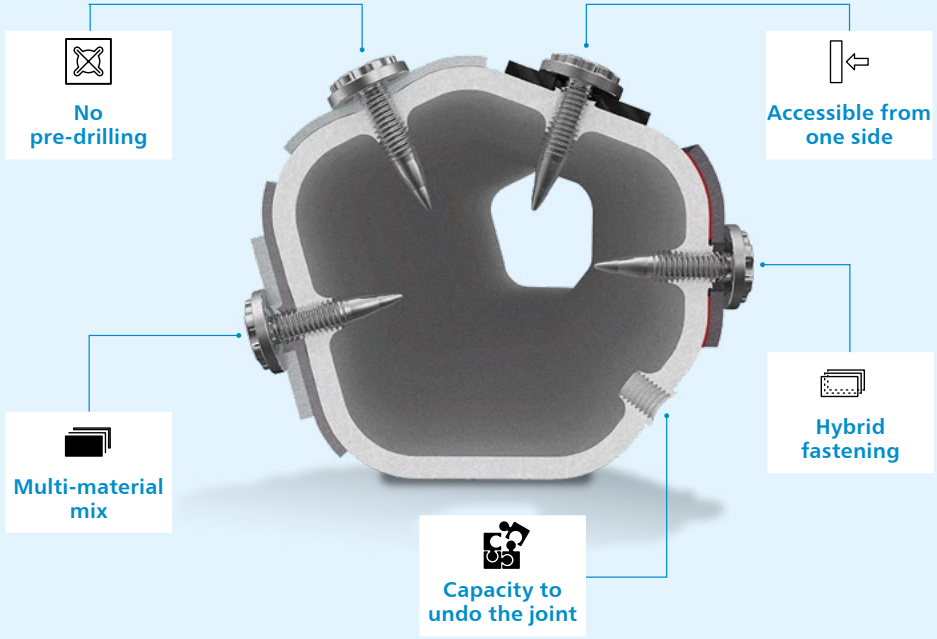
Reduces number of parts and handling of parts

Flowform®

Advantages

- Joining technology with single-side accessibility
- Manual screwdriving can be deployed in fully pre-drilled combination (e.g. pre-series or pro-totype production)
- Fastening process for hybrid sheet metal joints and for non-prepunched clamping parts
- Very good fastening performance
- Detachable fastening
- Joining materials of different types and of the same type with a cycle time under 3 seconds.

Fields of application for **Flowform®**



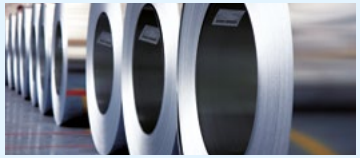
White goods



Automotive



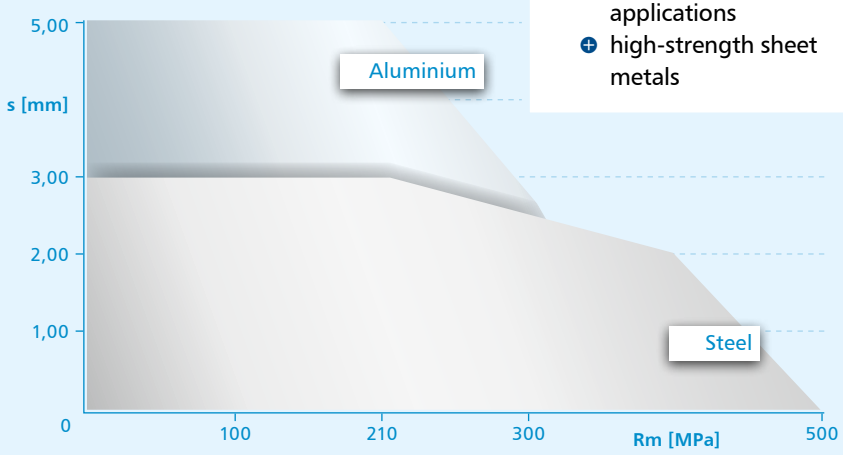
Other metal machining industry



shutterstock-ID: 60300172, 122762116, 71674225 | © Vereshchagin Dmitry, KKulikov, TGeorge

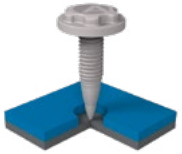
Illustration showing the application field for materials, thickness and strength

- hybrid fastenings
- multiple sheet metals
- fibre-reinforced applications
- high-strength sheet metals

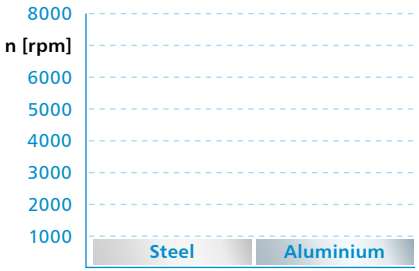


The image shows the range of applications for Flowform® screws. It is based on experience gained during practical use.
Note: The values shown are by way of example parameters. Specific values must always be determined by carrying out trials on original production parts. Our applications laboratory is always happy to answer any further questions.

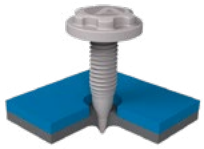
The screw-in process and process parameters



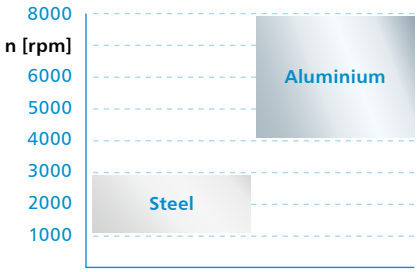
0 Positioning

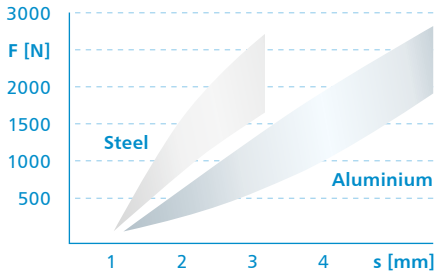


- Feed fastener
- Find drive engagement
- Use hold-down plate to clamp metal plates together
- Position the fastener



1 Hole forming



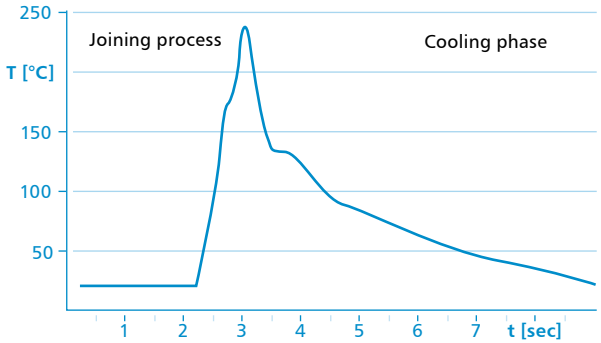


- Initiate rotation speed
- Initiate axial joining force
- Locally plastify the joining area

- Tip penetrates

Rotation speed and axial joining force depend on material and thickness

Flowform® Temperatue curve

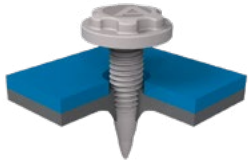


The graph shows a typical temperature curve during the joining process.

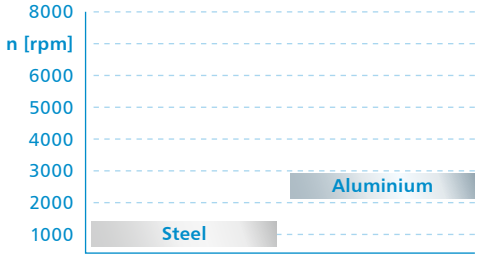
See page 14 for further information

The screw-in process – the five separate steps

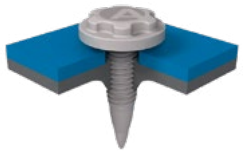
The screw-in process is divided into five separate steps. Different parameters need to be selected for each of these steps. These parameters depend on the joining combinations. Material thickness and strength, heat conductivity and the component rigidity all play a significant role in selecting the parameters.
The process parameters for each step consist of control, target and monitoring variables.



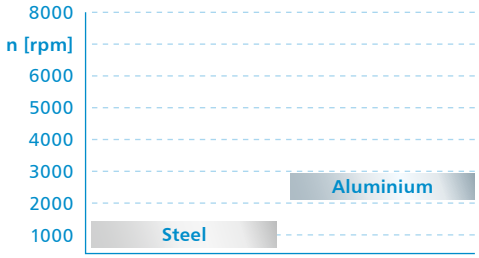
2 Thread forming



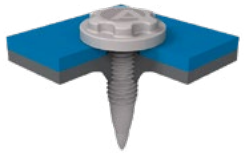
- Reduce rotation speed
- Reduce axial joining force
- Create a thread that is able to accept a metric screw



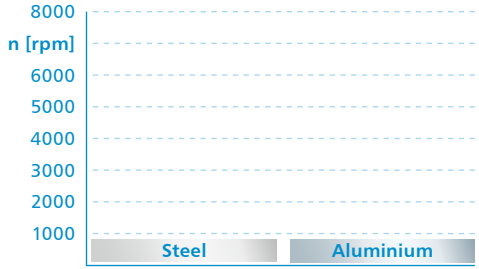
3 Screwing in



- Maintain rotation speed
- Maintain axial joining force
- Calibrate the formed thread



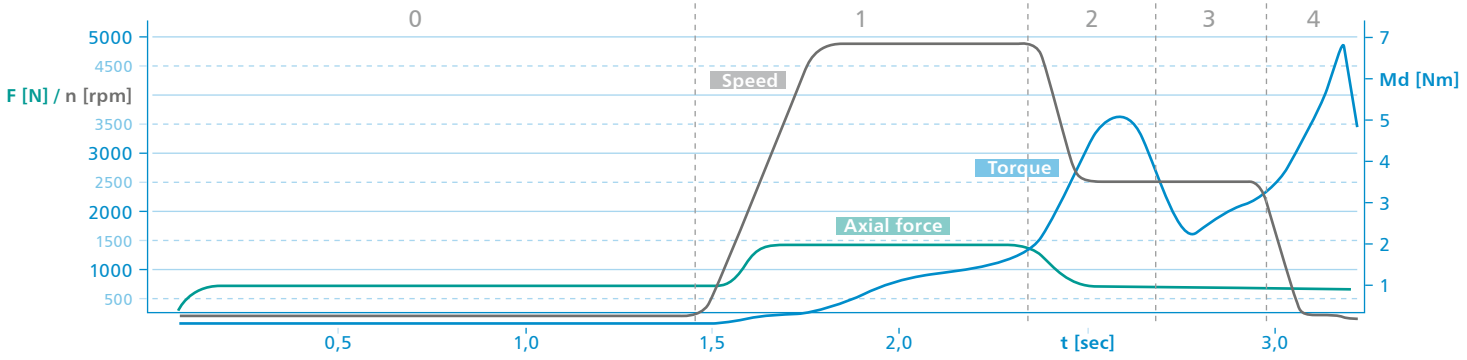
4 Tightening



- Reduce rotation speed
- Maintain axial joining force
- Reach the tightening torque

The values shown are by way of example parameters. Specific values must always be determined by carrying out trials on original production parts. Our applications laboratory is always happy to answer any further questions you may have.

Flowform® screw curve



25 %

lighter

than Flowform® by reducing size with same screw length

Flowform® Plus is the latest development to enhance flow-hole and thread-forming screws.



The Flowform® Plus Effect

Reduces thread forming torque

↘ The TRILOBULAR® cross-section geometry in the thread-tapping area, combined with the smaller diameter, results in lower tapping torques.

Self-piercing and extruding fastener

↘ Can fasten hybrid sheet-metal joints and non-prepunched clamping parts.

Expands the range of applications

↘ Our Flowform® Plus provides even more diverse, user-friendly, and efficient applications for our customers.

High strengths

↘ Flowform® Plus ensures that sheet steel up to a strength of 1000 MPa available at all times.

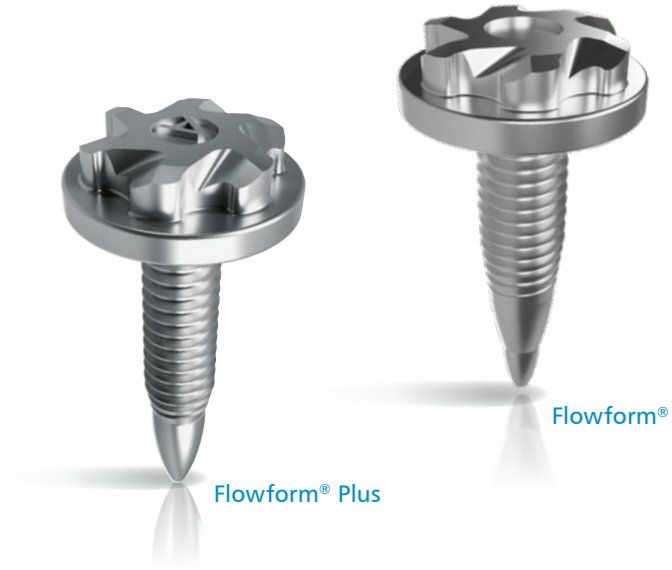
Flowform® Plus
the advanced screw that weighs less



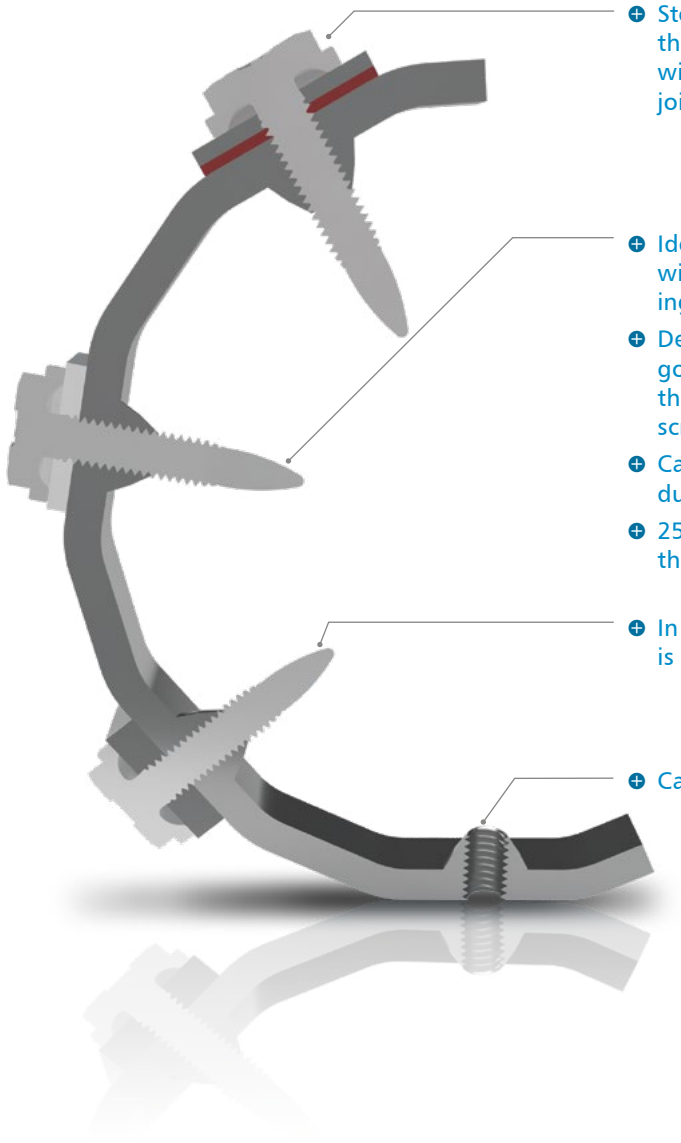
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Flowform® Plus also joins materials of different types and of the same type with a cycle time of under 3 seconds. Manual screwdriving is also possible.

- Reduces thread forming torque
- 25% weight reduction
- Can join sheet steel up to 1,000 Mpa strength
- Expands the range of applications
- Less gap formation



Benefits



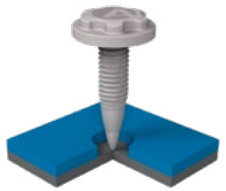
- Steel sheets up to 1,000 MPa with a thickness ≤ 1.0 mm in combination with an aluminum bottom layer are joinable
- Ideal for joining aluminum sheets without pre-holes, while also reducing gap formation
- Despite the smaller size, it has very good fastening properties due to the ductile and very high strength screw material
- Can be used on existing series production equipment
- 25% weight saving by scaling down the size of the fastener
- In thicker joint pairings, no pre-hole is required in the clamping part
- Can be removed

Flowform® Plus

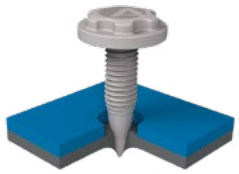
Advantages

- Single-side access joining technology
- Manual screwdriving possible
- Can fasten hybrid sheet-metal joints and non-prepunched clamping parts
- Detachable fastening
- Relatively high assembly pre-load force
- Joins materials of different types and of the same type with a cycle time under 3 seconds.

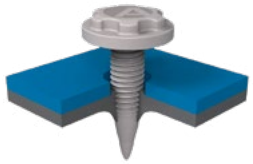
The screw-in process and process parameters



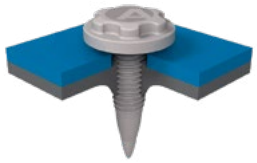
0 **Positioning**



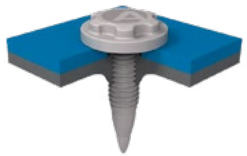
1 **Hole forming**



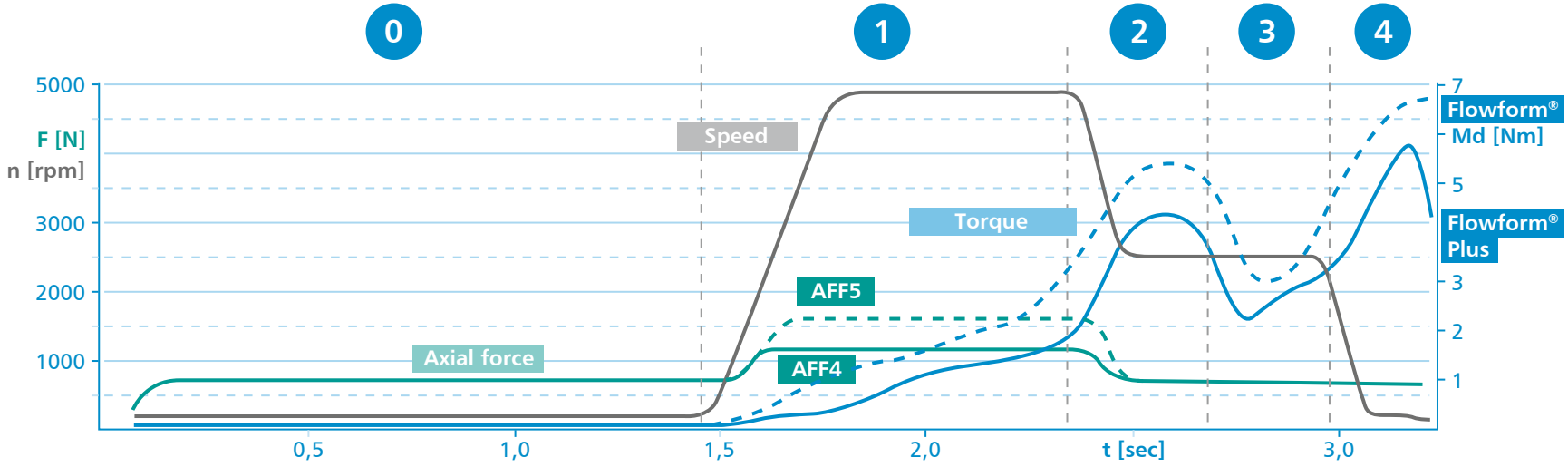
2 **Thread forming**



3 **Screwing in**



4 **Tightening**

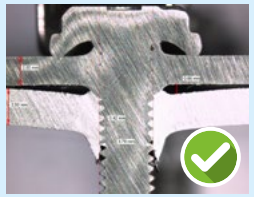


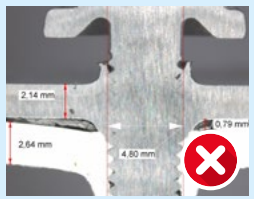
Flowform® Plus – reducing weight by decreasing the diameter of the fastener

Comparison
Flowform® Plus vs. Flowform®

Strength material

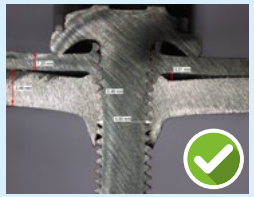
HX420LAD 2.0 mm
AC300 2.5 mm





- Axial joining forces >3.0 kN
- Thread-tapping torque >12 Nm

DP800 1.0 mm
AC300 2.5 mm

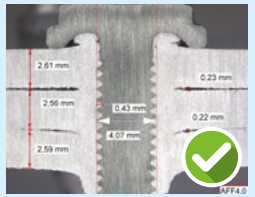


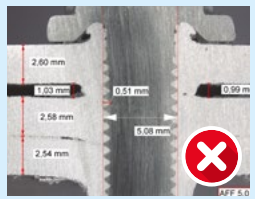


- Gap forms between the metal sheets

Applications using thicker materials

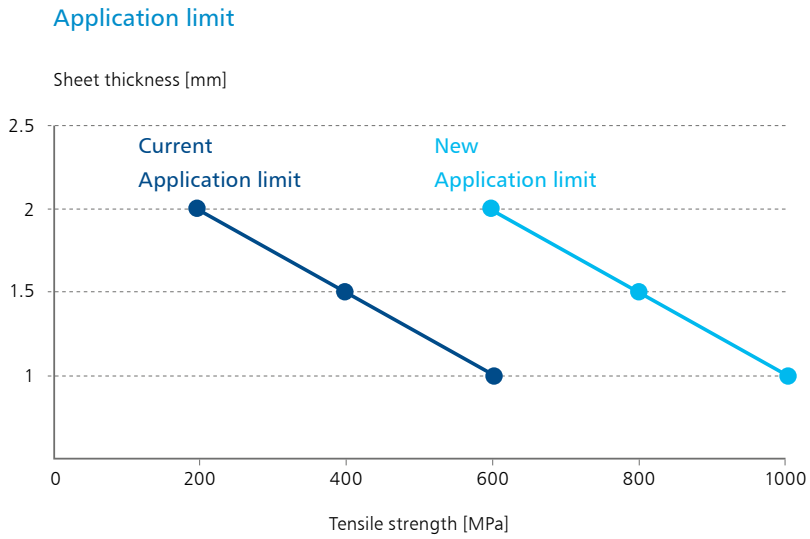
AC300 2.5 mm
AC300 2.5 mm
AC300 2.5 mm





- Axial joining forces >3.0 kN

Flowform® Plus – creating the lightweight advantage



Flowform® Plus – it's the structure that makes the difference



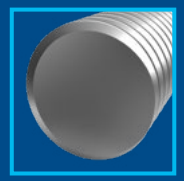
Application of load

- Smaller in size
- EP12 / EP10
- Short location times



Underhead channelling

Recess to accept rising material as the join is made



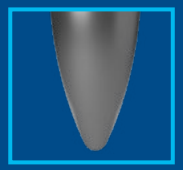
Round shaft cross-section

Bearing thread area with an excess to increase load-bearing capacity



Polygonal shaft cross-section

Thread-forming area to form the counter-thread



Polygonal tip cross-section

Solid tip geometry makes it possible to drill into sheet metals

The **polygonal cross-section** in the functional tip allows for lower joining forces when forming the holes, or with the same force, reduces the hole-forming time. The adapted radius at the end of the tip makes it possible to place more load on the tip, so that it can also be used in higher-strength sheet steel. The polygonal cross-section in the thread-forming area allows for low tapping torques and prevents chip formation during the screw-driving process.

In the bearing thread area the **round shaft cross-section** ensures optimum load capacity and a metric nut thread.

The **underhead channeling** accepts the material that rises during the hole-forming process.

With its lead-in chamfer, the **external force application** offers the shortest and best location process, thus reducing the cycle time. While the load application flank offers the best possible torque force transmission.

The difference between this version and Flowform® is the size and choice of material, and also that its heat treatment has been adapted. While in most cases the standard Flowform® has a diameter of 5.0 mm, the Flowform® Plus is just 4.0 mm in size (scaling down). The base material and the heat treatment are also different for these fasteners.

With or without pre-drilling

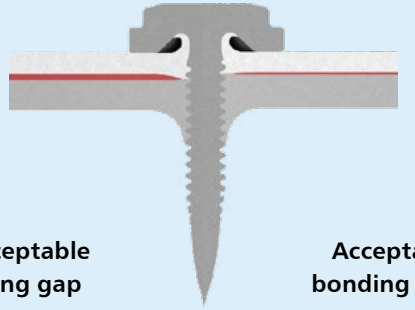
Joining without pre-drilling

Flat head with external drive

Fastening two sheets without pre-drilling	Fastening three sheets without pre-drilling



No pre-drilling. Why and when?

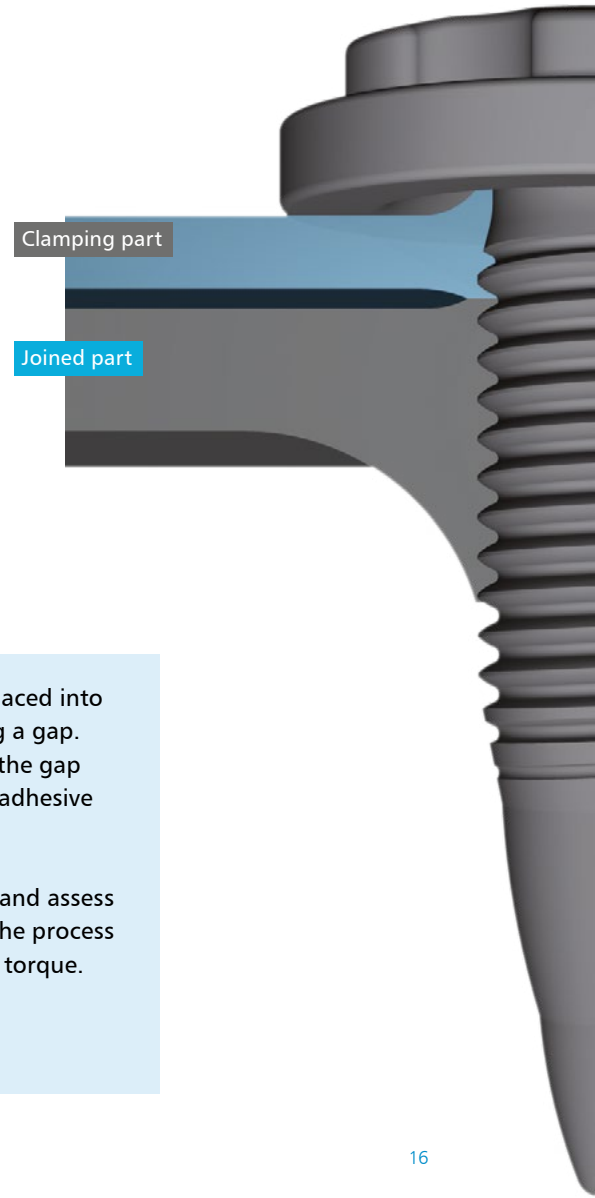


Unacceptable bonding gap

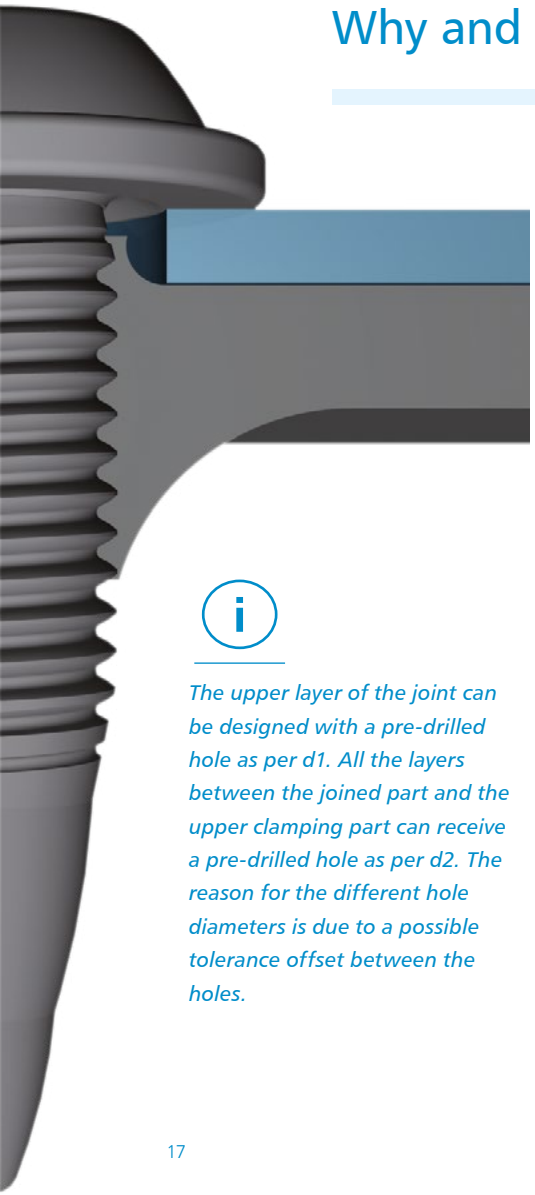
Acceptable bonding gap

In the case of pre-punched joints, material from the parts to be joined is displaced into the space between the components during the hole forming process, creating a gap. If adhesive is used, a prepunch in the clamping part may be recommended if the gap formation between the components leads to a reduction in the load-bearing adhesive surface due to air pockets.

As a general rule users must evaluate the size and shape of the bonding gap, and assess its effect on the stability of the join. The gap can be positively influenced by the process parameter settings such as clamping force, axial joining force, and tightening torque.



Pre-drilling.
Why and when?



The decision to pre-drill depends on a number of different influencing factors. If the overall thickness of the component is too great, then a hole needs to be pre-drilled to a residual thickness that can be joined reliably. A pre-drilled hole is also necessary if the screw head does not reach the head setting because of rising material or if the necessary axial joining force is too great. The illustration below shows pre-drilled holes with various head varieties, as well as the options for sizing and forming the pre-drilled holed.

The upper layer of the joint can be designed with a pre-drilled hole as per d1. All the layers between the joined part and the upper clamping part can receive a pre-drilled hole as per d2. The reason for the different hole diameters is due to a possible tolerance offset between the holes.

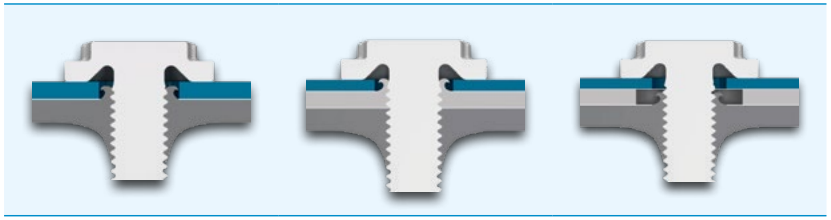
Dimensioning the pre-drilled holes

Dimensions	Ø d1 + 0.3 [mm]	Ø d2 + 0.3 [mm]
M4	6.0 mm	9.0 mm
M5	7.0 mm	10.0 mm
M6	8.0 mm	11.0 mm

Joint made with pre-drilled hole on clamping side

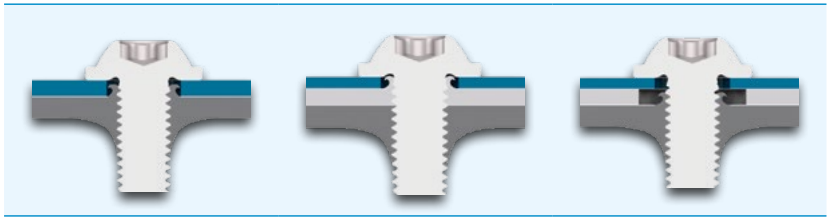
Flat head with external drive

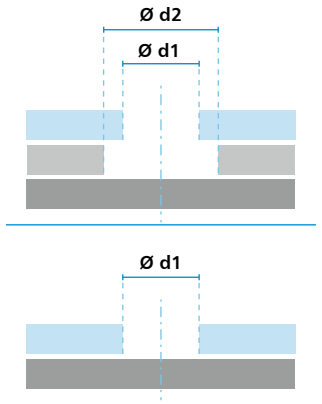
Two sheet fastening 1 × pre-drilled hole	Three sheet fastening 1 × pre-drilled hole	Three sheet fastening 2 × pre-drilled holes



Flat head with internal drive

Two sheet fastening 1 × pre-drilled hole	Three sheet fastening 1 × pre-drilled hole	Three sheet fastening 2 × pre-drilled holes





The values shown are by way of example parameters. Specific values must always be determined by carrying out trials on original production parts. Our applications laboratory is always happy to answer any further questions you may have.

Finding the right Flowform®

Selecting the head shape and drive

The Flowform® screw comes with two different head variants. They differ principally in the undercut feature and the drive geometry. The head geometry is selected according to the requirements of the application in question. Other designs can be obtained by arrangement with ARNOLD.

Other head shapes and drive options available upon request.



Flat head with external drive Factory standard: AWN-02-01-06

- Large underhead feature possible
- Can accept rising material
- Can join several sheet combinations without pre-drilled hole
- Low head height



Truss head with internal drive Factory standard: AWN-02-01-03

- Easier to find the drive
- Smaller underhead recess
- Economical

Selecting the right screw length

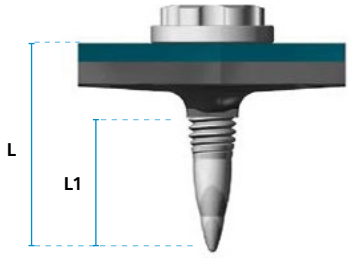
The length of screw necessary depends on the overall thickness of the sheet metals that are being joined. Because the penetration depth increases during the flow-hole forming process it is necessary to add in the height of the extrusion-hole.

Flowform® screw

Length L [mm]	M3.5	M4	M5	M6
12.00 + 0.8	✓	✗	✗	✗
14.00 + 0.8	✓	✓	✓	✗
16.00 + 0.8	✓	✓	✓	✗
20.00 + 0.8	✗	✓	✓	✓
25.00 + 0.8	✗	✓	✓	✓
30.00 + 0.8	✗	✗	✗	✓
Dimension: L1	7.1 mm	8.4 mm	10.4 mm	12.6 mm

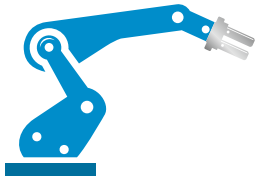
Other dimensions available upon request

We calculate the expected total component thickness of the joint combination, including the through-hole, and support our customers in selecting the correct Flowform® length.



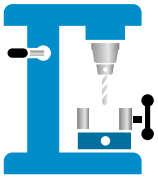
The right process technology

Flowform® is based on an interplay between the screw, the customer's application and the processing technology used. The challenge is to achieve a short cycle time and thus control the axial joining force and rotation speed during all five steps of the Flowform® screw-in process. Special screwdriving systems have been developed to handle Flowform® screws and these can be obtained from our partners.



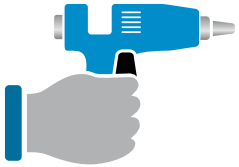
Robot-assisted screw fastening

- Different joining combinations
- Different positioning to component



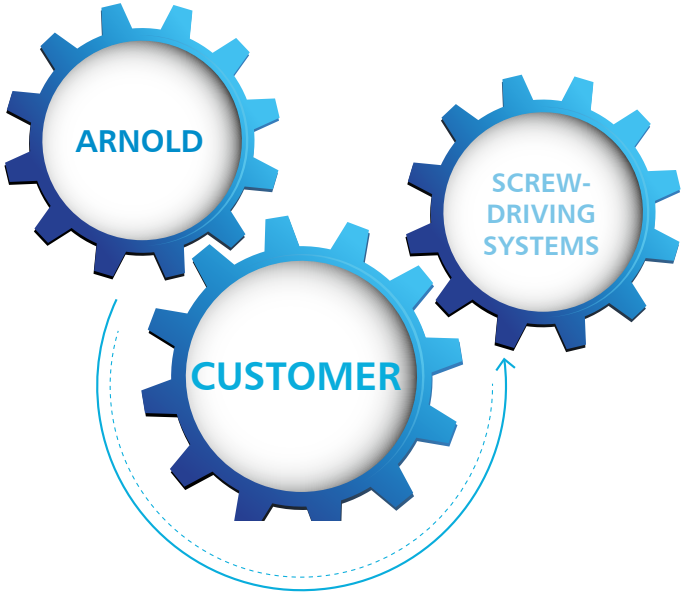
Stationary screw fastening

- Joining combinations with fixed positions on the component
- Component can be placed into stationary installation



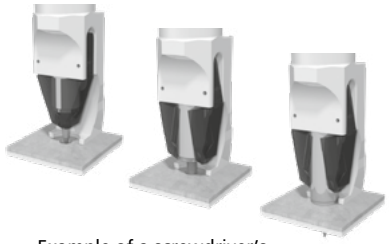
Manual fastening

- Joining combinations with sheet thicknesses and strengths for low axial force, suitable for manual fastening



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The screw feeds in a fully automated process to the screwdriver's die and then is held in position by jaws. A hold-down plate fixes the joining partner which sufficient axial force for the purpose, thus reducing the gap between the plates while the fastening is made. The hold-down plate defines the position for the Flowform® fastening.

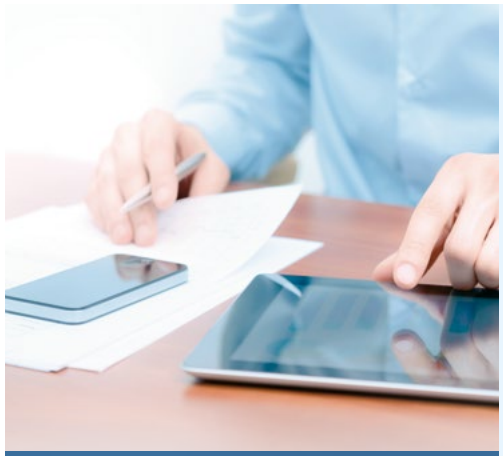


Example of a screwdriver's die with jaws.

Screwdiving system data

- Automatic screw feed
- Torque transducer
- Rotation speed drive motor (0–9000 rpm)
- Compressed-air cylinder
- (max. 6 bar) for axial force up to 3600 N
- Hold-down plate with path measurement system for pre-compressing the joining partner

Joining point analysis



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1 Customer inquiry

Customer using checklist to collect information

General Information

- Description of project
- Contact details
- Scheduling
- Contact

Application

- Clamping part
- Drawing
- Part for joining
- Corrosion protection
- Pre-drilling
- Initial application
- Material thickness
- Leak requirement
- Material
- Safety criticality

Fastener

- Dimensions
- Undercut feature
- Shape of drive
- Quantity required
- Initial sample
- Tensile strength
- Corrosion protection requirements

Several validation steps are required to ensure a reliable series process. This includes a laboratory joinability investigation as well as further screw validations using original components. Then the applications characteristics achieved using Flowform® need to be checked for functionality by the user. The investigations illustrated here merely show the preliminary trials under laboratory conditions.

2 Investigating availability



Contol variables

- Rotation speed
- Axial joining force
- Force of hold-down plate

The control variables are determined on an experimental basis for the specified joining point.

Target variables

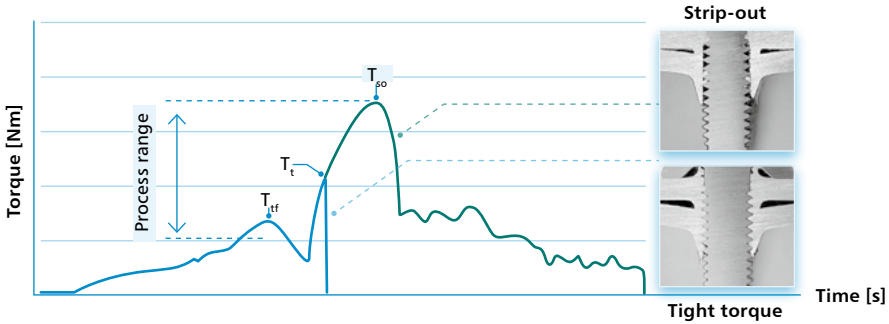
- Path
- Torque
- Angle

With the target variables determined it is possible to find the switch points in the joining process and define the fastening's characteristics, such as tightening torque.

Monitoring variables

- Time / path
- Torque
- Angle

These variables are used to monitor the joining process so as to maintain optimum fastening characteristics.

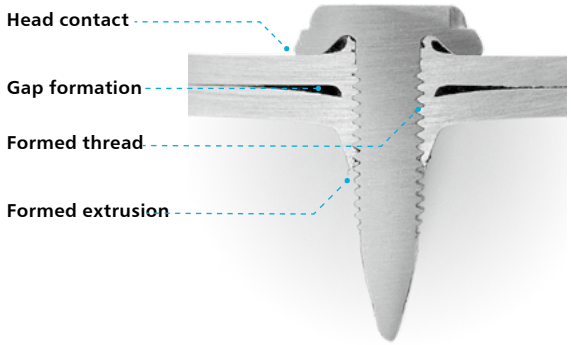


Torque curve

As joining points are validated the torques produced, such as thread forming torque (T_{tf}) and strip-out torque (T_{so}) are determined. Torques are influenced by the rotation speed and axial joining force variables and can vary for every combination of sheet metals. The tightening torque (T_t) can be derived from the characteristic torque curve

3 Investigating the fastening properties

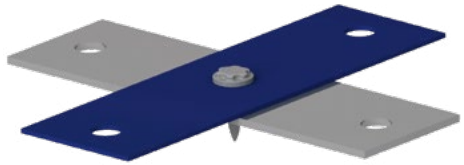
We create a micro-section in order to examine the thread and extrusion hole with internal thread, as well as the gap formation between the sheet layers, and the contact between the head and the clamping part.



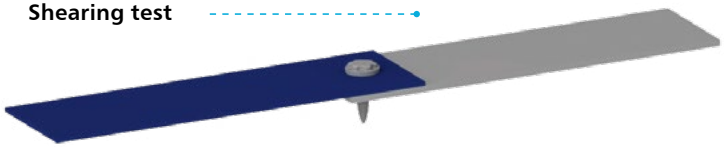
Fastening properties

We use shearing and cross-head pull tests to examine other fastening properties. These tests are based on the DVS/EFB guidelines (leaflet 3480-1). They are used to compare the failure parameters of similar joining procedures.

Crosshead pull test



Shearing test



4 Documentation



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Create the test report

- Selecting the screw,
- basic drawing
- Component designation
- (Clamping and joined part)
- Measured values, statistics and screw-in curves
- Micro-sections
- Predictions
- Notes



The results of the laboratory test are gathered together into a final document, and then discussed with the user.



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BlueFastening Systems

The ARNOLD GROUP

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Wherever customers need us.

ARNOLD – this name is internationally renowned for efficient and sustainable fastening systems at the highest level.

With a foundation of many years of expertise in the production of intelligent fastening systems and very complex extruded parts, the ARNOLD GROUP has developed over a number of years into a comprehensive supplier and development partner for complex fastening systems. With our positioning of "BlueFastening Systems", this development process will continue under a united and harmonised structure. Engineering, services, fasteners and functional parts, together with feeding and processing systems, all from a single source – efficient, sustainable and international.

ARNOLD UMFORMTECHNIK GmbH & Co. KG
Carl-Arnold-Straße 25
74670 Forchtenberg-Ernsbach
Germany
T +49 7947 821-0
F +49 7947 821-111

ARNOLD UMFORMTECHNIK GmbH & Co. KG
Im Weitblick 1
74670 Forchtenberg-Rauhbusch
Germany
T +49 7947 821-0
F +49 7947 821-111

ARNOLD UMFORMTECHNIK GmbH & Co. KG
Max-Planck-Straße 19
74677 Dörzbach
Germany
T +49 7947 821-0
F +49 7947 821-111

ARNOLD UMFORMTECHNIK GmbH & Co. KG
Logistics center
Dörzbach plant
Germany
T +49 7947 821-0
F +49 7947 821-111

ARNOLD FASTENING SYSTEMS Inc.
1873 Rochester Industrial Ct.
Rochester Hills, MI 48309-3336
USA
T +1 248 997-2000
F +1 248 475-9470

ARNOLD FASTENERS (SHENYANG) Co., Ltd.
No. 119-2 Jianshe Road
110122 Shenyang
China
T +86 2488 90633
F +86 2488 90999

ARNOLD TECHNIQUE FRANCE SAS
267 Route Nationale 7
38150 Salaise sur Sanne
France
T +33 (0)427 698177
F +33 (0)427 698178











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