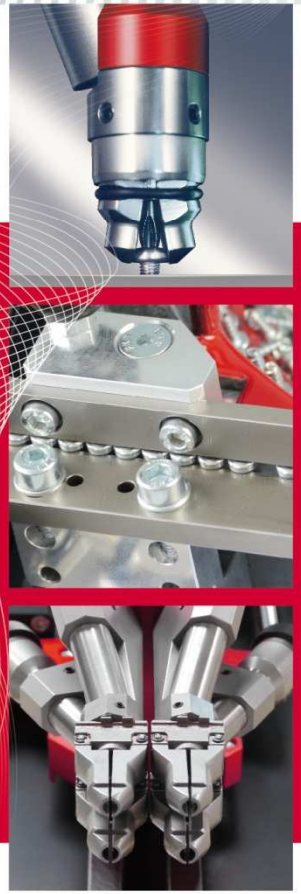
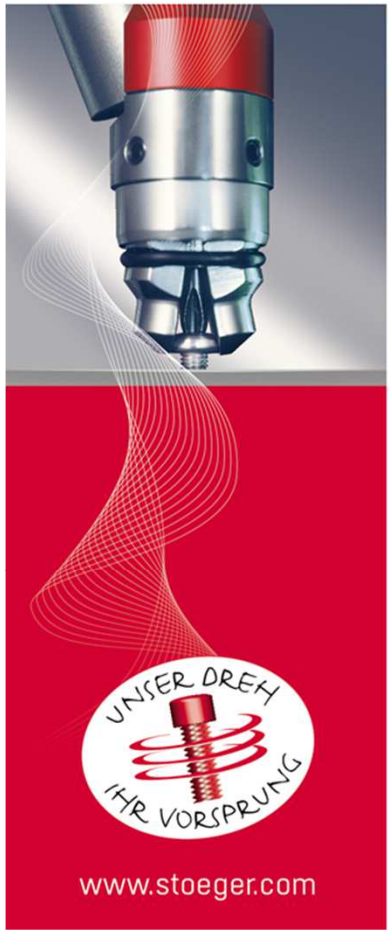


STÖGER AUTOMATION

Technical cleanliness in production and assembly

Lorenz Stöger, STÖGER AUTOMATION GmbH



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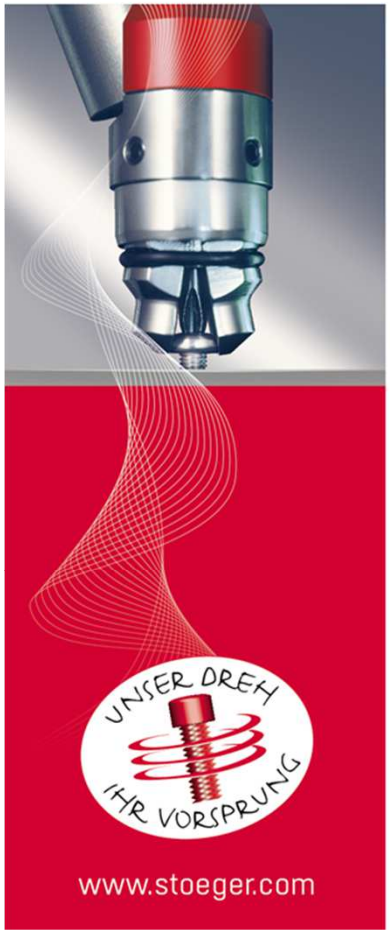
I. Introduction

- Sectors where cleanliness is crucial
  - e.g. Medical technology
  - Pharmaceutical industry
  - Automotive
  - Electronics
  - Aviation

- Why is cleanliness important?
  - Hygiene
  - Functionality
  - Optical appearance

- Different requirements for cleanliness demand different approaches



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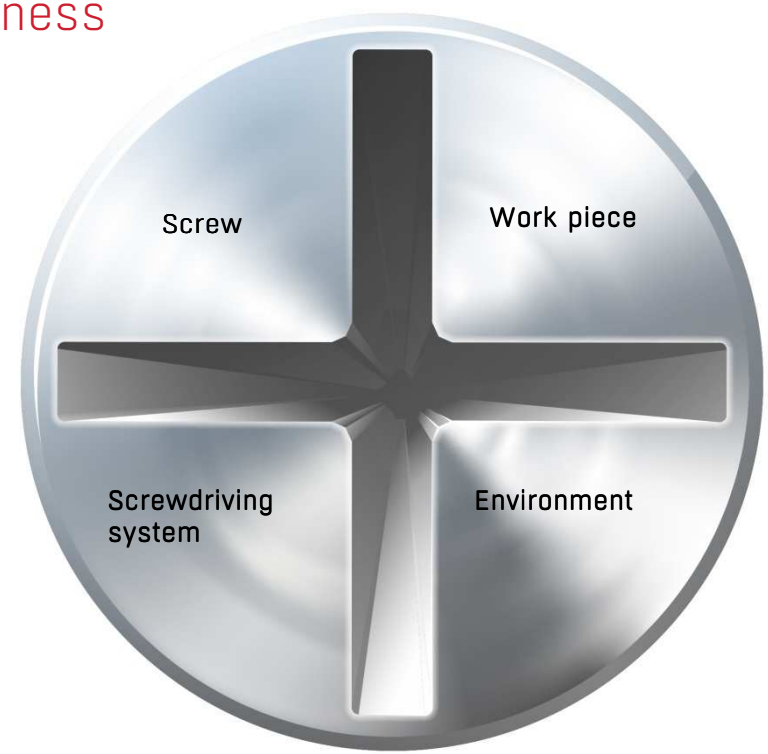
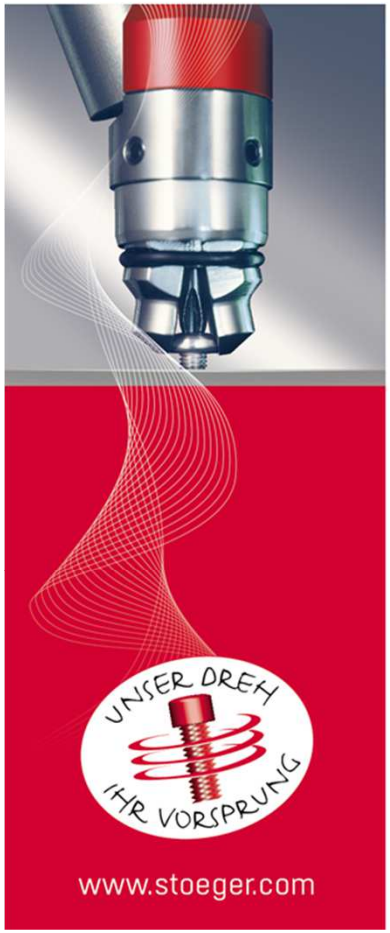
Components and factors requiring cleanliness





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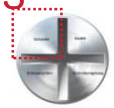
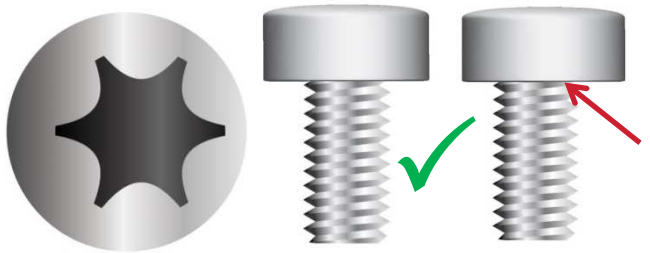
II. Challenges

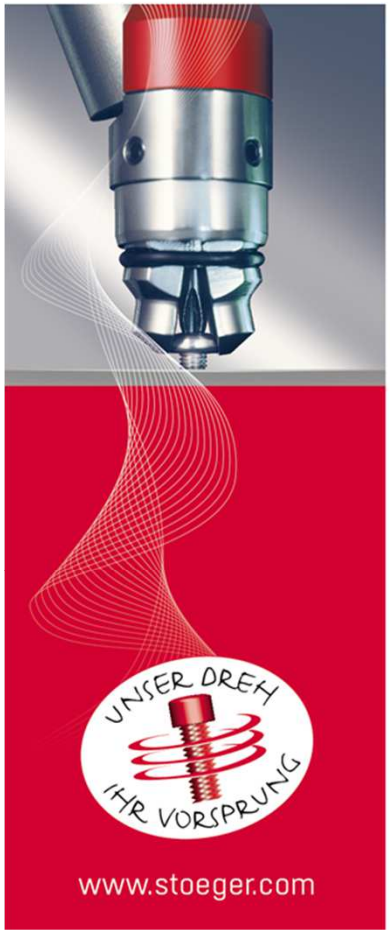
Screws



- Quality of the thread

- Screw geometry
  - Dimensional accuracy / Tolerances
  - e.g. slot or screw head not centered





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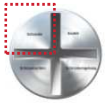
Screw



- coating or encapsulation of screws
- dirt particles in the bulk material
- abrasion (e.g. in the packing material, during transport etc.)

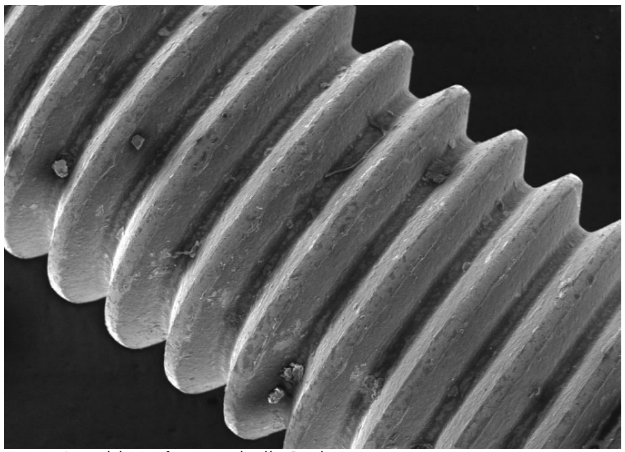
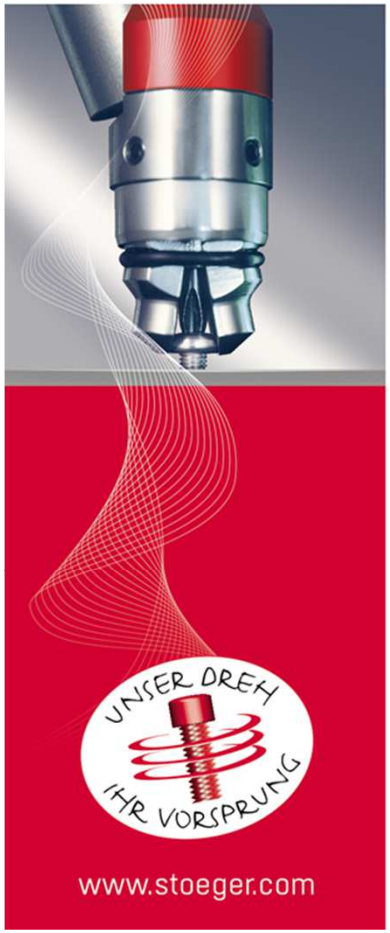


Foto: Arnold Umformtechnik GmbH



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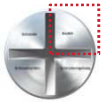
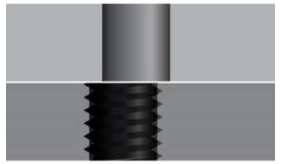
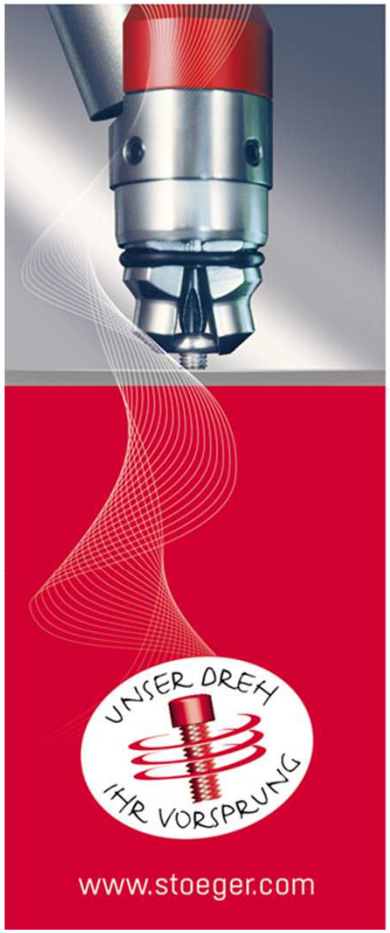
Work piece



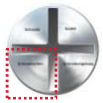
- Tolerances in the work pieces
  - faulty bore hole diameter
  - inaccurate positioning of the bore holes
  - tolerances due to material (plastic, cast materials, coatings)



- Contamination during production processes
  - e.g. caused by prior treatment:
    - drilling
    - countersinking
    - thread cutting
    - coating



Screwdriving system



nose piece

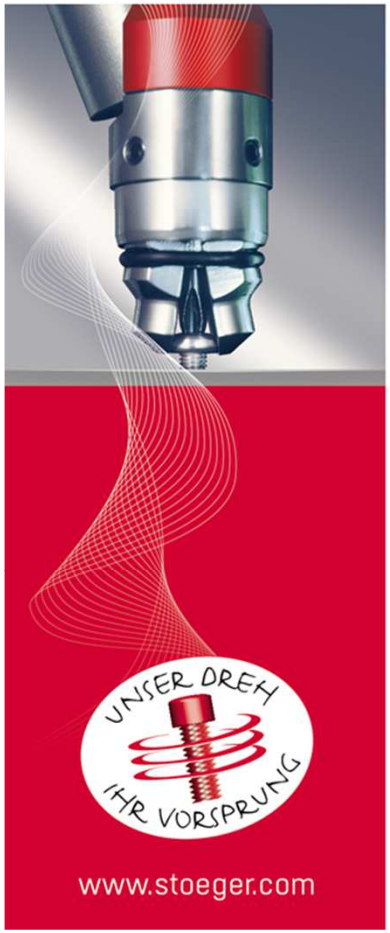
screwdriving tool

positioning accuracy

air current

feed system

screwdriving process



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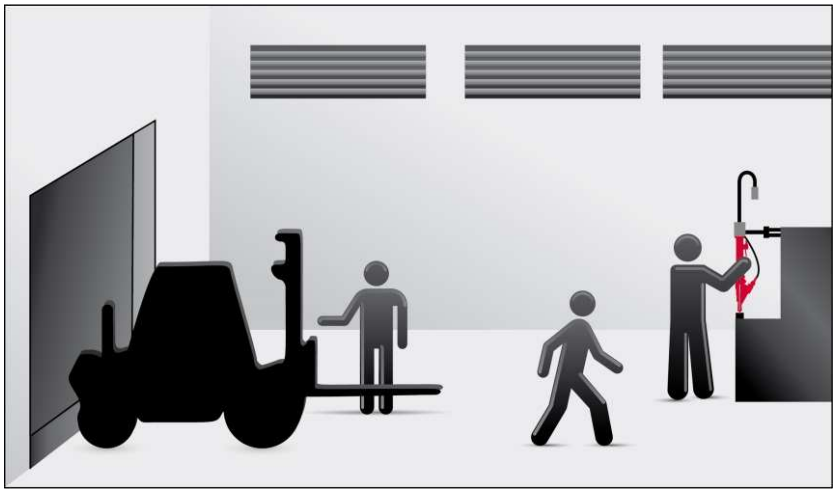
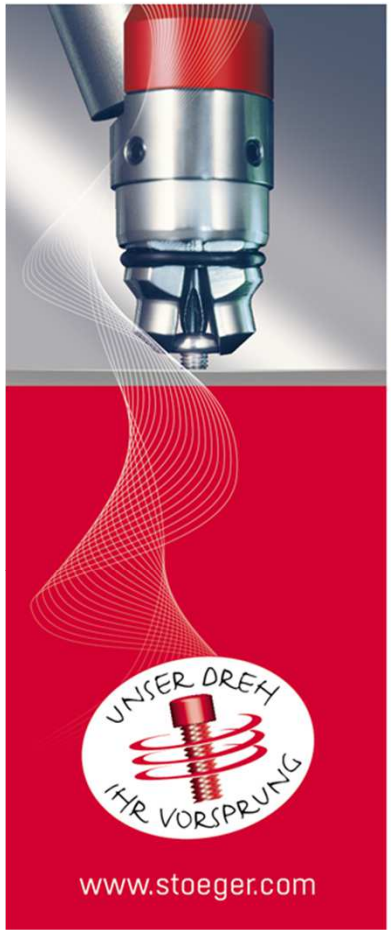
Environment

- ventilation / air conditioning / heating
- travel paths (forklift trucks, transport systems ...)
- staff (hair, particles of skin, food crumbs, dirty shoes ...)
- clothing (fluff, oil, dust, chips ...)
- cleaning of the work environment





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III. Requirements for the screwdriving process

Prevention of contamination of components

1) comply with standards or clean room classes

2) optimal adjustment of screwdriving parameters

   a) cycle time

   b) duration of screwdriving process

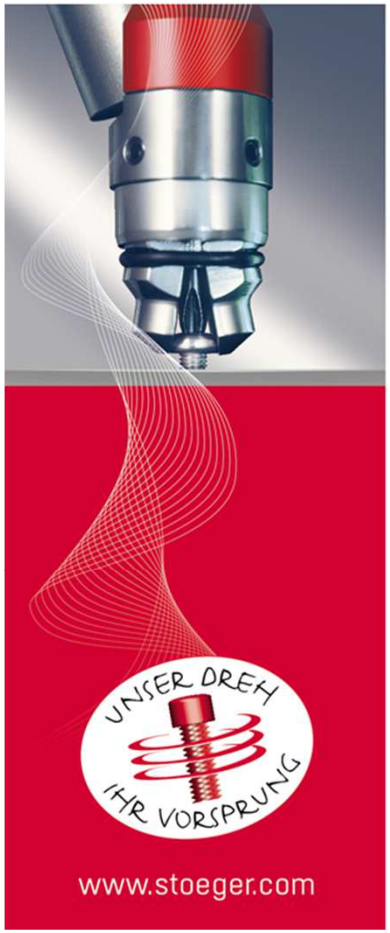
   c) screwdriving position

   d) rotational speed, torque

   e) tool stroke speed

   f) finding the screw head engagement

   g) hard or soft material (e.g. metal or plastic)



Relevant standards

VDA 19 Part 2

- deals with technical cleanlines, especially with particles of 15–1.000 µm
- measures to minimize / avoid the following in the entire process chain
  - Particles intruding from outside
  - Particles intruding through the process chain
  - Particles developing during the process

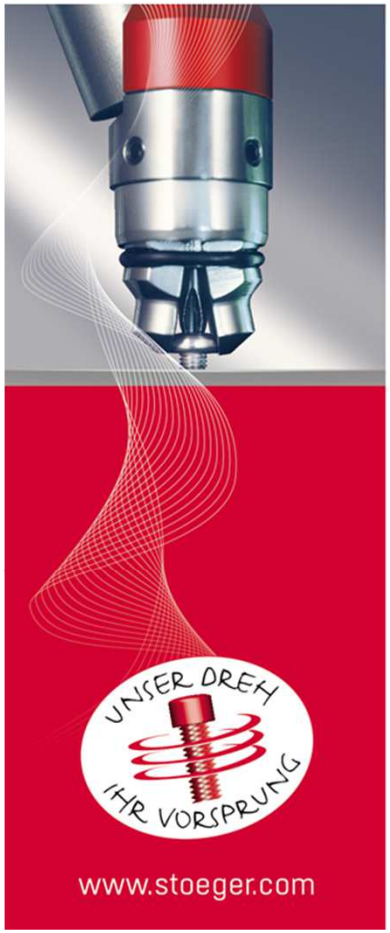
ISO 14644 (clean room)

- Standard for clean rooms and relevant clean room areas

Reinraumklassen nach ISO 14644-1

	Partikel je m^3;					
Klasse	**0,1 µm**	**0,2 µm**	**0,3 µm**	**0,5 µm**	**1,0 µm**	**5,0 µm**
ISO 1	10	2				
ISO 2	100	24	10	4		
ISO 3	1.000	237	102	35	8	
ISO 4	10.000	2.370	1.020	352	83	
ISO 5	100.000	23.700	10.200	3.520	832	29
ISO 6	1.000.000	237.000	102.000	35.200	8.320	293
ISO 7				352.000	83.200	2.930
ISO 8				3.520.000	832.000	29.300
ISO 9				35.200.000	8.320.000	293.000

Grafik: Wikipedia



Screwdriving parameter

a) Cycle time

The lower the cycle time the more particles can enter the screwdriving process: more vibration in the feed bowl, screw has to be fed faster into the system, thus harder surface contact, causing particles to chip off as well as abrasion etc.

b) Convolutions (threads)

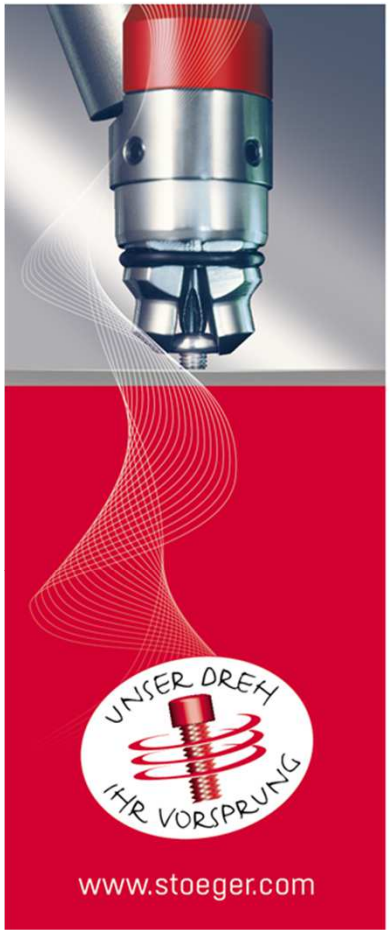
The more revolutions per screw-in lenth are needed the more abrasion will be caused

c) Screwdriving position

In processes for screwdriving in an upward direction particles will fall away from the work piece due to gravitation. Even screwdriving in a horizontal direction may bring better results.

d) Number of revolutions

A higher speed results in more abrasion due to higher friction.



e) Tool stroke speed

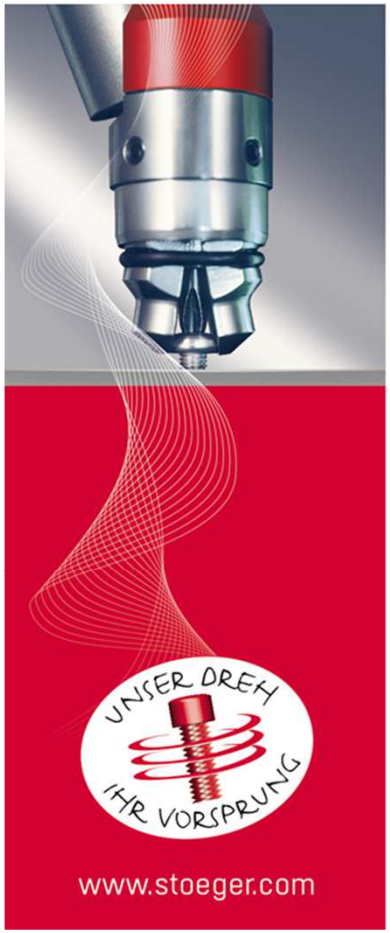
The higher the tool stroke speed the more force will be exerted on the connection, causing more abrasion or creation of particles.

f) Finding the screw head engagement

While the bit tries to engage in the slot, a lower revolution speed will ensure a smooth contact, thus reducing abrasion and the creation of particles.

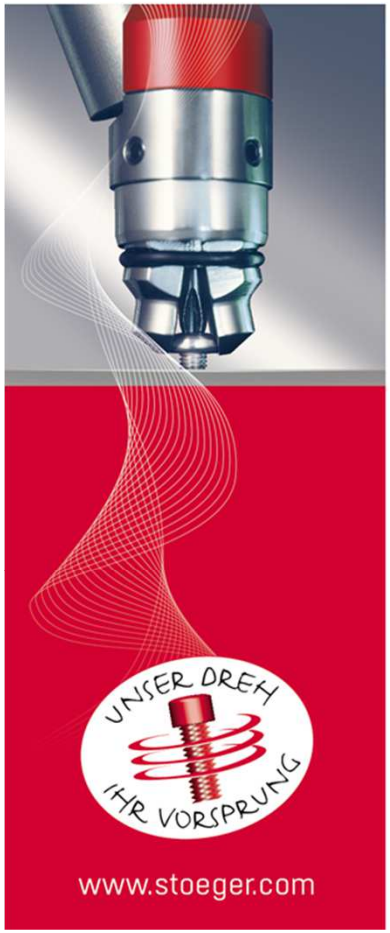
g) Hard / soft materials

Plastic materials may heat up too much, e.g. due to high speed, causing the formation of strings. Coating material of screws may result in abrasion.



IV. Possible solutions

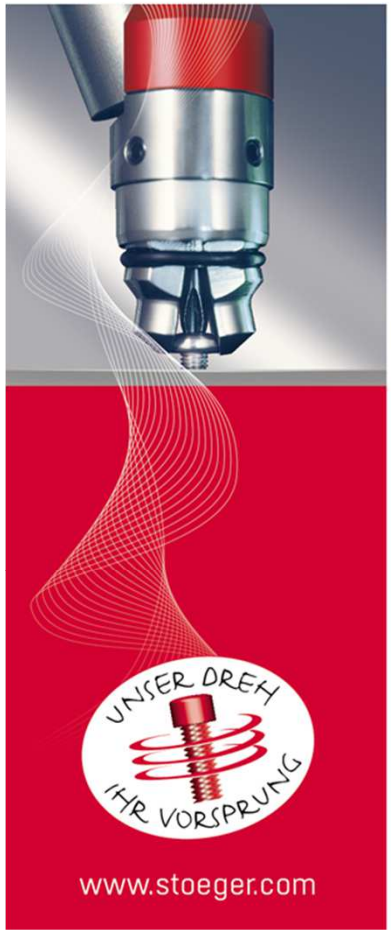
1) Use of standardised / true-to-size screws
2) Use of cleaned screws
3) Use of suitable feed units
4) Use of particle sluices
5) Use of vacuum screwdrivers, avoiding magnetic bits
6) Use of Pick & Place systems
7) Adjusting the screwdriving parameters
8) Use of magazines for screws
9) Optimum positioning of the feed units (no air current)
10) Use of suitable system combinations for screwdriving processes
11) Preventive measures



True-to-size screws

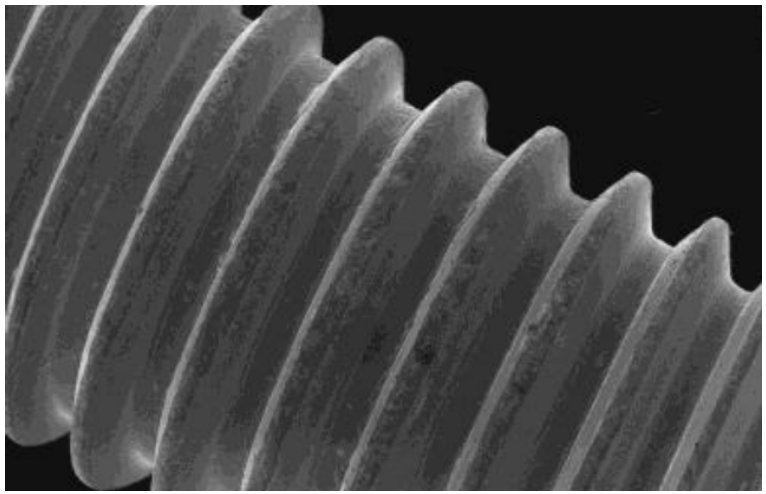
1) Use of standardised / true-to-size screws

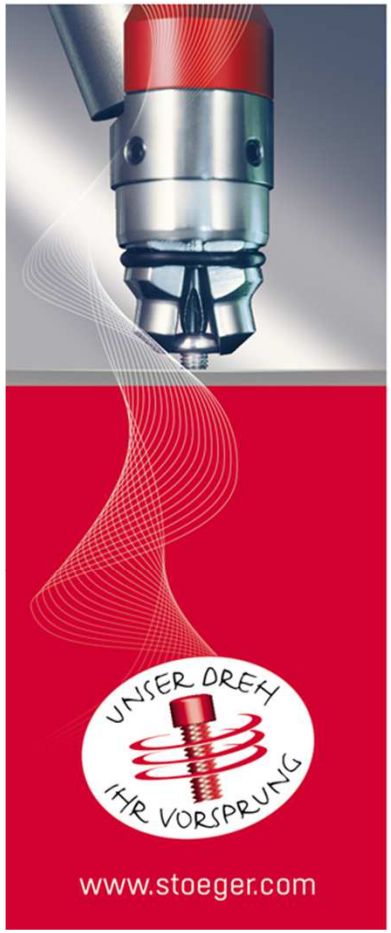
- Quick positioning of the bit in the screw slot
- Gentle on the screw heads
- No scratches or other damage



Cleaned screws

- Use of cleaned screws
  - Use of cleaned screws (e.g. CLEANCON® by Arnold Umformtechnik), which have been cleaned repeatedly during and after the production process and packed accordingly.





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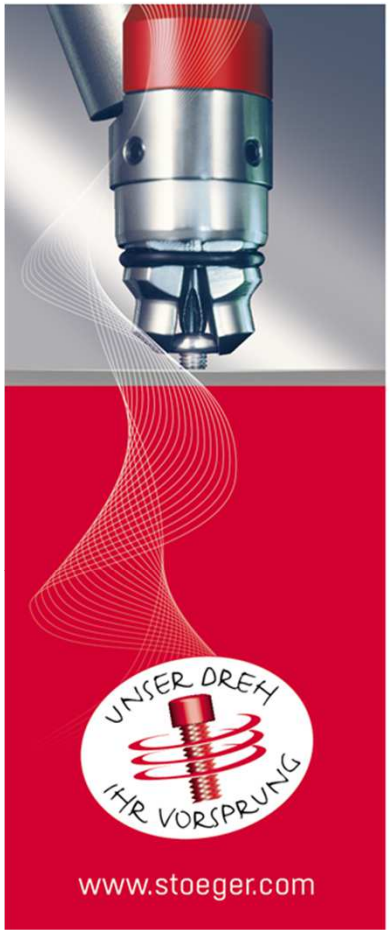
Bowl feeder

- Suitable for most fasteners
- Screws are sorted several times
- Vibration may cause abrasion and the creation of particles

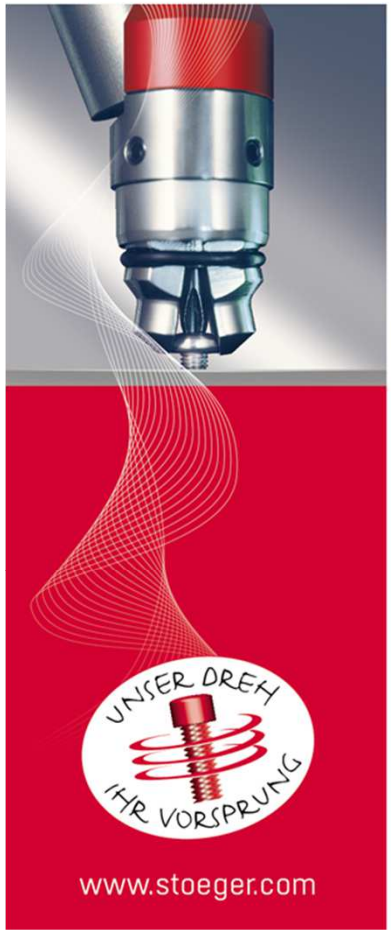
- Improved situation when using hoppers and linear tracks: the hopper serves as a buffer for the screws until their quantity in the feed bowl has dropped below a defined level; thus fewer screws in the feed bowl and consequently less friction. Feed bowl vibrates only when linear track has to be refilled.



STÖGER AUTOMATION

Step feeder

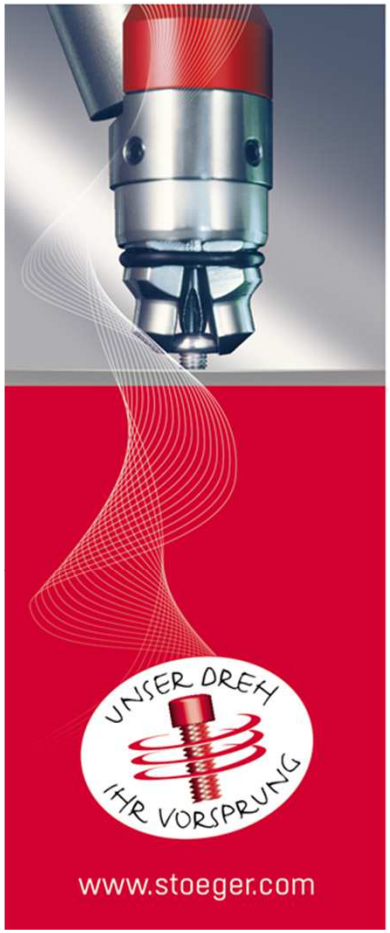
- Suitable for most fasteners
- Screws are transported into the rail of the singling mechanism through various steps
- Only this rail vibrates in order to position the screws correctly
- Screws are sorted several times
- The use of a hopper reduces the filling level in the step feeder bowl. Refilling will be necessary only when the quantity has dropped below a defined level.



STÖGER AUTOMATION

Segment feeder

- Suitable for most fasteners
- The sorting process is realised by an oscillating segment. The fasteners are transported via a linear track which is positioned diagonally.
- System works without vibration
- Screws are processed multiple times, which may cause abrasion
- The use of a hopper ensures that fewer screws are in the bowl, which could cause friction between the fastening elements. Refilling will be necessary only when the quantity has dropped below a defined level.



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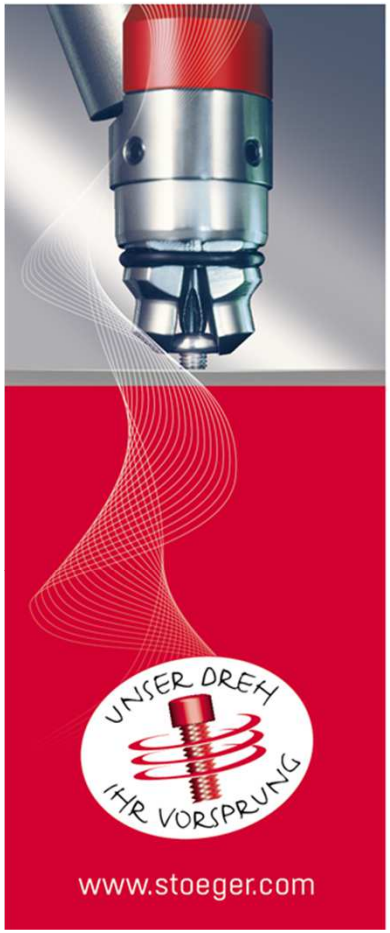
channel feeder 100

- Suitable for screws (head-shaft ratio important!), also for coated and encapsulated versions
- System works without vibration and sorting air current
- Each screw is sorted only once: a few screws only are fed from a bunker and placed on a transport band which leads to a sorting rail, ending in an exit rail. Only actually required screws are transported.



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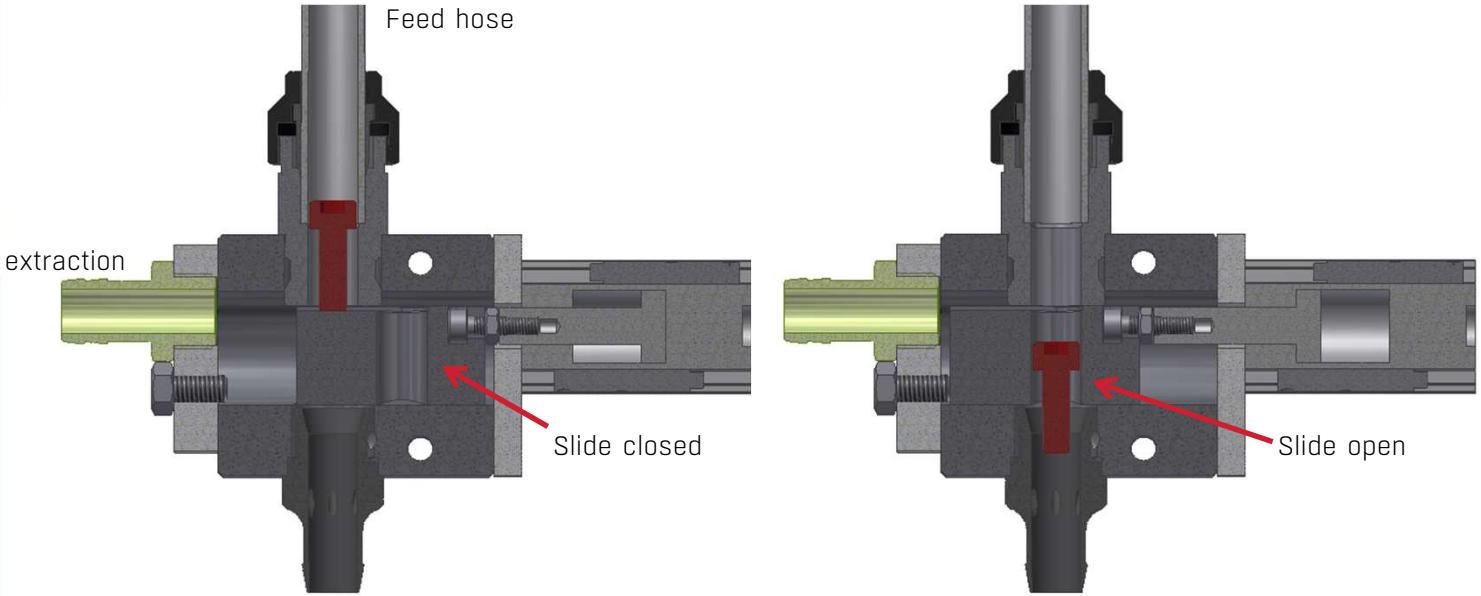
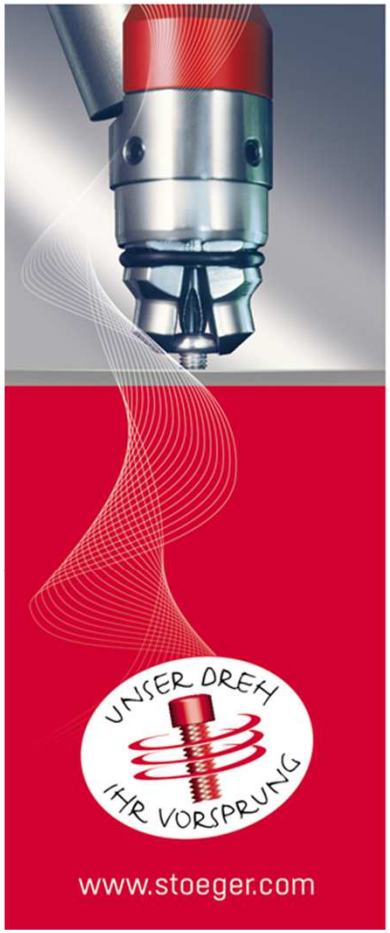
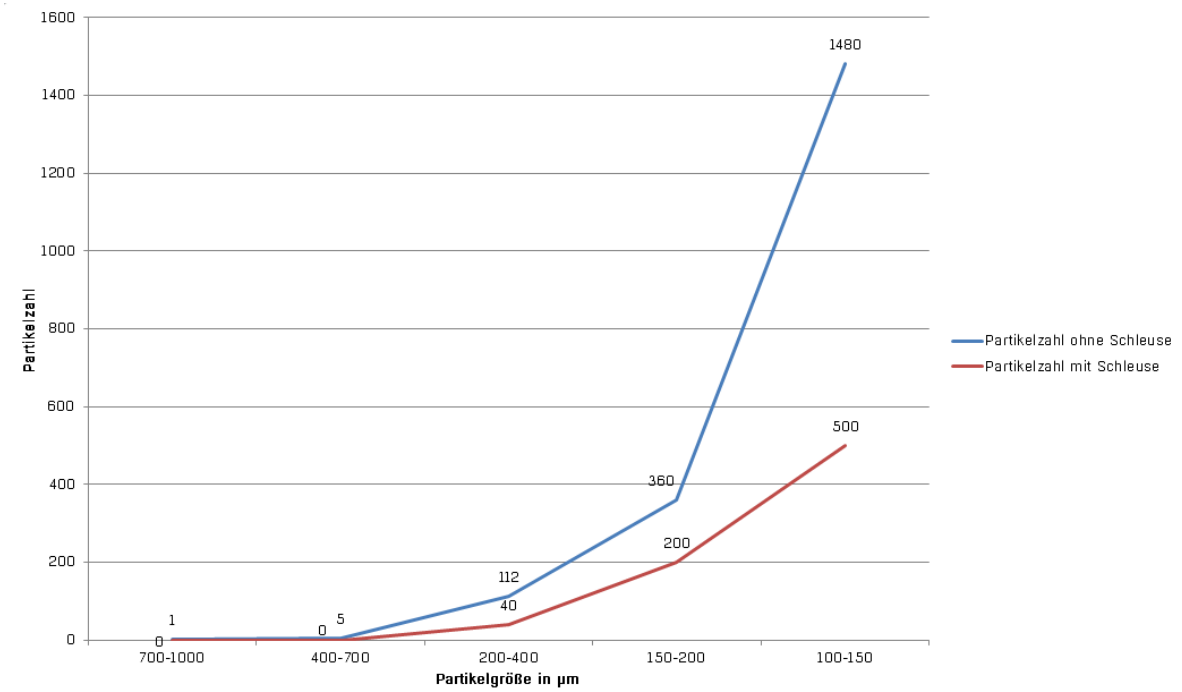
Particle sluice

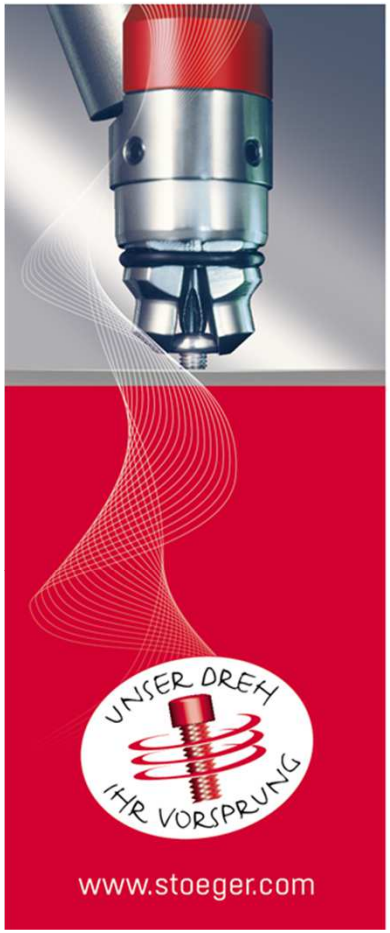




Particle sluice



Number of particles measured with and without using a particle sluice



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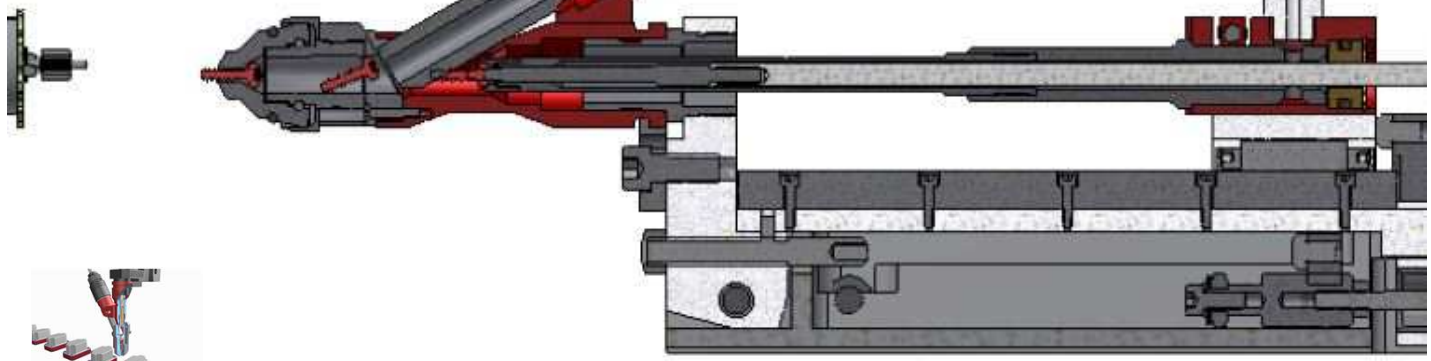
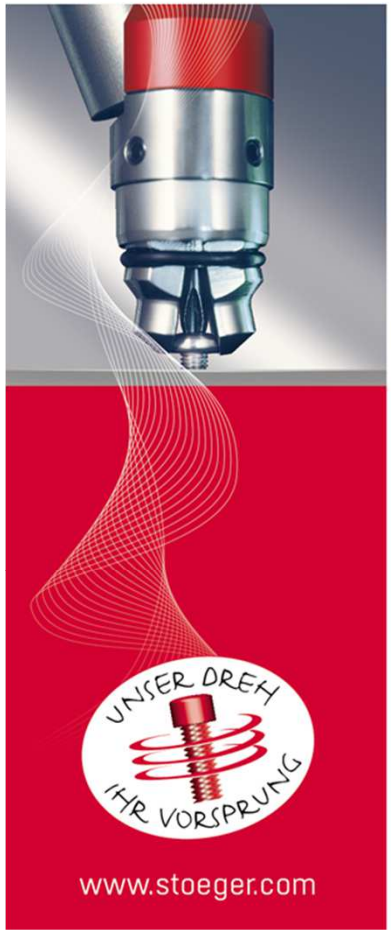
Vacuum screwdriver

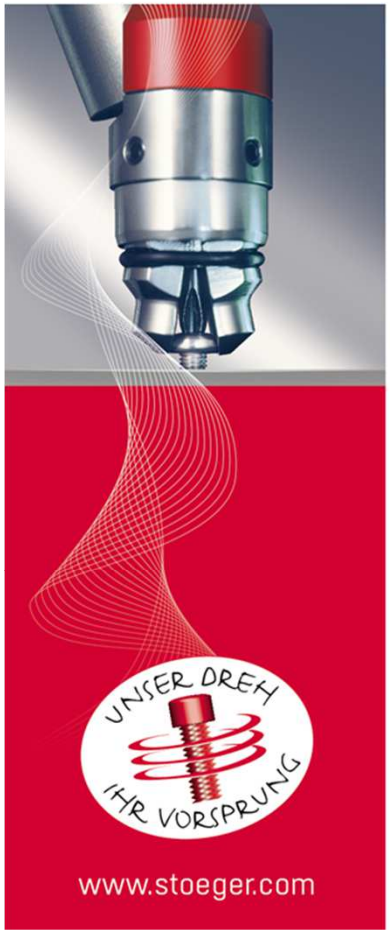
- Extraction of particles due to vacuum in screwdriving system
- Magnetic bits less suitable in clean environment, as metallic particles will be attracted





Pick & Place-Systems

- Use of Pick & Place Systems
  - advantage: no particles are blown to the work piece, as no transport air current
  - disadvantage: higher cycle times
  - disadvantage: more space required at screwdriving location as feed unit has to be positioned near screwdriving unit



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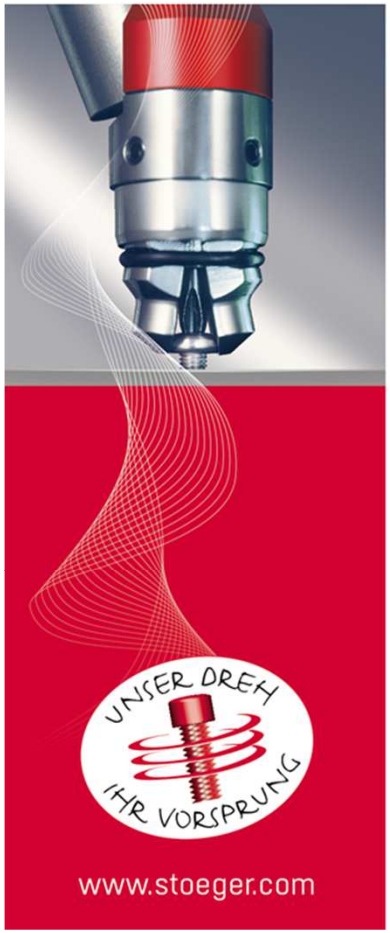
Screwdriving parameters



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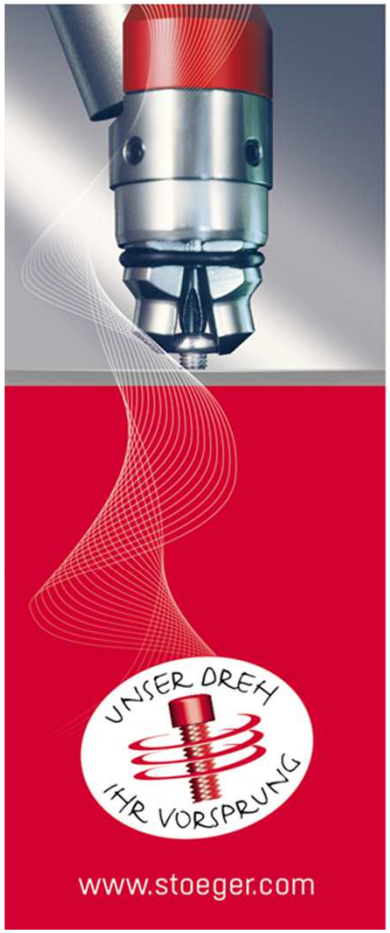
Feeding from a magazine

- Feeding screws from a magazine
  - relatively flexible system; no transport air current required, no intrusion of foreign particles
  - feeding from earlier mentioned feed systems
  - possible only with robot or axle/gantry system

image: drum magazine; possible also hose and bar magazines



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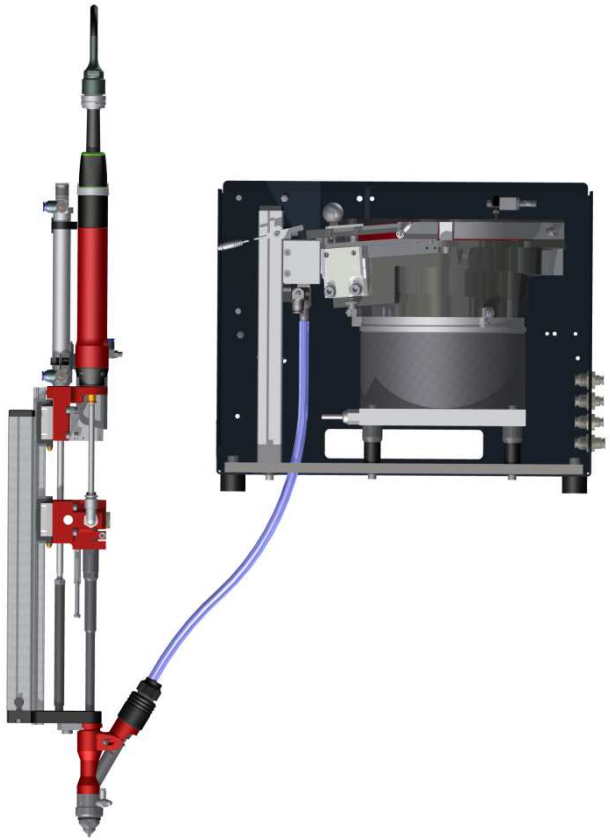
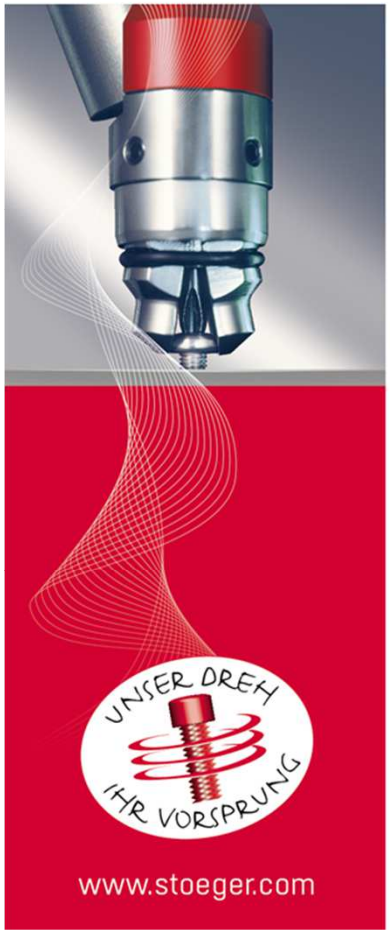
Placement





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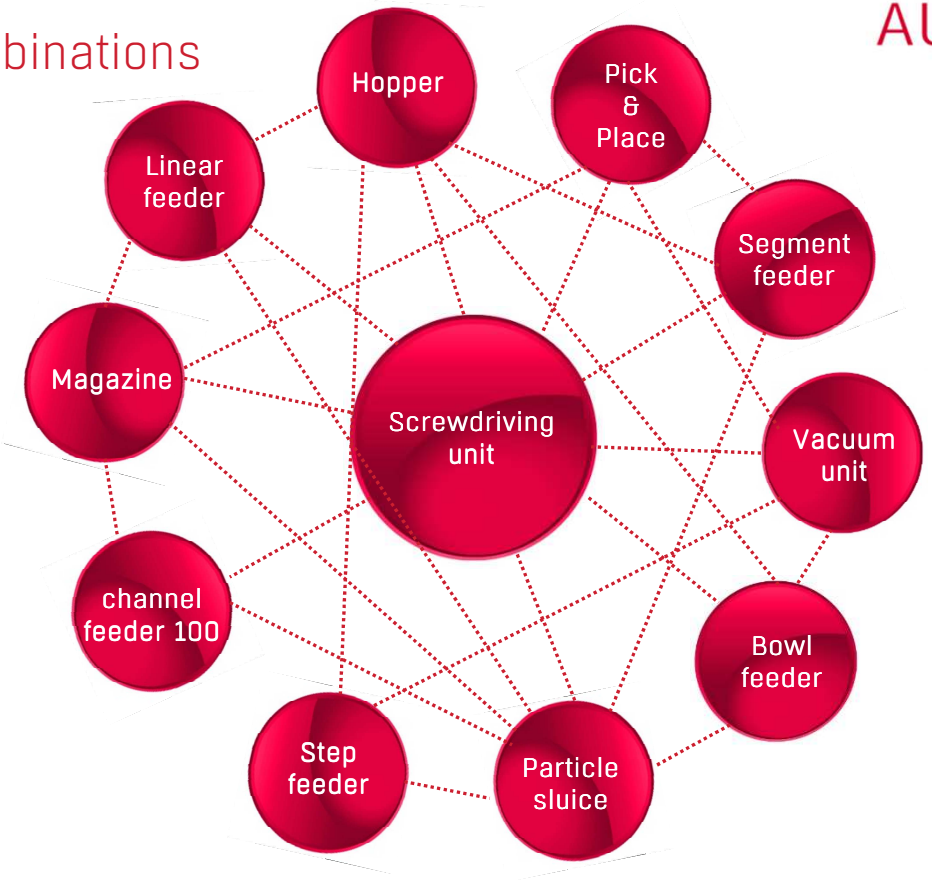
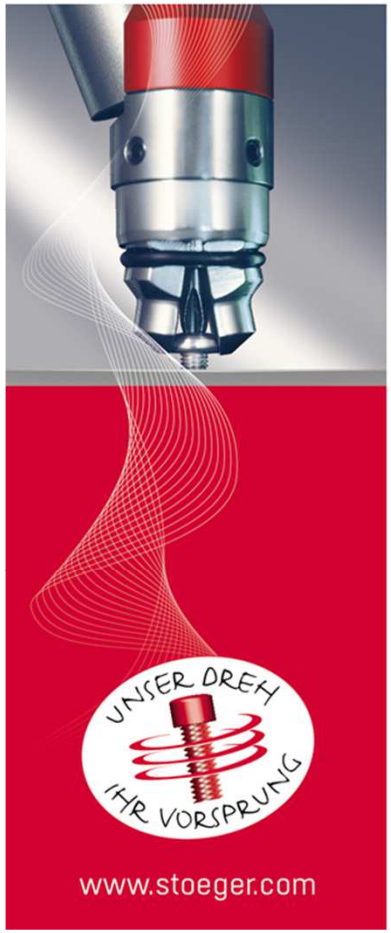
Combinations





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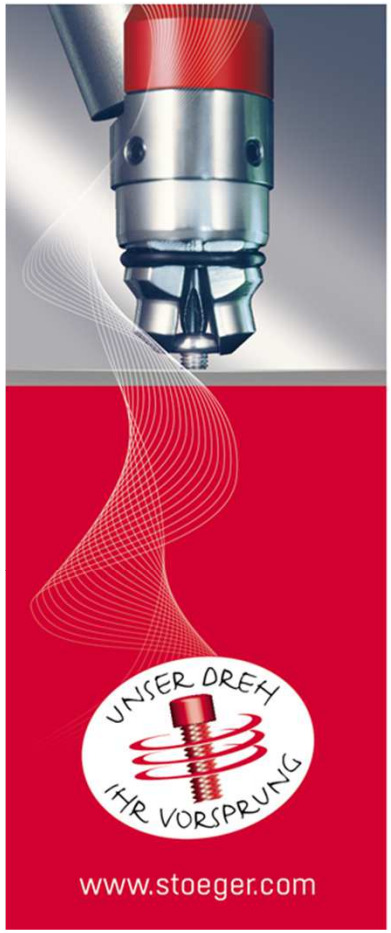
Care and maintenance

- Precautions:
  - Regular cleaning of screwdriving system and feed unit
  - Regular maintenance of screwdriving system and feed unit



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Conclusion

High degree of cleanliness means

- Lower susceptibility of failures in work piece and system
- Fewer customer complaints, higher customer satisfaction
- Lower costs

There are different approaches to achieve desired result. Our experts will be pleased to advise you to work out the optimal solution for your application.

STÖGER AUTOMATION

Thank you for your attention

STÖGER AUTOMATION GmbH
Gewerbering am Brand 1
82549 Königsdorf
Telefon: +49 8179 99767 0
Telefax: +49 8179 99767 50
E-Mail: info@stoeger.com

www.stoeger.com