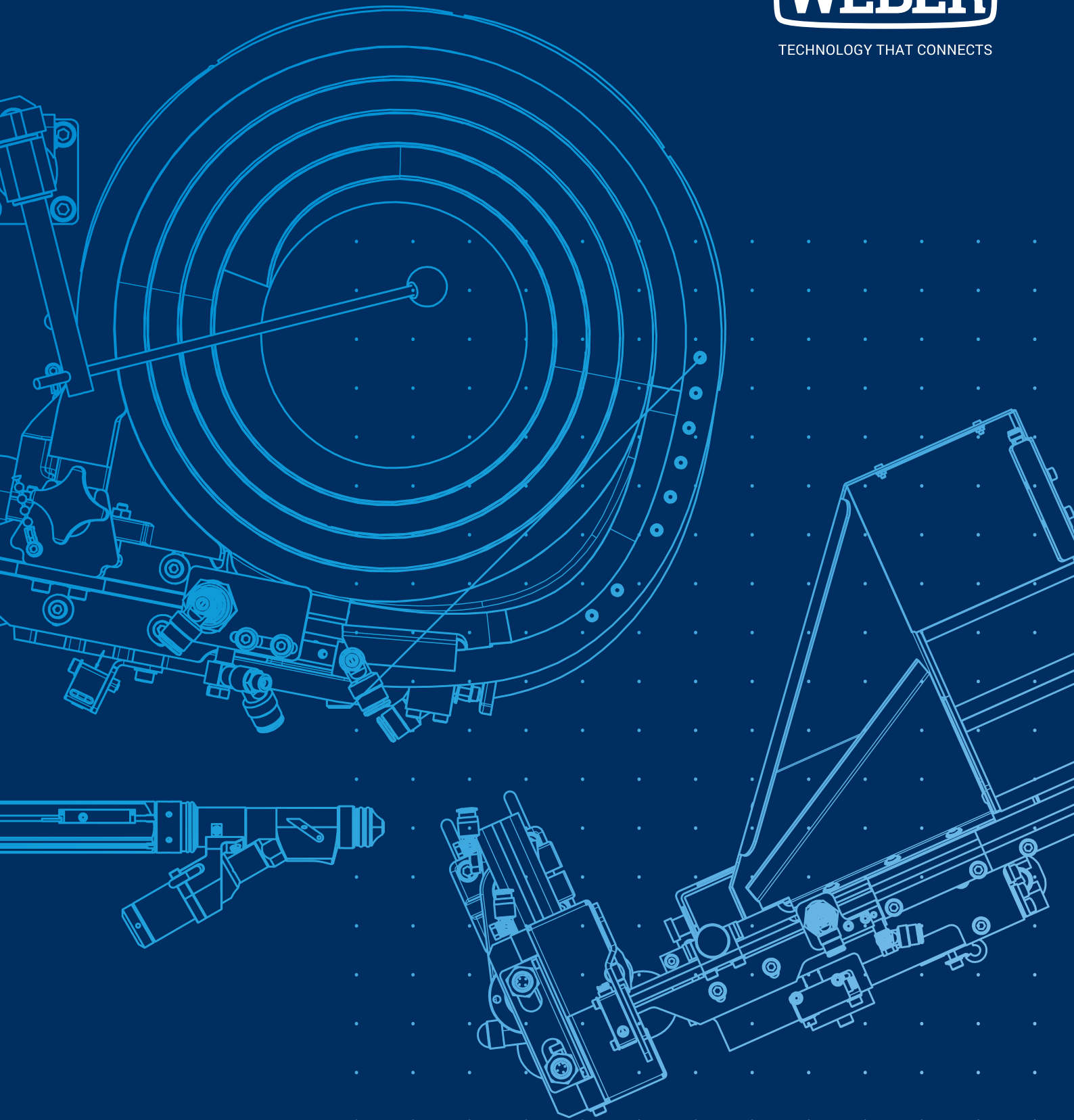




TECHNOLOGY THAT CONNECTS



Technical data

SCREWDRIVING TECHNOLOGY WITH AUTOMATIC FEEDING

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01 Handheld Screwdriving



WEBER handheld screwdrivers combine ergonomics and variability in each model. The advantages of the electric and pneumatic handheld screwdrivers are obvious: highly flexible, powerful, and thanks to programmable control nearly 100 percent process-reliable. In addition, ergonomics and variability play a central role

in manual fitting with handheld screwdrivers. Weber enables with its products – in particular thanks to their built-in bit stroke – fatigue-free working, while realizing high quantities in extremely short cycle times. Freedom in connection technology, as WEBER understands it.



Long service life thanks to wear-resistant surfaces



Economically viable from 20,000 screwdriving operation per year



Maximum flexibility thanks to compact design



Low moving mass for short cycle times

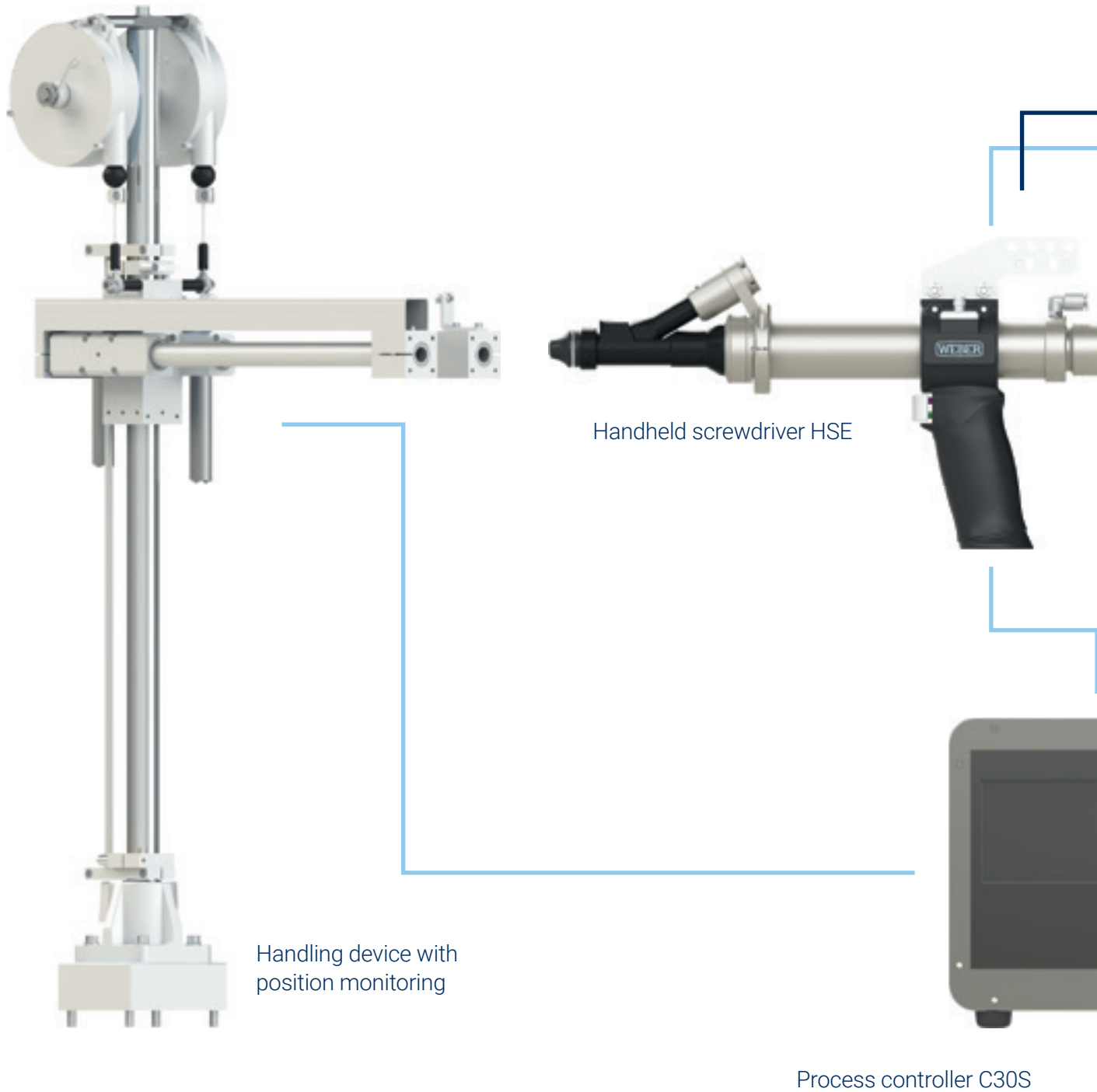
Overview of handheld screwdrivers

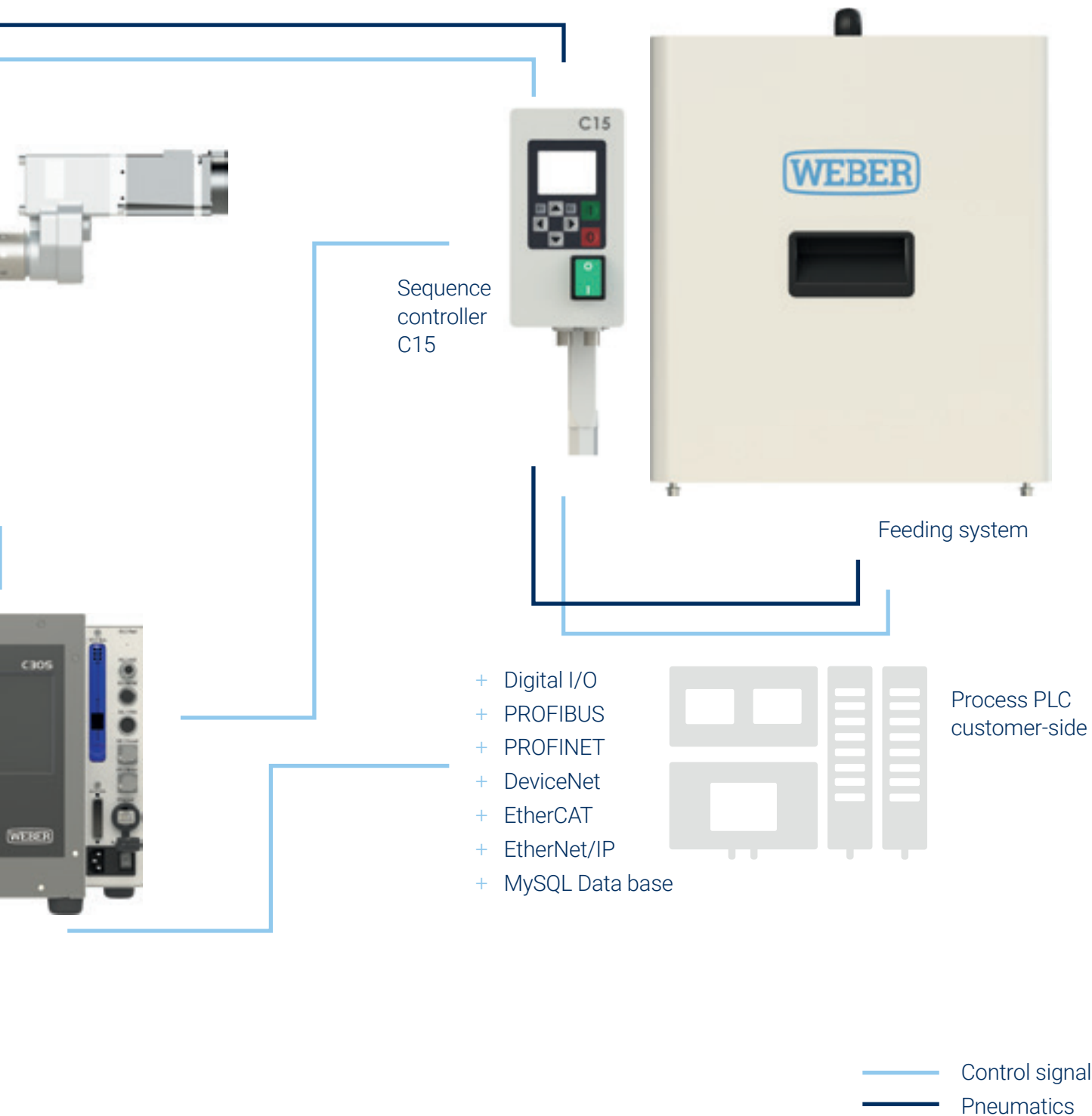
Ergonomics and variability - flexibility in fastening technology

Criteria	HET	HSE	HSP
For shank-heavy screws (Head diameter / Shaft length > 1,5 mm)	✓	✓	✓
For head-heavy screws (Head diameter / Shaft length < 1,5 mm)	✓	-	-
For nuts	✓	-	-
For inserting / press-fitting	-	✓	✓
Use as a tightening screwdriver	✓	-	-
Start trigger	✓	✓	✓
Mechanical shut-off clutch	-	-	✓
Integrated auto bit stroke	-	✓	✓
Quick bit change	✓	-	✓
With swivel arm principle (Feeding during screwdriving)	-	✓	✓
For automatic feeding (ZEB / ZEL)	-	✓	✓
Torque up to [mm]	30	10	5,3
With electric drive	✓	✓	-
With pneumatic drive	-	-	✓
Option customer-side drive	✓	✓	-
Option transducer with angle measurement (MDW)	✓	✓	-
Option integrated reaction transducer (MDG)	✓	✓	-
Integrated program changeover	✓	✓	-
Suitable for multi-stage screwdriving programs	✓	✓	-
Documentation of the screwdriving results	✓	✓	-
Combination with process controller C30S	✓	✓	-
Combination with process controller C50S	✓	✓	-
Combination with sequence controller CU30	-	✓	-
Combination with sequence controller C10S	-	-	✓
Combination with sequence controller C15S	-	✓	✓
Option screw bit lock function	-	✓	-
Option pistol grip for horizontal screwdriving	-	✓	✓
Option bit box	✓	-	-
Option vacuum version	✓	✓	-
Option magnetic screwdriving tool	✓	✓	✓
Option redundant measuring according to VDI / VDE 2862 sheet 2 category A	✓	✓	-
ESD-compliant	✓	✓	✓

System overview

Typical handheld screwdriver set up in your workstation



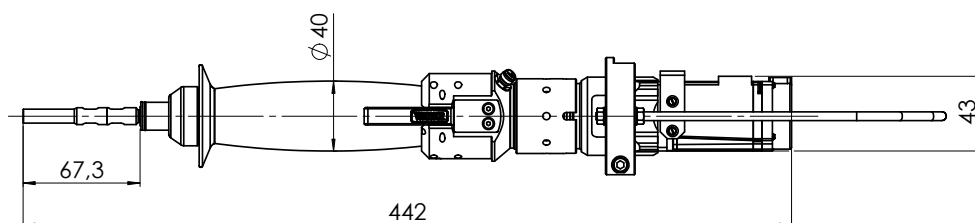


Electric handheld screwdriver



Features

- ◆ For various applications - without auto feeding
- ◆ For applications with high process repeatability requirements where a direct measuring system is mandatory
- ◆ With vacuum technology option for recessed screwdriving locations



Dimensions and technical data may differ depending on the configuration. Image shows HET10 with AEC.

Technical data

Series	03	10	30
Torque range [Nm]	0,2 - 1,5	1 - 3	1 - 10
Max. rotation speed [rpm]	2.500	1.500	1.500
Weight* [kg]	1,2	2,6	4
Total length* [mm]	340	380	400
Grip Ø [mm]	Ø40		
Tool holding coupler	1/4" with quick change chuck		
Option vacuum	yes		
Option magnetic screwdriving tool	yes		

*With direct drive

Technical changes reserved.

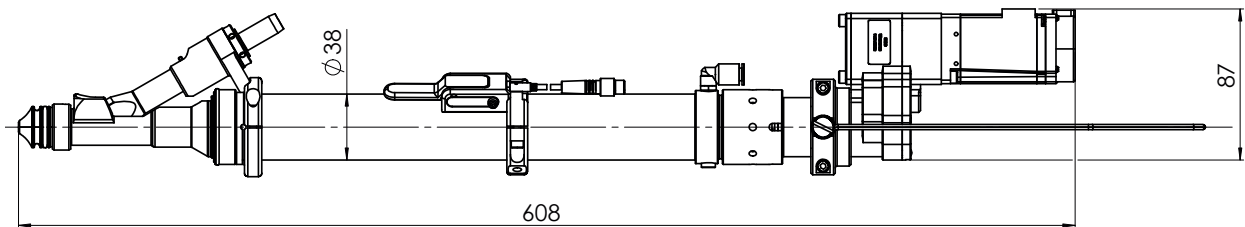


HSE

Electric handheld screwdriver with automatic feeding

Features

- ◆ With automatic bit stroke for user assisted application
- ◆ For standard applications with easily accessible screw locations
- ◆ With adjustable bit lock stroke for ease of finding the screwdriving location
- ◆ For applications with high process repeatability requirements where a direct measuring system is mandatory
- ◆ With vacuum technology option for recessed screwdriving locations (model HSE-V)
- ◆ With magnetic extension screwdriving tool option for slightly recessed screwdriving locations
- ◆ Suitable for automatic feeding



Dimensions and technical data may differ depending on the configuration. Image shows HSE10 130 with AEC.

Technical data

Series	03		10	
Torque range [Nm]	0,2 - 1,5	1 - 3	1 - 10	1,9 - 6
Max. rotation speed [rpm]	2.500	1.500	1.500	800
Head diameter [mm]	3 - 15			
Stroke length [mm]	90		90	130
Weight* [kg]	1,8		2	2,5
Total length* [mm]	464		480	580
Grip Ø [mm]	38			
Tool holding coupler	1/4" with quick change chuck			
Option vacuum	yes			
Option magnetic screwdriving tool	yes			

*With direct drive and standard screwdriving head ass'y

Technical changes reserved.

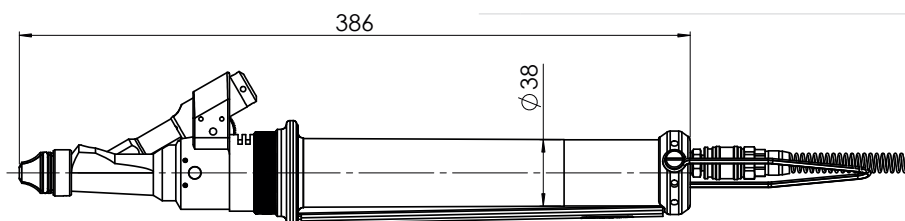


Pneumatic handheld screwdriver with automatic feeding



Features

- ◆ With integrated pneumatic drive for user assisted application
- ◆ For standard applications with easily accessible screw locations
- ◆ For shank heavy screws
- ◆ Torque adjustment via mechanical clutch
- ◆ With magnetic extension screwdriving tool option for slightly recessed screwdriving locations
- ◆ With vacuum technology option for recessed screwdriving locations
- ◆ Swivel arm principle: Feeding during screwdriving
- ◆ Suitable for automatic feeding



Dimensions and technical data may differ depending on the configuration. Image shows HSP32 80.

Technical data

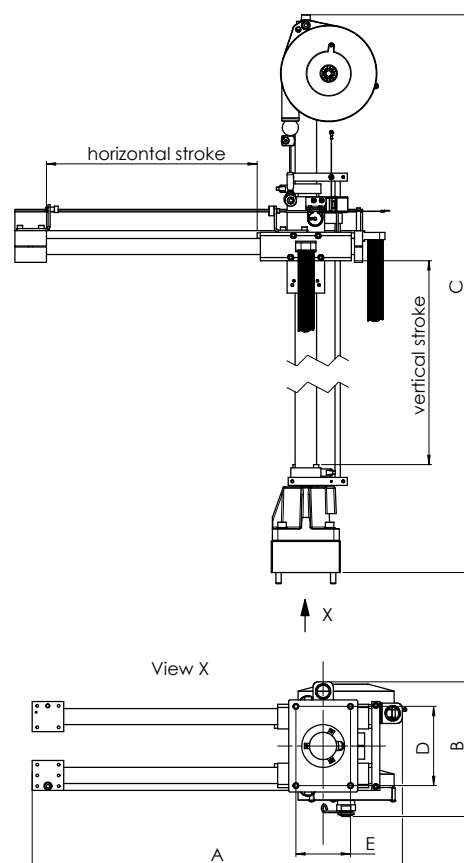
Series	HSP32			
Torque range [Nm]	0,5 - 5,3		0,5 - 4	0,5 - 3
Max. rotation speed [rpm]	650		1000	1500
Head diameter [mm]	3 - 14			
Stroke length [mm]	80	92	104	128
Weigth* [kg]	2,6	2,8	2,8	3,3
Total length* [mm]	385	420	445	490
Grip Ø [mm]	40			
Tool holding coupler	1/4" with quick change chuck			
Option magnetic screwdriving tool	yes			

*With standard screwdriving head ass'y

Accessories

Criteria	HET	HSE	HSP
Parallel arm with table top or wall mounting	✓	✓	✓
Linear support arm	✓	✓	✓
Balancer	✓	✓	✓
Vertical mounting	✓	✓	✓
Pistol grip	-	✓	✓
Foot switch	✓	✓	✓

Linear support arm	HHG7 ESD	HHG20 ESD
Option angle and linear monitoring	✓	✓
Horizontal stroke	200 mm	390 mm
Vertical stroke	400 mm	540 mm
Load capacity	0,8 - 2,5 kg 2,8 - 6,5 kg	8 - 12 kg 12 - 20 kg
A [mm]	440	700
B [mm]	245	250
C [mm]	940	1250
D [mm]	Ø 110	148
E [mm]	Ø 110	102



Balancer	diameter	weight	length	load capacity
Balancer 1 - 2,5 kg	146 mm	3,2 kg	2 m	1 - 2,5 kg
Balancer 2 - 4 kg	146 mm	3,2 kg	2m	2 - 4 kg

Pistol grip*	diameter	weight	length	electrical connection
HSE	40x30 mm	0,3	110 mm	M8 4-pole
HSP	38x25 mm	0,4	120 mm	-

*Always with mounting

Technical changes reserved.

02 Fixtured Screwdriving



As is well known, the whole is more than the sum of the individual parts. Hence also WEBER's screwdriving systems grow with the requirements that companies impose on automated assembly processes. Fixtured screwdriving technology is used if connection processes are more complex, cycle times are shorter and quality requirements are higher. WEBER's variably configurable fixtured screwdriving

spindles adapt themselves to all screwdriving cases: whether mouthpieces, stroke lengths, sensors or drive units – WEBER offers tailor-made solutions depending on the task and screwdriving process. Nevertheless, the effort to change tools on the screwdriving units remains low – thanks to the tool-free change of the screwdriving head assembly.



Long service life thanks to wear-resistant surfaces



Economically viable from 60,000 screwdriving operation per year



Maximum flexibility thanks to compact design



Low moving mass for short cycle times

Overview of fixtured screwdrivers

Configurable stationary screwdriving spindles for your application

Criteria	SER	SEB	SEV	SEM	SEK	SEV-E	SEV-C	SEV-L	SEV-P
For shank-heavy screws (Head diameter / Shaft length > 1,5 mm)	✓	✓	✓	-	-	✓	✓	✓	✓
For head-heavy screws (Head diameter / Shaft length < 1,5 mm)	-	-	-	-	✓	-	-	-	✓
For nuts	-	-	-	✓	-	-	-	-	✓
For inserting / press-fitting	✓	✓	✓	-	-	-	✓	✓	✓
For standard applications with easily accessible screw locations	✓	✓	-	-	-	-	✓	✓	✓
For limited access screwdriving locations	-	-	✓	✓	✓	✓	✓	✓	✓
For applications with hard-to-reach and extremely recessed screwdriving locations	-	-	-	✓	✓	✓	-	-	✓
Thread friendly application	✓	✓	✓	✓	✓	✓	✓	✓	✓
Closed spindle module	✓	✓	✓	✓	✓	-	✓	✓	✓
Spindle module - open slide design	-	-	-	-	-	✓	-	-	-
With integrated head clearance stroke	-	✓	-	-	-	-	-	-	-
With pneumatic bit stroke	✓	✓	✓	✓	✓	✓	✓	✓	-
With electrical bit stroke	-	-	-	-	-	✓	-	-	-
Low moving mass due to fixed drive motor	✓	✓	✓	✓	✓	-	✓	✓	✓
Modular drive concept	✓	✓	✓	✓	✓	✓	-	✓	✓
Torque range up to [Nm]	120	60	120	120	120	30	10	10	60
Designed for linear axis applications	✓	✓	✓	✓	✓	✓	-	✓	(✓)
Designed for application with industrial robots	✓	-	✓	✓	✓	✓	-	✓	✓
Designed for LWR applications	-	-	-	-	-	-	✓	✓	✓
Designed for HRC applications	-	-	-	-	-	-	✓	-	-
Swivel arm principle for automatic feeding	✓	✓	✓	✓*	✓*	✓	✓	✓	-
With vacuum technology	-	-	✓	✓	✓	✓	✓	✓	✓
Pick & Place version	-	-	✓	-	-	-	-	-	✓
Option redundant measuring according to VDI / VDE 2862 sheet 2 category A	✓	✓	✓	✓	✓	✓	-	-	✓

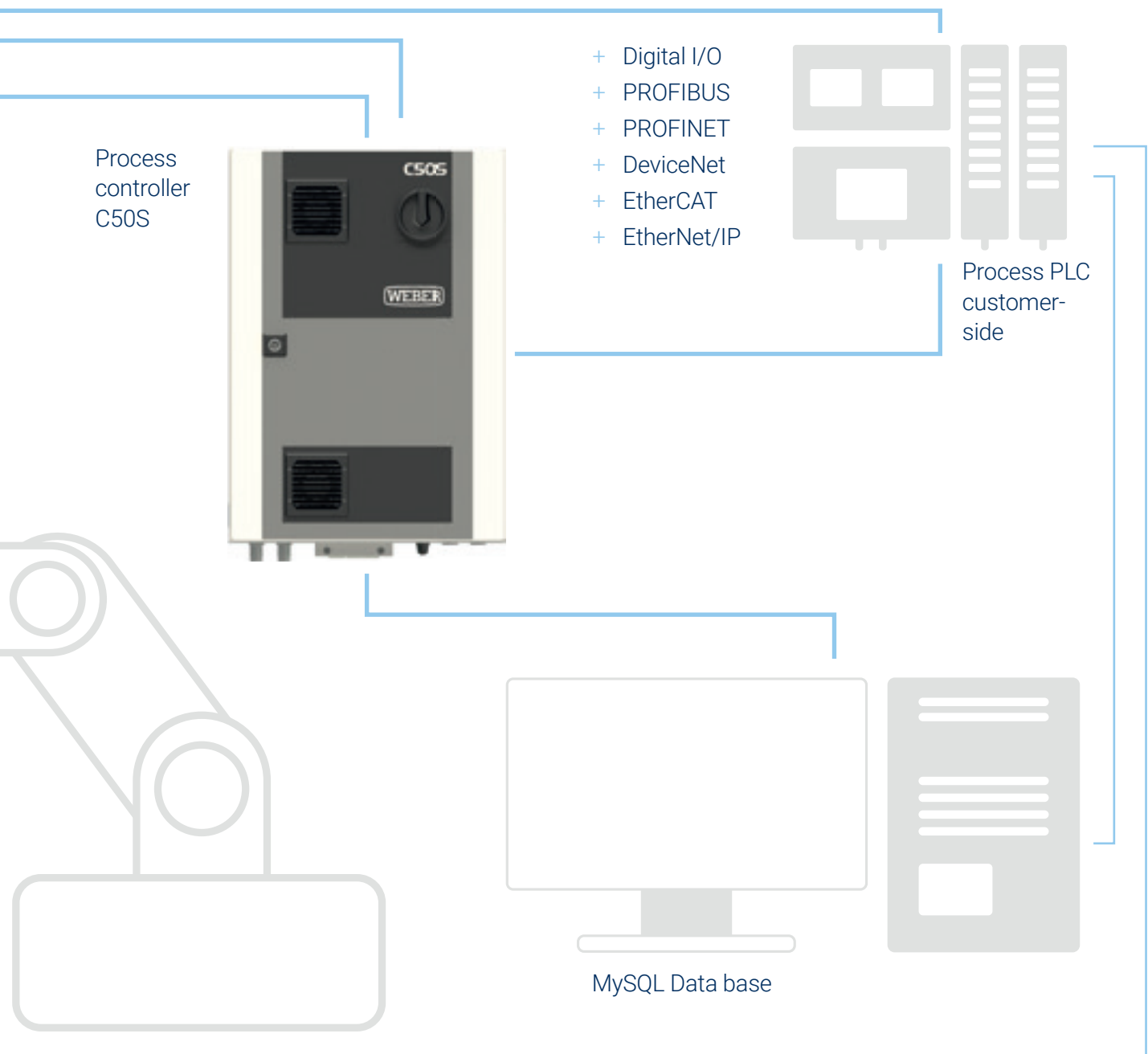
*Screwdriving tool ass'y in drawer design, feeding of the fastener during the screwdriving process

LWR = Lightweight robot

HRC = Human Robot Collaboration

Sequence controller
CU30





Positioning device

— Control signal
— Pneumatics

Modular design

Modular design screwdriving spindles for flexible configuration



Ball bushing



3-finger aligning guide



2-finger aligning guide



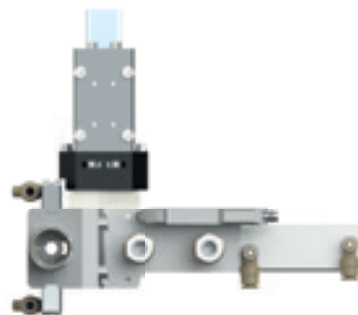
Guide bushing head



Downholder adaptor with swivel arm



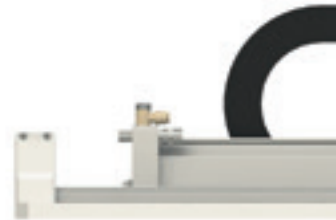
Connecting sleeve



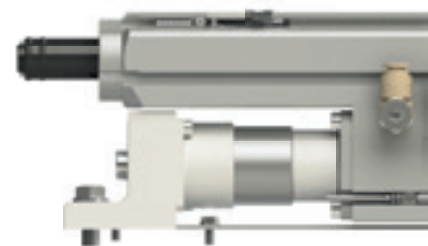
Nut feeding head



Vacuum screwdriving head ass'y



Screwdriving module SEV-E



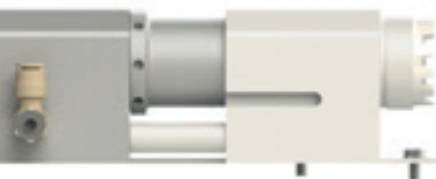
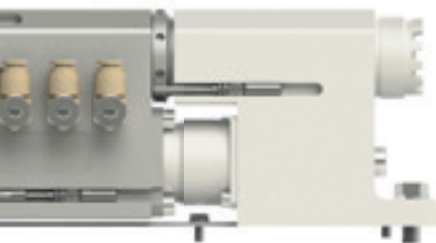
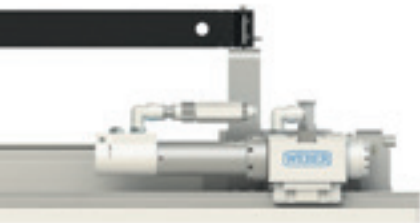
Screwdriving module SEB



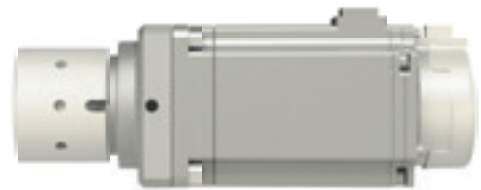
Screwdriving module SER



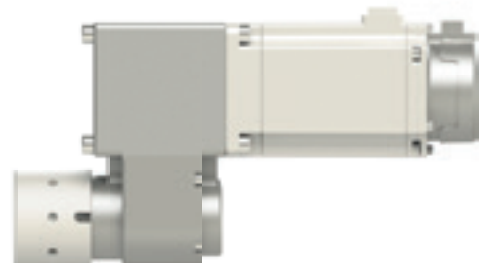
Vacuum module



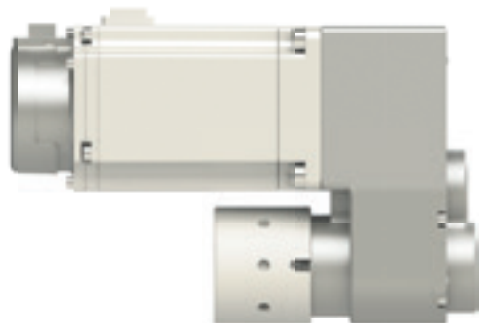
Dynamic transducer
MDW



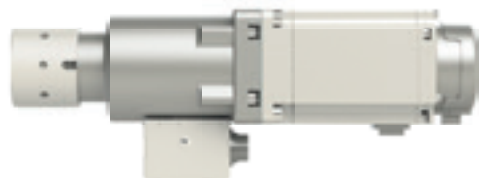
EC motor with direct drive



EC motor with offset gear



EC motor with inverse gear



EC motor with integrated
transducer MDG

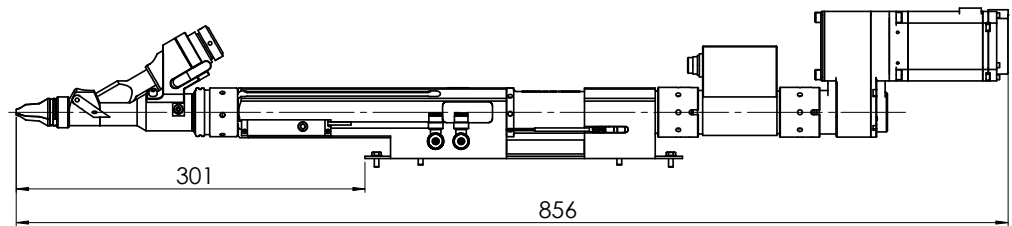


Fixtured screwdriver with closed spindle module



Features

- ◆ For standard applications with easily accessible screw locations
- ◆ Swivel arm principle: Feeding during screwdriving
- ◆ Suitable for automatic feeding



Dimensions and technical data may differ depending on the configuration. Image shows SER10 120 with MDW and AEC

Technical data

Series	03	10	30	60	120
Torque range [Nm]	0,3 - 3	1 - 10	3 - 30	6 - 60	12 - 120
Max. rotation speed [rpm]	2.500	2.500	1.500	1.500	300
Head diameter [mm]	3 - 16	5 - 21	9 - 24	9 - 24	9 - 24
Weight* [kg]	approx. 5	approx. 7	approx. 9	approx. 11	approx. 16
Bit stroke (intern) [mm]	70 90 120 190	90 120 160 240	120 160 200	120 160 200	160 200
Axial force bit (1 3 6 bar) [N]	30 90 180	45 135 270	70 210 420	70 210 420	160 480 960 70 210 420**
Max. overstroke depending on head diameter [mm]	11 - 18 7,4 - 38 24,4 - 68 89 - 126	4,5 - 33,3 2,3 - 63,3 42,3 - 103,3 89 - 126,4	2,5 - 42,2 42,5 - 82,2 42,3 - 84	2,5 - 42,2 42,5 - 82,2 42,3 - 84	2,5 - 42,2 42,5 - 82,2 42,3 - 84
Tool holding coupler	3/16"	1/4"	5/16"	7/16"	7/16"

*With direct drive and standard screwdriving head ass'y

**Version LAF Low Axial Force

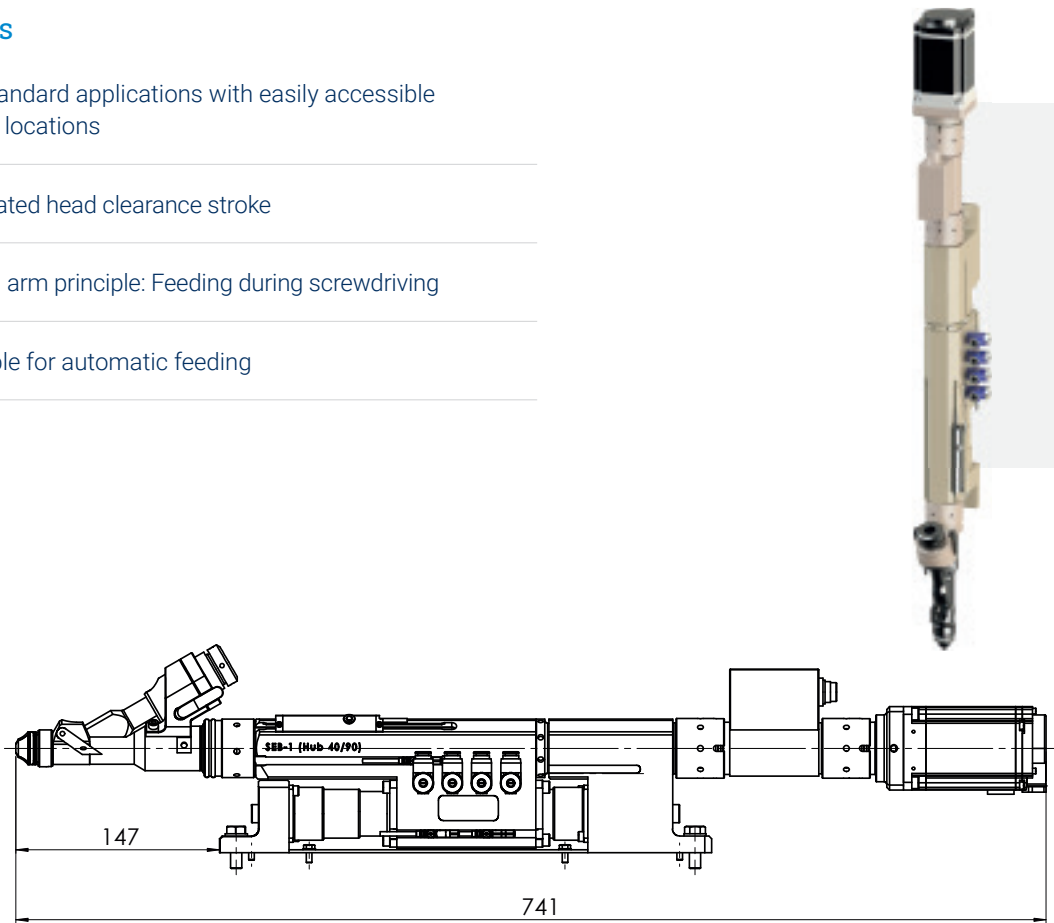
Technical changes reserved.



Fixtured screwdriver with integrated head stroke

Features

- ◆ For standard applications with easily accessible screw locations
- ◆ Integrated head clearance stroke
- ◆ Swivel arm principle: Feeding during screwdriving
- ◆ Suitable for automatic feeding



Dimensions and technical data may differ depending on the configuration. Image shows SEB10 90 with MDW and AEC.

Technical data

Series	03	10	30	60
Torque range [Nm]	0,3 - 3	1 - 10	3 - 30	6 - 60
Max. rotation speed [rpm]	2.500	2.500	1.500	1.500
Head diameter [mm]	2 - 13	4,5 - 22	9 - 24	9 - 24
Weight* [kg]	approx. 5	approx. 7	approx. 9	approx. 11
Bit stroke (spindle intern) [mm]	70 90 120 190	90 120 160 240	120 160 200	120 160 200
Axial force bit (1 3 6 bar) [N]	30 90 180	45 134 270	70 210 420	70 210 420
Max. overstroke depending on head diameter [mm]	11 - 18 7,4 - 38 24,4 - 68 89 - 126	4,5 - 33,3 2,3 - 63,3 42,3 - 103,3 89 - 126,4	2,5 - 42,2 42,5 - 82,2 42,3 - 84	2,5 - 42,2 42,5 - 82,2 42,3 - 84
Head stroke [mm]	30	40	60	60
Axial force head stroke (1 3 6 bar) [N]	45 135 270 N	75 225 450 N	115 345 690 N	115 345 690 N
Tool holding coupler	3/16"	1/4"	5/16"	7/16"

*With direct drive and standard screwdriving head ass'y

Technical changes reserved.

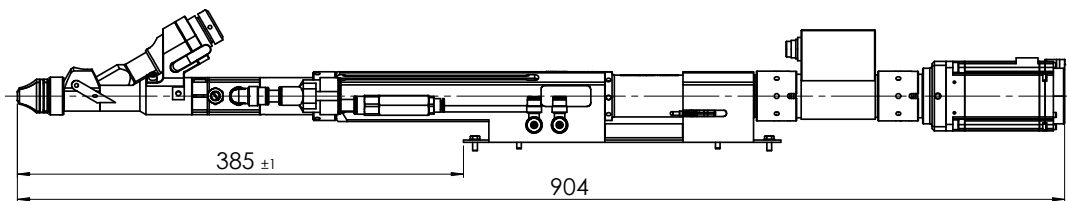


For hard to reach screwdriving locations



Features

- ◆ Version with vacuum technology for hard to reach screw locations
- ◆ For requirements of technical cleanliness with particulate reduction
- ◆ Swivel arm principle: Feeding during screwdriving
- ◆ Suitable for automatic feeding



Dimensions and technical data may differ depending on the configuration. Image shows SEV10 120 wiht MDW and AEC.

Technical data

Series	03	10	30	60	120
Torque range [Nm]	0,3 - 3	1 - 10	3 - 30	6 - 60	12 - 120
Max. rotation speed [rpm]	2.500	2.500	1.500	1.500	300
Head diameter [mm]	6,5 - 11	6,5 - 13	9 - 24	9 - 24	9 - 24
Weight* [kg]	from 5	from 7	from 9	from 11	from 16
Bit stroke (intern) [mm]	70 90 120 190	90 120 160 240	120 160 200	120 160 200	160 200
Axial force bit (1 3 6 bar) [N]	30 90 180	45 135 270	70 210 420	70 210 420	160 480 960 70 210 420**
Max. overstroke depending on head diameter [mm]	11 - 18 7,4 - 38 24,4 - 68 89 - 126	4,5 - 33,3 2,3 - 63,3 42,3 - 103,3 89 - 126,4	2,5 - 42,2 42,5 - 82,2 42,3 - 84	2,5 - 42,2 42,5 - 82,2 42,3 - 84	2,5 - 42,2 42,5 - 82,2 42,3 - 84
Tool holding coupler	3/16"	1/4"	5/16"	7/16"	7/16"

*With direct drive and standard screwdriving head ass'y

**Version LAF Low Axial Force

Technical changes reserved.

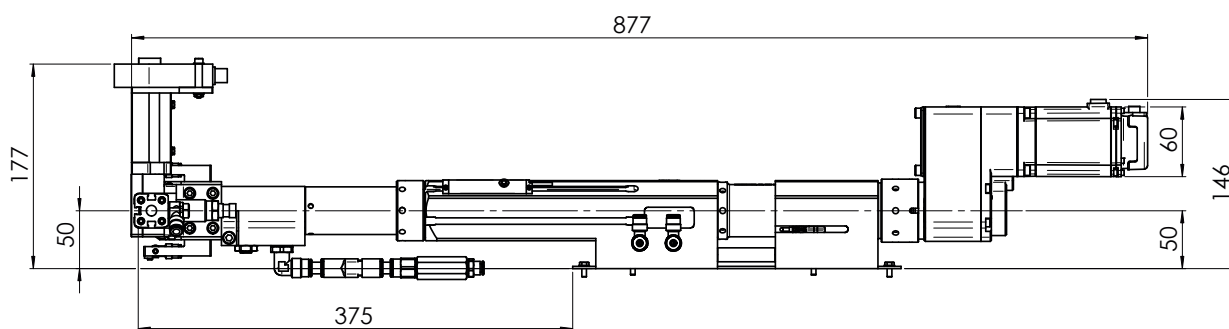
SEM | SEK

For nuts and head-heavy screws



Features

- ◆ Version with vacuum technology for the handling of nuts, also for hard to reach screw locations
- ◆ For head-heavy screws SEK
- ◆ For DIN-, flange- and application specific nuts SEM
- ◆ Screwdriving head ass'y in pusher design with profile tube, feeding during screwdriving
- ◆ Suitable for automatic feeding



Dimensions and technical data may differ depending on the configuration. Image shows SEM30 120 with AEC.

Technical data

Series	03	10	30	60	120
Torque range [Nm]	0,3 - 3	1 - 10	3 - 30	6 - 60	12 - 120
Max. rotation speed [rpm]	2.500	2.500	1.500	1.500	300
Head diameter (SEK) [mm]	3 - 16	5 - 21	9 - 24	9 - 24	9 - 24
Nut size (SEM)	M2 - M4	M3 - M8	M5 - M10	M5 - M10	M5 - M10
Nut size Ø collar or across corners [mm]	up to 10	up to 15	up to 20	up to 20	up to 20
Weight* [kg]	approx. 5	approx. 7	approx. 9	approx. 11	approx. 16
Bit stroke (intern) [mm]	70 90 120 190	90 120 160 240	120 160 200	120 160 200	160 200
Axial force bit (1 3 6 bar) [N]	30 90 180	45 135 270	70 210 420	70 210 420	160 480 960 70 210 420**
Max. overstroke depending on head diameter [mm]	11 - 18 7,4 - 38 24,4 - 68 89 - 126	4,5 - 33,3 2,3 - 63,3 42,3 - 103,3 89 - 126,4	2,5 - 42,2 42,5 - 82,2 42,3 - 84	2,5 - 42,2 42,5 - 82,2 42,3 - 84	2,5 - 42,2 42,5 - 82,2 42,3 - 84
Tool holding coupler	3/16"	1/4"	5/16"	7/16"	7/16"

*With direct drive and standard screwdriving head ass'y

**Version LAF Low Axial Force

Technical changes reserved.

SEV-E

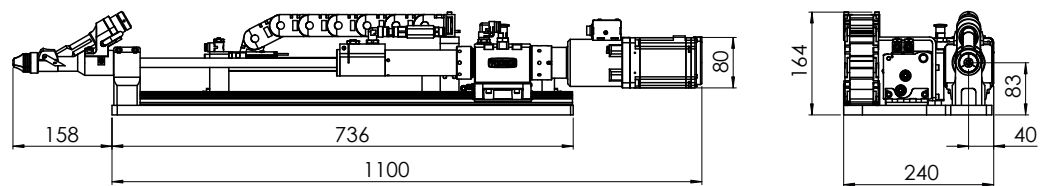


For severely recessed screwdriving locations



Features

- ◆ For severely recessed screwdriving locations and special applications with extremely long stroke requirements
- ◆ Open slide design with pneumatic or electric bit stroke
- ◆ For handling shank-heavy screws with swivel arm principle
- ◆ With energy chain for cable management
- ◆ Three types: right and left version for optimized length (stroke-pneumatic and electric), straight version for optimized width (stroke-pneumatic only)
- ◆ Combination possible with SEK or SEM screwdriving ass'y
- ◆ Suitable for automatic feeding



Dimensions and technical data may differ depending on the configuration. Image shows SEV-E10 350 with MDG

Technical data

Series	Pneum. stroke 03	Electr. stroke 10	Pneum. stroke 10	Electr. stroke 30	Pneum. stroke 30	Electr. stroke 30
Torque range [Nm]	0,3 - 3	1 - 10	1 - 10	1 - 10	3 - 30	3 - 30
Max. rotation speed [rpm]	2.500	2.500	2.500	2.500	1.500	1.500
Head diameter [mm]	3 - 16	5 - 21	5 - 21	5 - 21	9 - 24	9 - 24
Nut size Ø collar or across corners [mm]	see technical data SEM					
Weight* [kg]	approx. 13	approx. 19	approx. 15	approx. 21	approx. 24	approx. 30
Position dependent force compensation	-	✓	-	✓	-	✓
Bit stroke (intern) [mm]	300	350	350	350	300	350
Axial force bit (1 3 6 bar) [N]	44 133 265 N **	44 133 265 N **	44 133 265 N **	44 133 265 N **	72 217 434 N **	72 217 434 N **
Max. stroke speed [mm/s]	-	500	-	500	-	500

*With direct drive and standard screwdriving head ass'y

**+ - 150 N depending on the screwdriving direction

Technical changes reserved.

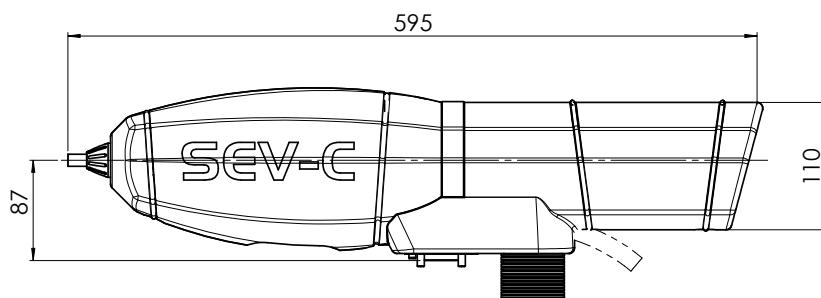
SEV-C

Human Robot Collaboration



Features

- ◆ For collaborative HRC applications
- ◆ For shank-heavy screws with vacuum technology
- ◆ Safety cover and mouthpiece pressure sensor
- ◆ Integrated LED strips for process status
- ◆ Swivel arm principle: Feeding during screwdriving
- ◆ Suitable for automatic feeding



Dimensions and technical data may differ depending on the configuration.

Technical data

Torque range [Nm]	1 - 6
Max. rotation speed [rpm]	800
Head diameter [mm]	6 - 12
Weight* [kg]	approx. 4,8
Bit stroke (intern) [mm]	90 130
Axial force bit (1 3 6 bar) [N]	20 60 120
Max. overstroke depending on head diameter [mm]	up to 35
Tool holding coupler	1/4"
Collaborative mode according to level 4 of ISO TS 15066	✓

*With direct drive, standard screwdriving head ass'y and cable pack

Technical changes reserved.



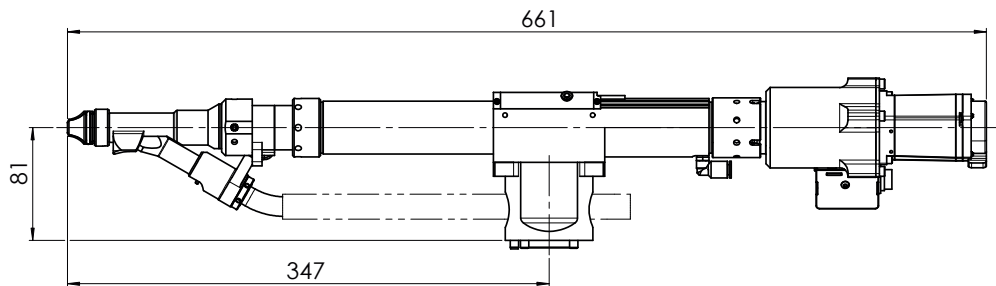
SER-L / SEV-L

Spindle for lightweight robots with automatic feeding



Features

- ◆ For lightweight robots and coexisting HRC applications
- ◆ With vacuum technology option for recessed screwdriving locations (SEV-L)
- ◆ Swivel arm principle: Feeding during screwdriving
- ◆ Suitable for automatic feeding



Dimensions and technical data may differ depending on the configuration. Image shows SER-L 130 with MDG.

Technical data

Series	SEV-L	SER-L
Torque range [Nm]	1 - 10	1 - 10
Max. rotation speed [rpm]	2500	2500
Head diameter [mm]	6 - 16	6 - 16
Weight* [kg]	approx. 3,7	approx. 3,6
Bit stroke (spindle intern) [mm]	90 130	90 130
Axial force bit (1 3 6 bar) [N]	20 60 120	20 60 120
Max. overstroke depending on head diameter [mm]	32 - 73,5	32 - 73,5
Tool holding coupler	1/4"	1/4"
Collaborative mode according to level 4 of ISO TS 15066	-	-

*With direct drive, standard screwdriving head ass'y and cable pack

Technical changes reserved.

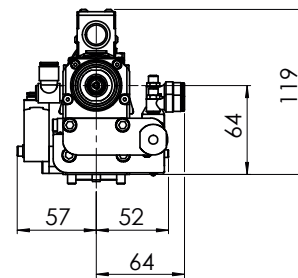
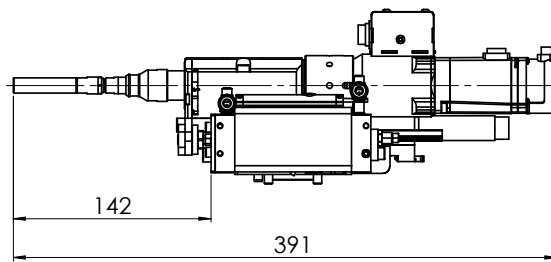


SEV-P

Pick & Place screwdriver for robot applications

Features

- ◆ For use with collaborative lightweight or industrial robots
- ◆ For Pick & Place applications with vacuum technology for fasteners of all types
- ◆ Automatic tool change with tool identification system using RFID (read & write)
- ◆ Force-controlled stroke and active depth measurement through optional head stroke slide
- ◆ Suitable for automatic feeding in Pick & Place design



Dimensions and technical data may differ depending on the configuration. Image shows SEV-P10 with MDG and feed slide.

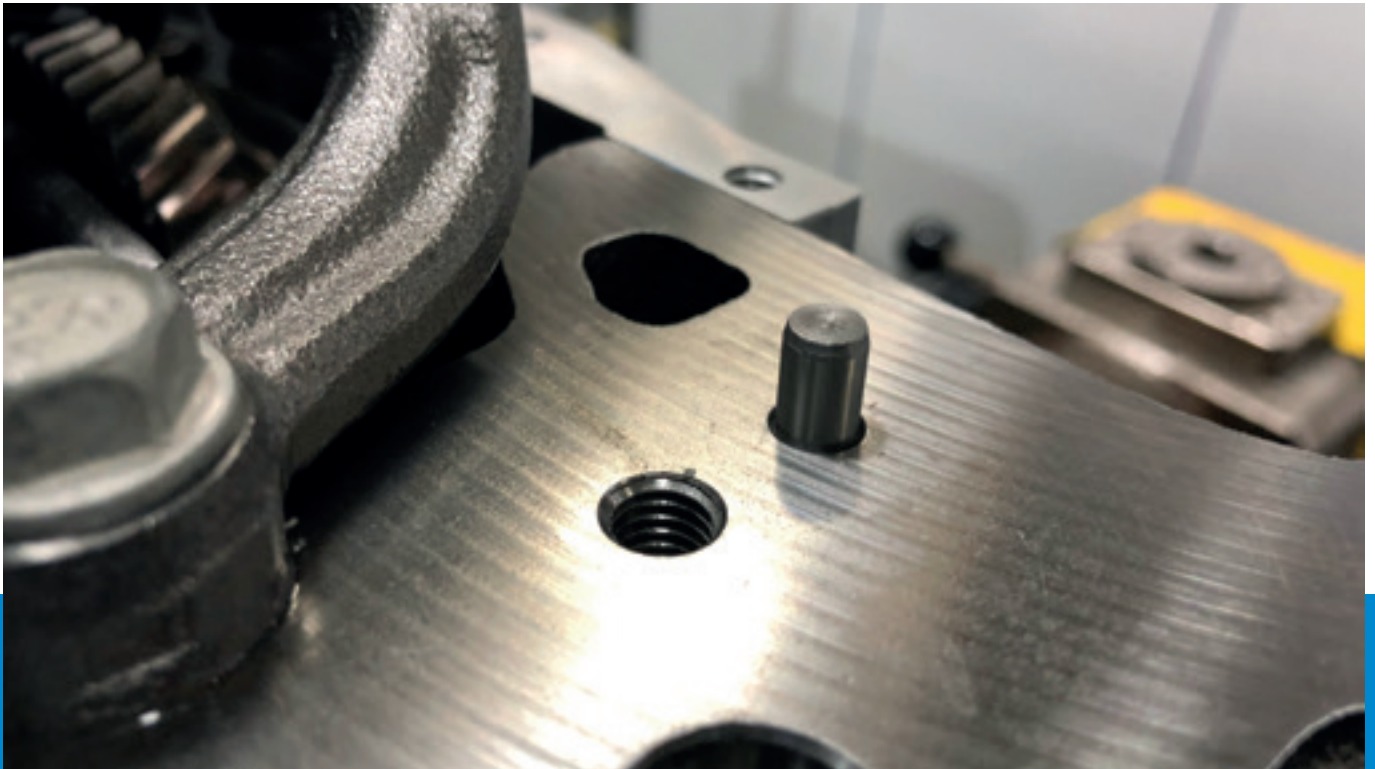
Technical data

Series	SEV-P10	SEV-P30	SEV-P60
Torque range [Nm]	0,5 - 10	3 - 30	6 - 60
Max. rotation speed [rpm]	2.500	1.500	850
Head diameter [mm] / Nut size	as needed		
Weight with / without slide [kg]	4,6 3,5	9,5 8	20 14
Bit stroke (spindle intern) [mm]	5	5	10
Axial force intern bit stroke [N]	5	5	5
Head stroke slide [mm]	50	50	125
Max. screw location recess [mm]	130	180	130
Axial force head stroke [N]	50	50	125
Tool holding coupler	1/4"	5/16"	7/16"

*With direct drive

Technical changes reserved.

03 Inserting and Press-fitting



Connection technology can do more – WEBER offers more. Automation of assembly processes also includes inserting and press-fitting technology. WEBER offers innovative fixtured and handheld systems in this range. With the insertion and press-fitting units for pins, bolts or clips, permanent force-fitting or

force- and form-fitting connections are realized. All systems have automatic feed systems or intelligent controllers and allow high process forces for setting or insertion. Quality control can be achieved during the joining process by a force-path monitoring system. The setting tools are pneumatically powered.



Pneumatic drive or feed requires
no separate drive control



Short cycle times due to automatic feeding and
swivel arm technology



Various designs for different demanding
insertion or press-fitting tasks

PEB | HPP



For various inserting applications

Features PEB

- ◆ Adjustable depth and optional insertion force monitoring
- ◆ Optional head clearance stroke - insertion stroke independent
- ◆ Optional for robot application
- ◆ Short cycle times due to automatic feeding and swivel arm technology

Features HPP

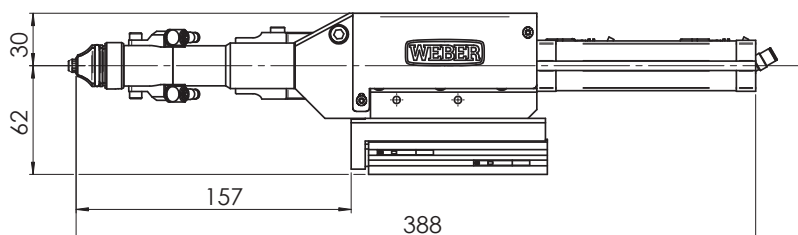
- ◆ Adjustable depth and optional insertion force monitoring
- ◆ Linear support arm or balancer for user assisted application
- ◆ Faster cycle times possible at manual workstations
- ◆ Optional bit lock stroke version



PEB



HPP



Dimensions and technical data may differ depending on the configuration. Image shows Standard PEB

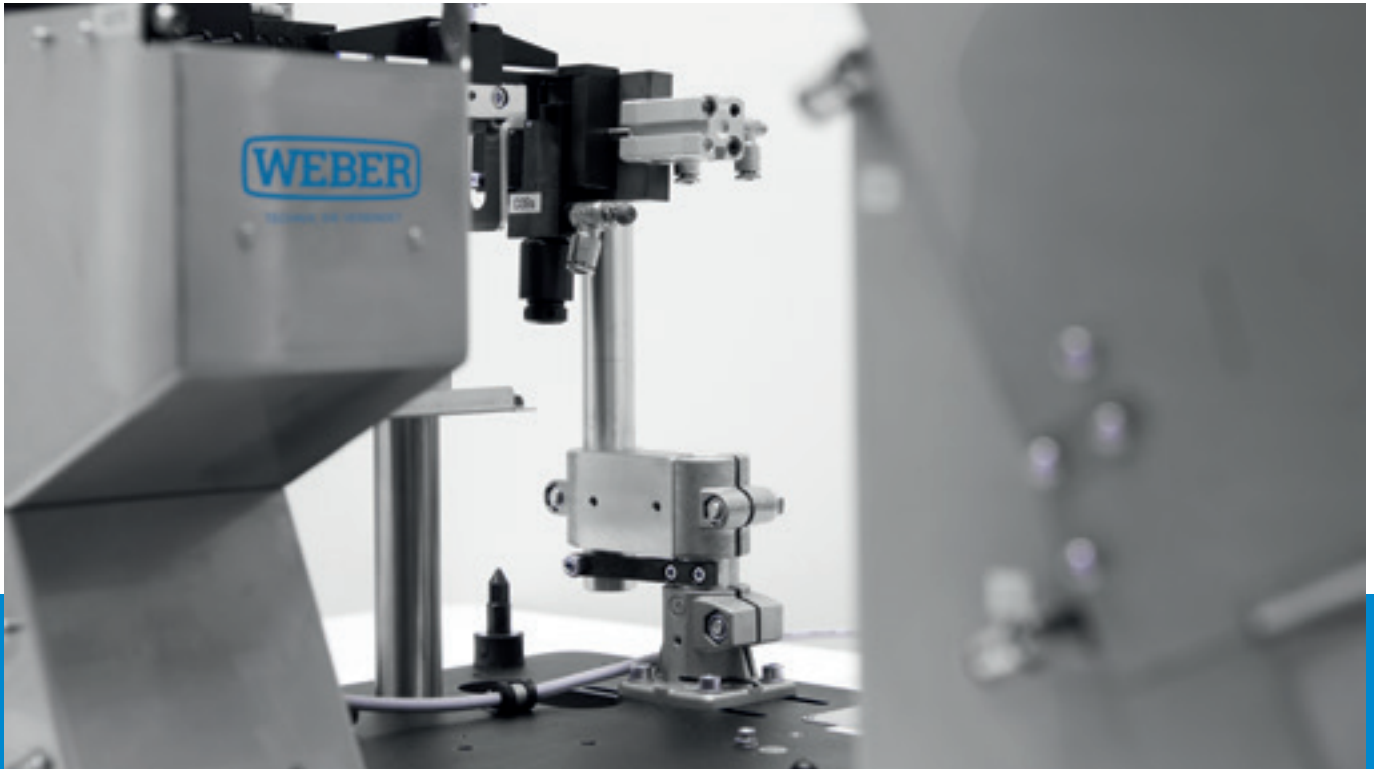
Technical data PEB

Model	Standard	Enhanced
Insertion-/press-fitting force [N]	50 - 600	up to 10.000
Weight [kg]	approx. 2,5	approx. 15
Pneumatic connection [bar]	4 - 8	4 - 8

Technical data HPP

Max. insertion-/press-fitting force [N]	190
Stroke [mm]	90 / 130
Weight [kg]	approx. 2
Pneumatic connection [bar]	4 - 8

04 Feeding technology



Automation of assembly processes normally pursues three objectives: efficiency enhancement, quality improvement and cost reduction. To achieve these objectives, the supply of fasteners must be trouble-free and as gentle as possible on the material. WEBER, with its automatic feed systems, achieves a maximum of process quality. The development of these systems requires experience

and know-how. WEBER has developed and manufactured individual components for many years, combining them to fully automated feeding systems. After currently more than 30,000 delivered screwdriving and assembly systems with automatic feeding, WEBER is one of the leading companies in this area.



Screws, bolts nuts, pins, washers,
caps and much more



Monitoring with numerous sensors such as
presence check and feeder level control



Cycle times as fast as 0.8 seconds

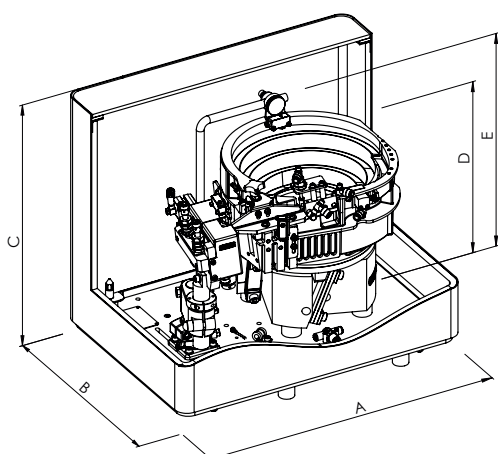
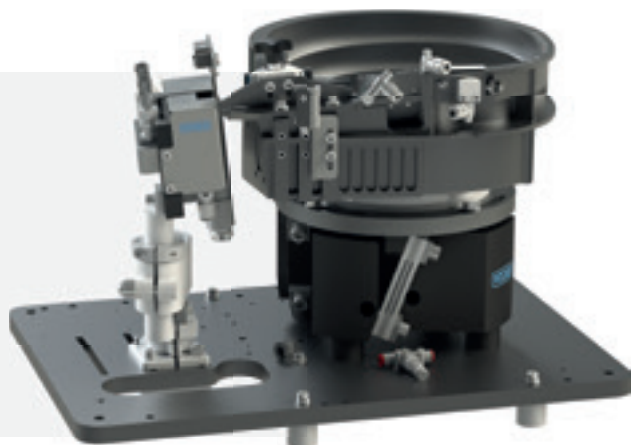


More than 60 years of experience
in feeding technology

Overview of feeding systems

Efficient and gentle feeding of fasteners

Criteria	120	ZEB		360	240	ZEL	
		240				360	480
For shank-heavy screws	✓	✓	✓	✓	✓	✓	✓
For head-heavy screws	✓	✓	✓	✓	✓	✓	✓
For nuts	✓	✓	✓	✓	✓	✓	✓
For washers	✓	✓	✓	-	-	-	-
For symmetrical elements	✓	✓	✓	✓	✓	✓	✓
For non-symmetrical elements	-	-	-	-	-	-	-
For elements with adhesive coating	-	-	-	✓	✓	✓	✓
Gentle feeding of parts	-	-	-	✓	✓	✓	✓
For shank diameter up to 2 mm	✓	-	-	-	-	-	-
For shank diameter up to 6 mm	-	✓	✓	✓	✓	✓	-
For shank diameter up to 12 mm	-	-	✓	-	✓	✓	✓
For shank diameter up to 14 mm	-	-	✓	-	✓	✓	✓
For shank diameter up to 16 mm	-	-	✓	-	-	-	✓
For shank length up to 22 mm	✓	✓	✓	✓	✓	✓	✓
For shank length up to 42 mm	-	✓	✓	✓	✓	✓	✓
For shank length up to 48 mm	-	✓	✓	-	✓	✓	✓
For shank length up to 70 mm	-	-	✓	-	✓	✓	✓
For shank length up to 160 mm	-	-	-	-	-	-	✓
For head diameter up to 4 mm	✓	✓	-	✓	-	-	-
For head diameter up to 12,5 mm	-	✓	✓	✓	✓	✓	✓
For head diameter up to 20 mm	-	-	✓	-	✓	✓	✓
For head diameter up to 24 mm	-	-	✓	-	-	-	✓
For head diameter up to 32 mm	-	-	-	-	-	-	✓
Fill volume / weight	0,3 l / 1,2 kg	1,2 l / 5 kg	3,8 l / 17 kg	1,2 l / 4 kg	3,0 l / 12 kg	15 l / 100 kg	



Technical data

Series	ZEB120	ZEB240	ZEB360
A Width [mm]	480 497 w. SDH*	480 497 w. SDH*	640 650 w. SDH*
B Depth [mm]	340 353 w. SDH*	340 353 w. SDH*	536 547 w. SDH*
C Height [mm]	456 463 w. SDH*	456 463 w. SDH*	602 607 w. SDH*
Weight [kg]	25 w. SDH*	29 w. SDH*	50 w. SDH*
Fill volume [ltr]	0,3	1,2	3,8
Fill weight [kg]	1,2	5,0	17,0
D Height to bowl [mm]	290	300	360
E Height to FSK** [mm]	305	382	440

*SDH = sound enclosure cover, **FSK = feeder level control

Technical changes reserved.

Features

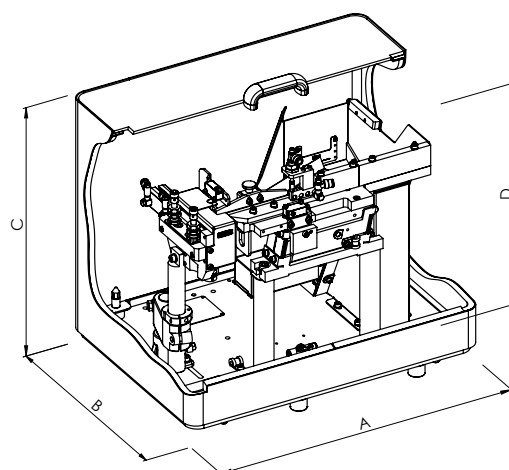
- ◆ Ideal for long screws, thin washers, head-heavy screws
- ◆ Universally applicable for fasteners of all types
- ◆ Vibratory technique for sorting and feeding fasteners
- ◆ Abrasion-resistant material for durable operations
- ◆ High output volume (cycle time up to 0.8 s)

Series	ZEB120	ZEB240	ZEB360
Screws			
Head-Ø [mm]	2,0 - 4,0	2,5 - 12,5	6,0 - 24,0
Thread	M1 - M2	M2 - M6	M4 - M14
Total length [mm]	≤ 22	≤ 48	≤ 73
Nuts			
Across corner [mm]	-	≤ 12,5	≤ 20
Thread	-	≤ M8	≤ M10
Height [mm]	-	≤ 9,5	≤ 9,5
Pin			
Pin-Ø [mm]	-	≤ 8	≤ 16
Length [mm]	-	≤ 50	≤ 80



Features

- ◆ Suitable for coated and sensitive parts
- ◆ Low particulate generation for a high level of technical cleanliness
- ◆ Low vibration exit track for low noise level
- ◆ Hopper - stainless steel
(Lift - hardened steel or PE)
- ◆ High process stability
- ◆ High output volume (cycle time up to 0.8 s)
- ◆ Configurable for Pick & Place applications with escapement TPP



Technical data






Series	ZEL240	ZEL360	ZEL480
A Width [mm]	480 497 w. SDH*	640 650 w. SDH*	1296 w. SDH*
B Depth [mm]	340	536	1000
C Height [mm]	456 w. SDH*	602 w. SDH*	1141 w. SDH*
Weight [kg]	approx. 60 w. SDH*	approx. 85 w. SDH*	approx. 350 w. SDH*
Fill volume [litr]	1,2	3,0	15,0
Fill weight [kg]	4,0	12,0	approx. 100,0
D Height to hopper [mm]	397	437	1033

*SDH = sound enclosure cover

Technical changes reserved.

Series	ZEL240	ZEL360	ZEL480
Screws			
Head-Ø [mm]	2,5 - 12,5	6,0 - 20,0	12,0 - 32,0
Thread	M2 - M6	M4 - M12	M6 - M16
Total length [mm]	≤ 42	≤ 73	≤ 160
Nuts			
Across corner [mm]	≤ 12,5	≤ 20	≤ 32,0
Thread	≤ M8	≤ M10	≤ M16
Height [mm]	≤ 9,5	≤ 9,5	≤ 20,0
Pins			
Pin-Ø [mm]	≤ 8	≤ 14	≤ 24,0
Length [mm]	≤ 48	≤ 73	≤ 160

Accessories

Optional accessories	ZEB	ZEL	
	Sound enclosure cover w/o hopper opening	✓	✓
	Basic frame	✓	✓
	Hopper frame only w. basic frame	✓	✓
	Feeder level control ZEL	-	✓
	Feeder level control ZEB	✓	-

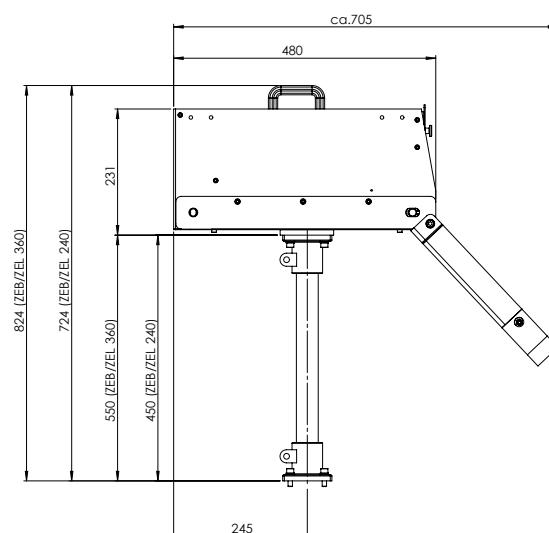


Accessories

Belt driven refill hopper

Features

- ◆ Bulk part storage
- ◆ Longer refill autonomy (for operators)
- ◆ Folding top cover (optional)
- ◆ 24V drive for global application
- ◆ Compact design
- ◆ Adjustable output
- ◆ Option: level sensor
- ◆ Option: lockable



Dimensions and technical data may differ depending on the configuration. Image shows BB08.

Technical data

Series	BB04	BB08	BB18
Length [mm]	380	480	580
Width [mm]	193	223	273
Height [mm]	201	231	251
Fill volume [ltr]	4	8	18
Max. fill weight [kg]	10	20	45

Technical changes reserved.

05 Control Systems



The controllers that are integrated in our automated screwdriving systems, are basically divided into screwdriving and process control systems. The screwdriving process controller monitors and controls the actual screwdriving process – it ensures that the preset speed, torque and depth are being maintained. In particular, the

controller is important in evaluating the process and documentation of all screwdriving data. Process controllers are responsible for the control of the entire system. For example, they control the stroke movement of the screwdriving spindle, the feeding of fasteners or the communication with peripheral devices.



All common field bus systems



Process evaluation and documentation of screwdriving/result data



Ensure optimum coordination of the WEBER components



Easy parameterisation

Overview of control systems

Process controller (1/2)

Features	C5S	C30S	C50S
General information			
ESD-compliant	✓	option	option
Remote maintenance via PC	via USB	via USB	via TCP/IP
Display, parameterisation und Visualisation			
Integrated touch display	-	✓	-
Integrated status leds	✓	-	-
External touch display	-	option	option
Operation and parameterisation via Windows PC	✓	-	✓
Screwdriving programs			
Torque measurement (directly by transducer)	-	✓	✓
Torque measurement (indirectly by motor power)	✓	✓	-
Number of storable screwdriving programs	15	31	255
User definable program levels	7 strategies	13 strategies	25 strategies
User definable application of the program steps (finding, screwdriving, seating, NIO treatment, etc.)	-	-	✓
Gradient screwdriving method (torque and depth)	-	-	✓
Relative torque	-	✓	✓
M360° process	-	-	✓
Results user definable from the program steps	-	- (fixed)	✓ (flexible)
Number of result values	-	4	5
Forming or pre-torque output	-	✓	✓
Digital depth sensor	✓	✓	✓
Connection additional analog depth sensor	✓	✓	✓
Redundant measurement acc. to VDI 2862, Cat. A	-	option	option
Set parameters via customer interface	-	option	option
Automatic release	w/o overrun time	incl. overrun time	incl. overrun time
Hardware connections			
Ethernet RJ45	-	option	✓
USB Master (for USB-Stick)	-	✓	-
USB Slave (for PC)	✓	✓	-
Interfaces for customer control			
Digital I/O	✓	✓	option
Digital I/O via RS232	-	option	-
Field bus interfaces	-	option	option
Curve recording			
Visualisation / Display of the screwdriving curves on the device	-	✓	✓
Curve memory in the controller	last result only	last result only	1000

Overview of control systems

Process controller (2/2)

Features	C5S	C30S	C50S
Statistics			
Logbook	-	✓	✓
Limit values	-	-	✓
Sigma values	-	-	✓
Results	-	✓	✓
Optional documentation possibilities			✓
On external system	-	-	option
Results (numeric values, part ID)	-	✓	✓
Process parameters	-	✓	✓
Curves	-	✓	✓
Via MySQL data base	-	✓	✓

Sequence controller

Features	C10S	C15S	CU30
General information			
ESD-compliant	-	-	✓
Possible remote maintenance via PC	-	-	✓
Emergency stop can be integrated by customer	✓	✓	✓
Integrated display	✓	✓	✓
Integrated feeder vibration control	✓	✓	✓
Pneumatics integrated	-	-	✓
Hardware connections			
USB Slave (for PC)	-	-	✓
RJ45 for field bus	-	-	option
Digital interface to C30S / C50S	-	-	option
Interfaces for customer control			
Digital I/O	✓	✓	✓
Field bus interfaces	-	-	option
Communication to WEBER screwdriving control	-	-	option

Models C10S and C15S can be easily integrated with feeding systems.

The CU30 is a high-quality sequence control with integrated pneumatics and PLC, which combines extensive functions and many options in a compact device.

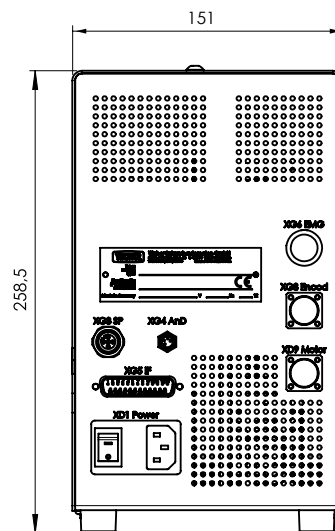
Technical changes reserved.



Process controller for simple screwdriving tasks

Features

- ◆ Easy configuration and testing via PC software
- ◆ Compatible with all WEBER fixtured screwdrivers, as well as handheld screwdrivers type HET, HSE
- ◆ Intuitive software with configurable programs and definable current consumption torque
- ◆ Extensive diagnostic and monitoring options of the spindle and interface



Technical data

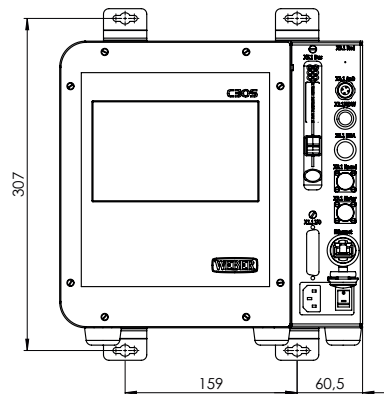
Supply	230 V, Type: IEC connection with L, N, PE, 230 V \pm 10% / 50 – 60 Hz
E-safety class	Safety class 1 (L, N, PE)
Drives	100 / 400 / 750 Watt
Processes	7 different process cycles
Programs	15 programs based on an individually parameterized process sequence
Customer interface	Digital I/O
Inputs	Automatic, program no., start, confirm error
Outputs	No error, ready to start, OK, NOK, depth reached
Weight	7,8 kg
Dimensions	266 / 152 / 332 mm (H / W / D, without plug)
Safety class	IP30

Technical changes reserved.

C30S



Process controller for complex screwdriving tasks



Features

- ◆ Integrated system software for configuration and control
- ◆ Compatible with all WEBER fixtured screwdrivers, as well as handheld screwdrivers type HET, HSE
- ◆ Integrated touch display for easy use and configuration
- ◆ Supports transducers for precise torque and angle measurement
- ◆ MySQL database connection optionally possible for extensive documentation
- ◆ Communication customer interface via field bus module
- ◆ Writing and reading of process parameters possible via optional interface

Technical data

Supply	Standard 230 V, Type: IEC connection with L, N, PE, 230 V \pm 10% / 50 – 60 Hz Option 115 V, Type: IEC connection with L, N, PE, 115 V \pm 10% / 50 – 60 Hz
E-safety class	Safety class 1 (L, N, PE)
Drives	100 / 400 / 750 Watt
Processes	13 different process cycles
Programs	31 programs based on an individually parameterized process sequence
Interfaces	Digital I/O, RS232, PROFIBUS, PROFINET, DeviceNet, EtherCAT, EtherNet/IP
Weight	7,8 kg
Dimensions	280 / 255 / 280 mm (W / D / H, without plug)
Safety class	IP30

Technical changes reserved.

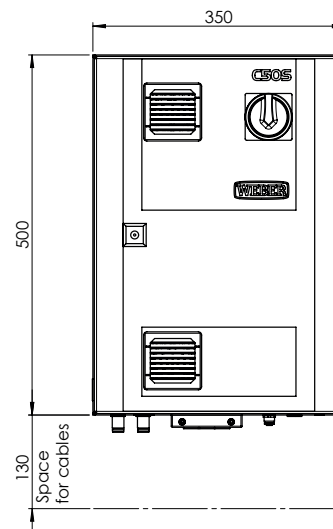
C50S



Process controller for high complex screwdriving tasks

Features

- ◆ Individual process flow with latest processes configurable
- ◆ Gradient screwdriving method (moment, depth), relative moment as well as M360° method
- ◆ Individual export of parameters and results
- ◆ MySQL database connection optionally possible for extensive documentation
- ◆ Communication customer interface via field bus module
- ◆ High IT security standard, interface monitoring and diagnostic functions
- ◆ Writing and reading of process parameters possible via optional interface



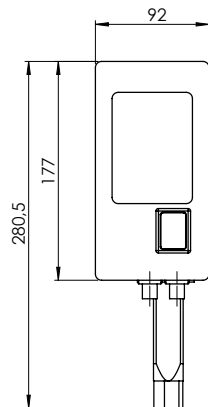
Technical data

Supply	Standard 230 V, Type: IEC connection with L, N, PE, 230 V \pm 10% / 50 – 60 Hz
E-Safety class	Safety class 1 (L, N, PE)
Drives	100 / 400 / 750 Watt
Programs	255 programs with up to 25 individual process steps
Interfaces	Digital I/O, RS232, PROFIBUS, PROFINET, DeviceNET, EthernetCAT, EtherNet/IP
Weight	20 kg
Dimensions	350 / 250 / 500 mm (W / D / H, without plug)
Safety class	IP54

Technical changes reserved.

C10S | C15S

Sequence controller



General features

- ◆ Integrated feeder vibration control
- ◆ LCD display with text display and password protection

Features C10S

- ◆ Compatible with ZEB feeder and handheld screwdriver type HSP

Features C15S

- ◆ Compatible with ZEB / ZEL feeders and handheld screwdrivers type HET / HSE
- ◆ Customer interface with inputs and outputs
- ◆ Depth shut-off and torque shut-off
- ◆ Optional emergency stop & screw presence

Technical data

Feeder vibration control	Frequency and amplitude adjustable
Supply	230 V, Type: IEC connection with L, N, PE, 230 V \pm 10% / 50 – 60 Hz
Supply (optional)	115 V Type: connection with L, N, PE, 115 V \pm 10% / 50 – 60 Hz
Power input	< 115 Watt
E-safety class	Safety class 1 (L, N, PE)
Weight	2,8 kg
Dimensions	178 / 92 / 192 mm (H / W / D, without plug)
Safety class	IP30

Technical changes reserved..

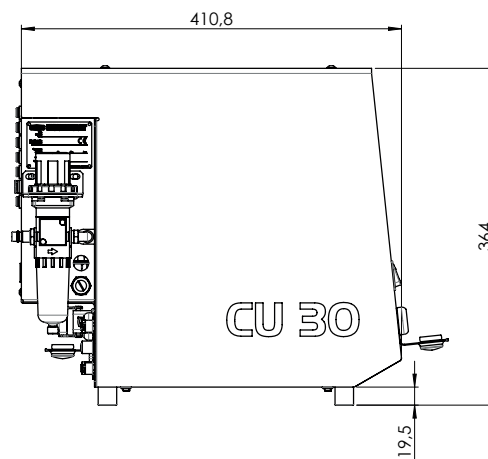
CU30

Sequence controller



Features

- ◆ Compact sequence controller with integrated pneumatics and PLC
- ◆ Compatible with all WEBER feeding systems as well as handheld and fixtured screwdrivers
- ◆ Optional integrated proportional valve for HSE handheld screwdriver
- ◆ Integrated touch display and software for configuration and management



Technical data

Supply	100-230 V, Type: IEC connection with L, N, PE, 230 V \pm 10% / 50 – 60 Hz
E-safety class	Safety class 1 (L, N, PE)
Power input	Average 40 Watt
Weight	13,5 kg
Compressed air supply	6 bar / 0,6 MPa
Dimensions	364 / 226 / 287 mm (H / W / D, without plug)
Safety class	IP30

Technical changes reserved

Accessories

Transducer



Features

- ◆ Torque and angle recording in one transducer
- ◆ Integrated measurement amplifier
- ◆ Evaluation of the transmitted signals by the screwdriving controller
- ◆ Non-contact transmission of torque from the shaft to the housing
- ◆ Measurement of the angle of rotation via encoding disc and light barrier
- ◆ Can also be used redundantly for category A fittings according to VDI / VDE 2862
- ◆ Cable connections upwards or downwards facing

Technical data

Model	MDW03		MDW10	MDW30		MDW60	MDW120
Measurement range [Nm]	0,1 - 1	0,3 - 3	1 - 10	1,5 - 15	3 - 30	6 - 60	12 - 120
Accuracy class	0,15 %						
Repeatability	0,05 %						
Usable torque	130 %						
Limit torque	200 %						
Handling temperature range [°C]	+10 ... +55						
Control actuation	off <2V, on >3,5 V						
Angle of rotation	2 tracks, 360 pulses						
Angular resolution	0,5°						
Max. rotation speed [rpm]	5.000						
Safety class when installed	IP 54						

Technical changes reserved.



Accessories

M30

Features

- ◆ Applicable for both active and passive sensors + screw joint simulator as well as MDW dynamic transducer or rotating transducer
- ◆ Small size and weight as well as battery operation make it very good for mobile use
- ◆ 10 sets of parameters (calibration) can be stored for different sensors
- ◆ Data logger for up to 600 measurement values with time and date stamp
- ◆ High resolution at 1/1000th of a second
- ◆ Trigger input for external control
- ◆ Battery powered (4 x AA) or with optional AC adapter
- ◆ USB and RS-232 interface for data transfer or print outs



Technical data

Model	M30
Dimensions (L x W x H) [mm]	40 x 100 x 200
Weight without cable and batteries [g]	330
Handling temperature range [°C]	+5 bis +45
Safety class	IP 40

Technical changes reserved.

Torque accuracy of screwdriving systems for automatic feeding

The appropriate drive for every screwdriving task

Pneumatic drive



- ◆ Repetition accuracy
 - ± 15 % for $cmk \geq 1,67$ (10-30 %)*
 - ± 15 % for $cmk \geq 2$ (30-100 %)*

Standard deviation ± 3 %

EC drive with current torque



- ◆ Process controller: C5S / C30S
- ◆ Repetition accuracy
 - ± 15 % for $cmk \geq 1,67$ (10-30 %)*
 - ± 15 % for $cmk \geq 2$ (30-100 %)*

Standard deviation ± 3 %

* Percentage value refers to the max. possible torque range of the system: e.g. MDW10 from 1-10 Nm.

EC drive
with reaction transducer MDG



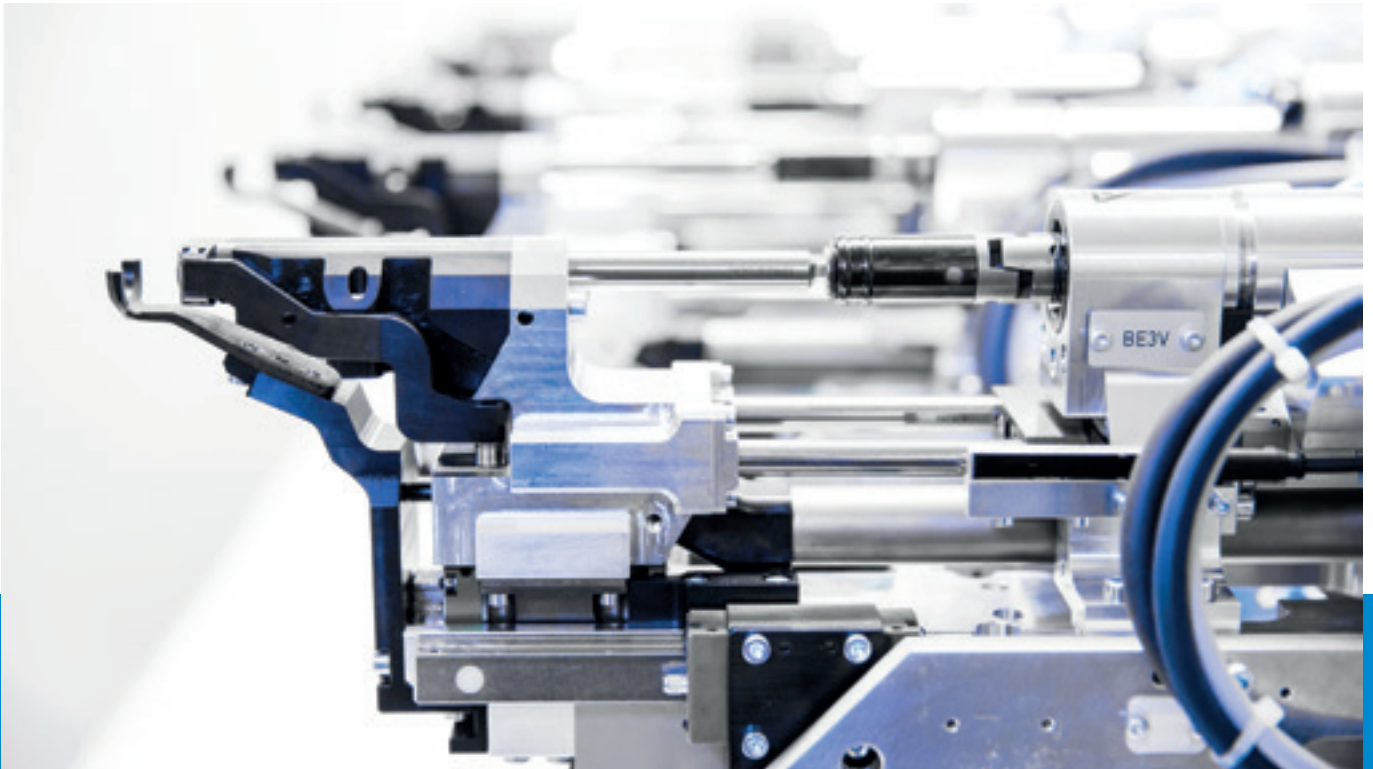
- ◆ Process controller: C30S / C50S
 - ◆ EC servo drive with integrated reaction transducer MDG ($> 0,5 \text{ Nm}$)
 - ◆ Repetition accuracy
 - $\pm 10 \%$ for $\text{cmk} \geq 1,67$ (10-30 %)*
 - $\pm 10 \%$ for $\text{cmk} \geq 2$ (30-100 %)*
- Standard deviation $\pm 2 \%$

EC drive
with transducer MDW



- ◆ Process controller: C30S / C50S
 - ◆ EC servo drive with transducer and angle measurement MDW
 - ◆ Repetition accuracy
 - $\pm 7 \%$ for $\text{cmk} \geq 1,67$ (10-30 %)*
 - $\pm 7 \%$ for $\text{cmk} \geq 2$ (30-100 %)*
- Standard deviation $\pm 1,4 \%$

06 Systems



As we all know, the whole is more than the sum of its parts. In the same way, WEBER screwdriving systems grow with the requirements that our customers have for automated assembly processes. Fixtured screwdriving systems are used when joining processes become more complex, cycle times become shorter and quality requirements become higher. The variably configurable

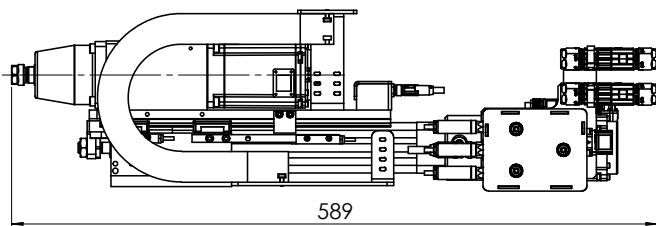
fixtured screwdriving spindle from WEBER adapt to all screwdriving applications: Whether mouthpiece, stroke lengths, sensors or drive technology – WEBER Screwdriving Systems offers customized solutions for all applications and screwdriving processes. Retooling on the screwdriving units is made easy by the screwdriving head assembly which can be changed without tools.



Setting system for sandwich structures

Features

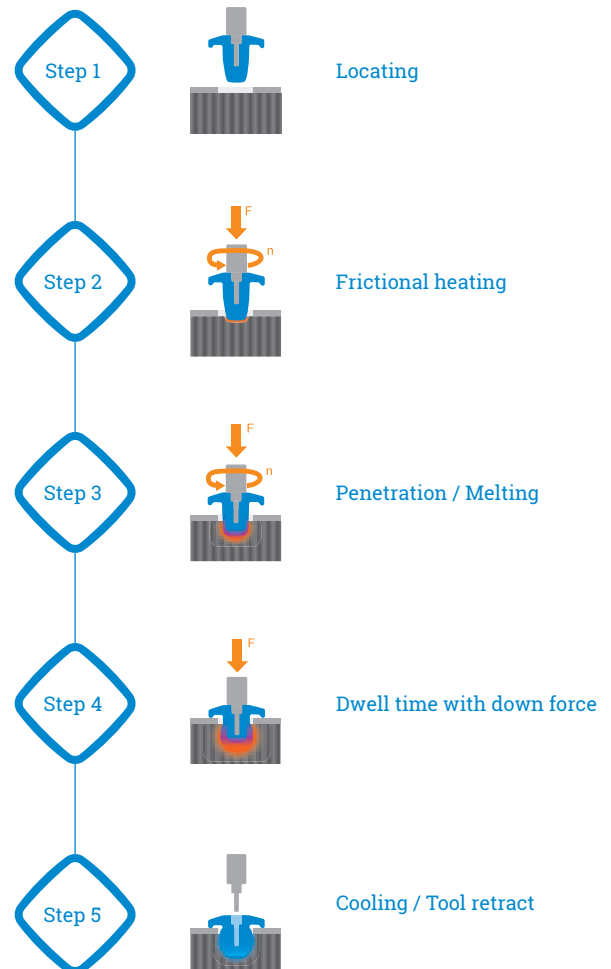
- ◆ The installation of plastic bosses in lightweight materials is possible with or without pre-hole
- ◆ User defined process parameters with monitoring and evaluation
- ◆ Feasibility study and evaluation of completed joints at the WEBER laboratory
- ◆ High resolution process results
- ◆ For tasks with accessibility from one side only
- ◆ Plastic bosses as fastening element or as usable fastening point for self-tapping screws



Technical data

Compact spindle design [mm] H x D x W	630 x 185 x 165
Spindle weight [kg]	approx. 13
EC drive [rpm]	up to 5.000
Max. axial force [N]	1.400
Cycle time (w/o cooling) [s]	from 3

Technical changes reserved.





Robot-assisted screwdriving system

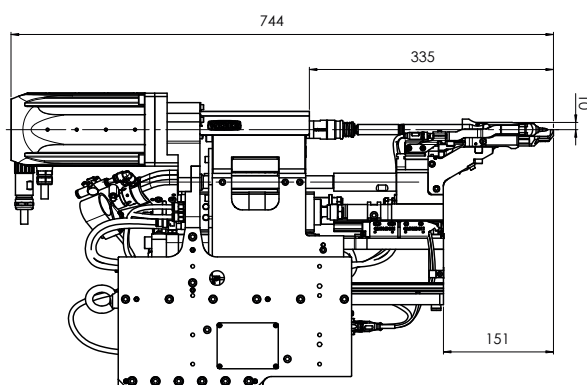
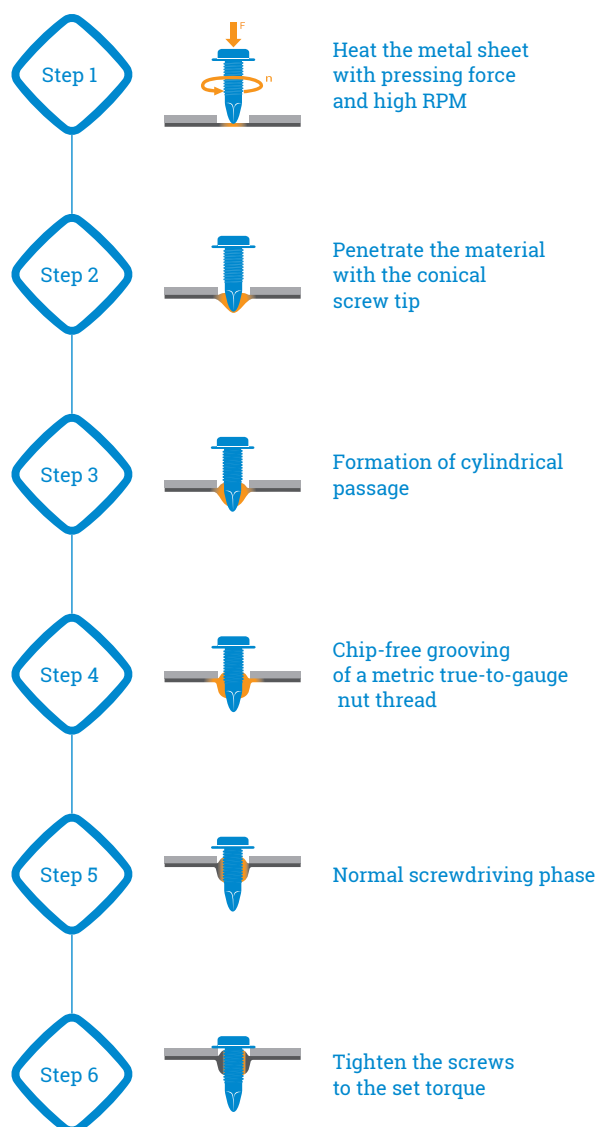


Flowdrilling Technology

- ◆ One-sided accessibility
- ◆ For assembling different materials with varying thicknesses
- ◆ Low heat joint forming
- ◆ High loosening torque and excellent vibration resistance

WEBER RSF Flow Drilling Joining System

- ◆ Active jaws to prevent screw tilting
- ◆ Manual quick tool change
- ◆ Modular spindle design



Dimensions and technical data may differ depending on the configuration. Image shows RSF25 in straight version.

Technical data

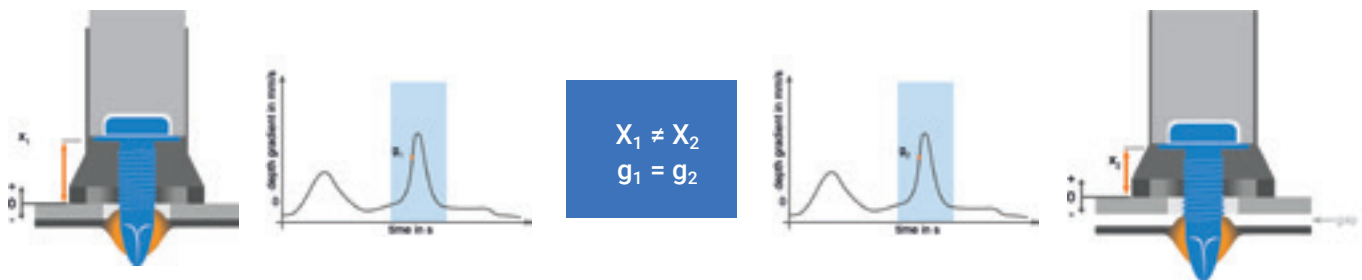
Torque [Nm]	up to 15
EC drive [rpm]	up to 8.000
Max. axial force (at 6 bar) [N]	up to 3.600
Holding down force (at 6 bar) [N]	up to 1.400
Cycle time [s]	from 1,6

Technical changes reserved.

Patented WEBER depth gradient

The right combination of strength and speed is the decisive factor for flow drilling joining technology: while high forces and speeds are essential for flow drilling, very little force is required during thread forming work since the thread pitch of the screw will determine the speed of penetration.

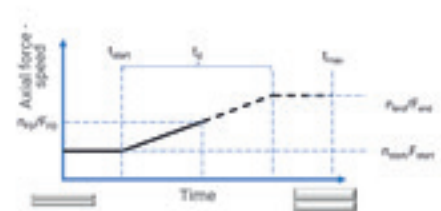
The patented WEBER depth gradient identifies changes in depth while the screw is breaking through the material and therefore always switches between these two processing steps at the optimum moment.



Patented WEBER Boost function

Fluctuations in material strength and thickness can cause situations where the sets of parameters specified in the laboratory do not perform optimally in practice. To date, any recalibration work required has been a very time-consuming

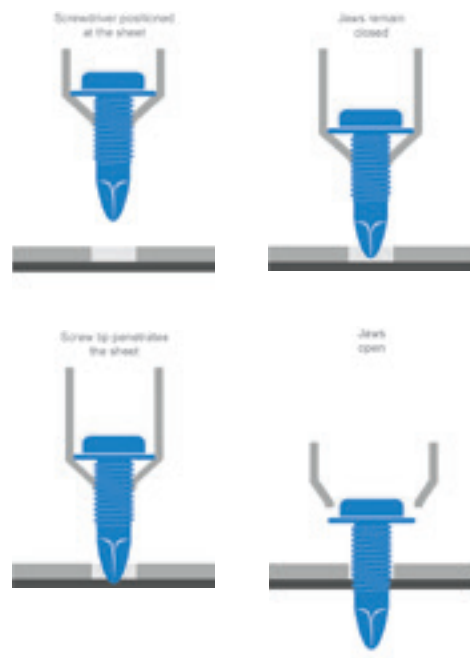
process that regularly needs to be adjusted to the ongoing production situation. To solve this problem, WEBER uses the new boost feature offered by the RSF25. This increases both axial force and speed automatically until the depth gradient is achieved.



Automatic pre-punch compensation

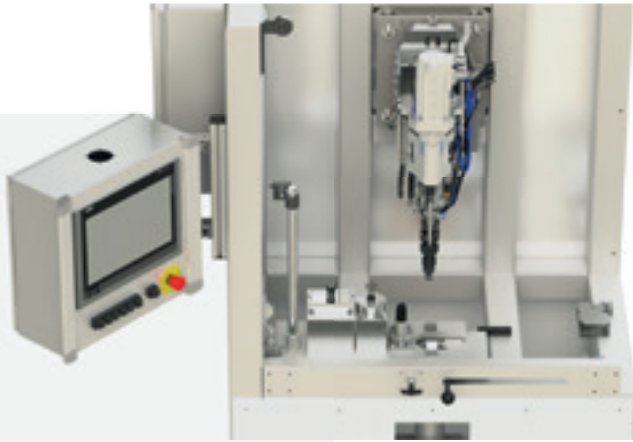
The screw is guided by the jaws right up to the point at which the screw tip and shank have penetrated the material. The jaws are opened and the screwdriving process can begin.

- ◆ Simplified spare parts management through standardized variants
- ◆ Increase process reliability
- ◆ Reduced NOK rate
- ◆ Reduced abrasion



Accessories RSF25

System for function testing



Features

- ◆ Defined, repeatable test sequence
- ◆ Direct OK/NOK evaluation
- ◆ Automated output of a detailed test report
- ◆ Different test scenarios can be selected



Testing the feeder and spindle in a continuous cycle

The components and processes of feeding screws to the spindle are tested for correct functioning. Depending on customer requirements, up to 500 elements can be run in one test cycle.



Torque test with CMK evaluation

For the tightening/torque testing, the functional capability of the sensor installed in the spindle is checked and verified with a measurement. The CMK values of the system are evaluated automatically.



Force measurement of strokes

First, the axial force of the screwdriver on the spindle is tested. In the second step, the force with which the downholder presses the screwdriving spindle onto the part before the fastener touches the part surface is recorded.



Screwdrivings and torque test

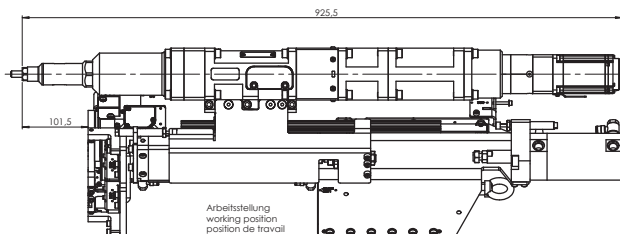
The test screwdrivings examine a complete process with feeding, screwdriving and reloading. After the last screwdriving process, the test cycle is completed with a torque test to verify the maximum rotational speed.



Inserting system for blind rivet nuts and bolts

Features

- Precise pre-alignment of hexagonal elements to the workpiece
- Suitable for fixtured or robotic applications with optional docking function
- Automatic removal and ejection of defective blind rivet nuts, or in the event of structural component faults
- Process monitoring with motor encoder and latest displacement & force sensor technology
- Standard with quick-change system for DIN mandrel or optional automatic mandrel changeover function
- Applicable in all working directions even if only accessible from one side



Dimensions and technical data may differ depending on the configuration..

Technical data

Inserting force [kN]	up to max. 25 (continuous operation)
Inserting stroke [mm]	up to max. 15
Standard head stroke [mm]	approx. 100
Weight [kg]	approx. 50
Processable sizes	M4 - M10 (blind rivet nuts) M5 - M8 (Blind rivet bolts)
Processable shapes	Round and hexagonal head, other shapes on request

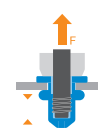
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Threading and positioning of the blind rivet nut



Insertion into the component



The mandrel is retracted to collapse (or "set") the insert



The mandrel is then counter-rotated, leaving the insert securely connected to the sheet



TECHNOLOGY THAT CONNECTS

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