SCHULER
Member of the ANDRITZ GROUP

Darstellung ist nur ein Beispiel und nicht verbindlich

KUNDE	*VDL Nedcar bv*
WERK	*für Werk Born, Niederlande*
ANFRAGE Nr.	*###*
SCHULER ANGEBOTSNUMMER	*28369*
DATUM	*Rev: 5 – 3. Juni 2020*
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BUDGETANGEBOT

– TECHNISCHER TEIL –

Schuler ServoLine Next XL

Kontakt

Ausgearbeitet für:

###Kunde###
###Straße###
###PLZ### ###Ort###
###Land###

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REVISIONEN

Rev. Nr.	Datum	verantwortlich	Änderungen	Kapitel

Vorgenommene Änderungen in den Revisionen werden in **unterschiedlichen Farben** markiert.

Inhaltsverzeichnis

1. Projektbeschreibung

1.1 Anlagenübersicht

Das Angebot, beschrieben mit diesem Dokument, beinhaltet eine Servo Tandem Press Line mit einer maximalen Ausbringung für **Teile aus Stahl von 15 Hüben** pro Minute und **Aluminium von 12 Hüben** pro Minute, **Schuler ServoLine XL.** Das Transfersystem, ein **Schuler Feeder**, ist ein Einzelarmsystem, welches eine platzsparende Konstruktion der gesamten Anlage erlaubt und eine hohe Sicherheit im Teiletransport sicherstellt.

Für eine maximale Ausbringung bieten wir unser Schuler Turn-Key Konzept mit Schuler FOL und EOL System an. Die Pressenverkettung erfolgt durch **Schuler Feeder**. Die Zieheinrichtung wird als energiesparendes und hoch effizientes **Schuler Economic Cushion (SEC)** ausgeführt. Alle eingesetzten Technologien entsprechen der führenden Pressenausrüstung in Genauigkeit und Geschwindigkeit

Die Anlage besteht aus folgenden Maschinenkomponenten:

		SCHULER ServoLine XL Bezeichnung:
1	Platinenlader	**1x Schuler High Speed FOL System**
2	Beladefeeder	**1x Schuler Feeder**
3	Presse 1	**1x Schuler SSL4-2500-4,6x2,5-1100**
	Presse 2	**1x Schuler SSE4-1600-4,6x2,5-1100**
	Presse 3-6	**4x Schuler SSE4-1200-4,6x2,5-1100**
4	Tischkissen Presse 1	**1x Schuler UCH6-600**
5	Pressenverkettung	**5x Schuler Feeder**
6	Entladefeeder	**1x Schuler Feeder**
7	Teileauslauf	**1x Schuler End of Line**

Die **Schuler ServoLine XL** ist mit der nach dem Stand der Technik entsprechenden **Schuler Line Control** ausgerüstet. Diese ermöglicht neben der Optimierung der Stößelbewegung und den damit inbegriffenen Vorteilen für den optimalen Umformprozess und der hohen Ausbringung viele weitere Vorteile.

Wir wären sehr erfreut, Ihnen unsere Konzepte präsentieren und erklären zu dürfen und gemeinsam mit Ihnen die kostenoptimierteste Ausrüstungskonfiguration und Unterstützungspaket zu definieren.

Zweck der Ausrüstung: Pressenanlagen zum Schneiden von Metallen oder zum Umformen von formbaren Metallen sowie zur Zufuhr und zum Abtransport von Roh- und Fertigteilen.

Das Angebot basiert auf Schuler Standards.

Die Ausführung und Dokumentation der Anlage erfolgt nach der Europäischen Maschinenrichtlinie 2006/42/EG in der aktuellen Version. Eine Konformitätserklärung nach der Maschinenrichtlinie wird ausgestellt.

1.2 Funktionshighlights

- **Einricht – Funktion**

  Mit dieser Funktion können die folgenden Einheiten bewegt werden:
  - Nur der Stößel mittels Drucktaster im Hauptbedienpult der Presse, mit oder ohne Last, ab Hubzahl 3/min mit vollem Arbeitsvermögen möglich.
  - Nur der Crossbarfeeder mittels mobilem Touch-Bildschirm oder mittels Drucktaster im Hauptbedienpult der Presse.

- **Smart Stopp – Funktion**
  - Die Anhaltezeit der Presskomponenten hängt von der individuellen Position und der Kollisionsgefahr ab. Wenn möglich fahren die Komponente kontinuierlich bis zur Endposition des Zykluses, ansonsten kompletter Halt.

- **Homing – Funktion**
  - Die Analgenkomponenten fahren automatisch in ihre Startposition nach einem unerwarteten Zyklusstopp durch die Pressen SPS zurück (Voraussetzung ist ein koordinierter Halt)

- **Full SPM Quick Restart - Funktion**
  - Die Pressenlinie startet mit der maximal eingestellten Ausbringungshubzahl (kein Hochlaufen der Anlage wie bei Schwungradlinien nötig).
  - Dauerlauf der Anlage startet automatisch (keine Bestätigung des Bedieners notwendig, Anlage erstellt Voraussetzungen für Dauerlauf automatisch).
  - Die Linienhubzahl kann durch den Bediener während der laufenden Produktion geändert werden, ein Anhalten der Anlage ist nicht notwendig
  - Alle Pressen werden immer in ihrer Position verriegelt, sobald ein Bediener den Werkzeugraum durch die elektrisch abgefragten Zugänge betritt. Die Presse kann sofort nach dem Quittieren des Schutzbereiches wieder anlaufen, da kein Schwungrad mehr anlaufen muss.

- **Energiespar – Funktion (Schuler Eco Form)**
  - Schuler Energiesparkissen (SEC)
  - Regeneratives Bremsen mit Servomotoren und Crossbar Feedern
  - Hauptantriebe mit gemeinsamen Gleichstromzwischenkreis

- **Smart Grid – Funktion**
  - Gemeinsamer DC-Bus für alle Pressen zusammen, um bei Bedarf Energie zwischen den Pressen zu verschieben
  - Energiespeicherung für Linie und Crossbar Feeder

- **Standby – Funktion**
  - Separat programmierbarer Standby der Linienkomponenten
  - Automatischer Neustart nach Pausen oder Wochenende

- **Ziehstifte Test – Funktion**
  - Test der Übereinstimmung der Ziehstifte zur Ausführung des Werkzeugs über einen Testhub

- **Energie Messung (siehe Kapitel Machine Monitoring System)**
  - Inklusive für gesamte Linie (Kühlwasser, Druckluft und Elektrik)

- **IE3 – Komponenten als Standard**
  - Falls verfügbar, sonst IE2

1.3 Anlagendaten

1.3.1 Produktionsdaten

Produktionsleistung Anlage		
Max. Ausbringungsleistung (abhängig von Teileart, Betriebsart, Werkzeug und Material)	1/min	max. 15 (Stahl) max. 12 (Aluminium)
Rohmaterial		siehe Kapitel 1.4
Teilespektrum		Karosserieteile Innen- und Außenhautteile Einzel- und Doppelteile
Platzbedarf Anlage		
Länge (inkl. FOL und EOL System)	mm	siehe Layout
Breite (inkl. Lichtschranken für Fahrtische) ohne Waschmaschine / Beöler (siehe Layout)	mm	siehe Layout
Tiefe (unter Flur)	mm	siehe Layout
Höhe (über Flur)	mm	siehe Layout

1.3.2 Umweltbedingungen

Umgebungstemperatur	°C	+10° bis +40°
Relative Luftfeuchtigkeit		< 50% bei 40°C oder < 90% bei 20°C
Luftverschmutzung		trocken und sauber, kein Staub
Aufstellhöhe über dem Meeresspiegel	m	< 1 000
Bodenebenheit	mm	Rohfußboden ±10 für Aufstellung

1.3.3 Elektrik

Energiebedarf Anlage		
Gesamtanschlussleistung (Durchschnitt bei max. Hubzahl)	kVA	ca. 2860
Betriebsspannung	V	400 V 3 / PE
Netzfrequenz	Hz	50
Steuerspannung allgemein	V	24 VDC

1.3.4 Fluid

Druckluft

Niederdruck erforderlich (nur für Tooling und Werkzeuge)	bar	6,0
• Presse (Produktion) ohne Verbrauch Werkzeuge + Tooling	Nm³/h	kein
• Verbrauch Crossbar Feeder (Tooling)	Nm³/h	abhängig von Teileart ca. 55-60 Ndm³/h pro Sauger max. 16 Sauger/Feeder ca. 900 Ndm³/h pro Feeder (Spitze) Bei regulärer Produktion beträgt der Verbrauch ca. 1/3 des Spitzenverbrauchs
• Verbrauch Werkzeuge + Tooling	Nm³/h	Werkzeuge nach Kundenspezifikation max. 1000 inkl. Tooling gesamte Linie
• Verbrauch Platinenlader	Nm³/h	ca. 400
• Verbrauch EOL	Nm³/h	ca. 150
Hochdruck erforderlich	bar	10 (Kompressor durch Schuler)
• Presse	Nm³/ ADC	Befüllung SGA, im Betrieb nur Ausgleich Leckage
• Verbrauch Werkzeuge	Nm³/h	durch Kunde falls benötigt
• Verbrauch Platinenlader und EOL (nur für Aluminiumplatinen)	Nm³/h	ca. ###
Erforderliche Druckluftqualität		
• Filterfeinheit	µm	< 20
• Entfeuchtung	%	90
Gemäß Druckluftqualitätsstandards:		
• max. Ölgehalt		nach ISO 8573 – 1 Qualitätsklasse 2
• max. Reststaubgehalt		nach ISO 8573 – 1 Qualitätsklasse 3

• max. Restwassergehalt		nach ISO 8573 – 1 Qualitätsklasse 4

Kühlwasser

Kühlwassermenge für Presse, Hydraulikaggregat und Schmieraggregat; Volumen abhängig von Belastung der Presse und Hubzahl	m³/h	ca. 45
Kühlwassermenge Schaltschränke Pressenantrieb	m³/h	ca. 45
Eingangstemperatur, max.	°C	30
Eingangstemperatur, min.	°C	20
Ausgangstemperatur, max.	°C	35
Druckdifferenz	bar	2,5

Servo-Torque Motoren

Kühlwassermenge	m³/h	ca. 30

- **Definition of the cooling water for the Servo Torque Motors:**

Inlet temperature, minimum (generation of condensate)	°C	20
Inlet temperature, maximum	°C	30
Increase of return temperature approx.	°K	ca. 7
Pressure maximum	bar	7
Filter quality	µm	≤100
Accumulation of mud and algae has to be prevented active.		
Pressure difference required between inlet and return	bar	2,0
p-H value at 20°C	pH	6,5 – 9,5
at a pH value of 8,2 there is no aggressive carbonic acid bounded.		
Water hardness	°dH	5 - 8
Content of sulphate	mg/l	<240

General: Not aggressive against copper.

- Water quality according to VDI 3803

- The Interface from plant to press ist defined in chapter structurel measures.

- **Requirements of the piping for cooling water for the Servo Torque Motors:**

a) Closed systems (hermetically sealed):

The maximum pressure of the system has to be limited to max. 7 bar. No special requirement on the configuration of piping and heat exchanger.

b) Open system with heat exchanger (supplied by customer)

In general the used copper pipe system in the motor can be combined to all other usual pipe materials without problems. Depending on the electrochemical series, less noble metals can lead to oxidation if an electrolyte (solute salts) and oxygen is available. This effect can appear in iron pipes and so it has to be considered during design of inflow and outflow of cooling water that electrochemical corrosion cannot occur in the supply system.

1.4 Material data

- **Material blanks**

FOL: Blank thickness Steel	mm	0.5 – 3.0
FOL: Blank thickness	mm	0.8 – 3.0
FOL: Blank cutting depth	%	max. 10 of blank thickness
FOL: Basic lubrication for blanks	g/m²	max. 2
FOL: Blank weight steel	kg	max. 60 max. 30 per blank with double stack
FOL: Blank shape	-	Rectangular blanks Contoured blanks with cutouts Tailored blanks with minimum dimensions, a rectangular blank serves as the smallest contour

Material

FOL: Steel	-	1.0338 etc. DIN 1623
FOL: Aluminum	-	according to EN 573-1
FOL: Tailored blanks	-	Only steel blanks, no aluminum blanks. Bead direction preferably upwards due to horizontal conveyor transport

- **Stack**

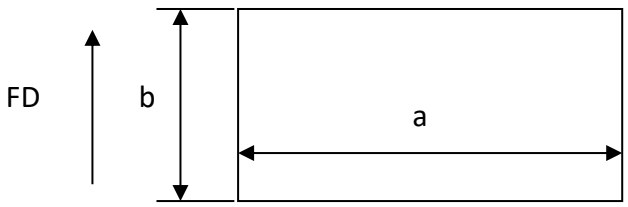
FOL: Position of stack on load cart	mm	± 20
FOL: Stack height on load cart	mm	min. 50 max. 500
FOL: Stack weight	kg	Single stack max. 15.000 Double stack max. 7.500 per stack

- **Reference blank**

A reference blank should be provided by the customer for commissioning of the destacker. The customer is responsible for providing the blanks in sufficient quantity.

- **Single stack**

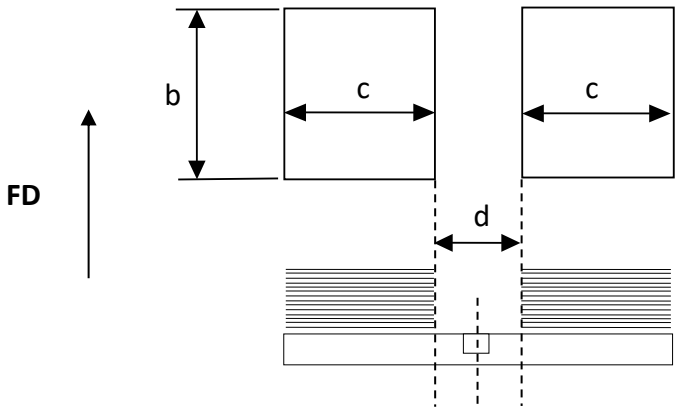
FOL: Blank width across flow direction (FD)	mm	Dim. a = 500 to 4100
FOL: Blank width in flow direction	mm	Dim. b = 350 to 2100



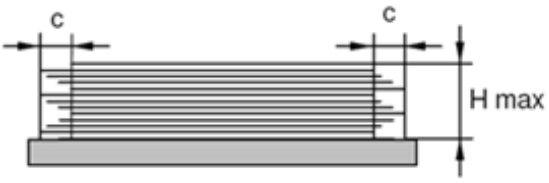
- **Double stack left right**

FOL: Blank width across flow direction	mm	Dim. c = 500 to 1950

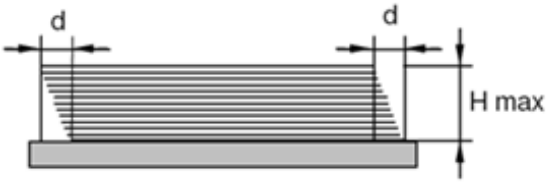
FOL: Blank width in flow direction	mm	Dim. b = 350 to 2100
FOL: Distance between blanks without side locators	mm	Dim. d = 100
FOL: Distance between blanks with side locators	mm	Dim. d = 200
FOL: Maximum width for both blanks	mm	Dim. c + d + c = 4100 max.



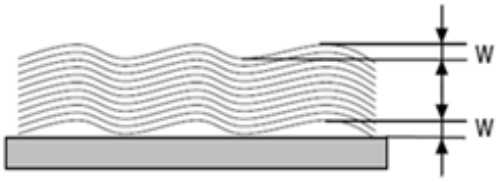
- **Tolerances refer to maximum stack height and maximum blank size**



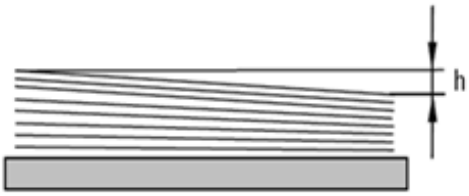
mm c = 5



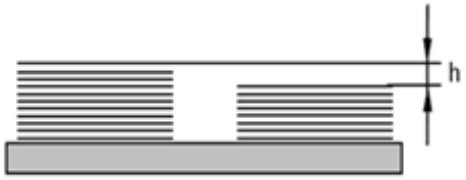
mm d = 5



mm w = 5
Radius min. 200



mm h = 50



		h = 70
	mm	For higher tolerances a separate tooling is necessary

- **Pallets**

  Please hand over the drawing of all pallets in file format PDF and DWG (DWF) or STEP (3D).

FOL: Max. pallet dimensions (length x width x height)	mm	???? x ???? x ????
FOL: Max. weight of one or two pallets with stack(s)	kg	20.000
FOL: Number of holes for centering pin for different sizes of pallets	-	10

1.5 Applied standards and guidelines

- **European Guidelines**

2006/42/EG	European Directive on machinery – Annex I
2014/30/EU	European directive on electromagnetic compatibility

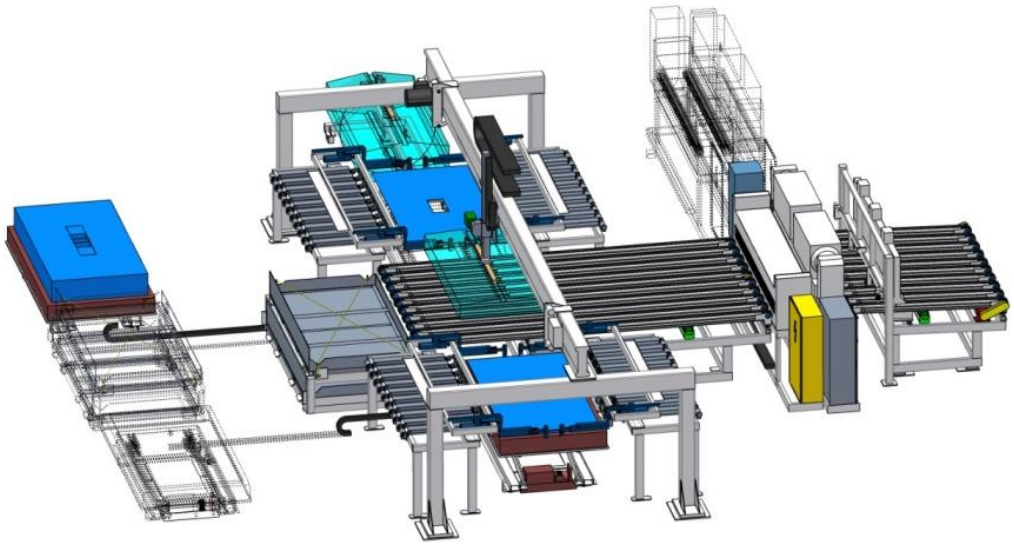
- **European Standards**

EN ISO 12100:2011	Safety of machinery – Risk assessment
EN ISO 16092-1:2019	Machine tools safety- Presses - Part 1: General safety requirements
EN ISO 16092-2:2019	Machine tools safety- Presses - Part 2: Safety requirement for mechanical presses
EN ISO 13849-1:2016	Safety-related parts of control systems

EN 60204-1:2018	Electrical equipment of machines
EN ISO 4413:2010	Hydraulic systems and their components
EN ISO 4414:2010	Pneumatic systems and their components
EN ISO 13850:2015	Emergency stop function
EN ISO 13855:2010	Safeguards
EN ISO 13857:2019	Safety distances to prevent hazard zones being reached.
EN ISO 14118:2018	Prevention of unexpected start-up
EN ISO 14119:2013	Interlocking devices associated with guards
EN ISO 14120:2015	Guards
EN ISO 14122-1,-2,-3,-4:2016	Permanent means of access to machinery
IEC/TR3 61000-5-1:1996	Electromagnetic compatibility

2. Anlagenkomponenten ServoLine 16 XL

2.1 Platinenlader



2.1.1 Load cart with scissor lift table

Loading and unloading of the pallets takes place through drivable load cart.

The integrated scissor lift table enables destacking with a constant height. The pallet is placed on the pallet cart by forklift or crane.


(Reference image)

Design:

- Load cart in welded steel design.
- The load carts are moved in and out by a motor and position measuring system operated automatically. The travel way is safeguarded.

- The production position is set out automatically and electrically monitored.
- Mechanical end stops in the rails for limiting travel path.
- Cable and hose connections via plastic power supply track on floor.
- Load cart with hydraulic scissor lift table and integrated hydraulic unit.
- Detection of last blank by means of 3 light sensors at each load cart, manual adjustable
- **Option**: Load cart with hydraulic split scissor lift table and integrated hydraulic unit. Detection of last blank by means of 2 x 2 light sensors at each load cart, manual adjustable
- **Option**: Last blank detection with optical vision system from the top
- Follow-up cycle control through absolute encoder.
- Pallet centering.

Automatic process:

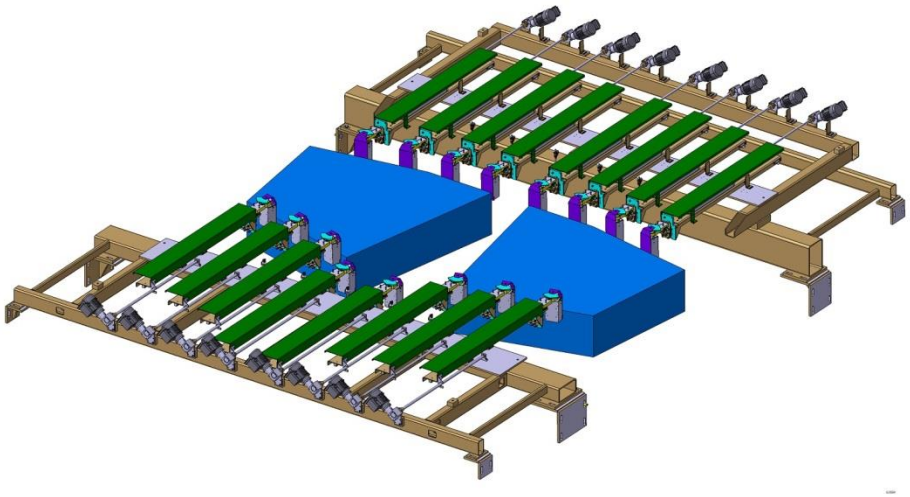
- Optical signal when the stack has been processed.
- Operator acknowledges the safeguarded moving area of the carts.
- Lifting gate is opened, pallet cart moves automatically out of the destacker. Lifting gate closes.
- After pallet un/loading the safeguarded moving area of the carts is acknowledged.
- The pallet cart moves automatically into the destacker.
- If light barriers are interrupted, an emergency stop is triggered in the defined safety circuit.

Technical data:

Number of pallet carts	2
Number of lift tables at each pallet cart	1
Travel distance	see layout

2.1.2 Automatic fanning unit

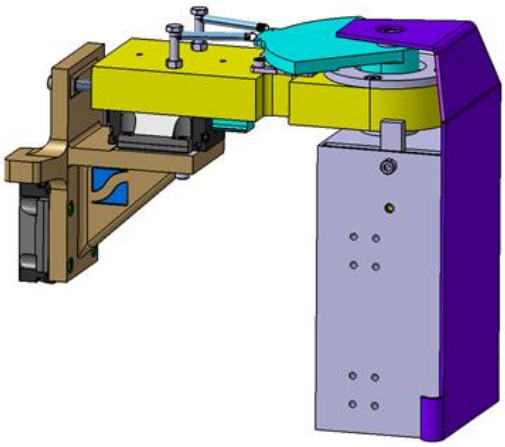
Fanning units for separation of the blanks. Automatic positioning of the magnets to the blank stack by auto touch.



Automatic fanning unit (Reference image)

Design:

- Frame in welded steel design.
- Positioning of fanner magnets through AC gear motor.
- Fanner magnet with horizontal spring system and proximity switch for “stop at stack”.
- Swiveling fanner magnets for positioning on contoured blanks with pneumatic clamping of the pivoting angle.
- Collision monitoring of fanner magnet and scissor lift table, stack or pallet by vertical guidance of the fanner magnets and proximity switch.
- Light barrier for control of the destacking place (recognition of collision risks due to wrong lying blanks).
- Light barrier for recognition of the stack surface.
- Selection of magnets programmable.



Fanner magnet (Reference image)

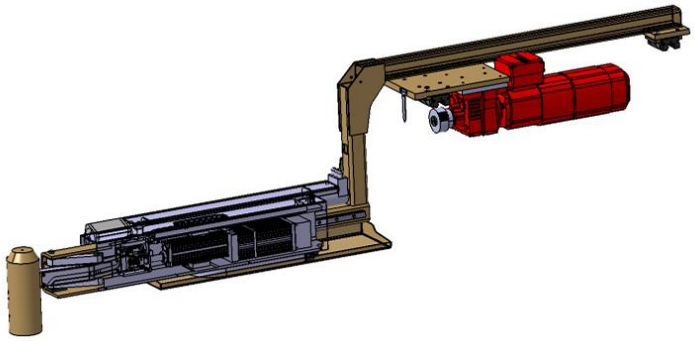
Technical data:

Number of fanner magnet units	2
Number of fanner magnets per unit	16
Maximum pivot angle of fanner magnets	± 45°

2.1.3 Automatically adjustable side locators - 3 axes

In addition to the magnets, the side locators ensure that the blanks keep their position on the stack during the destacking process. Blanks that fall back or loose are positioned within the side locators.

During tooling change the side locators move to position as an adjusting axis. During stack change, the stopper automatically moves to the edge of the stack using three axes. Like that it can also reach contoured blanks with cutouts.



Automatically adjustable side locators (Reference image)

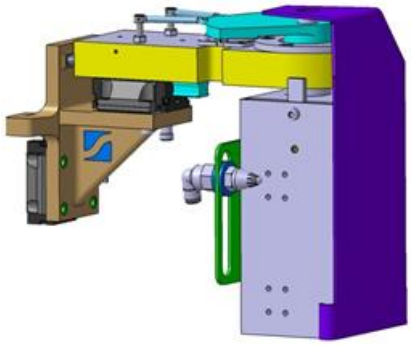
With automatically adjustable side stoppers the stack distance with double stacks is increased to min. 200 mm (centric lane).

The stoppers are mounted vertically on the rail and are equipped with a collision monitoring system.

2.1.4 Destacking of aluminum - Blow nozzles

To separate aluminum stacks, blow nozzles are added on the right and left side of the magnet.

The blow nozzle is automatically activated during the destacking process.



Fanner magnet with blowing nozzles (Reference image)

Design:

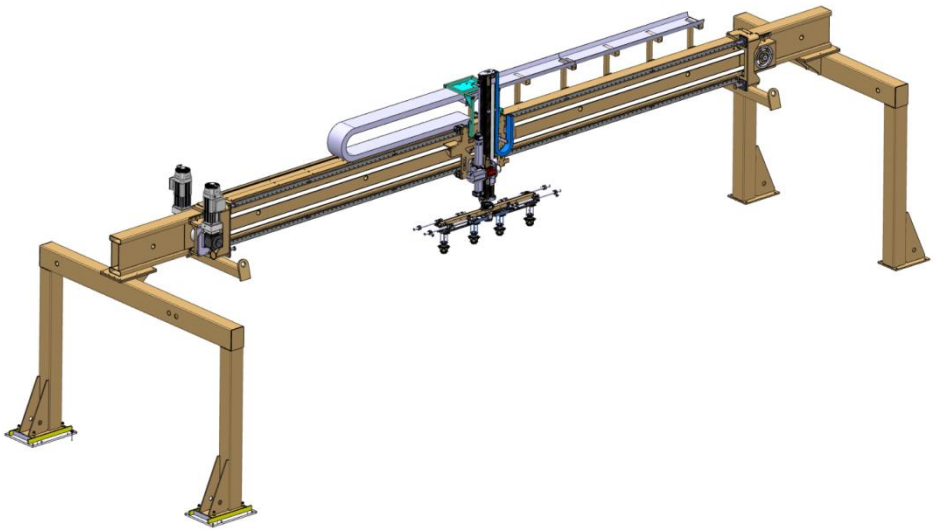
- Blow nozzles mounted on the right and left side on each magnet.
- One pneumatic valve each magnet for controlling the blow nozzles.
- Supply of compressed-air with 10 bar pressure by the customer
- **Option:** Additional high pressure compressor for 10 bar including air dryer

Technical data:

Total number of blow nozzles	64

2.1.5 Destack feeder XL

Two-axis feeder system with horizontal and vertical axis.



Desatck feeder (Reference image)

Design:

- Guide bridge with hardened guideways on carrier portal.
- Horizontal carriage driven by toothed belt and servo motor, planetary gear with reduced backlash. Overrun protection in the form of dead stops.
- Vertical carriage driven by rack and servo motor, planetary gear with reduced backlash. Overrun protection in the form of dead stops.
- Complete electro-pneumatic installation.
- Lubrication of the ball bearing guides using lubricant can.

Specific application:

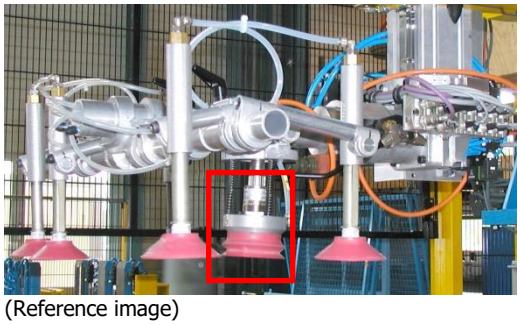
- Fast-acting coupling with integrated power supply for automatic tooling change.
- Basic tooling beam according Schuler design
- Vacuum generation Venturi.
- Option: Vacuum generation by vacuum pump (X-Pump) instead of Venturi at the tooling

Technical data:

Horizontal and vertical stroke	see layout
Number of basic tooling beams	2
Number of valves for vacuum circuits in tooling (Venturi)	2
Option: Number of vacuum pumps (X-Pump) at the feeder	2

2.1.6 Double blank check during destacking

The first double blank detection takes place during destacking. This double blank detection is done by one-sided measurement.



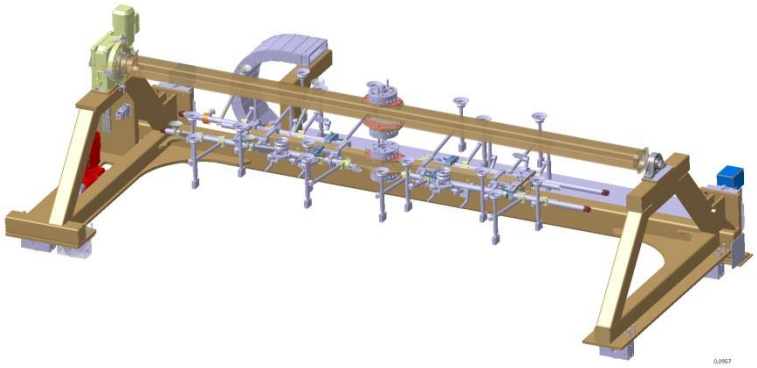
(Reference image)

Technical data:

Number of sensors	2
Number of analyzing units	1
Option: Number of additional analyzing units	1

2.1.7 Automatic tooling change cart for feeder

The tooling change cart enables the automatic change of the feeder tooling.



Automatic tooling change (Reference image)

Design tooling change cart

- Frame in a welded steel design.
- The tooling change cart is moved in and out by a motor and position measuring system operated automatically. The travel way is safeguarded.
- The production position is set out automatically and electrically monitored.
- Mechanical end stops in the rails for limiting travel path.
- Cable and hose connections via plastic power supply track on floor.
- 2 x automatic coupling system for the deposits.
- Two deposit stations with tooling available detection.

Cycle:

- Parallel to production the operator places the tooling for the next part on the cart.
- Turn unit turns 90°, therefore the upper deposit station is available for deposit of the tooling.
- Start of automatic tooling change.
- Safety gate opens.

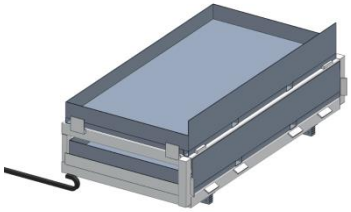
- Tooling change cart moves to tooling change position.
- Feeder places tooling on the deposit station and opens the coupling.
- Turn unit turns 180°.
- Automatic coupling of the new tooling to the feeder.
- Tooling change cart drives to offline position.
- Turn unit turns 270° for unloading of the old tooling.
- Safety gate closes.

2.1.8 Destack feeder tooling

Tooling is not included in the scope of delivery.

2.1.9 Blank deposit station - automatically movable

The first and the last blanks are placed onto the conveyor belt to eject it automatically into the deposit station. The belt then moves the blanks in reverse direction into the blank deposit station. During production the blank deposit station can be moved out automatically and emptied afterwards.



Blank deposit station (Reference image)

Design:

- Frame in a welded steel design.
- The blank deposit cart is moved in and out by a motor and position measuring system operated automatically. The travel way is safeguarded.
- Mechanical end stops in the rails for limiting travel path.
- Cable connections via plastic power supply track on floor.
- Bin centering.
- Control of fill level by counting and with light barriers.

Technical data:

Number of deposit bins	2

2.1.10 Conveyor belt 1

The conveyor belt transports the blanks from the deposit station in direction of the centering station.

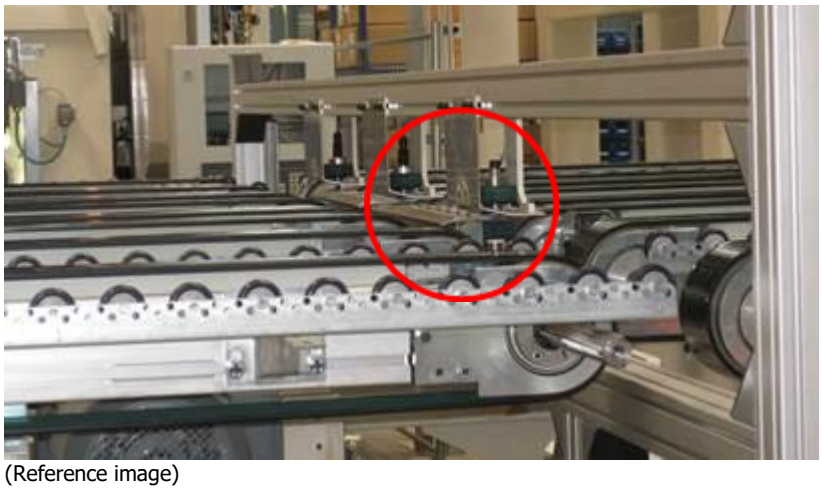
Design:

- Frame in a welded steel design.
- Belt lanes driven together by an electric motor.
- Flexible automatic adjustment of position of every separate belt lane
- Permanent magnets for all belt lines.
- Crash protection for brush cleaner consists of detection of deformed or displaced blanks by means of 2 x horizontal light barriers and 2 x vertical light sensors.
- Conveyor belt is moved automatically in the direction of travel (to bypass the brush cleaner or optional washer that has been moved out).
- Cleaning of the belt lanes by rotating brushes with dirt collection container.
- Option: Cleaning of the belt lanes with vacuum.
- Plastic power feed track on the floor.

Technical data:

Number of belt lanes		8
Belt width	mm	approx. 80

2.1.11 Double blank check in flow



(Reference image)

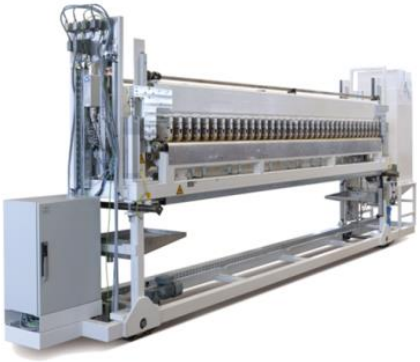
A second double blank check is carried out "in flow" by means of a two-sided sensor. The sensors are automatically adjustable on a separate frame. Double blanks that are detected are disposed of manually in the centering station.

Technical data:

Number of sensors	2
Number of analyzing units	2

2.1.12 Brush cleaner

The Sword brush is suited for the two-sided cleaning of steel and aluminum blanks for vehicle bodywork parts e.g. before they enter the press line. The WANDRES - Ingromat®-process moistens the linear brushes and thus removes even the finest particles from the product surface.



Brush cleaner (Reference image)

Design:

- Linear Brush Unit is mounted on a base frame.
- The brush cleaner is moved in and out by a motor and position measuring system operated automatically. The travel way is safeguarded.
- The production position is set out automatically and electrically monitored.
- Mechanical end stops in the rails for limiting travel path.
- Cable and hose connections via plastic power supply track on floor.
- Tub on floor with a place for 200 l barrel of antistatic cleaning agent Ingromat®.
- Barrel pump for antistatic cleaning agent, barrel provided by customer.
- Option: Supply module for 1000 l container with Ingromat® cleaning agent is placed in the basement.

- Segmented roller pairs before and after the linear brush for a safer transport of the blanks. The lower rollers are fixed and each is driven by a frequency-controlled electric motor. The upper rollers are pressed against the lower rollers by pressure springs.
- Brush cleaning with Wandres Ingromat® technology
- 2 x sword brushes with wiping direction 3: upper and lower brushes wipe simultaneously across direction of travel of the blank.
- Pressure buffer in the sword brush exerts constant wiping pressure onto the surface also on uneven blanks and tailored blanks.
- Manual height adjustment of the lower brushes for commissioning.
- Automatic parallel height adjustment of the upper brushes according product data.
- Scraper at the deviation point so that the dirt is removed from the brushes. Dirt and oil particles that spray off are sucked in by mechanical extraction and captured in the filter unit.
- Extraction consists essentially of an upright housing with mechanical pre-filters (2 units) and one after-filter (F9) and the ventilator.
- Extraction tubes are equipped with a heating that the dry lubricant from aluminum flows out.
- Manual emptying of the waste bin for oily solid residues and dry lubricant, waste bin is located on the base frame.
- Manual emptying of the waste bin for liquid residues, waste bin is located on the base frame.
- WANDRES - Ingromat®- control and filter unit.
- Electrical cabinet is mounted on a base frame.
- Control system is integrated in spraying unit.
- Visualization is integrated in the operation panel of the spraying unit.

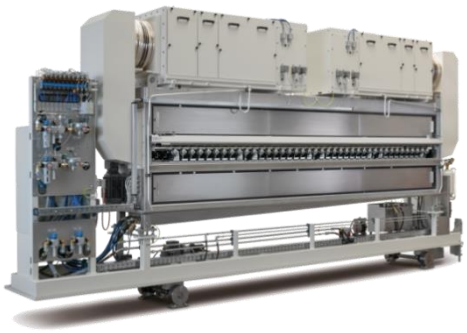
2.1.13 Spraying unit

Strip or partial spraying of forming oil on blanks.

Spraying takes place as the blanks pass through a sealed spraying chamber that only has access slits on the infeed and discharge side.

Each blank type is oiled in accordance with its own specially devised program. Different spraying patterns for top and bottom are possible. Setting up the patterns is user-friendly and is therefore possible with no special programming skills. Transfer of the programmed spraying patterns onto the blanks is position-dependent.

Forming oil sprayed beyond the edges of the blanks is caught in the spraying chamber.

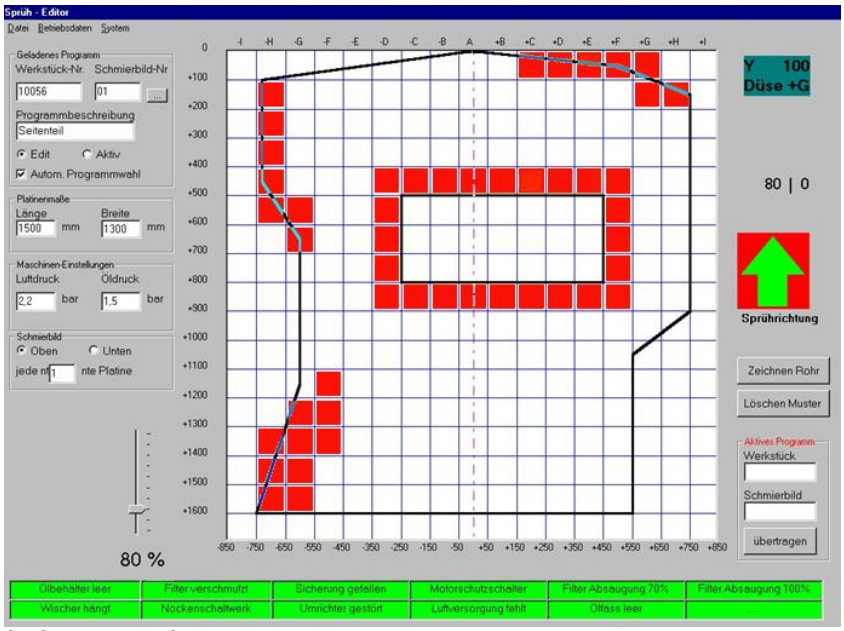


Spraying unit (Reference image)

Design:

- The spraying unit is mounted on a base frame.
- The spraying unit is moved in and out by a motor and position measuring system operated automatically. The travel way is safeguarded.
- The production positions is set out automatically and electrically monitored.
- Mechanical end stops in the rails for limiting travel path.
- Cable and hose connections via plastic power supply track on floor.
- Oil pan on floor with a place for 200 l barrel of forming oil.
- Barrel pump for forming oil, barrel provided by customer.
- Option: Supply module for 1000 l container with forming oil is placed in the basement.
- A buffer for changing the oil barrel during production is integrated in the system.
- Stainless steel chamber with extraction and filtration of the exhaust air.
- An automatic wiper removes drops from the frame.
- A conveying system transports the blanks through the chamber.
- The spray valves are fitted to an upper and lower spraying bar.
- Pressure control on each spray bar.
- Option: Automatic adjustment of compressed air and spray oil pressure for the upper and lower spray bars.
- Oil circulation through all spray nozzles.
- Separate heating elements on each spray bar.
- A vacuum is generated in the spray chamber by a filter system that extracts excess oil spray. This prevents oil spray from escaping.
- Electrical cabinet is mounted on a base frame.
- Stand-alone control system for the spraying unit and brush cleaner.
- Operation panel with visualization for the spraying unit and brush cleaner.

Technical data:		
Number / designation forming oil	-	1 / Please enter!
Forming oil application quantity	g/m²	0.5 - 3
Transport speed max.	m/min	180
Oil supply module		
Number / content type forming oil tank	-	1 / 200 l barrel
Number / content buffer tank	liters	1 / 40
Number / type pump	-	1 / piston pump 5:1, compressed-air actuation
Number / type forming oil filter	-	1 / double filter with mech. and electr. display
Spraying chamber		
Passage width	mm	4200
Spraying programs	-	255
Forming oil and spraying air pressure	bar	0,5 - 3,0
Number of valves /Type of pressure adjustment for forming oil	-	2/ manual
Number of valves /Type of pressure adjustment for spraying air	-	2/ manual
Lubricating of every blank / every nth blank	-	according product data
Forming oil heating	° C	approx. 40 – 45
Rows of spray valves	-	2
Spray nozzles top / bottom	-	41/41
Spraying width / spray valve	mm	approx. 100
Spray field length minimum	mm	approx. 100
Compressed-air supply - pipe diameter	“	1
Compressed-air supply - pressure	bar	5,5



(Reference image)

2.1.14 Conveyor belt 2

Design:

- Frame in a welded steel design.
- Belt lanes driven together by an electric motor.
- Flexible automatic adjustment of position of every separate belt lane
- Permanent magnets and magnets that can be switched off in handover area.
- Area can be bypassed by pivot-mounted belt when spraying unit is moved out.
- Cleaning of the belt lanes by rotating brushes with dirt collection container.
- **Option**: Cleaning of the belt lanes with vacuum.

Technical data:

Number of belt lanes		8
Belt width	mm	approx. 80

2.1.15 Optical centering station

An image processing system with line scan camera is used to center the blanks. The line scan camera takes a photograph while the blank is being transported to the load Crossbar Feeder on the conveyor belt and calculates the deviation from the standard position. Electrical switching magnets are used in the area of centering.

(Reference image)

Design:

- Frame construction for mounting the camera.
- Lighting unit.
- Image processing system with high-performance computer in control cabinet.
- High-resolution CCD camera in industrial design.
- User interface in Windows.
- Interface software from image processing system to PLC.
- Model and test parameter management.

Technical data:

Image processing system		2-D
Centering accuracy (target/actual)	mm	± 3
Position adjustment in direction of travel	mm	max.± 100
Position adjustment at right angles to direction of travel	mm	max. ± 100
ω rotation	°	within field of view max. ± 15
Field of view	mm	max. blank dimension + 200

Advantages:

- This system has the following advantages compared to mechanical centering:
- Full flexibility irrespective of blank shape.
- No scratching of the blank surface.
- No damage to the blanks caused by pushers.
- No relative movement of the blanks on the conveyor belts. Service life of the belts is significantly higher compared to mechanical centering.
- High reliability.
- Low maintenance costs.

2.1.16 Safety protection and sound protection equipment destacker

The following safety devices are supplied:

- Safety enclosure with sound protection according layout.
- Automatic gates in the sound protection where the pallet carts move out.
- Automatic gate in the sound protection where the blank deposit station moves out.
- The travel way of the pallet carts and blank deposit station is safeguarded by means of a light barrier and safety fences.
- Automatic roller gates in the sound protection where the cleaning unit and spraying unit move out.
- The travel way of the cleaning unit and spraying unit is safeguarded by means of safety fences.
- Automatic roller gate in the sound protection where the tooling change cart moves out.
- The travel way of the tooling change cart is safeguarded by means of safety fences.
- Access doors are protected electrically.
- Noise emission level: please refer to chapter “Noise emission level”
- Lighting: 300 lux.
- Roof made of sound protection elements. It cannot be walked on the roof of the sound protection.

Technical data:

Number of automatic gates	5
Number of safety light barriers	1
Number of access doors	4

2.1 Loading Feeder - with centering and orientation function

The loading feeder serves the purpose to center and reposition the blank coming from the destacker and feeding the blank into the die of the lead-off press. This feeder is taking over the blank at the take-over position of the destacker, after the optical detection of the actual position of the blank(s).

Detailed description of the design and functions, as well as further descriptions and options, see chapter “Interpress Automation”, if not otherwise stated in this chapter here.

The amount of additional necessary motion-axis, which are required for the centering operation, are described below.

2.1.1 Centering- and Orientation Axes

- Positioning in Material-Flow-Direction (X-Axis)

  Positioning in Material-Flow-Direction is by belts, which are driven separately on the left /right side in case of double-blanks.

- Positioning and Shifting in direction of axis Y respective Y1 and Y2

  The lateral shifting/spreading of Y1 and Y2 is independent of each other.

  In case of a single blank (not requiring separate Y1 and Y2), the motion of Y1 and Y2 is synchronous (Y-Axis).

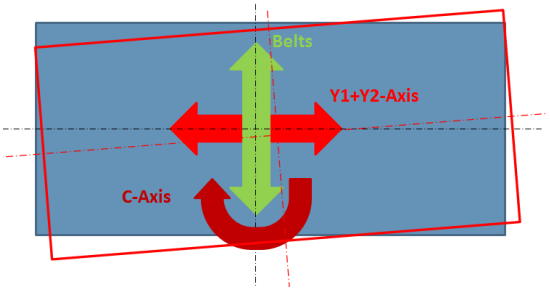
  The lateral positioning of the blank(s) in Y direction is also available for repositioning the blank(s) in addition to the basic centering-function, in case that the die requires a different position for blank(s) arriving from the initial destacking-position.

- Swivel around C respective C1 and C2 Axis

  The swiveling around C1 and C2 Axis is independent of each other. The motion is actuated by (2) spindle-drives on each side (left and right) on the crossbar. C1 and C2 are only used for centering double blanks.

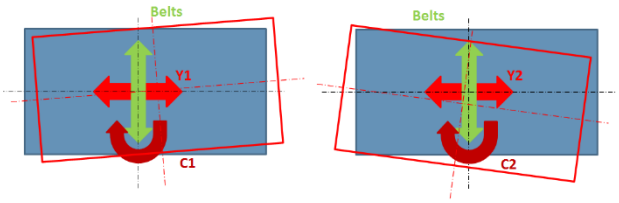
  In case of a single blank (not requiring C1 or C2 Axis), the swiveling is around C-Axis of the Feeder.

- Centering process



Single blank

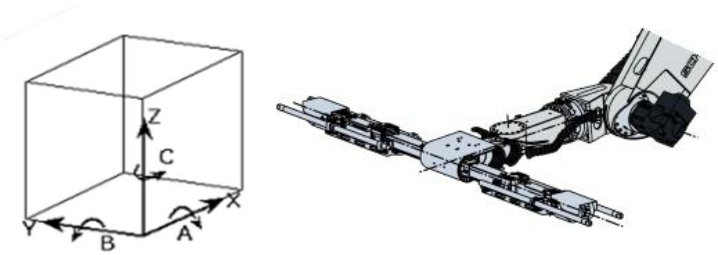
Positioning of single blank with means of transport belt in Material-Flow-Direction (X-Axis), swiveling of the C-axis and shifting of the Y-Axis (Y1+Y2 synchronous)



Double blanks

Positioning of double blanks with means of transport belts (left/right side) in Material-Flow-Direction (X-Axis), swiveling of the C1+ C2-axis and shifting of the Y1 also Y2 axis

2.1.2 Technical Data of the Centering- and Orientation Function



- **Additional Drives on the Crossbar**

Number of motors for		
– Swiveling/Shifting (left side)	-	2x (V2 and V22 - axis)
– Swiveling/Shifting (right side)	-	2x (V1 and V11 - axis)
Type	-	Servo

- **Centering range**

Swivel around C1, C2- Axis	°	(each) +/- 10
Swivel around C- Axis	°	+/- 10
Centering of blank(s) in material-flow-direction (X-Axis)	mm	±75
Centering of blank(s) cross to material-flow-direction (Y-Axis) respective (Y1 and Y2 – Axis)	mm	±75

- **Additional Re-Orientation cross to material-flow-direction**

Shifting in direction Y1, Y2- Axis: double blanks	mm	each max. 500
Shifting in direction Y- Axis: single blank		max. 300

- **Tooling (at centering unit, double deposit at Tooling-Change-Cart)**

Height of tooling area down (related to the “TCP” (tooling-center-point) of the crossbar)	mm	max. 335
Height of tooling area down (related to the “TCP” (tooling-center-point) of the crossbar)	mm	min. 45
Max. tooling window size (X x Y)	mm	1 580 x 950 x 2
*without additional re-orientation cross to material-flow-direction		(see drawing for details)*

Max. load of part specific equipment and part	kg	90 kg @ max. 16 SPM (30 kg tooling, 60 kg part) 110 kg @ reduced SPM (40 kg tooling, 70 kg part)

2.2 ServoLine XL Tandem Line Presses

2.2.1 Technical Data Servo Press Line

▪ Press Type		SSL4-2500 Station 1	SSE4-1600 Station 2	SSE4-1200 Station 3-5
▪ **Press Drive**				
Front End Designation (flow direction)	–	Front to rear	Front to rear	Front to rear
Total Tonnage	kN	25 000	16 000	12 000
Stations	–	1	1	3
Number of Slide Connections	–	4 –No plunger	4 –No plunger	4 –No plunger
Tonnage / off BDC – Slide	kN / mm	25 000 / 13 by drive train	16 000 / 13 by drive train	12 000 / 13 by drive train
Tonnage per Slide Left - Right	kN	12 500 – 12 500	8 000 - 8 000	6 000 - 6 000
Slide Stroke / Slide Drive	mm / type	1 300 / 6-Link	1 300 / eccentric	1 300 / eccentric
Press Energy / available from	kJ / 1/min	1000 / 3	600 / 3	450 / 3
Press Energy / available from	kJ / 1/min	see diagrams	see diagrams	see diagrams
Main Drive Power	kW	4x 319	2x 319	2x 319
Belt Type, Main Drive	–	not required due to Servo Direct Drive	not required due to Servo Direct Drive	not required due to Servo Direct Drive
Slow Inch Drive	1/min	via main drive starting from 3 SPM	via main drive starting from 3 SPM	via main drive starting from 3 SPM
Max. Output Pressline, in Line Production Mode	1/min	16	16	16
Adjustable Stroke Rate in Line Production Mode	1/min	3 – 16	3 – 16	3 – 16

▪ **Press Type**		**SSL4-2500 Station 1**	**SSE4-1600 Station 2**	**SSE4-1200 Station 3-5**
Adjustable Inching Stroke rate in Set-up mode	1/min	3 – 7	3 – 7	3 – 7
Adjustable Single Stroke Rate in Try-Out Mode (SPM valid for closed safety gates)	1/min	3 – 16	3 – 16	3 – 16
Eccentric Gear RPM Rate, variable over cycle (depending on calculated/programmed slide curve)	1/min	0– 19	0– 19	0– 19
▪ **Die Area – Slide**				
Die Area – Slide Size	mm x mm	4 600 x 2 500	4 600 x 2 500	4 600 x 2 500
Max. Die Size	mm x mm	5 000 x 2 600 (with CBF)	5 000 x 2 600 (with CBF)	5 000 x 2 600 (with CBF)
Shut Height Slide (SDAD – SDAU)	mm	1 150 - 1 450	1 150 - 1 450	1 150 - 1 450
Slide Adjustment	mm	300 ± 0.1	300 ± 0.1	300 ± 0.1
Slide Adjustment Speed	mm/min	approx. 60	approx. 60	approx. 60
Overload Stroke	mm	50	50	50
Die – Upper Die Weight	kg	25 000	25 000	25 000
Upper Die Clamps	Type	BERG BKZ 100 PSV	BERG BKZ 100 PSV	BERG BKZ 100 PSV
Number	–	12	12	12
Clamping / Holding Force	kN / kN	100 / 100	100 / 100	100 / 100
Stroke (travelling)	mm	800	800	800
Clamp Type	–	(El. travel) Hydraulic	(El. travel) Hydraulic	(El. travel) Hydraulic
Slide Gibbing	–	8–way, bronze	8–way, bronze	8–way, bronze
▪ **Slide Cushion (Option)**		Not equipped	Not equipped	Not equipped
Pneumatic slide cushion capacity	kN	no	no	no

▪ **Press Type**		**SSL4-2500 Station 1**	**SSE4-1600 Station 2**	**SSE4-1200 Station 3-5**
Pneumatic cushion stroke	mm	-	-	-
Pneumatic slide pin area	mm	-	-	-
▪ **Die Area - Moving Bolster**				
Numbers/ moving direction	No. / Dir.	2 / left - right	2 / left - right	2 / left - right
Die Clamping Area– Moving Bolster	mm x mm	4 600 x 2 500	4 600 x 2 500	4 600 x 2 500
Max. Die Size	mm x mm	5 000 x 2 600 (with CBF)	5 000 x 2 600 (with CBF)	5 000 x 2 600 (with CBF)
Moving Bolster Height	mm	800	800	800
Bed Height above Floor	mm	0	0	0
Pressure Box		Yes, 1-pcs.-design	No	No
Pin Plate or Pins with Shoulder	–	Pins with shoulder (without pin lifter plate)	–	–
Pressure Plate (Pin pattern size)	mm x mm	3 900 x 1 800	–	–
Number of Holes	–	351 per bolster	–	–
Pressure Pins Grid	–	27 x 13	–	–
Grid Distance	mm	150	–	–
Outer Diameter Pressure Pin	mm	49 (pin design according Schuler standard, see drawing)	–	–
Scope of Supply Pressure Pins **(Option)**	–	351 by Customer, as Option by Schuler	–	–

▪ **Press Type**		**SSL4-2500 Station 1**	**SSE4-1600 Station 2**	**SSE4-1200 Station 3-5**
Scope of supply covers (caps) **(Option)**	–	351 by Customer, as Option by Schuler	–	–
Die Centering (number / type) **(Option)**	–	4 per MB by customer, optional by Schuler (centering pin design acc. Schuler standard)	4 per MB by customer, optional by Schuler (centering pin design acc. Schuler standard)	4 per MB by customer, optional by Schuler (centering pin design acc. Schuler standard)
Moving Bolster retention (locking device)	Brand / Type	BERG/OPTIMA	BERG/OPTIMA	BERG/OPTIMA
Number	–	4x	2x	2x
Clamping / Holding force	kN/kN	40 / 200	40 / 200	40 / 200
Scrap Chutes in Front and Behind Station	mm	No	4 000 x 545	4 000 x 545
Scrap Chutes Left and Right of Station	mm	No	No	No
Scrap Openings in Moving Bolster	mm x mm	No	1x 590 x 790 center 2 x 1090 x 490 outer	1x 590 x 790 center 2 x 1090 x 490 outer
Energy Supply to MB	–	Cable and belt chain cover	Cable and belt chain cover	Cable and belt chain cover
Driving Velocity fast / slow	m/min	15 / 2	15 / 2	15 / 2
Slide and Bed Deflection (cross to flow direction)	mm/m	0,125 (OEM Schuler standard)	0,125 (OEM Schuler standard)	0,125 (OEM Schuler standard)
▪ **Die**				
Total Die Weight max.	kg	50 000	50 000	50 000

▪ **Press Type**		**SSL4-2500 Station 1**	**SSE4-1600 Station 2**	**SSE4-1200 Station 3-5**
Die Clamps on moving bolster	Type	by CUSTOMER	by CUSTOMER	by CUSTOMER
▪ **Die connections**		acc. to Customer standard	acc. to Customer standard	acc. to Customer standard
Controlled air	–	2x valves (right) option 2x (left), Connections 1/2"	2x valves (right) option 2x (left), Connections 1/2"	2x valves (right) option 2x (left), Connections 1/2"
Uncontrolled air	–	on right side each: 2x (DN25)	on right side each: 2x (DN25)	on right side each: 2x (DN25)
Die lubrication	–	no	no	no
Die coding	–	no	no	no
Die automation 24VDC incl. part present sensing	–	TBD	TBD	TBD
Part present identification	–	no	no	no
Die conveyor belt	–	no	no	no
▪ **Lower Die Clamping Units on Moving Bolster (manual setting) (Option)**	Brand / Type	Manual by Customer	Manual by Customer	Manual by Customer
Number	–	–	–	–
Clamping / Holding force	kN/kN	–	–	–
▪ **Other Specs**				
Noise Level, without press load and dies / tooling	dB(A)	with noise protection, max. reduction 10-15 dB(A)	with noise protection, max. reduction 10-15 dB(A)	with noise protection, max. reduction 10-15 dB(A)
Die Change – Level of automation	–	Fully automatic	Fully automatic	Fully automatic
Die change time (approx.) for last part on EOL conveyor, first part on centering station	sec.	180	180	180

▪ Press Type		SSL4-2500 Station 1	SSE4-1600 Station 2	SSE4-1200 Station 3-5
Die change time (approx.) for last part on EOL conveyor, first part on conveyor belt (Harbour)	sec.			
Lubrication system	Type	Centralised lubrication system with progressive distributor	Centralised lubrication system with progressive distributor	Centralised lubrication system with progressive distributor
Piping system	Type	Schuler Standard	Schuler Standard	Schuler Standard
Oil type - Hydraulic	Type	ISO HLP 46	ISO HLP 46	ISO HLP 46
Oil type - Lubrication	Type	ISO CLP 150	ISO CLP 150	ISO CLP 150
Oil volumes, unit type	Hydr.	integrated in hydr. cushion unit	integrated in hydr. cushion unit	integrated in hydr. cushion unit
Oil volumes, unit type	Lubr.	appr. 6 300 litre (central unit)	---	---
Opening on uprights:				
- width (between uprights)	mm	2 950	2 950	2 950
- width (between safety gates gibs)	mm	2 650	2 650	2 650
- height	mm	2 600	2 600	2 600
Distance between uprights cross to flow direction	mm	5 100	5 100	5 100
Distance between oil catching pans cross to flow direction	mm	4 650	4 650	4 650
Vibration Isolated Installation	–	No	No	No
Press Tonnage Monitoring System	–	Peak force Monitoring	Peak force Monitoring	Peak force Monitoring
Scrap Chute Covers in Bed	–	No	Yes, automatic	Yes, automatic

▪ **Press Type**		**SSL4-2500 Station 1**	**SSE4-1600 Station 2**	**SSE4-1200 Station 3-5**
Scrap Chutes under Press Bed	–	No	by CUSTOMER	by CUSTOMER
Standard Line Operating Side	–	Right	Right	Right
▪ **Energy Consumption**				
Electric power		see resp. chapter	see resp. chapter	see resp. chapter
Compressed Air During Production		see resp. chapter	see resp. chapter	only for the presses, “0”
Cooling Water Consumption approx.	m^3/h	see resp. chapter	see resp. chapter	see resp. chapter
▪ **Safety**				
Slide Restraint Device (according to EN ISO 16092-1 + 2)	–	Yes, over full stroke	Yes, over full stroke	Yes, over full stroke
Clutch and Brake System	–	Not required (Servo Drive)	Not required (Servo Drive)	Not required (Servo Drive)
Moving Bolster driving Area Protection	–	Sick MSL left and right	Sick MSL left and right	Sick MSL left and right
▪ **Requirements on building and foundation**				
Max. height of press approx.	mm	See Layout	See Layout	See Layout
External dimension of press (above floor)	mm x mm	See Layout	See Layout	See Layout
Depth of foundation, Min.	mm	5 500	5 500	5 500
Press weight static load	kN	6 600	4 500	4 000
Press weight stat + dyn. load with elastic installation (OPTION)	kN	7 920	5 400	4 800
Press weight stat + dyn. load with rigid installation	kN	11 880	8 100	7 200

2.2.2 Aufbau und Funktion

Split Press Frame

The press frame is constructed of welded, thermo stress-relieved steel. The frame consists of crown, bed and uprights. This structure is hold up by four pre-tensioned tie rods.

Press foundation

The bed is machined for installation on foundation plates on top of foundation pillars. The scope of supply of pillars, foundation plates, levelling plates, screws and nuts etc. is defined in chapter 4.

The complete foundation must be constructed such that a maximum deformation/settling given with the foundation drawing can be maintained. A Schuler specialist should be present for the levelling and anchoring of the press. Schuler will provide a foundation drawing showing all press-relevant details for the design of the foundation.

Foundation has to be checked regularly by the user during machine life. The requirements are displayed in the foundation plan.

The differential lowering of the support surfaces must not exceed 0,1 mm per m distance The short-term damage threshold is the 2-3-times this value. The lowering of the foundation has to be checked permanently and compared to the threshold value. Exceeding of the limit requires to the shutdown the machine.

In case of rigid installation: The press bed is equipped with brackets used for floor cover support. The brackets are designed for max. floor load of 500 kg/m².

- **Kopfstück**

Main Drive with Schuler ServoDirect Technology

In the Schuler ServoDirect Technology, the torque Servo motors are flanged longitudinal to the crown at the ends of 2 drive shafts and are easy accessible. The number of motors with identical type for the whole press line, is executed according the required press forces respectively torque and is described in the technical data. Fixation of main motors to the crown is by screw connection.

Each Servo Torque Motor is connected to the drive shaft via clamping set. Each drive shaft (2 drive shafts per crown) can be equipped with 2 motors. The drive shafts are guided in the crown by fixed/floating bearings. Lubrication of gearing is by central circular oil lubrication.

An additional brake and an encoder are located on the back side of the motor. The additional brake is spring actuated, dry running and is released by hydraulic. This locking concept by additional brake is approved by German employers' liability insurance association (BG, Berufsgenossenschaft). Further locking device is not required. All motors are water-cooled. The ball bearings are grease lubricated. The maintenance intervals of grease lubrication are indicated in the documentation.

The eccentric gears in the crown are driven by the 2 drive shafts with intermediate gears. The eccentric gears are mechanically linked by intermediate gear.

Exchange of a drive shaft or single motors can be done by bay crane. Break and encoders can be exchanged independent from the motors. All motors are controlled independently and enable to run the press with reduced output even if a motor has failed.

The main motors are located on the crown and are easy accessible for maintenance and inspection. All rotating elements are covered by steel covers safely but quickly removable.

Operating modes are described in chapter “Electric System”

For all of these drive modes the following advantages are provided by flexible programming of the time-stroke-characteristic independent from the set production stroke rate of the entire line:

- definable impact velocity at start of drawing (even without pre-acceleration by bed cushion)
- definable drawing velocity before BDC
- definable cutting velocity before BDC
- definable stopping time at BDC
- definable upstroke velocity after BDC
- definable time frame for automation around TDC
- available energy is completely usable within the overall stroke rate range

In general the Schuler servo press offers maximum flexibility and optimized production rates together with proven stiffness and high output of mechanical presses.

Features of main drive control cabinets:

- Regenerative feedback (4Q operation)
- Sinusoidal line current, i.e. low harmonics. Very low perturbations into the supply
- Line supply voltage fluctuations can be compensated
- For networks with significant voltage fluctuations, the magnitude of the DC link voltage - which can be parameterized - is kept constant
- Self-controlled technology (not dependent on line supply)

- Extremely high drive dynamic performance
- Reactive power can be compensated (inductive or capacitive).
  Users can reduce their power costs.

Kinetic Energy Storage for Servo Press

An additional separate kinetic energy accumulator in the basement allows significant reduction of installed power of the entire line.

Gearing and Main Drive Shaft Servo Press

For reversible drive mode, the gears are provided with double helical gearing with reduced backlash. The pinion gears are gas nitrated. Lubrication of all gears is by dripping lubrication, all bearings are supplied by the oil recirculating system. All distributors are located at the crown. Inspection openings with removable covers are embedded in the crown covers.

Absolute Encoder Crank Angle Position

Control of crank angle position is by an absolute encoder without mechanical cams. The encoder is located at the crown.

SCHULER – Link Drive for Lead Press

The lead press uses the SCHULER link drive system.

By using a link drive system, the speed of the slide is controlled for best drawing characteristics, i.e. slow speed during the work stroke before BDC and fast speed during the idle travel of the slide. In addition, this feature improves the press force rating of the drive system before BDC.

SCHULER Eccentric Drive in all Follow-on Stations

All follow-on stations use the SCHULER eccentric drive system.

Slide Locking System - Restraint Device acc. EN ISO 16092-1 + 2

The slide locking system allows safe access to the die area when the machine has stopped. It is located within the mechanical drive train and enables the safe position of the slide at any position over the whole slide stroke including range of slide adjustment. By this the press is put into a safe condition quickly, the unlocked position is monitored. The locked position is spring actuated. The locked condition is displayed on the operator station by visual indicator. This system is approved by German employers' liability

insurance association (BG, Berufsgenossenschaft). A frequent brake test applies automatically during standard production stop.

Common Maintenance Platform on Crowns

The press is equipped with a common maintenance platform on the crowns. The platforms are protected with railings that are covered with panels on outside and designed according the current safety rules (EN ISO 14122-2). The platform is made of floor plates, max. load is 200 kg/m².

Access to Maintenance Platform via Stair Way (Press line)

The access to the press maintenance platform on the crown is by a stair way from the FOL and from the EOL system separately. The location will be determined in corporation with the customer according the local plant conditions.

Lighting crown

The area between the bottom of the crown and top of the slide is lighted for inspection and maintenance purposes.

The area between presses under the crown platform is lighted.

Lighting between Presses

The area between presses is lighted.

- **Stößel**

Slide in Welded Design

The slide is made of thermo stress-relieved, welded steel. The clamping surface of the slide made of S235 (designation acc. to EN 10025) is provided with T-slots for fixing the upper die, built to customer specifications.

Slide Guiding (Block Guiding)

The eight guideways on each slide are provided with bronze wear strips which are lubricated automatically. The slide is guided on the press uprights over the complete slide stroke. The clearance can be adjusted accurately by set screws in both directions.

Oil Return Slide

Oil dust in the slide area is prevented by the following features.

- Elements of link drive with oil baffles
- Oil baffles for crown openings for connection rods.
- Large oil pans on slide around the pressure points
- Oil baffles below slide guiding
- Wiper for slide quiding
- Splash protection covers all over slide gibbing height
- Central oil return (also from slide).

Hydraulic overload safety device

The slide has its own hydraulic overload system. There is one hydraulic cushion below each connecting rod. If the designed load is exceeded for an individual connecting rod or for the complete slide, the press is automatically stopped and the slide is decompressed. The relief stroke is shown in the technical data sheet.

The overload safety device operates fully hydraulically according to the principle of a hydraulically pilot operated pressure relief valve.

The press is fully protected from overload in the range of the nominal press force rating.

Overload condition is displayed at the operator station. Re-starting the press is only possible via a key-operated switch.

The hydraulic overload system in the slide is charged by an axial piston pump located on the lubrication unit in the pit. The case of overload is displayed on the monitor

Slide Adjustment

The adjustment of the slide is motorized by AC brake motor.

The pressure points in the slide are equipped with worm gear drives for adjustment that are coupled universal shafts for synchronism. Adjustment speed, setting and display accuracy according technical data.

One central absolute encoder controls the adjustment of the shut height.

The set shut height is displayed digitally at the operator station (HMI).

The die depending shut height is reset automatically by program during die change to the stored value (entered or pre-set values).

Slide Adjustment End of Travel Monitoring

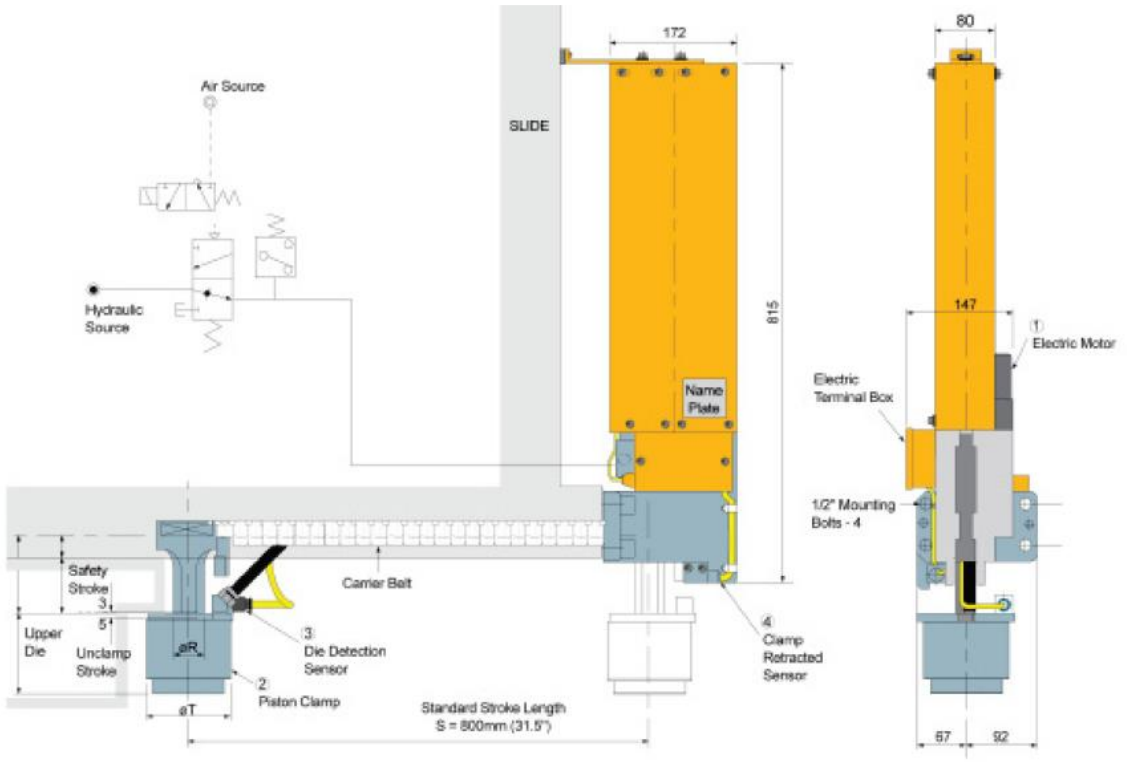
End of adjustment travel is protected by proximity switches additionally.

Slide Adjustment Rotation Monitoring

The rotation of each worm shaft is individually monitored to detect any out of sync motion and prevent damage in the drive train immediately thus reducing downtimes of the press.

Automatically Movable Die Clamps on Slide

The slide is equipped with upper die clamps for automatic clamping of the upper dies. These clamps move and clamp different die sizes automatically. In case of loss of power the clamping forces will be kept. Brand, type, number and forces are described in the technical data.



Picture only for reference

Die automation connection on slide

Each slide is equipped with die connections. Number and brand are according technical data.

Slide Weight Counterbalance (changeless pressure)

The weight of each individual slide and the upper die is partly counterbalanced by pneumatic cylinders. Initially the required pneumatic pressure is automatically set and kept during the die change procedure. During the operation of the press the initial pressure is automatically maintained.

- **Ständer**

Main Operator Panel on Press Upright

The SCHULER standard operator panel is located on the press upright.

The panel is equipped with all function-related actuating and display elements for the press. It has an E-Stop button and a graphical colour display for the visualization. The position will be determined mutually with the customer according to the plant layout.

Lighting of Die Space

Lighting of die space is by lighting fixtures installed on the press uprights with 300 Lux.

Receptacle for External Power Connection

The upright is equipped with a receptacle for connection to the plant power independent from the press power supply. Connection of the receptacle to the plant power is not included in the scope of supply.

Number and type of the plug is described in the technical data.

Safety gates between uprights

Two electrically driven safety gates protect the die area. Mechanical dropping prevention – e.g. brand Butzbach or similar prevents dropping of the gate in case of a failure. Windows made of safety glass are embedded in the safety gates. All safety gate positions (open, not closed, closed) are monitored by limit switches.

- **Fahrtisch**

Moving Bolster one-piece construction

Moving bolster carrying the die is provided for quick die change of the press.

Each moving bolster is one-piece construction including bolster plate. Four (4) load rings as lifting accessories for moving bolster transportation will be supplied for the whole line. Moving bolster sides are sheet metal covered.

Positioning of the moving bolster on the press bed is by flat keys.

Moving bolster area is equipped with holes for die centering and T-slot arrangement for manual die clamping to customer's specification.

Moving bolster is made in one-piece welded construction and thermal stress relieved.

Pressure Pin Holes with Plastic Bushings (at station with bed cushion)

The arrangement of the pressure pin holes is according customer's specification. The holes for the pressure pins are equipped with plastic bushings.

Automatic Positioning of Moving Bolster with electrical encoder

Positioning of the moving bolster and switching of the velocity between fast and slow driving is by electrical encoder.

Outside the press the end position of the moving bolster rails is with mechanical end stop.

Moving Bolster with Electric Drive

Moving bolster is powered by frequency controlled brake motor with reducer and connecting shafts to two wheels. For improved positioning switching over from fast to slow moving bolster driving velocity is done automatically. Braking from fast to slow is made electrically via frequency controlled motor. When the moving bolster has stopped, the mechanical brake will apply.

Automation on moving bolster

Each moving bolster is equipped with die connections. Number and brand are according technical data.

Scrap Chutes inside Moving Bolster

Scrap chutes for scrap removal are provided on the moving bolsters inside the clamping area. Size, number and location of scrap chutes are described in the technical data.

Lubricant Draining on Press Bed

Die Lubricant will be collected with help of a chute around the moving bolster clamping area. The draining of lubricant from the moving bolster to the bed is by an automatic quick disconnecting coupling in the press bed which is actuated when the moving bolster is lowered.

- **Pressentisch**

Automatic Air Coupling in Bed

Air supply to the moving bolster is by automatic quick disconnecting coupling in the press bed when the moving bolster is lowered.

Moving Bolster Lift Unit in Press Bed

The moving bolster is hydraulically lifted and lowered with the dies by lift cylinders in the press bed allowing the movement on profiled and flat rails at floor level. The lift units are connected to the central hydraulic supply and equipped with throttle control.

Schuler Moving Bolster Retracting Units

Schuler locking units prevent the unintentional lifting of the moving bolster during the slide retraction.

Brand, type, number and characteristics of the clamp are described in the technical data.

Hardened Gibs on Press Bed

Hardened gibs are mounted on the press bed to minimize the danger of fit rust considerably. The gibs are exchangeable.

Scrap Openings in Bed with Automatic Covers

Scrap openings for scrap removal are provided in the press bed. The scrap openings in the bed have covers which close automatically at the beginning of the ADC or for any access

to the die area. After ADC the flaps open automatically. The max. load is 500 kg/m². The end position of the flaps is electronically monitored.

Size, number and location of scrap openings are described in the technical data.

- **Flur**

Foundation Plates, Leveling Plates, Screws and Nuts

Foundation plates, leveling plates (including leveling), screws and nuts for erection of the press are scope of supply.

Floor Covers around Press on Steel Frames

Floor covers directly around the press (approx. 1 m around bed contour) to close the press pit are scope of supply including design, calculation (max. load 500 kg/m²) and manufacturing. The covers will be put on the foundation and a self-supporting substructure. The re-work or preparation of the foundation is not scope of supply but Schuler will deliver a drawing for proper preparation.

Moving Bolster Rails

Moving Bolster Rails on the press bed, for crossover between press bed and foundation as well as in the foundation including all levelling material are included in the scope of supply.

The cross over between press bed and foundation is smooth and shock free by special rail design.

Moving Bolster Rails for L-R

The press is equipped with moving bolster rails allowing die change to each side of the press only. Therefore each moving bolster is driving cross to flow direction.

Moving Bolster Rails Hardened

To avoid wear all rails in the bed and in the foundation are surface hardened and tempered additionally.

Energy supply to moving bolsters with multi-cable

The electrical energy and control signals for driving the moving bolster and for die function and die change functions is supplied by an electric multi-cable embedded in the

floor (cable drum below floor).
The floor channel for the cable is covered by a passable link chain. (max. 10t/m²

Air tanks

Built in accordance with legal specifications, including manufacturing data as compiled in a data book. Each air tank is equipped with a pressure relieve valve and connected to an automatic drainage system.

Compressor with surge tank

In case of supplied plant air pressure is not sufficient for air consumer of the press and for quick die change a compressor including surge tank will be supplied.

- **Cooling water**

  Supply of cooling water for cooling the hydraulic and lubrication units is needed. Cooling water consumption and cooling temperature are listed in the technical data.

- **Hydraulik**

- **Central Hydraulic Unit**

  Oil for all hydraulic functions except the overload system is supplied by one Central Hydraulic Unit. The hydraulic unit includes all necessary equipment like pump, regulation device and filter. The unit is installed in the press pit. The switching cabinet is placed on the unit. Every malfunction will be indicated and results in a press shut off. The hydraulic unit is equipped with an oil collecting pan. The unit is designed according DIN 24339, the equipment fulfils the requirements of ISO 4413 and ISO 4414.

  Further options are available upon request with additional costs and will be quoted separately.

  Hydraulic Unit with Double Filter

  The hydraulic unit is equipped with switchable double filter.

  Hydraulic Unit with By-pass Filter

  The hydraulic unit is equipped with a by-pass filter system.

Hydraulic Unit with Oil-Water Cooling Unit

The hydraulic unit is equipped with an additional cooling unit. Cooling is by oil-water heat exchanger.

- **Lubrication**

The main bearings, gears, slide gibs, etc. are supplied by a recirculating oil lubrication system. Piston distributors, with electronic lubrication monitoring, provide the required oil volume for each lubrication point. This ensures that the bearing points are supplied with the required oil quantity within a certain time interval, and prevents damage due to short-time lubrication deficiency or pressure fluctuations in the system.

Bearing points that require a small or periodic lubrication are supplied by an impulse lubrication system. This system is monitored by a pressure switch. Oil is supplied from a recirculating lubrication tank. The piping is in solid design, necessary hoses are monitored electrically.

Air cylinders with piston rod sealing that require a small or periodic lubrication are supplied by an impulse lubrication system.

Central Lubrication Unit

The press is equipped with a central lubrication unit. The unit supplies the hydraulic overload system as well and is installed in the press pit. The switching cabinet is placed on the unit. The lubrication unit consists of oil tank, the necessary pumps, regulating devices and valves, including electric control. Faults of the unit will be indicated and will stop the machine. Connections for oil filling and changing of old oil are at the unit. The lubrication unit is equipped with a oil sump. The unit is designed according DIN 24339, the equipment fulfils the requirements of ISO 4413 and ISO 4414.

Further options are available upon request with additional costs and will be quoted separately

Lubrication Unit with By-pass Filter

The lubrication unit is equipped with a by-pass filter system.

Lubrication Unit with Double Filter

The lubrication unit is equipped with switchable double filter.

Lubrication Unit with Oil-Water Cooling Unit

The lubrication unit is equipped with an additional cooling unit. Cooling is by oil-water-heat exchanger.

Lubrication Unit with Heating Unit

The lubrication unit is equipped with an additional heating unit. Heating is by heating rods inside the tank.

- **Sonstiges**

- **Standard Noise Protection**

The following Standard Noise Protection features are included in the scope of supply:

- Safety gates in closed design with safety glasses with option Noise Protection
- Noise protection elements around the crown platform with option Noise Protection
- Double helical gearing of main gear
- Link drive charcteristic for lead-off press (reduces the velocity of impact)
- Pre-acceleration of hydraulic bed cushion to 80 – 90% of slide velocity at the moment of the impact
- Damping of bed cushion system during up stroke
- Noise protection coating for scrape chute elements.

2.2.3 Zusätzliche Leistungen (inklusive)

Anti-Vibration Installation with Spring-Viscose-Elements

The installation of the press will be on anti-vibration elements. The elements will be fixed on the foundation plates by self-sticking fabric plates. Each spring element is embedded in a visco mass for damping impacts and vibrations effectively. Because of the high isolation level of the elements, the elastic installation of the press reduces forces to the foundation as well as vibration and the transmission of body noise. In case releveling is necessary, the support pillar must allow space to apply hydraulic jacks to the press feet.

Required earth resonance frequency	Hz	see foundation layout
Mount resonance frequency of the press	Hz	see foundation layout

Central Platform for Control Cabinets of Presses and Crossbar Feeder

A central platform for the control cabinets of presses and Crossbar Feeders is included in the scope of supply.

- The platform is arranged above FOL.
  Option: Arrangement above EOL
- The arrangement of the platform and of the control cabinets is shown in General Layout.

The benefits of the common platform are:

- No platform on building columns is required.
- No trenches or pockets in the floor to accommodate the cable trays,
- Easy to maintain
  - full accessibility with crane
  - short distances, easy access, all control cabinets on one level
- Transfer points are exactly defined
- Few interfaces and coordination necessary for cable routing

All cabinet inlets and outlets are from bottom side. The cabinet platform includes all cables and cable trays to the consumers. The cable trays are placed below the platform covers, low and high voltage and control cables are separated.

The platform is arranged on a solid floor substructure. For the supply of foundation plates and its grouting see responsibility list in chapter 4 of this document. Schuler will supply all required information about the floor loads to the customer. The customer is responsible to design and build a suitable floor substructure.

The platform is arranged independent from the press frame. One stair will provide access from floor level. From the cabinet platform will be one additional stair towards the common press platform on crown.

The platform is built as solid welded and screwed steel structure. Walkways are covered with lug pattern plates made of steel, partly designed as removable covers for access area if required. The max. traffic load of the platform is 200 kg/m².

If noise protection is included the side walls of the platform are part of noise protection housing of the press line. An additional housing (roof structure) is not required.

Noise Protection

The openings in the press structure above the safety gates are covered by a system of sound protection panels. The outline contour of the crown platforms is covered vertically by sound protection panels.

The noise protection in the column area is arranged on foundation in self-supporting design. Noise protection on crown area is directly attached on the crown platform. Air circulation caused by slide movement is made possible. All control panels are integrated in the noise protection

The following noise protection features are included in the scope of supply:

- Safety gates in noise protection design
- The area between the closed safety gates and the crown platform is covered by sound protection panels. The elements are partly removable for maintenance and repair purposes.
- Noise reduction elements in flow direction at front and rear of press(line) except openings for part flow, partly removable for inspection and maintenance.

Safety gates in noise protection design

The gates are in noise protection design and equipped with several windows (material VSG 6).

Noise emission level

Due to the structural design and the applied sound insulation measures, the sound level of the press specified in the technical data is achieved in load-free continuous operation (without tool and scrap noise) with closed lift gates.

The sound level is measured in accordance with ISO 230-5 (Determination of the noise emission) at a height of H = 1.55 m above the floor and at a distance of 1.0 m from the press.

The method corresponds to accuracy class 3 according to ISO 230-5. The sound level measurement is carried out according to EN ISO 16092-1 Annex F.2. According to EN ISO 16092-1 Appendix F.4, a load-free operating condition may be selected that is in accordance with the intended use of the press and generates high noise emissions. These conditions are met at 80% of the stroke velocity in load free continuous operation.

We point out that according to the regulations of the employers' liability insurance association, the operator is obligated to take measures in the working rooms to reduce the reflection sound.

The sound pressure level of the press under load with tools cannot be assured bindingly by us, as it depends very much on part, tools and scrap.

Reduction of noise emission during production maximum 15 dB (A) in the medium to high frequency range. This is achieved with completely closed sound insulation. Measuring point arrangement according to DIN 45635 T1, appendix A1.

2.2.4 Optionale Ausrüstung der Pressen

Pneumatic Slide Cushion

The slide is prepared to be equipped with a pneumatic slide cushion. The slide cushion is pressurized with bellow cylinders. Pneumatic surge tanks with sufficient volume are integrated in the system. SCHULER damping profile rules are used damping the B.D.C. of the slide cushion pin plate. Operation modes:

- Controlled at each cycle (cushion function)
- Out of operation

Slide cushion force is programmable between 25% and 100%. The adjustment of the ejector pressure is by die data storage and/or by key board input with digital pressure display (within the press visualization).

Constant pressure range is set to ±0,1 bar, measured near T.D.C. of the slide.

A minimum pressure remains when the cushion is deselected, which presses the plate against the damping elements in the starting position in order to prevent premature wear of the bellows cylinders and damping elements.

Pressure pins, pressure plate, damping rules, surge tanks and all other items to operate the system are scope of supply. Turning around vertical axis of the pressure plate is prevented by sliding guides. See also Technical Data for additional information.

Parallelism of the pressure plate will be performed by balance of forces of the pressure pins within the die. These die pins are to be set in way, that no tilting of the pressure plate will result from off-center load. If needed, additional pins for tilting compensation are to be positioned within the die in order to balance the load equally. That means each quarter of the plate is loaded with one pin as minimum when the cushion is in operation.

The minimum number of pins results from slide cushion tonnage and maximum allowed pressure pin load. The area of loaded pins should cover at least 2/3 in length and 2/3 in width of the pressure plate size. The Schuler operation manual contains additional

references to load cases and maximum allowed impact and releasing speeds which are to be respected.

First Filling of Units

First filling of all units in the basement will be supplied and handled by the customer. Required media quality and quantity will be defined in the documentation by Schuler.

Scrap Chutes under Press Bed

The scrap chutes in the press bed extend from the bottom side of the press bed to the scrap conveyor belt / scrap box.

Oil Filling Station for Units below Floor in Press Upright

An oil filling station for the units below floor is provided in the upright for filling from floor level (pump is optional). Maximum oil filling level will be indicated at floor level.

Further measures to reduce the sound level

The execution of the noise protection as a free-standing, self-supporting and decoupled noise protection housing including additional measures to increase the noise reduction capacity of the housing and further soundproofing measures (eg noise control measures underfloor or in the floor covers) achieves in further reduced sound level of the press in no-load continuous run(without tool and scrap noise) with closed lift gates.

The sound level is measured as described above.

In order to achieve a reduced noise level, it is also necessary that the customer himself also takes appropriate additional measures to reduce the noise of the conveyor system and the finished part outlet. This can be achieved, for example, by a complete enclosure of the conveyor system and the finished part outlet.

In addition, it is necessary by the customer:

- Low noise design for equipment in the basement provided by the customer (for example scrap removal)
- to insulate the foundation cover against noise emission
- Take measures to reduce sound reflection through the plant roof

The sound pressure level of the press under load with tools cannot be called binding by us, as it depends very much on part, tools and scrap management.

The above measures can reduce the sound pressure level during production **by up to 22 dB (A)** in the medium to high frequency range. This is achieved with completely closed noise protection.

Since the measurement with and without noise protection housing required by the standard is not possible, a measurement is carried out once inside and once outside the noise protection enclosure and the sound pressure reduction is determined from these measurements.

Measuring point arrangement according to DIN 45635 T1, appendix A1. Excluded are measuring points near the openings in the noise protection lining due to the flow of material (e.g. coil or blank inlet and finished part outlet)

In the case that the manufacturing and installation of the noise protection housing is commissioned by the customer himself, he is also responsible for ensuring that the manufacturer of the noise protection housing system implements all measures to further reduce the noise level.

Separate Cooling Circuit for the fluid cooled Servo Main Motors

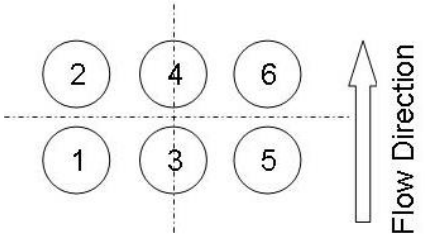
A separate cooling unit (industrial system) is used for cooling of the servo main motors independent from the plant cooling supply line. The cooling unit is located in the basement.

2.3 Schuler Servo-Hydraulisches Energie-Spar-Zieheinrichtung (SEC)

Energy Saving Bed Cushion - Schuler Energy Cushion (SEC)

The Schuler modular bed cushion is designed as Schuler Energy Cushion (SEC). The SEC provides reduction of up to 40% in energy consumption compared to standard modular cushion systems resulting in appr. 200 kW lower connected load. All functions and technical data are identical to the modular cushion design.

Arrangement and Numbers of Pressure Points for 6 Point Cushion



2.3.2 Technical Data Cushion

▪ **Servo-Hydraulic Bed Cushion**		**4-Point**
▪ **Technical Data**		
Station	---	1
Number of pressure box	---	1
Number of cylinders	---	with 4
Minimum force per cylinder	kN	125
Maximum force per cylinder	kN	1 250
Total force	kN	500 – 5 000
Maximum force difference between cylinders	kN	225
Ejector force per cylinder	kN	125
Usable drawing stroke, programmable	mm	25 – 350
Pre-acceleration	mm	max. 20
Build-up of pressure	mm	max. 10
Cushion working stroke	mm	max. 380
Down stroke for die change	mm	20
Total cushion stroke	mm	max. 400
Pick-up stroke (up from BDC of cushion) **(Option)**	mm	fix Option: freely programmable
Dynamic locking stroke (down from BDC of cushion) **(Option)**	mm	fix Option: freely programmable
Down stroke velocity	m/s	max. 0,5
Up stroke velocity	m/s	max. 0,5
Mechanical locking	Y / N	no, by redundant hydraulic valves

▪ **Servo-Hydraulic Bed Cushion**		**4-Point**
▪ **Components**		
Pressure box	One-piece, steel welded	1
Cylinder bridge	steel welded	2
Cylinder	Triple action, steel forged, sealing u. gibbings Trelleborg, piston made of heat treated steel	4
Control block	steel, valves by Moog	8
Accumulator	Bladder accumulator Hydac	12
Linear encoder	Temposonic	4
Pressure transducer	Hydac	12
▪ **Hydraulic Unit**		
High pressure pump	Axial piston pump Rexroth	2
Low pressure pump	Screw pump Leistritz, Seim	1
Cooling pump	Screw pump Leistritz, Seim	1
By-pass filter	Yes, see chapter 2.3	---
High pressure filter	Yes, see chapter 2.3	---
Low pressure filter	Yes, see chapter 2.3	---
Oil tank	Volume, steel welded	10.000 ltr.

2.3.3 Arrangement and Function of SEC Servo Hydraulic Bed Cushion

The pressure box is of sturdy welded steel construction guided by 8-way gibing with life-time lubrication. On the surface of the pressure box hardened liners are provided in the contact area of the pressure bolts.

The cylinder modules consist of a triple-acting hydraulic cylinder, valve control block, hydro accumulator and integrated position and pressure sensors.

All active control and closed-loop control processes to perform the bed cushion functions (pre-acceleration, drawing force control, retraction in BDC, controlled upstroke with pick-up position) take place in the cylinder modules. Pipes and flexible tubes are used only to supply pressure or as return line to the tank. This compact and extremely stiff hydraulic system eliminates vibration problems and achieves a highly dynamic control behaviour.

All cylinder modules of the bed cushion are of identical design and equipped with the same components (favourable for stock keeping of spare parts).

In case of "shut-down", two limit switch monitored logical seat valves shut off the oil flow from the displacement chamber to ensure protection against unintended movement in any stop position.

A pressure relief valve secures the system against inadmissible pressure increase.

The hydraulic power unit supplies the oil volumes and pressures required for the system pressure, the control pressure and the cooling circuits. Returning hot oil is collected, cooled down and fed again into the circuit.

All connections between cylinder module and power unit are designed by vibration-isolated flexible tubes. This ensures an easy and quick installation of the piping with firm machine placement and with positioning on spring-loaded elements.

- **Operating Modes**

  It should be observed that the bed cushion maximum force cannot be used over the whole stroke especially in conjunction with a slide cushion because this might exceed the operational capacity of the press.

  For setting the bed cushion force, you have to consider the force-stroke diagram (especially during the slide retraction) in order to prevent overloading of the slide drive unit outside the full load range and to avoid damage to the slide.

  The maximum number of strokes is dependent on the installed pump capacity of the hydraulic unit and the draw depth. Therefore it may happen that the bed cushion cannot be operated at maximum draw depth with the maximum number of strokes. The operating range of the drawing cushion is displayed in the strokes diagram.

  Automatic Mode

  In the cushion automatic mode, the bed cushion runs through the cycle functions according to the sequence of motions over the press stroke (refer to functions). The press can be operated in the single or continuous mode.

- **Displacing Function**

  The bed cushion home position is TDC.

  During the slide down stroke, the bed cushion is displaced against the programmed, exactly reproducible counter holding force. The bed cushion returns to TDC with delay to the slide return stroke according to the preset ejector speed thereby ejecting the workpiece.

- **Pad Function - Option**

  The sequence of functions corresponds to the displacing function. When you preselect the "pad" function, the cushion starts returning to the top position (TDC) simultaneously with the slide retraction. The slide retraction speed can be reduced to the cushion retraction speed, if required. Once the bed cushion reaches the top end position, the slide speed can be changed over to the normal setting.

Setup Mode

For set-up the bed cushion can be moved up and down manually.

With down stroke control, the bed cushion goes to the lowering position at low speed (rest position fixed underneath the BDC by positive stop).

With upstroke control, the programmed bed cushion TDC position is approached at low speed.

In the setup mode also the function "inching" is integrated. It allows the manual movement of the bed cushion up or down at random steps between TDC and lowering position.

Die Change Mode

For the die change, the moving bolsters are rolled in and out of the die space. The cushion moves automatically to the lowering position. After transfer of the new die data, the bed cushion goes back to the preselected TDC position.

- **Functions**

In the total cycle of one press stroke, the bed cushion can perform a number of different functions.

Pre-acceleration

The system is designed to minimize the contact impact between upper die and blank holder. The bed cushion down stroke is accelerated hydraulically shortly before the upper die contacts the cushion. This speed adjustment improves the part quality and increases the lifetime of die, bed cushion and press. In addition it reduces the noise emission. The pre-acceleration path is calculated by the cushion control taking account of the slide position and the slide speed, the stroke number and draw depth. The pre-acceleration function can be selected or unselected.

Pressure Buildup

When the slide with the upper die rests on the blankholder, the drawing force is being built up.

The physical elasticity of the total system especially the oil column in the lower cylinder area generates a specific path of pressure buildup. This pressure buildup path is dependent on the drawing force and the drawing stroke (height of oil column). The pressure buildup is always required regardless whether the system is operated with pre-acceleration or not.

Drawing Operation

In the actual drawing operation, the blank is formed between upper and lower die while being held by the blankholder at a specific force. The bed cushion supplies the blankholder force by displacing oil from the lower cylinder area. This process is pressure-controlled by one proportional valve on each cylinder. The oil pressure in the cylinder is permanently gauged by a pressure sensor and is compared with the set value. The proportional valve opens more or less accordingly. The blankholding force is either kept constant or is preselectable in the form of a pressure curve with a max. number of interpolation points. Such kind of pressure curve can be programmed individually for each cylinder module.

Retraction in BDC

If blankholders or ejectors are used on the upper die, deformation of the finished part may occur if the bed cushion after relief in BDC springs back to the top. To avoid this springback, the bed cushion is actively pulled down in its lower dead center.

Pick-up Position and Upstroke

The drawn part is stripped off the upper die by an upstroke of the blank holder then is moved to the part unloading position. The time of movement to pick-up position is programmable. When the part is unloaded from the die, the bed cushion moves to TDC in

a controlled hydraulically cushioned manner. This is the starting position for the next cycle (press stroke). The starting time point of upstroke is equally programmable.

SDDM (Schuler Diagnostic Data Monitor)

With the help of the “Schuler Data and Diagnostic Monitor” (SDDM) process parameters of the bed cushion will be displayed in a graphic mode and stored. After every slide stroke all control signals will be transferred to an PC system and shown as curves in the operator display.

Process data of the bed cushion are:

- • Actual and set values of all drawing forces
- • Position of the cushion and crank angle
- • Actual valve piston position

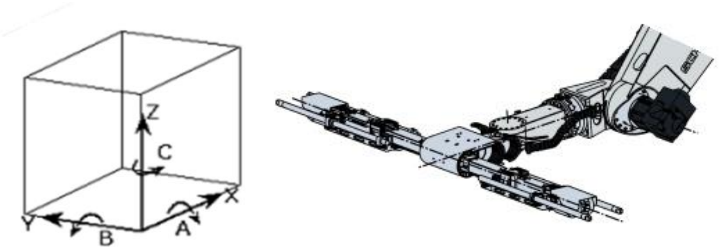
By this all relevant parameters of the bed cushion for high part quality are provided.

Selectable display of curves over crank angle or over time. Next to the graphic visualization on the operator panel all process data will be stored in a ring buffer to provide these data for comparisons. Storage of these data outside the ring buffer for record purposes is possible as well as loading of once stored data.

The system provides the press operator supervision of the running system by e.g. controlling cushion forces as well as support to die makers for die tryout and die optimization. Furthermore the system supports maintenance in fault analyses.

2.4 Pressenverkettung – Crossbar Feeder Automation

2.4.1 Technical Data



- Schuler Feeder Unit

-

Schuler Feeder – capable for max. line output – depending on e. g. die design and part geometry and other factors	1/min	refer to max. line output

- Working Area

Servo electric drives

X Feed pitch		
Station 1 – 2	mm	5 200
Following stations	mm	5 200
X Adjustment	mm	±150
Z Lifting / Lowering	mm	850 (die area) 625 (press gap)
Transportation height above moving bolster (Z) Drawing Station	mm	see bed and slide area
Transportation height above moving bolster (Z) Following Stations	mm	see bed and slide area
B Tilting crossbar around Y - Axis dyn.	°	±25 (depending on lever angle: up to ±45)
B Tilting crossbar around Y - Axis stat. (automatic die change)	°	90
Y Shifting of single parts	mm	max. 300 (±150)
Y Separation of double parts (spreading)	mm	max. 600

- Axis-Motion

Total number of axis for main motion	-	7
Number of motors for – B Tilting around Y- Axis	-	1

Number of motors for – Y Shifting / Separation (Standard)		2
Type	-	all with Servo Motors

- Locking

Number of lockings	-	with motor brakes
Safe locking in one defined park positon	-	yes
		W, E2 additional per bolt (in park position)
Manufacturer Brake	-	BOSCH REXROTH
Monitoring of locking	Y / N	YES (W, E2 axis)
Locking, additional mechanical visualization	Y / N	N, Indication in HMI; lamp in HMI

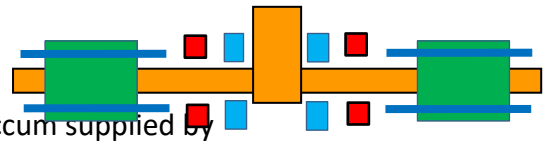
- Crossbar

Number of crossbars	-	1
Cross section of crossbar	mm x mm	80 x 80
Material	-	Stiff and light weight design
Height of the head of the double arm	mm	200
Max. load of part specific equipment and part	kg	100 @ max. 16 SPM (40 kg Tooling, 60 kg Part)
		120 @ reduced SPM (50 kg Tooling, 70 kg Part)

Tooling (at following units, double deposit at Tooling-Change-Cart)

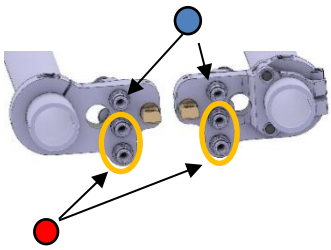
Height of tooling area down (related to lower edge of crossbar)	mm	max. 235
Height of tooling area up (related to lower edge of crossbar)	mm	max. 165
Max. tooling window size (X x Y)	mm	1 580 x 1 400 x 2
*without lateral shifting in Y-direction		(see drawing for details)*

4-fold Tooling with Central Vacuum



Vaccum supplied by		compact ejectors
Number of compact ejectors		4
Number of basic tooling device per Feeder Unit (description see below)	-	2 saddles (by Schuler)
Number of tooling units per Feeder Unit	-	4 (by customer)
Option: Tooling present control		2x2
Number of electric multicontact connectors between Crossbar Feeder and basic tooling devices		

Connections between basic tooling device and each tooling (4 fold tooling)



Number of connections vacuum/ blow off each tooling		1
Number of air connections each tooling (for additional functions)	-	2
Part present control	-	by compact ejectors

Option: Tooling present control	by proximity switch on basic saddle

2.4.2 Aufbau und Funktion

- Schuler Feeder

The Schuler Feeder system serves for part transfer between the individual press stations of the line. It consists of self-contained feeder unit with electrical drives and is attached to the press frame located between the press stations. In space saving units all necessary transfer and lift motions as well as tilting and relocation functions are integrated.

All axes have servo electrical drives for the transfer to conform to customers' requirements and operation, tuned for max. efficiency. All adjustment axes are monitored by encoders at the motors. All axes can be dynamically superimposed and infinitely programmed.

The Schuler Feeder makes it possible to drive the press slides in offset crank angles to each other. In this way the part transfer receives a greater time frame.

The Schuler Feeder consists of a single arm automation which carries the crossbar at its center thus reducing the crossbar deflection. All drive motions for transfer and relocation are integrated in the Schuler Feeder.

The Schuler Feeder allows the line to run in continuous run and single stroke mode.

The proven electrical components including cabinets are according to Schuler standard.

Drives for transfer- (X- Axis) and lift stroke (Z- Axis)

The vertical movement of the unit takes place by a combination of rotation of the arms. The horizontal motion (feed index) of the feeder is by combination of rotation of the arms including lifting and lowering. Each joint of the arms is driven and controlled by a direct drive. All axes are freely programmable by the servo motor drives.

Interlocking

All axis are locked by motor brakes.

Crossbar

The crossbar is driven by link arms and is of hollow type profile design.

Light weight design of crossbar for high performance mechanical properties, strength, stiffness and rigidity. Using this design the moving weight is low, allowing a higher stroke rate of the press system.

The crossbar carries the part depending tooling which takes the press parts.

The tooling is not within the scope of supply.

Tilting the crossbar around Y- Axis

The crossbar can be tilted around the Y- axis additionally, separately from the other. It allows production of press parts of higher complexity with increased strokes per minute.

- Motions in the Y- Axis

  Spreading of parts resp. lateral shifting (B, in Y- direction), either separately for each side or synchronous.

  Quick couplings

  The crossbar is equipped with controlled air connections for suction and blowing (each separated) as well as for special functions of the tooling.

  Quick couplings connect the vacuum cups on the tooling with the air supply system. The part monitoring is electrically monitored. In case of special functions of the tooling (e. g. a gripper system attached to the tooling), this will be connected by quick couplings with the compressed air supply system.

  To maintain short switching times, the feeding is from both sides of the crossbar, each side by separate valves. These are controlled by Profinet with dynamic cams.

  Painting Colors for Schuler Feeder

  Painting colors of Schuler Feeder according corporate design:

  - Movable parts: Light grey (RAL 7035)
  - Stationary parts: Light grey (RAL 7035)
  - Exception: Air vessels according local governments regulations
  - Without painting (if applicable): Aluminum parts, carbon-fiber parts, stainless steel deflectors for cable chains

2.4.3 Schuler Feeder with Additional Axis

The advanced Feeder unit provides additional axis for most complex die operations and optimisation of double part transportation with additional shifting or spreading functions.

Additional Drives		
Number of motors for		
– A Tilting around X- Axis	-	1x (D-axis)
– C Tilting around Z- Axis	-	1x (F-axis)
Type	-	Servo
Additional Tilting Axis		
A Tilting crossbar around X – Axis	°	±7,5
C Tilting crossbar around Z – Axis	°	±7,5
Additional Locking		
Number of lockings	-	all axis with motor brakes
Locked axis	-	all axis with motor brakes
Manufacturer	-	BOSCH REXROTH
Monitoring of locking	Y / N	N
Locking, additional mechanical visualization	Y / N	N

- Tilting around X- and Z- Axis

These additional axis are considered within the **Schuler Feeder-0** (Centering). For the following **Schuler Feeder 1-n**, these additional axis are **optional** (as **Option**).

The Crossbar of the Schuler Feeder is tilted around x-axis and z-axis by individual servomotors.

- Tilting of Double Parts (not included)

  This function is part of a special tooling and not included in scope of supply.

  By an additional air connection, which is available on the basic tooling device, a function for tilting of double parts integrated in the tooling can be supplied with air.

  Additionally tilting motions for double parts, around the Y1 and Y2- axis can be done via linear drives for lateral adjustment, if resp. fixtures have been included in the part specific tooling. In this case the tilt and shift motions are in a firm connection.

2.4.4 Zusätzliche Ausrüstung und Funktionen (inklusive)

Standard Motion Curves - Programming of Die Sets

Four (4) standard motion curves will be supplied by SCHULER. All other motion curves shall be supplied against payment by Customer.

Automatic Change for Crossbar Feeder Tooling

Part specific tooling will be exchanged during the automatic die change by means of automatically driven tooling carts. One tooling cart is related to each press gap or feeder system. The tooling will be transferred to and taken over from the tooling carts which move in new tooling and out the old tooling. Loading takes place in reverse sequence.

The automatic die change takes place in the following order:

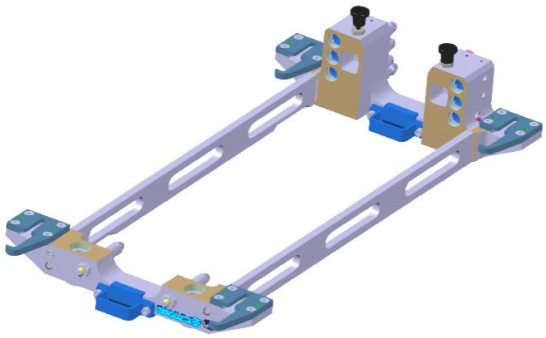
- Driving of tooling carts into the press line
- Moving the tooling into tooling change position
- Unlocking from crossbar and locking to cart
- Moving of Crossbar Feeder to tooling take over position
- Taken over of tooling in reverse order
- The Crossbar Feeder drives into park position
- Driving out of tooling carts

Tooling is to be changed manually outside the press line during production.

2.4.5 Basic Tooling Device

The “Basic Tooling Device” is attached at each side (left side / right side) of the Crossbar of the Feeder Unit (not for Feeder Unit with centering function). For the automatic

tooling change cart a Basic Tooling Device is required at each side (left side / right side) as well. The design is identical for each side.



Basic Tooling Device (reference picture, may differ in the specific case)

The scope of supply comprises:

Units of Basic Tooling Device

- Two (2) units at each Feeder Unit
- Two (2) units for one tooling change cart of each Feeder Unit

Features

The “Basic Tooling Device” is designed as a rigid frame with an interface towards the tooling. Furthermore the Basic Tooling Device is designed with a standard interface towards the Crossbar of the Feeder Unit and the tooling cart for automatic tooling change.

Following connections are provided within the interface:

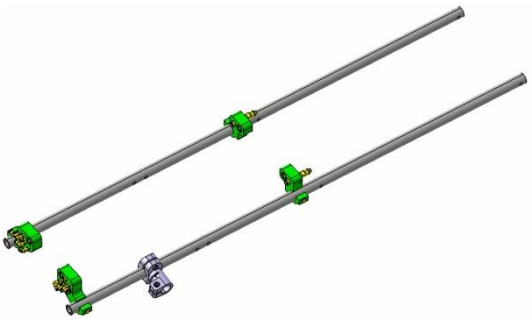
- mechanical coupling of Basic Tooling Device to the Crossbar of the Feeder Unit and the tooling cart for automatic die change
- mechanical coupling device for coupling the tooling to the Basic Tooling Device
- Compressed air and electrical interface (see description of tooling)

Advantages

- reduced storage space for tooling
- reduced investment for additional tooling

Tooling Interface for Crossbar at Feeder Unit

The tooling is supplied by the customer including the interface of the tooling. The tooling interface is designed for the required connection to the basic tooling device or single tooling.



Tooling supplied by customer (only for reference) – shown without suction cups, piping, electric, compressed air, etc.

2.5 Simulation Tool: Virtual Production Simulation (as separate package)

2.5.1 Purpose of the digital Press Model

The virtual production simulation increases production efficiency, part quality and avoids failures during set up of the transfer movement, die and tooling design.

The simulation tool includes all relevant components, offers all settings and adjustment ranges (motion curves, interference areas) in order to define the production movement.

2.5.2 Results of the simulation

Results of the simulation are:

- Definition of the part movement (transfer flow chart)
- Design verification of tooling equipment
- Validation of the die design or definition of permissible die size
- Validation of the interference free production movements
- Validation of the interference free die change movements (Option).
- Validation of the pre-setting, e.g. checking of the pressure pins, the position of the tooling set up .
- Offline-programming of press and transfer.

For this purpose the model of the press and transfer is available with the following information

- Dynamic, logical and physical limitations are represented.
- Adjustability of all relevant parameters for the transfer movement
- Integrated dimensioning and verification algorithms at the respective press line
- Display and down load of all relevant settings.

- **Adjustment of press parameters**

  All relevant process parameters can be adjusted.

- **Transfer flow chart**

  The operation sequences defined in the process flow chart (part tilting, trimming operation with scrap sizes) are positioned in the individual press stations. The transfer and press settings, like transfer height or lift stroke, and the selection of press motion are defined. The die specific tooling is verified.

  The part transfer including tooling and transfer movement is simulated. Potential interference components (die structure, pads, cams, gibs, pins, and the related working positions) are to be shown in the simulation.

  The verification of the simulation process either confirms the system settings or drives a change in the process sequence. Swept volumes defining permissible die sizes can be displayed

  These volumes specify die design as the suction cup arrangement defines the design of the tooling.

- **Simulation of the production process**

  During simulation of the production process the interaction of the motion curve of the transfer and slide is verified. Therefore the die structure is added. All movable components are shown in working position and in resting position. The clearance of press, die, automation and part movement is analysed. The validation of the transfer supports the die design. This procedure results in a concurrent engineering approach of system setup and die/tooling design.

- **Die Design**

  The press specific components influencing die design (bed, slide etc.) as well as restricted areas are included in the particular CAD-product.

  The process parameters and the part specific automation equipment are integrated and used also as specification for die design.

  For verification of pressure pin and t-slot positions or centering pins or scrap chutes during the die design, these parts are integrated in the press model by respective drawings.

2.5.3 DigiSim2.0

- **Scope of supply**
  - CAD Model of the press line, User interface for defining system parameters.
  - Control software to determine the motion parameters based on control parameters
  - Import-Export of die specific line adjustments
  - Interface to PLS system

2.5.4 PLS 3D Simulation Tool (DigiSim-View)

- The PLS 3D System displays the CAD-Modell of the line and animates the movements.
- Included functions:
  - Speed Selection
  - Collision check
  - Selection of component visualization (Hide / Unhide)
  - Organization of die and tooling data

2.5.5 Option Training

Included in quotation are 10 days of additional training for the digital simulation tool (5 days theoretical, 5 days hands on).

- **5 day theoretical training**

  Basic System Understanding (7) hours
  - Purpose of the system
  - Overview of possible adjustments
  - Use of the simulation in different steps of the process chain

File Management	(3) hours
• Open New Project	
• Save Project	
• Open Existing Project	
Transfer movement	10) hours
• Update movement to part positioning	
• Optimize movement for max. output	
• Define movement direction	
• Change position and timing of movement direction	
Press movement	(5) hours
• Definition of press movement	
Synchronization	(5) hours
• Transfer distance	
• Transfer-Press synchronization	
• Press and transfer movement variation for increased clearance	
Data Exchange	(3) hours
• Export Control Data to Line	
• Import Control Data from Line	
Total Sum	(30) hours

- **5 days hands on**

  During this part of the training die sets (supplied by customer) are adjusted in the simulation, exported to the production line and optimized either at the line or at the simulation.

  It is within the responsibility of the customer to prepare the required data and production schedule in order to select the preferred die sets.

  The highest percentage of this training will be on production site.

  The training will be at customers' plant. We expect training class rooms at customers' plant providing suitable training equipment.

  All training courses will be held in English. Customer is to supply translator if needed.

  The daily training will be in 8 teaching units lasting 45 minutes during day shift.

2.5.6 Optionale Ausrüstung für Crossbar Feeder

Tooling Set for Crossbar Feeder

One (1) set of tooling is quoted for (1) die set for the Crossbar Feeder (part to be defined), including design and calculation.

This number assumes an average part spectrum. Final prices will adapted after final agreement about number and sizes of parts.

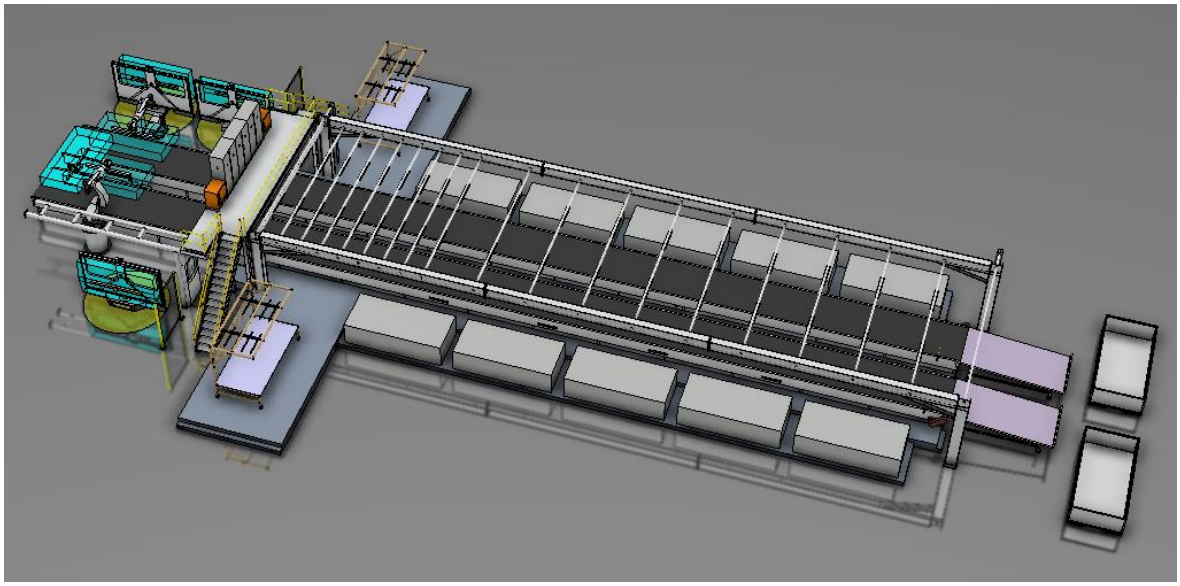
Separate Cooling Circuit for the fluid cooled Servo motors of Crossbar Feeder

A separate cooling unit as closed loop industrial system is used for cooling of the servo motors of the Crossbar Feeder independent from the plant cooling supply line. The cooling unit works as water-air cooler and is located in the basement.

2.6 Unloading Feeder (Unloading of Last Press) - Crossbar Feeder

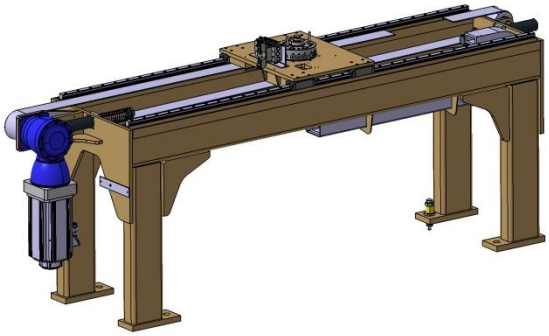
The unloading feeder serves the purpose to unload parts from the last press. The part is moved to the EOL unit. The design of this CBF is identical to the Crossbar Feeder, which are applied for the interpress automation. Technical data and description see within chapter “Interpress automation – Crossbar Feeder”.

2.7 End of Line System



2.7.1 Shuttle

On top of the shuttle, there is a deposit station, to take over the finished parts from the Crossbar Feeder of the last press stage. The shuttle transports the parts from the deposit station to the receiving position of the orientation robot. At the same time turning the unit is possible. The positioning is done via servo motor.



(Reference image)

Single components are placed alternating with left robot on the left exit conveyor and with right robot on the right exit conveyor.

Double components can either be handled as single components or can be split and placed on left and right exit conveyor.

Part turning ± 90° during transportation via servo motor.

Specific application:

- Fast-action coupling with integrated power supply for automatic tooling change.
- Basic tooling beam according Schuler design.
- Option: Vacuum generation by vacuum pump (X-Pump) instead of venturi at the tooling.

Technical data:

Number of deposit stations		1
Number of basic tooling beams		2
Travel way	mm	1800
Turning by selection		± 90°
Number of valves for vacuum circuits in tooling (Venturi)		4

Option: Number of vacuum pumps (X-Pump)	4

2.7.2 Orientation robot

The orientation robots take the parts from the shuttle and place them in a defined position on the exit conveyor.

Design:

- Standing 6-axis-robot.
- Standard robot control.
- Hand-held programming device with connecting cable.
- Integrated energy supply through axis 1.
- Connecting cable from robot to robot cabinet.
- Valve for control of tooling.
- Installation planning for robot.
- Installation of robot including installation plate for pneumatic and electric.
- Connecting cable from robot cabinet to control cabinet in cable channel on floor.
- The backup program of the robot manufacturer is used for local data saving.

Specific application:

- Fast-action coupling with integrated power supply for automatic tooling change.
- Basic tooling beam according Schuler design.
- Vacuum generation Venturi.
- **Option**: Vacuum generation by vacuum pump (X-Pump) instead of Venturi at the tooling.

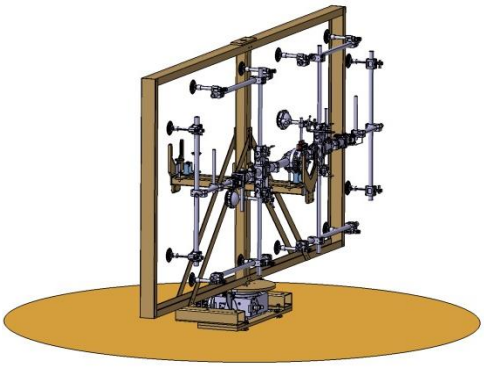
Technical data:

Type of robot		Kuka Robot
Number of robots		2
Robot control		KRC4
Cable length hand programming device	m	10
Connecting cable from robot to robot cabinet	m	max. 25
Number of basic tooling beams for each robot		2
Number of valves for vacuum circuits in tooling (venturi) at each robot		2

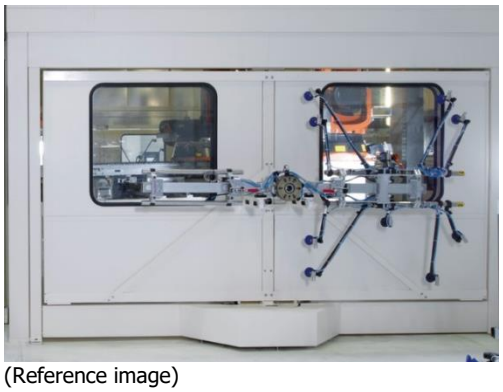
Option: Number of vacuum pumps (X-Pump) at each robot	4

2.7.3 Automatic tooling change for End of Line

The turning gate is used for a fully automatic change of the tooling for the robots and the shuttle



(Reference image)



(Reference image)

Design:

- Frame in a welded steel design.
- Turn axis driven by electric motor.
- Proximity sensors for recognition of both change positions.
- Two tooling deposits with sensor for tooling detection.
- Access protection around moving area.

Cycle:

- Parallel to production the tooling for the next part is set up by the operator.
- The safety area will be closed and reset by push button.
- The robot hangs its tooling in at the inner side of the turning gate.
- The turning gate turns 180°.
- Automatic coupling of the new tooling to the robot.

Technical data:

Number of deposits (each station)	2
Number of turning gates	3

2.7.4 Tooling for orientation robots

Tooling is not included in the scope of delivery.

2.7.5 Exit conveyor

The exit conveyor transports the finished press parts from the deposit position to the stacking position.

Design:

- Frame as steel design.
- Conveyor as wide belt.
- Conveyor driven by electric motor.
- Transport speed can be set via product data.
- Operation in continuous mode and cycle mode.
- Fixed installation on the floor.
- Overrun protection by means of sensor.
- **Option**: Parallel height adjustment through push button.
- **Option**: Pedestal left, right and between the exit conveyors.

Technical data:

Number of wide belts		2
Length outside safety protection End of Line	m	26
Belt width	mm	1800
Belt material		Novo 60 (Forbo Siegling)
Transport height above floor	mm	900

2.7.6 Steel platform and stairway End of Line

- Steel platform including a stairway to the crown of the last press and a crossing over the exit conveyors.
- The electrical cabinets of End of Line are installed on the crossing over the exit conveyors.

2.7.7 Lighting section for part inspection

Lighting system for visual part inspection fitted over the first stacking station of the conveyor belts.

- Frame for fixation of the lamps.
- 14 x LED lamps Regiolux PSO/1500 LED from above, no special lighting.

Technical data:

Length of lighting	m	5
Illuminance	lux	2000

2.7.8 Safety protection and sound protection equipment End of Line

The following safety devices are supplied:

- Safety enclosure with sound protection according layout.
- Access protection around the moving area of the automatic tooling change by means of safety fence or light barriers for the area of the moving bolsters.
- Access doors are protected electrically.
- For noise emission level: see chapter “Noise emission level”
- Lighting: 300 lux.
- Roof made of sound protection elements. It cannot be walked on the roof of the sound protection.

Technical data:

Number of safety light barriers	0
Number of access doors	2
Number of tooling change turning doors	3

3. System Elektrik

3.1 Allgemein

3.1.1 Scope of Delivery

The Scope of Delivery includes:

- Engineering
- Project-management
- Delivery of complete hardware and software
- Electrical installation machine
- Coordination and connection of interfaces
- Startup at customers facility
- Buy-off
- Documentation

3.1.2 Design Concept

The electrical equipment is designed for:

- High safety standards for personnel and equipment
- High performance functionality
- High reliability and long service life
- Easy operation, Quick fault diagnostic and fault elimination
- Fast installation and startup

This is achieved through:

- Use of proven components and systems from highly acclaimed manufacturers to assure long-term availability and extensive service and spare part delivery
- Limiting to few standard components
- Simple structure of control system
- use of remote PLC – I / O`s
- use of standardized, proven function modules for hardware and software
- ergonomically design of HMI
- availability of training on the systems
- good accessibility, exchangeability and identification of individual components
- detailed and comprehensive documentation done with Electric CAD systems

3.2 Elektrische Ausrüstung

Grundlage für die elektrische Ausführung der Anlage ist die Schuler „Spezifikation elektrische Ausrüstung“.

3.2.1 Spezifikation elektrische Ausrüstung

3.2.2 Specification Electrical Equipment (EU)

The line is designed according to the Schuler „Specification Electrical Equipment Line“.

- **Extract of the electrical specification**

  For final quote an extended extract of the electrical specification with the main points will be enclosed.

- **Guidelines, laws, standards and regulations**

  National regulations

  National laws are to be observed

  Schuler Guidelines

  Schuler Safety Guidelines have to be applied.

  Schuler ePlan-P8 Guideline has to be applied

  Schuler-Programming Guideline has to be applied

  Customer specifications

  No customer specifications are to be observed

  Use of special material

  No silicon materials should be used! (Requirements of the automotive industry)

Power plant - regulations

No restrictions for direct starting operation of squirrel-cage-motors

Engineering design

Plc control Siemens S7F with Profinet-Safe

HMI SPACE with WinCC

SDDM with WinCC

Motion Control with Beckhoff Twincat

Energy efficiency

Energy meter in power supply cabinet

Voltages / line connection

Operating voltage (for standard AC-motors)

400V 3/PE 50Hz

Control voltage general

24V DC

230V AC 50Hz

Voltage for lighting

24VDC (LED)

Voltage for electro-magnetic brakes

Same as for standard AC-motors

24V DC for servomotor-brakes

Line at the in-plant point of coupling (IPC)

Definition of (IPC)
Interface from grid customer to grid Schuler plant (press, press line)

Variant 1: Position of the control cabinets on platform above FOL or EOL, control cabinet stage hall or basement, **2 connection points**

connection point 1: Schuler cabinet power supply +11S0

connection point 2: Schuler cabinet main drive system +12S0

Type of connection: bus bar flanged end to SIEMENS Busway-System SIVACON LD

Position of IPC:

Interface is located on top of the Schuler control cabinet. The connection is made by the external distributor connection piece (flange end) (e.g. LD ... -FA3A) installed in the Schuler switch cabinet

Variant 2: Position of the control cabinets on platform above FOL or EOL,
1 connection point (Option)

One connection point for the entire Schuler energy rail system.

Type of connection: bus bar flanged end to SIEMENS Busway-System SIVACON LD

Position of connection point:

Interface is in the basement under platform.

The bus bar system from Schuler is guided on the shortest possible route vertically to the platform support in the basement area and ends approx. 2 m above the basement floor. It establishes the power connection for both Schuler switch cabinets + 11S0, + 12S0.

Grid, Network system

Customer: TN-C-grid (4-lines)

Machine: TN-S-grid (5-lines)

Design for the max. peak short circuit current

Ik'' = 50 kA at feed-in with conductor

Ik'' = 85 kA at feed-in with current rail system

Short circuit voltage Customer

uk </= 6%

Permissible line voltage tolerances

-10% to +10%

Max. asymmetry 3%, acc. IEC 61000-2-4 Tab. 1, cl. 3

Permissible frequency deviation

+/- 1Hz, acc. IEC 61000-2-4 Tab. 1, cl. 3

Permissible harmonic content

Initial compatibility level without Schuler max. cl.2,
compatibility level with Schuler max. cl. 3, acc. IEC 61000-2-4 Tab. 2 to 4

THD without Schuler max. 5%. THD with Schuler max. 10%, acc. IEC 61000-2-4 Tab. 5, cl. 3

Harmonic absorber

Not part of delivery

- **Operating conditions**

Permissible ambient temperatures for electrical equipment

Temperature range: +10°C to +40°C

Increased temp. Range e.g. Crown / Control cabinet platform: max. up to +45°C

Inner temperature of cabinets max. 45°C

Permissible relative atmospheric humidity

General : <=50% at +40°C (104°F) or
<=90% at +20°C (68°F)

General : between 30% and 95% (non-condensing)

Installation altitude

<= 1000m above sea level

- **Protective measures**

  Equipment grounding conductor system acc. VDE0100-540 and EN60204

  Grounding, one-sided grounding of control current circuits

  Residual-current-operated protective device for service outlets and lighting (except control cabinet lighting)

3.2.3 Material elektrische Ausrüstung

3.2.4 Electrical material main components

Separate Attachment: “Schuler_MaterialElektrischeAusruestung”

- **Sensors**

Safety switch	Pilz PSEN
Safety switch	Siemens 3SE…
Safety door locking mechanism	Schmersal AZM...

- **Motors**

Servo motor	BoschRexroth MS2N…
Servo motor	Siemens FT…

Motor	IEC-Norm motor
Main drive with servo motor	Oswald
Energy buffer motor	Oswald

- **Control**

Industrial pc	Beckhoff C…
PLC	Siemens S7-151x-F
RT-Ethernet-Switch-Module, EtherCAT	Beckhoff
Ethernet-Managed-Switch-Module	Phoenix…
Decentral I/O plc	Siemens ET200 SP Standard/ analog HF
Distributor active	Murrelektronik MVK…

- **Visualization**

Industrial pc (server)	Beckhoff C…
Display with touchscreen	Schuler SPACEpanel 22”
Ethernet-unmanaged-switch-modul	Phoenix…

- **Operating elements and lights**

Operating elements	Siemens 3SU1…

- **Drives**

Servo Drive controller	Bosch Rexroth IndraDrive
Static frequency converter	SEW Movidrive / Bosch Rexroth IndraDrive

Power converter	Siemens Sinamics S120 with ALM / Bosch Rexroth IndraDrive ML

- **Cabinet systems**

Electrical cabinet	Rittal VX…

- **Energy distribution**

Main switch	Siemens 3xL…
Motor protection switch	Siemens 3RV10…/3RV20…
Transformer protection switch	Siemens 3RV24…
Selective module	Murr Mico Pro
Energy measurement system	Data acquisition by Phoenix, Beckhoff Terminals

- **Power supply**

Power supply	Murr Emparro / Ultra
Mains buffer module	Murr Emparro / Ultra
Ups	Eaton

- **Control unit**

Power contactor	Siemens Sirius 3RT…
Aux. contactor	Siemens Sirius 3RH...

- **Miscellaneous**

Camera system	Bosch
Roboter	Kuka control KRC5 / Handheld SMART PAD

3.2.5 Control Cabinets

- Cabinets Central Control
- Control Cabinets for Transfersystem (E.g. Crossbar Feeder, Crossbar Robot, Robots)
- Control Cabinets for Press Modules
- Control Cabinets for Aggregates
- For all control cabinets applies:
- Power outlet with external voltage
- Control cabinet lighting
- Air condition corresponding to the environmental conditions
- Fully assembled and wired on terminal strips or plug-in connectors

3.2.6 Installation

Die Ausführung der Elektroinstallation erfolgt gemäß den Schuler Richtlinien für Installation.

3.3 Steuerung

3.3.1 Steuerung Layout (Design Architektur Netzwerk)

Das Steuerungslayout zeigt den prinzipiellen Zusammenhang zwischen der Netzwerkarchitektur der Bussysteme und deren Verknüpfung zu den einzelnen Maschinenkomponenten der Anlage.

Separater Anhang: “Schuler_##_ControlLayout”

Der detaillierte Aufbau und Darstellung aller einzelner Geräte und Anlagenteile ist in den elektrischen Schaltungsunterlagen dargestellt.

3.3.2 Safety integrated PLC Control

All safety functions are controlled in Safety integrated PLC Control SIEMENS S7F.

- specific software with Schuler and manufacturer standard software units.
- Program in ladder logic.
- Press Control
- FOL Control
- EOL Control

The safety functions are designed under consideration of the relevant safety regulations (CE) and are realized with Safety integrated PLC Control.

- Emergency stop
- Safety devices like safety gates, safety doors, light barriers.
- Enable of the movement such as moving bolster
- Slide lock
- Control of the brakes and stop motion safety signals of the main drives

3.3.3 Control Realtime PLC

All realtime functions are controlled in PLC control Beckhoff

- Specific software with Schuler and manufacturer standard software units.
- Program in ladder logic.
- Maind rive Control
- Crossbar Feeder Control
- Modular Cushion Control
- FOL / EOL Servo Drive Control

3.3.4 Line Control

- **General**

The Schuler Line Control allows easy operation of the press line "SmartStopp" functions and restart functions ensure a high overall availability.
The HMI control interface of the Line Control is integrated in the main control panel.

- **The major components**

- HMI of Line Control in the MOC (with an IPC touch panel)
- Line Control (fail-safe PLC) for controlling all control and safety signals of the Line Control).
- Realtime PLC to control the drive systems
- Network for standard and safety signals: ProfiNET
- Network for data communication: Ethernet / ProfiNET
- Network for fast line communication: EtherCAT

- **main functions**

  - Control of the interfaces to FOL, EOL and external system components.
  - Coordination, monitoring and control of all control and safety functions of the Line Control.
  - Coordination, monitoring and control of the entire drive network (main drives and transfer system).
  - Control and monitoring of the automatic die change (ADC).
  - The HMI user interface is the control center for visually monitoring of the entire line process and coordination of the data handling to the individual system components.

3.3.5 Control modular cushion

- **General**

  • The control and closed loop functions of the hydraulic implemented on an IPC (Industrial PC). The software application is based on the PLC programming software IEC 61131 Beckhoff and real-time kernel TwinCAT

  • Use of SCHULER standard die cushion control software with standard libraries for TwinCAT.

  • The process reliability of the forming process is ensured by various monitoring functions.

  • The input of the product data take place on the HMI System of the press.

- **Safety**

  The control functions of the hydraulic cushion that are related to safety are combined with the control voltages of the press. Each hydraulic cylinder can be switched off during standstill by two cartridge valves in series and monitored with proximity switches. This avoids hazardous situations caused by unwanted motion.

- **HMI**

  Programming of the Die Data

The set values of the forces for each cylinder are given in tabular form with the values for position and the corresponding force. Up to 10 of these force points can be programmed, these are then linearly interpolated.

Display of actual values and setpoints

The actual values and the set values of the forces as well as the position of the hydraulic cushion and the actual values of the valves may be graphically displayed on the screen. The measurement data are stored with by the PC-based visualization system called Schuler Data and Diagnostic Monitor (SDDM).

3.3.6 Control Crossbar Feeder (CBF)

- **Drives and Servo Control**
  - Realtime PLC-Control for high performance.
  - Energy-optimized operation by using a common DC link for all movement axes.
  - Elimination of energy storage motors. The energy required for starting and braking is drawn from the DC link with the aid of capacitors.
  - Water-cooled infeed power cabinet without the need to change fan filters.
  - CBF drive cabinets in space-saving modular design.
  - Drive communication through the EtherCat Bus-System. This offers fast and robust connection and the dynamics of the drives can be fully used.
  - Brushless AC-motors guaranty high dynamic and reliability.

- **Axis movements depending on the operating mode**

Set up mode

- Situation A: Press and CBF
  - Press and crossbar feeder run coupled to the master control system. Depending on the situation, this system decides who is moving at the moment.
    This function is used to check the phase shifts.
- Situation B: CBF only
  - To set up the tooling and crossbar feeder system, all axes can be moved individually. Press is in TDC.
  - The crossbar feeder system is moved over a virtual master axis according to the programmed motion curves. The CBF axes are coupled to the master axis.

Line mode	• The Crossbar Feeder System runs coupled to the master control system.

3.4 HMI System

3.4.1 Operating Modes

- Off
- Setup mode
- Tryout mode
- Line Mode

The Operating Modes can be only changed by activating a key switch.

In “Setup” mode, all Setup functions can be activated by pressing single push buttons or soft keys.

The “Die Change” is an automatic sequence and can be executed in all modes. Manual steps of the die change must be acknowledged during the sequence on the HMI. Manual actions during interruptions of the die change sequence can be initiated in the operating mode “Setup”.

Set up mode

- General:
  - operation with preselected “inching” stroke-rate
  - slide motion is up to maximum TDC
  - slide is moving while the push-button is pressed by the operator
  - separate axis of the transfer-system (e.g. the CBF) are not coupled within this operation mode. Thus, this axis shall be operated separately
- Situation A: with closed safety gates
  - inching by **1** hand operating (by push-button INCH)
- Situation B: with one open safety gate and active light-barrier
  - inching by **2** hand operating (by push-buttons INCH + CONFIRMATION at corresponding open safety gate)

Tryout mode (One Stroke)

- General:
  - slide motion is up to maximum TDC
  - slide is moving while the push-button is pressed by the operator
  - separate axis of the transfer-system (e.g. the CBF) are not connected within this operation mode. Thus, this axis shall be operated separately
- Situation A: with closed safety gates
  - operation with preselected “One Stroke” rate
  - inching by **1** hand operating (by push-button INCH). Slide is moving while the push-button INCH is pressed by the operator
  - one Stroke, start by **1** hand operating (by push-button START). Slide motion is up to TDC
- Situation B: with open safety gate and active light-barrier
  - Inching mode by 2 hand operation (by pushbutton INCH + CONFIRMATION on associated open safety guard)
  - One stroke: by 2 hand operation (by PRESS START pushbutton + CONFIRMATION on associated open safety guard)

Line mode (Production mode)

- General:
  - transfer-system runs synchronized with presses
  - all safety gates are closed
  - operation with preselected “Production” stroke-rate
  - start by **1** hand operating (by push-button START)

3.4.2 Operating Units

- **Main Operator Console (MOC) with Central Line HMI**

The main control panel (MOC) is equipped with individual control elements and screen displays. Frequently used operating functions of the line control, are implemented by

individual control elements, other control functions are operated by means of multifunctional buttons (+/-). The MOC thus serves as a superordinate control center for the press line, which monitors the entire production process for line operation, as well as the entire ADC cycle:

The main components and functions are:

- free standing Main Operator Console
- Touch Panel (HMI System)
- Emergency stop
- Cycle end, Line Start
- Operating Automatic Die Change (ADC) functions
- Preselection operating modes
- Operating and display devices for Line functions

Figure: Main Operator Console with SPACEpanels (Only for reference)

- **Local Operating Units (right side) – Main Operation Side**

  Units attached at all uprights on right side (in material flow direction). Equipped with main operating and display devices.

  Option: Change of operating side from right to left.

  Frequently used operating functions are realized via single push buttons, additional operating functions are realized via multi-function-buttons (+/-).

  Essential Components and functions:

  - 22” Touch Panel (Visualization System)
  - Emergency stop
  - Cycle end
  - Press operating
  - Operating mode pre-selection
  - Operating and display devices for slide and Crossbar Feeder
  - Integrated Display “slide locked”
  - Safety gates up/down
  - Moving bolster operating

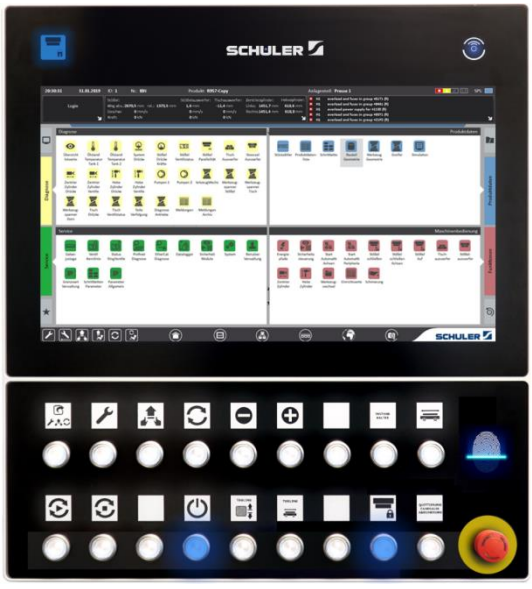


Figure: SPACEpanel 22 with Touch Panel and operation buttons

The labelling of the buttons under the display is based on ePaper technology and can therefore be switched to other languages with a single click.

- **Local Auxiliary Operating Units (left side)**

  Units are built-in in all uprights on left side, (in material flow direction).

  Frequently used operating functions are realized via single push buttons.

  Each press will be worked direct together with the related automation unit. For the Schuler control design a central control is necessary.

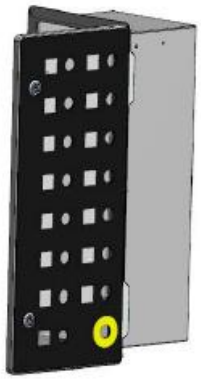


Figure: SPACEpanel OP with operation buttons

3.4.3 Signal pillar

At each press main operation upright consisting of:

type of signal	function
• Light green	ready for operation
• Light yellow	part monitoring
• Light red	fault
• Light blue	ADC

A horn for each moving bolster is also installed on the corresponding press upright.

3.4.4 HMI graphical user interface SPACE (Schuler Process Automation Environment)

The new SCHULER HMI user interface SPACE is a further development of the SCHULER Multi View visualization. The graphical user interface (GUI) has been designed according to the latest ergonomic requirements. Traditional HMI dialogs such as machine releases and function releases in the form of synoptics are still integrated in SPACE

The user interface is divided into 4 areas:

- **Status bar**

The status bar is devided into 3 areas.

- User area
- Display area of actual values
- Area for displaying messages

- **Footer bar with navigation area**

  Main navigation

  The visualization can basically be operated in 2 ways:
  - by mouse
  - by touchpad

  Footer bar

  5 icons shown are shown in the footer

	On click this icon is open all of the 4 main menus (Diagnostic, Maintenance, Product data, Functions)
	Click on this icon opens the synoptic page „Start Automatic run”
	Click on the world map icon opens a menu for changing the language of the screens.
	Is the question mark colored grey, it is possible to show a legend to the actual screen by click on the question mark icon.
	Saves a screenshot of the actual screen into the folder D://TIAProjects/SPACE/Schuler/Hardcopys ab

- **Work area**

Every press needs a lot of data that has to be entered, checked and managed. All function are grouped in 4 main areas.

- **Diagnostics (yellow)**

  All screens for monitoring and viewing the actual status of the press are shown within the tab „Diagnostics“.

  Click on the yellow bar with the caption „Diagnostics“ opens a menu, where selected data are shown.

  IMPORTANT: These display is only for diagnostics. It is not possible to change values on this screens.

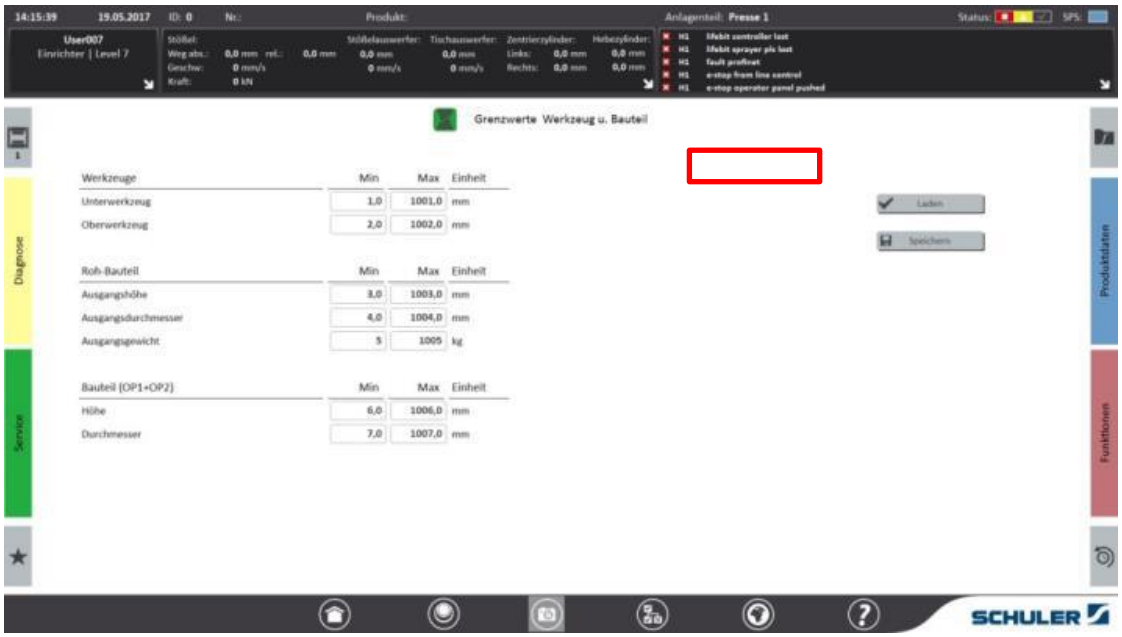
- **Service (green)**

  In the service area, all functions are grouped which are intended primarily for system administrators and service personnel.

  Click on the yellow bar with the caption „Diagnostics“ opens a menu, where all service functions are listed. All service function are primarily used by commissioning engineers and service personnel.

Changing limits

The user may not change the value here. During commissioning the values are entered by the Schuler personnel and may not be changed without release by Schuler. In case of changing the computer or occurrence of faults the values saved by Schuler can be reloaded.

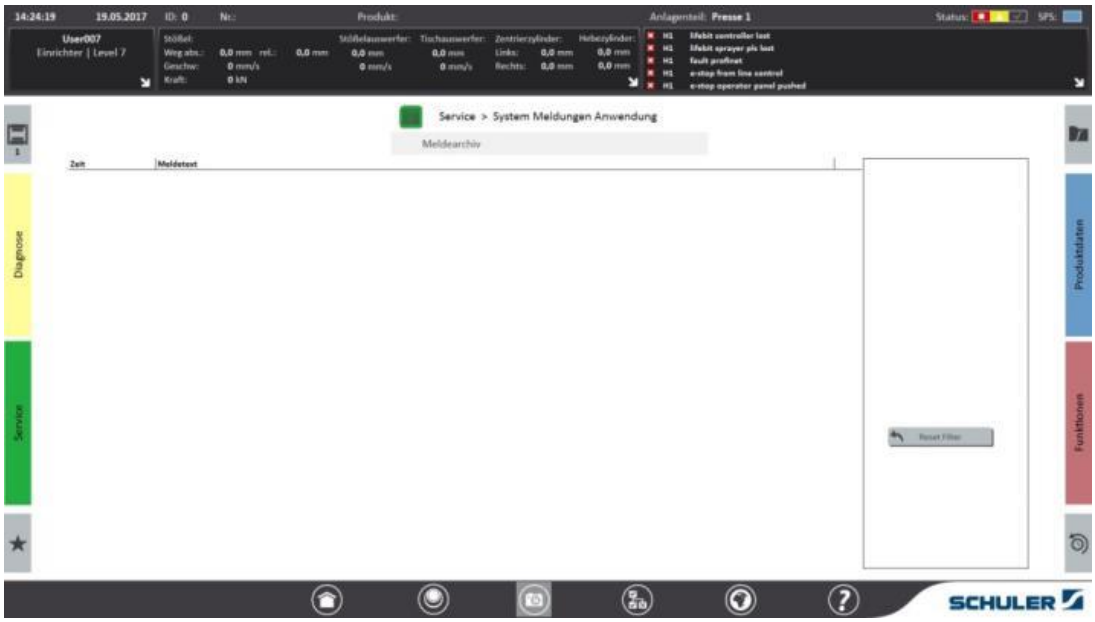


For specially trained maintenance personnel, it is possible to readjust components when replacing the components (eg encoders).
Operating errors or settings can lead to damage to the system!

System Messages - application

The system messages - application list is an enumeration of all actions performed in the user interface. Thus, logins, the loading of data records and general operating actions are documented here.

In the system messages window it is possible to filter and sort messages for better overview and information.

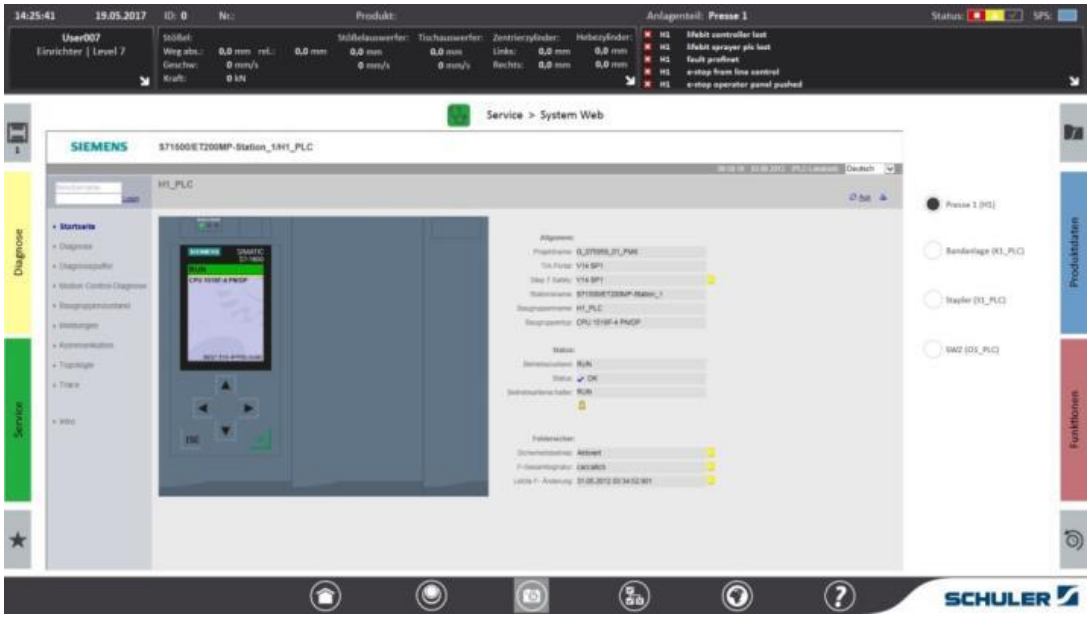


System messages WinCC / System messages TIA

These are unfiltered PLC messages, these data are intended for commissioning and service personnel.

System Web

The system web is a screen in which you can retrieve the status of the used controls and display their connections.

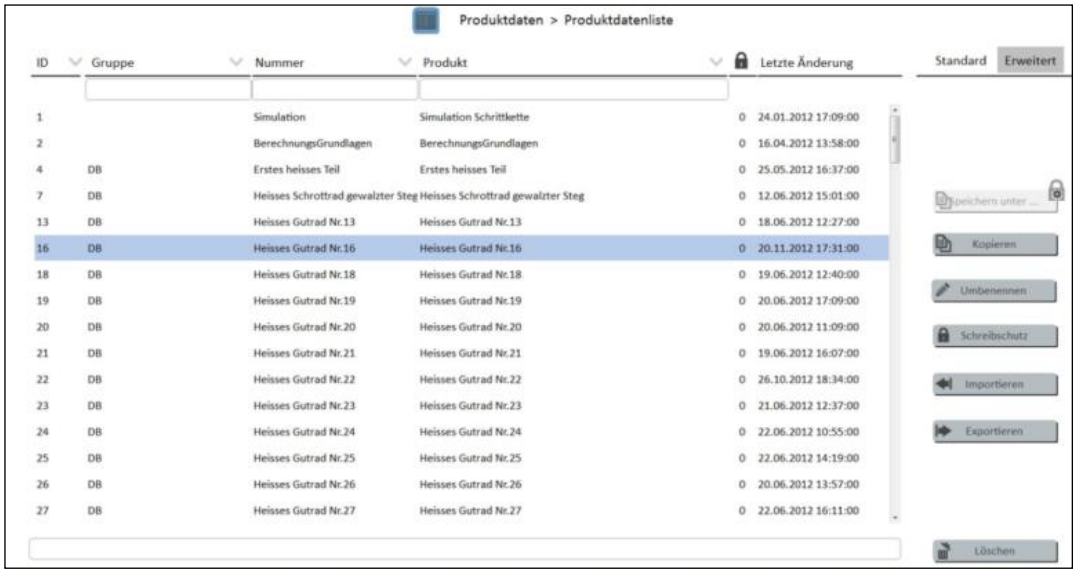


- **Production data (blue)**

  All functions for specification of the production are shown within the tab „Production data“. Here you will find above all the product data list and the functions for product data input.

- **Product data list**

  All production profiles are stored in the product data list. These production profiles are not machine-specific, but load the product target values for the entire system.

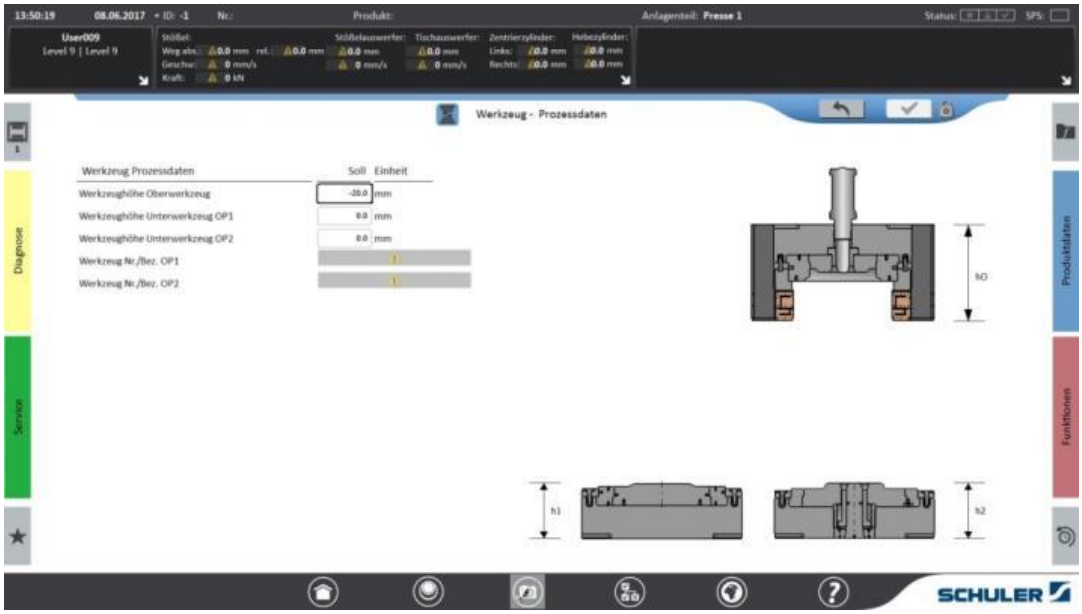


- Delete products
- Store product changes
- Add products
- Import/Export products

Input of product data

Product data is data that is stored in the record

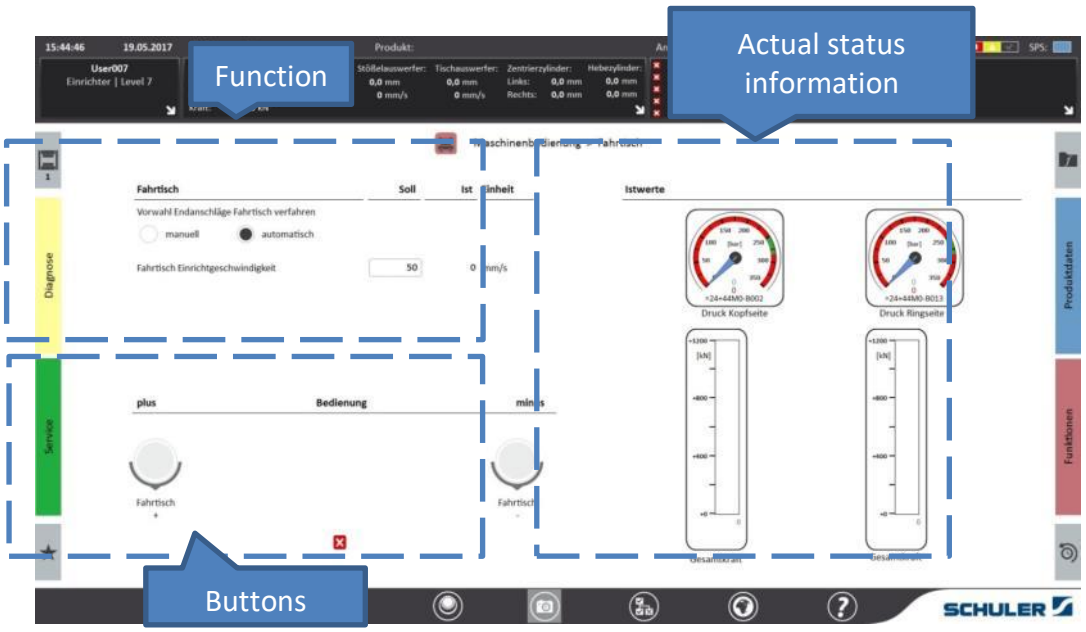
Up to 1000 complete product data records can be stored in the data memory. The data records includes all necessary product specific target values like strokes, forces, speed etc.



- **Functions/MFA (red)**

The set-up values and operator guidance for manual processes are stored for the set-up personnel are shown within the tab “Functions”. All manual processes, individual steps and approvals are to be understood by it.

All screens of the functions from the main group have the same window layout.



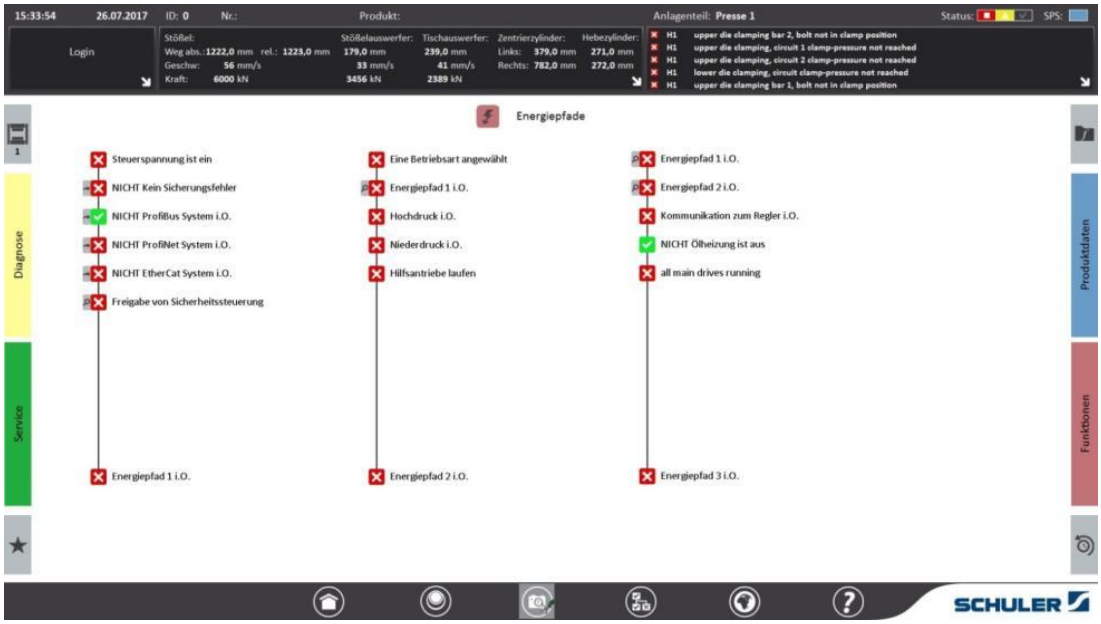
Buttons

Within the tab “Machine operating” button-icons are used as shown beside. Below each of these buttons is an indicator. This indicates if the function is enabled by the PLC.

Some commands require simultaneous pressing of the enabling button in addition to an action button.

Synoptic

The synoptic is an operator guidance that indicates whether a certain action / voltage has been released or why an action has not been released.



3.5 Steuerung Zusatzfunktionen / Zusatzausrüstung

Flywheel Energy Accumulator selectable dependent on process

The digital simulation program (option) calculates the power requirement of the dies and the motion curves. Dependent on these calculations selection or deselection of the energy accumulators is executed in the controls. For this purpose the simulation program, the motion program and the step7 program in the SIEMENS controls have to be adapted.

Scope of supply:

- Design of software.
- Documentation
- Commissioning

- **Press force monitoring system (sensors in the pressure points)**

Target

The monitoring system determines and displays the maximum individual and total values of the press forces of the last stroke. This offers the possibility of assessing, monitoring and optimizing the forming process.

The monitoring system primarily helps to control the forming process and the load on the machine, but does not represent an overload protection in the sense that the machine becomes force-free when the press force measuring device responds.

Execution

The press force is determined by measuring the hydraulic pressure changes in the pressure points and converting them into the corresponding force.

The pressure change is measured by pressure transmitters in the pressure point. Measurement signal processing and peak value determination are performed in the press control system. The measured values (peak forces) are displayed within the press visualization.

Furthermore, the permissible peak force can be specified as a tool-dependent parameter via the visualization system. The operator also has the option of selecting how the press should react when this limit value is exceeded (e.g. warning message or stopping the press).

Sensors

- 1 pressure transmitter per pressure point and press

Video Camera System with Monitors, Excecution

Scope of supply: xx cameras and y monitors including software in total on the left and right hand side of the presses. The video camera system is used for the moving bolster driving area monitoring during die change and for process monitoring during production. Functionallity All cameras can be preselected and the visual content will be displayed on the monitors. Pictures of up to 4 cameras can be displayed per monitor. The records of the cameras will be stored for some time according the capacity of the recorders. So occurrences on the press line can be analyzed later on.

3.6 Optionaler Umfang Elektrik

3.6.1 Safety concept - operation of the line Modular

The line is equipped with light barriers between all presses. This will make it possible to create safety areas using the activated light barriers and to perform limited movements of presses and/or transfer systems.

The line can be operated with closed and alternatively with partially opened lift gates / safety doors.

- With the line closed, all functions of the line can be selected and run. There is no limitation of speeds of presses and transfer systems.

- When the line is partially open, it is possible to create safety areas with the help of the activated photocells and to perform limited movements of presses and/or transfer systems.

Video Camera System with Monitors, Excecution

Scope of supply: xx cameras and y monitors including software in total on the left and right hand side of the presses. The video camera system is used for the moving bolster driving area monitoring during die change and for process monitoring during production. Functionallity All cameras can be preselected and the visual content will be displayed on the monitors. Pictures of up to 4 cameras can be displayed per monitor. The records of the cameras will be stored for some time according the capacity of the recorders. So occurrences on the press line can be analyzed later on.

3.7 SCHULER Machine Monitoring System (MMS)

The **Machine Monitoring System** (MMS) pursues the two goals of process reliability and machine efficiency

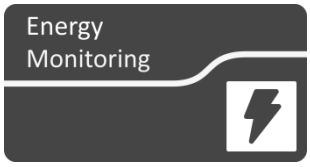
Modern Machine Monitoring System make the highest demands on sensor technology, data acquisition, forwarding, storage and automatic data processing (analysis,

diagnostics) as well as plant-specific knowledge. However, it also offers the greatest potential for cost savings, since the life of critical machine elements can be practically fully utilized, and at the same time necessary repair measures can be scheduled in coordination with the production plan.

The monitoring tasks described below are parts of the Schuler Machine Monitoring System and have the task of recording and evaluating the states of the various components / modules with methods of measurement technology.

This system is based on the know-how and experience of Schuler and is optimally embedded in the control structure of SCHULER machines.

SCHULER Energy Monitoring System



The main aim of the Energy Monitoring System is to provide the operator of our lines with information on actual energy consumption.

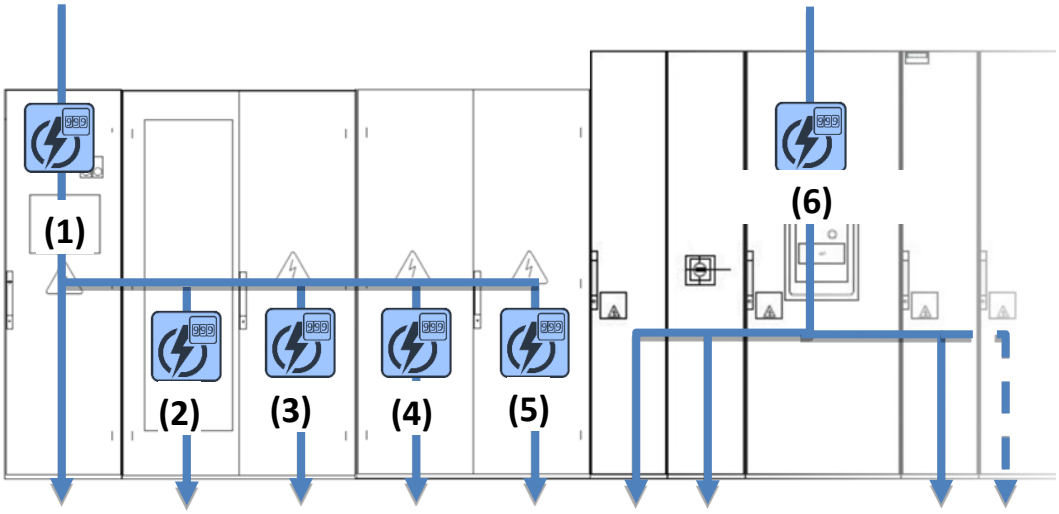
Schuler's lines are already designed to be energy-optimized in accordance with Schuler standards with regard to components, concept, and consumption.

In addition, the daily operation of the lines provides further opportunities to reduce the actual energy consumption of the lines.

The solutions developed by Schuler for measuring the consumption of electrical energy, compressed air and cooling water serve to provide information on the actual energy consumption of the lines as a basis for further evaluations and for optimizing the lines and processes.

With the help of the recorded measurement data, it is possible to compare different plant conditions and processes qualitatively and quantitatively with each other and thus draw conclusions about possible savings potential.

Measuring points consumption measurement - electrical energy



(1) Control cabinet feeding press line +11S0

(2) Outlet to control cabinet drawing device +19S0

(3) Outlet to control cabinet Crossbar Feeder +71S0

(4) Outlet to control cabinet FOL

(5) Outlet to control cabinet EOL

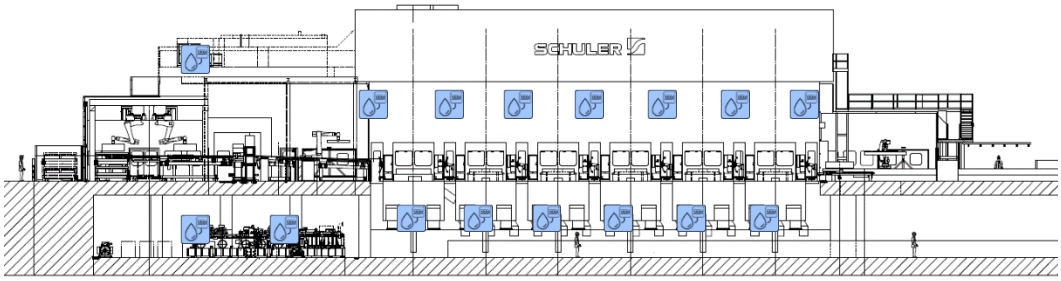
(6) Control cabinet main drives +12S0

Sensors

per measuring point

- 3x Phoenix Contact PACT RCP (configurable current transformer)
- 1x Beckhoff power terminal

Measuring points consumption measurement - cooling water



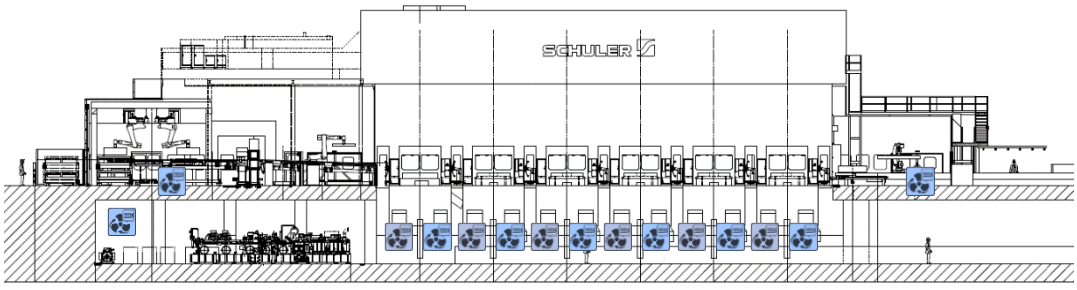
- 1x per press
- 1x per crossbar feeder
- 1x central drawing cushion unit
- 1x central lubrication unit
- 1x control cabinet cooling
- If die cooling is included in the scope of supply, one sensor per die stage with die cooling is additionally used.

Sensors

1 flow sensor per measuring point

- ≥ DN 80 Make Honsberg Type OMNI-FIS ...
- ≤ DN 50 Make IFM Type SM...
- Crossbar feeder: Make IFM Type SBY...

Measuring points consumption measurement - compressed air



- 1x low pressure per press
- 1x medium pressure per press (if included in the order)
- 1x high pressure per press

- 1x low pressure for FOL
- 1x low pressure for EOL
- 1x low pressure input on compressor (booster)

Sensors

per measuring point

- 1 flow sensor make IFM type SD...

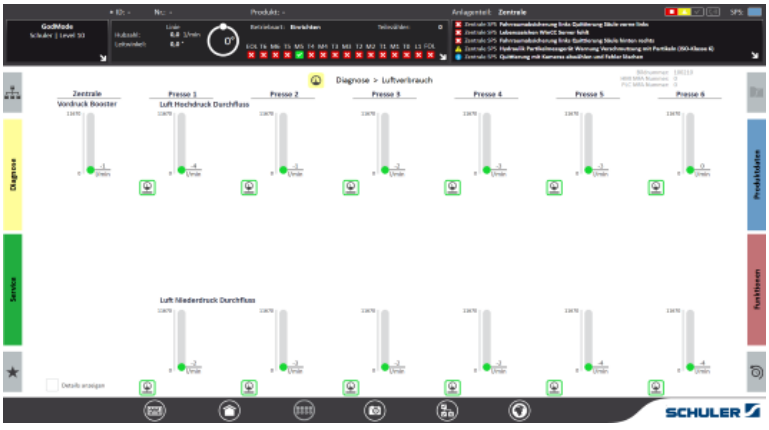
- **Analysis and display of current measured values**

The current measured values of the respective measuring points are continuously recorded with the corresponding sampling rate and displayed within the plant visualization. The measured values are not stored.

There is a separate display of the measured and consumption values for the electrical characteristic values and characteristic values of the fluid media.

Display of the current measured values

The measured values are displayed for the individual measuring points in an overview as numerical values and, if necessary, in scales. The display is updated cyclically.



Example of the overview of the current flow rates of compressed air (final implementation of the screen may differ from this)

- **Analysis and display of current and historical measured values**

The current measured values of the respective measuring points are continuously recorded with the corresponding sampling rate and stored in the data storage of the MMS computer.

Furthermore, the press line status "production" or "non-production" as well as the stroke numbers and product ID's are stored in the MMS computer.

A pre-processing of the measured values was carried out by calculating interval-based average values, minimum and maximum values.

The following analyses and displays are possible with the help of the acquired and stored data listed above:

- Display of the current measured values
- Overview of statistical basic values (max, min, average) of a period (only compressed air and cooling water)
- Display of historical stored measured values
- Display of the time period based media consumption
- Statistical analysis of media consumption values

Separate analysis and display of the measured and consumption values for the electrical characteristic values and characteristic values of the fluid media are carried out

Display of the current measured values

The measured quantities are displayed for the individual measuring points in an overview as numerical values. The display is updated cyclically.

Example of the overview of the actual values of the electrical parameters (final implementation of the display may differ from this)

Overview of statistical basic values of a period

The operator has the possibility to select a period and to display the calculated basic value minimum, maximum and average of the individual measuring points for this period.

Example of the display (final implementation of the display may differ from this)

Display of the time course of the stored measured values.

The operator has the possibility to select a period of time and to display the respective characteristic values of the individual measuring points for this period of time.

The measured values of the selected period are displayed separately in a diagram for each characteristic value (e.g. voltage, current, power or flow rate). The operator has the possibility to select a measuring point for which the measured values are displayed as described above.

Example of the overview of the display of historical data (final implementation of the display may differ from this)

Calculation and display of consumption values.

The operator can select a time period for which the consumption values are displayed for each measuring point and separately for the production status "in production", "standstill" and as a total value.

Based on the number of press strokes completed in the selected period, a specific consumption per stroke is determined and displayed for the respective measuring points and production status.

In addition, the operator has the option of selecting a tool from the list of tools/products used in the selected period.

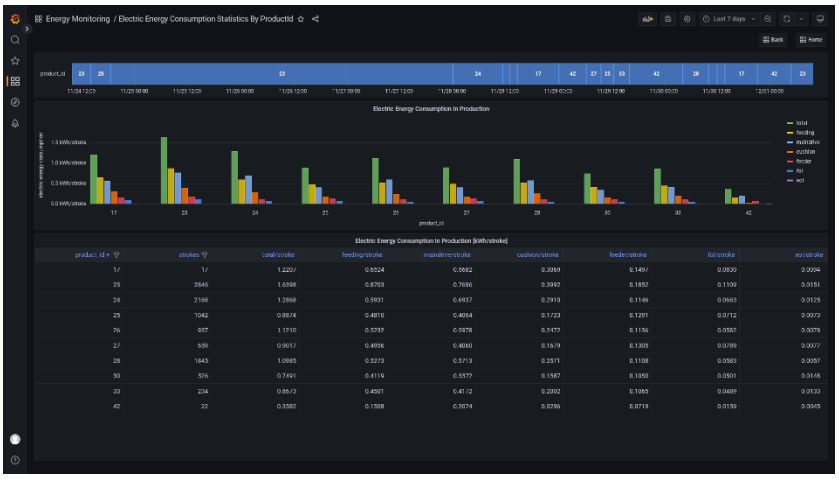
This allows the absolute and specific consumption values for a concrete tool in the selected period to be calculated and displayed. Thus, a tool-specific analysis of the consumption values is possible.

Example of the display of consumption values (final implementation of the display may differ from this)

Statistical analysis of media consumption values

The operator has the possibility to select a time period for which the consumption values for each measuring point are calculated and statistically processed.

This means that for all dies used in the selected period (product ID) and for each measuring point separately, the executed strokes and the specific consumptions are listed and displayed. In addition, a further breakdown can be made according to the different stroke numbers set for each product ID.



Example of the display (final implementation of the display may differ from this)

- **Data export**

  The operator has the possibility to export the data displayed in the predefined diagrams also as a data table and save it in a file in CSV format.

  This gives the operator the possibility to further use the data and perform further analysis and create reports.

Condition Monitoring System

The Condition Monitoring System (CMS) essentially pursues the goals of production safety and machine efficiency.

The monitoring of the machine condition is the mandatory prerequisite for condition-oriented maintenance. In the long term, this strategy is intended to replace reactive or preventive maintenance, which has been the norm up to now. In preventive maintenance, the machine is shut down at fixed intervals and components are checked or replaced.

Modern condition monitoring systems place the highest demands on sensor technology, measurement data acquisition, forwarding, storage and automatic measurement data processing (analysis, diagnosis) as well as plant-specific knowledge. However, it also offers the greatest potential for cost savings, since the service life of critical machine elements can be practically fully utilized, and at the same time necessary maintenance measures can be scheduled in coordination with the production plan.

The solutions (monitoring tasks) developed by Schuler in the field of condition monitoring have the task of measuring and evaluating the conditions of the various components and modules.

Depending on the development status of the respective solutions, they are available in different functional levels.

Function level 1:	Detection of timely faults; avoidance or minimization of component damage and consequential damage Measurement of condition variables ➔ Comparisons with limit values ➔ Display of measured values ➔ Warning and error messages
Function level 2:	Long-term observation; Manual evaluation of the Behavior of the measured data Measurement of the state variables ➔ Preprocessing of the data ➔ Storage of the data ➔ Representation of the temporal course

The aim is to make maintenance measures plannable and thus increase availability and reduce unexpected downtimes.

This system is based on Schuler's know-how and experience and is optimally embedded in the control structure of SCHULER machines.

- **Monitoring of large roller bearings by vibration analysis**

Target

The target is to detect changes in the state of the roller bearings at an early stage and before a spontaneous failure of the bearings and thus plan maintenance measures early without interrupting the production process unplanned.
If significant changes in the condition are detected by the MMS, further manual examinations can be carried out by means of external measurement technology.

Execution

The measurement takes place under defined conditions during the MMS test run to be carried out regularly.

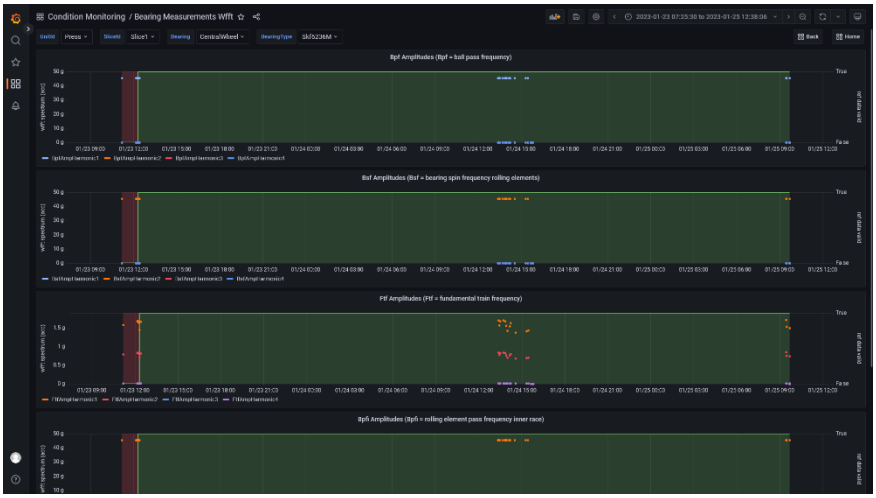
Here, the vibrations are measured and evaluated, which are generated by the movement of the bearings. The measured frequencies and amplitudes of the vibrations are typical for each bearing and depend on the dimensions and number of rolling elements.

By means of the methods of frequency analysis (for example envelope FFT) the frequency spectra are determined. The maximum amplitudes of the vibration acceleration of the bearing-typical frequencies are determined from the envelope curve spectrum.

This compressed data is stored in the database of the MMS computer.

In order to detect a change in the condition of the rolling bearings, several reference measurements are carried out in the new condition of the bearings, from which a reference value is calculated. These reference values are used as a basis for comparison for future measurements.

For each new measurement, the values obtained are compared with those reference values and a deviation is determined. If the deviation of the new values exceeds a previously defined tolerance, corresponding warning messages are generated.



Example of the extended view of the measured values and analysis results (final implementation of the screen may differ)

In addition, other KPIs such as crest factor and kurtosis are determined and displayed.

Sensors

Sensors are used according to the IEPE or ICP industry standard. The measuring points are carefully matched with the machine design and selected.

- 1 sensor per servomotor of the main press drive
- 1 sensor per energy storage motor

Monitoring of the bearing temperature of bearing bushings

Target

The target is to detect changes in the state of the bearing bushings of the drive shafts of the press gear early and to prevent spontaneous failures and further damage.

If significant changes in the condition are detected by the MMS, further investigation and maintenance measures can be planned early without interrupting the production process unplanned.

The target is to detect changes in the state of the bearing bushings of the drive shafts of the press gear early and to prevent spontaneous failures and further damage.

If significant changes in the condition are detected by the MMS, further investigation and maintenance measures can be planned early without interrupting the production process unplanned.

Execution

The temperatures of the bearing bushings are measured cyclically and compared with the last measured values.

If the new values exceed previously defined limits, corresponding warning messages are generated or the system is stopped.

Furthermore, the measured values saved in the MMS database can be displayed in diagram form over time.

By evaluating the illustrated time course, a tendency can be estimated to what extent the properties continue to change. This can be used in time to troubleshoot and, if necessary, replace the bearings.

Example of the view of the measured values and analysis results (final implementation of the screen may differ)

Sensors

- 2 sensors per drive shaft per press

4. Zusätzliche Leistungen (inklusive)

4.1 Painting according to Customer specification

Paint structure according to SCHULER painting standards (N 01.02.01).

The color scheme of the equipment will be according to the Customer specification. (A prepared color scheme is attached to the offer or can be sent on request.) Color according to RAL color system.

Some parts of the machine will have their final painting at customer’s plant.

Inner side of lubrication, hydraulic and cooling tanks as well as inner side of press frame or non-visible parts will not be painted but primed and sprayed with anti-corrosion protection oil.

Not corrosion protected piping is painted in the same color like the related body, if needed, media identification is achieved according DIN 2403.

4.2 Packing and Transport to Customers Plant

Transport to place of delivery (,) is included. Packing is included.

4.3 Cross transportation, gantry and stacking

Unloading at customer's plant, cross transportation to underneath of gantry and cleaning of parts is included in the scope of supply. Lifting gear (gantry) for stacking will be provided by Schuler.

4.4 Assembly and Start-up at customers plant

The scope of supply does include manpower, material (except production material), tools, assembly, installation and start-up of the equipment. Included are all necessary connections between the components as well as to the control cabinets, hydraulic and lubrication units and surge tanks. Not included are the connections from the plant supply lines for electricity, air, and cooling water to the feeding points on the equipment.

Interruption or severe impeding of the assembly, installation and start up, not caused by Schuler, may lead to additional time effort. This additional effort shall be charged at the rates as valid at that time.

All equipment (e.g. tools, tie rod stretching device, hooks etc.) used by Schuler or its subcontractors during assembling is not scope of supply if not mentioned otherwise.

4.5 Acceptance - Introduction

All acceptance procedures are only applicable to Schuler`s scope of supply, if not otherwise stated.

Equipment approval tests, such as for pre-acceptance and buy-off etc., will be carried out and documented in perfect accordance with SCHULER inspection procedures and standard tests.

4.6 Pre-acceptance at manufacturers site

4.6.1 Schuler internal quality checks

Schuler carries out the appropriate quality checks throughout the manufacturing process, according to the Schuler quality standards.

4.6.2 Pre-acceptance test before shipment

Pre-acceptance tests of single components will be carried out at manufacturers plant after later agreement and according to Schuler standard. Schuler will invite the CUSTOMER personnel 60 days before the pre-acceptance test. The scheduling will consider the project master schedule.

4.6.3 Pre-Acceptance FOL – EOL at manufacturer´s plant

Front of line and End of line systems will be sub assembled and pre-tested at manufacturer’s plant by specific tests and visual inspection before shipment according to Schuler standard protocols.

4.6.4 Pre-Acceptance Crossbar Feeder (CBF)

The Crossbar Feeder are tested and checked at Schuler according to Schuler standard protocols. This includes also a test-run of the CBF on a test stand.

4.7 Equipment pre-approval tests at Customer´s site - Standard

Equipment approval tests will be carried out and documented in accordance with SCHULER inspection procedures and standard tests, which are available upon request.

4.7.1 Included for Presses

- **pressure test**

  Pressure test with Schuler-Testing-Device for the presses will be done according to Schuler standard procedure.

- **Schuler Accuracy and Mechanical Values**

  Schuler accuracy and acceptance data will be according Schuler standard:

• Deflection of bed (lead off and follow up presses) and slide (lead off press) (cross to flow direction)	max. 0,125 mm/m at 2/3 distributed load
• Deflection of slide (cross to flow direction)- all presses without slide cushion	max 0,125 mm/m at 2/3 distributed load
• Maximum eccentric load during production	see attached diagrams
• Parallelism between moving bolster and slide in BDC at 0,5 x stroke before and after BDC maximum	0,08 mm/m 0,20 mm/m
• Maximum allowed deviation of angle run of slide travel half stroke down, up to 20 mm before BDC from 20 mm before BDC, down to BDC (= max. slide guidance tolerance, no guidance by link drive)	0,3 mm / m ≤ 0,4 mm
• Maximum actual height difference between the 2 moving bolster of 1 press adapted by slide adjustment	0,2 mm

4.8 Acceptance with „Technical Schuler-Acceptance Press line“

The entire line is verified according to Schuler standard acceptance protocols and procedures at customer site. The line is completely set up, all presses are running in line including automation with line functionalities.

The SPM rate for the entire line shall be proven with the maximum SPM production rate. The destacker will destack blanks from the pallets. These blanks will be transferred throughout the destacker up to the lead-off press, without forming or trimming operations. Schuler provides a test-tooling set for the relevant automation units, so that the blanks are transported by the automation units up to the lead-off press. The following downstream press line is running empty (without blanks) at the same line speed.

Test blanks in sufficient number and required quality as defined in chapter “destacker” shall be supplied by the customer in due time. The test-tooling and the blank storage in the lead-off press are property of Schuler and remain not with the customer.

The test will be done with two (2) blanking stacks with maximum blank stack height, including one stack change. If the line runs double parts (unattached) as well, the test will be done with double blanks (unattached) additionally.

The successful end of this test will be the earliest date to bring in production dies of the customer.

4.8.1 Definition: Technical Availability – with blank stacks

During the test which will be done with **(2) blank stacks** a Technical Availability of **(96 %)** of the line according to VDI guidelines 3423 under the following conditions shall be reached:

- Operation of the line by qualified personal (from customer), without changes in the personal.
- All spare parts recommended by Schuler are stored by the customer close to the line with free access to the operator.
- The technical availability applies for the duration of the test time as defined herein.

All interference by customer, by such as but not limited to quality of production material, supply of media, dies (here not applicable) and all other interference as defined under the VDI guideline 3423 or down times caused by force majeure of by circumstances not caused by Schuler, is not considered for calculation of the Technical Availability.

In case that the “Acceptance” is delayed by (2) month after the scheduled date latest, due to reasons not attributable to Schuler, the “Acceptance” shall be deemed as completed, latest after (2) month of the scheduled date.

4.8.2 Instruction

The operators will be instructed in the operation and safety aspects of the equipment. The instruction is carried out during the last week of the start-up. The operators are made available for that course by the customer.

4.8.3 Milestone – „Notice of operation readiness“

As soon as the tests as set forth are met, the **“notice of operation readiness”** shall be issued.

At customer site tests for **“notice of operation readiness”** take place. These tests are according to Schuler standard and documented within the Schuler test protocol.

The **“notice of operation readiness”** is announced in time and shall take place in any case with customer attendance.

With the **“notice of operation readiness”** it is documented, that the equipment complies with the national safety standards at site.

After the milestone **“notice of operation readiness”** the operation of the line is by the customer. Also the maintenance duties are within the responsibilities of the customer.

In case that the **“notice of operation readiness”** is delayed by **(2)** month after the scheduled date latest, due to reasons not attributable to Schuler, the **“notice of operation readiness”** shall be deemed as completed latest after (2) month of the scheduled date.

4.8.4 Milestone – „Ready for die“

As soon as the tests as set forth are met, the milestone **“Ready for die”** is reached. This will be the earliest date to bring in production dies of the customer. Major punch list items are already solved by Schuler.

4.9 Milestone: Availablility test 70% with dies

The SPM rate for the entire line shall be proven with the max. SPM production rate, for multiple die sets – ready for production - provided by customer. The destacker will destack blanks from the pallets. These blanks will be transferred throughout the destacker up to the end-of-line.

Test blanks in sufficient number and required quality as defined in chapter “destacker” shall be supplied by the customer in due time.

The customer provides in due time and good quality and in sufficient numbers multiple Die Sets (ready for production). As well the customer provides suitable tooling-sets for the automation units. The customer provides the operating personal of the line as well. The die change sequence shall be tested with these dies sets as well.

The aim is to simulate a realistic production condition. Therefore, the amount of die sets as well as die changes is limited up to the regular number of realistic production situations:

- in total **max. (2)** different die sets
- **max. (2) die set changes** in total (to be considered in calculation of availability)

- with **(5) day-shift**, consecutive

Shift 1 (07:00 am to 05:00 pm) Monday – Friday:

For the preparation of the availability test by Schuler, already tried-out die sets and toolings (by customer) shall be available. Further improvements of the tryout condition of the dies sets by the customer are possible, after a separate agreement by the parties only.

Latest after **(8) weeks after milestone I**, the **"Acceptance"** with this milestone shall take place.

Shift 2 (05:00 pm to 02:00 am) Monday – Friday:

Die tryout by customer (starting from milestone I)

4.9.1 Technical Availability – with customer dies

During this test a Technical Availability of **(70 %)** shall be reached, see definition below.

- **Assistance for die try-out**

Over the time frame of die try-out done by customer, Schuler provides an operator for the press line:

- Schuler provides supervision personal for 5 days/week
- The duration of the press operation is limited up the current milestone.

4.10 Milestone: Acceptance

As soon as the tests as set forth are met, the "acceptance" shall be issued.

At customer site the test for "Acceptance" takes place. This test is according to Schuler standard and documented within the Schuler test protocol.

The "Acceptance" is announced in time and shall take place in any case with customer attendance.

The "Acceptance" shall take place at the end of the above mentioned milestone:

For this milestone the technical availability of the line will be as shown in "Technical Availability" (see definition of availability with dies sets by customer), incl. automation.

Minor remaining topics shall be listed and timely solved by Schuler. The customer does not have out of this the right to refuse the "Acceptance". Hereto the Customer provides

Schuler enough time during the day-shift, so that all necessary works on the scope-of-supply can be done.

In case that the “Acceptance” is delayed by (2) month after the scheduled date latest, due to reasons not attributable to Schuler, the “Acceptance” shall be deemed as completed, latest after (2) month of the scheduled date.

4.11 Milestone: Availability test 96% with dies

The SPM rate for the entire line shall be proven with the max. SPM production rate, for multiple die sets – ready for production - provided by customer. The destacker will destack blanks from the pallets. These blanks will be transferred throughout the destacker up to the end-of-line.

Test blanks in sufficient number and required quality as defined in chapter “destacker” shall be supplied by the customer in due time.

The customer provides in due time and good quality and in sufficient numbers multiple Die Sets (ready for production). As well the customer provides suitable tooling-sets for the automation units. The customer provides the operating personal of the line as well. The die change sequence shall be tested with these dies sets as well.

The aim is to simulate a realistic production condition. Therefore, the amount of die sets as well as die changes is limited up to the regular number of realistic production situations:

- in total **max. (2)** different die sets
- **max. (2) die set changes** in total (to be considered in calculation of availability)
- with **(5) day-shift**, consecutive

Shift 1 (07:00 am to 05:00 pm) Monday – Friday:

For the preparation of the availability test by Schuler, already tried-out die sets and toolings (by customer) shall be available. Further improvements of the tryout condition of the dies sets by the customer are possible, after a separate agreement by the parties only.

Latest after **(8) weeks after milestone I**, the **“Acceptance”** with this milestone shall take place.

Shift 2 (05:00 pm to 02:00 am) Monday – Friday:

Die tryout by customer (starting from milestone I)

4.11.1 Technical Availability – with customer dies

During this test a Technical Availability of **(96 %)** shall be reached, see below.

- **Assistance for die try-out**

  Over the time frame of die try-out done by customer, Schuler provides an operator for the press line:
  - Schuler provides supervision personal for 5 days/week
  - The duration of the press operation is limited up the current milestone.

- **Definition: Technical Availability - with customer dies**

  During the test which will be done with customer dies a Technical Availability (see technical data above) of the entire line according to VDI guidelines 3423 under the following conditions shall be reached:
  - Operation of the line by qualified personal (from customer), without changes in the personal.
  - All spare parts recommended by Schuler are stored by the customer close to the line with free access to the operator.
  - The technical availability applies for the duration of the test time as defined for this milestone (see technical data above).
  - The stroke rate for the availability test will be agreed between customer and Schuler after determination of press part and die set.
  - The test requires the use of existing proven dies, toolings and blanks, which have to be provided by customer.

  All interference by customer, by such as but not limited to quality of production material, supply of media, dies and all other interference as defined under the VDI guideline 3423 or down times caused by force majeure of by circumstances not caused by Schuler, is not considered for calculation of the Technical Availability.

  Die try-out or any other circumstances not on behalf of Schuler not allowing producing parts are belonging to and will be considered as production time. This does not elongate the overall test time. Schuler will supply an expected down time list. Together with the customer these list items will be allocated to Schuler and customer down times according to their responsibility. Items not listed will be put on the list later after mutual agreement regarding the responsibility. The percentage of availability will be calculated according to this list.

A detailed allocation of days-shifts for the test shall take place during the order handling phase. This shall be done mutually by the project-manager from Schuler and customer, so that an acceptance test can take place in time.

- **Definition: stroke rate of customer die – for technical availability**

  The stroke rate for the availability test described as “die specific production rate” is defined and based upon following prerequisites:

  The 3D data of the die set and part is provided to Schuler, representing the real die set and part geometry.

  The SPM rate is based upon the Schuler Simulation. This Simulation considers simulation-parameters defined by Schuler, such as but not limited to: linear slide speed, slide impact speed, relevant slide positions (first contact, BDC, .release upper die,…) and velocities for standard-components. As such the Simulation does not take into account any die-specific limitations, such as but not limited to: cam speed, gas-spring requirements, cam timing and control, pneumatic air consumption of pneumatic cylinders, dynamic effects on the die and on the part and other.

  In addition, the part quality is not considered with regards to the simulated SPM rate.

  Also, the effects of the tooling (including tooling related items) on the stroke rate are not considered.

  The statement regarding the stroke rate takes into account the Schuler Scope of Supply solely.

  Because of above described topics, Schuler reserves the right to adapt the simulated “die specific production rate” in order to define a die specific production rate suitable for this technical availability test.

  In case that a part specific Electrical Energy consumption (Option) is provided by Schuler, this Energy consumption rate might differ from the rate measured during the real-production process. This is, because the actual forming force curve might vary/differ from the simulation as well as the consumption of other units, such as the automation and other factor´s beyond the influence of Schuler.

- **Acceptance Test Automatic Die Change**

  The Automatic Die Change approval test will be performed with **15 (fifteen)** consecutive die changes of which **10 (ten)** must be without any faults of any kind. If a fault occurs, it must be easily reset and the ADC continues. If any major fault occurs requiring any

intervention, the test will be restarted from the beginning. This test will be performed using **2 (two)** sets of running dies and prepared toolings supplied by the customer.

The tool change times specified in the technical data or in the tool change diagram assume a reduced slide adjustment path and a maximum of 20% difference in tool weight.

Definition: last part on the exit belt (shuttle), first part in the centring station.

4.12 Milestone: Acceptance

As soon as the tests as set forth are met, the “acceptance” shall be issued.

At customer site the test for “Acceptance” takes place. This test is according to Schuler standard and documented within the Schuler test protocol.

The “Acceptance” is announced in time and shall take place in any case with customer attendance.

The “Acceptance” shall take place at the end of the above mentioned milestone:

For this milestone the technical availability of the line will be as shown in “Technical Availability” (see definition of availability with dies sets by customer), incl. automation.

Minor remaining topics shall be listed and timely solved by Schuler. The customer does not have out of this the right to refuse the “Acceptance”. Hereto the Customer provides Schuler enough time during the day-shift, so that all necessary works on the scope-of-supply can be done.

In case that the “Acceptance” is delayed by (2) month after the scheduled date latest, due to reasons not attributable to Schuler, the “Acceptance” shall be deemed as completed, latest after (2) month of the scheduled date.

4.13 Documentation

The Documentation meets the requirements of the latest status of the EC machine standard, appendix I, number 1.7.4 and is according Schuler Standard.

Optional on request Schuler offers different styles of Documentation.

- **Scope of supply and language**

The delivery of the Documentation will be

• in the language of customers country	1-fold on USB Stick incl. documentation of purchased parts, reports and certificates

Documentation for purchased parts will be supplied in the language of customer's country only if available by original supplier. Apart from that it will be supplied in English.

- **Time of Delivery**

  For Buy Off (Schuler BÜ) of the equipment Schuler will supply a Documentation which reflects the actual status of the equipment.

  Revisions and adaptions of the equipment between Buy-Off (Schuler BÜ) and Final Acceptance (FA) are considered in a revised Documentation, which will be supplied within 40 working days after final acceptance (FA).

- **Structure of Documentation**

  The structure of the Documentation is according the recommendation of the German Association for Technical Communication (Verband für Technische Kommunication - tekom):

01	General
02	Description of the equipment
03	Safety
04	Structure and functions
05	Commissioning
06	Operating and display elements
07	Operation
08	Preventive maintenance
09	Corrective maintenance
10	Shutdown
11	Packaging and Transportation
12	Disposal
13	Spare Parts for mechanical equipment
14	Technical documents mechanical system
15	Technical documents hydraulic system

16	Technical documents pneumatic system
17	Technical documents lubrication system
18	Technical documents electrical system
19	Technical documents reports
20	Documentation of purchased parts

- **Format of Documentation**

  The documentation will be delivered in electronic format on USB Stick solely.
  The documents will be stored as .pdf-files (Adobe Acrobat®).

  Main chapters are linked to the list of content.

  Option: Documentation in paper format

  The Documentation will be supplied optional:
  - on paper, size DIN A4
  - filed and indexed by registers in folders with 4-hole technique
  - Laser prints with a maximum of 600 dpi resolution in black/white
  - Drawings in max. size DIN A3, folded to DIN A4.

  Documentation of purchased parts, reports and certificates will be in electronic style only (.pdf).

  Spare parts lists (mechanic), and device lists (electric and fluid) will be delivered in electronic style (Microsoft Excel) only.

- **Transferred Documents**

  The following documents are transferred to the customer and are also used for training:
  - Spare and wear part lists and overview drawings for identification of the spare parts.
  - General Layout and plans for customer (e.g. Bed and Slide Area)
  - Foundation Layout
  - Hydraulic and pneumatic diagrams.
  - Device list fluid with Schuler material code
  - Declaration of conformity
  - Safety instructions for the operator and maintenance staff

- Maintenance instructions with indication of the control intervals
- Schuler standard test record (mechanic)
- Technical manual: German / other languages after consulting
- Adjustment values und measurement Schuler Standard protocol

More documents than mentioned above will not be provided. Particular not supplied will be: Assembly- and detail drawings, production drawings, bills of material and software source codes.

Layout and content of the spare part lists according the attached example.

The copyrights for all drawings, calculation documents and software still remain at Schuler.

- **Documentation Electric**

The delivery of the electrical documentation refers to the following topics.

- Hardware documentation

  The Hardware documentation will be supplied according SCHULER standard in pdf Format, implemented in operation manuel.
  (Eplan licence will not be supplied).
  - Drawing system Electric circuit diagram :
    ePlan Electric P8 Version 263 (ePlan-License not included in the delivery)
  - System circuit layout:
    Splitting in function groups and locations acc. Schuler standard
  - Graphic symbol-representation:
    Schuler Standard EU acc. DIN 40719
  - Identification of electrical operational equipment:
    Schuler Standard acc. DIN 40719 respectively IEC 750 part 2.
  - Device list with Schuler material number:
    In accordance with the Schuler Group regulations, no original order number for purchased parts of spare and wearing parts is listed in the documentation
- Software documentation
  - PLC: control code parameters, backup stored on hard disk of line server
  - Motion control: parameters, backup stored on hard disk of line server

  No delivery and no documentation of source code for:
  - Schuler development tools for visualization, plc and realtime systems.
  - protected Schuler real-time applications
  - protected Schuler PLC-funktion blocks
  - protected Schuler visualization blocks or pictures."

- HMI (Visualization part)

  Visualization programs and parameter, backup stored on hard disk of line server
- Systemsoftware

  System programs and programming interfaces are not included in the delivery: Examples for corresponding programs are: Siemens SIMATIC STEP 7, WinCC, SIMOVIS, Beckhoff TwinCAT.

4.14 Site Preparation Conditions before Site Opening

Prior to start of assembly or installation, the items pointed out in this quotation have to be prepared by the customer (see responsibility list with site preparation conditions).

A common held pre-inspection on site will be done prior to planned site opening date.

- Written designation of a safety officer together with his contact details (approx. 2-4 weeks before site opening, in order to clarify plant rules, safety on customers plant, health and safety briefing on site
- Site coordinator by customer for coordination (contact coordination, contact person for Schuler)

If the site preparation conditions are not completely fulfilled, Schuler is not obligated to start assembly. Consequently the site opening date might be shifted. This may lead to a delay of buy-off and final acceptance date. The new buy-off and final acceptance date, as well as resulting additional costs, will be determined according to the actual situation (e.g. work load).

In case of complete delay of the site opening date caused by the customer, Schuler will still deliver the complete scope of supply according agreed schedule and according commercial place of delivery. If the customer is responsible for the transportation up to the site, the necessary transportation is to be provided on time by the customer. The customer is responsible to provide suitable storage areas to Schuler, with sufficient capacity within the press-shop. The cost arising out of this storage, as well as additional cost for Schuler, shall be borne by the customer. The updated buy-off date and also the final-acceptance date shall be determined according to the actual situation by Schuler.

- **Coordinator of Customer and Schuler Site Manager**

If the possibility of mutual hazard exists, due to the fact that several companies are working at the same time on customers' site, the customer has to appoint a coordinator according the regulation defined by the Institution for statutory accident insurance and prevention [Berufsgenossenschaft]. The coordinator has the authority to give directives to the Schuler employees concerning the mutual hazards. It is the responsibility of the

Schuler site manager to consult this coordinator about mutual hazards. The coordinator has to be available for the Schuler site manager directly.

The health and safety regulations which are valid at the place of installation have to be considered and kept (e.g. in Germany German Occupational Safety and Health Act (ArbSchG) and other regulations defined by the Institution for statutory accident insurance and prevention [Berufsgenossenschaft]. As a minimum the customer has to provide safety conditions according German laws and standards.

The requirements of the health and safety regulations have to be pointed out in a feasible way for Schuler's and customers employees. In case of doubt, the health and safety officer in Germany has to be consulted.

- **Safeguarding on site**

It is customers responsibility to provide correct safeguarding on site and of its hazard area according the health and safety regulations. Unauthorized persons should be kept from access. The prohibition of unauthorized entry should be suitable according the local conditions and suitable to the practicable requirements regarding the progress on site. This can be achieved by installing prohibitions of entry, placement of fix fences, protective walls, movable walls, mesh fences, chains or marker tape. Marker tape is easy to remove and should be used rarely for this reason. Separate (technical active) measures are required, if there is risk of falling e.g. by open press pits. It has to be considered that there should be only one (1) access to the site if possible.

4.15 Responsibility List together with Site Preparation Conditions

The following items (if required) are to be supplied by the customer or by Schuler:

4.15.1 Conditions for Pre Acceptance

• Provisions by customer according Schuler time schedule Delivery of agreed provisions by customer to the Schuler place of installation according Schuler time schedule.	not Schuler scope of supply
• Supply of required material in sufficient quantity and quality in time to the Schuler place of installation, if a test run is agreed.	not Schuler scope of supply
• First filling of lubrication oil, grease, hydraulic oil, wash oil or nitrogen etc., if a test run is agreed.	not Schuler scope of supply

4.15.2 Transportation, Storage and Assembly

• Transportation to european sea harbor	see commercial quotation
• Sea transportation	see commercial quotation
• Import clearance within 2 weeks	see commercial quotation
• Inland transportation within customers country	see commercial quotation
• In-plant transportation	Schuler
• Unloading and handling at site, assembly including lift gear or other erection equipment	Schuler
• Cleaning of delivered parts and disposing of packing material at customer plant	Schuler
• In-house or external storage if there is a delay by customer or enlarged import clearance	Customer
• Tie–rod tensioning device (except for first assembly, this means Schuler provision for first assembly – does not remain at customers plant)	Customer
• Start-up of equipment at customers plant	Schuler

4.15.3 Site Preparation Conditions by Customer

- Installation of workshop completed (see technical data in chapter 1)
  - Safeguarding on site. Preferably with (1) one single access
  - Anti-fall guard besides foundation pit
  - Set measurement point at floor level
  - Set measurement point at basement level
  - Press substructure (foundation) measured
  - Set batter boards for press center axis at basement and floor
  - Sufficent crane capacity available (tonnage according max. die weight)
  - Sufficient plant lighting available on floor and on basement (at least 300 Lux)
  - Press area protected from atmospheric influences (shop closed on all sides)
  - Low dust (free of builders's dust) and dry press area
  - In cases that the control cabinets are installed in seperated basement rooms: Clearance height of at least 2500 mm has to be available after installation of the door frames.
    Floor passable with forklift or hoisting device on the ceiling available.
  - Shop temperature more than 15°C and less than 30°C available

- Phone, Fax & DSL -Line (seperately für site office container and machine) close to this locations available

  For start-up of the line a remote access with min. 2-3 Mbit upload is required. If this connection is not available for Schuler additional actions need to be provided by Schuler. The cost arising out of this additional efforts, shall be borne by the customer.
- Medical first aid for Schuler available
- Sanitary facilities and recreation rooms available for Schuler employes in suitable distance (approx. 250m)
- Floor space for Schuler container available close to the location of assembly
- Parking area for the Schuler employees in suitable distance
- Approval issued (plant ID card, entrance, photographie)
- Approval issued (cran, welding)

- Free access and interim parking for heavy load trucks has to be ensured at the agreed times in the complete plant area up to the press foundation.

- The customer is responsible to provide the necessary openings in the roof and in the hall, to remove obstacles and for enlagement of access routes and for other issues:
  - Foundation of floor level ready for load of 10 t/m² in general
    Particularly the floor load capacity of 10 t / m² must be guaranteed in the following areas:
    - On floor level at pre-assebly area 15 m x 20 m = 300m². This area is located within the assembly area in front of the pít seen in assebly direction.
    - In the area of the access for heavy load trucks to the pre-assembly area.
    - 1,5 m beside left and right pit border over the line length for gantry crane.
    - For assebly by mobile crane more areas are required and have to be aggreed with Schuler.

    If the required load capacity of the mentioned areas can not be guaranteed, load capacity must be provided by the customer through appropriate measures (supporting of basement ceiling, etc.).
  - Clearance for flat-bed truck to the crane/gantry, close to the place of assembly
  - Entrance press area ready for heavy load traffic 10 t/m².
  - Vehicle access to the shop prepared for flat-bed truck, outside vehicle radius at least 26 m

- Extended entrance area with doors (Width x Height, 6 x 6 m)
- Extended entrance basement with doors (Width x Height, 6 x 6 m)
- Assembly area at floor level available in the bay (appr. 1.000 m²)
- Assembly area in basement available in the bay (appr. 800 m²)
- Outside storage area available, prepared for 10 t/m²

- Power and energy supply provided by the customer up to the aggregates
  - Building balcony for control cabinets and cable trays completed
  - Auxiliary energy pneum. 5 bar available
  - Auxiliary energy elec. 7x 45 KVA available (4x in the upper floor, 3 x in the basement. fuse protection 63A)
  - Complete power available for start-up
  - Cooling water for start-up available
  - Transformer station and power supply completed for the beginning of the start-up

- Concrete works and other works provided by the customer
  - Design and static calculations for foundation and pillars
  - Press pillars prepared for setting of leveling plates
  - Press foundation ready and able to carry load (if necessary with grouted foundation plates)
  - Anchor boxes for base plates installed
  - Opening in foundation for rails and energy supply.
  - Steel substructure for pit cover ready made and able to bear load.
  - Floor around the Press closed and ready for load of 10 t/m²
  - Required modifications on existing line components and rail system.
  - Reinforcement and plates in floor and on corners of foundation.
  - Oil and medium resistant foundation equivalent to German Act on the Regulation of Matters Pertaining to Water (Wasserhaushaltsgesetz - WHG) and German Ordinance on installations for handling of substances hazardous to waters (Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen - VUmwS)

4.15.4 Further structural measures

- Dropping protection around the pit starting from start of assembly — Schuler
- Foundation Plates — Schuler

• Levelling of foundation plates	Schuler
• Material (shim plates and screws) for foundation plates	Schuler
• Rails in foundation and bed	Schuler
• Supports on beds (for floor plates)	not Schuler scope of supply
• Material for rail leveling	Schuler
• Rail support, steel plate in foundation (6 to 8 mm doweled to the floor, with holes for grouting)	Customer
• Levelling of rails	Schuler
• Rail support between press and foundation in rail direction	Schuler
• Grout material and grouting of rails and foundation plates	Customer
• Girders for rail support	not Schuler scope of supply
• Floor covers directly around press (approx.1m around press)	Schuler
• Closing of existing pit	not Schuler scope of supply
• Floor cover support (steel work)	Schuler
• Design for floor covers respective steel work and rail support respective steel work and rail support.	Schuler
• Final floor coating or painting	Customer
• Connections from the plant supply lines for electricity, air, and cooling water to the feeding points on the presses (1 feeding point per medium and press station) including labelling and fixture.	Customer

4.15.5 Electrical Interface

• Electrical connections from the control cabinets to the supplied components up to a length of max. 35 m	Schuler
• Cable channels, cable ducts and cable trays etc. underneath (in the foundation) and inside the presses	Schuler

• Cable channels, cable ducts and cable trays etc. outside the presses (also to the control cabinet balcony)	Customer, not necessary for Schuler pressline because of cabinet platform FOL and/or EOL
• Control cabinet platform with sufficient space for the control cabinets and passage width	Schuler (above FOL and/or EOL)
• Dimensioning, delivery and installation of the cable channels on the cabinet platform	Schuler
• Transformer station and high-current busbar (TN-S net, 4 conductor net)	Customer
• Outgoing boxes for high-current busbar including fuses and assembly	Customer
• Connection of the transformer station and outgoing boxes of the high-current busbar to the main disconnect switches of the power supply cabinets	Customer
• Power supply of the cabinets till the interconnection point	Customer
• Power supply of the illumination power incl. outgoing boxes for high-current busbar including fuses and assembly	Customer
• Line conditioning harmonics	Customer
• Reactive power compensation (included in the transformer station)	Customer
• Installation and connection of the cables of the emergency lighting	
- customer side to the interconnection point	Customer
- within the press line	Schuler

4.15.6 Pre-Conditions for Schuler Acceptance at Customers Plant

• Material for production - blanks to be provided	Customer
• Early enough announcement and provision in time of 2 running die sets including tooling	Customer
• Further die sets (with tooling) and try–out of dies including transportation if required	Customer
• Engineering support for dies and tooling	Customer

• Centering pins for dies on moving bolsters	Customer
• Pressure pins in moving bolster in sufficient number and quality (complete number of pins)	Schuler
• Covers for pressure pin holes in moving bolster	not Schuler scope of supply
• Adapter plates for dies	(Customer)
• Clamping equipment for dies on moving bolster	Customer
• Automation equipment except from this quotation, e.g. tooling, suction cups, clamping devices etc.	Customer
• Drawings: See chapter 4.9 Documentation	Schuler

4.15.7 Units and Material for Production

• Required material for production (also during start-up and acceptance test runs)	Customer
• Initial fillings of lubrication oil, grease, hydraulic oil, washing oil, nitrogen etc. on site.	Customer
• Air filters and dryers. We assume, that dry and clean compressed air as specified above will be available within Schuler specified levels for quality and quantity	Customer
• Production and supply of every energy and media (e.g. electricity, air, water)	Customer
• Compressor for high pressure without air dryer and filter (air for counterbalance high pressure)	not Schuler scope of supply
• Air Vessel for high pressure for die change	Schuler
• Scrap chutes below the lower edge of press bed	Schuler
• Scrap conveyors	Customer
• Scrap boxes	Customer
• Blank feeding with safeguarding	Schuler
• End of line with safeguarding	Schuler

4.15.8 Additional Service and Provisions

• Large oil pan under floor for press line or line components	Customer
• Compatibility with “Wasser-Haushalts-Gesetz” (WHG §19) or other local laws will be ensured for the machine by Schuler and for the building by customer	Schuler/ Customer
• Cameras including software or video surveillance	not Schuler scope of supply
• Laptop computer, PC or industrial PC if not assembled within the press system	(Customer)
• Laser printer or Color printer	1x Schuler
• Programming unit	1x Schuler
• Interface to plant computer software	Schuler
• Launch assistance	not Schuler scope of supply
• Spare and wear parts	Customer
• Training	Schuler
• Additional safety equipment if not mentioned in this proposal	(Customer)
• FMEA	not Schuler scope of supply

The above mentioned items which are not Schuler scope of supply may be quoted additionally if required.

5. After Sales Service

5.1 Schulungsprogramm

5.1.1 Training Course: Terms and Conditions

Purpose of the training is operation and maintenance of the delivered production equipment. Training manuals for all participants will be distributed during the training. The training participant can comprehend and add to the content of the training documents. The training documents form the guidelines of the training and are individually supported using reference example such as videos, animations, 3D graphics and simulation, which are not actual elements of the training document.

Training time (day unit)	from 08 am to 4 pm
Training location	im Werk des Kunden oder bei Lieferanten
Deviating training times	on request
Training language	local language
Interpreter	Schuler provides (if necessary)
Training documents language	local language
Handover of the Training documentation	USB stick in the number of confirmed participants

Training date

An exact training date can only be determined once the order has been placed, depending on the current order backlog. If the event cannot take place due to force majeure or other unforeseeable events, the customer is not entitled to the training being performed by the deadline.

The following fees are charged for canceling a Schuler training session:

- Up to 14 calender days prior to the start of the event: all costs, with the exception of the costs, which arise in th ecourse of the travel and training execution of the trainer.
- Fewer than 14 calender days prior to the start oft the event: 100% of the costs

Provision of service

The seminars are carefully prepared and carried out according to the current state of knowledge. All events are conducted by experienced and renowned speakers. All materials, documents and handouts are created according to the latest findings. Schuler is not liable for damages caused by the application of skills acquired in the training or by the usage of training materials.

A basic learning objective test will be offered for each training module. This is performed only with reference to the knowledge acquired.

If the planned training content cannot be provided or only to a limited extent, for reasons which are beyond Schuler's control, the customer is not entitled to the training being completed.

Schuler reserves the right to permit participation on a case-to-case basis.

Insofar as not otherwise expressly stipulated in the scope of the order, the following services are considered in terms of the training:

- Travel costs, accommodation and catering for the trainer
- Performance of the training program
- Safety boots and protective vest for trainers
- Training date agreement with the customer, to perform the training, a minimum of up to 16 working weeks prior to starting training
- Agreements with the customer regarding training content, a minimum of up to 4 working weeks prior to starting training
- Printed handout for the number of confirmed participants
- Certificates are only provided by Schuler, only for participants who have attended the training
- In the event of training lasting several days, in directly consecutive half days
- Break of approx. 15 minutes before lunch, after lunch and a break of approx. 60 minutes at lunchtime

Insofar as not otherwise expressly stated in the scope of the order, the following services are to be provided by the customer or the customer shall assume the costs for them:

- Additional expenses not named here, which are incurred as a result of attending or staying at the training location, such as customer or country-specific safety instructions
- Adequate training space (see Forming Academy requirements catalog)
- Catering during the training event

5.1.2 Training Content

The training scope of the following described training components is only a benchmark. Within the training modules are shifts and changes in coordination with the customer possible.

Overview

Training Modules	Type	Location	Days	Runs	#P	∑#P
Principles of system	Theory	Customer				
Basics OPERATIONS	Theory	Customer				
Automation OPERATIONS	Theory & Practice	Customer				
Press line and transfer OPERATIONS	Practice	Customer				
Mechanical MAINTENANCE Automation	Theory & Practice	Customer				
Mechanical MAINTENANCE Servopress	Theory & Practice	Customer				
Electrical MAINTENANCE Automation	Theory & Practice	Customer				
Electrical MAINTENANCE Servopress	Theory & Practice	Customer				
Electric CUSHION modular	Theory & Practice	Customer				
Electric Crossbar Feeder	Theory & Practice	Customer				
HMI System	Theory & Practice	Customer				
			∑X Training days each 8 hrs.			

Comment:

Days #P	Number of training days per run Number of max. participants per run	Runs ∑#P	Number of runs for this training Total number of max. participants of all runs

A detailed description of the training content will be created after the fixing of the detailed training scope.

5.2 Launch Assistance (Option)

Schuler offer (Option) Launch Assistance after "**Acceptance**" of the press system:

- **(1)** Schuler specialist for the press line
- assistance of 8 hour/shift / 5 working days a week (MO-FR, 40h/week)
- For a periode of one **(1)** months

5.3 Launch Assistance (Option)

Schuler offer (Option) Launch Assistance after "**Acceptance**" of the press system:

- **(1)** Schuler specialist for the press line
- assistance of 8 hour/shift / 5 working days a week (MO-FR, 40h/week)
- For a periode of one **(1)** months

5.4 Spare parts (not included)

After final end of the design phase Schuler can prepare a proposal for a spare part package with individual component list:

- Mechanic
- Hydraulic
- Pneumatic
- Electric.