AIDA

DREHER AUTOMATION

Bipolar Plate Day@AIDA

Challenges for the automation for handling thin coil materials

Overview

DREHER AUTOMATION

1.

1. Update

- About Dreher Automation
- AIDA and Dreher as Partners

2.

2. Development of production concept for metallic bipolar plates

- 15 years experience in material handling with thickness less than 0,25 mm
- Development of high productive lines

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DREHER Automation

Automatic-Systeme Dreher GmbH

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- Founded in 1970
- Headquarter in
  Sulz am Neckar, Germany
- Annual turnover
  approx. 30 - 35 Mio. EUR
- Approx. 200 employees
  incl. apprentice
- Approx. 60 engineers in
  mechanic and electric design

Dreher Automation

- Duplication of production capacity to 9,250 m ^{2}

- Sustainability:
  - ➢ Building according to KfW Standard 55
  - ➢ 90 % of the electricity demand is covered by photovoltaics

Highly productive press automation

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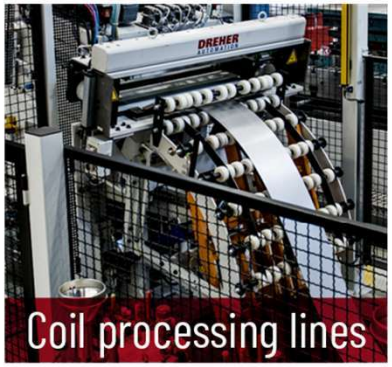

Highly efficient, future-oriented manufacturing process with maximum output.

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AIDA and Dreher as partners

Blanking line for steel

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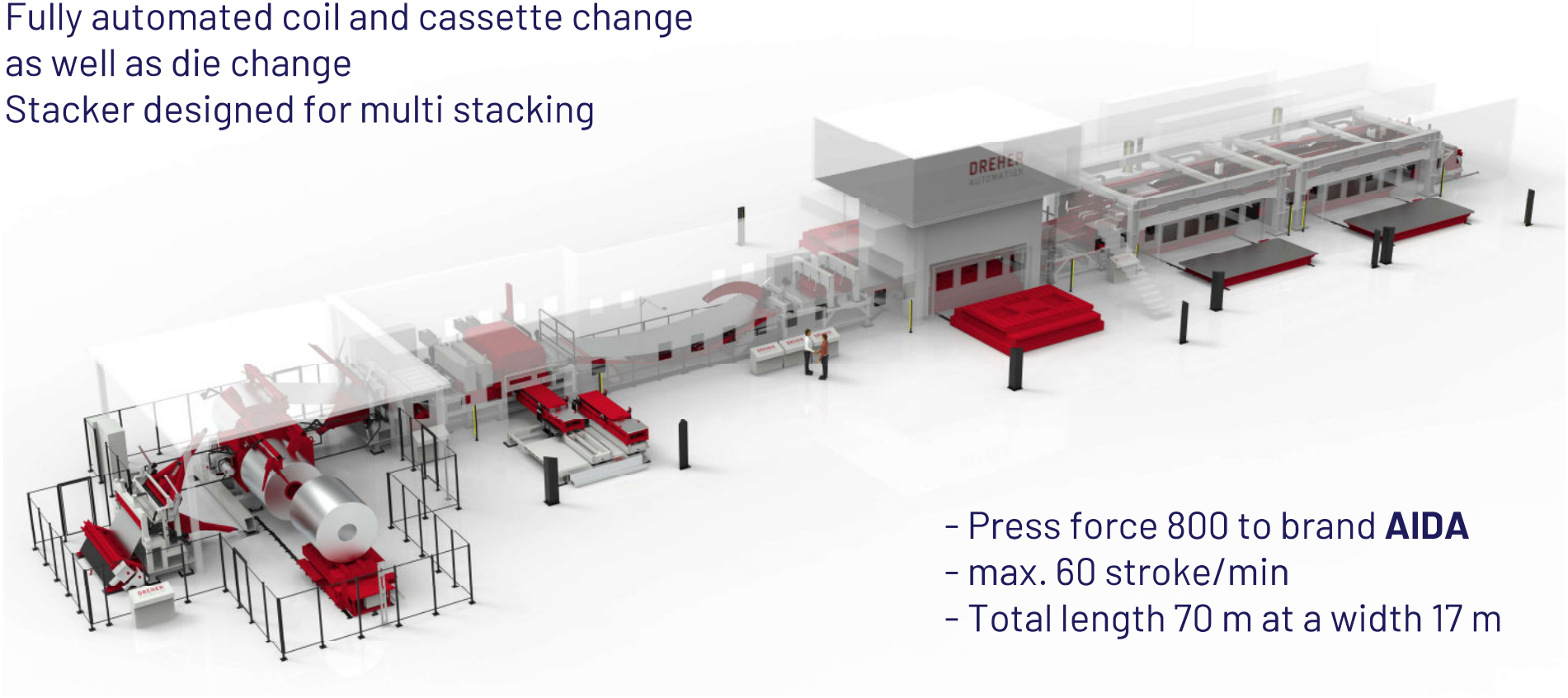
- Fully automated coil and cassette change as well as die change
- Stacker designed for multi stacking



- Press force 800 to brand **AIDA**
- max. 60 stroke/min
- Total length 70 m at a width 17 m

Blanking line for steel

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2 x 35 t double decoiler, high tensile strength steel, 800 t press, multi stacking device

Blanking line for steel and aluminum

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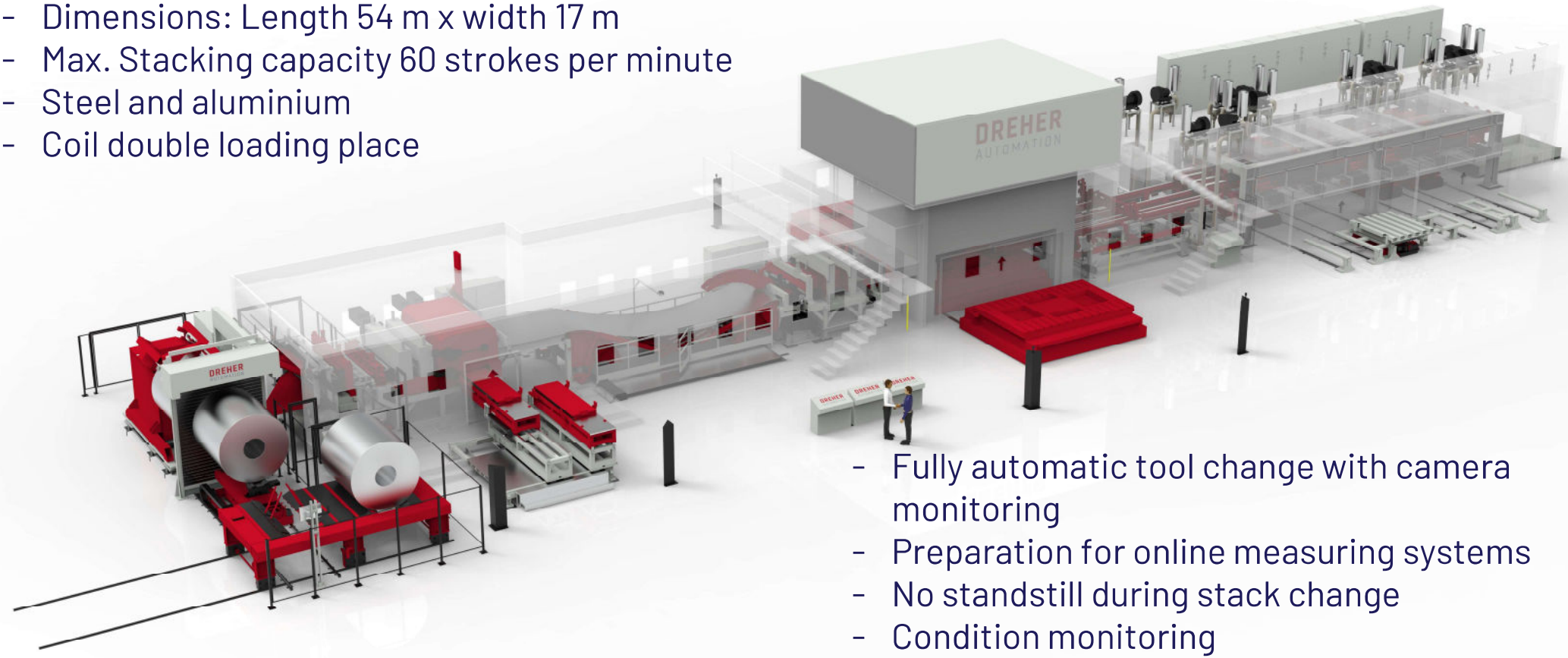
- Total pressing force: 800 t, brand **AIDA**
- Dimensions: Length 54 m x width 17 m
- Max. Stacking capacity 60 strokes per minute
- Steel and aluminium
- Coil double loading place



- Fully automatic tool change with camera monitoring
- Preparation for online measuring systems
- No standstill during stack change
- Condition monitoring
- Water-cooled main drive cabinets

Blanking line for steel and aluminum

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Automation for 1600 t AIDA Servo Press

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1600 t servo press incl. electric control of transfer from AIDA

Dreher scope of supply:

- 3 D Servo Transfer incl. servo motors
- Destacker and conveyor belt incl. control system from Dreher
- Challenge: Installation completely during Corona period in P.R. China

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Coil feeding of material with thickness less than 0,25 mm

Applications for thin material (< 0,25 mm)

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Cylinder head gaskets

Heat protection shields

Rotor – Stator parts

Single and multi-layer application

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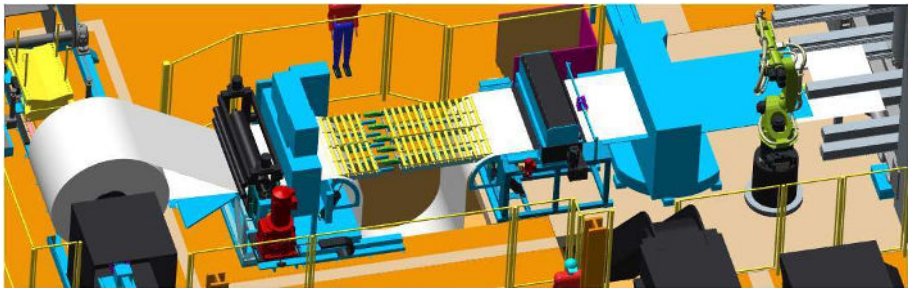
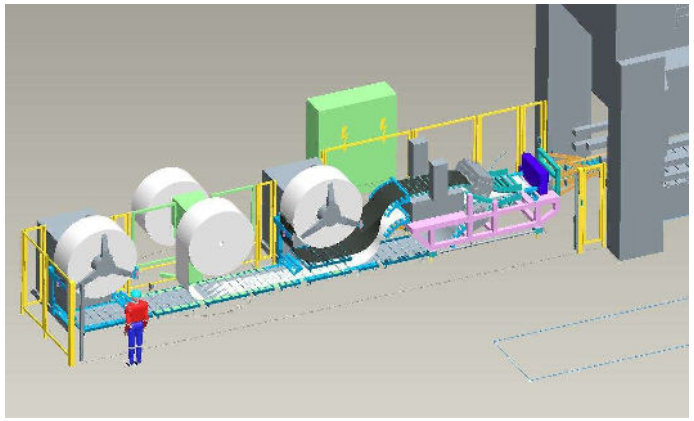


Single layer cut to length line 0,2 mm



Mulit layer with thickness 0,2 mm

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Bipolar plate production line

Mechanical bipolar plates

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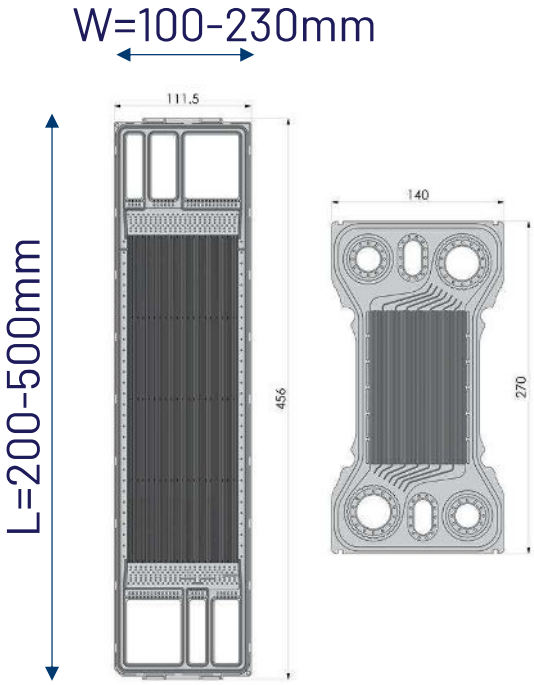
Target: >90% of the expected high volume BPP market



General requirement for the first line

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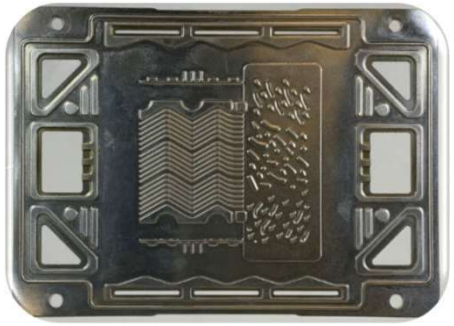
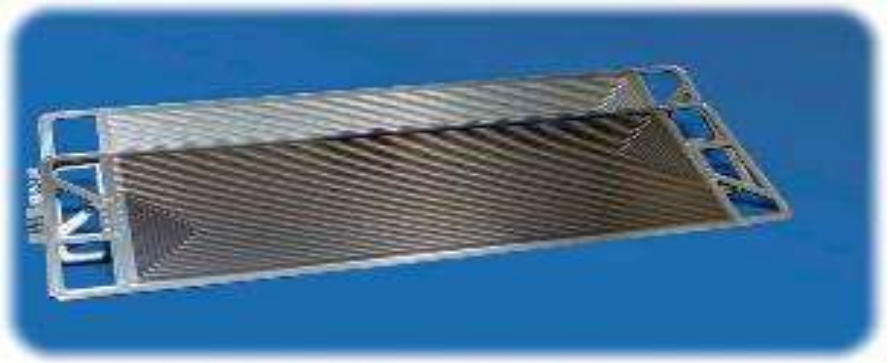
Technical parameters/requirements:

- Product dimension 400 – 140 mm
- Blank dimension 480 x 200 mm
- Material 1.4404
- Material thickness less than 0,1 mm
- Process: 1st: pre-stamping/piercing
  2nd: pre-embossing flow field
  3rd: final embossing flow field
  4th: final stamping
- Expected output ***15 spm***





Conditions and assumptions

1600 t tryout press with Dreher coil line was available at customer, but:

- Coil line designed for material > 0,3 mm
- No lubrication available (tests done with roller lubrication)
  ➡ Pushing and pulling tryout failed completely
- Change to spray lubrication including special support rolls
- Change of coil side guiding
- First development of support rolls
- Complete manual coil inserting

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Conditions:

- First experience with single tryout dies
- Material thickness 0,1 mm
- Prog. die not available
- No production press

First tryouts on die mounted transfer

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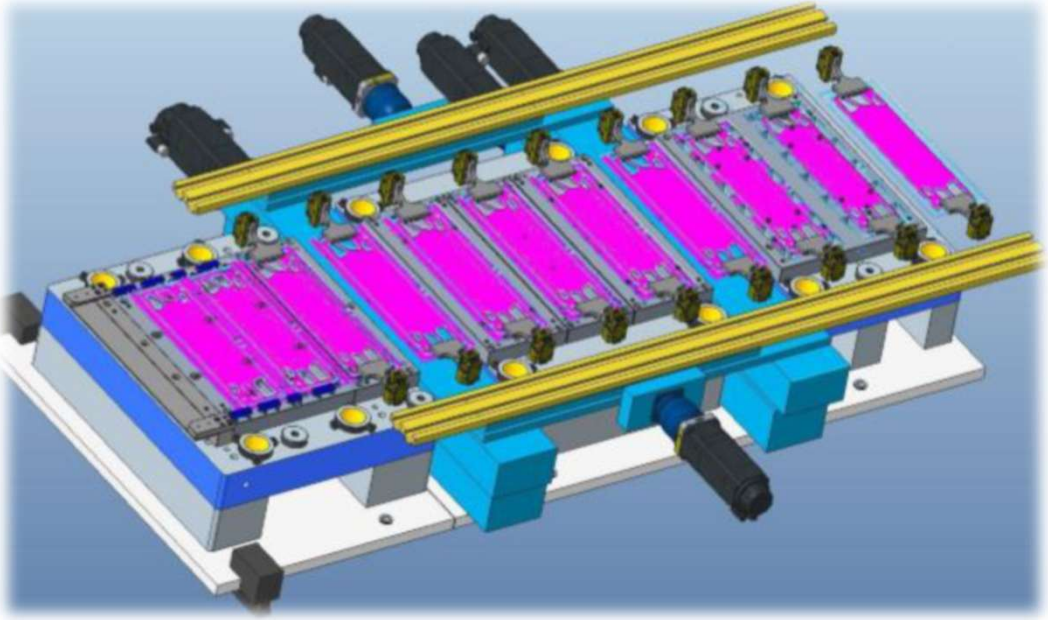

Production of bipolar plates

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Challenges for a coil line:

• Coil width min./max.	250 – 600	mm
• Coil weight, max .	25	kN
• Coil-outer diameter min.-/max.	475 - 1.200	mm
• Stainless steel thickness min.-/max.	0,075 – 0,5	mm
• Feeding accuracy at 1 m feeding length	+/- 0,1	mm
• Feeding height above floor level	1.200	mm
• Coil inserting	manual	
• Coil loading	by crane	

Major challenges:

- Feeding of very thin material
- Side guiding of thin material
- Transportation through press
- Achieving output
- Getting part out of die
- Transportation to following process
- ***Min. 40 spm***

Decision directly to combined process with transfer based on first tryout concept

Special challenges

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- Due to coil material thickness (0,075 mm) material needs to be winded on steel rolls. Therefore coils are not always in same position on the roll.

  Measure: Movable double decoiler

- Support of material required in complete coil line till die
- Support rolls also required inside spray lubrication unit
- Preventing of dust in the line and on the rolls
- Transportation of parts inside die
- Interfaces between die and part transportation
- Part execution at the end of die without damages to the part and the flow field

Line concept

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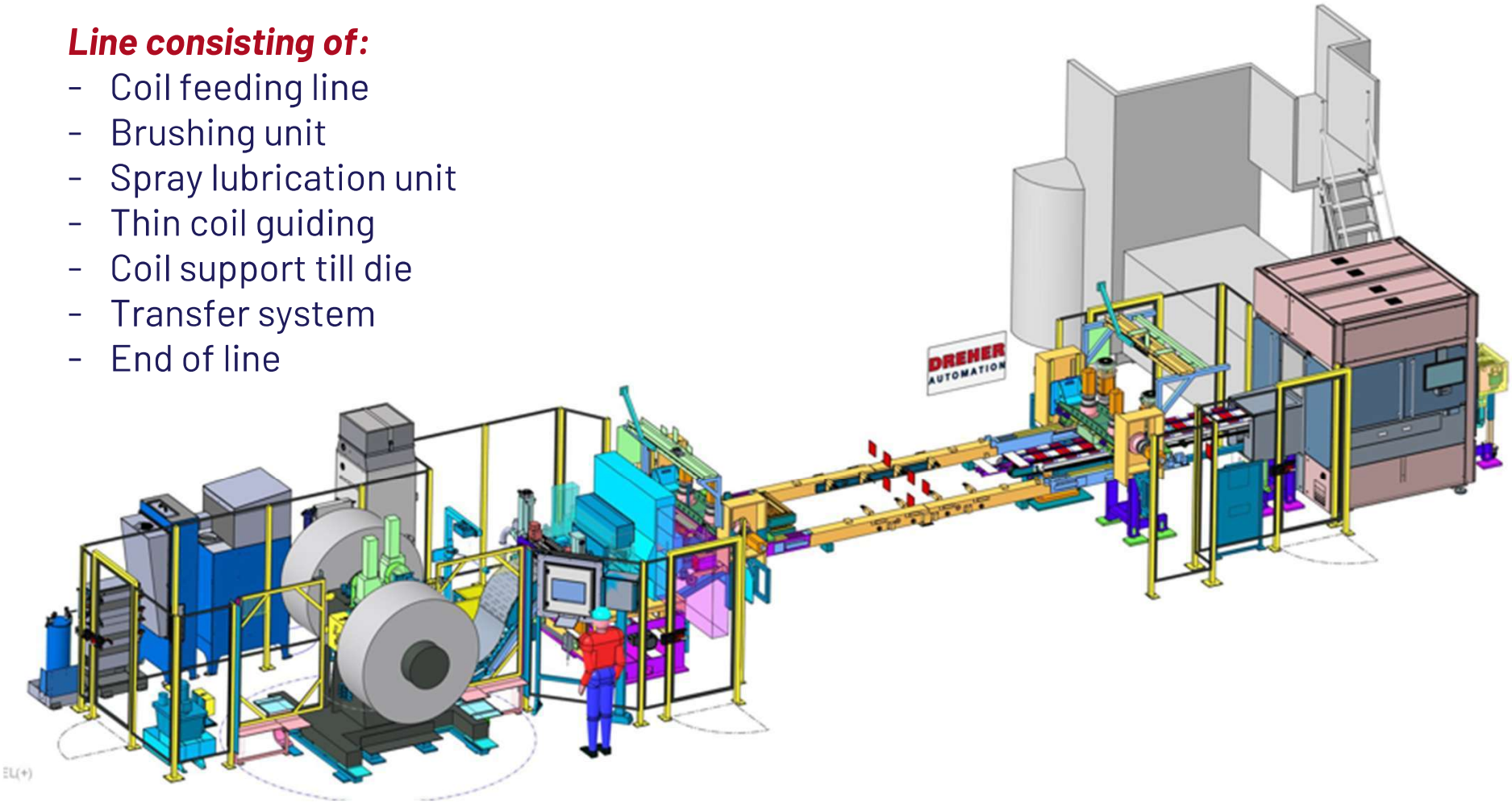
Line consisting of:

- Coil feeding line
- Brushing unit
- Spray lubrication unit
- Thin coil guiding
- Coil support till die
- Transfer system
- End of line



Coil line for bipolar plates

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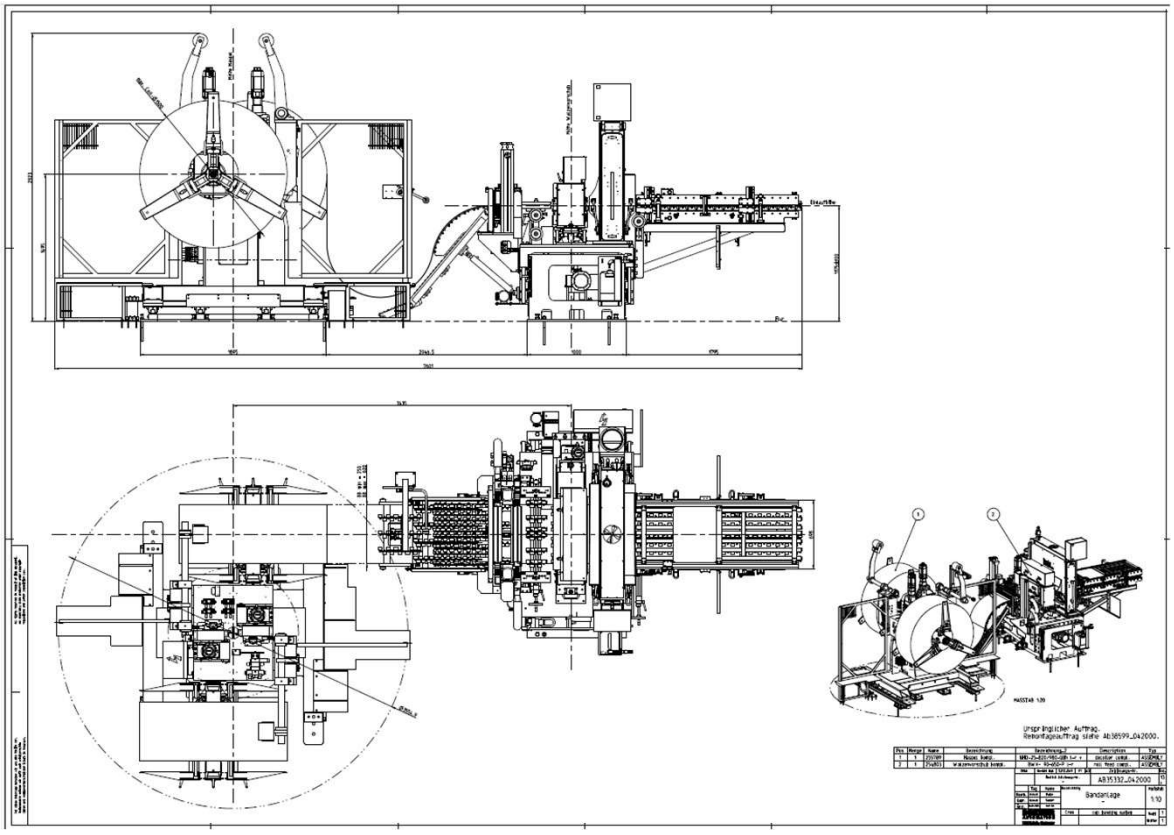

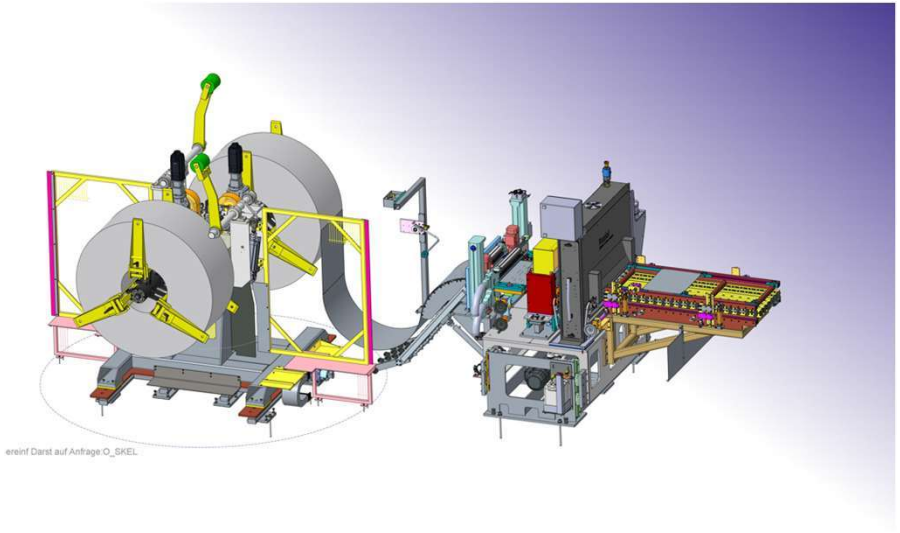

Coil line for bipolar plates

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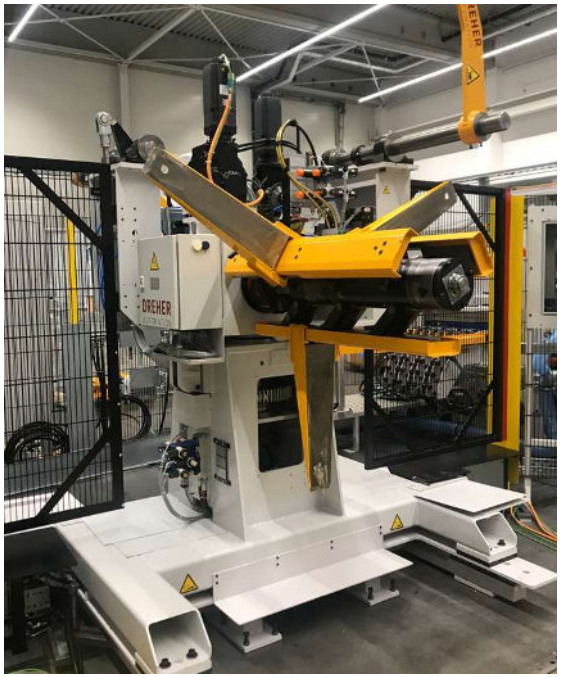

Double decoiler movable

Brushing unit

Roller feeder with cleaning lips, extentable for cleaning

Coi line for bipolar plates

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Thin coil guiding

Spray lubrication unit

Coil support rolls

Automation for bipolar plates production

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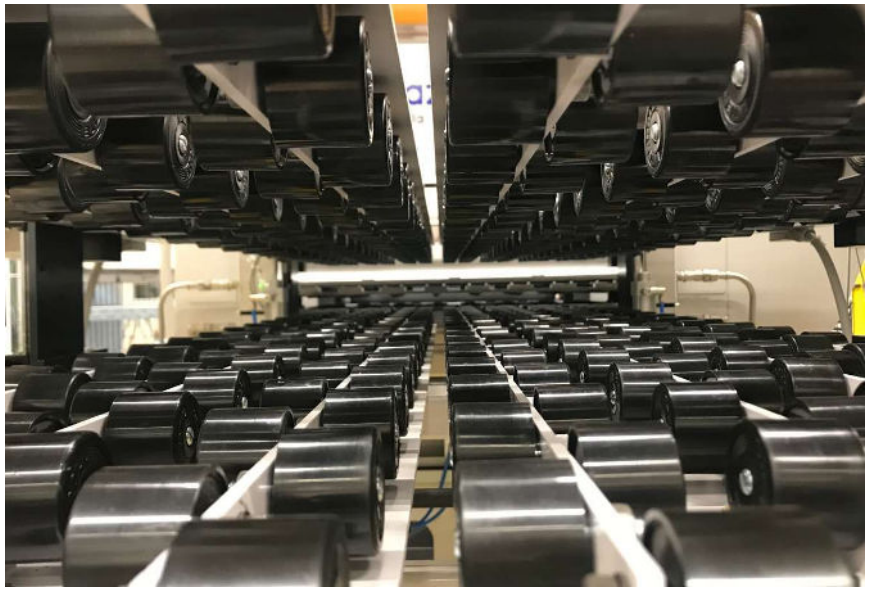
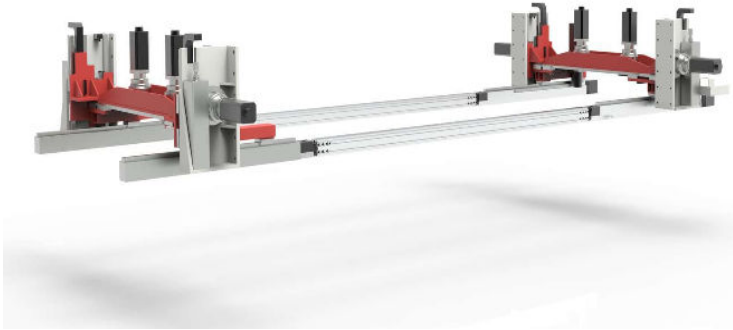


Coil support rolls



Transfer with automatic coupling and active grippers designed according die

End of line for bipolar plate production

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End of line

Production of bipolar plates

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Challenges for a coil line:

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• Coil weight, max .	25	kN
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• Feeding accuracy at 1 m feeding length	+/- 0,1	mm
• Feeding height above floor level	1.200	mm
• Coil inserting	manual	
• Coil loading	by crane	

Major challenges:

- Feeding of very thin material
- Side guiding of thin material
- Transportation through press
- Achieving output
- Getting part out of die
- Transportation to following process
- ***Min. 50 spm***

Prog-die or Transfer?

Testing of push-pull application

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Push-Pull feeders in assembly at Dreher for rotor-stator application, wooden support especially for test with bipolar plate material

Manual Preparation of skeleton

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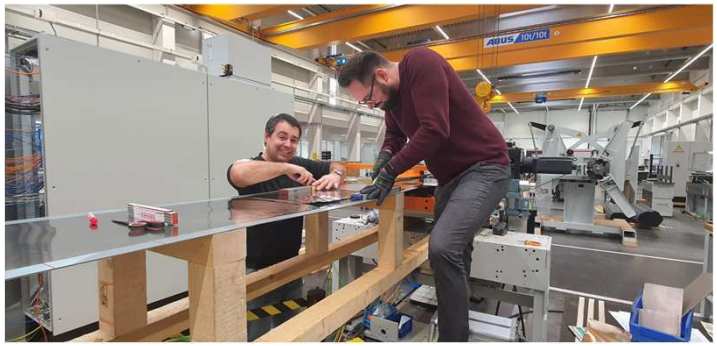

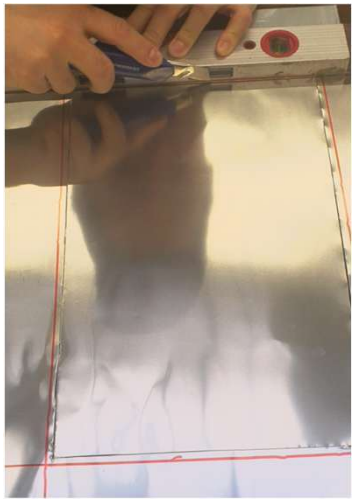

Manual preparation of coil skelaton with knife and scissor

Tests with skelaton, s = 0,075 mm

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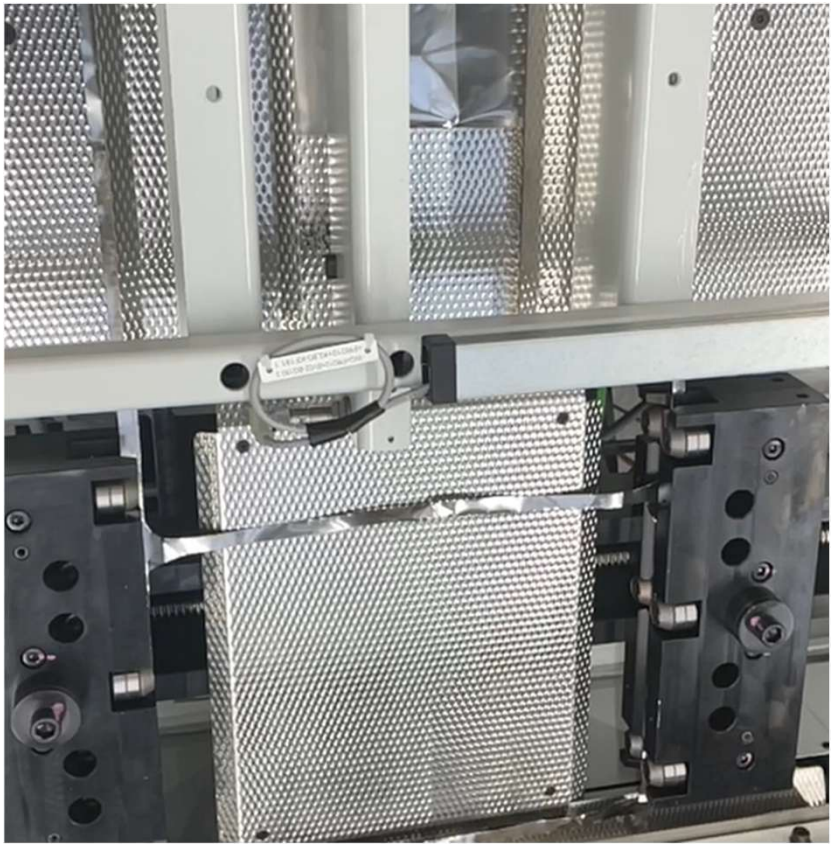

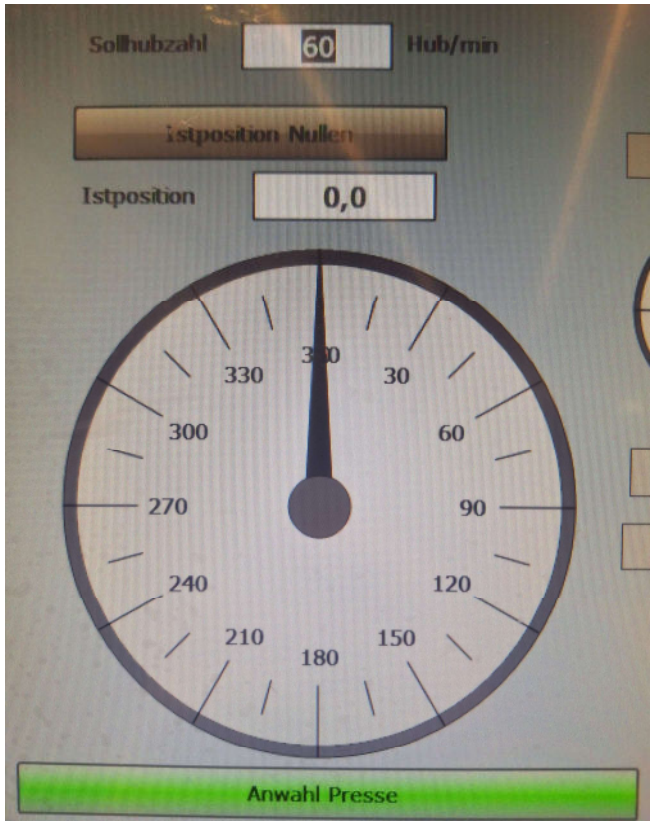

Test successful with speed up to 60 spm using simulation cams

Nevertheless: Problems with scrap, process window very unstable, risk when inside die too high

Upgrades to previous system

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Major upgrates:

- In the future no need of brushing unit as long as material is clean and environment of workshop is clean

- Feeding axis will be integrated onto the main transfer bar
- Transfer bar made out of steel with smaller cross section but higher stiffness
- Integratation of a pulling feeder in front of the die for higher stability during feeding

- Increase of speed for unloading unit

Optimizations coil line

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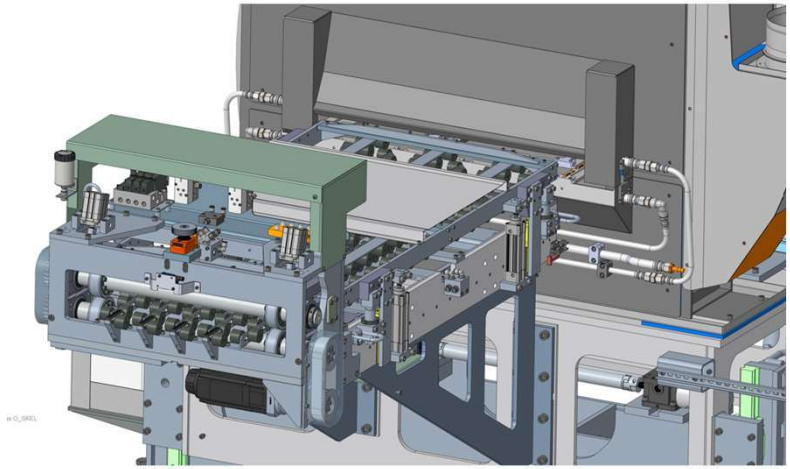
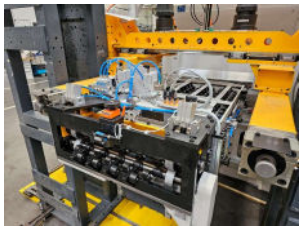
Previous (no additional pulling rolls)

Free feeding length approx. 3,0 m

Udated (incl. addtional pulling rolls between pushing feeder and die)





Free feeding length less than 0,5 m

Optimizations transfer

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Previous

Udated

Optimizations transfer (updated)

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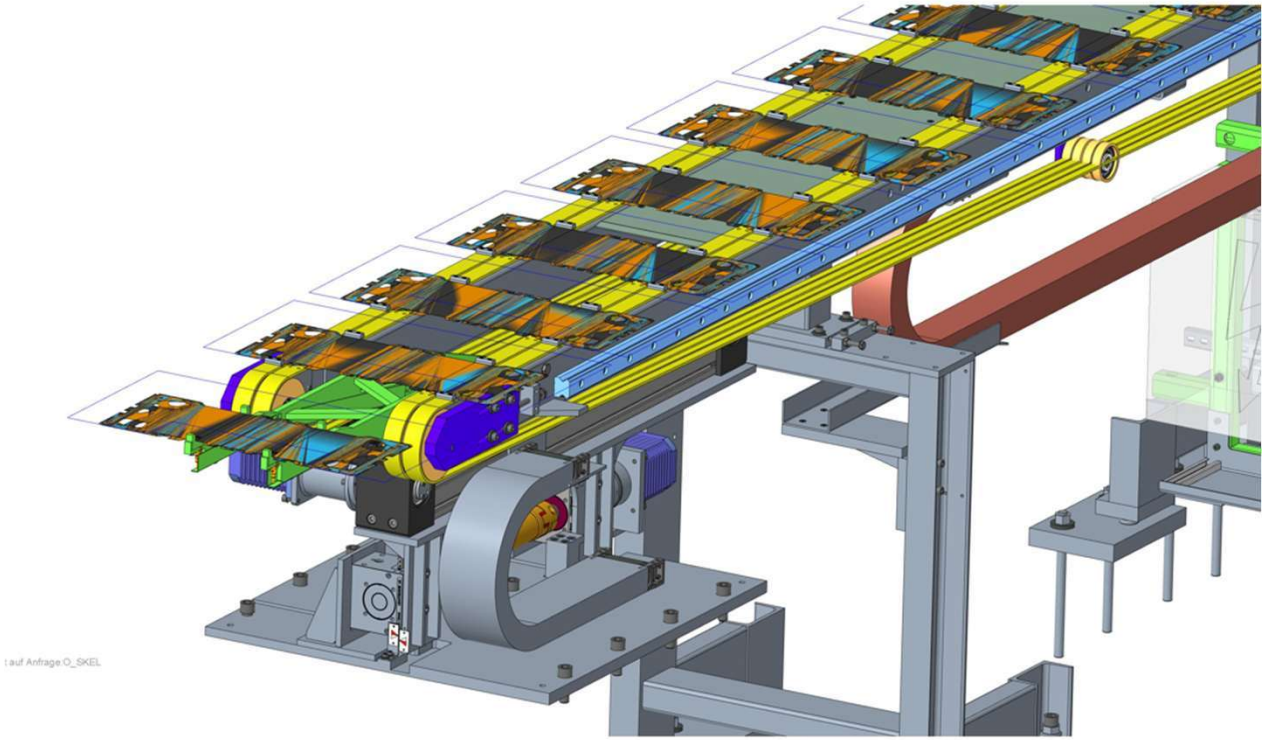

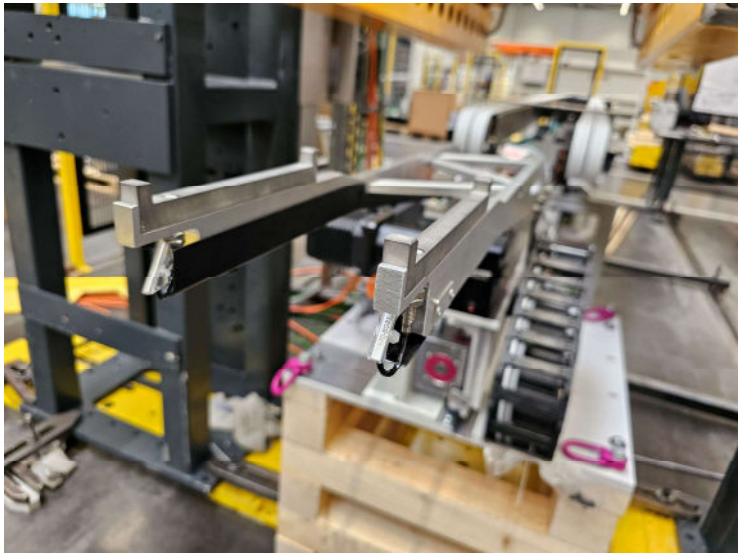

Cycle diagram 40 spm

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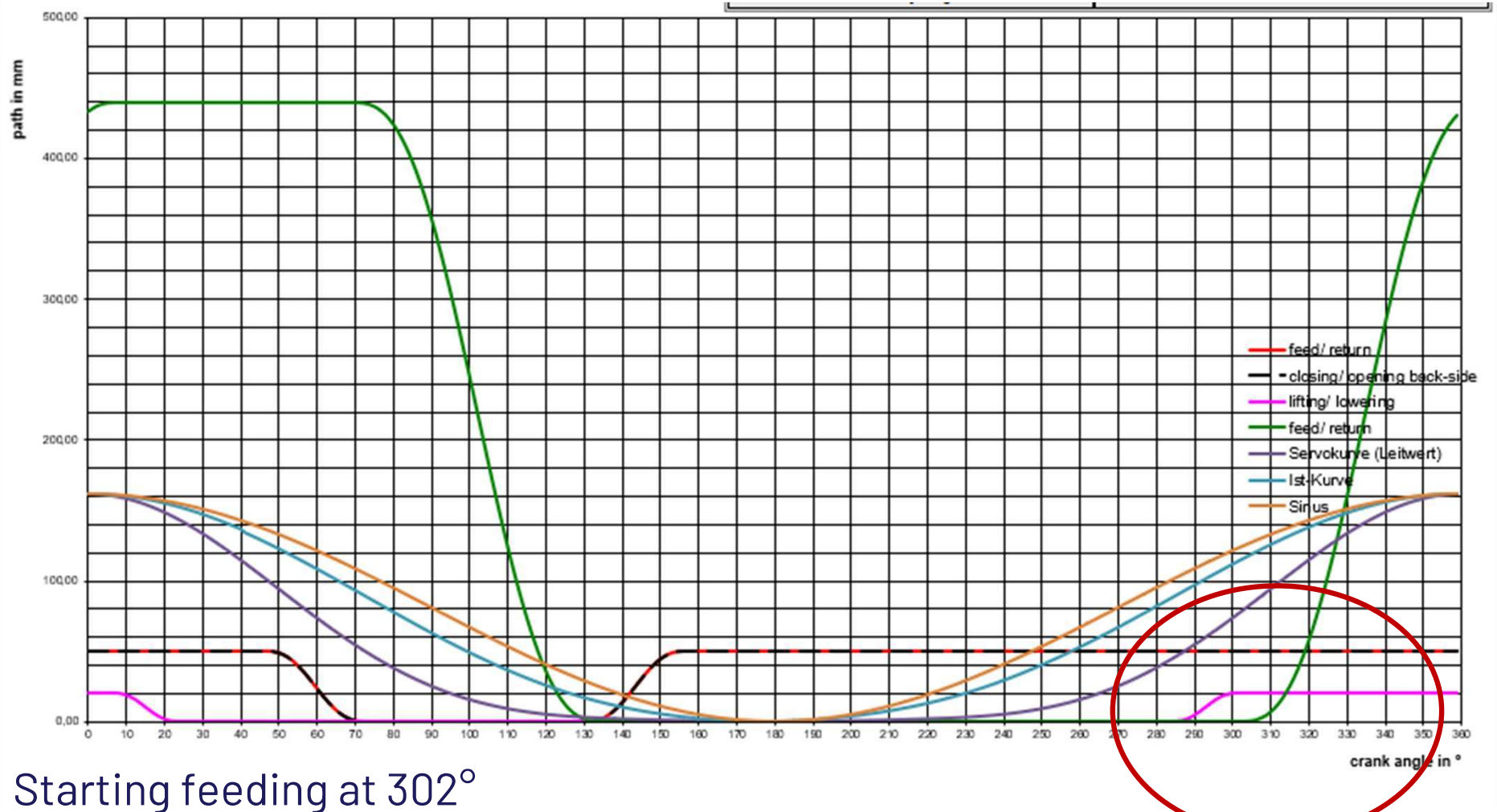

Starting feeding at 302°

Cycle diagram 50 spm

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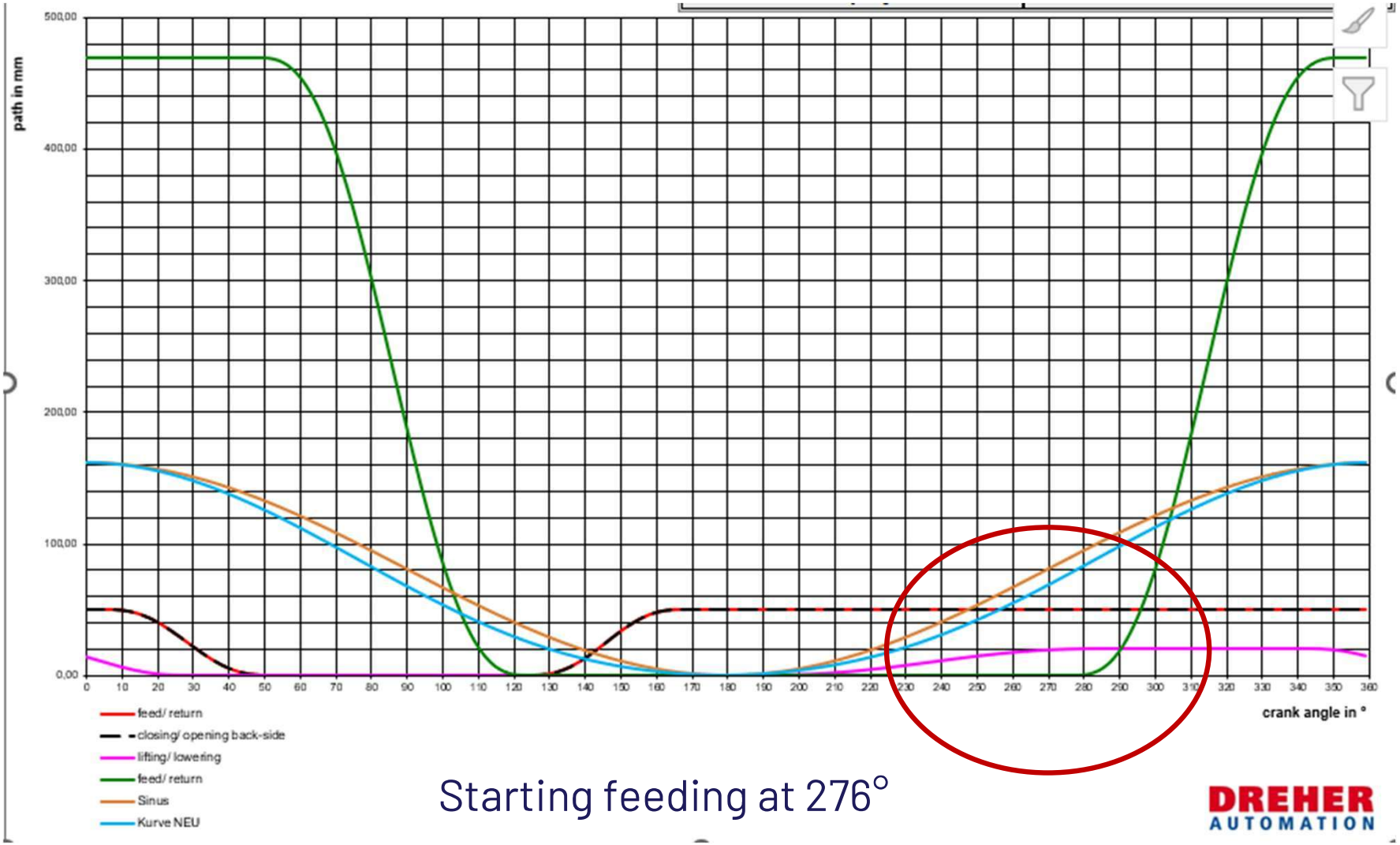

Starting feeding at 276°

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Process Challenges

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Major requirements for high speed lines for production of bipolar plates:

- High performance roller feeder with synchronization
- Support rolls to prevent any bending of coil material
- Special support rolls inside spray lubrication unit
- Rigid press with minimum deflection
- Highest accuracy of slide position
- Possibility to adjust press curve for optimization of cycle time
- Highest accuracy required to die to form the flow field
- Interface between die and transfer especially position of guiding columns
- End of line execution with interface to the die