
LVD
THE FUTURE OF
BENDING AUTOMATION
WELCOME to
International Seminar on Forming Technology
IMTMA
Steven Lucas – International Press Brake Product Manager
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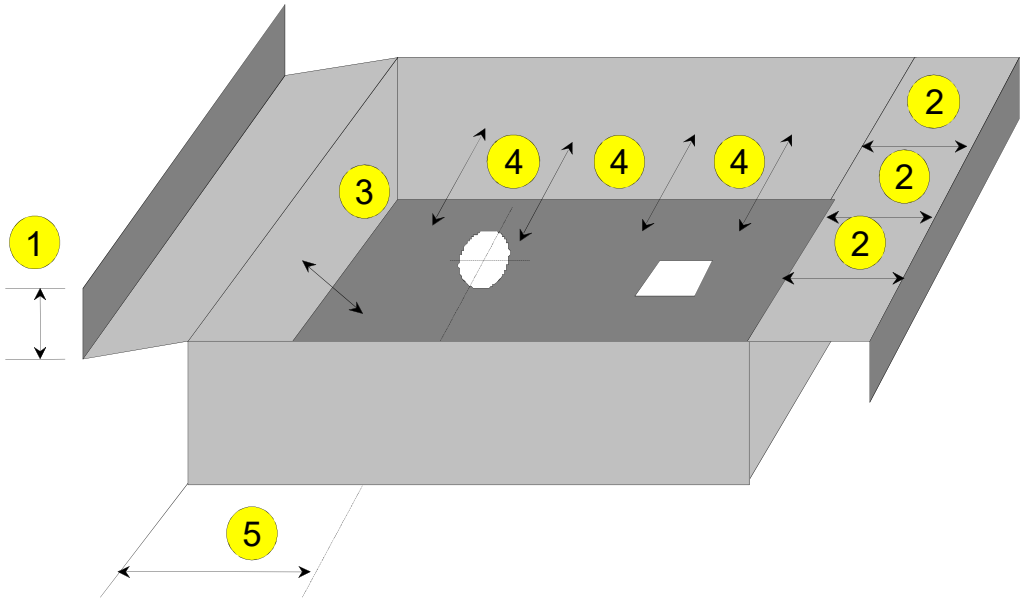
Main issues in bending technology



- Correct measure
- Correct angle

How to determine the bend allowance ?

BA = - 2 x s | DIN 6935 | Database

- **BA = - 2 x s**
- **Theory of the neutral axis DIN6935**
- **Bend allowance database**

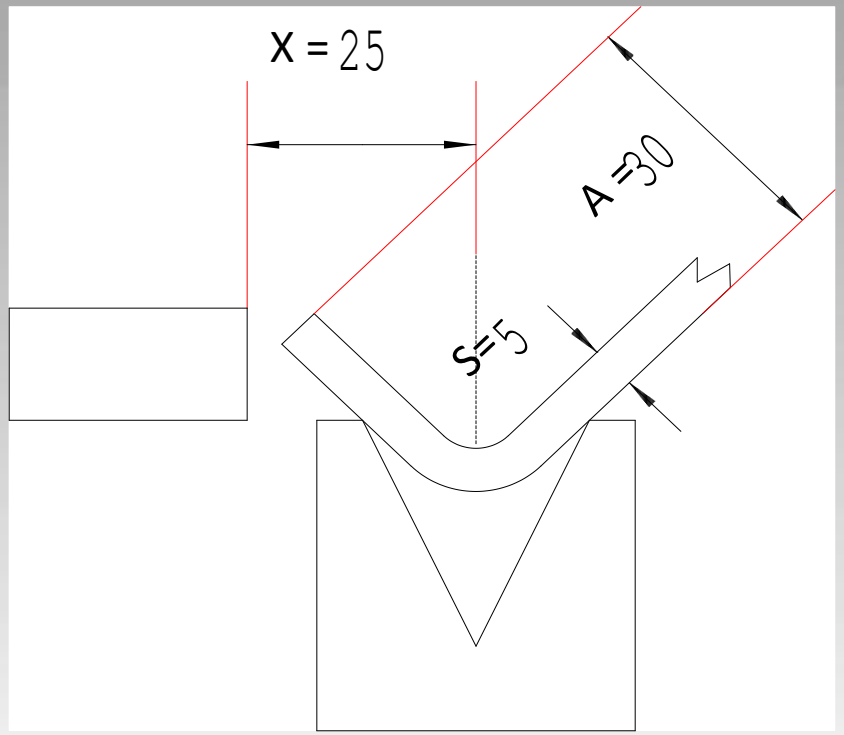
How to determine the bend allowance ?

BA = - 2 x s | DIN 6935 | Database

BA = - 2 x s

It is assumed that the bend allowance (BA) is equally divided:

The gauging equals X = A –BA/2



How ... ance ?

BA = - 2 x s | D...

Theory ... 6935

$$k = 0.65 + \frac{1}{2} \cdot \log\left(\frac{R_i}{S}\right)$$

- For acute angles:

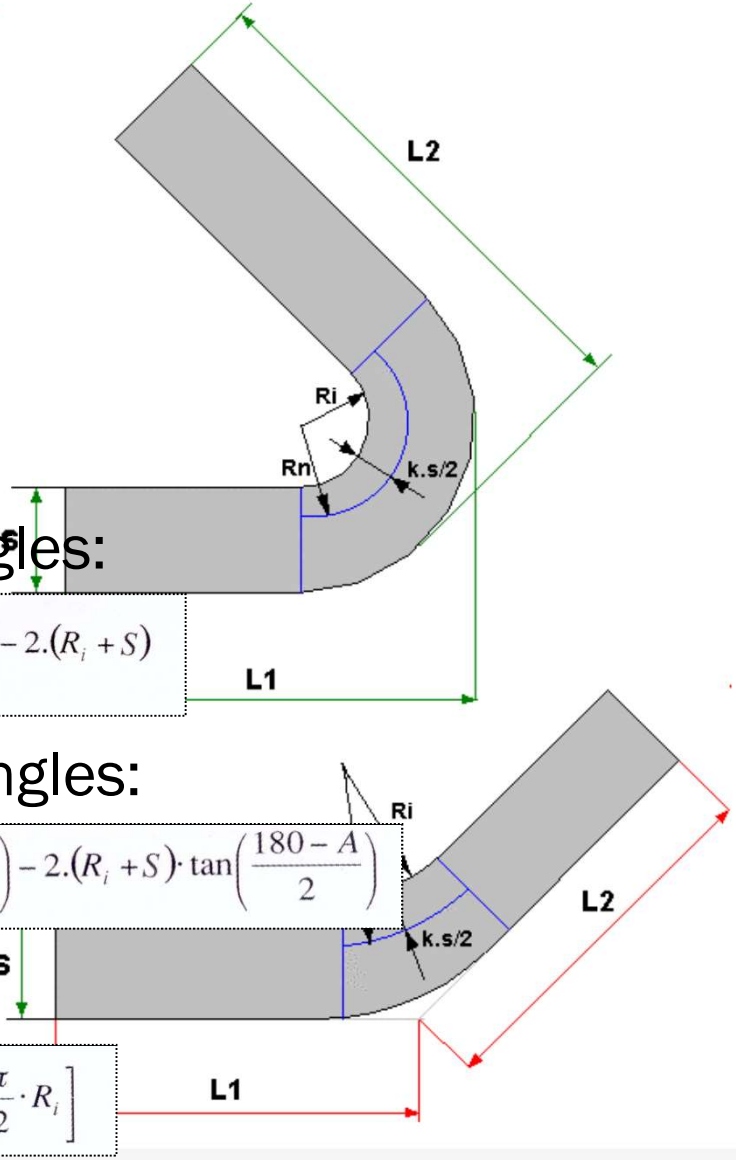
$$pv = \pi \cdot \frac{180 - A}{180} \cdot \left(R_i + k \cdot \frac{S}{2}\right) - 2.(R_i + S)$$

- For obtuse angles:

$$pv = \pi \cdot \frac{180 - A}{180} \cdot \left(R_i + k \cdot \frac{S}{2}\right) - 2.(R_i + S) \cdot \tan\left(\frac{180 - A}{2}\right)$$

- Reciprocal:

$$k = \frac{4}{\pi \cdot s} \cdot \left[pv + 2 \cdot (R_i + S) - \frac{\pi}{2} \cdot R_i\right]$$

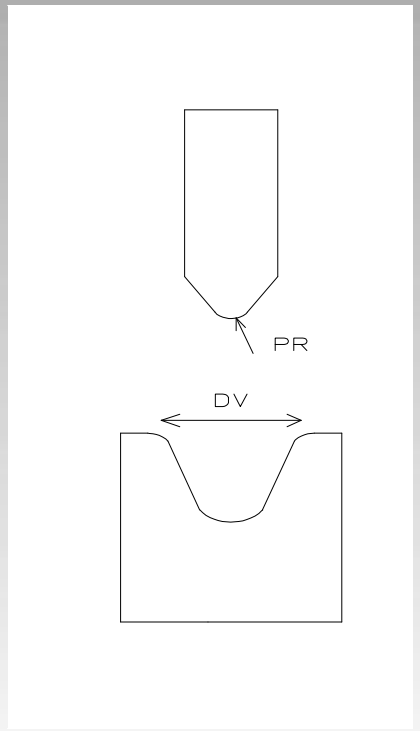


How to determine the bend allowance ?

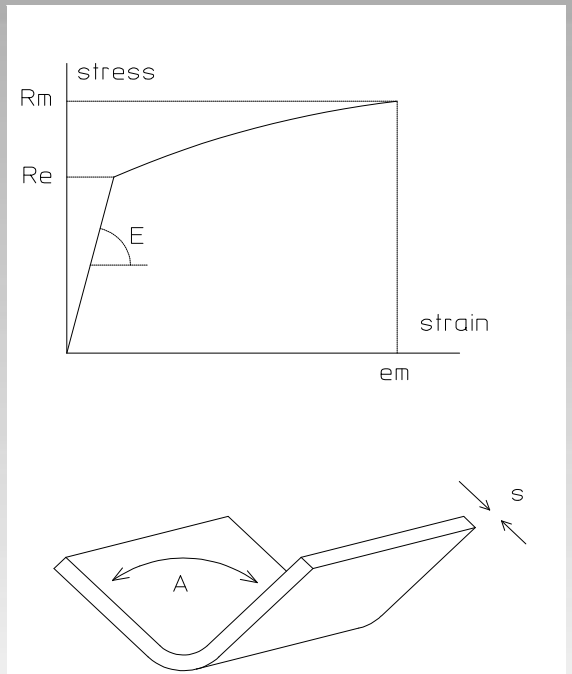
BA = - 2 x s | DIN 6935 | Database

Bend allowance database

- ✓Punch
- ✓Die



- ✓Material
- ✓Geometry



Example: comparison determination BA

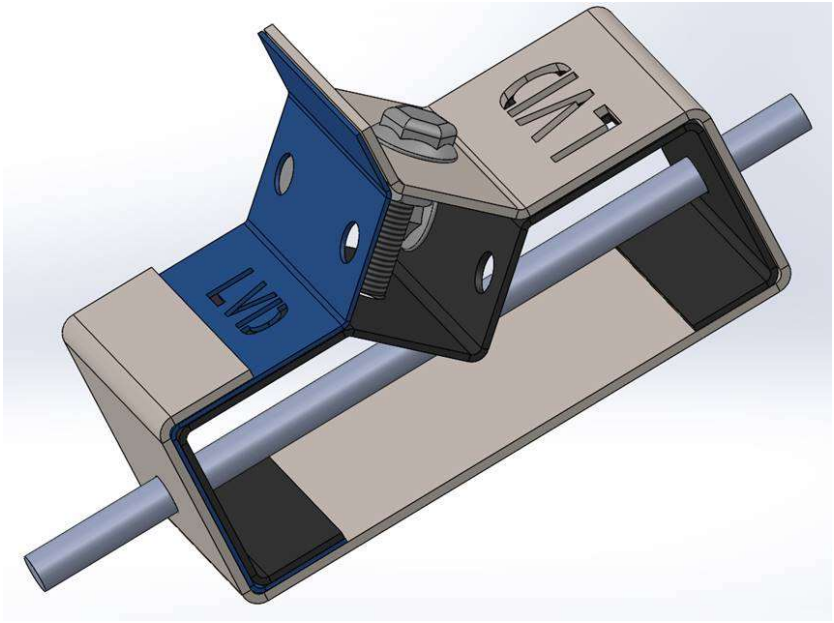
			Bend allowance		
Thickness	Die	Material	- S x 2	DIN 6935	Database
1,5 mm	V12 / 78°	DC04	- 3,00	- 3,00	- 2,90
1,5 mm	V08 / 78°	DC04	- 3,00	- 2,80	- 2,70
1,5 mm	V12 / 78°	X5CrNi18 10	- 3,00	- 3,00	- 3,10
4 mm	V24 / 78°	S235JRG2	- 8,00	- 7,60	- 7,09
4 mm	V30 / 78°	S235JRG2	- 8,00	- 7,90	- 7,26
4 mm	V24 / 78°	X5CrNi18 10	- 8,00	- 7,60	-7,57
4 mm	V30 / 78°	X5CrNi18 10	- 8,00	- 7,90	- 8,01
6 mm	V30 / 78°	S235JRG2	- 12,00	- 11,20	- 10,35
6 mm	V40 / 78°	S235JRG2	- 12,00	- 11,60	- 10,62
6 mm	V30 / 78°	X5CrNi18 10	- 12,00	- 11,20	- 10,89
6 mm	V40 / 78°	X5CrNi18 10	- 12,00	- 11,60	- 11,60

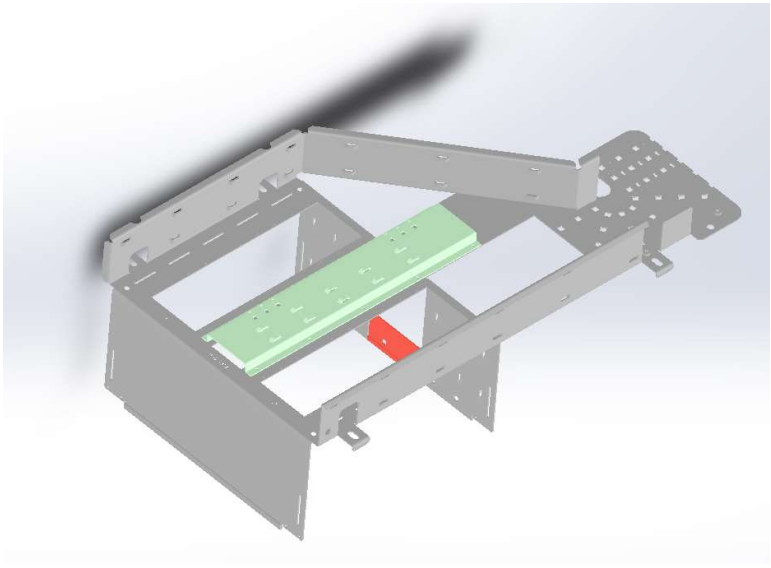
Required measurement : position off the holes

3D Part ⟹ Unfolding, based on the BA database

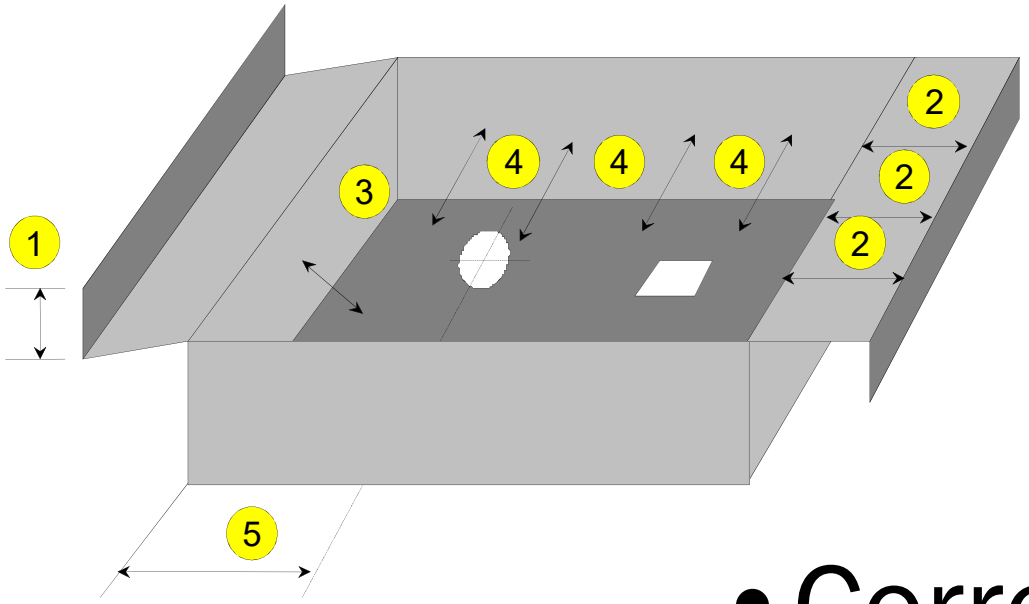
⇩

Cadman® B-3D





Main issues in bending technology



- Correct measure
- Correct angle

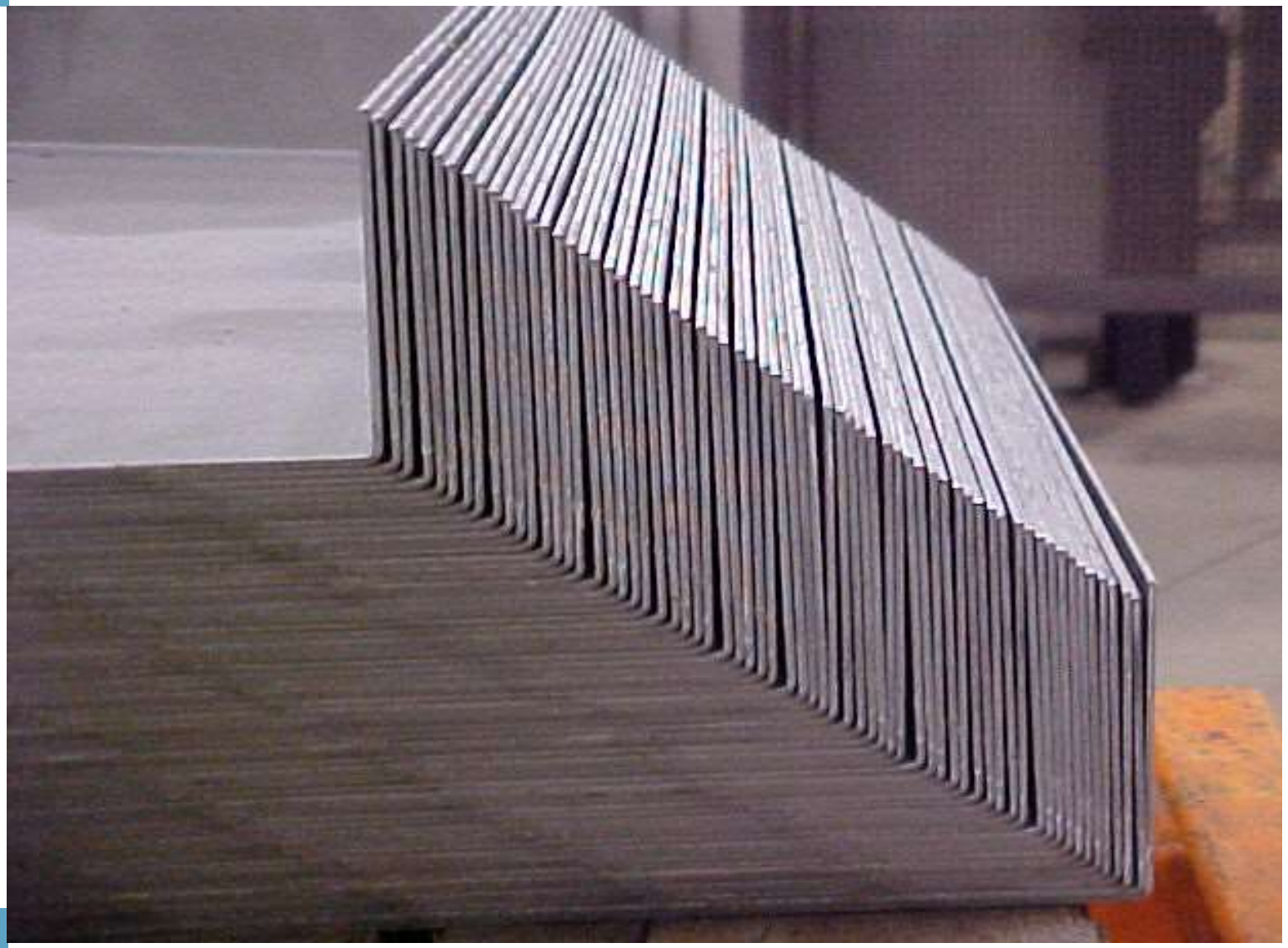
Bending technology

Coinning | Air Bending | Adaptive bending

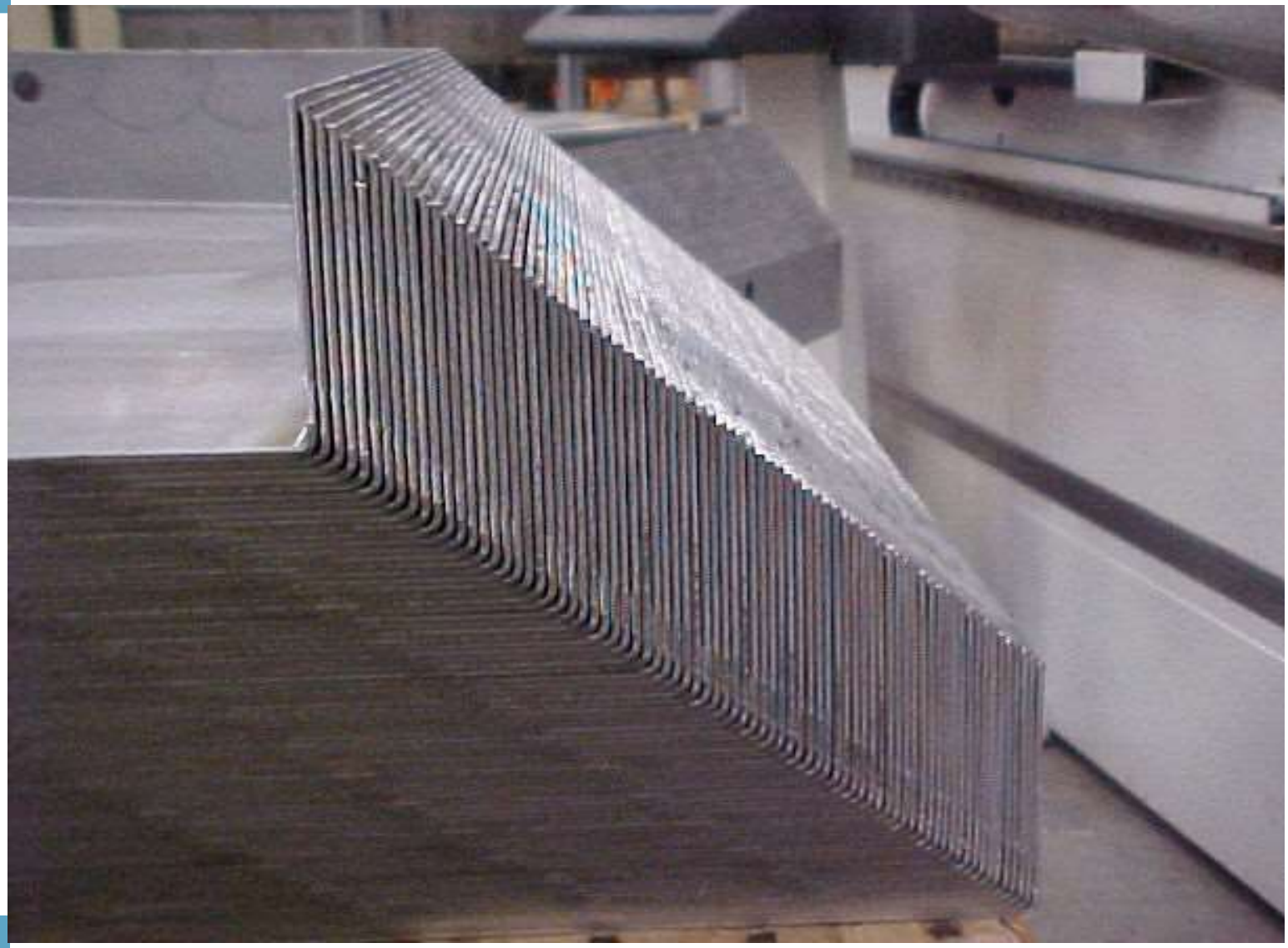
Y-axis : depth in mm for 1 degree angle modification.
Y-as : diepte in mm voor een wijziging van 1 graad in hoek.
L'axe Y : profondeur en mm pour un changement de l'angle de 1 degré.
Y-Achse : Tiefe in mm für eine Änderung von 1 Grad in Winkel.

V °	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
4	0,17	0,07	0,04	0,03	0,02	0,02	0,02	0,01	0,01	0,01
6	0,26	0,11	0,07	0,05	0,04	0,03	0,03	0,03	0,03	0,03
8	0,36	0,14	0,08	0,06	0,05	0,04	0,04	0,03	0,03	0,03
9	0,41	0,16	0,09	0,07	0,05	0,05	0,05	0,04	0,03	0,03
10	0,45	0,18	0,10	0,08	0,05	0,05	0,05	0,05	0,05	0,04
12	0,54	0,22	0,13	0,08	0,07	0,05	0,05	0,05	0,05	0,05
14	0,61	0,24	0,15	0,10	0,08	0,07	0,06	0,06	0,06	0,06
15	0,66	0,26	0,16	0,11	0,08	0,08	0,07	0,07	0,07	0,06
16	0,71	0,28	0,16	0,12	0,09	0,08	0,07	0,07	0,07	0,07
18	0,81	0,32	0,19	0,13	0,11	0,09	0,08	0,08	0,07	0,07
20	0,90	0,36	0,21	0,15	0,11	0,10	0,09	0,09	0,09	0,08
22	1,00	0,40	0,23	0,16	0,13	0,11	0,10	0,09	0,09	0,09
24	1,09	0,44	0,25	0,17	0,14	0,11	0,10	0,10	0,10	0,10

Bending technology – Result Air Bending

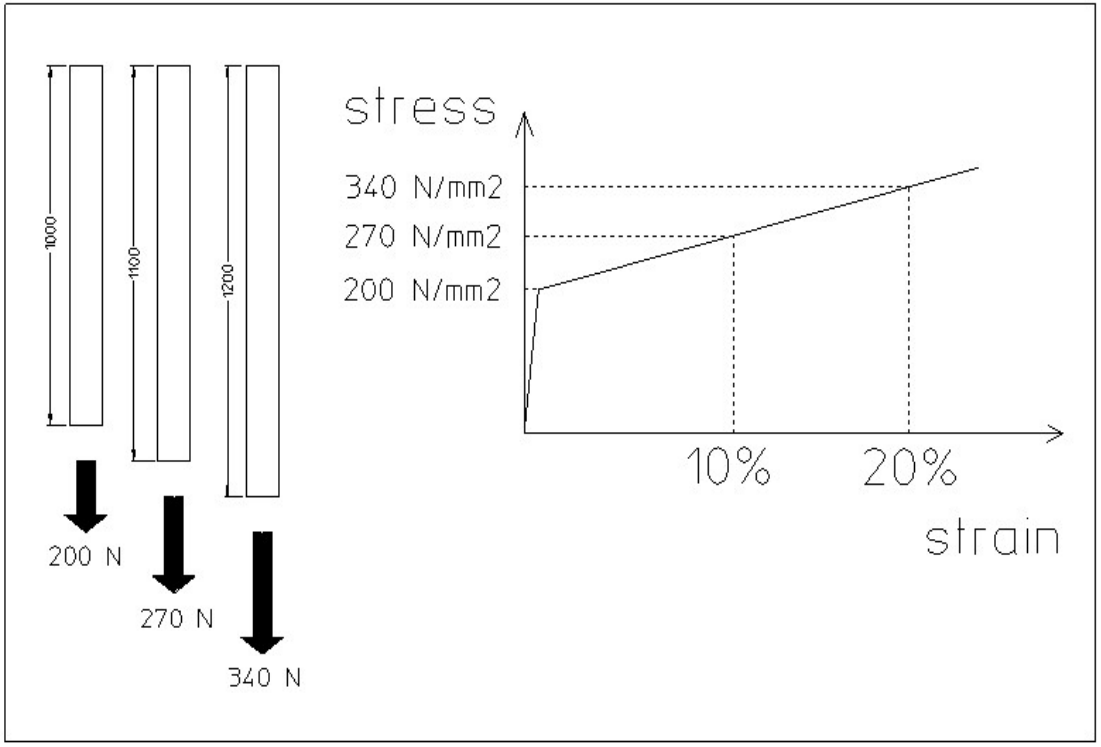


Bending technology – Result of Adaptive Bending



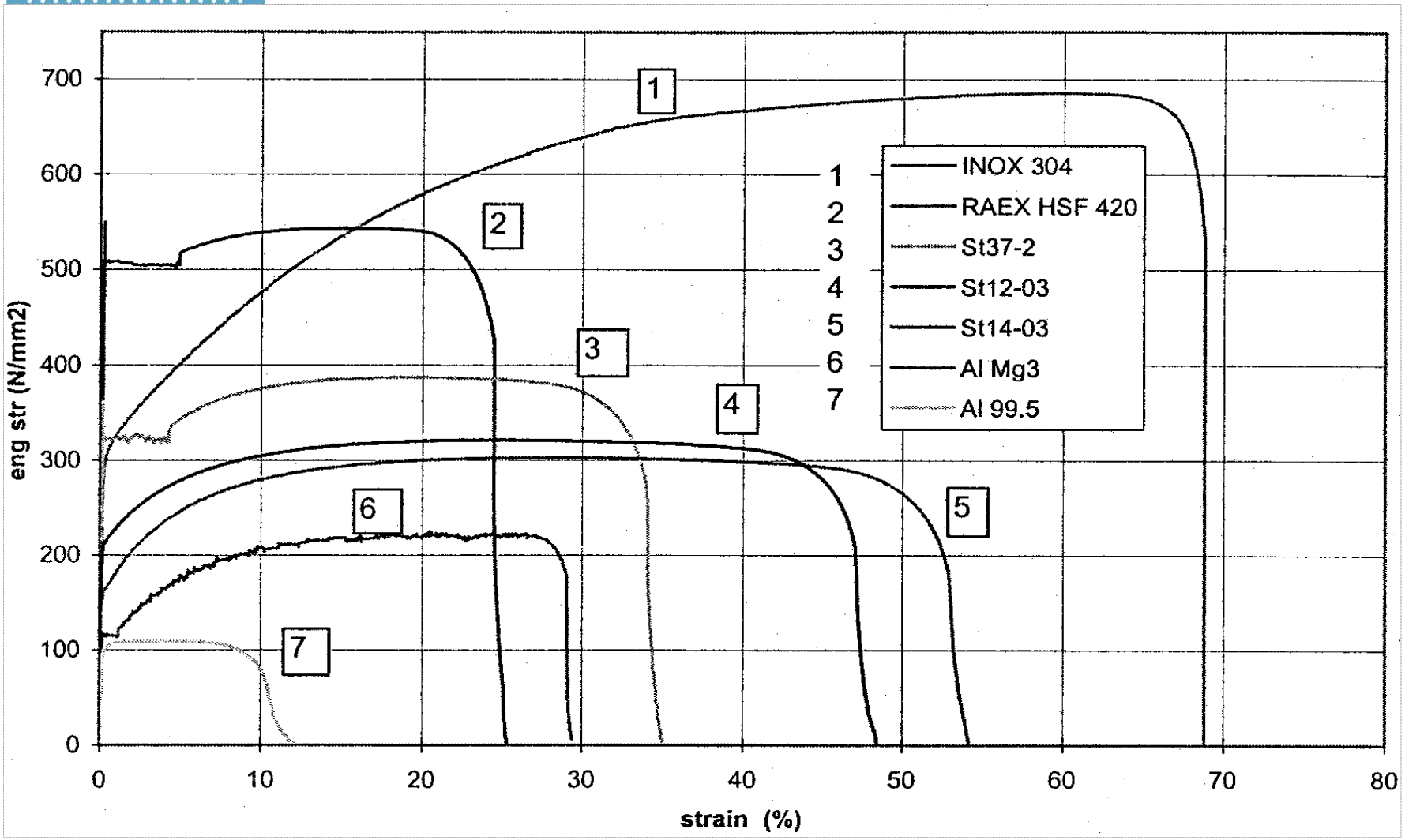
Bending technology – Strain hardening

Why is bend allowance (BA) and bend radius (BR) dependent on material ?

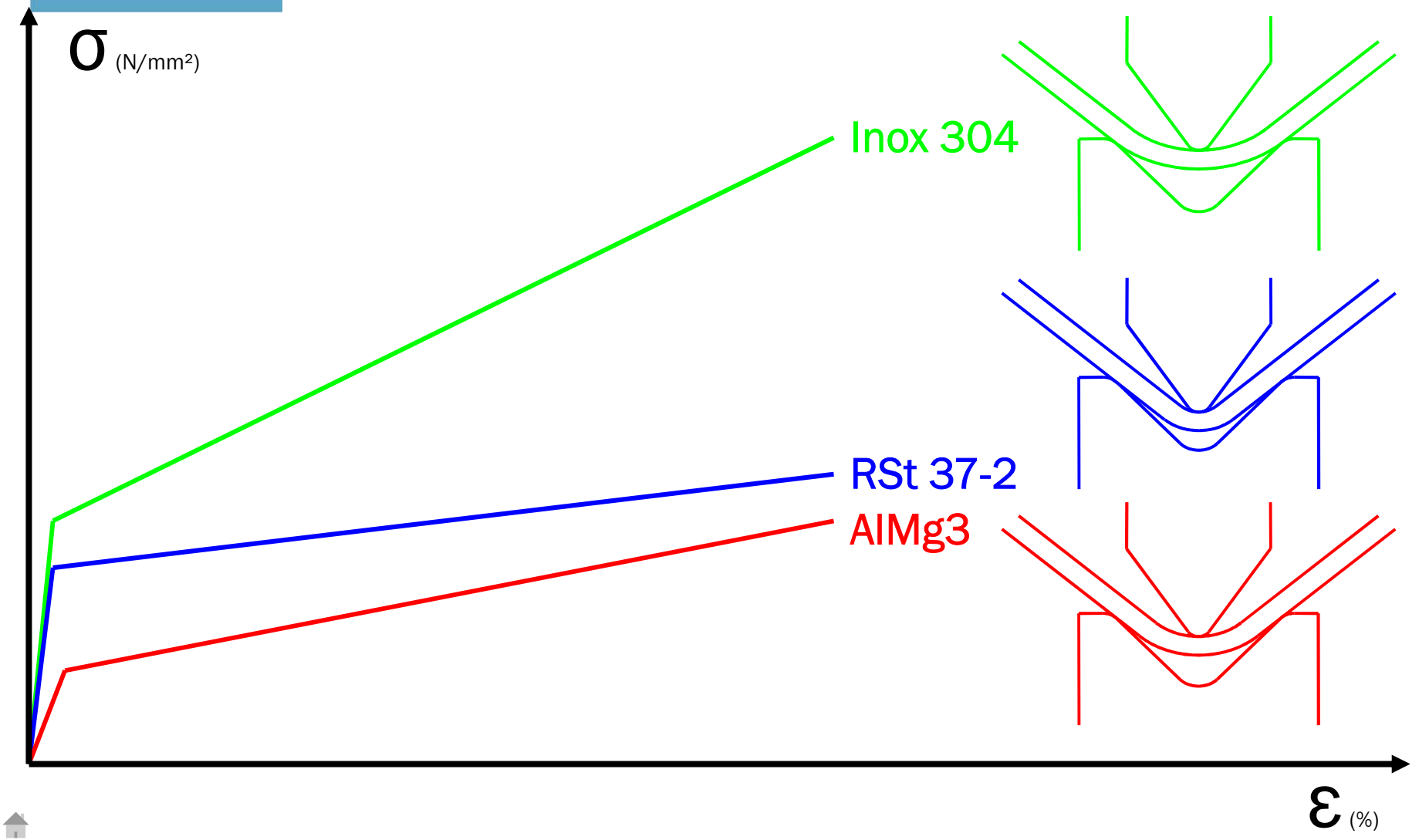


Strain hardening !

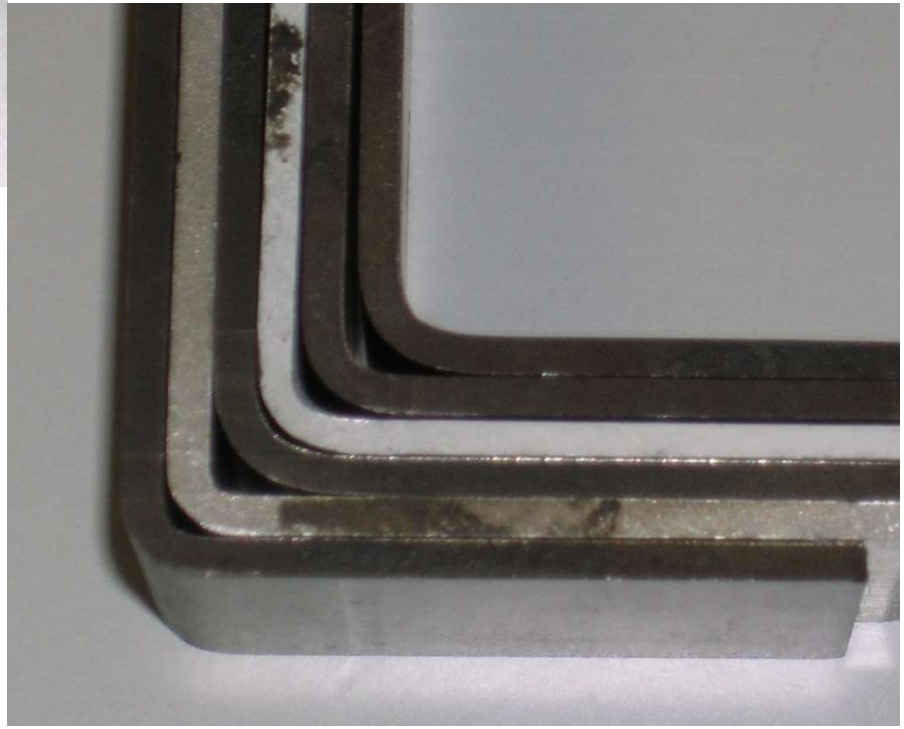
Bending technology – The flow curve (‘pull-test’)



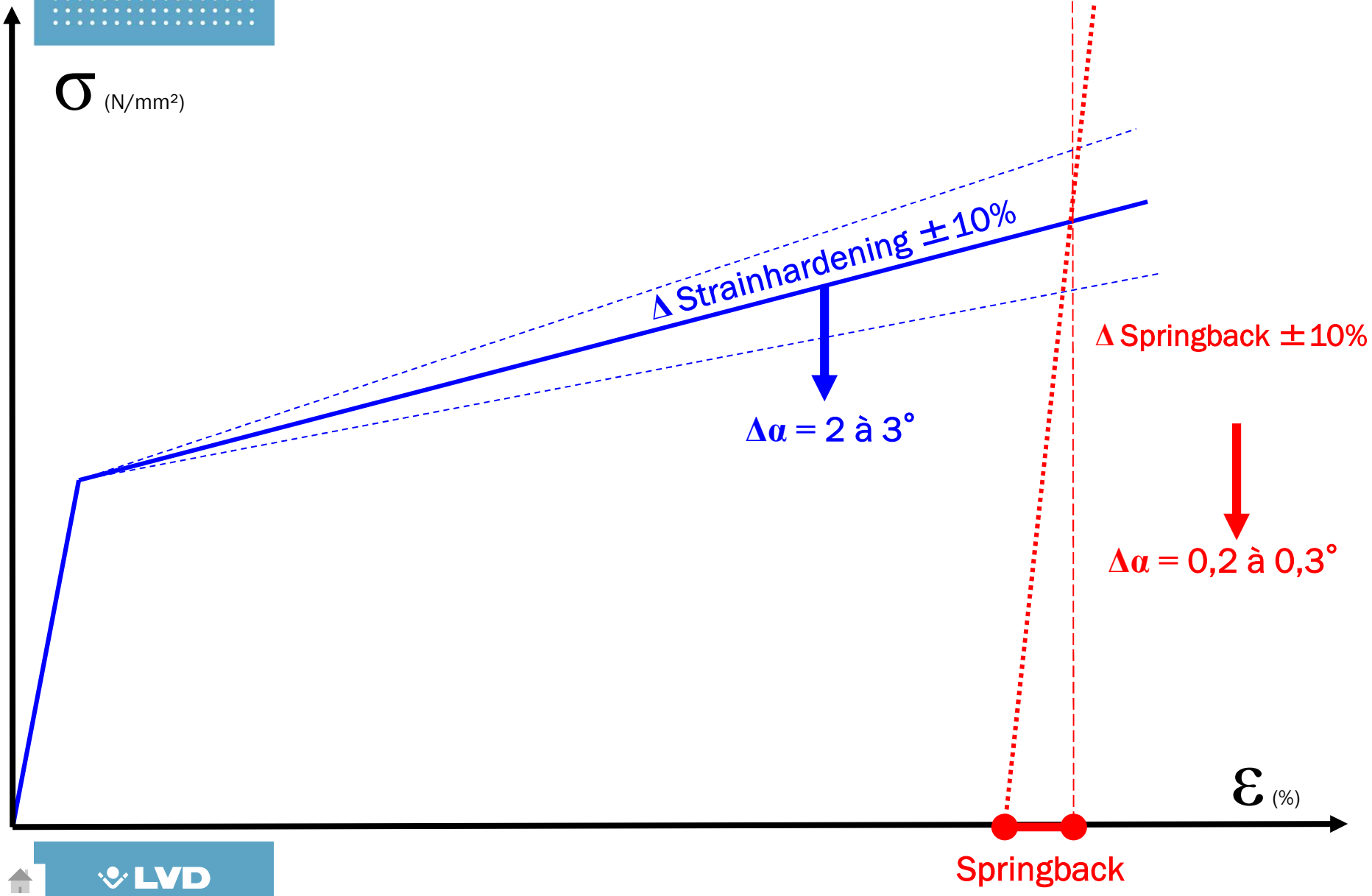
Bending technology



Bending technology



Bending technology



Bending technology

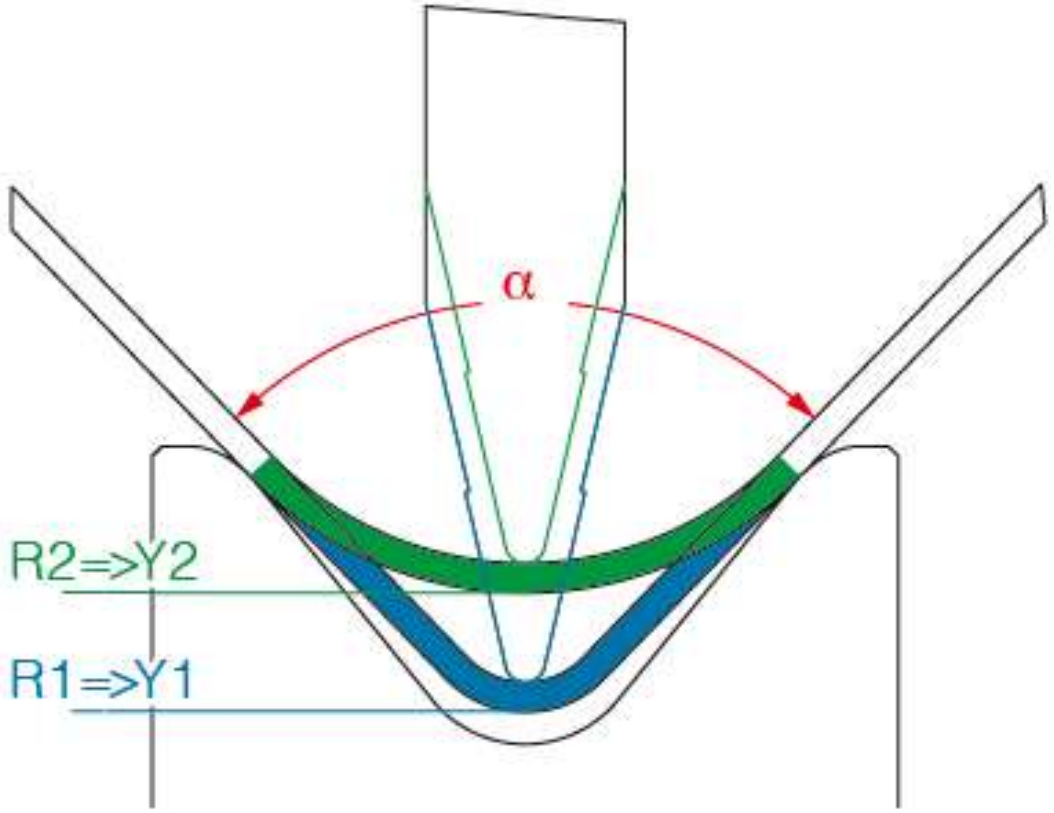
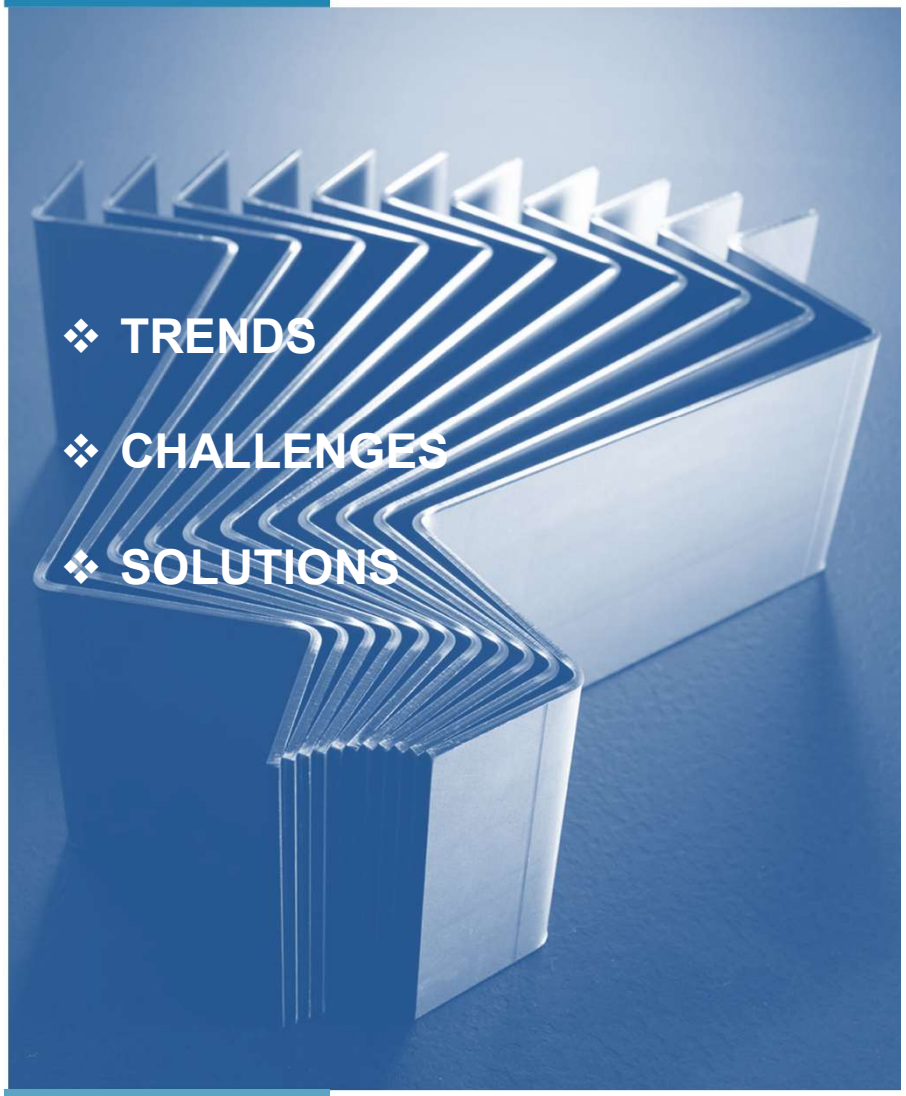


Fig. a

BENDING AUTOMATION



- TRENDS
- CHALLENGES
- SOLUTIONS

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BENDING AUTOMATION

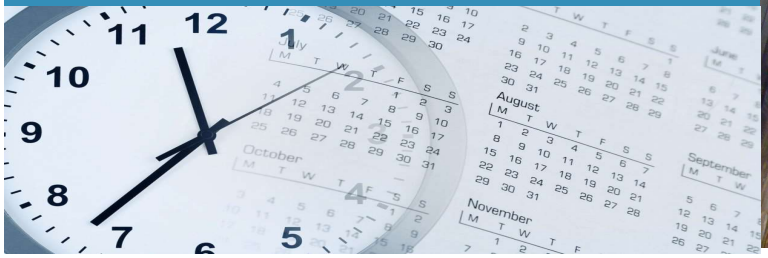
TRENDS

BENDING AUTOMATION

TRENDS

General industry trends impacting bending automation :

- Complex parts
- Complex assemblies
- Reduced batch size
- A lot of variety
- Shorter lead times



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BENDING AUTOMATION

TRENDS

Other trends impacting bending automation :

- Shortage of skilled labor
- Lack of robot programming knowledge
- Need for fast and easy programming
- Quality assurance during automated bending

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BENDING AUTOMATION

CHALLENGES

BENDING AUTOMATION

CHALLENGES

Software solutions need to be able to handle:

- Simple, standard and complex parts
- Standard and complex assemblies
- Automated part and robot programming
- Elimination of ‘Robot Teaching’

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BENDING AUTOMATION

CHALLENGES

THERE ARE NEEDS FOR:

Automated or quick tool setups and Joblists to produce :

- A lot of part varieties
- Small batches
- Need to increase throughput

Universal part gripper :

- Reduce costs associated with multliple grippers
- Eliminate time taken to change grippers
- One flexible gripper with cups and clamps for a wide variation of parts

BENDING AUTOMATION

CHALLENGES

The need to improve throughput due to:

- Short delivery times
- Stock reduction
- Minimizing work in progress
- Smaller batches
- Traceability

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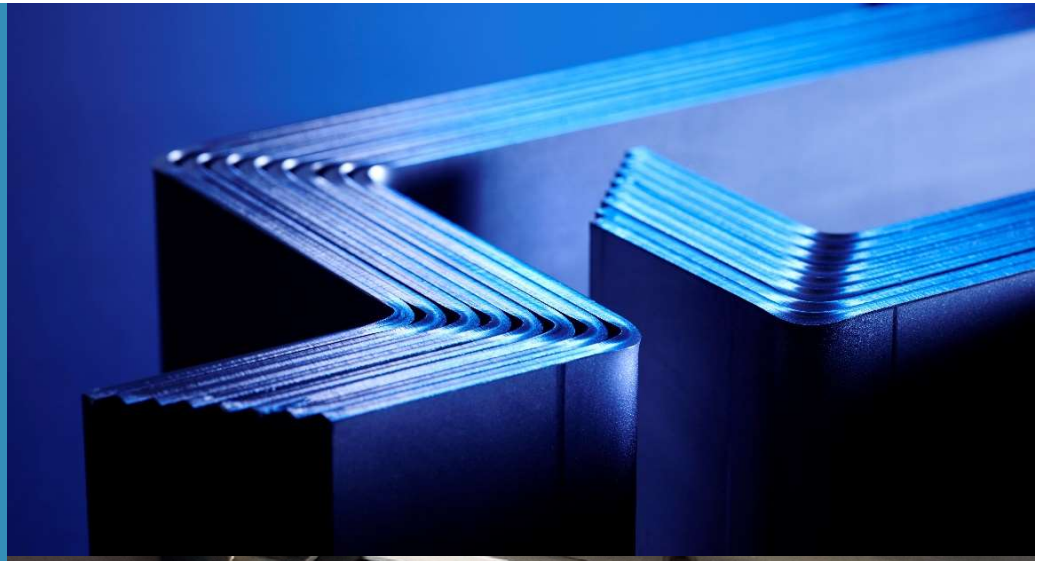
BENDING AUTOMATION

CHALLENGES

The need for real-time Adaptive Process Control to ensure:

- Process stability and consistency
- Quality Assurance



BENDING AUTOMATION

CHALLENGES

Automation that works in collaboration with the operator :

- ❖ Ability to run automated and manually with the automation cell
- ❖ Not all parts are suitable for automation
- ❖ Availability of operators on the market

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BENDING AUTOMATION

CHALLENGES

Availability of virtual simulation and self- programming solutions that can:

- Fully offline program (in the office) both the Press Brake and Robot
- Easy and fast programming with automatic solutions
- Eliminate the need for advanced robot skills
- Eliminate lost time due to teaching of the robot

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BENDING AUTOMATION

CHALLENGES

Controls need to be user friendly, intuitive and have self explaining User Interface because of:

- Shortage of skilled Labor
- Lack of programming knowledge

BENDING AUTOMATION

SOLUTIONS

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BENDING AUTOMATION

SOLUTION : Bending Cell

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Key features of Bending Cell

Affordable, Flexible and Fast “Art to Part” Automation:

- Flexible cell for automatic and manual operation
- Easy installation and setup
- Small footprint
- “Drag and Drop” – Intelligent ‘Self Programming’
- Full accessible cell for manual operation
- Flexible stacking of finished products on pallets
- Easy dropping of finished products in boxes
- Quick feeding of new parts in pallets
- Easy access for input and output of parts

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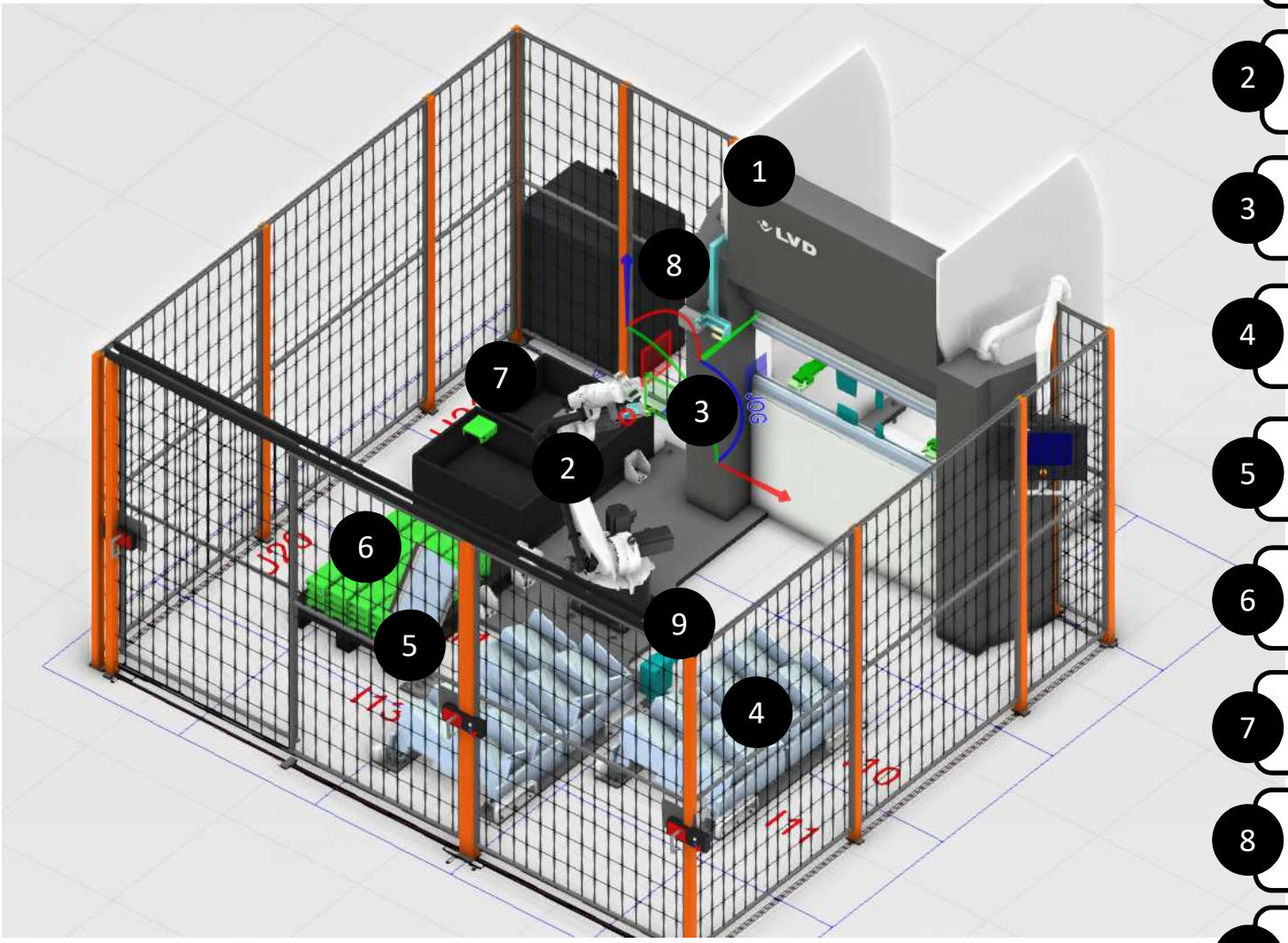
Bending-CELL

Components

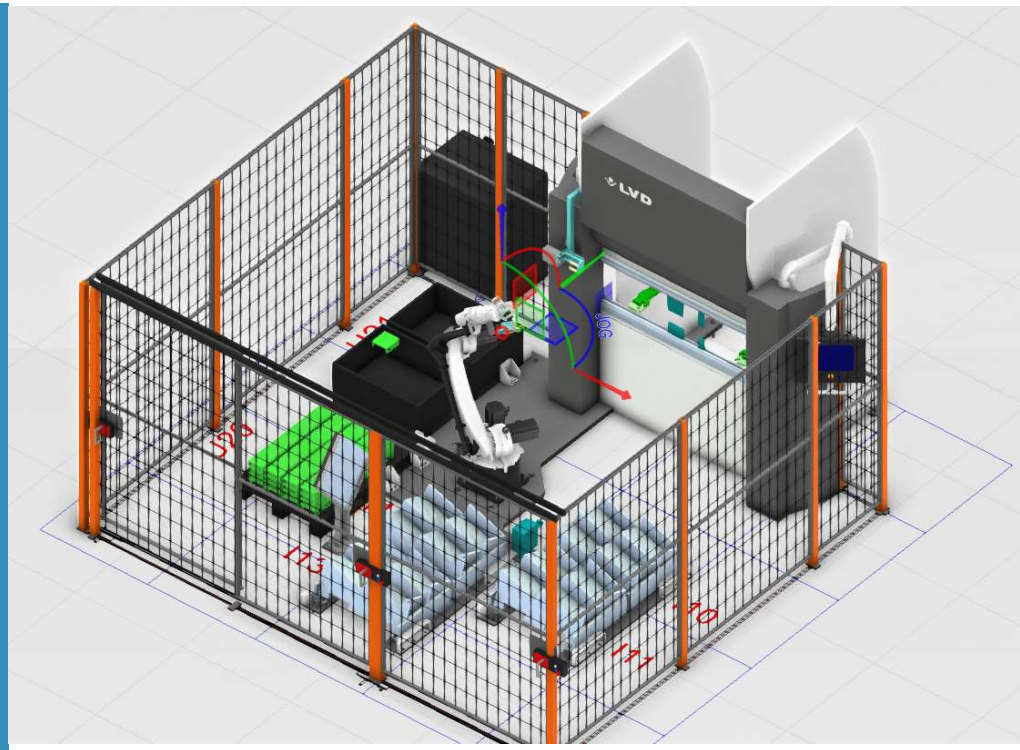


1. Press brake
2. Robot
3. Universal gripper
4. Input Pallets
5. Center Device
6. Output Pallets
7. Output Boxes
8. Re-grip station
9. Double sheet detector

Bending-CELL

Easy and fast automated programming

- Full offline automated ‘self- programming’ of parts. No teaching and programming in workshop
- Programming of Press Brake with the bending programming system Offline Programming Software
- Easy programming of “standard” products with robot automation - Standard products are divided in families
- Automatic and interactive programming of gripper positions with the Robot Programming system
- Automatic calculation of robot trajectory with the robot programming system
- Virtual simulation of part bending with robot



Bending programming system

Robot programming system

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Thank you for your attention