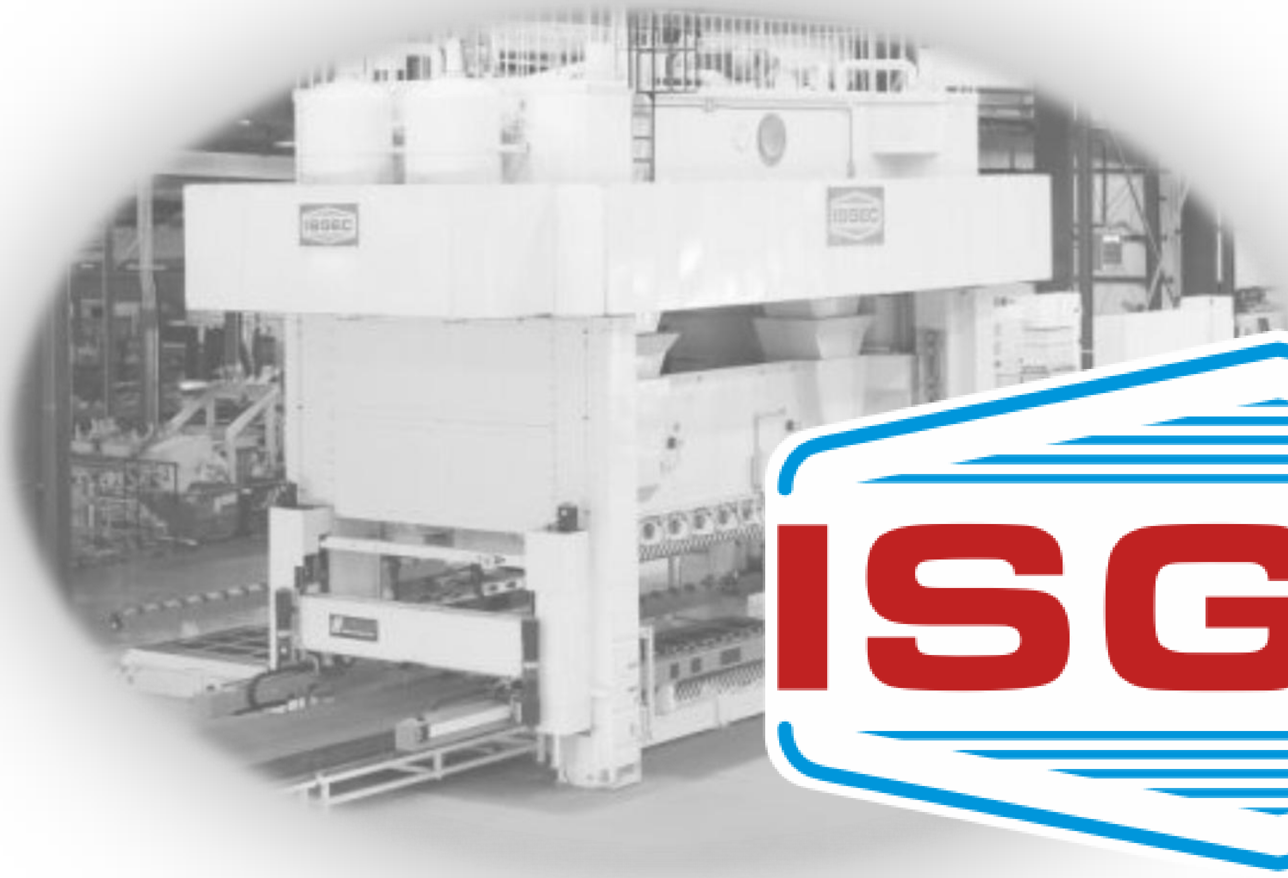
85+ YEARS & BEYOND ESTD. 1933

ISGEC

ISGEC HEAVY ENGINEERING LTD.



ISGEC

P R E S S E S

ISGEC
Isgec Heavy Engineering Ltd.

Isgec Heavy Engineering Ltd.

Isgec Foster Wheeler Boilers Pvt. Ltd.
(Subsidiary - Joint Venture with Amec Foster Wheeler North America Corp., USA)

Saraswati Sugar Mills Ltd.
(Wholly Owned Subsidiary)

ISGEC

Isgec Hitachi Zosen Ltd.
(Subsidiary - Joint Venture with Hitachi Zosen Corporation, Japan)

Isgec TITAN Metal Fabricators Pvt. Ltd.
(Subsidiary - **Joint Venture** with TITAN Metal Fabricators Inc., USA)

Isgec Redecam Enviro Solutions Pvt. Ltd.
(Subsidiary - **Joint Venture** with Redecam S.P.A, Italy

Process Equipment

Presses

Iron Castings

Metal Cutting Machinery

Contract Manufacturing

EPC Projects

Castings
(Isgec U.P. Steels Castings)

Boilers - Utility

Boilers
(Isgec IJT Boilers)

Sugar Plants & Machinery

Air Pollution Control Equipment

Subsidiaries & Joint Ventures

ISGEC Hitachi Zosen Limited

JV with
Hitachi Zosen Corp.
Japan

ISGEC TITAN Metal Fabricators

JV with
TITAN Metal Fabricators
USA

ISGEC SFW BOILERS

JV with
Sumitomo SHI FW Energia Oy
Finland

ISGEC REDECAM
Isgec Redecam Enviro Solutions

JV with
Redecam Group
Italy

SSM
Saraswati Sugar Mills Ltd.

A Wholly Owned Subsidiary

EAGLE PRESS & Equipment Co. Ltd.

A Wholly Owned Subsidiary in Canada

EAGLE PRESS AMERICA INC.

A Stepdown Subsidiary in USA

Strategic Technology Partnerships

- Amec Foster Wheeler, USA
- AP&T, Sweden
- Babcock Power Environmental Inc, USA
- Bosch Projects, South Africa
- CB&I Technology Inc., USA
- Envirotherm GmbH, Germany
- Fuel Tech Inc., USA
- Riley Power Inc., USA
- Siemens Heat Transfer Technology b.v. Netherlands
- Sumitomo SHI FW Energia Oy, Finland
- Taim Weser, Spain
- Thermal Engineering International (TEi), USA

85 Years & Beyond Estd. 1933

ISGEC
Isgec Heavy Engineering Ltd.

Corporate Overview

- Founded in 1933
- Turnover* : USD 787 Million (Euro 640 Million)
- Total Employee Strength over 2980**
- Listed on stock exchange (BSE)

*This does not include JV
* * This does not include SSM / JV / Contractual Staff

Link to Video

Eagle Press
(Wholly Owned Subsidiary of Isgec)

EAGLE PRESS
& Equipment Co. Ltd.

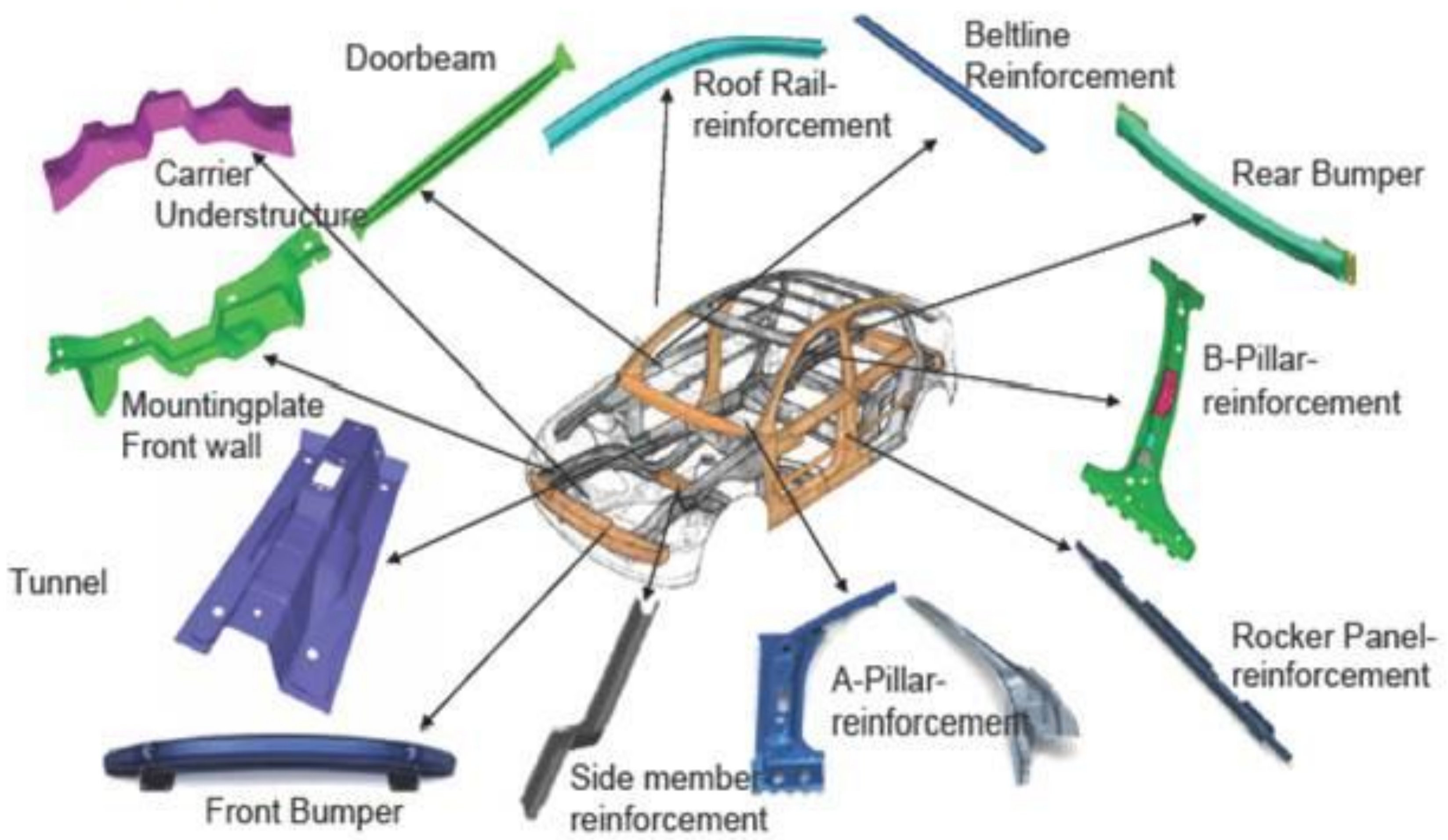
EAGLE PRESS
AMERICA INC.

Technical Alliance with AP&T for Hot Stamping Technology

ISGEC

AP&T
AUTOMATION · PRESSES · TOOLING

Best suited for components that must be lightweight and very strong such as structural automotive parts

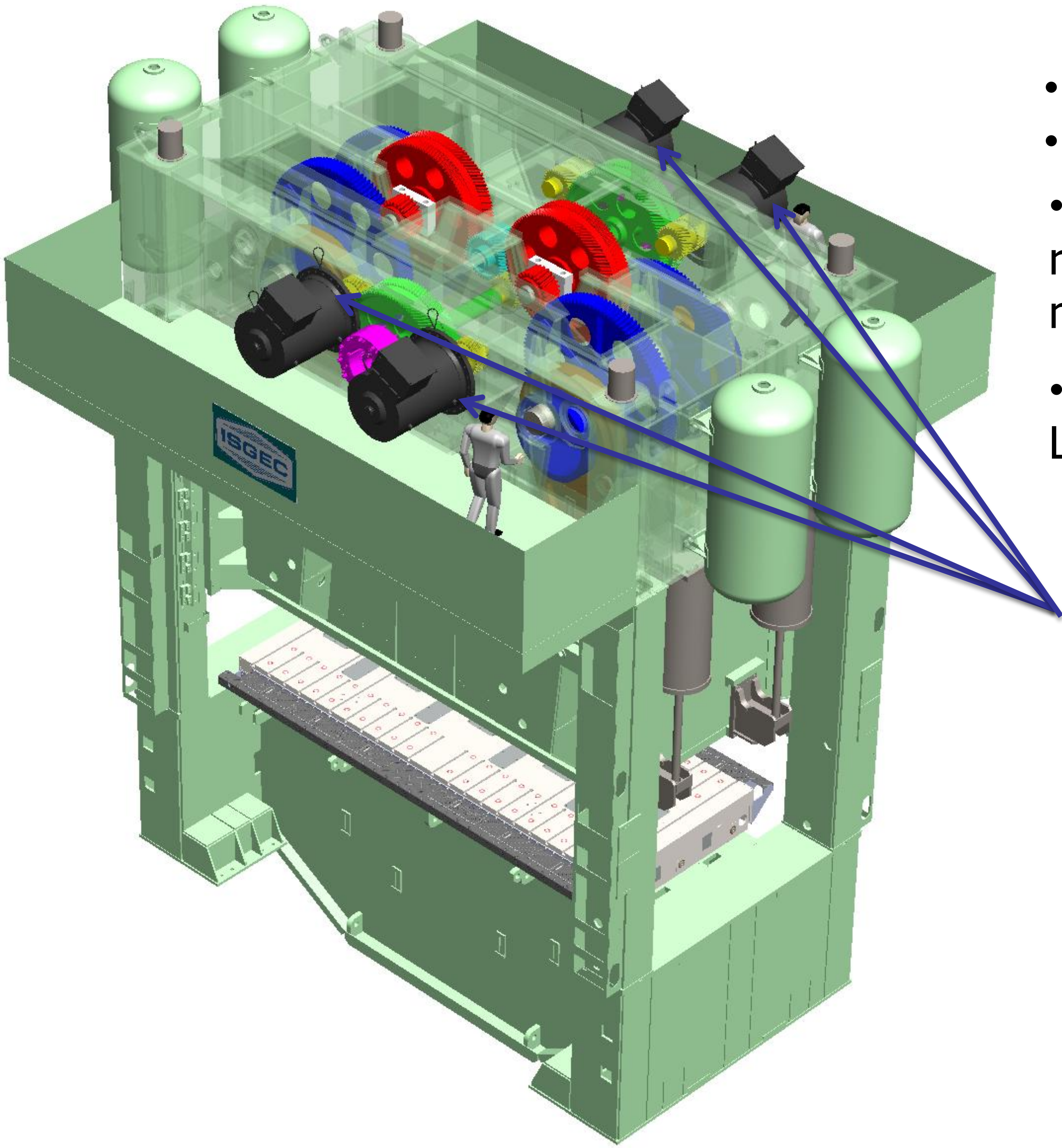


Next Generation Stamping Technology – "SERVO MECHANICAL PRESSES"

Servo Press Technology

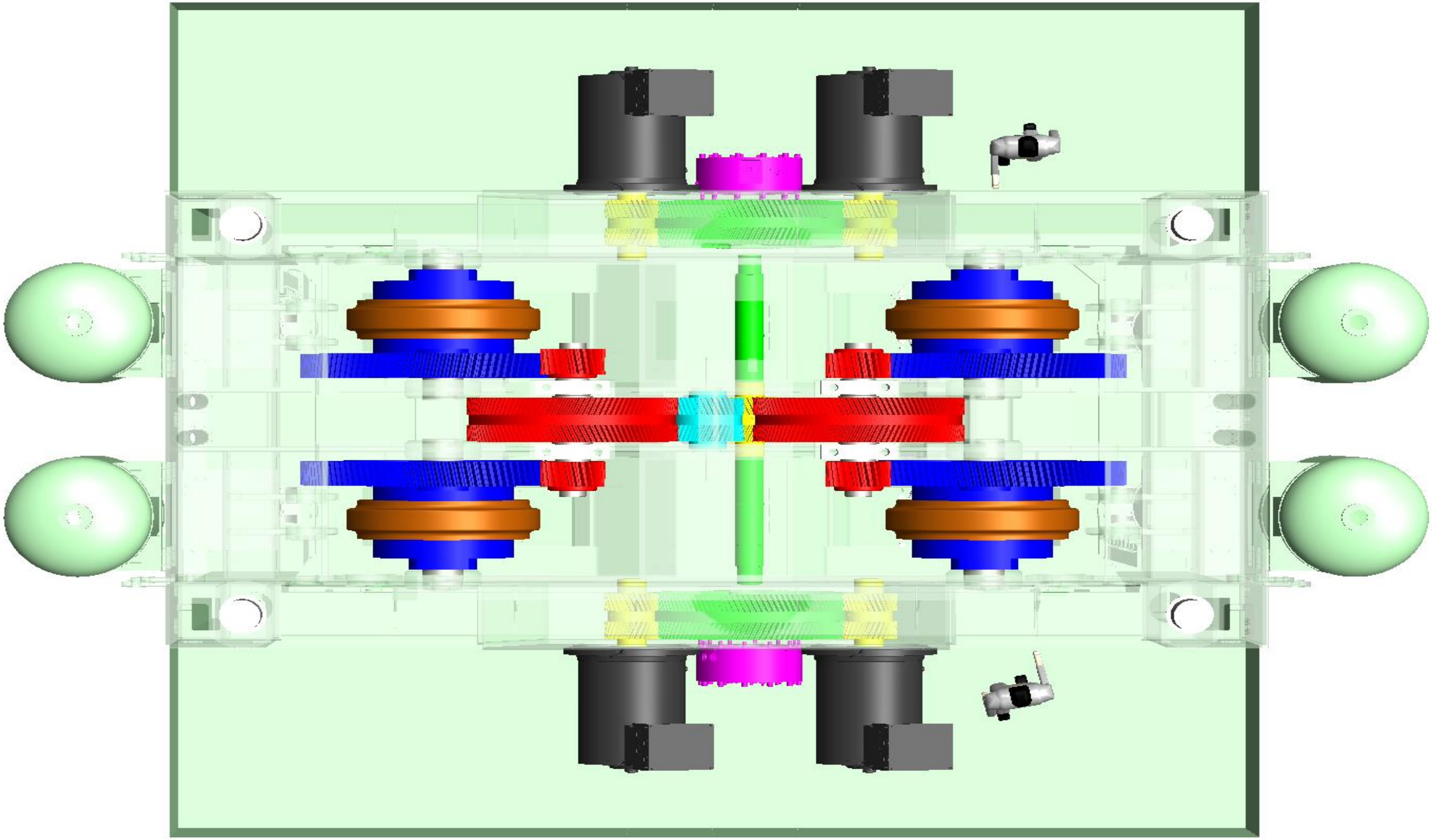
- **Construction**
- **Principle & Sizing**
- **Power / Energy Management**
- **Modes of Operations**
- **Key features of Servo Presses**

Servo Press Technology - Construction



- No flywheel
- No Clutch & brake system
- These components are replaced by high torque servo motors
- Less components, Less Maintenance

Servo Technology - Construction



Top View / Gear Train with High Torque Servo Motors

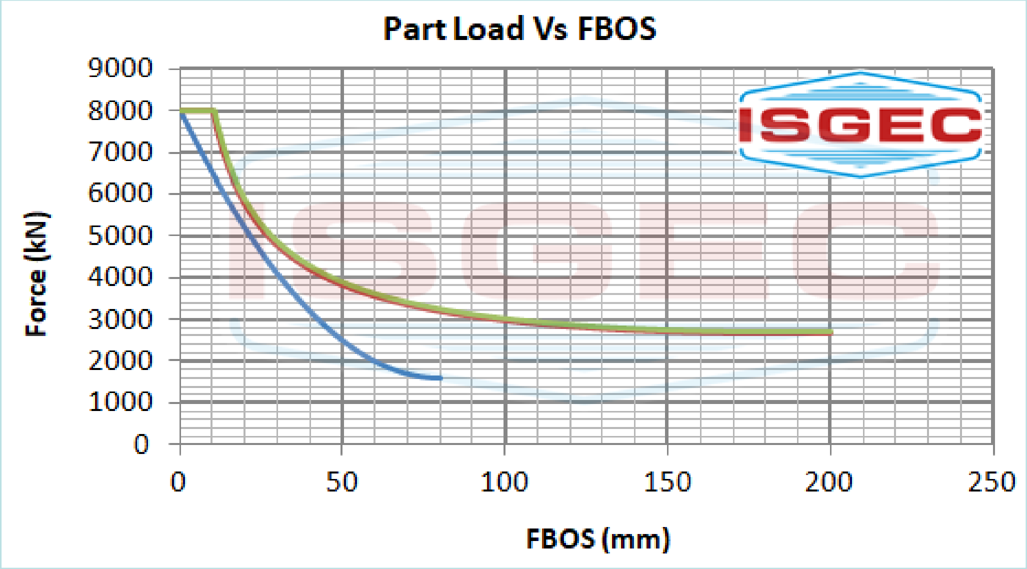
Servo Technology – Principle & Sizing

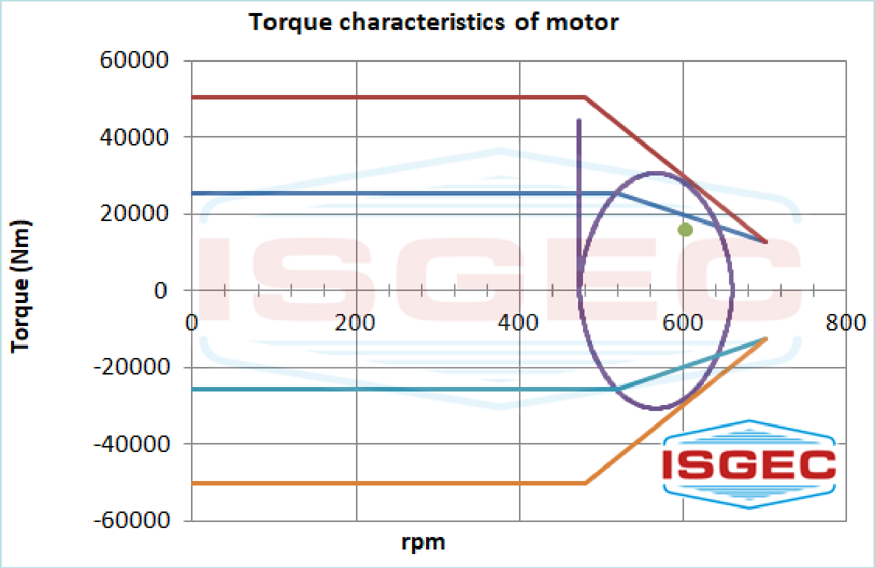
In order to start the sizing of the Servo press, the following data must be defined for the Servo press. Data of this study are:

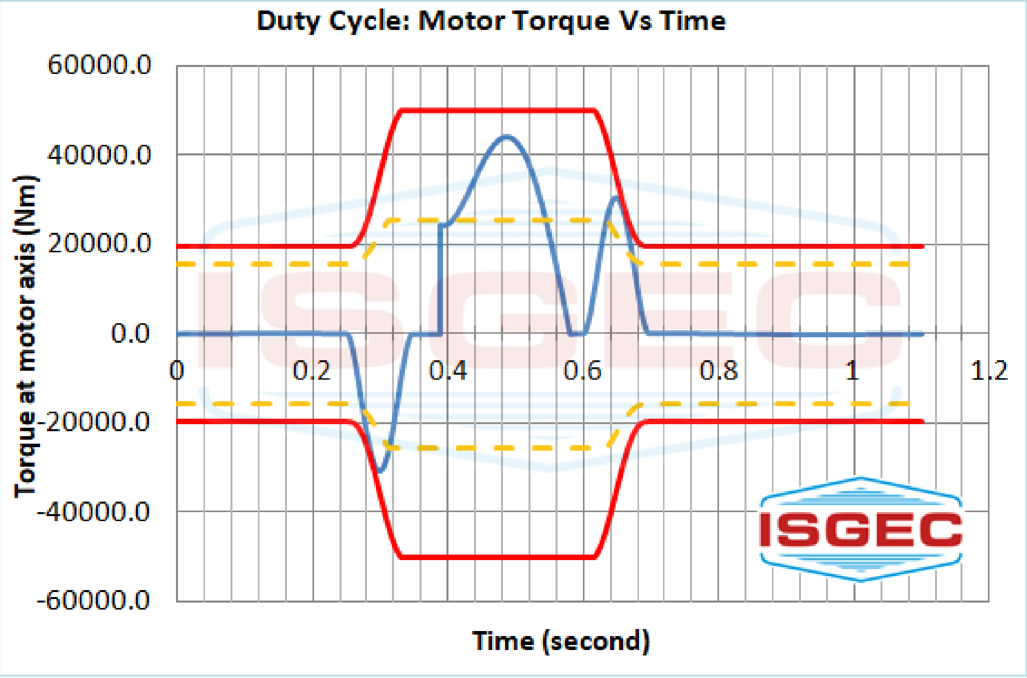
	kN	mm	mm		kJ
S.No	Rated force	Rated point	Stroke	spm	Energy
1	8000	10	400	40	200
2	8000	10	80	75	55
3	8000	----	----	----	----
4	8000	----	----	----	----

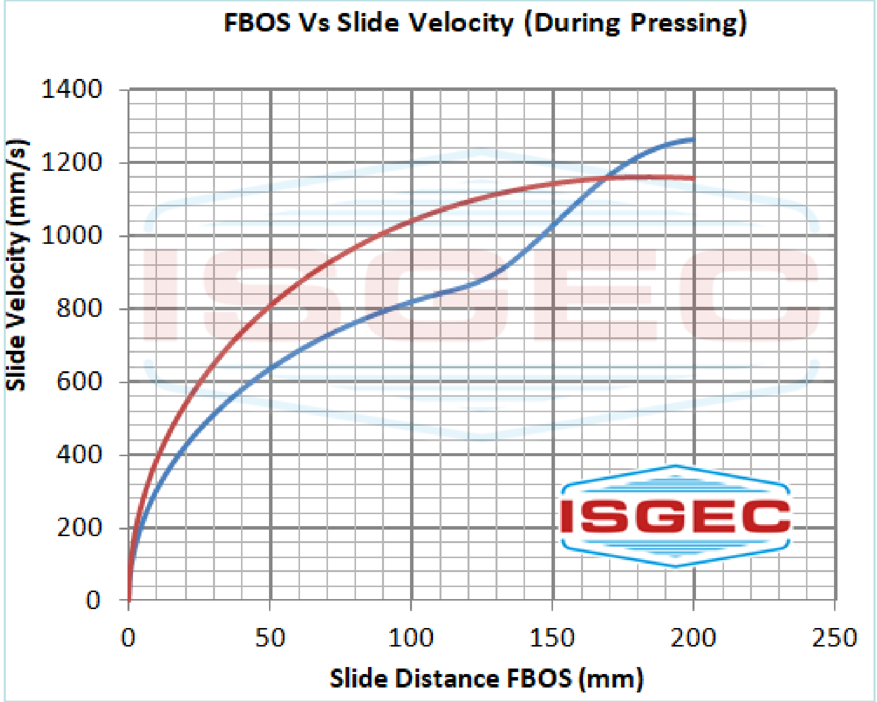
Servo Technology – Principle & Sizing

Part load is generated from the input data
Gear ratio are selected based on available motor and required speed & torque
Motors are checked for thermal stability for specified cycle load-speed combination
Servo profile is programmed as per desired forming speed









Servo Technology – Principle & Sizing

Force (F) = 800 kN

Stroke ('C) = 400 mm

Force Point/ Rated distance (h) = 10 mm

$$M_{exc} = 538171 Nm$$

$$Motor\_rated\_rpm = 400$$

$$N_{form} = 17 spm$$

N_{form} = Machine spm @ rated speed $n_{forming}$

$$i = \frac{400}{17} = 23.529 \approx 23.5$$

$$N_{torque} = \frac{\mathrm{M_{exc}}}{\mathrm{M_{motor}} i\, \eta_m \eta_e \eta_t} = \frac{538171}{11400 * 23.5 * 0.95} = 2.1 \Rightarrow 2$$

N_{torque} = No. of torque motors required

Motor 1FW3-287-3M Data

Max torque = 11400 Nm

Max speed = 1000 rpm

Rated torque = 6650 Nm

Rated speed = 400 rpm

Rated power = 276 kW

Servo Technology – Power / Energy Management

The M_{torque} required for forming along with the $n_{forming}$ define the required power during the forming process.

$$P_{needed} = M_{torque} \bullet \varpi_{forming} = M_{torque} \frac{2\pi \cdot n_{forming}}{60} = 2 \cdot 11400 \cdot \frac{2\pi \cdot 400}{60} = 960kW$$

Motor 1FW3-287-3M Data

Max torque	= 11400 Nm
Max speed	= 1000 rpm
Rated torque	= 6650 Nm
Rated speed	= 400 rpm
Rated power	= 276 kW

Servo Technology – Power / Energy Management

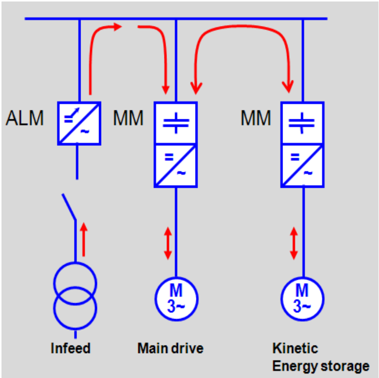
There are three possibilities to supply the power

- **Servopress without Energy Management**
  The mechanical power as well as all the losses (mechanical and electrical) must always be covered by the infeed. It means that the infeed line and the transformer must cover a peak power of 1.0MW . Significant load fluctuations that have a big impact in the line supply.

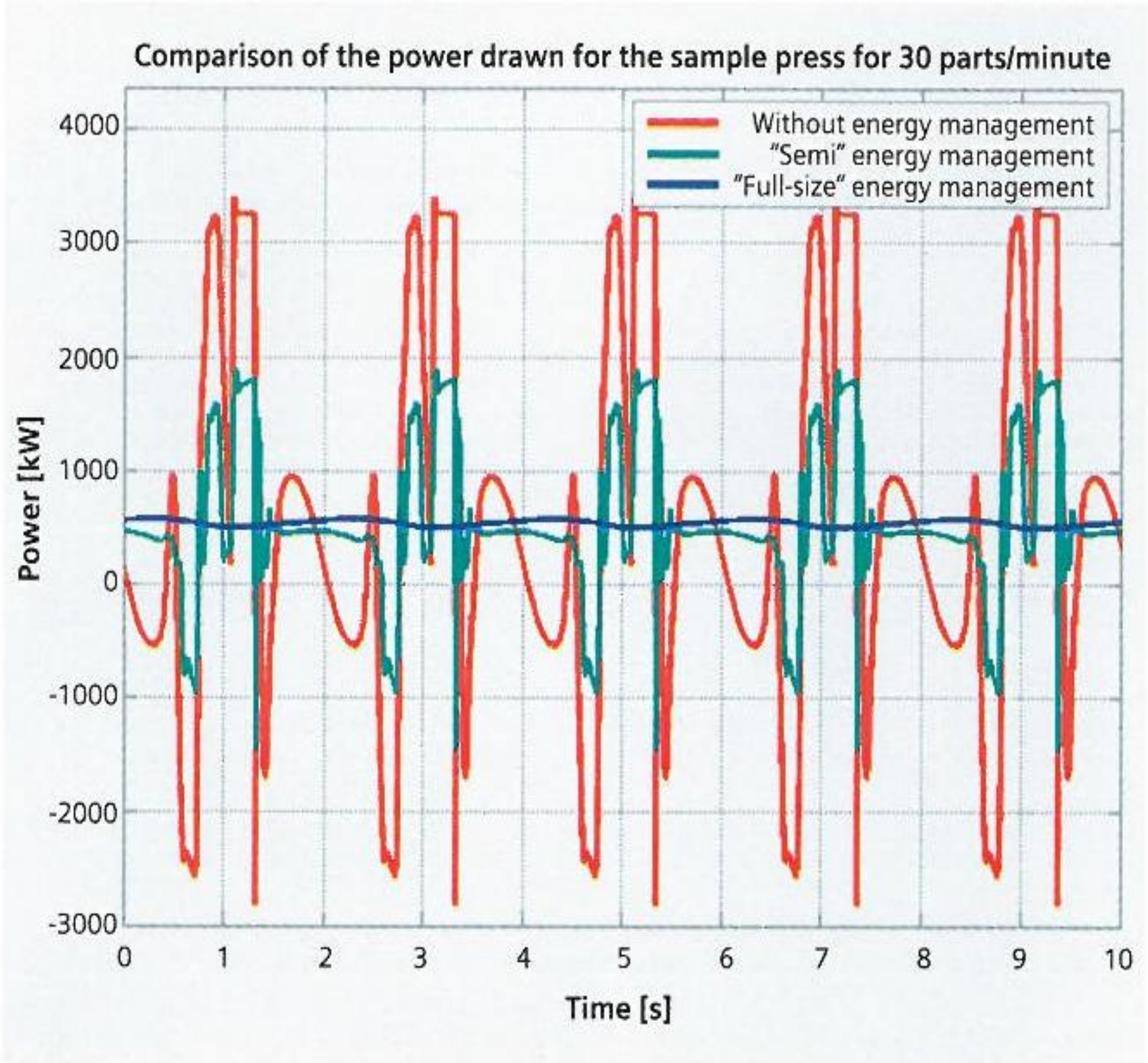
- **Servopress with "Full size" Energy Management**
  For a complete energy management, the drive system of the press is expanded to include kinematic energy buffer devices (motors and/or capacitors).The needed energy to accelerate the torque motors is supplied by the energy buffer. The needed energy generated when the torque motors decelerate is used to load the energy buffer. For this reason, the infeed only covers the energy of the part and the energy losses. The infeed and the transformer power are reduced to a minimum. The infeed sees an almost constant load. Regenerative power is not inserted to the line.

- **Servopress with "Semi" Energy Management**
  In this cases only part of the kinetic energy is recuperated, it means that the infeed must cover part of the needed energy to accelerate the torque motors. In addition there will be some peaks in the supply line.

VS



Servo Technology – Power / Energy Management



Servo Technology – Power / Energy Management

Currently, this energy buffer can be performed in two ways: **capacitors or flywheel motors.**

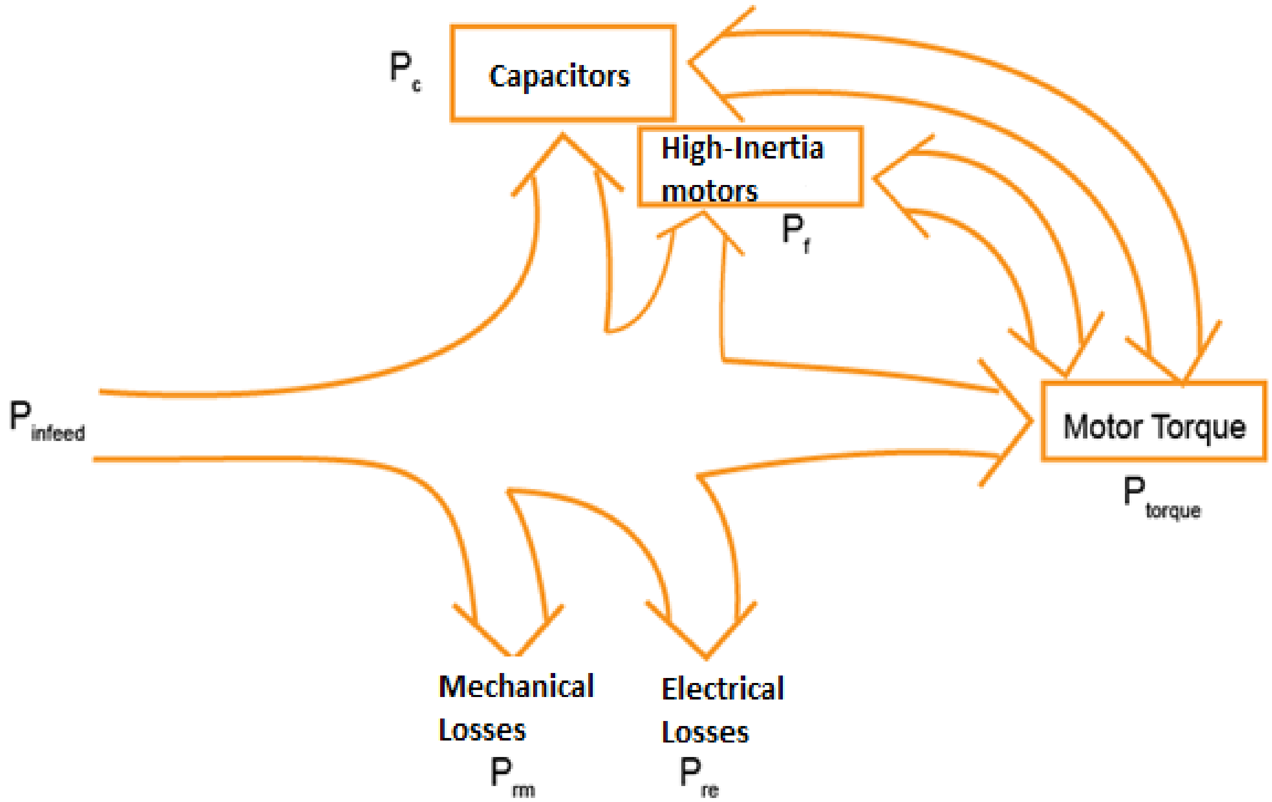
- Flywheel motors decelerate in order to return the energy to the internal (direct) electrical grid, which then feeds the torque motors to accelerate the masses of the press or to carry out the forming work. These motors accelerate (storing energy) when the torque motors decelerate, and thus return energy via the direct current grid.

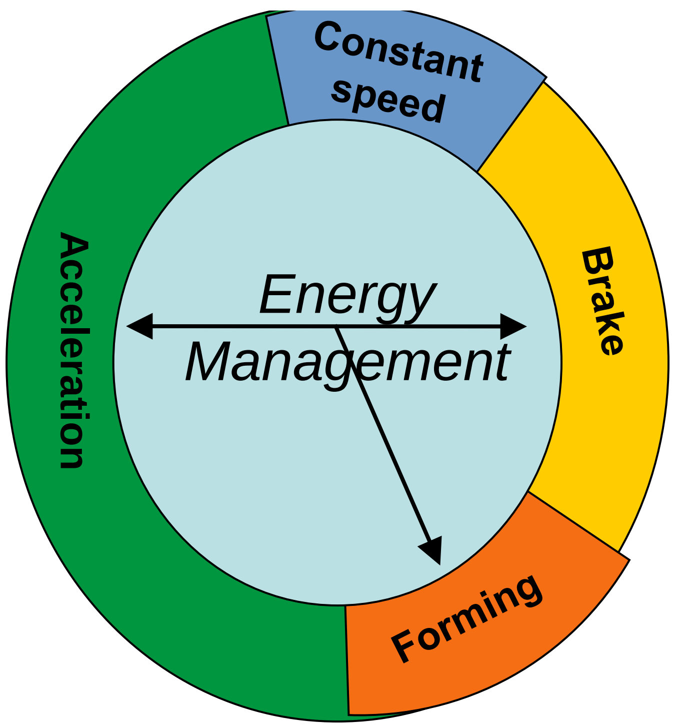
- The power required by the motors is linked to the power infeed of the grid, and the powers of the buffer ($P_{capacitors} + P_{flywheelmotors}$) P_f to the following equation:

$$P_{torque} + P_{rm} + P_{re} = P_{infeed} + P_c + P_f$$

$$P_{infeed} = P_{torque} + P_{rm} + P_{re} - P_c - P_f$$

- A greater inertia buffer power will require a lower power infeed installed and vice-versa.





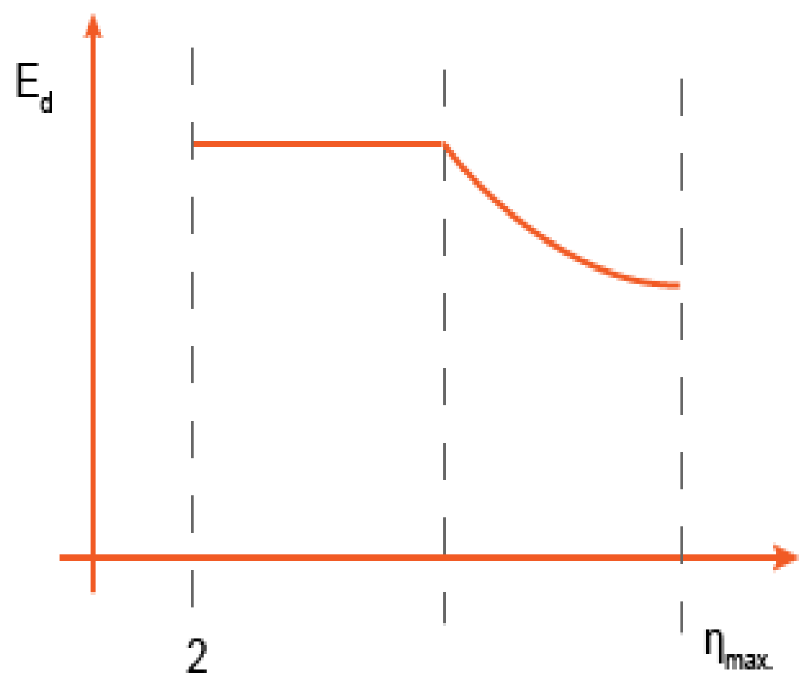
Servo Technology – Power / Energy Management

Other factor that must be considered to size the infeed is the available energy per press cycle. As it is explained before, in the case of "Full size" energy management, the infeed must be able to cover the energy of the part + the energetic losses. Therefore, the power supply must have the power determined by this equation:

$$P_{infeed} \cdot t_{cycle} \geq E_d + t_{cycle} \cdot \sum P_{loss}$$

$$P_{infeed} \geq \frac{E_d \cdot n_{production}}{60} + \sum P_{loss}$$

As there is a large speed difference between the minimum (approximately 2gpm) and the maximum speed, sometimes an available energy is established until a certain number of cycles. This way the power infeed is smaller.



In low-tonnage press, the work energies are small and may not need an energy buffer. But in a press 400t or above, the work energy is much higher and the energy needs are between 600 and 100 kJ per cycle. In these machines, the inertia buffer must be studied for it to meet the needed energy taking into account that a capacitor stores approximately 10 KJ and high-inertia motors can store up to 400 kJ each.

Servo Technology – Power / Energy Management

For the Servo Press of 8000 kN, the power for the motor torque is:

$$P_{needed} = M_{torque} \cdot \varpi_{forming} = M_{torque} \frac{2\pi \cdot n_{forming}}{60} =$$

$$P_{needed} = 2 \cdot 11400 \cdot \frac{2\pi \cdot 400}{60} = 960kW$$

1PH8:
Max power= 500 Kw

In this press, a "Full size" energy management with flywheel is installed,
Therefore, the power of the flywheel must be:

$$P_{flywheel} \geq 1000kW \Rightarrow 2x500kW$$

POWER SUPPLY
SINAMICS 235 Kw

and the infeed power is:

$$P_{infeed} \geq \frac{E_d \cdot n_{production}}{60} + \sum P_{loss}$$

$$\sum P_{loss} \approx 55kW$$

$$P_{infeed} = \frac{250 \cdot 40}{60} + 55 = 220 \rightarrow 235kW$$

Servo Technology – Sizing of Servo System

Isgec In-house calculation software

18-06-2019		
Job No.	Kauth Canada 400t press	
Press Operation mod	Pendulum	

Legends	
Input	
Output	

Input-Ecc gear position Vs rpm

Number of segments (each may be of different rpm) with-in 1 complete revolution of Ecc gear	Ecc gear start position (angle)	Ecc gear end position (angle)	Ecc gear rpm @ start position	Ecc gear rpm @ start position	% Asymmetry of S curve
S.No.	Θ_s	Θ_e	ω_s	ω_e	%
	deg	deg	rpm	rpm	
1	130	150	0	38	50
2	150	155	38	38	50
3	155	165	38	30	50
4	165	180	30	30	50
5	180	190	30	38	50
6	190	210	38	38	50
7	210	230	38	0	50

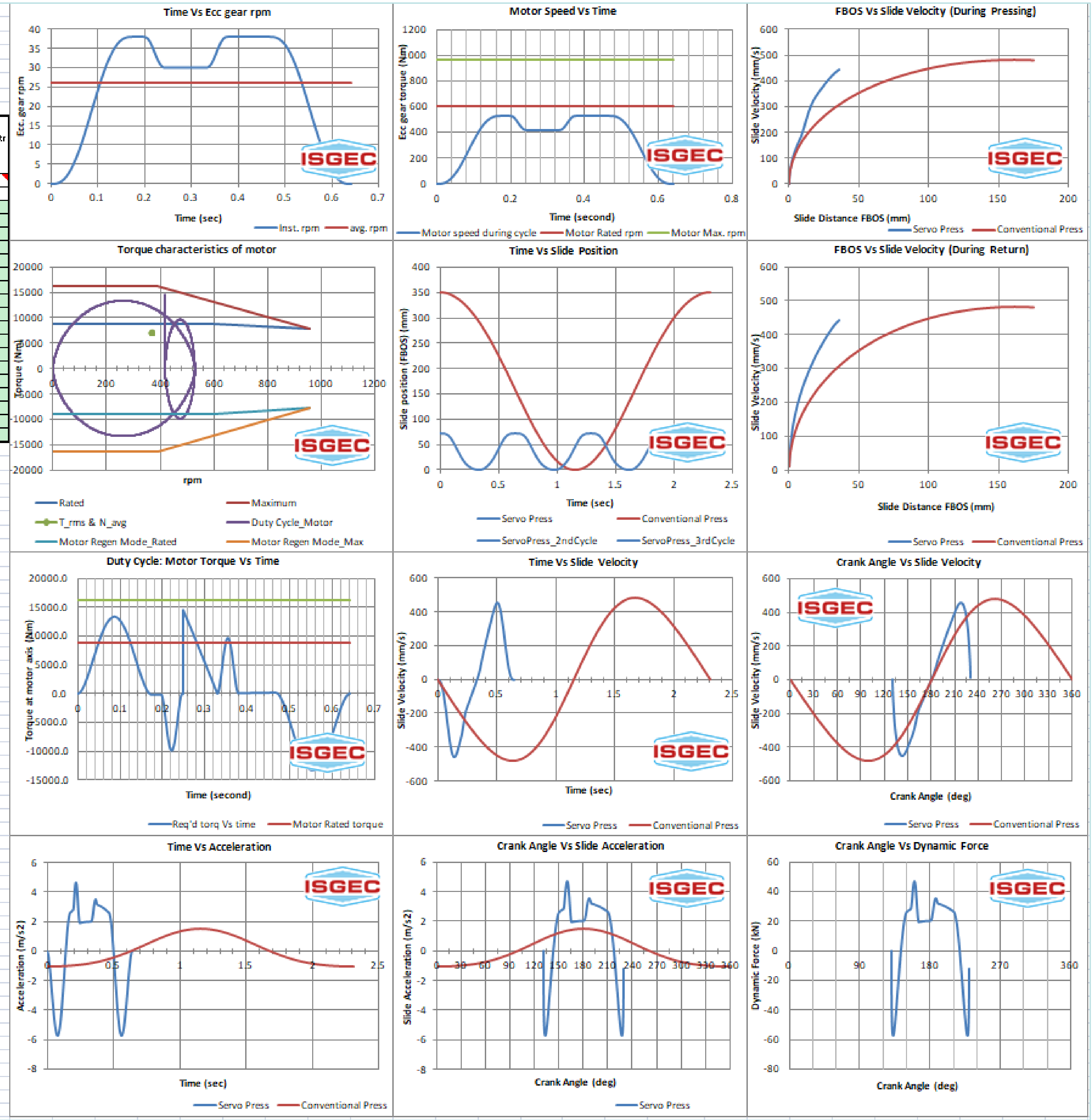
Error Checker

max S.No.		last value		last value
7		230		0
End Positions data OK				
Speed data OK				

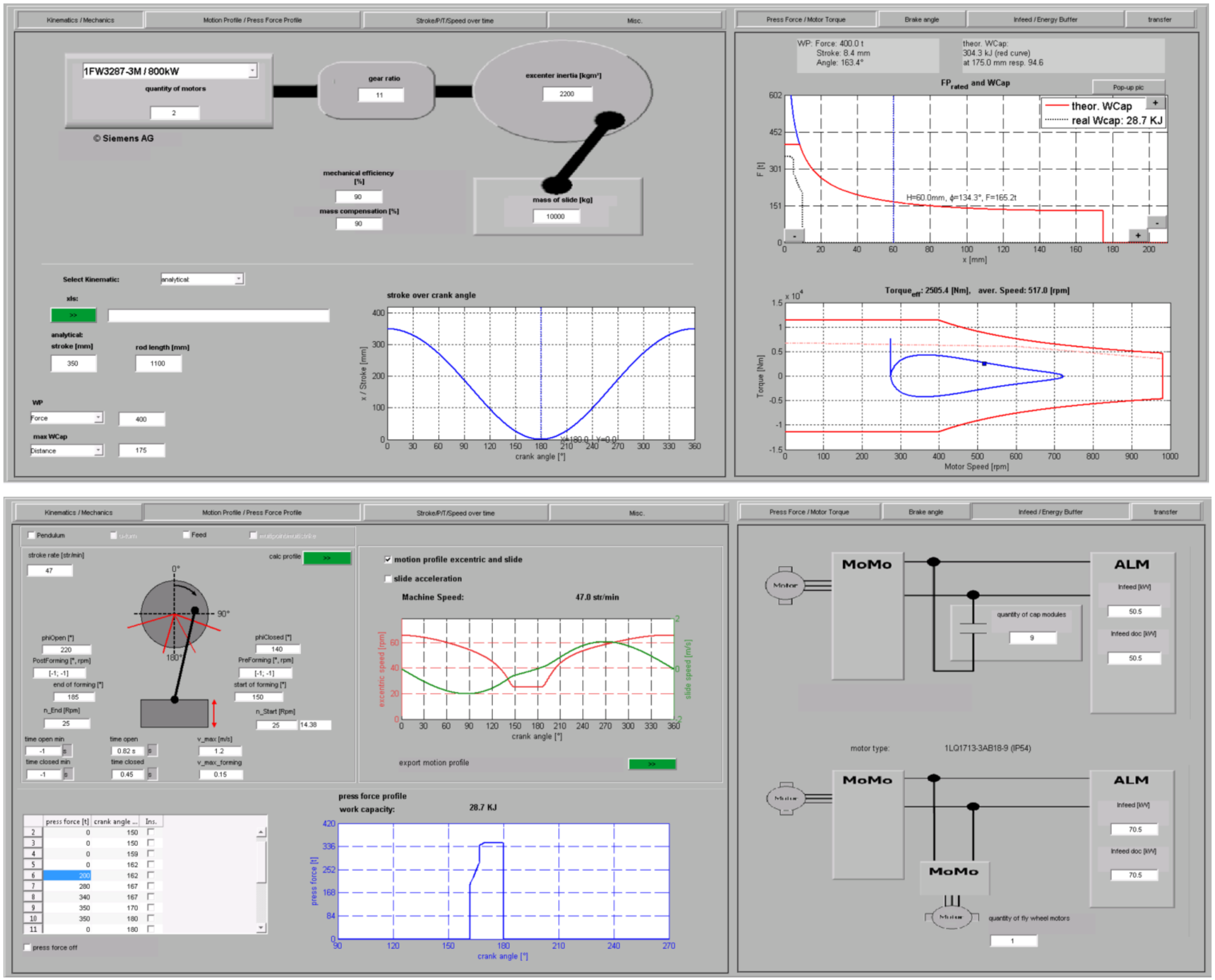
Input-Basic Press Data

Press Force	ton	400
	N	4000000
Rated distance	mm	6.5
Press stroke	mm	350
Rated angle (from TDC)	rad	2.8883
	deg	165.487
Rated angle (from BDC)	rad	0.25329
	deg	14.5
Con rod angle at rated ang	rad	0.04178
		2.4

Select Motor		Column nr
Max torque - rated rpm	8150Nm-600rpm	
Number of motors	2	
row no	4	
Model	1FW3 285-3M	2
Rated Speed	600	6
Max Speed	960	7
Speed at Max Torque	390	5
Rated Torque	4400	8
Max Torque	8150	4
Torque at max speed	3900	9
Power	275	3
Inertia	6.1	15



Servo Technology – Sizing of Servo System Validation using Siemens Solution

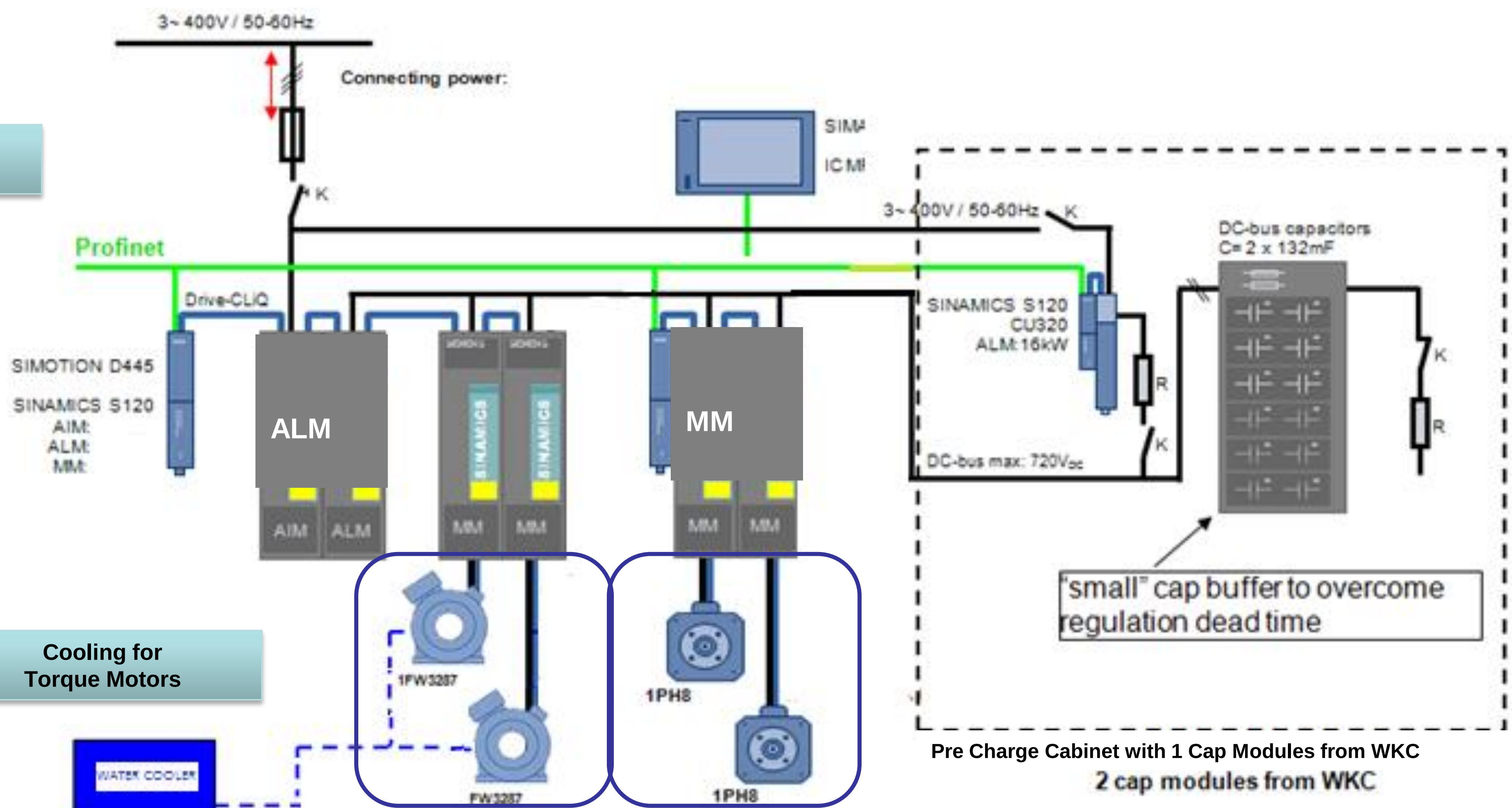


System Layout

SERVO PRESS CONTROL	ACTIVE INFEED	MAIN DRIVES	KINETIC ENERGY STORAGE SYSTEM*	PRE-CHARGING CIRCUIT	ELECTRIC ENERGY STORAGE SYSTEM

Electric Infeed X 120kW

Cooling for Torque Motors



Pre Charge Cabinet with 1 Cap Modules from WKC

2 cap modules from WKC

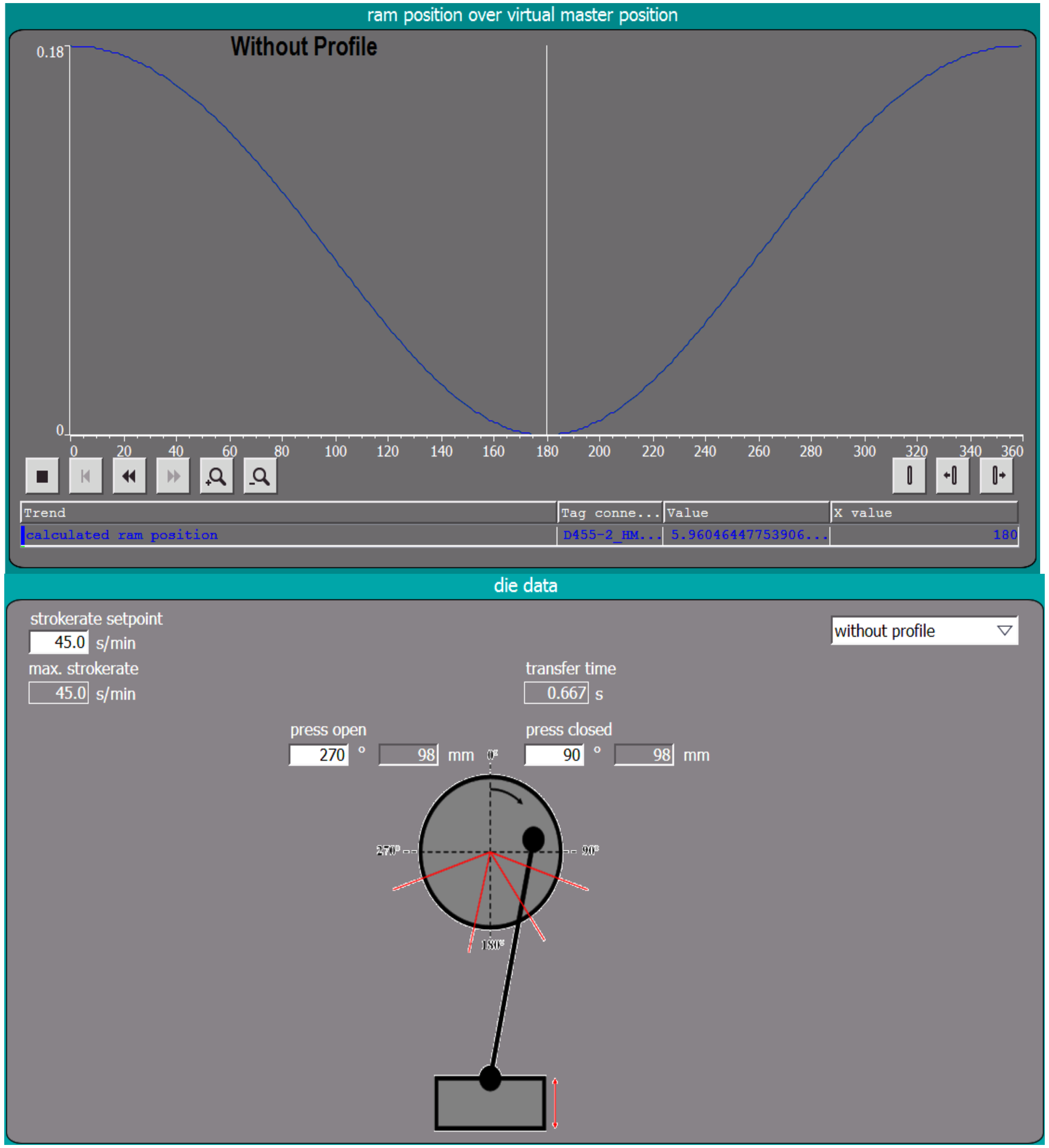
TORQUE MOTORS
2x 243 kW

FLYWHEELS
2x 275kW

A. Without Profile

It is Sinusoidal motion similar to Normal Eccentric drive Press. Following values are programmed for this mode.

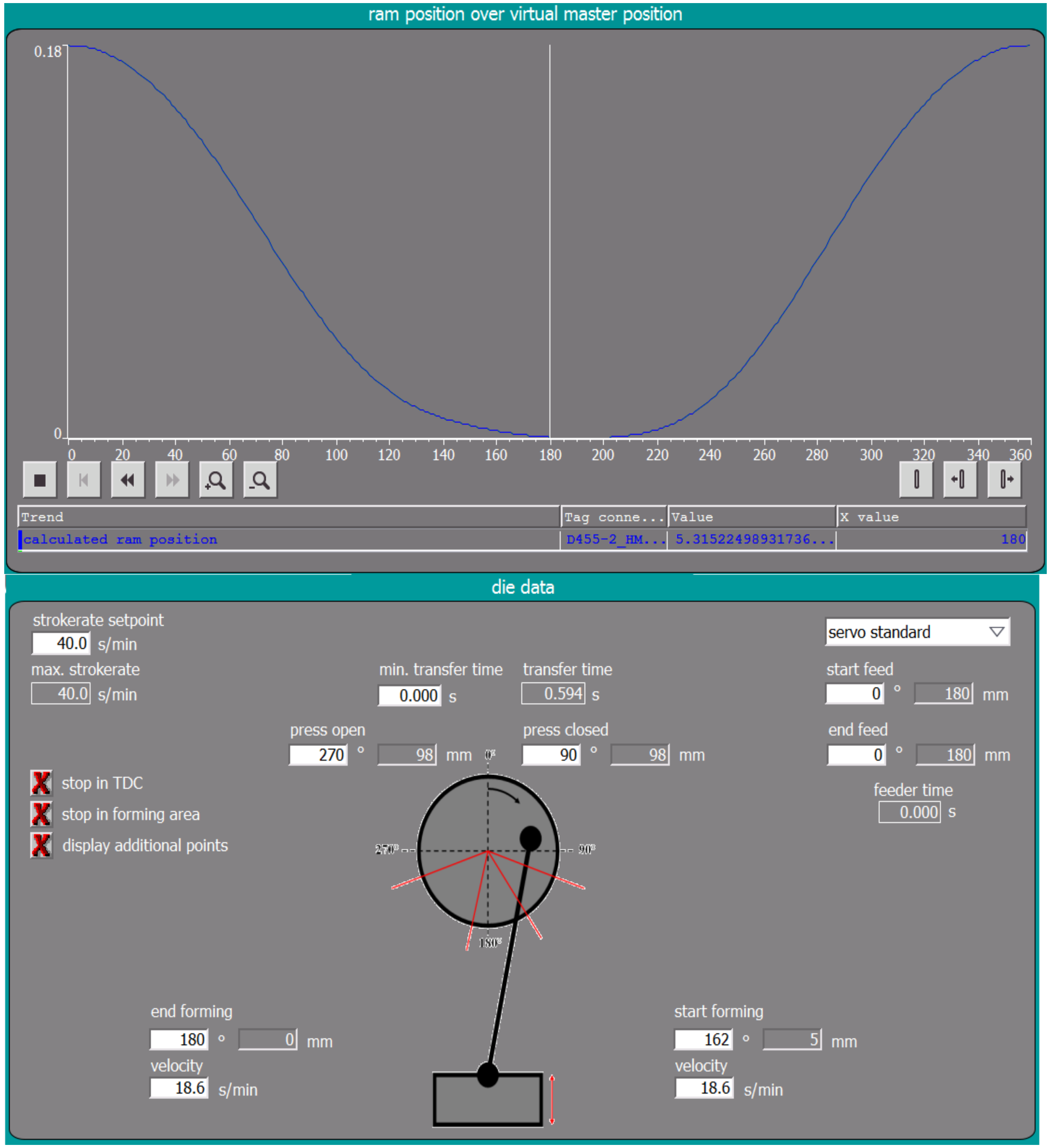
- **Stroke rate** (Desired SPM): If the user does not program this value, the software will show the maximum value that can be achieved.
- **Press Closed:** When we can't feed and transfer material
- **Press Opened:** When we can start to feed and transfer material.



B. Servo Standard

Following values are programmed in this mode.

- **Values of "Start Forming" :** Height and speed of slide.
- **Values of "End Forming" :** Height and speed of slide.
- **Stroke rate** (Desired SPM). If the user does not program this value, the software will show the maximum value that can be achieved.
- **Press Closed:** when we can't feed and transfer material.
- **Press Open:** when we can start to feed and transfer material.
- **Min Transfer Time**: Time between Press opened and press closed. The servo slows down the speed to ensure that the programmed Minimum transfer time is achieved.

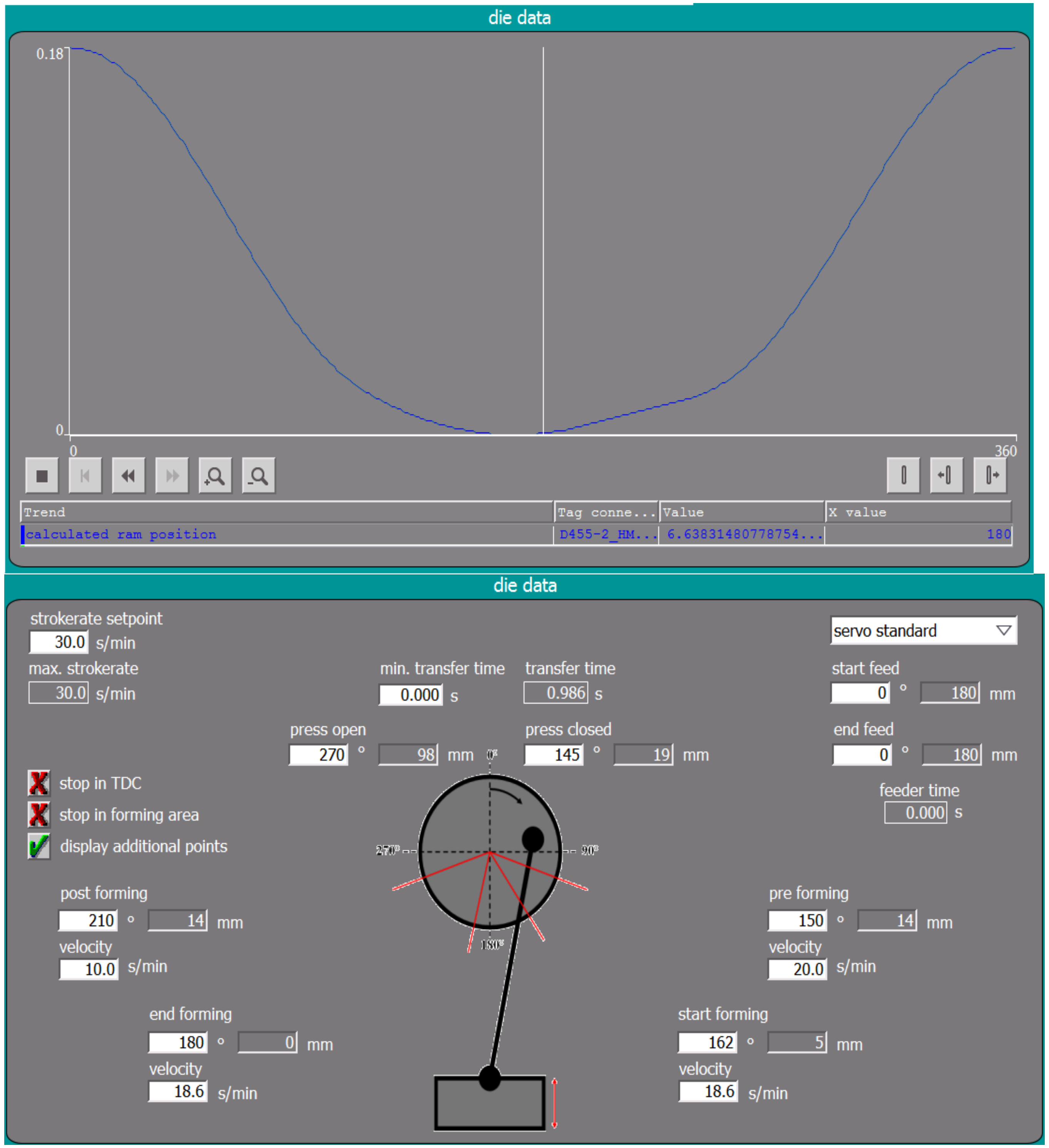


Servo Technology – Modes of Operations

B.1 Servo Standard with Additional Points

With this option the user has 2 more Programmable points. The other functions are the same as servo standard.

- **Values of "Pre Forming" :** Height and speed of slide.
- **Values of "Post Forming":** Height and speed of slide

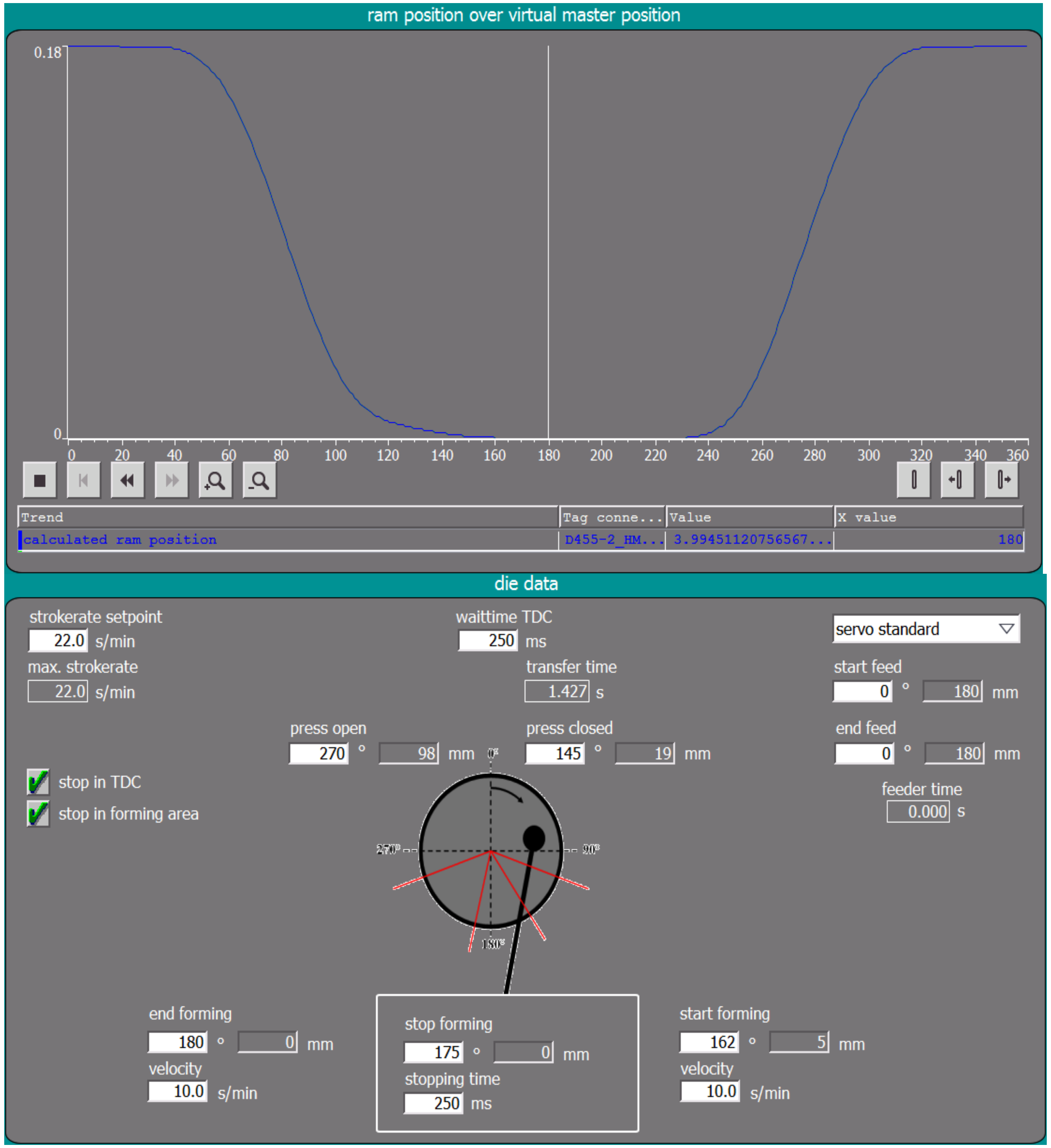


Servo Technology – Modes of Operations

B.2 Servo Standard with Stops

- **Stop in TDC:** M/c stops at top to give more time for loading & unloading

- **Stop in Forming Area:** M/c Stops in forming area to overcome spring back action.

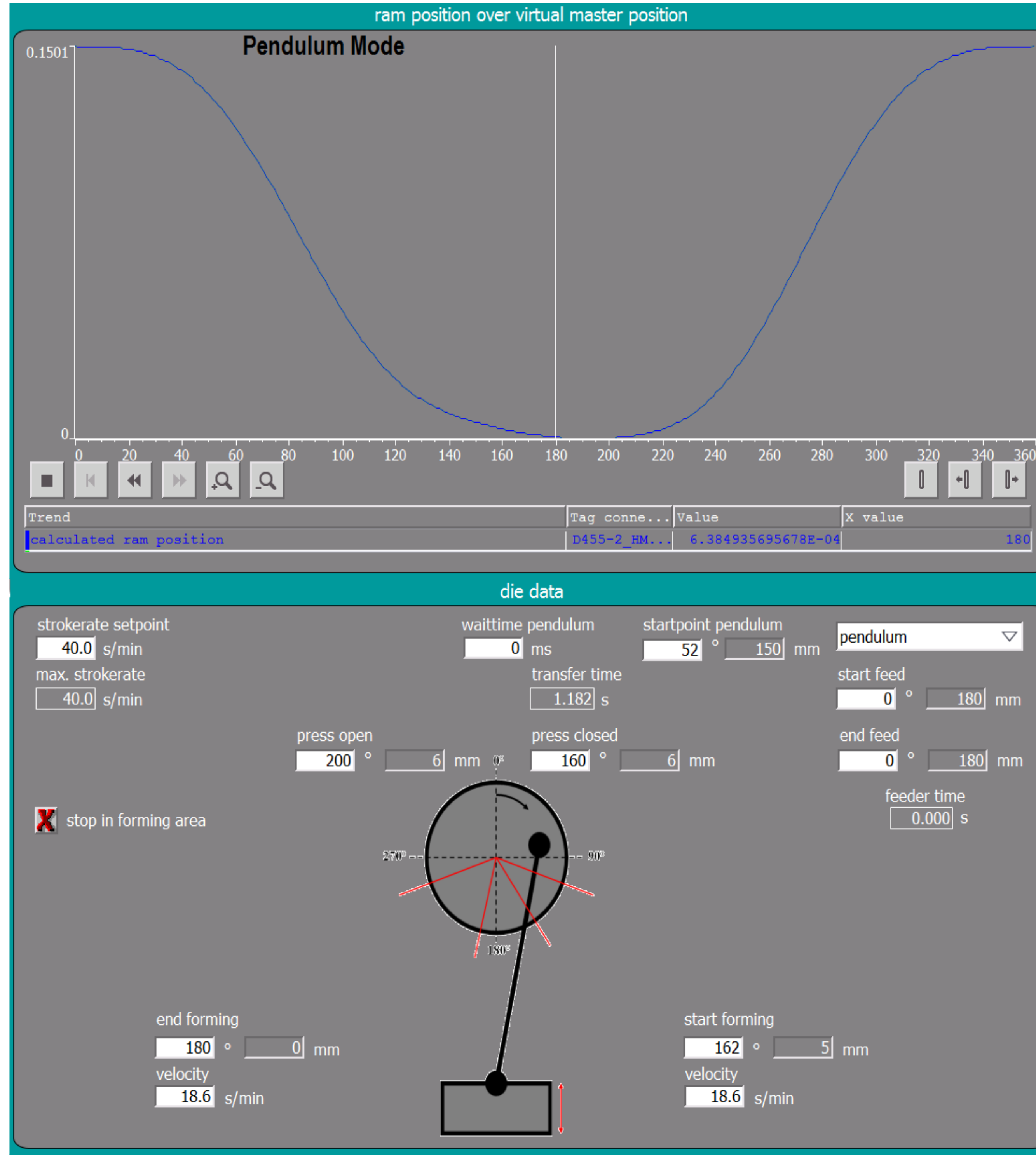


Servo Technology – Modes of Operations

C. Pendulum Mode

Following values are programmed in this mode.

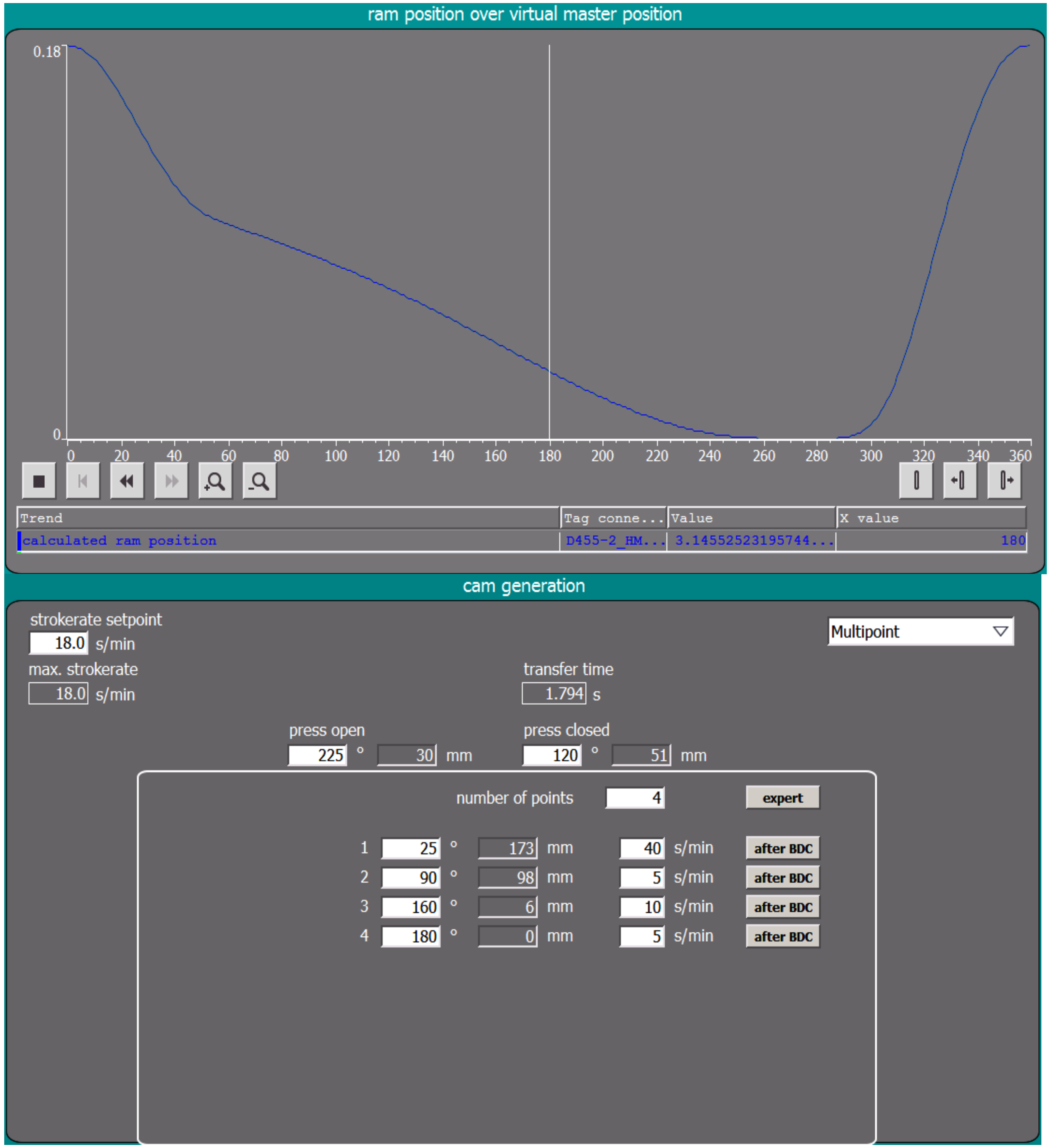
- **Start Point pendulum:** stroke of the pendulum in mm.
- **Values of "Start Forming".** (Height and speed of slide).
- **Values of "End Forming"**. (Height and speed of slide)
- **Stroke rate**. (Desired speed). If the user does not program this value, the software will show the maximum value that can be achieved.
- **Press Closed:** When we can't feed and transfer material).
- **Press Opened:** When we can start to feed and transfer material.
- **Wait Time**: After each stroke the press stops for this time.



D. Multipoint Mode

Following values are programmed in this mode.

- **Number of points:** user can parameterize between 2 and 10 the number of programmable points.
- **Programmable points:** for each point the user must program the height and the speed. Maximum 10 points can be programmed.
- **Stroke rate:** (Desired SPM) If the user does not program this value, the software will show the maximum value that can be achieved.
- **Press Closed:** When we can't feed and transfer material.
- **Press Opened :** When we can start to feed and transfer material.

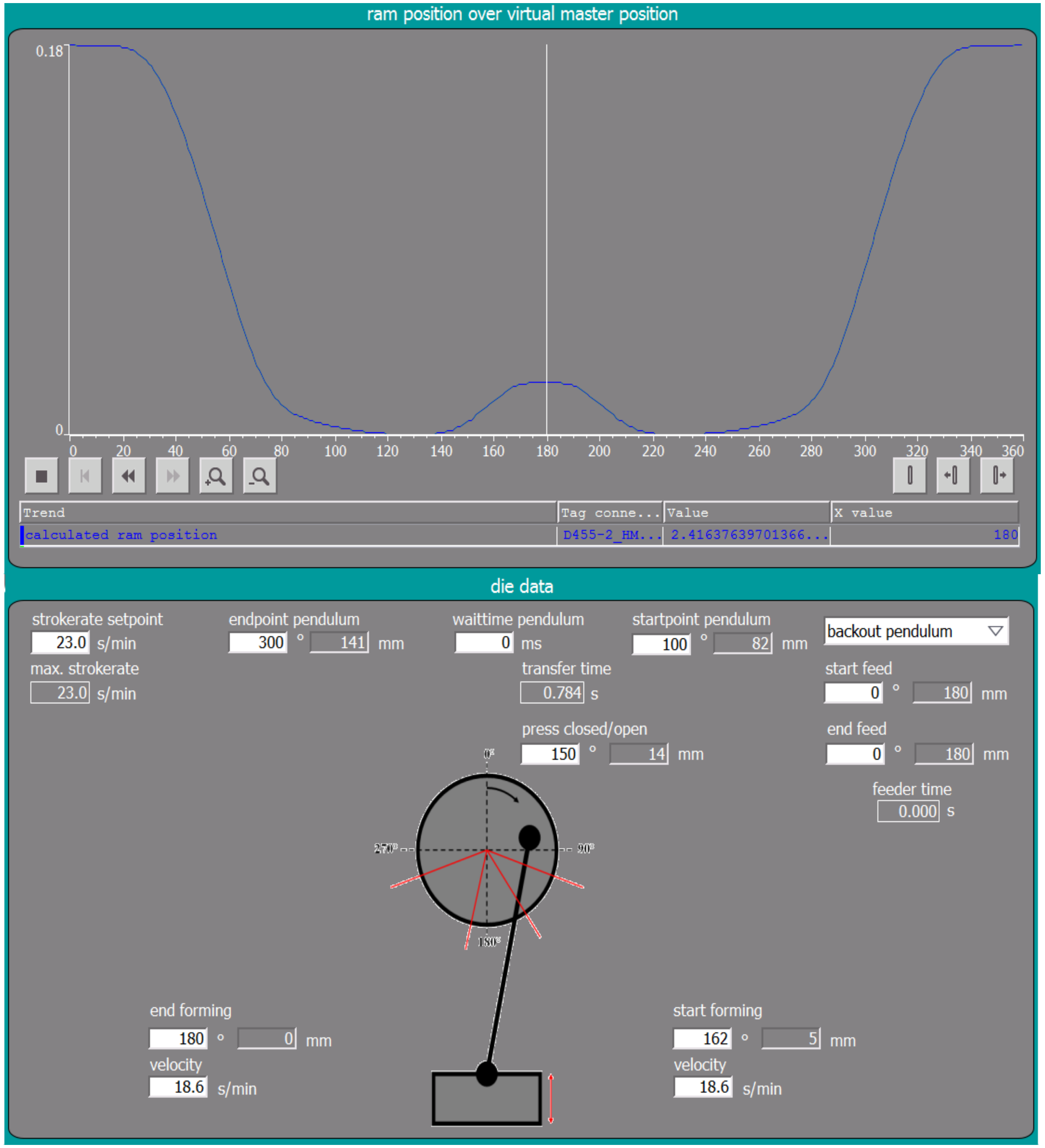


E. Back-out Pendulum Mode

During one stroke of the press the forming area is passed through twice and therefore the material being located in the forming area gets formed twice too. This way the part quality will be better, reducing the spring-back and having more precise drawings.

Following values are programmed in this mode.

- **Start Point pendulum:** stroke of the pendulum in mm.
- **Values of "Start Forming".** (Height and speed of slide).
- **Values of "End Forming".** (Height and speed of slide)
- **Stroke rate**. (Desired speed). If the user does not program this value, the software will show the maximum value that can be achieved.
- **Press Closed/ Open:** When we can't feed and transfer material.
- **Wait Time**: After each stroke the press stops for this time.



Servo Technology – Modes of Operations

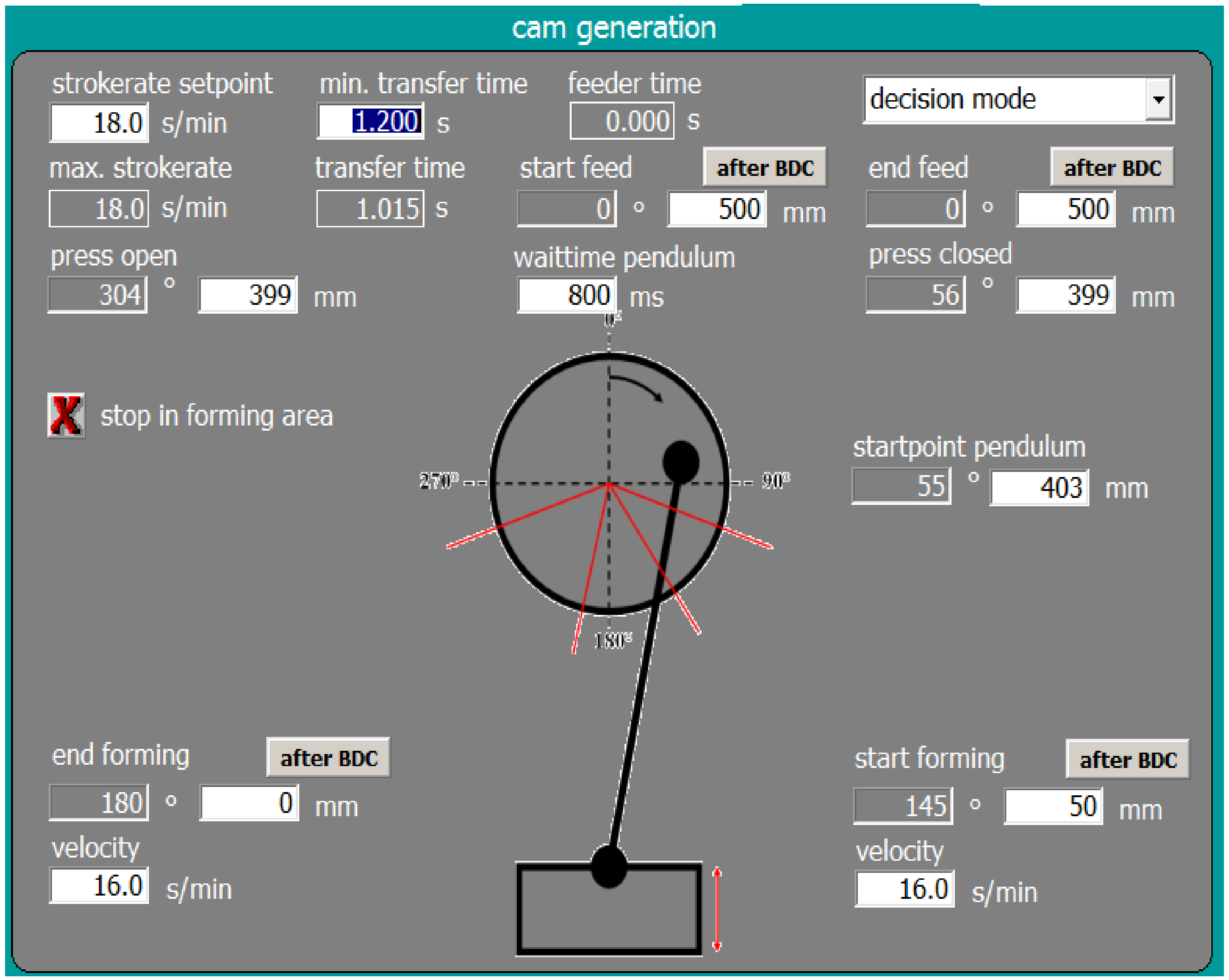
F. Decision Mode

This calculation allows the operator to decide between pendulum or servo standard based on two criteria:

- **Maximum Stroke rate.**
- **Energy consumption.**

The user must program next fields:

- **Start Point pendulum:** stroke of the pendulum in mm.
- **Values of "Start Forming":** (Height and speed of slide).
- **Values of "End Forming":** (Height and speed of slide)
- **Press Closed/Open:** (when we can't feed and transfer material).
- **Wait Time:** (for pendulum mode). After each stroke the press stops for this time.
- **Min transfer time:** (for servo-standard mode).Time between Press opened and press closed. The servo slows down the speed to ensure that the programmed Min transfer time is achieved.

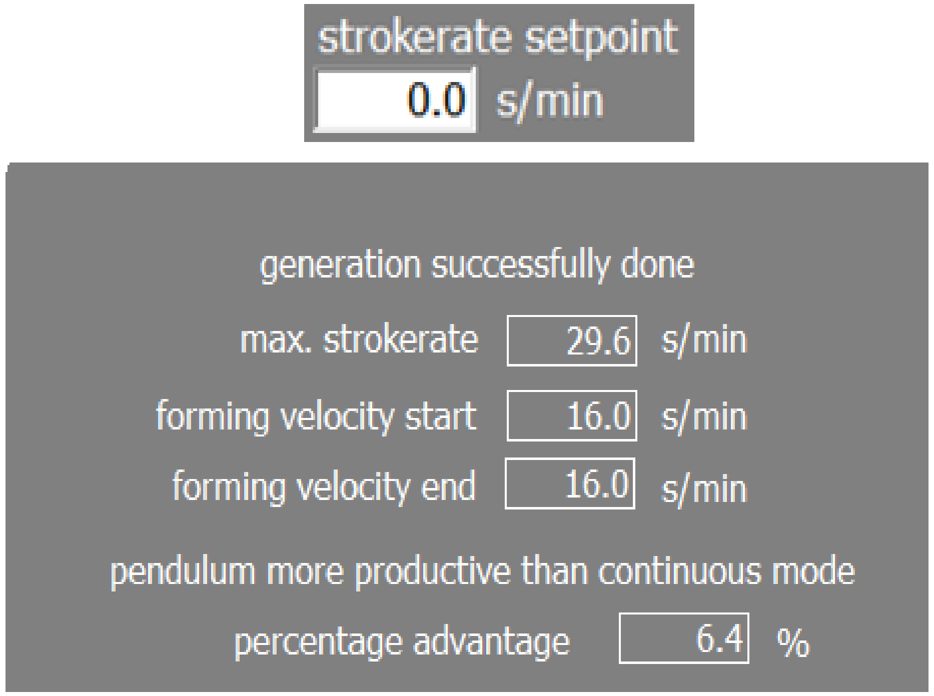


Servo Technology – Modes of Operations

F. Decision Mode

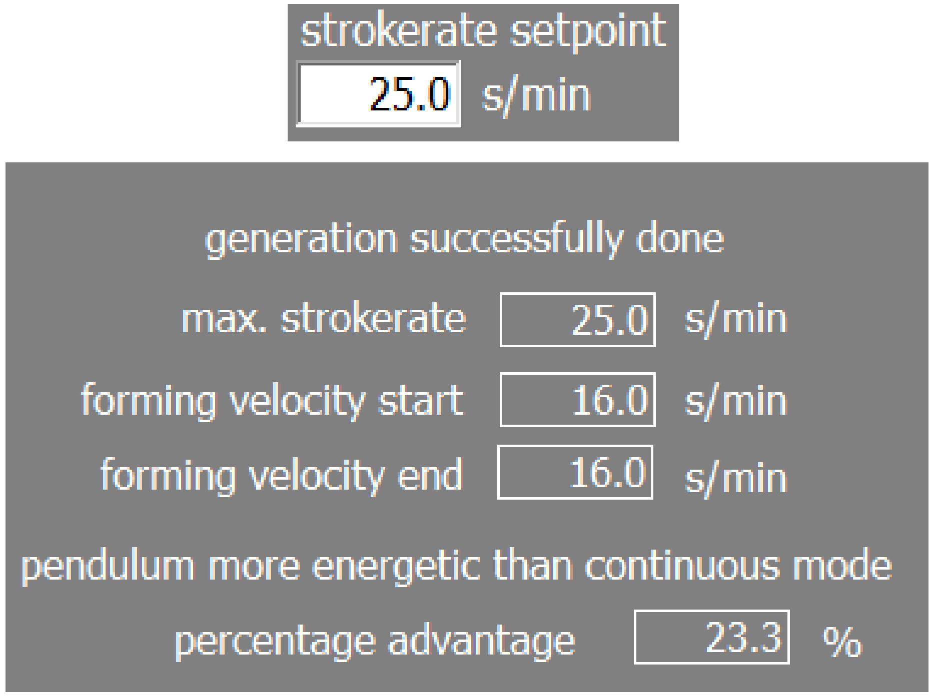
F1. Stroke rate comparison

If the stroke rate is set to 0 by the user, the maximum possible stroke-rate for both profiles will be calculated. The profile having the higher stroke rate is more productive and wins the comparison



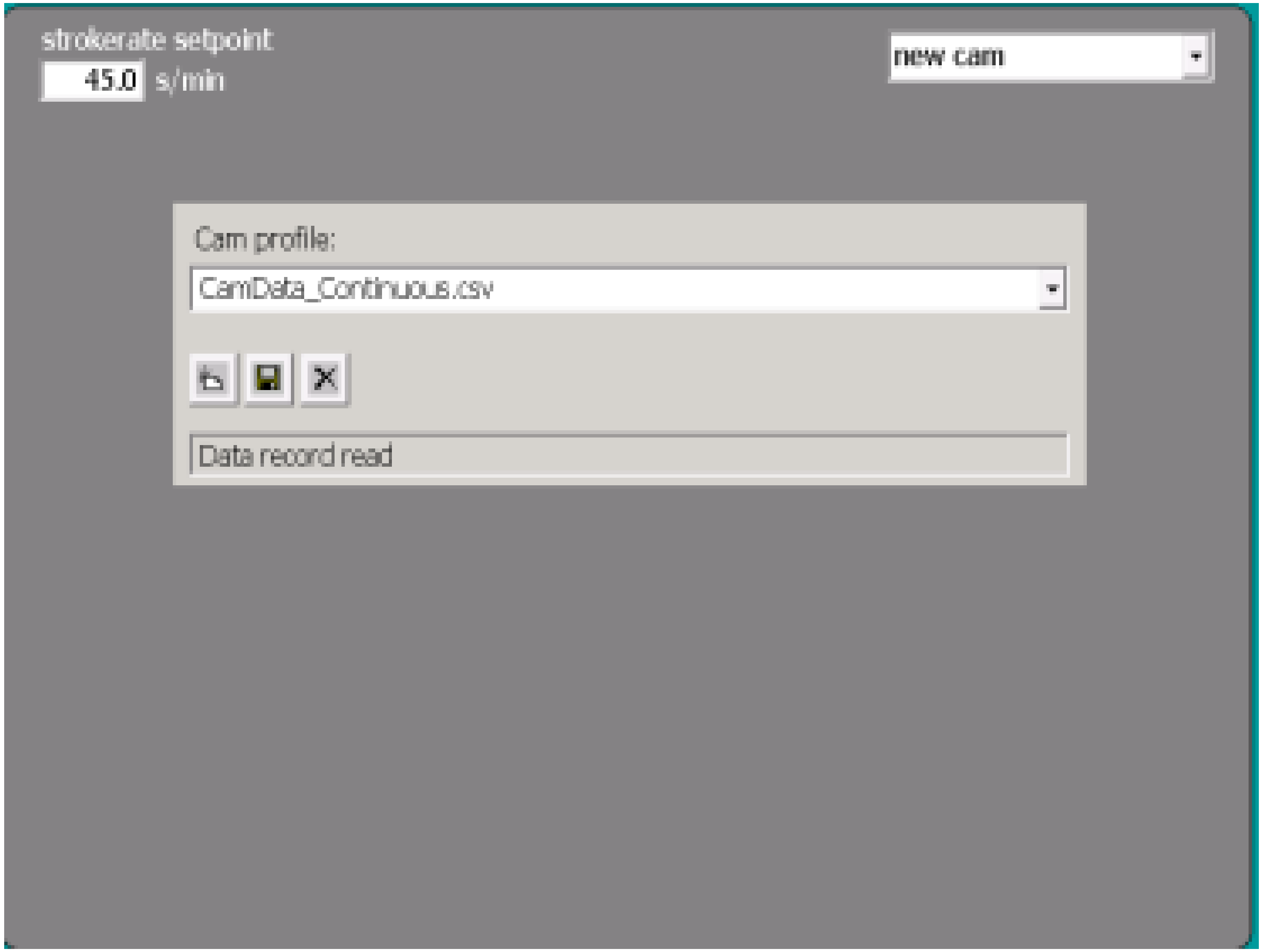
F2. Energy consumption

When entering a stroke rate value, OACAMGEN calculates a measuring value for the resulting servo standard profile respectively pendulum profile, which comprises the energetic losses during one cycle. The profile having the smallest losses is more effective concerning energetic aspects.

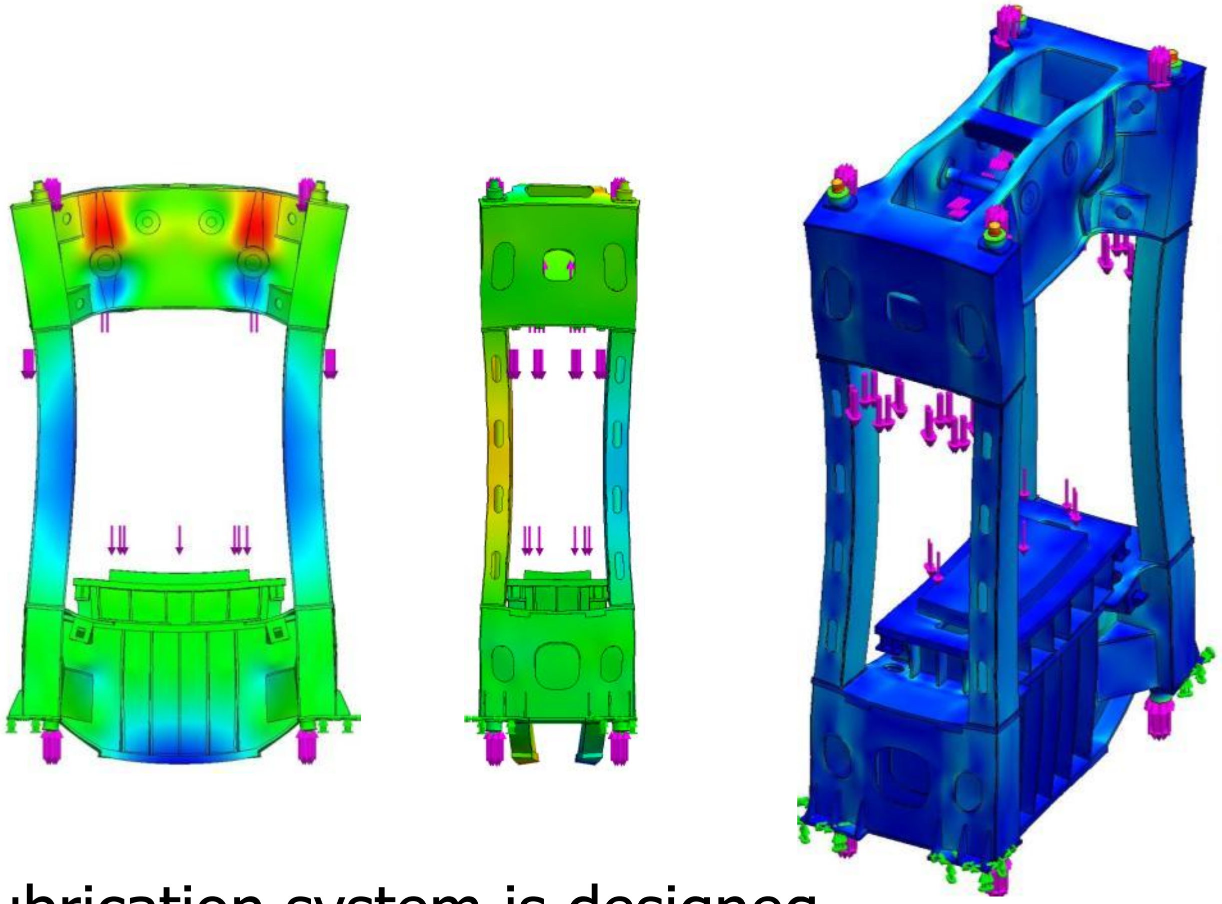


G. New Cam

This mode provides the user a possibility of using self-defined cam profiles for the movement of the press.
The particular cam profile has to be written in a table of 720 points as maximum.

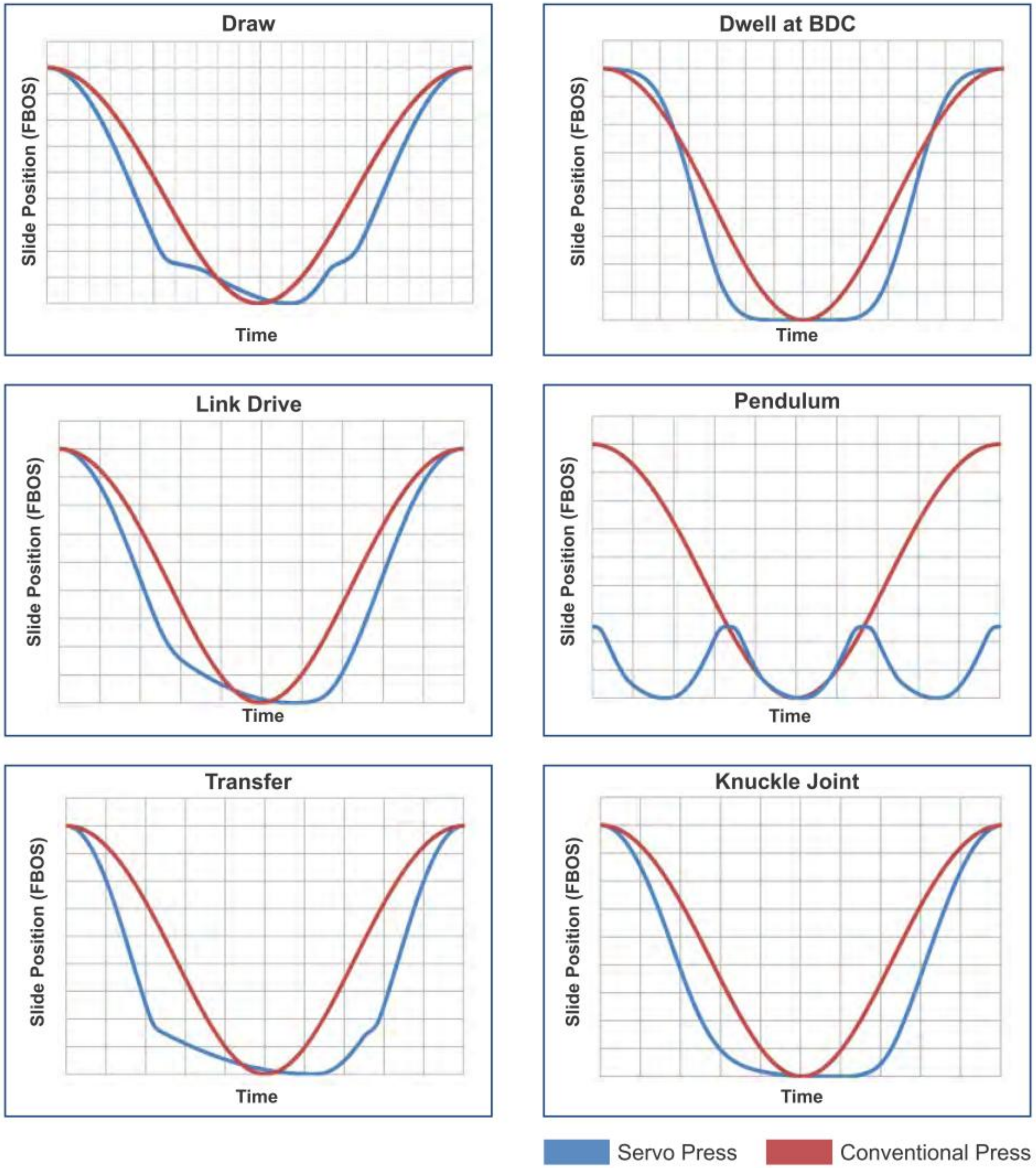


Key Features of Servo Presses

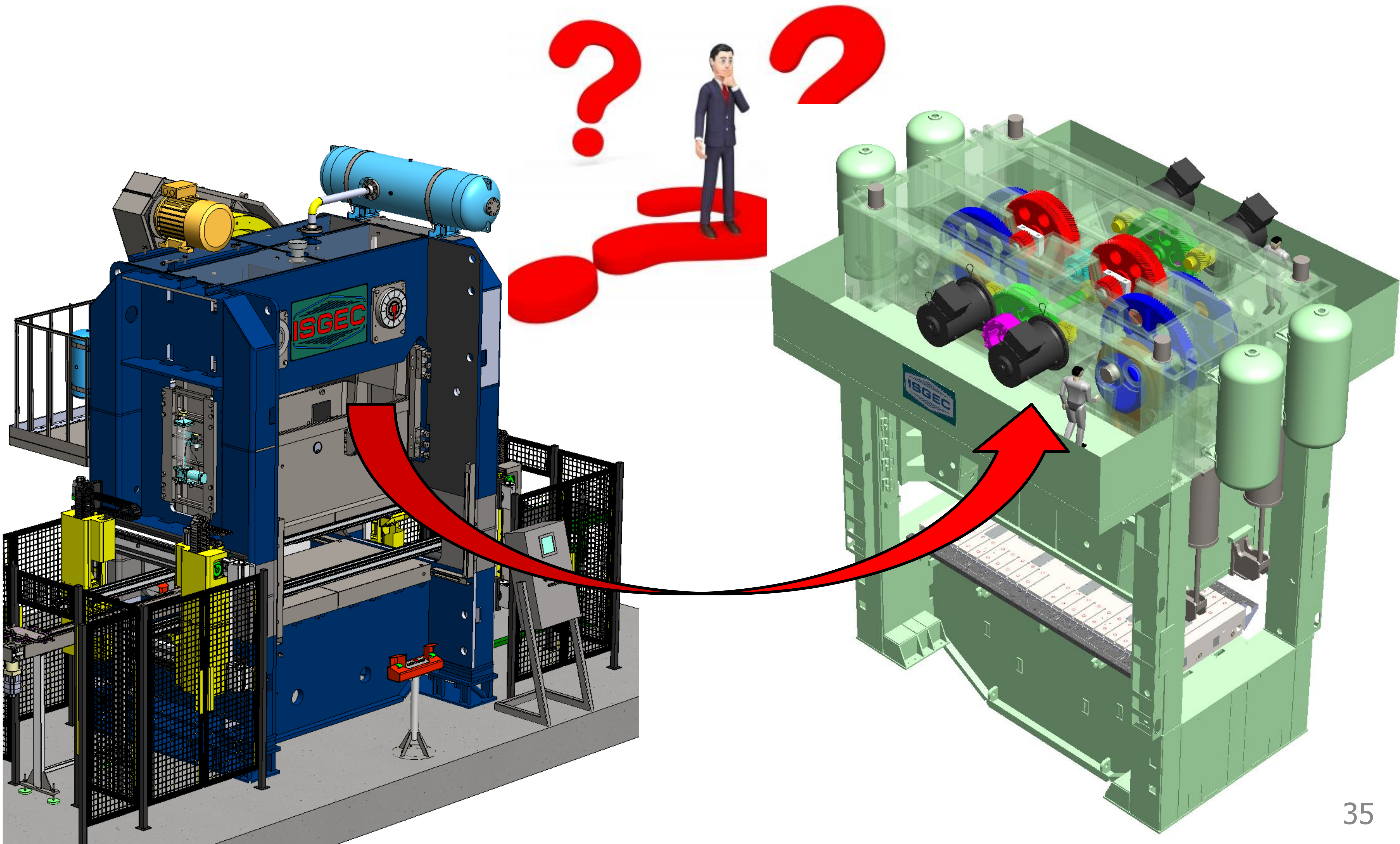


- Rigidity of structure, Strong Uprights
- Reduced height of machine.
- Wide Suspension Points
- Reduced clearance of gear trains/ bushes & lubrication system is designed accordingly.
- Use of blanking dampers and Use of isolation mounts for gadgets.
- Proper sensors selection to check reverse load

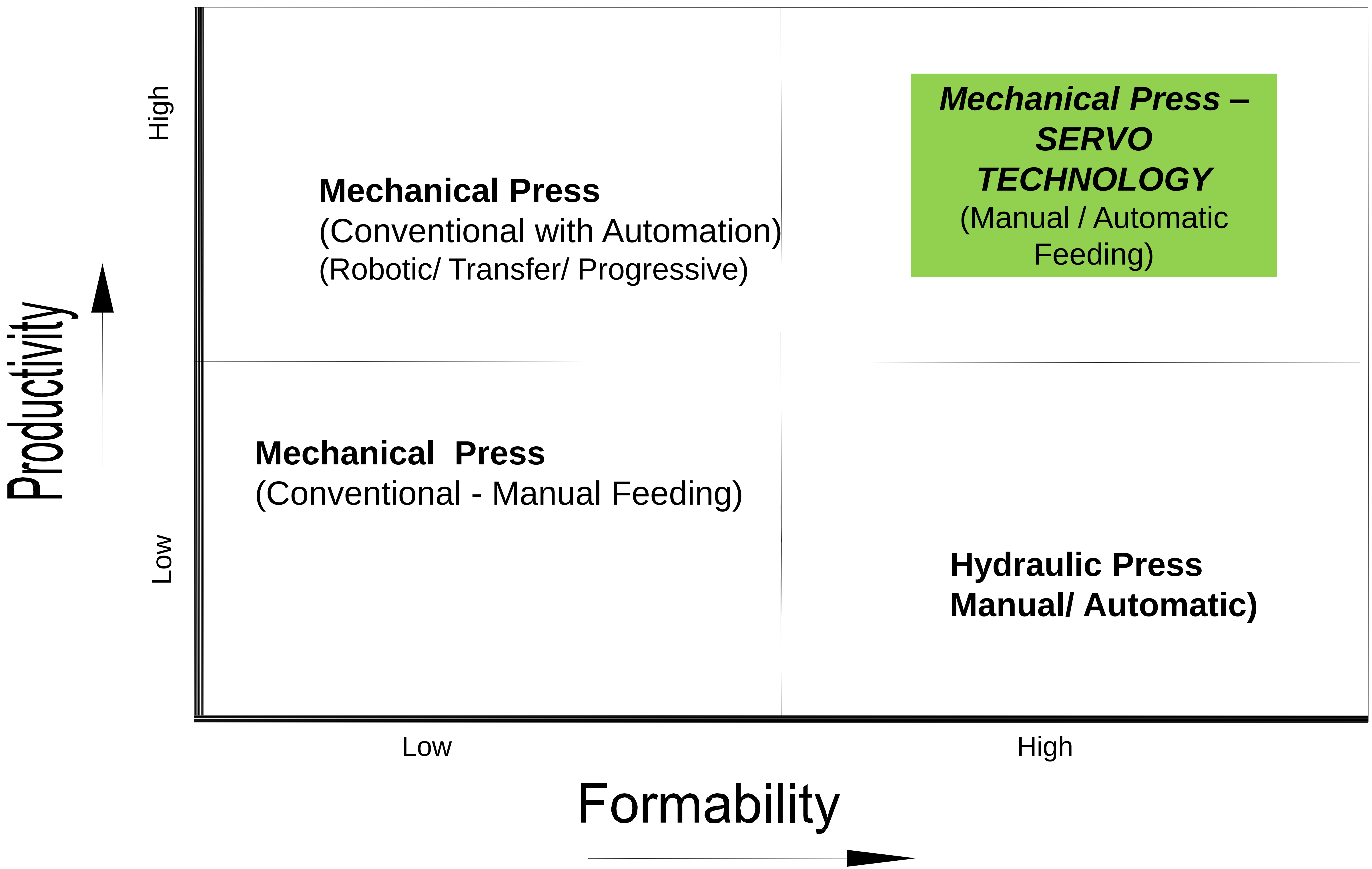
Motion profiles suitable for various stamping operations



Why To Switch to Servo Mechanical Press from Conventional Mechanical Press

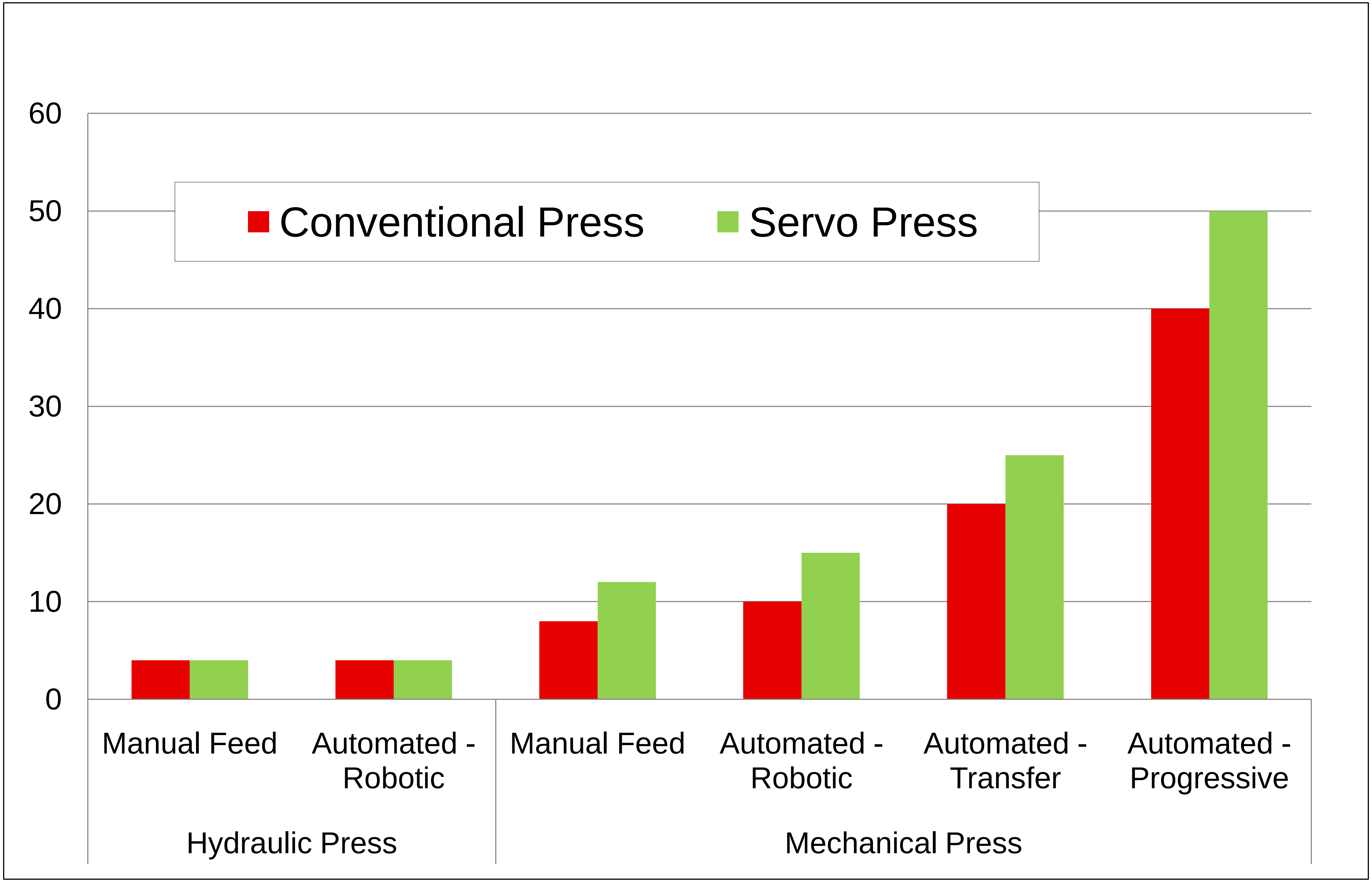


Next Generation Stamping Technology – " Servo Press"
High Productivity with High Formability



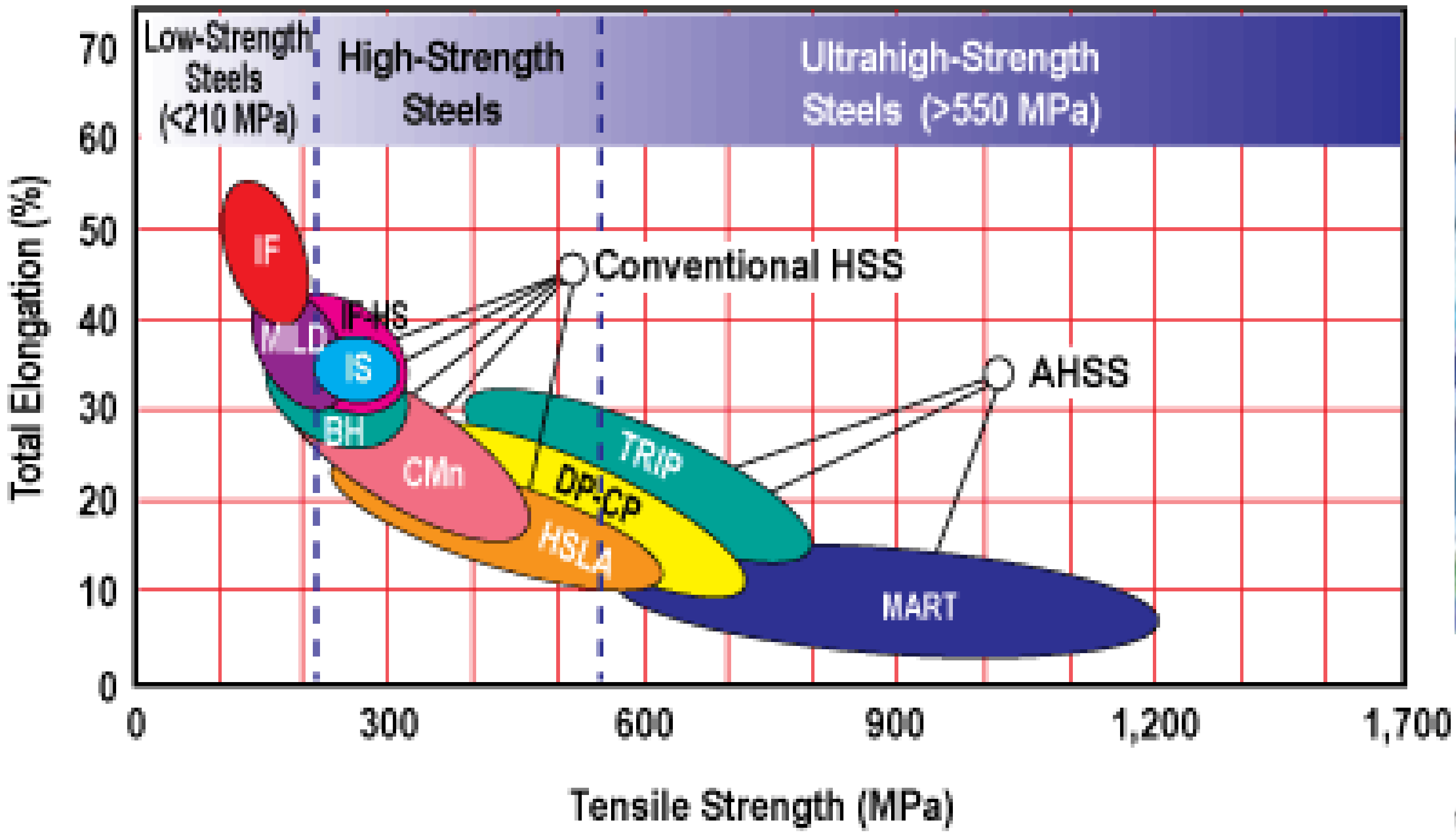
Next Generation Stamping Technology – " Servo Press"

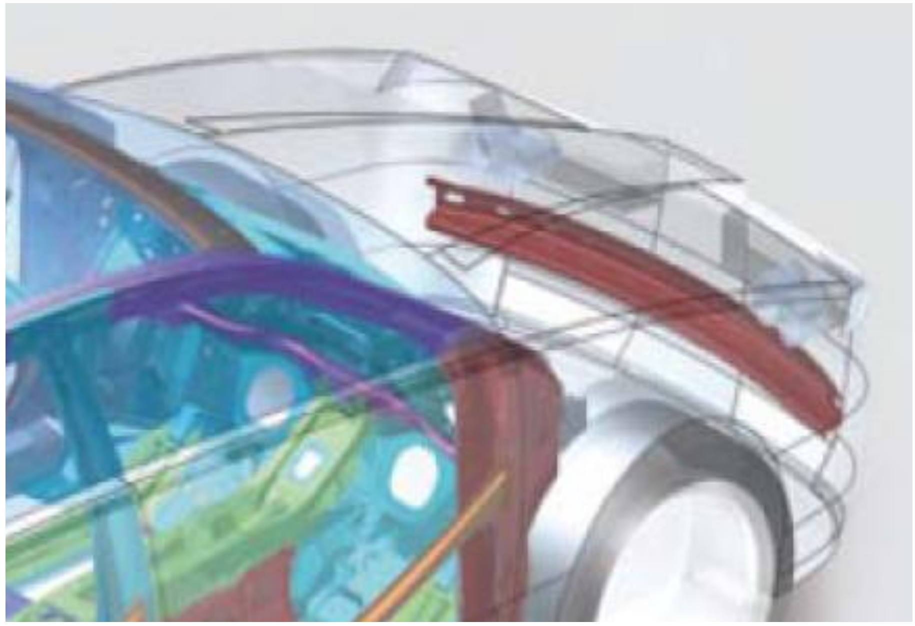
Productivity of Servo vs Conventional



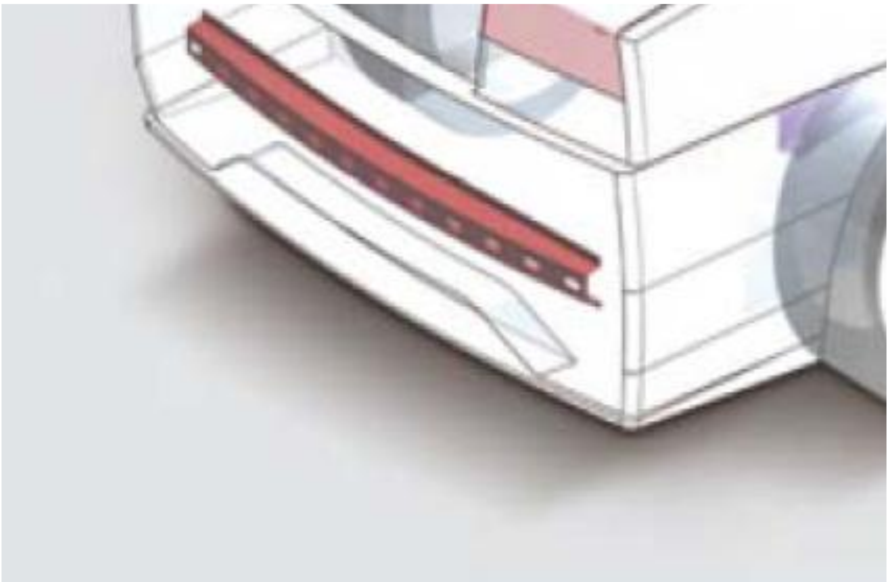
Next Generation Stamping Technology – “ Servo Press”

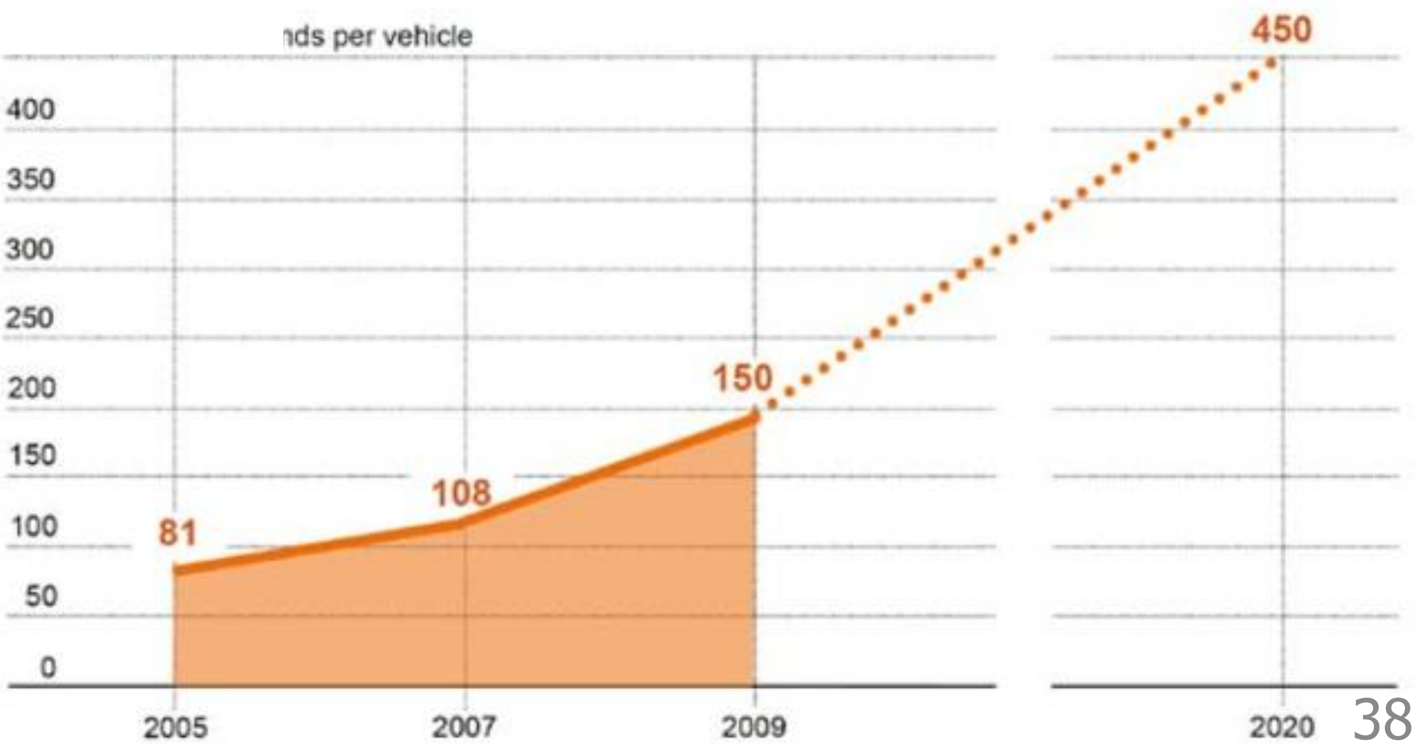
Processing of Advanced Materials





Growth of AHSS





Tangible Benefits: Servo Presses

- **Energy Cost**

Approximately 20% less power consumption than conventional mechanical press for same application.

Tangible Benefits: Servo Presses

- **<u>Operational Cost:</u>**

- Better productivity
- Less maintenance cost (machine & di maintenance cost.)
- Reduced number of rejections & less rework
- Improved die life

<u>Case Study:</u> Productivity Increase from 12 (Conventional Mechanical Presses) to 18 Components Per Minute (Servo Mechanical Presses)

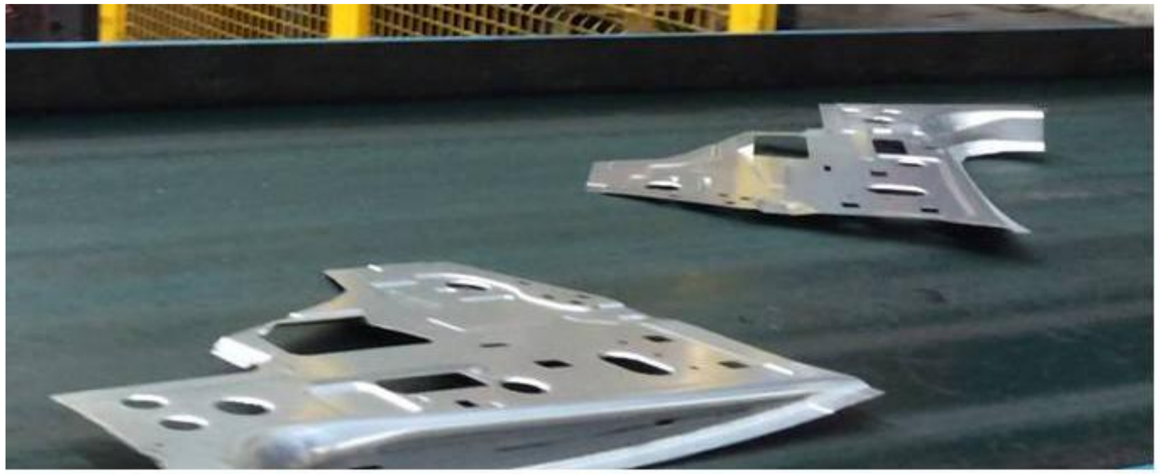
Tangible Benefits: Servo Presses

➢ Recent Trends in Sheet Metal Component Design and Manufacturing

- Forming suitable to Servo Press Operations
  "Light Weight and Use of High Strength Material".

- Reduction in no of operations from 5/4 to 3
  "Toyota Innovation"

- Integrated Operation
  "Part insertion /Operation during Component Forming"



Final Component

Machine to Supply Nut

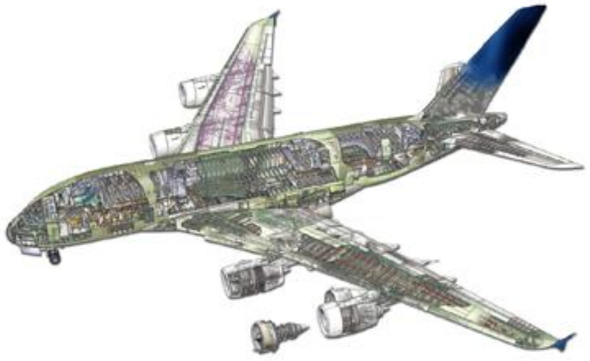
Servo Presses for Various Applications/Industry Segment

Automotive

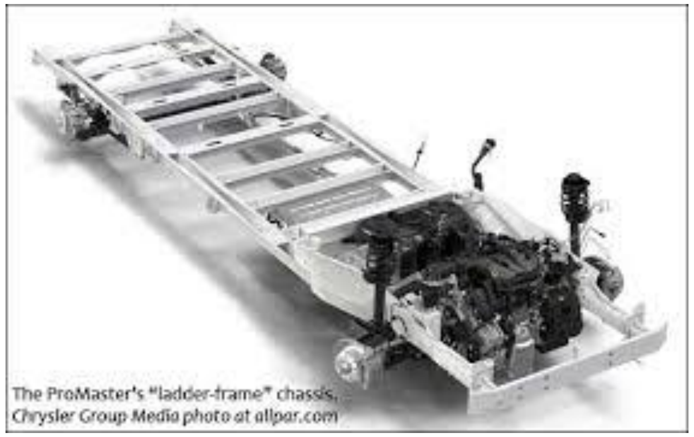
Railways

Shipyard

Automotive Gasket



Aeronautical



Long Member Chassis

Defence

Servo Press Specific Processes

Key Benefits of Servo Technology over Conventional

In drawing operation

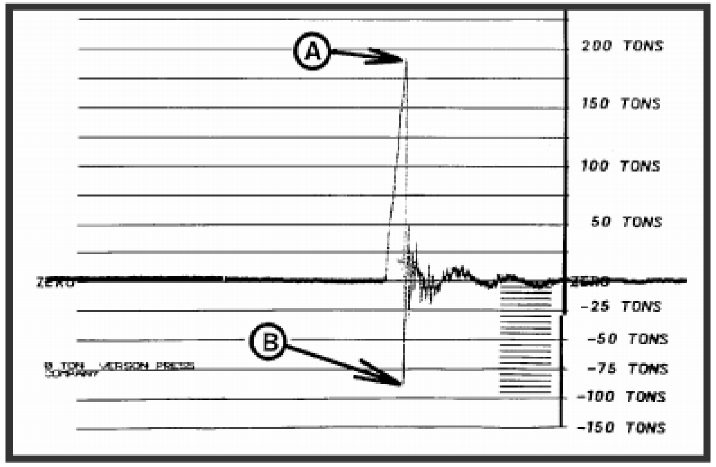
Slow speed in forming zone for better part quality

High energy available for forming

In blanking operation

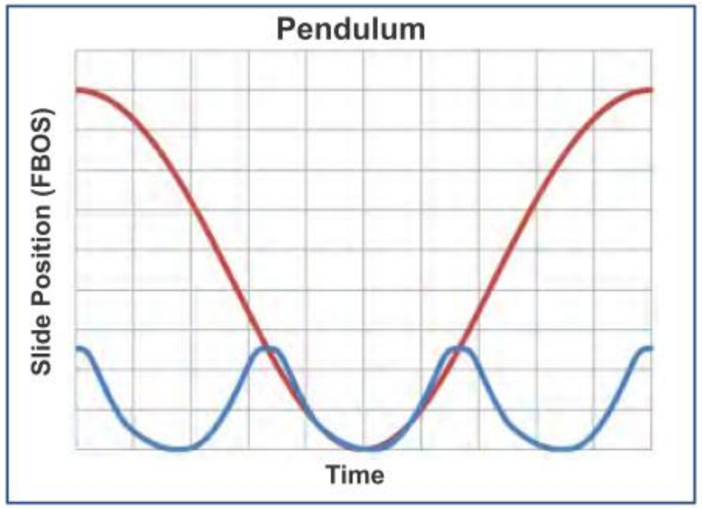
Slow speed at the point of die contact reduces vibration More productivity in pendulum mode

Waveform Signature of Excessive Snap Through



In Progressive operation

More productivity in pendulum mode



Isgec References

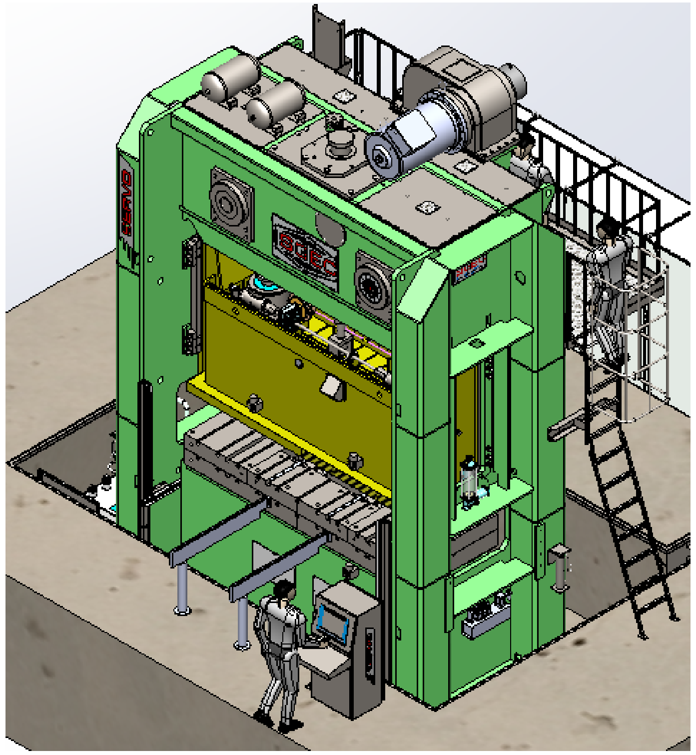
[Link to Video_Presses](#) [Link to Video WorldMaP](#)

400MT Press installed in Romania

400MT Press installed in Hungary

630MT Press installed in JLR Park, Slovakia

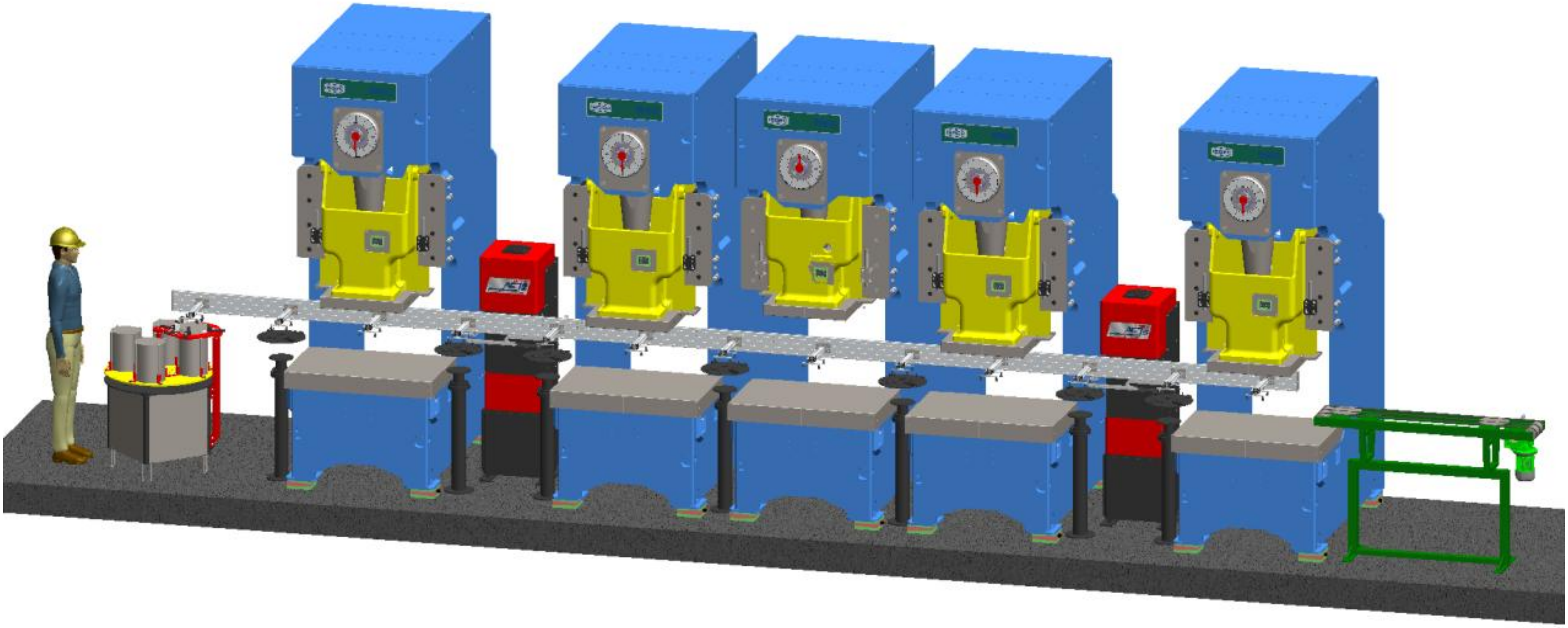
800MT Press installed in USA


630MT Servo Mechanical Press for Europe under Execution

ISGEC

ACTS

Automated Component Transfer System



Connectivity

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THANK YOU

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