

NEW TECHNOLOGIES IN COLD CHAMBER DIE CASTING PROCESS ACCORDING TO INDUSTRY 4.0

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AGENDA

- 1. New K-Series**
- 2. New GDK-Series**
- 3. K^{SERIES} AND GDK^{NEW} CONTROL PLATFORM**
- 4. Summary**

1. K-SERIES



Figure: K-Series Die Casting Machine

1.1. PORTFOLIO – K^{SERIES}



Machine type		K380	K510	K640	K830	K1050	K1320	K1680	K1900
Locking force	kN	3800	5100	6400	8300	10500	13000	16800	19000
Size of platens	mm x mm	1015	1135	1255	1390	1550	1730	1950	2180
Casting force	kN	410	550	620	710	880	1120	1330	1330
Casting stroke	mm	600	700	700	800	800	900	900	1000

1.2. LOCKING UNIT - OPTIMIZED

Increase of space between tie bars

→ higher range of applications with a smaller machine

Stainless steel coating on the platen

→ avoid corrosion

Enlarged sleeve opening in the fixed platen

→ better accessibility for dosing

Shorter and compact locking unit

→ shorter machine, less floor space

Split tie bar nut with hydraulic cylinder

→ improved reliability, easy maintenance

Optimized tie bars by stretch-nut principle

→ increase resistance against higher bending

Tie bar force measurement (front mounted)

→ higher life-time

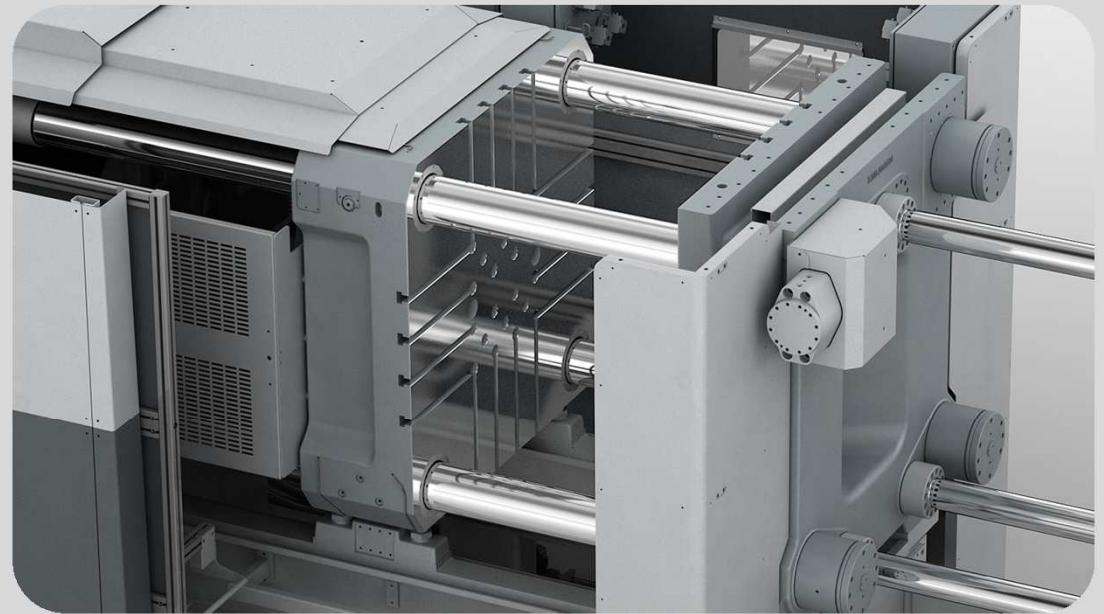
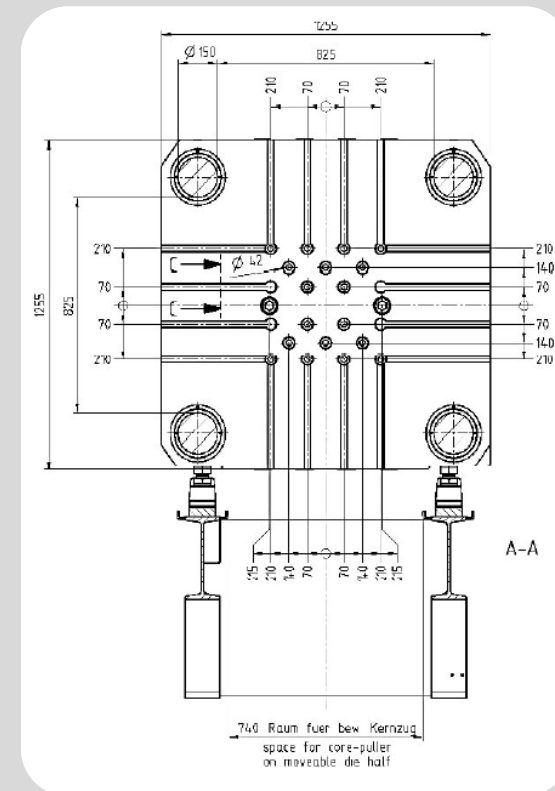
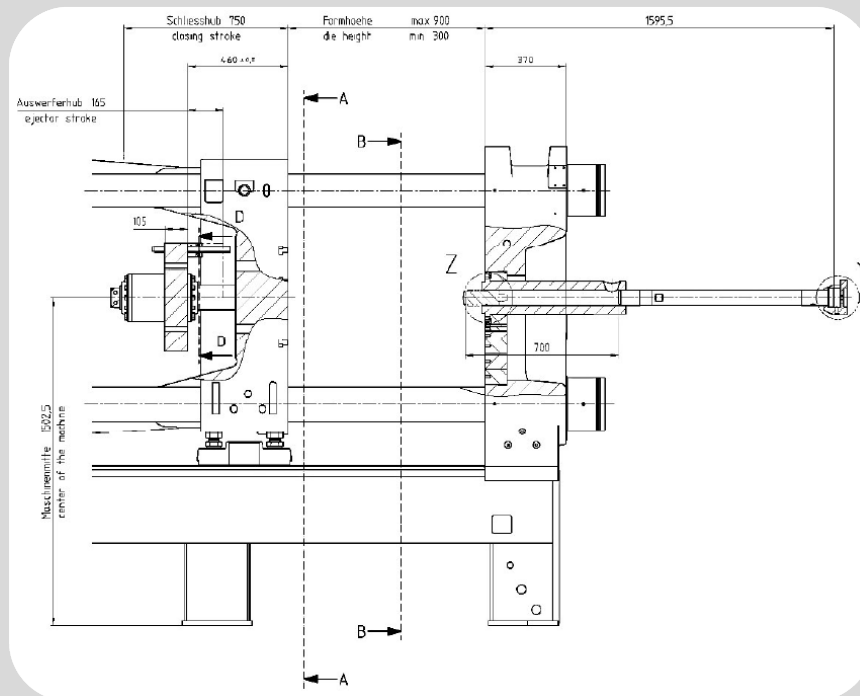


Figure: locking unit

1.3. LOCKING UNIT – BIGGER SIZE PLATENS

Compared to our competitors – bigger size of platens at same locking force

→ 1255 x 1255 mm compared to 1220 x 1220 mm



1.4. CASTING UNIT – HIGHER PERFORMANCE

- Highest dynamic shot end with...
 - extremely short pressure-rise time with new patented multiplier concept (without check-valve)
 - one central piston accumulator for 1st, 2nd and 3rd casting phase
- Real-time controlled shot end „RC“ (v+p) → now standard
- Highest repeatability in production → $C_{mk} \geq 1,33$
- Vacural® - preparation: machine
 - machine base opening for Vacural-furnace
- Bigger casting stroke → now standard
 - higher process flexibility
- Optimized and low-maintenance hydraulic concept

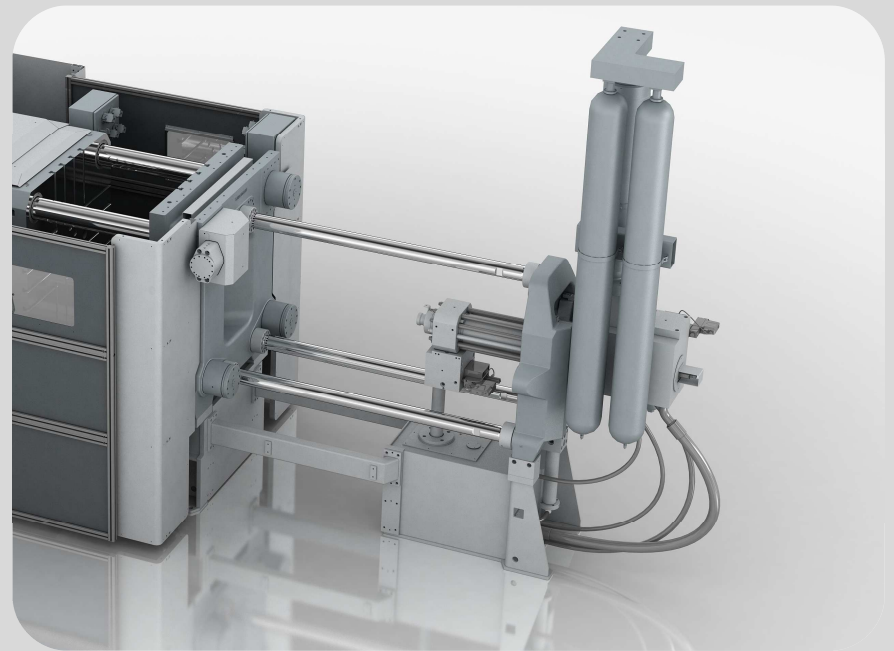
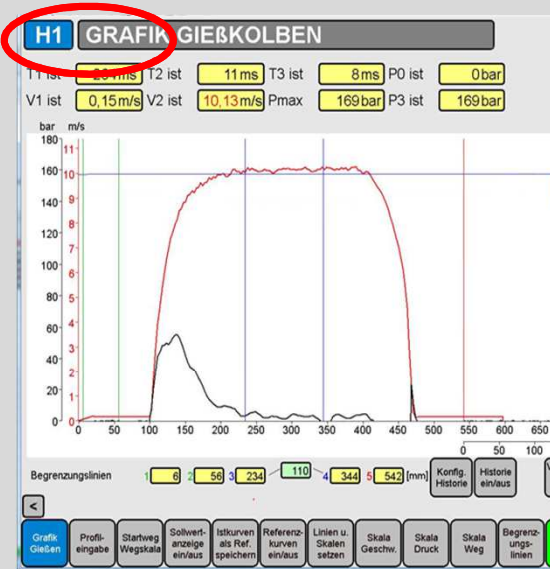


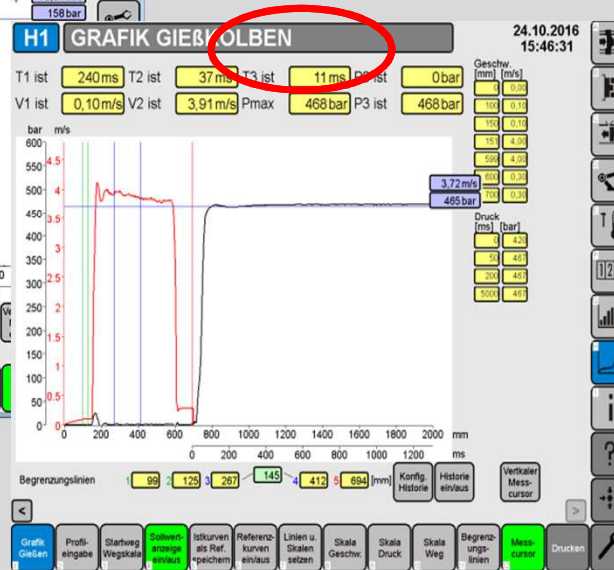
Figure: Casting Unit

1.5. CASTING UNIT – PERFORMANCE PARAMETERS



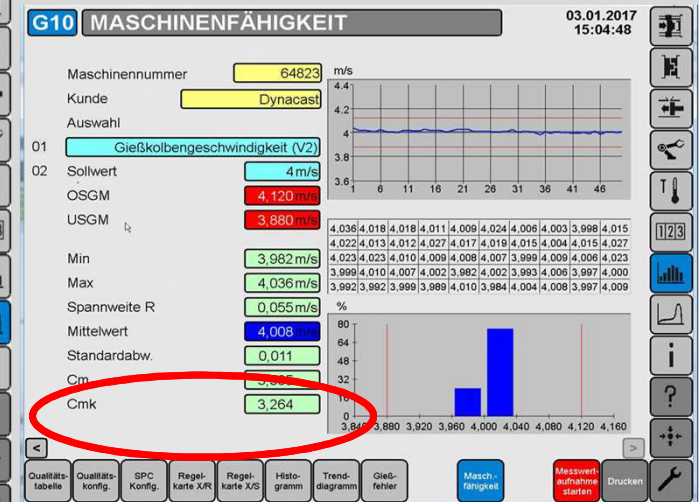
$$V_{\max} \geq 10 \text{ m/s}$$

$$a_{\max} \geq 500 \text{ m/s}^2$$



$$P_{\max} \geq 460 \text{ bar}$$

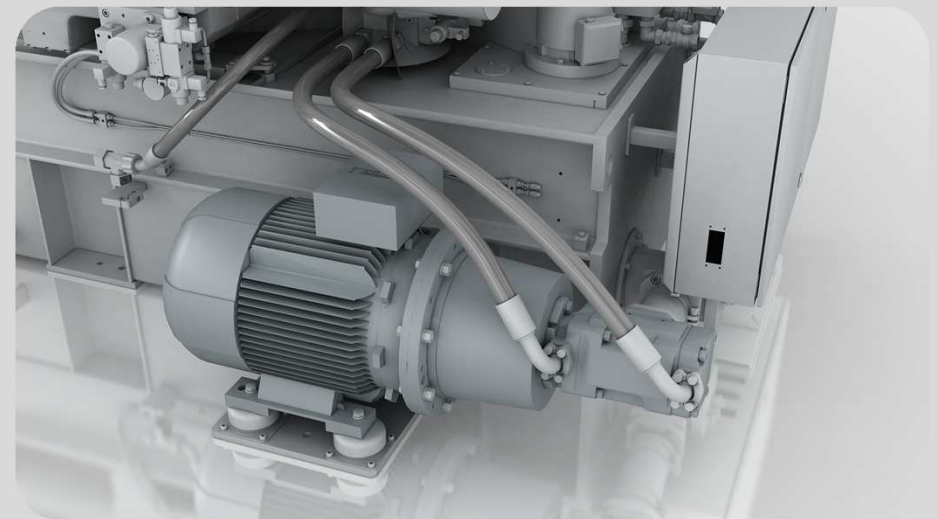
$$T3 = 11 \text{ ms}$$



$$Cmk \geq 1,33$$

1.6. MACHINE CONCEPT – DRIVE AND HYDRAULICS

- Flow control by frequency converter and using an asynchronous motor with vane pump
 - fast opening/closing – 10% cycle time reduction
 - reduced pressure peaks in hydraulic system
- New flow-optimized and low-maintenance hydraulic concept with significantly lesser valves and cold-drawn piping
- Electrical energy consumption lesser by more than 20% in comparison to DAK-Series
- Standardized pipes without welded flanges
- Robust pump with fast and easy exchangeable pump inserts



1.7. REFERENCES PICTURES



2. NEW GDK-SERIES

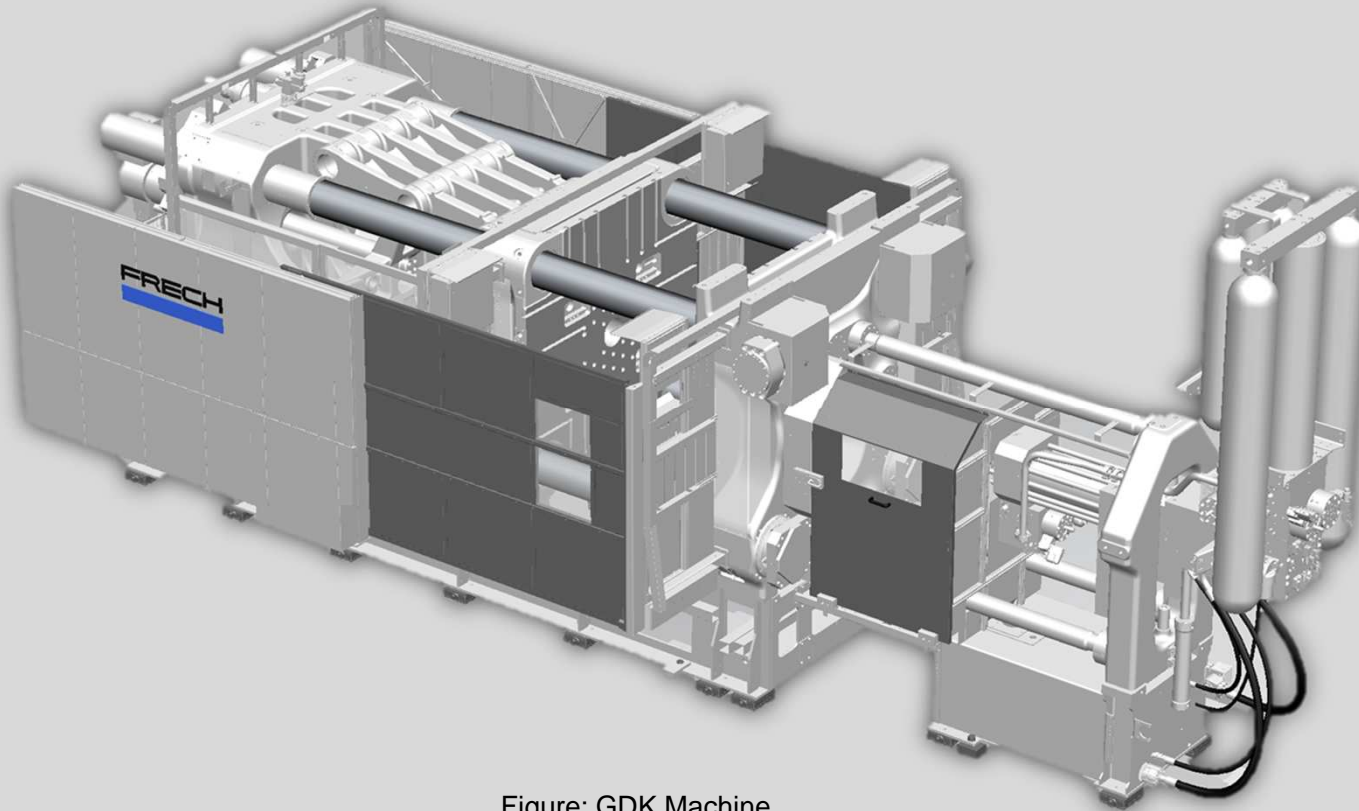


Figure: GDK Machine

2.1. GDK^{NEW} – DIVERSITY FOR ALL MARKET REQUIREMENTS

Machine type		GDK2200	GDK2400	GDK2600	GDK2800	GDK3200
Locking force	kN	22000	24000	26000	28000	32000
Size of platens	mm x mm	2160	2160	2500	2500	2500
Casting force	kN	1500	1500	1850	1850	2100
Casting stroke	mm	1000	1000	1200	1200	1200

Machine type		GDK3400	GDK3600	GDK3800	GDK4200	GDK4400	GDK4600
Locking force	kN	34000	36000	38000	42000	44000	46000
Size of platens	mm x mm	2700	2700	2700	2840	2840	2840
Casting force	kN	2100	2100	2400	2400	2800	2800
Casting stroke	mm	1200	1200	1400	1400	1400	1400

2.2. LOCKING UNIT

Advantages of new GDK3200:

Shorter overall length by 1,0m

→ equal length to competitors 2-platen-DCM

Higher locking force of 32.000kN (before 28.000kN)

Max. die height of 1.800mm

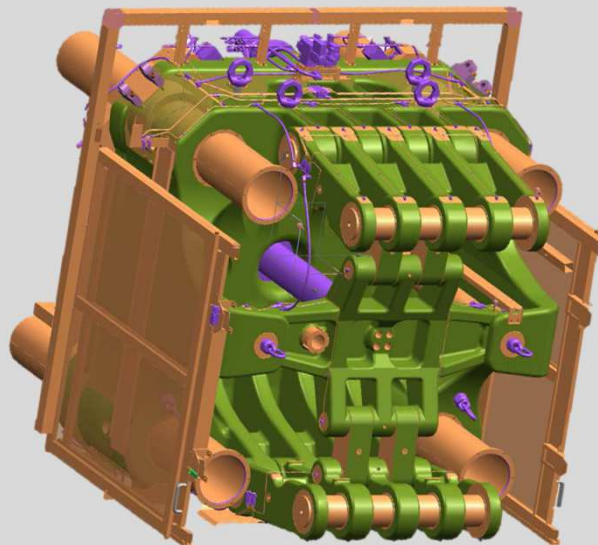


Figure 1: Locking unit

Figure 2: GDK2800S

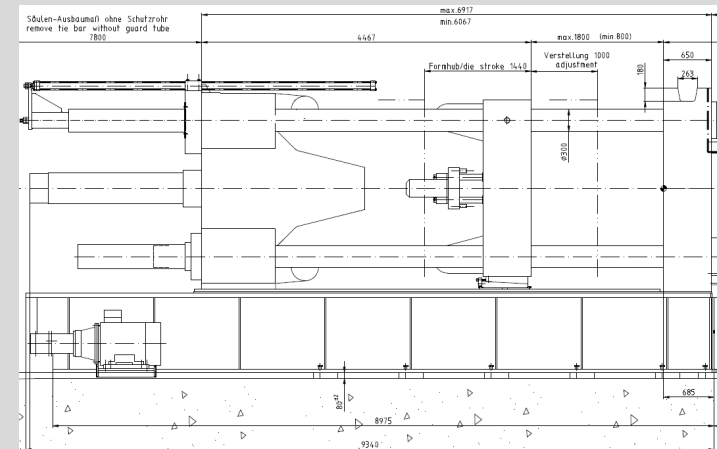
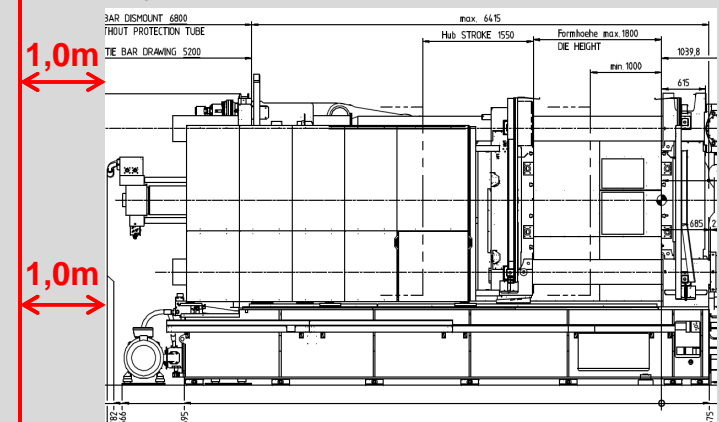


Figure 3: GDK3200 new

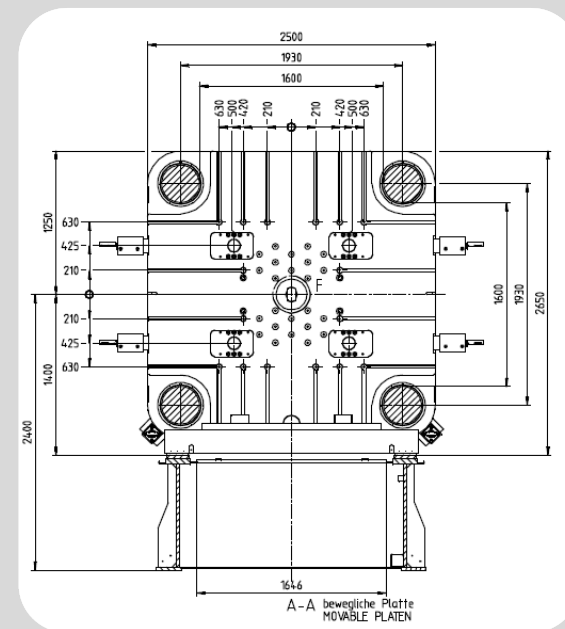
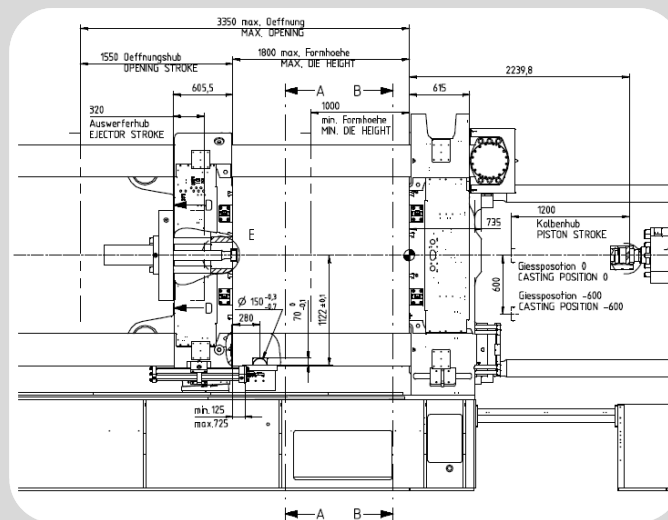


2.3. LOCKING UNIT BIGGER

Advantages of new GDK3200:

Larger tie bar clearance of 1.600mm (before 1.550mm)

Bigger clamping platens of 2.500mm (before 2.400mm)



2.4. CASTING UNIT

- High dynamic shot end for all parts → highest flexibility → 1 shot end for engine blocks and structure parts
- Pressure-rise time of 20 ms at 400 bar multiplier pressure
- Injection piston acceleration up to 650 m/s^2
- Injection velocity more than 10 m/s
- Prepared for Vacural® in standard
- Bigger casting stroke due to Vacural®-preparation
- Individual positioning of connection bars
 - Improved access for all dosing systems

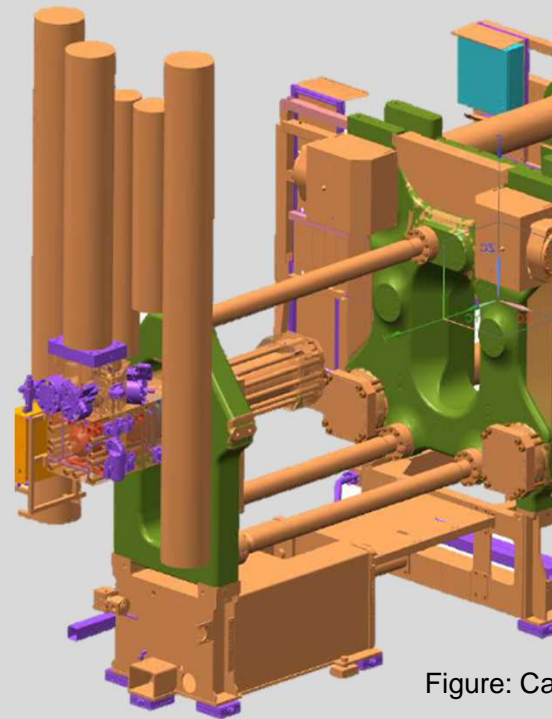
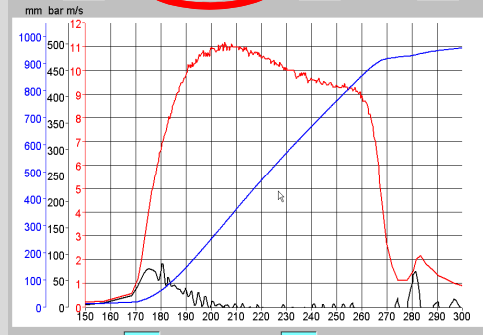


Figure: Casting unit

2.5. CASTING UNIT – PERFORMANCE PARAMETERS

H1 GRAFIK GIEßKOLBEN

T1 ist 86 ms T2 ist 32 ms T3 ist 0 ms P0 ist 40 bar
V1 ist 0,17 m/s V2 ist 10,62 m/s Pmax 158 bar P3 ist 158 bar



01 Start V1 1 mm Ende V1 20 mm
03 Start V2 250 mm Ende V2 600 mm

Toleranzverletzung !

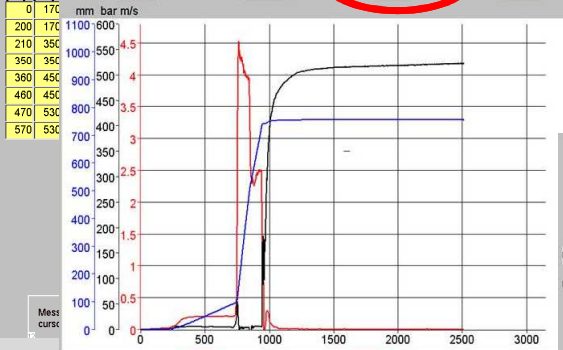
Grat. Gießen Profi- eingabe Start Zeitskala Sollwert- anzeige ein/aus Istkurven als Ref. speichern Referenz- kurven ein/aus Skala Weg Skala Geschw. Skala Druck Skala Zeit

$V_{max} \geq 10 \text{ m/s}$
 $a_{max} \geq 650 \text{ m/s}^2$

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Geschw. (mm) (m/s)	Druck (ms) (bar)
0 0,00	0 176
1 0,20	200 176
20 0,20	210 356
21 10,5	350 356
850 10,5	360 456
851 0,20	460 456
1000 0,20	470 536
	570 536

T1 ist 326 ms T2 ist 48 ms T3 ist 21 ms P0 ist 54 bar
V1 ist 0,43 m/s V2 ist 4,13 m/s Pmax 523 bar P3 ist 522 bar



01 Start V1 35 mm Ende V1 175 mm
03 Start V2 200 mm Ende V2 400 mm

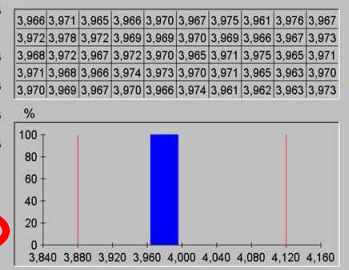
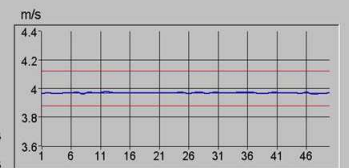
$P_{max} \geq 540 \text{ bar}$
 $T3 = 20-35 \text{ ms}$

T1 ist 326 ms T2 ist 48 ms T3 ist 21 ms P0 ist 54 bar
V1 ist 0,43 m/s V2 ist 4,13 m/s Pmax 523 bar P3 ist 522 bar

Geschw. (mm) (m/s)	Druck (ms) (bar)
0 0,00	0 530
1 0,20	100 0,20
100 0,20	101 4,00
500 4,00	501 2,50
800 2,50	800 2,50

Maschinennummer 190131
Kunde Dacia
Auswahl
01 Gießkolbengeschwindigkeit (V2)
02 Sollwert 4 m/s
OSGM 4,120 m/s
USGM 3,880 m/s
Min 3,961 m/s
Max 3,978 m/s
Spannweite R 0,018 m/s
Mittelwert 3,969 m/s
Standardabw. 0,004
Cm 7,568
Cmk 7,568

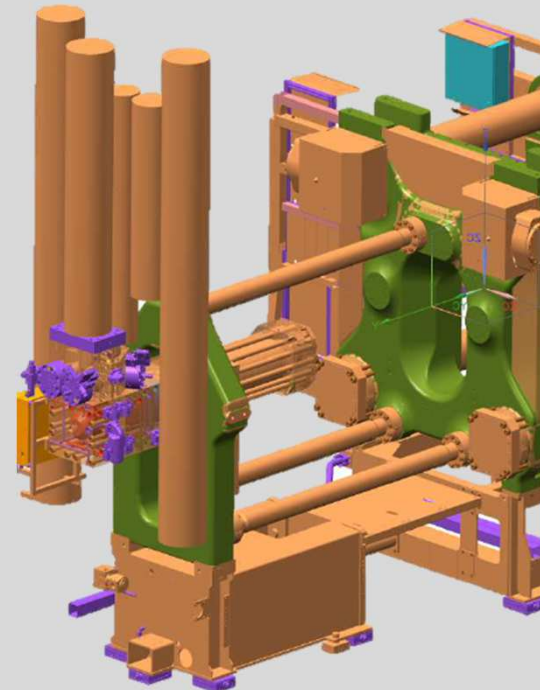
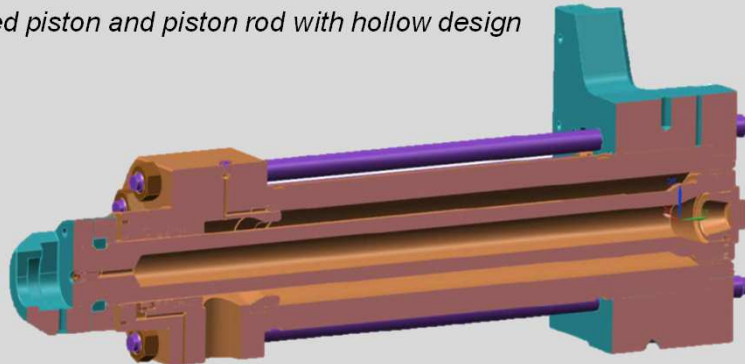
$Cmk \geq 1,66$



2.6. MACHINE CONCEPTS – EASY MAINTENANCE

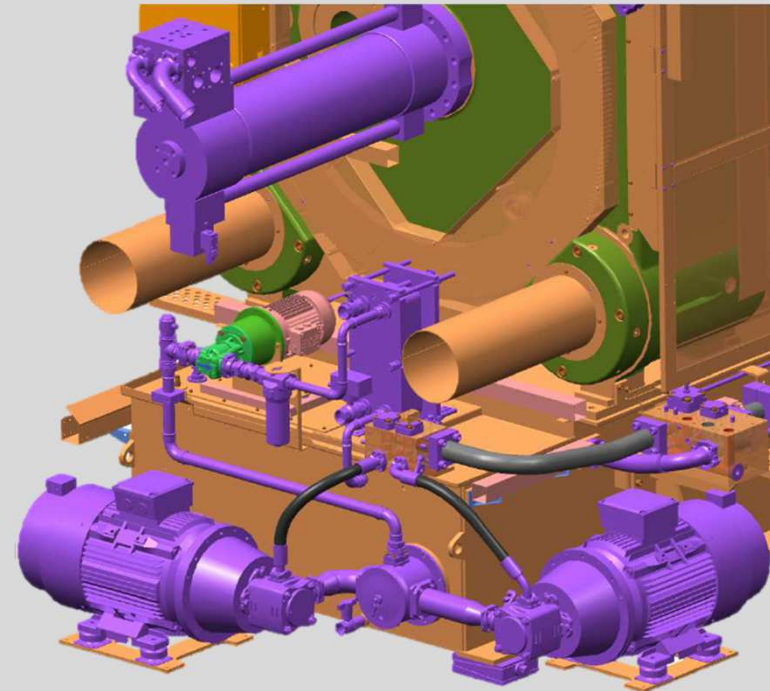
Design concept for easy maintenance and high reliability based on example of shot unit:

- *Tie rod design*
- *Cylinder removal from the fixed platen side*
- *Injection coupling for conventional die casting and Vacural®*
- *Stroke measuring system directly integrated in the piston rod*
- *Mass reduced piston and piston rod with hollow design*



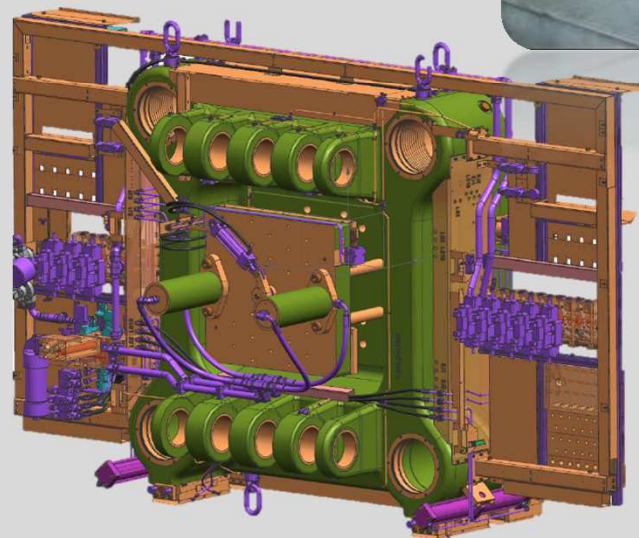
2.7. MACHINE CONCEPT – DIVE AND HYDRAULICS

- New hydraulic pump unit concept with frequency-drive control for more than 30% energy savings
- New closing cylinder with integrated internal differential circuit → faster opening/closing by 10%
- New external filtration/cooling combination-system with extra large heat exchanger → free access, quick change of filter
- Integrated oil tank volume reduced by 50%
3.000 l (before 6.000 l) – using one central suction filter
- Reduced number of pipes and hoses –
→ new design of cold-drawn pipes, no welding flanges
- Number of valves reduced by 30%
→ maintenance-friendly, reduced TCO



2.8. STANDARDIZATION – BY MODULAR CONCEPT

- *Standard valves, cylinder, blocks and pipe connections*
- *Modular energy connections for:*
 - *Core puller manifolds*
 - *Water cooling circuits*
 - *Heating/cooling circuits*
 - *Jet coolers*
 - *Vacuum and air-blowing*
 - *Electrical plug connectors*

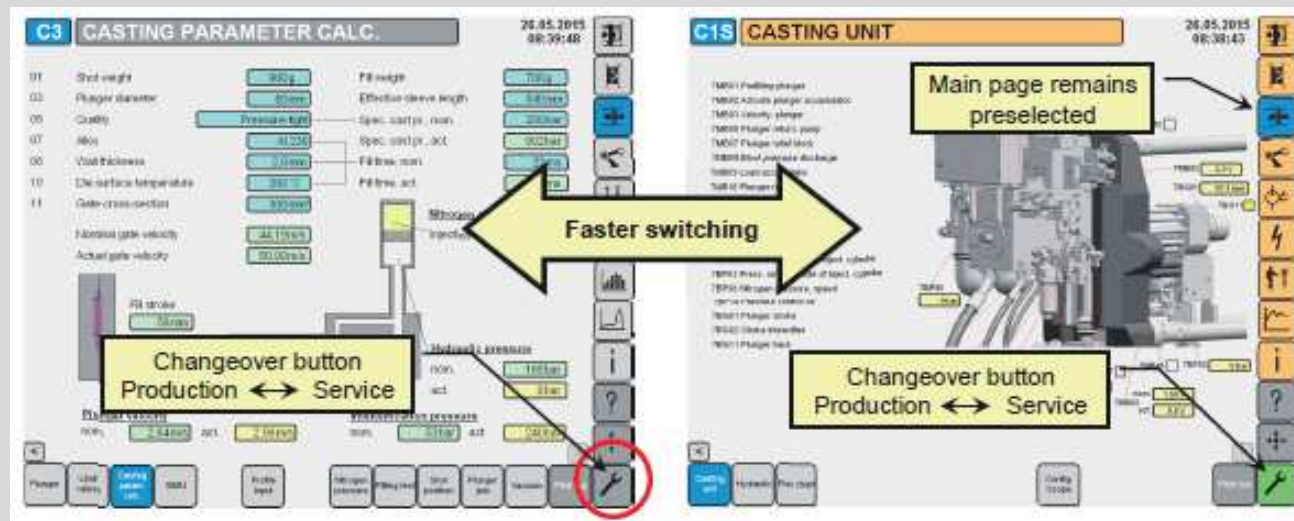


3. K^{SERIES} AND GDK^{NEW} CONTROL PLATFORM

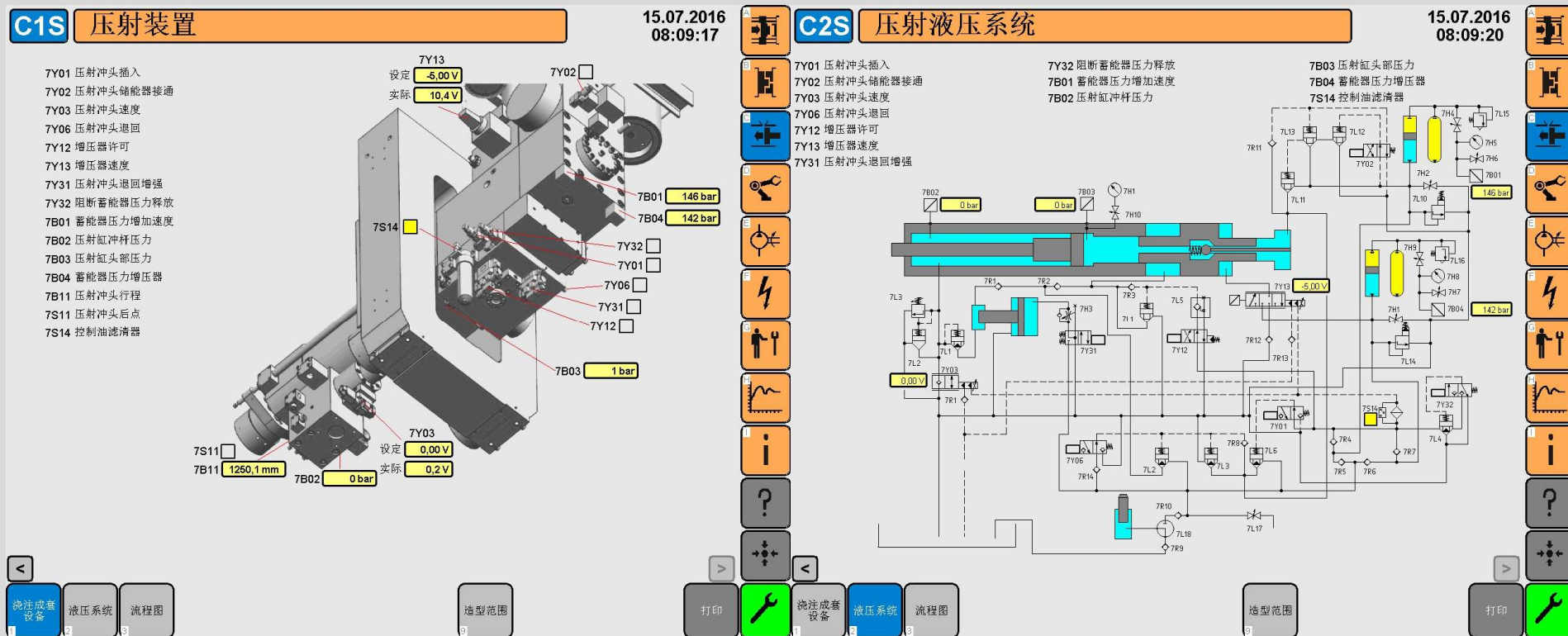
- Separate screen pages - Production and Maintenance
- User-friendly and self-explanatory operation
- Machine data interface via OPC (Industry 4.0)
- Easy use for service and diagnostics

Figure 1: Production view

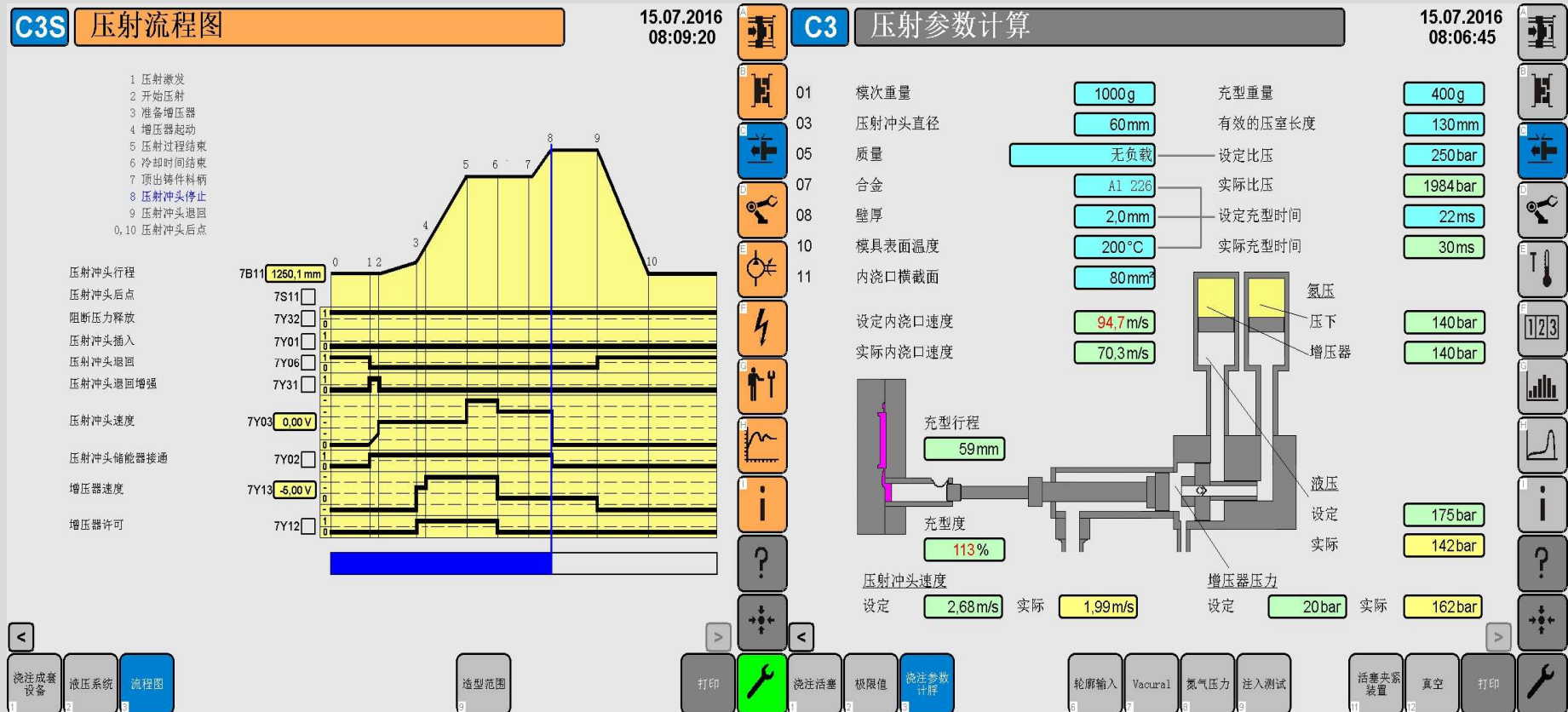
Figure 2: Service view



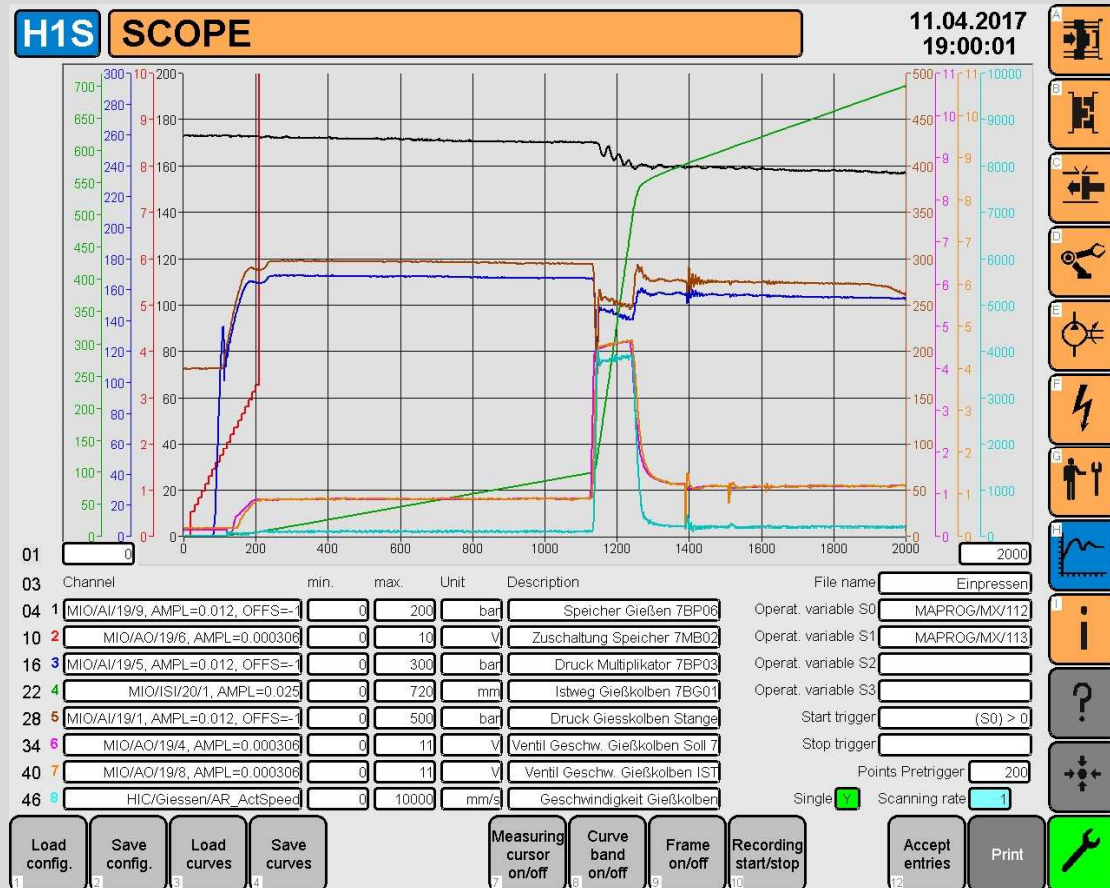
3.1. CONTROL PLATFORM



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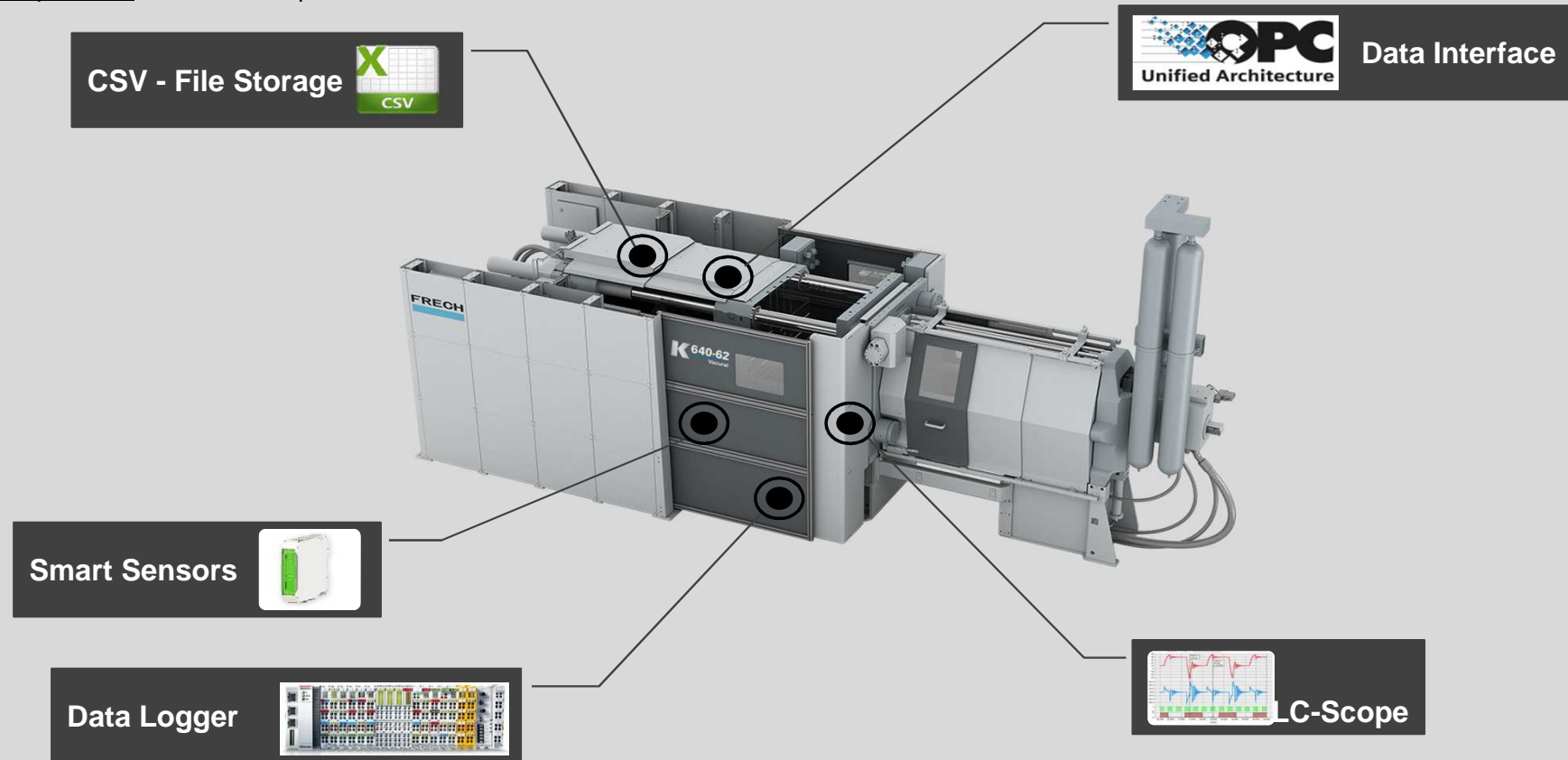


3.1. CONTROL PLATFORM

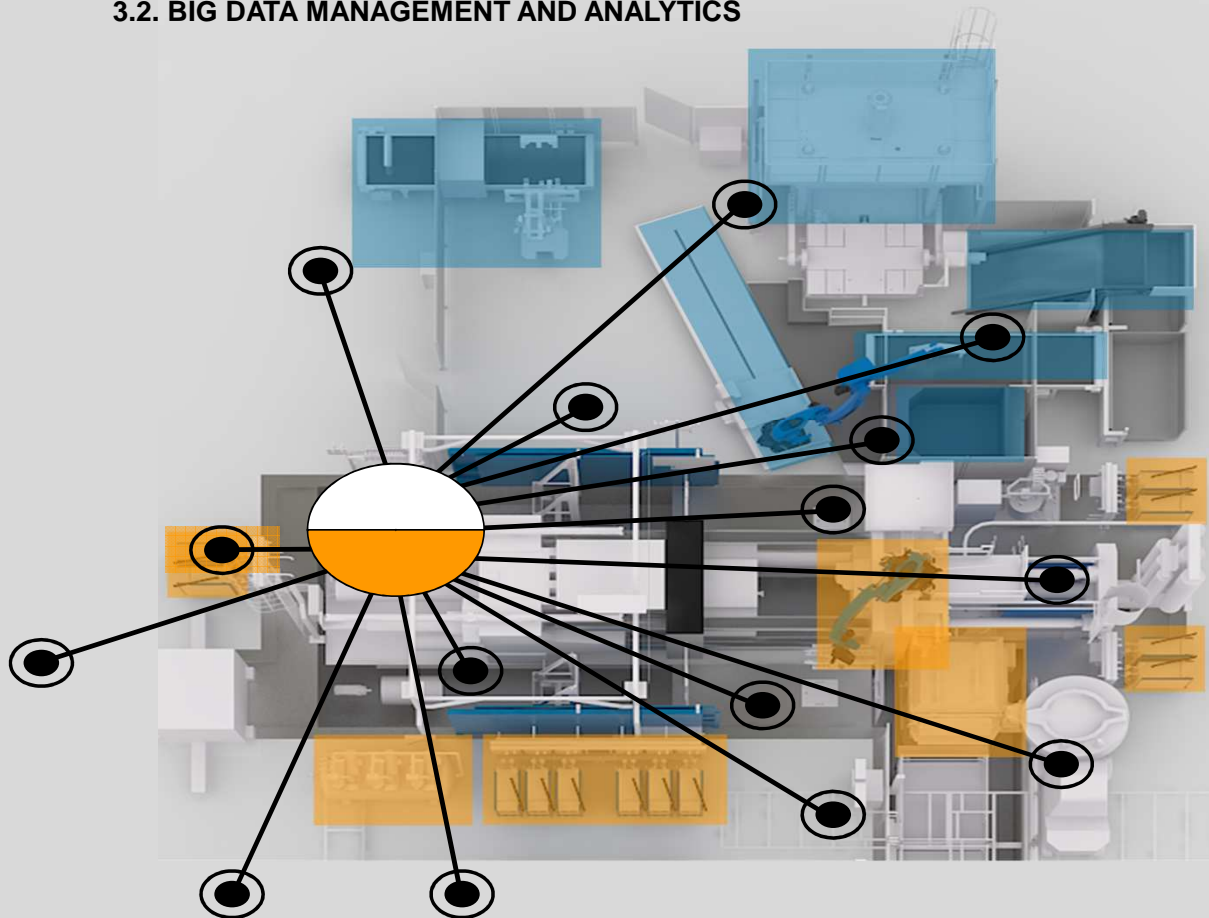


3.2. BIG DATA MANAGEMENT AND ANALYTICS

Data acquisition: Machines and process data from different sources



3.2. BIG DATA MANAGEMENT AND ANALYTICS



"Head / Segment - Control"

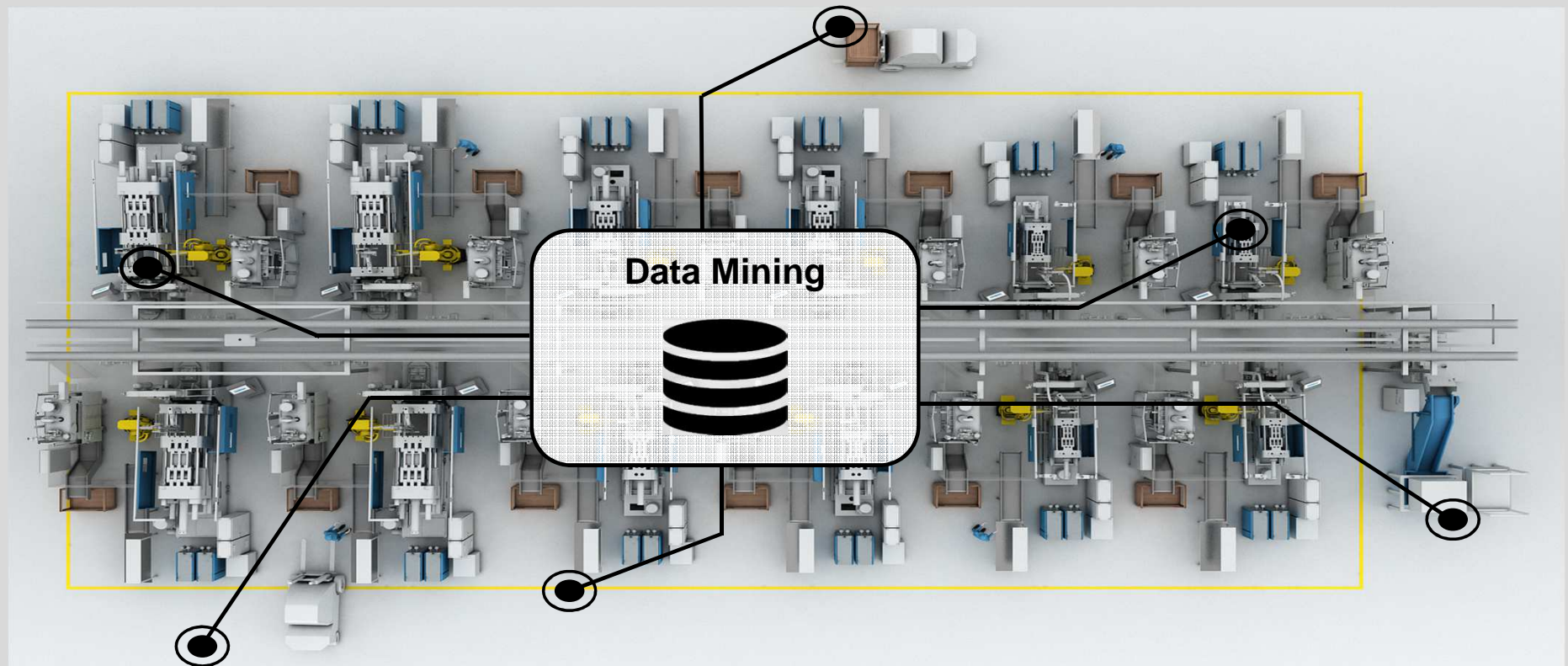
Sequence Control

Focusing on inner and outer
Logistics and Post-Processing

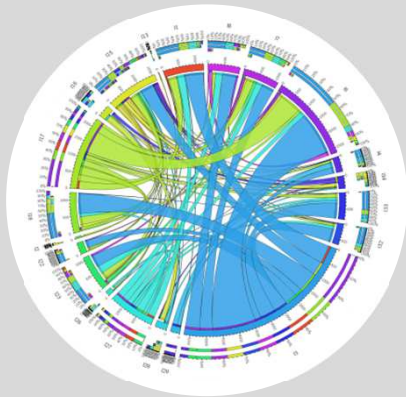
Process Control

Focusing on Process-Control
and Optimization

3.2. BIG DATA MANAGEMENT AND ANALYTICS



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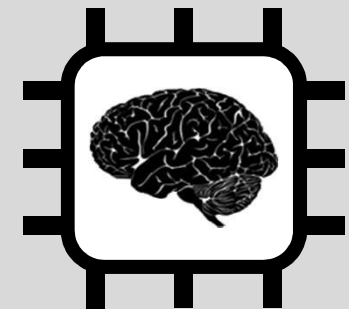
Big Data

Analytics



Understanding

Process and Interactions



Development

Assistance Systems

4. Summary

- K^{Series} and GDK^{new} highly dynamic die casting machine series
- More powerful and likewise more efficient and productive
- Shorter machine, bigger casting stroke and higher range of applications due to bigger platens
- One powerful shot end for various applications and alloys – e.g. engine blocks, structure parts and transmissions
- All machines are VACURAL®-prepared as standard
- Higher machine availability and lesser TCO
 - due to robust 3-platen design, new hydraulic concept with lesser valves and more robust piping
 - with friendly and easier maintenance/troubleshooting
- In mid-term perspective new FRECH dcm have better up-time and lesser TCO as 2-platen technology
- New shorter design of 3 platen for similar foot-print compared to 2-platen DCM

Many thanks for your attention!