## Highlights of the PUMA Pouring Robot

**The PUMA™ is the only fully automatic robotic pouring system with independent NC control over all axis; with its patented virtual ladle spout turning point feature.**

### PUMA™ Fully Automatic Pouring Robot 15 / 25

| Equipment Features | | Description |
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| General Overall Design: | | Newly designed with full operating flexibility using the latest in servo-motor, numerical control and human machine interface combination technologies proven by Bosch Rexroth.<br>Implementation of new weighting system. |
| Year of Design: | 1997 | Originally patented design. |
| | 2006 | Complete re-design and full implementation to Bosch Rexroth electrical controls system and servo-drive system. |
| Mechanical Design: | | F. Lauper |
| Model Versions: | 15<br>25 | Capacity up to 1500 kg (3300 lbs)<br>Capacity up to 2500 kg (5500 lbs) |
| Modularity: | | Fully realized in the design layout and operation for placement and commissioning. |
| Space Requirement: | | Compact requires very little floor space |
| Dimensions (mm): | PUMA 15<br>PUMA 25 | 4000 x 1500 x 3000*<br>4500 x 1800 x 3600*<br>* denotes without ladle and inoculation system |
| Weight: | 6,5<br>7,5 | tonnes, ca for PUMA 15*<br>tonnes, ca for PUMA 25*<br>* denotes without ladle and inoculation system. |
| Operational Modes: | | Manual, semi-automatic and automatic feedback. |
| Pouring Curve: | | Virtual pouring position which is independently controlled electronically.<br>Independently controlled movements in all axis with Bosch Rexroth NC components.<br>Full freedom in programming ladle movements and the virtual pouring position (Patented).<br>Spout up/down movement permits quick pre-pouring and clean at the end of pour.<br>Permits height adjustment and pattern related adjustment of pouring height.<br>Pour in far located pouring cups with optimal pouring quality and low pouring height.<br>Smaller pouring cup to be used. |
| Pouring Height: | | Readily adjustable with freedom in programming to allow low pouring heights. |
| Longitudinal Drive Movement: | 0 – 1200 | mm/second (Y-axis)<br>The adaptation of a newly designed two (2) wheel drives system that is directly coupled to a gear drive.<br>Easily transverse along the rail system on the floor.<br>Mounting technique and the placement of the rails may be built and installed flushed with the floor with no disability for manual pouring.<br>Design with very low maintenance requirements |

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| | | Laser encoder absolute reference, absolute incremental encoder on the moulding line and absolute incremental encoder on the servo-drive. |
| Dynamic Accuracy: | ±10 | mm |
| Way Signal: | | The adaptation of an absolute incremental encoder connected directly to servo drive controller. |
| Servo Drive Units: | | **A** axis (tilting)<br>**Y** axis (longitudinal)<br>**X** axis (horizontal)<br>**Z** axis (vertical)<br>**$X_1$** axis (horizontal – inoculation)<br>**D** axis (ladle changer) |
| Ladle Cover Handling System: | Optional | **E** axis (ladle cover turn) |
| Synchronization: | 0 - 630<br>0 - 1070 | mm/second (X-axis)<br>(depending on flask dimensions)<br>mm/second (Z-axis) height movement<br>(depending on flask dimensions) |
| Weighing System: | | Newly developed system with load cells located in the tilting device.<br>Better accuracy due to sufficiently less influences in the movement.<br>Tara: ladle<br>Pouring start by pre-pour sequence<br>Pouring stopped by weight control<br>Much shorter reaction time.<br>Tolerance of new weight cell is: ± 150 grams<br>Tolerance of new weight cells when pouring is: ± 1 kg |
| Temperature Measuring System: | | By a two phase colour photo resistive optical sensor. |
| Ladle Design: | PUMA 15<br>PUMA 25 | Newly designed round ladles with capacity up to 1500 kg (3300 lbs)<br>Newly designed round ladles with capacity up to 2500 kg (5500 lbs)<br>Round shaped ladles advantages are; low temperature drop and greater reduction in turbulence within the ladle during moving and pouring.<br>Longer spout design for low pouring heights and distanced pouring positions on the flask. |
| Ladle Transportation: | | The ladle design incorporates the lifting features for fork lift transportation.<br>Excellent accessibility to the ladle on all three sides. |
| Ladle Changer: | | Modular and separated from the pouring robot that allows for compact design of the robot.<br>Stationary or movable<br>Placement depends on the length of rails and the position of the ladle change system. |
| Metal Treatment: | Optional | KW-SLS Swisspour AG designed tundish cover<br>New design with a thermal efficient – temperature loss 4° K a minute.<br>Treatment of ductile iron can be done directly into the pouring ladle with no additional transfer of metal is required. |
| Pigging Function: | Optional | Reverse tilting |
| Ladle Cover Handling Module: | Optional | Separate and stationary |
| Inoculation: | Optional<br>Yes | Possible by KW-SLS Swisspour AG Inoculation System **COBRA**<br>Inoculant flow control<br>Filtered compressed air requirements: 14,4 $m^3$/hour; 5 bar |
| Power Supply: | Standard | 3ϕ, 400-$V_{AC}$ + NE + PE, 50/60 Hz |
| Control Supply: | 24-$V_{DC}$ | Internal control power supply |
| Emergency Supply: | 24-$V_{DC}$ | Internal battery power supply with charging unit |
| Control System: | PLC | Bosch Rexroth with Profibus DP |

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| | | Bosch Rexroth IPC MTX integrated PLC, HMI and NC hardware components. |
| Power Consumption: | 56<br>63 | kW for PUMA 15<br>kW for PUMA 25 |
| Trailing Cable Harness Connections: | 1x<br>1x<br>1x<br>2x<br>1x<br>1x | 24-$V_{DC}$ signal connections over trailing cable<br>3Φ, 400-$V_{AC}$ + NE + PE<br>Video<br>Optical<br>Profilbus<br>Air supply for inoculation system – if applicable |
| Indexing Configurations: | Yes<br>Yes | Single inline<br>Double inline for high speed moulding cycles |
| Designed for Usage: | | Cycled or continuous driven moulding lines |
| Types of Pouring Modes: | | Synchronous cycle pouring is when the pouring robot is pouring in synchronous with moulding line movement and automatically pours from one flask to the next.<br>Asynchronous cycle pouring is when the pouring robot is not pouring within the moulding cycle and automatically pouring within the movement of the moulding line. |
| Types of Pouring Functions: | | Weight, regulation (weight and time) and mass |
| Pouring Speed: | 2 - 35 | kg/s |
| Average Pouring Speed: | 7,5 | kg/s |
| Pouring Capacity: | 230<br>221<br>212 | moulds/hour – 36 kg iron per mould and pouring with movement of the line.<br>moulds/hour – 56,5 kg per mould pouring while stopping of the moulding line.<br>moulds/hour – 82 kg iron per mould only at stopping of moulding line.<br>* Denotes indirectly is defined by pouring rate |
| Remote Monitoring and Control:<br>Remote Control Room: | Yes<br>Optional | Video camera |
| Quality Management Parameters: | Standard | Quality assurance parameters can be stored and managed for process automatic and repeatability for all the respective pouring parameters in relationship to each type of flask characteristics.<br>Open for all the common data interfaces and database software. |
| SCADA: | Optional | Interfacing and connections applicable. |
| Pouring Strategies: | | Date<br>Pouring times and acceleration pouring ramps<br>Pouring temperatures<br>Pouring weights<br>Pouring heights<br>Inoculating quality<br>Ladle change<br>Ladle identification |
| Pouring Cup Positions Data: | Optional | Adaptable |
| Ladle Identification System: | Optional | Bit logic signals |
| Safety Features: | | Fully built in compliance to current CE Equipment Safety and Securities Standards.<br>Safety barriers around perimeter linked with interlocking safety switches (within the design).<br>Automatic emergency back tilt feature during power failure.<br>Emergency stop buttons on control console and control room.<br>Bumper guard system on both the front and rear positions (longitudinal).<br>24-$V_{DC}$ battery power supply and sensor control for loss of voltage. |

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| Factory Acceptance Test: | Yes | |
| Training: | Yes | |
| Pouring Sequence Timing Charts: | Yes | On request |
| Preliminary Layout Drawing: | Yes | On request |
| Reference List: | Yes | On request |