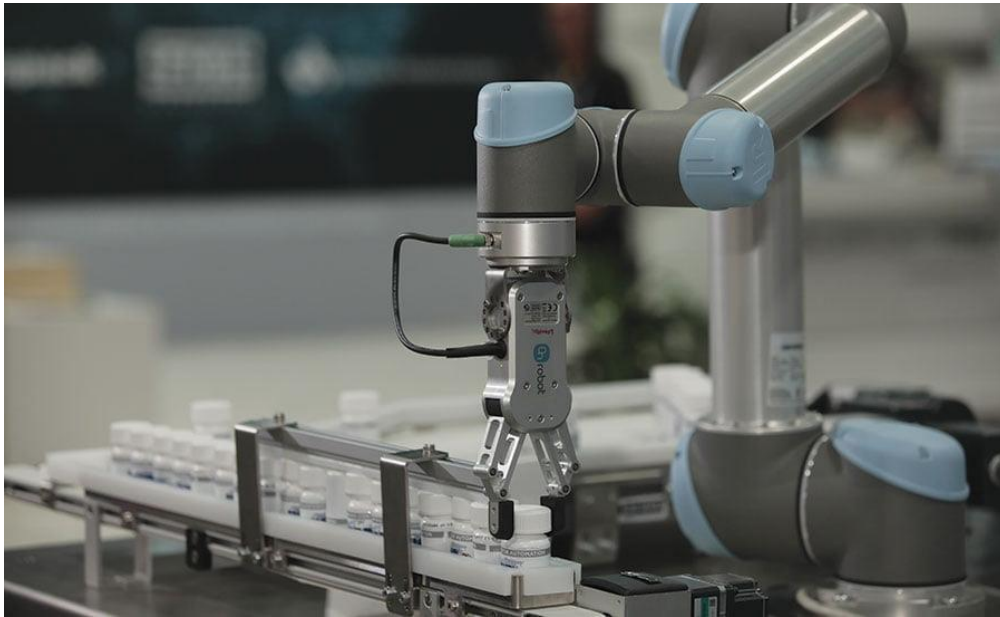## Industrial Robots for Pharmaceutical Manufacturing

How Manufacturers Use Robots for Pharmaceutical Manufacturing

Manufacturers utilize robots in pharmaceutical manufacturing to enhance productivity, accuracy, and safety throughout the production process. Here's a detailed overview of how robots are integrated into various stages of pharmaceutical manufacturing:

Automated Dispensing and Filling

- **Precise Dosing**: Robots automate the dispensing of active pharmaceutical ingredients (APIs) and excipients, ensuring accurate measurements to meet stringent formulation requirements.

- **High Throughput**: Automated systems can fill vials, syringes, or bottles at high speeds, significantly increasing production efficiency compared to manual processes.

Material Handling

- **Efficient Movement**: Robots manage the transportation of raw materials and finished products within the facility, optimizing workflows and reducing manual labour.

- **Warehouse Automation**: Automated guided vehicles (AGVs) and robotic arms are used for picking, packing, and sorting materials, enhancing inventory management and reducing the risk of errors.

Mixing and Compounding

- **Automated Mixing**: Robots can accurately mix components to create formulations, such as solutions, suspensions, or ointments, ensuring consistent quality and reducing contamination risks.

- **Customization**: Robotics allows for the compounding of personalized medications tailored to specific patient needs, particularly in areas like oncology or pediatrics.

Packaging and Labelling

- **Automated Packaging Systems**: Robots are employed in packaging lines to handle products, apply labels, and pack them into cartons, improving efficiency and accuracy.

- **Quality Control**: Vision systems integrated with robots inspect packaging for defects, ensuring that only properly labelled and sealed products reach the market.

Quality Control and Testing

- **Automated Testing**: Robots can conduct routine quality control tests, including checking pH, viscosity, and potency, helping to ensure compliance with regulatory standards.

- **Sample Management**: Robots facilitate the collection and preparation of samples for testing, streamlining the quality assurance process.

Research and Development

- **High-Throughput Screening**: In drug discovery, robots automate the testing of thousands of compounds against biological targets, accelerating the R&D process.

- **Data Analysis**: Advanced robotics can integrate with software systems to analyse data and optimize formulations based on experimental results.

The Types of Robots Used for Pharmaceutical Manufacturing

In **pharmaceutical manufacturing**, various types of robots are used to optimize production, improve precision, ensure safety, and maintain sterile environments. Here's a breakdown of the **types of robots** used in the industry:

Automated Dispensing Robots

- **Function**: These robots handle the precise dispensing of active pharmaceutical ingredients (APIs) and excipients into the production process.

- **Applications**: Used in formulation processes to ensure accurate and consistent ingredient measurement.

- **Examples**: Automated tablet presses, liquid dispensers.

Robotic Arms (Articulated Robots)

- **Function**: Multi-axis robotic arms perform tasks such as material handling, filling, assembling, and packaging.

- **Applications**: Used in packaging, picking and placing of products, and vial handling.

- **Examples**: FANUC and ABB robotic arms.

Liquid Handling Robots

- **Function**: These robots automate the pipetting, mixing, and transferring of liquids, particularly in drug formulation and R&D.

- **Applications**: Used in labs for drug development and high-throughput screening.

- **Examples**: Tecan Fluent, Hamilton STAR.

Automated Guided Vehicles (AGVs)

- **Function**: AGVs transport raw materials, intermediate products, and finished goods across production facilities.

- **Applications**: Used for moving materials between different areas of the manufacturing facility.

- **Examples**: AGVs by KUKA, MiR (Mobile Industrial Robots).

Cleanroom Robots

- **Function**: Robots designed to operate in sterile and controlled environments, such as cleanrooms, ensuring contamination-free operations.

- **Applications**: Used in the production of sterile drugs and biologics, handling highly sensitive materials in aseptic environments.

- **Examples**: Staubli's TX series cleanroom robots.

Palletizing and Material Loading Robots

- **Function**: Robots that automate the process of loading raw materials or finished products onto pallets for shipping or further processing.

- **Applications**: Used in end-of-line packaging and shipping processes to stack and organize products efficiently.

- **Examples**: FANUC's palletizing robots.

Technical Specifications for Pharmaceutical Manufacturing

- ❖ FANUC's palletizing robots
- ❖ Staubli's TX series cleanroom robots
- ❖ PerkinElmer Janus
- ❖ Uhlmann blister packaging machine

Technical Specifications for FANUC's palletizing robots

Specification	Details
Model	FANUC M-410iC/185
Application	Palletizing, depalletizing, material handling
Payload Capacity	185 kg (408 lbs)
Reach	3,140 mm (124 inches)
Axes	4-axis robotic arm
Repeatability	±0.05 mm
Max Speed	2,400 degrees per second
Mounting Options	Floor mounted
Controller	R-30iB Plus
Power Requirements	6 kVA
Weight	1,600 kg (3,527 lbs)
Protection Rating	IP67 (protection against dust and water ingress)
Environmental Conditions	Operating temperature: 0-45°C (32-113°F)
Software Features	Integrated FANUC iRVision (optional), collision detection, palletizing software (PalletTool)
End-of-Arm Tooling (EOAT)	Supports various grippers and custom end-effectors for handling boxes, bags, or trays
Cycle Time	1,700 cycles per hour (dependent on payload and application)
Integration Options	Easily integrates with conveyor systems and warehouse management systems (WMS)
Safety Features	Integrated safety systems with optional fencing, light curtains, and emergency stop systems

## Technical Specifications for Staubli's TX series cleanroom robots

Specification	Details
Model	Staubli TX2-60 Cleanroom/ Stericlean
Application	Cleanroom automation, material handling, assembly, sterile drug handling, semiconductor, etc.
Payload Capacity	4.5 kg (standard), up to 9 kg depending on the version
Reach	920 mm
Axes	6-axis robotic arm
Repeatability	± 0.02 mm
Protection Class	IP65 (arm), IP67 (wrist) – Protection against dust and water ingress
Cleanroom Certification	ISO 14644-1 Class 5 (Cleanroom) and ISO Class 2 (Stericlean version for sterile environments)
Surface Finish	Corrosion-resistant surface with cleanroom-grade coating
Mounting Options	Floor, ceiling, or wall mounted
Controller	CS9 Controller
Weight	52 kg
Operating Temperature	0°C to 40°C
Maximum Speed	Up to 180°/s on each axis (depending on the payload and application)
Power Requirements	230V AC or 380V AC (depending on configuration)
Software Features	Staubli Robotics Suite, VAL 3 programming, optional safety package for human-robot collaboration
Sterile Processing	Resistant to decontamination processes (e.g., VHP, alcohol, and other cleaning agents)
End-of-Arm Tooling (EOAT)	Compatible with various custom end-effectors, suitable for cleanroom and sterile environments

Technical Specifications for PerkinElmer JANUS

Specification	Details
Model	PerkinElmer JANUS G3
Application	Liquid handling for drug discovery, genomics, proteomics, sample preparation
Pipetting Capacity	Nanoliter to milliliter volumes
Pipetting Heads	Varispan (1- to 8-channel) or Multispan (96- or 384-channel)
Pipetting Accuracy	±0.1 µL (at 1 µL), ±1.0 µL (at 10 µL)
Precision	<2% CV at 1 µL, <1% CV at 10 µL
Plate Compatibility	96-, 384-, 1,536-well microplates, PCR plates, deep well plates
Deck Size	4, 8, 12, or 16 positions (configurable)
Software	JANUS WinPREP or JANUS G3 software
Liquid Handling Features	Liquid level sensing, reagent mixing, cherry-picking
Power Requirements	100-240V AC, 50/60 Hz
Weight	90-200 kg (depending on configuration)
Modularity	Flexible deck configurations, expandable with add-ons (heating, cooling, magnetic separation)
Integration	Robotic arms, plate readers, incubators, centrifuges

Technical Specifications for Uhlmann BEC 300 Blister Packaging Machine
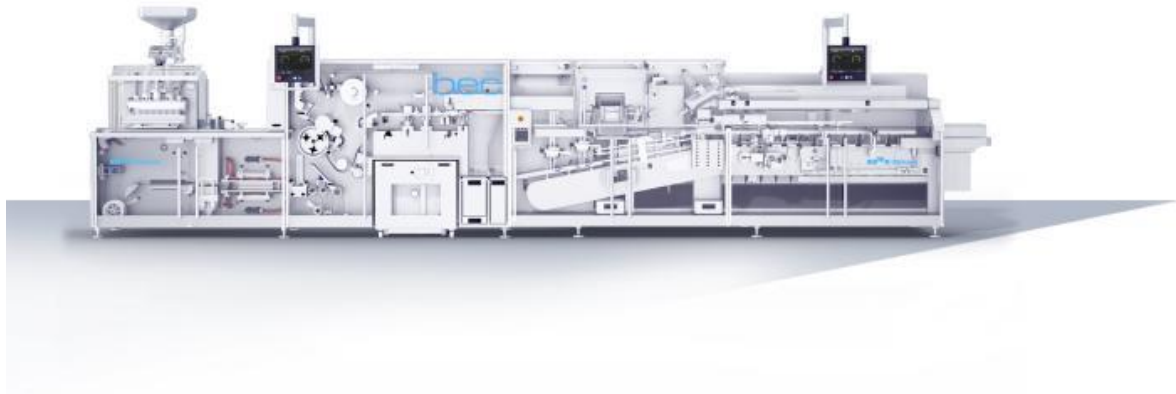
Specification	Details
Model	Uhlmann BEC 300
Application	Blister packaging of tablets, capsules, ampoules, and other unit doses in pharmaceutical manufacturing
Output Capacity	Up to 300 blisters per minute
Blister Size Range	Length: 60-150 mm, Width: 30-90 mm, Height: max. 12 mm
Forming Material	PVC, PVDC, Aclar, Alu, PET, PP
Sealing Material	Aluminum, paper, plastic, or a combination of these
Max. Forming Depth	12 mm
Sealing Type	Flat plate sealing for airtight and secure sealing of blisters
Stations	2 or 3 stations depending on the configuration (forming, sealing, and perforation/cutting)
Changeover Time	Less than 30 minutes
Control System	PLC with HMI touchscreen for easy operation and monitoring
Integrated Features	Integrated vision system for inspection, automatic rejection of defective blisters
Modularity	Modular design for easy upgrades and integration with cartoning or end-of-line systems
Power Requirements	400V / 50 Hz / 3 phase
Compressed Air Requirement	6 bar
Weight	Approx. 4,000 kg
Dimensions (L x W x H)	4,100 mm x 1,130 mm x 2,000 mm
Safety Features	Guard doors with safety interlocks, emergency stop buttons, and comprehensive safety monitoring systems
Compliance	GMP, FDA, and other pharmaceutical regulatory standards
Packaging Material Compatibility	Able to work with various forming and sealing materials, ensuring flexibility for different product types