APPLICATION NOTE

POWER AND CONTROL SOLUTIONS FOR TABLET COMPRESSION PRESSES

Pharmaceutical Manufacturing (UL)

Pharmaceutical manufacturing is a cornerstone of medicine, playing a critical role in producing innovative medications that enhance public health.

As the demand for medications increases, pharmaceutical equipment manufacturers need reliable, precise, and efficient electrical components. ABB's control and protection solutions help to ensure performance when it is needed the most.

What is tablet compression?

Tablet compression is the process of converting powdered or granular materials into solid tablets using a tablet compression press. These machines apply high-pressure punches to form tablets that meet strict pharmaceutical standards for dosage, shape, and weight. The process is essential in pharmaceutical manufacturing because it allows for the efficient, large-scale production of uniform and consistent tablets, which are one of the most common forms of medication.

Why is power and control important for tablet compression equipment?

Power and control are essential to the tablet compression process to ensure product quality, operational efficiency, and safety. Power systems drive the mechanical components that shape and compress tablets. Even minor variations in power can result in operational losses, including downtime and product waste. Therefore, effective power management, including overload and short-circuit protection, is critical for preventing equipment damage and maintaining consistent, reliable performance.

Control systems monitor critical variables such as compression force, speed, and fill depth. Precise control of these variables ensures that each tablet is uniform and in compliance with quality standards. Additionally, control systems enhance operator safety by immediately shutting down the equipment in response to emergencies or unsafe conditions.

Main benefits

Continuous operation

Avoid operational disruptions and downtime with ABB circuit breakers. Equipped with advanced trip units, our breakers identify voltage irregularities and protect your production system.

Energy-efficient system

Our AF contactor coil technology boosts control panel energy efficiency, which means less dissipated heat, reduced operating costs, and better equipment performance for your pharmaceutical processes.

Compact and easy to install

Save space, reduce assembly time, and experience greater design flexibility with our narrow designs in circuit breakers, contactors, and overload relays.

Safety and protection

Our product specifications help to enhance safety and reduce hazards by using surge protective devices and monitoring relays to help provide added equipment protection.

Pharmaceutical manufacturing

Process overview

Pharmaceutical manufacturing is a precision-driven process that transforms raw materials, active pharmaceutical ingredients (APIs) and excipients, into safe, effective, and consistent dosage forms. These forms include tablets, capsules, liquids, creams, inhaled formulations, and injectables, each requiring tailored handling and formulation techniques to meet strict quality and regulatory standards.

The following illustration outlines the core stages commonly involved in pharmaceutical manufacturing, beginning with raw material preparation and concluding with final product packaging.

Process	Steps	Description
Ingredient preparation	Weighing and dispensing	APIs and excipients are weighed in a controlled environment.
Ingredient processing	Granulation	Weighed ingredients are converted from powders to granules through wet or dry granulation.
	Drying	Moisture is removed from the product.
	Milling and sieving	Particles are further reduced to ensure uniformity and flow.
	Mixing and blending	The ingredients are mixed or blended to form a homogeneous mixture.
Product formation and finishing	Tablet compression or filling	The mixture is compressed into tablets or inserted into capsules.
	Tablet coating	A coating is applied to the tablet for protection, taste masking, and/or controlled release.
	Finishing and printing	The product is polished to enhance appearance and remove residues. Branding, identification marks, and dosing information added to final product.
Packaging	Primary and secondary packaging	Finished product is placed into packaging that directly contacts the product, such as blisters, bottles, or pouches. It is then enclosed in secondary packaging, such as cartons, along with labels and inserts.

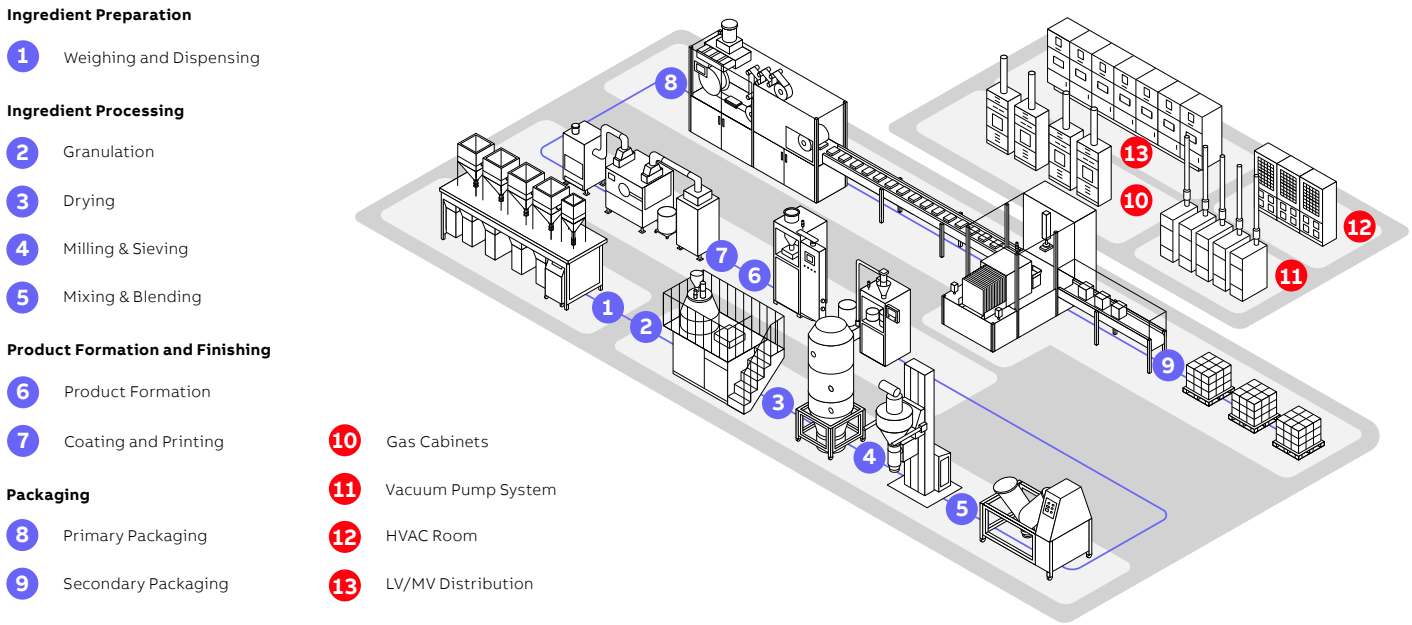


Figure 1: Layout of a generic pharmaceutical manufacturing process

Note: This diagram provides a simplified overview of pharmaceutical manufacturing and does not represent all processes or product types.

Tablet compression

Process overview and equipment types

The **tablet compression** process begins with the preparation of the powder or granulate, which must be uniform, dry, and free-flowing to ensure consistent tablet formation. Once the material is ready, it is fed into the tablet press.

Tablet compression involves four stages (1):

1. **Filling:** Powder or granules are transferred to the die cavity, a precisely shaped chamber that defines the tablet's shape and dimensions.
2. **Weight adjustment:** The tablet's weight is determined by adjusting the height of the lower punch and removing any excess material.
3. **Compression:** Compression rolls apply force to the upper and lower punches, compacting the powder within the die to form a solid tablet.
4. **Ejection:** The lower punch rises to eject the tablet out of the die cavity.

After ejection, each tablet is checked to verify it meets specifications for weight, thickness, and hardness. Tablets that fall outside of tolerance are automatically rejected. The accepted tablets are then dedusted to remove excess powder and may be coated for protection, taste-masking, or controlled release. Once coated, tablets can be printed with identifying marks or batch information before being packaged for distribution to pharmacies, retail stores, and healthcare providers.

Types of tablet compression presses

Selecting the appropriate **tablet compression** method is important as it must align with the formulation's physical and chemical characteristics to ensure consistent tablet quality and efficient production. Each machine has its own strengths and limitations, making the right choice essential for maintaining product integrity and meeting regulatory standards in pharmaceutical manufacturing.

Type (2)	Description
Single-punch	Single press with one set of punch and die. Ideal for small-scale production, R&D, or formulation development.
Rotary	Features multiple sets of punches and dies. Suitable for medium to large scale production.
High-speed rotary	Advanced rotary press designed for ultra-high-speed commercial manufacturing with high output and efficiency.
Multi-layer	Specialized rotary press that compresses two or more layers into a single tablet, supporting controlled release or combination dosing.

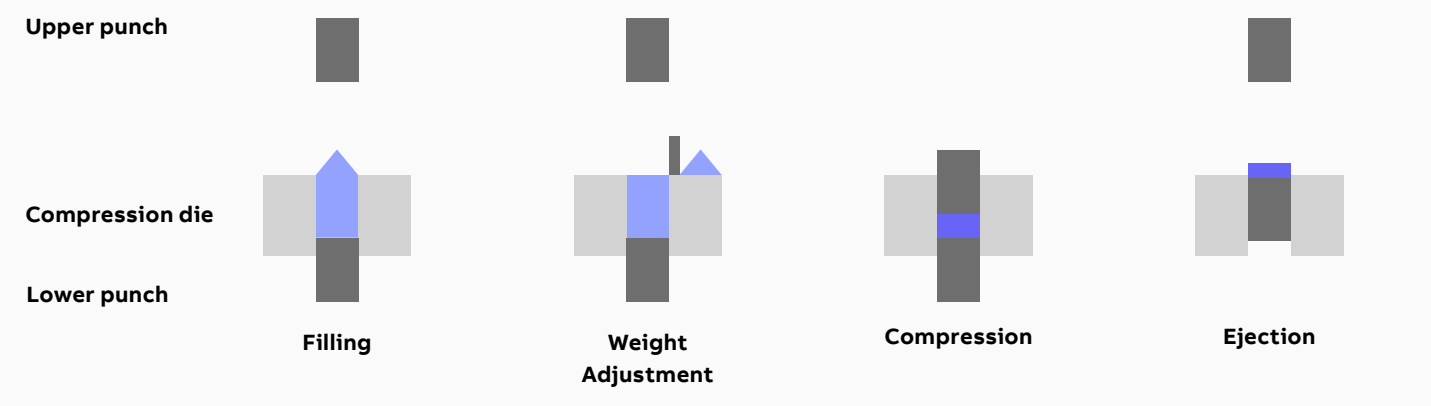
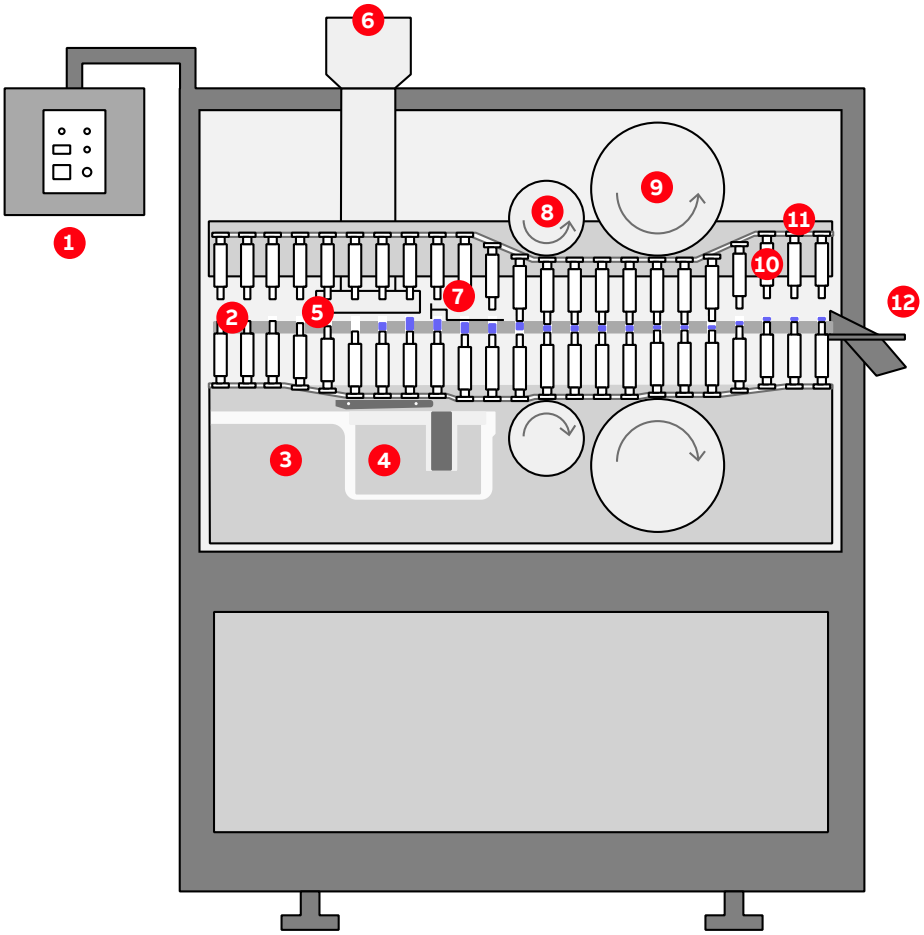


Figure 2: Tablet compression cycle (3)

Tablet compression press components

The tablet compression press is a machine designed to precisely convert powder or granules into uniform tablets. Each component of the press plays a specific role in the process. The dies and punches shape the tablets, while the compression rollers apply the force needed to form them.

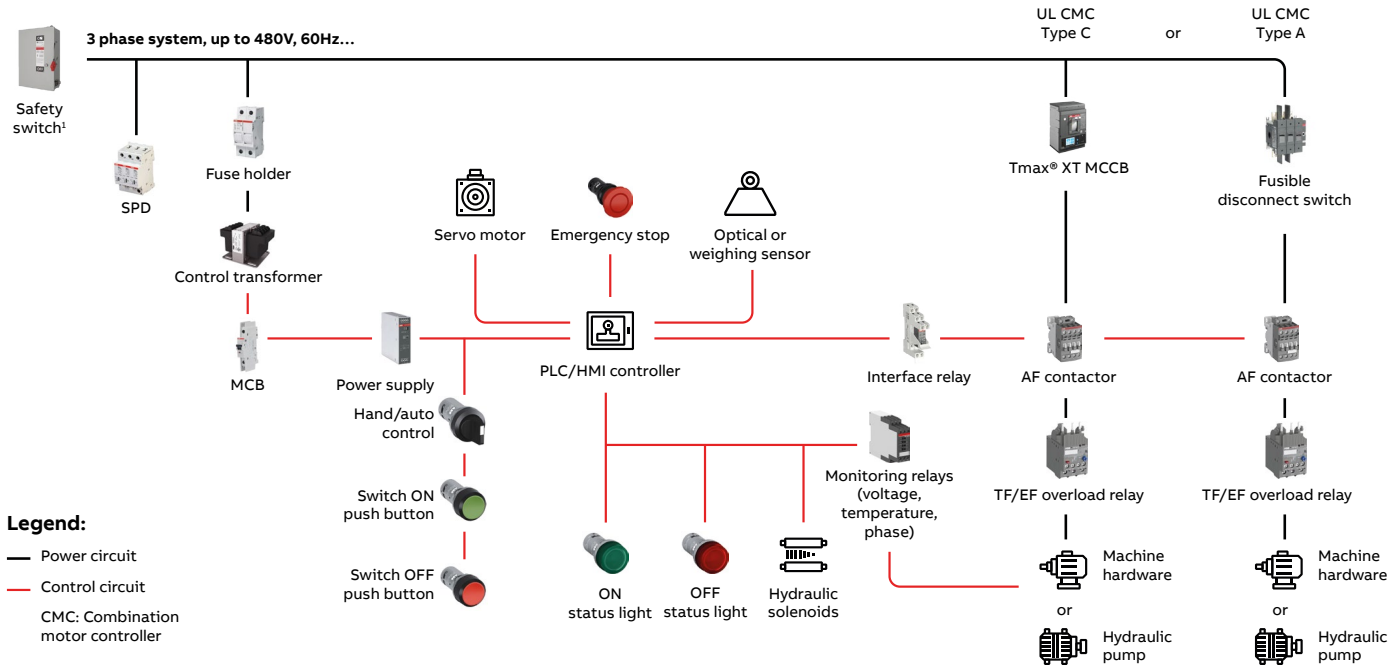
The diagram below identifies and defines these key components, illustrating their role within the tablet forming process. Reliable power and control systems are essential to maintain the performance of these components, directly supporting consistent product quality and optimal production throughput.



1. **Control screen**
   HMI that allows the operator to control and monitor the machine
2. **Dies**
   Shapes the tablets by determining their size and dimensions
3. **Turret**
   Rotating platform that holds and positions the punches and dies, the heart of the tablet compression press
4. **Weight control**
   Adjusts the volume of the granulated material to be compressed and determines the weight of the capsules
5. **Feeder**
   Controls the flow of material into the die cavity, ensuring consistent dosing
6. **Hopper**
   Holds granulated material and feeds it into the machine
7. **Scraper**
   Removes excess material from the die table after weight adjustment
8. **Precompression roll**
   Provides initial compression to the powder and removes air that may be trapped in the material
9. **Main compression roll**
   Compresses the material inside the die to form the finished tablet
10. **Punches**
    Compresses the material inside the die to form the tablets
11. **Cam tracks**
    Manages the movement of punches during the compression process
12. **Discharge chute**
    Guides the finished tablets to downstream processing or packaging

Figure 3: Tablet compression press components and functions (4)

Power and control solutions for tablet compression presses



Note: This configuration is for a generic system and is not representative of existing manufacturers.
¹ Use the fusible version to meet NEC code requirements.

Main components and functions

Primary functional requirements

- Fusible switches, circuit breakers, and surge protective devices, to prevent equipment damage or fires
- Safety switches for lock out tag out (LOTO) procedures to protect service personnel and emergency stops to protect machine users

Secondary optional requirements

- Monitoring relays to detect circuit abnormalities that could lead to equipment damage or impact performance (e.g. voltage, current, or temperature monitoring)

Power and control components and functionalities

Application	Electrical components	Functional description
Power circuit	Safety switch	Isolation, overload and short circuit protection
Power circuit	Surge protective device	Prevent damage from electrical surge
Power circuit	Fuse holder	Short circuit protection
Power circuit/Motor load	Circuit breaker	Isolation, overload and short circuit protection
Power circuit/Motor load	Fusible switch	Isolation, overload and short circuit protection
Motor load	AF contactor	Remote isolation and control
Motor load	TF/EF overload relay	Thermal and electronic overload protection
Control circuit	Miniature circuit breaker	Overload and short circuit protection
Control circuit	Control transformer	Reduces voltages from higher to lower
Control circuit	Power supply	Converts an electric input to a different current and voltage output
Control circuit	Interface relay	Isolates, connects, and ensures compatibility between components
Control circuit	Monitoring relays	Monitor the current, voltage, and temperature of machine hardware
Control circuit	Pilot devices	Provide visual status and machine control

Product offering

Tmax XT molded case circuit breakers

CATALOG LINK

WEB PAGE

AF contactors

CATALOG LINK

WEB PAGE

Safety switches

CATALOG LINK

WEB PAGE

Fusible disconnect switches

CATALOG LINK

WEB PAGE

Overload relays

CATALOG LINK

WEB PAGE

Assorted pilot devices

CATALOG LINK

WEB PAGE

Fuse holders

CATALOG LINK

WEB PAGE

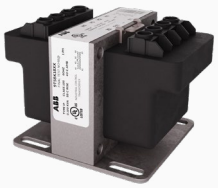
Surge protective devices

CATALOG LINK

WEB PAGE

Product offering

Control transformers



CATALOG LINK

WEB PAGE

Miniature circuit breakers

CATALOG LINK

WEB PAGE

Measuring and monitoring relays

CATALOG LINK

WEB PAGE

Definite purpose contactors

CATALOG LINK

WEB PAGE

Power supplies

CATALOG LINK

WEB PAGE

B series mini contactors

CATALOG LINK

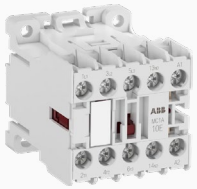
WEB PAGE

Interface relays and optocouplers

CATALOG LINK

WEB PAGE

M series mini contactors



CATALOG LINK

WEB PAGE

References

(1) S. Desai, C. R. Baru, J. Aenugu, and V. Beebireddy, “Description of Pharmaceutical Tablet Punching Machine,” *Int. J. Pharm. Biol. Sci.*, vol. 12, no. 1, pp. 61–68, 2022. [Online]. Available: http://www.ijpbs.com/ijpbsadmin/upload/ijpbs_625fce4d6978e.pdf [Accessed: Oct. 2, 2025].

(2) A. Kanetkar, “The science behind tablet compression that every formulator must know,” Pharma Trends, Mar. 11, 2019. [Online]. Available: https://pharma-trends.com/2019/03/11/the-science-behind-tablet-compression-that-every-formulator-must-know/ [Accessed: Oct. 2, 2025].

(3) Fluidpack, “Types of Tablet Compression Machines and Their Applications,” Fluidpack.net. [Online]. Available: https://www.fluidpack.net/blogs/types-of-tablet-compression-machines-and-their-applications [Accessed: Oct. 2, 2025].

(4) AIPAK, “10 Critical Tablet Compression Machine Parts,” iCapsulePack.com. [Online]. Available: https://www.icapsulepack.com/10-critical-tablet-compression-machine-parts/ [Accessed: Oct. 2, 2025].

CONTACT US

Do you have a similar project and are you searching for the right application configuration?
Contact us and talk to our experts!

U.S HQ Office:
ABB
305 Gregson Drive
Cary, NC 27511
United States
Phone: (800) 435-7365

electrification.us.abb.com

We reserve the right to make technical changes or modify the contents of this document without prior notice. With regard to purchase orders, the agreed particulars shall prevail. ABB Inc. does not accept any responsibility whatsoever for potential errors or possible lack of information in this document.

We reserve all rights in this document and in the subject matter and illustrations contained therein. Any reproduction, disclosure to third parties or utilization of its contents – in whole or in parts – is forbidden without prior written consent of ABB Inc.

99AKK108471A7000