

Safety Overview

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Revision Date: 9 May 2025

Introduction

This guide is an **Overview** containing original instructions written to assist in normal operations.

For detailed information, refer to **Area Operations** guides and/or **Maintenance** manual specific to the equipment being maintained.

CAUTION: Personnel should undergo proper training before attempting to operate any piece of equipment.

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1 Safety Overview

This **Area Operations Guide** provides an overview only. For the safe operation and maintenance of specific equipment, read the **Gypsum Technologies Area Operations Guides** and **Maintenance Manuals**.

CAUTION: This manual is NOT a complete Safety Procedure for performing maintenance or cleaning functions.

KEY: Incorporate this **Safety** information into your Plant specific **Lockout/Tagout** procedure.

All personnel must follow [Lockout/Tagout](#) (LOTO) program procedures.

CAUTION: Equipment has the potential to cause severe injury or even death.

KEY: Before undertaking or performing any maintenance or clean-out procedure, be sure to understand the safety concerns related to a piece of equipment. NEVER put yourself at risk.

Note: For any **Safety** concerns, speak with your management prior to undertaking any work.

1.1 Shutdown Guidelines

Shutdown Guidelines to follow BEFORE maintenance or repair work is started on motor-driven equipment:

- Confirm that the relevant control switch is in **OFF** position, and remains in the **OFF** position
- Confirm that power supply to equipment is shut off and Locked at:
 - The main control switch
 - The local disconnect to the respective motors
- Display a “**WORK IN PROGRESS**” sign on the equipment
- NEVER make a by-pass connection of a **Safety** switch (not even if it's faulty) – Replace it!
- For any fault that could lead to personal injury, report this to the nearest person in responsibility
- Keep locking keys to relay cabinets, etc. in a safe place accessible only to authorized personnel

Note: For normal **Startup** and **Shutdown** procedures, reference specific **Area Operations Guides**.

1.2 Compliance

All staff MUST operate in **Compliance** with company **Safety** procedures and local regulations.

2 Lockout/Tagout

It is your organization's responsibility to develop, implement, and enforce an energy control program which follows local regulations and standard for **Lockout/Tagout (LOTO)**.

CAUTION: Be Aware. Equipment may move or suddenly fall.

KEY: Before performing equipment maintenance or cleaning functions, ALWAYS Lock Out motive power sources (electrical, hydraulic, compressed air, pneumatic, etc.).

Equipment can store potential energy which can cause equipment to move or suddenly fall if pressure is removed. Examples are those held in a raised position by hydraulic or air pressure. Hazards can arise from equipment or material movement upstream or downstream of the machine that is Locked out.

IMPORTANT: For Safety, ALL staff MUST operate in compliance with **LOTO** procedures.

2.1 Lockout/Tagout Procedure

Prior to doing any equipment maintenance or cleaning, you MUST follow a **Lockout/Tagout (LOTO) Procedure**.

The following **LOTO** Procedure is recommended for when no other procedure has been defined for locking out equipment to control energy.

2.1.1 LOTO Procedure

LOTO Procedure:

1. Identify the equipment that needs to be Locked out
2. Shut down equipment
3. Confirm **Area/Zone** is turned **OFF**
4. Test the Manual actuator for the equipment/motor functions by running each motor in **Manual** for a few seconds, then back to the **OFF** position.
5. Open the **Disconnect** switch
6. Place a personal **Lock** on the switch to prevent system from being re-energized
7. Confirm that no personnel are in the **Area/Zone**
8. Test the **Lockout** by putting equipment or motor into **Manual** mode for a few seconds to confirm that it will not start, then back to the **OFF** position
9. To continue operation, remove **Lock** from the switch, and then turn switch back to the **ON** position.

3 Plant Controls

Plant Controls include:

- Human-Machine Interface (HMI)
- Programmable Logic Controller (PLC)
- JOG-OFF-AUTO (JOA)

3.1 HMI Controls

The **Human-Machine Interface (HMI) Controls** for each **Motor Drive** can be put into **Forward**, **Reverse**, **Off**, or **Auto**. Equipment runs continuously when a Drive is manually put in Forward or Reverse.

CAUTION: The HMI functions are NOT a replacement for physically isolating equipment.

KEY: To avoid potentially hazardous situations, ALWAYS be alert and aware of your surroundings.

The HMI provides valuable information and diagnostic tools, adding a level of safety. View status of all area safety devices on the **Safety Overview** screen.

Prior to working on any equipment, ALWAYS confirm that system equipment is NOT operational by using the normal means of starting it (Operator Control Station or manual **Start/Test** button).

3.2 Motor Alarms

Each Motor has programmed **Motor Alarms** that can:

- Generate codes specific to Motor features and functions
- Generate **Warnings**
- Shut down a Motor

The **HMI** displays messages that are saved in the **Alarm History** file. When an Alarm is set off, a Beacon attracts operator attention.

3.2.1 Alarm Operation

Alarm Operation instructions:

1. Check the **Alarm** code on the **HMI** display
2. Correct the issue
3. Use the **HMI** touch screen to reset the Motor (put Motor back into AUTO)
4. If necessary, use the control panel **Zone ON** button to restart the process

3.3 PLC Controls

Safety relays and all safety devices are monitored by the **Programmable Logic Controller (PLC)**. When a problem occurs, the **HMI** identifies which hard-wired device has been activated, and then displays status to aid in rapid troubleshooting.

3.4 JOA Controls

JOG-OFF-AUTO (JOA) Controls for **Selector Switch** operation of each **Motor** are panel-mounted.

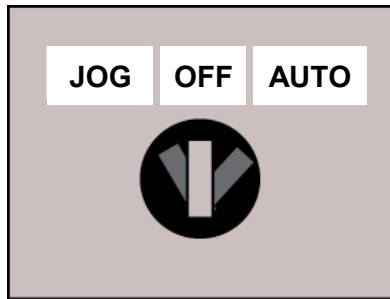


Figure 3.1 JOA Controls

Table 3.1 JOA Controls Operation

Switch Position	Operation
JOG	<ul style="list-style-type: none">• Maintenance mode <u>ONLY</u>• Manually powers the Motor to run• Equipment runs continuously• Overrides any interlocks when held in this Position
OFF	<ul style="list-style-type: none">• Stops the Motor
AUTO	<ul style="list-style-type: none">• Normal Operation mode• Automatically powers the Motor to run• Allows control from the PLC• Equipment responds appropriately to Line Start and Stop requests

3.5 Feeder Motors

The **JOG-OFF-AUTO (JOA)** Controls for **Selector Switch** operation of **Feeder Motors** are panel-mounted.

IMPORTANT: Moving the Selector Switch out of the **AUTO** position while a line is making board can cause a **Board Line** shutdown.

Table 3.2 JOA Feeder Motor Controls

Switch Position	Operation
JOG	<ul style="list-style-type: none"> Do <u>NOT</u> turn Feeder on in this mode unless the Additives Collecting Screw is running (otherwise the fed material has no flow path) This mode is used <u>ONLY</u> when the plant is <u>NOT</u> making Board Manually starts the Feeder Motor Overrides any interlocks when held in this Position The Operator has full control of Feeder speed from the HMI and can directly enter the speed reference (0-100%)
OFF	<ul style="list-style-type: none"> Stops the Feeder
AUTO	<ul style="list-style-type: none"> Normal Operation mode Automatically powers the Feeder Feeder starts sending its additive to the Mixer as controlled by the Board Line Master Start Sequence Allows control from the PLC, including interlocks Equipment responds appropriately to Line Start and Stop requests

3.6 Motor Safety

Steps to follow for **Motor Safety** BEFORE doing equipment maintenance or cleaning:

1. The **JOA** switch MUST be moved to the **OFF** position BEFORE opening a **Disconnect Switch**
2. Move the **JOA** switch to the **JOG** position for a few seconds to confirm the **Motor** will start. Move the **JOA** switch to the **OFF** position after confirming the motor runs for a few seconds
3. Then, open the **Disconnect Switch**
4. Move the **JOA** switch to the **JOG** position for a few seconds to confirm **Motor** will not start
5. Return **JOA** switch back to the **OFF** position

4 Electrical Switches

Electrical Switches located locally, at the **Drive Panel**, and by **Zone** are used for [Lockout/Tagout \(LOTO\)](#) purposes prior to doing equipment maintenance or cleaning.

Electrical Switches include:

- **Disconnect Switch** (Area with Fenced Zone: Drive Panels)
- **Field Disconnect Switch** (Area with Zone and no fencing)
- **Lockable Local Disconnect Switch** (Area without Zone)

4.1 Disconnect Switch

Each **Area** of the Plant has a **Disconnect Switch** that physically isolates, starts and stops an Area. Each **Drive Panel** has a lockable, panel-mounted Disconnect Switch that isolates all Drives in that Panel.

Note: Some Areas may also have a field-mounted Disconnect Switch that removes power to a Motor or series of Motors.

4.2 Safety Switch

Each **Zone** of the Plant has at least one **Safety Switch** that performs a Safety OFF on a group of equipment located in a Zone. The **Safety Switch Panel** may also have buttons that start and stop the corresponding equipment.

4.3 Electrical Safety

Steps to follow for **Electrical Safety** BEFORE performing **SIMPLE cleaning** or **adjustment** tasks:

4.3.1 Areas with Fenced Zones

1. The **JOA** function for these zones is done via the area HMI
2. Access to these zones is via the lockable safety gate access. See Section 7 for gate access procedures

4.3.2 Areas with Zones – No Fence

1. The **JOA** function for these zones is done via the area HMI
2. Confirm that the **Zone** is **OFF**
3. Open the Field disconnect switch
4. Place a lock on the switch to prevent the system from being re-energized
5. Put equipment or motor into manual mode for a few seconds after Field disconnect switch is opened to ensure that the equipment or motors will not start
6. Return equipment or motor to OFF mode

4.3.3 Areas without Zones

1. The **JOA** switch MUST be moved to the OFF position BEFORE opening a Switch
2. Confirm that the **Drive Panel** or **Zone** is in **OFF** mode BEFORE opening a Switch
3. Then, open an **Electrical Disconnect** or **Electrical Safety** Switch

4. Place a lock on the Switch to prevent system from being re-energized
5. Put equipment or Motor into **Manual** mode for a few seconds after the Switch is opened to ensure that the motor will not start
6. Return equipment or Motor to **OFF** mode
7. Confirm that the **Safety** indicator appears on the **HMI** screen

CAUTION: Equipment may automatically start.

KEY: To prevent equipment from being re-energized after an **Electrical Disconnect Switch** or **Electrical Safety Switch** has been opened, ALWAYS place a lock on the Switch.

5 Dump Valves

5.1 Safety Dump

Each **Zone** of the Plant has two **Safety Dump** Valves for pneumatic energy present. One Valve is manual, and the other Valve is electric.

5.2 Air Dump

An electronically controlled **Air Dump** solenoid coupled with a manual Valve dumps air pressure and removes pneumatic power to equipment that requires compressed air (e.g., **Bin Vents**, **Dust Collectors**) for [Lockout/Tagout](#) (LOTO).

CAUTION: Equipment automatically dumps air pressure under some circumstances.

KEY: Once air is dumped, ALWAYS ensure that air pressure has been isolated and **Locked Out** before servicing any piece of equipment.

Always use the manual **Air Dump** Valves for task specific access that requires manual lockout of 460V and compressed air, (e.g., maintenance work on **Vacuum Cups** or **Glue Valves** that may require dumping the compressed air supply to those devices in addition to the Main Air Supply).

6 Emergency Stop

Emergency Stop (E-Stop) Push Buttons (PBs) and **Pull Cord** switches are used to immediately **Stop** equipment in an EMERGENCY.

6.1 Push Buttons

A series of E-Stop **Push Buttons (PBs)** are located throughout the Plant and at each piece of equipment. These PBs are for use only in an emergency to immediately **Stop** equipment, put the drives into a **Safety OFF** state, and prevent any further danger to personnel in the safest manner possible.

CAUTION: Use E-Stops ONLY in an **EMERGENCY** – NOT for normal Shutdown.

KEY: DO NOT use E-Stop PBs for normal Shutdown. This can cause equipment damage.

Press an **E-Stop PB** to immediately **Stop** equipment, an area, or an entire system.

To re-energize equipment:

1. The **E-Stop PB** must be depressed
2. Reset the system from the **Operator Console**
3. Wait approximately 30 seconds for equipment to re-energize

6.2 Pull Cords

E-Stop **Pull Cords** are switches that can be pulled during hazardous situations to immediately **Stop** equipment and put drives and contactors in a safe state.

CAUTION: Use Pull Cords ONLY in an **EMERGENCY** – NOT for normal Shutdown.

KEY: DO NOT use **Pull Cords** for normal Shutdown. This can cause equipment damage.

6.2.1 Pull Cord Reset

For **Pull Cord Reset**:

1. Push the **Reset** button on the Pull Cord
2. Restart system from the **Operator Console**
3. Wait approximately 30 seconds for equipment to re-energize

7 Gate Access System

The **Gate Access System** is designed for incorporation into your [Lockout/Tagout \(LOTO\) Program](#). A physical barrier such as a **Safety Fence** often surrounds potentially hazardous areas that generally do not require access during normal operation. These areas are accessible only through a designated **Safety Gate**.

7.1 Gate Control Panel

The **Gate Control Panel** for each **Safety Gate** has push button (PB) controls with display lights that indicate if it is safe to unlock a Gate.

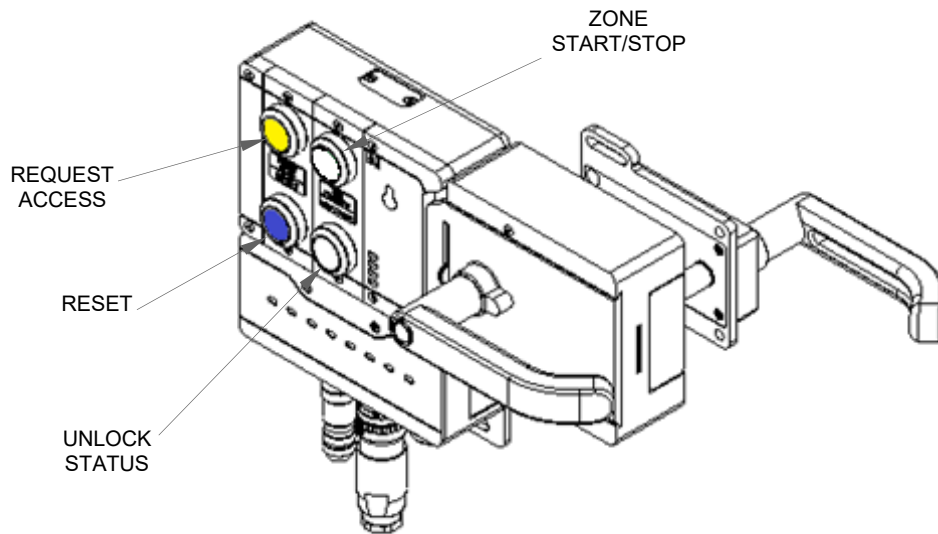


Figure 7.1 Gate Control Panel

Table 7.1 Gate Control Panel Push Buttons

Color	Push Button	When Pressed
YELLOW	REQUEST ACCESS	Releases Gate Handle when conditions are met, allowing access to a Zone
WHITE	ZONE START/STOP	Starts and Stops a Zone; button is Solid GREEN when a Zone is running
BLUE	RESET	Returns gate to Locked state
WHITE	UNLOCK STATUS	Gate Solenoid status

7.2 Safety Gates

Safety Gates help prevent people from entering areas with hazardous energy sources running, stored, or that could contain residual energy.

IMPORTANT: DO NOT override the [Gate Access System](#) or enter a gated area while equipment is operational.

CAUTION: Avoid Hazards. Proper Lockout/Tagout (LOTO) procedure MUST be followed.

KEY: A Personal Lock MUST be placed on the **Safety Gate** switch to prevent the gate from being locked behind a person.

7.2.1 Gate Access

For **Gate Access**, press the YELLOW **REQUEST ACCESS** PB on the **Gate Control Panel**. The Zone must be **OFF** before a **Gate Access** request is recognized by the system.

IMPORTANT: The operator MUST wait until conditions are met for the area to be safely shut down and isolated before the **Safety Gate** will open.

7.2.2 Gate Reset

For **Gate Reset**, press the BLUE **RESET** PB on the **Gate Control Panel** to reactivate the Gate Solenoid.

IMPORTANT: The operator MUST exit the area and close Gate BEFORE the **Gate Access System** can be Reset and normal operation restored.

7.2.3 Zone Restart

Once the **Safety Beacon** stops Blinking BLUE and turns **OFF**, press the GREEN **ZONE START/STOP** PB for **Zone Restart**.

7.2.4 Safety Gate Sequence

This **Safety Gate Sequence** takes place:

1. Operator turns off the Zone requiring access.
2. PLC performs a controlled stop of the Zone
3. Once Zone is OFF the operator presses the **Request Access** pushbutton. The **Request Access** pilot light starts blinking
4. VFDs are put into STO
5. Safety Air Dump activates
6. Safety PLC verifies all Gate access prerequisites are satisfied and time delay expired
7. Gate Solenoid energizes to permit access to the zone
8. Safety Beacon goes solid BLUE
9. The Gate can be opened

Table 7.2 Safety Gate Beacon Status

Beacon	Safety Gate Status
OFF	Gate is CLOSED ; Locked
Solid BLUE	Gate is OPEN ; Unlocked
Slowly Blinking BLUE	Gate is CLOSED ; Unlocked Note: RESET is required
Fast Blinking BLUE	A Safety Fault condition exists Note: RESET on HMI Safety screen, a technician may be required

Note: Safety Gates can be **Locked** in the **OPEN** position.

IMPORTANT: When the **Safety Beacon** is Slowly Blinking **BLUE** and **Safety Gate** is closed, the Gate MUST be locked.

7.3 Safe Torque Off

Safe Torque Off (STO) is an integrated safety function of the **Variable Frequency Drive (VFD)** that ensures no torque generating energy can be applied to a Motor, and it prevents unintentional starting in accordance with machinery safety standard **EN 60204-1**.

The STO function along with the [Gate Access System](#) allows for increased equipment safety for operators when accessing equipment for housekeeping and clearing jams.

CAUTION: The STO function does NOT electrically disconnect VFDs.

KEY: Be aware that STO ONLY halts torque in the Motor. Power is usually still connected to the VFD.

When the **STO** stops pulses at the insulated-gate bipolar transistor (IGBT), it secures a Drive, and then qualifies it against the EN 60204-1 code. The Motor does not restart until STO is reset.

Note: For a **VFD** without the **Safe Torque Off** function, time is needed to properly discharge before power is restored.

8 Detection Devices

Detection Devices for individuals and objects include:

- **Light Curtains** (specific area)
- **Area Scanners** (specific zone)

8.1 Light Curtains

Light Curtains project a grid of infrared beams that detect any object or individual that block the beams in a specific area. When a Light Curtain detects an object entering an area, it stops equipment that would present a hazard to an individual within the area that the Curtain encloses. This allows limited access to certain pieces of equipment without requiring the rest of a **Board Line** to be shut down.

For example, Light Curtains in the **Auto-Dunnage Placement (ADP)** area allow stacks of Dunnage to be placed while the rest of that Zone is active which allows the **Placement Robot** to pick up Dunnage from staging while the forklift blocks the **Outer Light Curtain** for **Cube Placement**.

CAUTION: Light Curtains allow access to the safeguarded area for a **LIMITED** scope of work, specific to the area.

KEY: DO NOT use **Light Curtains** in place of [Lockout/Tagout](#) procedures for maintenance or cleaning purposes.

Table 8.1 Light Curtain Pairs

Light Curtain	Normal State	Breaking the Curtain
Outer	Enabled	<ul style="list-style-type: none">• Disconnects power to the equipment within Curtains• Dumps all air from equipment within Curtains• Enables the Inner Curtain
Inner	Muted	Immediately stops Zone equipment when the Outer Curtain is tripped

8.1.1 Outer Light Curtain Reset

For **Outer Light Curtain Reset**:

1. Clear the Outer Light Curtain of any obstructions
2. Confirm that all personnel are outside of the space safeguarded by the Light Curtains
3. Once the **Reset** push button (PB) on operator console is flashing BLUE, press the **Reset** PB

Table 8.2 Light Curtain Beacon Status

Color	Status	Description
BLUE	Off	Curtain is not blocked; Machine in normal operation
	Solid	Curtain is blocked, or Trapped Key is removed Note: If Key is removed, no one outside can reset the Curtain.
	Flashing	Obstructions have been cleared and Curtain is ready for Reset
	Fast Flash	Faulted
GREEN	Off	Machine sequence is not expecting entry Note: Entering through the Curtain can interrupt a cycle, or shut down the entire machine.
	Solid	Entry is expected (e.g., to load a board stack or unload a cube)
	Flashing at Infeed	The board supply is almost depleted
	Flashing at Unload Conveyor	Cubes are ready for unload, and if not unloaded soon, machine is forced to idle

8.2 Trapped Key System

The **Trapped Key System** isolates power and allows for safe operator access to a protected Area and equipment. These Keys only prevent reset of their associated **Light Curtains**. Two Keys are provided in the case that two operators need access at the same time.

CAUTION: No personnel should enter a Light Curtain without a Trapped Key.

KEY: DO NOT leave the Plant with a Trapped Key.

IMPORTANT: When either of the Trapped Keys are removed, [Light Curtain Reset](#) is not possible.

8.2.1 Trapped Key Interlock

Trapped Key Interlock:

1. Insert Trapped Key into the access interlock
2. Turn the Key to the "0" position
3. Remove the Key
4. Keep Key on your person

5. Before re-energizing equipment, follow steps 1-4 in reverse

8.3 Area Scanners

Area Scanners detect when an individual or object enters a specific zone. When an Area Scanner detects an object entering an area, it stops equipment that would present a hazard to an individual within the area that the Scanner encloses. This allows limited access to certain pieces of equipment without requiring the rest of a **Board Line** to be shut down.

8.3.1 Area Scanner Reset

For **Area Scanner Reset**:

1. Clear the Area Scanner of any obstructions
2. Ensure that all personnel are outside of the space defined through Area Scanners
3. Once the **Reset** push button (PB) on operator console is Flashing BLUE, press the **Reset** PB

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