Mill Area

Area Operations Guide Prepared for:

Carmit Mister Fix Ltd.

40 m/min Wallboard Factory

Caesarea, Israel

Gyptech

Proven Technology Worldwide

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Introduction

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

For detailed information, refer to the **Maintenance** manual specific to the equipment being maintained.

For Safety information, consult the **Safety Overview** manual.

CAUTION: To avoid injury, personnel should complete formal safety training before operating any piece of equipment.

KEY: All personnel must follow Lockout/Tagout (LOTO) procedures and operate in compliance with both their company policy and local regulations.

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1 Area Overview

The purpose of the mill area is to produce stucco through the milling and calcining of raw gypsum. Gypsum enters the mill area in the form of 0-35mm rocks. These rocks are transferred to a vertical ball ring mill which grinds them to a fine powder. While in the mill the rock/powder mixture is heated to partially dehydrate or calcine the gypsum and produce stucco. The calcined powder is then cooled in a stucco cooler and sent up a bucket elevator to be discharged to the Stucco Handling Area.

Mill Area equipment includes:

- Rock Silo (By customer)
- Rock Silo Bin Vent
- Rock Silo Discharger
- Weigh Belt Feeder
- Rock Silo Weigh Belt Discharge Rotary Valve
- CP Mill/Classifier
- Mill Burner
- Combustion Air Blower
- Emergency Air Damper
- System Dust Collector
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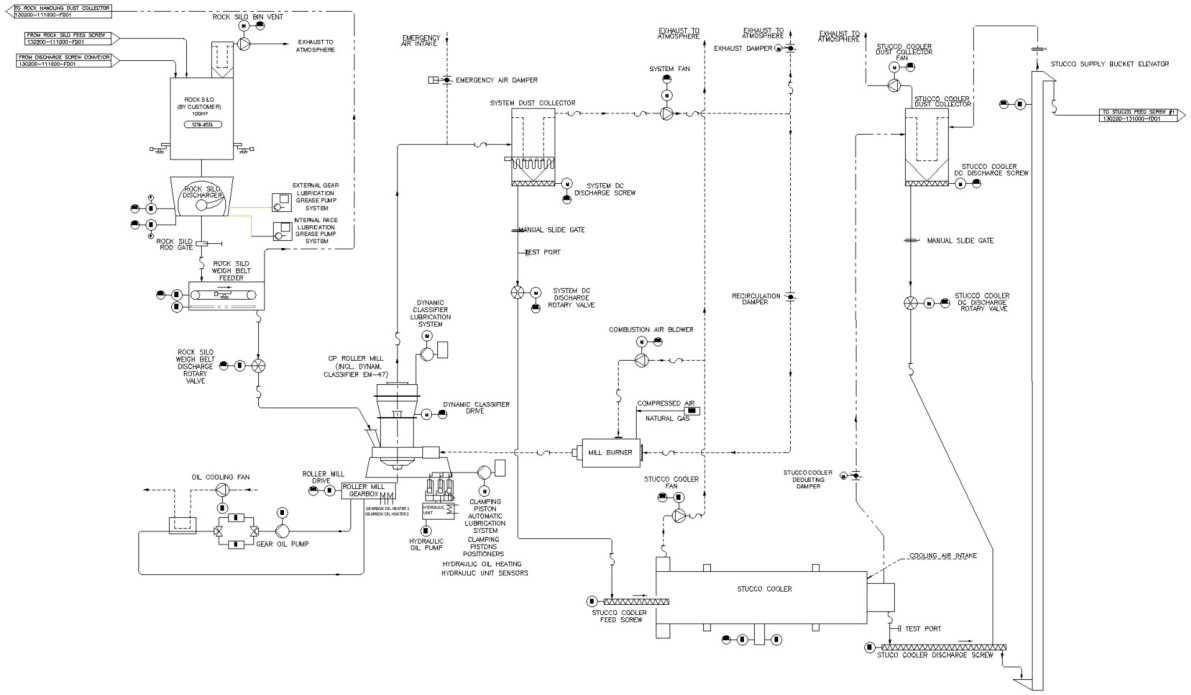

Figure 1: Mill System Overview

1.1 Rock Silo

The Rock Silo's function is to receive gypsum rock from the Rock Handling Area and provide a working volume of gypsum rock for the board plant. The rock silo has a maximum capacity of 100 m^3. Rocks are discharged from the rock silo to a weigh belt feeder.

The Rock Silo level is monitored using load cells and a high level limit switch.

1.2 Rock Silo Bin Vent

The purpose of the Rock Silo Bin Vent is to limit the amount of dust released to the atmosphere during the silo filling process. The bin vent is equipped with pulsing solenoids that are programmed to pulse in sequence, causing air to be blasted into the bags which knocks off dust collecting on the bag, restoring proper airflow and bin vent efficiency.

1.3 Rock Sio Discharger

The Rock Silo Discharger extracts wet, cohesive, sluggish, or other non free flowing bulk material stored or buffered in Silos. The Silo floor is flat with a circular discharge opening at its center. The undercut at the Silo wall and the rotary movement of a Discharge Arm act together to prevent material build-up at the Silo wall.

A rotating Discharge Arm conveys bulk material towards the Silo floor center and discharges it through the floor opening. To prevent material from flowing out in an uncontrolled manner, the discharge opening is

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covered by an inner cone. The bottom of the cone has vertical adjustment plates that can be adjusted to limit the slope of material, and to increase or decrease the discharge volume per revolution of the Arm.

During the discharge operation, the Discharge Arm passes underneath the inner cone during one rotation to activate the entire Silo bottom. One revolution of this specially curved and profiled Arm extracts a uniform disc of material from the Silo which assures mass flow. This keeps the bulk material column in motion, maintains its flowability, prevents solidification of the material over time, and reduces the risk of bridge formation inside the Silo.

A special plate joins the Discharge Arm to the shaft of the rotary chute which is connected to the Silo bottom by a slewing bearing and driven by this bearing. Each drive unit has one gear pinion, one main gear, one reducing gear, and one flanged connected electric motor. The three-phase motors are mechanically connected, operated and controlled by a frequency converter. Feed rate is determined by the inlet load cells on the weigh belt feeder.

1.4 Rock Silo Weigh Belt Feeder

The Rock silo Weigh belt feeder operates by continuously weighing a moving bed of material on its short conveyor and controlling belt speed to result in the desired flow rate at discharge. Therefore, the weigh belt feeder can achieve high rates while remaining compact.

1.5 Rock Silo Weigh Belt Discharge Rotary Valve

The Rock Silo Weigh Belt Discharge Rotary Valve discharges material from the Weigh Belt Feeder to CP Mill at a constant rate. This Valve also acts as a seal for the air flow system.

1.6 CP Mill

The function of the CP Vertical Ball Ring Mill is to produce stucco powder from gypsum rock. The Vertical Ball Ring Mill grinds the raw gypsum to a fine powder using large cast balls that are guided along grinding rings inside the mill. The raw material is gravity fed into the mill from above and after being ground is carried by a hot gas stream to the classifier. While transporting the gypsum powder, the hot gas stream also calcines the material to form stucco. The classifier then separates particles based on their size, discharging acceptable stucco to the System Dust Collector and sending larger particles back to the mill to repeat the grinding process.

At start up the CP Mill runs at 10% speed to reduce wear. As soon as the burner is on, the Mill runs at 100% speed and runs continuously while the stucco system requires refill. The CP Mill is continuously monitored by Temperature, Speed, Pressure, and Vibration sensors.

The CP Mill is interlocked with the Mill Burner and System Dust Collector Fan meaning that the Burner and the Mill Dust Collector Fan needs to be running before the CP Mill will run in automatic mode.

Upon shutdown, after the main flame has been off for 10 minutes, the Mill drive goes down to 50%. After another 10 minutes, the Mill drive goes to 10%. After 1 minute at 10% and when the discharge temperature drops below 125 C, the Mill will stop. The status of the Mill speed and time is shown on the HMI.

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A more detailed explanation of the CP Mill can be found in the Claudius Peters Operation and Maintenance Manual.

1.7 Mill Burner

The Mill Burner provides the heat needed for calcining stucco in the CP Mill. This burner uses natural gas as fuel to produce its flame. Intake air for the burner comes from the System Dust Collector's recirculation ducting as well as the Stucco Coolers discharge air ducting. For more information on the Air Heater refer to the Mill Burner/ Air Heater Operation and Maintenance Manual.

1.8 Combustion Air Blower

The Combustion Air Blower is used to pull hot air from the Stucco Cooler's cooling air discharge ducting. The air passing through this fan begins as clean ambient air from the outside environment. It then passes through the Stucco Cooler and absorbs heat from the stucco. This heated air passes through the Combustion Air Blower which sends it to the Mill Burner where it acts as low humidity combustion air for the burner. The Combustion Air Blower Fan is driven with a VFD which allows for adjustable air flow into the Mill Burner. The speed of the fan will follow a CDF curve based on the duct air temperature and can be adjusted on the HMI.

1.9 Emergency Air Damper

The function of the Emergency Air Damper is to lower the air temperature in the ducting and dust collector. When the air temperature gets too high the Emergency Air Damper opens up to introduce ambient air while the Burner ramps down.

1.10 System Dust Collector

The System Dust Collector is used to transport the stucco generated from the CP Mill.

The System Dust Collector consists of several rows of bags that are individually pulsed by a controller attached to the Dust Collector using compressed air and solenoid valves. The solenoid valve pulse and dwell times are controlled so adjacent rows of bags are not pulsed, one after the other, knocking dust onto each other, e.g. pulse 1 row, skip 2 rows. This also allows the air pressure in the header to recover before pulsing again.

The pulsing cycles are controlled via the Dust Collector Pressure Transmitter. When the differential pressure reaches a predetermined high value a pulsing cycle will begin and continue until the differential pressure drops below a predetermined low value.

- If the header pressure does not drop after an attempted pulse of a bag row, the Controller of Dust Collector flags that row as not pulsing and triggers an alarm.
- If the pressure drops but does not recover after a pulse, the Controller of Dust Collector flags that row's valve as not closing and triggers an alarm.
- System Dust Collector will send alarm signal to PLC and display alarms on HMI

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- The PLC also alarms the operator when the header pressure is too low

System Dust Collector loading is monitored by measuring the pressure across the System Dust Collector from clean side to dirty side using a differential pressure transmitter. The system is programmed to start a cleaning cycle at the high set point (mbar) and stop at the low set point. The cleaning cycle will start to pulse all the bags in the system until the differential pressure is below the low set point, then the cleaning cycle will stop.

The level in the System Dust Collector hopper is monitored by a high level switch. An alarm is generated when the level is above this switch. If the switch is not cleared by a predetermined time set by a programmer / maintenance personnel, the feed to the Dust Collector will stop. The Dust Collector and downstream equipment will keep running to clear material out of the Dust Collector Hopper.

1.11 System Fan

The System Fan is used to draw air and dust through the dust collection system. Air from the Mill System Fan is sent through the Exhaust Damper to exhaust to atmosphere and through the Recirculation Damper to be reused in the Mill Burner. This fan's operations are controlled by the rock loading in the mill and the burner output.

1.12 Exhaust Damper

The Exhaust Damper is used to control the amount of air that is being exhausted to the atmosphere from the System Fan. Opening and closing the Exhaust Damper changes the amount of pressure in the System Dust Collector and the CP Mill. Controlling the pressure into the mill is important as this pressure affects the performance of the Mill Burner and must be kept constant to keep hot gas flow consistent. Controlling this pressure is also important because of the difference in humidity between the recirculation air and the combustion air. In order to have correct burner functionality this ratio must be controlled and kept within the specified range. The Exhaust Damper is fully opened for Mill Area start up to allow for a purge of all gases and air in the ducting before starting up the mill.

1.13 Recirculation Damper

The Recirculation Damper controls the amount of recirculation airflow into the Mill Burner from the System Dust Collector. This position of this damper is not generally changed after initial set up. Fan speeds and Exhaust Damper settings are usually adjusted instead to control air flow and pressure in the ducting.

1.14 System Dust Collector Discharge Screw

The function of the System Dust Collector Discharge Screw is to collect and transfer material from the System Dust Collector to the System Dust Collector Discharge Rotary Valve. Under normal operation a minimal amount of material is in the Dust Collector Hopper.

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1.15 System Dust Collector Discharge Rotary Valve

The function of the System Dust Collector Rotary Discharge Valve is to discharge material from the Dust Collector at a constant rate while acting as an airlock to maintain pressure in the dust collection system.

1.16 Stucco Cooler

The function of the Stucco Cooler is to decrease the temperature of the stucco in the Mill Area after it has been calcined. After the calcining process, the stucco is very hot and steamy. Stucco in this condition does not store well and over time the quality of the stucco decreases drastically. In order to increase the quality of the stucco and minimize the amount of vapour present in the stucco mixture, the product is cooled in the Stucco Cooler. To ensure that only high-quality cooled stucco powder is discharged from the Stucco Cooler, a dust collection line from the Stucco Cooler Dust Collector is attached just before the Stucco Cooler Discharge Screw. This dust collection line draws in unwanted stucco dust and water vapour and transfers them to the Stucco Cooler Dust Collector.

The stucco cooler has a main drive and a maintenance drive. The main drive is used to turn the cooler during normal operation. The maintenance drive is a small backup drive. In the event the main drive fails, the maintenance drive will be used to turn the cooler a much slower rate to enable the stucco inside to be evacuated. It can also be run manually to rotate the cooler slowly for maintenance.

For more information on the Stucco Cooler see the Stucco Cooler Operation and Maintenance Manual.

Table 1.16 Stucco Cooler Temperature

Stucco Cooler	Temperature
Stucco Inlet	293 °F (145 °C)
Stucco Outlet	176 °F (80 °C)
Based on an ambient temperature of	104 °F (40 °C)

1.17 Stucco Cooler Fan

The Stucco Cooler Fan is used to draw in ambient air for use in the Stucco Cooler. Air is pulled from the outside environment through the cooling pipes of the Stucco cooler. During the cooling process the air becomes very hot. This hot air is pulled through the Stucco Cooler Fan and split between the Air Heater and an exhaust to the atmosphere based on how fast the Combustion Air Fan is running.

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The stucco cooling fan is controlled by a PID loop to maintain a constant discharge temperature set point of the stucco based on the stucco flow. The cooling fan is enabled when the stucco cooler temperature goes above a certain temperature threshold (e.g. 68°C). It stops when the temperature goes below this value.

1.18 Stucco Cooler Discharge Screw

The function of Stucco Cooler Discharge Screw is to transport stucco from the Stucco Cooler to the Stucco Supply Bucket Elevator.

1.19 Stucco Supply Bucket Elevator

The Stucco Supply Bucket Elevator transfers stucco from the Stucco Cooler Discharge Screw to Stucco Feed Screw #1. The Stucco Supply Bucket Elevator runs continuously while the stucco cooler is running. The Elevator motor current is monitored to detect if the Elevator is being overloaded. If it is detected as being overloaded, feed will be slowed from the Cooler Discharge screw, and an alarm will be displayed on the HMI.

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2 Operator Procedures

2.1 Area Start/Stop

Before attempting to start the area:

1. Confirm that all motors & valves are ready. The HMI will show the system to be 'ready'.
2. Confirm all pneumatic valves are open.

Note: If the HMI does not display 'ready' clicking on the status box will bring up a corresponding screen highlighting equipment not in a ready state.

If any of the above conditions are not met prior to starting the line, it will be indicated on the HMI. If any of the above conditions fails during operation, the affected motor is automatically shut down, and the reason for the shutdown is displayed on the HMI.

The equipment will start in the following sequence:

1. Equipment from the System Dust Collector Discharge Screw to Stucco Feed Screw #1 start up in reverse order.
2. Fans start up for an initial purge of the ducting system. Exhaust Dampers are fully opened for this initial air and gas purge.
3. After the gas purge has been completed the dampers return to their operating positions.
4. The CP Mill and Mill Burner now start running. Initially the burner will run at a small fraction of its full capacity.
5. Once the burner has heated up the system air to an acceptable temperature the Rock Silo Weigh Belt Feeder will start up at a fraction of its full capacity.
6. The system will then run until the mill outlet temperature setpoint has again been reached. The mill burner will then increase to a slightly higher percentage of its maximum capacity. As the burner jumps up in small increments the Rock Silo Weigh Belt Feeder will automatically adjust itself to keep a consistent air temperature out of the mill.
7. Step 5 then repeats until the Mill Burner has reached full capacity, at which point the Mill Area is at maximum throughput.

2.2 JA Controls

Each motor in the Mill Area has its own panel mounted JOA. The JOA is a three position selector switch referring to operational modes JOG / OFF / AUTO.

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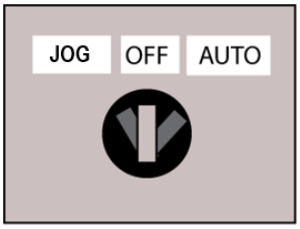

Figure 3: JOA Control

General Mode Selection:

1. JOG Setting: Select to manually power the motor. Selecting JOG causes the motor to run and overrides any interlocks.

   Note: When using this setting on screw conveyor motors the operator has full control of the speed of the screw from the HMI and can directly enter the speed reference (0-100%).

   Fed material is dropped into the corresponding Screw to be conveyed further down the line. The switch should not be turned on in JOG mode unless the corresponding Screw is running otherwise the fed material will have no flow path.

2. OFF Setting: Stops the motor.

3. AUTO Setting: Puts the motor into Automatic setting allowing control from the PLC.

The normal operating position is AUTO. In this mode, the equipment responds appropriately to starting and stopping requests, and the speed is controlled by the PLC. When the JOG is selected and is held in the position, the equipment runs continuously at the speed manually entered by the operator. This mode is used only for maintenance purposes.

Note: For safety reasons to ensure that the correct piece of equipment has de-energized after a manual disconnect has been opened, the JOG should be held for a few seconds to ensure that the equipment or motor will not start and then released.

JOA switches will also be shown on the HMI and are only for indications only.

The JOA switch is located in the field adjacent to a piece of equipment and wired to PLC inputs.

2.3 Motor Alarms

Each motor is programmed to generate alarm codes that are specific to the features and functions of the motor. Some of the alarm codes will shut down the motor and others will generate warnings. The alarm and warning messages are shown on the HMI and saved in the alarm history file.

Once a motor alarm has been set:

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1. A popup message on HMI overview will attract operator attention
2. Check the alarm code in the HMI and correct the issue
3. Re-set the motor using the HMI touch screen (put the motor back into auto)

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3 Troubleshooting

3.1 General

Problem	Possible Cause(s)	Possible Solutions
Low quality stucco leaving mill area	• Gypsum rock into mill area out of specification • Gypsum not fully calcined • Stucco particle size too large • Stucco not fully cooled	• Test material being loaded into rock silo and confirm conformity with project specifications • Refer to CP Mill and Stucco Cooler troubleshooting sections.

3.2 Dust Collectors

Problem	Possible Cause(s)	Possible Solutions
Loss of suction	• Filter bags clogged with material • Fan not turning on/operating correctly	• Inspect bags & clean if necessary • Check that solenoids are pulsing air • Refer to maintenance manual • If fan doesn't turn on when refill door of rock silo opens check door sensors to ensure they are unobstructed

3.3 CP Mill/Classifier/Rock Silo Discharger

Problem	Possible Cause(s)	Possible Solutions
Discharge stucco particle size too large	• Grinding pressure too low • Classifier adjusted incorrectly	• Check for damaged compression springs • Increase preload on compression springs • Close classifier blades further • Refer to Claudius Peters Operation and Maintenance Manual

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3.4 Stucco Cooler

Problem	Possible Cause(s)	Possible Solutions
Stucco not fully cooled	• Stucco cooler overloaded • Cooling air feed not constant • Drum rotational speed not constant	• Confirm correct feed rate of material into feed screw • Ensure that cooling pipes do not have any foreign material built up inside and that Stucco Cooler Fan is functioning correctly • Refer to Stucco Cooler Maintenance Manual

3.5 Fans

Problem	Possible Cause(s)	Possible Solutions
Rated output flow not being achieved	• Dampers not set up correctly in ducting • Deformed or leaking duct • Impeller blocked or clogged	• Inspect dampers and ducting. Look for leaks/clogs in ducting system and check that position of all dampers is correct. • Refer to fan vendor Maintenance Manual
Excessive vibration	• Fan rotor imbalance • Bearing or shaft damaged	• Contact maintenance personnel

3.6 Bucket Elevator

Problem	Possible Cause(s)	Possible Solutions
Excessive noise or vibration	• Damaged buckets • Foreign object in elevator boot • Excessively loose chain	• Check buckets for damage and replace if necessary • Check boot for foreign objects • Tighten chain to give buckets less play • Contact maintenance personnel
High level sensor triggered	• Foreign object in elevator boot • Hardened gypsum in elevator boot or buckets	• Check for blockages in boot and remove • Check buckets and boot for material buildup and clean if necessary

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3.7 Screw Conveyors

Problem	Possible Cause(s)	Possible Solutions
Material leaking from trough ends	• Seals worn • Screw loaded past recommended level	• Contact Maintenance Personnel to replace seals • Decrease screw fill percentage to recommended level
Screw plugged with material	• Materials out of specification • Screw loaded past recommended level	• Refer to Screw Conveyor Maintenance Manual • Perform drop test to check material properties • If material properties are out of specification notify supervisor • Remove all material from screw and decrease screw fill percentage to recommended level

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